

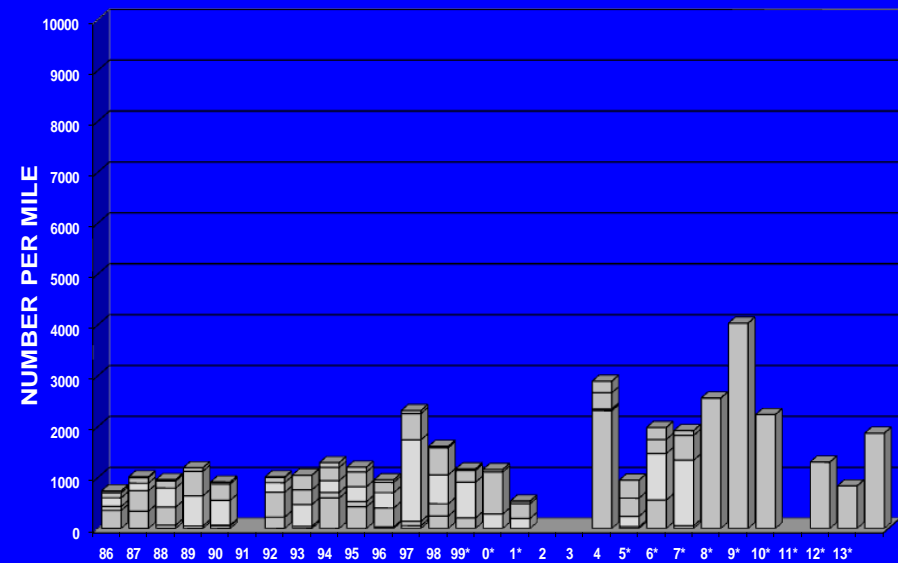
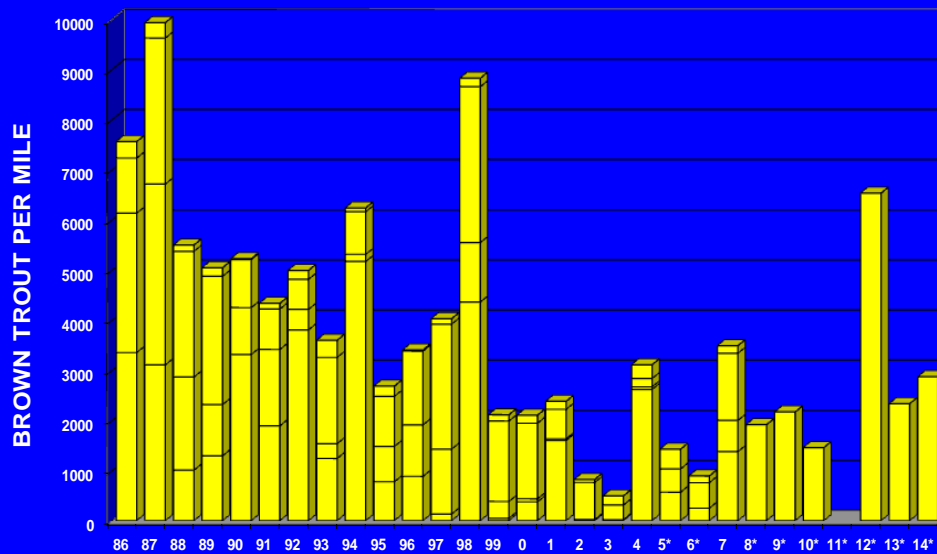
# Bighorn River Management

A photograph showing a green mesh net being pulled from the Bighorn River. The net is partially submerged, and a white rope is visible on the right side. The water is dark and rippled. The net appears to be catching something, possibly fish or aquatic plants.

## BROWN TROUT - UPPER SECTION

Spring Sampling

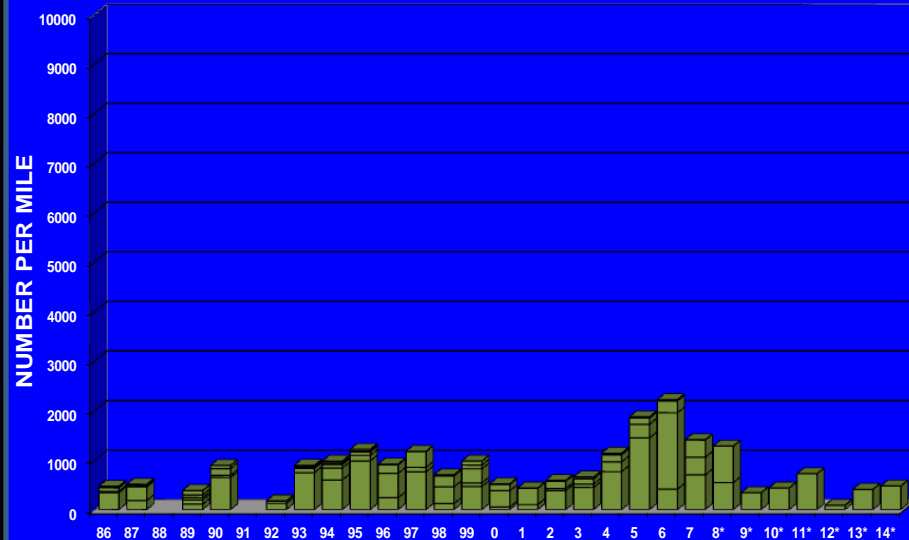
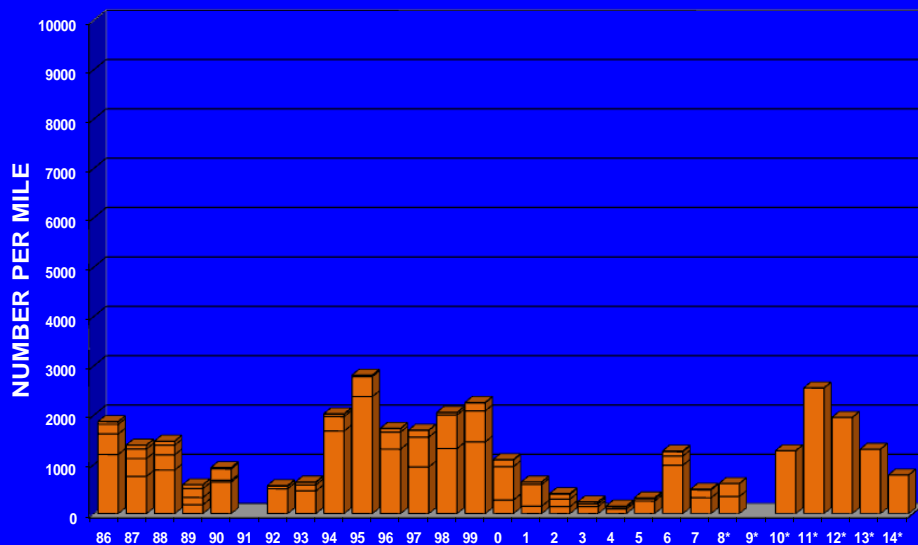
## RAINBOW - UPPER SECTION



