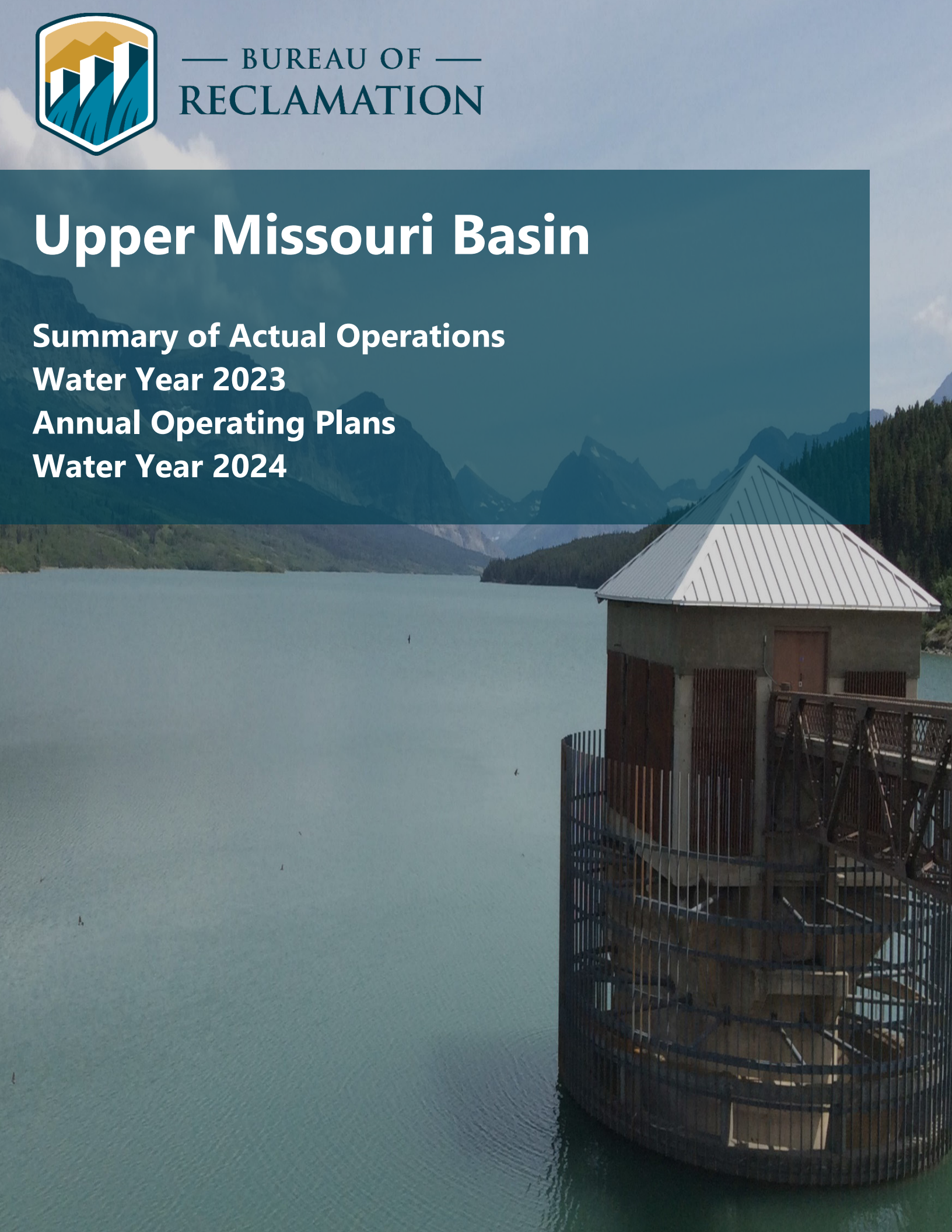
BUREAU OF RECLAMATION

# Upper Missouri Basin

## Summary of Actual Operations
## Water Year 2023
## Annual Operating Plans
## Water Year 2024



# Mission Statements

The U.S. Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; honors its trust responsibilities or special commitments to American Indians, Alaska Natives, Native Hawaiians, and affiliated Island Communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

**Cover Image** – Lake Sherburne, Glacier National Park (Department of the Interior)

# Upper Missouri River Basin

## Summary of Actual Operations
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Prepared by:

**Bureau of Reclamation**
**Technical Services Center, Hydrology and Water Operations**
**Wyoming Area Office**
**Montana Area Office**
**Dakotas Area Office**

# Acronyms and Abbreviations

| | |
|---|---|
| abv | above |
| AF | acre-feet |
| AOP | Annual Operating Plan |
| ASI | Annual Site Inspection |
| Avg | average |
| B | Boysen Reservoir |
| BB | Buffalo Bill Reservoir |
| BFID | Belle Fourche Irrigation District |
| CCID | Crook County Irrigation District |
| Corps | U.S. Army Corps of Engineers (USACE) |
| Div. | Diversion |
| EAP | Emergency Action Plan |
| EOM | end of month |
| FONSI | finding of no significant impact |
| ft | foot/feet |
| $ft^3/s$ | cubic feet per second |
| GID | Greenfields Irrigation District |
| gwh | gigawatt hours |
| HVID | Helena Valley Irrigation District |
| IDF | Inflow Design Flood |
| IJC | International Joint Commission |
| Insp | Inspection |
| KAF | Thousand acre-feet |
| kw | kilowatts |
| Max | maximum |
| Midvale | Midvale Irrigation District |
| Min | minimum |
| MRJBC | Milk River Joint Board of Control |

| | |
|---|---|
| msl | mean sea level |
| MTAO | Montana Area Office (Reclamation) |
| Mtn | Mountain |
| MW | Megawatt(s) |
| MWh | Megawatt-hours |
| N/A | not available |
| NRCS | Natural Resource Conservation Service |
| P-S MBP | Pick-Sloan Missouri Basin Program |
| PFR | Periodic Facility Review |
| Reclamation | Bureau of Reclamation |
| SM | Spirit Mountain |
| SMED | Spirit Mountain energy dissipation |
| SNOTEL | Snow Telemetry |
| SOD | Safety of Dams |
| SWE | snow water equivalent |
| System | system of dams, reservoirs, and powerplants on the North Platte River |
| USFWS | United States Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| Western | Western Area Power Administration (WAPA) |
| WGF | Wyoming Game and Fish Department |
| WY | water year |
| WYAO | Wyoming Area Office (Reclamation) |
| yr. | Year |

## Symbols

| | |
|---|---|
| # | number |
| % | percent |

# Contents

## Tables

## Figures

# Annual Operating Plans for Water Year 2023 for Bighorn Basin Units Under the Responsibility of the Wyoming Area Office (WYAO)

## Riverton Unit

The Riverton Project was reauthorized as the Riverton Unit Pick-Sloan Missouri Basin Program (P-S MBP) on September 25, 1970. Major facilities of this unit are Bull Lake Reservoir, Wind River Diversion Dam, Wyoming Canal, Pilot Butte Powerplant, Pilot Butte Reservoir, and Pilot Butte Canal. The major facilities provide irrigation water to approximately 73,000 acres on the Midvale Irrigation District (Midvale). The water supply comes partly from the natural flow of the Wind River and partly from water stored in Bull Lake and Pilot Butte Reservoirs.

### Bull Lake Reservoir

Bull Lake Reservoir is located on Bull Lake Creek, a tributary of the Wind River near Crowheart, Wyoming. Bull Lake has an active capacity of 151,737 acre-feet (AF) and is above all unit land. It is the principal storage facility for the unit and is operated by Midvale under contract with Reclamation. A small amount of flood control benefit is provided by normal operation for other purposes. However, when the Bull Lake Spillway is not operational the peak releases are limited to that of the outlet works (approximately 4,000 cubic feet per second [$ft^3/s$]). The status of the spillway requires adaptation of normal flood control operations as it is necessary to increase outflow as the inflows increase.

During the past several years, Midvale and Bureau of Reclamation (Reclamation) have entered into an annual agreement whereby Reclamation could store Boysen water in Bull Lake under any combination of four conditions set forth in the agreement. The agreement was approved for 2023 and the non-irrigation season releases were maintained above the required minimum flow rate of 20 $ft^3/s$. As outlined in the agreement, a minimum of 20 $ft^3/s$ of the reservoir releases were accounted for as Boysen water being released from Bull Lake.

#### *Summary of 2023 Operations*

Bull Lake Reservoir carried 66,220 AF of storage into water year (WY) 2023, 44 percent of the reservoir's active storage capacity. Table 1 below shows the monthly inflows, outflows, end of month (EOM) storage, and forebay elevation at Bull Lake Reservoir. First of month snow water equivalent (SWE) values, as represented by the snow telemetry (SNOTEL) sites within/near the basin above Bull Lake, are also shown. For each monthly inflow, outflow, storage, and SWE value the corresponding percent of average (30 years of historical data) are also shown.

**Table 1—WYT - Monthly inflow, outflow, storage, forebay elevation, and snow data for Bull Lake Reservoir**

| Month | Inflow (KAF) | Percent of 30-yr average | Outflow (KAF) | Percent of 30-yr average | EOM Storage (KAF) | Percent of 30-yr average | Elevation feet (ft) | Snow (in) | Percent of 30-yr average |
|---|---|---|---|---|---|---|---|---|---|
| Oct. 2022 | 7.5 | 117 | 2.3 | 36 | 71.4 | 94 | 5,776.0 | 0.1 | 0 |
| Nov. 2022 | 4.0 | 120 | 1.7 | 69 | 71.0 | 92 | 5,775.8 | 0.5 | 35 |
| Dec. 2022 | 3.6 | 147 | 1.7 | 85 | 72.9 | 94 | 5,776.6 | 2.7 | 85 |
| Jan. 2023 | 3.3 | 154 | 1.7 | 87 | 74.5 | 96 | 5,777.2 | 5.2 | 108 |
| Feb. 2023 | 2.2 | 127 | 1.6 | 93 | 75.2 | 96 | 5,777.5 | 7.2 | 106 |
| Mar. 2023 | 2.5 | 123 | 1.7 | 95 | 75.9 | 97 | 5,777.8 | 8.4 | 99 |
| Apr. 2023 | 4.9 | 118 | 2.2 | 68 | 78.6 | 100 | 5,778.9 | 11.5 | 104 |
| May 2023 | 46.2 | 158 | 17.7 | 134 | 107.1 | 113 | 5,789.7 | 12.2 | 113 |
| June 2023 | 87.5 | 134 | 49.6 | 169 | 145.0 | 111 | 5,802.6 | 2.0 | 111 |
| July 2023 | 48.4 | 106 | 49.2 | 112 | 144.1 | 109 | 5,802.3 | 0.0 | 0 |
| Aug. 2023 | 25.6 | 130 | 33.5 | 69 | 136.2 | 131 | 5,799.8 | 0.0 | 0 |
| Sep. 2023 | 9.5 | 100 | 63.6 | 173 | 82.1 | 107 | 5,780.3 | 0.0 | 0 |
| WY2023 | 245.1 | 128 | 226.5 | 119 | | | | | |

Inflow and outflow values are summed for the entire month, storage and elevation values are from the end of the month, and snow values are from the beginning of the month.

Using hydrological state data (snowpack, stream flows, etc.) forecasts of the April through July inflow volume are made each month between January and June. Table 2 shows the forecast amounts that were made in WY2023. For each forecast, table 2 shows the percent of average of the forecast compared to 30-years of historical inflow data.

**Table 2.—WYT - Forecasts of the April–July inflow volumes made into Bull Lake Reservoir each month starting in January and ending in June**

| Forecast issue month | April–July inflow forecast (KAF) | Percent of 30-yr average inflow |
|---|---|---|
| January 2023 | 150 | 104 |
| February 2023 | 170 | 118 |
| March 2023 | 170 | 118 |
| April 2023 | 160 | 111 |
| May 2023 | 155 | 108 |
| June 2023 | 151 | 105 |

Midvale began diverting water into the Wyoming Canal on May 5. Prolonged cold temperatures and snow on the ground delayed the start of the irrigation season. Diversions into the Wyoming Canal continued through October 6. The peak diversion of 1,416 $ft^3/s$ occurred on July 22. Additional hydrologic and statistical information pertaining to Bull Lake operations during 2023 can be found in tables 3, 4, and 5 and figure 1.

**Table 3.—WYT - Reservoir allocations for Bull Lake Reservoir**

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 5,739.00 | 722 | 722 |
| Top of active conservation | 5,805.00 | 152,459 | 151,737 |

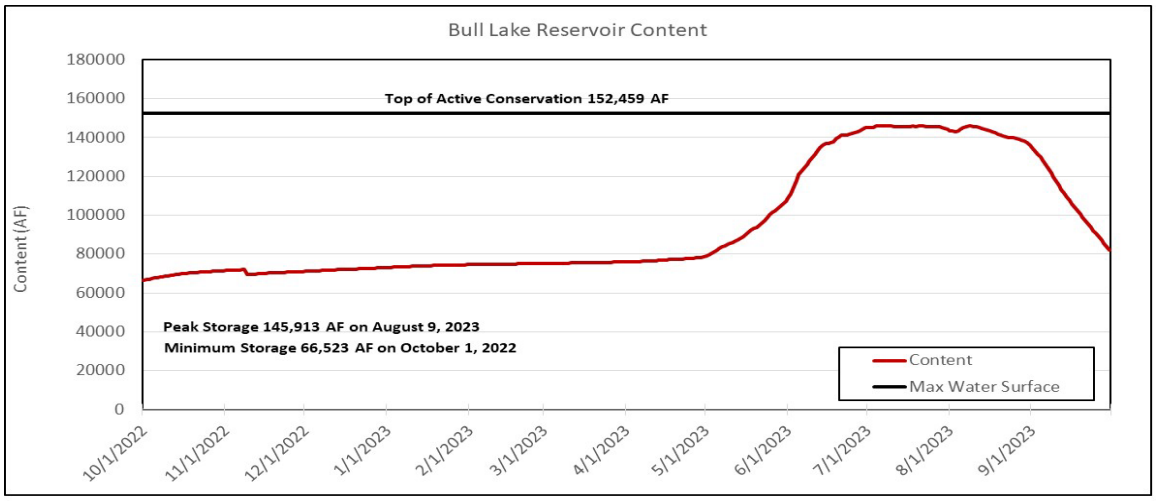
**Table 4.—WYT - Storage and elevation data for Bull Lake Reservoir**

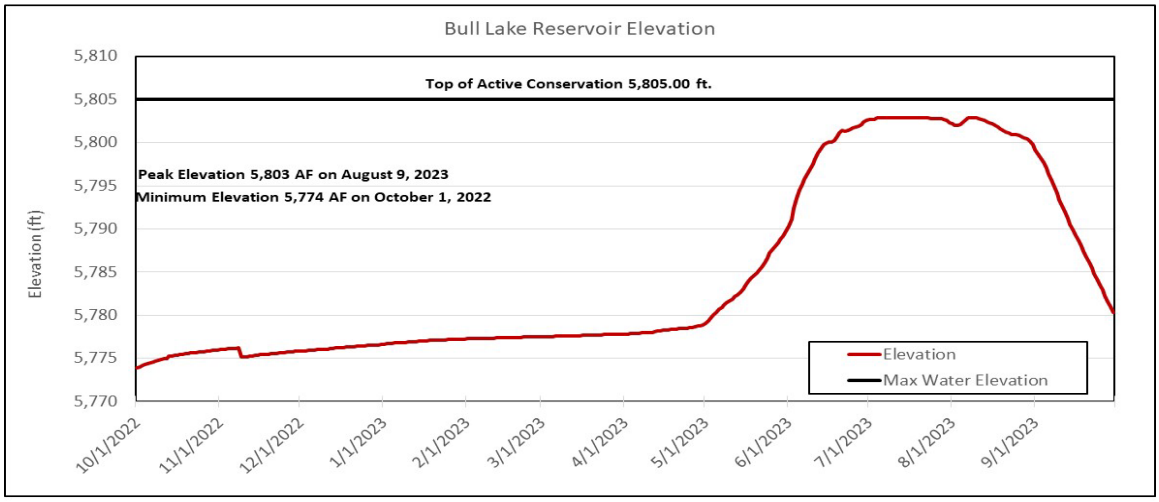
| Storage-elevation data | Elevation (feet) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 5,773.9 | 66,523 | 10/1/2022 |
| End of year | 5,780.31 | 82,146 | 9/30/2023 |
| Annual low | 5,773.9 | 66,523 | 10/1/2022 |
| Historic low* | 5,743.03 | 6,228 | 9/2/1950 |
| Annual high | 5,802.91 | 145,913 | 8/9/2023 |
| Historic high | 5,805.70 | 154,677 | 8/10/1965 |

* Prior to 1952 daily records were not available. End of month records were used to determine the historic low.

**Table 5.—WYT - Inflow and discharge data for Bull Lake Reservoir**

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 245,139 | Oct. '22–Sep. '23 | 226,540 | Oct. '22–Sep. '23 |
| Daily peak ($ft^3/s$) | 2,669 | 6/21/2023 | 2,281 | 6/21/2023 |
| Daily minimum ($ft^3/s$) | 22 | 9/27/2023 | 27 | 11/6/2022 |
| Peak spillway flow ($ft^3/s$) | N/A | N/A | 0 | N/A |
| Total spillway flow (AF) | N/A | N/A | 0 | N/A |



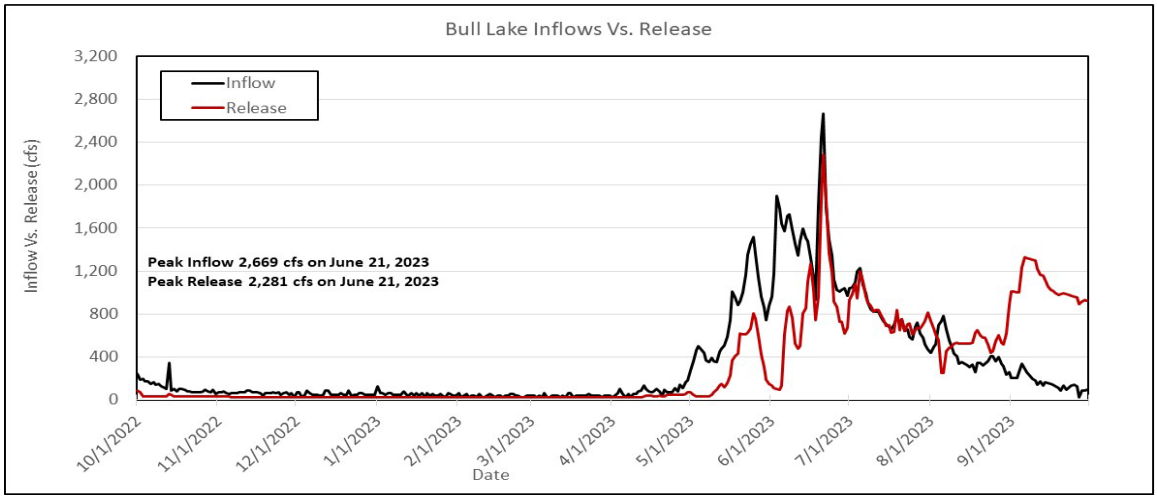




**Figure 1.—WYG - WY2023 storage, forebay elevation, inflow, and release at Bull Lake Reservoir.**

## Pilot Butte Reservoir

Pilot Butte Reservoir is an off-stream reservoir near Kinnear, Wyoming, and receives its water supply from the Wind River via the Wyoming Canal. Pilot Butte Reservoir has a total capacity of 33,721 AF. Of this amount 3,803 AF is inactive and 29,918 AF is active conservation storage. Pilot Butte Dam and the Wyoming Canal, which supplies the reservoir, are operated by Midvale under contract with Reclamation. The turbines at the inlet of the Wyoming Canal are currently in inactive status.

### *Summary of 2023 Operations*

Pilot Butte Reservoir began WY2023 with 17,985 AF of storage, at a pool elevation of 5,439.96 feet above mean sea level (msl). During October, the Bull Lake exchange agreement took place and Pilot Butte stored 9,944 AF as a part of the exchange. The agreement allows Midvale to divert and store an additional 10,000 AF of water from Bull Lake to Pilot Butte Reservoir via the Wyoming Canal. The agreement simultaneously transfers an equal amount of Boysen storage into Bull Lake Reservoir. The purpose of the agreement is to maintain a flow of no less than 20 $ft^3/s$ in Bull Lake Creek during the winter months. Bull Lake Creek is a prized fishery, and the agreement ensures its protection. Pilot Butte Reservoir ended WY2023 with a storage content of 27,400 AF, which is 174 percent of average. Pilot Butte did not have adequate space beginning in October 2023 to store additional water for the Bull Lake exchange agreement. Per article 1.E. of the agreement, on September 30, 2023, 10,000 AF of Boysen water in Pilot Butte was designated to Bull Lake for winter releases in WY2024.

Table 6 below shows the monthly inflows, outflows, EOM storage, and forebay elevation at Pilot Butte Reservoir. For each monthly inflow, outflow, and storage value the corresponding percentage of average (30 years of historical data) are also shown.

**Table 6.—WYT - Monthly inflow, outflow, storage, forebay elevation, and snow data for Pilot Butte Reservoir**

| Month | Inflow, KAF | Percent of 30-yr average | Outflow, KAF | Percent of 30-yr average | EOM Storage, KAF | Percent of 30-yr average | Elevation, ft |
|---|---|---|---|---|---|---|---|
| Oct. 2022 | 9.7 | 74 | 0.0 | N/A | 27.4 | 104 | 5,452.7 |
| Nov. 2022 | -0.2 | N/A | 0.0 | N/A | 27.2 | 99 | 5,452.4 |
| Dec. 2022 | 0.0 | N/A | 0.0 | N/A | 27.2 | 98 | 5,452.4 |
| Jan. 2023 | 0.1 | N/A | 0.0 | N/A | 27.3 | 98 | 5,452.5 |
| Feb. 2023 | 0.0 | N/A | 0.0 | N/A | 27.3 | 97 | 5,452.5 |
| Mar. 2023 | 0.0 | N/A | 0.0 | N/A | 27.3 | 97 | 5,452.5 |
| Apr. 2023 | 0.1 | 1 | 0.0 | N/A | 27.3 | 94 | 5,452.6 |
| May 2023 | 16.0 | 75 | 15.7 | 64 | 27.7 | 107 | 5,453.0 |
| June 2023 | 29.2 | 82 | 27.0 | 83 | 29.8 | 103 | 5,455.6 |
| July 2023 | 29.4 | 79 | 35.0 | 82 | 24.2 | 103 | 5,448.6 |
| Aug. 2023 | 32.1 | 98 | 35.6 | 100 | 20.7 | 107 | 5,444.0 |
| Sep. 2023 | 37.2 | 166 | 30.5 | 120 | 27.4 | 174 | 5,452.7 |
| WY2023 | 153.5 | 90 | 143.8 | 86 | N/A | N/A | N/A |

Inflow and outflow values are summed for the entire month, and storage and elevation values are from the end of the month.

Additional hydrologic and statistical information pertaining to Pilot Butte Reservoir during WY2023 can be found in tables 7, 8, and 9 and figure 2.

**Table 7.—WYT - Reservoir allocations for Pilot Butte Reservoir**

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 5,410.00 | 3,803 | 3,803 |
| Top of active conservation | 5,460.00 | 33,721 | 29,918 |

**Table 8.—WYT - Storage and elevation data for Pilot Butte Reservoir**

| Storage-elevation data | Elevation (feet) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 5,439.96 | 17,895 | 10/1/2022 |
| End of year | 5,452.66 | 27,400 | 9/30/2023 |
| Annual low | 5,439.96 | 17,895 | 10/1/2022 |
| Historic low | 5,409.00 (approximate) | 0 (approximate) | 10/1/2022 |
| Annual high | 5,455.75 | 29,989 | 5/12/2023 |
| Historic high | 5,460.60 | 37,465 | 4/20/1988 |

**Table 9.—WYT - Inflow and discharge data for Pilot Butte Reservoir**

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 153,500 | Oct. '22–Sep. '23 | 143,834 | Oct. '22–Sep. '23 |
| Daily peak ($ft^3/s$) | 893 | 8/6/2023 | 730 | 7/31/2023 |
| Daily minimum ($ft^3/s$) | 0 | Winter months | 0 | Winter months |
| Peak spillway flow ($ft^3/s$) | N/A | N/A | 0 | N/A |
| Total spillway flow (AF) | N/A | N/A | 0 | N/A |

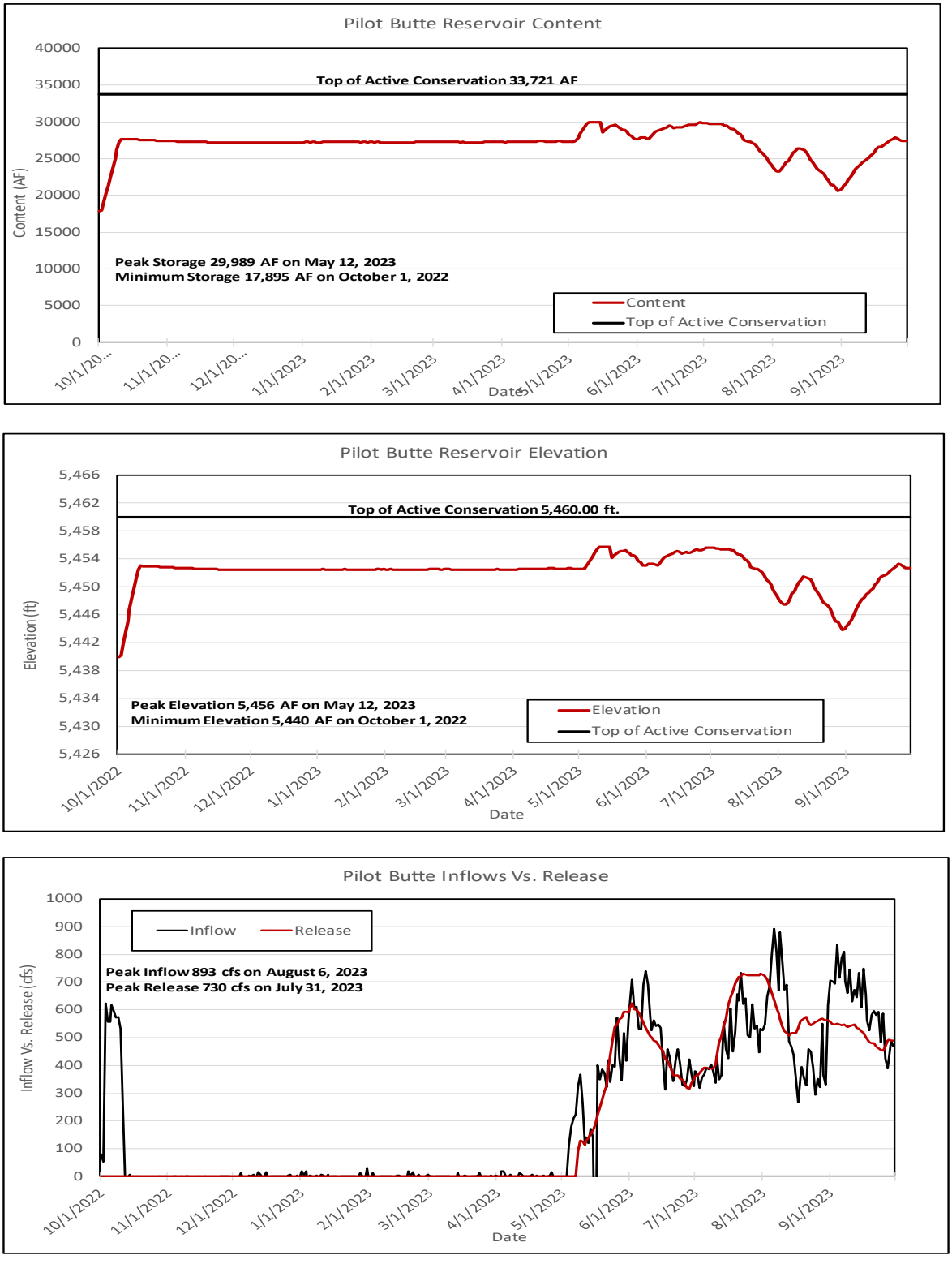



Figure 1.—WYG - WY2023 storage, forebay elevation, inflow, and release at Pilot Butte Reservoir.

# Boysen Reservoir and Powerplant

Boysen Reservoir (P-S MBP) is located on the Wind River above Thermopolis, Wyoming. The dam and reservoir were built for flood control, power generation, irrigation, recreation, and fish and wildlife. Boysen Reservoir has a total capacity of 892,226 AF. Of this amount, 219,181 AF are allocated for inactive and dead storage, 522,413 AF is for active conservation storage, and 150,632 AF is for exclusive flood control storage. Of the amount allocated for active conservation, 144,229 AF are specifically allocated for joint use flood control storage. All of the joint-use space is located between elevation 4,717.00 ft and elevation 4,725.00 feet, which is the top of the spillway gates when closed. The exclusive flood control space is located between elevation 4,725.00 feet and elevation 4,732.20 feet. When the reservoir rises above elevation 4,724.50 feet, the spillway gates are operated to maintain a minimum of six inches of clearance above the reservoir level for prevention of over-topping the gates. When all flood control space is filled, releases cannot be controlled to less than 14,000 $ft^3/s$ due to the required gate clearance.

Irrigation water is provided from the reservoir for several units, both upstream and downstream of Boysen Dam. Water is furnished downstream to about 7,500 acres in the Hanover-Bluff Unit (P-S MBP) and 3,400 acres on the Lucerne Canal in the Owl Creek Unit (P-S MBP). Supplemental water is furnished to other irrigation districts and to a number of individual water users below the dam. The Bighorn Canal Irrigation District and Hanover Irrigation District receive water under long-term contracts with Reclamation. Depending on availability, water is provided to Bluff Irrigation District, Kirby Ditch Irrigation District, Lower Hanover Canal Association, Bighorn Canal Irrigation District, and Hanover Irrigation District utilizing temporary water service contracts.

## Summary of 2023 Operations

Boysen Reservoir storage at the beginning of WY2023 was 644,653 AF. Table 10 below shows the monthly inflows, outflows, EOM storage, and forebay elevation at Boysen Reservoir. First of month SWE values, as represented by the SNOTEL sites within/near the basin above Boysen Reservoir, are also shown. For each monthly inflow, outflow, storage, and SWE value the corresponding percentage of average (30 years of historical data) are also shown. The well above normal inflow in Boysen can be attributed to a combination of above average snowpack and much above average spring precipitation. During the spring of WY2023 Boysen entered the exclusive flood pool and operations were directed by U.S. Army Corps of Engineers (Corps) and were coordinated with Reclamation's Montana Area Office and Regional Office.

Table 10.—WYT - Monthly inflow, outflow, storage, forebay elevation, and snow data for Boysen Reservoir

| Month | Inflow, KAF | Percent of 30-yr average | Outflow, KAF | Percent of 30-yr average | EOM storage, KAF | Percent of 30-yr average | Elevation feet | Snow inch's | Percent of 30-yr average |
|---|---|---|---|---|---|---|---|---|---|
| October 22 | 53.3 | 96 | 55.4 | 105 | 641.0 | 111 | 4,719.6 | 0.1 | 0 |
| November 22 | 45.6 | 93 | 53.6 | 115 | 633.0 | 109 | 4,719.1 | 0.7 | 44 |
| December 22 | 39.6 | 101 | 56.0 | 118 | 616.6 | 108 | 4,718.2 | 3.3 | 92 |
| January 23 | 41.2 | 109 | 57.2 | 123 | 600.6 | 106 | 4,717.2 | 6.2 | 110 |
| February 23 | 35.2 | 92 | 51.5 | 121 | 584.3 | 104 | 4,716.2 | 8.5 | 117 |
| March 23 | 47.5 | 89 | 62.6 | 109 | 569.2 | 102 | 4,715.2 | 10.3 | 111 |
| April 23 | 92.3 | 182 | 156.7 | 217 | 504.8 | 94 | 4,710.9 | 13.9 | 116 |
| May 23 | 251.6 | 179 | 146.7 | 122 | 609.7 | 110 | 4,717.8 | 14.5 | 121 |
| June 23 | 517.5 | 180 | 328.7 | 179 | 798.6 | 121 | 4,727.8 | 2.5 | 79 |
| July 23 | 196.7 | 148 | 287.9 | 187 | 707.3 | 111 | 4,723.2 | 0.0 | 0 |
| August 23 | 85.9 | 172 | 112.9 | 127 | 680.3 | 114 | 4,721.8 | 0.0 | 0 |
| September 23 | 70.3 | 152 | 77.8 | 120 | 672.8 | 116 | 4,721.4 | 0.0 | 0 |
| WY2023 | 1,476.7 | 150 | 1,447.0 | 148 | N/A | N/A | N/A | N/A | N/A |

Inflow and outflow values are summed for the entire month, storage and elevation values are from the end of the month, and snow values are from the beginning of the month.

Using hydrological state data (snowpack, stream flows, etc.) forecasts of the April through July inflow volume are made each month between January and June. Table 11 shows the forecast amounts that were made in WY2023. For each forecast, Table 11 shows the percent of average of the forecast compared to 30 years of historical inflow data.

**Table 11.—WYT - Forecasts of the April-July inflow volumes into Boysen Reservoir made each month starting in January and ending in June**

| Month forecast made | April–July inflow forecast, KAF | Percent of 30-yr average |
|---|---|---|
| January 2023 | 700 | 115 |
| February 2023 | 800 | 131 |
| March 2023 | 800 | 131 |
| April 2023 | 750 | 123 |
| May 2023 | 700 | 115 |
| June 2023 | 704 | 115 |

During WY2023, the powerplants associated with Boysen Reservoir had a gross generation of approximately 75,000 MWh (123 percent of Average).

Additional hydrologic and statistical information pertaining to the operation of Boysen Reservoir can be found in tables 12, 13, and 14 and figure 3.

## Important Events – WY2023

**October 6, 2022:** Winter flow rate was set at 900 $ft^3/s$.

**June 18, 2023:** Reservoir entered the exclusive flood control space.

**June 24, 2023:** Peak end of day forebay elevation observed with a pool elevation of 4,728.41 feet (810,589 AF).

**June 25, 2023:** Reservoir releases peak at 8,625 $ft^3/s$.

**July 15, 2023:** Reservoir elevation fell below the exclusive flood control space.

**Table 12.—WYT - Reservoir allocations for Boysen Reservoir**

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 4,685.00 | 219,181 | 219,181 |
| Top of active conservation | 4,717.00 | 597,365 | 378,184 |
| Top of joint use | 4,725.00 | 741,594 | 144,229 |
| Top of exclusive flood control | 4,732.20 | 892,226 | 150,632 |

**Table 13.—WYT - Storage and elevation data for Boysen Reservoir**

| Storage-elevation data | Elevation (feet) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 4,719.79 | 644,653 | 10/1/2022 |
| End of year | 4,721.36 | 672,770 | 9/30/2023 |
| Annual low | 4,710.40 | 498,247 | 5/12/2023 |
| Historic low elevation * | 4,684.18 | N/A | 3/18/1956 |
| Historic low content * | N/A | 235,737 | 9/24/2002 |
| Annual high | 4,728.41 | 810,589 | 6/24/2023 |
| Historic high | 4,730.83 | 922,406 | 7/6/1967 |

* Because sediment accumulates behind the dam, reservoirs are resurveyed periodically to update capacity. Based on the 1994 resurvey of Boysen Reservoir, the historic low content of 235,737 AF occurred at an elevation that was 2.69 feet higher than the historic low elevation.

**Table 14.—WYT - Inflow and discharge data for Boysen Reservoir**

| Inflow-outflow data | Inflow* | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 1,476,655 | Oct. '22–Sep. '23 | 1,446,959 | Oct. '22–Sep. '23 |
| Daily peak ($ft^3/s$) | 15,664 | 6/22/2023 | 8,625 | 6/25/2023 |
| Daily minimum ($ft^3/s$) | 219 | 12/20/2022 | 875 | 1/8/2023 |
| Peak spillway flow ($ft^3/s$) | N/A | N/A | 8,625 | 6/25/2023 |
| Total spillway flow (AF) | N/A | N/A | 265,602 | Oct. '22–Sep. '23 |

*High winds can affect the forebay reading used to calculate inflow.

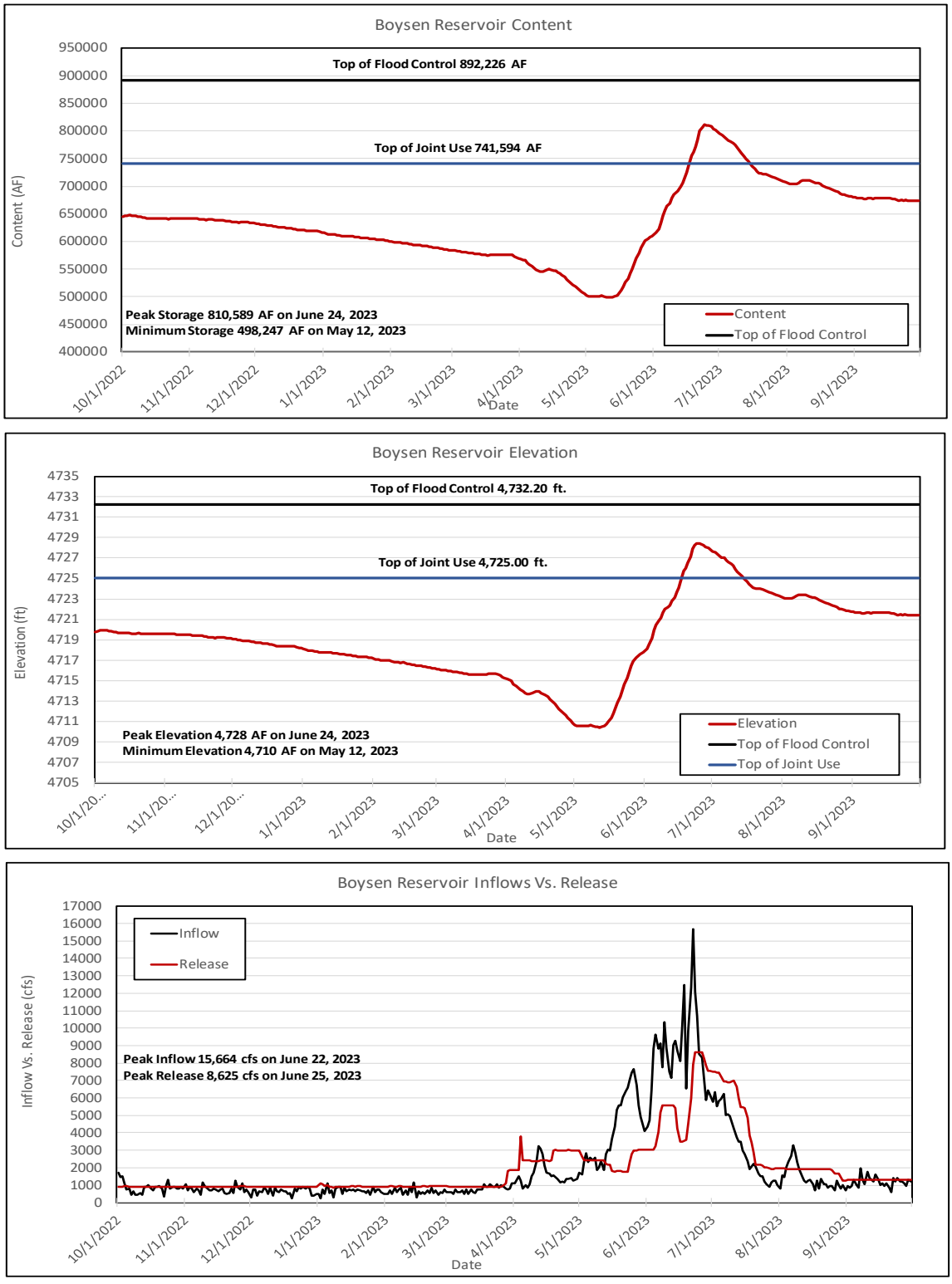



Figure 2.—WYG - WY2023 storage, forebay elevation, inflow, and release at Boysen Reservoir.

# Anchor Reservoir

Anchor Reservoir (P-S MBP) is located on the South Fork of Owl Creek, a tributary of the Bighorn River near Thermopolis, Wyoming. It has a total storage capacity of 17,228 AF with 17,160 AF of active storage. Construction of the dam provides supplemental irrigation supply for the Owl Creek Unit (P-S MBP). The dam was completed in November 1960. However, several major sinkholes developed in the lower portion of the reservoir after it began to fill, and corrective work to plug the sinkholes has not been successful. Two dikes in service since 1979 partition off the portions of the reservoir with high seepage losses. The top of the two dikes is at elevation 6415.00 feet. However, when the reservoir rises above elevation 6412.80 feet, water flows through a notch in one of the dikes into the sinkhole area. The reservoir is operated to not exceed an elevation of 6412.80 feet. Operation and maintenance of Anchor Dam is performed by Owl Creek Irrigation District under contract with Reclamation. Reclamation requires notification from the irrigation district any time the reservoir level is expected to exceed elevation 6400.00 feet. Operation above 6400.00 feet is directed by WYAO staff to avoid overtopping the dikes.

## Summary of 2023 Operations

The storage content of Anchor Reservoir at the beginning of WY2023 was 701 AF. Storage in the reservoir peaked on June 20 at elevation 6412.54 and storage content of 7,506 AF. The Owl Creek drainage experienced much above average spring precipitation. Reservoir operations were directed from the WYAO starting on May 27. Table 15 below shows the monthly inflows, outflows, storage, and forebay elevation at Anchor Reservoir. The negative inflows displayed in table 15 are the result of the calculated inflow, which is subject to the wind influencing the pool elevation reading in addition to the normal seepage from the reservoir. For each monthly inflow, outflow, and storage value the corresponding percentage of average (30 years of historical data) are also shown.

**Table 15.—WYT - Monthly inflow, outflow, storage, forebay elevation, and snow data for Anchor Reservoir**

| Month | Inflow, KAF | Percent of 30-yr average | Outflow, KAF | Percent of 30-yr average | Storage, KAF | Percent of 30-yr average | Elevation, ft |
|---|---|---|---|---|---|---|---|
| October 2022 | 0.4 | 69 | 0.5 | 93 | 0.6 | 144 | 6364.0 |
| November 2022 | 0.0 | N/A | 0.0 | N/A | 0.6 | N/A | 6363.8 |
| December 2022 | 0.0 | N/A | 0.0 | N/A | 0.6 | N/A | 6364.3 |
| January 2023 | 0.0 | N/A | 0.0 | N/A | 0.6 | N/A | 6364.6 |
| February 2023 | 0.0 | N/A | 0.0 | N/A | 0.6 | N/A | 6364.8 |
| March 2023 | 0.0 | N/A | 0.0 | N/A | 0.6 | N/A | 6364.2 |
| April 2023 | 0.6 | 104 | 0.0 | 8 | 1.1 | N/A | 6373.1 |
| May 2023 | 4.8 | 134 | 1.3 | 54 | 4.6 | 258 | 6401.0 |
| June 2023 | 11.0 | 160 | 8.8 | 171 | 6.8 | 194 | 6411.2 |
| July 2023 | 3.7 | 198 | 4.6 | 144 | 5.9 | 273 | 6407.4 |
| August 2023 | 1.0 | 389 | 2.5 | 131 | 4.5 | 833 | 6400.1 |
| September 2023 | 1.4 | 262 | 4.1 | 606 | 1.8 | 461 | 6380.5 |
| WY2023 | 22.9 | 154 | 21.8 | 153 | N/A | N/A | N/A |

Inflow and outflow values are summed for the entire month, and storage and elevation values are from the end of the month.

Additional hydrologic and statistical data pertaining to Anchor Reservoir operations during 2023 can be found in tables 16, 17, and 18 and figure 4.

**Table 16.—WYT - Reservoir allocations for Anchor Reservoir**

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 6343.75 | 66 | 66 |
| Top of active conservation* | 6441.00 | 17,228 | 17,160 |

* District operation has been restricted to elevation 6400.00 feet or less to prevent damage to the dikes and to minimize the chance of creating new sinkholes. Operations above elevation 6400.00 feet are directed by Reclamation.

**Table 17.—WYT - Storage and elevation data for Anchor Reservoir**

| Storage-elevation data | Elevation (feet) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 6366.40 | 701 | 10/1/2022 |
| End of year | 6380.47 | 1,768 | 9/30/2023 |
| Annual low | 6363.43 | 554 | 10/28/2022 |
| Historic low | N/A | N/A | N/A |
| Annual high | 6412.54 | 7,506 | 6/20/2023 |
| Historic high | 6418.52 | 9,252 | 7/3/1967 |

**Table 18.—WYT - Inflow and discharge data for Anchor Reservoir**

| Inflow-outflow data | Inflow | Date | Outflow* | Date |
|---|---|---|---|---|
| Annual total (AF) | 22.855 | Oct. '22–Sep. '23 | 21,775 | Oct. '22–Sep. '23 |
| Daily peak ($ft^3/s$) | 567 | 6/12/2023 | 366 | 6/21/2023 |
| Daily minimum ($ft^3/s$) | 0 | Winter months | 0 | Winter months |
| Peak spillway flow ($ft^3/s$) | N/A | N/A | 0 | N/A |
| Total spillway flow (AF) | N/A | N/A | 0 | N/A |

* Outflow is water released from the dam to Owl Creek. When the reservoir level rises above approximately 6412.80 feet, water flows through a notch in one of the dikes into the sinkhole area. This water is neither measured nor accounted for.

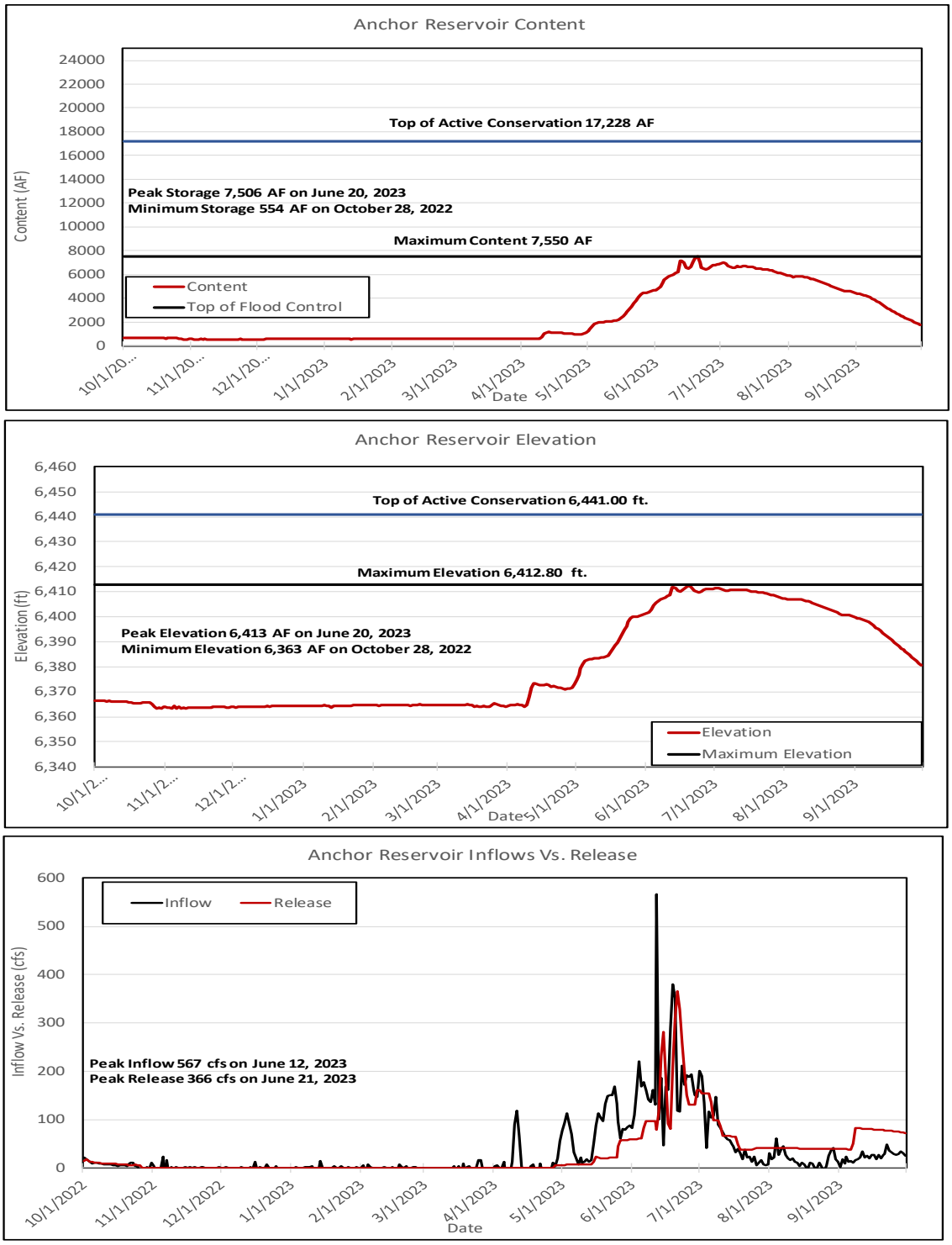



Figure 3.—WYG - WY2023 storage, forebay elevation, inflow, and release at Anchor Reservoir.

# Shoshone Project and Buffalo Bill Unit

The primary features of the original Shoshone Project included Buffalo Bill Dam and Reservoir, Shoshone and Heart Mountain Powerplants, and the canal and lateral systems for the Willwood, Frannie, Garland, and Heart Mountain Divisions. In 1982, The Buffalo Bill Dam and Reservoir Modifications, Shoshone Project, Wyoming, was authorized as the Buffalo Bill Unit (P-S MBP). The principal modifications to Buffalo Bill Dam included raising the height of the Dam by 25 feet, reconstructing the Shoshone Powerplant, construction of the Buffalo Bill Powerplant, construction of the Spirit Mountain Energy Dissipation Structure, pressurizing a portion of the Shoshone Canyon Conduit, enlarging and gating the spillway, constructing a visitor's center, and constructing the North Fork, South Fork, and Diamond Creek Dikes. The North and South Fork dust abatement dikes were designed to impound water in areas of the enlarged reservoir that would be dry during periods when the reservoir elevation is low, thereby reducing the dust producing area of the reservoir. The Diamond Creek protective dike prevents the enlarged reservoir from inundating Irma Flats.

Controlled releases are made from Buffalo Bill Reservoir at four points: (1) Shoshone Canyon Conduit, (2) Shoshone Powerplant, (3) the gated spillway, and (4) two river outlets (jet-flow valve and 4 x 5 high-pressure gates). Water for the Willwood, Frannie, and Garland Divisions of the Shoshone Project is diverted from the Shoshone River below Buffalo Bill Reservoir. The Heart Mountain Division is irrigated by water released at the dam through a high-level outlet to the Shoshone Canyon Conduit and Heart Mountain Canal. Irrigation releases for the project land along the Shoshone River are made through the Shoshone Powerplant, the river outlets, or through the Shoshone Canyon Conduit and Buffalo Bill or Heart Mountain Powerplants. Project works presently serve about 93,000 acres in the four divisions.

## Heart Mountain Powerplant

Shoshone Project, with a nameplate capability of 6,000 kilowatts (kW) and maximum discharge capacity of 360 $ft^3/s$, is located at the end of the Shoshone Canyon Conduit, which obtains its water from a high-level outlet, elevation 5233.00 feet, at Buffalo Bill Dam. The powerplant is located three and a half miles below the dam and discharges into the Shoshone River. During the summer months, the water released through the powerplant is used to satisfy a portion of the irrigation demand of lands diverting directly from the river.

## Shoshone Powerplant

Reconstructed as part of the Buffalo Bill Unit (P-S MBP), is located on the left bank of the Shoshone River at the toe of Buffalo Bill Dam and releases water directly into the Shoshone River. After 56 years of continuous use, the Shoshone Powerplant became obsolete because of safety problems beyond economical repair. On March 21, 1980, the original plant was taken out of service. In 1992, one of the three generating units was replaced with a new unit having a

nameplate capability of 3,000 kW. In accordance with the Buffalo Bill Reservoir Enlargement Winter Release Operation Agreement, a flow of at least 100 $ft^3/s$ is released to the Shoshone River at the base of the dam at all times. This is normally achieved by the use of the Shoshone Powerplant. A maximum release of approximately 200 $ft^3/s$ can be made through the Shoshone Powerplant.

## Buffalo Bill Powerplant

Buffalo Bill Unit (P-S MBP), with a nameplate capability of 18,000 kW, is located about one mile downstream of Buffalo Bill Dam on the right bank of the Shoshone River. Water for generation at this powerplant is supplied through a portion of the Shoshone Canyon Conduit, which was pressurized as part of the Buffalo Bill modification. The maximum discharge capacity of the three units at the Buffalo Bill Powerplant is 930 $ft^3/s$. The powerplant first generated power on July 15, 1992.

## Spirit Mountain Powerplant

Buffalo Bill Unit (P-S MBP), with a nameplate capability of 4,500 kW and discharge capacity of 560 $ft^3/s$, is a newly constructed energy dissipater powerplant located about one mile downstream from Buffalo Bill Dam on the right side of the Shoshone River. Water released through the Shoshone Canyon Conduit for Heart Mountain Canal or Heart Mountain Powerplant must be routed through the Spirit Mountain Powerplant or through associated sleeve valves to dissipate energy in the transition from the pressurized portion of the Shoshone Canyon Conduit to the free flow portion of the conduit. The discharge from the powerplant must be carried away from the plant by use of the free-flow conduit and operation of the powerplant depends on the availability of the conduit to carry discharged water.

## Buffalo Bill Reservoir

Buffalo Bill Dam and Reservoir, located on the Shoshone River above Cody, Wyoming, is a multipurpose facility that provides water for domestic, irrigation, municipal, fish and wildlife, power, and recreational use. It also provides a small amount of incidental flood control, although no storage space is specifically reserved for this purpose. The total storage capacity of the reservoir is 646,565 AF at elevation 5393.50 feet, the top of the active conservation pool.

### *Summary of 2023 Operations*

Buffalo Bill began WY2023 with 470,872 AF of storage. Operations to evacuate storage and deliver irrigation supply were maintained through mid-October. Table 19 below shows the monthly inflows, outflows, end of month storage, and forebay elevation at Buffalo Bill

Reservoir. First of month SWE values, as represented by the SNOTEL sites within the basin above Buffalo Bill Reservoir, are also shown. For each monthly inflow, outflow, storage, and SWE value the corresponding percentage of average (30 years of historical data) are also shown.

**Table 19.—WYT - Monthly inflow, outflow, storage, forebay elevation, and snow data for Buffalo Bill Reservoir**

| Month | Inflow KAF | Percent of 30-yr Average | Outflow KAF | Percent of 30-yr average | Storage KAF | Percent of 30-yr average | Elevation ft | Snow in | Percent of 30-yr average |
|---|---|---|---|---|---|---|---|---|---|
| Oct. 22 | 30.6 | 106 | 50.4 | 117 | 452.1 | 103 | 5,367.8 | 0.0 | N/A |
| Nov. 22 | 19.4 | 81 | 12.0 | 60 | 459.5 | 104 | 5,368.8 | 0.8 | 44 |
| Dec. 22 | 16.6 | 98 | 12.8 | 71 | 463.3 | 106 | 5,369.3 | 4.2 | 87 |
| Jan. 23 | 14.6 | 93 | 12.7 | 74 | 465.2 | 108 | 5,369.6 | 8.1 | 102 |
| Feb. 23 | 12.4 | 93 | 11.6 | 66 | 466.1 | 109 | 5,369.7 | 9.9 | 93 |
| March 23 | 14.8 | 68 | 26.0 | 97 | 454.9 | 108 | 5,368.1 | 13.2 | 100 |
| April 23 | 36.0 | 79 | 85.7 | 121 | 405.2 | 102 | 5,360.8 | 16.4 | 105 |
| May 23 | 243.2 | 129 | 127.0 | 91 | 521.4 | 116 | 5,377.3 | 15.1 | 94 |
| June 23 | 346.9 | 103 | 242.6 | 121 | 625.6 | 107 | 5,390.9 | 3.5 | 47 |
| July 23 | 139.2 | 79 | 167.3 | 94 | 597.5 | 102 | 5,387.3 | 0.0 | N/A |
| Aug. 23 | 52.6 | 118 | 126.4 | 112 | 523.6 | 102 | 5,377.6 | 0.0 | N/A |
| Sep. 23 | 26.5 | 105 | 97.1 | 110 | 453.1 | 100 | 5,367.9 | 0.0 | N/A |
| WY2023 | 952.7 | (102 ) | 971.7 | (104 ) | N/A | N/A | N/A | N/A | N/A |

Inflow and outflow values are summed for the entire month, storage and elevation values are from the end of the month, and snow values are from the beginning of the month.

Using hydrological state data (snowpack, stream flows, etc.) forecasts of the April through July inflow volume are made each month between January and June. Table 20 shows the forecast amounts that were made in WY2023. For each forecast, table 20 shows the percent of average of the forecast compared to 30 years of historical inflow data.

**Table 20.—WYT - Forecasts of the April-July inflow volumes made into Buffalo Bill Reservoir each month starting in January and ending in June**

| Month forecast made | April–July inflow forecast, KAF | Percent of 30-yr average |
|---|---|---|
| January 2023 | 700 | 94 |
| February 2023 | 670 | 90 |
| March 2023 | 700 | 94 |
| April 2023 | 750 | 100 |
| May 2023 | 700 | 94 |
| June 2023 | 639 | 85 |

During WY2023, the powerplants associated with Buffalo Bill Reservoir had a gross generation of approximately 127,000 MWh.

***Important Events – WY2023***

**October 20, 2023**: End of 2023 irrigation diversions by the Shoshone Projects.

**October 21, 2023**: Releases to the Shoshone River reduced to the winter outflow rate of 200 $ft^3/s$.

**April 26, 2023**: Irrigation diversions by the Shoshone Project were initiated for the WY2023 irrigation season.

**June 21, 2023**: Buffalo Bill Reservoir reached a peak pool elevation for the WY2023 of 5391.46 ft.

**Table 21.—WYT - Reservoir allocations for Buffalo Bill Reservoir**

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 5259.60 | 41,748 | 41,748 |
| Top of active conservation | 5393.50 | 646,565 | 604,817 |

**Table 22.—WYT - Storage and elevation data for Buffalo Bill Reservoir**

| Storage-elevation data | Elevation (feet) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 5370.40 | 470,872 | 10/1/2022 |
| End of year | 5367.88 | 453,100 | 9/30/2023 |
| Annual low | 5360.76 | 404,895 | 4/29/2023 |
| Historic low* | N/A | 19,080 | 1/31/1941 |
| Annual high | 5391.46 | 630,164 | 6/21/2023 |
| Historic high | 5393.51 | 646,647 | 7/30/1996 |

* Prior to 1952 daily records are not available. End-of-month data was used to determine the historic low.

**Table 23.—WYT Inflow and discharge data for Buffalo Bill Reservoir**

| Inflow-outflow data | Inflow* | Date | Outflow* | Date |
|---|---|---|---|---|
| Annual total (AF) | 952,720 | Oct. '22–Sep. '23 | 971,655 | Oct. '22–Sep. '23 |
| Daily peak ($ft^3/s$) | 8,152 | 6/20/2023 | 7,461 | 6/24/2023 |
| Daily minimum ($ft^3/s$) | 30* | 12/17/2022 | 191 | 11/13/2022 |
| Peak spillway flow ($ft^3/s$) | N/A | N/A | 5,147 | 6/22/2023 |
| Total spillway flow (AF) | N/A | N/A | 114,241 | Oct. '22–Sep. '23 |

*High winds in the area can result in a false forebay readings, which can affect computed inflows.

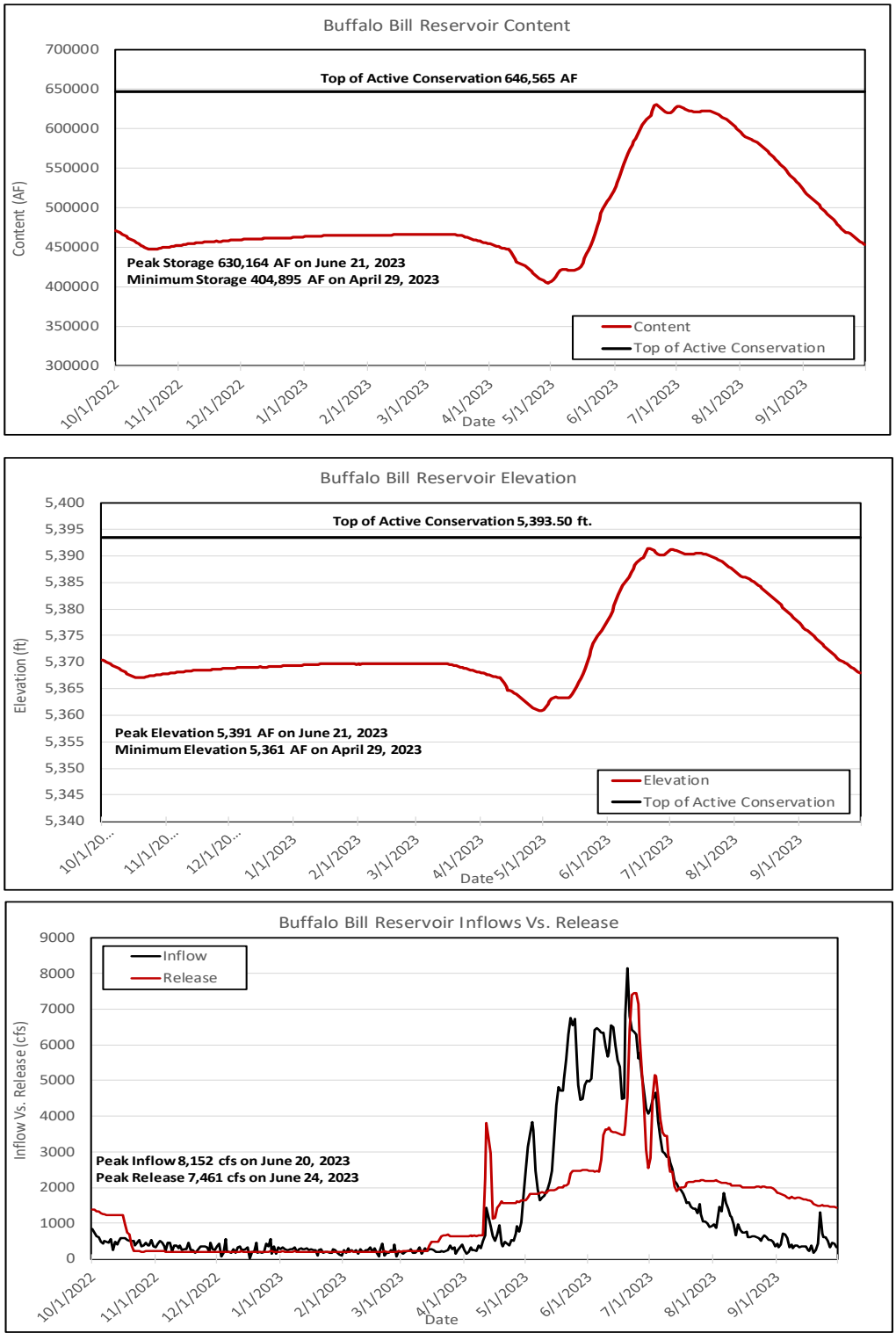



**Figure 4.—WYG WY2023 storage, forebay elevation, inflow, and release at Buffalo Bill Reservoir.**

# Summary of Reservoir Operations for Benefit of Fish and Wildlife, Environment, and Recreation

Flushing flow from Boysen Reservoir are often performed in the Spring (when possible, given other demands) to support the downstream fisheries. The Wyoming Game and Fish Department (WGF) requested a flushing flow. The flush was delayed several weeks due to downstream river ice. The flush of up to 5,000 $ft^3/s$ occurred on April 4, 2023.

