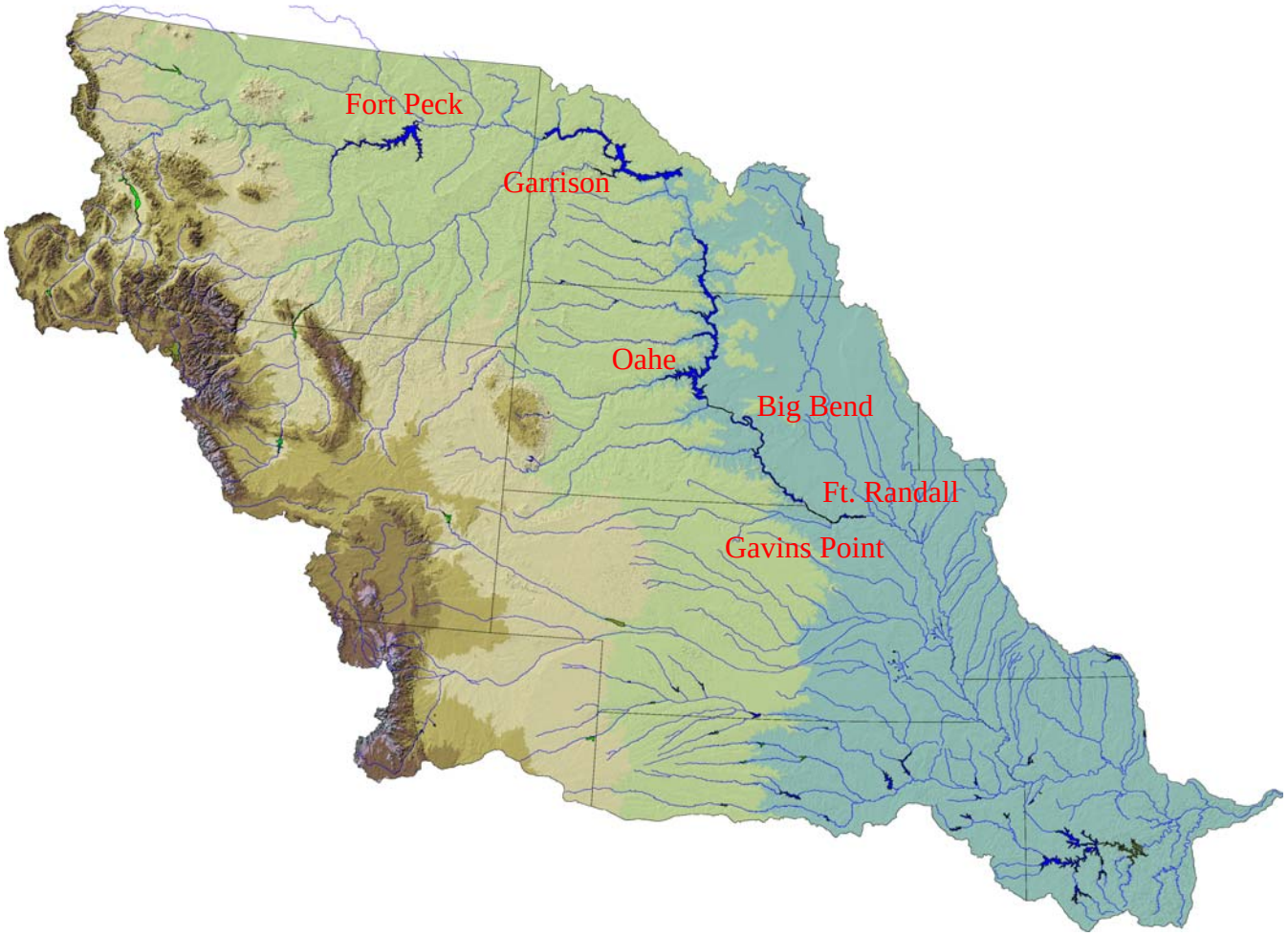
US Army Corps
of Engineers

Northwestern Division

*Missouri River Mainstem Reservoir System*

# Summary of Actual 2007 Regulation

## Missouri River Basin




*U.S. Army Corps of Engineers*
*Northwestern Division*
*Missouri River Basin Water Management Division*
*Omaha, Nebraska*

**April 2008**

# MISSOURI RIVER MAINSTEM RESERVOIRS

## Summary of Actual 2007 Regulation

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## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ACHP | Advisory Council on Historic Preservation |
| AOP | annual operating plan |
| AF | acre-feet |
| B | Billion |
| BOR | U.S. Bureau of Reclamation |
| cfs | cubic feet per second |
| COE | Corps of Engineers |
| Council | National Council Lewis and Clark Expedition Bicentennial |
| CWA | Clean Water Act |
| CY | calendar year (January 1 to December 31) |
| EA | Environmental Assessment |
| EIS | Environmental Impact Statement |
| elev | elevation |
| ESA | Endangered Species Act of 1973 |
| ft | feet |
| ft msl | feet above mean sea level |
| FY | fiscal year (October 1 to September 30) |
| GIS | Geographic Information System |
| GWh | gigawatt hour |
| KAF | 1,000 acre-feet |
| Kcfs | 1,000 cubic feet per second |
| kW | kilowatt |
| kWh | kilowatt hour |
| M | million |
| MAF | million acre-feet |
| MRBA | Missouri River Basin Association |
| MRNRC | Missouri River Natural Resources Committee |
| MRBWMD | Missouri River Basin Water Management Division |
| msl | mean sea level |
| MV | motor vessel |
| MW | megawatt |
| MWh | megawatt hour |
| NEPA | National Environmental Policy Act |
| OPPD | Omaha Public Power District |
| PA | 2004 Programmatic Agreement |
| plover | piping plover |
| pp | powerplant |
| P-S MBP | Pick-Sloan Missouri Basin Program |
| RCC | Reservoir Control Center |
| RM | river mile |
| Service | U.S. Fish and Wildlife Service |
| SHPO | State Historic Preservation Officer |

| | |
|---|---|
| SR-FTT | Steady Release – Flow-to-Target |
| tern | interior least tern |
| THPO | Tribal Historic Preservation Officer |
| TMDL | Total Maximum Daily Load |
| tw | tailwater |
| USBR | U.S. Bureau of Reclamation |
| USGS | United States Geological Survey |
| VERS | Visitation Estimation Reporting System |
| WCSC | Waterborne Commerce Statistics Center |
| Western | Western Area Power Administration |
| yr | year |

## DEFINITION OF TERMS

Acre-foot (AF, ac-ft) is the quantity of water required to cover 1 acre to a depth of 1 foot and is equivalent to 43,560 cubic feet or 325,850 gallons.

Cubic foot per second (cfs) is the rate of discharge representing a volume of 1 cubic foot passing a given point during 1 second and is equivalent to approximately 7.48 gallons per second or 448.8 gallons per minute. The volume of water represented by a flow of 1 cubic foot per second for 24 hours is equivalent to 86,400 cubic feet, approximately 1.983 acre-feet, or 646,272 gallons. Conversely, 1.5 cfs for 24 hours is approximately 1 million gallon per day (MGD)

Discharge is the volume of water (or more broadly, volume of fluid plus suspended sediment) that passes a given point within a given period of time.

Drainage area of a stream at a specific location is that area, measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the river above the specified point. Figures of drainage area given herein include all closed basins, or noncontributing areas, within the area unless otherwise noted.

Drainage basin is a part of the surface of the earth that is occupied by drainage system, which consists of a surface stream or body of impounded surface water together with all tributary surface streams and bodies of impounded water.

Gaging station is a particular site on a stream, canal, lake, or reservoir where systematic observations of hydrologic data are obtained.

Runoff in inches shows the depth to which the drainage area would be covered if all the runoff for a given time period were uniformly distributed on it.

Streamflow is the discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal, the word "streamflow" uniquely describes the discharge in a surface stream course. The term "streamflow" is more general than "runoff" as streamflow may be applied to discharge whether or not it is affected by diversion or regulation.

# MISSOURI RIVER MAINSTEM RESERVOIR SYSTEM

## Summary of Actual 2007 Regulation

## I. FOREWORD

This document contains a summary of the actual regulation of the Missouri River Mainstem Reservoir System (System) for the 2007 Calendar Year (CY). Two other reports related to System regulation are also available, the "System Description and Regulation", and "2006-2007 Annual Operating Plan". All three reports can be obtained by contacting the Missouri River Basin Water Management Division at 1616 Capitol Avenue - Suite 3300, Omaha, Nebraska 68102-3300, phone (402) 996-3841. The reports are also available on the Northwestern Division, Missouri River Water Management Division website at www.nwd-mr.usace.army.mil/rcc.

A basin map is presented on ***Plate 1*** and the pertinent data for the Missouri River System is shown on ***Plate 2.***

## II. REVIEW OF REGULATION – JANUARY-DECEMBER 2007

### A. General

During 2007 the System was regulated in accordance with the Master Water control Manual (Master Manual) and the applicable provisions of the 2006-2007 Annual Operating Plan (AOP), which was made available for review and comment by representatives of State and Federal agencies, Tribes, the general public, and specific interest groups. A summary of the significant events during 2007 is given in the following paragraphs.

### B. Precipitation and Water Supply Available in 2007

The 2007 runoff year was the eighth consecutive drought year experienced in the Missouri River basin. ***Table 1*** shows the runoff total for CY 2007 above Sioux City, IA as well as runoff in reaches from Sioux City to Hermann, MO. ***Table 2*** shows the CY 2007 monthly runoff for selected reaches.

#### 1. Plains Snowpack

November 2006 began with cooler than normal temperatures, particularly in areas of South Dakota and Nebraska. A light snow covered parts of Montana. Record lows were recorded in Aberdeen, SD, Sioux City, IA, Norfolk, NE and near Bozeman, MT. The colder temperatures were followed by much above normal temperatures, including a record high in Sioux City, IA. Meanwhile, western South Dakota did receive some snow with Rapid City reporting 8.2 inches on November 9-10. The warmer weather continued

through late-November with scattered showers occurring across the plains. Cooler temperatures returned for the last few days of the month. A shallow to moderate snow cover continued to prevail across parts of Montana.

In St. Louis, MO, November 29 to December 1 storm-total precipitation reached 3.6 inches, including a substantial ice accumulation and 4.2 inches of snow. Several record low temperatures were set in early December, but were not accompanied by any additional snow. A light to moderate snow cover persisted across parts of the upper basin, but moisture continued to diminish in much of South Dakota. Mostly dry conditions continued into mid-December. A major storm across the nation's mid-section provided much needed moisture. Heavy snow blanketed the central high plains, while ice accumulations were particularly severe in central Nebraska. Cheyenne, WY experienced its snowiest December day with 12.5 inches on December 20. Denver, CO had 20.7 inches of snow in 24 hours during December 20-21. North Platte, NE reported its third-wettest December day on December 20 with 1.4 inches of freezing rain and 2.6 inches of snow. Elsewhere in Nebraska, Kearney and Broken Bow reported second-wettest December days, also on December 20. A second storm contributed to more December precipitation and snowfall records. Great Falls recorded a daily record of 4.4 inches of snowfall on December 27. Farther east, significant ice accumulations were noted in a large swath in the lower basin, while heavy snow fell in the northern parts of the basin. Concordia, KS measured a daily-record snowfall for December 31 of 3.8 inches. Other reports near the end of the month included 16.9 inches of snow at Goodland, KS, 8.2 inches at North Platte, NE, and 11.3 inches in Bismarck, North Dakota. Snow depths were as much as 10 to 12 inches in parts of North Dakota, South Dakota, and Nebraska.

In early January, mild mostly dry weather prevailed across the plains except for somewhat cooler conditions in deeply snow-covered sections of eastern Colorado and western Kansas. Another storm, the fourth in two months, affected the nation's mid-section. Daily-record snowfall records were set at Billings, MT (3.2 inches) and Bozeman, MT (5.1 inches). Extremely cold air followed the storm. By mid-month widespread snow blanketed a good portion of the basin, but some shallow and patchy areas existed in Montana and South Dakota. The first measureable snow of the season in Norfolk, NE occurred on January 14 with 6.5 inches. Some warm weather after mid-month gradually melted some of the snow cover in Nebraska. However, North Platte, NE received 6.8 inches of snow and Grand Island, NE received 6.0 inches on January 20-21. Colder weather prevailed late in the month with deeply snow covered sections of the basin reporting temperatures as much as 20 degrees below normal.

February began with snow depth generally less than 4 inches across Nebraska, North Dakota, South Dakota, and Montana. Western South Dakota had little or no snow cover, while some small areas of North Dakota and Montana reported up to 10 inches. Bitterly cold conditions prevailed across the Dakotas and eastern Nebraska. A record setting storm encased much of the Midwest and Northeast. Billings, MT noted snow on seven consecutive days, totaling 12.9 inches on February 8-14. Great Falls, MT received 4.3 inches of snow and Havre, MT received 3.5 inches on February 23. In some areas warmer weather finally began to win out as Denver, CO and North Platte, NE ended 61

consecutive days with more than one inch of snow of snow cover. The streaks for Denver and North Platte were the second and third longest on record for those cities. A late February storm produced a daily record snowfall of 8.7 inches in Sioux City, IA, 10.1 inches in Huron, SD, and 6.0 inches in Williston, ND.

The late February storm lingered into the first days of March, and produced a daily record snowfall of 8.7 inches in Sioux City, IA. After the storm, relatively tranquil conditions prevailed across the basin, along with warmer temperatures. In Nebraska, most of the remaining snow cover melted, except roughly along and east of the Missouri River. By mid-month above normal temperatures prevailed. Record high temperatures occurred in Rapid City, SD and Bismarck, ND. Most of the plains snow cover had melted by mid-March except for eastern North Dakota and eastern South Dakota and some small sections of Wyoming. Record setting temperatures continued for several days and continued to lessen the plains snow cover. By the end of the month the remaining snow cover was generally less than four inches across North Dakota and Montana, while ranging up to 8 to 12 inches in some sections of Wyoming.

Early April was a stunning reversal from March, with unusually cold air settling across the plains. North Platte, NE, received a daily record snowfall of 4.9 inches on April 5. Cold temperatures and snow continued into mid-April. Bismarck, ND received 5.5 inches of snow, and Aberdeen, SD received 4.5 inches on April 10. Sioux Falls, SD also reported 6.3 inches on that day for the fourth snowiest April day on record. Warmer temperatures later in April melted the remaining snow cover.

**2. Mountain Snowpack**

a. Fall 2006

In Montana, the mountain snowfall season got off to a slow start and state-wide mountain snowpack was below average. December precipitation was 72 of normal. Mountain snow water content was 79 percent of average and 76 percent of the previous year.

In Wyoming, snow water equivalent (SWE) across the state was generally below average. The SWE average for the state was 82 percent of normal. In December, precipitation in the basins ranged from 39 percent of average to 180 percent of average.

The 2006 year ended with the mountain snowpack 80 percent of normal in the reach above Fort Peck and 77 percent of normal in the reach from Fort Peck to Garrison.

b. January 2007

January weather patterns in Montana remained similar to December with most of the mountain storm activity remaining west of the divide. January mountain precipitation was generally below average. Normally about 60 percent of the seasonal snowpack is in

place by the end of January. State-wide, mountain snowpack was 80 percent of average and 74 percent of the previous year.

Generally, the SWE across Wyoming was below average for January. Storms were sporadic. The SWE in the northwestern portion of the state was about 71 percent of normal, and the northeastern portion was 70 percent of normal. The southeast and southwest areas were both 77 percent of normal. January's precipitation was quite varied across the state. Basin precipitation ranged from 35 percent of average to 130 percent of average in certain basins.

The month of January ended with the mountain snowpack 80 percent of normal in the reach above Fort Peck and 74 percent of normal in the reach from Fort Peck to Garrison.

c. February 2007

February mountain snowfall was much improved compared to previous months. Mountain precipitation in the Missouri River headwaters was 129 percent of normal and the Yellowstone was 113 percent of normal. For the year, however, Montana mountain snowpack still remained below normal, 87 percent of average and 84 percent of the previous year.

In Wyoming SWE amounts across the state were below average for February at 81 percent of normal. The SWE varied from 77 percent of normal in the southwestern portion of the state to 86 percent in northeastern Wyoming. February precipitation was below average across most of Wyoming.

The month of February ended with the mountain snowpack 85 percent of normal in the reach above Fort Peck and 83 percent of normal in the reach from Fort Peck to Garrison.

d. March 2007

Mountain precipitation in Montana during March was 66 percent of average and March mountain snowpack increases were well below average. Mountain snowpack decreased an average of 17 percent due to above average temperatures and below average precipitation. Snowmelt occurred at lower elevations and warm-facing mountain exposures, but cooler temperatures late in the month slowed significant melt. Snowpack was 70 percent of average and 70 percent of last year.

During March, the SWE across Wyoming was below average at 72 percent of normal. The SWE in the northwestern portion of the state was about 66 percent of normal, and the northeastern portion was 80 percent of normal. The southeast and southwest areas were 75 and 66 percent of normal, respectively. February precipitation was below average across most of Wyoming.

The month of March ended with the mountain snowpack 73 percent of normal in the reach above Fort Peck and 76 percent of normal in the reach from Fort Peck to Garrison.

e. April 2007

In Montana, mountain precipitation during April was below average at 83 percent of normal. April was variable with record high temperatures and storms adding significant snow water. Unseasonably warm temperatures at the end of April continued the above average snowmelt. Mountain snowpack was well below average at 68 percent and 70 percent of the previous year.

Generally, the SWE across Wyoming was below average for April, with water content about 72 percent of average. Across the state SWE ranged from 82 percent in the northeast portion of the state to 45 percent in the southwest part of Wyoming. April's precipitation was below average across most of Wyoming.

The month of April ended with the mountain snowpack 61 percent of normal in the reach above Fort Peck and 65 percent of normal in the reach from Fort Peck to Garrison.

f. May 2007

In Montana, May was quite variable with the second and third weeks producing above average snowmelt and additional snow the last part of the month. The remaining snowpack was severely below average and well below last year. Mid-May temperatures caused rapid snowmelt, and snowpack ended the month 40 percent of average and 60 percent of the previous year.

The SWE across Wyoming dropped significantly during May and was much below average at 17 percent of normal. The SWE in the northwestern portion of the state was about 26 percent of normal and the northeastern portion was already melted out by the end of the month. The southeast and southwest areas were 27 and 15 percent of normal, respectively. May's precipitation was below average across most of Wyoming.

As the month of May ended, the mountain snowpack was 15 percent of normal in the reach above Fort Peck and 19 percent of normal in the reach from Fort Peck to Garrison, representing an early melt of the snowpack as well as a below-normal snowpack .

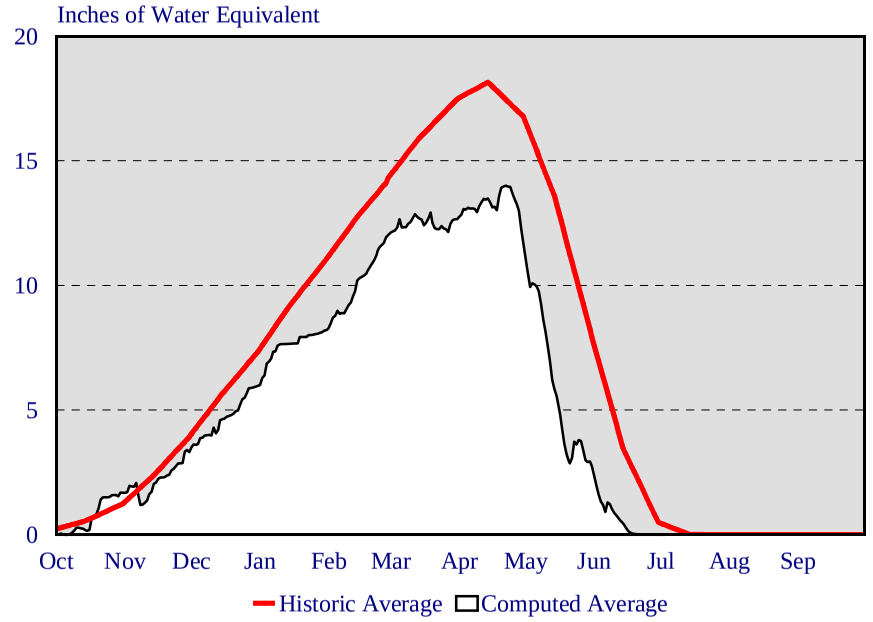
g. Summary

Overall snow water content totals recorded during the entire snow season ending July 1, 2007 were below normal. The mountain snowpack in the reach above Fort Peck peaked on April 22 at 76 percent of the normal peak accumulation. The mountain snowpack in the reach between Fort Peck and Garrison peaked on April 24 at 81 percent of the normal peak accumulation. The normal date for snow accumulation to peak is April 15. The 2006-2007 mountain snow accumulation and melt for the reaches above Fort Peck and Fort Peck to Garrison are illustrated in ***Figure 1***.

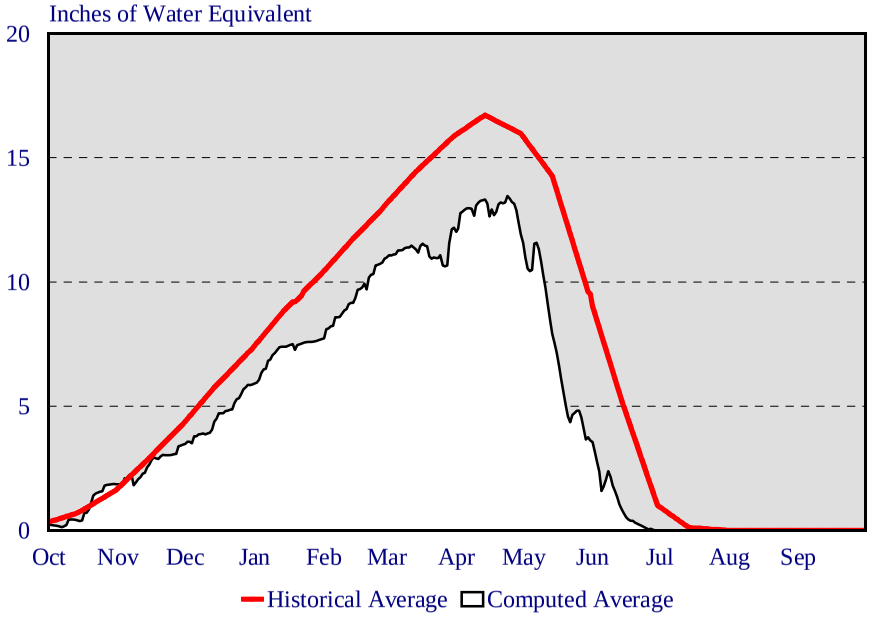
Figure 1

# *Missouri River Basin Mountain Snowpack Water Content 2006-2007*

### *Total Above Fort Peck*




### *Total Fort Peck to Garrison*




The mountain snowpack in the reach above Fort Peck peaked at 76% of the normal peak accumulation on April 22. The mountain snowpack in the reach between Fort Peck and Garrison peaked at 81% of the normal peak accumulation on April 24. The Missouri River basin mountain snowpack normally peaks near April 15.

## 3. Weather Conditions

The following weather summaries are from the USDA Weekly Weather and Crop Bulletins. ***Figure 2*** displays the drought magnitude and ***Figure 3*** displays percent of normal precipitation experienced by the basin at 3-month increments during the calendar year. As shown in ***Figure 2***, the year began with severe to extreme drought conditions in the large portions of Wyoming and some areas of western South Dakota and western Nebraska. Abnormally dry to moderate drought conditions persisted in the rest of the upper portion of the basin. By July, most of the basin had returned to normal conditions; most of Wyoming remained in moderate to severe drought conditions.

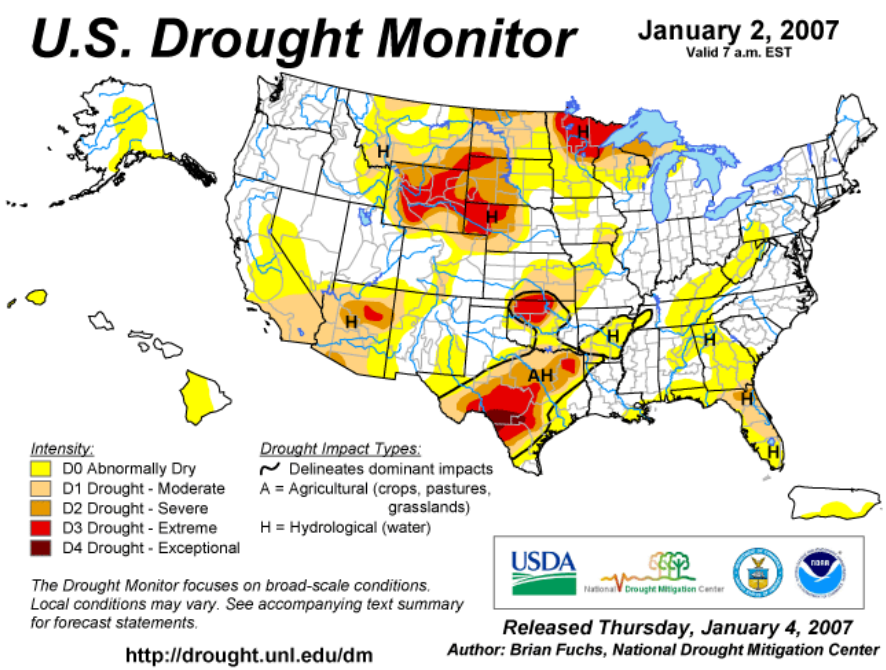
### a. January 2007

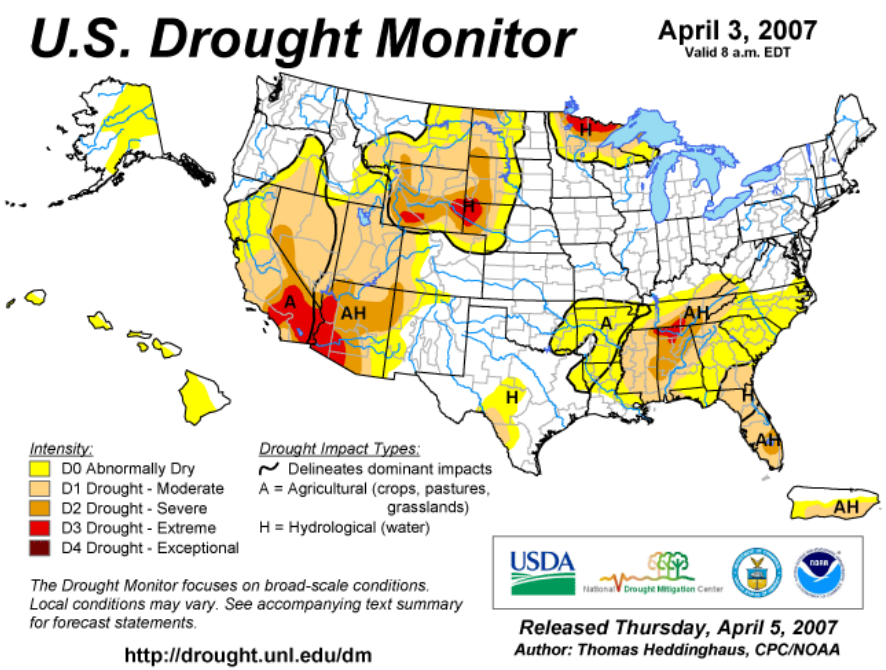
January began on a warm note but ended under a very chilly regime nationwide. Monthly temperatures ranged from more than 5°F below normal in deeply snow-covered areas of the central High Plains to at least 5°F above normal in a broad area stretching across the northern Plains and Midwest. In the wake of December storms, both Denver, CO and North Platte, NE ended the month with a 42$^{nd}$ consecutive day (December 21 – January 31) with at least a 1-inch snow cover at 7 a.m. For Denver it became the fifth-longest such streak (the record of 63 days was set in 1983-84), while for North Platte it stood as the seventh-longest spell with continuous snow cover (the record of 88 days was set in 1978-79). Meanwhile in northwestern Kansas, Goodland reported a snow depth of at least 8 inches on each day during the month, with a peak of 18 inches on January 1 and 2. Goodland also experienced 12 consecutive days (January 11-22) with temperatures below 32°F, the seventh-longest such streak there on record and longest since December 1983. As far as daily records set during the month, Chinook (downslope) winds resulted in Townsend, MT posting a daily-record high of 52°F on January 2. The colder air entering the basin by the second week in January, along with snow, resulted in daily-record totals in Montana. Billings posted a low of -18°F on January 12, representing its lowest minimum temperature since January 27, 1997, when it was -19°F. The month ended with temperatures averaging as much as 15°F above normal on the northern High Plains. Daily-record highs for January 25 were reached in Flatwillow, MT (66°F) and Dickinson, ND (59°F).

