GREAT LAKES--CONNECTING WATERS, PRINCIPAL HARBORS, AND RIVER CHANNELS

U.S. Engineer dept. Board of engineers for rivers and harbors

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U. S. Engineer dept. Board of engineers for rivers & harbors

GREAT LAKES—CONNECTING WATERS, PRINCIPAL HARBORS, AND RIVER CHANNELS

LETTER

FROM

THE CHIEF OF ENGINEERS, UNITED STATES ARMY

TRANSMITTING

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON REVIEW OF REPORTS HERETOFORE SUBMITTED ON GREAT LAKES—CONNECTING WATERS, PRINCIPAL HARBORS, AND RIVER CHANNELS, WITH FIVE ILLUSTRATIONS

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, May 31, 1935.

Hon. J. J. MANSFIELD,
Chairman Committee on Rivers and Harbors,
House of Representatives, Washington, D. C.

MY DEAR MR. MANSFIELD: 1. The Committee on Rivers and Harbors of the House of Representatives, by resolution adopted January 5, 1934, requested the Board of Engineers for Rivers and Harbors to review the reports submitted on the Great Lakes—Connecting Waters, Principal Harbors, and River Channels, submitted in House Document No. 253, Seventieth Congress, first session, with a view to determining whether further improvement is advisable at the present time. I enclose herewith the report of the Board in response thereto.

2. The connecting channels of the Great Lakes include the St. Marys River, between Lake Superior and Lake Huron; the Straits of Mackinac between Lake Huron and Lake Michigan; and the St. Clair River, Lake St. Clair, and Detroit River between Lake Huron and Lake Erie. A connecting channel between Lake Erie and Lake Ontario is afforded by the Welland Ship Canal, a Canadian project. These channels unite the Great Lakes into one waterway system, on which an enormous traffic in bulk commodities is transported. Because of the great volume of traffic, the policy has been adopted of

139406—35——1

providing separate channels for up- and down-bound vessels where practicable. The downbound vessels, carrying iron ore and grain from the upper lake to the lower lake ports, are more deeply loaded than the upbound vessels. The River and Harbor Act of July 3, 1930, authorized a comprehensive project described in the report under review for deepening the channels used by downbound vessels to provide depths suitable for vessels of 24-foot draft when the ruling lake is at its datum plane, at a cost not to exceed $29,266,000. Two further improvements subsequently have been recommended to Congress and adopted under the Public Works program; the removal of the old dike which divided the channel at the outlet of the St. Clair River, and the improvement of the approach to the Straits of Mackinac between Mackinac Island and Round Island. The work authorized is so far advanced that its substantial completion is expected by July 1, 1936, at a cost well within the limitation fixed.

3. The datum planes to which depths in the lake channels were referred when the present works were authorized were not the lowest levels of the Lakes, but were some 2 feet above the extreme low levels. Subsequently new datum planes have been adopted, designed to represent the levels which will be continuously available after the compensating works authorized in the project have been constructed. The construction of these works awaits the consent of the Dominion of Canada. As referred to the new datum planes, the ruling depth in the downbound inner lake channels is 23.3 feet. This depth is considered completely adequate for the vessels of the present lake fleet when loaded to capacity. The channels used only by upbound vessels have a ruling depth as referred to the new datum planes of approximately 20 feet, and are suitable for navigation by vessels of 18 feet draft or less at extreme lake levels.

4. The Lake Carriers' Association, representing the principal navigation interests concerned, requests the removal of certain shoals adjacent to the vessel courses in open waters of the Lakes, and the improvement of certain bends in restricted channels to afford greater safety to navigation and to reduce delays.

5. The commerce through the St. Marys River in the 8 years from 1923 to 1930, inclusive, ranged from 72,000,000 to over 92,000,000 tons annually, dropping to 44,613,671 tons in 1931, and 20,480,873 tons in 1932, and rising again to 40,307,893 tons in 1933. The commerce through the Detroit River during the 8 years from 1923 to 1930, inclusive, ranged from 80,000,000 to over 110,000,000 tons per annum, dropping to 47,447,138 tons in 1932 and rising to 66,009,703 tons in 1933. The resumption of the enormous traffic carried in 1930 and previous years is confidently anticipated with the economic recovery of the Nation.

6. The district and division engineers have fully investigated the advisability and justification of the various proposed improvements presented by the Lake Carriers' Association and recommend that three of these be undertaken. These are—

(*a*) The improvement of Southeast Bend in the St. Clair River. St. Clair River divides in a delta formation into several channels as it enters Lake St. Clair. The channel improved for navigation describes a half circle about 3 miles in length before entering the straight channel into the lake. The channel is a two-way channel 600 feet in

width. At no other place in the connecting channels is the danger of collision so great. The grounding of a large freighter might completely block navigation. The district and division engineers recommend the excavation of a separate straight channel, 300 feet in width and 25 feet deep across the bend, for the use of downbound vessels, at an estimated cost of $1,650,000. The necessary land has been found to be held by the State and can be deeded to the United States for the purpose proposed, although certain rights may have to be acquired by the United States by condemnation.

(*b*) The removal of a small midchannel shoal in the easterly approach to the Straits of Mackinac at an estimated cost of $50,000.

(*c*) A relatively minor widening of a bend in the channel in upper St. Marys River, at Brush Point, in the channel leading from Lake Superior to the Soo Locks, at an estimated cost of $175,500.

7. The Board of Engineers for Rivers and Harbors, concurring in general with the views of the reporting officers, reports that a separate downbound channel across the Southeast Bend, St. Clair River, separating the upbound and downbound traffic will remedy the present hazards to navigation and will result in savings in time of transit more than sufficient to justify the cost of the proposed improvement. The Board considers a channel width of 300 feet adequate for present and immediately prospective commerce, but believes that a right-of-way at least 1,000 feet wide should be obtained at this turn to accommodate any future widening of channel found necessary. The Board considers that the relatively small cost of obtaining a depth of 27 feet over Poe Reef Shoal in the Straits of Mackinac and of easing the turn and widening the channel above Brush Point Turn in St. Marys River is thoroughly justified by the resulting improved navigating conditions and the elimination of navigation hazards. Other improvements recommended by the Lake Carriers' Association are not considered warranted at this time.

8. The Board recommends that the project for the Great Lakes—Connecting waters, principal harbors, and river channels be modified to provide for the construction of a separate downbound channel across Harsen's Island at the Southeast Bend in St. Clair River to a depth of 25 feet below low-water datum and a bottom width of 300 feet, at an estimated cost of $1,650,000, with increase of $1,000 for annual maintenance of St. Clair River, subject to the condition that the State of Michigan quit claims to the United States, free of cost, all its right, title, and interest in the land needed for a right-of-way 1,000 feet wide, and furnish suitable areas for the disposal of dredged materials; for the removal of Poe Reef Shoal in South Channel of the Straits of Mackinac to a depth of 27 feet below low-water datum at an estimated cost of $50,000; and for widening Brush Point Turn in upper St. Marys River to a bottom width of 1,200 feet and the channel from Brush Point to Point Louise to a bottom width of 1,000 feet at an estimated cost of $175,500 with increase of $1,000 for annual maintenance of St. Marys River, all as shown on the accompanying maps.

9. After due consideration of these reports, I concur with the views of the Board of Engineers for Rivers and Harbors.

Very truly yours,

E. M. MARKHAM,
Major General, Chief of Engineers.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

WAR DEPARTMENT,
THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, D. C., May 23, 1935.

Subject: Great Lakes—Connecting Waters, Principal Harbors, and River Channels.

To: The Chief of Engineers, United States Army.

1. This report is in response to the following resolution, adopted January 5, 1934:

Resolved by the Committee on Rivers and Harbors of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors created under section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby, requested to review the reports on the Great Lakes—Connecting waters, principal harbors, and river channels, submitted in House Document Numbered 253, Seventieth Congress, first session, with a view to determining whether further improvement is advisable at the present time.

2. The locality under consideration comprises Lakes Superior, Michigan, Huron, Erie, and Ontario, and their connecting channels. The project authorized by Congress for the through waterway between Lake Superior and Lake Erie provides for depths in all two-way channels and in downbound channels suitable for vessels of 24-foot draft, and for depths in separate upbound channels suitable for vessels of 20-foot draft when the lake stages correspond to the established datum planes, and for compensating works in St. Clair River and Niagara River to compensate for the lowering of lake levels. In addition to work under the authorized project, the center dike of St. Clair Flats Canal has been removed and deepening of the channel between Mackinac Island and Round Island, Mich., to 27 feet for a width of 1,250 feet is in progress with funds allotted by the Public Works Administration. The total cost to June 30, 1934, of channels connecting Lake Superior and Lake Erie, including maintenance and operation and care of canals and locks in St. Marys River, was $66,418,127.03. Local cooperation has not been required in the improvement of the interconnecting channels. The Lake Carriers' Association, under permit from the Secretary of War, has removed some boulders from the channel through Vidal Shoals, St. Marys River, and widened the downbound channel through Middle Ground at Port Huron.

3. The Great Lakes and their connecting waterways are the most important unit of inland water transportation in the world. Commerce consists primarily of such bulk commodities as iron ore, grain, limestone, and coal. Savings in the cost of their transportation affect either directly or indirectly the whole population of the United States. The average commerce for the years 1929 to 1933 was 54,000,000 tons through the locks at Sault Ste. Marie; 21,500,000 tons through the Straits of Mackinac, Mich., and 65,400,000 through the St. Clair River, Mich. The decrease in tonnages during the past 5 years was a reflection of the general economic depression throughout the country. A definite uptrend in the volume of traffic during the next few years is reasonably assured.

4. The Lake Carriers' Association, representing 83 percent of the American tonnage on the Lakes, now suggests additional improvements in the connecting channels to eliminate delays and remove

existing hazards to navigation. The specific localities referred to are: Southeast Bend, St. Clair River; Thunder Bay Island Shoals, Lake Huron; Poe Reef Shoal, Straits of Mackinac; Brush Point Turn, St. Marys River; Point Iroquois Shoals and Gros Cap Reef, St. Marys River.

5. Southeast Bend, St. Clair River, is a sharp reverse curve about 3 miles long in the main ship channel, a short distance above the St. Clair Flats Canal. This two-way channel, with a present minimum width of 600 feet, accommodates 50 to 100 passages per day. Down bound vessels must turn on a radius of 2,100 feet at the upper end and on a radius of 3,000 feet at the center. Work in progress will provide a two-way channel of easy turns 1,000 feet wide above the bend and 700 feet wide below the bend. The locality is subject to periods of low visibility and fog, frequently slowing the movement of ships and occasionally stopping navigation. The Lake Carriers' Association states that Southeast Bend is the most hazardous stretch in the connecting channels, and urge widening to 800 feet or the construction of a separate downbound channel across the bend. The district engineer considers the present channel fairly practicable, but notes that 19 minor collisions have occurred in this reach in the past 12 years. He believes that difficulties of navigating the bend result in some delays, and that improvement to reduce delays and eliminate present hazards of navigation is justified.

6. He has considered three plans of improvement, involving widening the existing channel to 800 feet; widening to 700 feet, and the dredging of a separate downbound channel across Harsens Island.

(1) *Widening to 800 feet.*—This plan contemplates widening the present 600-foot channel to a width of 800 feet from a point approximately 2,600 feet below Harsens Island Light 17–A to a point near Lower Reach Light No. 5, a distance of about 20,500 feet, thence tapering to 700-foot width in a distance of about 3,500 feet, thence continuing 700 feet wide to St. Clair Flats Canal, at an estimated cost of $675,000. He reports that the bank-to-bank width of the river in the bend varies from 900 to 2,200 feet with the international boundary generally following the middle of the stream. The banks on both sides are low. On the American side the banks have been built up and bulkheaded and are lined with homes, summer cottages, and docks. On the Canadian side the land is marshy and undeveloped. He states that the widening proposed would not encroach on fast land, the material to be dredged consisting of sand, clay, and mud which will take a slope not flatter than 1 on 4. The land to be dredged is understood to be public property under the control of the Dominion of Canada, and no difficulty in obtaining Canadian consent to the work is anticipated. He states that widening of the existing channel to 800 feet would not eliminate the chief cause of difficulty in this locality, which is reverse curvature. He believes that even if the channel is widened to 800 feet, the Southeast Bend would still present a serious condition both with respect to the degree of curvature and direction, and that further requests for greater widths would continue until this section is improved to conform with the remainder of the interconnecting channels.

(2) Widening the channel as described above to 700 feet, at an estimated cost of $405,000. The district engineer states that this improvement will avoid considerable heavy cutting on the Canadian

side of the channel, but that it will be less satisfactory from a navigating standpoint than the proposed widening to 800 feet.

(3) *Separate downbound channel.*—This provides for a separate channel 18,500 feet long, 300 feet wide and 25 feet deep across Harsens Island, at an estimated cost of $1,650,000. A right-of-way 550 feet wide with an area of 180.55 acres would be required. The district engineer states that the area included in the right-of-way was originally lake bottom lands and that the State of Michigan holds title thereto in trust for the people of the State for the purposes of navigation, hunting, and fishing. With the exception of 15.75 acres, all land is leased by the State to private individuals under 50-year leases, with the option of renewal for 49 years. Twenty-two acres are in Muscamoot Bay, 90 acres are swamp land, 25 acres are farm land, and 44 acres are improved lots. The total value of the leases is $7,352 and the total assessed valuation of all property within the right-of-way is $60,085. He states that under the law passed in 1931 (Public Act 256) the Governor of the State of Michigan is empowered to deed State lands to the United States for purposes of navigation, but that the United States will probably be required to resort to condemnation proceedings to extinguish the rights of lessees. The district engineer further states that the construction of a cut-off will isolate certain lands between the proposed channel and the St. Clair River by severing State Highway M 154 in the vicinity of Tashmoo Park. The area served by the highway comprises 1,225 acres, involving 115 separate leases with a total value of about $25,000. The assessed valuation of the property is $136,750. It is computed that the increased discharge as a result of the construction of a cut-off across Southeast Bend will have the effect of lowering Lake Huron 0.07 foot, and that accordingly one additional sill will be required in St. Clair River, at an estimated cost of $100,000. The district engineer states that a separate downbound channel as proposed will save 1 mile in distance, or about 6 minutes in the time of passage, and that the separation of traffic should save 4 minutes in the upbound channel. He notes that these reductions in time of passage will result in savings sufficient to justify the cost of the separate downbound channel. He concludes that a separate downbound channel is the ultimate solution of the navigation problem at this bend, and recommends that it be authorized at this time.

