For indemnities, domestic mail, $91.36.
For rent, light, and fuel, $1,280.90.
For Rural Delivery Service, $29.78.
For vehicle service, $172.86.

Total, audited claims, section 3, $86,050, together with such additional sum due to increase in rates of exchange as may be necessary to pay claims in the foreign currency as specified in certain of the settlements of the General Accounting Office.

Sundry claims.

SEC. 4. For the payment of sundry claims allowed by the General Accounting Office under various Acts and certified to the Seventy-first Congress in Senate Document Numbered 169 and House Document Numbered 422, under the following departments: Treasury Department, $11,657.76; War Department, $5,163.22; in all, $16,820.98.

Short title.

SEC. 5. This Act may be cited as the "Second Deficiency Act, fiscal year 1930."

Approved, July 3, 1930.

July 3, 1930.
[H. R. 11781.]
[Public, No. 520.]

CHAP. 847.—An Act Authorizing the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes.

Rivers and harbors improvements.
Work authorized.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following works of improvement are hereby adopted and authorized, to be prosecuted under the direction of the Secretary of War and supervision of the Chief of Engineers, in accordance with the plans recommended in the reports hereinafter designated.

Fall River, Mass.

Fall River Harbor, Massachusetts, in accordance with the report submitted in House Document Numbered 158, Seventy-first Congress, second session.

Lynn, Mass.

Lynn Harbor, Massachusetts: The Chief of Engineers is hereby authorized to dredge a channel twenty-two feet deep and three hundred feet wide from deep water west of Bass Point, Nahant, to a turning basin five hundred and fifty feet wide at the head of the harbor, and to straighten the curve in the approach to the turning basin: *Provided*, That before prosecuting this work, local interests shall give assurances satisfactory to the Chief of Engineers and the Secretary of War that they will dredge and maintain a suitable channel of twenty-two-foot depth, extending a distance of four thousand eight hundred feet westerly from the inner end of the Federal improvement. The amount hereby authorized to be expended upon the said project shall not exceed the sum of $615,500.

Proviso.
Local cooperation required.

Salem, Mass.

Salem Harbor, Massachusetts, in accordance with the report submitted in House Document Numbered 112, Seventieth Congress, first session, and subject to the conditions set forth in said document.

Dorchester Bay and Neponset River, Mass.

Dorchester Bay and Neponset River, Massachusetts, in accordance with the report submitted in House Document Numbered 147, Seventieth Congress, first session, and subject to the conditions set forth in said document.

Nantucket Sound, Mass.

Nantucket Sound, Massachusetts, in accordance with the report submitted in House Document Numbered 182, Seventieth Congress, first session.

New Bedford, Mass.

New Bedford Harbor, Massachusetts, in accordance with the report of the Chief of Engineers as submitted in House Document Numbered 348, Seventy-first Congress, second session, except that the depth to be obtained in the entrance channel shall be thirty feet and the width shall be three hundred and fifty feet. There is hereby authorized to be expended on this project the sum of $718,000.

widened provided such proposed widening meets the approval of the Chief of Engineers and all expense incident thereto is paid by local interests.

Mississippi River, between Grafton and the northern boundary of the city of Saint Louis, in accordance with the report submitted in Rivers and Harbors Committee Document Numbered 12, Seventieth Congress, first session.

Mississippi River. Grafton to Saint Louis.

Illinois and Mississippi Canal, Illinois, in accordance with the report submitted in House Document Numbered 108, Seventieth Congress, first session. The payment of $8,450.75 to the Mud Creek special drainage district for work accomplished by the said district in reducing the maintenance cost on this canal to the United States is hereby authorized.

Illinois and Mississippi Canal, Ill.

Payment to Mud Creek drainage district.

Mill Creek and South Slough, Illinois, in accordance with the report submitted in Rivers and Harbors Committee Document Numbered 19, Seventy-first Congress, second session.

Mill Creek and South Slough, Ill.

The Secretary of War is hereby authorized to expend from funds appropriated and available for maintenance and improvement of existing river and harbor works, the sum of $25,235, as a contribution toward the relocation and reconstruction of the highway bridge across the Illinois and Mississippi Canal at Wyanet, Bureau County, Illinois, known as bridge numbered 10: *Provided*, That the highway authorities of Bureau County, Illinois, furnish assurances satisfactory to the Secretary of War that they will reconstruct and maintain said bridge without further cost to the United States.

Illinois and Mississippi Canal.

Relocation, etc., of bridge across, Wyanet, Ill.

Contribution.

Proviso. Condition.

Mississippi River between Missouri River and Minneapolis: The existing project is hereby modified in accordance with the report submitted in Rivers and Harbors Committee Document Numbered 8, Seventieth Congress, first session: *Provided*, That the sills in the new lock shall be placed at least nine feet below low water of 1864.

Mississippi River. Missouri River to Minneapolis.

Proviso. Sills in new lock.

Mississippi River between mouth of Wisconsin River and Minneapolis, Minnesota, in accordance with the report submitted in Rivers and Harbors Committee Document Numbered 24, Seventieth Congress, second session.

Wisconsin River to Minneapolis.

Mississippi River between mouth of Illinois River and Minneapolis: The existing project is hereby modified so as to provide a channel depth of nine feet at low water with widths suitable for long-haul common-carrier service, to be prosecuted in accordance with the plan for a comprehensive project to procure a channel of nine-foot depth, submitted in House Document Numbered 290, Seventy-first Congress, second session; and the sum of $7,500,000 in addition to the amounts authorized under existing projects, is hereby authorized to be appropriated for the prosecution of initial works under the modified project: *Provided*, That all locks below the Twin City Dam shall be of not less than the Ohio River standard dimensions.

Mouth of Illinois River to Minneapolis.

Existing project modified.

Channel depth.

Proviso. Lock construction.

Missouri River between Kansas City, Missouri, and Sioux City, Iowa: There is hereby authorized to be appropriated in the prosecution of the existing project the sum of $15,000,000, in addition to the unexpended balance of funds previously authorized, and it is intended that said sum be expended within a period of three years: *Provided, however*, That if said sum is not expended within said period said authorization shall not lapse.

Missouri River. Kansas City, Mo., to Sioux City, Iowa.

Proviso. Authorization not to lapse.

The project for the permanent improvement of the main stream of the Tennessee River for a navigable depth of nine feet in accordance with the recommendations of the Chief of Engineers in House Document Numbered 328 of the Seventy-first Congress, second session, is hereby authorized: *Provided*, That an expenditure of $5,000,000 shall be authorized to be appropriated for the prosecution

Tennessee River.

Provisos. Amount to be expended.

70TH CONGRESS, 1st Session | COMMITTEE ON RIVERS AND HARBORS, HOUSE OF REPRESENTATIVES, U. S. | DOCUMENT No. 12

ILLINOIS AND MISSISSIPPI RIVERS

LETTER

FROM

THE CHIEF OF ENGINEERS, UNITED STATES ARMY

TRANSMITTING

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON REVIEW OF REPORTS HERETOFORE SUBMITTED ON ILLINOIS AND MISSISSIPPI RIVERS, WITH ILLUSTRATION

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, May 11, 1928.

Hon. S. WALLACE DEMPSEY,
Chairman Committee on Rivers and Harbors,
House of Representatives, Washington, D. C.

MY DEAR MR. DEMPSEY: 1. Referring to letter of the chairman of the Committee on Rivers and Harbors of the House of Representatives, dated April 5, 1926, inclosing a copy of a resolution of the committee dated April 3, 1926, requesting the Board of Engineers for Rivers and Harbors to review the reports submitted in House Documents Nos. 1374, Sixty-first Congress, third session, and 50, Sixty-first Congress, first session, and in Rivers and Harbors Committee Documents Nos. 2, Sixty-seventh Congress, first session; 7, Sixty-seventh Congress, second session; and No. 4, Sixty-ninth Congress, first session, with a view to ascertaining and reporting the cost of rebuilding the locks and dams at La Grange and Kampsville in the Illinois River, Ill., to conform with the locks and dams now being built by the State of Illinois for the Illinois waterway between Lockport and Utica, Ill., also, with a view to ascertaining and reporting the advisability and cost of the partial removal of the dams at La Grange and Kampsville in the Illinois River with a view of maintaining a 9-foot channel with open river navigation in the Illinois River from Utica to Grafton; also, with a view of reporting the cost of constructing a 9-foot channel 200 feet wide with additional width around the bends in the Mississippi River from Grafton to the city of St. Louis, I inclose herewith the report of the board in response thereto.

