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SKAGIT RIVER, WASH.

LETTER

FROM

THE SECRETARY OF WAR

TRANSMITTING

REPORT FROM THE CHIEF OF ENGINEERS ON PRELIMINARY EXAMINATION OF SKAGIT RIVER, WASH.

MAY 19, 1928.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustration

WAR DEPARTMENT,
Washington, May 18, 1928.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

DEAR MR. SPEAKER: I am transmitting herewith a report dated May 9, 1928, from the Chief of Engineers, United States Army, on preliminary examination of Skagit River, Wash., authorized by the river and harbor act approved September 22, 1922, together with accompanying papers and map.

Sincerely yours,

C. B. ROBBINS,
Acting Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, May 9, 1928.

Subject: Preliminary examination of Skagit River, Wash.
To: The Secretary of War.

1. I submit, for transmission to Congress, my report, with accompanying papers and map, on preliminary examination of Skagit River, Wash., authorized by the river and harbor act approved September 22, 1922.

2. Skagit River is the largest stream tributary to Puget Sound and flows into Skagit Bay through several mouths. The existing project for its improvement provides for a low-water channel in the South Fork, to be obtained by the construction of a training dike, regulating

works, and a mattress sill at the head of the North Fork, together with the closing of subsidiary channels. It also provides for increasing the depth at Skagit City Bar by dredging and regulating works, subject to the condition that local interests assume responsibility for the payment of damages claimed or alleged to result from any work that may be done under the project. A channel providing easier access to the river from the sound is now desired. The range of tide between mean lower low water and mean higher high water is 11.4 feet.

3. In 1926 the traffic moved on the river amounted to 328,275 tons, 250,485 tons of which were floated logs. The general vessel traffic included canned milk, general farm produce, and vegetable seeds. It is stated that the valley grows 80 per cent of the cabbage seed produced in the entire United States. There is a continued increase in agricultural production, the delta of the Skagit River containing some of the richest farming land in the State. It is also expected that with better water made available at the mouth of the South Fork the shingle mills at Milltown will ship over 3,000 tons annually.

4. The district engineer states that the North Fork is now in better condition for navigation than is the South Fork. No work has been undertaken on Skagit City Bar, as the local cooperation required has not been forthcoming. In order to facilitate the movement of vessels through North Fork the mattress sill has been partially removed and the snag boat has done a limited amount of dredging. The two freight boats which move between Mount Vernon and Seattle draw 4½ and 7 feet, respectively. The water rates between these points are from 10 to 20 cents per 100 pounds, while the rail rates are from 34 to 68 cents. On this basis the estimated savings from use of the river approximate $250,000 annually.

5. Severe floods frequently do great damage along the river. The district engineer discusses this situation at some length, but as the department has already recommended a survey of Skagit River for flood control it will not be referred to further in this report. There are a number of power sites above the head of navigation, some of which are developed. Navigation on the river is hampered by lack of depth at low water. The district engineer believes that sufficient relief would result from part-time operation of the small pipe-line dredge recommended in his report on Puget Sound and tributary waters to justify the expense. The division engineer concurs.

6. The report of the district engineer has been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, agreeing with his views.

7. The large quantities of silt brought down the rivers entering Puget Sound are deposited outside their mouths, forming extensive tidal flats. Dependable channels of reasonable depth are expensive and difficult, if not impracticable, to maintain, since dredged cuts soon shoal and there is no pronounced littoral current to carry away eroded material. The expense involved in providing a channel which could be used at all stages of the tide is not justified. The nature and magnitude of the commerce do, however, warrant some betterment of navigable conditions. I therefore report that the improvement of Skagit River, Wash., is deemed advisable to the extent which can be accomplished under the general project recommended for Puget Sound and tributary waters.

EDGAR JADWIN,
Major General, Chief of Engineers.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

SYLLABUS

The Board of Engineers for Rivers and Harbors concurs with the district and division engineers in the opinion that further improvement is justifiable to such extent as can be accomplished by part-time operation of the small pipe-line dredge recommended in another report for operation in Puget Sound and its tributary waters.

[Second indorsement]

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, D. C., May 1, 1928.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. The following is in review of the report on preliminary examination of Skagit River, Wash., authorized by the river and harbor act approved September 22, 1922.

2. Skagit River, which is the largest stream tributary to Puget Sound, enters Skagit Bay, an arm of the sound, through several mouths. There is an existing project which provides for a low-water channel in the South Fork, to be obtained by the construction of a training dike, regulating works, and a mattress sill at the head of the North Fork, together with the closing of subsidiary channels. It also provides for increasing the depth at Skagit City Bar by dredging and regulating works, subject to the condition that local interests assume responsibility for the payment of all damages claimed or alleged to result from any work that may be done under the project. The improvement now desired is a channel providing easier access to the river from the sound. The range of tide between mean lower low water and mean higher high water is 11.4 feet.

3. The delta of the Skagit River contains some of the richest farming land in the State. The average annual production of oats, hay, potatoes, and general farm products totals about 120,000 tons. In addition, there is an extensive cultivation of vegetable seeds, amounting in value to over $200,000 annually. It is claimed that the valley grows 80 per cent of the cabbage seed produced in the entire United States. At Mount Vernon and at Burlington there are two large milk-condensing plants, the annual value of the products being approximately $4,000,000. In 1926 the total traffic on the river amounted to 328,275 tons, of which 250,485 tons was floated logs. It is to be expected that lumber shipments will decrease in the future on account of the removal of the terminal of the Puget Sound and Baker River Railway from a point on the Skagit River to Similk Bay, near Deception Pass. There is, however, a continued increase in agricultural products and in the tonnage of the canneries. With better water at the mouth of the South Fork, it is claimed that the shingle mills at Milltown would ship over 3,000 tons annually.