## BROWN TROUT - LOWER SECTION

Fall Sampling

## RAINBOW - LOWER SECTION



# Bighorn River Management Current Concerns

- **Water Management often viewed as overly conservative at the expense of the river more often than the reservoir.**

*Rule Curves Over Ruled by “Events”, “Bighorn River Ruled past balance”.*

- Crow Compact and Power Plant development on the Afterbay.
- Algae and aquatic vegetation excessive growth
- After high water releases an increase in trout gas bubble trauma followed by high rates of fungus and mortality.
- Turbidity

# BIGHORN FLOW RECOMENDATIONS

- **Best Fisheries Flow - Greater than 2,500 cfs**
- **Preferred Minimum Fisheries Flow – 2,500 cfs  
has maintained the strong Bighorn Fishery**
- **Water Savings Minimum Flow – 2,000 cfs**
- **Absolute Minimum Flow - 1,500 cfs**



Side Channel at 1,500 CFS  
DROUGHT

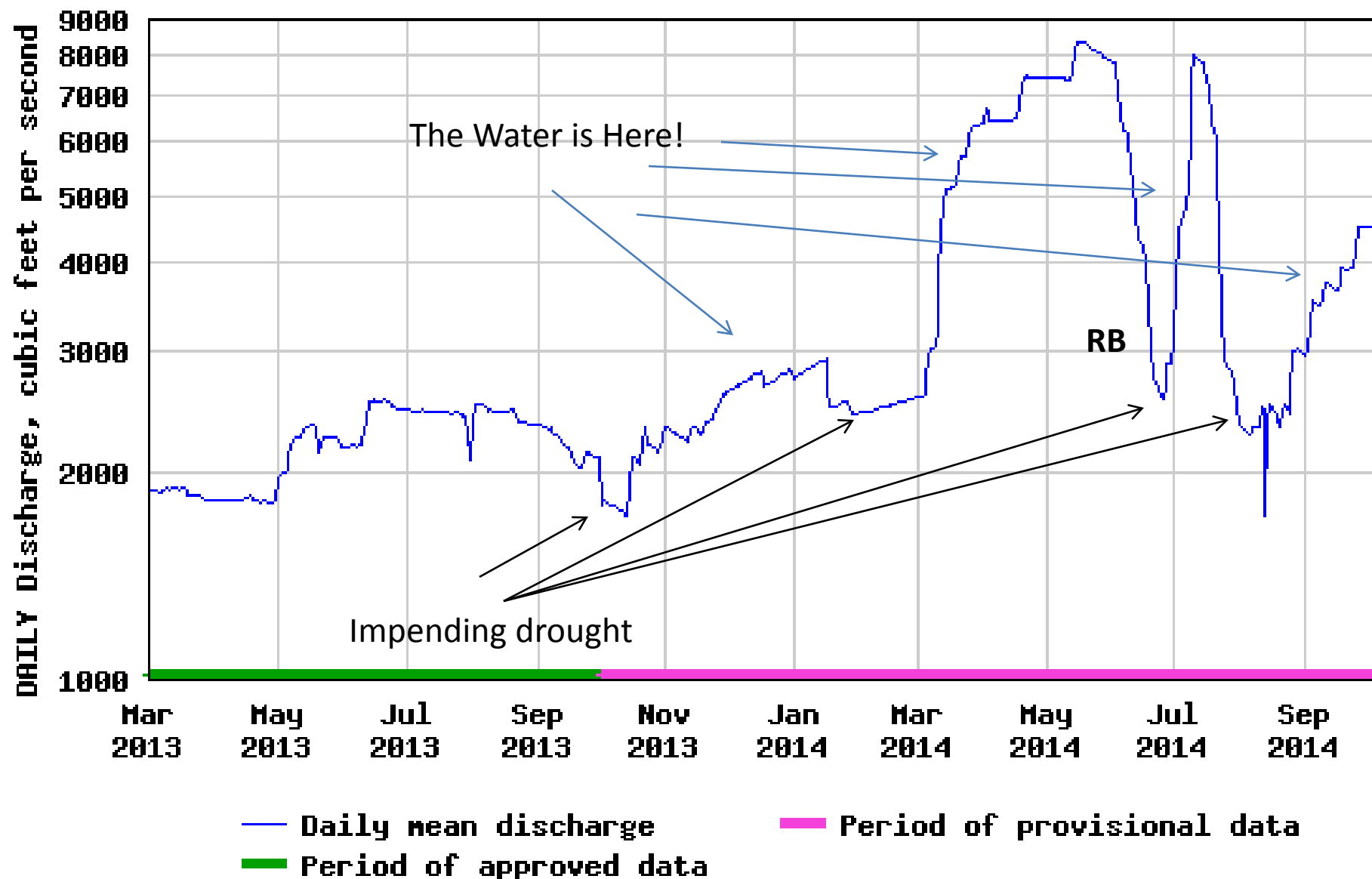




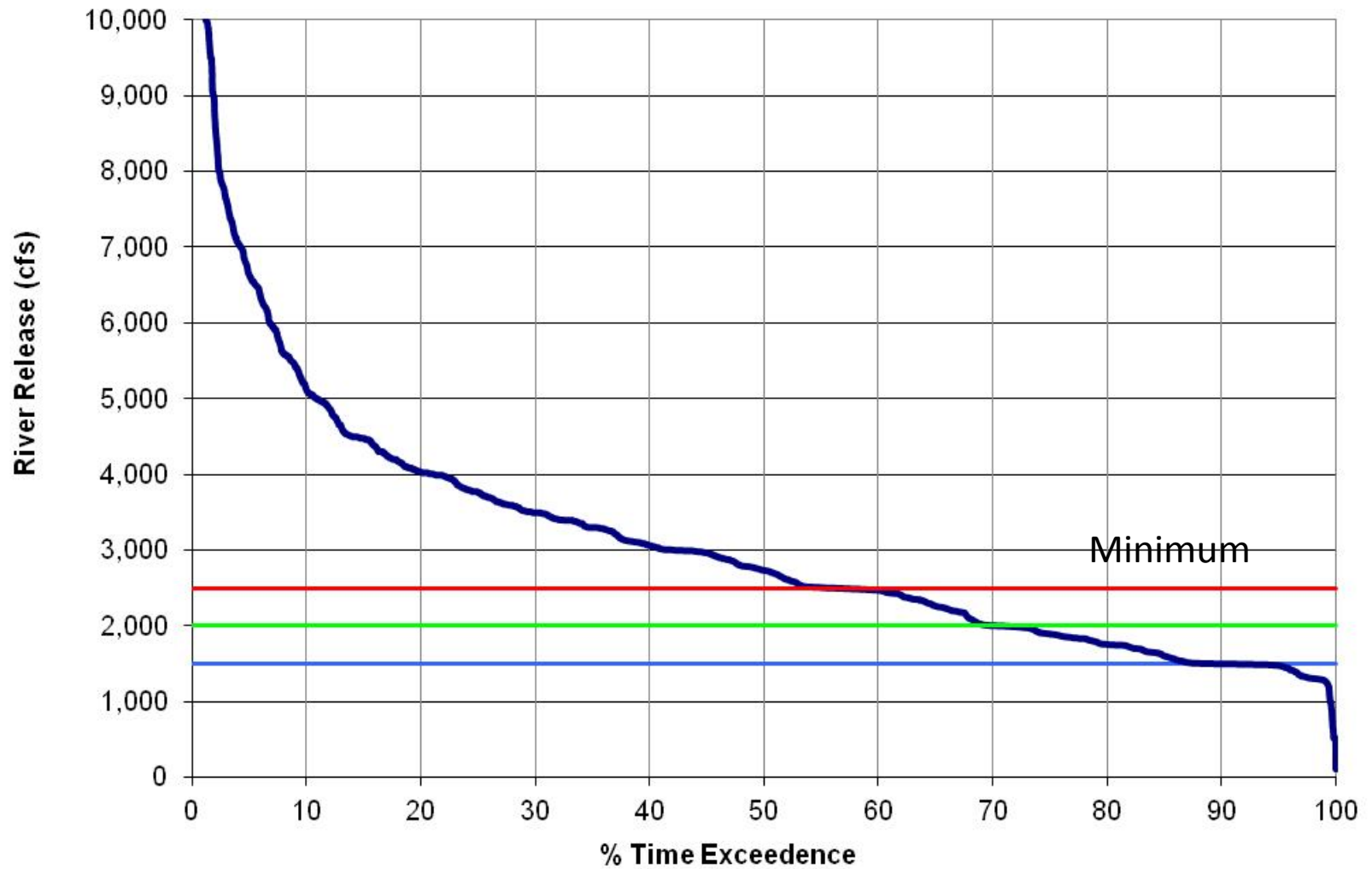
Side Channel at 1,900 CFS  
LESS DROUGHT