2. The primary purpose of the reports under review was the provision of a through waterway connecting Lake Michigan with deep water in the Mississippi River. In each case the channel depth considered was 9 feet, except in Document No. 50, Sixty-first Congress, first session, in which a 14-foot project was covered. The existing project for the Illinois River, which provides for a channel 9 feet deep and 200 feet wide between Utica and the mouth, is based on the reports contained in Document No. 4, Sixty-ninth Congress, first session. The improvement of the Mississippi River between the mouth of the Illinois and St. Louis is part of the project for improvement of the upper Mississippi to a depth of 6 feet. Below St. Louis there is already authority for maintaining a 9-foot channel.

3. A special board, appointed by the Chief of Engineers, has made a study of the case and submits a partial report on the specific questions contained in the resolution. It estimates that locks 600 feet long and 110 feet wide can be provided at La Grange and Kampsville for a total cost of $3,000,000. In addition, movable dams at these two sites would cost $1,000,000 each. The Illinois Waterway, now under construction by the State of Illinois, will have locks of these dimensions and fixed dams. Partial removal of the dams at La Grange and Kampsville so as to provide a channel 500 feet wide through them is estimated to cost $120,000. In the opinion of the special board this channel should not be provided unless the dams are replaced by movable dams of the Ohio River type. Dams of some type will be required to provide full project depth when diversions from Lake Michigan are materally reduced. The board figures that the Illinois River Channel would, if movable dams were provided, have a navigable capacity for traffic equal to or in excess of the State waterway. Under present conditions the construction of larger locks is felt to be unnecessary and should be deferred for consideration when a traffic develops justifying the expenditure.

4. Under present conditions a channel 9 feet deep and 200 feet wide can be provided in the Mississippi River from the mouth of the Illinois at Grafton to St. Louis by regulation and dredging, at an estimated cost of $1,500,000, with $125,000 annually for maintainance. With very small diversions a lock and dam may be required. This estimate does not provide for alleviating unsatisfactory navigation conditions at Chain of Rocks, 6 miles above the Eads Bridge at St. Louis. The navigable depth in this section of the Mississippi is 9 feet or more, but current velocities are high and the channel has an unfavorable alignment. It is probable that eventually some works may be necessary at Chain of Rocks to improve the navigable conditions for traffic on the Missouri and the upper Mississippi as well as on the through route to Chicago. The special board is not prepared at this time to make a recommendation as to the most advisable plan, but is of the opinion that the cost would not exceed $10,000,000. It recommends modification of the existing project for the Mississippi River so as to provide for a depth of 9 feet between Grafton and the northern boundary of the city of St. Louis.

5. The Board of Engineers for Rivers and Harbors recognizes the necessity of providing a channel depth in the Mississippi below Grafton equal to that authorized for the Illinois River and for the

Mississippi River below St. Louis. In reply to the specific questions in the resolution the board reports as follows:

(1) The estimated cost of rebuilding the locks and dams at La Grange and Kampsville in the Illinois River, Ill., to conform with the locks and dams now being built by the State of Illinois for the Illinois waterway between Lockport and Utica, Ill., is $5,000,000, of which $3,000,000 is the estimated cost of locks 110 feet wide and 600 feet long, and $2,000,000 the estimated cost of movable dams.

(2) Partial removal of the dams at La Grange and Kampsville in the Illinois River is not advisable at the present time unless they are replaced by movable dams. The estimated cost of providing a channel 500 feet wide through these dams is $120,000. Until the Illinois waterway is completed, in perhaps three or four years, a heavy tonnage of commerce can not be expected. When such a traffic develops and when the ultimate diversion from Lake Michigan is known, consideration should then be given to the relative desirability of partial removal of the dams or the provision of movable dams or other works to provide for the most economical transportation. Sufficient authority already exists to provide in the Illinois River a channel 9 feet deep and 200 feet wide by the time the Illinois waterway is completed.

(3) Excluding the works which may eventually be required at Chain of Rocks to improve navigable conditions above St. Louis, the cost of a 9-foot channel 200 feet wide, with additional width around the bends, in the Mississippi River from Grafton to the city of St. Louis is estimated under present conditions at $1,500,000, with $125,000 annually for maintenance. Eventually additional works may be needed, but the information now available leads to the conclusion that the regulating works and dredging covered by this estimate will provide reasonably adequate facilities for a number of years.

6. The board recommends that no change be made in the existing project for the Illinois River, but that the project for the Mississippi River between Grafton and the northern boundary of the city of St. Louis be modified so as to provide for a channel 9 feet deep and generally 200 feet wide, at an estimated cost of $1,500,000, with $125,000 annually for maintenance. It also concludes that investigation should be continued with a view particularly to determining the best method of providing for further improvement of navigation facilities in the Mississippi River between St. Louis and the mouth of the Illinois River, when commerce appears to justify such improved facilities.

7. After due consideration of the above-mentioned reports, I concur in the views of the board.

Very truly yours,

EDGAR JADWIN,
Major General, Chief of Engineers.

WAR DEPARTMENT,
BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, D. C., May 2, 1928.

Subject: Illinois-Mississippi Waterway.
To: The Chief of Engineers, United States Army.

1. This report is submitted in response to the following resolution adopted April 3, 1926:

Resolved by the Committee on Rivers and Harbors of the House of Representatives, That the Board of Engineers for Rivers and Harbors created under section 3 of the river and harbor act approved June 13, 1902, be, and it hereby is, requested to review the reports submitted in House Documents Numbered 1374, Sixty-first Congress, third session, and 50, Sixty-first Congress, first session, and in Rivers and Harbors Committee Documents Numbered 2, Sixty-seventh Congress,

first session; 7, Sixty-seventh Congress, second session; and No. 4, Sixty-ninth Congress, first session, with a view to ascertaining and reporting the cost of rebuilding the locks and dams at LaGrange and Kampsville in the Illinois River, Illinois, to conform with the locks and dams now being built by the State of Illinois for the Illinois Waterway between Lockport and Utica, Illinois; also with a view to ascertaining and reporting the advisability and cost of the partial removal of the dams at LaGrange and Kampsville in the Illinois River with a view of maintaining a 9-foot channel with open river navigation in the Illinois River from Utica to Grafton; also, with a view of reporting the cost of constructing a 9-foot channel 200 feet wide with additional width around the bends in the Mississippi River from Grafton to the city of St. Louis.

2. The reports under review are printed in five different documents. The primary purpose in each case was a through waterway connecting Lake Michigan with the Mississippi River. The channel depth considered exceeded 9 feet only in document No. 50, Sixty-first Congress, first session, in which the details of a 14-foot project between Chicago and the Gulf of Mexico were covered.

3. The waterways which would be traversed are the Chicago River, the Chicago Drainage Canal, the Illinois Waterway, the Illinois River, and the Mississippi River. Facilities for navigation in the two first named are adequate for barge traffic, though some interference is offered by the great number of drawbridges. An alternative route is offered by the narrow Sag Canal and Calumet Harbor. The State of Illinois is canalizing the Des Plaines and Illinois Rivers between Lockport and Utica, a distance of 60 miles, and expects to have the work completed by 1931. There is a Federal project providing for a channel in the Illinois River 9 feet deep and 200 feet wide between Utica and the mouth. The section of the Mississippi River between the mouth of the Illinois and St. Louis is under improvement to provide a depth of 6 feet. Below St. Louis provision is made for a 9-foot channel.

4. The special board appointed by the Chief of Engineers to make a study of the case submits a partial report on the specific features concerning which Congress desired information.

5. The estimated cost of providing locks at La Grange and Kampsville 600 feet long and 110 feet wide is $1,500,000 each. Movable dams of the Ohio River type are estimated to cost $1,000,000 each. The total cost for new locks and dams at the two sites is therefore $5,000,000. Locks now being built for the Illinois Waterway are of these dimensions and the dams are fixed structures. The above estimates are for larger locks alongside the present ones, whose general dimensions are 350 feet by 75 feet, since no part of the existing locks or foundations can be used for enlargement.

