

WATER-POWER INVESTIGATIONS IN SOUTHEASTERN ALASKA.¹

By GEORGE H. CANFIELD.

INTRODUCTION.

Systematic investigation of the water resources of Alaska was begun by the United States Geological Survey in 1906 and has been carried on in different parts of the Territory to the present time. This investigation was undertaken in response to the need for definite information in regard to water available for many uses, among which the most important are hydraulicking, dredging, and supplying power for mines, canneries, and sawmills.

The investigation of the water resources of southeastern Alaska was begun by the Geological Survey in cooperation with the Forest Service in 1915 and was designed to determine both the location and the possibilities of water-power sites. The results of previous years' work have already been published.²

The Geological Survey maintained a number of gaging stations in southeastern Alaska throughout the year, and other stations were installed in cooperation with individuals and corporations. The records obtained at these stations are contained in this paper. Acknowledgment is made to those who have assisted in this work, particularly to Mr. W. G. Weigle, special agent of the Forest Service at Ketchikan, and to Mr. Philip H. Dater, district engineer at Portland, Oreg.

The stations for which the records are presented are the following:

- Myrtle Creek at Niblack.
- Ketchikan Creek at Ketchikan.
- Fish Creek near Sea Level.
- Swan Lake outlet at Carroll Inlet.
- Orchard Lake outlet at Shrimp Bay.
- Shelockum Lake outlet at Bailey Bay.
- Karta River at Karta Bay.
- Cascade Creek at Thomas Bay.
- Green Lake outlet at Silver Bay.
- Baranof Lake outlet at Baranof.
- Sweetheart Falls Creek near Snettisham.
- Crater Lake outlet at Speel River, Port Snettisham.
- Long River below Second Lake, at Port Snettisham.
- Speel River at Port Snettisham.
- Grindstone Creek at Taku Inlet.

¹ In cooperation with the United States Forest Service.

² U. S. Geol. Survey Bull. 662, pp. 100-154, 1918; Bull. 692, pp. 43-83, 1919.

Carlson Creek at Sunny Cove.
 Sheep Creek near Thane.
 Gold Creek at Juneau.

STATION RECORDS.

MYRTLE CREEK AT NIBLACK, PRINCE OF WALES ISLAND.

LOCATION.—Halfway between beach and Myrtle Lake outlet, which is one-third mile from tidewater, 1 mile from Niblack, in north arm of Moira Sound, Prince of Wales Island, and 35 miles by water from Ketchikan.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 30, 1917, to December 31, 1918.

GAGE.—Stevens continuous water-stage recorder on right bank; reached by a trail which leaves beach near the mouth of the creek.

DISCHARGE MEASUREMENTS.—At medium and high stages made from a cable across creek at outlet of lake; at low stages made by wading.

CHANNEL AND CONTROL.—The gage is in a pool 10 feet upstream from a contracted portion of the channel, at a rocky riffle that forms a well-defined and permanent control. At the cable section the bed is smooth, the water deep, and the current uniform and sluggish.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the period from water-stage recorder, 4.40 feet at 5 p. m. November 18, 1917; discharge estimated from an extension of the rating curve, 387 second-feet; minimum discharge unknown, estimated at 30 second-feet in September, 1918.

ICE.—Stage-discharge relation not affected by ice.

ACCURACY.—Stage-discharge relation permanent. Rating curve, determined by four discharge measurements, is very well defined between 36 and 220 second-feet. Operation of water-stage recorder satisfactory for the following periods only: July 30 to November 28, December 16–22, 1917; February 14–15, March 20–25, April 7–10, October 24 to November 6, December 1, and December 30–31, 1918; unsatisfactory for other days of period because of stopping of clock due to condensation of moisture on and final rusting through of hair spring of the escapement. Discharge ascertained for periods recorder was operating by applying to rating table mean daily gage heights; for periods recorder was not operating, by determining with a planimeter the monthly means from an estimated hydrograph drawn by means of staff gage readings by observer about once every 10 days, maximum and minimum stages indicated by the recorder, and recorded hydrograph, and by comparison of the record for this station with that for Karta River. Results good except for periods when the recorder was stopped, for which they are fair.

Myrtle Lake, the outlet of which is 800 feet from Niblack Anchorage, is 95 feet above sea level and covers 122 acres. Niblack Lake, the outlet of which is 5,700 feet from Niblack Anchorage, is 450 feet above sea level, and covers 383 acres. Mary Lake, unsurveyed, is about 600 feet above sea level and is a mile long and one-fourth to one-half mile wide. The large lake area in this small drainage basin is the cause of the well-maintained flow during the winter and periods of little rainfall.

Discharge measurements of Myrtle Creek at Niblack, during 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Discharge.
Oct. 16.....	<i>Feet.</i> 1.78	<i>Sec.-ft.</i> 62
Oct. 24.....	2.24	101

Daily discharge, in second-feet, of Myrtle Creek at Niblack, for 1917-18.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1917.													
1.....		45	69	85	295		16.....		65	79	76	260	64.....
2.....		46	63	118	267		17.....		68	70	88	332	62.....
3.....		42	58	128	220		18.....		91	71	134	371	50.....
4.....		41	55	126	220		19.....		140	82	120	340	57.....
5.....		40	52	151	254		20.....		117	75	134	281	56.....
6.....		40	50	120	332		21.....		93	75	120	233	55.....
7.....		39	48	105	340		22.....		108	77	134	194	54.....
8.....		38	46	99	288		23.....		95	73	129	175
9.....		38	44	93	240		24.....		84	70	121	175
10.....		38	43	92	254		25.....		74	73	114	169
11.....		44	43	97	220		26.....		79	76	102	175
12.....		42	59	91	206		27.....		104	88	93	200
13.....		41	65	92	288		28.....		121	120	146	169
14.....		42	69	86	371		29.....		97	112	151	154
15.....		56	83	81	318		30.....	42	84	100	169	140
							31.....	41	76	200
Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
1918.													
1.....							79				146	233	
2.....											134		
3.....								45			126		
4.....	197										111		
5.....								38			109		
6.....							52				157		
7.....					40								
8.....					67								
9.....					104	114							
10.....					97								
11.....													
12.....													
13.....													
14.....			73										
15.....			68				44		33				
16.....													
17.....													
18.....	149					81							
19.....													
20.....				40									
21.....				50									
22.....				48	88								
23.....				45									
24.....				46									
25.....				48		71				102			
										104			
26.....					71		71				140		
27.....						73		39			146		
28.....	97										129		
29.....									45		124		
30.....											163	92	
31.....								40			157	84	

NOTE.—Discharge estimated for following periods, because of unsatisfactory operation of water-stage recorder: Nov. 29-30, Dec. 1-31, 1917 (mean discharge, 82 second-feet), Jan. 1-31 (mean discharge, 140 second-feet), Feb. 1-28 (mean discharge, 77 second-feet), Mar. 1-31 (mean discharge, 48 second-feet), April 1-30 (mean discharge, 70 second-feet), May 1-31 (mean discharge, 104 second-feet), June 1-30 (mean discharge, 83 second-feet), July 1-31 (mean discharge, 48 second-feet), August 1-31 (mean discharge, 50 second-feet), Sept. 1-30 (mean discharge, 43 second-feet), Oct. 1-15 (mean discharge, 90 second-feet), Oct. 16-23 (mean discharge, 105 second-feet), Nov. 7-31 (mean discharge, 130 second-feet), and Dec. 2-29, 1918 (mean discharge, 100 second-feet), by a comparison with hydrograph for Karta River, and from staff gage readings by observer, maximum and minimum stages indicated by recording pencil and gage-height graph (Dec. 16-22, 1917, Feb. 14-15, Mar. 20-25, and Apr. 7-10).

Monthly discharge of Myrtle Creek at Niblack for 1917-18.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1917.				
August.....	140	38	68.6	4,220
September.....	120	43	69.5	4,140
October.....	200	76	116	7,100
November.....	340	140	249	14,830
December.....		50	82	5,040
The period.....				35,300
1918.				
January.....	220	80	140	8,610
February.....	134		77	4,280
March.....	60	40	48	2,950
April.....	138	40	70	4,170
May.....	151	71	104	6,400
June.....	109	71	83	4,940
July.....	70	39	48	2,950
August.....	73	38	50	3,070
September.....	112	32	43	2,560
October.....	163		105	6,460
November.....			130	7,740
December.....	233		104	6,400
The year.....	233	32	835	60,500

NOTE.—Figures for December, 1917, to December, 1918, mostly estimated. See footnote to table of daily discharge.

KETCHIKAN CREEK AT KETCHIKAN.

LOCATION.—One-fourth mile below power house of Citizens Light, Power & Water Co., one-third mile northeast of Ketchikan post office, 200 feet downstream from mouth of Schoenbar Creek (entering from right), $1\frac{1}{4}$ miles from mouth of Granite Basin Creek (entering from left), and $1\frac{1}{2}$ miles from outlet of Ketchikan Lake.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—November 1, 1909, to June 30, 1912; June 9, 1915, to February 29, 1916.

GAGE.—Vertical staff fastened to a telephone pole near board walk on left bank at bend of creek 200 feet downstream from mouth of Schoenbar Creek; read once daily between 7 and 8 a. m. by employee of Citizens Light, Power & Water Co. The gage used since June 9, 1915, consists of the standard United States Geological Survey enameled gage, section graduated in hundredths, half-tenths, and tenths from zero to 10 feet. The original gage, established November, 1909, and read until June 30, 1912, is at same location and same datum. It is a staff with graduations painted every tenth foot.

DISCHARGE MEASUREMENTS.—At medium and high stages from footbridge about 500 feet upstream from gage (measuring section poor, as the bridge makes an angle of 20° with the current, and at high stages the flow is broken by large stumps near left bank and at middle of bridge); at low stages, by wading 50 feet below bridge or at another section 100 feet above gage. The flow of Schoenbar Creek has been added to obtain total flow past gage.

CHANNEL AND CONTROL.—Gage is located in a large, deep pool of still water at a bend in river. The bed of the stream at the outlet of this pool is a solid rock ledge, but changes in a gravel bar at lower right side of pool cause occasional changes in stage-discharge relation.

EXTREMES OF STAGE.—Maximum stage recorded during year 4.7 feet November 29; minimum stage recorded, 0.08 foot February 25-26 and March 6-12.

1909-1918: Maximum stage recorded, 8.3 feet November 18, 1917; minimum stage recorded, 0.08 foot February 25-26 and March 6-12.

WINTER FLOW.—Ice forms along banks but control remains open.

DIVERSIONS.—A small quantity of water is diverted above the station for the use of Ketchikan, New England Fish Co., and Standard Oil Co.

REGULATIONS.—Small timber dam and head gates are located at outlet of Ketchikan Lake. Water diverted through power house is returned to river above gage but causes very little diurnal fluctuation. During low water the flow is increased by water from the reservoir.

ACCURACY.—Stage-discharge relation changed during high water August 19, 1917, and large tree trunk lodged lengthwise on control, probably during high water October 11, 1918. Sufficient discharge measurements have not yet been made to define rating curves applicable August 19, 1917, to December 31, 1918.

COOPERATION.—The gage readings were taken by the Citizens Light, Power & Water Co.

Discharge measurements of Ketchikan Creek at Ketchikan during 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Fect.</i>	<i>Sec.-ft.</i>		<i>Fect.</i>	<i>Sec.-ft.</i>
Apr. 23.....	1.01	200	Oct. 17.....	a 1.77	363
May 7.....	1.36	330	23.....	a. 87	170
Aug. 12.....	.45	103			

a Stage-discharge relation changed by large tree trunk lodged on control.

Daily gage height, in feet, of Ketchikan Creek at Ketchikan for 1918.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....	1.1	0.24	0.20	0.20	0.82	0.86	1.00	0.80	0.38	0.30	2.6	2.7
2.....	2.25	.20	.20	.24	1.46	.70	.92	.76	.36	.50	1.60	2.4
3.....	1.3	1.80	.18	.36	1.70	.70	.84	.60	.30	.86	.80	1.85
4.....	2.1	1.20	.10	.40	1.70	.68	.70	.30	.30	4.1	.64	.68
5.....	1.2	.84	.10	.26	1.60	.50	.70	.56	.28	4.0	1.00	.40
6.....	1.0	.66	.08	.18	1.65	.44	.72	.26	.26	1.85	2.3	.18
7.....	.70	.64	.08	.24	1.6	.36	.74	2.1	.20	1.44	1.65	.64
8.....	.10	.60	.08	.46	1.3	.30	.70	1.95	.20	2.6	1.38	.56
9.....	.10	.76	.08	1.00	1.24	.24	.66	1.8	.18	1.6	.90	.44
10.....	.20	.66	.08	.48	1.20	.60	.70	1.5	.30	1.48	.68	.30
11.....	.44	.60	.08	.60	1.16	.90	.50	1.00	.28	4.35	.40	.26
12.....	.46	.40	.08	.60	1.10	.94	.66	.90	.20	1.9	.76	.18
13.....	.44	.30	.10	.66	1.10	1.00	.50	.40	.20	1.50	1.38	.18
14.....	.28	.24	.10	.70	.96	1.10	.46	.34	.18	1.46	1.18	1.30
15.....	.46	.20	.10	.76	.90	1.10	.54	.36	.10	1.20	.68	1.20
16.....	.42	.18	.10	.70	1.00	1.08	.44	.46	.18	1.26	.76	1.20
17.....	1.20	.18	.10	.66	1.10	1.08	.40	.48	1.30	2.20	.48	1.36
18.....	1.44	.16	.10	1.30	1.10	.96	.40	.46	1.10	1.10	.30	1.40
19.....	.82	.10	.10	1.68	1.14	.90	.40	.68	.30	1.6	.28	1.20
20.....	.60	.10	.10	1.50	1.18	.90	.38	1.30	.18	2.45	.30	.60
21.....	.46	.10	.40	1.46	1.20	.88	.36	1.10	.18	1.45	1.70	.56
22.....	1.28	.10	.18	1.48	.90	.86	.36	2.35	.18	.80	1.20	.48
23.....	1.30	.10	.20	1.30	.84	.86	.36	1.95	.50	.66	1.26	.90
24.....	1.34	.10	.36	.90	.70	.86	.34	1.40	.28	.68	1.60	.76
25.....	.74	.08	.38	.86	.68	.90	.48	1.10	1.30	.48	1.70	2.2
26.....	.60	.08	.30	.84	.60	.96	.56	1.0	.70	2.80	1.60	3.0
27.....	.66	.10	.36	.74	.60	.90	2.00	2.3	.26	1.65	1.38	1.30
28.....	.54	.30	.40	.74	1.50	.70	2.00	1.38	.20	1.6	2.5	.70
29.....	.40		.46	.80	1.10	.70	1.08	1.40	.20	1.36	4.7	.54
30.....	.24		.26	.96	1.08	.86	.84	.78	.18	1.50	3.4	.30
31.....	.20		.20		.98		1.00	.70		2.65		.20

FISH CREEK NEAR SEA LEVEL, REVILLAGIGEDO ISLAND.