7. *Thunder Bay Island Shoals, Lake Huron.*—This shoal, with minimum depths of about 22½ feet, lies 6 to 7 miles northwest of Thunder Bay Island Light and is within the limits of steamer lanes laid out for up- and down-bound traffic. Navigation interests state that a considerable detour is necessary to avoid these shoals with certainty at times of poor visibility. The district engineer states that these shoals constitute a possible hazard only to up-bound vessels, mainly vessels engaged in the stone trade out of Alpena, Mich., as vessels in this traffic may load to greater draft than up-bound traffic moving through the Detroit River. He estimates that such vessels may have to detour 5 miles, 17 times a year, resulting in an actual money loss of $340 per annum. He concludes that the cost of removing the shoal, estimated at $100,000, is incommensurate with the resulting savings.

8. *Poe Reef Shoal, Straits of Mackinac.*—This is a small shoal with minimum depths of 24 feet, 1½ miles east of Poe Reef Lighthouse. It

lies directly on the present sailing course through the South Channel of the Straits of Mackinac, used by all commerce between Lake Michigan and the lower lakes. Navigators state that while there is a possible passage on either side of the reef, it is impossible for a master to know his position with sufficient accuracy at times of low visibility, and that accordingly the reef constitutes a hazard to navigation. The district engineer points out that improvement is not urgent for up-bound traffic, but that a considerable tonnage of stone from Lake Huron is subject to some navigation hazards and delays, especially in times of fog and storm. He believes that the relatively small cost of obtaining a depth of 27 feet over the shoal is amply justified, and recommends its removal at an estimated cost of $50,000.

9. *Brush Point Turn, St. Marys River.*—At Brush Point in the upper St. Marys River, the channel makes a turn of 15°. The minimum natural width of channel at the turn between 26-foot contours is 1,000 feet. Above the turn the channel narrows to a minimum width of 700 feet opposite Point Louise, 7,000 feet upstream. Widths of channel above and below this section are 1,000 feet or more. Navigation interests state that while the channel has a fairly good width at this point, vessels meeting at the turn in times of low visibility have difficulty in passing. They request that the turn be widened by removing about 400 feet of the point. They state that this would result in extension of the straight and well-defined channel just below Brush Point and would materially aid navigation. The district engineer considered three plans of improvement, involving (*a*) increasing the width of the 15° turn from 1,000 feet to 1,600 feet, at a cost of $132,500; (*b*) increasing the width of the 15° turn from 1,000 feet to 1,600 feet and widening the channel above the turn to a width of not less than 1,000 feet, at a cost of $297,000; and (*c*) a modification of the above plans to provide for increasing the width of the 15° turn from 1,000 feet to 1,200 feet and widening the channel above the turn to a minimum width of 1,000 feet, at a cost of $175,500. The district engineer states that although the benefits from this improvement are intangible, it is believed that navigation will be facilitated and the hazard of traversing the course at times of low visibility will be reduced to an extent which will justify further improvement. He recommends increasing the width of the turn to 1,200 feet and widening the channel above the turn to a minimum width of 1,000 feet, at an estimated cost of $175,500.

10. *Point Iroquois Shoal, St. Marys River.*—This shoal extends northeasterly in White Fish Bay to within 1,000 feet of the sailing course as defined by the Birch Point Range Line. The Lake Carriers' Association suggests that the southeasterly end of the shoal be removed to project depth to afford greater width between these shoals and the sailing course. The district engineer reports that a recent survey of Point Iroquois Shoals indicates that the 27-foot contour approaches to within 640 feet of the sailing course as now marked. He finds that the quantity of material to be removed in order to give a clear channel 700 feet wide and 27 feet deep west of the range line is negligible and can be removed as an item of maintenance of the channel.

11. *Gros Cap Reef, St. Marys River.*—This is a shoal with minimum depth of approximately 23 feet lying 2,000 feet southeast of the Gros Cap Reefs Lightship and very close to the Birch Point Range Line.

The Lake Carriers' Association suggests that the reef be removed or the location of navigation aids be changed to avoid passing too close to the reef. The district engineer finds that the reefs project about 700 feet west of the channel line as marked by the Gros Cap Reef Lightship. He estimates that the removal of the shoal as suggested would involve sweeping operations and perhaps the use of explosives for rock removal. He considers that a suitable channel can be made available by relocating the Gros Cap Reef Lightship 700 feet to the southwestward. The lightship is a Canadian aid now located in Canadian waters. Its proposed movement would place it in American waters, but no difficulties are expected to arise in connection with its relocation in view of the fact that reciprocal arrangements on maintenance on both sides of the international boundary are in effect in other portions of the boundary waters.

12. The division engineer concurs in the views and recommendations of the district engineer and recommends that the project for the Great Lakes—connecting waters, principal harbors, and river channels be modified to provide for the construction of a separate downbound channel across Harsen's Island at the Southeast Bend in St. Clair River to a depth of 25 feet below low-water datum and a bottom width of 300 feet, at an estimated cost of $1,650,000 with increase of $1,000 for annual maintenance of St. Clair River; for the removal of Poe Reef Shoal in South Channel of the Straits of Mackinac to a depth of 27 feet below low-water datum at an estimated cost of $50,000; and for widening Brush Point Turn in upper St. Marys River to a bottom width of 1,200 feet and the channel from Brush Point to Point Louise to a bottom width of 1,000 feet, at an estimated cost of $175,500 with increase of $1,000 for annual maintenance of St. Marys River, all as shown on the accompanying maps. The total estimated cost of these improvements is $1,875,500 for new work and $2,000 for annual maintenance in addition to that now required.

VIEWS AND RECOMMENDATIONS OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

13. The Board concurs in the views and recommendations of the reporting officers. The principal improvement now requested is the widening of Southeast Bend in St. Clair River or the provision of a separate downbound channel across the bend to obviate the present hazards of navigation and reduce the time of passage. Other improvements requested are minor channel improvements involving the removal of shoals or easing of bends to provide safer navigation conditions in specific localities. The conditions with regard to width and curvature at Southeast Bend in the St. Clair River present a difficulty to navigation that is out of proportion to the facilities provided in the remainder of the interconnecting channels. The Board believes that widening the bend will greatly improve conditions but that it will not entirely eliminate the hazards of navigation which now exist at times of low visibility. It notes that the provision of a separate downbound channel will not only remove to a large extent the present hazards of navigation, but will result in material savings in time more than sufficient to justify the cost of the proposed improvement. The Board considers a channel width of 300 feet adequate for present and immediately prospective commerce, but believes

that a right-of-way at least 1,000 feet wide should be obtained at this turn to accommodate any future widening of channel found necessary. The removal of Poe Reef Shoal and the easing of the turn and widening of the channel at Brush Point Turn in St. Marys River are minor improvements desirable to reduce existing hazards to navigation. The Board believes that the relatively small cost of these improvements is fully justified by the resulting benefits to navigation. It, therefore, recommends that the project for the Great Lakes connecting waters, principal harbors, and river channels be modified to provide for the construction of a separate downbound channel across Harsen's Island at the Southeast Bend in St. Clair River to a depth of 25 feet below low-water datum and a bottom width of 300 feet at an estimated cost of $1,650,000 with increase of $1,000 for annual maintenance of St. Clair River, subject to the condition that the State of Michigan quitclaims to the United States free of cost all its right, title, and interest in the land needed for a right-of-way 1,000 feet wide and furnish suitable areas for the disposal of dredged materials; for the removal of Poe Reef Shoal in South Channel of the Straits of Mackinac to a depth of 27 feet below low-water datum at an estimated cost of $50,000; and for widening Brush Point Turn in upper St. Marys River to a bottom width of 1,200 feet and the channel from Brush Point to Point Louise to a bottom width of 1,000 feet at an estimated cost of $175,500 with increase of $1,000 for annual maintenance of St. Marys River, all as shown on the accompanying maps. The total estimated cost of these improvements is $1,875,500 for new work and $2,000 for annual maintenance in addition to that now required.

For the Board:

G. B. PILLSBURY,
Brigadier General, Corps of Engineers,
Senior Member.

REPORT OF THE DIVISION ENGINEER

WAR DEPARTMENT,
OFFICE DIVISION ENGINEER, GREAT LAKES DIVISION,
Cleveland, Ohio, May 14, 1935.

Subject: Review of reports in House Document No. 253, Seventieth Congress, first session, on Great Lakes—Connecting waters, principal harbors, and river channels.

To: The Chief of Engineers, United States Army.

AUTHORITY

1. This report is submitted in compliance with the following resolution adopted January 5, 1934:

Resolved by the Committee on Rivers and Harbors of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors created under section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the reports on the Great Lakes—Connecting Waters, Principal Harbors, and River Channels, submitted in House Document Numbered 253, Seventieth Congress, first session, with a view to determining whether further improvement is advisable at the present time.

NATURE OF THE REPORTS BEING REVIEWED

2. In the document under review the Chief of Engineers, on April 26, 1928, recommended modifying the existing project to provide a depth of at least 24 feet for the down-bound channels; for widening certain bends; and for constructing compensating works in St. Clair and Niagara Rivers. He also recommended a separate report as authorized for each of the principal harbors of the Great Lakes.

The recommended modification was authorized by the River and Harbor Act of July 3, 1930, except that the minimum project depth was increased by 1 foot to 25 feet.

DESCRIPTION

3. The locality under consideration comprises the watersheds of Lakes Superior, Michigan, Huron, Erie, and Ontario, and the connecting channels thereof. The geographical description of the watershed of the Great Lakes and the general description of the locality is given in the document under review.

4. United States Lake Survey Charts Nos. 0, 5, 43, and 63 are general maps of the region. Detail maps of specific locations are enclosed.

5. In their original condition the connecting channels had inadequate depths for economical navigation. In the St. Marys River locks were required to overcome the abrupt drop of about 20 feet at St. Marys Rapids. The region is subject to storms, fluctuations of water level, fog, and ice, all of which interfere with navigation. For about 5 months annually the region is winterbound.

EXISTING PROJECT

6. *Prior reports.*—Numerous reports have been made on the subject under review, the principal ones being listed in the document under review.

7. *Subsequent reports.*—Since the submission of that document the following reports have been made:

(*a*) Document 2 of the Committee on Rivers and Harbors, House of Representatives, Seventy-second Congress, first session, channel between Mackinac Island and Round Island, Mich., in which was recommended a channel 1,250 feet wide and 27 feet deep, at an estimated cost of $225,000, with $500 annually for maintenance.

(*b*) Document 3 of the Committee on Rivers and Harbors, House of Representatives, Seventy-second Congress, first session, channels in Lake St. Clair, Mich., in which was recommended the removal of the center dike in St. Clair Flats Canal, and the modification of the existing project for channels in Lake St. Clair to provide for a single channel 700 feet wide and 25 feet deep from the mouth of the St. Clair River to the open channel in Lake St. Clair, at an estimated cost of $350,000.

(*c*) Document No. 5 of the Committee on Rivers and Harbors, House of Representatives, Seventy-fourth Congress, first session, Grays Reef Passage, Mich., in which was recommended an improvement to provide a width of 3,000 feet and a depth of 25 feet through the east channel, at an estimated cost of $132,400.

(*d*) Senate Document No. 110, Seventy-third Congress, second session, St. Lawrence Waterway, in which the President recommended ratification of the St. Lawrence Treaty with Canada. This treaty provided for dredging and for one new lock in St. Marys River; dredging in St. Clair River, Lake St. Clair, and Detroit River; dredging in the Welland Canal; and dredging, locks, and power development in the St. Lawrence River; all to provide a minimum depth of 27 feet for navigation through the Great Lakes to the Atlantic Ocean.

8. The existing project provides for the following when the lake levels are at the established datum planes:

(*a*) A minimum depth of 25 feet and widths in 2-way channels and in 1-way down-bound channels as shown in detail on page 53, House Document No. 253.

(*b*) A minimum depth of 21 feet and suitable widths for up-bound channels.

(*c*) Compensating works in St. Clair and Niagara Rivers to compensate for lowering of lake levels.

(*d*) A channel 27 feet deep by 1,250 feet wide between Mackinac Island and Round Island, Straits of Mackinac, Mich.

9. *Present status.*—The work authorized and completed prior to 1927 is described in the document under review. Since that date the following has been accomplished:

St. Marys River: Removal of Round Island Middle Ground authorized by the act of January 21, 1927, 100 percent completed; widening to 500 feet of the Middle Neebish (upbound) Channel authorized by the act of January 21, 1927, 100 percent completed; and deepening of down-bound channels to minimum depth of 25 feet, 100 percent completed.

Mackinac Island and Round Island: Channel 27 feet deep by 1,250 feet wide authorized by the National Industrial Recovery Act of June 16, 1933, 22 percent accomplished (Jan. 1, 1935) with completion estimated about December 1, 1935.

St. Clair River: Deepening of downbound channels authorized by act of July 3, 1930, 30 percent accomplished with completion estimated about December 1, 1935.

St. Clair Flats Canal: Removal of center dike authorized by the National Industrial Recovery Act of June 16, 1933, 100 percent completed.

Lake St. Clair: Deepening down-bound channels to minimum depth of 25 feet, authorized by the act of July 3, 1930, 65 percent accomplished with completion estimated about July 1, 1936.

Detroit River: Deepening downbound channels to minimum depth of 25 feet authorized by the act of July 3, 1930, 35 percent accomplished with completion estimated about July 1, 1936.

Compensating works: Not started.

Grays Reef Passage, Mich.: Recommended by the Chief of Engineers but not yet authorized.

10. *Datum planes.*—On July 6, 1933, the established datum planes of the Great Lakes were modified as shown on the following table:

Location	Elevation in feet above mean sea level		Difference
	Old datum	New datum	
			Feet
Lake Superior	601.6	601.6	0.0
Lake Michigan	579.6	578.5	−1.1
Lake Huron	579.6	578.5	−1.1
Lake St. Clair	573.8	573.5	−.3
Lake Erie	570.8	570.5	−.3
Lake Ontario	244.5	244.0	−.5

In the execution of the work of deepening downbound channels some work was based on the "Old" datum planes and such work is therefore not completed to project depths by amounts of 0.3 or 1.1 feet, depending on the location. In the letter to the Chief of Engineers dated May 2, 1935, on the "Status of connecting channels on completion of work now in progress", it was recommended by the division engineer:

"(*a*) Any further deepening of the downbound channels await approval of the St. Lawrence Waterway or the construction of new ore carriers capable of being drafted deeper than 22 feet.

