

2019 Water Management Plan

Seasonal Update

October 22, 2019

1. Introduction

The annual Water Management Plan (WMP) is finalized prior to the implementation of actions identified in the 2019 NOAA Fisheries Columbia River System (CRS) Biological Opinion (2019 BiOp), the 2018 Action Agencies (AA) CRS Proposed Action (2018 CRSPA), 2019-2021 Spill Operation Agreement (2019-2021 Agreement), 2019 Fish Operations Plan (2019 FOP), and the 2000 U.S. Fish and Wildlife Service (USFWS) Federal Columbia River Power System (FCRPS) BiOp as supplemented in 2006 for Libby Dam operations (collectively referred to as the 2000/2006 BiOps¹). The WMP is also developed prior to the receipt of any seasonal information that may determine how many of the operational measures are implemented. The Seasonal Update is intended to supplement the WMP with more detailed information on operations as the water year progresses. Each section of the Seasonal Update will be updated when information is available and finalized when no further information is available.

The first update for the primary elements of Fall and Winter will be posted by November 1 of each year. The first update for the primary elements of Spring and Summer will be posted by March 1 of each year. The elements and operations included in the Seasonal Update are generally the same as have been previously presented in the Fall/Winter and Spring/Summer Updates to the WMP. The change to update in this manner is intended to present better continuity for tracking operations as they change throughout and across each season. The elements and operations described in the Seasonal Update and the approximate schedule for updates and finalization are as displayed in Table 1.

Table 1. Schedule for update and finalization of Seasonal Update elements and operations.

Section	Element	Begins	Finalized	Last Updated
2.1	Current Conditions (e.g., WSF, Streamflows)	October	July	October 1, 2019
2.2	Seasonal Flow Objectives	April	August	October 1, 2019
2.3	Flood Control	January	June	October 1, 2019
2.4	Storage Project Operations	September	September	October 1, 2019
2.5	Water Quality (Spill Priority Lists)	January	December	March 1, 2019

¹ The AAs are currently engaged in ESA section 7 consultation with NOAA Fisheries and USFWS on Columbia River System (CRS) operations that will update and replace the previously mentioned BiOps. Following the finalization to these BiOps, the AAs will review the 2020 WMP and make any updates to the WMP in coordination with the Technical Management Team (TMT).

	Specific Operations	Start Date	End Date	Last Updated
2.6	Burbot spawning temperature management (Libby Dam)	November	December 30	October 31, 2018
2.7	Lake Pend Oreille Kokanee (Albeni Falls Dam)	September 1	December 30	-
2.8	Upper Snake Flow Augmentation	April 1	August 31	-
2.9	Chum Flows (Bonneville Dam)	November 1	April 10	October 1, 2019
2.10	Hanford Reach Fall Chinook Protection	November	June	October 1, 2019
2.11	Snake River Zero Generation	December	February	October 1, 2019
2.12	Minimum Operating Pool	April 3	September 1	October 1, 2019
2.13	Spill Operations	April 3	September 1	October 1, 2019
2.14	Transport Operations	May 1	-	March 1, 2019
2.15	Fish Passage Research	March	October	March 1, 2019

2. Seasonal Update Elements and Specific Operations

2.1. Current Conditions

Water Supply Forecasts – NWRFC

The final water supply forecast (WSF) is defined as the forecast posted on NOAA’s Northwest River Forecast Center (NWRFC) website at 5:00 pm Pacific Standard Time on the 3rd business day of the month. NWRFC water supply forecasts are available on the following website.

<http://www.nwrfc.noaa.gov/ws/>

Table 2. The Dalles Dam Final Water Supply Forecasts.

Forecast Issue Date	January-July 2019		April-August 2019	
	Volume (MAF)	% of 30-year Average (101.4 MAF)	Volume (MAF)	% of 30-year Average (87.5 MAF)
January 4, 2019	93.5	92%	83.3	95%
February 5, 2019	85.0	84%	75.3	86%
March 5, 2019	84.5	83%	76.6	88%
April 3, 2019	84.1	86%	75.6	86%
May 3, 2019	90.4	90%	82.4	94%
June 5, 2019	92.1	91%	82.6	94%
July 3, 2019	89.0	90%	80.5	92%

Table 3. Grand Coulee Dam Final Water Supply Forecasts.

Forecast Issue Date	January-July 2019		April-August 2019	
	Volume (MAF)	% of 30-year Average (59.6 MAF)	Volume (MAF)	% of 30-year Average (56.8 MAF)
January 4, 2019	58.0	97%	55.9	99%
February 5, 2019	52.6	88%	51.4	90%
March 5, 2019	49.6	83%	49.0	86%
April 3, 2019	48.7	82%	47.9	84%
May 3, 2019	49.6	83%	48.7	86%
June 5, 2019	50.1	84%	48.5	85%
July 3, 2019	48.6	81%	47.0	82.9

Table 4. Lower Granite Dam Final Water Supply Forecasts.

Forecast Issue Date	January-July 2019		April-July 2019	
	Volume (MAF)	% of 30-year Average (27.4 MAF)	Volume (MAF)	% of 30-year Average (21.1 MAF)
January 4, 2019	23.1	84%	17.4	88%
February 5, 2019	22.6	82%	17.0	86%
March 5, 2019	24.8	90%	19.6	99%
April 3, 2019	24.6	90%	18.7	95%
May 3, 2019	29.0	106%	24.3	117%
June 5, 2019	29.8	109%	24.0	121%
July 3, 2019	29.3	107%	24.8	117%

Water Supply Forecasts - Corps

WSF for Libby and Dworshak Dams are produced by the Corps' Seattle and Walla Walla Districts, respectively. Corps' forecasts are available on the following website.

<http://www.nwd.usace.army.mil/Missions/Water/Columbia/Flood-Control/>

Table 5. Libby Dam Water Final Supply Forecasts.

Forecast Issue Date	April-August 2019	
	Volume (KAF)	% of 78-year (1929-2008) Average (6,282 KAF)
December	5784	92%
January	5721	91%
February	5318	85%
March	5478	87%
April	4752	76%
May	4983	79%
June	4676	74%

Table 6. Dworshak Dam Final Water Supply Forecasts.

Forecast Issue Date	April-July 2019	
	Volume (KAF)	% of 81-year (1929-2008) Average (2,663 KAF)
December	2276	86%
January	2239	84%
February	1951	80%
March	2142	81%
April	1964	74%
May	2438	92%
June	2425	91%

Water Supply Forecasts – Bureau of Reclamation

WSFs for Hungry Horse Dam are produced by the Bureau of Reclamation.

Table 7. Hungry Horse Dam Final Water Supply Forecasts.

Forecast Issue Date	April-August 2019		Date-July 2019		May-September 2019	
	Volume (KAF)	% of 30-year Average (2,070 KAF)	Volume (KAF)	% of 30-year Average (2,224 KAF)	Volume (KAF)	% of 30-year Average (1,835 KAF)
January	1740	90%	1897	90%	1533	91%
February	1700	88%	1976	88%	1500	89%
March	1750	90%	1790	91%	1580	93%
April	1560	81%	1515	81%	1400	83%
May	1730	89%	1350	86%	1460	86%
June	1700	88%	680	80%	1420	84%

Weekly Weather and Precipitation Retrospectives

Week	Weekly Weather / Precipitation Retrospective
October 1, 2018	<p>Temperatures: Below average.</p> <p>Precipitation: First widespread precipitation of the season. Above average east with some mountain snows.</p> <p>Streamflow: Mostly flat as precipitation either fell as mountain snow, or valley rains went into moistening very dry soils. Very small rises in some Snake drainages over the past weekend.</p>
October 8, 2018	<p>Temperatures: Below average, with chilly mornings but warm sunny afternoons.</p> <p>Precipitation: Above average in Snake Basin; below average west and north particularly as the week progressed.</p> <p>Streamflow: Mostly flat with very small and short-lived rises in the Snake basin.</p>
October 15, 2018	<p>Temperatures: Above average west; below average east.</p> <p>Precipitation: Mostly dry, which is very unusual for mid October.</p> <p>Streamflow: Flat.</p>

Week	Weekly Weather / Precipitation Retrospective
October 22, 2018	<p>Temperatures: Above average, with unusually high snow levels.</p> <p>Precipitation: Dry initially, then increased to well above average as first major fall storm crossed the basin this weekend.</p> <p>Streamflow: Very minor rises began this weekend on the lower Columbia, mid-C's and Clearwater. Mostly flat elsewhere as most rains went into moistening unusually dry soils.</p>
October 29, 2018	<p>Temperatures: Above average, with unusually high snow levels.</p> <p>Precipitation: Well above average, which offset the dry first half of October.</p> <p>Streamflow: Minor rises on many lower elevation streams this weekend, but most are falling rather quickly this morning.</p>
November 5, 2018	<p>Temperatures: Near average.</p> <p>Precipitation: Below average, especially in US basins.</p> <p>Streamflow: Flat or receding.</p>
November 12, 2018	<p>Temperatures: Near average.</p> <p>Precipitation: Some mountain snows in BC/Western MT, otherwise mostly dry in what is normally a particularly wet time of year.</p> <p>Streamflow: Flat or receding.</p>
November 19, 2018	<p>Temperatures: Slightly above average.</p> <p>Precipitation: First notable winter storms of the season US basins, with heavy valley rain and mountain snow Wednesday - Saturday.</p> <p>Streamflow: Very minor rises on the Willamettes, lower Columbia, Clearwater and Spokane. Flat elsewhere. Flows into the lower Columbia remain well below average, despite the increased precipitation.</p>
November 26, 2018	<p>Temperatures: Near average west; falling to below average east.</p> <p>Precipitation: Well above average, but with significant drying northern 2/3rd of the basin this weekend.</p> <p>Streamflow: Very minor rises on the Willamettes, lower Columbia, Clearwater, Spokane and mid-Cs. Flat elsewhere. Flows in the Willamettes and lower Columbia remain well below average.</p>
December 3, 2018	<p>Temperatures: Below average.</p> <p>Precipitation: Virtually dry through Friday, then turned wetter this weekend.</p> <p>Streamflow: Flat or receding. Ice formation noted on several higher elevation tributaries.</p> <p>Flows in the Willamettes and lower Columbia remained well below average.</p>
December 10, 2018	<p>Temperatures: Well above average, then fell to near average over the holiday weekend.</p> <p>Precipitation: Well above average initially, then diminished to below average over the holiday weekend. Major wind storm in OR on Tuesday, and western Washington on Thursday.</p> <p>Streamflow: Sharp, but rather brief rises on the Willamettes and lower Columbia, with minor rises in the Clearwater, Spokane and lower Snake. All flows then receded over the weekend.</p>
December 17, 2018	<p>Temperatures: Well above average, then fell to near average over the holiday weekend.</p> <p>Precipitation: Well above average initially, then diminished to below average over the holiday weekend. Major wind storms in Oregon on Tuesday and western Washington on Thursday.</p> <p>Streamflow: Sharp, but rather brief rises on the Willamettes and lower Columbia, with minor rises in the Clearwater, Spokane and lower Snake. All flows then receded over the weekend.</p>
December 24, 2018	<p>Temperatures: Began above average, dropped to about average and then much above average for this past weekend.</p> <p>Precipitation: Below average, particularly on the eastside.</p> <p>Streamflow: All flows flat or gradual recessions.</p>

Week	Weekly Weather / Precipitation Retrospective
December 31, 2018	<p>Temperatures: Briefly below average Monday -Wednesday, then rose to well above average.</p> <p>Precipitation: Well above average NW Washington and British Columbia; below average elsewhere.</p> <p>Streamflow: Mostly flat as most precipitation fell as mountain snow. Some ice jamming in headwater areas.</p>
January 7, 2019	<p>Temperatures: Largely above average across the basin.</p> <p>Precipitation: Above average in Canada, below average most everywhere else.</p> <p>Streamflow: Mostly flat with very small responses in the lowest elevations.</p>
January 14, 2019	<p>Temperatures: Started above average, dropped below and then returned to above average.</p> <p>Precipitation: Average in Canada, below average most everywhere else.</p> <p>Streamflow: Mostly flat with very small responses in the lowest elevations over the long weekend.</p>
January 21, 2019	<p>Temperatures: Above average initially, then fell to slightly below average.</p> <p>Precipitation: Mostly dry in what is normally one of the wettest times of year.</p> <p>Streamflow: Flat or receding.</p>
January 28, 2019	<p>Temperatures: Slightly below average.</p> <p>Precipitation: Mostly dry through Thursday, then increased to above average which halted the significant snowpack deterioration since mid-January.</p> <p>Streamflow: Flat or receding. Short-lived rises in lower elevation basins over the weekend.</p>
February 4, 2019	<p>Temperatures: Well below average, but just above cold snap criteria. Snow levels down to sea level.</p> <p>Precipitation: Above average North of Revelstoke and in the Snake Basin. Low elevation snow, especially in western Washington, and areas near the Gorge.</p> <p>Streamflow: Mostly flat, but with several minor ice jams in headwater areas.</p>
February 11, 2019	<p>Temperatures: Well below average.</p> <p>Precipitation: Well above average US basins (150-300% of normal), with considerable low elevation snow. Well below average in British Columbia.</p> <p>Streamflow: Mostly flat, but with several minor ice jams in headwater areas.</p>
February 18, 2019	<p>Temperatures: Well below average, with unusually low snow levels.</p> <p>Precipitation: Above average south half. Well below average north half.</p> <p>Streamflow: Mostly flat</p>
February 25, 2019	<p>Temperatures: Well below average, with unusually low snow levels.</p> <p>Precipitation: Well above average south half (200-300% of normal), resulting in large snowpacks gains at unusually low elevations. Well below average precip north half, with no precip in BC.</p> <p>Streamflow: Mostly flat. Natural flows are near record lows for this time of year.</p>
March 4, 2019	<p>Temperatures: Continues well below average, with unusually low snow levels.</p> <p>Precipitation: Well below average, with virtually no precip north half.</p> <p>Streamflow: Mostly flat. Natural flows near record lows for this time of year.</p>
March 11, 2019	<p>Temperatures: Warmed to above average.</p> <p>Precipitation: Below average</p> <p>Streamflow: Minor snowmelt rises on the Lower Snake/Clearwater, Spokane, lower Columbia side streams, and Willamettes. Mostly flat elsewhere. Natural flows are increasing, but still well below normal for mid-March.</p>