LOCATION.—In latitude 55° 24' W., near outlet of Lower Lake on Fish Creek, 600 feet from tidewater at head of Thorne Arm, 2 miles northwest of mine at Sea Level, and 25 miles by water from Ketchikan.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 19, 1915, to December 31, 1918.

GAGE.—Stevens water-stage recorder on right shore of Lower Lake, 200 feet above outlet.

DISCHARGE MEASUREMENTS.—At medium and high stages made from cable across creek, 1 mile upstream from gage and 500 feet above head of Lower Lake; at low stages made by wading at cable. Only one small creek enters Lower Lake, at point opposite gage, between the cable site and control.

CHANNEL AND CONTROL.—The lake is about 500 feet wide opposite the gage. Outlet consists of two channels, each about 60 feet wide, separated by an island 40 feet wide. From the lake to tidewater, 200 feet, the creek falls about 20 feet. Bed-rock exposed at the outlet of the lake forms a well-defined and permanent control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.52 feet at 12 a. m. January 1 (discharge computed from an extension of rating curve, 3,220 second-feet); minimum stage, 0.67 foot, March 13 (discharge, 46 second-feet).

1915-1918: Maximum stage recorded, 5.33 feet November 1, 1917 (discharge, 4,600 second-feet); minimum stage, 0.50 foot, February 11, 1916 (discharge, 22 second-feet).

ICE.—Lower Lake freezes over, but as gage is set back in the bank ice does not form in well, and the relatively warm water from the lake and the swift current keep the control open.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined below and extended above 1,500 second-feet. Operation of water-stage recorder satisfactory except for period indicated by break in record shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging results obtained by applying to rating table mean gage heights for regular intervals of day. Results good, except for short period of break in record, for which they are fair.

There are three large lakes in the upper drainage basin. Big Lake, 2 miles from beach at an elevation of 275 feet, covers 1,700 acres; Third Lake, 250 acres; and Mirror Lake, at an elevation of 1,000 feet, 800 acres. Two-thirds of the drainage basin is covered with a thick-growth of timber and brush interspersed with occasional patches of beaver swamp and muskeg. Only the tops of the highest mountains are bare. This large area of lake surface and vegetation, notwithstanding the steep slopes and shallow soil, affords a little ground storage and after a heavy precipitation maintains a good run-off. During a dry, hot period in summer, however, after the snow has melted, the flow becomes very low because of lack of ice or glaciers in the drainage basin.

Discharge measurements of Fish Creek near Sea Level during 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Dis-charge.
	<i>Fect.</i>	<i>Sec.-ft.</i>
Aug. 9.....	2.00	728
Oct. 18.....	1.53	374

Daily discharge, in second-feet, of Fish Creek near Sea Level for 1918.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....	2,020	132	132	168	318	546	492	395	329	157	1,100	1,960
2.....	1,730	123	153	142	334	447	480	340	259	136	875	1,300
3.....	1,220	197	139	123	702	408	395	269	202	182	610	710
4.....	1,200	414	114	139	1,050	395	329	210	161	962	373	474
5.....	875	512	101	132	1,250	421	290	176	136	1,680	324	368
6.....	632	460	91	119	1,030	486	270	157	111	1,150	384	340
7.....	466	351	82	111	734	525	264	210	98	726	655	312
8.....	340	329	73	139	574	595	275	632	87	632	581	302
9.....	264	312	65	243	525	710	285	670	80	574	480	254
10.....	220	351	62	275	506	830	301	602	89	625	384	233
11.....	188	280	58	312	560	938	368	473	106	956	307	210
12.....	168	228	55	285	553	875	460	351	119	1,150	440	188
13.....	149	184	50	285	518	710	447	269	119	1,250	581	157
14.....	116	149	59	269	499	618	384	499	114	822	532	153
15.....	116	119	78	259	512	525	340	176	101	532	362	136
16.....	132	104	80	233	512	499	312	153	91	373	334	302
17.....	213	89	80	192	506	505	285	180	87	307	285	440
18.....	310	80	80	220	454	518	275	197	114	318	228	525
19.....	312	67	84	197	395	505	254	280	192	486	188	492
20.....	264	65	87	648	362	400	238	974	210	1,020	157	368
21.....	233	58	108	553	334	421	224	1,000	184	929	224	285
22.....	329	64	116	441	346	390	197	806	153	670	346	233
23.....	539	64	119	384	330	368	180	1,310	132	506	606	220
24.....	602	64	132	346	307	373	165	1,030	129	440	539	243
25.....	512	65	132	302	296	421	161	710	165	414	532	285
26.....	402	65	119	280	302	499	168	567	378	618	662	632
27.....	324	71	106	264	373	546	180	480	428	1,050	640	539
28.....	285	108	142	259	610	492	447	581	334	1,010	574	414
29.....	224	.....	172	275	1,000	428	670	702	259	848	960	312
30.....	180	.....	188	312	902	402	539	595	473	857	1,730	243
31.....	149	.....	188	.....	718	.....	373	447	.....	965	.....	192

NOTE.—Discharge Dec. 2-6 estimated, because of clock stopping, from maximum and minimum stages indicated by the recorder and from a comparison of the hydrograph for this station with that for Karta River.

Monthly discharge of Fish Creek near Sea Level for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January.....	2,020	116	479	29,500
February.....	512	58	182	10,100
March.....	188	50	105	6,460
April.....	648	111	264	15,700
May.....	1,250	302	562	34,600
June.....	938	368	529	31,500
July.....	670	161	324	19,900
August.....	1,310	153	498	30,600
September.....	473	80	181	10,800
October.....	1,680	136	721	44,300
November.....	1,730	157	530	31,500
December.....	1,960	136	414	25,500
The year.....	2,020	50	401	290,000

SWAN LAKE OUTLET AT CARROLL INLET, REVILLAGIGEDO ISLAND.

LOCATION.—Halfway between Swan Lake and tidewater, on east shore of Carroll Inlet 1 mile from its head, 30 miles by water from Ketchikan.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—August 24, 1916, to December 31, 1918.

GAGE.—Stevens water-stage recorder on left bank, half a mile from tidewater; reached by a trail which leaves beach back of old cabin one-fourth mile south of mouth of creek. Gage was washed out by extreme high water in November, 1917. New gage installed 10 feet farther back in bank at old datum, but with a new control, on May 5, 1918.

DISCHARGE MEASUREMENTS.—At medium and high stages, made from a cable across stream 100 feet downstream from gage; at low stages, made by wading.

CHANNEL AND CONTROL.—The gage well is in a deep pool 25 feet upstream from a contracted portion of the channel, where a fall of 1 foot over bedrock forms a permanent control. The effect of the violent fluctuation of the water surface outside of the gage well is decreased in the inner float well, because the intake holes at the bottom are very small. At the cable section the bed is rough, the water shallow, and the current very swift. Point of zero flow is at gage height —1.0 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period May 5 to December 31, 4.82 feet at 3 a. m. November 30 (discharge, computed from extension of rating curve, 2,270 second-feet); minimum stage, 0.50 foot September 16 (discharge, 99 second-feet).

1915–1918: Maximum stage occurred probably on November 1, 1917 (discharge, estimated by comparison with Fish Creek, 5,500 second-feet); minimum discharge, 39 second-feet, April 2, 1917.

ICE.—Stage-discharge relation not affected by ice.

ACCURACY.—Stage-discharge relation permanent. Rating curve, determined by four discharge measurements and point of zero flow, is fairly well defined below 2,000 second-feet. Water-stage recorder operated satisfactorily May 5 to December 31, 1918, except for short periods in December indicated in footnote to daily discharge table. No water-stage recorder graph from October 1, 1917, to May 5, 1918; mean monthly flow, estimated from record of flow at Fish Creek and ratios between mean monthly flow at Swan Lake Outlet and Fish Creek, obtained from a comparison of the data for these stations. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging discharges obtained by applying to rating table mean gage heights for regular intervals of day. Results good except for periods of break in record, for which they are fair.

Swan Lake, whose area is about 350 acres, is $1\frac{1}{2}$ miles from tidewater, at an elevation of 225 feet.

Discharge measurements of Swan Lake outlet at Carroll Inlet during 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
Aug. 8.....	2.42	688
Oct. 11.....	3.63	1,430
22.....	2.12	631

Daily discharge, in second-feet, of Swan Lake outlet of Carroll Inlet for 1918.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....		603	644	440	288	176	1,380	1,860
2.....		492	540	350	227	160	930	1,320
3.....		460	436	291	190	480	598	820
4.....		488	374	255	166	1,510	406	1,050
5.....		572	346	212	145	2,140	309	368
6.....	990	675	354	197	133	1,420	792	306
7.....	720	760	385	388	122	919	770	279
8.....	608	902	420	730	109	960	562	244
9.....	612	990	460	720	104	684	440	207
10.....	666	1,170	468	666	145	980	343	194
11.....	760	1,320	562	468	151	1,580	270	178
12.....	740	1,140	662	350	141	2,100	402	162
13.....	652	930	612	270	126	1,617	577	151
14.....	666	820	520	220	116	960	300	139
15.....	698	720	468	185	108	580	360	135
16.....	698	720	448	197	101	388	285	202
17.....	597	770	440	300	131	326	235	279
18.....	512	795	420	291	188	406	194	300
19.....	452	698	402	585	190	562	166	309
20.....	406	594	368	1,260	180	1,260	153	244
21.....	378	562	326	875	155	898	372	247
22.....	368	504	291	1,080	137	612	320	183
23.....	342	504	267	1,410	135	440	960	190
24.....	332	562	248	902	137	374	770	244
25.....	357	621	255	648	290	385	608	285
26.....	432	702	264	512	711	619	760	616
27.....	520	735	288	492	540	1,680	652	532
28.....	919	621	594	662	374	1,350	562	402
29.....	1,350	532	585	644	276	1,050	1,290	300
30.....	1,050	524	520	500	214	1,230	2,060	222
31.....	795		440	374	.....	1,470	.....	190

NOTE.—Mean discharge, Oct. 1, 1917, to May 5, 1918, estimated, because of no gage-height graph, from a comparison of the records of flow for this station with those for Fish Creek as follows: Oct., 870 second-feet; November, 2,200 second-feet; December, 1917, 200 second-feet; January, 450 second-feet; February, 180 second-feet; March, 90 second-feet; April, 290 second-feet; May 1-5, 880 second-feet. Daily discharge estimated, because line drawn by pencil on gage-height graph was too faint to find, for following periods: Dec. 12-13, Dec. 19-24, Dec. 26-31, 1918.

Monthly discharge of Swan Lake outlet at Carroll Inlet for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January.....			450	27,700
February.....			180	10,000
March.....			90	5,530
April.....			290	17,300
May.....	1,350	332	678	41,700
June.....	1,320	460	716	42,600
July.....	644	255	432	26,600
August.....	1,410	185	531	32,600
September.....	711	101	201	12,000
October.....	2,140	160	946	58,200
November.....	2,060	153	610	36,300
December.....	1,860	135	392	24,100
The year.....			462	335,000

NOTE.—See footnote to table of daily discharge.

ORCHARD LAKE OUTLET AT SHRIMP BAY, REVILLAGIGEDO ISLAND.

LOCATION.—In latitude 55° 50' N., longitude 131° 27' W., at outlet of Orchard Lake, one-third mile from tidewater at head of Shrimp Bay, an arm of Behm Canal, 46 miles by water from Ketchikan.

DRAINAGE AREA.—Not measured.

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RECORDS AVAILABLE.—May 28, 1915, to December 31, 1918.

GAGE.—Stevens water-stage recorder on right bank 300 feet below Orchard Lake and 100 feet above site of timber-crib dam, which was built in 1914 for proposed pulp mill and washed out by high water August 10, 1915. Datum of gage lowered 2 feet September 15, 1915. Gage heights May 29 to August 10 referred to first datum; August 11, 1915, to August 17, 1916, to second datum. Datum of gage lowered 1 foot August 17, 1916. Gage heights August 18 to December 31, 1916, referred to this datum. Gage washed out probably during high water on November 1, 1917. New gage installed on April 28, 1918, at old site at the datum of August 17, 1916.

DISCHARGE MEASUREMENTS.—At medium and high stages made from cable 5 feet upstream from gage; at low stages by wading one-fourth mile below gage.

