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1932

# TRI-STATE TREATY COMMISSION

(NEW YORK — NEW JERSEY — CONNECTICUT)

FOR ABATEMENT OF POLLUTION  
OF HARBOR AND COASTAL WATERS  
WITHIN THE METROPOLITAN AREA

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## FINAL REPORT

OF THE

## JOINT COMMISSION

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PRESENTED BY THE MEMBERS  
OF THE NEW JERSEY TRI-STATE TREATY COMMISSION  
1932

**TRI-STATE TREATY COMMISSION**  
**(NEW YORK — NEW JERSEY — CONNECTICUT)**

**FOR ABATEMENT OF POLLUTION OF HARBOR AND COASTAL  
WATERS OF METROPOLITAN AREA**

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JOSEPH P. DAY, *Chairman*  
COL. FRANK S. TAINTER, *Vice-Chairman*  
MAYOR THOMAS A. TULLY, *Vice-Chairman*  
GERALD W. KNIGHT, *Secretary*  
S. E. STANTON, *Asst. Secretary*

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THOMAS K. SMITH, *Counsel*

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*Chairman*  
ABBOT LOW MOFFAT, *Assemblyman,*  
*Vice-Chairman*  
SENATOR JULIUS S. BERG  
DOCTOR THOMAS PARRAN, JR.  
*Commissioner, St. Dept. of Health*  
DOCTOR WILLIAM SCHROEDER, JR.  
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*Chairman, State Water Commission*  
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*Member, State Water Commission*  
STANLEY H. OSBORN, M.D.  
*Commissioner, State Dept. of Health*  
THOMAS A. TULLY  
*Mayor, New Haven*  
EDWARD T. BUCKINGHAM  
*Mayor, Bridgeport*

**REPORT OF THE TRI-STATE TREATY COMMISSION (NEW YORK—NEW JERSEY—CONNECTICUT) FOR ABATEMENT OF POLLUTION OF HARBOR AND COASTAL WATERS WITHIN THE METROPOLITAN AREA**

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*To the Legislature of the State of New York, the Legislature of the State of New Jersey and the General Assembly of the State of Connecticut:*

Pursuant to the provisions of Chapter 671 of the Laws of the State of New York of 1931, Joint Resolution No. 8 of the Senate and General Assembly of the State of New Jersey adopted April 21, 1931, and Chapter 142, Section 423-a of the Laws of the State of Connecticut of 1931, this Joint Commission was created.

The first meeting of the commission was held at the City of New York on June 3, 1931, and an organization perfected by the selection of Joseph P. Day of New York, as Chairman, Col. Frank S. Tainter of New Jersey, as Vice-Chairman, Mayor Thomas A. Tully of New Haven, Connecticut, as Vice-Chairman, Gerald W. Knight of New Jersey, as Secretary. Thomas K. Smith of Syracuse, New York was selected as Counsel.

Sub-committees on research and engineering, federal cooperation, legal, finance and publicity, were created to study and examine the several phases of the work and make recommendations for the guidance of the Joint Commission.

The committee on research and engineering made an intensive study of pollution of the waters of the district, the causes thereof and the remedies to be adopted to correct the same and filed their report of findings and recommendations, a copy of which is hereto annexed and made a part of this report.

Your honorable bodies are referred to such report for a complete statement of facts regarding the existing pollution within the district. We do not desire to repeat the statements in the said report, but we call your attention especially to the following facts:

At present the raw sewage from a population of approximately twelve million persons and the trade wastes of many thousands of industries, is discharged into the harbor and coastal waters of the district with no purification, regulation or control.

Since the report of the Metropolitan Sewage Commission of New York was made a few municipalities and groups of communities in each of the three states have for their own protection installed sewage treatment plants, but in most of these cases the treatment provided has been partial and of little effect on the general problem and has not kept pace with the tremendous growth



of the district. The population contributing to the pollution in the district is twice that reported by the New York Commission in 1914 and it is fair to assume that in the next fifteen years the population will increase in the same ratio.

The quantity of sewage discharged into the harbor waters of the district is estimated to be one billion gallons daily, which in a year would carry a million, six hundred thousand tons of sewage solids into the surrounding waters and one-half of that would be putrescible matter. The quantity of sewage discharged into the harbor has for years exceeded the assimilating power of the water.

The assumption has persisted for many years that the sewage and other organic matter discharged into these waters is promptly carried away by the vast quantities of pure water of the Hudson River and the tidal action of the sea through Long Island Sound and the Bay. It has been demonstrated that this is not a fact. The tidal movement in its ebb and flow merely causes the sewage to drift back and forth indefinitely in the bay and in some of the tidal rivers adjacent. Extensive dredging operations have to be carried on each year in order to free the ship slips and channels of sludge and other deposits. At the Brooklyn Navy Yard sludge to a depth of three feet accumulates in two years' time and requires dredging at such intervals at an expense of \$50,000 for that point alone. In connection with the dredging operations federal engineers have found that from the Narrows opposite Stapleton to Edgewater, on the Hudson, there is an overlying stratum of semi-fluid scum which is too light to settle in the dredge hoppers. Below the soft layer is a stiffer sludge which will settle to some extent. It is very offensive and the gases from it affect the paint of the ships. It has required six to eight months to dredge from the Jersey City waterfront and get down to a settleable mud.

This sludge is rapidly creeping toward the bathing beaches and unless prompt action is taken to change conditions it is only a matter of time when the sludge deposits on the bottom of the bay will keep on moving until a disgusting blanket will be thrust upon Long Island, Sandy Hook and the bathing beaches thereabouts, thereby rendering impossible the enjoyment of the great public beaches built at a cost of millions of dollars and giving recreation and healthful enjoyment to millions of people. When these black ugly streaks of sludge shall have reached the sandy shores of these beaches, public recreation at these points will cease and thousands of persons who cater to the wants of the public will lose their livelihood.

The effect of pollution on the bathing beaches and watering places within the metropolitan district has become a cause of acute anxiety not only to investors in shore properties, but also to the great army of city dwellers who make use of those facilities. Already a number of beaches have been ordered closed to bathing and others are threatened. Unless prompt steps to remedy the situation are taken, it is expected that the great beach at Coney Island will have to be closed within five or six years.

The effect upon fish life in the district is set forth in the annexed report. There is practically no fish life existing within the district.

The whole problem of pollution in the metropolitan district is more than a local one in that it affects three separate states and it can only be solved by their joint action and the cooperation of the Federal Government. There must be a general and unified control to insure effective accomplishment of the desired end.

Conditions in Connecticut, as affecting the metropolitan district, are confined to a narrow strip of territory adjacent to Long Island Sound between New Haven and the New York-Connecticut State Line, where Connecticut's largest and busiest industrial cities are located. Between these cities are many high class residential areas and recreational beaches, to which pollution is a serious menace.

Oil pollution is gradually being controlled through action of the Federal Government, but in the judgment of your Commission it is necessary that further steps be taken to eliminate oil pollution, which causes great economic loss.

It will be understood that the conditions with regard to the City of New York differ materially from conditions elsewhere in the district and for these reasons it has been an exceedingly difficult task to bring about a meeting of the minds of the commissioners from the several states. But this Commission, realizing that unified control is necessary to bring about the desired results, has earnestly striven to formulate a compact which would insure a control sufficiently central so as to provide for a comprehensive plan for abating the pollution of the waters of the district, while permitting full local autonomy as to methods to be employed.

A sub-committee on Federal Cooperation of which Thomas Wasser was chairman, conferred with the federal officials in charge of the harbor of New York, with the United States attorneys of the district and with others familiar with the effect of navigation on pollution of the harbor. As a result of such conferences, amendments to federal laws were suggested, such proposed amendments to be taken up and prepared in conference with the United States attorney and his assistants located at New York. A study by the permanent Commission should be made and plans evolved to control floating logs and debris and the breaking up of old barges and derelicts. It is quite apparent that the control thereof must be made more effective by amendments to the federal and state statutes.

As directed by the provisions of the statutes of the several states your Commission has agreed upon the terms of a compact between the three states of New York, New Jersey and Connecticut, which if adopted by such states and accompanied by the necessary legislation to carry the provisions of the compact into effect, will result in the eventual control and abatement of pollution in the district described therein. Such compact accompanies this report and is made a part hereof. We earnestly recommend the adoption of the same by the several states at once.



Accompanying this report are suggested bills which we deem necessary to render the compact effective. One of such bills creates the Inter-State Sanitation Commission. We recommend the adoption of such legislation and the appropriation this year of 1932 by the states of New York and New Jersey, each the sum of fifteen thousand dollars, or so much thereof as may be necessary for the expense of the permanent Commission.

We most earnestly urge prompt favorable action on the part of the legislatures and governors of the states of New York and New Jersey to the end that a permanent Commission shall be created forthwith and be able to function at the earliest date.

All of which is respectfully submitted.

February 10th, 1932.

<i>STATE OF NEW YORK</i>	<i>STATE OF NEW JERSEY</i>
JOSEPH P. DAY	F. S. TAINTER
WM. SCHROEDER, JR.	JOHN E. SLOANE
GEO. L. THOMPSON	J. LESTER EISNER
EDWARD J. COUGHLIN	GERALD W. KNIGHT
ABBOT LOW MOFFAT	
JULIUS S. BERG	
THOMAS PARRAN, JR.	

*STATE OF CONNECTICUT*

ERNEST L. AVERILL	E. T. BUCKINGHAM
JAMES A. NEWLANDS	THOMAS P. TULLY
SANFORD H. WADHAMS	WALTER R. STEINER
GEO. T. KIMBALL	STANLEY H. OSBORN

Mr. THOMAS J. WASSER of New Jersey declined to sign the report.

**APPENDIX A**

**TRI-STATE COMPACT**

WHEREAS, The tremendous growth of population and the development of the territory surrounding and adjacent to the harbor of New York has resulted in recent years in an increasingly serious pollution of the harbor, coastal and tidal waters in such area and the tributary waters therein; and

WHEREAS, Such pollution constitutes a grave menace to the health, welfare and recreational facilities of the people living in such area and is occasioning great economic loss; and

WHEREAS, The control of future pollution and the abatement of existing pollution in the waters in such area is of prime importance to the people living in such area and can best be accomplished through the cooperation of the states of New Jersey and New York and Connecticut by and through a joint or common agency;

Now, Therefore, the state of New York and the state of New Jersey and the state of Connecticut do agree and are bound as follows:

**ARTICLE I**

Each of the signatory states pledges each to the other, faithful cooperation in the control of future pollution and agrees to provide for the abatement of existing pollution in the tidal and coastal waters in the adjacent portions of the signatory states defined herein as coming within the district, and consistent with such object, to enact adequate legislation which will enable each of the signatory states to put and maintain the waters thereof in a satisfactory sanitary condition and particularly to protect public health; to render safe such waters as are now used or may later become available for bathing and recreational purposes; to abate and eliminate such pollution as becomes obnoxious or causes a nuisance; to permit the maintenance of major fish life, shell-fish and marine life in waters now available or that may by practicable means be made available for the development of such fish, shell-fish or marine life; to prevent oil, grease or solids from being carried on the surface of the water; to prevent the formation of sludge deposits along the shores or in the waterways; and with the fulfillment of these objectives to abate and avoid incurring unnecessary economic loss by safeguarding the rights of the public in its varied legitimate uses of the waters of the district.

**ARTICLE II**

To that end they do agree that there shall be created and they do hereby create a district to be known as "The Inter-State Sani-



tation District" (hereinafter referred to as "The District") which shall embrace the territory described as follows:

(1) All the coastal, estuarial and tidal waters within or covering portions of the signatory states and (2) those portions of all municipalities that border upon and the natural drainage from which is tributary to such tidal waters, together with (3) all areas in the signatory states the artificial drainage, sewage or sewage effluents from which now discharge or may in the future discharge through artificial outlets into such tidal waters described as follows:

(a) In Connecticut, Long Island Sound and estuaries and tidal waters thereof between the easterly side of New Haven Harbor at Morgan Point and the Connecticut-New York State boundary, and the Housatonic River up to the northerly boundary lines of the towns of Stratford and Milford.

(b) In New York, all of the tidal waters of Greater New York City; Long Island Sound and the estuaries and tidal waters thereof between the New York City line and the New York-Connecticut State boundary and between the New York City line and the easterly side of Port Jefferson Harbor; the Atlantic Ocean and the estuaries and tidal waters thereof between the New York City line and the easterly side of Fire Island Inlet; and the Hudson River and estuaries and tidal waters thereof between the New York City line and the New York-New Jersey boundary line extended.

(c) In New Jersey, the Hudson River and New York Upper Bay and estuaries and tidal waters thereof between the New York-New Jersey Boundary and Constable Point; the Kill van Kull and Arthur Kill and the tidal tributaries thereto; Newark Bay and estuaries and tidal waters thereof; Raritan Bay and Sandy Hook Bay and estuaries and tidal waters thereof; and the Atlantic Ocean and the estuaries and tidal waters thereof between Sandy Hook and the southerly side of Manasquan Inlet.

### ARTICLE III

There is hereby created "The Inter-State Sanitation Commission" (hereinafter referred to as "The Commission") which shall be a body corporate and politic, having the powers, duties and jurisdiction herein enumerated and such other and additional powers as shall be conferred upon it by the act or acts of a signatory state concurred in by the others and by the act or acts of Congress when necessary.

### ARTICLE IV

The Commission shall consist of five Commissioners from each state, each of whom shall be a resident voter of the state from which he is appointed.

The Commissioners shall be chosen in the manner and for the terms provided by law of the state from which they shall be appointed, and each Commissioner may be removed or suspended from office as provided by the law of the state from which he shall be appointed. The Commissioners shall serve without compensation, but shall be paid their actual expenses incurred and incident to the performance of their duties.

### ARTICLE V

The Commission shall elect from its number a chairman and vice-chairman and shall appoint and at its pleasure remove or discharge such officers and legal, clerical, expert and other assistants as may be required to carry the provisions of this Compact into effect, and shall fix and determine their duties, qualifications and compensation.

It shall adopt a seal and suitable by-laws and shall promulgate rules and regulations for its management and control.

It may maintain one or more offices for the transaction of its business and may meet at any time or place within the signatory states.

A majority of the members from each state shall constitute a quorum for the transaction of business, the exercise of any powers, or the performance of any duties, but no action of the Commission shall be binding unless a majority of the members from each state shall vote in favor thereof.

The Commission shall keep accurate accounts of all receipts and disbursements and shall make an annual report to the Governor and the Legislature of each state setting forth in detail the operations and transactions conducted by it pursuant to this Compact, and shall make recommendations for any legislative action deemed by it advisable, including amendments to the statutes of the signatory states which may be necessary to carry out the intent and purpose of this Compact, and changes in the district which concentration of population or other cause may require.

The Commission shall not incur any obligations for salaries, office or other administrative expenses prior to the making of appropriations adequate to meet the same; nor shall the Commission pledge the credit of any of the signatory states except by and with the authority of the legislatures thereof. Each state reserves the right to provide hereafter by law for the examination and audit of the accounts of the Commission by its comptroller or other official.

The Commissioners shall meet and organize within ten days after the effective date of this Compact.

