



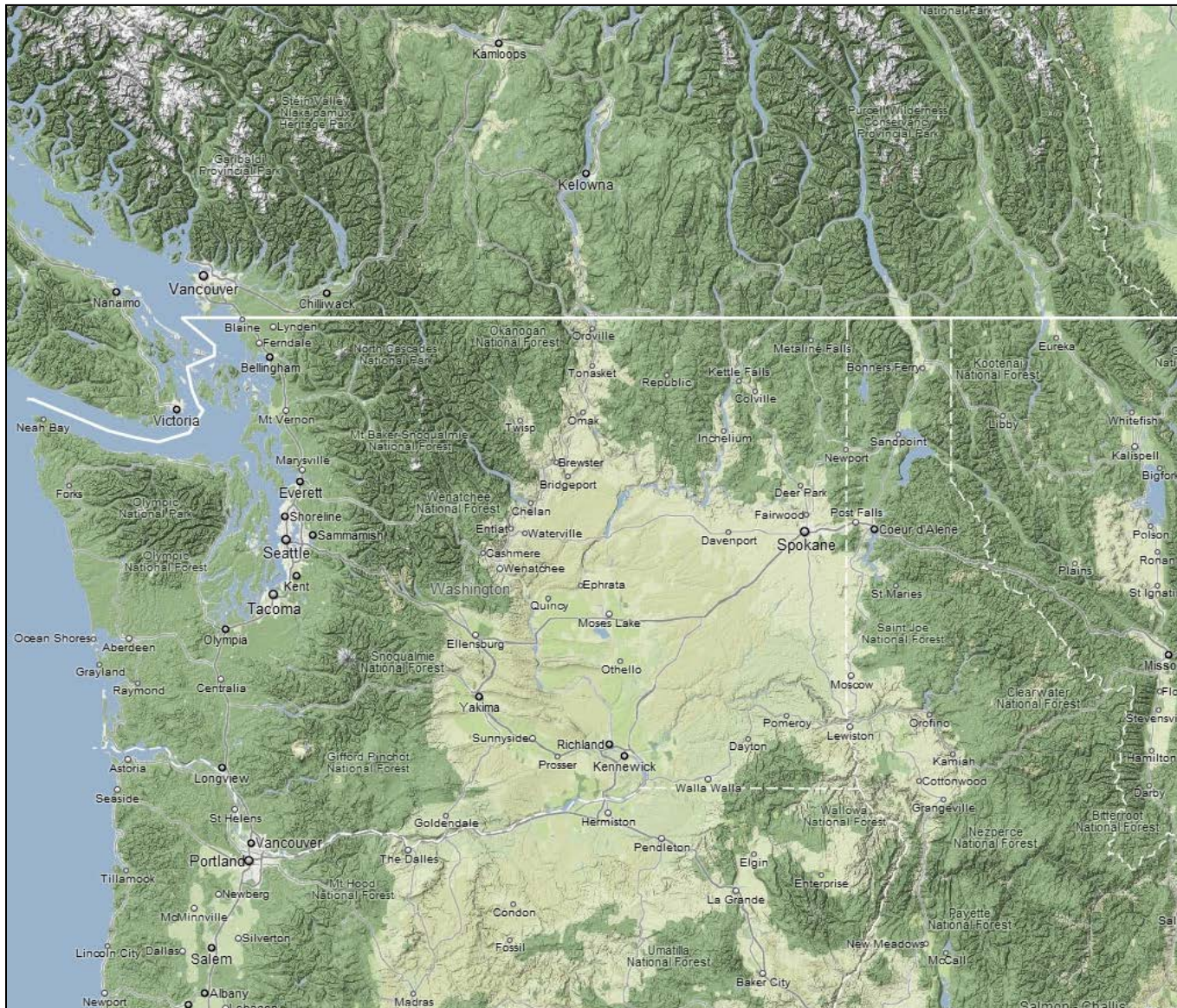
RiverWare for Planning and Realtime Operations at Libby Dam on the Kootenai River



