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42D CONGRESS,  
2d Session.

HOUSE OF REPRESENTATIVES.

{ Ex. Doc. 1,  
Part 2.

REPORT  
OF  
THE SECRETARY OF WAR,  
BEING PART OF  
THE MESSAGE AND DOCUMENTS  
COMMUNICATED TO THE  
TWO HOUSES OF CONGRESS  
AT THE  
BEGINNING OF THE SECOND SESSION OF THE FORTY-SECOND CONGRESS.

VOLUME II.

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1871.

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REPORT  
OF  
THE CHIEF OF ENGINEERS.

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# REPORT

## OF

### THE CHIEF OF ENGINEERS.

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OFFICE OF THE CHIEF OF ENGINEERS,  
Washington, D. C., October 20, 1871.

SIR: I have the honor to present, for your information, the following report upon the duties of the Engineer Department during the fiscal year ending June 30, 1871:

#### OFFICERS OF THE CORPS OF ENGINEERS.

The number of officers in the Corps of Engineers at the end of the fiscal year was 100 on the active list, and six on the retired list. In addition, the corps was aided in the performance of the duties intrusted to it, by a number of civil engineers, geologists, &c.

Since the last report, the corps has lost by death Major Chauncey B. Reese, brevet brigadier general United States Army; First Lieutenant William H. Chase and Brevet Second Lieutenant James B. Mackall, and one captain and two second lieutenants, by resignation; the captain, Brevet Lieutenant Colonel Peter S. Michie, having been appointed professor of natural and experimental philosophy at the Military Academy.

On the 30th of June, 1871, the officers were distributed as follows:

On duty in the office of the Chief of Engineers, including the Chief.	4
On duty with boards of engineers for fortifications.....	6
On duty with battalion of engineers.....	12
On duty, construction of fortifications.....	8
On duty, survey and construction of river and harbor improvements.....	23
On duty, construction of fortifications, and river and harbor improvements.....	21
On duty, survey of northern and northwestern lakes.....	6
On duty, explorations in the field west of Rocky Mountains.....	2
In charge of public buildings, grounds, &c.....	1
On special duty.....	1
Absent sick.....	1
Detached, on duty with generals commanding divisions, departments, &c., Light-House Establishment, Military Academy, &c..	15
Total.....	100

The officers detached were on duty as follows:

Lieutenant Colonel I. C. Woodruff, engineer third and fourth light-house districts.....	1
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on the cliffs and extension of wharf 50 feet. Gravelly Beach battery, to contain twelve 15-inch guns, is ready for the construction of platforms. The cliff batteries, to contain nine 15-inch guns, are ready for the construction of the magazines, breast-height walls and platforms.

It is expected that both these batteries will be completed during the next fiscal year, and in addition the mortar battery to contain four mortars. This battery is nearly completed now, and the timber for the platforms is on hand.

The next work to be undertaken is the barbette battery near Point Cavallo.

*Fort on Alcatraz Island, San Francisco Harbor, California, in charge of Major George H. Mendell, Corps of Engineers.*—This work occupies a valuable position for the defense of the entrance to, and inner waters of, the harbor of San Francisco, covering the whole of the rocky island, the shores of which rise abruptly from the water to a height sufficient to secure it from surprise. The fortifications have from their inception consisted chiefly of open barbette batteries for the heaviest guns. The recent introduction of guns so much larger than those formerly used has rendered the modification of the batteries at this work imperative.

Amount appropriated for fiscal year ending June 30, 1872, \$75,000.

Appropriation asked for next fiscal year, \$100,000.

During the past year, in Batteries 1 and 4, preparations were made for remodeling the defenses by the removal of gun-platforms and breast height walls. The work of cutting off the north caponnière, begun in the previous year, was completed and its conversion into a magazine traverse was commenced. In Battery 2, three service magazines were completed, as were also breast height walls for four guns, and the parapet except the sodding. In Battery 3, one service magazine was built, and the breast height walls for two guns commenced. One front pintle wooden platform for 15-inch gun was laid in Battery 2, and partially tested. The site of Battery 5 was sufficiently excavated to admit of the commencement of work on the gun platforms and other masonry. Considerable excavation was also made in Batteries 12 and 13, and the buildings and other public property on the island were kept in order and repair.

*Batteries at Point San Jose, San Francisco Harbor, California, in charge of Lieutenant Colonel C. S. Stewart, Corps of Engineers.*—The wood-work of the batteries continues to deteriorate necessarily. Six 42-pounder banded rifles, on iron carriages and front pintle wooden platforms, are mounted in the east battery.

No expenditures have been made during the year, and no appropriation is yet asked for the commencement of the new defenses projected for this point.

*Batteries on Angel Island, San Francisco Harbor, California, in charge of Lieutenant Colonel C. S. Stewart, Corps of Engineers.*—These temporary earth-works, erected during the late war, remain in the condition stated in the last annual report, with added deterioration due to the lapse of time, no expenditures having been made upon them during the year.

Two of the three works retain efficiency, and it is proposed to defer the commencement of the batteries of a permanent character projected to replace them.

No appropriation was made for fiscal year ending June 30, 1872.

No appropriation asked for next fiscal year.

*Defenses of the mouth of the Columbia River, Oregon, in charge of Major G. H. Mendell until April 11, 1871; since then, of Major Henry M. Robert,*



*Corps of Engineers.*—These defenses consist of Fort Stevens, on the south side, and three detached earthen barbette batteries at Cape Disappointment, on the north side of the entrance. They were built during the late war, and the materials used in their construction being those chiefly used in temporary works, they require frequent repairs. The revetments of all the interior slopes and traverses, and the timbers of the magazines at Cape Disappointment, are rotten and fallen in many places. They should all be replaced the coming year.

No appropriation was made for fiscal year ending June 30, 1872.

Appropriation asked for next fiscal year, \$20,000.

The only operation carried on during the past year at these works, was the erection of a picket fence around Fort Stevens.