### ARTICLE VI

It is recognized by the signatory states that, where tidal waters are used for such varied purposes as bathing, navigation, shellfish culture, the development of fish life and the disposal of wastes,



no single standard of purity is practicable in all parts of the district. In order to attain the objects of this Compact, the Commission, after proper study and after conducting public hearings upon due notice, shall group the designated waters of the district into classes. Where local conditions shall have changed in the future to such an extent that changes in classification become necessary, the Commission may, after conducting public hearings upon due notice, adopt such changes.

Two general classifications shall be used:

(1) Class "A," in which the designated water areas are expected to be used primarily for recreational purposes, shellfish culture or the development of fish life.

(2) Class "B," in which the designated water areas are not expected to be used primarily for recreational purposes, shellfish culture or the development of fish life.

#### ARTICLE VII

It is agreed between the signatory states that no sewage or other polluting matters shall be discharged or permitted to flow into, or be placed in, or permitted to fall or move into the tidal waters of the district, except under the following conditions and restrictions:

1. All sewage discharged or permitted to flow into Class "A" waters of the district shall first have been so treated as:—

(a) to remove all floating solids and at least 60% of the suspended solids; and

(b) to effect a reduction of organisms of the B. Coli group (intestinal bacilli) so that the probable number of such organisms shall not exceed one per cubic centimeter in more than 50% of the samples of sewage effluent tested by the presumptive method, provided, however, that in the case of discharge into waters used primarily for bathing this bacterial standard need not be required except during the bathing season; and

(c) to effect a reduction in the oxygen demand of the sewage effluent sufficient to maintain an average dissolved oxygen content in the tidal waters of the district and in the general vicinity of the point of discharge of the sewage in those waters, at a depth of about five feet below the surface, of not less than 50% saturation during any week of the year.

2. All sewage discharged or permitted to flow into Class "B" waters of the district shall first have been so treated as:—

(a) to remove all floating solids and at least 10% of the suspended solids, or such additional percentage as may by reason of local conditions be necessary to avoid the formation of sludge deposits in the Class "B" waters of the district, and

(b) to effect a reduction in the oxygen demand of the sewage effluent sufficient to maintain an average dissolved oxygen content

in the tidal waters of the district and in the general vicinity of the point of discharge of the sewage into those waters, at a depth of about five feet below the surface, of not less than 30% saturation during any week of the year.

3. If the Commission shall determine, after investigation, that owing to topography or other local conditions, either natural or artificial, in a part of any municipality discharging sewage into the tidal waters of the district, it would be impossible or impracticable to meet the above requirements in either Class "A" or "B" waters with respect to suspended solids or oxygen demand, a modification of these requirements may be permitted; provided, however, that the sewage discharged from adjoining areas in such municipality shall be given the additional treatment necessary to effect an average reduction of suspended solids and oxygen demand of all the sewage discharged from such contiguous areas (including the portion of the area of the municipality where the requirements have been modified) equal to the requirements stated above.

#### ARTICLE VIII

Each of the signatory states agrees, that in so far as waters within its jurisdiction may flow into any portion of the district, all sewage discharged or permitted to flow into any stream tributary to the tidal waters of the district shall be treated to that extent, if any, which may be necessary to maintain such tributary immediately above its confluence with the tidal waters of the district in a sanitary condition at least equal to the classification requirements determined by the Commission for the tidal waters of the district into which it discharges. The waters of the Hudson River, immediately above the New York-New Jersey boundary extended, shall be maintained in a sanitary condition at ebb tide at least equal to the sanitary condition prevailing in the waters of the river immediately below said boundary at flood tide.

#### ARTICLE IX

Nothing in this Compact shall be construed to repeal or prevent the enactment of any legislation or the enforcement of any requirement by any signatory state imposing any additional conditions and restrictions to further lessen or prevent the pollution of waters within its jurisdiction.

#### ARTICLE X

Subject to the provisions of this Compact the Commission, as soon as may be after its organization, after an investigation and after conducting public hearings upon due notice, shall by order prescribe the reasonable date, on or before which each municipality discharging sewage into the designated waters within the district shall be treating such sewage in accordance with the standards



specified in this Compact. And such order may prescribe that certain specific progress shall be made at certain definite times prior to the final date fixed in such order.

It is the desire of all parties to accomplish the objects herein set forth with the least possible injury to investments which have already been made in the construction of sewage treatment plants within the district, and where changes or additions to such plants would be necessary to conform to the standards herein adopted, a reasonable time to effect such changes or additions may, in the discretion of the Commission, be granted.

#### ARTICLE XI

Each of the signatory states agrees that it will prohibit the pollution of the said waters within the district in accordance with the several articles of this Compact, and that it will enact suitable and adequate legislation which will accomplish effectively the objects of this Compact and which will enable its officers, departments, boards and agents to accomplish satisfactorily the obligations and duties assumed by the state under the terms of this Compact, and it is further agreed that the courts of the several states shall have jurisdiction to enforce as against any person, corporation or municipality or any employee, department or subdivision of the respective signatory states any and all provisions of this Compact.

The Commission shall have authority to investigate and determine if the requirements of the Compact and/or the orders of the Commission pursuant thereto are complied with and if satisfactory progress has not been made, to bring action in its own name in the proper court or courts to compel the enforcement of any and all of the provisions of this Compact, and/or the orders of the Commission pursuant thereto.

#### ARTICLE XII

In order that future pollution be controlled and existing pollution be abated with the greatest possible economy and efficiency, the Commission shall cooperate and advise with the respective state authorities having jurisdiction over stream pollution, with a view to coordinating their activities and securing the most satisfactory results at lower cost. For such purpose the Commission may prepare a general plan of the most practicable and economical method of securing conformity with the standards herein set forth, having in view the future growth and development of the district. Such plan when completed shall be submitted to the Governor and the Legislature of each state and to the State agency or agencies in charge of sewage problems.

#### ARTICLE XIII

Terms used in this Compact are defined as follows:

*District* means the area more particularly described in Article II of this Compact.

*Commission* means the Inter-State Sanitation Commission.

*Municipality* means any city, incorporated village, borough, county, town, township, district, or any municipality governed by an improvement commission, or any other sub-division of any one of the signatory states, located within the district.

*Rule or Regulation* means any rule or regulation promulgated by the Commission touching the abatement of pollution of the waters of the district.

*Tidal Waters* means all those waters which ebb and flow within the designated district.

*Dissolved Oxygen* is the gaseous oxygen held in solution by the water at any given time. It is expressed as a percentage of the maximum amount of oxygen that would be required to saturate the water under the existing conditions of temperature and salinity.

*Sewage Effluent* means the treated sewage discharged from a treatment plant.

*Suspended Solids* means those solid particles carried in suspension in the untreated sewage or sewage effluent.

#### ARTICLE XIV

The signatory states agree to appropriate annually for the salaries, office and other administrative expenses such sum or sums as shall be recommended by the Commission and approved by the governors of the signatory states, the state of New York and the state of New Jersey agreeing each to appropriate 45% thereof, and the state of Connecticut agreeing to appropriate 10% thereof. The state of New York and the state of New Jersey obligate themselves hereunder, however, only to the extent of forty-five thousand dollars (\$45,000) each in any one year, and the state of Connecticut obligates itself hereunder only to the extent of ten thousand dollars (\$10,000) in any one year.

#### ARTICLE XV

Should any part of this Compact be held to be contrary to the Constitution of any signatory state or of the United States, all other severable objects of this Compact shall continue to be in full force and effect.

#### ARTICLE XVI

This Compact shall become effective as to the state of New Jersey and the state of New York immediately upon the signing



thereof by the representatives of such states, and thereafter it shall also become effective as to the state of Connecticut immediately upon the signing thereof by the representatives of such state; provided, however, that prior to the signing of this Compact by the representatives of the state of Connecticut the district as set forth in Article II shall not embrace any territory within the jurisdiction of the state of Connecticut, nor shall the Commission exercise any jurisdiction or perform any duties or acts affecting such territory; and the appropriations for salaries, office and other administrative expenses shall be borne equally by the state of New York and the state of New Jersey.

## APPENDIX B

### RECOMMENDED FORMS OF LEGISLATION

#### I

## AN ACT

Authorizing designated authorities in behalf of the state of New York (New Jersey) to enter into an agreement or compact with designated authorities of the state of New Jersey (New York) for the creation of the "Interstate Sanitation District," the establishment of the "Interstate Sanitation Commission," the control of future pollution and the abatement of existing pollution in the tidal and coastal waters of the adjacent portions of the signatory states and the defining of the powers and duties of such commission

*The People of the State of New York (New Jersey) represented in Senate and Assembly, do enact as follows:*

#### Section 1.

are hereby appointed commissioners upon the part of the state of New York (New Jersey) for the purpose of entering into and are hereby authorized as such commissioners to enter into an agreement or compact with the state of New Jersey (New York), by and through the commissioners appointed or who may be appointed under or by virtue of a law of the legislature of the state of New Jersey (New York) in the form following, that is to say:

(Here insert Tri-State Compact, as set forth in Appendix A)

§ 2. The said agreement or compact when signed or sealed by the commissioners of each state, as hereinbefore provided, shall become binding upon the state of New York (New Jersey) and shall be filed in the office of the secretary of state of the state of New York (New Jersey).

§ 3. If by death, resignation or otherwise, a vacancy occurs among those appointed hereunder by the state of New York (New Jersey), the governor of the state of New York (New Jersey) is hereby authorized to fill the same.

§ 4. The said commissioners together with the commissioners appointed from the state of New Jersey (New York) shall have power to apply to the congress of the United States for its consent or approval of the agreement or compact signed by them, but in the absence of such consent of congress and until the same shall

have been secured, the said agreement or compact shall be binding upon the state of New York (New Jersey) in all respects permitted by law of the two states of New York and New Jersey without the consent of congress to cooperate, for the purposes enumerated in said agreement or compact and in the manner provided therein.

§ 5. Until the compact shall have been signed by the representatives of the state of Connecticut, the district as set forth in article two of said compact shall not embrace any territory within the jurisdiction of the state of Connecticut nor shall the commission exercise any jurisdiction or perform any duties or acts affecting such territory and until the state of Connecticut shall through its duly designated representatives sign the said compact, the interstate sanitation commission shall consist of ten members.

§ 6. This act shall take effect immediately.

## APPENDIX B

### RECOMMENDED FORMS OF LEGISLATION

#### II

## AN ACT

To authorize the appointment of commissioners to the "Interstate Sanitation Commission" established by agreement or compact between the states of New York, New Jersey and Connecticut, within the "Interstate Sanitation District" defining their powers, duties and jurisdiction, providing for the study of a program, for examination of the accounts of said commission and making an appropriation for the expenses of said commission

*The People of the State of New York (New Jersey), represented in Senate and Assembly, do enact as follows:*

Section 1. The governor shall, by and with the advice and consent of the senate, appoint five commissioners to the interstate sanitation commission created by the agreement or compact between the states of New York and New Jersey and to which Connecticut may hereafter become a part as therein provided, entered into or about to be entered into under laws passed by the states of New York and New Jersey authorizing such agreement and compact, each of whom shall be a resident voter of the state of New York (New Jersey). One of such commissioners when appointed, shall hold office until January first, nineteen hundred and thirty-three, another shall hold office until January first, nineteen hundred and thirty-four, another shall hold office until January first, nineteen hundred and thirty-five, another shall hold office until January first, nineteen hundred and thirty-six, and another shall hold office until January first, nineteen hundred and thirty-seven. Each commissioner shall hold office until his successor has been appointed and qualified. The governor shall designate who shall serve for the respective terms.

At the expiration of the term of each commissioner and of each succeeding commissioner, the governor shall by and with the advice and consent of the senate, appoint a successor who shall hold office for a term of five years or until his successor has been appointed and qualified. In the event of a vacancy occurring in the office of a commissioner by death, resignation or otherwise, the governor shall, by and with the advice and consent of the senate, appoint his successor, who shall hold office for the unexpired term. The



five commissioners may be appointed by the governor before such agreement or compact shall have been executed on behalf of the states of New York and New Jersey by the designated authorities authorized to execute the same. Any commissioner may be removed upon charges and after hearing by the governor. When the said agreement or compact shall have been executed, the commissioners shall have the powers and duties and be subject to the limitations provided for in the compact and agreement entered into between the signatory states and laws adopted by said states, and together with five commissioners from the state of New Jersey (New York), shall form the "interstate sanitation commission," until the appointment of five commissioners from the state of Connecticut, who shall upon their appointment become members of the interstate sanitation commission, as provided for in said compact and agreement. The commissioners shall serve without compensation, but shall be paid their actual expenses incurred and incident to the performance of their duties.

§ 2. The commission shall elect from its number a chairman and vice-chairman and shall appoint and at its pleasure remove or discharge such officers and legal, clerical, expert and other assistants as may be required in the discharge of the duties of the commission and shall fix and determine their duties, qualifications and compensations. It shall adopt a seal and suitable by-laws and shall promulgate rules and regulations for its management and control. It may maintain one or more offices for the transaction or its business and may meet at any time or place within the signatory states. A majority of the members from each state shall constitute a quorum for the transaction of business, the exercise of any powers or the performance of any duties, but no action of the commission shall be binding unless a majority of the members from each state shall vote in favor thereof.

§ 3. The commission shall have power to make rules, regulations and orders with regard to the pollution of the waters within the district as set forth in the compact between the signatory states and as provided by law; to investigate and determine if the requirements of the compact and/or the orders of the commission are complied with and to bring action in its own name in the proper court or courts to compel the enforcement of any and all provisions of the compact and the orders of the commission pursuant thereto or pursuant to law; and to conduct investigations, inquiries or hearings at such place or places and at such times as it shall appoint. Such investigations, inquiries or hearings may be held by or before one or more of the commissioners of the interstate sanitation commission or by or before any person or persons appointed as its representative and when ratified, approved or confirmed by the interstate sanitation commission, his or their action shall be and be deemed to be the investigation, inquiry or hearing of the interstate sanitation commission. All state and municipal departments, commissions, boards and bodies having to

do with the waters of the states shall co-operate with the commission and shall furnish to the commission such information as the commission shall request, touching the pollution or the elimination thereof, of the waters of the district.

§ 4. Whenever the interstate sanitation commission shall be of the opinion that any person, association or corporation, municipal or otherwise within the district is failing or omitting, or about to fail or omit to do anything required of it by its order or by the laws governing the control or elimination of pollution of the waters of the district, or is doing or is about to do anything or permitting or about to permit anything to be done contrary to or in violation of such orders or such laws or the provisions of the compact, it may direct its legal representative to commence an action or a proceeding in the name of the interstate sanitation commission in an appropriate court having jurisdiction for the purpose of having such violations or threatened violations stopped and prevented either by mandamus or injunction. Such an action or proceeding when directed against any person, firm, association, corporation, municipal or otherwise, within the state may be brought in the supreme court of this state and the said court shall have and is hereby given the necessary and appropriate jurisdiction to grant mandamus or injunction as the case may require or any other relief appropriate to the case.

§ 5. Any powers herein granted to the interstate sanitation commission shall be regarded as in aid of and supplemental to and in no case a limitation upon any of the powers vested in it by the states of New York and New Jersey and/or by congress or the terms of the compact.

§ 6. No person, firm or corporation, municipal or otherwise, shall create, establish, cause or maintain any source of pollution within the district, not existing on the first day of April, nineteen hundred and thirty-two; provided, however, that after hearing and investigation on application of such person, firm or corporation, municipal or otherwise, the commission may issue such order relating to any such pollution as it shall find will best serve the public interest.

