68TH CONGRESS, 2d Session } HOUSE OF REPRESENTATIVES { REPORT No. 1122

RIVER AND HARBOR BILL

JANUARY 9, 1925.—Committed to the Committee of the Whole House on the state of the Union and ordered to be printed

Mr. DEMPSEY, from the Committee on Rivers and Harbors, submitted the following

REPORT

[To accompany H. R. 11472]

The Committee on Rivers and Harbors respectfully submits the following report in explanation of the accompanying bill authorizing the construction, repair, and preservation of certain public works on rivers and harbors, and recommends that the bill do pass.

The bill contains the following provisions as to the expenses of prosecuting the projects adopted in this act: (1) That no money shall be expended on any of the projects adopted in this bill during the fiscal year ending June 30, 1926; (2) that there shall be expended on all such projects during the fiscal year ending June 30, 1927, not to exceed $10,000,000; (3) that there shall not be expended to exceed $10,000,000 during any succeeding fiscal year.

In prosperous years when factories are running full time and the farms produce large crops, the railroads of the country are unable to carry all of its commerce and we can only provide for transportation of all the shipments offered by utilizing our waterways.

The railroads transported in the year 1923, 2,333,787,044 tons of freight, while our waterways carried 442,097,328 tons. In other words, the waterways carried more than one-sixth as much freight as the railroads. For the year 1923 the railroads set aside $1,077,000,000 for improvements. On the same basis we should expend $180,000,000 annually on our waterways. In view of these facts, the expenditure of not to exceed $10,000,000 for the fiscal year 1927, on the projects adopted by the bill which this report covers, and of not to exceed $10,000,000 annually thereafter on such projects until these projects are completed is so small as to be almost insignificant. Nor does the comparison grow less by taking into consideration projects already adopted, for all of them can be completed by an expenditure of $204,000,000, one-fifth of the amount appropriated by the railroads for like purposes for the single year 1923.

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The amount to be expended under this bill is small, too, when we compare it with previous bills adopting new projects. For instance, the act approved June 25, 1910 adopted 179 new projects at an estimated cost of $263,726,609, while the present bill—the first bill in three years—adopts only 33 projects and authorizes the expenditure for their improvement of only $10,000,000 for the fiscal year ending June 30, 1927, and of $10,000,000 annually thereafter until they are completed, the total cost being estimated at $39,151,650, less than 15 per cent of the amount authorized by the 1910 bill.

But the figures quoted do not give the real difference in the cost to the country, for in 1910 the wealth of the country was but $143,-139,573,114, while in 1922 our total wealth was $320,803,862,000, and the burden of a country's expenditure is in proportion to its wealth at the time the tax is paid.

It is to be borne in mind, too, that the freight of the country doubles every 10 years and that the pressure for facilities for shipment is twice and a half as great now as it was in 1910.

National expenditures for rivers and harbors have been and are small, too, in comparison with not alone the aggregate of local expenditures, but even with some of the single instances of expenditures in a locality. For instance, the port of Greater New York has entered upon a program of expenditure there to coordinate with Government improvements at a cost to that locality of about $600,000,000. Los Angeles is starting a program, as we are advised, of expending approximately $40,000,000. Philadelphia has recently built a single marine terminal at a cost of $50,000,000. Even a comparatively small city like Wilmington, Del., is expending $2,500,000 on port facilities, and Mobile, Ala., is expending $10,000,000 for like purposes, and Houston, Tex., approximately $20,000,000. New Orleans has expended approximately $40,000,000 for port facilities. Like illustrations for nearly every large port in the country can be given.

A scrutiny of the proposed projects will, the committee is convinced, commend them to an impartial judgment as based on these sound principles.

Detailed information in regard to each item in the bill is herewith set forth for the benefit of the Members.

Section 1, new projects:

GLEN COVE CREEK, N. Y.

Glen Cove Creek is a small tidal estuary extending inland about 1 mile from the easterly side of Hempstead Harbor on the north shore of Long Island. While the creek itself has not been improved by the United States, a breakwater pertaining thereto was constructed in Hempstead Harbor about 1 mile north of its mouth in 1906. The creek is navigable up to the city of Glen Cove for vessels of shoal draft at high tide only. The mean range of tide is 7.2 feet.

The district engineer states that the annual receipts by water at present amount to 16,000 to 18,000 tons, largely coal. It is claimed that a deeper channel would benefit a considerable section of Long Island by making possible the prompt and economical handling of road material, fuel, building material, etc. The population to be served is estimated at about 60,000, and the immediately prospective

water business at 95,700 tons per year. The saving on 15,000 to 18,000 tons of coal is figured at $7,500 to $9,000 annually. Nassau County requires for road building about 135,000 tons of broken stone each year, about half of which could move by way of Glen Cove Creek, at a saving in transportation costs. Due to its central location and the lower grades of its connecting highways, Glen Cove offers better facilities than adjacent water points, except for the limited depth of its channel.

In discussing the improvement of the creek, the natural channel of which is straight only in the upper stretch, the district engineer submits estimates for four different routes, ranging from $53,500 to $66,000 for channels 100 feet wide and 8 feet deep at mean low water. The district engineer considers that the benefits would be largely local, and thinks adequate arrangements for handling the commerce could be made without Federal expenditure by the development of a terminal, in the shelter of the breakwater, at or near the existing wharf at Glen Cove Landing. He therefore recommends against the proposed improvement.

The division engineer favors the improvement, following route 2, feeling that the liberal cooperation offered and the small cost of the work justify the United States in adopting the project.

The Board of Engineers for Rivers and Harbors agrees with the division engineer, subject to the provisions that local interests shall assume one-half the first cost of the work, provide all rights of way, spoil-disposal areas, and bulkheads, and give satisfactory assurances that adequate terminals will be built.

The Chief of Engineers concurs in the views of the Board of Engineers for Rivers and Harbors and states that the considerable area naturally tributary to Glencove Creek, and the decreased cost of transportation of bulk commodities which would result from water carriage, appear to justify the conclusion that an adequate tonnage will result from a deeper channel if provided with a modern terminal. The definite local benefits which would accrue from further developments of industry along the water front and from saving in freight rates are adequately covered by the cooperation provided.

HUDSON RIVER, N. Y.

Following is the report of the Chief of Engineers on this project:

JUNE 2, 1924.

Subject: Preliminary examination and survey, Hudson River, Hudson to Troy, N. Y.

To: The Secretary of War.

1. There are submitted herewith, for transmission to Congress, reports dated January 8, 1916, by Col. W. M. Black, Corps of Engineers, and January 23, 1924, by Lieut. Col. J. R. Slattery, Corps of Engineers, on preliminary examination and survey, respectively, of Hudson River, N. Y., from Hudson to the dam at Troy, with a view to securing a depth of 27 feet, with suitable width, authorized by the river and harbor act approved March 4, 1915.

2. The city of Hudson, at the lower end of the stretch of river under consideration, is 117 miles above the Battery, New York City; the Troy Dam is 36 miles farther north. This portion of the river has been provided by the United States with a channel of 12 feet deep at lowest low water and generally 400 feet wide The existing project also provides for a channel of the same depth 200 feet wide from the Troy Dam to Waterford, a farther distance of 2½ miles. Local interests desire to create deep-water ports at Albany and Troy, which with certain adjoining communities they designate as the Capital District, and request

a channel 27 feet deep at mean low water. Consideration of the matter has been held in abeyance until recently in response to the expressed wishes of the proponents. During the past year a firm of consulting engineers was employed by interested parties to make a study of the engineering and economic features pertaining to the proposed improvement. In his survey report the district engineer analyzes the report of this organization, which claims that benefits would accrue having a capitalized value of $22,450,000, itemized as follows:

(1) Reduction of flood damage	$500, 000
(2) Reduction in boat-operating costs	400, 000
(3) Saving through lower land values	2, 000, 000
(4) Reduction in freight-car time	1, 250, 000
(5) Reduction in freight rates	18, 300, 000
Total	22, 450, 000

He considers that no allowance should be made for items (1) and (3). While the planes of mean high and mean low water would probably be lowered, the cross section of the flood channel would be greatly affected, as the spoil from the channel dredging would be deposited along the banks and in branch channels. The saving in land values is based on the lesser cost of acquiring terminal sites in Albany than in New York City adequate for the entire annual increase in New York's foreign commerce. That wholesale transfer of such business from New York Harbor to Albany would result he regards as improbable. His calculations on possible reduction in boat operating costs lead him to believe that a capitalized saving of $200,000, one-half the figure given by the consulting engineers would be more conservative. A capitalized value of $1,250,000 for reduction in freight-car time he considers reasonable, assuming that steamship rates to Albany should be the same as to New York Harbor, which they will probably not be.

3. The district engineer discusses in considerable detail item (5), the benefits to be derived from reduction in freight rates. In view of the extensive assumptions on which it is based, he does not consider the particular figure of $18,300,000 sufficiently convincing to warrant the investment of such a large sum in a new port. That some annual saving in freight rates would result is probable, but, based upon certain confidential information and assumptions which he considers more conservative, he is inclined to place it at about $725,500, which capitalized at 7 per cent, the rate used in the local engineers' report, would warrant an investment of $10,363,600.

4. His estimates of cost for providing a channel 300 feet wide and 27 feet deep at mean low water are as follows:

Hudson to Albany-Greenbush Bridge at Albany, with annual maintenance of $150,000	$9, 675, 000
Albany-Greenbush Bridge to Troy Dam, with annual maintenance of $75,000	25, 191, 000
Albany-Greenbush Bridge to Watervliet, with annual maintenance of $75,000	13, 318, 000

The high figures for the comparatively short stretches covered by the last two items are due to the large amount of rock excavation required.

5. The complications attendant upon the passage of large vessels through the drawbridges at Albany are emphasized by the district engineer. These bridges are located at such short intervals that a vessel would find difficulty in keeping safe headway unless they could all be opened simultaneously, an arrangement very difficult to attain in practice. In view of this feature, and of the uncertainty of the development of a commerce which would justify expenditure for the more extensive improvement above the bridges, he concludes that the deep channel should be limited to the section between Hudson and the lower bridge. He therefore recommends a channel between those points 300 feet wide and 27 feet deep at mean low water, at an estimated cost of $9,675,000, with $150,000 annually for maintenance; subject to certain conditions of local cooperation pertaining to the construction and operation of terminals and the provision of spoil disposal areas. To insure completion of the channel improvement within a period of four years, he recommends that the initial appropriation be $3,230,000, which would include funds for the purchase of two 20-inch pipe line dredges, considered necessary for use on the work in addition to contractor's plant and for subsequent maintenance.

6. The division engineer, for reasons which he sets forth, is of the opinion that there are elements of uncertainty as to the growth of deep-draft commerce, and

the benefits resulting therefrom, which make the improvement unjustified unless local interests meet half the first cost. If this is done, he recommends adoption of the project along the lines and with the estimates and conditions proposed by the district engineer, except that he considers that the estimate of annual maintenance should be increased to $300,000.

7. These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith. The board recommends adoption of the project substantially as recommended by the district engineer, except that it favors an increase of channel width to 400 feet through rock cuts, at an additional cost of $1,500,000, and agrees with the division engineer regarding maintenance. Its proposals for cooperation, a slight modification of those of the district engineer, provide that local interests shall take the following action:

(*a*) Provide, without expense to the United States, dumping grounds for dredged material when these must be purchased.

(*b*) Organize an agency to design, construct, and operate suitable terminals and to promote the actual transfer of freight between ship and rail at such terminals.

(*c*) Before any Federal funds are expended on channel improvement, make provision satisfactory to the Chief of Engineers and the Secretary of War for the construction of terminals, providing, exclusive of pier ends, 3,600 feet of berthage, of which not less than 600 feet shall be designed and equipped for the economical handling of lumber; supporting warehouses, one of which shall be cold storage; a grain elevator capable of handling 1,000,000 tons of grain per season; and a publicly controlled belt-line railroad connecting the terminals with all railroads entering the capital district.

8. After due consideration of the above-mentioned reports, I concur as to the desirability of further improvement. For a distance of over a hundred miles above the Battery, the Hudson River has a channel adequate for a large percentage of the vessels entering the port of New York. Above the limits of that port, however, there is little movement of general commerce in ocean carriers, due to the absence of adequate transshipment facilities, and of any community whose location, rail connections, and financial strength have made practicable such a development. On the other hand, the so-called capital district, embracing the cities of Albany and Troy, is a populous and important industrial center. Railroad lines radiate from it to all parts of the country and transfer from one carrier to another has reached great proportions in the mmediate vicinity. The district is also the terminus of the New York State Barge Canal. The necessity for suitable terminals with their accessories, and for an alert and energetic organization to develop the commercial potentialities, is recognized by the locality. These requirements are adequately provided for in the recommendations for local cooperation submitted by the board.

9. Nevertheless, after allowing for all favorable aspects of the situation, there are still certain elements of uncertainly in the development on the upper Hudson of a deep-draft traffic of general interest commensurate with the large cost of the work. This fact is evident upon analysis of the claims made for future commerce. It is the general rule that a new port must in the early stages of its development, depend for the bulk of its business upon some few basic commodities moved in tramp or chartered vessels. Perishable commodities, or part cargo lots, moving to or from a wide variety of points, are carried ordinarily in ships of regularly established lines sailing on definite schedules. These can not be expected to call in large numbers at a port until its commercial position is firmly established. If, in the case of the Capitol District, we seek for such bulk commodities which may move in large quantities, the principal ones for which definite local claims have been advanced are oil, lumber, and grain. Inbound movement of the first two is probable, but it is likely that the area over which they would be distributed, and which would receive the benefits of lower water rates, would be a comparatively limited section principally in central New York. The grain movement would affect a much larger area. Proponents of the project claim that there would be diverted to an upper Hudson port about 25 per cent of the grain shipments of Montreal and of all American North Atlantic ports. The claim is, however, found upon analysis to be based on a variety of assumptions, the validity of which is too uncertain to justify full acceptance of the predicted tonnage. It is hardly possible to grant the claim advanced by certain advocates of the project, that it will furnish a satisfactory and adequate deep water outlet for the entire lakes area and upper Mississippi Valley, or solve the admittedly difficult transportation problems which that great section of the country now faces; nor is it regarded as a rival to any other outlet existing or proposed from those sections to the sea.

10. Many elements of uncertainty ordinarily exist in the development of a new port above another already established port. In analogous cases, such as Houston, Beaumont, and Orange, Tex., Congress has habitually recognized this by requiring the locality, in addition to providing any terminal developments found necessary, to contribute to the cost of the improvement. In the ordinary case the United States could not consistently undertake the proposed improvement on a materially different basis from that already laid down for other similar extensions of deep-water channels. After careful consideration of all the pertinent information available, I believe, however, that credit should in this instance be given to the State of New York for its great expenditure in the construction of the Barge Canal, a waterway connecting at this locality, and capable of handling a large commerce, and the construction of such a waterway should be regarded as an offset against the contribution which would otherwise be expected.

11. I concur in the view unanimously expressed in the above reports, as to the limits of the project. The capital district, from the point of view of transportation economies, is a unit whose needs and potentialities transcend those of any individual community contained in it. The Nation's interest lies not in extending deep water to any community as such, but rather in providing a port within the district adequate to serve its hinterland. A suitable site is available at Albany, below the Albany-Greenbush Bridge. To reach other sites proposed farther up the river would double or more than double the Government's expenditures and would, on account of physical conditions, greatly increase the difficulties of navigation, but it is doubtful if there would be any increase of commerce effected by so doing. I concur also with the Board of Engineers for Rivers and Harbors as to cost estimates and channel dimensions. The provision of two dredges proposed by the district engineer should not be considered a definite or fixed part of the project. As it was not certain that their construction will prove advantageous to the Government, the matter should be left for the future decision of the department.

12. I therefore recommend that the existing project for the improvement of the Hudson River between Hudson and Waterford, N. Y., be modified to provide for a channel 400 feet wide through rock cuts, 300 feet wide elsewhere, and 27 feet deep at mean low water, from that depth at Hudson to the Albany-Greenbush Bridge in Albany, at an estimated cost of $11,200,000 with $300,000 annually, for maintenance, subject to the conditions of local cooperation recommended by the Board of Engineers for Rivers and Harbors. The initial appropriations should be $1,500,000, the balance to be provided in three equal annual installments.

13. I further invite attention to the remarks of the board in paragraph 20 of this report regarding the condition of the Hudson River between New York City and Hudson.

LANSING H. BEACH,
Chief of Engineers.

FLUSHING BAY AND CREEK, N. Y.

Flushing Bay is an indentation on the north shore of Long Island, in the Borough of Queens. At its southern end it is joined by Flushing Creek, a tidal waterway extending south about 4 miles. The Federal Government has provided a channel 10 feet deep, 200 feet wide, and about 12,500 feet long through the bay and creek to Broadway Bridge, and thence 7 feet deep for about 3,500 feet up to the Main Street Bridge, narrowing uniformly from 200 to 160 feet.

The Board of Engineers for Rivers and Harbors agrees with the district and division engineers regarding the inadvisability of adopting at the present time a project for a deep channel to be constructed contingent upon future terminal development. It agrees further that improvement above Main Street Bridge, amounting practically to the construction of an artificial channel or slip, and of no direct and immediate benefit except as it would cause an appreciation of land values, is not one that can justifiably be undertaken by the Government. It feels, however, that if such improvement above Main Street Bridge were undertaken by local interests, at their own

expense, not only would the present owners be much benefited but the provision of the channel, coupled with the reclamation of adjacent lands, would be likely to lead eventually to important industrial developments on the upper creek. Under these conditions the United States could appropriately provide a channel of corresponding depth through the creek up to Main Street Bridge. The board accordingly recommends that the existing project for Flushing Bay and Creek be modified to provide for a channel 12 feet deep and 200 feet wide through the bay and creek up to Broadway Bridge, thence 12 feet deep up to Main Street Bridge, narrowing uniformly from 200 to 160 feet, at an estimated cost of $253,000, with $10,000 annually for maintenance, provided that local interests will dredge and maintain, under plans to be approved by the Secretary of War, a channel 12 feet deep and 160 feet wide from Main Street Bridge to Meteor Street.

The Chief of Engineers concurs in the recommendation of the board.

DELAWARE RIVER, PA. AND N. J.

The Delaware River drains parts of the States of New York, New Jersey, and Pennsylvania, and has a low-water discharge of about 5,200 second-feet at Trenton, N. J. The upper limit of tidal flow is at the foot of the rapids at Trenton, the mean range being 5.3 feet at Philadelphia and 5.5 feet at Trenton. The section between Philadelphia and Trenton, 30.5 miles long, has been provided under a Federal project with a channel 12 feet deep at mean low water and 200 feet wide, including training dikes and a turning basin. From Philadelphia to the sea there is a project depth of 35 feet. Local interests desire facilities for the movement of ocean carriers up the river to Trenton, and depths of 16, 20, and 25 feet have been suggested.

On the section of the river under consideration, 2,338,000 tons of commerce were moved in 1922, about 85 per cent being sand and gravel, the remainder coal, oil, pig iron, iron pipe, etc. A comparatively small portion of this tonnage pertained to Trenton, although that city is the center of an important industrial area, and receives and ships annually, by all transportation lines, a total of about 2,643,000 tons.

The district engineer analyzes the Trenton commerce and estimates that 449,000 tons might be expected to move over a deep channel with a reduction of freight costs amounting to not less than $337,500. About 70,000 tons now moving by water would benefit from a deeper channel to the extent of $50,000, and about 150,000 tons of new business pertaining to points below Trenton would move over a deep channel at a saving of $118,000. He estimates a total saving in freight charges of $505,500 annually. Direct shipment by ocean carriers to and from Trenton would not only result in lower freight rates, provided Philadelphia rates apply to Trenton, but would enlarge the opportunity of certain industries, notably iron and steel, to enter into foreign business.

A tabulation of the draft of vessels entering the deep-water port of Philadelphia during 1922 indicates that 42 per cent of the freighters and 74 per cent of the passenger vessels drew 18 feet or less, and that

57 per cent of the freight and 92 per cent of the passenger vessels drew 20 feet or less. The district engineer concludes from these figures that a channel depth of 20 feet at mean low water, with a 5-foot tide, will provide ample facilities for the river traffic to and from Trenton. He presents estimates for channels 200 feet wide between deep water at Philadelphia and Landing Street, Trenton, and 16 feet, 18 feet, and 20 feet deep, of $507,000, $865,000, and $1,326,000, respectively. Similar channels extending to Bordentown only are estimated to cost $200,000, $397,500, and $640,000, respectively. The prospective benefits from increased depth to Bordentown alone are not considered sufficient to justify the improvement, but the potential business at Trenton, combined with that of the lower section, warrants favorable consideration. He therefore recommends a channel extending from Allegheny Street, Philadelphia, to Landing Street, Trenton, 20 feet deep and 200 feet wide, widened at curves to 250 feet, and to 300 feet for 500 feet above and 500 feet below the railroad bridge at Biles Island, with a turning basin at the upper end 1,700 feet long and 400 feet wide, at a total estimated cost of $1,326,000, with $50,000 annually for maintenance, subject to the conditions that local interests shall provide adequate terminals, at least 50 per cent of which shall be open to all on equal terms, and rail and highway connections at Trenton, and furnish, without cost to the United States, suitable land areas, bulkheaded if necessary, for the disposal of material dredged between Bordentown and the northerly end of the channel.