Flushing flows from Buffalo Bill Reservoir are often performed in the Spring (when possible, given other demands) in support the downstream fisheries. The WGF, in coordination with Willwood Working Group Two, requested a flushing flow. The flush was delayed several weeks due to downstream river ice. A flush of up to 3,500 $ft^3/s$ occurred between April 11, 2023, and April 14, 2023.

Winter releases from Buffalo Bill Dam are set to support fisheries downstream as well as mitigate ice jams. Normally the non-irrigation season releases are determined by the criteria outlined in the Buffalo Bill Reservoir Enlargement Winter Release Operation Agreement. The criteria include the previous year's annual inflow, end of year reservoir content, and state account ownership. Based on those conditions, a winter release of 100, 150, 200, or 350 $ft^3/s$ will be provided below Buffalo Bill Powerplant. The agreement serves to ensure a minimum release of 100 $ft^3/s$ is always maintained below the dam. Reclamation continues to support the WGF Reservoir Research Branch in its efforts to assess fish population and species distribution in the enlarged reservoir using hydro acoustic technology and by providing WGF river access and an aluminum tube for planting fish in the Shoshone River off the deck of Buffalo Bill Powerplant. At the end of WY2022, based on the Agreement, Reclamation determined that a flow of 200 $ft^3/s$ was required for the winter release below Buffalo Bill Dam.

As Buffalo Bill Reservoir is drawn down the lakebed is exposed to wind erosion, which creates dust in the reservoir area and in the town of Cody, Wyoming. As a part of the enlargement of Buffalo Bill Reservoir, dust abatement dikes were built on the upper ends of the North and South Fork arms of the reservoir to hold water in areas that would become dry as the reservoir level decreased, thus reducing the area of dry lakebed. The top of the North Fork Dike is approximately 5370 feet. When the reservoir pool elevation drops below 5370 ft, the North Fork Dike helps to minimize the amount of lakebed exposure. The number of stop-logs at the outlet control structure on the South Fork Dike are used to maintain a nearly static water level above the dike of approximately 5393.23 feet at the end of the water year. The stop logs provide a larger impoundment behind the dike, which benefits waterfowl habitat and fishery conditions.

The Diamond Creek Dike was constructed to prevent Diamond Creek and the Irma Flats area from being inundated by the enlarged reservoir. Inflows from the Diamond Creek drainage enter Diamond Creek Reservoir that lies at the base of the dike. This water is then pumped into

Buffalo Bill Reservoir to maintain the elevation of Diamond Creek Reservoir between a maximum of 5340.40 feet and a minimum of 5339.50 feet. The normal water surface elevation is typically 5340.00 feet.

Reservoir levels during all of WY2023 were adequate for recreational activities on Buffalo Bill Reservoir.

## Water Year 2023 Flood Benefits

**Table 24.—WYT - Flood damage prevented in the Wind/Bighorn and Shoshone River systems[1]**

| Reservoir | Local | Main stem | 2023 total | 1950–2023 accumulation total |
|---|---|---|---|---|
| Bull Lake[2] | $142,800 | $0 | $142,800 | $16,987,000 |
| Boysen | $1,894,900 | $4,207,000 | $6,101,900 | $502,419,000 |
| Buffalo Bill[2] | $850,100 | $0 | $850,100 | $105,045,000 |

1 This data is received from the Army Corps of Engineers Omaha District Office and is revised annually. The period of assessment is 1950–2023.

2 No space is allocated to flood control, but some flood protection is provided by operation for other purposes.

# Outlook and Annual Operating Plans for Water Year 2024 for Bighorn Basin Reservoirs Under the Responsibility of the Wyoming Area Office (WYAO)

## Riverton Unit - Bull Lake Reservoir

Three operating plans were prepared in October 2023 to project operations under various runoff conditions for WY2024. The projected operations for three inflow scenarios are shown in tables 25, 26, and 27 and figure 6. The plans are prepared to show the probable limits of operations and therefore actual conditions and operations could vary widely from the most probable plan.

The primary objective of operations at Bull Lake is to provide irrigation water to the Midvale. Under normal operation, the reservoir also provides flood control benefits and a water resource for fish, wildlife, and recreation. Bull Lake is operated under the following criteria and limitations:

1. Based on forecasted inflows, March-June releases are scheduled with the objective of filling the lake to a content of 151,000 AF at elevation 5804.50 feet during July while eliminating or minimizing any spill.

2. During April-October, releases must be adequate to meet the irrigation needs of Midvale and downstream irrigators with senior water rights on Bull Lake Creek.

3. Based on the available water supply, non-irrigation season releases from Bull Lake to Bull Lake Creek are generally maintained between 20 and 45 $ft^3/s$.

4. Reclamation identified deficiencies in the existing spillway at Bull Lake Dam and determined the preferred corrective action was to construct a new labyrinth spillway and remove the existing spillway. Reclamation awarded a contract on September 20, 2018 to Malcolm International LLC for about $44.5 million to construct the project. Construction is ongoing but due to unforeseen groundwater issues near the new spillway the project has been delayed more than a year (completion in 2024). Heavy equipment is to use an alternate access on the south side of Bull Lake Creek. A normal access route along Bull Lake Creek will remain open for non-construction traffic. USFWS/Tribes asked us to avoid using the normal access route to avoid disturbance to wintering trumpeter swans. The reservoir will be lowered to 5777 feet (74,000 AF) for cofferdam installation/removal in fall 2024 of the construction period of 2024. Access across the dam will be closed during bridge removal/relocation and cofferdam completion at the existing spillway. An alternative access to the east side of dam will be provided with no dam crest closure in the month of April. Access to the left abutment of the dam may experience up to 15-minute delays. Access to the creek below the construction areas will remain open. The contract specifications require the contractor to meet the Tribal Employment Rights Office requirements Traffic Control Signage to Guide recreationalists.

If not for the modification to the spillway, normal operations of the reservoir would be to maintain the reservoir below elevation 5794.00 feet through the winter to prevent damage to the concrete in the spillway inlet from ice. The reservoir is operated to have a storage level of 100,000 AF or less by November 30. The objective at the onset of winter is to be as close as possible to the 100,000 AF level (5787.13 feet) and to also provide fishery habitat.

## 2024 Operating Plans

Operating plans have been generated for three scenarios for all months of the upcoming water year:

- Most probable inflow conditions are based on the historical median flows.

- Reasonable minimum inflow conditions are estimated to be lower decile flows. Lower decile flows are flows that have historically been exceeded 90 percent of the time.

- Reasonable maximum inflow conditions are estimated to be upper decile flows. Upper decile flows are flows that have historically been exceeded ten percent of the time.

Under all inflow scenarios, releases in October following the end of irrigation season and continuing through the fall and winter will be adjusted to reach and maintain the targeted winter pool elevation. Water diverted into the Wyoming Canal can be delivered to Midvale lands directly or routed through Pilot Butte Reservoir and delivered to district lands via the Pilot Canal.

**Table 25.—WYT - Monthly operating plans for WY2024 for Bull Lake Reservoir and other Riverton Unit features based on the most probable runoff scenario**

| Item | Unit | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bull Lake Reservoir (initial content: 82.1 KAF) | | | | | | | | | | | | | | |
| Reservoir inflow | KAF | 6.8 | 3.3 | 2.9 | 2.1 | 1.8 | 1.9 | 4.4 | 32.5 | 63.3 | 43 | 18.5 | 8.2 | 188.7 |
| Total dam release | KAF | 14.9 | 3.3 | 2.9 | 2.1 | 1.8 | 1.9 | 1.5 | 1.5 | 36.2 | 27 | 46.9 | 46.8 | 186.8 |
| Total dam release | $ft^3/s$ | 242 | 55 | 47 | 34 | 31 | 31 | 25 | 25 | 608 | 439 | 763 | 786 | N/A |
| Excess release | KAF | 13.4 | 1.8 | 1.4 | 0.6 | 0.4 | 0.4 | 0 | 0 | 34.7 | 25.5 | 0 | 0 | 78 |
| EOM content | KAF | 74 | 74 | 74 | 74 | 74 | 74 | 76.9 | 107.9 | 135 | 151 | 122.6 | 84 | N/A |
| EOM elevation | ft | 5,777 | 5,777 | 5,777 | 5,777 | 5,777 | 5,777 | 5,778.2 | 5,790 | 5,799.3 | 5,804.5 | 5,795.2 | 5,781.1 | N/A |
| BLR net change | KAF | -8.1 | 0 | 0 | 0 | 0 | 0 | 2.9 | 31 | 27.1 | 16 | -28.4 | -38.6 | 1.9 |
| Wind River | | | | | | | | | | | | | | |
| Flow abv BL Creek | KAF | 34 | 23.1 | 18.9 | 21.3 | 18.3 | 17.7 | 26.7 | 78.8 | 191.4 | 110.3 | 41.8 | 32.1 | 614.4 |
| Crowheart gage flow | KAF | 48.9 | 26.4 | 21.8 | 23.4 | 20.1 | 19.6 | 28.2 | 80.3 | 227.6 | 137.3 | 88.7 | 78.9 | 801.2 |
| Flow below div dam | KAF | 48.1 | 26.4 | 21.8 | 23.4 | 20.1 | 19.6 | 10.8 | 25.6 | 162.9 | 56.4 | 24.8 | 18.3 | 458.2 |
| Gain/return flow | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 4.8 | 7.4 | 7.1 | 7.4 | 6.1 | 5.4 | 38.2 |
| Indian irrigation | KAF | 1.2 | 0 | 0 | 0 | 0 | 0 | 1.8 | 6.1 | 6 | 6.1 | 5.5 | 4.5 | 31.3 |
| LeClair/Riverton | KAF | 5 | 0 | 0 | 0 | 0 | 0 | 3.5 | 18.8 | 24.2 | 27.2 | 21.1 | 15 | 114.8 |
| LeC/Riv. shortage | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Riverton gage flow | $ft^3/s$ | 681 | 443.7 | 354.5 | 380.6 | 349.4 | 318.8 | 172.5 | 131.2 | 2,350.5 | 494.9 | 70 | 70 | N/A |
| Wyoming Canal | | | | | | | | | | | | | | |
| Total diversion | KAF | 0.8 | 0 | 0 | 0 | 0 | 0 | 17.4 | 54.7 | 64.7 | 80.9 | 63.9 | 60.6 | 343 |
| North canal flow | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 9.8 | 26.4 | 31.2 | 36.5 | 36.1 | 30 | 170 |
| North canal shortage | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pilot Butte Reservoir (initial content: 27.4 KAF) | | | | | | | | | | | | | | |
| Reservoir inflow | KAF | 0.8 | 0 | 0 | 0 | 0 | 0 | 7.6 | 28.3 | 33.5 | 44.4 | 27.8 | 30.6 | 173 |
| Power generated | mwh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pilot canal release | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 6.7 | 28 | 33.1 | 43.9 | 37.4 | 33.3 | 182.4 |
| Pilot Canal shortage | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| EOM content | KAF | 28 | 27.8 | 27.7 | 27.6 | 27.5 | 27.3 | 28 | 28 | 28 | 28 | 18 | 15 | N/A |
| PBR net change | KAF | 0.6 | -0.2 | -0.1 | -0.1 | -0.1 | -0.2 | 0.7 | 0 | 0 | 0 | -10 | -3 | -12.4 |
| EOM elevation | ft | 5457.8 | 5457.6 | 5457.5 | 5457.4 | 5457.3 | 5457 | 5457.8 | 5457.8 | 5457.8 | 5457.8 | 5445.5 | 5441.3 | N/A |

Based on Most probable April–July runoff of: Bull Lake – 143 KAF/Wind River above (abv) Bull Lake Creek – 407 KAF. This plan assumes an annual demand of 170 KAF for the North Canal and 182 KAF for the Pilot Canal

**Table 26.—WYT - Monthly operating plans for WY2024 for Bull Lake Reservoir and other Riverton Unit features based on the minimum probable runoff scenario**

| Item | Unit | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bull Lake Reservoir (Initial content: 82.1 KAF) | | | | | | | | | | | | | | |
| Reservoir Inflow | kaf | 4.3 | 2.6 | 2.1 | 1.7 | 1.2 | 1.4 | 2.8 | 29.4 | 38.7 | 30 | 14.1 | 5.8 | 134.1 |
| Total Dam Release | kaf | 12.4 | 2.6 | 2.1 | 1.7 | 1.4 | 1.5 | 1.5 | 1.5 | 1.5 | 43.1 | 77.4 | 47.3 | 194 |
| Total Dam Release | ft3/s | 202 | 44 | 34 | 28 | 25 | 25 | 25 | 25 | 25 | 701 | 1259 | 795 | N/A |
| Excess Release | kaf | 10.9 | 1.1 | 0.6 | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12.7 |
| EOM Content | kaf | 74 | 74 | 74 | 74 | 73.8 | 73.6 | 74.9 | 102.8 | 140 | 126.9 | 63.6 | 22.2 | N/A |
| EOM Elevation | ft | 5,777 | 5,777 | 5,777 | 5,777 | 5,776.9 | 5,776.9 | 5,777.4 | 5,788.2 | 5,801 | 5,796.7 | 5,772.7 | 5,752.2 | N/A |
| BLR Net Change | kaf | -8.1 | 0 | 0 | 0 | -0.2 | -0.1 | 1.3 | 27.9 | 37.2 | -13.1 | -63.3 | -41.5 | -59.9 |
| Wind River | | | | | | | | | | | | | | |
| Flow abv BL Creek | kaf | 28.4 | 23.2 | 17.2 | 18.1 | 13.7 | 15.9 | 21 | 66.2 | 100 | 58.1 | 35.2 | 24.8 | 421.8 |
| Crowheart Gage Flow | kaf | 40.8 | 25.8 | 19.3 | 19.8 | 15.1 | 17.4 | 22.5 | 67.7 | 101.5 | 101.2 | 112.6 | 72.1 | 615.8 |
| Flow Below Div Dam | kaf | 40 | 25.8 | 19.3 | 19.8 | 15.1 | 17.4 | 5.1 | 21.9 | 28 | 30.3 | 24.8 | 16.5 | 263.9 |
| Gain/Return Flow | kaf | 0 | 0 | 0 | 0 | 0 | 0 | 4.8 | 7.4 | 7.1 | 7.4 | 6.1 | 5.4 | 38.2 |
| Indian Irrigation | kaf | 1.2 | 0 | 0 | 0 | 0 | 0 | 1.8 | 6.1 | 6 | 6.1 | 5.5 | 2.7 | 29.5 |
| LeClair/Riverton | kaf | 5 | 0 | 0 | 0 | 0 | 0 | 3.5 | 18.8 | 24.2 | 27.2 | 21.1 | 15 | 114.8 |
| LeC/Riv. Shortage | kaf | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Riverton Gage Flow | ft3/s | 549.2 | 433.6 | 313.9 | 322 | 263.2 | 283.6 | 76.7 | 70 | 83 | 70 | 70 | 70 | N/A |
| Wyoming Canal | | | | | | | | | | | | | | |
| Total Diversion | kaf | 0.8 | 0 | 0 | 0 | 0 | 0 | 17.4 | 45.9 | 73.5 | 70.9 | 87.8 | 55.6 | 351.9 |
| North Canal Flow | kaf | 0 | 0 | 0 | 0 | 0 | 0 | 9.8 | 26.4 | 31.2 | 36.5 | 50 | 30 | 183.9 |
| North Canal Shortage | kaf | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pilot Butte Reservoir (Initial content: 27.4 KAF) | | | | | | | | | | | | | | |
| Reservoir Inflow | kaf | 0.8 | 0 | 0 | 0 | 0 | 0 | 7.6 | 19.5 | 42.3 | 34.4 | 37.8 | 25.6 | 168 |
| Power Generated | mwh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pilot Canal Release | kaf | 0 | 0 | 0 | 0 | 0 | 0 | 6.7 | 28 | 33.1 | 43.9 | 37.4 | 33.3 | 182.4 |
| Pilot Canal Shortage | kaf | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| EOM Content | kaf | 28 | 27.8 | 27.7 | 27.6 | 27.5 | 27.3 | 28 | 19.2 | 28 | 18 | 18 | 10 | N/A |
| PBR Net Change | kaf | 0.6 | -0.2 | -0.1 | -0.1 | -0.1 | -0.2 | 0.7 | -8.8 | 8.8 | -10 | 0 | -8 | -17.4 |
| EOM Elevation | ft | 5,457.8 | 5,457.6 | 5,457.5 | 5,457.4 | 5,457.3 | 5,457 | 5,457.8 | 5,447.1 | 5,457.8 | 5,445.5 | 5,445.5 | 5,433.5 | N/A |

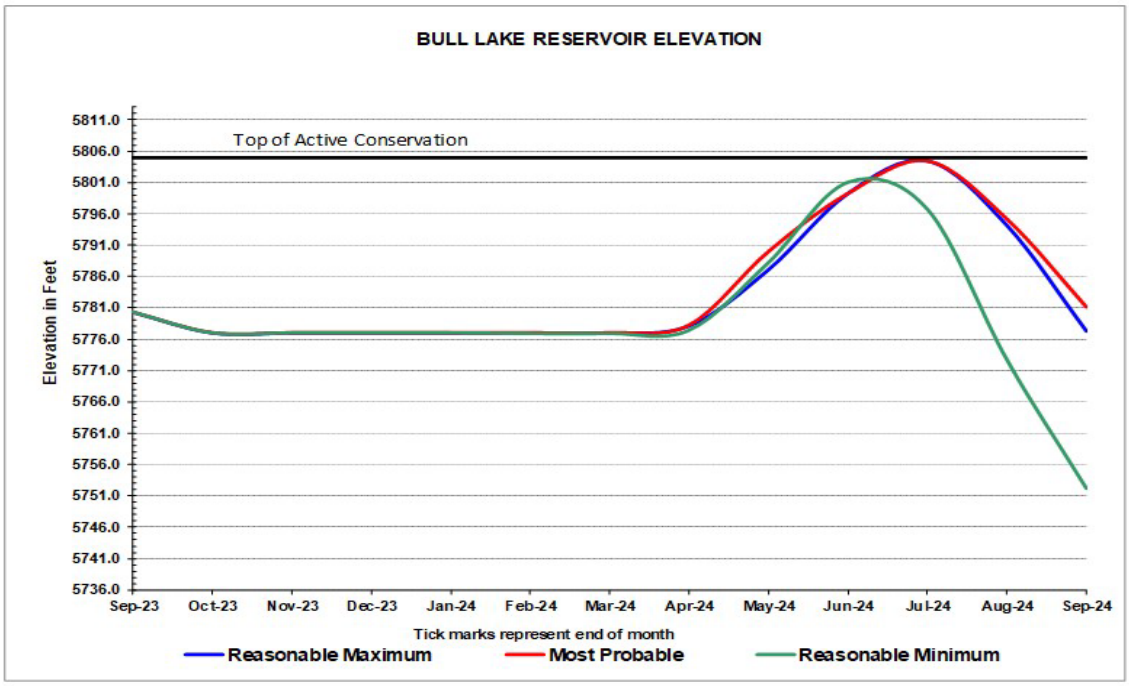
Based on Minimum April-July runoff of: Bull Lake – 101 kaf / Wind River ab Bull Lake Creek – 245 kaf. This plan assumes an annual demand of 184 KAF for the North Canal and 182 KAF for the Pilot Canal.

**Table 27.—WYT - Monthly operating plans for WY2024 for Bull Lake Reservoir and other Riverton Unit features based on the maximum probable runoff scenario**

| Item | Unit | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bull Lake Reservoir (Initial content: 82.1 KAF) | | | | | | | | | | | | | | |
| Reservoir inflow | KAF | 7.9 | 4.3 | 3.1 | 2.7 | 2.4 | 3 | 5.2 | 37 | 96.3 | 65 | 30 | 14.1 | 271 |
| Total dam release | KAF | 16 | 4.3 | 3.1 | 2.7 | 2.4 | 3 | 2.7 | 13.5 | 61.3 | 49 | 61.2 | 59.2 | 278.4 |
| Total dam release | $ft^3/s$ | 260 | 72 | 50 | 44 | 42 | 49 | 45 | 220 | 1030 | 797 | 995 | 995 | N/A |
| Excess release | KAF | 14.5 | 2.8 | 1.6 | 1.2 | 1 | 1.5 | 0 | 12 | 59.8 | 47.5 | 50.2 | 23.2 | 215 |
| EOM content | KAF | 74 | 74 | 74 | 74 | 74 | 74 | 76.5 | 100 | 135 | 151 | 119.8 | 74.7 | N/A |
| EOM elevation | ft | 5777 | 5777 | 5777 | 5777 | 5777 | 5777 | 5778.1 | 5787.1 | 5799.3 | 5804.5 | 5794.2 | 5777.3 | N/A |
| BLR Net Change | KAF | -8.1 | 0 | 0 | 0 | 0 | 0 | 2.5 | 23.5 | 35 | 16 | -31.2 | -45.1 | -7.4 |
| Wind River | | | | | | | | | | | | | | |
| Flow abv BL Creek | KAF | 37.1 | 32.5 | 30.3 | 31.7 | 20.5 | 27.5 | 27.9 | 145.3 | 366.8 | 217 | 77.4 | 50.6 | 1,064.6 |
| Crowheart gage flow | KAF | 53.1 | 36.8 | 33.4 | 34.4 | 22.9 | 30.5 | 30.6 | 158.8 | 428.1 | 266 | 138.6 | 109.8 | 1,343 |
| Flow below div dam | KAF | 52.3 | 36.8 | 33.4 | 34.4 | 22.9 | 30.5 | 13.2 | 104.1 | 363.4 | 185.1 | 79.9 | 46.2 | 1,002.2 |
| Gain/return flow | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 4.8 | 7.4 | 7.1 | 7.4 | 6.1 | 5.4 | 38.2 |
| Indian irrigation | KAF | 1.2 | 0 | 0 | 0 | 0 | 0 | 1.8 | 6.1 | 6 | 6.1 | 5.5 | 4.5 | 31.3 |
| LeClair/Riverton | KAF | 5 | 0 | 0 | 0 | 0 | 0 | 3.5 | 18.8 | 24.2 | 27.2 | 21.1 | 15 | 114.8 |
| LeC/Riv. shortage | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Riverton gage flow | $ft^3/s$ | 749.3 | 618.4 | 543.2 | 559.5 | 398.1 | 496 | 212.6 | 1,407.6 | 5,720.4 | 2,588 | 966.1 | 539.6 | N/A |
| Wyoming Canal | | | | | | | | | | | | | | |
| Total diversion | KAF | 0.8 | 0 | 0 | 0 | 0 | 0 | 17.4 | 54.7 | 64.7 | 80.9 | 58.7 | 63.6 | 340.8 |
| North Canal flow | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 9.8 | 26.4 | 31.2 | 36.5 | 30.9 | 30 | 164.8 |
| North Canal shortage | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pilot Butte Reservoir (Initial content: 27.4 KAF) | | | | | | | | | | | | | | |
| Reservoir inflow | KAF | 0.8 | 0 | 0 | 0 | 0 | 0 | 7.6 | 28.3 | 33.5 | 44.4 | 27.8 | 33.6 | 176 |
| Power generated | mwh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pilot Canal release | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 6.7 | 28 | 33.1 | 43.9 | 37.4 | 33.3 | 182.4 |
| Pilot Canal shortage | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| EOM content | KAF | 28 | 27.8 | 27.7 | 27.6 | 27.5 | 27.3 | 28 | 28 | 28 | 28 | 18 | 18 | N/A |
| PBR net change | KAF | 0.6 | -0.2 | -0.1 | -0.1 | -0.1 | -0.2 | 0.7 | 0 | 0 | 0 | -10 | 0 | -9.4 |
| EOM elevation | ft | 5,457.8 | 5,457.6 | 5,457.5 | 5,457.4 | 5,457.3 | 5,457 | 5,457.8 | 5,457.8 | 5,457.8 | 5,457.8 | 5,445.5 | 5,445.5 | N/A |

Based on Maximum April-July runoff of: Bull Lake – 204 KAF/Wind River ab Bull Lake Creek – 757 KAF. This plan assumes an annual demand of 165 KAF for the North Canal and 182 KAF for the Pilot Canal

# BULL LAKE RESERVOIR



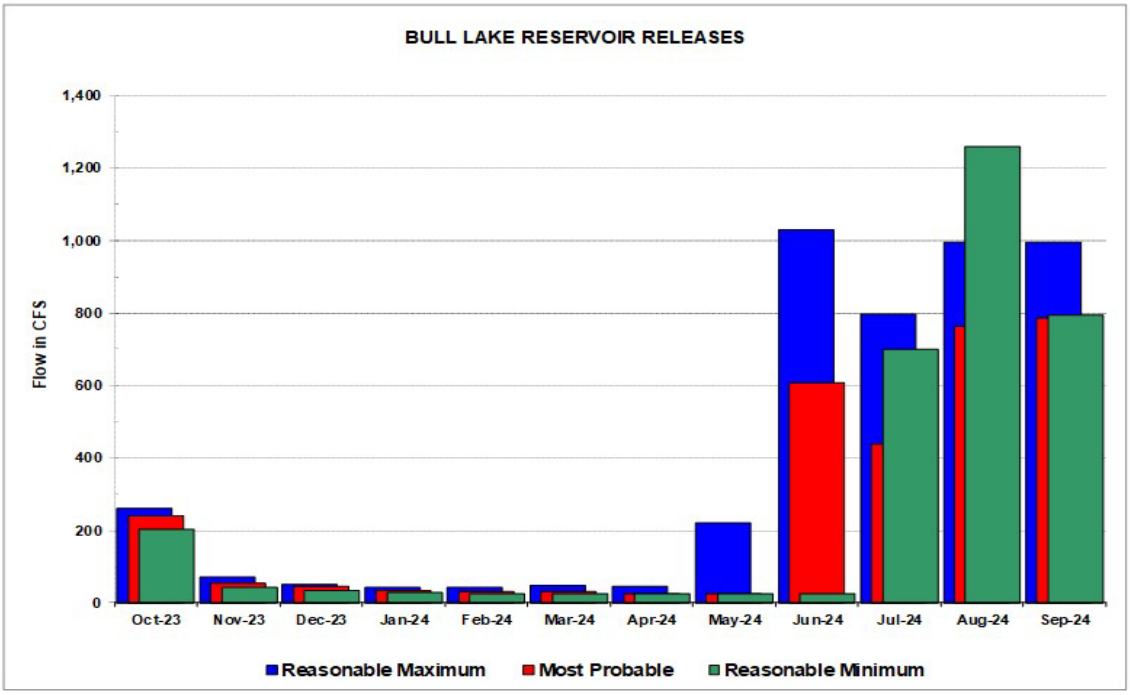




Figure 5.—WYG - WY2024 forebay elevation and inflow at Bull Lake Reservoir under a minimum, expected, and maximum forecasts.

# Boysen Reservoir and Powerplant

Three operating plans were prepared in October 2023 to project water operations under various inflow conditions during WY2024. The operations for the three runoff conditions are shown in tables 28, 29, and 30, and figure 7. These plans are presented only to show the probable limits of operations and therefore, actual conditions and operations could vary widely from the most probable plan.

The operating objectives at Boysen Dam and Reservoir are to provide water for irrigation, municipal and industrial use, and power generation; provide flood control in cooperation with the Corps of Engineers; and enhance fish, wildlife, and recreation opportunities in both the reservoir and the Wind/Bighorn River.

## Irrigation Season Release

During the irrigation season, water releases from Boysen Reservoir are made to satisfy all downstream senior water rights and storage contract commitments. Generally, demands for downstream senior water rights are met with a reservoir release between 900 and 1,200 $ft^3/s$. Releases above what is required to meet irrigation demands may be made to manage reservoir levels and generate power.

## Non-irrigation Season Release

During the non-irrigation season, releases are made to produce power, enhance the river and reservoir fishery, and provide storage space for the expected spring runoff or conserve storage if the reservoir is not expected to fill. Winter releases are generally in the range between 400 $ft^3/s$ and 1,150 $ft^3/s$, depending on reservoir conditions going into the winter. The Wyoming Game and Fish Department considers 800 $ft^3/s$ to be the preferred fishery flow from October through February and flows below 600 $ft^3/s$ to be detrimental to the river fishery. A release of approximately 1,150 $ft^3/s$ can be made through one unit at Boysen Powerplant. By releasing less than the capacity of one powerplant unit, annual maintenance can be performed on the other unit during the winter months.

## General Operating Procedures

1. October–February: Releases of water for power generation are scheduled to evacuate storage while assuring an adequate water supply for the upcoming irrigation season. It is desirable to maintain a uniform release during November–February to reduce the risk of ice jams, which may cause flooding or damage to bridges and other structures.

2. March–July: Based upon monthly water supply forecasts and as soon as river ice conditions allow, releases are scheduled to meet the irrigation demand as a minimum. Greater releases may be made, if necessary, to eliminate or minimize a spill, with the objective of filling the reservoir to elevation 4724.50 feet (731,841 AF) by the end of July. Depending on inflows, attempts will be made to provide a reservoir level of at least elevation 4707.00 feet from the end of May through the end of August for recreational boating access. For the spawning of rainbow trout, it is desirable to have stable or slightly rising river flows from mid-March through early June. When conditions are suitable and without affecting power operations, attempts will be made to limit the drop in reservoir level to two feet or less during the reservoir fish spawn and hatch period (which begins in March and ends in May). A rising pool is desirable during this period.

3. August–September: As soon as storage has peaked, water releases are scheduled to meet the irrigation demand and generate power. Releases above what is needed to meet irrigation demand may be made to generate power and prevent the need to release water through the spillway gates if inflow conditions warrant.

## 2024 Operating Plans

Operating plans have been generated for three scenarios for all months of the upcoming water year:

- Most probable inflow conditions are based on the historical median flows.

- Reasonable minimum inflow conditions are estimated to be lower decile flows. Lower decile flows are flows that have historically been exceeded 90 percent of the time.

- Reasonable maximum inflow conditions are estimated to be upper decile flows. Upper decile flows are flows that have historically been exceeded ten percent of the time.

Annual operating plans are found in tables 28, 29, and 30, and figure 7. Turbine unit outage schedules are found in table 34.

**Table 28.—WYT - Monthly operating plans for WY2024 for Boysen Reservoir based on the most probable runoff scenario**

| Item | Unit | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boysen Reservoir (initial content: 672.8 KAF) | | | | | | | | | | | | | | |
| Monthly inflow | KAF | 65 | 49.6 | 38.5 | 37.4 | 37 | 49.5 | 44 | 158 | 265 | 138.4 | 39.6 | 46.3 | 968.3 |
| Monthly inflow | $ft^3/s$ | 1,057 | 834 | 626 | 608 | 643 | 805 | 739 | 2,570 | 4,453 | 2,251 | 644 | 778 | N/A |
| Turbine release | KAF | 73.8 | 59.5 | 61.5 | 61.5 | 57.5 | 61.5 | 97.7 | 110.7 | 113.1 | 126.5 | 89.2 | 77.4 | 989.9 |
| Bypass/spill/waste | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total release | KAF | 73.8 | 59.5 | 61.5 | 61.5 | 57.5 | 61.5 | 97.7 | 110.7 | 113.1 | 126.5 | 89.2 | 77.4 | 989.9 |
| Total release | $ft^3/s$ | 1,200 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,642 | 1,800 | 1,901 | 2,057 | 1,451 | 1,301 | N/A |
| EOM content | KAF | 664 | 654.1 | 631.1 | 607 | 586.5 | 574.5 | 520.8 | 568.1 | 720 | 731.9 | 682.3 | 651.2 | N/A |
| EOM elevation | ft | 4720.87 | 4720.32 | 4719.01 | 4717.58 | 4716.32 | 4715.56 | 4711.99 | 4715.15 | 4723.89 | 4724.5 | 4721.88 | 4720.16 | N/A |
| Net change content | KAF | -8.8 | -9.9 | -23 | -24.1 | -20.5 | -12 | -53.7 | 47.3 | 151.9 | 11.9 | -49.6 | -31.1 | -21.6 |
| Boysen Power Plant | | | | | | | | | | | | | | |
| Turbine release | KAF | 73.8 | 59.5 | 61.5 | 61.5 | 57.5 | 61.5 | 97.7 | 110.7 | 113.1 | 126.5 | 89.2 | 77.4 | 989.9 |
| Turbine release | $ft^3/s$ | 1,200 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,642 | 1,800 | 1,901 | 2,057 | 1,451 | 1,301 | N/A |
| Generation | gwh | 6.513 | 5.243 | 5.372 | 5.303 | 4.895 | 5.185 | 7.985 | 9.009 | 9.764 | 11.361 | 7.997 | 6.815 | 85.442 |
| Max generation | gwh | 11.904 | 11.52 | 11.904 | 11.904 | 11.136 | 11.904 | 11.52 | 11.904 | 11.52 | 11.904 | 11.904 | 11.52 | 140.544 |
| Percent max generation | percent | 55 | 46 | 45 | 45 | 44 | 44 | 69 | 76 | 85 | 95 | 67 | 59 | N/A |
| Average | kwh/AF | 88 | 88 | 87 | 86 | 85 | 84 | 82 | 81 | 86 | 90 | 90 | 88 | 86 |
| EOM power cap | mw | 16 | 16 | 16 | 16 | 16 | 16 | 15 | 16 | 16 | 16 | 16 | 16 | N/A |

**Table 29.—WYT - Monthly operating plans for WY2024 for Boysen Reservoir based on the minimum probable runoff scenario**

| Item | Unit | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boysen Reservoir (initial content: 672.8 KAF) | | | | | | | | | | | | | | |
| Monthly inflow | KAF | 46.3 | 37.3 | 31.3 | 29.7 | 27.6 | 41.2 | 31.4 | 61 | 64 | 29.9 | 24.2 | 36.3 | 460.2 |
| Monthly inflow | $ft^3/s$ | 753 | 627 | 509 | 483 | 480 | 670 | 528 | 992 | 1,076 | 486 | 394 | 610 | N/A |
| Turbine release | KAF | 73.8 | 59.5 | 61.5 | 61.5 | 57.5 | 43 | 41.7 | 63 | 71.4 | 73.8 | 73.8 | 71.4 | 751.9 |
| Bypass/spill/waste | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total release | KAF | 73.8 | 59.5 | 61.5 | 61.5 | 57.5 | 43 | 41.7 | 63 | 71.4 | 73.8 | 73.8 | 71.4 | 751.9 |
| Total release | $ft^3/s$ | 1,200 | 1,000 | 1,000 | 1,000 | 1,000 | 699 | 701 | 1,025 | 1,200 | 1,200 | 1,200 | 1,200 | N/A |
| EOM content | KAF | 645.3 | 623.1 | 592.9 | 561.1 | 531.2 | 529.4 | 519.1 | 517.1 | 509.7 | 465.8 | 416.2 | 381.1 | N/A |
| EOM elevation | ft | 4719.82 | 4718.54 | 4716.72 | 4714.7 | 4712.7 | 4712.58 | 4711.87 | 4711.73 | 4711.21 | 4708.01 | 4704.1 | 4701.13 | N/A |
| Net change content | KAF | -27.5 | -22.2 | -30.2 | -31.8 | -29.9 | -1.8 | -10.3 | -2 | -7.4 | -43.9 | -49.6 | -35.1 | -291.7 |
| Boysen Power Plant | | | | | | | | | | | | | | |
| Turbine release | KAF | 73.8 | 59.5 | 61.5 | 61.5 | 57.5 | 43 | 41.7 | 63 | 71.4 | 73.8 | 73.8 | 71.4 | 751.9 |
| Turbine release | $ft^3/s$ | 1,200 | 1,000 | 1,000 | 1,000 | 1,000 | 699 | 701 | 1,025 | 1,200 | 1,200 | 1,200 | 1,200 | N/A |
| Generation | gwh | 6.482 | 5.174 | 5.27 | 5.173 | 4.742 | 3.53 | 3.409 | 5.094 | 5.737 | 5.796 | 5.49 | 5.029 | 60.926 |
| Max generation | gwh | 11.904 | 11.52 | 11.904 | 11.904 | 11.136 | 11.904 | 11.52 | 11.904 | 11.52 | 11.904 | 11.904 | 11.52 | 140.544 |
| Percent max generation | percent | 54 | 45 | 44 | 43 | 43 | 30 | 30 | 43 | 50 | 49 | 46 | 44 | N/A |
| Average | kwh/AF | 88 | 87 | 86 | 84 | 82 | 82 | 82 | 81 | 80 | 79 | 74 | 70 | 81 |
| EOM power cap | mw | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 15 | 15 | 14 | 13 | 12 | N/A |

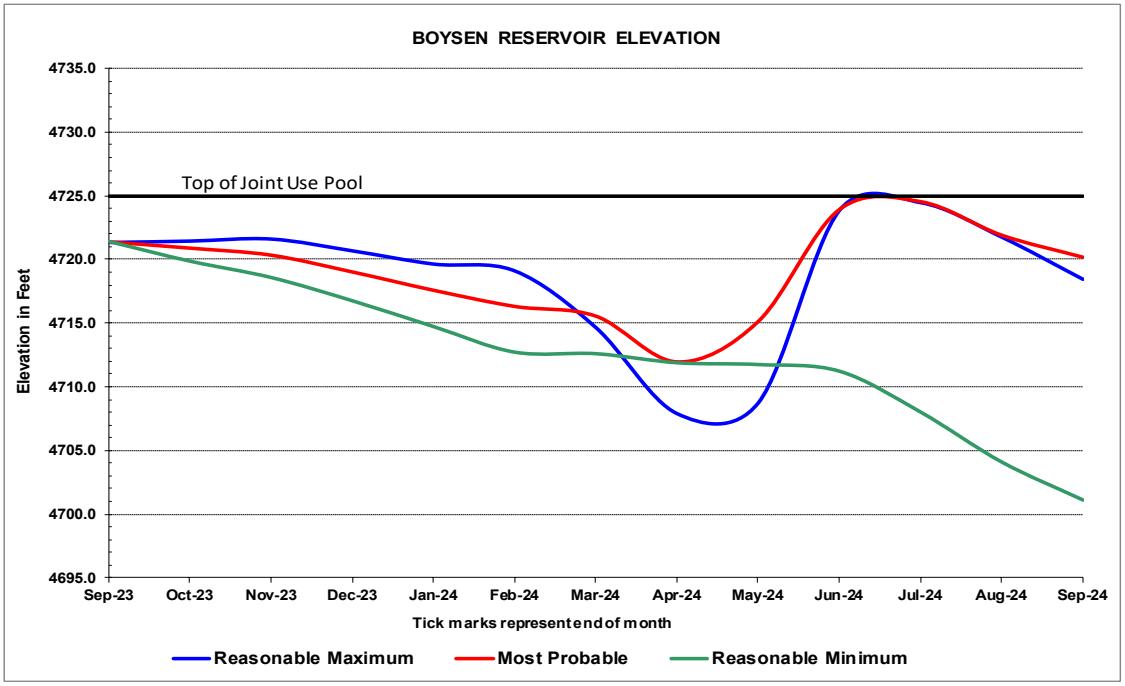
Based on reasonable minimum April–July inflow of 186 KAF.

**Table 30.—WYT - Monthly operating plans for WY2024 for Boysen Reservoir based on the maximum probable runoff scenario**

| Item | Unit | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boysen Reservoir (Initial content: 672.8 KAF) | | | | | | | | | | | | | | |
| Monthly inflow | KAF | 75.9 | 62.3 | 44.7 | 43.1 | 48 | 62.7 | 70.2 | 245 | 535 | 280 | 74.3 | 63 | 1,604.2 |
| Monthly inflow | $ft^3/s$ | 1,234 | 1,047 | 727 | 701 | 834 | 1,020 | 1,180 | 3,985 | 8,991 | 4,554 | 1,208 | 1,059 | N/A |
| Turbine release | KAF | 73.8 | 59.5 | 61.5 | 61.5 | 57.5 | 135.3 | 135.2 | 136.8 | 137.9 | 135.2 | 125.8 | 121.7 | 1,241.7 |
| Bypass/spill/waste | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 31.4 | 96.9 | 152.4 | 132.9 | 0 | 0 | 413.6 |
| Total release | KAF | 73.8 | 59.5 | 61.5 | 61.5 | 57.5 | 135.3 | 166.6 | 233.7 | 290.3 | 268.1 | 125.8 | 121.7 | 1,655.3 |
| Total release | $ft^3/s$ | 1,200 | 1,000 | 1,000 | 1,000 | 1,000 | 2,200 | 2,800 | 3,801 | 4,879 | 4,360 | 2,046 | 2,045 | N/A |
| EOM content | KAF | 674.9 | 677.7 | 660.9 | 642.5 | 633 | 560.4 | 464 | 475.3 | 720 | 731.9 | 680.4 | 621.7 | N/A |
| EOM elevation | ft | 4721.47 | 4721.63 | 4720.7 | 4719.66 | 4719.12 | 4714.65 | 4707.87 | 4708.72 | 4723.89 | 4724.5 | 4721.78 | 4718.46 | N/A |
| Net change content | KAF | 2.1 | 2.8 | -16.8 | -18.4 | -9.5 | -72.6 | -96.4 | 11.3 | 244.7 | 11.9 | -51.5 | -58.7 | -51.1 |
| Boysen Power Plant | | | | | | | | | | | | | | |
| Turbine release | KAF | 73.8 | 59.5 | 61.5 | 61.5 | 57.5 | 135.3 | 135.2 | 136.8 | 137.9 | 135.2 | 125.8 | 121.7 | 1,241.7 |
| Turbine release | $ft^3/s$ | 1,200 | 1,000 | 1,000 | 1,000 | 1,000 | 2,200 | 2,272 | 2,225 | 2,317 | 2,199 | 2,046 | 2,045 | N/A |
| Generation | gwh | 6.531 | 5.289 | 5.448 | 5.398 | 5.01 | 11.331 | 10.582 | 10.072 | 11.29 | 11.907 | 11.193 | 10.528 | 104.579 |
| Max generation | gwh | 11.904 | 11.52 | 11.904 | 5.952 | 9.132 | 11.904 | 11.52 | 11.904 | 11.52 | 11.904 | 11.904 | 11.52 | 132.588 |
| Percent Max generation | percent | 55 | 46 | 46 | 91 | 55 | 95 | 92 | 85 | 98 | 100 | 94 | 91 | N/A |
| Average | kwh/AF | 88 | 89 | 89 | 88 | 87 | 84 | 78 | 74 | 82 | 88 | 89 | 87 | 84 |
| EOM power cap | mw | 16 | 16 | 16 | 16 | 16 | 16 | 14 | 14 | 16 | 16 | 16 | 16 | N/A |

Based on reasonable maximum April–July inflow of 1,130 KAF.

# BOYSEN RESERVOIR



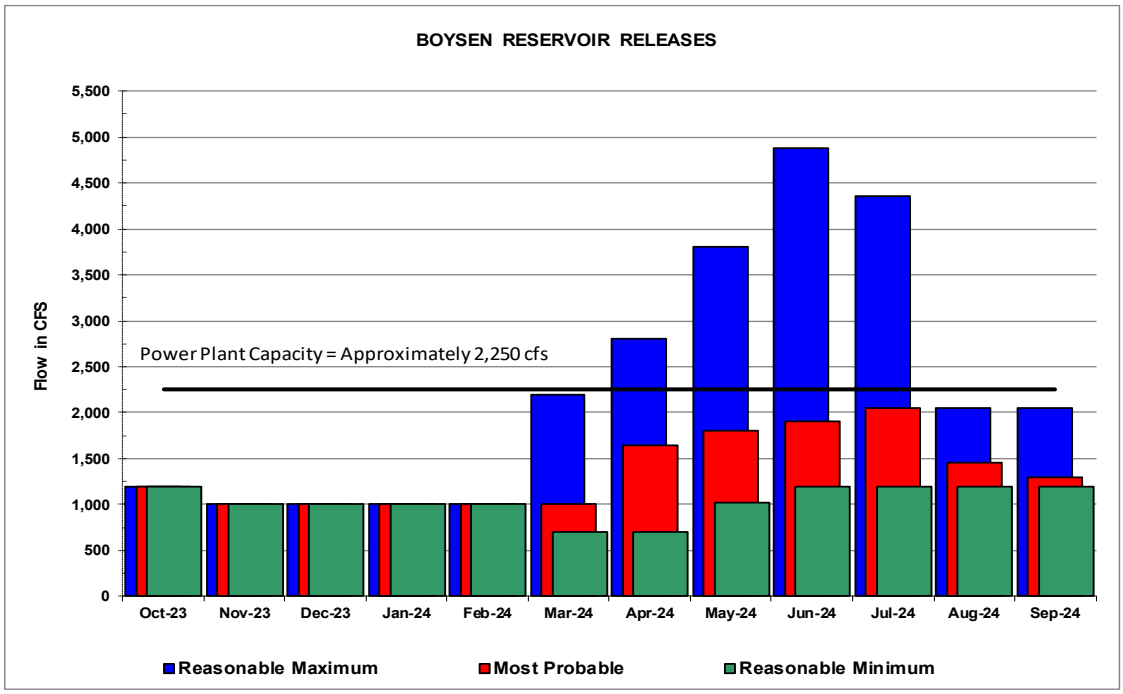




Figure 6.—WYG - WY2024 forebay elevation and inflow at Boysen Reservoir under a minimum, expected, and maximum forecast.

# Buffalo Bill Reservoir and Powerplants

Three operating plans were prepared for WY2024 to show the operations of Buffalo Bill Reservoir that could occur under various runoff conditions. The operations for the three runoff conditions are shown in tables 31, 32, and 33 and figure 8. These plans were prepared only to show the probable limits of operations; therefore, actual conditions and operations could vary widely from the most probable plan.

## Normal Operating Procedures

At the end of the irrigation season, releases will be adjusted with the objective of filling the reservoir to elevation 5393.50 feet (646,565 AF) while meeting the release criteria of the "Buffalo Bill Reservoir Enlargement Winter Release Operation Agreement" *(*Agreement). Under the Agreement, Buffalo Bill Reservoir will be operated to ensure that a minimum flow of 100 $ft^3/s$ is provided in the river below the dam at all times. Additional winter releases beyond the 100 $ft^3/s$ minimum release up to a combined total of 350 $ft^3/s$ in the river below Buffalo Bill Powerplant will be provided based on the criteria set forth in the agreement.

Reservoir releases to meet downstream irrigation requirements will, to the extent possible, be made through the most efficient power turbines available, after meeting winter flow requirements. A release of at least 100 $ft^3/s$ will be made through the Shoshone Powerplant, whenever the powerplant is available, to provide the required river flow directly below the dam. If the Shoshone Powerplant is not available, the release will be made through the jet flow valve at the dam.

During irrigation season, releases are determined by the requirements for irrigation, and municipal and industrial demand. If snow conditions, inflow, and reservoir content indicate an assured fill of the reservoir, additional releases may be required after the start of the spring runoff to provide flood control and make optimum use of the water for power generation. An attempt is made to maintain a release of 7,000 $ft^3/s$ or less during the runoff season and assures that outflow is less than inflow at all times of flood rate inflow.

## 2024 Operating Plans

Under most probable inflow conditions, projected inflows for October, November, and December of WY2024 have been adjusted to reflect the recent trends for the basin. Inflows for January through September of WY2023 are median flows or flows that have historically been exceeded 50 percent of the time.

The reasonable minimum volumes are determined from historical lower decile flows for all months of WY2024. A lower decile flow is a flow that has historically been exceeded 90 percent of the time.

Upper decile volumes are determined from flows that have historically been exceeded ten percent of the time. These values are projected for January through September of WY2024 in the reasonable maximum inflows operating plan.

At the beginning of WY2024, storage in Buffalo Bill Reservoir was 451,127 AF. Winter releases under all three scenarios are the same as defined by the AOP. Based on the criteria set forth in the Agreement, the 2024 winter release would be 200 ft3/s. Ice in the Shoshone River can limit Reclamation's ability to change releases during the winter months due to the potential of ice jams near Lovell, Wyoming.

The Shoshone, Buffalo Bill, Heart Mountain, and Spirit Mountain Powerplants will all be available for power generation in WY2024 after all the winter maintenance is completed. Releases from Buffalo Bill Reservoir will be dependent upon the most efficient operation of all the powerplants while providing the required flow in the Shoshone River.

## Table 31.—WYT - Monthly operating plans for WY2024 for Buffalo Bill Reservoir based on the most probable Runoff scenario

| Item | Unit | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Buffalo Bill Reservoir (initial content: 451.1 KAF) | | | | | | | | | | | | | | |
| Monthly inflow | KAF | 26.8 | 20.4 | 16.3 | 16.3 | 13.4 | 21.9 | 45 | 160 | 300 | 160 | 42 | 21 | 843.1 |
| Shoshone release | KAF | 6.2 | 6 | 6.2 | 6.2 | 5.8 | 6.2 | 12.2 | 10.6 | 11.4 | 11.2 | 6.2 | 6 | 94.2 |
| Non-power release | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 15.7 | 0 | 1.2 | 3.7 | 0 | 0 | 20.6 |
| Total flow below dam | KAF | 6.2 | 6 | 6.2 | 6.2 | 5.8 | 6.2 | 27.9 | 10.6 | 12.6 | 14.9 | 6.2 | 6 | 114.8 |
| Buffalo Bill release | KAF | 15.2 | 5.9 | 6.1 | 6.1 | 5.7 | 33.1 | 47.6 | 56.3 | 52.1 | 51.6 | 49.8 | 49.4 | 378.9 |
| Municipal delivery | KAF | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 3.6 |
| Heart Mtn release | KAF | 14.9 | 0 | 0 | 0 | 0 | 0 | 7.2 | 18.6 | 18 | 18.6 | 17.2 | 11 | 105.5 |
| Heart Mtn Delivery | KAF | 8 | 0 | 0 | 0 | 0 | 0 | 7 | 36 | 42 | 48 | 41 | 33 | 215 |
| Total outflow | KAF | 44.6 | 12.2 | 12.6 | 12.6 | 11.8 | 39.6 | 90 | 121.8 | 125 | 133.4 | 114.5 | 99.7 | 817.8 |
| Spill/waste | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.7 | 0 | 0 | 3.7 |
| EOM targets | KAF | N/A | 463.9 | N/A | N/A | N/A | N/A | 470 | N/A | 620 | 626.2 | N/A | 475 | N/A |
| EOM content | KAF | 431.9 | 440.1 | 443.8 | 447.5 | 449.1 | 431.4 | 386.4 | 424.6 | 599.6 | 626.2 | 553.7 | 475 | N/A |
| Est total storage | KAF | 435.3 | 443.5 | 447.2 | 450.9 | 452.5 | 434.8 | 389.8 | 428 | 603 | 629.6 | 557.1 | 478.4 | N/A |
| EOM elevation | ft | 5365.44 | 5366.62 | 5367.15 | 5367.68 | 5367.91 | 5365.37 | 5358.53 | 5364.36 | 5388.14 | 5391.5 | 5382.18 | 5371.55 | N/A |
| Net change content | KAF | -17.8 | 8.2 | 3.7 | 3.7 | 1.6 | -17.7 | -45 | 38.2 | 175 | 26.6 | -72.5 | -78.7 | 25.3 |
| Flow below BB pwr | KAF | 21.4 | 11.9 | 12.3 | 12.3 | 11.5 | 39.3 | 75.5 | 66.9 | 64.7 | 66.5 | 56 | 55.4 | 493.7 |
| Flow below BB pwr | $ft^3/s$ | 348 | 200 | 200 | 200 | 200 | 639 | 1,269 | 1,088 | 1,087 | 1,082 | 911 | 931 | N/A |
| Spring inflow | KAF | 3.7 | 3.6 | 3.7 | 3.7 | 3.5 | 3.7 | 3.6 | 3.7 | 3.6 | 3.7 | 3.7 | 3.6 | 43.8 |
| Passing Cody gage | KAF | 40 | 15.5 | 16 | 16 | 15 | 43 | 86.3 | 89.2 | 86.3 | 88.8 | 76.9 | 70 | 643 |
| Passing Cody gage | $ft^3/s$ | 651 | 260 | 260 | 260 | 261 | 699 | 1,450 | 1,451 | 1,450 | 1,444 | 1,251 | 1,176 | N/A |
| Shoshone Power Plant | | | | | | | | | | | | | | |
| Shoshone release | KAF | 6.2 | 6 | 6.2 | 6.2 | 5.8 | 6.2 | 12.2 | 10.6 | 11.4 | 11.2 | 6.2 | 6 | 94.2 |
| Generation | gwh | 1.127 | 1.087 | 1.128 | 1.13 | 1.059 | 1.126 | 2.16 | 1.881 | 2.154 | 2.229 | 1.223 | 1.138 | 17.442 |
| Max generation | gwh | 2.232 | 2.16 | 2.232 | 2.232 | 2.088 | 1.562 | 2.16 | 2.232 | 2.16 | 2.232 | 2.232 | 2.16 | 25.682 |
| Percent max generation | | 50 | 50 | 51 | 51 | 51 | 72 | 100 | 84 | 100 | 100 | 55 | 53 | N/A |
| Average | kwh/AF | 182 | 181 | 182 | 182 | 183 | 182 | 177 | 177 | 189 | 199 | 197 | 190 | 185 |
| EOM power cap | mw | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | N/A |
| Buffalo Bill Power Plant | | | | | | | | | | | | | | |
| Buffalo Bill release | KAF | 15.2 | 5.9 | 6.1 | 6.1 | 5.7 | 33.1 | 47.6 | 56.3 | 52.1 | 51.6 | 49.8 | 49.4 | 378.9 |
| Generation | gwh | 4.085 | 1.604 | 1.663 | 1.666 | 1.558 | 8.879 | 12.188 | 13.385 | 12.968 | 13.391 | 13.055 | 12.758 | 97.2 |
| Max generation | gwh | 12.053 | 10.368 | 9.374 | 10.714 | 10.022 | 10.714 | 12.182 | 13.392 | 12.96 | 13.392 | 13.392 | 12.96 | 141.523 |
| Percent max generation | | 34 | 15 | 18 | 16 | 16 | 83 | 100 | 100 | 100 | 100 | 97 | 98 | N/A |
| Average | kwh/AF | 269 | 272 | 273 | 273 | 273 | 268 | 256 | 238 | 249 | 260 | 262 | 258 | 257 |
| EOM power cap | mw | 16 | 14 | 13 | 14 | 14 | 14 | 17 | 18 | 18 | 18 | 18 | 18 | N/A |

| Item | Unit | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spirit Mountain Power Plant | | | | | | | | | | | | | | |
| Spirit Mtn release | KAF | 22.9 | 0 | 0 | 0 | 0 | 0 | 13.3 | 34.4 | 33.3 | 34.4 | 34.4 | 33.3 | 206 |
| Generation | gwh | 2.285 | 0 | 0 | 0 | 0 | 0 | 1.191 | 2.434 | 2.739 | 3.206 | 3.29 | 3.052 | 18.197 |
| Max generation | gwh | 3.348 | 2.592 | 2.678 | 3.348 | 3.007 | 3.248 | 1.296 | 3.348 | 3.24 | 3.348 | 3.348 | 3.24 | 36.041 |
| Percent max generation | N/A | 68 | 0 | 0 | 0 | 0 | 0 | 92 | 73 | 85 | 96 | 98 | 94 | N/A |
| Average | kwh/AF | 100 | N/A | N/A | N/A | N/A | N/A | 90 | 71 | 82 | 93 | 96 | 92 | 88 |
| EOM power cap | mw | 3 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 5 | 5 | 5 | 4 | N/A |
| Heart Mountain Power Plant | | | | | | | | | | | | | | |
| Heart Mtn release | KAF | 14.9 | 0 | 0 | 0 | 0 | 0 | 7.2 | 18.6 | 18 | 18.6 | 17.2 | 11 | 105.5 |
| Generation | gwh | 3.567 | 0 | 0 | 0 | 0 | 0 | 1.724 | 4.453 | 4.309 | 4.453 | 4.117 | 2.633 | 25.256 |
| Max generation | gwh | 3.571 | 0 | 0 | 0 | 0 | 0 | 1.728 | 4.464 | 4.32 | 4.464 | 4.464 | 4.32 | 27.331 |
| Percent max generation | | 100 | 0 | 0 | 0 | 0 | 0 | 100 | 100 | 100 | 100 | 92 | 61 | N/A |
| Average | kwh/AF | 239 | N/A | N/A | N/A | N/A | N/A | 239 | 239 | 239 | 239 | 239 | 239 | 239 |
| EOM power cap | mw | 5 | 0 | 0 | 0 | 0 | 0 | 2 | 6 | 6 | 6 | 6 | 6 | N/A |
| Total generation | | | | | | | | | | | | | | |
| Total generation | gwh | 11.064 | 2.691 | 2.791 | 2.796 | 2.617 | 10.005 | 17.263 | 22.153 | 22.17 | 23.279 | 21.685 | 19.581 | 158.095 |
| EOM power cap | mw | 27 | 17 | 16 | 17 | 17 | 16 | 24 | 31 | 32 | 32 | 32 | 31 | N/A |

Based on most probable inflow of 665 KAF.