§ 7. Whenever the commission shall determine upon investigation that sewage from any city, village, town, county, borough, municipality as defined in the compact, building, steamboat or other vessel, or any garbage, offal or any decomposable or putrescible matter of any kind is being discharged into any waters of the district, and whenever in the opinion of the commission such discharge is polluting such waters in a manner injurious to or so as to create a menace to public health, welfare and recreational purposes or so as to create a public nuisance or so as to be obnoxious, the commission may order the municipality, corporation or person so discharging sewage, refuse or other matter, to show cause before it or its duly designated representative why such discharge should not be discontinued or why said commis-



sion should not issue an order regulating such pollution. A notice shall be served on the municipality, corporation or person so discharging sewage, refuse or other matter, directing such municipality, corporation or person to show cause before the said commission on a date specified in such notice, why an order should not be made directing the discontinuance of such discharge or otherwise regulating the said pollution. Such notice shall specify the time when and place where a public hearing will be held by the commission or its duly delegated representative and shall be served personally or by mail at least fifteen days before said hearing and in case of a municipality or a corporation, such service shall be upon an officer thereof. The person or persons presiding at such hearing shall take evidence and after conducting such public hearing, the commission shall by order prescribe a reasonable date on or before which such municipality, corporation or person discharging sewage, refuse or other matter into the designated waters within the district, shall cease to discharge such refuse or other matter and shall treat such sewage in accordance with the standards specified in the compact, and such order may prescribe that certain specific progress shall be made at definite times prior to the final date fixed in such order. The commission shall have authority to require from the officials and persons responsible for the execution of such orders satisfactory evidence at specified times of proper progress in the execution of such orders.

§ 8. The commission may prepare a general plan of the most practicable and economical method of securing conformity with the standards set forth in the compact, having in view the future growth and development of the district and to that end may confer with all governing bodies of the municipalities within the district and any other bodies having to do with sewage and garbage disposal and the pollution of the waters of the district, with the secretary of war of the United States, with appropriate committees of congress and any and all other federal authorities having jurisdiction in the premises, with representatives of chambers of commerce and other civic bodies within the district and with such bodies, commissions and legislative committees as may exist or be created in any of the signatory states, for the purpose of bringing about a comprehensive program for the abatement and elimination of pollution.

§ 9. The commission shall keep accurate accounts of all receipts and disbursements and shall report to the governor and the legislature of each signatory state, on or before the twenty-fifth day of January in each year, setting forth in detail the transactions conducted by it and shall make recommendations for any legislative action deemed by it advisable, including amendments to the statutes of the signatory states which may be necessary to carry out the intent and purposes of the compact between the signatory states.

§ 10. The comptroller of each of the signatory states is hereby authorized and empowered from time to time to examine the accounts and books of the interstate sanitation commission, including its receipts, disbursements and such other items referring to its financial standing as such comptroller may deem proper and to report the results of such examination to the governor of such state.

§ 11. The sum of fifteen thousand dollars (\$15,000), or so much thereof as may be necessary, is hereby appropriated out of any moneys in the state treasury not otherwise appropriated for the expenses of the interstate sanitation commission. The moneys hereby appropriated shall be paid out of the state treasury on the warrant of the comptroller upon vouchers audited by the chairman of the interstate sanitation commission.

§ 12. This act shall take effect immediately.



## APPENDIX C

## REPORT OF THE RESEARCH AND ENGINEERING COMMITTEE

## PERSONNEL

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FRANK S. TAINTER, *Chairman*

Consulting Engineer of Parsons, Klapp, Brinekerhoff and Douglas,  
New York City.

Member of New Jersey State Department of Health.

THOMAS PARRAN, JR., M. D.

Commissioner, New York State Department of Health.

CHARLES A. HOLMQUIST

Director Division of Sanitation, New York State Department of  
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JAMES A. NEWLANDS

President of the Henry Souther Engineering Co., Hartford, Conn.  
Member of Advisory Council, Connecticut State Department of  
Health.

WILLIAM SCHROEDER, JR., M. D.

Chairman, New York City Sanitation Commission.

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H. A. FOSTER, *Engineering Assistant*

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## REPORT OF THE RESEARCH AND ENGINEERING COMMITTEE

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The Research and Engineering Committee was appointed to facilitate the drafting of a Tri-State Treaty to bring about the abatement of pollution of the harbor and coastal waters within the Metropolitan Area. To this end, the committee was given two main objectives:

1. To determine the Treaty Area, to recommend standards of purity for the interstate tidal waters and to recommend minimum degrees of treatment for sewage discharged into the waters of the Treaty Area.
2. To assemble and interpret all available data and statistics relating to the pollution of the inter-state tidal waters.

### PART I—REPORT ON THE FIRST OBJECTIVE

We submit the following recommendations as to subjects to be included in the treaty:

#### I. TREATY AREA

The definition of the area to be brought within the jurisdiction of the permanent Inter-State Sanitation Commission should be in the following terms:

“(1) All the coastal, estuarial and tidal waters within or covering portions of the signatory states and (2) those portions of all towns, cities, boroughs and villages that border upon and the natural drainage from which is tributary to such tidal waters, together with (3) all areas in the signatory states the artificial drainage, sewage or sewage effluents from which now discharge or may hereafter discharge through artificial outlets into such tidal waters described as follows:

“(a) In Connecticut,—Long Island Sound and estuaries and tidal waters thereof between the easterly side of New Haven Harbor at Morgan Point and the Connecticut-New York State boundary.

“(b) In New York,—all of the tidal waters of Greater New York City; Long Island Sound and the estuaries and tidal waters thereof between the New York City line and the New York-Connecticut State boundary and between the New York City line and the easterly side of Port Jefferson Harbor; the Atlantic Ocean and the estuaries and tidal waters thereof between the New York City line and the easterly side of Fire Island Inlet; and the Hudson



River and estuaries and tidal waters thereof between the New York City line and the New York-New Jersey State boundary extended.

“(c) In New Jersey,—the Hudson River and New York Upper Bay and estuaries and tidal waters thereof between the New York-New Jersey State boundary and Constable Point; the Kill van Kull and Arthur Kill and the tidal tributaries thereto; Newark Bay and the estuaries and tidal waters thereof; Raritan Bay and Sandy Hook Bay and estuaries and tidal waters thereof; and the Atlantic Ocean and the estuaries and tidal waters thereof between Sandy Hook and the southerly side of Manasquan Inlet.”

## II. STANDARDS OF PURITY

The Treaty should include a statement of the standards of purity to be maintained in the tidal waters, as expressed in the following clauses:

“It is recognized that where tidal waters are used for such varied purposes as bathing, navigation, shellfish culture, the development of fish life and the disposal of wastes, no single standard of purity is practicable in all parts of the Treaty Area. In order to attain the objects of this Compact, therefore, the Commission, after proper study and after conducting public hearings upon due notice, shall group the designated waters of the Treaty Area into classes. Where local conditions shall have changed in the future to such an extent that changes in the classification become necessary, the Commission may, after conducting public hearings upon due notice, adopt such changes.

“Two general classifications shall be used:

“(1) Class ‘A,’ in which the designated water areas are expected to be used primarily for recreational purposes, shell-fish culture or the development of fish life.

“(2) Class ‘B,’ in which the designated water areas are not expected to be used primarily for recreational purposes, shell-fish culture or the development of fish life.

“No sewage or other polluting matters shall be discharged or permitted to flow into, or be placed in, or permitted to fall or move into the tidal waters of the Treaty Area, except under the following conditions and restrictions:

“1. All sewage discharged or permitted to flow into the waters of Class ‘A’ shall first have been so treated as

“(a) to remove all floating solids and at least 60% of the suspended solids; and

“(b) to effect a reduction of organisms of the B. Coli group (intestinal bacilli) so that the probable number of such organisms shall not exceed one per cubic centimeter in more than 50% of the samples of sewage effluent tested by the presumptive method, except that in the case of discharge into waters used pri-

marily for bathing this bacterial standard need not be required except during the bathing season; and

“(c) to effect a reduction in the oxygen demand of the sewage effluent sufficient to maintain an average dissolved oxygen content in the tidal waters of the Treaty Area and in the general vicinity of the point of discharge of the sewage into those waters, at a depth of about five feet below the surface, of not less than 50% saturation during any week of the year.

“2. All sewage discharged or permitted to flow into the waters of Class ‘B’ shall first have been so treated as

“(a) to remove all floating solids and at least 10% of the suspended solids, or such additional percentage as may by reason of local conditions be necessary to avoid the formation of sludge deposits in the Class ‘B’ waters of the Treaty Area; and

“(b) to effect a reduction in the oxygen demand of the sewage effluent sufficient to maintain an average dissolved oxygen content in the tidal waters of the Treaty Area and in the general vicinity of the point of discharge of the sewage into those waters, at a depth of about five feet below the surface, of not less than 30% saturation during any week of the year.

“3. If the Commission shall determine, after investigation, that owing to topography or other local conditions, either natural or artificial, in a part of any municipality discharging sewage into the waters of the Treaty Area, it would be impossible or impracticable to meet the above requirements in either Class ‘A’ or ‘B’ waters with respect to suspended solids or oxygen demand, a modification of these requirements may be permitted; provided, however, that the sewage discharged from adjoining areas in such municipality shall be given the additional treatment necessary to effect an average reduction of suspended solids and oxygen demand of all the sewage discharged from such contiguous areas (including the portion of the area of the municipality where the requirements have been modified) equal to the requirements stated above.

“4. All sewage discharged or permitted to flow into any stream tributary to the tidal waters of the Treaty Area shall be treated to that extent, if any, which may be necessary to maintain such tributary immediately above its confluence with the tidal waters of the Treaty Area in a sanitary condition at least equal to the classification requirements determined by the Commission for the tidal waters of the Treaty Area into which it discharges. The waters of the Hudson River, immediately above the New York-New Jersey State boundary extended, shall be maintained in a sanitary condition at ebb tide at least equal to the sanitary condition prevailing in the waters of the river immediately below said boundary at flood tide.

“5. Nothing in this Compact shall be construed to repeal or prevent the enactment of any legislation or the enforcement of any requirement by any signatory state imposing any additional



conditions and restrictions to further lessen or prevent the pollution of waters within its jurisdiction.”

### III. TIME FOR PUTTING REMEDIES INTO EFFECT

The following clauses should be included in the Treaty:

“Subject to the provisions of this Compact, the Commission shall set up a schedule aiming to establish certain dates on or before which all communities related to the designated waters of the Treaty Area shall have taken the necessary steps to bring about the construction of works needed for treating their sewage in accordance with the standards of purity specified in this Compact. Any portion of such schedule affecting any signatory state shall require the affirmative vote of the representatives of said state on the Commission.

“The administration of the laws enacted under this Compact shall be undertaken by the duly authorized officers or agents of the signatory states; provided, however, that the Commission shall have authority to investigate and determine if the requirements of the Compact are complied with and to bring action in the proper court or courts having jurisdiction to sue for the enforcement of any and all of the provisions of this Compact.”

### IV. PROPOSALS NOT RECOMMENDED

We do not recommend giving the Commission the power to issue bonds for construction purposes, to prepare plans for sewage treatment projects, nor the right to approve or disapprove plans for new projects or the alteration or extension of existing plants. Such powers and duties should be left with the state or local authorities or, if necessary, through the state or federal courts.

## PART II—REPORT ON THE SECOND OBJECTIVE

### Studies of Existing Conditions of Pollution in the Inter-State Tidal Waters

#### INTRODUCTION

The second objective of the Research and Engineering Committee was to assemble information and data necessary to enable a clear understanding of existing conditions of pollution in the tidal waters of the adjacent portions of the three states. The following report includes only a summary of the pertinent data collected, and the conclusions based on the voluminous material reviewed.

With the short time and limited funds available elaborate and independent studies of the general problem of tidal water pollution were impossible. Such limitations, however, did not obstruct the work of the committee since many thorough and excellent studies of the general problem have been made in past years by various commissions and authorities and it remained only for the

mass of existing information to be compiled, compared and thoroughly reviewed. The detailed work of the committee, therefore, embraced an exhaustive study of all reports and published records that could be located and which were pertinent to the subject, and the collection and assembling of additional unpublished data from the files of the respective departments of health of the several states, and from other public bodies.

#### ACKNOWLEDGMENTS

Acknowledgment is gratefully made for the assistance rendered to the committee through the cooperation of the Departments of Health of the respective states, the Sanitation Department of New York City, the Westchester County Sanitary Sewer Commission, the Passaic Valley Sewerage Commission, the Hackensack Sewerage Commission, the Federal Government, the Conservation, Water and other Departments of the several states, and various other regional and local authorities.

#### PREVIOUS STUDIES OF THE PROBLEM

Although the Tri-State Commission is the first public body that has studied the question of pollution of the tidal waters from the viewpoint of the three states, various phases of the problem have been under examination for many years. In 1902, the U. S. Geological Survey published a paper discussing the pollution of the Passaic, Raritan and Hudson Rivers, in addition to other water areas (Water Supply and Irrigation Paper No. 72). The pollution of the waters of New York Harbor was brought to public attention in the 1905 and 1906 reports of the New York Bay Pollution Commission, which had been created by the New York State Legislature in 1903. As a result of the work of that Commission, in 1906 the legislature created the Metropolitan Sewerage Commission of New York, which remained in existence until 1914.

The *Metropolitan Sewerage Commission* carried out elaborate and detailed studies of pollution in all of the New York Harbor waters, and published extensive reports in 1910, 1912 and 1914. Although the intention of the legislature was that the Commission should carry out its investigation in cooperation with the State of New Jersey, the efforts of the Commission to obtain this cooperation were without result. Consequently, the costs of this investigation were carried entirely by the City of New York, although the studies were extended to include pollution of the harbor waters from sources in New Jersey. The Commission also made recommendations as to a general plan for main drainage, sewage collection and disposal for the whole of New York City.

In its 1914 report, the Metropolitan Sewerage Commission summarized conditions at that time as follows:

“At the present time, the crude sewage of a population of over 6,000,000 persons is discharged through several hundred outlets



into the harbor without purification, regulation or control of any kind. The discharges, all of which take place at the shore line or beneath the docks and piers, discolor the water, pollute the shores, produce offensive deposits and cause solid matters, plainly recognizable as of sewage origin, to float about in plain sight. Bathing and the taking of shellfish for food are no longer safe north of the Narrows.

"The pollution, objectionable as it is at the present time, is rapidly increasing. Within the next thirty years the population will be about double what it is today and the quantity of sewage will increase in proportion. The pollution is most objectionable in summer when it is desirable that the water should be cleanest; it is most intense in those sections where the density of population and the congestion of water traffic are greatest.

"The members of the Commission feel that they cannot state the need of improvement too strongly. The public has been made aware of the situation through the numerous reports which the Commission has issued from time to time. Among great cities, New York is practically alone in not possessing either a system of main drainage and sewage disposal or a plan and policy for the sanitary conservation of its water highways."