The Board of Engineers for Rivers and Harbors agrees in general with the district engineer. The board learns, however, that the public terminals at Trenton may be located at a point about 4,000 feet below Landing Street rather than where first proposed. It considers that the 20-foot channel should not extend above this development. It recommends the improvement to Landing Street, Trenton, or to such point below as may be selected for the public terminals, substantially as proposed by the district engineer, conditioned on certain local cooperation in the matter of dumping grounds and terminal facilities.

The Chief of Engineers concurs in the views of the Board of Engineers for Rivers and Harbors, and states that many large industries are located on the river between Philadelphia and Trenton and at the latter city, several being of national importance. The raw materials used come from widely separated points, both foreign and domestic, and few of the finished products are consumed locally. Much of this material can be moved by water to or from foreign and coastwise points with material economy and resulting lower prices to the general public. The potential tonnage is large, and the possible savings are of sufficient magnitude to justify the provision of facilities for its movement. The nature of the commerce, present and prospective, is such that a channel depth of 20 feet at mean low water, or 25 feet at mean high water, should serve a considerable tonnage, and encourage the development of additional industries dependent upon economical transportation. He therefore reports that the further improvement by the United States of Delaware River, Pa. and N. J., between Philadelphia and Trenton is deemed advisable to the extent of providing a channel 20 feet deep at mean low water and generally 200 feet wide from Allegheny Street, Philadelphia, to Landing Street,

Trenton, or to such point below as may be selected for the public terminals, following substantially the lines proposed by the district engineer, at an estimated cost of $1,326,000, with $50,000 annually for maintenance; provided that local interests give satisfactory assurance to the Secretary of War that they will provide public terminals at Trenton having not less than 3,000 linear feet of berthing space, with adequate covered storage and mechanical equipment, capable of handling about 500,000 tons annually; will provide satisfactory rail and highway connections therewith; and will furnish. without cost to the United States, suitable areas, bulkheaded if necessary, for the disposal of dredged material.

WILMINGTON HARBOR, DEL.

The lower end of the Christiana River, which flows into the Delaware River about 29 miles below Philadelphia, constitutes the harbor of Wilmington. The project under which improvement has been made by the United States provides for a channel 21 feet deep and 250 feet wide from the Delaware to the mouth of the Brandywine; thence 21 feet deep and 200 feet wide to the pulp works; thence 10 feet deep and 200 feet wide to the Philadelphia, Baltimore & Washington Railroad bridge No. 4; and thence 7 feet deep and 100 feet wide to Newport, a total distance of 8¾ miles. The mean range of tide is 6 feet at the mouth and 5.4 feet at Newport.

The project recommended in House Document No. 114, Sixty-seventh Congress, first session, was adopted by the act of September 22, 1922, amending the project to the following extent: Dredging to a depth of 25 feet an entrance channel 400 feet wide and a basin containing about 70 acres extending up to the Lobdell Canal; removing 1,700 feet of old south jetty; constructing 2,350 feet of new south jetty, 2,500 feet of north bulkhead, and four dolphins. Local interests are obligated to construct the north-side bulkhead and pay toward maintenance one-half of any amount required over $65,000 and not exceeding $100,000, and any additional sum required above $100,000.

The city of Wilmington is expending $2,500,000 on the development of a marine terminal. It has already built 1,210 feet of berthing bulkhead and 850 feet of retaining bulkhead on the south side of the entrance. Four hundred and sixty feet of this bulkhead is within the section proposed to be built by the United States. In view of its program of expenditure and the national importance of the port as developed by a canvass of its tributary zone, claimed to extend into Canada, local interests ask to be relieved of the construction of the north-side bulkhead and of all obligation for maintenance of the improvement. They also request that the direction and form of the entrance channel be changed to provide a direct deep-water channel along the proposed new south jetty, with a flared mouth to facilitate navigation to and from the Delaware River.

The district engineer considers that the new deep-water channel should be tangent to the curve at the Lobdell Canal and follow straight along the front of the new terminal and the proposed new south jetty, and have a mouth expanding from 400 to 1,000 feet. He believes that this will assist in the natural maintenance of the channel. He considers the construction of the bulkhead along the

north shore unnecessary for a project depth of 25 feet. The portion of the basin which is shown on plate "E" of the original report as extending into the bend at the base of the north jetty he considers unnecessary. The omission of a portion of this turning basin would admit of widening the mouth of the entrance channel without changing the cost of the project. He estimates the cost of maintenance will be $111,000—$81,000 for the 21-foot channel and $30,000 for the 25-foot section. It therefore appears to him to be inequitable to charge local interests with the prescribed portion of the cost above $65,000, as on that basis they would be assessed practically full maintenance of the 25-foot project. He recommends that the project be modified as follows: (*a*) By changing the limits of the 25-foot dredging; (*b*) by omitting the construction of the north bulkhead until its necessity has been demonstrated and relieving local interests of obligation to build it while the project depth is limited to 25 feet; (*c*) by changing the estimated annual cost of maintenance from "between $65,000 and $82,500" to $100,000, with the provision that local interests shall bear one-half of any necessary expenditure above that figure; and (*d*) by relieving local interests of the obligation as to maintenance prescribed by the approved project.

The results obtained from the active canvass and publicity campaign of the board of harbor commissioners indicate that a substantial tonnage may seek the new terminal when deep water is available. The board concurs with the district and division engineers in the opinion that a bulkhead on the north bank will probably be unnecessary for the maintenance of a 25-foot channel. It concurs with the division engineer as to the limits of the project and also in the opinion that the south jetty should be built by local interests, as it will act as a bulkhead for the reclamation of land needed in connection with the future expansion of the marine terminal. It does not consider advisable any change in requirements as to maintenance of the project.

The board therefore recommends that the existing project be modified by omitting the north-side bulkhead, by providing that no dredging shall be done within 50 feet of any bulkhead, and by making it incumbent upon local interests to construct the south jetty.

The Chief of Engineers concurs in the recommendation of the board.

SALEM RIVER, N. J.

Salem River is a tidal tributary of the Delaware River, which it enters through Salem Cove about 45 miles below Philadelphia. Little Salem River unites with the Salem River at the town of Salem. The existing project for improvement provides for a channel 9 feet deep at mean low water and 100 feet wide from the Delaware River to the fixed highway bridge over Little Salem River.

Salem is the center and distributing point of an important agricultural and manufacturing community. The mouth of Salem River is directly across the Delaware River from the new terminus of the Chesapeake & Delaware Canal, which is now being improved to a depth of 12 feet. A new water terminal is planned by local interests in conjunction with the New Jersey State Board of Commerce and Navigation in the event of the adoption of a plan for the cut-off of a troublesome horseshoe bend just below the town.

The district engineer presents plans for further improvement to depths of 9 feet and 12 feet, including a cut-off to eliminate the horseshoe bend. He recommends a 12-foot channel with a width of 150 feet through Salem Cove and 100 feet thence to the town, at an estimated cost of $130,000 for new work and $6,000 annually for maintenance, subject to certain local cooperation. The division engineer concurs in the views of the district engineer.

The Chief of Engineers concurs in the views of the district engineer, the division engineer, and the Board of Engineers for Rivers and Harbors, and reports that the further improvement of Salem River, N. J., is deemed advisable to the extent of providing a rectified channel 12 feet deep and 100 feet wide from the fixed bridge in the city of Salem to Salem Cove, and 150 feet wide through the cove to deep water in the Delaware River, at an estimated cost of $130,000 for new work and $6,000 annually for maintenance, subject to the provision that local interests shall furnish a free right of way for the proposed cut-off, and contribute 50 per cent of the cost of dredging.

CAMBRIDGE HARBOR, MD.

Cambridge Harbor is a tidal estuary on the south side of Choptank River, about 18 miles above its mouth. Under the existing project the United States has provided a channel 12 feet deep at mean low water and 150 feet wide up to the railroad wharf, widened to about 400 feet at the turn opposite the steamboat wharf; for an irregularly shaped anchorage 10 feet deep east of the head of the 12-foot channel, between the railroad wharf and Mill Wharf, approximately 250 feet by 150 feet; for an anchorage of general triangular shape 8 feet deep and about 200 feet wide on the west side of the channel between the steamboat wharf and a point opposite Mill Wharf; for an irregular area about 700 feet long and 360 feet wide adjacent to the head of the 12-foot channel on the west side and extending from a point opposite Mill Wharf to the drawbridge 10 feet deep except along the northwest side, where a depth of 8 feet and a width of 40 feet is provided; and for an area 8 feet deep and about 360 feet wide and 500 feet long above the drawbridge. The length of the improved sections is about 4,000 feet.

The water-borne commerce during 1922 amounted to 76,326 tons, the largest items being oysters, vegetables, fuel, and lumber. Cambridge, which is the second largest town on the Eastern Shore of Maryland, has a number of industries using water transportation, including 14 oyster packing plants, 5 tomato and fruit packing houses, 2 box factories, and 2 shipyards. Most of the business of the locality is transacted over the water route to and from Baltimore and Chesapeake Bay points, although Cambridge is a terminus of a branch of the Pennsylvania Railroad. Regular daily steamboat service is maintained to and from Baltimore.

The district engineer reports that the water front below the bridge is practically all in use for water business. While some improvement of the existing facilities is possible, new terminal developments are limited to sites above the bridge. He states that the harbor is congested at times by vessels seeking anchorage, and that the existing drawbridge interferes with free access to the upper harbor, due to its limited width of opening and slow operation. The limits of

the existing project extend so close to the shore and to wharf fronts that its maintenance is likely to cause damage to private property. He considers the locality worthy of further improvement, but would limit the work of the United States to the provision of a main channel, leaving to local interests all dredging of side channels and anchorage grounds. He accordingly recommends that a new project be adopted, providing for a channel 150 feet wide and 12 feet deep at mean low water below the drawbridge, and 10 feet deep and 150 feet wide above that point, widened to 250 feet at the upper end of the harbor, at an estimated cost of $18,500, with $550 annually for maintenance: *Provided,* That local interests shall furnish, without cost to the United States, suitable areas and bulkheads for the deposit of material dredged above the bridge and give satisfactory assurances that the existing bridge will be removed, or replaced by a mechanically operated drawbridge with a clear horizontal opening of not less than 60 feet.

Cambridge Harbor has a commerce which is large and important in comparison with the moderate expenditures made by the United States, totaling $67,408.43, including maintenance. The development of the water front has not been well coordinated and has made several sharp bends in the channel necessary. The establishment of harbor lines, now under consideration, should prevent further encroachments on the harbor. Additional anchorage area and access to water front now undeveloped or in process of development above the bridge seems necessary for the relief of congestion in the lower harbor. The existing project is objectionable in that it provides for dredging outside of the main channel, close up to the shore line, and along existing wharves.

The board therefore recommends the improvement of Cambridge Harbor, Md., by the provision, in lieu of the existing project, of a channel 12 feet deep at mean low water and 150 feet wide from the 12-foot depth in the Choptank River to the drawbridge, and thence 10 feet deep and 100 feet wide, terminating in a turning basin 200 feet square at the upper end of the harbor, at an estimated cost of $15,000, with $400 annually for maintenance: *Provided,* That no dredging be done by the United States within 30 feet of any wharf and that local interests shall furnish, without cost to the United States, suitable bulkheaded areas for the disposal of material excavated above the bridge.

The Chief of Engineers concurs with the recommendation of the board.

ONANCOCK RIVER, VA.

The Onancock River rises in Accomac County, Va., and flows into Pocomoke Sound on the easterly side of Chesapeake Bay, about 30 miles south of the Maryland State line. Under the existing project the United States has provided a channel 8 feet deep at mean low water across the bar and 7 feet deep in the river up to the town of Onancock. The mean range of tide is 1.7 feet. A channel depth of 12 feet is desired.

In 1922, 21,000 tons of food products, fertilizer, brick, coal, and lumber products were moved by water. A substantial increase in water-borne commerce was shown in the first seven months of 1923.

The district engineer reports that about half of the shipments from this rich agricultural section are made by water, in spite of the limit placed upon such movements by the inadequate depth provided by the existing project. The region is handicapped by the badly congested rail lines and lack of facilities for regular Chesapeake Bay steamers, the loaded draft of which is about 9 feet. Recent highway construction, furnishing better communication with Onancock, the natural center of distribution for this part of Virginia, will, in the opinion of the district engineer, increase the water-borne commerce. With increased channel depth, a reduction of freight rates to and from Baltimore and Chesapeake Bay points should result. He estimates the cost of a channel 200 feet wide across the bar and generally 100 feet wide in the river, with depths of 10 and 12 feet, at $37,700 and $87,100, respectively. While a 10-foot channel would provide some relief, he considers preferable a depth of 12 feet, and recommends the provision of a channel 12 feet deep at mean low water, 200 feet wide over the bar and 100 feet wide in the river, with a turning basin of about 2.3 acres near the head of navigation, at an estimated cost of $87,100, with $2,000 annually for maintenance. The division engineer considers a depth of 10 feet sufficient, but otherwise concurs with the district engineer.

The Board of Engineers for Rivers and Harbors agrees with the district and division engineers as to the advisability of the improvement. The board believes, however, that adequate facilities will be provided by a channel 10 feet deep at mean low water in the river and 12 feet deep across the bar, at an estimated cost of $60,000, with $2,000 annually for maintenance.

The Chief of Engineers concurs in the views of the Board of Engineers for Rivers and Harbors as to the advisability of the improvement and as to the depth which should be initially provided. It is his opinion, however, that a depth of 10 feet in the river may be found inadequate in the near future, and that a project should be adopted at this time which would admit of providing increased channel depth without additional legislation, should it be found necessary. This section of Virginia is served by a branch railroad, which is unable to handle with necessary dispatch the large quantity of perishable fruits and vegetables seeking the market. Considerable dependence is therefore placed upon the water route from Onancock, which offers prompt delivery and lower freight rates. The existing channel is used to a lesser extent than is actually required for economical crop movement, as the regular Chesapeake Bay steamers require greater depth than is available. The products of this region enter into general trade, with Baltimore as the distributing point, and are of sufficient importance to justify further improvement of the river at the moderate expense involved. He therefore reports that modification of the existing project for the improvement of Onancock River, Va., is deemed advisable to the extent of providing a channel 12 feet deep, 200 feet wide across the bar, and generally 100 feet wide in the river, with a turning basin near the head of navigation, following substantially the lines proposed by the district engineer at an estimated cost of $87,100, with $2,000 annually for maintenance; with the understanding that the initial dredging in the river shall be to 10 feet only, the full project depth to be provided if the needs of commerce are later found to demand it.

NORFOLK HARBOR, VA.

The Southern and Eastern Branches of Elizabeth River form part of the harbor of Norfolk, which has an entrance channel with a project depth of 40 feet and width of 750 feet. The 40-foot channel extends up the southern branch, with a general width of 450 feet, to the Belt Line bridge, about 1¾ miles. Above this bridge the river has a project depth of 25 feet and a width of 300 feet to a point about 1,000 feet above the Virginian Railway bridge, a distance of about 1½ miles; and a project depth of 22 feet and a width of 200 feet to the Norfolk & Western Railway bridge, a further distance of 2 miles. Above the latter bridge the river forms part of the intracoastal waterway from Norfolk to Beaufort Inlet, and has a project depth of 12 feet. Local interests desire a channel in the southern branch 30 feet deep between the Belt Line and Virginian Railway bridges, and 28 feet deep between the latter and the Norfolk & Western Railway bridge, together with a straightening of the channel lines.

In 1922 the commerce of the southern branch amounted to about 800,000 tons, 543,000 tons pertaining to the section between the two lower bridges and the balance to the section above. During the same period the intracoastal waterways carried 514,000 tons, some of which pertained to southern branch terminals. The portion of the canal tonnage which passed to or from the main harbor, representing additional tonnage for the river, can not be segregated from the total.

The district engineer reports that two large oil plants, which receive oil by water and have bunkering facilities, are located between the Belt Line and Virginian Railway bridges. It is claimed that increased cost of oil to consumers results from delays and rehandling caused by inadequate depth. Eleven fertilizer plants are located on the southern branch, four being below the Virginian Railway bridge and seven above. Most of their raw materials are received in ocean steamers, for which the present depth in the upper section is inadequate. The district engineer considers the straightening of the channel advisable, as affecting all classes of traffic, including canal tows, and recommends a channel 30 feet deep and 450 feet wide between the Belt Line and Virginian Railway bridges, and a channel 25 feet deep and 200 feet wide thence to the Norfolk & Western Railway bridge, at an estimated cost of $449,000, with $3,000 annually for maintenance. The division engineer considers a width of 375 feet sufficient for the 30-foot channel, but otherwise concurs with the district engineer. The cost of the improvement proposed by the division engineer is estimated by the district engineer at $392,000.

The eastern branch has been provided with a channel 25 feet deep and 500 feet wide up to the Norfolk & Western bridge, about 1 mile, and a channel 22 feet deep and 500 feet wide for a further distance of one-half mile to the Campostella Bridge. Local interests desire a channel 30 feet deep and 250 feet wide from the mouth to the Virginian Railway bridge, about 2¾ miles, and a channel 25 feet deep and 200 feet wide for a further distance of 2,500 feet.

Under the wording of the act consideration can be given only to the section between the Norfolk & Western Railway bridge and the Vir-

ginian Railway bridge. On this section the district engineer reports that there are three shipyards and several terminals and other developments. Two of the shipyards are handicapped by insufficient depth of water. One of the other interests has dredged to depths of 20 to 30 feet in front of its property, and is reclaiming a large area for industrial purposes. The district engineer considers the existing and prospective developments sufficient to justify the improvement to a depth of 30 feet, but feels that such a depth in this section would not be of particular value while the depth in the lower section is limited to 25 feet. He therefore recommends a channel 25 feet deep and 250 feet wide at an estimated cost of $169,000, with $2,000 annually for maintenance. The division engineer concurs in this recommendation.

The Board of Engineers for Rivers and Harbors agrees with the division engineer except as to the width of the channel proposed for the eastern branch. It considers that the present requirements of this section will be adequately met by a width of 200 feet, the cost of which, as estimated by the district engineer, would be $149,000. The total cost of the improvement recommended for the southern and eastern branches is $541,000, with $5,000 annually for maintenance.

The Chief of Engineers concurs in the views of the Board of Engineers for Rivers and Harbors. Norfolk Harbor occupies an important position among the seaports of the United States, and has an expanding commerce. The most economical points for further development, particularly along industrial lines, are on those sections of the harbor now under consideration. Already a considerable commerce has developed on the southern branch, and the existing channel depths are inadequate for its economical movement. Existing plants of general value to shipping are handicapped by lack of channel depth in the eastern branch. These developments and others in prospect justify further Federal expenditure. He therefore reports that the further improvement of Norfolk Harbor, Va., is deemed advisable to the extent of providing in the Southern Branch of the Elizabeth River a channel 30 feet deep at mean low water and 375 feet wide from the upper end of the 40-foot channel, at the Belt Line Railway bridge, to the Virginian Railway bridge, and thence 25 feet deep and generally 200 feet wide to the Norfolk & Western Railway bridge; and in the eastern branch a channel 25 feet deep at mean low water and 200 feet wide from the upper end of the present 25-foot channel, at the Norfolk & Western Railway bridge, to the Virginian Railway bridge, following in general the lines proposed by the district engineer, at a total estimated cost of $541,000, with $5,000 annually for maintenance, provided that local interests shall furnish, without cost to the United States, suitable areas for the disposal of dredged material.

INLAND WATERWAY FROM NORFOLK, VA., TO BEAUFORT INLET, N. C. (LAKE DRUMMOND CANAL)

Lake Drummond Canal, or, as it is more familiarly known, the Dismal Swamp Canal, extends from Deep Creek, an arm of Elizabeth River, Va., to the Pasquotank River, N. C. It is about 22½ miles long, 50 feet bottom width, 90 feet or more on the surface,

has a navigable depth of about 9 feet, and a lock at each end 250 feet long and 39 feet wide. The approaches to the canal are under improvement by the United States to a depth of 10 feet and a width of 100 feet.

The canal was built with private capital more than 100 years ago under a charter by the States of Virginia and North Carolina. The original canal was narrow and but 5 feet deep, but it afforded a useful means of transportation between the waters of North Carolina and Chesapeake Bay. Shortly after the Civil War a competitive canal—the Albemarle & Chesapeake—connecting the same waters was constructed, also with private capital. Being of larger dimensions, this canal soon attracted the bulk of the traffic and practically put its rival out of business until, in 1892, the present owners—the Lake Drummond Canal & Water Co.—purchased and enlarged the Dismal Swamp Canal and again acquired the ascendency over its competitor. The fact that all traffic through these waterways was subject to tolls gave early rise to the question of a Government-owned free waterway. After investigation Congress adopted a project for the acquisition of the Albemarle & Chesapeake Canal and its enlargement to 12 feet depth and a minimum width of 90 feet. The route of the Albemarle & Chesapeake Canal was selected as the cheapest and most desirable after consideration had been given to four possible routes, including the Dismal Swamp Canal route. The estimated cost of a sea-level canal 12 feet deep by the latter route was $5,600,000, including $1,750,000 asked by the owners for the canal. The estimate for the Albemarle & Chesapeake route was $2,733,000, including $500,000 asked for the canal. The work of reconstruction and enlargement is well advanced, and traffic is responding thereto by leaving the Dismal Swamp Canal for the Albemarle & Chesapeake route.

