Stream Flow Monitoring Report I – Salmon Creek

Annex Creek/Salmon Creek Hydroelectric Project

(FERC Project No. 2307)

Alaska Electric Light and Power Company

Juneau, Alaska

April 19, 2017

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1. INTRODUCTION AND PURPOSE

In October 2015, Alaska Electric Light & Power (AEL&P) requested an amendment to its license that would allow the operation of the stream gage to be performed by the licensee. By Order issued December 30, 2015, the Federal Energy Regulatory Commission (FERC) approved the amendment and stipulated that a new stream flow plan be developed after consultation with Alaska Department of Fish and Game (ADF&G), National Marine Fisheries Service (NMFS), and the United State Fish and Wildlife Service (USFWS). AEL&P prepared a plan in consultation with ADF&G, NMFS, and USFWS, as well as with the Alaska Department of Natural Resources (ADNR) Water Division and National Weather Service (NWS).

By Order issued August 9, 2016 the FERC approved the stream flow monitoring plan with a requirement to file a instream flow monitoring report biannually to the FERC, NMFS, USFWS and ADF&G. The report is to review operation of the gage, identify when supplemental water was released and include information on the operation of the supplemental water valve. The report is to be submitted for agency review, with a 30-day review and comment period, prior to filing with the FERC. Documentation of agency consultation should be included in the report.

1.1. Gage Operation

The stream gage started operation on April 27, 2016, taking level measurements on a 15 minute basis. This data is automatically distributed to www.aelp.com/sc where it is available for public display. Real-time flow data is supplied directly to the AEL&P SCADA system where it is continuously monitored. On August 26, 2016, Alaska Hydroscience prepared a Gage Installation Report which was submitted to FERC and published to www.aelp.com/sc.

The communication path between the gage and the AEL&P system is through a cellular phone modem, this link did have four short communication failures. These communication failures generated an alarm for the AEL&P System Operator. In two cases, the communications were restored within an hour and in the other two cases, personnel were dispatched to site within two hours to power cycle the communication equipment which resolved the issue. In all instances, the streamflow reading prior to communication failure was evaluated and in all cases it was well above 9CFS. Stream levels do not drop quickly so there was no danger of reaching a low flow condition.

The above communication failures resulted in AEL&P engineering staff reviewing the spare parts on hand in the event of a communication or equipment failure. A spare sensor, datalogger and communication equipment were purchased to allow the site to be repaired quickly in the event of a failure.

On November 4, 2016, Alaska Hydroscience provided a 2016 water year summary, with a description and analysis of gage operation, as well as computer daily mean information and corrected flow

measurements. After review, those documents were published at www.aelp.com/sc. The station description and analysis has been attached to this report as Appendix B.

Since this report covers the calendar year, to December 31, 2016, Figure 1 has been added to show the corrected discharge measurement for the last three months of 2016. Two manual readings were taken in October and one manual reading in December, those are marked in the figure. The discharge readings between December 9th and 17th have been corrected as shown due to icing of the sensor. Daily Mean Discharge for these months has been calculated and is located in Appendix C with the daily mean discharge measurements for water year 2016.

The 15 minute raw data has not been attached due to the volume of data, the complete file is available for download at www.aelp.com/sc or AEL&P will provide it in hardcopy upon request.