The reports of the Metropolitan Sewerage Commission have been under discussion and study by the officials of New York City ever since 1914 and various reports have been issued recommending steps to be taken to alleviate the pollution of the harbor waters. Although considerable planning had been carried on in the succeeding years, little progress in the matter of providing physical works for the removal of pollution from harbor waters had been made, up to the past year. On February 25, 1931, the Sanitary Commission of New York City submitted to the Mayor a report on the General Plans for Sewage Disposal for the City of New York, recommending a program for construction of sewerage and disposal works which would require a number of years to complete and which would greatly improve the sanitary conditions in the harbor. As a result of this report, steps were taken to start work on the first project for this program,—i.e., the Ward's Island Sewage Treatment Plant,—construction of which was commenced during the past summer. It is recognized by the Sanitary Commission that it will require a number of years to overcome the condition of pollution from New York City's sewage, and that satisfactory results can only be obtained through cooperative treatment of pollution from the other communities now discharging sewage into the harbor waters.

The *U. S. Engineer Offices* of the First and Second Districts, New York City, in 1925 reported upon their investigations of the pollution of the navigable waters and tributaries within the Metropolitan District, including the Hudson River up to Poughkeepsie. These investigations included a survey of pollution by sewage, industrial wastes and oil and also discussed the existing laws and jurisdiction

of the several authorities. The reports of the U. S. District Engineers have been of great assistance to our committee as noted elsewhere in our report.

Steps to alleviate pollution from sources outside of New York City have been taken in several localities. In Westchester County, the *Westchester County Sanitary Sewer Commission* has been in existence since June 27, 1926. This Commission has studied the problem of sewage disposal in the entire county, and has constructed several trunk sewers and disposal plants. When its general program is completed, the conditions of pollution in the tidal waters adjacent to Westchester County should be considerably improved.

Studies of conditions in Nassau County, New York, have been made by the *Governor's Special Long Island Sanitary Commission*, which submitted a report on May 15, 1931. This report recommended the appointment of a county sanitary commission to provide and operate trunk and outlet sewers and sewage treatment plants where required in Nassau County.

The *Passaic Valley Sewerage Commission* was established by law passed in 1902 which was revised in 1907. The district covered by this commission includes the greater portion of the Passaic River Valley in New Jersey, from the Great Falls above Paterson to the mouth. The Commission has constructed a trunk sewer which is designed to receive all the sewage from the district, a pumping plant and sedimentation basins located near the shore of Newark Bay, and an outfall sewer discharging into New York Upper Bay near Robbins Reef. These sewerage and sewage treatment works were placed in operation on August 2, 1924, and have resulted in considerable improvement of conditions in the Passaic River and to some extent also in Newark Bay.

The *Hackensack Sewerage Commission* has been studying the problem of eliminating pollution on the Hackensack River, in New Jersey, since January, 1931, and is preparing a report to be submitted to the Boards of Chosen Freeholders of Hudson and Bergen Counties. The Commission plans to eliminate pollution on the river by a comprehensive project which will provide for the sewage from all the communities in the Hackensack watershed, and will propose legislation to enable the financing and construction of this project.

The *Joint Outlet Trunk Sewer*, originally constructed in 1902, serves several towns in the Elizabeth and Rahway River watersheds. This sewer delivers at a treatment plant in Elizabeth, with discharge into Arthur Kill. The Rahway Valley Trunk Sewer, now under construction, will receive the sewage of a number of towns in the Rahway Valley. It will have a treatment plant in Woodbridge Township, with discharge into the Rahway River. These two trunk sewers were constructed by joint action of the interested municipalities, for the purpose of handling the sewage from the greater portion of their respective watersheds.



In the Raritan River Valley, extensive studies have been made, and various trunk sewer and sewage treatment projects are under consideration. The several municipalities have been ordered by the State Board of Health to take steps leading to the elimination of pollution of the river, but no final plans have as yet been adopted.

In Connecticut: Stream pollution in Connecticut has been under investigation for a period of about forty-five years, and while some of the municipalities have contributed to the solution of this problem by carrying on local investigations, the most important studies have been made by the State Health Department and other State commissions. The earliest official investigation of stream pollution in Connecticut was authorized in 1886 and reports on these studies were made by the State Board of Health. In 1887 a Sewage Commission was appointed, and between 1899 and 1902 submitted reports on sewage disposal in the state. Other studies under the direction of the State Board of Health were published during the period of 1909 to 1912. These investigations were confined principally to setting down records of the stream pollution conditions of the times, and comparisons with pollution in other states and foreign countries.

In 1915, the State Board of Health submitted a report on an investigation of pollution of waters within the state by sewage, with recommendations for such legislation as would lead to the control of such pollution. Following the publication of this report the Industrial Wastes Board was appointed in 1917, and submitted reports between 1918 and 1921. These reports represent an important addition to the literature of Connecticut problems and include the results of a considerable number of investigations on methods for the treatment of industrial wastes, made under cooperative agreements between the industries and the State Industrial Wastes Board. Subsequent to the final report of this board, in 1921, and after further investigations under authority of the General Assembly, the State Water Commission was created in 1925. This Commission has the duty of protecting the waters of the state from pollution by sewage or industrial wastes, and has accomplished a great deal towards the elimination of such pollution within the past five years. The State Board of Health has also made numerous investigations on public health problems involving the protection of shellfish areas and bathing beaches. A very careful study of the shellfish areas and bathing beaches along the entire shore line of Connecticut, covering three years' work, is ready for publication and should be of considerable interest to the Tri-State Commission, as it gives a fair picture of existing conditions.

In addition to the work done in the several states by these various commissions, the problem has also been studied by various legislative committees and municipal authorities, whose work cannot be covered in this brief summary.

With the exception of the Metropolitan Sewerage Commission and the Federal Government, the work done by the various regional or district commissions has been chiefly for the purpose of eliminating conditions of pollution on particular drainage areas, or to improve certain streams. They have not been interested in any general elimination of pollution of the interstate tidal waters. Notwithstanding the work of the Metropolitan Sewerage Commission, whose final report was submitted in 1914, no very definite progress in the actual construction of works to carry out its recommendations appears to have been made until 1931.

The summary of existing conditions given in the present report will show that proper progress has not been made, that pollution has increased in spite of all the investigations and reports that have been prepared, and that conditions in many localities will become intolerable unless steps are taken in the near future to obtain joint action by all communities which share in the responsibility for the pollution of the interstate tidal waters.

#### POPULATION AND SEWAGE FLOW

The accompanying Tables 1-3 contain a summary of statistics which we have assembled to show the sewage flow which reaches the streams flowing into the Treaty Area, or which is discharged directly into the tidal waters of the Treaty Area. We have also shown the population which contributes this sewage.

In preparing these statistics, population figures were tabulated by towns or incorporated places; but in New York City the data were further subdivided into assembly districts in order to obtain a more accurate distribution of the population. Estimates were made of the population contributing sewage in the year 1970, by a study of the growth of population as shown by the census reports.

For areas outside of New York City, the extent of sewage treatment in future years was assumed to increase only in proportion to the estimated increase of population contributing sewage.

In estimating future conditions for New York City, it was found advisable to give consideration to the probable development of sewage treatment works. For this purpose, it was assumed that, by 1970, the "Plan A" sewage disposal system proposed by the Sanitary Commission in their report dated February 25, 1931 would be in operation. This involves a rather complete re-alignment of the population and sewage statistics for areas tributary to various portions of the harbor. The results are shown in Table 4.

The data on sewage flow and population are summarized in the tables by watersheds in order to show more clearly the extent to which pollution from sewage is concentrated at various points in the tidal waters. In general, the figures show the population located on a given watershed, and the sewage contributed by that population. In certain cases, however, an artificial re-alignment of drain-



age areas was necessary because the sewage from certain communities on the watershed was transferred through a trunk sewer to some other watershed. As an example, the Passaic Valley Trunk Sewer collects the sewage from a number of municipalities in the Passaic River watershed in New Jersey and discharges this sewage into New York Upper Bay. The population and sewage so affected are therefore grouped with the New York Upper Bay watershed instead of with the Passaic River watershed. (For location of watersheds, see Fig. 2.)

In estimating the total sewage flow from a given watershed, some consideration must be given to the extent to which the sewage is treated in the various communities. To combine the rate of flow from a town providing no treatment of its sewage with that from another town where the sewage was highly purified before final discharge would not indicate the true situation. The degree of purification varies greatly in different towns; but for purposes of comparison three classification were used:

- (1) Untreated sewage.
- (2) Partially treated sewage—includes sedimentation with or without screening.
- (3) Fully treated sewage—includes both sedimentation and some form of filtration.

In combining the sewage flows, untreated sewage was given a "weight" of 100 per cent, partially treated sewage was given a weight of 67 per cent, and fully treated sewage was given a weight of 15 per cent. The resulting figures are described as "equivalent untreated sewage" flow.

A similar method was used to determine the "equivalent contributing population." This may be considered as the population whose raw sewage would be equivalent in polluting strength to the sewage actually discharged on the watershed, after making allowance for the various degrees of treatment that are provided in the several communities. The figures for equivalent population and equivalent sewage are not directly proportional, due to the fact that the rates of sewage flow per capita are not the same in all places.

While the estimates of population and sewage flow are based on conditions existing in 1930, in making allowances for the treatment of sewage in the various communities the treatment plants in operation or under construction in 1931 were included.

In the tables, sewage flow is given as the annual average flow, in million gallons per day. Population estimates are based on the number of permanent residents as shown by the census tabulations. In some localities the summer population is considerably greater than that shown by the census, and in New York City there is a large transient population which is not included in the estimates but which contributes a considerable amount of sewage; but no allowance for these conditions was made in the estimates.

#### MINIMUM STREAMFLOW

In estimating the extent to which sewage is diluted by the fresh water flowing into the tidal waters, it was necessary to determine the minimum flow in the various streams. It was decided to make this estimate on the basis of the average flow in the driest month expected. There might be short periods when the actual streamflow is less than this amount, but these would not have any significance as to dilution of sewage in the tidal waters on account of the effect of the large drainage areas and of the large basins of tidal water in smoothing out these short-time minimum flows.

The estimates were based on a study of all existing records of streamflow within the general limits of the drainage areas involved. These records were extensive enough to permit a fair estimate of probable future conditions. The adopted rates of flow, in c. f. s. per square mile, are not uniform, but vary according to the hydrologic conditions in the several watersheds as indicated by the streamflow records. Allowance was made, as far as possible, for the effect on minimum streamflow caused by diversion of water for municipal water supplies. On the Hudson River watershed a special factor was the regulating effect on minimum flow caused by the operation of the Sacandaga Reservoir at Conklingville. This is operated so as to maintain a minimum average flow in the Hudson River at Spier Falls of 3,000 c. f. s., and consequently causes a decided effect on the minimum flow of the entire Hudson River watershed below that point.

The estimated minimum streamflow on each watershed is given in Tables 1 to 3.

#### TOTAL POLLUTION BY STATES

Table 5 gives a summary of the data on population and sewage flow for the three states, and the percentages of the total attributed to each state. The portions of the states included in this summary are as follows:

(a) In New Jersey—all drainage areas tributary to the Treaty Area, as defined in the recommended draft of the Tri-State Treaty. (See Fig. 1.)

(b) In New York—all drainage areas tributary to the Treaty Area, and including the Hudson River watershed upstream as far as Newburgh. Although the Treaty Area extends only up to the N. Y.-N. J. State Boundary, it was believed that the sewage from communities as far upstream as Newburgh might have some influence on pollution below the interstate boundary.

(c) In Connecticut—all drainage areas tributary to the Treaty Area, but excluding the Housatonic River watershed above Shelton. The Housatonic River watershed is so sparsely populated with respect to the flow of the stream that the effect of pollution from that territory upon the river at Shelton was considered to be negligible.



#### POLLUTION OF THE WATERS OF NEW YORK HARBOR

An attempt has been made to show the total effective pollution of the waters of New York Harbor, caused by the various communities in the States of New Jersey and New York. In Table 6 is given a summary of the "equivalent population contributing untreated sewage" and the "equivalent untreated sewage flow" in various parts of the harbor. These values are given for 1930, and for 1970 with New York City's Plan "A" for disposal in effect. The figures are intended to indicate the total equivalent pollution carried by the harbor waters at various points. In making this summary the following assumptions as to the flow of the tidal waters were adopted:

(a) Sewage discharged into the Harlem River is carried equally to the Hudson River and the East River.

(b) All sewage discharged into the East River is ultimately carried into New York Upper Bay.

(c) Water discharged into Newark Bay is carried as follows:  
To Kill van Kull and Upper Bay—83.7 per cent.  
To Arthur Kill—16.3 per cent.

(d) All sewage carried into New York Upper Bay is ultimately carried into the Lower Bay through the Narrows.

(e) All sewage discharged into Jamaica Bay is carried into the Atlantic Ocean and does not reach the Lower Bay.

These assumptions are based on extensive tests and investigations that have been made by the Metropolitan Sewerage Commission and by the U. S. Coast and Geodetic Survey.

In estimating the amount of sewage brought into the harbor by the Hudson River, four assumptions were made:

(1) That all the sewage discharged on the entire watershed of the Hudson River reached the harbor waters.

(2) That only the sewage discharged at Newburgh or below reached the harbor waters, the sewage from above Newburgh being assumed to be purified by natural processes as it comes down the river.

(3) That only the sewage from below the N. Y.-N. J. state boundary reached the harbor.

(4) That only the sewage from below the New York City boundary reached the harbor.

#### DILUTION OF SEWAGE IN NEW YORK HARBOR

In studying the possibility of dilution of sewage in the harbor waters, it is obvious that attention must be given to tidal action. The volume of water carried into and out of the harbor at each tide is very great, and the interconnection of the different branches of the harbor provides an opportunity for the transportation of sewage from one part of the harbor to another. Dilution of the sewage is brought about by the fresh water flowing into the harbor

from the rivers, notably from the Hudson, and by considerable volumes of clean sea water which are carried back into the harbor on each flood tide.

The river water available for dilution, in the driest months expected, has been estimated from studies of streamflow records, as shown in Tables 1-3. But the determination of the volume of sea water available for dilution is much more complicated. A study of this question was made for the Metropolitan Sewerage Commission, to obtain the volume of diluting sea water in months of average streamflow. We have corrected these results to obtain the amount of sea water available for sewage dilution at the time when the streamflow is reduced to the minimum adopted for this report. The results are given in Table 7.

In this table the amounts of land water and sea water available for dilution of sewage are given at several points in the harbor. The rates of flow are given in c. f. s. (cubic feet per second) and in m. g. d. (million gallons daily). The total of land and sea water combined is also given. The total equivalent sewage flow at these points is given together with the equivalent contributing population. The portion of the table showing conditions as existing in 1930 gives the results (a) including all sewage from the entire Hudson River watershed, or (b) including only the sewage from below the N. Y.-N. J. state boundary. The table for 1970 includes only the sewage from below the N. Y.-N. J. line, and is also based on "Plan A" development of the sewage disposal project for New York City.

The table shows the ratio of diluting water to the sewage flow, and the rate of flow of the diluting water (either land water alone, or land and sea water combined) in c. f. s. per 1,000 population. In interpreting these results, it may be considered that with fresh water streams, the minimum ratio of dilution of untreated sewage to avoid nuisance should be about 40:1, or that the diluting water should be available at a rate of about 6 c. f. s. per 1,000 population. With sea water; the amount of dilution should be increased about 20 per cent.

