

RECLAMATION

Managing Water in the West

**Yellowtail Dam & Bighorn Lake
Water Supply & Operations Meeting**

Billings, Montana

September 20, 2007

Welcome & Introductions



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Purpose of Meeting

- **Public outreach / education regarding Yellowtail Dam & Bighorn Lake**
- **Present Operation Scenarios for fall / winter 2007-2008**
- **Obtain feedback / comment from public & interested parties**

Meeting Agenda

- | | |
|---------|--|
| 6:30 pm | Doors open |
| 7:00 pm | Introductions, Welcome, and Meeting Objectives |
| 7:05 pm | Overview of Yellowtail Unit |
| 7:15 pm | Recap of Water Year 2007 |
| 7:45 pm | Fall / Winter Reservoir Operation Scenarios |
| 8:15 pm | Facilitated Public Discussion |
| 9:00 pm | Adjourn |

Montana Area Office is responsible for managing the water supplies and administering Reclamation programs for Reclamation projects located in Montana east of the continental divide.



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Yellowtail Unit

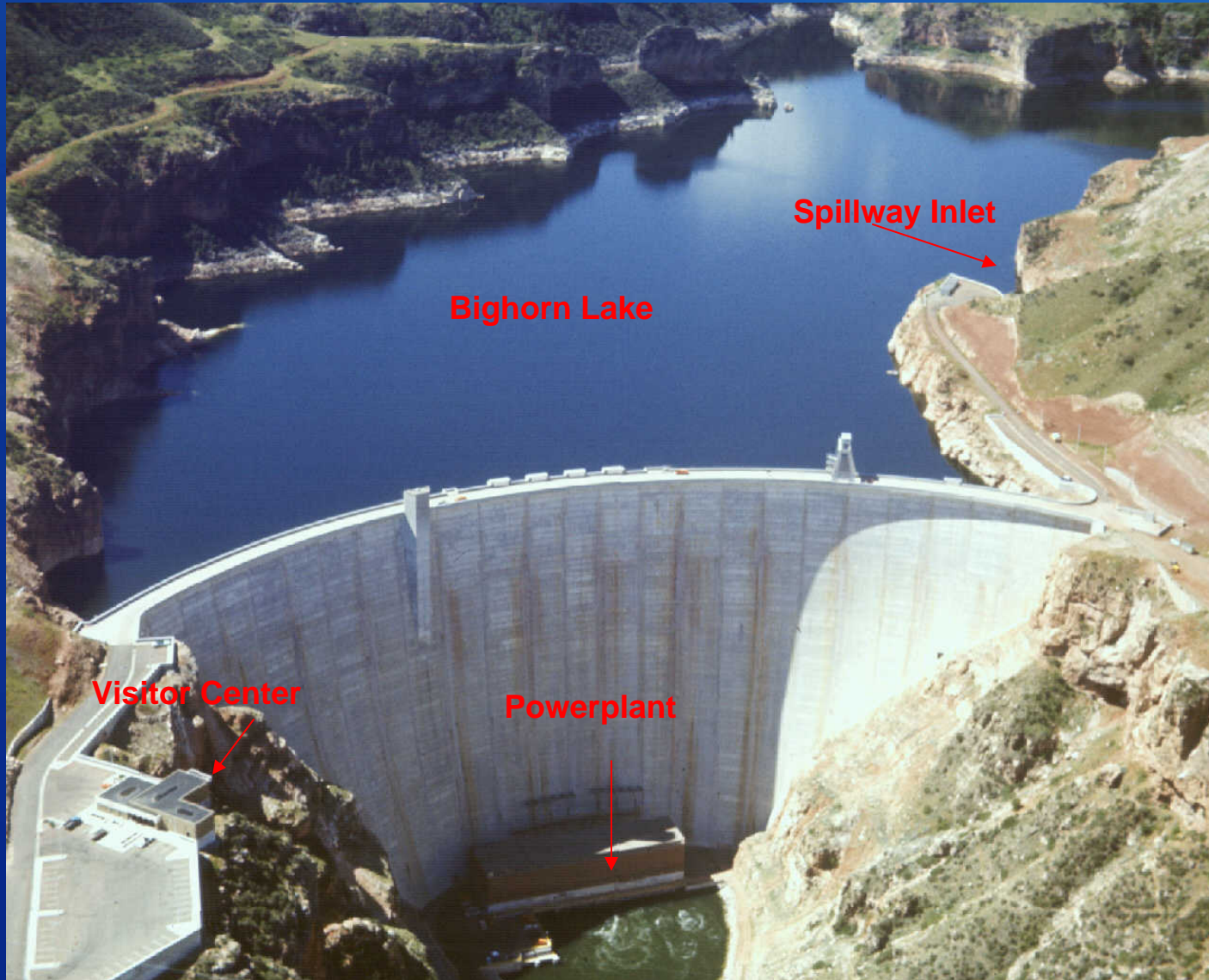
- **Authorization:**
 - **Senate Document 191—USACE/Reclamation plan for Missouri River Basin Development**
 - **Flood Control Act of Dec. 22, 1944 (ch.665 Stat. 887)**
- **Project Purposes (Definite Plan Report)**
 - **Flood Control (Exclusive flood storage = 259 KAF)**
 - **Hydropower 200 MW - (Currently 250 MW)**
 - **Irrigation**
 - **Recreation**
 - **Fish & Wildlife**
 - **Sediment storage**

YELLOWTAIL DAM, BIGHORN LAKE AND AFTERBAY



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YELLOWTAIL DAM and BIGHORN LAKE



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YELLOWTAIL DAM, BIGHORN LAKE and AFTERBAY



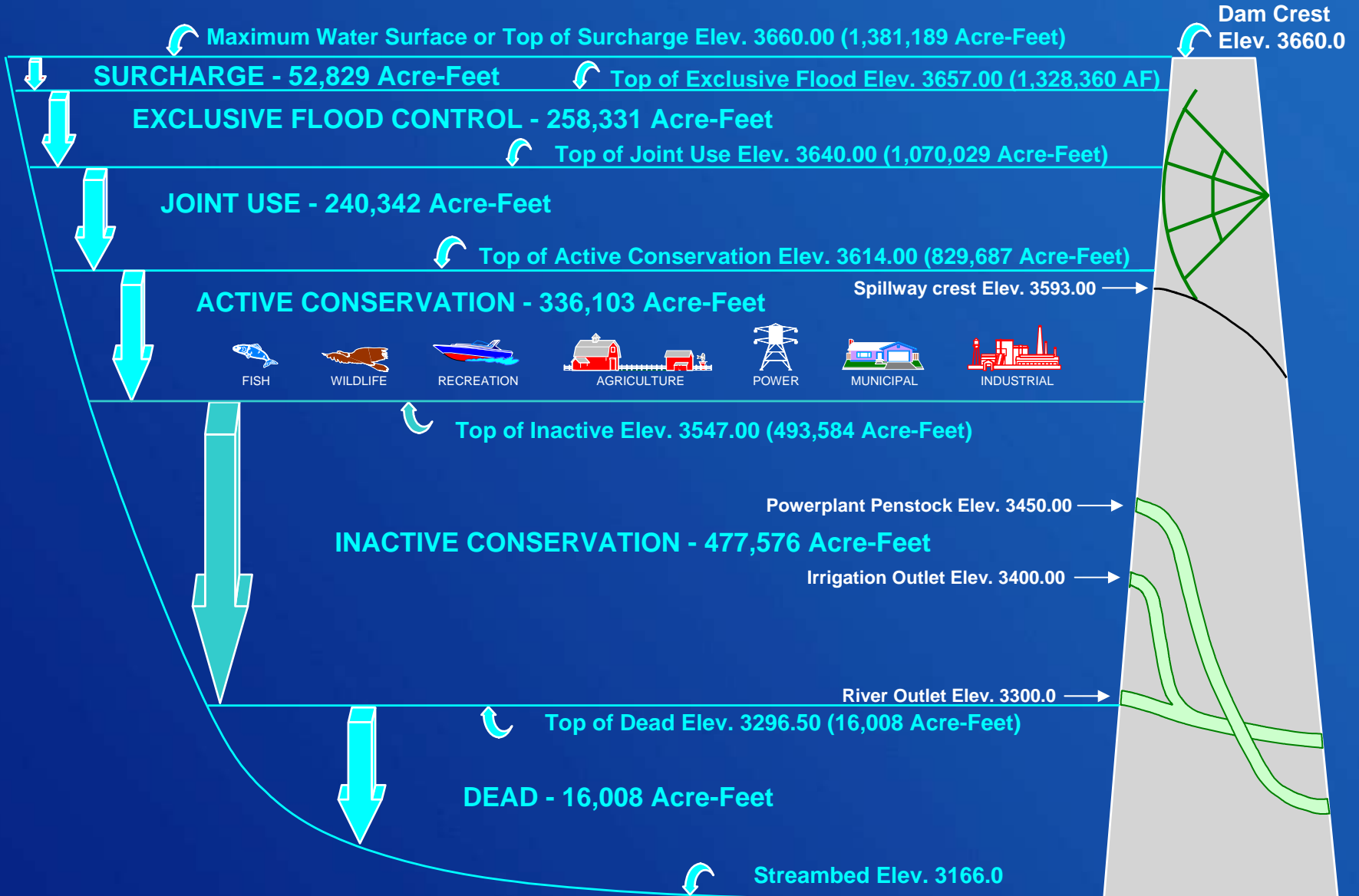
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YELLOWTAIL AFTERBAY DAM and AFTERBAY



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BIGHORN RESERVOIR ALLOCATIONS



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Coordination of Reservoir Operations

- **Bureau of Reclamation**
- **Corps of Engineers**
- **BIA Irrigation Project**
- **Crow Tribe**
- **Western Area Power Administration**
- **National Park Service**
- **Montana Fish, Wildlife, & Parks**
- **Wyoming Game and Fish Department**
- **Special Interest Groups** (Guides, Outfitters, Concessionaires, Friends of Bighorn River, Friends of Bighorn Lake, etc.)

Operational Targets

- Operational targets established over many years based on input from many sources
- Bighorn River streamflow targets based on studies by MFWP and letter to Reclamation in 1986 and supported by wetted perimeter studies in 1997. Target flows for trout fishery are 2,500; 2,000; and 1,500 cfs
- Lake elevations for launching boats established by NPS: Ok-A-Beh and Barry's Landing = 3580; Horseshoe Bend = 3615
- Reservoir elevation of at least 3547 for powerplant

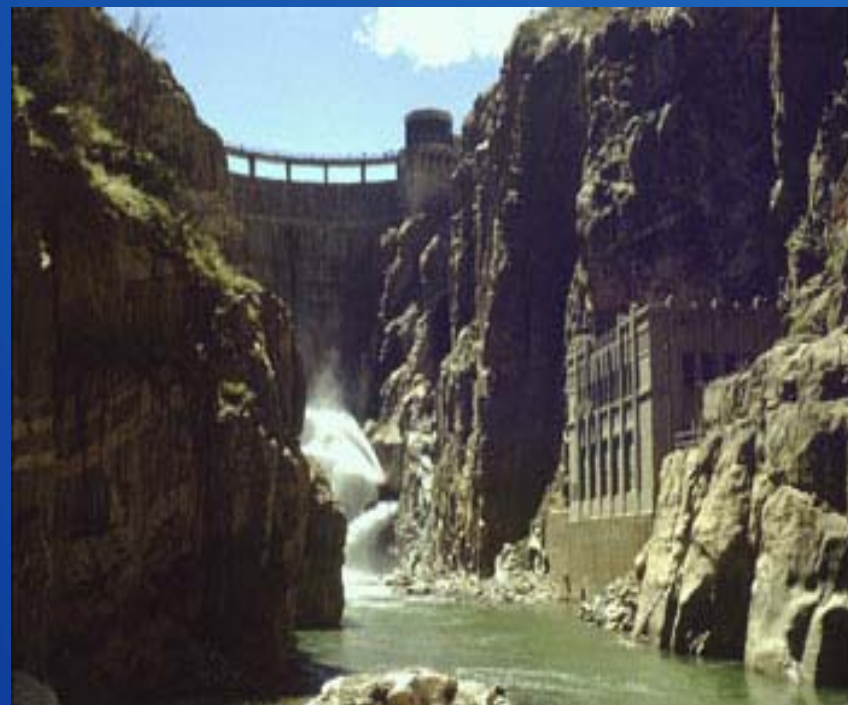
Typical Operations to Supply Senior Water Rights

- Bighorn Canal = 300 to 550 cfs from YT Afterbay
- Release to the Bighorn River = approx. 1,400 cfs
- Tributary flows and return flows satisfy balance of irrigation demand

Operations in the Bighorn River Basin are closely coordinated with the Wyoming Area Office which is responsible for Boysen & Buffalo Bill operations.



