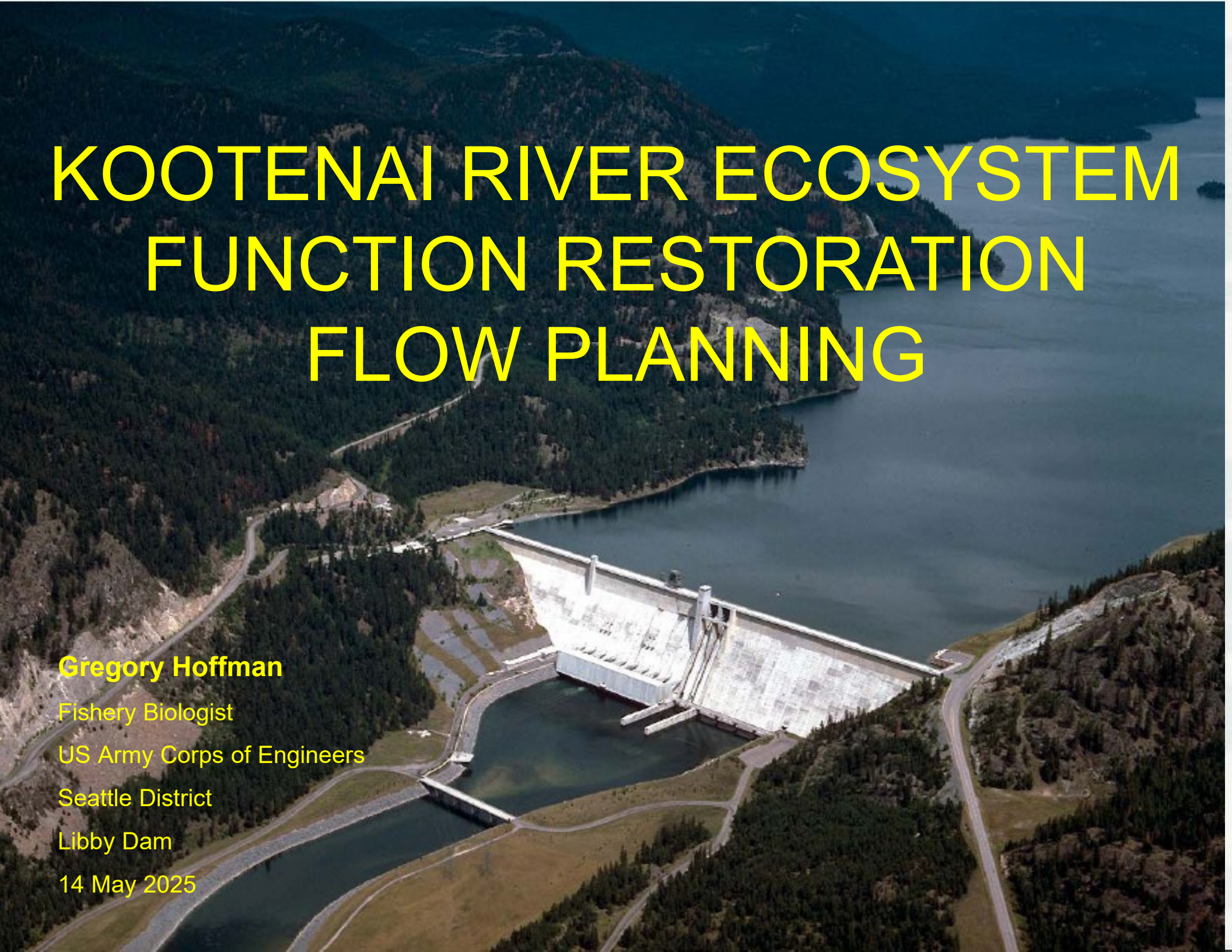
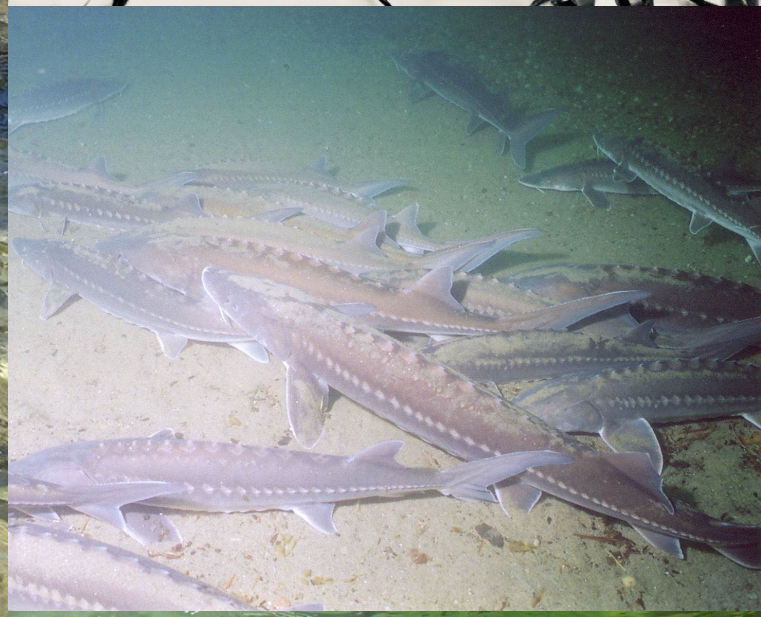
# KOOTENAI RIVER ECOSYSTEM FUNCTION RESTORATION FLOW PLANNING

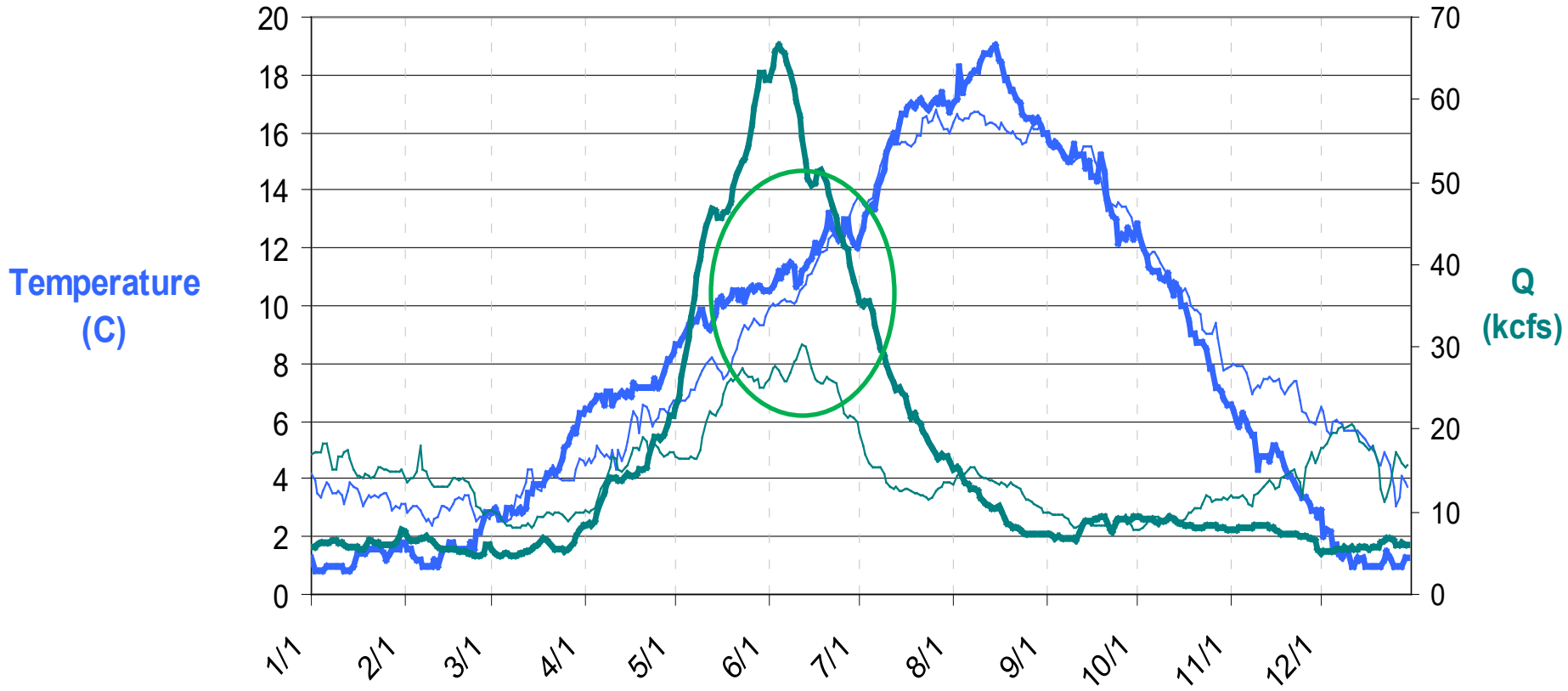


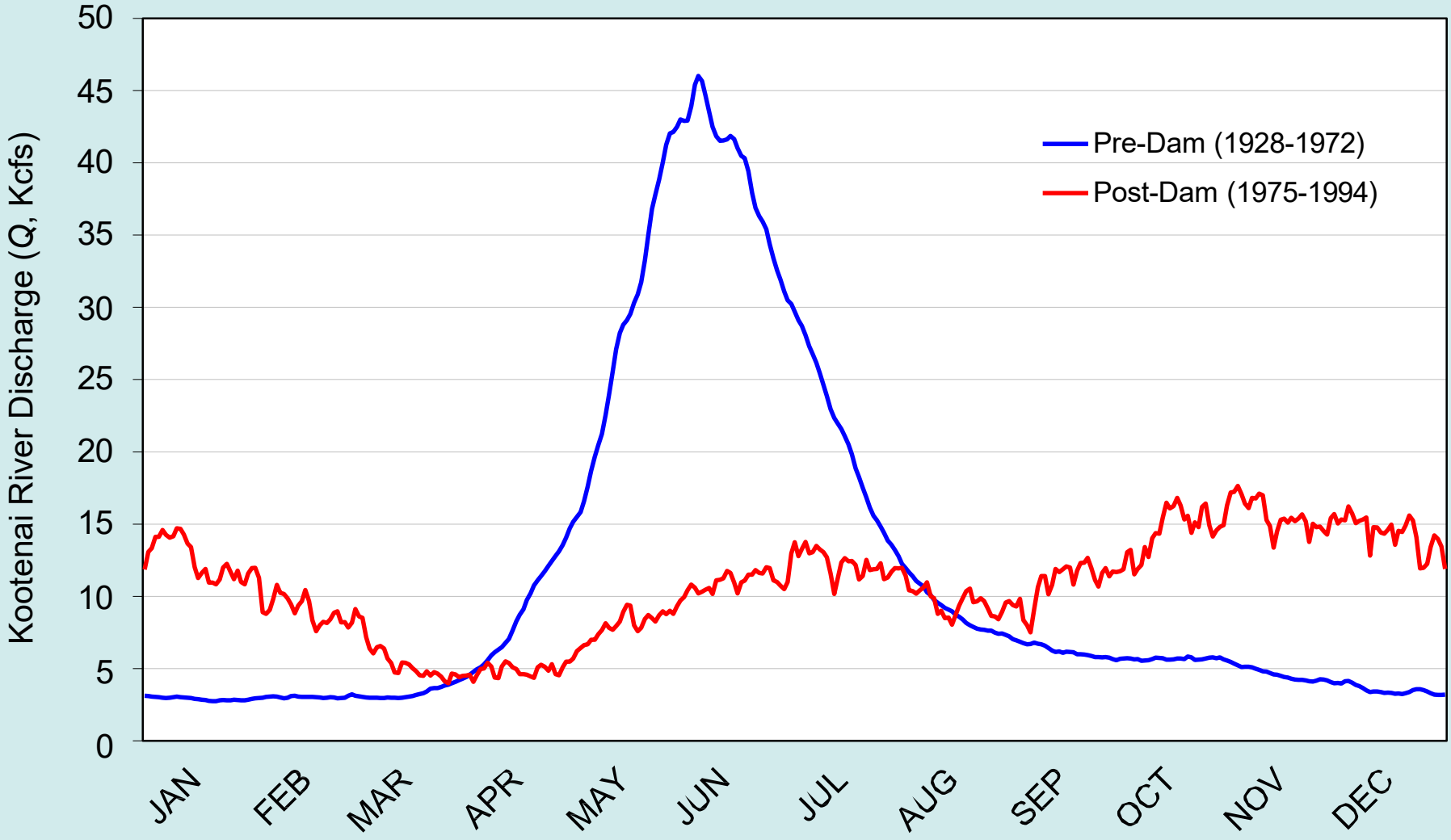
**Gregory Hoffman**
Fishery Biologist
US Army Corps of Engineers
Seattle District
Libby Dam
14 May 2025


LIBBY



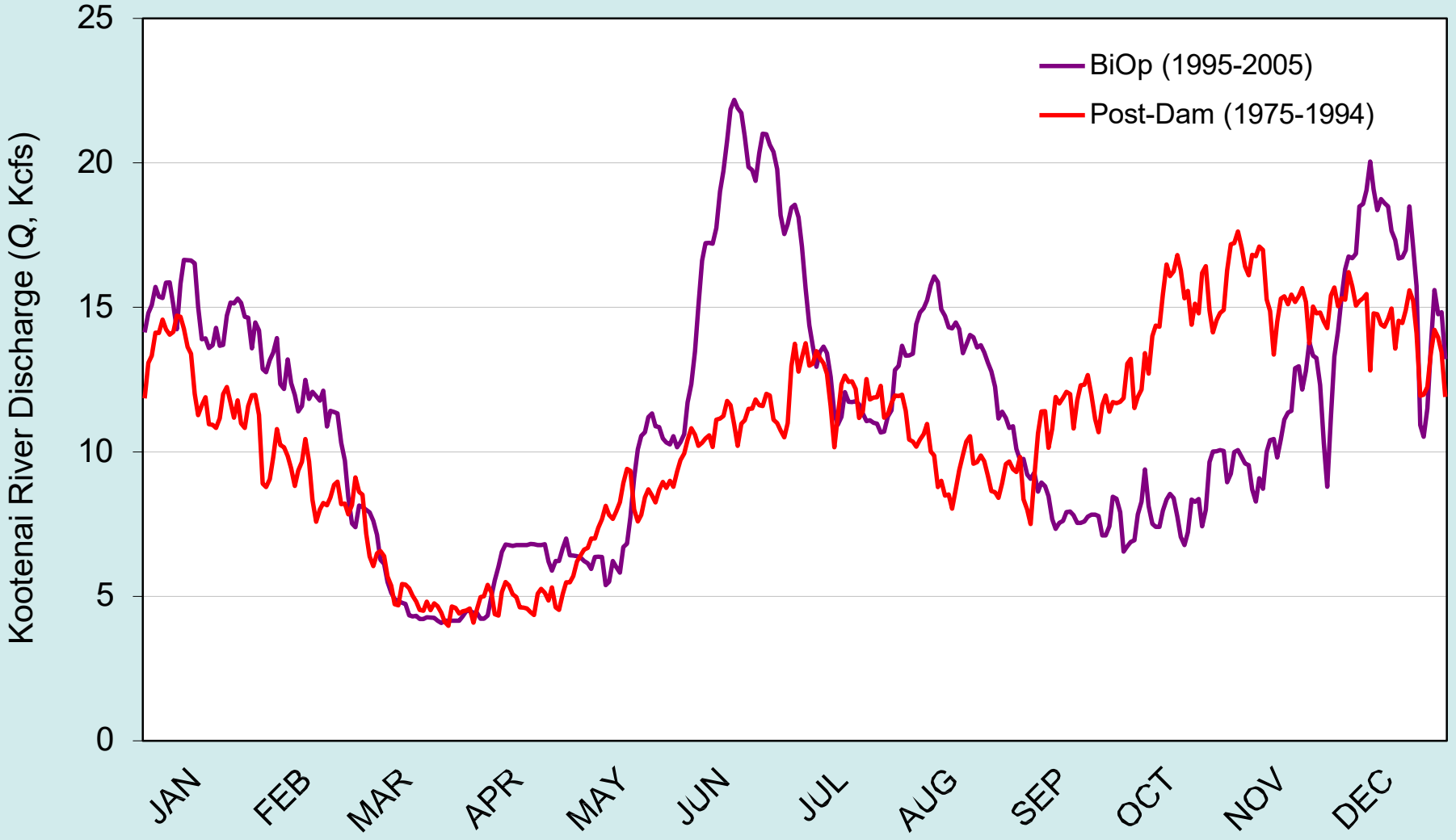
## Kootenai River Temperature and Flow
## Pre-Libby Dam vs Post-Libby Dam



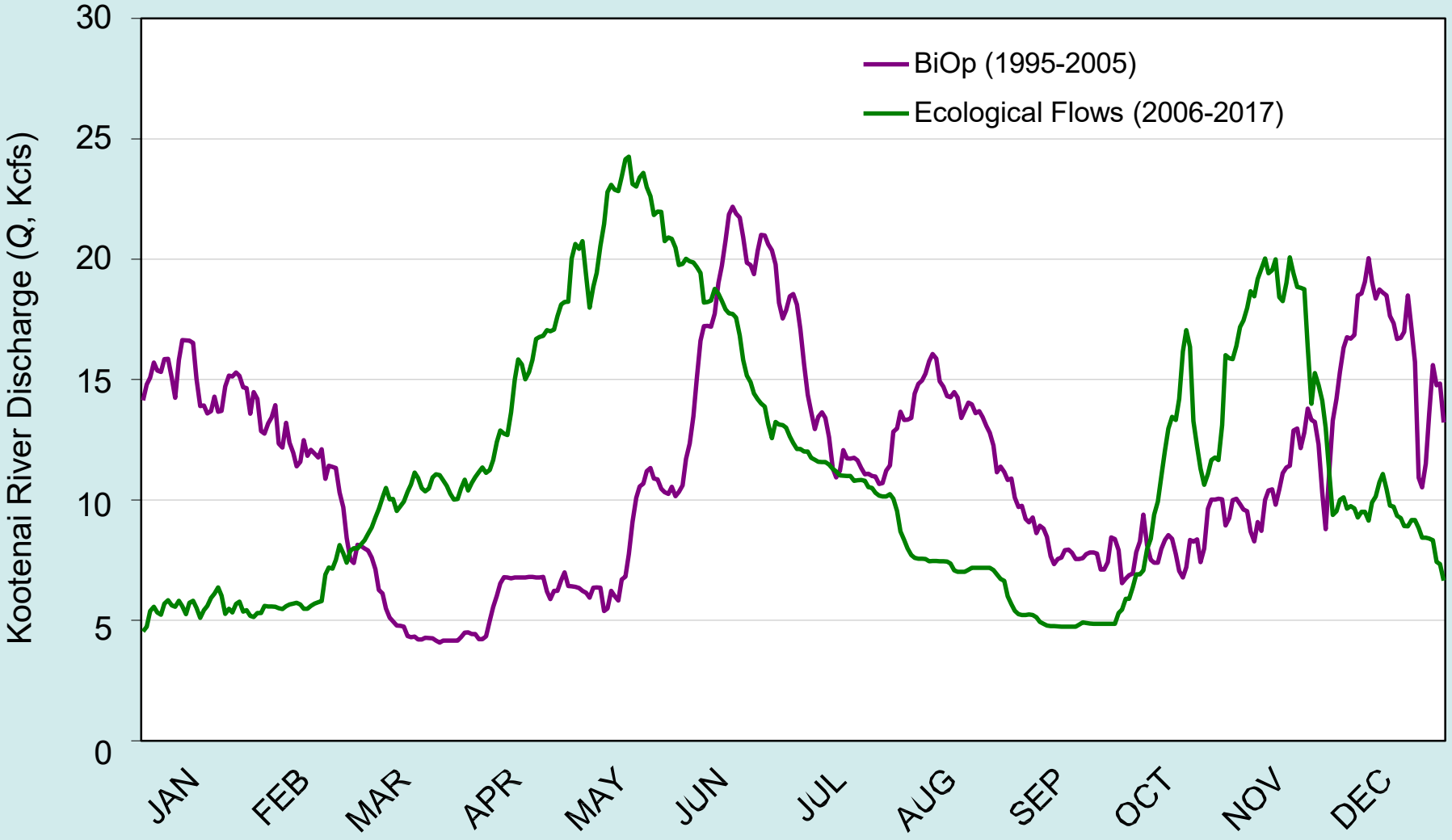

Kootenai River Discharge (Q, Kcfs)
50
45
40
35
30
25
20
15
10
5
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Pre-Dam (1928-1972)
Post-Dam (1975-1994)

35 cfs ~ 1 cms

# Sturgeon spawning flows – flow increase to increase depth



# Flow normalization – Aquatic & Riparian objectives



KOOTENAI RIVER ECOSYSTEM FUNCTION RESTORATION FLOW PLAN
May 5, 2005

Introduction

The Proposed Action contained in the Supplemental BA included Libby Dam operations to support spawning, incubation and rearing of Kootenai River white sturgeon (sturgeon). The Corps and BPA, in conjunction with the Service and state and tribal biologists, have further refined the Proposed Action, in part by developing this flow plan. The objective of this plan, in conjunction with the concurrent habitat placement plan, is to restore ecosystem function in support of Kootenai River white sturgeon recovery consistent with the Corps responsibilities to provide for flood control, in order to avoid jeopardizing the likelihood of the continued existence of sturgeon. The plan embraces functional "normative" river concepts while continuing to support salmon flow augmentation in the mainstem Columbia River.