# USGS 06287000 Bighorn River near St. Xavier, MT

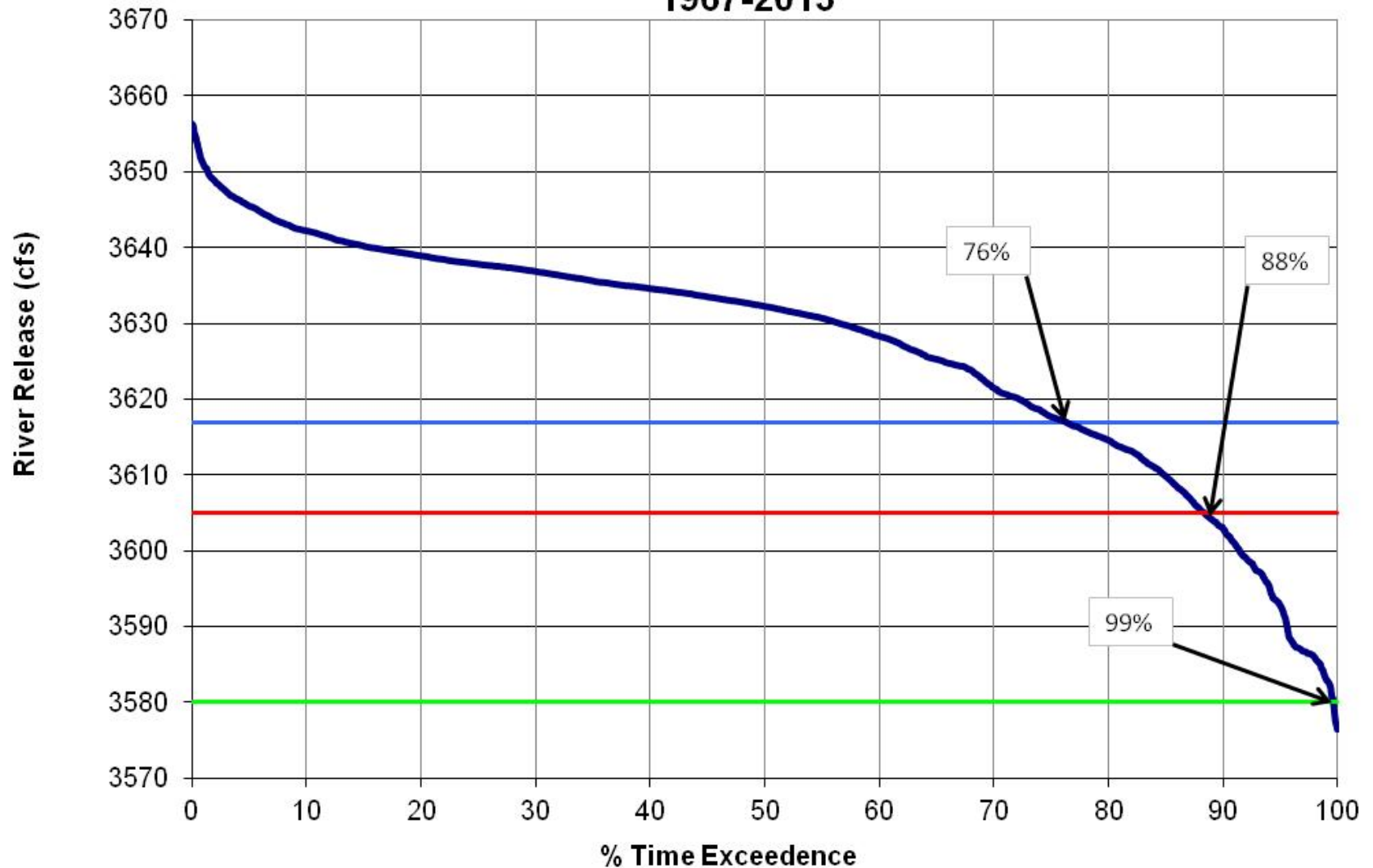


## Bighorn River Water Year 1967-2013





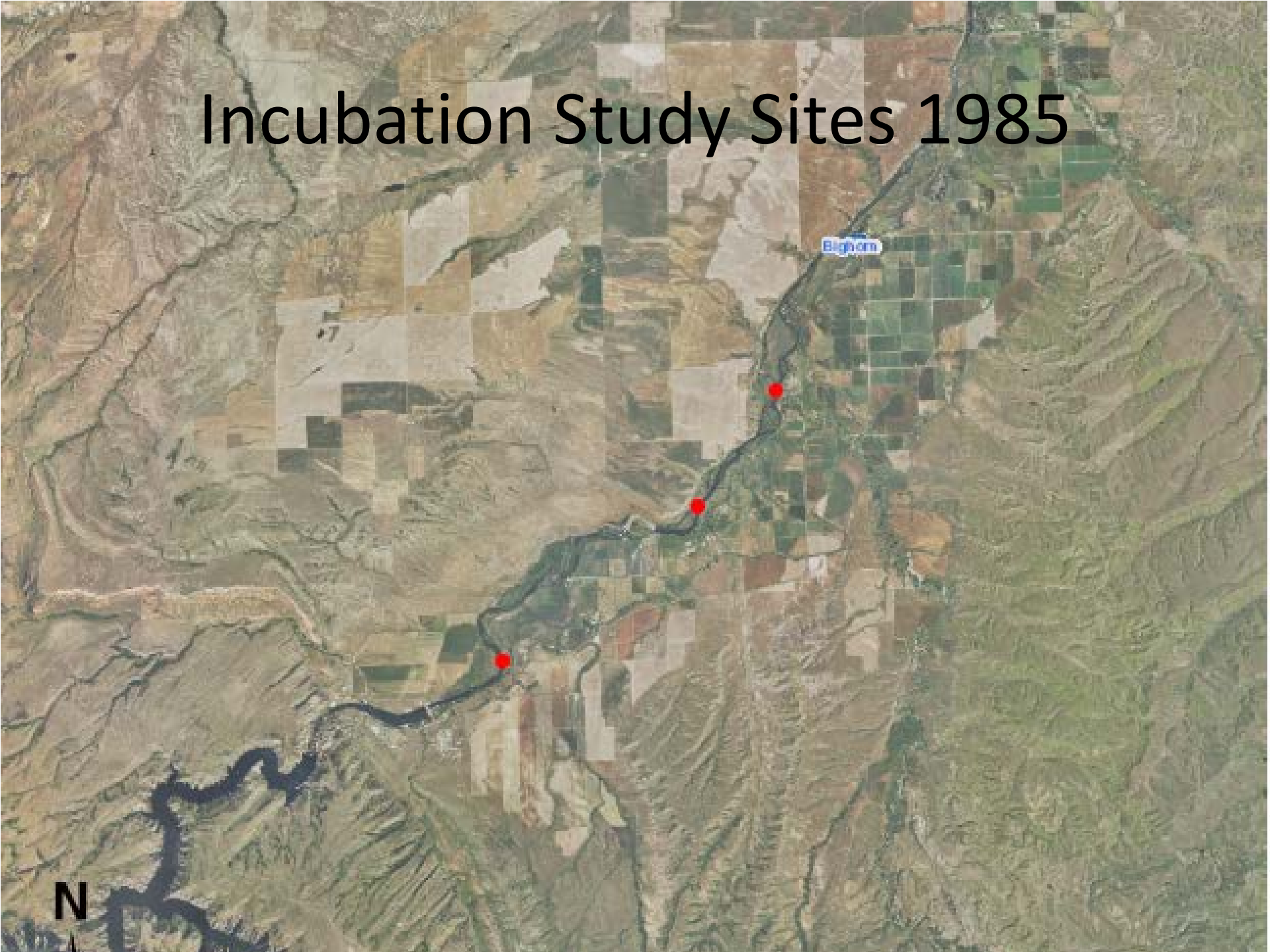
**Bighorn Lake Elevation  
May 20 - September 5  
1967-2013**



