

RECLAMATION

Managing Water in the West

Yellowtail Dam & Bighorn Lake

Fort Smith, Montana

April 12, 2007

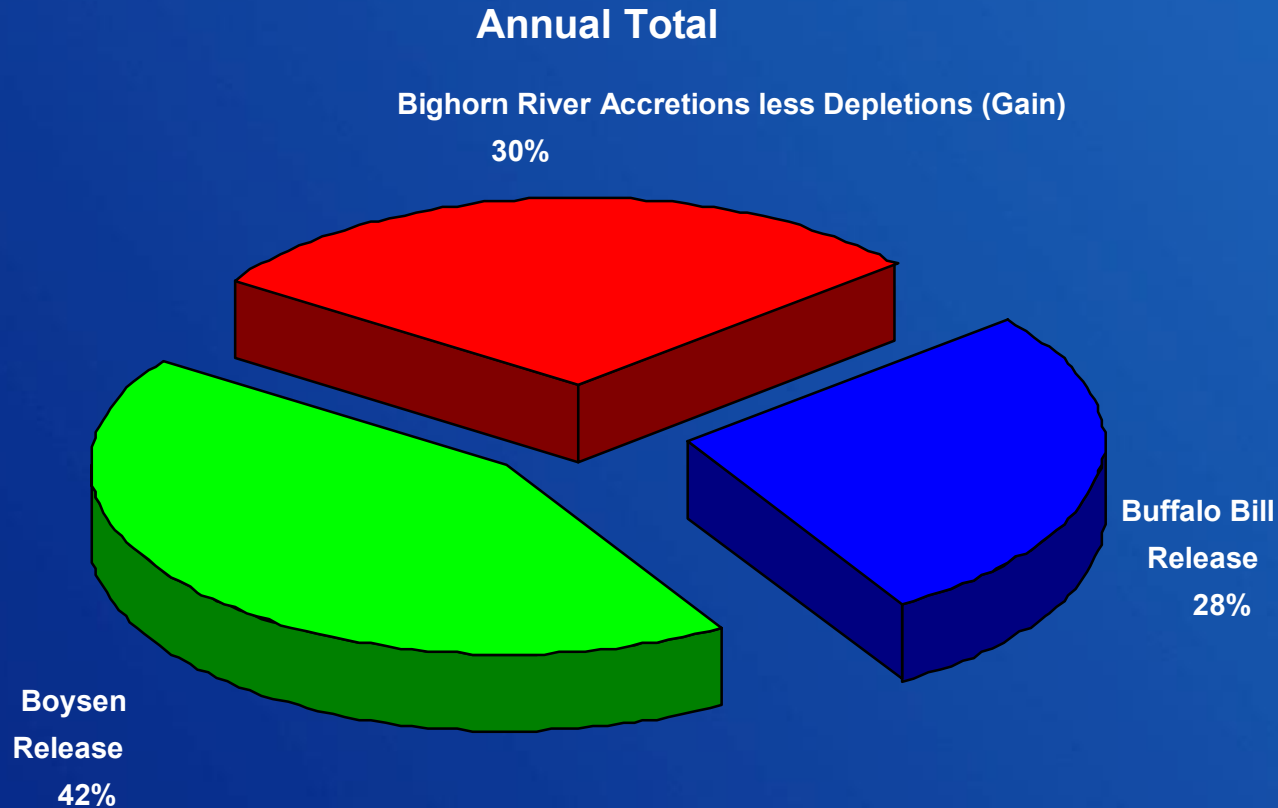
Operating Requirements & Objectives

- **Mandatory /Legal**
 - Recognize all Senior Downstream Water Rights
 - Fulfill Compact obligation with Native American Tribes
 - Meet Contract Commitments for Stored Water
 - Dam Safety
- **Operating Objectives**
 - Maximize Power Generation Benefit
 - Maintain Storage Space for Flood Control
 - Maintain desired Lake levels for Recreation, Reservoir Fishery and Waterfowl
 - Maintain desired River Flow levels for the River Fishery and water quality