"(*b*) Further deepening of upbound channel through St. Marys River (estimated cost $644,000) be deferred until it can be justified by prospective reduction in cost of transportation.

"(*c*) The upbound channel through Detroit River be deepened to full project depth of 21 feet referred to the new datum planes, as added maintenance, at an estimated cost of $220,000, and the district engineer, Detroit, be authorized to submit estimates therefor so as to begin the work upon the completion of Livingstone Channel and so as to prosecute it at an economical rate with the Government plant available."

11. The total costs of the channels connecting Lakes Superior and Erie as of June 30, 1934, is as follows:

New work, including canals and locks in St. Marys River	$57,355,159.36
Maintenance	2,354,967.86
Total, new work and maintenance	59,710,127.22
Operation and care of canals and locks in St. Marys River	6,707,999.91
Total, new work, maintenance and operation, and care	66,418,127.03

The modification of the existing project as recommended in the document under review and authorized by the act of July 3, 1930, at a cost of $29,266,000 has recently been reestimated, with the result that the total cost of the modification is expected to be about $19,780,000, or a saving of about $9,486,000 from the original estimate.

OTHER IMPROVEMENTS

12. *Local cooperation.*—The connecting channels being through waterways, no cooperation by local interests has ever been required.

13. *Improvement by Lake Carriers' Association.*—This association has made two minor improvements in the connecting channels. In 1917, it removed about 210 cubic yards of boulders from Vidal Shoals

in St. Marys River, and in 1922 it removed about 349,000 cubic yards of material from Port Huron Middle Ground in St. Clair River.

14. *Terminal and transfer facilities.*—These facilities have not been required by the Federal Government in connection with improvements to connecting channels. At the principal harbors adequate terminal and transfer facilities have been continually maintained and are considered among the most modern in the world. They are described in general in the document under review and in detail in "Transportation on the Great Lakes, Transportation Series No. 1 (Revised 1930)."

COMMERCE AND VESSEL TRAFFIC

15. *Commerce.*—The volume of traffic traversing the connecting channels of the Great Lakes is indicated in the following table:

Year	St. Marys Falls Canals, Mich. and Ontario		Straits of Mackinac, Mich.		St. Clair River, Mich.	
	Short tons	Value	Short tons	Value	Short tons	Value
1929	92, 622, 017	$1, 000, 327, 459	28, 986, 913	$361, 359, 249	99, 677, 966	$1, 076, 522, 033
1930	72, 897, 752	760, 968, 185	25, 854, 254	301, 956, 031	81, 684, 168	852, 782, 714
1931	44, 613, 671	521, 686, 758	21, 270, 511	229, 541, 682	54, 889, 436	641, 552, 297
1932	20, 480, 873	354, 716, 804	12, 479, 509	150, 564, 192	36, 511, 005	632, 370, 607
1933	40, 307, 893	534, 411, 772	19, 229, 349	227, 309, 312	54, 235, 207	719, 158, 845
Annual mean	54, 184, 441	634, 420, 996	21, 564, 107	254, 146, 093	65, 399, 556	784, 477, 299

The commerce of the Lakes is essentially one of bulk commodities of which the principal are as follows:

Iron ore—Lake Superior to Lakes Erie and Michigan.

Grain—Lake Superior to Lake Erie and St. Lawrence River.

Coal—Lake Erie to Lakes Superior and Michigan.

Stone—Lake Huron to Lake Michigan.

Stone—Lake Huron to Lake Erie.

Additional data are given in the district engineer's report, in the document under review, and in Transportation on the Great Lakes, Transportation Series No. 1 (Revised 1930).

16. *Vessel traffic.*—The past few years has witnessed a definite trend to the self-unloading type of vessel for the coal and stone trade, both by construction of new vessels and conversion of existing ships into self-unloaders. For general sizes of vessels now operating on the Great Lakes see the district engineer's report, the document under review, and Transportation on the Great Lakes, Transportation Series No. 1 (Revised 1930).

IMPROVEMENTS DESIRED

17. The division and district engineers did not consider a public hearing necessary because of the general character of the connecting channels. The views of all United States vessel interests were requested and the views of the Lake Carriers' Association, representing about 83 percent of the American tonnage on the Lakes, were taken as a measure of the improvements desired. This association requested the following improvements:

(*a*) *St. Clair River, Southeast Bend.*—Widen this bend from 600 to 800 feet in width. The present two-way channel is a reverse curve with a total curvature of about 180° in a length of 3 miles. The grounding of a 600-foot freighter across this channel would block the channel. The widths above and below the locality are from 800 to 1,000 feet for similar two-way traffic. At no other point in the connecting channels is there so great a danger of collision. The minimum width should be at least as much as other straighter reaches. It is emphasized that the special board on Great Lakes channels recognized the need for wider channels and considered reducing the hazard by providing a separate downbound channel. Attached to the district engineer's report are subsequent letters from the Cleveland lodge of the International Shipmasters' Association and from a number of vessel masters urging the construction of a separate downbound channel across this bend. In addition, a separate downbound channel is urged by the president of the Lake Carriers' Association in a letter addressed to the division engineer, copy attached.

(*b*) *Lake Huron, Thunder Bay Island Shoals.*—Remove the shoals lying 6 to 7 miles northwest of Thunder Bay Island Light. They have a minimum depth of about 22½ feet and are within the limits of steamer lanes laid out for upbound and downbound traffic. To avoid these shoals at times of obscure vision would require a considerable detour, and also an effective aid to navigation.

(*c*) *Straits of Mackinac, Poe Reef Shoal.*—Remove the shoal lying about 1½ miles east of Poe Reef Lighthouse. It is directly on the sailing course and has a minimum depth of 24 feet of water. While a navigable passage exists on either side, the shoal is a hazard at times of low visibility, fog, and storm.

(*d*) *St. Marys River, Brush Point Turn.*—Remove about 400 feet of this turn at the point where the shoal juts out into the river and the channel changes direction. This would be in extension of the straight and well-defined channel just below Brush Point and would materially aid navigation and make for safety at this location. The present channel has fairly good width but vessels meeting at the turn have difficulty, especially at times of low visibility.

(*e*) *St. Marys River, Point Iroquois Shoals.*—Remove a part of the southeasterly end of these shoals. At this point the shoal encroaches to within a few hundred feet of Birch Point range line. The remainder of the shoal is in general 1,000 feet away from the range line.

(*f*) *St. Marys River, Gros Cap Reef.*—Investigate with a view to removal, or to a change in location of aids, the shoal about 2,000 feet southeast of Gros Cap Reef Lightship. It has about 23 feet over it and is very close to Birch Point range line. Also the Point Iroquois Light, if it were moved about 8,000 feet east 20° north of its present location, would be in a better position, and a slight change in course from Whitefish Point would avoid Gros Cap Reefs.

(*g*) The association points out that the special board on Great Lakes channels in the document under review computed that a delay of 7 minutes for each upbound boat in Lake Superior trade would justify spending a million dollars in St. Marys River and that the suggested improvements would not only prevent delay but would contribute materially to safer navigation.

SPECIAL SUBJECTS

18. The existing development of water power at Sault Ste. Marie in St. Marys River will not be affected by the present report. There are no problems of land reclamation or flood control involved in this report.

PLANS OF IMPROVEMENT

19. *St. Clair River, Southeast Bend*—(*a*) *Widening to 800 feet.*—This plan contemplates widening the present 600-foot channel to a width of 800 feet from a point about 2,600 feet below Harsens Island Light 17–A to a point near Lower Reach Light No. 5, a distance of about 20,500 feet, thence tapering to 700-foot width in a distance of about 3,500 feet, thence continuing 700 feet wide to St. Clair Flats Canal.

On the easterly side of the channel between Haybury Highway Light No. 2 and Southeast Bend Light No. 4, the widening may cause some falling in of the banks. The land area in this vicinity is low and marshy and is public property of the Canadian Government. There should be no difficulty obtaining Canadian consent for the work. The widening may require the relocation of two aids to navigation, which the local superintendent of lighthouses does not consider difficult or costly.

The district engineer estimates the cost as follows, based on hydraulic dredging:

Dredging 2,700,000 cubic yards, at 22 cents	$594,000
Overhead, supervision, contingencies	81,000
Total	675,000

(*b*) *Widening to 700 feet.*—To provide a widening to 700 feet is estimated to cost as follows:

Dredging 908,000 cubic yards, at 40 cents	$363,200
Overhead, supervision, contingencies	41,800
Total	405,000

(*c*) *Separate downbound channels.*—The third plan considered for the Southeast Bend is to provide a separate downbound channel 300 feet wide and 25 feet deep, extending across Harsens Island from Harsens Island Light No. 17–A to about 1,500 feet below Lower Reach Light No. 7, a distance of about 18,500 feet.

The right-of-way for this channel is on land held in trust by the State of Michigan for its people for the purposes of navigation, fishing, and hunting. Subject to these purposes about 91 percent of this right-of-way has been leased to private individuals. The proposed channel will cut State Highway No. M154 in the vicinity of Tashmoo Park and thereby isolate some lands between the new channel and the St. Clair River.

The district engineer estimates the cost as follows:

Dredging 6,267,000 cubic yards, at 20 cents	$1,253,400
Overhead, supervision, contingencies	396,600
Total	1,650,000

20. *Lake Huron, Thunder Bay Island Shoals.*—(*a*) The removal of these shoals involves the clean-up, to a depth of 27 feet, of about 8,846,000 square yards of area by dipper dredge and derrick boat.

The district engineer considers the cost of such a plan to be prohibitive and not warranted.

(*b*) The removal of the four most easterly shoals marked "G," "H," "I," and "J" on the attached map was considered by the district engineer and estimated to cost about $100,000.

(*c*) The removal of the most easterly shoal marked "J" on the attached map was also considered and estimated to cost about $20,000.

21. *Straits of Mackinac, Poe Reef Shoal.*—The removal of this shoal involves the clean-up, to a depth of 27 feet, of about 22,000 square yards of area by dipper dredge and derrick boat. The district engineer estimates the cost to be $50,000.

22. *St. Marys River, Brush Point Turn.*—(*a*) The first plan considered increases the width of the 15° turn from 1,000 to 1,600 feet. For a depth of 26 feet the district engineer estimates the cost to be $132,500.

(*b*) The second plan considered consists in securing, in addition to the above widening, a width of not less than 1,000 feet throughout the turn. The plan involves additional dredging above the turn for a distance of about 7,000 feet. The total improvement is estimated by the district engineer to cost as follows:

Widen turn from 1,000 to 1,600 feet, 530,000 cubic yards, at 25 cents	$132, 500
Widen channel above turn to 1,000 feet, 658,800 cubic yards, at 25 cents	164, 700
Total, including overhead, contingencies, supervision	297, 200

(*c*) The third plan considered is a modification of the first two plans. A width of 1,200 feet at the turn can be obtained by a small amount of dredging. Under this plan the cost as estimated by the district engineer would be:

Widen turn from 1,000 to 1,200 feet, 43,200 cubic yards, at 25 cents	$10, 800
Widen channel above turn to 1,000 feet, 658,800 cubic yards, at 25 cents	164, 700
Total, including overhead, contingencies, supervision	175, 500

23. *St. Marys River, Gros Cap Reefs, and Point Iroquois Shoals.*—A portion of Gros Cap Reefs projects about 700 feet west of the channel line as marked by Gros Cap Reefs Lighthouse. The shoal, as marked by the lightship and the present sailing course, has an area of about 67,700 square yards with a least depth of 24.5 feet. Its removal is estimated by the district engineer to cost about $70,000. At Iroquois Shoals the removal of about 40 feet of one projecting shoal will give a minimum width of 700 feet west of Birch Point Range line. The plan considered by the district engineer is to move the Gros Cap Reef Lightship to the westerly edge of Gros Cap Reef—about 700 feet—and thus eliminate dredging these shoals and to remove the small projecting Point Iroquois Shoal as a matter of maintenance.

VIEWS OF THE DISTRICT ENGINEER

24. *St. Clair River, Southeast Bend.*—The district engineer considers the present channel fairly practicable. While there has been no actual blocking of the channel, there have been 19 minor collisions in the past 12 years, resulting in damages estimated at $60,000. Normally vessels meet in this bend and great care in navigation is required, with the result that the entire movement is slowed down. A widening to 700 or 800 feet would ease conditions and save some time. The

saving of 1 minute of time would justify an investment of about $405,000 and a saving of nearly 2 minutes would justify an investment of about $675,000. The proposed widening will not cure difficulties of navigation around reverse curves and in any case requests for easement of conditions would probably continue.

The district engineer points out that the special board of engineers seriously considered a separate downbound channel through Harsen's Island. The downbound cut-off will save 1 mile in distance, or about 6 minutes in time. The separation of traffic should save 4 minutes in the upbound channel. On this basis he estimates annual savings of $66,700. These savings, at 4 percent, represent a justified investment of $1,667,500.

The district engineer views a separate downbound channel at this bend as the ultimate solution and believes it should be adopted now. It is his opinion that the land needed for the improvement can be obtained by a quitclaim deed from the State of Michigan followed by condemnation proceedings to determine the rights of the lessees and the damages to them, if any.

25. *Lake Huron, Thunder Bay Island Shoals.*—In the opinion of the district engineer, these shoals constitute a possible hazard only to upbound vessels, mainly in the stone trade out of Alpena, Mich. Some of this traffic may load to greater draft than upbound traffic through the Detroit River and must therefore avoid the shoals having about 22 feet over them. He estimates that on perhaps 17 trips of these vessels they may have to take a course about 5 miles longer than the usual upbound course, resulting in an actual money loss of $340 per season. He points out such loss cannot justify the cost.