**Table 32.—WYT - Monthly operating plans for WY2024 for Buffalo Bill Reservoir based on the minimum probable runoff scenario**

| Item | Unit | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Buffalo Bill Reservoir (initial content: 451.1 KAF) | | | | | | | | | | | | | | |
| Monthly inflow | KAF | 21 | 18.4 | 14.3 | 12.9 | 11.4 | 19.4 | 37 | 120 | 180 | 95 | 28.2 | 17.4 | 575 |
| Shoshone release | KAF | 6.2 | 6 | 6.2 | 6.2 | 5.8 | 6.2 | 6 | 6.2 | 6 | 6.2 | 6.2 | 6 | 73.2 |
| Non-power release | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total flow below dam | KAF | 6.2 | 6 | 6.2 | 6.2 | 5.8 | 6.2 | 6 | 6.2 | 6 | 6.2 | 6.2 | 6 | 73.2 |
| Buffalo Bill release | KAF | 15.2 | 5.9 | 6.1 | 6.1 | 5.7 | 6.1 | 21.6 | 28.3 | 50 | 51.6 | 52.4 | 52.5 | 301.5 |
| Municipal delivery | KAF | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 3.6 |
| Heart Mtn release | KAF | 14.9 | 0 | 0 | 0 | 0 | 0 | 5.8 | 0 | 14.8 | 15.4 | 14.6 | 3.4 | 68.9 |
| Heart Mtn delivery | KAF | 8 | 0 | 0 | 0 | 0 | 0 | 7 | 36 | 42 | 48 | 41 | 33 | 215 |
| Total outflow | KAF | 44.6 | 12.2 | 12.6 | 12.6 | 11.8 | 12.6 | 40.7 | 70.8 | 113.1 | 121.5 | 114.5 | 95.2 | 662.2 |
| Spill/waste | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| EOM targets | KAF | N/A | 463.9 | N/A | N/A | N/A | N/A | 470 | N/A | 623 | 626.2 | N/A | 475 | N/A |
| EOM content | KAF | 426.1 | 432.3 | 434 | 434.3 | 433.9 | 440.7 | 437 | 486.2 | 553.1 | 526.6 | 440.3 | 362.5 | N/A |
| Est total storage | KAF | 429.5 | 435.7 | 437.4 | 437.7 | 437.3 | 444.1 | 440.4 | 489.6 | 556.5 | 530 | 443.7 | 365.9 | N/A |
| EOM elevation | ft | 5,364.59 | 5,365.5 | 5,365.75 | 5,365.79 | 5,365.73 | 5,366.71 | 5,366.18 | 5,373.1 | 5,382.1 | 5,378.58 | 5,366.65 | 5,354.76 | N/A |
| Net change content | KAF | -23.6 | 6.2 | 1.7 | 0.3 | -0.4 | 6.8 | -3.7 | 49.2 | 66.9 | -26.5 | -86.3 | -77.8 | -87.2 |

| Item | Unit | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Flow below BB pwr | KAF | 21.4 | 11.9 | 12.3 | 12.3 | 11.5 | 12.3 | 27.6 | 34.5 | 56 | 57.8 | 58.6 | 58.5 | 374.7 |
| Flow below BB pwr | $ft^3/s$ | 348 | 200 | 200 | 200 | 200 | 200 | 464 | 561 | 941 | 940 | 953 | 983 | N/A |
| Spring inflow | KAF | 3.7 | 3.6 | 3.7 | 3.7 | 3.5 | 3.7 | 3.6 | 3.7 | 3.6 | 3.7 | 3.7 | 3.6 | 43.8 |
| Passing Cody gage | KAF | 40 | 15.5 | 16 | 16 | 15 | 16 | 37 | 38.2 | 74.4 | 76.9 | 76.9 | 65.5 | 487.4 |
| Passing Cody gage | $ft^3/s$ | 651 | 260 | 260 | 260 | 261 | 260 | 622 | 621 | 1,250 | 1,251 | 1,251 | 1,101 | N/A |
| Shoshone Power Plant | | | | | | | | | | | | | | |
| Shoshone release | KAF | 6.2 | 6 | 6.2 | 6.2 | 5.8 | 6.2 | 6 | 6.2 | 6 | 6.2 | 6.2 | 6 | 73.2 |
| Generation | gwh | 1.125 | 1.083 | 1.122 | 1.122 | 1.05 | 1.124 | 1.089 | 1.141 | 1.141 | 1.192 | 1.155 | 1.063 | 13.407 |
| Max generation | gwh | 2.232 | 2.16 | 2.232 | 2.232 | 2.088 | 1.562 | 2.16 | 2.232 | 2.16 | 2.232 | 2.232 | 2.16 | 25.682 |
| Percent max generation | - | 50 | 50 | 50 | 50 | 50 | 72 | 50 | 51 | 53 | 53 | 52 | 49 | N/A |
| Average | kwh/AF | 181 | 181 | 181 | 181 | 181 | 181 | 182 | 184 | 190 | 192 | 186 | 177 | 183 |
| EOM power cap | mw | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | N/A |
| Buffalo Bill Power Plant | | | | | | | | | | | | | | |
| Buffalo Bill release | KAF | 15.2 | 5.9 | 6.1 | 6.1 | 5.7 | 6.1 | 21.6 | 28.3 | 50 | 51.6 | 52.4 | 52.5 | 301.5 |
| Generation | gwh | 4.079 | 1.599 | 1.656 | 1.657 | 1.548 | 1.659 | 5.798 | 7.494 | 12.638 | 13.051 | 13.071 | 12.897 | 77.147 |
| Max generation | gwh | 12.053 | 10.368 | 9.374 | 10.714 | 10.022 | 10.714 | 12.182 | 13.392 | 12.96 | 13.392 | 13.392 | 12.96 | 141.523 |
| Percent max generation | - | 34 | 15 | 18 | 15 | 15 | 15 | 48 | 56 | 98 | 97 | 98 | 100 | N/A |
| Average | kwh/AF | 268 | 271 | 271 | 272 | 272 | 272 | 268 | 265 | 253 | 253 | 249 | 246 | 256 |
| EOM power cap | mw | 16 | 14 | 13 | 14 | 14 | 14 | 17 | 18 | 18 | 18 | 18 | 18 | N/A |
| Spirit Mountain Power Plant | | | | | | | | | | | | | | |
| Spirit Mtn release | KAF | 22.9 | 0 | 0 | 0 | 0 | 0 | 12.8 | 34.4 | 33.3 | 34.4 | 34.4 | 33.3 | 205.5 |
| Generation | gwh | 2.276 | 0 | 0 | 0 | 0 | 0 | 1.279 | 3.321 | 2.862 | 2.962 | 2.84 | 2.623 | 18.163 |
| Max generation | gwh | 3.348 | 2.592 | 2.678 | 3.348 | 3.007 | 3.248 | 1.296 | 3.348 | 3.24 | 3.348 | 3.348 | 3.24 | 36.041 |
| Percent max generation | | 68 | 0 | 0 | 0 | 0 | 0 | 99 | 99 | 88 | 88 | 85 | 81 | N/A |
| Average | kwh/AF | 99 | N/A | N/A | N/A | N/A | N/A | 100 | 97 | 86 | 86 | 83 | 79 | 88 |
| EOM power cap | mw | 3 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 4 | 4 | 4 | 3 | N/A |
| Heart Mountain Power Plant | | | | | | | | | | | | | | |
| Heart Mtn release | KAF | 14.9 | 0 | 0 | 0 | 0 | 0 | 5.8 | 0 | 14.8 | 15.4 | 14.6 | 3.4 | 68.9 |
| Generation | gwh | 3.567 | 0 | 0 | 0 | 0 | 0 | 1.388 | 0 | 3.543 | 3.687 | 3.495 | 0.814 | 16.494 |
| Max generation | gwh | 3.571 | 0 | 0 | 0 | 0 | 0 | 1.728 | 4.464 | 4.32 | 4.464 | 4.464 | 4.32 | 27.331 |
| Percent max generation | | 100 | 0 | 0 | 0 | 0 | 0 | 80 | 0 | 82 | 83 | 78 | 19 | N/A |
| Average | kwh/AF | 239 | | | | | | 239 | | 239 | 239 | 239 | 239 | 239 |
| EOM power cap | mw | 5 | 0 | 0 | 0 | 0 | 0 | 2 | 6 | 6 | 6 | 6 | 6 | N/A |
| Total Generation | | | | | | | | | | | | | | |
| Total generation | gwh | 11.047 | 2.682 | 2.778 | 2.779 | 2.598 | 2.783 | 9.554 | 11.956 | 20.184 | 20.892 | 20.561 | 17.397 | 125.211 |
| EOM power cap | mw | 27 | 17 | 16 | 17 | 17 | 16 | 24 | 31 | 31 | 31 | 31 | 30 | N/A |

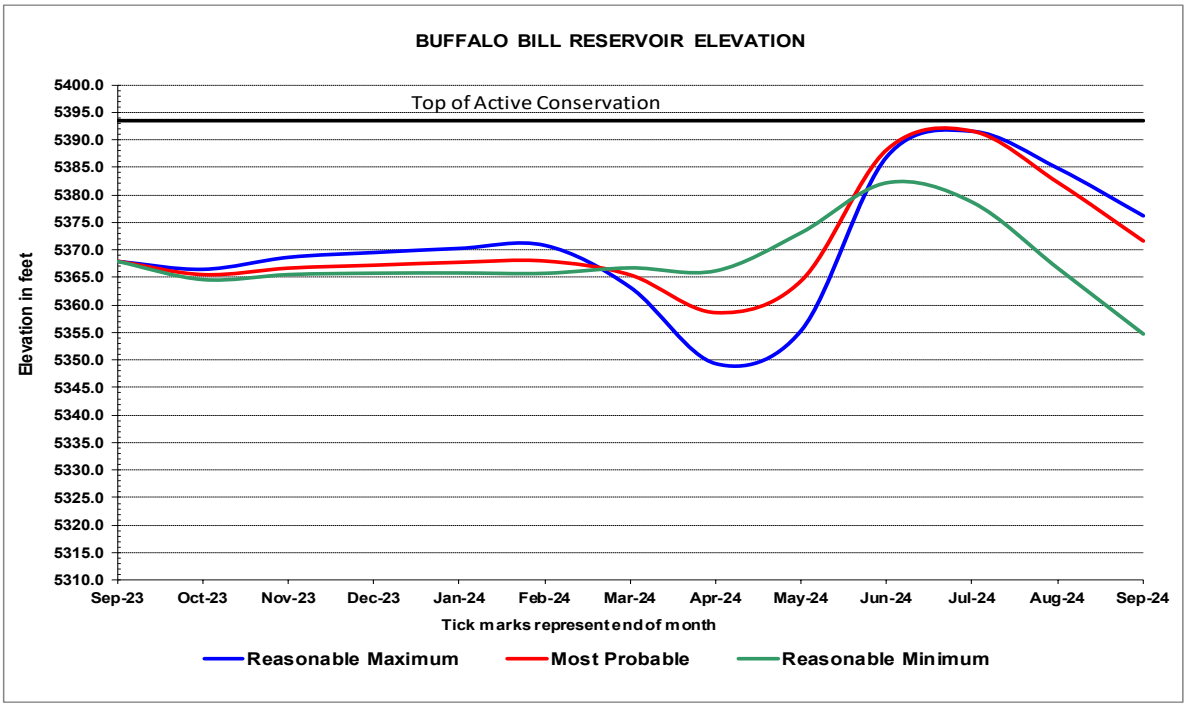
Based on reasonable minimum April-July inflow of 432 KAF.

**Table 33.—WYT - Monthly operating plans for WY2024 for Buffalo Bill Reservoir based on the maximum probable runoff scenario**

| Item | Unit | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Buffalo Bill Reservoir (initial content: 451.1 KAF) | | | | | | | | | | | | | | |
| Monthly inflow | KAF | 33.7 | 27.5 | 18.8 | 17.9 | 15.7 | 23.5 | 65 | 275 | 560 | 290 | 74.2 | 36 | 1,437.3 |
| Shoshone release | KAF | 6.2 | 7.7 | 8 | 8 | 7.5 | 8.6 | 12.6 | 13.3 | 11.8 | 11.4 | 11.3 | 6 | 1,12.4 |
| Non-power release | KAF | 0 | 0 | 0 | 0 | 0 | 27.4 | 76.7 | 112.3 | 210.6 | 123.4 | 4.4 | 0 | 554.8 |
| Total flow below dam | KAF | 6.2 | 7.7 | 8 | 8 | 7.5 | 36 | 89.3 | 125.6 | 222.4 | 134.8 | 15.7 | 6 | 667.2 |
| Buffalo Bill release | KAF | 15.3 | 4.2 | 4.3 | 4.3 | 4 | 40.2 | 48.7 | 57.2 | 53.6 | 52 | 51.2 | 48.7 | 383.7 |
| Municipal delivery | KAF | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 3.6 |
| Heart Mtn release | KAF | 14.8 | 0 | 0 | 0 | 0 | 0 | 7.2 | 18.6 | 18 | 18.6 | 18.6 | 13.1 | 108.9 |
| Heart Mtn delivery | KAF | 8 | 0 | 0 | 0 | 0 | 0 | 7 | 36 | 42 | 48 | 41 | 33 | 215 |
| Total outflow | KAF | 44.6 | 12.2 | 12.6 | 12.6 | 11.8 | 76.5 | 152.5 | 237.7 | 336.3 | 253.7 | 126.8 | 101.1 | 1,378.4 |
| Spill/waste | KAF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 57.5 | 210.6 | 119.9 | 0 | 0 | 388 |
| EOM targets | KAF | N/A | 463.9 | 470 | N/A | N/A | 470 | 475 | N/A | 590 | 626.3 | N/A | N/A | N/A |
| EOM content | KAF | 438.8 | 454.1 | 460.3 | 465.6 | 469.5 | 416.5 | 329 | 366.3 | 590 | 626.3 | 573.7 | 508.6 | N/A |
| Est total storage | KAF | 442.2 | 457.5 | 463.7 | 469 | 472.9 | 419.9 | 332.4 | 369.7 | 593.4 | 629.7 | 577.1 | 512 | N/A |
| EOM elevation | ft | 5366.44 | 5368.62 | 5369.49 | 5370.24 | 5370.78 | 5363.14 | 5349.29 | 5355.37 | 5386.91 | 5391.51 | 5384.8 | 5376.16 | N/A |
| Net change content | KAF | -10.9 | 15.3 | 6.2 | 5.3 | 3.9 | -53 | -87.5 | 37.3 | 223.7 | 36.3 | -52.6 | -65.1 | 58.9 |
| Flow below BB pwr | KAF | 21.5 | 11.9 | 12.3 | 12.3 | 11.5 | 76.2 | 138 | 182.8 | 276 | 186.8 | 66.9 | 54.7 | 1,050.9 |
| Flow below BB pwr | $ft^3/s$ | 350 | 200 | 200 | 200 | 200 | 1,239 | 2,319 | 2,973 | 4,638 | 3,038 | 1,088 | 919 | N/A |
| Spring inflow | KAF | 3.7 | 3.6 | 3.7 | 3.7 | 3.5 | 3.7 | 3.6 | 3.7 | 3.6 | 3.7 | 3.7 | 3.6 | 43.8 |
| Passing Cody gage | KAF | 40 | 15.5 | 16 | 16 | 15 | 79.9 | 148.8 | 205.1 | 297.6 | 209.1 | 89.2 | 71.4 | 1,203.6 |
| Passing Cody gage | $ft^3/s$ | 651 | 260 | 260 | 260 | 261 | 1,299 | 2,501 | 3,336 | 5,001 | 3,401 | 1,451 | 1,200 | N/A |
| Shoshone Power Plant | | | | | | | | | | | | | | |
| Shoshone release | KAF | 6.2 | 7.7 | 8 | 8 | 7.5 | 8.6 | 12.6 | 13.3 | 11.8 | 11.4 | 11.3 | 6 | 112.4 |
| Generation | gwh | 1.129 | 1.403 | 1.467 | 1.472 | 1.384 | 1.554 | 2.163 | 2.237 | 2.152 | 2.239 | 2.234 | 1.154 | 20.588 |
| Max generation | gwh | 2.232 | 2.16 | 2.232 | 2.232 | 2.088 | 1.562 | 2.16 | 2.232 | 2.16 | 2.232 | 2.232 | 2.16 | 25.682 |
| Percent max generation | N/A | 51 | 65 | 66 | 66 | 66 | 99 | 100 | 100 | 100 | 100 | 100 | 53 | N/A |
| Average | kwh/AF | 182 | 182 | 183 | 184 | 185 | 181 | 172 | 168 | 182 | 196 | 198 | 192 | 183 |
| EOM power cap | mw | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | N/A |
| Buffalo Bill Power Plant | | | | | | | | | | | | | | |
| Buffalo Bill release | KAF | 15.3 | 4.2 | 4.3 | 4.3 | 4 | 40.2 | 48.7 | 57.2 | 53.6 | 52 | 51.2 | 48.7 | 383.7 |
| Generation | gwh | 4.118 | 1.147 | 1.181 | 1.184 | 1.103 | 10.708 | 12.172 | 13.034 | 12.956 | 13.382 | 13.399 | 12.705 | 97.089 |
| Max generation | gwh | 12.053 | 10.368 | 9.374 | 10.714 | 10.022 | 10.714 | 12.182 | 13.392 | 12.96 | 13.392 | 13.392 | 12.96 | 141.523 |
| Percent max generation | N/A | 34 | 11 | 13 | 11 | 11 | 100 | 100 | 97 | 100 | 100 | 100 | 98 | N/A |
| Average | kwh/AF | 269 | 273 | 275 | 275 | 276 | 266 | 250 | 228 | 242 | 257 | 262 | 261 | 253 |
| EOM power cap | mw | 16 | 14 | 13 | 14 | 14 | 14 | 17 | 18 | 18 | 18 | 18 | 18 | N/A |
| Spirit Mountain Power Plant | | | | | | | | | | | | | | |
| Spirit Mtn release | KAF | 22.8 | 0 | 0 | 0 | 0 | 0 | 13.3 | 34.4 | 33.3 | 34.4 | 34.4 | 33.3 | 205.9 |

| Item | Unit | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Generation | gwh | 2.286 | 0 | 0 | 0 | 0 | 0 | 1.118 | 2.13 | 2.57 | 3.18 | 3.284 | 3.142 | 17.71 |
| Max generation | gwh | 3.348 | 2.592 | 2.678 | 3.348 | 3.007 | 1.741 | 1.296 | 3.348 | 3.24 | 3.348 | 3.348 | 3.24 | 34.534 |
| Percent max generation | N/A | 68 | 0 | 0 | 0 | 0 | 0 | 86 | 64 | 79 | 95 | 98 | 97 | N/A |
| Average | kwh/AF | 100 | N/A | N/A | N/A | N/A | N/A | 84 | 62 | 77 | 92 | 95 | 94 | 86 |
| EOM power cap | mw | 3 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 5 | 5 | 5 | 4 | N/A |
| Heart Mountain Power Plant | | | | | | | | | | | | | | |
| Heart Mtn release | KAF | 14.8 | 0 | 0 | 0 | 0 | 0 | 7.2 | 18.6 | 18 | 18.6 | 18.6 | 13.1 | 108.9 |
| Generation | gwh | 3.543 | 0 | 0 | 0 | 0 | 0 | 1.724 | 4.453 | 4.309 | 4.453 | 4.453 | 3.136 | 26.071 |
| Max generation | gwh | 3.571 | 0 | 0 | 0 | 0 | 0 | 1.728 | 4.464 | 4.32 | 4.464 | 4.464 | 4.32 | 27.331 |
| Percent max generation | | 99 | 0 | 0 | 0 | 0 | 0 | 100 | 100 | 100 | 100 | 100 | 73 | N/A |
| Average | kwh/AF | 239 | N/A | N/A | N/A | N/A | N/A | 239 | 239 | 239 | 239 | 239 | 239 | 239 |
| EOM power cap | mw | 5 | 0 | 0 | 0 | 0 | 0 | 2 | 6 | 6 | 6 | 6 | 6 | N/A |
| Total Generation | | | | | | | | | | | | | | |
| Total generation | gwh | 11.076 | 2.55 | 2.648 | 2.656 | 2.487 | 12.262 | 17.177 | 21.854 | 21.987 | 23.254 | 23.37 | 20.137 | 161.458 |
| EOM power cap | mw | 27 | 17 | 16 | 17 | 17 | 16 | 23 | 30 | 32 | 32 | 32 | 31 | N/A |

# BUFFALO BILL RESERVOIR



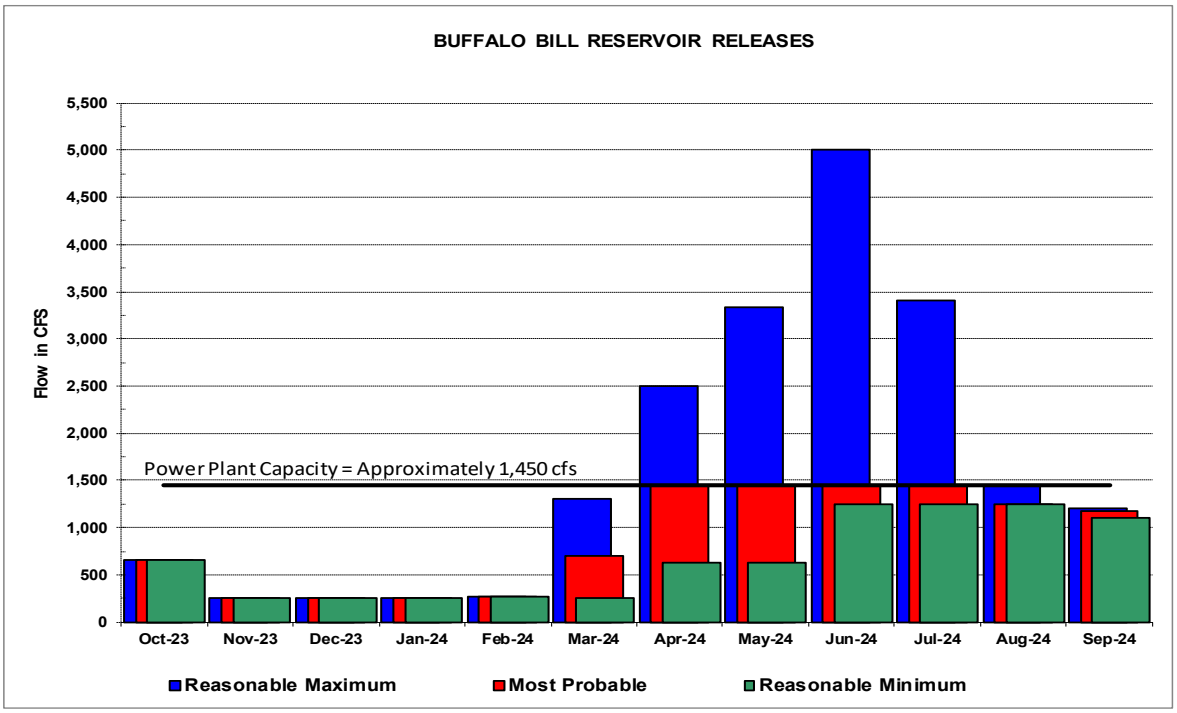




Figure 7.—WYG - WY2024 forebay elevation and inflow at Buffalo Bill Reservoir under a minimum, expected, and maximum forecast.

Table 34.—WYT - WY2024 Scheduled Outages for Bighorn Powerplants

| Power plant | Task name | Start | Finish | Outage hours | Notes |
|---|---|---|---|---|---|
| Boysen | Unit 1 Annual | 10/17/2023 | 12/27/2023 | 1,572 | |
| Boysen | Unit 1 Watt Hour Meter Install | 2/5/2024 | 2/15/2024 | 240 | |
| Boysen | Unit 1 Hard Wire Logic Install | 3/4/2024 | 3/14/2024 | 240 | |
| Boysen | Unit 2 STATOR | 1/8/2024 | 1/11/2024 | 72 | |
| Boysen | Unit 2-Watt Hour Meter Install | 2/19/2024 | 2/29/2024 | 240 | |
| Boysen | Unit 2 Hard Wire Logic Install | 3/18/2024 | 3/28/2024 | 240 | |
| SMED | SMED Minor Annual | 9/18/2023 | 11/16/2023 | 588 | |
| Buffalo Bill | BB Unit 1 Minor Annual | 11/27/2023 | 12/21/2023 | 588 | |
| Buffalo Bill | BB Unit #3 Six Year Major | 1/8/2024 | 2/8/2024 | 756 | |
| Heart Mountain Unit One | Seasonal Plant - No Water | 10/18/2023 | 4/15/2024 | 0 | Seasonal Plant - No water |

# Annual Operating Plans for Water Year 2023 for Missouri Basin Units Under the Responsibility of the Montana Area Office

## Water Year 2023 Precipitation, Snowpack, and Water Supply Forecasts

Reclamation's Montana Area Office (MTAO) has oversight and operational responsibility of ten reservoirs East of the Continental Divide in the state of Montana. These reservoirs are associated with Clark Canyon Dam and Canyon Ferry Dam in the Missouri River headwaters in Southwestern Montana; Gibson Dam and associated off-stream dams of Pishkun Dikes and Willow Creek Dam along the Rocky Mountain front; Tiber Dam in Central Montana; Sherburne Dam and associated Milk River project dams of Fresno Dam and Nelson Dikes along Northern Montana; and Yellowtail Dam near the Montana-Wyoming border. The following sections will describe specific operations for Water Year 2023 (WY2023) of each facility.

The remainder of this section documents basin wide conditions and specific data for each of the reservoirs for MTAO. Precipitation greatly effects operational decisions and is an important factor for all reservoirs. The main data sets that are tracked are overall precipitation and snow water equivalent (SWE). Monthly data on valley and mountain precipitation per basin during WY2023 can be found in tables 35 and 36 and figures 9 and 10.

Each January, Reclamation begins to forecast the April through July runoff volumes for Reclamation reservoirs east of the Continental Divide. These forecasts are based on snow content

and other basin parameters such as antecedent conditions, drought indexes, and El Niño-Southern Oscillation data. Other agencies that also forecast runoff include the U.S. Army Corps of Engineers (Corps) and the Natural Resource Conservation Service (NRCS).

On January 1, the NRCS reported mountain snowpack or SWE throughout Montana and parts of Wyoming ranged from 108 percent of normal in the Bighorn basin to 159 percent of normal in the Milk River Basin. A tabular report of the snow water content is also shown in table 37. Reclamation's water supply forecasts prepared on January 1 indicated April through July runoff volumes varied from 72 percent of average at Fresno Dam to 109 percent of average at Sherburne Dam, table 38. All of Reclamation's reservoirs reached their peak snowpack for the year between April 7 and April 26, figure 11.

## Table 35.—MTT - 2023 Annual monthly precipitation data for valleys of interest in Montana and Wyoming

### PRECIPITATION IN INCHES AND PERCENT OF AVERAGE
### 2023 VALLEY PRECIPITATION

| BASIN | OCT | | NOV | | DEC | | JAN | | FEB | | MAR | | APR | | MAY | | JUN | | JUL | | AUG | | SEP | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % |
| **Beaverhead** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 1.10 | | 0.76 | | 0.71 | | 0.65 | | 0.61 | | 0.81 | | 1.41 | | 2.11 | | 2.38 | | 1.16 | | 1.00 | | 1.09 | |
| Monthly Precip and % of Average | 0.75 | 69 | 1.00 | 133 | 0.84 | 119 | 0.62 | 96 | 0.52 | 86 | 1.48 | 183 | 1.05 | 75 | 1.95 | 92 | 3.27 | 138 | 0.30 | 25 | 2.58 | 259 | 1.70 | 156 |
| Year-to-Date Precip and % of Average | 0.75 | 69 | 1.76 | 95 | 2.60 | 101 | 3.22 | 100 | 3.74 | 98 | 5.22 | 113 | 6.28 | 104 | 8.22 | 101 | 11.50 | 109 | 11.79 | 101 | 14.37 | 113 | 16.07 | 117 |
| **Jefferson** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 0.91 | | 0.59 | | 0.52 | | 0.41 | | 0.42 | | 0.58 | | 1.15 | | 1.81 | | 2.25 | | 1.17 | | 0.97 | | 1.01 | |
| Monthly Precip and % of Average | 0.84 | 92 | 0.82 | 140 | 0.77 | 149 | 0.58 | 143 | 0.43 | 103 | 1.07 | 185 | 0.82 | 71 | 1.93 | 107 | 2.92 | 129 | 0.40 | 35 | 2.45 | 253 | 1.87 | 185 |
| Year-to-Date Precip and % of Average | 0.84 | 92 | 1.66 | 111 | 2.43 | 120 | 3.01 | 124 | 3.45 | 121 | 4.52 | 132 | 5.34 | 117 | 7.27 | 114 | 10.19 | 118 | 10.59 | 108 | 13.04 | 121 | 14.91 | 127 |
| **Madison** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 1.76 | | 1.60 | | 1.81 | | 1.56 | | 1.45 | | 1.76 | | 2.17 | | 2.63 | | 2.62 | | 1.30 | | 1.18 | | 1.35 | |
| Monthly Precip and % of Average | 2.37 | 135 | 2.35 | 148 | 2.44 | 135 | 1.60 | 103 | 1.30 | 90 | 2.95 | 168 | 1.57 | 72 | 1.67 | 63 | 3.60 | 137 | 0.65 | 50 | 3.12 | 264 | 2.01 | 149 |
| Year-to-Date Precip and % of Average | 2.37 | 135 | 4.73 | 141 | 7.16 | 139 | 8.77 | 130 | 10.06 | 123 | 13.01 | 131 | 14.58 | 121 | 16.25 | 110 | 19.86 | 114 | 20.51 | 110 | 23.63 | 119 | 25.64 | 121 |
| **Gallatin** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 1.37 | | 0.84 | | 0.64 | | 0.55 | | 0.58 | | 0.93 | | 1.90 | | 2.48 | | 2.80 | | 1.23 | | 1.13 | | 1.25 | |
| Monthly Precip and % of Average | 2.23 | 163 | 1.11 | 132 | 1.23 | 191 | 0.84 | 153 | 0.69 | 120 | 1.57 | 169 | 1.08 | 57 | 1.43 | 58 | 4.46 | 159 | 0.91 | 74 | 1.95 | 173 | 1.88 | 150 |
| Year-to-Date Precip and % of Average | 2.23 | 163 | 3.34 | 151 | 4.56 | 160 | 5.40 | 159 | 6.10 | 153 | 7.67 | 156 | 8.75 | 129 | 10.18 | 110 | 14.63 | 121 | 15.54 | 117 | 17.50 | 121 | 19.38 | 124 |
| **Missouri Above Toston** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Precip Average | 1.21 | | 0.91 | | 0.88 | | 0.75 | | 0.72 | | 0.97 | | 1.56 | | 2.18 | | 2.50 | | 1.23 | | 1.06 | | 1.15 | |
| Monthly Precip and % of Average | 1.50 | 124 | 1.25 | 138 | 1.28 | 146 | 0.88 | 118 | 0.71 | 98 | 1.68 | 174 | 1.10 | 70 | 1.80 | 82 | 3.50 | 140 | 0.56 | 45 | 2.53 | 237 | 1.99 | 172 |
| Year-to-Date Precip and % of Average | 1.50 | 124 | 2.75 | 130 | 4.03 | 134 | 4.91 | 131 | 5.62 | 126 | 7.30 | 134 | 8.39 | 120 | 10.19 | 111 | 13.68 | 117 | 14.25 | 110 | 16.77 | 120 | 18.76 | 124 |
| **Sun-Teton** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 0.93 | | 0.55 | | 0.45 | | 0.42 | | 0.48 | | 0.62 | | 1.52 | | 2.31 | | 2.82 | | 1.05 | | 1.13 | | 1.33 | |
| Monthly Precip and % of Average | 1.86 | 200 | 0.91 | 166 | 0.89 | 200 | 0.48 | 113 | 0.42 | 88 | 0.92 | 148 | 1.74 | 114 | 2.91 | 126 | 2.79 | 99 | 0.36 | 35 | 0.90 | 80 | 2.13 | 160 |
| Year-to-Date Precip and % of Average | 1.86 | 200 | 2.77 | 187 | 3.66 | 190 | 4.14 | 177 | 4.56 | 162 | 5.47 | 159 | 7.21 | 145 | 10.12 | 139 | 12.90 | 128 | 13.26 | 119 | 14.17 | 115 | 16.30 | 120 |
| **Marias** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 1.02 | | 0.99 | | 0.71 | | 0.74 | | 0.69 | | 0.82 | | 1.37 | | 1.96 | | 2.86 | | 1.15 | | 1.03 | | 1.16 | |
| Monthly Precip and % of Average | 1.21 | 119 | 1.11 | 111 | 1.44 | 204 | 0.26 | 35 | 0.78 | 112 | 0.93 | 112 | 0.79 | 57 | 2.03 | 103 | 2.15 | 75 | 0.39 | 34 | 1.28 | 125 | 0.95 | 82 |
| Year-to-Date Precip and % of Average | 1.21 | 119 | 2.32 | 115 | 3.76 | 138 | 4.02 | 116 | 4.80 | 115 | 5.72 | 115 | 6.51 | 103 | 8.54 | 103 | 10.69 | 96 | 11.09 | 90 | 12.37 | 93 | 13.32 | 92 |
| **Milk** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 0.89 | | 0.53 | | 0.38 | | 0.41 | | 0.34 | | 0.48 | | 1.10 | | 2.01 | | 2.85 | | 1.56 | | 1.20 | | 1.21 | |
| Monthly Precip and % of Average | 1.67 | 188 | 0.41 | 77 | 0.73 | 194 | 0.13 | 30 | 0.35 | 102 | 0.76 | 158 | 0.57 | 51 | 2.53 | 126 | 3.27 | 115 | 0.88 | 56 | 0.78 | 65 | 0.87 | 72 |
| Year-to-Date Precip and % of Average | 1.67 | 188 | 2.08 | 146 | 2.80 | 156 | 2.93 | 133 | 3.28 | 129 | 4.04 | 133 | 4.60 | 112 | 7.14 | 116 | 10.41 | 116 | 11.28 | 107 | 12.06 | 103 | 12.94 | 100 |
| **St. Mary** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 2.61 | | 3.22 | | 2.55 | | 2.55 | | 2.27 | | 2.59 | | 2.34 | | 2.93 | | 3.85 | | 1.43 | | 1.37 | | 1.78 | |
| Monthly Precip and % of Average | 1.69 | 65 | 3.23 | 100 | 3.65 | 143 | 0.91 | 36 | 2.31 | 102 | 1.38 | 53 | 1.39 | 59 | 2.36 | 81 | 2.46 | 64 | 0.48 | 34 | 2.81 | 205 | 1.60 | 90 |
| Year-to-Date Precip and % of Average | 1.69 | 65 | 4.91 | 84 | 8.56 | 102 | 9.47 | 87 | 11.78 | 89 | 13.16 | 83 | 14.54 | 80 | 16.90 | 80 | 19.36 | 78 | 19.84 | 75 | 22.64 | 82 | 24.24 | 82 |
| **Bighorn Above Yellowtail** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 1.11 | | 0.62 | | 0.46 | | 0.43 | | 0.51 | | 0.73 | | 1.38 | | 2.18 | | 1.41 | | 0.80 | | 0.62 | | 1.12 | |
| Monthly Precip and % of Average | 0.79 | 71 | 0.82 | 133 | 0.62 | 133 | 0.90 | 206 | 0.72 | 140 | 0.96 | 131 | 0.76 | 55 | 1.28 | 59 | 4.34 | 307 | 0.88 | 110 | 1.18 | 192 | 1.41 | 126 |
| Year-to-Date Precip and % of Average | 0.79 | 71 | 1.61 | 93 | 2.23 | 102 | 3.12 | 119 | 3.84 | 122 | 4.80 | 124 | 5.56 | 106 | 6.83 | 92 | 11.17 | 126 | 12.05 | 125 | 13.23 | 129 | 14.64 | 129 |

**The following National Weather Service station locations were input into PRISM to compute the data in Table MTT1A:**

**Beaverhead.....Dillon 18 WSW, Dillon Airport, Grant 5 SE, Lima, Polaris 3.7 NNE and Wisdom**

**Jefferson.....Alder 19 S, Boulder 0.3 E, Diloon 18 WSW, Dillon Airport, Glen 0.2 SE, Grant 5 SE, Laurin 2 NE, Lima, Sheridan 1.4 ENE, Twin Bridges, Wisdom and Wise River 3 WNW**

**Madison.....Bozeman Montana State University, Ennis, Hebgen Dam, Norris Madison Power House, Old Faithful and West Yellowstone Gateway**

**Gallatin.....Bozeman 6 W Experimental Farm, Bozeman 1.5 SSE, Bozeman Gallatin Field Airport and Logan Landfill**

**Missouri Above Toston.....Alder 19 S, Boulder 0.3 E, Bozeman 1.5 SSE, Bozeman 6 W Experimental Farm, Bozeman Gallatin Airport and Bozeman Montana State University, Dillon 18 WSW, Dillon Airport, Ennis, Glen 0.2 SE, Grant 5 SE, Hebgen Dam, Laurin, Lima, Logan Landfill, Norris Madison Power House, Old Faithful, Polaris 3.7 NNE, Sheridan 1.4 ENE, Townsend, Trident, Twin Bridges, West Yellowstone Gateway, Wisdom and Wise River 3 WNW**

**Sun-Teton.....Cascade 5 S, Choteau 8 NE, Choteau, Dutton 3.3 ENE, Fairfield, Great Falls Weather Forecast Office, Rogers Pass 9 NNE and Sun River 4 S**

**Marias.....Chester, Conrad, Cut Bank Airport, Dunkirk 19 NNE, East Glacier, Galata 16 SW and Shelby**

**Milk.....Chinook, Fort Belknap 2 SW, Gildford, Glasgow Weather Forecast Office, Goldbutte 7 N, Harlem 20 S, Havre Airport ASOS, Hingham 12 N, Hinsdale 4 SW, Hogeland 7.0 SSE, Malta, Rudyard 21 N, Saco 1 NNW and Simpson 6 N Wildhorse**

**St. Mary.....East Glacier and St Mary 1 SSW**

**Bighorn Above Yellowtail....Basin, Black Mountain, Boysen Dam, Buffalo Bill Dam, Burris, Cody 12 SE, Cody 7.6 NNW, Deaver, Dubois, Emblem, Fort Smith 0.5 ENE, Greybull South Big Horn Co Airport, Lander 11 SSE, Lander 7.3 WNW, Lander Airport, Lovell, Pahaske, Pavillion, Powell Field Station, Rairden 2 WSW, Riverton Regional Airport, Shell 9.5 NNW, Shell, Shoshoni, Sunshine 3 NE, Ten Sleep 0.3 SSW, Tensleep 16 SSE, Thermopolis, Thermopolis 9 NE, Worland 14.4 SW and Worland Municipal Airport**

# PRECIPITATION IN INCHES AND PERCENT OF AVERAGE
# 2023 VALLEY PRECIPITATION

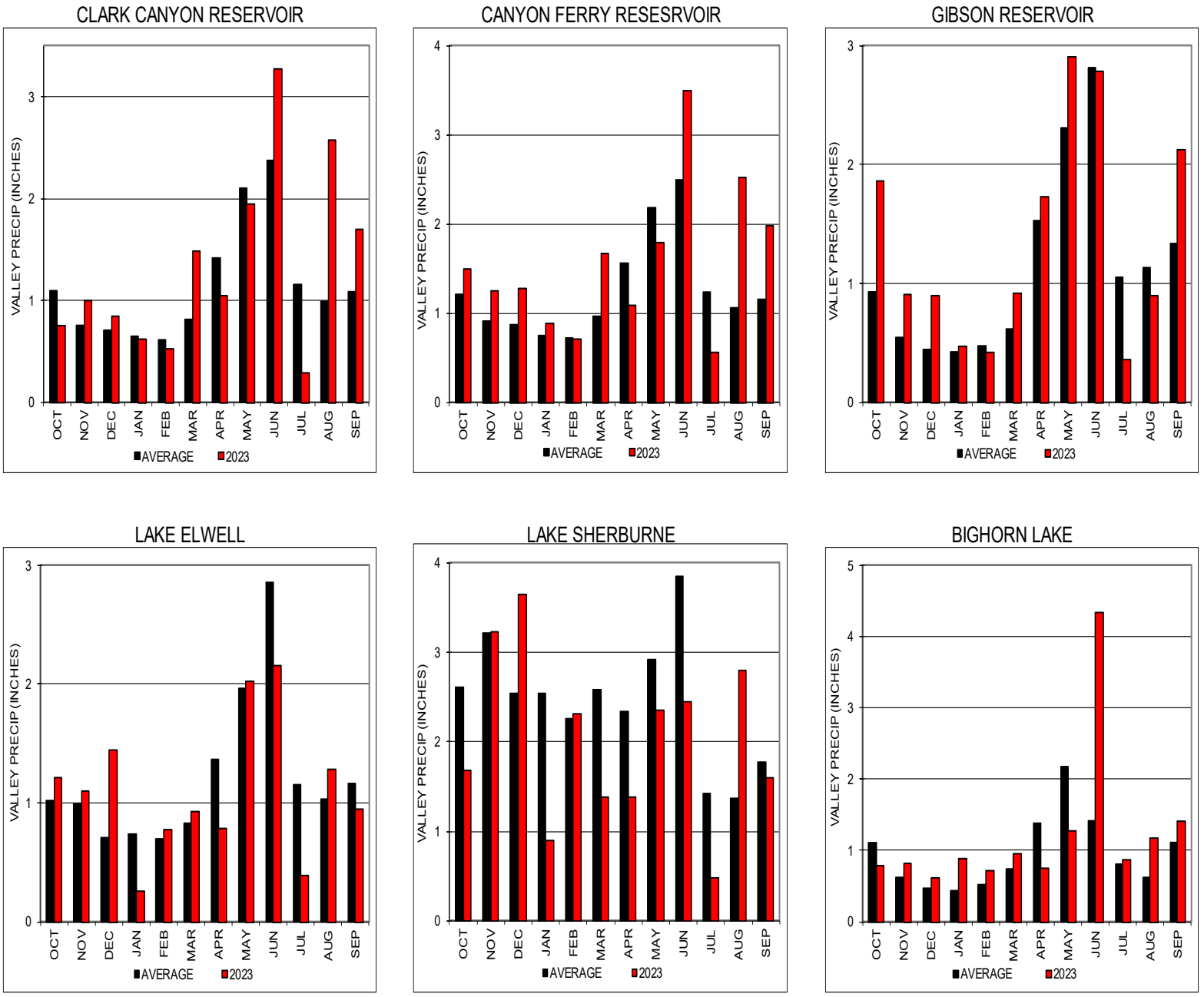



Figure 9.—MTG - WY2023 monthly precipitation in valleys above MTAO managed reservoirs in Montana.

## Table 36.—MTT - WY2023 Annual monthly precipitation data for mountains of interest in Montana and Wyoming

### PRECIPITATION IN INCHES AND PERCENT OF AVERAGE
### 2023 MOUNTAIN PRECIPITATION

| BASIN | OCT | | NOV | | DEC | | JAN | | FEB | | MAR | | APR | | MAY | | JUN | | JUL | | AUG | | SEP | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % | IN. | % |
| **Lima Reservoir** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 2.18 | | 2.16 | | 2.84 | | 2.48 | | 2.20 | | 2.42 | | 2.60 | | 3.02 | | 2.90 | | 1.22 | | 1.22 | | 1.64 | |
| Monthly Precip and % of Average | 3.24 | 149 | 3.86 | 179 | 3.82 | 135 | 2.70 | 109 | 1.84 | 84 | 4.26 | 176 | 1.84 | 71 | 2.30 | 76 | 2.50 | 86 | 0.48 | 39 | 4.16 | 341 | 2.02 | 123 |
| Year-to-Date Precip and % of Average | 3.24 | 149 | 7.10 | 164 | 10.92 | 152 | 13.62 | 141 | 15.46 | 130 | 19.72 | 138 | 21.56 | 128 | 23.86 | 120 | 26.36 | 116 | 26.84 | 112 | 31.00 | 123 | 33.02 | 123 |
| **Clark Canyon Reservoir** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 2.26 | | 2.44 | | 2.64 | | 2.40 | | 2.17 | | 2.53 | | 3.09 | | 3.39 | | 3.17 | | 1.20 | | 1.26 | | 1.70 | |
| Monthly Precip and % of Average | 2.40 | 106 | 3.29 | 135 | 3.03 | 115 | 2.24 | 93 | 1.76 | 81 | 4.06 | 160 | 2.54 | 82 | 2.23 | 66 | 3.86 | 122 | 0.36 | 30 | 3.87 | 308 | 2.13 | 125 |
| Year-to-Date Precip and % of Average | 2.40 | 106 | 5.69 | 121 | 8.71 | 119 | 10.96 | 112 | 12.71 | 107 | 16.77 | 116 | 19.31 | 110 | 21.54 | 103 | 25.40 | 105 | 25.76 | 102 | 29.63 | 112 | 31.76 | 112 |
| **Jefferson Drainage** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 2.23 | | 2.52 | | 2.76 | | 2.52 | | 2.25 | | 2.53 | | 3.11 | | 3.32 | | 3.18 | | 1.33 | | 1.32 | | 1.68 | |
| Monthly Precip and % of Average | 2.18 | 98 | 3.14 | 125 | 2.84 | 103 | 2.09 | 83 | 1.76 | 78 | 3.89 | 154 | 2.66 | 86 | 2.75 | 83 | 4.78 | 150 | 0.56 | 42 | 3.39 | 257 | 2.32 | 138 |
| Year-to-Date Precip and % of Average | 2.18 | 98 | 5.32 | 112 | 8.16 | 109 | 10.26 | 102 | 12.01 | 98 | 15.90 | 107 | 18.56 | 104 | 21.31 | 100 | 26.09 | 107 | 26.64 | 104 | 30.03 | 111 | 32.35 | 113 |
| **Madison Drainage** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 3.06 | | 3.63 | | 4.38 | | 3.91 | | 3.49 | | 3.81 | | 4.06 | | 3.94 | | 3.30 | | 1.49 | | 1.53 | | 2.00 | |
| Monthly Precip and % of Average | 3.45 | 113 | 4.98 | 137 | 5.31 | 121 | 3.30 | 84 | 3.29 | 94 | 5.81 | 152 | 2.95 | 73 | 2.13 | 54 | 5.25 | 159 | 0.74 | 50 | 5.36 | 352 | 2.10 | 105 |
| Year-to-Date Precip and % of Average | 3.45 | 113 | 8.43 | 126 | 13.74 | 124 | 17.04 | 114 | 20.33 | 110 | 26.14 | 117 | 29.09 | 110 | 31.21 | 103 | 36.46 | 109 | 37.20 | 106 | 42.56 | 116 | 44.66 | 116 |
| **Gallatin Drainage** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 3.37 | | 3.50 | | 3.60 | | 3.30 | | 3.30 | | 3.87 | | 5.00 | | 4.70 | | 4.00 | | 1.93 | | 1.80 | | 2.13 | |
| Monthly Precip and % of Average | 3.77 | 112 | 4.40 | 126 | 3.97 | 110 | 2.93 | 89 | 3.83 | 116 | 5.60 | 145 | 3.13 | 63 | 2.00 | 43 | 8.10 | 203 | 1.53 | 79 | 5.27 | 293 | 2.67 | 125 |
| Year-to-Date Precip and % of Average | 3.77 | 112 | 8.17 | 119 | 12.13 | 116 | 15.07 | 109 | 18.90 | 111 | 24.50 | 117 | 27.63 | 107 | 29.63 | 97 | 37.73 | 109 | 39.27 | 107 | 44.53 | 116 | 47.20 | 117 |
| **Canyon Ferry Reservoir** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 2.55 | | 2.93 | | 3.31 | | 3.00 | | 2.71 | | 3.00 | | 3.51 | | 3.59 | | 3.25 | | 1.42 | | 1.41 | | 1.79 | |
| Monthly Precip and % of Average | 2.60 | 102 | 3.74 | 128 | 3.63 | 110 | 2.46 | 82 | 2.37 | 87 | 4.61 | 154 | 2.81 | 80 | 2.45 | 68 | 5.25 | 161 | 0.70 | 49 | 3.94 | 280 | 2.30 | 128 |
| Year-to-Date Precip and % of Average | 2.60 | 102 | 6.35 | 116 | 9.98 | 114 | 12.44 | 106 | 14.81 | 102 | 19.42 | 111 | 22.23 | 106 | 24.68 | 100 | 29.93 | 107 | 30.63 | 105 | 34.57 | 113 | 36.86 | 114 |
| **Gibson Reservoir** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 2.46 | | 2.67 | | 2.68 | | 2.37 | | 2.37 | | 2.44 | | 2.73 | | 3.65 | | 3.87 | | 1.38 | | 1.55 | | 1.93 | |
| Monthly Precip and % of Average | 2.28 | 93 | 2.87 | 108 | 3.32 | 124 | 1.11 | 47 | 2.53 | 107 | 1.66 | 68 | 2.36 | 87 | 4.71 | 129 | 4.23 | 109 | 0.48 | 34 | 1.87 | 120 | 2.85 | 148 |
| Year-to-Date Precip and % of Average | 2.28 | 93 | 5.15 | 100 | 8.47 | 108 | 9.58 | 94 | 12.12 | 96 | 13.78 | 92 | 16.14 | 91 | 20.85 | 98 | 25.07 | 99 | 25.55 | 96 | 27.41 | 97 | 30.26 | 101 |
| **Lake Elwell Reservoir** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 3.22 | | 4.04 | | 4.20 | | 4.00 | | 3.58 | | 3.70 | | 3.62 | | 4.14 | | 4.30 | | 1.60 | | 1.66 | | 2.38 | |
| Monthly Precip and % of Average | 2.72 | 84 | 3.64 | 90 | 4.90 | 117 | 1.68 | 42 | 3.98 | 111 | 1.98 | 54 | 3.18 | 88 | 4.12 | 100 | 3.08 | 72 | 0.50 | 31 | 2.04 | 123 | 3.02 | 127 |
| Year-to-Date Precip and % of Average | 2.72 | 84 | 6.36 | 88 | 11.26 | 98 | 12.94 | 84 | 16.92 | 89 | 18.90 | 83 | 22.08 | 84 | 26.20 | 86 | 29.28 | 84 | 29.78 | 82 | 31.82 | 84 | 34.84 | 86 |
| **Sherburne Reservoir** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 5.50 | | 7.65 | | 7.15 | | 7.30 | | 5.50 | | 6.30 | | 4.50 | | 4.05 | | 5.30 | | 1.90 | | 1.85 | | 3.15 | |
| Monthly Precip and % of Average | 4.55 | 83 | 5.15 | 67 | 9.05 | 127 | 2.20 | 30 | 6.10 | 111 | 2.90 | 46 | 3.20 | 71 | 1.85 | 46 | 4.25 | 80 | 1.15 | 61 | 4.90 | 265 | 3.15 | 100 |
| Year-to-Date Precip and % of Average | 4.55 | 83 | 9.70 | 74 | 18.75 | 92 | 20.95 | 76 | 27.05 | 82 | 29.95 | 76 | 33.15 | 76 | 35.00 | 73 | 39.25 | 74 | 40.40 | 73 | 45.30 | 79 | 48.45 | 81 |
| **Bighorn Lake** | | | | | | | | | | | | | | | | | | | | | | | | |
| Monthly Average Precip | 2.47 | | 2.37 | | 2.35 | | 2.16 | | 2.19 | | 2.63 | | 3.33 | | 3.63 | | 2.52 | | 1.35 | | 1.26 | | 2.01 | |
| Monthly Precip and % of Average | 1.57 | 64 | 2.83 | 119 | 2.86 | 122 | 2.09 | 97 | 2.24 | 102 | 2.74 | 104 | 2.93 | 88 | 2.20 | 61 | 6.86 | 272 | 1.58 | 117 | 2.58 | 206 | 2.30 | 115 |
| Year-to-Date Precip and % of Average | 1.57 | 64 | 4.40 | 91 | 7.26 | 101 | 9.35 | 100 | 11.59 | 101 | 14.33 | 101 | 17.27 | 99 | 19.46 | 92 | 26.32 | 111 | 27.90 | 112 | 30.49 | 116 | 32.79 | 116 |

The following Natural Resources Conservation Service SNOTEL site data was used to compute Table MTT1B:

Lima Reservoir.....Crab Creek, Divide, Island Park, Lakeview Ridge and Tepee Creek

Clark Canyon Reservoir.....Beagle Springs, Bloody Dick, Darkhorse Lake, Divide, Lakeview Ridge, Lemhi Ridge and Tepee Creek

Jefferson Drainage.....Beagle Springs, Bloody Dick, Calvert Creek, Clover Meadow, Darkhorse Lake, Divide, Frohner Meadow, Lakeview Ridge, Lemhi Ridge, Lower Twin, Moose Creek, Mule Creek, Rocker Peak, Saddle Mtn, Short Creek and Tepee Creek

Madison Drainage.....Beaver Creek, Black Bear, Carrot Basin, Clover Meadow, Lower Twin, Madison Plateau, Tepee Creek and Whiskey Creek

Gallatin Drainage.....Carrot Basin, Lick Creek and Shower Falls

Canyon Ferry Reservoir.....Beagle Springs, Beaver Creek, Black Bear, Bloody Dick, Calvert Creek, Carrot Basin, Clover Meadow, Darkhorse Lake, Divide, Frohner Meadow, Lakeview Ridge, Lemhi Ridge, Lick Creek, Lower Twin, Madison Plateau, Moose Creek, Mule Creek, Rocker Peak Saddle Mtn, Short Creek, Shower Falls, Tepee Creek and Whiskey Creek

Gibson Reservoir.....Dupuyer Creek, Mount Lockhart, Waldron and Wood Creek, Gibson (NWS/PRISM)

Lake Elwell Reservoir.....Badger Pass, Dupuyer Creek, Mount Lockhart, Pike Creek and Waldron

Sherburne Reservoir.....Flattop Mountain and Many Glacier

Bighorn Lake.....Bald Mountain, Bear Trap Meadow, Blackwater, Bone Springs Div, Cold Springs, Deer Park, Evening Star, Grave Springs, Hobbs Park, Kirwin, Little Warm, Middle Powder, Owl Creek, Powder River Pass, Shell Creek, South Pass, St. Lawrence Alt, Sylvan Lake, Sylvan Road, Timber Creek, Togwotee Pass, Townsend Creek and Younts Peak.

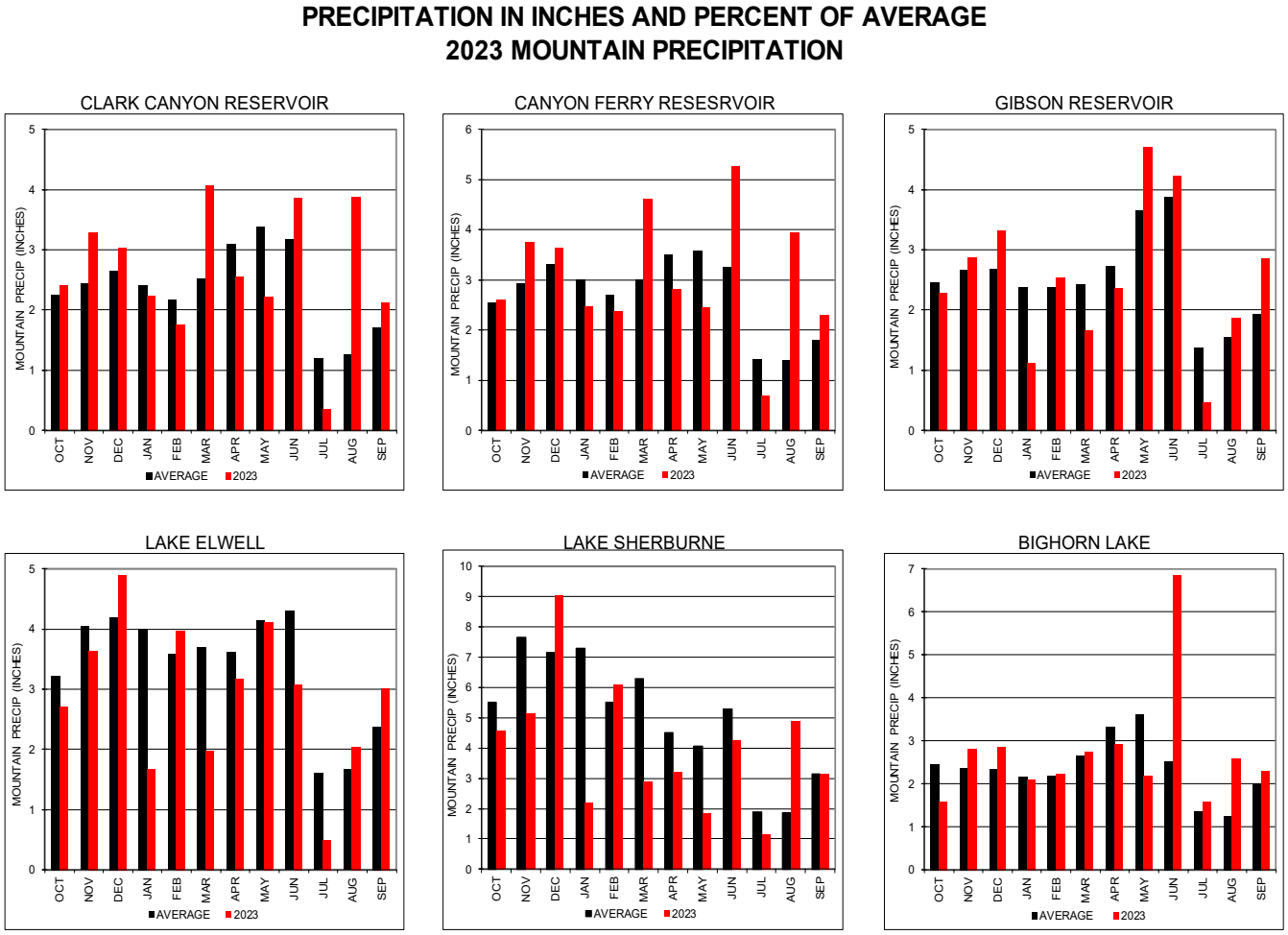



Figure 10.—MTG WY2023 monthly precipitation in mountains above MTAO managed reservoirs in Montana.

Table 37.—MTT - 2023 NRCS mountain snow water content as a percent of normal (median)

| Drainage Basin | January 1 | February 1 | March 1 | April 1 | May 1 |
|---|---|---|---|---|---|
| Missouri Headwaters | 121 | 112 | 107 | 120 | 120 |
| Sun | 120 | 90 | 96 | 97 | 101 |
| Marias | 118 | 92 | 106 | 101 | 102 |
| St. Mary | 111 | 78 | 89 | 84 | 80 |
| Milk River | 159 | 169 | 166 | 256 | |
| Bighorn Basin | 108 | 108 | 108 | 110 | 106 |

Table 38.—MTT - 2023 Reclamation water supply forecasts

| Reservoir | Jan. 1, KAF[1] | Percent of average | Feb. 1, KAF[1] | Percent of average | Mar. 1 KAF[1] | Percent of average | Apr. 1 KAF[2] | Percent of average | May 1 KAF[3] | Percent of average | Jun. 1 KAF[4] | Percent of average | Actual April-July KAF[5] | Percent of average | Percent of April forecast[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Clark Canyon | 73 | 92 | 73 | 92 | 57 | 72 | 75 | 95 | 65 | 102 | 48 | 101 | 81 | 102 | 108 |
| Canyon Ferry | 1,980 | 108 | 2,263 | 123 | 2,069 | 113 | 2,535 | 138 | 1,772 | 117 | 1,083 | 110 | 2,208 | 121 | 87 |
| Gibson | 403 | 99 | 372 | 92 | 391 | 96 | 385 | 95 | 293 | 82 | 163 | 78 | 340 | 84 | 88 |
| Tiber | 368 | 98 | 316 | 84 | 312 | 83 | 315 | 84 | 248 | 77 | 100 | 53 | 260 | 69 | 83 |
| Sherburne | 108 | 109 | 92 | 93 | 94 | 95 | 92 | 93 | 77 | 86 | 42 | 71 | 72 | 73 | 78 |
| Fresno[7] | 59 | 72 | 53 | 66 | 54 | 67 | 41 | 81 | 24 | 55 | 5 | 21 | 59 | 72 | 109 |
| Yellowtail | 1,277 | 103 | 1,284 | 104 | 1,283 | 104 | 1,267 | 103 | 830 | 79 | 715 | 91 | 2,000 | 162 | 158 |

[1] Runoff Forecast for April-July; Fresno Reservoir is March through September
[2] Runoff Forecast for April-July; Fresno Reservoir is April through September
[3] Runoff Forecast for May-July; Fresno Reservoir is May through September
[4] Runoff Forecast for June-July; Fresno Reservoir is June through September
[5] Fresno Reservoir is Actual March through September
[6] Fresno Reservoir is percent of March Forecasted
[7] Fresno Reservoir Forecast is natural flow of Milk River at Eastern Crossing for March through September and percents are based on median values; Forecasts by Alberta Environment and Protected Area

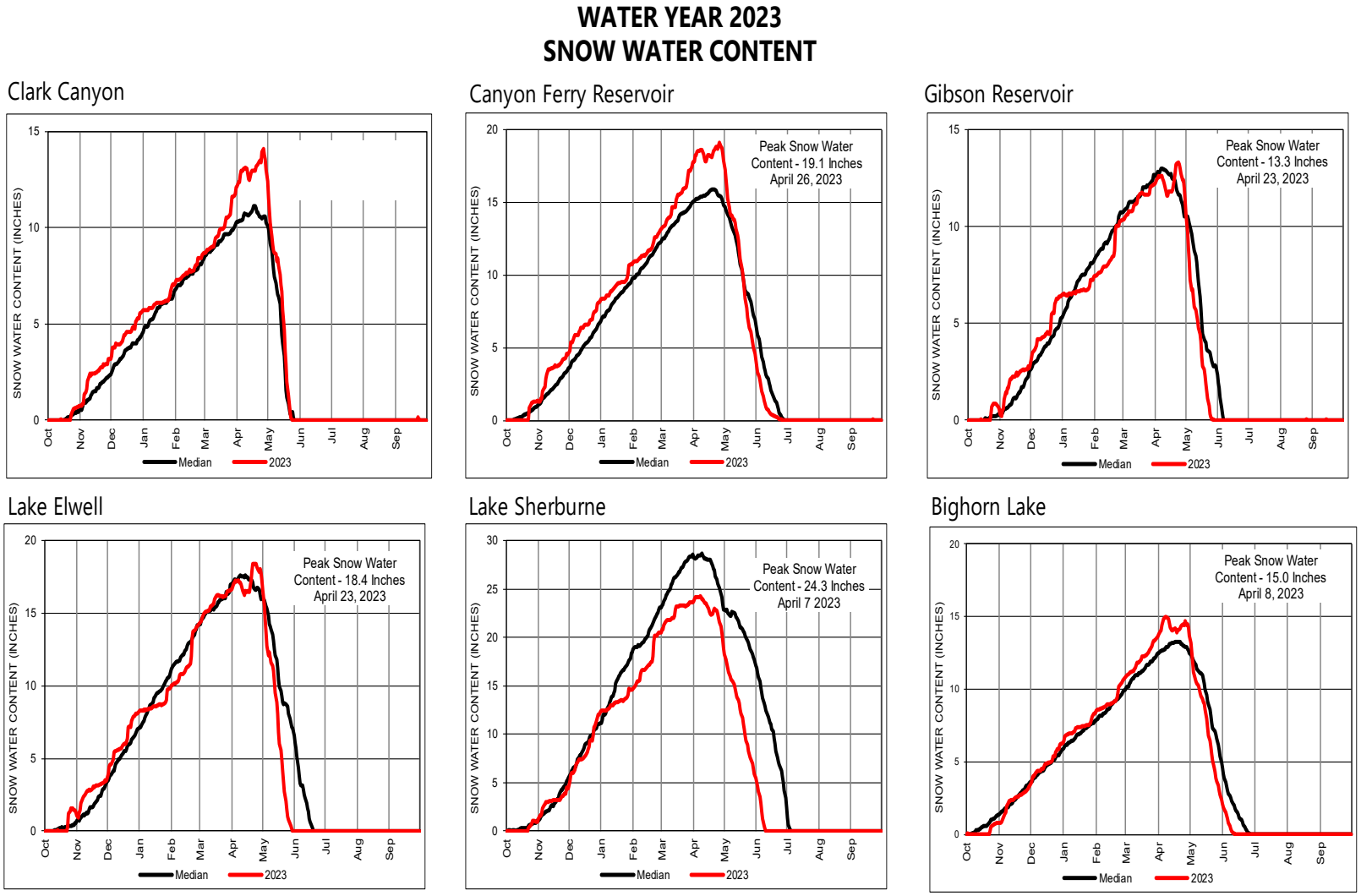



**Figure 11.—MTG - WY2023 Snow water equivalent and average SWE in the mountains above MTAO managed reservoirs in Montana.**

## Flood Benefits

The Corps evaluated reservoir regulation data and indicated four reservoirs provided flood relief to the Missouri River mainstem during WY2023: Clark Canyon Reservoir on the Beaverhead River, Canyon Ferry Lake on the Missouri River, Lake Elwell on the Marias River, and Bighorn Lake on the Bighorn River. Peak inflows regulated by reservoir operations are listed in table 39.

**Table 39.—MTT - WY2023 peak flows regulated at Reclamation reservoirs**

| Reservoir | Peak Inflow ($ft^3/s$) | River Discharge ($ft^3/s$) | Date |
|---|---|---|---|
| Clark Canyon Reservoir | 801 | 253 | 06/05/23 |
| Canyon Ferry Lake | 19,869 | 8,091 | 06/04/23 |
| Lake Elwell | 3,906 | 531 | 05/08/23 |
| Bighorn Lake | 23,264 | 16,422 | 06/25/23 |

The Corps estimated reservoir operations reduced flood damages by $37,663,000 in WY2023. Flood damages are prevented by storing water which would have contributed to flooding and are categorized as local or Missouri River mainstem (downstream of Fort Peck Reservoir). Flood damages prevented are listed in table 40 and figure 12 shows annual flood damages prevented since 1950.

**Table 40.—MTT - WY2023 flood damages prevented (thousands of dollars)**

| Reservoir | Local | Mainstem | WY2023 total | Total accumulated |
|---|---|---|---|---|
| Clark Canyon Reservoir | 33 | 396 | 429 | 66,112 |
| Canyon Ferry Lake | 1,785 | 16,867 | 18,652 | 922,211 |
| Lake Elwell | 0 | 2,488 | 2,488 | 404,231 |
| Fresno Reservoir | 4,844 | 0 | 4,844 | 64,263 |
| Gibson Reservoir[1] | 0 | 0 | 0 | 17,185 |
| Bighorn Lake | 1,244 | 10,006 | 11,250 | 540,113 |
| Lake Sherburne[2] | 0 | 0 | 0 | 32,622 |
| **Total** | **7,906** | **29,757** | **37,663** | **2,046,737** |

[1] No space allocated for flood control, but some flood protection provided through other purposes.
[2] Includes Corps estimated flood damages.