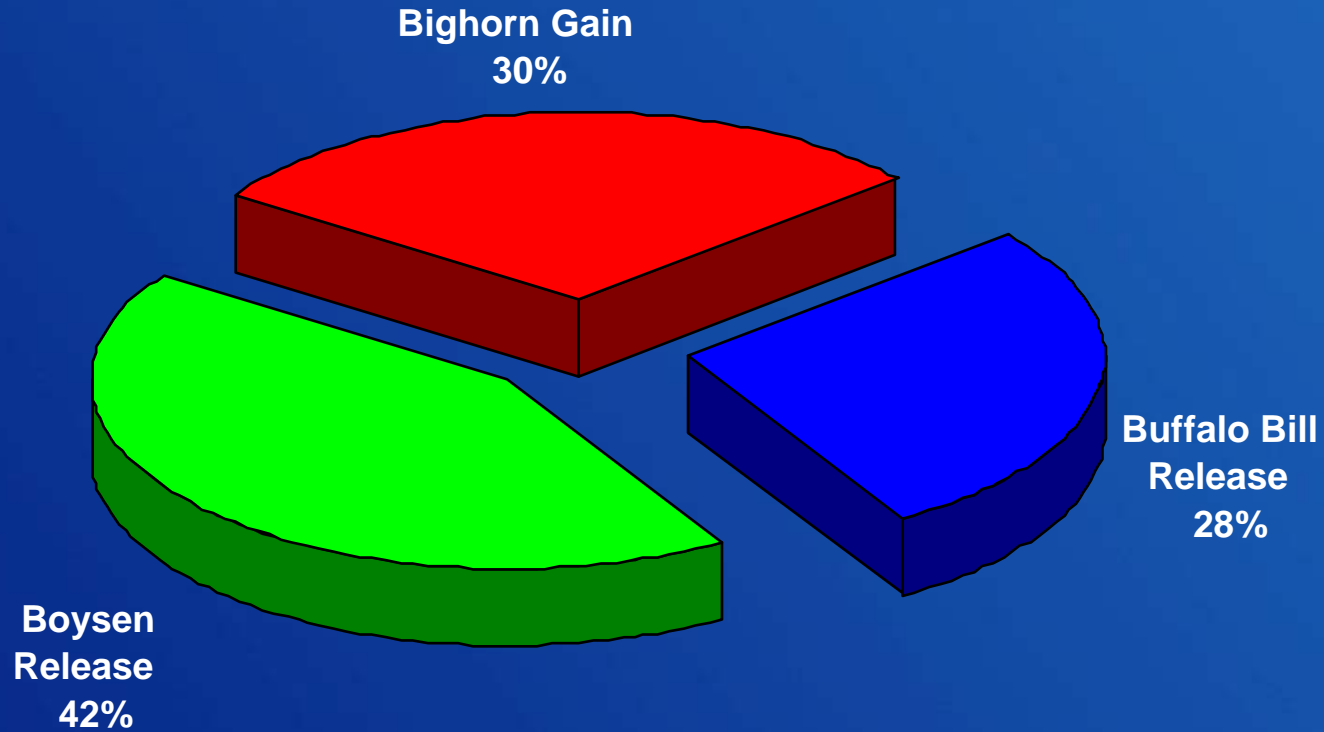
**Boysen Dam and Reservoir
Wind River**



**Buffalo Bill Dam and Reservoir
Shoshone River**

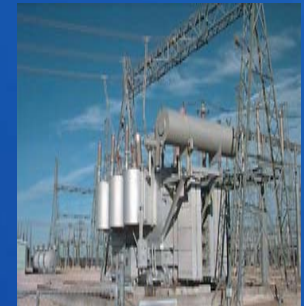
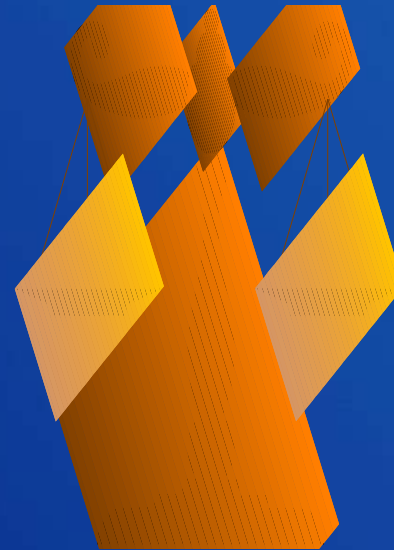
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Bighorn Lake Annual Inflow Distribution Based on 1967-2005 Data





OPERATIONS - A BALANCING ACT AMONG THE COMPETING INTERESTS



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OPERATING OBJECTIVES

- ✓ Recognize all downstream senior water rights.
- ✓ Meet contractual commitments for stored water.
- ✓ Maintain adequate storage space for flood control.
- ✓ Maximize the power benefits.
- ✓ Maintain lake levels for recreation, reservoir fishery, and waterfowl interests.
- ✓ Maintain river flow levels for river fishery.

OPERATING GUIDELINES & TARGETS

- ✓ **Senior Water Rights – Bypass of inflow during irrigation season**
 - ✓ River – approx. 1,400 cfs
 - ✓ Bighorn Canal – 300-550 cfs

- ✓ **Contract Commitments**
 - ✓ PPL-MT 6,000 acre-feet/year as called for
 - ✓ Northern Cheyenne – 30,000 acre-feet/year (undeveloped)

- ✓ **Flood Control – Provide adequate storage space to safely store forecasted spring runoff**
 - ✓ Reservoir elevation at end of March between 3605 and 3614

- ✓ **Power Generation**
 - ✓ Minimize spills or other releases that bypass the power turbines
 - ✓ Limit power plant discharge to a 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 which occur during July-August and December-February

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OPERATING GUIDELINES & TARGETS

(continued)

- ✓ **River Fishery Flows**
 - ✓ 2,500 cfs – Provides good spawning & 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 (no side channel habitat)
 - ✓ 1,000 cfs – Minimum base flow as identified in Definite Plan Report
 - ✓ Minimize changes in releases after fish spawning has occurred

- ✓ **Lake Recreation – Desired lake levels to launch boats between Memorial Day and Labor Day Weekends**
 - ✓ Horseshoe Bend – At or above elevation 3615 (originally 3593)
 - ✓ Barry's Landing & Ok-A-Beh – At or above elevation 3580 (originally 3586 & 3596)
 - ✓ Black Canyon – Restrict lake level to elevation 3642 or lower

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

- ✓ **Waterfowl and 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

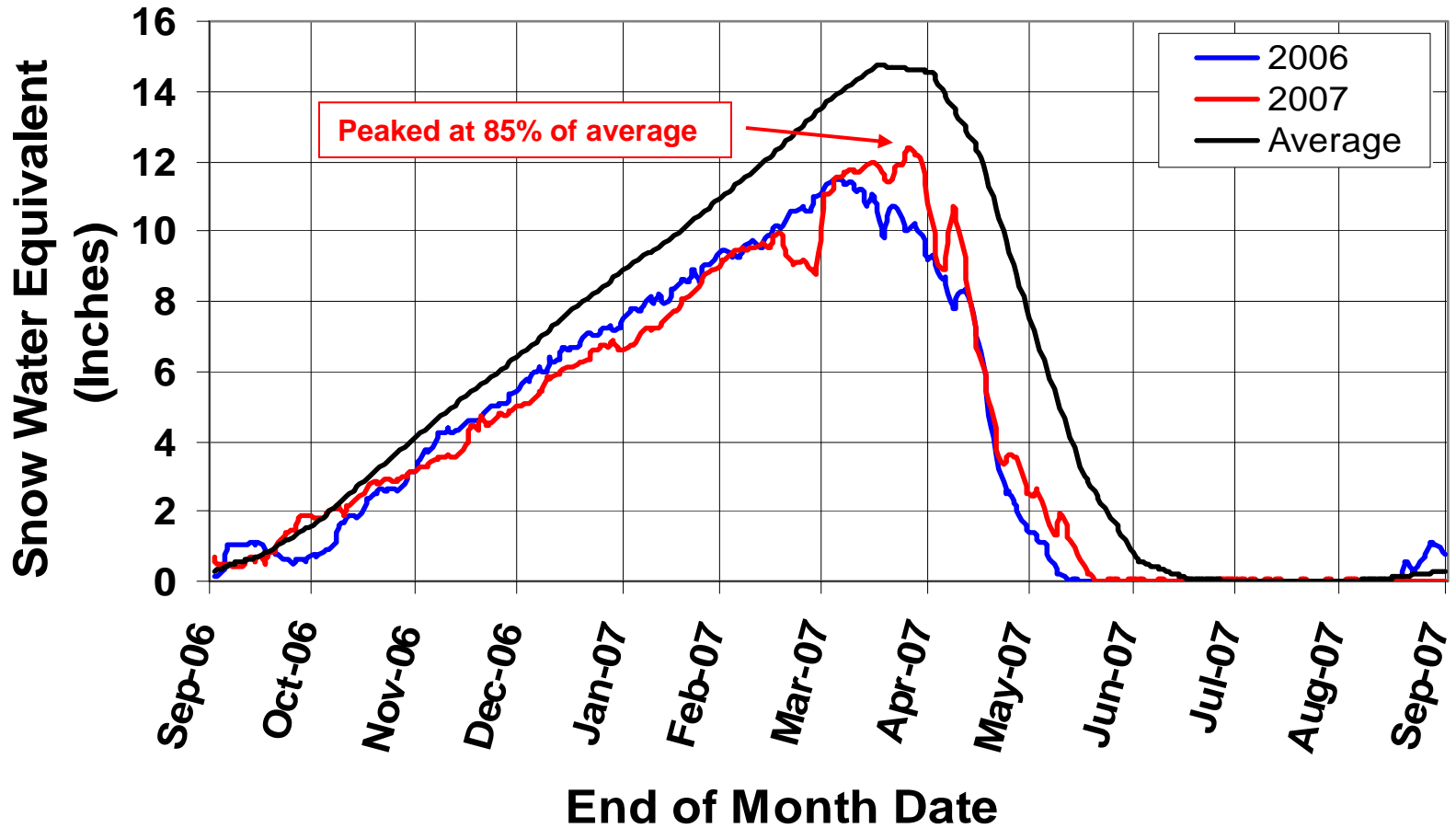
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Recap of Water Year 2007

- ✓ **Mountain Snowpack**
- ✓ **Precipitation**
- ✓ **Inflow to Bighorn Lake**
- ✓ **Bighorn River Releases**
- ✓ **Bighorn Lake Storage Conditions**

