

# RECLAMATION

*Managing Water in the West*

## Yellowtail Dam & Bighorn Lake Operating Criteria Review

Billings, MT  
September 29, 2009

# WIND RIVER RANGE



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# OPERATING CRITERIA REVIEW GOALS

- **Improve Overall Project Benefits**
  - **Higher Lake Levels for Recreation and Fishery**
  - **More Consistently Meet Desired Fishery Flow Targets**
  - **Enhance Power Generation**
  - **Improve Flood Control Operations**
  - **More Transparent Methods for Operating Decisions**

# PROPOSED CHANGES

- **Modified Reservoir Elevation Targets**
- **Revised Method for Calculating River Gains**
- **Improved Method for Forecasting Winter Gains**
- **Improved & Transparent Procedure for Setting Winter Release**
- **New Operating Procedure for Spring Runoff Season using Reservoir Operational Rule Curves**

# PROPOSED RESERVOIR TARGETS

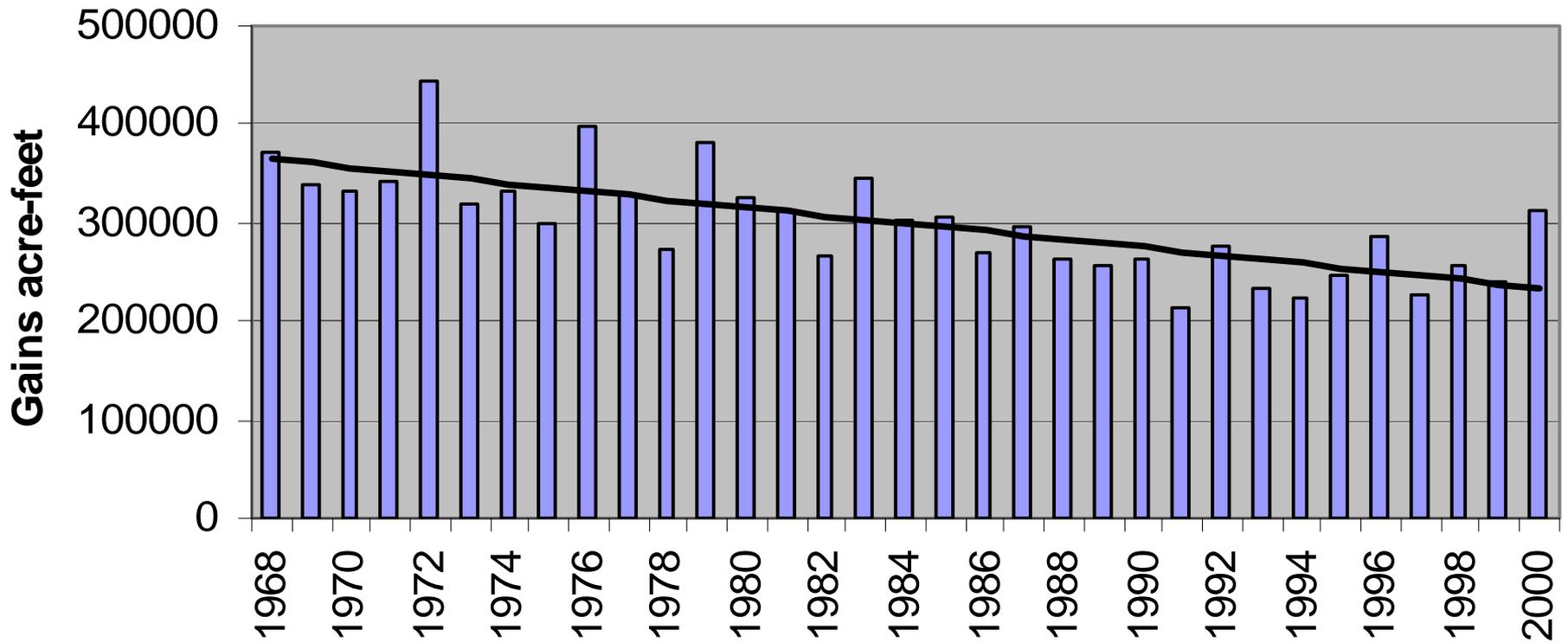
<u>Date</u>	<u>Existing Targets</u>	<u>Proposed Targets</u>	<u>Difference (feet)</u>
Oct 31	3635	3638-40	+3-5 ft
Nov 30	3630	Eliminated	
Mar 31	3605-14	3617-21	+7-13 ft
July 31	3640	3640	Same

# November-March Gains

- **Gains Prior to 1991 not used in Analysis**
- **New Method for Calculating Gains**
- **Nov-Mar Gain Forecast based on Correlation with Actual April-Oct Gains**

# Trend in Nov-Mar Gains 1968-2000

**Bighorn Lake Nov-Mar Gains  
1968-2000**



# Nov-Mar Release Calculation

- **Water Balance Equation Used to Calculate Nov-Mar Release Rate Based On:**
  - **Nov-Mar Release from Buffalo Bill and Boysen Reservoirs**
  - **Forecasted Nov-Mar River Gains**
  - **Draft Reservoir to near Elevation 3617-3621 by March 31**
  - **Preference to River Flow before reducing releases below 2000 cfs**
  - **Preference to Lake Level before increasing releases above 2500 cfs**
  - **Minimize reductions in River Release.**

# March 31 Reservoir Level Targets

River Release

March 31 Target Elev.

Greater Than 2500 cfs

3620.6

2000-2500 cfs

3618.0

Less Than 2000 cfs

3616.7

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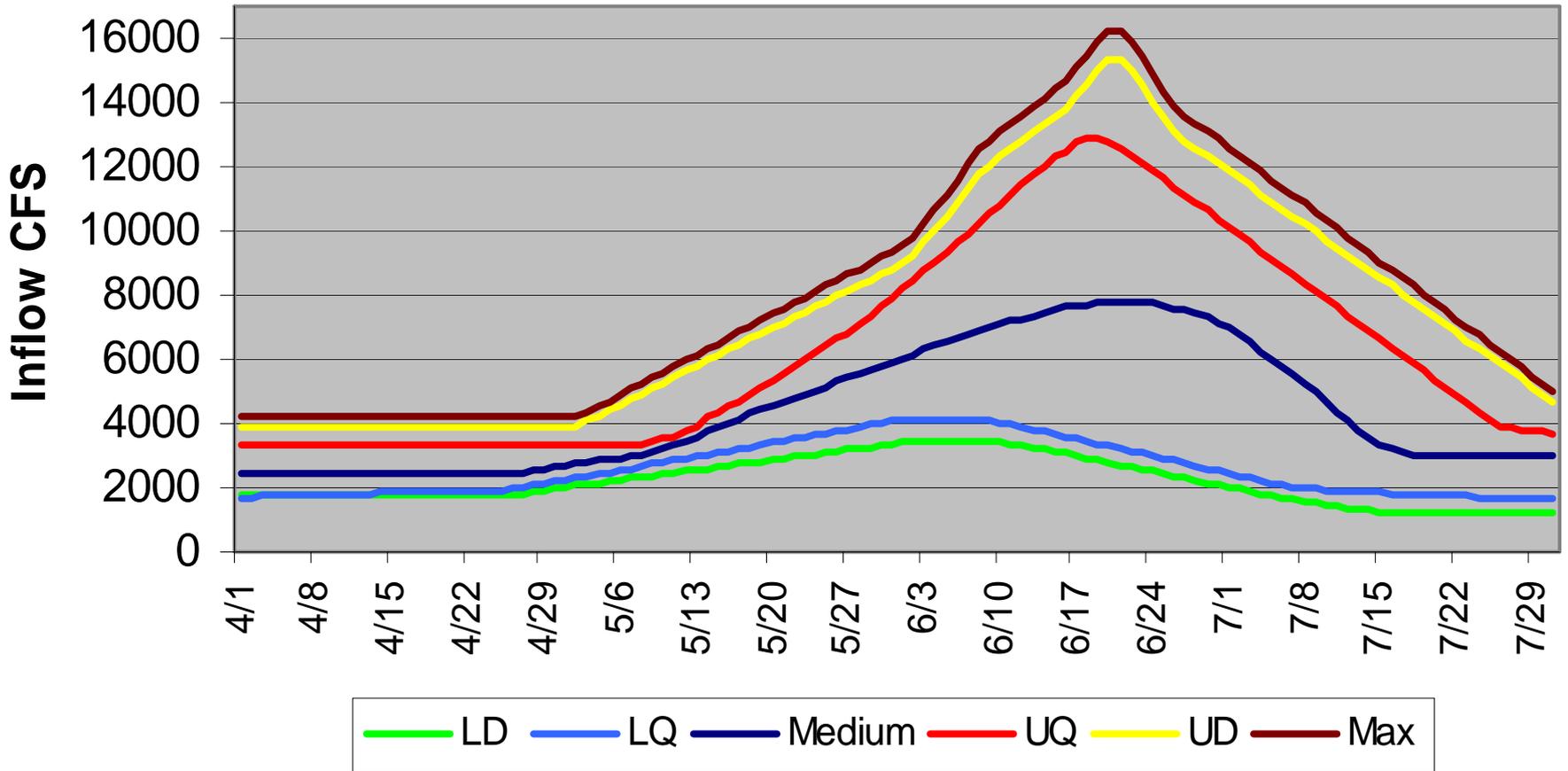
# Operational Rule Curves April-July