Week	Weekly Weather / Precipitation Retrospective
March 18, 2019	<p>Temperatures: Well above average, with several record highs Mon-Wed.</p> <p>Precipitation: Well below average.</p> <p>Streamflow: Minor snowmelt rises on many lower elevation streams, especially the Lower Snake/Clearwater, Spokane and lower Columbia side streams, and Willamettes. Natural flows increased to near average for late March.</p>
March 25, 2019	<p>Temperatures: Slightly above average, but with cold nights east of Cascades slowing runoff somewhat.</p> <p>Precipitation: Below average. Driest March on record above Grand Coulee since 1977.</p> <p>Streamflow: Minor snowmelt rises on many lower elevation streams, especially the Snake, Spokane, lower Columbia, and Willamettes. Natural flows increased to above average, especially in the Snake Basin.</p>
April 1, 2019	<p>Temperatures: Slightly above average.</p> <p>Precipitation: Turned much wetter; increasing to 200-500% of normal US basins.</p> <p>Streamflow: Slight flow decrease, followed by much more significant rises this weekend, especially the Snake/Clearwater, Spokane, lower Columbia, mid-Cs, and Willamettes. Several rivers in minor to moderate flood stages in southern and eastern OR this morning.</p>
April 9, 2019	<p>Temperatures: Slightly above average.</p> <p>Precipitation: Well above average US basins (200-500% of normal) with late season snowpack gains above 6000ft. Near average in BC.</p> <p>Streamflow: Large flow and flood crests on the Snake, Lower Columbia and Willamette. Record early April unregulated flows at Lower Granite and The Dalles, followed by rapid recessions. Mostly flat in BC.</p>
April 15, 2019	<p>Temperatures: Above average.</p> <p>Precipitation: Increased to above average NW WA and BC; decreased to below average elsewhere.</p> <p>Streamflow: Sharp recessions leveled off; followed by snowmelt rises in both US and BC basins this weekend.</p>
April 22, 2019	<p>Temperatures: Above average through Friday, then fell below average.</p> <p>Precipitation: Below average.</p> <p>Streamflow: Flows temporarily peaked Wed-Thu, followed by modest recessions due to cooler/drier weather.</p>
April 29, 2019	<p>Temperatures: Near average through Fri, then rose above average.</p> <p>Precipitation: Well below average.</p> <p>Streamflow: Modest recessions slowed as drier weather was offset by gradual snowmelt.</p>
May 6, 2019	<p>Temperatures: Well above average, with near record highs Thu-Sat.</p> <p>Precipitation: Well below average.</p> <p>Streamflow: Steadily increasing snowmelt flows, especially above Grand Coulee and the Salmon Basin.</p>
May 13, 2019	<p>Temperatures: Cooled to below average.</p> <p>Precipitation: Increased to well above average (200-500% of normal), especially in US basins, with a few daily precip records broken.</p> <p>Streamflow: Significant basinwide rises as the peak of the spring runoff commenced. Unregulated flows increased to over 600 kcfs at The Dalles. Isolated tributary flooding in eastern WA, Central ID and western MT.</p>
May 20, 2019	<p>Last Week:</p> <p>Temperatures: Above average.</p> <p>Precipitation: Above average US basins, especially in the Snake Basin; below average in BC, western WA/OR.</p> <p>Streamflow: Rather sharp basinwide recessions slowed this weekend. Unregulated flows at The Dalles dropped from 591 kcfs to around 400 kcfs.</p>

Week	Weekly Weather / Precipitation Retrospective
May 27, 2019	<p>Temperatures: Above average, especially in BC where valley high temperatures were well into the 80s.</p> <p>Precipitation: Below average, but with scattered thunderstorms and locally heavy downpours in the mountains.</p> <p>Streamflow: Significant flow increases in BC and Salmon Basin (central ID) driven by rapidly increasing snowmelt. More modest rises elsewhere as snowpacks continue to deplete. Unregulated flows at The Dalles re-rose to near 500 kcfs.</p>
June 3, 2019	<p>Temperatures: Fell to below average.</p> <p>Precipitation: Below average, but with scattered thunderstorms east of the Cascades. Some minor, but unusually late, snowfall above 5000ft this weekend.</p> <p>Streamflow: Snowmelt flows peaked in BC early in the week, with smaller peaks in high elevation streams. Recessions began this weekend, despite increased rainfall. Unregulated flows at The Dalles had a second peak near 520kcfs, then fell to around 450kcfs this weekend.</p>
June 10, 2019	<p>Temperatures: Record heat mid-week cooling to slightly above normal.</p> <p>Precipitation: Below average, but with scattered thunderstorms east of the Cascades.</p> <p>Streamflow: Very warm temperatures caused significant rises in BC and western Montana. Elsewhere smaller rises where last of snow is remaining (Salmon, Clearwater).</p>
June 17, 2019	<p>Temperatures: Fell from slightly above average to slightly below average.</p> <p>Rainfall: Above average in BC and western MT. Mostly dry elsewhere.</p> <p>Streamflow: Steady recessions, with natural flows well below normal for late June. Flows in BC diminished due to cooler temps. Flows at The Dalles fell to 240kcfs (normal is around 325kcfs).</p>
June 24, 2019	<p>Temperatures: Slightly below average.</p> <p>Rainfall: Near average, with scattered strong thunderstorms Wed and Thu producing spotty heavy rain and grid-disruptive lightning.</p> <p>Streamflow: Flows in BC leveled off, then re-rose due to rainfall and increasing snowmelt. Elsewhere, recessions continued. Unregulated flows at The Dalles leveled off to between 200-230kcfs (normal is around 325kcfs).</p>
July 1, 2019	<p>Temperatures: Near average.</p> <p>Rainfall: Well above average in BC and western MT (250% of normal). Below average elsewhere, but with scattered severe thunderstorms Mon-Wed. Higher humidity and rainfall has lowered the wildfire threat for the time being.</p> <p>Streamflow: Gradual recessions, except in BC where flows increased this weekend due to rainfall and increasing snowmelt.</p>
July 8, 2019	<p>Temperatures: Near average west; slightly above average east</p> <p>Rainfall: Below average overall, except above average west of Cascades and in BC.</p> <p>Streamflow: Gradual recessions, except in BC where high snowmelt flows continued.</p>
July 15, 2019	<p>Temperatures: Below average, then rose to above average this weekend.</p> <p>Rainfall: Above average NW WA and BC. Mostly dry elsewhere.</p> <p>Streamflow: Gradual recessions, except in BC where minor rises were noted Wed-Fri.</p>
July 22, 2019	<p>Temperatures: Slightly above average.</p> <p>Rainfall: Below average, but with isolated, mostly mountain thunderstorms in OR, ID and BC.</p> <p>Streamflow: Gradual recessions, except in BC where a noticeable flow spike peaked Tue-Wed and has since receded back to typical late July snowmelt flows.</p>
July 29, 2019	<p>Temperatures: Above average in what is normally the warmest week of the year.</p> <p>Rainfall: Below average, but with scattered showers and thunderstorms in ID, BC and western MT. Streamflow: Gradual recessions.</p>

Week	Weekly Weather / Precipitation Retrospective
August 5, 2019	<p>Temperatures: Well above average initially, then cooled to slightly below average.</p> <p>Rainfall: Increased to above average, but the thunderstorms and heavy rains were rather localized.</p> <p>Streamflow: Very minor flow spikes in some BC, MT and ID headwaters from the thunderstorms. Otherwise, gradual recessions continued.</p>
August 12, 2019	<p>Temperatures: Slightly above average.</p> <p>Rainfall: Above average in BC and western MT. Little, if any elsewhere.</p> <p>Streamflow: Flat or receding. Last week's heavy rainfall, and somewhat muted heat so far this summer, has boosted base flows closer to the long term average.</p>
August 19, 2019	<p>Temperatures: Well above average, especially west of Cascades where record highs are possible Tue-Wed.</p> <p>Rainfall: Below average.</p> <p>Streamflow: Flat or receding.</p>
August 26, 2019	<p>Temperatures: Well above average, with record warm temps west of Cascades Tue-Thu.</p> <p>Rainfall: Below average. Scattered thunderstorms northwest half producing spotty rainfall.</p> <p>Streamflow: Flat or receding. Lowest natural flows of the year are typically observed in September (around 88 kcfs), although this year, they will be higher than the record low flows we had in late February-early March.</p>
September 2, 2019	<p>Temperatures: Near average, with normal temperatures falling steadily this time of year.</p> <p>Rainfall: Well above average, especially east of the Cascades, but drying out late in the week.</p> <p>Streamflow: Minor rises in BC where heavy rains fell on fairly moist soils. Flat elsewhere as rains almost entirely soaked into the ground.</p>
September 9, 2019	<p>Temperatures: Slightly above average, then fell to below average this weekend. First mountain snows of the season fell this past weekend in BC and the Cascades.</p> <p>Rainfall: Increased to well above average (200-300% of normal).</p> <p>Streamflow: Minor rises in BC where heavy rains fell on moist soils. Mostly flat elsewhere as heavy rains soaked into the dry soils. Unregulated flows at The Dalles rose above average for the first time since early June.</p>
September 16, 2019	<p>Temperatures: Near average, but with cool days and warm nights.</p> <p>Precipitation: Well above average (200-400% of normal), with a few daily rainfall records broken.</p> <p>Streamflow: Very minor, basinwide rises as soils continued to saturate. Rises in BC were muted as some precipitation fell as mountain snow.</p>
September 21, 2019	<p>Temperatures: Fell to well below average with unusually low snow levels. First widespread, hard freeze east of Cascades, with patchy frost west.</p> <p>Precipitation: Well above average east of Cascades (200-400% of normal), with record early-season snowfall in many locations. Below average west, but with pockets of heavier east in the Willamette Valley.</p> <p>Streamflow: Mostly flat as most precipitation fell as snow in the mountains.</p>

2.2. Seasonal Flow Objectives

Project	Planning Dates	BiOp Season Average Flow Objective – (kcfs)	Season Average Flow to date (kcfs)
Priest Rapids	Spring 4/10–6/30	135	123
McNary	Spring 4/10–6/30	220-260 ⁱ	189.1
	Summer 7/1–8/31	200	143.2
Lower Granite	Spring 4/3–6/20	85-100 ⁱ	120.3
	Summer 6/21–8/31	50-55 ⁱⁱ	36.4

- i. Varies according to NWRFC April forecast.
- ii. Varies according to NWRFC June forecast.

2.3. Flood Control

Flood Control Elevations and April 10 objective elevations per each forecast period are listed in the table below. Forecasted flood control elevations will be calculated beginning in December after the Libby and Dworshak water supply forecasts are available. Subsequent forecasted flood controls will be updated after the final water supply forecasts are available January-April.

Grand Coulee and all Canadian projects will be operated for standard flood control. Hungry Horse and Libby will be operated for Variable Q (VARQ) Flood Control. Beginning in January, the Corps calculates Upper Rule Curve elevations based on the monthly official final forecasts. Projects are operated using these elevations as an upper limit, with the objective of reaching their spring refill elevations. Detailed flood control operations are available at the following website.

<http://www.nwd-wc.usace.army.mil/report/colsum>.

The April 10 elevations shown in the table below are calculated by linear interpolation between the March 31 and April 15 forecasted flood control elevations.

Project	Elevation Date Objective	Dec	Jan	Feb	Mar	Apr
Libby	Jan 31	2420.9	2422.2			
	Feb 28	2426.8	2428.9	2436.4		
	March 31	2429.6	2432.2	2442.4	2441.3	
	April 10	2429.6	2432.2	2442.4	2441.4	
	April 15	2429.6	2432.2	2442.4	2441.5	
	April 30	2429.6	2432.2	2444.1	2441.5	2453.0
Hungry Horse	Jan 31	3544.1	3548.5			
	Feb 28	3539.4	3547.8	3548.7		
	March 31	3534.1	3547.0	3548.4	3545.1	
	April 10	3532.3	3546.8	3548.4	3544.6	
	April 15	3531.4	3546.7	3548.3	3544.4	3553.1
	April 30	3528.8	3546.3	3548.2	3543.7	3553.6
Grand Coulee	Jan 31	1290.0	1290.0			
	Feb 28	1290.0	1290.0	1290		
	March 31	1282.1	1281.2	1283.3	1283.3	
	April 10	1280.6	1269.0	1283.3	1283.3	
	April 15	1279.8	1262.9	1283.3	1283.3	1283.3
	April 30	1269.9	1249.9	1275	1272.0	1278.9
Brownlee	Jan 31	2077.0	2077.0			
	Feb 28	2053.9	2053.1	2060.6		
	March 31	2058.3	2053.2	2068.2	2049.3	
	April 15	2060.3	2055.2	2071.9	2055.6	2061.3
	April 30	2061.3	2056.2	2075.9	2062.6	2068.7
Dworshak	Jan 31	1547.0	1547.9			
	Feb 28	1543.4	1545.0	1560.1		
	March 31	1555.0	1557.4	1571.1	1559.0	
	April 10	1562.3	1564.8	1573.6	1559.9	
	April 15	1566.0	1568.5	1574.8	1559.8	1573.8
	April 30	1546.9	1550.8	1574.8	1559.8	1573.8

2.4. Storage Project Operations

Libby Dam

Bull Trout Minimum Flows: Libby Dam minimum outflow of 7 kcfs for bull trout (as described in the 2000/2006 BiOps) occurred from June 26 through August 31. Libby Dam minimum outflows for bull trout (as described in the 2000/2006 BiOps) from May 15th to the end of the Sturgeon pulse and during the month of September were 6 kcfs. The bull trout minimum outflows were determined based on the Corps, May WSF (April to August) for Libby Dam that was 4,983 KAF (85% of average (1981-2010)). More information regarding bull trout minimum flows relative to associated WSF are specified in the 2000/2006 BiOps and may be found in Table 10 on page 26 of the Water Management Plan on the following website.

https://pweb.crohms.org/tmt/documents/wmp/2019/Final/20181221_WMP_2019_Final_Revisio n1.pdf

April 10 and Refill Targets: The April 10 upper FRM rule curve target elevation was 2441 feet based on the March runoff forecast volum for April – August of 5,478 KAF (93% of average from 1981-2010). Due to low inflows, the Corps operated Libby Dam at minimum outflows of 4 kcfs from January 1 through April 21, 2019, with the exception of March 4 through 14 due to an emergency operation to protect the KTOI hatchery sturgeon and save the year class of burbot. The observed Libby Dam midnight forebay elevation on April 10, 2019, was 2406 feet.

The Corps operated Libby Dam to achieve the highest forebay elevation in July and August by maintaining minimum outflows of 7 kcfs upon completing of the sturgeon pulse on June 26 through August 31. Due to insufficient water supply volume the Corps did not refill within 5 feet of full (full is 2,459 feet) in July, or August of 2019. The 2018 Proposed Action (page 43) provides the following guidance regarding refill at Libby Dam, “To provide for summer flow augmentation, attempt to refill within 5 feet of full (full is 2,459 feet) in July or early August (exact date to be determined in-season), based on available water supply and spring flow operations, while also managing total dissolved gas and meeting flod risk management objectives.” The peak Libby Dam midnight reservoir elevation during July was 2441.1 feet that occurred on July 31, 2019. The reservoir elevation remained stable in August, with a peak Libby Dam midnight reservoir elevation of 2442.4 feet that occurred on August 23

Libby operations regarding April 10 and refill were coordinated during the TMT meetings on May 15, June 19, and July 31, 2019, and more information may be found in the TMT meeting minutes on the following website.