6. Partial removal of the two Federal dams at La Grange and Kampsville to provide a channel 500 feet wide through them is estimated to cost $120,000. The special board feels that this work should not be undertaken unless the dams be replaced by movable dams, at an estimated cost of $1,000,000 each, or $2,000,000 for both. When diversions are materially reduced, dams of some type will be required to provide full project depth. The board suggests that movable dams in connection with the existing locks would give a navigable capacity for traffic equal to or in excess of the State waterway. If commerce eventually requires larger locks at La Grange and Kampsville, they can be built alongside the present ones, thus providing double locks. When such a condition arises the special board is of the opinion that double locks should also be provided throughout the State waterway.

7. The provision of a channel 9 feet deep and 200 feet wide in the Mississippi River from the mouth of the Illinois River at Grafton to St. Louis is a vexing problem. For the 23-mile section above the mouth of the Missouri a channel can be obtained under present conditions by regulation and dredging at an estimated cost of $1,500,000, with $95,000 annually for maintenance. With smaller diversion, regulation becomes more difficult, and with very small diversions a lock and dam may be required.

8. Between the mouth of the Missouri and St. Louis, a distance of 15 miles, a channel of the desired dimensions can be maintained with an average annual expenditure of $30,000, as this section is already stabilized. Conditions at Chain of Rocks, 6 miles above the Eads Bridge at St. Louis are, however, a detriment to navigation and may become a serious obstacle. During low-water periods there is sometimes a difference in elevation of 2 feet in the water surface in a distance of 1 mile. The navigable depth over Chain of Rocks is 9 feet or more, but current velocities are high and the channel has an unfavorable alignment. Some works may eventually be required to remedy these conditions for the betterment of navigable conditions for traffic on the Missouri and the upper Mississippi, as well as on the through route to Chicago. The special board does not, at this time, recommend a final plan of improvement. It is of the opinion that the cost would not exceed $10,000,000. It recommends modification of the existing project for the Mississippi River between Grafton and the northern boundary of the city of St. Louis to provide for a depth of 9 feet.

9. The Board of Engineers for Rivers and Harbors realizes the desirability of providing a channel depth in the Mississippi River between Grafton and St. Louis equal to that authorized for the Illinois River and for the Mississippi below St. Louis. Otherwise through navigation between the Lakes and points on the Mississippi above and below St. Louis would not be possible on an economical basis.

10. In reply to the specific questions in the resolution, the board reports as follows:

(1) The estimated cost of rebuilding the locks and dams at La Grange and Kampsville in the Illinois River, Ill., to conform with the locks and dams now being built by the State of Illinois for the Illinois waterway between Lockport and Utica, Ill., is $5,000,000, of which $3,000,000 is the estimated cost of locks 110 feet wide and 600 feet long, and $2,000,000 the estimated cost of movable dams.

(2) Partial removal of the dams at La Grange and Kampsville in the Illinois River is not advisable at the present time unless they are replaced by movable dams. The estimated cost of providing a channel 500 feet wide through these dams is $120,000. Until the Illinois Waterway is completed, in perhaps three or four years, a heavy tonnage of commerce can not be expected. When such a traffic develops and when the ultimate diversion from Lake Michigan is known, consideration should then be given to the relative desirability of partial removal of the dams or the provision of movable dams or other works to provide for the most economical transportation. Sufficient authority already exists to provide in the Illinois River a channel 9 feet deep and 200 feet wide by the time the Illinois Waterway is completed.

(3) Excluding the works which may eventually be required at Chain of Rocks to improve navigable conditions above St. Louis, the cost of a 9-foot channel 200 feet wide, with additional width around the bends, in the Mississippi River from Grafton to the city of St. Louis is estimated under present conditions at $1,500,000, with $125,000 annually for maintenance. Eventually additional works may be needed, but the information now available leads to the conclusion that the regulating works and dredging covered by this estimate will provide reasonably adequate facilities for a number of years.

11. The board recommends that no change be made in the existing project for the Illinois River, but that the project for the Mississippi River between Grafton and the northern boundary of the city of St. Louis be modified so as to provide for a channel 9 feet deep and generally 200 feet wide, at an estimated cost of $1,500,000, with $125,000 annually for maintenance.

12. Investigation should be continued with a view to determining the most practicable and economical method of providing for further improvement of navigation facilities in the section of the Mississippi River between St. Louis and the mouth of the Illinois River, when commerce appears to justify such facilities.

For the board:

HERBERT DEAKYNE,
Brigadier General, Assistant Chief of Engineers,
Senior Member.

ILLINOIS-MISSISSIPPI WATERWAY, UTICA TO ST. LOUIS

SYLLABUS

In response to a resolution of the Committee on Rivers and Harbors of the House of Representatives concerning certain features of the Illinois-Mississippi waterway between Chicago and St. Louis, the special board reports that rebuilding the existing locks and dams at Kampsville and La Grange to conform to those being built by the State of Illinois would cost $5,000,000, this includes movable dams; that partial removal of the existing dams at La Grange and Kampsville would cost $120,000 and compel a large amount of additional dredging; that such removal is now inadvisable; and that it is advisable to substitute movable for fixed dams at La Grange and Kampsville; that depending on the nature of the improvement decided upon the increase of the project depth of the Mississippi River from Grafton to St. Louis would cost from $50,000 per annum for seasonal dredging to secure required depth during 80 per cent of the navigation season up to $15,000,000 for a complete canalization with two dams.

This is an interim report. For the present the board recommends:

(*a*) That the existing project for Illinois River, Utica to Grafton, be modified to include movable dams at Kampsville and La Grange, to be built when found necessary.

(*b*) That existing projects for the improvement of the Mississippi River between Grafton and St. Louis be modified so as to substitute a 9-foot project depth for a 6-foot project depth without increase in estimated costs, in order that expenditures now being made under existing law may be confined to those of assistance in securing the greater depth.

ST. LOUIS, MO., *April 7, 1928.*

Subject: Illinois-Mississippi Waterway, Utica to St. Louis.
To: The Chief of Engineers, United States Army, Washington, D. C.

1. This report is submitted in response to a resolution by the Committee on Rivers and Harbors of the House of Representatives, reading as follows:

Resolved by the Committee on Rivers and Harbors of the House of Representatives, That the Board of Engineers for Rivers and Harbors created under section 3 of the river and harbor act approved June 13, 1902, be, and it hereby is, requested to review the reports submitted in House Documents Numbered 1374, Sixty-first Congress, third sesssion, and 50, Sixty-first Congress, first session, and in Rivers and Harbors Committee Documents Numbered 2, Sixty-seventh Congress, first session, 7, Sixty-seventh Congress, second session, and #4, Sixty-ninth Congress, first session, with a view to ascertaining and reporting the cost of rebuilding the

locks and dams at La Grange and Kampsville in the Illinois River, Illinois, to conform with the locks and dams now being built by the State of Illinois for the Illinois Waterway between Lockport and Utica, Illinois; also, with a view to ascertaining and reporting the advisability and cost of the partial removal of the dams at La Grange and Kampsville in the Illinois River with a view of maintaining a 9-foot channel with open river navigation in the Illinois River from Utica to Grafton; also, with a view of reporting the cost of constructing a 9-foot channel 200 feet wide with additional width around the bends in the Mississippi River from Grafton to the city of St. Louis.

Adopted April 3, 1926.

J. H. McCann, *Clerk.*

Attest:

APPOINTMENT OF THE BOARD

2. The board of officers appointed April 30, 1926, consisted of Col. Chas. L. Potter, Maj. Cleveland C. Gee, Maj. Beverly C. Dunn, Maj. John C. Gotwals, and Maj. Rufus W. Putnam.

Col. Edward H. Schulz was appointed member of board October 5, 1926, vice Major Putnam, relieved, and Lieut. Col. G. R. Spalding and Maj. C. L. Hall were appointed members of board November 12, 1927, vice Majors Gee and Dunn, relieved.

By virtue of retirement, Col. C. L. Potter, ceased to be a member on January 24, 1928, but was reappointed to the board March 10, 1928.

The board as finally constituted is as follows: Col. Charles L. Potter, United States Army, retired; Col. Edward H. Schulz, Corps of Engineers; Lieut. Col. George R. Spalding, Corps of Engineres; Maj. C. L. Hall, Corps of Engineers; and Maj. John C. Gotwals, Corps of Engineers.

