

revetment complete (being a plank-beam construction) extends old north revetment a distance of 461 feet eastwardly.

Under the direction of Mr. S. F. Garfield, United States inspector, 15 rows of willows have been planted north of the north pier, to prevent the drift of sand over the pier. These rows are about 200 feet long. The cuttings immediately put out roots in the wet sand and are doing well.

The following is the result of soundings taken on the 24th of June, after all work was completed:

Depth of water outside, 11½ feet.
Available inside of piers, 8½ feet.

WORK CONSTRUCTED FROM 1867 TO JUNE 30, 1879.

	Crib-work.	Pile-work.
	Feet.	Feet.
North side of channel and extensions.....	600	986
South side of channel and extensions.....	502	316
Total.....	1,102	1,302

The north pier 100 feet longer than the south pier.

As heretofore recommended, the unappropriated balance of \$52,500 can be applied to all improvements of a permanent character sufficient under the present project; \$25,000 of this balance can be profitably expended in the fiscal year ending June 30, 1881, in extending the piers.

Original estimate (1866) amended (1877)	\$202,000
Appropriated and allotted (1867-79)	149,500
Unappropriated balance	52,500

OPERATIONS CONTEMPLATED FOR YEAR 1879-'80.

1. Extend north pier 100 feet, 2 cribs each 50 feet by 30 feet.
 2. Dredge channel to 14 feet depth of water.
- All to be done by hired labor, purchase of material in open market, and by using the government dredge.

This work is situated in the Michigan collection district, Michigan. It is situated at the South Haven light. The nearest port of entry is Grand Haven, Mich.

STATEMENT OF VESSELS ENTERED AND CLEARED FROM JUNE 1, 1878, TO JUNE 1, 1879.

Entered:	
Number.....	212
Tonnage.....	28,971
Cleared:	
Number.....	205
Tonnage.....	23,549

HISTORY OF THE WORK.

Original depth at entrance and between piers in channel 7 feet, with a troublesome bar, having between 9 and 10 feet water on it, about 750 feet from entrance to the harbor. This in November, 1866.

Plan adopted in 1866, with estimate, was, "To extend two parallel piers 120 feet apart, having a direction of south 84° 3' west from the mouth of the river into 12 feet water," which contemplated the widening

of the mouth of the river to 120 feet; protecting banks by sheath-piling; building 1,088 feet pier-work; dredging the whole water-way between the piers to a depth of 12 feet, and dredging a channel across outer bars; cost \$128,288.47.

First appropriation given March 2, 1867 \$43,000

Continuation of history begun and published in Report of Chief of Engineers for 1876, as follows:

In 1875, the depth available in mid-channel was 9 feet; 1875-'76, 525 feet pile-revetment, 14 feet wide, was built, extending north revetment eastwardly. The amount of dredging (in bank and in channel) was—slabs, &c., 11,969.48 cubic yards; sand, 29,982 cubic yards = 41,951.48 cubic yards. Except at one point (on river-bed opposite inward extension of new revetment) there was 9½ feet water in channel.

1876-'77.—Necessary repairs—securing pier-heads, &c.—were made.

Through the south revetment, near shore-line, a breach of 90 feet was made, through which the sand entered and filled channel between piers, so as to leave but 6½ feet water.

1877-'78.—In August the removal of old slab-docks on south side was completed, and the crib-work connected with shore-line by a pile construction of 316 linear feet. Dredging away old dock and removing sand in channel was done by government machinery—5,010 cubic yards slabs, &c., and 22,510 cubic yards sand, &c.

In fall of 1877 the depth in channel from entrance to warehouse was 9 feet.

In spring of 1878 the channel barred to about 7½ feet for a short distance between the piers.

Appropriated, 1867.....	\$43,000	Appropriated, 1875.....	10,000
Appropriated, 1870.....	10,000	Appropriated, 1876.....	10,000
Appropriated, 1871.....	15,000	Appropriated, 1878.....	12,000
Appropriated, 1872.....	12,000	Appropriated, 1879.....	7,500
Appropriated, 1873.....	20,000		
Appropriated, 1874.....	10,000	Total.....	149,500

Money statement.

July 1, 1878, amount available	\$12,100 02	
Amount appropriated by act approved March 3, 1879.....	7,500 00	\$19,600 02
July 1, 1879, amount expended during fiscal year	7,978 61	
July 1, 1879, outstanding liabilities	1,375 75	9,354 36
July 1, 1879, amount available	10,245 66	
Amount (estimated) required for completion of existing project.....	52,500 00	
Amount that can be profitably expended in fiscal year ending June 30, 1881.	25,000 00	

Abstract of proposals received and opened July 26, 1878, for furnishing the materials and doing the work of continuing improvements, South Haven Harbor, Mich.