<http://pweb.crohms.org/tmt/agendas/2019/>

Sturgeon Pulse: On May 10, 2019, the AAs received System Operational Request (SOR) FWS #1 regarding the 2019 Libby Dam releases for sturgeon and bull trout augmentation flows. As described in the 2000/2006 BiOp the 2019 sturgeon pulse volume was 0.8 MAF (Tier 2 year based on the Corps Libby Dam May final WSF (April- August) of 5,478 KAF). The following specifications were included in the SOR.

- The 2019 sturgeon operations at Libby Dam will consist of one period of ramp- up/pre-peak/ascending limb flows, one period of peak flow (limited to 20,000 cubic feet per second (cfs)), and one period of ramp-down/post-peak/receding limb flows. The ramp-up and ramp-down will occur within 2006 BO ramping rates.
- Selective withdrawal gates at Libby Dam above elevation 2,326 mean sea level will be installed immediately prior to, and during, the augmentation operations, with the objective of passing the warmest water available in the forebay as it becomes available. Minimum submergence of selective withdrawal gates at Libby Dam is 30 feet, and gates

will be installed to keep withdrawal elevations within 30-40 feet until all gates are installed.

- Release of the warmest water possible from Libby Dam, in combination with lower volume of release, will allow the Kootenai River temperature to increase to appropriate spawning temperatures at Bonners Ferry (8-10°C) during the receding limb of the hydrograph.
- Based on the Service's 2006 BO on operations of Libby Dam, and the May final April-August volume runoff forecast of 4.98 MAF, we are within a Tier 2 operations year for Kootenai River white sturgeon. The minimum recommended release volume for sturgeon conservation in a Tier 2 year is 0.80 MAF, and we recommend the following procedures for discharge of at least this minimum volume:
 - Increase discharge from Libby Dam to ~20,000 (peak) cubic feet per second (cfs) when the Regional Team of Biologists determines that high elevation tributary run-off is peaking.
 - Maintain peak discharge (~20,000 cfs, depending on head of the forebay and river stage at Bonners Ferry) for as long as possible (~ 22 days of peak flows), taking into account the shape and volume of the ascending and descending limbs of the hydrograph and the total sturgeon flow augmentation volume available (i.e. 0.80 MAF). Although ~20,000 cfs is requested for sturgeon operations, under current conditions dam managers may need to increase outflows from Libby Dam to full powerhouse for flood risk management purposes.
 - After peak flows, decrease discharge at Libby Dam (post-peak), adhering to ramping rates in the 2006 BO, to stable summer flows, to no less than bull trout minimum flows (7,000 cfs in Tier 2).
 - Total number of days at peak discharge will depend on real time conditions and the shape of the inflow hydrographs.

As always, flood risk reduction operations supersede sturgeon flow augmentation, and dam managers will coordinate operations with regional sturgeon managers.

Sturgeon augmentation discharge may be extended for additional days if the Corps elects to provide volume in excess of the minimum volume requirement in the 2006 BO and to control the refill rate of Libby Dam.

Additional recommendations may be provided as water supply forecasts are updated. The USFWS coordinated the SOR during the following TMT meeting.

May 15, 2019, TMT Meeting. The USFWS, presented the SOR from US Fish & Wildlife Service regarding 2019 Libby Dam releases for sturgeon and bull trout augmentation flows. The objective of the operation is to provide and maximize the duration of peak river stages/flows during the spring run-off period; with the goal of providing conditions that will enable sturgeon to migrate to, and spawn over, rocky substrates that exist upstream of Bonners Ferry. They were hoping to repeat last year’s successful operations, but due to temperatures and low snowpack, there isn’t a lot of snowmelt runoff to work with. The USFWS noted that they will take the same approach as in 2018 and focus on stretching the duration of the peak out longer, using volume to make the pulse as long as possible. The plan is to release 20,000 cfs out of Libby dam and hold for about 22 days, then ramp back down to summer BiOp flows.

The Corps, summarized what operations look like now at Libby Dam and expanded on the sturgeon operations for the SOR. The official water supply forecast for May reflects an April through August runoff forecast at Libby of 4.98 MAF, or 85% of average. That forecast sets the sturgeon volume at 0.8 MAF and the bull trout minimum flow to 7 kcfs, which will be the outflow for much of the summer. The project is currently on the VarQ flow of 18 kcfs and will hold that until starting the sturgeon pulse around May 29, or whenever the runoff occurs.

The following are the TMT polling resulting regarding implementation of the SOR.

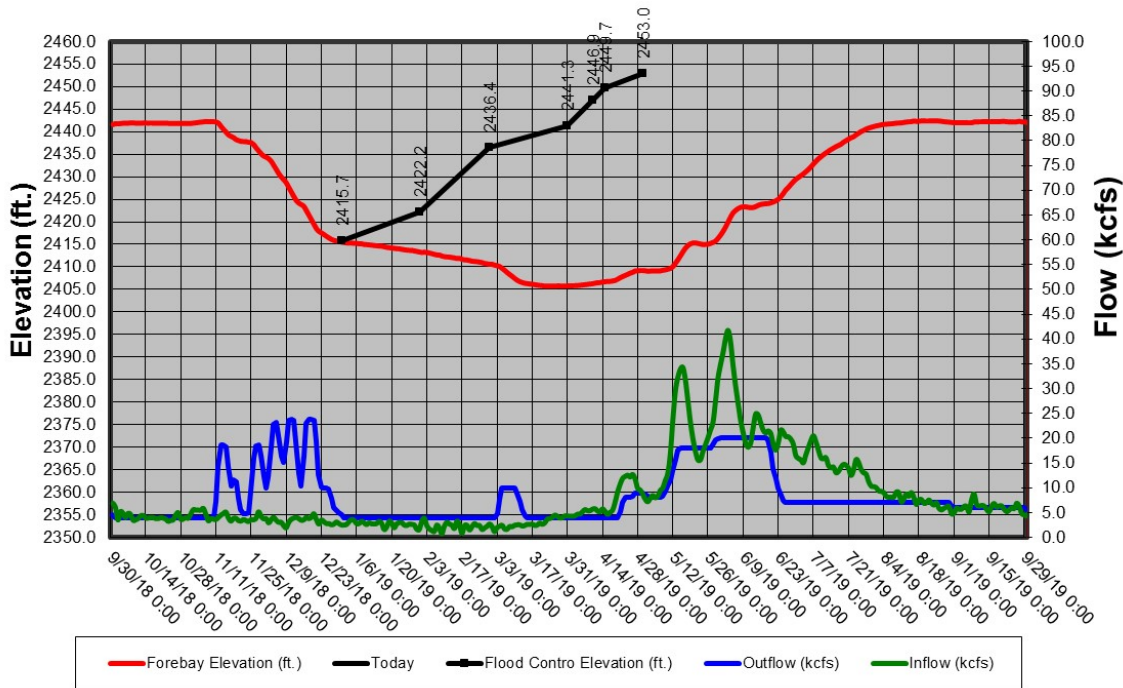
BOR	Support
BPA	Support
Colville Tribe	Support
COE	Support
Idaho	Support
Kootenai Tribe	Absent
Montana	Support (Contacted by Corps after the meeting)
Nez Perce Tribe	Support
NOAA	Support
Oregon	Support
SpokaneTribe	Absent
Umatilla Tribe	Support
USFWS	Support
Warm Springs Tribe	Absent
Washington	Support

Based on the polling results from the TMT the Corps will implement the SOR. The Corps followed up with Montana after the meeting and Montana was in support of the SOR.

Summer Draft Target: As described in the the 2018 CRSPA (pg 29) Libby Dam releases are managed to meet the September 30 targets (draft to 10 feet from full, elevation 2449 feet) by the end of September, except in the lowest 20th percentile water years, as measured at The Dalles, when the draft increases to 20 feet from full (elevation 2439 feet) by the end of September. If the project is forecast to fail to refill 20 feet from full, Libby will operate to pass inflow or operate to maintain minimum flows through the summer months.

The Dalles May Water Supply forecast of 82.4 MAF (94% of average) set the end of September draft target to 2449 feet this year. Due to insufficient water supply volume following the sturgeon pulse there was no draft during the month of September to 2449 feet for flow augmentation. Libby Dam remained on bull trout minimum outflows of 7 kcfs (June 26 through August 31) following the Sturgeon pulse, reaching a maximum forebay elevation of 2442.4 feet on August 23. Libby Dam bull trout minimum outflows during the month of September were 6 kcfs and the September 30 midnight reservoir elevation was 2442.1 feet.

Libby Operations



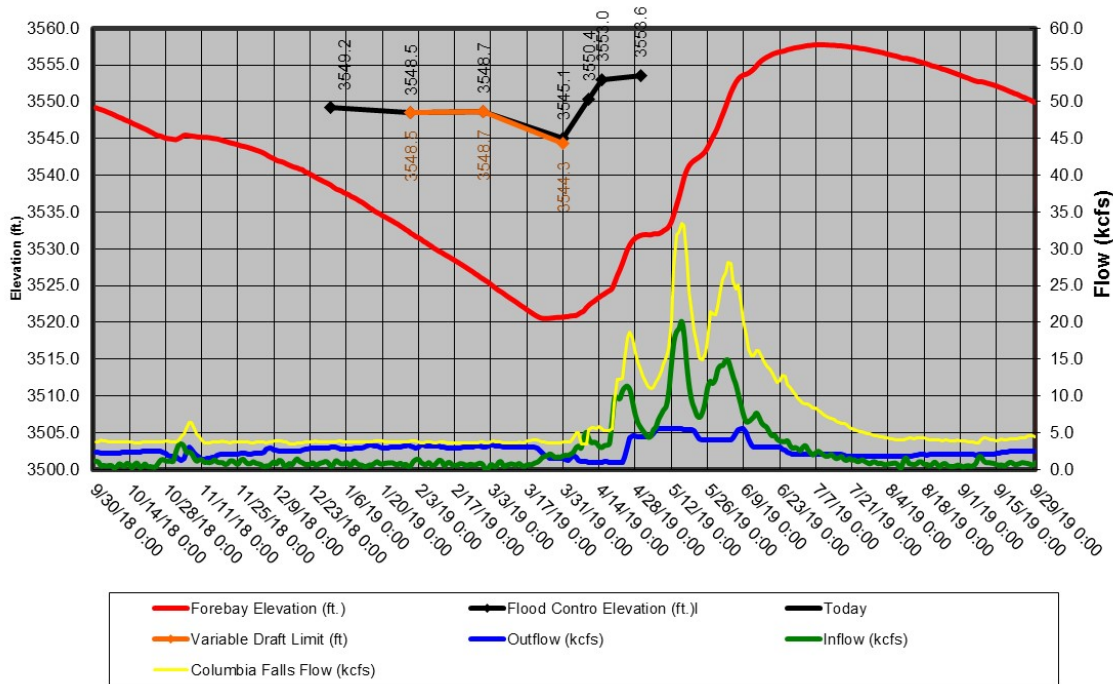
Hungry Horse Dam

Water Supply Forecast and Minimum Flows: The minimum flow requirements are measured at two locations the South Fork Flathead River below Hungry Horse Dam and the Flathead River at Columbia Falls. The minimum flows will be determined monthly, beginning in January, with the Bureau of Reclamation’s WSF forecast for Hungry Horse Reservoir for the period of April 1 to August 31. The final flow levels, for the remainder of the calendar year, are based on the March Final forecast.

April 10 and June 30 Refill Objectives: The Bureau of Reclamation computes Hungry Horse’s final April 10 elevation objective by linear interpolation between the March 31 and April 15 forecasted flood control elevations based on the March Final WSF.

Summer Draft Limit: The summer reservoir draft limit at Hungry Horse is 3550 feet (10 feet from full) by September 30, except in the lowest 20 percentile of water years (The Dalles April-August < 72.2 MAF) when the draft limit is elevation 3540 feet (20 feet from full) by September 30. The RFC’s May Final April-August forecast is used to set the official draft limit.

Hungry Horse Operations



Grand Coulee Dam

April 10 and June 30 refill Objective: The Bureau of Reclamation computes Grand Coulee’s final April 10 elevation objective by linear interpolation between the March 31 and April 15 forecasted flood control elevations based on the March Final WSF for The Dalles. The April 10 elevation this year is computed to be 1283.3 feet. The observed elevation at 1262.7 was the result of flow augmentation support for chum and chinook salmon below Bonneville Dam and chinook salmon in the Hanford Reach below Priest Rapids Dam.

The Lake Roosevelt Incremental Storage Release Program: This section will be updated throughout the season as new information becomes available.

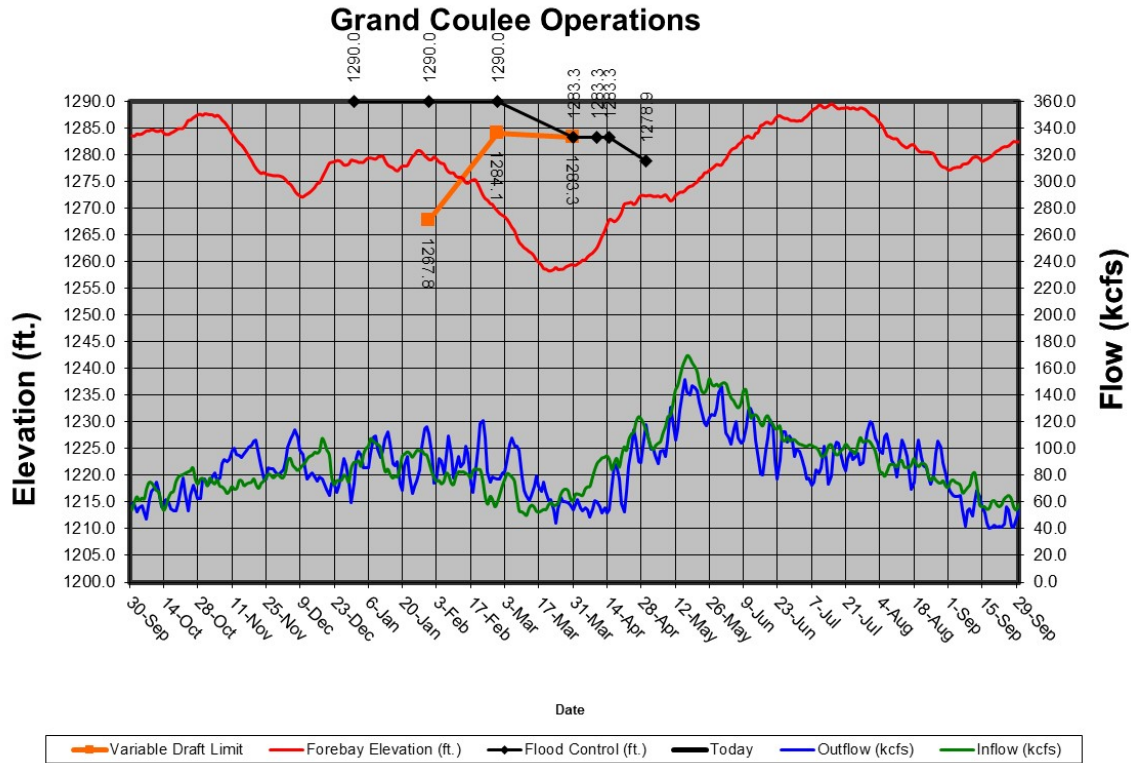
Table 8. Lake Roosevelt releases requested for 2019.