# Rainbow Trout Management Implications for year class 2014

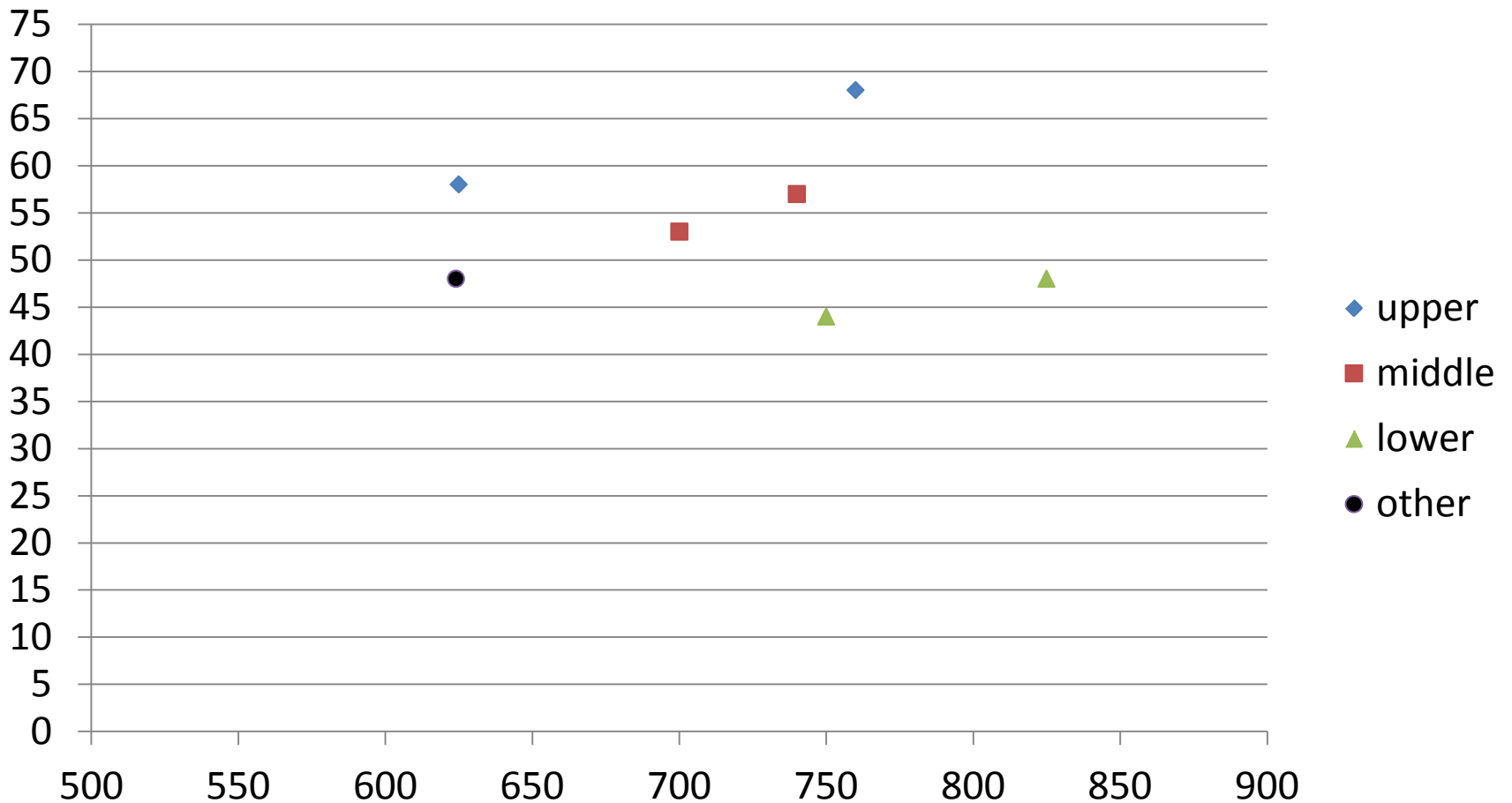


# Incubation Study Sites 1985

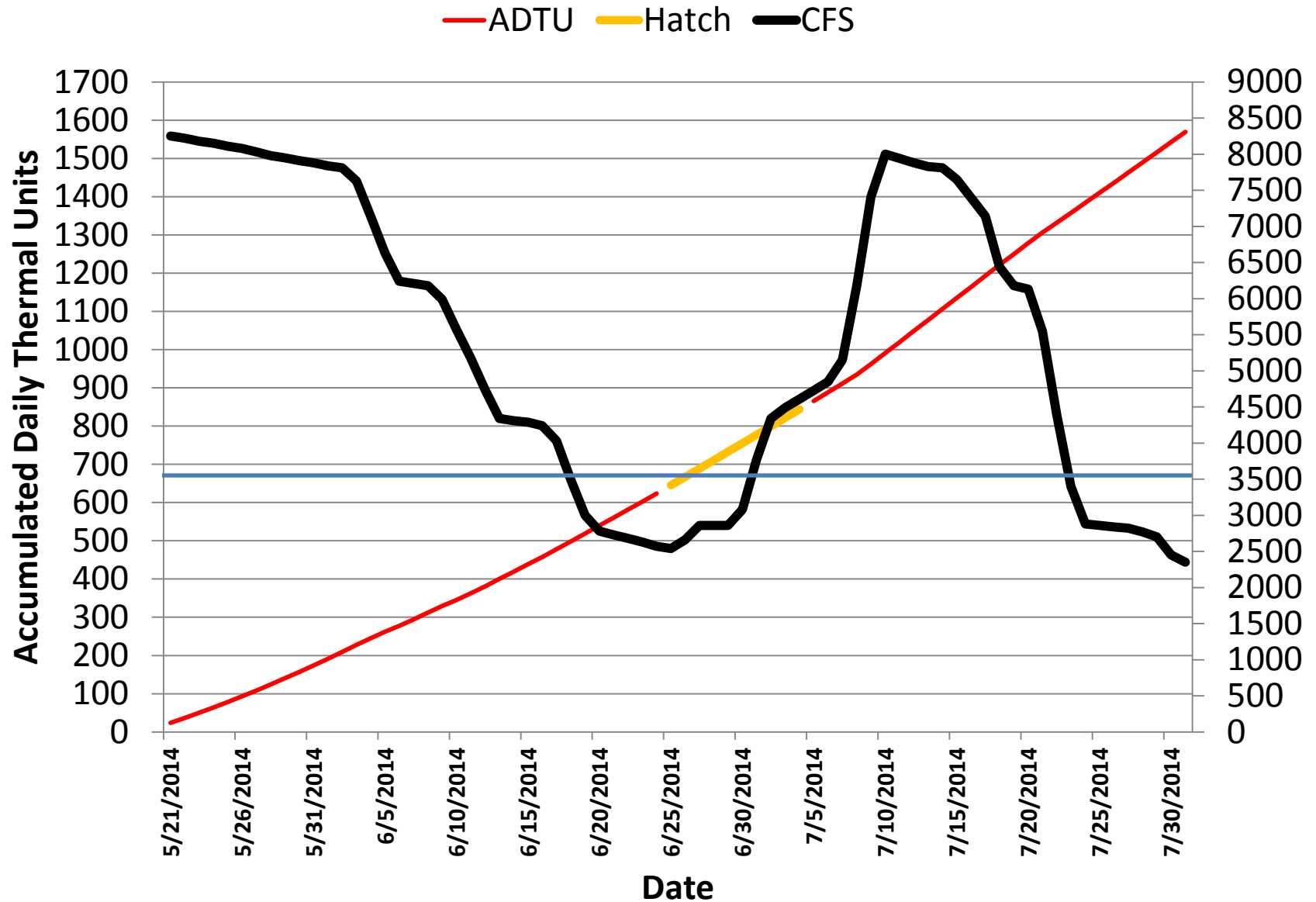