In the report favoring the purchase of the Albemarle & Chesapeake Canal is the following statement:

> If the above recommendation of the board be approved, and if the Albemarle & Chesapeake Canal be purchased by the United States, the business of the now competing Dismal Swamp Canal will probably be practically ruined. While it is understood that for such indirect damage done to the canal company it has no legal redress, it is thought proper to invite the attention of Congress to the condition which will then exist.

It is claimed that the prophecy of the special board has come true and that the revenue of the Dismal Swamp Canal Co. is now insufficient to maintain the canal and pay for operation and taxes. In support of this statement there has been submitted a financial report compiled by a certified accountant from which it appears that the revenues have been steadily decreasing in recent years and have now fallen below operating expenses. When to these expenses interest, taxes, legal services, etc., are added a substantial annual loss is shown. In view of this situation it is locally feared that the canal company will be forced out of business and that the residents of the contiguous country, whose interests and investments have been largely based upon the existence of the canal, will be deprived of this transportation route upon which they depend in a large measure and will suffer personal loss and inconvenience thereby. It is desired by the canal company and by the people interested along the route that the Federal Government purchase

the canal and operate it in the interests of general commerce and navigation. When the report under review was being prepared and consideration given to the selection of a route the canal company set a price of $1,750,000 as the value of its property. In response to a recent inquiry as to the terms upon which the canal company would be willing to transfer its property to the United States, the board received the following reply:

* * * The query necessarily arises as to the sum which the United States should in equity and justice pay to the owners. They have invested in good faith for the public use about one and three quarters million dollars and the payment of any less sum will mean a loss to that extent. How much shall the Government offer? What sum under all the conditions, based upon a spirit of equity and fair dealing should be recommended? This query must be primarily answered by your board and ultimately by Congress. The owners have faith in the integrity and spirit of fairness on the part of the board and likewise on the part of Congress. They place their case in your hands. I am directed to express the hope that the board will accept the foregoing statement as an adequate response to their request for a proposal from the canal company.

THE LAKE DRUMMOND CANAL & WATER CO.,
By M. K. KING, *President.*

Since its enlargement by the present company the canal has been well maintained and has furnished the only dependable means of transportation to a thriving section of country. When the canal was first opened the contiguous territory was undeveloped. As a result of the facilities offered for communication with outside markets, many farms have been put under cultivation, drainage districts established, roads constructed, and private capital invested, all these interests being predicated upon the existence of the canal as a public highway. During the period 1910–1915 the commerce of the canal, including the approaches maintained by the United States, averaged about 450,000 tons annually. Of this average tonnage probably an average of more than 400,000 tons passed through the Dismal Swamp Canal. Since 1915 the other waterway via the Albemarle & Chesapeake Canal had been steadily improved until 1920, when the waterway with the full project dimensions of 12 feet depth with minimum width of 90 feet was completed. During this period since 1915 the tonnage via the Albemarle & Chesapeake Canal has continually increased, while the tonnage through the Dismal Swamp Canal has correspondingly decreased until in 1919 less than 113,000 and in 1920 only 135,883 tons passed through that canal.

The abandonment of the Dismal Swamp Canal through insufficient revenues to maintain it would result in substantial financial loss to its owners and a loss that can not be measured or even approximately estimated to those people who live or own property adjacent to the canal and who depend upon it as a highway for the transportation of their products. The owners of the canal now ask compensation for the loss of their property in such amount as may be recommended by the board and authorized by Congress. The residents and owners of abutting property desire that the United States take over and maintain the canal as a free public highway.

It is recognized that the rights of the United States are paramount and that it was fully justified in the interests of the general public in the course it has pursued and that it can not be legally held for indirect damages resulting from such action. It is claimed, however, that in so doing it has incurred a moral obligation to the

local community that should be met by just compensation to the canal company and by the United States assuming control and maintaining this established waterway. The board does not feel called upon to measure the moral obligation of the United States (believing that this should be left to Congress alone, whose attention was invited to the condition that would follow the opening of the Albemarle & Chesapeake Canal as a free waterway), but rather to determine the question of the acquisition of the canal by its value to present and prospective commerce and its relation to the community to be affected.

The adjacent territory is extremely fertile and its developments still in its infancy. The board made an inspection of a considerable part of the canal on May 15, 1921, and on the 16th held a public hearing in Norfolk in reference to the present inquiry. It was learned that reclamation on a large and comprehensive scale is really just beginning through the organization of drainage districts, one of which comprises 10,000 acres. There has already been spent on this project $75,000, and bonds have been sold to the amount of $233,000 for its completion. Other drainage districts are under way, and in the near future there should be a considerable growth in local commerce if the canal is maintained. The Albemarle & Chesapeake Canal does not afford an alternative route for the commerce originating in or destined for the immediate vicinity of the Dismal Swamp Canal.

This commerce can be served only by the maintenance of the latter canal, and this applies also in a large degree to the commerce of Pasquotank River, on which is the important town of Elizabeth City, with large tonnage, most of which now uses the Albemarle & Chesapeake Canal. As mentioned above, 135,883 tons passed through the Dismal Swamp Canal, and practically all of this tonnage was tonnage that could not be transported via the Albemarle & Chesapeake Canal. In normal years, even with no further development of the contiguous territory, this tonnage would probably amount to 200,000 tons.

It seems probable that if the canal were maintained as a free waterway it would, in connection with the Pasquotank River, develop an annual traffic approximating 250,000 to 300,000 tons. Maintenance and operation would cost about $30,000 annually. Under these conditions it is believed that an expenditure of $500,000 by the United States is warranted in the public interest. This is the same amount as was paid for the Albemarle & Chesapeake Canal and in the circumstances is, in the opinion of the board, a fair and equitable sum to be paid for the property and rights of the Lake Drummond Canal Co.

The board reports that in its opinion it is advisable in the public interest of the United States to acquire the Lake Drummond canal, provided the canal and all rights and privileges appertaining thereto can be purchased for the sum of $500,000. If taken over the canal should be maintained at its present dimensions for the benefit of the commerce naturally tributary thereto and as an auxiliary of the Albemarle & Chesapeake Canal, which affords adequate facilities for through commerce between Norfolk and Beaufort Inlet.

After careful consideration of this item the committee decided in favor of its adoption on condition that local or other interests contribute 25 per cent of the cost.

WATERWAY FROM CHARLESTON TO WINYAH BAY, S. C.

Alligator Creek is a tidal stream entering the South Santee River near its mouth. It forms part of the inland waterway between Charleston and Winyah Bay, S. C., and as such is under improvement under a project providing for a channel 4 feet deep at mean low tide and 60 feet wide. The mean range of tide is about 5 feet. Four Mile Creek is a small tidal stream flowing through the swampy delta between the South and North Santee Rivers and into the latter. It is not under improvement by the United States, but local interests desire that it be used in lieu of the route following the North and South Santee Rivers and Six Mile Creek.

The district engineer, who is also the division engineer, reports that the commerce passing through Six Mile Creek in 1923 amounted to about 10,000 tons. During the same year about 420 pleasure craft used this section of the inland waterway en route between northern points and Florida. Navigation is conducted with difficulty and delay on account of the tortuous channel in Six Mile Creek and conflicting tides in it and in the South and North Santee Rivers. Four Mile Creek offers a route devoid of bad curves and 10 miles shorter. Alligator Creek enters South Santee River through a long curve. A cut about 3,000 feet long through the marsh would eliminate this objectionable feature, save about 1½ miles, and place the entrances to Alligator Creek and Four Mile Creek cut-off at directly opposite points on the South Santee.

Increased tonnage is expected to result from these improvements. The district engineer estimates that saving in distance and in freight rates would amount to about $19,165 for a 4-foot waterway, and to $24,710 if a depth of 6 feet is provided. The cost of a channel 4 feet deep at mean low water and 60 feet wide is estimated at $51,000 for Four Mile Creek and the necessary land cut and $19,210 for the rectification of the mouth of Alligator Creek. A channel of the same width 6 feet deep is estimated at $61,800 and $42,970 for Four Mile Creek and Alligator Creek, respectively. No increased maintenance cost is expected to result from rectification of Alligator Creek. The estimated cost of maintenance for the Four Mile Creek work is $1,000 annually for the first two years and $500 thereafter. The district engineer recommends that a 6-foot channel be provided subject to the conditions that local interests shall furnish, without cost to the United States, necessary rights of way and spoil-disposal areas.

The Board of Engineers for Rivers and Harbors agrees with the district engineer concerning the Four Mile Creek route except as to the depth of channel to be provided. The board considers adequate facilities would be provided by a channel 4 feet deep, at an estimated cost of $51,000. It believes that rectification of Alligator Creek is inadvisable at the present time.

The Chief of Engineers concurs in the views of the Board of Engineers for Rivers and Harbors, and states this is an essential part of the intracoastal waterway between Georgetown, S. C., and Jacksonville, Fla. The existing route, following the North Santee River, Six Mile Creek, and South Santee River, has not been found satisfactory for local or through navigation. The present and prospective use of the waterway justifies improved facilities. The principal

benefits expected can, however, be attained by a cut through the Santee delta, by the proposed Four Mile Creek route, 4 feet deep at mean low tide. This depth is the same as that provided by the existing project between Charleston and the South Santee, and with the prevailing mean tidal range of about 5 feet is believed adequate for the type of vessel ordinarily using the waterway. Under these conditions he does not consider that an increase in depth of such a cut to 6 feet would produce any large additional saving, nor does he consider justified any rectification of the eastern end of Alligator Creek, which would reduce very little the length of the through route, and might produce undesirable changes in the regimen of this tidal waterway. He reports that the improvement of Alligator Creek and Four Mile Creek, S. C., is deemed advisable to the extent of providing a channel 4 feet deep and 60 feet wide in Four Mile Creek, with a cut through the marsh to connect with the South Santee River, at an estimated cost of $51,000, with $1,000 annually for maintenance for the first two years and $500 annually thereafter, provided that local interests shall furnish, without cost to the United States, the necessary rights of way and suitable areas for the disposal of excavated material.

SHIPYARD RIVER, S. C.

Shipyard River or Creek is a tidal tributary of Cooper River, which it enters about 7 miles north of the Battery, Charleston, S. C. The United States in 1913 did a small amount of dredging at the entrance, and in 1920 and 1921 required a contractor, then dredging in Cooper River, to remove from Shipyard River certain shoals caused by material flowing in from his spoil banks on the intervening marshes. The controlling depth at mean low tide is about 10 feet. The mean range of tide is 5.2 feet. Local interests have requested a channel depth sufficient for vessels of 20 to 22 feet draft.

The district engineer, who is also the division engineer, reports that three industries are located on the river, the water-borne commerce of which amounted to 165,000 tons in 1922. Two of these, which are lumber plants, receive logs by water from nearby timber stands, and ship their product both by rail and by water. Their output in 1922 totaled 41,180,000 board feet, of which about 40 per cent moved by water. Both companies have difficulty in securing a sufficient number of vessels of a draft which can navigate the river. They estimate that annual savings in freight rates on their shipments would amount to $45,000 if larger and more economical vessels could be used. The third company now on the river operates a fertilizer plant. At present it depends upon rail transportation, but states that a deep channel would enable it to receive a large part of its 15,000 to 20,000 tons of raw materials by water, with a material saving in freight rates. Located on the lower entrance to the river are two concerns which would not benefit from and do not urge the proposed improvement. Another interest, the Gulf Refining Co., has recently started the development of an oil terminal on its property, about one-third of a mile above the mouth, and has obtained a permit from the department to dredge a channel 28 feet deep from Cooper River up to its wharf.

In the opinion of the district engineer, the probable benefits to navigation justify improvement by the United States from Cooper River to the upper lumber plant. He considers that general benefits would accrue from this improvement, since it would form practically a continuation of Charleston Harbor, and believes that a contribution by local interests of about 12 per cent of the cost of the work would be equitable. A channel depth of 18 feet at mean low water would be sufficient for the class of vessels desired by the lumber and fertilizer interests, as at high tide a draft of 20 to 22 feet could be carried thereon. He therefore recommends a channel 18 feet deep and 100 feet wide, increased at the bends and at the mouth, extending for a distance of about 1⅙ miles up to the vicinity of the Tuxbury Lumber Co.'s plant, with a turning basin at the upper end 500 feet long and 250 feet wide, at an estimated cost of $54,500, with $1,600 annually for maintenance; provided that local interests contribute $6,500 to the first cost of the work. The Government channel would connect with the 28-foot channel contemplated to be dredged at its own expense by the Gulf Refining Co. between Cooper River and its terminal.

These reports have been referred as required by law to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, agreeing with the district engineer, except in the matter of local cooperation, the requirement for which it considers should be made 50 per cent of the cost of the work. The work proposed by the Gulf Refining Co. reduces the cost of the improvement from $62,000, as originally estimated, to about $55,000. The board believes that this saving of $7,000 should be credited as local cooperation, and that other interests should contribute $24,000 to the cost of the improvement, leaving $31,000 to be provided by the United States.

The Chief of Engineers concurs in the views of the Board of Engineers for Rivers and Harbors and states that Shipyard River has already been developed to some extent, and offers favorable sites for further industrial development, convenient to the city of Charleston, as is evidenced by the proposed terminal of the Gulf Refining Co. That the existing plants have a considerable water traffic, even with the limited depth available, and that with improved facilities for navigation it seems probable that increased commerce will result as well as lower transportation costs. As, however, the immediate benefits of the work would accrue largely to a limited number of concerns, he considers that a division of the cost on a 50 per cent basis is equitable and in keeping with the Government's general policy in similar cases. The work to be done by the Gulf Refining Co. will result in a deeper channel than is needed by other interests; it will nevertheless reduce the total cost of an 18-foot project, and the saving resulting therefrom may properly be considered a local contribution, as computed by the board. He therefore reports that the further improvement of Shipyard River, S. C., by the United States is deemed advisable by the provision of a channel 18 feet deep at mean low water from deep water in Cooper River for a distance of about 1⅙ miles above the mouth, generally 100 feet wide, with increased width at bends, and with a turning basin at the upper end of the same depth and 500 feet long and 250 feet wide, following in general the lines proposed by the district engineer, at an estimated

cost of $55,000, with $1,600 annually for maintenance; provided that local interests shall dredge a suitable channel at their own expense, to a depth of at least 18 feet, from the mouth to the upper end of the Gulf Refining Co.'s wharf; and provided further that local interests shall contribute $24,000 to the first cost of the remaining work.

FERNANDINA HARBOR, FLA.

Fernandina Harbor is in the northeastern part of Florida, about 23 miles north of the entrance to Jacksonville Harbor. It consists of the lower portion of Amelia River, a tidal estuary, extending past the city of Fernandina, and its connection with the Atlantic between Amelia and Cumberland Islands. The United States has provided two jetties at the entrance, with a view to producing a controlling depth of 19 feet over the bar and has dredged channels with depths varying from 20 to 24 feet up the Amelia River to the mouth of Lanceford Creek, about 1¼ miles above Fernandina. At present there is an entrance channel with a least width of 1,000 feet and a limiting depth of 26 feet, except for a small shoal at one point with a limiting depth of 25 feet. This outer channel is not directly east across the bar but northeast near the end of the north jetty, making an angle of 43° with the channel between the jetties. It is, however, entirely practicable for navigation.

The commerce of the harbor for some years past has averaged over 400,000 tons, except during the period of the war and in 1921. The greater part of this has consisted of outbound phosphate rock. This material is mined from deposits in north central Florida and shipped to Fernandina for export or coastwise shipment. The single railroad entering Fernandina, and a concern known as the Florida Terminal Co., affiliated with the producers of the phosphate rock, have both constructed terminals at Fernandina for handling the material into vessels, with adequate railway yards and other auxiliary facilities. The latter of these two terminals is on the Amelia River a short distance above the town of Fernandina. Local interests desire a channel 26 feet deep and 400 feet wide from the sea past the city and the two terminals and up to Lanceford Creek.

The district engineer recommends a channel 26 feet deep with the following widths: 1,000 feet across the bar east of the north jetty; thence 400 feet wide to Calhoun Street, Fernandina; thence 300 feet wide to Lanceford Creek. His estimate for this work is $101,000 and $5,000 annually for maintenance. He further recommends repair of the jetties at a cost of $220,000. The division engineer considers that there is no necessity for increasing the present channel depth above the wharf of the Florida Terminal Co., and that the project width of the channel across the bar should be 400 feet. He recommends this modified project at a first cost of $54,100, and concurs with the district engineer in his recommendations and estimates for jetty repair.

The Board of Engineers for Rivers and Harbors finds that the existing depths have in the past resulted in vessels having to leave the harbor partially loaded. The recent installation of the Florida Terminal Co.'s facilities is likely to result in increased shipping, the needs of which can be met by furnishing a depth of 26 feet up to

these terminals. Dredging above these terminals to Lanceford Creek does not appear to be justified. The board therefore recommends the provision of channels as favored by the division engineer. It considers that the repair of the jetties, being a matter of maintenance of the existing project, is not within the scope of the present report.

The Chief of Engineers reports that on account of the marked success of the jetties in providing deep water at the entrance, there exists a channel from the sea to the upper phosphate terminals at Fernandina which, with a few exceptions, has a controlling depth of 26 feet. The increased convenience to commerce which would result justifies the United States in undertaking some extension of the existing depth, which can be done at a reasonable cost. In view of the favorable conditions now existing, he states that the further improvement of Fernandina Harbor, Fla., is deemed advisable by extending the existing channel depth of 26 feet at mean low tide for a width of 300 feet from a point opposite Calhoun Street, Fernandina, to the south end of the Florida Terminal Co.'s development, together with the necessary small amount of dredging to a depth of 26 feet to remove the few shoals spots mentioned in the reports; at an estimated cost of $54,000 for new work and $5,000 annually for maintenance.

MIAMI HARBOR, FLA.

Miami is situated on the east coast of Florida, near the upper end of Biscayne Bay, about 360 miles south of Jacksonville and 160 miles north and east of Key West by water. The existing project for improvement by the United States provides for an entrance channel 300 feet wide and 20 feet deep at mean low water, from the ocean to the bay, protected by jetties 1,000 feet apart, and a refuge basin 18 feet deep in the bay near the inner end of this cut. This project has not yet been completed and the present governing depth is 17 feet. The city of Miami has dredged a channel 100 feet wide and 18 feet deep from the inner end of the entrance channel to a turning basin at the municipal dock, and another channel was dredged by the Florida East Coast Railroad from the entrance channel to another part of the city. Local interests desire a channel 25 feet deep to admit ocean carriers of the type regularly engaged in traffic through the Florida Straits and along the coast to the north.

The district engineer presents a project for a channel 25 feet deep, 500 feet wide from deep water to near the outer ends of the jetties, thence 300 feet wide through the entrance, reducing to 200 feet wide across Biscayne Bay and following the route of the existing municipal channel, and the extension of the north and south jetties 1,300 feet and 600 feet, respectively, at an estimated cost of $1,605,000 for new work and $25,000 annually for maintenance, subject to the condition that local interests shall dredge and enlarge the present turning basin at the municipal dock to a depth of 25 feet. It appears that local interests have agreed to do this. The division engineer concurs in the opinion of the district engineer as to the desirability of further improvement as proposed except as regards the initial development. He considers that it would be sufficient to provide at first channels 300 feet wide from deep water through the entrance and 150 feet wide across the bay, leaving additional widths for consideration later in the light of future commercial developments. The cost of this modified project would be $1,162,000.

The Board of Engineers for Rivers and Harbors believes that the rapid development of southeastern Florida and the large present and prospective commerce in fruits, vegetables, and sugar demand increased facilities for coastwise transportation. It considers that Miami, from its geographical position and the fact that it is the commercial and financial center of the section, is the logical port to be provided with such facilities. It concurs with the district engineer as to the extent and manner of improvement, believing that the channel dimensions recommended by him are desirable to insure the safe passage of vessels over the rock bottom which will obtain.

The Chief of Engineers concurs in the views of the district engineer and the Board of Engineers.

BAYOU LA BATRE, ALA.

Bayou La Batre is a small stream entering Mississippi Sound about 10 miles west of Mobile Bay and 8 miles east of the Mississippi-Alabama State boundary line. It is not under improvement by the United States. At the mouth it is about 500 feet wide, and at the fixed county bridge, about 2½ miles above, it has a width of about 100 feet. A narrow channel with depths in excess of 5½ feet exists for about three-quarters of the distance between the bridge and the mouth. The limiting depth over the bar and in the lower 2½ miles of the bayou is about 3 feet at mean low water. The mean range of tide is 1.75 feet. During heavy north winds the water surface is lowered about 1½ feet. The desires of local interests range from a channel 6 feet deep to one 12 feet deep and 100 feet wide in the bayou and 150 feet wide over the bar.

