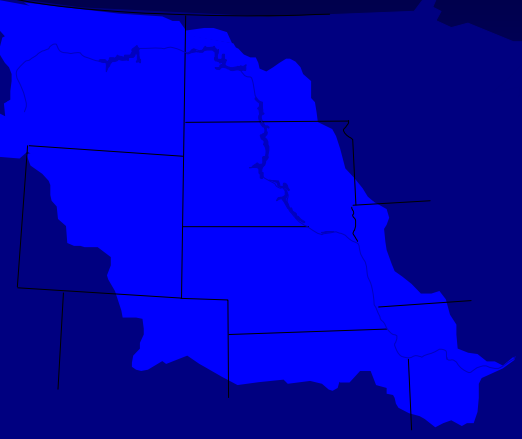
Missouri River Basin
RCC
Since 1954
Water Management Division

US Army
Corps of Engineers

Missouri River Mainstem System



Spring 2009 AOP Meetings

April 6, 2009	*7 p.m.*	*Fort Peck, Montana*
April 7, 2009	*1 p.m.*	*Bismarck, North Dakota*
April 7, 2009	*6 p.m.*	*Fort Pierre, South Dakota*
April 8, 2009	*1 p.m.*	*Jefferson City, Missouri*
April 8, 2009	*6 p.m.*	*Kansas City, Missouri*
April 9, 2009	*1 p.m.*	*Nebraska City, Nebraska*

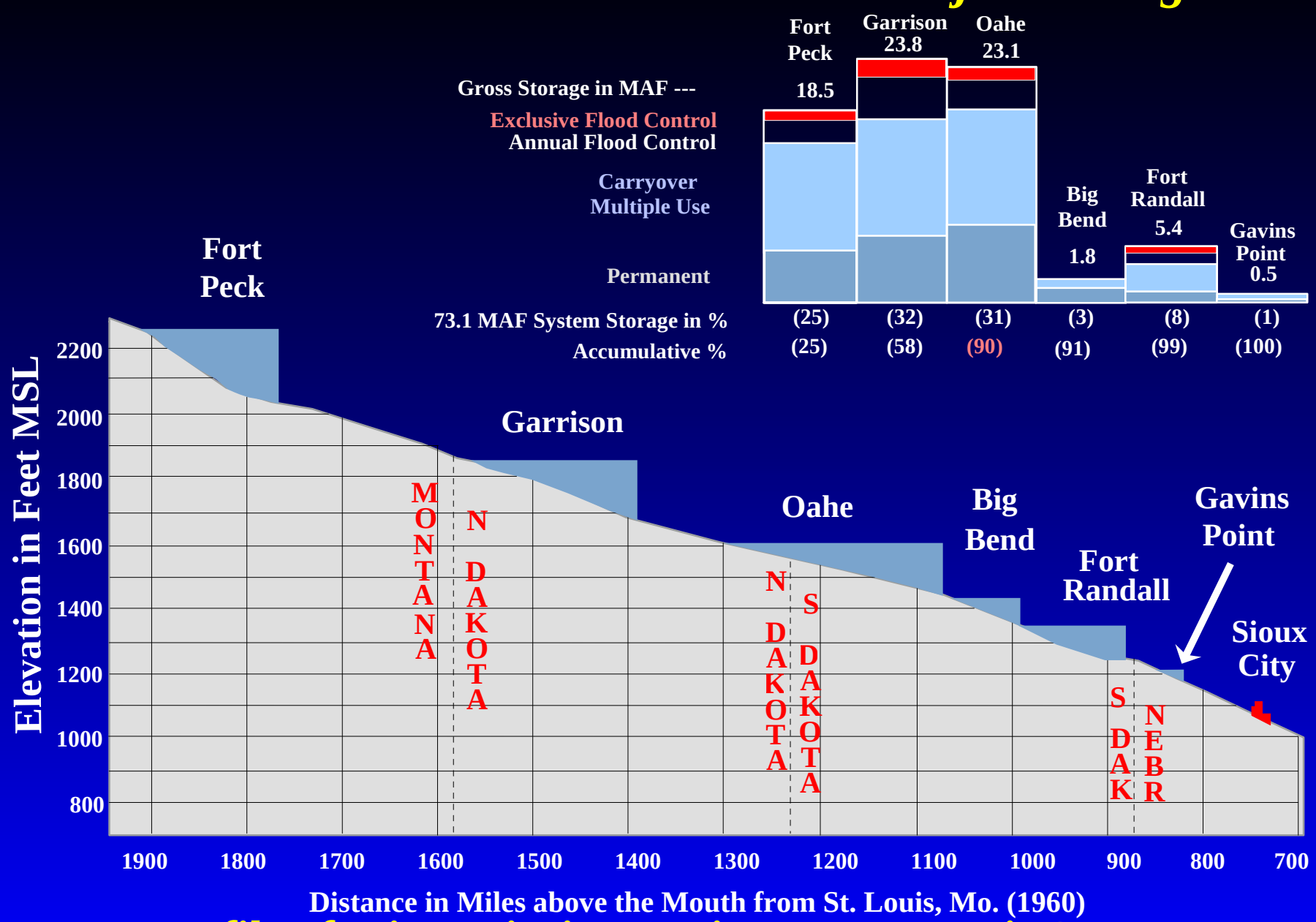
Off Duty Hours Telephone Contact 402-659-7170