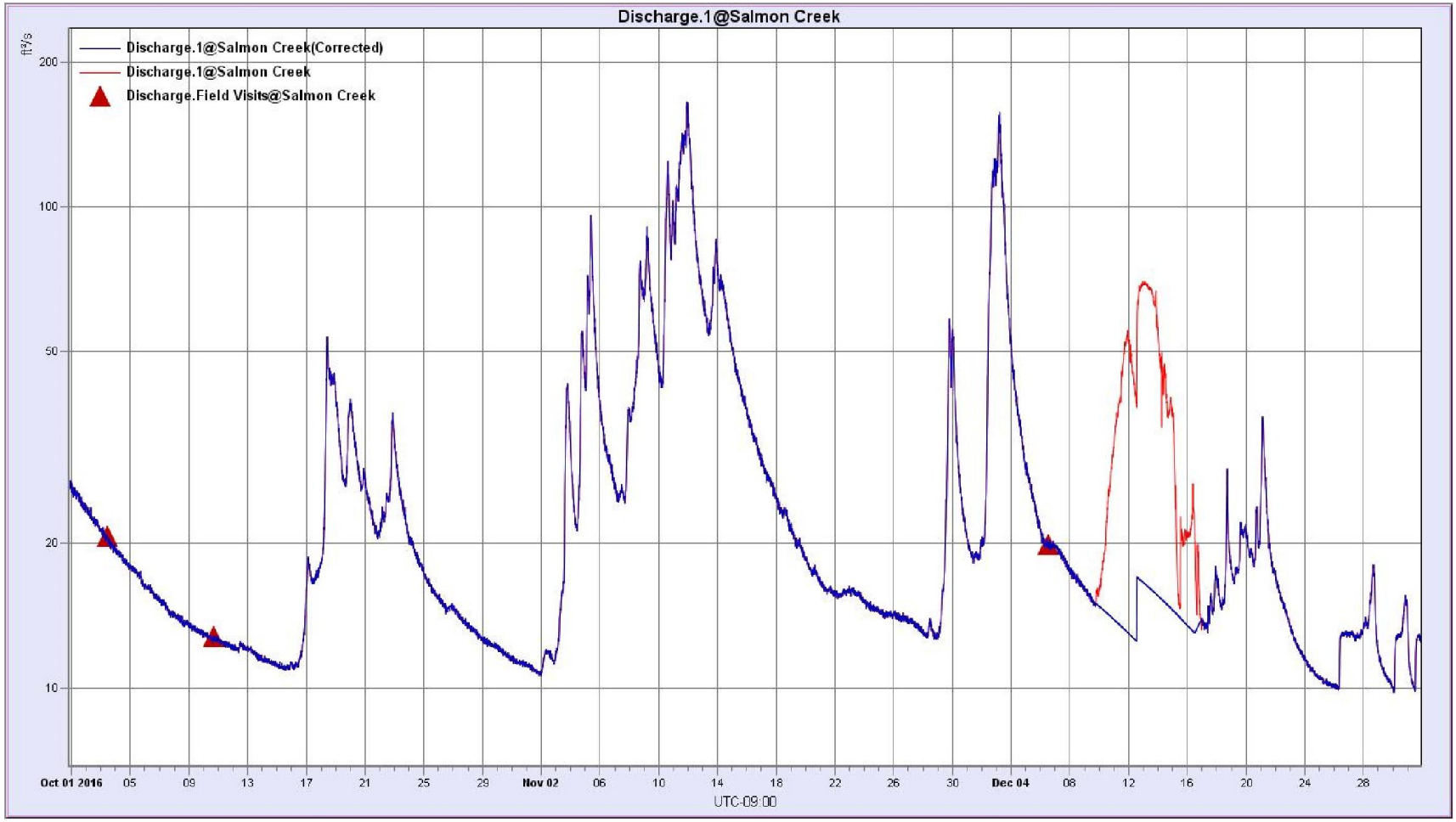

Figure 1 – October/November/December 2016 Corrected Discharge

1.2. Supplemental Valve Operation

The supplemental water valve is a 6" valve tapped off of the penstock at the base of the dam. The valve discharges water directly into the natural drainage. Operation of the valve is performed remotely by the AEL&P System Operator who also has real-time indication of the streamflow. When the flow drops below 9CFS, an alarm is generated and the Operator opens the valve and logs the operation.

The valve is either open or closed, there are no intermediate positions. The Operator has feedback on the valve position, provided by limit switches which show the valve position as well as an analog signal which reflects valve position. In addition to valve position, there is a flowmeter on the outlet of the valve. The amount of flow through the valve when open varies with the lake elevation. At a higher elevation there is more flow and at a lower elevation the flow is less. The valve has been sized to ensure 3CFS of flow at a low lake elevation, so typically more CFS is discharged to the stream.

1.3. Supplemental Valve Release

Prior to September 30, 2016 the AEL&P gage was run in parallel with the USGS gage to verify accuracy. Control of the supplemental valve was based on the value of the USGS gage. On March 2, 2016, a false reading of 3CFS was recorded, although this was likely due to an error with the instrument the supplemental valve was opened and water discharged. The reading corrected the next morning and at 8:15am the valve was closed. It is AEL&P policy to err on the side of discharging water if there is an issue with the sensor.

Cold temperatures through December resulted in frequent operations of the supplemental water valve. On December 12, 2016 AEL&P staff noted that the gage reading was likely not correct, due to the low ambient temperatures in the area and the increase stream flow readings. The supplemental valve was opened, a trip to site verified that the sensor was encased in ice. While false readings due to sensor icing is not a new issue, having increased awareness of streamflow due to the owner operated gage, ensured that the issue was detected and the valve operated. During subsequent cold periods, the flow has dropped to below the alarm limit of 9CFS prior to exhibiting false readings due to icing. In these instances, the valve was opened when the alarm was received.