*Sea-coast mortar batteries.*—The appropriations of 1870 and 1871, for sea-coast mortar batteries, amounted, in all, to the sum of \$175,000. This sum has been apportioned between the important ports of Portland, Boston, New York, Philadelphia, and San Francisco, as follows:

At Portland, for the emplacement of 4 mortars .....	\$5,000
Boston.....do.....do.....14....do.....	34,000
New York.....do.....do.....40....do.....	80,000
Philadelphia..do.....do.....6....do.....	21,000
San Francisco.do.....do.....28....do.....	35,000

Making a total of ninety-two mortars in all.

Projects for the batteries for nearly all these mortars have been prepared and approved, and the constructions have been commenced at some points.

The fire from mortars is an important part of the defense of our harbors against iron-clads, and a further appropriation for batteries of this description is recommended.

Amount appropriated for fiscal year ending June 30, 1872, \$100,000.

Appropriation asked for next fiscal year, \$100,000.

*Examinations of tidal currents.*—Careful surveys and examinations to determine the strength and direction of the tidal currents in the channels opposite to and near the works of defense for our sea-ports on the Atlantic, Gulf, and Pacific shores have been made, or are still in progress, under the direction of the several officers charged with the supervision of the fortifications at the respective points, except upon the Pacific coast, where the observations were under the direction of Lieutenant Colonel B. S. Alexander, Corps of Engineers.

#### BOARDS OF ENGINEERS.

*The board of engineers for fortifications,* stationed in New York City, consisting of Colonel J. G. Barnard, Colonel G. W. Cullum, Lieutenant Colonel Z. B. Tower, and Lieutenant Colonel H. G. Wright, have been engaged during the past year upon the plans for the modifications of the sea-coast defenses and the decision and investigation of questions connected therewith.

*The board of engineers for the Pacific coast,* consisting of Lieutenant Colonel B. S. Alexander and the officers in charge of the construction of fortifications in San Francisco harbor, with Lieutenant Thomas H. Handbury as recorder, have been occupied with projects for the defense of the Pacific coast.

#### BATTALION OF ENGINEERS AND DEPOTS.

*Battalion of engineers, commanded by Major Henry L. Abbot, Corps of Engineers, headquarters Willet's Point, eastern entrance to New York*

Amount expended during fiscal year ending June 30, 1871.	\$2,102 32
Amount available July 1, 1871 .....	9,029 25
Amount required for fiscal year ending June 30, 1873.....	<u>10,000 00</u>

(See Appendix V 25.)

#### EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

Lieutenant Colonel Thom was charged with and completed the following examinations and surveys directed to be made by the second section of act of July 11, 1870:

1. Fifteen Mile Falls, New Hampshire.
2. Coheco River, at Dover, New Hampshire.
3. Royals River, Maine.
4. Narragangus River, Maine.
5. Sullivan River, Maine.
6. Sullivan's Falls, Maine.

The reports of these examinations will be found in Appendix V.

The surveys of the following harbors and rivers are completed, and the reports thereon will be submitted at an early day:

1. At Wells Harbor, Maine, (act of March 3, 1871.)
2. Re-survey of Fifteen Mile Falls, New Hampshire, (act of March 3, 1871.)
3. Wellfleet Harbor, Massachusetts, (act of July 11, 1870.)
4. Duxbury Harbor, Massachusetts, (resolution of House of Representatives.)
5. Wareham Harbor, Massachusetts, (resolution of House of Representatives.)

#### HARBORS AND RIVERS ON THE PACIFIC COAST.

##### IMPROVEMENT OF RIVERS IN OREGON.

Officer in charge, Major R. S. Williamson, Corps of Engineers, to April 11, 1871; since that date, Major H. M. Robert, Corps of Engineers.

1. *Lower Willamette River, Oregon.*—Operations during the past fiscal year have been confined to dredging on Swan Island Bar. The season suitable for dredging is very short, being limited to the latter part of the summer, a portion of the autumn and of the spring. There remains yet a distance of 2,000 linear feet to be deepened to complete the channel to a depth of 17 feet at low water, which, it is expected, may be completed during the summer of 1872.

Access to this river has, within the last year, been rendered very difficult by the filling up of the channel across St. Helen's Bar, in the Columbia River, and of that through the bar at the mouth of the Willamette, which was deepened by dredging two years ago. The increasing foreign commerce of Portland, Oregon, needs the removal of these obstructions, many vessels grounding in the two rivers during the year, and all over 17 or 18 feet draught having to forward from one-third to one-half their cargoes by lighters for a distance of eighty or one hundred miles before they can ascend the river. The dredge-boat used on the work at present is one loaned to the United States by the city of Portland, and is not well fitted for the work, costing \$3,000 for annual repairs. An appropriation of \$50,000 for the construction and running expenses during one year of a steam-dredge and two scows for use on these rivers is earnestly recommended by the officer in charge.

Amount available July 1, 1870 .....	\$11,046 02
Amount appropriated by act of July 11, 1870 .....	31,000 00
Amount expended during the fiscal year ending June 30, 1871 .....	24,329 48
Amount available July 1, 1871 .....	17,716 54
Amount required for fiscal year ending June 30, 1873. ....	50,000 00

(See Appendixes W 1, 2, and 3.)

2. *Upper Willamette River, Oregon.*—A survey of this river above Oregon City was made last autumn by Lieutenant W. H. Heuer, Corps of Engineers.

The work to be done consists in scraping the bars with a Long's scraper, and in removing snags after the high-water season with a snag-boat built for the purpose. Wing-dams will also be built in several places. No estimate for funds required for the fiscal year 1872-'73 can be rendered until after the close of the present working season.

Amount appropriated by act of March 3, 1871, and available on July 1, 1871 .....	\$16,000 00
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(See Appendixes W 1, 2, and 3.)

3. *Umpqua River.*—An examination of the rapids of this river was made by Major Williamson, Corps of Engineers, in the autumn of 1870.

Preparations have been made for blasting a channel through the most dangerous rapids, which will be carried on during the present fiscal year.