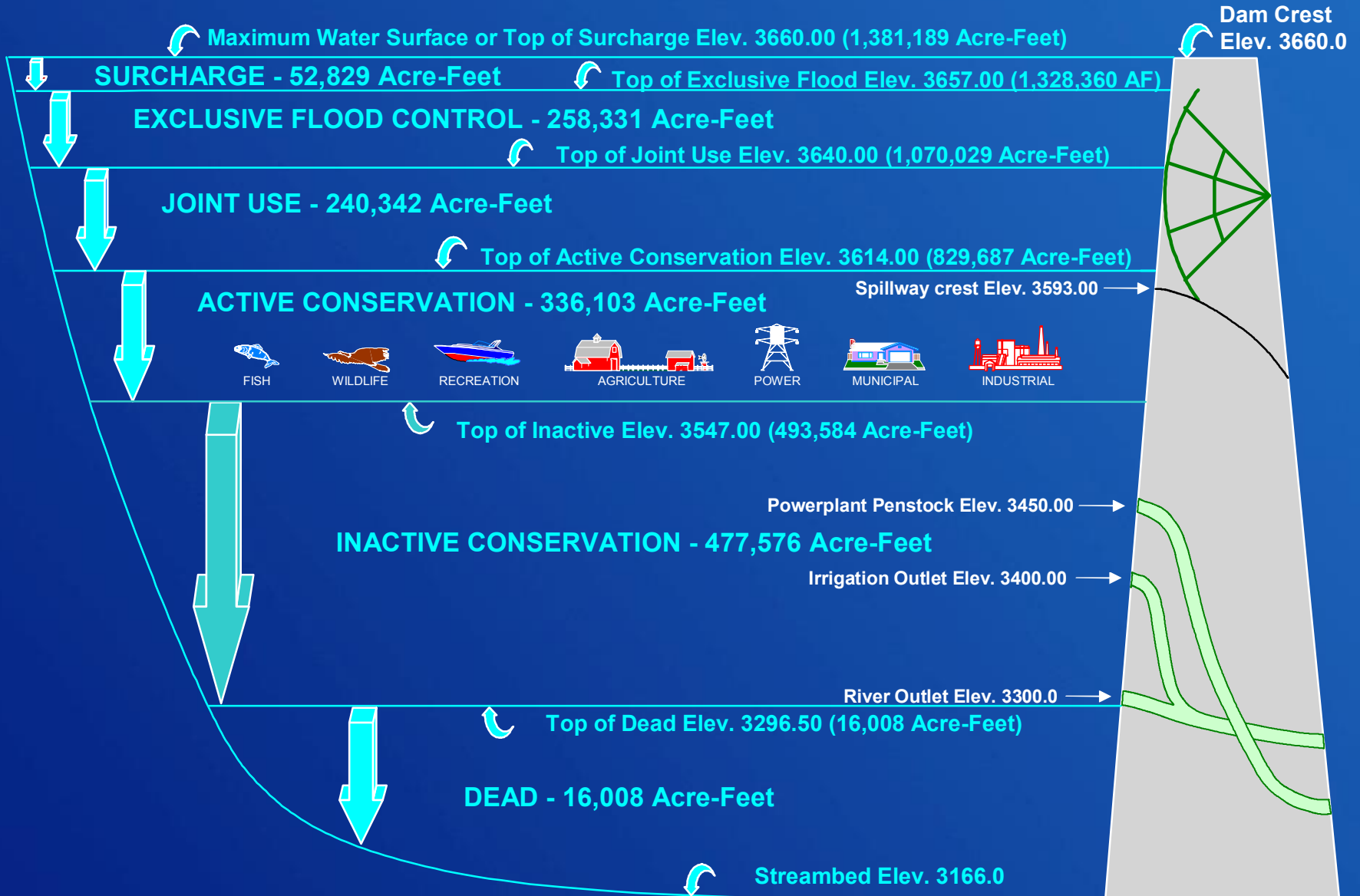
Multipurpose Benefits

- **Water Rights**
 - Regulate stream flow and release water for irrigation
- **Compact Commitments with N. Cheyenne and Crow tribes**
- **Industrial water supply**
 - 6,000 AF contract with PPL- MT
- **Flood control**
 - Flood protection = \$27.5 million in 1997
- **Hydropower**
 - 260 MW powerplant (8,000 cfs)
 - Peaking power supplied to two grid systems
 - Annual generation = 879.0 million kWhrs (1967-2006)
 - Annual power sales @ .023/kwhr = \$20.3 million in annual revenue
 - Montana and Wyoming both benefit from power generated
- **Fish & Wildlife**
 - Lake fishery, river fishery, and waterfowl
- **Recreation**
 - Bighorn Canyon Recreation Area and Bighorn River
- **Water Quality**
 - Reduce high levels of nitrogen supersaturation
 - Sediment retention