“Bucket”	2019 Releases (acre-feet)	Total Lake Roosevelt Incremental Storage Releases Program (acre-feet)
Odessa		
M&I		
Instream Flow		

Summer Draft Limit: The Grand Coulee summer draft limit is set by the magnitude of the RFC's July Final April-August WSF at The Dalles Dam.

Drum Gate Maintenance: Drum gate maintenance was deferred in 2019.

Banks Lake: This section will be updated as information becomes available.



Dworshak Dam

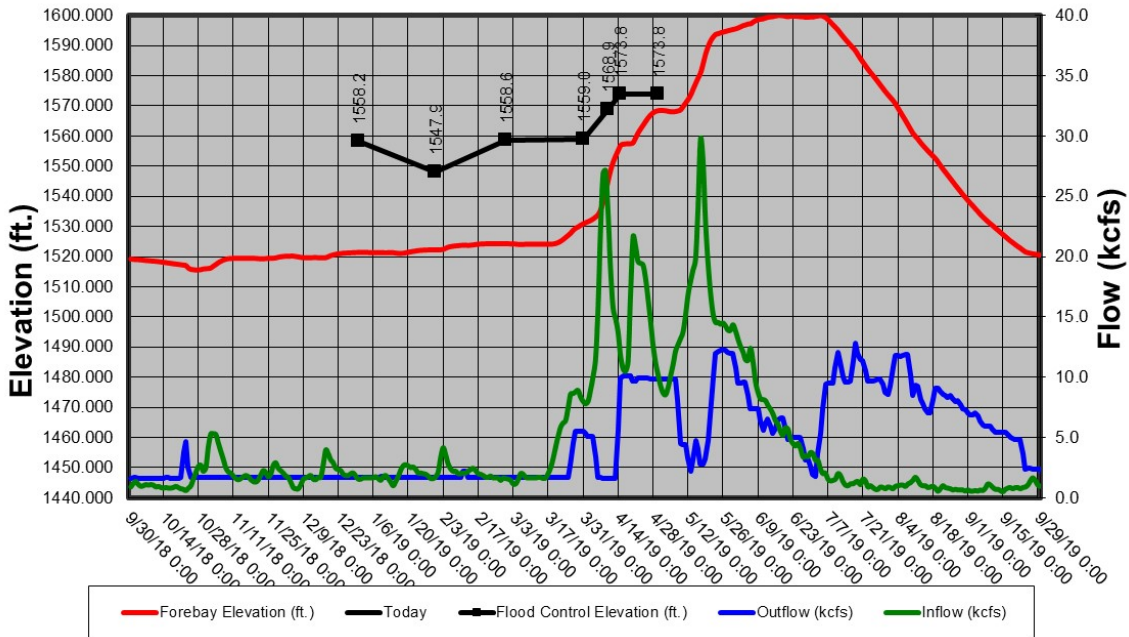
July 17, TMT Meeting. The Nez Perce Tribe coordinated with the TMT SOR #2019-1, Dworshak Dam Discharge Management, dated July 9, 2019. The objective of the SOR was to request prioritization of the following Dworshak Dam operations described in the 2018 CRSPA (page 45). Specifically, the SOR requested prioritizing operating Dworshak Dam to maintain water temperatures at Lower Granite Dam tailwater at or below the water quality standard of 68° F, over drafting Dworshak Dam elevation 1535 feet by the end of August.

TMT Members were polled on the SOR and provided the following responses.

BOR	Support
BPA	Support
Colville Tribe	Absent during the TMT meeting but was supported during the previous FPAC meetings
COE	Support
Idaho	Support
Kootenai Tribe	Absent
Montana	Support
Nez Perce Tribe	Support
NOAA	Support
Oregon	Support
Spokane Tribe	Support
Umatilla Tribe	Support
USFWS	Support
Warm Springs Tribe	Support
Washington	Support

Based on the results of the poll the Corps decided to implement the SOR. Dworshak Dam midnight reservoir elevation on August 31, was 1538.7 feet. Lower Granite Dam tailwater (LGNW) day average temperature from August 1 through 31 was 67.2 ° F. During the month of August the day average minimum was 66.0 ° F on August 11 and a maximum day average of 68.1 °F on August 6.

Dworshak Operations



2.5. Water Quality

The AAs have coordinated the following spill priority lists with the TMT to date, and they may be found on the following website.

<http://pweb.crohms.org/tmt/documents/spill-priority/>

2.6. Burbot Temperature Management (Libby Dam)

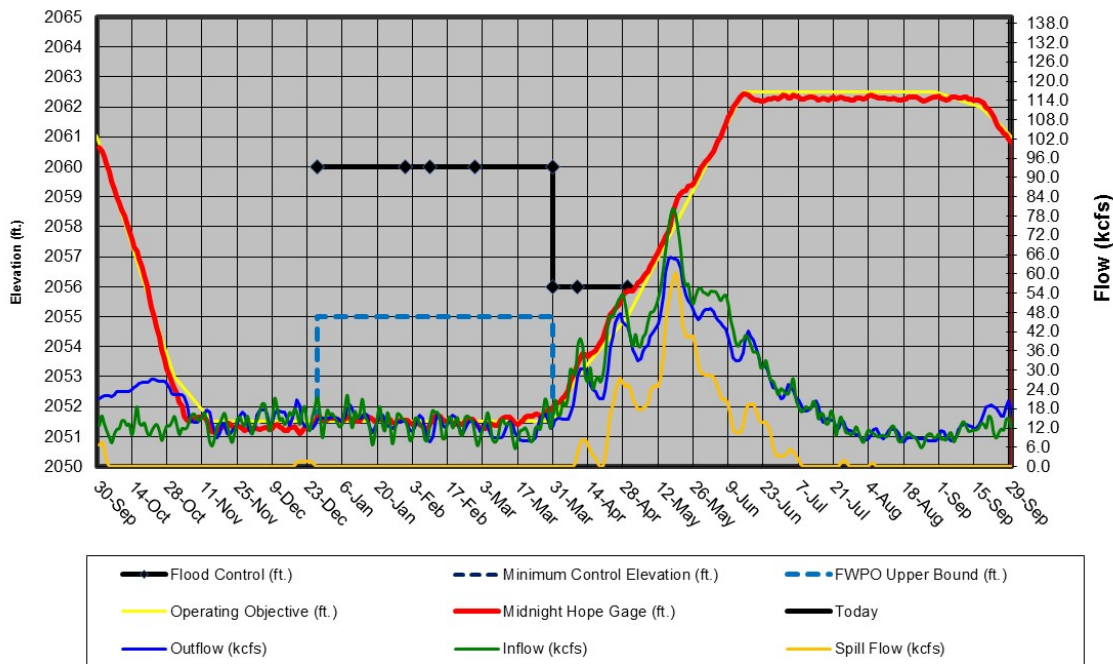
Under the terms of a Memorandum of Understanding (MOU) prepared in 2005 by the Kootenai Valley Resource Initiative (KVRI) and signed by the Corps, the selective withdrawal gate system at Libby Dam has been set to release the coldest water available in the forebay starting in early

November, before reservoir isothermy prevents temperature control capability. The purpose of this operation is to provide river temperatures that are closer to normative thermal conditions to optimize spawning conditions for burbot in the Bonners Ferry reach of the Kootenai River. This operation will likely result in November and December temperatures being slightly cooler than the existing selective withdrawal temperature rule curve.

2.7. Lake Pend Oreille Kokanee Spawning Flows (Albeni Falls Dam)

Regarding the 2017-2018 operation the the AAs implemented an MCE of 2051 feet (operating range of 2051-2052 feet). No flexible winter power operations were requested by BPA.

Albeni Falls Operations



2.8. Upper Snake Flow Augmentation

This section will be updated throughout the season as new information becomes available.

2.9. Chum Operation

Date	TMT Coordination Summary
October 17, 2018	TMT discussed the potential start of the chum spawning operation. No chum have been observed to date. Better information will be available in two weeks. TMT will discuss the start date of the chum spawning operation at the TMT meeting on October 31.
October 29, 2018	<p>The Corps updated the TMT on chum, which arrived earlier than previously expected. Current operations show Bonneville Dam project outflows are 98.1 kcfs, with a project tailwater elevation of 10.2 feet. The RFC Bonneville Dam inflow forecast indicates slightly higher inflows, ranging from 88 kcfs to 134 kcfs over the next 10-day period. The 30-day weather forecasts are indicating above average temperatures and below average precipitation; the 90-day forecasts are expected to follow the same trend. NOAA, reminded the group that when the chum operation starts, it runs for five months (through April 2019). NOAA noted that the chum salmon spawning surveys below Bonneville Dam thus far are surprisingly active, on October 22, 60 chum were observed and on October 25, 137. Today's survey (not yet posted), however, did not observe any chum. This is causing some confusion as chum are in the area as confirmed by counts from crews in the field and fish passing over Bonneville (ladder count of 3). NOAA notified the group of today's FPAC meeting, and the general agreement to start the operation on November 2, at 6:00 am, with regular check-ins on river and spawning conditions.</p> <p>BPA clarified that holding the tailwater at a constant elevation between now and the start of the chum operation on November 2 will be difficult, as there is not enough water currently to keep 11 feet around the clock. NOAA noted the preference to provide spawning habitat around the clock, if at all possible.</p> <p>The Corps confirmed the following operation that will start at 6:00 am on Friday, November 2.</p> <p>Operate the Bonneville tailwater in the following order of operating ranges as outflow increases:</p> <ol style="list-style-type: none"> 1. 11.5-13.0 feet during all hours. 2. If necessary, increase outflow up to 16.5 feet during nighttime hours, with highest flows around midnight. 3. If necessary, increase outflow to 18.5 feet during nighttime hours, with highest flows around midnight.

Date	TMT Coordination Summary
	<p>4. Then, if necessary, operate to provide a tailwater between 13.0-16.5 feet during daytime hours, and up to the maximum within the 24-hour ramp rate during nighttime hours.</p> <p>Due to concerns regarding the ability to hold Grand Coulee reservoir above 1,283 feet until November 15, BOR, Colville Tribe, and BPA will stay in close coordination. Additionally, if conditions change drastically (i.e., the forecasted precipitation does not materialize), an unscheduled TMT meeting will be called.</p>
November 7, 2018	<p>The Corps, updated the TMT on the chum operation which started on November 2. Bonneville Dam project tailwater elevations have been between 11.5 - 13.0 feet, as coordinated with TMT at the October 29 meeting. Outflows are forecast to be around 121-134 kcfs for the next 10-day period. Climate forecasts show higher than average to normal temperatures over the next 6 - 10 days, with lower than average precipitation in the same timeframe. Looking further out, the 8 - 14 day forecast calls for above average temperatures and below average precipitation; the 30 day outlook is for above average temperature and above average precipitation.</p> <p>NOAA, reported that on October 22, 60 chum were observed and on October 25, 137. These chum were reported to be both green and ripe, however, no redds were sighted. BPA, reported recent survey data (not yet posted) that showed 93 chum on November 1 and 40 on November 5; additionally, there were 1,300 Chinook estimated in the Hamilton Creek area. A total of 14 chum have passed Bonneville. WDFW, noted the survey on October 29 and none of the chum observed in prior surveys were found and none were observed. Four sea lions were observed closer to the islands than mid channel between Ives/Pierce and the South Shore Bank.</p> <p>The group discussed the railroad bridge construction and pile driving that is happening near Hamilton Creek, noting that it would be helpful if WDFW could consult internally for more information on when the pile driving will be complete. Those who visited the creek observed that the pile driving is disruptive to the chum and is causing increased sedimentation on the spawning grounds. Additionally, the Corps provided an update on removal of the sunken tugboat off of Ives Island, noting that contractors were not able to remove the boat this year and will plan for removal next year. Salmon Managers asked that the boat be removed prior to chum spawning season.</p>
November 21, 2018	<p>The Corps updated the TMT on the chum operation, which started on November 2. Bonneville Dam project tailwater elevations have been between 11.3 – 13.0 feet during all hours as coordinated with TMT at the November 13 meeting. Bonneville project tailwater has been fluctuating between 11.3 - 11.8 feet, and has been in that range over the past several days. NOAA, reported that 93 chum were observed on November 1, and 13 on November 13, with very few redds sighted. WDFW, noted that 100 chum were observed during this week’s survey, and so far</p>