### b. February 2007

During February, wetter-than-normal conditions were observed in the northern Plains. During the first part of the month temperatures ranged from 10 to 25°F below normal in the Dakotas and eastern Nebraska. From February 13-16, Russell, KS (4, -5, -6, and -4°F) posted four consecutive daily-record lows. Rapid City, SD (-20°F) obliterated its February 14 standard by 17°F (previously, -3°F in 1973). Bismarck, ND (-34°F on February 15) posted its lowest reading since February 3, 1996, when the thermometer registered -36°F. Perhaps more impressive was Bismarck's plunge from its hottest weather (112°F on July 30, 2006) since July 1936 to its coldest weather since February 1996, and an overall temperature range of 146°F, in a span of less than 7 months. In

Figure 2


U.S. Drought Monitor
January 2, 2007
Valid 7 a.m. EST
Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
Drought Impact Types:
Delineates dominant impacts
A = Agricultural (crops, pastures, grasslands)
H = Hydrological (water)
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
http://drought.unl.edu/dm
USDA
National Drought Mitigation Center
Released Thursday, January 4, 2007
Author: Brian Fuchs, National Drought Mitigation Center


U.S. Drought Monitor
April 3, 2007
Valid 8 a.m. EDT
Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
Drought Impact Types:
Delineates dominant impacts
A = Agricultural (crops, pastures, grasslands)
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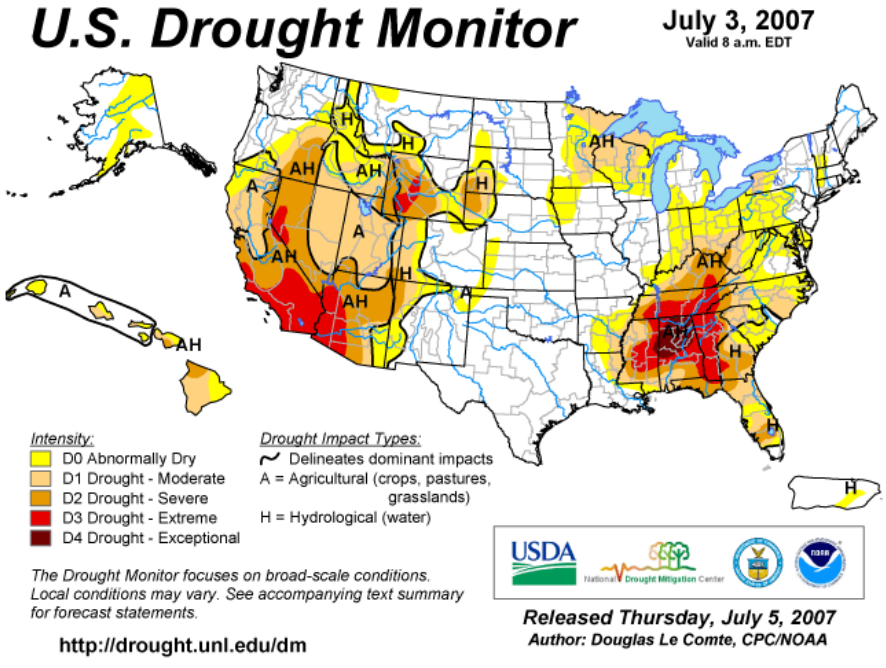
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
http://drought.unl.edu/dm
USDA
National Drought Mitigation Center
Released Thursday, April 5, 2007
Author: Thomas Heddinghaus, CPC/NOAA


U.S. Drought Monitor
July 3, 2007
Valid 8 a.m. EDT
Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
Drought Impact Types:
Delineates dominant impacts
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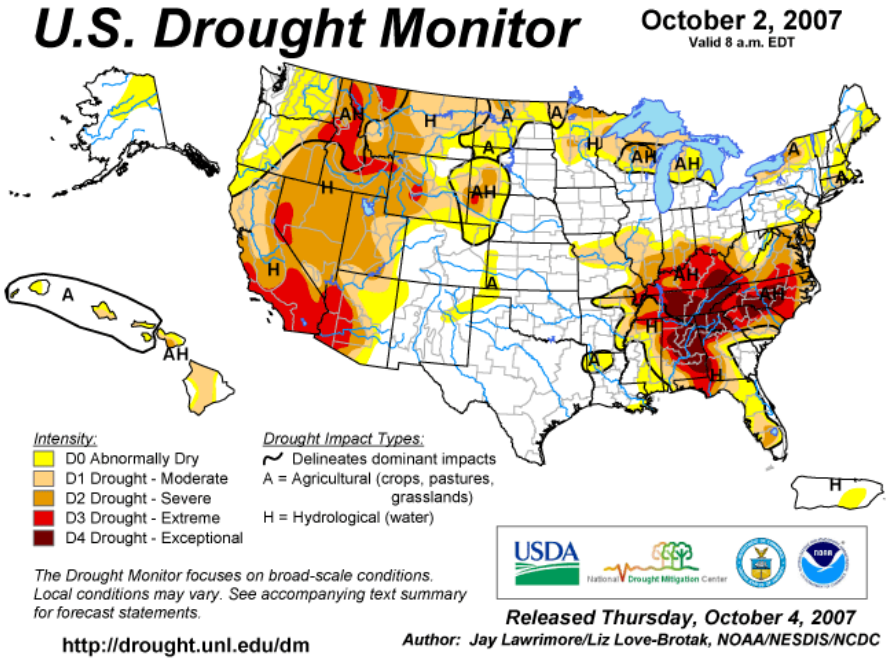
http://drought.unl.edu/dm
USDA
National Drought Mitigation Center
Released Thursday, July 5, 2007
Author: Douglas Le Comte, CPC/NOAA


U.S. Drought Monitor
October 2, 2007
Valid 8 a.m. EDT
Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
Drought Impact Types:
Delineates dominant impacts
A = Agricultural (crops, pastures, grasslands)
H = Hydrological (water)
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
http://drought.unl.edu/dm
USDA
National Drought Mitigation Center
Released Thursday, October 4, 2007
Author: Jay Lawrimore/Liz Love-Brotak, NOAA/NESDIS/NCDC

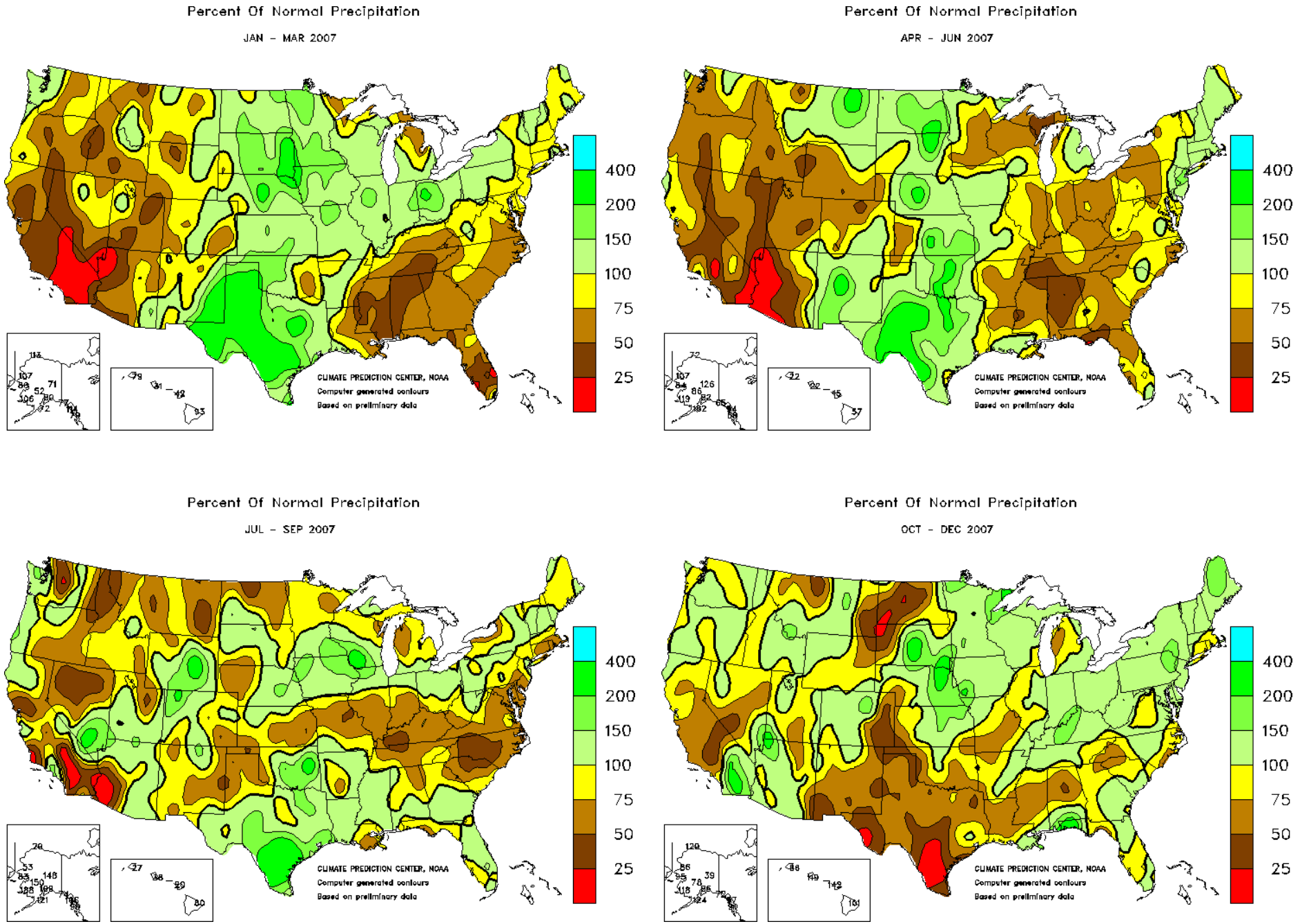

Percent Of Normal Precipitation
JAN - MAR 2007
400
200
150
100
75
50
25
CLIMATE PREDICTION CENTER, NOAA
Computer generated contours
Based on preliminary data
Percent Of Normal Precipitation
APR - JUN 2007
400
200
150
100
75
50
25
CLIMATE PREDICTION CENTER, NOAA
Computer generated contours
Based on preliminary data
Percent Of Normal Precipitation
JUL - SEP 2007
400
200
150
100
75
50
25
CLIMATE PREDICTION CENTER, NOAA
Computer generated contours
Based on preliminary data
Percent Of Normal Precipitation
OCT - DEC 2007
400
200
150
100
75
50
25
CLIMATE PREDICTION CENTER, NOAA
Computer generated contours
Based on preliminary data



Figure 3

South Dakota, preliminary data from near Usta, Perkins County, showed a 160-degree swing from a peak of 120°F on July 15, 2006, to -40°F on February 15, 2007. Relatively speaking, the central Plains had a break from wintry weather. Following near-record snow-cover durations in locations such as Denver, CO, and North Platte, NE, the snow finally melted away. Both Denver and North Platte reported at least 1 inch of snow on the ground at the official morning observation tie on 61 consecutive days from December 21 – February 19. All-time records – 88 days (1978-79) in North Platte and 63 days (1983-84) in Denver – remained on the books. However, Goodland, KS, retained its snow cover through month's end, boosting its all-time record to 71 days (December 20 – February 28). Goodland, chilled in part by its persistent snow pack, also experienced 78 consecutive days (December 16 – March 3) with temperatures below 50°F, smashing its 1992-93 mark of 75 days. Elsewhere on the Plains, February 24 was anything but a tranquil day. Wet snow and high winds closed I-70 and other roads on the central High Plains. A gust to 75 m.p.h. was clocked in Hays, KS.

c. March 2007

Record-setting warmth in March followed a nearly nationwide cold snap from mid-January through February. Warmth rivaled conditions observed in March 2004, which was the nation's second-warmest March since the beginning of the 20th century. Rapid City, SD (82°F on March 12) tied a monthly record most recently attained on March 26, 1993. At Bismarck, ND, the high of 75°F on March 12 represented earliest reading of 75°F or greater. Again in Rapid City, SD (83°F on March 20) the monthly standard of 82°F was erased. It was the second-warmest March behind 1910 in locations such as Dodge City, KS and North Platte, NE. At month's end, heavy rain shifted into the Midwest, where the March 31 was the wettest March day on record in Sioux Falls, SD (3.27 inches; previously 2.39 inches on March 25, 1995), and Sioux City , IA (2.25 inches; previously, 1.68 inches on March 29, 1940). Sioux Falls also set a monthly precipitation record of 4.98 inches, eclipsing its March 1998 standard of 4.08 inches.

d. April 2007

A severe and historic early-April freeze followed record-setting March warmth. On April 7-8, several monthly record lows were established in locations that had just experienced record-high March temperatures. Lows dipped to 6°F on April 6 in South Dakota locations such as Rapid City and Aberdeen. A daily-record low for April 7 included 14°F in McCook, NE. As the month drew to a close, Kansas City, MO, was one of the several locations reporting cooler weather in April than March. It was only the fourth such occurrence in Kansas City, along with 1907, 1910, and 1918. Kansas City's March average temperature of 52.6°F (8.8°F above normal) was followed in April by a reading of 51.9°F (2.5°F below normal). Kansas City also experienced a record-setting streak of 10 consecutive days (April 4-13) with highs below 50°F, edging an April 1888 mark by 2 days. Heavy rain fell on the Plains and upper Midwest towards the end of the month. On April 21, the 2.32-inch rainfall in Watertown, SD, represented its first 2-inch total on an April day since April 19, 1957. Less than a week later, heavy rain erupted across the central Plains on April 24, when Lincoln, NE (2.60 inches), experienced its

wettest April day on record (previously, 2.34 inches on April 28, 1974). Daily-record totals for April 24 included 3.46 inches in Kearney, NE, 2.09 inches in Denver, CO, and 2.08 inches in Sioux City, IA. Heat intensified at month's end across much of the U.S. April 29 was the warmest April day on record in locations such as Spencer, IA (93°F; previously, 92°F on April 21, 1980). Elsewhere in Iowa, Sioux City notched consecutive daily-record highs of 93°F on April 29-30. Daily record highs also topped 90°F in several other places, including Yankton, SD (92°F on April 29), and St. Louis, MO (91°F on April 30).

e. May 2007

Wet weather across the central one-third on the Nation contrasted with drier-than-normal conditions in the East and West. In fact, record or near-record May wetness was observed in several locations from Texas to the Dakotas. Aberdeen, SD (7.62 inches on May 5), shattered its all-time daily rainfall record previously set with a 4.35-inch total on May 14, 1908. Aberdeen (7.75 inches on May 5-6) also set a 24-hour rainfall standard, previously attained when 5.20 inches fell on June 29-30, 1978. Watertown, SD, received a state-record 8.73 inches of rain during a 24-hour period on May 5-6 (previously, 8.00 inches in Elk Point on September 10, 1900), followed by significant flood in the James River basin. See ***Plate 3*** for a radar image of the precipitation totals for the May 5-6 storm over the basin. The James River crested 6.69 feet above flood stage (on May 7) in Huron and 6.81 feet (on May 8) above flood stage in Forestburg, the fourth-highest level in both locations behind high-water marks in April 1997, 1881, and 2001. Torrential rain also fell in the nation's mid-section, where Topeka, KS (5.10 inches on May 6), endured its third-wettest day on record behind 5.61 inches on September 23, 2005, and 5.23 inches on March 15, 1919). In addition, more than 100 tornadoes were catalogued on May 4-5 from Texas to South Dakota. A few days later, the Grand River near Sumner, MO, crested 13.90 feet above flood stage on May 12, second only to the July 1993 flood level of 16.52 feet above flood stage. Along the Missouri River, Brownville, NE (6.84 feet above flood stage on May 9), noted its highest level since June 25, 1996, its highest crest since July 26, 1993. High rainfall amounts continued to occur during May as May 29 was the wettest day in more than 110 years of record-keeping in Broken Bow, NE, where 5.65 inches fell. See ***Plate 4*** for a radar image of the precipitation totals for the May 29-30 storm over the basin. Broken Bow's previous wettest day, August 10, 1968, featured 4.72 inches. In addition, Broken Bow (10.82 inches) completed its wettest moth on record, eclipsing the 10.33-inch total observed in June 1975. In South Dakota, Aberdeen's monthly rainfall climbed to 12.23 inches, second only to a 12.39-inch sum in May 1906. Elsewhere in South Dakota, 5-day (May 29 – June 2) rainfall totaled 8.24 inches near Deadwood and 6.28 inches in Lead. Aberdeen's year-to-date precipitation reached 16.08 inches on May 25, surpassing its 2006 annual total of 15.94 inches. Aberdeen's normal annual precipitation is 20.22 inches. Record-high May rainfall totals where established in Broken Bow, NE (10.82 inches; normal of 3.51 inches; previous record of 7.87 inches in 1923) and Glasgow, MT (6.61 inches; normal of 1.72 inches; previous record of 5.69 inches in 1899 and 1906). Second-wettest May on record was established in Aberdeen, SD (12.23 inches; normal of 2.69 inches; record is 12.39 inches

in 1906) and Huron, SD (7.41 inches; normal is 3.00 inches; record is 7.69 inches in 1962).

f. June 2007

Wetness, already a problem on the central Plains by the end of May, intensified during June. In western South Dakota, 5-day (May 29 – June 2) rainfall totaled 8.24 inches near Deadwood and 6.28 inches in Lead. Miles City, MT, (2.02 inches on June 6) experienced its wettest June day since June 7, 1993, when 2.45 inches fell. The storm's central barometric pressure fell below 980 millibars (28.94 inches of mercury) over the north-central U.S. on June 7, a day after Goodland, KS (981.8 millibars, or 28.99 inches), set a record for its lowest June pressure. The storm's trailing cold front swept across the northern Plains from June 6-8, trailed by cooler weather but preceded by widespread thunderstorms. More than a dozen tornadoes were spotted across the upper Midwest on June 7, followed the next day by nearly 300 reports of wind gusts at least 58 m.p.h. Denver, CO (31°F on June 8) experienced its latest freeze on record by 6 days, eclipsing the former mark of 30°F on June 2, 1951. Light freezes were also noted on June 8 in locations such as Cheyenne, WY (31°F), and Scottsbluff, NE (32°F). By June 10-11, heavy rain returned to the nation's mid-section. In Chase County, NE, as much as 4 to 10 inches of rain fell in a 72-hour period from June 11-13. In South Dakota, Aberdeen surpassed its normal annual precipitation total of 20.19 inches on June 13. Aberdeen's January 1 – June 13 total of 20.33 inches was second only to a 21.85-inch sum during the same period in 1896. In contrast, rainfall largely bypassed pockets of the High Plains and western Corn Belt; record-low June total in Nebraska included 0.25 inch (9 percent of normal) in Scottsbluff and 0.24 inch (6 percent of normal) in Omaha. Selected daily-record highs included 107°F (on June 25) in Chadron, NE; 100°F (on June 24) in Denver, CO; and 99°F (on June 29) in Casper, WY.

g. July 2007

The month began with record or near-record flooding in several basins in western Missouri due to end-of-June rainfall that totaled from 4 to 12 inches. Near Horton, MO, the Little Osage River crested 12.31 feet above flood stage on July 1, second only to the high-water mark (18.40 feet above flood stage) established on October 4, 1986. In the same Osage River watershed, the Marais des Cygnes River achieved its second-highest crest on record near the eastern Kansas towns of Osawatomie (21.19 feet above flood stage on July 1), La Cygne (11.07 feet above flood stage on July 2), and Trading Post (15.26 feet above stage on July 2). In all three Kansas locations, record crests along the Marais des Cygnes River occurred in July 1951. By July 6, record-setting heat spread across the northern High Plains and Midwest. Cut Bank, MT (106°F on July 6) reported triple-digit heat for the first time since August 6, 1983, and experienced its hottest day since August 5, 1961, when it was 107°F. Highs reached 98°F in Sioux City, IA, on July 7 and 8, in the midst of a 3-week period (June 24 – July 14) when rainfall totaled just 0.02 inch. Record-low July totals were reported in several upper Midwestern locations, including Sioux City, IA (a trace, or 3.79 inches below normal). Sioux Falls, SD's rainfall totaled just 0.32 inch in the 39-day period from June 23 – July 31. The hot, dry

weather wore on through month's end throughout the High Plains. Records for the hottest month had stood since July 1917 in Cut Bank and July 1936 in Great Falls and Lewistown. Other historically hot July months that were surpassed by the heat of July 2007 included 2003 (in Helena, MT) and 2006 (in Rapid City, SD and Riverton, WY). Miles City, MT (110°F on both July 23 and 24), posted highs of 110°F or greater on consecutive days for the first time on record. Elsewhere in Montana, Cut Bank (100°F on July 23) noted its second triple-digit reading this month (along with 106°F on July 6) after going nearly 24 years without a day of 100-degree heat. Late in the month, extreme heat also spread into the Dakotas, Wyoming, and western Nebraska, resulting in daily-record highs in locations such as Pierre, SD (109°F on July 25), Bismarck, ND (106°F on July 23), and Worland, WY (104°F on July 23). In western Nebraska, Valentine notched highs of 100°F or greater on 5 consecutive days from July 21-25.

h. August 2007

The month began with wetness in the northern Plains. Huron, SD netted 2.33 inches of rain on August 3. Huron's rainfall represented its fourth-highest August daily total on record, well behind the 4.11-inch standard set on August 2, 1956. St. Louis, MO endured its longest spell of 95-degree heat since July 1980. St. Louis experienced 11 days in a row with high of 95°F or greater from August 2-12, second only to August 1980 when St. Louis experienced 14 consecutive such days. Heavy rain fell across the upper Midwest during the middle of the month resulting in a record monthly total in Mobridge, SD (5.76 inches; previously 5.45 inches in 1951). Mobridge collected 4.43 inches on August 17, representing its wettest day on record (previously, 3.66 inches on July 11, 1997). Other daily-record totals included 3.24 inches (on August 23) in Ottumwa, IA; and 4.12 inches (on August 24) in St. Joseph, MO. These rains registered an unofficial daily total of 12.34 inches at Rathbun Dam on the Chariton River in south central Iowa. See ***Plate 5*** for a radar image of the precipitation totals for the May 23-24 storm.

i. September 2007

An impressive cold snap arrived on the northern Plains on September 14, when daily-record lows dipped to 22°F in Williston, ND and 28°F in Kennebec, SD. In Iowa, Sioux City (32°F on September 15) experienced its second-earliest freeze, behind September 13, 1902. According to Iowa's state climatologist, more than half of the state was affected by the September 15 freeze. It was also Iowa's most widespread freeze so early in the season since September 12-13, 1902. The Western water year (October 1 – September 30) ended with some positive signs across the eastern slopes of the northern and central Rockies and adjacent High Plains. For example, Billings, MT, received 16.87 inches of precipitation (114 percent of normal) during the 12-month period ending September 30, representing its first wetter-than-normal year since 1997-98 and ending a run of 8 consecutive drier-than-normal years.

j. October 2007

The month began with record-setting heat in the high Plains. In Pierre, SD a daily-record 2.55 inches of rain fell on October 6, shattering the previous mark for the date (0.99 inch). Near mid-month locally heavy rains soaked the Plains. Denver, CO notched its wettest October day (2.48 inches on October 13). Omaha, NE (1.71 inches on October 14) also collected a daily-record total helping to boost its month-to-date precipitation to an October-record 6.23 inches (previously, 5.86 inches in 1877). By week's end, October precipitation records were also established in locations such as Pierre, SD (5.70 inches, previously, 5.39 inches in 1982), and Norfolk, NE (6.81 inches; previously, 4.57 inches in 1968). Warm weather briefly returned to the northern and central High Plains, where daily records included 83°F (on October 24) in Miles City, MT, and 80°F (on October 25) in Denver, CO. Three days after a daily-record low of 6°F, Laramie, WY (69°F on October 25), noted a daily-record high. Just a few days later, cool weather settled across the Plains. The season's first freeze in Billings was reached (30°F) on October 27. That event tied the record for Billings' latest first freeze on record, previously established on October 27, 1967.

k. November 2007

Persistent warmth in early November resulted in record-high temperatures across the western portion of the country. On November 4, a record-high of 81°F was recorded in Russell, KS. Continued warmth on the High Plains also resulted in a record for November 10 in Miles, City, MT (72°F). During the 36 days from October 18 – November 22, no measureable rain fell in Dodge City, KS. In that span, Dodge City's winds gusted to 30 m.p.h. or higher on 19 of 36 days, while temperatures ranged from 14°F (on November 22) to 90°F (on October 20). After mid-month, record-setting warmth spread from the West across the remainder of the country. On November 19, Kearney, NE posted a record high of 81°F. However, by November 22 record lows were set in Laramie, WY (-10°F) and Russell, KS (11°F). Farther north, heavy snow spread into Montana by November 18, when daily records reached 12.6 inches in Neihart and 7.8 inches in Great Falls. From November 18-21, a total of 9.7 inches of snow blanketed Great Falls.

l. December 2007

Daily records were set in Grand Forks, ND in early December of -19 and -26°F on December 5 and 8, respectively. In St. Joseph, MO, precipitation totaled 2.34 inches on December 10-11, while temperatures ranged from 13 to 33°F. Records for December 15 included -21°F in Laramie, WY. St. Louis, MO noted its fourth-snowiest December day on record, with a 6-9-inch total on the 15th. On December 22 a daily-record total of 9.0 inches of snow was recorded in Topeka, KS. Christmas Day featured snowfall total of 5.5 inches in Lander, WY, and 4.1 inches in Scottsbluff, NE. Through December 25, Lander's month-to-date snowfall climbed to 34.6 inches (368 percent of normal).

Meanwhile, Denver, CO netted 7.8 inches of snow in an 18-hour period on December 24-25.

### 4. 2007 Calendar Year Runoff

Runoff for the period January through December 2007 for the basin above Sioux City, Iowa, totaled 21.3 MAF, 85 percent of normal runoff based on the historical period of 1898-1998, as shown in ***Table 1***. The 21.3 MAF in 2007 represents a runoff slightly higher than the lower quartile (19.5 MAF) runoff as shown on ***Figure 4***. Monthly runoff during 2007 above Sioux City, IA varied from a low of 43% in September to a high of 113% in December. ***Figure 5*** indicates the monthly variation of runoff for CY 2007.

The observed monthly runoffs for 2007 from Fort Peck downstream to Sioux City, IA by major river reach are presented in ***Table 2***. The table lists the runoff by month and reach and is the basic compilation of the runoff into the System. This forecast forms a basis for intra-system balancing of storage accumulated in the System and is updated by the Reservoir Control Center (RCC) on the first of each month to forecast the runoff for the remainder of the year. The monthly accumulation of actual runoff is shown under the "Accumulated Summation above Sioux City" column. As the season progresses and the actual runoff is accumulated, the forecast becomes more reliable. The majority of the annual runoff has usually occurred by the end of July, and the remainder of the year can be estimated with a greater degree of accuracy.

**Table 1**
**2007 Calendar Year Runoff for Selected Reaches**

| Reach | 1898 – 1998 Average Runoff Volume (in 1000 AF) | Calendar Year 2007 Runoff Volume (in 1000 AF) | Percent of Average Runoff |
|---|---|---|---|
| Above Fort Peck | 7,395 | 5,217 | 71 |
| Fort Peck to Garrison | 10,840 | 7,689 | 71 |
| Garrison to Oahe | 2,430 | 1,478 | 61 |
| Oahe to Fort Randall | 910 | 553 | 61 |
| Fort Randall to Gavins Point | 1,675 | 1,862 | 111 |
| Gavins Point to Sioux City | 1,940 | 4,497 | 232 |
| **TOTAL ABOVE SIOUX CITY** | **25,190** | **21,296** | **85** |
| | | | |
| | **1967–2007 Average Runoff** | | |
| Sioux City to Nebraska City* | 7,510 | 10,740 | 143 |
| Nebraska City to Kansas City* | 11,500 | 14,450 | 125 |
| Kansas City to Hermann* | 23,360 | 21,510 | 92 |
| **TOTAL BELOW SIOUX CITY*** | **42,370** | **46,700** | **110** |

** Runoff in the reaches from Sioux City to Hermann is not adjusted to 1949 depletion levels. Averages are taken from USGS Water Data Reports for the period 1967-2007.*

# Table 2

## Missouri River Basin

## Calendar Year 2007 runoff above Sioux City, IA

01-Feb-08

with Holdouts Thru July

| Reach Above | Fort Peck | Garrison | Oahe | Fort Randall | Gavins Point | Sioux City | Summation above Gavins Point | Summation above Sioux City | Accumulated Summation above Sioux City |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Values in 1000 Acre Feet | | | | | |
| | (Historic) | | | | | | | | |
| JAN 2007 | 256 | 184 | -9 | -17 | 73 | 148 | 487 | 635 | 635 |
| NORMAL | 315 | 260 | 10 | 20 | 100 | 35 | 705 | 740 | 740 |
| DEPARTURE | -59 | -76 | -19 | -37 | -27 | 113 | -218 | -105 | -105 |
| % OF NORM | 81% | 71% | -90% | -85% | 73% | 423% | 69% | 86% | 86% |
| FEB 2007 | 362 | 211 | 19 | 94 | 199 | 212 | 885 | 1,097 | 1,732 |
| NORMAL | 365 | 360 | 90 | 50 | 125 | 85 | 990 | 1,075 | 1,815 |
| DEPARTURE | -3 | -149 | -71 | 44 | 74 | 127 | -105 | 22 | -83 |
| % OF NORM | 99% | 59% | 21% | 188% | 159% | 249% | 89% | 102% | 95% |
| MAR 2007 | 627 | 917 | 203 | 146 | 335 | 932 | 2,228 | 3,160 | 4,892 |
| NORMAL | 610 | 1,010 | 580 | 220 | 205 | 300 | 2,625 | 2,925 | 4,740 |
| DEPARTURE | 17 | -93 | -377 | -74 | 130 | 632 | -397 | 235 | 152 |
| % OF NORM | 103% | 91% | 35% | 66% | 163% | 311% | 85% | 108% | 103% |
| APR 2007 | 498 | 635 | 190 | 3 | 196 | 649 | 1,522 | 2,171 | 7,063 |
| NORMAL | 665 | 1,115 | 500 | 145 | 180 | 340 | 2,605 | 2,945 | 7,685 |
| DEPARTURE | -167 | -480 | -310 | -142 | 16 | 309 | -1,083 | -774 | -622 |
| % OF NORM | 75% | 57% | 38% | 2% | 109% | 191% | 58% | 74% | 92% |
| MAY 2007 | 826 | 1,439 | 73 | 106 | 210 | 937 | 2,654 | 3,591 | 10,654 |
| NORMAL | 1,120 | 1,280 | 320 | 145 | 185 | 275 | 3,050 | 3,325 | 11,010 |
| DEPARTURE | -294 | 159 | -247 | -39 | 25 | 662 | -396 | 266 | -356 |
| % OF NORM | 74% | 112% | 23% | 73% | 114% | 341% | 87% | 108% | 97% |
| JUN 2007 | 1,114 | 2,340 | 429 | 84 | 147 | 513 | 4,114 | 4,627 | 15,281 |
| NORMAL | 1,655 | 2,715 | 435 | 160 | 180 | 270 | 5,145 | 5,415 | 16,425 |
| DEPARTURE | -541 | -375 | -6 | -76 | -33 | 243 | -1,031 | -788 | -1,144 |
| % OF NORM | 67% | 86% | 99% | 53% | 82% | 190% | 80% | 85% | 93% |
| JUL 2007 | 460 | 800 | 134 | -63 | 80 | 267 | 1,411 | 1,678 | 16,959 |
| NORMAL | 835 | 1,815 | 180 | 60 | 135 | 215 | 3,025 | 3,240 | 19,665 |
| DEPARTURE | -375 | -1,015 | -46 | -123 | -55 | 52 | -1,614 | -1,562 | -2,706 |
| % OF NORM | 55% | 44% | 74% | -105% | 59% | 124% | 47% | 52% | 86% |
| AUG 2007 | 165 | 150 | 200 | 146 | 145 | 199 | 806 | 1,005 | 17,964 |
| NORMAL | 360 | 625 | 65 | 40 | 115 | 130 | 1,205 | 1,335 | 21,000 |
| DEPARTURE | -195 | -475 | 135 | 106 | 30 | 69 | -399 | -330 | -3,036 |
| % OF NORM | 46% | 24% | 308% | 365% | 126% | 153% | 67% | 75% | 86% |
| SEP 2007 | 159 | 96 | 118 | -50 | 81 | 103 | 404 | 507 | 18,471 |
| NORMAL | 345 | 470 | 115 | 40 | 110 | 95 | 1,080 | 1,175 | 22,175 |
| DEPARTURE | -186 | -374 | 3 | -90 | -29 | 8 | -676 | -668 | -3,704 |
| % OF NORM | 46% | 20% | 103% | -125% | 74% | 108% | 37% | 43% | 83% |
| OCT 2007 | 265 | 355 | 76 | 114 | 197 | 242 | 1,007 | 1,249 | 19,720 |
| NORMAL | 400 | 525 | 70 | 10 | 120 | 75 | 1,125 | 1,200 | 23,375 |
| DEPARTURE | -135 | -170 | 6 | 104 | 77 | 167 | -118 | 49 | -3,655 |
| % OF NORM | 66% | 68% | 109% | 1140% | 164% | 323% | 90% | 104% | 84% |
| NOV 2007 | 255 | 355 | 1 | -105 | 91 | 137 | 597 | 734 | 20,454 |
| NORMAL | 390 | 410 | 65 | 10 | 120 | 75 | 995 | 1,070 | 24,445 |
| DEPARTURE | -135 | -55 | -64 | -115 | -29 | 62 | -398 | -336 | -3,991 |
| % OF NORM | 65% | 87% | 2% | -1050% | 76% | 183% | 60% | 69% | 84% |
| DEC 2007 | 230 | 207 | 44 | 95 | 108 | 158 | 684 | 842 | 21,296 |
| NORMAL | 335 | 255 | 0 | 10 | 100 | 45 | 700 | 745 | 25,190 |
| DEPARTURE | -105 | -48 | 44 | 85 | 8 | 113 | -16 | 97 | -3,894 |
| % OF NORM | 69% | 81% | 11000% | 950% | 108% | 351% | 98% | 113% | 85% |
| | | | | Calendar Year Totals | | | | | |
| | 5,217 | 7,689 | 1,478 | 553 | 1,862 | 4,497 | 16,799 | 21,296 | |
| NORMAL | 7,395 | 10,840 | 2,430 | 910 | 1,675 | 1,940 | 23,250 | 25,190 | |
| DEPARTURE | -2,178 | -3,151 | -952 | -357 | 187 | 2,557 | -6,451 | -3,894 | |
| % OF NORM | 71% | 71% | 61% | 61% | 111% | 232% | 72% | 85% | |

