



March 15, 2017

TO: Flood Authority Members
FROM: Scott Boettcher, Staff
SUBJECT: Replacement of Gages and Annual Maintenance Cost Increase

The purpose of this memo is to provide Flood Authority members with a proposal to replace two Chehalis River Basin gages cognizant of the future cost to the Flood Authority for on-going operations and maintenance. We will review and discuss this proposal on tomorrow's 3-16-2017 Flood Authority conference call. Please feel free to call or email if you have questions (i.e., 360/480-6600, scottb@sbgh-partners.com).

A. Background

1. National Weather Service (NWS) owns and operates two stream gages in the Chehalis River Basin that are used for forecasting and flood monitoring.
 - Chehalis River at Centralia -- <http://water.weather.gov/ahps2/hydrograph.php?wfo=sew&gage=cenw1>
 - Skookumchuck River at Centralia -- <http://water.weather.gov/ahps2/hydrograph.php?gage=ctaw1&wfo=sew>
2. These gages are consistently the top gages people sign-up for to receive Flood Authority email gage alerts -- <https://data.wa.gov/dataset/Gage-Alert-Sign-Ups-2014-16/f4wb-hxgz>
3. In the Chehalis Basin, the NWS has historically not had the maintenance and operations budget necessary to keep the gages in top shape with the result being sometimes faulty or inaccurate readings, most recently February 10, 2017.
4. These gages are old and likely at the end of their useful life.
5. NWS summarizes the circumstance of the Chehalis River at Centralia gage yielding faulty readings on 2-10-2017 in Attachment A.

B. Proposal to Replace Two NWS Gages Using Unobligated Local Projects Monies

1. The Flood Authority Projects Committee asked WEST Consultants to coordinate with NWS and provide the Flood Authority with a proposal that:
 - a. Replaces the two gages in Centralia with more modern bridge-mount radar gages as was done by the Flood Authority on the West Fork of the Satsop River when that gage failed in November 2015.

- b. Provides the coordination, evaluation, and calibration necessary for the two new radar gages to provide the NWS with the information they need to use the new gages for their forecast point (so they can retire the two old gages).
 - c. Provides the Flood Authority with the future cost of operations and maintenance for the new gages as the new gages will be Flood Authority gages.
2. WEST's Capital Budget proposal to acquire, install, calibrate, and replace the NWS gages (3-17-2017 through 6-30-2020) is as follows:

Replace Gages and Provide Necessary Calibration and Coordination with NWS to support NWS Forecast Point		
Category	Description	Cost
Verification of NWS Rating Curve	The NWS currently uses a synthetic or derived rating curve to convert forecast stream flows to forecast stages. It has been many years since it has been checked or verified. WEST will use the most recent hydraulic model and cross sections to verify the NWS rating curve.	\$5,295
Replace Centralia at Chehalis Gage	WEST will install and calibrate new equipment to upgrade river stage monitoring and automated data transmission. New equipment will be of the same type as installed on West Fork Satsop in 2016. WEST will coordinate gage calibration with the NWS.	\$28,300
Replace Skookumchuck Gage	WEST will install and calibrate new equipment to upgrade river stage monitoring and automated data transmission. New equipment will be of the same type as installed on West Fork Satsop in 2016. WEST will coordinate gage calibration with the NWS.	\$28,000
		\$61,595

3. WEST's Operations and Maintenance proposal to be funded by the Flood Authority starting July 2020 can be found in Attachment B.

C. Recommended Next Steps

1. Projects Committee recommends moving forward to acquire, install, calibrate, and replace the two Centralia NWS gages at a cost of \$61,595 using remaining unobligated small projects Capital Budget dollars as described above.
2. Projects Committee recommends continuation of the current allocation approach toward annual gage O&M costs, namely:
 - Grays Harbor County – 22% of total O&M costs.
 - Lewis County – 64% of total O&M costs.
 - Thurston County – 14% of total O&M costs.

[Note: See following for more info on current allocation approach – https://www.ezview.wa.gov/Portals/_1492/images/2017%20Flood%20Warning%20System%20Costs%2009132016.pdf.]