The business of the locality consists in the handling and canning of shrimp and oysters and the manufacture of fertilizer and crushed oyster shells. It is the largest shrimp and oyster canning and shipping point in Alabama, and one of the largest on the Gulf coast. During the season of 1921–22, a period of about eight months, the commerce amounted to about 15,000 tons. Much of the product of the five canneries is now shipped by rail. It is claimed that increased channel depth will increase the business on the stream 100 per cent or more and provide a valuable harbor of refuge for small boats. Most of the sea food handled here was formerly handled at Biloxi, but it has been diverted to this point by a law forbidding the shipment out of Alabama in their raw state of shrimp and oysters taken in State waters.

The district engineer submits alternative estimates on two projects differing as to channel width. For a channel 6 feet deep and 100 feet wide from the bridge to deep water in Mississippi Sound he presents a figure of $42,626.25, with $9,000 annually for maintenance. He recommends the alternative project providing for a channel in the bayou 6 feet deep and 75 feet wide except where the existing depths are 6 feet or more for a least width of 50 feet, and a channel 6 feet deep and 100 feet wide over the bar, at an estimated cost of $20,358, with $5,000 annually for maintenance, provided local interests contribute 50 per cent of the initial cost and 50 per cent of the cost of maintenance, and provided suitable places for deposit of dredged material. This measure of cooperation appears to be satisfactory to the interested parties.

The division engineer concurs in the views of the district engineer, except as to the maintenance. He recommends assumption of the entire cost of maintenance by the Federal Government.

The board considers that the public benefits resulting from the shellfish canning industry and a harbor of refuge for small craft would be such as to warrant undertaking the improvement on the basis of local cooperation recommended by the division engineer. It therefore recommends improvement of Bayou La Batre, Ala., to the extent of providing a channel 6 feet deep and 100 feet wide across the bar, and 6 feet deep and 75 feet wide between the mouth and the fixed highway bridge except where the existing depth is 6 feet or more for a width of at least 50 feet, at an estimated cost of $20,000, with $5,000 annually for maintenance; provided that local interests shall contribute 50 per cent of the first cost of the work and furnish without cost to the United States suitable areas for the deposit of dredged material.

The Chief of Engineers, at the hearings before the committee, recommended the adoption of this project.

LOUISIANA AND TEXAS INTRACOASTAL WATERWAY FROM THE MISSISSIPPI RIVER AT OR NEAR NEW ORLEANS, LA., TO CORPUS CHRISTI, TEX.

The reports of the Chief of Engineers and the Board of Engineers for Rivers and Harbors on this project are as follows:

The Secretary of War:

1. There are forwarded herewith, for transmission to Congress, reports dated June 1, 1923, and December 5, 1923, with maps, by Col. G. M. Hoffman, Corps of Engineers, on preliminary examination and surveys, respectively, of the intracoastal waterway from the Mississippi River at or near New Orleans, La., to Corpus Christi, Tex.; Galveston and Sabine section of the inland waterway of Texas; waterway from Bayou Teche, La., to the Mermentau River; waterway from Lake Charles, La., to the Sabine River, Tex. and La., through the Calcasieu River, La., to Sabine River, Tex. and La., authorized by the river and harbor acts approved March 3, 1923, March 4, 1915, and September 22, 1922.

2. The proposed waterway would pass through southern Louisiana from the Mississippi River to the Sabine River on its western boundary and would extend into the State of Texas, generally following the coast line, to a point about two-thirds of the distance to the international boundary. Existing projects provide for a series of waterways, which would on completion give through inland navigation from the Mississippi River opposite New Orleans to Corpus Christi, except for the section between Port Arthur and Galveston Bay, for which section no canal has as yet been authorized. The limiting depth of this waterway would be 5 feet. Certain sections of the route already have improved or projected channels with depths of 25 feet or more, viz, Calcasieu River to Sabine River, 30 feet, being provided by local interests; Sabine River to Port Arthur, 30 feet; and Aransas Pass to Corpus Christi, 25 feet. The section between Galveston Bay and Matagorda Bay has been recommended for improvement to a depth of 9 feet and a width of 100 feet (H. Doc. No. 395, 67th Cong., 2d sess.), but no action has yet been taken by Congress. Proponents of a through waterway desire a channel with a depth of 9 feet and a bottom width of 100 feet, extending from the Mississippi River to Corpus Christi.

3. The existing waterway between New Orleans and Bayou Teche, although having a cross section of but 5 by 40 feet, carried in 1922 a total commerce of 171,000 tons. A considerable traffic is also carried by certain of the rivers of southern Louisiana connecting with or forming an integral part of the proposed waterway, the tonnage consisting largely of logs and sugar cane.

4. The division engineer, Gulf division, who was charged with the duty of making the preliminary examination and survey in this case, reports that a large interchange of commerce might be expected between the various Gulf ports

which would be connected by the proposed waterway and with the Mississippi River system. The completion within a comparatively few years of the 9-foot project for the Ohio River would add a large through traffic from the great industrial sections along that stream. Return cargoes of Louisiana and Texas products, such as sulphur, oil, salt, rice, and lumber, might be expected, as commodities of this nature could move at lower cost by water than by rail. While a large local traffic would undoubtedly develop, and in fact exists at present on some sections of the waterway even with inadequate depth, justification of the project would be found, in the opinion of the division engineer, in the large potential through commerce between the Mississippi Valley and points on the Gulf coast. A study of probable tonnage was made by Maj. Gen. George W. Goethals, United States Army, retired, at the instance of the Intracoastal Canal Association. His report, which is attached hereto, indicates a potential waterborne commerce of about 12,000,000 tons annually. Allowing for duplication of tonnage in his report, he states that the present possibilities of the proposed waterway are conservatively estimated at five to seven million tons annually.

5. The route proposed by the division engineer extends from the Mississippi River opposite New Orleans to the Atchafalaya River at Morgan City; thence north of West Cote Blanche and Vermilion Bays to Vermilion River; thence north of White and Grand Lakes to the Mermentau River; thence to the Calcasieu River, following the Lake Misere Canal; thence to the Sabine River at Orange, Tex., via the 30-foot Lake Charles Waterway; thence to Port Arthur by the existing Sabine-Neches Canal; thence southwest to Port Bolivar; and thence across Galveston Bay and along the coast to Gulf, Tex. This course differs in some sections from that followed by the existing projects in its avoidance of broad shallow lakes or bays where navigation has been found difficult, and maintenance cost for a 5-foot canal high and uncertain.

6. The existing waterway leaves the Mississippi River at Harvey, opposite New Orleans, where a lock is provided to take care of the difference in elevation of the river and the waterway. The present lock is inadequate for an enlarged waterway, and a new one would be required. The Plaquemine waterway offers a route from the Mississippi, 112 miles above New Orleans, to Morgan City which can be prepared for the use of traffic at small expense and with little delay, pending completion of the new lock at Harvey and the enlarged canal between that point and Morgan City.

7. The division engineer belives that at least a million tons will move over the proposed waterway, and recommends its construction under certain conditions which are in general as follows:

A channel 9 feet deep and 100 feet wide via the Plaquemine waterway to Morgan City and thence to the Vermilion River, following the route suggested, at an estimated cost of $2,220,000, with $50,000 annually for maintenance, provided adequate guaranties are given of an annual traffic of 250,000 tons, exclusive of local traffic; $110,000 covers the cost of necessary work on the Plaquemine waterway to Morgan City.

A new lock at Harvey at an estimated cost of $600,000, with $35,000 annually for maintenance and operation, when prospective tonnage reaches 250,000 tons annually. A channel from New Orleans to Morgan City via the Harvey Canal route, 7 feet deep and 75 feet wide at an estimated cost of $2,540,000, with $60,000 annually for maintenance, when an annual traffic of 400,000 tons is assured, and enlargement to 9 by 100 feet, at an estimated additional cost of $1,470,000, with $10,000 annually for maintenance, when a total traffic of 600,000 tons is assured.

A waterway with a least cross section of 9 by 100 feet, from Vermilion River to Galveston, at an estimated cost of $5,282,000 and $80,000 for maintenance, when an additional through traffic of 750,000 tons annually is assured.

A waterway from Galveston to Gulf, Tex., 9 by 100 feet, at an estimated cost of $2,231,000, with $75,000 annually for maintenance, generally in accordance with previous recommendations, but terminating at Gulf and following the modified route.

The purchase of four 20-inch pipe-line dredges at a total cost of $1,600,000.

The provision of all rights of way by local interests without cost to the United States.

The total cost of the work recommended is $15,943,000, with $310,000 annually for maintenance.

8. These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith. A very thorough investigation has been made by the board through its

resident member, who spent several weeks in the field checking the commercial possibilities of the waterway as developed by General Goethals and the division engineer. Careful consideration of all the information presented leads the board to agree with the division engineer as to the advisability of the project, and to recommend its adoption, subject to certain requirements of local cooperation.

9. This portion of the Gulf coast is rich in natural resources, and in the production of agricultural products, and consumes a considerable tonnage of manufactured products. On account of the natural topography, railroad construction is difficult and very costly, and the movement of commerce is now dependent to a large extent on waterways, of which there are many, both natural and artificial. The proposed improvement would pass through this important area, and would provide for the economical transportation of the products of its salt and sulphur mines, oil refineries, and sugar, rice, and lumber mills. It would extend the 9-foot waterways of the Mississippi and Ohio Valleys and admit of direct shipments of manufactured products from large industrial areas as far northeast as Pittsburgh, Pa., for distribution in Louisiana and Texas and northern Mexico. Adequate potential tonnage is available to justify the construction of the waterway at Government expense. To insure a reasonable return on the necessary expenditure, however, it is essential that some provision be made for the actual movement of commerce by the new route. It appears that this can best be assured by requiring that local interests shall provide adequate vessels, terminals, and auxiliary equipment to move a specified minimum tonnage on the various sections of the waterway.

10. In considering the several points which bear upon the proposed enlargement of the intracoastal waterway westward from New Orleans, I have reached the conclusion that the enlarged waterway should not terminate at Gulf, Tex., as recommended by the division engineer, Gulf division, and the Board of Engineers for Rivers and Harbors. This opinion is based on the following facts:

The first and only important port and railroad center west of Galveston is not at Gulf, but at Corpus Christi, the logical port of Aransas Pass.

Congress already has approved the project for a 25-foot channel from Aransas Pass to Corpus Christi, a distance of 21 miles, which stretch was formerly included as a portion of the intracoastal waterway between the Mississippi and the Rio Grande Rivers. This stretch of 21 miles is thus eliminated from the present proposition for the enlargement of the intracoastal waterway along the coast of Texas.

The town of Gulf, Tex., is served only by a spur of a single railroad, while Corpus Christi is already an established railroad center, having four separate railroads either terminating at or entering the port, besides being the logical point of distribution, etc., for a vast territory to the north and west of said center.

The proposed waterway between Galveston and Gulf, Tex., estimated by the division engineer to cost $2,231,000 to build, including one 20-inch pipe line dredge, will serve only one or two towns having practically a single commodity, while by extending the same waterway westward to Aransas Pass (or in reality to Corpus Christi) a far more important commercial port will be reached.

The difficulty of maintaining a channel 9 by 100 feet through the open bays between Galveston and Gulf appears to be given undue importance. From personal knowledge of the local conditions, gained during tours of duty as district engineer and as division engineer, I am satisfied that a dependable channel can be had without the large expense incident to construction along the north shore of these bays. Following substantially the lines laid down in House Document 395, Sixty-seventh Congress, second session, the waterway can be extended to Aransas Pass without increasing the total cost over that given by the Board of Engineers for Rivers and Harbors, viz, $16,000,000.

11. After due consideration of the above-mentioned reports, I concur in the opinion of the Board of Engineers for Rivers and Harbors that the great and growing importance of this section of the Gulf coast, as a producer of certain basic materials and food products and as a consumer of manufacturing products, is an indication of a potential water-borne commerce, which, if fully developed, would be adequate to justify the Government in undertaking the proposed work not only as far westward as the town of Gulf, Tex., but, for the same reasons, to Aransas Pass and Corpus Christi. I, therefore, recommend the provision of a waterway 9 feet deep at mean low water and 100 feet bottom width between New Orleans and Aransas Pass, Tex., and of the same cross section between the Mississippi and Morgan City, via Plaquemine Waterway, with such passing places, widening at bends, locks or guard locks, and railway bridges over artificial cuts, as are necessary, following in general the route proposed by the division engineer, except between Galveston and Gulf where the open bays should be used,

and with such further modifications or changes of routes as may be found desirable by the department, at an estimated cost of $16,000,000, with $300,000 annually for maintenance, including operation of locks, subject to the following conditions:

(1) That local interests shall defray the cost of constructing or remodeling all highway bridges, together with their subsequent maintenance and operation, and shall furnish, without cost to the United States, all rights of way and necessary spoil-disposal areas.

(2) That work on the New Orleans-Sabine River section shall not be commenced until the Secretary of War has received satisfactory assurances that there will be available by the date of its completion adequate vessels, terminals, and auxiliary equipment for the economical handling of at least 500,000 tons of commerce annually.

(3) That work on the Sabine River-Galveston Bay section shall not be commenced until the Secretary of War has received satisfactory assurances that there will be available, by the date of its completion, adequate vessels, terminals, and auxiliary equipment for the economical handling of at least 400,000 tons annually, and that the general carrier service required for the New Orleans-Sabine River section will be extended to terminals on Galveston Bay and at Houston.

(4) That work on the Galveston Bay-Aransas Pass section shall not be commenced until the Secretary of War has received satisfactory assurances that there will be available, by the date of its completion, adequate vessels, terminals, and auxiliary equipment for the economical handling of at least 300,000 tons annually.

12. The initial appropriation should be $4,000,000.

LANSING H. BEACH, *Chief of Engineers.*

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, D. C., March 11, 1924.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. The following is in review of the reports of the division engineer, Gulf division, on preliminary examination and survey of the intracoastal waterway from the Mississippi River at or near New Orleans, La., to Corpus Christi, Tex., Galveston and Sabine section of the inland waterway of Texas; waterway from Bayou Teche, La., to the Mermentau River; waterway from Lake Charles, La., to the Sabine River, Tex., and La., through the Calcasieu River, La., to Sabine River, Tex. and La., authorized by the river and harbor acts approved March 3, 1923, March 4, 1915, and September 22, 1922.

2. Federal projects exist for the dredging of channels from the Mississippi River at New Orleans to Bayou Teche; from Franklin on the Teche to the Mermentau River; from the Mermentau to the Calcasieu, and from the Calcasieu to the Sabine. These, when completed, would give a waterway with a governing depth of 5 feet across southern Louisiana from New Orleans to the Sabine River. An existing project also provides for a 5-foot waterway between Galveston and Aransas Pass, and 25 feet thence to Corpus Christi. The Chief of Engineers has recommended a 9-foot waterway from Galveston Bay to the 9-foot depth in Matagorda Bay (H. Doc. No. 395, 67th Cong., 2d sess.); Congress has taken no action on this document. In addition, the Federal Government has made numerous improvements of the principal rivers and bayous in southern Louisiana which intersect or coincide with the routes of the above-mentioned waterways. Local interests have constructed various canals of limited length in this section; the most important is a 30-foot channel from the Sabine River to the Calcasieu and thence north to Lake Charles, now being dredged by Calcasieu Parish. No complete project, however, exists for the proposed waterway as a whole, nor for any improvement in the stretch between Port Arthur and Galveston Bay. Consideration was given to a through project in House Document No. 640, Fifty-ninth Congress, second session, but it was at that time considered unjustified except for limited stretches in Texas and Louisiana.

3. The existing waterways carry a material commerce, notably the Harvey Canal, a section of the channel from the Mississippi River to Bayou Teche, which in 1922 had a commerce of 171,000 tons of a general character. The traffic is limited by the restricted depths and by the noncompletion of certain of the projects, which render only local commerce practicable. Certain of the improved streams in southern Louisiana, notably Bayous Terrebonne, LaFourche, and Teche and the Calcasieu River, also carry considerable traffic, of which the most important items are logs and sugar cane destined for mills.

4. The division engineer points out that the waterway, in connection with existing facilities in Lakes Borgne and Pontchartrain and Mississippi Sound, would provide a navigable inland connection between Mobile, Pascagoula, Gulfport, Biloxi, New Orleans, the Sabine ports, the Galveston Bay ports, including Houston, the small ports on Matagorda Bay or its branches, and Corpus Christi. These ports in 1922 handled a total commerce of over 44,000,000 tons, valued at nearly $2,000,000,000. With added facilities a large interchange of commerce between them might be expected. The waterway would, moreover, connect with the Mississippi River and its navigable tributaries, including the Ohio, the contemplated improvement of which to a 9-foot depth within the next few years would then result in a through channel from the great manufacturing areas of Ohio, West Virginia, and western Pennsylvania to the Louisiana and Texas coast. Under these conditions there might be expected a diversion to the water route of a considerable existing all-rail commerce of steel and other manufactured products south, with return cargoes of sulphur, oil, salt, rice, lumber, and other commodities. A large local traffic might also be anticipated, particularly in view of the tonnage now carried, even on restricted depths, in those sections of the waterway now in existence.

5. The division engineer proposes the following route: From the Mississippi River via Harvey Canal No. 1, Little Barataria Bayou, Big Barataria Bayou, a land cut south of Lake Salvador, Harvey Canal No. 2, Bayou La Fourche, the Company Canal, Bayous Terrebonne, Black, Chene, and Boeuf to the Atchafalaya at Morgan City; via the Little Wax Bayou, connecting waterways, and a land cut to Bayou Portage near the west end of the Hanson Canal, and north of West Cote Blanche Bay and Vermilion Bay to the Vermilion River; via the Vermilion, Schooner Bayou, and a land cut north of White Lake and Grand Lake to the Mermentau River; thence west and northwest, utilizing the Lake Misere Canal, Watkins Canal, Bayou Tete Bois, and Bayou Black, to the Calcasieu River; thence along the route of the 30-foot Lake Charles waterway, now under construction, to the Sabine River, and via the existing Sabine-Neches waterway to Port Arthur; thence southwest generally parallel to the Gulf coast, principally by land cut, to Port Bolivar; thence across Galveston Bay and southwest to Gulf, Tex., following in general the route recommended in House Document No. 395, Sixty-seventh Congress, second session, except that the waterway, instead of being carried through West Galveston Bay and Matagorda Bay, would, so far as practicable, be a land cut just to the north of those bays.

6. The route is in general the same as that taken by the existing partial waterways. Wherever possible, however, and notably in the vicinity of Lake Salvador, between Bayou Portage and the Mermentau River, and west of Galveston, the division engineer has avoided the broad, shallow lakes or bays, in which navigation conditions are often difficult and maintenance would be high and uncertain, preferring instead a land cut, which while higher in first cost, would give a more satisfactory and more easily maintained channel.

7. By this route there is necessary one lock at Harvey to pass from the Mississippi River to the general level of the waterway, which is at or very near to Gulf level. A lock west of the Teche is avoided by going southwest from Morgan City through Little Wax Bayou instead of up the Teche and through the Hanson Canal. Guard locks for maintenance purposes would be necessary at the crossing of the Brazos River, as recommended in House Document No. 395. The existing Harvey Canal lock would be quite inadequate for the proposed waterway, and an additional lock would be required.

8. In the opinion of the division engineer, the most important function of the waterway would be as a carrier of through commerce between the Gulf coast and the Mississippi Valley. He points out that a 9-foot channel from the Mississippi to the vicinity of Morgan City can be obtained cheaply and rapidly by limited improvements in Bayou Plaquemine. This he considers should at the beginning of the project be utilized for through traffic in deep-draft barges east of Morgan City, the more expensive channel via Bayou Black and the Company and Harvey Canals being deepened first to 7 feet and later to 9 feet, if commerce justifies it. West of Gulf, Tex., difficult maintenance conditions in Matagorda Bay, disclosed by recent borings and investigations, indicate that as in the section between Galveston and Gulf, an adequate 9-foot waterway should be a land cut north of the bay, and would furthermore probably require guard locks at the crossing of the Colorado River. In view of the resulting large expense, and the limited prospective commerce beyond Gulf, he believes that the 9-foot waterway should end at Gulf, the present 5-foot project beyond that point being adequate under present conditions.

9. A commercial survey of the route was made for the Intracoastal Canal Association, a local body interested in the project, by Maj. Gen. George W. Goethals, United States Army, retired. His report indicates a total potential waterborne commerce of over 12,000,000 tons, some of which, however, probably involves duplication, as being included under the head of both receipts and shipments. The division engineer believes that a conservative estimate of waterway traffic would be at least a million tons, which, if it could be guaranteed, would adequately recompense the Government for its outlay. He accordingly recommends the construction of a waterway as follows:

(1) A channel 9 feet deep and 100 feet wide from the Mississippi via the Plaquemine Waterway to Morgan City, thence via the Atchafalaya River, Little Wax Bayou and Bayou Blue, with necessary land cuts, to Vermilion River, at an estimated cost of $2,220,000 and $50,000 annually for maintenance; provided that adequate guarantees are given for the provision of transportation facilities and the creation of an annual traffic of 250,000 tons, excluding local and short distance traffic. Of the above estimate, the cost of improving the Plaquemine Waterway proper is $110,000 with $10,000 annually for maintenance, the remainder being for the channel from Morgan City to the Vermilion.