Bighorn Lake Inflow Distribution Based on 1967-2006 Data

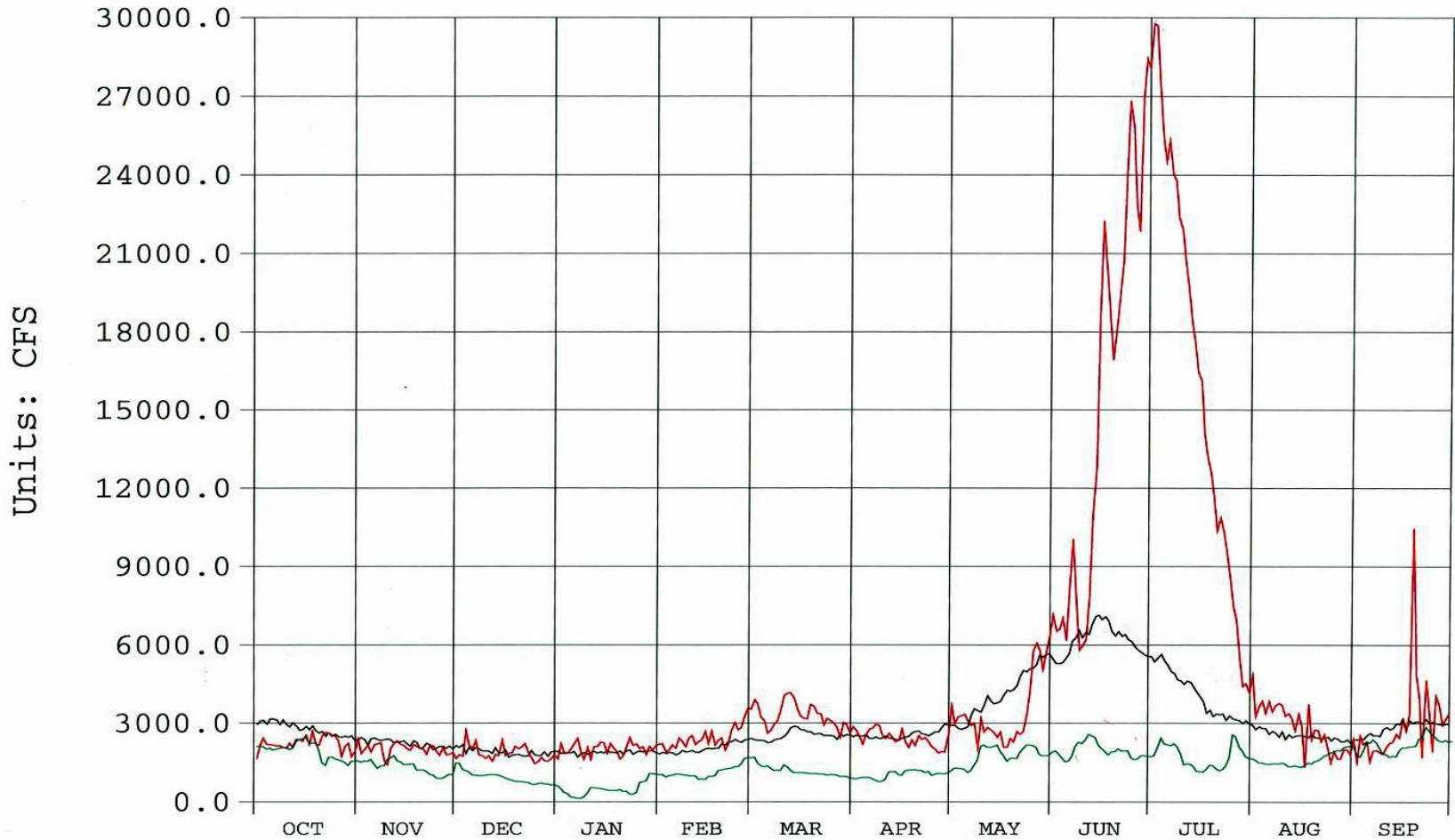


BIGHORN LAKE STORAGE ALLOCATIONS



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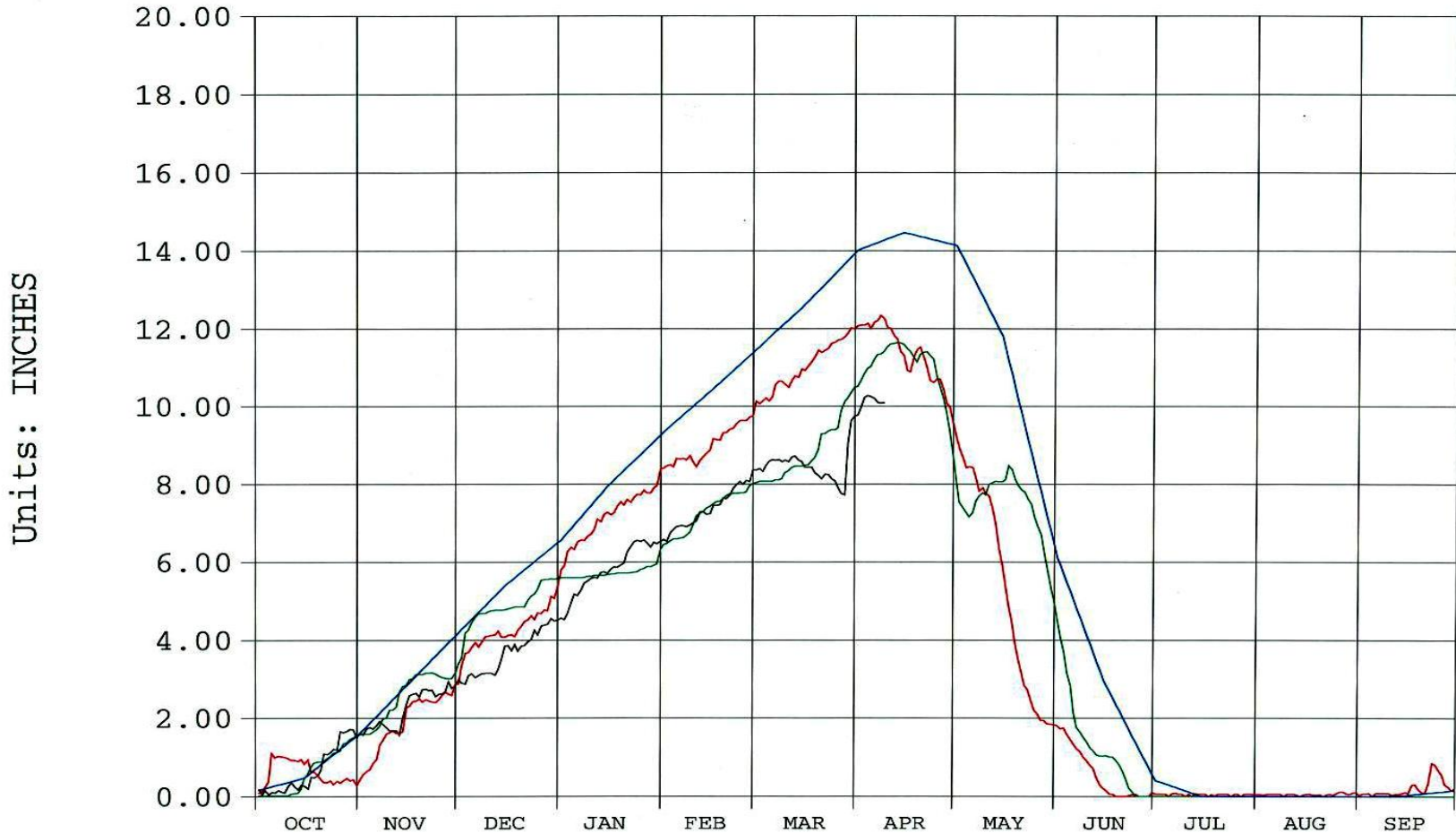
Archive Data From 1-OCT Through 30-SEP
Plotted 04/04/2007 09:17



BHR Bighorn Lake (Yellowtail), Bighorn River near Fort Smith, MT
— IN30AVG Last 30 years average inflow (cfs)
— IN Daily Mean Computed Inflow (cfs)

2007
1967 2004

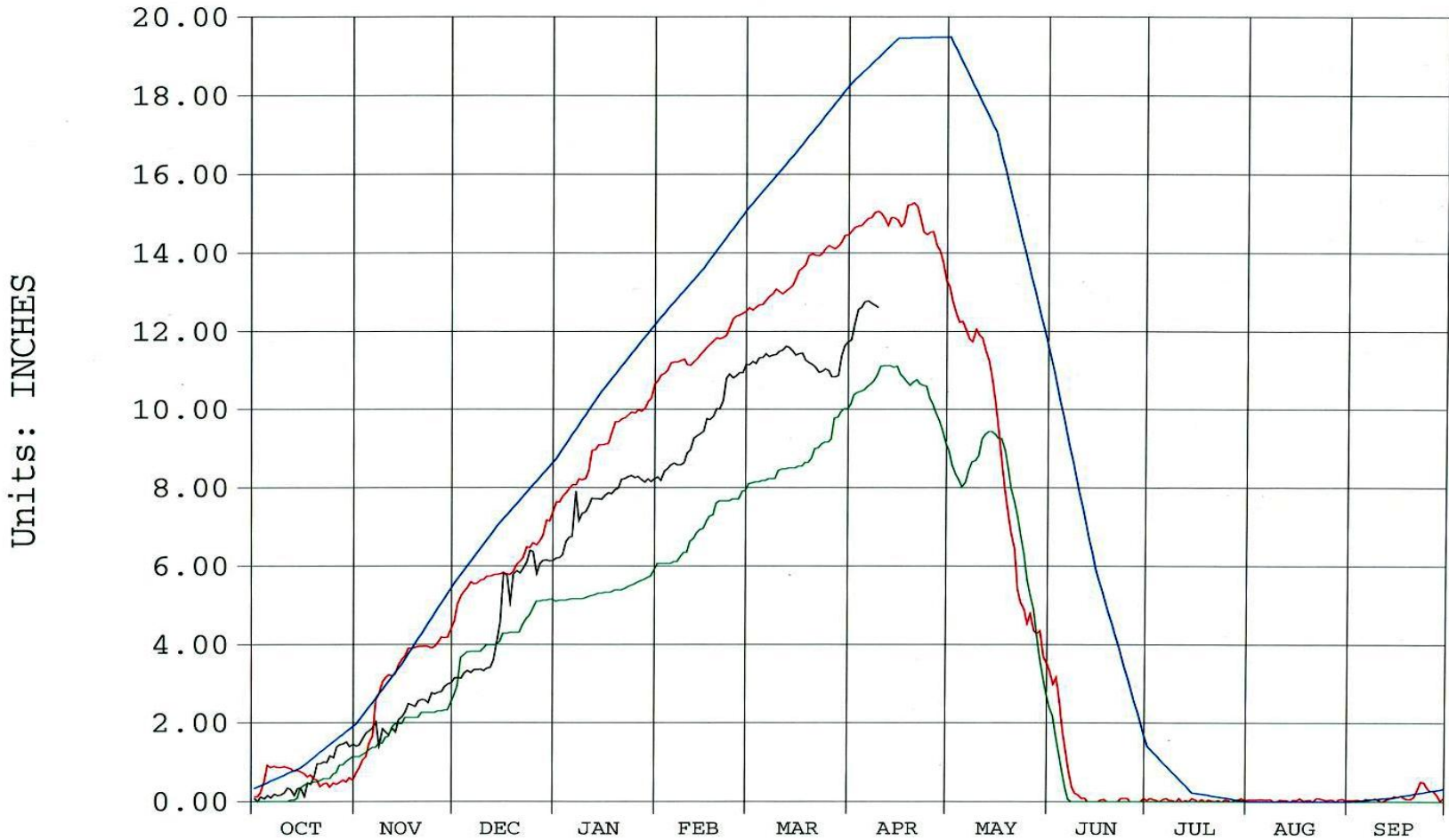
Archive Data From 1-OCT Through 30-SEP
 Plotted 04/09/2007 14:45