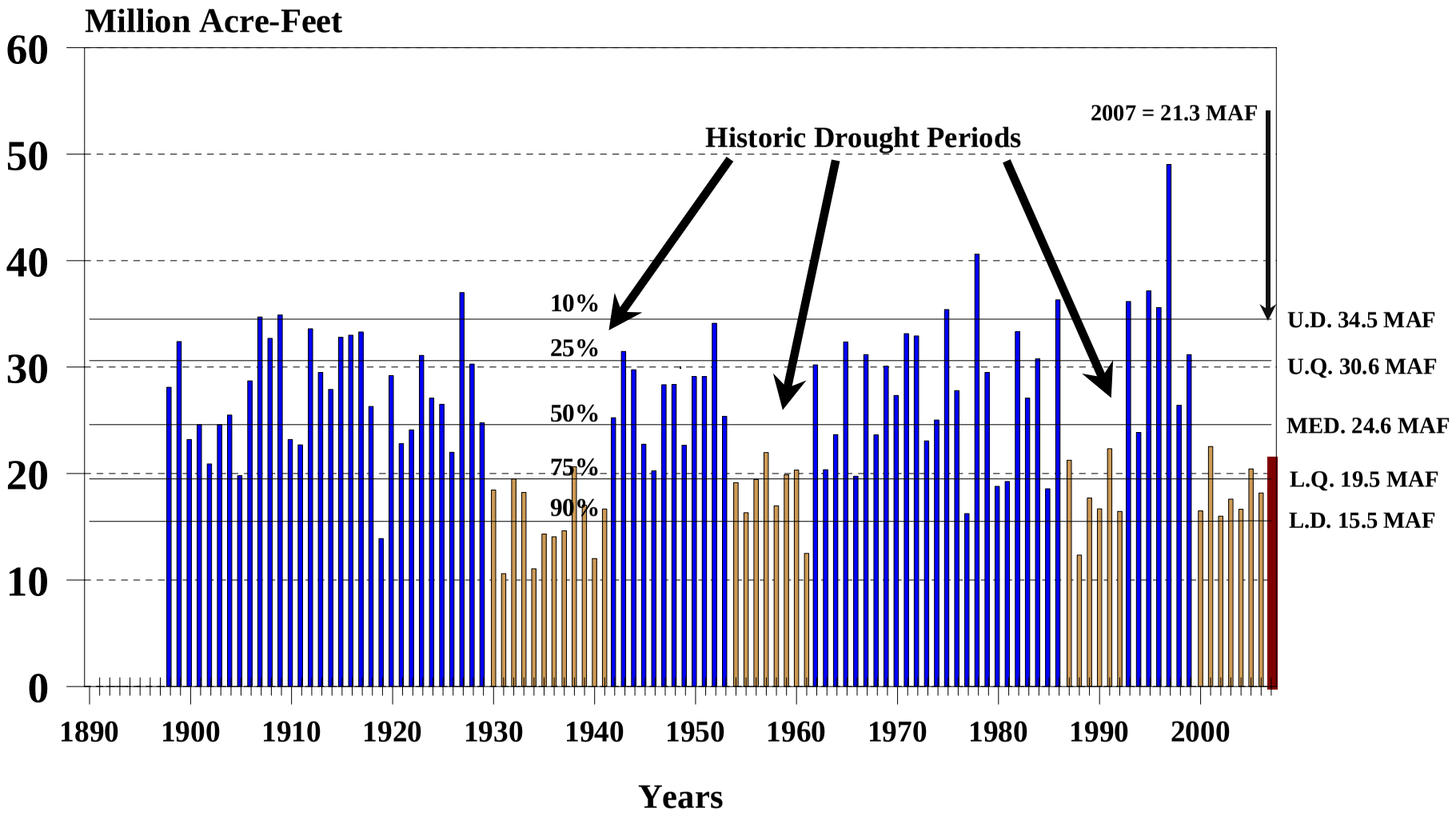
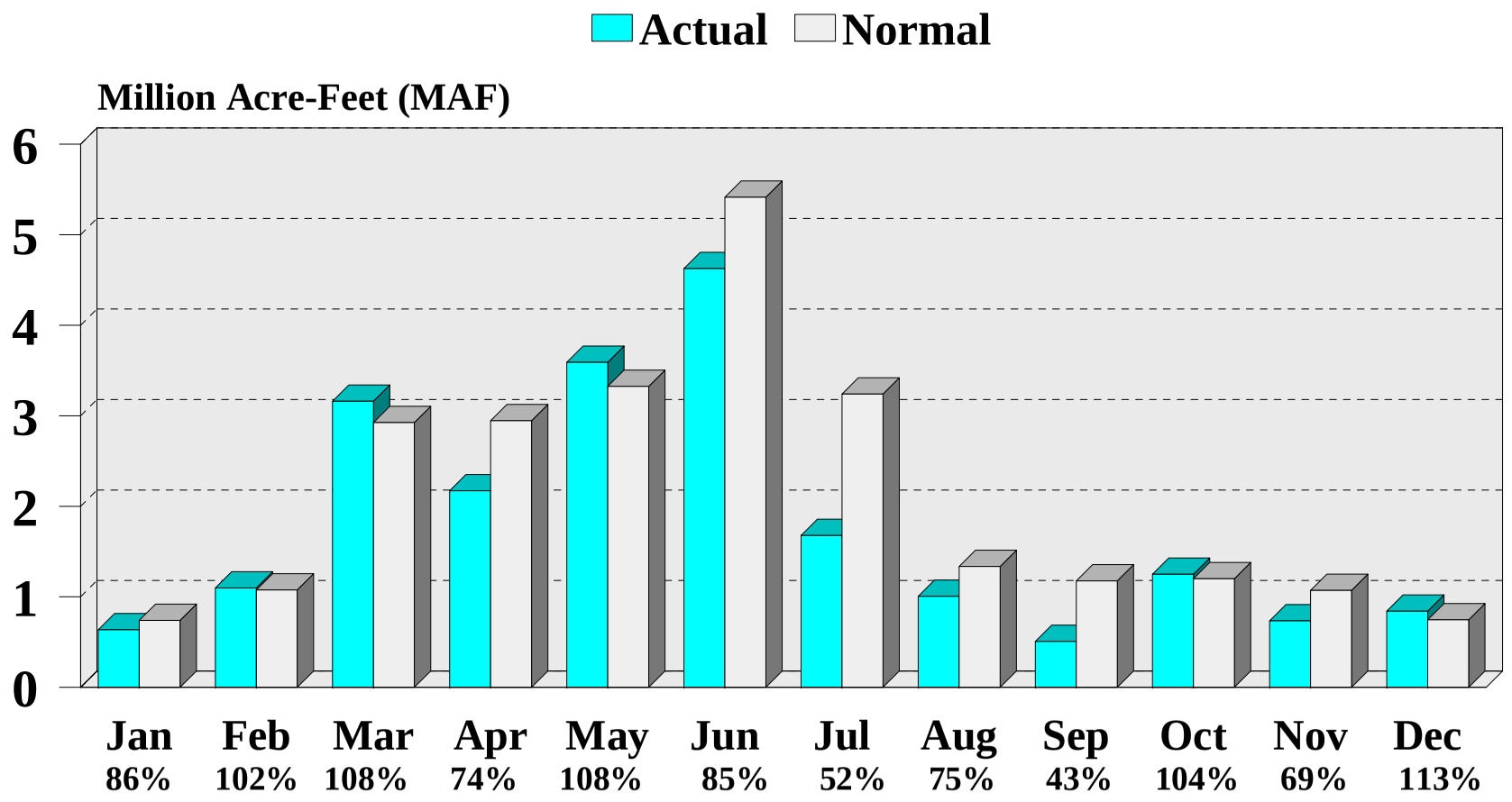

Missouri River Basin
Annual Runoff above Sioux City, Iowa
Million Acre-Feet
60
50
40
30
20
10
0
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
Years
2007 = 21.3 MAF
Historic Drought Periods
10%
25%
50%
75%
90%
U.D. 34.5 MAF
U.Q. 30.6 MAF
MED. 24.6 MAF
L.Q. 19.5 MAF
L.D. 15.5 MAF

Figure 4

Figure 5

# Missouri River Basin
# 2007 Monthly Runoff above Sioux City, Iowa




**2007 Runoff : 21.3 MAF - 85% of normal**
**Normal Runoff: 25.2 MAF**

## C. System Regulation

### 1. System Regulation – January to December 2007

System storage on January 1, 2007 was 34.4 MAF, 1.6 MAF less than the System storage on January 1, 2006. Gavins Point releases varied from a low of 10,500 cfs to a high of 16,000 cfs during January. The System storage declined throughout the month of January. February 1 System storage was 34.0 MAF. The System storage continued to decline and reached a new record low of 33.9 MAF on February 8. Gavins Point releases during February and March fluctuated between 9,000 cfs and 16,000 cfs. The higher releases were made during low-temperature periods when river ice was forming. The March spring pulse from Gavins Point was not conducted in 2007 because the System storage on March 1 was 34.3 MAF, which was 2.2 MAF below the minimum storage level of 36.5 MAF needed to conduct the first March pulse as per the Master Manual. The March 15 System storage was 35.1 MAF, which was above the navigation season preclude level of 31.0 MAF. Per the Master Manual, since the March 15 storage level was between 49.0 and 31.0 MAF, the navigation service level was set at minimum service, per the Master Manual criteria.

The plan for the System releases to support the 2007 navigation season during the T&E tern and plover nesting season is referred to as the Steady Release – Flow-to-Target (SR-FTT) plan. The SR-FTT release plan calls for Gavins Point releases to be set at an initial steady rate and then adjusted the releases upward or downward during the nesting season to meet downstream flow targets, if necessary. Depending on where the initial steady release is set, this regulation makes a larger amount of habitat available early in the nesting season and saves additional water in the upper three reservoirs, when compared to the Steady Release (SR) plan. The SR-FTT plan also reduces the potential for flooding nests and exceeding the anticipated level of incidental take for listed terns and plovers when compared to the Flow-to-Target (FTT) plan.

Flow support for the 2007 navigation season began on March 23 at Sioux City, IA; March 25 at Omaha, NE; March 26 at Nebraska City, NE; March 28 at Kansas City, MO; and April 1 at the mouth of the Missouri River near St. Louis, MO. System releases on March 21 were 9,000 cfs. System releases during April ranged from 8,000 to 14,000 cfs. Downstream tributary inflow was significant towards the beginning of the navigation so that the navigation flow targets at Omaha (25,000 cfs), Nebraska City (31,000 cfs), and Kansas City (35,000 cfs) were met even with this less-than-normal System release. As a water conservation measure, the flow target at Sioux City (25,000 cfs) was not met in late March and early April since there was no barge traffic in those reaches.

On April 1 System storage was 35.9 MAF, 1.0 MAF less than the previous year's April 1 System storage. The May 1 System storage was 36.6 MAF, 3.4 MAF less than the required 40.0 MAF necessary to run the May spring pulse from Gavins Point Dam.

Early spring rainfall produced a March-April runoff of 5.3 MAF above Sioux City, which is 91% of normal. Runoff volumes above Sioux City for May, June, and July were 3.6, 4.6, and 1.7 MAF, respectively. Normal runoff for those months is 3.3, 5.4, and 3.2 MAF, respectively. Mountain snowpack peaked at 76% of normal above Fort Peck and 81% of normal between Fort Peck and Garrison. The runoff from the mountain snowpack, along with the significant summer rainfall, resulted in the May-July runoff above Sioux City of 9.9 MAF, 83% of normal.

System storage peaked on July 4, 2007 at 40.3 MAF; the peak for the previous year was 39.1 MAF. The end-of-July System storage was 39.3 MAF, 19.3 MAF less than 1967-2007 end-of-July average (58.6 MAF), but 1.6 MAF higher than the previous year. System storage began a steady decline through the late summer, then held nearly steady during the fall once the navigation season ended. End-of-month storages were: August, 38.4 MAF; September, 37.4 MAF; October, 37.3 MAF; November, 37.1 MAF; and December, 36.8 MAF. The end-of-December System storage was 2.4 MAF more than the previous year and 15.9 MAF less than 1967-2007 end-of-December average. The lowest System storage during 2007, which was also a record low System storage, occurred on February 8 at 33.9 MAF. As per the Master Manual, the July 1 water in storage check resulted in the navigation season being shortened by 35 days from the normal ending date of December 1 at St. Louis, MO.

## 2. Fort Peck Regulation – January to December 2007

### a. General

Fort Peck, the third largest Corps storage reservoir, serves all authorized purposes. Fort Peck's primary functions are: (1) to capture the snowmelt runoff and localized rainfall runoff from the large drainage area above Fort Peck Dam, which are metered out at controlled release rates to meet the authorized purposes while reducing flood damages in the Fort Peck to Garrison reach; (2) to serve as a secondary storage location for water accumulated in the System from reduced System releases due to major downstream flood control regulation, thus helping to alleviate large pool increases in Garrison, Oahe, and Fort Randall; and (3) to provide the water needed to meet all authorized purposes that draft storage during low-water years.

***Table 3*** lists the average monthly inflows and releases in cfs and the end-of-month (EOM) pool elevation in ft msl for Fort Peck for 2006 and 2007 as well as the averages since the System first filled in 1967.

### b. Winter Season 2007

The Fort Peck reservoir level began 2007 at elevation 2199.4 ft msl, 34.6 feet below the annual flood control zone and 2.2 feet below the elevation for this same date the previous year. The minimum reservoir level, which was also a record low, occurred on March 4 at 2196.2 ft msl.

c. Winter River and Ice Conditions Below Fort Peck

No special release reductions were required to prevent ice-jam flooding downstream of Fort Peck Dam. December 2006 and January and February 2007 discharges were below average. Ice-cover formation on the Missouri River began on November 27, 2006 when the Missouri River stage rose over 4.6 feet in the Wolf Point, MT area. The stage at Wolf Point peaked near 8.2 feet on December 6, 2006, which is 2.6 feet below flood stage and 0.1 feet lower than last year's peak. The Missouri River at Culbertson, MT rose quickly in later November and peaked on December 8, 2006 at a stage of 9.0 feet. Missouri River stages at Culbertson, MT peaked for the season on February 24, 2007. No reports of ice-affected flooding on the Missouri River below Fort Peck Dam were recorded during the 2007 winter season. The Fort Peck reservoir froze over on January 12, 2007 and was free of ice on March 28, 2007. The previous winter's freeze date was February 24, 2006, which was the latest freeze date on record for Fort Peck. However, it should be noted that the reservoir did not freeze over in 1987 or 1992.

d. Spring Open Water Season 2007

The releases averaged 6,300 cfs in March, 4,200 cfs in April, 6,800 cfs in May, and 6,100 cfs in June. Oahe and Fort Peck were given top priority in 2007 during the forage fish spawn. Releases in May and June were scheduled to provide a rising reservoir level at Fort Peck during the fish spawn while still meeting the minimum flow requirements for downstream irrigation. The reservoir elevation rose slowly and steadily from the end of March (2197.5 ft msl) until the end of June (2203.1 ft msl).

e. Summer Open Water Season 2007

Summer release rates, which are generally higher than spring releases due to the increased demand for hydropower, were about 6,500 cfs, well below average. The inflows during the summer months were also below average. The Fort Peck pool slowly declined from 2203.1 ft msl at the end of June to 2200.3 ft msl at the end of September.

f. Fall Open Water Season 2007

Releases were reduced from approximately 7,000 cfs to 4,000 cfs in mid-September, when irrigation ceased for the season. Releases were maintained near this minimum level during October and November and then increased to the winter release rate in December, when power demands increased.

g. Summary

The highest Fort Peck reservoir level during 2007 occurred on July 6 at 2203.2 ft msl. The lowest reservoir level during 2007, which was a record low, occurred on March 4 at 2196.2 ft msl. The previous record low before the current 8-year drought was 2208.7 ft msl in April 1991. The average annual inflow of 7,000 cfs during CY 2007 was 70% of normal (1967-2007). The average annual release of 6,300 cfs during CY 2007 was 67%

of normal (1967-2007). In 2007, Fort Peck did not rise into the annual flood control and multiple use zone, which extends from 2234.0 to 2250.0 ft msl.

**Table 3**
**Fort Peck – Inflows, Releases, and Elevations**

| Month | Ave Monthly Inflow (cfs) | | | Ave Monthly Release (cfs) | | | EOM Elevation (ft msl) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2007 | 2006 | 1967-2007 | 2007 | 2006 | 1967-2007 | 2007 | 2006 | 1967-2007 |
| January | 5,600 | 6,800 | 7,300 | 10,100 | 8,100 | 11,000 | 2197.5* | 2201.0 | 2228.3 |
| February | 7,500 | 5,700 | 8,800 | 10,700 | 7,100 | 11,400 | 2196.3* | 2200.4 | 2227.6 |
| March | 9,400 | 8,500 | 12,000 | 6,300 | 5,400 | 8,100 | 2197.5* | 2201.5 | 2228.7 |
| April | 7,500 | 11,400 | 10,400 | 4,200 | 6,500 | 7,500 | 2198.8 | 2203.4 | 2229.4 |
| May | 11,900 | 11,100 | 15,200 | 6,800 | 6,900 | 9,200 | 2200.8 | 2204.9 | 2230.9 |
| June | 12,800 | 12,200 | 18,600 | 6,100 | 7,900 | 9,900 | 2203.1 | 2206.2 | 2233.2 |
| July | 5,800 | 5,900 | 12,100 | 6,700 | 8,200 | 10,200 | 2202.3* | 2204.9 | 2233.3 |
| August | 4,700 | 5,800 | 7,900 | 7,000 | 8,000 | 10,100 | 2200.9* | 2203.6 | 2232.2 |
| September | 5,300 | 6,000 | 7,800 | 5,100 | 6,800 | 8,900 | 2200.3 | 2202.6 | 2231.4 |
| October | 5,100 | 6,500 | 7,300 | 4,000 | 5,700 | 8,200 | 2200.3 | 2202.5 | 2230.8 |
| November | 4,500* | 5,500 | 7,100 | 3,900 | 7,200 | 8,600 | 2200.1 | 2201.3 | 2230.0 |
| December | 4,500 | 5,500 | 6,600 | 5,300* | 9,500 | 9,700 | 2199.5 | 2199.4 | 2228.8 |

* monthly minimum of record

### 3. Garrison Regulation – January to December 2007

a. General

Garrison, the largest Corps storage reservoir, is another key component in the regulation of the System. Its primary functions are (1) to capture the snowmelt runoff and localized rainfall runoff from the large drainage area between the Fort Peck and Garrison dams, which are metered out at controlled release rates to meet the authorized purposes, while reducing flood damages in the Garrison to Oahe reach, particularly the urban Bismarck area; (2) to serve as a secondary storage location for water accumulated in the System from reduced System releases due to major downstream flood control regulation, thus helping to alleviate large pool increases in Oahe and Fort Randall; and (3) to provide water needed to meet all authorized purposes that draft storage during low-water years.

***Table 4*** lists the average monthly inflows and releases in cfs and the EOM pool elevation in ft msl for Garrison for 2006 and 2007 as well as the averages since the System filled in 1967.

b. Winter Season 2007

Releases from Garrison were below normal for a seventh consecutive winter season. Garrison began 2007 at 1807.8 ft msl, 4.2 feet lower than the previous year's elevation of 1812.0 ft msl, but 2.0 feet higher than the record low of 1805.8 set in May 2005. The 1807.8 ft msl elevation is 29.7 feet below the base of the annual flood control and multiple use zone. The reservoir level declined throughout the winter season to an elevation of 1806.6 ft msl on February 22, 2007. This elevation was nearly 31 feet below the base of the annual flood control and multiple use zone of 1837.5 ft msl.

c. Winter River and Ice Conditions Below Garrison

The Missouri River in the Bismarck, ND area rose over 5 feet between November 29 and December 1, 2006 during river ice cover formation. A complete ice cover never formed but an ice cover near the left channel bank remained essentially from the first of December through mid-March. An open channel on the right bank side of the Missouri River remained during the entire winter season. Garrison releases were adjusted to meet the downstream channel conditions during melt and ice formation periods. The winter peak ice-affected Missouri River stage at Bismarck was 11.1 feet on December 1, 2006. This was well below the Bismarck flood stage of 16 feet and the Corps' winter freeze-in stage target of 13 feet. Garrison reservoir froze over on December 22, 2006 and was free of ice on April 26, 2007.

d. Spring Open Water Season 2007

In 2007 Oahe and Fort Peck were given priority during the forage fish spawn in April and May. Garrison's releases were adjusted to back up System releases for downstream flow support and to maintain a steady to rising pool at Oahe. The Garrison pool level remained fairly level during April due to the incremental runoff between Fort Peck and Garrison and record low System releases. The reservoir level at the beginning of the navigation season (April 1) was 1808.7 ft msl, 2.0 feet lower than the level at the start of the 2006 navigation season. Even with priority being given to Oahe, the Garrison pool level remained fairly steady through the forage spawn season in April and then rose 4.5 and 5.0 feet in May and June, respectively.

e. Summer Open Water Season 2007

During May and June the snowpack runoff caused the Garrison pool to rise. The peak pool during 2007 occurred on July 9 at 1818.3 ft msl. The pool level fell during the months of July and August as inflows decreased. A daily peaking pattern was established at Garrison during the nesting season to protect terns and plovers nesting below the project. See Section II.F.3. of this report regarding modifications made to the intake structure to assist with coldwater fishery habitat in the Garrison reservoir.

f. Fall Open Water Season 2007

Fall releases were reduced to the 11,000 cfs range when irrigation ceased for the season in mid-September, followed by higher December releases of around 15,000 cfs to provide hydropower during winter demand increases.

g. Lake Audubon / Snake Creek Embankment

In October of 2006 the Omaha District Geotechnical Branch of Engineering Division placed a 36.5-foot maximum restriction on the maximum difference in pool levels between Lake Audubon and Lake Sakakawea. To avoid the likely possibility that this restriction would be exceeded the following winter when Lake Audubon would be ice covered, the Corps lowered Lake Audubon in November 2006 by two (2) additional feet to elevation 1843 ft msl. In March 2007 the Corps modified the 36.5-foot maximum restriction to a 43-foot maximum water level difference between Lake Audubon and Lake Sakakawea based on the results of an underseepage evaluation. In April 2007, following ice-out, Lake Audubon was brought back up to its normal summer pool level of 1847.2 ft msl. In November 2007 Lake Audubon was lowered to its normal winter pool level of 1845 ft msl.

h. Summary

Buford-Trenton pumping costs totaled $15,070.14 for 2007. The highest Garrison reservoir level during 2007 occurred on July 9 at 1818.3 ft msl, which was 1.4 feet higher than the 2006 peak. The average annual inflow of 16,000 cfs during calendar year 2007 was 71% of normal (1967-2007). The average annual release of 14,100 cfs during calendar year 2007 was 66% of normal (1967-2007). In 2007, Garrison did not rise into the annual flood control zone, which extends from 1837.5 to 1850.0 ft msl.

**4. Oahe and Big Bend Regulation – January to December 2007**

a. General

Oahe, the second largest Corps storage reservoir, serves all authorized purposes. Oahe's primary functions are (1) to capture snowmelt and localized rainfall runoff from the large drainage area between the Garrison and Oahe dams, which are metered out at controlled release rates to meet the authorized purposes, while reducing flood damages in the Oahe to Big Bend reach, especially in the urban Pierre and Fort Pierre areas; (2) to serve as a primary storage location for water accumulated in the System from reduced System releases due to major downstream flood control regulation, thus helping to alleviate large reservoir level increases in Big Bend, Fort Randall and Gavins Point; and (3) to provide water needed to meet all authorized purposes that draft storage during low-water years,

**Table 4**
**Garrison – Inflows, Releases, and Elevations**

| Month | Ave Monthly Inflow (cfs) | | | Ave Monthly Release (cfs) | | | EOM Elevation(ft msl) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2007 | 2006 | 1967-2007 | 2007 | 2006 | 1967-2007 | 2007 | 2006 | 1967-2007 |
| January | 13,400 | 15,500 | 15,500 | 15,900 | 17,800 | 23,000 | 1807.0* | 1811.4 | 1832.2 |
| February | 15,300 | 12,300 | 19,000 | 15,800 | 15,500 | 24,200 | 1806.9* | 1810.6 | 1831.2 |
| March | 21,400 | 15,400 | 27,300 | 14,800 | 14,500 | 19,600 | 1808.7* | 1810.7 | 1832.7 |
| April | 13,300 | 20,300 | 22,600 | 13,500 | 13,800 | 19,200 | 1808.6 | 1812.5 | 1833.2 |
| May | 30,400 | 24,400 | 28,500 | 13,300 | 15,300 | 21,200 | 1813.1 | 1814.7 | 1834.5 |
| June | 36,100 | 31,000 | 45,300 | 16,000 | 19,800 | 23,100 | 1818.1 | 1817.4 | 1838.5 |
| July | 12,500 | 13,900 | 31,900 | 15,900 | 20,600 | 24,500 | 1816.9 | 1815.5* | 1839.6 |
| August | 9,400 | 10,700 | 18,100 | 16,000 | 22,000 | 24,300 | 1814.6 | 1812.1* | 1837.9 |
| September | 9,800 | 11,200 | 16,500 | 11,600 | 18,100 | 20,700 | 1813.7 | 1809.5* | 1836.6 |
| October | 10,500 | 12,800 | 17,300 | 10,800 | 12,100 | 19,000 | 1813.2 | 1809.6* | 1836.0 |
| November | 10,900 | 13,600 | 16,000 | 10,800 | 13,100 | 20,000 | 1812.7 | 1808.9* | 1834.8 |
| December | 8,900 | 12,100 | 13,900 | 14,900 | 15,300 | 20,400 | 1810.9 | 1807.8* | 1833.2 |

* monthly minimum of record

particularly downstream water supply and navigation. In addition, hourly and daily releases from Big Bend and Oahe fluctuate widely to meet varying power loads. Over the long term, their release rates are geared to back up navigation releases from Fort Randall and Gavins Point in addition to providing storage space to permit a smooth transition in the scheduled annual fall drawdown of Fort Randall. Big Bend, with less than 2 MAF of storage, is primarily used for hydropower production, so releases from Oahe are generally passed directly through Big Bend.

***Table 5*** lists the average monthly inflows and releases in cfs and the EOM pool elevations in ft msl for Oahe for 2006 and 2007 as well as the averages since the System first filled in 1967.

A settlement agreement was approved in an order of dismissal by the United States District Court, District of South Dakota on August 8, 2003, in the case of Lower Brule Sioux Tribe et al. v. Rumsfeld, et al. (Civil No. 02-3014 (D.S.D.)). The agreement provides that the Corps will consult with the Lower Brule Tribe and the Crow Creek Sioux Tribe during any review and revision of the Missouri River Master Water Control Manual. This agreement also provides that the Corps will coordinate the regulation of Big Bend and the water level of Lake Sharpe with the two Tribes to include the following: the Corps will normally strive to maintain an reservoir level at Lake Sharpe between elevation 1419 ft msl and 1421.5 ft msl; when the level of Lake Sharpe drops below elevation 1419 ft msl or exceeds elevation 1421.5 ft msl, the Chief of the Water Management Division will provide notice to such persons as the Tribes shall designate in writing. When it is anticipated that the water level will drop below 1418 ft msl or rise

above 1422 ft msl, or, in the event the water level falls below 1418 ft msl or rises above 1422 ft msl, the Commander, Northwestern Division, or his designee, shall immediately contact the Chairpersons of the Tribes or their designees to notify them of the situation and discuss proposed actions to remedy the situation. During 2007, the Big Bend reservoir level varied in the narrow range between elevations 1419.4 to 1421.3 ft msl. As per the settlement agreement no additional coordination was necessary.

***Table 6*** lists the average monthly inflows and releases in cfs and the EOM pool elevations in ft msl for Big Bend for 2006 and 2007 as well as the averages since the System first filled in 1967.

b. Winter Season 2007

Flooding in the Pierre-Fort Pierre area, especially at street intersections in the Stoeser Addition, has been a recurring problem since 1979. High Oahe releases, coupled with the formation of river ice cover in the LaFrambois Island area, have historically caused water to back up into a storm sewer outlet flooding street intersections. The city of Pierre installed a valve on the Stoeser Addition storm sewer in the fall of 1998 to prevent winter flooding; however, Oahe releases will continue to be constrained at times to prevent flooding at other locations. No flooding problems were experienced in this area during the winter of 2007. There were no ice events during this winter season in the Pierre/Fort Pierre area on the Missouri River. The Oahe Project staff performs inspections during cold weather periods for location of the head of ice cover should it form on the Missouri River below the project and monitors stages at four downstream gaging stations. During periods of rapid ice formation a one-unit minimum release may be imposed on the project and peak releases may be limited. During the winter of 2006-2007 a one-unit minimum was imposed between January 30 and February 1 and then again between February 19 and February 21. The Oahe reservoir froze over on January 16, 2007 and was free of ice on March 23, 2007.

Big Bend was regulated in the winter season to follow power peaking requirements with hourly releases varying widely. The daily average flow varied between 0 and 34,400 cfs. The Big Bend reservoir froze over on January 13, 2006 and was free of ice on March 26, 2007.

c. Spring Open Water Season 2007

Releases from Oahe are generally set lower during weekends than on weekdays. The normal regulation is to maintain Oahe releases above 3,000 cfs during weekend daylight hours beginning in early April. This minimum release is scheduled to enhance downstream fishing and boating use during the recreation season. During the spring of 2007, no minimum release rate criteria were established for Oahe. Due to the ongoing drought conditions and ensuing low reservoir levels, making large releases during shorter periods of the day rather than a constant lower release maximized power production during the periods of highest demand.

**Table 5**
**Oahe – Inflows, Releases, and Elevations**

| Month | Ave Monthly Inflow (cfs) | | | Ave Monthly Release (cfs) | | | EOM Elevation (ft msl) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2007 | 2006 | 1967-2007 | 2007 | 2006 | 1967-2007 | 2007 | 2006 | 1967-2007 |
| January | 15,600 | 18,600 | 23,500 | 14,900 | 13,700 | 21,100 | 1572.9* | 1576.8 | 1598.8 |
| February | 16,100 | 15,800 | 27,600 | 18,400 | 12,400 | 18,500 | 1572.3* | 1577.6 | 1600.6 |
| March | 19,500 | 16,200 | 30,900 | 8,000* | 18,900 | 18,700 | 1575.8 | 1576.7 | 1603.0 |
| April | 15,200 | 15,600 | 26,500 | 8,600 | 13,300 | 21,300 | 1577.7 | 1577.4 | 1603.8 |
| May | 14,100 | 15,800 | 27,600 | 3,700 | 16,200 | 22,000 | 1580.5 | 1577.0 | 1604.7 |
| June | 22,000 | 19,100 | 28,300 | 12,300 | 21,900 | 25,500 | 1582.8 | 1575.8* | 1604.7 |
| July | 15,600* | 19,900 | 27,000 | 19,400 | 27,200 | 29,700 | 1581.4 | 1573.4* | 1603.8 |
| August | 17,900 | 21,800 | 25,600 | 21,100 | 29,500 | 32,700 | 1580.1 | 1570.3* | 1601.8 |
| September | 13,500 | 20,600 | 22,200 | 8,100* | 15,300 | 29,000 | 1580.9 | 1571.4* | 1600.0 |
| October | 12,100 | 12,500 | 20,400 | 10,600 | 7,300 | 24,000 | 1580.8 | 1572.6* | 1598.9 |
| November | 10,600* | 13,800 | 21,300 | 5,400* | 10,400 | 22,700 | 1582.3 | 1573.2* | 1598.3 |
| December | 15,200 | 15,200 | 20,700 | 13,600* | 15,400 | 21,100 | 1582.2 | 1572.8* | 1598.0 |

* monthly minimum of record

**Table 6**
**Big Bend – Inflows, Releases, and Elevations**

| Month | Ave Monthly Inflow (cfs) | | | Ave Monthly Release (cfs) | | | EOM Elevation (ft msl) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2007 | 2006 | 1967-2007 | 2007 | 2006 | 1967-2007 | 2007 | 2006 | 1967-2007 |
| January | 13,800 | 12,800 | 20,900 | 14,500 | 12,600 | 20,900 | 1420.1 | 1420.8 | 1420.5 |
| February | 17,200 | 11,500 | 18,600 | 16,800 | 11,900 | 18,600 | 1420.5 | 1420.3 | 1420.4 |
| March | 8,200* | 18,100 | 19,400 | 7,600* | 18,000 | 19,300 | 1421.0 | 1420.3 | 1420.3 |
| April | 7,700 | 12,700 | 21,700 | 7,800 | 12,100 | 21,400 | 1420.7 | 1420.7 | 1420.5 |
| May | 3,700 | 15,000 | 22,400 | 3,400 | 15,000 | 22,300 | 1420.8 | 1420.4 | 1420.4 |
| June | 11,600 | 20,400 | 25,700 | 11,600 | 20,500 | 25,500 | 1420.3 | 1419.9 | 1420.3 |
| July | 17,300 | 24,600 | 29,100 | 17,600 | 23,700 | 28,600 | 1419.6 | 1420.6 | 1420.3 |
| August | 20,000 | 27,600 | 32,200 | 19,000 | 27,500 | 31,700 | 1420.3 | 1420.0 | 1420.2 |
| September | 7,100* | 14,300 | 28,700 | 6,400* | 13,500 | 28,300 | 1420.8 | 1420.3 | 1420.3 |
| October | 10,400 | 6,800 | 23,900 | 9,900 | 6,200 | 23,400 | 1420.7 | 1420.7 | 1420.5 |
| November | 5,100* | 9,600 | 24,300 | 4,900* | 9,800 | 22,500 | 1420.4 | 1420.3 | 1420.4 |
| December | 13,100 | 14,400 | 21,000 | 12,300* | 13,800 | 20,800 | 1420.6 | 1420.8 | 1420.5 |

* monthly minimum of record

In 2006 Oahe and Fort Peck were given priority during the forage fish spawn in April and May. The Oahe pool level on April 1 was 1575.7 ft msl, 1.0 feet lower than the previous year. Starting in mid-April releases from Garrison and Oahe were adjusted in order to maintain a steady to rising Oahe pool level to promote the forage fish spawn in the Oahe reservoir. The pool level rose steadily through April and May, reaching a peak of 1583.2 on June 21.

d. Summer Open Water Season 2007

After reaching its peak of 1583.2 ft msl on June 21 the Oahe reservoir pool level steadily declined through June, July, and August. The August 1 elevation was 1581.4 ft msl. The September 1 elevation was 1580.3 ft msl, which was 10 feet higher than the previous year but 19.1 feet below the 1967-2007 average of 1600.0 ft msl. The annual minimum pool elevation of 1571.9 ft msl occurred on February 15. This is 1.7 feet higher that the new record low that was set in 2006.

e. Fall Open Water Season 2007

The Oahe reservoir elevation rose slightly through September, October and November. Releases were reduced in September to initiate the annual fall drawdown of the Fort Randall reservoir prior to the close of the navigation season. Low releases were maintained in October and November to facilitate the Fort Randall drawdown. Higher releases were scheduled in late November for winter energy production.

f. Summary

The highest Oahe reservoir level during CY 2007 occurred on June 21 at 1583.2 ft msl. The lowest reservoir level during the 2007 calendar year occurred on February 15 at 1571.9 ft msl. The average annual inflow to Oahe of 15,600 cfs was 62% of average (1967-2007). The average annual release from Oahe (12,000 cfs) was 50% of average (1967-2007). In 2007, Oahe did not rise into its annual flood control zone, which extends from 1607.5 to 1617.0 ft msl. Big Bend ended the year at 1421.1 ft msl, within the normal regulating range.