The flow plan sets forth guidelines to utilize existing or increased sturgeon "tier" volumes during late May and June, creating a rise, or "freshet" from Libby Dam, followed by a gradually declining, or receding, limb of the hydrograph into July (normative shape). These guidelines provide the flexibility to augment peak local inflows at Bonners Ferry with up to 35 kcfs from Libby Dam to 1) create attraction flows, 2) stimulate spawning behavior, and 3) enhance velocity for egg incubation, should successful spawning occur (i.e. embryos attached to appropriate substrates).

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Seattle District

# Flow Plan Implementation Protocol Technical Team

# FPIP Flow Plan

*for*

# 2024 Sturgeon Operations at Libby Dam

**May 8, 2024**


U.S. Army Corps of Engineers
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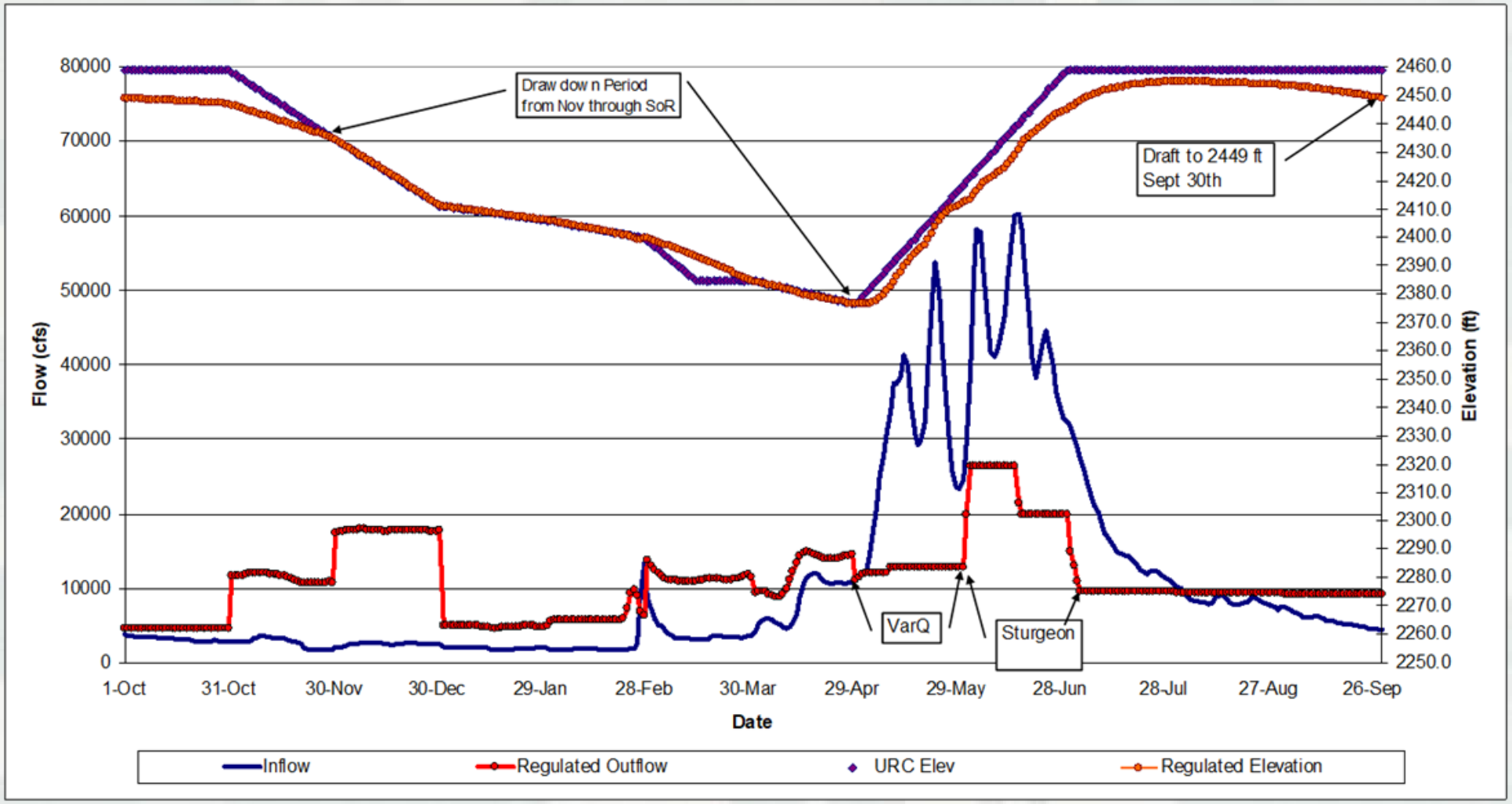
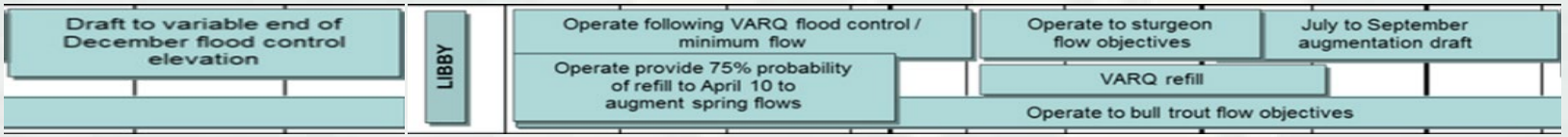
Bonneville Power Administration
*Scott Bettin and Tammy Mackey*
U.S. Fish and Wildlife Service
*Ahren Ramirez*
Montana Fish, Wildlife & Parks
*Jim Dunnigan and Ryan Sylvester*
Idaho Department of Fish and Game
*Sean Wilson and Troy Smith*
Kootenai Tribe of Idaho (ʔaq̓ anqmi)
*Shawn Young and Nate Jensen*
Lower Kootenay Band (Yaqan nu?kiy)
*Isaac Decker*
Ktunaxa Nation Council
*Ben Meunier*
BC Ministry of Water, Land and Resource Stewardship
*Sarah Stephenson*

# Libby Dam Typical Water Year



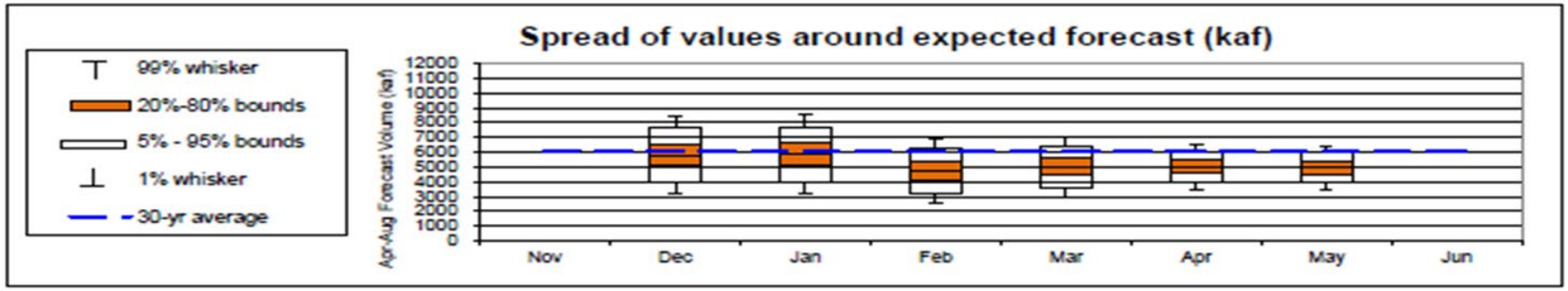



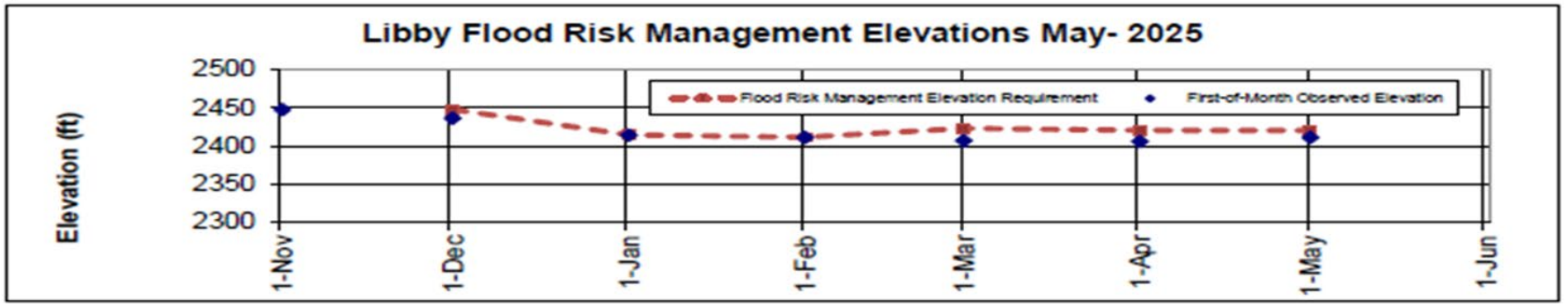
## Libby : May Runoff Forecast & Flood Risk Management Calculation — WY 2025

| Runoff Forecast | May | 1991-2020 Average | 1991 - 2020 Percent of Average | 1929-2020 Average | 1929 - 2020 Percent of Average |
|---|---|---|---|---|---|
| Most Probable Runoff Volume: Apr-Aug (kaf) | 4944 | 6080 | 81% | 6259 | 79% |
| Most Probable Runoff Volume: Apr-Jul (kaf) | 4528 | 5670 | 81% | 5708 | 79% |
| Most Probable Runoff Volume: May-Jul (kaf) | 4095 | 5014 | 82% | 5183 | 79% |

| *Forecast/Reservoir Data* | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
|---|---|---|---|---|---|---|---|---|
| Apr-Aug Runoff Forecast (kaf) | | 5812 | 5871 | 4728 | 5004 | 5023 | 4944 | |
| First-of-Month Elev (ft) | 2447.5 | 2436.1 | 2414.4 | 2410.9 | 2407.0 | 2405.8 | 2411.2 | |

| *Seasonal FRM Requirements* | 30-Nov | 31-Dec | 31-Jan | 28-Feb | 31-Mar | 30-Apr | | |
|---|---|---|---|---|---|---|---|---|
| Flood Risk Management Space (kaf) | 500 | 1867 | 1983 | 1541 | 1647 | 1656 | | |
| Flood Risk Management Elevation (ft) | 2448.0 | 2414.6 | 2411.5 | 2423.1 | 2420.4 | 2420.2 | | |

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**Tiered sturgeon volumes measured as discharge in excess of 4 kcfs minimum flow.**

| Apr-Aug Forecast (MAF) | Sturgeon Volume (MAF) |
|---|---|
| Less than 4.80 | 0.0 |
| 4.8 to 5.40 | 0.8 |
| 5.40 to 6.35 | 0.80 to 1.12 |
| 6.35 to 7.40 | 1.12 to 1.20 |
| 7.40 to 8.50 | 1.20 |
| 8.5 to 8.90 | 1.20 to 1.60 |
| Greater than 8.90 | 1.60 |

Note: Linear interpolate between values as needed

**End of September Target elevation for Koocanusa Reservoir**

| Libby Water Supply Forecast for April – August Inflow (percentile) | Libby Water Supply Forecast for April – August Inflow (MAF*) | End-of-September Target Pool Elevation (ft-NGVD29)** |
|---|---|---|
| ≤15th Percentile | 4.48 | 2439 |
| 25th Percentile | 5.08 | 2449 |
| 75th Percentile | 7.06 | 2449 |
| ≥85th Percentile | 7.53 | 2454 |

*MAF = million acre-feet, value based on the current 1991 to 2020 30-year period

**Targets are interpolated between 15th and 25th percentile and between 75th and 85th percentile

**Minimum bull trout releases from Libby Dam after sturgeon flow augmentation volume is exhausted through August 31, based on May final Libby Dam water supply forecast for April-August. Note: minimum bull trout flows from May 15–May 31 and all of September is 6,000 cfs.**

| Apr-Aug Forecast Runoff Volume at Libby | Min Bull Trout Flows (after Sturgeon Pulse and Through August 31) |
|---|---|
| forecast <4.80 MAF | 6,000 cfs |
| 4.80 MAF≤ forecast < 6.00 MAF | 7,000 cfs |
| 6.00 MAF≤ forecast < 6.70 MAF | 8,000 cfs |
| 6.70 MAF≤ forecast | 9,000 cfs |

*MAF = million acre-feet

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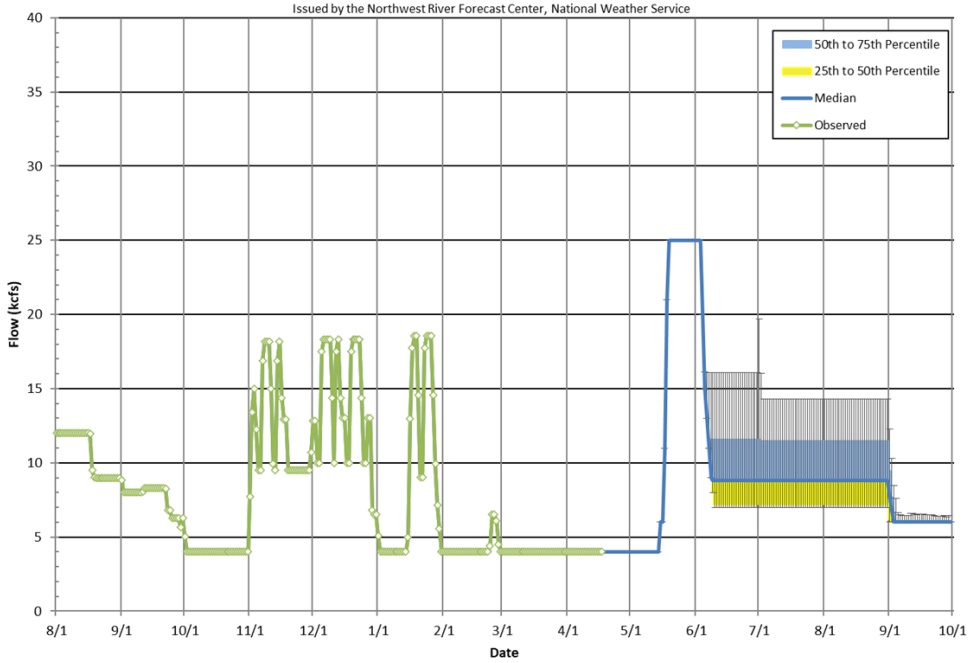
## Libby Dam Outflow - Probability Chart

Corps of Engineers Projections Based on the 41 Ensemble Streamflow Prediction Traces
Issued by the Northwest River Forecast Center, National Weather Service

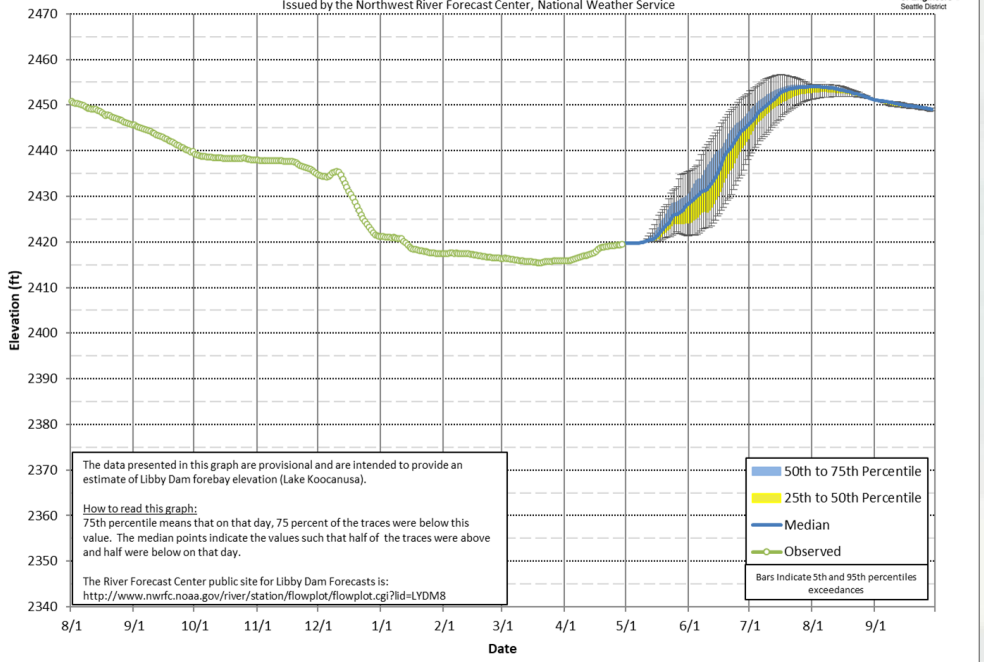



Modeled using current ESP traces as of 04/30/24

## Lake Koocanusa Elevation - Probability Chart

US Army Corps of Engineers
Seattle District

Corps of Engineers Projections Based on the 41 Ensemble Streamflow Prediction Traces
Issued by the Northwest River Forecast Center, National Weather Service