Amount appropriated by act of March 3, 1871, and available July 1, 1871 .....	\$22,500 00
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No appropriation asked for the year ending June 30, 1873.

(See Appendixes W 1, 2, and 4.)

4. *Examination of the bar of the Sacramento River, California, known as the Hog's Back.*—This was made under the direction of Major Williamson, by Lieutenant W. H. Heuer, Corps of Engineers.

This bar consists of a number of shoals extending about three and one-half miles, having 7 to 8 feet depth of water, with deep water between them. The average width of the 7-foot channel over them is 200 feet, the narrowest width 75 feet. The least depth of 7 feet is at Eagle Nest Shoal, which is about 400 feet across.

Some attempts have been made to improve this navigation by dredging, but a rise in the river soon refilled the portion dredged, and it was found of no avail. Wing-dams have also been tried, and although the effect of those built by the California Steam Navigation Company has in some cases been beneficial, in others they have caused the formation of bars injurious to navigation. Major Williamson recommends an appropriation of \$7,500 for the purpose of constructing a dam 500 feet long at Eagle Nest, and one of 700 feet near Suterville; and also for repairs of the old dam at Heacock's Shoals. To be effective, such works must be extended wherever the strength of the current is insufficient to prevent deposit.

(See Appendix W 5.)

5. *Examination and survey at Santa Cruz, California.*—Major Williamson reports that by an act of the legislature of California approved February 11, 1870, a commission was appointed "to examine the harbor of Santa Cruz and Salina Slough in the bay of Monterey for the purpose

months of May and June, 1871, which embraces all the points of interest in and near this harbor, and showing, by comparison with the various former surveys, the changes that have since occurred.

The amount of funds that were available for this work on

July 1, 1870, was.....	\$5,131 57
Amount appropriated therefor by act of March 3, 1871....	6,000 00
Total .....	11,131 57
Amount expended during the fiscal year ending June 30, 1871	2,102 32
Amount available July 1, 1871.....	9,029 25

The contemplated work yet to be done for the preservation and improvement of this harbor is as follows, viz :

1. A dike across the head of Lancey's Harbor, at Abel Hill, the estimated cost of which is.....	\$3,500 00
2. The repair of the existing bulk-head and jettées, and planting of beach-grass along Beach Point and the State Dike now required, say.....	1,000 00
3. Completing the stone apron-work for the protection of Long Point, requiring about 1,000 tons.....	3,000 00
4. A work to prevent the extension of the flats between Stevens's Point and Lobster Point, estimated at.....	4,000 00
5. The planting of beach-grass for the protection of the outer sand-hills lying between the State Dike and Cove Section, for an extent of nearly one mile, say.....	3,000 00
6. To provide for annual repairs of the bulk-heads and jettées, say.....	2,500 00
Contingencies.....	2,029 25
Total.....	19,029 25
Amount available July 1, 1871, (as above).....	9,029 25
Amount required for the fiscal year ending June 30, 1873..	10,000 00

Which could be profitably expended upon the work in that year.

Respectfully submitted.

GEO. THOM,  
*Lieutenant Colonel Engineers.*

#### APPENDIX W 1.

*Annual report on the works of river improvement in Oregon for the fiscal year ending June 30, 1871.*

UNITED STATES ENGINEER OFFICE,  
*Portland, Oregon, September 6, 1871.*

SIR: I have the honor to submit the following report of the operations of this office for the works of river improvement in Oregon, during the fiscal year ending June 30, 1871.

At the opening of the year the work was under the charge of Major R. S. Williamson, Corps of Engineers, assisted by Lieutenant William H. Heuer, Corps of Engineers.

On the 11th of April, 1871, in compliance with Special Orders No. 124, dated March 28, 1871, from the War Department, Adjutant General's Office, I relieved Major R. S. Williamson at San Francisco, California, from his duties as superintendent of river improvement in Oregon, being at the same time assigned to duty as engineer of the 13th light-house district.

On the 13th of April I sailed for Portland, Oregon, arriving on the 17th. On the following day I visited the dredger at Swan Island Bar, which was at work under a general order from Major Williamson.

The water having risen suddenly 2 feet and a strong current running, with appearances of stormy weather, I gave orders to lay up, which was accordingly done on April 19, the crew being discharged, and the boats loaned by the city of Portland to the Engineer Department placed in charge of a watchman. I then visited the site of the Yaquina light-house, returning to Portland on the 28th of April, established this office on the 2d of May, and left on the 12th for Cape Disappointment, and afterward for San Francisco on business connected with my duties as light-house engineer, arriving at Portland again on the 30th of May.

#### MOUTH OF THE WILLAMETTE RIVER.

At this point, two years ago, a channel about 1,000 feet long, 100 feet wide, and 17 feet deep at low water, was cut. I have not had time to visit this point, but hope to do so during the summer. I find, however, that the general opinion among river-pilots and steamboat-men is that this channel cannot be kept open without dredging each year. One vessel grounded here this year, and had to be lightered, at great expense, before she could be got over, and vessels drawing 18 and 19 feet of water never attempt to cross this bar now without lightering. This subject will be more fully referred to below.

#### LOWER WILLAMETTE RIVER.

*Swan Island Bar.*—Work at this point has been in progress at different times during the last four years. The result of the work performed this spring season is the deepening of the channel to 17 feet at low water for a distance of 85 linear feet, besides cleaning out of 100 feet in length by 45 to 100 feet wide and 2 feet deep of the old cut, this latter being the deposit made by the unusually long winter freshet. The amount of excavation was 1,400 cubic yards, including 900 cubic yards cleaned out of the old channel. There remains yet a distance of 2,000 linear feet to be cut through, varying in width from 100 to 250 feet, when the channel will be completed to a depth of 17 feet at low water, and for a distance of one mile. The character of the work hitherto performed here is of a very satisfactory nature, and it is believed when completed it will need only occasional work to keep a good channel open. I do not think that the work in this bar can be completed this year, in consequence of the short period intervening between the summer and fall freshets; but expect to resume operations about the 10th of August next, which will consist, as formerly, of dredging on the line of the cut, and removing any snags lodged during the present season of high water.