- Adam Price -



US Army Corps of Engineers

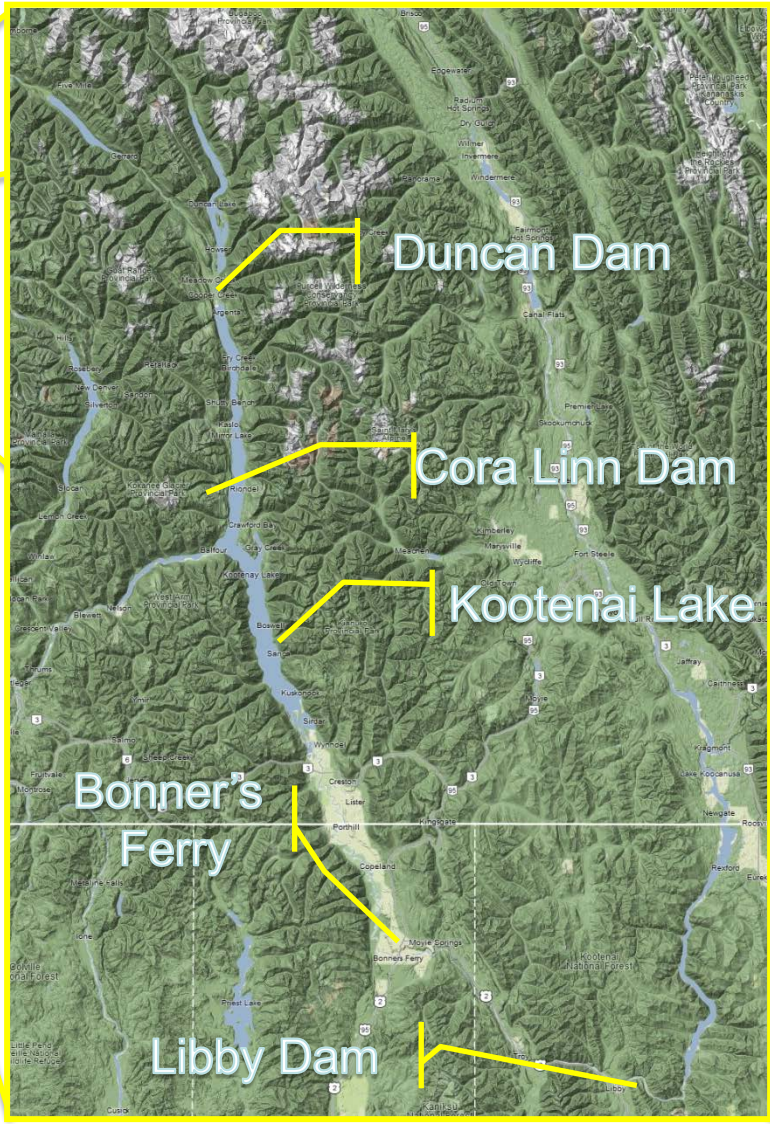
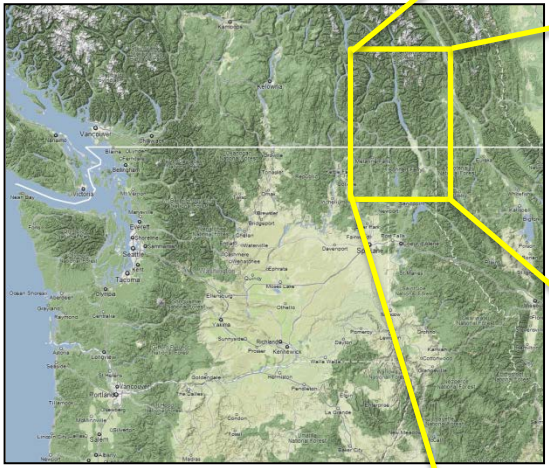