(2) A new lock 75 feet wide and 425 feet long between gates, with a depth of 12 feet over the sills at low water, at Harvey, La., at an estimated cost of $600,000, and $35,000 annually for maintenance and operation, as soon as there are prospects of an increase in tonnage through it to a total of 250,000 tons annually. A channel from New Orleans to Morgan City, via the Harvey Canals, 7 feet deep with a bottom width of 75 feet, at an estimated cost of $2,540,000 and $60,000 annually for maintenance, exclusive of the first cost and of the maintenance and operation costs of the new Harvey Lock, provided an annual tonnage of 400,000 tributary to this section be assured; this to be enlarged to a depth of 9 feet and bottom width of 100 feet, at an estimated additional cost of $1,470,000 and $10,000 annually for maintenane, when a total annual tonnage of 600,000 is assured.

(3) A waterway from Vermilion Bayou to Galveston, at an estimated cost of $5,282,000 and $80,000 annually for maintenance, when assurances are received that transportation facilities will become available on its completion and use made of the route to the extent of an additional 750,000 tons annually, not including local and short-distance traffic.

(4) A waterway from Galveston to the Gulf, generally in accord with the recommendations of House Document No. 395, Sixty-seventh Congress, second session, except for modifications in routing as given above, at an estimated cost of $2,231,000 and $75,000 annually for maintenance.

(5) The proposed alignment to be subject to such changes as may be deemed advisable by the department on the basis of future investigations.

(6) One 20-inch pipe-line dredge to be constructed by the United States for work east of the Vermilion River, and three similar dredges for work between the Vermilion River and Galveston, at a total cost of $1,600,000; which item is not included in the above total estimates.

(7) All rights of way to be furnished by local interests, without cost to the United States.

The total estimated cost of the project is $15,943,000, with $310,000 annually for maintenance. The division engineer recommends an initial appropriation of $4,000,000.

10. The board, before passing on the case, considered further investigation advisable as to the commercial prospects and economic value of the waterway, and directed that this be undertaken by the resident member of the board. A copy of the special report submitted by him is attached hereto.

11. The proposed waterway passes through a section of the Gulf coast which is rich in natural resources and has a considerable and growing population. Immediately west of the Mississippi it has navigable connection with six Louisiana parishes, which are among the most important sugar raising and milling areas of the United States. West of the Teche it passes three important salt mines, at Jefferson Island, Weeks Island, and Avery Island, whose potential production is almost unlimited and which at present are producing in the neighborhood of 400,000 tons per year. Farther west the route is directly through the largest single rice-producing area of the country, and along the southern edge of important stands of yellow pine, cypress, and hardwood. In the vicinity of the Sabine and Galveston Bay ports are groups of oil refineries, operating both on the production of local fields and on crude oil piped from the mid-continent fields, or imported from Mexico. These ports engage in a large foreign and

coastwise traffic in oil, including a considerable movement of crude and fuel oil from the Sabine to the Galveston Bay ports. At Sulphur, La., Freeport, Tex., and Gulf, Tex., are the only sulphur mines in the United States operating on a commercial scale. Their total output is in the neighborhood of 2,000,000 tons annually, which generally supplies the needs of the country and enters largely into export trade. The Sabine ports and the cities of Galveston, Houston, and Texas City, together with the neighboring refineries and oil fields, are consumers of steel and miscellaneous products from Pittsburgh or Birmingham; and Houston, the largest city in southeast Texas and the focus of a number of important railroads, is an important distributing center. From these facts it is evident that there is, beside strictly local traffic, the possibility of a large through movement on the waterway, consisting partly of raw materials moving east to New Orleans or to the consuming centers of the Mississippi Valley, partly of manufactured products moving west, and partly of oil, sulphur, and other commodities moving from points of production to intermediate ports along the route for export or coastwise shipment. Assuming satisfactory conditions as to equipment, rates, and channel, the estimate in the special report for the annual tonnage of a 9-foot waterway, section by section, is approximately as follows:

Between New Orleans and Morgan City, 1,600,000 tons, two-thirds eastbound.

Between Morgan City and the Sabine ports, 1,150,000 tons, about balanced.

Between the Sabine ports and Galveston Bay, 1,600,000 tons, four-fifths westbound.

Between Galveston Bay and Gulf, Tex., 700,000 tons, principally eastbound.

The special report states that this would be largely through or long-distance commerce, requiring for economy a breaking and reassembling of tows at New Orleans and to a lesser extent at Galveston. In order to carry it, there must be provided equipment, terminals, and other facilities for at least one large common carrier, comparable in magnitude with the Federal Barge Line on the Mississippi River, using equipment interchangeable with Mississippi River equipment, where practicable. There must also be provided facilities for the movement of bulk oil, particularly between the Sabine ports and Galveston Bay, and for the movement of bulk sulphur from Gulf to Galveston Bay. Given the channels and equipment, there is still the possibility of a wide variation of resulting tonnage either above or below the estimates given, depending on the modification of rail rates which may result from the waterway, and on the provision or nonprovision of satisfactory joint rates and divisions for combined rail and water movements. Suitable and equitable arrangements along this line may require some time to obtain. The experience of the Federal Barge Line indicates, however, that in time, and with persistence and adequate resources, they can be obtained. The best guaranty that they will be in the provision by local or other interests of the necessary facilities for handling prospective commerce, which are likely to involve a capital investment of some millions of dollars; an expenditure that will hardly be entered into unless the interests concerned seriously contemplate extensive use of the waterway and are prepared to make the necessary efforts to attain their end.

12. It is accordingly recommended in the special report that the construction of the waterway from New Orleans to Galveston Bay be predicated upon the provision of equipment to handle a general commerce of at least 500,000 tons per year between New Orleans and points west, including 200,000 tons to or from points in the Mississippi Valley; that that part between the Sabine ports and Galveston Bay be further predicated on the additional provision of equipment for handling 400,000 tons of petroleum products; and that for the section between Galveston and Gulf there be required equipment to handle annually at least 300,000 tons of sulphur. The special report further recommends that the section between Morgan City and New Orleans be constructed initially to the full depth of 9 feet in addition to the Plaquemine waterway improvement; that while a bottom width of 125 feet may be desirable at some future time for the section between New Orleans and Galveston, a uniform width of 100 feet be provided throughout the waterway at present; that provision be made in the project for suitable passing places; and that the Government be not responsible for the construction or operation of bridges over natural waterways on the route.

13. The board is of the opinion that the great and growing importance of this section of the Gulf coast as a producer of certain basic materials and food products and as a consumer of manufactured products is an indication of a potential water-borne commerce which, if fully developed, would be adequate to justify the Government in undertaking the proposed work. The situation is in many ways particularly favorable for the development of such a commerce.

The topography of southern Louisiana is such that railroads extending in an east and west direction through the coastal section can be constructed only at large expense. Branch lines have been built along ridges extending in a southerly direction, but much of the country's transportation needs are supplied by numerous waterways, natural and artificial. While this indicates an important local business, there are, directly on the route of the proposed waterway numerous sugar, rice, and lumber mills, salt and sulphur mines, and oil refineries, the products from all of which move to a considerable extent in interstate trade. It is from such sources, and from the through shipments of manufactured products for distribution or consumption at Texas points, that the sustaining business of the waterway is expected to come.

14. The analysis of available traffic in the attached report of the resident member of the board indicates that the Galveston-Gulf section is justified irrespective of the remainder of the waterway by the potential sulphur and oil movements. While the traffic included in the estimates pertains largely to one company, the magnitude of its production, representing a large part of the total national output of sulphur, justifies the provision of more economical transportation facilities, especially as, under the highly competitive conditions existing in the sulphur business, any saving will probably be reflected in the selling price of the product. Moreover, this part of the waterway would be available for the use of another important sulphur company, at Freeport, which, although it favors the movement of its product by ocean carriers direct from that port, has shipped considerable amounts of sulphur to Galveston in the past for export or coastwise movement. The New Orleans-Sabine River section is also justified irrespective of other sections, though its traffic would be largely increased by the continuation of the waterway farther west. The Sabine River-Galveston Bay section would be likely to carry a considerable general through commerce, but it is somewhat questionable whether this alone would compensate for the cost. To justify this section there should be added to such general commerce a heavy movement in oil.

15. The investigations of the division engineer indicate that an adequate channel beyond Gulf could be provided only at an expense not at present justified, and that between Galveston and Gulf a land route should be utilized where practicable. In view of these additional investigations, the board is constrained to modify its recommendations contained in House Document No. 395, Sixty-seventh Congress, second session, and to concur with the division engineer as regards the terminus of this western section of the waterway. The board considers that a 9-foot depth from New Orleans west is desirable at the outset, as access to that port is essential to the development of any important through commerce. The proposed width of 100 feet on the bottom is believed sufficient at the outset: Passing places may be found necessary and should be authorized. Local interests should provide for the construction or reconstruction, maintenance, and operation of all highway bridges. Modification of the details of routing should be left to the discretion of the department.

16. The board therefore recommends the provision of a waterway 9 feet deep at mean low water and 100 feet bottom width between New Orleans and Gulf, Tex., and of the same cross section between the Mississippi and Morgan City, via Plaquemine waterway, with such passing places, widening at bends, locks, or guardlocks, and railway bridges over artificial cuts as are necessary following in general the route proposed by the division engineer, with such modifications as may be found desirable by the department, at an estimated cost of $16,000,000, with $310,000 annually for maintenance, subject to the following conditions:

(1) That local interests shall defray the cost of constructing or remodeling all highway bridges, together with their subsequent maintenance and operation, and shall furnish, without cost to the United States, all rights of way and necessary spoil disposal areas.

(2) That work on the New Orleans-Sabine River section shall not be commenced until the Secretary of War has received satisfactory assurances that there will be available by the date of its completion adequate vessels, terminals, and auxiliary equipment for the economical handling of at least 500,000 tons of commerce annually, exclusive of local movements.

(3) That work on the Sabine River-Galveston Bay section shall not be commenced until the Secretary of War has received satisfactory assurances that there will be available by the date of its completion adequate vessels, terminals, and auxiliary equipment for the economical handling of at least 400,000 tons annually of petroleum products, and that the general carrier service required for the New Orleans-Sabine River section will be extended to terminals on Galveston Bay and at Houston.

(4) That work on the Galveston Bay-Gulf section shall not be commenced until the Secretary of War has received satisfactory assurances that there will be available by the date of its completion adequate vessels, terminals, and auxiliary equipment for the economical handling of at least 300,000 tons annually of sulphur.

17. In compliance with law, the board reports that except as contemplated by the above recommendations there are no questions of terminal facilities, water power, or other subjects so related to the project proposed that they may be coordinated therewith to lessen the cost and compensate the Government for expenditures made in the interests of navigation.

For the board:

H. TAYLOR,
Senior Member of the Board.

HOUSTON SHIP CHANNEL (BUFFALO BAYOU, TEX.)

Buffalo Bayou is a tributary of the San Jacinto River. It is navigable from its mouth to White Oak Bayou in the city of Houston, 23 miles. The lower 16½ miles forms part of the Houston Ship Channel, and the remaining 6½ miles from the turning basin at the head of the ship channel to the foot of Main Street, in Houston, is used for light-draft navigation, the existing project providing for a channel 8 feet deep and 40 feet wide. The present controlling depth is 5 feet at mean low tide. The improvement desired is a channel 12 feet deep and 80 feet wide and easing the bends. The district engineer deems it advisable to provide a channel 10 feet deep and 60 feet wide with eased bends at an estimated cost of $249,000, and the division engineer concurs.

The Board of Engineers for Rivers and Harbors states that more than two-thirds of the cost of the proposed work is for easing the bends, and it is not convinced of the necessity of so large an expenditure for this purpose. The board deems it advisable for the United States to undertake additional improvement to the extent of providing a channel 10 feet deep at mean low water and 60 feet wide, without easing the bends, from the turning basin at the head of the ship channel to and including a small turning basin in the mouth of White Oak Bayou, at an estimated cost of $88,000 and $15,000 annually for maintenance for the first two years and $12,000 annually thereafter, contingent upon the following cooperation:

(*a*) Furnishing free of cost to the United States all necessary rights of way and easements for construction and maintenance of the channel and for suitable dumping grounds during construction and maintenance.

(*b*) Release of the United States from all claims for damages to private or municipal property due to the improvement and its maintenance, such as undermining banks, cracking of buildings, injury to roads, walks, etc., from pipe-line overflows.

The Chief of Engineers concurs in the views of the board.

MISSISSIPPI RIVER AT NAUVOO, ILL.

The town of Nauvoo lies about 12 miles above Keokuk on the eastern bank of the Mississippi. This section of the river is part of the stretch between the mouth of the Missouri and St. Paul, for which the United States has adopted a project looking to the provision of a 6-foot channel. A power dam has been constructed across

the Mississippi at Keokuk which has provided a permanent pool extending about 50 miles upstream. The resulting increase in depth has rendered unnecessary any work of channel improvement in the stretch of river included in the pool, and has to this extent benefited navigation and resulted in economy to the Government. It has, however, to some degree increased the hazards of navigation, both on account of the increased width of the river, which permits the formation of larger waves, and on account of the flooding of woodlands on both banks of the stream. The dead and partially submerged trees, or their stumps which remain under water after the upper portions have decayed make it hazardous for navigators to approach close to the banks, as vessels on the Mississippi are accustomed to do on the approach of a storm in order to obtain shelter from the waves.

The district engineer reports that these unsafe conditions can be remedied by the provision of suitable harbors of refuge along the pool. He gives consideration to several plans, concluding that the most satisfactory would be a breakwater above the steamboat landing at Nauvoo, extending 225 feet out into the stream, thence 375 feet downstream at an angle of about 120° with the shore arm; to be constructed of a mound of rock and clay, topped with reinforced concrete boxes filled with sand or rock. His estimate for this work is $19,500, with $700 for annual maintenance. The division engineer concurs in these views and recommendations, and points out that the needs for a larger harbor, which may develop with increased navigation, can be met by an extension of the breakwater proposed by the district engineer.

The Board of Engineers for Rivers and Harbors concurs in the views of the district and division engineers.

The Chief of Engineers concurs in the views of the district and division engineers and the Board of Engineers for Rivers and Harbors, and states that the United States has benefited materially from the construction of the Keokuk Dam, which has rendered unnecessary any expenditures for the creation or maintenance of a channel over a considerable stretch of the Mississippi River. The case of Lake Pepin, on the Mississippi about 53 miles below St. Paul, is an analogous one. Here the river is from 1 to 2½ miles wide for a length of 20 miles, and strong winds produce wave conditions generally similar to those above the Keokuk Dam; and the United States has provided harbors of refuge at four points along the shores of the lake for the protection of navigation. It thus appears that the proposed work at Nauvoo has precedents on the Mississippi River and is in accordance with established policy. Moreover, the Keokuk Pool is both longer and deeper than Lake Pepin, and the danger to boats seeking shelter close to the shore is, unless some harbor be provided, much greater on account of the standing timber just below the water surface.

MISSISSIPPI RIVER AT FORT MADISON, IOWA

Fort Madison is 174 miles above the mouth of the Missouri River and 21 miles above the power dam at Keokuk. This section of the Mississippi River is included in the general project for improving the river from St. Paul to the mouth of the Missouri River, but

through the completion of the lock and dam at Keokuk, causing a pool 45 miles in length to form, improvement of the main channel here is rendered unnecessary. The greatly increased width and depth in the vicinity of Fort Madison permit the development of waves of considerable height, making navigation by river boats dangerous, besides causing damage to the city water front and, injury to small craft. The improvement desired is such as will afford safety for vessels desiring to lie in the harbor. The district engineer presents a plan of improvement which provides for a breakwater extending from shore 450 to 500 feet and the repair of an existing launch harbor, at an estimated cost of $31,000 for the former and $10,000 for the latter. He considers the locality worthy of improvement to this extent, but in view of the present small commerce he recommends that the breakwater be not constructed until the city decides to build a modern terminal, which apparently it will not do until commerce revives. The small harbor is needed now, and this should be repaired at once. To enable the entire work to be done when needed, he recommends that the existing project for the improvement of the Mississippi River from St. Paul to the mouth of the Missouri River be modified so as to include the repair of the Fort Madison launch harbor and the construction of a 450-foot breakwater, at a total estimated cost for construction of $41,000, and for maintenance $300 per year.

The division engineer, the Board of Engineers, and the Chief of Engineers concur in the recommendation.

MISSISSIPPI RIVER, FROM THE MOUTH OF THE OHIO RIVER TO ST. LOUIS

The provision in the bill authorizes a modification of the plans for the existing project which increases the width of the channel from 200 feet to 300 feet, with increased widening at the bends so as to facilitate the handling of tows. It is found that the 200-foot width which was authorized at a time when the traffic was carried in packet boats, is not suitable for navigation by the modern towboat, which, with its six barges, makes a tow 900 feet long and 150 feet wide.

The bill also provides that the project shall be prosecuted with a view to its completion in five years. The project was adopted in 1910, and is now only 34 per cent completed. The modification of the project made in the bill will not increase the cost of its completion. It is believed the work can be done at a cost considerably under this estimate if funds are furnished so that the project can be completed within five years. The length of this section of the river is 200 miles.

MISSISSIPPI RIVER, FROM ST. LOUIS TO MINNEAPOLIS

The provision in the bill authorizes the War Department to prosecute the project with a view to its completion in five years, and with a view to securing a channel 200 feet wide and 6 feet deep, with additional width in the bends of the river. The length of this section of the river is 669 miles. The existing project was adopted in 1907. Only 53 per cent of the work is completed. It is believed that if appropriations are made so that the project can be completed within five years there will be a considerable saving in the cost of completion.

MISSOURI RIVER, FROM KANSAS CITY TO THE MOUTH

The provision in the bill authorizes the War Department to prosecute the project with a view to its completion in five years, and with a view to securing a permanent navigable channel 6 feet deep and 200 feet wide, with increased width in the bends of the river. The length of this section of the river is 398 miles. The existing project was adopted in 1912, and is only about 35 per cent completed. It is believed that if funds are furnished sufficient to complete the project within five years a considerable saving can be made from this estimate.

OHIO RIVER, LOCK AND DAM CONSTRUCTION

The provision in the bill authorizes the Secretary of War to prosecute the project for lock and dam construction on this river with a view to its completion within five years.

(See statement hereafter made on section 2 of the bill for additional data regarding this project.)

TENNESSEE RIVER, FROM LOCK AND DAM NO. 2 TO FLORENCE, ALA.

This item provides for the improvement for navigation purposes of that section of the river between Lock and Dam No. 2 (the Wilson Dam) and Florence. The construction of the Wilson Dam will completely shut off navigation until Lock and Dam No. 1 is completed. The district engineer reports that if the work is authorized at this time, while his organization and plant are intact, it can be completed at an estimated cost of $1,609,000; but if the work is delayed until it is necessary to assemble new forces and new plant, the cost would be about $2,249,000, and would consume a much longer time in completing. The section of the river below Florence (256.5 miles) has been improved by the Government under a project which provides for a channel 6 feet deep and 150 feet wide, and the completion of this dam and Dams Nos. 2 and 3 heretofore authorized will extend navigation on the river over the Muscle Shoals section.

TENNESSEE RIVER AND TRIBUTARIES, N. C., TENN., ALA., AND KY.

This item authorizes the completion of a survey of the Tennessee River and its tributaries with a view to the preparation of plans for improvement for navigation and the most efficient development for water-power development. The river and harbor act approved September 22, 1922, authorized this investigation, but limited the cost to $200,000. The possibilities for water-power development on this basin are greater than on any other basin in the country. The estimated cost to complete the investigation is $315,800.

The committee held full and complete hearings on this item and it is convinced that a complete survey will result in plans that will effect a material saving to the Government in expenditures for navigation improvements, and will also reveal that there is a greater amount of potential water power available in this basin than previous investigations have shown.

GREEN BAY HARBOR AND FOX RIVER, WIS.

The following is the report of the Chief of Engineers on this project:

The Fox River has its source in Columbia County, Wis., and flows through Lake Winnebago into Green Bay, an arm of Lake Michigan. Its lower section, a stretch of about 5 miles, between the cities of De Pere and Green Bay, is known as Green Bay Harbor. Oshkosh is located on Lake Winnebago 15 miles from the point where the Lower Fox River leaves the lake, and about 47 miles above De Pere. In the reports the section between Oshkosh and the mouth is considered in two parts, that above and that below De Pere.

OSHKOSH TO DE PERE

Between the lake and De Pere the United States has provided 19 locks and 9 dams in connection with a project for a waterway 6 feet deep and 100 feet wide. A second outlet from the lake, passing the city of Neenah, has been provided with a narrow channel 6 feet deep and about 1 mile long. The lake below Oshkosh has natural depths in excess of the requirements of navigation. A channel 7 feet deep down to De Pere is desired by local interests, who claim that the present depth does not admit of carrying full barge loads.