Valve Opened				Valve Closed			
Date	Time	Stream Flow (CFS)	Release Flow (CFS)	Date	Time	Stream Flow (CFS)	Release Flow (CFS)
3/2/16	4:15pm	3	4.2	3/3/16	8:15am	16.48	4.2
12/12/16	11:04am	35.33F	4.4	12/20/16	4:11pm	19.4	4.4
12/26/16	5:42am	8.97	4.4	12/28/16	4:15pm	16.4	4.4
12/29/16	11:56pm	8.93	4.3	12/30/16	9:30pm	13.86	4.3
12/31/16	10:05am	8.98	4.3				

Table 1 - Supplemental Valve Operation

1.4. Agency Consultation

A copy of the draft report with a request for consultation was sent on March 17, 2017 by Christy Yearous with AEL&P to ADF&G, USFWS and NMFS by e-mail.

Comments on the draft report were received from NMFS on April 6, 2017. A request was made to add additional graph options on the website to show the previous 3 months and 6 months of data. AEL&P is in the final steps of publishing a new company wide website, the anticipated on-line date is May 1, 2017. The changes requested by NMFS have been incorporated into the new webpage for Stream Flow. The webpage will be available through the “ABOUT US” menu, “Salmon Creek Project”.

A copy of the request for consultation and comments received are in Appendix A.

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APPENDIX A: AGENCY COMMENTS

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From: Christy Yearous
Sent: Friday, March 17, 2017 12:10 PM
To: 'Steve Brockmann'; 'Sean Eagan - NOAA Federal'; 'Johnson, Shawn L (DFG)'
Subject: Salmon Creek Stream Gage - Monitoring Report
Attachments: P-2307_March_2017_StreamFlow_Report_DRAFT.pdf

Per the Salmon Creek Streamflow Monitoring Plan, AEL&P is required to submit semi-annual reports for the AEL&P operated Salmon Creek stream gage. Attached is the first semi-annual report, I apologize for the tardiness I had logged that this was due to FERC at the end of the month; however, when I reread the Order this week I found that it was due on March 1st and that we need to provide a 30-day agency review. So please provide comments to me via e-mail by April 17, 2017. I will then incorporate any comments received and submit the report to FERC after the comment period is complete.

Overall we have found that operating the gage, results in increased company awareness of streamflow. We have stocked spare equipment and now have sensor icing procedures in place in our SCADA system, both of these have been a positive addition.

Please confirm receipt of this e-mail, I want to make sure that we have the correct agency contacts in place.

Thank you,
Christy
AEL&P
463-6387

From: Sean Eagan - NOAA Federal <sean.eagan@noaa.gov>
Sent: Thursday, April 06, 2017 3:03 PM
To: Christy Yearous; Susan Walker - NOAA Federal
Subject: 2016 Salmon Creek Flow data

Ms Yearous,

The National Marine Fisheries Service staff reviewed the 2016 discharge data and found it to be excellent. There were a few issues with freezing in late December, but it appears AEL&P worked quickly to mitigate these problems.

Please add Sue Walker (copied above) to the distribution list for future reports as she in NMFS hydropower coordinator.

The AEL&P website is functioning as AEL&P agreed to in the 2016 licence amendment. Thank you.

Once I saw the intermittent freezing issues from Dec 24- Dec 30, I assumed similar challenges confronted AEL&P in January but I could not see that data.

Would AEL&P be willing to add additional buttons to AEL&P's website so that all discharge data since the last bi-annual report was view able? This could either be done with "buttons" for "1 month ago", "2 months ago" etc or a button that says "last three months" and a second "last six months".. I imagine these would be minor coding changes to the current "previous month" button.

Thank you for doing a great job collecting the 2016 data and considering our request. I agree that increased company awareness of streamflow is an added benefit to this new gaging arrangement.

Thank you,
Sean Eagan

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Sean Eagan
Hydrologist
NOAA - National Marine Fisheries Service

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907-586-7345
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APPENDIX B: 2016 WATER YEAR STATION DESCRIPTION AND ANALYSIS

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Salmon Creek Gaging Station near Juneau, Alaska

Station Description and Analysis 2016

LOCATION.—Lat 58°19'57", long 134°27'57" referenced to North American Datum of 1927, and Lat 58°19'56", long 134°28'04"referenced to World Geodetic System 1984. Gage is located on the left bank (when facing downstream), about 0.3 mi upstream from the mouth and 2.5 mi northwest of Juneau.

