SOURIS BASIN AND RESERVOIR INFORMATION

Introduction

The Souris River, or Mouse River, as it is named in the United States, has its headwaters in the Province of Saskatchewan and flows generally in a southeasterly direction, crossing the United States border into the State of North Dakota near Sherwood, North Dakota. The river continues its southeasterly flow to Velva, North Dakota, where it reverses course and flows northeasterly to Towner, North Dakota and then northwesterly to the Canadian border and into the Province of Manitoba near Westhope, North Dakota. The Souris River eventually flows into the Assiniboine River, a tributary of the Red River of the North. The Souris River valley is flat and shallow, and its semi-arid prairie has been extensively cultivated. Major reservoirs have been constructed in both the U.S. and Canadian portions of the basin, including Boundary, Rafferty and Alameda Reservoirs in Saskatchewan, and Lake Darling in North Dakota.

The basin also includes a number of wildlife refuges and small impoundments along the U.S. portion of the river. The U.S. Fish and Wildlife Service (USFWS) operates three national wildlife refuges located on the Souris River in North Dakota. The Upper Souris National Wildlife Refuge is located near Foxholm, North Dakota, upstream of the City of Minot. J. Clark Salyer National Wildlife Refuge is located near Upham, North Dakota, downstream of the City of Towner. Des Lacs National Wildlife Refuge is located on the Des Lacs River (a tributary of the Souris River) near Kenmare, North Dakota.

All of the major storage impoundments in the Souris River basin in North Dakota are located on national wildlife refuges, and are operated by the USFWS under water rights permits issued by the State of North Dakota.

Operational and Liaison Responsibilities Under the 1989 International Agreement

Pursuant to the 1989 International "*Agreement Between The Government Of Canada And The Government Of The United States Of America For Water Supply And Flood Control In The Souris Basin*," flood control within the Souris basin is afforded by several reservoirs in Canada and the United States collectively known as the "*Souris Basin Project*". This term refers to the development and operation of Rafferty Dam, Alameda Dam, and the Boundary Diversion channel in Canada, the operation of the existing Boundary Reservoir in Saskatchewan, and the operation of the existing Lake Darling Reservoir in North Dakota in the United States for flood control. Rafferty Reservoir, Boundary Reservoir, and Alameda Reservoir are known collectively as the "*Canadian Reservoirs*." The project also includes a number of rural and levee improvements along the Souris River in North Dakota and improvements to other USFWS Refuge structures in North Dakota.

Under the provisions of Article X of the 1989 International Agreement for Water Supply and Flood Control in the Souris River Basin, the Government of Saskatchewan and the U.S. Department of the Army (Army) are designated as the responsible entities for the

management of the improvements covered by the Agreement during periods of flood. In Saskatchewan this authority rests with the formerly named Saskatchewan Water Corporation, now called the Saskatchewan Watershed Authority (SWA), a Provincial Crown Corporation. In the United States this authority rests with the U.S Army, Corps of Engineers (USACE) through its St. Paul District. During non-flood periods, SWA is also the responsible entity for operations in Canada, while the USFWS is the responsible entity in the United States.

A June 2, 1989 Memorandum of Understanding (MOU) between the USFWS and the Corps formalized and established the procedures, administration, cooperation and coordination between the two agencies for operation of Lake Darling for flood control purposes under the 1989 International Agreement and for identification and remediation of adverse impacts of the Souris Basin Project to fish and wildlife resources, refuge facilities and operations on the Upper Souris River and J. Clark Salyer National Wildlife Refuges.

The objectives of the operating plan are:

- To provide 1-percent (100-year) flood protection at Minot, North Dakota
- To provide flood protection to urban and rural areas downstream of Rafferty Dam, Alameda Dam, and Lake Darling Dam
- To ensure, to the extent possible, that the existing benefits from the supply of water in the Souris River basin and the supply of water to the Souris Basin Project are not compromised

Section 6.0 of Annex A of the 1989 Agreement provides that these responsible entities will accomplish liaison with interested states, provinces and agencies from time-to-time as to the operation of the project. Additionally, Section 6.0 provides that representatives of the Army, Saskatchewan Water Corporation, USFWS and North Dakota State Engineer have responsibility to monitor reservoir operations under the Agreement.

Further responsibilities of the Governments of Canada and the United States are defined in Article V of the 1989 International Agreement. These responsibilities include consultation with interested states, provinces and agencies concerning preparation of reservoir regulation manuals and periodic review and revision of the operating plan contained in Annex A, at five-year intervals, or as mutually agreed, to maximize the provision of flood control and water supply benefits that can be provided consistent with the terms of the agreement.

Forecasting and Flood Operations Coordination

Representatives of SWA and the Corps formally established the Forecasting and Flood Operations Coordinating Group (FFOCG) on March 24, 1999 to coordinate activities for the flood operations. Representatives of agencies having responsibilities under the 1989 Agreement and other agencies directly involved in forecasting and reservoir operations,

and member agencies of the International Souris River Board were selected to participate. All of the people involved were already actively involved in the generation of forecasts and exchange of information between jurisdictions.

FFOCG representatives are from the following agencies:

- Saskatchewan Watershed Authority, formerly Saskatchewan Water Corporation
- Corps
- North Dakota State Water Commission/North Dakota State Engineer
- USFWS

Beginning on February 1 of each year, and thereafter on the 15th and last day of the month until runoff occurs, the SWA prepares forecasts of the maximum 30-day and 90-day runoff, with assistance from the National Weather Service as appropriate.

In accordance with the operating plan for the Canadian Reservoirs and Lake Darling, contained in "Annex A" of the 1989 International Agreement, flood control operation of the Souris Basin Project is triggered if:

- A February 1, or subsequent spring runoff estimate shows a 50-percent chance of a 30-day unregulated runoff volume at the Sherwood Crossing equaling or exceeding 175,200 ac-ft

- A 10-percent (10-year) flood volume, and/or the local 30-day runoff volume at Sherwood Crossing equaling or exceeding 30,000 ac-ft

During years of flood operation, the terms of Annex A of the 1989 Agreement establish reservoir target drawdown levels for Rafferty, Alameda and Boundary reservoirs in Canada and Lake Darling in North Dakota. In these years it also provides for target flows in North Dakota for the Souris River at Sherwood and Minot. In addition to the SWA forecasts, the NWS North Central River Forecast Center (NCRFC) in Chanhassen, Minnesota issues a spring flood outlook for the North Dakota portion of the basin.

The planning of flood operations is a highly coordinated effort. Agency representatives meet by conference call on a regular basis from March through June to review reservoir operations, based on updated forecasts and the latest flow information. Flow and water level information is exchanged between agencies by way of the Internet and other electronic formats on a daily basis. Members of the various agencies are kept informed of forecasts and planned reservoir operations through normal communication channels. Between conference calls as required by conditions, members of FFOCG maintain contact by individual phone calls and various forms of electronic communications. Whenever precipitation events occur, and a change in flow conditions is warranted, reservoir operation plans are updated and a conference call is held to discuss reservoir operations, target flows, and possible impacts to downstream interests. In all cases, every effort is made to minimize the impacts of high flows, while operating the system within the intent of the 1989 Agreement.

Also participating in the conference calls, which are public meetings, are interested citizens, representatives from the City of Minot, Eaton Irrigation District, Souris River Joint Water Resources Board, State Water Commission, the Corps and USFWS.

How Large Is The Souris River Flood Of 2011?

- The Souris River at Sherwood gage was established in March 1930.

- Since March 1, 2011 the USGS has made 28 measurements of discharge on the Souris River at Sherwood to document the flood. Seven out of 28 measurements were greater than the previous peak of record of 14,800 cubic feet per second set in 1976. The measurements combined with the recorded water levels have been used to compute the daily streamflow for the Sherwood gage.

- The provisional peak flow of 29,700 cubic feet per second occurred on June 24. The peak flow at Sherwood is about two times larger than the previous peak flow of 14,800 cubic feet per second in 1976.

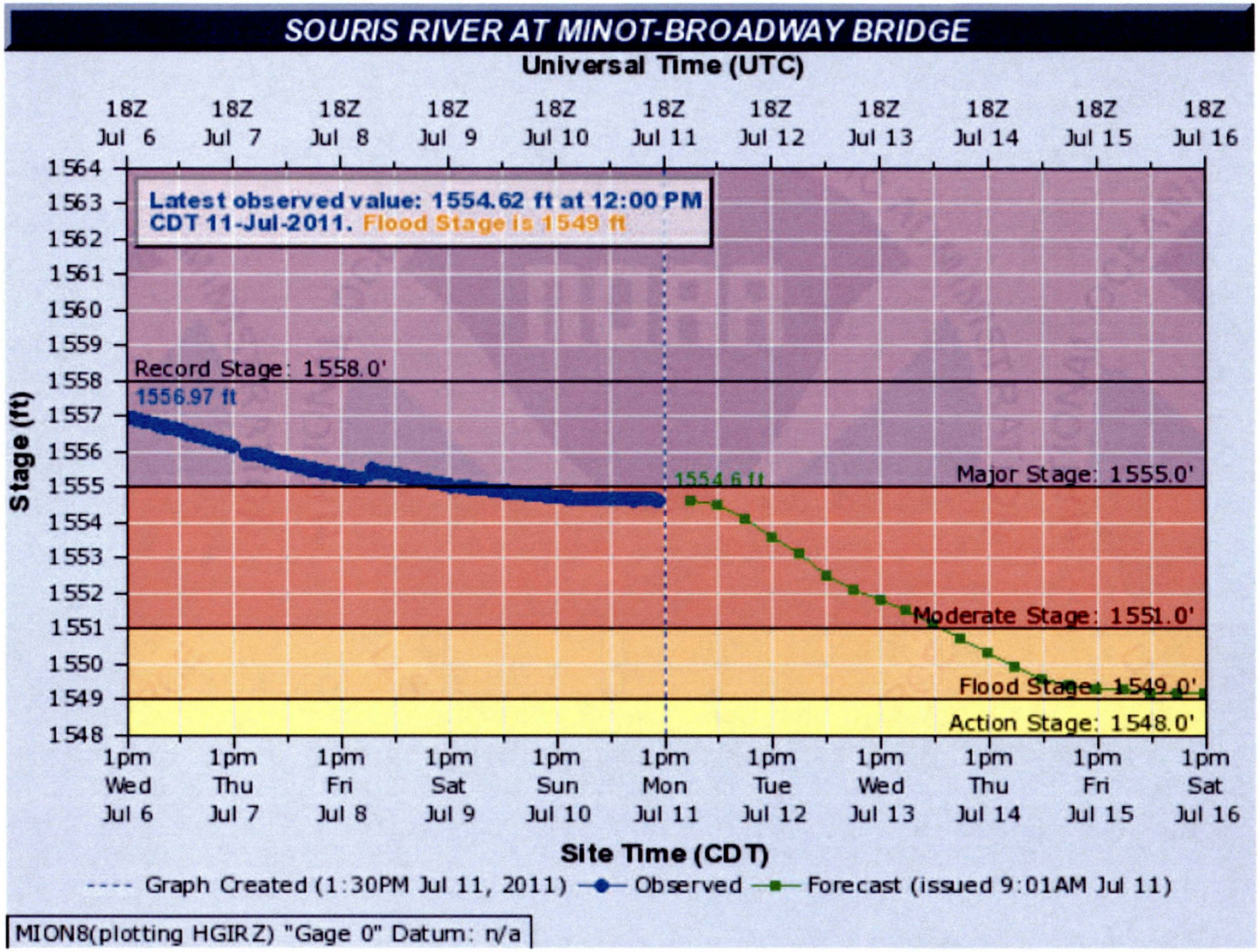
- The volume or amount of water flowing past the Sherwood gage also has been record breaking. During the first nine months of the 2011 water year (October 1, 2010 through June 30, 2011) 1,201,000 acre-feet has been measured at the Sherwood gage (fig. 1), and the record breaking volume of water will continue to increase because of the high flows still in the river.

- Total volume of flow in June was 632,800 acre/ft or about the same as the largest total annual volume of 635,300 acre/ft that occurred in 1976.

- On June 24, 2011 more water passed the Souris River at Sherwood gage than was recorded in 45 (total annual volume) out of 82 years of record!

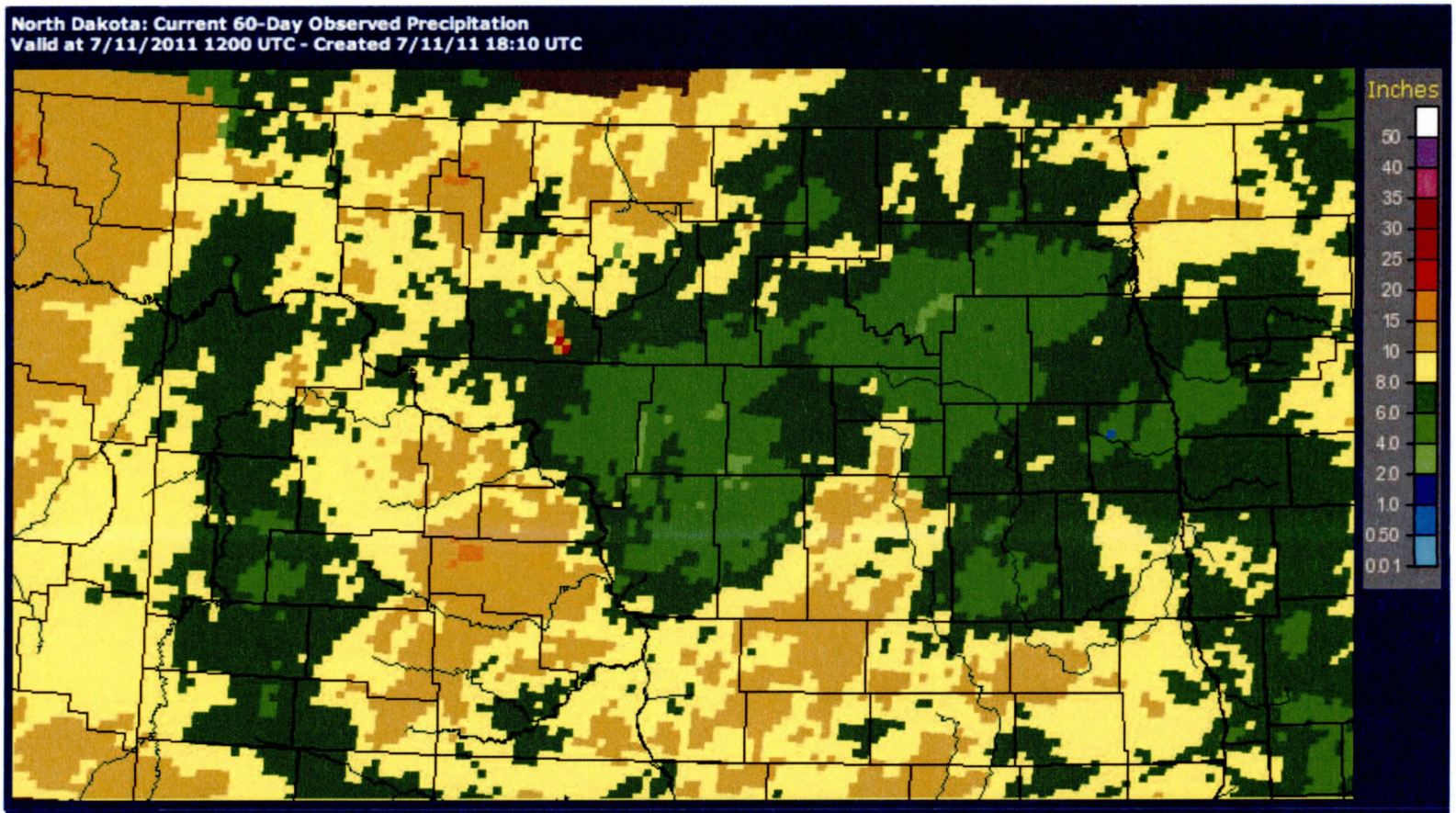
- By all measures, 2011 is truly a great flood in the Souris River Basin.

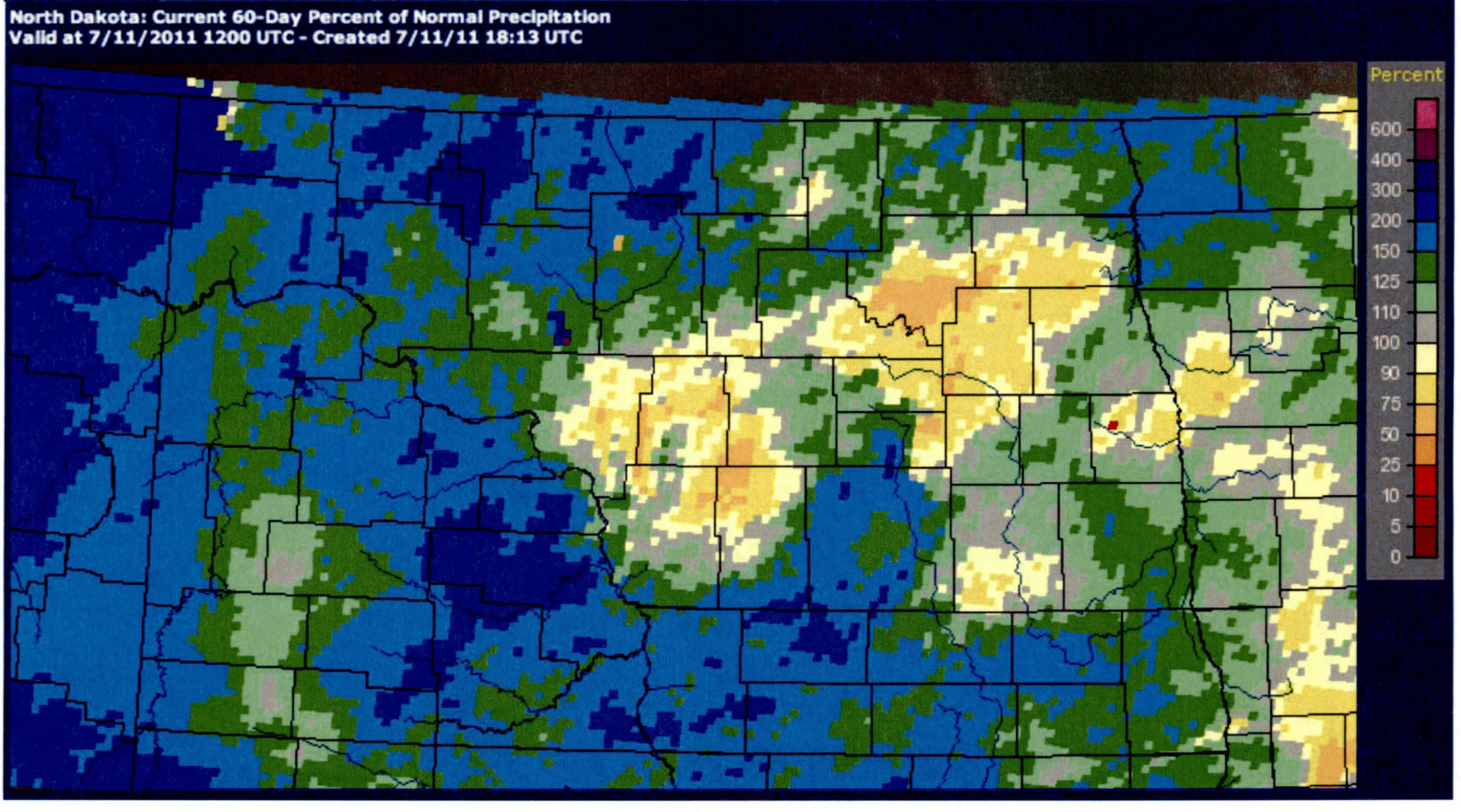
National Weather Service
Advanced Hydrologic Prediction Service
water.weather.gov/ahps/



NOTE: Near real time data is available at this location, courtesy of the USGS installing a temporary automated gauge for the Spring Flood.