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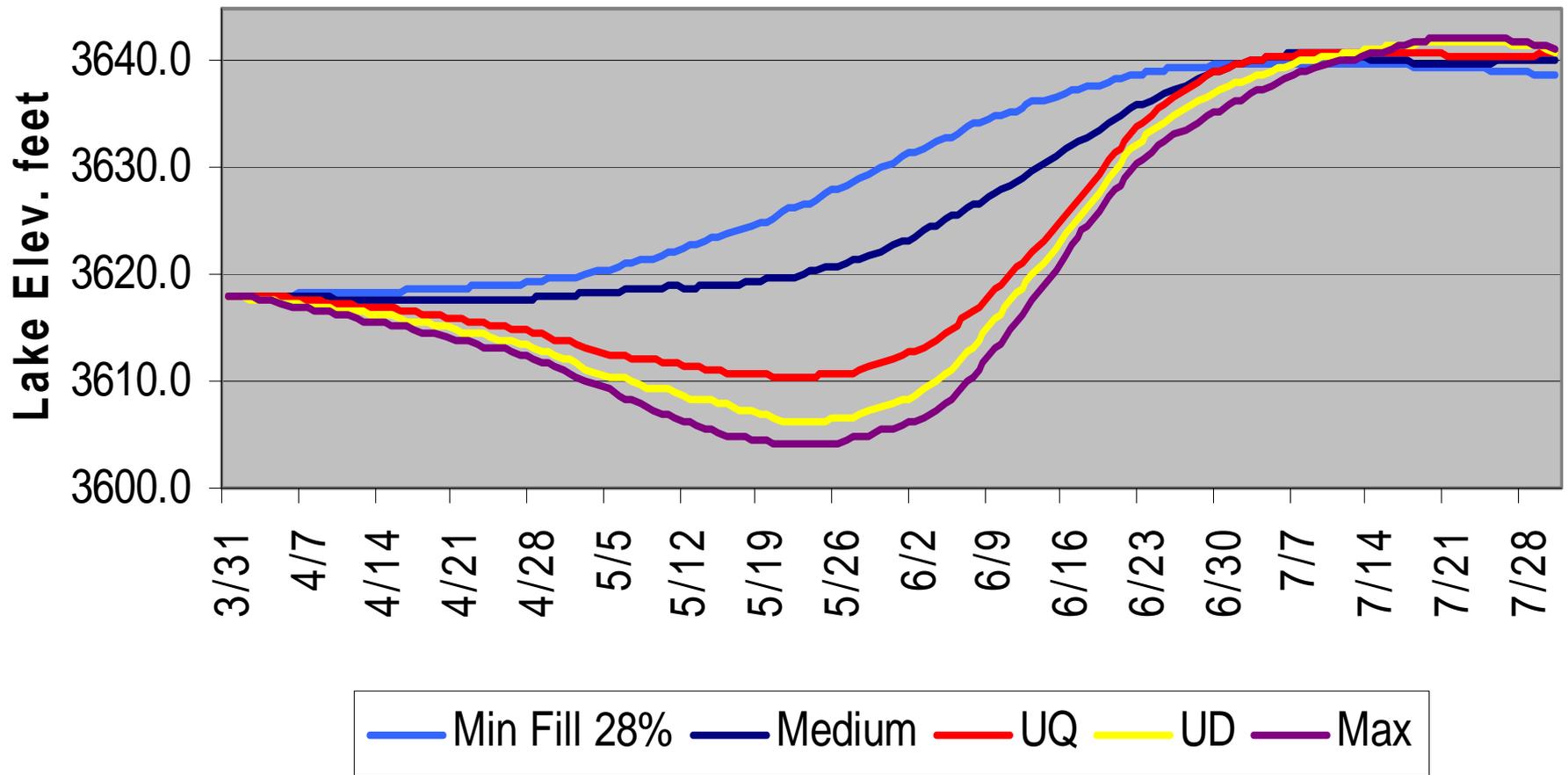
# April-July Inflow Hydrographs