26. *Straits of Mackinac, Poe Reef Shoal.*—This shoal lies near the middle of an otherwise free and open channel about 2 miles wide which is used by all commerce to and from Lake Michigan. The district engineer points out that improvement is not urgent for upbound traffic limited by depth of upbound connecting channels, but that a considerable tonnage of stone from Lake Huron is subjected to hazard and delay especially in times of fog and storm. He believes that an expenditure of $50,000 for removal of this shoal is justified.

27. *St. Marys River, Brush Point Turn.*—The district engineer considers that if a more suitable turn can be procured at moderate cost, improvement as insurance against hazard during periods of low visibility is warranted. He believes that improvement of the 700-foot channel above Brush Point Turn is warranted, even though the economic benefits are not tangible.

28. *St. Marys River, Gros Cap Reefs and Iroquois Shoals.*—In the opinion of the district engineer the conditions at these localities can be relieved by adjustnent of aids for Gros Cap Reefs and a slight amount of maintenance for Iroquois Shoals, and that these improvements can be made under the existing project.

RECOMMENDATIONS OF THE DISTRICT ENGINEER

29. In view of the above considerations the district engineer recommends that the existing project for the Great Lakes—Connecting Waters, Principal Harbors, and River Channels be modified to provide for the construction of a separate downbound channel across the

Southeast Bend, St. Clair River, Mich., to a depth of 25 feet at low-water datum and a bottom width of 300 feet, at an estimated cost of $1,650,000 with $1,000 increase in annual maintenance of the St. Clair River; for the removal of Poe Reef Shoal, South Channel, Straits of Mackinac, Mich., to a depth of 27 feet below low-water datum at an estimated cost of $50,000; and for widening Brush Point Turn, St. Marys River, to 1,200 feet and the channel from Brush Point to Point Louise to 1,000 feet, at an estimated cost of $175,500 with increase of $1,000 in annual maintenance for St. Marys River. The total estimated cost of these improvements is $1,875,500 for new work and $2,000 for annual maintenance in addition to that now required.

VIEWS OF THE DIVISION ENGINEER

30. *St. Clair River, Southeast Bend.*—The sinuous channel accommodates 2-way traffic where from 50 to 100 passages occur per day. It is a sharp reverse curve about 3 miles long. At its upper end a downbound vessel must turn on a radius of about 2,100 feet and at about its center the turn is on a radius of about 3,000 feet. At its upper end an upbound vessel must turn on a radius of about 3,200 feet. For 2-way traffic these navigating conditions are obviously difficult. The locality is subject to frequent periods of low visibility and fog which frequently slow movement of ships and at times stop movement altogether. The present channel is 600 feet minimum width. Work now in progress above the bend will provide a 2-way channel of easy turns and 1,000 feet minimum width and below the bend a channel of easy turns and 700 feet minimum width. Navigators consider Southeast Bend the most hazardous stretch in connecting channels and it is merely fortunate that no serious collision has occurred in it. The division engineer believes that widening of this bend will ameliorate conditions and provide for safer movement of traffic, but he does not believe that the widening will eliminate the ever-present hazard inherent in present conditions. Deducting the cost of widening the existing channel to 800 feet ($675,000 from the total cost of $1,650,000) makes the extra cost of the separate down-bound channel $975,000.

The division engineer concurs in the plan recommended by the district engineer for a separate down-bound channel 300 feet wide and 25 feet deep across Harsens Island, principally because separation of traffic will eliminate the hazards inherent with two-way movement at this location. In addition, the probable future deepening of connecting channels to a 27-foot depth for the Great Lakes to the ocean waterway will introduce a different and less easily handled type of vessel to these channels, which will further emphasize the need for separate channels at Southeast Bend. If the separate down-bound channel is built now, deepened to 27 feet at a later time, and the up-bound route later deepened to the same depth over a width of 500 feet, the extra cost will be no greater than widening the existing channel to 800 feet and later deepening it to 27 feet.

The necessary land for this proposed channel is held in trust by the State of Michigan, subject to the paramount rights of navigation, fishing, and hunting and can be deeded to the United States for the purpose proposed. The rights of the lessees of the land included in the right-of-way, the damages to property and for possible isolation

of adjacent land owners, if any, can be adjusted, it is believed, by outright purchase or by condemnation. The district engineer's estimated cost of $1,650,000 is concurred in.

31. *Straits of Mackinac, Poe Reef Shoal.*—A practicable channel exists on either side of this shoal, which lies nearly in the center of a channel about 2 miles in width. The route is traversed by a large tonnage of deep-draft commerce plying between Lake Huron and Lake Michigan. The division engineer believes that the relatively small cost of $50,000 for obtaining a depth of 27 feet over this shoal is warranted.

32. *St. Marys River, Brush Point Turn.*—Recent improvements above this turn in upper St. Marys River have provided channels of 1,000 feet minimum width. The route below the turn lies in natural deep water and is more than 1,000 feet in width. The recommendation of the district engineer increases the width of channel a short distance above the turn from about 700 feet width to 1,000 feet width and increases the width at the turn to 1,200 feet. The improvement rectifies a channel between Lake Superior and St. Marys Falls Canals and Locks which is otherwise very satisfactory and can be accomplished at moderate cost. The district engineer's cost estimate of $175,500 is concurred in.

RECOMMENDATION OF THE DIVISION ENGINEER

33. I therefore recommend that the project for the Great Lakes, connecting waters, principal harbors, and river channels be modified to provide for the construction of a separate down-bound channel across Harsen's Island at the Southeast Bend in St. Clair River to a depth of 25 feet below low-water datum and a bottom width of 300 feet at an estimated cost of $1,650,000 with increase of $1,000 for annual maintenance of St. Clair River; for the removal of Poe Reef Shoal in South Channel of the Straits of Mackinac to a depth of 27 feet below low-water datum at an estimated cost of $50,000; and for widening Brush Point Turn in upper St. Marys River to a bottom width of 1,200 feet and the channel from Brush Point to Point Louise to a bottom width of 1,000 feet at an estimated cost of $175,500 with increase of $1,000 for annual maintenance of St. Marys River, all as shown on the accompanying maps. The total estimated cost of these improvements is $1,875,500 for new work and $2,000 for annual maintenance in addition to that now required.

34. The report of the district engineer is transmitted herewith.

M. C. TYLER,
Colonel, Corps of Engineers,
Division Engineer.

REPORT OF THE DISTRICT ENGINEER

SYLLABUS

The district engineer is of the opinion that to afford greater safety and ease in navigation throughout the Great Lakes, connecting waters, and river channels, further improvement at certain restricted localities is advisable at this time. He recommends that the existing project be modified to provide for the construction of a separate down-bound channel 25 feet deep and 300 feet wide across the Southeast Bend, St. Clair River, Mich., at an estimated cost of $1,650,000, with an increase in cost of maintenance of $1,000 per year; for the removal of Poe

Reef Shoal in the South Channel, Straits of Mackinac, Mich., at an estimated cost of $50,000, with no increase in annual maintenance; and for the widening of Brush Point Turn, St. Marys River, Mich., to 1,200 feet and of the channel from Brush Point to Point Louise to 1,000 feet at an estimated cost of $175,500, with an increase in cost of maintenance of $1,000 per year.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Detroit, Mich., March 25, 1935.

Subject: Review of preliminary examination and survey reports on Great Lakes, connecting waters, principal harbors, and river channels.

To: The Chief of Engineers, United States Army.
(Through the Division Engineer.)

1. *Authority.*—On January 5, 1934, the Committee on Rivers and Harbors of the House of Representatives, United States, adopted the following resolution:

Resolved by the Committee on Rivers and Harbors of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors created under section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby, requested to review the reports on the Great Lakes, connecting waters, principal harbors, and river channels, submitted in House Document Numbered 253, Seventieth Congress, first session, with a view to determining whether further improvement is advisable at the present time.

2. The Chief of Engineers, under date of January 25, 1934, requested the division engineer to submit a report covering the subject matter of the resolution. This office was subsequently directed by the division engineer to prepare such a report.

3. *Nature of reports being reviewed.*—The reports being reviewed are preliminary examination and survey reports which were called for by the River and Harbor Act approved January 21, 1927, as follows:

Great Lakes: With a view to providing ship channels with sufficient depth and width to accommodate the present and prospective commerce at low-water datum for the Great Lakes and their connecting waters, and their principal harbors and river channels, either by means of compensation or regulatory works or by dredging and rock removal in the separate localities, or by both methods.

4. In the document under review, the Chief of Engineers reported that the modification of the then existing project for the Great Lakes connecting channels was deemed advisable so as to provide for deepening all down-bound channels and the up-bound channel at St. Clair Flats Canal to afford depths below datum planes of 24 feet in soft bottom, generally 25 feet in hard bottom, 25 feet through the shoal at the foot of Lake Huron (800 feet in width), 25 feet in the Fighting Island Channels and through the Livingstone Channel, 26 feet in Round Island Middle Ground and Round Island Shoals Nos. 1 and 2, and 27 feet in West Neebish Rock Cut; for widening by 300 feet the bend at Light No. 27 at Little Rapids Cut; for widening to 600 feet the channel through the Southeast Bend, St. Clair River; and for the construction of compensating works in St. Clair and Niagara Rivers. The recommended channel widths in localities where there was no physical separation of up-bound and down-bound traffic varied from 600 feet to 1,400 feet. Where such separation existed, the recommended widths were 300 feet in the West Neebish Channel, St. Marys River; 300 feet in the east and west channels, St. Clair Flats Canal; 450 feet in the rock section of Livingstone Channel, Detroit River; and 800 feet in the earth section of Livingstone Channel. The

above depths and widths of channel were considered suitable for 23-foot navigation. With regard to the principal harbors, it was recommended that each be made the subject of a separate report when and as specifically authorized by Congress in each case.

5. The modification of the project was authorized by the River and Harbor Act approved July 3, 1930. As adopted by Congress, it provided for deepening the downbound channels and the upbound channel at St. Clair Flats Canal 1 foot more than the Chief of Engineers deemed advisable, in order to provide channels suitable for vessels of 24-foot draft. The other features of the project as recommended by the Chief of Engineers were adopted. The estimated cost of the work as authorized was $29,266,000, including the cost of compensating works in the Niagara River and St. Clair River. The estimated annual maintenance cost was $171,500.

6. *Description—Tributary area.*—The general locality is shown on United States Lake Survey Charts Nos. 0, 5, 43, and 63. For a geographical description of the watershed and a general description of the locality under consideration, reference is made to the document containing the reports being reviewed. Since the date of that document the enlargement of the Welland Canal connecting Lake Ontario with Lake Erie has been completed. The following maps showing details at the several localities under discussion accompany this report:

South East Bend, St. Clair River, Mich.
Harsens Island, St. Clair River, Mich.
Thunder Bay Shoals, Lake Huron, Mich.
Poe Reef Shoal, South Channel, Straits of Mackinac, Mich.
Upper St. Marys River, Mich.

7. *Prior reports.*—For a discussion of the reports submitted and published prior to the reports being reviewed reference is made to pages 25–27 of the document containing the latter. Since the date of that document three reports bearing upon the Great Lakes connecting channels have been made. Two of these were in response to a resolution adopted December 17, 1930, by the Committee on Rivers and Harbors of the House of Representatives, requesting a review of the reports submitted in Document No. 253, Seventieth Congress. The first of these reports was published in Document No. 2 of the Committee on Rivers and Harbors, House of Representatives, Seventy-second Congress, first session. The Chief of Engineers recommended therein a channel 1,250 feet wide and 27 feet deep between Mackinac Island and Round Island, Mich., at an estimated cost of $225,000, with $500 annually for maintenance.

8. The second report is contained in Document No. 3 of the Committee on Rivers and Harbors, House of Representatives, Seventy-second Congress, first session. It was recommended therein that the center dike in the St. Clair Flats be removed and the project for the channels in Lake St. Clair be modified to provide for a single channel 700 feet wide and 25 feet deep from the mouth of the St. Clair River to the open channel in Lake St. Clair, all at an estimated cost of $350,000.

9. A third report was made in response to a resolution adopted January 5, 1934, by the Committee on Rivers and Harbors of the House of Representatives, requesting a review of the reports on Grays Reef Passage, Mich., submitted in House Document No. 883, Sixty-third Congress, second session. In this report the Chief of Engineers

under date of August 21, 1934, recommended the improvement of the passage to provide a width of 3,000 feet and a depth of 25 feet through the east channel at an estimated cost of $132,400—no provision for maintenance being considered necessary.

10. In addition to the above, a survey of the economic aspects of the Great Lakes-St. Lawrence project has been made by an interdepartmental board composed of representatives of the War Department, the Department of Commerce, the Federal Power Commission, and the Power Authority of the State of New York. The report of this survey was submitted to the President on January 10, 1934, and transmitted to the Senate in a message from the President of same date. It has been printed in Senate Document No. 110, Seventy-third Congress, second session.

11. *Existing project.*—The existing project for the through waterway between Lake Superior and Lake Erie provides for depths in the downbound channels (including all two-way channels) suitable for vessels drawing 24 feet, and where separate upbound channels are provided, depths suitable for vessels drawing 20 feet, when the lake stages correspond to the established datum planes. For project depths and widths at the controlling localities in the downbound channels, reference is made to table III on page 53 of the document under review. The project dimensions in the separate upbound channels of the waterway are Middle Neebish Channel, St. Marys River, depth 21 feet and width 500 feet; Amherstburg Channel, Detroit River, depths 21 and 22 feet and widths, 600 and 800 feet. A separate upbound channel east of Stag Island in the St. Clair River having a project depth of 20 feet and width of 800 feet, is a part of the existing project, but is not critical since the down-bound channel west of the island is being constructed as a two-way channel. The construction of compensating works in the St. Clair River and Niagara River to compensate for the lowering of lake levels as a result of diversion of waters from the lakes and increasing the dimensions of the channels in the connecting waters, is an integral part of the project.

12. Since the date of initiation of the existing project, new low-water datum planes have been adopted for all of the Lakes except Lake Superior. The new planes are lower than the previous ones by the following amounts:

	Feet
Lakes Huron and Michigan	1.1
Lake Erie	.3
Lake Ontario	.5

Due to the fact that much of the work under the project had been either completed or placed under contract prior to the change in datum planes, the depths to which some sections of the channels have been excavated are referred to the previous planes and consequently these sections are deficient in depth as referred to the new planes. This is particularly true in the lower St. Marys River, the maximum deficiency there amounting to 1.1 feet.