ATTACHMENT A

NWS Summarization of Chehalis River at Centralia Faulty Readings 2-10-2017

From: [Brent Bower - NOAA Federal](#)
To: [Scott Boettcher](#)
Cc: [Donald Price](#); [Logan Johnson - NOAA Federal](#)
Subject: Chehalis River gage at Centralia data problem
Date: Thursday, February 16, 2017 3:44:11 PM

Scott, I am sending you some information that I think would be of interest to the Chehalis Basin Gages group. Would you please pass it along through the group email, and maybe save it for documentation purposes? Thanks.

The Chehalis River gage at Centralia had a data problem early on the morning of Feb 10, 2017. Since this group is considering the issues with Chehalis River basin gaging, and this gage in particular has been discussed, I thought I would pass this on to the group for informational purposes and to see an actual example of an infrequent but known, recurring issue. I attached a graphic of it as well.

During the rising limb of a high water/flood event, the gage reported a 2 foot jump at 3 am. Feb 10. No reports were missing around that time. I checked all upstream gages and as expected, none showed any quick rise like that. I can't know for sure what caused the problem, but I have some thoughts. This behavior has been seen before during high water events. Sometimes it happens on the recession limb as well.

I called City of Centralia police/EM and requested that they check the staff gage. They did and called back. They had read the staff gage there as ~64 1/2 ft. (the staff gage is only in whole foot increments). I gave it a 64.5'. At that same time, the gage was reporting 63.37'. So the gage had jumped up ~2 feet but it still needed another foot jump to catch up to the river. The total difference the gage had gone off was a tad over 3 feet. I made the total adjustment to the gage so that it would read correctly from that point on, and then adjusted the previous data accordingly back to when the jump occurred. That is what is seen in the hydrograph I attached.

Possible issues include:

1. plugged inlet to stilling well kept water level low and then it opened up (at least somewhat) and the well filled up to closer to a correct level.

Other possibilities:

2. shaft encoder is bad internally or electronically. (It seems all the readings would continue to go bad in this scenario.)
3. float somehow getting hung up (held down I guess)
4. something with the the data logger/telemetry (LARC) (This is least likely to cause values to lag then jump up.)

The gage equipment is very old and although we can still get it fixed, it is getting more difficult. Some of the technology dates back to the 1970s or even 1960s I believe.

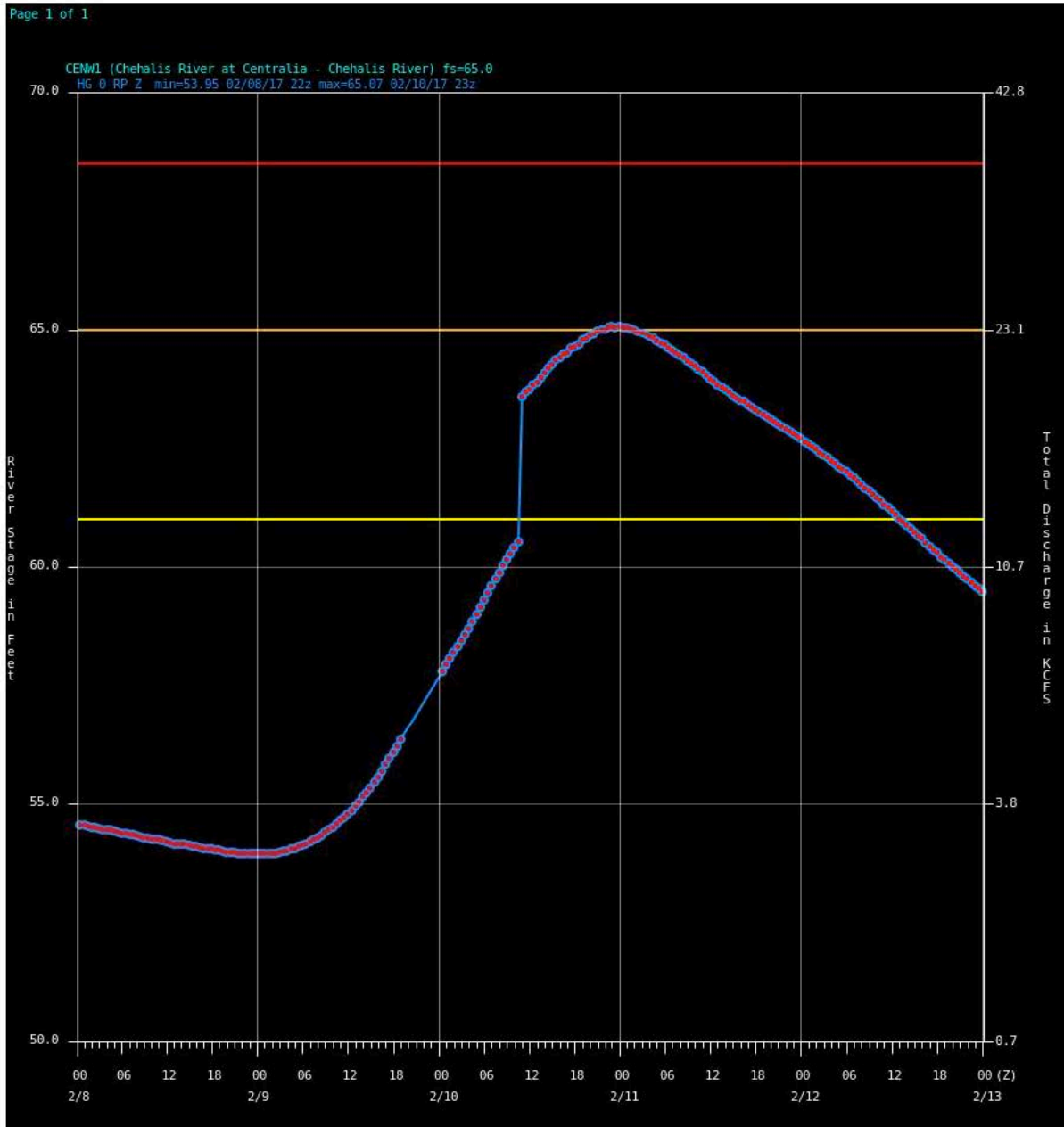
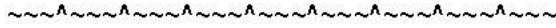
Thanks,