4. The district engineer states that the depth of water available in the North Fork is now much better than in the South Fork. No work has been done toward deepening the Skagit City Bar by dredging, as the local cooperation required has not been forthcoming. In order to facilitate the movement of vessels, the mattress sill which was placed across the North Fork has been partially removed and a limited amount of dredging has been done by the snag boat in connection with its main work of removing obstructions. At present there is only one freight boat making regular trips between Mount Vernon

and Seattle. In the fall, when grain and hay shipments are heavy, a second boat is used. One of these vessels draws 7 feet loaded and the other 4½ feet, and neither goes above Mount Vernon. Some local movements are, however, made in the upper river. The water rates between Mount Vernon and Seattle are from 10 to 20 cents per 100 pounds, while the rail rates are from 34 to 68 cents. On this basis it is estimated that the savings resulting from use of the river approximate $250,000 annually.

5. The river is subject to severe floods which frequently occasion great damage. This is discussed at some length by the district engineer but is not referred to further here, as the department has already recommended a survey for flood control. There are a number of power sites on the river, some of which are developed, but they are all above the head of navigation.

6. While the commerce handled on the river fluctuates from year to year, the tonnage is considerable and appears to be increasing at a moderate rate. Movements between this section and Seattle are very much cheaper by water than by rail. No saving in transportation costs results from such shipments destined by rail to eastern points, since Mount Vernon has the same rates as Seattle. The district engineer considers it undesirable to undertake any work on the South Fork at the present time other than what may occasionally be necessary to facilitate the movement of logs from Tom Moore slough, which amounts to some 385,000 tons annually. The North Fork route is shorter, and although it has a steeper slope, there is comparatively little difficulty in its navigation. The depth on the bar is about the same as at the South Fork, but the extent of the shallow water is somewhat shorter. While a channel which could be used at all stages of the tide would be very much more satisfactory to those interested, the cost of such work would be high in proportion to the benefits. The present commerce is, however, hampered by lack of depth at low water. In view of the relief to navigation which would result from limited dredging across the bar and the deepening of small shoals in the river, work which could be accomplished at comparatively small expense, the district engineer recommends that such work be undertaken by the small dredge which it is proposed in another report be obtained for general work on Puget Sound and tributary waters. The division engineer concurs.

7. It is evident that commerce and navigation are obstructed to an extent by the existing conditions at the mouth of the river. The tonnage is of sufficient magnitude and of a nature to justify some Federal expenditure. The conditions at the mouths of all the principal tributaries of Puget Sound are such that dependable channels which can be used at all stages of the tide can not be obtained with a reasonable expenditure of money. The board agrees with the district and division engineers that some relief to navigation could be afforded through the operation of the small pipe-line dredge recommended in another report to be obtained for operation in Puget Sound and its tributary waters. It therefore recommends that such further improvement of Skagit River, Wash., be undertaken as can be accomplished by part-time operation of this proposed dredge.

8. In compliance with law, the board reports that there are no questions of terminal facilities, water power, or other related subjects which could be coordinated with the suggested improvement in such

manner as to render the work advisable in the interests of commerce and navigation.

For the board:

HERBERT DEAKYNE,
Brigadier General, Assistant Chief of Engineers,
Senior Member.

PRELIMINARY EXAMINATION OF SKAGIT RIVER, WASH.

SYLLABUS

The existing project for the improvement of the bar at the mouth of the South Fork has not been a success, and the work authorized at Skagit City Bar was dependent upon local cooperation, which has not been furnished. The boat line now uses the North Fork, but can operate only on tides. The water-borne commerce is considerable in amount and value, but the district engineer does not consider it of sufficient importance to warrant any modification or enlargement of the existing project. He considers that a small amount of dredging with a view to securing such limited increase of depths as will permit navigation at somewhat lower stages of the tide would be justifiable. He states that this could best be done by a small hydraulic dredge, and calls attention to the fact that he has recently submitted a favorable report on preliminary examination covering such a dredge for use under the general project for "Puget Sound and its tributary waters."

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Seattle, Wash., February 8, 1928.

Subject: Preliminary examination of Skagit River, Wash.
To: The Chief of Engineers, United States Army
(Through the Division Engineer).

1. In compliance with section 12 of the river and harbor act of September 22, 1922, and instructions contained in department letter [1] of October 5, 1922, the following report, with map, is submitted on a preliminary examination of Skagit River, Wash. This report is based on a report made by Col. W. J. Barden, Corps of Engineers, in 1924, with the data brought up to date.

2. *General description.*—The following description of the Skagit River Basin is quoted from Water Supply Paper No. 419, published in 1916 by the United States Geological Survey:

Skagit River, the largest stream tributary to Puget Sound rises in Beaver Lake, British Columbia, 20 miles north of the Canadian line, and flows southwestward 125 miles to its mouth near Mount Vernon, Skagit County, Wash. Below Mount Vernon it passes by several channels through its delta into Skagit Bay, an arm of the sound.