Bidders.		Residences.	Pine, per cubic foot.	Hemlock, per cubic foot.	Drift-bolts, per pound.	Screw-bolts, per pound.	Pine piles, per linear foot.	Stone, per cord.	Brush, per cord.	Driving piles, per foot.	Dredging, per cubic yard.	Aggregate.
Names.												
N. Stanton Gere.....	Geddes, N. Y.....	\$0 20	\$0 17	\$0 02½	\$0 08½	\$0 10	\$6 00	\$2 00	\$0 10	\$0 10	\$0 12½	\$7,527 75
Albert Conroy.....	Milwaukee, Wis.....	22	22	2½	5	8	10 00	4 00	16	16	13½	9,385 24
James McArthur.....	Chicago, Ill.....	35	25	3	10	10	8 00	8 00	10	10	25	13,255 95
U. Culbert & Co.....	Muskegon, Mich.....	21	17	3	5	14	7 00	3 00	30	30	14½	8,900 95
Coates & Geer.....	Saugatuck, Mich.....	20	14	3	4	10	8 00	3 00	10	10	20	10,190 93
Squire & White.....	Grand Haven, Mich.....	20	17	3½	5½	9	6 00	2 00	13	13	12½	7,566 89
Chicago Dredging and Dock Company.....	Chicago, Ill.....	28	15	3	4½	7	7 00	2 00	15	15	18	9,587 78
O. B. Green.....	do.....	21	14	4	5	10	6 50	4 50	15	15	14	8,286 24

Contract awarded to N. Stanton Gere.

DD 12.

IMPROVEMENT OF SAINT JOSEPH HARBOR, MICHIGAN.

The contractor, Mr. N. Stanton Gere, of Geddes, N. Y., under contract of August 7, 1878, begun work at this harbor on the 24th of August, by placing 48 cords of stone in the end crib of south pier.

The work under this contract continued until November 27, when suspended on account of the continued rough weather.

At this time the contractor had the 2 cribs—one 50 by 30 feet raised 17 courses, the other 50 by 24 feet raised 16 courses—ready for sinking; also, repairs had been put upon the piers, viz: refilling with brush and stone, planking, replacing old timbers by new ones, refastening timbers, and other slight repairs found necessary, leaving the work in good condition.

Materials used in repair work: pine, 646.06 cubic feet; drift-bolts and spikes, 575 pounds; screw-bolts, 1,965.3 pounds; brush, 149½ cords; stone, 184 cords. Government timber framed, 1,158 cubic feet.

The contractor resumed work in May, and by 30th of June had accomplished but little.

One crib (50 by 24 by 17½ feet) was sunk and accepted on the 28th June. It stands in 15½ feet of water, in good level and line.

The contractor will be able to complete his contract on or before September 30.

A bad bar formed outside, extending from north to south and about 500 feet out from the end of north pier.

Complaint having been made, authority was given for dredging a way so as to permit the passage of the large iron-ore vessels which run to this port.

The United States dredging apparatus arrived here June 3, but was delayed and hindered in the work by bad weather, breakage, &c.; succeeding, however, in making one cut 20 feet wide with 16 feet of water and a second cut well advanced.

The machinery when hindered from working outside is put at work in the river removing the bar at the foot of the wing-dam or taking out stone along the north side of the channel near the pier.

There have been 6,740 cubic yards of sand and stone removed, and much work of this kind remains to be done.

The depth of water over the bar is 11½ feet at the best crossing, which is about 1,500 feet south of the piers.

This harbor ought to be made safe as a harbor of refuge. It is an important point for vessels, to say nothing of the general local trade, which employs 3 steamers, making daily trips to and from Chicago, besides the large iron-ore crafts.

The wing-dam built 5 years ago at the mouth of canal to Benton Harbor is doing good work, and it is hoped that under present appropriation it may be refilled and built at least 200 feet farther in length.

It became necessary for the steamers running to Benton Harbor to dredge the bar away from the foot of the wing-dam in order to get out in the spring. This will hardly be necessary, however, after the contemplated improvements are made this year.

WORK CONSTRUCTED FROM 1866 TO JUNE 30, 1879.

- North side and extensions, 400 feet crib-work (50 feet lost 1876).
- South side and extensions, 616 feet pile-work.
- Wing-dam in river, 528 feet pile-work (+ 194 feet single pile new).
- Reconstruction of north pier (1866-'67) 409 feet and over.
- Reconstruction of south pier (1866-'67) 200 feet and over.

The work under project of January 30, 1875, viz, to extend the north pier 400 feet in a direction north 78° west, has been accomplished, and successfully serves the purpose intended. The balance of the estimated for pier-work will be expended in securing old work on both piers and in dredging.

For expenditure on the improvements projected for the benefit of Benton Harbor, viz, filling and ballasting the wing-dam, dredging the bar at lower end of wing-dam, and revetting the Paw-Paw River in extension of the wing-dam, the estimate of \$15,000, less amount appropriated March 3, 1879, is recommended as necessary.