13. A complete description of the work completed and authorized on the interconnecting channels prior to 1927 is given in paragraphs 32–41 of the report of preliminary examination under review (see pp. 28–30, Doc. 253). Since that report, the following has been accomplished: In the St. Marys River, the removal of the Round

Island middle ground and the widening of the Middle Neebish Channel, both authorized by the River and Harbor Act of January 21, 1927, and the deepening of the downbound channels as authorized by the River and Harbor Act of July 3, 1930, have been completed to project depths referred to the previous datum plane. In the St. Clair River, the project, exclusive of the compensating works, is approximately 30 percent complete. Funds for completion of the channel in this river are now available and it is expected that full project dimensions will be attained by December 1, 1935. In Lake St. Clair the project is about 65 percent complete and the work remaining to be done is scheduled for completion by July 1, 1936. In the Detroit River the project is approximately 35 percent complete and is expected to be fully completed by July 1, 1936. The construction of the compensating works provided for in the project has necessarily been deferred because of the unusually low lake levels that have obtained during the past several years. In the St. Clair River, Lake St. Clair, and the Detroit River the channels are for the most part being excavated to project depths referred to the new datum planes. On the estimated dates of completion given above, there will remain several localities in each of these channels where the depths will be deficient when referred to the new datum planes because the work therein was completed or contracted for prior to the adoption of the new planes. At the head of the St. Clair River (foot of Lake Huron) this deficiency will amount to 1.1 feet. At the head of Russell Island in the St. Clair River it will amount to 0.5 foot. At all other localities where a deficiency will exist, it will not exceed 0.3 foot.

14. In addition to the above, the removal of the center dike at St. Clair Flats Canal has been completed and the deepening of the channel between Mackinac Island and Round Island, Mich., has been begun, both under the provisions of title II of the National Industrial Recovery Act approved June 16, 1933. The latter work is scheduled for completion by the end of the 1935 navigation season.

15. The cost to June 30, 1934, of the channels between the Lakes from Lake Superior to Lake Erie, has been $57,355,159.26 for new work, including the cost of the St. Marys Falls Canal and locks, and $2,354,967.86 for maintenance. In addition, the total cost to the same date of operation and care of the St. Marys Falls Canal and locks has been $6,707,999.91.

16. *Local cooperation.*—In the improvement of the interconnecting channels, local cooperation has never been required because of the general nature of the through waterway.

17. *Other improvements.*—The Lake Carriers' Association, under permits from the Secretary of War, has performed some work of minor improvement in the through channels. In 1917, approximately 210 cubic yards of boulders were removed by the association from the channel through Vidal Shoals, St. Marys River, and in 1922, approximately 348,911 cubic yards of material were dredged by the same agency from the Middle Ground at Port Huron for the purpose of widening the downbound channel there.

18. *Terminal and transfer facilities.*—In the reports under review, there was no special requirement on the part of the Federal Government with respect to additional facilities of this nature, and no such requirements are considered necessary in connection with the improvements now being considered. The construction and improve-

ment of such facilities by private interests has always kept pace with the improvement of the Lake channels.

19. *Improvements desired.*—The views of all United States steamship interests on the Great Lakes, on the subject of the resolution, have been solicited by letter. Because of the general character of the through waterway, a public hearing was not considered necessary in the first instance, and inasmuch as no interest developed as a result of the solicitations of this office, except on the part of the Lake Carriers' Association, no hearing was held. The views of that association, which represents approximately 83 percent of the gross registered tonnage under United States registry on the Lakes, may be taken as an authoritative statement of the improvements desired. In a letter from the association, under date of March 13, 1934, the following suggestions were made:

(*a*) That the channel at Southeast Bend through the delta of the St. Clair River be widened to 800 feet throughout its entire length of approximately 4½ miles. The reason advanced in justification of this improvement is that an extremely hazardous condition exists there due to the curvature of the channel and frequent meeting of vessels therein; and in the event of a collision or grounding, involving a modern 600-foot freighter, the channel might be completely blocked until the vessel could be salvaged.

(*b*) That the shoal areas lying about 6 miles north by west and 7 miles north by east from Thunder Bay Island Light in Lake Huron be removed to provide suitable depths for 24-foot navigation, since they lie within the steamer lanes laid out for up-bound and down-bound traffic and now have a depth of only 22½ feet over them. This would require the removal of all material within the 27-foot contour as shown on drawing D. M. 10/58 herewith.

(*c*) That the shoal area lying about 1½ miles easterly from the Poe Reef Lighthouse in the South Channel, Straits of Mackinac, be removed to provide for depths suitable for 24-foot navigation, since it is located directly on the sailing course and now has a depth of only 24 feet over it.

(*d*) That the shoal which juts out into the upper St. Marys River at Brush Point be cut back about 400 feet. The reason given in justification of this improvement is that the channel changes direction at this point and vessels meeting at the turn have difficulty in passing, especially at times of low visibility, and as a result, the improvement would make for safety at a location where accidents are likely to occur.

(*e*) That the southeasterly end of the Point Iroquois shoals in Whitefish Bay at the head of the St. Marys River be removed to project depth in order to give greater width between these shoals and the sailing course as defined by the Birch Point Range Line.

(*f*) That the shoal southeast of Gros Cap Reef Lightship in Whitefish Bay, at the head of St. Marys River, which encroaches on the sailing course and has a depth of only 23¼ feet over it, be removed or the location of the aids to navigation in this locality be changed in order to avoid it.

20. It is pointed out by the association that the suggested improvements cover localities which either were overlooked in the reports under review or were omitted for reasons which it is considered may well be modified in view of later developments. It is also the view of the association that, in addition to contributing materially to the safety of navigation by removing existing hazards, the proposed improvements would save delay to shipping by reason of the greater assurance masters would have in traversing the several channels. In this latter connection, reference is made to the finding in the report under review (p. 81) that a delay of 7 minutes for each up-bound boat in the Lake Superior trade would justify the expenditure of a million dollars in the St. Marys River.

21. Communications have also been received from Cleveland Lodge No. 4 of the International Shipmasters Association of the Great Lakes

and a number of masters of vessels pointing out the hazards that attend the navigation of the Southeast Bend, St. Clair River, and urging the elimination of these hazards by the construction of a separate channel for down-bound vessels across the bend. Copies of these communications [1] are enclosed herewith. These views are endorsed by the Lake Carriers' Association.

22. *Commerce.*—In the report on preliminary examination under review (p. 34), a statement was submitted showing the traffic through the St. Marys Falls Canals for the period 1887 to 1926, inclusive. Table I [1] submitted herewith continues the statement to include the year 1933. Table II [1] herewith is a statement of interlake traffic between Lakes Michigan and Huron via the South Channel, Straits of Mackinac for the years 1929–33, including Table III [1] is a statement of traffic through the St. Clair River for the years 1925–33 inclusive.

23. The decreases in tonnages and values of commerce during the past 5 years are merely a reflection of the trend of general economic conditions throughout the country. With improvement in those conditions, a definitely upward trend in the volume of traffic may reasonably be expected.

24. The improvements now under discussion, being in the nature of refinements in the present project intended to reduce hazards to navigation and to increase the ease of navigating at various localities throughout the interconnecting channels, will not appreciably alter the conclusions on prospective commerce and savings in freight rates pertaining to the whole project as contained in the reports under review.

25. There is a considerable use of the through waterway by passenger craft, yachts, fishing boats, motor boats and other similar craft, but as the present dimensions of the project are greatly in excess of those required by such craft, the volume of this traffic has no bearing on the present discussion.

26. *Vessel traffic.*—Supplementing the data on vessel traffic contained in the report on preliminary examination under review (p. 36), table IV [1] herewith gives the sizes of freight carriers using the locks at the St. Marys Falls Canals for the years 1927 to 1933, inclusive, and tables V [1] and VI [1] show, for the year 1933, the classification of bulk-freight steamers and self-unloading bulk freighters included in the membership of the Lake Carriers' Association. A comparison of the data contained in these tables with those given in the prior reports indicates a continuation of the trend toward the use of larger sized freighters. The most noteworthy change in the character of vessels in recent years has been the conversion of freighters into self-unloaders for use in the stone and coal trade.

27. *Difficulties attending navigation.*—A discussion of this subject is contained in the report on preliminary examination under review (p. 31). There has been no change in the conditions described therein, except that the lakes other than Lake Superior, are now passing through a stage of exceptionally low levels.

28. *Survey.*—A sounding survey has been made of the Southeast Bend, St. Clair River, in connection with the prosecution of the work of the present 24-foot project. Sweeping and sounding surveys were made, for the purpose of this report, of Poe Reef Shoal in the Straits of Mackinac, Gros Cap Reef, and Point Iroquois Shoals at the head of

[1] Not printed.

the St. Marys River, and Brush Point Turn in the upper St. Marys River. The data on Thunder Bay Island Shoal were obtained from sweeping surveys of the U. S. Lake Survey made in 1907 and 1910. In addition to the foregoing, a survey was made of a 1,200-foot strip of land on Harsens Island between the upper and lower ends of the Southeast Bend, St. Clair River, with a view to the determination of the possibility of constructing a separate down-bound channel across the bend. This survey included the usual data necessary for the determination of quantities and character of material and in addition an investigation of the county and State records of the real estate within and adjoining the strip.

29. *Plans of improvement.*—The plans of improvement that have been considered involve channel widening and removal of shoals at various localities throughout the waterway as follows:

30. *Southeast Bend, St. Clair River.*—The existing project provides for a width of 600 feet in the Southeast Bend from Harsens Island Light No. 17A to Lower Reach Light No. 5, a distance of approximately 23,000 feet. Below the bend the 600-foot width continues to the head of the St. Clair Flats Canal where the project width is 700 feet. Up stream from Harsens Island Light No. 17A the project width is 1,000 feet. The bank to bank width of the river in the bend varies from 900 to 2,200 feet. The international boundary generally follows the middle of the stream. The banks on both sides are low. On the American side they generally have been built up and bulk-headed and the shores are lined with homes, summer cottages and docks. On the Canadian side the land is marshy and undeveloped. Natural widths of channel in excess of 800 feet exist for a distance of about 2,600 feet below Harsens Island Light No. 17A.

31. The plan of improvement suggested by the Lake Carriers' Association contemplates widening the channel to 800 feet from this point downstream to Lower Reach Light No. 5. From this light the channel would taper to a width of 700 feet in a distance of 3,500 feet and thence be continued at 700-foot width to the St. Clair Flats Canal 7,500 feet farther downstream. The widening would not encroach on fast land. The material consists of sand, clay, and mud which will take a slope not flatter than one on four. Some sloughing of the banks may result on the Canadian side between Maybury Highway Light and Southeast Bend Light No. 4, but would not amount to more than 75 feet at any place and in the aggregate will not exceed 10 acres. Since the land is understood to be public property under the control of the Dominion of Canada and the Province of Ontario and is entirely undeveloped marshland, no difficulty in obtaining Canadian consent to the work should be experienced. The volume of material to be removed is estimated at 2,200,000 cubic yards to a project depth of 25 feet plus 500,000 cubic yards to a 2-foot over-depth, a total of 2,700,000 cubic yards. It is suitable for dredging by hydraulic pipe-line methods. The widening would result in a change in location of one or possibly two aids to navigation on the American side. These aids are mounted on frame structures and their relocation would not involve a large expenditure. The local superintendent of lighthouses has been consulted and can foresee no difficulty in connection with their relocation. It is estimated that the cost of completing the work would be as follows:

Dredging 2,700,000 cubic yards, at 22 cents	$594,000
Contingencies, overhead, supervision	81,000
Total	675,000

32. An estimate has also been made of the cost of increasing the width to 700 feet. The quantity of material to be removed to obtain such a width is considerably less than in the former case since it avoids much of the heavy cutting on the Canadian side of the channel. However, the area to be dredged is not proportionately reduced and consequently a higher unit cost for the dredging can be expected. The cost of the dredging necessary to obtain a channel not less than 700 feet wide throughout the bend is estimated as follows for a 25-foot depth with 2 feet overdepth dredging:

Dredging 908,000 cubic yards, at 40 cents	$363,200
Contingencies, overhead, supervision	41,800
Total	405,000

33. Consideration has also been given to the construction of a separate downbound channel 300 feet wide and 25 feet deep across Harsens Island—thus eliminating the bend for downbound traffic as urged by the Cleveland Lodge of the International Shipmasters Association and others. The length of this channel would be approximately 18,500 feet. On the assumption that side slopes of one vertical on four horizontal will be necessary, a right-of-way 550 feet wide is required. The total area of land within such right-of-way is 180.55 acres. By virtue of the fact that this property was originally lake bottom lands the State of Michigan holds the title thereto, in trust for the people of the State for the purposes of navigation, hunting, and fishing. Although the subject of litigation for a number of years, the State's title was confirmed by a decision of the Supreme Court of the State of Michigan in 1910.

34. With the exception of about 15.75 acres, all the land is leased by the State to private individuals under 50-year leases with the option of renewal for 49 years. The rights of the lessees are subject to the paramount rights of hunting, fishing, and navigation recognized by law. The portion of the proposed right-of-way adjoining the river bank has been surveyed into lots averaging about 100 feet by 50 feet. Back from the river the land is leased in larger areas. There are a total of 108 individual leases or assigns within the right-of-way. Two of these cover about 100 acres back from the river and the remainder cover lots along or close to the river bank.

35. Of the approximate total of 181 acres within the right-of-way, 22 acres are in Muscamoot Bay, 90 acres are swamp land, 25 acres are lands which are suitable for the farming of hay crops except during very high water, and 44 acres are improved lots. The improvements are frame structures of moderate value. The lease holders pay to the State nominal sums for the period of the leases. The total value of the 108 leases is $7,352. The total assessed valuation of all the property within the right-of-way as obtained from the local tax rolls is $60,085.