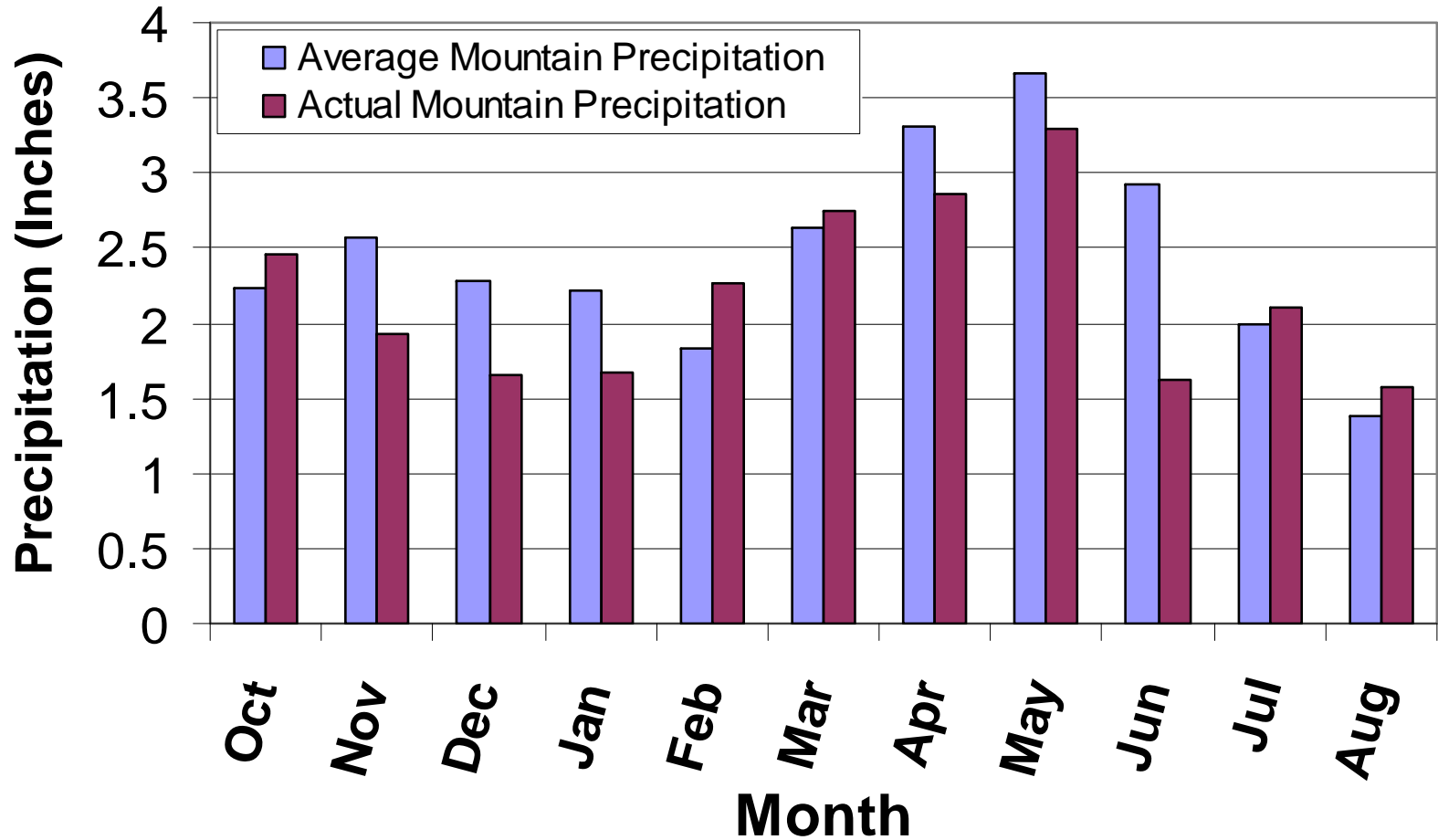
Recap of Water Year 2007

Mountain Snowpack Conditions

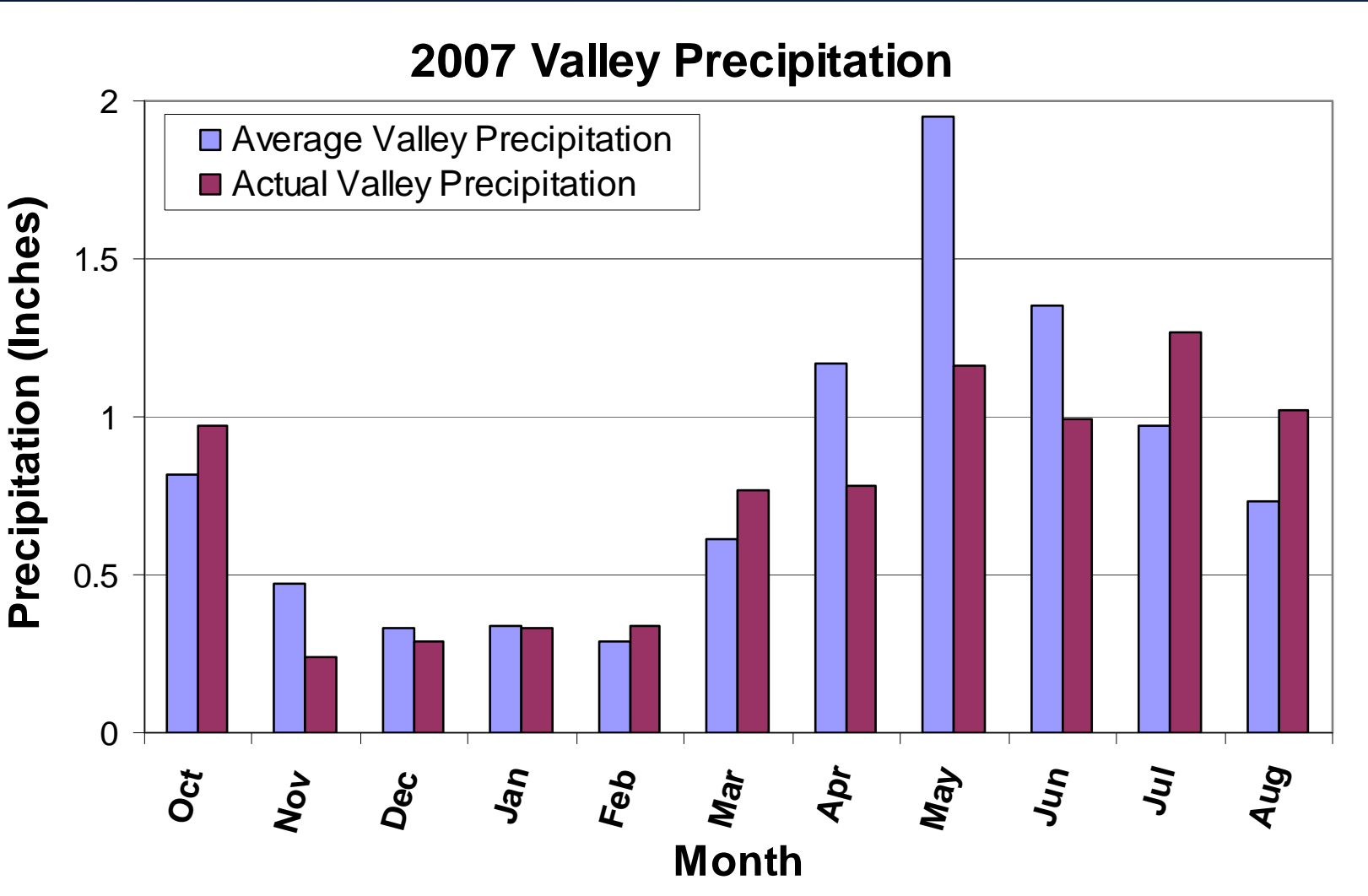


Recap of Water Year 2007

2007 Mountain Precipitation



Recap of Water Year 2007



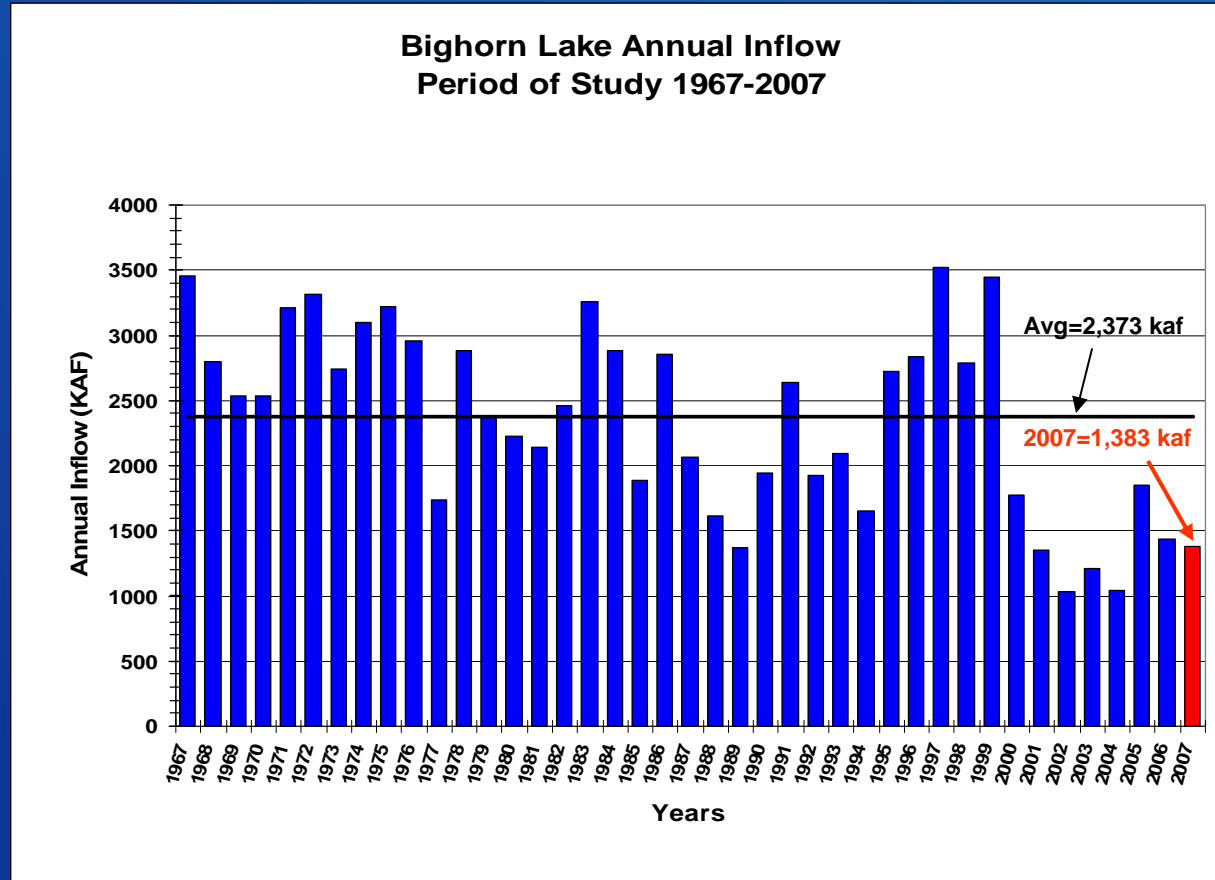
Recap of Water Year 2007

Annual Inflow (acre-feet)

BY YEAR		RANKED		
YEAR	SUMMATION	MISS	YEAR	SUMMATION
1967	3458698.00	0	1997	3516450.50
1968	2805523.00	0	1967	3458698.00
1969	2538975.00	0	1999	3443793.50
1970	2536716.75	0	1972	3320208.00
1971	3215818.25	0	1983	3259034.00
1972	3320208.00	0	1975	3221720.25
1973	2738184.75	0	1971	3215818.25
1974	3094672.25	0	1974	3094672.25
1975	3221720.25	0	1976	2966925.50
1976	2966925.50	0	1984	2887518.75
1977	1740630.88	0	1978	2887243.00
1978	2887243.00	0	1986	2851288.75
1979	2370932.00	0	1996	2842566.75
1980	2226959.75	0	1968	2805523.00
1981	2143234.00	0	1998	2787867.25
1982	2458121.25	0	1973	2738184.75
1983	3259034.00	0	1995	2718941.00
1984	2887518.75	0	1991	2639744.75
1985	1883584.62	0	1969	2538975.00
1986	2851288.75	0	1970	2536716.75
1987	2064115.00	0	1982	2458121.25
1988	1619253.75	0	1979	2370932.00
1989	1367536.38	0	1980	2226959.75
1990	1942052.25	0	1981	2143234.00
1991	2639744.75	0	1993	2092193.75
1992	1925226.38	0	1987	2064115.00
1993	2092193.75	0	1990	1942052.25
1994	1657113.88	0	1992	1925226.38
1995	2718941.00	0	1985	1883584.62
1996	2842566.75	0	2005	1847983.25
1997	3516450.50	0	2000	1776761.12
1998	2787867.25	0	1977	1740630.88
1999	3443793.50	0	1994	1657113.88
2000	1776761.12	0	1988	1619253.75
2001	1347515.12	0	2006	1432633.00
2002	1029821.19	0	2007	1382972.00
2003	1208316.75	0	1989	1367536.38
2004	1041571.12	0	2001	1347515.12
2005	1847983.25	0	2003	1208316.75
2006	1432633.00	0	2004	1041571.12
2007	1382972.00	0	2002	1029821.19

Average of 40 years:
2007 is 57.0% of average

2372685.75



2007 - 6th Lowest of Record

2000's - Lowest of Record

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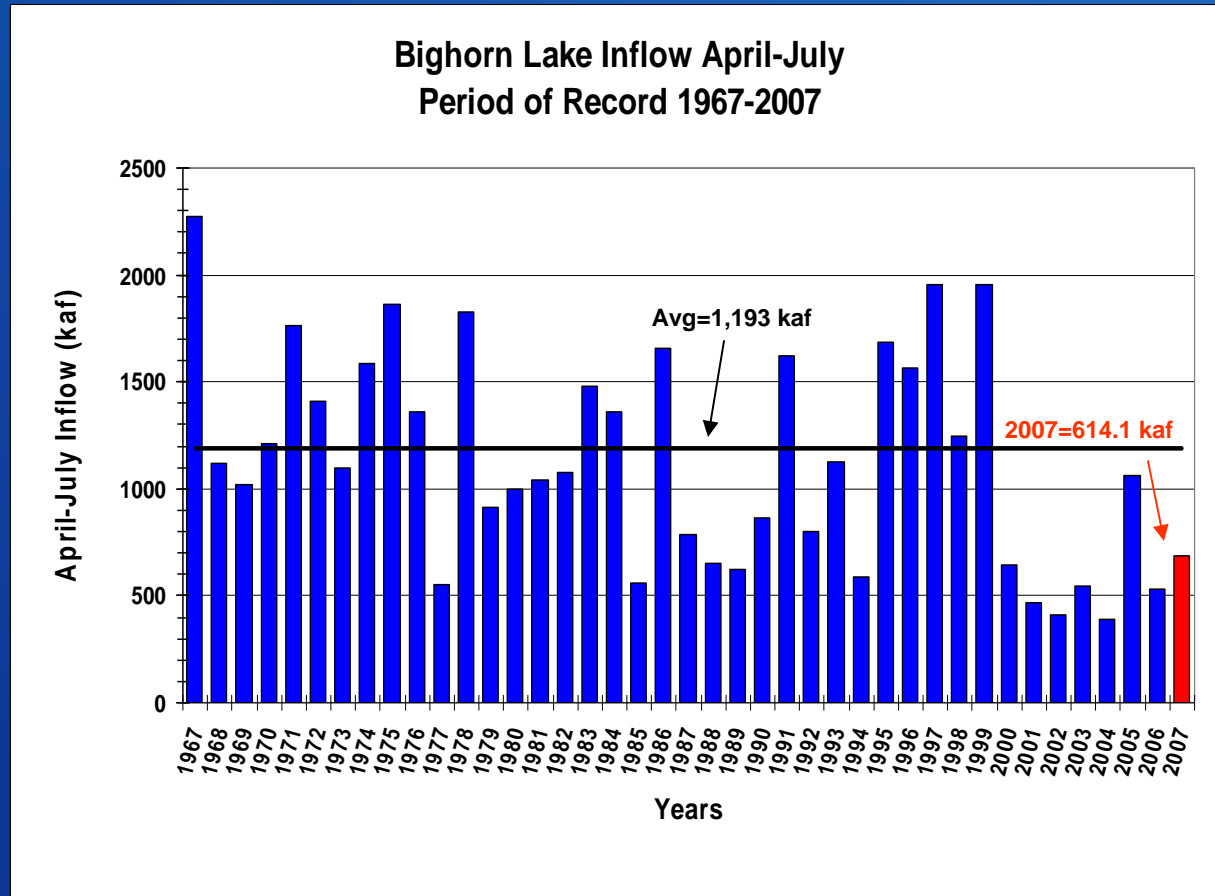
Recap of Water Year 2007