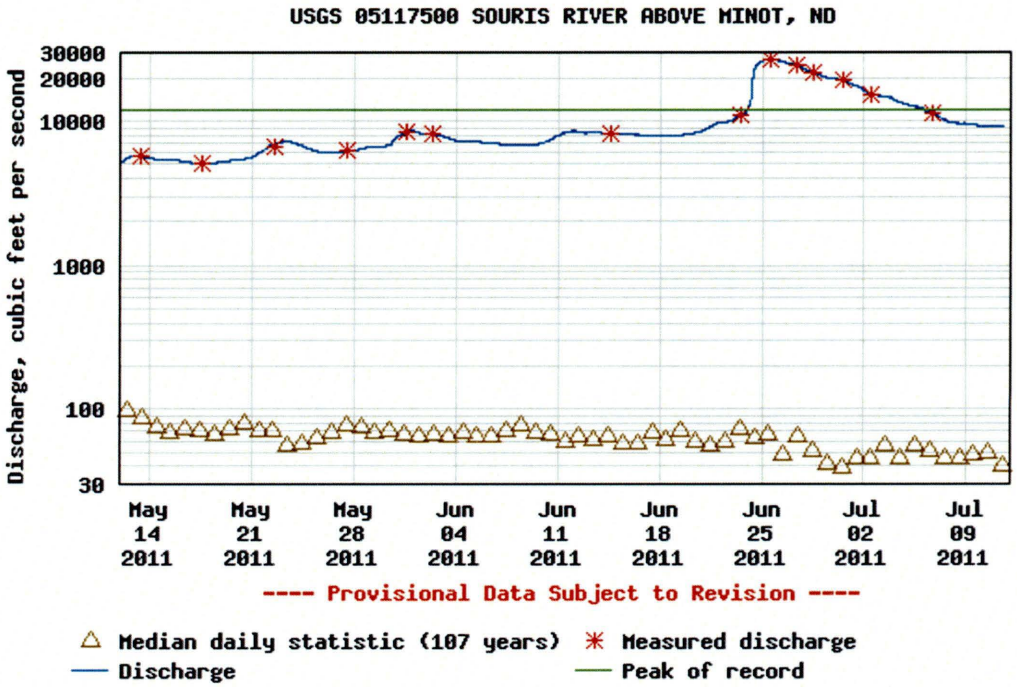
Forecasts for the Souris River at Minot-Broadway Bridge are issued as needed during times of high water, but are not routinely available.


North Dakota: Current 60-Day Observed Precipitation
Valid at 7/11/2011 1200 UTC - Created 7/11/11 18:10 UTC
Inches
50
40
35
30
25
20
15
10
8.0
6.0
4.0
2.0
1.0
0.50
0.01


North Dakota: Current 60-Day Percent of Normal Precipitation
Valid at 7/11/2011 1200 UTC - Created 7/11/11 18:13 UTC
Percent
600
400
300
200
150
125
110
100
90
75
50
25
10
5
0

Discharge, cubic feet per second

Most recent instantaneous value: 9,200 07-11-2011 13:15 CDT



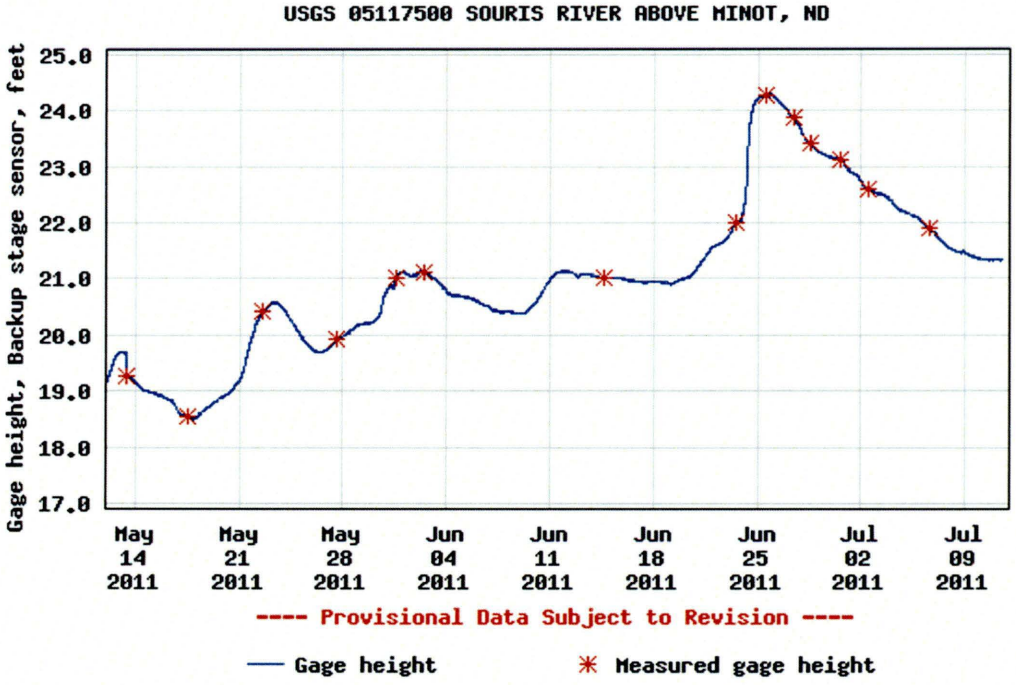
Create presentation-quality / stand-alone graph. Subscribe to WaterAlert

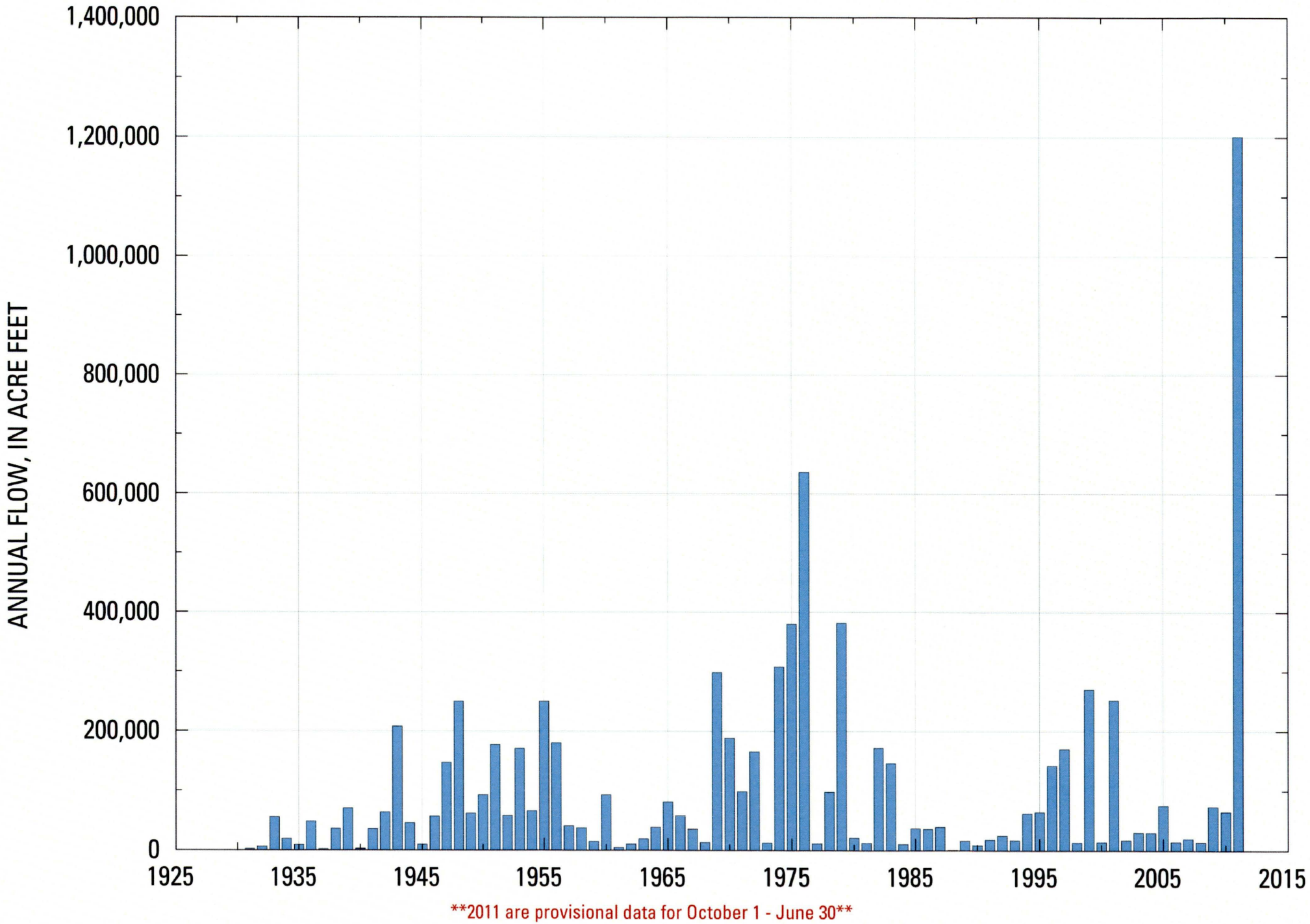
Daily discharge statistics, in cfs, for Jul 11 based on 107 years of record more

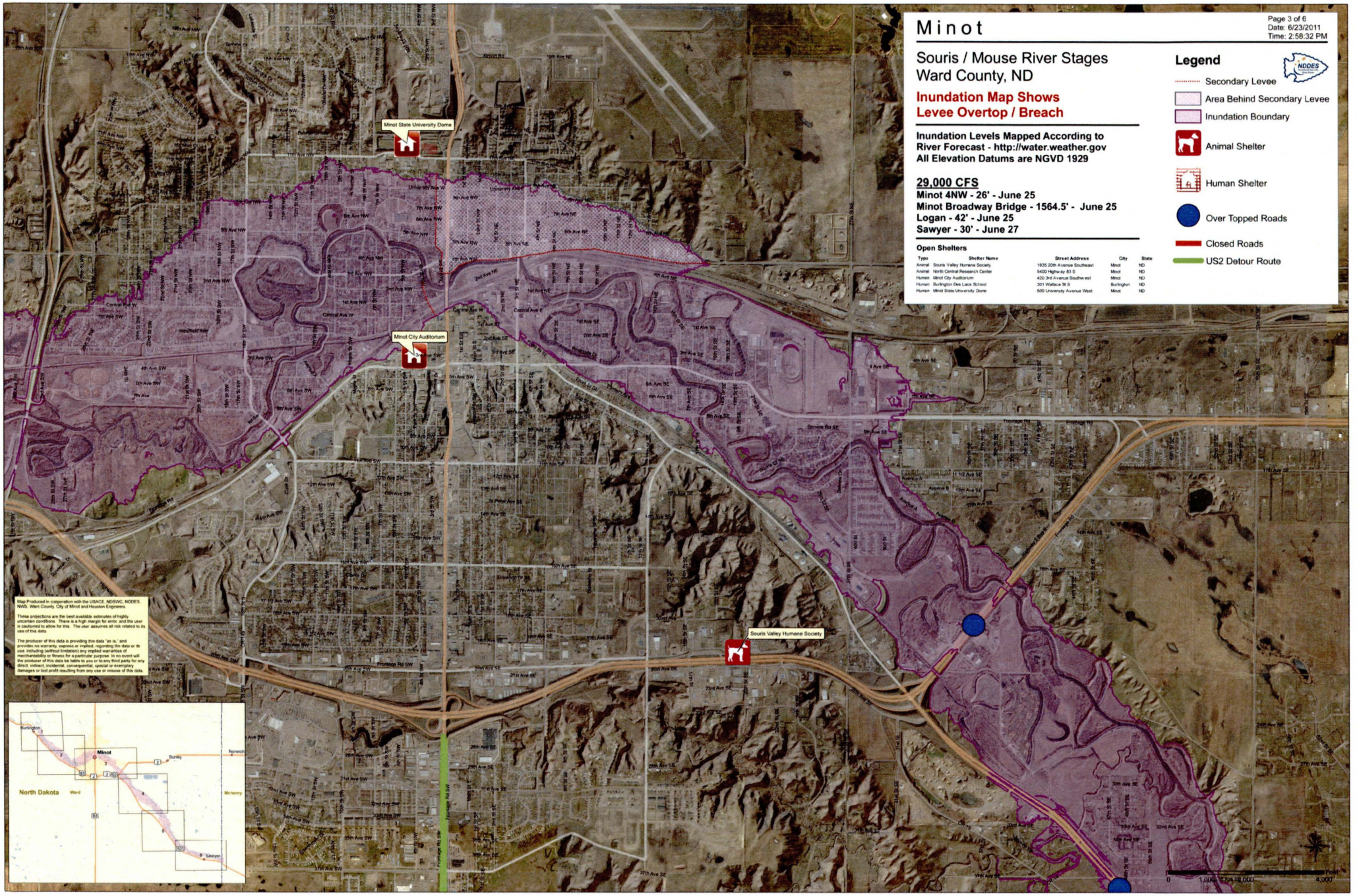
Min (1935)	25th percen-tile	Median	Mean	75th percen-tile	Max (1953)	Most Recent Instantaneous Value Jul 11
0.00	4.6	40.	122	156	1470	9200