The district engineer considers that some further improvement is justified by the increasing commerce, which amounted in 1921 to 205,000 tons, largely coal. Existing difficulties of navigation appear to be caused principally by insufficient depth over ledge areas at various points. Bowlders deposited on the ledge bottom during high water further reduced the available depth and make navigation hazardous. The district engineer believes that a project depth of 7 feet throughout would be unduly expensive, as reconstruction of the locks would be necessary, the present depth over the sills being 6 feet. He recommends modification of the existing project to the extent of providing channels 7 feet deep at low water and 100 feet wide, widened at bends, over the ledge sections at Kaukauna, Combined Locks, Little Chute, Drunkards Point, Appleton, and Grignon Rapids. The ledge area below the De Pere Lock he would deepen to 9.6 feet to provide a navigable channel at low lake level during southerly gales, which greatly reduces the elevation of the water surface in Green Bay Harbor. He also recommends widening the Neenah Channel to 100 feet and providing a concrete retaining wall at Kaukauna to prevent a possible breach at that point. Deepening the ledge section above the Menasha Lock is not, in his opinion, advisable at present, as the cost would be great and the existing commerce is only about one-fourth that of the Fox River below this point. The work recommended is estimated to cost $294,300, with no material addition to present maintenance charges. The division engineer concurs with the district engineer.

GREEN BAY HARBOR

In Green Bay Harbor the United States has provided an inner channel between the cities of Green Bay and De Pere, 15 feet deep and 150 feet wide, with a turning basin at the upper end. Local interests desire an increase in channel depth to 18 feet and an enlarged turning basin of the same depth, to admit of lake carriers proceeding directly to De Pere, where cargoes of coal could be transshipped to barges destined for Fox River points at a saving estimated by interested parties at not less than $75,000 annually. They also claim that such a channel would invite industrial development along the shores of Green Bay Harbor, adding materially to the commerce.

The district engineer states that most of the coal now handled on the lower Fox River is transshipped at the city of Green Bay from lake carriers of 6,000 to 10,000 tons to river barges. Removal of this transshipping point to De Pere would reduce the length of necessary barge movement by about 10 miles for each round trip. Enlarged coal-handling facilities have recently been provided at De Pere, which, with additional developments proposed, would admit of handling a total of 300,000 tons annually. The district engineer recommends the improvement desired, at an estimated cost of $110,000, provided the city of De Pere will pay for all dredging within the city limits, estimated to cost $50,000. Local representatives have agreed to this provision. The division engineer considers the proposed improvement advisable, with the local cooperation proposed, but suggests the further condition that local interests shall be required to provide, without cost to the United States, suitable spoil areas on the banks for the disposition of excavated material.

These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, agreeing with the district and division engineers.

After due consideration of the above-mentioned reports, I concur in the views of the district and division engineers and the Board of Engineers for Rivers and Harbors. The cost of coal distribution is important to the numerous industries and communities along the Fox River; any economy effected is of benefit to these industries and to the communities and public which they serve. Movement of coal is in general more economical by lake carriers than by barges. At comparatively moderate cost provision can be made for the passage of deep-draft vessels 5 miles farther up the harbor, admitting of transshipment at De Pere instead of at the city of Green Bay. Facilities for such movement are particularly desirable, as the waterfront of the city of Green Bay is restricted, and opportunity for further economical development is limited. Transshipping facilities are being provided at De Pere by local interests, who also offer a large measure of cooperation in the first cost of the work. Further economy is possible for existing and prospective barge movements on the river by providing greater depth over the dangerous ledge areas specified by the district engineer. The retaining wall recommended at Kaukauna appears desirable to protect the canal bank from possible washout. Increased width in Neenah Channel will greatly ameliorate navigation conditions. I, therefore, report that the improvement of Green Bay Harbor and Fox River, Wis., from Oshkosh to its mouth is deemed advisable to the extent of providing a channel 18 feet deep and 150 feet wide between the cities of Green Bay and De Pere, with a turning basin for 500-foot vessels at the upper end; a channel 9.6 feet deep and 100 feet wide through the ledge section below the De Pere Lock; channels 7 feet deep and 100 feet wide, with necessary widening at the bends, through the ledge sections at Kaukauna, Combined Locks, Little Chute, Drunkards Point, Appleton, and Grignon Rapids; widening the Neenah Channel to 100 feet with depth of 6 feet; and providing a concrete retaining wall at Kaukauna, at a total estimated cost of $404,300, with $16,000 annually for maintenance ($3,000 greater than estimated annual maintenance of existing project); provided that the city of De Pere shall pay for all dredging within the city limits, estimated to cost $50,000, and provided further that local interests shall provide suitable places for the deposit of excavated material on the shores of Green Bay Harbor.

MUSKEGON HARBOR, MICH.

Muskegon Harbor, on the east shore of Lake Michigan, has been improved by the Federal Government to the extent of providing two parallel piers projecting into the lake, and a channel 300 feet by 20 feet between them and into Muskegon Lake, a landlocked body of water which forms the water front of the city. Local interests state that the existing entrance is dangerous and the depth inadequate. They desire increased channel depth and protection by breakwaters.

The district engineer reports that the wishes of local interests can be met by the construction of arrowhead breakwaters, the removal of the outer ends of the present piers, and the dredging of a basin and channel to depths varying from 24 to 21 feet, at a cost of $1,144,000, with $25,000 annually for maintenance. He considers that local interests should contribute one-fourth the first cost, or $286,000. In view of their refusal to do this and of the uncertainty of benefits resulting commensurate with the expenditure, he recommends that no change be made in the existing project.

The Board of Engineers for Rivers and Harbors states that the commerce of Muskegon has of recent years increased more rapidly than that of any of its important competitors on the eastern shore of Lake Michigan. If car-ferry service be excluded from the comparison, it stood first among these ports in 1921 in water-borne traffic. Its total tonnage has heretofore been low compared to several neigh-

boring ports on account of the absence of car-ferry service. Such service is about to be established between Muskegon and Milwaukee; terminals have been arranged for and negotiations completed with the Pennsylvania and the Chicago, Milwaukee & St. Paul Railroads for their use of the ferry. When the ferry is in operation it will assist in relieving the freight congestion in Milwaukee and in Chicago. Muskegon is a very favorable terminal for a car ferry on account of its superior trunk-line connections.

The board states further that Muskegon is becoming a manufacturing center of considerable importance. There is a likelihood that, in addition to the commerce produced by these, there will be an extensive business developed by the establishment of a blast furnace, which it is claimed will bring in large quantities of raw material by water in boats drawing up to 22 feet. Such boats could not utilize full draft in the present channel. Moreover, Muskegon is already the distributing center for gasoline for a considerable part of Michigan. This is brought in by tank steamers, which are restricted to partial loads by existing conditions. The board considers that the above commercial developments, present and prospective, justify a change in the project. Better protection of the entrance is demanded by all of them; and increased depth, while not needed for the car-ferry service, is required for the tankers and other large vessels. The general benefits to be derived from the improvement are believed to be sufficient to justify the United States in bearing the entire cost. The board, therefore, recommends the improvement of the harbor according to the plans and estimates submitted by the district engineer.

The Chief of Engineers concurs in the recommendation of the board.

FRANKFORT HARBOR, MICH.

Frankfort Harbor lies on the east shore of Lake Michigan about opposite Sturgeon Bay. The harbor proper consists of a small land-locked body of water known as Lake Betsie. The United States has provided a channel 200 feet wide and 18 feet deep from that depth in Lake Michigan to Lake Betsie, a distance of about 2,000 feet, together with parallel piers 200 feet apart, and revetments along the land cut. The harbor is a terminus of the Ann Arbor Railroad, which operates a car ferry connecting with ports on the western side of the lake. Local interests desire the removal of the outer ends of the existing piers, construction of an arrowhead breakwater, and an increase in depth to 20 feet at the entrance.

The district engineer reports that the car-ferry movement, which continues throughout the year, is exposed to serious hazard by the present narrow channel. Not only is it difficult in rough weather for vessels to make the entrance, but since the parallel piers are not effective in reducing wave action the water between them is frequently very rough and navigation is difficult until the inner harbor is reached. In recent years both jetties have been damaged by vessels striking them, and a car ferry has been sunk by such a collision. He points out that the 1922 commerce of the harbor amounted to 1,364,000 tons, which placed it seventh in importance among the harbors of Lake Michigan, and that all those having greater com-

merce have more effective protection at the entrance than parallel piers. He submits two alternative proposals for improvement. The first contemplates the construction of an arrowhead breakwater at the entrance, inclosing a basin of about 70 acres; removal of the outer 813 feet of the present south pier and repair of the remainder; removal of the entire north pier and revetment, widening of the channel to 300 feet, and construction of a new north revetment 1,200 feet long; and dredging to 21 feet for a width of 600 feet in the basin and to 19 feet in the channel between the piers; at an estimated cost of $1,200,000 with $18,000 annually for maintenance.

His alternative proposal is similar to the above, except that he would not widen the channel nor remove the present north revetment, would remove a portion of the present north pier and repair the remainder, and would dredge to depths of 20 and 18 feet, respectively; the estimated cost of this plan is $980,000, with $15,000 for annual maintenance. Under the latter plan he proposes that if a wider channel be desired the necessary work should be undertaken by local interests. He feels that this should be the extent of their contribution, and that they should be permitted but not required to undertake it. He considers preferable the more extensive plan. The division engineer concurs generally in these views, but recommends the adoption of the lesser project, with minor modifications regarding the dredged area within the breakwaters and the siting of the south breakwater. He believes that if widening of the inner channel is found necessary it could be done by local interests under a permit from the Secretary of War, that it is not an essential part of the present improvement, and that it should not be considered in connection therewith. His estimate for the work is $954,000.

The Board of Engineers for Rivers and Harbors concurs with the division engineer, except that it prefers the siting of the south breakwater recommended by the district engineer. The estimate of cost for the solution it recommends is $987,000.

The Chief of Engineers concurs in the views of the Board of Engineers for Rivers and Harbors, and states that the modification of the present project for Frankfort Harbor was considered in 1916 and reported on in House Document No. 1089, Sixty-fourth Congress, first session. That document contained a recommendation for work substantially the same as that now proposed, contingent upon cooperation by local interests to the extent of 50 per cent of the first cost. At the time of the report the annual commerce was about 700,000 tons. Since then it has approximately doubled. It is almost exclusively car ferry, which on Lake Michigan is a character of commerce of great general importance, serving as it does to link up the important railroad lines of the East and West and to avoid the necessity of routing freight through Chicago, where it is subject to long and expensive delays due to the congestion of rail facilities. The ferry service at Frankfort is controlled and operated by the Ann Arbor Railroad. This railroad, however, connects with the large eastern trunk lines, and its ferries serve four ports on the western shore of the lake, a more general service than that given by the ferries from any other of the eastern Lake Michigan ports. Under these conditions he believes it to be incumbent on the Government to provide safe and adequate navigation conditions at Frankfort. Such conditions unquestionably do not at present exist. The entrance is exposed

to severe storms, particularly to the southwest, and the narrow channel is hazardous to vessels and has already been the cause of serious accidents. The plan proposed by the district engineer is in general satisfactory, and is an improvement over that recommended in House Document No. 1089, Sixty-fourth Congress, first session, in that it effects a considerable economy by placing the outer ends of the breakwaters somewhat closer to the shore. With provision of these breakwaters and of an adequate deep-water basin within them, enlarged to the northward as proposed by the division engineer, wave effects within the entrance should be reduced to the point of safety. Widening of the inner channel is therefore considered unnecessary. If desired by local interests, it can be undertaken by them without congressional authority. The depths of 18 and 20 feet proposed by the district engineer in his alternative solution correspond with those provided at other lake ports of the same general class and are believed sufficient under present conditions.

GREAT SODUS BAY HARBOR, N. Y.

Great Sodus Bay, on Lake Ontario, about 31 miles east of Charlotte Harbor, has been improved by the United States by the provision of parallel piers extending into the lake at the entrance and by a channel between them 150 feet wide and 15½ feet deep, with increasing width at the lake end. Within the bay natural depths of more than 18 feet exist over a considerable area. The Pennsylvania Railroad owns and operates a coal trestle on the bay west of the entrance, available on equal terms to all carriers, and also a small commercial wharf. Request is made that the entrance channel be increased to a depth of 20 feet and width of 300 feet, and be resited so as to have its axis parallel to the pier, and that more adequate aids to navigation be provided.

The principal importance of Great Sodus Bay is as a shipping point for bituminous coal. Its commerce in 1922 was 119,000 tons, and in the past years has been as much as 191,000 tons. Its only important competitor on Lake Ontario in this traffic is Charlotte Harbor. The coal for Great Sodus Bay comes over the Pennsylvania Railroad, principally from West Virginia points; at Charlotte Harbor it is received from Pennsylvania coal fields over the Buffalo, Rochester & Pittsburgh Railroad. Both ports are served by lake carriers whose charges in general appear to be about equal; in addition Charlotte Harbor handles a considerable car-ferry traffic. Rail rates on coal at Great Sodus Bay are somewhat in excess of those at Charlotte Harbor; despite this fact the Great Sodus Bay coal is enabled to compete with the Charlotte Harbor coal, largely, it is alleged, on account of the superior steaming qualities of the former.

The district engineer states that the coal carriers in this trade have a maximum draft of about 18 feet and can be accommodated at the more important lake ports where they deliver their cargoes, but that due to limited depth at Great Sodus Bay they are unable to load to full draft. He considers that satisfactory navigation conditions at Great Sodus Bay could be provided by a channel with a depth of 19 feet under ordinary conditions. Since during the navigation season the level of the lake is usually a foot above low water, a depth of 18 feet at low water would be sufficient. He

believes that the present project width of the channel is sufficient, since on account of its short length there should not be any occasion for vessels to pass each other between the piers. He discusses the possibility of extending the piers to provide more effectively for maintenance of the channel, but finds that this would be quite expensive, and from experience at other lake harbors he feels that it would be unnecessary. The present direction of the channel is probably the most economical that could be provided, and should prove satisfactory with adequate aids to navigation. He accordingly recommends a channel 18 feet deep at low-water datum and 150 feet wide, at an estimated cost of $82,000, with $12,500 annually for maintenance. He believes, however, that local interests should meet one-half the first cost of such work, and should be required to provide, at their own expense, an 18-foot channel from deep water inside the bay to the coal terminal; and moreover, that the project should be adopted provisionally for a period of three years, with the understanding that if at the end of that time conditions as to commerce or maintenance costs are unsatisfactory the increased project should be discontinued and the present project for 15½ feet resumed.

The division engineer concurs in these views, except that he believes it possible to reduce the cost of new work to $51,300 by the use of a new dredge recently acquired by the Government, and that in view of this reduced cost and of the importance of Great Sodus Bay as a harbor of refuge the United States should assume the entire first cost of work in the channel entrance. He considers, moreover, that the experimental period should be extended to five years.

The Board of Engineers for Rivers and Harbors agrees with the division engineer except in regard to the experimental feature of the project. It considers this unnecessary and inadvisable, and recommends that the project be adopted in the usual manner.

The Chief of Engineers concurs in the views of the Board of Engineers for Rivers and Harbors, and states that the shipment of soft coal on Lake Ontario is a matter of considerable national importance, and, due to the location of the coal fields and connecting railroads, it is at present practically restricted to the two ports of Charlotte Harbor and Great Sodus Bay. These ports are served by different railroads. To render efficient service to the lake carriers which compete for the traffic, it is proper that they should be more on a parity as regards depth of channel. The project depth of 15½ feet obtaining at Great Sodus Bay was adopted many years ago and is no longer appropriate to the more economical type of vessel operating on Lake Ontario. The first cost of the work is small, and the estimated maintenance cost only $4,500 in excess of the sum estimated as required to maintain the present project. The requirement that local interests should provide an 18-foot channel within the bay to the coal trestle is considered an adequate measure of local cooperation, and will involve on their part an expenditure almost equal to that of the Government, as well as the necessary continuing expenditures for maintenance of this inner channel. The economic value of the work is sufficient to justify its adoption without the qualification of a limited experimental period. He therefore reports that the modification of the existing project for the improvement of Great Sodus Bay Harbor, N. Y., is deemed advisable to the extent of providing an entrance channel 18 feet deep at low-water datum and 150 feet

wide, at an estimated cost of $51,300, with $12,500 annually for maintenance, provided that local interests shall dredge and maintain at their own expense a satisfactory channel of equal depth from deep water within the bay to the coal terminal.

BLACK ROCK CHANNEL AND TONAWANDA HARBOR, N. Y.

A channel 21 feet deep and from 200 to 500 feet wide has been provided by the United States from Buffalo Harbor, through Black Rock Canal and the Niagara River to a turning basin of the same depth at North Tonawanda. Tonawanda inner harbor has a channel 16 feet deep and generally 400 feet wide, and Tonawanda Creek a channel 16 feet deep, generally 180 feet wide and about 1,250 feet long. Local interests desire that Black Rock Canal just south of the International Bridge be widened; that the bulkhead on the west side of the canal be extended south along Squaw Island to provide mooring facilities for vessels, and that the westerly end of Rattlesnake Island Shoal in the Niagara River be removed. Other improvements were requested, which were either permissible as items of maintenance of the existing project, or were subsequently considered undesirable and the requests withdrawn.

3. The commerce moving through Black Rock Channel is very large, amounting in 1922 to 2,420,000 tons. The greater part of this business was, however, handled in comparatively light-draft vessels. The limiting width of the canal, 200 feet, is such that the district engineer states large craft do not attempt to pass within it. Light-draft tugs and barges pass without difficulty on account of the greater width of channel available for such craft, and when necessary moor along the towpath. For the safety of large vessels, signals are operated which preclude the possibility of their meeting within the restricted channel. The district engineer considers that mooring of large vessels in the canal is undesirable until a wider channel is provided throughout its length, which the limited deep-draft traffic does not warrant at present. He states, however, that some difficulty is experienced by the larger ships in making the turn south of the International Bridge, and proposes easing this turn by removing a maximum of 100 feet from the point opposite Forest Avenue, at an estimated cost of $63,250. In Niagara River, north of Black Rock Lock, the channel width is badly restricted by the encroachment of the westerly end of Rattlesnake Island Shoal. The cost of removing this shoal to provide a channel width of 500 feet is estimated at $12,100. The district engineer recommends undertaking these two items of work at a total estimated cost of $75,350 with $500 annually for maintenance. The division engineer concurs.

The Chief of Engineers concurs in the views of the district and division engineers and the Board of Engineers for Rivers and Harbors. The large commerce passing through this section of the Niagara River, involving in 1922 a total of 9,384 vessel movements, justifies such further improvement as will assure reasonably safe navigation conditions. As the greater number of the craft engaged in this traffic are of light draft, there appears to be no present need for a general widening of the Black Rock Canal. Navigation will apparently be adequately served by increased width at the two points

proposed. The work requested, which are items of maintenance of the existing projects, have already been undertaken in so far as the resulting benefits appear to be commensurate with current costs. He therefore reports that the further improvement of Black Rock Channel and Tonawanda Harbor is deemed advisable to the extent of providing for the widening of Black Rock Canal immediately south of the International Bridge and for the removal of the westerly end of the Rattlesnake Island Shoal, as proposed by the district engineer, at an estimated cost of $75,000, with $500 annually for maintenance.

LOS ANGELES AND LONG BEACH HARBORS, CALIF.

The report of the Chief of Engineers on this project is as follows:

1. There are submitted herewith, for transmission to Congress, reports dated April 23, 1923, and April 15, 1924, by Maj. E. D. Ardery, Corps of Engineers, on preliminary examination and survey, respectively, of Los Angeles and Long Beach Harbors, Calif., authorized by the river and harbor act approved September 22, 1922.

2. Los Angeles Harbor, the name by which the locality is generally known, is on the coast of California, about 96 miles northwest of San Diego and 410 miles southeast of San Francisco. It has been provided by the United States with a breakwater about 11,000 feet long, a main entrance channel 30 feet deep at mean lower low water, terminating in a turning basin within the harbor; channels 20 feet deep extending from the turning basin into the East and West Basins, a channel 30 feet deep from the turning basin to the westerly side of the West Basin, and a channel 20 feet deep extending through East Basin to the Long Beach-Los Angeles city line in Cerritos Channel. In addition, the Los Angeles River, which formerly deposited its large burden of silt in the harbor, has been diverted. Local interests have given considerable cooperation in the harbor improvement and in the river diversion works.

3. The commerce of the port has increased greatly during the past few years, owing principally to extensive oil-field developments. In 1923 it amounted to 26,550,000 tons, an increase of over 23,000,000 tons since 1919. This has resulted in great congestion in the harbor. Local interests request additional improvements as follows:

(*a*) A depth of 37 feet in the entrance channel.

(*b*) Additional dredging to 30 feet in West Basin, in connection with work now being undertaken there by the city.

(*c*) A depth of 32 feet through Cerritos Channel.

(*d*) Reclamation of an area known as Reservation Point on the east side of the inner harbor entrance.

(*e*) Additional dredging in the southwest section of the outer harbor.