## Bighorn Lake April-July Inflow



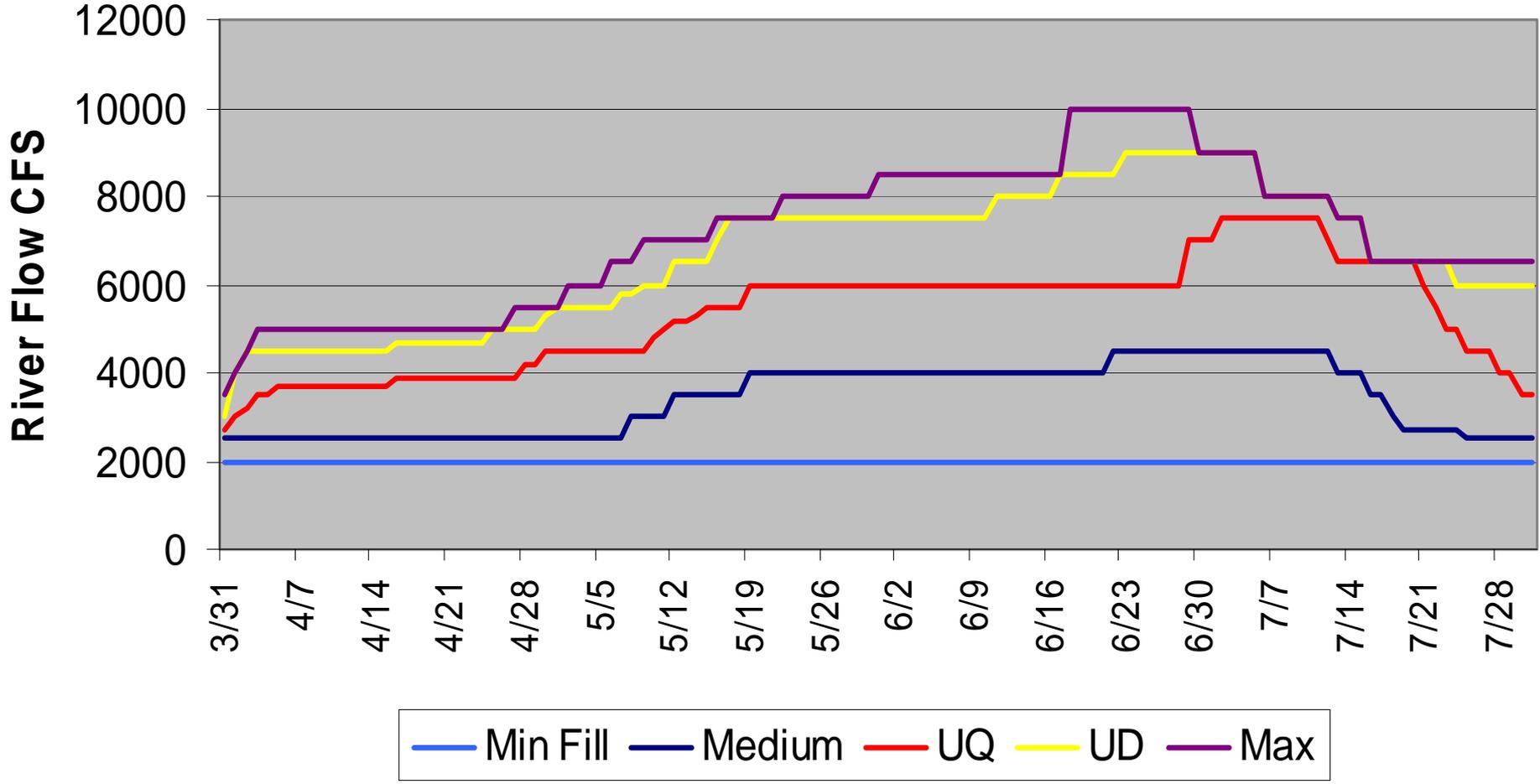
# Bighorn Lake April-July Rule Curves

## Bighorn Lake Rule Curves



# Bighorn Lake River Release

## Bighorn River Release



# RESULTS

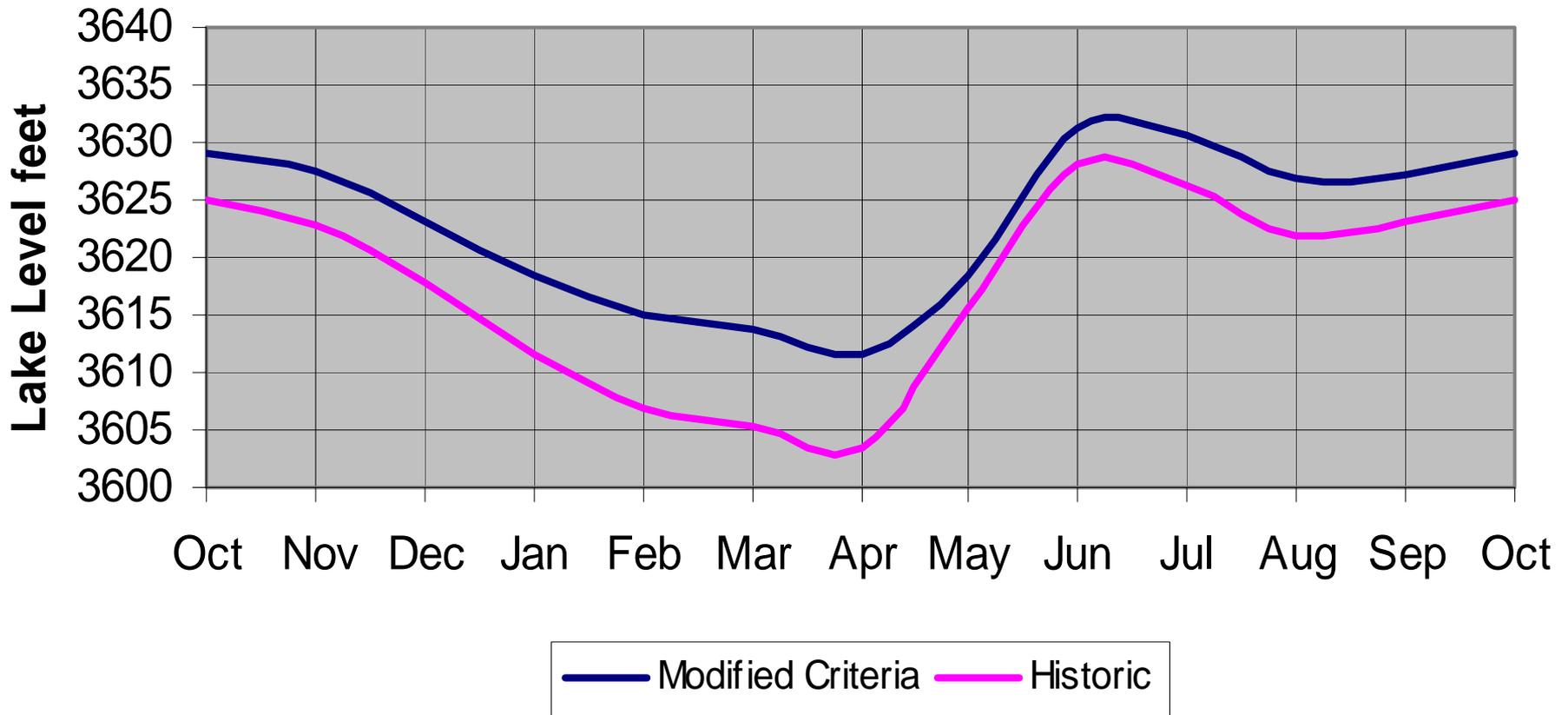
Based on 1988-2008 Model Study



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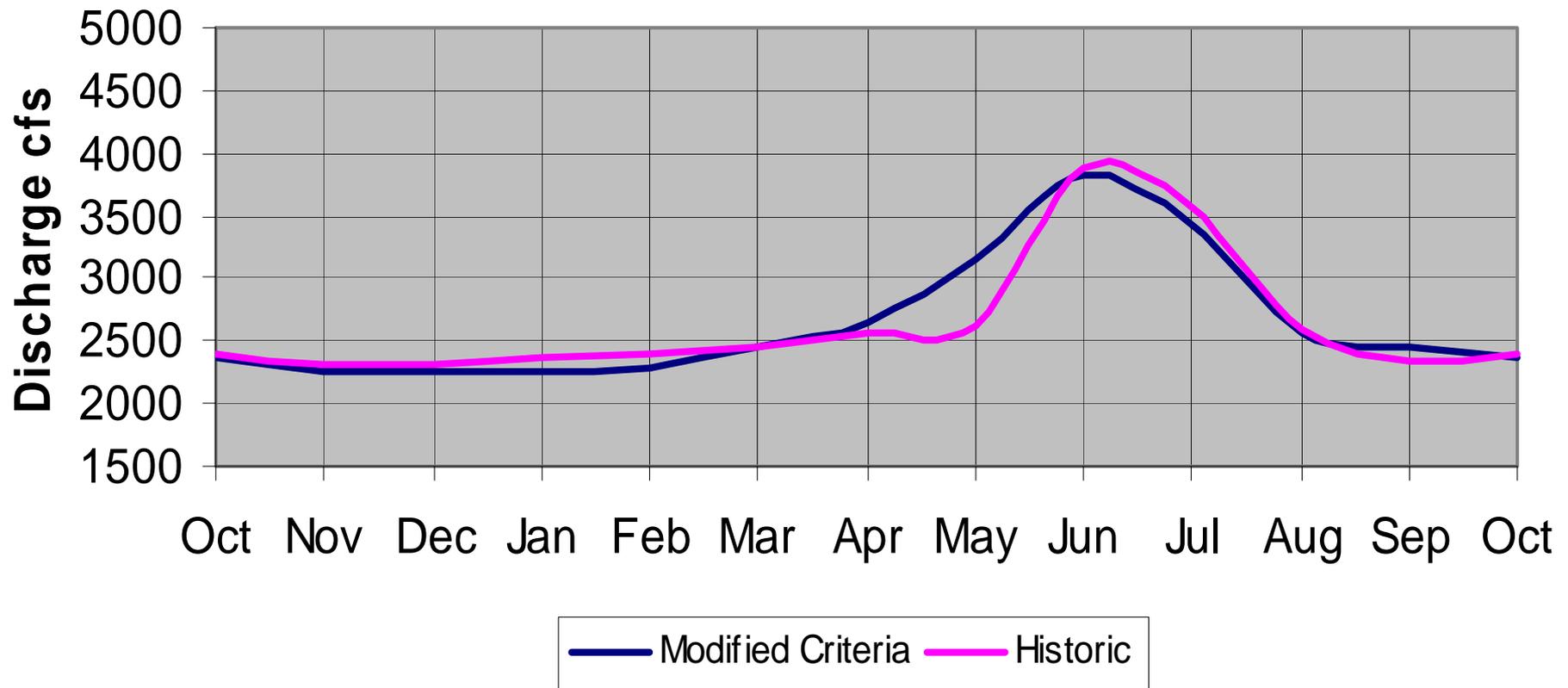
# Results Reservoir Elevation

**Bighorn Lake Elev. Modified Criteria vs. Historic  
1988-2008 Averages**



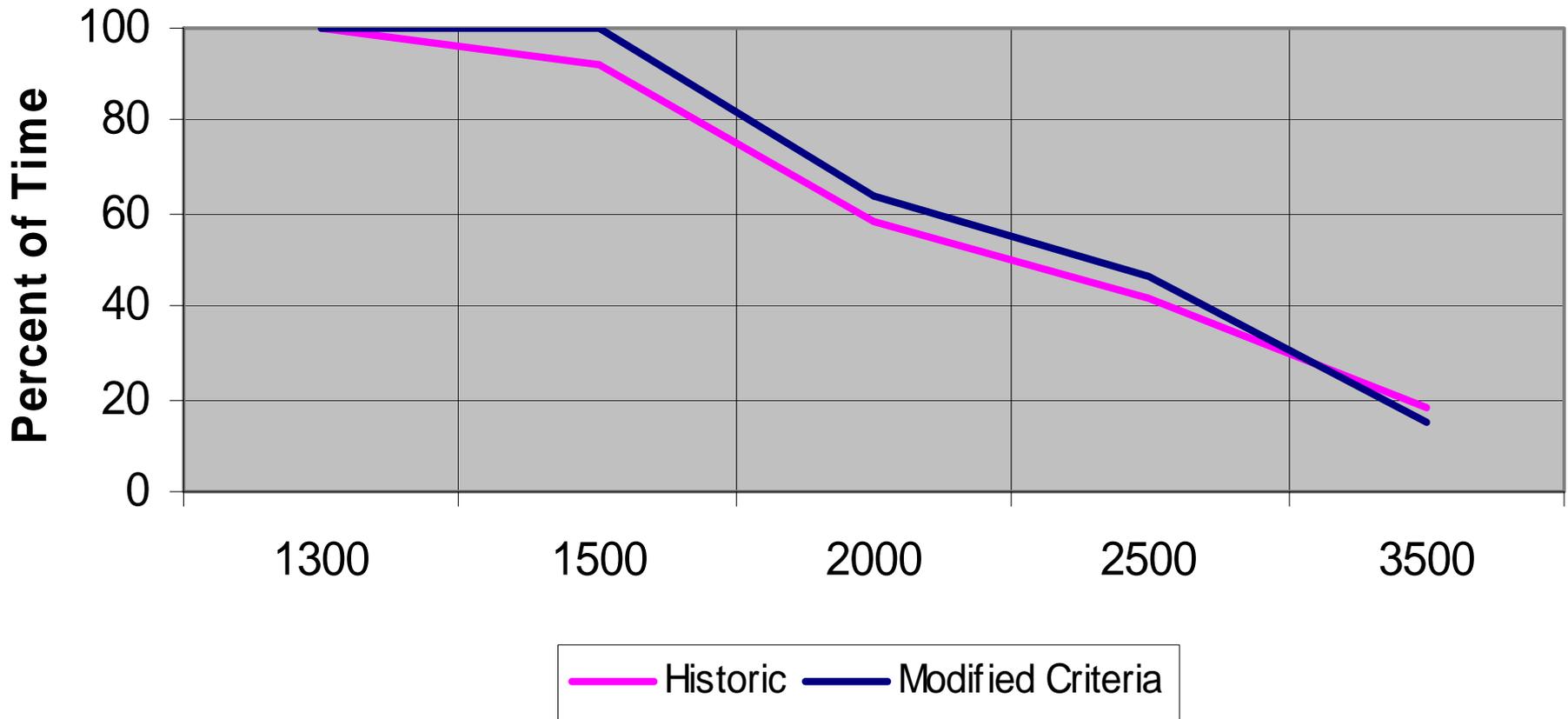
# Results River Flows

**Bighorn River below Afterbay Dam Modified Criteria vs Historic  
1988-2008 Averages**



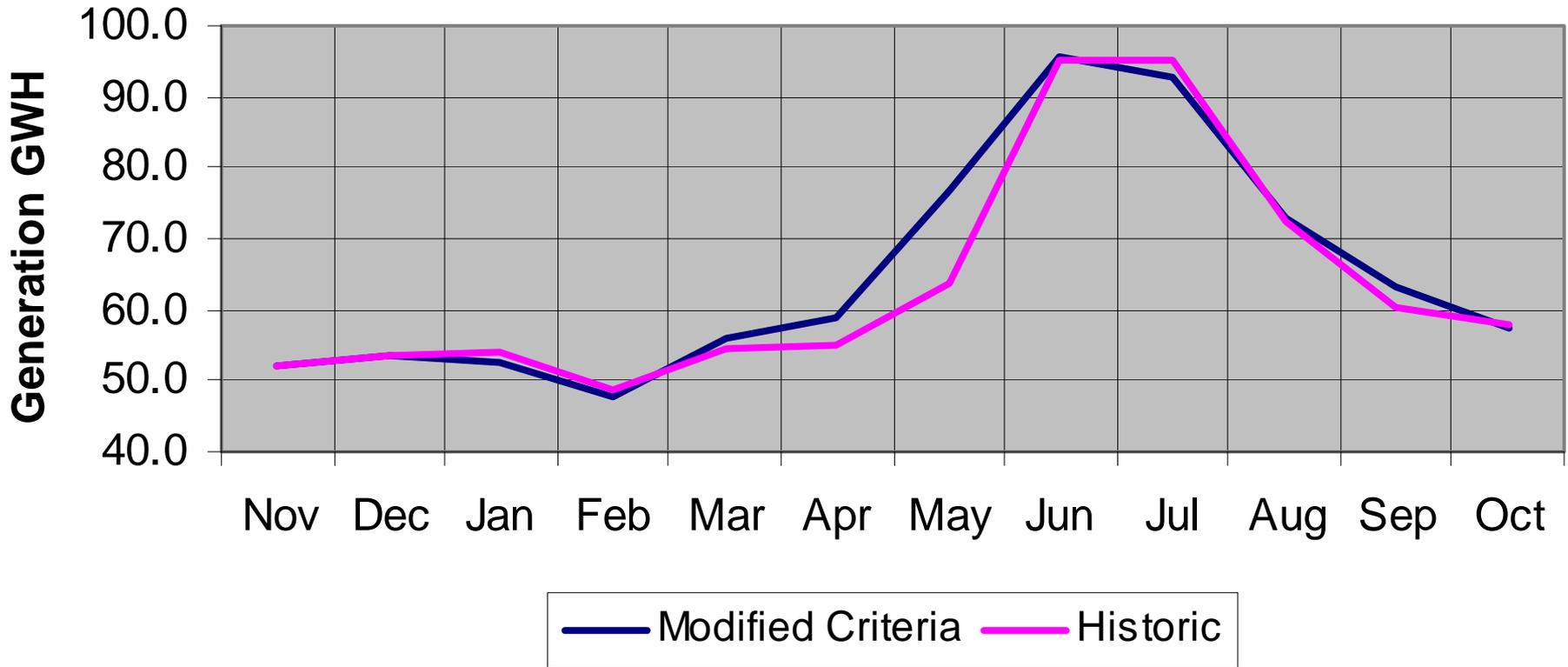
# Percent of Time Fishery Flows are Met

**Bighorn River Fishery Flows 1988-2008**  
**% of of Time above Fishery Flow Targets**



# Power Generation

## Yellowtail Dam Power Generation Modified Criteria vs. Historic 1988-2008



# Power Generation GWHs

<u>Period</u>	<u>Mod Criteria</u>	<u>Historic</u>	<u>Difference</u>
Annual	780.1	762.2	+17.9
Dec-Feb	153.8	156.0	- 2.2
July-Aug	165.7	167.5	- 1.8