April-July Inflow (acre-feet)

BY YEAR		RANKED		
YEAR	SUMMATION	MISS	YEAR	SUMMATION
1967	2271119.00	0	1967	2271119.00
1968	1121723.50	0	1997	1957909.38
1969	1022204.56	0	1999	1954361.38
1970	1211447.62	0	1975	1863084.12
1971	1761603.00	0	1978	1828506.38
1972	1412024.50	0	1971	1761603.00
1973	1097200.62	0	1995	1687499.88
1974	1583350.50	0	1986	1659118.12
1975	1863084.12	0	1991	1619218.88
1976	1356278.50	0	1974	1583350.50
1977	549853.88	0	1996	1567308.00
1978	1828506.38	0	1983	1482762.75
1979	910146.06	0	1972	1412024.50
1980	999731.81	0	1984	1356584.88
1981	1038870.25	0	1976	1356278.50
1982	1073918.62	0	1998	1249862.25
1983	1482762.75	0	1970	1211447.62
1984	1356584.88	0	1993	1124839.38
1985	562000.69	0	1968	1121723.50
1986	1659118.12	0	1973	1097200.62
1987	788028.94	0	1982	1073918.62
1988	653689.31	0	2005	1065040.62
1989	622719.25	0	1981	1038870.25
1990	867187.94	0	1969	1022204.56
1991	1619218.88	0	1980	999731.81
1992	801294.06	0	1979	910146.06
1993	1124839.38	0	1990	867187.94
1994	587368.44	0	1992	801294.06
1995	1687499.88	0	1987	788028.94
1996	1567308.00	0	1988	653689.31
1997	1957909.38	0	2000	643018.12
1998	1249862.25	0	1989	622719.25
1999	1954361.38	0	2007	614100.00
2000	643018.12	0	1994	587368.44
2001	469897.88	0	1985	562000.69
2002	408570.88	0	1977	549853.88
2003	548248.62	0	2003	548248.62
2004	392148.84	0	2006	528198.00
2005	1065040.62	0	2001	469897.88
2006	528198.00	0	2002	408570.88
2007	614100.00	0	2004	392148.84

Average of 41 years:
2007 is 51.0% of average

1192800.00



2007 - 9th Lowest of Record

2000's - Lowest of Record

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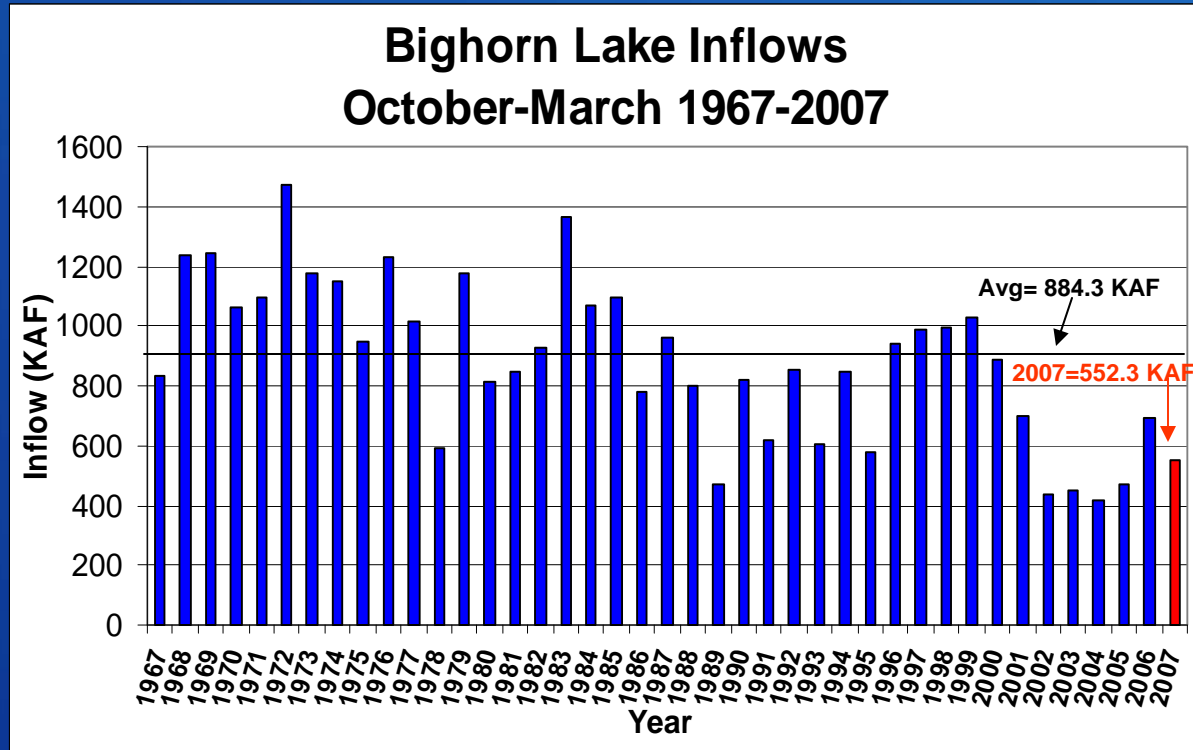
Recap of Water Year 2007

Oct-Mar Inflow

BY YEAR			RANKED		
YEAR	SUMMATION	MISS	YEAR	SUMMATION	
1967	834245.12	0	1972	1470721.38	
1968	1238291.88	0	1983	1364720.00	
1969	1240469.62	0	1969	1240469.62	
1970	1061894.50	0	1968	1238291.88	
1971	1095205.50	0	1976	1233259.12	
1972	1470721.38	0	1973	1177332.88	
1973	1177332.88	0	1979	1174329.25	
1974	1147734.25	0	1974	1147734.25	
1975	946935.31	0	1985	1097558.88	
1976	1233259.12	0	1971	1095205.50	
1977	1015415.69	0	1984	1069980.50	
1978	590550.12	0	1970	1061894.50	
1979	1174329.25	0	1999	1031390.69	
1980	815887.88	0	1977	1015415.69	
1981	849700.56	0	1998	994570.38	
1982	926300.62	0	1997	988951.00	
1983	1364720.00	0	1987	961437.62	
1984	1069980.50	0	1975	946935.31	
1985	1097558.88	0	1996	943944.00	
1986	781831.69	0	1982	926300.62	
1987	961437.62	0	2000	884101.38	
1988	801650.38	0	1992	856148.94	
1989	468751.25	0	1981	849700.56	
1990	818507.44	0	1994	846254.44	
1991	617245.12	0	1967	834245.12	
1992	856148.94	0	1990	818507.44	
1993	603146.94	0	1980	815887.88	
1994	846254.44	0	1988	801650.38	
1995	581452.56	0	1986	781831.69	
1996	943944.00	0	2001	700601.75	
1997	988951.00	0	2006	695317.38	
1998	994570.38	0	1991	617245.12	
1999	1031390.69	0	1993	603146.94	
2000	884101.38	0	1978	590550.12	
2001	700601.75	0	1995	581452.56	
2002	438375.44	0	2007	552314.31	
2003	452875.66	0	1989	468751.25	
2004	419681.56	0	2005	468269.72	
2005	468269.72	0	2003	452875.66	
2006	695317.38	0	2002	438375.44	
2007	552314.31	0	2004	419681.56	