# Incubation Study Results for Accumulated Thermal Units

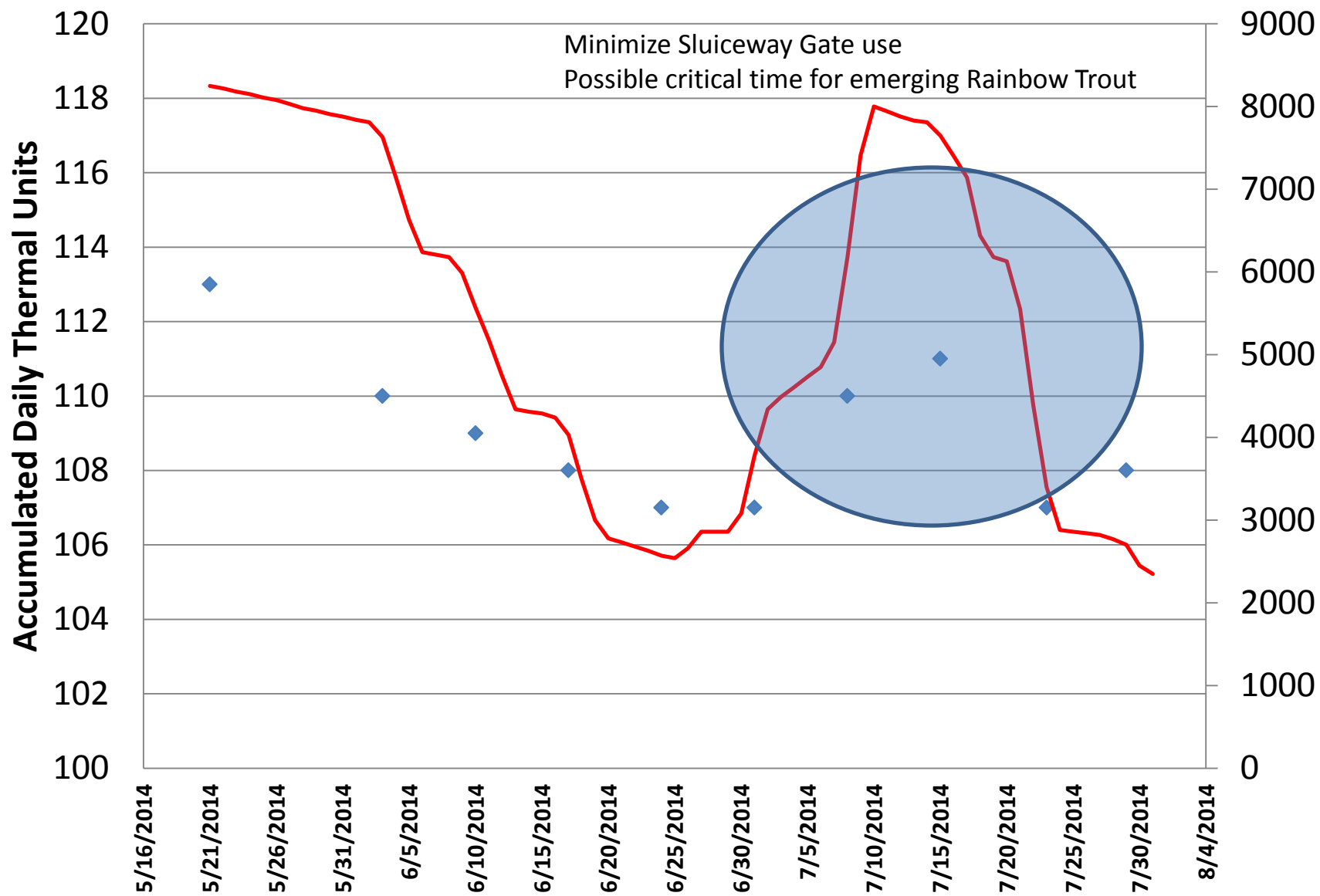


# Rainbow Trout Accumulated Daily Thermal Unit for Eye-Up and Hatch vs Cubic Feet Per Second May 21 to July 31<sup>st</sup>, 2014