**5. Fort Randall Regulation – January to December 2007**

a. General

Fort Randall, the fourth largest System reservoir, serves all authorized purposes. Fort Randall's primary functions are: (1) to capture snow and localized rainfall runoffs in the drainage area between the Big Bend and Fort Randall dams, which are metered out at controlled release rates to meet the authorized purposes while reducing flood damages in the Fort Randall reach where several areas have homes and cabins in close proximity to the river; (2) to serve as a primary storage location along with the upstream projects for water accumulated in the System when System releases are reduced due to major downstream flood control regulation, thus helping to alleviate large pool increases in the

very small Gavins Point Project; (3) to provide a location to store the water necessary to provide increased winter hydropower energy by allowing an annual fall drawdown of the reservoir to occur with a winter reservoir refilling that is unique to Fort Randall; and (4) to provide water needed to meet all authorized purposes, particularly navigation and downstream water supply, that draft storage during low water years.

***Table 7*** lists the Fort Randall average monthly inflows and releases in cfs and the EOM pool elevation in ft msl for 2006 and 2007 as well as the averages since the System was first filled in 1967.

b. Winter Season 2007

The Fort Randall winter release ranged from 1,800 to 17,800 cfs. The Fort Randall reservoir level reached a low of 1337.06 ft msl on December 7, 2006. The Fort Randall reservoir (Lake Francis Case) froze over on January 15, 2007 and was ice free on March 21, 2007.

c. Spring Open Water Season 2007

The March releases were at reduced levels as Gavins Point releases were maintained at the 9,000 cfs open water release rate prior to the start of the navigation season. Releases were adjusted as needed to back up System releases from Gavins Point and to maintain the Gavins Point pool in the desired range.

d. Summer Open Water Season 2007

A daily peaking pattern was established at Fort Randall during the nesting season to provide flexibility to regulate over a range of releases while minimizing impact to birds nesting below the project.

e. Fall Open Water Season 2007

Due to the 35-day shortening of the navigation season, the annual fall drawdown of Fort Randall was begun September 4, after the Labor Day holiday.

f. Summary

The highest Fort Randall reservoir level during CY 2007 occurred on May 14 at 1360.6 ft msl. The lowest reservoir level during CY 2007 occurred on November 27 at 1338.8 ft msl. The average annual inflow to Fort Randall of 12,600 cfs was 50% of average (1967-2007). The average annual release from Fort Randall of 12,300 cfs was 50% of average (1967-2007). In 2007, Fort Randall rose into its annual flood control zone, which extends from 1350.0 to 1365.0 ft msl. However, the normal summer regulating pool level at Fort Randall is 1355.0 ft msl. Normal regulation of Fort Randall includes the lowering of the pool level at the end of the navigation season to 1337.5 ft

msl, 17.5 feet below the normal summer level, to make room for winter generation releases from the upper reservoirs.

**Table 7**
**Fort Randall – Inflows, Releases, and Elevations**

| Month | Ave Monthly Inflow (cfs) | | | Ave Monthly Release (cfs) | | | EOM Elevation (ft msl) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2007 | 2006 | 1967-2007 | 2007 | 2006 | 1967-2007 | 2007 | 2006 | 1967-2007 |
| January | 15,300 | 15,100 | 22,200 | 12,700 | 8,500* | 15,300 | 1346.2 | 1347.8 | 1347.3 |
| February | 19,800 | 12,900 | 20,300 | 9,600 | 11,700 | 13,500 | 1353.5 | 1348.5 | 1352.2 |
| March | 10,500 | 20,200 | 21,900 | 4,100* | 11,600 | 16,100 | 1358.0 | 1355.0 | 1356.3 |
| April | 8,900 | 14,800 | 24,000 | 6,900 | 11,400 | 21,700 | 1359.2 | 1357.3 | 1357.7 |
| May | 5,800 | 16,100 | 25,100 | 7,700* | 17,300 | 25,300 | 1357.6 | 1356.2 | 1357.3 |
| June | 14,100* | 22,100 | 28,000 | 15,500 | 23,500 | 27,500 | 1356.3 | 1355.1 | 1357.4 |
| July | 18,200 | 25,100 | 30,000 | 21,100 | 26,000 | 31,000 | 1354.0 | 1354.1 | 1356.3 |
| August | 22,200 | 30,200 | 33,000 | 20,400 | 29,500 | 33,700 | 1354.8 | 1354.0 | 1355.4 |
| September | 6,400* | 14,900 | 29,100 | 20,000 | 26,300 | 34,000 | 1343.6 | 1344.5 | 1351.1 |
| October | 11,900 | 5,900 | 23,300 | 11,500 | 12,400 | 32,300 | 1343.4 | 1337.5 | 1343.1 |
| November | 3,800* | 10,500 | 22,300 | 7,900 | 9,900 | 29,000 | 1339.2 | 1337.8 | 1336.5 |
| December | 14,700 | 16,700 | 22,000 | 10,700 | 10,600 | 17,200 | 1343.0 | 1343.8 | 1341.2 |

* monthly minimum of record

### 6. Gavins Point Regulation – January to December 2007

a. General

Gavins Point, the most downstream of the System projects, is primarily used for flow re-regulating to smooth out the release fluctuations of the upper projects to better serve downstream purposes. With a total storage of less than 500,000 acre-feet, it provides only a small amount of flood control and is generally maintained in a narrow reservoir elevation band between 1205.0 and 1208.0 ft msl. Due to the limited storage, releases from Gavins Point must be backed up with releases out of the upper reservoirs. Gavins Point is the key location in the initiation of release reductions for downstream flood control. Even though it has only a small amount of storage space for flood control, this volume is usually adequate to perform significant downstream flood control by coordinating Gavins Point release reductions with the upstream projects. Releases greater than the powerplant capacity, near 35,000 cfs, are passed through the spillway.

***Table 8*** lists the Gavins Point average monthly inflows and releases in cfs and the EOM pool elevation in ft msl for 2006 and 2007 as well as the averages since the System was filled in 1967.

b. Winter Season 2007

The Gavins Point average daily release was below the normal winter release rate for the entire winter season. No record low average releases or inflows were set this winter season. However, the December average monthly release of 12,000 cfs was the third lowest and tied with the December 1991 average monthly release. The Gavins Point reservoir (Lewis and Clark Lake) froze over on December 6, 2006 and was free of ice on March 21, 2007.

c. Winter River and Ice Conditions Below Gavins Point

The Gavins Point winter release rate was varied between 11,000 cfs and 15,000 cfs in December, 10,500 cfs and 16,000 cfs in January and between 10,000 cfs and 15,000 cfs in February. The first 2007 winter season's ice reports were made on November 30, 2006. The reports indicated 25 percent floating ice with pans ranging from 3 to 10 feet in the Missouri River at Sioux City. After December 1, 2006 ice was not reported on the Missouri River from Sioux City and downstream until December 20, 2006 when a cold spell produced floating ice. Another round of sub-zero temperatures from mid-January through mid-February produced the longest period of ice formation for the winter season. The largest volumes and the greatest extent of floating ice during the winter season occurred from January 15 - 18. During this time 5- to 20-foot floating ice pads filled 90 to 10 percent of the channel in the Sioux City to Waverly reach of the Missouri River. By February 22, 2007 the report of floating ice diminished to essentially zero percent from Sioux City, IA to the mouth of the Missouri River.

d. Spring Open Water Season 2007

The System storage on March 1 was 34.3 MAF, which was 2.2 MAF below the minimum storage level of 36.5 MAF needed to conduct the first March pulse as per terms of the Master Manual. Therefore, the March pulse was not conducted. The March 15 System storage was 35.1 MAF, which was above the navigation season suspension storage level of 31.0 MAF.

Flow support for the 2007 navigation season began on March 23 at Sioux City, IA; March 25 at Omaha, NE; March 26 at Nebraska City, NE; March 28 at Kansas City, MO; and April 1 at the mouth of the Missouri River near St. Louis, MO. System releases on March 21 were 9,000 cfs. System releases during April ranged from 8,000 to 14,000 cfs. Downstream tributary inflow was significant towards the beginning of the navigation so that the navigation flow targets at Omaha (25,000 cfs), Nebraska City (31,000 cfs), and Kansas City (35,000 cfs) were met even with this less-than-normal System release. As a water conservation measure, the flow target at Sioux City (25,000 cfs) was not met in late March and early April since there was no barge traffic in that reach of the Missouri River.

The May 1 System storage was 36.6 MAF, 3.4 MAF less than the required 40.0 MAF storage total necessary to run the May pulse. The first May pulse was run in 2006; the

minimum storage for the first May pulse was 36.5 MAF. Therefore, the May pulse was not conducted.

The March, April and May average monthly releases of 10,100, 10,200, and 10,600 cfs, respectively, were all historic minimums (1967-2007).

e. Summer Open Water Season 2007

Due to large rainfall events in the lower basin in May, the System releases were maintained at a much lower level so as not to add to downstream flooding. System releases were increased to 18,000 cfs in early June and then to 21,000 cfs in early July to meet downstream needs. System releases were increased to 24,500 cfs in late July for 10-day period in order to meet navigation targets.

f. Fall Open Water Season 2007

System releases were maintained in the 18,000 to 23,500 cfs range in September and the first half of October to meet the downstream minimum navigation targets. Releases to support navigation stopped on October 15, 2006, resulting in a 35-day shortening of the navigation season. In 2006, 2005 and 2004 the navigation season was shortened by 44, 48 and 47 days, respectively.

g. Summary

The highest Gavins Point reservoir level during CY 2007 occurred on February 26 at 1209.1 ft msl. The lowest reservoir level during CY 2007 occurred on July 10 at 1205.2 ft msl. The average annual inflow to Gavins Point of 14,800 cfs was 54% of average (1967-2007). The average annual release from Gavins Point of 14,600 cfs was 53% of average (1967-2007).

## D. Non-Routine Regulation and Other Items Pertaining to System Regulation

Numerous regulation activities are performed each year that, although at one time may have been considered special, are now considered routine. These include release restrictions from a particular project for a period of time to permit soundings, to facilitate limited construction within or adjacent to the downstream channel, and to pattern releases to facilitate measurements of downstream discharges and water surface profiles. Events that occurred in connection with regulation activities during CY 2007 that may be considered unusual, or recently have come to the attention of the Missouri River Basin Water Management Division (MRBWMD), are discussed in the following paragraphs.

**Table 8**
**Gavins Point – Inflows, Releases, and Elevations**

| Month | Ave Monthly Inflow (cfs) | | | Ave Monthly Release (cfs) | | | EOM Elevation (ft msl) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2007 | 2006 | 1967-2007 | 2007 | 2006 | 1967-2007 | 2007 | 2006 | 1967-2007 |
| January | 13,500 | 11,000* | 17,400 | 13,900 | 11,400* | 17,400 | 1207.0 | 1207.3 | 1207.6 |
| February | 13,900 | 13,200 | 16,700 | 13,200 | 13,400 | 17,600 | 1208.2 | 1206.9 | 1205.7 |
| March | 9,700* | 13,700 | 20,100 | 10,100* | 14,000 | 20,100 | 1207.3 | 1206.2 | 1205.5 |
| April | 10,300* | 15,200 | 25,700 | 10,200* | 14,300 | 25,500 | 1207.2 | 1208.1 | 1205.7 |
| May | 10,500* | 18,500 | 29,100 | 10,600* | 19,200 | 28,800 | 1206.5 | 1206.1 | 1205.9 |
| June | 17,500 | 24,900 | 30,700 | 17,700 | 24,400 | 30,400 | 1205.6 | 1206.7 | 1206.2 |
| July | 21,500 | 26,100 | 33,200 | 21,100 | 26,500 | 32,700 | 1206.1 | 1205.1 | 1206.8 |
| August | 22,300 | 30,800 | 35,400 | 21,500 | 29,500 | 34,900 | 1207.3 | 1207.5 | 1207.4 |
| September | 21,100 | 27,900 | 36,000 | 20,900 | 27,600 | 35,700 | 1207.3 | 1207.5 | 1207.7 |
| October | 14,800 | 14,800 | 34,600 | 14,500 | 14,600 | 34,400 | 1207.4 | 1207.6 | 1207.8 |
| November | 9,500 | 11,300 | 31,300 | 9,100 | 11,400 | 31,300 | 1208.0 | 1207.1 | 1207.6 |
| December | 12,500 | 13,100 | 19,400 | 12,700 | 12,600 | 19,400 | 1207.3 | 1207.9 | 1207.4 |

* monthly minimum of record

**1. Lawsuits**

On May 24, 2006, the State of Missouri filed a complaint in the District of Minnesota challenging the adequacy of the Corps' National Environmental Policy Act (NEPA) compliance for the spring rise technical criteria. Oral arguments were held on September 22, 2004. On November 2, 2006 the Court held in favor of the Corps. Judge Paul Magnuson found that the Corps did not violate NEPA by preparing an Environmental Assessment (EA) rather than a supplemental Environmental Impact Statement (EIS), when it implemented the revisions to the Master Manual incorporating the spring rise technical criteria. The Court found the Corps also complied with NEPA in its consideration of a range of alternatives and fully analyzed the environmental impacts of the revision. The State of Missouri appealed this decision to the 8th Circuit Court of Appeals. Oral arguments were held in October 2007. On February 8, 2008 the 8th Circuit Court affirmed the district court ruling.

**2. Master Manual Revision**

A summary of the process used in the 2006 revision of the Master Manual to include technical criteria for a Gavins Point spring pulse can be found in the "Summary of Actual 2005 Regulation" report. A Record of Decision revising the Master Manual was signed on February 28, 2006.

The Corps is committed to monitoring both the physical and biological impacts of the bimodal spring pulse releases, including the response of the pallid sturgeon to the pulses, further evaluation of interior drainage and groundwater concerns, and potential impacts to

cultural resources. Within an overall adaptive management strategy, the results of monitoring will be used to develop future modifications to the criteria. If information becomes available through the research, monitoring, and evaluation processes that indicate a change to the spring pulse technical criteria, then the adaptive management process, including any NEPA work required, will be followed to revise the Master Manual.

### 3. Fort Peck Mini-Test and Intrasystem Unbalancing

As described in the 2006-2007 AOP, the Fort Peck "mini-test" and the unbalancing of the three large upper reservoirs were not implemented due to low System storage. When System storage recovers sufficiently, the Corps anticipates that both these regulation plans will be implemented. The endangered species modified flow "mini-test," which was designed to monitor the effects of higher spring releases and warmer water released from the Fort Peck spillway, requires a reservoir elevation of approximately 2229 ft msl to avoid unstable flows over the spillway. The "mini-test" was not possible in 2007 because reservoir elevations during May and June were approximately 24 feet below the spillway crest elevation of 2225 ft msl.

The Missouri River Natural Resources Committee (MRNRC) previously has provided recommended guidelines (Table VII, 2006-2007 AOP) for unbalancing the upper three reservoirs to benefit reservoir fishery and the endangered terns and plovers. As a result of the continuing drought conditions and low reservoir elevations, the criteria for unbalancing the reservoirs were not met in 2007.

### 4. Summary of Drought Impacts

CY 2007 was the eighth consecutive year of drought in the Missouri River basin. System storage set a new record low of 33.9 MAF on February 8, 2007, 0.2 MAF below the previous record low set in December 2006 and 6.9 MAF below the record low of 40.8 MAF set in the previous drought in January 1991. System storage ended 2007 at 36.8 MAF, 2.4 MAF higher than the previous year. Because the bulk of the carryover multiple use storage is in the upper three reservoirs, Fort Peck, Garrison, and Oahe reservoirs have also set new record low pool levels during the current drought: -Fort Peck reservoir at elevation 2196.2 ft msl on March 4, 2007; Garrison reservoir at elevation 1805.8 ft msl on May 12, 2005; and, Oahe reservoir elevation at 1570.2 ft msl on August 30, 2006. Impacts of the drought have been felt across the basin. Some of the municipal, rural, industrial, and irrigation water intakes in the reservoirs and along the river reaches have been forced to make modifications to maintain access to the water. Many of the boat ramps have been extended, relocated or closed as the reservoir levels declined. Coldwater habitat in the reservoirs has been dramatically reduced threatening the viability of the coldwater fisheries. Cultural resources, once covered by water, are now exposed and vulnerable to additional erosion and looting. Noxious weeds have become even more problematic as thousands of acres of bare shoreline appear. Hydropower generation in 2007 was the lowest on record since the System first filled in 1967.

The only authorized purpose that is not adversely impacted by the drought is flood control, which is actually enhanced during drought conditions. The negative impacts of drought will be felt even after runoff returns to normal because of the time that will be required to refill the evacuated storage. Full service project releases to all purposes will not resume until the System storage has recovered to near normal levels, however, as System storage increases, improved service will be provided. On the contrary, if the drought persists, further reductions in service to authorized purposes will occur, and the lower the System storage declines, the more stringent the conservation measures become, even to the point of having no navigation season. Users who rely on the Missouri River need to closely monitor current and forecasted river and reservoir conditions and take necessary steps to ensure they can function through a wide range of river flows and reservoir levels.

## E. Reservoir Elevations and Storage

Reservoir elevations and storage contents of the System reservoirs at the end of July 2007 are presented in ***Table 9*** and the same information for CY 2007 is presented as ***Table 10***.

***Figures 8A*** and ***8B*** show the end-of-July pool elevations for Fort Peck, Garrison, and Oahe plus total System end-of-July storage for 2005 through 2007. Individual tables with the historic maximum, average, and minimum pool elevations for each reservoir are also shown on ***Figures 8A*** and ***8B***. During CY 2007 both Garrison and Oahe had higher July 31 pool levels in 2007 than they did in 2006. Fort Peck Lake was at elevation 2202.3 ft msl, 2.6 feet lower than at the same time in 2006. On July 31, 2006 Lake Sakakawea was at elevation 1816.9 ft msl, 1.4 feet higher than at the same time in 2006. Lake Oahe was at elevation 1581.4 on July 31, 2007, 8.0 feet higher than at the same time in 2006. The storage gain in Oahe was due to the lower-than-normal System releases made from March through June, including record low releases in March, April and May. The lower-than-normal System releases were made to offset downstream flooding in the State of Missouri from rainfall runoff and were sufficient to meet navigation targets in reaches being utilized for commercial navigation.

**Table 9**
**Reservoir Levels and Storages – July 31, 2007**

| Project | Reservoir Elevation | | Water in Storage – 1,000 AF | | |
|---|---|---|---|---|---|
| | Elevation (ft msl) | 12-Month Change (ft) | Total | Above Min. Level* | 12-Month Change |
| Fort Peck | 2202.3 | -2.6 | 9342 | 5131 | -408 |
| Garrison | 1816.9 | +1.4 | 12,514 | 7534 | +342 |
| Oahe | 1581.4 | +8.0 | 12,045 | 6672 | +1667 |
| Big Bend | 1419.6 | -1.0 | 1611 | -10 | -41 |
| Fort Randall | 1354.0 | -0.1 | 3445 | 1928 | -3 |
| Gavins Point | 1206.1 | +1.0 | 360 | 39 | +24 |

*Net usable storage above minimum reservoir levels established for power, recreation, irrigation diversions, and other purposes.

**Table 10**
**Reservoir Levels and Storages – December 31, 2007**

| Project | Reservoir Elevation | | Water in Storage – 1,000 AF | | |
|---|---|---|---|---|---|
| | Elevation (ft msl) | 12-Month Change (ft) | Total | Above Min. Level* | 12-Month Change |
| Fort Peck | 2199.5 | +0.1 | 8912 | 4701 | +5 |
| Garrison | 1810.9 | +3.1 | 11,102 | 6122 | +663 |
| Oahe | 1582.2 | +9.4 | 12,148 | 6775 | +1888 |
| Big Bend | 1420.6 | -0.2 | 1657 | 36 | -19 |
| Fort Randall | 1343.0 | -0.8 | 2628 | 1111 | -60 |
| Gavins Point | 1207.3 | -0.6 | 392 | 71 | -16 |

*Net usable storage above minimum reservoir levels established for power, recreation, irrigation diversions, and other purposes.

## F. Summary of Results

### 1. Flood Control

Releases during CY 2007 were influenced by continuation of the drought conservation measures to conserve System storage. The storage crest was much lower than the base of the annual flood control zone. With mountain snowpack below normal and little plains snowpack, the basin remained in drought conditions. However, significant spring rains did somewhat lessen drought severity throughout the basin, as shown on Figure 2. Based on the below normal snowpack and plains snow, the expectation was for a much-below-normal runoff, and water conservation measures were implemented to conserve the remaining storage according to Master Manual criteria.

The estimated total flood damages prevented by Corps projects in the basin during CY 2007 exceeded $3.6 billion. The estimated total flood damages prevented by the System during CY 2007 was $365,860,000. The total damages prevented in the Missouri River basin includes $35,639,000 in the Omaha District and $330,221,000 in the Kansas City District. The unindexed flood damages prevented by the System since construction now totals $18.7 billion, the bulk of which was prevented between 1993 and 1999 (see ***Figure 6B***). ***Figure 6A*** indicates the flood damages prevented indexed to 2007. Although the System prevents enormous amounts of damage, it is not capable of totally eliminating flooding along the Missouri River.

***Figure 7*** shows the actual regulated Missouri River flows that were experienced at Sioux City, Nebraska City and St. Joseph and the unregulated flows that would have been experienced if the System and tributary reservoirs had not been in regulation.

# *Missouri River Mainstem Reservoirs*
# *Flood Damages Prevented*

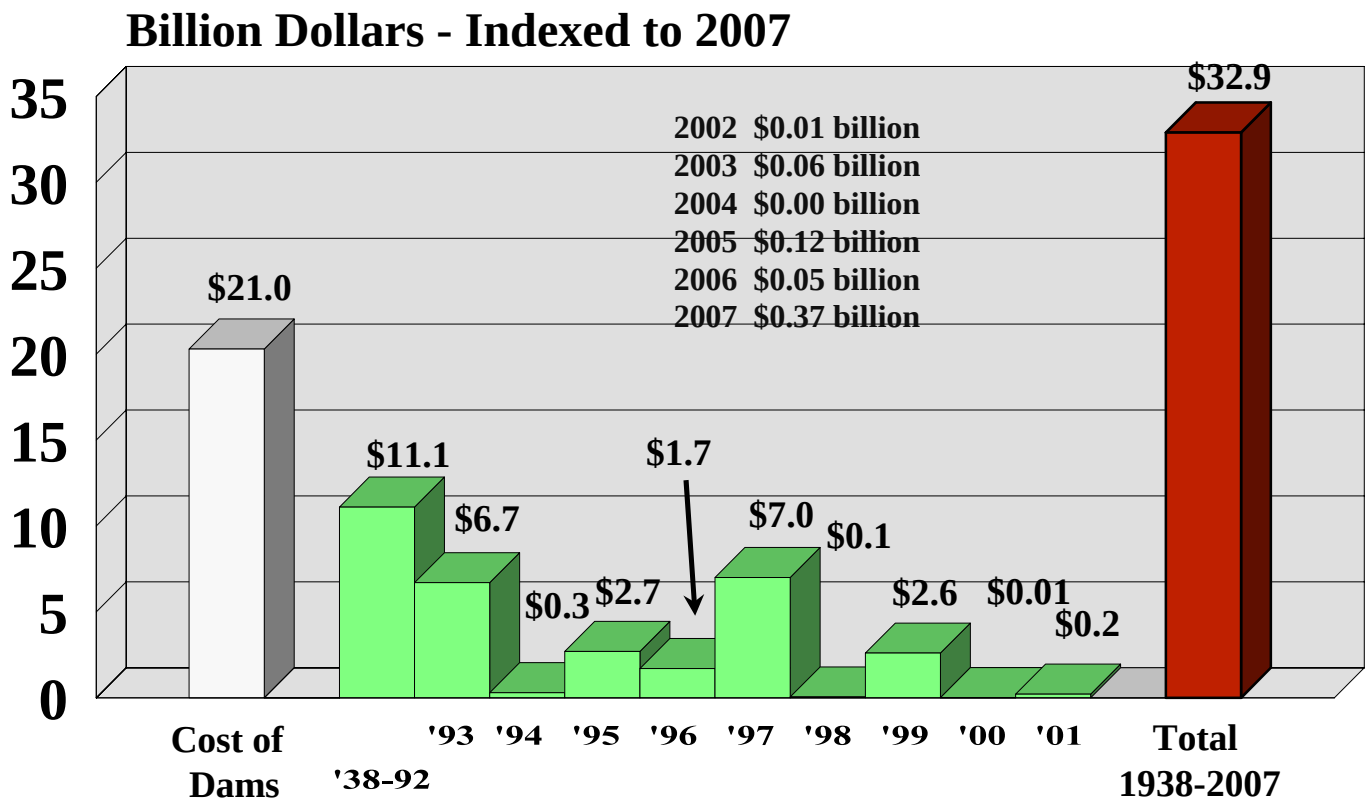



Figure 6A

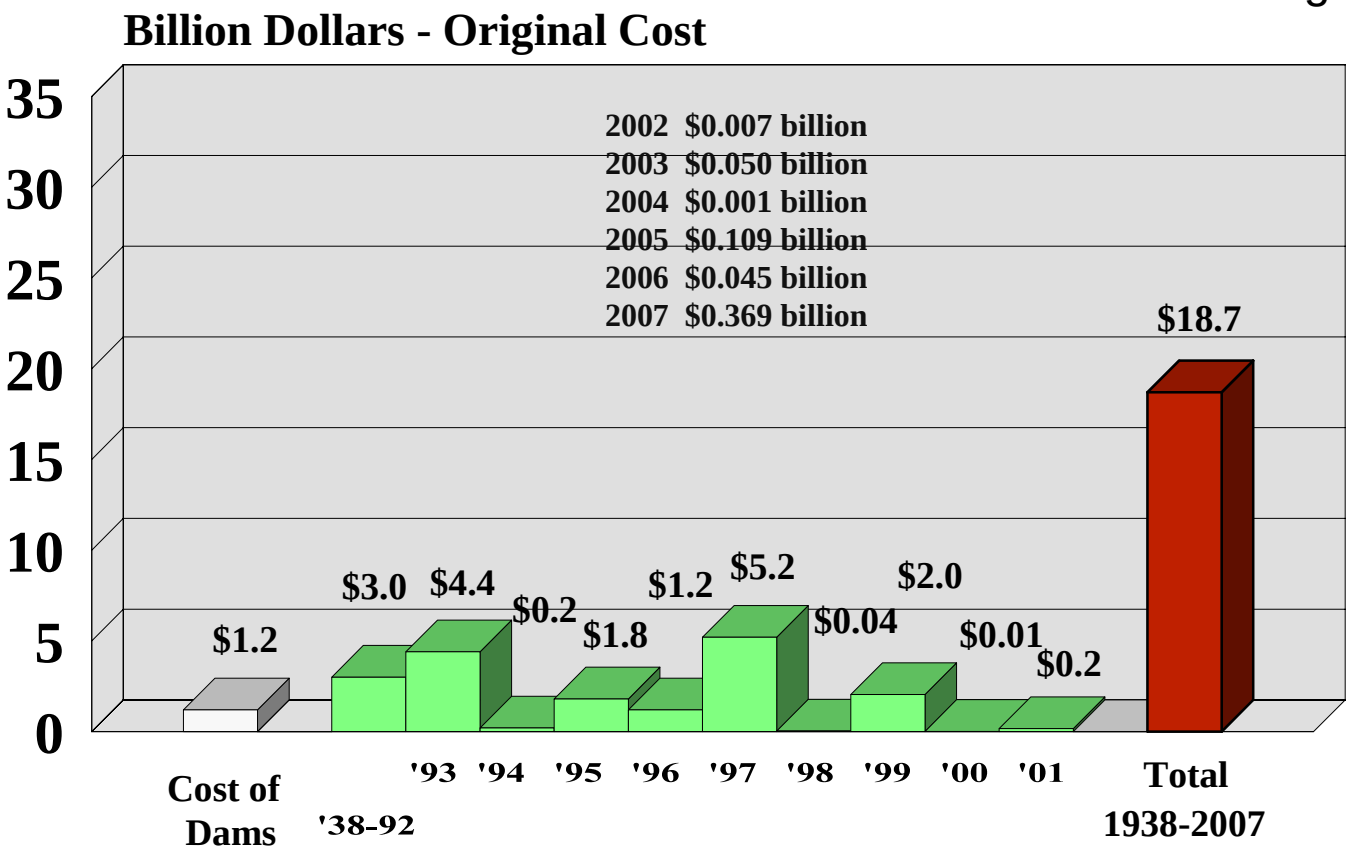



Figure 6B

### 2. Irrigation

Federally developed irrigation projects are not being served directly from System reservoirs. Releases from the reservoirs, however, are being utilized by numerous private irrigators as well as Federally financed projects that take water from the river. About 900 private irrigators pump directly from the reservoir or river reaches. Releases from the reservoirs during 2007 generally met the needs of irrigators, however the reduction of releases from Fort Peck and Garrison in September may have resulted in an earlier than desired end to the irrigation season in those reaches. Also due to the shortening of the navigation season Fort Randall reservoir was drawn down earlier than normal, which impacted irrigation pumping directly from that reservoir. Low reservoir levels and releases have also resulted in additional pumping costs, difficulty in, or in some cases inability to, access the water, and/or the need to dredge in order to maintain access.

### 3. Water Supply and Water Quality Control

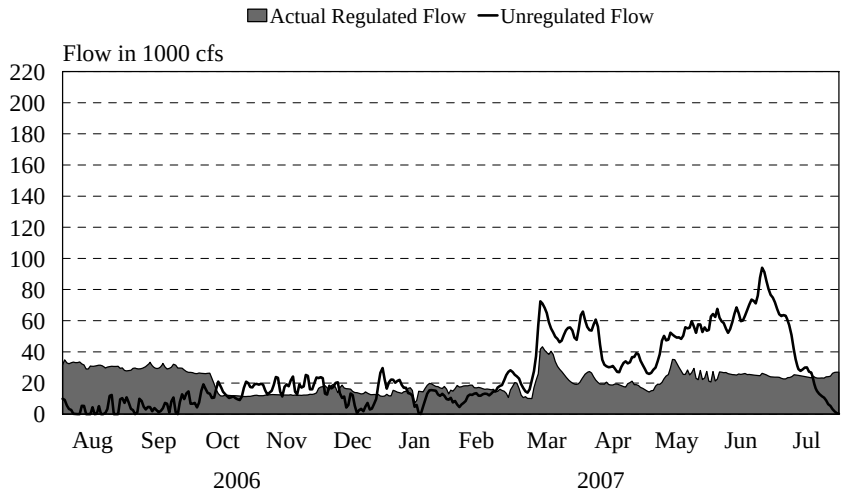
Problems at municipal and industrial (M&I) intakes located in the river reaches and System reservoirs are related primarily to intake or river access problems rather than inadequate water supply. In emergency situations, short-term adjustments to protect human health and safety would be considered to keep M&I intakes functioning.

Low reservoir levels during the current drought have contributed to both intake access and water quality problems for intakes on Garrison and Oahe reservoirs, including several Tribal intakes. The Standing Rock Sioux Tribe's intake at Fort Yates, ND failed in November 2003, leaving the community without water for several days. The Bureau of Reclamation (BOR) has installed a temporary intake and drilled a well to ensure continued water supply for that community. The BOR has also lowered the intake at Wakpala, SD on the Oahe reservoir. The Cheyenne River Sioux Tribe, with assistance from the Corps, relocated their Mni Waste' water intake, which serves over 14,000 residents of and near the Cheyenne River Indian Reservation. The new intake was dedicated in 2007. The Corps has used its emergency authority to lower the intake at Parshall, ND on Garrison reservoir. Other intakes that have been identified as having problems or potential problems include Mandaree, ND and Twin Buttes, ND on Garrison reservoir. If the drought continues, reservoir pool levels and releases may continue to fall below their previous historic lows creating the potential for additional intake access and water quality problems at both river and reservoir intakes.