BOYR Boysen Reservoir, Wind River near Thermopolis, WY
 SE Snow Water Equivalent (inches)
 SE_AVG Snow Water Equivalent Average (inches)

2007 2006 1981
 2006

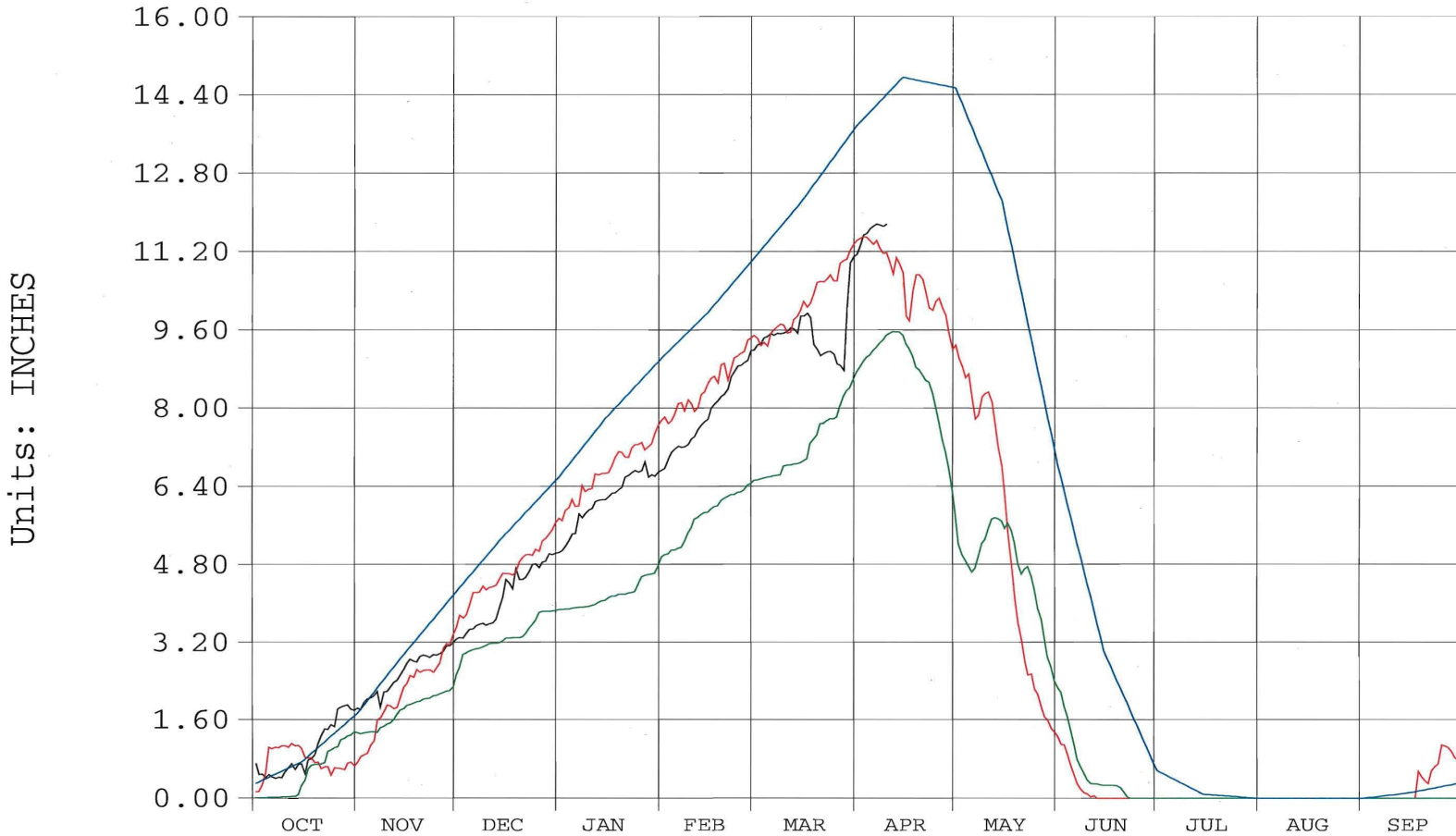
Archive Data From 1-OCT Through 30-SEP
 Plotted 04/09/2007 14:46



BBR Buffalo Bill Reservoir, Shoshone River near Cody, WY
 SE Snow Water Equivalent (inches)
 SE_AVG Snow Water Equivalent Average (inches)