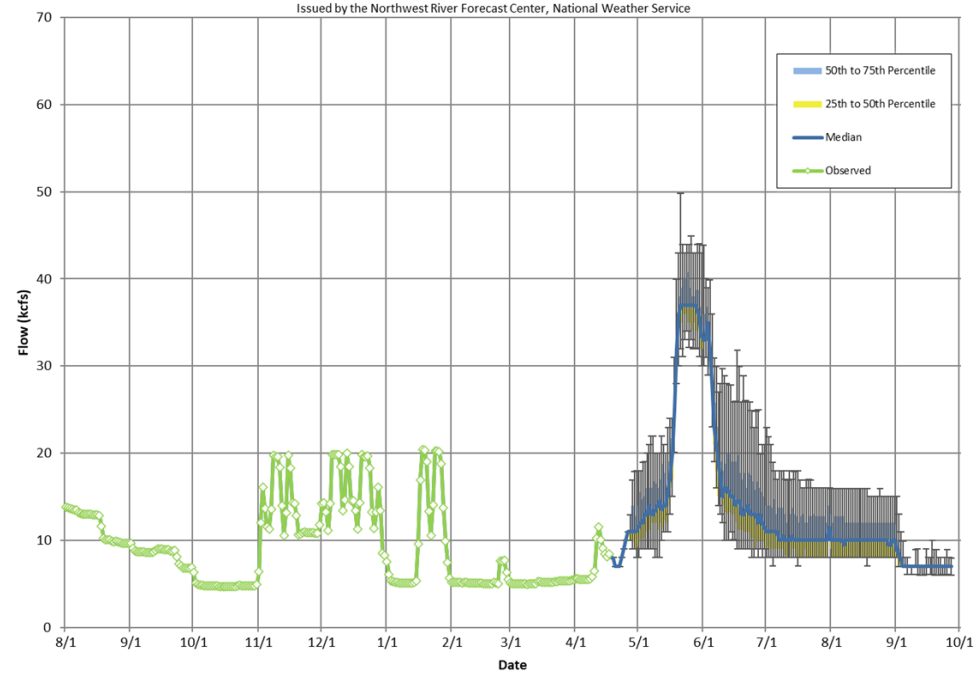

The data presented in this graph are provisional and are intended to provide an estimate of Libby Dam forebay elevation (Lake Koocanusa).

How to read this graph:
75th percentile means that on that day, 75 percent of the traces were below this value. The median points indicate the values such that half of the traces were above and half were below on that day.

The River Forecast Center public site for Libby Dam Forecasts is:
http://www.nwrfc.noaa.gov/river/station/flowplot/flowplot.cgi?lid=LYDM8

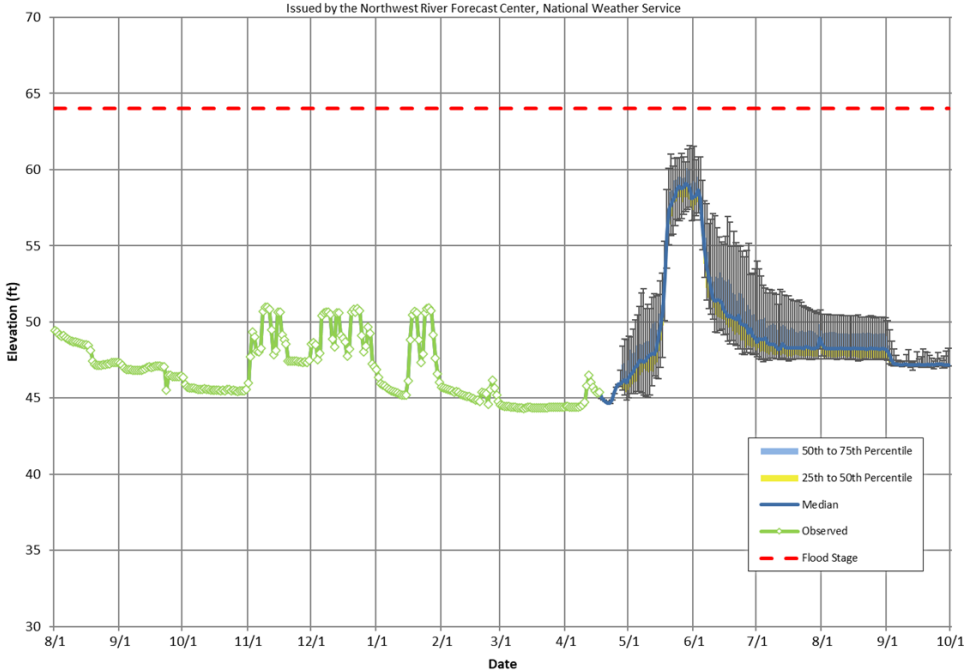
## Bonners Ferry Flow - Probability Chart

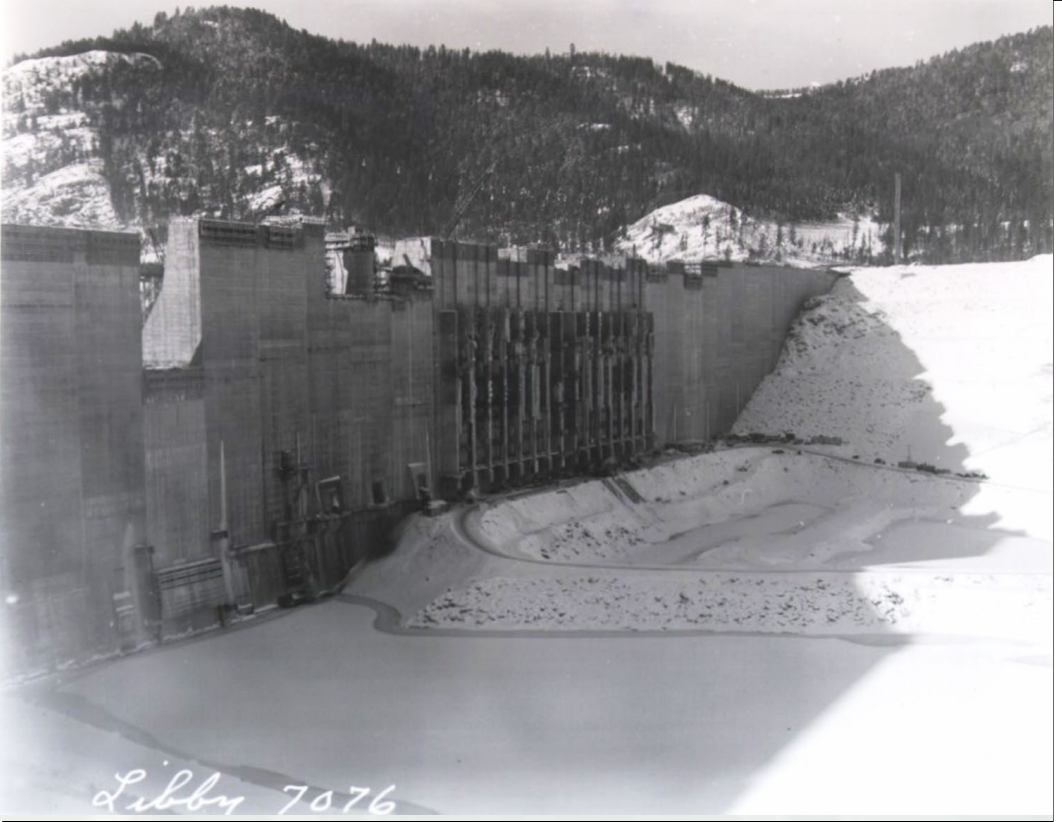
Corps of Engineers Projections Based on the 41 Ensemble Streamflow Prediction Traces
Issued by the Northwest River Forecast Center, National Weather Service

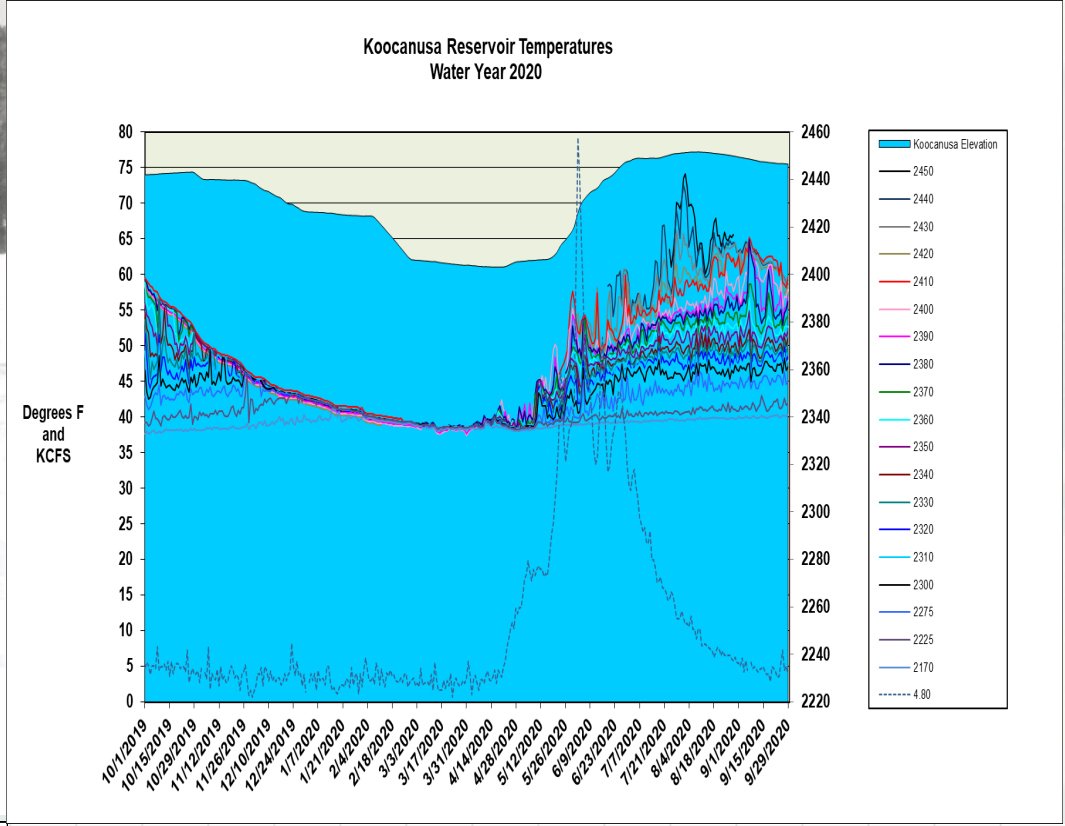


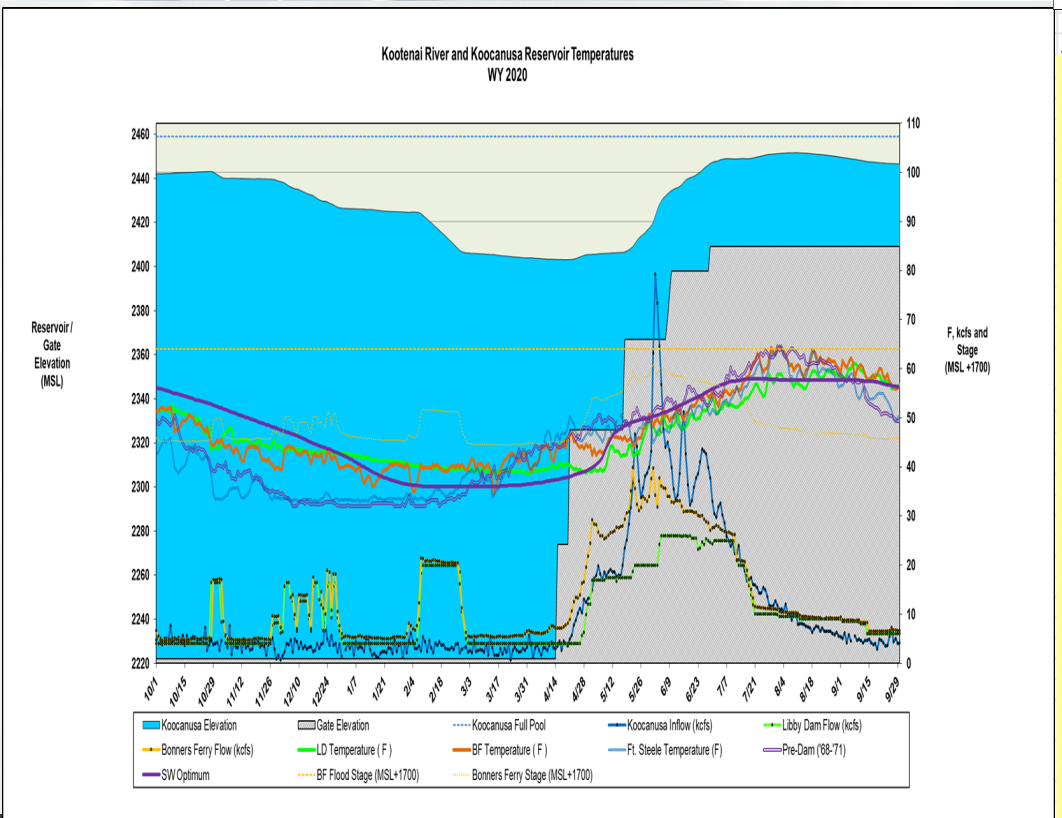

## Bonners Ferry Stage

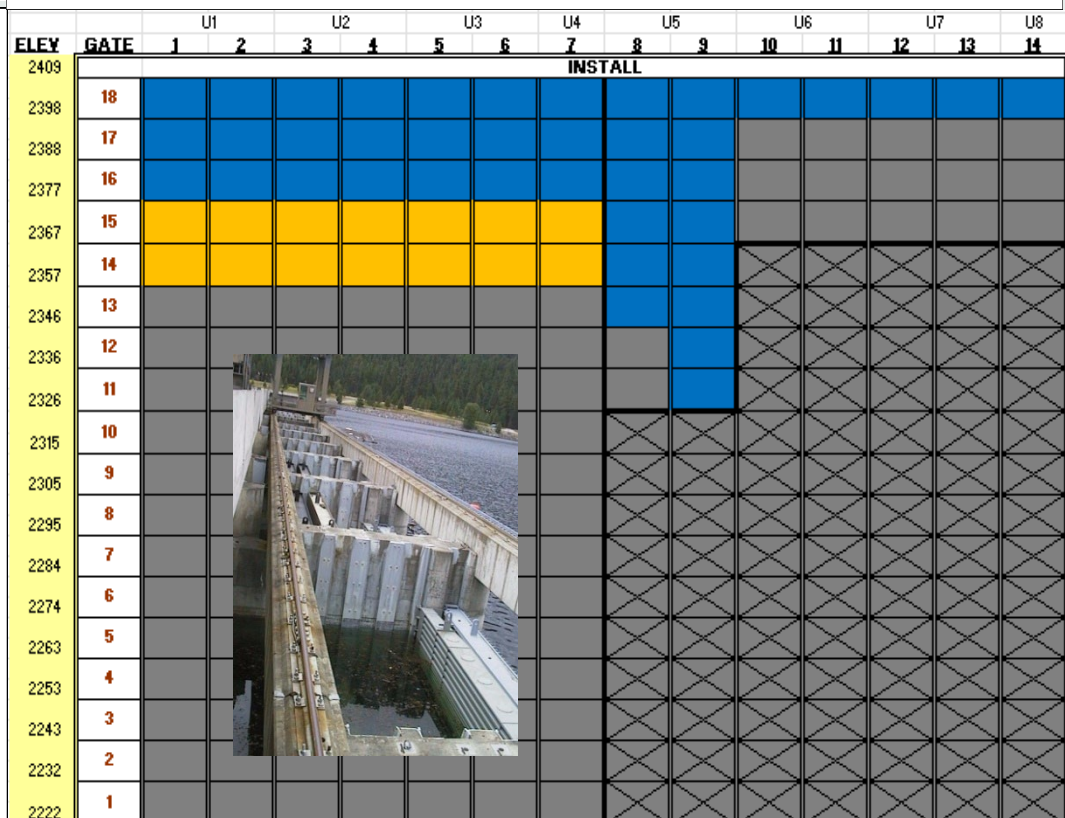
Corps of Engineers Projections Based on the 41 Ensemble Streamflow Prediction Traces
Issued by the Northwest River Forecast Center, National Weather Service