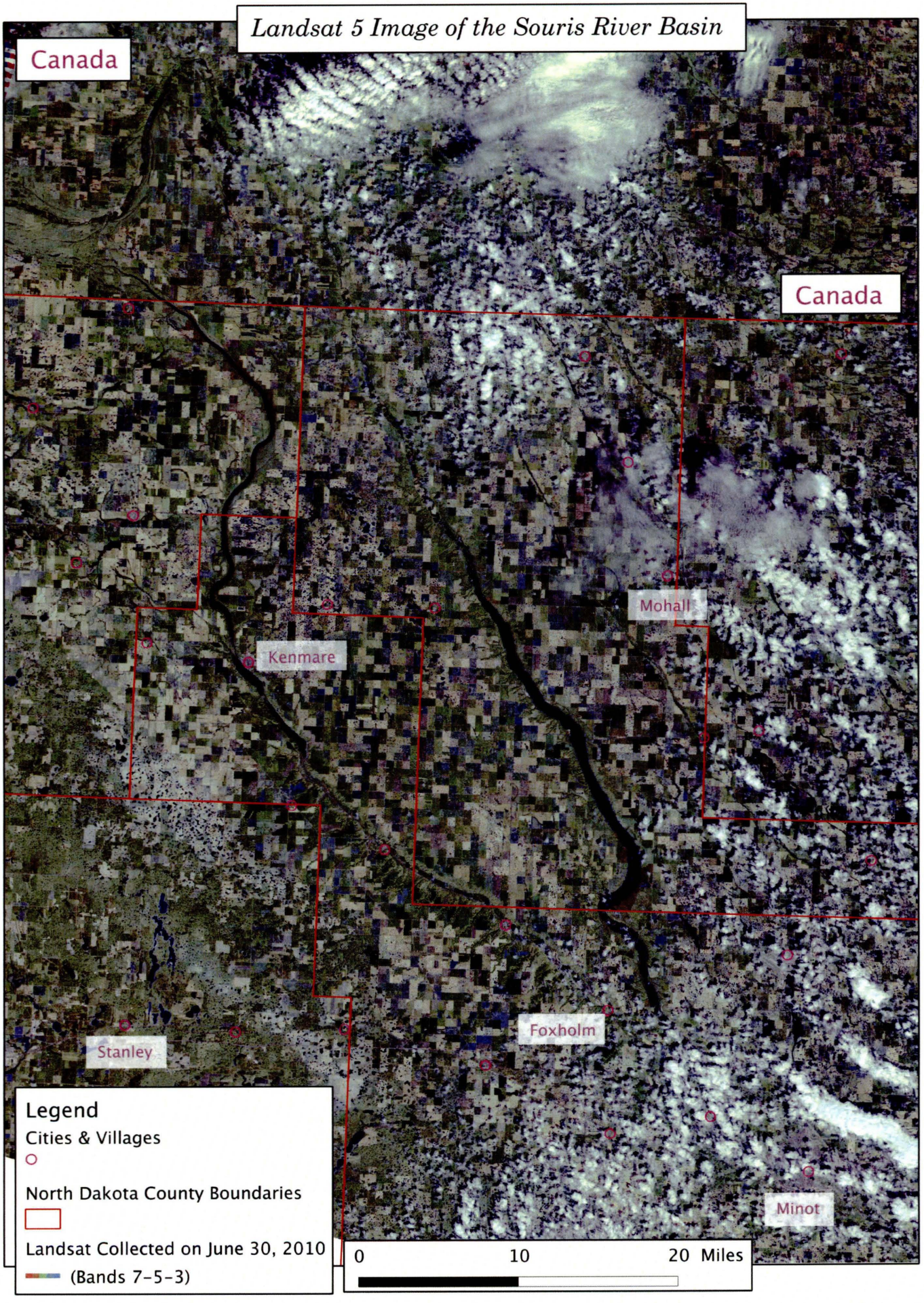
Gage height, Backup stage sensor, feet

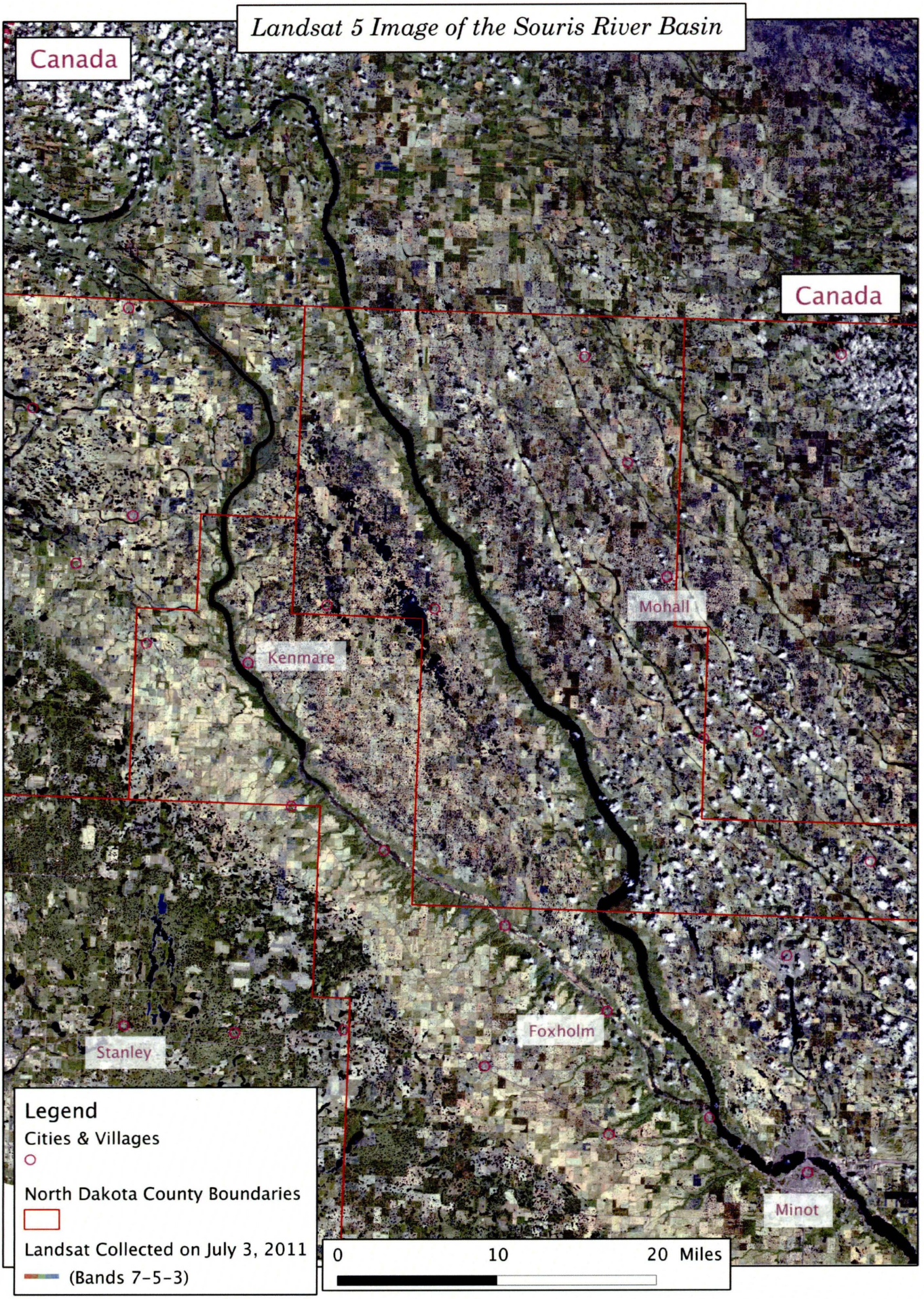
Most recent instantaneous value: 21.34 07-11-2011 13:15 CDT




Souris River near Sherwood, North Dakota
ANNUAL FLOW, IN ACRE FEET
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
1925
1935
1945
1955
1965
1975
1985
1995
2005
2015
2011 are provisional data for October 1 - June 30


Minot
Page 3 of 6
Date: 6/23/2011
Time: 2:58:32 PM
Souris / Mouse River Stages
Ward County, ND
Inundation Map Shows
Levee Overtop / Breach
Inundation Levels Mapped According to
River Forecast - http://water.weather.gov
All Elevation Datums are NGVD 1929
29,000 CFS
Minot 4NW - 26' - June 25
Minot Broadway Bridge - 1564.5' - June 25
Logan - 42' - June 25
Sawyer - 30' - June 27
Open Shelters
Type Shelter Name Street Address City State
Animal Souris Valley Humane Society 1935 20th Avenue Southeast Minot ND
Animal North Central Research Center 5400 Highway 83 S Minot ND
Human Minot City Auditorium 420 3rd Avenue Southeast Minot ND
Human Burlington Des Lacs School 301 Wallace St S Burlington ND
Human Minot State University Dome 500 University Avenue West Minot ND
Legend
NDDES
Secondary Levee
Area Behind Secondary Levee
Inundation Boundary
Animal Shelter
Human Shelter
Over Topped Roads
Closed Roads
US2 Detour Route
Minot State University Dome
Minot City Auditorium
Souris Valley Humane Society
Map Produced in cooperation with the USACE, NDSWC, NDDES, NWS, Ward County, City of Minot and Houston Engineers.
These projections are the best available estimates of highly uncertain conditions. There is a high margin for error, and the user is cautioned to allow for this. The user assumes all risk related to its use of this data.
The producer of this data is providing this data "as is," and provides no warranty, express or implied, regarding the data or its use, including (without limitation) any implied warranties of merchantability or fitness for a particular purpose. In no event will the producer of this data be liable to you or to any third party for any direct, indirect, incidental, consequential, special or exemplary damages or lost profit resulting from any use or misuse of this data.
North Dakota
Ward
Minot
Burlington
Surrey
Norwich
Mchenry
Sawyer
0
1,000
2,000
4,000
Feet


Landsat 5 Image of the Souris River Basin
Canada
Canada
Mohall
Kenmare
Foxholm
Stanley
Minot
Legend
Cities & Villages
North Dakota County Boundaries
Landsat Collected on June 30, 2010
(Bands 7-5-3)
0
10
20 Miles


Landsat 5 Image of the Souris River Basin
Canada
Canada
Mohall
Kenmare
Foxholm
Stanley
Minot
Legend
Cities & Villages
North Dakota County Boundaries
Landsat Collected on July 3, 2011
(Bands 7-5-3)
0
10
20 Miles

Search the North Dakota WSC:
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2011 Flood Information

Streamgages in the Souris River Basin in U.S. and Canada

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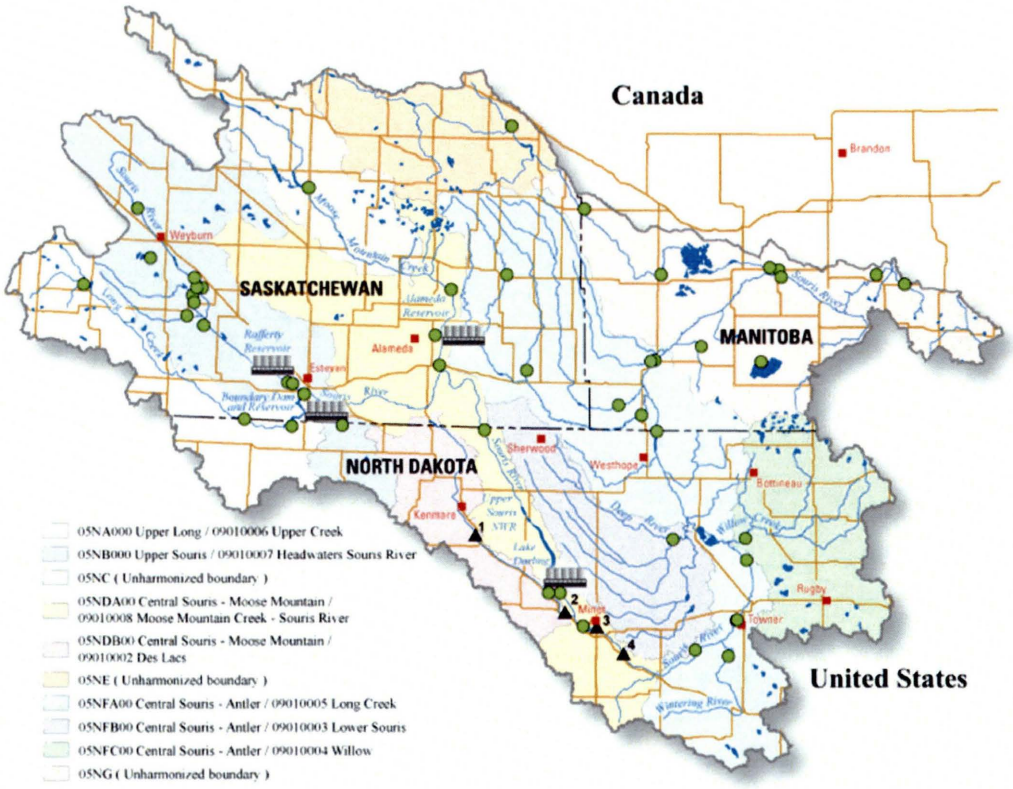
Select a site from the map to view data.



Hydrologic Monitoring Network

- Canada and U.S. Souris River Basin streamgages
- Reservoir data

Short-term streamgages active in 2011 *Active*

1. 483517101595000 DES LACS RIVER NEAR BADEN, ND
2. 481658101254700 DES LACS RIVER AT BURLINGTON, ND
3. 481417101174500 SOURIS RIVER AT BROADWAY BRIDGE AT MINOT, ND
4. 480911101090200 SOURIS RIVER AT LOGAN, ND

The Souris, or Mouse, River originates in the Yellow Grass Marshes north of Weyburn, Saskatchewan, Canada, and flows southeast, crossing the northern boundary of North Dakota west of Sherwood. It then forms a loop and flows back north, entering Manitoba near Westhope. The river eventually flows into the Assiniboine River near Brandon, Manitoba.

MISSOURI RIVER BASIN AND RESERVOIR INFORMATION

Introduction

Six dams and reservoir projects make up the Missouri River reservoir system. Each of the projects were constructed by the federal government, and they are operated and maintained by the U.S. Army Corps of Engineers (Corps) for the purposes of flood control, water supply, recreation, irrigation, hydropower, water quality, fish and wildlife habitat, and navigation.

The first of the mainstem dams to be constructed was Fort Peck, which was completed under an authorization by Congress as part of the Rivers and Harbors Act of 1935. Later, the Pick-Sloan Plan, a cooperative effort between the U.S. Army Corps and Bureau of Reclamation, called for the construction of five more mainstem dams along the Missouri River. Authorization of the Pick-Sloan Plan came with Congressional passage of the Flood Control Act of 1944. The other five mainstem dams built on the Missouri River are Garrison, Oahe, Big Bend, Fort Randall, and Gavins Point. The reservoirs behind each of the six mainstem dams are Fort Peck Lake, Lake Sakakawea, Lake Oahe, Lake Sharpe, Lake Francis Case, and Lewis and Clark Lake. The Army Corps operates the Missouri River mainstem system under the guidance of the Missouri River Master Water Control Manual, also known as the Master Manual.

The Master Manual

The Master Manual was originally developed in 1960, and it has undergone a series of revisions the most recent of which was completed in 2004.

Directed by the Master Manual, the Corps has system storage and reservoir level targets that are to be met by March 1. These targets are a total system storage of 56.8 million acre-feet, and pool elevations of 2,234' above mean sea level (amsl), 1,837.5' amsl, and 1,607.5' amsl for Fort Peck Lake, Lake Sakakawea, and Lake Oahe, respectively. This year reservoir system on March 1 is at 57.6 million acre-feet, 2,235.8' amsl, 1,838.5' amsl, and 1,607.7' amsl, for System Storage, on Fort Peck Lake, Lake Sakakawea, and Lake Oahe, respectively.

2011 Conditions

On July 10, system storage in the six mainstem reservoirs was 72.6 million acre-feet (MAF), 14.3 MAF above the average system storage for the end of June, and 7.0 MAF more than last year. On July 2, the system storage exceeded the previous system storage annual maximum record of 71.8 MAF, which was set in July, 1975. The year-to-date runoff into the Missouri River System above Sioux City is 42.3 MAF, 261% of normal. The Corps predicts runoff above Sioux City for 2011 to be 57.7 MAF, 233% of normal. This projected inflow will be the highest inflow to date, and 8.7 MAF more than the previous record inflow of 49.04 MAF in 1997.

The highest recorded elevation on Lake Sakakawea thus far in 2011 is 1,854.6' amsl. On July 10, Lake Sakakawea was at an elevation of 1854.4' amsl, 4.4' into the Exclusive Flood Pool. 5' higher than a year ago, and 15' above its average daily elevation for July. The previous maximum daily elevation was 1854.8', which occurred in July of 1975. Releases from Garrison are planned to drop from 140,000 cfs to 135,000 cfs on July 12. Releases will slowly be reduced the remainder of the year and are expected to be at 110,000 cfs by the end of July. Prior to this event, the maximum discharge from Lake Sakakawea was 65,200 cfs in 1975.

The elevation at Fort Peck was 2,249.8' amsl on July 10. This is 15' higher than a year ago and 17.1' higher than the average daily July elevation. The previous maximum daily July elevation for Fort Peck was 2,251.6' in 1975. On July 10 releases from Fort Peck were 44,900 cfs. Releases from Fort Peck will drop to 40,000 cfs around July 15 and are expected to end the month at 35,000 cfs.

The stage in Williston on June 13 was 29.27'. The average June gauge stage at Williston is 18.45' (USGS Gage 06330000 Monthly Statistics, period of record 1966 2002). The previous record stage was set in 1912 and was 28.0'.

The river stage and flow on July 11 in Bismarck was 19.11' and 141,000 cfs, respectively. Post-construction of Garrison Dam, the average July gauge stage at Bismarck was 6.29' and the average June flow at Bismarck was 24,200 cfs. The previous river stage record, post-dam, was 16.11' (instantaneous value) in the spring of 2009, which was caused by an ice jam. The 2005 Burleigh County FEMA Flood Insurance Study (FIS) states there is a 1% chance every year (or commonly referred to as the 100-year flow) of 94,000 cfs, and a 0.2% chance every year (or commonly referred to as the 500 year flow) of 148,000 cfs.

The elevation of Lake Oahe was 1619.4' amsl on July 11, just 2' higher than last year, and 14.9' higher than the average daily July elevation. The maximum daily July elevation for Oahe was 1618.6 in 1995. On July 10, the release from Lake Oahe was 150,500 cfs. Releases from Oahe are planned to decrease to 145,000 cfs by July 12 and then to 135,000 cfs by the end of the month. Prior to this event the maximum flow out of Lake Oahe was 59,300 cfs in 1997.

The river stage on July 11, 2011 at Pierre, SD was 18.99'. The average July gauge stage at Pierre is 8.4'. The 2004 Hughes County FEMA Flood Insurance Study (FIS) states there is a 1% chance every year (or commonly referred to as the 100 year flow) of 70,000 cfs at Pierre.

On July 8, the mountain snowpack was 11% and 10% of the normal April 15 peak in the "Total above Fort Peck" and the "Total Fort Peck to Garrison" reaches, respectively. The "Total above Fort Peck" reach appears to have peaked on May 2 at 141% of the normal peak. The "Total Fort Peck to Garrison reach appears to have peaked on April 15 and May 2 at 136% of the normal peak.

Recent Timeline For The Missouri River Basin Above Lake Sakakawea

March 1 According to the Master Manual the Corps is to have the system at or near Base Annual Flood Control by March 1.

	03/01/2011	Base Annual Flood Control
Fort Peck	2,235.8' amsl	2,234' amsl
Lake Sakakawea	1,838.5' amsl	1,837.5' amsl
Lake Oahe	1,607.7' amsl	1,607.5' amsl
System	57.6 MAF	57.1 MAF

The Master Manual sets March 1 as its operating starting date due to the predictability of inflows between August 1 and March 1 (Master Manual pg VI -14). The system storage levels that are met on March 1 was designed to serve authorized purposes during a 12-year drought such as that experienced during the 1930's (Master Manual pg VI-18)

April 1 Mountain snowpack 116% and 112% of normal.

April 13 SWC voices concern over high volumes of water in the Missouri River System at the Annual Operating Plan (AOP) meeting.

April 20 State Engineer, Todd Sando sends a letter to Corps Brigadier General McMahon, Commander of the Portland Division, stating his concern with the high volume of water in the reservoirs, the unknown snowpack, and the relatively low downstream releases. "*I am concerned with the high levels of Lake Sakakawea and Lake Oahe, and the above normal snowpack that will be generating a great deal of addition runoff. We are concerned your forecast does not adequately address the current conditions of the basin and the potential for above normal precipitation this summer.*"

May 1 The Corps releases mountain snowpack data showing snowpack conditions 136% and 141% of the normal peak levels above Fort Peck and Garrison, respectively. The late peaking, above normal mountain snowpack seemed to be unanticipated.

May 5 City/County/State and Corps officials meet to discuss the likelihood for high releases out of Lake Sakakawea, according to the Corps forecast there was a potential for releases of 55,000 cfs, resulting an estimated crest stage of 14' at Bismarck.