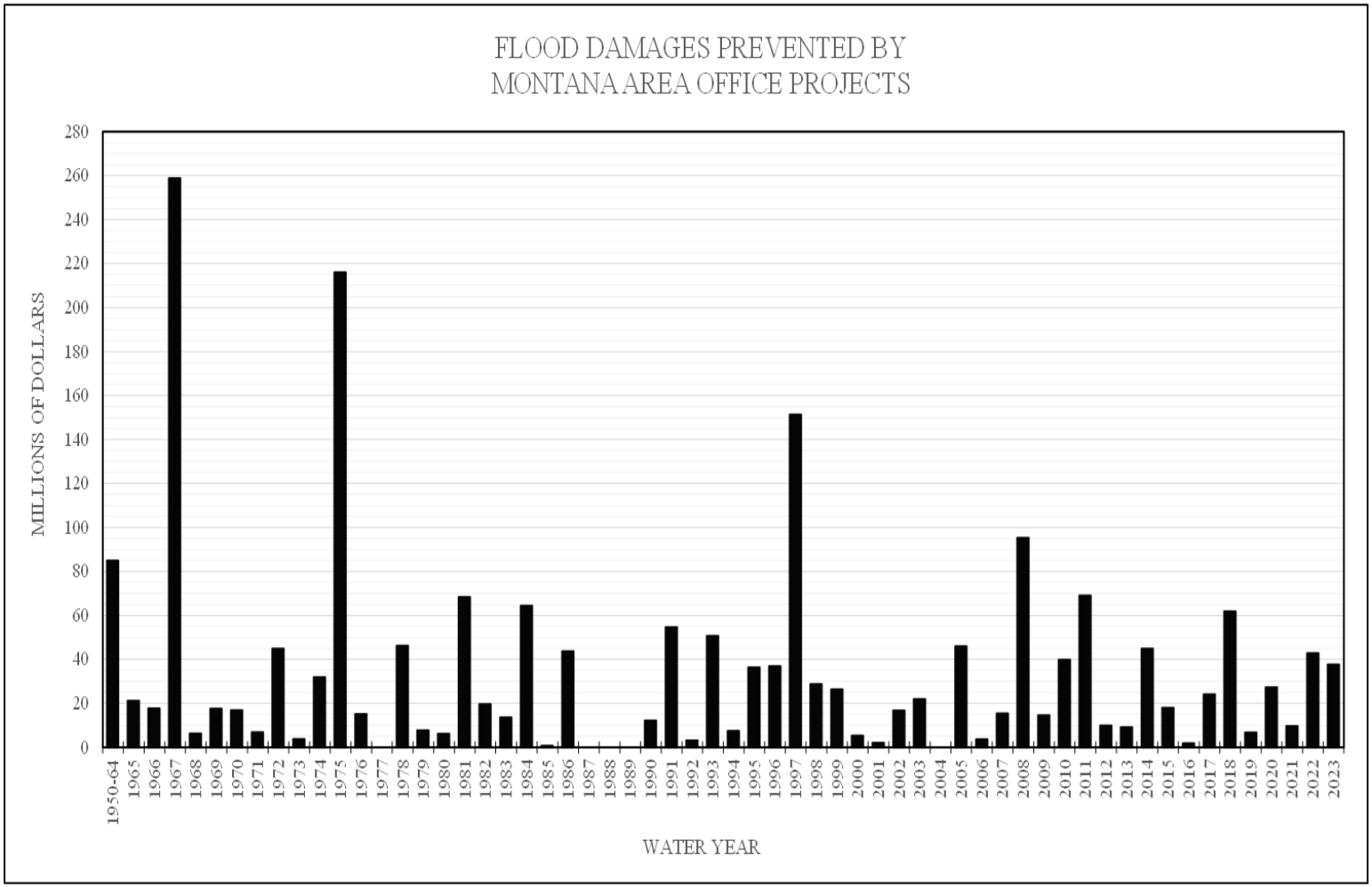



**Figure 12.—MTG - Flood damages prevented by Montana Area Office dams.**

# Unit Operational Summaries for Water Year 2023

## Clark Canyon Reservoir

Clark Canyon Reservoir is located on the Beaverhead River approximately 20 miles upstream from Dillon, Montana. The reservoir is the storage facility for the East Bench Irrigation Unit. Flood control, recreation, and fish and wildlife are among the other functions served by the reservoir.

### *Summary of WY2023 Operations*

#### October through December

WY2023 started in October with a winter release rate of 25 $ft^3/s$, which is set by the East Bench Joint Board (Joint Board) with concurrence by Reclamation. Moderate to severe drought conditions existed in the Red Rock and Beaverhead basins going into WY2023. Storage carryover in October was near 70 percent of average or 53,500 AF. However, the groundwater return-flows from upstream irrigation projects kept inflows into Clark Canyon near 190 $ft^3/s$ which allowed the reservoir storage to start recovering during the fall. See tables 42 through 44 for specific data related to Clark Canyon Reservoir (Figure 13) inflows, releases, and storage content.

Figure 13.—MTG - Aerial view of Clark Canyon Reservoir.

### January through March

In January, Reclamation begins to forecast the April through July runoff volume based on snowpack measurements and other basin parameters. The January 1 forecasted runoff was 108 percent of average, see table 38 for monthly forecasted runoff volumes. January exhibited below normal temperature and above normal precipitation patterns throughout the Beaverhead and Red Rock Basins, while February and March precipitation ranged from 90–125 percent of normal. The Beaverhead and Red Rock Basins slowly recovered from the drought conditions present in the fall throughout the winter. An improvement to abnormal to moderate designations by the middle of February according to the Montana drought monitor map (figure 14).

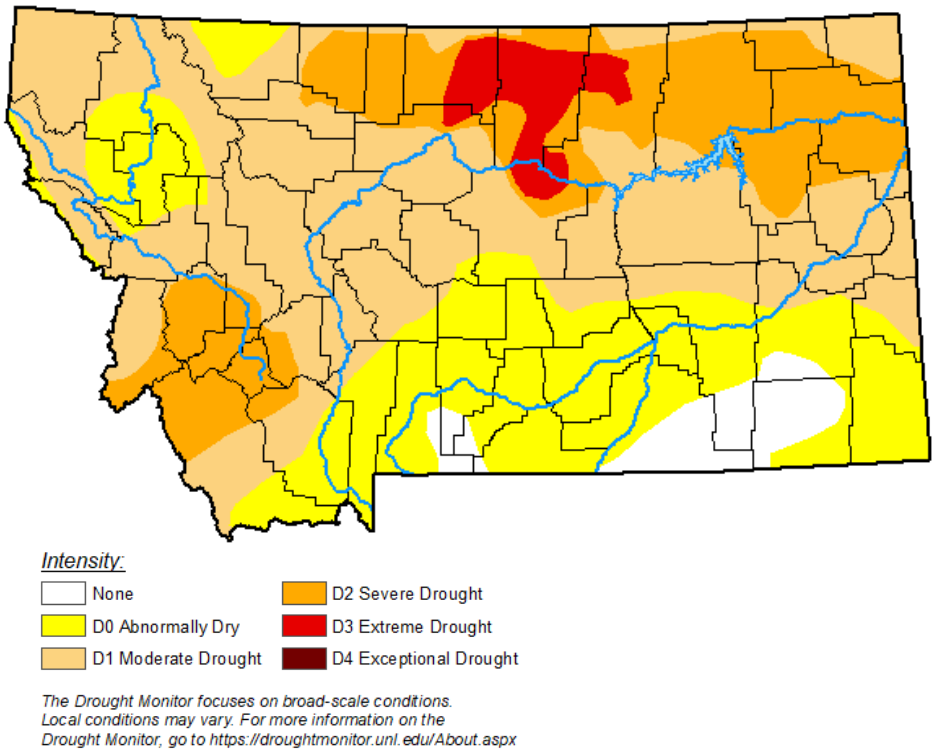



**Figure 14.—MTG - Montana drought monitor map February 14, 2023.**

The Joint Board, consisting of three representatives from the East Bench Irrigation District and three representatives from Clark Canyon Water Supply Company met in March 2023 to discuss the water supply outlook for the 2023 irrigation season. The projected storage content prepared and presented by Reclamation showed resulting storage contents with the options of full allotments and the first tier reduced allotment within the drought management plan. The drought management plan provides guidance for setting reduced allotments to conserve storage in

drought years. The Joint Board reviewed and discussed the forecasts operational plans and made tentative full allotments decision with the option to revisit the forecast and set the final allotments in April.

**April through July**

Snow continued to fall during March which resulted in the Red Rock Basin SWE being near 125 percent of median and the Beaverhead near 111 percent of median. Therefore, the April 1 forecasted runoff volume into Clark Canyon increased from March to 75,000 AF, or 95 percent average. By mid-April the Joint Board met again to determine the final irrigation allotments, which with the increased snowpack, was set at full allotments. Releases to the Beaverhead River were still being maintained near 25 $ft^3/s$ during April to continue filling the reservoir.

On May 1, Reclamation's May through July forecasted inflow volume increased to 102 percent of average. May and June are historically the highest months in the year to receive rainfall and augment the snowmelt runoff volume. Due to the snowmelt runoff and precipitation, by the end of June, Southwestern Montana was out of a drought status designation. Release changes from Clark Canyon Dam during June were based upon irrigation demands.

The drainage area above Lima Reservoir accounts for about 25 percent of the total drainage area above Clark Canyon Reservoir. Lima Reservoir is a private irrigation facility located upstream of Clark Canyon Reservoir on the Red Rock River. Lima Reservoir did fill in late May and spilled additional runoff throughout June and July which was captured in Clark Canyon. The actual April through July runoff volume into Clark Canyon was 80,680 AF, 102 percent of average.

**August through September**

Releases were made to continue meeting irrigation demands during August and into September. Inflows continued to be near 300 $ft^3/s$ during the two months, therefore storage remained steady as inflows matched releases. The Joint Board met in early September to discuss winter release rates and end of season shut down schedules. Releases from Clark Canyon were stepped down from 300 $ft^3/s$ on September 30 to a winter release rate of 100 $ft^3/s$ by October 12.

Most of the storage water released from Clark Canyon Reservoir during WY2023 was released from May through September for meeting downstream irrigation demands. Storage in Clark Canyon Reservoir ended year the year at 111,942 AF, 146 percent of average.

**Important Events – WY2023**

April 2023: East Bench Joint Board set full irrigation allotments.

**Table 41.—MTT - Reservoir allocations for Clark Canyon Reservoir***

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 5470.60 | 1,115 | 1,115 |
| Top of active conservation | 5535.70 | 125,016 | 123,901 |
| Top of joint use | 5546.10 | 174,300 | 49,284 |
| Top of exclusive flood control | 5560.40 | 251,436 | 77,136 |

*2016 reservoir survey and revised area-capacity ,table was implemented on October 1, 2019.

**Table 42.—MTT - Storage and elevation data for Clark Canyon Reservoir**

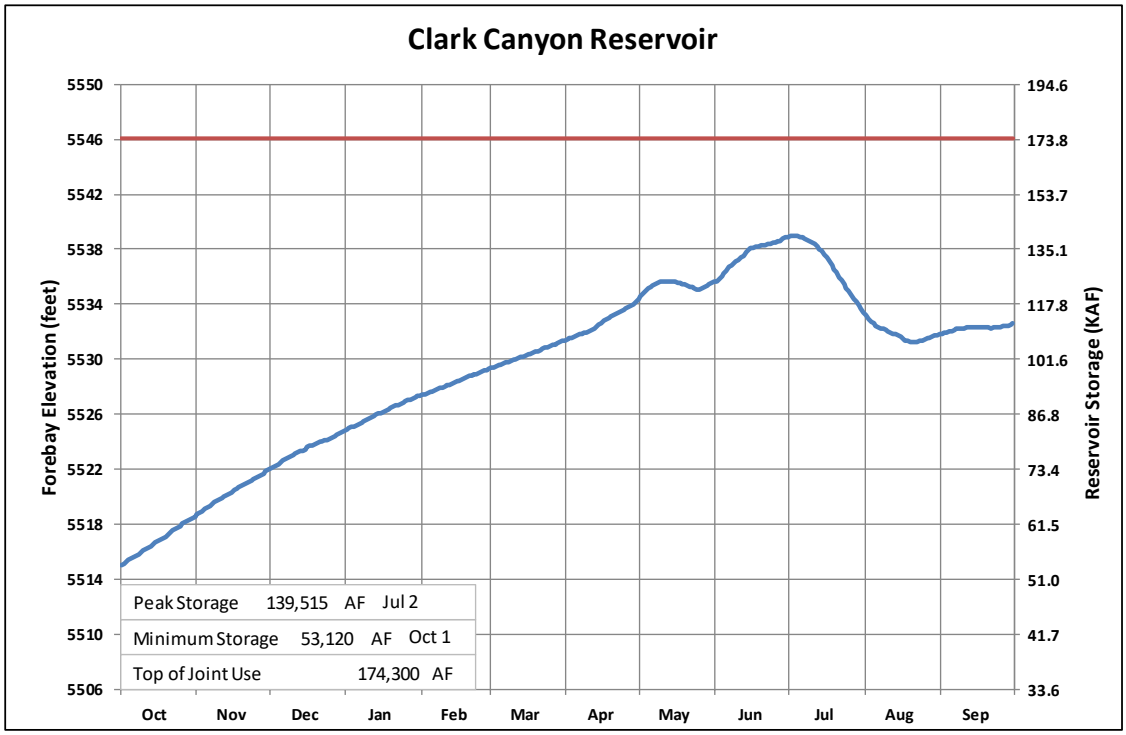
| Storage-elevation data | Elevation (ft) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 5515.02 | 53,499 | 10/1/2022 |
| End of year | 5532.58 | 111,942 | 9/30/2022 |
| Annual low | 5515.02 | 53,499 | 10/1/2022 |
| Annual high | 5538.98 | 139,515 | 7/2/2022 |
| Historic high | 5564.70 | 283,073 | 6/25/1984 |

**Table 43.—MTT - Inflow and discharge data for Clark Canyon Reservoir**

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 182,387 | Oct. '22–Sep. '23 | 123,564 | Oct. '22–Sep. '23 |
| Daily peak ($ft^3/s$) | 801 | 6/5/2023 | 898 | 7/22/2023 |
| Daily minimum ($ft^3/s$) | 91 | 5/16/2023 | 25 | 10/22/2022 |
| Peak spill ($ft^3/s$) | | | 0 | |
| Total spill (AF) | | | 0 | |

Table 44.—MTT - WY2022 monthly inflow, outflow, and storage data for Clark Canyon Reservoir

| Month | Inflow, KAF | Percent of 30-yr avg | Outflow, KAF | Percent of 30-yr avg | Content, KAF | Percent of 30-yr avg |
|---|---|---|---|---|---|---|
| October | 11.7 | 67 | 1.6 | 19 | 63.2 | 73 |
| November | 11.6 | 67 | 1.5 | 19 | 73.3 | 76 |
| December | 11.0 | 74 | 1.6 | 21 | 82.7 | 79 |
| January | 10.7 | 81 | 1.6 | 25 | 91.7 | 82 |
| February | 8.7 | 74 | 1.7 | 25 | 98.9 | 83 |
| March | 9.9 | 67 | 1.7 | 25 | 107.1 | 84 |
| April | 13.9 | 92 | 1.7 | 20 | 119.4 | 89 |
| May | 18.0 | 105 | 12.7 | 56 | 124.7 | 98 |
| June | 31.6 | 122 | 17.0 | 53 | 139.2 | 117 |
| July | 17.2 | 81 | 41.0 | 95 | 115.4 | 123 |
| August | 18.7 | 123 | 25.2 | 80 | 108.9 | 141 |
| September | 19.4 | 130 | 16.4 | 97 | 111.9 | 146 |
| Annual | 182.4 | 92 | 123.6 | 62 | | |
| April–July | 80.7 | 102 | | | | |



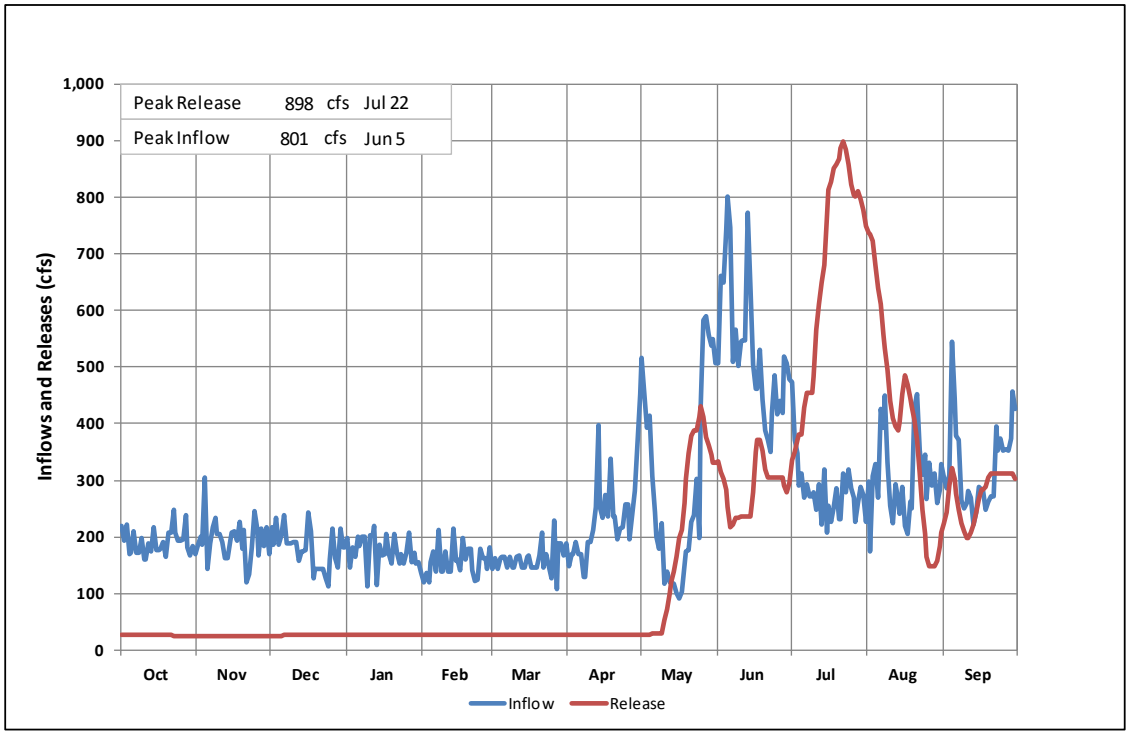




Figure 15.—MTG - WY2023 hydrologic data for Clark Canyon Reservoir.

## Canyon Ferry Lake and Powerplant

Canyon Ferry Lake, formed by Canyon Ferry Dam, is located on the Missouri River near Helena, Montana. Canyon Ferry's storage is operated for power generation and irrigation; however, flood control, recreation, and fish and wildlife are among the other functions served by the reservoir. The main irrigation projects include the Crow Creek Unit, the Helena Valley Unit, and replacement storage for the East Bench Unit. A small amount of municipal water is also furnished to the city of Helena, Montana, through facilities for the Helena Valley Unit.

Figure 16.—MTG. - Canyon Ferry Dam and Powerplant.

### *Summary of WY2023 Operations*

#### October through December

Water year 2023 started out with very warm temperatures and normal precipitation conditions. Climatic conditions during October were near normal, however, a shift in November and December occurred. This shift resulted in very cold temperatures and normal to above normal precipitation patterns in the Gallatin, Jefferson, and Madison Basins, which are the main tributaries to the Missouri River headwaters above Canyon Ferry Reservoir. Inflows were forecasted near 80 percent of average and storage content was also below normal, therefore releases below Holter Dam were reduced to 3,500 $ft^3/s$ in October to recover and or try to maintain reservoir storage. A river release target of 3,000 $ft^3/s$ below Holter Dam is the minimum release required as per operational agreements. The desired fishery flows below Holter Dam on the Missouri River is 4,100 $ft^3/s$. Inflows were less than releases therefore the reservoir slowly declined in elevation throughout the months. In mid-December releases were increased by 1,000 $ft^3/s$ for approximately ten days in coordination with NorthWestern Energy as per the

operational agreement. NorthWestern Energy can supplement river flows and use up to 47,500 AF of water in Canyon Ferry from December through February. The reservoir continued to draft as releases surpassed inflows. By December 31, the Montana drought monitor map showed most of the basins above Canyon Ferry as abnormally to severely dry. See tables 45 through 48 for specific data related to Canyon Ferry Reservoir inflows, releases, and storage content.

**January through March**

In January, Reclamation begins to forecast the April through July runoff volume based on snow content and other basin parameters. The January 1 forecasted runoff was 108 percent of average, see table 4 for monthly forecasted runoff volumes. The higher-than-average forecast is due to the continual building of snowpack in the basins above Canyon Ferry reservoir, which was 121 percent of median on January 1, 2023. Releases were increased to 3,900 $ft^3/s$ in response to the forecast. The February 1 forecasted runoff increased to 123 percent of average as a boost of snow fell in January and releases were increased to 4,100 $ft^3/s$ below Holter Dam. The flows continued to be adjusted throughout January and February in coordination with Northwestern Energy. The March 1 runoff forecast decreased slightly to 113 percent of average as the snowfall began to level off to near average conditions. In accordance with Reclamation's most probable operational plan, releases were increased to 4,300 $ft^3/s$.

**April through July**

On April 1, the Montana drought monitor map still had the watershed above Canyon Ferry designated as mostly abnormally dry. However, Reclamation's April through July forecasted inflow volume increased to 138 percent of average in response to high snowpack (120 percent of median on April 1) and very cold conditions. The operational plan was to keep Canyon Ferry Reservoir storage near the same by the end of April while releases would increase throughout as inflows increased. Diversions for the Helena Valley Irrigation District (HVID) to the Helena Valley Reservoir began the second week of April. Snow continued to build during April which resulted in peak snowpack for the year (figure 11) on April 26, 2023, of approximately 19 inches of snow water equivalent. Overall monthly average inflows matched the average release of 5,500 $ft^3/s$ throughout April and resulted in the storage elevation remaining constant near 3,779.5 feet.

On May 1, Reclamation's May through July forecasted inflow volume was 117 percent of average. May and June are historically the most productive months of the year for rainfall to augment the snowmelt runoff volume. The weather was warm causing steady snowmelt throughout the month. Inflows quickly rose from 8,000 $ft^3/s$ to 13,000 $ft^3/s$ in the first week and remained between 10,000 $ft^3/s$ and 18,000 $ft^3/s$ for the rest of the month. This volume of water required releases to increase from 5,700 $ft^3/s$ to near 8,200 $ft^3/s$. The high inflows caused the end of the month elevation to rise to near 3792.0 feet. Inflows during May were 151 percent of average.

The snowmelt continued to decline rapidly and the peak inflow into Canyon Ferry occurred on June 4 near 19,870 $ft^3/s$ and in response releases were increased to 14,200 $ft^3/s$ to control the remaining available space in the reservoir. By June 7 the snowpack in the Upper Missouri Basin

had declined to 44 percent of average (figure 17). By mid-June inflows matched releases as the reservoir was nearly full. As inflows declined during the second half of the month, releases were also decreased to near 7,000 $ft^3/s$ by the months end. The reservoir reached full pool, elevation 3797.0 feet by the end of the month.

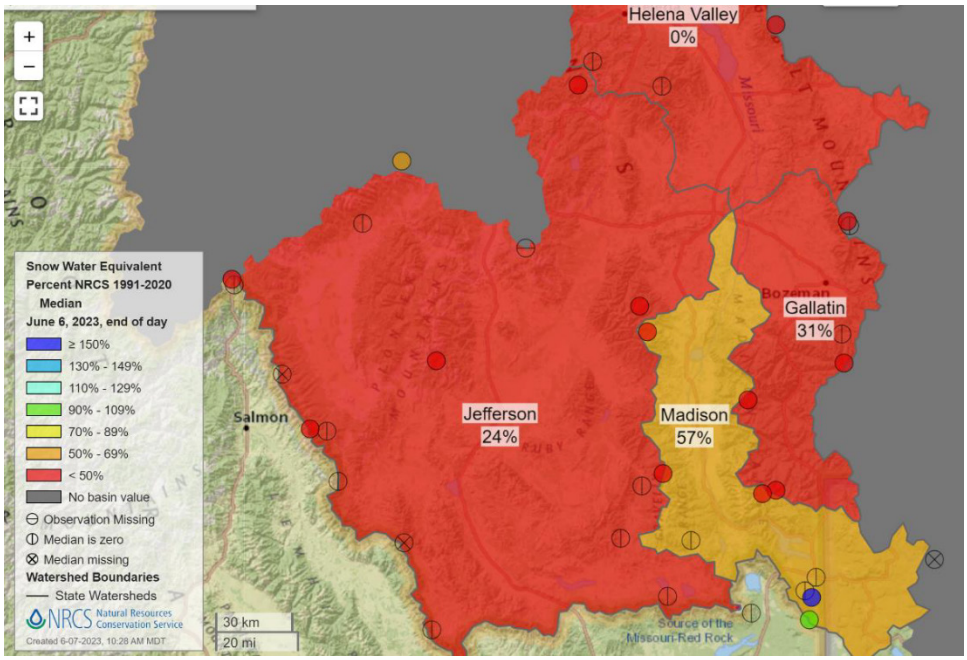



**Figure 17.—MTG - NRCS snow water equivalents, June 7, 2023.**

At the beginning of July, Canyon Ferry was at full pool and entered the flood control space for a brief amount of time as inflows were higher than forecasted. During this time Reclamation coordinated with USACE and determined releases could remain constant as the upstream U.S. Geological Survey (USGS) stations were declining and inflows would soon be lower than releases. The small amount of storage in the exclusive flood control space (0.2 feet) was evacuated within a week. Releases were gradually reduced from near 7,100 to 4,100 $ft^3/s$ by the third week in July. Precipitation and temperatures were near normal conditions for the month of July.

The April through July runoff into Canyon Ferry during WY2023 was 121 percent of average, totaling 2,208,000 AF. The runoff improves the drought conditions in Southwestern Montana, figure 18.

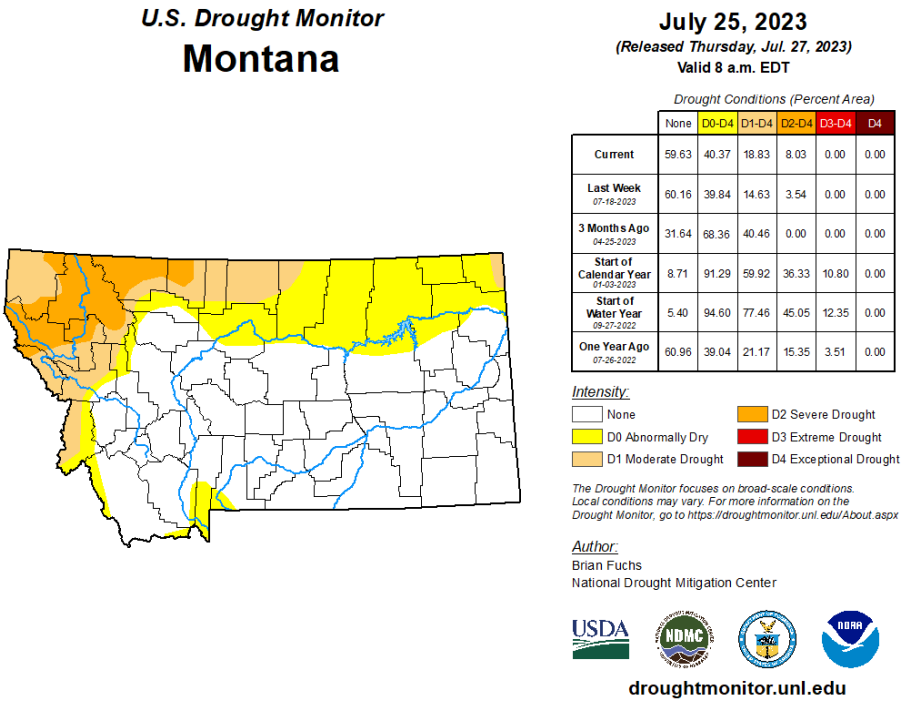



Figure 18.—MTG - Montana Drought Monitor Map July 25, 2023.

**August through September**

Releases from Canyon Ferry were managed to maintain flows below Holter Dam near 4,100 $ft^3/s$. Storage in Canyon Ferry continued to decline, as normal, throughout August and September. HVID diversions continued to be adjusted to meet irrigation demands. August and September were near normal temperatures, while much above average precipitation fell in the basins. Canyon Ferry reservoir ended the water year at elevation 3790.1 feet, 106 percent of average.

**Important Events -WY2023**

**December 2022 – February 2023:** In coordination with Northwestern Energy, base flow releases were increased due to colder weather. The volume delivered was in accordance with the operation agreement in using 47,500 AF of water in Canyon Ferry.

**April 12, 2023:** Helena Valley Irrigation District started pumping water to the Helena Valley Reservoir. Diversions from Canyon Ferry Reservoir were adjusted throughout the season to meet irrigation demands from the Helena Valley Reservoir.

**June 2023:** Peak inflows into Canyon Ferry was 19,869 $ft^3/s$ on June 4. Peak release to the Missouri River was 14,631 $ft^3/s$ on May 12.

**October 1, 2023:** HVID discontinued all diversions to Helena Valley Reservoir.

**Table 45.—MTT - Reservoir allocations for Canyon Ferry Reservoir***

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 3728.00 | 388,641 | 387,542 |
| Top of active conservation | 3770.00 | 1,087,216 | 698,575 |
| Top of joint use | 3797.00 | 1,886,950 | 799,734 |
| Top of exclusive flood control | 3800.00 | 1,993,036 | 106,086 |

*2016 reservoir survey and revised area-capacity table was implemented on October 1, 2020.

**Table 46.—MTT - Storage and elevation data for Canyon Ferry Reservoir**

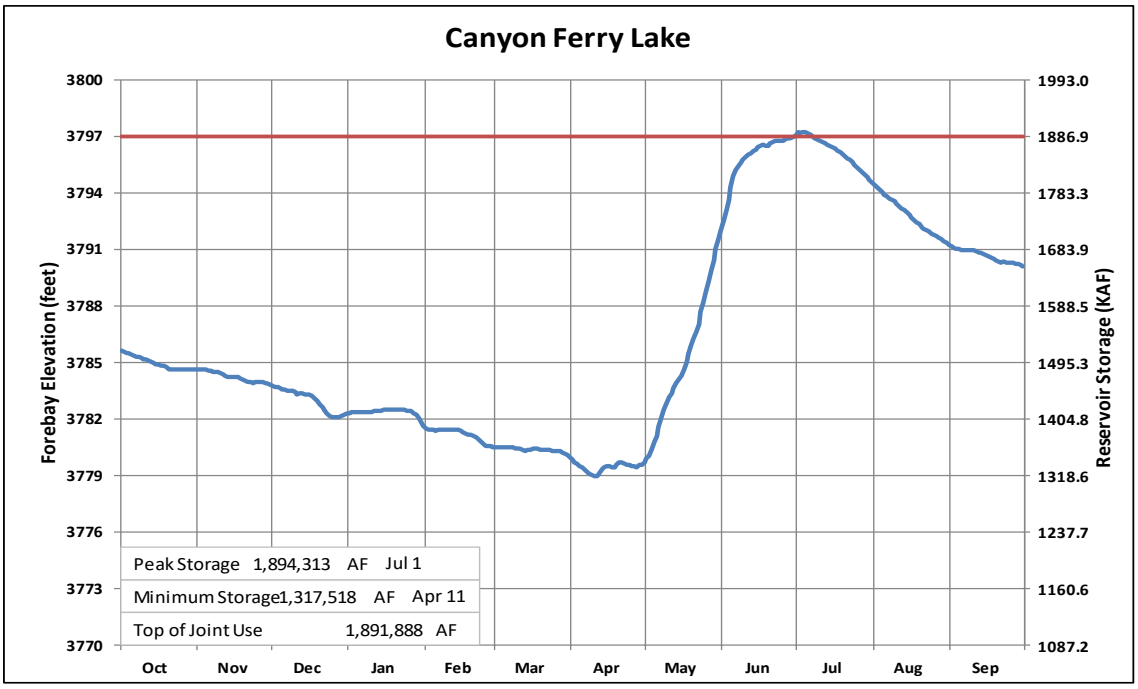
| Storage-elevation data | Elevation (ft) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 3785.71 | 1,517,205 | 10/1/2022 |
| End of year | 3790.11 | 1,655,320 | 9/30/2023 |
| Annual low | 3778.96 | 1,317,518 | 4/11/2023 |
| Annual high | 3797.21 | 1,894,313 | 7/1/2023 |
| Historic high | 3800.00 | 2,050,900 | 6/23/1964 |

**Table 47.—MTT - Inflow and discharge data for Canyon Ferry Reservoir**

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 3,775,643 | Oct. '22–Sep. '23 | 3,637,528 | Oct. '22–Sep. '23 |
| Daily peak ($ft^3/s$) | 19,869 | 6/4/2023 | 14,840 | 6/12/2023 |
| Daily minimum ($ft^3/s$) | 1,347 | 1/31/2023 | 3,414 | 11/25/2022 |
| Peak spill ($ft^3/s$) | | | 11,283 | 6/8/2022 |
| Total spill (AF) | | | 1,034,021 | Oct. '22–Sep. '23 |

**Table 48.—MTT - WY2023 monthly inflow, outflow, and storage data for Canyon Ferry Reservoir**

| Month | Inflow, KAF | Percent of 30-yr avg | Outflow pumped to HVID, KAF | Percent of 30-yr Avg | Outflow to river, KAF | Percent of 30-yr avg | Content, KAF | Percent of 30-yr avg |
|---|---|---|---|---|---|---|---|---|
| October | 183.0 | 80 | 0.0 | | 216.2 | 94 | 1,484.0 | 95 |
| November | 182.1 | 75 | 0.0 | | 205.9 | 90 | 1,460.2 | 93 |
| December | 180.0 | 86 | 0.0 | | 227.2 | 90 | 1,413.1 | 92 |
| January | 215.1 | 101 | 0.0 | | 233.7 | 90 | 1,394.4 | 94 |
| February | 178.3 | 88 | 0.0 | | 211.4 | 86 | 1,361.3 | 94 |
| March | 244.0 | 95 | 0.0 | | 260.0 | 94 | 1,345.3 | 94 |
| April | 327.6 | 105 | 5.5 | 74 | 335.3 | 112 | 1,337.7 | 93 |
| May | 804.6 | 151 | 14.1 | 85 | 373.3 | 114 | 1,716.9 | 108 |
| June | 822.3 | 117 | 15.3 | 83 | 650.8 | 141 | 1,888.4 | 103 |
| July | 253.6 | 90 | 20.3 | 98 | 340.7 | 95 | 1,801.3 | 102 |
| August | 165.4 | 119 | 21.9 | 107 | 274.6 | 106 | 1,692.0 | 103 |
| September | 219.7 | 140 | 12.9 | 107 | 256.4 | 111 | 1,655.3 | 106 |
| Annual | 3,775.6 | 108 | 90.0 | 94 | 3,637.5 | 105 | | |
| April–July | 2,208.2 | 121 | | | | | | |



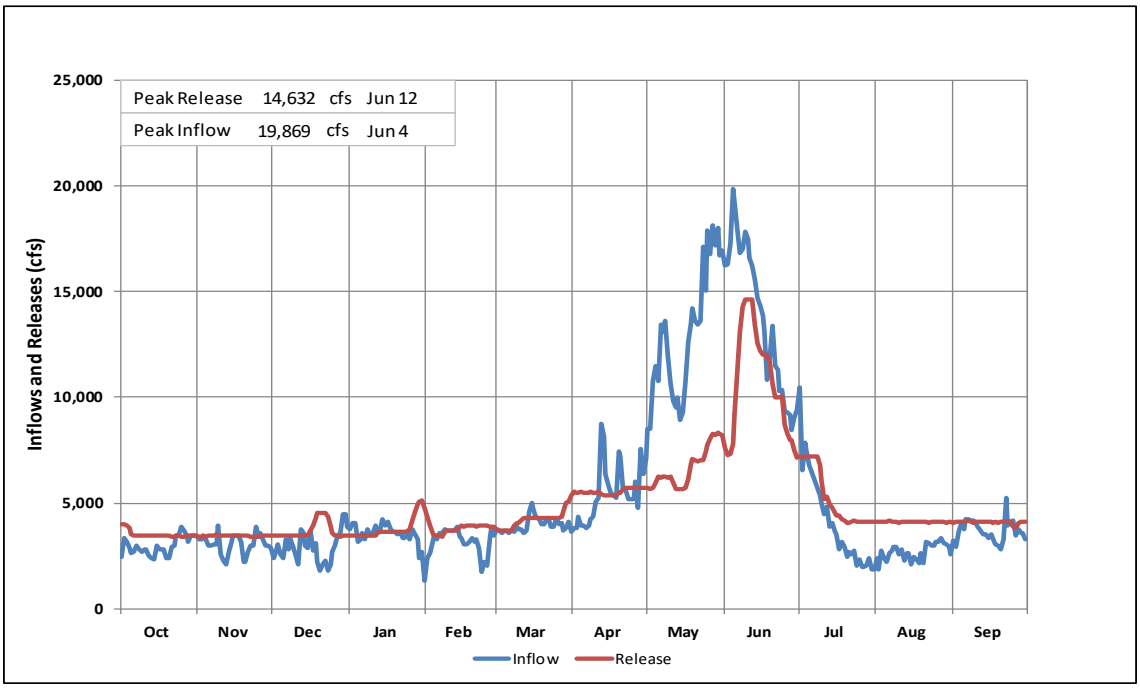




Figure 19.—MTG - WY2023 hydrologic data for Canyon Ferry Reservoir.

## Helena Valley Reservoir

Helena Valley Reservoir is a regulating off-stream reservoir for Helena Valley Unit (P-S MBP), located west of Canyon Ferry Reservoir. It has a total capacity of 10,451 AF, which is used for irrigation and furnishing a supplemental municipal water supply to the city of Helena, Montana. Helena Valley Reservoir receives its entire water supply by pumping from Canyon Ferry Reservoir. When fully developed, Helena Valley Unit can irrigate about 14,100 acres of full-service land and 3,500 acres of supplemental service lands. Present development services about 13,867 full-service acres, including 5,200 acres previously irrigated by pumping from Helena Valley Reservoir or from other streams.

**Figure 20.—MTG - View of Helena Valley Reservoir and Dam.**

### *Summary of WY2023 Operations*

At the beginning of the water year, storage in Helena Valley Reservoir was approximately three feet below full pool. The reservoir slowly declines throughout the winter as a result of municipal demands and seepage. The reservoir drafts another four to five feet by late March or early April. The operating criteria goals are to fill Helena Valley Reservoir by May 1 and maintain it nearly full through June. In response, diversions to the Helena Valley Unit from Canyon Ferry Reservoir started on April 12. Storage in Helena Valley Reservoir steadily increased with diversions from Canyon Ferry. Diversions were made as needed throughout the year to meet irrigation demands and refill the reservoir. All irrigation deliveries were discontinued for the 2023 season on October 1, 2023. The reservoir provided an adequate water supply to satisfy all irrigation requirements for the Helena Valley Unit and supplement the city of Helena's municipal water supply.

Statistical information pertaining to Helena Valley Reservoir is shown in tables 49 through 52.

**Table 49.—MTT - Reservoir allocations for Helena Valley Reservoir***

| Reservoir allocations | Elevation (feet) | Reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive storage | 3805.00 | 4,554 | 4,554 |
| Top of active conservation storage | 3820.07 | 10,451 | 5,897 |

*Based on original area-capacity table

**Table 50.—MTT - Storage and elevation data for Helena Valley Reservoir**

| Storage elevation data | Elevation (feet) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 317.13 | 9,000 | 10/01/2022 |
| End of year | 3817.64 | 9,241 | 9/30/2023 |
| Annual low | 3813.07 | 7,247 | 4/6/2023 |
| Annual high | 3820.00 | 10,415 | 7/2/2023 |
| Historic high | 3820.60 | 10,738 | 6/02/1975 |

**Table 51.—MTT - Inflow and discharge data for Helena Valley Reservoir**

| Inflow-outflow data | Annual (AF) |
|---|---|
| Pumped from Canyon Ferry to Helena Valley Unit | 90,016 |
| Released from reservoir for irrigation | 78,992 |
| Delivered to the City of Helena for municipal use | 1,173 |

Table 52.—MTT - WY2023 monthly elevation and storage data for Helena Valley Reservoir

| Month | Forebay elevation (feet) | Storage content (KAF) | Pumped to Helena Valley (KAF) |
|---|---|---|---|
| October | 3816.23 | 8.6 | 0.0 |
| November | 3815.52 | 8.3 | 0.0 |
| December | 3814.90 | 8.0 | 0.0 |
| January | 3814.25 | 7.7 | 0.0 |
| February | 3813.64 | 7.5 | 0.0 |
| March | 3813.17 | 7.3 | 0.0 |
| April | 3819.32 | 10.1 | 5.5 |
| May | 3819.76 | 10.3 | 14.1 |
| June | 3819.77 | 10.3 | 15.3 |
| July | 3816.02 | 8.5 | 20.3 |
| August | 3818.34 | 9.6 | 21.9 |
| September | 3817.64 | 9.2 | 12.9 |
| Annual | | | 90.0 |

## Sun River Project

Storage for the Sun River Project is provided by Gibson, Willow Creek, and Pishkun Reservoirs, which are all single purpose irrigation structures. The project serves 95,000 acres on the Greenfields and Fort Shaw Irrigation Districts. A diversion dam is located on the Sun River about three miles below Gibson Reservoir to divert flows down the Pishkun Supply Canal to Pishkun Reservoir, or down the Willow Creek Feeder Canal to Willow Creek Reservoir. Releases are made from Pishkun Reservoir to supply Greenfields Irrigation District. Releases from Willow Creek Reservoir reenter the Sun River where they can be diverted at the Fort Shaw Diversion Dam to supply Fort Shaw Irrigation District.

Figure 21.—MTG - Gibson Reservoir and Dam.

## Gibson Reservoir

Gibson Reservoir is located on the Sun River west of Augusta, Montana. Gibson Reservoir typically fills each year due to adequate inflows in most years.

### *Summary of 2023 Operations*

#### October through December

Gibson Reservoir typically begins the new water year with a nearly empty reservoir. Releases from Gibson during October normally mimic inflows and are passed through the reservoir to either the river or through canals to assist in refilling of Willow Creek Reservoir. Storage levels remained steady as average releases and inflows were both near 170 $ft^3/s$ during October. Approximately 90 of the 170 $ft^3/s$ release from Gibson was diverted to the Willow Creek feeder canal. The river releases help meet any remaining downstream irrigation demands while also providing beneficial flows for the fall brown trout spawn. See tables 53 through 56 for specific data related to Gibson Reservoir inflows, releases, and storage content.

Releases from Gibson were decreased from 170 to 95 $ft^3/s$ on November 23 as diversions to the canal ceased. November and December precipitation was above average and much below average temperatures in the Sun River drainage. Gibson Reservoir continued to fill approximately seven feet by the end of December as inflows were near 140 $ft^3/s$ and releases to the Sun River were near 100 $ft^3/s$.

### January through March

In January, Reclamation begins to forecast the April through July runoff volume based on snowpack measurements and other basin parameters. The January 1 forecasted runoff was 99 percent of average at 403,000 AF. The snowfall slowed during the month and dropped below median which resulted in a SWE of 90 percent by the beginning of February. Therefore, the February 1 runoff forecast dropped slightly to 92 percent of average. Inflows during February averaged near 110 $ft^3/s$ and releases were maintained near 100 $ft^3/s$. A snowstorm mid-month brought the SWE back to median conditions by March 1. Gibson Reservoir storage slowly filled another four feet to elevation 4621.47 feet or 10,055 AF by the end of March.

### April through June

The April through July spring forecast for Gibson Reservoir was 385,000 AF, 95 percent of average. April temperatures were below normal while snow continued to accumulate resulting in an April 23 peak snowpack. Both Willow Creek and Pishkun reservoirs need to be refilled to meet the irrigation demands throughout the summer. See the next sections for more information on Willow Creek and Pishkun Reservoirs.

The May through July spring forecast for Gibson was 293,000 AF, 82 percent of average. Diversion to Pishkun Reservoir via the Pishkun Supply Canal was initiated in early May. The snow melted rapidly resulting in a peak inflow of 5,260 $ft^3/s$ on May 6. This rapid runoff raised the reservoir elevation 45 feet, to elevation 4702.0 feet by May 10. Reservoir elevation increased to 4712.0 feet by May 18 while only 2.6 inches of SWE remained in the basin. Depending on runoff conditions and reservoir levels, Gibson's spillway gates are to remain open until inflows and remaining snowpack indicate that the runoff is receding. Once runoff has peaked, the spillway gates are gradually closed to fill the reservoir another 12 feet to the top of the conservation pool at elevation 4,724.0 feet. Since there was little snow remaining, the gates were closed, allowing the remaining storage space to be filled by the end of May. Releases from Gibson were reduced from 2,950 to 2,000 $ft^3/s$ by June 1.

Inflows and releases were matched for the first half of June as the reservoir was full. Releases were increased again to a river discharge below diversion dam near 2,600 $ft^3/s$ on June 10. Releases to the Sun River below Sun River Diversion Dam were quickly reduced to near 140 $ft^3/s$ by June 21.

### July through September

July temperatures were near normal, and little precipitation fell within the Sun River drainage. Irrigation requirements were high, and Gibson Reservoir was drafting quickly. The actual April through July runoff totaled 340,000 AF, 84 percent of average. Releases from Gibson Reservoir continued to be adjusted to meet downstream senior water rights and minimum river flows while also diverting water to Pishkun Reservoir. Diversions to Pishkun were discontinued on August 14 as Gibson Reservoir reached the minimum content near 5,500 AF.

Releases from Gibson during late August and September were designed to pass all inflows for downstream users. Therefore, Gibson reservoir remained at minimum content (5,500 AF) for the

rest of the water year. Temperatures in September were near normal, while much needed precipitation fell in the basin. By the end of September, the Montana drought monitor map designated the Sun River area drought conditions as abnormally dry to moderate.

## Pishkun Reservoir

Pishkun Reservoir, near Augusta, Montana is an off-stream reservoir supplied by a feeder canal which diverts water from the Sun River below Gibson Reservoir. Releases are made from Pishkun Reservoir to supply Greenfields Irrigation District (GID).

**Figure 22.—MTG - Aerial view of Pishkun Reservoir.**

### *Summary of WY2023 Operations*

The content in Pishkun Reservoir at the beginning of the WY2023 was 36,213 AF at elevation 4362.70 feet. Storage during the fall and winter decreased to 34,940 AF due to evaporation and ice storage. Diversions from the Sun River started refilling the reservoir on May 13, 2023.

The reservoir slowly filled and reached near the top of active conservation pool at elevation 4370.0 feet in mid-June. Irrigation releases from Pishkun Reservoir began on May 18. Pishkun releases from May through August were designed to meet irrigation demands. The GID delivered a reduced allotment of 1.5 AF per acre (full allotment is 2.0 AF per acre) to its water users in WY2023 due to drought conditions in the basin. Approximately 207,567 AF of water was

released from Pishkun Reservoir from May 18 through August 17 to help meet irrigation demands on GID. All diversions from the Sun River into Pishkun Reservoir were discontinued on August 17.

Additional hydrologic and statistical data pertaining to Pishkun Reservoir can be found in tables 57 through 60.

## Willow Creek Reservoir

Willow Creek Reservoir obtains its water supply from Willow Creek and the Sun River via the Willow Creek Feeder Canal. Releases from Willow Creek Reservoir enter the Sun River and can be diverted for irrigation at the Fort Shaw Diversion Dam, the Floweree Canal of the Broken O Ranch, and other downstream senior water users.

**Figure 23.—MTG - View of Willow Creek Dam and Reservoir.**

### *Summary of WY2023 Operations*

Willow Creek Reservoir began to refill during the fall through the Willow Creek Feeder canal as the reservoir storage was low. The diversions were discontinued in late November due to weather. Natural inflows into Willow Creek Reservoir also contributes to the overall inflows. Storage increased approximately 8,100 AF or nine feet from October through March 30.

From early May through mid-June, GID again initiated diversions from the Sun River via the Willow Creek Feeder Canal to assist in continuing to fill the reservoir another nine and a half feet. Willow Creek reservoir reached near full at elevation 4,140.03 on June 25. On June 21, releases from Willow Creek Reservoir were started for meeting downstream demands. These releases continued to fluctuate throughout the summer until releases ceased on August 17. Willow Creek Feeder Canal diversions began again on October 1 to begin refilling the reservoir in preparation for next year.

Additional hydrologic and statistical data pertaining to Willow Creek Reservoir can be found in tables 61 through 64.

***Important Events – WY2023***

**May 3, 2023**: Began to refill Willow Creek Reservoir via Willow Creek Feeder Canal.

**May 11, 2023**: Diversions to the Pishkun Supply Canal were initiated.

**June 21, 2023**: Releases from Willow Creek Reservoir were initiated to supplement the Sun River.

**August 17, 2023**: Releases from Pishkun Reservoir for irrigation deliveries were discontinued for the season.

**Table 53.—MTT - Reservoir allocations for Gibson Reservoir***

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 4557.50 | 0 | 0 |
| Top of active conservation | 4724.00 | 98,688 | 98,688 |

*2009 reservoir survey and revised area-capacity table was implemented on January 1, 2013.

**Table 54.—MTT - Storage and elevation data for Gibson Reservoir**

| Storage-elevation data | Elevation (ft) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 4610.44 | 5,578 | 10/1/2022 |
| End of year | 4611.78 | 6,027 | 9/30/2023 |
| Annual low | 4609.08 | 5,170 | 11/20/2022 |
| Annual high | 4724.06 | 98,767 | 6/5/2022 |
| Historic high | 4732.23 | 116,400 | 6/8/1964 |

**Table 55.—MTT - Inflow and discharge data for Gibson Reservoir**

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 414,088 | Oct. '22–Sep. '23 | 413,638 | Oct. '22–Sep. '23 |
| Daily peak ($ft^3/s$) | 5,259 | 5/6/2023 | 3,205 | 6/9/2023 |
| Daily minimum ($ft^3/s$) | 66 | 1/29/2023 | 95 | 11/26/2022 |

**Table 56.—MTT - WY2023 monthly inflow, outflow, and storage data for Gibson Reservoir**

| Month | Inflow, KAF | Percent of 30-yr avg | Outflow to canal, KAF | Percent of 30-yr avg | Outflow to river, KAF | Percent of 30-yr avg | Content, KAF | Percent of 30-yr avg |
|---|---|---|---|---|---|---|---|---|
| October | 10.6 | 82 | 5.5 | 168 | 10.6 | 113 | 5.6 | 32 |
| November | 8.8 | 64 | 4.0 | 115 | 8.5 | 84 | 5.9 | 28 |
| December | 8.5 | 76 | 0.0 | | 6.0 | 71 | 8.4 | 35 |
| January | 7.3 | 73 | 0.0 | | 6.2 | 85 | 9.4 | 35 |
| February | 6.1 | 66 | 0.0 | | 5.6 | 85 | 9.9 | 34 |
| March | 6.4 | 45 | 0.0 | | 6.2 | 72 | 10.1 | 29 |
| April | 22.3 | 52 | 0.0 | | 6.4 | 27 | 25.9 | 49 |
| May | 195.9 | 128 | 32.6 | 71 | 123.2 | 104 | 98.6 | 109 |
| June | 94.8 | 61 | 65.0 | 100 | 104.6 | 68 | 88.9 | 97 |
| July | 27.0 | 51 | 80.0 | 98 | 83.6 | 88 | 32.3 | 71 |
| August | 15.1 | 71 | 32.6 | 78 | 41.6 | 83 | 5.7 | 34 |
| September | 11.3 | 82 | 0.4 | 4 | 11.0 | 60 | 6.0 | 44 |
| Annual | 414.1 | 81 | 220.1 | 84 | 413.6 | 81 | | |
| April-July | 340.0 | 84 | | | | | | |

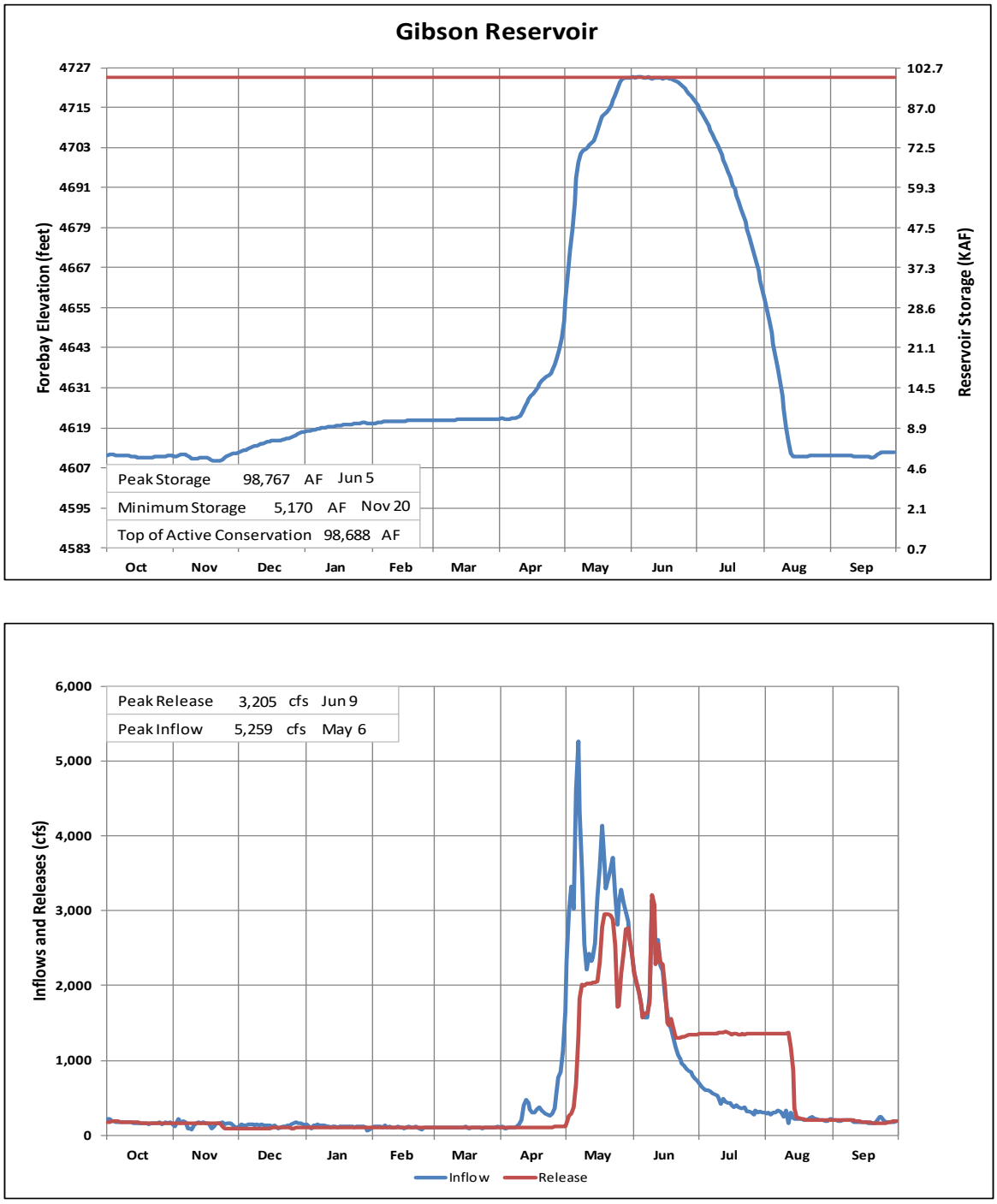



Figure 24.—MTG - WY2023 hydrologic data for Gibson Reservoir.

**Table 57.—MTT - Reservoir allocations for Pishkun Reservoir***

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 4342.00 | 16,008 | 16,008 |
| Top of active conservation | 4370.00 | 46,694 | 30,686 |

*2002 reservoir survey and revised area-capacity table was implemented on October 1, 2005.

**Table 58.—MTT - Storage and elevation data for Pishkun Reservoir**

| Storage-elevation data | Elevation (ft) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 4362.58 | 36,052 | 10/1/2022 |
| End of year | 4362.52 | 35,972 | 9/30/2023 |
| Annual low | 4361.74 | 34,942 | 4/6/2023 |
| Annual high | 4369.70 | 46,239 | 6/17/2023 |
| Historic high | 4371.40 | 48,950 | 7/4/1953 |

**Table 59.—MTT - Inflow and discharge data for Pishkun Reservoir**

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 204,533 | Oct. '22–Sep. '23 | 205,113 | Oct. '22–Sep. '23 |
| Daily peak ($ft^3/s$) | 1,363 | 8/6/2023 | 1,628 | 7/17/2023 |
| Daily minimum ($ft^3/s$) | 0 | * | 0 | * |

* During non-irrigation season

Table 60.—MTT - WY2023 monthly inflow, outflow, and storage data for Pishkun Reservoir

| Month | Inflow, KAF | Percent of 30-yr avg | Outflow, KAF | Percent of 30-yr avg | Content, KAF | Percent of 30-yr avg |
|---|---|---|---|---|---|---|
| October | -0.5 | | 0.0 | | 35.6 | 124 |
| November | -0.2 | | 0.0 | | 35.3 | 120 |
| December | 0.0 | | 0.0 | | 35.3 | 120 |
| January | -0.1 | | 0.0 | | 35.2 | 120 |
| February | -0.2 | | 0.0 | | 35.0 | 120 |
| March | 0.0 | | 0.0 | | 35.0 | 116 |
| April | 0.0 | | 0.0 | | 35.0 | 96 |
| May | 27.4 | 64 | 19.9 | 58 | 43.0 | 93 |
| June | 64.6 | 103 | 62.3 | 91 | 45.2 | 113 |
| July | 79.4 | 102 | 87.7 | 109 | 36.9 | 99 |
| August | 35.0 | 81 | 35.2 | 79 | 36.7 | 106 |
| September | -0.7 | | 0.0 | | 36.0 | 127 |
| Annual | 204.5 | 83 | 293.5 | 84 | | |

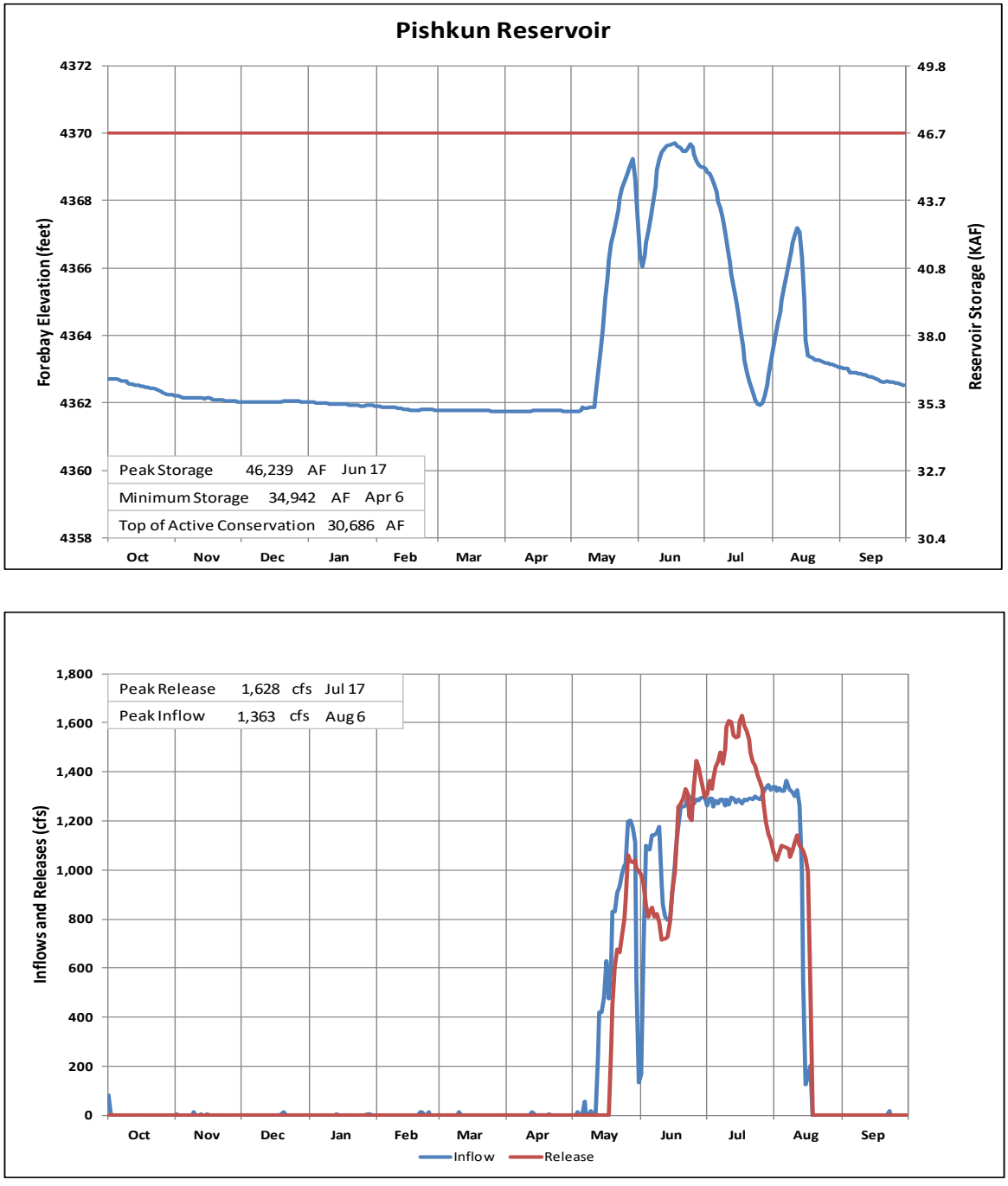



Figure 25.—MTG - WY2023 hydrologic data for Pishkun Reservoir.

**Table 61.—MTT - Reservoir allocations for Willow Creek Reservoir***

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 4085.28 | 1 | 1 |
| Top of active conservation | 4142.00 | 31,852 | 31,851 |

*2021 reservoir survey and revised area-capacity table was implemented on October 1, 2021.