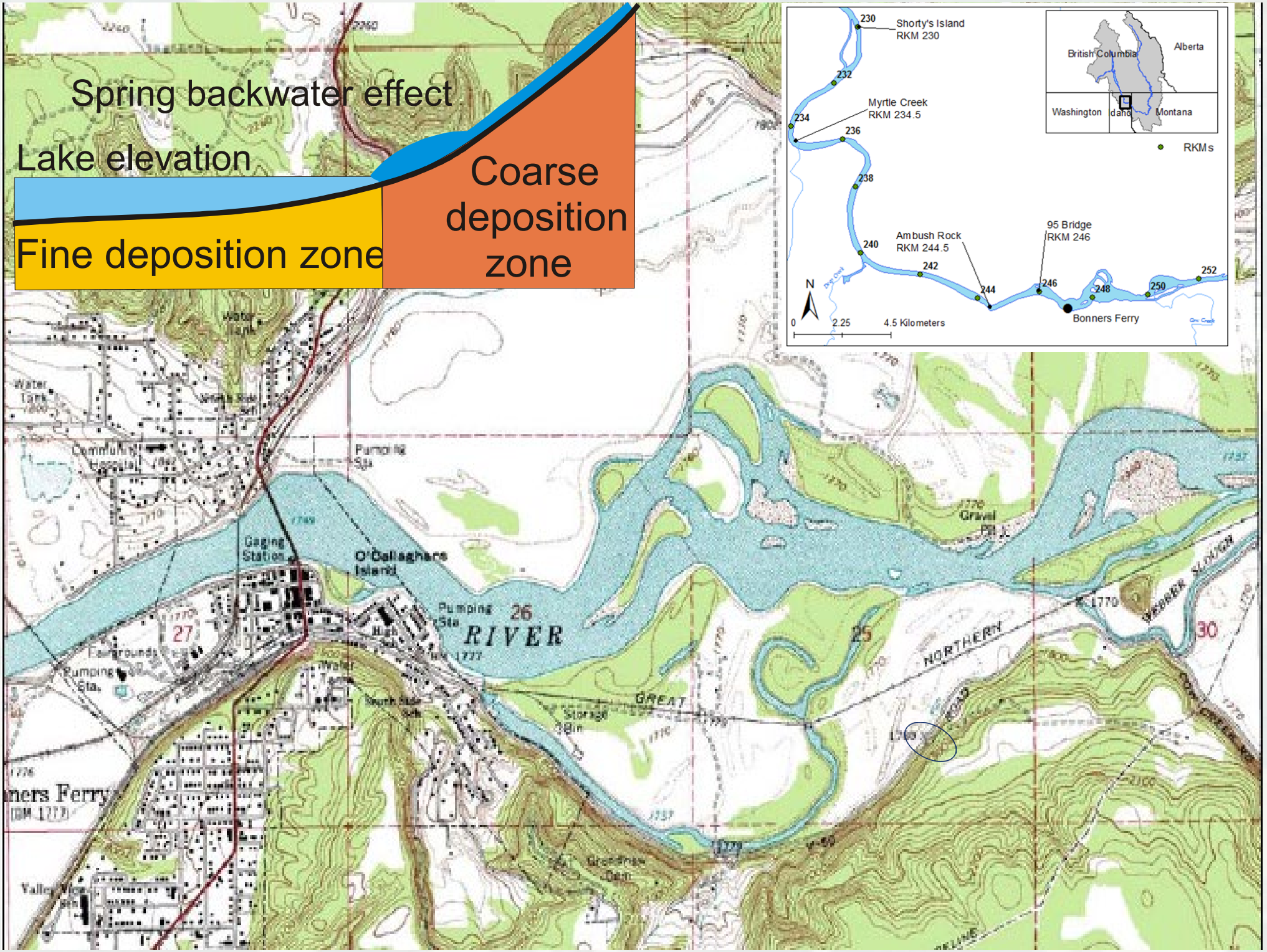


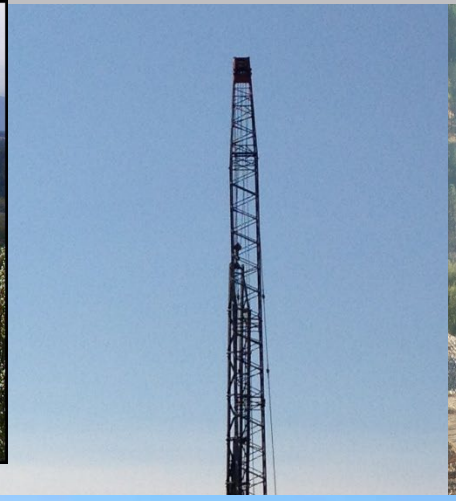

Libby 7076


Koocanusa Reservoir Temperatures
Water Year 2020
Degrees F and KCFS
Koocanusa Elevation
10/1/2019
10/15/2019
10/29/2019
11/12/2019
11/26/2019
12/10/2019
12/24/2019
1/7/2020
1/21/2020
2/4/2020
2/18/2020
3/3/2020
3/17/2020
3/31/2020
4/14/2020
4/28/2020
5/12/2020
5/26/2020
6/9/2020
6/23/2020
7/7/2020
7/21/2020
8/4/2020
8/18/2020
9/1/2020
9/15/2020
9/29/2020


Kootenai River and Koocanusa Reservoir Temperatures
WY 2020
Reservoir / Gate Elevation (MSL)
F, kcfs and Stage (MSL +1700)
Koocanusa Elevation
Gate Elevation
Koocanusa Full Pool
Koocanusa Inflow (kcfs)
Libby Dam Flow (kcfs)
Bonners Ferry Flow (kcfs)
LD Temperature ( F )
BF Temperature ( F )
Ft. Steele Temperature (F)
Pre-Dam ('68-'71)
SW Optimum
BF Flood Stage (MSL+1700)
Bonners Ferry Stage (MSL+1700)


ELEV
GATE
U1
U2
U3
U4
U5
U6
U7
U8
INSTALL


Spring backwater effect
Lake elevation
Fine deposition zone
Coarse deposition zone
230
Shorty's Island
RKM 230
232
Myrtle Creek
RKM 234.5
234
236
238
240
Ambush Rock
RKM 244.5
242
95 Bridge
RKM 246
244
246
248
250
252
Bonners Ferry
British Columbia
Alberta
Washington
Idaho
Montana
RKMs
N
0
2.25
4.5 Kilometers
RIVER
O'Callaghans Island
Gaging Station
Pumping Sta.
Gravel Pit
NORTHERN
GREAT
Storage Bin
Bonners Ferry







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RESEARCH ARTICLE

WILEY

# Collateral benefits: River flow normalization for endangered fish enabled riparian rejuvenation

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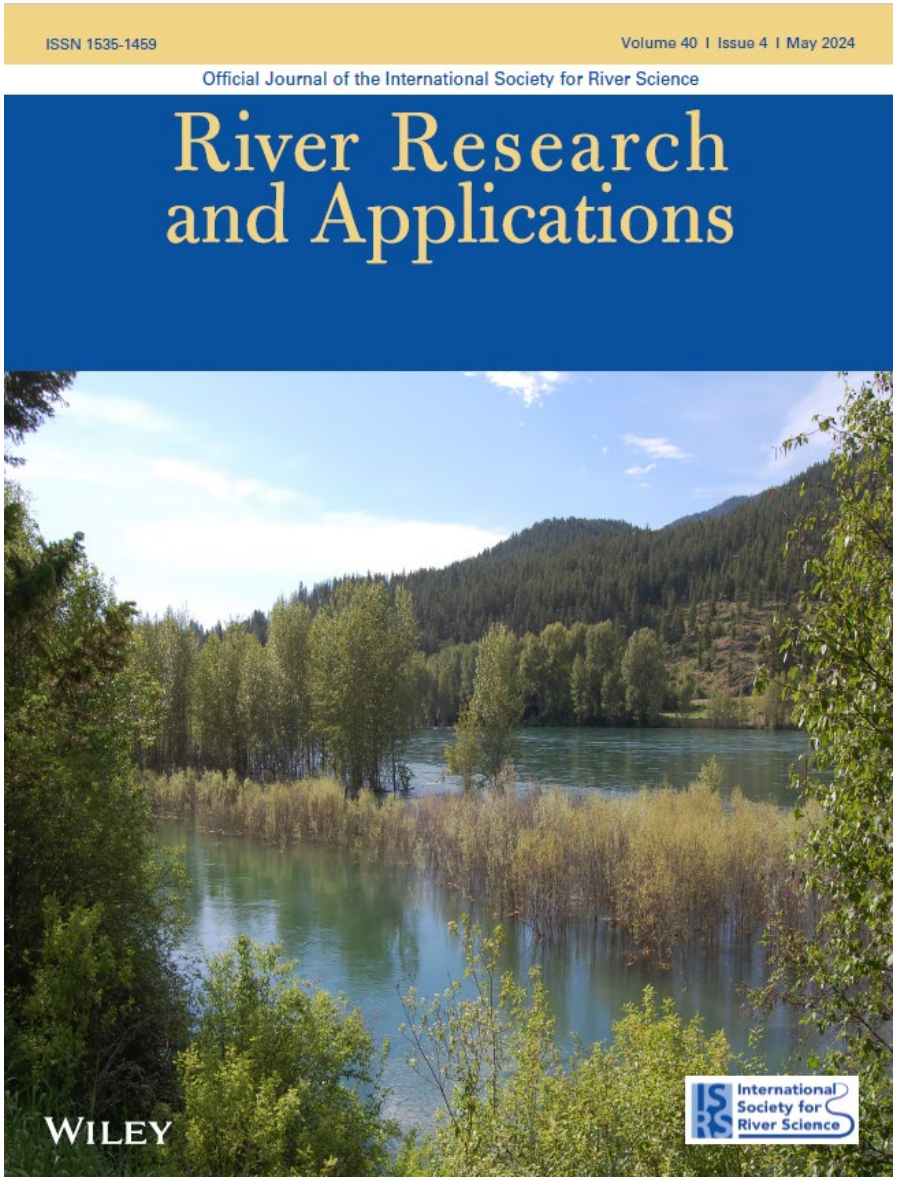
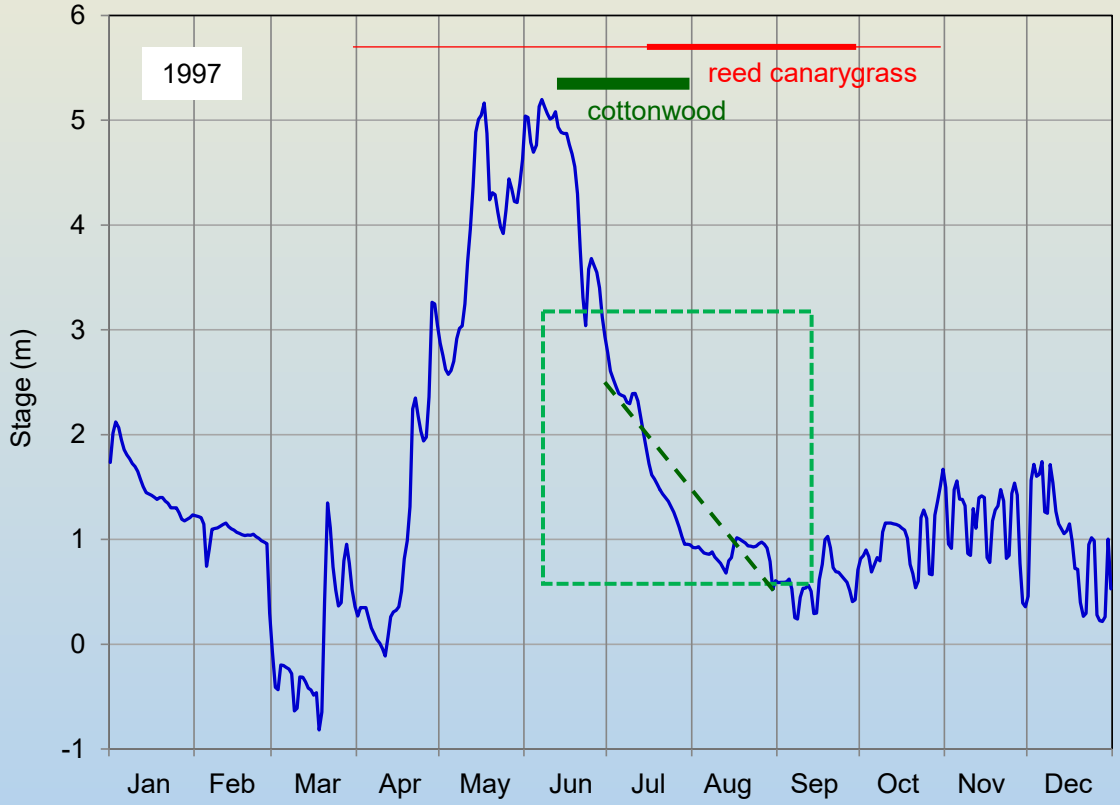
**Funding information**
Natural Sciences and Engineering Research Council of Canada; Bonneville Power Administration; Alberta Environment and Parks

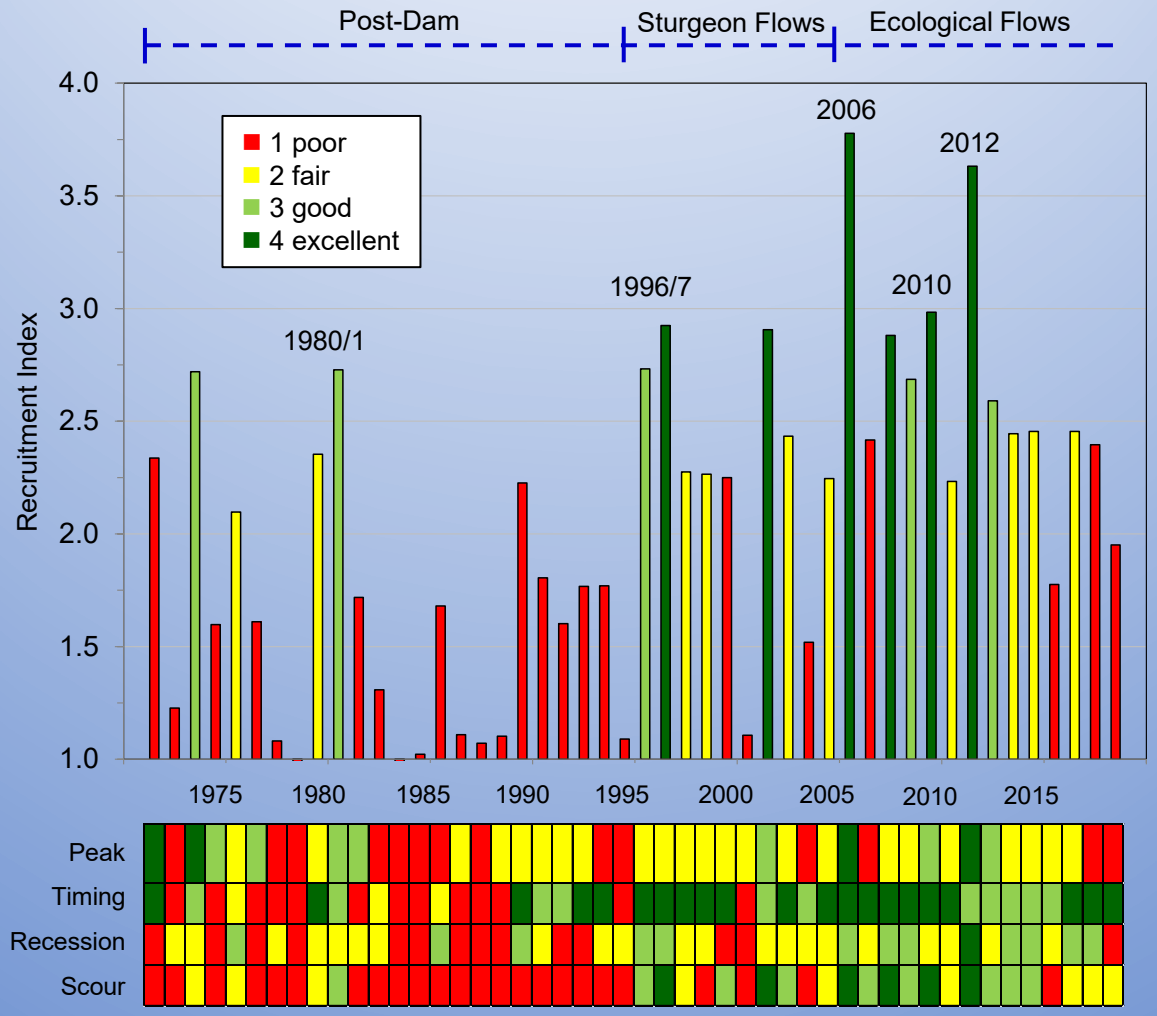
## Abstract

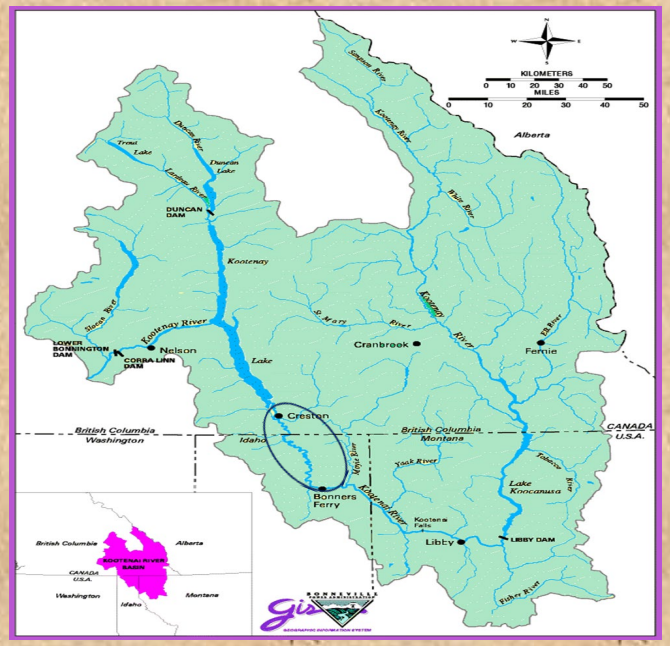
Like most rivers worldwide, the transboundary North American Kootenay/i River has experienced multiple impacts including watershed developments, river channelization, and floodplain clearing, draining, and diking. Construction of Libby Dam was authorized by the 1964 Columbia River Treaty (CRT) between the United States and Canada, and in 1975 began regulating downstream flows for flood risk management and hydropower generation. Following cumulative impacts, the endemic Kootenai River White Sturgeon population collapsed and was designated as endangered in 1994 (U.S. Endangered Species Act). Subsequent Biological Opinions from the U.S. Fish and Wildlife Service prescribed Libby Dam operations to provide springtime flow pulses for sturgeon spawning. These provided the unanticipated benefit of substantial seedling recruitment of native and introduced riparian cottonwoods and willows. The regulated flow regime was further adaptively managed to provide a more normative (natural) regime, to balance ecological functions with flood risk management and hydropower generation. The broadened ecological considerations would be consistent with the proposed priorities for the modernization of the international CRT. The observed responses revealed that (1) diverse aquatic and riparian organisms are dependent on common river flow characteristics; (2) a normalized flow regime provided substantial ecological benefits; and (3) due to multiple influences, hybrid ecosystems develop along regulated rivers, with a blending of natural and altered processes and communities. For other regulated rivers, we recommend that (1) high springtime flows be allowed, as feasible; (2) followed by the gradual post-peak recession; and (3) the maintenance of sufficient flows through the warm and dry interval of mid to late summer.