2/8/2012

BUILDING STRONGSM



US Army Corps of Engineers



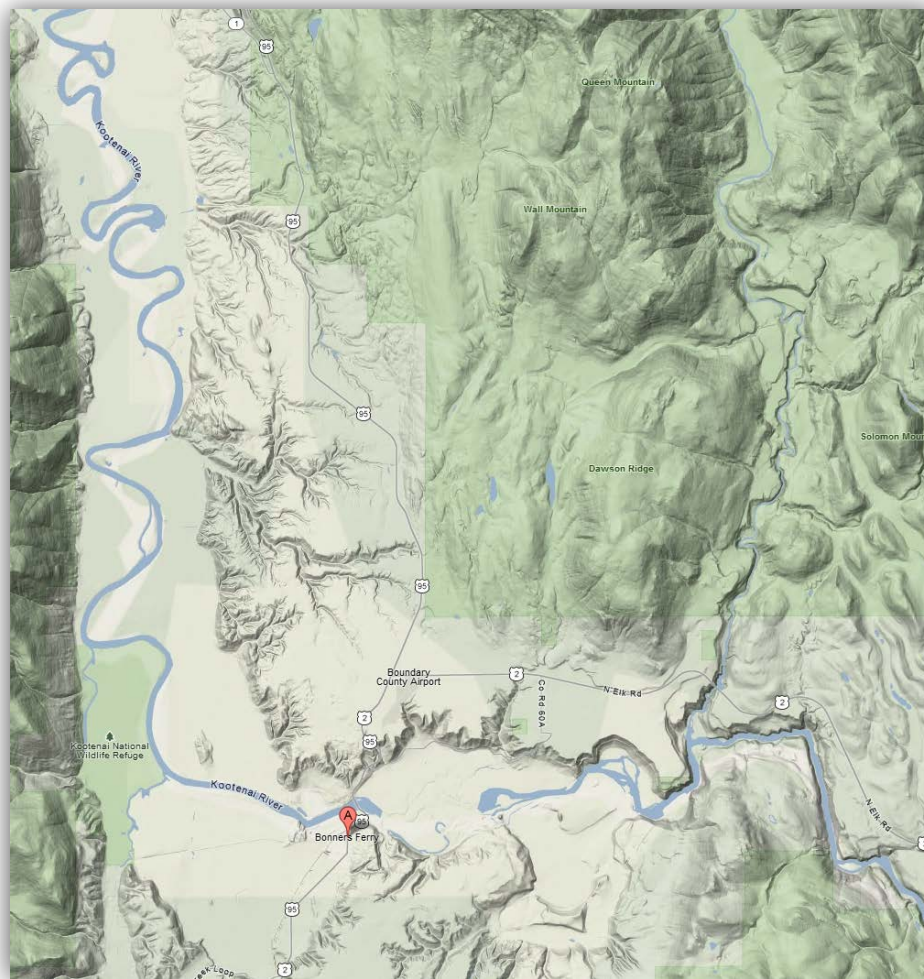


Facets

- Bonner's Ferry Flood Control
- BiOps
- Modular Refill Guidance (VarQ)
- Forecast Time Series

