U.S. Army Corps
of Engineers
Seattle District

Flow Plan Implementation Protocol Technical Team

SUMMARY
of
2021 Sturgeon Operations at Libby Dam

March 31, 2022

U.S. Army Corps of Engineers
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WY2021 Libby Dam FPIP Sturgeon Flow Augmentation Operations

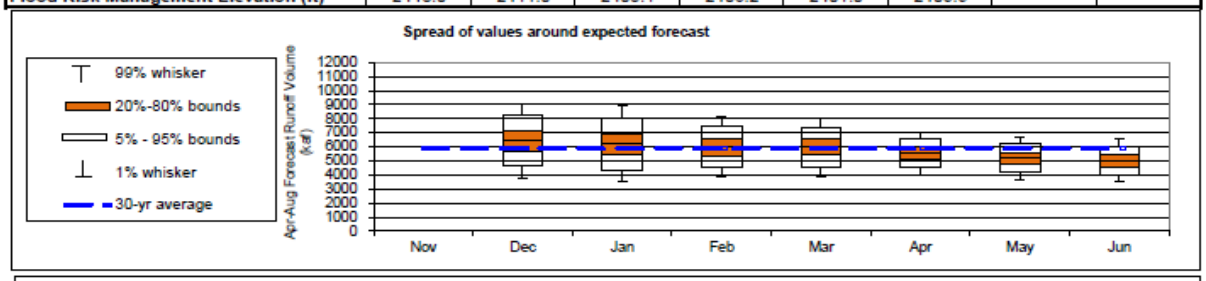
Monthly precipitation in the Kootenai basin through the fall, winter, and spring (October – June) of Water Year 2021 varied from below normal to above normal. The monthly April through August Water Supply Forecast (WSF) for Koocanusa Reservoir (Figure 1) decreased over the winter, from 6.442 million acre-feet (MAF) in December to 5.979 MAF in the February forecast. The monthly forecasts continued to decrease from late winter through early summer, from 5.98 MAF in March to 5.006 MAF in June.

Libby : June Runoff Forecast & Flood Control Calculation WY 2021

Runoff Forecast	June	1981-2010 Average	1981 - 2010 Percent of Average	1929-2008 Average	1929 - 2008 Percent of Average
Most Probable Runoff Volume: Apr-Aug (kaf)	5006	5885	85%	6282	80%
Most Probable Runoff Volume: Apr-Jul (kaf)	4540	5342	85%	5720	79%
Most Probable Runoff Volume: May-Jul (kaf)	4205	4821	87%	5199	81%

Forecast/Reservoir Data	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Apr-Aug Runoff Forecast (kaf)		6442	6215	5979	5980	5549	5191	5006
First-of-Month Elev (ft)	2446.1	2434.8	2410.9	2407.6	2403.4	2401.2	2403.9	2413.8

Seasonal FRM Requirements	30-Nov	31-Dec	31-Jan	28-Feb	31-Mar	30-Apr
Flood Risk Management Space (kaf)	500	2000	2105	2173	2349	2039
Flood Risk Management Elevation (ft)	2448.0	2411.0	2408.1	2406.2	2401.0	2409.9



