

SKAGIT RIVER FLOOD REPORT

by

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CUMMIE RIVER

FLOOD REPORT

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SKAGIT RIVER FLOODS

There have been three large floods on the Skagit River of which there is authentic record. These were November 18-19, 1897, November 29-30, 1909, and December 29-30, 1917. The magnitude and duration of these floods varied considerably on different tributaries of the Skagit River and consequently on the Skagit River itself. Floods closely approaching these three may be expected on an average of once in ten years. In addition to these floods there are sure indications of a much greater flood at the Reflector Bar and Sedro Woolley gaging stations and also traditions among the Indians.

Taking up the floods on the different tributaries:

Skagit River at Reflector Bar
above Marblemount, Wash.
(See Exhibit "A")

Of the three known floods, that of 1909 was the greatest. The floods of 1897 and 1917 were lower than the 1909 flood and practically equal. There is an old cabin on the Davis ranch, one and one-half miles below Reflector Bar, which has been through all three floods. The flood crests of 1897 and 1917 were about one foot above

the floor of this cabin. The high-water mark of 1909, as pointed out near the front door of the Davis house, was found by levels to be 2.5 feet higher than those of 1897 and 1917. By means of flood marks on walls of Canyon Diablo above gage and a drift log below gage in conjunction with high-water mark at the Davis ranch, it was determined that the crest of the 1909 flood exceeded that of 1917 at Reflector Bar gaging station by about 2.5 feet. The crest of the flood for 1909, gage height 15.0 feet, gives 58,800 second feet; 1897 and 1917, gage height 12.5 feet, 41,700 second feet.

In addition to these floods there is a record of a much higher flood a great many years ago. The right stream bank at the gaging station is composed of sand and gravel certainly deposited by the river. This bank slopes both downstream and away from the stream; the downstream slope indicating the slope of the flood crest as it left the canyon; and the slope away from the stream representing the diking effect noticed on many streams that overflow their banks. i.e., a stream with high velocity is carrying a large amount of silt, sand, etc., and when this water goes over the bank the velocity drops and its carrying capacity drops even more rapidly. Thus it drops most of its load where it tops the bank. A stream in its upper or middle course finally cuts its stream bed so that it no longer tops these banks; but we

find that this is not the case at Reflector Bar for if the river no longer topped this bank vegetation, leaves, dirt, logs, humus, etc., would have collected over the sand. This deposit, however, is of clear sand, and from appearances it might be judged that the bank had been topped in the last ten or fifteen years. It is certain though that this flood has not occurred in the last forty-five years, for the flood of 1897 was the largest flood until 1909 in the recollection of settlers who arrived in 1873. The drift of the 1909 flood is still along the river in great quantities and very little rotted. The flood mark for 1909 on canyon wall above gaging station is still distinct. Neither drift nor flood marks can be found for this earlier and higher flood. Sixty or eighty years would probably rot away almost all drift except cedar logs. Considering the difference in brightness of the 1909 and 1917 flood marks, it would probably also efface the flood mark on the canyon walls. The lack of humus, etc., on the gravel deposit makes it certain, I think, that the flood has occurred in the last one hundred years. The river probably has cut a little since then, but since the cutting at the gaging station is regulated by the rock canyon below the Davis ranch it is certain that this cutting has been very little, probably not more than one or two-tenths. The flood.

at the gage, topped the bank at a gage height of 18.0 feet. The deposit is of very coarse sand or small gravel and is found for two hundred yards away from the bank. The slope away from the river is fairly steep, but to carry this coarse sand through trees, brush, logs, and vegetation it is practically certain that the river must have topped the bank at least one foot; it may have been considerably more, but from the high-water mark at Sedro Woolley it is not thought that it exceeded one foot materially. It will be estimated that it overtopped the bank one and one-half foot, giving a discharge of 95,000 second-feet. There is no drift above that brought in by the 1909 flood either near the station or between there and the mouth of the canyon seven miles below. It is certain, therefore, that no flood in the last sixty years could have exceeded that of 1909 in this portion of the river. Flood marks at Sedro Woolley show 1909 to have reached the highest stage since the great flood previously noted, but the discharge probably has been as great at other times at that station.

Skagit River at Power Camp near Marblemount, Wash.

(See Exhibit "B")

Flood for 1909, gage height 22 feet; 1917, 19 feet; 1897 discharge probably about the same as 1917 but gage height uncertain. Two new provisional rating curves have been drawn up, one applicable up to the flood of 1917,

the other during and after this flood. The first curve gives a maximum discharge for 1909 of 63,500 second-feet; the second curve for 1917, 47,400 second-feet discharge; 1897 estimated the same. The earlier and greater flood must have had a discharge of 100,000 second-feet based on the discharge at Reflector Bar. The gage height for this great flood would have been about 28 feet.

Skagit River below Cascade River at Marblemount, Wash.

