

REPORT OF THE CHIEF OF ENGINEERS OFFICE OF THE CHIEF OF ENGINEERS  
Washington DC October 20 1873

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9. *Saugatuck Harbor, Michigan.* — During the year the south-side revetment, under contract, at date of last report, has been completed. Two hundred and eighty feet of pile pier, prolonging south pier westward, has been put under contract and will be completed this season. Some slight repairs have been put upon this pier by hired labor.

Work under contract which provides for the building of 400 feet of north pier this season has not yet been commenced.

In order to make more secure what has already been done to make necessary repairs and to complete the north pier to maintain an unchangeable stability of the channel, there is great necessity for additional appropriations for this harbor.

Amount on hand July 1, 1872 .....	\$19,183.12
Amount of appropriation of March 3, 1873 .....	10,000.00
Amount expended during fiscal year ending June 30, 1873 .....	13,773.11
Amount available July 1, 1873 .....	15,450.01`
Amount required for fiscal year ending June 30, 1875 .....	25,000.00

(See Appendix C 9.)

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C 9  
SAUGATUCK HARBOR, MICHIGAN.

Under contract with F. L. Tebel, the revetment of the south slab pier with pile work has been completed Much difficulty was experienced by contractor in securing a proper alignment of the piling.

Under contract with John Roost, which provides for the building of 280 feet of pile pier, prolonging south pier westward work is still in progress The piles are nearly all driven, and work on superstructure is well advanced.

Repairs have been put on old work of 1870 '71, consisting of overhauling and replacing of filling, placing additional filling, and driving and securing fender piles to protect vessels against the protruding bolt heads in waling The piles were furnished and driven by contractor at contract rates; other materials were purchased in open market, and the work was performed by hired labor

Work under a contract of 1873 with John Roost, which provides for the building of 400 feet of close piling for the north pier, has not yet commenced. The condition of the harbor at the close of the year is so carefully detailed in the report of my assistant, Col. William B Gaw, that I beg leave to offer it herewith.

UNITED STATES ENGINEER OFFICE.,  
Detroit, Mich., June 30, 1873

COLONEL I have the honor to present you the following facts in relation to my recent examination of Saugatuck Harbor, made in obedience to your verbal instructions communicated to me on the 19th instant.

I noticed first beginning my observations and measurements at the lake end of the pier, that the shore line on the south side of the works had somewhat changed in consequence of a recent break in the pier (now repaired) of such a character as to permit the sand that had accumulated adjacent to the

pier to wash out to such extent as to leave the shore-line at present, in common with the shore-line of 1869, for a distance up the lake of 200 feet beyond which point the shore-line has not perceptibly changed from that of 1871.

Proceeding further up the river it was observed that the slab filling in the revetment is not sufficiently compact to prevent the sand from flowing through it. Therefore, the *old basin* (formerly the old bed of the river,) south of the central portion of the pier will not fill up as rapidly as anticipated. It appears to me that the work would be rendered more secure if the filling in the revetment was made more impervious, particularly at points of greatest impact of both the current and wave, and also weighted heavier with stone.

Continuing my observations and measurements up the river along the face of the pier I discovered on reaching a point 2,650 feet from the extreme lake end of the pier a greater flow of water through the revetment. This I found to be in consequence of the ruptured condition of the work which begins at this point and extends a distance of 400 feet.

Two hundred feet farther up where the revetment comes in contact with the sand hill at station 2750, I found the point of greatest impingement of the current against the revetment. Here, close to the face of the revetment, I found the bottom scooped out as it were to the depth of 28 feet, undermining the work to some extent. The prime cause of the break in the revetment, although aided by the current may be attributed to the accumulated sand which was brought down by the influence of the late spring rains from the slope of the adjacent hill in the shape of land slides against the rear wall of the work in such accumulated quantity as to overcome the stability of the structure by its superincumbent pressure. The revetment has been pressed out of its original line at this point from 4 to 8 feet for a distance of 150 feet up the line and consequently has been rendered so unstable it would overturn and float away if it were not supported by fender piles.

The angle of elevation of the sand hill opposite the break is  $34^{\circ} 10'$  evidently more than the angle of repose for sand as the dry sand is constantly running or sliding down the slope against the structure. Judging from the torn and rugged masses hanging against the slope of this hill which have partially slid down additional land slides must occur again at this place during the next rainy season. Should this threatened land slide come with the next spring freshets, the broken position of the revetment would certainly be carried away or additionally injured. In view of these facts, the work of reparation should begin as soon as practicable and, if possible, carried to completion during this summer season.

If it was deemed advisable a wing-dam might be constructed at small expense at a point about 900 feet above the extreme end of the curved revetment on the east side of the river, extending at least 100 feet out on an angle of  $20^{\circ}$  to the east shore line which would have the effect to change the direction of the current and thereby lessen its tendency to scour out and deepen the channel contiguous to the ruptured portion of the revetment; and more, it would cause the current to scour away the point of sand on the north side in the deep bend of the river and thereby straighten the channel lines and render this section of the river less difficult to navigate. It would, also, cause additional deposits of sand close along the face of the curved revetment, and consequently render all this curved section of the revetment less liable to fracture. I am not certain, however, that a wing-dam located at the point above described would stand any very great length of time, as the steady encroachment of the sand upon the river on the west side must, sooner or later, cause serious abrasion of the banks to take place at corresponding points on the east side.