Average of 41 years:
2007 is 62.46% of average

884325.56



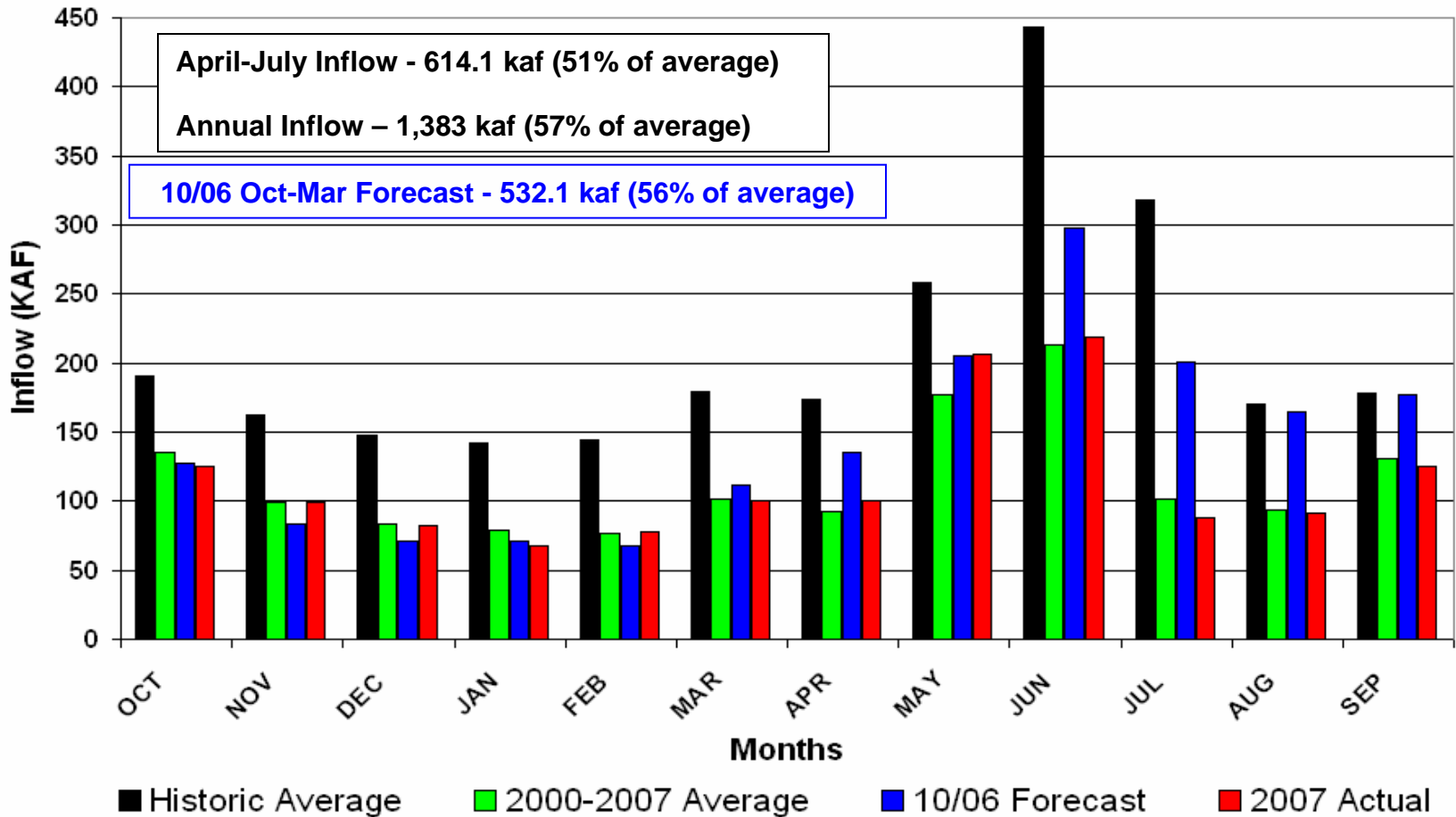
2000's - Lowest of Record

2007 - 6th Lowest of Record

RECLAMATION

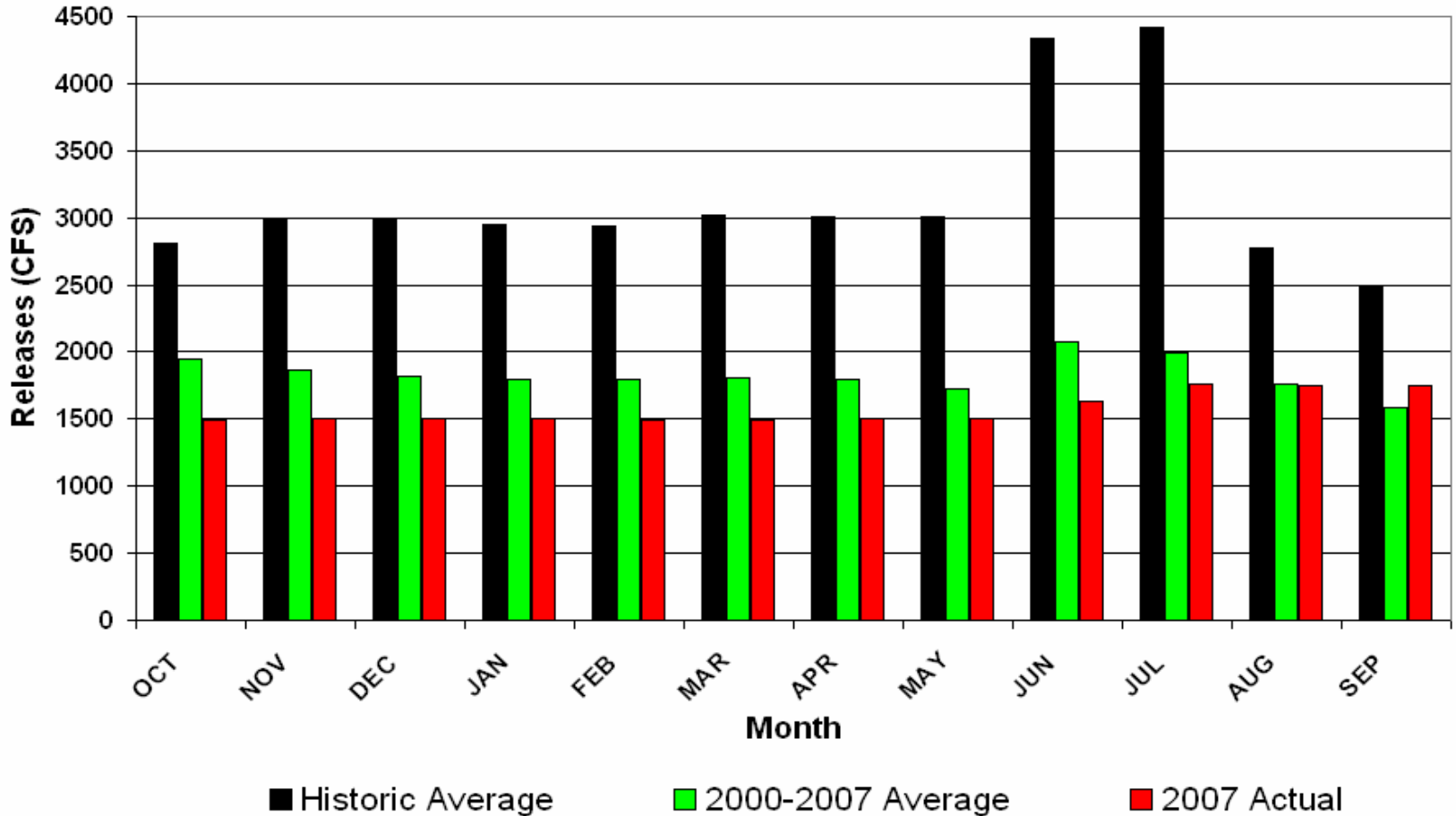
Recap of Water Year 2007

Inflow to Bighorn Lake



Recap of Water Year 2007

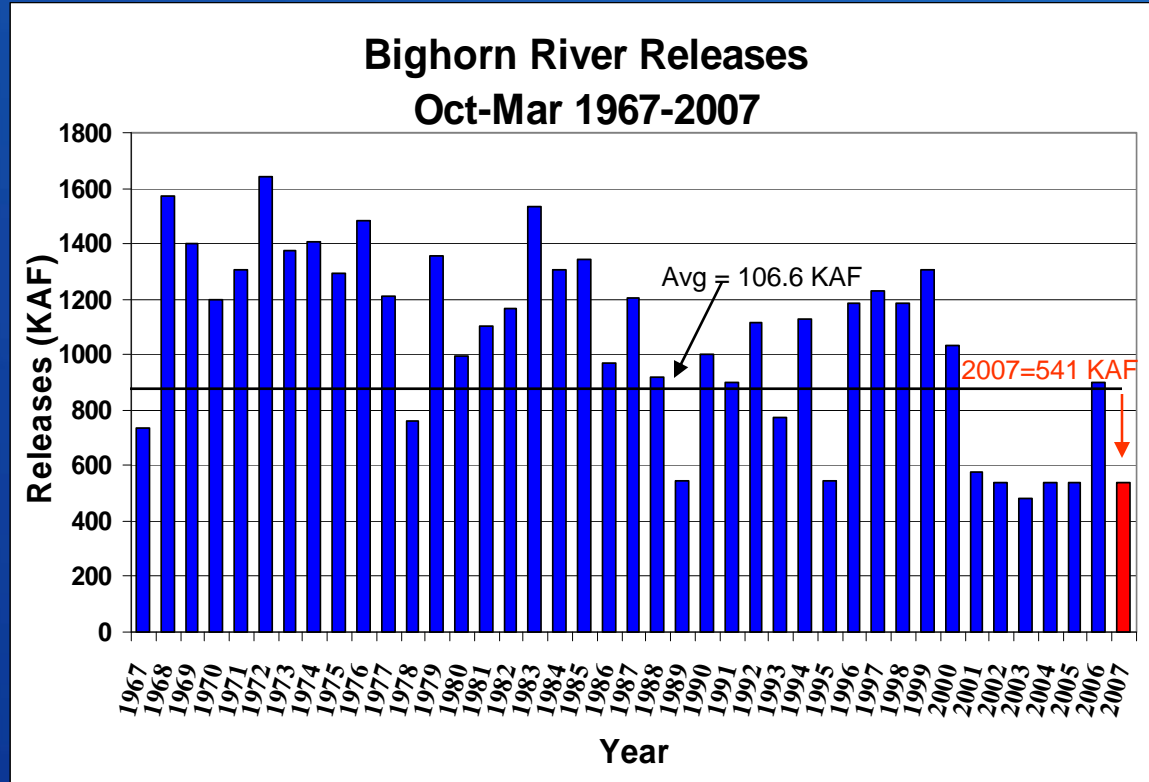
Bighorn River Releases



Recap of Water Year 2007

Oct-Mar River Release (acre-feet)

BY YEAR			RANKED		
YEAR	SUMMATION	MISS	YEAR	SUMMATION	
1967	758204.75	0	1972	1643381.50	
1968	1570698.38	0	1968	1570698.38	
1969	1399907.62	0	1983	1531143.62	
1970	1196635.50	0	1976	1484718.25	
1971	1307631.50	0	1974	1406707.38	
1972	1643381.50	0	1969	1399907.62	
1973	1377199.62	0	1973	1377199.62	
1974	1406707.38	0	1979	1357071.50	
1975	1291333.50	0	1985	1343076.62	
1976	1484718.25	0	1971	1307631.50	
1977	1210292.50	0	1999	1306625.25	
1978	776026.38	0	1984	1304641.00	
1979	1357071.50	0	1975	1291333.50	
1980	992951.94	0	1997	1231461.00	
1981	1100649.88	0	1977	1210292.50	
1982	1163055.75	0	1987	1204937.25	
1983	1531143.62	0	1970	1196635.50	
1984	1304641.00	0	1996	1186483.50	
1985	1343076.62	0	1998	1184553.00	
1986	969729.94	0	1982	1163055.75	
1987	1204937.25	0	1994	1125525.88	
1988	916216.50	0	1992	1118006.12	
1989	629338.50	0	1981	1100649.88	
1990	1000290.69	0	2000	1030263.12	
1991	901986.44	0	1990	1000290.69	
1992	1118006.12	0	1980	992951.94	
1993	835737.81	0	1986	969729.94	
1994	1125525.88	0	1988	916216.50	
1995	578133.38	0	1991	901986.44	
1996	1186483.50	0	2006	897538.81	
1997	1231461.00	0	1993	835737.81	
1998	1184553.00	0	1978	776026.38	
1999	1306625.25	0	1967	758204.75	
2000	1030263.12	0	2001	733380.50	
2001	733380.50	0	1989	629338.50	
2002	541076.38	0	1995	578133.38	
2003	482133.72	0	2004	545165.75	
2004	545165.75	0	2007	541196.25	
2005	538765.00	0	2002	541076.38	
2006	897538.81	0	2005	538765.00	
2007	541196.25	0	2003	482133.72	



2000's - Lowest of Record

2007 - 4th Lowest of Record

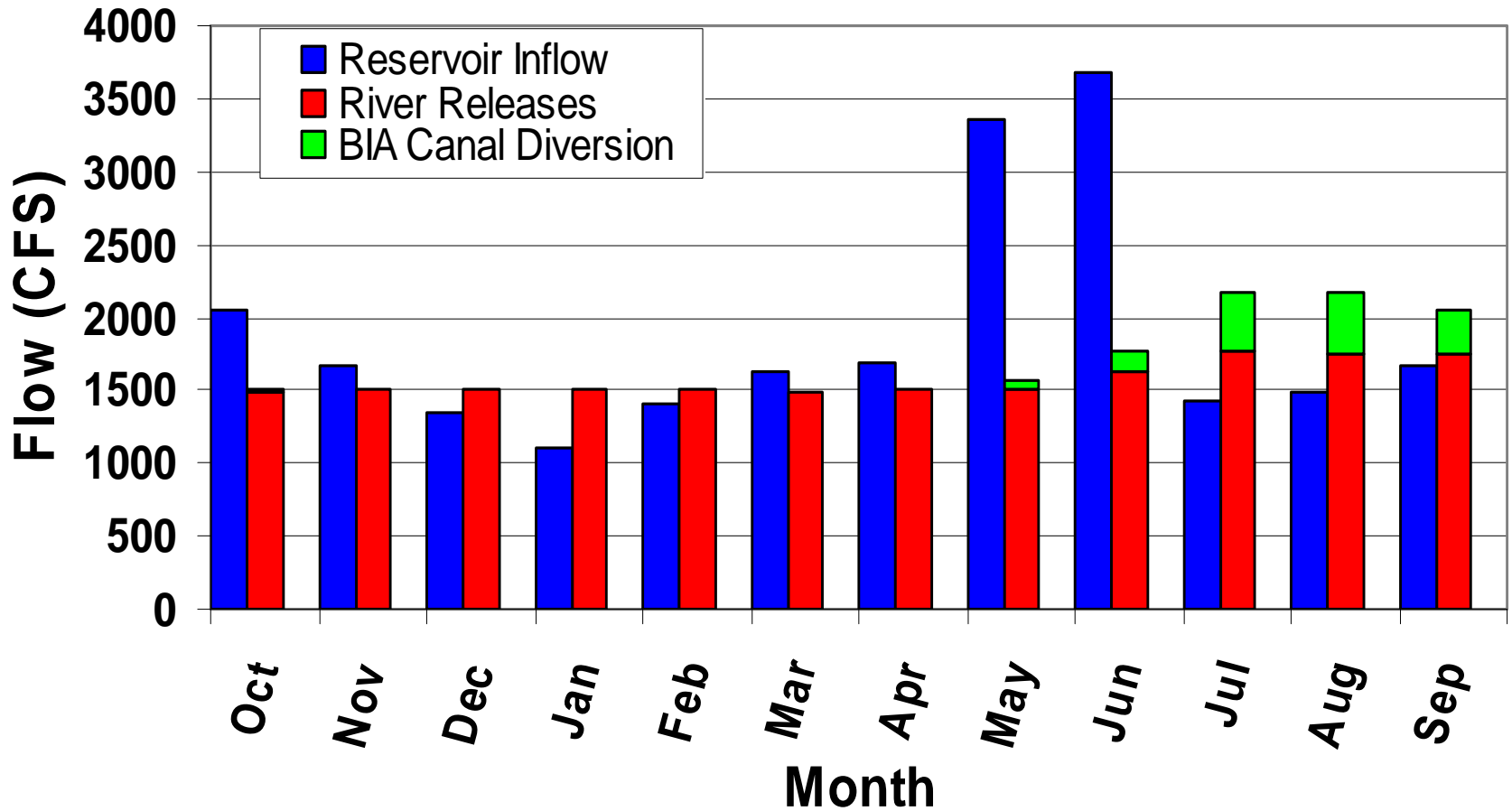
Average of 41 years:
2007 is 50.76% of average