KEYWORDS
*Acipenser transmontanus*, Columbia River Treaty, environmental flows, functional flows, *Populus*, restoration, *Salix*




1997
reed canarygrass
cottonwood
Stage (m)
6
5
4
3
2
1
0
-1
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Post-Dam
Sturgeon Flows
Ecological Flows
Recruitment Index
4.0
3.5
3.0
2.5
2.0
1.5
1.0
1 poor
2 fair
3 good
4 excellent
1980/1
1996/7
2006
2010
2012
1975
1980
1985
1990
1995
2000
2005
2010
2015
Peak
Timing
Recession
Scour


KILOMETERS
0 10 20 30 40 50
MILES
0 10 20 30 40 50
Alberta
DUNCAN DAM
Kootenay
Kootenay River
Slocan River
Duncan Lake
Trout Lake
Lardeau River
Duncan River
Slocan River
Kootenay River
White River
Elk River
St. Mary River
Kootenay River
Flathead River
LOWER BONNINGTON DAM
CORRA LINN DAM
Nelson
Lake
Cranbrook
Fernie
Creston
British Columbia
Washington
Idaho
British Columbia
Montana
CANADA
U.S.A.
Moyie River
Yaak River
Kootenai River
Bonners Ferry
Lake Koocanusa
Kootenai Falls
Libby
LIBBY DAM
Fisher River
British Columbia
Alberta
KOOTENAI RIVER BASIN
CANADA
U.S.A.
Washington
Idaho
Montana

## OBJECTIVES

1) The primary objective of Libby Dam Operational Strategy #1 is to **maximize river stage early in the season by "stacking" dam discharge on top of the peak of the local, downstream freshet**, which typically occurs in mid-May.
    - Previous operations have targeted connection of off-channel habitats as early and as long as possible
    - Recent Lower Tier volumes (e.g. 2024) under this strategy have not resulted in connectivity
    - Libby Dam discharge will likely be limited to ~20 kcfs (3-4 Units) from May 12-27 due to *required transmission line maintenance and upgrades*.

2) The primary objective of Libby Dam Operational Strategy #2 is to **align commencement of a sturgeon pulse (20 kcfs maximum discharge) with the projected peak of the high elevation runoff,** which historically occurred ~ June 1.
    - Delay will allow Kootenay Lake backwater to increase stage in the river as the lake fills and will likely provide warmer discharge temperatures from the dam associated with warming inflows into the reservoir and longer days during the receding limb of the hydrograph (spawning)
    - Limiting discharge at Libby Dam to 20 kcfs would flatten and extend the peak of the hydrograph

3) The primary objective of Libby Dam Operational Strategy #2 is to **align commencement of a sturgeon pulse (25 kcfs maximum discharge) with the projected peak of the high elevation runoff,** which historically occurred ~ June 1.
    - Discharging full powerhouse capacity (25 kcfs) from Libby Dam would decrease the duration of high flows but would result in higher peak discharge and stage than Strategy #2.

## DRAFT 2025 FPIP SCENARIOS

1) Begin **20 kcfs discharge ~15 MAY** (~ peak of local tributary runoff downstream of Libby Dam)
    a) BiOp ramping rates UP and DOWN
    ~~b) BiOp ramping rates UP / BiOp ramping rates DOWN / 9 kcfs through 30 September~~
    c) BiOp ramping rates UP / 2x BiOp ramping rate DOWN
    ~~d) BiOp ramping rates UP / 2x BiOp ramping rates DOWN / 9 kcfs through 30 September~~

2) Begin **20 kcfs discharge ~01 JUNE** (~ peak of high elevation runoff upstream of Libby Dam)
    a. BiOp ramping rates UP and DOWN
    ~~b. BiOp ramping rates UP / BiOp ramping rates DOWN / 9 kcfs through 30 September~~
    c. BiOp ramping rates UP / 2x BiOp ramping rate DOWN
    ~~d. BiOp ramping rates UP / 2x BiOp ramping rates DOWN / 9 kcfs through 30 September~~

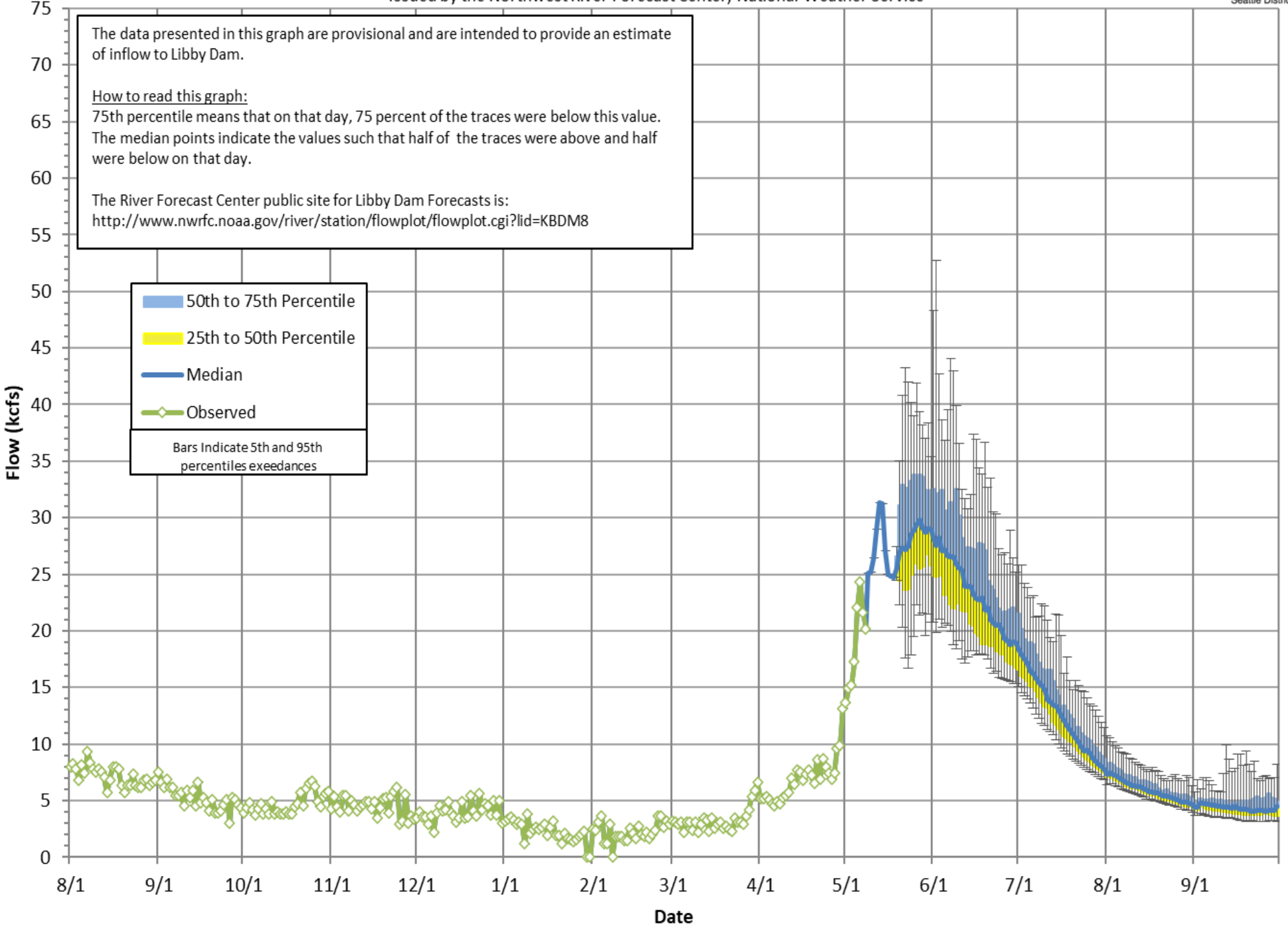
3) Begin **25 kcfs discharge ~01 JUNE** (~ peak of high elevation runoff upstream of Libby Dam)
    a) BiOp ramping rates UP and DOWN
    ~~b) BiOp ramping rates UP / BiOp ramping rates DOWN / 9 kcfs through 30 September~~
    c) BiOp ramping rates UP / 2x BiOp ramping rate DOWN
    ~~d) BiOp ramping rates UP / 2x BiOp ramping rates DOWN / 9 kcfs through 30 September~~

Modeled using current ESP traces as of 05/09/25

# Libby Dam Inflow- Probability Chart

Corps of Engineers Projections Based on the 44 Ensemble Streamflow Prediction Traces
Issued by the Northwest River Forecast Center, National Weather Service

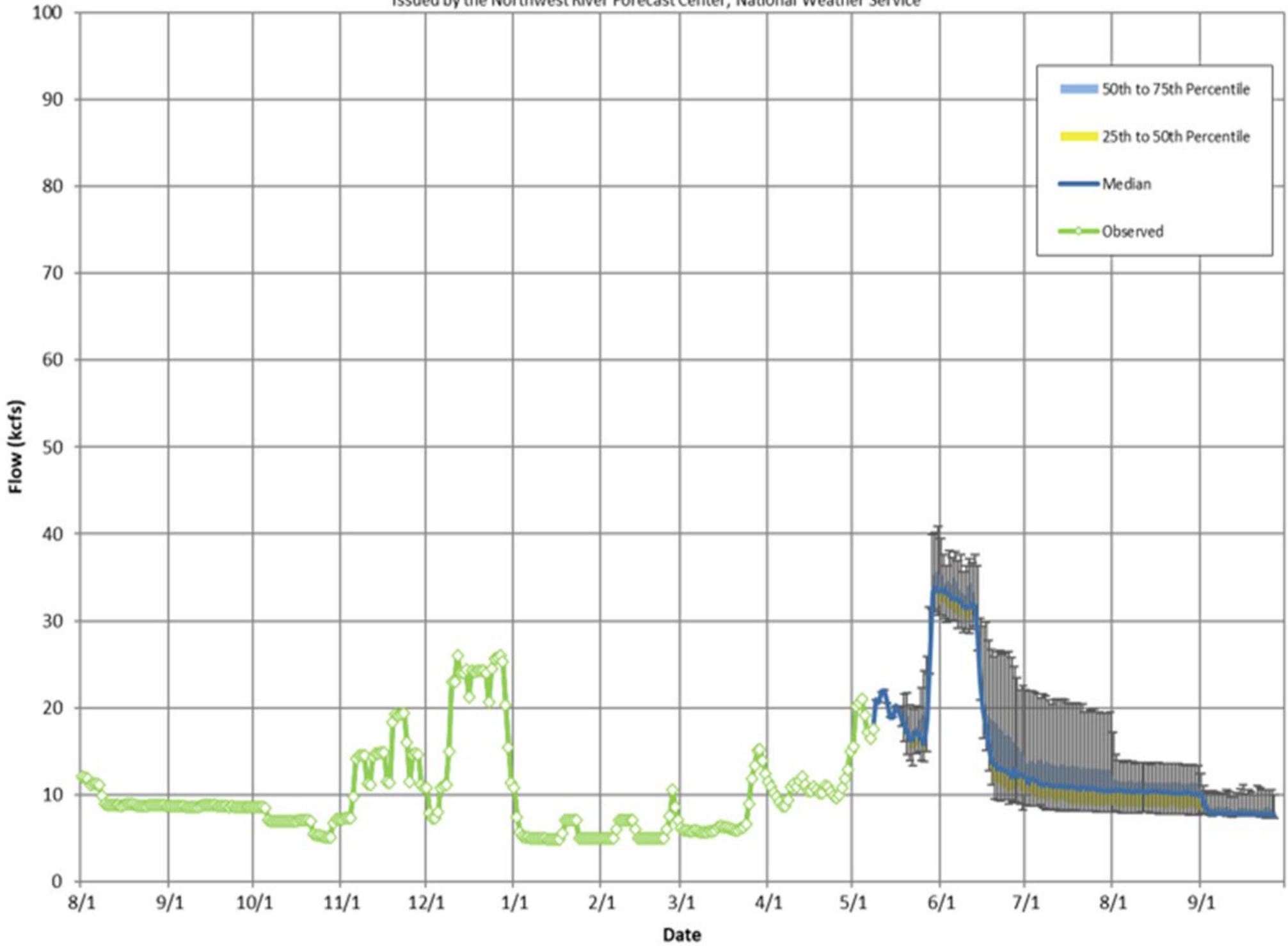
US Army Corps of Engineers
Seattle District



Modeled using current ESP traces as of 05/09/25

# Bonners Ferry Flow - Probability Chart

Corps of Engineers Projections Based on the 44 Ensemble Streamflow Prediction Traces
Issued by the Northwest River Forecast Center, National Weather Service



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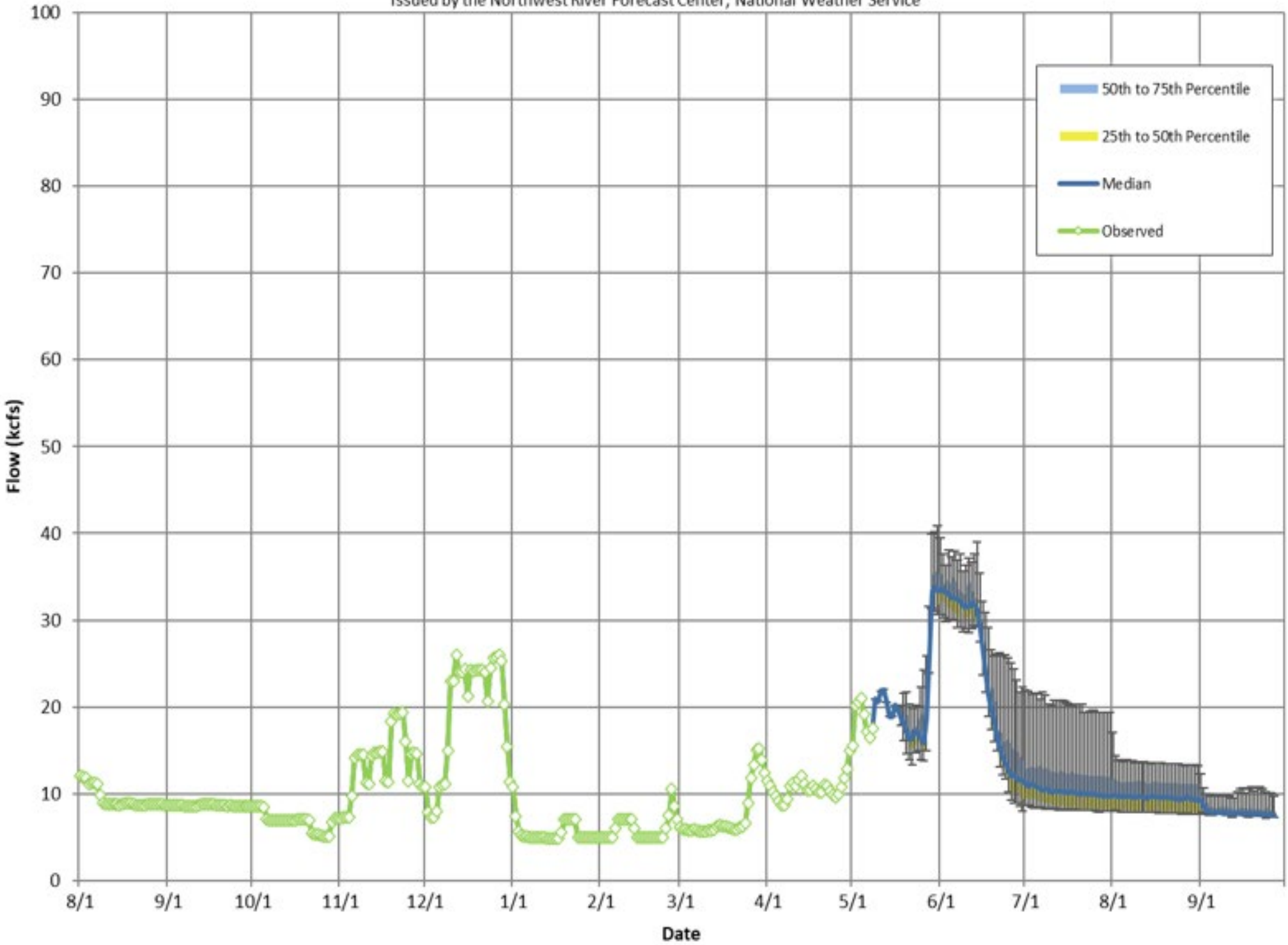

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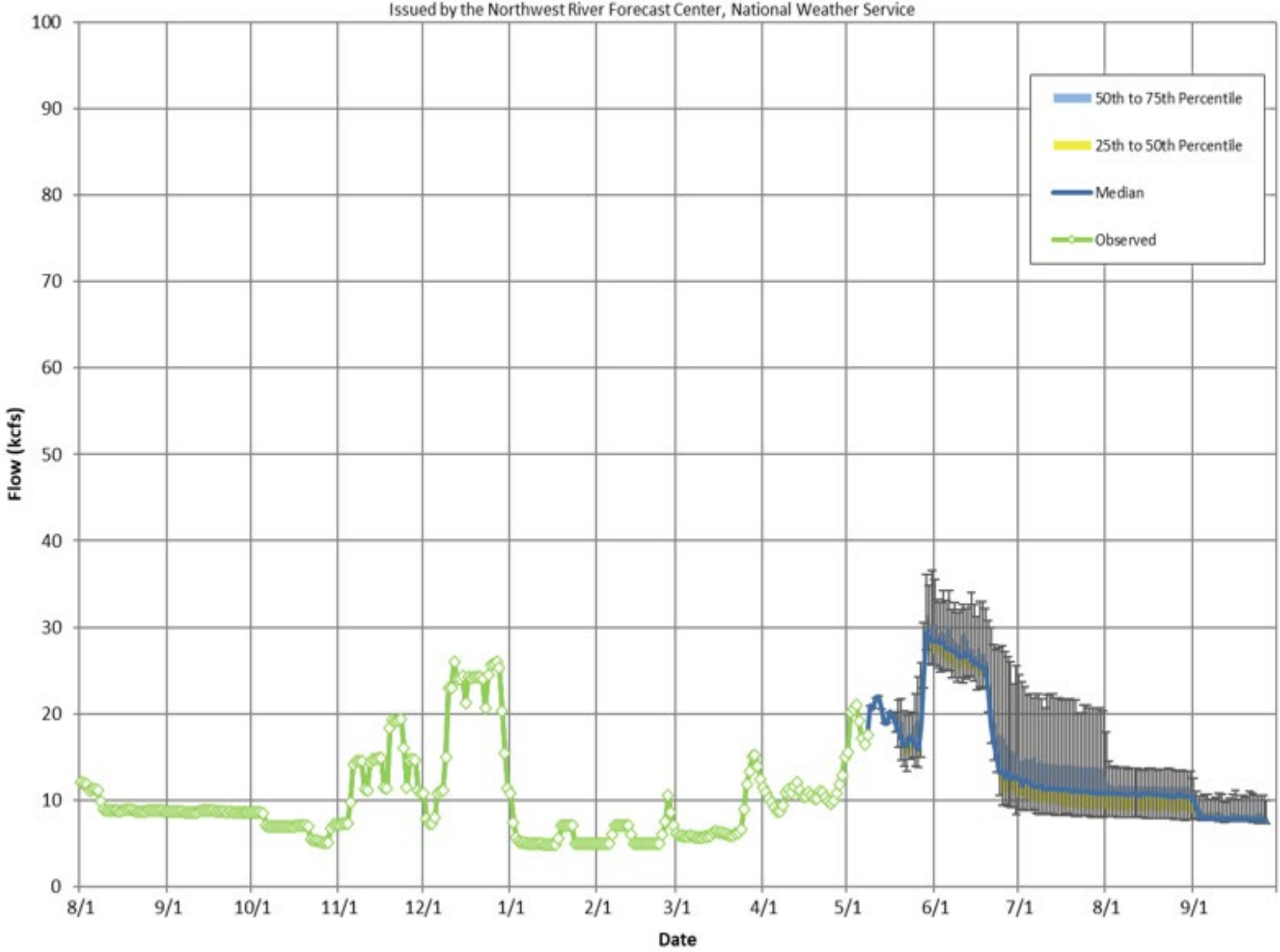