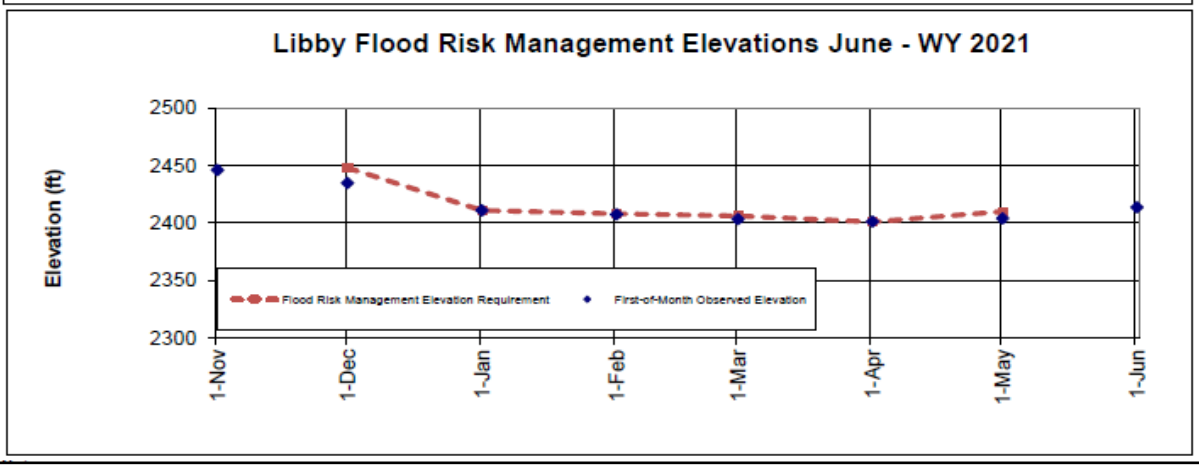


Figure 1. Final June 2021 Koocanusa Reservoir April through August WSF.

Koocanusa Reservoir was drafted to the required flood risk management (FRM) target of 2411.0 ft above Mean Sea Level (MSL) at the end of December 2021 (full pool for Koocanusa Reservoir is 2,459.0 ft MSL). Libby Dam discharge was lowered to minimum flow of 4,000 cubic feet per second (cfs) for most of January, with an increase to 15,000 cfs the last week of the month to draft towards the end-of-month FRM target of 2408.1 ft. Reservoir elevation at the end of January was 2407.6 ft, so discharge remained at minimum for the first ten days of February to meet the new end-of-month FRM target of 2406.2 ft. A request for increased flows was received from the Kootenai Tribe of Idaho (KTOI) in order to aid in the breakup of ice formation at hatchery intakes that had developed after several days of sub-freezing temperatures. This request was approved, and outflows were increased to 8,000 cfs on February 11 and lowered to 5,000 cfs on February 17 (Figure 2). Discharges returned to 4,000 cfs on February 23, and the reservoir ended the month at an elevation of 2405.6 ft, 2.8 ft below the FRM target. Discharge remained at minimum flows for March and April, and FRM elevation target for both months were met. Koocanusa Reservoir reached a minimum elevation of 2401.02 ft on 06 April.

The initial controlled flow (ICF) for the Dalles, Oregon, was calculated as 277,000 cfs in the Declaration of Initiation of System Refill report issued by the Corps' Northwest Division Office on 30 April, which set the start of refill of Koocanusa Reservoir for 01 May. An initial VarQ flow of 10,800 cfs was calculated using the April 2021 WSF. The May 2021 WSF was 5.19 MAF, or 88 percent of average. Rather than decreasing discharge to the new calculated VarQ flow of 5,900 cfs for May - which would have caused de-watering of newly wetted and productive river varial zone prior to re-watering shortly thereafter via FPIP sturgeon flow augmentation operations - the FPIP Technical Team agreed to use available sturgeon volume to augment flows and keep Libby Dam discharge at 9,000 cfs beginning on 06 May.

The 2020 CRSO EIS and associated documents lay out several changes to the VarQ procedures at Libby Dam. A new storage reservation diagram (SRD) changes the end of month flood risk mitigation (FRM) target elevations from December to April. The new SRD requires a deeper draft of Lake Koocanusa during lower water supply forecast years. This deeper draft is offset by changes to the computation of VarQ FRM minimum flows during the refill period (generally starting on 1 May but could be earlier for May WSF >6.9 MAF). First, the new minimum flow procedure contains an updated chart for determining the initial flow, which is lower for lower WSF. Second, the VarQ minimum flow now accounts for the known volume to be released during the sturgeon pulse, thus eliminating the double accounting of flow that previously existed. This change further lowers the minimum flow to be released. Third, the VarQ minimum flow now has a recalculation frequency of up to daily, changed from monthly under the pre-CRSO procedure. Typically, this recalculation is done to account for over-release resulting from following BiOp ramping rates to get to the specified VarQ minimum and will therefore lower the minimum flow to account for the increased volume released, particularly during declining WSF years. However, under-release due to inflows coming in lower than the VarQ minimum flow, or lower releases due to downstream flood concerns, could result in a higher release during a recalculation. The 2020 USFWS BiOp states: "The Proposed Action adjusts the refill equations for all years, which results in increased likelihood of reservoir refill in all but the lowest 5 percent of years."