May 6 The Corps issues a press release stating that they are planning increasing releases out of Garrison to 49,000 cfs by mid-May.

May 10-11 2.5 to 3.5 inches of rain fall in eastern Montana.

May 20 The Corps sends out a press release announcing Garrison Dam releases will be increased to 60,000 cfs.

May 20-22 5 to 8 inches of rain fall in eastern Montana, western South Dakota, and northern Wyoming.

May 23 The Corps sends out a press release announcing Garrison dam releases will be increased to 75,000 cfs.

May 24 The Corps sends out a press release announcing Garrison dam releases will be increased to 85,000 cfs.

May 25 1.5 to 2 inches of rain fall over eastern Montana.

May 26 The Corps announces that they will increase releases to from 110,000 cfs-120,000 cfs from lower five reservoirs, and 50,000 cfs from Fort Peck.

May 28 The Corps anticipates more rain and announces releases will be increased to 150,000 cfs from the lower five reservoirs, and 50,000 cfs from Fort Peck.

May 30-31 2 to 4 inches of rain fall in Montana.

June 1 The Corps opens Lake Sakakawea spillway gates for the first time

2011 Alternatives For Missouri River System Management

There has been considerable discussion regarding the Corps management of the Missouri River system in 2011. The following scenarios examine the affects of several plausible changes in reservoir operation, if the Corps had known several significant precipitation events totaling 9"to 17.5" over the course of three weeks were going to fall within the watershed.

Scenario 1

The volume of water that passed the Bismarck gauge between March 1[i] and June 12 was 9.47 MAF. If the Corps had increased releases so that the river stage at Bismarck was 11.5' amsl[ii], or 46,000 cfs, on April 13 as the Water Commission advised, an additional 1.25 MAF could have been released. That is the difference between 1853.3' on June 13 to a potential elevation of 1849.9' on June 13. If the additional 1.25 MAF had been used in holding back releases from Garrison Dam, flows of 46,000 cfs could have been maintained through Bismarck until June 5, at which time the Corps would have to ramp up to the current release schedule and reach the same peak discharge and river stage.

Scenario 2

If the Corps had disregarded any potential ice jam problems or other flooding concerns in the Bismarck area in the spring of 2011 and increased releases so that the water the passed the Bismarck gauge was at a river stage of 11.5', or 46,000 cfs, on March 1, the Corps could have discharged an additional 2.4 MAF, which would have resulted in a reservoir elevation of 1846.7' on June 13. Or if the additional 2.4 MAF had been used in holding back releases, flows of 46,000 cfs could have been maintained through Bismarck

until June 12, at which time the Corps would have to ramp up to the current release schedule.

Scenario 3

In order for flows on the Missouri River to not exceed 46,000 cfs through June 30 and to reach the average June 30 elevation for Lake Sakakawea of 1,838.7' amsl, the Corps would have had to already drawn Lake Sakakawea down to an elevation of 1,814.7' amsl by March 1, which is 22.8' lower than their March target elevation of 1,837.5' amsl. In other words, if the Corps had known that volume of water was going to be entering the system Lake Sakakawea would have needed to be drawn down 22.8' lower than their Multiple Use Pool (power generation, water supply, navigation, recreation) in order to avoid flooding problems in Bismarck.

Conclusion

Scenarios can be developed in hindsight that might have lessened the flood impact. However, the 9" to17.5" of rain in large portions of the basin could not have been foreseen. In addition, the inflows this year are potentially 8.7 MAF, or more, above the previous record inflow. In short there was a lot of water in the basin, and potentially more to come in the foreseeable future. If releases had been increased a reasonable amount at an earlier date it is likely it would have just delayed the inevitable, and if the Lake Sakakawea had been drawn down sufficiently to compensate for the received inflows, the reservoir would have had to have been drawn down to levels that were causing serious problems in North Dakota several years ago.

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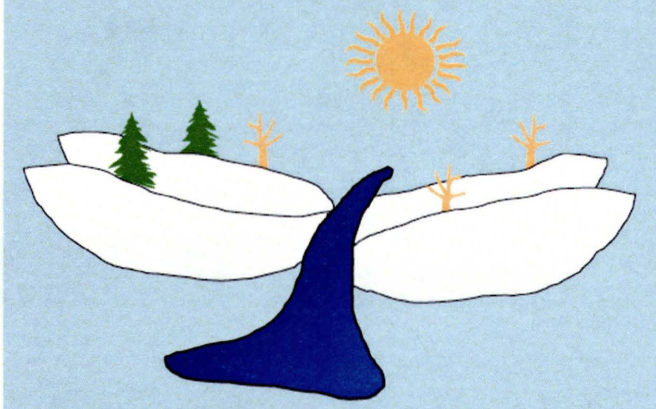
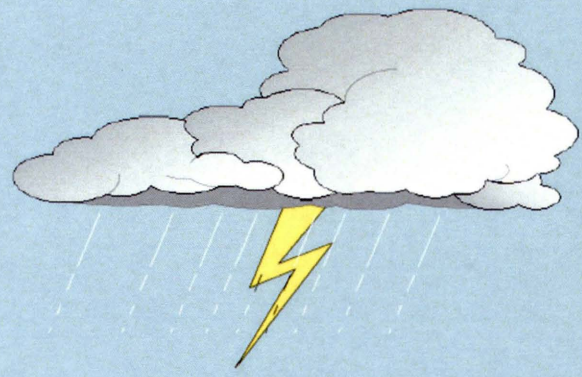
[i] Target date for annual target levels to be met in order to begin reservoir operations for the year.

[ii] If the river stage in Bismarck goes above this elevation, Bismarck-Mandan residents begin noticing flooding effects.

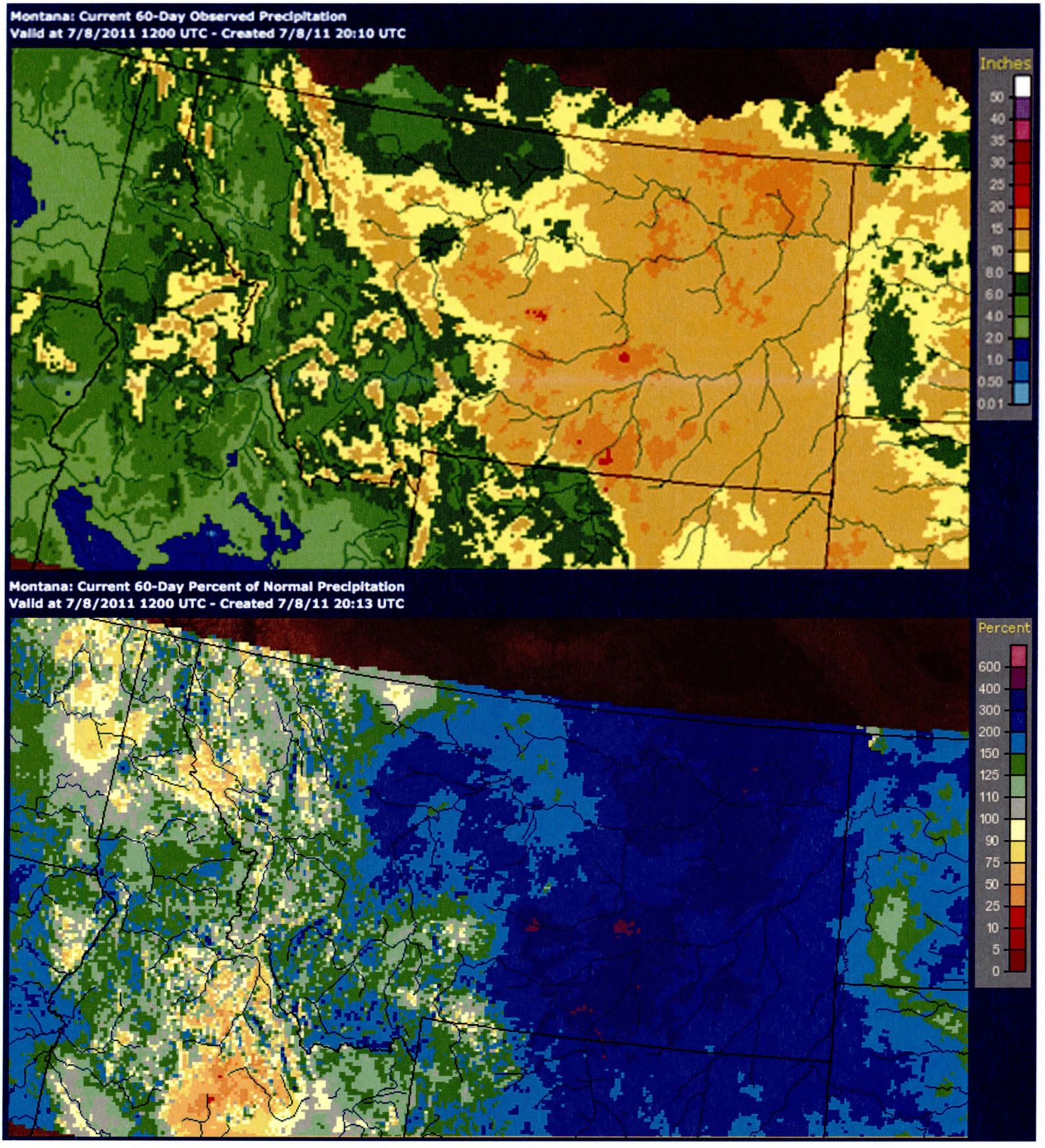
Runoff Components

Plains Snowpack	Mountain Snowpack	Rainfall
		
March and April	May, June and July	March through October

2011 Forecast* = 57.7 MAF

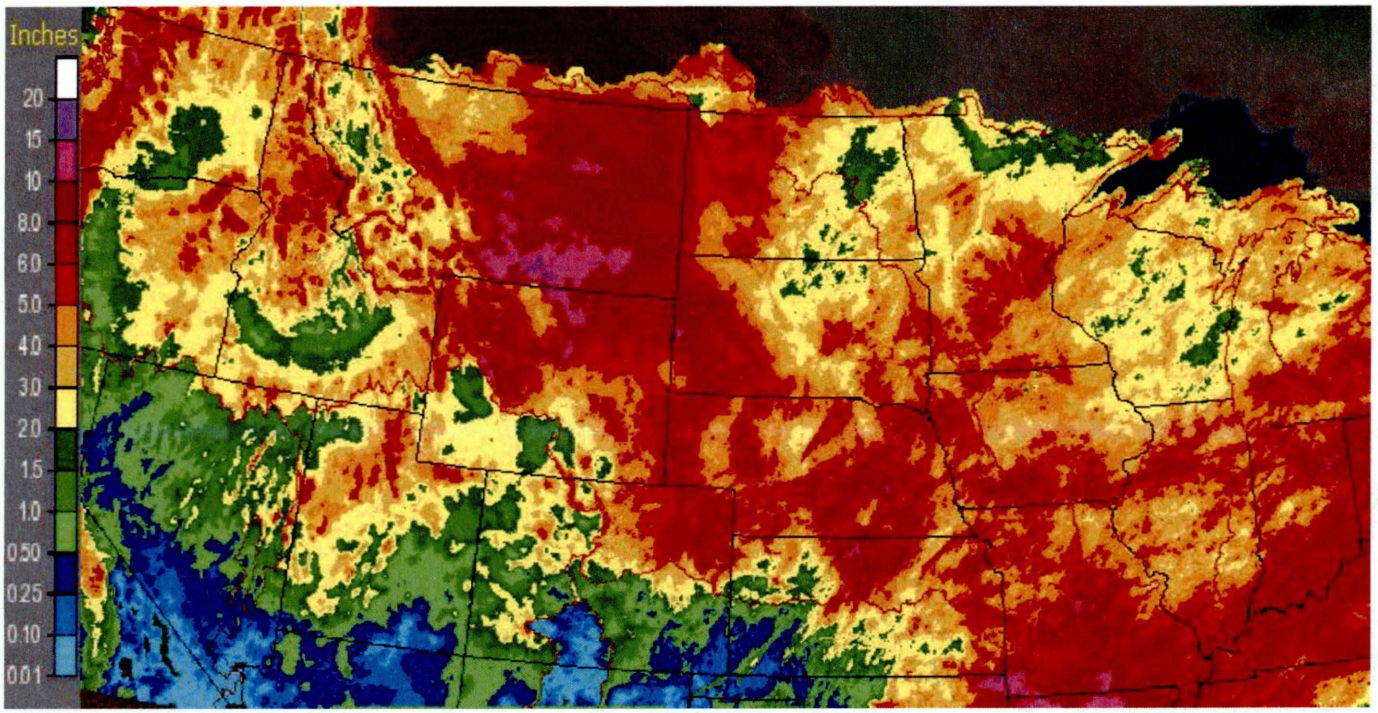
Highest runoff since 1898

Previous Record was 49.0 MAF in 1997


Montana: Current 60-Day Observed Precipitation
Valid at 7/8/2011 1200 UTC - Created 7/8/11 20:10 UTC
Inches
50
40
35
30
25
20
15
10
8.0
6.0
4.0
2.0
1.0
0.50
0.01
Montana: Current 60-Day Percent of Normal Precipitation
Valid at 7/8/2011 1200 UTC - Created 7/8/11 20:13 UTC
Percent
600
400
300
200
150
125
110
100
90
75
50
25
10
5
0

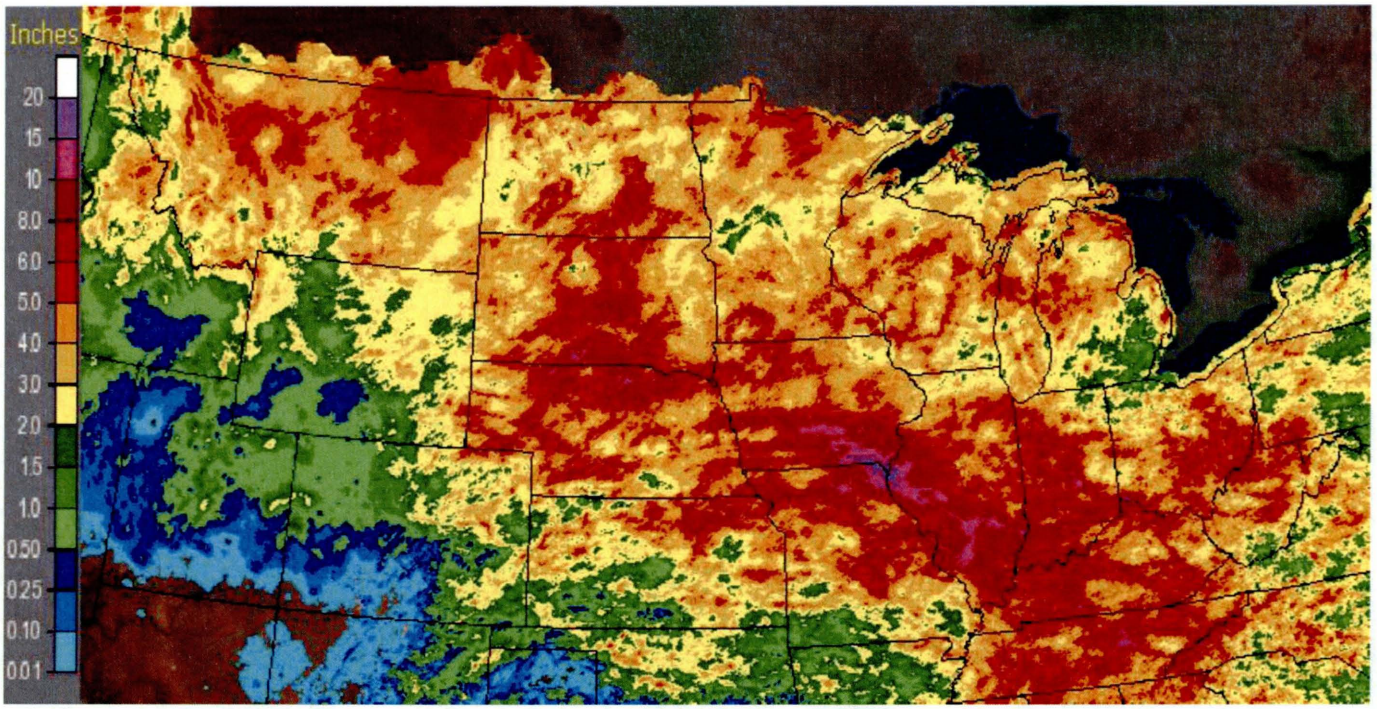
May 2011 Precipitation

Missouri Basin RFC Pleasant Hill, MO: May, 2011 Monthly Observed Precipitation
Valid at 6/1/2011 1200 UTC- Created 6/2/11 17:40 UTC



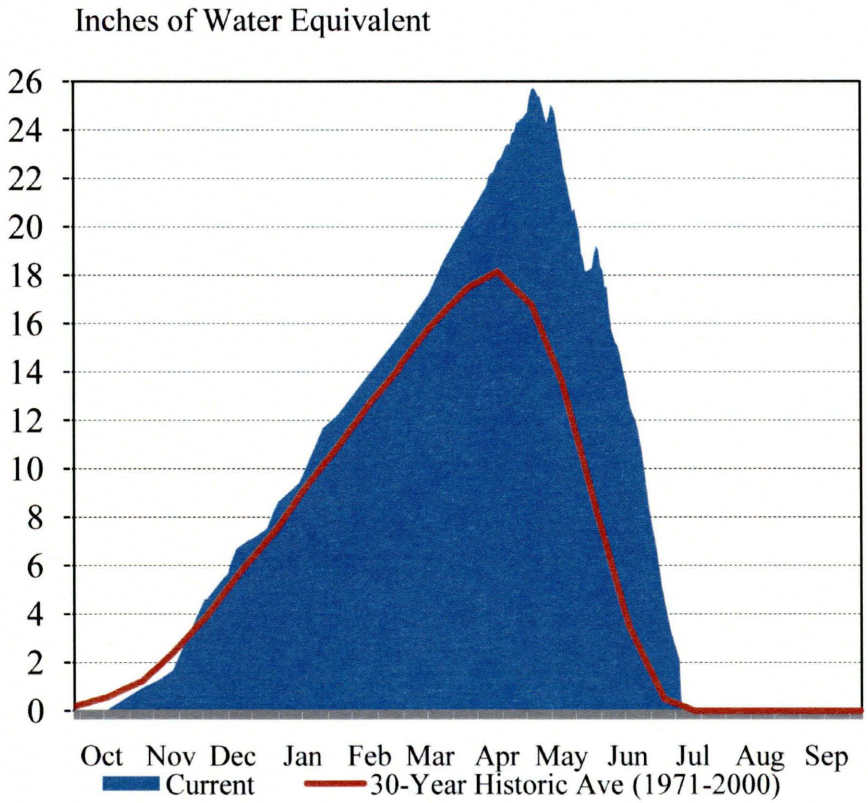
June 2011 Precipitation

NWS Central Region: June, 2011 Monthly Observed Precipitation
Valid at 7/1/2011 1200 UTC- Created 7/2/11 17:40 UTC