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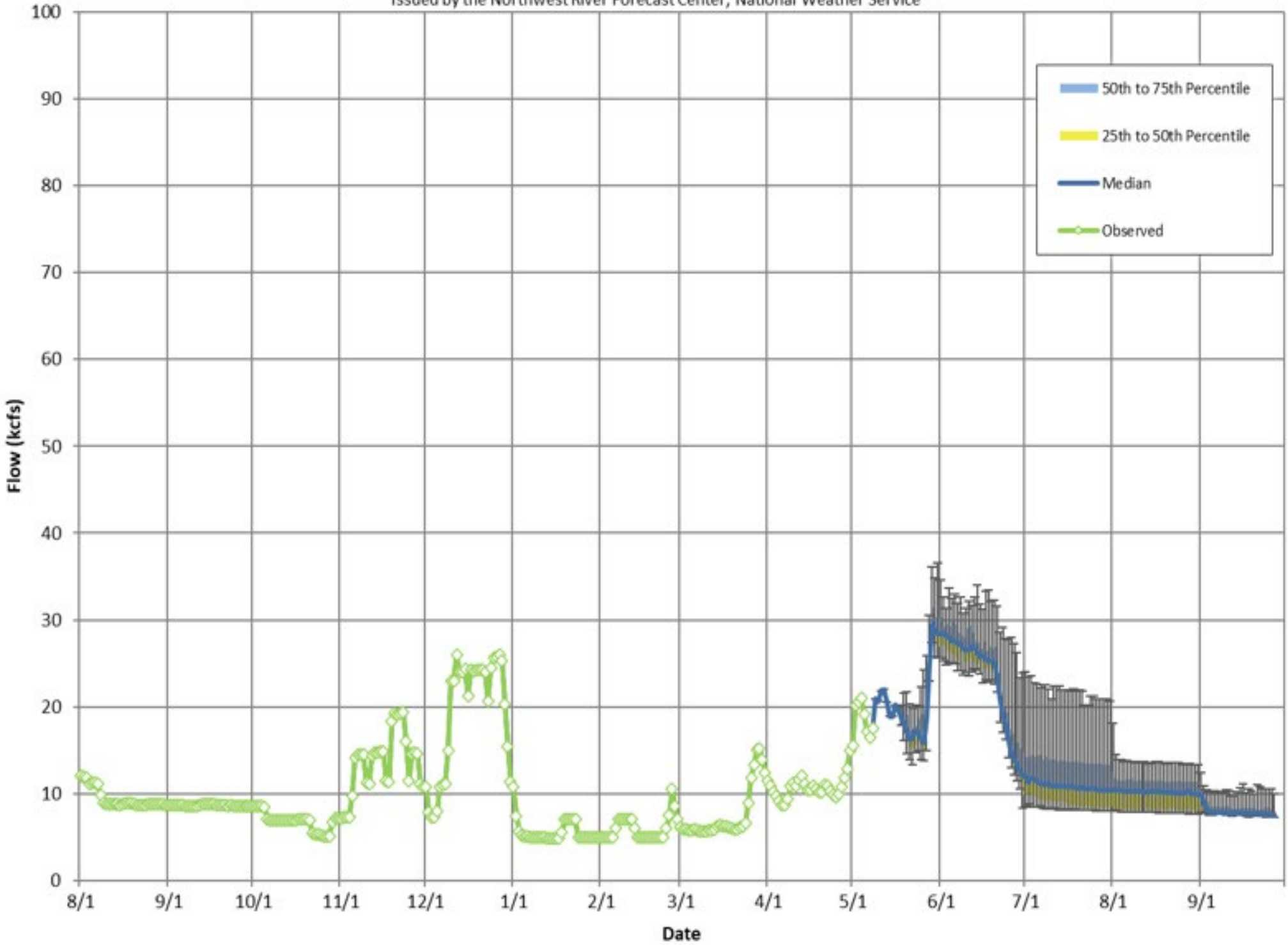

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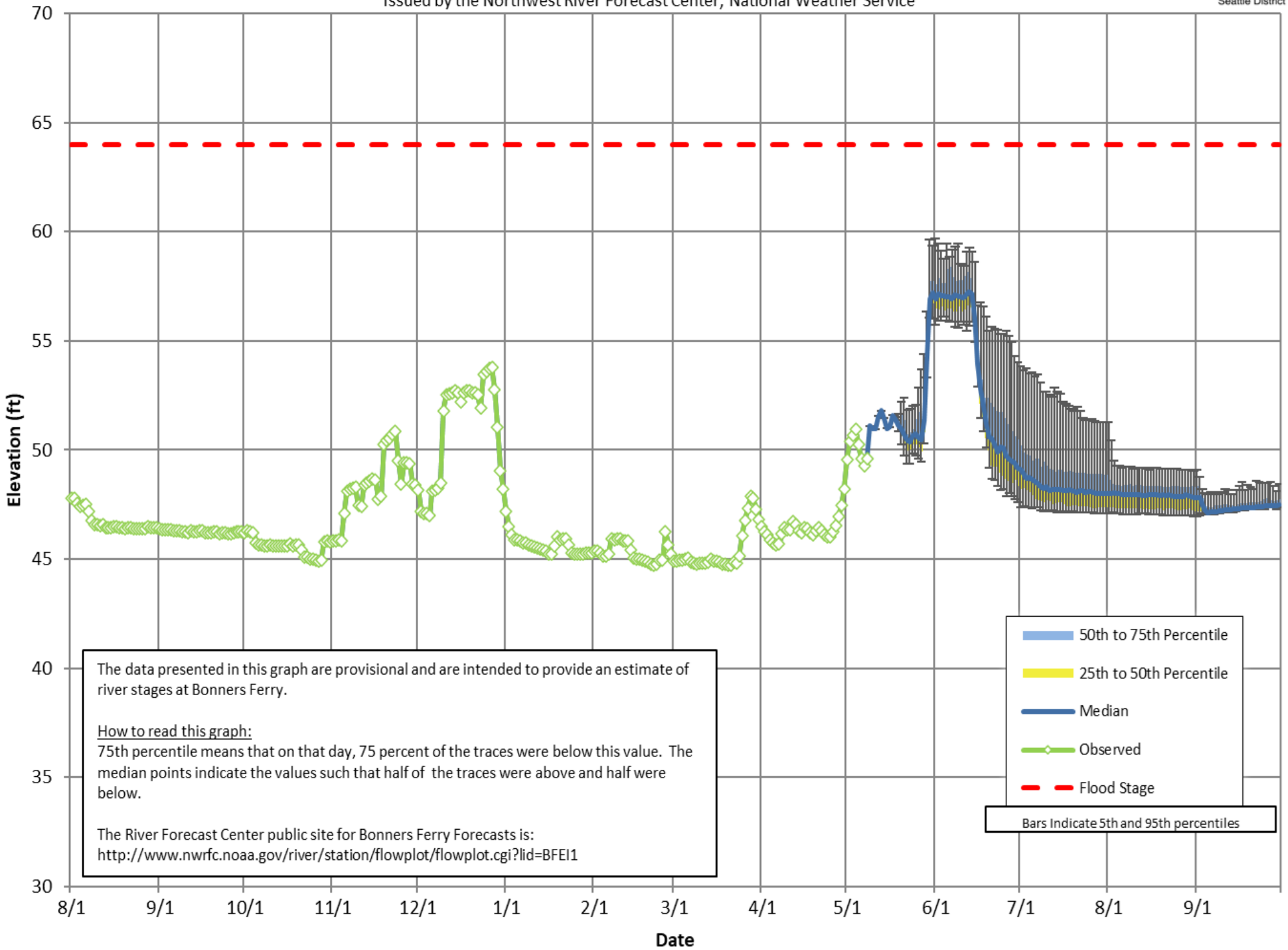
# Bonners Ferry Stage

Corps of Engineers Projections Based on the 44 Ensemble Streamflow Prediction Traces
Issued by the Northwest River Forecast Center, National Weather Service

US Army Corps of Engineers
Seattle District




The data presented in this graph are provisional and are intended to provide an estimate of river stages at Bonners Ferry.

How to read this graph:
75th percentile means that on that day, 75 percent of the traces were below this value. The median points indicate the values such that half of the traces were above and half were below.

The River Forecast Center public site for Bonners Ferry Forecasts is:
http://www.nwrfc.noaa.gov/river/station/flowplot/flowplot.cgi?lid=BFEI1

Modeled using current ESP traces as of 05/09/25

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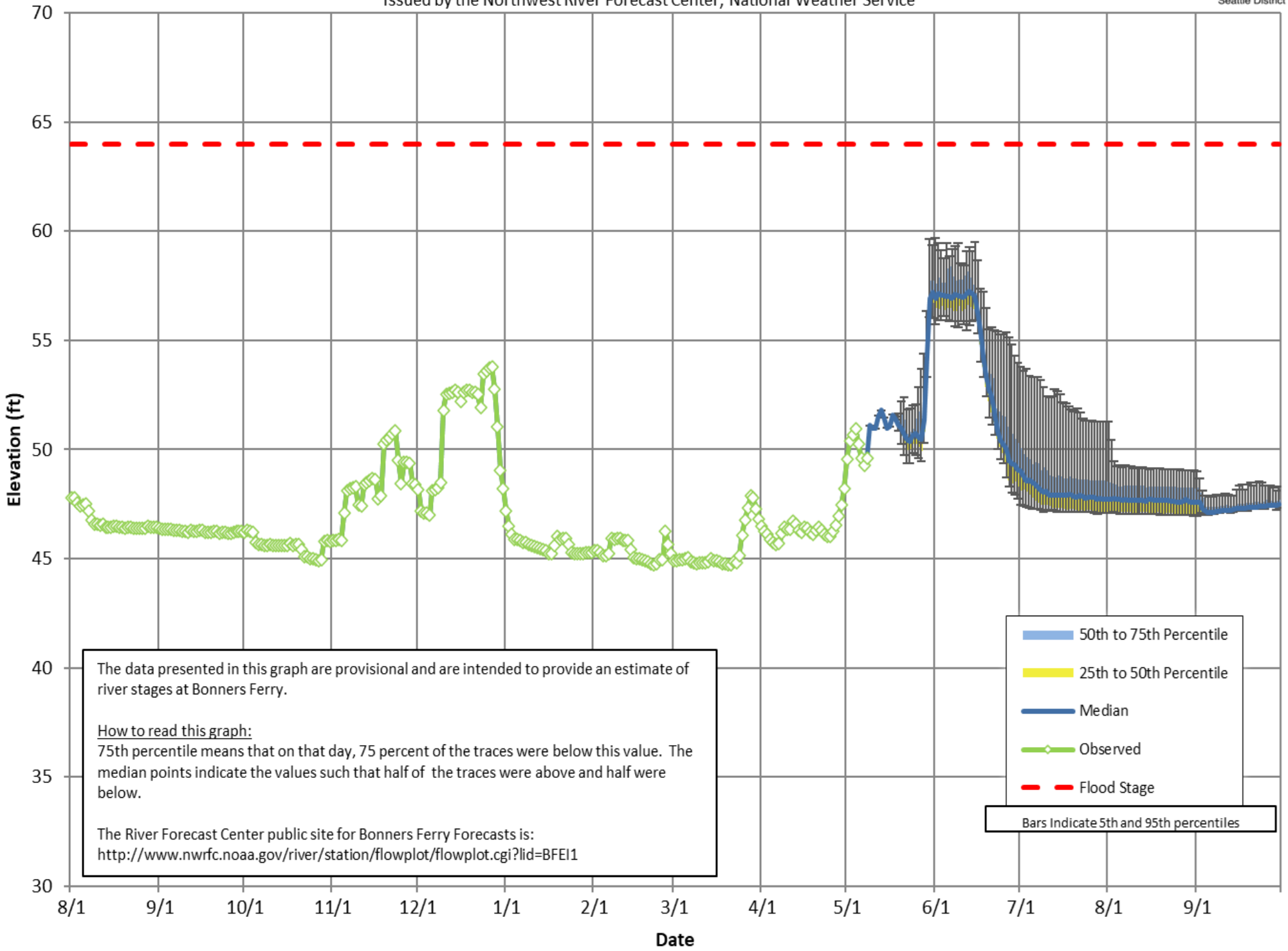
US Army Corps of Engineers
Seattle District

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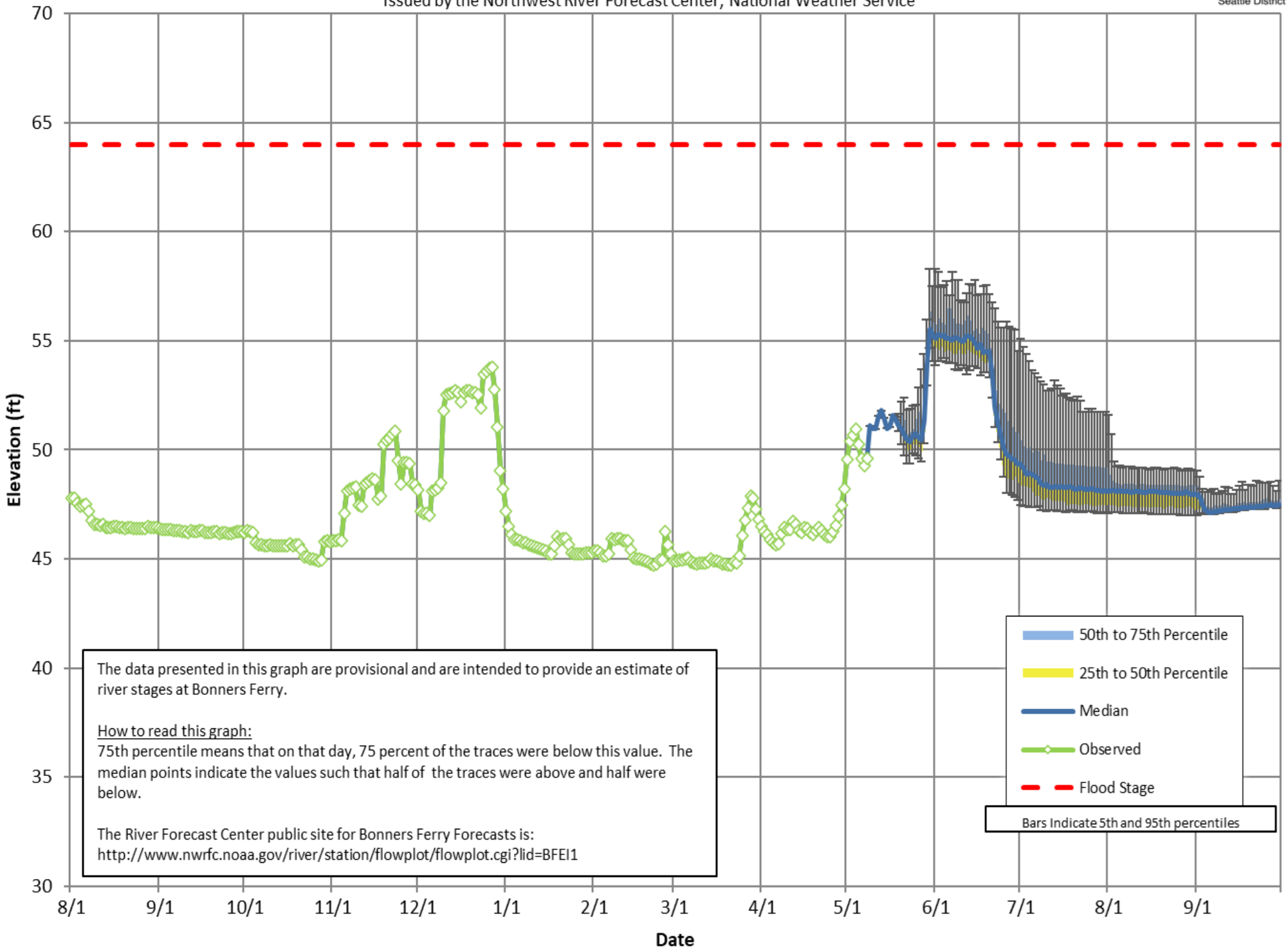


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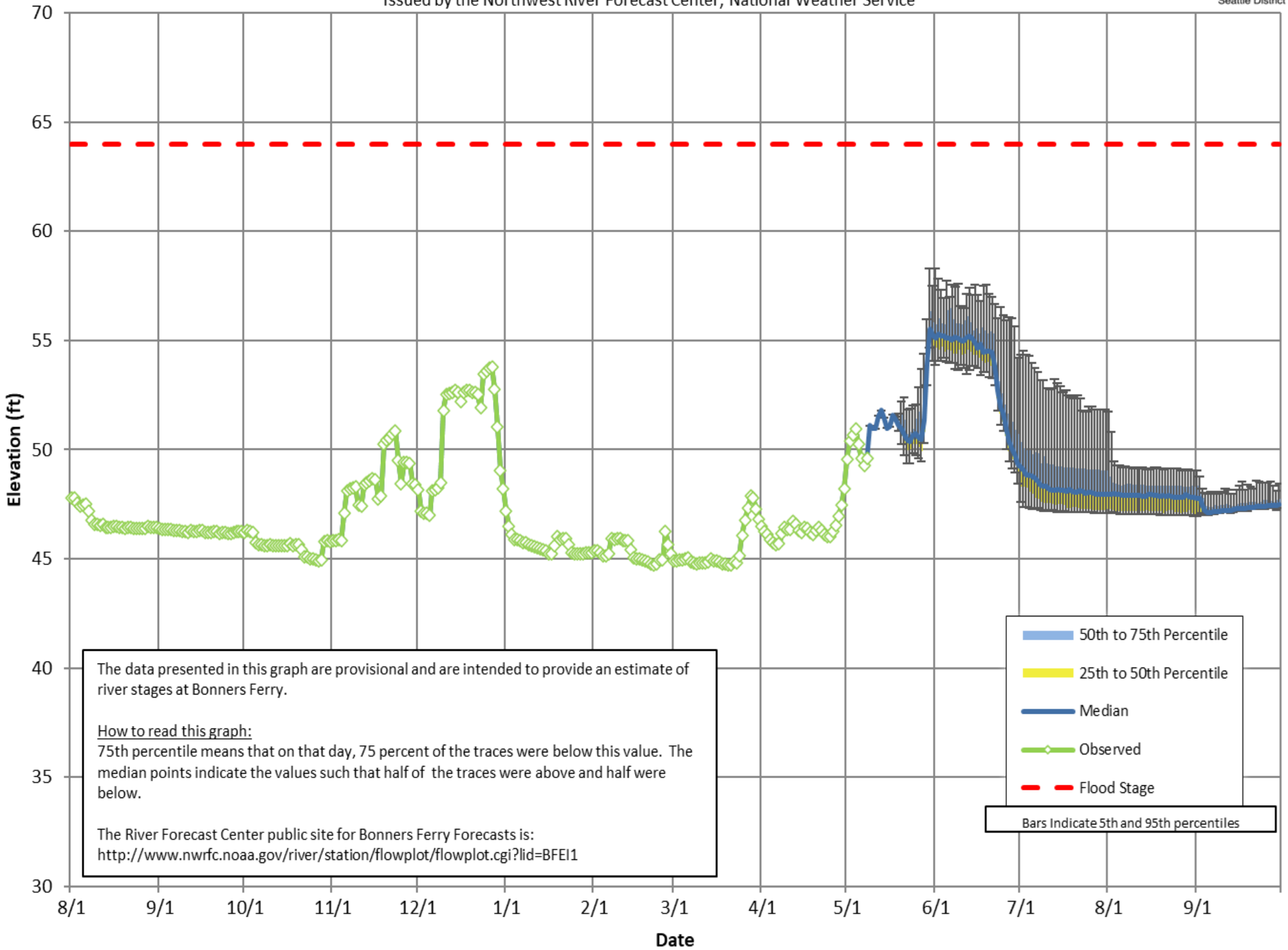