I made several measurements of the width of the river at points above the first great bend, and took soundings on the lines of measurement with the view to ascertain the capacity of the river bed at these several points above the section of proposed enlargement with the following results: The first measurement was made at a point 750 feet above the extreme north end of the curved revetment, where the river was found to be 225 feet wide. Soundings were taken on this line beginning at a point 25 feet from the west shore line thence at interval distances of 25 feet toward the east shore line as follows: 7.5, 9, 7, 11.5, 12, 11.5, 11, 7.5.

The second measurement was taken 150 feet above the north end of the curved revetment and the width found to be 265 feet. Soundings beginning 25 feet from the west shore line thence at interval distances of 25 feet toward the east shore as follows: 8, 8.5, 9, 11, 13, 12, 13, 12, 7.6.

The third measurement was taken at the upper end of the curved revetment with the following results width of river 269 feet soundings beginning as above 25 feet from the west shore line thence at intervals of 25 feet as follows: 6, 7, 8, 11, 12.5, 13, 12.5, 12.5, +19 feet to the shore.

The fourth measurement was taken at a point 2,750 feet from the lake end of the revetment with the following results: width of river including 140 feet of marsh on the north shore 320 feet. Soundings beginning close to the face of the revetment, thence at intervals of 25 feet across to the north shore as follows 28, 19, 13.5, 16.5, 13.5, 6, 2.5, 1.5, 1, 1.5, 1, 5, 0.8.

The fifth measurement was made at the west end of the old slab revetment on the north side of the river with the following results width of river 200 feet measuring from the face of the revetment on the south side to the shore line on the north. Soundings as follows, beginning close to the face of the pier on the south side thence as usual at intervals of 25 feet: 12, 13, 14, 14.5, 12, 11, 9, 6.

From these measurements it may be seen that the capacity of the river bed is considerably less at points above than what it is at points below within the limits of proposed enlargement It has been further observed that the river at several points within the limits of the first section of five miles above the lake, is not more than 230 feet wide and therefore the capacity of the river bed at these upper points possesses no advantage of water way over portions of the river bed within the limits of the proposed enlargement. Taking these facts into consideration it would appear unnecessary to make the water way or width of channel at the mouth of the river more than 225 feet.

Very respectfully your obedient servant,

WM. B. GAW,  
*United States Assistant Engineer.*

S. M. MANSFIELD,  
*Capt. Engineers, Bet. Lieut. Col., U. S. A., Detroit, Mich.*

In order to make more secure what has already been done, and to make certain necessary reparation of injured work; to complete the north pier; to maintain an unchangeable stability of the channel, there is grave necessity for additional congressional appropriations in favor of this harbor.

Amount on hand July 1, 1872 .....	\$19,183.12
Amount of appropriation approved March 3, 1873 .....	10,000.00

	29,183.12
Amount expended in fiscal year .....	13,733.11

Amount on hand July 1, 1873 .....	15,450.01
Amount required for fiscal year ending June 30, 1875 .....	25,000.00

*Statement of vessels entered and cleared at Saugatuck Harbor for the year 1872*

	No. of vessels.	Tonnage.
Entered .....	747	79,157
Cleared .....	747	79,161

*Abstract of proposals received and opened August 21, 1871, for improving labor at Saugatuck, Michigan.*

Bidders' names and residences.	Timber.			White oak piles, linear feet.	Iron.		Stone, cord.	Handling slabs, cord.	Driving piles, linear ft.	Aggregate.
	Pine, cubic foot.	Oak, linear foot.	Oak, linear foot.		Drift-bolts, lb.	Screw-bolts and washers, lb.				
Charles P. Morse & Samuel G. Hart, Fulton, N. Y.	\$0 35	\$0 20	\$0 30	\$0 22	\$0 08	\$0 10	\$12 00	\$3 00	\$0 40	\$9,284 00
James Caldwell, Fulton, N. Y. ....	29	35	20	15	07	09	11 50	3 00	20	7,141 30
Nathan B. White, Grand Haven, Mich.	36	35	09½	15	10	12½	15 00	75	30	7,521 00
John Roost, Holland, Mich.	30	32	28	15	06½	07½	11 00	1 50	30	6,991 27½

Contract awarded to John Roost.

*Abstract of proposals received and opened May 5, 1873, for improving the harbor at Saugatuck, Michigan.*

Bidder's name and residence.	Timber.			Iron.		Oak piles, linear feet.	Stone, cord.	Slabs, cord.	Driving piles, linear ft.	Aggregate.
	Pine, cubic foot.	Oak, linear foot.	Oak, linear foot.	Drift-bolts, lb.	Screw-bolts and washers, lb.					
John Roost, Holland, Mich. ....	\$0 35	\$0 40	\$0 30	\$0 08	\$0 09	\$0 16	\$13 00	\$3 50	\$0 35	\$9,403 18