The FPIP sturgeon volume augmentation operation began on 06 May with the use of available volume to maintain Libby Dam outflows at 9,000 cfs, as described above. This was a Tier 2 year with an associated sturgeon volume of 0.928 MAF. Libby Dam discharge was increased to 25,000

cfs (full powerhouse capacity) beginning 13 May. An unexpected transmission line limitation forced Libby Dam discharge to decrease 20,000 cfs on 25 May. Discharge began decreasing to 9,000 on 31 May and sturgeon volume was expended on 03 June.

As per the Service's System Operation Request, which was based on the FPIP Technical Team Flow Plan, Libby Dam was operated to achieve the following objectives:

1) Provide flows at Bonners Ferry of ≥30,000 cfs for as many days as possible during the peak of local tributary discharge downstream of Libby Dam to optimize the likelihood of sturgeon migration and spawning activity in improved habitat upstream of Bonners Ferry; and

2) Provide river stage at Bonners Ferry of ≥ 1,758' Mean Sea Level (MSL; flood stage is 1,764') for as many days as possible during the peak of the local tributary discharge downstream of Libby Dam to connect the Kootenai River to Nimz Ranch off-channel habitat.

Kootenai River flow at Bonners Ferry was ≥30,000 cfs for 15 days, and river stage at Bonners Ferry was ≥ 1,758' MSL for 1 day (Figure 2). River stage during the spring freshet is strongly influenced by local tributary discharge, as well as the elevation of Kootenay Lake (Figure 3), which is managed for flood risk reduction in compliance with the 1938 International Joint Commission (IJC) Rule curve (Figure 3, inset).