THE ILLINOIS-MISSISSIPPI SYSTEM

3. The Illinois–Mississippi waterway, when completed, will constitute a navigable channel between the harbor of Chicago on Lake Michigan in the St. Lawrence watershed, and the city of St. Louis, on the Mississippi River. It will consist of the six following sections:

(I) The Chicago River, from Lake Michigan to the entrance of the Chicago Drainage Canal, 6 miles, under Federal improvement (Chicago (Ill.) district).

(II) The Chicago Drainage Canal, from its junction with the Chicago River to Lockport, 30 miles, constructed and operated by the Sanitary District of Chicago, connection made with Chicago River under War Department permit (Chicago (Ill.) district).

(III) The Illinois waterway, from Lockport to Starved Rock, Utica, 60 miles, under improvement by the State of Illinois, under War Department permit (Chicago (Ill.) district).

(IV) The Illinois River, from Starved Rock, Utica, to Grafton, 231 miles, under Federal improvement (Chicago (Ill.) district).

(V) The Mississippi River, from Grafton to the mouth of Missouri River, 23 miles, under Federal improvement (Rock Island (Ill.) district).

(VI) The Mississippi River, from the mouth of Missouri River to St. Louis (Eads Bridge), 15 miles, under Federal improvement (St. Louis (Mo.) district).

The total length of the waterway under consideration is thus 365 miles.

EARLY HISTORY

4. The American Indians undoubtedly made use for travel between the St. Lawrence and Mississippi watersheds of a route coincident with the Illinois-Mississippi waterway, except for some slight variations near the head waters of the Chicago and Des Plaines Rivers, made to reduce the length of portage. French explorers learned of the existence of this route at an early date, and a canal to avoid the portage is said to have been suggested by Joliet in 1674. From that time until the surrender of the western forts by the British in 1795 the Illinois-Mississippi route was the main channel for military and for the fur trade between Canada and the Mississippi Valley.

As soon as the Illinois country was developed enough to produce any commerce of its own, a demand arose for a canal to connect Chicago and the Illinois River. A survey of a canal route was completed as early as 1820. In 1836 the construction was commenced of the Illinois and Michigan Canal from Bridgeport (Chicago) to La Salle, on the Illinois River. The work was completed in 1848. The canal had 16 locks and was originally built to accommodate boats measuring 103 feet by 17 feet by 4.5 feet. The canal is still in existence but is used only from Joliet to La Salle. The ruling clearance of fixed bridges is now 11 feet 2 inches.

Even before the canal was completed its importance was greatly diminished by the introduction of railways into the West, and at the present time its physical characteristics are such that while it carries a little commerce, it has long since ceased to be of any perceptible importance in the movement of goods between Chicago and St. Louis.

In the last decade of the nineteenth century a drainage canal was built so as to connect the Chicago and Des Plaines Rivers, for the purpose of carrying sewage diluted by Lake Michigan water away from Lake Michigan. There was thus established another waterway between the St. Lawrence and Mississippi watersheds. The new canal, while its navigable character was entirely secondary to its main purpose, was provided in 1908 with a lock connecting with the lower portion of the Illinois -Michigan Canal.

In 1920 the State of Illinois commenced the construction of a navigable canal of the latest type, with modern locks, intended to provide a first-class channel from navigable water at the level of Lake Michigan to the navigable portion of the Illinois River. There followed a public demand that the portions of the Illinois-Mississippi waterway under Federal control be improved so as to carry commerce in town of the size and draft which could be carried on the portions not under Federal control. This demand raised complex engineering questions some of which are enumerated in paragraphs 1 and 2 above, and are discussed at some length in the body of this report. Before proceeding to such discussion, however, it seems advisable to give a brief technical description of each of the elements of the new Illinois-Mississippi waterway.

1. CHICAGO RIVER

5. The Chicago River is naturally a tributary of Lake Michigan. Originally it was a sluggish creek, nearly stagnant for the greater part of the year. Federal improvement was undertaken in 1896, previous

to which time work was done by the city of Chicago. The present project depth of 21 feet was fixed by the act of March 2, 1899. Through the operations of the Chicago Sanitary District, which is at present diverting water from Lake Michigan so as to reverse the flow of the Chicago River, a current of 1 to 1¼ miles per hour exists in the main stream from Michigan Avenue, the head of Chicago Harbor, to the junction of the North and South Branches. The flow is thence along the South Branch to the junction of the West and South Forks of the South Branch, thence along the West Fork to the entrance of the Chicago Drainage Canal. This entire portion of the stream therefore now consitutes an open waterway, flowing away from Lake Michigan.

The width of the stream as improved is from 200 to 250 feet, but the channel is crossed by numerous bridges, with less clearance, so that the effective width of through tows is 60 feet. The bridges are all draw spans. The least width of new and reconstructed bridges varies from 140 to 200 feet.

It is proper to point out, however, that the land traffic across the river is so enormous that any full use of the waterway by river towboats will involve great transportation difficulties.

Adequate terminals for transfer from barge to rail or truck have been planned and will presumably be built by municipal funds. The only terminal planned for transfer from lake steamer to river barge is at Calumet Harbor. The connection of this harbor with the Chicago Drainage Canal is via the Sag Canal, an artificial waterway with a bottom width of 36 to 50 feet and a ruling depth of about 14 feet. This canal, although provided with passing basins, is manifestly inadequate for modern inland water traffic.

While no comment on Chicago terminal facilities is demanded by the instructions of the board, it is deemed advisable to point out that for full development of the Illinois-Mississippi system, further expenditures will be necessary to provide an enlarged channel between the Calumet district and the drainage canal, and thus with the Illinois River system. Further provision for interchange terminals will also be necessary.

II. CHICAGO DRAINAGE CANAL

6. The Chicago Drainage Canal is an artificial waterway connecting the south branch of Chicago River with the Des Plaines River at Lockport. It was built 1892 to 1900 by the Chicago Sanitary District, a taxing body of the State. The canal is 30 miles long, 160 to 200 feet wide, and has a ruling depth of 24 feet. All bridges are drawbridges. The current is about 1.3 to 1.7 miles per hour. There are no locks. There are limited terminal facilities with, however, considerable traffic in stone. Navigation is free.

The flow of the canal is maintained by the intake of water from Lake Michigan, mainly via the Chicago River, but partly via the Sag Canal. The flow is controlled at the outlet at Lockport. This flow is authorized by a revocable permit from the Secretary of War, dated March 3, 1925. However, since this is a lake-level canal, no discharge is actually necessary for its use for navigation as distinct from sanitary uses, except for the lockages at Lockport.

No comment by the board upon this portion of the waterway is required, and no Federal expenditures are in prospect.

III. ILLINOIS STATE WATERWAY

7. The Illinois State Waterway is connected with the drainage canal by locks at Lockport. Below Lockport the improvement is by the canalization of the Des Plaines River from Lockport to its junction with the Kankakee River (17 miles) and thence of the Illinois River to Starved Rock, Utica (43 miles). The waterway is being built by the State of Illinois, by authority of a permit of the Secretary of War dated March 4, 1920.

The ruling bottom width except at the locks, is 200 feet and the ruling depth will be 9 feet when in earth and 10 feet when in rock. The canal will contain five locks, each 600 feet long, 110 feet wide, and 14 feet deep over the miter sill, located and described as follows:

Miles from Lake Michigan	Location	Lift	Present status	
			Lock	Dam
		Feet		
36	Lockport	35–41	Completed	None needed.
42	Brandon Road	30–32	Begun	Begun.
56	Dresden Island	18–21	Not begun	Not begun.
83	Marseilles	23–24	Completed	Old dam to be retained and raised.
96	Starved Rock	8–18	Completed, except gates.	25 per cent done.
Total		114–136		

The variation in head is due to the changes in total quantity of flow passing through the canal.

The lock at Starved Rock is 1 mile above Utica. The State expects to arrange for the alteration or removal of all bridges along the State portion of the waterway.

The State now expects to complete construction in 1931. It is the understanding of the board that, owing to provisions of the State constitution, tolls must be charged on traffic unless revenues from incidental power are sufficient to defray all costs. No rates have yet been fixed.

According to estimates of State engineers the canal system will require a flow from the drainage canal of 1,500 cubic foot-seconds for maximum lockages. In House Document No. 1374 (par. 19) an estimate of 1,000 cubic foot-seconds was made for the least flow necessary for lockages from Lake Michigan to the Illinois River. This board believes that figure is correct if based on a canal designed to save water. The State of Illinois estimates its present necessities at 51 lockages of 30 cubic foot-seconds each. This board does not believe in the possibility of such a large number of lockages at Lockport, but after considering questions of seepage and evaporation, and the needs of the Illinois-Michigan Canal, has concluded that the figure of 1,500 cubic foot-seconds is on the whole reasonable.