Intake owners today are generally better prepared to handle periods of low water due to adjustments made to intakes or regulations procedures. The intake owners have made various adjustments to their operations to account for low water levels. Some of these adjustments involve using warm water to keep ice formation from building up on intake screens, installing new pumps, lowering intakes, installing sediment redirection vanes and ice deflectors, obtaining, or arranging to obtain, alternate sources of water; and cleaning screens more thoroughly and frequently. While these remedial actions were

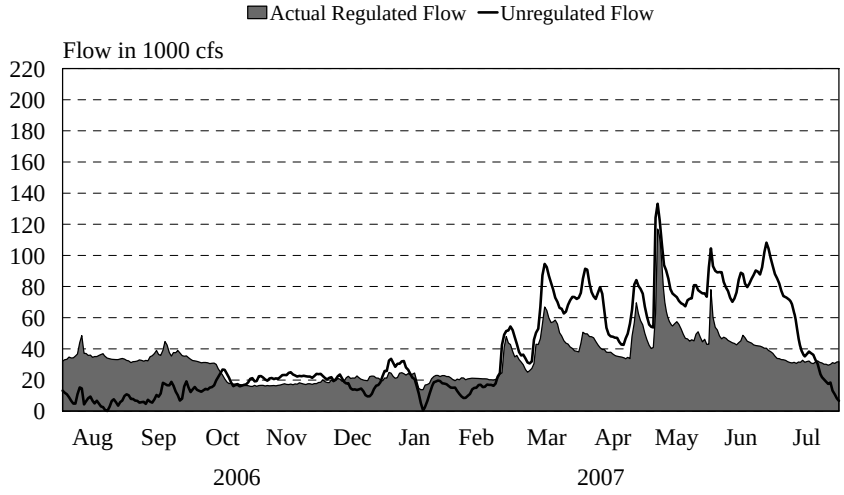
# Sioux City

## Regulated and Unregulated Flows




# Nebraska City

## Regulated and Unregulated Flows




# St. Joseph

## Regulated and Unregulated Flows

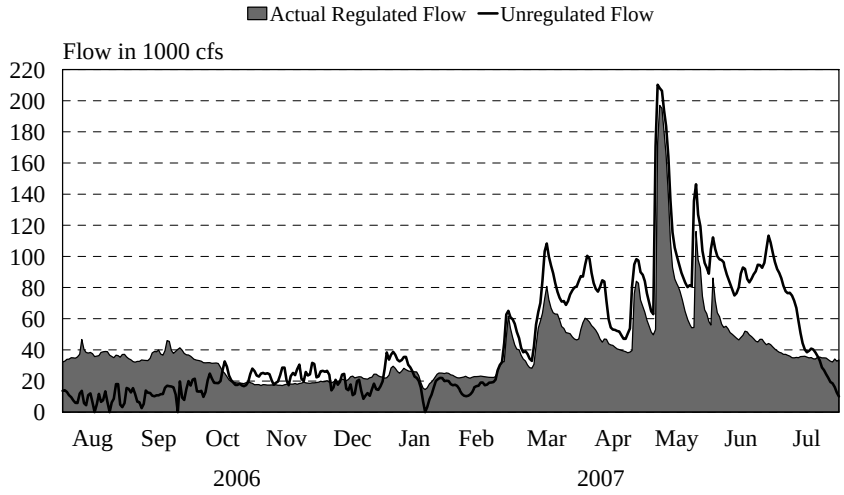
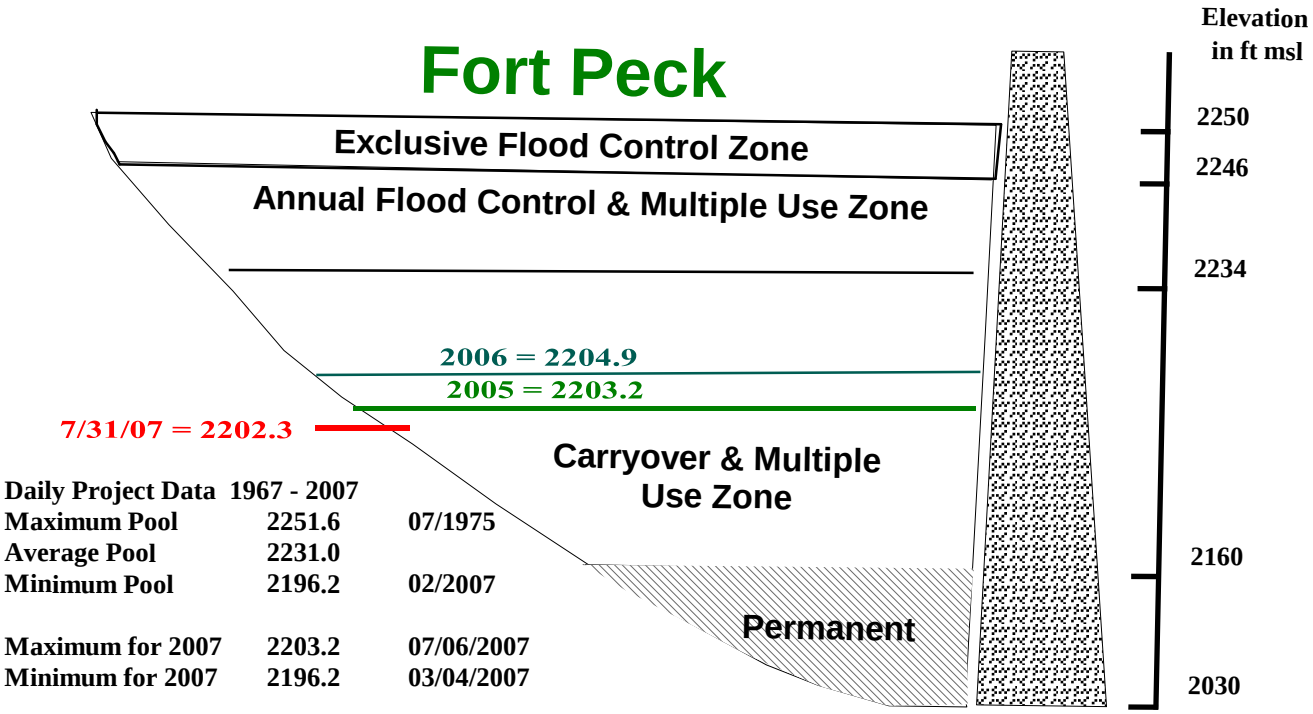


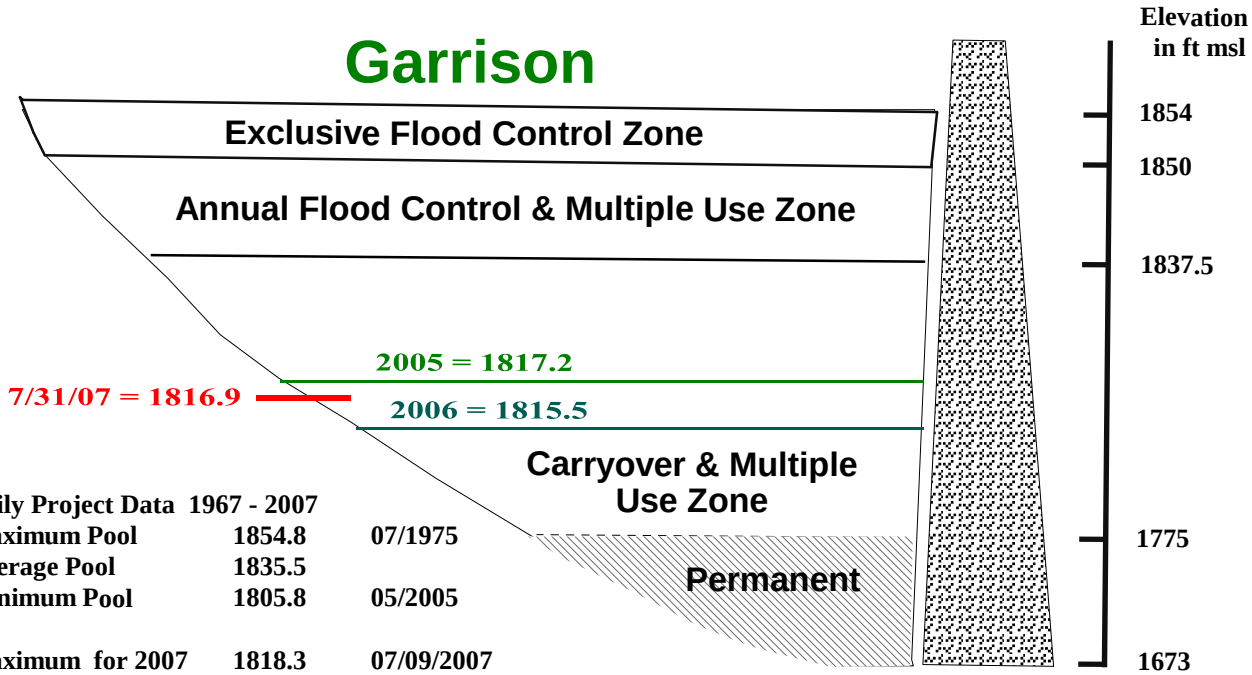



Figure 7

# Missouri River
## End-of-July Pool Elevations



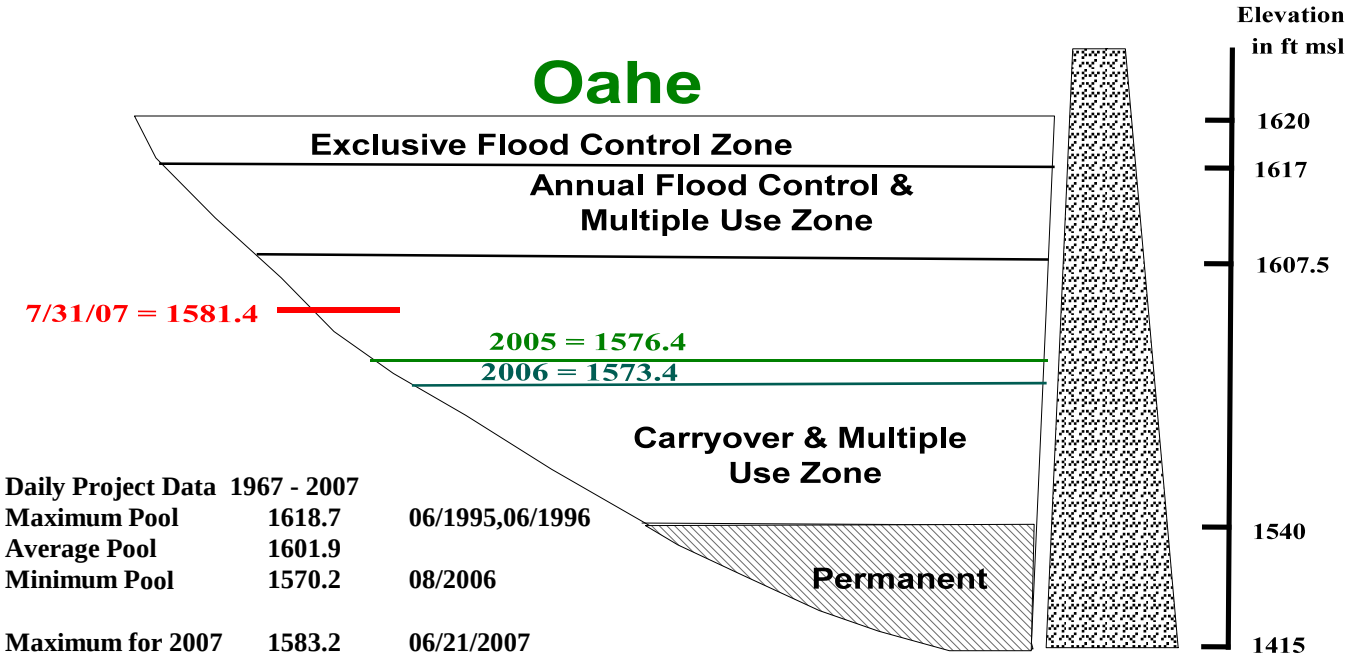

| Daily Project Data 1967 - 2007 | | |
|---|---|---|
| Maximum Pool | 2251.6 | 07/1975 |
| Average Pool | 2231.0 | |
| Minimum Pool | 2196.2 | 02/2007 |
| Maximum for 2007 | 2203.2 | 07/06/2007 |
| Minimum for 2007 | 2196.2 | 03/04/2007 |



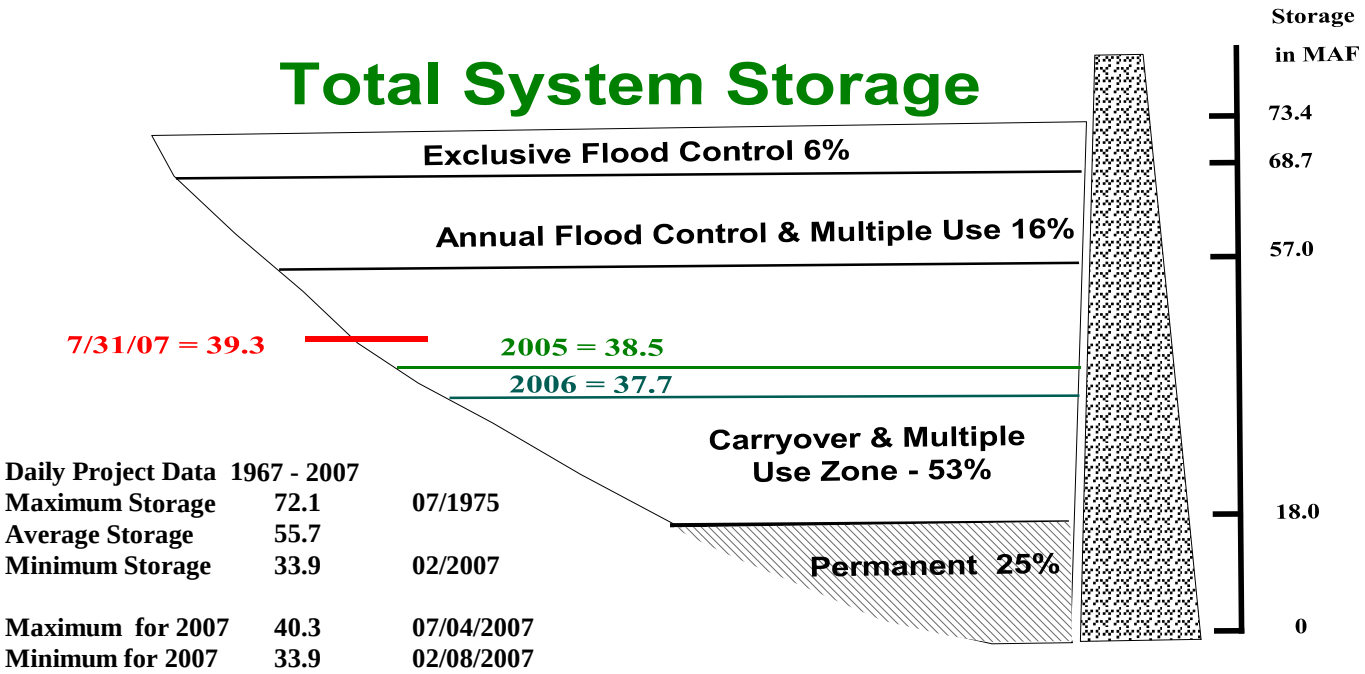

| Daily Project Data 1967 - 2007 | | |
|---|---|---|
| Maximum Pool | 1854.8 | 07/1975 |
| Average Pool | 1835.5 | |
| Minimum Pool | 1805.8 | 05/2005 |
| Maximum for 2007 | 1818.3 | 07/09/2007 |
| Minimum for 2007 | 1806.6 | 02/22/2007 |

Figure 8A

# System Reservoirs
## and Total System Storage




| Daily Project Data 1967 - 2007 | | |
|---|---|---|
| Maximum Pool | 1618.7 | 06/1995,06/1996 |
| Average Pool | 1601.9 | |
| Minimum Pool | 1570.2 | 08/2006 |
| | | |
| Maximum for 2007 | 1583.2 | 06/21/2007 |
| Minimum for 2007 | 1571.9 | 02/15/2007 |




| Daily Project Data 1967 - 2007 | | |
|---|---|---|
| Maximum Storage | 72.1 | 07/1975 |
| Average Storage | 55.7 | |
| Minimum Storage | 33.9 | 02/2007 |
| | | |
| Maximum for 2007 | 40.3 | 07/04/2007 |
| Minimum for 2007 | 33.9 | 02/08/2007 |

Figure 8B

expensive, they have significantly improved the ability of the intakes to operate at lower river stages and reservoir levels.

During 2007, the Omaha District conducted long-term, fixed-station ambient monitoring at the System reservoirs and the lower Missouri River. Water quality conditions of the water discharged through each of the System dams was continuously monitored (i.e., hourly data-logging and monthly sampling). Intensive water quality surveys were conducted at Oahe and Fort Randall.

The Omaha District has identified seven priority water quality issues that have relevance to the System projects. These identified priority issues and their relative ranking are:

(1) Determine how regulation of the System dams effects water quality in the impounded reservoir and downstream river. Utilize the CE-QUAL-W2 hydrodynamic and water quality model to facilitate this effort.

(2) Evaluate how eutrophication is progressing in the System reservoirs, especially regarding the expansion of anoxic conditions in the hypolimnion during summer stratification.

(3) Determine how flow regime, especially the release of water from System projects, affects water quality in the Missouri River.

(4) Provide water quality information to support Corps reservoir regulation elements for effective water quality and aquatic habitat management.

(5) Provide water quality information and technical support to the States in the development of their Section 303(d) lists and development and implementation of Total Maximum Daily Loads (TMDL) at District projects, including the System projects.

(6) Identify existing and potential water quality problems at District projects, and develop and implement appropriate solutions.

(7) Evaluate water quality conditions and trends at District projects.

Note: Relative ranking of priority in parentheses (1 = highest priority).

***Table 11*** provides a summary of water quality issues and concerns at each of the System projects, based on Omaha District monitoring and a review of current State water quality reports.

Maintaining coldwater habitat in Garrison reservoir during late summer continues to be a challenge due to the ongoing drought in the western United States. If the drought persists and the reservoir level continues to drop, it will become more probable that coldwater habitat will not be maintained in the Garrison reservoir through the summer

# Table 11
# Water Quality Issues and Concerns

| Project | TMDL Considerations* | | | | Fish Consumption Advisories | | Other Potential Water Quality Concerns |
|---|---|---|---|---|---|---|---|
| | On 303(d) List | Impaired Uses | Pollutant/Stressor | TMDL Completed | Advisory in Effect | Identified Contamination | |
| ***Fort Peck*** • Fort Peck Lake | Yes | Drinking Water Supply<br>Primary Contact Recreation | Lead<br>Mercury<br>Metals<br>Noxious Aquatic Plants | No | Yes | Mercury | --- |
| ***• Missouri River immediately below Fort Peck Dam*** | Yes | Aquatic Life Support<br>Cold Water Fishery – Trout<br>Warm Water Fishery | Flow Alteration<br>Metals<br>Other Habitat Alterations<br>Riparian Degradation<br>Thermal Modifications | No | No | --- | --- |
| ***Garrison*** • Lake Sakakawea | Yes | Fish and Other Aquatic Biota<br>Fish Consumption | Low Dissolved Oxygen<br>Water Temperature<br>Methyl-Mercury | No | Yes | Mercury | Hypolimnetic Dissolved Oxygen Levels |
| ***• Missouri River immediately below Garrison Dam*** | No | --- | --- | --- | Yes | Mercury | Dissolved oxygen in Garrison Dam tailwaters (associated with late summer hypolimnetic lake withdrawals) |
| ***Oahe*** • Lake Oahe | No | --- | --- | --- | No | --- | --- |
| ***Big Bend*** • Lake Sharpe | No | --- | --- | Yes | No | --- | TMDL completed for sediment. A nonpoint source management project is being implemented in the Bad River watershed. |
| ***Fort Randall*** • Lake Francis Case | No | --- | --- | --- | No | --- | --- |
| ***• Missouri River immediately below Fort Randall Dam*** | No | --- | --- | --- | No | --- | --- |
| ***Gavins Point*** • Lewis and Clark Lake | No | --- | --- | --- | No | --- | Sedimentation<br>Emergent Aquatic Vegetation |
| ***• Missouri River immediately below Gavins Point Dam*** | Yes | Recreation<br>Aquatic Life<br>Public Drinking Water Supply | Pathogens<br>Dieldrin<br>PCBs<br>Arsenic | No | Yes | Dieldrin<br>PCBs | Summer ambient water temperature (NPDES limitations regarding cooling water discharges) |

* Information taken from published state Total Maximum Daily Load (TMDL) 303(d) reports and listings.

months. The pool elevation of the Garrison has reached a point where the reduced hypolimnetic volume of cold water, in concert with the degradation of dissolved oxygen in the deeper water of the reservoir, is limiting the maintenance of coldwater habitat through the end of the summer, the thermal stratification period. Water temperature and dissolved oxygen levels are primary water quality factors that determine the suitability of water for coldwater aquatic life.

The State of North Dakota has defined optimal coldwater fish habitat in the Garrison reservoir as being ≤15°C and having dissolved oxygen levels ≥ 5 mg/l. The measured water temperature and dissolved oxygen concentration depth profiles that were obtained through water quality monitoring conducted at the Garrison reservoir during 2003 through 2007 were used to estimate the volume of water in the reservoir that meets the optimal coldwater habitat conditions defined by the State of North Dakota. ***Plate 6*** shows reservoir and optimal coldwater habitat volumes for 2003 to 2007. Optimal coldwater habitat present in the Garrison reservoir during 2007 appears to have been similar to that present in 2003 through 2006.

The reduction of coldwater habitat in the reservoir is exacerbated by the releases from the Garrison Dam intake structure. Because the invert elevation of the intake portals to the power tunnels (i.e., penstocks) is 2 feet above the reservoir bottom, water drawn through the penstocks comes largely from the lower depths of the reservoir. Thus, during the summer thermal stratification period, water is drawn from the coldwater habitat volume of the reservoir. Three water quality management measures were identified for implementation in an effort to preserve the coldwater habitat in the reservoir. These measures, which were first implemented at Garrison in July 2005 included: 1) modification of the dam's intake trash racks, 2) utilization of head gates to restrict the opening to the dam's power tunnels, and 3) modification of the daily flow cycle and minimum flow releases from the dam. The three implemented water quality management measures were targeted at drawing water into the dam from higher elevations within the reservoir. Implementation of the three water quality management measures was continued in 2006 and 2007.

Based on water quality monitoring of the water discharged through Garrison Dam, it appears that up to 830,000 acre-feet of water meeting optimal coldwater habitat criteria may have been prevented from being discharged through Garrison and retained in the reservoir due to the implementation of the water quality management measures in 2007. This compares to the 380,000 and 1,020,000 acre-feet of optimal coldwater habitat that was potentially saved in 2005 and 2006, respectively. Similar to 2005 and 2006, implementation of the water quality management measures in 2007 warmed the water that was discharged through Garrison Dam during the summer by 2 to 4°C. Although the water quality management measures were implemented to preserve coldwater habitat in the reservoir, they also had the probable benefit of allowing water quality standards criterion established by the State of North Dakota for dissolved oxygen to be met in the Missouri River immediately below Garrison Dam during late summer minimum flow releases.

## 4. Navigation

The first towboat to enter the Missouri River from the Mississippi River in 2007 was the *MV Leslie Ann*, owned by Jefferson City River Terminal. The towboat entered on March 30, 2007 with three loads of cement bound for the Jefferson City River Terminal, MO at River Mile (RM) 143. The first towboat to travel upstream of Kansas City, MO was the *MV Claude R* of McDonough Marine Service with one barge of power plant equipment, 2 transformers and 1 generator (estimated value of $15 million) for unloading at a Brownville, NE destination (RM 535). The tow arrived on April 26, 2007. The equipment was off-loaded on May 1, 2007 then carried by surface transportation to the Omaha Public Power District (OPPD) Nebraska City Power Station. There were no tows with a Sioux City, IA destination during 2007. The most upstream tow was the *MV Omaha*, arriving at Blair, NE on May 22, 2007 with four empty barges for loading alfalfa pellets at Consolidated Blenders Terminal and bound for Guntersville, Alabama. The *MV Omaha* made six trips to Blair, NE during the 2007 navigation season.

With the drought continuing through 2007, the navigation industry was again impacted by minimum service navigation flow support and a 35-day shortened season.

The Waterborne Commerce Statistics Center (WCSC) data for 2006 shows total Missouri River tonnage at 8.3 million tons. This includes 8.04 million tons for sand and gravel, 56,504 tons for waterways materials, and 198,254 tons for long-haul commercial tonnage. The long haul commercial tonnage was the lowest since 1952. The extreme low water conditions during 2006 and resulting navigation channel issues caused several towing companies to stay off the river for a month late in the navigation season. The largest total tonnage year was 2001 at 9.73 million tons. The largest long-haul commercial tonnage year, excluding sand, gravel, and waterway material, occurred in 1977 at 3.3 million tons. Tonnages of commodities shipped during 2003 through 2006 are shown in ***Table 12***. ***Figure 9A*** shows the value of the commodities since 1960, using 2007 present-worth computations. ***Figure 9B*** shows tonnage value of long-haul commercial commodities since 1960. The commercial tonnage figure for 2007 is an estimate and will change once final WCSC tabulations are available. ***Figure 10*** shows total navigation tonnage on the Missouri River. Missouri River long-haul commercial tonnage in 2007 is currently estimated to total about 359,000 tons, based on towboat activity and barge counts from the Corps' daily boat reports.

Navigation season target flows for past years are given in ***Table 13***. ***Table 14*** shows the scheduled lengths of past navigation seasons with total tonnage and ton-miles for each year. The 2007 navigation season was shortened 35 days in accordance with the Master Manual.

***Figure 11*** presents discharge data at Sioux City, IA; Nebraska City, NE; and Kansas City, MO for the August 2006 through December 2007 period. The three graphs demonstrate that actual flows at these locations are influenced considerably by System releases. Tributaries between Gavins Point and Kansas City provided much inflow during the navigation season. Supplemental Missouri River navigation support was

# Missouri River

## Total Navigation Tonnage Value - 2008 Present Worth

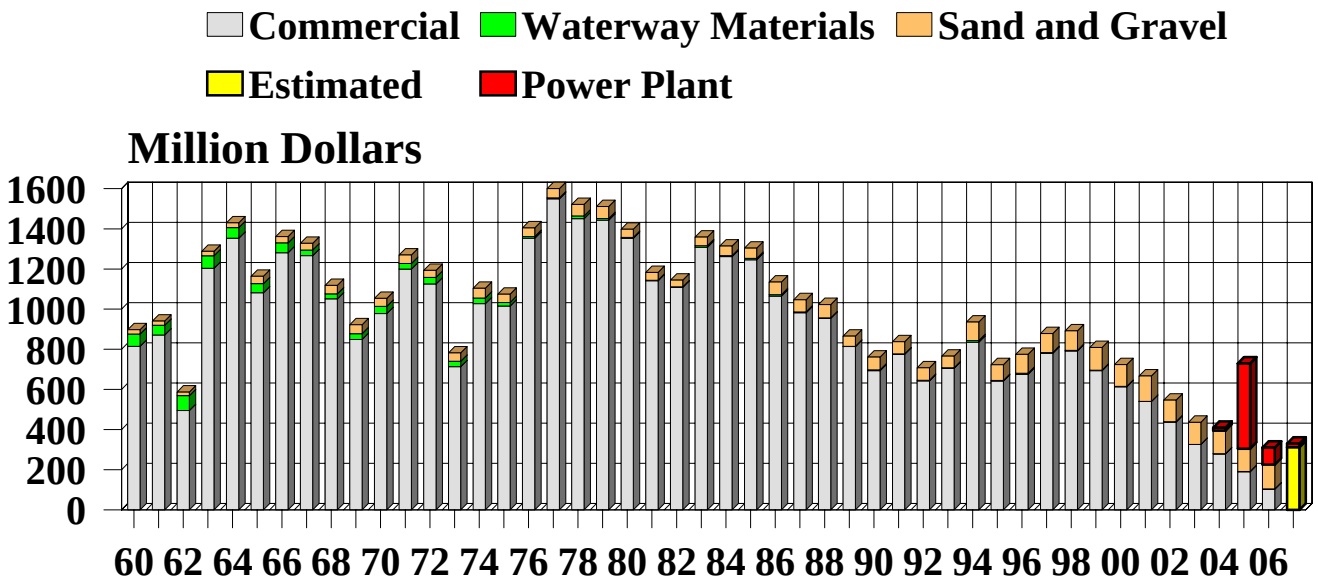



Figure 9A

## Commercial Navigation Tonnage Value - 2008 Present Worth

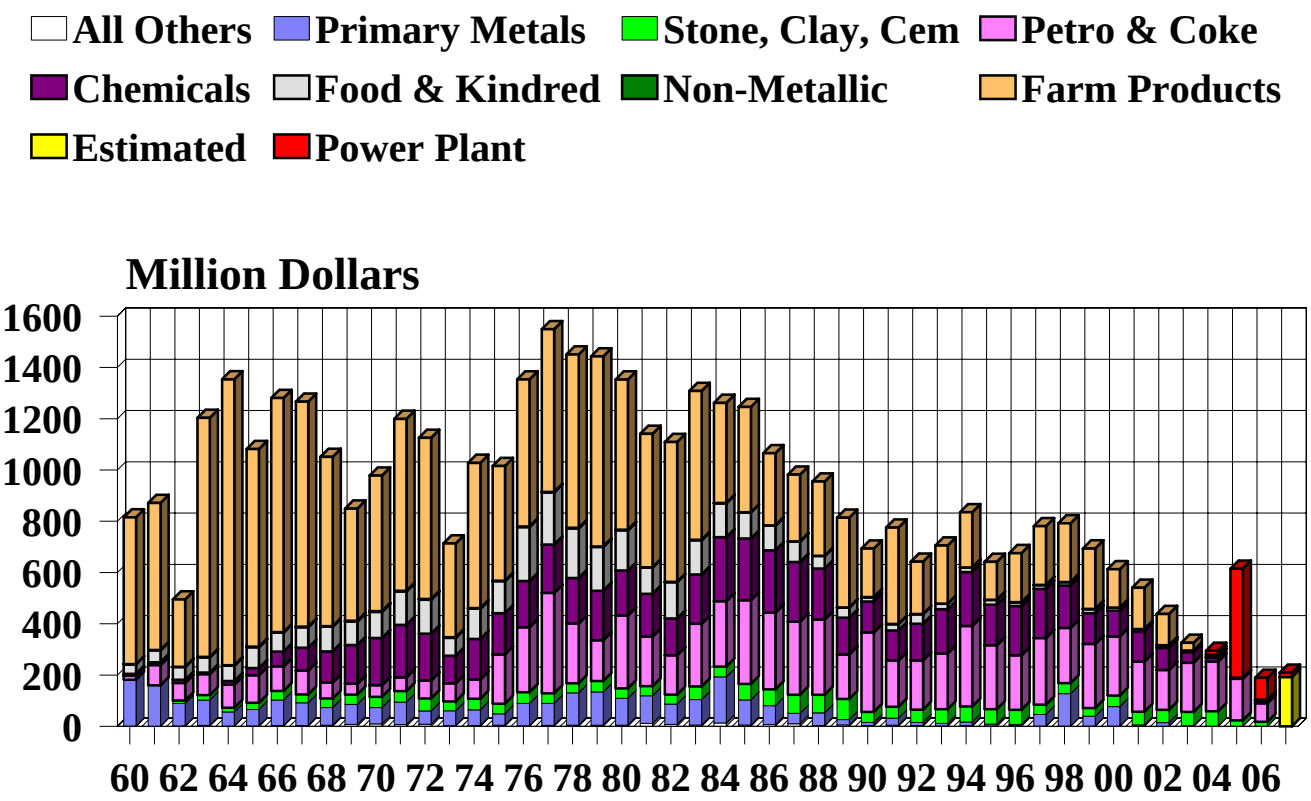
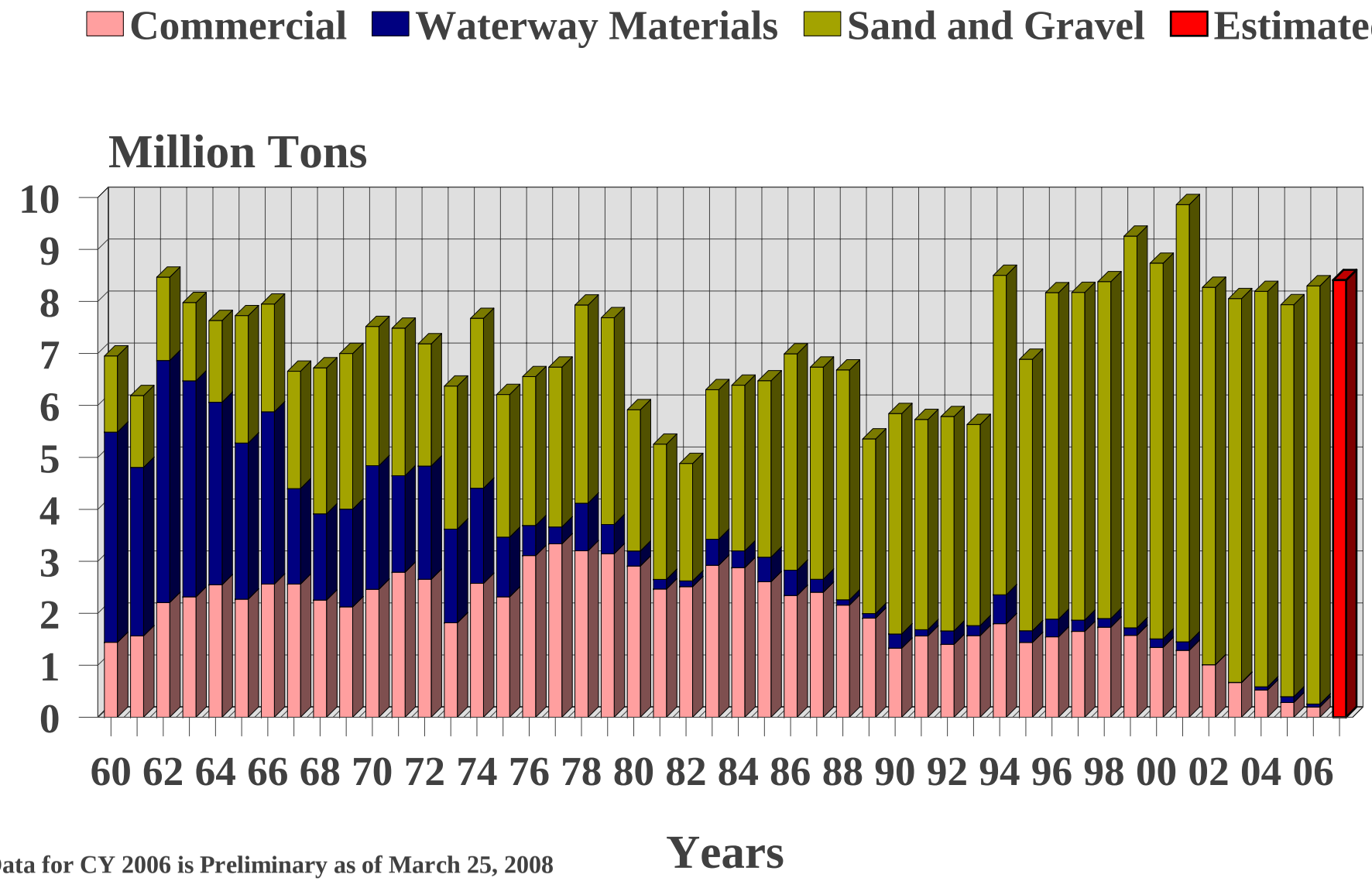



Figure 9B

**Commercial Value Excludes Sand, Gravel & Waterway Materials**

**Data for Calender Year 2006 is Preliminary as of March 25, 2008**

# *Missouri River*
# *Total Navigation Tonnage*




Data for CY 2006 is Preliminary as of March 25, 2008



Figure 10

provided from releases Kansas River reservoir projects from September 26 to October 15. The bulk of the releases were from the Tuttle Creek project. Refer to Section II.C. of this report for further discussion on System releases during the 2007 navigation season.