CHANNEL AND CONTROL.—From Orchard Lake, at elevation 134 feet above high tide, the stream descends in a series of rapids for 1,000 feet through a narrow gorge, then divides into two channels and enters the bay in two cascades of 100-foot vertical fall. Opposite the gage the water is deep and the current sluggish. At the site of the old dam bedrock is exposed, but for 30 feet upstream the channel is filled in with loose rock and brush placed during construction of dam. This material forms a riffle which acts as a control for water surface at gage at low and medium stages and is scoured down when ice goes out of lake; the rock outcrop at site of old dam acts as a control at high stages and is permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period April 28 to December 31, 1918, 6.85 feet October 5 (discharge, 3,620 second-feet); minimum stage recorded, 0.58 foot September 17 (discharge, 110 second-feet).

1915-1918: Maximum stage occurred, probably, on November 1, 1917 (discharge estimated by multiplying maximum discharge at Fish Creek on that date by 1.55, which is the ratio between the maximum discharges of Orchard Lake outlet and Fish Creek on October 16 and 15, 1915, 7,100 second-feet); minimum discharge, estimated, 20 second-feet February 11, 1916.

ICE.—Stage-discharge relation not affected by ice.

ACCURACY.—Stage-discharge relation changes occasionally during high water. Rating curve, determined by four discharge measurements made since new gage was installed, point of zero flow, and form of upper portion of old rating curve, is well defined below 4,000 second-feet. Water-stage recorder operating satisfactory April 28 to December 31, 1918. No water-stage recorder record from October 11, 1917, to April 27, 1918; mean monthly or part monthly flow estimated from record of flow at Fish Creek and ratios between mean monthly flows at Orchard Lake outlet and Fish Creek, obtained from a comparison of the data for these stations. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging discharges obtained by applying to rating table mean gage heights for regular intervals of day. Results good, except for period of break in record, for which they are fair.

The highest mountains on this drainage basin are only 3,500 feet above sea level and are covered to an elevation of 2,500 feet by a heavy stand of timber and a thick undergrowth of brush, ferns, alders, and devil's club. The topography is not so rugged as that of the area surrounding Shellockum Lake, and the proportion of vegetation, soil cover, and lake area is greater, so that more water is stored and the flow in the Orchard Lake drainage basin is better sustained.

Discharge measurements of Orchard Lake outlet at Shrimp Bay during 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
Apr. 29.....	2.30	523
Aug. 10.....	3.02	856
Oct. 20.....	5.30	2,240

Daily discharge, in second-feet, of Orchard Lake outlet at Shrimp Bay for 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....		655	838	860	607	482	206	1,790	1,860
2.....		635	695	735	522	361	176	1,080	1,520
3.....		1,500	655	607	440	287	383	735	928
4.....		1,900	735	526	393	232	1,950	512	611
5.....		1,520	882	488	332	196	3,370	384	418
6.....		1,160	1,020	530	294	170	1,860	662	329
7.....		905	1,050	565	558	151	1,020	950	294
8.....		838	1,160	613	1,050	135	860	635	268
9.....		928	1,250	635	950	122	675	526	225
10.....		978	1,340	655	795	120	1,130	421	204
11.....		1,190	1,460	735	572	196	1,960	327	189
12.....		928	1,310	882	430	211	2,930	443	160
13.....		1,020	1,100	860	337	185	1,900	715	142
14.....		1,050	1,050	715	280	160	1,050	588	132
15.....		1,080	1,000	635	244	138	655	450	125
16.....		1,100	1,020	607	218	122	440	358	204
17.....		928	1,080	596	329	110	347	294	468
18.....		838	1,100	558	358	147	393	244	502
19.....		715	950	530	501	237	547	204	512
20.....		655	860	462	2,010	237	2,000	176	273
21.....		576	815	405	1,430	206	1,280	461	309
22.....		554	735	378	978	170	815	978	251
23.....		533	735	350	2,100	151	580	1,160	225
24.....		554	775	324	1,400	179	406	905	273
25.....		606	860	358	1,000	183	421	675	375
26.....		735	928	396	1,020	675	884	860	719
27.....		905	950	393	775	558	1,930	715	655
28.....	446	1,360	860	596	860	408	1,620	675	479
29.....	540	760	755	655	1,080	312	1,310	1,190	361
30.....	675	1,220	715	735	928	246	1,430	2,490	284
31.....		1,020		488	665		2,010		222

NOTE.—Mean discharge estimated, because of no gage record, from a comparison of the records of flow for this station with those of Fish Creek as follows: October, 11-31, 1,020 second-feet; November, 2,500 second-feet; December, 1917, 220 second-feet; January, 525 second-feet; February, 200 second-feet; March, 90 second-feet; April, 1-27, 420 second-feet.

Monthly discharge of Orchard Lake outlet at Shrimp Bay for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January.....			525	32,300
February.....			200	11,100
March.....			90	5,530
April.....			433	25,800
May.....	1,900	533	949	58,400
June.....	1,460	655	956	56,900
July.....	882	324	577	35,500
August.....	2,100	218	757	46,500
September.....	675	110	236	14,000
October.....	3,370	176	1,180	72,600
November.....	2,490	176	720	42,800
December.....	1,860	125	439	27,000
The year.....			592	428,000

NOTE.—See footnote to table of daily discharge.

SHELOCKUM LAKE OUTLET AT BAILEY BAY.

LOCATION.—In latitude $56^{\circ} 00' N.$, longitude $131^{\circ} 36' W.$, on mainland near outlet of Shelockum Lake, three-fourths mile by Forest Service trail from tidewater at north end of Bailey Bay, and 52 miles by water north of Ketchikan.

DRAINAGE AREA.—18 square miles (measured on sheets Nos. 5 and 8 of the Alaska Boundary Tribunal, edition of 1895).

RECORDS AVAILABLE.—June 1, 1915, to December 31, 1918.

GAGE.—Stevens continuous water-stage recorder on right shore of lake, 250 feet above outlet. Gage house was pushed off the well by a snowslide January 4, 1917. Gage not put into operation again until May 23.

DISCHARGE MEASUREMENTS.—Made from cable across outlet of lake, 200 feet below gage and 50 feet upstream from crest of falls.

CHANNEL AND CONTROL.—Opposite the gage the lake is 600 feet wide; at the outlet bedrock is exposed and the water makes a nearly perpendicular fall of 150 feet. This fall forms an excellent and permanent control for the gage. At extremely high stages the lake has another outlet about 200 feet to left of main outlet. Point of zero flow is at gage height 0.6 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.92 feet, at 12.7 a. m. October 5 (discharge, 1,200 second-feet); minimum discharge (estimated from hydrograph for Fish Creek to have occurred March 13), 21 second-feet.

1915-1918: Maximum stage, 6.84 feet at 8 a. m. November 1, 1917 (discharge, 2,780 second-feet); minimum discharge, estimated from climatic records, 2.5 second-feet.

ICE.—Stage-discharge relation not affected by ice.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Operation of water-stage recorder satisfactory except for periods of break in record shown in the footnote to daily-discharge table. Daily discharge ascertained by applying to the rating table mean daily gage heights determined by inspection of gage-height graph, or, for days of considerable fluctuation, by averaging discharges obtained by applying to rating table mean gage heights for regular intervals of day. Results excellent, except for periods of break in record, for which they are fair.

Shelockum Lake, at an elevation of 344 feet, covers only 350 acres. The drainage basin above the lake is rough, precipitous, and covered with little soil or vegetation. There are no glaciers or ice fields at the source of the tributary streams. Therefore, because of little natural storage, the run-off after a heavy rainfall is rapid and not well sustained, and during a dry summer or winter the flow becomes very low. The large amount of snow that accumulates on the drainage basin during the winter maintains a good flow in May and June.

The following discharge measurement was made by G. H. Canfield:

August 10, 1918: Gage height, 3.04 feet; discharge, 330 second-feet.

Daily discharge, in second-feet, of Shelockum Lake outlet of Bailey Bay for 1918.

Day.	Jan.	Feb.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.	980	70		306	220	180	92	490	
2.	705	65		252	170	128	84	311	
3.	455	51		220	141	97	269	216	
4.	455	123		210	123	77	774	152	
5.	350			204	98	65	1,040	119	
6.				210	84	55	484	395	107
7.	241			220	170	48	326	455	91
8.	141			230	472	43	363		80
9.	110			230	438	38	265		70
10.	98			230	378	48	374		65
11.	88			252	263	81	580		59
12.	81			311	182	80	1,040		48
13.	71			324	132	59	622		43
14.	62			275	107	63	336		42
15.	55			252	86	53	216		41
16.	52			230	88	47	155		67
17.	57			220	91	49	139		123
18.	97		392	200	91	80	220		145
19.	98		350	180	253	110	328		132
20.	84		336	160	1,010	42	680		98
21.	80		316	150	618	90	472		78
22.	139		314	141	522	77	331		71
23.	204		363	136	902	71	243		66
24.	196		422	132	438	115	204		84
25.	150		490	141	311	313	206		107
26.	115		455	145	259	660	426		180
27.	98		378	160	252	378	705		150
28.	92		324	210	490	239	600		115
29.	86		311	210	542	162	525		87
30.	80		392	180	392	119	525		65
31.	75			190	256		542		51

NOTE.—Jan. 28 to Feb. 1, discharge interpolated. Feb. 5 to June 17, mean discharge estimated, because of no record except maximum and minimum stages indicated by the recorder and gage reading on Apr. 27, from record of flow at Fish Creek and ratios, between mean monthly discharges at Fish Creek and Shelockum Lake outlet, obtained from a comparison of the record for these stations as follows: Feb. 5-28, 65 second-feet; March, 42 second-feet; April, 132 second-feet; May, 310 second-feet; June 1-17, 420 second-feet; July 4 to Aug. 10, daily discharge estimated, because of supply of paper on recorder running out on July. 3, from a gage-height graph drawn by comparison with that for Orchard Lake outlet through maximum and minimum stages indicated by recorder at Shelockum Lake. Nov. 8 to Dec. 5, discharge estimated, because of no record due to catching of float, from record of flow at Fish Creek and ratios obtained from a comparison of the record for these stations, as follows: Nov. 8-30, 200 second-feet; Dec. 1-5, 320 second-feet.

Monthly discharge of Shelockum Lake outlet at Bailey Bay for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January.	980	52	186	11,400
February.			67	3,720
March.			42	2,580
April.			132	7,860
May.			310	19,100
June.			405	24,100
July.	324	132	210	12,900
August.	1,010	84	309	19,000
September.	660	38	122	7,260
October.	1,040	84	425	26,100
November.			231	13,700
December.		41	125	7,690
The year.			214	155,000

NOTE.—See footnote to table of daily discharge.

KARTA RIVER AT KARTA BAY, PRINCE OF WALES ISLAND.

LOCATION.—In latitude 55° 34' N., longitude 132° 37' W., at head of Karta Bay, an arm of Kasaan Bay, on east coast of Prince of Wales Island, 42 miles by water across Clarence Strait from Ketchikan.

DRAINAGE AREA.—49.5 square miles (U. S. Forest Service reconnaissance map of Prince of Wales Island, 1914).

RECORDS AVAILABLE.—July 1, 1915, to December 31, 1917.

GAGE.—Stevens continuous water-stage recorder on left bank, half a mile above tidewater, at head of Karta Bay and $1\frac{1}{4}$ miles below outlet of Little Salmon Lake. Two per cent of total drainage of Karta River enters between outlet of lake and gage.

DISCHARGE MEASUREMENTS.—At medium and high stages made from cable across river 50 feet upstream from gage; at low stages by wading at cable section.

CHANNEL AND CONTROL.—From Little Salmon Lake, $1\frac{1}{2}$ miles from tidewater, the river descends 105 feet in a series of rapids in a wide, shallow channel, the banks of which are low but do not overflow. The bed is of coarse gravel and boulders; rock crops out only at outlet of lake. Gage and cable are at a pool of still water formed by a riffle of coarse gravel that makes a well-defined and permanent control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 4.1 feet at 12 p. m. December 1 (discharge computed from an extension of the rating curve, 2,960 second-feet); minimum stage, 0.91 foot, March 12 (discharge, 66 second-feet).

1915–1918: Maximum stage, 5.5 feet November 1, 1917 (discharge, 5,070 second-feet); minimum flow, 21 second-feet, February 11, 1915.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 80 and 1,500 second-feet; extended below 80 second-feet to the point of zero flow and above 1,500 second-feet by estimation. Operation of water-stage recorder satisfactory except for periods indicated by breaks in record as shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging results obtained by applying gage heights for regular intervals to rating table. Results excellent except for periods of break in record, for period affected by ice, and for discharges above 1,500 second-feet, for which they are fair.

The combined area of Little Salmon Lake at elevation 105 feet, and Salmon Lake at elevation 110 feet, is 1,600 acres. The slopes along the right shore of lakes and at head of Salmon Lake are gentle, and the area included by the 250-foot contour above lake outlet is 5,500 acres. The drainage area to elevation 2,000 feet is heavily covered with timber and dense undergrowth of ferns, brush, and alders. The upper parts of the mountains are covered with thin soil and brush. Only a few peaks at an elevation of 3,500 feet are bare. This large lake and flat area and thick vegetal cover affords considerable natural storage, which, after heavy precipitation, maintains a good run-off. The snow usually melts by the end of June, and the run-off becomes very low during a dry, hot summer.

The Forest Service in the summer of 1916 constructed a pack trail from tidewater to outlet of Little Salmon Lake.