IV. ILLINOIS RIVER

8. The Illinois River is formed by the junction of the Des Plaines and Kankakee Rivers. Its projected improvement from this point to Starved Rock, 1 mile above Utica (part of State Waterway) is described in the preceding paragraph. From Starved Rock to La Salle

7.4 miles, it has not yet been improved. It is obstructed by rock and bowlders and has a ruling depth of about 4 feet when there is a discharge of 3,000 cubic feet per second. Under natural conditions (i. e., before the construction of the Chicago Drainage Canal) the least depth was less than 2 feet. Its natural flow at Utica, apart from any diversion from Lake Michigan, was 500 cubic feet per second at low water and 71,000 cubic feet per second at high water.

9. From La Salle to mouth at Grafton, 223 miles, the river has been under improvement at various times by both the State and Federal Governments, the State work being limited to the two dams at Henry and Copperas Creek. Under these authorities there have been built the following locks and dams:

Miles below Utica		Built by	Lift	Dimensions	Depth on sill	Character of dam
			Ft. in.	*Feet*	*Feet*	
34.0	Henry	State	6 6	75 by 350	7	Timber-and-rock filled cribs.
93.2	Copperas Creek	do	6 3	75 by 350	7	Do.
152.4	La Grange	United States.	7 4	73 by 350	7	Piling with earth and rock fill.
198.5	Kampsville	do	7 7	73 by 350	6½	Do.

10. As a result of the additional flow from Lake Michigan the State locks have been drowned out. The partial removal of these dams appears to be advisable and contemplated by the act of January 21, 1927. During the high water months of the year the two Federal locks are not used; as navigation which at present is of a draft of 6 feet or less can then proceed over the dams, but at low water the dams concentrate a sufficient fall to make the use of the locks necessary so long as the dams remain an obstruction to flow. The removal of these dams until a dredged channel has been secured would interrupt navigation, which with present flow can depend upon a navigable depth everywhere between La Salle and Grafton of 7½ feet, except as this is interrupted by the sill of Kampsville lock, over which, under extreme conditions, there is but 6½ feet.

11. *Bridges.*—There are 25 bridges over the Illinois River from Utica to the mouth, 11 highway and 14 railway bridges. They are all low bridges with draws, 18 with swing, 3 of bascule, 3 of lift type, and 1 pontoon. The horizontal clearances vary from 88 to 200 feet. All bridges that have been reconstructed or built recently provide for a horizontal clearance in the draw of 200 feet. Those that are not now provided with sufficient clearance should be reconstructed as soon as possible and certainly at such time as to provide for the needs of the expected traffic.

12. *Floods.*—The district engineer, Chicago, is now preparing a special report on floods, etc., in compliance with recent act of Congress.

13. *Changes in cross section.*—Comparative sections as of 1902–1904 and 1926–27, indicate an annual deposit of about 1,000,000 cubic yards, a minor portion of which is due to sewage; the balance is sediment brought in from tributaries. These deposits have generally occurred on the sides of the channel, rather than in the channel itself. In fact, the channel depths have in some cases improved.

V. MISSISSIPPI, GRAFTON TO MOUTH OF MISSOURI

14. The Illinois River empties into the Mississippi at Grafton, 654 miles below Minneapolis, Minn., the head of navigation on the latter stream, and 1,298 miles above Head of Passes. The section of the river from Grafton to the mouth of the Missouri, like the rest of the navigable upper Mississippi, has been under improvement by the Federal Government. The work has been done by regulation and dredging.

This portion of the stream, 23 miles in length, has a project depth of 6 feet at low water, and a natural low-water depth of about 3 feet. Its estimated low-water flow, apart from water diverted from Lake Michigan watershed, is 20,000 cubic foot-seconds. The mean flow under the same conditions is about 100,000 cubic foot-seconds, and the extreme high water flow is about 450,000 cubic foot-seconds. The act of January 21, 1927, provided for a preliminary examination of the Mississippi River from Minneapolis, Minn., to the mouth of the Missouri (including this section) with a view to increasing the project depth to 9 feet. The report is in preparation by the district engineer at Rock Island, Ill.

VI. MISSISSIPPI, MOUTH OF MISSOURI TO ST. LOUIS

15. The Mississippi River from the mouth of the Missouri River to St. Louis has also been under improvement by the Federal Government for many years by regulation and dredging. This portion of the river is 15 miles long. Its low water and mean flow, apart from the flow derived from the Lake Michigan watershed are respectively 40,000 and 185,000 cubic foot-seconds. The bankful flow at St. Louis is 600,000 cubic foot-seconds, and extreme flood flow (estimated), 1,350,000 cubic foot-seconds. The project depths are 6 feet from mouth of Missouri to the northern boundary of the city, a distance of 5 miles, and thence 9 feet to Eads Bridge, St. Louis, a distance of 10 miles.

16. It is important to note that at the head of this section is the mouth of the Missouri River, a stream whose improvement has been authorized to a depth of 6 feet, and that the lower end of the section (St. Louis) is at the head of the main Mississippi Waterway, with a project depth of 9 feet and a least width of 300 feet.

It is therefore pertinent to remember that Sections V and VI, Mississippi River from Grafton to St. Louis, constitute a short link with a project depth of 6 feet, separating two great systems of 9-foot project depth, 327 miles and 1,270 miles in length. If the Ohio River be considered, this short link may also be regarded as separating the second city of the Nation (Chicago) from St. Louis, Pittsburgh, Cincinnati, New Orleans, and other large cities all now on a 9-foot waterway, with an aggregate length of 2,250 miles.

PREVIOUS REPORTS AND REVIEWS

17. The resolution of April 30, 1926, by the Committee on Rivers and Harbors of the House of Representatives calls specifically for a review of five reports previously submitted to Congress. An examination of each of these documents from the point of view of a 9-foot project follows:

HOUSE DOCUMENT NO. 50, SIXTY-FIRST CONGRESS, FIRST SESSION

This document, dated June 9, 1909, contains the report of a special board of engineers on a 14-foot waterway in the Mississippi River from St. Louis, Mo., to the mouth of that river, and via Illinois River to Chicago.

While the report includes a consideration of the survey of a proposed waterway between Lockport, Ill., and St. Louis, Mo., previously made, it did not give the details of that survey.

For such details it is necessary to refer to House Document No. 263, Fifty-ninth Congress, first session, December 18, 1905, in which are printed very complete and accurate studies and maps of the section considered.

This report contemplated the canalization of the Des Plaines and Illinois Rivers between Lockport and Utica by 9 locks and 5 new movable dams. As to the channel below Utica, the following is quoted from the report (p. 18):

> From the dam above Utica to Grafton, the low-water slope of the Illinois River is exceedingly small, varying at different places, but not exceeding 0.13-foot per mile for long distances. The natural low-water discharge of 500 cubic feet per second at Utica was not sufficient to maintain an open channel suitable for river navigation, and the river was improved by locks and dams. * * * The additional flow provided by the Chicago Drainage Canal is now 4,200 cubic feet per second. It will allow the removal of the present locks and dams, and it makes practicable the maintenance of an open channel considerably deeper than the 7 feet now provided by those structures.

As to the Mississippi River between Grafton and St. Louis (p. 530, Doc. 263) a movable dam was suggested at Alton to pool the Mississippi River up to the mouth of the Illinois River, a lateral canal from Alton to St. Louis Harbor, and a lock at the lower end of the canal to have a lift of 30 feet.

The 14-foot waterway was not recommended, and while a 9-foot project was suggested as being the best solution no estimate and detailed plans for such a channel were made.

An estimate for such a channel is included in Document 1374, Sixty-first Congress, third session, a review of which follows.

HOUSE DOCUMENT NO. 1374, SIXTY-FIRST CONGRESS, THIRD SESSION

18. This document, dated February 9, 1911, contains the report of a special board of engineers appointed in pursuance of the river and harbor act approved June 25, 1910, "to consider and report upon a waterway from Lockport, Ill., by way of the Des Plaines and Illinois Rivers, to the mouth of the Illinois River, and certain related subjects."