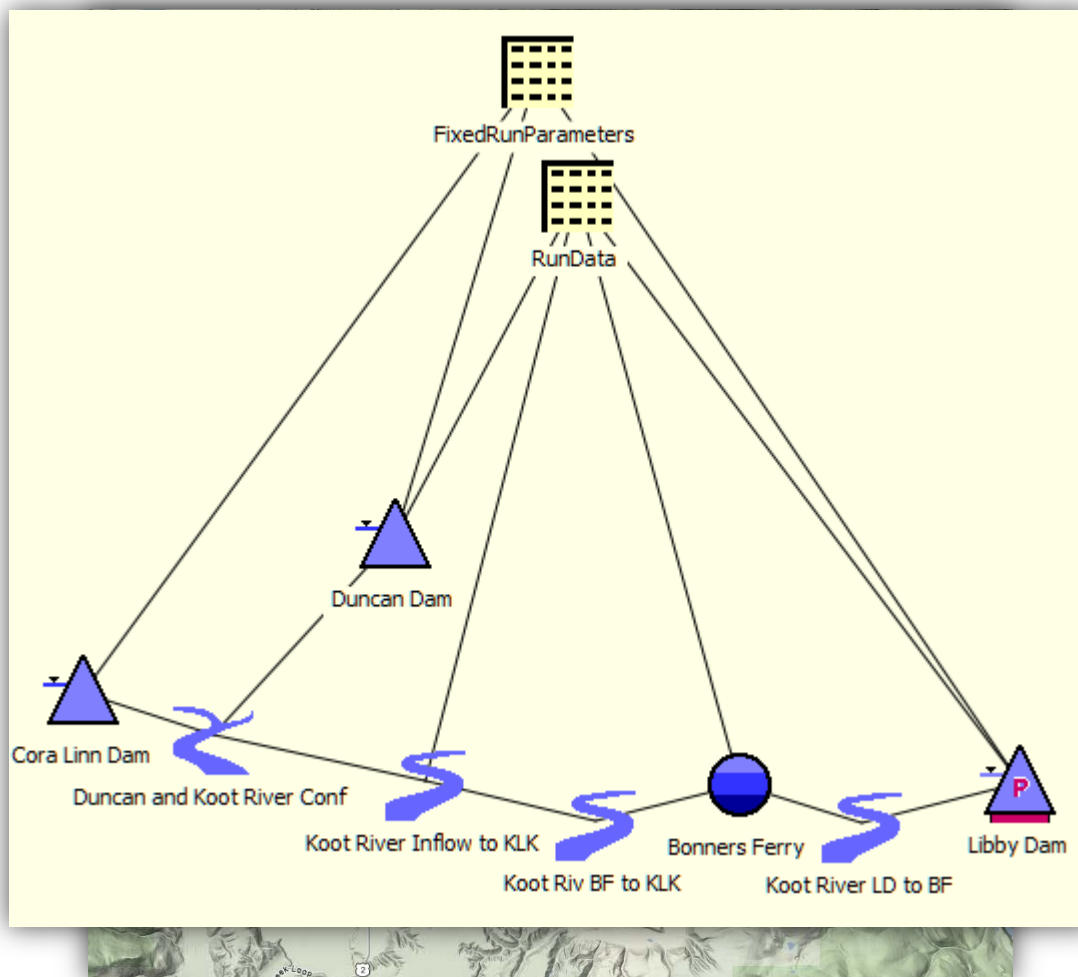


Bonner's Ferry Flood Control





Bonner's Ferry Flood Control





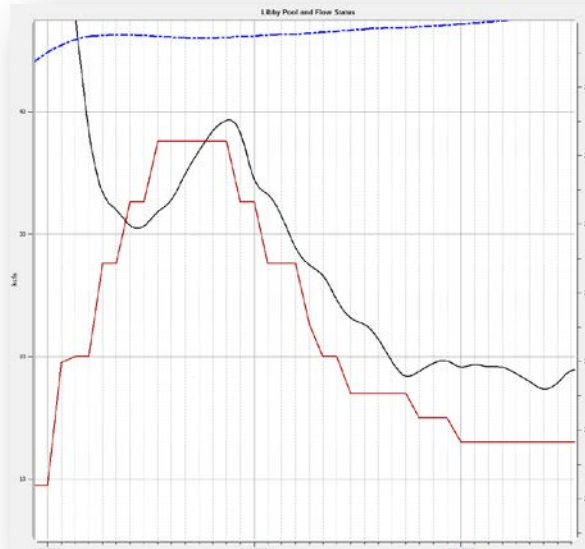
BiOps

- Seasonal minimum flows for sturgeon, bull trout and salmon.
- “Sturgeon Pulse”
 - Stepped increase in flows in June-July
 - Variable start date.
 - Shape/peak/volume forecast dependent
 - Shape dependent on prior conditions.
 - Peak also elevation dependent (PHC + spill)



Sturgeon Pulse

“If these conditions are met, increase discharge from Libby Dam to 15 kcfs for 3 days, followed by discharge of 20 kcfs for 3 days, discharge of full powerhouse capacity for 3 days, then maintain peak discharge of PHC + spill of up to 10 kcfs for 7 days.....reduce discharge to PHC for 4 days, reduce discharge to 20 kcfs for at least 3 days... If modeled summer flat flow is at least 15 kcfs, maintain 17 kcfs until volume is exhausted....” -- 2011 Libby Operation





Modular Refill Guidance (VarQ)

$$VQ_{Final} = VQ_{New} - \text{Adjustment For Duration}$$

$$VQ_{New} = VQ_{Init} + \text{Adjustment For Storage}$$

$$VQ_{Init} = \text{Interpolation based on Current Apr - Aug WSF}$$

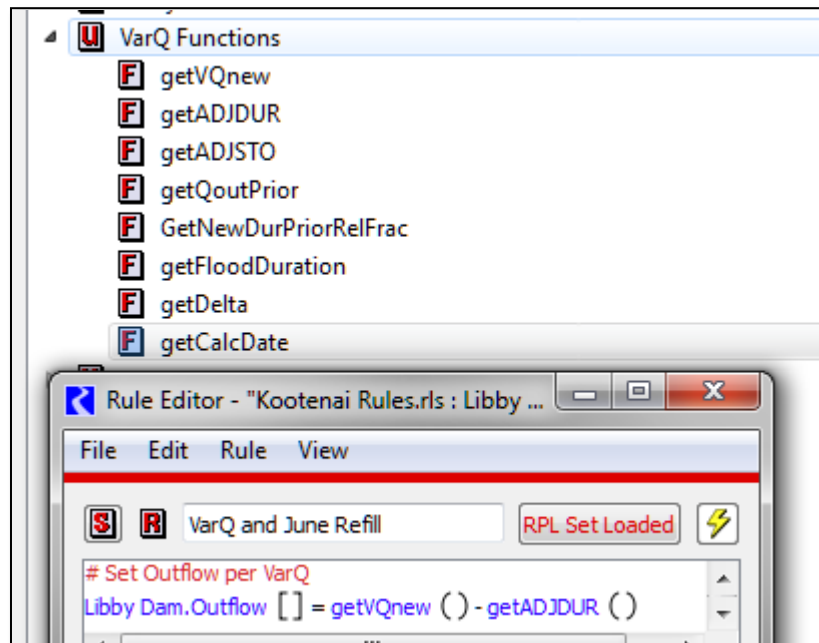
$$AdjStorage = \frac{\Delta}{Duration} \quad \Delta = \text{Req'd Space} - \text{Actual Space}$$

$$AdjDur = \frac{[VQ_{New} - Q_{out}_{Prior}] * PriorDays}{NewDuration - PriorDays}$$



