Libby Dam Water Management Overview

2016 Kootenai River White Sturgeon
Libby Dam Flow Augmentation Operation

Greg Hoffman
Fishery Biologist

Seattle District
Libby Dam
16 May 2016

US Army Corps of Engineers
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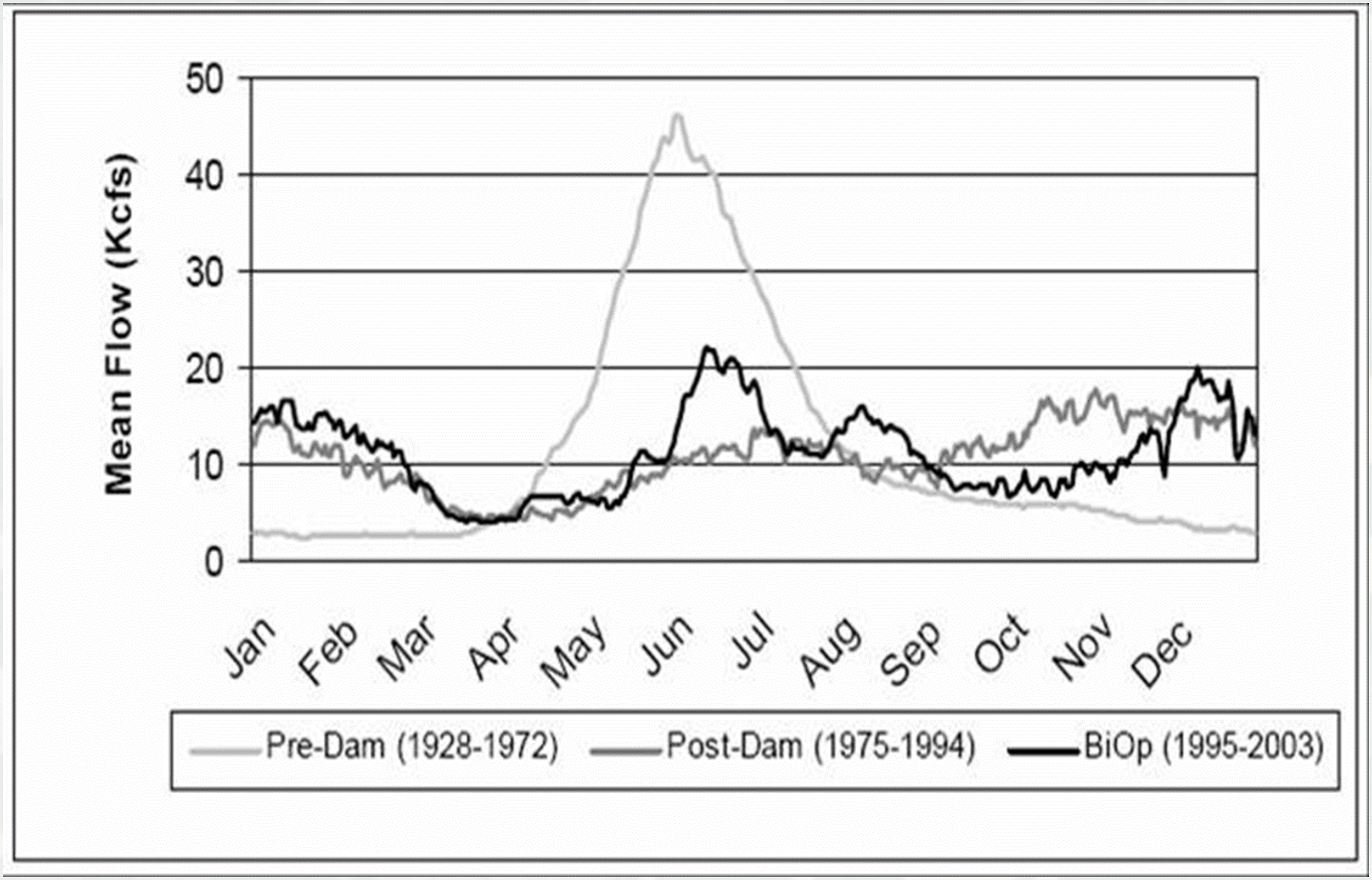
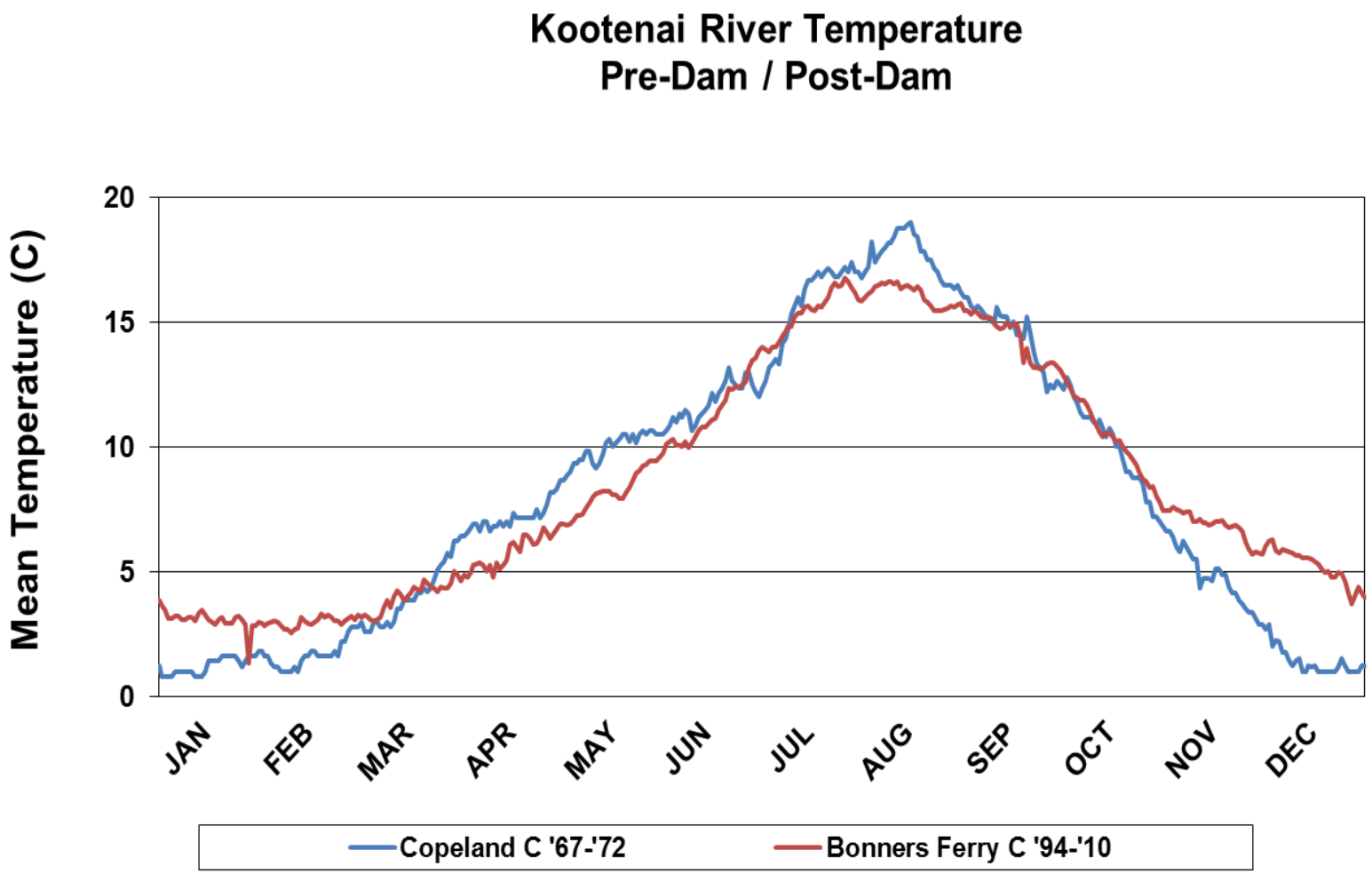
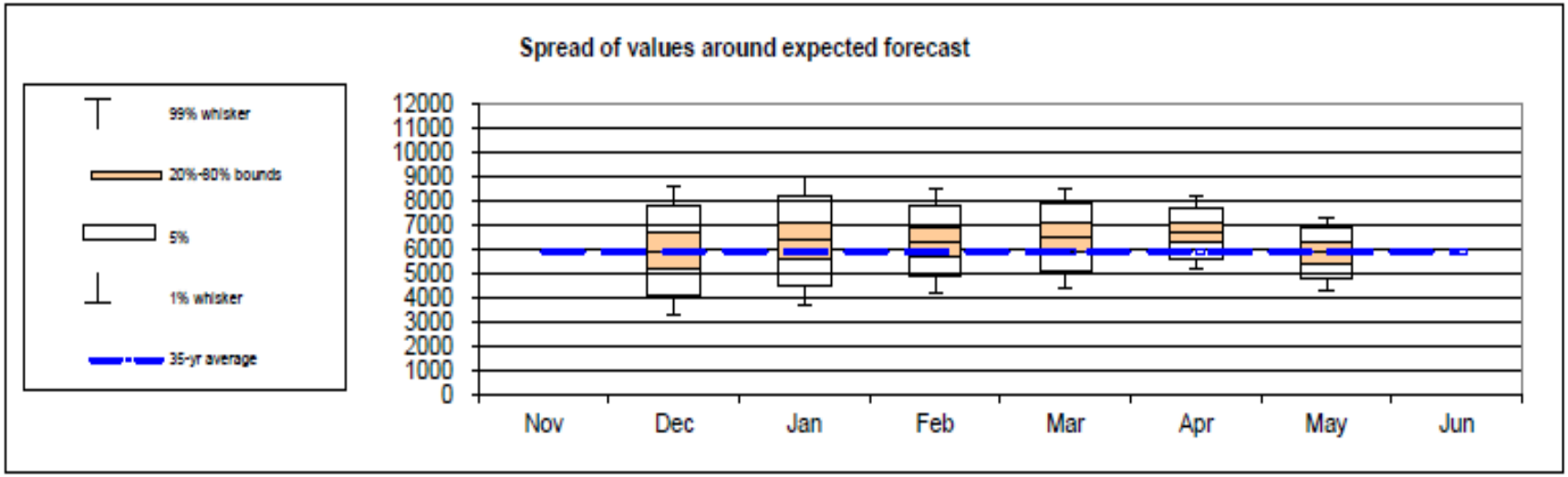

Mean Flow (Kcfs)
50
40
30
20
10
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Pre-Dam (1928-1972)
Post-Dam (1975-1994)
BiOp (1995-2003)


Kootenai River Temperature
Pre-Dam / Post-Dam
Mean Temperature (C)
20
15
10
5
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Copeland C '67-'72
Bonners Ferry C '94-'10

