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Columbia River Bar Improvement.

Through favor of Senator Grover we are in possession of the following reports, interesting to people of Oregon and Washington territory:

Project of Maj. G. L. Gillespie, Corps of Engineers.

UNITED STATES ENGINEER OFFICE, Portland, Oregon, December 5, 1880.

GENERAL: I have the honor to submit for the consideration of the department a chart of the mouth of the Columbia river, showing the location and character of an improvement which I now propose as a means for hastening the deepening of the channel through the Middle sands inside the bar.

On the 17th of December, 1879, I submitted a plan and estimates for a stone dike on the south side of the entrance, but the project, as is stated in my last annual report, will cost a great deal of money and will consume a great deal of time, owing to the manner in which appropriations are made for large undertakings. This latter consideration has led me for some time past to a thoughtful study of the harbor and its shoals, to ascertain if it be not possible to dispense with the massive structure which the original project contemplated. The shoals, and the two channels of approach through them, are now in a favorable condition for attempting, by a speedy process, to build up Clatsop spit, and to hold the banks of the inside channel for a proper direction of the currents to maintain deep water along the line observed in the chart of 1841. The short passage between the north and south channels, through the Middle sands, at a point indicated in my previous reports on this harbor, has not been effected with the rapidity and success I anticipated. I believe the cut is gradually deepening, but the process is so slow that the channel cannot be used with convenience by deep draught vessels when winds and tides are unfavorable.

An attempt was made to hasten the deepening by narrowing across the depression, leaving the currents to carry out to sea the displaced material. This was a laborious undertaking with the means available, and very expensive; an increase of three to four feet was obtained, but I was compelled to forego operations on account of insufficiency of funds applicable to the object. The work will be resumed when the new appropriation becomes available.

The commerce of the river is increasing rapidly, capital is flowing into Oregon and Washington territory in large quantities to build railroads and develop the resources of the country, and it is of the greatest importance to the commercial public that a deeper channel be made as speedily as possible from the outside to a safe anchorage on the inside.

I have heretofore been unwilling to recommend any construction which involved the use of timber because of the exposure of the site; but the great demands upon the river and the many and new interests centering in this section induce me to recommend an improvement which is capable of being made rapidly and quickly, and which, if not permanent at first, may be made so by annual strengthenings and additions.

The project proposed is to build, along the line previously established on the south side, a strong pile-dike, rising three feet above low tide, 8,000 feet long, and twenty feet wide from outside to outside, filled with fascines and stone, and securely protected on both sides with mattresses and stone. The dike will start near Stevens, and, following the twelve-foot curve, will be directed a little westward of the outer part of the headland at cape Hancock. The dike so located will prevent the escape of water at ebb tide over a great part of Clatsop spit, and project the ebb currents, which have usually a maximum surface velocity of six feet per second, in the direction of the cut which I have been attempting to improve by the scraper, and will have sufficient depth of water on the east side to enable the plant to work and the scows to move alongside and dump their material directly into the work. If placed on or near the spine of the shoal, a landing must be made on the inside some distance from the work; a tramway must be built to connect the landing with the dike, and extended over the dike as it progresses.

Wherever it will be necessary to drive piles in the latter case, it will be equally possible to approach the dike with the scows in the former case. The shore-line on both sides of the heel of the dike will be revetted with fascines and mattresses to prevent erosions by the waves and currents. This work should be done in one work-

ing season; and if it proves efficacious, which I do not doubt, in cutting out the middle sands, it can be strengthened by additions of mattresses and stone, converting the structure into one of a permanent character, and may be extended at will.

The Columbia river and its affluents drain an area of nearly 200,000 square miles; the country through which it passes is settling up rapidly, and foreign capital is coming in to promote manufacturing industries, to build railroads, and to open the valuable coal mines. These undertakings are still in their infancy, but they have assumed such proportions as to make the opening of the inner shoals at the river's mouth an object of interest to our whole country. The execution of the plan will not be without its difficulties, but I believe it to be thoroughly practicable if commenced with an appropriation equal to the estimate for the entire work.

It is desirable that the work be commenced as early as the 1st of April next, and pushed vigorously during the summer and autumn, before the coming of the heavy southwesterly gales, which create the highest seas and offer the greatest impediments to continuous and safe labors. I do not think it can be doubted that the proper place for the improvement is on the south side, or that the maintenance of a deep water channel through the inner shoals is dependent mainly upon the building up of Clatsop spit, and the holding of it in a position approximate to the one it now has.