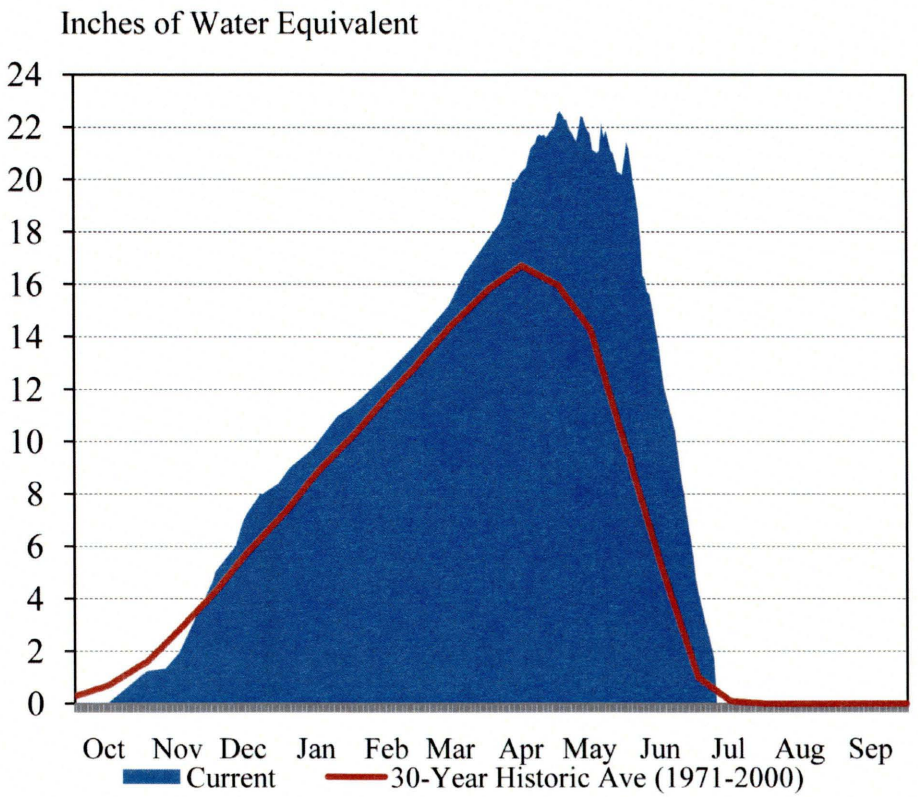


Missouri River Basin
Mountain Snowpack Water Content
2010-2011

Total above Fort Peck



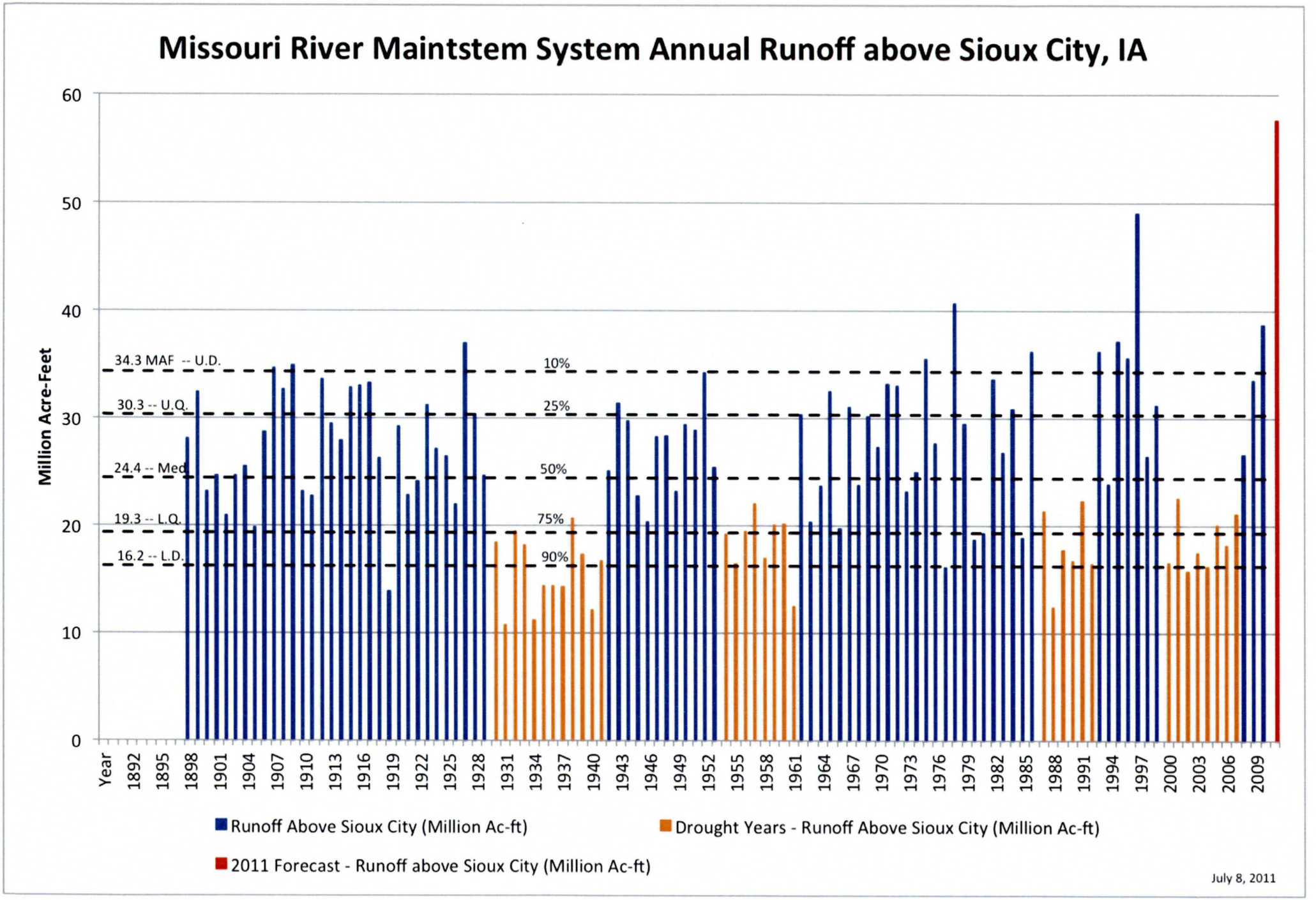
Total Fort Peck to Garrison



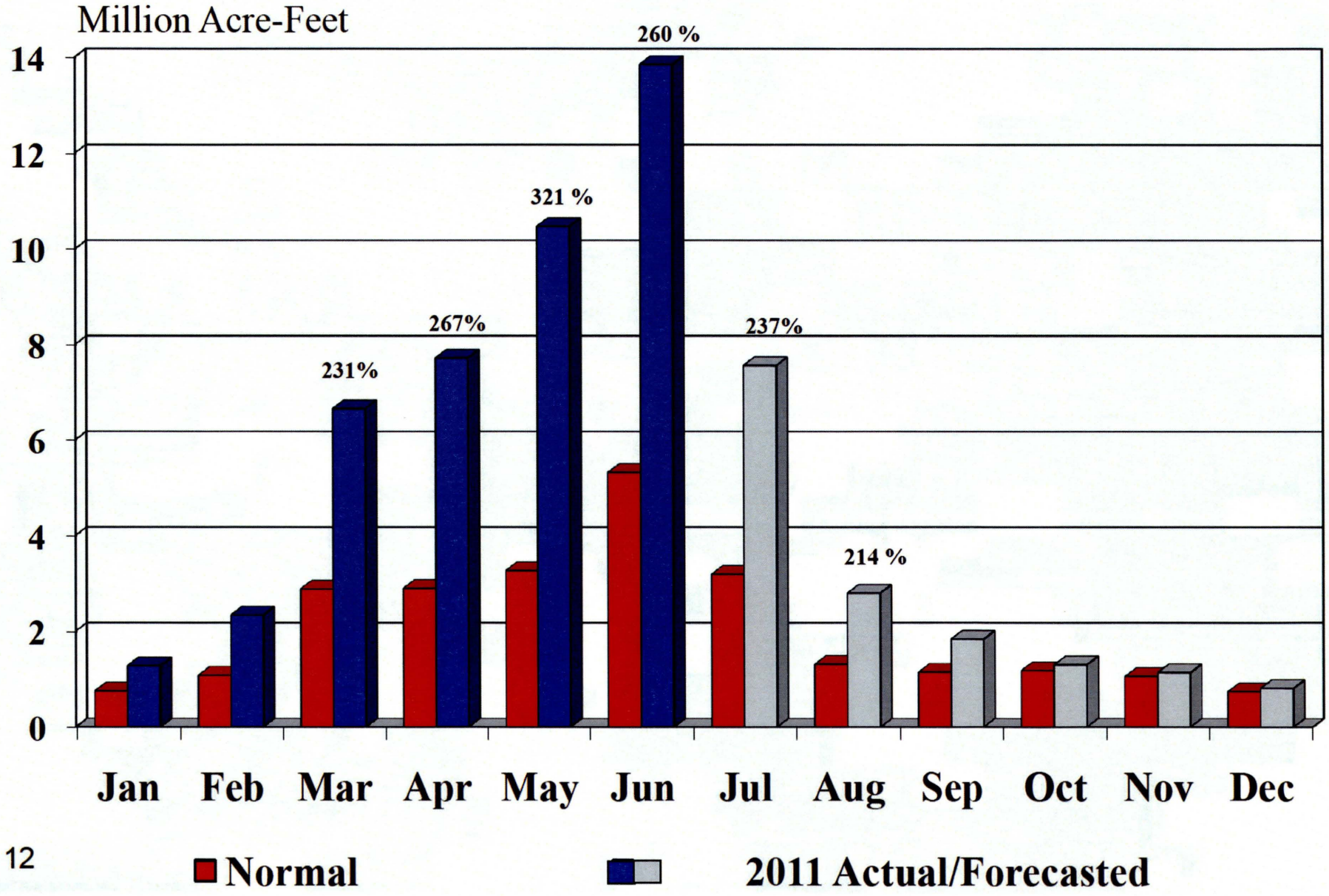
The Missouri River Basin mountain snowpack normally peaks near April 15. The mountain snowpack in both the "Total above Fort Peck" and the "Total Fort Peck to Garrison" reaches peaked on May 2 at 141 percent and 136 percent of the normal April 15 peak, respectively. The current mountain snowpack, as of July 8, is 11 percent and 10 percent of the normal April 15 peak in the "Total above Fort Peck" and the "Total Fort Peck to Garrison" reaches, respectively.

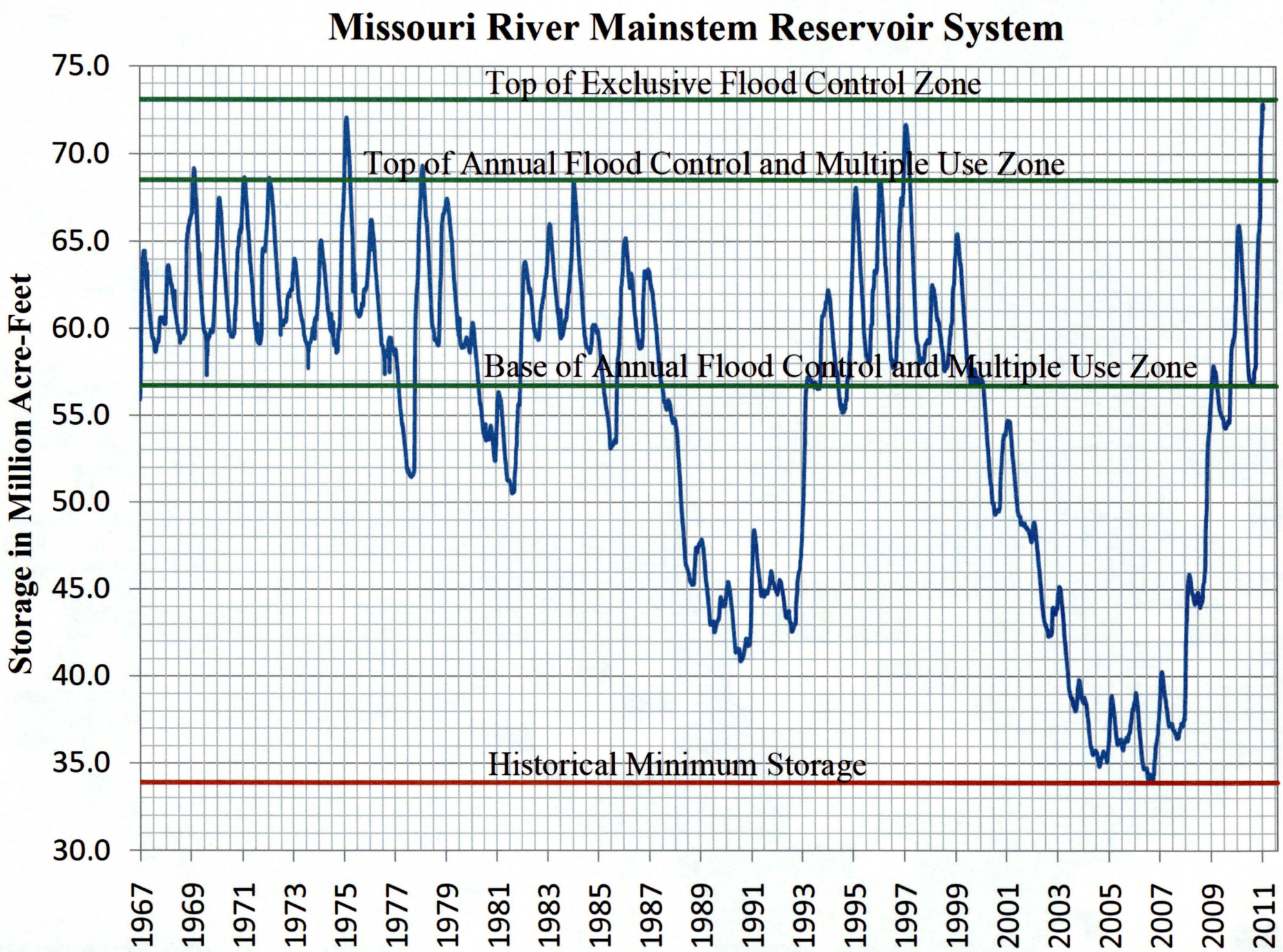
July 8, 2011

Provisional data. Subject to revision.

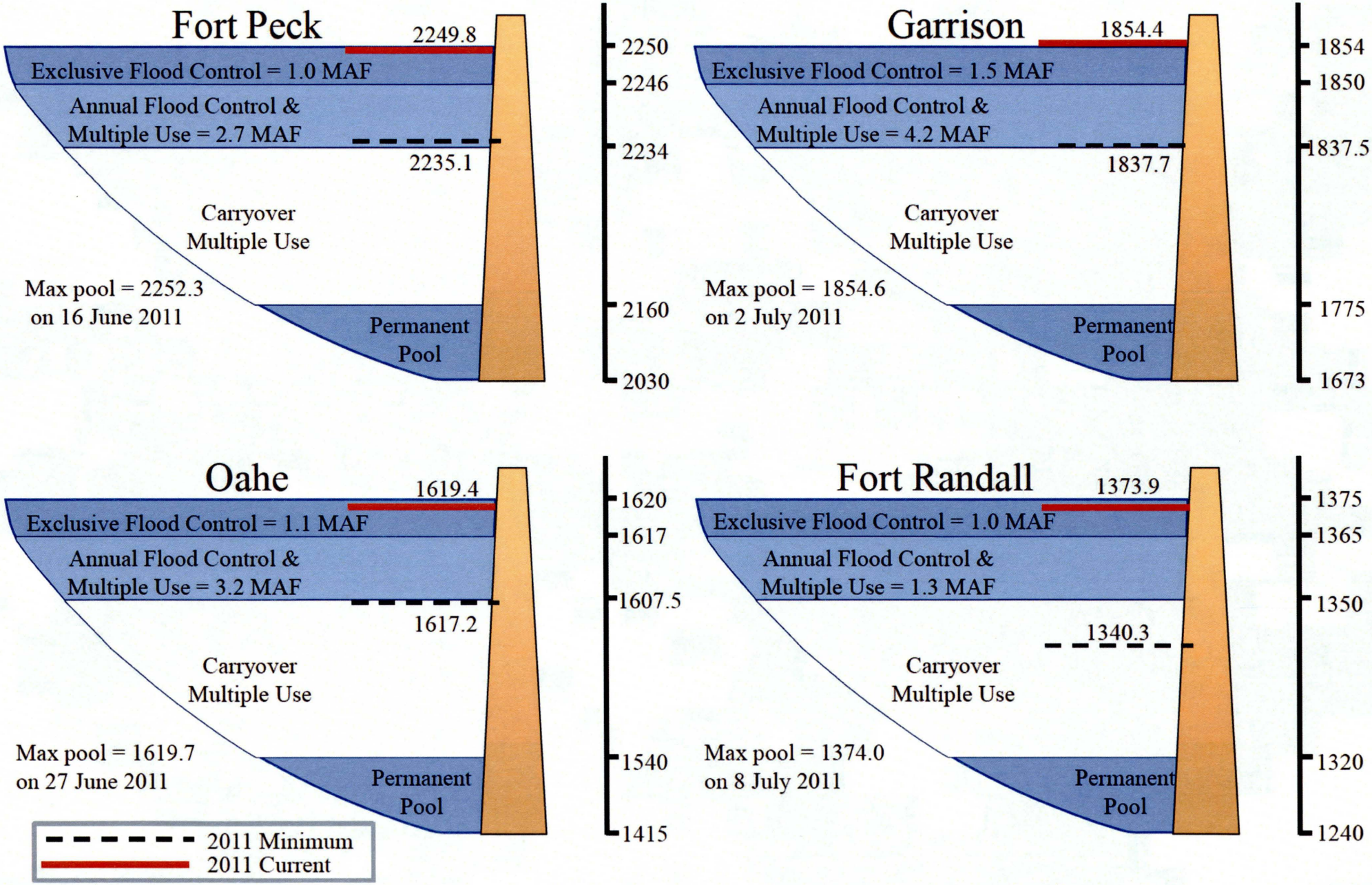

Missouri River Maintstem System Annual Runoff above Sioux City, IA
Million Acre-Feet
60
50
40
30
20
10
0
34.3 MAF -- U.D.
30.3 -- U.Q.
24.4 -- Med.
19.3 -- L.Q.
16.2 -- L.D.
10%
25%
50%
75%
90%
Year
1892
1895
1898
1901
1904
1907
1910
1913
1916
1919
1922
1925
1928
1931
1934
1937
1940
1943
1946
1949
1952
1955
1958
1961
1964
1967
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
Runoff Above Sioux City (Million Ac-ft)
Drought Years - Runoff Above Sioux City (Million Ac-ft)
2011 Forecast - Runoff above Sioux City (Million Ac-ft)
July 8, 2011