**Table 62.—MTT - Storage and elevation data for Willow Creek Reservoir**

| Storage-elevation data | Elevation (ft) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 4121.24 | 8,918 | 10/1/2022 |
| End of year | 4126.18 | 12,968 | 9/30/2023 |
| Annual low | 4121.24 | 8,918 | 10/1/2022 |
| Annual high | 4140.03 | 29,059 | 6/25/2023 |
| Historic high | 4144.80 | 36,033 | 6/22/2018 |

**Table 63.—MTT - Inflow and discharge data for Willow Creek Reservoir**

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 22,382 | Oct '21–Sep '22 | 18,332 | Oct '21–Sep '22 |
| Daily peak ($ft^3/s$) | 270 | 6/10/2023 | 267 | 7/27/2023 |
| Daily minimum ($ft^3/s$) | 0 | * | 0 | * |

Table 64.—MTT - WY2022 monthly inflow, outflow, and storage data for Willow Creek Reservoir

| Month | Inflow, KAF | Percent of 30-yr avg | Outflow, KAF | Percent of 30-yr avg | Content, KAF | Percent of 30-yr avg |
|---|---|---|---|---|---|---|
| October | 4.0 | 211 | 0.0 | | 12.9 | 64 |
| November | 3.4 | 186 | 0.0 | | 16.4 | 74 |
| December | 0.3 | 49 | 0.0 | | 16.7 | 74 |
| January | 0.1 | 35 | 0.0 | | 16.8 | 73 |
| February | 0.1 | 15 | 0.0 | | 16.8 | 72 |
| March | 0.3 | 55 | 0.0 | | 17.1 | 72 |
| April | 0.2 | 11 | 0.0 | | 17.3 | 68 |
| May | 5.6 | 140 | 0.0 | | 22.9 | 80 |
| June | 6.8 | 210 | 1.1 | 47 | 28.6 | 96 |
| July | 0.8 | 91 | 11.3 | 150 | 18.1 | 79 |
| August | 0.6 | 287 | 5.9 | 264 | 12.7 | 67 |
| September | 0.2 | 29 | 0.0 | | 13.0 | 68 |
| Annual | 22.4 | 136 | 18.3 | 111 | | |

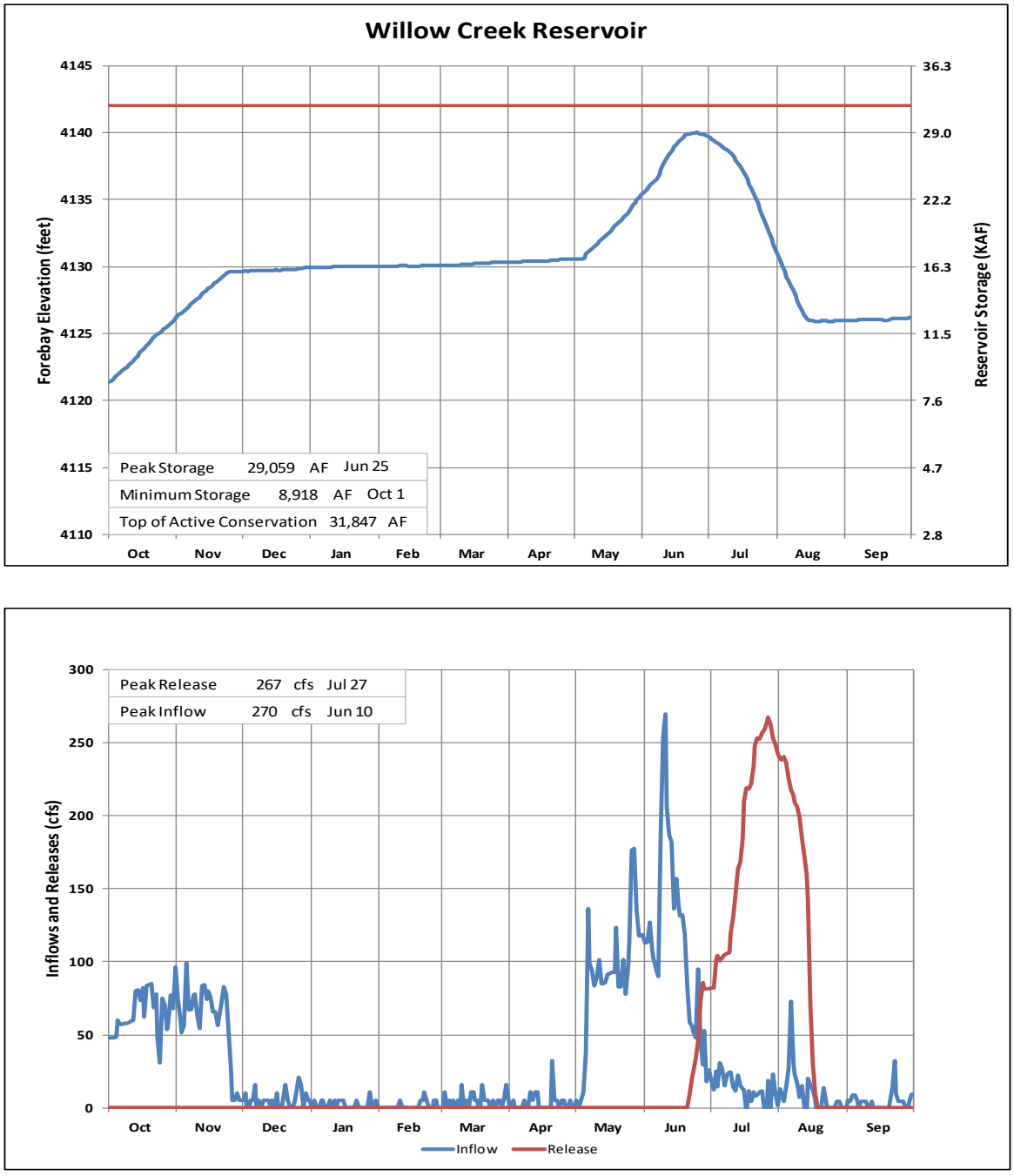



Figure 26.—MTG - WY2023 hydrologic data for Willow Creek Reservoir.

## Lake Elwell (Tiber Dam)

Tiber Dam (P-S MBP) is located on the Marias River near Chester, Montana. It was built to provide water supply for 127,000 acres in the Lower Marias Unit and for flood control. Because the irrigation distribution works were not constructed, the reservoir is operated for flood control, fishery, and recreation benefits. The reservoir provides irrigation water to municipalities and several individual operators by water service contracts. Reclamation has a storage allocation agreement with the Chippewa Cree Tribe for 10,000 AF of water and Blackfeet Tribe for 45,000 AF.

The river outlet works underwent extensive modification to incorporate the addition of a 7.5-megawatt powerplant, privately owned by Tiber Montana, LLC. Construction of the powerplant was completed and brought on-line in June 2004. The Tiber Montana, LLC powerplant capacity is approximately 700 $ft^3/s$.

**Figure 27.—MTG - View of Tiber Dam and Lake Elwell.**

### *Summary of 2023 Operations*

A bathymetric survey of Tiber Dam was conducted in 2021 and the report with new area capacity tables was finalized in May 2022. The new tables were implemented at the start of WY2023.

The hydrologic conditions in the Marias River Basin during WY2023 were dry. Although snowpack peaked near average during April, WY2023 was a dry year. Releases remained at 500 $ft^3/s$ for the entire year. The reservoir drafted to a low point of 2979.5 feet by the middle of

March and peaked three feet from full in June. The year ended at lower-than-average storage. The following is a summary of WY2023 hydrologic conditions in the Marias River Basin and corresponding operations of Lake Elwell and Tiber Dam. See tables 65 through 68 for specific data related to Lake Elwell inflows, releases, and storage content.

### October through December

Storage in Lake Elwell started the year near normal at 104 percent of average. Conditions were drier than average during October and November. Conditions were wetter than average in December. Inflow during this period totaled only 29 percent of average due to the overall drier conditions and cooler than average temperatures. Releases were maintained at 500 $ft^3/s$. By the end of December 2022, Lake Elwell storage was at 2983.0 feet, 100 percent of average.

### January through March

In January, Reclamation begins to forecast the April through July runoff volume based on snowpack measurements and other basin parameters. Snowpack was 118 percent of median at the start of January and runoff was forecasted to be 98 percent of average. Precipitation was mixed during January through March but overall, it was drier than average. Inflows remained well below average through March.

### April through July

April precipitation was also below average. However, snowpack peaked on April 21 at 100 percent of the median peak snowpack. April through July inflow forecasts remained below average through runoff. Every month during runoff was drier than average. Actual runoff ended up being only 69 percent of average. Lake Elwell peaked near elevation 2990 feet during June which is three feet below normal full pool. Releases were kept at 500 $ft^3/s$ for essentially the entire water year to conserve storage.

### August through September

August and September were wetter than average but inflows remained well below average. On September 26, an efficiency test was conducted on the powerplant turbine. Releases were briefly fluctuated between 550 and 500 $ft^3/s$ for the test.

#### *Important Events – WY2023*

On September 26, 2022, an efficiency test was conducted on the powerplant turbine. Releases were briefly fluctuated between 550 and 500 $ft^3/s$ for the test.

**Table 65.—MTT - Reservoir allocations for Lake Elwell***

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 2966.40 | 543,079 | 543,079 |
| Top of active conservation | 2976.00 | 655,956 | 112,877 |
| Top of joint use | 2993.00 | 918,394 | 262,438 |
| Top of exclusive flood control | 3012.50 | 1,323,068 | 404,674 |

*2021 reservoir survey and revised area-capacity table was implemented on October 1, 2022.

**Table 66.—MTT - Storage and elevation data for Lake Elwell**

| Storage-elevation data | Elevation (ft) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 2987.77 | 834,940 | 10/1/2022 |
| End of year | 2987.49 | 775,948 | 9/30/2023 |
| Annual low | 2979.45 | 701,849 | 3/26/2023 |
| Annual high | 2989.98 | 865,426 | 6/25/2023 |
| Historic high | 3011.42 | 1,303,858 | 7/19/2011 |

**Table 67.—MTT - Inflow and discharge data for Lake Elwell**

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 309,894 | Oct. '22–Sep. '23 | 365,048 | Oct. '22–Sep. '23 |
| Daily peak ($ft^3/s$) | 3,906 | 5/8/2023 | 542 | 5/17/2023 |
| Daily minimum ($ft^3/s$) | -395 | 8/19/2023 | 482 | 3/5/2023 |
| Peak spill ($ft^3/s$) | | | 0 | NA |
| Total spill (AF) | | | 0 | NA |

Table 68.—MTT - WY2023 monthly inflow, outflow, and storage data for Lake Elwell

| Month | Inflow, KAF | Percent of 30-yr avg | Outflow, KAF | Percent of 30-yr avg | Content, KAF | Percent of 30-yr avg |
|---|---|---|---|---|---|---|
| October | 3.1 | 20 | 30.6 | 77 | 801.0 | 103 |
| November | 4.6 | 22 | 29.6 | 91 | 775.9 | 101 |
| December | 7.7 | 44 | 30.6 | 97 | 753.1 | 100 |
| January | 10.6 | 66 | 30.4 | 96 | 733.8 | 99 |
| February | 8.3 | 41 | 27.5 | 94 | 716.8 | 98 |
| March | 15.9 | 38 | 29.8 | 86 | 702.9 | 95 |
| April | 49.0 | 89 | 31.1 | 82 | 720.9 | 96 |
| May | 138.7 | 105 | 32.3 | 59 | 827.1 | 100 |
| June | 68.3 | 46 | 30.5 | 42 | 864.9 | 96 |
| July | 3.9 | 9 | 31.1 | 48 | 837.8 | 95 |
| August | -1.9 | - | 31.2 | 61 | 804.7 | 96 |
| September | 1.7 | 17 | 30.4 | 69 | 775.9 | 96 |
| Annual | 309.9 | 58 | 365.0 | 69 | | |
| April-July | 260.0 | 69 | | | | |

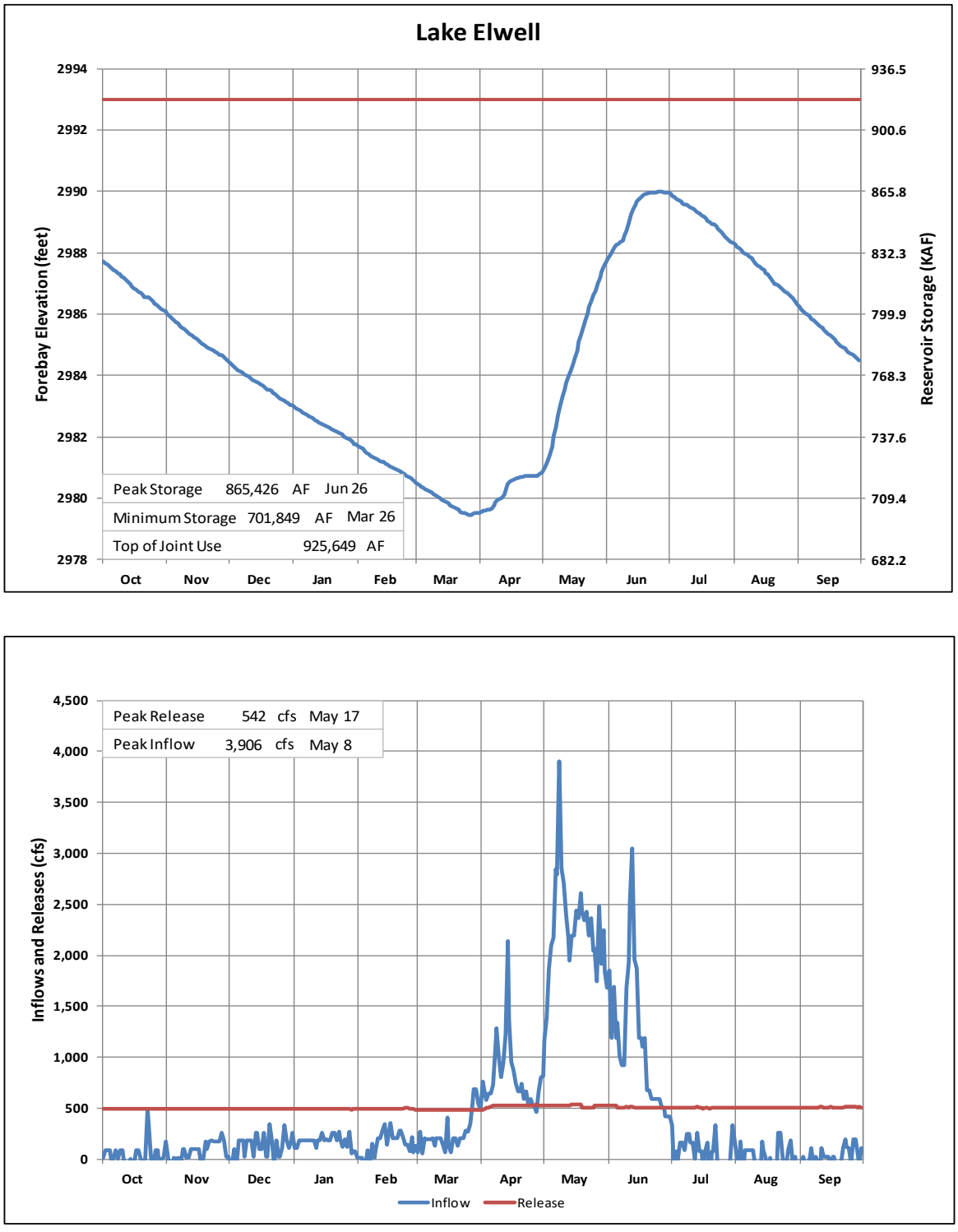



Figure 28.—MTG - WY2023 2023 hydrologic data for Lake Elwell.

# Milk River Project

The 117,000-acre Milk River Project, located in north-central Montana, is served by Sherburne, Fresno, and Nelson Reservoirs. Sherburne and Nelson Reservoirs are single-purpose irrigation structures. Fresno Reservoir has joint-use flood control space, provides a municipal water supply to several municipalities on or near the Project, and serves as the primary irrigation storage structure for the Project. Approximately 101,500 acres are served by irrigation districts, 9,500 acres are served by private facilities and between 5,000 and 6,000 acres are served supplemental water by the Fort Belknap Indian Irrigation Project.

## Lake Sherburne

Lake Sherburne is located in Glacier National Park on Swiftcurrent Creek, a tributary of the St. Mary River in the Hudson Bay Drainage Basin. The use of boundary waters of the St. Mary and Milk Rivers are divided between Canada and the United States by the 1909 Boundary Waters Treaty. The United States utilizes its entitlement to St. Mary River water by regulating flows through storage in Lake Sherburne and diverting St. Mary River flows through the St. Mary Canal to the Milk River Basin.

**Figure 29.—MTG - Lake Sherburne's outlet works.**

### *Summary of WY2023 Operations*

WY2023 started off with much below average storage in Lake Sherburne and stayed that way until runoff. Snowpack peaked below average, but Lake Sherburne filled during June and

remained full until early July. Dry conditions after runoff resulted in lower-than-average carryover. See tables 69 through 72 for specific data related to Lake Sherburne inflows, releases, and storage content.

### October through December

At the start of WY2023, storage content in Lake Sherburne was much below average. Diversions to the St. Mary Canal were stopped on September 30. Releases from Lake Sherburne were shutoff for the season on October 6. Temperatures were cooler than average during the October through December period. There were no large precipitation events to significantly increase storage. Inflows were only 43 percent of average through the end of December and Lake Sherburne storage was only 62 percent of average.

### January through March

In January, Reclamation begins to forecast the April through July runoff volume based on snowpack measurements and other basin parameters. On January 1, 2023, the NRCS reported mountain snowpack SWE in the St. Mary Basin was 111 percent of median. Precipitation was below average for the January through March period. March was much cooler than average. Snowpack was only 84 percent of average by the end of March.

### April through July

Releases from Lake Sherburne started on April 4 to provide water for St. Mary Canal diversions. Starting releases from Lake Sherburne before starting diversions into the St. Mary Canal fills storage space in Lower St. Mary Lake and behind the St. Mary Diversion Dam if that space is not already filled by natural runoff.

The St. Mary Canal started up on April 5 to begin the transfer of water from the St. Mary River Basin to Fresno Reservoir. A lot of snow and ice removal was required once the canal started moving water. Temperatures were much below average during startup. Shortly after startup, a broken turnout was discovered on the St. Mary Canal. The canal had to be shut down for repairs. Releases from Lake Sherburne were shut off during the repairs to conserve storage. The repairs were completed on April 17. While the St. Mary Canal was down for repairs, Fresno Reservoir filled to normal full pool about mid-April from natural runoff in the Milk River Basin. Therefore, releases from Lake Sherburne and diversions to the St. Mary Canal were not restarted until April 25. Diversions started off small and were not ramped up until the first week of May.

The U.S. can create a deficit delivery during March, April, and May in the St. Mary River Basin. A deficit delivery is when Canada receives less natural flow than what they are entitled. A deficit delivery is allowed under the guidance of the International Joint Commission (IJC) Procedures Manual for natural flow calculations of the St. Mary and Milk River Basins (Procedures Manual). The specific guidance on deficit deliveries is called the Letter of Intent A deficit delivery allows Reclamation to conserve storage in Lake Sherburne or maintain desired flows in the St. Mary Canal. A small deficit delivery to Canada in the St. Mary River Basin occurred during the second of April. Additional deficits were possible in WY2023 but because runoff increased in May, no additional deficit was created.

Mountain snowpack SWE was 84 percent of median on April 1. Snowpack peaked on April 7 at 84 percent of the median peak snowpack. Precipitation and resulting inflows were below average during April. Cooler than averages temperatures delayed snowmelt runoff.

Inflows picked up towards the end of April and Lake Sherburne began refilling. Lake Sherburne filled to near normal full pool during early June and remained near full through end of the month. The peak elevation for the year was 4787.84 feet on June 28.

However, snow melted out during June and precipitation was drier than average during the month. This melt out was sooner than any other year on record. An above average amount of storage from Lake Sherburne was used during July to maintain the St. Mary Canal at 600 $ft^3/s$ since base flows were much below average.

**August through September**

Releases from Lake Sherburne remained high to support St. Mary Canal diversions until storage decreased to approximately 10,000 AF towards the end of August. St. Mary Canal diversions remained at 600 $ft^3/s$ until August 15 when diversions started decreasing to balance water use with Canada. Diversions to the canal were turned off on September 1 due to lack of storage and natural runoff in the St. Mary River Basin. Releases from Lake Sherburne were shut off on October 2. Releases from Lake Sherburne are required until October 1 in accordance with the biological opinion for bull trout. Based on provisional data, diversions from the St. Mary River to the Milk River totaled 131,729 AF in WY2023.

During WY2023, there were several conference calls with the IJC Field Representatives due to the drought conditions. Deficit deliveries on St. Mary River were repaid between September 16 and 30.

## Fresno Reservoir

Fresno Reservoir is located upstream of all Project lands on the Milk River near Havre, Montana. The top 33,841 AF of storage is used jointly for flood control and conservation and is typically not filled until the start of spring runoff. Fresno Reservoir stores the natural flow of the Milk River along with water diverted into the Milk River from the St. Mary River and Lake Sherburne. Stored water is used principally for irrigation but Havre and Chinook, Montana have a contract for a minimum flow in the river of 25 $ft^3/s$ during the winter to maintain suitable water for municipal use. The city of Harlem and the Hill County Water District also have contracts for municipal water use.

Figure 30.—MTG - Aerial view of Fresno Reservoir and Dam.

### *Summary of WY2023 Operations*

Reservoir storage in the Milk River Basin started off the year below average. Heavy plains snowpack in WY2023 filled Fresno and Nelson Reservoirs. Irrigation allotments were two AF per acre for the season but releases for the year ended in early September based on lack of reservoir storage. End of year storage was low in Fresno and Lake Sherburne due to dry conditions in the upper end of the basin. See tables 73 through 76 for specific data related to Fresno Reservoir inflows, releases, and storage content.

### October through December

Releases from Fresno Reservoir were 40 $ft^3/s$ at the start of the water year. This is the minimum release from Fresno Reservoir based on the minimum allowed gate opening for one gate on the river outlet works. The quantity of water released varies depending on the elevation of the reservoir. Storage was 87 percent of average at the start of the water year.

Inflows during October through December was 93 of average. Precipitation was above average during October and December and below average during November. Temperatures were below average during November and December which allowed snowpack to accumulate throughout the basin.

### January through February

Snowpack in the Bear Paw Mountains was 159 percent of median on January 1. Plains snowpack throughout the Milk River basin was also above average. January precipitation was below average, but February precipitation was near average. Temperatures were above average.

### March through June

Spring runoff season generally occurs during March through June. The most reliable water supply runoff forecast for the Milk River Basin occurs on March 1. The March 1 forecast for

natural runoff above Fresno Reservoir for March through September was only 67 percent of median. The Milk River runoff forecast is provided by Alberta Environment and Protected Areas. The March water supply outlook showed that Fresno and Nelson Reservoirs were not expected to fill, and irrigation allotments would need to be reduced.

March precipitation was above average while temperatures remained below average. Inflows were much below average during March due to the cold temperatures. Storage in Fresno Reservoir at the end of March was only 72 percent of average.

April was dry. However, temperatures warmed during the first half of April and were above 70 ºF on April 10 and 11, a near record high for both days. This rapidly melted the snowpack in the Milk River Basin. Flooding occurred along the Milk River downstream of Fresno Dam. Fresno Reservoir was essentially full by April 17. Due to the heavy runoff, Dodson South Canal washed out in a reach. Malta Irrigation District had to shut off diversions to Nelson Reservoir to make repairs but was able to get the canal running again in less than one week.

**Figure 31.—MTG - Malta Irrigation District repairing Dodson South Canal, April 2023.**

The Milk River Joint Board of Control (MRJBC) set the initial irrigation allotment for the 2023 irrigation season at two AF/acre at their April 25 meeting. Releases were increased on May 7 for the start of the irrigation season to meet irrigation water orders by Malta Irrigation District. Storage in Fresno Reservoir peaked for the season on May 8 at 2575.04 feet, with a content of 91,952 AF.

Precipitation was drier than average above Fresno Reservoir but above average downstream of Fresno Reservoir. Fresno Reservoir storage drafted only a few feet to 85,800 AF, 128 percent of average by June 2. There were enough timely rains to keep irrigation demands low through June.

The first irrigation of the season typically ends near the end of June. Most of the irrigation did end at the end of June except for a few users. Fresno and Nelson Reservoirs were full going into July.

**July through September**

Precipitation was below average for the July through September time-period while temperatures were above average. Irrigation releases from Fresno Reservoir started ramping up on June 29 for the second irrigation. Irrigation demands were high and releases for irrigation were made until early September. On September 9, releases from Fresno Reservoir were reduced to 100 $ft^3/s$. The 100 $ft^3/s$ release was for Fort Belknap Indian Irrigation Project and the downstream municipalities. With the St. Mary Canal shutting off on September 1, inflows into Fresno Reservoir were only 29 percent of average during September. Storage in Fresno Reservoir reached its minimum for WY2023 on September 30 at 2,553.5 feet or 25,223 AF. Releases were decreased to the winter release of approximately 40 $ft^3/s$ on October 2.

## Nelson Reservoir

Nelson Reservoir, located near Malta, Montana, is an off-stream reservoir, receiving its water supply from the Milk River by diversion through the Dodson South Canal. Nelson Reservoir is the only source of water supply for the lower portion of the Malta Irrigation District. Nelson Reservoir also serves the Glasgow Irrigation District when water is not available from Fresno Reservoir.

Figure 32.—MTG - Aerial view of Nelson Reservoir and Dikes.

### *Summary of Water Year 2023 Operations*

#### October through March

Storage in Nelson Reservoir at the start of WY2023 was 80 percent of average. Storage slowly decreased through seepage and evaporation until. Storage in Nelson Reservoir on March 31 was 73 percent of average.

#### April through July

Diversions through the Dodson South Canal and runoff reached Nelson Reservoir on April 2. Dodson South Canal failed in a reach because of heavy runoff from snowmelt during April. It was inoperable for about one week. See figure 31 for a photo of the repair work. Even with the failure, Nelson Reservoir nearly filled. Storage peaked at 2221.3 feet, 77,530 AF on June 30.

Releases for irrigation through the Nelson South Canal started on May 24. Releases through the Nelson North Canal for Glasgow Irrigation District occurred during June 28 through July 18. Releases to Nelson South Canal stopped on June 21 at the end of the first irrigation. Releases restarted on July 5 through the Nelson South Canal.

#### August through September

Irrigation releases were shut off for the season on September 10. Malta Irrigation District continued to operate the Dodson South Canal into October to capture natural runoff and irrigation return flows. Storage in Nelson Reservoir was at 115 percent of average at the end of WY2023.

Additional hydrologic and statistical information pertaining to the operation of Nelson Reservoir during 2023 can be found in tables 77 through 80 and figure 35.

***Important Events – WY2023***

**October 6, 2022:** Releases from Lake Sherburne are shut off for the winter season.

**April 2, 2023:** Diversions to Dodson South Canal reach Nelson Reservoir.

**April 5, 2023:** Releases begin from Lake Sherburne for the irrigation season.

**April 6, 2023:** Diversions to St. Mary Canal started to move water to the Milk River Basin.

**April 19, 2023:** A conference call was held with the IJC Field Representatives to discuss St. Mary and Milk River apportionments. This was the first call of the season.

**April 25, 2023:** MRJBC set the irrigation allotment at two AF/acre at a MRJBC meeting.

**May 7, 2023:** Fresno Reservoir releases were increased for the start of the irrigation season.

**June 20, 2023:** A MRJBC meeting was held. Water supply was discussed at the meeting. The allotment remained at two AF/acre.

**June 21, 2023:** A conference call was held with the IJC Field Representatives to discuss St. Mary and Milk River apportionments.

**August 23, 2023:** A conference call was held with the IJC Field Representatives to discuss St. Mary and Milk River apportionments.

**September 1, 2023:** St. Mary Canal diversions were discontinued for the season.

**September 9, 2023:** Releases from Fresno Reservoir are set at approximately 100 $ft^3/s$ to serve the municipalities and Fort Belknap Irrigation District.

**September 10, 2023:** Releases from Nelson Reservoir were discontinued.

**September 22, 2023:** A conference call was held with the IJC Field Representatives to discuss St. Mary and Milk River apportionments.

**October 2, 2023:** Releases from Fresno Reservoir are set to the winter release rate of approximately 40 $ft^3/s$.

**October 2, 2023:** Lake Sherburne releases were discontinued.

**Table 69.—MTT - Reservoir allocations for Lake Sherburne***

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 4729.30 | 1,899 | 1,899 |
| Top of active conservation | 4788.00 | 66,147 | 64,248 |

*2002 reservoir survey and revised area-capacity table was implemented on October 1, 2005.

**Table 70.—MTT - Storage and elevation data for Lake Sherburne**

| Storage-elevation data | Elevation (ft) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 4741.99 | 10,008 | 10/1/2022 |
| End of year | 4747.50 | 14,595 | 9/30/2023 |
| Annual low | 4742.00 | 10,008 | 10/01/2022 |
| Annual high | 4787.84 | 65,871 | 6/28/2023 |
| Historic high | 4788.30 | 68,371 | 6/30/1986 |

**Table 71.—MTT - Inflow and discharge data for Lake Sherburne**

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 98,320 | Oct '22–Sep '23 | 93,743 | Oct '22–Sep '23 |
| Daily peak ($ft^3/s$) | 1,047 | 6/10/2023 | 840 | 7/14/2023 |
| Daily minimum ($ft^3/s$) | -14 | 4/6/2023 | 0 | * |

*During non-irrigation season

Table 72.—MTT - WY2023 2023 monthly inflow, outflow, and storage data for Lake Sherburne

| Month | Inflow, KAF | Percent of 30-yr avg | Outflow, KAF | Percent of 30-yr avg | Content, KAF | Percent of 30-yr avg |
|---|---|---|---|---|---|---|
| October | 2.4 | 36 | 0.4 | 12 | 12.1 | 62 |
| November | 2.9 | 38 | 0.0 | | 15.0 | 60 |
| December | 2.6 | 67 | 0.0 | | 17.6 | 62 |
| January | 2.3 | 82 | 0.0 | | 19.8 | 64 |
| February | 1.5 | 64 | 0.0 | | 21.4 | 64 |
| March | 1.6 | 42 | 0.0 | | 23.0 | 70 |
| April | 5.9 | 61 | 1.8 | 10 | 27.1 | 113 |
| May | 36.2 | 116 | 4.5 | 25 | 58.8 | 158 |
| June | 21.5 | 54 | 14.9 | 79 | 65.3 | 111 |
| July | 8.5 | 46 | 37.5 | 149 | 36.3 | 70 |
| August | 7.4 | 87 | 33.0 | 105 | 10.7 | 38 |
| September | 5.5 | 103 | 1.6 | 9 | 14.6 | 94 |
| Annual | 98.3 | 70 | 93.7 | 67 | | |
| April–July | 72.1 | 73 | | | | |

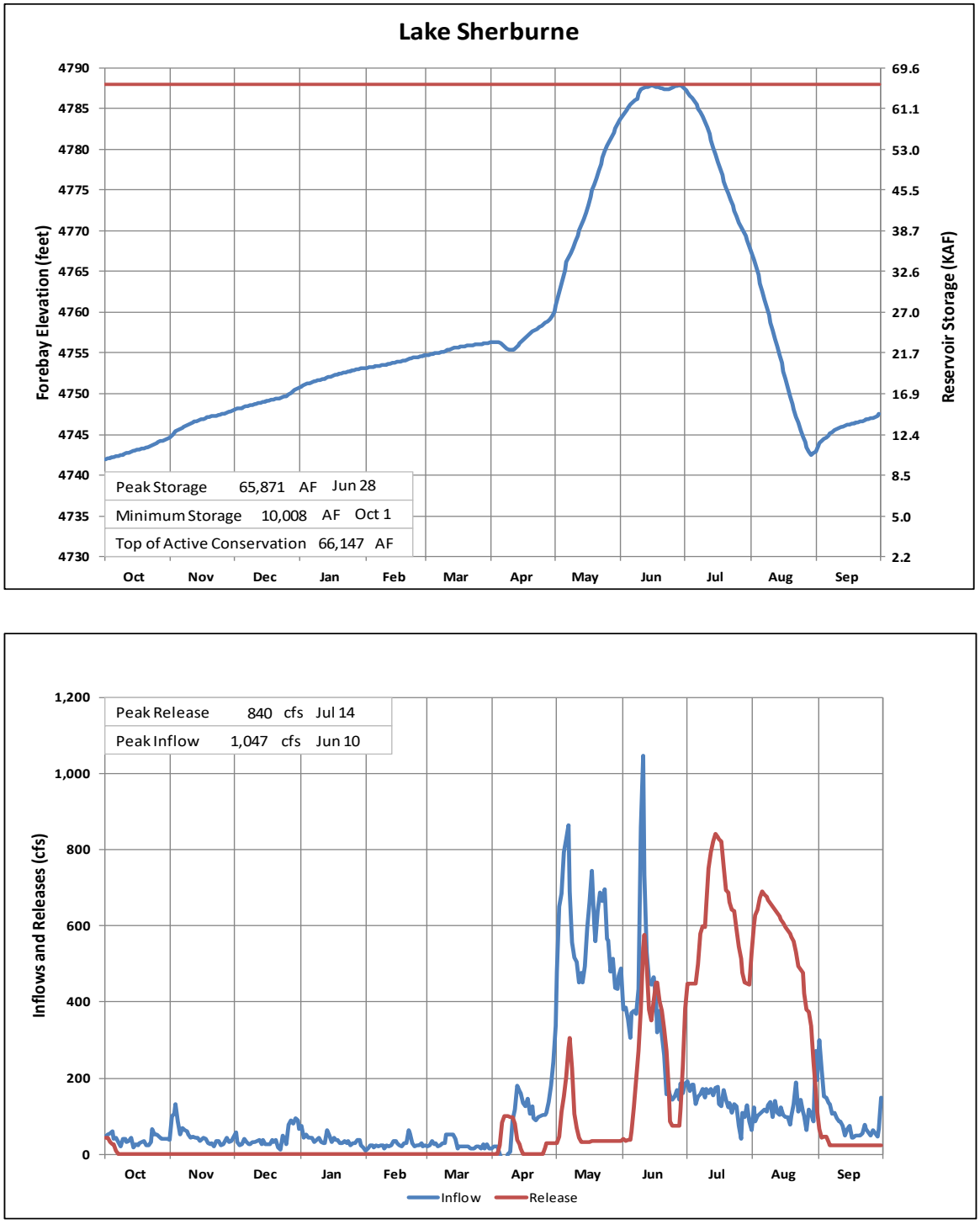



Figure 33.—MTG - WY2023 hydrologic data for Lake Sherburne.

**Table 73.—MTT - Reservoir allocations for Fresno Reservoir***

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 2530.00 | 158 | 158 |
| Top of active conservation | 2567.00 | 57,905 | 57,747 |
| Top of joint use | 2575.00 | 91,746 | 33,841 |

*2010 reservoir survey and revised area-capacity table was implemented on October 1, 2013.

**Table 74.—MTT - Storage and elevation data for Fresno Reservoir**

| Storage-elevation data | Elevation (ft) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 2559.31 | 36,775 | 10/1/2022 |
| End of year | 2553.54 | 25,223 | 9/30/2023 |
| Annual low | 2553.54 | 25,223 | 9/30/2023 |
| Annual high | 2575.04 | 914,952 | 5/8/2023 |
| Historic high | 2579.30 | 153,694 | 4/2/1952 |

**Table 75.—MTT - Inflow and discharge data for Fresno Reservoir**

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 189,981 | Oct. '22–Sep. '23 | 201,533 | Oct. '22–Sep. '23 |
| Daily peak ($ft^3/s$) | 5,182 | 4/11/2023 | 1,027 | 7/26/2023 |
| Daily minimum ($ft^3/s$) | -17 | 1/10/2022 | 0.0 | 4/11/2023 |

Table 76.—MTT - WY2023 2023 monthly inflow, outflow, and storage data for Fresno Reservoir

| Month | Inflow, KAF | Percent of 30-yr avg | Outflow, KAF | Percent of 30-yr avg | Content, KAF | Percent of 30-yr avg |
|---|---|---|---|---|---|---|
| October | 8.0 | 127 | 2.6 | 47 | 42.2 | 99 |
| November | 1.5 | 51 | 2.5 | 84 | 41.1 | 96 |
| December | 0.7 | 41 | 2.6 | 86 | 39.2 | 95 |
| January | 0.6 | 46 | 2.6 | 85 | 37.2 | 94 |
| February | 3.2 | 75 | 2.3 | 76 | 38.1 | 96 |
| March | 1.8 | 7 | 2.6 | 26 | 37.3 | 72 |
| April | 59.1 | 182 | 7.8 | 47 | 88.5 | 130 |
| May | 27.8 | 66 | 30.5 | 71 | 85.8 | 127 |
| June | 35.4 | 71 | 30.7 | 66 | 90.6 | 125 |
| July | 17.0 | 57 | 54.7 | 109 | 52.9 | 104 |
| August | 28.6 | 98 | 48.3 | 115 | 33.2 | 84 |
| September | 6.3 | 29 | 14.3 | 74 | 25.2 | 59 |
| Annual | 190.0 | 77 | 201.5 | 82 | | |
| April-July | 139.3 | 90 | | | | |

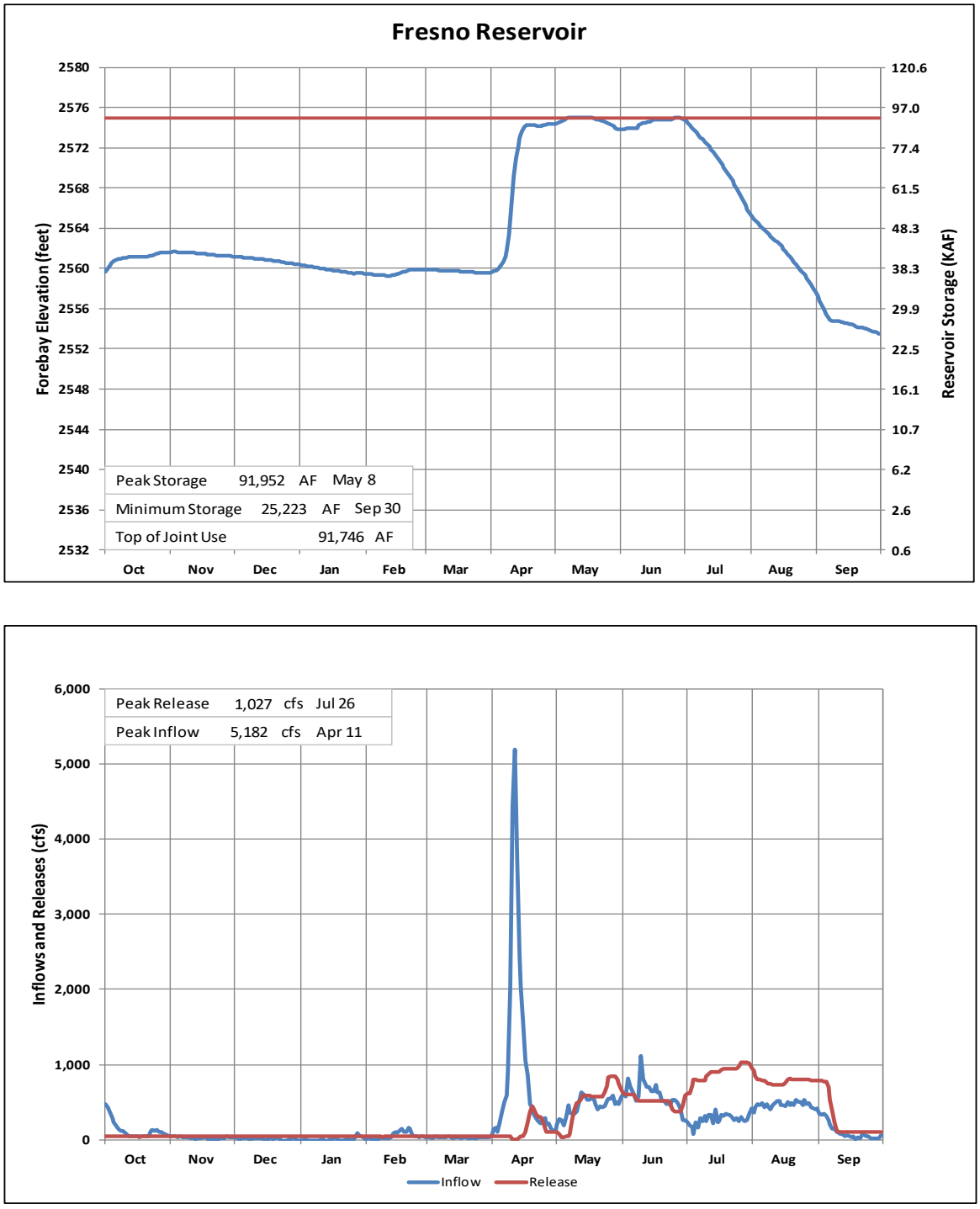



Figure 34.—MTG - WY2023 hydrologic data for Fresno Reservoir.

**Table 77.—MTT - Reservoir allocations for Nelson Reservoir**

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 2200.00 | 18,140 | 18,140 |
| Top of active conservation | 2221.60 | 78,950 | 60,810 |

*1999 reservoir survey and revised area-capacity table was implemented on October 1, 2001.

**Table 78.—MTT - Storage and elevation data for Nelson Reservoir**

| Storage-elevation data | Elevation (ft) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 2212.39 | 44,772 | 10/1/2022 |
| End of year | 2218.30 | 65,452 | 9/30/2023 |
| Annual low | 2210.71 | 40,117 | 4/1/2023 |
| Annual high | 2221.27 | 77,530 | 6/30/2023 |
| Historic high | 2221.68 | 79,297 | 6/1/2007 |

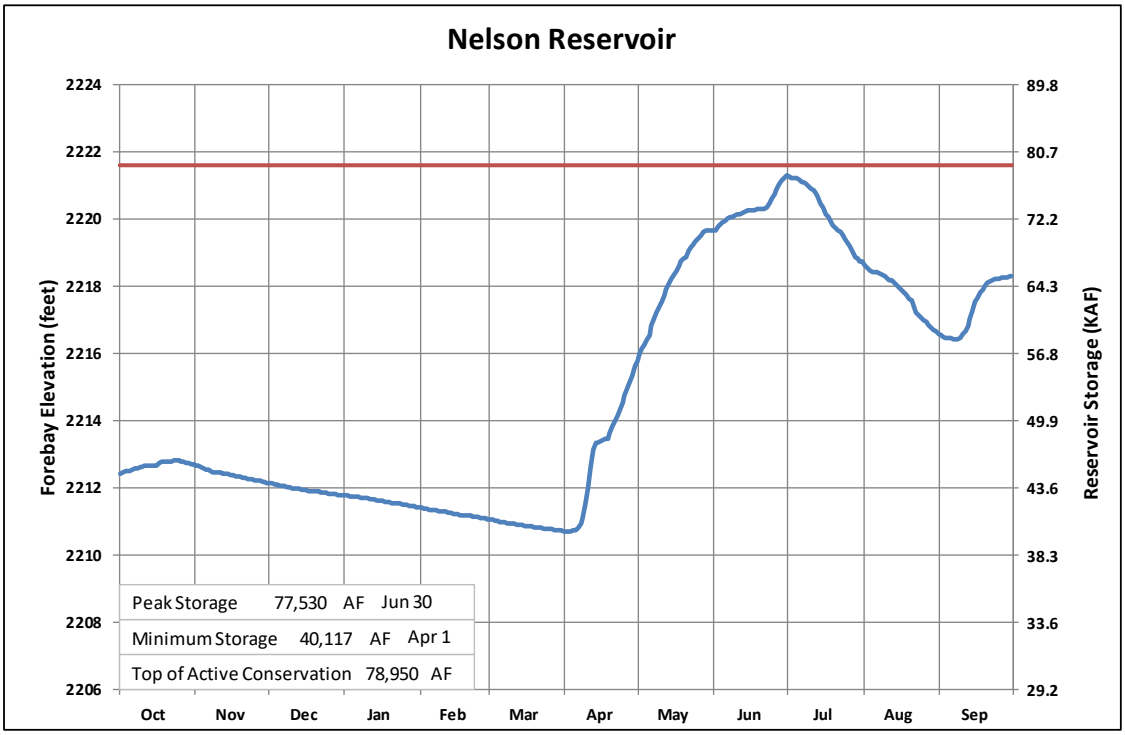
**Table 79.—MTT - Inflow and discharge data for Nelson Reservoir**

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 55,517 | Oct. '22–Sep. '23 | 34,569 | Oct. '22–Sep. '23 |
| Daily peak ($ft^3/s$) | 904 | 4/11/2023 | 360 | 7/17/2023 |
| Daily minimum ($ft^3/s$) | -273 | 8/22/2023 | 0 | * |

*During non-irrigation season

Table 80.—MTT - WY2023 monthly inflow, outflow, and storage data for Nelson Reservoir

| Month | Inflow, KAF | Percent of 30-yr avg | Outflow, KAF | Percent of 30-yr avg | Content, KAF | Percent of 30-yr avg |
|---|---|---|---|---|---|---|
| October | 0.9 | 2 | 0.0 | | 45.7 | 81 |
| November | -1.6 | | 0.0 | | 44.1 | 80 |
| December | -1.0 | | 0.0 | | 43.0 | 81 |
| January | -1.1 | | 0.0 | | 42.0 | 81 |
| February | -0.9 | | 0.0 | | 41.1 | 81 |
| March | -0.9 | | 0.0 | | 40.1 | 73 |
| April | 15.8 | 37 | 0.0 | | 56.0 | 87 |
| May | 16.7 | 188 | 1.9 | 19 | 70.8 | 113 |
| June | 12.5 | 129 | 5.7 | 59 | 77.5 | 123 |
| July | 2.4 | 35 | 12.6 | 88 | 67.1 | 121 |
| August | 3.0 | 31 | 11.2 | 106 | 58.9 | 109 |
| September | 9.7 | 140 | 3.1 | 74 | 65.5 | 116 |
| Annual | 55.5 | 19 | 34.6 | 12 | | |



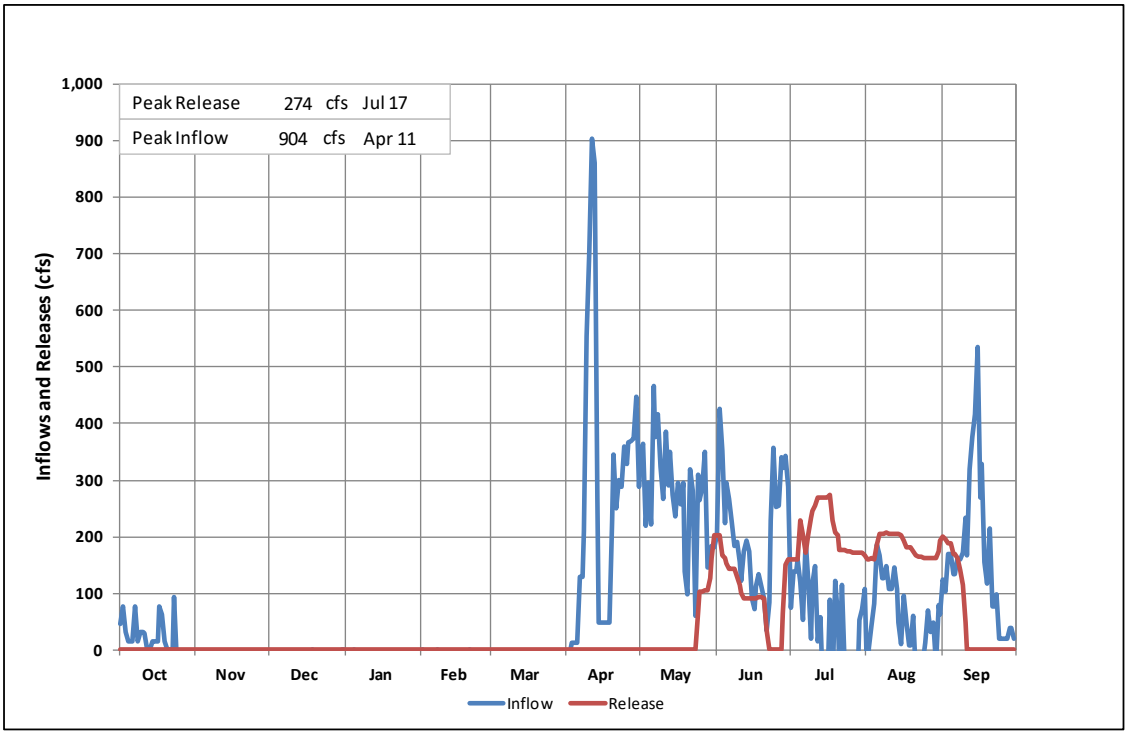




Figure 35.—MTG - WY2023 2023 hydrologic data for Nelson Reservoir.

## Bighorn Lake and Yellowtail Powerplant

Bighorn Lake (P-S MBP) is located on the Bighorn River about 45 miles southwest of Hardin, Montana. The dam and reservoir were built for power generation, irrigation, flood control, fish and wildlife and recreation. Reclamation has a storage allocation agreement with the Northern Cheyenne Tribe for 30,000 AF and the Crow Tribe for up to 300,000 AF of water. Reclamation has an industrial water service contract with Talen Energy for 6,000 AF. Bull Lake, Boysen, and Buffalo Bill Reservoirs are three major tributary reservoirs located in Wyoming upstream of Bighorn Lake. These reservoirs are operated and managed by Reclamation's Wyoming Area Office (WYAO) and all reservoir and river operations in the Bighorn River Basin are closely coordinated between the MTAO and WYAO.

**Figure 36.—MTG - View of Yellowtail Dam and Powerplant.**

### *Summary of WY2023 Operations*

The largest influence of Yellowtail Dam operations during WY2023 was June precipitation. Precipitation was nearly 350 percent of average and was the wettest June for the 129 years of record in the Bighorn River Basin. Snowpack was near to above median through late April. Runoff forecasts were near average through June 1, but the record June precipitation resulted in the highest inflows and releases since 1967. See tables 81 through 84 for specific data related to Lake Sherburne inflows, releases, and storage content.

### October

Storage in Bighorn Lake started WY2023 at elevation 3,633.5 feet, 106 percent of the 30-year average. The above average precipitation during September 2022 kept releases at 2,500 $ft^3/s$ to start the WY2023.

October was warm and dry. Releases were kept at 2,500 $ft^3/s$ based on forecasted winter releases.

### November through February

Winter river releases are set during the early part of November based on the established operating criteria. The release is based on current storage, forecasted inflows and a March 31 storage target of 3,617 feet. The initial winter release for WY2023 was 2,410 $ft^3/s$.

Releases were slightly increased during the winter months to stay on track with the end of March storage target as inflows were higher than forecasted. No major changes were needed due to snowpack and forecasts being in the normal range. By the end of February, river releases were 2,750 $ft^3/s$ while storage was at elevation 3616.6 feet.

### March

On March 1, the operational focus shifts from March 31 to April 30 in accordance with established operating criteria. Snowpack and forecasted inflows were near average on March 1. The storage target for April 30 was 3612.8 feet based on the March 1 April through July inflow forecast of 1,283,000 AF, 104 percent of average.

Temperatures were cooler than average while precipitation was above average. River releases were increased to 4,000 $ft^3/s$ during March. Storage decreased to a minimum of the year of 3,613.9 feet on March 14. Storage on March 31 was 3615.0 feet.

### April through June

The April 1 April through July inflow forecast stayed about the same at 1,267,00 AF. Snowpack was above average. Under this forecast, Bighorn Lake was expected to fill to normal full pool, 3640 feet. Releases were increased to 6,000 $ft^3/s$ during April. April was drier than average but snowpack peaked above average in the Bighorn Basin. Storage in Bighorn Lake ended the month at 3616.6 feet, 106 percent of average.

Warm temperatures during May accelerated the snowmelt runoff resulting in higher than forecasted inflows towards the end of May. Snowpack was much below average by the end of May due to the early melt of the snowpack. May precipitation was below average. Releases were reduced to 3000 $ft^3/s$ by May 25 based on storage in Bighorn Lake, the declining snowpack, and forecasted inflows.

The April through July inflow forecast was higher than the previous month at 1,329,100 AF which included actual April and May inflow volume. Releases were expected to peak at 8,500 $ft^3/s$ under median inflow conditions. The forecast included the much above precipitation that fell during the first four days of June. Releases were increased to 7000 $ft^3/s$ by June 10 based on storage and increasing inflow conditions.

Heavy precipitation continued for most of June with large weather events happening every week. The additional runoff from the rain peaked inflows on June 25 at 23300 $ft^3/s$. This was the highest daily average inflow since 1967. June precipitation was the highest on record in the Bighorn River basin. See figure 37 to see a graphic of the percent of average precipitation.

Releases to the Bighorn River were increased to 15,000 $ft^3/s$ by June 22. After a USGS measurement of the river, a shift change was applied to the river gage and reported releases were changed to 16,000 $ft^3/s$. This was the highest river release since 1967. Inflows from tributaries downstream of Yellowtail Dam increased flows on the Bighorn River at the mouth to approximately 23,000 $ft^3/s$

Storage peaked at elevation 3,647.7 feet or 1,120,900 AF on June 30. Operations were closely coordinated with the Corps.

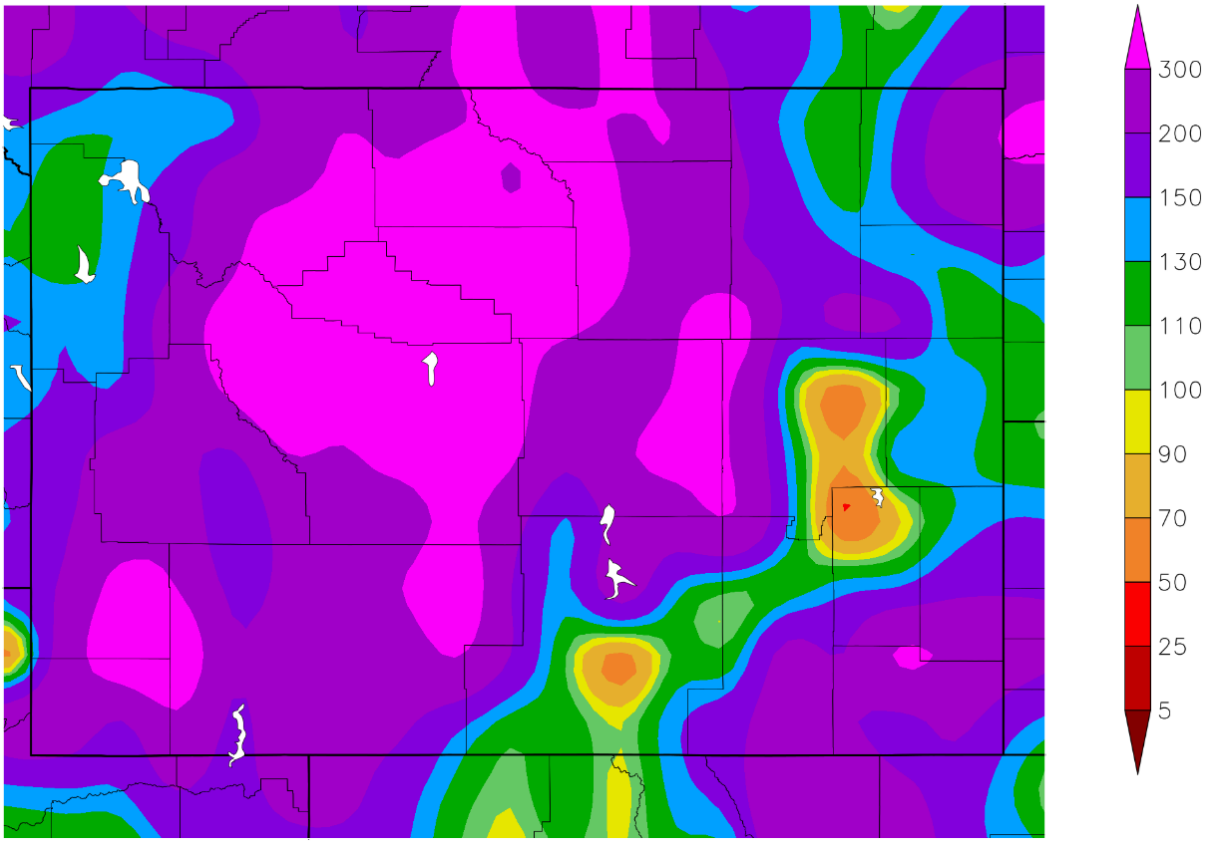



Figure 37.—MTG - Precipitation during June 2023 from NOAA Regional Climate Centers.

**July through September**

Inflow forecasts continued to be refined following the heavy runoff during June. Releases to the river were decreased to 15000 $ft^3/s$ on July 3 to provide some relief downstream. Inflows and releases continued to decrease during July. Releases to the river were down to 10000 $ft^3/s$ by July 17.

Conditions remained wetter than average during July through September. Temperatures trended from below to above average. Bighorn Lake exited the exclusive flood control pool on July 25. Releases were reduced to 40,000 $ft^3/s$ by end of July and 3000 $ft^3/s$ by end of September. Storage ended WY2023 at elevation 3638.3 feet, 988,300 AF, 113 percent of average.

Total generation produced at Yellowtail Powerplant during WY2023 was 780,887 megawatt-hours, 101 percent of average. Approximately 70 percent of all water released from Yellowtail Dam during WY2023 was released through the powerplant, 2,190,574 AF. The remaining 934,503 AF was released either through the river outlet gates or the spillway gates.
More water than normal was released through the spillway and river outlet works this year due to the high releases and several maintenance activities. Western Area Power Administration was making transmission line upgrades that limited power generation. All releases through the Yellowtail Powerplant were shut off for a week in September for replacement of the uninterruptable power supply. Repair and construction work on and near Yellowtail Dam spillway kept the Yellowtail Afterbay lower than normal for extended period of time.

The reservoirs in the Bighorn River Basin ended the water year with above average storage. With the forecasted releases from Boysen and Buffalo Bill, winter releases were expected to be greater than 3,000 $ft^3/s$.

***Important Events – WY2023***

**May 4, 2023**: The Bighorn Canal is started for the irrigation season.

**September 17, 2023**: The Bighorn Canal was shut down for the irrigation season.

For more detailed information on the operations of Boysen and Buffalo Bill Reservoirs during WY2023, refer to the narratives for Boysen Reservoir and Powerplant and Shoshone Project under the responsibility of the WYAO.

**Table 81.—MTT - Reservoir allocations for Bighorn Reservoir***

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 3547.00 | 467,473 | 467,473 |
| Top of active conservation | 3614.00 | 778,317 | 310,844 |
| Top of joint use | 3640.00 | 1,011,052 | 232,735 |
| Top of exclusive flood control | 3657.00 | 1,263,682 | 252,630 |

*2017 reservoir survey and revised area-capacity table was implemented on October 1, 2020.

**Table 82.—MTT - Storage and elevation data for Bighorn Reservoir**

| Storage-elevation data | Elevation (ft) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 3633.45 | 931,130 | 10/1/2022 |
| End of year | 3638.28 | 988,258 | 9/30/2023 |
| Annual low | 3613.92 | 789,009 | 3/14/2023 |
| Annual high | 3647.72 | 1,120,855 | 6/30/2023 |
| Historic high | 3656.36 | 1,363,994 | 7/6/1967 |

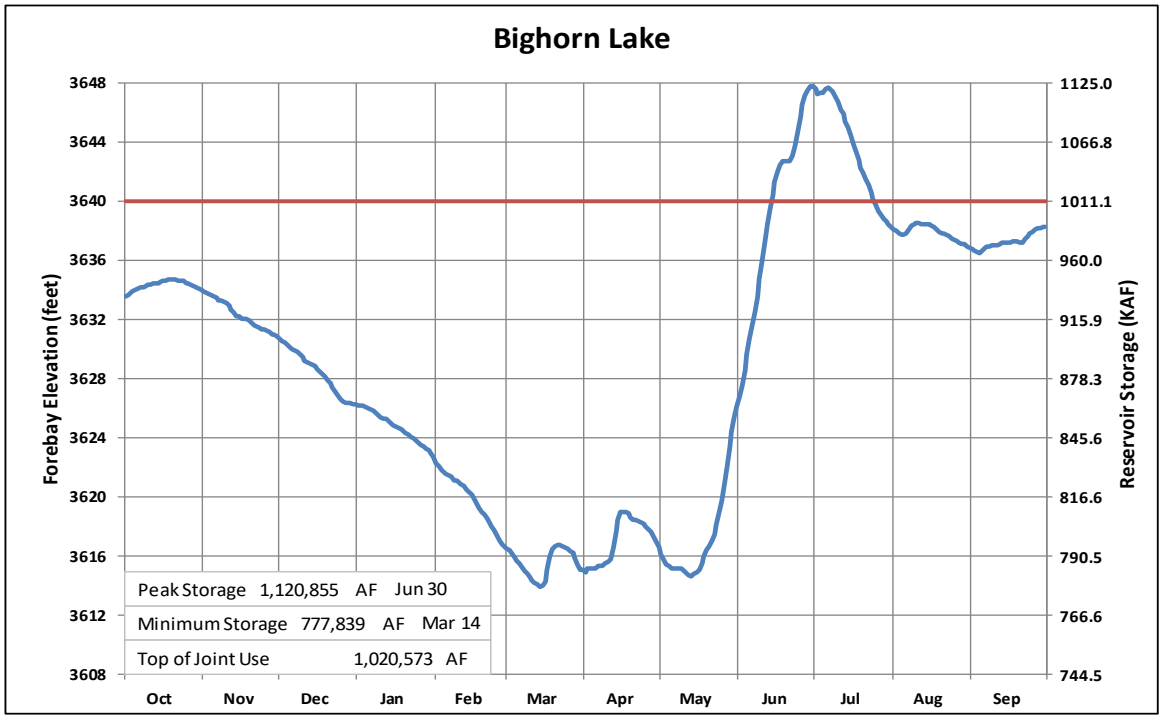
**Table 83—MTT - Inflow and discharge data for Bighorn Reservoir**

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 3,182,912 | Oct. '22–Sep. '23 | 3,095,898* | Oct. '22–Sep. '23 |
| Daily peak ($ft^3/s$) | 23,264 | 6/25/2023 | 16,183* | 6/25/2023 |
| Daily minimum ($ft^3/s$) | 925 | 12/23/2022 | 2,335* | 12/4/2022 |
| Peak spill ($ft^3/s$) | | | 13,575 | 6/24/2023 |
| Total spill (KAF) | | | 934,503 | May–Sept 2023 |

*Discharge to the Bighorn River

**Table 84.—MTT - WY2023 monthly inflow, outflow, and storage data for Bighorn Reservoir**

| Month | Inflow, KAF | Percent of 30-yr avg | Outflow to canal, KAF | Percent of 30-yr avg | Outflow to river, KAF | Percent of 30-yr avg | Content, KAF | Percent of 30-yr avg |
|---|---|---|---|---|---|---|---|---|
| October | 155.2 | 94 | 0.0 | | 153.7 | 96 | 937.2 | 106 |
| November | 106.2 | 86 | 0.0 | | 143.2 | 99 | 904.6 | 103 |
| December | 100.9 | 95 | 0.0 | | 146.0 | 99 | 863.6 | 103 |
| January | 119.2 | 112 | 0.0 | | 151.3 | 101 | 835.8 | 104 |
| February | 102.0 | 93 | 0.0 | | 146.9 | 104 | 794.6 | 102 |
| March | 173.2 | 110 | 0.0 | | 187.4 | 106 | 784.6 | 102 |
| April | 288.8 | 163 | 0.0 | | 283.2 | 142 | 794.3 | 106 |
| May | 325.7 | 106 | 11.4 | 103 | 250.6 | 110 | 862.6 | 106 |
| June | 870.0 | 184 | 17.1 | 81 | 598.5 | 185 | 1,120.9 | 121 |
| July | 515.2 | 187 | 19.7 | 72 | 632.3 | 232 | 988.3 | 109 |
| August | 229.1 | 147 | 23.5 | 88 | 229.9 | 132 | 969.4 | 111 |
| September | 197.5 | 119 | 10.6 | 65 | 172.8 | 113 | 988.3 | 113 |
| Annual | 3,182.9 | 137 | 82.2 | 77 | 3,095.9 | 136 | | |
| April–July | 1,999.6 | 162 | | | | | | |



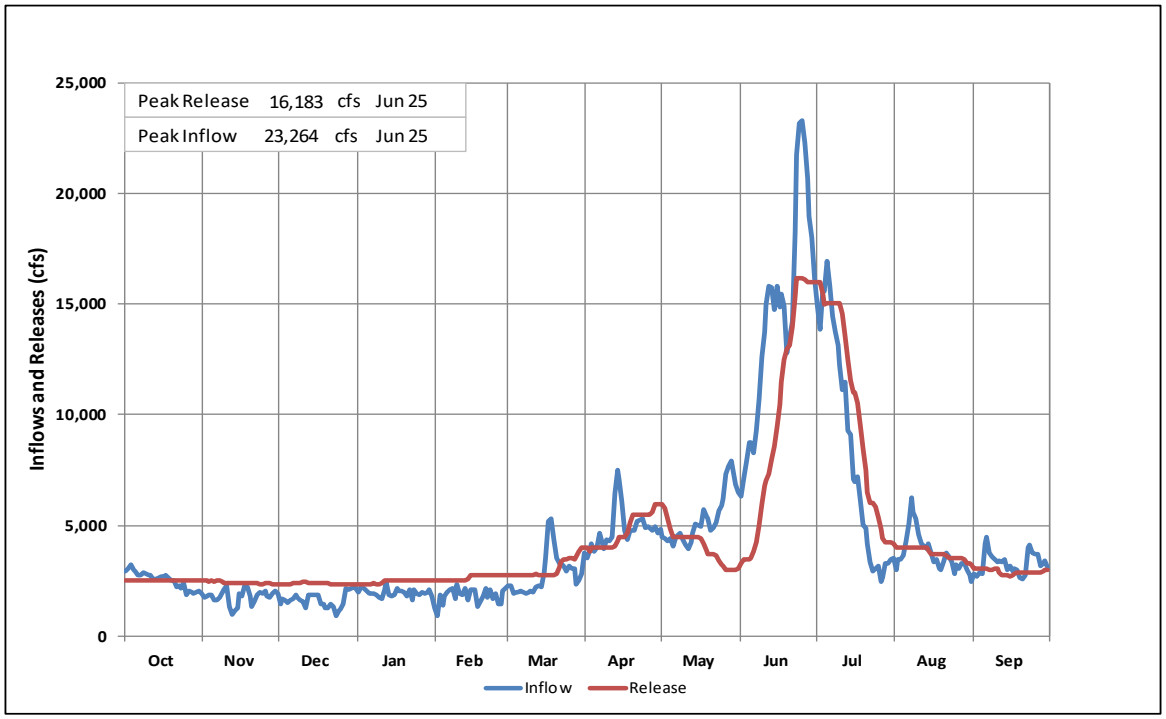




Figure 38.—MTG - WY2023 hydrologic data for Bighorn Reservoir.