#### COLUMBIA RIVER.

In connection with the improvement of the Willamette River, the question of access thereto naturally arises, and it appears that obstruc-



tions in the channel of the Columbia River, below the mouth of the Willamette, have been forming, which are now serious obstacles to the development of the foreign trade of this port. I refer especially to the St. Helen's Bar, about twenty miles below the mouth of the Willamette, the old channel through which has seemingly been filled up within the last two years, causing constant and extended delays to vessels of 17 or 18 feet draught. By the annexed statement furnished me by the collector of customs for this district, it will be seen that during the past nine months 106 vessels, of an aggregate tonnage of 73,714 tons, have arrived at this port. Of these 70 were steamers, 5 ships, 23 barks, and 8 brigs and schooners, and many were heavily laden with railroad iron, and took out, on their departure, full cargoes of wheat hence to Liverpool and China.

There are two English firms in this city, Messrs. Corbett and McCleary, and Messrs. Hewitt, Flowerdon & Co., constantly engaged in shipping wheat directly to Liverpool, which, before the opening of the Swan Island Bar, found its exit by steamer to San Francisco, and there was reshipped for exportation. Since October last, the coin collections at this port alone amounted to \$210,000, and more than twenty vessels with full cargoes have arrived in this river from distant foreign ports, taking out from hence full cargoes of domestic produce. This is exclusive of the trade with British Columbia, in which two steamships are constantly employed besides occasional sailing-vessels. The coastwise trade, especially with San Francisco, is very large, and constantly increasing, but cannot be estimated closely for the reason that vessels engaged therein are not required, except in certain cases, to report at the custom-house.

The following instances will evince the difficulties which confront the masters of large vessels coming to this port: The British bark Skidder, now in port from England, with railroad iron, was detained several days on the bar at the mouth of the Willamette, and only got over it by sending forward one-third of the cargo on lighters. The duty collected on this cargo exceeded \$17,000. The British iron ship Dorenby, also in port now, with a similar cargo, grounded on the St. Helen's Bar, and was brought into port only by lightering. The duties paid on her cargo aggregated nearly \$19,000. The American bark Garibaldi, just arrived with a full cargo from China, was delayed for some time on the St. Helen's Bar. Duties on her cargo exceeded \$15,000. The British ship Bristolian, drawing 19 feet of water, is now in the mouth of the Columbia River, and steamboats are going down from here a distance of one hundred and ten miles to lighter her ere she can ascend the river to this point. All these ships are chartered to take return cargoes, one-half of which they will take at the wharves of this city, then dropping down below St. Helen's, a distance of thirty-five miles, will there receive the remainder from steamboats. In order to secure return cargoes of wheat, &c., vessels from distant ports must arrive here in the latter part of the summer, which is the season of extreme low water in these two rivers.

In view, therefore, of the rapid increase of the commerce of these rivers, and the material injury thereto by the obstacles presented by these two bars, I would respectfully recommend that I be authorized to make such examinations at St. Helen's and the mouth of the Willamette as will be necessary to determine the best method of removing these obstructions to navigation.

The dredger hitherto used on the improvement of the Lower Willamette is the property of the city of Portland, has been in use five years, during four of which it has been loaned to the engineer officer in charge by the city authorities, is an ordinary single-dipper dredge, built hur-



riedly by contract, and will not last much longer. It is too small for the work, cost originally \$25,000, coin, and the annual expense of keeping it in repair has been about \$3,000. There is no other dredger in this part of the country, and as one will be needed from time to time on Swan Island Bar, annually at the mouth of the Willamette, and on the new bar at St. Helen's, I would respectfully recommend that an appropriation be asked, for the construction and fitting out of a steam-dredger and two scows, of \$35,000 for the former, and \$4,000 for the latter.

The probable operations for the year 1871-72 will consist of a continuation of dredging on Swan Island Bar, the cut through which will not be completed until the summer of 1872; also of such examinations and work as I may be authorized to make on the bar at the mouth of the Willamette, and which may be necessary to keep that channel open.

During the fiscal year the following amounts were received and expended on account of the improvement of the Willamette River at Portland, Oregon, and to mouth of river:

Balance July 1, 1870.....	\$11, 046 02
Appropriated July 11, 1870.....	31, 000 00
	<hr/>
Total available.....	42, 046 02
Expended during the year.....	24, 329 48
	<hr/>
On hand July 1, 1871, and available.....	17, 716 54
	<hr/>
Estimated cost of completing Swan Island work with the present dredger.....	17, 000 00
	<hr/> <hr/>

*Estimate for the fiscal year 1872-73.*

Construction and fitting out of a steam-dredger for use on the Lower Willamette and Columbia River Bars.....	\$35, 000 00
Construction of two scows for use with dredger.....	4, 000 00
Running expenses for season.....	11, 000 00
	<hr/>
Total.....	50, 000 00
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UPPER WILLAMETTE RIVER.

A survey was made by Major Williamson of the worst bars, with a view to estimating the cost of improving the navigation on this river. (See Major Williamson's report of December 12, 1870, Senate Ex. Doc. No. 14.)

Amount appropriated.....	\$16, 000 00
Available July 1, 1871.....	16, 000 00
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The probable operations for the ensuing year will consist of an examination of the points most favorable for work during the coming low-water season; the construction of a Long's scraper, and a snag-boat with snag-pulling apparatus, and work with these appliances whenever and wherever it may be found to be most needed. Wing-dams will also be built in several places. After the experience of this summer's work, a report will be made, with an estimate for such funds as may be required for next year's work.

## UMPQUA RIVER.

A reconnaissance by Major Williamson was made of the rapids of this river, (Senate Ex. Doc. No. 14,) and appropriation made by Congress of \$22,500, which was available July 1, 1871.

An examination of this stream will be made immediately and a project submitted for the expenditure to best advantage of the appropriation. Probable operations during the ensuing year will consist of blasting a channel through the most dangerous rapids.

No appropriation asked for the year ending June 30, 1873.