The special board recommended a channel of 8-foot depth as most advisable for immediate construction, this to be increased later to 9 feet. An 11-foot depth in new locks was to be provided at the start.

The total final cost for the 9-foot channel, Utica to St. Louis, to be secured under this plan was estimated at $8,765,000, which, if expressed in dollars of to-day, would be about $18,400,000.

This final plan called for the construction of 4 new and larger locks, at each of the 2 State and 2 Federal dams in the Illinois between Utica and Kampsville, and for a cut 500 feet wide through the Chain of Rocks in the Mississippi River. Project depths elsewhere to be secured by regulation and annual dredging.

The lock dimensions proposed were 80 by 600 feet with 11 feet on the miter sills. They were to be in addition to and alongside the old locks, thus providing a double passageway at the dams. The special board summed up its discussion of the waterway proposed as follows:

> With these lock dimensions three barges, carrying about 9,000 tons of freight, may be locked through with their towboat. A waterway of these dimensions would have a capacity exceeding 100,000,000 tons per annum, and would accommodate barge tows carrying about nine times the ordinary train load of this vicinity. In addition, the vessels using it would be capable of navigating the Ohio and lower Mississippi Rivers. Such a waterway would not require a diversion of more than 1,000 second-feet from Lake Michigan, and this amount would not injuriously lower lake levels nor cause excessive flooding of lands in the Illinois Valley.

These conclusions as to the capacity of the channel are not applicable to the State waterway, now under construction with single locks.

In forwarding the report of the special board to the Secretary of War and Congress, Gen. W. H. Bixby, then Chief of Engineers, said:

> The recommendations of the special board as to the diversion of water from Lake Michigan are that said diversion be restricted to the minimum required for purposes of sanitation; but should the diversion eventually authorized by Congress exceed that contemplated by the board a change in the method of improvement of the Illinois River * * * may then be desirable.

The Board of Engineers for Rivers and Harbors in its review stated:

> After careful consideration, the Board of Engineers for Rivers and Harbors concurs in general with the special board in its conclusions concerning the waterway from Lockport, Ill., to the mouth of the Illinois River, but it does not believe that the plan of improvement proposed for the Mississippi River between the mouth of the Illinois and St. Louis should be adopted until report has been made as required by Congress upon the improvement of the Mississippi River by dams at or near Jefferson Barracks and Commerce.

HOUSE DOCUMENT NO. 2, SIXTY-SEVENTH CONGRESS, FIRST SESSION

19. This document dated November 1, 1921, is a review by the Board of Engineers for Rivers and Harbors of the report of the special (Bixby) board printed in Document No. 1374 referred to above.

In its review the Board of Engineers for Rivers and Harbors had the assistance and advice of the division engineer and the three district engineers concerned.

Its conclusions as to the Illinois-Mississippi waterway contained the following statements:

> It will be seen from the district engineer's report that the estimates for the Illinois River are largely influenced by the amount of water discharged into it through the Chicago Sanitary Canal. The effect of this additional volume of water will be readily understood when it is considered that the normal low-water flow in the Illinois River is only about 500 second-feet. The existing locks and dams were found necessary to secure the project depth of 7 feet when the normal flow only was available. With the increased volume of 4,167 feet, they are of doubtful necessity in connecton with either an 8 or 9 foot channel, and with the probable minimum increment of 7,500 second-feet, or possibly 10,000 second-feet, the locks and dams become an obstruction to navigation rather than an aid and should be removed.
>
> In House Document No. 1374, * * * the estimate for a channel 8 feet deep from Utica to St. Louis, made in 1911, is $3,710,000. The difference in favor of the present estimate ($1,930,000) is due chiefly to the substitution of more extensive dredging for regularization works.

Attention is invited to the fact that no method of securing relief at Chain of Rocks in the Mississippi appears to have been considered in this review, and also to the fact that no difficulty in securing 8 feet in the Illinois was anticipated as a large diversion (7,500 second-feet) was assumed.

HOUSE DOCUMENT NO. 7, SIXTY-SEVENTH CONGRESS, SECOND SESSION

20. In its review of the special (Bixby) report as submitted and printed as Document No. 2, above, the Board of Engineers for River and Harbors had based their plans and recommendations for an 8-foot channel upon the assumption of an increment of 7,500 cubic feet per second to the natural flow of the Illinois River—

it being later learned that it was not the intention of the committee to have this quantity (7,500) so considered. (P. 1, Doc. 7, dated April 20, 1922.)

The board studied the subject anew and based "its recommendation upon the temporary permit flow of 4,167 second-feet." (Doc. 7 p. 2.)

In its review printed in Document No. 2, the board recommended the removal of all dams in the Illinois River below Utica. With the flow reduced to that of the temporary permit the board, in report dated March 14, 1922 (Doc. No. 7), considered that the best solution was to adhere to the then existing 7-foot project for the Illinois but to provide for an extension of that project upstream from La Salle to a short distance above Utica in order to connect with the Illinois waterway under construction by and at the expense of the State of Illinois and to modify the Mississippi River project from Grafton to St. Louis in order to permit the attainment of a 7-foot depth throughout that reach, stating that "this reach is the most critical of the entire distance from the sanitary canal to St. Louis."

In this review (Doc. No. 7), as in that printed in Document No. 2, no special reference was made to the difficult navigation of the Chain of Rocks.

HOUSE DOCUMENT NO. 4, SIXTY-NINTH CONGRESS, FIRST SESSION

21. This document, dated March 29, 1926, contains a further review of the special (Bixby) report (Doc. No. 1374), a consideration of the two previous reviews (Docs. Nos. 2 and 7), as well as a review of House Document No. 50, Sixty-first Congress, first session, with a view—

To ascertaining and reporting the cost of constructing channels, each 200 feet wide, and of 7, 8, and 9 feet in depth, respectively, in the Illinois River, Ill., between Utica and the mouth, including separate estimates for each of the aforesaid channels upon the basis of assumed diversions of water from Lake Michigan through the Illinois River of 2,000, 4,167, 7,500, 8,500, and 10,000 second-feet, respectively; also with a view to recommending such depth and width of channel in said river which would be most suitable for navigation purposes, the quantity of diversion from Lake Michigan necessary for navigation purposes in said recommended channel; and to report when, assuming all funds for such purpose available, the Sanitary District of Chicago can have in operation sewage-treatment plants capable of treating the sewage with the amount of water recommended as necessary for navigation in such recommended channel.

The report of the district engineer, Chicago, made in connection with this review and printed in Document No. 4 as a part thereof is exhaustive and valuable.

Appendix A thereof (pp. 33–36) is a review of the previous documents referred to by the committee.

Appendix B (pp. 37–172) contains a very searching study of the economics of the improvement, including a discussion of the characteristics of suitable towboats and barges, types and capacities of the necessary interchange terminals, estimates of local and through commerce and a statement of resulting benefits.

In Appendix C (pp. 173–214) appears a detailed description of the waterway, a discussion of the various methods and degrees of improvement, and, finally, general specifications for a suitable waterway.

Appendix E (pp. 215–250) contains a study of the economics of diversion of water from Lake Michigan, considering sanitation, water power, navigation and riparian damages both on the Great Lakes and the Illinois waterway.

Appendix F (pp. 251–264) is a review of the representations of various local interests.

The salient features of the district engineer's conclusions are as follows:

(*a*) The various methods and costs of improvement of the Illinois River from Utica to Grafton, as given in Document No. 4, page 3, are shown for a 9-foot by 200-foot project, being based on various diversions from Lake Michigan.

(*b*) The most suitable channel is 9 feet depth by not less than 200 feet width.

(*c*) The least possible diversion required for complete canalization is an annual average of 1,000 cubic feet per second (or a maximum of 1,650 cubic feet per second) at Lockport. The necessary diversions by other practicable improvements are given.

(*d*) The time required for a sewage treatment not involving sand filtration, and for a diversion of about 4,000 cubic feet per second is estimated at seven years.