# Summary Of Operations for Water Year 2023 for Reservoirs Under the Responsibility of the Dakotas Area Office

## Angostura, Belle Fourche, Deerfield, E.A. Patterson, Lake Tschida, Jamestown, Keyhole, Pactola, and Shadehill

# Weather Summary for North And South Dakota Water Year (WY) 2023

October precipitation was much above normal at Angostura reservoir, normal at Keyhole reservoir; below normal at Deerfield reservoir; much below normal at Pactola and Shadehill Reservoirs; and very much below normal at Belle Fourche, Dickinson, Heart Butte, and Jamestown reservoirs.

November precipitation was very much above normal at Heart Butte reservoir; much above normal at Deerfield and Jamestown reservoirs; above normal at Belle Fourche reservoir; below normal at Keyhole, Pactola, and Shadehill Reservoirs; and very much below normal at Angostura and Dickinson reservoirs.

December precipitation was very much above normal at Angostura, Deerfield, Heart Butte, Jamestown, and Keyhole reservoirs; much above normal at Pactola reservoir; above normal at Belle Fourche reservoir; normal at Shadehill Reservoir; and very much below normal at Dickinson reservoir.

January precipitation was very much above normal at Deerfield and Keyhole reservoirs; normal at Pactola and Shadehill Reservoirs; below normal at Belle Fourche and Jamestown reservoirs; much below normal at Heart Butte reservoir; and very much below normal at Angostura and Dickinson reservoirs.

February precipitation was very much above normal at Belle Fourche, Deerfield, Jamestown, Keyhole, and Pactola reservoirs; normal at Shadehill Reservoir; below normal at Heart Butte reservoir; much below normal at Angostura reservoir; and very much below normal at Dickinson reservoir.

March precipitation was much above normal at Heart Butte reservoir; much above normal at Jamestown and Shadehill Reservoirs; below normal at Deerfield, Keyhole, and Pactola reservoirs; much below normal at Angostura reservoir, and very much below normal at Belle Fourche and Dickinson reservoirs.

April precipitation was very much above normal at Belle Fourche reservoir; above normal at Deerfield, Jamestown, and Pactola reservoirs; normal at Shadehill Reservoir; below normal at Angostura and Keyhole reservoirs; and very much below normal at Dickinson and Heart Butte reservoirs.

May precipitation was very much above normal at Belle Fourche, Deerfield, Keyhole and Pactola reservoirs; above normal at Dickinson and Shadehill Reservoirs; normal at Angostura, Heart Butte, and Jamestown Reservoirs.

June precipitation was very much above normal at Deerfield reservoir; above normal at Dickinson, Heart Butte, Jamestown, and Pactola reservoirs; normal at Belle Fourche and Shadehill Reservoirs; and below normal at Angostura and Keyhole Reservoirs.

July precipitation was very much above normal at Belle Fourche, Deerfield, Keyhole and Pactola reservoirs; normal at Heart Butte reservoir; below normal at Angostura, Jamestown, and Shadehill Reservoirs; and much below normal at Dickinson reservoir.

August precipitation was very much above normal at Deerfield, Dickinson, Heart Butte, and Pactola reservoirs; much above normal at Belle Fourche reservoir; above normal at Angostura reservoir; normal at Keyhole and Shadehill Reservoirs; and much below normal at Jamestown reservoir.

September precipitation was much above normal at Belle Fourche and Shadehill Reservoirs; much above normal at Deerfield, Dickinson, Heart Butte, Jamestown, and Pactola reservoirs; below normal at Keyhole reservoir; and very much below normal at Angostura reservoir.
Total annual precipitation for Reclamation facilities in North Dakota, South Dakota, and northeastern Wyoming are shown in table 85.

**Table 85.—DKT - Total annual precipitation for Reclamation reservoirs in North Dakota, South Dakota, and Northeastern Wyoming (inches)**

| Reservoirs | 2023 total | Average total | Percent |
|---|---|---|---|
| Angostura [1] | 22.70 | 17.67 | 128 |
| Belle Fourche [2] | 21.27 | 15.86 | 134 |
| Deerfield [3] | 22.62 | 20.43 | 111 |
| Keyhole [4] | 18.33 | 17.99 | 102 |
| Pactola | 24.36 | 20.58 | 118 |
| Shadehill [5] | 21.97 | 17.86 | 123 |
| Dickinson | 15.44 | 17.35 | 89 |
| Heart Butte | 21.89 | 16.79 | 130 |
| Jamestown | 20.30 | 19.84 | 102 |

[1] Angostura Reservoir's annual precipitation data is from the Hot Springs, South Dakota climate station.
[2] Belle Fourche Reservoir's annual precipitation data is from the Newell, Sout Dakota climate station.
[3] Deerfield reservoir's annual and average precipitation data is from the Deerfield, Dam flip bucket rain gauge recorded by Hydromet.
[4] Keyhole Reservoir's annual precipitation data is from the Sundance, Wyoming climate station.
[5] Shadehill Reservoir's annual precipitation data is from the Lemmon, Sout Dakota climate station.

**Table 86.—DKT - Comparison of end-of-water-year storage content for reservoirs in North Dakota, South Dakota, and Northeastern Wyoming (AF)**

| Reservoir | Storage September 30, 2022 | Storage September 30, 2023 | Change in storage |
|---|---|---|---|
| Angostura | 61,946 | 92,889 | 30,943 |
| Belle Fourche | 91,970 | 142,498 | 50,528 |
| Deerfield | 15,369 | 15,048 | -321 |
| Keyhole | 119,643 | 130,164 | 10,521 |
| Pactola | 51,481 | 53,420 | 1,939 |
| Shadehill | 92,565 | 116,151 | 23,586 |
| Dickinson | 7,220 | 7,771 | 551 |
| Heart Butte | 53,951 | 58,546 | 4,595 |
| Jamestown | 27,408 | 31,032 | 3,624 |

Table displays the changes in storage content between September 30, 2021, and September 30, 2022, at reservoirs in North and South Dakota and eastern Wyoming.

# Flood Benefits

## Reservoirs in North and South Dakota and Northeastern Wyoming

- One Bureau of Reclamation reservoir in North Dakota and two Bureau of Reclamation reservoirs in South Dakota provided flood relief during WY2023.

- The information on the distribution of flood damages prevented is provided by the Corps of Engineers. The distributions of flood damages prevented for each reservoir are as follows:

**Table 87.—DKT - Flood damage prevented in 2023, accumulated total 1950–2023**

| | Local | Main-stem | 2023 total | Previous accumulations | 1950-2023 accum. totals |
|---|---|---|---|---|---|
| Heart Butte | $958,900 | $2,129,600 | $3,088,500 | $17,039,900 | $20,128,400 |
| Shadehill | $0 | $144,500 | $144,500 | $14,144,400 | $14,158,900 |
| Angostura | $0 | $0 | $0 | $22,900 | $22,900 |
| Pactola | $0 | $48,200 | $48,200 | $4,945,800 | $4,994,000 |
| Keyhole | $0 | $131,800 | $131,800 | $4,932,000 | $5,063,800 |
| Jamestown | $31,390,100 | $0 | $31,390,100 | $220,762,800 | $252,152,900 |
| Total | $32,349,000 | $2,454,100 | $34,803,100 | $261,847,800 | $296,650,900 |

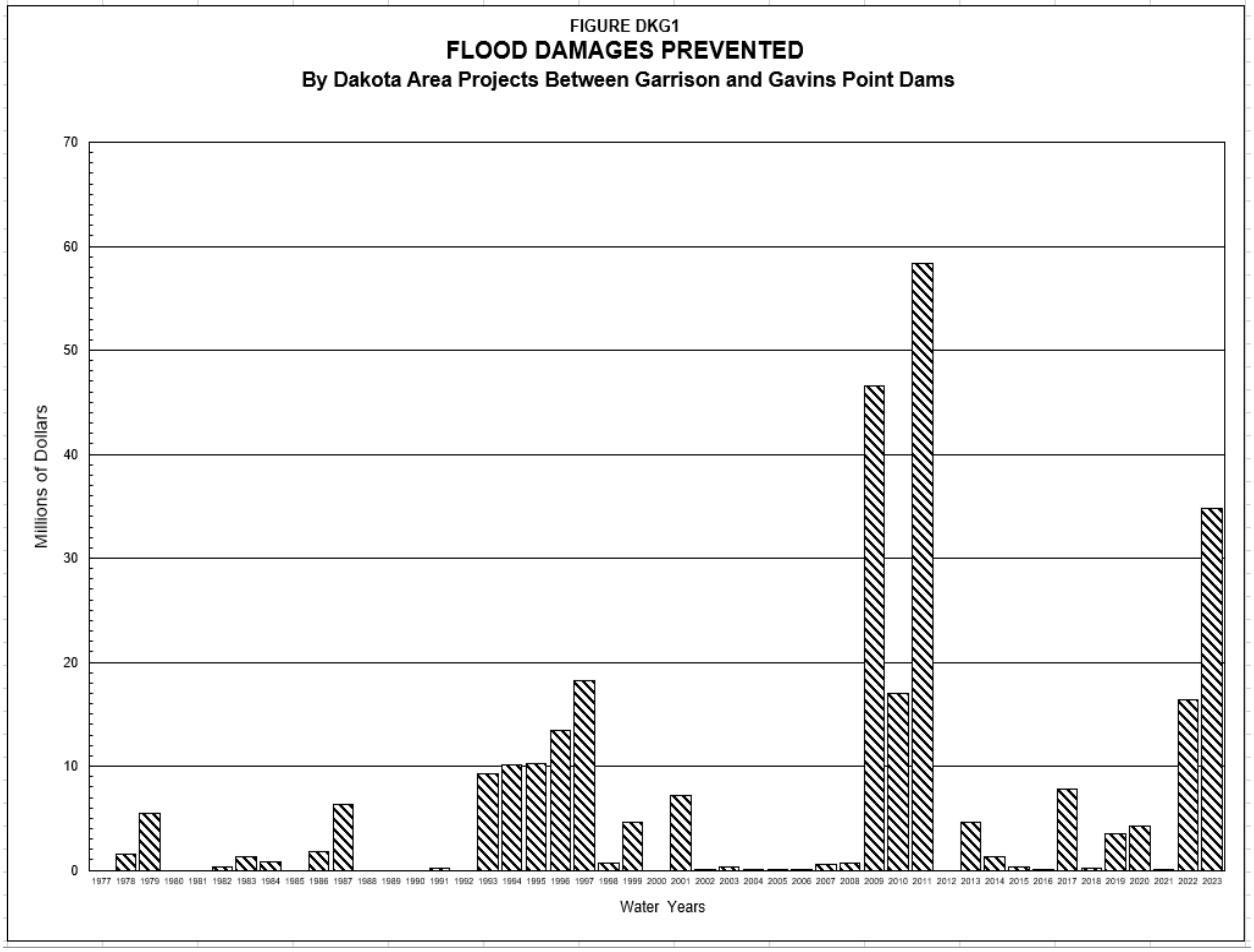



Figure 39.—DKG - Flood damages prevented.

# Unit Operational Summaries for WY2023

## Dickinson Reservoir

### Background

Dickinson Dam and Edward Arthur Patterson Lake (Dickinson Reservoir) is located on the Heart River one mile west of Dickinson, North Dakota. The reservoir has a dead capacity of 349 AF, an inactive capacity of 89 AF and an active conservation capacity of 8,041 AF (for a total storage capacity of 8,479 AF at the top of conservation elevation 2,420.00). Reservoir water is used for irrigating approximately 230 acres along the Heart River downstream of the dam and for municipal use by the Dickinson Parks and Recreation District.

## WY2023 Operations Summary

E.A. Patterson Reservoir (Dickinson Dam) started WY2023 at elevation 2,418.89 feet and with a storage of 7,220 AF, which is 1.11 feet and 1,259 AF below the top of the conservation pool. Precipitation for WY2023 was 13.45 inches, which is 86 percent of its 15.63-inch average. Inflows for WY2023 totaled 22,806 AF, which is 117 percent of its 19,515 AF average. Peak inflows occurred in April, totaling 18,640 AF for the month. The peak reservoir elevation for WY2023 was 2,420.83 feet, with a storage of 9,507 AF and occurred on April 10, 2023. The minimum elevation for WY2023 was 2418.75 feet, with a storage of 7,071 AF, and occurred on October 22, 2022. WY2023 ended at elevation 2,419.39 feet, and storage of 7,771 AF, which is 0.61 feet and 708 AF below the top of the conservation pool.

Dickinson Dam went into Internal Alert on April 6, with a reservoir elevation over 2420.00 feet. On April 11, the reservoir went into Response Level 1, with a reservoir elevation over 2420.50 feet. The maximum computed daily inflow and outflow reached 2,700 cubic feet per second on April 11. On April 17, the reservoir went back to Internal Alert when the reservoir elevation fell below 2420.50 feet. On June 9, the reservoir returned to normal operations, with a reservoir elevation under 2420.00 feet and remained in normal operations for the remainder of the water year.

An Emergency Management program, orientation seminar and communications drill were conducted on March 29, 2023.

An Annual Site Inspection (ASI) was conducted on August 9, 2023, by personnel from DKAO.

## Monthly Statistics for WY2023

Record and near record monthly inflows in 72 years of record keeping were recorded in the following months: December had its ninth highest inflow; April had its sixth lowest inflow.

Record or near record monthly end of month content in 72 years of record keeping were recorded in the following months: August had its tenth highest storage; September had its ninth highest storage.

Additional statistical information on Dickinson Reservoir and its operations during WY2023 can be found in table 88 and figure 40.

**Table 88.—DKT - Hydrologic Data for 2023, Dickinson Reservoir**

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage Allocation (AF) |
|---|---|---|---|
| Top of inactive | 2405.00 | 438 | 438 |
| Top of active conservation | 2420.00 | 8,452 | 8,014 |
| Top of joint use | | | |
| Top of exclusive flood control | | | |

| Storage-elevation data | Elevation (ft) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 2418.89 | 7,220 | Oct 01, 2022 |
| end of year | 2419.39 | 7,771 | Sep 30, 2023 |
| annual low | 2418.75 | 7,071 | Oct 22, 2022 |
| annual high | 2420.83 | 9,507 | April 10, 2023 |
| historic high | 2422.19 | 9,348*** | March 21, 1997 |

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 22,806 | Oct '22–Sep '23 | 22,256 | Oct '22–Sep '23 |
| daily peak ($ft^3/s$)* | 2,677 | April 11, 2023 | 2,703 | April 11, 2023 |
| daily minimum ($ft^3/s$)** | 0 | ** | 0 | ** |

| | Inflow | | Outflow | | Content | |
|---|---|---|---|---|---|---|
| Month | AF | Percent of avg | AF | Percent of avg | AF | Percent of avg |
| October | -75 | N/A | 0 | 0 | 7,145 | 129 |
| November | 140 | 81 | 0 | 0 | 7,285 | 133 |
| December | 240 | 174 | 0 | 0 | 7,525 | 137 |
| January | 226 | 80 | 193 | 113 | 7,558 | 135 |
| February | 386 | 36 | 386 | 53 | 7,558 | 127 |
| March | 485 | 7 | 551 | 9 | 7,492 | 107 |
| April | 18,640 | 431 | 17,412 | 423 | 8,720 | 121 |
| May | 2,040 | 85 | 2,221 | 88 | 8,539 | 119 |
| June | 369 | 16 | 477 | 21 | 8,431 | 118 |
| July | -104 | Na | 966 | 70 | 7,361 | 112 |
| August | 550 | 168 | 50 | 6 | 7,861 | 129 |
| September | -90 | Na | 0 | 0 | 7,771 | 134 |
| Annual | 22,807 | 117 | 22,256 | 115 | | |
| April–July | 20,945 | 213 | | | | |

* 24-hour daily inflow and 15-minute instantaneous discharge

** Frequently observed during fall and winter months

*** Due to new area-capacity table, the capacity that corresponds to the new historic high elevation is less than a previous historic high-capacity amount (11,520 AF @ Elevation 2421.08 feet on June 9, 1982).

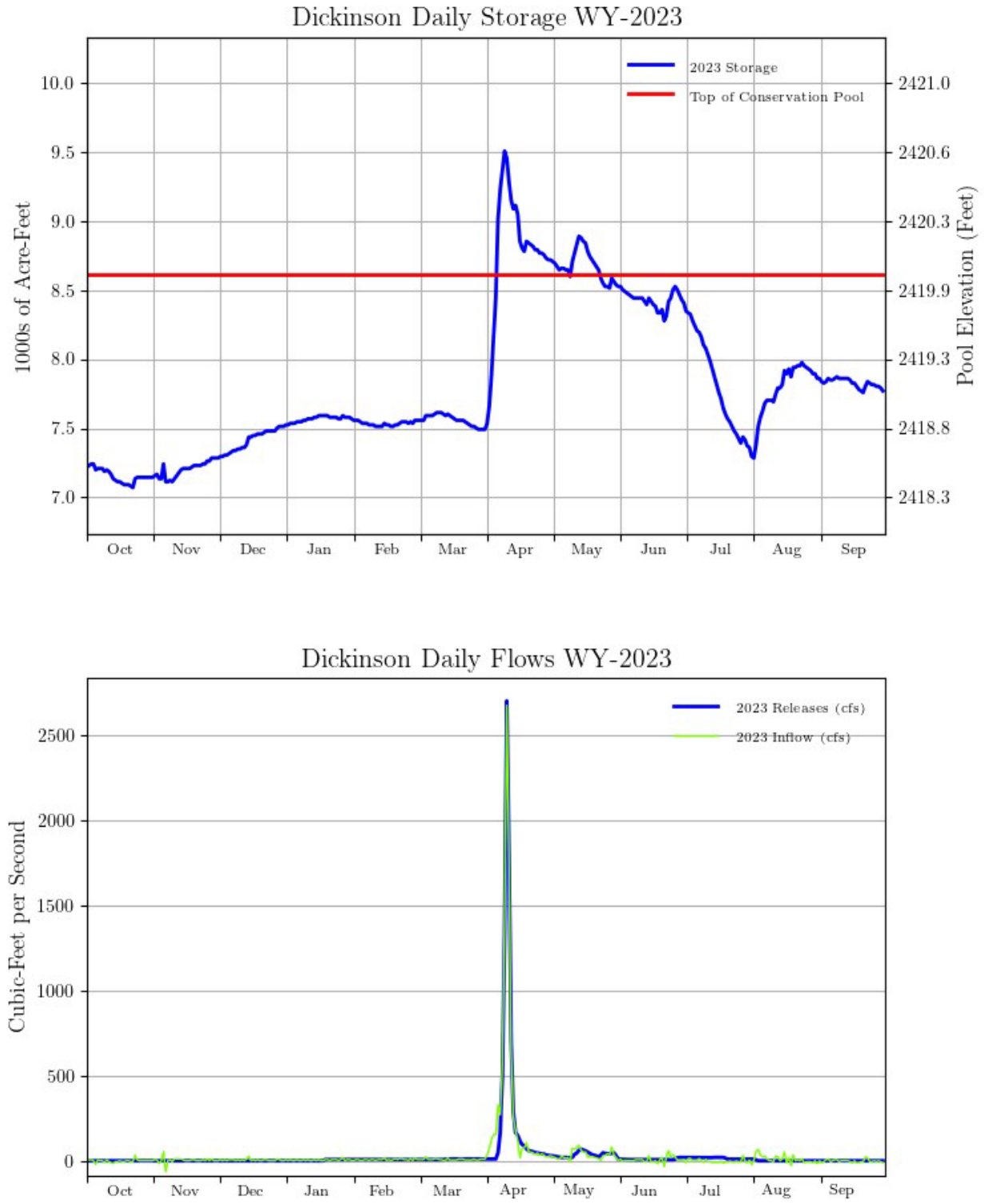



Figure 40.—DKG - Dickinson Reservoir.

# Heart Butte Reservoir

## Background

Heart Butte Dam and Lake Tschida (Heart Butte Reservoir) are located on the Heart River 15 miles south of Glen Ullin, North Dakota. The reservoir has a dead storage capacity of 4,328 AF, an active conservation capacity of 60,763 AF (for a total storage capacity of 65,091 AF at the top of active conservation elevation 2064.50), and an exclusive flood control space of 147,605 AF. Flood control storage is located above the crest of an ungated morning glory inlet spillway. Heart Butte Reservoir is primarily used for flood control and the authorized irrigation of up to 13,100 acres of which about 7,320 acres are now being irrigated.

## Water Year 2023 Operations Summary

Lake Tschida Reservoir (Heart Butte Dam) started WY2023 at elevation 2060.73 feet and with a storage of 53,951 AF, which is 3.77 feet and 13,191 AF below the top of the conservation pool. Precipitation for WY2023 was 21.89 inches, which is 130 percent of its 16.79-inch average. Inflows for WY2023 totaled 134,666 AF, which is 155 percent of its 86,844 AF average. Peak inflows occurred in April, totaling 99,643 AF for the month. The peak reservoir elevation for WY2023 was 2,075.92 feet, with a storage of 109,830 AF and occurred on April 15, 2023. The minimum elevation for WY2023 was 2060.35 feet, with a storage of 52,888 AF, and occurred on October 18, 2022. WY2023 ended at elevation 2062.30 feet, and storage of 58,456 AF, which is 2.20 feet and 6,635 AF below the top of the conservation pool.

Heart Butte Dam went into Internal Alert on April 12, with a reservoir elevation over 2064.50 feet. Later, on the same day, the reservoir continued to rise above 2067.00 feet and Response Level One was declared. The computed maximum daily inflow reached 12,549 cubic feet per second ($ft^3/s$) on April 12 and the maximum daily outflow rate reached 3,478 $ft^3/s$ on April 15. Response Level One was reduced to Internal Alert on April 26 and remained there until May 3, when the reservoir returned to normal operations, with a reservoir under 2064.50 feet. Internal Alert for reservoir elevation was declared for a second time on May 13 and remained there until May 19 when it went back into normal operations for the remainder of the water year. Heart Butte Dam has remained in Internal Alert since 2013 due to sediment transport into the conduit and a boil downstream of the dam. Final Design of a Safety of Dams modification project is underway to reduce the risk of internal erosion failure.

An Emergency Management program, orientation seminar and communications drill were conducted on March 9, 2023.

An ASI was conducted on August 31, 2023 by personnel from DKAO.

## Monthly Statistics for Water Year 2023

Record and near record monthly inflows in 74 years of record keeping were recorded in the following months: April had its seventh highest inflow, and August had its tenth highest inflow.

Record or near record monthly end of month content in 74 years of record keeping were recorded in the following months: February had its eighth highest storage.

Additional statistical information on Heart Butte Reservoir and its operations during WY2023 can be found in table 89 and figure 41.

**Table 89.—DKT - Hydrologic data for 2023 Heart Butte Reservoir**

| Reservoir allocations | Elevation (feet) | Total Reservoir Storage (AF) | Storage Allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 2030.00 | 4,328 | 4,328 |
| Top of active conservation | 2064.50 | 65,091 | 60,763 |
| Top of joint use | | | |
| Top of exclusive flood control | 2094.50 | 212,696 | 147,605 |
| **Storage-elevation data** | **Elevation (ft)** | **Storage (AF)** | **Date** |
| Beginning of year | 2060.73 | 53,951 | Oct 01, 2022 |
| End of year | 2062.30 | 58,456 | Sep 30, 2023 |
| Annual low | 2060.35 | 52,888 | Oct 18, 2022 |
| Annual high | 2075.92 | 109,830 | April 15, 2023 |
| Historic high | 2086.23 | 173,203 | April 09, 1952 |

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 134,666 | Oct '22–Sep '23 | 129,931 | Oct '22–Sep '23 |
| Daily peak ($ft^3/s$) | 12,549 | April 12, 2023 | 3,478 | April 15, 2023 |
| Daily minimum ($ft^3/s$) | 0 | * | 0 | * |

| | Inflow | | Outflow | | Content | |
|---|---|---|---|---|---|---|
| Month | AF | Percent of avg | AF | Percent of avg | AF | Percent of avg |
| October | 62 | 4 | 623 | 27 | 53,390 | 92 |
| November | 1,250 | 95 | 464 | 33 | 54,176 | 94 |
| December | 1,489 | 156 | 612 | 47 | 55,053 | 96 |
| January | 1,356 | 116 | 614 | 53 | 55,566 | 97 |
| February | 1,732 | 48 | 556 | 27 | 56,742 | 96 |
| March | 2,338 | 8 | 1,528 | 9 | 57,552 | 83 |
| April | 99,643 | 426 | 88,889 | 372 | 68,306 | 99 |
| May | 13,379 | 132 | 18,047 | 169 | 63,638 | 93 |
| June | 4,366 | 44 | 3,226 | 35 | 64,778 | 94 |
| July | 2,879 | 70 | 4,995 | 65 | 62,662 | 96 |
| August | 4,643 | 285 | 6,303 | 115 | 61,002 | 99 |
| September | 1,526 | 233 | 4,072 | 138 | 58,456 | 98 |
| Annual | 134,663 | 155 | 129,929 | 151 | | |
| April-July | 120,267 | 253 | | | | |

* Frequently observed during fall and winter months

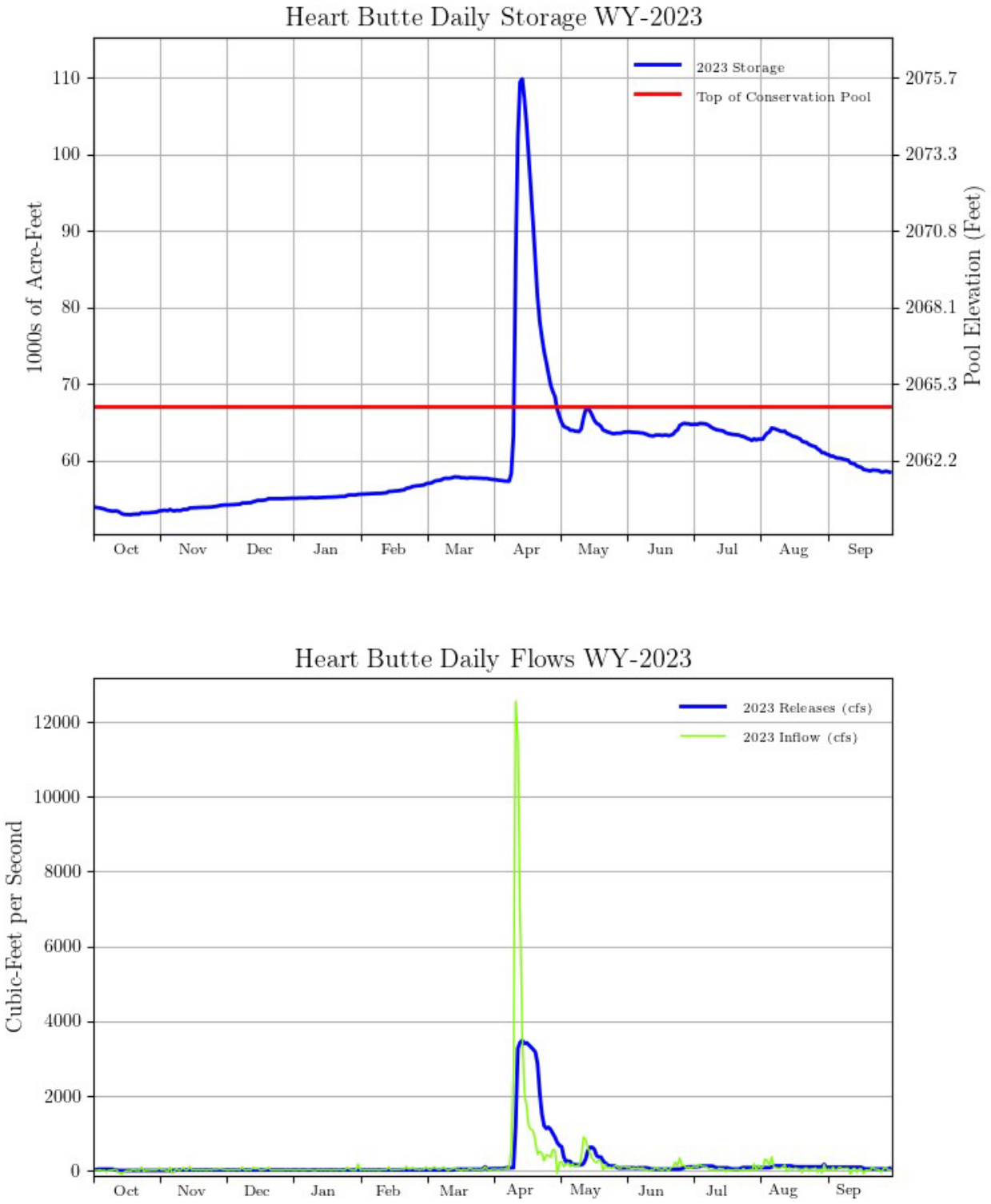



**Figure 41.—DKG - Heart Butte Reservoir.**

# Jamestown Reservoir

## Background

Jamestown Reservoir is located on the James River just above the city of Jamestown, North Dakota. The reservoir has a dead capacity of 292 AF, an active conservation capacity of 23,934 AF (for a total top of active conservation capacity of 24,226 AF at elevation 1,428.00), a joint-use capacity of 6,262 AF, and an exclusive flood control space of 190,502 AF. Exclusive flood control storage is located below the crest of an ungated morning glory inlet spillway and flood control releases are controlled by two gated outlets. The joint-use space is available for flood control at the beginning of spring runoff and is used for conservation purposes during the summer months.

## WY2023 Operations Summary

Jamestown Reservoir started WY2023 at elevation 1429.61 and with a storage of 27,408 AF, which is 1.39 feet, and 3,080 AF above the top of the conservation pool (elevation 1,428.00 and storage 24,226 AF). Precipitation for WY2023 was 20.30 inches, which is 102 percent of its 19.84-inch average. Inflows for WY2023 were the eleventh highest inflows on record for the dam and totaled 155,973 AF, which is 251 percent of its 62,024 average. Peak inflows occurred in May, totaling 87,874 AF for the month. The peak reservoir elevation for WY2023 was 1,443.93 with a storage of 106,754 AF and occurred on May 20, 2023. The minimum reservoir elevation for WY2023 was 1429.53 with a storage of 27,241 AF and occurred on November 7, 2022. WY2023 ended at elevation 1,431.23 with storage of 31,032 AF, which is 0.23 feet, and 544 AF above the top of active conservation pool. The maximum instantaneous discharge of 1,111 $ft^3/s$ occurred on May 19, 2023. The maximum 24 hour computed inflows occurred on May 12 with 4,184 $ft^3/s$.

Jamestown Dam went into Internal Alert (IA) on March 5, when the reservoirs elevation reached 1,431.00 feet or over.

Jamestown Dam went to Response Level 1 (RL1) on May 4, when the reservoirs elevation reached 1,440.00 feet or over.

Jamestown Dam went back to Internal Alert (IA) on June 12, when the reservoirs elevation reached 1,439.99 feet or under.

Jamestown Dam went back to normal operations on July 21, when the reservoirs elevation reached 1,430.99 feet or under.

Jamestown Dam again went back into Internal Alert (IA) on September 24, when the reservoirs elevation reached 1,431.00 feet or over and remained in Internal Alert for the rest of the water year. No water was released specifically for downstream irrigation.

An Emergency Management program, orientation seminar and communications drill were conducted on March 22, 2023.

A Periodic Review (PR) was conducted on September 13, 2023, by personnel from the regional office and the Dakotas Area Office.

## Monthly Statistics for WY2023

Record and near record monthly inflows in 70 years of record keeping were recorded in the following months: January had its seventh highest inflow, May had its second highest inflow, June had its ninth highest inflow, July had its ninth highest inflow, and September had its eighth highest inflow.

Record and near record monthly end of month content in 70 years of record keeping were recorded in the following months: January had its tenth highest storage, February had its eighth highest storage, and May had its third highest storage.

Additional statistical information on Jamestown Reservoir and its operations during WY2023 can be found in table 90 and figure 42.

Table 90.—DKT Hydrologic data for 2023 Jamestown Reservoir

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 1400.00 | 292 | 292 |
| Top of active conservation | 1428.00 | 24,226 | 23,934 |
| Top of joint use | 1431.00 | 30,488 | 6,262 |
| Top of exclusive flood control | 1454.00 | 220,990 | 190,502 |

| Storage-elevation data | Elevation (ft) | Storage (AF) | Date |
|---|---|---|---|
| Beginning of year | 1429.61 | 27,408 | Oct 01, 2022 |
| End of year | 1431.23 | 31,032 | Sep 30, 2023 |
| Annual low | 1429.53 | 27,241 | Nov 07, 2022 |
| Annual high | 1443.93 | 106,754 | May 20, 2023 |
| Historic high | 1454.10 | 222,318 | April 26, 2009 |

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 155,973 | Oct '22–Sep '23 | 152,326 | Oct '22–Sep '23 |
| Daily peak ($ft^3/s$) | 4,184 | May 12, 2023 | 1,111 | May 19, 2023 |
| Daily minimum $ft^3/s$) | 0 | * | 0 | * |

| | Inflow | | Outflow | | Content | |
|---|---|---|---|---|---|---|
| Month | AF | Percent of avg | AF | Percent of avg | AF | Percent of avg |
| October | -63 | NA | 0 | 0 | 27,345 | 104 |
| November | 548 | 32 | 0 | 0 | 27,893 | 108 |
| December | 779 | 118 | 0 | 0 | 28,672 | 111 |
| January | 894 | 379 | 0 | 0 | 29,566 | 116 |
| February | 712 | 176 | 0 | 0 | 30,278 | 119 |
| March | 1,092 | 17 | 123 | 13 | 31,247 | 101 |
| April | 37,182 | 148 | 6,085 | 64 | 62,344 | 134 |
| May | 87,874 | 818 | 57,773 | 367 | 92,445 | 223 |
| June | 12,628 | 283 | 62,865 | 600 | 42,208 | 119 |
| July | 10,204 | 239 | 23,252 | 327 | 29,160 | 90 |
| August | -166 | NA | 167 | 3 | 28,827 | 92 |
| September | 4,290 | 303 | 2,062 | 43 | 31,032 | 111 |
| Annual | 155,973 | 251 | 152,327 | 247 | | |
| April–July | 147,888 | 332 | | | | |

* Frequently observed during fall and winter months

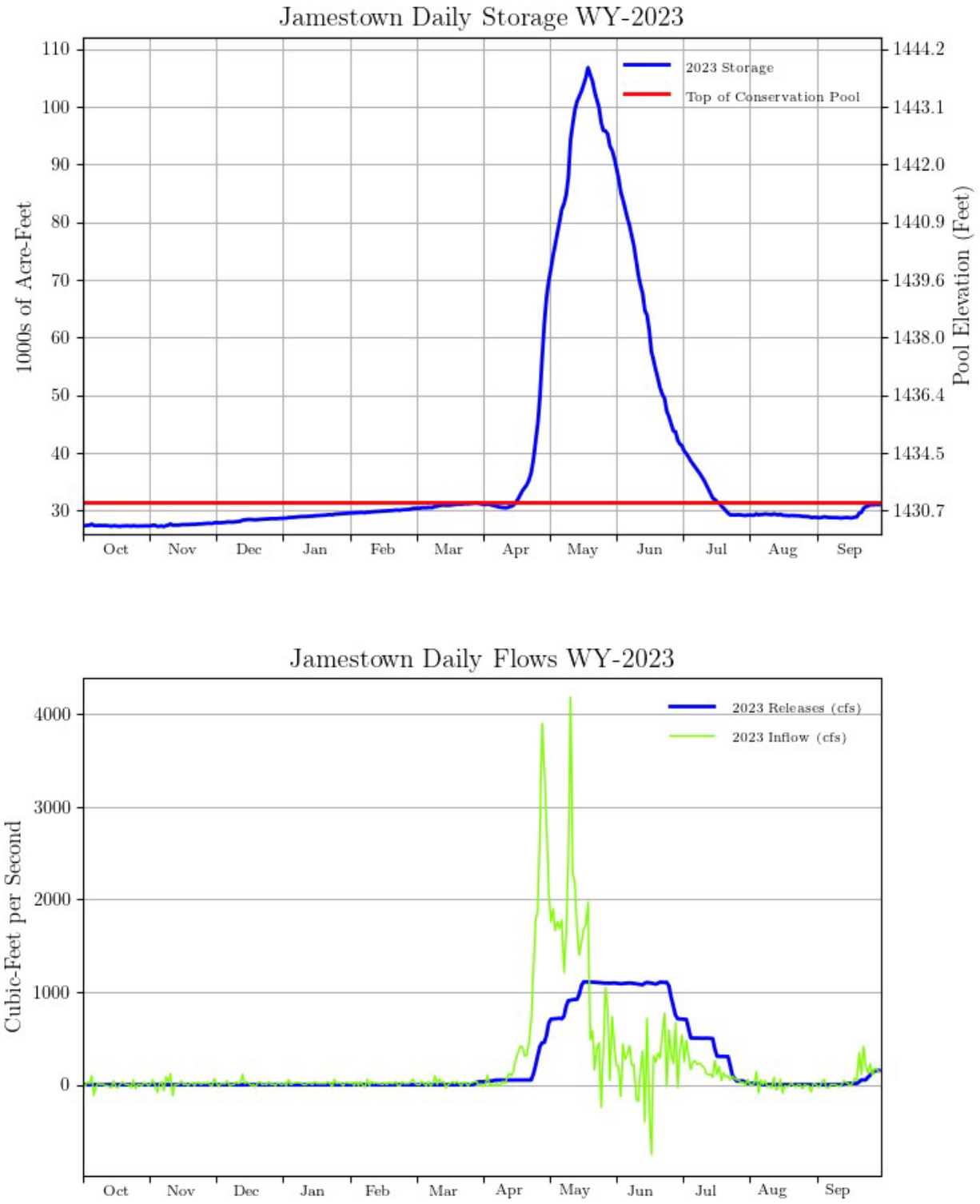



**Figure 42.—DKG - Jamestown Reservoir.**

# Angostura Reservoir

## Background

Angostura Reservoir (P-S MBP), located on the Cheyenne River above Hot Springs, South Dakota, was built to service about 12,200 acres in the Angostura Unit (P-S MBP) and for power generation. It has a total capacity of 123,048 AF with an additional surcharge capacity of 57,308 AF. Its principal use is for irrigation of the Angostura Unit, which diverts its water from a high-level outlet at the dam. In the early years, water surplus to irrigation needs was released to the river through a small power plant with a nameplate capacity of 1,200 kilowatts. Because of the low runoff, and because actual irrigation diversions were higher than previously anticipated, it was concluded that continued operation of the power plant was economically infeasible. Except for a few operations of less than 24 hours each, the plant was last operated in February 1959. In 1966, the plant was officially closed, and the equipment was declared surplus in March 1968. Disposal of this equipment was completed in 1971. Releases for irrigation are made through the canal outlet works into the Angostura Main Canal having a design capacity of 290 $ft^3/s$. Releases to the Cheyenne River are only made when the reservoir is assured of filling.

Reclamation's Sedimentation and River Hydraulics Group of the Technical Service Center in Denver conducted a sedimentation survey of Angostura Reservoir in 2004 and provided a survey report and new Area and Capacity Tables in August of 2005. The previous survey was done in 1979. Angostura Reservoir accumulated 7,716 AF of sediment since the last survey. Since construction in 1949, Angostura has accumulated 36,867 AF of sediment. The sedimentation rate from 1949 to 2004 has averaged 670 AF per year. The new Area and Capacity Tables were first used in WY2006.

## WY2023 Operations Summary

Angostura Reservoir Started WY2023 at elevation 3170.67 feet and with a storage of 61,946 AF, which is 16.53 feet and 61,946 AF below the top of the conservation pool. Precipitation for WY2023 was 22.70 inches at Oral Station which is 128 percent of average. Inflows for WY2023 totaled 64,589 AF (78 percent of average). Peak inflows occurred in July totaling 13,126 AF for the month. The peak reservoir elevation for WY2023 was 3,182.78 feet, storage of 103,768 AF, which is 4.42 feet and 19,280 AF below the top of the conservation pool and occurred on August 13, 2023. The minimum elevation for WY2023 was 3170.65 feet, storage of 61,889 AF, which is 16.55 feet and 61,159 AF below the top of the conservation pool and occurred on October 2, 2022. WY2023 ended at elevation 3180.03 feet, and storage of 92,889 AF, which is 7.17 feet and 30,159 AF below the top of the conservation pool. Angostura Reservoir ended the WY with 50,684 AF in active storage.

The Angostura Irrigation District had a total water allotment of 33,552 AF for its irrigators. Releases for irrigation began June 13, 2023, and reached a peak of 235 $ft^3/s$ on July 28, 2023. The irrigation releases were terminated on September 23, 2023. Total irrigation releases were 32,700 AF and total deliveries were 17,174 AF.

An Emergency Action Plan Orientation Meeting was held on March 22, 2023.

An ASI for Angostura Dam was conducted on August 29, 2023. There are three incomplete SOD recommendations to be completed by the Denver TRT Team regarding Probabilistic Seismic Hazard Analysis Seismic Analysis of Structural Elements, and methodology/accuracy of historic Toe Drain Flow Data.

No dam safety related incidents occurred during FY2023.

There were no large construction contracts at Angostura in 2023.

## Monthly Statistics for WY2023

Record and near record monthly inflows in 72 years of record keeping were recorded in the following months: August had its seventh highest inflow.

Record and near record monthly end of month content in 72 years of record keeping were recorded in the following months: October had its seventh lowest storage, November had its seventh lowest storage, December had its seventh lowest storage, January had its seventh lowest storage, February had its eighth lowest storage, March had its eighth lowest storage, April had its ninth lowest storage, and May had its tenth lowest storage.

Additional statistical information on Angostura Reservoir and its operations during WY2023 can be found in table 91 and figure 43.

Table 91.—DKT - Hydrologic data for 2023 Angostura Reservoir

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 3163.00 | 42,205 | 42,205 |
| Top of active conservation | 3187.20 | 123,048 | 80,843 |
| Top of joint use | | | |
| Top of exclusive flood control | | | |

| Storage-elevation data | Elevation (ft) | Storage (AF) | Date (end-of-day) |
|---|---|---|---|
| Beginning of year | 3170.67 | 61,946 | Sep 30, 2022 |
| End of year | 3180.03 | 92,889 | Sep 30, 2023 |
| Annual low | 3170.65 | 61,889 | Oct 02, 2022 |
| Annual high | 3182.78 | 103,768 | Aug 13, 2023 |
| Historic high | 3189.37 | 152,228** | May 20, 1978 |

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 64,589 | Oct '22-Sep '23 | 33,646 | Oct '22-Sep '23 |
| Daily peak ($ft^3/s$) | 1,030 | Aug 03, 2023 | 238 | July 29, 2023 |
| Daily minimum ($ft^3/s$) | -92 | Feb 02, 2023 | 1 | April 13, 2023 |

| | Inflow | | Outflow | | EOM content*** | |
|---|---|---|---|---|---|---|
| Month | AF | Percent of avg | AF | Percent of avg | AF | Percent of avg |
| October | 994 | 44 | 79 | 7 | 62,861 | 65 |
| November | 1,790 | 76 | 81 | 6 | 64,570 | 66 |
| December | 2,020 | 99 | 74 | 11 | 66,516 | 67 |
| January | 2,496 | 111 | 80 | 14 | 68,932 | 69 |
| February | 2,047 | 46 | 68 | 8 | 70,911 | 68 |
| March | 5,528 | 41 | 66 | 1 | 76,373 | 69 |
| April | 5,903 | 77 | 63 | 2 | 82,213 | 71 |
| May | 10,672 | 60 | 72 | 1 | 92,813 | 78 |
| June | 8,903 | 46 | 4,185 | 21 | 97,531 | 82 |
| July | 13,126 | 186 | 12,059 | 76 | 98,598 | 90 |
| August | 9,341 | 293 | 10,516 | 82 | 97,422 | 97 |
| September | 1,769 | 169 | 6,303 | 117 | 92,889 | 97 |
| Annual | 64,589 | 78 | 33,646 | 41 | | |
| April–July | 38,604 | 74 | | | | |

** Due to new area-capacity table, the capacity that corresponds to the new historic high elevation is less than a previous high-capacity amount (169,020 AF at Elevation 3189.0 feet on June 18, 1962)

*** EOM Content – End of Month Content

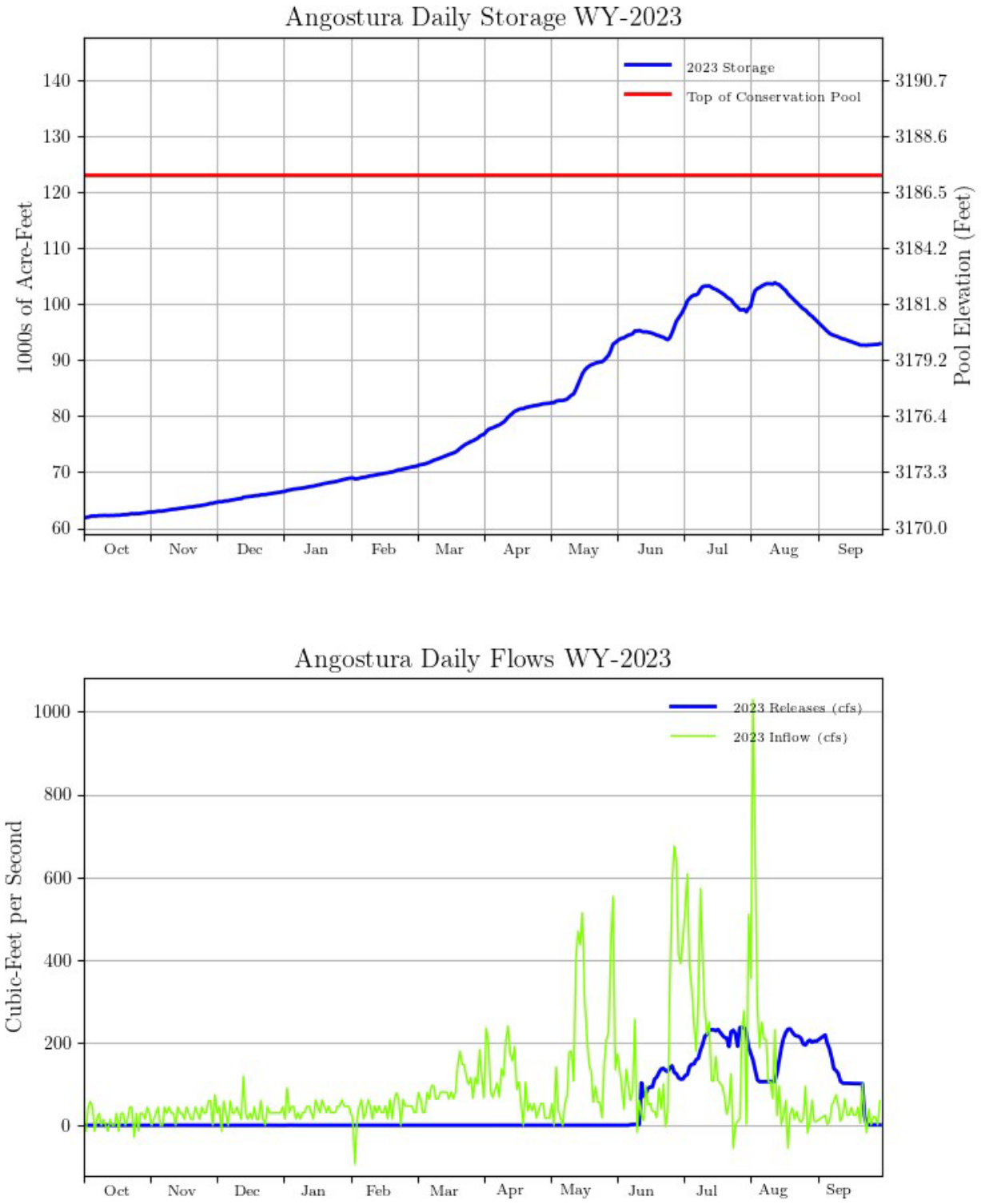



**Figure 43.—DKG - Angostura Reservoir.**

# Belle Fourche Reservoir

## Background

Belle Fourche Reservoir located near Belle Fourche, South Dakota, is formed by Belle Fourche Dam on Owl Creek, a tributary of the Belle Fourche River. It has a total capacity of 172,873 AF (169,790 AF active). The reservoir is filled by diverting water from the Belle Fourche River through the Inlet Canal, which has a capacity of 1,300 $ft^3/s$. The reservoir is used for irrigation of 57,000 acres in the Belle Fourche Project, which also receives a supplemental supply from Keyhole Reservoir. From November 1965 through May 1977, the active capacity of the reservoir was temporarily limited to 160,300 AF at elevation 2981.8 feet until the damaged spillway was replaced.

When the Belle Fourche Reservoir storage right is satisfied by the reservoir filling, the South Dakota Department of Environment and Natural Resources provide guidelines for complying with water rights on the Belle Fourche River. The district is required to continue to bypass five $ft^3/s$ for domestic use prior to diverting the Johnson Lateral water right for up to 40 $ft^3/s$. If flows into the diversion dam are greater than 45 $ft^3/s$, the district is required to bypass up to 60 $ft^3/s$ for downstream irrigation rights. Any flows in excess of these amounts can be diverted into the reservoir and stored. If all of these rights are not needed the district can divert flows into the reservoir.

## WY2023 Operations Summary

Belle Fourche Reservoir started WY2023 at elevation 2963.19 feet and with a storage of 91,970 AF of storage, which is 11.81 feet and 80,903 AF below top of conservation pool. Precipitation for WY2023 was 21.27 inches at Belle Fourche Station which is 134 percent of average. Inflows for WY2023 totaled 132,953 AF (116 percent of average). Peak inflows occurred in May totaling 16,895 AF for the month. The peak reservoir elevation for 2023 was 2974.77 feet, storage of 171,029 AF, and occurred on June 24, 2023. The minimum elevation for WY2023 was 2963.24 feet, storage of 92,250 AF, and occurred on October 1, 2022. WY2023 ended at elevation 2971.05 feet and storage of 142,498, AF, which is 3.95 feet and 30,375 AF below the top of the conservation pool. Belle Fourche Reservoir ended the water year with 139,415 AF in active storage.

The Belle Fourche Irrigation District (BFID) had a full water allotment of 18 inches for its irrigators, which was increased to 21 inches towards the end of the season. The North Canal and South Canals were turned on May 2, 2023. Releases reached a peak of 310 $ft^3/s$ on July 29, 2023, for North Canal and a peak of 250 $ft^3/s$ on July 31, 2023, for South Canal. The South Canal was shut off on September 22, 2023. The North Canal was shut off on September 30, 2023. Total irrigation releases for the 2023 season were 88,820 AF.

An Emergency Action Plan Orientation Meeting was held on April 19, 2023.

The ASI for Belle Fourche Dam was conducted on September 19, 2023. There are no incomplete SOD recommendations.

No dam safety related incidents occurred.

Belle Fourche Dam entered Internal Alert on May 12, 2023, after reaching reservoir elevation 2974.0 (2975.0 is the top of conservation and 2977.25 is the spillway crest elevation). The reservoir elevation was at 2,974.18 and inflows were approximately 300 $ft^3/s$. The Belle Fourche Irrigation District was releasing 100 $ft^3/s$ from North Canal and 100 $ft^3/s$ from South Canal for a total release of 200 $ft^3/s$.

The highest elevation for 2023 was 2974.77 on June 24, 2023. Normal operations were resumed on August 17, 2023, after reaching reservoir elevation 2972.81 and low precipitation forecasted. The Belle Fourche Irrigation District was making irrigation deliveries to North Canal and South Canal for a combined release of 410 $ft^3/s$. Inflows were approximately 175 $ft^3/s$.

Belle Fourche Road Maintenance Contract No. 140R6023C0003 was awarded to Bachman Construction LLC in 2023 with a base year and four option years. The total amount of the contract with all option years is $260,860.00. The contract includes watering, scarifying, blading, and mowing road shoulders for approximately 15.5 miles of government managed gravel roads and two gravel parking areas at Belle Fourche Reservoir six times per year during the summer recreation seasons. It also includes loading, delivering, and dressing government supplied gravel as needed. This contract will extend into FY2024.

## Monthly Statistics for WY2023

Record and near record monthly inflows in 72 years of record keeping were recorded in the following months: August had its fifth highest inflow and September had its seventh highest inflow.

Record and near record monthly end of month content in 72 years of record keeping were recorded in the following months: July had its eighth highest storage; August had its fourth highest storage, and September had its second highest storage.

Additional statistical information on Belle Fourche Reservoir and its operations during WY2023 can be found in table 92 and figure 44.

Table 92.—DKT - Belle Fourche Reservoir

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 2,927.00 | 3,083 | 3,083 |
| Top of active conservation | 2,975.00 | 172,873 | 169,790 |
| Top of joint use | | | |
| Top of exclusive flood control | | | |

| Storage-elevation data | Elevation (ft) | Storage (af) | Date (end-of-day) |
|---|---|---|---|
| Beginning of year | 2,963.19 | 91,970 | Sep 30, 2022 |
| End of year | 2,971.05 | 142,498 | Sep 30, 2023 |
| Annual low | 2,963.24 | 92,250 | Oct 01, 2022 |
| Annual high | 2,974.77 | 171,029 | June 24, 2023 |
| Historic high | 2,975.92 | 196,792 | May 30, 1996 |

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 132,954 | Oct '22–Sep '23 | 82,426 | Oct '22–Sep '23 |
| Daily peak ($ft^3/s$) | 1,625 | Aug 30, 2023 | 560 | Aug 01, 2023 |
| Daily minimum ($ft^3/s$) | -719* | June 14, 2023 | 0 | Oct 01, 2022 |

| | Inflow | | Outflow | | EOM content** | |
|---|---|---|---|---|---|---|
| Month | AF | Percent of avg | AF | Percent of avg | AF | Percent of avg |
| October | 6,938 | 67 | 0 | 0 | 98,908 | 128 |
| November | 8,435 | 87 | 0 | 0 | 107,343 | 124 |
| December | 8,867 | 101 | 0 | 0 | 116,210 | 122 |
| January | 10,763 | 121 | 0 | 0 | 126,973 | 122 |
| February | 10,286 | 110 | 0 | 0 | 137,259 | 122 |
| March | 14,552 | 93 | 0 | 0 | 151,811 | 118 |
| April | 11,856 | 86 | 0 | 0 | 163,667 | 116 |
| May | 16,895 | 116 | 10,890 | 143 | 169,672 | 114 |
| June | 13,388 | 116 | 12,351 | 74 | 170,709 | 119 |
| July | 9,059 | 230 | 19,919 | 56 | 159,849 | 143 |
| August | 11,262 | 386 | 25,515 | 74 | 145,596 | 181 |
| September | 10,652 | 207 | 13,750 | 80 | 142,498 | 208 |
| Annual | 132,953 | 116 | 82,425 | 73 | | |
| April–July | 51,198 | 117 | | | | |

* Frequently observed during fall and winter months

** EOM Content – End of Month Content

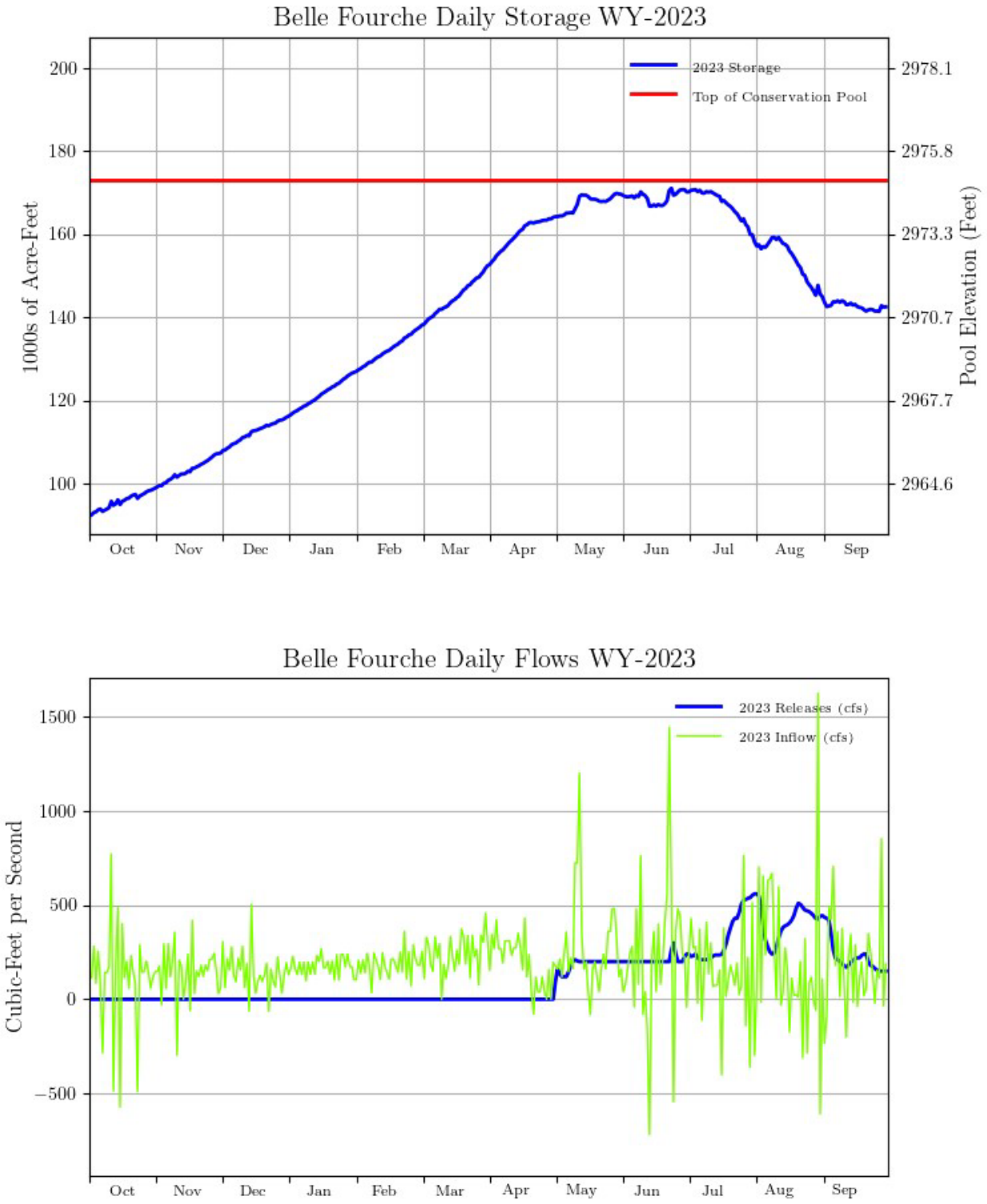



**Figure 44.—DKG - Belle Fourche Reservoir.**

# Deerfield Reservoir

## Background

Deerfield Reservoir is located on Castle Creek, a tributary of Rapid Creek above Rapid City. Deerfield Reservoir (Rapid Valley Project) and Pactola Reservoir (Rapid Valley Unit, P S MBP), furnish a supplemental irrigation supply to about 8,900 acres in the Rapid Valley Water Conservancy District (District) and furnish replacement water for a portion of the water used from Rapid Creek by Rapid City. A contract is in place between the United States, Rapid City, South Dakota, and the district for the storage space at Deerfield Reservoir. The majority of prior rights to the flows of Rapid Creek during the irrigation season is held by individuals and ditch companies in the Rapid Valley Water Conservancy District.

In 1985 Deerfield Dam was modified to accommodate a larger flood as determined from the results of the Probable Maximum Flood analysis. These modifications consisted of raising the crest of the dam 38 feet, excavating an unlined auxiliary spillway, removing, and filling in the old spillway, and extending the existing emergency gate passageway to the new control house at the higher crest elevation. The reservoir has a total capacity of 15,654 AF with an additional 26,657 AF of surcharge capacity.

During the winter of 1995–1996 the hollow jet valves were removed to allow the installation of the jet flow valves as part of the outlet works modification contract. The work was done to improve fish habitat in one and a half miles of the creek immediately downstream of the dam. The stream improvement project was a cooperative effort accomplished by the City of Rapid City, Rapid Valley Water Conservancy District, Black Hills Fly Fishers, Bureau of Reclamation, US Forest Service, and SD Game Fish and Parks. The project modified the outlet works of Deerfield Dam by installing Jet Flow Gates to allow greater minimum winter releases than the six-inch bypass can provide.