Libby: May Runoff Forecast & Flood Risk Management Calculation WY 2016

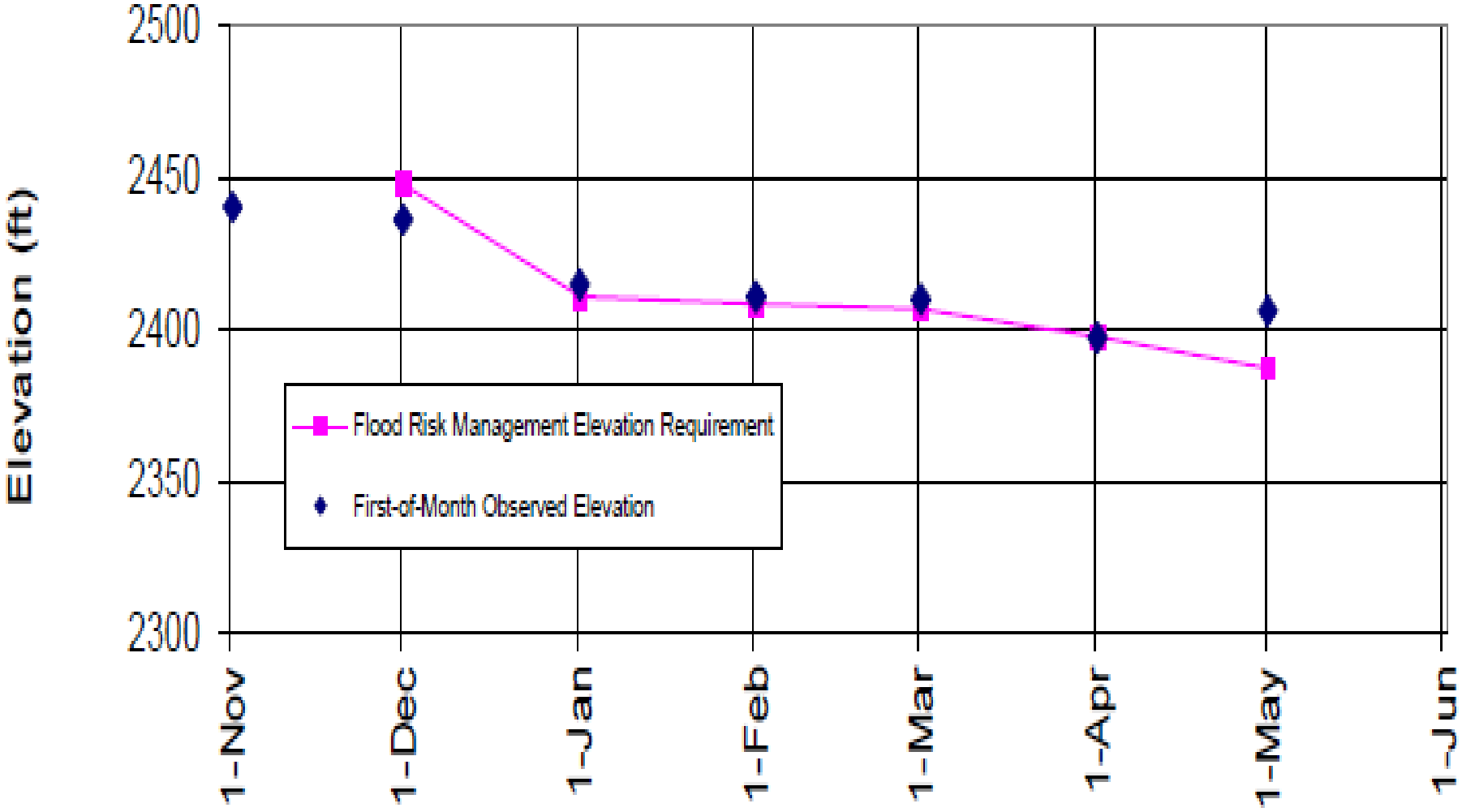
Runoff Forecast and Flood Risk Management				1981-2010 Average	Percent of Average	1929-2008 Average	Percent of Average
Most Probable Runoff Volume:	Apr-Aug	5831	KAF	5885	99%	6282	93%
	Apr-Jul	5357	KAF	5342	100%	5720	94%
	May-Jul	4207	KAF	4821	87%	5199	81%

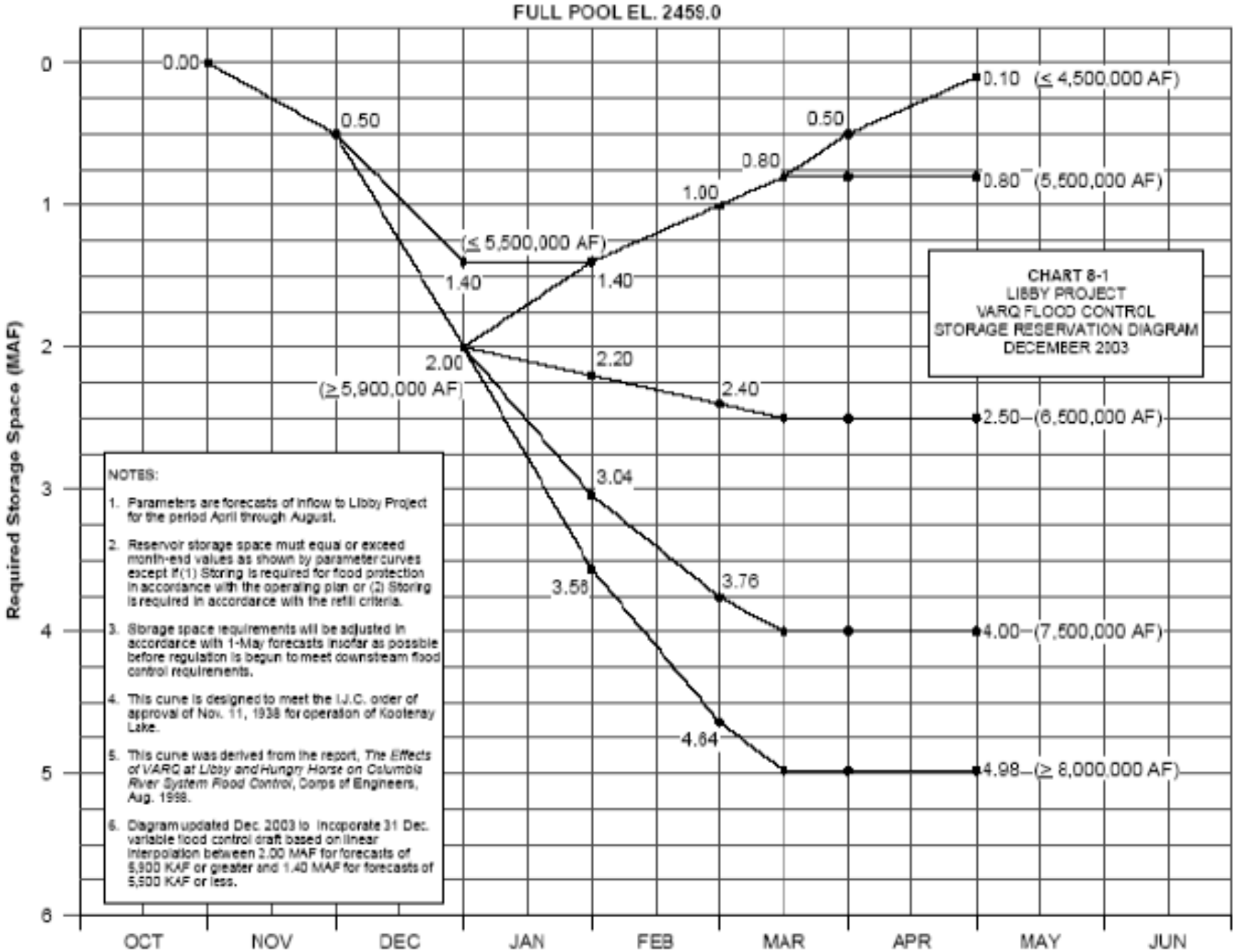
Seasonal Flood Risk Management	VARQ Flood Risk Management Implemented							
Forecast Date >>	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Apr-Aug Runoff Forecast		5940	6354	6318	6472	6681	5831	
First-of-Month Elev	2440.7	2436.5	2415.0	2411.0	2410.1	2397.6	2406.5	
Date >>	30-Nov	31-Dec	31-Jan	28-Feb	31-Mar	30-Apr		
d Risk Management Space	500	2000	2083	2145	2453	2772		
Risk Management Elevation	2448.0	2411.0	2408.7	2407.0	2397.8	2387.4		