DRAINAGE AREA.—Drainage area 9.69 mi^2 as reported by the USGS, flows are regulated.

ESTABLISHMENT AND HISTORY.—Gage established on April 27, 2016 at the location of U.S.Geological gaging station number 15051010.

GAGE.—A Campbell Scientific CS450 vented and temperature compensated transducer is coupled to a Campbell Scientific CR6 data logger and records stage data in 15 minute intervals. The transducer is housed in 1 inch galvanized pipe and set and referenced to vertical datum established by the U.S. Geological Survey (see reference marks). Additional equipment housed in a gage house on left bank.

CONTROL.—Low flow control is a boulder/cobble riffle immediately below the orifice and staff gage. The channel is the control at medium and high stages. Shifting from the rating is possible at all stages as the gage reach can be alternately scoured and filled.

DISCHARGE MEASUREMENTS.—Measurements are made by wading in the vicinity of the gage. High flow measurements can be measured from a bridge approximately 0.25 mi downstream.

FLOODS.—U.S. Geological Survey recorded a maximum discharge of 2110 ft^3/s, Nov. 22, 2005 and gage height 4.20 ft. Minimum discharge recorded by the U.S. Geological Survey was 3.5 ft^3/s, March 17-20, 2006.

WINTER FLOW.—The stage-discharge relationship will be periodically affected by ice during cold periods most winters.

REGULATION AND DIVERSIONS.—Flow is regulated by Salmon Creek Reservoir located 2 miles upstream. Diversion upstream for off-stream hydropower plant; outflow from the plant goes into Gastineau Channel and is not included in the discharge records.

ACCURACY.— Accuracy of the discharge records should be fair to good with the exception of ice affected record which will be fair to poor.

REFERENCE MARKS.—The gage is referenced to several vertical reference marks (RMs) established by the U.S. Geological Survey to accurately track vertical datum for the gage. The existing gage will continue to reference these RMs to maintain accurate vertical datum.

RM 1 – Brass cap anchored in concrete 2 feet shoreward of the orifice on left bank, elevation 2.44 feet. This RM is the base RM from which to begin level surveys.

RM 4 – Lag bolt driven in 3 foot diameter spruce tree 20 feet from the left edge of water and 30 feet upstream of the orifice and outside staff gage, elevation 10.82 feet.

RP 1 – ¼ inch anchor bolt drilled in concrete block 1 foot upstream of orifice, elevation 2.44 feet.

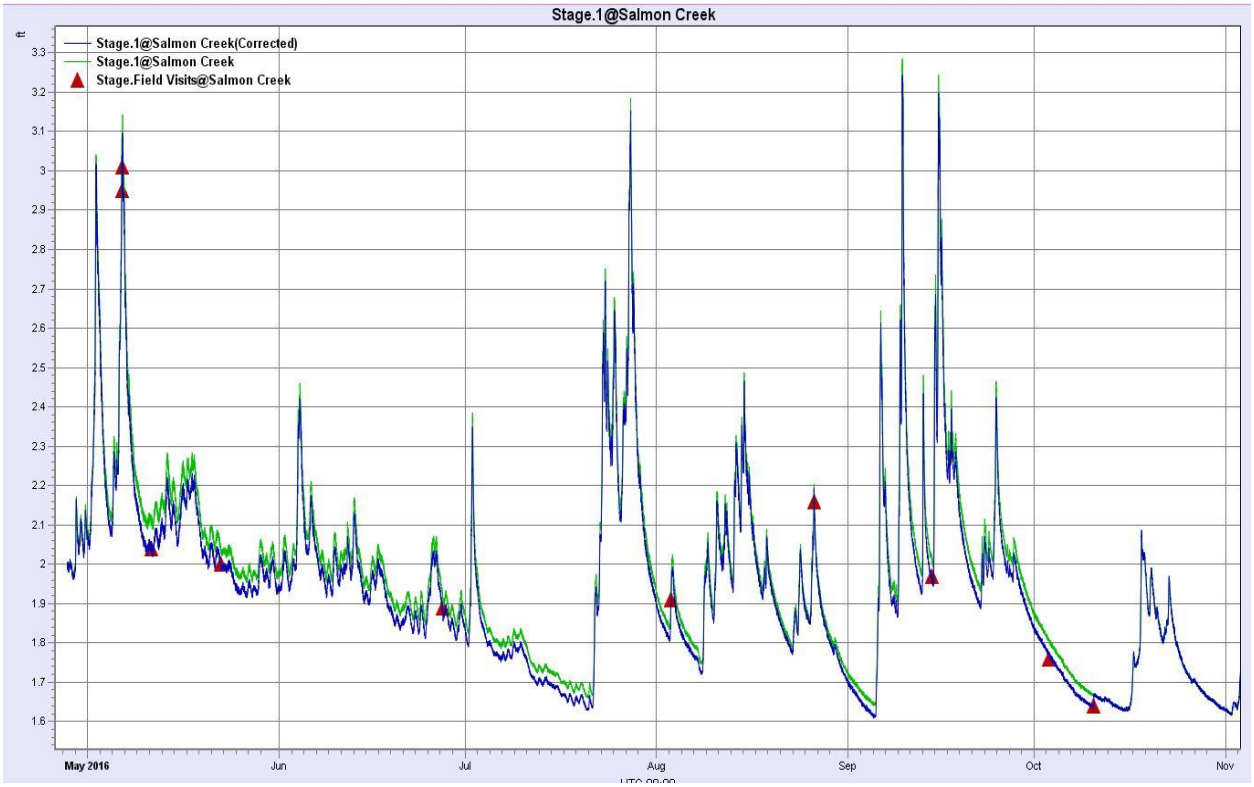
RM 5 – ¼ inch lag bolt on upstream side of two foot diameter cottonwood 25 feet from left edge of water and 12 feet downstream of the orifice, elevation 8.574 feet.