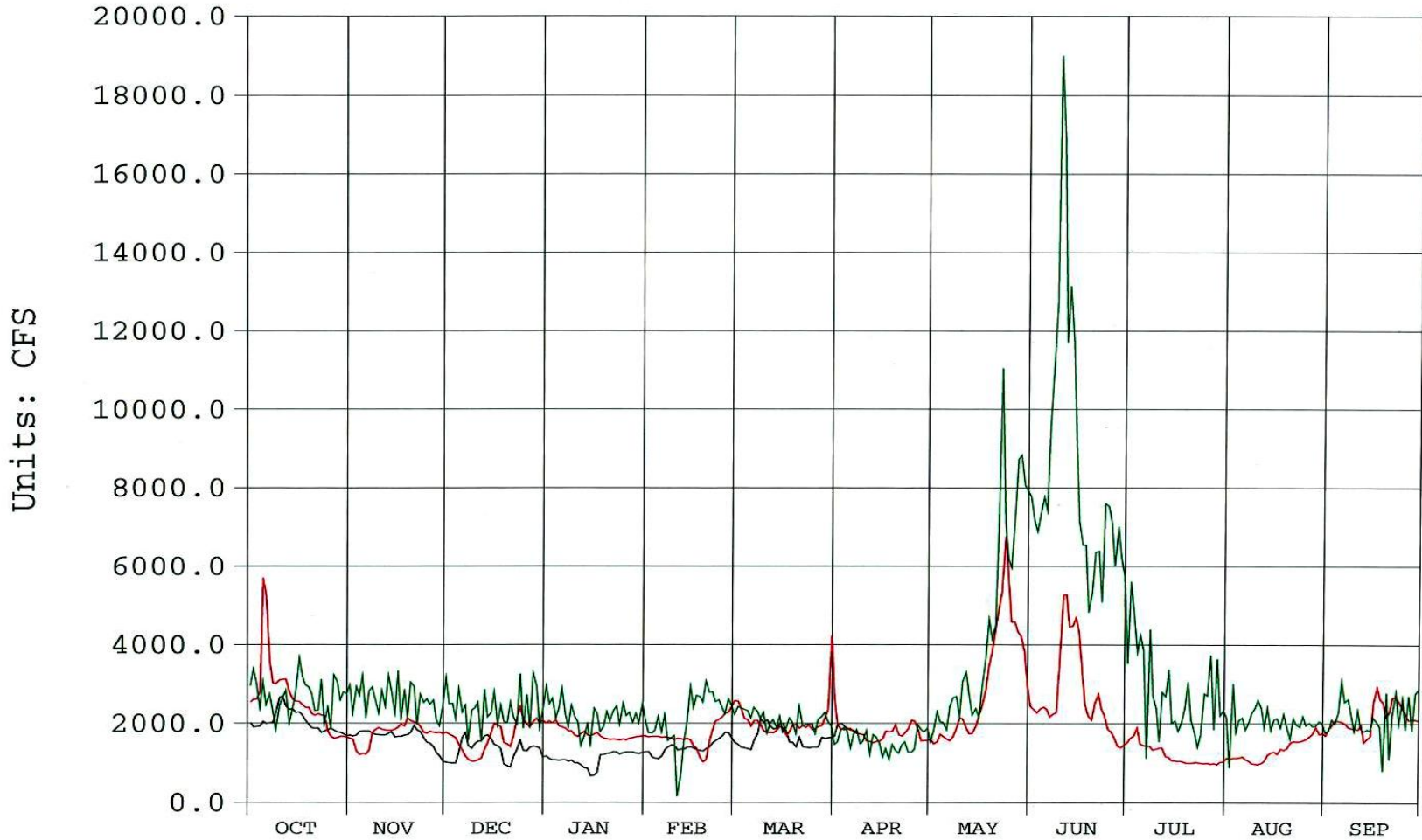
2007 2006 1981
 2006

Archive Data From 1-OCT Through 30-SEP
 Plotted 04/10/2007 12:25



BHR Bighorn Lake (Yellowtail), Bighorn River near Fort Smith, MT
 SE Snow Water Equivalent (inches) 2007 2006 1981
 SE_AVG Snow Water Equivalent Average (inches) 2006

Archive Data From 1-OCT Through 30-SEP
Plotted 04/09/2007 14:47



BHR
_____ IN

Bighorn Lake (Yellowtail), Bighorn River near Fort Smith, MT
Daily Mean Computed Inflow (cfs)

2007 2006 1981

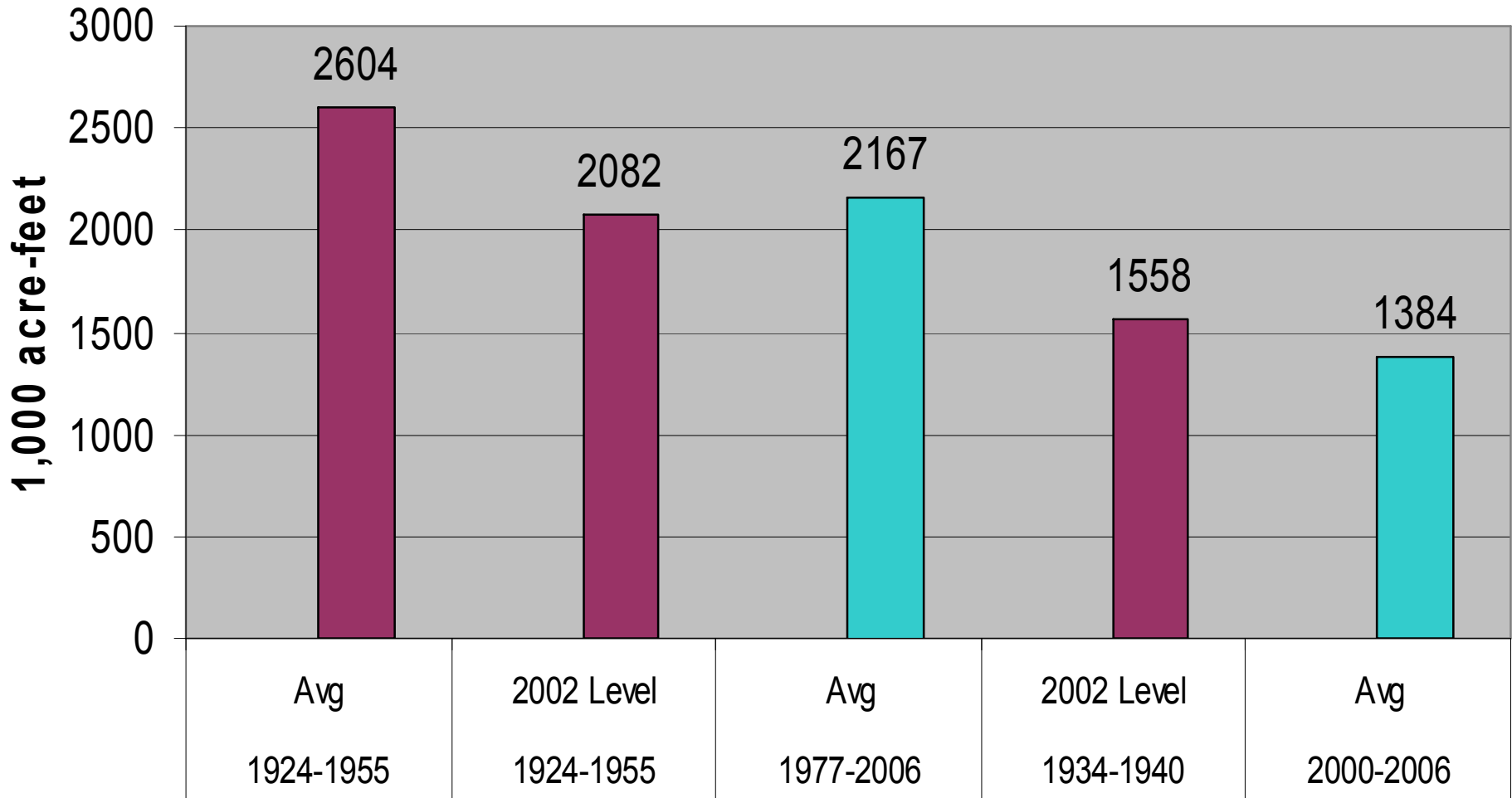
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Drought Management

- **1934-1940: Critical Period used in planning the project, 8 year drought**
- **2000-2007: Current drought started in 2000 and has continued to present. We are now in our 8 year of drought**

