RECLAMATION
Managing Water in the West

Yellowtail Dam & Bighorn Lake
2011 Operations Review

Billings, MT
October, 2011
BIGHORN LAKE
2011 Operations Review Based on Draft Criteria
<table>
<thead>
<tr>
<th></th>
<th>Target</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct 31 Lake Elev.</td>
<td>3638-3640</td>
<td>3627.72</td>
</tr>
<tr>
<td>Nov-Mar Release</td>
<td>2,370 cfs</td>
<td></td>
</tr>
<tr>
<td>Mar 31 Lake Elev.</td>
<td>3618</td>
<td>3620.91</td>
</tr>
</tbody>
</table>
Bighorn Lake 2011 Nov-Mar Operations

Lake Elevation feet

1-Nov     1-Dec     1-Jan     1-Feb     1-Mar

2011 - Planned Drawdown to 3618 - Top of Joint Use - NPS Recommended Min
Recap of Water Year 2011

Bighorn Lake November-March Inflow
1967-2011

2011 – 646 kaf
Ave. – 696 kaf
Spring Runoff Season
Recap of Water Year 2011

2011 Valley Precipitation

- Precipitation (Inches)
- Month:
  - Oct, Nov, Dec, Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sept
- Average Valley Precipitation
- Actual Valley Precipitation
Recap of Water Year 2011

Mountain Snowpack Conditions on January 1

SE = 100% of average
April-July Forecast = 1,127.6 kaf (100%)
Recap of Water Year 2011

Mountain Snowpack Conditions on February 1

SE = 108% of average
April-July Forecast = 1,160.8 kaf (102%)
Recap of Water Year 2011

Mountain Snowpack Conditions on March 1

SE = 104% of average
April-July Forecast = 1,204.3 kaf (106%)
Recap of Water Year 2011

SE = 266% of average
April-July Forecast = 2,575.2 kaf (226%)
Recap of Water Year 2011

Mountain Snowpack Conditions on April 1

SE = 113% of average
April-July Forecast = 1,400.0 kaf (123%)
Recap of Water Year 2011

Mountain Snowpack Conditions on May 1

- SE = 142% of average
- April-July Forecast = 1,905.8 kaf (167%)
Recap of Water Year 2011

SE = 266% of average
April-July Forecast = 2,575.2 kaf (226%)

Mountain Snowpack Conditions on June 1

RECLAMATION
Recap of Water Year 2011

Mountain Snowpack Conditions - 2011

Peaked on 5/22 @ 206% of average
5.9” above average peak on 4/15
Recap of Water Year 2011
6-30-2011
Recap of Water Year 2011
7-7-2011
Recap of Water Year 2011
7-21-2011
Rule Curve Operations Apr-July
Top of Conservation Elev. 3614

Top of Joint Use Elev. 3640

Top of Exclusive Flood Pool Elev. 3657

Top of Inactive Elev. 3547

Bighorn Lake
## Apr-July Forecasts 2011 & Rule Curve Targets

<table>
<thead>
<tr>
<th>Date</th>
<th>Forecast</th>
<th>% of Avg</th>
<th>Rule Curve Min Elev.</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 1</td>
<td>1,400,000</td>
<td>121%</td>
<td>3611.1</td>
<td>5/20</td>
</tr>
<tr>
<td>April 15</td>
<td>1,703,877</td>
<td>148%</td>
<td>3606.3</td>
<td>5/23</td>
</tr>
<tr>
<td>May 1</td>
<td>1,905,829</td>
<td>165%</td>
<td>3604.2</td>
<td>5/23</td>
</tr>
<tr>
<td>May 15</td>
<td>2,147,700</td>
<td>189%</td>
<td>3602.7</td>
<td>5/23</td>
</tr>
<tr>
<td>June 1</td>
<td>2,575,182</td>
<td>223%</td>
<td>3602.7</td>
<td>5/23</td>
</tr>
<tr>
<td>Actual</td>
<td>2,572,304</td>
<td>223%</td>
<td>3606.5</td>
<td>5/20</td>
</tr>
</tbody>
</table>
### 2011 New Record Event