Missouri River Runoff above Sioux City
2011 Actual/Forecasted versus Normal



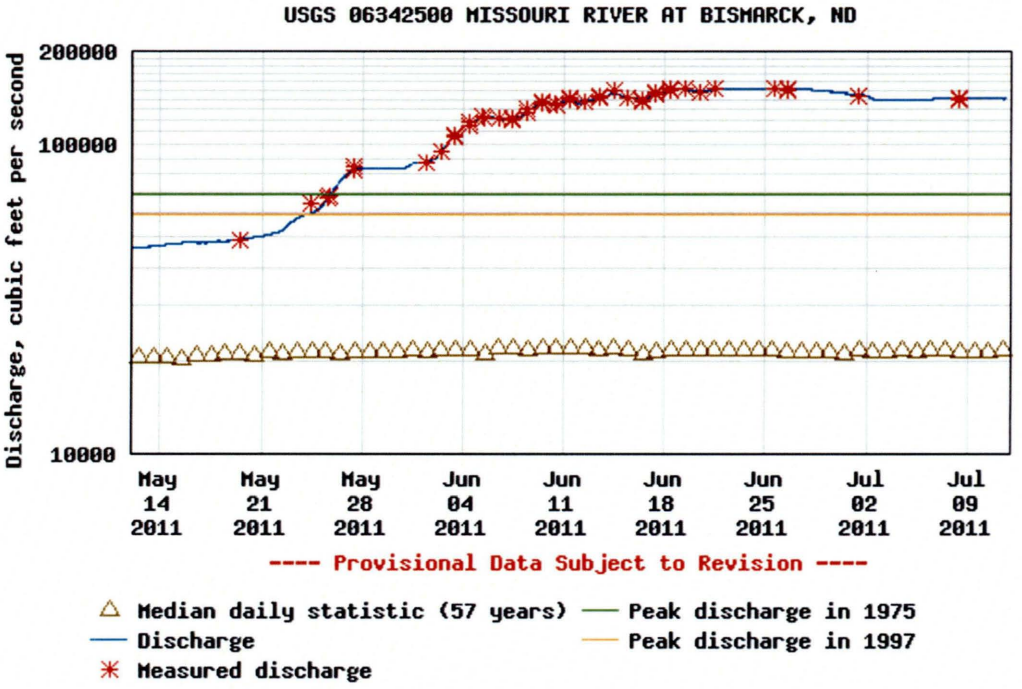

Missouri River Mainstem Reservoir System
Storage in Million Acre-Feet
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
Top of Exclusive Flood Control Zone
Top of Annual Flood Control and Multiple Use Zone
Base of Annual Flood Control and Multiple Use Zone
Historical Minimum Storage
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011

Mainstem Reservoir Levels
10 July 2011



Discharge, cubic feet per second

Most recent instantaneous value: 141,000 07-11-2011 13:15 CDT



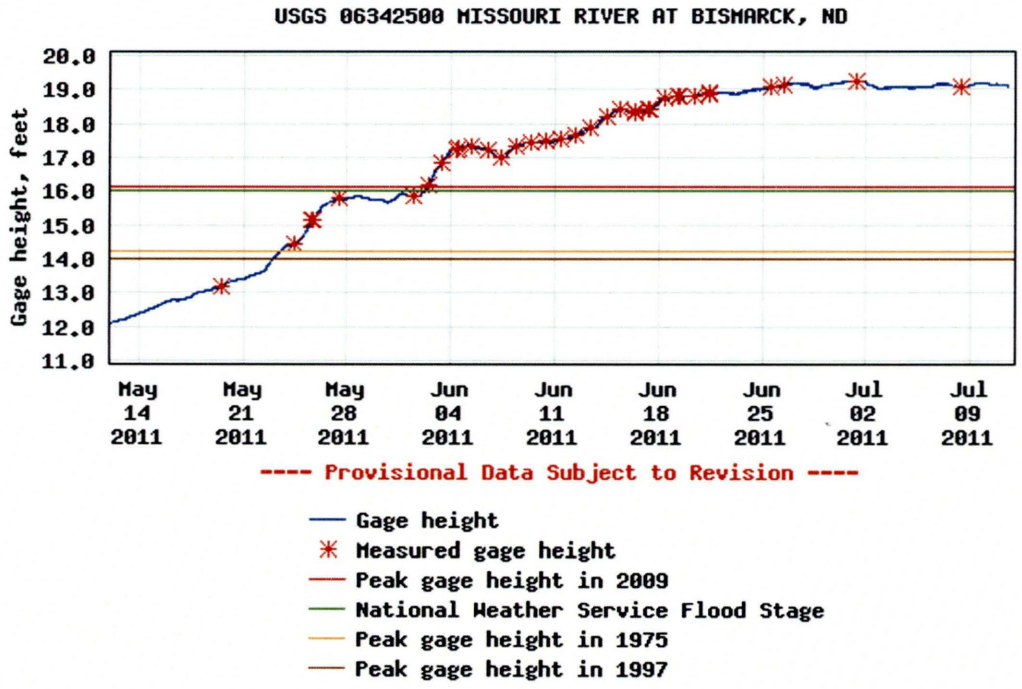
Create presentation-quality / stand-alone graph. Subscribe to WaterAlert

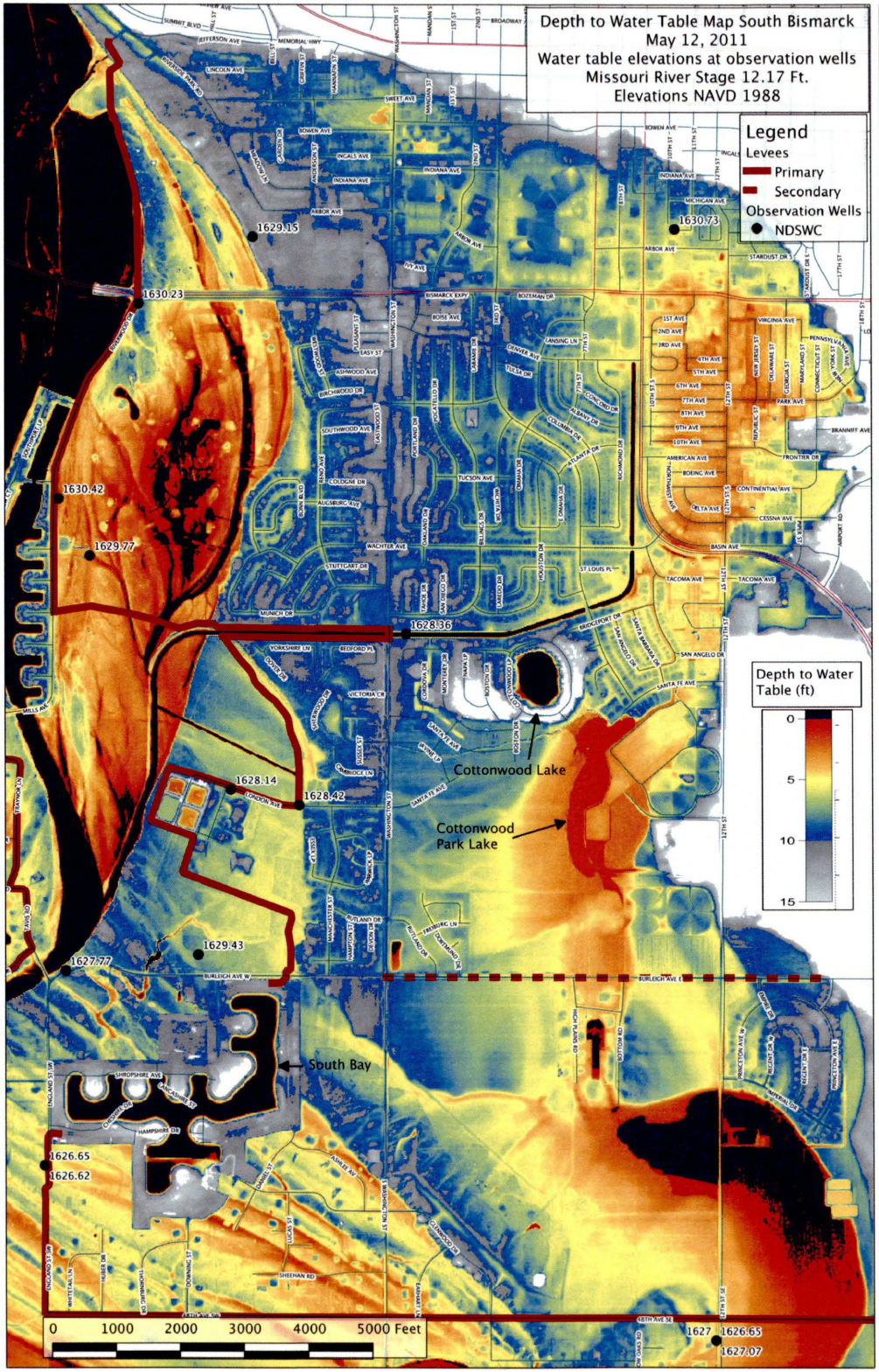
Daily discharge statistics, in cfs, for Jul 11 based on 57 years of record more

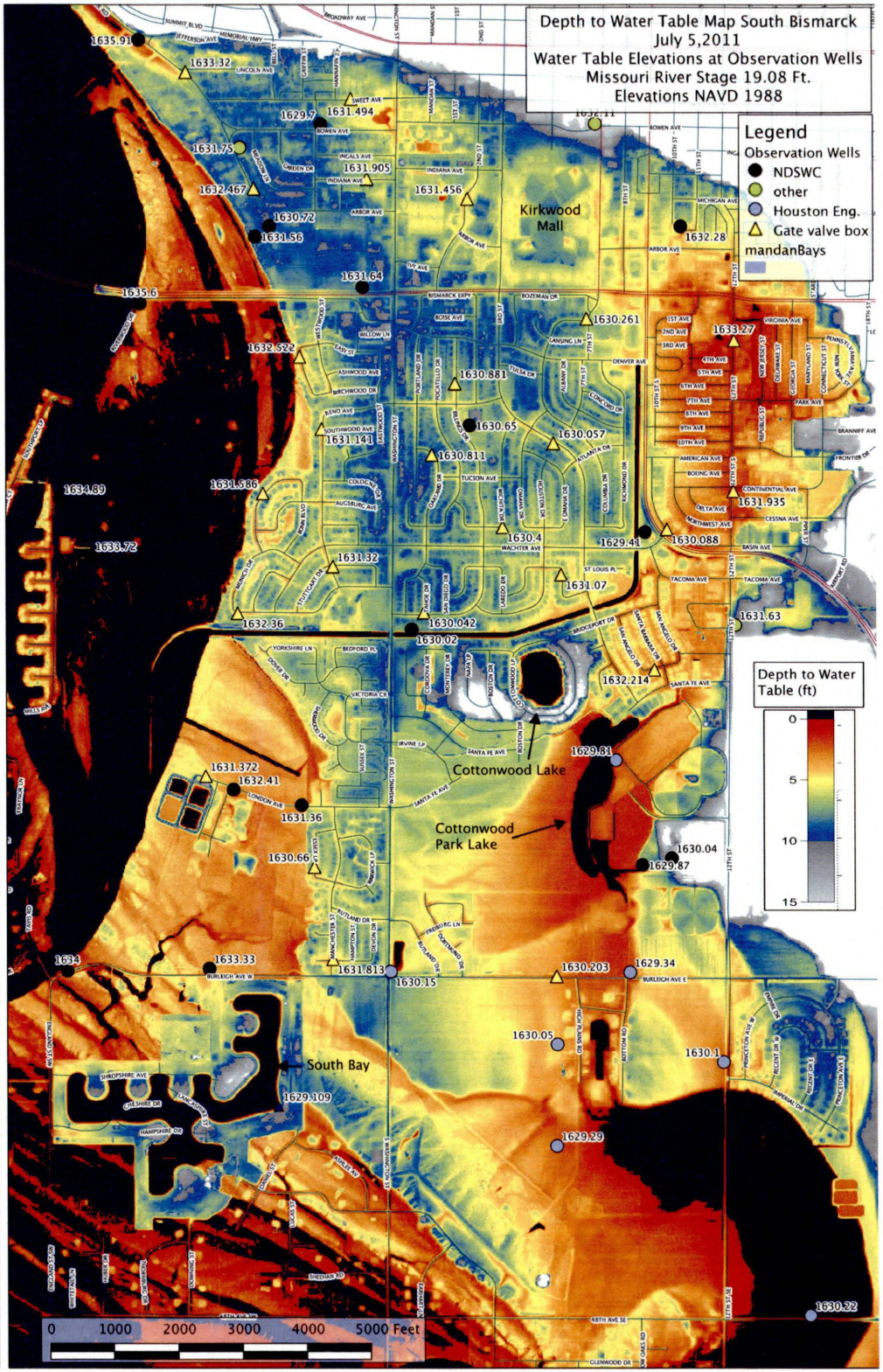
Min (1960)	25th percen-tile	Median	Mean	75th percen-tile	Max (1975)	Most Recent Instantaneous Value Jul 11
11000	17400	21600	24300	28900	67300	141000

Gage height, feet

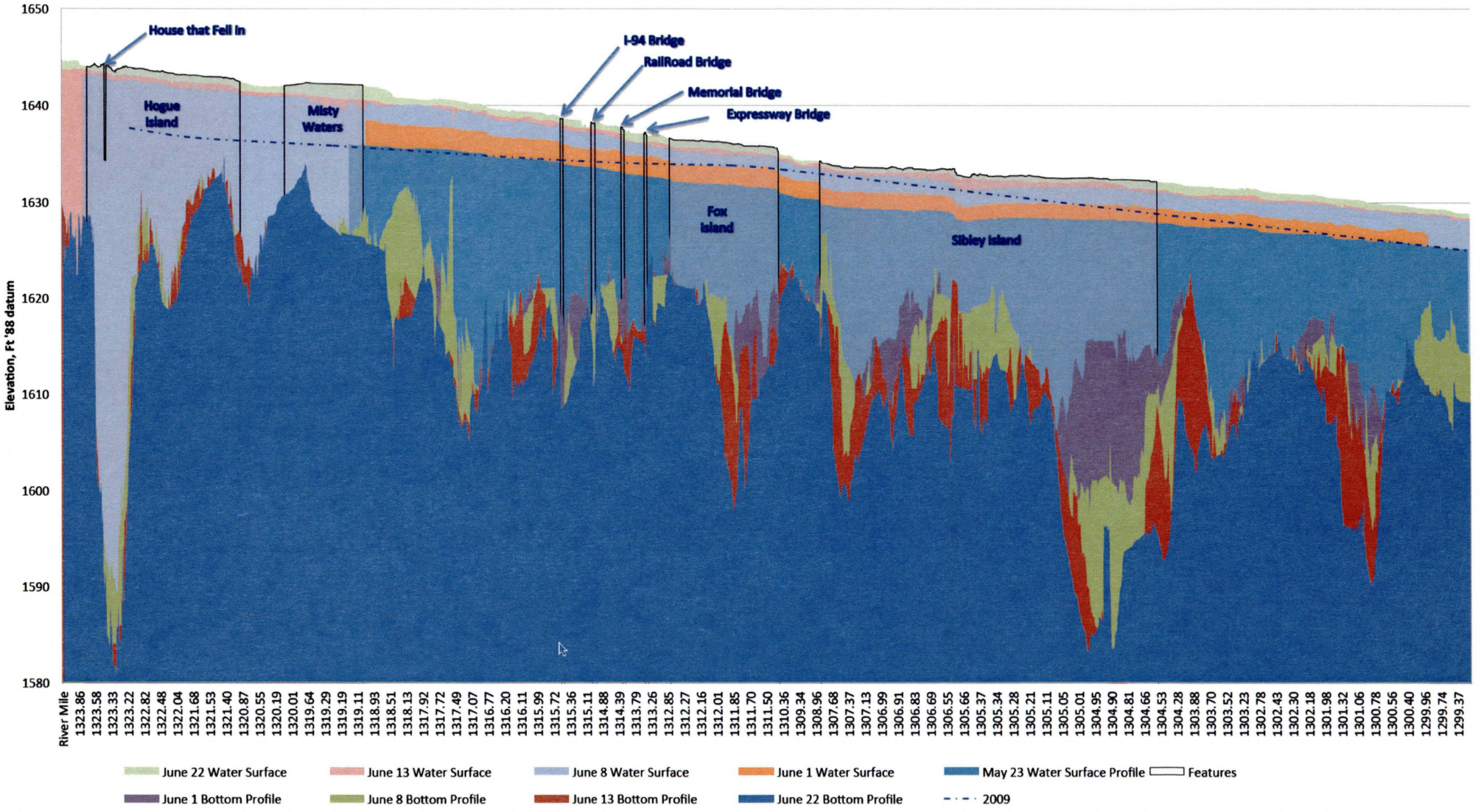
Most recent instantaneous value: 19.10 07-11-2011 13:15 CDT