## WY2023 Operations Summary

Deerfield Reservoir started WY2023 at elevation 5907.30 feet and with a storage of 15,369 AF, which is 0.70 feet to full and 285 AF below the top of the conservation pool. Precipitation for WY2023 was 22.62 inches which is 111 percent of average. Inflows for WY2023 totaled 12,442 AF (118 percent of average). Peak inflows occurred in June, totaling 1,926 AF for the month. The peak reservoir elevation for WY2023 was 5908.63 feet, storage of 15,933 AF and occurred on July 1, 2023. The minimum elevation for WY2023 was 5905.70 feet, storage of 14,706 AF, and occurred on March 16, 2023. WY2023 ended at elevation 5906.53 feet and with a storage of 15,048 AF, which is 1.47 feet to full and 606 AF below the top of the conservation pool. Deerfield ended the water year with 14,897 AF in active storage.

Natural flows in Rapid Creek were above average throughout the water season. Rapid Valley Conservation District and the City of Rapid City did not need to order water from either Deerfield or Pactola reservoirs in 2023 since there were enough natural flows to meet the water demands.

Emergency Action Plan Orientation Meeting was held on April 18, 2023.

A Periodic Facility Review (PFR) was performed May 3, 2023. There are no incomplete SOD recommendations.

No dam safety related incidents occurred in 2023.

Deerfield Reservoir entered Internal Alert on June 30, 2023, with reservoir elevation 5908.55 and inflows of 125 $ft^3/s$ due to approximately three to four inches of rain precipitation in the drainage area above the reservoir during the prior day. The City of Rapid City was releasing approximately 75 $ft^3/s$ through the river outlet works. The USGS stream gage located downstream of the outlet works was reading 85 $ft^3/s$ due to local drainage runoff from saturated conditions. Safe channel capacity downstream is 90 $ft^3/s$ so the release was kept within those guidelines. The highest elevation for 2023 was 5908.63 on July 1, 2023. Normal operations were resumed on July 19, 2023, with a reservoir elevation of 5906.86 and releases matching inflows of approximately 25 $ft^3/s$.

No construction contracts occurred at Deerfield Dam in 2023.

## Monthly Statistics for WY2023

Record and near record monthly inflows in 71 years of record keeping were recorded in the following months: July had its sixth highest inflow, and September had its eighth highest inflow.

Record and near record monthly end of month content in 71 years of record keeping were recorded in the following months: October had its tenth highest storage, and June had its highest ever storage.

Additional statistical information on Deerfield Reservoir and its operations during WY2023 can be found in table 93 and figure 45.

Table 93.—DKT - Hydrologic data for Water Year 2023 Deerfield Reservoir

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 5839.00 | 151 | 151 |
| Top of active conservation | 5908.00 | 15,654 | 15,503 |
| Top of joint use | | | |
| Top of exclusive flood control | | | |

| Storage-elevation data | Elevation (ft) | Storage (AF) | Date (end-of-day) |
|---|---|---|---|
| Beginning of year | 5907.30 | 15,369 | Sep 30, 2022 |
| End of year | 5906.53 | 15,048 | Sep 30, 2023 |
| Annual low | 5905.70 | 14,076 | Mar 16, 2023 |
| Annual high | 5908.63 | 15,933 | July 01, 2023 |
| Historic high | 5909.05 | 16,157 | Feb 25, 1985 |

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 12,441 | Oct '22–Sep '23 | 12,762 | Oct '22–Sep '23 |
| Daily peak ($ft^3/s$) | 133 | June 29, 2023 | 81 | July 01, 2023 |
| Daily minimum ($ft^3/s$) | -162* | Aug 15, 2023 | 12 | Dec 26, 2022 |

| | Inflow | | Outflow | | EOM content** | |
|---|---|---|---|---|---|---|
| Month | AF | Percent of avg | AF | Percent of avg | AF | Percent of avg |
| October | 753 | 105 | 1,045 | 129 | 15,077 | 117 |
| November | 683 | 106 | 878 | 188 | 14,882 | 114 |
| December | 747 | 111 | 796 | 187 | 14,833 | 112 |
| January | 734 | 111 | 792 | 189 | 14,775 | 109 |
| February | 692 | 113 | 721 | 175 | 14,746 | 107 |
| March | 873 | 97 | 799 | 123 | 14,820 | 106 |
| April | 1,145 | 93 | 855 | 81 | 15,110 | 107 |
| May | 1,139 | 78 | 947 | 69 | 15,302 | 107 |
| June | 1,926 | 149 | 1,312 | 99 | 15,916 | 112 |
| July | 1,942 | 203 | 2,655 | 223 | 15,193 | 109 |
| August | 728 | 98 | 1,179 | 98 | 14,742 | 109 |
| September | 1,080 | 163 | 774 | 68 | 15,048 | 116 |
| Annual | 12,442 | 118 | 12,763 | 122 | | |
| April–July | 6,152 | 125 | | | | |

* Frequently observed during fall and winter months

** EOM Content – End of Month Content

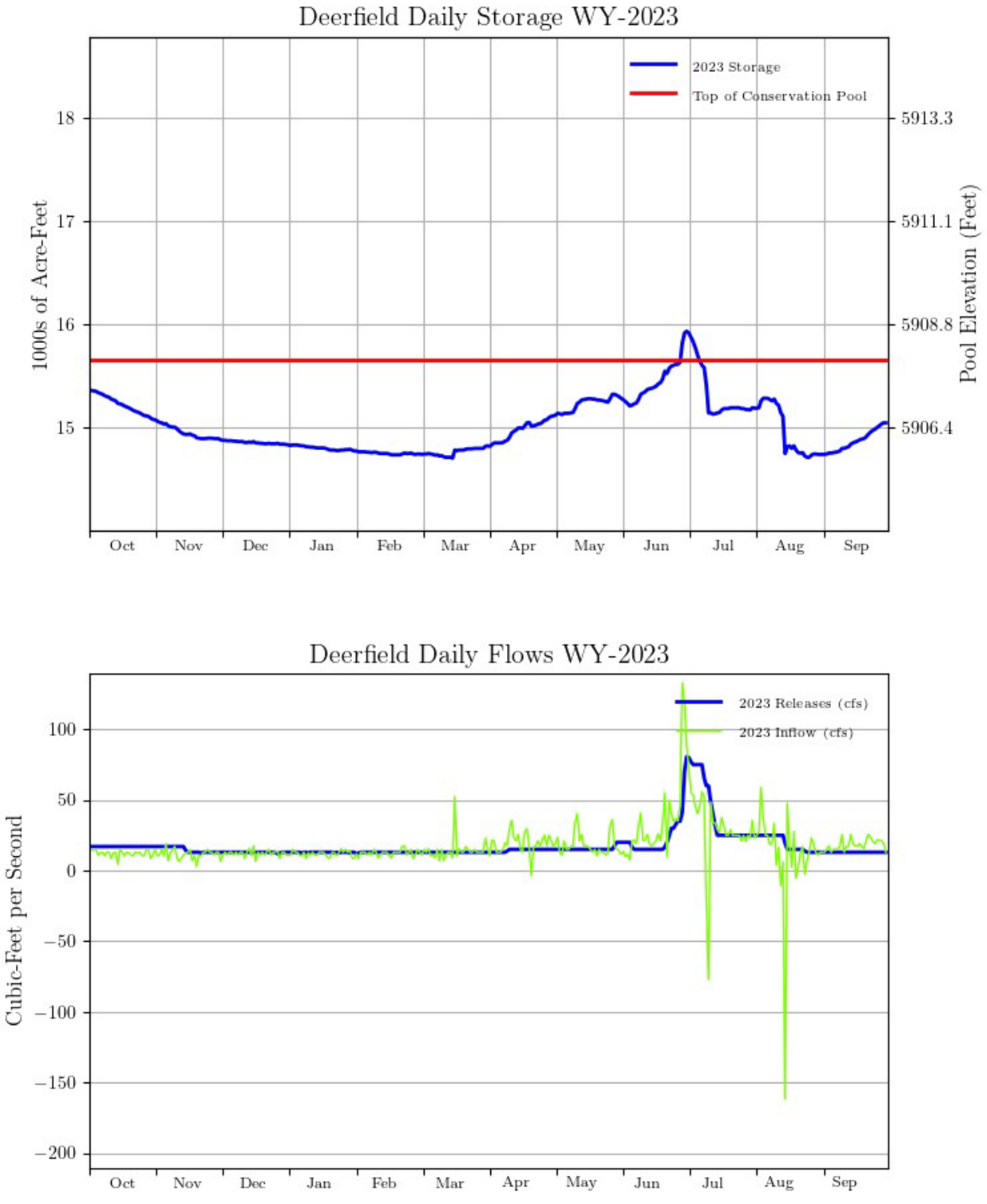



Figure 45.—DKG - Deerfield Reservoir.

# Keyhole Reservoir

## Background

Keyhole Reservoir (P-S MBP) located on the Belle Fourche River below Moorcroft, Wyoming, has a conservation capacity of 188,671 AF (182,079 AF active) and 140,463 AF of exclusive flood control space. It was constructed to furnish a supplemental irrigation supply to 57,000 acres in the Belle Fourche Project and for flood control. Keyhole Reservoir is subject to the Belle Fourche River Compact, and the inflows and storage in the reservoir are allocated ten percent to Wyoming users and ninety percent to South Dakota users, subject to prior rights. On January 3, 1963, the Belle Fourche Irrigation District executed a long-term contract for the use of 7.7 percent of active storage space in the reservoir. This space will be used to store water belonging to the irrigation district under its prior water right along with the district's pro rata share of storable inflows to Keyhole Reservoir. On January 1, 1985, the Crook County Irrigation District's contract for 18,080 AF of space in Keyhole Reservoir became effective. The allocated space is used by each organization to store its pro rata share of inflows to Keyhole Reservoir. The flood control space at Keyhole Reservoir is all located above an ungated spillway. The spillway capacity is 11,000 $ft^3/s$ at maximum water surface elevation. The downstream safe channel capacity is 3,000 $ft^3/s$. Formulas for forecasting inflows have not been developed. Research by the Soil Conservation Service during WY1992 through 1994 show that inflow forecasting to Keyhole Reservoir is not reliable since there is no consistent snowpack and precipitation is highly cyclical. No further efforts to develop forecast models are planned.

Reclamation's Sedimentation and River Hydraulics Group of the Technical Service Center in Denver conducted a sedimentation survey of Keyhole Reservoir, in 2003. The sedimentation surveyor provided a survey report which included the new Area and Capacity Tables, in July of 2005. The previous survey was done in 1978. Keyhole Reservoir accumulated 5,082 AF of sediment since the previous survey. Since construction in 1952, Keyhole has accumulated 12,495 AF of sediment. The sedimentation rate from 1952 through 2003 has averaged 240 AF per year. The new Area and Capacity Tables were first used in WY2006.

## WY2023 Operations Summary

Keyhole Reservoir started WY2023 at elevation 4,090.62 feet and storage of 119,643 AF, which is 8.68 feet and 69,028 AF below the top of the conservation pool. Precipitation for WY2023 was 18.33 inches which was 102 percent of average. Inflows for WY2023 totaled 10,521 AF (64 percent of average). Peak inflows occurred in March, totaling 7,357 AF for the month. The peak reservoir elevation for WY2023 was 4092.78 feet, storage of 134,433 AF, which occurred on July 11, 2023. The minimum elevation for WY2023 was 4,090.28 feet, storage of 117,459 AF, which occurred on November 22, 2022. WY2023 ended at elevation 4092.18 feet and storage of 130,164 AF, which is 7.12 feet and 58,507 AF below the top of the conservation pool. Keyhole Reservoir ended the water year with 123,572 AF in active storage.

There were no irrigation releases by Crook County Irrigation District and Belle Fourche Irrigation District (BFID) in WY2023.

An Emergency Management/Security Tabletop Exercise was held March 29, 2023.

The ASI of Keyhole was conducted on July 18, 2023. There are no incomplete SOD recommendations.

No dam safety related incidents occurred at Keyhole in 2023.

There were no construction contracts at Keyhole in 2023.

## Monthly Statistics for WY2023

Record and near record monthly inflows in 72 years of record keeping were recorded in the following months: No inflow records were set in 2023.

Record and near record monthly end of month content in 72 years of record keeping were recorded in the following months: No storage records were set in 2023.

Additional statistical information on Keyhole Reservoir and its operations during WY2023 can be found in table 94 and figure 46.

Table 94.—DKT - Hydrologic data for 2023 Keyhole Reservoir

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 4051.00 | 6,592 | 6,592 |
| Top of active conservation | 4099.30 | 188,671 | 182,079 |
| Top of joint use | | | |
| Top of exclusive flood control | 4111.50 | 329,134 | 140,463 |

| Storage-elevation data | Elevation (ft) | Storage (AF) | Date (end-of-day) |
|---|---|---|---|
| Beginning of year | 4090.62 | 119,643 | Sep 30, 2022 |
| End of year | 4092.18 | 130,164 | Sep 30, 2023 |
| Annual low | 4090.28 | 117,459 | Nov 22, 2022 |
| Annual high | 4092.90 | 134,433 | July 11, 2023 |
| Historic high | 4100.38 | 210,222 | May 21, 1978 |

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 10,521 | Oct '22–Sep '23 | 0 | Oct '22–Sep '23 |
| Daily peak ($ft^3/s$) | 659 | Mar 16, 2023 | 0 | Oct 01, 2022 |
| Daily minimum ($ft^3/s$) | -290* | July 25, 2023 | 0 | Oct 01, 2022 |

| | Inflow | | Outflow | | EOM content** | |
|---|---|---|---|---|---|---|
| Month | AF | Percent of avg | AF | Percent of avg | AF | Percent of avg |
| October | -1,547 | 392 | 0 | 0 | 118,096 | 120 |
| November | -573 | 180 | 0 | 0 | 117,523 | 120 |
| December | 127 | 68 | 0 | 0 | 117,650 | 120 |
| January | 510 | 102 | 0 | 0 | 118,160118,8 | 120 |
| February | 707 | 27 | 0 | 0 | 67 | 118 |
| March | 7,357 | 93 | 0 | 0 | 126,224 | 117 |
| April | 1,990 | 81 | 0 | 0 | 128,214 | 119 |
| May | 3,571 | 74 | 0 | 0 | 131,785 | 119 |
| June | 2,071 | 68 | 0 | 0 | 133,856 | 120 |
| July | -1,145 | 128 | 0 | 0 | 132,711 | 124 |
| August | -1,632 | 86 | 0 | 0 | 131,079 | 129 |
| September | -915 | 53 | 0 | 0 | 130,164 | 131 |
| Annual | 10,521 | 64 | 0 | 0 | | |
| April–July | 6,487 | 69 | | | | |

* Frequently observed during fall and winter months
** EOM Content – End of Month Content

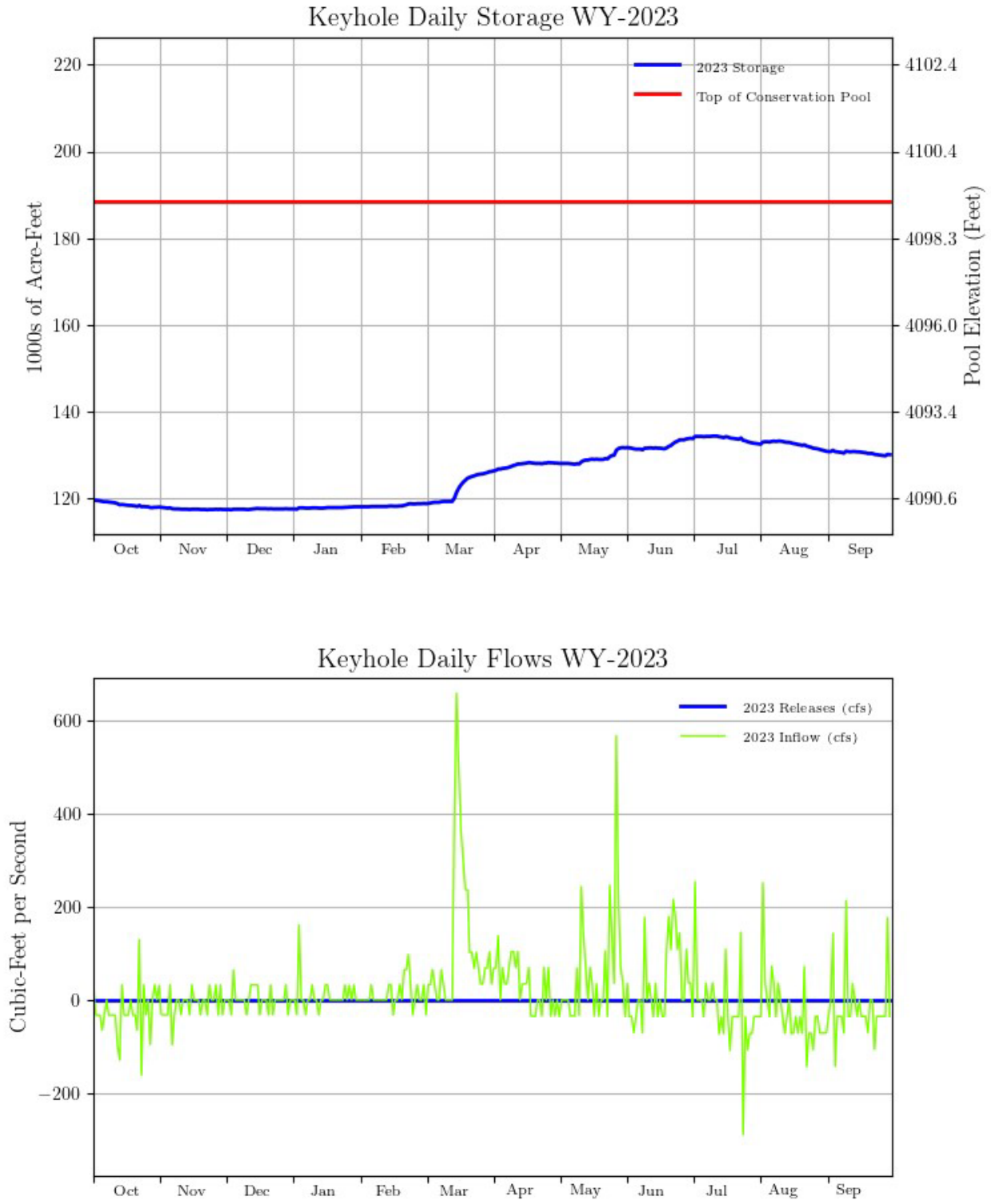



Figure 46.—DKG - Keyhole Reservoir.

# Pactola Reservoir

## Background

Pactola Reservoir, Rapid Valley Unit (P-S MBP), located on Rapid Creek above Rapid City, South Dakota, acts in conjunction with Deerfield Reservoir, Rapid Valley Project, to furnish a supplemental irrigation supply to about 8,900 acres in the Rapid Valley Water Conservancy District, replacement water for Rapid City, and a supply of domestic water for private water systems both above and below the city. The reservoir is also operated to provide flood control. It has a conservation capacity of 55,972 AF (54,955 AF active) and 43,057 AF of exclusive flood control space. The flood control space is all below the ungated spillway crest, and releases in this pool are controlled by the river outlet works. Rapid City has contracts for Pactola and Deerfield Reservoir water. The Rapid Valley Sanitation District and Hisega Meadows Water Inc. also have contracts for water service from Pactola Reservoir. Operation of the two reservoirs is integrated to maintain as much water as possible in the upstream facility, Deerfield Reservoir, and at the same time maintain a uniform outflow from Deerfield to maximize fishery benefits in the stream between the reservoirs. Since no inflow forecasts are available, the reservoir is normally operated as full as possible. Two SNOTEL (North Rapid Creek and Blind Park) sites were installed in the Pactola and Deerfield drainage basin in May of 1990.

As part of the Safety Examination of Existing Structures (Safety of Dams) Program, a study was made in the early 1980s to determine the adequacy of Pactola Dam, Spillway, and Reservoir to safely pass the new Inflow Design Flood (IDF) determined on the basis of present-day hydrologic technology. The studies showed that the facility was not able to safely handle the new IDF. Modification work was completed in 1987 and provided sufficient surcharge storage and spillway capacity to pass the IDF. Modification work consisted of raising the crest of the dam 15 feet, widening the existing rock-cut spillway chute and stilling basin from 240 to 425 feet, relocating Highway 385 to the new dam crest, extending the existing gate access shaft to the higher crest elevation, and reconstructing a new two-level gate control house at the higher crest elevation.

A new long-term storage contract was signed on July 31, 2007, between Reclamation and the city of Rapid City. The contract provides storage space of 49,000 AF for the city and 6,000 AF was retained by Reclamation.

## WY2023 Operations Summary

Pactola Reservoir started WY2023 at elevation 4574.81 feet and with a storage of 51,481 AF, which is 5.39 feet and 2,552 AF below the top of the conservation pool. Precipitation for WY2023 was 24.36 inches which is 118 percent of average. Inflows for WY2023 totaled 41,880 AF (107 percent of average). Peak inflows occurred in July, totaling 9,054 AF for the month. The peak reservoir elevation for WY2023 was 4580.39 feet, storage of 56,139 AF, and occurred on July 8, 2023. The minimum elevation for WY2023 was 4573.23 feet, storage of

50,221 AF, which occurred on December 24, 2022. WY2023 ended at elevation 4,577.18 feet and storage of 53,420 AF, which is 3.02 feet and 2,552 AF below the top of the conservation pool. Pactola Reservoir ended the water year with 52,403 AF in active storage.

Natural flows in Rapid Creek were above average throughout the water season. Rapid Valley Conservation District and the City of Rapid City did not need to order water from either Deerfield or Pactola reservoirs in 2023 since there were enough natural flows to meet the water demands.

An Emergency Action Plan Orientation Meeting was held on April 18, 2023.

A Periodic Facility Review (PFR) was performed May 4, 2023. There is one incomplete SOD recommendation regarding an Issue Evaluation study to understand the risks with static potential failure modes at the dam.

No dam safety related incidents occurred at Pactola Dam during 2023.

Pactola Reservoir entered Internal Alert on July 3, 2023, with a reservoir elevation of 4580.35 and the City of Rapid City making releases of approximately 225 $ft^3/s$ to match inflows. Precipitation in the drainage basin above Pactola increased releases from Deerfield Reservoir which increased the inflows reaching Pactola. The highest elevation for 2023 was 4580.39 on July 8, 2023. Normal operations were resumed on July 19, 2023, with a reservoir elevation of 4579.60 feet, and releases matching inflows of approximately 150 $ft^3/s$.

No construction contracts occurred at Pactola Dam during 2023.

## Monthly Statistics for WY2023

Record and near record monthly inflows in 68 years of record keeping were recorded in the following months: July had its fifth highest inflow and August had its tenth highest inflow.

Record and near record monthly end of month content in 68 years of record keeping were recorded in the following months: August had its seventh highest storage.

Additional statistical information on Pactola Reservoir and its operations during WY2023 can be found in table 95 and figure 47.

Table 95.—DKT - Hydrologic data for Water Year 2023 Pactola Reservoir

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 4456.10 | 1,017 | 1,017 |
| Top of active conservation | 4580.20 | 55,972 | 54,955 |
| Top of joint use | | | |
| Top of exclusive flood control | 4621.50 | 99,029 | 43,057 |

| Storage-elevation data | Elevation (ft) | Storage (af) | Date (end-of-day) |
|---|---|---|---|
| Beginning of year | 4574.81 | 51,481 | Sep 30, 2022 |
| End of year | 4577.18 | 53,420 | Sep 30, 2023 |
| Annual low | 4573.23 | 50,221 | Dec 24, 2023 |
| Annual high | 4580.39 | 56,139 | July 08, 2023 |
| Historic high | 4589.43 | 64,246 | June 29, 2015 |

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 41,879 | Oct '22-Sep '23 | 39,941 | Oct '22-sep '23 |
| Daily peak ($ft^3/s$) | 250 | July 01, 2023 | 229 | July 04, 2023 |
| Daily minimum ($ft^3/s$) | 8 | Dec 01, 2022 | 12 | Dec 01, 2022 |

| | Inflow | | Outflow | | EOM content* | |
|---|---|---|---|---|---|---|
| Month | AF | Percent of avg | AF | Percent of avg | AF | Percent of avg |
| October | 2,266 | 98 | 2,875 | 145 | 50,872 | 111 |
| November | 1,980 | 113 | 2,575 | 161 | 50,277 | 109 |
| December | 1,729 | 115 | 1,722 | 108 | 50,285 | 110 |
| January | 1,899 | 121 | 1,939 | 130 | 50,245 | 109 |
| February | 1,752 | 113 | 1,720 | 128 | 52,277 | 109 |
| March | 2,166 | 84 | 1,897 | 102 | 50,546 | 108 |
| April | 3,750 | 87 | 1,800 | 60 | 52,496 | 109 |
| May | 4,915 | 71 | 2,105 | 37 | 55,306 | 112 |
| June | 5,731 | 80 | 5,096 | 76 | 55,941 | 112 |
| July | 9,054 | 207 | 9,809 | 166 | 55,186 | 114 |
| August | 4,395 | 149 | 4,607 | 108 | 54,974 | 119 |
| September | 2,243 | 97 | 3,797 | 129 | 53,420 | 117 |
| Annual | 41,880 | 107 | 39,942 | 104 | | |
| April–July | 23,450 | 103 | | | | |

* EOM Content – End of Month Content

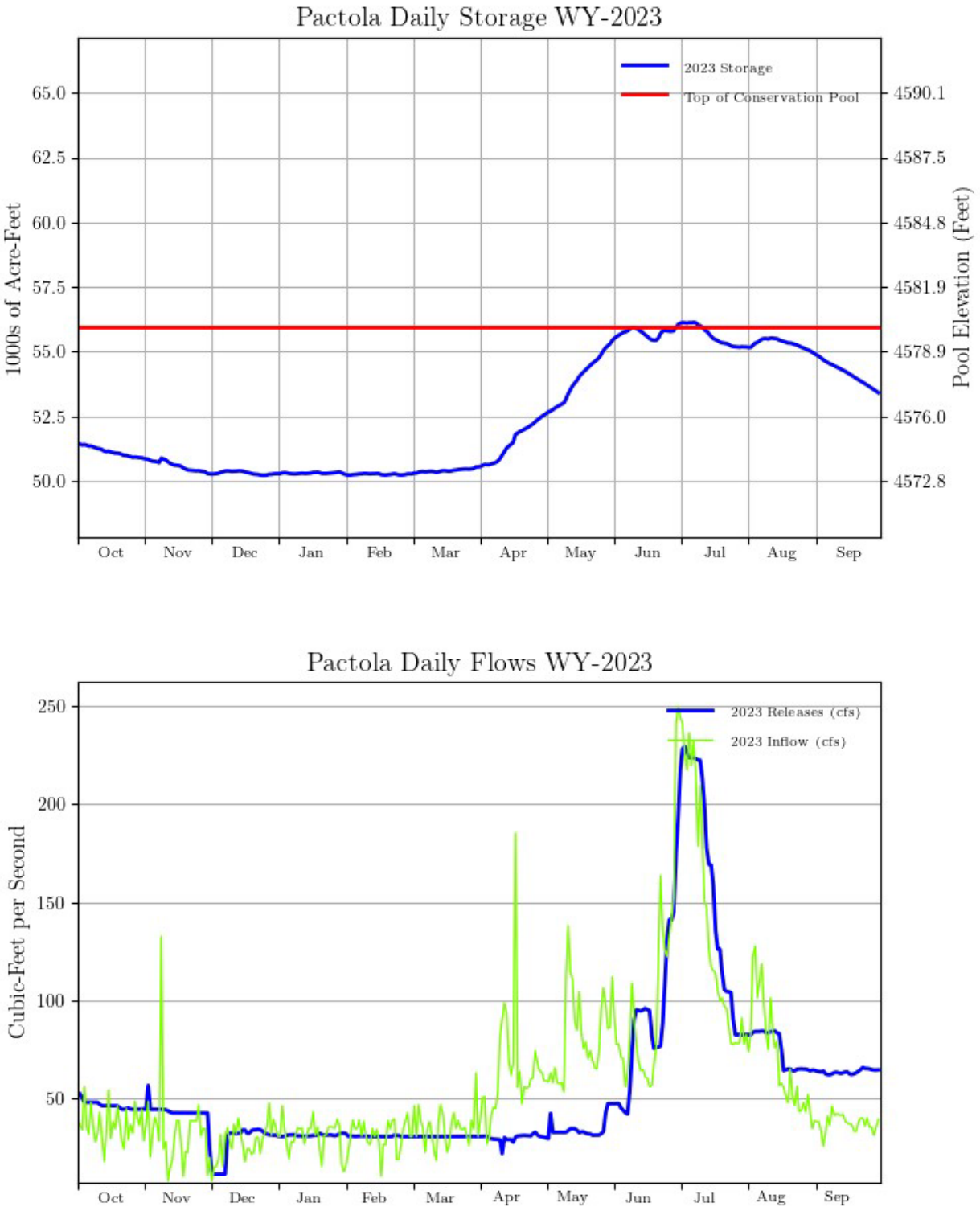



Figure 47.—DKG - Pactola Reservoir.

# Shadehill Reservoir

## Background

Shadehill Reservoir, a feature of the Shadehill Unit (P-S MBP), is located on the Grand River near Shadehill, South Dakota, and was constructed for irrigation of 9,700 acres, and for flood control, recreation, and fish and wildlife purposes. The reservoir has a dead and conservation capacity totaling 120,172 AF with an additional exclusive flood control capacity of 230,004 AF and a surcharge capacity of 119,560 AF. Flood control space is all located above the crest of an un-gated glory-hole spillway. Because of the questionable quality of water, it was decided to postpone construction of distribution works for irrigation.

After further study, it was concluded that water from Shadehill Reservoir can be used for sustained irrigation if certain limitations of soils, leaching water, soil amendments, and drainage are met. A definite plan report covering 6,700 acres which meets these limitations has been completed, approved by the Commissioner, and released for distribution. On December 17, 1963, landowners within the area voted 24 to 21 against formation of an irrigation district. Further action on development of the area was deferred until the landowners were more agreeable. Pending more extensive irrigation development, an additional 51,500 AF of space between elevations 2260 and 2272 was allocated to flood control. Allocations and evacuation of this space was made possible by modification of the outlet works in 1969 to permit a discharge of 600 $ft^3/s$ to the river. In June of 1975, the West River Conservancy Sub-District was formed combining all but one of the old individual contracts for water supply from the reservoir into one. Acreage contracted for by the district was 5,000 acres; however, only 3,064 acres were developed. On March 18, 1986, the contract between Reclamation and the West River Conservancy Sub-District was assigned to the Shadehill Water User District, an organization, which succeeded the Sub-District under South Dakota law. This contract has expired and presently conservation releases are meeting irrigation demands. Should irrigation releases be required a temporary water service contract will need to be executed with the Shadehill Water User District.

Because certain release criteria reduced the effectiveness of flood control operations in the zone between elevation 2260 and 2272, and because the Corps of Engineers has constructed Bowman Haley Reservoir upstream from Shadehill Reservoir with 53,800 AF of flood control space, the Corps requested that the interim flood control agreement be terminated and that responsibility for the operations of Shadehill Reservoir when the pool is between elevations 2260 and 2272 revert to Reclamation. By a revised field working agreement dated May 15, 1972, it was agreed that the space between elevation 2260 and 2272 (51,500 AF) be reallocated to conservation use. However, space below elevation 2,272 will continue to be evacuated before the start of the spring runoff, but to a lesser extent than in the past.

## WY2023 Operations Summary

Shadehill Reservoir started WY2023 at elevation 2266.02 feet and with a storage of 92,565 AF, which is 5.98 feet and 27,607 AF below the top of the conservation pool. Precipitation for WY2023 was 21.97 inches which was 123 percent of average. Inflows for WY2023 totaled 38,983 AF (53 percent of average). Peak inflows occurred in April, totaling 15,826 AF for the month. The peak reservoir elevation for WY2023 was 2271.87 feet, storage of 119,521 AF, and occurred on July 26, 2023. The minimum elevation for WY2023 was 2264.74 feet, storage of 87,282 AF, and occurred on February 23, 2023. WY2023 ended at elevation 2271.19 feet and storage of 116,151 AF, which is 0.81 feet and 4,021 AF below the top of the conservation pool. Shadehill Reservoir ended the water year with 72,282 AF in active storage.

All irrigation demands were met from river maintenance releases. There were no storage releases for irrigation needed during WY2023.

An Emergency Action Plan Orientation Meeting was held on April 13, 2023.

An ASI for Shadehill Dam was conducted on June 14, 2023. There was one SOD recommendation to permanently abandon the hydraulic piezometer terminal well at Shadehill Dam by backfilling with ASTM C33 concrete sand. This recommendation was completed in 2023.

No dam safety related incidents occurred at Shadehill in 2023.

No construction contracts occurred at Shadehill in 2023.

## Monthly Statistics for WY2023

Record and near record monthly inflows in 72 years of record keeping were recorded in the following months: November had its ninth lowest inflow.

Record and near record monthly end of month content in 72 years of record keeping were recorded in the following months: No storage records were achieved.

Additional statistical information on Shadehill Reservoir and its operations during WY2023 can be found in table 96 and figure 48.

Table 96.—DKT - Hydrologic Data for 2023 Shadehill Reservoir

| Reservoir allocations | Elevation (feet) | Total reservoir storage (AF) | Storage allocation (AF) |
|---|---|---|---|
| Top of inactive and dead | 2250.80 | 43,869 | 43,869 |
| Top of active conservation | 2272.00 | 120,172 | 76,303 |
| Top of exclusive flood control | 2,302.00 | 350,176 | 230,004 |

| Storage-elevation data | Elevation (ft) | Storage (AF) | Date (end-of-day) |
|---|---|---|---|
| Beginning of year | 2266.02 | 92,565 | Sep 30, 2022 |
| End of year | 2271.19 | 116,151 | Sep 30, 2023 |
| Annual low | 2264.74 | 87,282 | Feb 23, 2023 |
| Annual high | 2271.87 | 119,521 | July 26, 2023 |
| Historic high | 2297.90 | 318,438 | April 10, 1952 |

| Inflow-outflow data | Inflow | Date | Outflow | Date |
|---|---|---|---|---|
| Annual total (AF) | 38,983 | Oct '22–Sep '23 | 15,397 | Oct '22–Sep '23 |
| Daily peak ($ft^3/s$) | 762 | May 15, 2023 | 24 | July 06, 2023 |
| Daily minimum ($ft^3/s$) | -167* | Nov 06, 2022 | 0 | May 22, 2023 |

| | Inflow | | Outflow | | EOM content** | |
|---|---|---|---|---|---|---|
| Month | AF | Percent of avg | AF | Percent of avg | AF | Percent of avg |
| October | -895 | -71 | 1,237 | 32 | 90,433 | 84 |
| November | -417 | -47 | 1,189 | 36 | 88,827 | 84 |
| December | 886 | 117 | 1,213 | 48 | 88,500 | 85 |
| January | 387 | 43 | 1,200 | 51 | 87,687 | 85 |
| February | 1,083 | 34 | 1,083 | 52 | 87,687 | 85 |
| March | 4,075 | 17 | 1,204 | 11 | 90,558 | 77 |
| April | 15,826 | 80 | 1,261 | 7 | 105,123 | 88 |
| May | 11,842 | 108 | 1,255 | 13 | 115,710 | 96 |
| June | 2,922 | 33 | 1,398 | 17 | 117,234 | 97 |
| July | 3,311 | 98 | 1,474 | 28 | 119,071 | 100 |
| August | 481 | 169 | 1,475 | 36 | 118,077 | 102 |
| September | -518 | 1,400 | 1,408 | 40 | 116,151 | 104 |
| Annual | 38,983 | 53 | 15,397 | 21 | | |
| April–July | 33,901 | 79 | | | | |

* Frequently observed during fall and winter months
** EOM Content – End of Month Content

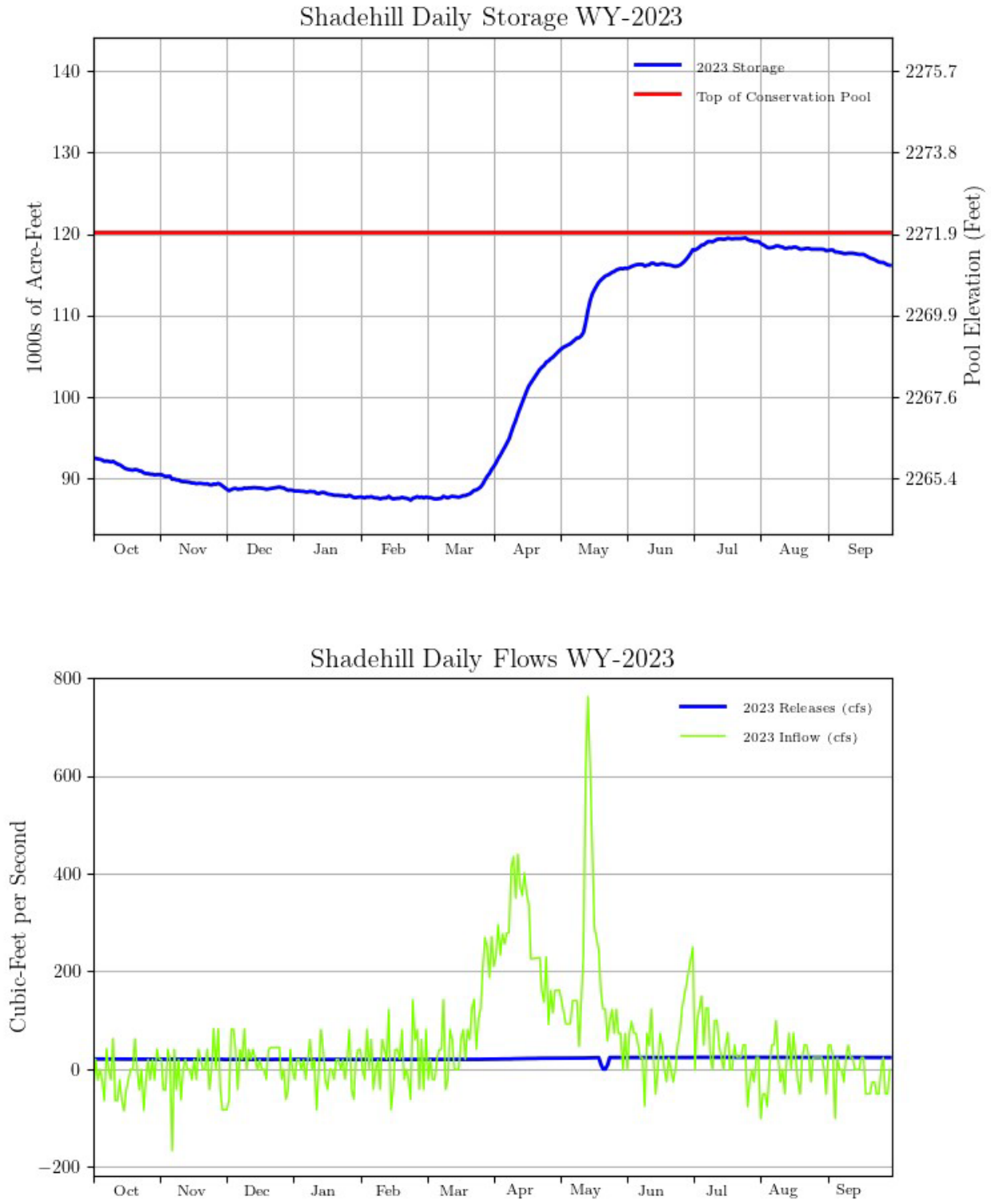



**Figure 48.—DKG - Shadehill Reservoir.**

# Outlook And Operating Plans for Water Year 2024 for Reservoirs Under the Responsibility of the Dakotas Area Office

## E.A. Patterson, Heart Butte, Jamestown, Angostura, Belle Fourche, Deerfield, Keyhole, Pactola, and Shadehill

# Operating Plans for WY2024

## Dickinson Reservoir

Dickinson Reservoir (E. A. Patterson Reservoir) ended WY2023 at elevation of 2419.39 with a storage of 7,771 AF, which is 0.61 feet and 708 AF below the top of the active conservation pool (elevation 2,420.00 at 8,479 AF).

The reservoir is normally operated as full as possible at all times. Excess water will be released by spilling over the Bascule gate after the reservoir has filled, and by gated releases through the 24-inch river outlet valve. No releases are planned until irrigation water is required or if the spring runoff deems it necessary for flood protection.

## Heart Butte Reservoir

Heart Butte Reservoir (Lake Tschida Reservoir) ended WY2023 at elevation 2062.30 with a storage of 58,456 AF, which is 2.20 feet and 6,635 AF below the top of the active conservation pool (elevation 2064.50 at 65,091 AF).

Since there are no accurate inflow forecasts available, plans are to operate the reservoir as close to the top of the conservation pool as possible while regulating releases required, maintaining downstream conservation commitments, and preserving flood control space. During winter months, and when the reservoir level is below the spillway crest at elevation 2064.50, the river releases will be maintained at about ten $ft^3/s$ to ensure a live stream flow below Heart Butte Dam. This will continue through the winter until the spring runoff requires higher releases sometime in late March or early April. Excess water is released only when the reservoir is full or ensured of filling.

# Jamestown Reservoir

Jamestown Reservoir ended WY2023 at elevation 1431.23 and storage of 31,032 AF, which is 0.32 feet and 544 AF above the top of the joint use pool (elevation 1431.00 at 30,488 AF). Water releases will be shut off when the reservoir elevation reaches approximately 1429.60 and will continue shut throughout the winter until spring runoff requires releases to be made for flood protection. The reservoir is normally operated under the following criteria and limitations set forth in the Field Working Agreement between the Corps and Reclamation that reads:

## Flood Control Regulation of Joint-Use Pool - Jamestown Reservoir

The joint space between elevations 1428 and 1431 will be used for seasonal multipurpose regulation. For purposes of flood control storage, the reservoir water elevation will be no higher than 1429.8 at the beginning of spring runoff period. That portion of the joint-use pool between elevations 1429.8 and 1431.0 will be used for storage and regulation of the spring runoff and summer rainstorms. In addition, water stored in this zone may be used during the summer months for conservation purposes. Storage remaining in the joint-use pool above elevation 1429.8 feet. msl after September 1 will be evacuated as directed by the Corps of Engineers.

The Bureau has the option of lowering the reservoir below elevation 1429.8 feet msl should it be desirable based on water supply needs. There are no requirements for maintaining a specified minimum reservoir release.

Season: Beginning of spring runoff to September 1

Elevation 1429.80 (base of flood control zone) to Elevation 1431.00 (top of joint use pool).

Release greater of:

1. Conservation releases.
2. Based on inflows occurring at the time and the existing potential for further inflows, releases will be maintained as necessary to result in a pool elevation of 1431 at the time inflows cease.

Season: September 1 through November 1

Make releases necessary to evacuate reservoir to elevation 1429.80 prior to November 1.

Season: November 1 to beginning of spring runoff

Make releases necessary to maintain elevation 1429.80.

## Angostura Reservoir

Angostura Reservoir ended WY2023 at elevation 3180.03 feet, and storage of 92,889 AF, which is 7.17 feet and 30,159 AF below the top of the conservation (elevation 3187.2 at 123,048 AF).

Since Angostura Reservoir is the principal source of water for the Angostura Irrigation District and no accurate inflow forecasts are available for this reservoir, it is always operated as full as possible. Water may be released from the facility if the reservoir is expected to fill to meet irrigation demands; ergo, excess water is released through the spillway when the reservoir is nearly full and assured of filling.

Releases are made from Angostura Reservoir for flood control or irrigation requirements. Flood control releases are not expected unless precipitation events occur to fill the reservoir.

## Belle Fourche Reservoir

Belle Fourche Reservoir ended WY2023 at elevation 2971.05 feet and storage of 142,498 AF, which is 2.95 feet and 30,375 AF below the top of the conservation (elevation 2975.0 at 172,873 AF).

Normal operation at the Diversion Dam during the winter is to maintain flows in the Inlet Canal to store water in Belle Fourche Reservoir. A bypass of five $ft^3/s$ is made at the Belle Fourche Diversion Dam to provide flows for domestic use between the diversion dam and the Belle Fourche River confluence with Owl Creek. No releases from the reservoir are planned until irrigation begins in the spring. When the volume of water supply available from the reservoir can be estimated in May or June, the Belle Fourche Irrigation District will establish allotments of water to each irrigator and the storage will be used accordingly. The Standing Operating Procedures for Belle Fourche Dam limit the maximum drawdown of the reservoir to 0.3 feet per day as established in the 1984 Safety Evaluation of Existing Dams report.

Higher rates of drawdown are acceptable if the total drawdown is limited to 20 feet. This restriction will affect delivery rates to water users in the late summer if the reservoir does not fill. At low reservoir levels, the draw down rate becomes the governing factor for releases.

## Deerfield Reservoir

Deerfield Reservoir ended WY2023 at elevation 5906.53 feet and with a storage of 15,048 AF, which is 1.47 feet and 606 AF below the top of the conservation (elevation 5908 feet at 15,654 AF).

The reservoir winter draw down was at 15,348 AF on December 1, 2023. A target of 15,000 AF of storage by March 1 will usually dictate the winter release, which is set near December 1. The winter release is set based on water usage from Deerfield by the Rapid Valley Water Conservancy District (District) and the storage target of 15,000 AF by March 1. The goal is to be near full by May 1 which is the start of the irrigation season.

The Rapid Valley Water Conservancy District did not order water from Deerfield for irrigation in WY2023. The City of Rapid City did not release water from Deerfield for municipal use in WY2023.

A release of around 13 $ft^3/s$ will be maintained until the spring runoff requires higher releases in late March or early April. Excess water is normally released only when the reservoir is full or assured of filling. Since no inflow forecasts are available, the reservoir is normally operated as full as possible. Two SNOTEL sites (North Rapid Creek and Blind Park) are operated in the Pactola and Deerfield drainage basin. Deerfield storage may be required to meet District irrigation needs in WY2024.

The jet flow gates are used for winter releases and provide minimum stream flows of 6 $ft^3/s$ or more which will enhance winter fishery conditions in Castle Creek and improve fishery production conditions in the stream.

Storage at the end of water year will depend on the amount of inflow to the Pactola-Deerfield system and the need for project water deliveries from Deerfield Reservoir. During average and above average inflow years, summer releases will be made to bring the reservoir storage to about 14,900 AF by September 30. This is to accommodate minimum releases of six $ft^3/s$ into Castle Creek during the winter. The actual release will depend on runoff conditions and will consider downstream ice conditions in Castle Creek.

## Keyhole Reservoir

Keyhole Reservoir ended WY2023 at elevation 4092.18 feet and storage of 130,164 AF, which is 7.12 feet and 58,507 AF below the top of conservation (elevation 4099.3 at 188,671 AF).

Releases from Keyhole Reservoir are made for either irrigation requirements or flood control. Releases are not anticipated from the reservoir from October–May. Flood control releases are not expected unless extreme precipitation events occur to fill the reservoir.

Discharges from toe drains of the dam and downstream inflows normally satisfy downstream requirements for stock water and other minor uses during this period. Releases from storage accounts will be made during the summer in response to irrigation demand from the Belle Fourche Irrigation District in South Dakota and the Crook County Irrigation District in Wyoming. Each organization maintains a storage account in Keyhole Reservoir and the contract with the Belle Fourche Irrigation District also includes provisions for the annual purchase of

additional unsold South Dakota storage. Peak irrigation demand releases are normally between 125 and 175 $ft^3/s$.
The Belle Fourche Irrigation District has lands along the inlet canal that during drought conditions can depend entirely on Keyhole Reservoir for storage. These lands are served with flows from the Belle Fourche River and storage from Keyhole. Additionally, water contracted by Belle Fourche Irrigation District may be released from Keyhole Reservoir to supplement storage in Belle Fourche Reservoir if necessary. Finally, Crook Country Irrigation District also contracts irrigation water from Keyhole Reservoir.

## Pactola Reservoir

Pactola Reservoir ended WY2023 at elevation 4577.18 ft and storage of 53,420 AF, which is 3.02 ft and 2,552 AF below the top of the conservation (elevation 4580.2 at 55,972 AF).

Operating criteria established for the reservoir in the Definite Plan Report called for minimum winter conservation releases to be seven $ft^3/s$ from October 1 to April 15 and 20 $ft^3/s$ from April 15 to October 1, when the reservoir content is below 29,000 AF and releases of 15 $ft^3/s$ from October 1to March 1 and 20 $ft^3/s$ from March 1 through October 1 are established for reservoir content above 29,000 AF. Minimum summer conservation releases are 20 $ft^3/s$ at all reservoir contents.

1. Reservoir content less than 29,000 AF (with no water in the U.S. storage)

    a. October 1–April 15 7 $ft^3/s$
    b. April 15–October 1 20 $ft^3/s$

2. Reservoir content greater than 29,000 AF (with no water in the U.S. storage)

    a. October 1–March 1 15 $ft^3/s$
    b. March 1–October 1 20 $ft^3/s$

Pactola Reservoir is operated as close to the top of the conservation pool as possible, while regulating releases required to maintain a downstream fishery and to preserve flood control space. The new long-term storage contract for Pactola, between Reclamation and the City of Rapid City, was signed on July 31, 2007. New operating criteria for releases to Rapid Creek were established in the Standard Operating Plans. The following minimum releases will be made as long as water is available in the Fisheries, Wildlife, and Recreation Pool.

1. Reservoir content less than 29,000 AF (with water in the U.S. storage)

    a. October 1–April 15 15 $ft^3/s$
    b. April 15–October 1 20 $ft^3/s$

2. Reservoir content greater than 29,000 AF (with water in the U.S. storage)

    a. Year round 20 $ft^3/s$

Although it is not mandatory, if possible Pactola Releases can be adjusted during the summer months to aim for 40 $ft^3/s$ passing the gauging station in Founder's Park. Also, if possible, during the cooler fall months the Bureau aims for 30 to 35 $ft^3/s$ passing the gauging station in Founder's Park. Such releases are dependent on U.S. storage and inflows from the watershed below the dam.

The irrigators need to order flows from storage if their demand limits natural flows past Farmingdale to less than 10 $ft^3/s$. Also, the Bureau of Reclamation has an instream flow right for U.S. storage release flows that is in addition to the 10 $ft^3/s$ minimum required by the state for natural flows past Farmingdale.

The winter release for WY2024 is approximately 40 $ft^3/s$ and has been coordinated with the City of Rapid City, South Dakota Department of Game, Fish, and Parks, local water users, Forest Service, and Corps of Engineers.

With a reservoir content of 29,000 AF and above, a release of 20 $ft^3/s$ has been specified in the Finding of No Significant Impact for the Environmental Assessment for the Pactola Reservoir Water Service Contact Renewal (FONSI No. DK600-00-03).

Pactola winter releases can be increased by 2 or 3 $ft^3/s$ during extremely cold weather to replace water that is lost in the formation of ice in the creek channel.

Once the channel is covered with ice and snow, which provides insulation for the stream, the releases can be reduced if below average snowpack and inflow conditions indicate a need to conserve storage. During the flood control season, total releases will be controlled between 20 and 1,000 $ft^3/s$. Releases in excess of 200 $ft^3/s$ when storage is below the top of the conservation pool at elevation 4580.20 will be cleared with the USACE. The USACE will issue release orders on a current basis when storage is in the exclusive flood control pool. Contract negotiations with water users at Pactola Reservoir will provide the basis for future reservoir operations.

During the irrigation season of May 1–October 30 sufficient natural flows to meet prior rights of the irrigators will be bypassed through the reservoir. Orders by water users will be released under the provisions of contracts with the water users. Drought conditions that have existed in past years have resulted in conservation measures being initiated by water users. Continuation of water conservation measures will assist in conserving reservoir storage and refilling of the reservoir.

# Shadehill Reservoir

Shadehill Reservoir ended WY2023 at elevation 2271.19 feet and storage of 116,151 AF, which is 0.81 feet and 4,021 AF below the top of the conservation (elevation 2272.0 at 120,172 AF).

The winter release will be maintained at approximately 50 $ft^3/s$ to prepare the reservoir elevation for spring inflows. This release rate will be maintained constant until ice comes out of the channel in the spring to prevent ice jams at crossings. In the spring, after ice comes out of the channel, the release will be adjusted based on inflows and storage in the reservoir. Operation is to fill the reservoir in the spring, maintain a near full reservoir during the summer and position the reservoir in the fall as discussed in the SOP. Releases for irrigation demands will be met by conservation releases.

Shadehill Reservoir releases water year-round to meet minimum basic natural flow requirements of downstream water users which consist primarily of ranchers.

# Summary of Operations for Water Year 2023 for Reservoirs Under the Responsibility of the U.S. Army Corps of Engineers

## Big Bend South Dakota, Fort Peck Montana, Fort Randall South Dakota, Garrison, North Dakota, Gavins Point, Nebraska, and Oahe, South Dakota

# Overview

The Missouri River main stem reservoir system, consisting of six reservoirs located in Montana, North Dakota, South Dakota, and Nebraska provides for the following beneficial uses: flood control, irrigation, navigation, power, municipal and industrial water supply, water quality control, fish and wildlife, and recreation. Based on information from the Corps' 20232024 AOP, the capacity and storage allocations of the main stem system were updated to current values and are shown in table 97 in upstream to downstream order as follows:

**Table 97.—CET - Reservoir storage allocation (1,000 acre-feet)**

| Dam | Permanent | Carryover multiple use | Flood control and multiple use | Exclusive flood control | Storage |
|---|---|---|---|---|---|
| Fort Peck, Montana | 4,088 | 10,700 | 2,704 | 971 | 18,463 |
| Garrison, North Dakota | 4,794 | 12,951 | 4,211 | 1,495 | 23,451 |
| Oahe, South Dakota | 5,315 | 13,353 | 3,208 | 1,107 | 22,983 |
| Big Bend, South Dakota | 1,631 | 0 | 118 | 61 | 1,810 |
| Fort Randall, South Dakota | 1,469 | 1,532 | 1,306 | 986 | 5,293 |
| Gavins Point, Nebraska | 295 | 0 | 79 | 54 | 428 |
| Totals | 17,592 | 38,536 | 11,626 | 4,674 | 72,428 |

Each main stem facility serves a powerplant. The number of generating units and total nameplate capabilities are shown in table 98 below:

**Table 98.—CET - U.S. Army Corps powerplant generating capacity for the main stem Missouri**

| Powerplant | Units | Capacity (kilowatts) |
|---|---|---|
| Fort Peck, MT | 5 | 185,250 |
| Garrison, ND | 5 | 583,300 |
| Oahe, SD | 7 | 786,030 |
| Big Bend, SD | 8 | 517,470 |
| Fort Randall, SD | 8 | 320,000 |
| Gavins Point, NE | 3 | 132,300 |
| Totals | 36 | 2,524,350 |

Main stem system releases are regulated to support the multiple use purposes of the reservoirs. The navigation season on the Missouri River below the dams normally is from late March to late November. Generally, releases from the system for navigation are higher during late summer and fall lowering the system storage. During that time, much of the system's hydropower is generated from the lower most projects. During closure of the navigation season, higher releases are made, and more power is generated from the upstream Fort Peck and Garrison Reservoirs. This offsets the reduced release and generation from the downstream projects during winter closure of the river for navigation. The desired annual target system storage level is 56.1 million AF on the first of March.

Operation of the Missouri River main stem reservoir system provides the following eight beneficial uses: flood control, irrigation, navigation, power, municipal and industrial water supply, water quality control, fish and wildlife, and recreation. Table 99 presents the regulation benefit for most of those uses as recorded in 2022–2023, 2021–2022, and the average. Benefits are defined as the tons of produce shipped, dollars of damages prevented, kilowatt hours of electricity produced, and reservoir elevation and river stages maintained. For the shipping information, estimates also were provided this year which included the sand, gravel, and waterway material shipped. Table 99 shows damages prevented at September 2023 price levels.

**Table 99.—CET - Main Stem Reservoir System comparison of present and past benefits**

| Use of regulated water | Period of use or season | Totals | Totals | Long-Term |
|---|---|---|---|---|
| Navigation[1] | April–December[2] | 0.640 million tons[3] (2023) | 0.543 million tons (2022) | 1.54 million tons[4] |
| Flood damages prevented | October–September | $0.7 billion (2023) | $0.4 billion (2022) | $103.7 billion[5] |
| Energy | August–July | 7.7 billion kWh (Aug. 22-July 23) | 7.5 billion kWh (Aug. 21-July 22) | 9.4 billion kWh[6] |

[1]If sand, gravel, and waterway material are included:
4.788 million tons (2023) (estimated)
4.638 million tons (2022)
6.42 million tons (1967-2023 average)
[2]End of navigation season shortened 3 days in 2022 and extended 0 days in 2023.
[3]2023 tonnages are estimated.
[4]1967 2023 average. Peak tonnage shipped in 1977 (3.336 million tons)
[5]Total damages prevented (1938-2023)
[6]1968 2023 Average

A detailed description of the main stem system operations is presented in annual operating reports prepared by and available for distribution from the U.S. Missouri River Basin Water Management Division, U.S. Army Corps of Engineers, Northwestern Division, Omaha, Nebraska.

# Energy Generation

There are 14 Federal powerplants located in the Upper Missouri River Basin that are currently operating. Eight of the power plants are owned and operated by Reclamation and have a total capacity of 348,100 kilowatts. The other six are owned and operated by the Corps and have a total capacity of 2,524,350. Energy generated by the 14 power plants is marketed by the Department of Energy.

Total generation in the combined system in WY2023 was 9,073.217 million kilowatt hours, 569.644 million kilowatt hours more than in WY2022. A summary of the past ten years of energy generation within the Upper Missouri River Basin is shown in table 100 below.

Table 100.—CET - Reclamation and USACE energy generation (million kilowatt-hours)

| Year | Reclamation | USACE | Total |
|---|---|---|---|
| 2023 | 1,303.438 | 7,769.779 | 9,073.217 |
| 2022 | 1,047.699 | 7,455.874 | 8,503.573 |
| 2021 | 957.399 | 8,873.925 | 9,831.324 |
| 2020 | 1,470.049 | 11,772.247 | 13,242.296 |
| 2019 | 1,488.146 | 12,506.578 | 13,994.724 |
| 2018 | 1,790.992 | 11,355.764 | 13,146.756 |
| 2017 | 1,560.628 | 9,092.514 | 10,653.142 |
| 2016 | 1,164.801 | 7,652.158 | 8,816.959 |
| 2015 | 1,316.344 | 9,323.682 | 10,640.026 |
| 2014 | 1,559.297 | 8,729.714 | 10,289.011 |

A comparison of 2022 and 2023 generation and other data from Missouri Basin Region powerplants is shown in table 101. Tables 102 through 107 show the monthly generation, power releases, and total downstream releases, respectively, for all Federal plants in the Missouri Basin Region. The annual energy generation for each of the last several years for all Reclamation, Corps, and combined plants is shown graphically in figures 49, 51, and 53, respectively. Monthly generation for each month during the past several years is shown graphically in figures 50, 52, and 54.

For a more detailed account of powerplants operation at Reclamation facilities during the year, refer to the 2023 operation summaries. Information on the Corps' powerplants operations can be obtained from the annual operating reports prepared by and available for distribution from the Missouri River Basin Water Management Division, U.S. Army Corps of Engineers, Northwestern Division, Omaha, Nebraska.

**Table 101.—CET - Annual energy production statistics (million Kwh) for WY2023**

| Reclamation Powerplants | Installed Capacity (KW) | Million Kwh Generated 2022 | Million Kwh Generated 2023 | Water Used for Generation (KAF) | Percent of Total Water Released | Kwh per AF | River Release (KAF) | Total Release (KAF) |
|---|---|---|---|---|---|---|---|---|
| Canyon Ferry | 50,000 | 228.835 | 281.454 | 2,420.018 | 66.53 | 116.30 | 3,547.5 | 3,637.5 |
| Pilot Butte[1] | 1,600 | 0.000 | 0.000 | 0.000 | 0.00 | N/A | 143.8 | 143.8 |
| Boysen | 15,000 | 62.162 | 75.017 | 919.329 | 63.54 | 81.60 | 1,447.0 | 1,447.0 |
| Shoshone | 3,000 | 18.128 | 20.293 | 128.580 | 13.23 | 157.82 | | |
| Buffalo Bill | 18,000 | 62.116 | 70.236 | 311.783 | 32.09 | 225.27 | | |
| Heart Mountain | 6,000 | 15.293 | 19.802 | 92.284 | 9.50 | 214.58 | | |
| Spirit Mountain [2] | 4,500 | 15.506 | 16.712 | 162.654 | 16.74 | 102.75 | | |
| Total for Buffalo Bill Reservoir[3] | 31,500 | 111.043 | 127.043 | 695.302 | 71.56 | 182.72 | 751.1 | 971.7 |
| Yellowtail | 250,000 | 645.639 | 780.887 | 2,190.574 | 70.08 | 356.48 | 3,095.9 | 3,125.6 |
| **Subtotal** | **348,100** | **1,047.679** | **1,264.401** | **6,225.223** | **66.75** | **203.11** | **8,985.3** | **9,325.6** |
| Corps of Engineers Powerplants | | | | | | | | |
| Fort Peck | 185,250 | 806.094 | 709.185 | 4,668.00 | 100.00 | 151.92 | 4,668.0 | 4,668.0 |
| Garrison | 583,300 | 1,762.329 | 2,060.960 | 13,982.00 | 100.00 | 147.40 | 13,982.0 | 13,982.0 |
| Oahe | 786,030 | 2,009.844 | 2,040.782 | 14,043.00 | 100.00 | 145.32 | 14,043.0 | 14,043.0 |
| Big Bend | 494,320 | 776.968 | 777.137 | 14,051.00 | 100.00 | 55.31 | 14,051.0 | 14,051.0 |
| Fort Randall | 320,000 | 1,433.603 | 1,450.847 | 14,153.00 | 98.84 | 102.51 | 14,319.0 | 14,319.0 |
| Gavins Point | 132,300 | 667.026 | 730.868 | 15,934.00 | 98.49 | 45.87 | 16,179.0 | 16,179.0 |
| **Subtotal** | **2,501,200** | **7,455.864** | **7,769.779** | **76,831.00** | **99.47** | **101.13** | **77,242.0** | **77,242.0** |
| **Total Missouri Basin** | **2,849,300** | **8,503.543** | **9,034.180** | **83,056.22** | **95.94** | **108.77** | **86,227.3** | **86,567.6** |

[1] River Release and Total Release at Pilot Butte Reservoir is computed inflow to Pilot Butte Reservoir due to the location of the powerplant at inlet of supply canal.

[2] Spirit Mountain Powerplant is used to dissipate energy in the transition from the pressurized portion of the Shoshone Canyon Conduit to the free flow section of the conduit.
Water used for generation at Spirit Mountain Powerplant is then routed to Heart Mountain Canal or used for generation at Heart Mountain Powerplant.

[3] This represents the total for the four separate powerplants at Buffalo Bill Dam.