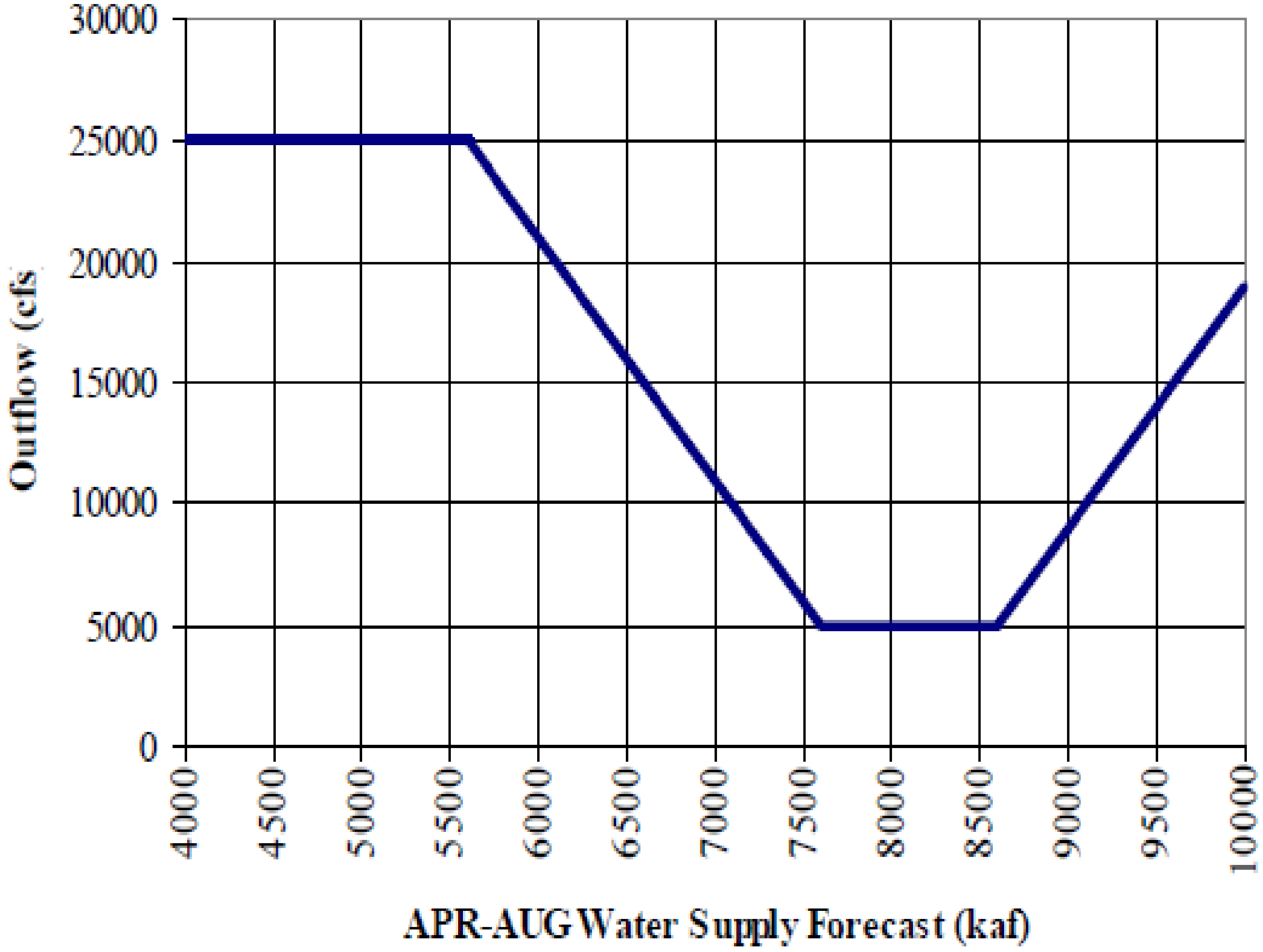


Libby Flood Risk Management Elevations - 2016

Latest water supply forecast: May




FULL POOL EL. 2459.0
Required Storage Space (MAF)
0
1
2
3
4
5
6
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
0.00
0.50
(≤ 5,500,000 AF)
1.40
1.40
1.00
0.80
0.50
0.10 (≤ 4,500,000 AF)
0.80 (5,500,000 AF)
2.00
(≥5,900,000 AF)
2.20
2.40
2.50–(6,500,000 AF)
3.04
3.58
3.76
4.00–(7,500,000 AF)
4.64
4.98–(≥ 8,000,000 AF)
CHART 8-1
LIBBY PROJECT
VARQ FLOOD CONTROL
STORAGE RESERVATION DIAGRAM
DECEMBER 2003
NOTES:
1. Parameters are forecasts of inflow to Libby Project for the period April through August.
2. Reservoir storage space must equal or exceed month-end values as shown by parameter curves except if (1) Storing is required for flood protection in accordance with the operating plan or (2) Storing is required in accordance with the refill criteria.
3. Storage space requirements will be adjusted in accordance with 1-May forecasts insofar as possible before regulation is begun to meet downstream flood control requirements.
4. This curve is designed to meet the I.J.C. order of approval of Nov. 11, 1938 for operation of Kootenay Lake.
5. This curve was derived from the report, The Effects of VARQ at Libby and Hungry Horse on Columbia River System Flood Control, Corps of Engineers, Aug. 1998.
6. Diagram updated Dec. 2003 to incorporate 31 Dec. variable flood control draft based on linear interpolation between 2.00 MAF for forecasts of 5,900 KAF or greater and 1.40 MAF for forecasts of 5,500 KAF or less.

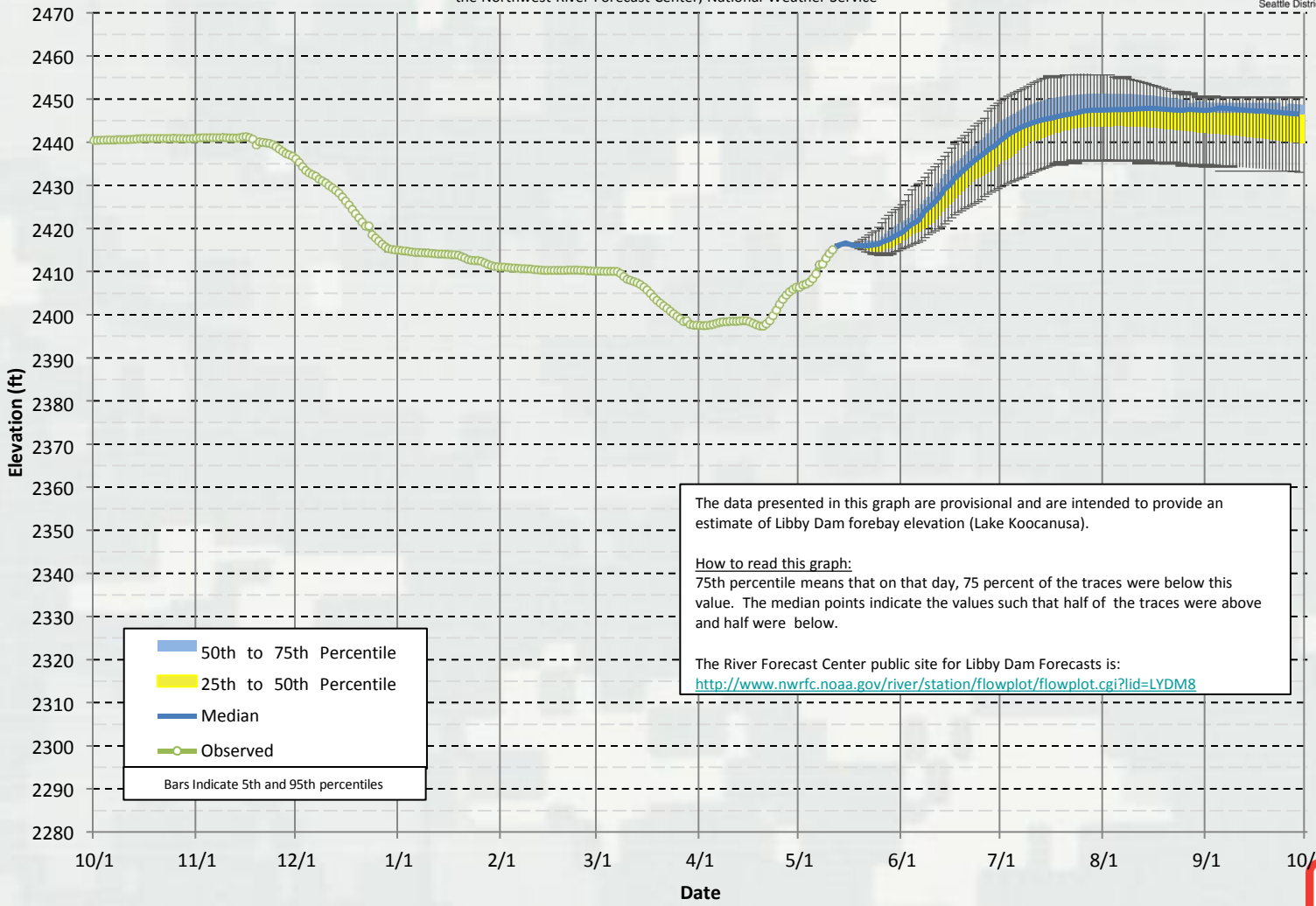

30000
25000
20000
15000
10000
5000
0
Outflow (cfs
4000
4500
5000
5500
6000
6500
7000
7500
8000
8500
9000
9500
10000
APR-AUG Water Supply Forecast (kaf)

Modeled using current ESP traces as of 05/12/16

Lake Koocanusa Elevation - Probability Chart

Corps of Engineers Projections Based on the 52 Ensemble Streamflow Prediction Traces Issued by the Northwest River Forecast Center, National Weather Service

US Army Corps of Engineers
Seattle District

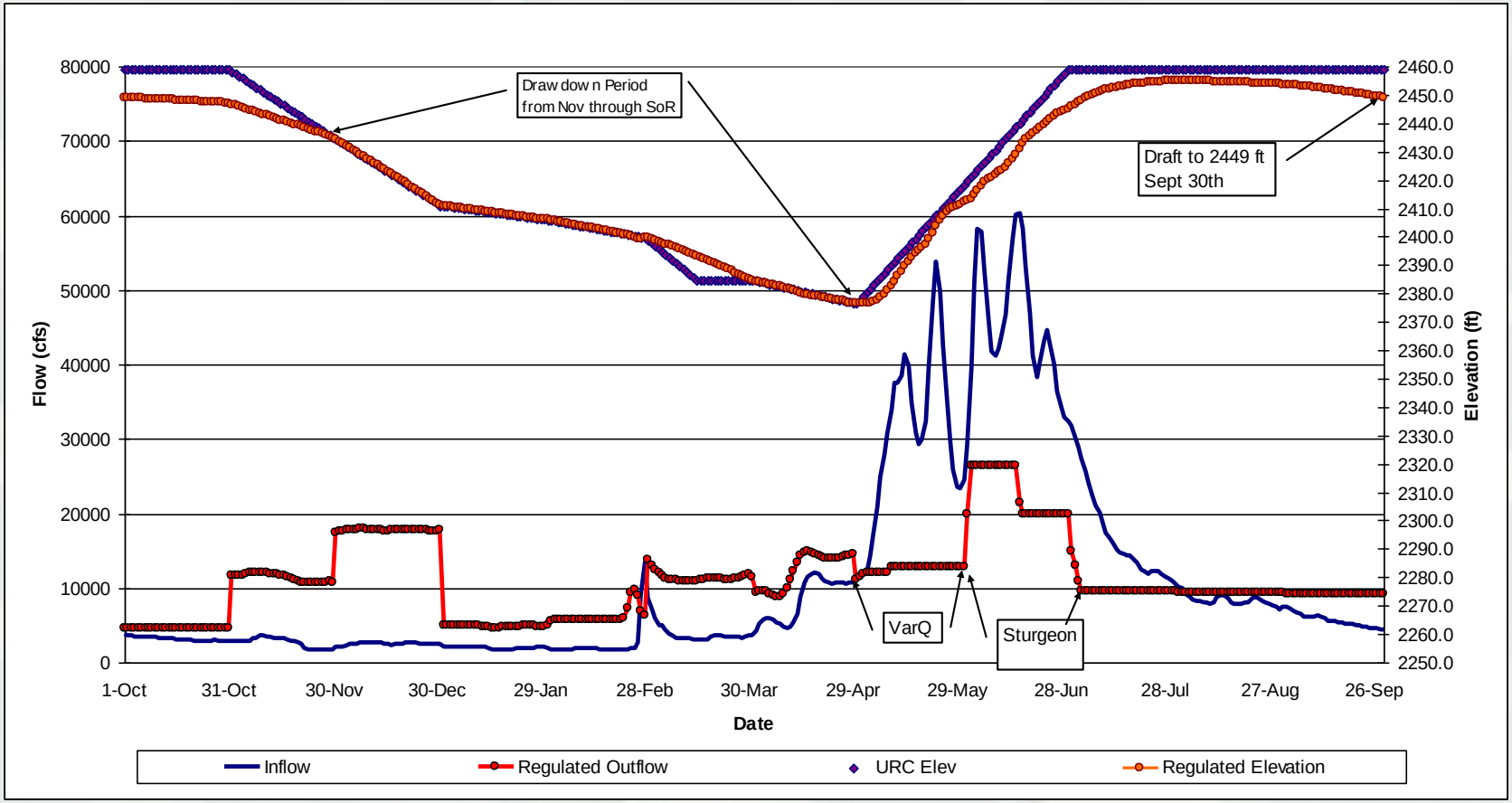


The data presented in this graph are provisional and are intended to provide an estimate of Libby Dam forebay elevation (Lake Koocanusa).

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.