Daily discharge, in second-feet, of Karta River at Karta Bay for 1918.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....	2,620	280	135	210	536	681	332	112	243	290	1,940	2,560
2.....	2,060	264	149	188	572	588	314	112	201	233	1,300	2,030
3.....	1,820	597	135	184	1,130	536	290	112	180	224	1,020	1,320
4.....	1,700	1,330	118	206	1,380	529	264	103	152	719	722	852
5.....	1,240	1,020	112	192	1,280	580	248	97	176	1,390	536	595
6.....	916	764	103	168	1,050	665	238	94	115	916	1,220	467
7.....	681	618	97	156	862	730	233	152	106	697	1,380	474
8.....	522	572	88	264	790	853	229	229	94	730	1,000	350
9.....	441	529	81	610	817	952	224	264	86	617	862	290
10.....	382	480	74	756	880	943	224	308	86	705	625	274
11.....	415	540	69	773	980	862	220	290	112	1,060	480	238
12.....	454	360	66	705	990	773	229	254	115	1,510	508	206
13.....	415	290	76	641	889	705	238	229	106	1,150	633	180
14.....	402	243	83	550	880	665	229	254	97	773	603	172
15.....	376	224	83	487	889	625	220	238	88	565	522	160
16.....	415	192	86	441	862	610	197	206	81	428	415	304
17.....	952	168	86	395	764	610	188	184	78	494	338	501
18.....	1,020	152	86	690	681	610	180	168	88	657	280	649
19.....	773	138	83	1,580	588	543	172	180	115	757	238	657
20.....	602	128	100	1,320	543	487	184	565	118	1,520	206	543
21.....	641	118	115	990	501	434	152	673	112	1,270	302	402
22.....	970	115	130	782	474	402	145	580	106	980	748	396
23.....	1,200	109	140	705	441	382	132	722	97	730	907	434
24.....	1,140	109	150	625	441	396	125	649	103	625	844	588
25.....	871	109	150	550	474	402	118	522	372	572	853	657
26.....	714	109	143	508	550	408	115	454	1,270	808	1,150	1,070
27.....	641	106	140	480	641	415	112	382	1,010	1,060	1,170	925
28.....	543	118	180	480	1,070	389	109	363	697	1,080	1,040	681
29.....	441	.....	220	529	1,220	353	109	363	501	1,120	1,500	501
30.....	363	.....	240	565	1,020	338	109	332	376	1,350	1,880	363
31.....	314	.....	240	.....	840	.....	109	285	.....	1,820	.....	290

NOTE.—Discharge Feb. 11-13, Mar. 20 to Apr. 1, and Dec. 29-31 estimated, because of clock stopping, from maximum and minimum stages indicated by the recorder and from a comparison of the hydrograph for this station with the climatic data for Ketchikan and the hydrograph for Fish Creek.

Monthly discharge of Karta River at Karta Bay for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January.....	2,620	314	839	51,600
February.....	1,330	106	349	19,400
March.....	240	66	121	7,440
April.....	1,580	184	224	13,300
May.....	1,380	441	808	49,700
June.....	952	338	583	34,700
July.....	332	109	193	11,900
August.....	722	94	306	18,500
September.....	1,270	78	236	14,000
October.....	1,820	224	866	53,200
November.....	1,940	206	843	50,200
December.....	2,560	160	617	38,000
The year.....	2,620	66	499	362,000

NOTE.—See footnote to table of daily discharge.

CASCADE CREEK AT THOMAS BAY NEAR PETERSBURG.

LOCATION.—One-fourth mile above tidewater on each shore of south arm of Thomas Bay; 22 miles by water from Petersburg. One small tributary enters the river from the left half a mile above gage and 2 miles below lake outlet.

DRAINAGE AREA.—21.4 square miles (measured on the United States Geological Survey geologic reconnaissance map of the Wrangell mining district, edition of 1907).

RECORDS AVAILABLE.—October 27, 1917, to December 31, 1918.

GAGE.—Stevens water-stage recorder on left bank, one-fourth mile from tidewater; reached by trail which leaves beach back of old cabin at mouth of creek.

DISCHARGE MEASUREMENTS.—At medium and high stages, made from log footbridge across stream one-fourth mile upstream from gage; at low stages, made by wading.

CHANNEL AND CONTROL.—From the outlet of a lake at an elevation of 1,200 feet above sea level and 3 miles from tidewater the river descends in a continuous series of rapids and falls through a narrow, deep canyon. Gage is in a protected eddy above a natural rock weir, which forms a well-defined and permanent control. The bed of river under the footbridge is rough and the current swift and irregular, but this section is the only place on the whole river where even at low and medium stages there are no boils and eddies.

EXTREMES OF STAGE.—Maximum stage recorded during period, 7.65 feet at 11 p. m. November 18, 1917 (discharge computed from extension of rating curve, 1,980 second-feet); minimum stage, 0.80 foot about April 6, 1918 (discharge, 17 second-feet).

ICE.—Stage-discharge relation not affected by ice.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined below 1,200 second-feet. Operation of water-stage recorder satisfactory except for periods indicated in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging discharge for equal intervals of day. Results good except for periods when recorder did not operate satisfactorily, for which they are fair.

The first site on this stream for a storage reservoir is at a small lake 3 miles from tidewater, at an elevation of 1,200 feet above sea level. The drainage area above the gaging station is 21 square miles and above the lake outlet 17 square miles. Flow during summer is augmented by melting ice from glaciers on upper portion of drainage area.

Discharge measurements of Cascade Creek at Thomas Bay during 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Mar. 6.....	a 1.13	24	Aug. 15.....	3.82	325
May 27.....	3.46	223	Oct. 5.....	5.66	943

a Ice on control but apparently bridged over.

Daily discharge, in second-feet, of Cascade Creek at Thomas Bay for 1917-18.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1917.				1917.				1917.			
1.....		955	128	11.....		552	84	21.....		910	.....
2.....		1,370	116	12.....		518	77	22.....		692	.....
3.....		658	104	13.....		772	73	23.....		518	.....
4.....		425	93	14.....		1,470	70	24.....		355	.....
5.....		368	87	15.....		1,020	.....	25.....		280	.....
6.....		410	84	16.....		640	.....	26.....		260	.....
7.....		588	83	17.....		752	.....	27.....	140	270	.....
8.....		410	99	18.....		1,060	.....	28.....	220	210	.....
9.....		305	96	19.....		1,720	.....	29.....	183	175	.....
10.....		535	88	20.....		1,370	.....	30.....	304	144	.....
								31.....	518	.....	.....

Daily discharge, in second-feet, of Cascade Creek at Thomas Bay for 1917-18—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1918.												
1.....		37		19		270	318	440	518	292	305	270
2.....		36		19		220	368	395	410	318	210	240
3.....		54		19		230	305	380	330	652	160	175
4.....		48				240	280	355	270	1,000	129	119
5.....		42				280	292	342	250	955	383	104
6.....		40	24			330	368	425	220	640	393	94
7.....	97	40	22			368	470	455	200	470	260	90
8.....	84	40	22			425	535	410	200	455	200	81
9.....	71	39	21			455	605	410	183	368	153	72
10.....	64	38	20			500	640	395	318	380	127	66
11.....	62		20			640	622	342	485	355	117	60
12.....	62		20			570	570	318	260	455	117	57
13.....	56		20			500	500	292	200	410	104	54
14.....	53		20			500	500	305	175	292	93	60
15.....	51		20			535	552	305	192	220	83	60
16.....	49		20			552	658	462	230	167	74	.....
17.....	50		20			605	750	500	379	230	69	.....
18.....	48		20			605	770	425	710	260	65	.....
19.....	45		20			535	770	734	570	260	69	.....
20.....	42		20			485	692	1,470	380	330	248	.....
21.....	53		20			470	622	1,180	260	260	330	.....
22.....	60		20			455	552	980	192	200	330	.....
23.....	58		19			470	500	1,470	260	167	292	.....
24.....	52		19			552	470	1,270	260	148	250	.....
25.....	48		19			675	455	830	780	183	200	.....
26.....	46		19			675	440	605	1,300	280	160	.....
27.....	46		19			640	500	734	980	368	134	.....
28.....	44		19	125		588	710	1,220	658	355	119	.....
29.....	42		19			552	640	1,200	470	330	134	.....
30.....	39		19			552	535	955	355	518	240	.....
31.....	38		19		342		500	710		440		.....

NOTE.—Discharge estimated for following periods because of unsatisfactory operation of water-stage recorder: Dec. 15-31, 1917 (mean discharge, 65 second-feet), by comparison with record of flow for Long River at Port Snettisham; Jan. 1-6 (mean discharge, 114 second-feet), Feb. 11-28 (mean discharge, 24 second-feet), Mar. 1-5 (mean discharge, 22 second-feet), Mar. 7-9 and Apr. 4-30 (mean discharge, 54 second-feet) by comparison with hydrograph for Long River and climatic records for Juneau; May 1-30 (mean discharge, 190 second-feet) by comparison with records of flow for Long River; Oct. 3-4 and Nov. 24 to Dec. 6 from hydrograph drawn by comparison with that for Sweetheart Falls Creek through maximum and minimum stages indicated by recorder; Dec. 16-31, 1918 (mean discharge, 82 second-feet), by comparison with records of flow for Long River.

Monthly discharge of Cascade Creek at Thomas Bay for 1917-18.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1917.				
November.....	1,720	144	657	39,100
December.....	128		73.8	4,540
1918.				
January.....		38	65.9	4,050
February.....	54		27.3	1,520
March.....	24	19	29.3	1,250
April.....		18	50.5	3,000
May.....			195	12,000
June.....	675	220	482	28,700
July.....	770	280	532	32,700
August.....	1,470	292	656	43,300
September.....	1,300	175	400	23,800
October.....	1,000	148	376	23,100
November.....	383	65	185	11,000
December.....	270		90.8	5,580
The year.....	1,470	18	257	187,000

NOTE.—See footnote to table of daily discharge.

GREEN LAKE OUTLET AT SILVER BAY, NEAR SITKA.

LOCATION.—In latitude 56° 59' N., longitude 135° 5' W., at outlet of Green Lake, head of Silver Bay, 10½ miles by water south of Sitka.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—August 22, 1915, to December 31, 1918.

GAGE.—Stevens water-stage recorder on right bank, at outlet of lake, reached by trail which leaves the beach one-fourth mile north of mouth of stream, ascends a 600-foot ridge, and then drops down to the outlet of the lake. Gage datum lowered 1 foot December 27, 1916.

DISCHARGE MEASUREMENTS.—Made from cable across outlet 30 feet below gage.

CHANNEL AND CONTROL.—From Green Lake, 240 feet above sea level and 1,800 feet from tidewater, the stream descends in a series of falls and rapids through a narrow canyon whose exposed rock walls rise vertically more than 100 feet.

EXTREMES OF DISCHARGE.—Maximum stage during period, from water-stage recorder, 130 feet, September 26, 1918 (discharge, estimated from extension of rating curve 3,300 second-feet); minimum stage recorded, 0.01 foot, March 27–28, 1918 (discharge, 11 second-feet).

ICE.—Ice forms on lake and at gage, but because of current and flow of relatively warm weather from the lake the control remains open.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 10 and 1,300 second-feet. Operation of water-stage recorder satisfactory except for periods indicated by breaks in record, as shown in the footnote to the daily-discharge table. Daily discharge ascertained by applying to the rating table mean daily gage height, determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging results obtained by applying to rating table gage heights for regular intervals of day. Records good, except those for periods when gage was not operating satisfactorily, which are fair.

In the fall and winter the flow is low because there is little ground storage, and on most of the drainage area the precipitation is in the form of snow. This accumulated snow produces a large run-off during the spring, and the melting ice from the glacier and the ice-capped mountains augments the run-off from precipitation during the summer. The area of Green Lake is estimated to be only 100 acres.

Daily discharge, in second-feet, of Green Lake outlet at Silver Bay for 1918.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Oct.	Nov.	Dec.
1.....	328	42	33	18	87	303	-----	406	-----	-----	-----
2.....	424	41	34	14	110	286	-----	354	-----	-----	-----
3.....	320	42	29	24	254	270	-----	328	-----	-----	-----
4.....	270	65	25	30	346	354	-----	354	-----	-----	-----
5.....	188	65	22	19	294	461	-----	337	662	-----	-----
6.....	130	53	23	14	226	578	-----	371	-----	-----	-----
7.....	100	44	23	13	182	728	706	518	-----	-----	-----
8.....	81	46	19	14	188	889	774	490	-----	-----	-----
9.....	73	-----	18	23	247	797	820	406	-----	-----	-----
10.....	70	-----	20	28	312	700	728	415	-----	-----	-----
11.....	66	-----	20	39	406	610	684	380	-----	-----	-----
12.....	63	-----	18	44	397	557	684	328	-----	-----	-----
13.....	60	-----	15	60	320	547	547	380	-----	152	-----
14.....	55	-----	14	54	286	-----	599	406	-----	166	64
15.....	49	-----	13	52	262	-----	695	354	-----	156	64
16.....	46	-----	13	50	303	-----	774	461	-----	147	69
17.....	48	-----	14	47	-----	-----	820	470	-----	-----	80
18.....	62	28	14	111	-----	-----	843	354	-----	-----	95
19.....	59	26	15	346	-----	-----	820	354	-----	-----	94
20.....	51	26	14	270	-----	-----	751	557	-----	-----	80
21.....	51	28	14	161	-----	-----	620	557	-----	-----	81
22.....	191	38	14	116	-----	-----	528	499	-----	-----	194
23.....	270	33	15	114	-----	-----	490	866	-----	-----	223
24.....	247	30	13	106	-----	-----	442	-----	-----	-----	286
25.....	166	36	12	86	-----	-----	452	-----	-----	-----	233
26.....	120	37	12	79	-----	-----	461	-----	-----	-----	328
27.....	106	30	11	79	-----	-----	490	-----	-----	-----	182
28.....	85	28	11	76	-----	-----	578	-----	-----	-----	118
29.....	63	-----	12	81	-----	-----	490	-----	-----	-----	90
30.....	54	-----	25	89	-----	-----	424	-----	-----	-----	80
31.....	47	-----	24	-----	-----	-----	406	-----	-----	-----	73

NOTE.—Discharge estimated for the following periods because of unsatisfactory operation of water-stage recorder: Jan. 8-12 and Feb. 9-17 (mean discharge, 44 second-feet), by comparison with hydrograph for Baranof Lake outlet at Warm Spring Bay and climatic data at Sitka; June 10, discharge interpolated; May 17-31 (mean discharge, 330 second-feet), June 14-30 (mean discharge, 610 second-feet), July 1-6 (mean discharge, 510 second-feet), Aug. 24-31 (mean discharge, 650 second-feet), Sept. 1-24 (mean discharge, 340 second-feet), Sept. 25-30 (mean discharge, 1,100 second-feet), Oct. 1-31 (mean discharge, 420 second-feet), Nov. 1-12 (mean discharge, 520 second-feet), Nov. 17-30 (mean discharge, 320 second-feet), and Dec. 1-13 (mean discharge, 190 second-feet), by maximum and minimum stages indicated by recorder and by comparison with record of flow for Baranof Lake outlet.