Original estimate (1866-'79).....	\$137,216 71
Appropriated (1866-'79).....	124,000 00
Unappropriated balance.....	13,216 71

OPERATIONS CONTEMPLATED FOR YEAR 1879-'80.

Harbor.

1. Extend north pier 50 feet. 1 crib 50 by 30 by 26½ feet. To be done by contract, after inviting proposals in the usual way.

River.

1. Complete wing-dam at mouth of Benton Harbor canal, by extending it 200 feet and renewing lost filling and ballast.
2. Build training-wall or dam of brush and stone (300 feet) at root of wing-dam to confine water of Paw-Paw River to the channel. To be done by hired labor and purchase of materials in open market.

This work is located in the Michigan collection-district, Michigan. It is situated at the Saint Joseph lights. The nearest port of entry is Grand Haven, Mich.

STATEMENT OF VESSELS ENTERED AND CLEARED FROM JUNE 1, 1878, TO JUNE 1, 1879.

<i>Saint Joseph.</i>	
Entered:	
Number	223
Tonnage	85,664
Cleared:	
Number	242
Tonnage	109,352

<i>Benton Harbor.</i>	
Entered:	
Number	338
Tonnage	75,089
Cleared:	
Number	336
Tonnage	74,900

HISTORY OF THE WORK.

Between 1836 and 1864 the United States at Saint Joseph constructed about 1,312 feet of piers, of which 1,100 feet constituted the north and 212 feet the south piers, respectively, embracing the revetment of cut through narrow tongue of sand. Appropriations given between 1836 and 1864 amounted in the aggregate to \$162.

Depth of water in 1866 was: at entrance, about 12 feet, with 9 feet water-way inward.

Plans for continuing improvements here, approved in 1866, looked to extending south pier 200 feet into the lake and making necessary repairs to piers.

ESTIMATE.

Building 200 feet south pier (pile-work).....	\$13,317 13
Repairs to 409 feet north pier (from surface of water).....	10,095 14
Repairs to 200 feet south pier (from surface of water).....	5,047 57
	28,459 84
Appropriated June 23, 1866.....	6,000 00

Continuation of history begun and published in report of Chief of Engineers for 1876, as follows:

1874, 1875, 1876. A wing-dam (pile revetment 14 feet wide) designed to deflect the current and give free communication to the canal, extending to Benton Harbor, for a length of 528 feet, was constructed, and a channel dredged so as to permit vessels of 9 feet draught to pass up to Benton Harbor. The north pier was extended 300 feet (6 cribs, each 50 by 24 feet); but in March, 1876, the outer crib was driven from its place, carried ashore, and under continuous seas so broken up as to be worthless.

Soundings in spring 1876 developed nothing less than 17 feet water on a line straight out in mid-channel to deep water.

Up the river the channel was but 5½ feet deep at a point 600 feet below end of wing-dam. This bank was reduced later to 10½ feet by action of current and wheel of vessels passing upward.

1876-'77. One hundred and twenty-eight cords stone put into piers and used as riprap.

The north pier received extension of 1 crib, 50 by 24 feet, and wing-dam was prolonged 194 feet by a single row of piles.

1877-'78. Superstructure over north pier completed and outer end decked over, the pier refilled and rippapped, and a few other repairs made.

The water was reported good, there being from 15 to 17 feet in the best approaches.

Appropriated 1866	\$6,000	Appropriated 1875	\$35,000
Appropriated 1867	23,000	Appropriated 1876	12,000
Appropriated 1870	15,000	Appropriated 1878	12,000
Appropriated 1871	10,000	Appropriated 1879	6,000
Appropriated 1872	3,000		
Appropriated 1874	2,000	Total.....	124,000

Money statement.

July 1, 1878, amount available.....	\$14,059 78
Amount appropriated by act approved March 3, 1879.....	6,000 00
	\$20,059 78
July 1, 1879, amount expended during fiscal year.....	2,975 18
July 1, 1879, outstanding liabilities	6,481 03
	9,456 21
July 1, 1879, amount available	10,603 57
Amount (estimated) required for completion of existing project.....	13,216 71
Amount that can be profitably expended in fiscal year ending June 30, 1881.	13,216 71

Abstract of proposals received and opened July 26, 1878, for furnishing the materials and doing work of continuing improvements at Saint Joseph Harbor, Michigan.