1066191.75

RECLAMATION

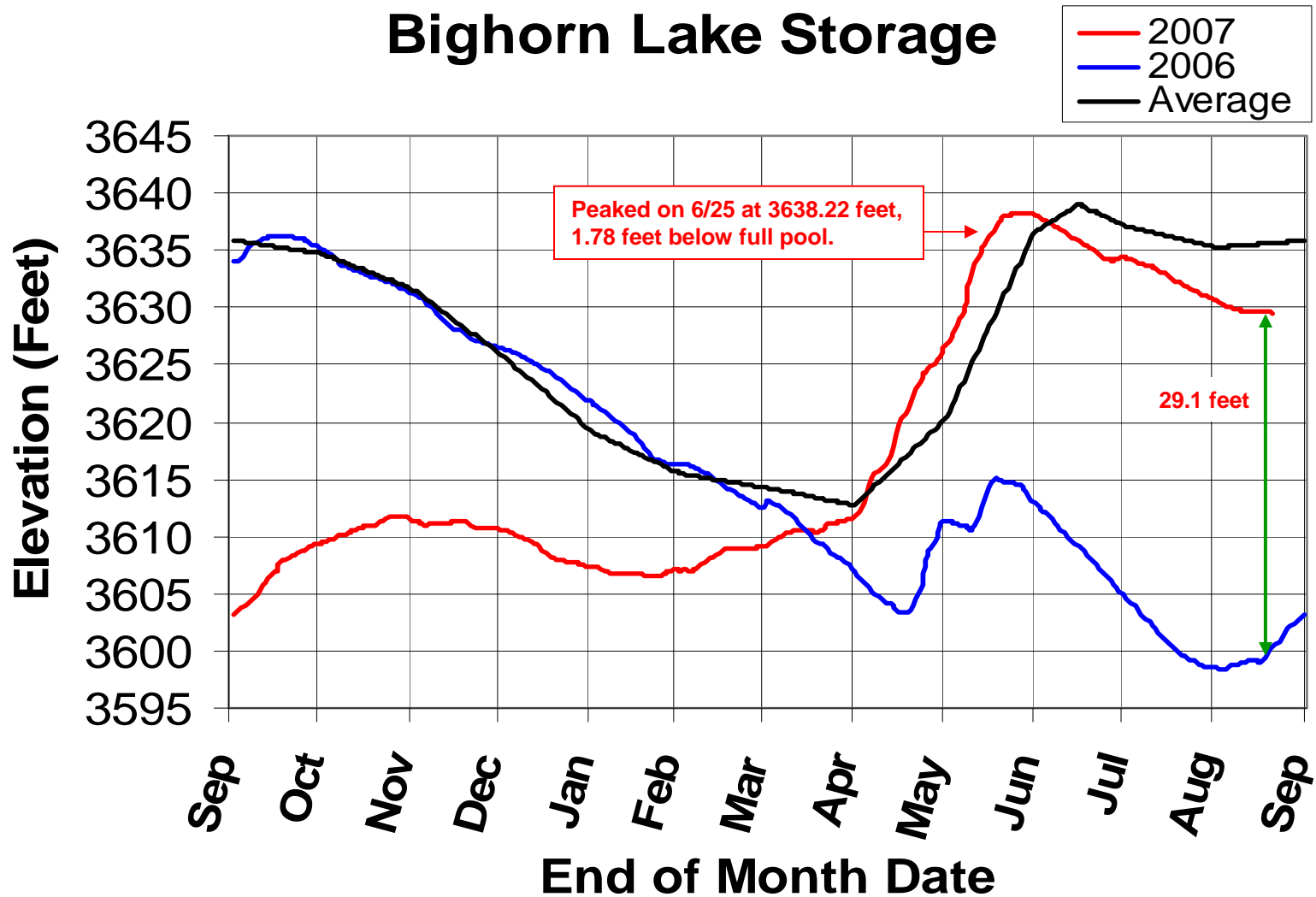
Recap of Water Year 2007

2007 Bighorn Flows



Recap of Water Year 2007

Bighorn Lake Storage



BIGHORN LAKE CURRENT CONDITIONS

September 19, 2007

Elevation

3629.6 ft – 10.4 feet below full pool

29.1 feet higher than last year

Storage

955,800 af – 89% full

Inflows = 1,870 cfs

Total Outflow = 1950 cfs

River = 1,750 cfs

BIA Canal = 200 cfs

RECLAMATION

Water Supply Forecasts

- Reclamation monitors snow pack data each month from mid-October through May
- By about February 1 snow pack becomes a major factor
- Monthly plans are adjusted as needed based primarily on snow data
- Significant changes to operation plans may be needed
- Fall forecasts are heavily dependent upon statistical information and analysis

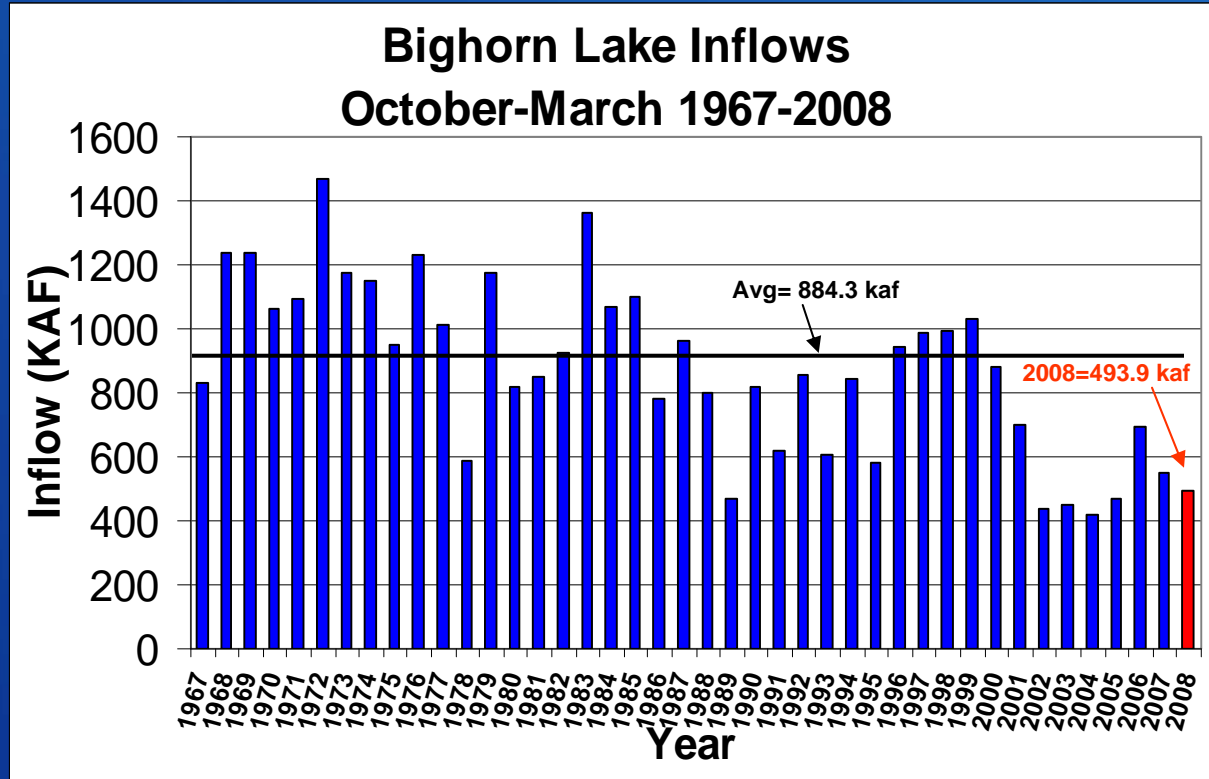
Oct. 2007-Mar. 2008 Water Supply Outlook

Oct-Mar Inflow

BY YEAR			RANKED		
YEAR	SUMMATION	MISS	YEAR	SUMMATION	
1967	834245.12	0	1972	1470721.38	
1968	1238291.88	0	1983	1364720.00	
1969	1240469.62	0	1969	1240469.62	
1970	1061894.50	0	1968	1238291.88	
1971	1095205.50	0	1976	1233259.12	
1972	1470721.38	0	1973	1177332.88	
1973	1177332.88	0	1979	1174329.25	
1974	1147734.25	0	1974	1147734.25	
1975	946935.31	0	1985	1097558.88	
1976	1233259.12	0	1971	1095205.50	
1977	1015415.69	0	1984	1069980.50	
1978	590550.12	0	1970	1061894.50	
1979	1174329.25	0	1999	1031390.69	
1980	815887.88	0	1977	1015415.69	
1981	849700.56	0	1998	994570.38	
1982	926300.62	0	1997	988951.00	
1983	1364720.00	0	1987	961437.62	
1984	1069980.50	0	1975	946935.31	
1985	1097558.88	0	1996	943944.00	
1986	781831.69	0	1982	926300.62	
1987	961437.62	0	2000	884101.38	
1988	801650.38	0	1992	856148.94	
1989	468751.25	0	1981	849700.56	
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1991	617245.12	0	1967	834245.12	
1992	856148.94	0	1990	818507.44	
1993	603146.94	0	1980	815887.88	
1994	846254.44	0	1988	801650.38	
1995	581452.56	0	1986	781831.69	
1996	943944.00	0	2001	700601.75	
1997	988951.00	0	2006	695317.38	
1998	994570.38	0	1991	617245.12	
1999	1031390.69	0	1993	603146.94	
2000	884101.38	0	1978	590550.12	
2001	700601.75	0	1995	581452.56	
2002	438375.44	0	2007	552314.31	
2003	452875.66	0	1989	468751.25	
2004	419681.56	0	2005	468269.72	
2005	468269.72	0	2003	452875.66	
2006	695317.38	0	2002	438375.44	
2007	552314.31	0	2004	419681.56	