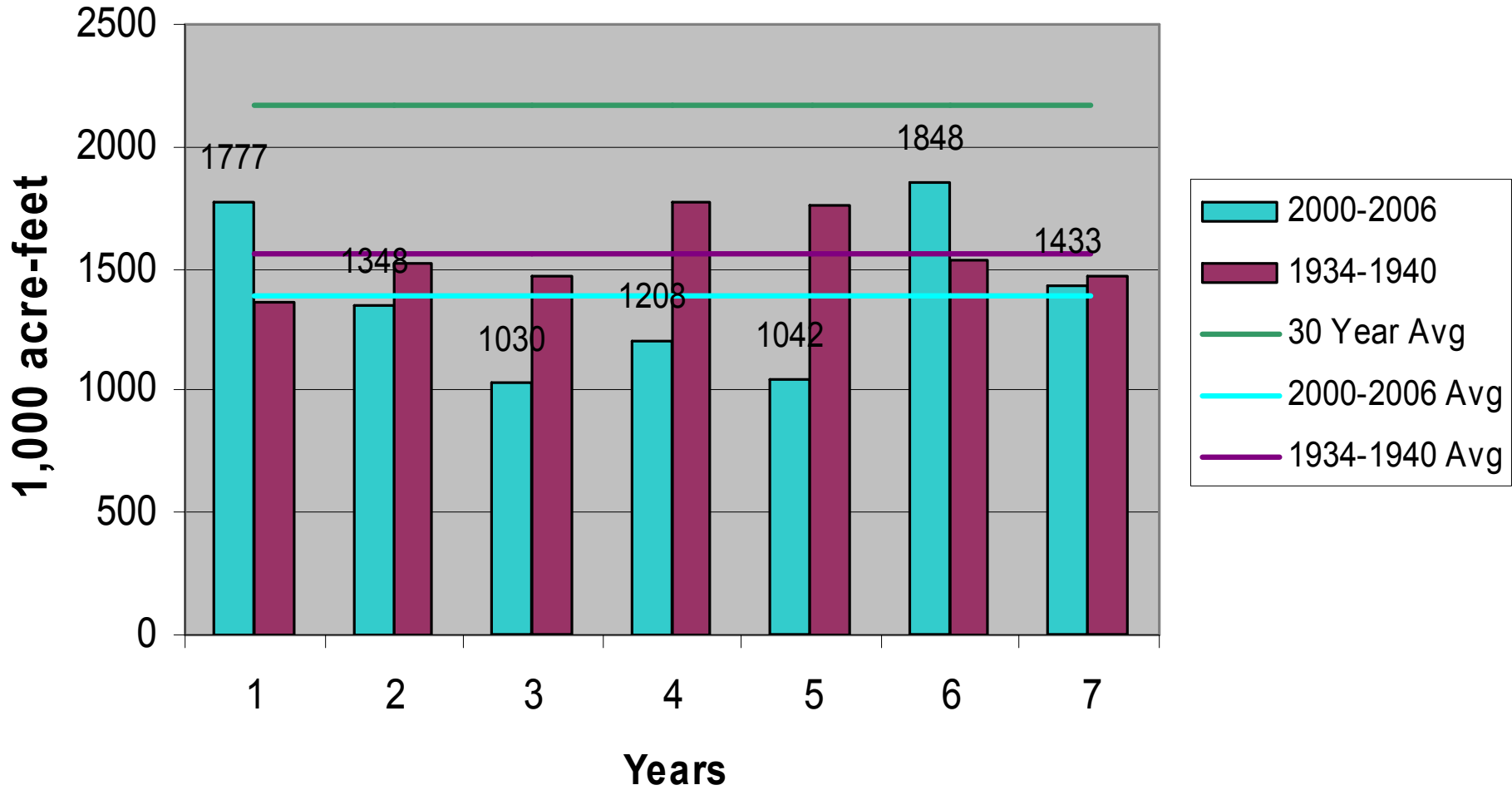
Bighorn Lake Inflow

Average Years vs Drought Periods

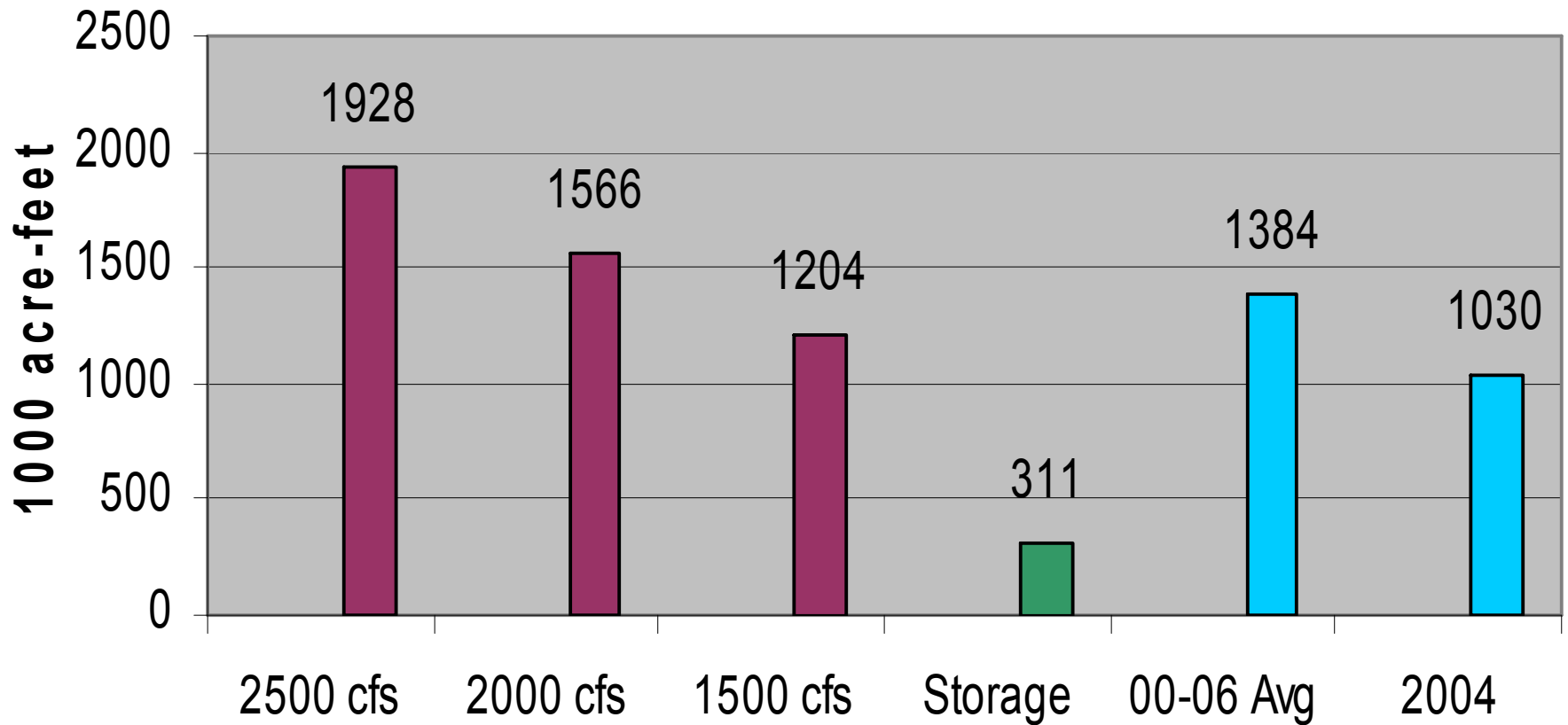


Bighorn Lake Inflows

2000-2006 Drought vs 1934-1940 Drought



Annual Volume of Water Required to Meet River Targets vs Drought Supply



Flood Management

- **Flood Runoff Years**

	» Peak Inflow	Apr-Jul Volume
– 1967	30,000 cfs	2,271,000 af
– 1978	23,215 cfs	1,829,000 af
– 1997	21,006 cfs	1,958,000 af