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

Typical Water Year – Lake Koocanusa

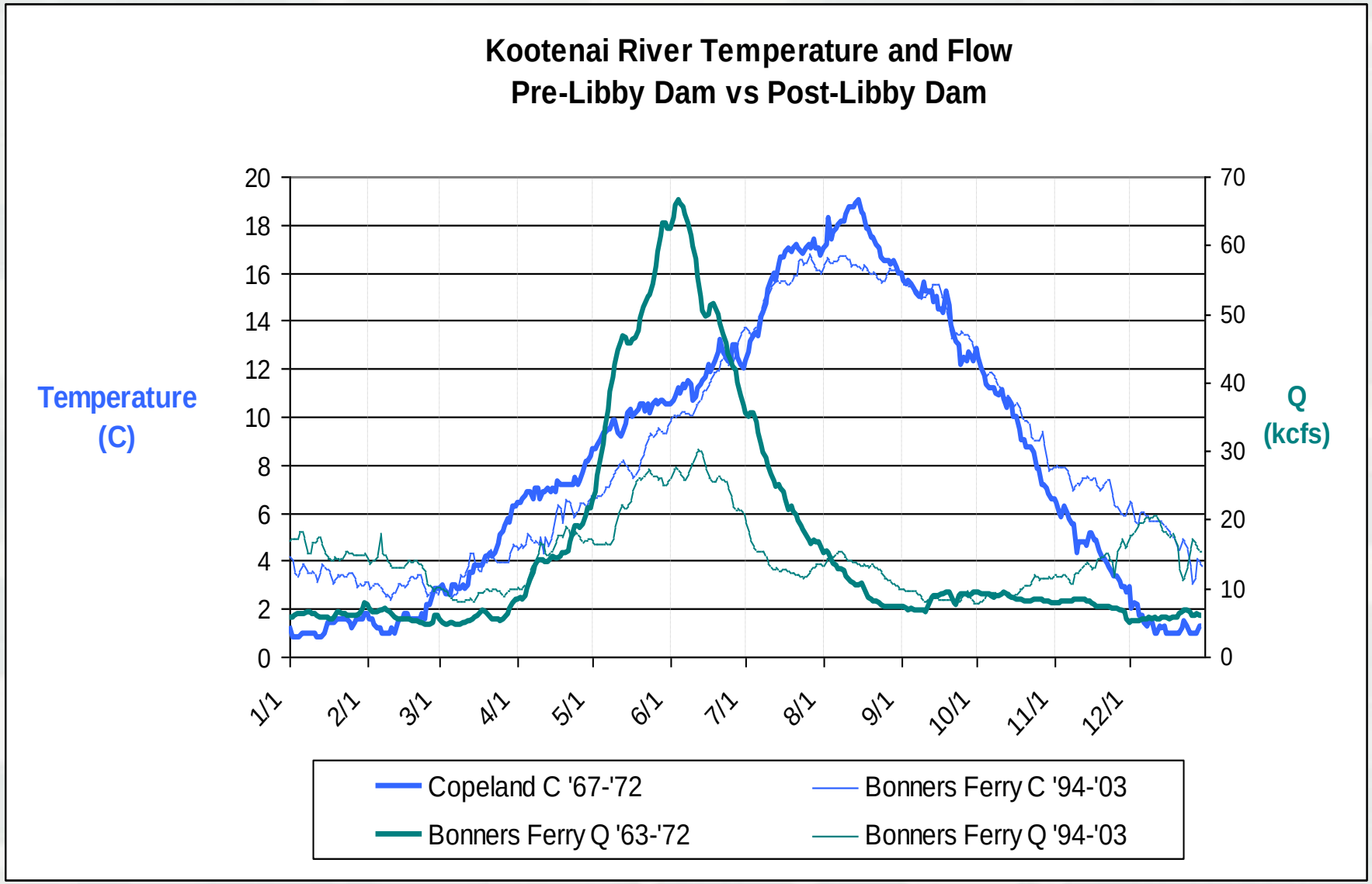


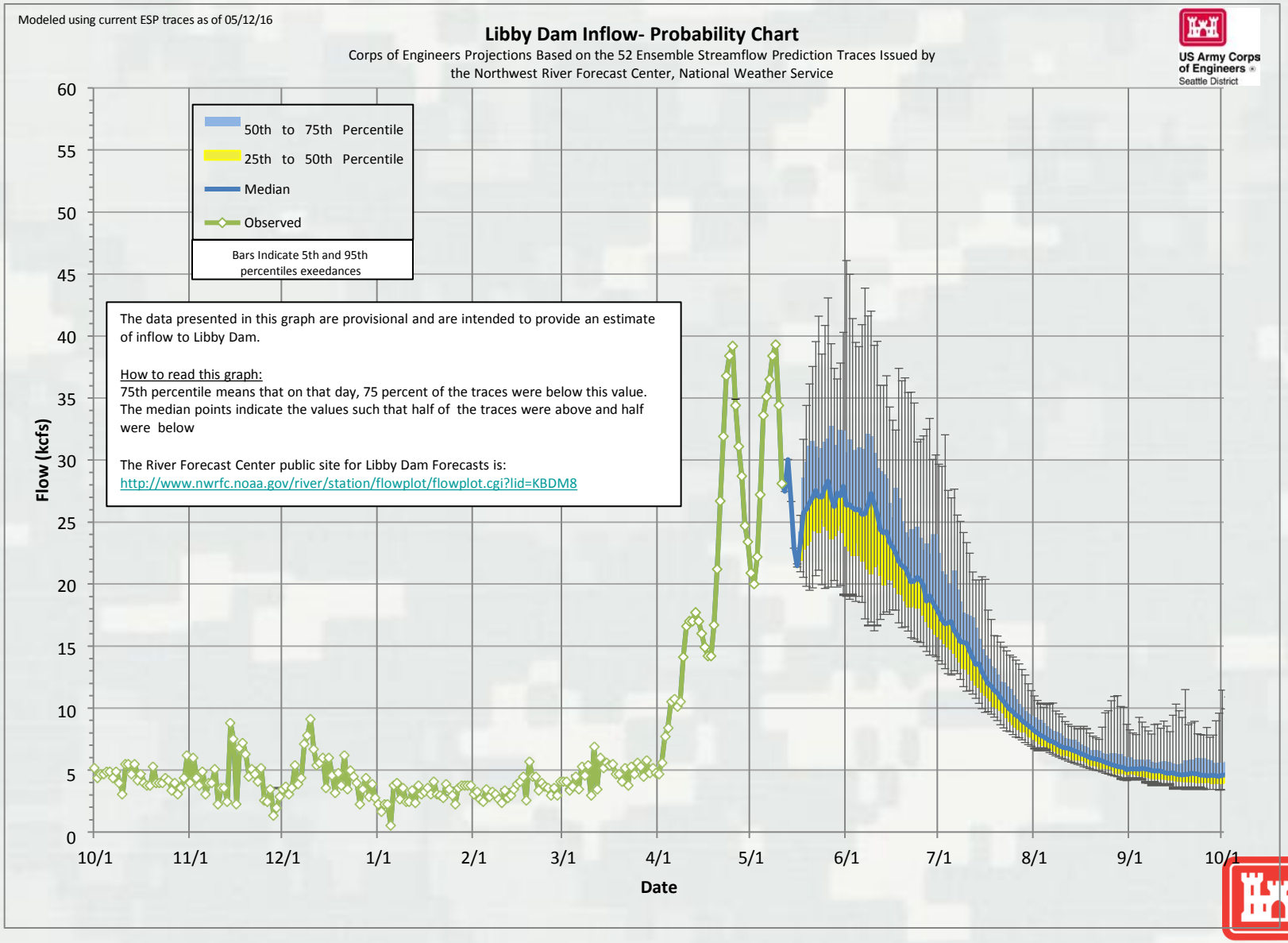
Sturgeon Tiered Flows

Forecast runoff Volume (maf*) at Libby	Sturgeon flow volume (maf) from Libby Dam	Min bull trout flows between sturgeon and salmon flows
0.00 < forecast < 4.80	Sturgeon flows not requested	6 kcfs
4.80 < forecast < 6.00	0.8	7 kcfs
6.00 < forecast < 6.70	1.0	8 kcfs
6.70 < forecast < 8.10	1.2	9 kcfs
8.10 < forecast < 8.90	1.2	9 kcfs
8.90 < forecast	1.6	9 kcfs

*maf = million acre feet

Normal April – August Inflow is 6.337 MAF


Kootenai River Temperature and Flow
Pre-Libby Dam vs Post-Libby Dam
Temperature (C)
Q (kcfs)
20
18
16
14
12
10
8
6
4
2
0
70
60
50
40
30
20
10
0
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
Copeland C '67-'72
Bonners Ferry C '94-'03
Bonners Ferry Q '63-'72
Bonners Ferry Q '94-'03