Modular Refill Guidance (VarQ)

$$VQ_{Final} = \left[VQ_{Init} - \frac{\Delta}{Duration} \right] + \frac{\left[\left(VQ_{Init} - \frac{\Delta}{Duration} \right) - Q_{out_{Prior}} \right] * PriorDays}{NewDuration - PriorDays}$$





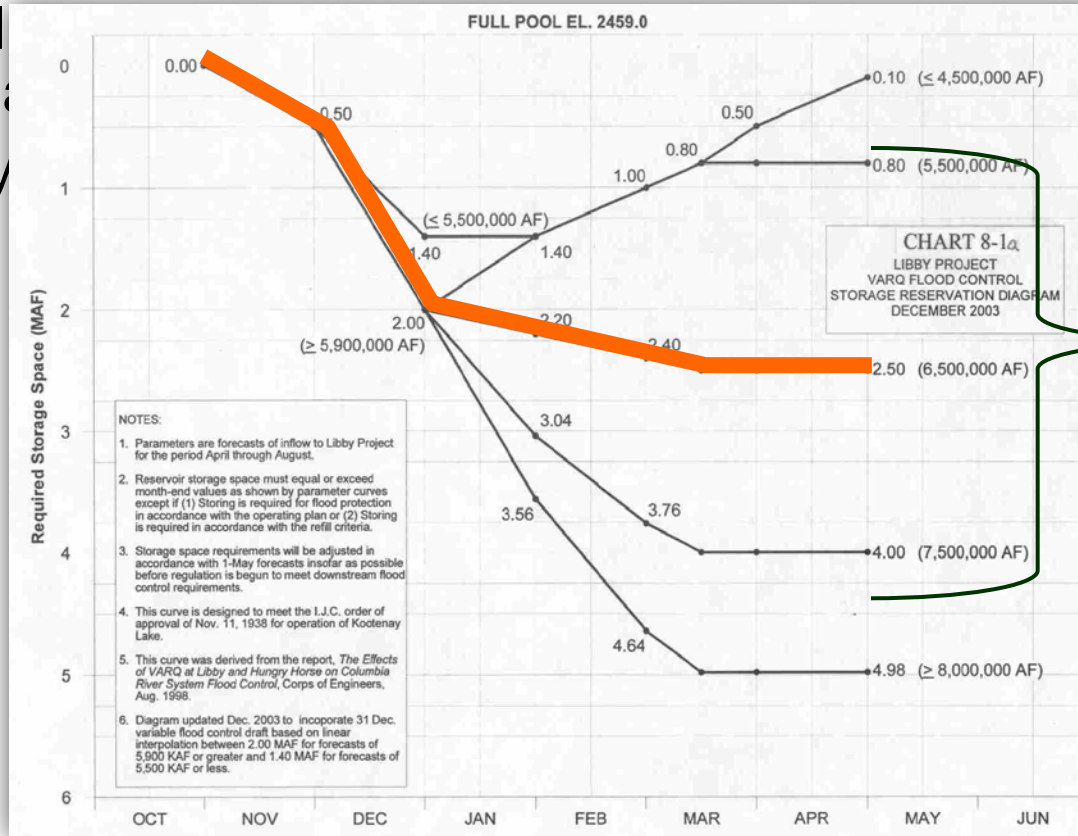
Forecast Time Series

- Drawdown, refill, surgeon operations, minimum flows all vary with current timestep's April – August forecast.
- VarQ refill also depends in part on what the forecast was on a specific date in the past.
- Refill may be declared retroactively



