

In my report of February 12, 1879, in response to a telegram from the Chief of Engineers, I submitted the following estimate for completing the work on the latest plan:

Completing breakwater.....	\$85,000
Extending pier (200 feet).....	32,000
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Making for crib-work.....	117,000
exclusive of dredging and refilling the piers with stone. These had been estimated as follows:	
Dredging.....	\$64,175
Filling piers.....	5,000
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	69,175
For this work there was available—	
From appropriation for last fiscal year.....	20,000
Appropriation approved March 1, 1879.....	40,000
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	60,000

leaving a total of \$126,175 estimated to complete the work.

I believe it would be economy to do the entire work in a single year.

The harbor of Michigan City is in the collection-district of Chicago. The following statistics have been received from the collector:

Revenue for the district not given.....	\$421 60
Revenue at Michigan City.....	
Entrances:	
Sail.....	371 53,664
Steam.....	50 14,484
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Total.....	421 68,148
Clearances:	
Sail.....	393 58,283
Steam.....	46 13,568
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Total.....	439 72,851

There is a light-house on the shore near the east pier, and a beacon-light on the lake end of the west pier.

Money statement.

July 1, 1878, amount available.....	\$50,000 00
Amount from sale of tug and fuel.....	1,024 54
Amount appropriated by act approved March 3, 1879.....	40,000 00
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	\$91,024 54
July 1, 1879, amount expended during fiscal year.....	43,862 70
July 1, 1879, outstanding liabilities.....	4,923 30
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	48,786 00
July 1, 1879, amount available.....	42,238 54
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Amount (estimated) required for completion of existing project.....	126,175 00
Amount that can be profitably expended in fiscal year ending June 30, 1881.	126,175 00

INNER HARBOR AT MICHIGAN CITY.

The appropriation of \$75,000 for harbor of Michigan City by act of June 18, 1878, required that the sum of \$25,000 should be expended for the inner harbor. As this required a separate set of accounts, it has been treated as a distinct appropriation.

The project for expenditure of this appropriation contemplated the enlargement of the inner harbor by extending it further up Trail Creek.

The harbor was limited by the railroad crossing, and the room was entirely insufficient for the present or prospective commerce.

The city authorities went to the expense of contracting with the railroad companies to construct a draw-bridge across the creek.

A dredge belonging to the city was taken through the present pile-bridge by removing and replacing a sufficient width on a Sunday when there were few passing trains.

A considerable amount of work was done by this dredge at the city's expense.

As no survey of the location or estimate for the proposed extension had been made by the United States, I was directed to make a survey and submit a project and estimate. This was done in October, and the following project and estimate submitted:

To extend the inner harbor above the railroad bridge by dredging in Trail Creek. Sheet No. 3.

All questions regarding right of way had been assumed and satisfactorily settled by the city authorities.

The cut proposed was to be not less than 120 feet wide and to have a depth of 15 feet.

The estimate for extending this a distance of 2,700 feet, with a basin of sufficient capacity for turning vessels, is as follows:

Excavation required, 214,000 cubic yards.	
Estimated price per yard, 20 cents.	
Amount for excavation.....	\$42,800
Add for contingencies.....	7,200
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	50,000

The city authorities offered the use of the dredge and dump-scows for prosecuting the work, which could by this means be begun at once, and as I believed it could be done cheaper than by contract, a recommendation was made that the offer be accepted. By department letter dated November 14, 1878, the project was approved, and authority given to do the work by contract. This was subsequently modified by letter of December 4, 1879, authorizing the use of the city dredge until other dredges can be employed by contract.

The work was accordingly begun December 12 and continued until December 23, when the extreme cold compelled a suspension of work until March.

The entire amount excavated to June 30 in extending the harbor amounts to 45,440 cubic yards. About one-half of this amount has been towed out and dumped into the lake, and the remainder has been left upon the banks for filling the quay.

Under direction of the city, the banks have been protected by a substantial revetment, constructed as shown on sheet No. 4. This work has followed as fast as the cut has been made, the extent of both being indicated by the part covered with broken lines on sheet No. 3.

Early in November a considerable bar was formed between the piers at the entrance to inner harbor. This interfered so seriously with the navigation that authority was given by the Chief of Engineers to hire a dredge for its removal. A dredge was procured from Chicago and 3,281 cubic yards of material were removed and dumped in the lake. The dredge was hired at a cost of \$50 per day, and the resulting price per cubic yard of material was 26 cents.

In March and April severe storms caused a more extensive bar to form between the piers.

Propositions were received for the work as follows, viz :

Chicago Dredging and Dock Company	40 cents per cubic yard.
O. B. Green	33 cents per cubic yard.
U. Culbert & Co.....	25 cents per cubic yard.