Other High Runoff Years 1971, 1972, 1975, 1976, 1983, 1999

Largest of Record

1923

43,000 cfs

September Rain Event

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Flood Runoff vs Flood Control Sapce

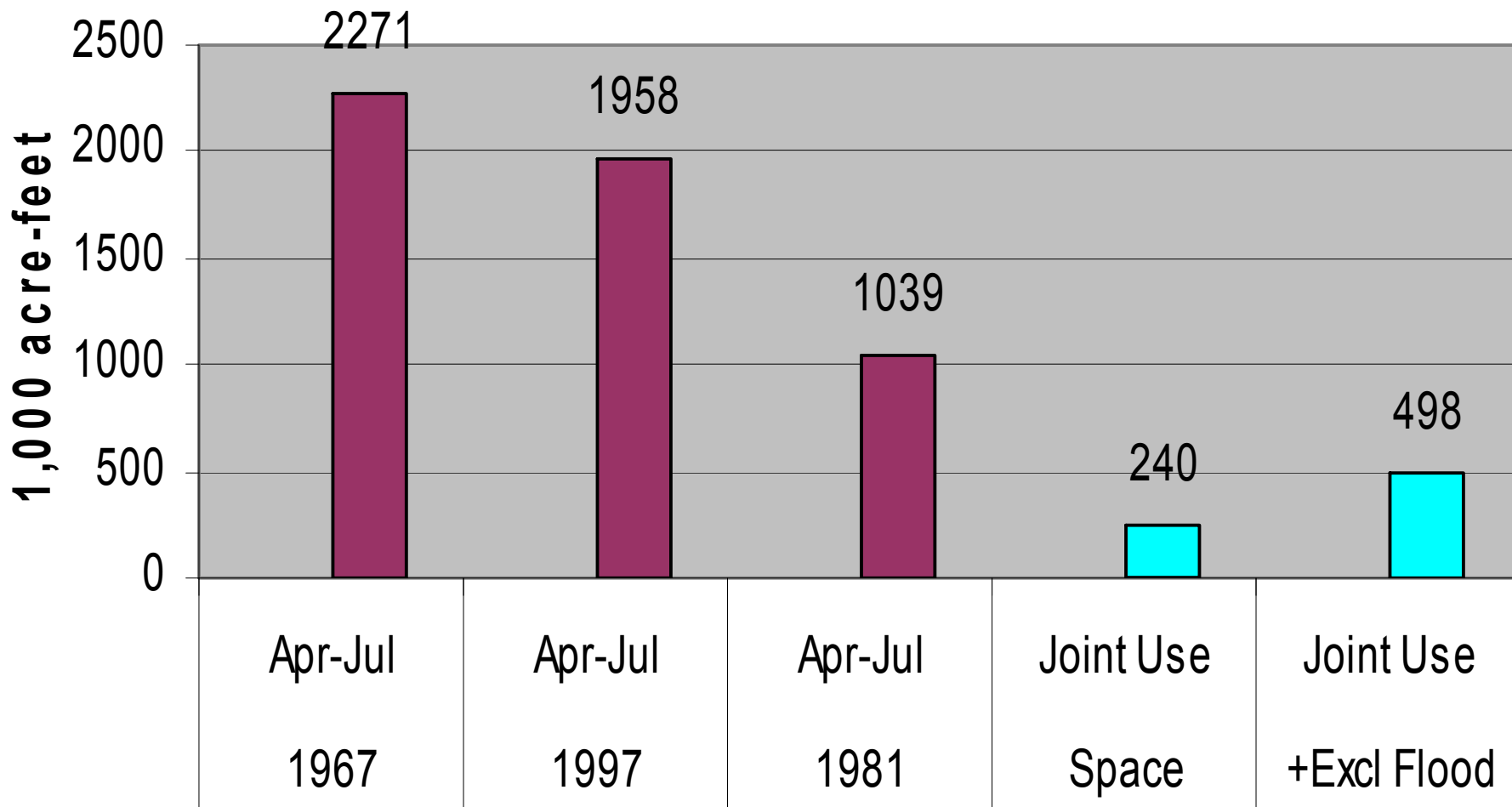
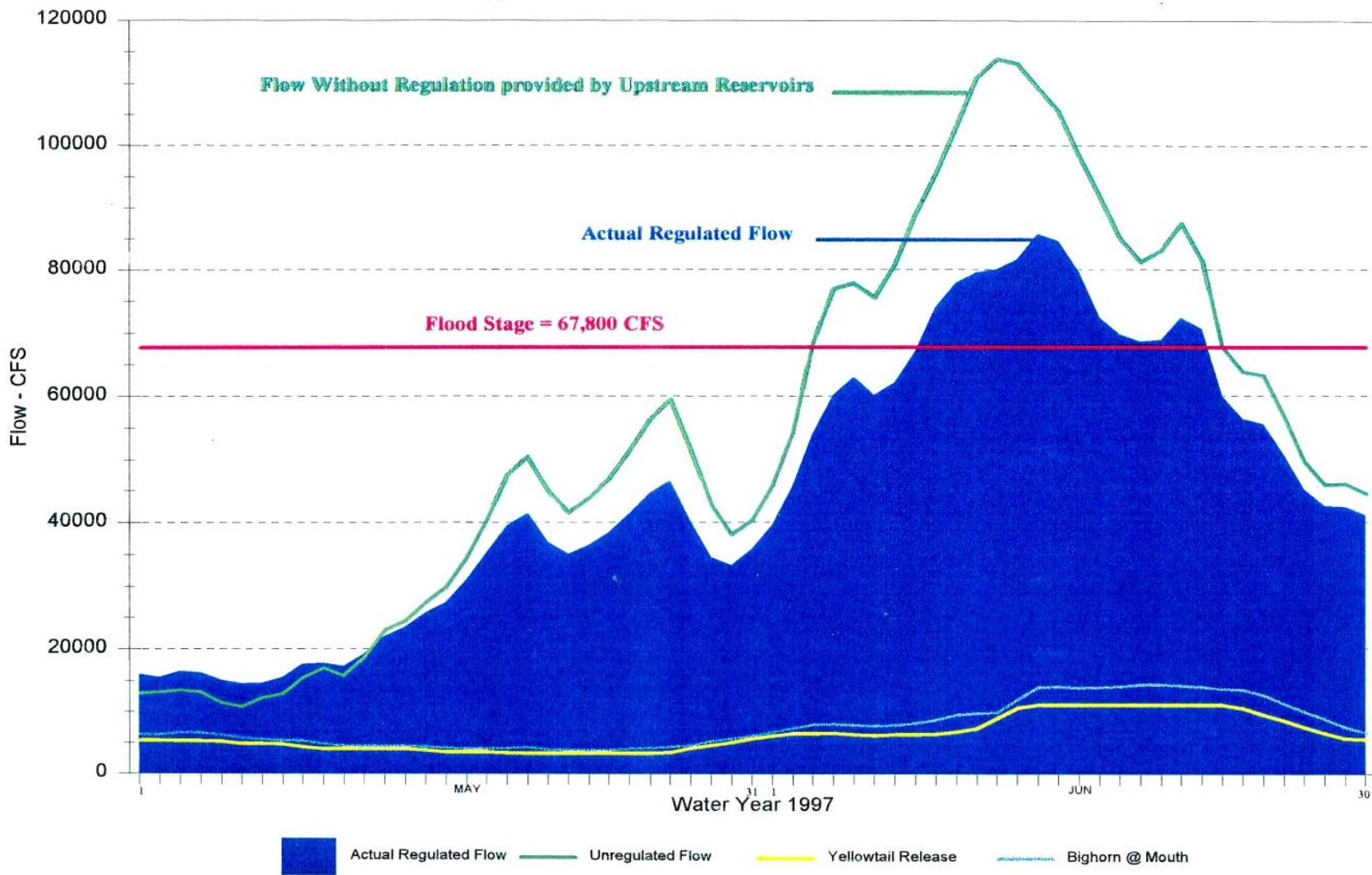