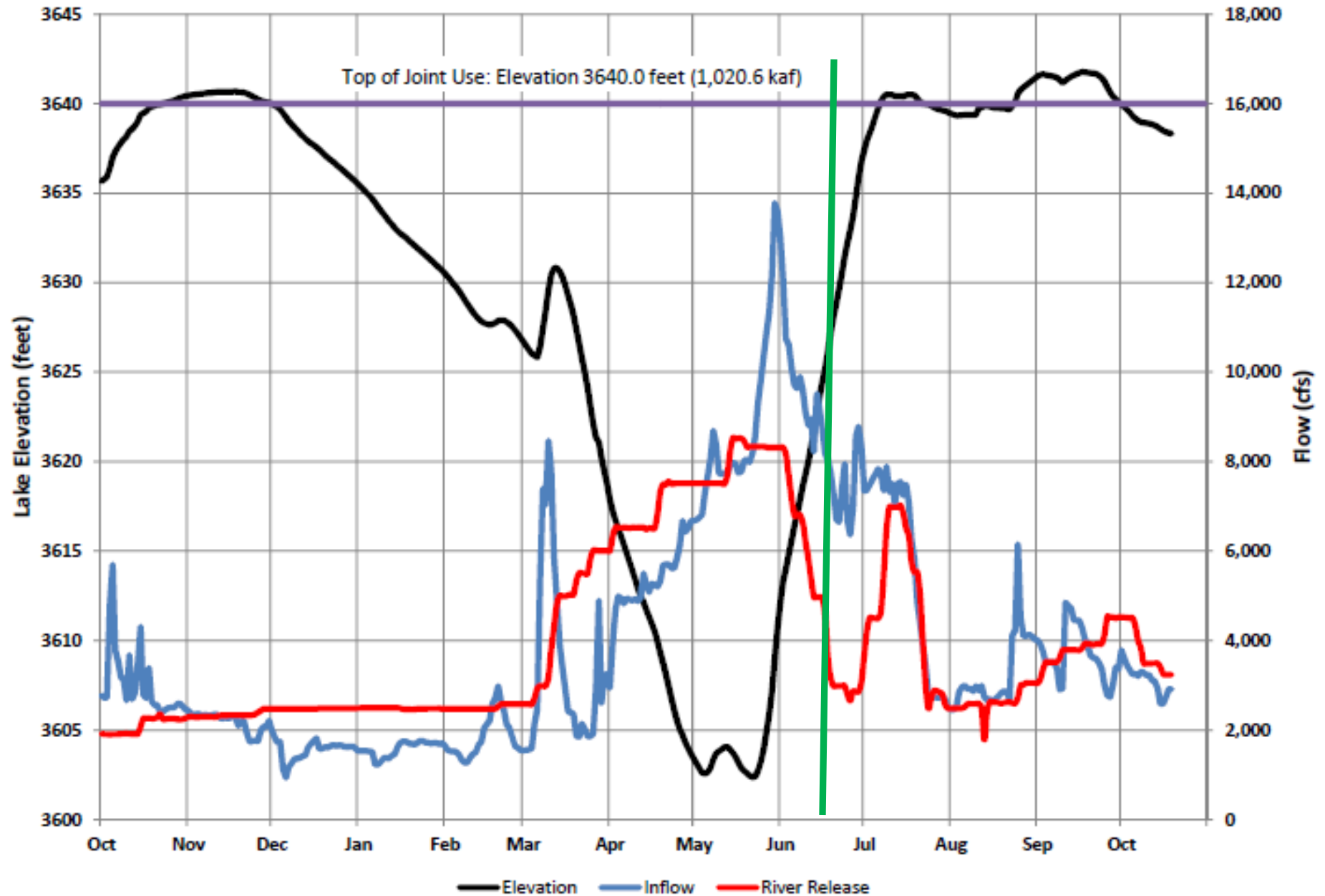
# Gas Saturation vs Cubic Feet Per Second May 21 to July 31<sup>st</sup>, 2014

—◆— Gas Saturation    — CFS





## Bighorn Lake Operations 2014

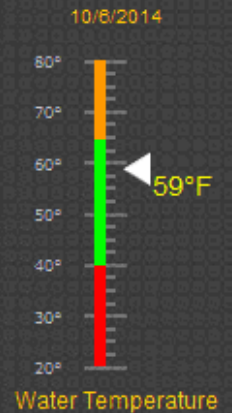
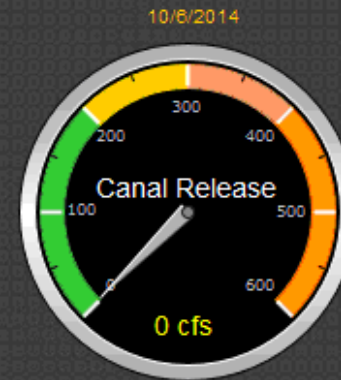
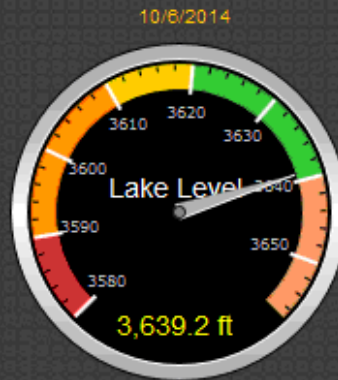
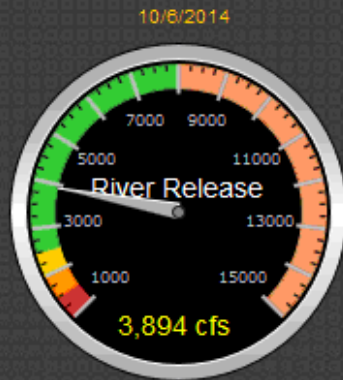