Date	TMT Coordination Summary
	<p>8,000 Chinook have been observed this season. There were 5,000 Chinook estimated yesterday with the majority of those being natural origin/wild, upriver brights. A total of 90 chum have passed Bonneville.</p> <p>BPA, presented photographs from the field around Ives Island, from both November 9 & 16. BPA noted that Hamilton Creek has gone dry upstream of the confluence with Hamilton Springs. Hamilton Creek is flowing downstream of the confluence with flow from Hamilton Springs. The areas of upwelling in the Ives Pocket area were flowing on November 9 but have since dried up by November 16. The forecasted wave of rain is expected to recharge Hamilton Creek. The Corps reported that Bonneville inflows are forecast to drop from 130 to 125 kcfs for the next 10 - day period. Climate forecasts show rain and freezing level drop over next 3 days, with a dry weekend and then a higher freezing level and rain early next week.</p> <p>Forecasts show above average temperatures and above average precipitation over the next 6 - 10 days and 8 - 14 days. Looking ahead, the 30 - day (and 90 - day) outlook has warmer than average temperatures and likely normal precipitation. In addition, the Willamette flow forecasts show a significant rise, which could help minimize the amount of water needed to meet the targeted Bonneville tailwater elevation. The plan is to continue the chum operation to maintain tailwater in the 11.3 – 13.0 foot range for the foreseeable future. BOR, noted that Grand Coulee operations for chum are likely heading for the lowest end of November elevation in post BiOp era since 2000, which was 1,276.7 feet.</p>
November 28, 2018	<p>The Corps, updated the TMT on the chum operation that was coordinated during the November 13 TMT meeting. The steps of the operation are posted to today's agenda. At Bonneville, the current total outflow is 121.9 kcfs, and the project tailwater elevation is 11.5 feet. Project inflows are forecast to range from 120 down to 115 kcfs, with continued similar flows over the next 10 - day period. Current forecasts for the Columbia Basin are looking dry, with up to 25% - 50% below average precipitation over the next 5 - 10 days. Climate forecasts over the next 6 - 10 days show a probability of below average temperatures and precipitation, with a probability of above average precipitation 8 - 14 days out. The increased precipitation should help with the chum operation and hopefully decrease augmentation needed from Grand Coulee. Looking ahead at the 30 - day outlook, forecasts show probability of above average temperatures, while precipitation shows equal chance of being below or above normal at this time.</p> <p>BPA, reported that 355 chum were counted yesterday (November 26), and that teams are out marking redds today. NOAA reported that the cumulative passage at Bonneville Dam is 163 to date, with 41 passing yesterday. BPA also noted that the USGS gauge at Hamilton Creek would be helpful to add as a link on the meeting</p>

Date	TMT Coordination Summary
	agendas so that TMT can track it. BPA shared that the recent rains have re-watered Hamilton Creek.
December 7, 2018	<p>The following was an email sent to the TMT on Demcember 7, to provide an update on the chum operation.</p> <p>“TMT Members and Alternates,</p> <p>As a result of an unexpected down power of Columbia Generating Station there is a need to move some additional water through the system over the next 2 - 4 days. Due to generally dry conditions we are making a small adjustment to the chum operation to minimize the risk of chum spawning at higher elevations while this water moves through the system. After coordination with WA we are narrowing the daytime tailwater elevation from 11.3 to 13.0 feet down to 11.3 to 12.0 feet in order to keep the daytime TW below elevation 12.0 feet and move any additional water at night. The BPA and Corps will give an update on this operation during our next TMT meeting that is scheduled for Wednesday, December 12. Project operations and additional information on the chum operation may be found on the agenda for our next meeting on the following website.”</p> <p>Note: Operation reverts back to 11.3 to 13.0 feet on December 11.</p>
December 20, 2018	<p>The following was an email sent to the TMT on Demcember 20, to provide an update on the chum operation.</p> <p>“TMT Members, Alternates, and Interested Parties,</p> <p>The Action Agencies (AA) will start the chum incubation operation on Wednesday, December 26, at 0500 hours, as coordinated during our December 12, TMT meeting. Based on the recommendation from the FPAC the AA's will maintain a Bonneville Dam (BON) tailwater (TW) minimum of 11.3 feet on all hours during the chum incubation operation. Prior to commencement of the chum incubation operation the AA's will continue to operate the Bonneville Dam tailwater in accordance with the current chum spawning operation that was coordinated during our December 12, TMT Meeting (see agenda for details). The BON minimum TW elevation for chum incubation will be effective through April 9, 2019, unless coordinated otherwise with the TMT. The AA's will provide an update on the chum operation during our next TMT meeting on January 2, 2019. BON hourly operations data as well as additional information regarding the chum operation may be found on the January 2, TMT Meeting agenda on the following website.”</p>
December 21, 2018	The following was an email sent to the TMT on Demcember 21, to provide an update on the chum operation.

Date	TMT Coordination Summary
	<p>“TMT Members, Alternates, and Interested Parties,</p> <p>The Action Agencies (AA) revised the start date/time of the chum incubation from December 26, to today (December 21) at 1200 hours based on the recommendation from Washington Department of Fish and Wildlife (WDFW). The revised start date/time was based on WDFW survey that occurred today that indicated chum spawning is complete. The AA's will maintain a Bonneville Dam (BON) tailwater (TW) minimum of 11.3 feet on all hours during the chum incubation operation. The BON minimum TW elevation for chum incubation will be effective today through April 9, 2019, unless coordinated otherwise with the TMT. The AA's will provide an update on the chum operation during our next TMT meeting on January 2, 2019. BON hourly operations data as well as additional information regarding the chum operation may be found on the January 2, TMT, meeting agenda on the following website.”</p>
January 2, 2019	<p>The Corps, provided an update on chum operations. Per the email sent to TMT members on December 21, 2018, Action Agencies shifted from the chum spawning to incubation operations at Bonneville Dam. The change was made as a result of WDFW surveys on December 21, 2018, which showed that chum were no longer present. The incubation operation sets a minimum Bonneville tailwater elevation of 11.3 feet at all hours.</p> <p>Current hourly data at Bonneville show the current tailwater at an average of 11.8 feet, with yesterday’s range between 11.4 - 14.3 feet. Project inflows are currently around 119 kcfs and are forecast to go up this weekend to around 140 kcfs and back down to 126 kcfs at the start of next week. Flows should be sufficient to maintain the Bonneville tailwater at or above the minimum of 11.3 feet for chum redd incubation protection.</p> <p>Chum spawning ground surveys below Bonneville at the Ives/Pierce Island complex peaked around 365 on November 27, went down to 322 on December 4, and on December 11, 198 lives were observed, with 19 redds. BPA and WA noted survey data from after December 11 are not yet posted.</p>
January 16, 2019	<p>The Corps reported that the Action Agencies continue to implement the chum incubation operation at Bonneville Dam, which maintains a tailwater elevation minimum of 11.3 feet at all hours. This operation will continue until otherwise coordinated with the TMT. WA added that WDFW estimates a total of 15,000 Chinook spawning in the area this year. WA noted that the Hamilton counts are not final, however, they are expected to be between 2,000 - 3,000 chum.</p> <p>Current hourly data at Bonneville Dam show a total outflow at 0800 hours of 181 kcfs and project tailwater elevation at 14.2 feet. Inflow forecasts over the next 10 - day period show a decrease in inflows down to 135 kcfs over the first 3 days and then ramping up to 150 kcfs by the end of the 10 - day period.</p>

Date	TMT Coordination Summary
January 30, 2019	<p>The Corps reported no change to chum incubation operations since implementation began on December 21, 2018. Operations at Bonneville Dam continue to maintain a tailwater elevation no lower than a minimum of 11.3 feet at all hours, and will do so until otherwise coordinated with the TMT. Current hourly data at Bonneville show a total outflow of 136.5 kcfs and project tailwater elevation at 11.9 feet. RFC inflow forecasts over the next 10 - day period anticipate a slight increase in project inflows up to 148 kcfs tomorrow, then coming back down to 120 kcfs by the end of the 10 - day period. WA noted that the most recent chum survey data are listed on the FPC website.</p>
February 13, 2019	<p>The chum incubation operation continues with a Bonneville Dam tailwater minimum of 11.3 feet at all hours. Today's tailwater was 12.7 feet and outflows at 0800 were 138 kcfs. The inflow forecast is for a slight increase to 150 kcfs and then back down at the end of the 10-day period to near 120 kcfs.</p> <p>Reclamation, noted that the current Bonneville Dam tailwater operation for chum is forecasted to draft Grand Coulee Dam by April 10 to 1252 feet, which is 31 feet below the April 10 FRM elevation of 1283.3 feet based on current below average water supply conditions.</p>
February 27, 2019	<p>The chum incubation operation continues with a Bonneville Dam tailwater minimum of 11.3 feet all hours. Today at 0700, the tailwater elevation was 13 feet and outflows were 156.2 kcfs. The inflow forecast is for a slight decrease from today's high of 135 kcfs down to 115 kcfs by the end of the 10-day period.</p> <p>NOAA questioned if 115 kcfs was enough to maintain chum. NOAA noted that the next 10 days does not look promising precipitation-wise and that salmon managers have decided to hold the course for chum and revisit next week. They do NOT want to risk overdrafting Grand Coulee based on the forecast.</p>
March 6, 2019	<p>The chum incubation operation continues with a Bonneville Dam tailwater minimum of 11.3 feet all hours. TMT faced a difficult decision today whether or not to dewater the chum redds. With flows especially low this year, agencies need to be careful not to overdraft early in the season. Balancing these two issues is difficult. ID, pointed out, this season shaped up to look dry but a few unexpected snow storms hit the area. With that in mind, salmon managers expressed an interest in not rushing into a decision, in the event that the upcoming forecast changes. Much of the conversation centered on whether to wait or not and how much water would be necessary to change conditions.</p> <p>BPA reported that the support for chum also meets the minimum flow requirements at Hanford Reach. Both operations are expected to continue drafting Grand Coulee Dam. There is currently little to no chance of achieving the 1,283 feet April 10 elevation objective for flood risk management at Grand Coulee while meeting the downstream flows.</p>

Date	TMT Coordination Summary
	<p>Reclamation, advocated for making a decision now. If managers chose today to de-water chum it could save a differential of two feet of water over a week, estimated Reclamation. “We keep kicking the can down the road,” Reclamation said. The problem with this is that it could result in drafting water that is necessary later in the season. Reclamation pointed to drying conditions across the board in Northern Basin, where most of the Columbia’s water comes from. Hoping the Snake will bail us out is tenuous, Reclamation said. Reclamation called for salmon managers to make a decision on today’s call about whether or not to “abandon” chum.</p> <p>With the possibility of the forecast changing, salmon managers decided to continue operating to meet chum flows at Bonneville Dam and scheduled a TMT conference call for Monday, March 11, to revisit the issue. The Corps asked salmon managers to think about specific operations they would like to run if they were to dewater chum.</p>
March 11, 2019	<p>The chum incubation operation continues with a Bonneville Dam tailwater minimum of 11.3 feet all hours. TMT faces a difficult decision today whether or not to dewater chum salmon. With flows especially low this year, agencies need to be careful not to overdraft early in the season. At last Wednesday’s TMT, salmon managers decided to stay the course with the chum operation. Today should offer new information for salmon managers to inform their decision of whether or not to dewater chum and fall Chinook salmon that spawned downstream of Bonneville Dam this year.</p>
March 13, 2019	<p>Reclamation, reported on operations at Grand Coulee Dam. Outflows and inflows have continued to decrease over the last week. The dam is drafting about half a foot a day. This will likely continue for the foreseeable future. Reclamation is continuing to operate to maintain the chum operation, which requires a Bonneville Dam tailwater minimum of 11.3 feet.</p> <p>NOAA, position – as well as FPAC’s – is to maintain chum for the next week, then re-assess. NOAA noted there is some risk to spring flows but the risk is worth it for the moment considering all of the low elevation snow still in the region that isn’t accounted for in the forecasts and that Snake River flows may be increasing soon as temperatures warm.</p> <p>Reclamation, took the same position as he has in weeks past, saying, “We keep hoping for average conditions. We’ll see how it goes. There’s going to be a point given snowpack that we may not have the flows coming out of Coulee we have hoped for.”</p> <p>Reclamation mentioned that the STP is showing Grand Coulee at elevation 1,248</p>

Date	TMT Coordination Summary
	<p>feet on April 10, which is well below 1283.3. If streamflows come in lower, the elevation will be even lower and could be problematic for the ferry across Lake Roosevelt. It will also potentially mean there will not be much water going into spring.</p> <p>NOAA said there is the option to just operate to maintain Vernita Bar, or even to cut that and just focus on refill. At the moment, the data seem to show Snake River flows increasing. However, the data next week could show a different story. Since every single day is important for the development and emergence of the chum, NOAA is siding on maintaining the chum at least for this week and then revisiting. NOAA noted that he recognizes that we are not where we want to be with Grand Coulee elevation and that the FRM elevation of 1,283 feet on April 10 is not an option at this point.</p> <p>The Colville Tribe, mentioned there seems to be quite a bit of low elevation snow, which may help with inflows into Coulee and in the lower Columbia River, especially with forecasted temperatures in the mid- to high 50s this coming week.</p> <p>WA, echoed The Colville Tribe, saying that anecdotally that WA has observed a lot of low elevation snow in his travels which may melt and provide increased runoff.</p> <p>The USFWS, said it seems like it is a tradeoff between two bad options. No one likes to see Grand Coulee get this low. Choosing to de-water chum is almost certain to wipe out a cohort of chum and fall Chinook below Bonneville Dam. However, that choice also has impacts on juvenile survival this spring. The USFWS position right now is to use the water available now in Grand Coulee to prevent almost certain loss of chum and fall Chinook below Bonneville. It is a gamble, he said but it seems like salmon managers are united in wanting to take that risk.</p> <p>ID, wondered if anyone has a good estimate of when Vernita Bar fall Chinook are estimated to emerge from the redds. BPA, said water temperatures are still really cold for chum incubating below Bonneville. Temperature units are currently accruing at approximately 2-4 degrees Celsius per day. The chum are still on track to emerge by April 10 or so. The estimate for emergence of Vernita Bar fall Chinook is May 11.</p>
March 20, 2019	<p>The Corps, began by providing the TMT with an update on the current water supply forecasts for Corps projects.</p> <ul style="list-style-type: none"> • The Dalles: NWRFC April to August volume forecast (5 days QPF) is 73 maf, or 83% of average; and,