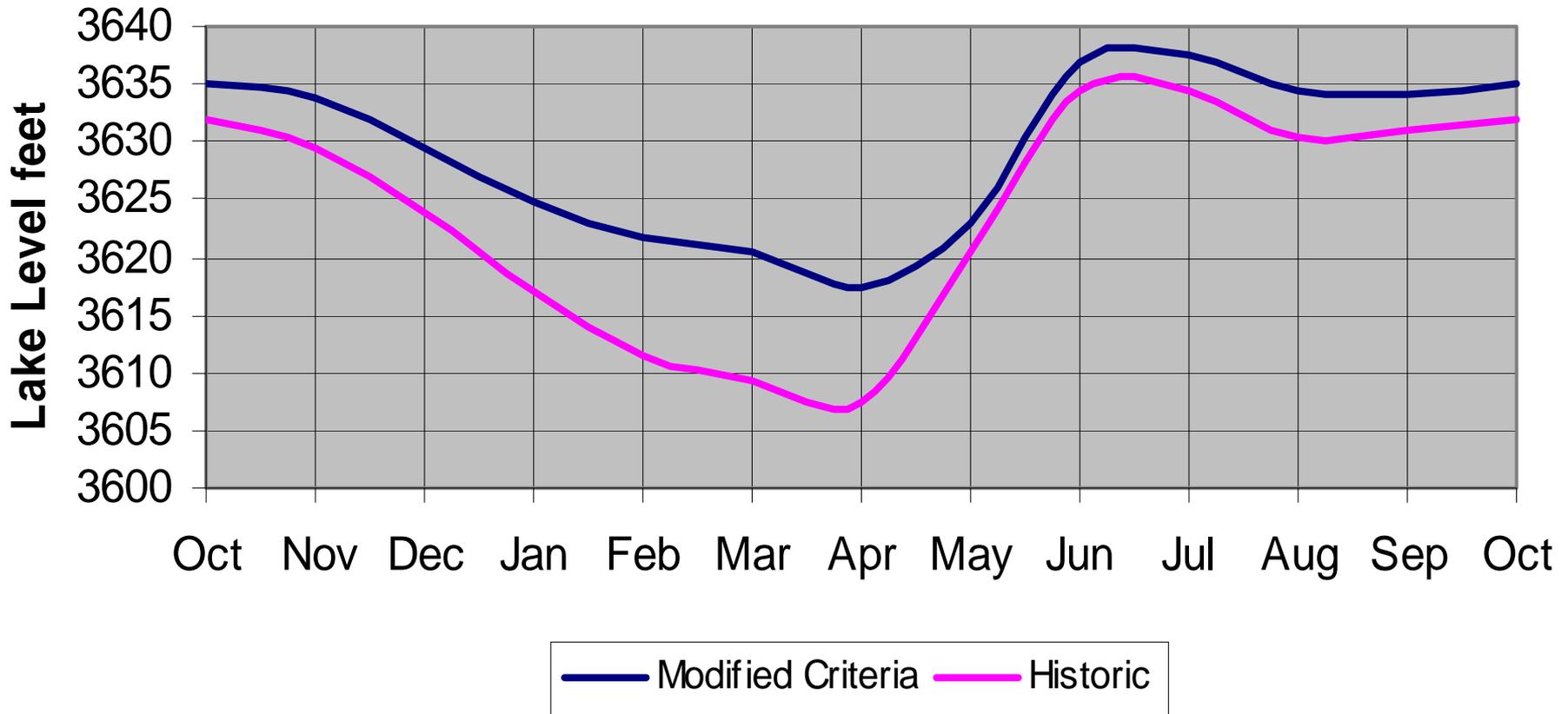
# 1988-2008 Compared to 1967-2008

<u>Period</u>	<u>Average Annual Inflow AF</u>
1988-2008	1,992,619
1967-2008	2,343,002
1988-2008 (w/o 01-07)	2,327,807

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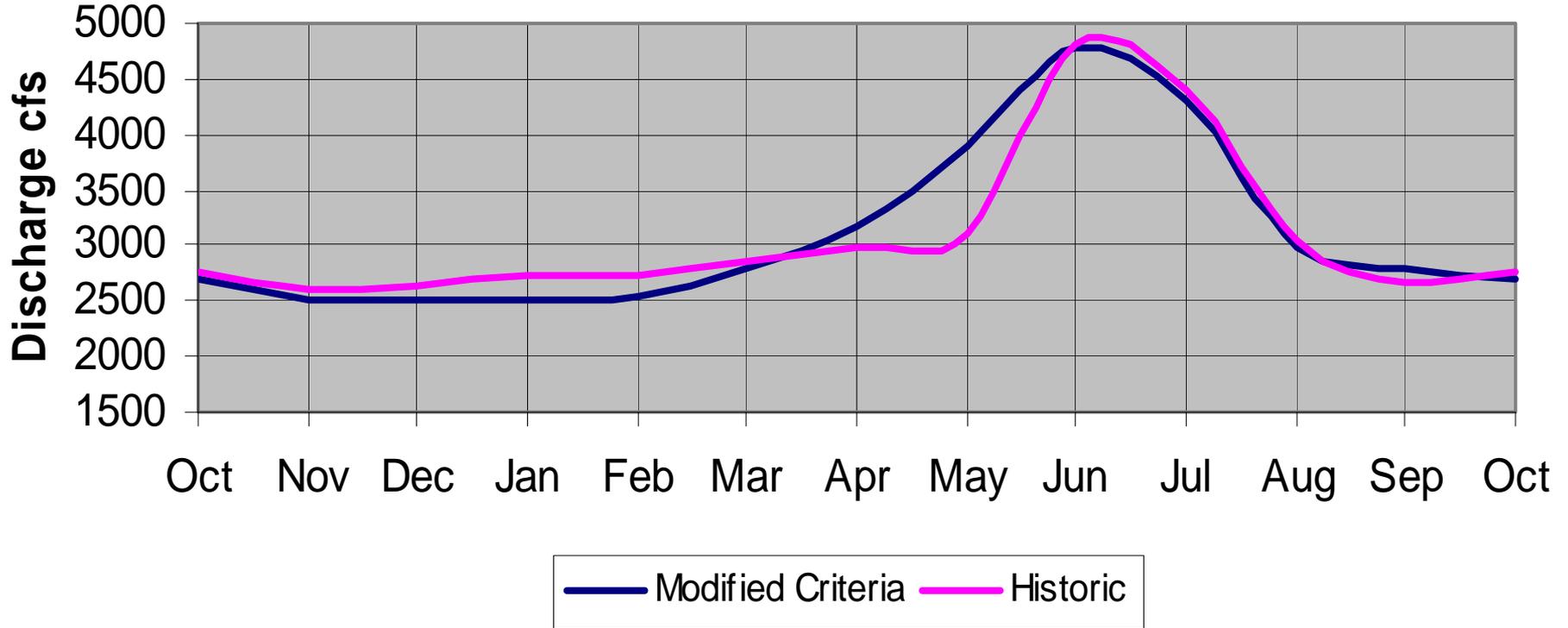
# Results Reservoir Elevation w/o 01-07

**Bighorn Lake Elev. Modified Criteria vs. Historic  
1988-2008 (w/o 01-07) Averages**



# Results River Flows w/o 01-07

Bighorn River below Afterbay Dam Modified Criteria vs Historic  
1988-2008 Averages (w/o 01-07)



# Results – Summary

## 1988-2008 Study Period

- **Lake Levels**
  - Jan-April      7-8 feet higher
  - May-June        3 feet higher
  - July-Dec        4-5 feet higher
- **River Flows**
  - 1,500 cfs    + 8% of time, met 100% of time for study period
  - 2,000 cfs    + 5% of time
  - 2,500 cfs    + 5% of time
  - 3,500 cfs    - 3% of time
- **Power Generation +2% increase**
- **Flood Control – Slight Improvement**