Respectfully submitted.

HENRY M. ROBERT,  
*Major of Engineers, United States Army.*

*Tonnage arrived and departed from the customs district of Willamette, from October 1, 1870, to June 30, 1871, nine months inclusive.*

52 steamers, 1 ship, 19 barks, 6 others, inward coasting, tonnage.....	59,426
18 steamers, 4 ships, 4 barks, 2 others, inward foreign, tonnage.....	14,288
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70 steamers, 5 ships, 23 barks, 8 others, total.....	73,714
<hr/>	<hr/>
58 steamers, 5 others, outward coasting.....	52,611
21 steamers, 3 ships, 12 barks, 1 other, outward foreign.....	20,901
<hr/>	<hr/>
	73,512

*Tonnage owned in customs district of Willamette, June 30, 1871.*

	Ton nage.
5 sail.....	749.77
30 steamboats.....	7,043.24
6 barges.....	334.58
<hr/>	<hr/>
Total tonnage.....	8,127.59

H. W. SCOTT;  
*Collector,*  
Per W. S. DUSENBURY.

A true copy :

HENRY M. ROBERTS,  
*Major of Engineers, United States Army.*

W 2.

SAN FRANCISCO, CALIFORNIA,  
*August 3, 1871.*

GENERAL: I have the honor to submit the following report of operations, under the appropriation for examinations and surveys on north and northwest rivers and lakes, and Atlantic and Pacific coasts, for the fiscal year ending June 30, 1871.

Under this appropriation I have made examinations and surveys of Upper Willamette and Umpqua Rivers in Oregon, and of the Sacramento River, California. Full and detailed reports of each work, accompanied by maps and estimates of the cost of proposed improvements, have been forwarded to the Chief of Engineers.

The following statement shows the amount received and expended during the year:

On hand July 1, 1870.....	\$0 00
Received during the year.....	19,000 00
Total on hand and received.....	10,000 00
Expended.....	4,526 58
Deposited to credit of Treasurer of United States.....	5,473 42
Balance on hand June 30, 1871.....	0 00

Respectfully submitted.

R. S. WILLIAMSON,  
*Major, Corps of Engineers, U. S. A.*

Brigadier General A. A. HUMPHREYS,  
*Chief of Engineers, U. S. A., Washington, D. C.*

SAN FRANCISCO, CALIFORNIA,  
*August 3, 1871.*

GENERAL: I have the honor to submit the following report of operations, under the appropriation for "surveys of military defenses," for the fiscal year ending June 30, 1871:

The work of reducing meteorological observations has been continued from time to time during the year; the computer, however, was employed during most of the time on other work, which was paid for out of other appropriations. Finally he resigned, on the 31st of May last, and his place has not been filled. A quantity of observations are still uncomputed.

The following are the amounts received and expended during the fiscal year ending June 30, 1871:

On hand July 1, 1870.....	\$563 85
Received during the year.....	600 00
Total.....	1,163 85
Expended during the year.....	1,103 34
Balance on hand June 30, 1871.....	60 51

Respectfully submitted.

R. S. WILLIAMSON,  
*Major, Corps of Engineers, U. S. A.*

Brigadier General A. A. HUMPHREYS,  
*Chief of Engineers, U. S. A., Washington, D. C.*

SAN FRANCISCO, CALIFORNIA,  
*August 3, 1871.*

GENERAL: I have the honor to submit the following report of operations, under the appropriation for "surveys and examinations on the Pacific coast," for fiscal year ending June 30, 1871:

No field work has been done under this appropriation during the past fiscal year. I am directed by the Chief of Engineers, United States Army, to make examinations of Eureka and Santa Cruz Harbors during

the present fiscal year, and to pay for the same out of this appropriation, which will be done.

The following statement exhibits the amounts on hand, received, and expended during the past year:

On hand July 1, 1870.....	\$4,473 40
Received during the year.....	0 00
Total on hand and received.....	4,473 40
Expended during the year.....	694 82
Balance on hand June 30, 1871.....	3,778 58

Respectfully submitted.

R. S. WILLIAMSON,  
Major, Corps of Engineers, U. S. A.

Brigadier General A. A. HUMPHREYS,  
Chief of Engineers, U. S. A., Washington, D. C.

SAN FRANCISCO, CALIFORNIA,  
August 3, 1871.

GENERAL: I have the honor to submit the following report of operations under the appropriation for "improvement of Willamette River at Portland, and mouth of river Oregon," for the fiscal year ending June 30, 1871.

This work has been carried on under the immediate charge of my assistant, Lieutenant W. H. Heuer, Corps of Engineers, United States Army.

The operations on this river during the past fiscal year have been confined to dredging on Swan Island Bar. Work was recommenced on the 8th of August, 1870, and continued uninterruptedly until the 24th of December, 1870. During this time, 23,765 cubic yards of material (clay and sand) were excavated, and 1,594 linear feet of channel of 17 feet deep made. This makes a channel of 17 feet in depth by 100 feet in width at the bottom, for a length of 2,299 feet. There yet remains to be cut through about 1,500 linear feet of channel, as above, which now contains 15 feet of water.

The cost of the dredging this year has been 95.5 cents per cubic yard.

The following is a statement of funds received and expended during the year:

On hand July 1, 1870.....	\$0 00
Received during the year.....	11,000 00
Expended during the year.....	10,746 34
Balance on hand July 1, 1871.....	253 66

The balance has been turned over to Major H. M. Robert, Corps of Engineers, who, by direction of the Chief of Engineers, United States Army, relieved me from duty, under this appropriation, on the 31st of March, 1871.

Respectfully submitted.

R. S. WILLIAMSON,  
Major Corps of Engineers, U. S. A.

Brigadier General A. A. HUMPHREYS,  
Chief of Engineers, U. S. A., Washington, D. C.

SAN FRANCISCO, CALIFORNIA,

August 3, 1871.