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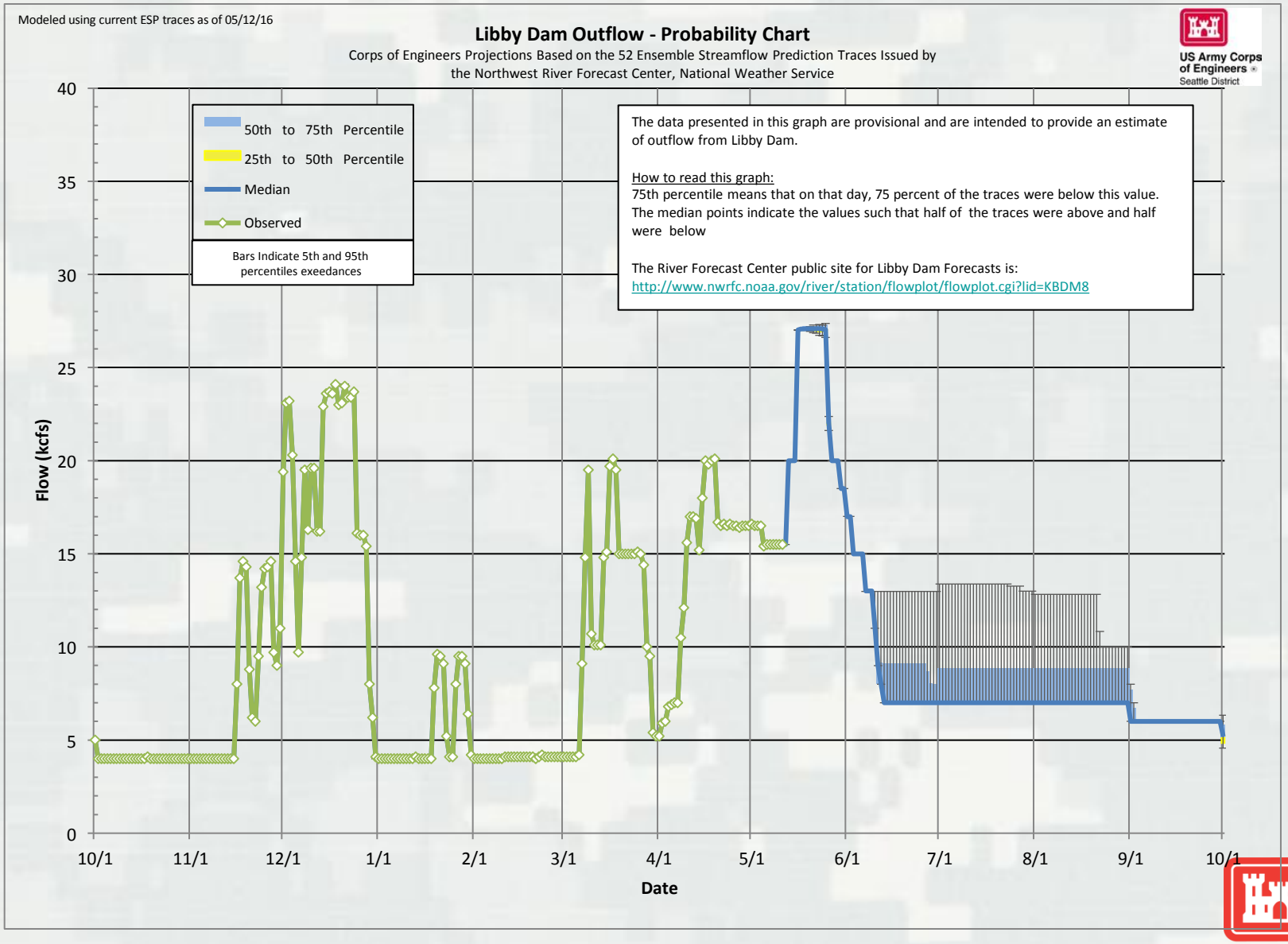
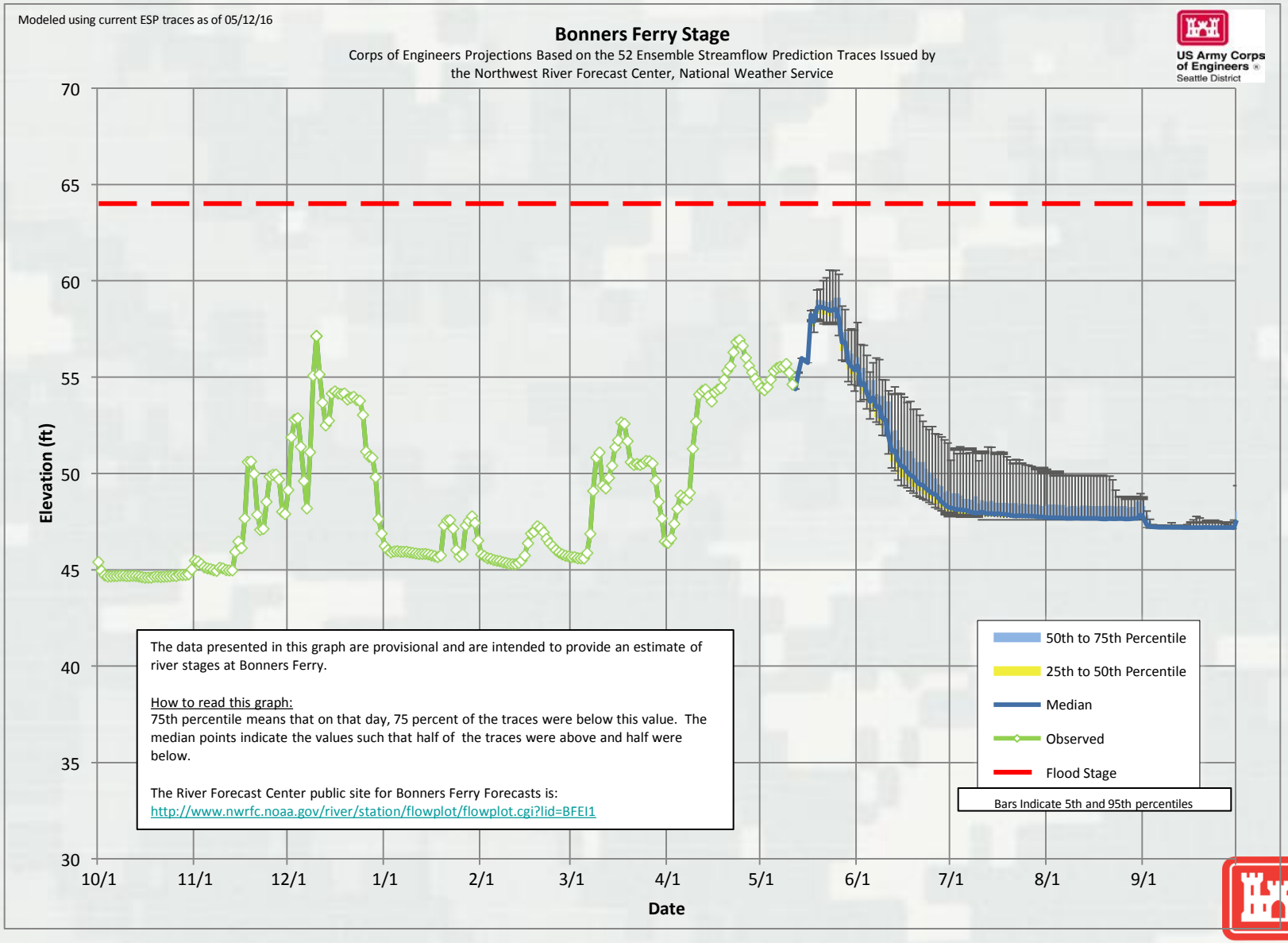
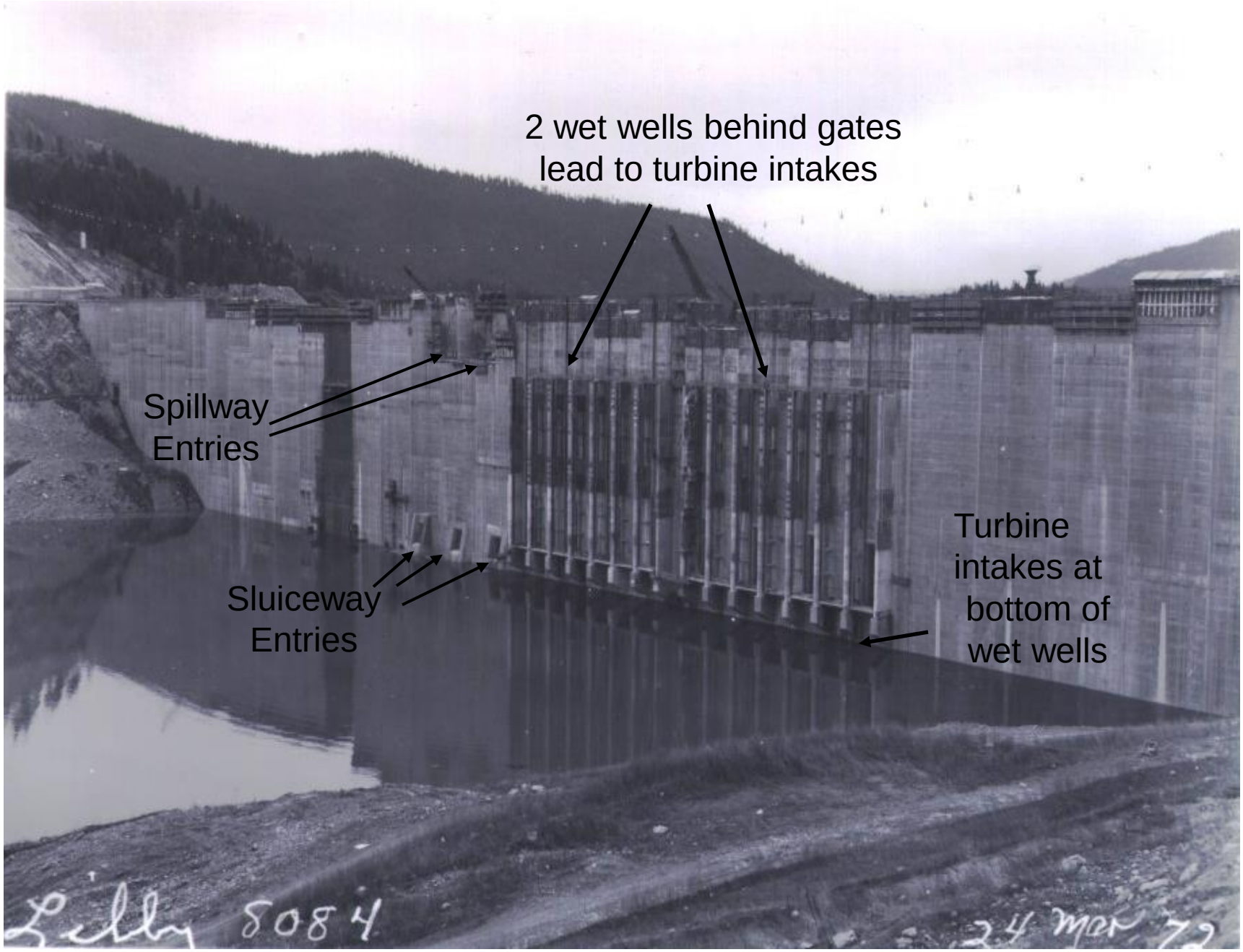
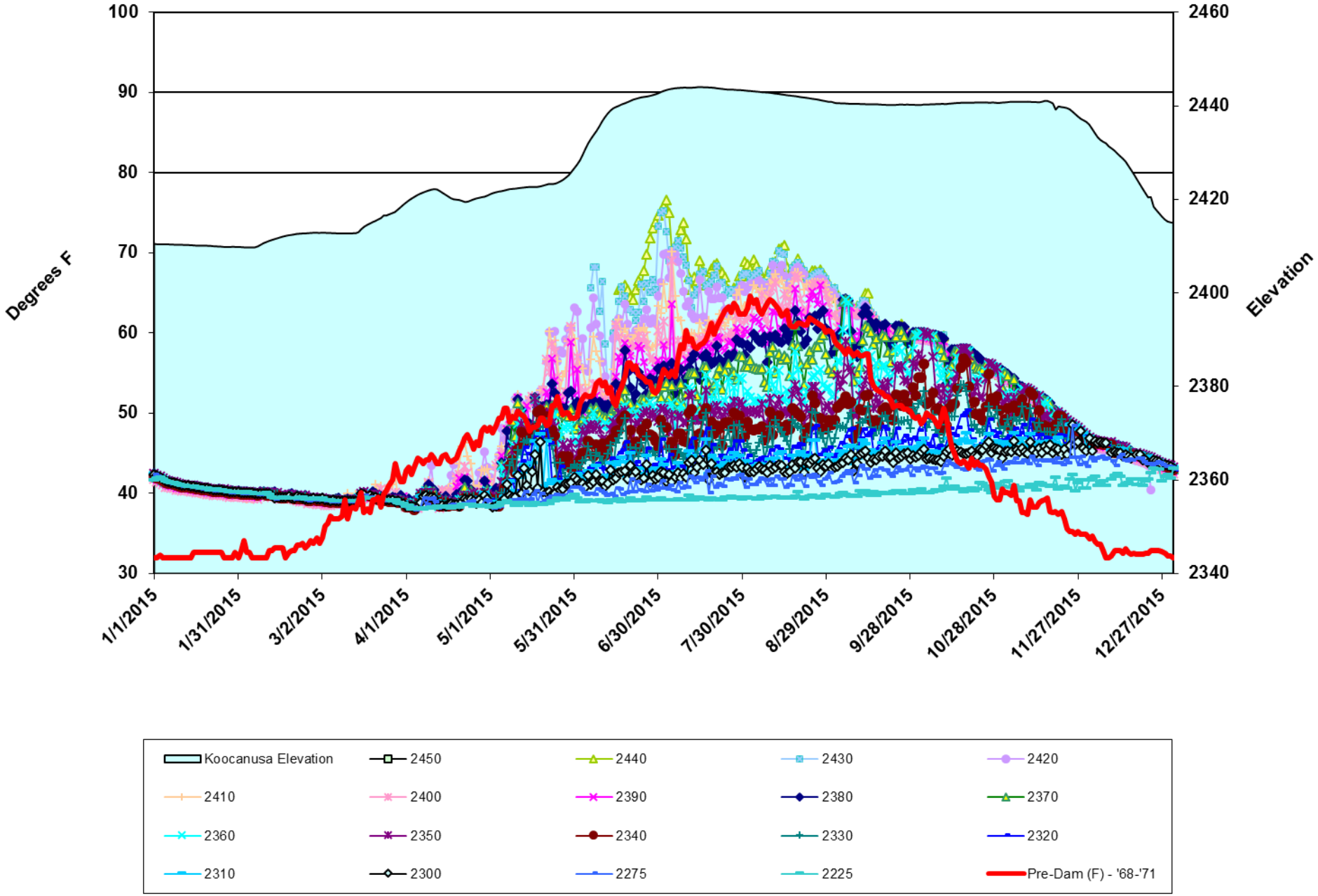
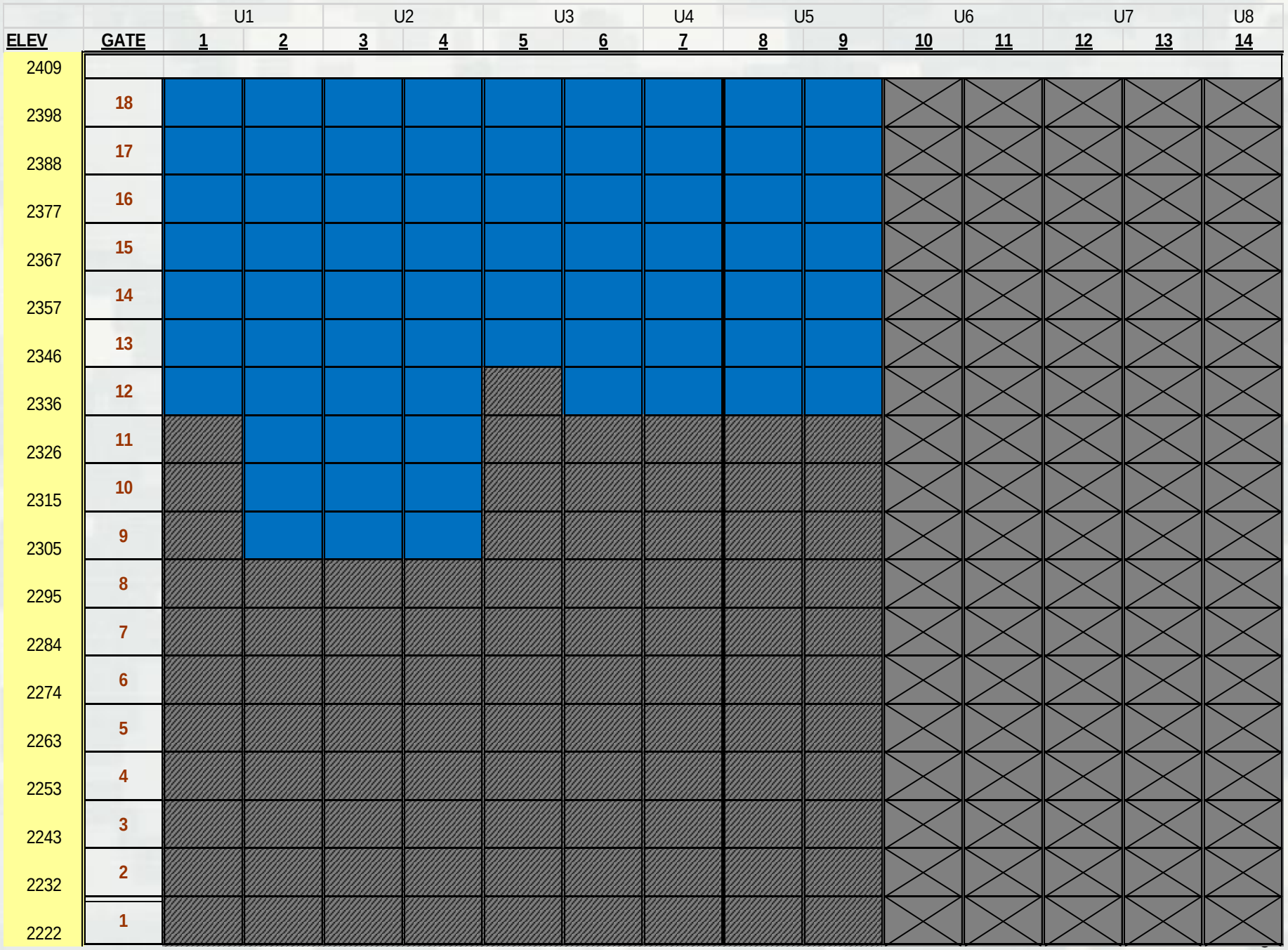