Any estimates of dilution of sewage by sea water in the harbor must be considered very approximate as the volumes of diluting sea water cannot be accurately determined. Moreover, an estimate of dilution based on total volumes of sewage and diluting water in a branch of the harbor does not tell the whole story. For the sewage and harbor water seldom have adequate opportunity for proper mixing and there will be local areas where the concentration of sewage will be much greater than that indicated by the average figures. Also, the sea water estimated as available for dilution of sewage in the different branches of the harbor is generally not clean sea water except off places near the ocean; at other points the "new sea water" is really water which has not been at the place on the previous tide, but comes from some other part of the harbor. However, in spite of these limitations, it is believed that this study warrants the following conclusions:



(1) If the "land water" only is considered available for dilution of sewage, no branch of the harbor above the Narrows has a sufficient capacity for the disposal of the sewage discharged into it, under present conditions.

(2) If sea water as well as land water can be considered for dilution, the only part of the harbor providing sufficient dilution at present is the Hudson River.

(3) The worst branches of the harbor as regards dilution of sewage at present are the Harlem River, East River (particularly the lower East River south of Hell Gate), Newark Bay, Arthur Kill and Kill van Kull. This is also verified by results of tests for dissolved oxygen as discussed elsewhere in this report.

(4) Under conditions estimated to exist in 1970:

(a) If no further work is done to provide for treatment of the sewage now reaching the harbor waters, future conditions will be intolerable in all parts of the harbor.

(b) If New York City carries out the proposed plan of construction for Sewage disposal (Plan "A" of the Sanitary Commission), conditions in the Hudson River, Upper Bay, Harlem River and East River will be somewhat improved over the present conditions, even after making allowance for the increase in population during the intervening forty years. However, it is doubtful whether conditions in the harbor would be satisfactory at that time unless plans are carried into effect to treat also large parts of the sewage discharged into the Hudson River above New York City as well as that contributed to the River and Upper Bay from New Jersey.

(c) To maintain Newark Bay and the Kills in a satisfactory condition in the future will require the introduction of a large degree of purification of sewage in the New Jersey communities tributary thereto, to provide both for the present untreated sewage and for the increasing population.

#### DISSOLVED OXYGEN TESTS IN THE TIDAL WATERS

One of the most satisfactory methods for determining the degree of pollution existing in a body of water is by the dissolved oxygen test. In discussing the significance of this test, the Metropolitan Sewerage Commission of New York stated (1912 Report, p. 626): "The amount of dissolved oxygen which is present in a natural body of water affords the best means available for measuring the burden of pollution which has been put upon the water and gives a basis upon which to form an opinion as to maximum quantity of sewage which the water can properly absorb. So far as future conditions are concerned, the test has reference chiefly to the possibility that the sewage materials in the water may putrefy and produce offensive odors. If there is much oxygen, this probability is remote; if there is but little, the danger is imminent. . . . The scientific value of the analysis depends on the fact that the oxygen which is

normally present in the water is used up by the processes of nature in changing the decomposable substances of the sewage into harmless and inoffensive compounds. This change has been termed 'digestion'."

The amount of oxygen that can be dissolved in clean water varies with the temperature, and with the salinity of the water; it is less for warm than for cold water, and is less with salt water than with fresh water. The maximum amount that can be dissolved under any given conditions is taken as 100% saturation. The actual amount of oxygen present in a given sample of water is then given as a percentage of possible saturation under the existing conditions.

When the water contains organic matter, as in sewage, the dissolved oxygen will be consumed by the "digestive" processes at a rate which depends on the concentration of the organic matter in the water. As the digestion proceeds, the rate of consumption of oxygen gradually decreases. When the dissolved oxygen drops below 100% saturation, the water begins to absorb oxygen from the atmosphere. The rate at which this oxygen is absorbed increases as the percentage of oxygen in the water decreases. A point is reached, therefore, when the rate at which the organic matter consumes oxygen may equal the rate at which additional oxygen is absorbed from the atmosphere, in which case as long as other conditions do not change the percentage saturation will remain constant at the depressed value. If the rate of oxygen consumption exceeds the rate of oxygen supply, the percentage saturation will decrease and dissolved oxygen may become depleted resulting in the creation of offensive conditions.

The digestive processes are most active during warm weather, at which time the amount of oxygen in the water is the least. It is during the summer months, therefore, that the greatest deficiencies in dissolved oxygen will occur.

Tests for dissolved oxygen in the tidal waters of the Treaty Area have been made by several agencies. In the accompanying diagrams and tables are given summaries of some of these tests. Where possible, averages are given of all tests made between June 1st and September 30th, as it is believed that these averages give the most accurate picture of relative conditions. Individual tests are affected by many conditions, such as wind velocity, depth at which sample is taken, stage of the tide, etc.; whereas these variable effects are absorbed by using the seasonal averages.

*New York Harbor and Newark Bay:*—Extensive tests in New York Harbor and Newark Bay have been made by the Metropolitan Sewerage Commission and by the engineers of the Board of Estimate and Apportionment. The results as taken from the reports of the chief engineer of the Board of Estimate and Apportionment are plotted in Figure 3. The curves on this diagram show the average dissolved oxygen percentages for the main branches of the harbor for the summer months during the years



1909-1931. While there is considerable irregularity in the individual curves, there is a marked decrease in oxygen shown between 1909 and 1916, with a more gradual decrease since that year. This is also shown by the five-year averages given in the following table, which indicate a continual decrease in all parts of the harbor, except at the Kill van Kull:

PERCENTAGE OF DISSOLVED OXYGEN

Averages of Samples Analyzed between June 1st and September 30th

	1911 to 1915	1916 to 1920	1921 to 1925	1926 to 1930
Hudson River below Spuyten Duyvil.....	54	44	39	36
Harlem River .....	33	24	24	23
Upper East River.....	58	45	44	44
Lower East River.....	54	25	23	21
Upper Bay .....	69	53	45	36
Kill van Kull.....	63	42	45	37
Narrows .....	72	59	56	47
Combined average .....	56	43	40	35

It is believed that fluctuation in the average figures from year to year is due largely to variations in the flow of upland water through the rivers and also to variations in the air temperature in different years—low streamflow and high temperatures tending to cause low oxygen percentages.

The diagram also shows that, since 1920, the average dissolved oxygen in summer months has not gone above 50% in any part of the harbor except at the Narrows and the Upper East River and even at those points it has seldom reached 50% since 1925.

The Harlem and lower East Rivers show the worst results, remaining below 30% since 1915, and reaching a low value of about 14% in 1926.

The branches of the harbor in their relative degree of pollution may be listed as follows, giving the most badly polluted sections first:

- Lower East River.
- Harlem River.
- Hudson River (below Spuyten Duyvil).
- Kill van Kull.
- Upper Bay.
- Upper East River.
- The Narrows.

Table 8 gives minimum observed oxygen tests for 1909 and 1931, and shows the serious conditions now existing in the Harlem and Lower East Rivers. This table also illustrates the great increases in pollution which have taken place in the last 20 years in all the harbor waters except Jamaica Bay.

The *Passaic Valley Sewerage Commission* have made dissolved oxygen tests in New York Harbor and Newark Bay since 1923, which are shown graphically in Figure 4. This shows summer averages at certain points in the Upper Bay, and for Newark Bay and adjacent waters. The curves for New York Harbor are reasonably consistent with the average curves in Figure 3. They show a tendency to a gradual decrease in dissolved oxygen in the Upper Bay and adjacent waters in the last few years. The effect of the Passaic Valley Sewer discharge at Robbins Reef is apparently to reduce the dissolved oxygen at that point at a slightly greater rate than it is being reduced at other parts of the harbor.

A marked improvement in the Passaic River is shown in 1924, when the Passaic Valley Sewer commenced operation. This effect is also shown at the mouth of the Hackensack River, and in the averages for the Bay. In spite of this local improvement, however, the general tendency at present is towards a reduction in oxygen content, indicating a continuous increase in pollution in these waters.

The Arthur Kill is shown to be considerably more polluted than the Kill van Kull. All of the waters in Newark Bay and adjacent waterways are badly polluted, and at no point has the average summer oxygen content been above 50% since 1927.

*Hudson River above Spuyten Duyvil*.—Available tests for this portion of the tidal waters are not as extensive as for the various branches of New York Harbor. In September, 1924, the U. S. Engineer Office, 1st District, New York City, tested samples of river water at various points from Poughkeepsie to New York City. Average results, omitting samples which were taken from tributary streams or were taken near the shore and affected by local pollution, are summarized below:

LOCATION	Distance from New York City Hall	Average dissolved oxygen	Sea water
	Miles	Per cent	Per cent
Poughkeepsie.....	74	72	6
Low Point.....	63	82	8
Storm King Mt.....	54	70	8
Verplanck.....	39	59	12
Croton Point.....	33	64	14
Ossining.....	32	61	20
Scarsboro.....	30	61	20
Tarrytown.....	27	58	28
Irvington.....	24	45	30
Dobbs Ferry.....	22	55	32
Yonkers.....	17	50	46
Mt. Saint Vincent.....	15	48	50

The District Engineer's Report on Investigation of Pollution of Navigable Waters and their Tributaries (1925) states:—

“*Poughkeepsie to Peekskill*.—Dissolved oxygen samples were taken on two consecutive days in September at 15 points within



this area. The center portion (of the river) showed higher values between 75% and 82% but along the city waterfronts at Poughkeepsie, Newburgh, Beacon City and Cornwall, results were obtained between 55% and 72% due to the effect of the sewage discharge at these towns. It is very probable that lower values would be obtained at other times and from a series of more extensive observations."

The latter statement can be further verified by the fact that the stream flow in the Hudson River watershed during September, 1924, was probably as much as twice the minimum monthly flow.

"At the time of our inspection, no visible evidence of extensive pollution could be detected in the Hudson River in this area by the general appearance of the water surface, with the exception of small areas of light oil often seen, and the floating domestic sewage along the city waterfronts.

"Microscopic examinations of bottom samples along the Poughkeepsie waterfront showed sludge deposits were being formed and not being carried away. At Newburgh, the sewage deposits are largely forming above the low water line and only an oily scum was observed on the surface.

"*Peekskill to New York City*:—Determinations of dissolved oxygen value of the waters in this area were made at 22 points on two successive days in September, 1924. An average for such determinations was 54%. A cross section at Verplanck gave an average of 59%, while one taken at Mt. St. Vincent gave 48%. The other samples were taken generally from one-quarter to three-quarters of a mile offshore from the larger communities along the river, and vary between a minimum of 42% and a maximum of 72%. It is quite probable that observations taken during July or August would furnish appreciably lower values.

"A personal inspection of the physical condition of the waters gave ample proof of extensive pollution."

*Nassau and Suffolk Counties*:—The U. S. District Engineer's Report (noted above) records 52 dissolved oxygen determinations in October, 1924, with average results as follows:

Manhasset Bay .....	87%
Hempstead Harbor .....	83
Cold Spring Harbor and Oyster Bay.....	87
Huntington Harbor and Northport Bay.....	79

"Long Island included in the counties of Nassau and Suffolk presents no serious problem from the standpoint of pollution. There are no trade waste discharges of any consequence, and over 20% of the sewage from the north shore is treated effectively. About 3.22 m.g.d. of sewage are discharged along the north shore from the city line to Montauk Point. However, this is run into large bodies of water, which are flushed by tidal action, with the clean waters of the Atlantic Ocean through Long Island Sound. All of the towns on the south shore discharge their sewage into

cesspools, the effluent reaching the bay through the ground waters."

Referring to the reports of the New York State Department of Health, the District Engineer's report states:—"There are no public sewer systems discharging into Great South Bay, and the pollution is concentrated in two areas. At Bay Shore, local discharges pollute the bay. At Patchogue similar conditions exist, though in a more aggravated form. West of Great South Bay are a number of small bays, creeks, inlets and marshlands which constitute Hempstead Bay. A considerable number of private sewers, drains and overflowing sewers, located all along the shore, discharge into these waters."

The only public sewer systems now discharging into Great South Bay are at Patchogue and Ocean Beach, both of which serve small communities and also have partial treatment of the sewage. There are no public sewers discharging into Hempstead Bay. The only public sewerage systems discharging into the Atlantic Ocean east of New York City are at Long Beach and Atlantic Beach.

*Long Island Sound*:—Extensive tests of dissolved oxygen in Long Island Sound are not available. The limited data at hand indicate that the waters of the Sound contain relatively little polluting matter, except in the immediate vicinity of outfall sewers, and in the larger harbors. The western end of the Sound, between New Rochelle and Throgg's Neck, is subject to some pollution from New York City. Since the East River flows into Long Island Sound during each flood tide, some of the sewage discharged into the Upper East River will be carried into the Sound. But on the following ebb tide the direction of current will be reversed, and the water flowing from the Sound into the East River will carry some of this sewage back into the East River. Under average conditions, the total volume of water carried by the ebb tide is greater than that on the flood tide; hence the only portion of the East River sewage which could remain in the Sound after ebb tide would be that which is lost due to diffusion.

From an examination of the float experiments of the Metropolitan Sewerage Commission, it is believed that little if any sewage discharged into the Upper East River west of College Point will reach Long Island Sound on the flood tide. We have estimated the volume of sewage discharged into the East River east of College Point and Clason Point, for 1930, as follows:

Contributing Population .....	317,645
Sewage Flow—m.g.d. ....	38.70

Since the river is flowing towards the Sound only one-half of the time, it may be assumed that about 20 million gallons of sewage reach the Sound from New York City each day (equivalent to 2.67 mill. cu. ft. per day or 1.38 mill. cu. ft. per tide). Some of this sewage will remain in the Sound, as a result of diffusion with the large bodies of water, and the remainder will be carried back into



the East River and eventually into the Upper Bay. We have no data on which to base an estimate of the amount of sewage lost into the Sound by diffusion, but the above figures indicate that the quantities involved must be small, particularly in relation to the total volumes of water flowing on each tide.

#### INDUSTRIAL WASTES

The inter-state tidal waters receive considerable quantities of polluting material originating as trade or industrial waste products, which are disposed of by the industries by discharging into the sewers or water courses. These wastes may be grouped into four classes, according to the manner in which they pollute the waters:—

(1) Solids which tend to form deposits in the waterways, or floating solids which may be dangerous to navigation.

(2) Organic material,—such as the waste from creameries or slaughter houses,—which has a polluting effect very similar to that resulting from domestic sewage.

(3) Chemicals which may be carried in solution or suspended in the water in the form of an emulsion.

(4) Oils and oily products.

Detailed information as to industrial wastes in the Metropolitan District is difficult to obtain. No regular reports on this matter are submitted to the various governing bodies by the industries involved, and the only way such data can be obtained is by original surveys and examinations of all the industries in the District. The only extensive survey of this nature which we have been able to find is included in reports by the U. S. Engineers of the First and Second Districts, in New York. Some study of this question has also been made in the Hackensack, Passaic and Raritan River Valleys, in New Jersey. The State Water Commission of Connecticut has made a study of industrial wastes on the principal rivers discharging into Long Island Sound.

The question of industrial wastes which are injurious to navigation is not considered herein, as this matter is under the jurisdiction of the Federal Government and it is believed that it can be kept under control through adequate enforcement of existing laws and regulations. Organic wastes can generally be handled effectively through the regular sewage treatment plants. Their effect as to pollution of the tidal waters is equivalent to a certain increase in the population contributing sewage. What this increase should be can only be determined by special study in each community. No general attempt has been made to express the equivalent population of the industrial wastes in preparing the statistics on sewage flow presented in this report, as the necessary information was not available. However, in localities where industrial development is extensive, the data on sewage flow include some allowance for pollution by industrial wastes.