Average of 41 years:
2007 is 57.0% of average

884325.56

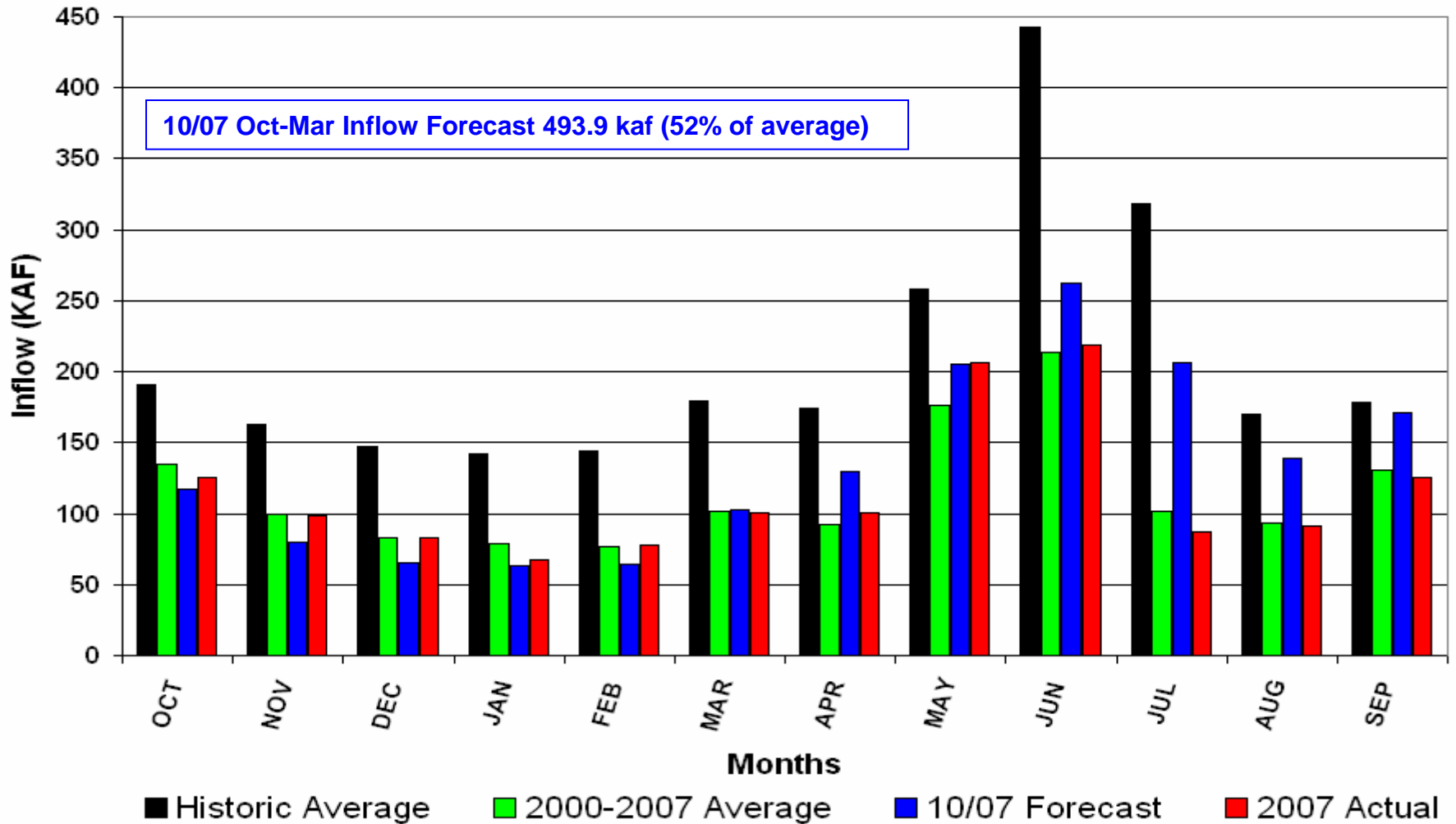


2000's - Lowest of Record

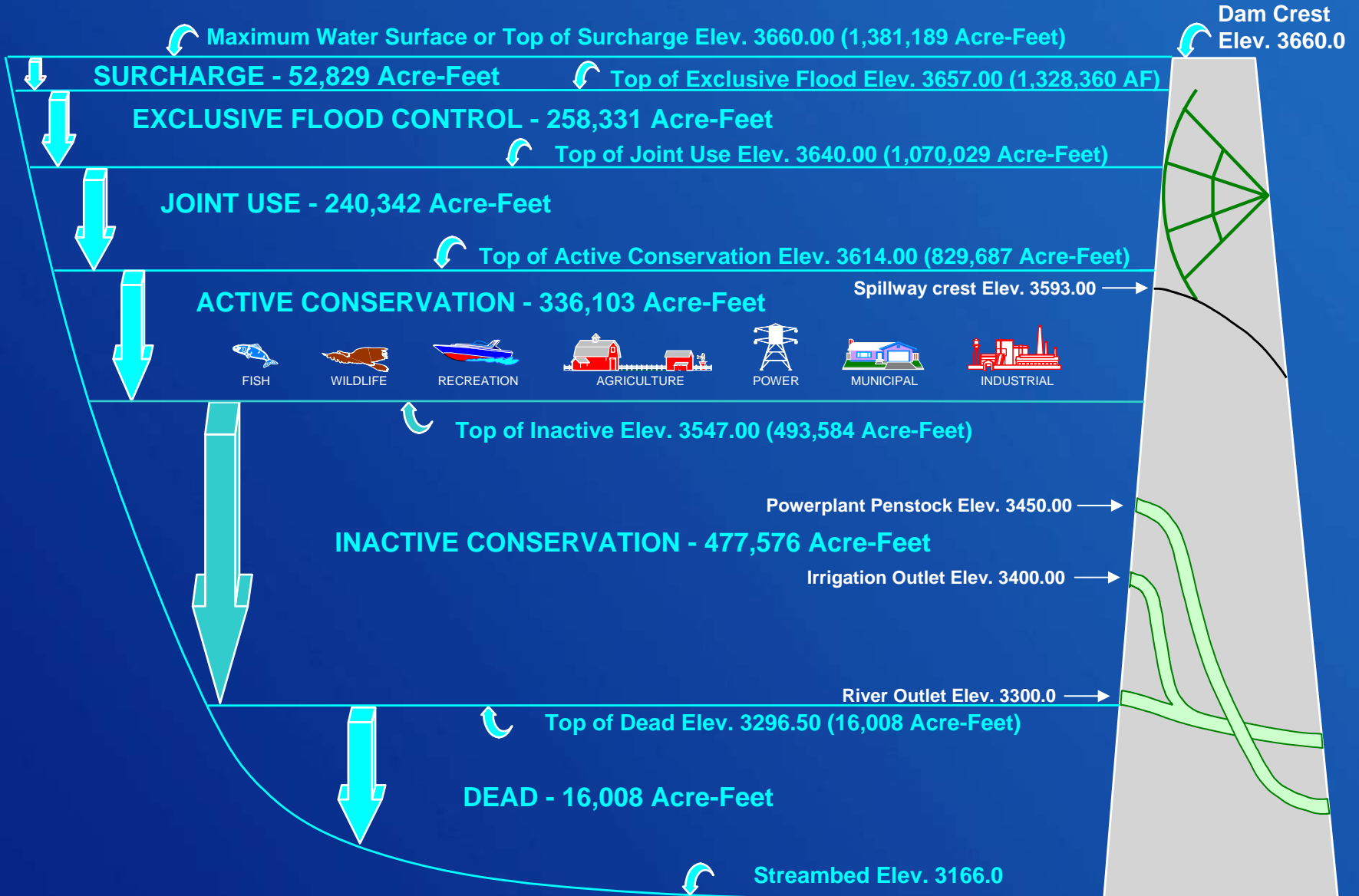
2007 - 6th Lowest of Record

2008 Forecast - 493,900 af (52% of average)

Bighorn Lake Inflows

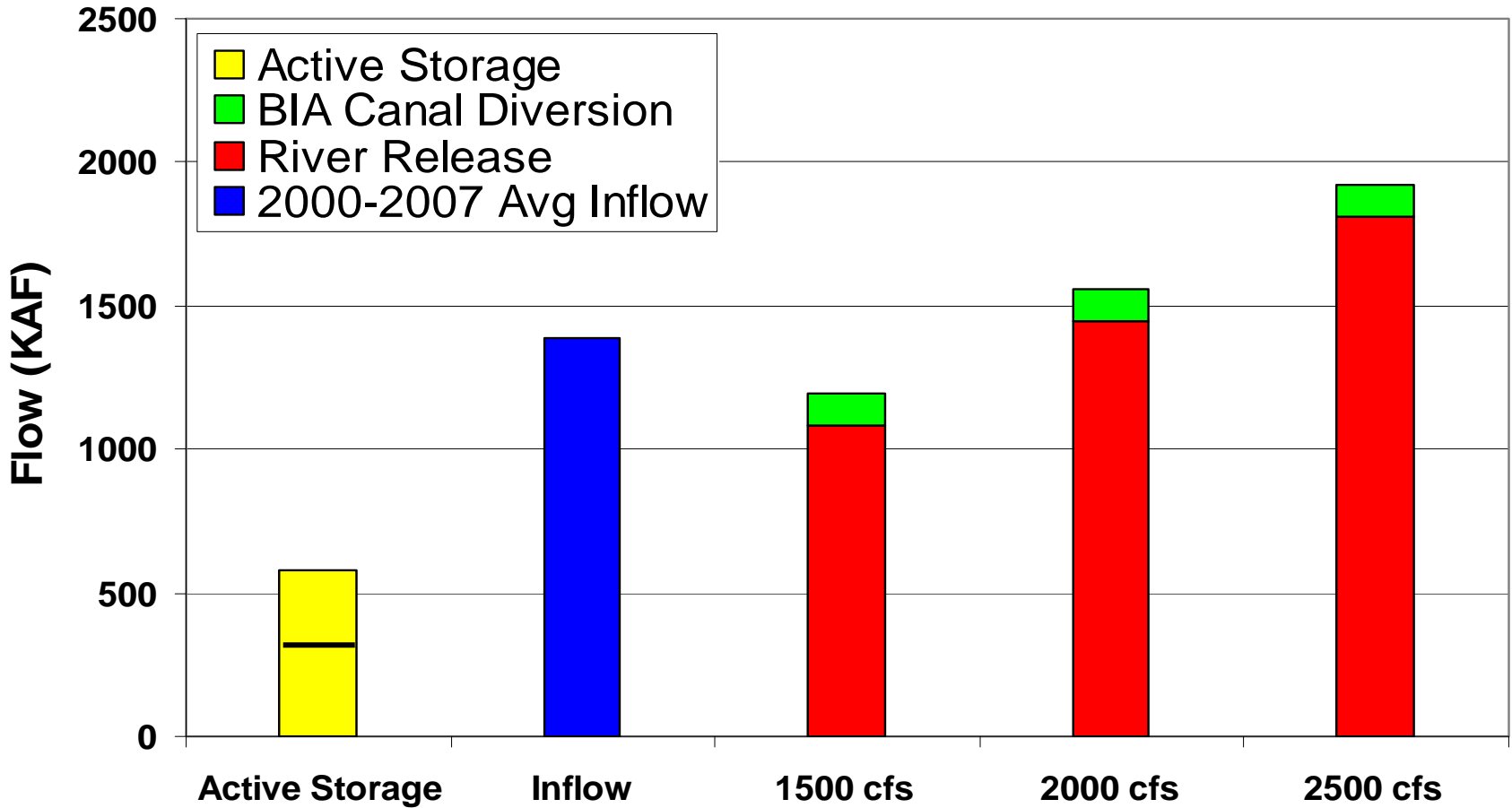


BIGHORN RESERVOIR ALLOCATIONS



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Bighorn Lake Inflow and Release Comparison



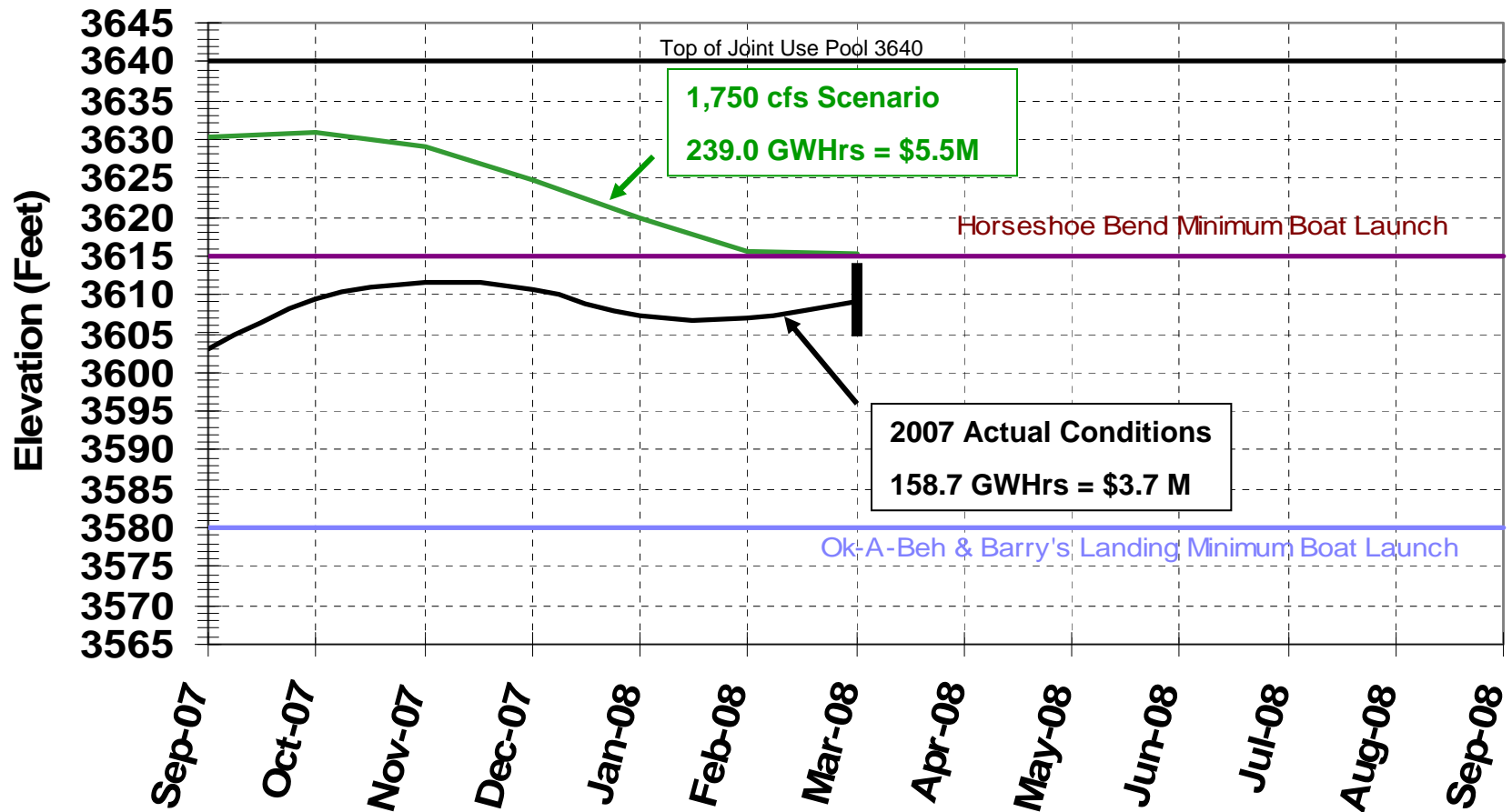
Bighorn Lake Operation Scenarios

Most Probable Inflows (1,750 cfs Scenario):

- Maintain fall and winter release at 1,750 cfs through March
- Reservoir level expected to reach elevation 3615 by the end of March (typical flood control target is 3605 to 3614).
- Generation during October – March would total 239.0 GWHrs.

1,750 CFS Scenario

BIGHORN LAKE ELEVATION



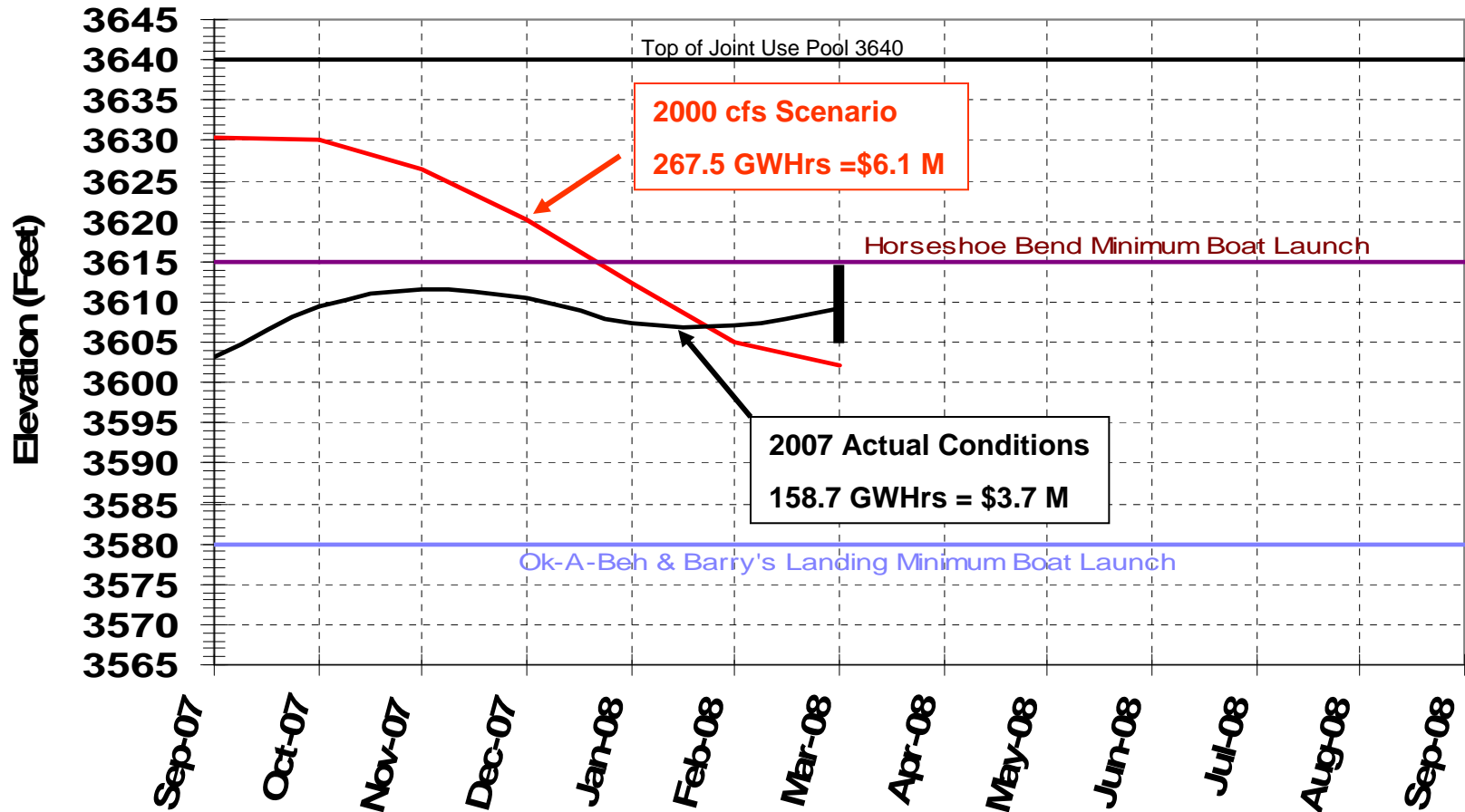
Bighorn Lake Operation Scenarios

Most Probable Inflows (2,000 cfs Scenario):

- Increase release from 1,750 cfs in mid-October and maintain at 2,000 cfs through March.
- Reservoir level expected to reach elevation 3602 by the end of March (typical flood control target is 3605 to 3614).
- Generation during October – March would total 267.5 GWHrs.