Its basin comprises 3,100 square miles on the western slope of the Cascade Mountains, touching the crest for 130 miles, measured along the divide, or 90 miles in a straight line, extending from Indian Pass northward along the eastern boundaries of Snohomish, Skagit, and Whatcom Counties to the Canadian line, thence northward 20 miles into British Columbia, where it reaches Fraser River Basin.

Altitudes within this area range from sea level to about 7,000 feet on the Cascade divide and to more than 11,000 feet at the summit of Mount Baker—the highest peak in this basin. Other mountains whose slopes are drained by the Skagit are Glacier Peak and Mount Shuksan. Roughly speaking, the greater part of this area that is above an altitude of 1,000 feet—approximately 2,500 square miles—is in the Washington and Snoqualmie National Forests. Above the timber line and within the zone of perpetual snow much of the surface is

[1] Not printed.

barren rock. On Mount Baker and Glacier Peak there are many glaciers which furnish the most permanent water supply of the river. Below an elevation of about 4,000 feet the area is, in general, timbered with Douglas fir and hemlock, which are smaller and less abundant with increase in altitude. Some of the heaviest stands of Douglas fir are found on the lower stretches of this area. Cedar also is abundant.

The prevailing soil on the higher elevations is coarse glacial gravel, but there are many pockets of loam in the valleys, and the deposits of limestone and clay at the mouth of Baker River are notable, as they furnish materials for the Portland cement factories there. Underbrush and litter are thick on the lower levels and along the stream courses, become thinner up the slopes, and die out before they reach the timber line.

The greater part of this area is snow covered to a depth of 2 to 10 feet in winter and to much greater depths on the higher slopes and peaks. As on all streams in the Puget Sound region, the minimum stages of the streams are reached in September and October, when freezing nights cut off the snow water from the higher slopes and the drought still prevails in the valleys and low areas. A second low stage comes in February when the streams in the higher courses are ice locked and when all precipitation is held back in the form of snow.

The two largest tributaries of Skagit River are Sauk and Baker Rivers. Thunder Creek, Ruby Creek, and Cascade River are also large, as they head in the high Cascades.

Sauk River, the largest of the tributaries, drains 731 square miles, mostly in the northeastern part of Snohomish County, and enters the Skagit approximately at the head of navigation near the town of Rockport. From its mouth to its most distant source at Indian Pass the river is about 50 miles long. Glacier Peak, 10,436 feet above sea level, is the highest peak in this area. A large part of the basin is above the timber line and much of it is in the zone of perpetual ice and snow.

Baker River, the tributary second in importance, heads at Hannegan Pass, on the eastern slope of Mount Shuksan, and flows southward about 25 miles, passing through Baker Lake, on the southeastern slope of Mount Baker, to its junction with the Skagit, 40 miles above the mouth of that river, at Concrete, Wash. The basin of this stream comprises 295 square miles, is very mountainous and rugged, and is chiefly in Whatcom County, within the Washington National Forest. Like the Sauk, this river drains much surface within the zone of perpetual ice and snow and is fed by the glacial fields of Mounts Baker and Shuksan.

3. Complete discharge data are not available. Skagit County, in cooperation with the United States Geological Survey, maintains an automatic gauge at The Dalles, about 2 miles below the mouth of the Baker River. Records are available for the years 1925 and 1926 and give a maximum discharge of 85,400 second-feet and a minimum of 3,400 second-feet, with a mean discharge of 8,630 second-feet. No flood occurred during this time. It is estimated that the discharge in ordinary floods at Sedro Woolley is over 200,000 second-feet and that floods have occurred in which the discharge was over 400,000 second-feet. Low water usually occurs in February and March and in September and October, and high water in May, June, July, and November.

4. The lower river is affected by the tide to the Great Northern Railway bridge, about 17 miles above its mouth. The extreme tidal range at the mouth is 20.5 feet; the range between mean lower low water and mean higher high water is 11.4 feet.

5. *Original condition.*—In its original condition extensive shoals at the mouths of both the North and South Forks prevented access from Skagit Bay to the river channels except on tides. Inside the mouths ample depths were in general available to the forks. The least depth was at the Skagit City Bar, about 6 miles from the mouth of the South Fork. In the early days what was known as the "Old Main River" was the principal channel. When first

officially examined in 1875 the river was much obstructed by snags and at and above the forks navigation was completely blocked by two large timber jams or rafts. After the removal of these rafts in 1877–1879, mainly by the efforts of the early settlers, the river was navigable for boats of about 3 feet draft at most stages to Avon, 14 miles above the mouth, and during ordinary high water to the Sauk River 69 miles from the mouth. During extreme high water boats occasionally ascended the river as far as the Portage (about 96 miles).

6. *Examinations and surveys.*—Examinations and surveys of this waterway and reports thereon have been made as follows:

(*a*) Examination, February 11, 1875. (P. 791, A. R., C. of E., 1875.) Favorable for improvement by removal of snags, log jams, and some bank protection at an estimated cost of $15,000.

(*b*) Examination, July 14, 1881. (P. 2603, A. R., C. of E., 1881.) Favorable for construction of snag boat at an estimated cost of $15,000 and $10,000 per year for operation, for snagging on this and other streams entering Puget Sound.