22. With this report before it, and with its broad knowledge of other national projects, the Board of Engineers for Rivers and Harbors summed up (par. 29) its full discussion of the improvement as follows:

> The position of the War Department in the matter of the diversion at Chicago is set forth in the documents connected with the issue of the permit of March 3, 1925, namely, that every effort should be made to restrict the amount of diverted water. The board, in its present report, is concerned primarily with providing an immediately workable scheme of navigation in the Illinois River, and hence has based its estimates on the actual existing diversion, which, as explained in paragraph 26 is approximately 8,250 cubic feet per second. It invites attention to the fact that it does not recommend this as the final figure; the work it proposes will be useful in any future project that may be based on a lesser diversion. As indicated in paragraph 20 above, there are many facts which have a bearing on the matter of the amount of diversion, among these being the successful and economical operation of the immensely important commerce of the Lakes, whose magnitude and benefits far exceed those of any probable commerce now foreseen on the Illinois River and waterway. It has been shown by the present investigation that the amount of diversion is not a governing factor in providing a 9-foot channel on the Illinois, as the amount can be varied within wide limits and still leaves such a channel entirely practicable, though its cost would be increased as the diversion decreases. The problems in question are in process of investigation and it is hoped of orderly settlement. For the present, therefore, the board does not recommend that any final figure for the diversion should be set; nor that any change be now made in the policy with respect to the proper ultimate diversion.

23. Upon receipt of the report referred to in the preceding paragraph, the Committee on Commerce of the United States Senate adopted a resolution, June 14, 1926, reading:

That the Board of Engineers for Rivers and Harbors be, and hereby is, authorized and requested to review its report, published in Rivers and Harbors Committee Document No. 4, Sixty-ninth Congress, first session, with a view to clarifying its recommendations.

The letter of the Committee on Commerce transmitting the above resolution, contained the following paragraph:

It is the understanding of this committee that in submitting its report, the Board of Engineers for Rivers and Harbors did not intend to make any recommendations which would have any bearing upon the question of diversion and if such be the case, it would be wise if the board could so revise its report as, to make this matter clear beyond question.

In reply to this resolution the Board of Engineers for Rivers and Harbors submitted a review dated June 15, 1926, from which the following paragraphs are quoted:

It was not the intent of the board, in its * * * previous report, to commit the Government in any way regarding the legality or permanency of the existing diversion.

* * * * * * *

If it is felt that the former recommendation of the board might be interpreted as fixing any permanent diversion, a solution may be found in changing the recommendation so as to propose that a project for a channel 9 feet by 200 feet be adopted, and that the department be definitely authorized, not only to provide it for existing conditions of low-water flow, but also, and without further reference to Congress, to continue to provide it, by suitable changes in the works of improvement, if the low-water flow be reduced within the limits contemplated by the table on page 3 of House Committee Document No. 4, Sixty-ninth Congress, first session. The estimates in that table assume that the works corresponding to a given estimate are undertaken ab initio. On that basis a limiting authorization figure would be $2,666,000, the estimated cost of providing the channel by canalization with the least flow contemplated in the table. If, however, the low-water flow should be reduced by successive steps, and at each step certain works had to be provided appropriate to the then existing flow, the necessity might arise for modifying some part of the work in a manner which would somewhat increase the ultimate cost. The amount of such increase can not be accurately estimated, since it is unknown at what rate and by what steps the flow may hereafter be reduced; but it is estimated that the cost under such conditions might reach $3,000,000 or $3,500,000.

* * * * * * *

* * * It is understood that Congress, if it approves this recommendation, will thereby have authorized the department to undertake any works covered by the estimates in the table on page 3 of House Document No. 4, Sixty-ninth Congress, first session, which may be necessary in the future to provide a channel of the dimensions specified, and will have authorized the necessary expenditures therefor, up to a limiting total of $3,500,000.

The table referred to (Doc. No. 4, p. 3) is as follows:

TABLE I.—*Illinois River, Ill.*

Method of improvement	Instantaneous maximum diversion, Lockport (cubic feet per second)	Annual average diversion, Lockport (cubic feet per second)	Cost, thousands of dollars		
			First cost	Maintenance and operation	Annual charge (maintenance and operation plus 4 per cent first cost)
Complete canalization [2]	1,650	1,000	2,666	226	[2] 33
Partial canalization (State dams out)			5,133	210	41
Complete canalization [2]	3,300	2,000	2,619	216	[2] 32
Partial canalization (State dams out)			5,108	171	37
Open channel			6,050	105	34
Partial canalization (present dams retained) [2]	4,580	3,000	1,914	191	[2] 26
Partial canalization (State dams out)			3,697	147	26
Open channel			4,482	97	27
Partial canalization (present dams retained)	6,050	4,167	1,383	180	23
Partial canalization (State dams out) [2]			2,262	133	[2] 22
Open channel			3,465	89	27
Partial canalization (present dams retained)	7,050	5,000	1,264	178	22
Partial canalization (State dams out)			1,789	130	22
Open channel [2]			2,365	87	[2] 19
Partial canalization (present dams retained)	8,250	6,000	1,141	168	21
Partial canalization (State dams out)			1,349	126	18
Open channel [2]			1,925	80	[2] 19
Partial canalization (State dams out)	10,050	7,500	942	122	16
Open channel [2]			1,540	76	[2] 13
Partial canalization (State dams out) [2]	11,250	8,500	171	114	[2] 12
Open channel			1,320	70	12
Partial canalization (State dams out)	13,050	10,000	171	105	11
Open channel [2]			990	63	[2] 10

[1] On the assumption that the flow is regulated primarily in the interests of navigation.
[2] Indicates method which, considering, first, maintenance and operation costs, is cheapest, in terms of Federal money expended, for the given diversion.

NEW LEGISLATION, ILLINOIS RIVER

24. Attention is invited to the fact that the estimate of $2,666,000 referred to in the report of the Board of Engineers for Rivers and Harbors (par. 24) above, and the revised estimate of $3,500,000 recommended in that report both contemplated the use by minor alterations of the present fixed dams and small locks (350 by 75), and that the act of January 21, 1927, which authorizes the modification of the existing project in the Illinois River in the following words also contemplated the use of the existing structures:

Illinois River, Ill.: Modification of existing project so as to provide a channel with least dimensions of nine feet in depth and two hundred feet in width from the mouth to Utica: *Provided*, That the State of Illinois transfer to the United States without cost all rights and titles in the two State-owned dams on the Illinois River; and that local interests furnish the United States without cost all necessary areas for the economical disposal of material dredged in creating and maintaining the channel herein and hereby authorized: *Provided further*, That nothing in this act shall be construed as authorizing any diversion of water from Lake Michigan: *Provided further*, That there is hereby authorized to be appropriated for this project a sum not to exceed $3,500,000.

COMMERCIAL POSSIBILITIES

25. The report of Maj. R. W. Putnam, Corps of Engineers (H. Doc. No. 4, 69th Cong., 1st sess.) estimates the prospective commerce of the system of waterways under consideration at 7,500,000 tons. The board is satisfied, from the experience of the past, that this large tonnage will not move except over a waterway adequate in all respects and provided with adequate terminals. On the other hand, with these conditions fulfilled, the estimate seems reasonable.

26. As indicated in paragraph 25, the large commerce expected and necessary to justify the improvement will demand adequate facilities. The traffic capacity of the present small locks in the Federal section of the Illinois River is not as great as that which will be provided by the State Waterway when it is completed, notwithstanding the fact that the lower lift of the Federal locks permits more rapid operation. Elsewhere (par. 10) it is stated that under present conditions navigation may move over the dams except during low-water months, but this, of course, refers to the present light-draft packet boats now using the river. If the dams are left as they are, all towboat traffic such as is anticipated with the completed system will need to use the locks, as they will draw too much water to pass over the dams in safety, except at very high river stages. This will necessitate a breaking of tows designed to take full advantage of the larger locks.

In this light and in view of the new legislation (par. 24) the board submits the following responses to the inquiries of the River and Harbor Committee.

COST OF NEW FEDERAL LOCKS

27. Ascertaining and reporting the cost of rebuilding the locks and dams at La Grange and Kampsville in the Illinois River to conform to the locks and dams now being built by the State of Illinois for the Illinois Waterway.

The existing locks are of masonry construction on pile foundations, the general dimensions being 350 feet by 75 feet. They were completed 1889 to 1893 at which time the low-water lift at Kampsville was 8.6 feet and at La Grange 7.45 feet. The two dams are of rock fill and pile construction. The dam at Kampsville was lowered 2 feet in 1904, by the Sanitary District of Chicago under a War Department permit. The locks were designed to provide a least depth of 7 feet over the miter sills at low water of 1879.