Chemical wastes, and particularly acids, cannot generally be handled in the sewage treatment plants. In fact, if present in large quantities, they may partially or wholly destroy the effectiveness of the purification process. Their presence in any large amounts in the tidal waters would probably be very injurious to fish or shellfish life; but, in most cases, the great dilution by the tides or streamflow will prevent the accumulation of the chemicals to a dangerous extent. Moreover, since the tidal water is generally alkaline, the tendency will be to neutralize the acid wastes to a considerable extent. Oil wastes are discussed in more detail below.

#### New Jersey

In the Hackensack River valley, great quantities of industrial wastes are discharged into the river between Hackensack and Newark Bay. A joint commission has been formed to solve the sewage disposal problems of this valley, and efforts are under way to bring about the proper treatment of trade wastes.

In the Passaic River valley, there is extensive industrial activity between Paterson and Newark. Practically all domestic sewage in this area is carried in the Passaic Valley Sewer which discharges into New York Upper Bay at Robbins Reef and has been in operation since August 2, 1924. The sewer commission is attempting to bring about the treatment of all objectionable wastes at their source before they are discharged into the trunk sewer, and it is expected that eventually all such wastes in the Passaic Valley will be eliminated from the river by this means.

In the Raritan River valley, it has been estimated that industrial wastes discharged directly into the river courses are equal to ten million gallons daily, and to be equivalent to the sewage discharged from a community of not less than 50,000 people. Plans are under way to secure proper treatment for these wastes.

On the shores of New York Upper Bay, Newark Bay, Kill van Kull and Arthur Kill there are numerous manufacturing plants and several large oil refineries.

#### New York

On the Hudson River, above New York City, there is a considerable amount of manufacturing. The plants are distributed among the various towns and the resulting industrial wastes are sufficiently diluted by the river flow to avoid any general nuisance, except in the immediate vicinity of the larger towns.

In New York City, the principal industrial development is in Manhattan, Brooklyn and Queens. The distribution of manufacturing plants is not uniform, though most of the trade wastes come from factories located in a relatively narrow strip along the waterfront. In Manhattan, the greater portion of such plants are located on the East River and Harlem River. Most of the wastes in Brooklyn originate along the waterfront from a point about two miles south of Gowanus Canal to the head of Newtown Creek.



Long Island City and Astoria are the industrial centers of Queens. A large portion of the trade wastes in New York City are discharged directly into the sewers.

There is no serious pollution of tidal waters from industrial wastes on the north shore of Long Island Sound in Westchester County, nor on the shores of Long Island Sound from New York City as far east as Port Jefferson and Fire Island Inlet.

#### Connecticut

A recent survey by the State Water Commission is the basis of the following summary.

Quinnipiac River.—Rises in central Connecticut and flows southerly into New Haven Harbor. It receives some industrial waste from the plant located in Meriden. The sewage in Meriden receives partial treatment, which is to be increased in the near future. The Wallingford Steel Co. produces a considerable volume of acid pickle liquors which are now discharged into the stream; this is under laboratory study and is to be corrected.

Naugatuck River.—Rises in northwestern Connecticut, and, flowing southerly, joins the Housatonic River at Derby. This is perhaps the most heavily polluted stream in Connecticut. The Naugatuck Valley is the seat of the brass and copper industry of Connecticut, and the stream receives the industrial wastes of all large brass and copper plants along its course. Extensive research work in the form of laboratory studies, looking toward the solution of this industrial waste problem, has been carried out at Yale University. In the meantime, changes in plant processes during the past two years have resulted in material reduction of the volume of strong acid liquors discharged into the stream.

Housatonic River.—Constitutes the principal watershed of western Connecticut, rising in Massachusetts and, flowing southerly, enters the Sound east of Bridgeport. It receives the Naugatuck at Derby, a few miles above its mouth. It is a relatively clean stream, above Derby. Most of the sewage entering the river above that point is treated, and the diluting and natural purifying effects of the river flow practically eliminate all effects of pollution as far downstream as Derby. Below Derby, all the pollution of the Naugatuck River is carried by the Housatonic.

Pequonnock River.—This stream passes through the city of Bridgeport just before entering the Sound. The lower reaches of the Pequonnock are heavily polluted, with both domestic sewage and industrial wastes.

Norwalk River.—This river has been greatly improved recently. The only large metallurgical plant on the river now treats the acid pickle liquors by neutralization and precipitation of the iron. The city of Norwalk has recently put in operation a modern sewage disposal plant, including sedimentation, sludge digestion and chlorination of the effluent.

Noroton River.—Relatively clean down to Stamford, where there are a number of industrial plants. During the past three years a great deal of progress has been made in correcting pollution from these plants. The city of Stamford has installed sewage treatment consisting of Imhoff tanks, with chlorination of the effluent. New Canaan, further upstream, is just completing an activated sludge plant for treating its sewage.

Byram River.—Flows into the Sound between Portchester and East Portchester. It is a relatively clean stream. One felt manufacturing plant has been the source of complaint due to its wastes, but a treatment plant now approaching completion will neutralize the acid wastes and remove the fiber formerly reaching the stream.

#### OIL POLLUTION

The pollution from oil is widespread, as it is not limited to the vicinity of the point of discharge but is carried great distances by the action of wind and tide. Moreover, it is not self-purifying but persists for long periods of time (though it is claimed that an extremely thin film of oil on the surface of the water will be consumed by natural processes within a few hours). Oily discharges are of two types,—light oil with specific gravity less than that of water, and heavy oil. It is the light oil which is carried about and appears in the form of patches and streaks on the water surface. In general, the heavy oil is not visible to the eye but forms an oily sludge on river and harbor bottoms.

The principal effects of oil pollution are:—

- (1) By collecting on sewage solids, it interferes with their oxidization.
- (2) Floating oil interferes with absorption of oxygen by the water from the atmosphere.
- (3) It may render fish and shellfish unfit for food.
- (4) It increases fire hazard of docks and bulkheads.
- (5) It makes beaches unfit for bathing.
- (6) It interferes with pleasure boating.

The sources of oil pollution are:—

(a) Oil originating from shipping.—The discharge of oil from ships, barges, etc., is prohibited by Federal statutes within territorial waters. This source may also include oil discharged from vessels at the shipyards and drydocks. It is believed that the control of this source of pollution should be left in the hands of the Federal authorities.

(b) Oil discharged directly into the water from industrial plants.—This originates chiefly at oil refineries, oil storage and distribution stations located on shore, and gas manufacturing plants. These plants generally have recovery installations to remove oil from their waste waters. The American Petroleum Institute has issued a Manual on Disposal of Refinery Wastes, outlining methods to be followed by the oil industry for the preven-



tion of pollution from this source. Improvement of conditions in this respect should be brought about through effective enforcement of existing laws and regulations.

(c) Oil entering the waterways through the sewers.—This represents oil from garages, industrial plants and street washings. It was estimated in 1924 that about 7,000,000 gallons of crank case oil are dumped into the harbor yearly through the sewers. The American Petroleum Institute recommended the elimination of this source of pollution by urging all large cities to let contracts covering the collection of crank case drainings and other garage wastes.

#### FISHING AND SHELLFISH INDUSTRIES

We have made an investigation of records of the fishing and shellfish industries in the three states to determine, if possible, what effect pollution of the inter-state tidal waters has had upon these industries. It was found that few detailed statistics have been published and the available information is quite limited and scattered. However, there are certain facts and trends relating to the industries which are discussed below.

##### Fishing Industry

Data furnished by the U. S. Bureau of Fisheries, by the Fish and Game Commission of New Jersey and the Conservation Department of New York show signs of a decided falling off in fishing within the last 30 years in the lower reaches of the Hudson River, and in Westchester County, New York City, Nassau county and the New Jersey counties bordering on the harbor waters (Bergen, Hudson, Middlesex and Monmouth counties). This decline has not always been continuous, nor does it apply to the entire area. For instance, the catch of shad in the Hudson River shows a great fluctuation from year to year, due, evidently, to causes quite distinct from pollution of the river water.

It is well agreed by authorities on the subject that excessive pollution is injurious to major fish life, due largely to reduction in the dissolved oxygen content of the water. The minimum dissolved oxygen content required for the maintenance of fish life is subject to some variation, depending not only on the species of fish but on other physical conditions. It is probable that 20% saturation of dissolved oxygen is the minimum allowable without causing serious injury to fish life. Of equal importance is the existence of sludge deposits on the bottom which would have a serious effect on the growth or survival of fish eggs deposited thereon. Industrial wastes of certain types, particularly acids and oils, are especially injurious to fish life if present in considerable quantities.

Statistics available for areas not influenced by pollution show that the fishing industry is subject to sudden changes. Hence, it would be difficult to prove the apparent decline in this industry in the waters of New York Harbor is due entirely or even

principally to pollution. However, it is believed that the great decrease or even total extinction of commercial fishing in certain portions of these waters must be directly influenced by their polluted condition.

##### Shellfish

Statistics furnished by the Conservation Department of New York State, and giving the number of acres of tidal water under lease or franchise in New York State for the propagation of oysters, are available from 1904 to 1930. These show a continuous reduction in acreage, starting at 33,956 acres in 1915 and dropping off to 10,728 acres in 1930. The rate of reduction, however, has been decreasing in recent years and indications are that a minimum point has now been reached. Whether this acreage will increase appreciably in the future remains to be seen. Similar statistics for New Jersey and Connecticut were not available.

This striking feature of the oyster industry has been attributed to several causes. There seems to be considerable doubt as to whether pollution in the tidal waters is a direct cause of this condition. The decline in New York State has been blamed on a failure in the "set" of young seed oysters in Connecticut during recent years. New York oysters were formerly raised from seed oysters (or "spat") brought in from other areas, particularly from Connecticut. The failure of the "set" in Connecticut is generally attributed to other causes than pollution from the rivers and communities along the shore of that state.

Measures are in force to overcome the troubles of the industry due to failure of the "set". These involve the propagation of seed oysters by artificial means, much as fresh-water fish are raised in fish hatcheries. It is anticipated that these methods will eventually result in the production of sufficient seed oysters to satisfy the needs of the local industry.

It is known that oysters will grow more rapidly in waters containing a moderate amount of polluting organic matter, and such oysters are not necessarily unhealthful for food. It is necessary, however, that they be properly cleansed of any polluting matter carried into them by the water before they can be considered safe for food. Regulations have been established, therefore, under which oysters raised in polluted areas must be transplanted to non-polluted waters some time before being placed on the market, in order that they may become thoroughly washed by natural processes.

Considerable areas within the tidal waters of the three states have been so restricted by their respective health authorities. In most of these areas, oysters may be raised but may not be taken for marketing purposes without additional treatment as explained above. These areas are said to be prohibited for market shellfish. This restriction, while only partial under the law, is, in effect, a complete barrier to propagation of oysters in many cases as the men in the industry find it uneconomical to market oysters under these requirements.



It may be stated, therefore, that pollution of the tidal waters has had an injurious effect on the oyster industry, and that improvement in conditions of pollution will be of considerable assistance to the industry.

#### CONCLUSIONS

1. The total population of the three States on the watersheds draining into the Treaty Area (excluding the Hudson River above Newburgh) was about 11,900,000 in 1930. Of these, about 1,100,000 were not provided with sewerage facilities, leaving a contributing population of about 10,800,000. This is expected to increase to 24,100,000 by 1970.

2. The total volume of sewage discharged into these watersheds in 1930, after making allowance for the treatment provided in various communities, was about 1,350 million gallons daily (m. g. d.) which is estimated to be equivalent to the untreated sewage of a population of about 9,600,000.

3. The sewage discharged to the Treaty Area is contributed by the three States in the following approximate proportions:

New York .....	74%
New Jersey .....	20%
Connecticut .....	6%

4. The total equivalent untreated sewage reaching the waters of New York Harbor (including Jamaica Bay, Newark Bay, and the Kills) in 1930 was about 1,250 m. g. d., from an equivalent population of about 8,900,000. Of this, the portion originating in New York City was about 970 m. g. d. from an equivalent population of 6,900,000. New York City therefore furnishes about 77½% of the sewage reaching the tidal waters of New York Harbor.

5. The effects of pollution of the inter-State tidal waters are shown most conclusively by tests for dissolved oxygen in these waters. Such tests have been carried on in the waters of New York Harbor on an extensive scale for the last 22 years. The tests show that the dissolved oxygen in all the main branches of the harbor declined rapidly between 1909 and 1916 and at a less rapid rate since that year. The general tendency apparently is for this decrease to continue. Since 1920 the average dissolved oxygen in summer months has not gone above 50% in any part of the harbor except at the Narrows and Upper East River, and even at those points it has seldom reached 50% since 1925. The Harlem and Lower East River show the worst results. Minimum values of less than 20% have been noted in many parts of the harbor during the past summer, with zero per cent being observed in the Lower East River and Harlem River. Jamaica Bay shows only a slight degree of pollution. All the waters in Newark Bay and adjacent waterways are badly polluted, and the average summer oxygen content has not been above 50% since 1927.

6. Conditions in local portions of the harbor are already decidedly offensive, due to lack of opportunity for tidal action to flush out the sewage deposits. The Harlem and Lower East Rivers are rapidly approaching the conditions of open sewers. The slips between piers are collecting points for sewage sludge deposits, and must be dredged out at regular intervals at considerable expense.

7. Outside of New York Harbor and Newark Bay, the conditions of pollution are not so serious. The Hudson River shows very little pollution at Poughkeepsie. Even as far downstream as Tarrytown, the dissolved oxygen is above 50%. Further south, evidence of pollution is more prominent, due partly to the sewage from New York City which is carried upstream on the flood tide. There is little evidence of pollution in the waters of Long Island Sound, except locally near outfall sewers and large towns, and at the extreme west end which is affected somewhat by New York City. There is no serious pollution of Great South Bay, except at one or two local points.

8. Pollution of the tidal waters from industrial wastes is a serious problem. Organic wastes can generally be handled through the sewage treatment plants. Other wastes, particularly oils and chemicals, must be eliminated at their source. There are extensive industries on the shores of the Harlem and East River, New York Upper Bay, Newark Bay, and the Staten Island Kills, as well as in the Connecticut towns along Long Island Sound. Efforts are being made to secure cooperative help from these industries to prevent discharge of untreated wastes into the waterways. Further strengthening of the hands of state authorities in this regard should be helpful.

9. Control of oil wastes from ships is in the hands of the Federal Authorities. Pollution from this source has been considerably reduced, but strict enforcement of existing regulations is necessary.

10. The fishing and shellfish industries have fallen off considerably in the past 20 years, and the decline in the oyster industry is particularly noticeable. This is not due entirely to pollution, but the contamination of the tidal waters by sewage has necessitated prohibition of raising market shellfish in certain restricted areas. These restrictions apply to a major portion of the waters of New York Harbor, the large harbors of Long Island Sound in Connecticut, and certain limited areas on the Long Island shore. The fishing industry has also been greatly reduced in certain parts of the waters of New York Harbor, but the Hudson River fishery above New York City apparently has not been seriously affected by pollution.