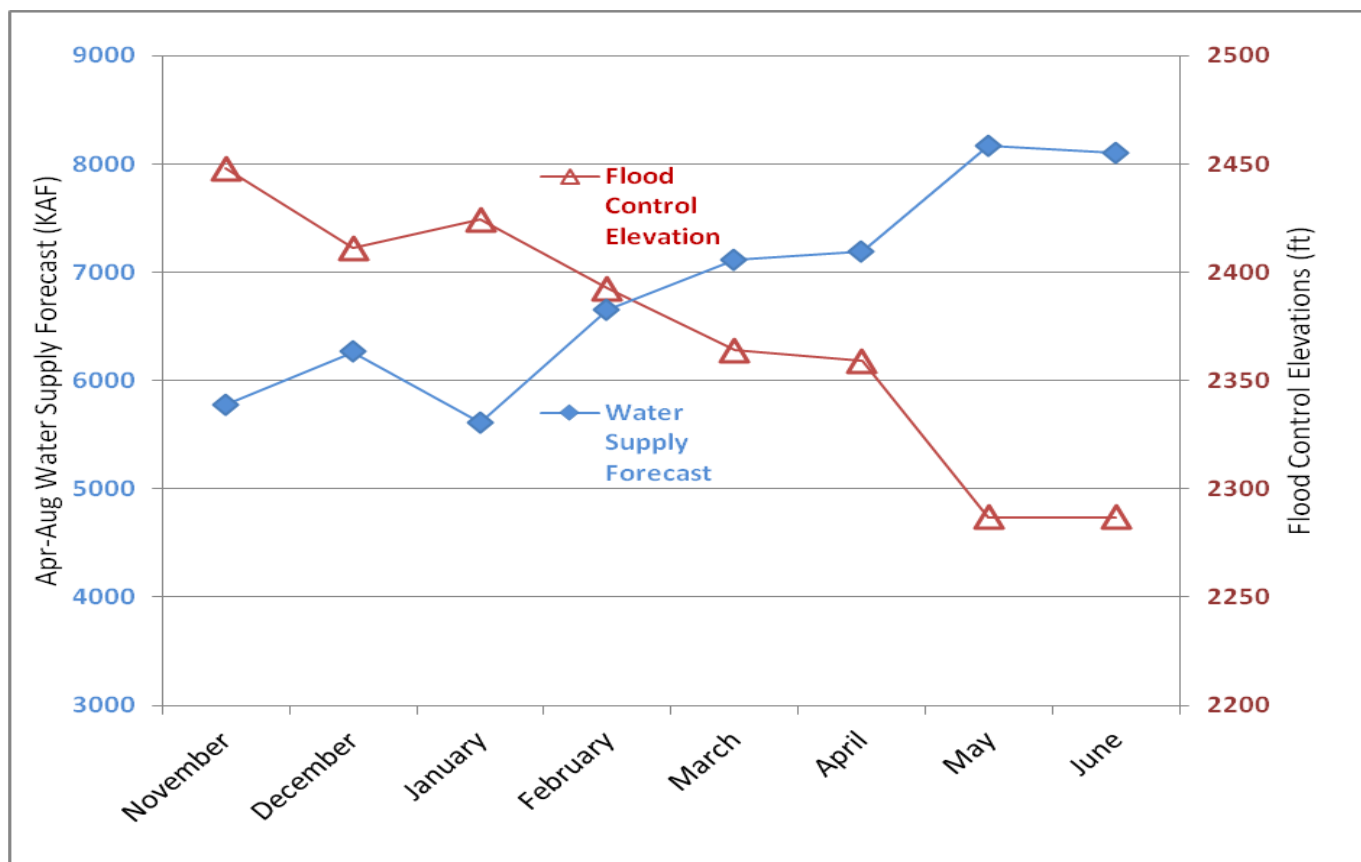
Forecast Time Series

- Drawdown, refill, surgeon operations, minimum flows all vary with current timestep's April – August forecast.
- VarQ refill specific d
- Refill may





2011 Libby WSF and Flood Control Elevations





Forecast Time Series

- Solution:

Libby Refill Date
Value: 137894400.6093 MonthAndDay

Edit Date/Time Slot Values:
May 15th Apply

Scroll: Oct 1, 2012

Compress Repeated Values

	Cnt	MonthAndDay
09-30-2012 Sun	237 :	May 29 I 0
05-25-2013 Sat	128 :	May 15 I 0

Show: Description

WSF TDA
Value: 92 :

Evaluation Time: Beginning of timestep, current ti
Evaluation Range: Run start to run finish (Step: 1 D
HistoricalData.MonthlyWSF_TDA | GetDate
/ @"Curre

Scroll: Sep 30, 2012

Compress Repeated Values

	Cnt	MAF
10-01-2012 Mon	92 :	114.47 O 0
01-01-2013 Tue	31 :	93.22 O 0
02-01-2013 Fri	28 :	103.44 O 0
03-01-2013 Fri	31 :	105.73 O 0
04-01-2013 Mon	30 :	114.55 O 0
05-01-2013 Wed	153 :	114.47 O 0