As immediate action was necessary, authority was asked by telegraph, April 19, to get the dredging done at the price last named. In the afternoon of the same day authority was received and a dispatch was sent for the dredge to start at once for the work. The bar was more extensive than was contemplated, but at the end of June it was nearly all removed to a depth of 16 feet, the amount excavated being 15,398 cubic yards.

The expense of removing obstructions from the entrance to inner harbor has been \$4,166.75, and it is probable that further expenses of this kind must be incurred annually until the outer harbor is completed.

It is expected that the railroad company will complete the draw-bridge at an early day; it is then proposed to employ one or more additional dredges to work in the harbor extension.

Estimated cost of extending inner harbor 2,700 feet.....	\$50,000 00
Amount appropriated.....	25,000 00
Expended removing bars.....	4,166 75
Available for existing project.....	20,833 25

Money statement.

July 1, 1878, amount available	\$25,000 00
July 1, 1879, amount expended during fiscal year	\$6,144 42
July 1, 1879, outstanding liabilities.....	2,477 23
	8,621 65
July 1, 1879, amount available.....	16,378 35
Amount (estimated) required for completion of existing project	29,166 75
Amount that can be profitably expended in fiscal year ending June 30, 1881.	29,166 75

HISTORY OF THE WORK TO JUNE 30, 1879.

The history of this work from its commencement to June 30, 1874, is given in Report of the Chief of Engineers for 1876, pp. 447-451.

Amount appropriated for 1874-'75..... \$50,000

In August, 1874, a contract was made for the construction of a pile breakwater, but after many trials and losses, in which the contractors exhibited commendable energy and judgment, only 45 feet of double piling was the result of the season's work.

For this reason a recommendation was made by Major Gillespie to return to the original plan of construction by cribs. It was also recommended that the east pier of the outer harbor be completed to the shore-line on the same plan as the outer part of the same pier.

To consider these recommendations a Board of Engineers was convened by Special Orders No 167, dated Headquarters Corps of Engineers, December 14, 1874. The Board confirmed the recommendations.

At the close of the fiscal year 320 feet of double row piling had been

driven from the shore-line and 200 feet from the south end of the outer part of the pier, the superstructure closely following.

The east side of the pier was protected by brush ballasted with stone, and stone filling was added to the cribs.

The west pier received many repairs and considerable filling of stone.

Amount appropriated for 1875-'76 \$50,000

During the summer of 1875, 600 linear feet of crib foundation was constructed for breakwater. The cribs were 50 feet long and 30 feet wide. One of the cribs, resting upon a place where the sand was 16 feet deep, was undermined, the stone filling settled down, and it was raised from its place; it was refilled, but a few days later, in a storm, it was torn from its place and driven on the beach; it was then replaced by a new crib.

The modification of the east pier was completed and large quantities of stone which had been washed out were replaced.

A good riprap of stone was placed in front and at the ends of the breakwater.

Amount appropriated for 1876-'77 \$35,000

The last appropriation was not approved until August 14, and none of it was available until September 14, when \$16,000 of the amount was allotted. It was the 1st of October before active operations could be begun.

The following extract is taken from the Annual Report for 1876 :

* * * During the suspension these cribs had settled considerably out of line and level, and when work was resumed the top courses were 1 to 3 feet below the water surface, while a great deal of the stone filling had been washed out.

To build up these cribs and correct their alignment at that season of the year proved a most arduous task and an expensive one, but by seizing every possible chance a skilled body of workmen under the supervision of an energetic and experienced foreman pushed the work ahead until the latter part of November when the first course of superstructure was finished over the entire length of the breakwater except crib No. 1, which had separated at 8 feet below the water surface. The second course was placed for a distance of 200 feet from the east end, and all was solidly filled with stone. * * *

In November a succession of gales did much damage. The final injuries of the season are described in the following extract from report of Mr. J. A. Manning, foreman in immediate charge of the work :

* * * On November 28, 29, and 30 a severe gale from the northeast raged, and on December 1 it increased so that a vessel could not have made the harbor without wrecking. During the day it was noticed that No. 8 crib was lifting from its foundation, and at 5 p. m. it floated in on the beach, where it now lies in good condition. During this blow a large quantity of the superstructure was torn off and came in on the beach.

The bulkhead at the end of old east pier was also torn out, and the superstructure of the crib badly broken. From this time forward the ice continued to make, and the stone and timber on hand for the work became covered with it so that it was impracticable to attempt any further work outside. The force was employed in getting such timber, &c., as was worth saving from the wreck together, and on December 9 we stopped work.