11. Disposal of sewage by dilution in the harbor waters was feasible in the past, but the diluting capacity of the rivers and tides is already greatly depleted in nearly all parts of the district and in many sections this capacity is completely exhausted. Future growth of population will render these conditions still more serious. The plans for sewage treatment under consideration by



New York City will go far to provide for present and future conditions, but they will not produce the required improvement unless supplemented with treatment of sewage reaching these waters from other areas.

12. The problem of eliminating pollution of the tidal waters has been studied for many years, but no extensive results have been attained. This is because the problem is one requiring cooperative action by all the communities whose sewage now tends to pollute these waters. To this end, we believe the enactment of a Treaty between the States of New York, New Jersey and Connecticut is of prime importance.

Respectfully submitted, December 16, 1931.

RESEARCH AND ENGINEERING COMMITTEE.

F. S. TAINTER, *Chairman*  
 CHARLES A. HOLMQUIST  
 JAMES A. NEWLANDS  
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 WILLIAM SCHROEDER, JR.

TABLE 1. NEW JERSEY WATERSHEDS—POPULATION, SEWAGE FLOW AND DILUTION

WATERSHED	Drainage area sq. mi.	MINIMUM STREAM FLOW (MONTHLY AVERAGE)		1930 CONDITIONS			1970	
		c.f.s.	m.g.d.	Total population	Population contributing sewage	Equivalent untreated sewage m.g.d.	Dilution ratio	Population contributing sewage
Hudson River.....	25	2	1.3	215,149	214,889	25.81	.....	301,000
Upper New York Bay.....	.....	1	0.6	1,179,063	1,179,063	125.40	.....	2,040,000
Newark Bay.....	21	3	1.9	302,444	302,444	36.45	.....	2,538,000
Arden Kill.....	26	4	2.6	356,875	356,875	39.58	.....	760,000
Hackensack River.....	212	15	9.7	272,680	248,310	10.69	0.9/1	603,000
Passaic River.....	976	60	38.8	259,113	87,465	1.08	36/1	169,000
Elizabeth River.....	30	5	3.2	61,477	58,540	4.80	4.4/1	144,000
Rahway River.....	90	33	21.2	288,037	192,660	17.77	6/1	423,000
Raritan River.....	1,120	165	106.8	36,913	21,707	2.20	.....	46,000
Lower New York Bay.....	146	10	6.5	28,563	15,051	0.86	16/1	31,000
Shrewsbury River.....	122	21	13.6	84,203	71,321	4.86	.....	145,000
Atlantic Ocean (to Manasquan river).....	.....	.....	.....	.....	.....	.....	.....	.....
Totals.....	.....	.....	.....	3,083,311	2,748,365	262.50	.....	5,180,000
Including New York State.....	.....	.....	.....	22,927	11,311	0.23	.....	.....



**TABLE 2. CONNECTICUT WATERSHEDS—POPULATION, SEWAGE FLOW AND DILUTION**

WATERSHED	Drainage area sq. mi.	MINIMUM STREAM FLOW (MONTHLY AVERAGE)		1930 CONDITIONS				1970
		c. f. s.	m. g. d.	Total population	Population contributing sewage	Equivalent untreated sewage m. g. d.	Dilution ratio	Population contributing sewage
New Haven Harbor.....	236	43	27.8	278,455	235,200	27.43	1/1	317,000
New Haven to Milford.....	42	6	3.9	15,820	500	0.07	56/1	15,000
Housatonic River (incl. Naugatuck River).....	1,930	347	224.5	*302,390	†175,000	25.44	9/1	†263,000
Bridgeport Harbor.....	54	8	5.2	166,588	146,000	21.90	0.24/1	219,000
Fairfield to Saugatuck.....	129	23	14.9	10,842	2,500	0.37	40/1	10,000
Norwalk River.....	63	11	7.1	41,732	21,700	3.07	2.3/1	48,000
Norton Point to Shippan Point.....	36	5	3.2	12,407	3,100	0.34	9/1	10,000
Stamford Harbor.....	30	5	3.2	57,367	32,000	3.43	0.9/1	64,000
Sound Beach to East Portchester.....	82	15	9.7	35,652	27,600	2.12	4.6/1	48,000
Totals.....				921,253	643,600	84.17		994,000
Including New York State.....				13,396				

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NOTE: Minimum stream flow estimates have not been reduced to allow for storage and water supply diversions.  
 \* Does not include population in Mass.  
 † Housatonic watershed above Shelton is not included.

**TABLE 3. NEW YORK STATE WATERSHEDS—POPULATION AND SEWAGE FLOW**

WATERSHED	Drainage area sq. mi.	Minimum stream flow (Monthly average) c. f. s.	1930 CONDITIONS				1970—ESTIMATED							
			Total population	Population contributing sewage	Equivalent untreated sewage m. g. d.	Equivalent untreated contributing population	Total population	Population contributing sewage						
<b>Hudson River System:</b>														
Mohawk River.....	12,020	4,815	477,104	324,996	41.14	240,346	625,500	478,500						
Hudson above Troy.....			185,000	66,445	12.58	64,974	198,000	77,000						
Hudson, Troy-Newburgh.....			526,281	297,271	46.51	252,371	662,000	433,500						
Hudson, Newburgh—New Jersey Line.....			281,215	113,522	13.39	102,537	570,000	322,500						
Hudson, East Bank—N. J. Line extended to New York City Line.....	1,034	91												
Hudson, East Bank—New York City	36	6	256,431	213,675	16.66	142,450	600,000	550,000						
Manhattan.....	9	1	739,700	739,700	158.03	723,000	851,700	851,700						
Bronx.....	2								6,000	6,000	0.70	6,000	30,000	30,000
Total Hudson New York State Section.....	13,101	4,913	2,471,731	1,779,609	289.01	1,531,678	3,537,200	2,743,200						
Total Hudson, above New York City.....	13,090	4,912	1,726,031	1,033,909	130.28	802,678	2,655,500	1,861,500						
Total Hudson, above New Jersey Line.....	13,054	4,906	1,469,600	820,234	113.62	660,228	2,055,500	1,311,500						
Total Hudson, above Newburgh.....	12,020	4,815	1,188,385	706,712	100.23	557,691	1,483,500	989,000						
<b>Long Island Sound:</b>														
Bronx.....	8	12	7,800	7,800	1.00	7,800	34,000	34,000						
Westchester county.....	69								147,230	121,495	8.88	77,332	300,000	275,000
Nassau County.....									110,501	21,200	1.57	14,467	300,000	100,000
Suffolk County.....									38,637	6,700	0.38	4,467	100,000	25,000
Total.....	77	12	304,168	157,195	11.83	104,066	734,000	434,000						
<b>Upper East River:</b>														
Bronx.....	27		570,284	570,284	70.60	570,284	1,721,600	1,721,600						
Queens.....	44		303,439	303,439	25.00	231,960	1,504,000	1,504,000						
Total.....	71	8	873,723	873,723	95.60	802,244	3,225,600	3,225,600						
<b>Harlem River:</b>														
Manhattan.....	5		459,460	459,460	100.30	459,460	560,800	560,800						
Bronx.....	13		681,174	681,174	84.40	681,174	1,344,400	1,344,400						
Total.....	18	2	1,140,634	1,140,634	184.70	1,140,634	1,905,200	1,905,200						

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**TABLE 3. NEW YORK STATE WATERSHEDS—POPULATION AND SEWAGE FLOW—Continued**

WATERSHED	Drainage area Sq. mi.	Minimum stream flow (Monthly average) c. f. s.	1930 CONDITIONS				1970—ESTIMATED	
			Total population	Population contributing sewage	Equivalent untreated sewage m.g.d.	Equivalent untreated contributing population	Total population	Population contributing sewage
<b>Lower East River:</b>								
Manhattan.....	8	.....	668,152	668,152	146.30	668,152	687,500	687,500
Brooklyn.....	14	.....	848,573	848,573	94.50	848,573	1,215,200	1,215,200
Queens.....	13	.....	339,997	339,997	36.37	338,797	1,266,000	1,266,000
Total.....	35	4	1,856,722	1,856,722	277.17	1,855,522	3,168,700	3,168,700
<b>Upper New York Bay:</b>								
Brooklyn.....	25	.....	1,045,573	1,045,573	116.30	1,045,573	1,917,500	1,917,500
Richmond.....	3	.....	44,500	44,500	8.40	44,500	170,000	170,000
Total.....	28	3	1,090,073	1,090,073	124.70	1,090,073	2,087,500	2,087,500
<b>Lower New York Bay:</b>								
Richmond.....	20	2	22,816	22,816	4.00	21,250	305,100	305,100
<b>Newark Bay and Kill Van Kull:</b>								
Richmond.....	11	2	66,830	66,830	12.60	66,830	395,900	395,900
<b>Arthur Kill:</b>								
Richmond.....	26	4	24,200	24,200	4.50	24,200	219,000	219,000
<b>Jamaica Bay:</b>								
Brooklyn.....	34	.....	666,255	666,255	63.30	568,255	2,367,300	2,367,300
Queens.....	48	.....	435,693	435,693	39.70	370,693	1,930,000	1,930,000
Total.....	82	10	1,101,948	1,101,948	103.00	938,948	4,297,300	4,297,300
<b>Atlantic Ocean:</b>								
Nassau County.....	.....	.....	192,552	7,317	1.10	4,878	600,000	150,000
Total.....	.....	.....	9,145,397	8,121,067	1,108.21	7,580,323	20,475,500	18,931,500
Total, except N. Y. State above Newburgh.....	.....	.....	7,957,012	7,414,355	1,007.98	7,022,632	18,990,000	17,942,500
Total, except N. Y. State above N. J. Line.....	.....	.....	7,675,797	7,300,833	994.59	6,920,095	18,420,000	17,620,000
Total, New York City.....	.....	.....	6,930,446	6,930,446	966.00	6,676,501	16,520,000	16,520,000

**TABLE 4. NEW YORK CITY—POPULATION AND SEWAGE IN 1970**

*Plan "A" for Disposal in Effect*

	Estimated population	Equivalent population	Equivalent sewage (m.g.d.)
<b>Hudson River</b>			
Bronx.....	30,000	20,000	2
Manhattan.....	868,000	578,600	126
Total.....	898,000	598,600	128
<b>Upper East River</b>			
Manhattan.....	705,600	105,800	.....
Bronx.....	3,090,000	463,500	.....
Queens.....	2,100,000	315,000	.....
Total.....	5,895,600	884,300	105
<b>Long Island Sound (City Is.)</b>			
Bronx.....	10,000	1,500	1
<b>Lower Bay</b>			
Outlet Island			
Manhattan.....	526,400	350,900	.....
Queens.....	670,000	446,700	.....
Brooklyn.....	3,132,700	2,088,500	.....
Richmond.....	4,329,100	2,886,100	.....
Total.....	305,100	45,800	.....
<b>Jamaica Bay</b>			
Brooklyn.....	4,634,200	2,931,900	326
Queens.....	2,367,300	355,100	.....
Total.....	1,930,000	289,500	.....
<b>Upper Bay</b>			
Richmond.....	4,297,300	644,600	71
<b>Kill van Kull</b>			
Richmond.....	170,000	113,300	25
<b>Arthur Kill</b>			
Richmond.....	395,900	263,900	50
Total.....	395,900	263,900	50
<b>Grand total.....</b>	<b>16,520,000</b>	<b>5,527,900</b>	<b>723</b>



TABLE 5. POPULATION AND SEWAGE FLOW

SUMMARY BY STATES FOR TREATY AREA

	1930 CONDITIONS				1970 CONDITIONS
	Total population	Population contributing sewage	Equivalent untreated sewage m.g.d.	Equivalent population	Population contributing sewage
New York State (excluding Hudson River above Newburgh).....	7,979,939	7,425,666	1,008.23	7,023,612	17,942,000
New Jersey.....	3,060,384	2,737,054	262.25	2,014,356	5,180,000
Connecticut.....	907,857	643,600	84.17	570,300	994,000
Totals.....	11,948,180	10,806,320	1,354.65	9,608,268	24,116,000
Percentages:					
New York.....	66.8%	68.7%	74.4%	73.1%	74.4%
New Jersey.....	25.6	25.3	19.4	21.0	21.5
Connecticut.....	7.6	6.0	6.2	5.9	4.1
	100.0%	100.0%	100.0%	100.0%	100.0%

TABLE 6. POPULATION AND SEWAGE, NEW YORK HARBOR

	1930 CONDITIONS		1970 NEW YORK DISPOSAL PLAN A	
	Equivalent population	Equivalent untreated sewage, m.g.d.	Equivalent population	Sewage m.g.d.
East River — South End.....	3,228,083	465.12	885,800	106
Newark Bay and Kill van Kull.....	529,699	60.82	1,172,900	142
Hudson River at Battery:				
(1) Total watershed.....	2,311,712	407.17	2,330,600	385
(2) Below Newburgh.....	1,754,021	306.94	1,550,600	245
(3) Below New Jersey Line.....	1,651,484	293.55	1,259,100	207
(4) Below New York City Line.....	1,509,034	276.89	891,600	164
Upper Bay at Narrows:				
(1) Total Hudson River.....	7,930,165	1,173.30	5,793,400	852
(2) Hudson River below Newburgh.....	7,372,474	1,073.07	5,613,400	712
(3) Hudson River below New Jersey Line.....	7,269,937	1,059.68	4,721,900	674
(4) Hudson River below New York City Line.....	7,127,487	1,043.02	4,354,400	631
Arthur Kill at Perth Amboy.....	404,507	51.79	920,000	121
Lower New York Bay:				
(1) Total Hudson River.....	8,503,567	1,249.92	9,967,300	*1,345
(2) Hudson River below Newburgh.....	7,945,876	1,149.89	9,187,300	*1,205
(3) Hudson River below New Jersey Line.....	7,843,339	1,136.30	8,895,800	*1,167
(4) Hudson River below New York City Line.....	7,700,889	1,119.64	8,528,300	*1,124
Jamaica Bay.....	938,948	103.00	644,600	71

\* Includes Outlet Island.

TABLE 7. DILUTION OF SEWAGE, NEW YORK HARBOR, 1930

DILUTION IN MONTH OF MINIMUM AVERAGE STREAMFLOW (1 m.g.d. = 1.5472 cfs.)

	Hudson River off Ft. Washington Pt.	Hudson River off Battery	East River South End	Upper Bay Narrows	Newark Bay	Arthur Kill at Perth Amboy
Water Available for Dilution:						
Land water — cfs.....	4,912	4,914	13	5,000	81	59
Land water — mgd.....	3,175	3,176	8	3,232	52	38
Sea water — cfs.....	5,800	23,700	1,790	33,400	253	41
Sea water — mgd.....	3,750	15,320	1,157	21,590	164	27
Land and sea water — cfs.....	10,712	28,614	1,803	38,400	334	100
Land and sea water — mgd.....	6,925	18,496	1,165	24,822	216	65

	1930 CONDITIONS					
Equivalent contributing population.....	*1,378,995	*2,311,712	3,228,083	*7,930,165	529,699	404,507
Equivalent untreated sewage, mgd.....	*223.33	*407.17	465.12	*1,173.30	60.82	51.79
Dilution Ratio for Sewage:						
Land water only.....	14.2/1	7.8/1	.....	2.75/1	0.85/1	0.73/1
Land and sea water.....	31/1	45/1	2.5/1	21/1	3.5/1	1.25/1
Dilution per 1,000 Population:						
Land water only.....	3.6 cfs.	2.1 cfs.	.....	0.6 cfs.	0.15 cfs.	0.15 cfs.
Land and sea water.....	7.8 cfs.	12.4 cfs.	0.6 cfs.	4.8 cfs.	0.6 cfs.	0.25 cfs.