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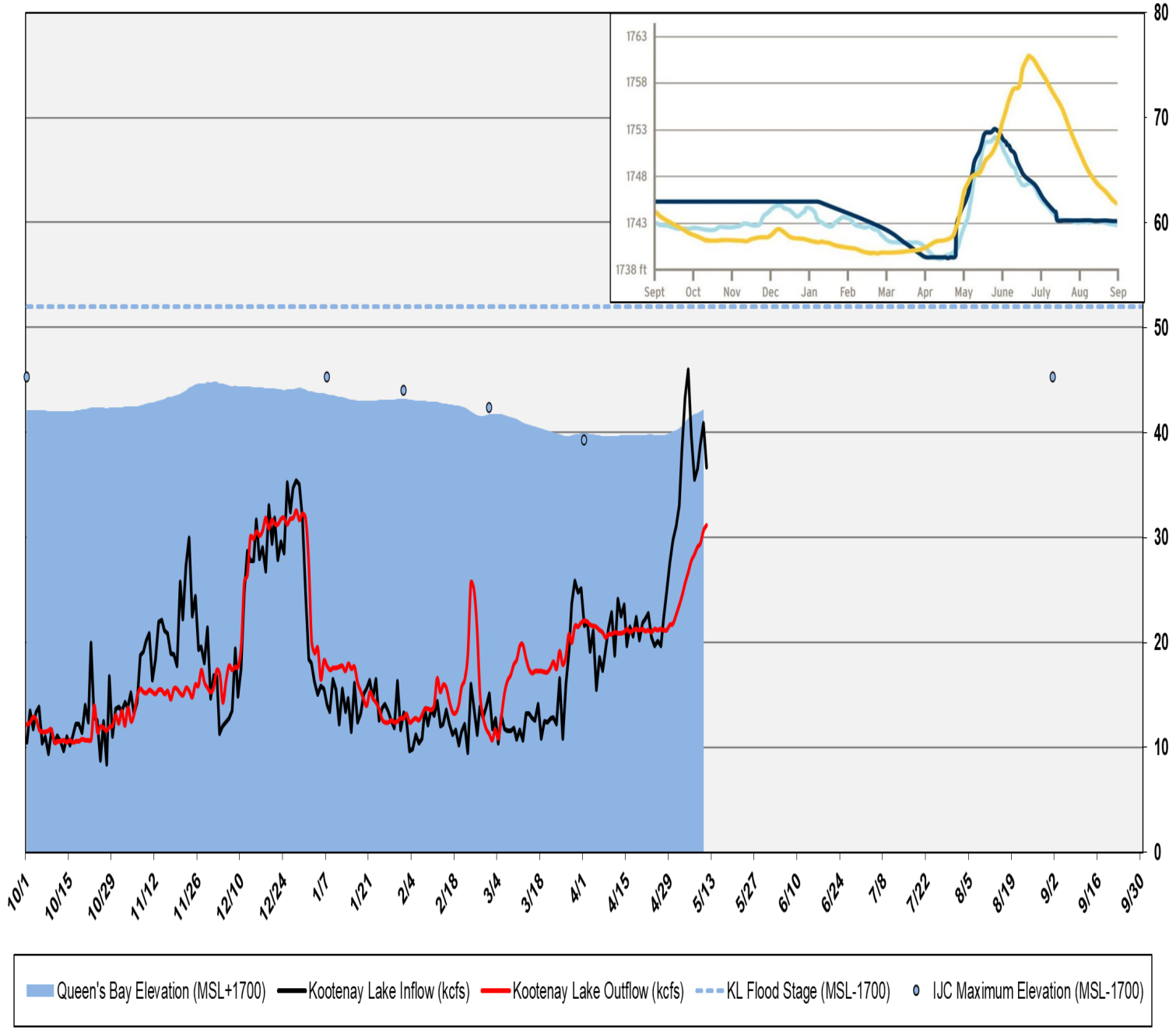
# Kootenai/ay River and Kootenay Lake
# Flow and Elevation
# WY 2025

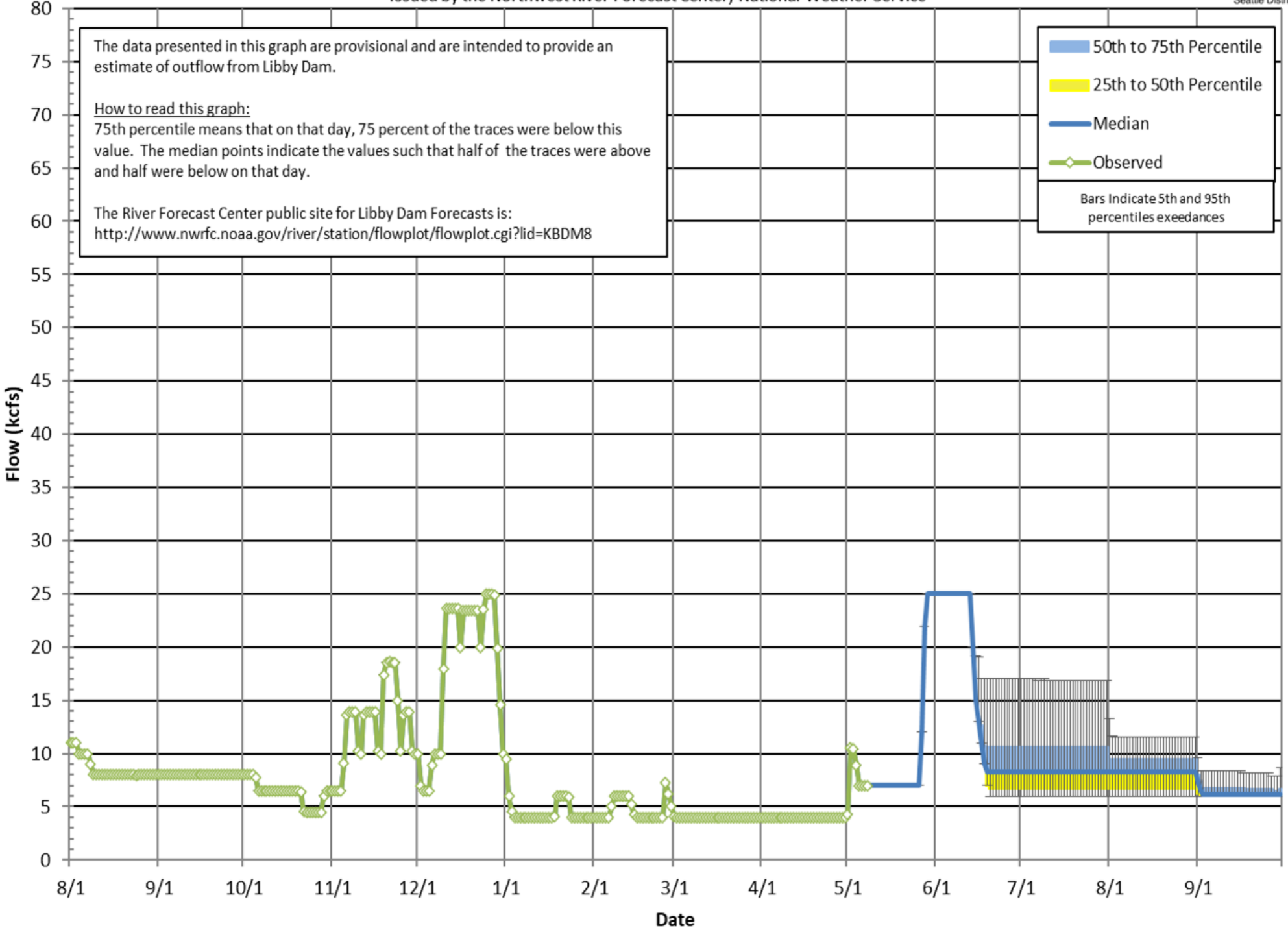


Modeled using current ESP traces as of 05/09/25

# Libby Dam Outflow - Probability Chart

Corps of Engineers Projections Based on the 44 Ensemble Streamflow Prediction Traces
Issued by the Northwest River Forecast Center, National Weather Service

US Army Corps of Engineers
Seattle District



Modeled using current ESP traces as of 05/09/25

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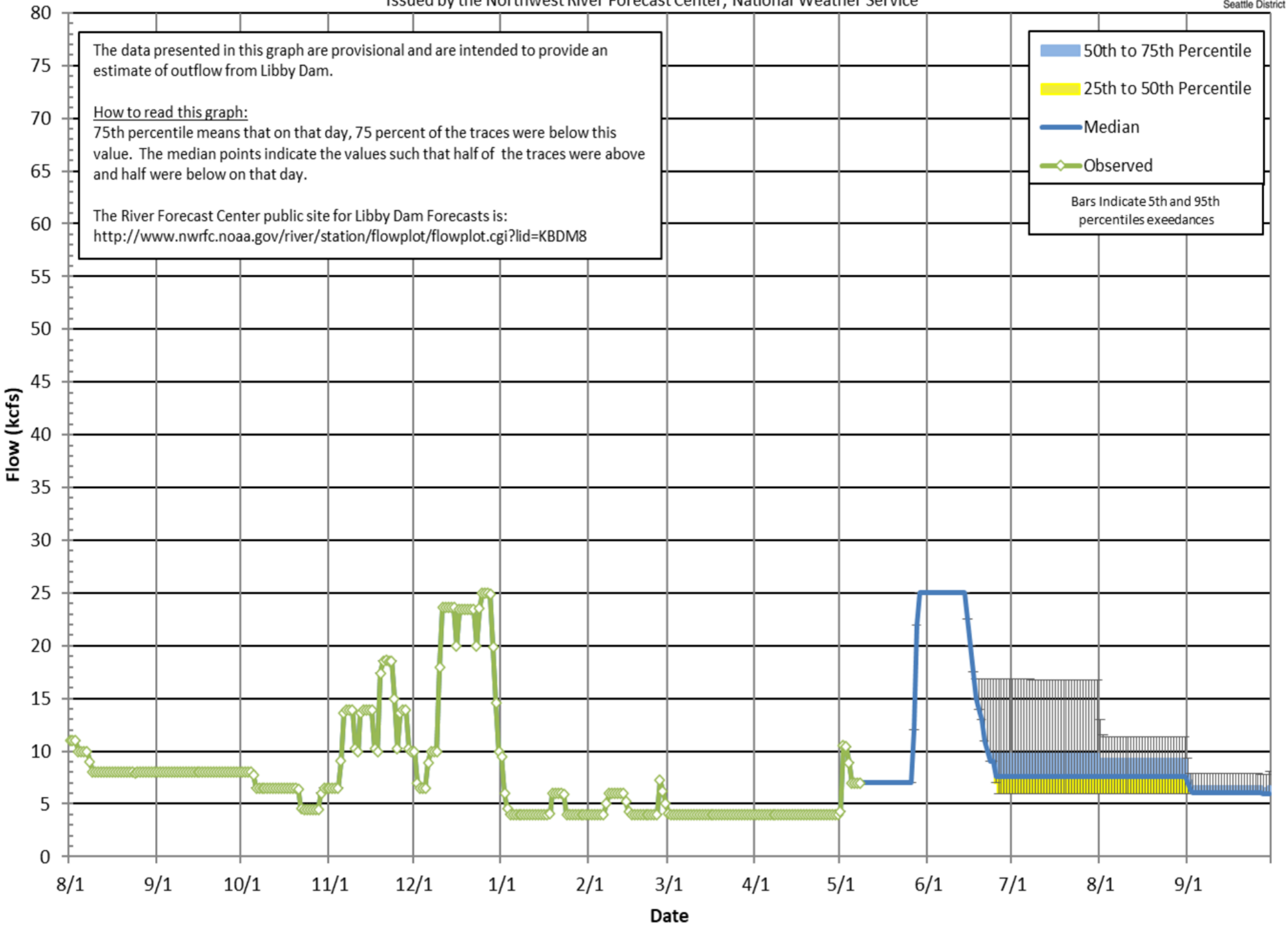
Seattle District



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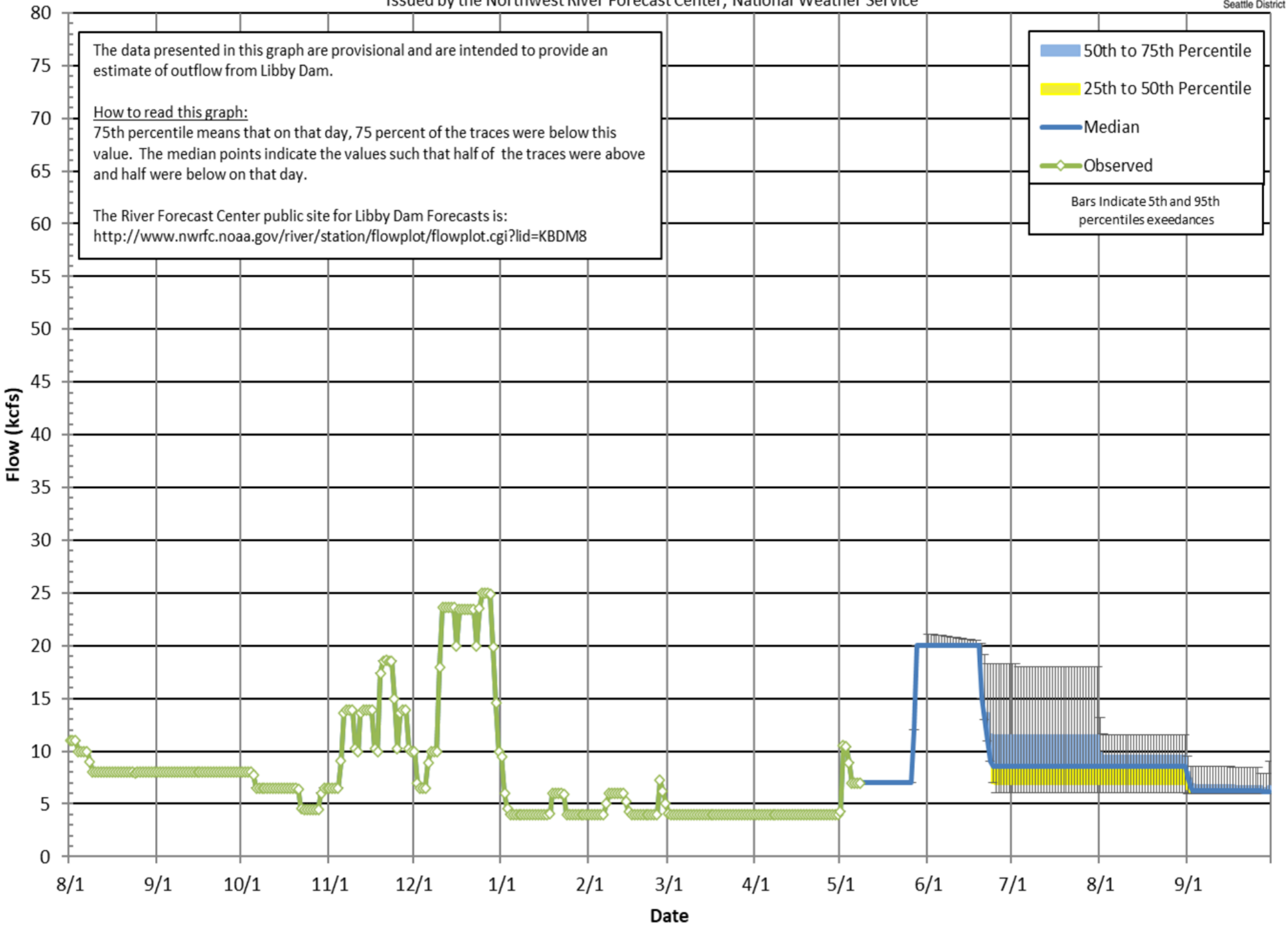