Modeled using current ESP traces as of 05/12/16
Libby Dam Outflow - Probability Chart
Corps of Engineers Projections Based on the 52 Ensemble Streamflow Prediction Traces Issued by the Northwest River Forecast Center, National Weather Service
US Army Corps of Engineers
Seattle District
50th to 75th Percentile
25th to 50th Percentile
Median
Observed
Bars Indicate 5th and 95th percentiles exeedances
The data presented in this graph are provisional and are intended to provide an estimate of outflow from Libby Dam.
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 Libby Dam Forecasts is:
http://www.nwrfc.noaa.gov/river/station/flowplot/flowplot.cgi?lid=KBDM8
Flow (kcfs)
0
5
10
15
20
25
30
35
40
10/1
11/1
12/1
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
Date


Modeled using current ESP traces as of 05/12/16
Bonners Ferry Stage
Corps of Engineers Projections Based on the 52 Ensemble Streamflow Prediction Traces Issued by the Northwest River Forecast Center, National Weather Service
US Army Corps of Engineers
Seattle District
Elevation (ft)
70
65
60
55
50
45
40
35
30
10/1
11/1
12/1
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
Date
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
50th to 75th Percentile
25th to 50th Percentile
Median
Observed
Flood Stage
Bars Indicate 5th and 95th percentiles


2 wet wells behind gates
lead to turbine intakes
Spillway
Entries
Sluiceway
Entries
Turbine
intakes at
bottom of
wet wells
Libby 8084
24 MAR 72