**Table 12**
**Missouri River Tonnage by Commodities (In Thousands of Tons)**

| Commodity Classification Group | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|
| Farm Products | 105 | 41 | 9 | 12.5 |
| Corn | 70 | 32 | 9 | 12.5 |
| Wheat | 15 | 5 | 0 | 0 |
| Soybeans | 19 | 1.5 | 0 | 0 |
| Misc Farm Product | 1 | 2.5 | 0 | 0 |
| Nonmetallic Minerals | 7381 | 7606 | 7540 | 8043 |
| Sand/Gravel | 7375 | 7606 | 7540 | 8043 |
| Misc Nonmetallic | 6 | 0 | 0 | 0 |
| Food and Kindred | 23 | 0 | 1.4 | 25 |
| Pulp and Paper | 0 | 0 | 0 | 0 |
| Chemicals | 118 | 48 | 6.6 | 13.5 |
| Fertilizer | 114 | 41 | 3.8 | 11.3 |
| Other Chemicals | 4 | 7 | 2.8 | 2.2 |
| Petroleum (including coke) | 213 | 216 | 180 | 80.6 |
| Stone/Clay/Glass | 203 | 221 | 88 | 66.5 |
| Primary Metals | 2 | 0 | 0.1 | 0 |
| Waterway Materials | 5 | 60 | 111 | 56.5 |
| Other | 0 | 0 | 0 | 0 |
| | | | | |
| Total Commercial | 8050 | 8192 | 7936 | 8298 |
| Total Long Haul Commercial | 670 | 526 | 285 | 198 |

### 5. Power-Eastern Division, Pick-Sloan Missouri Basin Program (P-S MBP)

The energy generated in 2007 was transmitted over a Federal transmission system that traverses 7,745 circuit miles. This past year, service was provided to 360 customers. Customers in a 6-state area receiving direct service include 194 municipalities, 2 Federal agencies, 33 state agencies, 28 BOR projects, 5 irrigation districts, 36 rural electric cooperatives, 7 public utility districts, 30 private utilities, 27 Native American Services, and 1 inter-project sale. Additional benefits were provided by the interconnections to the Southwestern and Bonneville Power Administrations and other areas of the Western Area Power Administration (Western). Statistics from the Omaha Public Power District (OPPD) show that the average customer uses approximately 11,000 kilowatt hours (kWh) of energy annually. Based upon the total System generation of 4.9 billion kWh, the energy generated in CY 2007 by this portion of the Federal power system could have supplied all of the yearly needs of 447,000 residential OPPD customers.

# Table 13
# Navigation Season Target Flows
# in 1,000 cfs

| Year | Months | Sioux City | Omaha | Nebraska City | Kansas City |
|---|---|---|---|---|---|
| 1967 | Apr-Jun | 28 | 28 | 34 | 38 |
| | Jul-Nov | 31 | 31 | 37 | 41 |
| 1968 | Apr-Nov | 31 | 31 | 37 | 41 |
| 1969 | Apr-Jun(1) | 35.0-40.0 | 35.0-40.0 | 41.0-46.0 | 45.0-50.0 |
| | Jul(1) | 36 | 36 | 42 | 46 |
| | Aug-Sep(1) | 50.0-55.0 | 50.0-55.0 | 55.0-60.0 | 55.0-60.0 |
| | Oct-Nov(1) | 40.0-45.0 | 40.0-45.0 | 45.0-50.0 | 50.0-55.0 |
| 1970 | Apr-May | 31 | 31 | 37 | 41 |
| | May-Sep(1) | 36 | 36 | 42 | 46 |
| | Oct-Nov(1) | 40 | 40 | 46 | 50 |
| 1971 | Apr-May(1) | 36 | 36 | 42 | 46 |
| | May-Nov(1) | 45.0-50.0 | 45.0-50.0 | 50.0-55.0 | 55.0-60.0 |
| 1972 | Apr-Nov(1) | 40.0-50.0 | 40.0-50.0 | 45.0-55.0 | 50.0-60.0 |
| 1973-74 | Apr-Nov | 31 | 31 | 37 | 41 |
| 1975 | Apr | 31 | 31 | 37 | 41 |
| | May-Nov(1) | 35.0-60.0 | 35.0-60.0 | 41.0-66.0 | 45.0-70.0 |
| 1976 | Apr-Jul(1) | 34.0-38.0 | 34.0-38.0 | 40.0-44.0 | 44.0-48.0 |
| | Aug-Dec(1) | 31.0-34.0 | 31.0-34.0 | 37.0-40.0 | 41.0-44.0 |
| 1977 | Apr-Nov | 31 | 31 | 37 | 41 |
| 1978 | Apr | 31 | 31 | 37 | 41 |
| | May-Jul(1) | 35.0-46.0 | 35.0-46.0 | 41.0-52.0 | 45.0-56.0 |
| | Aug-Nov(1) | 46.0-51.0 | 46.0-51.0 | 52.0-57.0 | 56.0-61.0 |
| 1979 | Apr-Jul(1) | 36.0-42.0 | 36.0-42.0 | 42.0-48.0 | 46.0-52.0 |
| | Aug-Nov(1) | 31.0-36.0 | 31.0-36.0 | 37.0-42.0 | 41.0-46.0 |
| 1980 | Apr-Nov | 31 | 31 | 37 | 41 |
| 1981 | Apr-Nov(2) | 31 | 31 | 37 | 41 |
| 1982 | Apr-Sep | 31 | 31 | 37 | 41 |
| | Oct | 31.0-36.0 | 31.0-36.0 | 37.0-42.0 | 41.0-46.0 |
| | Nov-Dec(1) | 36.0-46.0 | 36.0-46.0 | 42.0-52.0 | 46.0-56.0 |
| 1983 | Apr-Jun | 31 | 31 | 37 | 41 |
| | Jul | 31.0-36.0 | 31.0-36.0 | 37.0-42.0 | 41.0-46.0 |
| | Aug-Nov(1) | 36 | 36 | 42 | 46 |
| 1984 | Apr-Jun | 31 | 31 | 37 | 41 |
| | Jul-Dec(1) | 31.0-44.0 | 31.0-44.0 | 37.0-50.0 | 41.0-54.0 |
| 1985 | Apr-Dec | 31 | 31 | 37 | 41 |
| 1986 | Apr(1) | 36.0-41.0 | 36.0-41.0 | 42.0-47.0 | 46.0-51.0 |
| | May-Dec(1) | 41.0-46.0 | 41.0-46.0 | 47.0-52.0 | 51.0-56.0 |
| 1987 | Apr-Nov | 31 | 31 | 37 | 41 |
| 1988 | Apr-Nov(2) | 31 | 31 | 37 | 41 |
| 1989 | Apr-Aug(3) | 28 | 28 | 34 | 38 |
| | Sep-Oct(3) | 28 | 28 | 34 | 35 |
| 1990-93 | Apr-Oct(4) | 25 | 25 | 31 | 35 |
| 1994 | Apr-Dec | 31 | 31 | 37 | 41 |
| 1995 | Apr-May | 31 | 31 | 37 | 41 |
| | Jun-Dec(1) | 46.0-56.0 | 46.0-56.0 | 52.0-62.0 | 56.0-66.0 |
| 1996 | Apr(1) | 41 | 41 | 47 | 51 |
| | May(1) | 41.0-51.0 | 41.0-51.0 | 47.0-57.0 | 51.0-61.0 |
| | Jun-Dec(1) | 56 | 56 | 62 | 66 |
| 1997 | Apr-Dec(5) | * | * | * | * |
| 1998 | Apr-Dec(5) | 31 | 31 | 37 | 41 |
| 1999 | Apr-Dec(1) | 31.0-43.0 | 31.0-43.0 | 37.0-49.0 | 41.0-53.0 |
| 2000 | Apr-Jun | 31 | 31 | 37 | 41 |
| | Jul-Dec(3) | 29.5 | 29.5 | 35.5 | 39.5 |
| 2001 | Apr-Dec(3) | 28 | 28 | 34 | 38 |
| 2002 | Apr-Jun(3) | 27 | 27 | 33 | 37 |
| | Jul-Dec(3) | 25 | 25 | 31 | 35 |
| 2003 | Apr-Nov(4) | 25 | 25 | 31 | 35 |
| 2004-07 | Apr-Oct(6) | 25 | 25 | 31 | 35 |

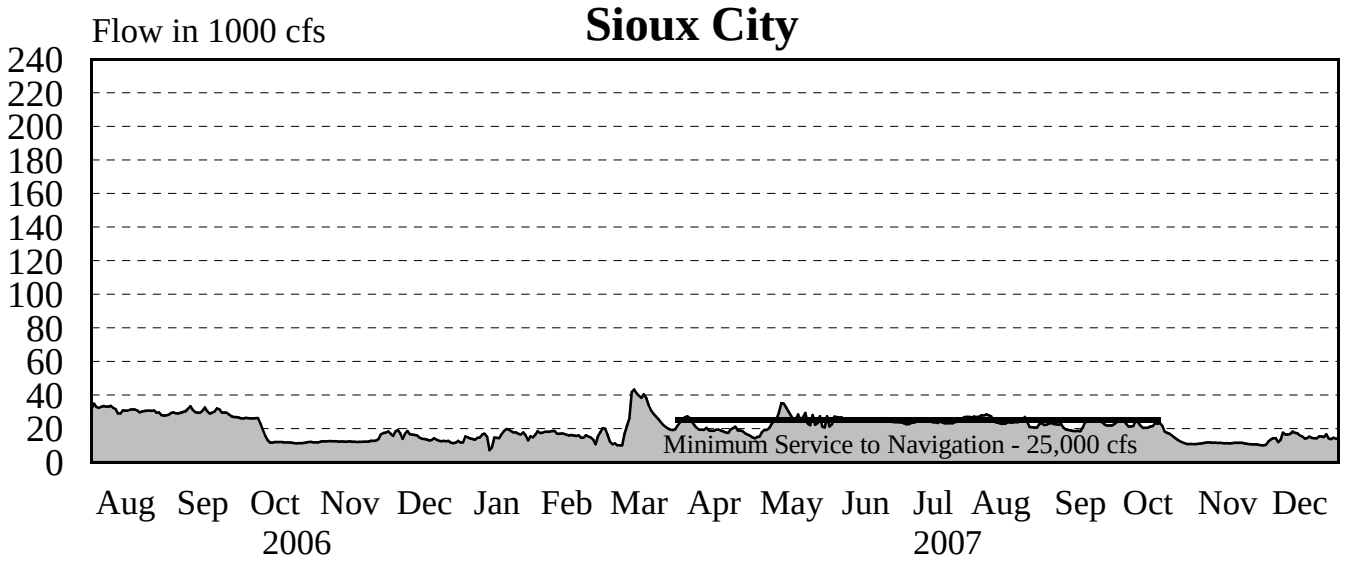
(1) Downstream flow targets above full-service navigation level as a flood control storage evacuation measure.
(2) Full service flows provided for shortened season.
(3) Navigation targets below full service as a water conservation measure.
(4) Navigation targets at minimum service as a water conservation measure.
(5) Releases determined by flood control storage evacuation critiera and not adjusted to meet specific navigation targets.
(6) Minimum service targets at Sioux City and Omaha not met during periods when there was no navigation in those reaches.

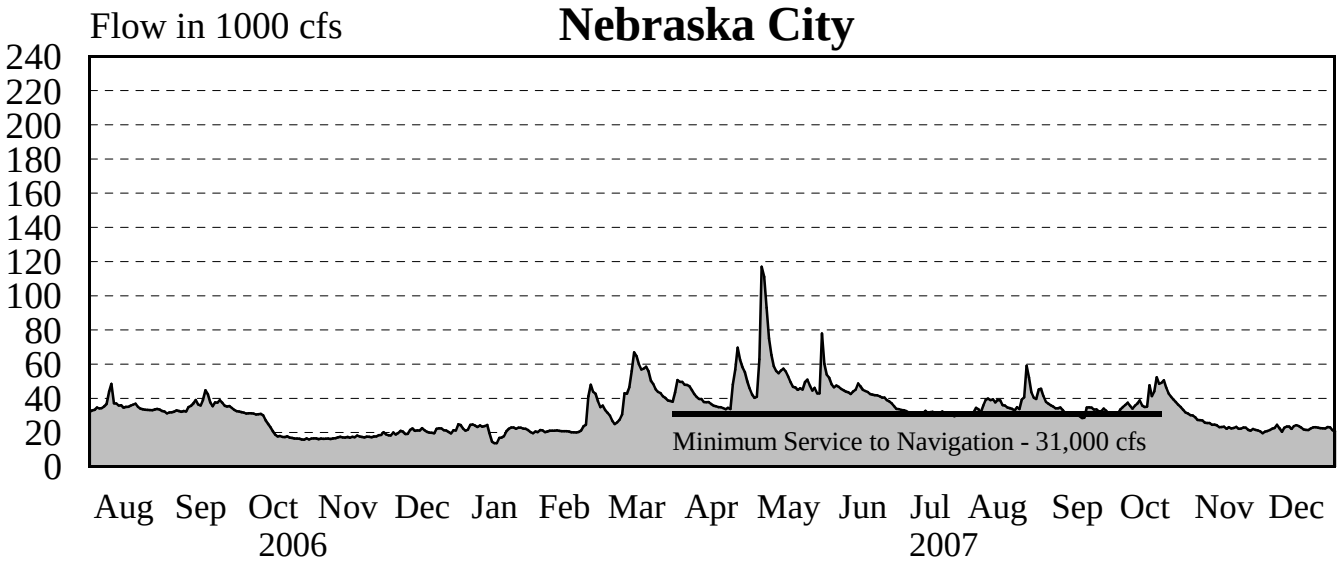
## Table 14
## Missouri River Navigation
## Tonnage and Season Length

| Year | Scheduled Length of Season (Months) | Commercial (Tons) (1) | Total Traffic (Tons) (2) | Total Traffic (1000 Ton-Miles) (2) |
|---|---|---|---|---|
| 1967 (3) | 8 | 2,562,657 | 6,659,219 | 1,179,235 |
| 1968 | 8 (4) | 2,254,489 | 6,724,562 | 1,047,935 |
| 1969 | 8 (4) | 2,123,152 | 7,001,107 | 1,053,856 |
| 1970 | 8 (5) | 2,462,935 | 7,519,251 | 1,190,232 |
| 1971 | 8 (4) | 2,791,929 | 7,483,708 | 1,329,899 |
| 1972 | 8 (4) | 2,665,579 | 7,182,841 | 1,280,385 |
| 1973 | 8 | 1,817,471 | 6,370,838 | 844,406 |
| 1974 | 8 | 2,576,018 | 7,673,084 | 1,227,525 |
| 1975 | 8 (4) | 2,317,321 | 6,208,426 | 1,105,811 |
| 1976 | 8 (4) | 3,111,376 | 6,552,949 | 1,535,912 |
| 1977 | 8 | 3,335,780 | 6,734,850 | 1,596,284 |
| 1978 | 8 (4) | 3,202,822 | 7,929,184 | 1,528,614 |
| 1979 | 8 (4) | 3,145,902 | 7,684,738 | 1,518,549 |
| 1980 | 8 | 2,909,279 | 5,914,775 | 1,335,309 |
| 1981 | 7 1/4 (6) | 2,466,619 | 5,251,952 | 1,130,787 |
| 1982 | 8 (4) | 2,513,166 | 4,880,527 | 1,131,249 |
| 1983 | 8 (4) | 2,925,384 | 6,301,465 | 1,300,000 |
| 1984 | 8 (4) | 2,878,720 | 6,386,205 | 1,338,939 |
| 1985 | 8 (4) (7) | 2,606,461 | 6,471,418 | 1,201,854 |
| 1986 | 8 (4) (7) | 2,343,899 | 6,990,778 | 1,044,299 |
| 1987 | 8 | 2,405,212 | 6,735,968 | 1,057,526 |
| 1988 | 7 1/2 | 2,156,387 | 6,680,878 | 949,356 |
| 1989 | 6 3/4 | 1,906,508 | 5,352,282 | 796,799 |
| 1990 | 6 3/4 | 1,329,000 | 5,841,000 | 552,509 |
| 1991 | 6 3/4 | 1,563,000 | 5,729,000 | 537,498 |
| 1992 | 6 3/4 | 1,403,000 | 5,783,000 | 593,790 |
| 1993 | 8 (8) | 1,570,000 | 5,631,000 | 615,541 |
| 1994 | 8 | 1,800,000 | 8,501,000 | 774,491 |
| 1995 | 8 (4) | 1,439,000 | 6,884,000 | 604,171 |
| 1996 | 8 (4) | 1,547,000 | 8,165,000 | 680,872 |
| 1997 | 8 (4) | 1,651,000 | 8,172,000 | 725,268 |
| 1998 | 8 (4) | 1,735,000 | 8,379,000 | 777,727 |
| 1999 | 8 (4) | 1,576,000 | 9,252,000 | 699,744 |
| 2000 | 8 | 1,344,000 | 8,733,000 | 628,575 |
| 2001 | 8 | 1,288,000 | 9,732,000 | 566,150 |
| 2002 | 8 (9) | 1,009,000 | 8,266,000 | 409,980 |
| 2003 | 8 (10) | 667,000 | 8,050,000 | 256,788 |
| 2004 | 6 1/2 (11) | 525,498 | 8,192,219 | 181,995 |
| 2005 | 6 1/2 (11) | 284,641 | 7,935,747 | 129,882 |
| 2006 | 6 1/2 (11) | 198,300 (12) | 8,298,190 (12) | 100,00 (12) |
| 2007 | 6 3/4 (11) | 359,000 (13) | 8,409,000 (13) | 150,000 (13) |

(1) Includes commercial tonnage except for sand and gravel or waterway materials. Tonnage compiled by Waterborne Commerce Statistics Center (WCSC).
(2) Includes commodities; sand, gravel, and crushed rock; and waterway improvement materials. Tonnage by WCSC.
(3) Mainstem Reservoir System first reached normal operating storage level in 1967.
(4) 10-day extension of season provided.
(5) 10-day extension and 10-day early opening provided.
(6) Full service flows for shortened season in preference to reduced service.
(7) 10-day extension provided for 1985 season in trade for 10-day delayed support of 1986 season.
(8) Lower Missouri River closed: 57 days in 1993, 20 days in 1995, and 18 days in 1999.
(9) To protect endangered shore birds below Gavins Point Dam, the Corps did not support navigation from July 3 to August 14, 2002. Average days towing industry off the river was 23 days.
(10) 6-day shortening of season to follow CWCP. From Aug 11 to Sep 1 Corps did not support navigation flows to comply with lawsuit to follow 2000 Biological Opinion. Navigation industry left the river during this period.
(11) 47-day shortening, 2004; 48-day shortening, 2005; 44-day shortening, 2006; 35-day shortening, 2007
(12) Preliminary Data from WCSC. Final data expected spring of 2008.
(13) Estimated using boat report barge counts.

# Missouri River Flows at Sioux City, Nebraska City and Kansas City



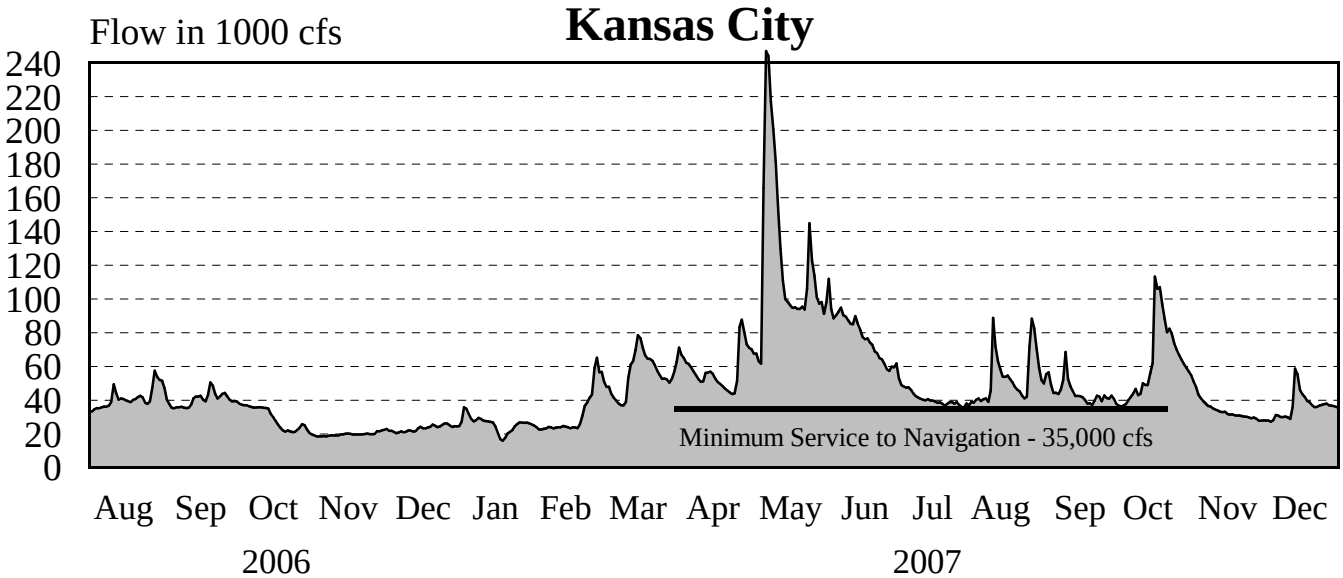






Figure 11

In addition to the clean, renewable energy transmitted to the Midwest area, the hydropower system provides an added measure of stability to the regional power system with the ability to meet full load in 5 seconds or less. Large coal-fired and nuclear units are reinforced by idle hydropower units, typically in 30 seconds. Outside utilities can have access to the hydropower capability within several minutes of a known problem.

The excellent reliability of the hydropower system is indicated by having to maintain a 10% reserve, while thermal power must maintain a 15% reserve. Although the Federal hydropower system that serves the Missouri River region accounts for only 9% of the region's energy, it is large enough to fill gaps and provide a positive benefit to the integrated system.

CY 2007 generation of 4.9 billion kWh, a record low, was 52 percent of average since the System first filled in 1967. Energy generation was below normal due to lower than normal pool levels, below normal runoff, and below-normal releases at all powerplants. Western purchased about 5.6 billion kWh between January 1, 2007 and December 31, 2007, at a cost of $284.4 million to supplement System hydropower production.

System generation with individual project distribution for each calendar year since 1954 is shown on ***Figure 12***. The gross generation from the Federal system (peak capacity and energy sales) for 2007 is shown in ***Table 15***. The tabulations in ***Table 16*** and ***Table 17*** summarize the total gross generation and power regulation for the Eastern Division, P-S MBP, marketing area system for the past operating year. Actual settlement figures at the end of the billing periods differ somewhat from the calendar month figures shown.

**Table 15**
**Gross Federal Power System Generation – January 2007 through December 2007**

| | Energy Generation 1,000 kWh | Peak Hour kWh | Generation Date |
|---|---|---|---|
| Corps Power Plants – Mainstem | | | |
| Fort Peck | 619,552 | 149,000 | 4 Feb |
| Garrison | 1,309,609 | 354,000 | 18 Jun |
| Oahe | 1,101,511 | 561,000 | 17 Jul |
| Big Bend | 477,029 | 454,000 | 2 Aug |
| Fort Randall | 922,913 | 362,000 | 21 May |
| Gavins Point | 488,995 | 91,000 | 27 Jul |
| Corps Subtotal | 4,919,609 | 2,164,000 | 2 Aug |
| | | | |
| USBR Powerplants | | | |
| Canyon Ferry | 411,921 | 50,000 | Jan 2007 |
| Yellowtail* | 263,645 | 91,000 | Jul 2007 |
| USBR Subtotal | 675,566 | | |
| | | | |
| Federal System Total | 5,595,175 | | |

* Includes only half of total Yellowtail generation, which is marketed by the Eastern Division, P-S MBP.

# Mainstem Power Generation
# 1954 - 2007

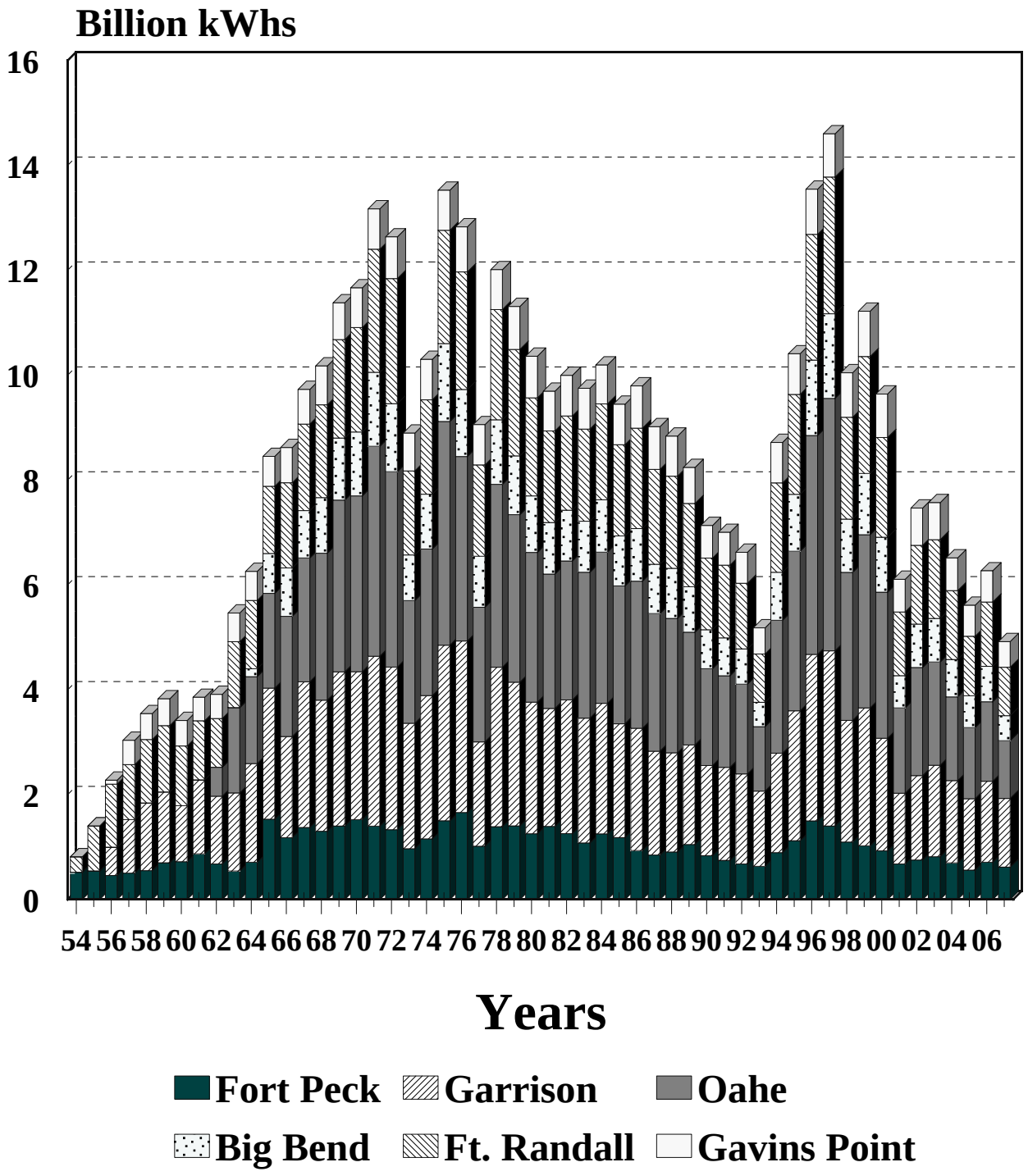





Figure 12

# Table 16

Historical Generation and Load Data - Peaks
Eastern Division, Pick-Sloan Missouri River Program*
Data at plant - 1,000 kW
January 1, 2007 through December 31, 2007

| Period | Corps of Engineers Hourly Generation (Gross)** | (plus) | USBR Hourly Generation (Gross)** | (equals) | Federal Hour Generation (Gross)** | (plus) | Interchange and Purchases Received** | (equals) | Peak Total System Load | Peak Date | Peak Hour |
|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 1,113 | | 64 | | 1,177 | | 846 | | 2,023 | 16-Jan | 9:00 |
| February | 1,187 | | 44 | | 1,231 | | 801 | | 2,032 | 15-Feb | 8:00 |
| March | 1,075 | | 46 | | 1,121 | | 582 | | 1,703 | 7-Mar | 8:00 |
| April | 849 | | 46 | | 895 | | 616 | | 1,511 | 5-Apr | 7:00 |
| May | 538 | | 57 | | 595 | | 865 | | 1,460 | 1-May | 16:00 |
| June | 1,369 | | 64 | | 1,433 | | 246 | | 1,679 | 25-Jun | 16:00 |
| July | 1,277 | | 65 | | 1,342 | | 797 | | 2,139 | 24-Jul | 15:00 |
| August | 1,504 | | 66 | | 1,570 | | 277 | | 1,847 | 13-Aug | 15:00 |
| September | 1,271 | | 67 | | 1,338 | | 1,541 | | 1,541 | 4-Sep | 16:00 |
| October | 534 | | 53 | | 587 | | 1,419 | | 1,419 | 29-Oct | 8:00 |
| November | 579 | | 59 | | 638 | | 2,037 | | 2,037 | 27-Nov | 18:00 |
| December | 1,171 | | 52 | | 1,223 | | 732 | | 1,955 | 14-Dec | 8:00 |

* This tabulation summarizes the total gross generation and power operations for the Eastern Division marketing area system shown on Table 15.
** During hour of peak total system load

# Table 17

Historical Generation and Load Data - Total
Eastern Division, Pick-Sloan Missouri Basin Program*
Data at plant - 1,000 kWh
January 1, 2007 through December 31, 2007

| Period | Corps of Engineers Generation (Gross) | (plus) | USBR Generation (Gross) | (equals) | Federal Generation (Gross) | (plus) | Scheduled Interchange and Purchases Received | (equals) | Total System Load |
|---|---|---|---|---|---|---|---|---|---|
| January | 486,160 | | 42,676 | | 528,836 | | 511,991 | | 1,040,827 |
| February | 454,363 | | 35,441 | | 489,804 | | 488,112 | | 977,916 |
| March | 308,094 | | 38,725 | | 346,819 | | 513,974 | | 860,793 |
| April | 298,068 | | 37,235 | | 335,303 | | 463,958 | | 799,260 |
| May | 285,463 | | 39,111 | | 324,574 | | 452,987 | | 777,560 |
| June | 459,394 | | 42,621 | | 502,015 | | 413,241 | | 915,256 |
| July | 604,786 | | 46,389 | | 651,175 | | 330,712 | | 981,887 |
| August | 617,219 | | 44,180 | | 661,399 | | 278,532 | | 939,931 |
| September | 392,944 | | 37,202 | | 430,146 | | 339,247 | | 769,392 |
| October | 349,330 | | 36,264 | | 385,594 | | 494,269 | | 879,863 |
| November | 245,092 | | 39,296 | | 284,388 | | 662,396 | | 946,784 |
| December | 418,696 | | 44,569 | | 463,265 | | 668,081 | | 1,131,346 |

*Powerplants from Table 15

### 6. Fish Management

Rainbow smelt are the primary forage species in both Garrison and Oahe. Successful rainbow smelt reproduction is dependent on many factors including stable reservoir levels during the smelt spawning period, generally in April and early May. Most eggs are laid in water less than 1-foot deep and are subject to desiccation through wave action and slight drops in water level. In the Fort Peck reservoir, a forage fish spawn normally occurs between April 15 and May 30. As per the 2006-2007 AOP, if runoff was not sufficient to keep all pool levels rising during the fish spawn in 2007, the Corps would, to the extent reasonably possible, set releases to result in a steady-to-rising pool level in Fort Peck and Oahe during April and May. Reservoir levels rose in the spring of 2007 in Fort Peck, Garrison, and Oahe reservoirs. However, despite the steady to rising pool level in Lake Sakakawea and favorable weather conditions, smelt spawning success appeared to be poor. The state of North Dakota recorded the lowest abundance of young smelt since surveys began. The lack of success was attributed to the lack of suitable spawning substrate and very low volume and quality of nursery and spawning habitat. The standard adult population surveys conducted by the state of North Dakota documented the poorest condition and size structure for walleye, sauger and northern pike since the introduction of rainbow smelt in 1971.