36. The title of the State of Michigan to this property rests on the fact that these lands were lake bottom at the date the State was admitted to the Union. This fact was established to the satisfaction of the Supreme Court of the State of Michigan in 1910. In view of

this fact, it would seem to follow that they are subject to the paramount right of navigation as exercised by the Federal Government. However, since a large portion of the property is now above high water, it is to be expected that the Government's right to take such land for navigational purposes without compensation would be strongly contested. As has been noted previously, the State holds the title thereto in trust for the people for purposes of navigation, hunting, and fishing, and all leases to individuals are expressly subject to these paramount rights. Still it is questionable whether this reservation on the leases so completely subordinates the rights of the lessees that no claim could be legally established by them for the loss of those rights if extinguished by the State or Federal Government in the exercise of the paramount right of navigation. It is reasonable to assume therefore that condemnation proceedings to extinguish such rights would have to be resorted to in order to obtain the necessary right-of-way.

37 In the event of the construction of a cut-off, certain lands between the proposed channel and the St. Clair River would be isolated from the mainland by the severing of State Highway M 154 in the vicinity of Tashmoo Park. Not all of the property between the cut-off and the river would be thus affected since access to the lower end of the island thus created is at the present time via boat only. The area served by the highway comprises approximately 1,225 acres. This property is similar in character to that within the right-of-way of the proposed channel; i. e., State-owned lands leased to individuals. There are in this affected area 115 separate leases or assigns having a total value of approximately $25,000. The assessed valuation of this property is $136,750.

38. The material to be removed consists of silt, sand, clay, and marl and is suitable for removal by hydraulic pipe-line dredges. Adequate disposal areas exist on both sides of the channel. No difficulty is to be expected in obtaining such areas since the land is low and marshy. The total quantity of material to be removed to the 27-foot depth—i. e., 25 feet plus 2 feet of overdepth with side slopes of 1 on 4—is 6,267,000 cubic yards.

39. The total cost of the cut-off is therefore estimated as follows:

Dredging 6,267,000 cubic yards, at 20 cents	$1, 253, 400
Overhead, engineering supervision, and contingencies	396, 600
Total	1, 650, 000

40. It is computed that the increased discharge as a result of the construction of a cut-off across Southeast Bend will have the effect of lowering Lake Huron 0.07 foot. The present project provides for the construction of compensating works in the St. Clair River to correct for such lowering of the Lakes as may result from dredging in the river, in addition to the lowering due to authorized diversions. From studies which have been made of the effects of several types of sills at various locations in the river it appears that to overcome the additional lowering of 0.07 foot resulting from the cut-off will require the construction of one additional sill at an estimated cost of $100,000. The lowering of lake levels that might result from widening the channel in the bend to 700 feet or 800 feet would be of minor importance and would not appreciably affect the present plans for the construction of compensating works under the existing project.

41. *Thunder Bay Island Shoals.*—On account of the exposed location and the character of the bottom, any work of removal done on these shoals should be carried to a depth of 27 feet below datum. The area of the largest shoal within the 27-foot contour is 8,600,000 square yards. The other shoals vary in size from 9,000 to 72,000 square yards, their combined areas amounting to 246,000 square yards. The removal of these shoals to a depth of 27 feet would involve sweeping operations with derrick boat and some dipper dredging. On account of the exposed locality frequent interruptions to the work are to be expected. The cost of the removal of all the shoals would be prohibitive. Consideration has been given to the removal of the four most easterly shoals, marked "G, H, I, and J" on the accompanying map, as they are somewhat isolated from the main area. The estimated cost of their removal is as follows:

56,000 square yards, at $1.50	$84,000
Contingencies, overhead, supervision	16,000
Total cost	100,000

The most easterly shoal marked "J" has an area of 9,000 square yards. It is estimated that its cost of removal would amount to $20,000.

42. *Poe Reef Shoal.*—The least depth over this shoal as shown by soundings on 50 feet by 10 feet centers is 25.6 feet. Above the 27-foot submarine contour the shoal has a length of about 1,600 feet and a maximum width of about 200 feet with the longer axis of the shoal lying along the sailing course. The area of the shoal within the 27-foot contour is 22,000 square yards. Probings indicate that the material is gravel and boulders. The actual quantity of material to be removed in order to obtain a swept depth of 27 feet is small, there being only about 400 cubic yards above the 27-foot contour. The removal of this shoal would involve some dipper dredging and the sweeping of the entire area to 27 feet by derrick boat and perhaps the use of explosives to break up the larger boulders. The area is exposed to storms and frequent interruptions of the operations are to be expected. The estimated cost of the work is as follows:

22,000 square yards, at $2	$44,000
Contingencies, overhead, supervision	6,000
Total cost	50,000

43. *Brush Point Turn.*—The minimum natural width of the channel between 26-foot contours at this turn is about 1,000 feet. The angle of turn is about 15°. The widening requested by the Lake Carriers' Association would increase the width to 1,600 feet at the point where the 1,000-foot width now occurs. A depth of 26 feet below datum should be allowed since this conforms to the minimum depth prescribed in the project for the St. Marys River above the locks. The quantity of material necessary to be removed to effect this widening is approximately 530,000 cubic yards, including 2 feet overdepth dredging. The material is soft and suitable for removal by hydraulic dredge. At an estimated over-all unit cost of 25 cents per cubic yard the cost of the improvement would be $132,500. Immediately upstream from the turn the channel again narrows, reaching a minimum width of 700 feet between 26-foot contours opposite Point Louise. Since the widths above and below this section of the river are at

least 1,000 feet, a plan for securing this width throughout this section has been considered. The length of the section in which widening is necessary in order to connect with the 1,000-foot channel upstream is about 7,000 feet. The quantity of material to be removed to a 26-foot depth plus 2 feet overdepth dredging is about 658,800 cubic yards. It is soft material which it is estimated can be dredged at an over-all unit cost of 25 cents per cubic yard, or at a total cost of $164,700. The total estimated cost of widening at the Brush Point Turn as requested by the Lake Carriers' Association plus the widening to 1,000 feet of the section of the river upstream from the turn would therefore be $297,200. A plan has also been considered which would involve only a moderate amount of widening at the Brush Point Turn. A width of 1,200 feet at this point can be obtained by the removal of about 43,200 cubic yards of material which includes 2 feet of overdepth dredging below the 26-foot project depth. Combining this amount of widening with the widening of the channel above the turn to 1,000 feet as given above, the total quantity of material to be removed above the 28-foot overdepth grade becomes 702,000 cubic yards. At an estimated over-all unit cost of 25 cents per cubic yard the cost of the improvement would be $175,500.

44. *Gros Cap Reefs and Point Iroquois Shoals.*—The survey of the Gros Cap Reefs shows that they encroach on the present sailing courses, the reefs projecting about 700 feet west of the channel line as marked by the Gros Cap Reefs Lightship. The area of the shoal above the 27-foot sweeping contour and within the channel as marked by the lightship and the present sailing course is 67,700 square yards. The least depth over the reef as revealed by soundings on 100-foot by 10-foot centers is 25.8 feet although for the most part the soundings are 27 feet and over. The least depth as revealed by sweeping surveys is 24.5 feet below datum. The quantity of material lying above the 27-foot contour is about 600 cubic yards. The material is gravel and boulders. The removal of the shoal within the limits thus described would involve sweeping operations by derrick boat and perhaps the use of some explosives. It is estimated that the cost of the operations would be about $70,000. The survey of Point Iroquois Shoals shows that at one point the 27-foot submarine contour approaches within 640 feet of the sailing course as marked by the Birch Point Range. The quantity of material to be removed in order to give a clear channel 700 feet wide and 27 feet deep west of the range line is negligible, being less than 100 cubic yards. The material is soft and can be removed as an item of maintenance of the channel. A change in the location of the aids to navigation in this section of the river would obviate the necessity of dredging at Gros Cap Reefs. Such a change would involve the movement of the Gros Cap Reefs Lightship about 700 feet southwestward from its present location. The resulting changes in the sailing courses would be negligible.

45 *Discussion.*—The arguments for and against the proposed improvements and the prospective benefits that may accrue therefrom are discussed under the headings of the several localities below.

46. *South East Bend, St. Clair River.*—The usable width of this channel prior to adoption of the 24-foot project was about 500 feet. At the time of the preliminary examination report now under review the Lake Carriers' Association recommended that this bend be eliminated by constructing an independent downbound channel

through the delta of the St. Clair River. This recommendation was not favorably considered at that time by the special board charged with the preparation of the report because the work would involve questions of rights-of-way and land reclamation of considerable complexity and the board was of the opinion (p. 81) that the general question of improving the Lake transportation system should not be complicated by a consideration of this special improvement. However, the Board recognized in its report of survey that the frequent meeting of up-bound and down-bound vessels in this bend constituted a real hazard which could be reduced by widening the bend. The Board gave consideration to providing a 600-foot width from Harsens Island Light No. 9 to the head of the St. Clair Flats Canal at an estimated cost of $258,800 and an 800-foot width at an additional expenditure of $525,600. The 600-foot width was recommended by the Board because it was felt that this width could be obtained at a relatively small expenditure and as there was a likelihood that a better solution involving a separate down-bound channel through the delta might be adopted, the provision for an 800-foot width at that time did not appear advisable.

47. A search of the available records does not disclose any cases of a blockade as having occurred in this channel. From information obtained from the records of the Steamboat Inspection Service, the reports of the Great Lakes Protective Association, and the records of this office, there has been a total of 19 collisions or groundings in this section of the river in the past 12 years. In most cases the damage to vessels was slight, the total for the 19 accidents amounting to about $60,000. The channel is now 100 feet wider than when the above accidents occurred. It is believed that the possibility of a complete blockade of the channel is remote.

48. The Southeast Bend in its present condition is a fairly practicable channel. However, great care must be exercised in negotiating the bend when there is the possibility of meeting another vessel at the turns. During seasons of normal traffic on the Lakes, the navigator could expect to meet at least one other vessel in this stretch of the river. The result is that due to the necessity of proceeding with caution there is a natural slowing down in the rate of movement of the vessels. The extent of the delay cannot be defined and consequently the economic benefit of widening the channel or constructing a separate downbound channel is impossible of reasonably accurate determination.

49. If a separate downbound channel were constructed along the route proposed the downbound sailing distance would be shortened about 1 mile, which is equivalent to about 6 minutes' sailing time for the average vessel. The average number of vessels to which this saving would apply is about 10,000 per year. On the assumption of an average total hourly cost of $40 per vessel the annual theoretical saving to the downbound traffic would amount to $40,000. Such an annual saving, if reflected in freight rates, would justify an expenditure of $1,000,000. In addition there might be expected a saving in the time of transit to upbound vessels because of the removal of the possibility of meeting in the bend. On the basis of 10,000 upbound passages per year, a saving of 4 minutes per vessel would justify an additional expenditure sufficient to warrant the cost of $1,650,000 for constructing a separate downbound channel.

50. The widening of the existing channel to 700 or 800 feet would not strike at one of the chief causes of difficulty at this locality, which is the reverse curvature. Such a plan would, no doubt, increase the ease of navigation and would probably result in a saving in time of transit. On a similar basis for computing savings as used above, a saving of about 1 minute per vessel would justify the cost of $405,000 for the 700-foot channel and of slightly less than 2 minutes would justify the cost of $675,000 for the 800-foot channel. However, there is no assurance that widening will conclusively solve the difficulty. The situation with regard to width and curvature in this section of the river presents a difficulty to navigation that is out of proportion to the facilities provided in the remainder of the interconnecting channels. The average degree of curvature throughout the bend is about 1°. The only other locality throughout the interconnecting channels where a comparable degree of curvature exists is at the turn at Round Island Shoals in the upper St. Marys River where the curvature is slightly less than 1° (about 50 minutes). At that locality, however, the channel has been widened to approximately 3,500 feet. At Light No. 27 at the head of the Little Rapids Channel in the St. Marys River, which is the next sharpest turn in the 2-way channels, the degree of curvature is about 35 minutes and a width of about 1,300 feet has been provided. Even if widened to 800 feet, the southeast bend would still present a serious condition both with respect to degree of curvature and direction that is not encountered at any other location. Further requests for greater widths until this section is brought into conformity with the rest of the waterway may therefore reasonably be expected.

51. It is therefore my opinion that it is the wisest course to adopt the ultimate solution of the problem at this time. The problem of rights-of-way and land reclamation does not present serious difficulties in view of the fact that the land is State owned and is leased subject to the paramount right of navigation. Since the date of the report under review, the State legislature has passed a law (Public Act 256, 1931) under which the Governor is empowered to deed State lands to the United States for purposes of navigation. A practicable solution to the problem of right-of-way would seem to lie in obtaining a quitclaim deed from the State of Michigan under the authority of the above act conferring upon the United States all the right, title, and interest of the State, following which condemnation proceedings could be instituted against the leases. The rights of the lessees could then be determined by the courts and damages, if any, awarded.

52. *Thunder Bay Island Shoals.*—The shoal areas in this vicinity lie outside of the lane for downbound steamers recommended by the Lake Carriers' Association. The shoals therefore constitute a hazard in the usual case only to the upbound traffic. This traffic is limited to drafts conforming to the least depth in the upbound channels which is 21 feet in the Amherstburg Channel, Detroit River. The least sounding over the shoals is 22 feet, which occurs in the most easterly shoal area. However, there is some upbound traffic in the stone trade out of Alpena, Mich., which may load to drafts in excess of the other upbound commerce. The volume of such commerce for the year 1933—the largest of the past 5 years—was 136,000 tons. The removal of the four most easterly shoal areas, marked "G," "H," "I," and "J," on the map, would enable the vessels in this trade to proceed with safety

along the general route of all the other upbound traffic. Otherwise it would be necessary for them to take a course farther to the east, with some loss of time and also with the possibility of entering the lane reserved for downbound traffic. The average number of trips of such vessels during a year of the volume of 1933 would be about 17. A course well to the eastward, avoiding the shoals, would be about 5 miles longer than the usual upbound course. The loss of time would amount to about 30 minutes per trip or 8½ hours for the season. At an average of $40 per hour the actual money loss per season would not exceed $340 and would probably be much less, since the detour would not be necessary under good weather conditions and in many cases the vessels would not be loaded to drafts which would necessitate a detour. On the basis of the probable annual savings to accrue, the expenditure of $100,000 for the removal of the four most easterly shoals would not be justified nor would an expenditure of $20,000 for the removal of the shoal "J", lying farthest to the east, be warranted by the probable benefits.