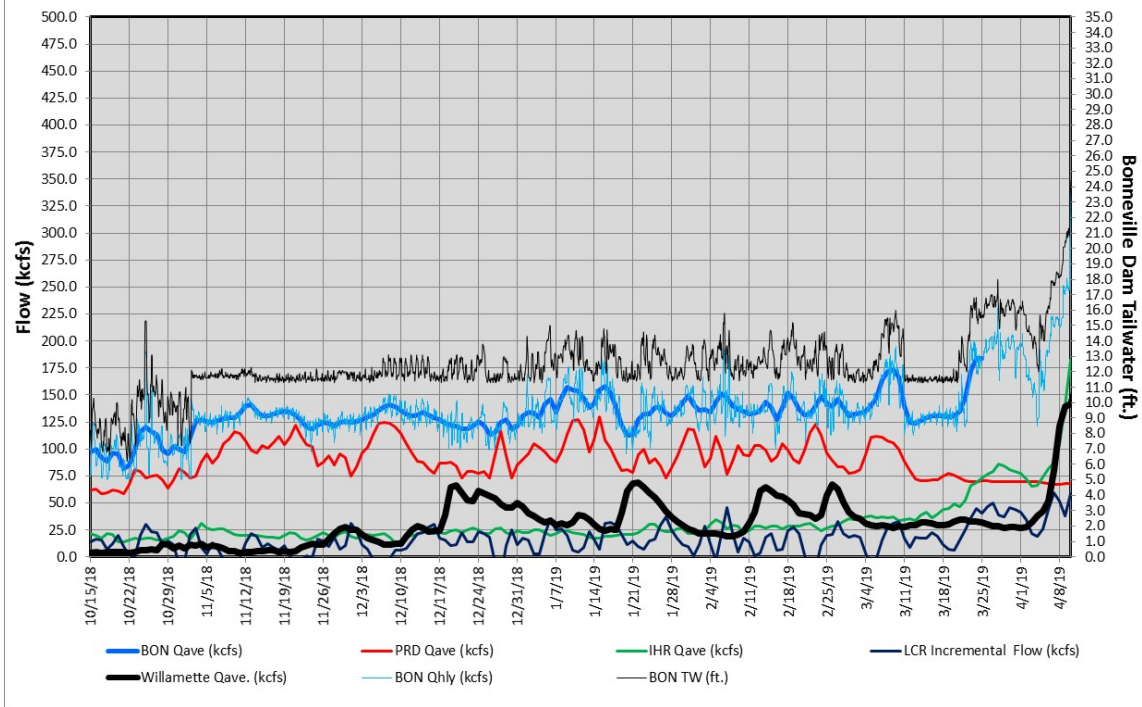
Date	TMT Coordination Summary
	<p>• Lower Granite: NWRFC April to July volume forecast (5 days QPF) is 17 maf, or 88% of average.</p> <p>Reclamation, reported on Grand Coulee operations. The project is currently operating to meet Vernita Bar, with a midnight elevation of 1258.7 feet, inflows of 52,000 cfs and outflows of 75,000 cfs.</p> <p>The forecasted increase in Snake River inflows will help provide the chum tailwater, and thus Grand Coulee operating for Vernita Bar is sufficient to maintain the chum tailwater below Bonneville Dam. Over the next 10-day period, inflows at Lower Granite are expected to increase up to about 56 kcfs, and inflows at Bonneville are forecast to hover between 133-145 kcfs. With the Snake River coming up, as well as incrementals, Bonneville inflows will be more than enough to meet the 11.3 feet chum tailwater minimum.</p> <p>Chum Cumulative Day Average Degree Days - March 15</p> <p>NOAA, provided a report on chum emergence and temperature units (TUs), noting that emergence for both chum and Chinook is expected at around 1,000 TUs. According to the information available, the earliest spawning chum within the area monitored for temperature, is approaching up to 1,300-1,400 TUs, and the later spawners are up to around 1,000 TUs. NOAA concluded that the magic numbers have been hit, if indeed the numbers accurately reflect where the chum spawned – which is not the case for all of the chum that spawned downstream of Bonneville Dam. WDFW, noted that site visits to Hamilton Creek suggest that emergence will be later in the Hamilton area, as the emergence has not peaked yet. Additionally, Chinook are further behind in regard to emergence and TUs, as they tend to spawn in locations without hyporheic flow.</p> <p>It was noted that TUs are also tracked for the Hanford Reach fish below Priest Rapids, and they're estimated for a later emergence, estimated to be around May 11th. This is likely the timeframe that fall Chinook and chum from later spawners below Bonneville will be emerging.</p>
April 3, 2019	<p>The Corps, stated for the record that the TMT did not end chum operations early, and thus the Chum operation will end on April 10 when spill season starts on the lower Columbia River. WDFW, noted appreciation that flows were able to support chum all season, however, he expects that emergence will be complete sometime after the April 10 end date. Charlie also included the hope that flows will be sufficient to maintain depth compensation in the Ives-Pierce area to avoid TDG concerns.</p>

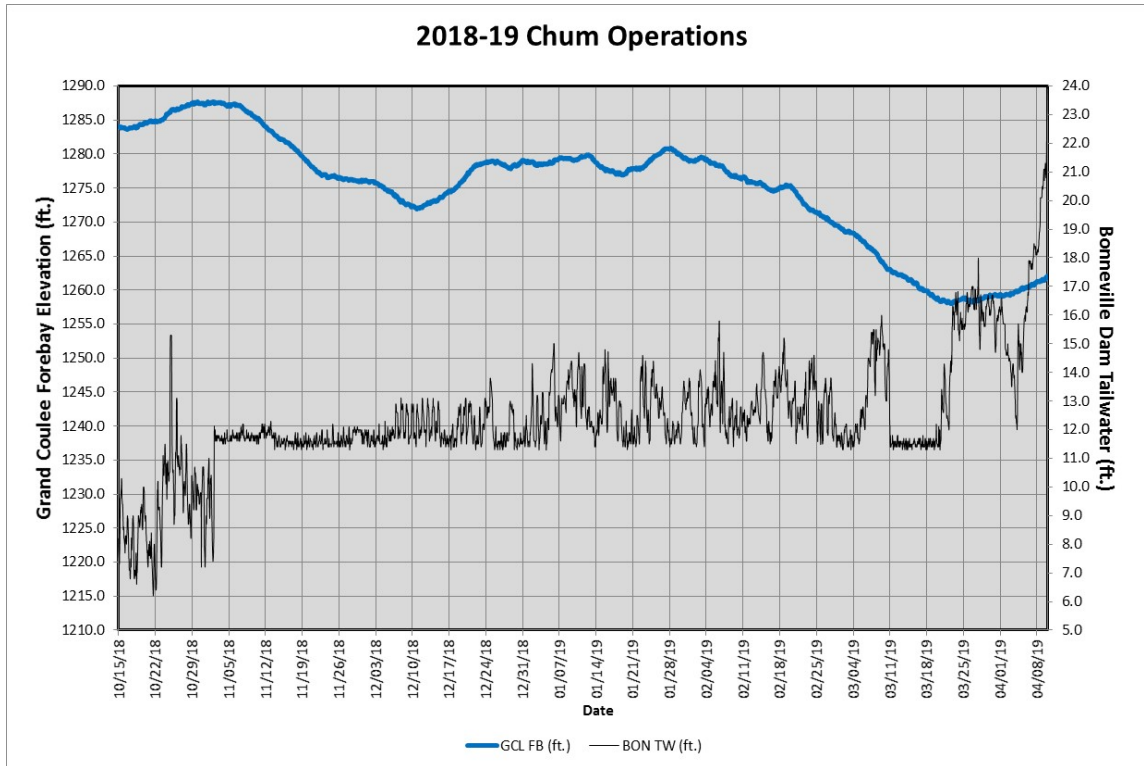
Dates	Chum Water Management Summary
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Dates	Chum Water Management Summary
November 2, 2018	The chum operation began during a period of very low flows in the Columbia River with the flow at Bonneville Dam averaging ~100 kcfs in the last half of October. At the start of the chum operation the forebay at Grand Coulee Dam was at ~elevation 1288 feet. Hamilton Creek was completely dry until it finally watered up on October 29.
November 2-20, 2018	Dry conditions and east winds require as much as 140 kcfs on many hours to meet the 11.5 foot TW minimum. The augmentation for the chum operation drafts Grand Coulee to ~elevation 1278 feet.
November 21, 2018	The drop in the minimum TW to 11.3 feet allows operation to minimize the draft on Grand Coulee.
November 21 - December 7, 2018	Hourly TW is generally below 12.0 feet with an average across this period of 11.7 feet. Augmentation from Grand Coulee drafts Lake Roosevelt to ~elevation 1274 feet.
December 7, 2018	Columbia Generating Station unexpectedly drops generation. The chum daytime operating range is modified to 11.3 - 12.0 feet from 11.3 to 13.0 feet allowing daytime operation to keep the daytime tailwater below 12.0 feet.
December 11, 2018	Operation reverts back to the original operation of 11.3 to 13.0 feet as the impact of the loss of generation is managed by BPA.
December 18 - 25	Above average precipitation finally produces a response on the Willamette River which lowers the augmentation required from Grand Coulee. This combined with increased inflow to Grand Coulee allows Lake Roosevelt to fill to ~elevation 1278 feet.
December 25 - January 16	Grand Coulee forebay is being managed to minimize draft as a measure against the uncertainty of drum gate maintenance. The water supply forecasts to date have been close to the trigger.
January 17 - February 5	During this period Grand Coulee generally passed inflow ending the day on February 5 at elevation 1278.4 feet.
February 5	February final forecasts were released and were lower across the board. The forecasted April 10 objective at Grand Coulee has increased to elevation 1283.3 feet. The April 30 FRM elevation based on the February final forecast is 1275 feet. Therefore, drum gate maintenance will not be scheduled this year.
January 16 - February 20	During this period Grand Coulee drafted approximately 3 feet in support of the chum operations. Additional inflow from Canadian storage releases were passed above that needed for chum but ended each week at the same elevation as would have occurred if the releases did not occur.
January 17 - February 5	During this period Grand Coulee generally passed inflow ending the day on Feb 5 at elevation 1278.4 feet.
February 5	February final forecasts were released and were lower across the board. The

	forecasted April 10 objective at Grand Coulee has increased to elevation 1283.3 feet. The April 30 FRM elevation based on the February final forecast is 1275 feet. Therefore, drum gate maintenance will not be scheduled this year.
January 16 – February 22	During this period Grand Coulee drafted approximately 3 feet in support of the chum operations. Additional inflow from Canadian storage releases were passed above that needed for chum but Grand Coulee ended each week at the same elevation as would have occurred if the releases did not occur.
February 23 – March 11	Continued draft (~9') of Grand Coulee to support the chum operation. During this period flow on the Snake River increased in flow from the ~25-30 kcfs to close to 40 kcfs.
March 12-20	Continued draft (~4') of Grand Coulee to support the chum operation with inflow to Lake Roosevelt 55 kcfs. Continued increase in Snake River flow makes up the difference and the TW below BON ran very close to the minimum.
March 21- April 10	Snake River flow increases from ~50 kcfs to just over 100 kcfs by April 10. The increase in Snake Flow allows Grand Coulee to follow the Hanford Reach flow and fill 4' to elevation 1262 feet on April 10 and 1272.4 feet by April 30. BON TW during this period was well above 13 feet.

2018-19 Chum Operations





Chum survey data gathered at the Ives/Pierce Island Complex will be summarized in the table below. Data from all Chum survey areas, including the Ives/Pierce Island Complex, are provided by the Fish Passage Center and available on the following website.

http://www.fpc.org/spawning/spawning_surveys.html

Table 8. Chum Data from Surveys of the Ives/Pierce Island Complex

Date	Lives	Dead ⁱ	Redds ⁱⁱ	Visibility
17-Sep-18	0	0	0	6 ft.
24-Sep-18	0	0	0	6 ft.
1-Oct-18	0	0	0	5 ft.
4-Oct-18	0	0	0	4.5 ft.
11-Oct-18	0	0	0	5 ft.
18-Oct-18	0	0	0	6.5 ft.
22-Oct-18	60	0	0	6 ft.
25-Oct-18	137	0	0	5.5 ft.
29-Oct-18	0	0	0	5 ft.
1-Nov-18	93	0	0	4.5 ft.
5-Nov-18	40	1	0	4.5 ft.
9-Nov-18	NC	0	NC	6 ft.
13-Nov-18	13	0	0	4 ft.
15-Nov-18	NC	0	NC	5.5 ft.
20-Nov-18	128	0	9	4.5 ft.
26-Nov-18	NC	0	NC	6 ft.
27-Nov-18	365	0	37	5 ft.
4-Dec-18	322	53	67	4.5 ft.
11-Dec-18	198	42	19	5 ft.
18-Dec-18	26	5	0	3.5 ft.
26-Dec-18	5	3	0	5 ft.
2-Jan-19	0	0	0	5 ft.

i. Dead are newly sampled fish only.

ii. Redds are an instantaneous count for the day, not cumulative.

2.10. Vernita Bar/Hanford Reach Fall Chinook Protection Program Operations (Non-BiOp Action)

The Hanford Reach Fall Chinook Protection Agreement (Agreement) establishes the obligations of the Parties with respect to the protection of fall Chinook in the Hanford Reach of the Columbia River. The Parties agree that during the term of the Agreement these flow regimes address all issues in the Hanford Reach with respect to fall Chinook protection and the impact of operation of the seven dams operating under Mid-Columbia Hourly Coordination, including the obligations of Grant, Chelan, and Douglas under any new licenses issued by the Federal Energy Regulatory Commission (FERC).

Beginning in mid-October, under the terms of the Hanford Reach Fall Chinook Protection Program Agreement, river flows are reduced every Sunday morning (day of lowest power

demand) to the Priest Rapids Dam minimum operating discharge of 36,000 cubic feet per second (ft³/s) [1000 cubic meters per second (m³/s)]. This allows the Agency and Utility Party Monitoring Team to manually survey for redd distribution at Vernita Bar just downstream of Priest Rapids Dam. These drawdowns occur every Sunday morning until the initiation of fall Chinook spawning has been set both above and below the 50,000 ft³/s (1,416 m³/s) flow elevations. A final drawdown is conducted on the Sunday prior to Thanksgiving to establish the minimum critical flow needed to protect pre-emergent fall Chinook. Given the previously described limitations, this weekly reduction in river flow affords the best viewing conditions for aerial flights. Aerial flights are therefore scheduled to be conducted concurrent with the Sunday morning drawdowns, when possible.

Date	Summary
October 3, 2018	The 2018-2018 Hanford Reach Protection Program will begin with Reverse Load Factoring on October 15, 2018. During Reverse Load Factoring discharge from Priest Rapids Dam (as measured as the USGS gage) will target between 55-70 kcfs during daylight hours. Redd counts on Vernita Bar will begin on October 21, and may continue on every Sunday throughout the Spawning Period. During redd surveys, discharge from Priest Rapids Dam will be need to be temporarily reduced to approximately 38 kcfs. Specific details for operational support during the Vernita Bar redd counts will be updated throughout the season and will be provided in individual flow requests.
October 21, 2018	On Sunday, October 21, representatives from Grant PUD and Washington Dept. of Wildlife conducted the first Vernita Bar redd survey. One redd was observed below the 50 kcfs elevation and no redds were observed above the 50 kcfs elevation. Five redds are required for the Initiation of Spawning, therefore the date for the Initiation of Spawning has not been set. A second spawning ground survey will be conducted next Sunday, October 28. Next Sunday, October 28, please schedule discharge from Priest Rapids Dam to be approximately 38 kcfs from 0700 – 1500.
October 28, 2018	On Sunday, October 28, 2018 representatives from Grant PUD, the Washington Department of Fish & Wildlife, and the Columbia River Inter-Tribal Fish Commission conducted the second 2018 Vernita Bar spawning ground survey. A total of eight redds were observed on Vernita Bar. Five redds are required above and below the 50 kcfs elevation to determine the Initiation of Spawning date for each zone. Six redds were below the 50 kcfs elevation and two redds were above the 50 kcfs elevation. Therefore, the Initiation of Spawning date for the below 50 kcfs elevation has been set as October 24 (Wednesday prior to the Sunday survey). A third spawning ground survey will be conducted next Sunday, November 4 to count redds above the 50 kcfs elevation.