A strong revetment will be required on the inside of the dike, after completion, extending across the little bay to the eastward of the government landing, but this need not be undertaken at once, and will be much simpler and less costly in its construction than the dike.

ESTIMATE OF COST.
6,000 feet of dike, at \$30 per foot..... \$180,000
1,500 feet of dike (shoals), at \$40 per foot..... 60,000
2,500 feet of shore revetment, at \$10 per foot..... 25,000
Total..... \$265,000
Contingencies of engineering, surveys, inspection, etc..... 20,000
\$285,000

The success of the project is so dependent upon rapidity of construction, only obtainable by the use of strong and costly plant, that I would urge the appropriation of the full amount of the estimate so that the dike may be built in its entirety before the opening of the next winter.

Charts accompany this report showing the location and character of the proposed improvement. I am, general, very respectfully, your obedient servant.

G. L. GILLESPIE,
Major of Engineers, Bvt. Lieut. Col., U. S. A.
Chief of Engineers, U. S. A.
Report of the Board of Engineers.

New York, Feb. 12, 1881.
GENERAL: This board, in accordance with instructions from the office of the chief of engineers, dated December 24, 1880, to consider the whole subject of the improvement of the mouth of the Columbia river, have the honor to report:

A careful examination has been made of the documents and charts in connection with the subject transmitted from the office of the chief of engineers, including the various reports made by the local engineer, Maj. G. L. Gillespie, corps of engineers.

As a first step in this inquiry, a comparative study of the charts to note the changes in the shoals and channels became necessary.

Admiral Vancouver's chart of 1792 represents the river discharge, through a single channel, nearly due west into the ocean, with a depth on the bar of 4½ fathoms. The Clatsop shoal, or south breakers, which form the southern margin of the channel, had an extent in a westerly direction of about 7 miles. The north edge of the channel lay about one-half mile south of cape Disappointment. The chart is on a small scale and its claims to accuracy of detail not known, but the striking feature of the existence of but one channel could not have been a matter of mistake.

Sir Edward Belchers admiralty chart of 1839 exhibits for the first time Sand island, whose eastern extremity was 1½ nautical miles north from point Adams. The island formed the eastern apex of a large triangular shoal, which presented its base to seaward, and the line of the base extending nearly north and south. The island and shoal separated the waters into a north and south channel, the former leading northwest, towards the cape, where it was turned abruptly to the south-southeast, skirting the north breakers, which had extended southerly for a distance of a little more than two nautical miles, and then entered the ocean in a west by south course, over a bar with 4½ fathoms over it. The south channel was

in the channels and shoals, which have been uniform in their causes and results.

The north channel has not only been narrowed and shoaled by the movement of Sand island, but it has also been considerably curved northwards. The north breakers have been cut away from a southerly projection of two and one-half miles from cape Hancock to that of one mile.

The southeast end of the Middle sands and a projection from Clatsop shoals have considerably narrowed the south channel near the outlet, and threaten even to close it.

The navigable depth in the north channel has decreased since 1841 from six fathoms to fourteen feet at the present time, and over the bar from four and one-half fathoms to twenty-one feet. The depth over the bar of south channel has also decreased from four and one-half fathoms in 1868 to nineteen feet.

The distance of the north bar from cape Hancock has varied from about four miles in 1839 to two miles at the present time. The distance of the south bar from point Adams has varied from four to three and one-half miles nearly west from point Adams.

The northward swing of Clatsop spit has been particularly hurtful to the south channel, as thereby a considerable portion of its flow has been forced over the Middle sands, to the detriment of the bar.

Between 1879 and 1880 both Peacock spit and Clatsop spit have approached the Middle sands and narrowed the width of the northern depression. This in 1878 had a width across between the three fathom curves of 2,800 feet, with a depth of fourteen feet; in 1879 a width of 2,400 feet, and the same depth as before; in 1880 a width of 1,000 feet, and a depth of seventeen feet. The great decrease in width and increase in depth in one year, between 1879 and 1880, indicate a possible close approach to a breach at this point through the Middle sands.

The more southerly depression had in 1878 a width between the three-fathom curves of 4,600 feet, with a depth of fifteen feet; in 1879 the same width, with a depth of thirteen feet; and in 1880 a width of 1,700 feet, and a depth of seventeen feet. The great decrease in width and increase in depth during the last year of observations indicate likewise a close approach to a breaking through at this point.

Considering also that here the currents of the south channel set directly against this narrow bulkhead, it becomes not impossible that the breach here may be the first effected.