Bidders.		Pine, per cubic foot.	Oak, per cubic foot.	Drift-bolts, per pound.	Screw-bolts, per pound.	Stone, per cord.	Brush, per cord.	Piles, each.	Aggregate.
Names.	Residences.								
N. Stanton Gere	Geddes, N. Y.	\$0 20	\$0 24	\$0 03	\$0 04	\$6 00	\$3 00	\$15 00	\$7,218 00
Thomas Keeler	Fulton, N. Y.	22	30	3	4½	9 00	2 00	12 00	9,107 90
James McArthur	Chicago, Ill	22	40	4	3	8 00	8 00	12 00	10,882 16
Robert M. Steel	Saint John's, Mich	23	30	2½	3½	7 50	2 00	12 50	8,422 54
James Caldwell	Fulton, N. Y.	21	30	3½	10	8 50	3 00	15 00	8,911 41
U. Culbert & Co.	Muskegon, Mich.	24	30	3	5	6 60	3 25	10 00	8,152 20
Chicago Dredging and Dock Company	Chicago, Ill.	28	35	3	4½	7 00	2 00	10 00	8,780 97

Contract awarded to N. Stanton Gere.

DD 13.

HARBOR OF REFUGE, PORTAGE LAKE, MANISTEE COUNTY, MICHIGAN.

The appropriation of March 3, 1879, gives \$10,000 for a harbor of refuge at this point.

A report, giving information of the result of the survey of Portage Lake, Michigan, with a view to its adaptability as a harbor of refuge, is contained in Senate Ex. Doc. No. 24, Forty-fifth Congress, third session.

The plan proposed for construction of a harbor of refuge here embraces—

Three hundred feet width of entrance and 18 feet depth of channel, revetments of pile-work and piers of crib-work.

ESTIMATE.

Dredging 265,000 cubic yards sand	\$53,000
1,500 feet of pile-revetment	15,000
1,000 feet of pile-pier	25,000
1,050 feet of crib-work, 24 feet wide	63,000
200 feet of crib-work, 30 feet wide	16,600
Contingencies, &c., 10 per cent	172,600
Total	179,200
Appropriated March 3, 1879	10,000
Unappropriated balance	179,860

Seventy-five thousand dollars could be profitably expended in fiscal year 1881 in carrying out the plan proposed.

OPERATIONS CONTEMPLATED FOR YEAR 1879-'80.

To expend the greater part of the recent appropriation in dredging a channel between the lakes of sufficient width and depth to answer local requirements and build jetties (of temporary character—brush-mats

and stone laid on the beach and in rear of the lines of permanent work) in the large lake to protect the cut from filling in.

Dredging to be done by contract, after inviting proposals in the usual way; balance of work to be carried on by hired labor and purchase of material in open market.

Portage Lake is located in the Michigan collection district, Michigan. The nearest light-house is at Manistee. The nearest port of entry is Grand Haven, Mich.

Money statement.

Amount appropriated by act approved March 3, 1879	\$10,000
July 1, 1879, amount available	10,000
Amount (estimated) required for completion of existing project	179,860
Amount that can be profitably expended in fiscal year ending June 30, 1881	75,000

REPORT OF SURVEY OF PORTAGE LAKE, MANISTEE COUNTY, MICHIGAN, WITH A VIEW TO ITS ADAPTABILITY AS A HARBOR OF REFUGE.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., November 13, 1878.

GENERAL: I have the honor to transmit herewith a report and map of survey of Portage Lake, Michigan, and an estimate of cost for improvement proper to be made "with a view to its adaptability as a harbor of refuge," as provided for in the second section of the river and harbor act of June 18, 1878, as per letter from your office dated August 7, 1878

PORTAGE LAKE, MICHIGAN,

is situated 8 to 10 miles north of Manistee, about midway between Point Au Sable and Point Aux Bees Scies, distant from each other 50 miles.

The shore of Lake Michigan here bows to the eastward, forming a sort of shallow bay, and Portage Lake lies at the deepest point of the bow, just inside of the shore of Lake Michigan, from which it is separated by a narrow belt (30 rods) of high wooded hills. At a depression in this belt, about one mile south of the narrow, crooked, and deep gully which was the original water communication (now closed) between the two lakes, a connection is maintained, of no value, however, beyond permitting the passage of very small boats.

Looking at a map of Lake Michigan, we find Portage Lake at a point on the eastern shore about 30 miles north of an east and west line dividing the lake in the middle. A dozen harbors are scattered along this shore, and, with the exception of Grand Haven, 100 miles southward, none of them answer the purpose of a refuge in storms for the deep-draught grain-laden vessels of the lakes, while to the northward the nearest points for refuge are Traverse Bay and the Manitou Islands, equally distant, 50 miles.

Here, then, is a dangerous coast-line of 150 miles, with no adequate harbor of refuge. Portage Lake would seem to be a most desirable location for such a harbor, occupying as we see about the center of this line of exposed coast. To make it available would be a simple matter; all that is needed is to dredge a channel of the proper width and depth, and construct works for its maintenance. The material to be dredged is sand that has been swept by the storms gradually into a cut 500 feet wide and 12 to 20 feet deep, made here in 1871 when bringing down (some 8 feet) the level of the little lake.