Koocanusa Reservoir Temperatures
2015




U1
U2
U3
U4
U5
U6
U7
U8
ELEV
GATE
1
2
3
4
5
6
7
8
9
10
11
12
13
14
2409
2398
2388
2377
2367
2357
2346
2336
2326
2315
2305
2295
2284
2274
2263
2253
2243
2232
2222
18
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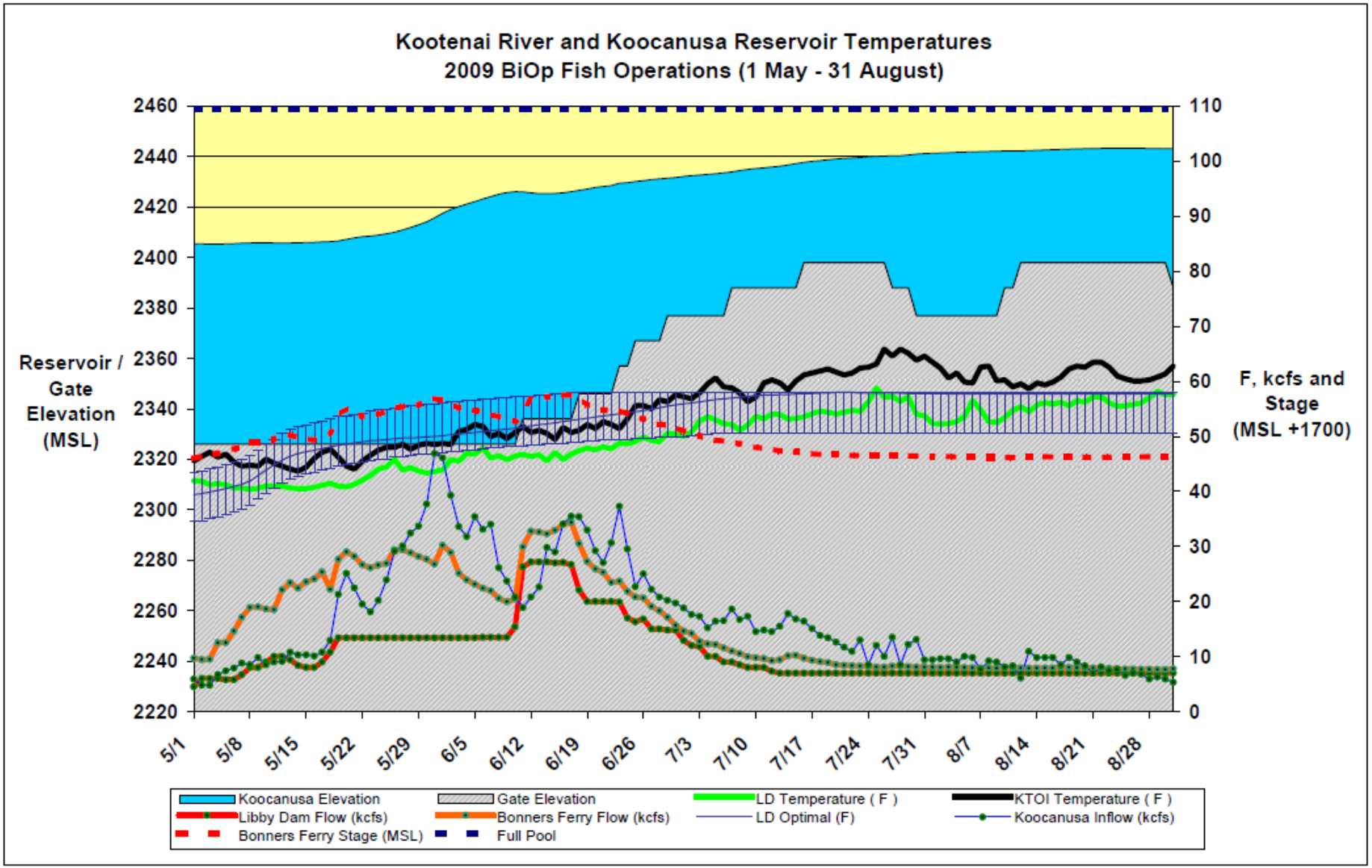
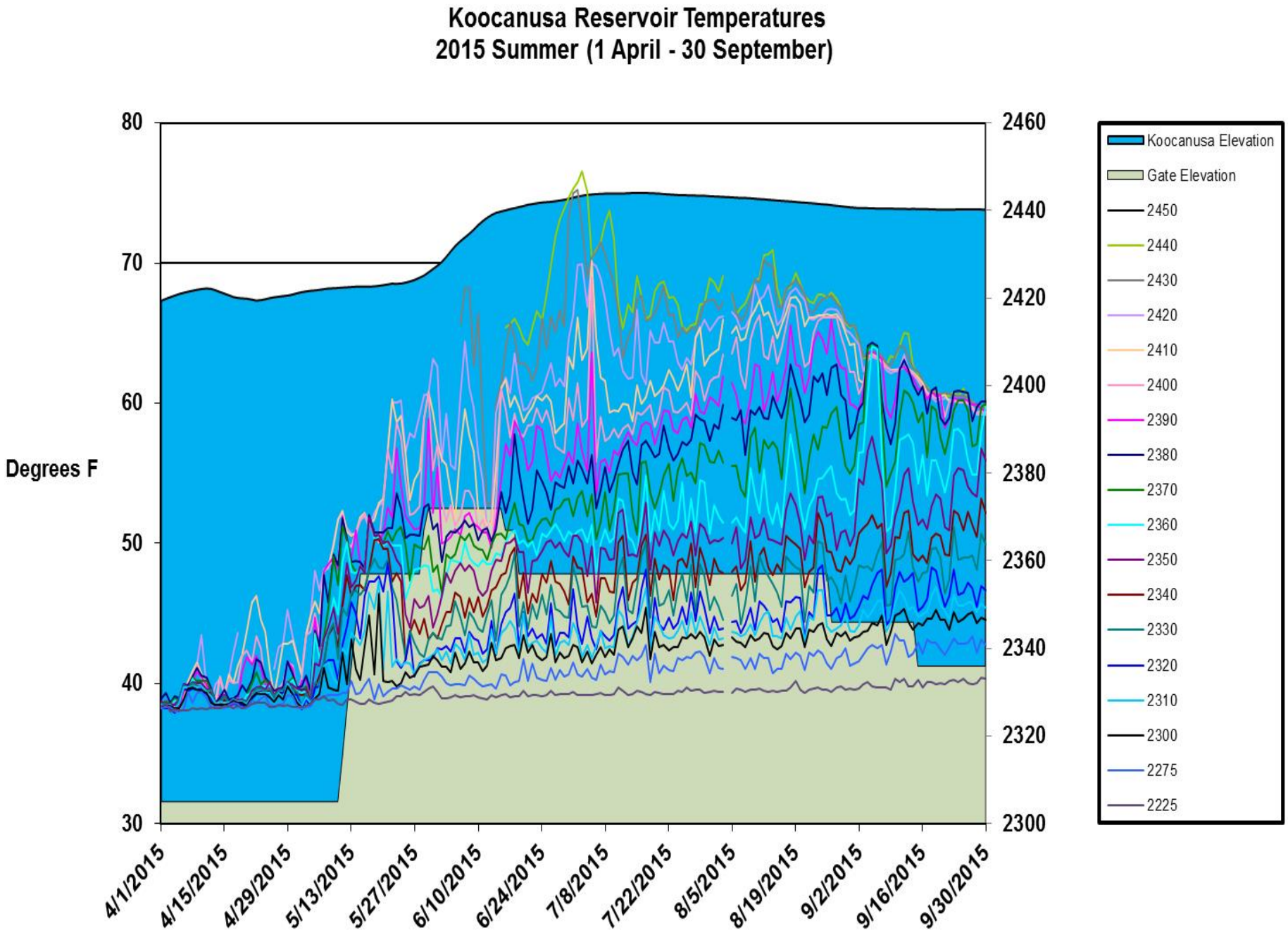
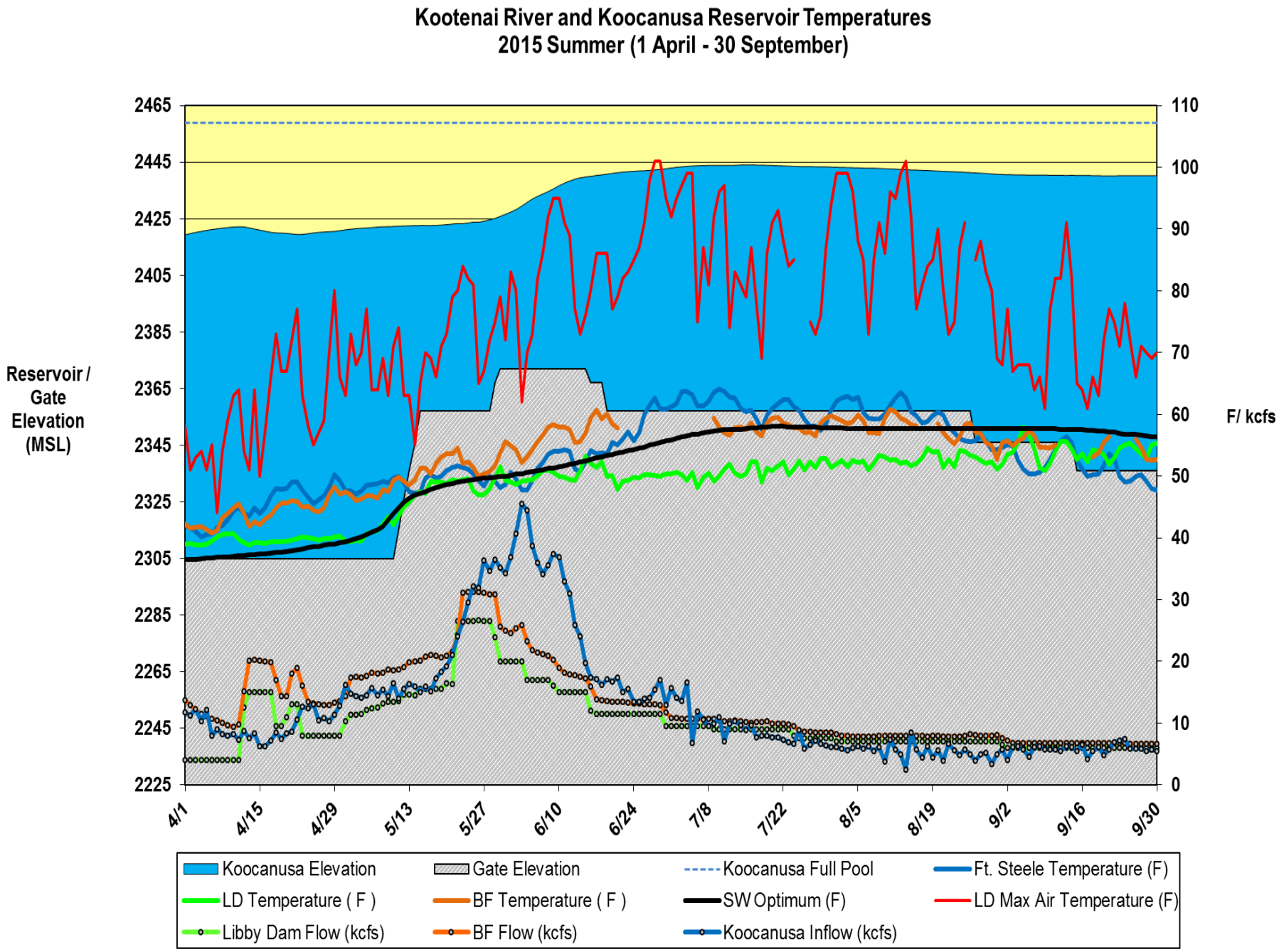
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1


Kootenai River and Koocanusa Reservoir Temperatures
2009 BiOp Fish Operations (1 May - 31 August)
Reservoir / Gate Elevation (MSL)
F, kcfs and Stage (MSL +1700)
2460
2440
2420
2400
2380
2360
2340
2320
2300
2280
2260
2240
2220
110
100
90
80
70
60
50
40
30
20
10
0
5/1
5/8
5/15
5/22
5/29
6/5
6/12
6/19
6/26
7/3
7/10
7/17
7/24
7/31
8/7
8/14
8/21
8/28
Koocanusa Elevation
Gate Elevation
LD Temperature (F)
KTOI Temperature (F)
Libby Dam Flow (kcfs)
Bonners Ferry Flow (kcfs)
LD Optimal (F)
Koocanusa Inflow (kcfs)
Bonners Ferry Stage (MSL)
Full Pool


Koocanusa Reservoir Temperatures
2015 Summer (1 April - 30 September)
Degrees F
80
70
60
50
40
30
2460
2440
2420
2400
2380
2360
2340
2320
2300
4/1/2015
4/15/2015
4/29/2015
5/13/2015
5/27/2015
6/10/2015
6/24/2015
7/8/2015
7/22/2015
8/5/2015
8/19/2015
9/2/2015
9/16/2015
9/30/2015
Koocanusa Elevation
Gate Elevation
2450
2440
2430
2420
2410
2400
2390
2380
2370
2360
2350
2340
2330
2320
2310
2300
2275
2225


Kootenai River and Koocanusa Reservoir Temperatures
2015 Summer (1 April - 30 September)
Reservoir / Gate Elevation (MSL)
F/ kcfs
2465
2445
2425
2405
2385
2365
2345
2325
2305
2285
2265
2245
2225
110
100
90
80
70
60
50
40
30
20
10
0
4/1
4/15
4/29
5/13
5/27
6/10
6/24
7/8
7/22
8/5
8/19
9/2
9/16
9/30
Koocanusa Elevation
Gate Elevation
Koocanusa Full Pool
Ft. Steele Temperature (F)
LD Temperature (F)
BF Temperature (F)
SW Optimum (F)
LD Max Air Temperature (F)
Libby Dam Flow (kcfs)
BF Flow (kcfs)
Koocanusa Inflow (kcfs)

“The Issue”

2. BLUF: Generator stator temperatures exceed manufacturer’s recommended operational limits when operating the units at full capacity. Cooling from the tail water with river temperatures exceeding 52 °F during the summer months at Libby Dam appears to be the problem. Ecologically optimal temperatures for the river are in the low 60’s. Given the status of the generator cooling systems, Libby Dam would not be able to operate at full Powerhouse capacity without decreasing the temperature of the river by removing Selective Withdrawal bulkheads.