Brent

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Brent Bower
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ATTACHMENT B

Operations and Maintenance Proposal to be Funded by the Flood Authority starting July 2020

EXISTING O & M (showing 2% cost-escalation 2018)							ADDITIONAL O & M				
Breakdown of 2017 Annual O & M Costs		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
WEST	<i>Gage maintenance</i> -- 10 gages (including 2 stream gages) located across Chehalis Basin.	\$38,438	\$38,438	\$38,438	\$38,438	\$39,207	\$39,991	\$40,791	\$41,607	\$42,439	\$43,287
WEST	<i>Gage maintenance</i> -- 2 new additional gages							\$ 5,600	\$11,500	\$11,730	\$11,965
WEST	<i>Operational support</i> -- On-going support for website monitoring and updates for both routine operations and during potential flood events.	\$11,336	\$11,336	\$11,336	\$11,336	\$11,563	\$11,794	\$12,030	\$12,270	\$12,516	\$12,766
WEST	<i>Operational support</i> -- 2 new additional gages							\$ -	\$ -	\$ -	\$ -
WEST	<i>Spare parts inventory</i> -- Extra parts in the event of broken or malfunctioning gages.	\$ -	\$ 6,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000
WEST	<i>Spare parts inventory</i> -- 2 new additional gages							\$ -	\$ 1,000	\$ 1,000	\$ 1,000
OneRain	<i>Website</i> -- One-rain annual subscription (120 sensors in and near Chehalis Basin).	\$ 3,811	\$ 3,811	\$ 5,261	\$ 5,261	\$ 5,500	\$ 5,500	\$ 5,500	\$6,000	\$ 6,000	\$ 6,000
OneRain	<i>Website</i> -- 2 new additional gages							\$ -	\$ -	\$ -	\$ -
Lewis County	<i>Billing and processing.</i>	\$ -	\$ 900	\$ 900	\$ 900	\$ 900	\$ 900	\$ 900	\$ 900	\$ 900	\$ 900
Lewis County	<i>Billing and processing</i> -- 2 new gages							\$ -	\$ -	\$ -	\$ -
Total (Existing) -->		\$53,585	\$60,485	\$57,935	\$57,935	\$59,169	\$60,185	\$61,221	\$ 62,777	\$63,855	\$64,954
Total (New) -->								\$66,821	\$75,277	\$76,585	\$77,918
								\$ 5,600	\$12,500	\$12,730	\$12,965