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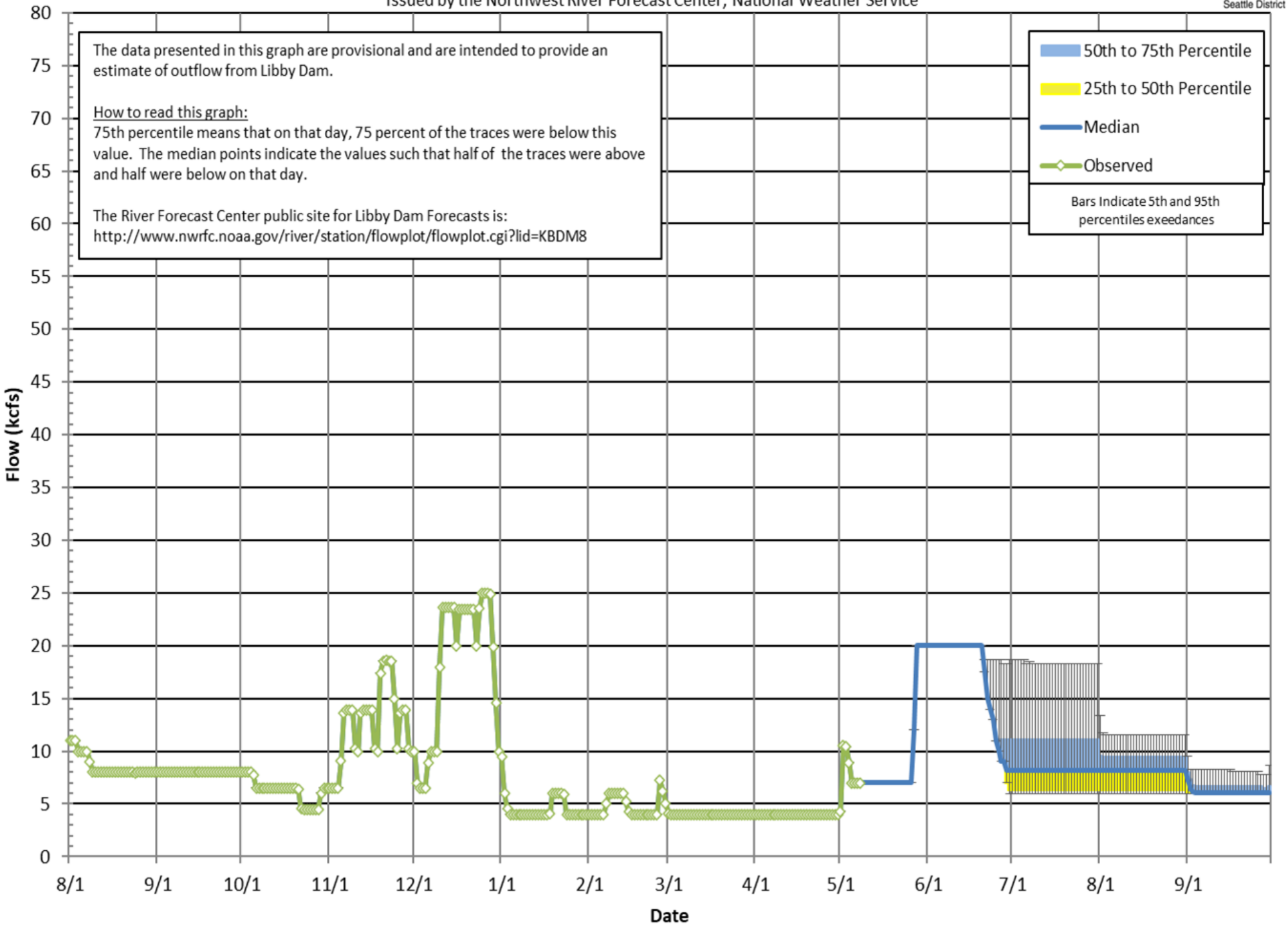
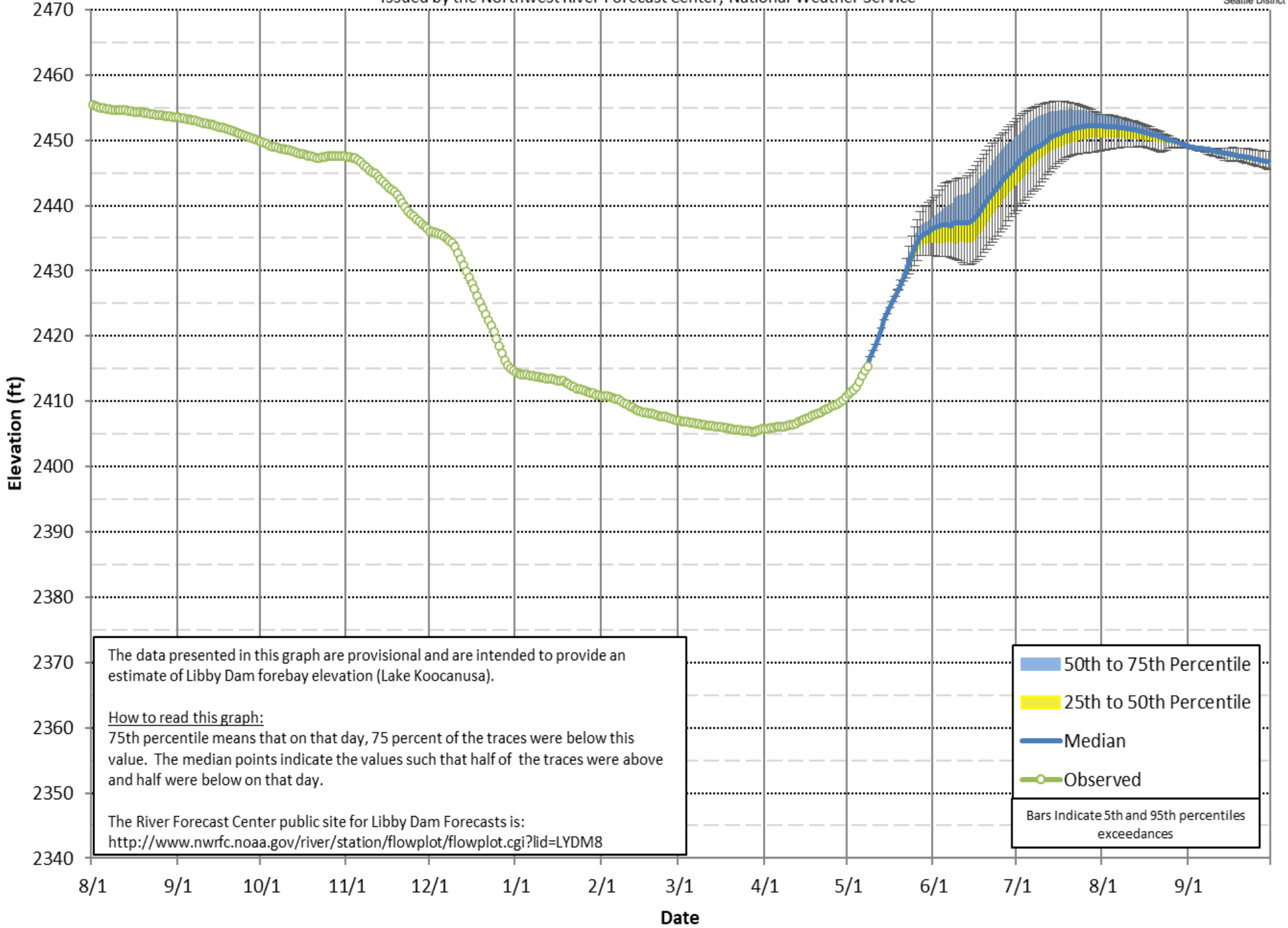


Modeled using current ESP traces as of 05/09/25

# Lake Koocanusa Elevation - Probability Chart

Corps of Engineers Projections Based on the 44 Ensemble Streamflow Prediction Traces
Issued by the Northwest River Forecast Center, National Weather Service

US Army Corps of Engineers
Seattle District




The data presented in this graph are provisional and are intended to provide an estimate of Libby Dam forebay elevation (Lake Koocanusa).

How to read this graph:
75th percentile means that on that day, 75 percent of the traces were below this value. The median points indicate the values such that half of the traces were above and half were below on that day.

The River Forecast Center public site for Libby Dam Forecasts is:
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Modeled using current ESP traces as of 05/09/25

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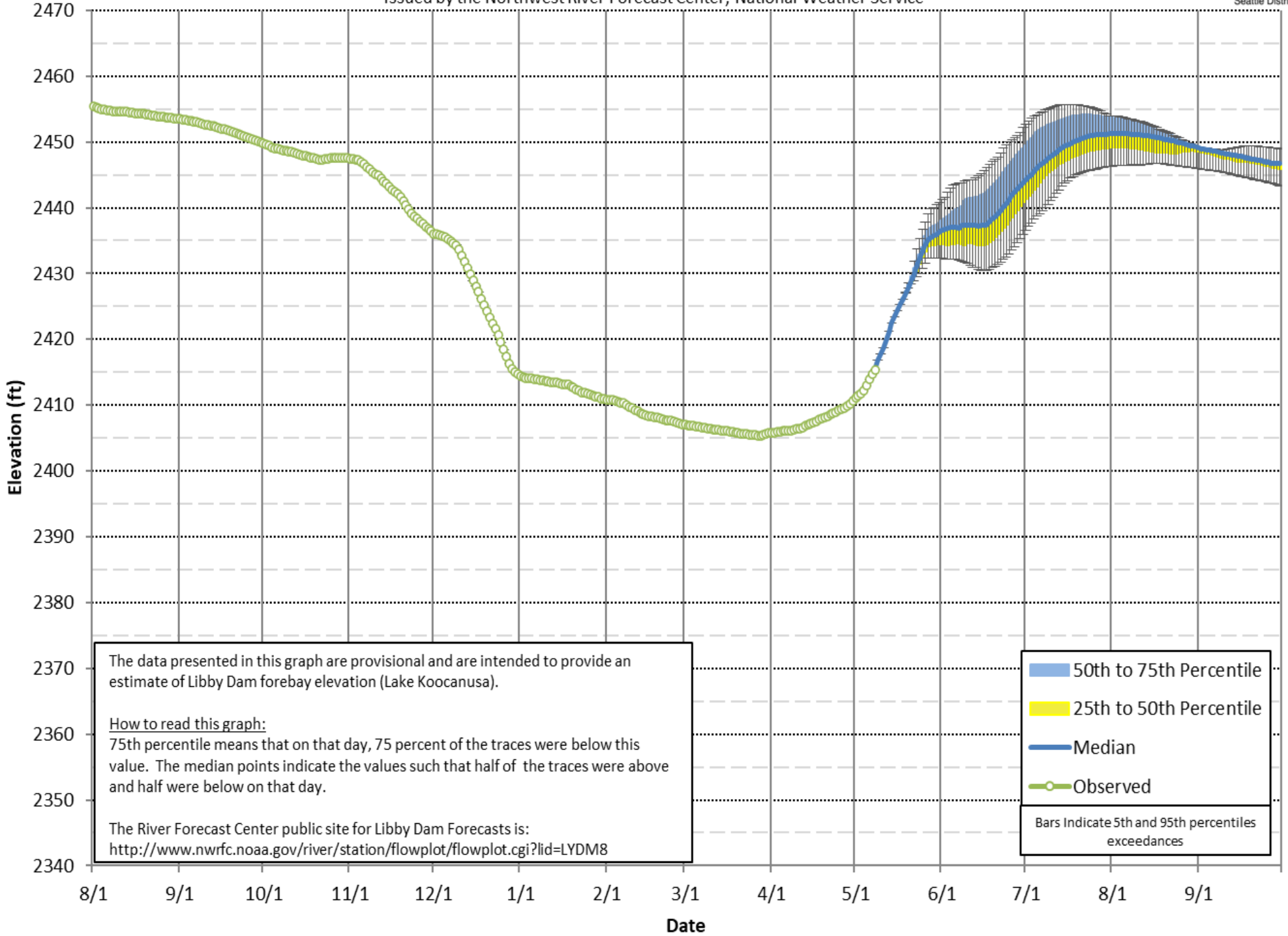
Issued by the Northwest River Forecast Center, National Weather Service

US Army Corps of Engineers
Seattle District

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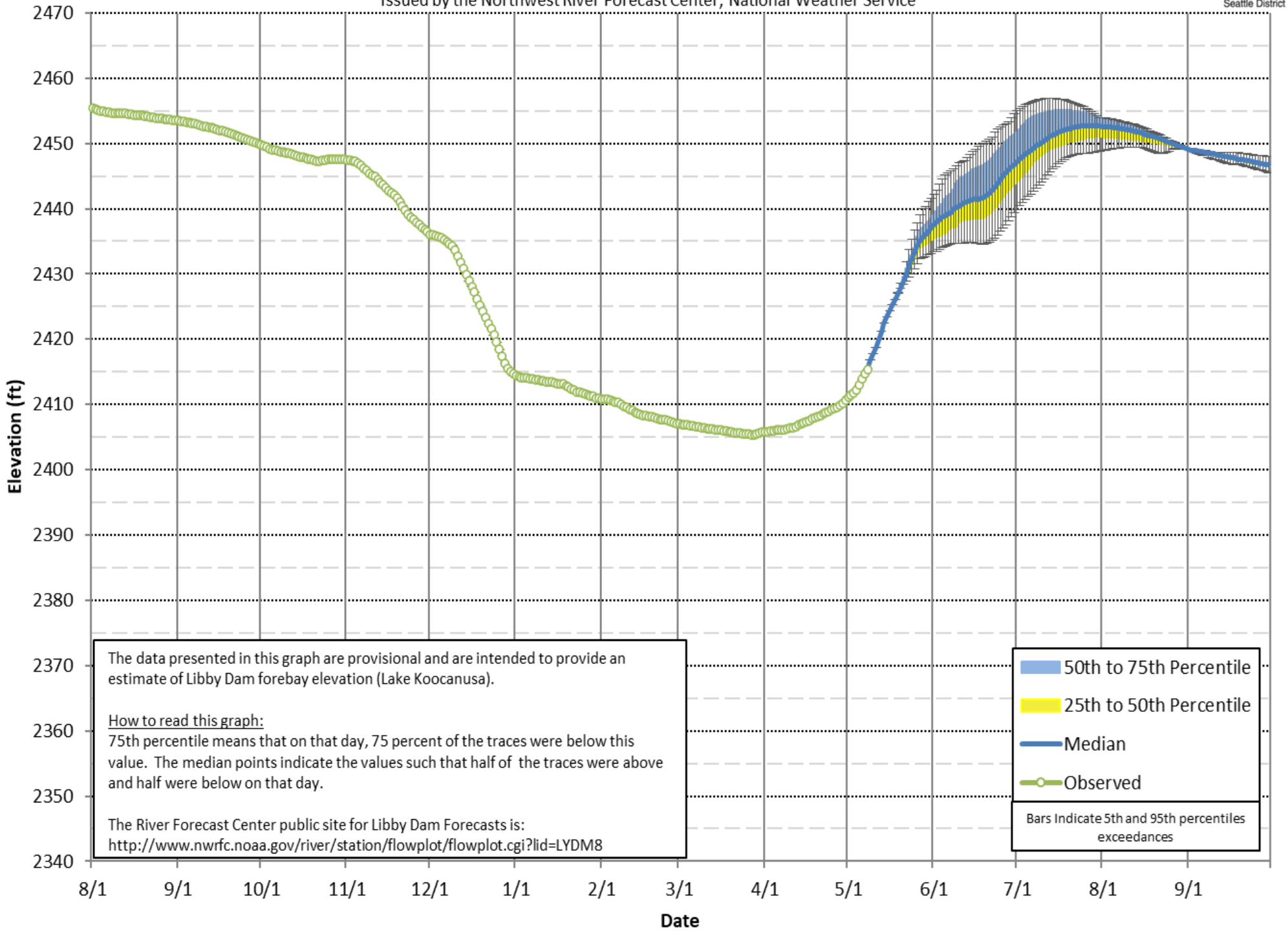
US Army Corps of Engineers
Seattle District

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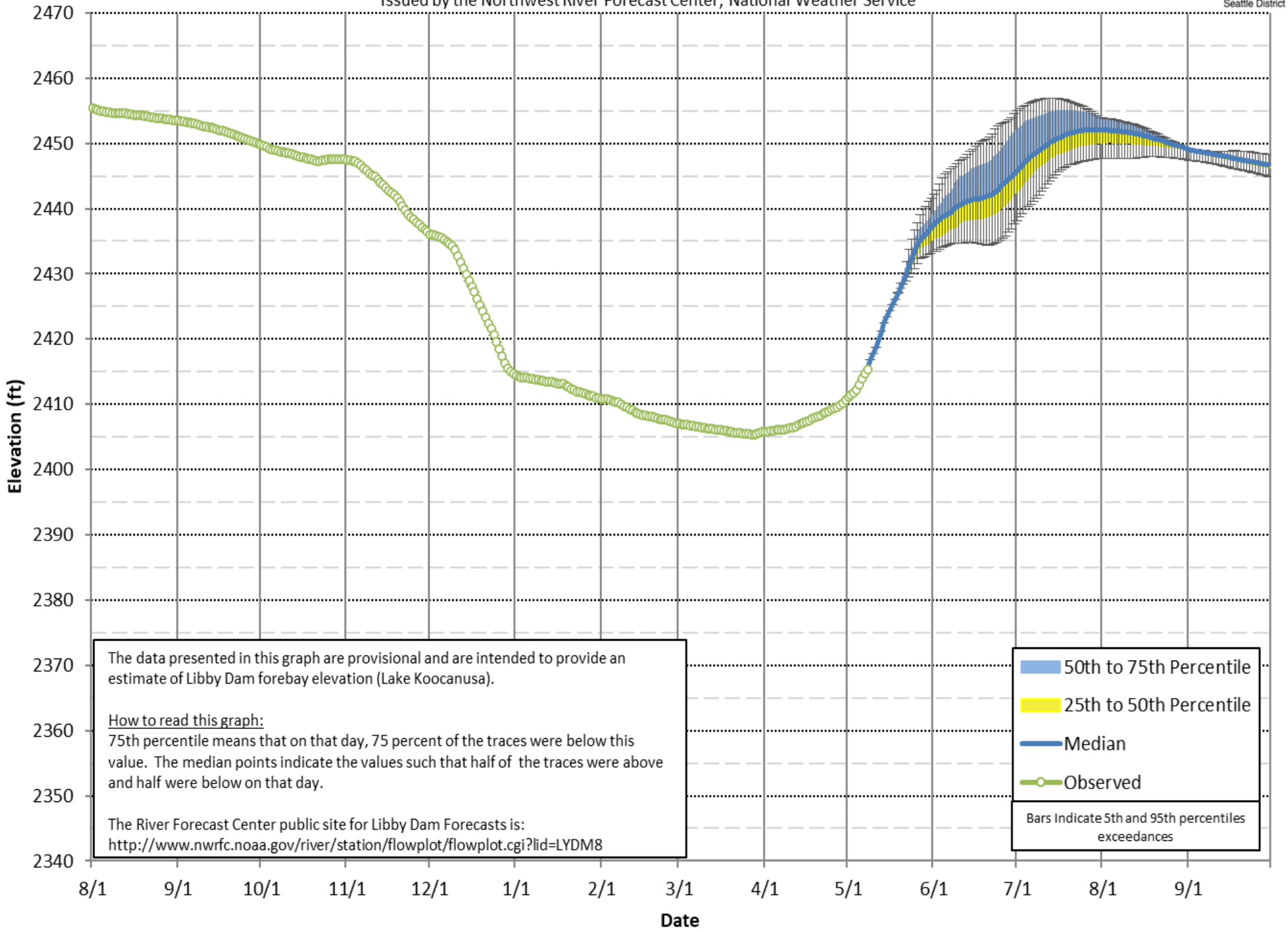


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YAQAN NUKIY
LOWER KOOTENAY BAND
KOOTENAI TRIBE OF IDAHO
KTUNAXA NATION
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IDAHO FISH & GAME
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DEPARTMENT OF THE INTERIOR
US Army Corps of Engineers ®