# Comparisons for 2009



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**2009**

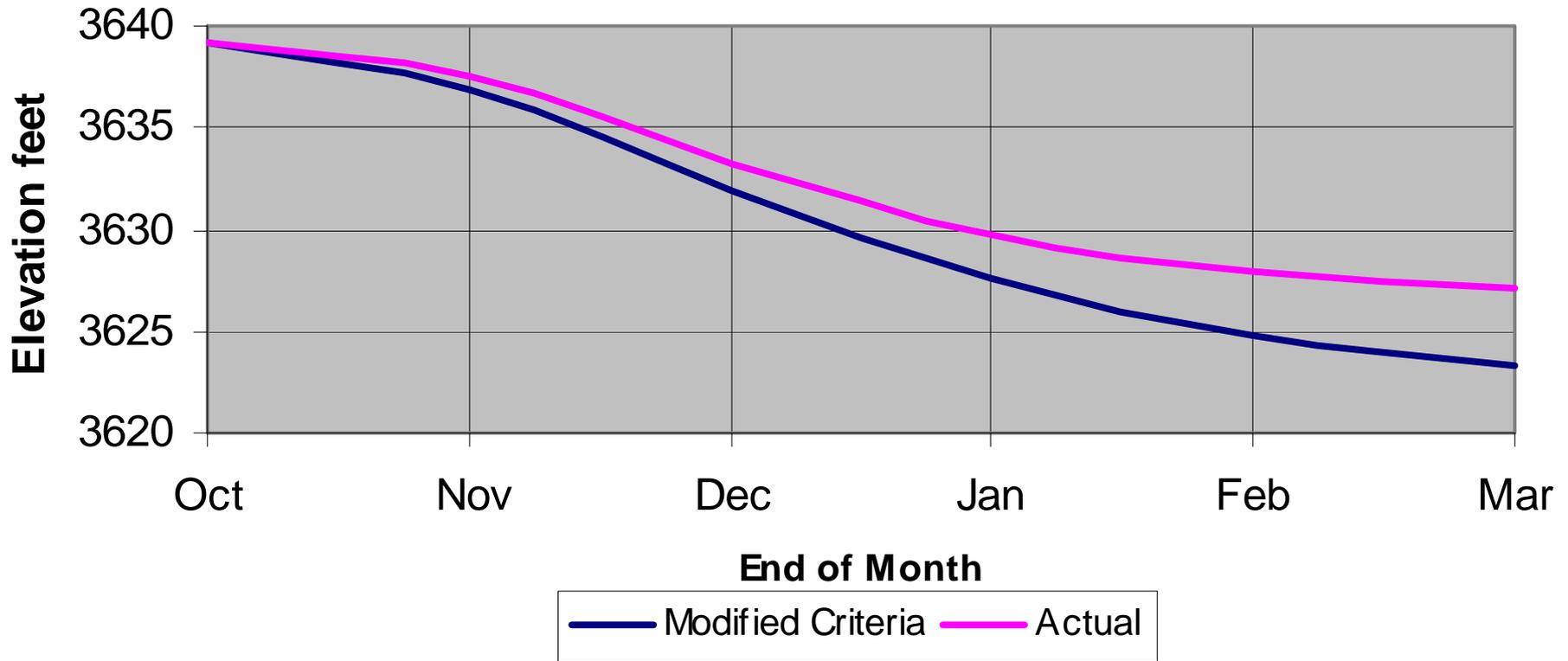
# **Bighorn Lake Nov-Mar River Release**

	<u>River Release</u>	<u>End of March Lake Elevation</u>
<b>Revised Criteria</b>	<b>2546 cfs</b>	<b>3623 ft</b>
<b>Actual</b>	<b>2450 cfs</b>	<b>3627 ft</b>
<b>Difference</b>	<b>+96 cfs</b>	<b>- 4 ft</b>

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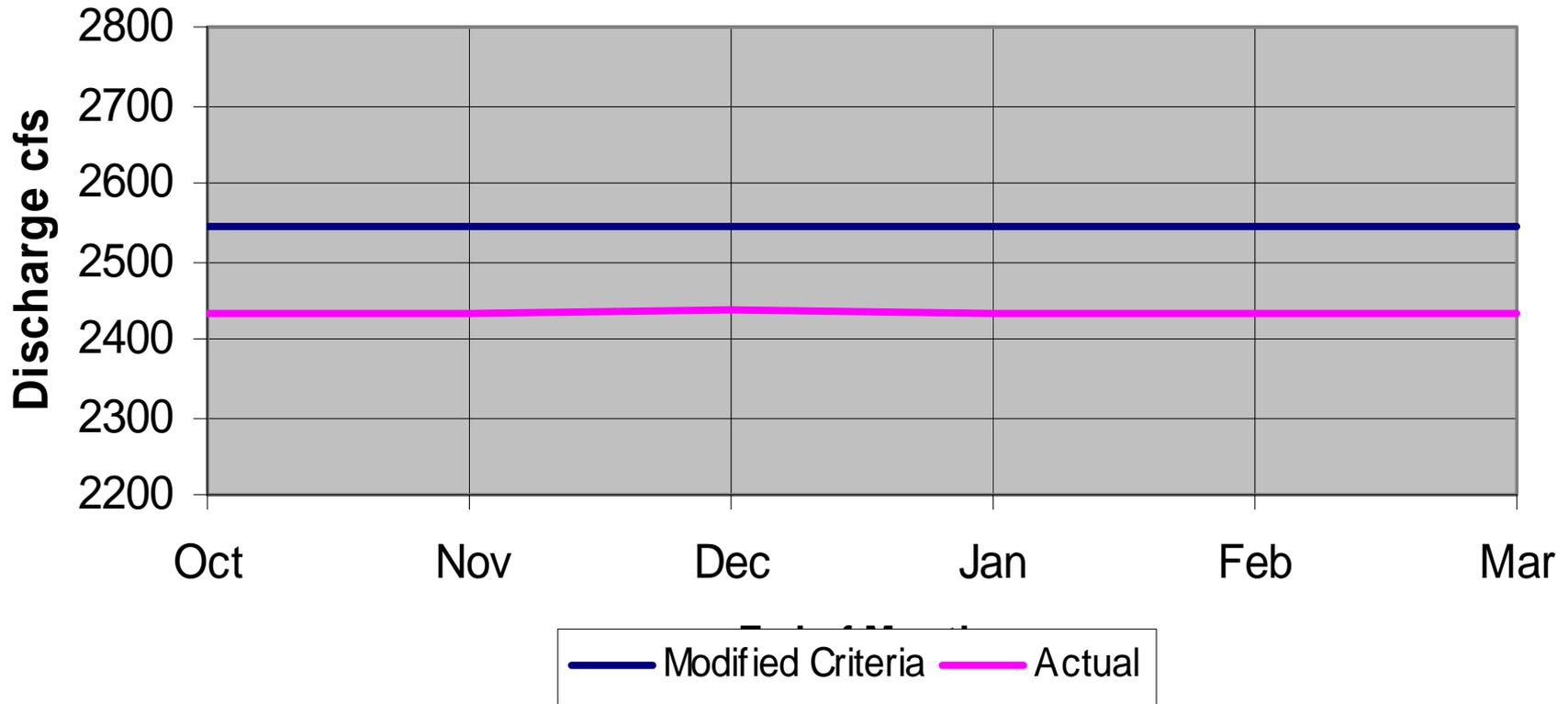
# Bighorn Lake Proposed Criteria vs. Actual 2009

**Bighorn Lake Elevation 2009  
Modified Criteria vs. Actual**



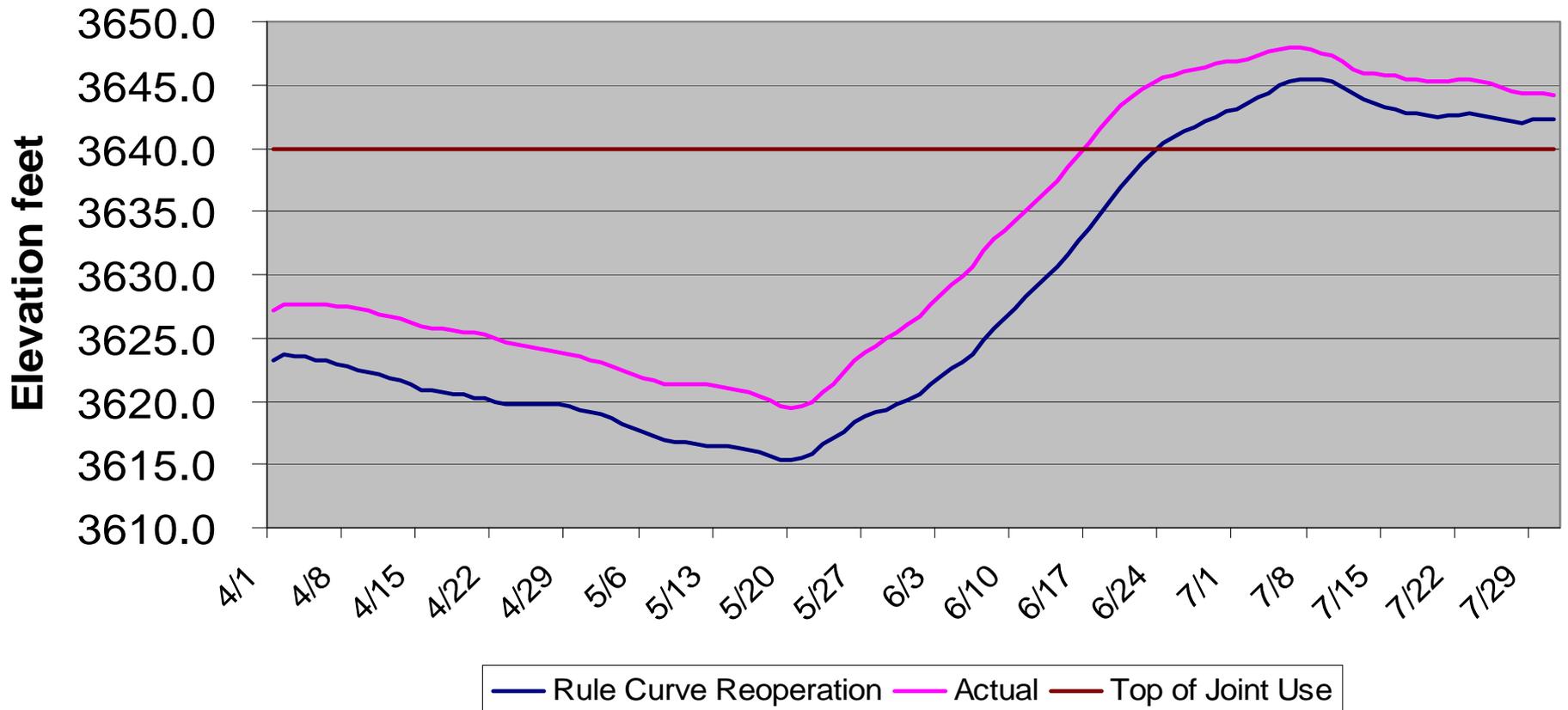
# Bighorn River Proposed Criteria vs Actual 2009