Monthly discharge of Green Lake outlet at Silver Bay for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January.....	428	46	127	7,810
February.....	65	26	40.0	2,220
March.....	34	11	18.0	1,110
April.....	346	13	75.2	4,470
May.....	-----	87	296	18,200
June.....	889	-----	582	34,600
July.....	843	-----	600	36,900
August.....	-----	354	489	30,100
September.....	-----	-----	492	29,300
October.....	-----	-----	420	25,800
November.....	-----	-----	378	22,500
December.....	-----	64	190	11,700
The year.....	-----	11	309	225,000

NOTE.—See footnote to table of daily discharge.

BARANOF LAKE OUTLET AT BARANOF, BARANOF ISLAND.

LOCATION.—In latitude 57° 5' N., longitude 134° 54' W., at townsite of Baranof, at head of Warm Spring Bay, east coast of Baranof Island, 18 miles east of Sitka across island, but 96 miles from Sitka by water through Peril Strait.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 28, 1915, to December 31, 1918.

GAGE.—Stevens water-stage recorder on right bank 700 feet below Baranof Lake and 800 feet above tidewater at head of Warm Spring Bay.

DISCHARGE MEASUREMENTS.—At medium and high stages, from cable across stream 100 feet below lake and 600 feet above gage; at low stages, by wading 100 feet below cable.

CHANNEL AND CONTROL.—From Baranof Lake, at elevation 130 feet above sea level and 1,500 feet from tidewater, the stream descends in a series of rapids and small falls and enters the bay in a cascade of about 100 feet concentrated fall. The bed is of glacial drift, boulders, and rock outcrop. The gage is in an eddy 50 feet downstream from the foot of a small fall and 100 feet upstream from a riffle which forms a well-defined control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5 feet at 10 p. m., September 26 (discharge, computed from an extension of rating curve, 2,920 second-feet); minimum, 0.40 foot, March 20–22 (discharge, 30 second-feet).

1915–1918: Maximum stage recorded during period, 5.3 feet August 10, 1915 (discharge, computed from extension of rating curve, 3,350 second-feet); minimum flow, estimated by discharge measurement and climatic data, 28 second-feet, February 13, 1915.

ICE.—Because of the swift current and flow of relatively warm water from the lake, the stream remains open.

DIVERSIONS.—The flume to Olsen's sawmill diverts from the stream 200 feet below gage only sufficient water to operate a 25-horsepower Pelton water wheel.

ACCURACY.—Stage-discharge relation permanent, not affected by ice. Rating curve well defined below 2,000 second-feet. Operation of water-stage recorder satisfactory except for periods indicated in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging discharge for equal intervals of day. Results good except for periods when recorder did not operate satisfactorily and for periods when water was frozen in well, for which they are fair.

The drainage area is rough and precipitous, and the vegetable and soil cover is thin, even on the foothills of the mountains. The run-off is rapid, and the ground storage is small. During a hot, dry period, however, the flow is greatly augmented by melting ice from several small glaciers and ice-capped mountains.

Discharge measurements of Baranof Lake outlet at Baranof during 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Dis-charge.
	<i>Fect.</i>	<i>Sec.-ft.</i>
Mar. 18.....	0.44	30
Dec. 10.....	1.21	125

WATER-POWER INVESTIGATIONS IN SOUTHEASTERN ALASKA. 73

Daily discharge, in second-feet, of Baranof Lake outlet at Baranof for 1918.

Day.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			36	147	568	855	668	820	432	1,010	930
2			34	167	545	855	615	668	384	590	788
3			36	245	545	820	615	545	545	460	492
4		45	36	362	590	788	615	480	1,540	333	336
5			36	400	640	725	615	480	1,010	780	255
6			32	348	755	890	615	392	640	2,250	218
7			30	309	890	1,100	755	356	568	1,140	195
8			36	300	1,230	1,180	725	333	640	725	167
9			53	324	1,140	1,230	695	318	545	545	145
10			83	384	1,050	1,230	725	400	890	380	131
11			98	484	1,010	1,180	668	522	1,230	297	114
12			107	545	930	1,050	615	448	1,430	261	107
13			122	568	855	890	640	362	1,010	253	106
14			116	522	890	930	640	315	640	228	104
15			102	500	1,010	1,050	640	312	456	203	104
16			106	488	1,010	1,180	695	356	345	191	104
17			101	436	1,010	1,280	640	900	339	169	104
18		33	127	404	1,010	1,380	568	1,880	432	145	.....
19	76	32	147	366	970	1,330	568	1,330	500	125	.....
20	73	30	155	345	890	1,180	725	788	440	118	.....
21	72	30	151	327	890	1,050	725	522	370	195	.....
22	98	30	143	324	890	970	695	380	300	522	.....
23	139	32	151	339	855	930	890	330	261	1,050	.....
24	155	32	151	362	930	820	1,140	309	252	1,180	.....
25	145	34	141	370	970	820	855	1,090	245	755	.....
26	145	38	135	436	855	820	668	2,510	338	640	.....
27	135	35	129	522	820	788	750	2,130	615	492	.....
28	122	35	127	755	890	855	1,180	1,100	640	400	.....
29		37	131	930	890	755	1,330	725	668	408	.....
30		39	141	820	855	725	1,540	545	1,340	640	.....
31		40		668	.....	725	1,140	.....	1,880	.....	.....

NOTE.—Discharge estimated for the following periods, because of unsatisfactory operation of water-stage recorder: Jan. 1-18 (mean discharge, 140 second-feet), Feb. 1-28 (mean discharge, 66 second-feet), and Mar. 1-17 (mean discharge, 66 second-feet) by comparison with record of flow for Green Lake outlet; Silver Bay, from climatic records at Sitka, and from staff gage reading, 0.58 foot, Mar. 4; Dec. 18-31 (mean discharge, 150 second-feet) by comparison with record of flow for Sweetheart Falls near Snettisham.

Monthly discharge of Baranof Lake outlet at Baranof for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January			129	7,930
February			66	3,670
March		30	51.6	3,170
April	155	30	99.8	5,940
May	930	147	436	26,800
June	1,230	545	879	52,300
July	1,380	725	980	60,300
August	1,540	568	773	47,500
September	2,510	312	722	43,000
October	1,880	245	675	41,500
November	2,550	118	550	32,700
December	930	.....	210	12,900
The year	2,510	.....	464	338,000

NOTE.—See footnote to table of daily discharge.

SWEETHEART FALLS CREEK NEAR SNETTISHAM.

LOCATION.—In latitude $57^{\circ} 56\frac{1}{2}'$ N., longitude $133^{\circ} 41'$ W., on east shore 1 mile from head of south arm of Port Snettisham, 3 miles south of mouth of Whiting River, 7 miles by water from Snettisham, and 42 miles by water from Juneau. No large tributaries enter river between gaging station and outlet of large lake, $2\frac{1}{2}$ miles upstream.

DRAINAGE AREA.—27 square miles (measured on United States Geological Survey topographic map of the Juneau gold belt, edition of 1905).

RECORDS AVAILABLE.—July 31, 1915, to March 31, 1917; May 21, 1918, to December 31, 1918.

GAGE.—Stevens water-stage recorder on right bank, 300 feet upstream from tidewater on east shore of Port Snettisham. Gage washed out in November, 1917, and record from April 20, 1917, lost with gage. New Stevens water-stage recorder installed May 21, 1918, at same datum and at approximate location of old gage.

DISCHARGE MEASUREMENTS.—At medium and high stages, made from cable across river one-fourth mile up stream from gage; at low stages, made by wading in channel at mouth of creek exposed at low tide.

CHANNEL AND CONTROL.—From the outlet of the lake at an elevation of 520 feet above sea level and $2\frac{1}{2}$ miles from tidewater the water descends in a series of rapids and falls through a narrow, deep canyon. Gage is in a pool at foot of two falls, each 25 feet high, which are known as Sweetheart Falls; outlet of pool is a natural rock weir, which forms a well-defined and permanent control for gage.

EXTREMES OF DISCHARGE.—1915-1918: Maximum stage recorded, 7.15 feet at midnight, September 26, 1918 (discharge, computed from an extension of the rating curve, 2,880 second-feet); minimum flow, estimated from discharge measurement and climatic data, 15 second-feet February 11, 1916.

ICE.—Stage-discharge relation not affected by ice.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 40 and 1,300 second-feet; extended beyond these limits by estimation. Operation of water-stage recorder satisfactory except for period September 26-28, as shown in footnote to daily discharge table. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging results obtained by applying to rating table gage heights for regular intervals of day. Results excellent except for period of break in record and for discharge above 1,300 second-feet, for which they are fair.

In the fall and winter the run-off is small because the precipitation is in the form of snow, and because of the small amount of ground storage; during a hot, dry period the low run-off from the ground and lake stage is augmented by melting ice from one glacier.

Discharge measurements of Sweetheart Falls Creek near Snettisham during 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
May 24.....	1.35	253
Sept. 1.....	3.38	1,030

Daily discharge, in second-feet, of Sweetheart Falls Creek near Snettisham for 1918.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....		565	645	545	992	446	765	625
2.....		498	545	463	665	348	545	585
3.....		456	491	410	470	352	379	435
4.....		459	452	393	368	555	282	324
5.....		525	446	365	306	725	380	249
6.....		645	488	382	264	545	1,140	210
7.....		745	625	446	234	418	1,220	191
8.....		685	725	452	216	407	785	178
9.....		785	805	404	199	372	505	157
10.....		865	805	358	288	315	344	148
11.....		990	805	330	463	288	261	135
12.....		968	785	306	400	368	216	117
13.....		885	705	300	315	449	219	103
14.....		845	685	309	258	463	188	95
15.....		905	705	309	228	428	171	88
16.....		885	725	410	222	344	150	104
17.....		865	765	525	285	300	137	119
18.....		845	805	463	730	365	121	133
19.....		865	785	446	945	400	108	133
20.....		765	725	905	785	390	104	117
21.....	267	705	653	905	525	348	181	111
22.....	258	645	585	905	376	291	418	135
23.....	246	645	545	1,190	306	234	438	146
24.....	252	705	525	1,260	330	213	460	176
25.....	282	925	488	1,140	622	191	410	183
26.....	327	865	463	885	1,790	178	354	216
27.....	396	805	442	805	2,470	176	321	205
28.....	705	765	505	1,040	1,710	205	273	171
29.....	1,120	745	505	1,240	1,120	297	333	144
30.....	1,010	745	488	1,440	685	410	585	127
31.....	745		585	1,305		780		111

NOTE.—Discharge Sept. 26-28 estimated, because inner well and float wires became disarranged during flood, by high-water mark in well (gage height 7.15 feet) and comparison with hydrographs of near-by stations.

Monthly discharge of Sweetheart Falls Creek near Snettisham for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
May 21-31.....	1,120	246	510	11,100
June.....	990	456	753	44,800
July.....	805	442	623	38,300
August.....	1,440	300	666	41,000
September.....	2,470	199	619	36,800
October.....	780	176	376	23,100
November.....	1,220	104	393	23,400
December.....	625	88	193	11,900
The period.....				230,000

NOTE.—See footnote to table of daily discharge.

CRATER LAKE OUTLET AT SPEEL RIVER, PORT SNETTISHAM.

LOCATION.—At outlet of Crater Lake, 1 mile upstream from edge of tide flats at head of north arm of Port Snettisham, 2 miles by trail from cabins of Speel River project, which are 42 miles by water from Juneau.

DRAINAGE AREA.—11.9 square miles above water-stage recorder at lake outlet, and 13 square miles above staff gage at beach (measured on topographic maps of the Alaska Boundary Tribunal, edition of 1895).

RECORDS AVAILABLE.—January 23, 1913, to December 31, 1918.

GAGE.—Stevens water-stage recorder on left shore of lake 100 feet upstream from outlet. A locally made water-stage recorder having a natural vertical scale and a time scale of 7 inches to 24 hours was used until replaced by Stevens gage June 29, 1916. The gage datum remained the same during the period. During the winter, because of inaccessible location and deep snow, the operation of the gage at the lake was discontinued, and the stage read at staff gage in channel exposed at low tide at beach. The first gage at beach was set at an unknown datum and washed out in winter of 1915-16. Another staff gage was set at about the same location November 24, 1916. Other staff gages were set at about the same location January 11 and November 13, 1918.

DISCHARGE MEASUREMENTS.—Made from cable across outlet of lake, 100 feet downstream from gage and 10 feet upstream from crest of first falls. The rope sling from which discharge measurements were first made was replaced in fall of 1915 by a standard U. S. Geological Survey gaging car, making more reliable measurements possible.