(See Exhibit "C")

Flood of 1897 was 2.2 feet higher than 1917 and 1.3 feet higher than 1909, as determined by high-water marks made by residents at Marblemount during each flood. Cascade River was the cause of the great variation from upper stations. The Cascade had an enormous flood in 1897. The flood of 1909 was not nearly so great, and that of 1917 was about midway between the two.

Skagit River at Rockport, Wash.

Flood of 1897 was the highest of the known floods; amount higher than 1909 or 1917 is not known. Flood of 1909 was about .7 feet higher than that of 1917. There is a tradition among the Indians that a number of their tribe were drowned, in a great flood at night, on the bench where the Guthbert ranch now is. This bench is at least fifteen feet above the flood mark of 1917. This flood

was probably the great flood previously noted at the Reflector Bar gaging station.

Skagit River below Baker River near Concrete.

(See Exhibit "G")

Flood of 1897 was about three feet higher than flood of 1909. This was determined by running levels from an 1897 high-water mark in old barn (above mouth of Baker River) to a hotel near the cement plant, the footing of which was just touched by 1909 flood. These levels showed a difference of nearly five feet, but there may have been a difference in elevation of the water surface of nearly two feet due to the slope.

Skagit River at Sedro Woolley

(See Exhibits "H" and "I")

Flood of 1909 was 1.6 feet higher than 1917 and 0.5 foot higher than 1897. The stream bed is continually shifting at this station and actual flood crests are not strictly comparable, but the curves must draw together in their upper portion. When the river begins cutting across bends velocity in the main stream is checked and changes in control produce less effect than at low stages. When the main channel is choked so that it increases the stage for a given discharge, then the sloughs and overflowed banks carry proportionally more water than with the channel free and unobstructed. From measurements made by U. S. Army engineers in 1908 and measurements made by Survey

engineers in 1910 there is evidence that a pronounced channel change took place during the flood of 1909.

Probably this flood greatly widened the lower river in places and took out log jams and other obstructions. Just how long the river had been in this obstructed condition is uncertain, but it is probable that even while the river was in this obstructed condition that a stage of 55 feet would have given as much discharge as 54 feet would have given on the 1917 curve. There have been several changes, due to the hand of man, that affect the discharge somewhat:

First.--The Northern Pacific Railway some time between 1887 and 1899 displaced trestle work with earth embankment on both sides of the river. The trestle extended from the hills on the left side to the Sedro Woolley yards, so that the earth embankment materially changed the stage-discharge relation above and below the railway crossing, although it probably did not affect that relation greatly at the crossing.

Second.--The dikes along the river tend to raise the stage for a given discharge by prevention of flow and channel storage in the bottom lands. Floods such as 1897, 1909, and 1917 usually break or overtop the dikes; so it is doubtful if their peaks were affected materially. About November 20, 1911, the river cut across Sterling Bend (aided by dynamite) below the N. P. bridge at Sedro Woolley. This caused a rapid lowering of the stream bed due to cutting

off two and one-half miles of river, and by 1917 three feet less gage height than prior to November 20, 1911, gave practically the same discharge at low and medium stages. A revision of the curve used in 1909 gives, on November 20th, a maximum discharge of 169,000 second-feet. The flood of December 30, 1917, gives a maximum discharge of 157,000 second-feet. It is estimated that the flood of 1897 reached a maximum discharge of 171,000 second-feet.

In addition to the foregoing floods, the mark of an older and much higher flood was found at the same point where the 1909 flood was noted (see exhibit "H"). Referred to the gage at the Northern Pacific bridge this flood would have given a gage height of 60 feet and a discharge of 225,000 second-feet. Mr. Hart who came to the valley in 1878 stated that all of the oldest trees (cedar and fir mostly) showed these marks distinctly but that spruce two and one-half feet in diameter were not so marked. These early settlers could not imagine what made the marks and made inquiries of the Indians. Some of the oldest Indians, judged to be about seventy years of age, told them that when they were small boys a big water came "very quick" and that their tribe did not have time to save their smoked salmon and dried venison; consequently, they nearly starved that winter. Mr. Hart estimated at that time, from the age of the Indians who were able to remember the flood, that this flood must have occurred about sixty years pre-

vicious to 1879. This makes the date of the flood about 1880 and is confirmed by my study at Reflector Bar and by the young spruce trees which did not have the high-water mark on in 1879.

Two great summer floods are distinctly remembered by the settlers in this valley. These were the floods of 1880 and 1894. The bottom lands around Mount Vernon were covered both times for long periods (see exhibit "I"). The river must have reached a stage of about 54 feet at Sedro Woolley with a discharge of from 130,000 to 150,000 second-feet.

Floods on Tributaries of the Skagit River.

Cascade River

(See Exhibits "C" and "D")

Of the three floods, 1897, 1909, and 1917, that of 1909 was the lowest; the flood of 1897 was the greatest and followed by that of 1917 about half-way between 1909 and 1897. Some settlers claim that of 1917 was the highest, but I think none of them were there in 1897.

Sauk River at Darrington

(See Exhibit "E")

No record of 1897 flood, which was probably the largest. The cascade and South Fork of Skykomish were higher in 1897 than in 1909 or 1917. The flood of 1909 was about one foot higher than 1917.