3. Potential Solutions

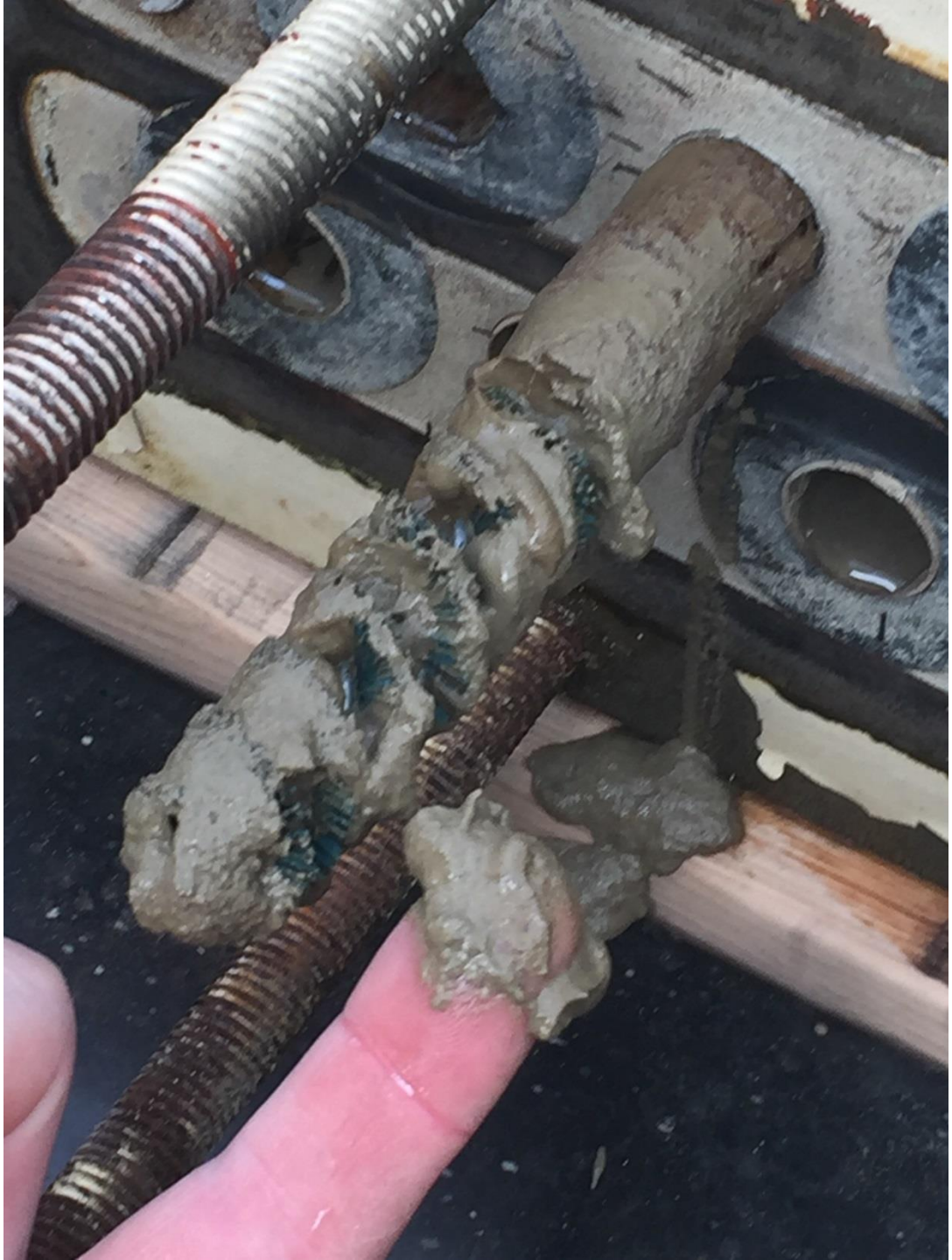
a. Use reservoir water for cooling rather than river water
    1) Possibly connect to drain lines from hemispherical bulkheads in 6,7, and 8
    2) Possibly connect to transformer deluge water supply system

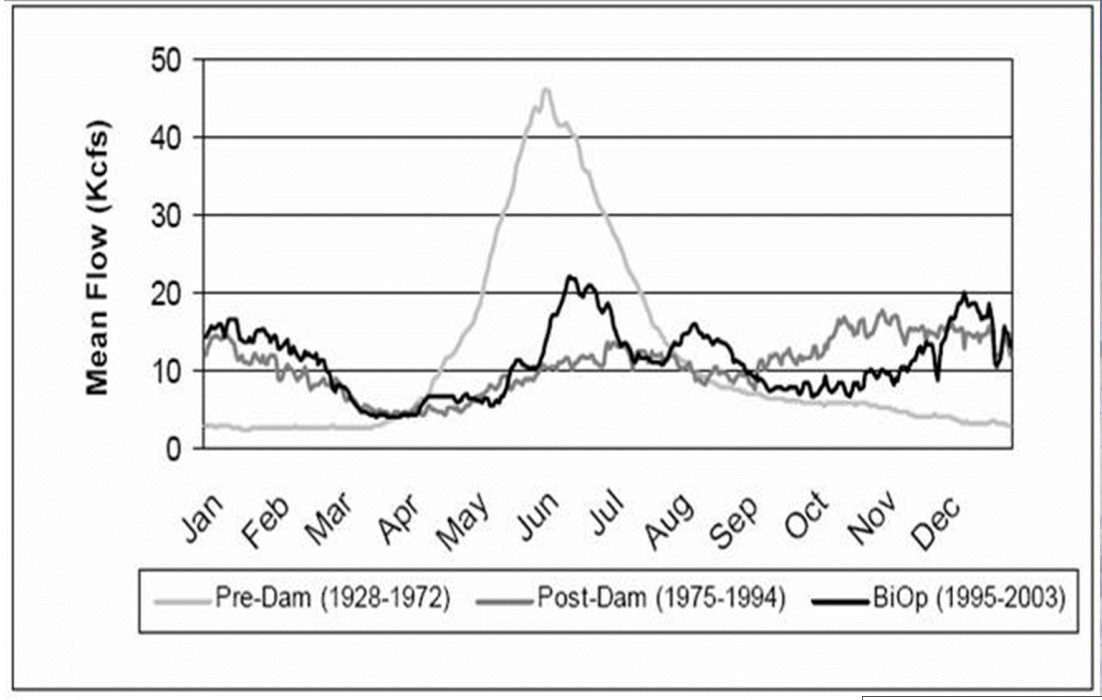
b. Install new upgraded coolers (6 each) on the stator

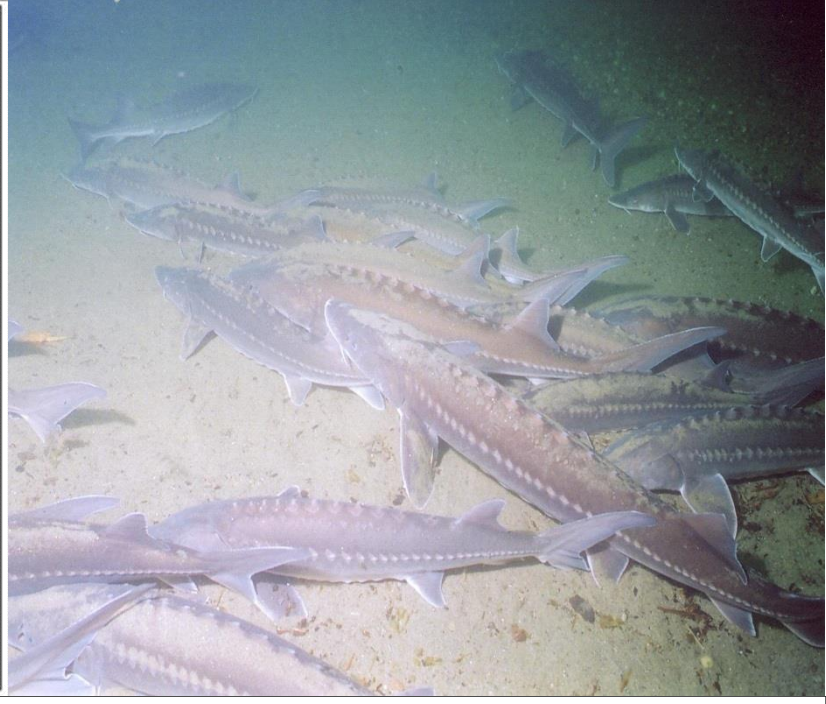
c. Provide additional water flow through the cooling system by increasing pumping capacity and efficiency.

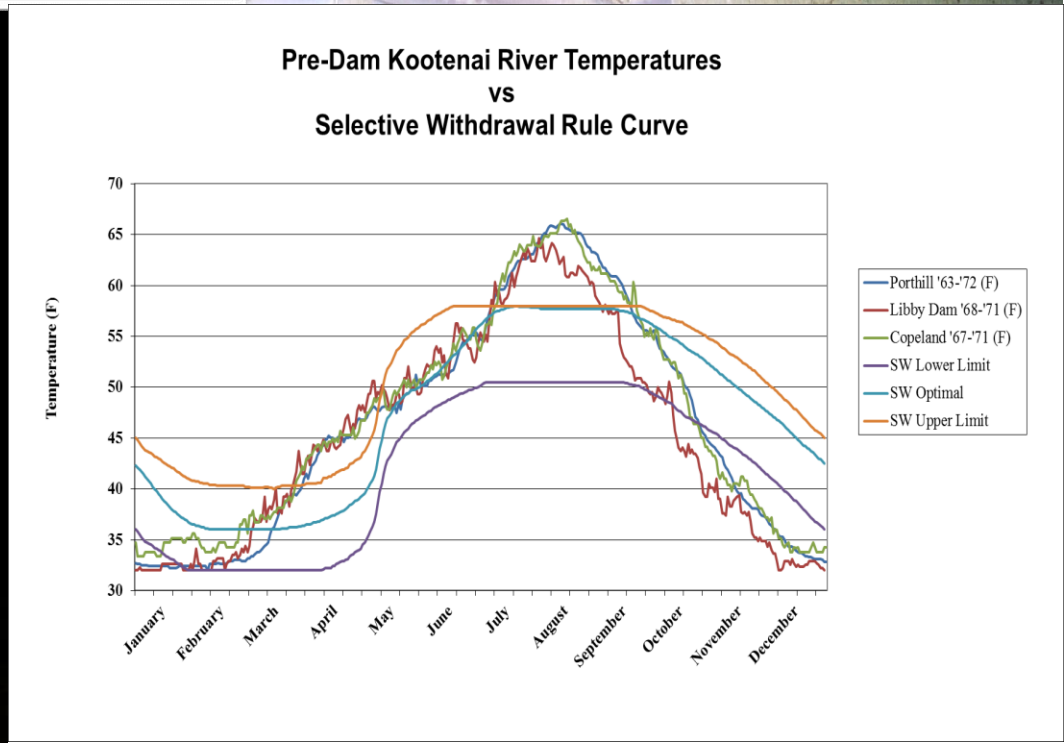
d. Modify air flow design through the air housings of Units 1-4 based on the design of Unit 5

e. Operate the Selective Withdrawal system such that <50°F water is always being passed through the units during the summer months.




Mean Flow (Kcfs)
50
40
30
20
10
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Pre-Dam (1928-1972)
Post-Dam (1975-1994)
BiOp (1995-2003)




Pre-Dam Kootenai River Temperatures
vs
Selective Withdrawal Rule Curve
Temperature (F)
70
65
60
55
50
45
40
35
30
January
February
March
April
May
June
July
August
September
October
November
December
Porthill '63-'72 (F)
Libby Dam '68-'71 (F)
Copeland '67-'71 (F)
SW Lower Limit
SW Optimal
SW Upper Limit