(*c*) Preliminary examination, November 8, 1890. (H. Ex. Doc. No. 38, 51st Cong., 2d sess.) Unfavorable except for more efficient removal of snags.

(*d*) Survey "Skagit River from mouth to the town of Sedro, Wash.," ordered by river and harbor act of June 3, 1896. Report dated December 11, 1897. (H. Doc. No. 204, 55th Cong., 2d sess.) Unfavorable.

(*e*) Preliminary examination and survey, "Skagit River, Wash., up to Sedro Woolley," ordered by river and harbor act of March 2, 1907. Reports on preliminary examination dated April 15, 1907, and on survey dated March 31 and November 3, 1908 (H. Doc. No. 1188, 60th Cong., 2d sess.), favorable for securing a reliable channel of entrance through the delta at the mouth by construction of a training dike and cutting off subsidiary channels and by construction of regulating dikes and a mattress sill at head of North Fork at an estimated cost of $100,000.

(*f*) Preliminary examination and survey, "Skagit River, Wash., from Sedro Woolley to Baker," ordered by river and harbor act of June 25, 1910. Reports on preliminary examination dated November 5, 1910, and on survey dated February 29, 1912 (H. Doc. No. 909, 62d Cong., 2d sess.), unfavorable.

(*g*) Preliminary examination and survey, "Skagit River, Wash.," ordered by river and harbor act of July 25, 1912. Report on preliminary examination dated December 6, 1912, and on survey dated January 26, 1914 (H. Doc. No. 935, 63d Cong., 2d sess.), favorable for improvement of Skagit City Bar by combined dredging operations and training walls at not to exceed $30,000.

(*h*) Report of Board of Engineers for Rivers and Harbors dated December 9, 1919, and related report by district engineer dated October 10, 1919, on previous report (*g*) as required by river and harbor act of March 2, 1919. (H. Doc. No. 591, 66th Cong., 2d sess.) Favorable for same work, but at an estimated cost of $45,000 and with local cooperation to the extent of assuming all claims for damages.

7. *Previous project.*—The removal of snags and other obstructions in this river was first undertaken in 1880 under an appropriation of $2,500 made by the act of June 14, 1880. Since 1882 this work has

been continued by the snag boat maintained and operated under the general appropriation for the improvement of Puget Sound and tributary waters.

8. *Existing project.*—The existing project, based on report printed in House Document No. 1188, Sixtieth Congress, second session, was adopted by the river and harbor act of June 25, 1910, and provides for a low-water channel in the South Fork between Skagit Bay (Saratoga Passage) and deep water in the river by the construction of a training dike at the mouth of the river, regulating dikes and a mattress sill at the head of the North Fork, and closing subsidiary channels in the delta, at an estimated cost of $100,000. This project was modified by the act of March 2, 1919, which provided for increasing the available depth at Skagit City Bar by dredging and the construction of training dikes at an estimated cost of $30,000 as proposed in House Document No. 935, Sixty-third Congress, second session. This act required "that before work on this project is commenced, the report shall be referred to the Board of Engineers for Rivers and Harbors for review as to whether the project should be modified to meet existing conditions or whether conditions of local cooperation should be imposed." This review was published in House Document No. 591, Sixty-sixth Congress, second session, and recommended an increase in the estimate to $45,000 and that no work be done until local interests assume responsibility for the payment of all damages claimed or alleged to result from any work that may be done under this project. The length of the section included in the project is 9½ miles. The estimated annual cost of maintenance is $5,000.

9. *Work done and present condition.*—The mattress sill at the head of North Fork, the dikes closing off subsidiary sloughs, and the training dike at the mouth of the South Fork, were completed in 1911 with the exception that the latter dike is 5,550 feet shorter than the project length of 16,000 feet. This shortening was occasioned by the increased cost of the work. Since completion, minor repairs have been made to the dikes as required and they are in general in good condition. The expected results were not, however, secured, and the controlling depth over the bar at the mouth of the South Fork does not exceed 1½ feet at mean lower low water. The expenditures under this project to January 31, 1928, have been $99.829.80 for new work and $27,347.11 for maintenance, a total of $127,176.91.

10. No work has been done on the bar at Skagit City pending the acceptance of the terms of local cooperation as imposed by Congress. The depth over this bar at low water in the river and at low tide is from 1½ to 2 feet.

11. The river has been kept cleared of snags and other obstructions by the operation of the snag boat under the general appropriation for the improvement of "Puget Sound and tributary waters," but no separate record has been kept of the cost of this work. The boat is equipped with a clamshell bucket and has done a limited amount of dredging in connection with its main work of removing obstructions.

12. Within the last few years the freight boats plying on this river have ceased to use the South Fork on account of the shallow depths therein and now use the North Fork. The deterioration of the South Fork appears to date from about 1896, when a series of floods widened and shoaled the channel at Skagit City Bar and to some extent at other points. Also while formerly the larger part of the flow of the

river was carried by the South Fork, this condition has now been reversed. It is possible also that the construction of the dike at the mouth of the South Fork has somewhat decreased the gradient. The mattress sill across the North Fork was intended to throw more water down the South Fork, but apparently has not done so, or at least has not been effective in improving the depths in the latter, and the sill has recently been partially removed in order to facilitate navigation in the North Fork.