In Oahe, the annual larval smelt surveys revealed larval densities similar to those found in 2006. The Chinook salmon population has been rebuilding since the low abundance experienced during the late 1990's and showed a gain in both numbers of anglers fishing for salmon and number of salmon harvested during June and July of 2007

The ongoing drought has continued to cause a decline in coldwater habitat in the Garrison reservoir. The Corps has installed plywood barriers on the trash racks on the intake structures of powerplant units 2 and 3 during 2005 and on unit 1 during 2007. In addition hydropower peaking patterns were adjusted to try to limit the volume of cold water released. As shown on ***Plate 6***, the measures preserved coldwater habitat through the summer, but the volume of optimal habitat was very low for a few weeks in the late summer.

### 7. Threatened and Endangered Species

This was the 22nd year of reservoir regulation since the piping plover and least tern were Federally listed as threatened and endangered species, respectively. This was the second year of operating for the pallid sturgeon per the revised Master Manual. No spring pulse was released from Gavins Point Dam in March or May 2007 as there was not enough water in storage per the Master Manual.

The terns and plovers nest on sparsely vegetated sandbars, islands, and shoreline of the Missouri River and the reservoirs. Stream gages have been installed on the Missouri River to monitor stream flows during the nesting season. These gages provide a check, as well as a stage history, throughout the season to help relate the effects of regulation and natural events at intervals along the river. The gaging data must be supplemented

with observations of nesting activities and conditions to provide the information that is needed for regulation. A dynamic flow routing model has been developed to accurately predict river stages along the river for different combinations of daily and hourly power-peaking.

Beginning in 1999, the Omaha District created a computerized Threatened and Endangered Species Data Management System. Report data, which is updated daily, includes nest records, census and productivity data, site descriptions, field journals, and messages. This database provided vital information again during the 2007 nesting season and proved to be a valuable tool in aiding release decisions benefiting the terns and plovers.

Although the Corps prevented inundation of nests where possible and created habitat following the listing, fledging ratios continued to be lower than predicted by the USFWS 1990 Biological Opinion until 1998, when fledge ratios exceeded the goal for both species. Predation, habitat degradation, severe weather, nest inundation, record runoff, and other factors contributed to the previously disappointing low fledging. The record fledging that occurred for both species in 1998 and the subsequent above-average and new record fledge ratios achieved since then can be attributed to the large amount of habitat created by the high flows of 1997 and the declining reservoir levels during the current drought. The creation of additional habitat has also allowed greater flexibility in the release levels at the lower two System projects.

During 2007, the majority of plovers were again found on the Garrison reservoir, below Gavins Point and on the Oahe reservoir. The number of piping plover adults was lower than the record numbers experienced in 2005; however there was a record number of adult interior least terns on the Missouri River in 2007. Fledge ratios were lower, falling to 0.66 chicks per pair of plovers and 0.75 chicks per pair of interior least terns. A record number of adult terns (1,010) were recorded on the system during the summer of 2007. The majority of least terns were found on the Missouri River reaches below the Gavins Point and Garrison dams and on Lake Oahe. A detailed description of the factors affecting tern and plover nesting can be found in the Missouri River Recovery Program 2007 Annual Report.

The population distribution and productivity for terns and plovers for 1986 through 2007 are shown on ***Table 18*** and ***Table 19***. Productivity estimates for these birds on the Missouri River does not include least terns and piping plovers raised in captivity. The captive rearing facility was not utilized in 2007. Adult birds in this table are considered breeders even though they may not have had nesting success. The term "fledglings/pair" refers to the number of young birds produced per breeding pair. This ratio is an estimate, as the fate of every single fledgling is impossible to ascertain.

# Table 18
## Missouri River System
## Interior Least Tern Survey Data

| | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fort Peck Lake** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | - | 4 | 3 | 4 | 6 | 10 | 0 | 7 | 9 | 2 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 2 |
| Fledglings/Pair | - | - | 0 | 3.00 | - | 0.40 | {} | 0 | 0.44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 |
| **Fort Peck to Lake Sakakawea** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | - | - | 18 | 48 | 92 | 66 | 110 | 31 | 58 | 95 | 128 | 162 | 25 | 40 | 13 | 39 | 34 | 38 | 48 | 34 | 36 | 77 |
| Fledglings/Pair | - | - | 0.33 | 0 | 0.17+ | 0.55+ | 0.25+ | 0.45+ | 1.41+ | 0.99+ | 0.33 | 0.53 | .1.52 | 1.70 | 0.15 | 0.97 | 0.59 | 0.63 | 0.50 | 2.18 | 1.17 | 1.38 |
| **Lake Sakakawea** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | - | - | 7 | 15 | 6* | 8 | 29+ | 17 | 35 | 7 | 27 | 2 | 23 | 9 | 10 | 34 | 21 | 25 | 16 | 26 | 48 | 53 |
| Fledglings/Pair | - | - | 0 | 0 | - | - | 0.83+ | 0.12+ | 0 | 0 | 0.15 | 0 | 1.04 | 0.67 | 0.20 | 0.76 | 0.86 | 0.56 | 0.88 | 0.31 | 0.71 | 0.72 |
| **Garrison to Lake Oahe** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | 171 | 175 | 142 | 121 | 174 | 195 | 198 | 145 | 217 | 284 | 105 | 41 | 141 | 105 | 105 | 125 | 126 | 144 | 142 | 157 | 139 | 123 |
| Fledglings/Pair | - | - | 0.93 | 0.43 | 0.44+ | 0.58 | 0.48 | 0.28 | 0.54 | 0.91 | 0.08 | 0.39 | 1.52 | 1.50 | 1.03 | 1.26 | 1.83 | 1.28 | 1.13 | 0.73 | 0.81 | 1.06 |
| **Lake Oahe** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | 16* | 21* | 82 | 97 | 100 | 143 | 124 | 125 | 160 | 84 | 74 | 101 | 110 | 57 | 85 | 94 | 106 | 70 | 73 | 131 | 128 | 186 |
| Fledglings/Pair | 0.75 | 1.62 | 0 | 0 | - | - | 0.42 | 0 | 0.06 | 0 | 0.24 | 0.16 | 1.29 | 0.88 | 1.01 | 1.34 | 1.32 | 1.20 | 1.26 | 0.87 | 1.14 | 0.48 |
| **Ft. Randall to Niobrara** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | 25 | 60 | 0 | 4 | 26 | 32 | 13 | 38 | 43 | 10 | 2 | 0 | 64 | 124 | 72 | 71 | 84 | 50 | 71 | 76 | 55 | 74 |
| Fledglings/Pair | 0.48 | 0.43 | 0 | 0 | 0.31+ | 0.63 | 0.46 | 0 | 0 | 0 | 0 | 0 | 0.94 | 1.03 | 1.26 | 0.14 | 0.71 | 0.92 | 0.37 | 0.47 | 0.69 | 0.30 |
| **Lake Lewis and Clark** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | 0 | 0 | 45 | 29 | 63 | 55 | 29 | 76 | 44 | 16 | 28 | 60 | 120 | 76 | 44 | 58 | 46 | 46 | 13 | 4 | 0 | 85 |
| Fledglings/Pair | - | - | 0.13 | 0.62 | 0.35+ | 0 | 1.59 | 0.97 | 0 | 0 | 0 | 1.57 | 2.33 | 0.21 | 0.38 | 1.17 | 1.04 | 0.39 | 0.00 | 0.00 | 0.00 | 1.58 |
| **Gavins Point to Ponca** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | 181 | 232 | 252 | 210 | 167 | 193 | 187 | 272 | 211 | 93 | 82 | 115 | 148 | 161 | 149 | 232 | 314 | 366 | 359 | 476 | 383 | 410 |
| Fledglings/Pair | 0.26 | 0.46 | 0.49 | 0.55 | 0.46+ | 0.26 | 0.21 | 0.83 | 0.48 | 0.49 | 0.27 | 0.90 | 2.27 | 2.41 | 1.72 | 1.09 | 1.32 | 0.75 | 1.04 | 1.34 | 0.63 | 0.59 |
| **Total Adults** | 393 | 492 | 549 | 528 | 634 | 702 | 690 | 711 | 777 | 591 | 446 | 481 | 635 | 572 | 551 | 653 | 731 | 741 | 722 | 904 | 802** | 1,010 |
| **Fledglings/Pair** | 0.26 | 0.46 | 0.59 | 0.54 | 0.38 | 0.41 | 0.42 | 0.50 | 0.41 | 0.67 | 0.21 | 0.66 | 1.73 | 1.42 | 1.22 | 1.04 | 1.27 | 0.87 | 0.95 | 1.09 | 0.80** | 0.75 |

**5-Year Running Average Interior Least Tern Fledge Ratio Goal = 0.94**

- Data not collected
* Partial Survey Results
{} No Birds Found
\+ Subsampling of Selected Nesting Areas

** includes adults and fledglings from Lake Francis Case
The data does not include least terns and piping plovers raised in captivity. The data represents only wild fledged birds.
From 1990 to 2003 the 10-Year Least Tern Fledge Ratio was 0.70 (1990 and 2000 Biological Opinions).
From 2004 to current 5-Year running average goal is 0.94 (2003 Amended Biological Opinion)
Data in this table may differ from previous reports. As information becomes available, this table is updated.

# Table 19
# Missouri River System
# Piping Plover Survey Data

| | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fort Peck Lake** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | 16 | 10 | 20 | 12 | 22 | 25 | 26 | 30 | 4 | 5 | 0 | 0 | 4 | 2 | 0 | 4 | 2 | 17 | 9 | 26 | 20 | 16 |
| Fledglings/Pair | - | - | 1.70 | 1.50 | 3.18 | 1.20 | 1.00 | 0.60 | 1.50 | 1.20 | 0 | 0 | 0 | 2.00 | 0 | 1 | 2 | 0.35 | 2.22 | 1.08 | 1.2 | 0.5 |
| **Fort Peck to Lake Sakakawea** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | - | - | 5 | 11 | 17 | 13 | 0 | 4 | 9 | 20 | 24 | 23 | 4 | 5 | 4 | 3 | 2 | 6 | 0 | 2 | 5 | 0 |
| Fledglings/Pair | - | - | 0 | 0.18 | 0 | 0 | {} | 0+ | 0 | 3.50 | 1.00 | 0.87 | 1.00 | 0 | 0 | 1.33 | 0 | 2.67 | 0 | 4 | 0.4 | 0 |
| **Lake Sakakawea** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | - | - | 143 | 57 | 132 | 150 | 108 | 8 | 45 | 24 | 70 | 3 | 119 | 83 | 277 | 424 | 469 | 528 | 738 | 746 | 430 | 399 |
| Fledglings/Pair | - | - | 0 | 0 | - | - | 1.50 | 8.5+ | 1.24 | 0 | 0.57 | 0.67 | 1.24 | 1.25 | 1.61 | 1.25 | 1.65 | 1.06 | 1.5 | 0.89 | 0.61 | 0.7 |
| **Garrison to Lake Oahe** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | 139 | 160 | 113 | 84 | 71 | 124 | 77 | 127 | 119 | 261 | 45 | 6 | 74 | 139 | 99 | 149 | 119 | 149 | 164 | 220 | 175 | 222 |
| Fledglings/Pair | - | - | 0.97 | 0.26 | 1.04+ | 1.13+ | 1.06+ | 0.54+ | 0.87 | 0.87 | 0.09 | 0 | 1.84 | 0.88 | 1.41 | 1.53 | 2.03 | 1.66 | 1.16 | 0.8 | 0.77 | 0.97 |
| **Lake Oahe** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | 4* | 4* | 55 | 140 | 88 | 87 | 143 | 66+ | 85 | 30 | 21 | 31 | 98 | 46 | 141 | 184 | 203 | 301 | 372 | 364 | 331 | 273 |
| Fledglings/Pair | - | 2.50* | 0 | 0 | - | - | 0.97+ | 0.33 | 0.09 | 0.93 | 0.29 | 1.29 | 1.06 | 0.30 | 1.45 | 1.41 | 2.16 | 1.84 | 1.41 | 1.21 | 0.99 | 0.62 |
| **Ft. Randall to Niobrara** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | 11 | 16 | 0 | 0 | 12 | 25 | 8 | 12 | 17 | 0 | 3 | 0 | 33 | 51 | 62 | 38 | 35 | 37 | 42 | 42 | 37 | 21 |
| Fledglings/Pair | 0.18 | 0.13 | 0 | 0 | 0.67* | 0.48 | 0.75 | 0 | 0 | 0 | 0 | 0 | 1.27 | 1.02 | 0.87 | 0.74 | 1.03 | 1.46 | 0.71 | 0.81 | 0.38 | 0 |
| **Lake Lewis and Clark** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | 0 | 0 | 31 | 18 | 30 | 33 | 6 | 32 | 12 | 4 | 6 | 32 | 84 | 67 | 28 | 34 | 44 | 14 | 0 | 24 | 4 | 20 |
| Fledglings/Pair | - | - | 0.06 | 0.56 | 0.67+ | 0 | 0 | 0.06 | 0.33 | 0 | 0 | 1.25 | 2.45 | 0.30 | 0.5 | 0.71 | 1.68 | 1.57 | 0 | 0.17 | 0.5 | 1.8 |
| **Gavins Point to Ponca** | | | | | | | | | | | | | | | | | | | | | | |
| Adults | 172 | 177 | 212 | 122 | 148 | 166 | 112 | 109 | 62 | 63 | 22 | 22 | 49 | 141 | 186 | 218 | 260 | 286 | 262 | 340 | 309 | 300 |
| Fledglings/Pair | 0.05 | 1.13 | 0.62 | 0.21 | 0.39+ | 0.35 | 0.34 | 1.06 | 0.61 | 0.16 | 0 | 0 | 2.20 | 1.60 | 2.17 | 1.85 | 2.29 | 1.9 | 1.87 | 1.97 | 0.78 | 0.39 |
| **Total Adults** | 342 | 367 | 579 | 444 | 521 | 623 | 480 | 388 | 353 | 407 | 191 | 117 | 465 | 534 | 797 | 1054 | 1134 | 1338 | 1587 | 1764 | 1311 | 1251 |
| **Fledglings/Pair** | 0.06 | 1.08 | 0.73 | 0.32 | 0.76 | 0.62 | 0.94 | 0.76 | 0.61 | 0.84 | 0.39 | 0.87 | 1.61 | 1.01 | 1.58 | 1.41 | 1.91 | 1.5 | 1.49 | 1.15 | 0.78 | 0.66 |

**10-Year Running Average Piping Plover Fledge Ratio Goal = 1.22**

- Data not collected
* Partial Survey Results
{} No Birds Found
\+ Subsampling of Selected Nesting Areas

The data does not include least terns and piping plovers raised in captivity. The data represents only wild fledged birds.
From 1990 to 2000 the 15-Year Piping Plover Fledge Ratio Goal was 1.44 (1990 Biological Opinion).
From 2001 to 2003 the goal was 1.13 (2000 Biological Opinion)
From 2004 to current the 10-year running average goal is 1.22 (2003 Amended Biological Opinion)
Data in this table may differ from previous reports. As information becomes available, this table is updated.

## 8. Recreation and Resource Management

The System reservoirs provide outstanding opportunities for boating, fishing, swimming, camping, and other outdoor recreation pursuits. Tourism related to the reservoirs is a major economic factor in all of the states adjoining the System. However, during extended drought periods, such as the Missouri River basin is currently experiencing, recreation may be adversely affected. The pool levels at the upper three large reservoirs, Fort Peck, Garrison, and Oahe, have been the most affected by the drought. Due to their relatively small size, the lower three reservoirs are regulated in a similar manner year-to-year and are not significantly impacted by the drought. The low pool levels at the upper three reservoirs make some boat ramps unusable, expose large areas of beach and sometimes make areas of the reservoirs unreachable. Thus, the low pools adversely affect recreation activities such as boating, fishing, swimming, and camping.

During 2007 the Corps spent approximately $530,000 extending and relocating boat ramps to maintain public access where such work was feasible. Considerable effort has been required by all parties involved to maintain recreation access to the reservoirs as the drought progresses. However, in some locations it is impossible to extend or relocate boat ramps due to the local topography. Of the 11 reservoir access areas located on the Fort Peck reservoir, 8 ramps were usable for all or most of the 2007 recreation season. At Garrison, 26 of the total 35 reservoir access areas were available for the majority of the recreation season. At Oahe, 9 of 12 access areas were available on the North Dakota portion of the reservoir although all of these were in river conditions, and 20 of 27 were available on the South Dakota portion in 2007. Access areas at the upper three reservoirs include Corps-owned as well as Tribal, state, and privately-owned facilities. In 2002, many of the Federal recreation areas and boat ramps in South Dakota were turned over in fee title to the state of South Dakota and the Bureau of Indian Affairs through the Title VI process. Since the land transfer, both the Federal treasury and the Corps have provided money to the South Dakota Game Fish and Parks, Cheyenne River Sioux Tribe, and Lower Brule Sioux Tribe for operations and stewardship of the Title VI lands they received. Congress is also capitalizing a trust fund to cover these costs in the future.

During 2007, public use at these reservoirs totaled 39,157,500 visitor hours, a 2% decrease from 2006. Visitor attendance figures at the System projects from 2004 through 2007 are shown in ***Table 20***. Although overall visitation was down in 2007, Fort Peck and Oahe experienced increases; the other projects experienced decreases. ***Figure 13*** displays recreation related visitor hours at each of the six mainstem projects for the years 1954 through 2007. Although the drought has had an impact on visitation during the past 6 years, much of the reduction shown in Figure 12 is attributed to the data collection changes associated with the South Dakota Title VI land transfer mentioned previously. Since the land transfer occurred, the Corps has not collected visitation data consistent with previous years at the recreation sites in South Dakota. The 2007 visitation in South Dakota presented in ***Table 20*** and ***Figure 13*** reflects water-related use on the reservoirs but not the visitation at the campgrounds that were turned over to the State of South Dakota and the Tribes.

The reporting method was changed from recreation days to visitor hours in 1987, and the reporting period was changed from calendar year to fiscal year in 1989 for all Corps projects. All Corps projects, including the System projects, are now reporting visitation using the Visitation Estimation Reporting System (VERS).

**Table 20**
**Visitation at System Reservoirs in Visitor Hours**

| Mainstem Project | 2004 | 2005 | 2006 | 2007 | Percent Change 2006-2007 |
|---|---|---|---|---|---|
| Fort Peck | 5,252,800 | 5,445,900 | 5,374,200 | 5,630,400 | + 5 % |
| Garrison | 13,894,500 | 12,698,600 | 14,016,900 | 12,309,600 | - 12 % |
| Oahe | 7,140,000 | 7,700,600 | 7,386,000 | 8,045,400 | + 9 % |
| Big Bend | 3,433,500 | 2,980,900 | 3,325,000 | 3,096,900 | - 7 % |
| Fort Randall | 1,275,400 | 1,103,600 | 1,033,400 | 1,000,100 | - 3 % |
| Gavins Point | 8,907,900 | 8,800,200 | 8,928,300 | 9,075,100 | -2 % |
| **System Total** | **39,904,100** | **38,729,800** | **40,063,900** | **39,157,500** | **-2 %** |

**9. Cultural Resources.**

As acknowledged in the 2004 Programmatic Agreement for the Operation and Management of the Missouri River Main Stem System (PA), wave action and the fluctuation of reservoirs levels results in erosion along the banks of the reservoirs. With the recent drought conditions, additional cultural resource sites have become exposed as the pool levels have declined. The Corps will continue to work with the Tribes utilizing 36 CFR Part 800 and the PA to address the exposure of these sites. The objective of a programmatic agreement is to deal "…with the potential adverse effects of complex projects or multiple undertakings…" The objective of the PA was to collaboratively develop a preservation program that would avoid, minimize, and/or mitigate the adverse effects of the System regulation.

The planned preservation program is outlined by multiple stipulations in the PA. One of the stipulations, or program components, is the 5-year plan. This plan outlines how the Corps will accomplish its responsibilities under the PA and National Historic Preservation Act. The "Draft Five Year Plan, dated February 2005" (see website ***https://www.nwo.usace.army.mil/CR***) is currently being implemented. The plan includes inventory, testing and evaluation, mitigation, and other specific activities that will allow the Corps to avoid, minimize, and/or mitigate the adverse effects to cultural sites on the Corps' lands within the System.

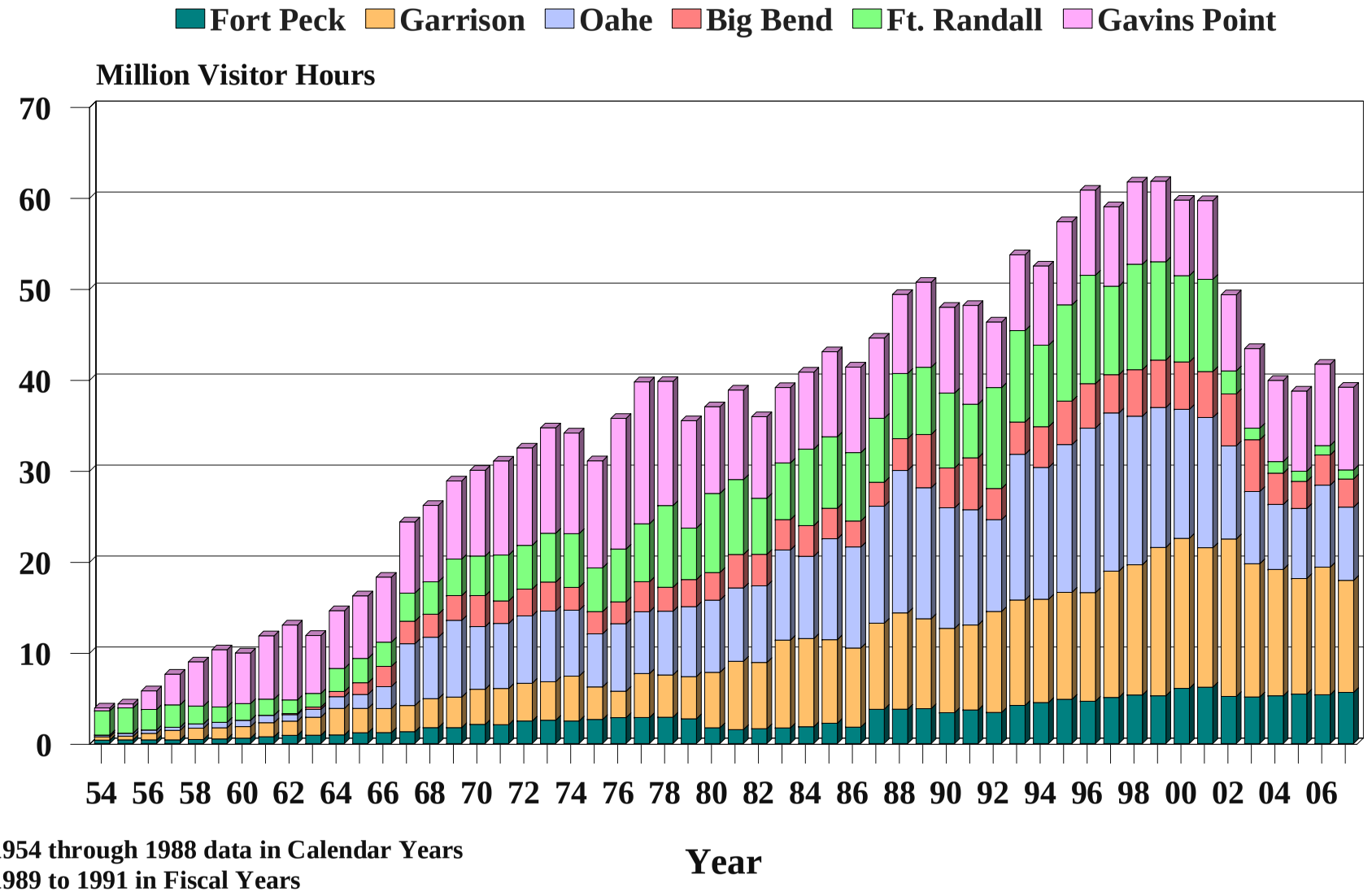
Under the terms of Stipulation 18 of the PA the Corps has agreed to consult/meet with the affected Tribes and Tribal Historic Preservation Officers (THPO's), State Historic Preservation Officers (SHPO's), the Advisory Council on Historic Preservation (ACHP) and other parties on the draft AOP. The purpose of this consultation/meeting is to determine whether operational changes are likely to cause changes to the nature, location or severity of adverse effects to historic properties or to the types of historic

properties affected and whether amendments to the Corps' Cultural Resources Management Plans and Five-Year Plan are warranted in order to better address such effects to historic properties. During 2007 the Corps hosted several informational meetings on the draft 2007-2008 AOP with the Tribes including on August 23, 2007 in Rapid City, South Dakota and October 25, 2007 in Bismarck, North Dakota. The Corps also participated in government to government consultation with the Cheyenne River Sioux Tribe in Eagle Butte, South Dakota on two occasions: June 23, 2007 and October 5, 2007.