RM 6 – ¼ inch lag bolt on upstream side of 1 foot diameter spruce tree, 15 feet from the left edge of water and 15 feet upstream of the orifice, elevation 7.774 feet.

STATION ANALYSIS

GAGE HEIGHT RECORD.—The gage height record is complete from installation on April 27, 2016 with no periods of missing record.

GAGE HEIGHT CORRECTIONS.—Gage height corrections to the recorder are used to adjust for differences between the recorded values and readings of the outside reference gage during site visits. A plot of corrected gage heights and measured field values of gage height is shown below in figure 1.



Stage data from Salmon Creek gaging station showing raw and corrected recorded values and field readings from the outside reference gage.

Corrections to gage height were applied as follows:

4/27/16 to 5/11/16: correction of 0.00 ft prorated to -0.07 ft

5/11/16 to 5/22/16: correction of -0.07 ft prorated to -0.04 ft (level survey)

5/22/16 to 8/03/16: correction of -0.04 ft prorated to -0.03 ft

8/03/16 to 8/26/16: correction of -0.03 ft prorated to -0.01 ft

8/26/16 to 9/14/16: correction of -0.01 ft prorated to -0.05 ft

9/14/16 to 10/10/16: correction of -0.05 ft prorated to -0.03 ft

DATUM CORRECTIONS.— Level survey conducted on May 22, 2016. No datum corrections were needed.

RATING.—Rating 1 was developed by the USGS and continued in use for the 2016 water year. The gage reach is under section control at low to midrange discharges. The gage reach is subject to scour and fill during peak flows and during lower discharges when salmon spawn throughout the gage reach. Nine discharge measurements were used for rating analysis, including five discharge measurements conducted by the USGS. Discharge measurements ranged from 12.8 to 366 ft^3/s. Rating curve and rating equation points are shown below:

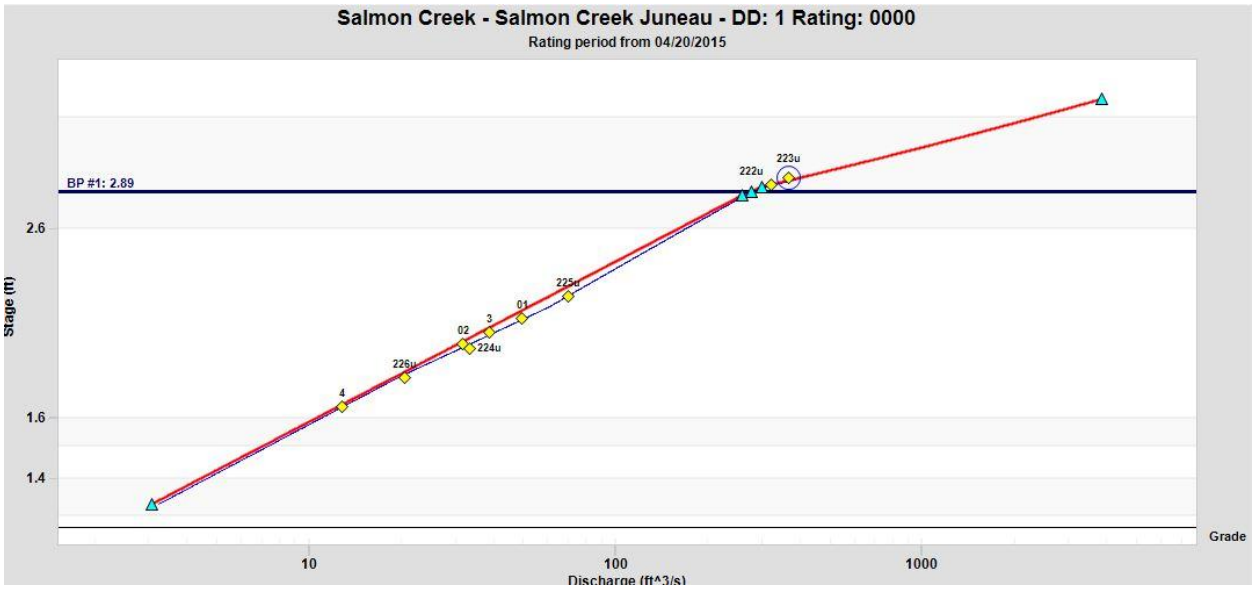
Rating Curve

Salmon Creek Rating 2016 - Used to compute discharge with stage variable shift.

Label: Salmon Creek
Description: Site ID-Salmon Creek
Curve on: November 4, 2016 Curve Start Date: April 20, 2015 Location: Salmon Creek Juneau

Stage	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1.00	0.00	0.00	0.00	0.00	4.41	7.00	10.59	15.39	21.66	29.65
2.00	39.66	51.99	66.97	84.96	106.32	131.45	160.76	194.69	233.68	282.63
3.00	389.17	550.06	760.28	1,030.42	1,372.48	1,799.96	2,327.99	2,973.35	3,754.63	

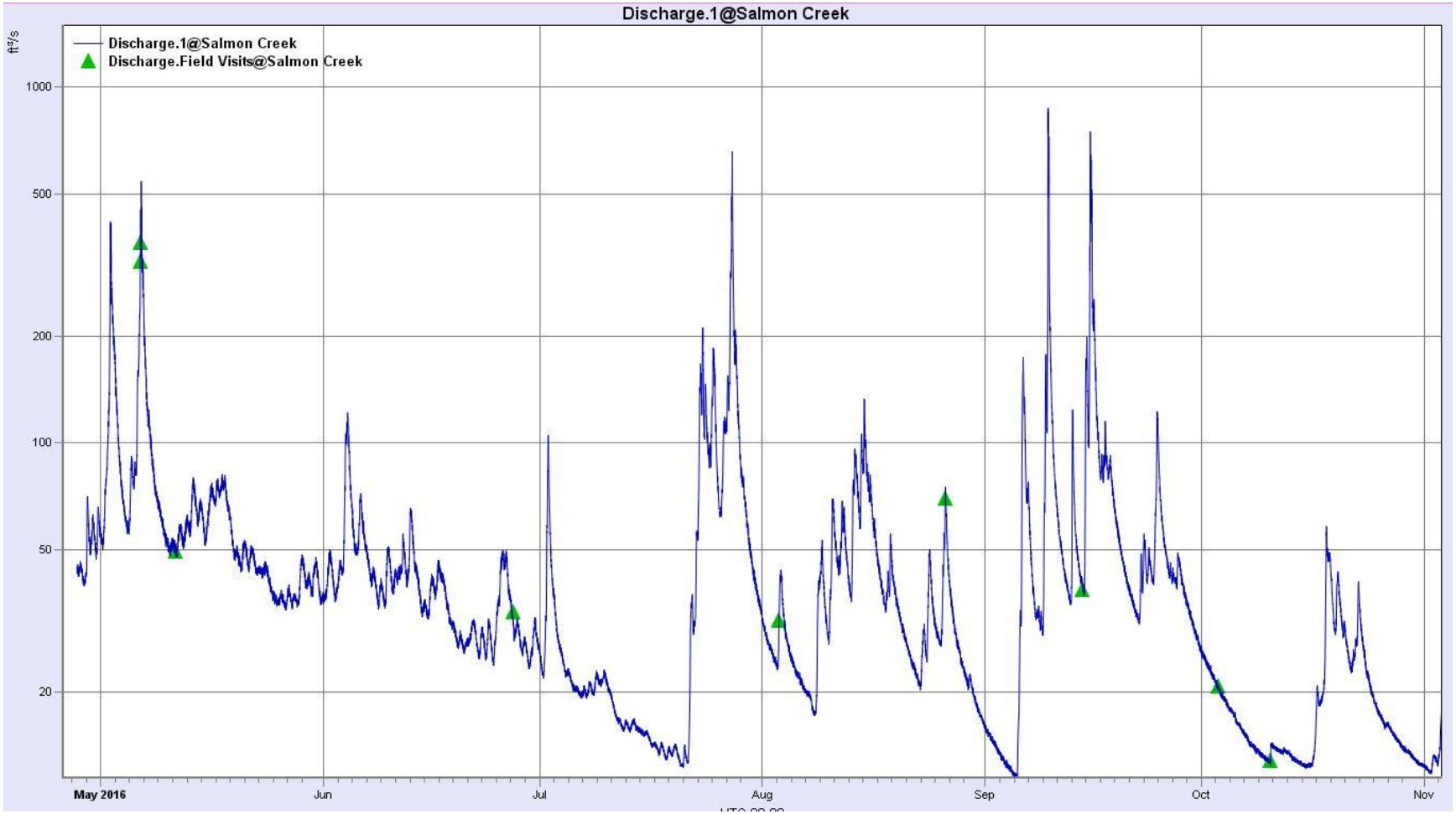
DISCHARGE RECORD.—Rating number 1 was used to compute discharge with a single stage variable shift to adjust for slight scour conditions. The shift was defined by measurements 1-4 and three measurements made by the USGS. The shifted rating is shown below. The stage variable shift is in effect below stages of 3.08 feet.