2,000 CFS Scenario

BIGHORN LAKE ELEVATION



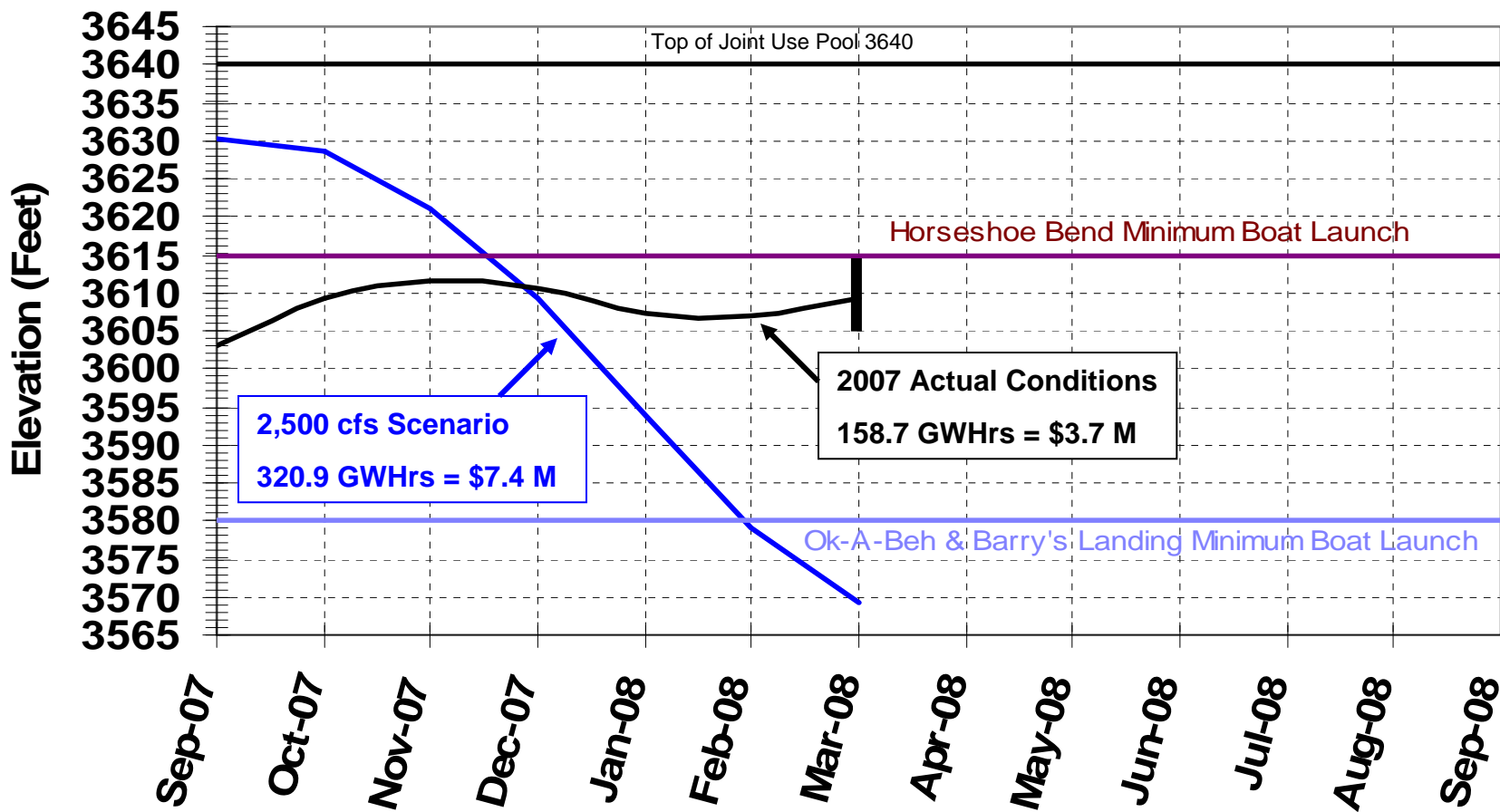
Bighorn Lake Operation Scenarios

Most Probable Inflows (2,500 cfs Scenario):

- Increase release from 1,750 cfs during mid-October and maintain at 2,500 cfs through March.
- Reservoir level expected to reach elevation 3569 by the end of March (typical flood control target is 3605 to 3614).
- Generation during October – March would total 320.9 GWHrs.

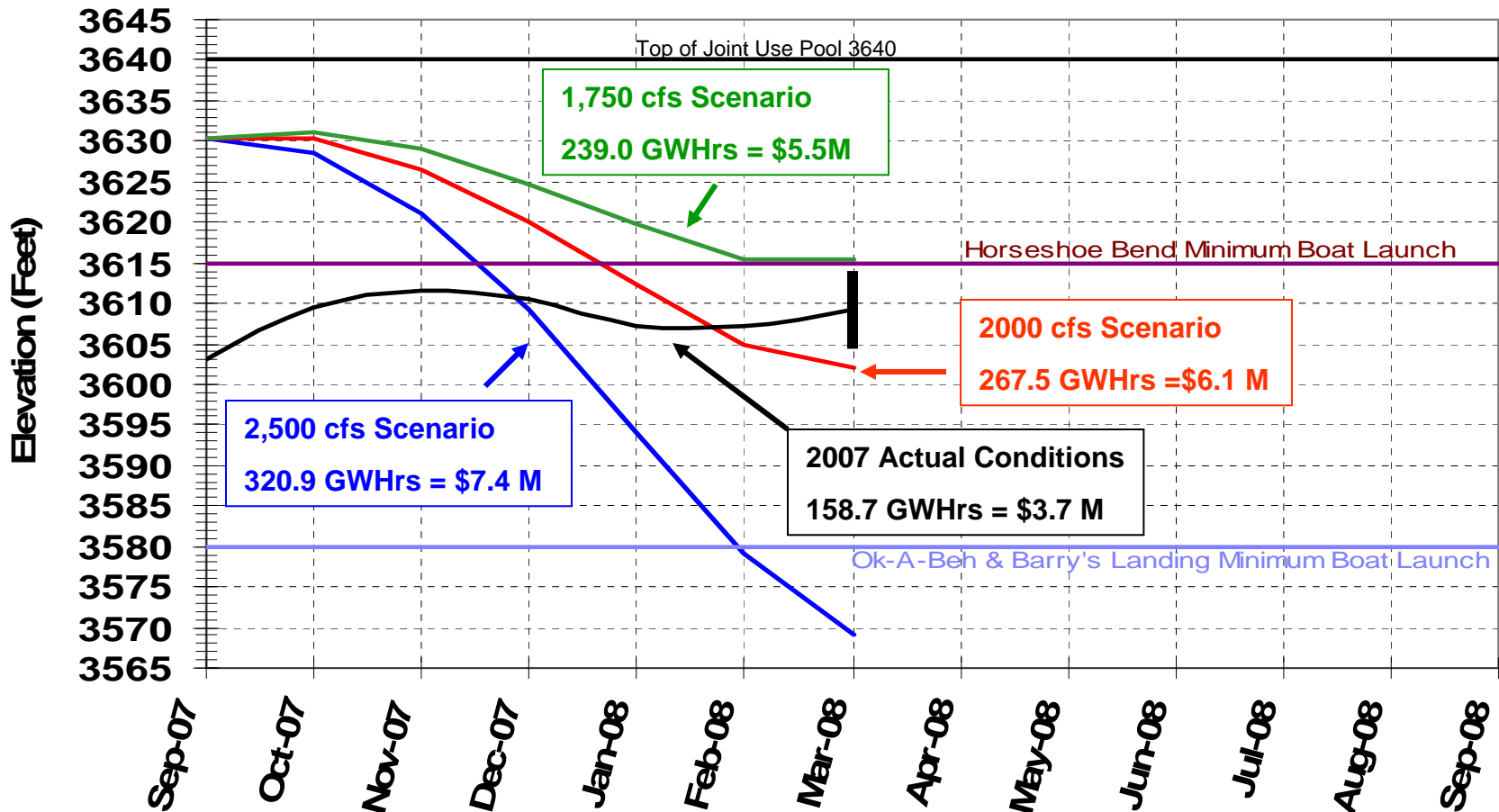
2,500 CFS Scenario

BIGHORN LAKE ELEVATION



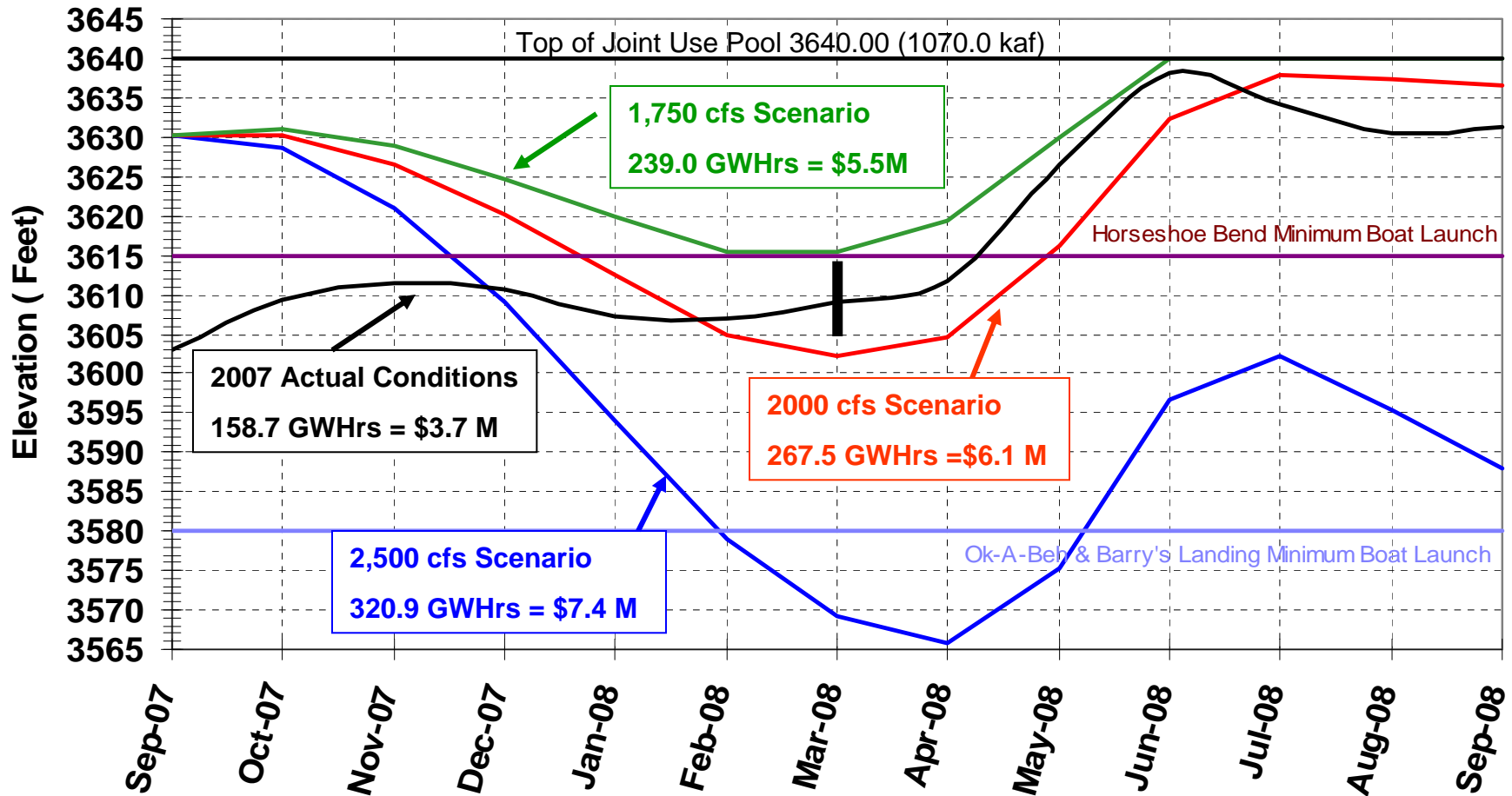
Comparison of Scenarios

BIGHORN LAKE ELEVATION



Scenarios Projected Out Through 12 Months

BIGHORN LAKE ELEVATION



Reclamation's Internet Website

<http://www.usbr.gov/gp/water/>

- near real-time data available through the HYDROMET data system
- summaries and plots of historical data
- annual reservoir operating plan publication
- monthly water supply reports
- project data
- snow plots
- links to related internet sites

RECLAMATION

- **Discussion & Comments**

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Comments ?

The information presented at this meeting can be found on the Montana Area Office website at:

www.usbr.gov/gp/mtao/yellowtail/index.cfm.

Please mail comments to:

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Bureau of Reclamation

2900 4th Avenue North, Suite 501

Billings, MT 59107

fax your comments to:

406-247-7338

or email your comments to:

pholwegner@gp.usbr.gov

by **October 4, 2007**

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