Depth to Water Table Map South Bismarck
May 12, 2011
Water table elevations at observation wells
Missouri River Stage 12.17 Ft.
Elevations NAVD 1988
Legend
Levees
Primary
Secondary
Observation Wells
NDSWC
Depth to Water Table (ft)
0
5
10
15
Cottonwood Lake
Cottonwood Park Lake
South Bay
1629.15
1630.73
1630.23
1630.42
1629.77
1628.36
1628.14
1628.42
1629.43
1627.77
1626.65
1626.62
1627
1626.65
1627.07
0 1000 2000 3000 4000 5000 Feet


Depth to Water Table Map South Bismarck
July 5,2011
Water Table Elevations at Observation Wells
Missouri River Stage 19.08 Ft.
Elevations NAVD 1988
Legend
Observation Wells
NDSWC
other
Houston Eng.
Gate valve box
mandanBays
Depth to Water Table (ft)
0
5
10
15
Kirkwood Mall
Cottonwood Lake
Cottonwood Park Lake
South Bay
1635.91
1633.32
1629.7
1631.494
1631.75
1631.905
1632.467
1631.456
1630.72
1631.56
1632.28
1631.64
1635.6
1630.261
1633.27
1632.522
1630.881
1630.65
1630.057
1631.141
1630.811
1634.89
1631.586
1631.935
1633.72
1630.4
1629.41
1630.088
1631.32
1631.07
1632.36
1630.042
1630.02
1631.63
1632.214
1629.81
1631.372
1632.41
1631.36
1630.66
1630.04
1629.87
1634
1633.33
1631.813
1630.15
1630.203
1629.34
1630.05
1630.1
1629.109
1629.29
1630.22
0 1000 2000 3000 4000 5000 Feet

Missouri River Water/Bottom Profile through Bismarck/Mandan



State of North Dakota

Office of the State Engineer

900 EAST BOULEVARD AVE. • BISMARCK, ND 58505-0850
701-328-2750 • FAX 701-328-3696 • http://swc.nd.gov

April 20, 2011

Brigadier General John R. McMahon
Commander and Division Engineer
U.S. Army Corps of Engineers
1125 NW Couch St., Suite 500
Portland, OR 97209

RE: High Missouri River System Reservoir Levels

Dear Brigadier General McMahon:

I am concerned with the high levels of Lake Sakakawea and Lake Oahe, and the above normal snowpack that will be generating a great deal of additional runoff. We are concerned your forecast does not adequately address the current conditions in the basin and the potential for above normal precipitation this summer.

As of April 20, Lake Oahe had the second highest daily April elevation of 1616.8 feet, only to be exceeded in April 1997; and Lake Sakakawea had the third highest daily April elevation of 1845.1 feet, surpassed by April of 1972, and 1997. The mountain snowpack is well above average at 114% and the plains spring runoff is currently ongoing. The downstream discharges seem low compared to the mountain snowpack, and the current availability of flood storage.

I ask the Corps to limit the usage of the exclusive flood pools to only when absolutely necessary. We urge the Corps to be cognizant of impacts that high releases out of the dams have on channel erosion, and encourage the Corps to have enough foresight so the evacuation of water can be made in an orderly fashion and limit unnecessary peaking. I also ask the Corps to review the runoff forecast and ensure its accuracy.

I thank you for taking my concerns under consideration.

Sincerely,

Todd Sando, P.E.
State Engineer

TS:BE:KC:mmb/1392

North Dakota nd.gov Official Portal for North Dakota State Government

State Water Commission

Missouri River Issues

2011 Flooding Information Included in this area you will find the latest information related to Flooding issues along the Missouri River.

Background Missouri River background information and water management issues

News and Information

Water Data List of links to sites providing Missouri River water data

Studies and Reports Studies and reports related to the Missouri River

Missouri River Links List of links to sites related to the Missouri River

Devils Lake Update – July 8th 2011

- **Hydrologic Update**
    - Elevation of Devils Lake July 7th, 2011 is 1454.30 ft-msl
        - Current Volume of Lake is 4.17 M ac-ft , current area is 208,000 ac.
    - Apparent Peak and Record El. On June 27th was 1454.39 ft-msl
        - From January 1, 2011 to June 27th 2011 increase of 2.8 feet – increase in volume of 542,000 ac-ft and increase of 32,000 ac area.
    - Lake must rise 3.7 ft (to 1458.0) to spill from the natural outlet in Tolna Coulee
        - The volume inflow needed for spill is 864,000 ac-ft with an increase of area of 52,000 acres.
    - National Weather Service forecast indicates a 90% chance for a water level of 1454.3 ft, 50% chance for 1454.3 ft and 10% chance for 1454.5 ft. from now to September 29th
    - For May and June precipitation in Baker was 5.97 inches a 113% increase from average, Cando 4.52 inches a 86% reduction, Crary 4.92 inches a 82% reduction and Rolla 6.05 inches which is 106% increase from normal.
- **West Outlet Operation**
    - Operation of the outlet began on May 26th 2011 with a flow of 150 cfs. in increase in flow of 250 cfs began on June 8th and has continued to this date.
    - The sulfate concentration in the Sheyenne River below Baldhill Dam on June 28th was found to be 295 mg/L which is below the 450 mg/L constraint.
- **East End Outlet Project**
    - The east end outlet is being designed by Bartlett & West /AECOM. The outlet will have a 350 cfs capacity. The date of completion of the project is scheduled on June 1, 2012, which will require winter construction.

- At this time 18,075 feet of 96 -inch diameter reinforced concrete pipe is to be awarded to Cretex Concrete Products. The award of 1,275 feet of high pressure steel pipe is pending.

- The total project cost is estimated to be $40M to $80M.

- Besides the Pipe contract (1) there will also be contracts for pumps (2), valves (3), clearing and grubbing (4), pipe installation (5), Intake pump station and outlet structure (6).

- Contracts 4 and 5 will require pre-qualifications of contractors.

- The power company will be chosen soon from Nodak or Ottertail.

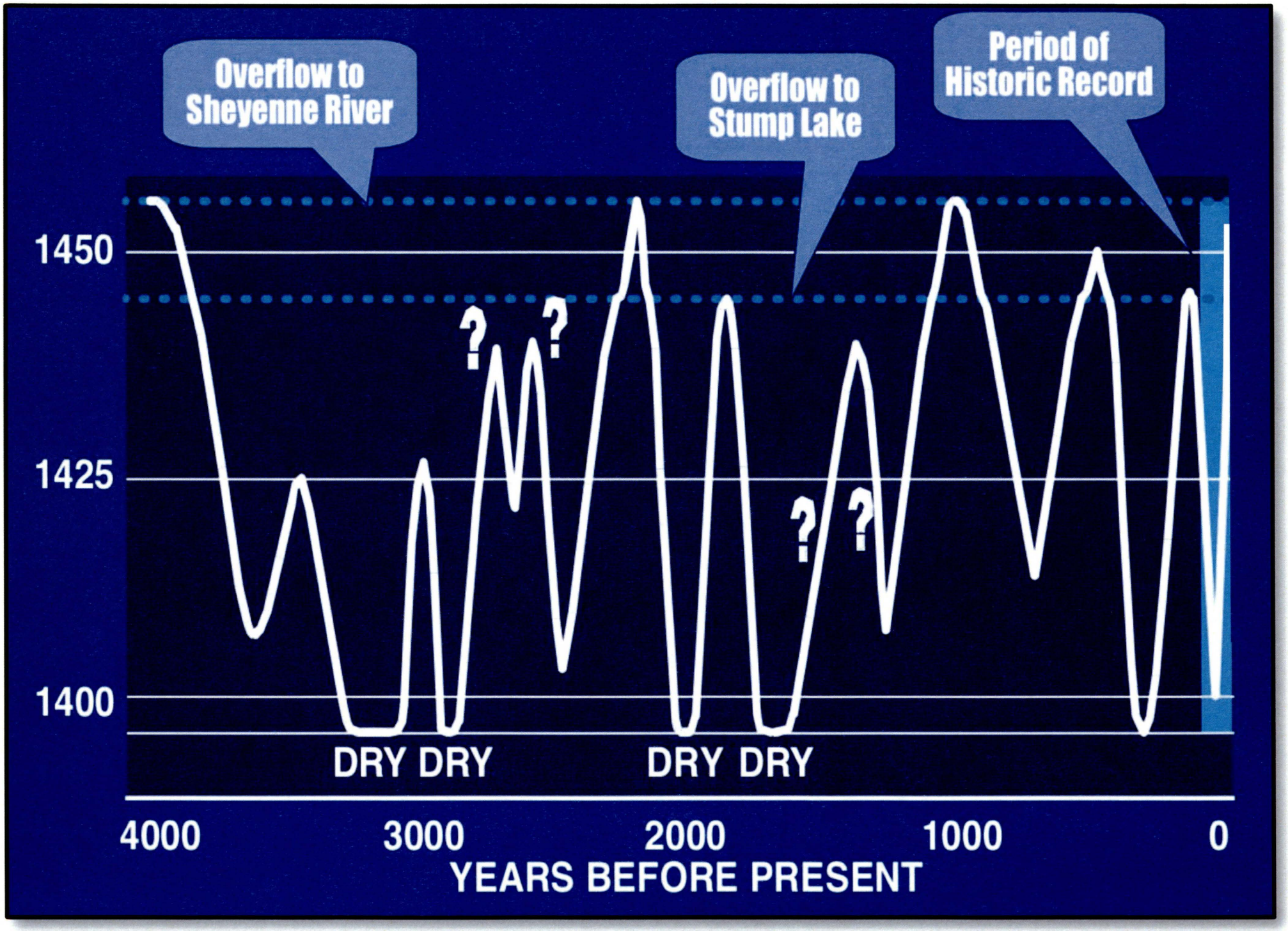
- Land acquisitions are being completed by Bartlett & West. A cultural resource field study has been completed

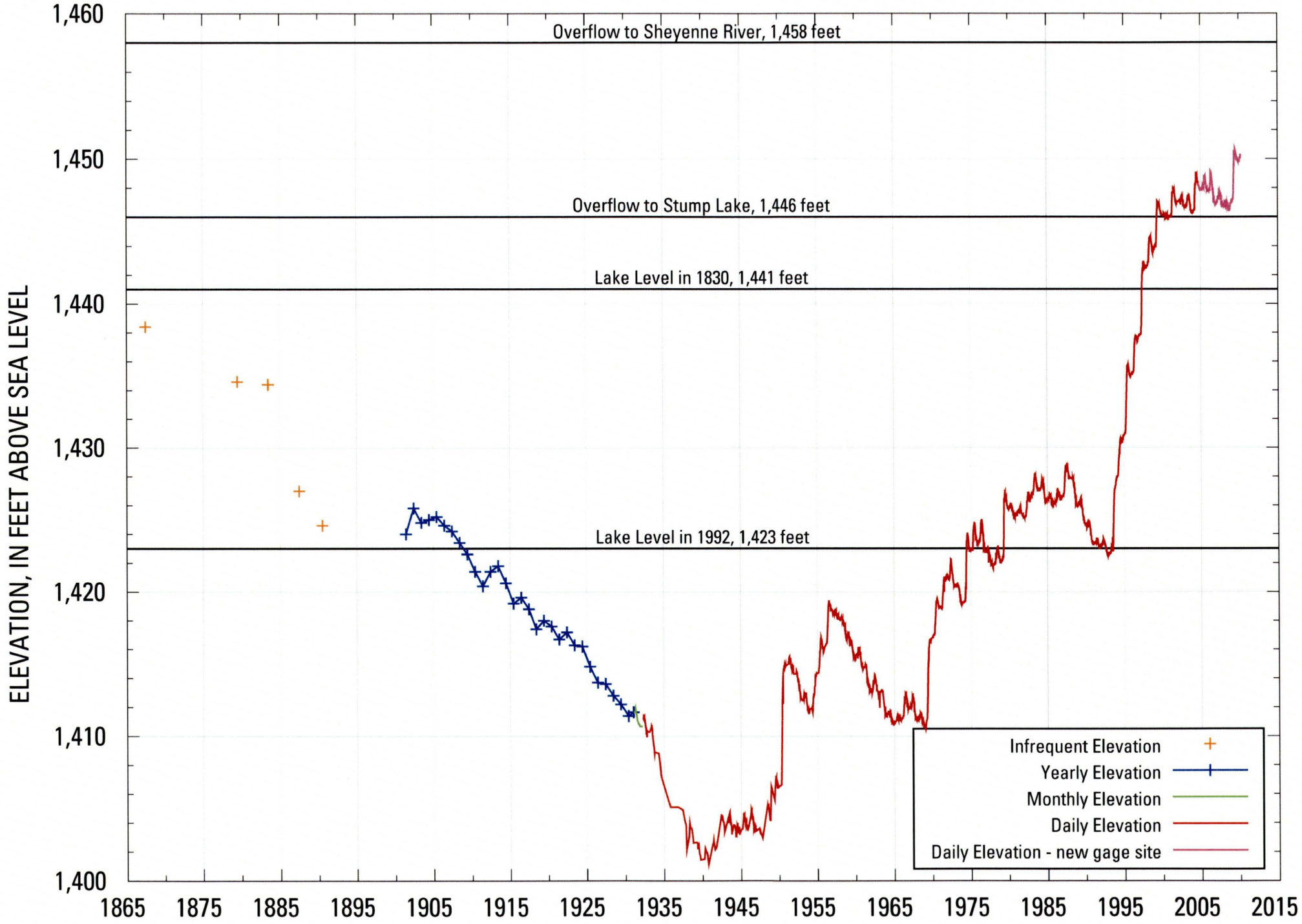
- **Tolna Coulee Sediment and Control Structure**

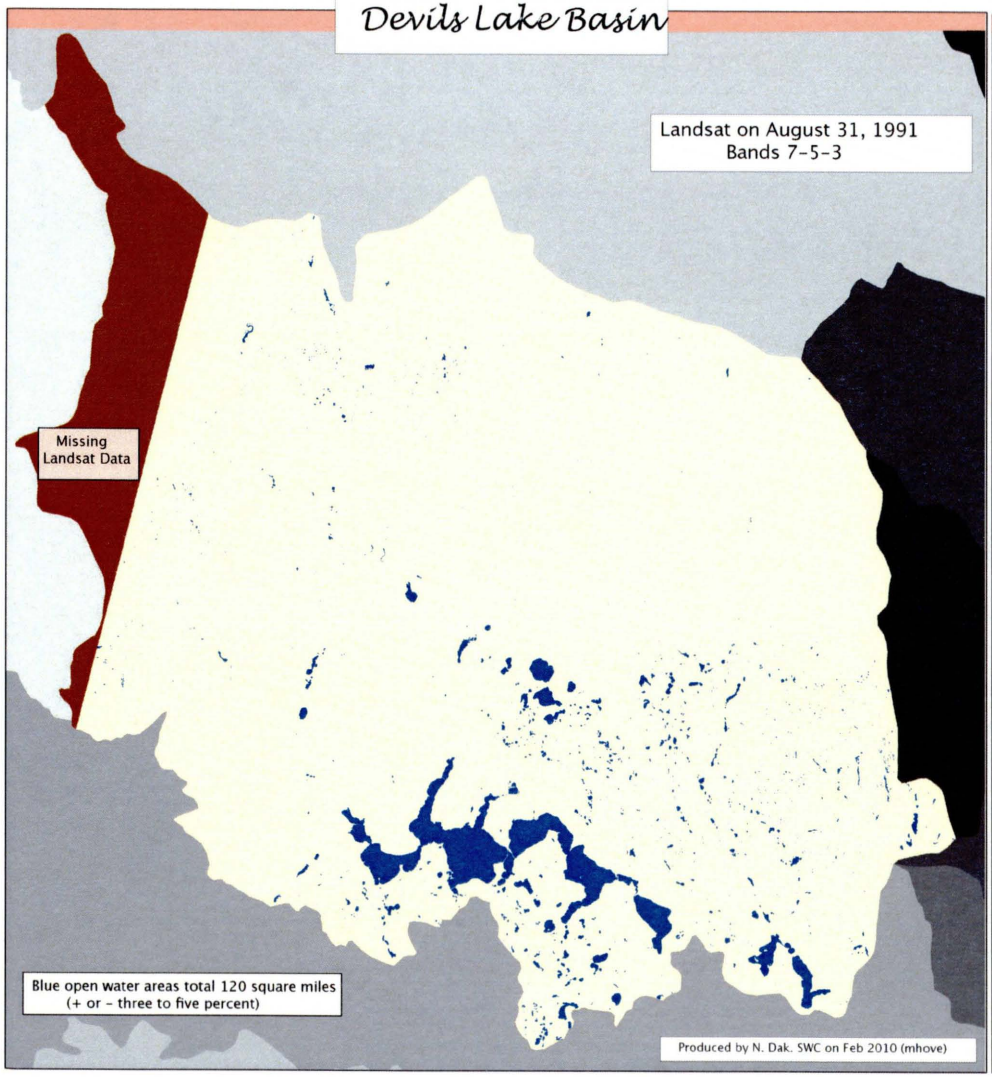
  - The ruling that Tolna Coulee sediment since statehood was one foot is being reexamined by the North Dakota Geological Survey and State Water Commission.