Date	Summary
November 4, 2018	On Sunday, November 4, 2018 representatives from Grant PUD and the Washington Department of Fish & Wildlife conducted the third 2018 Vernita Bar spawning ground survey. The intent of this survey was to establish the Initiation of Spawn data for the above 50 kcfs elevation zone (the below 50 kcfs Initiation of Spawn date was established during the previous Sunday survey). Five redds are required above and below the 50 kcfs elevation to determine the Initiation of Spawning date for each zone. A total of 24 redds were observed on Vernita Bar above the 50 kcfs elevation. Therefore, the Initiation of Spawning date for the above 50 kcfs elevation has been set as October 31, 2018 (the Wednesday prior to the survey).
November 18, 2018	On Sunday, November 18, 2018 representatives from Grant PUD and the Washington Department of Fish & Wildlife conducted the fourth 2018 Vernita Bar spawning ground survey. A total of 128 redds were counted on Vernita Bar. During the survey the Monitoring Team observed spawning activity and concluded that spawning is ongoing. Therefore, we are requesting that Spawning Period flows continue for an additional week. We will return to Vernita Bar on Sunday, November 25 to conduct a supplemental spawning ground survey.
November 25, 2018	On Sunday, November 25, 2018 representatives from Grant PUD and the Washington Department of Fish & Wildlife conducted the fifth 2018 Vernita Bar spawning ground survey. The intent of this week's survey was to determine the Critical Elevation for the 2018-2019 protection season.
November 29, 2018	On December 3, 2018 Post-Hatch below the 50 kcfs elevation will begin. Post-Hatch below the 50 kcfs elevation requires no less than 15 cm below the 50 kcfs elevation. Post-Hatch above the 50 kcfs elevation is projected to occur on December 16, 2018 and will require no less than 15 cm below the Critical Elevation (65 kcfs).
December 12, 2018	On December 14, 2018 the Post-Hatch Period above the 50 kcfs elevation will begin. Post-Hatch above the 50 kcfs elevation requires no less than 15 cm below the Critical Elevation (65 kcfs) at all times. The next protection periods, Emergence and Rearing, are projected to begin on February 25, 2019. During the Rearing Period flow fluctuation from Priest Rapids Dam will be limited based on inflow from Rock Island Dam.
February 4, 2019	We are projecting that the Emergence and Rearing Periods will be begin on March 1, 2019. During the Emergence and Rearing Periods the minimum flow below Priest Rapids Dam will be the Critical Elevation (65 kcfs) and flow fluctuations will be constrained based on Wanapum inflow. Projected dates may change depending on water temperatures.

Date	Summary
February 22, 2019	The recent cold temperatures have pushed the projected date for Emergence and Rearing to 3/9/2019 (average date for start of Emergence and Rearing is 3/17). I will continue to provide updates as the season progress. For more details see the attached memo. Please contact me if there are any questions.
March 4, 2019	Grant PUD is now projecting that the Emergence and Rearing Protection Periods will begin on 3/12/2019 (average start date is 3/17).
March 11, 2019	Grant PUD is projecting that the Emergence and Rearing periods will begin tomorrow, 3/12 at 0:00.
April 12, 2019	Grant PUD will continue to be in the Emergence and Rearing Periods. These periods requires no less than the Critical Elevation (65 kcfs) at all times and daily flow fluctuation constraints based on Wanapum inflow. Grant PUD is projecting that the enhanced weekend minimum flows (CJAD II) will begin on Saturday, April 27 and will continue for four consecutive weekends. If we experience a warming trend the start date for the CJAD II weekends may shift to April 20. We are projecting that the Emergence Period will end on May 13 (average date = May 12) and the Rearing Period will end on June 14 (average date = June 13).
April 18, 2019	Grant PUD is projecting that the enhanced weekend minimum flow requirements (CJAD II) will begin on Saturday, April 27. During these four consecutive weekends the minimum flow below Priest Rapids Dam will be calculated as the average of the daily hourly minimum Priest Rapids outflow from Monday through Thursday of the current week. We continue to be in the Emergence and Rearing Periods. These periods requires no less than the Critical Elevation (65 kcfs) at all times and daily flow fluctuation constraints based on inflow. Grant PUD is projecting that the Emergence Period will end on May 13 (average date = May 12) and the Rearing Period will end on June 14 (average date = June 13).
May 10, 2019	This weekend will be the third of four CJAD II enhanced minimum flow weekends. Grant PUD is projecting that the Emergence Period (minimum flow constraint) will end on May 15. The Rearing Period (daily flow fluctuation constraint) will continue until approximately June 16. Projected dates may change based on water temperature.
May 13, 2019	On May 14 at 24:00 the Emergence Period, which requires a minimum flow of 65 kcfs, will end (average end date = May 12). The Rearing Period (daily flow fluctuations) will continue until approximately June 15 (average end date = June 13). Additionally, there remains one weekend of the enhanced weekend minimum flow requirement (i.e. CJAD II).

Date	Summary
June 11, 2019	<p>Grant PUD is projecting that the Rearing Period will end at 2400 on June 15 (average date = June 13). The warm temperatures expected in the coming days may move that date to June 14. Grant PUD will provide updates as the date approaches. See the attached memo for protection date details and requirements.</p> <p>With the completion of the Rearing Period the 2018-2019 protection season will end. The 2019-2020 season will begin on October 15, 2019 with reverse load factoring. If there are any questions please contact Grant PUD.</p>

2.11. Snake River Zero Generation (Non-BiOp Action)

According to the Lower Snake projects’ operating manuals, from December 1 through February 28, "zero" minimum project discharge is permitted on a limited basis. Under an agreement between the Corps of Engineers and the fishery agencies, zero river flow is allowed for water storage during low power demand periods (at night and on weekends) when there are few, if any, actively migrating anadromous fish present in the Snake River. Water stored under zero river flow conditions may maximize power production from the Columbia River Basin system, but zero river flow operations are not recommended at Lower Snake projects when fish are actively migrating in the Snake River.”

Salmon Managers submitted System Operations Request (SOR) 2005-22 Snake River Zero Nighttime and Weekend Flow, to the Action Agencies (AA) on December 6, 2005. The SOR may be found on the following website.

<http://pweb.crohms.org/tmt/sor/2005/2005-22.pdf>

In the SOR the Salmon Managers provided the AAs with the following table to clarify the criteria of “... few, if any ...” prior to the implementation of the Zero Generation Operation.

The few migrating adult criterion trigger will be defined on a sliding scale outlined in the following table. The table applies to both “wild” and “total” categories of returning adult steelhead.

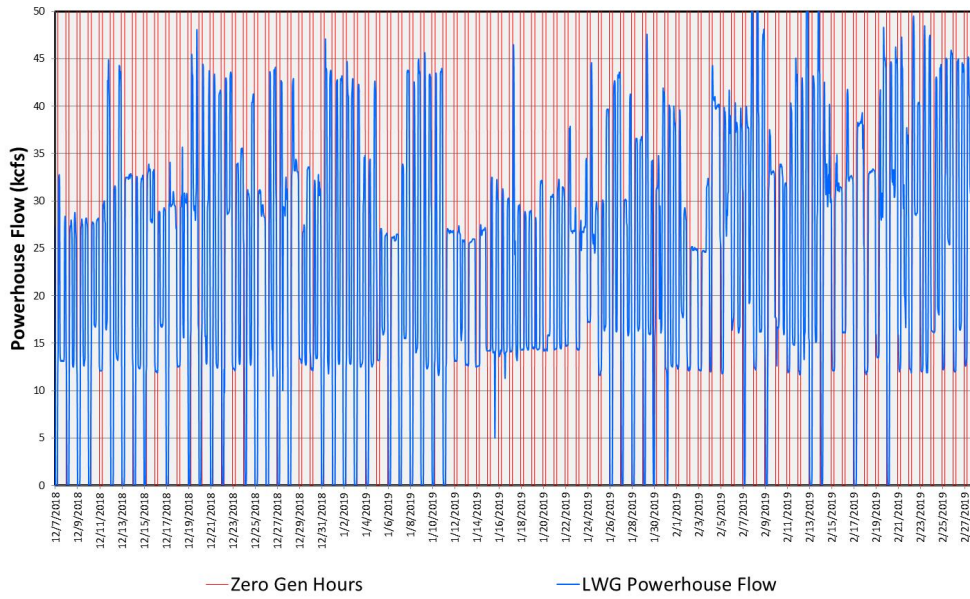
Run to date>#	Run to date< #	Few criteria< #
0	30,000	10
30,000	60,000	20
60,000	100,000	35
100,000	150,000	50
150,000	200,000	65
200,000	250,000	80
250,000		100

The AAs implemented the Snake River Zero Nighttime Generation Operation on the Lower Snake River during winter of 2018/2019 during the following TMT meeting.

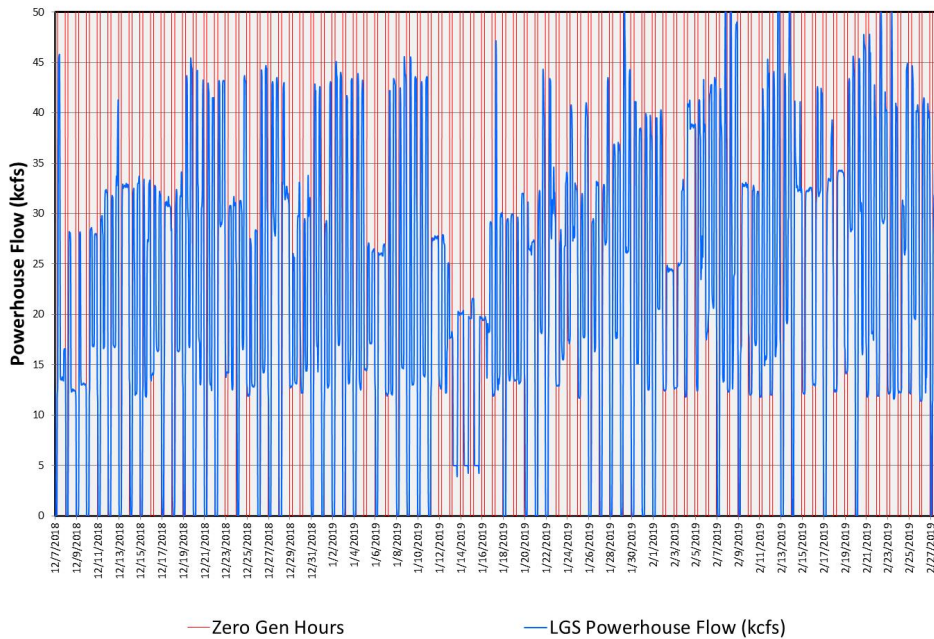
November 21, 2018 TMT Meeting. NOAA updated the group on Snake River Zero Generation criteria for the year. The criteria are based on the size of the adult steelhead run to date at Lower Granite Dam. For this year, the criteria for “few” steelhead are less than 20 total steelhead and 10 wild steelhead. These numbers reflect the low-run year. BPA noted that it affects the start date, the window of time is from December through the end of February, and operations don’t start until both criteria are met. So far, the running 3- day average counts are 74 total steelhead and 22 wild. There will be an email notification from NOAA when criteria are met.

NOAA Fisheries notified the AA’s the criteria had been achieved and the AA’s implemented the Snake River Zero Generation operation on December 6, 2018, through February 28, 2019. This years Lower Granite Dam adult steelhead criteria (rolling 3-day average of less than 10 wild and less than 20 combined) was achieved on December 5, 2018, because the 3 day rolling average (12/2 to 12/4) wild steelhead passage was 5 and combined 16.

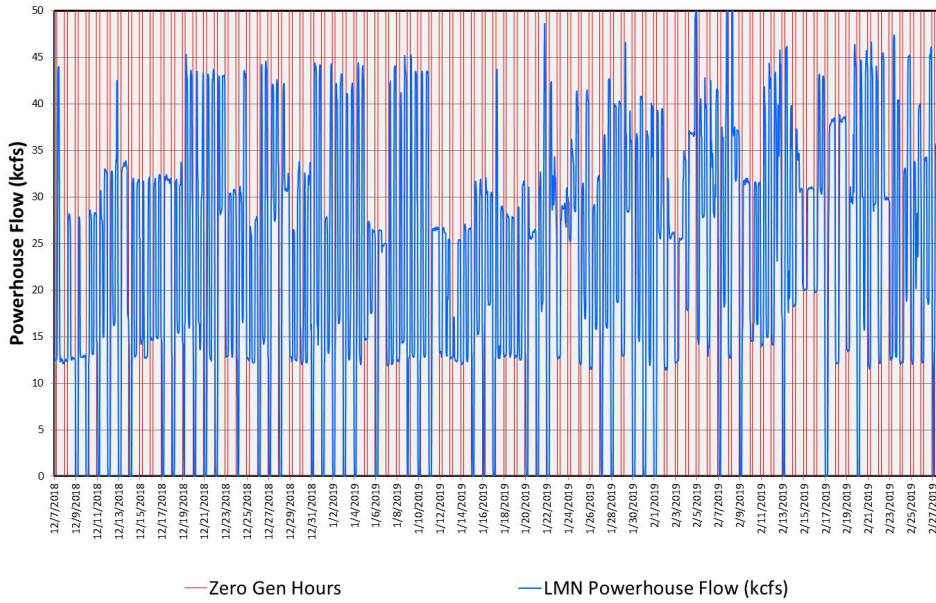
LWG Zero Gen Operations

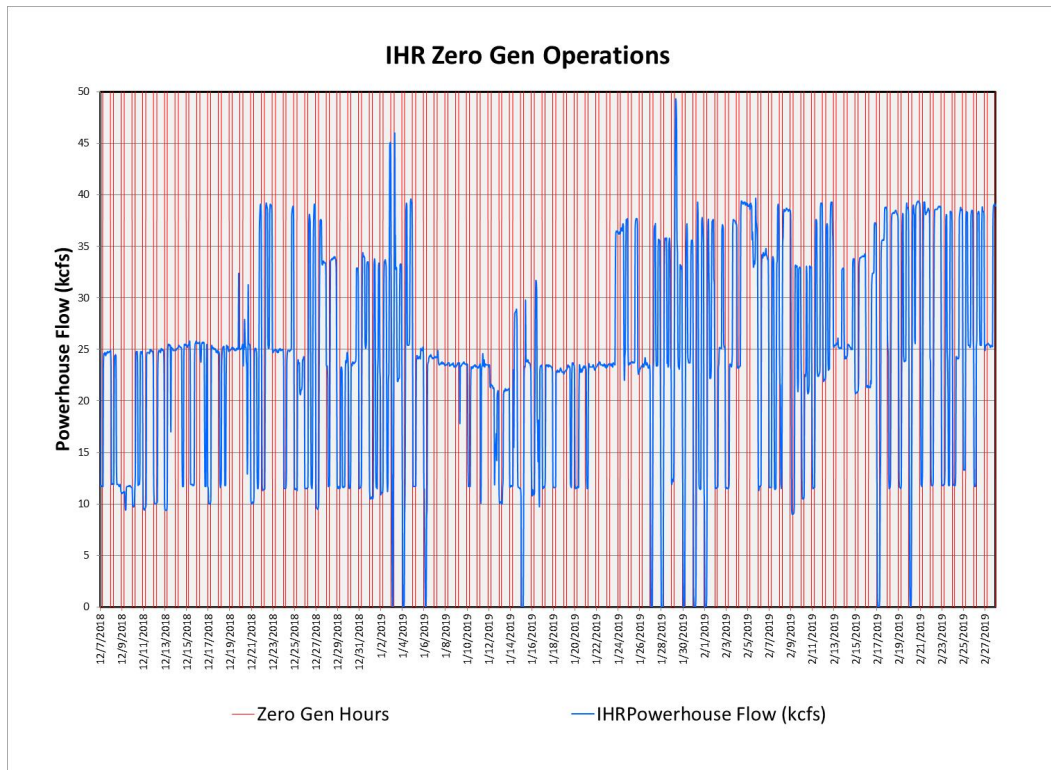


LGS Zero Gen Operations



LMN Zero Gen Operations





2.12. Minimum Operating Pool (MOP)

In accordance with the Columbia River System Proposed Action (CRSPA), dated November 2, 2018, and the 2019-2021 Spill Operation Agreement (Agreement), dated December, 2018, the BPA and Corps will operate the Lower Snake River projects (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor Dams) at Minimum Operating Pool (MOP) (unless adjusted to meet authorized project purposes, primary navigation) from April 3 through August 31 as specified in the CRSPA and the Agreement. MOP ranges at Lower Snake River Projects are found in Table 9 below.