# Rule Curves

**Friends  
of the Bighorn River**

Yellowtail Operations  
and  
Bighorn River Status

Refresh



Bighorn

Daily

Snowpack

Boysen

Buffalo Bill

Shift

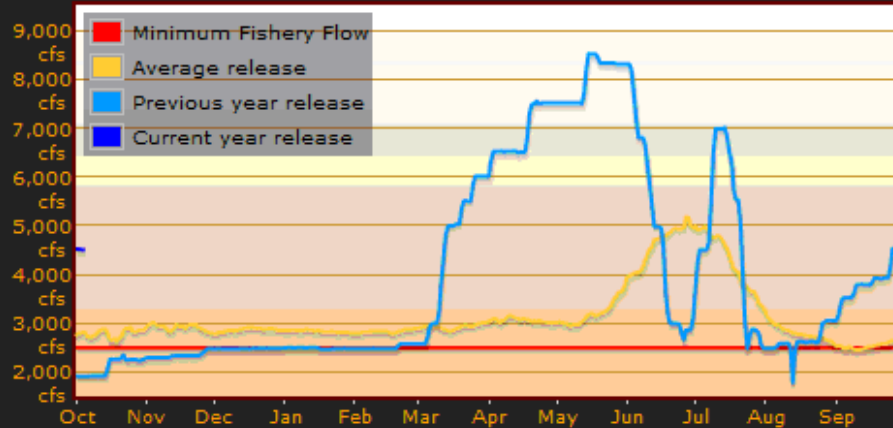
Weather

News

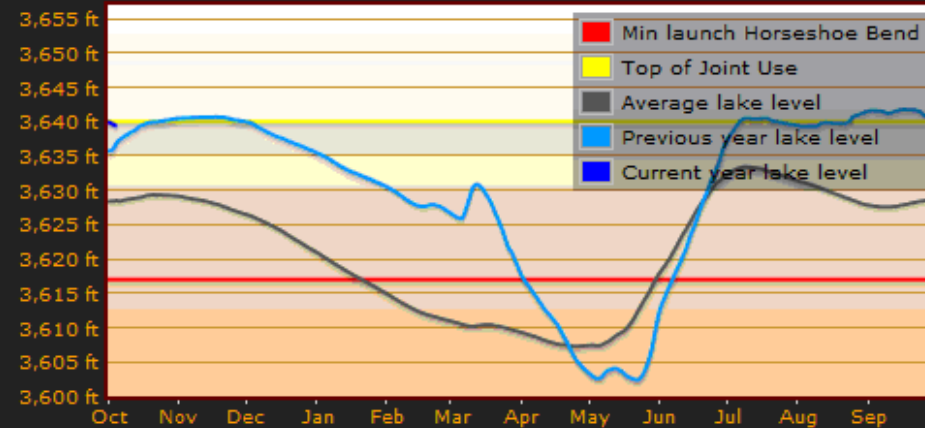
FOBR Blog

Interactive

River Releases



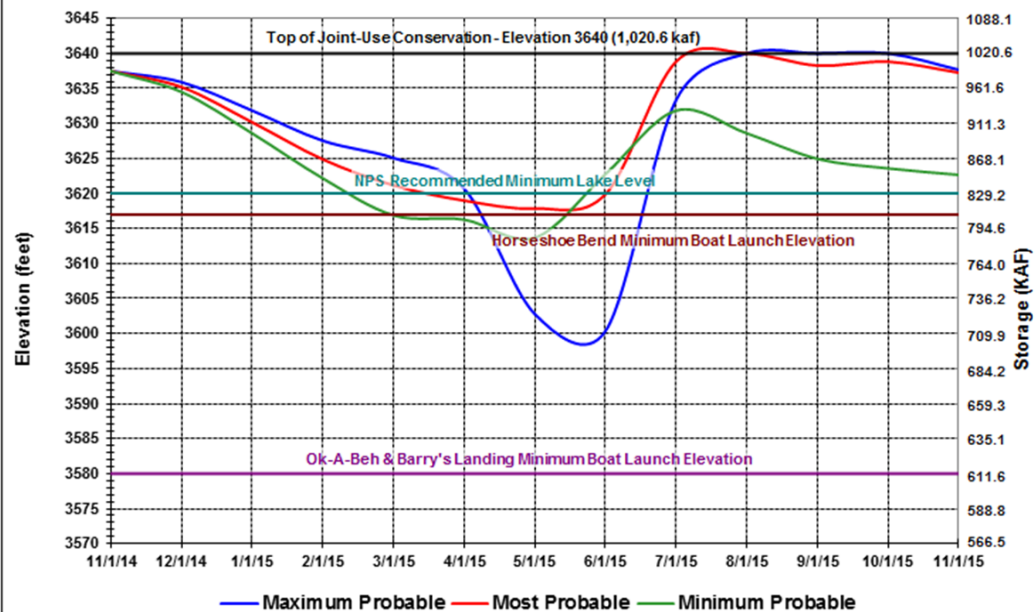
Lake Levels



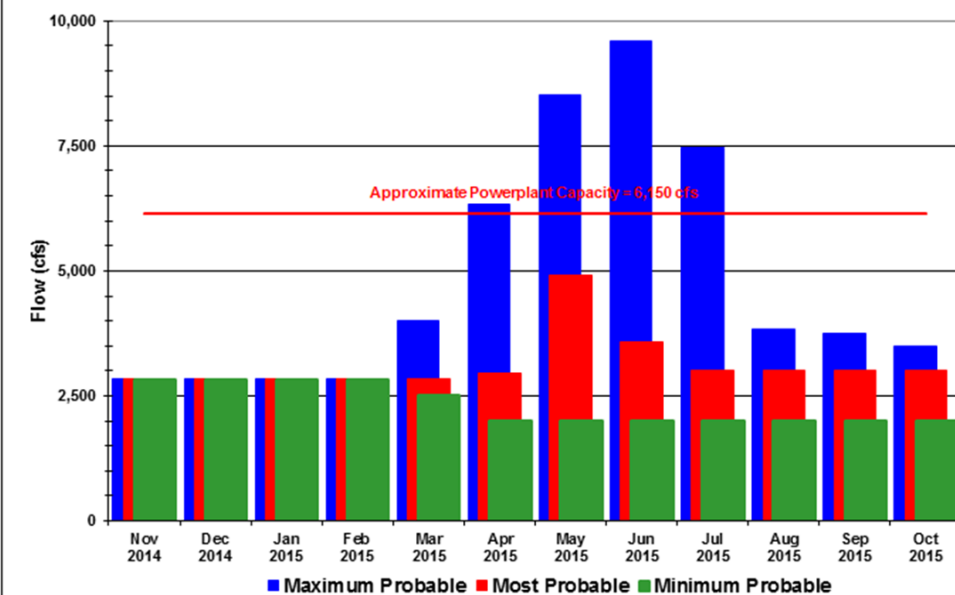
**Transparent guidelines to manage water**