CHANNEL AND CONTROL.—The gage is on left shore of lake, 100 feet upstream from outlet, where the stream becomes constricted into a narrow channel, the bed of which is composed of large boulders and rock outcrops that form a well-defined and permanent control.

ACCURACY.—Stage-discharge relation permanent. Rating curve defined by 19 discharge measurements, 13 of which were made by employees of the Speel River Project (Inc.) and 6 by an engineer of the United States Geological Survey, and is well defined below and extended above 1,000 second-feet. Rating curve used January 1 to June 18 and November 18 to December 31 for staff gages at beach fairly well defined. Operation of water-stage recorder satisfactory except for September 10-14, when gage clock was run down, and 8 a. m. September 2-27, when record was badly torn by pencil during large flood. Discharge record January 1 to June 18 and November 18 to December 31 computed from gage-height records for staff gages at beach. Daily discharge June 20 to November 17 ascertained by applying to rating table daily gage height determined by inspecting gage-height graph, or for days of considerable fluctuation, by averaging results obtained by applying to rating table mean gage heights for regular intervals of the day.

Crater Lake is 1,010 feet above sea level and covers 1.1 square miles. The sides of the mountains surrounding the lake are steep and barren, and the tops are covered by glaciers.

Discharge measurements of Crater Lake outlet at Speel River, Port Snettisham, during 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Jan. 25.....	1.72	40.0	Mar. 29.....	1.25	9.4
30.....	1.62	26.3	May 25.....	1.89	73

NOTE.—Gage heights refer to datum of staff gage at beach.

Daily discharge, in second-feet, of Crater Lake outlet at Speel River, Port Snettisham, for 1918.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....		24	12	10	34	155	338	517	562	231	251	236
2.....		23	13	10	43	129	282	416	402	216	164	132
3.....		23	14	10	48	140	265	375	316	398	108	127
4.....		24	14	11	53	155	251	350	280	562	76	91
5.....		24	15	10	60	438	261	316	255	517	92	88
6.....		25	15	10	67	195	338	362	235	327	662	86
7.....		26	14	10	65	255	457	443	216	241	568	74
8.....		25	14	11	63	270	517	402	200	293	251	62
9.....		24	15	12	68	336	532	350	362	227	139	55
10.....		23	15	12	72	525	532	316		178	92	44
11.....	17	21	15	12	83	358	532	304		148	67	48
12.....	17	20	14	11	94	409	517	282		223	58	44
13.....	17	16	14	11		400	472	316		350	58	41
14.....	17	12	14	11		380	487	350		304	52	38
15.....	17	12	15	12		409	517	362	186	245	47	41
16.....	17	12	14	12		496	547	517	225	161	41	44
17.....	15	11	13	13		554	594	547	350	135	39	51
18.....	16	11	14	14		496	642	429	742	194	44	91
19.....	17	10	14	80		450	626	547	728	194	35	58
20.....	17	10	13	53		350	578	578	443	146	45	48
21.....	17	10	12	46		327	542	815	261	116	55	38
22.....	44	10	11	36		304	487	762	176	95	175	48
23.....	77	10	10	32		316	472	1,130	153	78	118	55
24.....	60	10	10	29		362	457	1,230	208	68	113	62
25.....	39	10	10	27		517	472	780	313	62	108	70
26.....	38	11	10	24	77	472	457	578		60	104	66
27.....	36	11	10	23	106	402	457	594		58	100	62
28.....	32	11	10	23	610	375	626	868	745	58	91	48
29.....	29	11	10	23	900	388	594	1,110	416	66	104	44
30.....	26		10	24	325	402	487	1,450	278	95	122	36
31.....	25		11		255		610	920		227		29

NOTE.—Daily discharge, for days when staff gages were not read during periods Jan. 1 to June 19 and Nov. 18 to Dec. 31, estimated from climatic data and records of flow for Long River. Discharge estimated for following periods, because water-stage recorder was not operating: Sept. 10-14 (mean discharge, 335 second-feet) and Sept. 26-27 (mean discharge, 1,300 second-feet), by comparison with records of flow for Long River. Records Jan. 1 to June 19 and Nov. 18 to Dec. 31 show discharge at mouth of creek at beach; June 20 to Nov. 17, discharge at outlet of Crater Lake. Mean discharge estimated 44 second-feet Jan. 1-10 and 75 second-feet May 13-25.

Monthly discharge of Crater Lake outlet at Speel River, Port Snettisham, for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January.....		15	33.2	2,040
February.....	26	10	16.8	933
March.....	15	10	12.7	781
April.....	80	10	20.7	1,230
May.....	900	34	129	7,930
June.....	554	129	347	20,600
July.....	642	251	482	29,600
August.....	1,450	282	591	36,300
September.....		186	411	24,500
October.....	562	58	202	12,400
November.....	662	35	133	7,910
December.....	206	29	65.4	4,020
The year.....		10	204	148,000

NOTE.—See footnote to table of daily discharge.

LONG RIVER BELOW SECOND LAKE, AT PORT SNETTISHAM.

LOCATION.—One-half mile downstream from outlet of Second Lake, 1 mile downstream from outlet of Long Lake, one-half mile upstream from head of Indian Lake; 2½ miles by trail and boat across Second Lake from cabins of the Speel River project at head of the North Arm of Port Snettisham, 42 miles by water from Juneau.

DRAINAGE AREA.—33.2 square miles (measured on sheet No. 12 of the Alaska Boundary Tribunal maps, edition of 1895).

RECORDS AVAILABLE.—November 11, 1915, to December 31, 1918.

GAGE.—Stevens continuous water-stage recorder on right bank one-half mile below outlet of Second Lake.

DISCHARGE MEASUREMENTS.—At medium and high stages made from cable across river at gage; at low stages made by wading one-fourth mile downstream.

CHANNEL AND CONTROL.—At the gage the channel is deep and the current sluggish; banks are low and are overflowed at extremely high stages; bed smooth except for one large boulder. A rapid, 500 feet downstream, forms a well-defined and permanent control.

EXTREMES OF DISCHARGE.—Maximum stage during year, 10.2 feet at about 1 a. m. September 27 (discharge, estimated from extension of rating curve, 5,300 second-feet); minimum flow, 24 second-feet, March 28.

1916-1918: Maximum stage, 10.2 feet September 27, 1918 (discharge, estimated from extension of rating curve, 5,300 second-feet); minimum flow, 23 second-feet, February 13, 1916.

ICE.—Stage-discharge relation affected by ice during January, February, March, and April.

ACCURACY.—Stage-discharge relation permanent; affected by ice or poor connection between well and river January 1-17 and January 28 to April 25. Rating curve fairly well defined between 50 and 400 second-feet and well defined between 400 and 2,000 second-feet. Operation of water-stage recorder satisfactory except for periods indicated in footnote to daily-discharge table. Daily discharge ascertained by applying to the rating table daily gage heights determined by inspecting the gage-height graph. Records good except for stages below 400 second-feet and periods of break in record, for which they are fair.

The area draining to Long River between Long Lake Outlet and this station comprises only 1.3 square miles, including First Lake and Second Lake. Because this area is at a low altitude and has no glaciers the run-off per square mile from it is greater early in the spring but much less in summer than that from the area above Long Lake, which is partly covered by glaciers.

Discharge measurements of Long River below Second Lake, at Port Snettisham, during 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
Mar. 28.....	a 0.70	24
May 25.....	1.94	224

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Long River below Second Lake, at Port Snettisham, for 1918.

Day.	Jan.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....	100	.....	175	530	780	1,180	1,340	680	530	474
2.....	225	.....	186	450	680	1,020	1,020	600	393	456
3.....	200	.....	225	411	640	930	840	862	282	354
4.....	150	.....	227	405	600	840	740	1,260	207	264
5.....	116	.....	237	450	600	780	660	820	457	200
6.....	96	.....	244	530	720	840	600	975	1,440	175
7.....	88	.....	204	620	885	975	565	760	1,090	154
8.....	82	.....	184	680	1,060	1,410	530	780	700	138
9.....	76	.....	213	720	1,160	800	512	600	456	130
10.....	73	.....	234	780	1,160	740	769	480	314	126
11.....	70	.....	254	862	1,160	720	1,180	418	244	120
12.....	69	.....	295	840	1,140	660	952	530	215	119
13.....	68	.....	301	780	1,090	720	720	740	198	118
14.....	67	.....	312	800	1,110	780	565	760	168	118
15.....	66	.....	285	840	1,180	820	509	600	152	117
16.....	64	32	259	840	1,210	680	565	435	135	117
17.....	63	35	230	840	1,280	1,140	866	396	132	117
18.....	62	38	220	908	1,380	952	1,690	512	120	157
19.....	61	220	212	885	1,360	1,060	1,690	418	108	162
20.....	61	140	205	840	1,280	1,160	1,160	366	103	132
21.....	59	120	198	582	1,240	1,440	780	293	137	118
22.....	131	100	196	760	1,140	1,480	548	232	285	209
23.....	194	90	200	760	1,060	2,110	480	180	262	222
24.....	154	84	210	820	1,060	2,110	520	181	339	246
25.....	120	116	225	998	1,060	1,510	844	162	309	175
26.....	103	127	259	975	1,020	1,870	2,940	144	298	237
27.....	95	141	295	885	998	1,260	4,130	134	259	184
28.....	84	144	600	820	1,240	1,570	2,110	137	227	141
29.....	80	166	930	840	1,260	1,840	1,180	277	317	120
30.....	75	175	820	862	1,160	2,480	840	323	399	114
31.....	70	.....	660	.....	1,310	1,900	.....	548	.....	108

NOTE.—Discharge estimated for following periods, because stage-discharge relation was affected by ice or poor connection between well and river or because of unsatisfactory operation of water-stage recorder: Jan. 1-17, Jan. 23-31, Feb. 1-23 (mean discharge, 41 second-feet), Mar. 1-31 (mean discharge, 26 second-feet), Apr. 1-15 (mean discharge, 27 second-feet), and Apr. 16-25, by comparison with hydrographs for Crater and Carlson creeks and climatic data for Juneau; May 1-24, September 27-29, and Dec. 29 and 31, by maximum and minimum stages indicated by recorder and comparison with hydrographs of other stations.

Monthly discharge of Long River below Second Lake, at Port Snettisham, for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January.....	225	59	97.5	6,000
February.....	.....	.....	41	2,280
March.....	.....	.....	26	1,600
April.....	.....	.....	71.1	4,230
May.....	930	175	300	18,400
June.....	998	405	744	44,300
July.....	1,380	600	1,070	65,800
August.....	2,480	660	1,220	75,000
September.....	4,130	509	1,060	63,100
October.....	1,260	134	504	31,000
November.....	1,440	103	342	20,400
December.....	474	108	181	11,100
The year.....	4,130	.....	471	343,000

NOTE.—See footnote to table of daily discharge.

SPEEL RIVER AT PORT SNETTISHAM.

LOCATION.—At entrance of canyon one-fourth mile downstream from mouth of Long River and 8 miles upstream from tide flats and the cabins of Speel River Project, Inc., which are at head of north arm of Port Snettisham, and 42 miles by water from Juneau.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 1, 1916, to September 30, 1918.

GAGE.—Stevens water-stage recorder, 150 feet to the left of the constriction of the river at the entrance of the canyon. The gage is reached from cabins of the Speel River Project by trail to head of Second Lake, boat across Second Lake, trail to head of Indian Lake, boat across Indian Lake, trail down Long River and Indian River to canyon, and cable across river near entrance of the canyon—a total distance of about 7 miles. Recorder washed-out during flood September 26-27, 1918.

DISCHARGE MEASUREMENTS.—Made from cable having a clear span of 400 feet across river, half a mile below gage and one-fourth mile below lower end of canyon.

CHANNEL AND CONTROL.—For several miles above the canyon the river flows through a wide, flat sandy bed in which the channels are continually shifting. The river is constricted from a width of 500 feet to 75 feet at the entrance of the canyon. This constriction of the channel and a rock outcrop at the entrance of the canyon form a very sensitive and permanent control. The extreme range in stage is 28 feet. Above a stage of 22 feet part of the flow passes through a secondary channel, the bed of which is rock overgrown with brush, which begins near gage and re-enters main channel at lower end of canyon. Below a stage of about 4 feet water from stream does not reach well except by seepage through the gravel. Stage-discharge relation is therefore not permanent for stages below 4 feet. At the gaging cable the bed of the river is gravel, with one large rock outcrop near the middle of the stream. The current is very swift, and the stream carries a large quantity of sand in suspension.

EXTREMES OF DISCHARGE.—1916-1918: Maximum discharge, estimated by multiplying maximum discharge at Long River September 27, 1918, by 6.8 (the ratio between the maximum discharges at Speel and Long rivers August 30, 1918), 35,600 second-feet, September 27, 1918; minimum discharge, 127 second-feet, March 28-31, 1918.

ICE.—Ice does not form at control, but so much frost forms in gage shelter and on metal parts of gage that the gage does not operate satisfactorily during the winter.

ACCURACY.—Stage-discharge relation permanent except for stages below about 1,000 second-feet, when frequent measurements are necessary to estimate the flow. Rating curve fairly well defined between 1,200 and 10,000 second-feet; extended above 10,000 second-feet; rating curve used January 28 to March 31 determined by two discharge measurements, fairly well defined. Operation of water-stage recorder not satisfactory for periods indicated in footnote to daily-discharge table because of the frequent stopping of clock. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph. Results fair for periods when gage was operating satisfactorily; poor for periods when clock was not running.