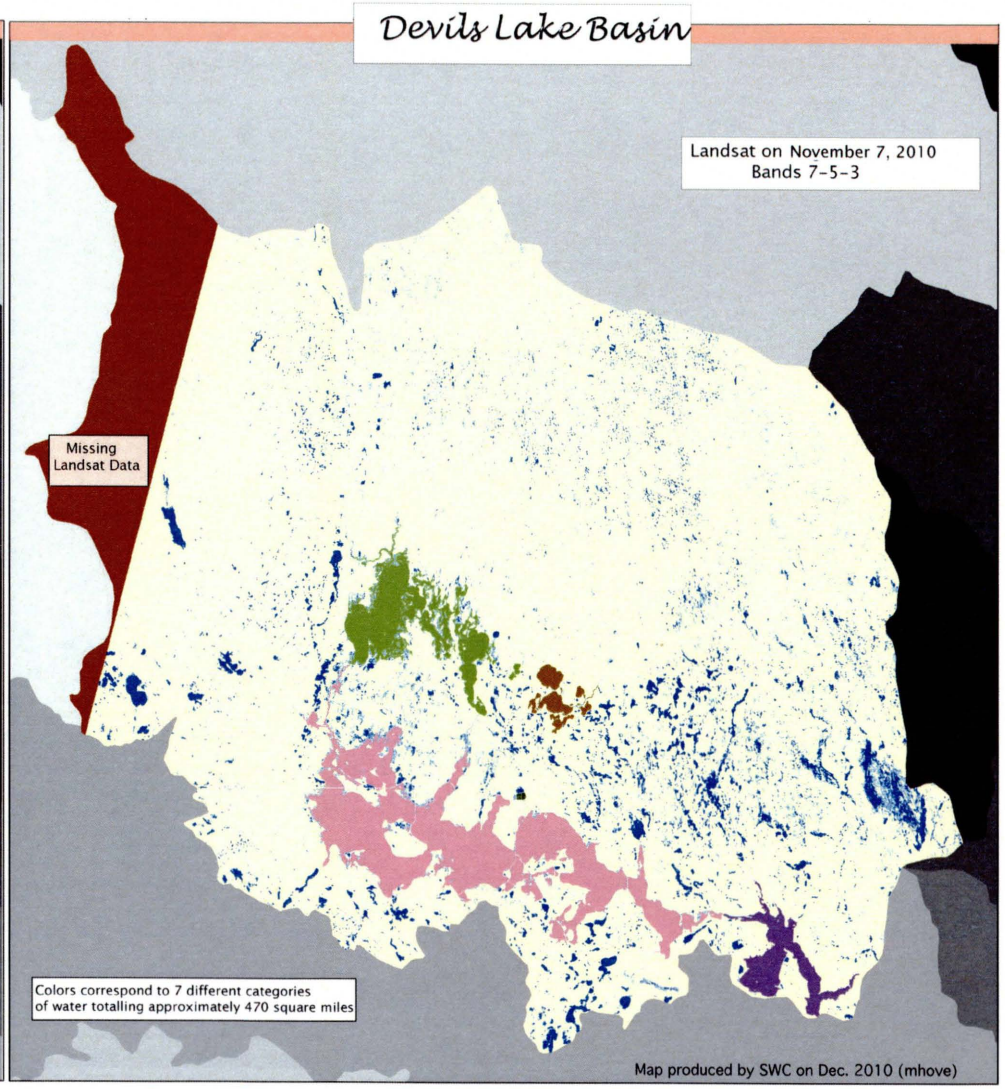
  - The Corps of Engineers control structure design is 95% complete at this time.

  - The cost estimate from the Corps on June 20th was $9.1M. This estimate has not been updated at this time.


Overflow to Sheyenne River
Overflow to Stump Lake
Period of Historic Record
1450
1425
1400
? ?
? ?
DRY DRY
DRY DRY
4000
3000
2000
1000
0
YEARS BEFORE PRESENT


Overflow to Sheyenne River, 1,458 feet
Overflow to Stump Lake, 1,446 feet
Lake Level in 1830, 1,441 feet
Lake Level in 1992, 1,423 feet
ELEVATION, IN FEET ABOVE SEA LEVEL
1,460
1,450
1,440
1,430
1,420
1,410
1,400
1865
1875
1885
1895
1905
1915
1925
1935
1945
1955
1965
1975
1985
1995
2005
2015
Infrequent Elevation
Yearly Elevation
Monthly Elevation
Daily Elevation
Daily Elevation - new gage site

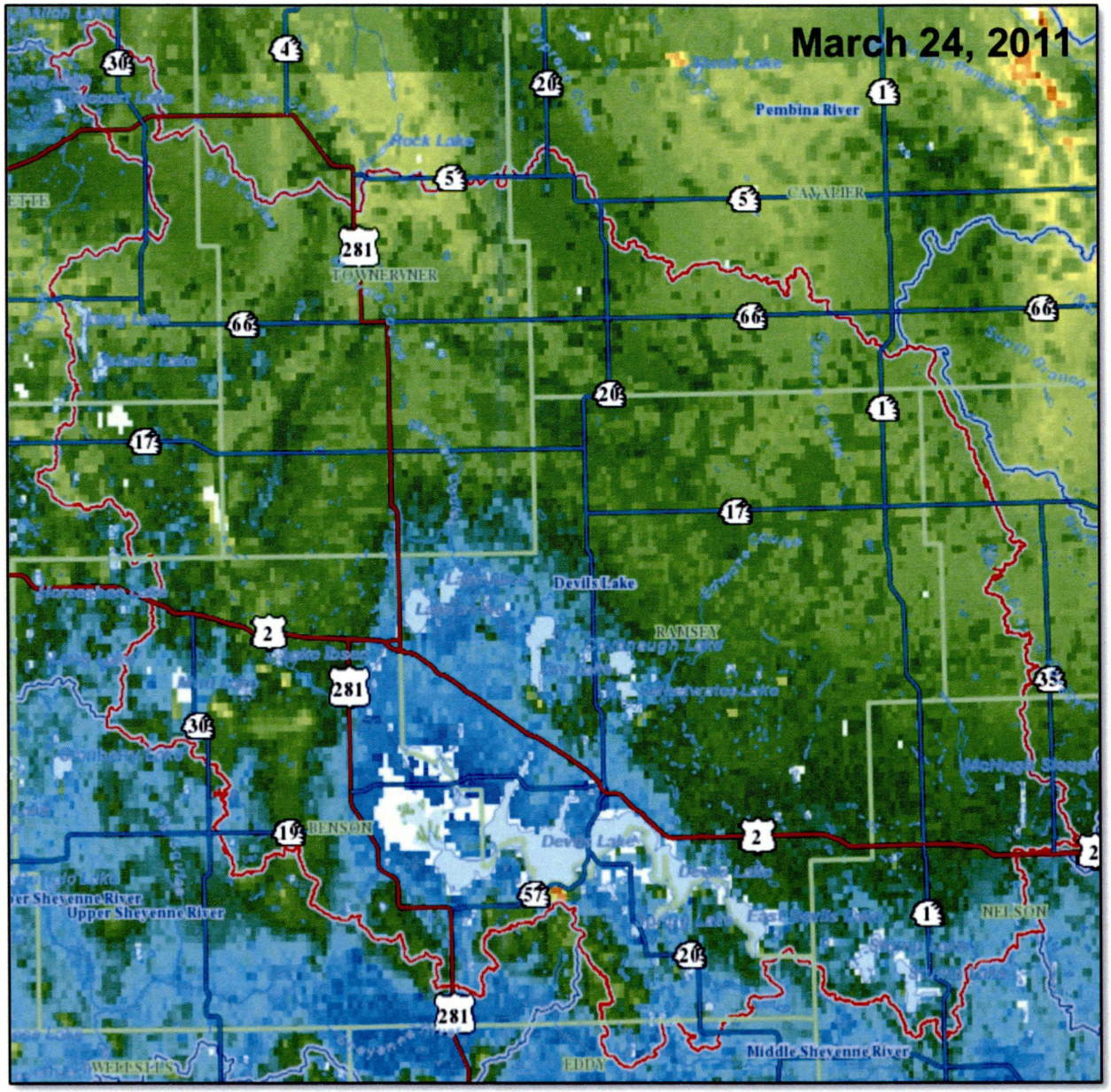

Devils Lake Basin
Landsat on August 31, 1991
Bands 7-5-3
Missing
Landsat Data
Blue open water areas total 120 square miles
(+ or - three to five percent)
Produced by N. Dak. SWC on Feb 2010 (mhove)


Devils Lake Basin
Landsat on November 7, 2010
Bands 7-5-3
Missing
Landsat Data
Colors correspond to 7 different categories
of water totalling approximately 470 square miles
Map produced by SWC on Dec. 2010 (mhove)

The Devils Lake Basin: Current Moisture Conditions

March 24, 2011
Volume: 837,230 acre-feet
Average Moisture Depth: 4.09”
Minimum Moisture Depth: 0.55”
Maximum Moisture Depth: 7.48”

March 20, 2009
Volume: 741,775 acre-feet
Average Moisture Depth: 3.62”
Minimum Moisture Depth: 0”
Maximum Moisture Depth: 5.59”



TOLNA COULEE ISSUES

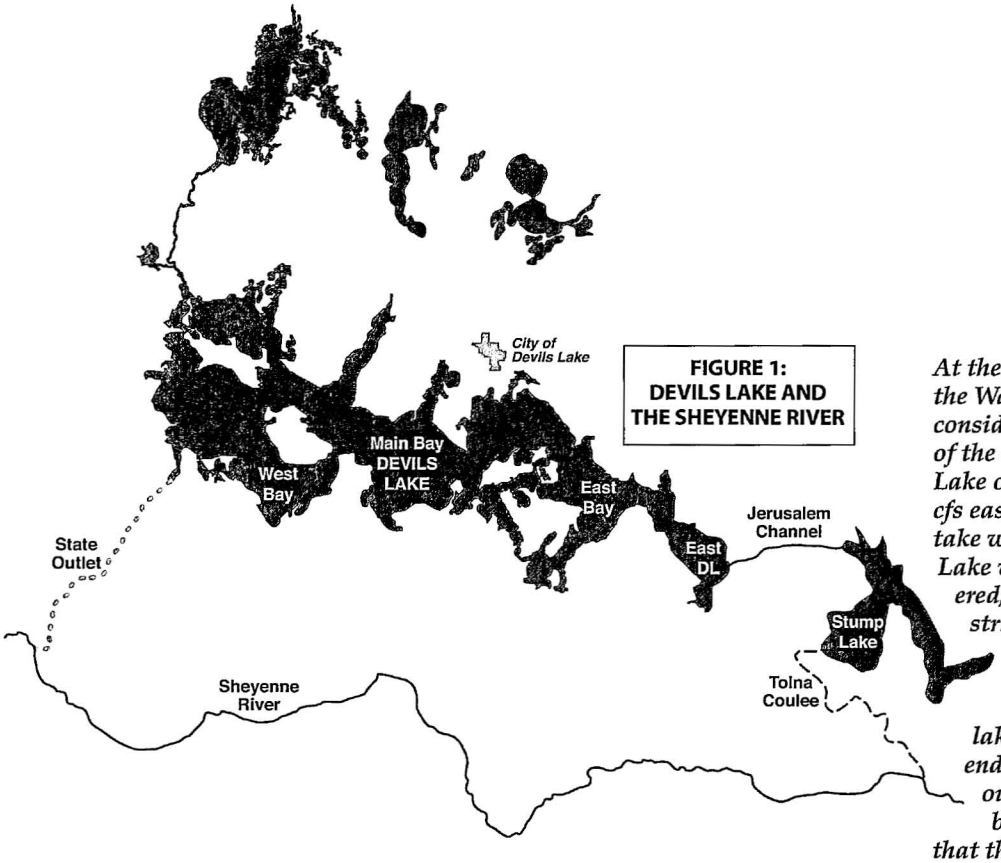


FIGURE 1: DEVILS LAKE AND THE SHEYENNE RIVER

At the time this was written, the Water Commission was considering a 100 cfs expansion of the existing west end Devils Lake outlet. In addition, a 250 cfs east end outlet that would take water from East Devils Lake was also being considered; along with a control structure on Tolna Coulee to limit discharge, while allowing natural erosion to occur, should the lake spill. Both the west end expansion and east end outlet were being pursued because it was expected that they could be operated without exceeding water quality standards on the Sheyenne River.

BACKGROUND

One of the most urgent water management challenges facing North Dakota for nearly two decades has been the ongoing flooding crisis in the Devils Lake basin. Since Devils Lake began its most recent historic rise back in 1993, from an elevation of 1422.6 feet (above mean sea level), it has risen about 30 feet, and has inundated hundreds of square miles of land.

In its natural condition, Devils Lake is a closed basin lake until it reaches an elevation of 1458 feet, where it naturally spills from Stump Lake, through Tolna Coulee, and into the Sheyenne River (see Figure 1). Should this ever occur, there exists the potential for tremendous damages to downstream communities and the aquatic environment.

The Flood Fight

To combat the lake's relentless rise and to reduce the risk of a natural overflow, the State of North Dakota, in cooperation with various local and federal agencies and organizations, has worked to implement a three-pronged flood-fighting strategy. This three pronged approach has included the storage of water in upper portions of the basin to prevent it from causing additional flood damages around the lake; the implementation of infrastructure protection efforts - including dams, levees, roadway raises, and structure relocations; and finally, an outlet from the west end of Devils Lake to the Sheyenne River.

In August 2005, construction on a state-sponsored emergency Devils Lake outlet was completed. The outlet was originally built with an operational capacity of 100 cubic feet per second (or cfs). However, in June 2010, the state completed a major expansion to the outlet, increasing its capacity to 250 cfs. The outlet will be in operation again in 2011.

The SWC analyzed a range of additional emergency outlet alternative routes in 2010. Given the urgent need to move Devils Lake floodwater, the East Devils Lake outlet to the Tolna Coulee has been judged the most viable alternative. Design is underway with project completion set for 2012. Modification of the natural outlet at Stump Lake through Tolna Coulee to the Sheyenne River was among the options considered, but is plagued with

many issues. Impediments include federal regulations, international treaties, and litigation. The East Devils Lake outlet accomplishes the goal of moving floodwater from Devils Lake in a controlled fashion, while being the least problematic to implement quickly.

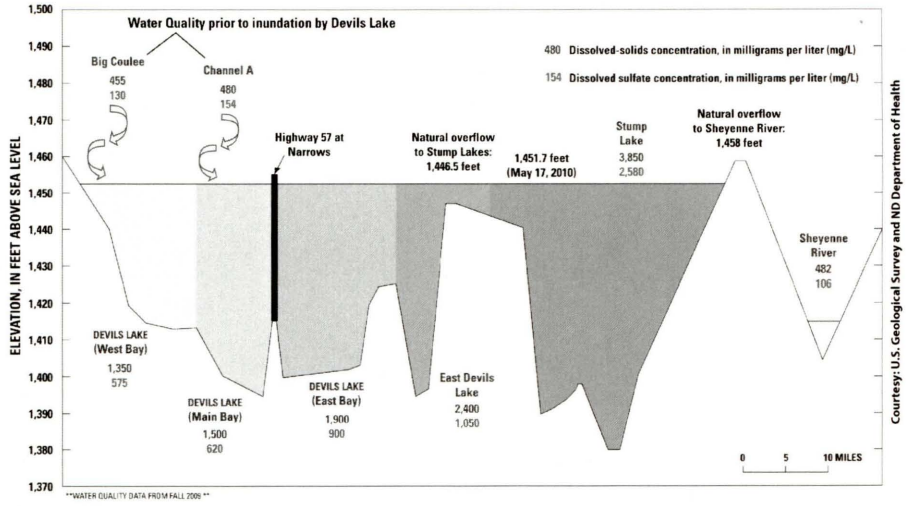


FIGURE 2: CROSS-SECTION OF THE DEVILS LAKE SYSTEM SHOWING WATER QUALITY DIFFERENCES

TOLNA COULEE ISSUES

Water quality has always made the development of any outlet from Devils Lake challenging, because of the difference in water quality between Devils Lake and the Sheyenne River. This issue was even challenged in court, when a lawsuit was brought against the state by the People to Save the Sheyenne, and the Province of Manitoba. However, Southeast District Court and North Dakota Supreme Court rulings in 2004 and 2005, respectively, ruled that the state had complied with water standards. To even further complicate the water quality issue is the fact that water quality within Devils Lake itself, varies greatly from west to east (See Figure 2).

The following are among the reasons that prevent the State of North Dakota from building an emergency outlet at Stump Lake via Tolna Coulee:

- Concentrations of Selenium and Cadmium are present in Stump Lake at levels that would result in water quality violations downstream for those trace minerals. With the United States Environmental Protection Agency's near-zero tolerance for trace minerals, this is an impossible obstacle to overcome.

- There is a sulfate concentration limit of 750 milligrams per liter (mg/L) on the upper Sheyenne River. From Figure 2, note that sulfate concentrations in Stump Lake are the highest in the Devils Lake system, in excess of 2,500 mg/L. If the state were to discharge water via an outlet from Stump Lake to the Sheyenne River, sulfate concentrations in the Sheyenne River would exceed 750 mg/L, and the state would be in violation of the water quality standard for sulfates.

- Even if water from Stump Lake were to be blended with higher quality water from the new East Devils Lake outlet, the sulfate, Selenium, and Cadmium concentrations present in Stump Lake are at high enough levels that they would still cause water quality violations downstream of a blended outlet.

- The State of Minnesota and the Province of Manitoba have both agreed that it is imperative for North Dakota to implement measures to prevent a natural overflow of Devils Lake. However, Minnesota and Manitoba have also expressed their opposition to the release of water from Stump Lake via an outlet.

- Manitoba has frequently pointed out that North Dakota is bound by the Boundary Waters Treaty Act of 1909, that among other things, says waters on one side of the border shall not be negatively impacted so as to cause injury of health or property on the other side. This issue has been raised because flows from Devils Lake to the Sheyenne and Red Rivers ultimately reach Canada.

As a final point, it is important to note that while any combination of outlets will reduce the risk of a natural overflow and the resulting impacts, no combination of the planned outlets will guarantee that a natural overflow can be prevented.

In addition, the Water Commission understands that there may be impacts resulting from operation of Devils Lake outlets. For that reason, a mitigation plan is being developed to address potential problems.

Comments or questions on this fact sheet, or regarding Devils Lake in general can be directed to the Water Development Division of the Water Commission at 701-328-2752, or e-mail bengelhardt@nd.gov.

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The North Dakota Department of Health and U.S. Geological Survey also contributed to the development of this fact sheet.

State Water Commission

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