Table 9. Minimum Operating Pool (MOP) elevation ranges for Lower Snake River Projects¹.

Project	Normal Operating Elevation Range		MOP Elevation Range	
	Minimum	Maximum	Minimum	Maximum
Lower Granite	733.0	738.0	733.0	734.5
Little Goose	633.0	638.0	633.0	634.5
Lower Monumental	537.0	540.0	537.0	538.5
Ice Harbor	437.0	440.0	437.0	438.5

1. MOP elevations provided in feet above mean sea level (NGVD29).

In-season adjustments to MOP, if necessary, will be an expanded forebay operating range (Expanded MOP), raised minimum forebay elevation (Raised MOP), or a variable forebay operating range (Variable MOP). Additional information regarding MOP operations will be described in the 2019 Fish Operations Plan (FOP) that is in the 2019 Fish Passage Plan (Appendix E) on the following website.

<http://pweb.crohms.org/tmt/documents/fpp/>

At John Day Dam from April 10 to September 30, the forebay is operated within a 2.0 foot range (262.5 to 264.5 feet) as described in the and the Agreement and the CRSPA. The minimum elevation will be adjusted upward as necessary to facilitate irrigation pumping.

2.13. Spill for Juvenile Fish Passage

Planned 2019 spring and summer spill operations are included below as described in the Agreement.

Table 1.1.

Planned 2019 spring spill operation, applying estimated 120% mean total dissolved gas spill caps and performance standard spill⁴ flex operations.

Location	COE Estimated Mean 120% Total Dissolved Gas Spill Cap (16 hours)	Performance Standard Spill (8 hours)
Lower Granite	45 kcfs	20 kcfs
Little Goose	52 kcfs	30%
Lower Monumental	44 kcfs	30 kcfs (bulk spill pattern)
Ice Harbor	87 kcfs	30%
McNary	180 kcfs	48%
John Day	146 kcfs	32%
The Dalles	135 kcfs	40%
Bonneville	122 kcfs	100 kcfs

Table 1.2.

Planned summer spill operations, starting June 21 at Lower Snake River projects and June 16 at the Lower Columbia River projects through August 31, 2019; no spill curtailment criteria. Table 1.1 key points apply.

Location	Summer Spill Operation: Volume/Percent of Total Flow Routed to Spillway (June 21/16 – Aug 31)
Lower Granite	18 kcfs
Little Goose	30%
Lower Monumental	17 kcfs
Ice Harbor	30%
McNary	57%
John Day	35%
The Dalles	40%
Bonneville	95 kcfs

Additional information regarding spill for juvenile fish passage will be described in the 2019 Fish Operations Plan (FOP) that may be found in the 2019 Fish Passage Plan (Appendix E) on the following website.

<http://pweb.crohms.org/tmt/documents/fpp/>

2.14. Juvenile Transportation

The 2019 FOP (page FOP-12) stated juvenile transportation would be initiated at Lower Granite, Little Goose, and Lower Monumental dams on April 24 (collection starting on April 23) or as

coordinated through the Technical Management Team (TMT), FPOM and the Regional Implementation Oversight Group (RIOG), but begin no later than May 1. The juvenile transportation operation was coordinated during the April 17 TMT Meeting. During the meeting the Corps clarified that collection for this years juvenile transportation operation would begin on April 23 at Lower Granite, Little Goose, and Lower Monumental Dams with the first barge departure on April 24.

2.15. Fish Passage Research in 2019

The following is a brief summary of fish passage research that will be performed in 2019. A more comprehensive discussion of these operations as well as additional maintenance activities may be found in the 2019 Fish Passage Plan in Appendix A on the following website.

<http://pweb.crohms.org/tmt/documents/fpp/2019/>

2.15.1. BONNEVILLE DAM

2.15.1.1. PH2 Fish Guidance Efficiency (FGE) Program – Unit 15 Construction and Gatewell Hydraulic Measurements.

- a) Dates: Spring and summer 2019.
- b) Description: Steel plates were installed in all A and B gatewells of Units 11-18 in 2015-2016. They functioned well from a hydraulic standpoint; limiting flow through the gatewell slots and reducing guided fish mortality. Unfortunately the plates were found to be structurally inadequate, thereby necessitating an alternative design to be formulated that would provide hydraulic equivalency to the steel plate design but also be structurally sound. A concrete corbel will be placed in the same location as the steel plates (downstream of the VBS on the gatewell beam at el. +31) and will occlude approximately the same amount of the gatewell return flow area as the steel plates, located near the head gate. The concrete will be rigid enough to not vibrate, which is what is believed to have been the failure mechanism of the steel plates. Thus the feature will be structurally sound.

Unit 15 will need to be dewatered and out of service during construction for approximately six weeks. Following the construction period and Unit 15 water-up, the A, B, and C gatewells will have hydraulic measurement equipment installed sequentially and tested for a duration of approximately two weeks total.

Hydraulic testing: a daily schedule will be provided for test operations at Unit 15. Hydraulic measurements in gatewell slots 15A, 15B, and 15C are scheduled to occur in the upper 1% range (18.0-18.5 kcfs) if possible, or the highest unit flow if not able to achieve the target flow range. Additionally, flow conditions representative of middle 1% will also be measured. Adjacent units

14 and 16 operations in the 1% range are requested during the test periods to provide stable operations to minimize hydraulic changes in the gatewell.

2.15.1.2. Evaluation of Lower Columbia River Dam Fish Ladder Modifications to Improve Pacific Lamprey Passage.

- a) Dates: Data collection is ongoing; lamprey tagging May through August 2019
- b) Description: Radio telemetry (RT) and passive integrated transponder (PIT) tag detections will be used to evaluate passage success of adult Pacific Lamprey through the lower Columbia River and opportunistically in the Mid-Columbia and Snake Rivers. This study requires surgical implantation of adult Pacific Lamprey with radio transmitters and half-duplex PIT tags which occurs at the BON Adult Fish Facility (AFF). Adult lamprey are collected from a trap in the AFF ladder and the BON WA Shore Lamprey Flume. In addition this study will require researcher access to RT receivers located around the Project to download data and maintain systems. Some maintenance will require access to the fishways and will occur during the winter maintenance period when adult fishways are dewatered.

2.15.1.3. Evaluation of an Experimental Wetted Wall at the BON Bradford Island Fishway.

- a) Dates: April through September 2019.
- b) Description: Lamprey-specific fishways have been employed to allow lamprey to bypass obstacles in traditional fishways. An experimental wetted wall was installed in the BON Bradford Island (BI) Fishway upstream of the count station window. This structure will pass lamprey from the top of the BI Fishway, where lamprey experience poor passage success, into the adjacent MUWS channel, which is outfitted with a lamprey passage structure (LPS). Monitoring of the wetted wall is needed to assess its efficacy in passing adult lamprey, to adjust lamprey escapement estimates at Bonneville Dam, and to ensure minimal risk to migrating adult salmonids.

2.15.2. THE DALLES DAM

2.15.2.1. Evaluation of Lower Columbia River Dam Fish Ladder Modifications to Improve Pacific Lamprey Passage.

- a) Dates: Data collection is ongoing; lamprey tagging May through August 2019
- b) Description: Radio telemetry (RT) and passive integrated transponder (PIT) tag detections will be used to evaluate passage success of adult Pacific Lamprey through the lower

Columbia River and opportunistically in the Mid-Columbia and Snake Rivers. This study requires surgical implantation of adult Pacific Lamprey with radio transmitters and half-duplex PIT tags which occurs at the BON Adult Fish Facility (AFF). Adult lamprey are collected from a trap in the AFF ladder and the BON WA Shore Lamprey Flume. In addition this study will require researcher access to RT receivers located around TDA to download data and maintain systems. Some maintenance will require access to the fishways and will occur during the winter maintenance period when adult fishways are dewatered.

2.15.3. JOHN DAY DAM

2.15.3.1. Evaluation of Lower Columbia River Dam Fish Ladder Modifications to Improve Pacific Lamprey Passage.

- a) Dates: Data collection is ongoing; lamprey tagging May through August 2019
- b) Description: Radio telemetry (RT) and passive integrated transponder (PIT) tag detections will be used to evaluate passage success of adult Pacific Lamprey through the lower Columbia River and opportunistically in the Mid-Columbia and Snake Rivers. This study requires surgical implantation of adult Pacific Lamprey with radio transmitters and half-duplex PIT tags which occurs at the BON Adult Fish Facility (AFF). Adult lamprey are collected from a trap in the AFF ladder and the BON WA Shore Lamprey Flume. In addition this study will require researcher access to RT receivers located around TDA to download data and maintain systems. Some maintenance will require access to the fishways and will occur during the winter maintenance period when adult fishways are dewatered.

2.15.4. McNARY DAM

2.15.4.1. Study of Adult Steelhead Fallback (Overshoots) through the Spillway Weir.

- a) Dates: Fall 2019.
- b) Description: The objectives of this study are to:
 - Estimate the seasonal duration of winter spill for steelhead overshoots;
 - Estimate weekly timing and duration of winter spill for steelhead overshoots;
 - Determine if winter spill at McNary Dam has unintended consequences for overwintering upstream stocks of steelhead.

2.15.5. ICE HARBOR DAM

2.15.5.1. Adult Lamprey Studies.

- a) Dates: July through October 2019.
- b) Description: Installation of an adult lamprey passage structure at the South Shore Fish Ladder (SFE2) is expected to be completed in February 2019. This passage structure will provide a lower velocity passage route into adult fish ladder during a prescribed lamprey passage season. DIDSON acoustic cameras will be used to evaluate passage behavior of Pacific lamprey at the entrance and exit of the passage structure, as well as monitor the entrance area for adult salmonid interactions. The monitoring equipment will be installed during the in-water work window while the South fish ladder is dewatered, and will involve installation of I-beams on the fishway walls to position the acoustic cameras. Operation of monitoring equipment will occur throughout the adult lamprey passage season (early July–October), and removed during the next in-water work window. The design of the lamprey passage structure allows for the quick removal of the entrance component from the bulkhead slot in the event that SFE2 is needed as the primary fish ladder entrance or if adult salmonid attraction and interaction is deemed harmful in coordination with NOAA Fisheries.

2.15.5.2. IHR Unit 2 Direct Injury and Sensor Fish Characterization

- a) Dates: September through October 2019
- b) Description: Juvenile spring Chinook salmon and Sensor Fish will be directly released into turbine unit 2 to evaluate the new fixed-blade runner. The study is expected to require approximately four weeks of total study time. Direct release pipes will be installed in all three intakes of Unit 2 for direct fish and Sensor Fish releases. Release pipes will be installed on the STS frames. Three specific turbine operations will be tested. Project support will be provided for equipment install, removal, and turbine operations. A one-day Unit 2 outage is expected for release pipe install and removal. Another consideration will be river flow and unit priority during the study period. Specific dates for Project support, outages, and operations will be scheduled appropriately with the Project and through FPOM closer to study implementation.

2.16. LOWER MONUMENTAL DAM

2.16.1. LMN FGE Gate Closure Study

- a) Dates: February through July 2019.

b) Description: This study is to estimate and compare fish guidance efficiency (FGE) at two adjacent units with head gates in the raised (control) and stored (treatment) operating positions, and to estimate impacts (if any) to FGE and juvenile fish passage performance when units are operated with head gates stored. Results will aid in determining the appropriate path forward for restoring the 10-minute emergency head gate closure criterion.

Hydroacoustic transducers will be installed on the trash rack and STS frames in units 2 and 3. During the study, Unit 2 will be fixed at the mid-range of the 1% operating range (25°) and Unit 3 will operate at the same mid-range of the 1% range for as much of the day as possible during the study period.

Installation is expected to occur during the in-water work window in February 2019. A dive to install transducers on the trash racks will require a three-unit outage. Project personnel will assist with alternating unit 2 and unit 3 head gate orientation between raised and stored operating positions once per week on a random block design for the duration of the study beginning approximately 20 April 2019 through approximately 12 July 2019. During the study, unit operating priority will switch to unit 2 being first priority and unit three being second priority. If low flow conditions occur where two turbine units cannot operate, operating gates will remain in either the raised or lowered position in units 2 and 3 and operation will alternate on the random block design rather than changing head gate position.

Adult fish passage will not be affected as all in-water work will be conducted during the work window. No specific turbine unit operating points (MW) are requested for this study. The dive to remove transducers will occur during the in-water work window in FY20.

c) Impacts to FPP Criteria: Any modification to unit priority order or other FPP criteria will be coordinated through FPOM.

2.17. LITTLE GOOSE DAM

No studies are planned at Little Goose Dam in 2019.

2.18. LOWER GRANITE DAM

No studies are planned at Lower Granite Dam in 2019.