**Bighorn River Flow 2009  
Modified Criteria vs. Actual**



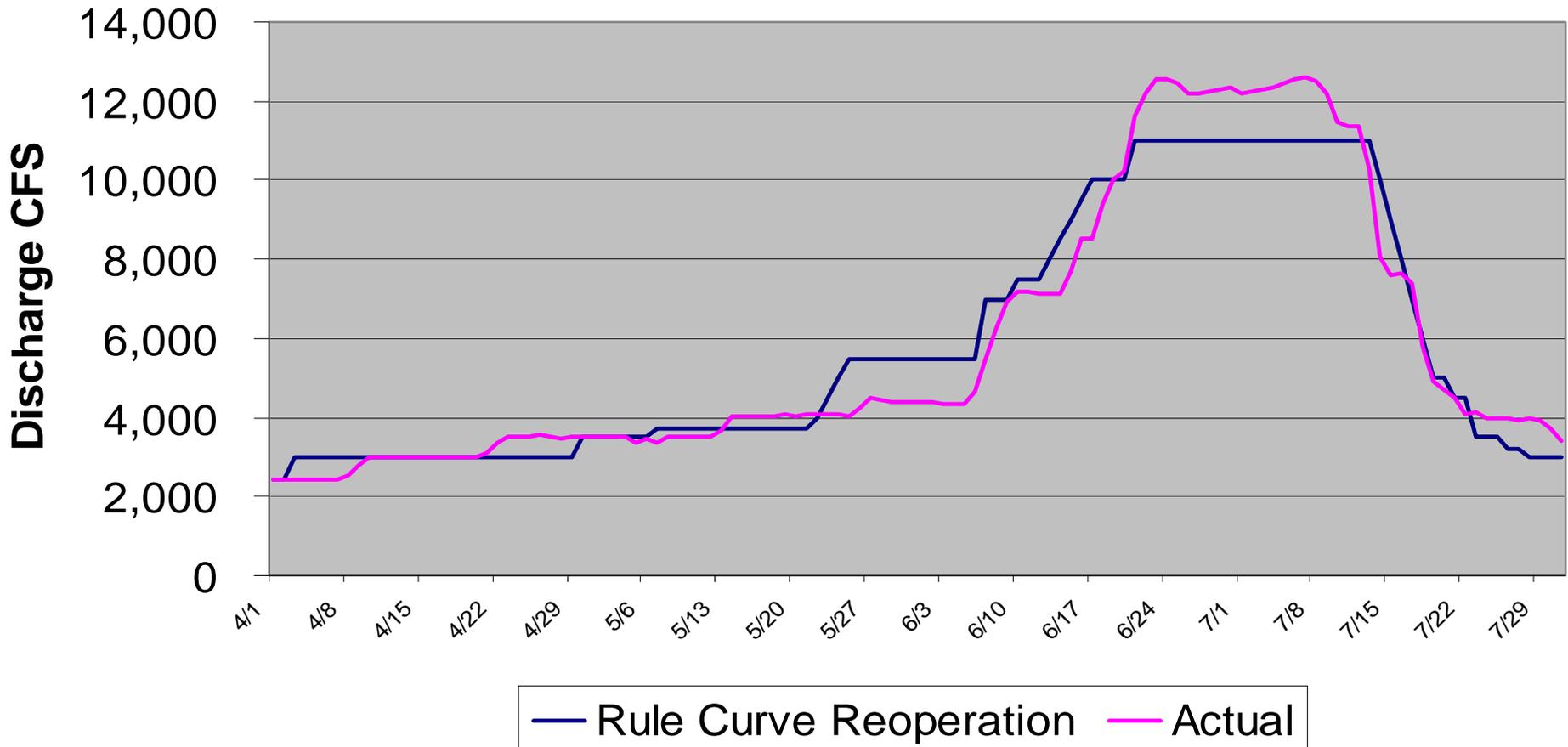
# Bighorn Lake Elevation April- July 2009

Bighorn Lake Rule Curve vs Actual Operation 2009



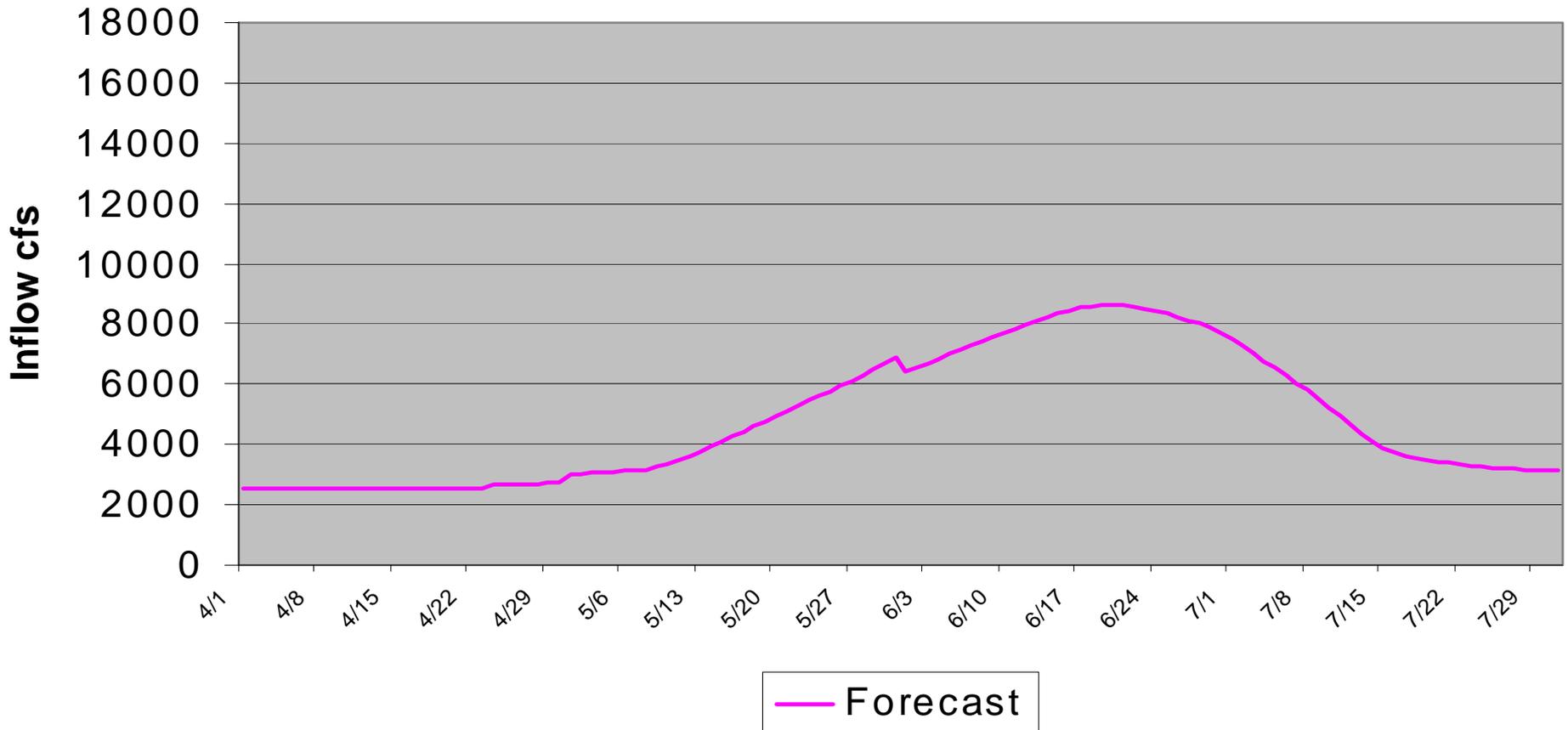
# Bighorn River April-July 2009

## Bighorn Lake Rule Curve Operation vs Actual 2009



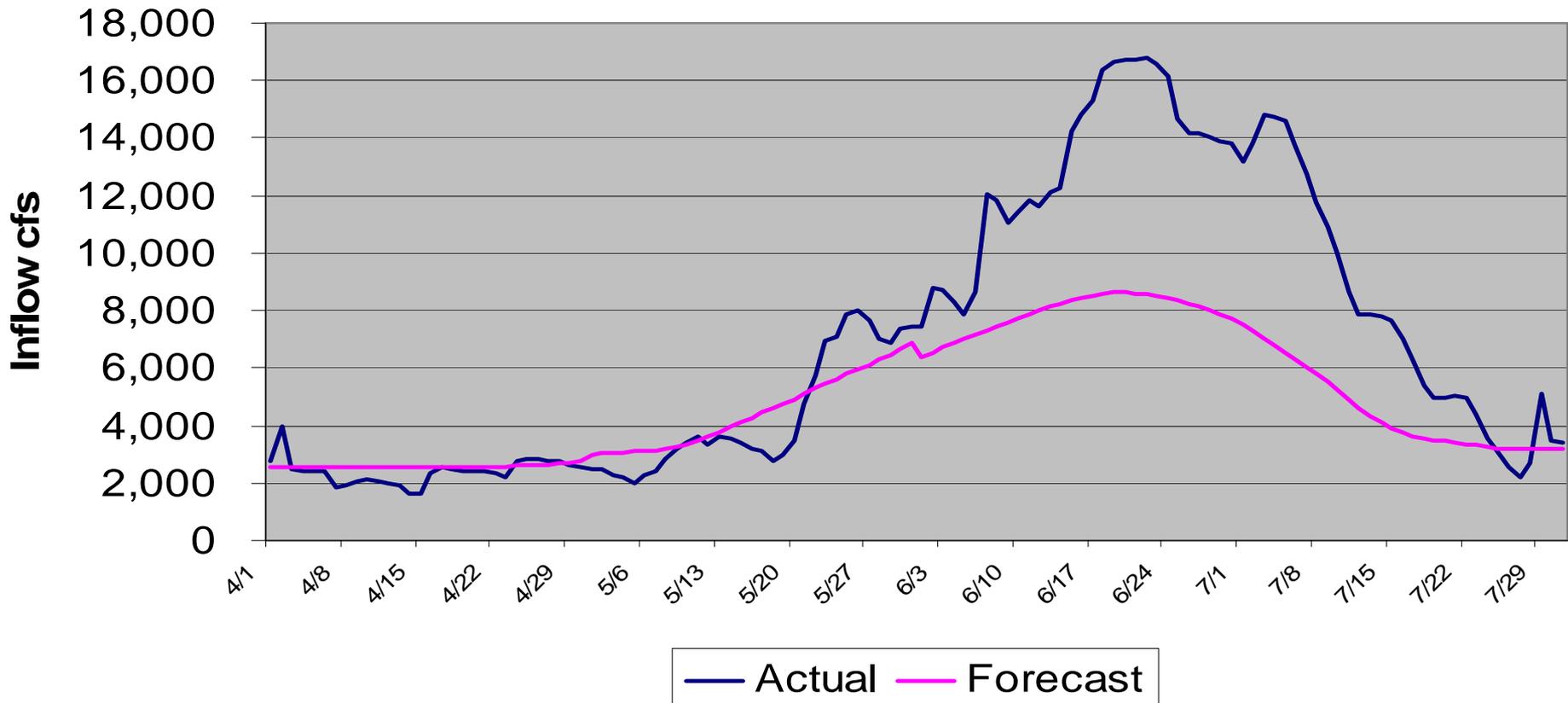
# Bighorn Lake Forecasted Apr-July Inflow