Discharge measurements of Speel River at Port Snettisham during the year ending Sept. 30, 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Discharge.
	Feet.	Sec.-ft.
Jan. 28.....	α 4.2	243
Mar. 28.....	α 2.7	127
Sept. 3.....	13.6	5,250

α Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Speel River at Port Snettisham for 1918.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1.		206	173		690			6,800	8,500
2.		190	166		715			6,150	6,690
3.		182	166		740			5,750	4,980
4.		182	166		830			5,220	
5.		173	166		860			4,370	
6.		173	152		890			4,490	
7.		173	145		980			4,900	
8.		166	138		980			4,190	
9.		166	138		1,040			3,950	
10.		166	138		1,070			4,070	
11.		166	138		1,130			4,010	
12.		166	138		1,160			3,890	
13.		166	133		1,220			4,130	
14.		158	133		1,280			4,370	
15.		158	133		1,280			4,760	
16.		158	130		1,320			6,580	
17.		158			1,350			5,950	
18.		166			1,350			5,390	
19.		166		1,000	1,420	4,830		5,950	
20.		152		600	1,490	4,250	8,610	7,280	
21.		173		620	1,560		7,400	9,200	
22.		182		640	1,740		6,800	9,820	
23.		182		640	1,805		6,800	20,000	
24.		190		665	1,840		5,850		
25.		190		665	1,910		6,580		
26.		190		665	1,940		6,470		
27.		198		665	2,190		6,150		
28.	243	198	127	665	4,130		6,580		
29.	233	173	127	690	4,130		6,800		
30.	215		127	690	3,130		6,920		
31.	215		127		2,500		7,660		

NOTE.—Discharge estimated for following periods, because of unsatisfactory operation of water-stage recorder, by comparison with records of flow for Long River: Jan. 1-27, 400 second-feet; March 17-27, 130 second-feet; Apr. 1-10, 130 second-feet; Apr. 11-18, 150 second-feet; Apr. 19; May 31; June 1-18, 3,600 second-feet; June 21-30, 4,500 second-feet; July 1-19, 5,900 second-feet; Aug. 23; Aug. 24-31, 11,100 second-feet; Sept. 1; Sept. 4-30, 7,200 second-feet.

Monthly discharge of Speel River at Port Snettisham for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January.....			378	23,200
February.....	206	166	181	10,100
March.....	173	127	141	8,670
April.....	1,000	600	357	21,200
May.....	4,130	690	1,570	96,500
June.....			3,900	236,000
July.....			6,300	387,000
August.....		3,890	7,400	455,000
September.....			7,150	425,000
The period.....				1,660,000

NOTE.—See footnote to table of daily discharge.

GRINDSTONE CREEK AT TAKU INLET.

LOCATION.—On north shore of Taku Inlet, between Point Bishop and Point Salisbury, one-fourth mile west of mouth of Rhine Creek and 11 miles by water from Juneau.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 6, 1916, to December 31, 1917.

GAGE.—Stevens continuous water-stage recorder on left bank, 200 feet from tidewater, installed September 16, 1916. A Lietz seven-day graph water-stage recorder was used May 6 to June 17, 1916.

DISCHARGE MEASUREMENTS.—At all stages made by wading either in the channel on the beach, which is exposed at low tide, or 100 feet below gage at high tide.

CHANNEL AND CONTROL.—For a distance of one-fourth mile from tidewater the stream descends in a series of rapids and falls through a narrow, rocky channel. The gage is at upper end of a turbulent pool between two falls, the lower of which forms a well-defined control. When gage was installed, logs were jammed in channel near upper end of pool.

EXTREMES OF DISCHARGE.—1916-18: Maximum stage, 6 feet at 7 p. m. September 26, 1918 (discharge, estimated from an extension of the rating curve, 700 second-feet); minimum stage, -0.24 foot April 5-7, 1918 (discharge, 2.6 second-feet).

ICE.—Stage-discharge relation sometimes affected by ice.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined below 150 second-feet; extended above 150 second-feet by estimation. Operation of water-stage recorder satisfactory except for periods shown in the footnote to daily-discharge table. Discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging results obtained by applying to rating table mean gage heights for regular intervals of day. Records good except those for periods of break in record and discharge above 150 second-feet, which are poor.

Discharge measurements of Grindstone Creek at Taku Inlet during 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>
Jan. 9	0.30	11
Mar. 27	-.22	2.9

Daily discharge, in second-feet, of Grindstone Creek at Taku Inlet for 1918.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Nov.	Dec.
1.	15	8.4	4.3	2.7	12	52	51	34	88		68
2.	20	8.4	4.2	2.7	12	47	46	34	71		50
3.	18	8.4	3.4	2.7	15	47	39	35	60		39
4.	19	8.1	3.1	2.7	20	51	36	35	53		31
5.	18	7.9	3.1	2.6	23	62	36	36	47		27
6.	16	7.9	3.2	2.6	27	87	47	36	40		27
7.	14	7.3	3.3	2.6	28	86	48	37	35		25
8.	12	7.3	2.9	3.2	26	76	45	37	31		23
9.	11	7.7	2.9	6.9	27	75	43	37	28		22
10.	12	7.1	2.9	4.9	35	73	40	37	50		21
11.	11	6.9	2.9	4.2	40	69	38	38	35	26	20
12.	11	6.9	2.9	4.0	43	67	43	37	29	26	19
13.	9.4	6.6	2.9	4.2	42	65	42	38	26	25	
14.	9.0	6.0	3.2	4.3	42	76	41	38	31	23	
15.	8.8	4.8	3.2	4.3	40	75	41	38	24	23	
16.	9.2	4.9	3.2	4.3	38	68	38	39	24	22	
17.	8.4	5.1	3.2	4.3	37	63	37	40	29	21	
18.	8.2	5.1	3.2	11	36	62	36	39	46	19	
19.	8.1	5.4	3.2	21	37	63	35	40	31	19	
20.	7.7	5.2	3.0	15	36	53	34	41	27	21	
21.	9.8	5.2	2.7	11	36	53	33	42	24	39	
22.	16	5.4	2.7	10	36	49	31	46	23	55	
23.	16	5.1	2.7	11	36	47	30	112	88	46	
24.	16	4.8	2.8	12	36	49	29	93	31	38	
25.	14	4.8	2.8	11	37	90	28	83	92	31	
26.	12	4.8	2.8	9.8	36	72	27	90	365	27	33
27.	11	4.8	2.8	9.8	39	73	27	103	310	27	22
28.	10	4.4	2.7	9.8	90	58	27	124	134	31	19
29.	9.8		2.7	10	95	66	28	257	96	85	17
30.	9.4		2.9	11	75	73	27	314	75	65	17
31.	9.0		2.9		60		32	121			17

NOTE.—Discharge estimated for following periods because of unsatisfactory operation of water-stage recorder: Jan. 1-6, from line drawn on cylinder; Jan. 7-8 and Feb. 26, by interpolation; Aug. 29-30 and Sept. 26-29, by gage-height graph drawn by comparison with that for Sheep Creek through maximum and stages indicated by recording pencil; Oct. 1-31 (mean discharge, 55 second-feet), Nov. 1-10 (mean discharge, 50 second-feet), and Dec. 13-25 (mean discharge, 21 second-feet), by comparison with records of flow for Crater Lake outlet at Port Snettisham and from maximum and minimum stages indicated by recording pencil Oct. 1 to Nov. 10.

Monthly discharge of Grindstone Creek, at Taku Inlet for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January	20	7.7	12.2	750
February	8.4	4.4	6.24	347
March	4.3	2.7	3.05	188
April	21	2.6	7.19	428
May	95	12	38.5	2,370
June	90	47	64.9	3,860
July	51	27	36.6	2,250
August	314	34	68.8	4,230
September	365	23	68.1	4,050
October			55.0	3,380
November		19	39.0	2,320
December	68	17	24.8	1,530
The year	365	2.6	35.4	25,700

NOTE.—See footnote to table of daily discharge.

CARLSON CREEK AT SUNNY COVE.

LOCATION.—At Sunny Cove, on west shore of Taku Inlet, 20 miles by water from Juneau.

DRAINAGE AREA.—22.26 square miles (determined by engineering department of Alaska Gastineau Mining Co. from surveys made by that company).

RECORDS AVAILABLE.—July 18, 1916, to December 31, 1918.

GAGE.—Stevens water-stage recorder on left bank, 2 miles from tidewater; inspected several times a week by employees of Alaska Gastineau Mining Co.

DISCHARGE MEASUREMENTS.—At high stages, made from cable across river one-half mile downstream from gage; at medium and low stages, made by wading 500 feet upstream from gage.

CHANNEL AND CONTROL.—Above the gage the stream meanders in one main channel and several small channels through a flat, sandy basin about a mile long; just below the gage the channel contracts and the stream passes over rocky falls that form a well-defined and permanent control. The point of zero flow is at gage height -1.5 feet.

EXTREMES OF DISCHARGE.—1916-1918: Maximum stage, 8.1 feet at 2 p. m. September 26, 1918 (discharge, computed from extension of rating curve, 6,200 second-feet); minimum flow, estimated from climatic data and hydrographs for streams in near-by drainage basins, 10 second-feet, April 1-7, 1918.

ICE.—Stage-discharge relation affected by ice January 1 to May 3.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 70 and 2,000 second-feet, extended below 70 second-feet to point of zero flow and above 2,000 second-feet by estimation; curve used January 1-25 determined by one discharge measurement, and form of standard rating curve fairly well defined. Operation of water-stage recorder satisfactory except for periods of break in record as indicated in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging results obtained by applying to rating table mean gage heights for regular intervals of the day. Records good except for stages below 70 second-feet and above 2,000 second-feet, for period January 1 to May 3, when stage-discharge relation was affected by ice, and for periods of break in record, for which they are fair.

Discharge measurements of Carlson Creek at Sunny Cove during 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Jan. 3 ^a	0.52	112	July 26.....	1.63	437
Feb. 4 ^a.....	.25	23	Aug. 23.....	4.10	1,610
Mar. 27 ^a		10.3	Sept. 21.....	.66	199

^a Control and river covered with thick ice; measurement made 2 miles below gage; metered discharge corrected by -5 per cent to give flow at gage.

Daily discharge, in second-feet, of Carlson Creek at Sunny Cove for 1918.

Day.	Jan.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1.....	67		86	405	745	530	470	227
2.....	175		90	524	575	455	382	219
3.....	125		125	416	575	455	320	845
4.....	97		152	470	575	425	290	1,110
5.....	80		152	575	622	560	265	574
6.....	75		180	816	840	515	233	320
7.....	72		152	860	975	710	233	290
8.....	70		154	820	950	470	223	485
9.....	68		177	820	928	440	202	308
10.....	67		221	820	860	402	1,150	278
11.....	67		263	860	905	393	590	259
12.....	66		292	860	882	345	302	818
13.....	66		290	745	905	620	247	861
14.....	66		285	905	1,000	455	233	622
15.....	64		221	882	928	504	253	440
16.....	62		210	860	882	636	440	272
17.....	60		190	860	950	440	1,000	312
18.....	57	90	191	860	882	666	1,520	410
19.....	57	180	174	860	780	867	530	340
20.....	57	105	167	710	710	1,000	338	.....
21.....	60		148	675	675	974	229	.....
22.....	62		156	605	605	1,050	185	.....
23.....	63		172	692	575	1,760	430	.....
24.....	67		191	820	530	1,200	343	.....
25.....	67		237	1,340	485	698	1,540	.....
26.....	58		320	840	470	710	4,110	.....
27.....	46		302	840	788	995	1,930	.....
28.....	38		1,050	762	1,000	975	470	.....
29.....	32		1,250	928	590	1,300	315	.....
30.....	29		668	928	564	1,670	245	.....
31.....	27		491	.....	870	692	.....	.....

NOTE.—Discharge estimated for following periods, because stage-discharge relation was affected by ice or water-stage recorder was not operating: Jan. 11-14, Jan. 26-31, Feb. 1-28 (mean discharge, 18 second-feet), Mar. 1-31 (mean discharge, 11 second-feet), Apr. 1-17 (mean discharge, 13 second-feet), Apr. 19, Apr. 21-30 (mean discharge, 76 second-feet), and May 1-3, by comparison with hydrograph for Grindstone Creek and climatic data at Juneau and from current-meter measurements; July 11-26, Aug. 29-Sept. 2, Sept. 11-17, and Sept. 19-20, from estimated gage-height graph drawn by comparison with that for Gold Creek through maximum and minimum stages indicated by recorder; Oct. 20-31 (mean discharge, 180 second-feet), Nov. 1-30 (mean discharge, 270 second-feet), and Dec. 1-31 (mean discharge, 125 second-feet), by comparison with records of flow for Long River.

Monthly discharge of Carlson Creek at Sunny Cove for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January.....	175	27	66.6	4,100
February.....			18.0	1,000
March.....			11.0	676
April.....			45.2	2,690
May.....	1,250	86	282	17,300
June.....	1,340	405	779	46,400
July.....	1,000	485	762	46,900
August.....	1,670	345	739	45,400
September.....	4,110	185	634	37,700
October.....			360	22,100
November.....			270	16,100
December.....			125	7,690
The year.....	4,110		341	248,000

NOTE.—See footnote to table of daily discharge.

SHEEP CREEK NEAR THANE.

LOCATION.—At lower end of flat basin, above diversion dam for flume leading to Treadwell power house at beach and 1 mile by tramway and ore railway from Thane.

DRAINAGE AREA.—4.57 square miles above gaging bridge (measured on United States Geological Survey map of Juneau and vicinity, edition of 1917).

RECORDS AVAILABLE.—July 26, 1916, to December 31, 1918.

GAGE.—Stevens water-stage recorder on right bank, at pool formed by an artificial control just below small island three-tenths mile upstream from diversion dam. Recorder inspected once a week by an employee of the Alaska Castineau Mining Co.