**Previous Record set in 1967**

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>1967</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr-Jul Volume</td>
<td>2,572,304 af</td>
<td>2,271,121 af</td>
</tr>
<tr>
<td></td>
<td>+301,183 af</td>
<td></td>
</tr>
<tr>
<td>Apr-Jul % of Avg</td>
<td>223%</td>
<td>197%</td>
</tr>
<tr>
<td></td>
<td>+13%</td>
<td></td>
</tr>
<tr>
<td>Peak River Release</td>
<td>15,460 cfs</td>
<td>24,090 cfs</td>
</tr>
<tr>
<td></td>
<td>-8,630 cfs</td>
<td></td>
</tr>
<tr>
<td>Peak Lake Elev.</td>
<td>3655.03</td>
<td>3656.43</td>
</tr>
<tr>
<td></td>
<td>-1.40</td>
<td></td>
</tr>
</tbody>
</table>

**RECLAMATION**
<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>1967</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr-July Volume @ St. X.</td>
<td>2,971,249 af</td>
<td>2,866,858 af</td>
</tr>
<tr>
<td></td>
<td>+104,391 af</td>
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</tr>
<tr>
<td>Peak Flow @ St. X.</td>
<td>39,580 cfs</td>
<td>45,537 cfs</td>
</tr>
<tr>
<td></td>
<td>-5,957 cfs</td>
<td></td>
</tr>
<tr>
<td>Apr-July Gains</td>
<td>717,806 af</td>
<td>569,975 af</td>
</tr>
<tr>
<td></td>
<td>+147,831 af</td>
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</tbody>
</table>
Recap of Water Year 2011

Bighorn Lake April-July Inflow
1967-2011

2011 – 2,572 kaf
Ave. – 1,138 kaf

April-July Inflow (kaf)

Years

2011
Bighorn River System Operations

Three main Reservoirs

Boysen Reservoir – Wind River

Buffalo Bill Reservoir – Shoshone River

Bighorn Lake – Bighorn River
# Apr-July Reservoir Inflows

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>Inflow AF</th>
<th>% of Avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boysen</td>
<td>994,772</td>
<td>163%</td>
</tr>
<tr>
<td>Buffalo Bill</td>
<td>1,230,390</td>
<td>179%</td>
</tr>
<tr>
<td>Gains</td>
<td>717,807</td>
<td>582%</td>
</tr>
<tr>
<td>Bighorn Lake</td>
<td>2,572,304</td>
<td>223%</td>
</tr>
<tr>
<td>Reservoir</td>
<td>A-J Flow af</td>
<td>% of Total</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------</td>
<td>------------</td>
</tr>
<tr>
<td>Boysen Release</td>
<td>833,063</td>
<td>32%</td>
</tr>
<tr>
<td>Buffalo Bill Release</td>
<td>1,043,475</td>
<td>40%</td>
</tr>
<tr>
<td>Bighorn Gains</td>
<td>717,807</td>
<td>28%</td>
</tr>
<tr>
<td>Bighorn Lake</td>
<td>2,572,304</td>
<td>100%</td>
</tr>
<tr>
<td>Reservoir</td>
<td>Space Used AF</td>
<td>% of Available</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Boysen</td>
<td>368,694</td>
<td>55%</td>
</tr>
<tr>
<td>Buffalo Bill</td>
<td>320,359</td>
<td>53%</td>
</tr>
<tr>
<td>Bighorn Lake</td>
<td>500,703</td>
<td>62%</td>
</tr>
<tr>
<td>Total</td>
<td>1,188,756</td>
<td>57%</td>
</tr>
</tbody>
</table>
Percent of Total Useable Storage Space Filled
Conservation, Joint Use and Exclusive Flood Pools

Percent of Total Useable Storage Space Filled

Conservation, Joint Use and Exclusive Flood Pools

4/1 5/1 6/1 7/1

Boysen Buffalo Bill Yellowtail Full Level

RECLAMATION
Composite Reservoir
2011 Bighorn River Basin System Operations (Composite Reservoir)

- Joint Use Pool: 376,594 af
- Exclusive Flood Pool: 408,955 af

Flow (cfs) and Acre-feet graph showing:
- Unregulated
- Regulated Flow
- Composite Storage
- Top of Joint Use
- Top of Exclusive Flood Pool
- Top of Active Conservation
2011 COMPARED TO 1967
2011 v. 1967 Bighorn Composite Reservoir Storage

Joint Use Pool 376,594 af
Exclusive Flood Pool 408,955 af
2011 v 1967 Unregulated Flow
Bighorn River at St. Xavier

Flow cfs

0 5,000 10,000 15,000 20,000 25,000 30,000 35,000 40,000 45,000 50,000

4/1 5/1 6/1 7/1

2011 Unregulated 1967 unregulated

RECLAMATION
2011 v. 1967 Regulated Flow
Bighorn River at St. Xavier

Flow cfs

2011 Regulated Flow
1967 Regulated Flow
Questions or Comments