(*f*) Extension of the existing breakwater from its present eastern end, to the northeast and north, connecting with the mainland just west of the mouth of the silt diversion channel in Long Beach, with suitable openings, thus inclosing an area of open sea to the south of the main entrance and of Terminal Island.

4. The district engineer discusses each proposal in detail, and reaches the conclusion that further improvement of the harbor is justified, generally following the lines suggested.

He considers, however, that a depth of 35 feet in the entrance channel will adequately serve the needs of navigation, particularly in view of the mean tidal range of slightly more than 5 feet. The present width of this channel, 550 feet, he thinks inadequate, as vessels now moor at wharves which have been built along the westerly side. He would provide for enlargement at this point by giving the channel a width of 1,000 feet when such action can be taken without danger of extending the effect of surge to the inner harbor. He states that this widening may not be immediately necessary, and the proposed dredging in the southwest section of the outer harbor will not be required until the port authorities have undertaken certain terminal developments on the adjacent shore; nevertheless he thinks they should now be authorized.

5. Extension of the breakwater is considered desirable as a means of protection for terminals planned to be developed on the south side of Terminal Island, and to provide for safe intraport vessel movements, when Cerritos Channel shall

have been closed by a solid fill approach to Terminal Island. The construction of piers in the outer harbor is part of a plan prepared by local interests for comprehensive port development. It is claimed that the inner harbor will be fully developed by the time a breakwater could be completed, as about eight years would be required for its construction. By that time, with the continued growth of commerce which is expected, Terminal Island would offer the only remaining economical point for deep-water terminals. The district engineer believes that the local benefits which would result from the reclamation of land on Terminal Island, under protection of the breakwater, make it proper for local interests to bear a large part of the cost of breakwater construction. Several sites have been suggested for the breakwater, of which the district engineer thinks the outer one the most desirable as providing a larger anchorage area for naval and merchant vessels. The costs of construction at an inner harbor and an outer site, for which he has made estimates, are respectively $14,000,000 and $18,200,000. In recommending the larger structure, the district engineer considers that the United States should pay only the difference in the costs of the two, which is about $4,000,000, basing his contention on the national interest involved in the increased anchorage which the more extensive one would make available. He thinks that local interests should meet the balance of the cost, viz, $14,200,000, unless future developments justify a change of attitude. His estimates for the works proposed are as follows:

Main entrance channel, 35 feet deep	$1, 076, 000
Widening main entrance channel to 1,000 feet	975, 000
Dredging channel 100 feet wide and 30 feet deep in West Basin	296, 000
Cerritos Channel, 32 feet deep and 300 feet wide	326, 000
Reclamation of Reservation Point	250, 000
Dredging area of about 60 acres in outer harbor to a depth of 35 feet	254, 000
Breakwater, with slopes of 1 on 2 on the outside and 1 on 1½ on the inside	18, 200, 000
Total	21, 377, 000

In addition to their share in the breakwater costs, local interests should create a unified port administration and belt-line railroad, dredge the remainder of Cerritos Channel, reserve a section of the water front thereon to permit of an eventual solid fill connecting with Terminal Island, and make the necessary exchanges of land at Reservation Point. Under these conditions the United States, out of the above total of $21,377,000, would now bind itself to the expenditure of $7,177,000.

6. The division engineer concurs with the district engineer, except in recommending that the Government should fix definitely and finally the figure of $4,000,000 as its share of the breakwater work.

7. These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith. The board discusses at some length the development and commerce of Los Angeles Harbor and its relation to the breakwater proposal. It reaches the conclusion that a breakwater is desirable; that the inner and less expensive site, requiring an expenditure of $14,000,000, is satisfactory; and that the benefits resulting to the locality justify a 50 per cent contribution for this item. It agrees with the recommendations and estimates of the district engineer for the other work, except that it prefers to report the possibility of reclamation at Terminal Island without recommendation, believing it to be outside the province of channel improvement proper. It proposes that the locality take the following cooperative action:

(*a*) Cede to the United States, in lieu of that portion of the military reservation at Reservation Point which will be required for widening the main entrance channel, an equivalent area to the east, adjoining the present Federal holdings.

(*b*) Dredge, at its own expense, a portion 200 feet in width of the proposed 30-foot channel along the easterly, northerly, and part of the westerly sides of west basin.

(*c*) Obtain title to the water front on both sides of Cerritos Channel for a length of 1,500 feet at such location as may be approved by the Secretary of War and reserve it from development, to the end that this section of the channel may be filled and used as an approach to Terminal Island; agree to make, or meet the cost of, such fill when called on to do so by the Secretary of War; and hold and save the United States from loss arising out of any claims for damage which may be filed as a result of the closure of said channel.

(*d*) Contribute one-half the first cost of the breakwater, which is now estimated at $14,000,000; funds being made available annually in amounts equal to Federal appropriations for the breakwater.

(*e*) Organize a port district or equivalent organization embracing the cities of Los Angeles and Long Beach and such other communities as may be found desirable, with full jurisdiction over the development and operation of the ports and port facilities within these communities; which organization shall prepare final plans, subject to the approval of the Chief of Engineers and the Secretary of War, for the ultimate development of the port, and shall put them into effect as the need arises.

(*f*) Create a publicly owned or controlled belt-line railroad, or the equivalent, serving uniformly and without discrimination all railroads entering the port and all terminals of the port; the plan adopted to be subject to the approval of the Chief of Engineers and the Secretary of War.

(*g*) Make provision satisfactory to the Chief of Engineers and the Secretary of War, before any Federal funds are expended on the breakwater, for terminal construction in the outer harbor east of the main entrance channel, having a transshipment capacity of at least 1,000,000 tons per year of general cargo.

8. After due consideration of the above-mentioned reports, I concur in general in the views of the Board of Engineers for Rivers and Harbors.

9. The tremendous growth of the commerce of Los Angeles Harbor, reaching in 1923 the extraordinary figure of over 26,000,000 tons, is too well known to require amplification. Taken in connection with the exceptionally large proportion of deep-draft vessels calling at the port, it is ample warrant for the dredging in the main channel, Cerritos Channel, west basin, and the southwest section of the outer harbor, advocated by the district engineer, and which I consider necessary to meet existing conditions.

10. The breakwater proposal, on the other hand, looks not to the present but to the future in which the port's business would be not only larger but of a quite different character. Los Angeles and Long Beach, in spite of their great tonnage, do not as yet constitute a truly national port. The bulk of the traffic is either oil from the intensively developed adjacent fields, or building materials required by the growth of the neighboring communities, which growth is principally due to a heavy influx of population in recent years from all parts of the country. These conditions will not obtain indefinitely. Moreover, the present basic commodities of oil and lumber, especially the former, may be moved in large quantities over a very limited water front. So long as the character of the port remains what it is, there should be no serious difficulty in handling its traffic in the present inner harbor. Local interests, however, now propose to enter the field of general transshipment business. The volume of general commerce predicted by their engineers requires a yearly average increase of a million tons—that is, an increase each year equal to approximately the total of the present general commerce, a figure too large to be obtained from the limited area of southern California, which constitutes the port's present hinterland. Its realization would require that Los Angeles and Long Beach become the gateway of much of the southwestern United States. Given sufficient effort, and proper cooperation among all concerned, this end can be attained. If it is attained, a radical change in the layout of the harbor is necessary. The most compact, economical, and satisfactory plan is that providing for development of the outer harbor, behind the shelter of a breakwater. In House Document No. 1013, Sixty-sixth Congress, third session, dated 1921, I recommended against such a structure. Developments in the past three years have, however, been so great that the conditions upon which that report was based have completely changed, and the present situation leads me to the belief that with suitable Federal encouragement the communities concerned will bend their efforts toward extending the area of the United States tributary to their port, and making the latter an important factor in the country's general commerce. In view of the national interests involved in this course, I now consider justified the construction of a breakwater as proposed by the board. The board further regards the direct advantages which will result to the locality such that it should meet half the first cost.

11. If Congress adopts this project it is on the understanding that local interests will carry out their harbor developments efficiently and with broad vision, and will avoid any such commerce-hampering measures as the conversion to industrial use of any of the limited area now available or capable of reclamation for harbor development. This point has been ably elaborated by the board in paragraphs 25 to 27, inclusive, of its report. I concur in these views, and urge that they be carefully considered by all interested parties.

12. I therefore report that modification of the existing project for the improvement of Los Angeles Harbor is deemed advisable to provide for the dredging to a depth of 35 feet at mean lower low water of the main channel, from that depth at the entrance up to and including the turning basin; for widening the entrance of this channel to 1,000 feet, with a depth of 35 feet; for dredging to 35 feet an irregular area of 60 acres, more or less, in the southwest corner of the outer harbor; for providing a channel 30 feet deep and 300 feet wide, along the easterly, northerly, and a portion of the westerly sides of west basin; and for dredging to a depth of 32 feet a channel 300 feet wide, from the turning basin to the Los Angeles-Long Beach Line in Cerritos Channel; all on the general lines proposed by the district engineer, and for extension of the breakwater to Long Beach, as proposed by the Board of Engineers for Rivers and Harbors. As items of cooperation, local interests should meet the conditions proposed by the board and summarized in paragraph 7 above. Moreover, full compliance with the requirements (*e*), (*f*), and (*g*) should be a condition precedent to the undertaking of any breakwater construction by the Federal Government. The total estimated cost of the project is $17,000,000, of which the United States will be required to furnish $10,000,000 with nominal maintenance. The initial appropriation should be $2,000,000. It is further recommended that if local interests give satisfactory assurances that they will assume the increased cost, estimated at $4,200,000, the breakwater be built on the site recommended by the district engineer rather than on that proposed by the board.

13. Although not strictly a harbor development matter, reclamation of land at Reservation Point is regarded as an incidental feature so intimately connected therewith that it can not be omitted. Some place upon the water front is necessary to accommodate the engineer dredges when in port, other craft connected with the improvement or supervision of this harbor and others in the district, and for the economical storage of Government property. The tract will be available for other Government activities or agencies. It can be reclaimed as an incident to dredging more economically than by any other method, and the $250,000 spent for the purpose is probably much less than it would cost for the United States to acquire any other area less advantageously located. It is therefore recommended that the sum of $250,000 be provided for this purpose and that the Secretary of War be authorized to permit other branches or departments of the Government to use such portion or portions of the area as may not be needed by the War Department upon repayment of the proper proportional cost.

LANSING H. BEACH,
Chief of Engineers.

SAN DIEGO HARBOR, CALIF.

San Diego Harbor, Calif., 12 miles from the Mexican boundary, has been provided by the Federal Government with a channel 35 feet deep at mean lower low water from the entrance to points within the harbor, and an approach 32 feet deep to Municipal Pier No. 1. The range between mean lower low water and mean higher high water is 5.4 feet. The reports printed in House Document No. 1000, Sixty-sixth Congress, third session, recommended dredging areas D and E, and by the action of Congress these areas are now part of the existing project. The removal of about one-third of area F as an approach to the new Municipal Pier No. 2 was also favorably reported by the Chief of Engineers, but was not authorized by Congress.

For the past six years the commerce of San Diego has averaged about 630,000 tons. Decreased receipts of fuel oil and coal in 1922 caused a decline in tonnage to 445,000 tons. Some business may have been diverted on account of inadequate terminal and warehousing facilities, the existing equipment being used to its full capacity. When the large municipal pier of modern type now under construction is completed, probably in 1924, facilities will be available for handling a greatly increased commerce. Active steps are already

being taken to arrange for shipments of cotton, grain, copper, fruit, etc., from the Imperial Valley, Southern California, and more eastern points through the port of San Diego.

The district engineer calls attention to the necessity of dredging outside the pierhead line to admit of vessels reaching the north face and part of the end of the new municipal pier. The removal of about one-third of area F under two alternative plans, at estimated costs of $121,000 and of $149,000, will give such access to the pier. The district engineer recommends improvement at the latter figure, which covers dredging to a depth of 32 feet at mean lower low water an area 262½ by 1,000 feet, with an additional area of triangular shape, considered necessary to facilitate navigation. The division engineer agrees in general with this recommendation, but believes that local interests should assume 50 per cent of the cost of the work.

The board considers it probable that a considerably increased commerce will be attracted to San Diego upon completion of the excellent terminal facilities now under construction. The port is favorably situated and has very good rail connections, particularly since the recent opening to traffic of the San Diego & Arizona Railroad. From its study of the probable commerce the board believes that the municipality is providing facilities which will be used more largely for transshipment of commerce in domestic and foreign trade than for purely local business. It feels that the general interests served by these facilities warrant the United States in cooperating to the extent proposed. It therefore recommends modification of the existing project for the improvement of San Diego Harbor, Calif., to the extent of dredging to a depth of 32 feet at mean lower low water that part of area F north of the prolongation of the center line of B Street, 262.5 feet wide, extending westerly from the United States pierhead line 1,000 feet and 1,500 feet on its northerly and southerly boundaries, respectively, at an estimated cost of $149,000: *Provided*, That there shall be furnished, free of cost to the United States, satisfactory areas for the disposal of excavated material. It considers that the entire amount of the estimated cost should be made available in a single appropriation.

The Chief of Engineers concurs in the views of the board, and states that the above recommendation is substantially that made, with regard to area F, in my report contained in House Document No. 1000, Sixty-sixth Congress, third session. That recommendation was based on the then contemplated construction of Municipal Pier No. 2. Subsequently to its submission the city of San Diego gave consideration to modifying its plans for the pier to an extent which would have rendered the proposed dredging useless; and Congress, in authorizing a revision of the project based on House Document No. 1000, Sixty-sixth Congress, third session, did not provide for any work in area F. The city has now returned to its former plans for the pier, which it is rapidly pushing to completion.

The original recommendation of the Chief of Engineers, as restated and elaborated in the report of the Board of Engineers for Rivers and Harbors, is accordingly appropriate to existing conditions.

PETALUMA CREEK, CALIF.

Petaluma Creek rises in western California and flows generally south for about 20 miles into San Pablo Bay, the northern arm of San Francisco Bay. The city of Petaluma is situated on the creek about 16 miles above its mouth. The United States has provided a channel 8 feet deep through shoal water in San Pablo Bay at the mouth of the creek, thence 6 feet deep up to McNears Canal, and thence 4 feet deep to Washington Street Bridge in Petaluma. The tidal range between mean lower low water and mean higher high water is 6.9 feet at the mouth of the creek and 8 feet at Washington Street Bridge.

Local interests are now desirous that the Federal improvement be carried past Washington Street Bridge for a distance of 935 feet in order to serve certain wharves and industries situated on the creek above the bridge. This section of the creek has been improved in the past by the private dredging of channels of limited depth at a cost of $5,000. The United States has done no work above the bridge, and such extension and improvement was reported upon unfavorably in House Document No. 849, Sixty-fifth Congress, second session, on which the present project for Petaluma Creek is based.

The district engineer, who is also the division engineer, reports that the creek above Washington Street Bridge has silted up to such an extent as to be practically bare at low tide. A certain amount of commerce is, however, handled by shallow-draft boats at high tide. The tonnage amounted in 1922 to 8,500 tons. The district engineer computes that there are in addition about 10,000 tons per year now moved by other routes to points above the bridge, which might be expected to follow an improved channel. He considers that the freight savings on the probable resulting commerce would be sufficient to justify the Government in dredging a channel for 935 feet, 40 feet wide, and 4 feet deep at mean lower low water at an estimated cost of $7,000 and $1,600 annually for maintenance, provided that local interests contribute one-half the initial cost and provide adequate dumping grounds.

The board finds that the business carried on in the section of the creek above the bridge is largely local in nature and that the benefits from the improved channel would accrue principally to a few concerns. It accordingly feels that the United States is not justified in assuming the first cost of any work here. On the other hand it points out that maintenance of the channel desired would add little to the cost of maintaining the present project. Shoaling in Petaluma Creek is caused principally by material brought down from the stretches above the improved section. Such material has been deposited in the channel above the bridge to the extent that the bottom is exposed at low water. Material now brought down from the upper river is deposited in the section at present under improvement by the Federal Government, whence it must be dredged. If therefore, the improvement were carried above the bridge, as desired by local interests, the amount of silt to be removed thereafter by maintenance dredging would not be materially increased, the effect being rather to shift upstream the point at which the necessary dredging must be done. The board therefore feels that, if local interests will assume the entire first cost of dredging the stretch above the bridge, the United States

may justifiably undertake its future maintenance, as the limited but definite benefits which would result would involve no materially increased expenditure. It accordingly recommends modification of the existing project to the extent of providing above Washington Street bridge a channel 935 feet long, 40 feet wide, and 4 feet deep at mean lower low water, at an estimated cost of $7,000, and with no estimated cost of maintenance in excess of that now required for Petaluma Creek; provided that local interests shall assume the entire first cost of the work.

The Chief of Engineers concurs in the views of the board.

SIUSLAW RIVER, OREG.

The Siuslaw River has a drainage area of about 800 square miles in western Oregon, and flows into the Pacific Ocean about 160 miles south of the Columbia River. The United States, with the cooperation of local interests, has provided two jetties at the mouth which have resulted in an entrance channel with a depth of 16 feet at mean lower low water, or about 23 feet at mean higher high water. At Acme (Cushman), 7 miles from the mouth, and for some miles above, the river has depths of 12 feet or more. Below Acme vessel movement is interfered with by three shoals, one of which has a limiting depth of 5½ feet.

The report under review recommends the provision of a channel 12 feet deep at mean lower low water, 200 feet wide through the shoal below Florence, and 150 feet wide through the two shoals above that point. Congress has taken no action on this recommendation.

The district engineer states that the commerce passing through the mouth of the river during 1922 amounted to about 11,000 tons. Along the river are a number of sawmills and shingle mills having the capacity for a much larger output than is now found practicable on account of limited channel depth. Free movement of vessels up the river, which would be made possible by a channel through the shoals, he thinks would result in material benefits to commerce. He considers a survey unnecessary, as conditions have changed little since the previous survey was made except that dredging costs are now higher. A channel 12 feet deep, 200 feet wide through the shoal below Florence, and 150 feet wide through the shoal just above that town and through North Fork Shoal is estimated to cost under present conditions $74,000, with $20,000 annually for maintenance.

The district engineer considers that some relief should be provided in view of the potential commerce and the limited utility of the entrance channel due to inadequate depth in the river above, and recommends improvement to the extent of providing a channel 12 feet deep and 150 feet wide through North Fork Shoal at an estimated cost of $33,000, with $10,000 annually for maintenance. The division engineer agrees with the district engineer in recommending the provision of a channel through the upper shoal.

The board finds that of the large amount of timber tributary to the Siuslaw River, estimated at thirty to forty billion feet, more than half is owned by the United States. The Government timber is on the market, and the sale of the stands on the revested railroad lands

is required by law. It considers it likely that adequate water transportation facilities would produce a wider market for this timber, the sale of which is desired, and would also increase its stumpage value. For any large movement of lumber by water the board believes that there should be provided through the shoals, considering the available tidal range, a least depth of 12 feet. In view of the considerable direct interest of the United States on account of the probable increase in the value of its timber holdings, and the very substantial contribution by local interests to the work already done, amounting to about 40 per cent of the total cost, the board renews its previous recommendation for modification of the existing project to provide for a channel 12 feet deep at mean lower low water, 200 feet wide through the lower shoal, and 150 feet wide through the two upper shoals, at a present estimated cost of $74,000, with $20,000 annually for maintenance.

The Chief of Engineers concurs with the board's views.

COLUMBIA RIVER, WASH.

The Willamette River enters the Columbia from the south, 99 miles above th mouth of the latter. A 30-foot channel is provided in the Columbia to the mouth of the Willamette, thence up the Willamette to the city of Portland. From the mouth of the Willamette up the Columbia to Vancouver, a distance of 4½ miles, the Government has provided a channel 150 feet wide and 20 feet deep at low water. The tidal range at Vancouver at low-water stages varies from 0.8 to 2.5 feet for spring and neap tides, respectively.

The city of Vancouver had in 1920 a population of 12,600 and is claimed to have now about 15,000. In 1922 its water-borne commerce was 20,000 tons, principally lumber. Recent developments promise a material increase in this commerce. A municipal wharf has recently been completed, and a veneer plant and paper mill with frontage on the river are under construction. Based on the performance of the municipal and other existing wharves during eight months of 1923 and on the probable commerce of the two new plants, it is estimated that there will shortly be about 145,000 tons per year available for water shipment. Local interests desire that the channel be improved to such a depth as to permit the use of larger vessels than can now reach the city. They offer to meet the entire first cost of the improvement, provided that the United States assume its maintenance.

The district engineer reports that while some coastwise lumber vessels can now come to Vancouver, the greater part of the coastwise or foreign commerce of the port must be carried on by lighterage of material to Portland and transshipment. The saving which would result by eliminating this lighterage movement would be about $1 per ton on lumber and $2 per ton on other items. He finds further that the products of the veneer plant, the greater part of which will probably go to California, could be moved by vessels, if sufficient water were available, at a saving of about $3.80 per ton over the probable cost of rail shipment. He finds that the dredging of the channel to 25 feet would cost $30,000 and estimates that the annual maintenance cost, at present $10,000, would be increased to $18,000. He considers it possible, however, that economical maintenance can

best be attained by the construction of certain regulating works, for which he proposes a tentative layout, at an estimated cost with contingencies of $93,000; but feels that these works should not be undertaken until there has been opportunity to observe the effects of the annual freshets in shoaling the deeper channel. He recommends that the 25-foot project be adopted, at an estimated cost of $123,000 for new work and $18,000 annually for maintenance; the actual work to be undertaken by the United States, but the entire first cost to be assumed by the port of Vancouver; and the United States to assume the entire cost of maintenance. He recommends further that the port of Vancouver be required to advance its contributions to the work in annual installments of about $30,000, which figure is the maximum that the port has available annually for such work. The division engineer concurs.