53. *Poe Reef Shoal.*—This shoal lies directly on the present sailing course through the south channel of the Straits of Mackinac. The least depth over the shoal as revealed by soundings is 25.6 feet. The south channel is used by all commerce between Lake Michigan and the lower Lakes. Commerce between Lake Michigan and Lake Superior via the St. Marys River uses the passage between Round Island and Mackinaw Island, where a depth of 27 feet is now being obtained. There is an eastbound movement of about 2,400,000 tons of iron ore and 2,000,000 tons of grain through the south channel. This is largely in the nature of return cargoes for the east-west coal movement. Since some of the coal vessels return light under present conditions, greater depths in this channel than now exist are not urgently needed. Vessels in the westbound coal movement are limited in draft by the project depth of the upbound channels in the Detroit River. The principal commerce to benefit by the removal of the shoal is the westbound movement of stone. The average volume of this stone movement for the past 5 years has been 3,000,000 tons. Although a practicable channel past the shoal exists, the additional maneuvering to make this channel will no doubt result in some loss of time which during fog or storms may be considerable. The annual carrying charges on an initial expenditure of $50,000 for the removal of the shoal would amount to $2,000. If an aggregate of 50 hours running time is saved to the deep-draft vessels using the channel, the expenditure would be justified. It seems reasonable that such a saving should result, since the average number of passages per year of vessels in the stone, ore, and grain trade is 970. The shoal constitutes a restriction on what would otherwise be a free and open channel about 2 miles wide for vessels of all drafts, and since its removal may be obtained at a relatively small expenditure it appears to be justified.

54. *Brush Point Turn.*—The special board in the preliminary examination under review (p. 41) considered a recommendation of the Lake Carriers' Association for widening the channel at this locality and reached the conclusion that the natural channel had ample width and depth. In its present recommendation the association presents the argument that while the width is fairly good, vessels meeting at the turn have difficulty in passing, especially at times of

low visibility. To improve this condition it is suggested that the point be cut back 400 feet, giving a least width of 1,600 feet. This is a greater width than has been considered necessary at other turns in the interconnecting channels where the changes of direction are equal to or greater than at this locality. The expenditure to obtain this improvement seems too large to assume unless there is a real hazard to navigation to be overcome. There is nothing in the record of accidents in the St. Marys River that would indicate an extremely hazardous condition here. By a moderate expenditure the point can be cut back to give a width of 1,200 feet. Such a width compares favorably with that at the other turns and is felt to be all that is warranted at this time.

55. Above the Brush Point Turn there is another change of direction of about the same degree in the channel and the width is only 700 feet. It is felt that the widening of this turn is of more importance than at Brush Point. As the Round Island Channel immediately above the turn is 1,000 feet wide and the Point Aux Pins Course immediately below Brush Point has a least width of 1,000 feet, it would seem that widening of the intermediate course to 1,000 feet is necessary to obtain the full benefit of the greater widths already provided. The only other locality in the interconnecting channels where the width in the turns of the two-way channel is less than 1,000 feet is in the Southeast Bend of the St. Clair River. Although the benefits from the improvement are intangible, it is believed that navigation in this stretch of the river will be facilitated and the hazard of traversing the course in time of fog will be reduced to an extent that will justify the moderate expenditure necessary to give this channel a width in conformity with the adjacent channels.

56. *Gros Cap Reefs and Point Iroquois Shoals.*—The position of the shoal areas in this locality is such that ship channels of suitable depth, width, and direction may be obtained without additional dredging except for a small amount of maintenance work at one point on the Point Iroquois Shoals. By cutting this point back about 60 feet, amounting to less than 100 cubic yards of dredging, and moving the Gros Cap Reef Lightship westward 700 feet, a channel having not less than 700 feet on either side of the sailing courses is obtained, with only a minor change in the direction of those courses. The lightship is a Canadian aid and now located in Canadian waters. Its proposed movement would place it in American waters, but no difficulties are expected to arise in connection with its movement in view of the fact that reciprocal arrangements on the maintenance of aids on both sides of the international boundary are now in effect in other portions of the boundary waters.

57. *Conclusions.*—The widening of the channel at Southeast Bend, St. Clair River, to 700 or 800 feet will not give the ultimate relief at this point which is necessary to afford a facility of navigation in conformity with the remainder of the interconnecting channels. The adoption at this time of the ultimate solution to this problem which lies in eliminating this bend for downbound traffic by the construction of a separate channel across the delta on the American side will result in the most economical course eventually. The theoretical economic saving that will accrue as a result of shortening the time of negotiating this section of the river would appear to justify the cost of the cut-off.

58. The cost of removal of all the shoals at Thunder Bay Island is prohibitive. The removal of the four most easterly shoal areas would be of benefit to only a small portion of the upbound traffic and the resultant benefit to that commerce would not justify the expenditure. Further improvement is therefore not considered advisable at this time.

59. The removal of the Poe Reef Shoal is a desirable improvement which appears to be justified by the volume of the commerce benefited. The restriction to the free use of the channel which now exists is out of proportion to the relatively minor cost of removal of the cause.

60. A moderate amount of widening at Brush Point Turn to give a width at the turn comparable to the widths provided at other similar places in the waterway is justified. In the channel above the turn, widening to obtain a clear width in conformity with the widths in adjacent channels can be obtained at a moderate cost and appears to be justified in order to obtain the full benefit from the improvements already provided.

61. The removal of the Gros Cap Reef is not necessary, since a relocation of the aid to navigation at this locality and a slight change in the sailing course will avoid this obstruction. At Point Iroquois Shoals a small amount of maintenance dredging is all that is necessary in order to afford a suitable channel in this locality. Further improvement does not appear to be advisable at this time.

62. *Recommendation.*—It is recommended that the existing project for the Great Lakes—connecting waters, principal harbors, and river channels—be modified to provide for the construction of a separate downbound channel across the Southeast Bend, St. Clair River, Mich., with a depth of 25 feet at low water datum and bottom width of 300 feet at an estimated cost of $1,650,000, with an increase in cost of $1,000 per year for maintenance of the St. Clair River; for the removal of the Poe Reef Shoal, in the south channel, Straits of Mackinac, Mich., to a depth of 27 feet below low-water datum at an estimated cost of $50,000; and for the widening of Brush Point Turn, St. Marys River, to 1,200 feet and of the channel from Brush Point to Point Louise to 1,000 feet at an estimated cost of $175,500, with an increase in cost of $1,000 per year for maintenance of the St. Marys River.

R. C. CRAWFORD,
Major, Corps of Engineers, District Engineer.

O

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY.

ST CLAIR RIVER, MICH.

SOUTHEAST BEND

TO ACCOMPANY REVIEW REPORT DATED MAR. 25, 1935

In 1 Sheet — Scale 1: 20,000

Scale of Feet

U.S. ENGINEER OFFICE, DETROIT, MICH., MAR. 25, 1935

Submitted: H. T. Cash, Engineer — Transmitted: P. B. Crawford, Major, Corps of Engineers

Drawn by A.K. — File No. D.S.C. 17/158

139408-D U.S. GOVERNMENT PRINTING OFFICE: 1935

LOCATION MAP
Scale of Feet

DIRECTION AND VELOCITY OF WIND AT DETROIT, MICH.
From U.S. Weather Bureau Records
AVERAGE OF 1926 & 1927 May to Nov. inclusive
— Scale of Hours —
— Legend —
0-20 miles per hour
20-40 " "
40 up " "

PROPOSED 300 FT. WIDE CHANNEL
RIGHT OF WAY LINE
THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS RECOMMENDS 1000 FOOT RIGHT OF WAY.

End of State Highway

Minimum width between 25 Ft. contours is 600 Ft.

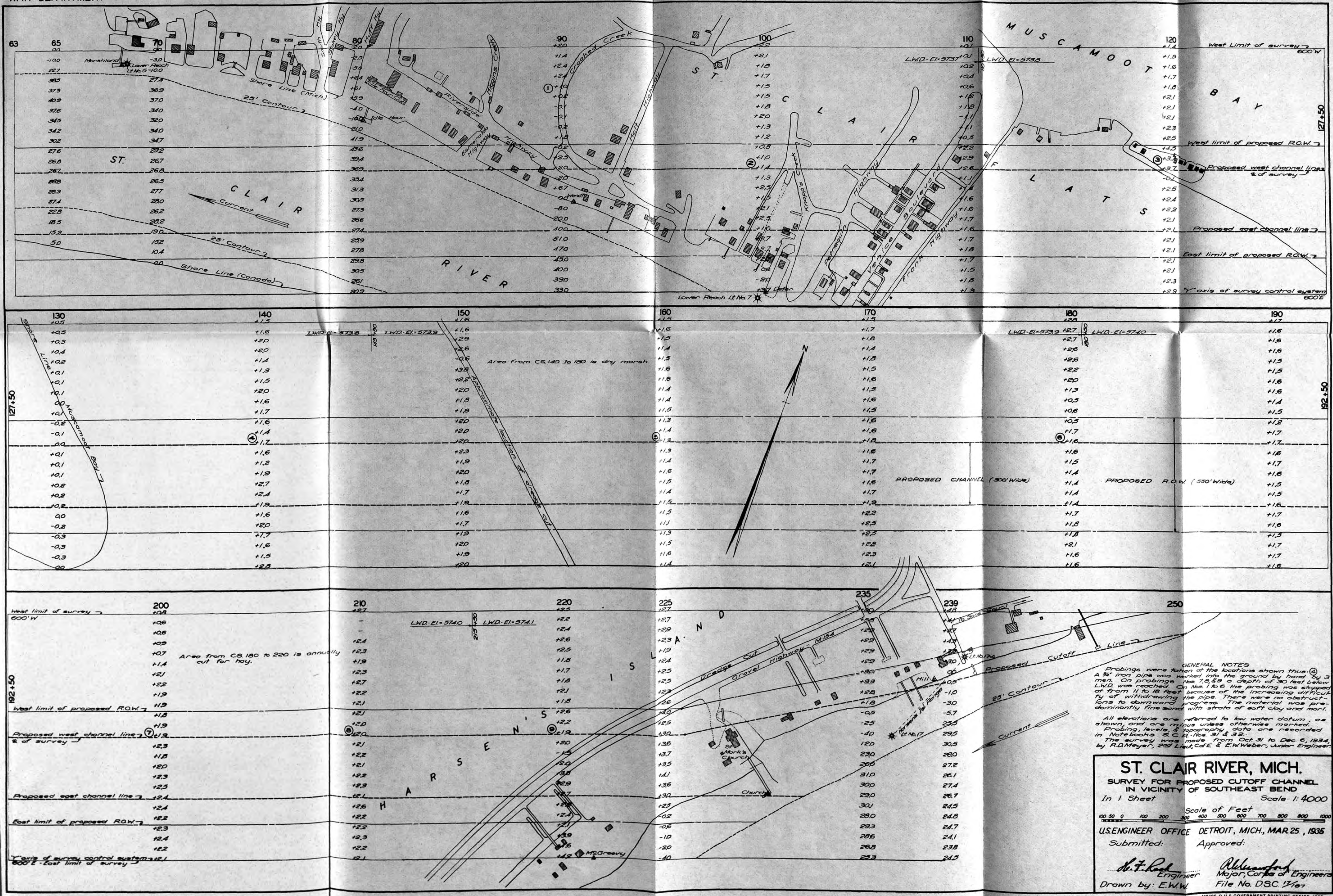
25 Ft. contour

INTERNATIONAL BOUNDARY

Contour depths are referred to the sloping surface of the river when Lake Huron is at elevation 578.5 Ft. and Lake St. Clair at elevation 573.5 Ft. above Mean Tide at New York.