DISCHARGE MEASUREMENTS.—At extremely high stages, made from gaging bridge two-tenths mile downstream from gage; at low stages, made by wading near bridge section. No streams enter between gage and measuring section, but seepage inflow ranges from a small amount to 10 per cent of total flow, the percentage of inflow usually being large after periods of heavy precipitation.

CHANNEL AND CONTROL.—The station is near the lower end of a flat basin through which the stream meanders in a channel having low banks and a bed of sand and gravel. An artificial control was built 2 feet below the intake for the gage well, to confine the flow in one channel during high water and to insure a permanent stage-discharge relation. The spillway of the control at low stages consists of a timber, 16 feet long, set in the bed of the stream. During medium and high stages another timber, 8 feet long, bolted at the top near the right end, forms part of the control. A 3-foot cut-off wall is driven at the upstream face of the spillway. There are wing walls at each end, and an 8-foot apron extends downstream from the control.

ICE.—Control covered with ice and snow from February 16 to April 20. Flow passes through gravel bed under and around weir and enters creek again above gaging section one-fourth mile downstream.

EXTREMES OF DISCHARGE.—Maximum stage during year, 3.5 feet, at 2 p. m. September 26 (discharge, estimated from extension of rating curve, 820 second-feet); minimum flow, estimated from climatic records and discharge measurement on March 29, 3.5 second-feet, March 29-31.

1916-1918: Maximum stage during period, 3.5 feet, at 2 p. m. September 26, 1918 (discharge, estimated from extension of rating curve, 820 second-feet); minimum flow, 1.0 second-foot, April 6-8, 1917.

ACCURACY.—Stage-discharge relation changed, owing to clogging with sand of intake pipe, May 29. Rating curve used January 1 to May 28 fairly well defined below 250 second-feet; curve used May 29 to December 31, fairly well defined below 700 second-feet. Operation of water-stage recorder satisfactory except for periods indicated in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging discharges obtained by applying to rating table mean gage heights for regular intervals of the day. Records fair.

Discharge measurements of Sheep Creek near Thane during 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Jan. 18.....	0.38	9.5	Aug. 28.....	1.31	147
Feb. 11.....	.23	6.7	Sept. 26.....	2.70	550
25.....	a-.15	5.6	30.....	.96	71
Mar. 29.....	(b)	3.5	Dec. 24.....	.72	26
July 23.....	c.90	54			

a Weir under 2 feet of ice and snow, water seeping through gravel and around weir entering creek above measuring section.

b Measurement made at tailrace of power house at beach.

c Intake pipe clogged with sand.

Daily discharge, in second-foot, of Sheep Creek near Thane for 1918.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....	11	9.5	5.1	.....	9.5	83	.....	55	154	59	77	.....
2.....	11	9.2	5.0	.....	9.5	75	.....	48	104	53	64	.....
3.....	12	9.0	5.0	.....	9.9	75	.....	47	70	86	51	.....
4.....	13	8.7	4.9	.....	19	86	.....	46	60	116	46	.....
5.....	14	8.4	4.8	.....	43	97	.....	44	53	79	140	.....
6.....	14	8.3	4.7	.....	43	126	.....	42	46	64	220	.....
7.....	13	7.9	4.6	.....	43	126	.....	42	44	64	104	.....
8.....	11	7.6	4.6	.....	41	121	.....	42	38	62	86	.....
9.....	11	7.6	4.5	.....	55	126	.....	42	33	53	.....	.....
10.....	10	7.5	4.5	.....	70	116	.....	41	86	55	.....	.....
11.....	10	7.3	4.4	.....	78	116	.....	41	49	51	.....	.....
12.....	10	7.1	4.4	.....	85	108	.....	41	40	90	.....	.....
13.....	10	7.0	4.3	.....	66	102	.....	62	33	86	.....	.....
14.....	10	6.9	4.3	.....	64	116	.....	49	31	100	.....	.....
15.....	10	6.7	4.2	.....	55	116	.....	49	33	77	.....	.....
16.....	9	6.5	4.2	.....	57	108	.....	57	35	68	.....	.....
17.....	9	6.3	4.1	.....	51	111	.....	51	49	75	.....	.....
18.....	9	6.2	4.1	.....	49	104	75	68	95	88	.....	.....
19.....	9	6.1	4.0	.....	43	102	72	66	49	75	.....	.....
20.....	8.7	6.0	4.0	5.2	43	86	70	111	36	64	.....	.....
21.....	8.7	5.8	3.9	6.5	41	75	66	100	30	59	.....	.....
22.....	8.7	5.8	3.9	8.7	38	64	59	114	27	53	.....	.....
23.....	9.3	5.6	3.8	8.5	38	68	55	160	51	48	.....	.....
24.....	9.9	5.5	3.8	8.7	43	81	55	118	38	44	.....	26
25.....	9.9	5.4	3.7	9.0	51	192	51	94	111	40	.....	27
26.....	10	5.4	3.7	9.0	62	111	48	94	440	31	.....	33
27.....	10	5.3	3.6	9.0	73	97	66	147	184	31	.....	28
28.....	10	5.2	3.6	9.0	272	90	75	131	114	31	.....	27
29.....	9.9	.....	3.5	9.0	210	.....	57	151	90	42	.....	25
30.....	9.9	.....	3.5	9.2	121	.....	59	220	70	86	.....	24
31.....	9.7	.....	3.5	.....	97	.....	64	304	.....	90	.....	23

NOTE.—Discharge estimated for following periods because of unsatisfactory operation of water-stage recorder: Jan. 1-3, Jan. 13-17, Mar. 11-28, Mar. 30-31, and Apr. 1-19 (mean discharge, 4.5 second-feet), by comparison with hydrograph for Gold Creek and climatic data for Juneau; May 1, June 29-30 (mean discharge, 105 second-feet), and July 1-17 (mean discharge, 75 second-feet), by comparison with records of flow for Grindstone Creek, and from maximum stages indicated by recording pencil; Nov. 9-30 (mean discharge, 60 second-feet) and Dec. 1-23 (mean discharge, 40 second-feet), by comparison with records of flow for Sweetheart Falls Creek, and from maximum and minimum stages indicated by recording pencil.

Monthly discharge of Sheep Creek near Thane for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January.....	14	8.7	10.3	633
February.....	9.5	5.2	6.92	384
March.....	5.1	3.5	4.26	262
April.....	9.2	.....	5.91	352
May.....	272	9.5	63.6	3,910
June.....	192	64	103	6,130
July.....	.....	48	69.3	4,260
August.....	304	41	86.4	5,310
September.....	440	27	76.4	4,550
October.....	116	31	65.2	4,010
November.....	.....	.....	62.9	3,740
December.....	.....	.....	37.7	2,320
The year.....	440	.....	49.3	35,900

NOTE.—See footnote to table of daily discharge.

GOLD CREEK AT JUNEAU.

LOCATION.—At highway bridge at lower end of Last Chance basin, 200 feet upstream from diversion dam of Alaska Electric Light & Power Co. and one-fourth mile from Juneau.

DRAINAGE AREA.—9.47 square miles (determined by engineering department of Alaska Gastineau Mining Co. from surveys made by that company).

RECORDS AVAILABLE.—July 20, 1916, to December 31, 1918.

GAGE.—Stevens continuous water-stage recorder on left bank at upstream side of highway bridge. A staff gage was installed September 19, 1916, on left wing wall of diversion dam 200 feet downstream and used in determining the time of changes in stage-discharge relation at the well gage.

DISCHARGE MEASUREMENTS.—At medium and high stages made from gaging bridge suspended, at right angles to current, from floor of highway bridge; at low stages, made by wading near gage.

CHANNEL AND CONTROL.—Station is at lower end of a flat gravel basin three-fourths mile long. For 20 feet upstream from gage the stream is confined between the abutments of an old bridge, and for 15 feet downstream it is confined between the abutments of present bridge. For a distance of 130 feet farther downstream the stream is confined in a narrow channel which is not subject to overflow. Because of the steep gradient of channel opposite and for 150 feet below gage, a short stretch of the channel immediately below the gage acts as the control. The operation of the head gates of flume at diversion dam, 200 feet downstream, does not affect the stage-discharge relation at gage, but the swift current during high stages shifts the gravel in bed of stream, thereby causing changes in the stage-discharge relation.

EXTREMES OF DISCHARGE.—1916-1918: Maximum stage, 6.8 feet September 26, 1918 (discharge estimated from extension of rating curve, 2,600 second-feet); minimum discharge, 0.9 second-foot March 26, 1918.

ICE.—Stage-discharge relation affected by ice in January, February, and March.

DIVERSION.—Water diverted at several points upstream for power development is returned to creek above gage, except about 20 second-feet for seven months (when there is a surplus over amount used by Alaska Electric Light & Power Co., which has prior right) and 1 second-foot the remainder of year, used by the Alaska-Juneau Gold Mining Co. A dam 200 feet downstream diverts water into the flume of the Alaska Electric Light & Power Co.

REGULATION.—No storage or diversions above station regulate the flow more than a few hours in low water.

ACCURACY.—Stage-discharge relation changed during periods of high water; 12 discharge measurements made during year, by use of which rating curves have been constructed applicable as follows: January 2-27, rating curve for period stage-discharge relation was affected by ice fairly well defined; April 18 to May 28, rating curve same as used October 9 to December 31, 1917, well defined; May 29 to June 24, fairly well defined; June 25 to September 26, fairly well defined below and poorly defined above 500 second-feet; September 27 to November 29, fairly well defined below and poorly defined above 500 second-feet; November 30 to December 31, poorly defined. Operation of water-stage recorder satisfactory except for periods indicated in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph, or, for days of considerable fluctuations, by averaging discharges obtained by applying to rating table mean gage heights for equal intervals of the day. Records fair.

Discharge measurements of Gold Creek at Juneau during 1918.

[Made by G. H. Canfield.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	<i>Feet.</i>	<i>Sec.-ft.</i>		<i>Feet.</i>	<i>Sec.-ft.</i>
Jan. 2.....	a 0.89	40	June 7.....	2.45	248
18.....	a .29	7.2	July 23.....	1.59	144
Feb. 11.....	b .15	4.0	Sept. 7.....	1.25	84
26.....	b—.04	1.6	30.....	1.61	126
Mar. 26.....	(c)	.5	Nov. 9.....	1.38	86
Apr. 11.....		d 2.0	27.....	1.26	66

a Deep snow and ice along shore and on bar in middle of creek; control open.

b Creek frozen over at gage; ice arched over at control.

c Well frozen solid; control frozen over.

d Discharge estimated.

Daily discharge, in second-feet, of Gold Creek at Juneau for 1918.

Day.	Jan.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....	30		16	85	222	134	219	110	129	143
2.....	37		16	59	182	114	158	123	88	100
3.....	18		84	78	166	114	126	228	70	70
4.....	16		84	96	160	105	107	300	63	48
5.....	12		101	137	170	114	95	154	272	39
6.....	12		92	238	248	158	83	105	700	34
7.....	10		72	264	307	162	93	96	272	31
8.....	9		69	244	307	123	71	93	109	28
9.....	8		89	252	304	112	56	88	85	27
10.....	8		119	241	239	102	272	80	79	25
11.....	8		132	213	225	96	141	73	73	24
12.....	8		132	213	219	91	90	88	68	22
13.....	8		118	181	234	187	68	143	63	21
14.....	8		105	216	266	119	65	209	58	20
15.....	8		89	224	239	119	83	139	53	20
16.....	8		87	211	228	170	112	107	48	20
17.....	8		79	213	248	124	180	123	45	32
18.....	7	16	76	222	231	151	352	147	39	28
19.....	7	39	69	200	192	208	138	110	35	27
20.....	7	23	62	152	192	314	85	88	48	25
21.....	7	15	62	137	187	345	59	76	80	24
22.....	11	12	55	122	160	377	48	69	133	28
23.....	17	12	54	145	160	615	140	64	102	32
24.....	14	11	62	208	168	535	102	58	91	32
25.....	12	10	79	555	143	435	375	49	79	35
26.....	10	10	103	310	128	415	1,520	39	66	33
27.....	9	10	128	291	206	454	523	32	73	24
28.....	8	11	432	236	245	515	214	30	80	20
29.....	7	15	335	288	141	575	152	54	272	18
30.....	7	15	165	331	139	635	129	177	158	16
31.....	6		102		216	328		242		16

NOTE.—Discharge estimated for following periods, because of unsatisfactory operation of water-stage recorder: Jan. 1, Jan. 27-31, Feb. 1-28 (mean discharge, 4 second-feet), Mar. 1-31 (mean discharge, 1 second-foot), and Apr. 1-17 (mean discharge, 2 second-feet) from discharge measurements, climatic records at Juneau, and by comparison with hydrograph for Sheep Creek; May 13, by interpolation; July 9-11, 1 p. m. Sept. 26 to Oct. 1, Oct. 5 to 13, Oct. 26 to Nov. 7, Nov. 10-16, Nov. 18-26, Nov. 28 to Dec. 4, and Dec. 6-20, by comparison with records of flow for streams in near-by drainage basins, and from maximum and minimum stages indicated by recording pencil.

Monthly discharge of Gold Creek at Juneau for 1918.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January.....	30	6	11.1	682
February.....			4.0	222
March.....			1.0	61
April.....	39		7.8	464
May.....	432	16	105	6,460
June.....	555	59	212	12,600
July.....	307	128	209	12,900
August.....	615	91	260	16,000
September.....	1,520	48	195	11,600
October.....	300	30	113	6,950
November.....	700	35	118	7,020
December.....	143	16	34.3	2,110
The year.....	1,520		106	77,100

NOTE.—See footnote to table of daily discharge.