REMARKS.— Records of discharge are complete. Discharge records are fair due to drift in stage recordings and the relatively poor gage reach and lack of cross sections available to consistently make good discharge measurements. The stage variable shift used to compute discharges for the 2016 would not be needed if a slight offset adjustment was made to the existing rating. If future measurements follow similar patterns the rating will be recomputed to better fit the observed measurements. The following files are included as an attachment to this document:

Salmon Creek 15 min 2016 WY- containing discharge values in 15 min time steps.

Salmon Creek daily mean discharge- containing daily mean discharge values.



Computed stream discharge and field measurements for Salmon Creek near Juneau, Alaska from April 27 – October 9, 2016.

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APPENDIX C: 2016 DAILY MEAN DISCHARGE

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Daily Mean by Year

Salmon Creek discharge

Identifier: Discharge.1@Salmon Creek
Location: Salmon Creek Juneau
Units: ft^3/s
Filter: None

Year: 2015 **Aggr:** * **Min:** * **Max:** *

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	* UN	* UN	* UN	* UN	* UN	* UN	* UN	67 UN	42 UN	26 UN	29 UN	15 UN
2	* UN	* UN	* UN	* UN	* UN	* UN	* UN	220 UN	40 UN	59 UN	25 UN	14 UN
3	* UN	* UN	* UN	* UN	* UN	* UN	* UN	100 UN	49 UN	30 UN	34 UN	13 UN
4	* UN	* UN	* UN	* UN	* UN	* UN	* UN	62 UN	92 UN	24 UN	28 UN	12 UN
5	* UN	* UN	* UN	* UN	* UN	* UN	* UN	80 UN	53 UN	21 UN	23 UN	18 UN
6	* UN	* UN	* UN	* UN	* UN	* UN	* UN	260 UN	59 UN	20 UN	21 UN	99 UN
7	* UN	* UN	* UN	* UN	* UN	* UN	* UN	140 UN	44 UN	20 UN	19 UN	45 UN
8	* UN	* UN	* UN	* UN	* UN	* UN	* UN	79 UN	39 UN	21 UN	26 UN	32 UN
9	* UN	* UN	* UN	* UN	* UN	* UN	* UN	61 UN	40 UN	22 UN	40 UN	210 UN
10	* UN	* UN	* UN	* UN	* UN	* UN	* UN	52 UN	43 UN	21 UN	44 UN	100 UN
11	* UN	* UN	* UN	* UN	* UN	* UN	* UN	52 UN	43 UN	18 UN	49 UN	52 UN
12	* UN	* UN	* UN	* UN	* UN	* UN	* UN	56 UN	46 UN	16 UN	54 UN	39 UN
13	* UN	* UN	* UN	* UN	* UN	* UN	* UN	64 UN	52 UN	16 UN	59 UN	66 UN
14	* UN	* UN	* UN	* UN	* UN	* UN	* UN	66 UN	37 UN	16 UN	77 UN	53 UN
15	* UN	* UN	* UN	* UN	* UN	* UN	* UN	58 UN	35 UN	15 UN	89 UN	270 UN
16	* UN	* UN	* UN	* UN	* UN	* UN	* UN	71 UN	41 UN	14 UN	59 UN	140 UN
17	* UN	* UN	* UN	* UN	* UN	* UN	* UN	75 UN	42 UN	14 UN	41 UN	89 UN
18	* UN	* UN	* UN	* UN	* UN	* UN	* UN	71 UN	33 UN	14 UN	41 UN	78 UN
19	* UN	* UN	* UN	* UN	* UN	* UN	* UN	52 UN	29 UN	14 UN	38 UN	55 UN
20	* UN	* UN	* UN	* UN	* UN	* UN	* UN	48 UN	27 UN	13 UN	30 UN	43 UN
21	* UN	* UN	* UN	* UN	* UN	* UN	* UN	48 UN	29 UN	15 UN	25 UN	36 UN
22	* UN	* UN	* UN	* UN	* UN	* UN	* UN	46 UN	27 UN	38 UN	22 UN	37 UN
23	* UN	* UN	* UN	* UN	* UN	* UN	* UN	44 UN	28 UN	130 UN	27 UN	47 UN
24	* UN	* UN	* UN	* UN	* UN	* UN	* UN	41 UN	27 UN	110 UN	39 UN	62 UN
25	* UN	* UN	* UN	* UN	* UN	* UN	* UN	36 UN	41 UN	120 UN	29 UN	67 UN
26	* UN	* UN	* UN	* UN	* UN	* UN	* UN	36 UN	43 UN	88 UN	51 UN	45 UN