During the winter considerable damage was done to the cribs. Such portions of the superstructure as survived the gale of the 1st of December were torn off by later ones, and in February, during a severe blow, No. 9 crib, which had been somewhat damaged at the time No. 8 came out, also lifted and came in on the beach. * * *

The remainder of the year was consumed in repairing these damages.

Maj. G. L. Gillespie, Corps of Engineers, was relieved from charge of this work by Capt. G. J. Lydecker, Corps of Engineers, in accordance with Special Orders No. 85, Adjutant-General's Office, Washington, D. C., April 21, 1877.

No appropriation was made for 1877-78.

During the summer of 1877 the repairs of cribs were completed, and a superstructure, limited by lack of funds to 4 feet in height, was added, except over crib No. 1.

In October and November violent gales did much damage to this work, most of which would have been avoided had the superstructure been completed to its full height.

An allotment of \$2,500 was made for repairs from the appropriation for "repairs, preservation, extension, and completion of river and harbor works."

Notwithstanding these repairs, the breakwater was left in a very bad condition at the end of the year. Seven of the cribs had no superstructure remaining, and the portions which had not been carried away were much injured.

After removing the broken timbers and projecting bolts, to obtain an even top on which to build, the mean depths of the cribs below water were as follows: No. 1, 9 feet; No. 4, 5 feet; No. 5, 4 feet; No. 6, 4 feet; No. 7, 7 feet; No. 8, 5 feet; No. 9, 3 feet. The stone was washed out to much greater depths. (See Plate No. 5, with Annual Report for 1879.)

Amount appropriated for 1878-79:

Outer harbor.....	\$50,000
Inner harbor.....	25,000

In accordance with letter from the Chief of Engineers dated June 27, 1878, Capt. G. J. Lydecker, Corps of Engineers, transferred this work to Maj. F. A. Smith, Corps of Engineers.

During the year all the cribs were cleared of broken and projecting timbers and bolts. Crib No. 1 was raised 5 courses, and the remaining 550 feet of breakwater to its full height of 8 feet above water, filled with stone, and the top covered with plank.

A Board of Engineers was constituted by Special Orders No. 80, Headquarters Corps of Engineers, July 24, 1878, and adopted a method of sinking the cribs upon a foundation of piles driven through the sand into the clay.

In the following winter and spring 4 cribs were constructed according to the new design. (Sheet No. 2, Annual Report, 1879.)

Piles were driven and cut off for foundations of 2 cribs, and one of the cribs was put in position and filled with stone.

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IMPROVEMENT OF THE HARBOR AT NEW BUFFALO, MICHIGAN.

No work has been done during the year, and no appropriation for future work is recommended.

On the 1st of July, 1878, there remained available from former appropriations the sum of \$5,000, none of which has been expended.

As the money was appropriated for the construction of a harbor at the south end of Lake Michigan, the location being finally changed in favor of Michigan City, it is recommended that it be made available for the latter work.

Money statement.

July 1, 1878, amount available.....	\$5,000 00
July 1, 1879, amount available.....	5,000 00

APPENDIX D D.

ANNUAL REPORT OF MAJOR S. M. MANSFIELD, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1879.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., July 16, 1879.

GENERAL: I have the honor to forward herewith my annual reports relating to the works of harbor improvements under my charge for the fiscal year ending June 30, 1879.

Very respectfully, your obedient servant,

S. M. MANSFIELD,

Major of Engineers and Bvt. Lieut. Col., U. S. A.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

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IMPROVEMENT OF CHARLEVOIX HARBOR, MICHIGAN.

Contract was made August 7, with Hervey S. Dale, of Chicago, for doing the work of pier extension (5 cribs) and repairs, according to terms of advertisement and specifications dated July 5, 1878.

Under this contract work began August 19. By the 30th of November (close of season 1878) the 5 cribs, each 50 feet by 20 feet by 10½ feet, were placed and secured in position, of which 3 extend the north pier 150 feet and 2 extend the south pier 100 feet. In addition, the outer crib on each pier was decked over with 3-inch pine plank, for protection during the winter, and intervals between cribs were carefully filled. On the south side of channel brush protection (fascine mattress) work, extending shore connection inward 140 feet, was placed, and 64 $\frac{6}{128}$ cords of stone used to ballast the old north pier.

The contractor has not yet resumed work of building the 6 courses of superstructure over these cribs, and asks for an extension of 3 or 4 weeks, when work contracted for will be completed.

The permanent work built by the United States comprehends—

	Crib-work.	Brush-work.
	Feet.	Feet.
North side of channel and extensions.....	150	299
South side of channel and extensions.....	290	
Total.....	440	299