Show: Description

WSF Lib
Value: 0

Evaluation Time: Beginning of run
Evaluation Range: Run start to run finish (S
HistoricalData.MonthlyWSF_LIB | GetDate
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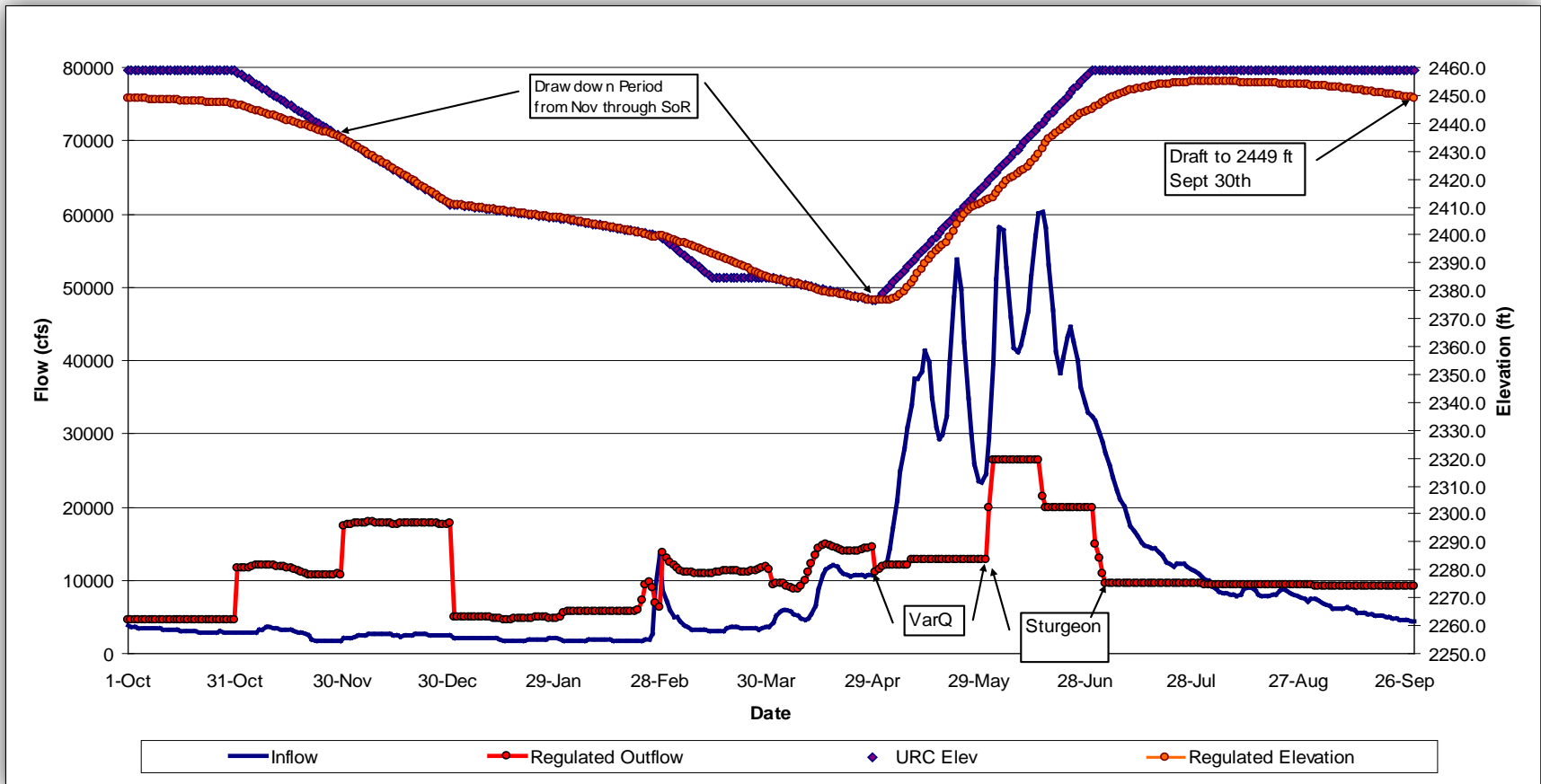
Scroll: Sep 30, 2012

Compress Repeated Values

	Cnt	MAF
10-01-2012 Mon	61 :	0.00 O
12-01-2012 Sat	31 :	8.42 O
01-01-2013 Tue	31 :	7.24 O
02-01-2013 Fri	28 :	7.66 O
03-01-2013 Fri	31 :	7.53 O
04-01-2013 Mon	30 :	7.15 O
05-01-2013 Wed	31 :	8.05 O
06-01-2013 Sat	30 :	7.50 O
07-01-2013 Mon	31 :	7.30 O
08-01-2013 Thu	61 :	7.36 O