## Bighorn Lake Inflow April-July 2009



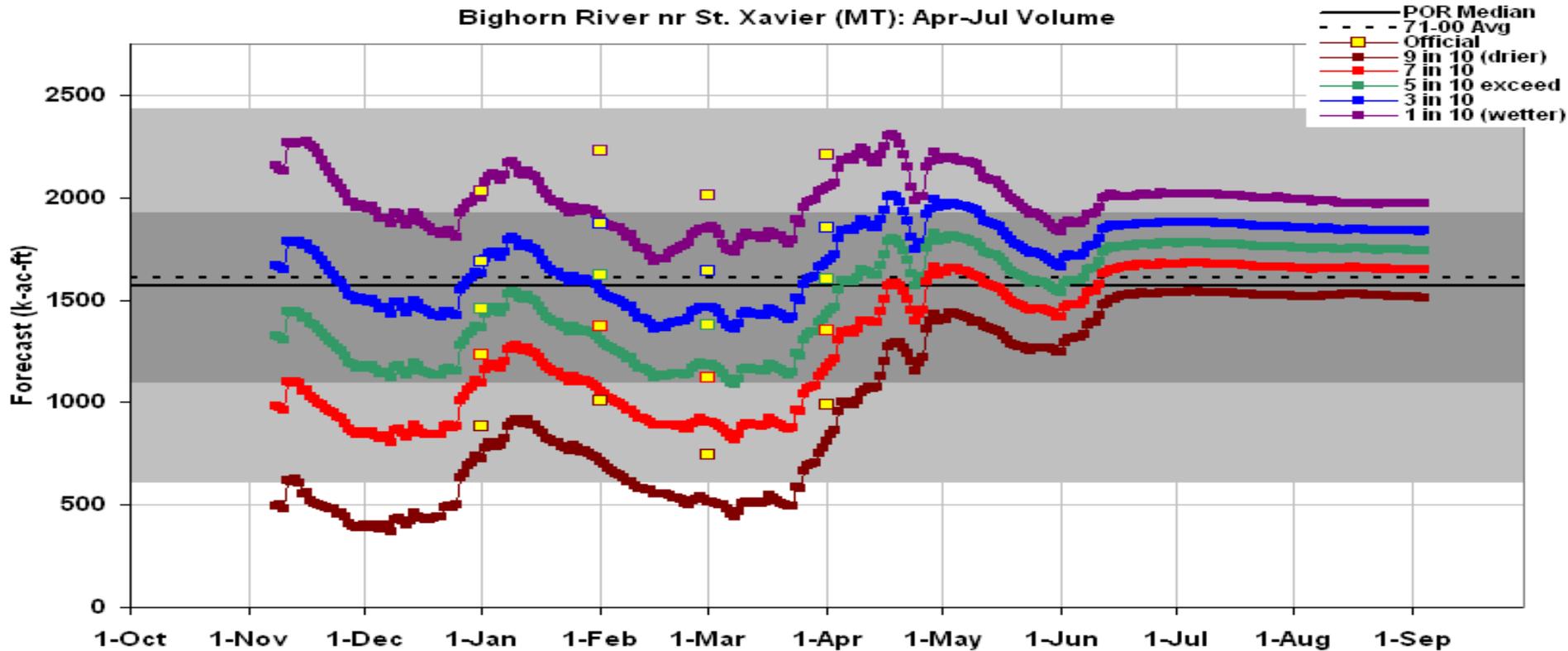
# Bighorn Lake April-July Inflow Forecasted vs Actual

## Bighorn Lake Inflow April-July 2009



# NRCS Apr-July Forecast

Bighorn River nr St. Xavier (MT): Apr-Jul Volume



This is an automated product based solely on SNOTEL data, provisional data are subject to change.

This product is a statistically based guidance forecast combining indices of snowpack and precipitation.

**Yellow squares** are the official outlooks. **Gray background** is the historical period of record variability.

This product does not consider climate information such as El Niño or short range weather forecasts, or

a variety of other factors considered in the official forecasts. This product is not meant to replace

or supersede the official forecasts produced in coordination with the National Weather Service.

Science Contact: [Jim.Marron@por.usda.gov](mailto:Jim.Marron@por.usda.gov) [www.wcc.nrcs.usda.gov/wsf/daily\\_forecasts.html](http://www.wcc.nrcs.usda.gov/wsf/daily_forecasts.html)