13. *Bridges.*—The lower river is crossed by eight bridges, as shown by the following table:

No.	Miles above mouth—	Owner	Character	Clear width	Vertical clearance at high water
				Feet	*Feet*
1	3½, North Fork	Skagit County	Swing	80	7
2	5½, South fork	do	do	115	10
3	12¼	do	do	109	6
4	17	do	do	100	10
5	17¼	Pacific Northwest Traction Co	do	98	8
6	17¾	Great Northern Ry. Co	do	80	12
7	25	Northern Pacific Ry. Co	do	91	10
8	25¼	Skagit County	do	100	13

In addition to the above, there is a fixed bridge of 60 feet horizontal clearance and 5 feet vertical clearance at high water over Tom Moore slough on the South Fork, but this slough is not a main channel of the river. It is used only for the floating of logs.

14. *Towns.*—Mount Vernon, about 11 miles above the mouth, and Sedro Woolley, about 14 miles farther upstream, each with a population of some 3,500, are the largest towns in the valley. Mount Vernon is the county seat of Skagit County, and is the center of an extensive agricultural and dairying community. Skagit City, Conway (Fir), and Milltown are small settlements on the South Fork below Mount Vernon.

15. *Railways.*—The Great Northern Railway traverses the district north and south through Mount Vernon, and the Northern Pacific runs in the same direction through Sedro Woolley. A branch of the former runs west from Burlington to Anacortes and east up the Skagit River to Rockport. The Puget Sound & Baker River Railway Co., referred to in paragraph 24, is a common carrier, but is operated almost exclusively for the transportation of logs.

16. *Adjacent ports.*—The only comparable port to the north is Bellingham, distant about 25 miles, which, besides its ocean shipments, handles much of the same class of produce as Mount Vernon. Bellingham has a population of 25,585 (1920 census) and is the fifth city in the State. The domestic commerce in 1926 amounted to 1,758,447 tons, with a value of $40,906,017. About 13 miles to the south, at the mouth of the Stilaguamish River, is Stanwood, similarly situated to Mount Vernon, in that it is difficult of approach by water, the mouths of the river being very shallow. The population of Stanwood is about 700 and its commerce in 1926 was 98,193 tons, with a value of $2,779,220.

17. Farther south, about 35 miles from Mount Vernon, is Everett, a city of 27,644 (1920 census) and the fourth largest in the State. Its

domestic commerce is similar to that of Bellingham and was in 1926, 1,983,173 tons, valued at $14,333,737.

18. *Resources and local industries.*—The Skagit River delta contains some of the richest farming land in the State. The average yearly production of oats is given as approximately 50,000 tons; of hay 30,000 tons; of potatoes 12,000 tons; of straw 18,000 tons; of general farm products 10,000 tons; or a total of 120,000 tons of coarse farm products. In addition, there is the production of vegetable seed, which amounts in value to over $200,000 per annum and is increasing. It is said that the valley grows 80 per cent of the cabbage seed produced in the entire United States.

19. The delta is also a good dairying country and there are two large condensing plants at Mount Vernon and one at Burlington, the annual value of the product being approximately $4,000,000.

20. All of this tonnage comes from a territory within a radius of about 10 miles from Mount Vernon. Commodities are generally trucked to the shipping centers of Mount Vernon, Sedro Woolley, Burlington, and other small towns, Mount Vernon being the principal point from which shipments by water are made.

21. *Past and present commerce.*—In Appendix I[1] is given a tabulation of the commercial statistics as obtained from the annual reports of the Chief of Engineers from 1890 to date. That for 1926 was as follows:

Commodity	Tons	Value
Canned milk	13,956	$2,093,400
Hay, grain, and vegetables	6,139	262,774
Floated logs	250,485	1,377,666
Sand, gravel, and rock	45,825	46,237
Miscellaneous	11,870	3,264,250
Total	328,275	7,044,327

22. Prior to the advent of the railroads into this valley in about 1890, the river afforded practically the only means of communication with the outside world. Since that time the number of passengers carried by boat has steadily decreased from about 12,000 in 1892 to none in 1926. The percentage of the commerce carried by boats has largely decreased but the total amounts have increased, the average for the last five years having been 70,216 tons per year.

23. The only company now operating freight boats on a regular schedule is the Skagit River Navigation Co. This company operates one boat regularly between Seattle and Mount Vernon, making three trips a week, the times of arriving and departing from the Skagit River being variable according to the stage of the tide. A second boat is put on the river in the fall of the year when the grain and hay shipments are heavy. These vessels are stern-wheel freighters. One draws 2½ feet light and 7 feet loaded, and the other 20 inches light, and 4½ feet loaded. No freight boats now go above Mount Vernon.

24. The bulk of the water-borne traffic has always been the floating or rafting of logs. This reached a maximum of 674,492 tons in 1918 and the average for the five years prior to 1926 was approximately

[1] Not printed.