(Omitting Hudson River Watershed above New York-New Jersey Line)

Contributing population.....	718,767	1,651,484	.....	7,269,937	.....
Equivalent untreated sewage, mgd.....	109.71	293.55	.....	1,059.68	.....
Dilution Ratio for Sewage:					
Land water only.....	29/1	10.8/1	.....	3.0/1	.....
Land and sea water.....	63/1	63/1	.....	23/1	.....
Dilution per 1,000 Population:					
Land water only.....	6.8 cfs.	3.0 cfs.	.....	0.7 cfs.	.....
Land and sea water.....	14.9 cfs.	17.3 cfs.	.....	5.3 cfs.	.....

1970 CONDITIONS — NEW YORK CITY DISPOSAL "PLAN A" IN EFFECT

(Omitting Hudson River Watershed above New York-New Jersey Line)

Water Available for Dilution:					
Land water — cfs.....	.....	4,914	13	5,000	.....
Sea water — cfs.....	.....	23,700	1,790	33,400	.....
Land and sea water — cfs.....	.....	28,614	1,803	38,400	.....
Equivalent contributing population.....	.....	1,259,100	885,800	4,721,900	.....
Dilution per 1,000 Population:					
Land water only.....	.....	3.9 cfs.	.....	1.1 cfs.	.....
Land and sea water.....	.....	22.8 cfs.	2.0 cfs.	8.1 cfs.	.....

\* Includes total Hudson River Watershed.



TABLE 8. MINIMUM OBSERVED DISSOLVED OXYGEN SATURATIONS  
AT SELECTED STATIONS—NEW YORK HARBOR 1909 AND 1931

Station	Minimum percentage Saturation	
	1909	1931
<i>East River</i>		
Throggs Neck .....	88	48
42nd St. ....	57	0
23rd St. ....	52	4
Pier 10 .....	43	1
<i>Hudson River</i>		
Mt. St. Vincent .....	60	43
Spuyten Duyvil .....	55	26
155th St. ....	69	28
42nd St. ....	65	18
Pier A .....	57	12
<i>Harlem River</i>		
Morris Heights .....	46	1
Willis Ave. ....	32	0
106th St. ....	21	1
<i>Upper Bay</i>		
Bell Buoy 2 G. ....	60	15
Robbins Reef .....	62	11
The Narrows .....	62	22
<i>Kill van Kull</i>		
Shooters Island .....	78	24
<i>Arthur Kill</i>		
Opp. Fresh Kills .....	71	11
Tottenville Ferry .....	100	43
<i>Jamaica Bay</i>		
Barren Island .....	78	69
Beach Channel and L. I. R. R. ....	80	79
Bergen Beach or Carnarsie .....	67	46

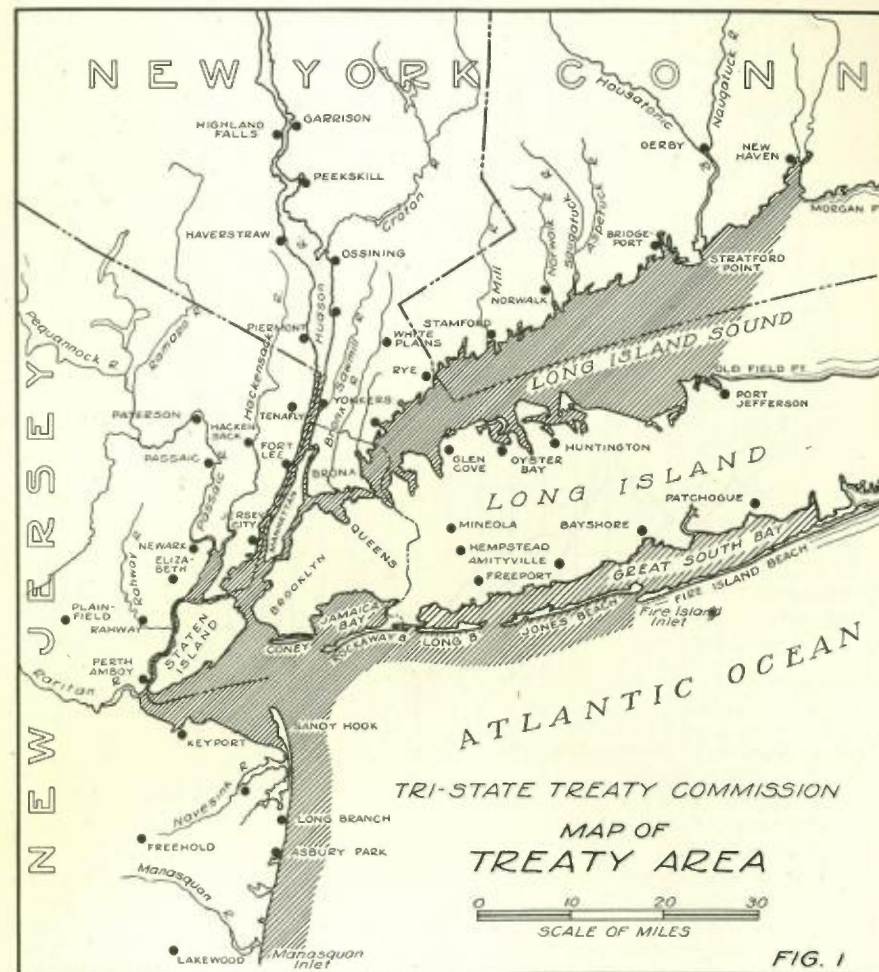


FIG. 1



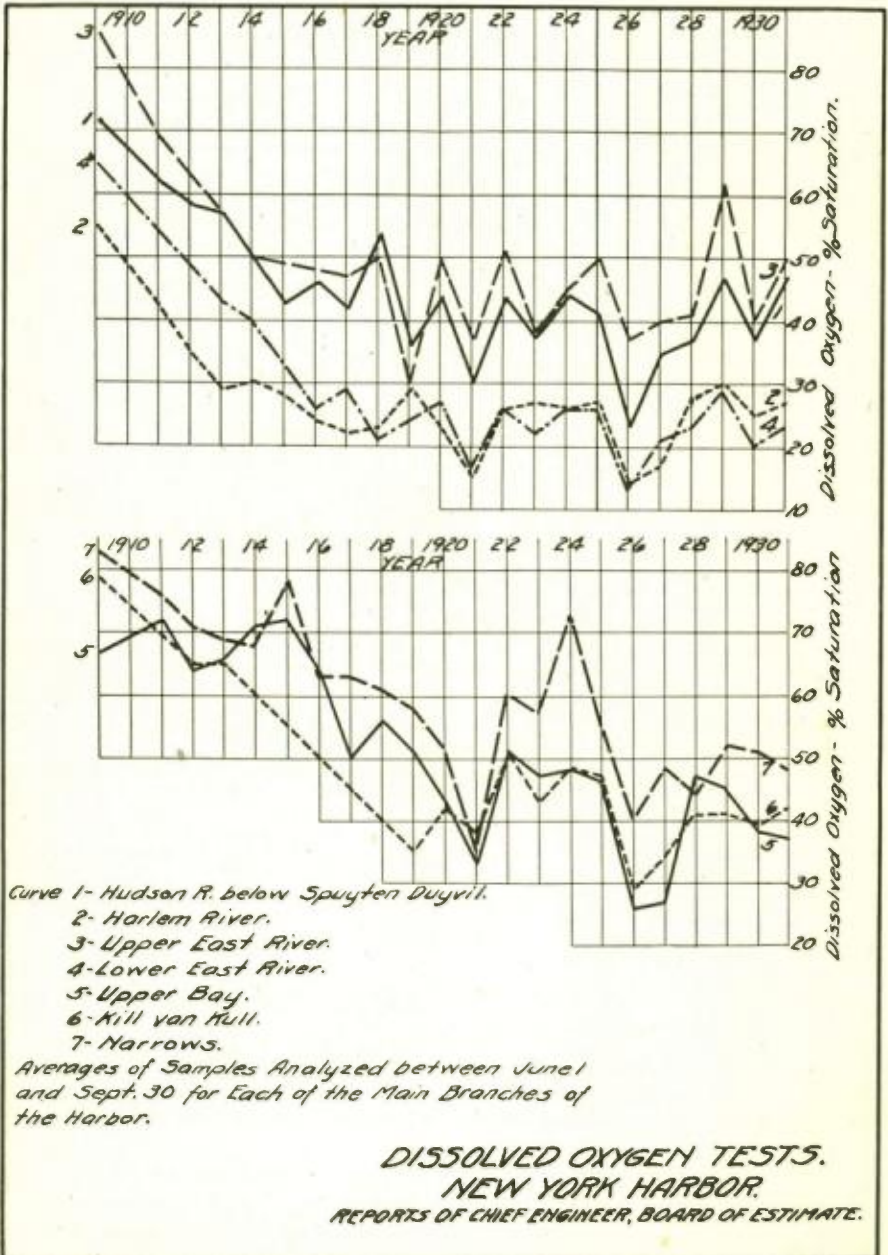
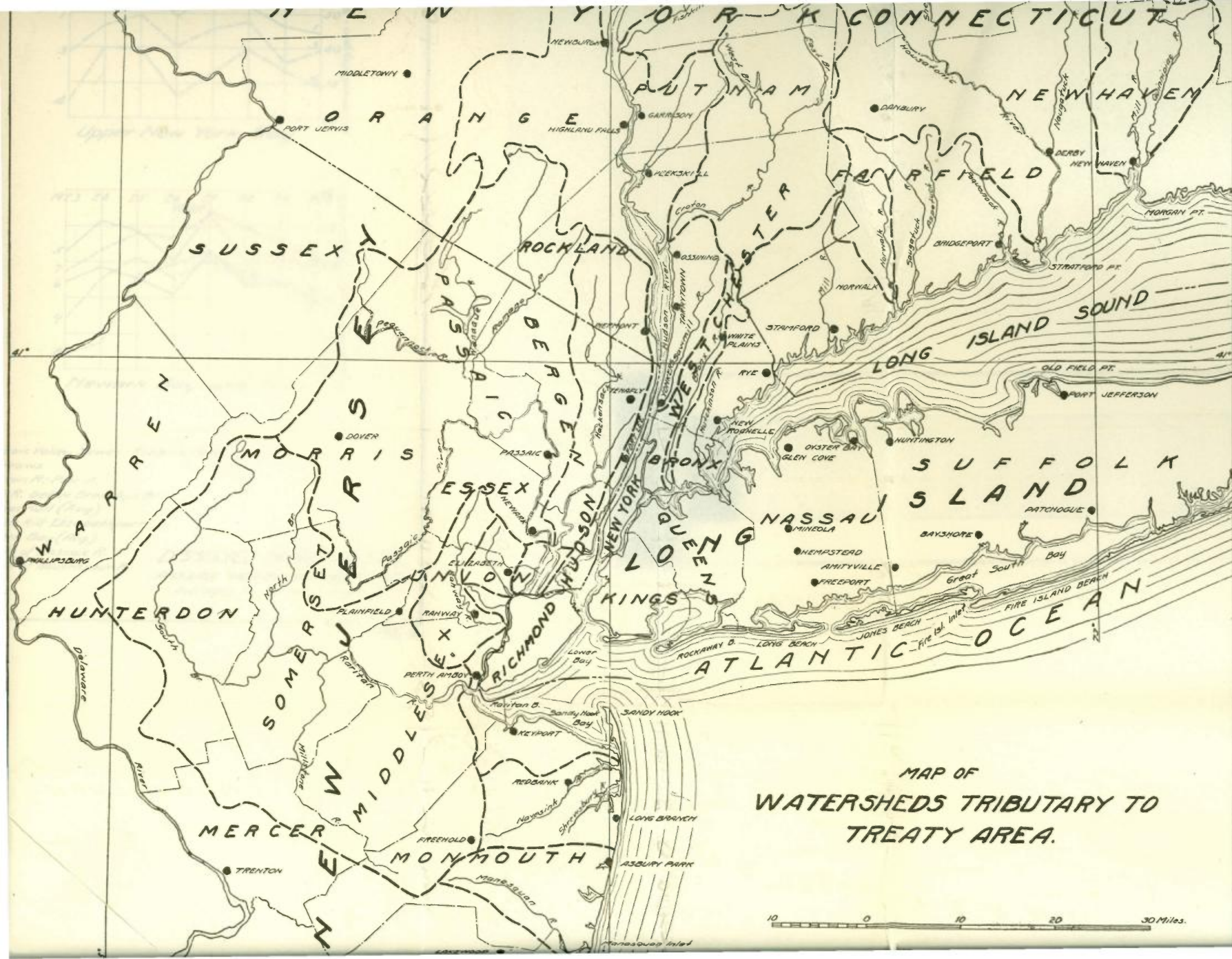


FIG. 3.





SUSSEX

WESTCHESTER

HUNTERDON

SOMERSET

QUEEN

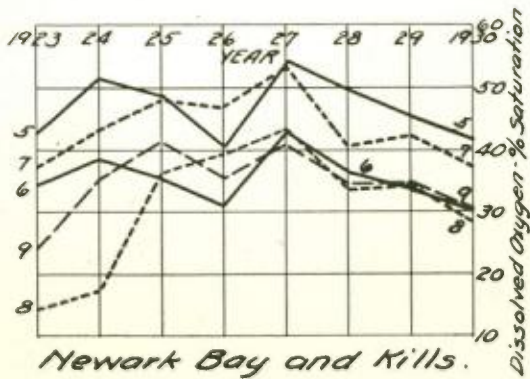
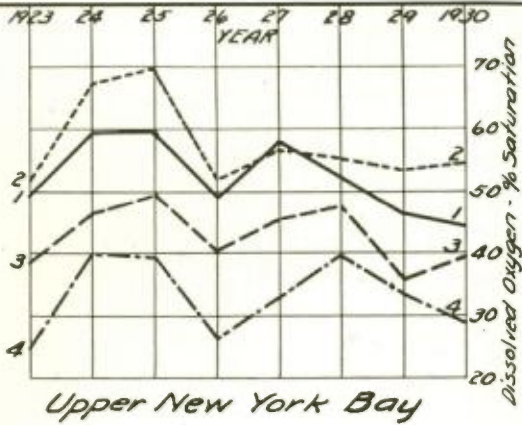
MERCER

MONMOUTH

MAP OF  
WATERSHEDS TRIBUTARY TO  
TREATY AREA.

10 0 10 20 30 Miles.





Curve 1 - Passaic Valley Sewer - Robbin's Reef.

2 - Narrows

3 - Hudson R. - Pier A.

4 - East R. below Brooklyn Br.

5 - Kill van Kull (Avg.)

6 - Arthur Kill - Elizabethport.

7 - Newark Bay (Avg.)

8 - Mouth of Passaic R.

9 - Mouth of Hackensack R.

**DISSOLVED OXYGEN TESTS.**  
**PASSAIC VALLEY SEWAGE COMM.**  
 Averages for June 1 - Sept. 30.