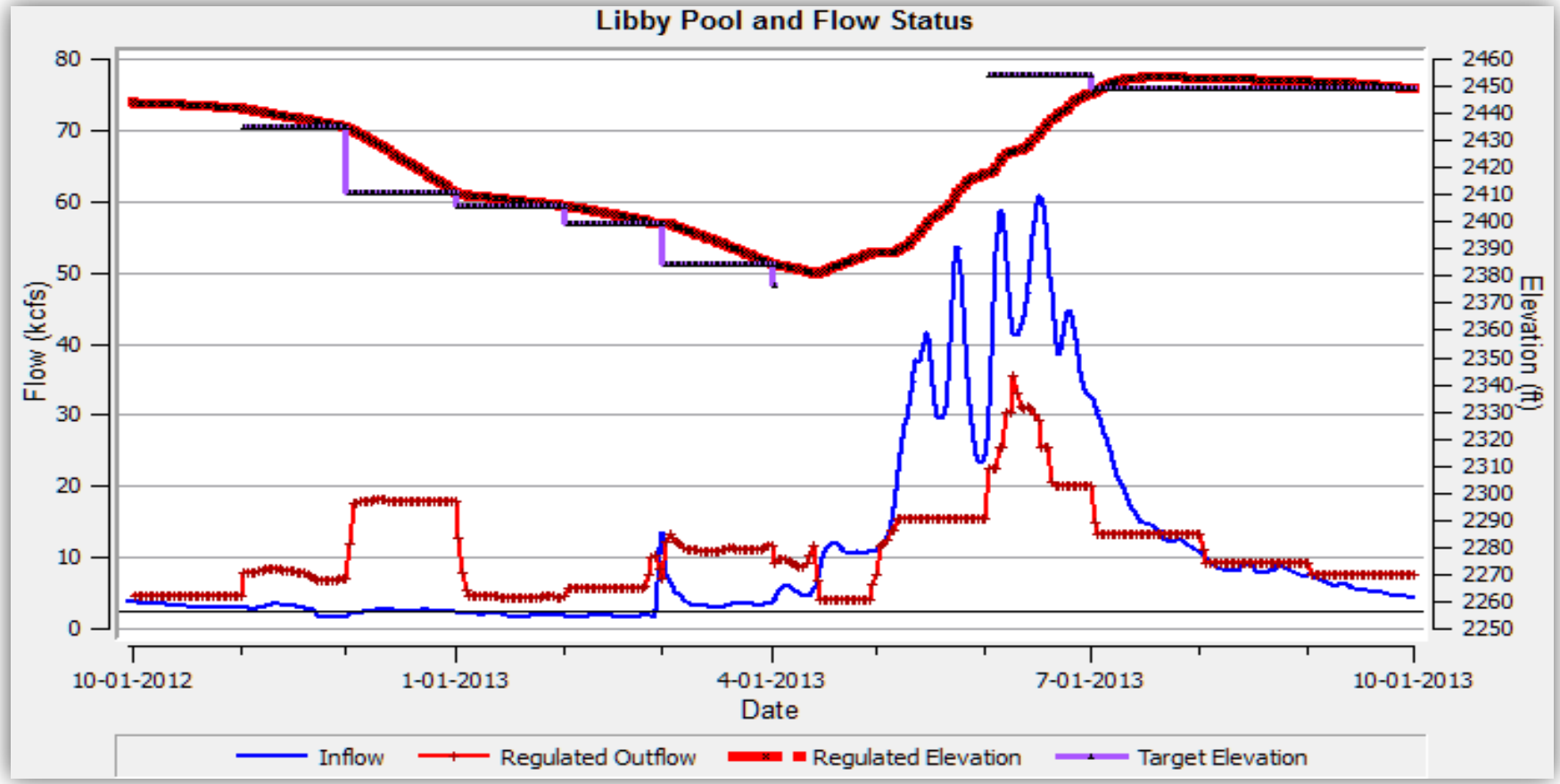


What an average year may look like for Libby Dam regulation





What an average year may look like for Libby Dam regulation





Riverware Implementation

Excel Input File Creator

- Run Type
 - Realtime (Single trace, 0-2 weeks)
 - Seasonal Planning (Multiple Traces)
 - Policy Studies (e.g. 2010 Level hydrographs)
- Optional forecast fluctuation
- Optional filtering weather years
- Exports to new excel file



Riverware Processing

- Realtime model & planning/study model
- Eventually automatically running single trace overnight



Output to import

- Pre-configured analysis and graphs
- Easy sharing with non-RW users
- Study parameters and data preserved



Questions/Comments/Suggestions?