346,990 tons. Most of these logs were brought in by rail by the Puget Sound and Baker River Railway, which traverses the upper Skagit Valley to near Hamilton (41 miles above the mouth) and thence back into the timbered hills, and dumped into the river about 5 miles above Mount Vernon. There they were rafted and then towed down the South Fork and across Skagit Bay to Utsaladdy, where deep-draft towboats took them to the various mills on Puget Sound. However, this company, on account of the difficulties of navigating the river, has extended its terminus to Similk Bay, near Deception Pass, and is no longer using the Skagit River. The English Logging Co. is the only one operating on the lower river at the present time. It dumps its logs into Tom Moore slough near the mouth of the South Fork, from which place they are towed to Utsaladdy. There are two companies operating three boats on the river above Mount Vernon towing logs from points between the mouth of the Baker River and Rockport to salt water. These boats are small steam and gasoline boats designed for use on this river. They have drafts from 18 inches to 28 inches. During low stages of the river these boats make use of the fluctuations in the river due to the operations of the power plant of the Puget Sound Power & Light Co., at the mouth of the Baker River, to float the log rafts over the bars below. These fluctuations amount to as much as 10 inches at The Dalles, 2 miles below the Baker River.

25. *Prospective commerce.*—The total tonnage will be less in the future than in recent years, due to the closing down of the operations on this river of the Puget Sound & Baker River Railroad, as explained in the preceding paragraph. Of the agricultural products listed in paragraph 18, over 75 per cent of the canned milk was shipped by water prior to 1923, the total shipments in 1922 amounting to over 20,000 tons. In 1923 one of the canneries changed its products to butter and powdered milk, with the result that water shipments in 1923 fell off to about 12,000 tons. In 1926 it was 13,956 tons. This, however, represents an increase in output for the other two canneries, and this increase is expected to continue. The seeds go by water to Seattle for cleaning, storage, and distribution. The tonnage, though small, is of much value and is likely to increase. A limited portion only of the heavy farm products are shipped by water. With better boat service the proportion would probably increase. It is stated that more hay would be shipped to British Columbia ports if more water were available, as the boats engaged in that trade can not enter the river.

26. It is stated that with better water at the mouth of the South Fork the shingle mills at Milltown would ship by water over 30,000,000 shingles (3,000 tons) per annum.

27. The supplies brought in by boat are greater in value and but little less in tonnage than the outbound products and may be expected to increase in proportion to the latter.

28. *Desires of local interests.*—For the purpose of securing the desires and views of local interests, a public hearing was held at Mount Vernon on November 30, 1923, at which some 75 people were present. A copy of the minutes of the hearing [1] accompanies this report.

[1] Not printed.

29. Stated in general terms the desires of the community are for easier access to the Sound than at present exists in order that the water-borne commerce may be carried on with greater regularity and certainty.

30. The brief,[1] accompanied by a copy of previous report,[1] presented by Mr. H. L. Willis for the river committee of Skagit County, the Mount Vernon Commercial Club, and the Mount Vernon Rotary Club, states that the general commerce and industries of the Skagit Valley are increasing rapidly. It is claimed that navigable conditions have greatly deteriorated in recent years and that navigation is hampered thereby. Navigation and flood control are considered closely related. Large sums have been expended for dikes and drainage ditches but these have not attained the object for which they were built. If a comprehensive plan for the entire river length could be devised that would promise relief from flood damage in its upper reaches and free navigation in its lower reaches, efforts would be made for the formation of a drainage district covering the portion of the county affected to cooperate with the Federal Government in carrying out such plans.

31. The thought is expressed that a better navigable channel as well as some lessening of flood danger would be secured by (1) rock jetties at the mouth to confine and direct the current with resultant scour and increased depth, (2) the removal of obstructions and dredging, using the dredged materials for levees, and (3) bank protection.

32. The North Fork is indicated as being easier of improvement under present conditions. The brief concludes with the statement that the needs of commerce would justify the expenditure of several million dollars to give permanent and open access to the sea.

33. Savings in freight rates by the use of the river were stated to be approximately $250,000 annually, the river rates being from 10 to 20 cents per hundred pounds for the Seattle-Mount Vernon haul, as against 34 to 68 cents by rail.

34. The Tom Moore Boom Co., which operates in Tom Moore slough, requested further improvement of the channel in the South Fork at the mouth. The removal of the outer portion of the present jetty and its extension in a straight line to a connection with the outer section of the channel of the West Pass of the Stilaguamish River was suggested; also dredging the channel 6 feet deep by 150 feet wide, and forming a jetty on the south side by using the dredged material and some brush.

35. *Terminal and transfer facilities.*—There are no modern terminal and transfer facilities on the river. There is one wharf at Mount Vernon which is open to the general public use and is considered adequate for existing commerce. Bank landings are made at other points on the river.

36. *Floods.*—The Skagit River, in common with other rivers similarly located in this section, is subject to severe floods which frequently occasion great damage. The whole of the Pacific Northwest is subject to a peculiar warm, moist wind blowing off the ocean, usually from the southwest, which is known as the "chinook." Such

[1] Not printed.

a wind may occur at any time of the year and may be felt by a large or small extent of territory at the same time. A chinook wind striking a snow field causes the snow to melt with abnormal rapidity. The conditions surrounding the source of the Skagit River are therefore such that a flood is liable to occur at almost any time. For example, in the year 1896 there was a flood in January 22 feet high near Mount Vernon, one in June 20 feet high; and one in November of 24 feet. A chinook wind will usually cause a marked rise in the lower river about 36 hours after it begins to blow, the amount of the rise depending on the intensity and warmth of the wind and the amount of fresh snow on the mountains. The highest floods usually occur in November and December, when the winds carry a large amount of moisture, causing heavy precipitation, and when the snow is loose and porous.