As previously stated the locks now being built by the State of Illinois are 600 feet by 110 feet with 14 feet on the miter sill. These correspond to the Ohio River standard except that the latter have a depth of 11 feet over the miter sill.

28. Owing to the character of the foundations no part of the existing locks at La Grange and Kampsville can be utilized in the construction of new larger ones. If dams are to be used at all the board believes they should be movable. The old dams can not be economically rebuilt into movable dams.

The board is of the opinion that a proper rebuilding of these locks and dams at La Grange and Kampsville would require their complete replacement.

The estimated cost of two new locks and movable dams is $5,000,000.

As suggested hereinafter (par. 30), it is desirable to replace the present fixed dams with movable dams, making minor changes only to existing locks for the present, with the idea that if and when new and larger locks are needed they can be built alongside the old ones. The cost of new movable dams, minor changes to locks, and removal of old dams is estimated at $2,000,000 for both. The new locks, if desired, will cost $3,000,000 additional.

PARTIAL REMOVAL OF FEDERAL DAMS

29. Ascertaining and reporting the advisability and cost of the partial removal of the dams at La Grange and Kampsville with a view of maintaining a 9-foot channel with open-river navigation in the Illinois River from Utica to Grafton.

30. The current of the Illinois is so gentle that navigation in slack water will not be appreciably easier than in open river. Lockages cause a delay and expense to commerce that should be avoided where possible. The pools now formed by the La Grange and Kampsville dams are required for even the present navigation in the Illinois River until extensive dredging is completed. Even with this dredging complete and to provide 9-foot navigation with facilities measuring up to those of the new State waterway, these pools are required at times of low river discharge.

However, to maintain these pools by the present fixed dams serious disadvantages are encountered. First, due to the absence of a navigable pass practically all heavy towboat traffic will be forced to use the locks except at very high river stages. Second, fixed dams increase the river stages and thus cause annoyance to riparian owners during freshets.

On the other hand, if these pools are formed by movable dams, navigation can use the open river to great advantage during all times except period of low river discharge, and the injurious effects of increasing river stages at time of freshet are avoided. At the same time such dams can be used in a way to minimize dredging and can be adapted to the discharge of the river however variable the flow may be.

The disadvantages involved in the retention of the present fixed dams can be avoided and every advantage anticipated from their partial removal can be attained, if movable dams are installed. In addition the dredging required, in either case can be reduced by properly designed movable dams.

The board believes that it is advisable to replace the existing dams at LaGrange and Kampsville by movable dams at a cost of about $1,000,000 each. If, however, the movable structures are built in connection with the necessary dredging all in one step the total cost will not exceed the present authorized cost ($3,500,000) by more than $1,000,000 and may be less. It is possible that existing law (act of January 21, 1927) would permit the erection of movable dams, but the board believes that it would be preferable to modify the project so as to authorize such structures.

The present locks, even though smaller than the State locks, will, if coupled with movable dams, give a capacity for traffic equal to or

in excess of that of the State waterway equipped as it is with its higher lift single locks and higher fixed dams.

When commerce requires larger locks at these localities, they can be built adjacent to and probably shoreward of the present ones, thus providing double locks.

Until they are replaced by movable dams, the board is of the opinion that it is inadvisable to "partially remove" the present fixed dams by lowering their crests or otherwise. The cost of making a channel 500 feet wide through both dams is estimated at $120,000.

COST OF 9-FOOT CHANNEL, GRAFTON TO ST. LOUIS

31. Reporting the cost of constructing a 9-foot channel 200 feet wide, with additional width around the bends in the Mississippi River from Grafton to the city of St. Louis.

32. Under present conditions a channel 9 feet deep and 200 feet wide, Grafton to mouth of Missouri River, with additional width in the bends, can be obtained by regulation and dredging.

The estimated costs are: Initial dredging, $300,000; initial regulating works, $1,200,000; maintenance dredging, $72,000 annually; maintenance of regulating works, $23,000 annually.

33. *Mouth of Missouri River to St. Louis.*—This portion of the river is already stabilized. The average year's cost for maintenance or regulating structures is $30,000.

If it were merely a question of securing a 9-foot depth in this section with no regard to velocities and curvatures, it is thought that no question would arise as to the desirability of open-channel methods.

34. However, a condition has arisen at the Chain of Rocks, 6 to 10 miles above Eads Bridge, which is a detriment to navigation and may become an obstacle. Due to the narrowing of the river through St. Louis Harbor and to the regulating works below the city, the low-water plane at a short distance below the Chain of Rocks has fallen 4½ feet since 1872 and about 6 feet since 1840—the latter being based upon less reliable data—without any corresponding lowering on the Chain of Rocks. The result has been that at low water during 1925 a water surface drop of 2 feet in 1 mile at this locality was observed. This produces a velocity at low water far beyond that existing anywhere else between Grafton and Cairo. This drop in the low-water plane has been steadily progressive and bids fair to produce a serious obstruction unless some remedial measures are undertaken. Any attempt to cut down the Chain of Rocks to ease this slope will probably draw down the water surface above and may seriously increase the cost and difficulty of maintaining the increased depth to and above the mouth of the Missouri. These conditions are further aggravated by bad alignment of the channel, particularly at the water towers of the St. Louis water supply at this point. It is proper to point out that remedial measures at Chain of Rocks looking toward a reduction in velocity with a straighter channel will be necessary whatever the authorized project depth.

35. The board has considered the construction of a low-fixed dam, the back-water effect of which reaches to the mouth of the Missouri. The proposed dam reduces velocities on the Chain of Rocks section, above the dam, to those suitable for heavy commerce. The cost of this low-fixed dam as given above with appurtenant locks and approach channels, is estimated at $10,000,000.

SUMMARY—GRAFTON TO ST. LOUIS

36. This channel (Grafton to St. Louis) can be provided under present conditions of flow and at river stages above 4 feet on the Alton gauge by seasonal dredging. This would provide the desired channel through 80 per cent of the navigation period. The dredging will cost $50,000 per year. Such dredging slightly alleviates present channel conditions, but would not satisfy the needs of heavy river traffic routed through the improved Illinois River.

To meet reasonably the needs of modern barge traffic over this link of the waterway the stabilization of this entire reach should be completed and should be further supported by seasonal dredging. This type of improvement would provide the channel desired under present conditions of flow, but would be handicapped by swift currents and restricted channels at Chain of Rocks. The cost of such regulating works would be $1,200,000, with maintenance and dredging charges of $125,000 per year.

Under existing law new regulating works are being built, old regulating works are being maintained, and the channel is being dredged between Grafton and St. Louis with a view to securing a depth of 6 feet at low water. It is estimated that about $400,000 is left to be expended for regulating works in this section of the river, and that an annual charge for maintenance and for dredging of $75,000 is required. If the works are redesigned with a view to obtaining a 9-foot depth, additional works at a cost of $800,000 will be necessary, and additional maintenance and dredging will be required at an annual increase of about $50,000.

With reduced flow and to avoid unsatisfactory channel conditions, the improvement of this reach for a dependable 9-foot channel demands slack-water improvement. The slack watering of this reach under such conditions can be accomplished by a lock and movable dam at Alton at a cost of $5,000,000 and a low fixed dam and lock at Chain of Rocks at a cost of $10,000,000. This large project would provide the facilities demanded by modern barge traffic under any possible condition of flow. No radical change in the existing methods of improvement is now advisable.

SUBSEQUENT REPORT

37. The board expects in a subsequent report to present a full project for improving the Illinois-Mississippi waterway from Utica to Grafton with a view to securing a depth of 9 feet.

It submits the following recommendations at this time:

RECOMMENDATIONS

38. (*a*) That the existing project for Illinois River, Utica to Grafton, be modified to include movable dams at Kampsville and La Grange, to be built when found necessary.

(*b*) That existing projects for the improvement of the Mississippi River between Grafton and St. Louis be modified so as to substitute a 9-foot project depth for a 6-foot project depth without

increase, in estimated costs, in order that expenditures now being made under existing law may be confined to those of assistance in securing the greater depth.

CHAS. L. POTTER,
Colonel, United States Army, Retired.
EDWARD H. SCHULZ,
Colonel, Corps of Engineers.
GEO. R. SPALDING,
Lieutenant Colonel, Corps of Engineers.
C. L. HALL,
Major, Corps of Engineers.
JOHN C. GOTWALS,
Major, Corps of Engineers.