Suiattle River

Nothing is known directly of this river, but in 1897 from flow of Cascade and South Fork of Skykomish it is thought that it probably reached a flow of 60,000 second-feet. This is confirmed by the high stage at Concrete on the main Skagit. In 1917 the Sauk at Darrington was nearly a foot lower than in 1909, but was said to be higher in 1917 than in 1909 near the mouth of the river. Evidently the Suiattle was much higher in 1917 than in 1909.

General

(See Exhibits "J" and "K")

Although the floods of 1897, 1909, and 1917 are the only ones given here, it must not be assumed that these are remarkably greater than some others. The floods of 1896 and 1906 were large and did not fall far short of those mentioned above. On some of the tributaries of the Sauk and Suiattle these floods may have been greater than in 1909 or 1917. At Sedro Woolley it is not probable that such floods as 1820 (approximately) occur upon an average oftener than once in two or three hundred years. It is not certain that it was as high on the tributaries as given on the curves and the tables. The flood may have been due to an extreme "Chinook" wind melting the snow on the upper Skagit, which in other large floods has never been affected. It is more probable though that the extreme "Chinook" was combined with an extraordinary rainfall, which would bring

up the lower tributaries as given. No doubt this flood crest could be traced through the Skagit basin, and thus determine definitely whether this was an extreme flood on all tributaries. The method of determining is simply to examine the old cedars and firs and find out to what elevation the river mud may be found in the crevices of the bark. This, when compared with the flood mark of 1917, will show the magnitude of the 1820 flood. Care must be exercised, of course, in not confusing 1897 or 1909 flood marks with those of the earlier flood. The lack of marks on young trees will be one method of determining this. Another is that the 1897 and 1909 marks will be comparatively bright while the mud of the 1820 flood will only be found in protected crevices.

Due to the limited time on this report errors may be found in the plotting of some of the measurements. Unchecked measurements were also plotted. These facts in no way affect the flood estimates, as the lower portion of the rating curves is only valuable to give a general shape to the curve and to be used as a starting point.

James E. Stewart,

Assistant Engineer.

Tacoma, Washington,

July, 1918.

Exhibit "K"

Date			Precipitation at Blaine Wash.		
(a) 1897	(b) 1909	(c) 1917	(a)	(b)	(c)
Nov. 15	Nov. 26	Dec. 26	.00	.00	.48
16	27	27	.00	.52	1.30
17	28	28	1.80	2.60	1.44
18	29	29	1.28	2.00	2.00
19	30	30	.00	.02	.00
	TOTAL		3.08	5.14	5.22

Date			Maximum Temperature at Seattle, Wash.		
(a) 1897	(b) 1909	(c) 1917	(a)	(b)	(c)
Nov. 15	Nov. 26	Dec. 26	45	44	52
16	27	27	45	45	57
17	28	28	56	59	61
18	29	29	61	57	59
19	30	30	40	45	58

Date			Minimum Temperature at Seattle, Wash.		
(a) 1897	(b) 1909	(c) 1917	(a)	(b)	(c)
Nov. 15	Nov. 26	Dec. 26	35	36	35
16	27	27	39	40	51
17	28	28	43	43	55
18	29	29	40	43	51
19	30	30	34	39	49

Exhibit "J"

Location	Drainage area Sq. Mi.	1820		1897		1909		1917	
		Maximum Discharge Sec. - ft.	Maximum run-off Per Sq. Mi.	Maximum discharge Sec. - ft.	Maximum run-off per Sq. Mi.	Maximum discharge Sec. - ft.	Maximum run-off per Sq. Mi.	Maximum discharge Sec. - ft.	Maximum run-off Per Sq. Mi.
Skagit River Power Camp	1,090	100,000	92	47,400	43	63,500	58	47,400	43
Cascade R. Power Camp	222	46,000	207	40,000	180	26,000	117	32,000	144
Sauk River at Darrington	293	48,000	164	44,000	150	40,000	137	36,000	123
Suitttle River at mouth	345	60,000	174	55,000	159	38,000	110	45,000	130
Baker R. below Anderson Cr.	184	50,000	272	26,700	199	46,200	251	36,700	199
Total		304,000		222,000		214,000		197,000	
Skagit R. below Baker River		275,000		205,000		185,000		175,000	
Skagit River nr. Sedro Woolley	2,930	225,000	77	171,000	58	169,000	58	157,000	54

Note.--Estimated discharge has been carried to only two significant figures where no flood mark was available.

Exhibit "I"

(Run-off, total in acre-feet.)

Year	Columbia River at The Dalles	Skagit River near Sedro Woolley
1880	192,000,000	16,000,000 (est.)
1894	225,000,000	17,000,000 (est.)
1911	136,000,000	12,500,000
1912	133,000,000	9,940,000
1913	154,000,000	12,000,000
1914	135,000,000	11,400,000
1915	106,000,000	7,780,000
1916	173,000,000	12,700,000
1917		11,100,000