Figure 12

# *System Project Visits*

## *1954 to 2007*




1954 through 1988 data in Calendar Years
1989 to 1991 in Fiscal Years
1992 to present in VERS System
2002 to present reflect changed accounting due to Title VI land transfer to State of South Dakota

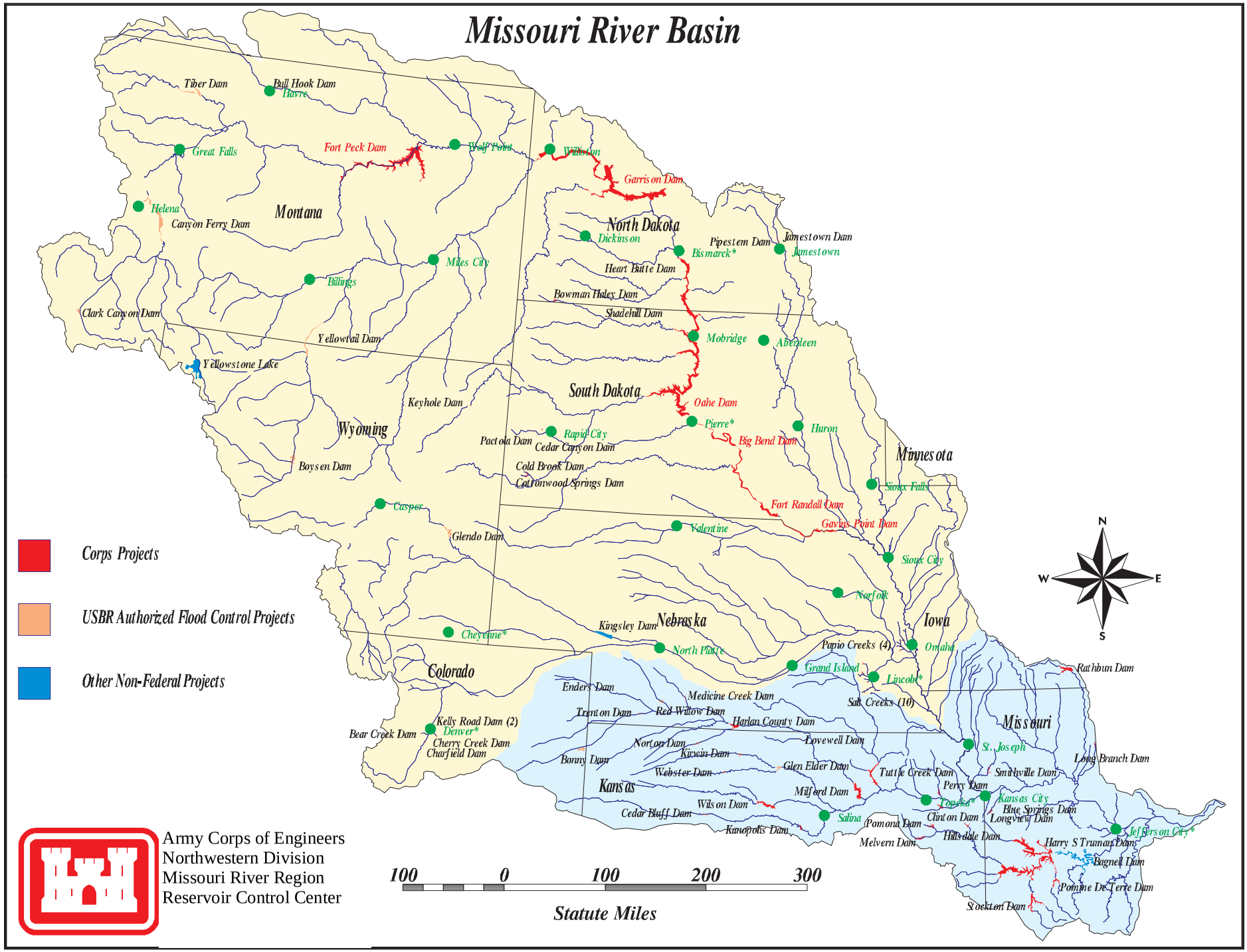

Missouri River Basin
Tiber Dam
Bull Hook Dam
Havre
Great Falls
Fort Peck Dam
Wolf Point
Williston
Garrison Dam
Helena
Canyon Ferry Dam
Montana
North Dakota
Dickinson
Pipestem Dam
Jamestown Dam
Jamestown
Bismarck*
Heart Butte Dam
Miles City
Billings
Bowman Haley Dam
Shadehill Dam
Clark Canyon Dam
Yellowtail Dam
Mobridge
Aberdeen
Yellowstone Lake
South Dakota
Oahe Dam
Keyhole Dam
Pierre*
Huron
Wyoming
Rapid City
Pactola Dam
Cedar Canyon Dam
Big Bend Dam
Minnesota
Boysen Dam
Cold Brook Dam
Canyon Springs Dam
Sioux Falls
Fort Randall Dam
Casper
Gavins Point Dam
Valentine
Glendo Dam
Sioux City
Norfolk
Kingsley Dam
Nebraska
Iowa
Cheyenne*
North Platte
Papio Creeks (4)
Omaha
Grand Island
Rathbun Dam
Colorado
Lincoln*
Enders Dam
Medicine Creek Dam
Salt Creeks (10)
Trenton Dam
Red Willow Dam
Missouri
Kelly Road Dam (2)
Harlan County Dam
Bear Creek Dam
Denver*
Cherry Creek Dam
Norton Dam
Lovewell Dam
St. Joseph
Long Branch Dam
Chatfield Dam
Kirwin Dam
Bonny Dam
Webster Dam
Glen Elder Dam
Tuttle Creek Dam
Smithville Dam
Perry Dam
Kansas
Milford Dam
Topeka*
Kansas City
Blue Springs Dam
Wilson Dam
Longview Dam
Cedar Bluff Dam
Salina
Pomona Dam
Clinton Dam
Jefferson City*
Kanopolis Dam
Melvern Dam
Hillsdale Dam
Harry S Truman Dam
Bagnell Dam
Pomme De Terre Dam
Stockton Dam
Corps Projects
USBR Authorized Flood Control Projects
Other Non-Federal Projects
N
W
E
S
100 0 100 200 300
Statute Miles
Army Corps of Engineers
Northwestern Division
Missouri River Region
Reservoir Control Center

Plate 1

## Summary of Engineering Data -- Missouri River Mainstem System

| Item No. | Subject | Fort Peck Dam - Fort Peck Lake | Garrison Dam - Lake Sakakawea | Oahe Dam - Lake Oahe |
|---|---|---|---|---|
| 1 | Location of Dam | Near Glasgow, Montana | Near Garrison, ND | Near Pierre, SD |
| 2 | River Mile - 1960 Mileage | Mile 1771.5 | Mile 1389.9 | Mile 1072.3 |
| 3 | Total & incremental drainage areas in square miles | 57,500 | 181,400 (2) 123,900 | 243,490 (1) 62,090 |
| 4 | Approximate length of ful reservoir (in valley miles) | 134, ending near Zortman, MT | 178, ending near Trenton, ND | 231, ending near Bismarck, ND |
| 5 | Shoreline in miles (3) | 1520 (elevation 2234) | 1340 (elevation 1837.5) | 2250 (elevation 1607.5) |
| 6 | Average total & incrementa inflow in cfs | 10,200 | 25,600 15,400 | 28,900 3,300 |
| 7 | Max. discharge of record near damsite in cfs | 137,000 (June 1953) | 348,000 (April 1952) | 440,000 (April 1952) |
| 8 | Construction started - calendar yr | 1933 | 1946 | 1948 |
| 9 | In operation (4) calendar yr. | 1940 | 1955 | 1962 |
| | Dam and Embankment | | | |
| 10 | Top of dam, elevation in feet msl | 2280.5 | 1875 | 1660 |
| 11 | Length of dam in feet | 21,026 (excluding spillway | 11,300 (including spillway | 9,300 (excluding spillway |
| 12 | Damming height in feet (5) | 220 | 180 | 200 |
| 13 | Maximum height in feet (5) | 250.5 | 210 | 245 |
| 14 | Max. base width, total & w/o berms in feet | 3500, 2700 | 3400, 2050 | 3500, 1500 |
| 15 | Abutment formations ( under dam & embankment) | Bearpaw shale and glacial fil | Fort Union clay shale | Pierre shale |
| 16 | Type of fill | Hydraulic & rolled earth fil | Rolled earth fillec | Rolled earth fill & shale berms |
| 17 | Fill quantity, cubic yards | 125,628,000 | 66,500,000 | 55,000,000 & 37,000,000 |
| 18 | Volume of concrete, cubic yards | 1,200,000 | 1,500,000 | 1,045,000 |
| 19 | Date of closure | 24 June 1937 | 15 April 1953 | 3 August 1958 |
| | Spillway Data | | | |
| 20 | Location | Right bank - remote | Left bank - adjacent | Right bank - remote |
| 21 | Crest elevation in feet ms | 2225 | 1825 | 1596.5 |
| 22 | Width (including piers) in fee | 820 gated | 1336 gated | 456 gated |
| 23 | No., size and type of gates | 16 - 40' x 25' vertical lift gates | 28 - 40' x 29' Tainter | 8 - 50' x 23.5' Tainter |
| 24 | Design discharge capacity, cfs | 275,000 at elev 2253.3 | 827,000 at elev 1858.5 | 304,000 at elev 1644.4 |
| 25 | Discharge capacity at maximun operating pool in cfs | 230,000 | 660,000 | 80,000 |
| | Reservoir Data (6) | | | |
| 26 | Max. operating pool elev. & area | 2250 msl 246,000 acres | 1854 msl 380,000 acres | 1620 msl 374,000 acres |
| 27 | Max. normal op. pool elev. & area | 2246 msl 240,000 acres | 1850 msl 364,000 acres | 1617 msl 360,000 acres |
| 28 | Base flood control elev & area | 2234 msl 212,000 acres | 1837.5 msl 307,000 acres | 1607.5 msl 312,000 acres |
| 29 | Min. operating pool elev. & area | 2160 msl 90,000 acres | 1775 msl 128,000 acres | 1540 msl 117,000 acres |
| | Storage allocation & capacity | | | |
| 30 | Exclusive flood contro | 2250-2246 975,000 a.f. | 1854-1850 1,489,000 a.f. | 1620-1617 1,102,000 a.f. |
| 31 | Flood control & multiple use | 2246-2234 2,717,000 a.f. | 1850-1837.5 4,222,000 a.f. | 1617-1607.5 3,201,000 a.f. |
| 32 | Carryover multiple use | 2234-2160 10,785,000 a.f. | 1837.5-1775 13,130,000 a.f. | 1607.5-1540 13,461,000 a.f. |
| 33 | Permanent | 2160-2030 4,211,000 a.f. | 1775-1673 4,980,000 a.f. | 1540-1415 5,373,000 a.f. |
| 34 | Gross | 2250-2030 18,688,000 a.f. | 1854-1673 23,821,000 a.f. | 1620-1415 23,137,000 a.f. |
| 35 | Reservoir filling initiate | November 1937 | December 1953 | August 1958 |
| 36 | Initially reached min. operating poo | 27 May 1942 | 7 August 1955 | 3 April 1962 |
| 37 | Estimated annual sediment inflov | 18,100 a.f. 1030 yrs. | 25,900 a.f. 920 yrs. | 19,800 a.f. 1170 yrs. |
| | Outlet Works Data | | | |
| 38 | Location | Right bank | Right Bank | Right Bank |
| 39 | Number and size of conduits | 2 - 24' 8" diameter (nos. 3 & 4) | 1 - 26' dia. and 2 - 22' dia. | 6 - 19.75' dia. upstream, 18.25' dia. downstream |
| 40 | Length of conduits in feet (8) | No. 3 - 6,615, No. 4 - 7,240 | 1529 | 3496 to 3659 |
| 41 | No., size, and type of service gates | 1 - 28' dia. cylindrical gate 6 ports, 7.6' x 8.5' high (net opening) in each control shaft | 1 - 18' x 24.5' Tainter gate per conduit for fine regulation | 1 - 13' x 22' per conduit, vertical lift, 4 cable suspension and 2 hydraulic suspension (fine regulation) |
| 42 | Entrance invert elevation (msl | 2095 | 1672 | 1425 |
| 43 | Avg. discharge capacity per condui & total | Elev. 2250 22,500 cfs - 45,000 cfs | Elev. 1854 30,400 cfs - 98,000 cfs | Elev. 1620 18,500 cfs - 111,000 cfs |
| 44 | Present tailwater elevation (ft msl | 2032-2036 5,000 - 35,000 cfs | 1670-1680 15,000- 60,000 cfs | 1423-1428 20,000-55,000 cfs |
| | Power Facilities and Data | | | |
| 45 | Avg. gross head available in feet (14 | 194 | 161 | 174 |
| 46 | Number and size of conduits | No. 1-24'8" dia., No. 2-22'4" dia. | 5 - 29' dia., 25' penstocks | 7 - 24' dia., imbedded penstocks |
| 47 | Length of conduits in feet (8) | No. 1 - 5,653, No. 2 - 6,355 | 1829 | From 3,280 to 4,005 |
| 48 | Surge tanks | PH#1: 3-40' dia., PH#2: 2-65' dia. | 65' dia. - 2 per penstock | 70' dia., 2 per penstock |
| 49 | No., type and speed of turbines | 5 Francis, PH#1-2: 128.5 rpm, 1-164 rpm , PH#2-2: 128.6 rpm | 5 Francis, 90 rpm | 7 Francis, 100 rpm |
| 50 | Discharge cap. at rated head in cfs | PH#1, units 1&3 170', 2-140' 8,800 cfs, PH#2-4&5 170'-7,200 cfs | 150' 41,000 cfs | 185' 54,000 cfs |
| 51 | Generator nameplate rating in kW | 1&3: 43,500; 2: 18,250; 4&5: 40,000 | 3 - 121,600, 2 - 109,250 | 112,290 |
| 52 | Plant capacity in kW | 185,250 | 583,300 | 786,030 |
| 53 | Dependable capacity in kW (9) | 181,000 | 388,000 | 534,000 |
| 54 | Avg. annual energy, million kWh (12 | 1,087 | 2,318 | 2,717 |
| 55 | Initial generation, first and last uni | July 1943 - June 1961 | January 1956 - October 1960 | April 1962 - June 1963 |
| 56 | Estimated cost September 1999 completed project (13) | $158,428,000 | $305,274,000 | $346,521,000 |

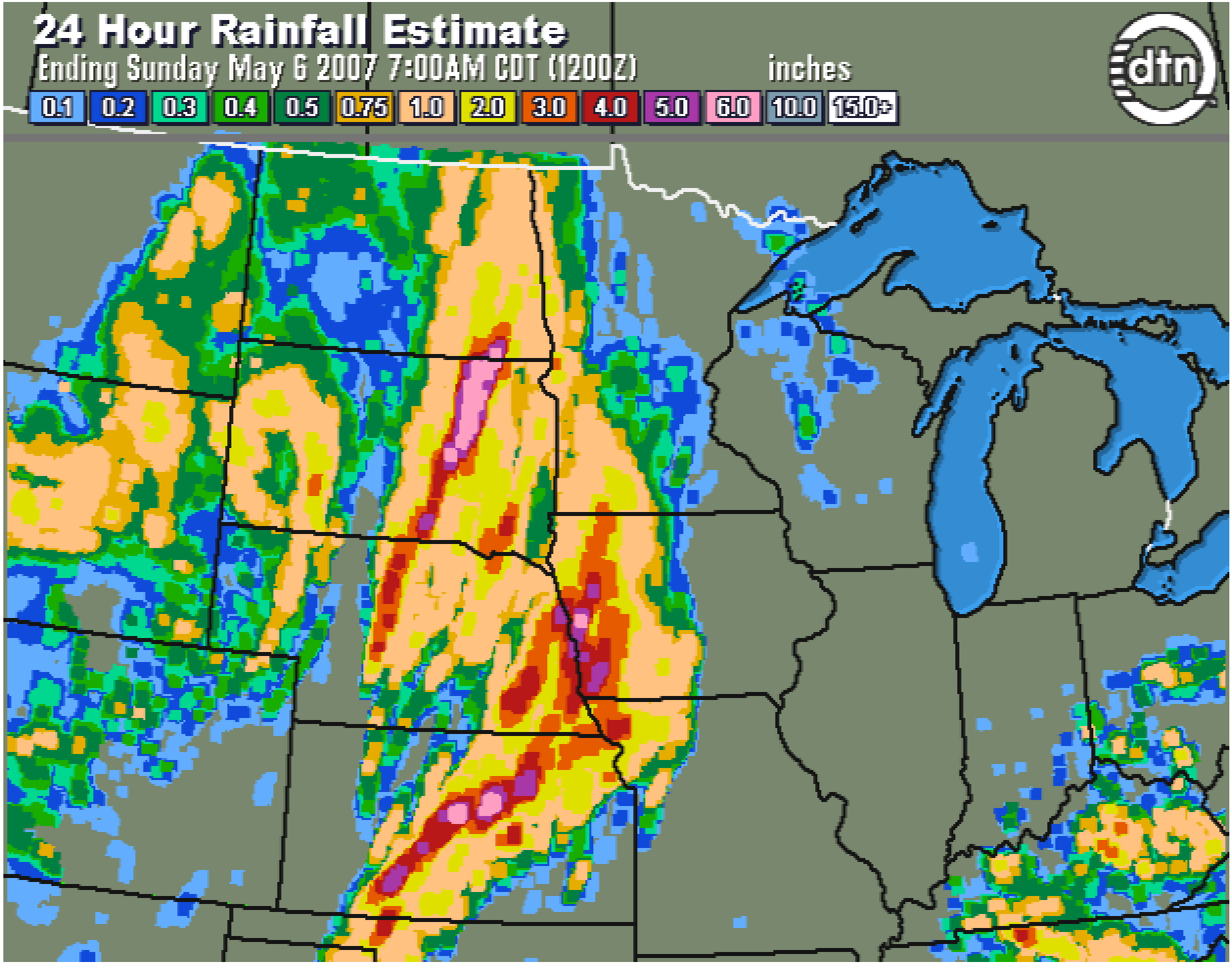
Plate 2A

# Summary of Engineering Data -- Missouri River Mainstem System

| Big Bend Dam - Lake Sharpe | Fort Randall Dam - Lake Francis Case | Gavins Point Dam - Lewis & Clark Lake | Total | Item No. | Remarks |
|---|---|---|---|---|---|
| 21 miles upstream Chamberlain, SD | Near Lake Andes, SD | Near Yankton, SD | | 1 | (1) Includes 4,280 square miles of non-contributing areas. |
| Mile 987.4 | Mile 880.0 | Mile 811.1 | | 2 | |
| 249,330 (1) 5,840 | 263,480 (1) 14,150 | 279,480 (1) 16,000 | | 3 | (2) Includes 1,350 square miles of non-contributing areas. |
| 80, ending near Pierre, SD | 107, ending at Big Bend Dam | 25, ending near Niobrara, NE | 755 miles | 4 | |
| 200 (elevation 1420) | 540 (elevation 1350) | 90 (elevation 1204.5) | 5,940 miles | 5 | (3) With pool at base of flood control. |
| 28,900 | 30,000 1,100 | 32,000 2,000 | | 6 | |
| 440,000 (April 1952) | 447,000 (April 1952) | 480,000 (April 1952) | | 7 | (4) Storage first available for regulation of flows |
| 1959 | 1946 | 1952 | | 8 | (5) Damming height is heigh from low water to maximum operating pool. Maximum height is from average streambed to top of dam. |
| 1964 | 1953 | 1955 | | 9 | |
| 1440 | 1395 | 1234 | | 10 | |
| 10,570 (including spillway | 10,700 (including spillway | 8,700 (including spillway | 71,596 | 11 | (6) Based on latest available storage data. |
| 78 | 140 | 45 | 863 feet | 12 | |
| 95 | 165 | 74 | | 13 | (7) River regulation is attained by flows over low-crested spillway and through turbines. |
| 1200, 700 | 4300, 1250 | 850, 450 | | 14 | |
| Pierre shale & Niobrara chalk | Niobrara chalk | Niobrara chalk & Carlile shale | | 15 | |
| Rolled earth, shale, chalk fil | Rolled earth fill & chalk berm | Rolled earth & chalk fil | | 16 | (8) Length from upstream face of outlet or to spiral case. |
| 17,000,000 | 28,000,000 & 22,000,000 | 7,000,000 | 358,128,000 cu. yds | 17 | (9) Based on 8th year (1961) of drought drawdown (From study 8-83-1985). |
| 540,000 | 961,000 | 308,000 | 5,554,000 cu. yds. | 18 | |
| 24 July 1963 | 20 July 1952 | 31 July 1955 | | 19 | |
| Left bank - adjacent | Left bank - adjacent | Right bank - adjacent | | 20 | (10) Affected by level of Lake Francis case. Applicable to pool at elevation 1350. |
| 1385 | 1346 | 1180 | | 21 | |
| 376 gated | 1000 gated | 664 gated | | 22 | (11) Spillway crest |
| 8 - 40' x 38' Tainter | 21 - 40' x 29' Tainter | 14 - 40' x 30' Tainter | | 23 | (12) 1967-2006 Average |
| 390,000 at elev 1433.6 | 620,000 at elev 1379.3 | 584,000 at elev 1221.4 | | 24 | (13) Source: Annual Report on Civil Works Activities of the Corps of Engineers. Extract Report Fiscal Year 1999. |
| 270,000 | 508,000 | 345,000 | | 25 | |
| 1423 msl 61,000 acres | 1375 msl 102,000 acres | 1210 msl 31,000 acres | 1,194,000 acres | 26 | (14) Based on Study 8-83-1985 |
| 1422 msl 60,000 acres | 1365 msl 95,000 acres | 1208 msl 28,000 acres | 1,147,000 acres | 27 | |
| 1420 msl 57,000 acres | 1350 msl 77,000 acres | 1204.5 msl 24,000 acres | 989,000 acres | 28 | |
| 1415 msl 51,000 acres | 1320 msl 38,000 acres | 1204.5 msl 24,000 acres | 450,000 acres | 29 | |
| 1423-1422 60,000 a.f. | 1375-1365 985,000 a.f. | 1210-1208 59,000 a.f. | 4,670,000 a.f. | 30 | |
| 1422-1420 117,000 a.f. | 1365-1350 1,309,000 a.f. | 1208-1204.5 90,000 a.f. | 11,656,000 a.f. | 31 | |
| | 1350-1320 1,607,000 a.f. | | 38,983,000 a.f. | 32 | |
| 1420-1345 1,621,000 a.f. | 1320-1240 1,517,000 a.f. | 1204.5-1160 321,000 a.f. | 18,023,000 a.f. | 33 | |
| 1423-1345 1,798,000 a.f. | 1375-1240 5,418,000 a.f. | 1210-1160 470,000 a.f. | 73,332,000 a.f. | 34 | |
| November 1963 | January 1953 | August 1955 | | 35 | |
| 25 March 1964 | 24 November 1953 | 22 December 1955 | | 36 | |
| 4,300 a.f. 430 yrs. | 18,300 a.f. 250 yrs. | 2,600 a.f. 180 yrs. | 92,500 a.f. | 37 | |
| | Left Bank | | | 38 | |
| None (7) | 4 - 22' diameter | None (7) | | 39 | |
| | 1013 | | | 40 | |
| | 2 - 11' x 23' per conduit, vertical lift, cable suspension | | | 41 | |
| 1385 (11) | 1229 | 1180 (11) | | 42 | |
| | Elev 1375 | | | 43 | |
| | 32,000 cfs - 128,000 cfs | | | | |
| 1351-1355(10) 25,000-100,000 cfs | 1228-1239 5,000-60,000 cfs | 1155-1163 15,000-60,000 cfs | | 44 | |
| 70 | 117 | 48 | 764 feet | 45 | |
| None: direct intake | 8 - 28' dia., 22' penstocks | None: direct intake | | 46 | |
| | 1,074 | | 55,083 | 47 | |
| None | 59' dia, 2 per alternate penstock | None | | 48 | |
| 8 Fixed blade, 81.8 rpm | 8 Francis, 85.7 rpm | 3 Kaplan, 75 rpm | 36 units | 49 | |
| 67' 103,000 cfs | 112' 44,500 cfs | 48' 36,000 cfs | | 50 | |
| 3 - 67,276, 5 - 58,500 | 40,000 | 44,100 | | 51 | |
| 494,320 | 320,000 | 132,300 | 2,501,200 kw | 52 | |
| 497,000 | 293,000 | 74,000 | 1,967,000 kw | 53 | Corps of Engineers, U.S. Army |
| 1,001 | 1,778 | 740 | 9,642 million kWh | 54 | Compiled by |
| October 1964 - July 1966 | March 1954 - January 1956 | September 1956 - January 1957 | July 1943 - July 1966 | 55 | Northwestern Division |
| | | | | 56 | Missouri River Region |
| $107,498,000 | $199,066,000 | $49,617,000 | $1,166,404,000 | | January 2007 |

Plate 2B

Plate 3


24 Hour Rainfall Estimate
Ending Sunday May 6 2007 7:00AM CDT (1200Z)
inches
0.1
0.2
0.3
0.4
0.5
0.75
1.0
2.0
3.0
4.0
5.0
6.0
10.0
15.0+
dtn

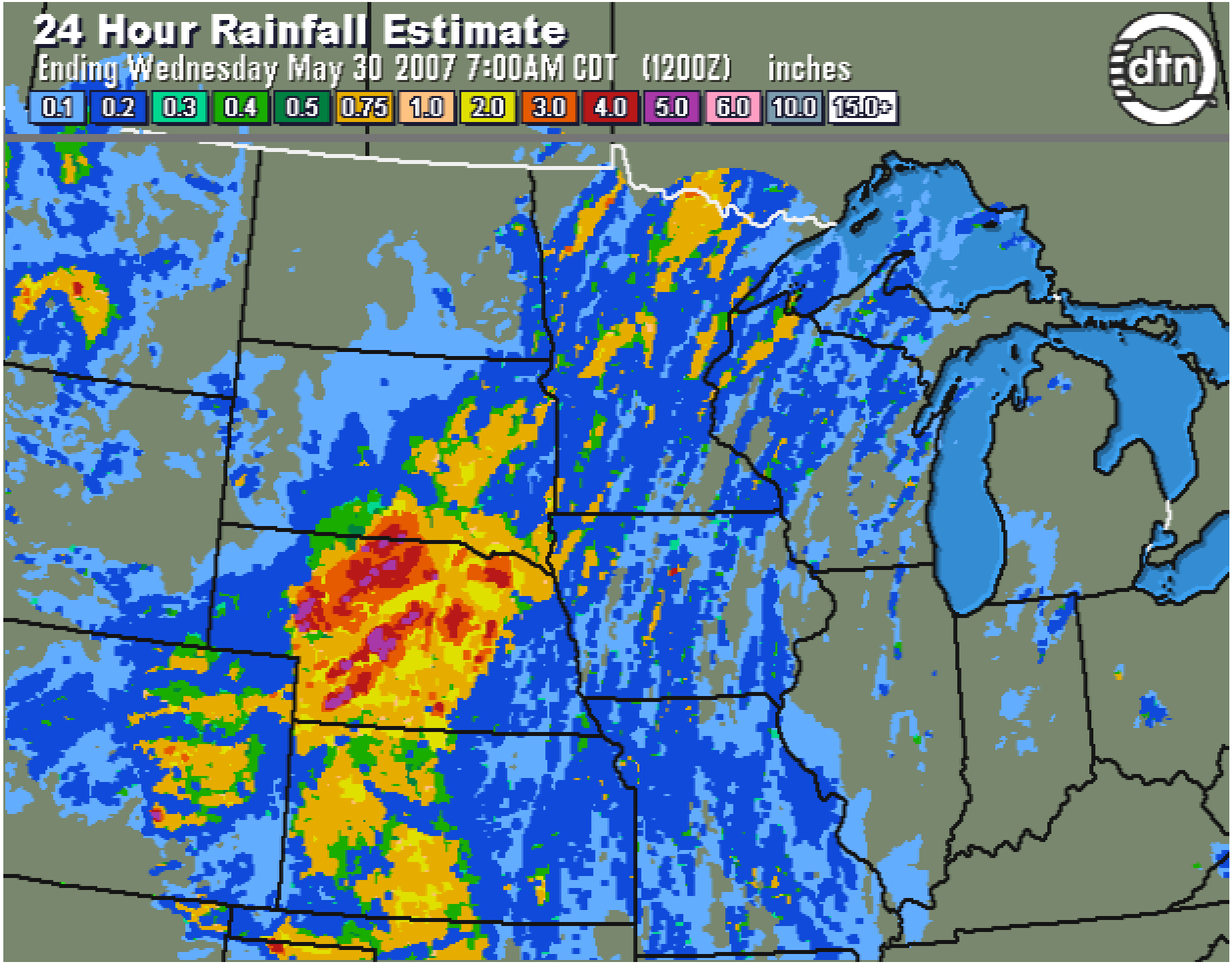
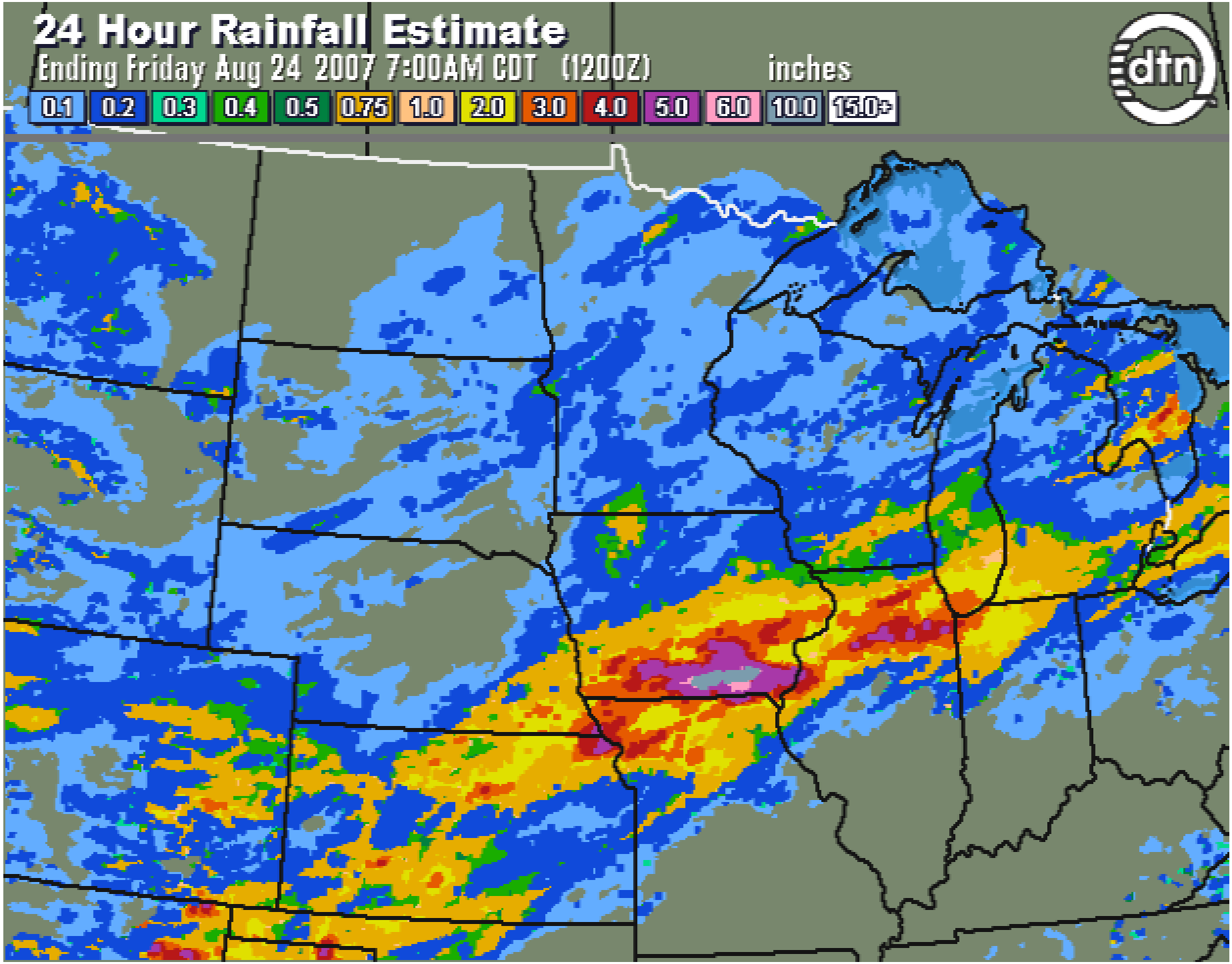

24 Hour Rainfall Estimate
Ending Wednesday May 30 2007 7:00AM CDT (1200Z) inches
0.1
0.2
0.3
0.4
0.5
0.75
1.0
2.0
3.0
4.0
5.0
6.0
10.0
15.0+
dtn

Plate 4

Plate 5


24 Hour Rainfall Estimate
Ending Friday Aug 24 2007 7:00AM CDT (1200Z)
inches
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0.2
0.3
0.4
0.5
0.75
1.0
2.0
3.0
4.0
5.0
6.0
10.0
15.0+
dtn

# Garrison Dam / Lake Sakakawea - Optimal Coldwater Habitat

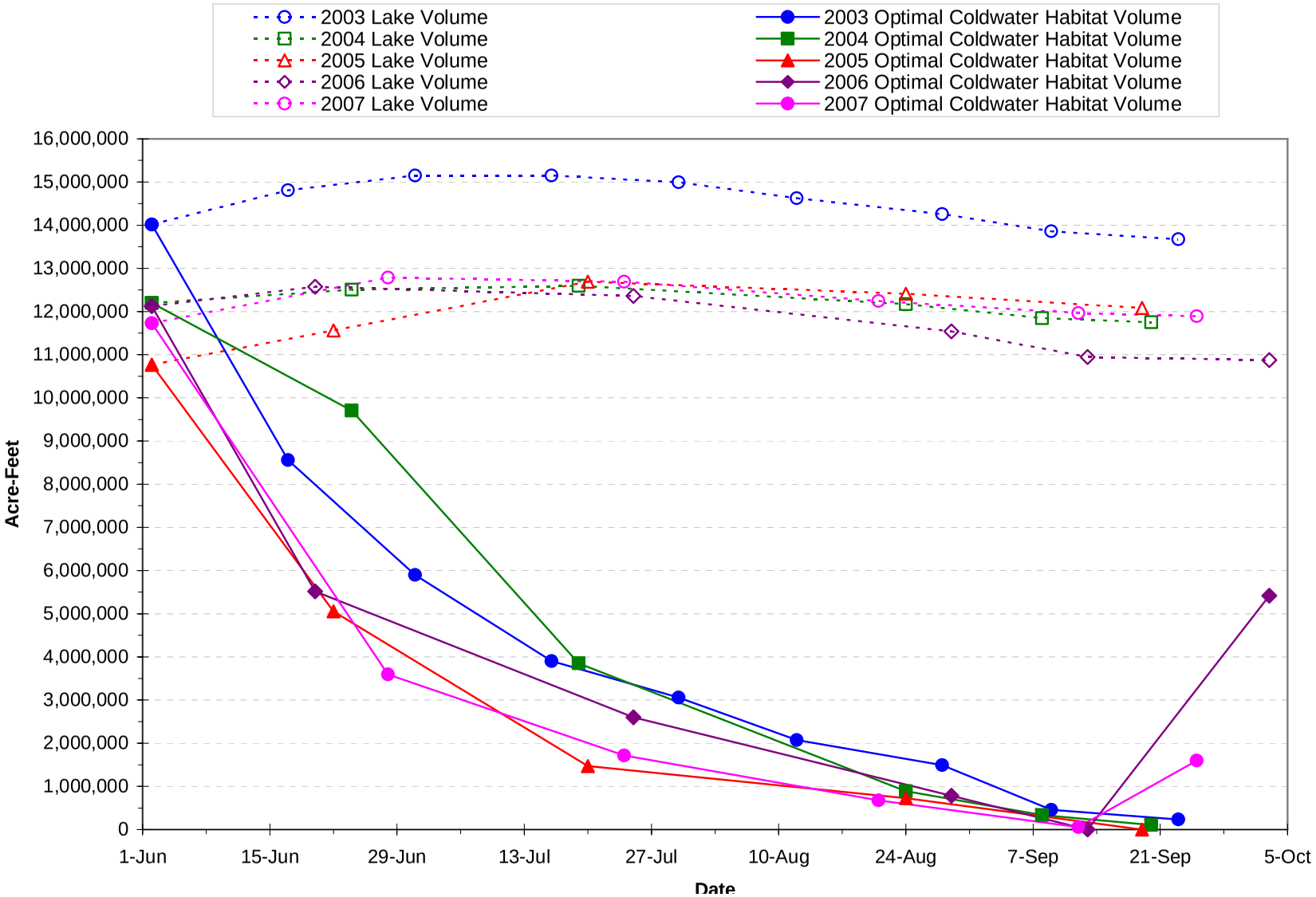


Plate 6