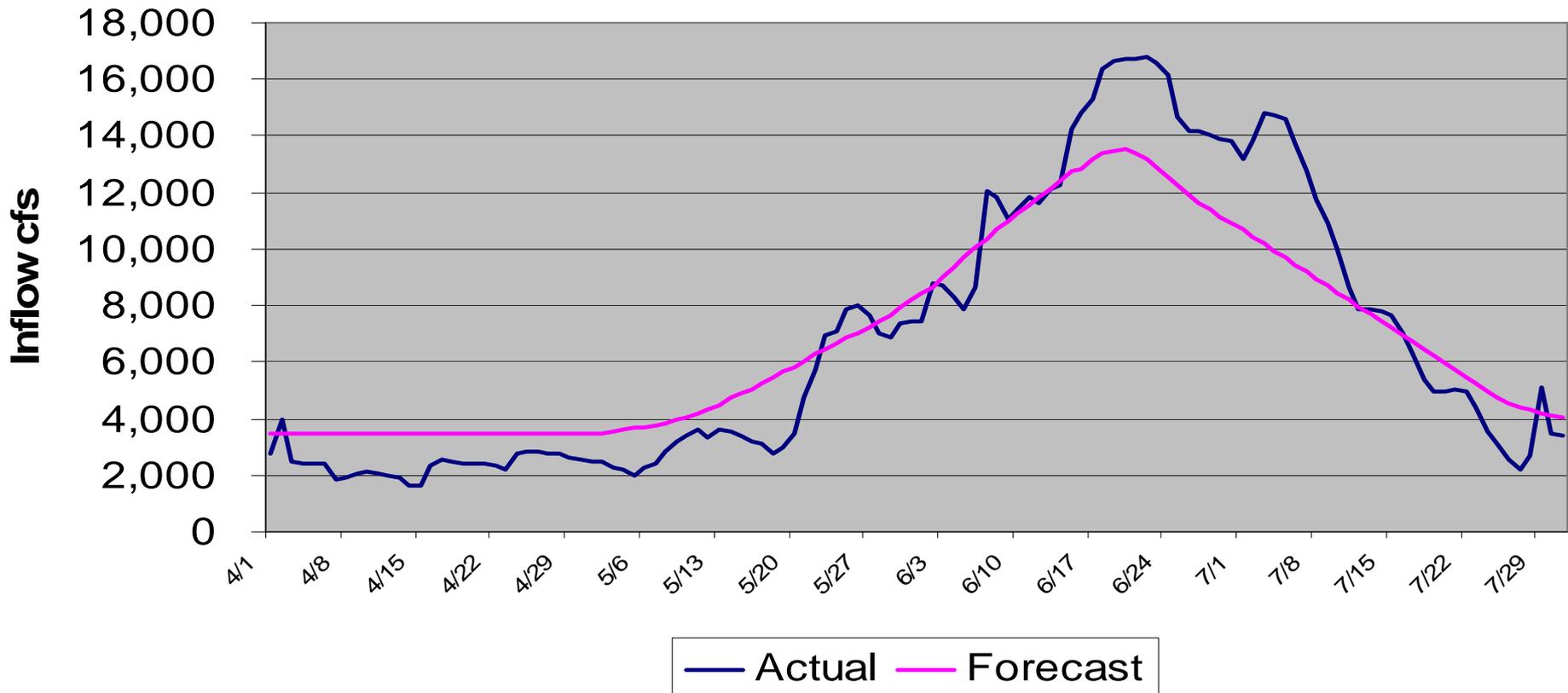
Created 6:52 Sep 4 2009



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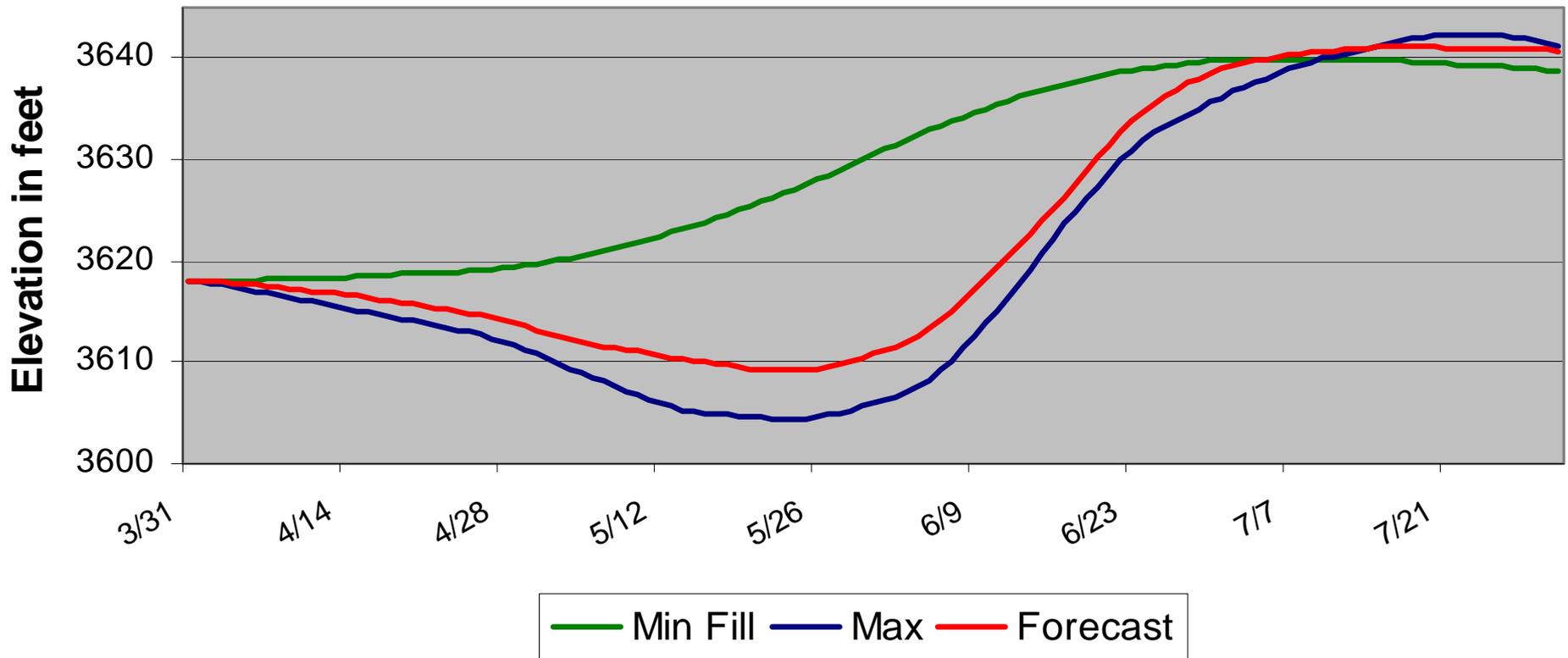
# Rule Curve Inflow vs Actual 2009

## Bighorn Lake Inflow April-July 2009



# 2009 Rule Curve using Actual Inflow

**Bighorn Lake Elevation  
for Forecast A-J Inflow with Rule Curves**



# LOOKING AHEAD TO 2010



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# River Release Nov-Mar 2010

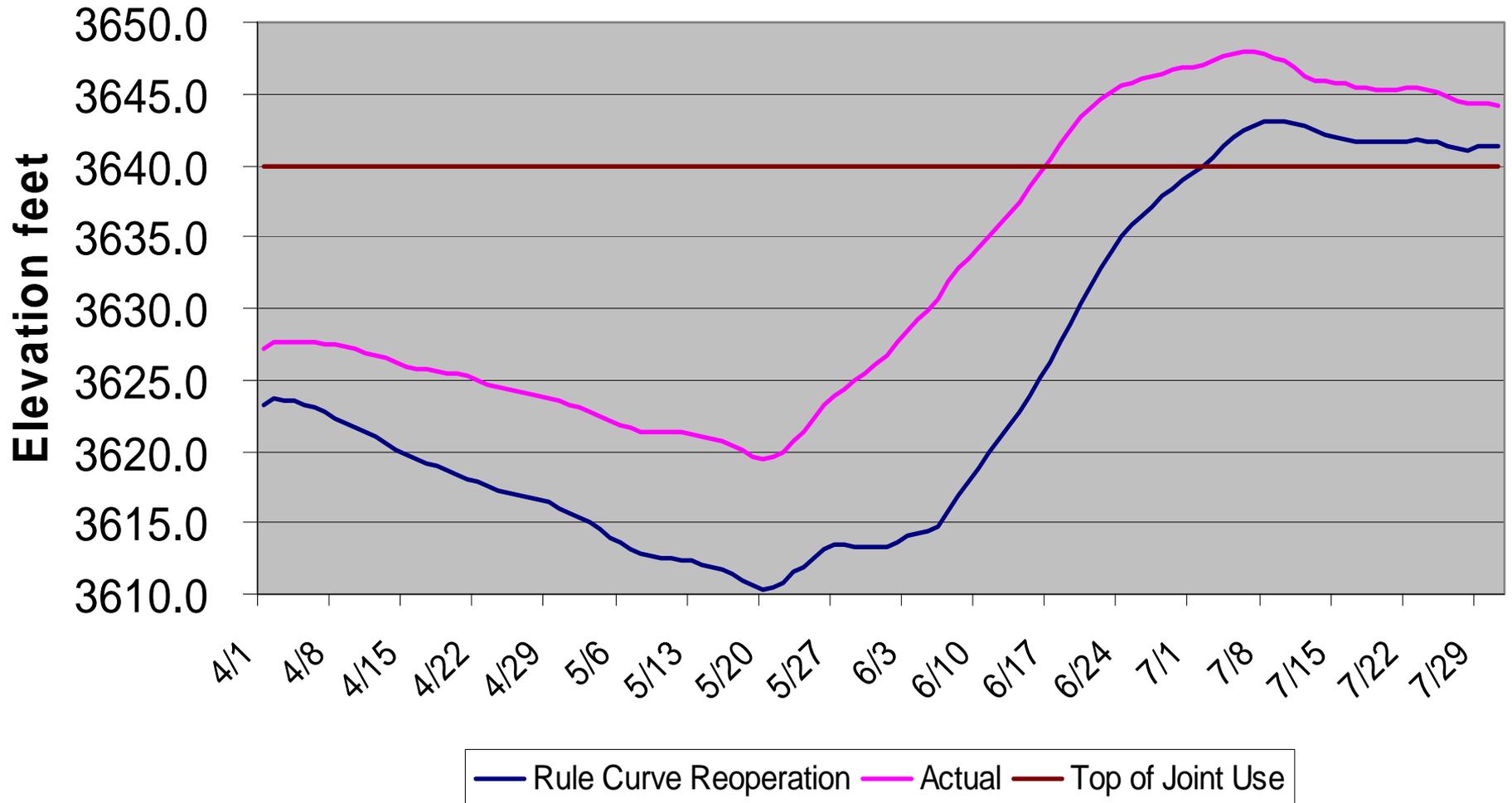
- Planned Boysen Release - 900 cfs
- Planned Buffalo Bill Release – 390 cfs
- Forecasted Nov-Mar Gains - 244,000 acre-feet
- End of Oct. Lake Level – 3638-3639 ft
- Calculated River Release Rate - **2700-2800 cfs**
- Expected End of March Lake Elev. - **3620.6 ft**

# Discussion & Questions

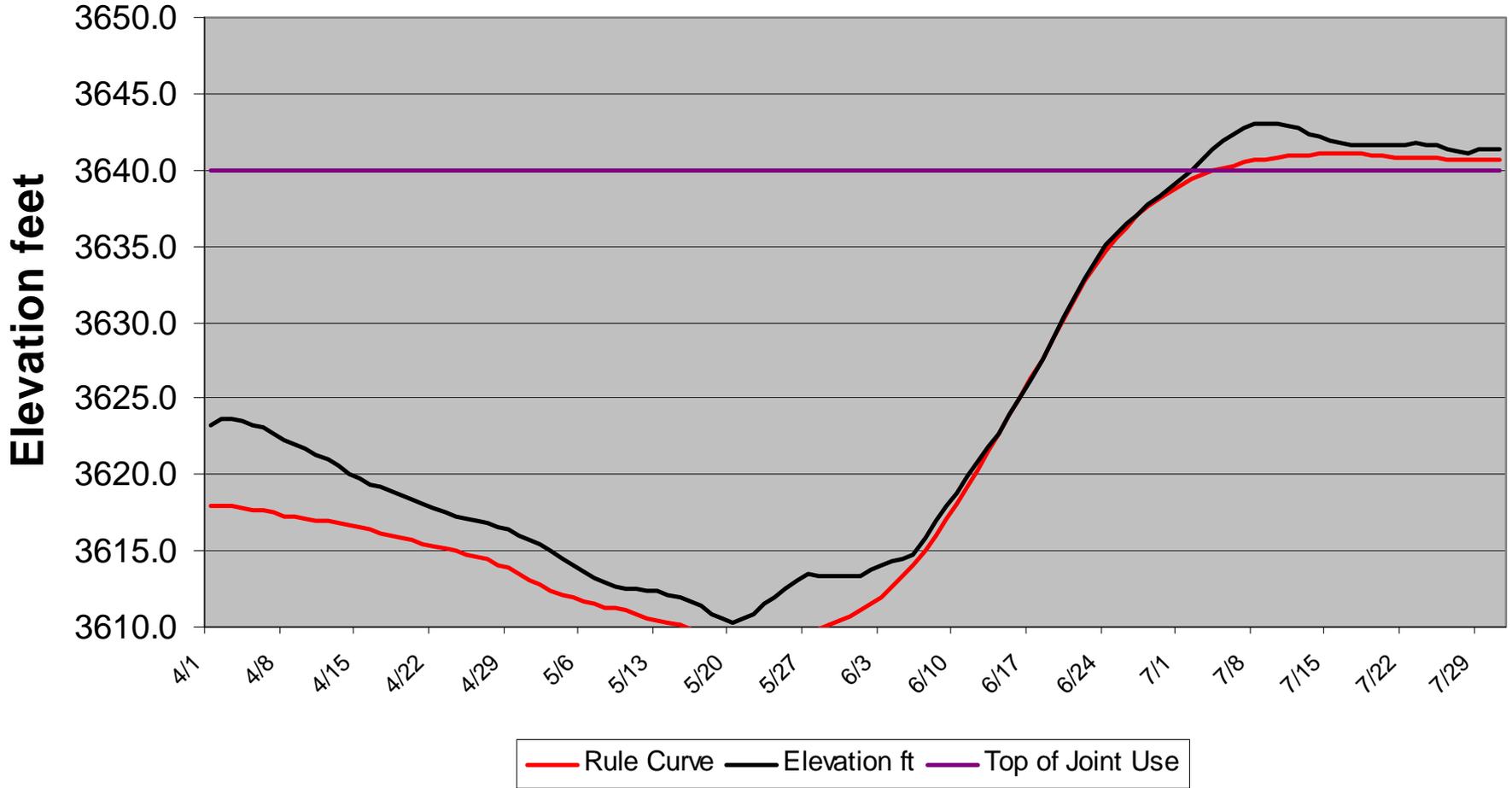


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## Bighorn Lake Rule Curve vs Actual Operation 2009



# Bighorn Lake Rule Curve Operation 2009



# Bighorn Lake Rule Curve vs Actual Operation 2009