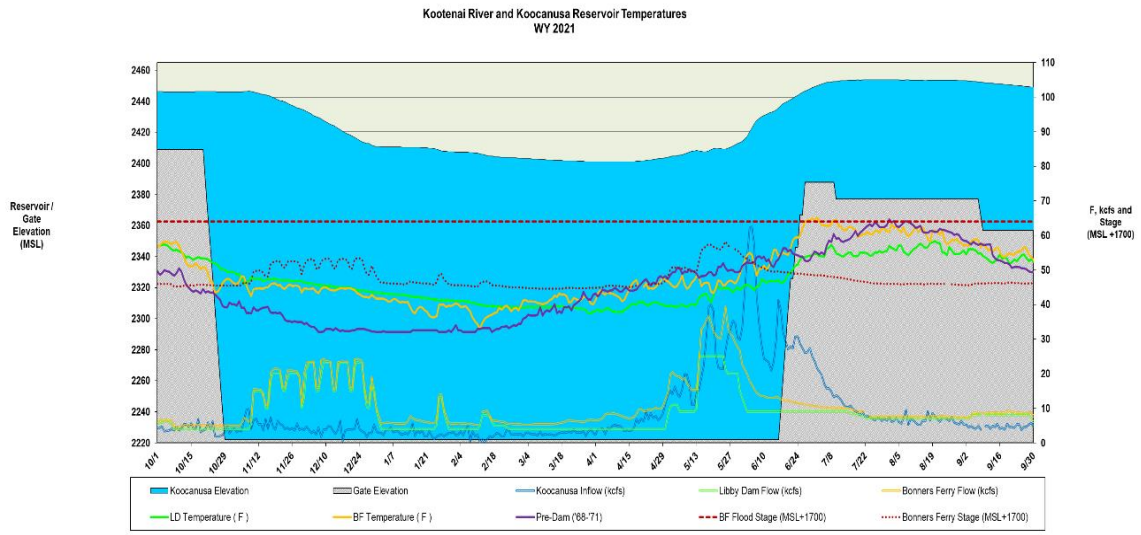


Figure 2. WY2021 Koocanusa Reservoir forebay thermograph, selective withdrawal gate placement, reservoir elevation and inflow, and Kootenai River flow and temperature. Inflow temperature is from the Ft. Steele gage, Kootenay River, British Columbia.

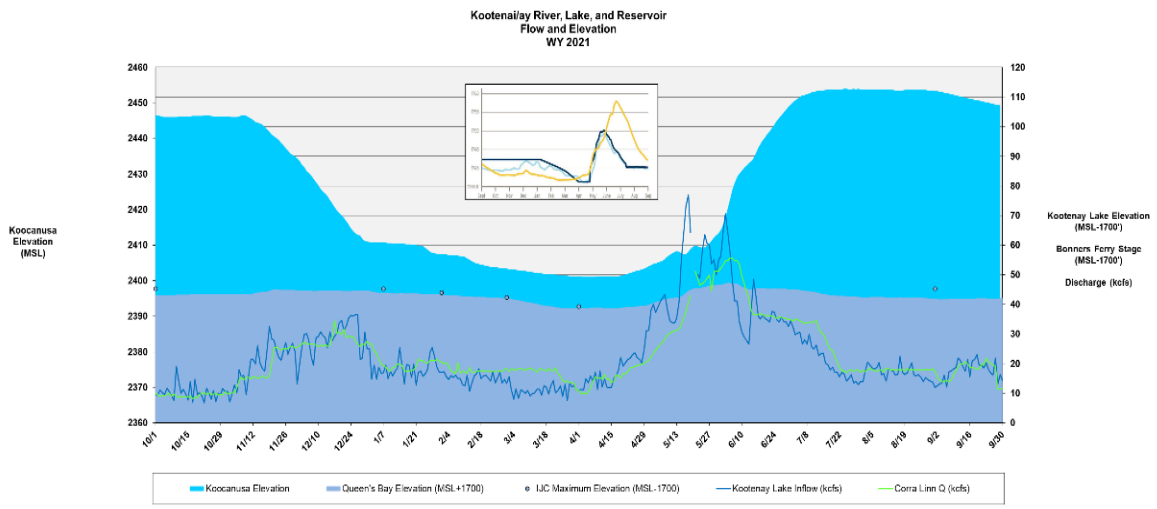


Figure 3. WY2021 Kootenay Lake elevation relative to 1938 International Joint Commission (IJC) Rule Curve.

The operation of Libby Dam for the remainder of summer was to maintain gradually decreasing outflows in the range of 7,000-9,000 cfs and target an end-of-September elevation of 2449.0 ft. Koocanusa Reservoir reached a maximum elevation of 2453.91 ft on 24 July. Libby Dam outflows remained at 9,000 cfs through 15 July before gradually decreasing to 7,000 cfs on 23 July. Reservoir inflows remained high in August and dam discharge increased to 8,000 cfs on 04 September to meet the end-of-September target of 2449.0 ft. Koocanusa Reservoir ended Water Year 2021 at an elevation of 2449.22 ft.

WY2021 Libby Dam Temperature Operations

The Selective Withdrawal System (SWS) crane was not functional during the 2021 FPIP Sturgeon Flow Augmentation Operation. The SWS system was back in service on 16 June, at which point selective withdrawal gates were installed as quickly as possible (Figure 2). Discharge temperature returned to normative for a brief period, and then was reduced via removal of selective withdrawal gates to avoid discharge of rapidly warming reservoir surface temperatures (Figure 4). River temperature remained cool through the summer and into fall under record high air temperatures.