Table 102.—CET - Monthly generation at Reclamation Power powerplants (million Kwh)

| MONTH | CANYON FERRY | PILOT BUTTE | BOYSEN | HEART MOUNTAIN | SPIRIT MOUNTAIN | BUFFALO BILL | SHOSHONE | YELLOWTAIL | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| **October** | 23.295 | 0.000 | 2.700 | 1.949 | 1.812 | 1.786 | 1.564 | 55.167 | **88.273** |
| **November** | 23.555 | 0.000 | 2.282 | 0.000 | 0.000 | 0.000 | 1.418 | 54.948 | **82.203** |
| **December** | 24.262 | 0.000 | 4.845 | 0.000 | 0.000 | 0.000 | 1.693 | 50.978 | **81.778** |
| **January** | 24.036 | 0.000 | 4.834 | 0.000 | 0.000 | 0.022 | 1.714 | 50.351 | **80.957** |
| **February** | 21.658 | 0.000 | 4.372 | 0.000 | 0.000 | 0.000 | 1.592 | 49.501 | **77.123** |
| **March** | 23.777 | 0.000 | 5.201 | 0.000 | 0.000 | 3.387 | 1.258 | 64.742 | **98.365** |
| **April** | 23.087 | 0.000 | 10.270 | 1.581 | 0.610 | 10.185 | 1.663 | 105.803 | **153.199** |
| **May** | 23.926 | 0.000 | 10.130 | 3.725 | 2.551 | 12.397 | 1.756 | 85.243 | **139.728** |
| **June** | 23.566 | 0.000 | 6.351 | 1.641 | 2.983 | 12.101 | 1.889 | 63.038 | **111.569** |
| **July** | 23.892 | 0.000 | 7.014 | 3.655 | 3.036 | 12.867 | 2.029 | 76.540 | **129.033** |
| **August** | 23.245 | 0.000 | 10.309 | 3.692 | 2.917 | 10.239 | 1.965 | 73.508 | **125.875** |
| **September** | 23.155 | 0.000 | 6.709 | 3.559 | 2.803 | 7.252 | 1.752 | 51.068 | **96.298** |
| **Total** | **281.454** | **0.000** | **75.017** | **19.802** | **16.712** | **70.236** | **20.293** | **780.887** | **1,264.401** |

Table 103.—CET - Water used for power generation (KAF) at Bureau of Reclamation

| WY 2023 Month | Canyon Ferry | Boysen | Pilot Butte | Shoshone | Buffalo Bill | Heart Mountain | Spirit Mountain[1] | Yellowtail | Total |
|---|---|---|---|---|---|---|---|---|---|
| **October** | 202.267 | 29.671 | 0.000 | 12.775 | 12.334 | 8.956 | 17.393 | 149.094 | **432.488** |
| **November** | 205.856 | 26.314 | 0.000 | 11.980 | 0.000 | 0.000 | 0.000 | 138.849 | **382.998** |
| **December** | 213.749 | 56.010 | 0.000 | 12.651 | 0.000 | 0.000 | 0.000 | 141.831 | **424.241** |
| **January** | 212.488 | 57.181 | 0.000 | 12.321 | 0.190 | 0.000 | 0.000 | 146.981 | **429.162** |
| **February** | 193.545 | 51.502 | 0.000 | 11.407 | 0.000 | 0.000 | 0.000 | 143.243 | **399.698** |
| **March** | 214.393 | 62.165 | 0.000 | 8.111 | 15.769 | 0.000 | 0.000 | 183.132 | **483.570** |
| **April** | 209.987 | 153.201 | 0.000 | 8.785 | 45.299 | 7.271 | 6.999 | 278.292 | **709.834** |
| **May** | 208.363 | 130.540 | 0.000 | 9.321 | 54.832 | 17.415 | 25.302 | 246.399 | **692.172** |
| **June** | 188.466 | 78.804 | 0.000 | 10.027 | 45.601 | 7.719 | 28.519 | 191.449 | **550.584** |
| **July** | 190.012 | 83.261 | 0.000 | 10.770 | 53.583 | 17.091 | 29.092 | 229.758 | **613.566** |
| **August** | 189.366 | 112.914 | 0.000 | 10.430 | 51.280 | 17.193 | 28.208 | 205.166 | **614.556** |
| **September** | 191.527 | 77.766 | 0.000 | 10.004 | 32.895 | 16.641 | 27.141 | 136.380 | **492.355** |
| **Total** | **2,420.018** | **919.329** | **0.000** | **128.580** | **311.783** | **92.284** | **162.654** | **2,190.574** | **6,225.223** |

[1] Spirit Mountain Powerplant is used to dissipate energy in the transition from the pressurized portion of the Shoshone Canyon Conduit to the free flow of the conduit.
Water used for generation at Spirit Mountain Powerplant is then routed to Heart Mountain Canal or used for generation at Heart Mountain Powerplant.
[1] Spirit Mountain Powerplant is used to dissipate energy in the transition from the pressurized portion of the Shoshone Canyon Conduit to the free flow of the conduit.
Water used for generation at Spirit Mountain Powerplant is then routed to Heart Mountain Canal or used for generation at Heart Mountain Powerplant.

Table 104.—CET - Monthly Generation at USACE Power powerplants (Million Kwh)

| Month | Fort Peck | Garrison | Oahe | Big Bend | Fort Randall | Gavins Point | Total | Basin Total |
|---|---|---|---|---|---|---|---|---|
| **October** | 39.092 | 129.121 | 182.748 | 69.377 | 180.881 | 88.292 | **689.511** | **777.784** |
| **November** | 39.910 | 131.718 | 166.432 | 68.452 | 132.710 | 73.223 | **612.445** | **694.648** |
| **December** | 53.950 | 154.624 | 110.160 | 46.042 | 69.718 | 40.028 | **474.522** | **556.300** |
| **January** | 58.413 | 200.475 | 135.987 | 55.374 | 65.915 | 39.393 | **555.557** | **636.514** |
| **February** | 53.284 | 174.637 | 102.926 | 41.398 | 52.193 | 33.048 | **457.486** | **534.609** |
| **March** | 44.749 | 147.185 | 149.463 | 61.025 | 80.770 | 45.414 | **528.606** | **626.971** |
| **April** | 42.349 | 140.025 | 77.433 | 33.867 | 86.780 | 44.264 | **424.718** | **577.917** |
| **May** | 67.525 | 172.461 | 163.784 | 60.673 | 112.222 | 56.471 | **633.136** | **772.864** |
| **June** | 76.531 | 196.443 | 163.923 | 58.383 | 131.649 | 62.674 | **689.603** | **801.172** |
| **July** | 88.332 | 212.791 | 240.457 | 84.577 | 171.222 | 80.054 | **877.433** | **1,006.466** |
| **August** | 75.580 | 215.417 | 257.885 | 93.383 | 184.014 | 81.175 | **907.454** | **1,033.329** |
| **September** | 69.470 | 186.063 | 289.584 | 104.586 | 182.773 | 86.832 | **919.308** | **1,015.606** |
| **Total** | **709.185** | **2,060.960** | **2,040.782** | **777.137** | **1,450.847** | **730.868** | **7,769.779** | **9,034.180** |

Table 105.—CET - Water used for power generation (KAF) at USACE powerplants

| WY 2023 Month | Fort Peck | Garrison | Oahe | Big Bend | Fort Randall | Gavins Point | Total |
|---|---|---|---|---|---|---|---|
| October | 254.000 | 861.000 | 1,292.000 | 1,228.000 | 1,842.000 | 1,952.000 | **7,429.000** |
| November | 266.000 | 901.000 | 1,202.000 | 1,192.000 | 1,429.000 | 1,584.000 | **6,574.000** |
| December | 353.000 | 1,081.000 | 807.000 | 800.000 | 739.000 | 827.000 | **4,607.000** |
| January | 395.000 | 1,429.000 | 974.000 | 975.000 | 656.000 | 807.000 | **5,236.000** |
| February | 374.000 | 1,294.000 | 740.000 | 735.000 | 498.000 | 682.000 | **4,323.000** |
| March | 322.000 | 1,061.000 | 1,056.000 | 1,081.000 | 742.000 | 972.000 | **5,234.000** |
| April | 299.000 | 990.000 | 544.000 | 613.000 | 780.000 | 956.000 | **4,182.000** |
| May | 450.000 | 1,188.000 | 1,095.000 | 1,125.000 | 1,025.000 | 1,194.000 | **6,077.000** |
| June | 492.000 | 1,292.000 | 1,085.000 | 1,096.000 | 1,233.000 | 1,365.000 | **6,563.000** |
| July | 543.000 | 1,343.000 | 1,577.000 | 1,561.000 | 1,634.000 | 1,783.000 | **8,441.000** |
| August | 481.000 | 1,358.000 | 1,716.000 | 1,737.000 | 1,762.000 | 1,818.000 | **8,872.000** |
| September | 439.000 | 1,184.000 | 1,955.000 | 1,908.000 | 1,813.000 | 1,994.000 | **9,293.000** |
| **Total** | **4,668.000** | **13,982.000** | **14,043.000** | **14,051.000** | **14,153.000** | **15,934.000** | **76,831.000** |

Table 106.—CET - Total Water Releases (KAF) for WY2023 at Bureau of Reclamation powerplants

| Month | Canyon Ferry | Boysen | Pilot Butte | Buffalo Bill | Bull Lake | Anchor | Yellowtail | Total |
|---|---|---|---|---|---|---|---|---|
| October | 216.186 | 55.391 | 0.000 | 50.447 | 2.314 | 0.463 | 149.094 | **473.894** |
| November | 205.856 | 53.597 | 0.000 | 11.980 | 1.674 | 0.000 | 138.849 | **411.955** |
| December | 227.161 | 56.010 | 0.000 | 12.767 | 1.687 | 0.000 | 141.831 | **439.455** |
| January | 233.716 | 57.181 | 0.000 | 12.699 | 1.714 | 0.000 | 146.981 | **452.291** |
| February | 211.432 | 51.502 | 0.000 | 11.562 | 1.556 | 0.000 | 143.243 | **419.296** |
| March | 259.985 | 62.590 | 0.000 | 25.978 | 1.727 | 0.000 | 183.132 | **533.412** |
| April | 335.266 | 156.707 | 0.000 | 85.736 | 2.189 | 0.034 | 279.056 | **858.987** |
| May | 425.459 | 146.728 | 15.692 | 127.025 | 17.691 | 1.284 | 257.417 | **991.296** |
| June | 650.804 | 328.656 | 27.041 | 242.633 | 49.634 | 8.816 | 611.742 | **1,919.325** |
| July | 340.667 | 287.918 | 35.049 | 167.343 | 49.245 | 4.588 | 647.758 | **1,532.567** |
| August | 274.621 | 112.914 | 35.562 | 126.431 | 33.496 | 2.463 | 247.795 | **833.282** |
| September | 256.376 | 77.766 | 30.491 | 97.056 | 63.615 | 4.127 | 178.713 | **708.143** |
| **Total** | **3,637.528** | **1,446.960** | **143.834** | **971.656** | **226.540** | **21.775** | **3,125.612** | **9,573.904** |

Table 107.—CET - Total water releases (KAF) for WY2023 at U.S. Army Corps of Engineers powerplants

| Month | Fort Peck | Garrison | Oahe | Bend | Fort Randall | Gavins Point | Total |
|---|---|---|---|---|---|---|---|
| October | 254.000 | 861.000 | 1,292.000 | 1,228.000 | 1,842.000 | 1,952.000 | **7,429.000** |
| November | 266.000 | 901.000 | 1,202.000 | 1,192.000 | 1,429.000 | 1,584.000 | **6,574.000** |
| December | 353.000 | 1,081.000 | 807.000 | 800.000 | 739.000 | 827.000 | **4,607.000** |
| January | 395.000 | 1,429.000 | 974.000 | 975.000 | 656.000 | 807.000 | **5,236.000** |
| February | 374.000 | 1,294.000 | 740.000 | 735.000 | 498.000 | 684.000 | **4,325.000** |
| March | 322.000 | 1,061.000 | 1,056.000 | 1,081.000 | 742.000 | 994.000 | **5,256.000** |
| April | 299.000 | 990.000 | 544.000 | 613.000 | 780.000 | 983.000 | **4,209.000** |
| May | 450.000 | 1,188.000 | 1,095.000 | 1,125.000 | 1,025.000 | 1,194.000 | **6,077.000** |
| June | 492.000 | 1,292.000 | 1,085.000 | 1,096.000 | 1,233.000 | 1,396.000 | **6,594.000** |
| July | 543.000 | 1,343.000 | 1,577.000 | 1,561.000 | 1,634.000 | 1,783.000 | **8,441.000** |
| August | 481.000 | 1,358.000 | 1,716.000 | 1,737.000 | 1,773.000 | 1,900.000 | **8,965.000** |
| September | 439.000 | 1,184.000 | 1,955.000 | 1,908.000 | 1,968.000 | 2,075.000 | **9,529.000** |
| **Total** | **4,668.000** | **13,982.000** | **14,043.000** | **14,051.000** | **14,319.000** | **16,179.000** | **77,242.000** |

**Table 108.—CET - Total water storage (in KAF) for WY2022 and WY2023**

| Reclamation reservoirs | Top of conservation capacity [3] | Dead and inactive capacity | 2022 total storage | 2023 total storage | 2022 percent of average | 2023 percent of average |
|---|---|---|---|---|---|---|
| Clark Canyon | 174.4 | 1.1 | 52.3 | 111.9 | 55 | 119 |
| Canyon Ferry | 1,891.9 | 396.0 | 1,348.7 | 1,655.3 | 83 | 102 |
| Helena Valley | 10.5 | 4.6 | 8.4 | 9.2 | 112 | 123 |
| Gibson | 96.5 | 0.0 | 5.5 | 6.0 | 23 | 25 |
| Willow Creek | 31.8 | 1.0 | 13.1 | 13.0 | 65 | 64 |
| Pishkun | 46.7 | 16.0 | 36.2 | 36.0 | 112 | 111 |
| Lake Elwell | 925.6 | 554.3 | 816.8 | 775.9 | 103 | 98 |
| Sherburne | 66.1 | 1.9 | 11.3 | 14.6 | 67 | 86 |
| Fresno | 92.9 | 0.4 | 39.8 | 25.2 | 86 | 55 |
| Nelson | 79.0 | 18.1 | 45.2 | 65.5 | 79 | 115 |
| Bull Lake | 152.5 | 0.7 | 74.7 | 82.1 | 99 | 108 |
| Pilot Butte | 33.7 | 3.8 | 5.5 | 27.4 | 31 | 152 |
| Boysen | 741.6 | 219.2 | 635.2 | 672.8 | 106 | 112 |
| Anchor[1] | 17.2 | 0.1 | 0.5 | 1.8 | 149 | 539 |
| Buffalo Bill[2] | 646.6 | 41.7 | 405.6 | 453.1 | 91 | 102 |
| Bighorn Lake | 1,020.6 | 469.9 | 866.8 | 988.3 | 91 | 104 |
| E. A. Patterson | 8.6 | 0.5 | 4.2 | 7.8 | 67 | 125 |
| Lake Tschida | 67.1 | 5.2 | 43.6 | 58.5 | 77 | 103 |
| Jamestown Reservoir | 31.5 | 0.8 | 20.7 | 31.0 | 72 | 108 |
| Shadehill Reservoir | 120.2 | 43.9 | 74.3 | 116.2 | 70 | 110 |
| Angostura Reservoir | 123.0 | 42.2 | 75.5 | 92.9 | 89 | 109 |
| Deerfield Reservoir | 15.7 | 0.2 | 15.0 | 15.0 | 113 | 113 |
| Pactola Reservoir | 56.0 | 1.0 | 52.7 | 53.4 | 113 | 115 |
| Keyhole Reservoir | 188.7 | 6.6 | 128.1 | 130.2 | 145 | 147 |
| Belle Fourche Reservoir | 172.9 | 3.1 | 69.2 | 142.5 | 94 | 193 |
| **Subtotal** | **6,811.2** | **1,832.3** | **4,849.2** | **5,585.6** | | |
| U.S. Army Corps Reservoirs | | | | | | |
| Fort Peck | 17,578.0 | 4,073.0 | 15,495.0 | 13,387.0 | | |
| Garrison | 22,332.0 | 4,980.0 | 18,216.0 | 15,673.0 | | |
| Oahe | 22,035.0 | 5,373.0 | 18,896.0 | 15,612.0 | | |
| Big Bend | 1,738.0 | 1,621.0 | 1,686.0 | 1,691.0 | | |
| Fort Randall | 4,433.0 | 1,517.0 | 2,640.0 | 2,727.0 | | |
| Gavins Point | 393.0 | 307.0 | 370.0 | 376.0 | | |
| **Subtotal** | **68,509.0** | **17,871.0** | **57,303.0** | **49,466.0** | | |
| **Total Upper Missouri Basin** | **75,320.2** | **19,703.3** | **62,152.2** | **55,051.6** | | |

[1] Percent of average content of Anchor Reservoir is based on a 22-year average, 1991-2012.

[2] Percent of average content of Buffalo Bill Reservoir is based on a 20-year average, 1993-2012; to reflect the operation of the reservoir since 1992 when the dam was raised and the capacity of the reservoir was increased to 646,565 AF.

[3] Includes joint-use space.

## Table 109.—CET - WY2023 end of month reservoir contents (KAF)

| RECLAMATION RESERVOIRS | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLARK CANYON RESERVOIR | 63.2 | 73.3 | 82.7 | 91.7 | 98.9 | 107.1 | 119.4 | 124.7 | 139.2 | 115.4 | 108.9 | 111.9 |
| % of Average | 61.1% | 65.4% | 70.1% | 74.6% | 77.5% | 79.0% | 83.6% | 90.3% | 105.9% | 104.4% | 116.0% | 118.8% |
| CANYON FERRY RESERVOIR | 1,484.0 | 1,460.2 | 1,413.1 | 1,394.4 | 1,361.3 | 1,345.3 | 1,337.7 | 1,716.9 | 1,888.4 | 1,801.3 | 1,692.0 | 1,655.3 |
| % of Average | 90.7% | 88.3% | 88.2% | 90.8% | 91.5% | 92.0% | 90.1% | 104.4% | 102.0% | 100.9% | 101.0% | 102.1% |
| HELENA VALLEY RESERVOIR | 8.6 | 8.3 | 8.0 | 7.7 | 7.5 | 7.3 | 10.1 | 10.3 | 10.3 | 8.5 | 9.6 | 9.2 |
| % of Average | 123.1% | 123.1% | 123.6% | 126.6% | 130.0% | 128.0% | 109.2% | 112.6% | 115.0% | 114.2% | 118.4% | 123.4% |
| GIBSON RESERVOIR | 5.6 | 5.9 | 8.4 | 9.4 | 9.9 | 10.1 | 25.9 | 98.6 | 88.9 | 32.3 | 5.7 | 6.0 |
| % of Average | 19.2% | 17.8% | 23.0% | 23.6% | 22.9% | 21.0% | 41.4% | 109.8% | 98.5% | 62.8% | 21.3% | 25.4% |
| WILLOW CREEK | 12.9 | 16.4 | 16.7 | 16.8 | 16.8 | 17.1 | 17.3 | 22.9 | 28.6 | 18.1 | 12.7 | 13.0 |
| % of Average | 0.1% | 76.1% | 76.0% | 75.5% | 74.3% | 72.9% | 68.3% | 80.4% | 98.2% | 74.9% | 62.3% | 64.3% |
| PISHKUN RESERVOIR | 35.6 | 35.3 | 35.3 | 35.2 | 35.0 | 35.0 | 35.0 | 43.0 | 45.2 | 36.9 | 36.7 | 36.0 |
| % of Average | 0.1% | 103.0% | 103.6% | 104.5% | 103.8% | 102.4% | 87.7% | 93.5% | 107.9% | 99.5% | 102.5% | 111.0% |
| LAKE ELWELL (TIBER DAM) | 801.0 | 775.9 | 753.1 | 733.8 | 716.8 | 702.9 | 720.9 | 827.1 | 864.9 | 837.8 | 804.7 | 775.9 |
| % of Average | 105.2% | 103.3% | 102.1% | 101.6% | 100.2% | 97.7% | 97.7% | 101.1% | 98.5% | 97.8% | 97.9% | 97.9% |
| SHERBURNE LAKE | 12.1 | 15.0 | 17.6 | 19.8 | 21.4 | 23.0 | 27.1 | 58.8 | 65.3 | 36.3 | 10.7 | 14.6 |
| % of Average | 60.5% | 59.7% | 63.1% | 64.3% | 64.5% | 80.0% | 133.1% | 171.1% | 116.1% | 74.2% | 38.1% | 86.0% |
| FRESNO RESERVOIR | 42.2 | 41.1 | 39.2 | 37.2 | 38.1 | 37.3 | 88.5 | 85.8 | 90.6 | 52.9 | 33.2 | 25.2 |
| % of Average | 93.0% | 90.9% | 89.8% | 88.1% | 87.2% | 63.0% | 117.0% | 118.4% | 119.5% | 91.0% | 72.8% | 54.5% |
| NELSON RESERVOIR | 45.7 | 44.1 | 43.0 | 42.0 | 41.1 | 40.1 | 56.0 | 70.8 | 77.5 | 67.1 | 58.9 | 65.5 |
| % of Average | 77.5% | 76.4% | 76.9% | 77.2% | 77.3% | 73.7% | 91.1% | 116.5% | 127.7% | 121.7% | 108.3% | 115.0% |
| BULL LAKE | 71.4 | 71.0 | 72.9 | 74.5 | 75.2 | 75.9 | 78.6 | 107.1 | 145.0 | 144.1 | 136.2 | 82.1 |
| % of Average | 95.5% | 94.2% | 96.0% | 97.9% | 98.8% | 99.7% | 103.7% | 120.4% | 115.0% | 111.8% | 132.2% | 108.4% |
| PILOT BUTTE RESERVOIR | 27.4 | 27.2 | 27.2 | 27.3 | 27.3 | 27.3 | 27.3 | 27.7 | 29.8 | 24.2 | 20.7 | 27.4 |
| % of Average | 103.1% | 98.2% | 98.1% | 98.0% | 97.5% | 92.5% | 89.1% | 102.8% | 100.3% | 95.1% | 96.9% | 152.0% |
| BOYSEN RESERVOIR | 641.0 | 633.0 | 616.6 | 600.6 | 584.3 | 569.2 | 504.8 | 609.7 | 798.6 | 707.3 | 680.3 | 672.8 |
| % of Average | 107.6% | 107.2% | 107.7% | 107.9% | 106.9% | 105.5% | 96.0% | 111.1% | 121.7% | 109.0% | 110.1% | 112.3% |
| ANCHOR RESERVOIR | 0.58 | 0.57 | 0.59 | 0.61 | 0.62 | 0.59 | 1.13 | 4.65 | 6.84 | 5.92 | 4.49 | 1.77 |
| % of Average[1] | 203.9% | 232.8% | 250.8% | 262.8% | 236.0% | 161.7% | 227.0% | 303.7% | 201.4% | 270.4% | 754.7% | 538.9% |
| BUFFALO BILL RESERVOIR | 452.1 | 459.5 | 463.3 | 465.2 | 466.1 | 454.9 | 405.2 | 521.4 | 625.6 | 597.5 | 523.6 | 453.1 |
| % of Average[2] | 106.9% | 107.8% | 109.1% | 110.1% | 111.4% | 109.9% | 102.7% | 119.0% | 110.2% | 103.9% | 103.0% | 101.8% |
| BIGHORN LAKE | 937.2 | 904.6 | 863.6 | 835.8 | 794.6 | 784.6 | 794.3 | 862.6 | 1,120.9 | 988.3 | 969.4 | 988.3 |
| % of Average | 97.5% | 96.6% | 97.2% | 99.3% | 97.7% | 97.7% | 100.7% | 99.8% | 112.2% | 100.6% | 102.7% | 104.1% |
| E. A. PATTERSON LAKE | 7.1 | 7.3 | 7.5 | 7.6 | 7.6 | 7.5 | 8.7 | 8.5 | 8.4 | 7.4 | 7.9 | 7.8 |
| % of Average | 119.6% | 123.4% | 128.1% | 127.5% | 117.1% | 95.6% | 110.2% | 109.8% | 110.1% | 103.2% | 118.9% | 124.8% |
| LAKE TSCHIDA | 53.4 | 54.2 | 55.1 | 55.6 | 56.7 | 57.6 | 68.3 | 63.6 | 64.8 | 62.7 | 61.0 | 58.5 |
| % of Average | 93.4% | 94.2% | 95.8% | 96.8% | 95.0% | 84.8% | 103.7% | 97.2% | 99.1% | 101.2% | 104.8% | 102.9% |
| JAMESTOWN RESERVOIR | 27.3 | 27.9 | 28.7 | 29.6 | 30.3 | 31.2 | 62.3 | 92.4 | 42.2 | 29.2 | 28.8 | 31.0 |
| % of Average | 101.7% | 105.5% | 107.9% | 110.7% | 112.2% | 85.8% | 109.9% | 203.4% | 113.3% | 85.8% | 88.2% | 108.0% |
| SHADEHILL RESERVOIR | 90.4 | 88.8 | 88.5 | 87.7 | 87.7 | 90.6 | 105.1 | 115.7 | 117.2 | 119.1 | 118.1 | 116.2 |
| % of Average | 88.2% | 87.7% | 88.6% | 88.9% | 86.8% | 78.6% | 89.8% | 98.8% | 101.2% | 104.4% | 107.7% | 110.1% |
| ANGOSTURA RESERVOIR | 62.9 | 64.6 | 66.5 | 68.9 | 70.9 | 76.4 | 82.2 | 92.8 | 97.5 | 98.6 | 97.4 | 92.9 |
| % of Average | 72.7% | 73.9% | 74.6% | 75.5% | 74.1% | 74.6% | 77.7% | 84.8% | 89.7% | 99.6% | 109.7% | 109.4% |
| DEERFIELD RESERVOIR | 15.1 | 14.9 | 14.8 | 14.8 | 14.7 | 14.8 | 15.1 | 15.3 | 15.9 | 15.2 | 14.7 | 15.0 |
| % of Average | 112.6% | 110.1% | 107.9% | 105.9% | 104.5% | 103.5% | 105.1% | 105.7% | 110.5% | 107.6% | 108.1% | 112.7% |
| PACTOLA RESERVOIR | 50.9 | 50.3 | 50.3 | 50.2 | 50.3 | 50.5 | 52.5 | 55.3 | 55.9 | 55.2 | 55.0 | 53.4 |
| % of Average | 109.2% | 107.4% | 108.0% | 108.0% | 107.8% | 106.7% | 107.9% | 110.8% | 110.9% | 113.5% | 116.9% | 115.1% |
| KEYHOLE RESERVOIR | 118.1 | 117.5 | 117.7 | 118.2 | 118.9 | 126.2 | 128.2 | 131.8 | 133.9 | 132.7 | 131.1 | 130.2 |
| % of Average | 133.7% | 133.5% | 133.4% | 133.2% | 130.2% | 129.4% | 129.6% | 129.6% | 131.9% | 138.3% | 144.5% | 146.8% |
| BELLE FOURCHE RESERVOIR | 98.9 | 107.3 | 116.2 | 127.0 | 137.3 | 151.8 | 163.7 | 169.7 | 170.7 | 159.8 | 145.6 | 142.5 |
| % of Average | 120.1% | 116.3% | 114.8% | 115.0% | 114.9% | 113.7% | 113.2% | 109.3% | 114.4% | 135.4% | 169.5% | 192.5% |
| **CORPS RESERVOIRS** | **Oct** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** |
| FORT PECK RESERVOIR | 13,387.0 | 13,304.0 | 12,988.0 | 12,742.0 | 12,522.0 | 12,586.0 | 12,546.0 | 12,443.0 | 12,462.0 | 12,471.0 | 12,249.0 | 12,007.0 |
| GARRISON RESERVOIR | 15,673.0 | 15,401.0 | 15,079.0 | 14,948.0 | 14,923.0 | 14,941.0 | 15,015.0 | 15,450.0 | 17,239.0 | 17,899.0 | 17,175.0 | 16,699.0 |
| OAHE RESERVOIR | 15,612.0 | 15,446.0 | 15,627.0 | 15,607.0 | 15,671.0 | 15,577.0 | 15,128.0 | 15,547.0 | 15,939.0 | 16,022.0 | 15,371.0 | 14,598.0 |
| BIG BEND RESERVOIR | 1,691.0 | 1,668.0 | 1,663.0 | 1,690.0 | 1,684.0 | 1,642.0 | 1,696.0 | 1,687.0 | 1,649.0 | 1,685.0 | 1,673.0 | 1,646.0 |
| FORT RANDALL RESERVOIR | 2,727.0 | 2,163.0 | 2,287.0 | 2,683.0 | 2,976.0 | 3,269.0 | 3,475.0 | 3,410.0 | 3,437.0 | 3,393.0 | 3,401.0 | 3,271.0 |
| GAVINS POINT RESERVOIR | 376.0 | 369.0 | 362.0 | 362.0 | 302.0 | 338.0 | 345.0 | 346.0 | 328.0 | 333.0 | 346.0 | 363.0 |

[1] Percent of average content of Anchor Reservoir is based on a 22-year average, 1991-2012; this is due to the availability of data for Anchor Reservoir.

[2] Percent of average content of Buffalo Bill Reservoir is based on an 20-year average, 1993-2012; to reflect the operation of the reservoir since 1992 when the dam was raised and the capacity of the reservoir was increased to 646,565 acre-feet.

## Table 110.—CET - WY2023 monthly inflows (KAF) into Bureau of Reclamation Reservoirs

| RECLAMATION RESERVOIRS | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLARK CANYON RESERVOIR | 11.7 | 11.6 | 11.0 | 10.7 | 8.7 | 9.9 | 13.9 | 18.0 | 31.6 | 17.2 | 18.7 | 19.4 | 182.4 |
| % of Average | 56.1% | 58.0% | 65.9% | 75.1% | 68.7% | 60.4% | 81.4% | 84.7% | 99.9% | 66.6% | 99.3% | 107.9% | 78.1% |
| CANYON FERRY RESERVOIR | 183.0 | 182.1 | 180.0 | 215.1 | 178.3 | 244.0 | 327.6 | 804.6 | 822.3 | 253.6 | 165.4 | 219.7 | 3,775.6 |
| % of Average | 71.9% | 68.7% | 82.8% | 100.7% | 86.3% | 96.4% | 107.0% | 161.5% | 119.9% | 86.3% | 107.7% | 120.2% | 106.9% |
| HELENA VALLEY RESERVOIR | -0.4 | -0.3 | -0.3 | -0.3 | -0.3 | -0.2 | 2.8 | 10.5 | 12.0 | 20.7 | 21.6 | 13.4 | 79.2 |
| % of Average | N/A | N/A | N/A | N/A | N/A | N/A | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% | 0.2% | 0.1% |
| GIBSON RESERVOIR | 10.6 | 8.8 | 8.5 | 7.3 | 6.1 | 6.4 | 22.3 | 195.9 | 94.8 | 27.0 | 15.1 | 11.3 | 414.1 |
| % of Average | 65.8% | 53.1% | 62.6% | 60.3% | 56.5% | 44.1% | 53.1% | 133.3% | 62.6% | 48.0% | 63.0% | 65.5% | 79.4% |
| WILLOW CREEK | 4.0 | 3.4 | 0.3 | 0.1 | 0.1 | 0.3 | 0.2 | 5.6 | 6.8 | 0.8 | 0.6 | 0.2 | 22.4 |
| % of Average | 0.5% | 0.5% | 0.1% | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.2% | 0.2% | N/A | 0.1% | 0.2% |
| PISHKUN RESERVOIR | -0.5 | -0.2 | 0.0 | -0.1 | -0.2 | 0.0 | 0.0 | 30.3 | 64.6 | 79.4 | 35.0 | -0.7 | 207.5 |
| % of Average | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 0.1% | 0.1% | 0.1% | 0.1% | N/A | 0.1% |
| LAKE ELWELL (TIBER DAM) | 3.1 | 4.6 | 7.7 | 10.6 | 8.3 | 15.9 | 49.0 | 138.7 | 68.3 | 3.9 | -1.9 | 1.7 | 309.9 |
| % of Average | 18.4% | 21.6% | 45.4% | 66.8% | 38.1% | 41.3% | 93.0% | 111.8% | 50.8% | 9.4% | N/A | 14.4% | 61.0% |
| SHERBURNE LAKE | 2.4 | 2.9 | 2.6 | 2.3 | 1.5 | 1.6 | 5.9 | 36.2 | 21.5 | 8.5 | 7.4 | 5.5 | 98.3 |
| % of Average | 37.1% | 42.2% | 76.1% | 75.4% | 65.5% | 45.8% | 54.6% | 117.5% | 58.0% | 45.8% | 83.3% | 91.4% | 71.3% |
| FRESNO RESERVOIR | 8.0 | 1.5 | 0.7 | 0.6 | 3.2 | 1.8 | 59.1 | 27.8 | 35.4 | 17.0 | 28.6 | 6.3 | 190.0 |
| % of Average | 111.9% | 67.9% | 80.7% | 63.6% | 82.5% | 7.5% | 198.8% | 64.7% | 72.5% | 50.2% | 95.1% | 30.7% | 77.5% |
| NELSON RESERVOIR | 0.9 | -1.6 | -1.0 | -1.1 | -0.9 | -0.9 | 15.8 | 16.7 | 12.5 | 2.4 | 3.0 | 9.7 | 55.5 |
| % of Average | 0.0% | N/A | N/A | N/A | N/A | N/A | 0.2% | 0.2% | 0.2% | 0.0% | 0.0% | 0.2% | 0.1% |
| BULL LAKE | 7.5 | 4.0 | 3.6 | 3.3 | 2.2 | 2.5 | 4.9 | 46.2 | 87.5 | 48.4 | 25.6 | 9.5 | 245.1 |
| % of Average | 134.0% | 126.2% | 144.7% | 154.7% | 137.0% | 135.8% | 130.5% | 165.3% | 142.0% | 104.7% | 122.6% | 100.4% | 131.3% |
| PILOT BUTTE RESERVOIR[1] | 9.7 | -0.2 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 16.0 | 29.2 | 29.4 | 32.1 | 37.2 | 153.5 |
| % of Average | 86.5% | N/A | N/A | 69.0% | N/A | N/A | 1.2% | 68.1% | 78.5% | 71.2% | 98.9% | 158.9% | 85.7% |
| BOYSEN RESERVOIR | 53.3 | 45.6 | 39.6 | 41.2 | 35.2 | 47.5 | 92.3 | 251.6 | 517.5 | 196.7 | 85.9 | 70.3 | 1,476.7 |
| % of Average | 90.3% | 93.0% | 105.3% | 112.4% | 94.2% | 91.3% | 188.7% | 209.8% | 202.1% | 150.2% | 150.2% | 134.5% | 157.6% |
| ANCHOR RESERVOIR | 0.35 | -0.01 | 0.02 | 0.02 | 0.01 | -0.03 | 0.58 | 4.80 | 11.00 | 3.66 | 1.04 | 1.40 | 22.86 |
| % of Average[2] | 0.1% | N/A | 0.0% | 0.0% | 0.0% | N/A | 0.1% | 0.1% | 0.2% | 0.2% | 0.5% | 0.3% | 0.1% |
| BUFFALO BILL RESERVOIR | 30.6 | 19.4 | 16.6 | 14.6 | 12.4 | 14.8 | 36.0 | 243.2 | 346.9 | 139.2 | 52.6 | 26.5 | 952.7 |
| % of Average | 119.0% | 90.6% | 105.8% | 99.6% | 95.3% | 78.1% | 88.0% | 153.3% | 115.3% | 86.8% | 117.1% | 106.7% | 113.4% |
| BIGHORN LAKE | 155.2 | 106.2 | 100.9 | 119.2 | 102.0 | 173.2 | 288.8 | 325.7 | 870.0 | 515.2 | 229.1 | 197.5 | 3,182.9 |
| % of Average | 92.4% | 82.3% | 92.1% | 107.9% | 91.2% | 117.3% | 203.2% | 127.8% | 213.1% | 202.7% | 151.5% | 119.2% | 147.9% |
| E. A. PATTERSON LAKE | -0.1 | 0.1 | 0.2 | 0.2 | 0.4 | 0.5 | 18.6 | 2.0 | 0.4 | -0.1 | 0.6 | -0.1 | 22.8 |
| % of Average | N/A | 61.4% | 158.9% | 100.6% | 23.2% | 7.4% | 560.3% | 181.0% | 20.3% | N/A | 116.8% | N/A | 132.6% |
| LAKE TSCHIDA | 0.1 | 1.3 | 1.5 | 1.4 | 1.7 | 2.3 | 99.6 | 13.4 | 4.4 | 2.9 | 4.6 | 1.5 | 134.7 |
| % of Average | 4.2% | 83.3% | 155.1% | 160.7% | 35.9% | 8.0% | 592.1% | 244.6% | 60.1% | 78.2% | 345.5% | 576.0% | 182.4% |
| JAMESTOWN RESERVOIR | -0.1 | 0.5 | 0.8 | 0.9 | 0.7 | 1.1 | 37.2 | 87.9 | 12.6 | 10.2 | -0.2 | 4.3 | 156.0 |
| % of Average | N/A | 42.2% | 125.8% | 318.1% | 166.7% | 10.1% | 102.4% | 951.5% | 281.7% | 184.1% | N/A | 212.9% | 201.0% |
| SHADEHILL RESERVOIR | -0.9 | -0.4 | 0.9 | 0.4 | 1.1 | 4.1 | 15.8 | 11.8 | 2.9 | 3.3 | 0.5 | -0.5 | 39.0 |
| % of Average | N/A | N/A | 96.5% | 42.2% | 24.8% | 16.0% | 85.0% | 93.7% | 49.3% | 75.2% | 58.5% | N/A | 51.3% |
| ANGOSTURA RESERVOIR | 1.0 | 1.8 | 2.0 | 2.5 | 2.0 | 5.5 | 5.9 | 10.7 | 8.9 | 13.1 | 9.3 | 1.8 | 64.6 |
| % of Average | 41.2% | 56.4% | 101.7% | 109.6% | 40.4% | 48.6% | 70.0% | 80.1% | 57.3% | 398.7% | 557.7% | 166.1% | 92.8% |
| DEERFIELD RESERVOIR | 0.8 | 0.7 | 0.7 | 0.7 | 0.7 | 0.9 | 1.1 | 1.1 | 1.9 | 1.9 | 0.7 | 1.1 | 12.4 |
| % of Average | 98.6% | 99.9% | 107.2% | 107.6% | 111.6% | 87.8% | 86.3% | 73.7% | 138.0% | 194.9% | 89.9% | 151.8% | 110.8% |
| PACTOLA RESERVOIR | 2.3 | 2.0 | 1.7 | 1.9 | 1.8 | 2.2 | 3.8 | 4.9 | 5.7 | 9.1 | 4.4 | 2.2 | 41.9 |
| % of Average | 104.9% | 106.4% | 114.8% | 120.7% | 112.5% | 77.5% | 82.4% | 71.2% | 85.0% | 239.3% | 151.0% | 104.9% | 108.8% |
| KEYHOLE RESERVOIR | -1.5 | -0.6 | 0.1 | 0.5 | 0.7 | 7.4 | 2.0 | 3.6 | 2.1 | -1.1 | -1.6 | -0.9 | 10.5 |
| % of Average | N/A | N/A | 66.8% | 103.4% | 27.2% | 117.6% | 92.7% | 87.7% | 127.5% | N/A | N/A | N/A | 78.8% |
| BELLE FOURCHE RESERVOIR | 6.9 | 8.4 | 8.9 | 10.8 | 10.3 | 14.6 | 11.9 | 16.9 | 13.4 | 9.1 | 11.3 | 10.7 | 133.0 |
| % of Average | 60.3% | 85.3% | 99.2% | 116.7% | 114.6% | 102.5% | 101.3% | 99.9% | 130.0% | 185.5% | 520.0% | 223.5% | 117.2% |

[1] Negative values are the result of calculated inflow based on reservoir release and change in reservoir content.

[2] Percent of average inflow for Anchor Reservoir is based on a 22-year average, 1991-2012, this is due to the availability of data for Anchor Reservoir.

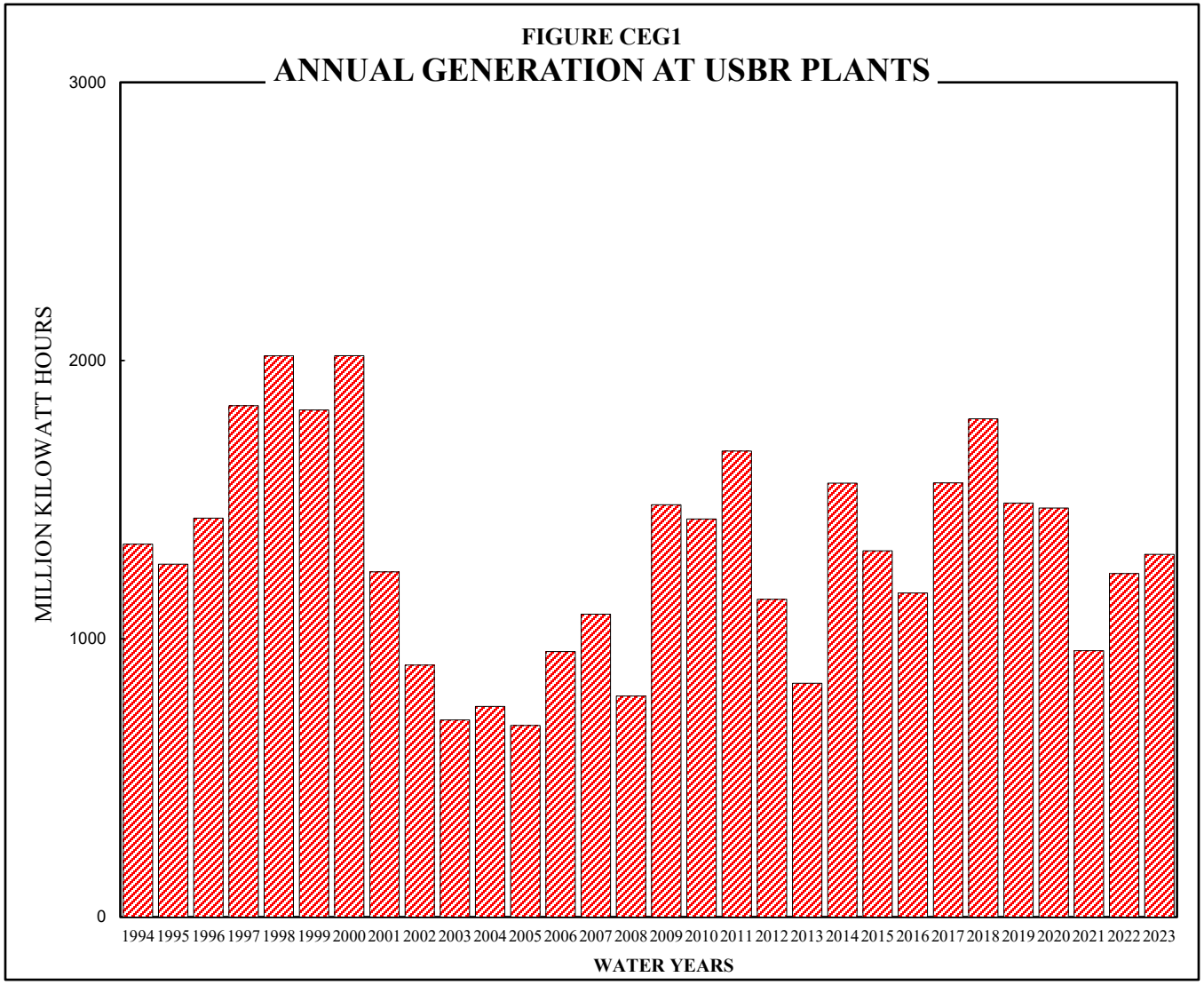



Figure 49.—CEG - Annual generation at Bureau of Reclamation powerplants.

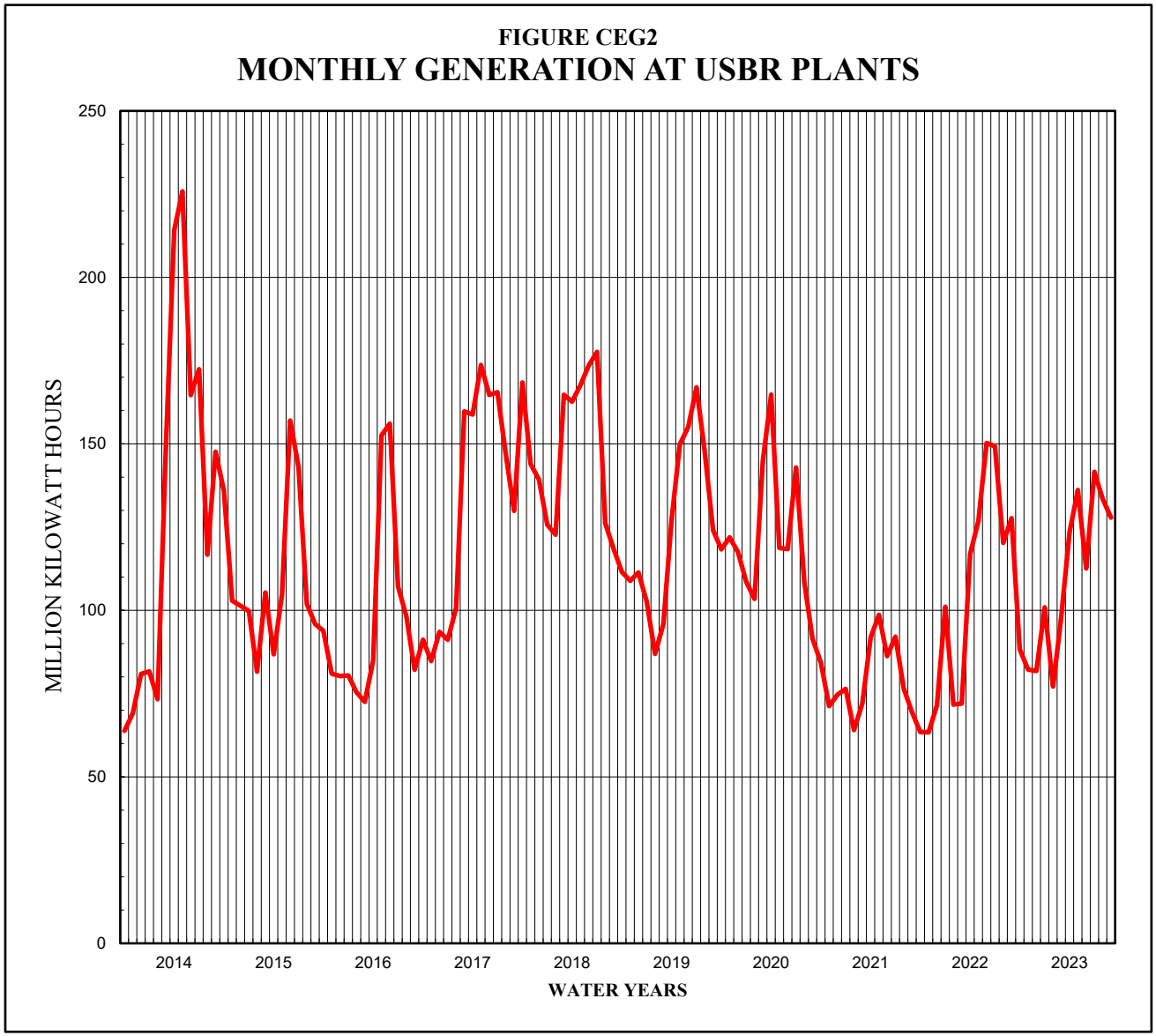



Figure 50.—CEG - Annual generation at Bureau of Reclamation powerplants.

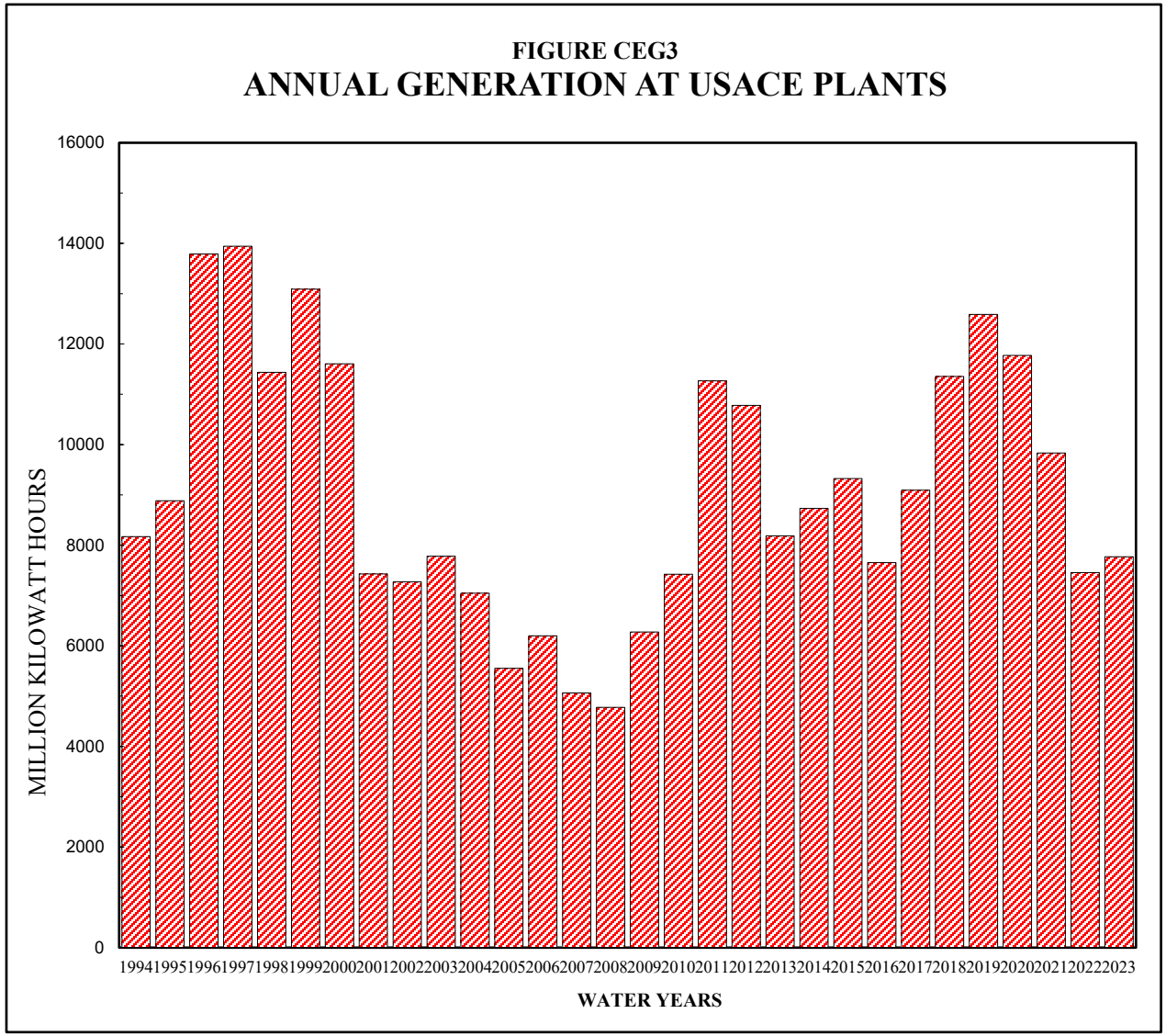



Figure 51.—CEG - Monthly power generation at Bureau of Reclamation powerplants.

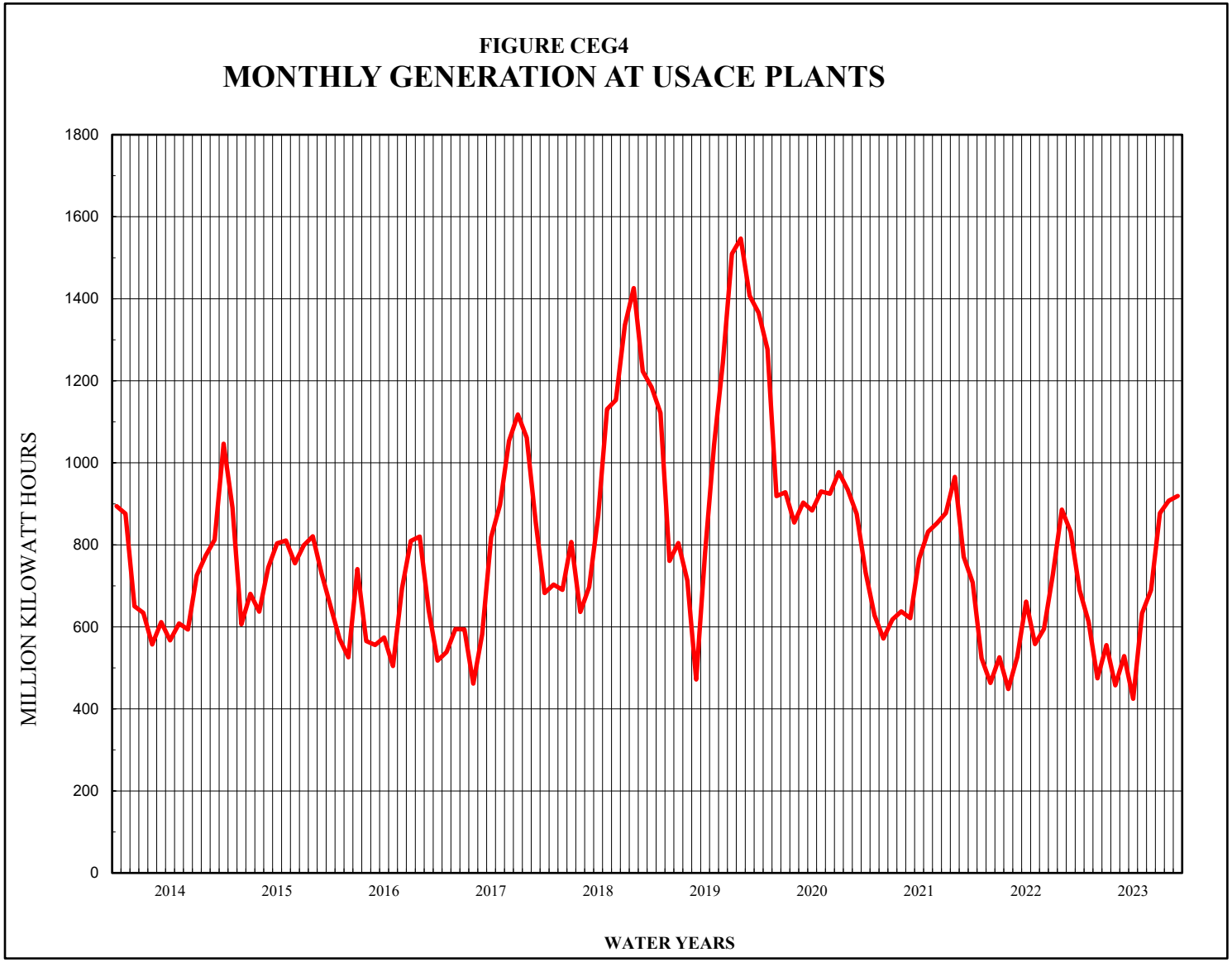



Figure 52.—CEG - Annual generation at USACE plants.

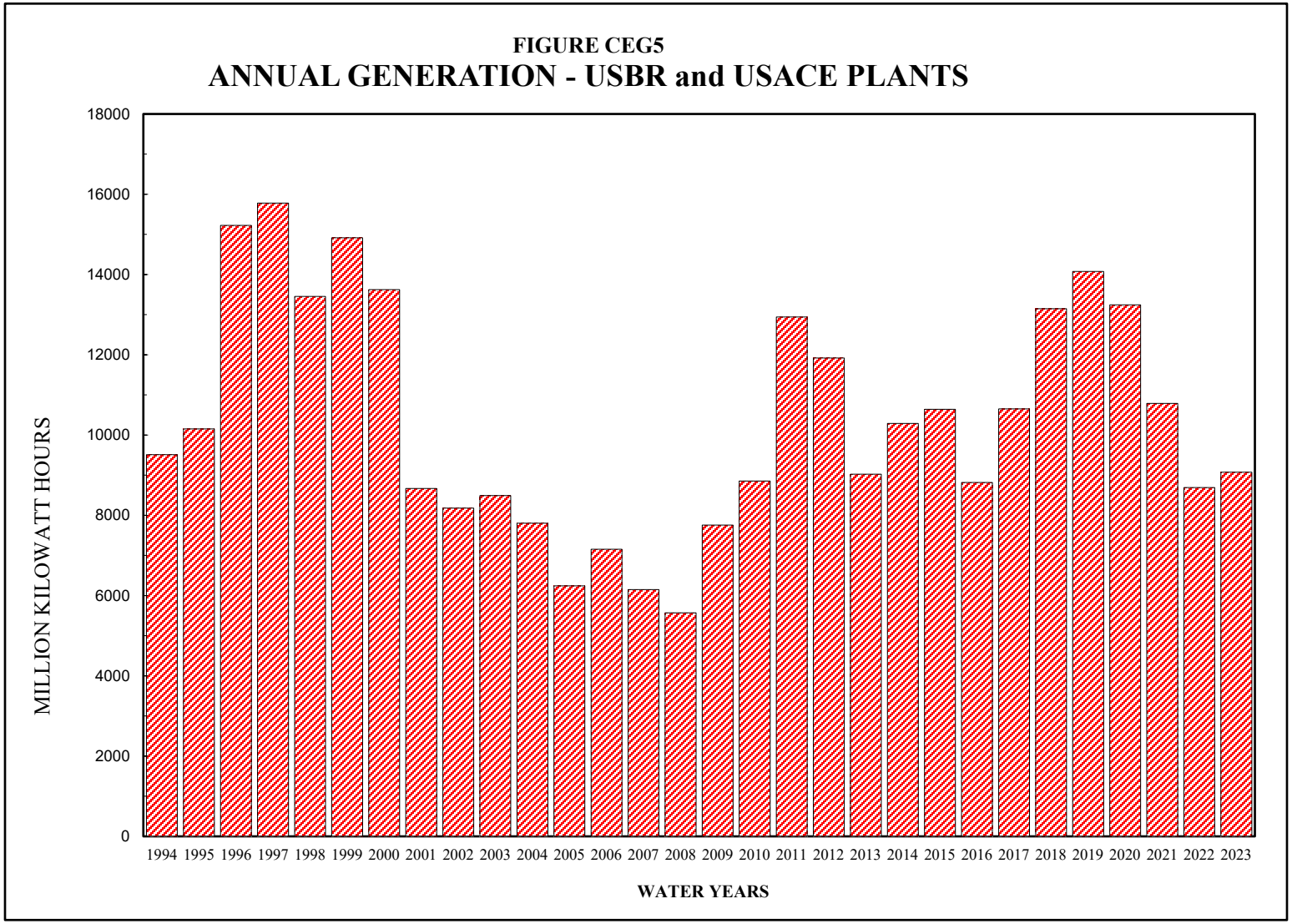



Figure 53.—CEG - Monthly power generation at U.S. Army Corps of Engineers powerplants.

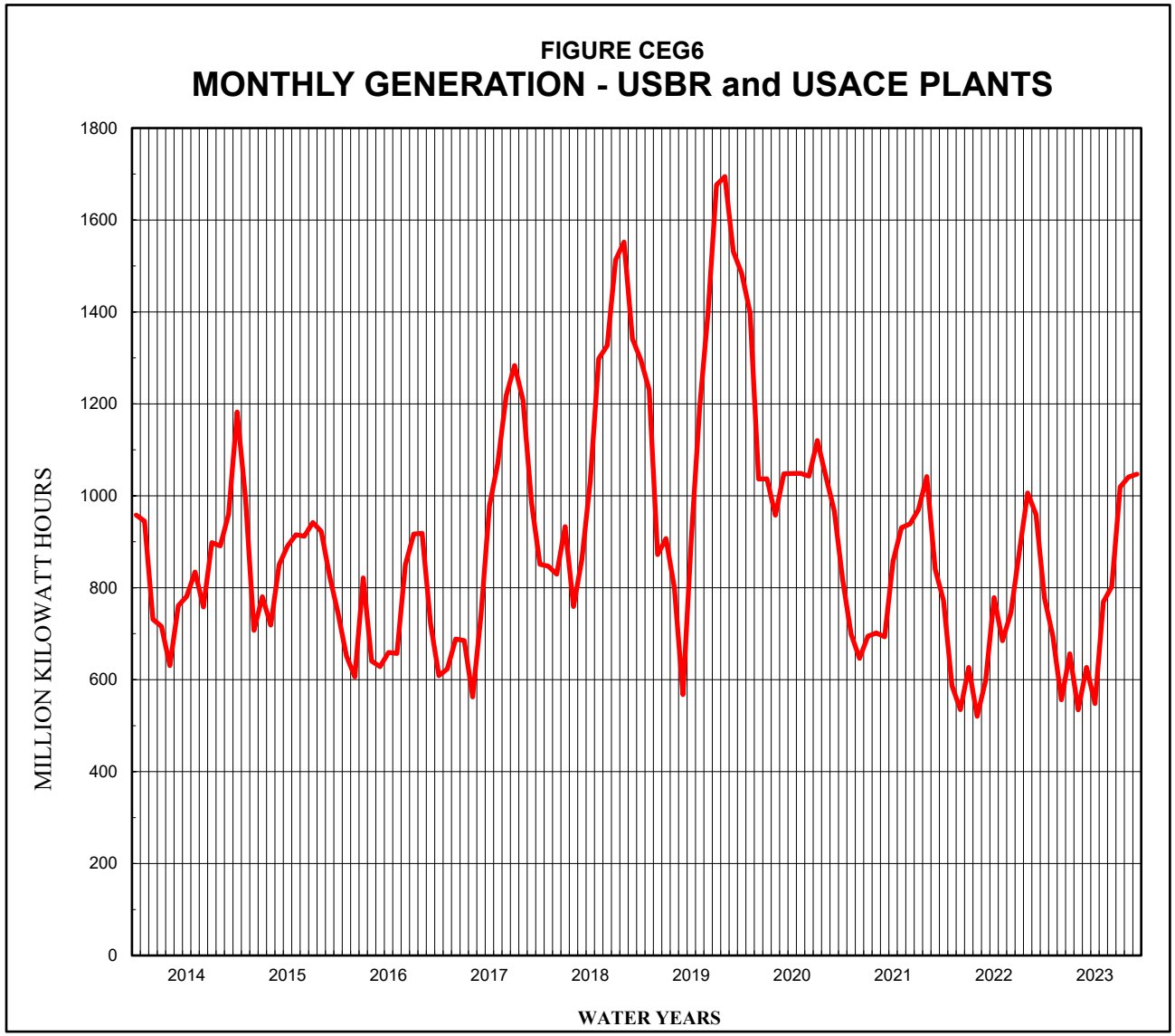



Figure 54.—CEG - Annual generation at Reclamation and USACE powerplants.