# BIGHORN LAKE

## BIGHORN LAKE ELEVATION



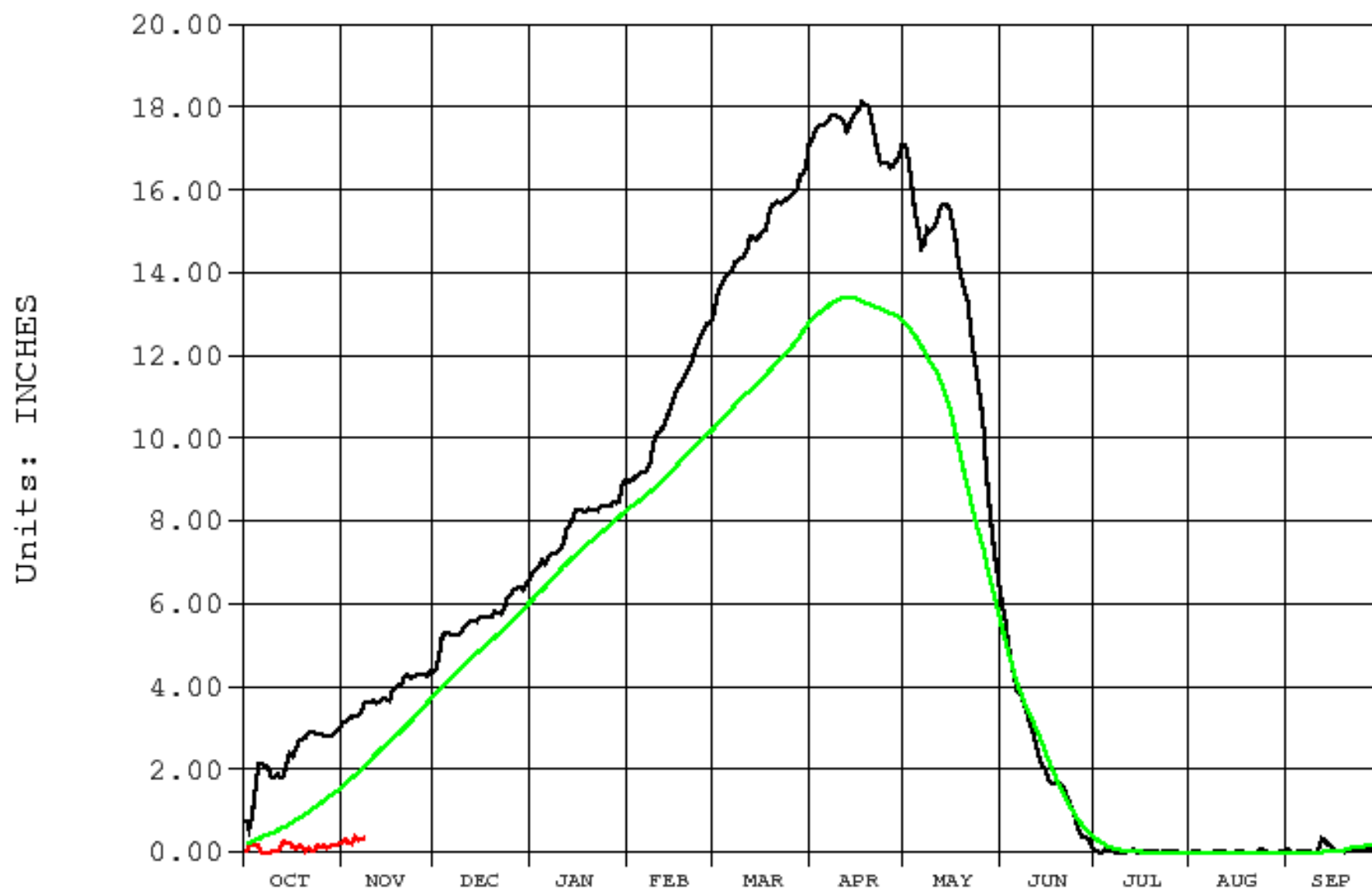
## BIGHORN RIVER FLOW BELOW AFTERBAY





Archive Data From 1-OCT Through 30-SEP

Plotted 11/08/2014 13:10 (Provisional Data Subject to Revision)



BHR Bighorn Lake (Yellowtail), Bighorn River near Fort Smith, MT

— SE Snow Water Equivalent (inches)

— SE\_AVG Snow Water Equivalent Average (inches)

2014 2015  
2015

## **November thru March Operations**

A stable reservoir release is desirable for the late fall and winter period to provide certainty for power generation, reliability for the river fishery during the brown trout spawn, and to minimize potential disruption to downstream ice conditions. This fall/winter release rate is set after the irrigation season ends (generally around the middle of October) and prior to the start of significant brown trout spawning (generally around the middle of November). A formal procedure for calculating this release was established in the draft criteria.

First, an initial fall/winter river release is calculated using the new end-of-March lake elevation target of 3,617. If this calculated release falls between 2,000 cfs and 2,500 cfs then the end-of-March lake elevation target remains at 3,617. If the calculated release is greater than 2,500 cfs then the release is re-calculated using an end-of-March lake elevation target of 3,619. Should the initial calculated release be less than 2,000 cfs then the release is re-calculated using an end-of-March lake elevation target of 3,615. These procedures provide some sharing between upstream and downstream beneficiaries and stakeholders in the risk associated with experiencing either a high or low spring runoff.

## January thru March Operations

Beginning in January each year, monthly water supply forecasts are prepared for Bighorn Lake which estimate the runoff for the April thru July period, based primarily on the water content in the mountain snowpack and normal spring precipitation. Typically, the river release rate established in early November will not be changed until **after the first of April**. If however, gains to the system are trending noticeably higher or lower than forecasted in early November, **minor adjustments** in river release rates may be necessary to bring the reservoir elevation back in line with the end-of-March target elevation.

Likewise, if the April thru July inflow forecasts prepared in February or March indicate that spring runoff is expected to be either **considerably** higher or lower than average, adjustment to the end-of-March target elevation and the fall/winter release rate may be made **prior to April 1**, to prepare the reservoir for potentially high or potentially low spring runoff.

## **April thru July Operations (Rule Curves)**

Rule curve methodology is an inflow routing procedure that has been applied to Yellowtail operations over the past couple of years. Using the Bighorn Lake Rule Curve spreadsheet and the spring runoff forecast, a rule curve is developed to identify the desired reservoir elevations during the April thru July runoff season. The rule curve is updated with each revision to the runoff forecast (revisions are normally available around the 1st and 15th of each month). **Once the rule curve is established, it is used to help guide operations until the next revision is made, or through the remainder of the runoff season, whichever is applicable.**



## **August thru October Operations**

In years with a good water supply, river releases will be established at 2,500 cfs or more while meeting the desired end-of-October reservoir elevation target **range of 3,635 to 3,640**. This target range is established to provide desirable reservoir levels for: 1) reservoir-based recreation; 2) waterfowl hunting; and, 3) a water supply sufficient for allowing adequate fall/winter river releases for river fishery and power generation purposes. In runoff years when a river release of 2,500 cfs cannot be met without drafting the reservoir below elevation 3,635 by the end-of-October, operations are planned based on meeting the end-of-March target elevation of near 3,617 with a fairly uniform release throughout the late summer, fall and winter seasons.

# Key Pieces

- Inflow forecast adjustments (inaccuracies) This fundamentally changes the rule curves and discussion about future elevations and flows.
- March target elevation 3617 may not be a proper target this elevation was regularly lower and the reservoir typically filled-result is higher releases in the spring to compensate for gains followed by quick reductions once a target fill rate is established.
- Default to drought conditions every October and November-currently the snowpack is well below average-how long can the BOR hold on?
- Is the August-October period really operated on a Range from 3635 to 3640? Appears as if 3640 is a hard target based on 2014 and use of the flood pool.

Every story should have a happy ending😊  
Spined by a catfish in the spring netting survey  
No infection-Healed great!  
As for the Bighorn System can we as a group evaluate and  
implement meaningful changes?



Discussion?



Jerry La Fleiche, FBHL witness