The board agrees in general with the district and division engineers, and states that while not committed to the tentative system of regulating works which the district engineer proposes, it feels that the sum of $93,000 which he estimates for them is a fair contribution toward such works on the part of local interests.

The Chief of Engineers concurs in general with the district and division engineers and the Board of Engineers for Rivers and Harbors and states that the port of Vancouver has good rail and highway connections with important timber and fruit lands in southern Washington. There are a number of industrial plants in the city and vicinity and additional ones are being constructed. Some of the most important of these plants are located conveniently for direct water shipments. A saving in freight rates is possible if deeper draft vessels can reach the wharves, and should result in a material increase in water-borne tonnage after the completion of the new paper mill and veneer plant. Of this prospective tonnage a sufficient part would be of general public interest to justify participation in improvement of the channel by the United States to the extent of assuming the cost of maintenance. A decision as to the proper system of regulating works can not be made until experience shall have shown where such works are actually needed. The sum estimated for them is considered an adequate measure of local contribution in addition to the $30,000 for initial dredging. He therefore reports that the further improvement of the Columbia and lower Willamette Rivers below Vancouver, Wash., and Portland, Oreg., is deemed advisable to the extent of providing a channel 25 feet deep and 300 feet wide between the mouth of the Willamette River and the city of Vancouver, provided that local interests shall pay for the original cost of dredging the new channel at an estimated cost of $30,000, and for such dike construction, to an amount not to exceed $93,000, as may be found necessary for economical maintenance, the contributed funds being made available in the installments of about $30,000 per year until the work is completed. The initial work involves no expense to the United States; the estimated maintenance cost of $18,000, $8,000 in excess of the estimated cost of maintaining the existing project, need not be made available until the year following completion of the original dredging.

DEEP RIVER, WASH.

Deep River is a small tidal stream in southern Washington, entering the Columbia River about 20 miles from the ocean. No improvement has been made by the United States. Local interests desire to be able to navigate the river at all stages of tide with boats drawing 6 feet. The mean range of tide is 6 feet.

In 1922 the commerce of the river amounted to 138,000 tons, of which 134,000 tons were logs, for the storage of which the river has a capacity of about 50,000,000 feet board measure. More than 17,000 passengers were carried in the same year.

The district engineer reports that the 3,000 people living in the vicinity are largely engaged in farming and logging. There being no railroad connections, the business, both passenger and freight, exclusive of logs, is conducted by water with Astoria, on the southern bank of the Columbia. A steamer, drawing slightly in excess of 6 feet, makes two trips daily between Astoria and the town of Deep River. A regular schedule can not be maintained, and at times transfer to small boats is necessary, owing to insufficient depth at the entrance and near the town of Deep River. The logs are towed to mills along the Columbia River. The district engineer recommends a channel 8 feet deep at mean lower low water, 100 feet wide through the bar at the mouth, and 60 feet wide in the river up to the town of Deep River, at an estimated cost of $10,200, with $2,400 annually for maintenance. The division engineer concurs.

The board agrees with the favorable views of the district and division engineers, but recommends the adoption of the improvement subject to the provision that local interests shall bear 50 per cent of the first cost of the work.

The Chief of Engineers concurs in the views of the Board of Engineers for Rivers and Harbors as to the advisability of the improvement. Further development of this section is contingent upon the provision of such channel depth that reliable boat service can be maintained and log rafts moved with economy. While to some extent the commerce is of a local nature, the interest of the United States appears to be sufficient to justify improvement by the Government. On account, however, of the isolated nature of the community, which is without practicable means of transportation except by water, and of the very limited cost of the proposed work, it is my opinion that the entire expense should be met by the United States. He therefore reports that the improvement of Deep River, Wahkiakum County, Wash., and entrance thereto is deemed advisable to the extent of providing a channel 8 feet deep at mean lower low water, 100 feet wide through the bar at the entrance, and 60 feet wide in the river up to the town of Deep River, at an estimated cost of $10,200, with $2,400 annually for maintenance.

PORT ORCHARD BAY, WASH.

Port Orchard Bay is an arm of Puget Sound, situated about opposite the port of Seattle. It is the site of the Bremerton Navy Yard. The bay is connected with Puget Sound by two passages, of which only the southern one, known as Richs Passage, is suitable for large vessels. This passage has ample depths, except in the

vicinity of Point Glover, where a shoal with a limiting low-water depth of 32 feet lies axially in mid-channel. Deeper water is found on both sides of this shoal, but the tortuous course of the channel makes navigation difficult. It is reported that capital ships are unable to safely negotiate the entrance except in daylight and at the end of flood tide.

The district engineer reports that the commerce of Richs Passage and Port Orchard Bay is of minor importance and can readily be accommodated by existing depths, but that the restrictions placed on navigation of large vessels by the shoal in the passage interfere seriously with the operations of the Navy. Naval officers have recommended the removal of the shoal to a depth of 40 feet at mean lower low water. The district engineer considers that depths additional to those now existing are justified from the point of view of national defense, but believes that 45 feet at mean lower low water would be preferable to 40 feet. He estimates the cost of dredging the shoal to 45 feet at $133,000, with practically no maintenance cost. He submits an alternative estimate of $49,000 for dredging to a depth of 40 feet.

The board is of the opinion that the improvement of Richs Passage is desirable, but feels that 40 feet at mean lower low water is adequate for the needs of the Navy, a view which is confirmed by informal advices received from the Navy Department. It therefore recommends the dredging of the shoal to the lesser depth.

The Chief of Engineers concurs in the views of the Board of Engineers for Rivers and Harbors, and states that the strategic importance of the Bremerton Navy Yard, which is the only point on our northern Pacific coast where battleships or other unusually large vessels can be dry-docked, is such as to justify the provision of a safe and adequate channel through Richs Passage. This can apparently be accomplished by the removal of the existing shoal to a depth of 40 feet, as recommended by the Navy Department and the board, which would provide a readily navigable channel of a depth corresponding to that provided or recommended for the more important navy yards. The estimate of the district engineer appears reasonable, but it is believed preferable to set the round sum of $50,000 for the work. He therefore reports that the improvement of the entrance to Port Orchard Bay, Wash., is deemed advisable to the extent of removing the shoal near Point Glover in Richs Passage to a depth of 40 feet at mean lower low water, at an estimated cost of $50,000. It is not anticipated that there will be any maintenance required. From the nature of the case the entire cost should be borne by the United States.

DUWAMISH WATERWAY, SEATTLE HARBOR, WASH.

Duwamish Waterway is the name applied to the lower part of Duwamish River, which has been improved and straightened by local interests. It is connected with Elliott Bay by the East and West Waterways; through navigation is, however, possible only by the latter. The existing project provides for the maintenance of both of these channels. It also provides for maintenance of Duwamish Waterway after local interests shall have provided a channel 20 feet deep at mean lower low water and 150 feet wide from its

junction with the West Waterway up to the Eighth Avenue South Bridge. Local interests have not yet completed the channel to these dimensions. They have, however, expended large sums for the improvement of the waterway. The material excavated has been used in reclaiming the Duwamish River marshes, and has given to Seattle its largest undeveloped area of level land.

The district engineer, who is also the division engineer, states that the land bordering Duwamish Waterway is the most suitable area in Seattle for industrial development. It is also one of the few unoccupied stretches of water front available for marine terminals when the city, through its normal increase in size and commerce, outgrows the existing facilities of Elliott Bay. He therefore considers the locality worthy of further improvement at the expense of the Government, and presents several alternative plans. He recommends a channel 200 feet wide and 30 feet deep from the West Waterway to First Avenue, and 150 feet wide and 20 feet deep from First to Eighth Avenues; the excavation of a turning basin 600 feet long by 350 feet wide just above the First Avenue Bridge; and the enlargement of the channel between Eighth Avenue south and Fourteenth Avenue south to a cross section of 150 feet by 15 feet; at a total cost of $365,000. His recommendation is conditioned upon local interests being required to contribute 50 per cent of the cost of the work, furnish the places of deposit of dredged material, together with necessary bulkheads, and assume the cost of delivery of material to points of deposit beyond a certain distance from the point of dredging. These recommendations meet the desires of local interests, who have agreed to furnish the required cooperation.

The Board of Engineers for Rivers and Harbors concurs in the views of the district engineer.

The Chief of Engineers concurs in the views of the district engineer and the Board of Engineers for Rivers and Harbors.

COWLITZ RIVER, WASH.

The Cowlitz River flows in a generally southwesterly direction for about 130 miles from a point about 11 miles south of Mount Rainier, where four streams form its headwaters, and enters the Columbia River about 70 miles above its mouth. Its drainage area is 2,460 square miles, and the annual rainfall ranges from about 45 inches in the lower valleys to 100 inches in the vicinity of Mount Rainier. Except for a series of canyons about 6 miles long and from 150 to 300 feet deep, the river flows through valleys from 3,000 feet to several miles wide.

The lower 37 miles have been improved by the United States for navigation by the provision of a channel 50 feet wide, 4 feet deep at mean lower low water, from the mouth to Ostrander and 2½ feet deep thence to Castle Rock, and a channel 40 feet wide and 2½ feet deep thence to Toledo. The tidal variation is 4 feet at the mouth and zero at Ostrander, 9 miles above. In 1922 the commerce amounted to 222,000 tons, 187,000 tons of which were floated timber. The balance was largely material used in building the new town of Longview, near the mouth. Request is made for relief from floods, no increase in navigation facilities being desired.

Floods are of frequent occurrence and sometimes reach stages of about 20 feet at Kelso, about 5 miles above the mouth, 30 feet at Mossy Rock, about 60 miles above the mouth, and 50 to 60 feet in the upper reaches of the river. At Mayfield, about 50 miles from the mouth, the discharge of the river varies from about 1,000 to 50,000 second-feet. The maximum discharge at Kelso has been estimated at 90,000 second-feet. Below Kelso levees built by local interests protect the adjacent lands. Above that point and within a distance of about 40 miles 4,000 acres are subject to overflow. No serious damage is reported in the succeeding 55 miles, but above that, in a stretch of 17 miles, about 10,000 acres is menaced by floods. Extensive bank erosion is reported, and claim is made that floods generally limit agricultural production to one crop each year.

The district engineer reports the total value of flooded lands, buildings, and annual products as $3,748,000, the average value of cleared lands being about $300 per acre. He thinks the value of land would increase 50 to 75 per cent, and the quantity of products 30 to 35 per cent, if the flood menace were removed. The population immediately affected is about 1,100. He considers levee construction and bank protection, together with the removal of drift and log jams, the most practicable means of relief. Local interests offer to contribute labor or money to the work, but have no organization by which they alone could carry out a plan for flood control. The district engineer recommends a survey at an estimated cost of $7,200, with a view to preparing plans which might be carried out by the State and local interests. The division engineer concurs in this recommendation.

The board considers that flood-control works would have no beneficial effect on navigation, and that, on the score of other national interests, the area and population affected are so small that the United States would hardly be justified in undertaking a survey.

The Chief of Engineers states that about 14,000 acres of arable land are affected by Cowlitz River floods. The owners of this property have expressed their willingness to assist in the work in such measure as they are able, but are without an organization which would be effective in coordinating their efforts at obtaining relief. The United States is interested to the extent that flood control might have a beneficial effect in reducing the cost of maintaining the improved navigable channel. What further general benefits might result from flood control works can be determined only by a survey. In view of the known interest of the United States, the area affected, and the impracticability of scattered communities agreeing upon a comprehensive flood-control plan prepared locally, he reports that a survey of Cowlitz River, Wash., is deemed advisable, with a view to preparing plans and estimates of cost for the prevention and control of floods on said river and its tributaries and to determining the extent to which the United States and local interests should cooperate in carrying out any plans recommended. The estimated cost of the necessary survey is $7,200.

HILO HARBOR, HAWAII

Hilo Harbor, on the east coast of the island of Hawaii, is under improvement by the United States under a project providing for the construction of a breakwater and for the removal of shoals at the

entrance of the inner harbor to a depth of 35 feet at mean lower low water, the total cost of the work not to exceed $1,700,000. The dredging has been completed, and it is expected that, under an existing contract obligating the balance of the funds authorized, the breakwater can be extended to a total length of about 6,900 feet. The original project provided for a breakwater 10,170 feet long, but this was amended in 1912 to provide for certain dredging without increasing the original limit of cost.

The business of the harbor has increased materially, amounting in 1923 to 290,000 tons. Hilo Harbor is the only improved port on the island, the landing at Mahukona being in an open roadstead on the westerly shore. While the facilities provided have increased the safety of shipping, this island, the largest of the Hawaiian group, can not be fully developed until the harbor has been given greater protection from the heavy seas. Local interests desire extension of the breakwater to the length originally contemplated and the removal of shoals in the harbor.

The district engineer lays particular stress upon the rough condition of the harbor by heavy seas from the north. To ameliorate this condition, he considers necessary the extension of the breakwater to a length of 10,170 feet. Vessels of 33 and 34 foot draft are now calling at the islands. For the safe entrance and maneuvering of such large vessels in Hilo Harbor he would remove to a depth of 35 feet at mean lower low water certain shoal areas, designated on the plan as A, B, and C. The estimated cost of the breakwater extension and dredging is given as $2,089,954. The division engineer concurs with the district engineer and submits theoretical estimates as to the probable effect on wave heights in the harbor of different lengths of breakwater. These calculations, while not conclusive, are believed to indicate the necessity for construction of the breakwater to the point contemplated in the original project.

The Board of Engineers for Rivers and Harbors feels that while some extension of the breakwater is undoubtedly needed the full length may not be required and that a portion of the dredging of area A will probably be unnecessary until there is a further development of terminal facilities; but believes that the project as recommended by the district engineer should be adopted.

The Chief of Engineers concurs in general in the views of the district and division engineers and the Board of Engineers for Rivers and Harbors, and states that Hilo is the only improved harbor of the island of Hawaii, which has a large and growing commerce and great possibilities for future development. Vessels of 30 feet and over make it a port of call. Present navigation conditions are not satisfactory and can be ameliorated by deepening the inner harbor over an increased area and by extending the breakwater. As pointed out by the board, experience gained during the further breakwater construction may permit of the cessation of work at a point short of the full length of 10,170 feet; also, dredging south of the line XY will probably not be immediately required. These are, however, uncertain points, and legal authority for completion of the work should not be restricted. He reports that adoption of a project for the further improvement of Hilo Harbor, Hawaii, is deemed advisable by providing for the extension of the breakwater to a length of 10,170 feet, and dredging areas A, B, and C to a depth of 35 feet at mean lower low water at a cost of $2,100,000 and $5,000 annually for maintenance.

PONCE HARBOR, PORTO RICO

Ponce Harbor is the principal port on the southern coast of Porto Rico. Terminal facilities are concentrated at the eastern end, which affords the greatest protection to shipping. While the harbor as a whole has adequate depths for seagoing vessels, the shores are low and marshy; commerce with vessels of any size has therefore, until recently, required transfer by lighter to or from the port of Ponce. Much of it is still so handled. A few years ago, however, the municipality constructed a modern terminal with road and railroad connections, adequate for vessels of medium draft.

Accurate figures on commerce are not available, but it is claimed that Ponce Harbor handles about one-fourth the import and export business of Porto Rico. It is the second port of the island in commercial importance, San Juan on the northern coast being the first. The topography of Porto Rico makes transportation between the northern and southern sections difficult and expensive, and renders necessary a port of general commerce on each coast. Ponce Harbor has from early times fulfilled this function for the southern part of the island. It has no important competitors, though certain minor ports or terminals are maintained by sugar interests for their special needs.

The district engineer, who is also the division engineer, considers that improvement is justifiable to the extent of dredging areas totaling 153 acres in the eastern part of the harbor to depths of 30 feet, 18 feet, and 9 feet; by the construction of bulkheads along the shore, adjacent to the dredged areas, for the retention of dredged material and the reclamation of marshy land for terminal developments; and by sea walls on Penoncillo Point, the site of the present deep-water terminal. He considers that the bulkheads should be constructed by the municipality under plans approved by the War Department, or by the United States at the expense of the municipality, at an estimated cost of $508,000; and that of the cost of the sea walls and dredging, estimated also at $508,000, one-half should be borne by local interests and paid in advance of the work by installments equal to the appropriations or allotments made by the United States. Local interests have agreed in general to this program, although their agreement as to contribution for the sea wall and dredging is based on a lower estimated cost and they desire to make payment thereof in annual installments.

The Board of Engineers for Rivers and Harbors concurs in the views of the district engineer.

The Chief of Engineers concurs with the district engineer and the Board of Engineers for Rivers and Harbors, and reports that the improvement of the harbor of Ponce, P. R., is deemed advisable to the extent of dredging areas in the eastern part of the harbor to depths of 30, 18, and 9 feet, respectively, and constructing bulkheads along the shore and sea walls at Penoncillo Point, in the manner recommended by the district engineer, subject to the conditions of local cooperation recommended by him, at an estimate cost to the United States of $254,000 for new work and $30,000 annually for maintenance.

Section 2 of the bill adopts the policy of completing all projects, heretofore adopted and uncompleted, within a period of five years, and of completing all projects hereafter adopted within five years after the date of their adoption, if it is physically practicable to do so.

The work of completing river and harbor projects has in many instances been very much prolonged and delayed. The most notable instance of this, and of its evils, is the Ohio River, where we have expended upward of $70,000,000, and have been engaged 14 years on the project for lock and dam construction. This river is about 1,000 miles long. With the vast expenditure so far made only 339 miles is open to improved transportation. Disconnected stretches, where the improvement is completed, total 217 miles. It will cost only $25,000,000 to complete the project. When this is done we will have navigation from Pittsburgh and all the intermediate country to the Gulf. This river, in conjunction with the Mississippi River, will be invaluable to commerce, but, until it is completed, the expenditures so far made are of no value to through commerce and of only very limited value locally. What is true of the Ohio is true in a less degree of many of the other projects adopted by Congress.

The testimony before the committee shows that with reasonable appropriations each year for five years all projects can be completed. The adoption of this provision will, it is believed, make much more certain the regularity and unformity of appropriations and continuity of work, all of which are necessary to insure economy in the execution of the work, in securing the benefits of improved transportation routes within a reasonable time, and in realizing the effort to relieve congestion by rail.

Section 3 authorizes such investigations as may be necessary on those navigable streams and their tributaries where power development is practicable as will furnish a general plan for the most effective navigation improvement in combination with the most efficient development of potential water power. The limit of cost of this investigation is placed at $500,000.

Section 4 of the bill amends section 6 of the river and harbor act of 1920, which provided for the printing of the laws relating to rivers and harbors which were adopted between March 4, 1913, and March 4, 1921. These laws have been compiled and are now in type in the Printing Office. The purpose of the item in this bill is to have included in the volume the laws adopted between March 4, 1921, and the end of the present Congress, so that the volume will be up to date when ready for distribution.

Section 5 provides that hereafter a per diem of $7 in lieu of other travel allowances shall be paid to officers and enlisted men of the Army for the actual time consumed while traveling by air in connection with aerial surveys of rivers and harbors, and a per diem of $6 for the actual time consumed in making aerial surveys, to be paid from appropriations available for the particular improvement for which the survey is being made.

This section also provides that when, in the opinion of the Secretary of War, the changes of a station of an officer of the Corps of Engineers is primarily in the interest of river and harbor improvement, the mileage and other allowances to which he may be entitled incident to such change of station may be paid from appropriations for such improvements.

Section 6 carries authorizations for 155 preliminary examinations and surveys. The committee endeavored to confine these authorizations to such localities as were prospectively valuable. No provision for surveys has been made since the passage of the 1922 river and harbor act. The average number of similar items carried in the last 12 river and harbor acts was 152.

Section 7: The Secretary of Agriculture is authorized by act of April 8, 1905 (33 Stats. 706), to permit the taking of earth, stone, and timber from the national forests for use in the construction of works under the Federal irrigation laws. He is authorized by the act of March 4, 1915 (38 Stats. 1100), to grant permits to the Navy Department and to the Alaskan Engineering Commission to take such materials for the use of the Navy and for the construction of Government railways and other works in Alaska, respectively.

It is thought that it would be in the public interest if similar authority were conferred with respect to the activities of the War Department. In the prosecution of river and harbor works especially it is sometimes necessary to obtain timber and other materials from forest reserves, as there is no other source of supply. At present the materials must be paid for from appropriations for the works, as the Forest Service is without authority to waive the ordinary and usual charges therefor. The object of this provision is to authorize the Secretary of Agriculture, in his discretion, to permit the War Department to take such materials free of charge where they are to be applied to public works under that department.

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