Figure MTG13 Yellowstone River @ Forsyth And Bighorn River Below Yellowtail Dam



DAM SAFETY CONCERNS

1972 Rapid City Flood

- **Rain Event – 15 inches in 6 hours**
- **Peak discharge – 50,000 cfs**
- **Loss of life – 237 dead, 8 missing**
- **Injured – 3,057**
- **Homes Lost – 1,335**
- **Automobiles destroyed – 5,000**
- **Estimated Total Damage - \$160 million in 1972 dollars about a \$500 million in 2007 dollars**

DAM SAFETY CONCERNS

- **Inflow Design Flood**
 - Peak Inflow 126,000 cfs
 - 10 Day Flood Volume 1,070,000 acre-feet
 - Peak Discharge 86,000 cfs
- **Maximum Probable Flood**
 - Peak Inflow 887,000 cfs
 - 20 Day Flood Volume 4,700,000 acre-feet
 - Peak Discharge 630,300 cfs

YELLOWTAIL DAM OPERATING CRITERIA

- REQUIREMENTS
- OBJECTIVES
- MUTIPURPOSE OBJECTIVES

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OPERATING REQUIREMENT SENIOR WATER RIGHTS

- **Bypass of inflow during irrigation season Apr-Sept**
- **River - 1,300 to 1,400 cfs**
- **Bighorn Canal – 300 to 500 cfs**
- **Total Discharge Required – 1,600 cfs to 1,900 cfs**

OPERATING REQUIREMENT CONTRACTUAL COMMITMENTS

- **Developed**
 - PPL Montana
 - 6,000 acre-feet/year as called for
- **Future**
 - Northern Cheyenne - Undeveloped
 - 30,000 acre-feet/year
 - Crow Tribe's Compact - Undeveloped
 - 300,000 acre-feet/year 150,000 acre-feet/year reserved for use below fishery reach. Compact has yet to be Ratified and approved

OPERATING REQUIREMENT DAM SAFETY

- **Provide Adequate Storage Space & Release Capacity to Safely pass Large Flood Events**
- **Inspect, Monitor and Maintain Structure to Insure Safe Operation**

OPERATING OBJECTIVES FLOOD CONTROL

- **SPRING RUNOFF - Provide adequate Joint Use Exclusive Flood Space to control flood runoff based on snow conditions and potential spring rain events**
- **SUMMER & FALL - Maintain Exclusive Flood Pool for regulation of late summer and fall rain events**

OPERATING OBJECTIVE

POWER GENERATION

- **Minimize spills or other releases that bypass the power turbines**
- **Limit power plant discharge to maximum of about 4,500 cfs to retain power peaking capability**
- **Optimize power plant efficiency**
- **Provide higher generation levels during the peak seasonal demand periods: July-August and December-February**

OPERATING OBJECTIVE RIVER FISHERY FLOW TARGETS

- **2,500 cfs - Provides good spawning and rearing conditions in all major side channels**
- **2,000 cfs - Provides limited spawning and rearing conditions in most side channels**
- **1,500 cfs – Provides only main channel habitat and no side channel habitat**
- **1,000 cfs – Minimum base flow as identified in Definite Plan Report**
- **Minimize release reductions after fish spawning activities have occurred**

OPERATING OBJECTIVE LAKE RECREATION

- **Desired lake levels to launch boats between Memorial Day and Labor Day weekends**
- **Horseshoe Bend – At or above elevations 3615 (originally 3593)**
- **Barry's Land & Ok-A-Beh – At or above elevation 3580 (originally 3586 & 3596)**
- **Black Canyon – Limit lake level to elevation 3642 to prevent flooding of campground**
- **Optimum Lake Level During Recreation Season for Recreation - 3630 to 3640**

OPERATING OBJECTIVE RESEVIOR FISHERY

- **Maintain a stable or rising lake level during April and May to enhance walleye and sauger spawning activities**

OPERATING OBJECTIVE WATERFOWL & OTHER INTERESTS

- **Maintain the reservoir elevation at or above 3635 during September – October to provide suitable waterfowl habitat at the upper end of the reservoir**
- **Lake level at or below 3635 before winter freeze up to reduce potential for ice jams near Lovell**

MULTIPURPOSE OBJECTIVES

Elevations Targets

- Sept – Oct: A Desired Lake Elevation of 3635 provides space for late summer and fall rainstorms, recreation enhancement and wildlife habitat
- March: Position Lake Level between 3605 and 3615 to provide good fall and winter generation, prepare reservoir for spring runoff and provide desired fishery flows. This also increases probability of raising pool during Walleye Spawning
- July: Fill reservoir to normal full level of 3640 to provide good water supply for all water uses while leaving adequate space to control summer and fall rain events.

MULTIPURPOSE OBJECTIVES

Desired River Operating Range

- **1,500 cfs – Approximate discharge to provide “firm” power generation as identified in DPR and provide minimum target flow for river fishery. Provide more than adequate water for downstream irrigation demands. Protects Reservoir storage in low runoff years except for the period of 2002 - 2004**
- **4,500 cfs – Provides optimum power generation (allows full peaking) while providing more than adequate water conditions for river fishery and irrigation needs**

COMMON GROUNDS

Where Improvements are Needed

- **Communications**
- **Spring-Summer Runoff Forecasts**
- **Fall-Winter Forecasts**
- **Revise Inflow Date to Current Level of Development**
- **Water Supply Monitoring**
 - **Streamflow**
 - **Snowpack**
 - **Precipitation**
 - **Soil Moisture Conditions**
- **Refinement in Needs**
 - **Fishery Flows**
 - **Recreation Levels**
 - **Other**

QUESTIONS & COMMENTS

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