GENERAL: I have the honor to submit the following report of operations under the appropriation for "repairs, &c., of works on harbors and rivers" for the fiscal year ending June 30, 1870. The only operations carried on under this appropriation during the past fiscal year was the removal of the Blossom Rock. The contractor, Mr. A. W. Von Schmidt, by surface-blasting, dredging, and raking, succeeded in obtaining the depth of water required by his contract. A careful survey to ascertain these facts was made by my assistant, Lieutenant W. H. Heuer, Corps of Engineers, United States Army. The work was accepted by me on behalf of the Government on the 8th of December last, and the contract money (\$75,000) was paid to Mr. Von Schmidt, the contractor. A full and detailed report of the operations for removing this rock from their commencement until the acceptance of the work by me has been sent to the Chief of Engineers, to which I respectfully refer you.

The following statement exhibits the amounts received and expended by me during the year:

On hand July 1, 1870.....	\$80,394 53
Received during the year.....	0 00
Total accounted for.....	80,394 53
Expended during the year.....	76,406 34
Balance on hand June 30, 1871.....	3,988 19

Respectfully submitted.

R. S. WILLIAMSON,

*Major Corps of Engineers, U. S. A.*

Brigadier General A. A. HUMPHREYS,

*Chief of Engineers, U. S. A., Washington, D. C.*

W 3.

SAN FRANCISCO, CALIFORNIA,

December 23, 1870.

GENERAL: I have the honor to forward herewith a report of a survey of the Willamette River, above Oregon City, Oregon, by my assistant, Lieutenant W. H. Heuer, United States Engineers. The object of the survey being to afford data to determine the nature of the obstructions to the navigation of the river, and the probable cost of its improvement, it was evidently not necessary to make a minute survey except of those portions of it where obstacles exist. The portions of the river examined extended from Corvallis to the falls at Oregon City; the obstacles above Corvallis are so numerous at the low stages of the river, and so difficult of removal, that I did not think it necessary to extend the survey above that place.

I have the honor to be, very respectfully, your obedient servant,

R. S. WILLIAMSON,

*Major United States Engineers.*

Brigadier General A. A. HUMPHREYS,

*Chief of Engineers, U. S. A., Washington, D. C.*



SAN FRANCISCO, CALIFORNIA,

December 23, 1870.

MAJOR: In accordance with your order of September 7, 1870, I left Portland, Oregon, with my party, on September 8, and proceeded up the Willamette River by steamboat to Salem, Oregon. This was done to see the obstructions to the navigation of the river, as well as what had been done toward improving it by the Steamboat Company.

After leaving Oregon City we steamed up the river for about five miles and arrived at Rock Island, where the river widens and the channel becomes tortuous. During high water the river rushes down the channel, which contains points of rocks and rocky reefs, under which eddies are formed, rendering navigation difficult; but during ordinary stages of the river, steamboatmen consider it perfectly safe. They do not, therefore, deem any immediate improvement necessary. After leaving Rock Island the river contains a good depth of water, until we arrive opposite the mouth of Molalla River, one of the tributaries of the Willamette, ten miles above Oregon City, where a shoal is formed consisting of small gravel and boulders. As the boats cross the shoal without difficulty, no improvement is deemed necessary here. Proceeding farther up the river, we find deep water, until arriving just below the mouth of the Yamhill River, another tributary, about thirty-five miles above Oregon City. Here a shoal extends entirely across the river, carrying about three feet of water. The river is about 1,000 feet wide, the channel narrow, and the current rapid. The shoal is gravel, which vary in size, but averaging about four inches in length, nearly flat, with rounded edges. This shoal is probably due to the increased width of the river, as well as to the gravel brought down by the Yamhill River during its annual freshets. The river might be temporarily improved here by a system of wing-dams, but the boatmen say that other bars higher up the river are so much worse than this one that they do not consider the Yamhill Bar a serious obstacle to navigation.

Between Yamhill Bar and Salem are numerous shoals, covered by 24 to 30 inches depth of water, with deep water between them. The names of the bars are Runaway Bar, Bennett's Dread, Five Islands, Tow Head, Matheney's, Beaver and Lone Tree Rapids, McCloskey's Chute, and Chitwood Bar. Each of these shoals are of the same nature. Of the bars just mentioned, Matheney's, Beaver, and Lone Tree Rapids and Chitwood Bar are the worst, on account of the channel being less wide and more tortuous than on the other bars. The depth of water is about the same on each of these bars.

Steamboats navigate the river between Oregon City and Salem (sixty-five miles) during the entire year, and as far as Corvallis, forty-two miles above Salem, during nine months of the year. During a high-water stage of the river, they run up as far as Eugene City, about eighty miles above Salem.

From the 1st of October to the 1st of August the river is said to be high, and the boats make their trips regularly, transporting heavy loads of freight; after that navigation above Salem ceases, and all towns above Salem either have to wagon their grain and supplies to or from Salem or stow them away until navigation reopens.

The bars between Salem and Corvallis are not very numerous. They are of a similar nature to those below, but have a few inches less depth of water, and the boulders become larger as we go higher up the river. Above Salem we surveyed Humphrey's Rapid and Bowers Bar. They are considered the worst bars in the whole river, and if they were improved, it is thought navigation would open to Corvallis during the entire year. The names of the other bars above Salem are Eola Bar, Rocky Rapids, Independence Bar, Buena Vista Bar, Luckamute Bar, and Long Crossing. None of these, however, are considered serious obstacles to navigation. The upper Willamette River varies in width from 300 to 1,000 feet; its average width from Albany to Oregon City is probably 500 feet. At every shoal on the river it is wider than it is immediately above or below the shoal. The difference between the highest water and low water of this river varies at different places. Where the banks are high it is said to be as much as 60 feet; at Salem it is about 40 feet. The banks of the river generally are low, and heavily timbered for a distance of about half a mile in width; beyond that is fine prairie land, forming by far the most valuable farming land in the State.

During the year, October 1, 1869, to October 1, 1870, 51,437 tons of freight were carried by the boats navigating the river. The People's Transportation Company monopolize the carrying trade of the river. They run seven steamboats above the falls at Oregon City and two below. Within the last few years this company has improved the navigation at Chitwood, Matheney's and Runaway Bars by building wing-dams in the river, thereby contracting its width and causing the increased current to wash the finer gravel from the shoals into deeper water below the dams.