37. In accordance with an agreement between Skagit County and the United States Geological Survey, that department has made an extensive study of the flood flow in the Skagit Valley. The report has not yet been completed, but copies of portions of it have been furnished this office. The largest floods appear to have been as follows:

About December, 1815.	November 3, 1883.	November 16, 1906.
About 1856.	October 30, 1887.	November 30, 1909.
December 14, 1879	May 27, 1894.	December 30, 1917.
1880.	November 16, 1896.	December 12, 1921.
1882.	November 19, 1897.	

38. Flood heights and discharges at Sedro Woolley (25 miles above the mouth, drainage area 2,970 square miles) were as follows:

Date	Gauge height [1]		Discharge	Run-off	Accuracy
			Cubic feet per second	*Second feet per square mile*	*Per cent*
About 1815	63. 5	33. 5	400, 000	134	15
About 1856	60. 0	30. 0	350, 000	101	15
Nov. 16, 1896	54. 8	24. 8	185, 000	62	15
Nov. 19, 1897	54. 9	24. 9	190, 000	64	15
Nov. 16, 1906	54. 7	24. 7	180, 000	61	15
Nov. 30, 1909	56. 5	26. 5	220, 000	74	10
Dec. 30, 1917	54. 1	24. 1	195, 000	66	10
Dec. 13, 1921	54. 3	24. 3	210, 000	71	10

[1] Zero of gauge set at elevation of extreme low water in Puget Sound.

39. At Mount Vernon the discharge of the 1921 flood was the only one determined, and this was unsatisfactory due to breaking dikes, etc. The discharge in the river channel proper was 140,000 cubic feet per second (accuracy within 20 per cent) and the total discharge was roughly estimated at 190,000 cubic feet per second.

40. The decrease in peak discharge as the flood advances down the river is due to the overflow of the banks, the overflow district acting as a storage basin. The duration of course increases in the lower sections.

41. The upper valley is generally narrow with little low land. Near Sedro Woolley the hills recede and the valley widens into the delta, comprising an area of nearly 100 square miles of highly culti-

vated and valuable farming land. It is here that the greatest damage from floods occurs, though the towns in the upper valley are liable to damage from the larger floods. Below Sedro Woolley the channels have been generally diked (leveed), but the work has been done at various times by individuals and by some 21 different diking districts organized under the State law. It is probably unfortunate for the community at large that no control has been exercised by Federal or State authority. Approximately $2,000,000 have been expended, but in the absence of such control and of any well-studied and comprehensive plans these dikes have in many cases been improperly designed and located, the distance apart varying from 600 feet to 2,000 feet. In general in an effort to inclose as much land as possible the dikes have been placed close to the river bank without reference to the area required for passage of flood waters. As a result, frequent breaks occur, both due to overlapping and undermining of river bank and dike.

42. The channel is also restricted by the bridges above Mount Vernon and particularly at the Great Northern Railway bridge, which is located immediately below a right-angled bend. The dike above this bridge was broken and the railway track to Burlington was washed out during the floods of 1909, 1917, and 1921, the water flowing across country to Padilla Bay along the general direction of what was apparently a former river channel.

43. Possible means of flood prevention would be: (*a*) Storage or detention reservoirs on the upper portion of the river or on the tributaries; (*b*) revision or reconstruction of the present diking system according to a properly designed plan; (*c*) a system of emergency dikes built back of the present ones; (*d*) construction of an outlet or relief channel above the Great Northern Railway bridge running to Padilla Bay; (*e*) straightening, widening, and deepening the channel of the present river bed with proper bank protection; (*f*) digging an entire new channel or channels through the delta with necessary bank protection; (*g*) enlargement of channel way at bridges; (*h*) removal of drift and construction of drift barriers; or some combination of these methods.

44. The Geological Survey report referred to indicates that due to the effect of glaciation and uplift and subsidence of the land on river drainage, it will be impracticable, with one exception, to found flood-protection dams or reservoirs on solid rock in this valley.

45. The cost of complete protection from floods such as those of 1815 or 1856, carrying 350,000 to 400,000 cubic feet per second at Sedro Woolley, would probably be prohibitive, and protection from the most severe recent floods such as those of 1909 and 1921, carrying well over 200,000 cubic feet per second, would require the expenditure of very large sums of money and should only be undertaken after a most thorough investigation and study. The necessity of such investigation is recognized by the local interests and efforts are being made looking to that end.

46. It seems clear that the flood problem in this valley is largely independent of that of navigation and requires special treatment. Work done solely for the benefit of navigation would have little or no effect on flood prevention. Works carried out primarily for flood protection might or might not incidentally improve the navigable capacity of the river, depending upon the methods adopted.

47. *Water power.*—There are a number of power sites on the river and its tributaries. The city of Seattle has built a power plant at the Gorge, 97 miles from the mouth and 12 miles below Ruby Creek. The installation consists of about 50,000 horsepower and is the first unit of a project which will eventually develop 550,000 horsepower and will include dams at the Gorge and above.

48. The Puget Sound Power & Light Co. has a plant at the mouth of the Baker River. This development includes a concrete dam 293 feet high which makes a reservoir with an area of 2,200 acres and a capacity of 140,000 acre-feet, with a 105-foot draw down and 130,000 acre-feet with 75-foot draw down. The installed capacity is 39,000 kilovolt-amperes, 6,600 volt, 3-phase, 60 cycles, in two equal units, although 42,000 kilowatts have been carried.