Normally, selective withdrawal gates at Libby Dam are placed within ~30-40 ft. of the forebay surface prior to commencement of sturgeon flow augmentation to enable discharge of the warmest water possible throughout the spring freshet period, and gates are stacked progressively through the spring and early summer as the reservoir refills. The overall intent of this strategy is to provide a stable-to-warming thermograph throughout the operation, including pre-spawn developmental temperature, optimal spawning temperature (~50° F at Bonners Ferry), and post-spawn egg incubation and larval development temperature; it is believed that sturgeon spawning activity peaks as flow is receding and temperature is increasing. In addition, survival of burbot larvae and juveniles during early spring is temperature-dependent, and though the reservoir is/was largely isothermic during late winter and early spring, warming surface water in the forebay of the reservoir may, in some years, contribute to increased discharge temperatures (related to discharge volume and atmospheric warming).

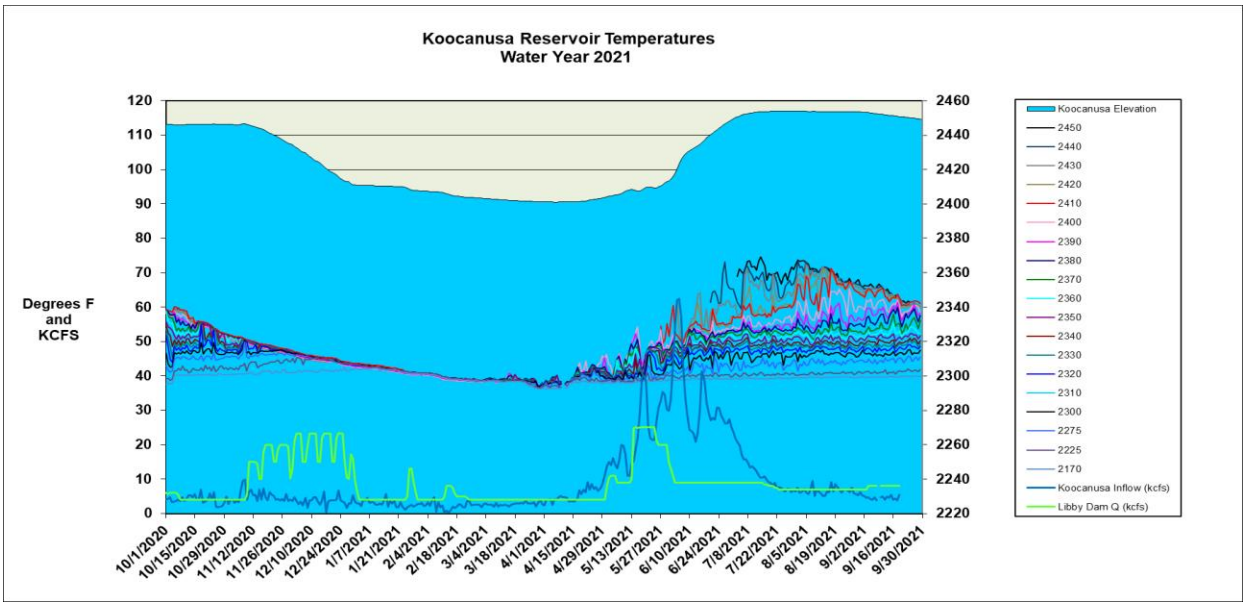


Figure 4. WY2021 Koocanusa Reservoir inflow, discharge, temperature and elevation.

Temperature in the Bonners Ferry reach during sturgeon flow augmentation ranged from ~ 43 to 54° F, though temperatures of 50°+ F at Bonners Ferry were not observed until 01 June (Figure 2) related to the lack of temperature management capability via the SWS at Libby Dam. Discharge temperature from Libby Dam ranged from ~ 39 to 45°F (Figure 2).