WAR DEPARTMENT

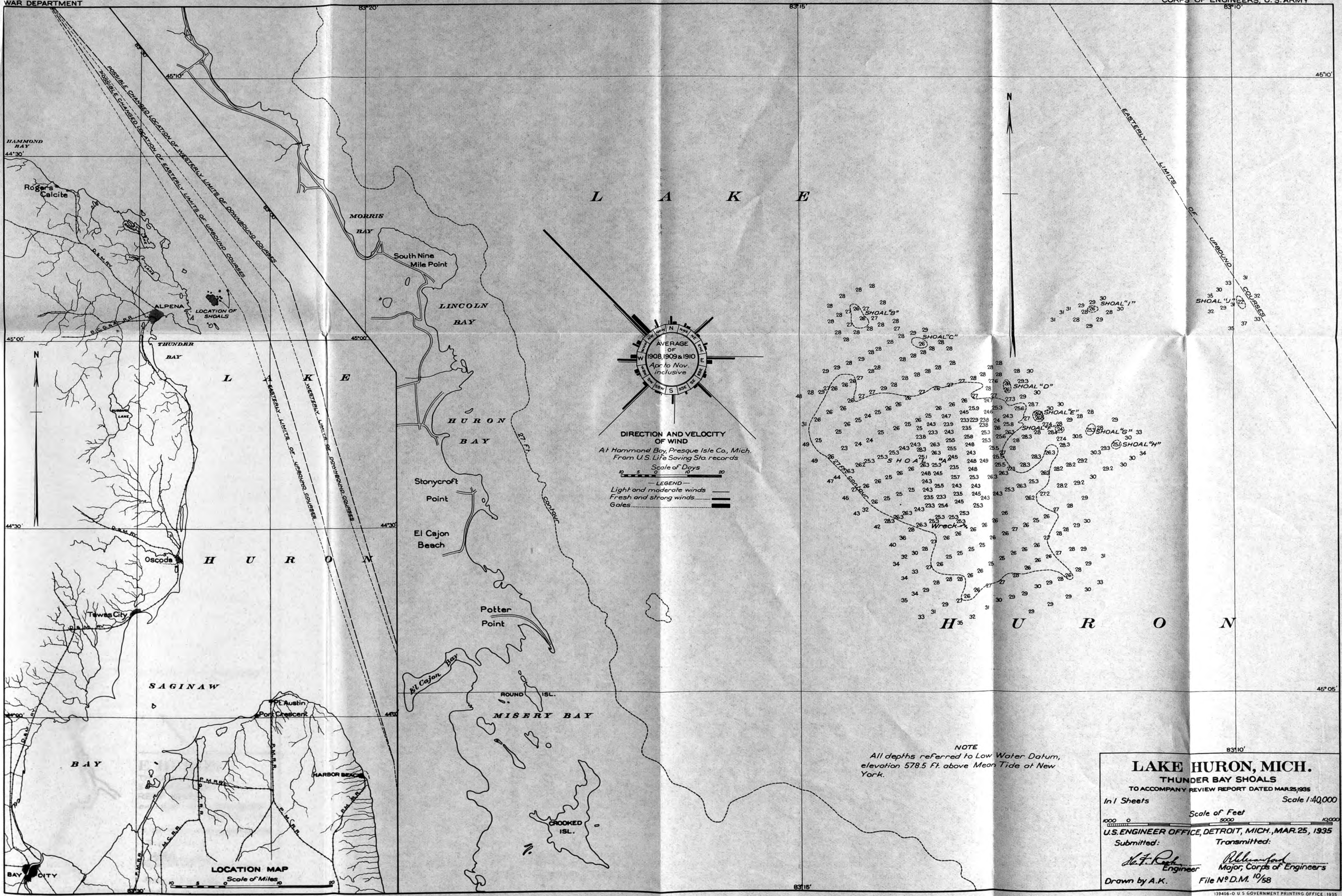
CORPS OF ENGINEERS, U. S. ARMY


ST. CLAIR RIVER
MUSCAMOOT BAY
ST. CLAIR FLATS
HARSEN'S ISLAND
Shore Line (Mich.)
Shore Line (Canada)
25' Contour
Current
Crooked Creek
Riverside Highway
Higgins Creek
Lower Reach Lt. No. 5
Lower Reach Lt. No. 7
Marshland
Idle Hour
Venice Boulevard
Frank Highway
Knapps Creek
West Limit of survey 600' W
West limit of proposed R.O.W.
Proposed west channel line & of survey
Proposed east channel line
East limit of proposed R.O.W.
"Y" axis of survey control system 600' E
Area from C.S. 140 to 180 is dry marsh
Approximate location of Dredge Cut
PROPOSED CHANNEL (300' Wide)
PROPOSED R.O.W. (550' Wide)
Area from C.S. 180 to 220 is annually cut for hay.
"Y" axis of survey control system 600' E - East limit of survey
Dredge Cut
Gravel Highway M 154
Proposed Cutoff Line
St. Mark's Church
Church
McGreevy
GENERAL NOTES
Probings were taken at the locations shown thus: (4)
A ¾" iron pipe was worked into the ground by hand by 3 men. On probings Nos. 7, 8, & 9 a depth of 30 feet below L.W.D. was reached. On Nos. 1 to 6 the probing was stopped at from 11 to 18 feet because of the increasing difficulty of withdrawing the pipe. There were no obstructions to downward progress. The material was predominantly fine sand with strata of soft clay and marl.
All elevations are referred to low water datum, as shown, and are minus unless otherwise marked.
Probing, levels, & topography data are recorded in Notebooks S.C.R.-Nos. 31 & 32.
The survey was made from Oct. 31 to Dec. 6, 1934, by R.D. Meyer, 2nd Lieut., C of E. & E.W. Weber, Junior Engineer.
ST. CLAIR RIVER, MICH.
SURVEY FOR PROPOSED CUTOFF CHANNEL
IN VICINITY OF SOUTHEAST BEND
In 1 Sheet
Scale 1:4000
Scale of Feet
U.S. ENGINEER OFFICE DETROIT, MICH., MAR. 25, 1935
Submitted:
Approved:
Engineer
Major, Corps of Engineers
Drawn by: E.W.W.
File No. D.S.C. 17/167

139406-O U.S. GOVERNMENT PRINTING OFFICE: 1935

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY


LAKE HURON, MICH.
THUNDER BAY SHOALS
TO ACCOMPANY REVIEW REPORT DATED MAR. 25, 1935
In 1 Sheets
Scale 1:40,000
Scale of Feet
U.S. ENGINEER OFFICE, DETROIT, MICH., MAR. 25, 1935
Submitted:
Transmitted:
Engineer
Major, Corps of Engineers
Drawn by A.K.
File Nº D.M. 10/58
NOTE
All depths referred to Low Water Datum, elevation 578.5 Ft. above Mean Tide at New York.
DIRECTION AND VELOCITY OF WIND
At Hammond Bay, Presque Isle Co., Mich. From U.S. Life Saving Sta. records
Scale of Days
LEGEND
Light and moderate winds
Fresh and strong winds
Gales
AVERAGE OF 1908, 1909 & 1910
Apr. to Nov. inclusive
L A K E
H U R O N
SHOAL "A"
SHOAL "B"
SHOAL "C"
SHOAL "D"
SHOAL "E"
SHOAL "F"
SHOAL "G"
SHOAL "H"
SHOAL "I"
SHOAL "J"
Wreck
27 Ft. contour
EASTERLY LIMITS OF UPBOUND COURSES
MORRIS BAY
South Nine Mile Point
LINCOLN BAY
HURON BAY
Stonycroft Point
El Cajon Beach
Potter Point
El Cajon Bay
ROUND ISL.
MISERY BAY
CROOKED ISL.
45°10'
45°05'
83°20'
83°15'
83°10'
LOCATION MAP
Scale of Miles
HAMMOND BAY
Rogers
Calcite
ALPENA
LOCATION OF SHOALS
THUNDER BAY
L A K E
H U R O N
Oscoda
Tawas City
SAGINAW
BAY
BAY CITY
Pt. Austin
Port Crescent
HARBOR BEACH
POSSIBLE CHANGED LOCATION OF WESTERLY LIMITS OF DOWNBOUND COURSES
POSSIBLE CHANGED LOCATION OF EASTERLY LIMITS OF UPBOUND COURSES
EASTERLY LIMITS OF UPBOUND COURSES
WESTERLY LIMITS OF DOWNBOUND COURSES
45°00'
44°30'
44°00'

139406-O U.S. GOVERNMENT PRINTING OFFICE 1935

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY

UPPER PENINSULA OF MICHIGAN

ST. IGNACE

POINT ST. IGNACE

MACKINAC ISLAND

Goose Isl

Goose Isl Shoal

North Graham Shl

South Graham Shl

Majors Shl

Round Isl.

STRAITS OF MACKINAC

LAKE HURON

BOIS BLANC ISLAND

Reynolds Reef

MACKINAW CITY

MICHIGAN

MICHIGAN CENTRAL RAILROAD

PT. AU SABLE

SOUTH CHANNEL

Poe Reef

Poe Reef Lt

AREA TO BE IMPROVED

CHEBOYGAN PT.

COREWOOD PT.

CHEBOYGAN

CHEBOYGAN RIVER

NINE MILE PT

279° (W¼N) 13¾ Miles

275½° (W¾N) 20 Miles

247½° (WSW) 6¾ Miles

44½° (NE) 10¾ Miles

278° (W¼N) 9 Miles

81° (E¾N) 22½ Miles

278° (W¼N) 11 Miles

267° (W¼S) 42 Miles

285½° (WNW¾W) 73¼ Miles from Great Duck Isl Lt

302½° (NW by W½W) 32⅜ Miles

359½° (True N½E) 2 Miles

300½° (NW by W½W) 16½ Miles

316½° (NW¾N) 3¼ Miles

302½° (NW by W½W) 18 Miles

278° (W¼N) 44½ Miles from Great Duck Isl Lt

296½° (NW by W¾W) 47½ Miles

302° (NW by W¾W) 22⅝ Miles

293½° (NE by E¾E) 11½ Miles

3¼ Miles

WEST 12 Miles

4 Miles

(1) B Gas

AVERAGE OF 1908, 1909 & 1910 April to Nov. inclusive

DIRECTION AND VELOCITY OF WIND

At Hammond Bay, Presque Isle Co., Mich. From U.S. Life Saving Sta. records

Scale of Days 10 5 0 10 20

—LEGEND—

Light and moderate winds

Fresh and strong winds

Gales

600'W 400'W 200'W 0 Ref to △74 200'E 400'E 600'E 800'E 1000'E

8800'N 8700'N 8600'N 8500'N 8400'N 8300'N Ref to △74 8200'N 8100'N

27' Sweeping Contour

27' Sweeping Contour

DETAILED SOUNDINGS

Scale 1"=200'

0 50 100 200 300 400 500

Soundings in feet, are referred to elevation 578.5 feet above Mean Sea Level

Scale 1:120,000

0 1 2 3 4 5000 10000 20000 30000

LAKE HURON

SOUTH CHANNEL STRAITS OF MACKINAC POE REEF SHOAL

To accompany review report dated Mar. 25, 1935

In 1 Sheet Scale as shown

U.S. ENGINEER OFFICE, DETROIT, MICH., MAR. 25, 1935

Transmitted:

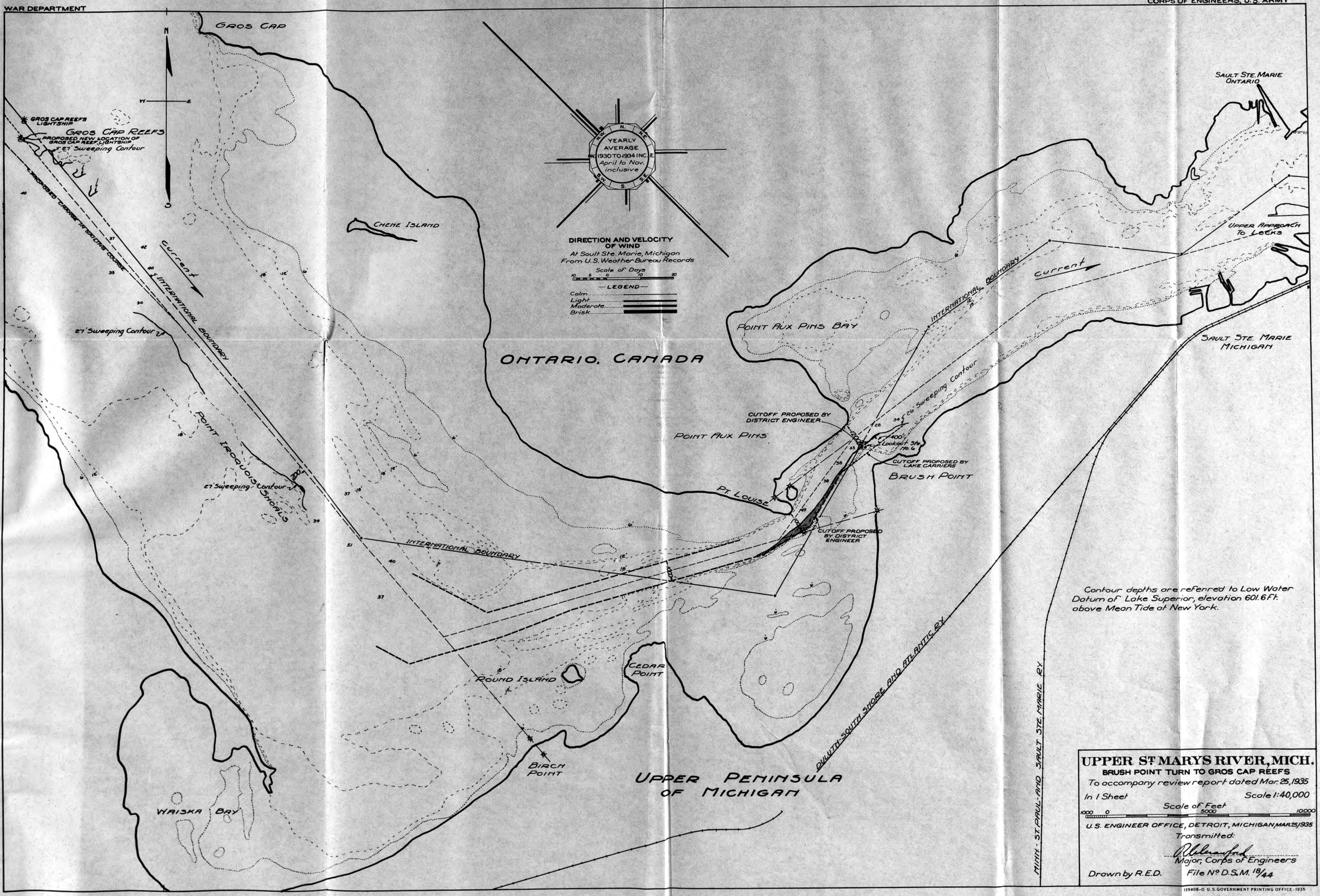
Major, Corps of Engineers

Drawn by R.E.D. File No. D.M. 10/59

139406-0 U.S. GOVERNMENT PRINTING OFFICE: 1935

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY


Gros Cap
Gros Cap Reefs Lightship
Gros Cap Reefs
Proposed new location of Gros Cap Reef Lightship
27' Sweeping Contour
Proposed change in sailing course
Current
International Boundary
Cheне Island
YEARLY AVERAGE 1930 TO 1934 INC. April to Nov. inclusive
N. NE. E. SE. S. SW. W. NW.
DIRECTION AND VELOCITY OF WIND
At Sault Ste. Marie, Michigan From U.S. Weather Bureau Records
Scale of Days
LEGEND
Calm
Light
Moderate
Brisk
27' Sweeping Contour
Ontario, Canada
Point Iroquois Shoals
27' Sweeping Contour
Point Aux Pins Bay
Point Aux Pins
Pt. Louise
Cutoff proposed by District Engineer
Lookout Sta. No. 6
Cutoff proposed by Lake Carriers
Brush Point
26' Sweeping Contour
International Boundary
Current
Upper Approach to Locks
Sault Ste. Marie Ontario
Sault Ste. Marie Michigan
Cutoff proposed by District Engineer
International Boundary
Round Island
Cedar Point
Birch Point
Waiska Bay
Upper Peninsula of Michigan
Duluth-South Shore and Atlantic Ry.
Minn.-St. Paul and Sault Ste. Marie Ry.
Contour depths are referred to Low Water Datum of Lake Superior, elevation 601.6 Ft. above Mean Tide at New York.
UPPER ST. MARYS RIVER, MICH.
BRUSH POINT TURN TO GROS CAP REEFS
To accompany review report dated Mar. 25, 1935
In 1 Sheet
Scale 1:40,000
Scale of Feet
1000 0 5000 10000
U.S. ENGINEER OFFICE, DETROIT, MICHIGAN, MAR. 25, 1935
Transmitted:
Major, Corps of Engineers
Drawn by R.E.D.
File No. D.S.M. 18/44

139406-O U.S. GOVERNMENT PRINTING OFFICE: 1935