49. The drainage area above the city of Seattle development is approximately one-third of the total of the river and that above the proposed development on the Baker River is nearly one-tenth of the total. The completion of these projects may be expected to have a beneficial effect on the navigable capacity of the lower river by increasing the flow at low stages. They will also have some effect in reducing the height of floods should these occur at times when the reservoirs are not full.

50. *Local cooperation.*—No specific offer of any local cooperation in the cost of an improvement primarily designed for the improvement of navigation has been submitted. Reference has been made in paragraph 10 to the fact that the cooperation required of local interests as a prerequisite of the authorized improvement at Skagit City Bar has not been furnished.

51. *Discussion and recommendation.*—The commerce handled by boat is considerable in amount and, though it fluctuates some from year to year, appears to be increasing at a moderate rate. The rates to Seattle are materially lower by boat than by rail and for products destined for coastwise or foreign shipment or for local consumption at Seattle the saving in freight is large. However, Mount Vernon has terminal rates, so that for eastern rail shipments no saving is effected by movement through Seattle. The total amount of water shipments is also likely to be limited by the seasonal character of the products. The coarse farm products, amounting to some 120,000 tons per annum, all come into the market within a short period, and as it is evident that the boat line for profitable operation must be assured of a more or less constant amount of freight it is probable that the greater part of these products will continue to be shipped by rail. Fortunately, the canneries furnish a fairly constant amount of freight and this is probably largely responsible for the reasonably good service now furnished.

52. The boat line has now abandoned the use of the South Fork. Some deterioration of this fork has undoubtedly occurred, though not as much as believed by the local interests. The chief cause is thought to have been the diversion of a greater amount of water down the North Fork, though there probably have been other contributing causes. The existing project for improvement has not been a success. Due to lack of funds the jetty at the mouth was not built to full project length, and it is probable that extension to full length, a second jetty, and considerable maintenance dredging, all at large expense, would be required to keep a good channel open at the mouth. The

work authorized at Skagit City Bar was not carried out through failure of local interests to provide the required cooperation and it is improbable that such cooperation will be furnished. Under the circumstances it appears undesirable to do any work on the South Fork at the present time other than what may occasionally be required to facilitate the movement of the logs out of Tom Moore slough, which amounts to some 385,000 tons per annum.

53. The North Fork is shorter and has a steeper gradient. There appears to be comparatively little difficulty in navigating that fork. The depth on the bar is about the same as at the South Fork, but the bar is somewhat shorter. The distance to Seattle is greater than by way of the South Fork, and the small settlements of Skagit City, Conway (Fir), and Milltown, at which the boats formerly stopped, are now deprived of this service. The general feeling as indicated at the hearing seemed to be that while the conditions remained as at present any work of improvement had best be directed to this channel. A desire was expressed for a channel suitable for use at all stages of the tide, but it was recognized that to secure this result twin dikes or jetties would be required at the mouth, together with considerable amounts of dredging there as well as in the river. The cost of this work would be high and as large amounts of silt are brought down annually by floods the channels would probably require redredging, in whole or large part, each year. Neither the existing nor prospective commerce is believed to be sufficient in amount to warrant undertaking such a project.

54. The present commerce is, however, somewhat hampered by lack of depth at low tide. The boats must run on the tide and must time their departure so as to pass over the bar and the shoal spots in the river at the proper stage of the tide. Sometimes this does not allow sufficient time to discharge and take on cargo at Mount Vernon, in which case the boat must go out partially loaded or wait over another tide, which would disrupt its schedule. On this account no trips above Mount Vernon have been made for some time, whereas formerly considerable freight was taken at Avon. A limited amount of relief looking to a slight increase of depth at the mouth and over a few short shoals in the river with a view to permitting navigation at stages of tide somewhat above the lowest seems desirable and justifiable. This could best be secured by a small light-draft hydraulic dredge. The same act calling for this examination also called for one on "Puget Sound and tributary waters, Wash., particularly in respect to the condition of the channels and mouths of such rivers, with a view to the clearing of such channels and mouths of sand bars and other obstructions by the use of a suction dredge or otherwise." Report on preliminary examination on this item was submitted on January 14, 1924, and report on survey is being submitted on even date with this report. The latter report is favorable to the construction of a light-draft hydraulic pipe-line dredge for general use on the various rivers tributary to Puget Sound to be operated under the general project for Puget Sound and tributary waters. It is my opinion that should such a dredge be provided the needs of this locality can be cared for reasonably well for the present.

55. I therefore report that in my opinion the amount of present and prospective commerce on the Skagit River is not sufficient to

warrant any modification or enlargement of the existing project for that river, but that it is of sufficient importance to justify a small amount of dredging at the bar at the mouth and at small shoals in the river with a view to securing such limited increase of depth as will permit navigation at somewhat lower stages; that this work can best be done by the construction and operation of a small hydraulic dredge under the project for "Puget Sound and tributary waters."

56. In compliance with law, I further report that at the present time there are no questions of terminal facilities, water power, floods, or other related subjects which could be coordinated with the suggested improvement so as to lessen the cost or compensate the Government for expenditures made in the interest of navigation. Also that the work suggested would be of general rather than of local or special benefit and that no local cooperation is therefore considered necessary.

JNO. S. BUTLER,
Major, Corps of Engineers,
District Engineer.

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