27	* UN	* UN	* UN	* UN	* UN	* UN	* UN	37 UN	31 UN	250 UN	33 UN	43 UN
28	* UN	* UN	* UN	* UN	* UN	* UN	43 UN	39 UN	28 UN	140 UN	25 UN	40 UN
29	* UN	* UN	* UN	* UN	* UN	* UN	56 UN	43 UN	25 UN	70 UN	22 UN	33 UN
30	* UN	* UN	* UN	* UN		* UN	56 UN	42 UN	29 UN	47 UN	19 UN	28 UN
31	* UN		* UN	* UN		* UN		39 UN		36 UN	17 UN	
Aggr	*	*	*	*	*	*	*	70	40	47	37	63
Min	*	*	*	*	*	*	*	34	23	12	16	11
Max	*	*	*	*	*	*	*	540	120	660	130	870

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Daily Mean by Year

Daily Mean Discharge

Identifier: Discharge.1@Salmon Creek
Location: Salmon Creek Juneau
Units: ft^3/s
Filter: None

Year: 2016 **Aggr:** * **Min:** * **Max:** *

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	25 UN	11 UN	19 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
2	22 UN	12 UN	67 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
3	20 UN	24 UN	98 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
4	19 UN	33 UN	38 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
5	17 UN	59 UN	25 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
6	16 UN	31 UN	20 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
7	15 UN	27 UN	19 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
8	14 UN	51 UN	17 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
9	13 UN	64 UN	15 EP	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
10	13 UN	76 UN	14 EP	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
11	12 UN	120 UN	13 EP	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
12	12 UN	95 UN	14 EP	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
13	12 UN	65 UN	16 EP	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
14	11 UN	63 UN	15 EP	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
15	11 UN	43 UN	14 EP	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
16	12 UN	33 UN	13 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
17	17 UN	27 UN	15 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
18	37 UN	23 UN	17 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
19	32 UN	20 UN	19 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
20	31 UN	18 UN	20 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
21	23 UN	16 UN	24 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
22	26 UN	16 UN	15 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
23	25 UN	16 UN	12 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
24	19 UN	15 UN	11 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
25	16 UN	14 UN	10 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
26	15 UN	14 UN	12 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
27	14 UN	14 UN	13 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
28	13 UN	13 UN	15 UN	UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN	* UN
29	12 UN	27 UN	11 UN	UN		* UN	* UN	* UN	* UN	* UN	* UN	* UN
30	12 UN	30 UN	13 UN	UN		* UN	* UN	* UN	* UN	* UN	* UN	* UN
31	11 UN		12 UN	UN		* UN		* UN		* UN	* UN	
Aggr	18	36	21	29	*	*	*	*	*	*	*	*
Min	11	11	9.8	10	*	*	*	*	*	*	*	*
Max	54	170	160	180	*	*	*	*	*	*	*	*

Date Processed: March 17, 2017 00:26