The results in some cases were satisfactory, and would have been better had the dams been better constructed and placed in more favorable localities. As a rule, they were roughly constructed, and consisted of a log being thrown into the stream, making an angle of about 135° with the current. Willow bushes and gravel were then thrown in on the up-stream side of the log. The log, being aground, would remain in place until the water raised, when it would be carried away. In a few instances the dams were constructed by driving light piles into the gravelly bed of



the river, then placing the logs against the piles, and brush and gravel against the logs. The dams so constructed are still standing.

The danger to be apprehended in building wing-dams in the river is, that the current striking the dam is deflected to the opposite shore, which, if it be of a soft character, is gradually washed away, leaving the river as wide as before the dam was constructed. When the banks are washing away, the trees fall into the river, ground, and offer a partial protection to further wash until the river rises and floats them off. The current then carries them off until they lodge on some gravel-bar, where they form a wing-dam, and sometimes produce a bad effect. The river pilots say that at nearly every bar the channel changes from year to year; it is, therefore, probable that any change which a wing-dam will produce on a bar will be temporary. It will produce an increased depth of water, but the gravel which it scours out will be deposited below, and may make another shoal as bad as the original.

Surveys were made of the following-named bars of the river, viz: Bower's Bar, Humphrey's Rapid, Chitwood Bar, Beaver and Lone Tree Rapids, and Matheny's Bar. Maps of each of these bars accompany this report. They will now be described in the above order, commencing at

#### BOWER'S BAR.

This obstruction is three miles above Albany. The river suddenly widens from 225 feet to 400 feet, where the shoal is found. The distance from 3 feet depth of water above, to the same depth below the shoal, is 150 feet. Average depth of water on the shoal is 2 feet. The current flows nearly west, with a velocity of 400 feet per minute. Immediately above the shoal the current is less rapid. The bed of the river is gravel, averaging about 2 pounds in weight; some of them, however, weigh as much as 20 pounds. Near the shoal are three bare gravel-bars, two of them on the north side of the channel, the other near the mouth of the creek on the south side of the channel. The lower of these bars is gradually washing away on the channel side. The south bank of the river is clay, stands nearly vertically, and is also gradually wearing away. The north bank is a gravelly shore, having a gradual slope from the water's edge for a distance of about 200 feet. Beyond that we find timber. The river can be improved here by building a wing-dam from the foot of the northerly gravel-bar to the head of the lower bar. This would be 325 feet long, would concentrate the current, and cause it to scour the shoal, but would also undermine the south bank and cause it to wash. This can be remedied by piling close to shore, and then throwing in logs and brush behind the piles; 500 linear feet of piling would probably suffice. The estimated cost of the wing-dam is \$300; that of the bulk-head for shore protection, \$2,600, making a total estimated cost of this improvement, \$3,500.

After leaving Bower's Bar, we pass down the river without meeting with any serious obstacles until we arrive at

#### HUMPHREY'S RAPID.

This obstruction is about twenty miles, by river, above Salem. The bed of the river is gravel, like that on the other shoals, but the obstruction consists of two rocky reefs, nearly parallel to each other, about 150 feet apart, putting out from opposite sides of the channel. The lower one projects from the south shore, and is 125 feet in length, by an average width of 75 feet. The upper reef puts out from an island on the north side of the channel for a distance of 250 feet, and has an average width of 100 feet. These two obstacles cause the boat, in ascending or descending, to make two sharp turns in contrary directions, (like the letter S,) and the current being rapid, (nearly 400 feet per minute,) has a tendency to throw a boat, in crossing, broadside on the lower reef, which is covered by about 2 feet of water. The upper one is barely covered. A channel can be made by blasting through either of these ledges of rock, but the work would be very expensive. An equally good channel, at a small cost, can be made between the island and the north shore. This chute contains an average depth of 15 feet of water, except at its upper end, and for a distance of 300 feet, where there is less than 3 feet of water. This shoal, however, is all small gravel, none of it any larger than an egg; and if a wing-dam 220 feet long was constructed diagonally across the current, its lower end abutting against the head of the small gravel-bar near the head of the island, the increased current would soon scour out the small gravelly shoal, and give a channel 75 feet wide in its narrowest part.

At the end of the island was an immense accumulation of drift, probably 20 feet high, which lodges there during every freshet. This was set fire to and burned out in a few days. The only objection to building a dam at the head of this bar is, that it might catch the drift and choke any channel which it might form. This is not probable, because the gravel-bar against which the dam would abut is about 3 feet high, whereas the top of the dam would be but a few inches above the water surface. The estimated cost of building this dam—220 feet in length—is \$700.

The next important obstruction below this is called

## CHITWOOD BAR.

This is about a mile and a half below Salem, and gives the steamboat men considerable trouble during low-water stage of the river. The river contains a long gravel-bar or island, the foot of which is about 600 feet above the shoal. At the shoal the river widens suddenly from 300 to 675 feet. Immediately above and below the shoal is a good channel, carrying upward of 3 feet of water. Length of the shoal between the 3-foot curves, above and below, is 475 feet. On the west bank, a little above the shoal, is a wing-dam 150 feet long; another was built from the foot of the island, and is 550 feet long. The shoal commences at the foot of the long wing-dam, and extends across the river, covered with from 20 to 30 inches of water. In the prolongation of the shorter wing-dam, and distant from its foot about 140 feet, is a pile driven into the gravelly bed of the river. In ascending the river, the boats hug the west bank until they arrive about 150 feet below the wing-dam; a line is then taken from the boat, and one end made fast to the pile, the other end remaining on board wound around the capstan. The boat then backs; the result is, that she is carried into mid-stream, and held there by the line. The engine is then quickly reversed, a few feet of progress made, and the spare line taken in. The probabilities are that by this time the boat is aground. She again commences to back, which throws a little water under her, and causes her to raise a trifle on the wave so produced. The engine is again quickly reversed, and more progress made. This process is repeated, sometimes for hours, until the boat reaches the pile, after which she has no more difficulty. While surveying this bar, a break 100 feet long occurred in the long dam near the foot of the island. The water, which was 2 feet deep before the break, soon increased to 8 feet depth. A good channel can be made through the break of this dam by throwing a dam 200 feet long from the west bank, 500 feet above, and parallel to the one already built on this bank. The lower dam should also be lengthened 200 feet. The channel would then be on the east side of the river, until, crossing through the break of the long dam, we would again arrive in deep water, in the old channel above the shoal.