The proposition to construct a training wall starting from the shore-line at point Adams north from Fort Stevens, to have a length of 6,500 feet, and a direction about west-northwest along the interior 2-fathom curve of Clatsop spit, although earnestly recommended and made the occasion of a call for immediate construction, is not approved.

The distance from point Adams to the section in the Middle sands which it is the object of this structure to wash away by its action in deflecting the currents of the channel is five nautical miles, and it is quite probable, considering the distance of the point to be affected and the large volume of water in the channel to be deflected, that to accomplish the desired result a training wall nearly if not quite three miles long would be required.

The probability of an early breach at one or two points of the Middle sands, so far at least as the rapid wearing away during the past year can support the assertion, is very great, and it becomes a matter of serious consideration whether before material progress in the construction of the proposed work could be made, or even preparations to undertake it perfected, the natural causes now in active operation would not have accomplished the desired result.

As a training wall long enough to effect this object would consolidate and fix Clatsop spit in its present position, it might be well to inquire into the influence of such consolidation upon the future condition of the channel. The spit has been for years near its present position and extent, and though contracting considerably the waterway between point Adams and cape Hancock, it has not had the effect of deepening the outlets, which have, on the contrary, diminished both in width and depth. The present position of this spit invites, if it does not compel, the tail of the Middle sands to tread to the southeast, and thus injuriously affects the outlet of the south channel, although its position and considerable projection into the south channel have for many years been effectual in moving the middle sands to the west and also to the

north, thereby injuriously affecting the north channel in depth and width, as also in changing the direction of the south channel, to its injury and deterioration in depth and width; yet it does not appear that its effect in forcing a break through the middle sands, which might prove at least temporarily beneficial, has been conspicuous. This naturally leads to a statement of a fact that the increased southerly projection of Peacock spit during the past year has probably been the principal cause of the considerable increase of erosion across the middle sands west of Sand island.

Clatsop spit in its change of position and growth has unfortunately been associated with a great deterioration of navigation over the bar, and it constitutes a principal feature in the poorest exhibition of navigable facilities which the Columbia river at its mouth has afforded for the past ninety years.

It is not the purpose to analyze the changes which have taken place in the channels and other features—which, however, have been mainly dependent upon the movement of Sand island with its shoal, and of Clatsop spit—nor to determine whether one was caused by the other, or whether both movements were forced by the same powerful agency.

It is sufficient, after what has been pointed out, to state that the present extent and position of Clatsop spit constitute it a hurtful feature of the outlet, and that it would be a beneficial change if it were set back in the place which it formerly occupied, in a direction nearly west.

The conclusion is that the proposed training wall along the inner edge should not be built, because—

First, it would be too short to effect the purpose designed, of making a breach for the channel across the middle sands.

Second, if extended far enough to be effectual, the training wall would consolidate Clatsop spit in position and extent, and constitute a hurtful impediment to a future improvement of the channel; and, Third, because the natural causes now at work would succeed in making the desired breaches through the sands, or operate some other convulsion, entirely changing the present conditions of the entrance before effectual progress could be made in the construction of the training wall.

The features of the outlet, as they have been and now exist, possess neither fixed position nor outlines, and it would seem to be first necessary, by the construction of a solid work, to force the ever-shifting channels and shoals to assume general characteristics of permanence before a definite solution of the problem of improvement could be effected, or the possibility even of such result be predicted.

If the middle sands, for instance, could be consolidated by a detached work across the opening of the river, leaving large intervals at its extremities, viz, for a north channel between its north end and cape Hancock, and for a south channel between its south end and point Adams, a considerable advance would be made to bring the problem within the result of such solution as it would admit of. Auxiliary works, as experience might dictate, would possibly be necessary, or submerged jetties might be run out from cape Hancock and point Adams, so as to insure a limited scour in a fixed direction, and thus obtain a suitable depth over the bar.

But the changes which appear now to be imminent lead the board to think that all constructions at this time would be premature, as it is likely that the benefit from natural causes which will follow a change may endure for years.

Moreover, any plan which could be devised might probably interfere with the new courses of the channels supposed about to form, and even be impracticable under the new condition of things.

For the above reasons, the board consider it unnecessary to submit any plan at this time for the improvement of the mouth of the Columbia. Respectfully submitted.

Z. R. TOWER,
Col. Eng., Bvt. Maj. Gen., U. S. A.
JOHN NEWTON,
Col. Eng., Bvt. Maj. Gen.
HENRY L. ABBOT,
Lieut. Col. Eng., Bvt. Brig. Gen.
Brig. Gen. H. G. WRIGHT,
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