The estimated cost of this improvement is \$1,400. The east bank would also have to be protected by a bulk-head of piles and logs. This is estimated at \$2,600.

Leaving Chitwood Bar, we pass down the river nine miles, and reach

## BEAVER AND LONE TREE RAPIDS.

These two rapids, being only a mile apart, and each of them being shoal, were surveyed as one rapid. That nearest the top of the map is called Beaver Rapids. The average width of the river at and between these rapids is 700 feet; the bed of the river is large coarse gravel. The fall of the river from the head of Lone Tree to the foot of Beaver Rapids, a little over a mile, is 5.6 feet. The observed velocity of the current was 204 feet per minute, but in the shoalest part, between the two gravel-bars, it was swifter.

Between the two rapids the channel is well defined, and contains from 4 to 8 feet of water, but at the rapids it is scarcely 3 feet in depth, and very narrow. Beaver Rapid is navigated without much difficulty, but when in Lone Tree Rapids the boats have to cross the current above the upper gravel-bar, and are liable to be swept broadside against the bar. As the swiftest current and smallest gravel are between the two gravel-bars, I think that the best place for making a channel. This can be properly done by building a dam from the head at gravel-bar No. 2, diagonally across the current to the south shore, 200 feet. This will scour away the small gravel at the foot of bar No. 1. If it does not give a channel sufficiently wide, concentrate the current still more by throwing out a wing-dam from the right bank, 300 feet long, toward the head of bar No. 1. This will deflect the current toward the left bank, and materially assist the lower dam in producing sufficient scour. The estimated cost of the two wing-dams is \$1,500.

If the upper dam should be built, it might cause the left bank to wash, which is low and flat, and covered with trees. To prevent this we should have to pile and protect the left bank for a linear distance of 1,000 feet. This it is estimated will cost \$5,100.

Four miles below Beaver Rapids we reach

## MATHENEY'S BAR,

which is about fifteen miles below Salem, and a place where the boats frequently ground. The river widens to 750 feet, has a velocity of 300 feet per minute, and a gravelly bottom. Two dams have been built here by the company. The upper one was very rudely constructed and was not of sufficient length, and the lower one, though being well constructed, is, I think, improperly located. This shoal might be improved by repairing the old upper dam, and extending it 350 feet further out, as indicated on the map. This would leave a water-way 400 feet wide, and would soon scour out gravel enough to make a good channel. There is no danger of the left bank washing, as it is a coarse gravelly shore.

Immediately below the bar the river becomes from 12 to 15 feet deep. The cost of repairing the old upper dam; and extending it 350 feet, would be \$1,200.

## RECAPITULATION.

Improving Bower's Bar .....	\$3,500
Improving Humphrey's Bar .....	700
Improving Chitwood Bar .....	4,000
Improving Beaver and Lone Tree Bars .....	6,600
Improving Matheney's Bar .....	1,200
Total .....	<u>16,000</u>

The wing-dams, of which the above estimates were made, are of the simplest construction, consisting of logs 2 feet in diameter and long as possible, to be thrown diagonally across the current and held in position by four piles, two at each end of each log; willow brush to be lodged against the upper side, and held in place by gravel. These dams would be equally as good as any of those constructed by the company, and might answer the purpose for which they are intended, viz: temporarily improving the navigation of the river at such bars on which they may be placed. The dams already constructed have benefited the navigation at certain localities; navigation has become more difficult at others, but the injury to other parts of the river is not necessarily to be attributed to the wing-dams.

If the river should be improved at Matheney's Bar, Beaver and Lone Tree Rapids, and Chitwood Bar, the result would be that boats might make the trip from Oregon City to Salem in a few hours less time than at present, and would be able to carry a little more freight. As all the boats plying on this river are owned by one company, it is questionable whether any improvement on these bars, by the Government, would cause any reduction in the freight tariff.

Should the two obstacles above Salem be removed, viz, Humphrey's Rapid and Bower's Bar, boats might get to Albany and Corvallis during low-water stage.

Before closing this report, I wish to thank Assistants Charles F. Brown and S. D. Adair for their valuable services during the survey.

Respectfully submitted.

WM. H. HEUER,  
*Lieutenant of Engineers.*

Major R. S. WILLIAMSON,  
*United States Engineers.*

W 4:

SAN FRANCISCO, CALIFORNIA,  
*December 12, 1870.*

GENERAL: In accordance with the order of the Chief of Engineers, dated Washington, July 23, 1870, placing me "in charge of the survey of the Umpqua River, Oregon, and instructing me to inform myself of the nature and extent of the surveys required, and to submit, at an early day, a project and estimate therefor, having regard to the strictest economy," I have to submit the following report:

A surveying party, consisting of Lieutenant Heuer and three assistants, under my supervision, sailed from here on the 2d of September. Upon our arrival in Oregon, the party was placed in the field, surveying the bars of the Upper Willamette River, while Lieutenant Heuer and I went by stage to Roseburgh, Oregon, with the view of getting information in regard to the Umpqua River. While there, we conversed with parties interested in the navigation of this river, and ascertained that a small stern-wheel steambot, drawing about 13 inches of water, had, during this year, when the river was about 4 feet above its present low-water stage, ascended the river from Scottsburgh, twenty-five miles from its mouth, to Roseburgh, a distance by the river of about one hundred and twenty miles, but that the river had such a rapid current and so many obstructions, that the boat had to be hauled through the rapids by lines,