Missouri River Mainstem System

US Army
Corps of Engineers

Water Management Office, 12565 West Center Road, Omaha, NE 68144-3869
Internet Address: http://www.nwd-mr.usace.army.mil/rcc

Mainstem Project Storage

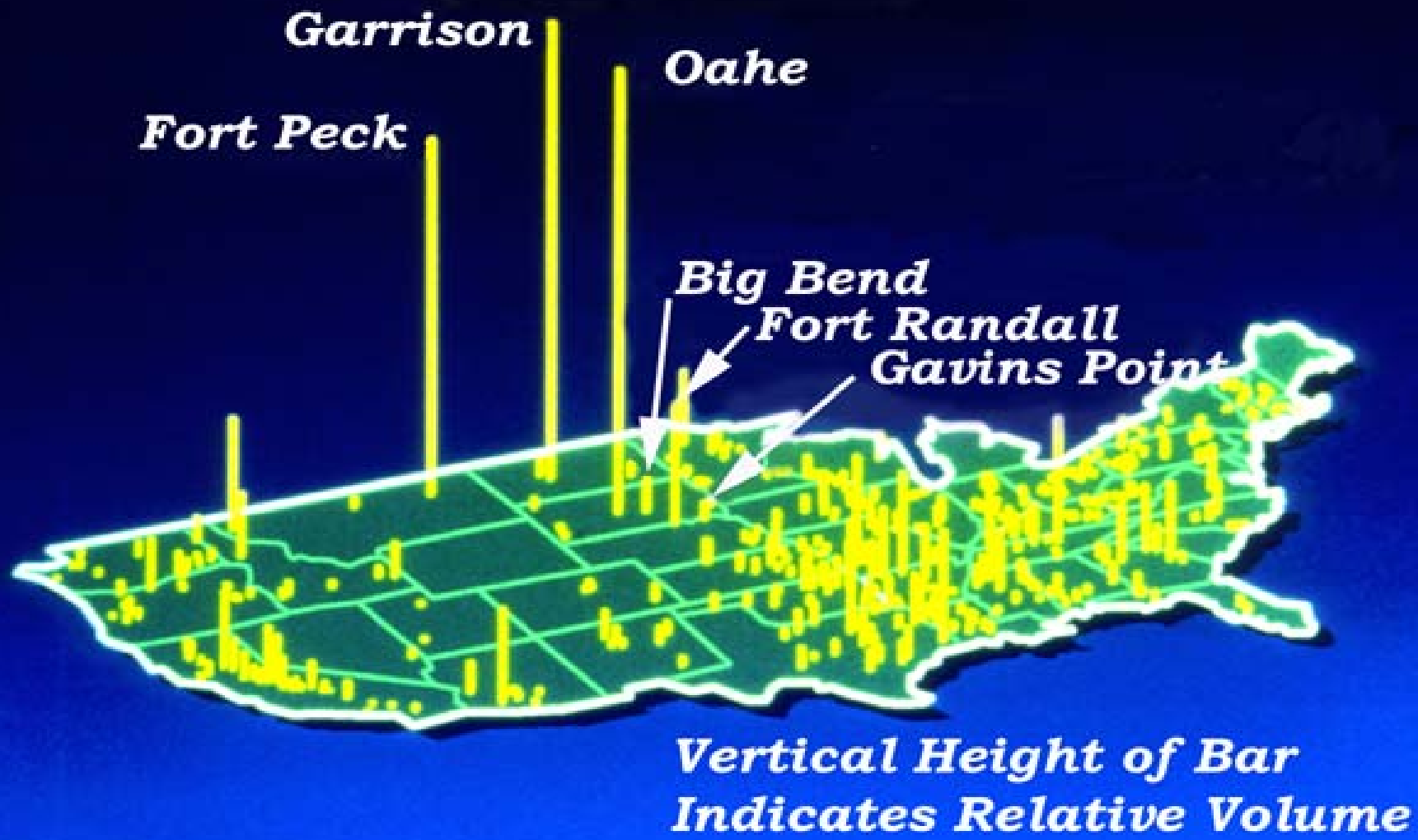


Profile of Missouri River Mainstem Reservoir System

Mainstem System Congressionally Authorized Project Purposes

Flood Control
Navigation
Hydroelectric Power
Irrigation
Water Supply and Water Quality
Recreation
Fish and Wildlife
- Endangered Species

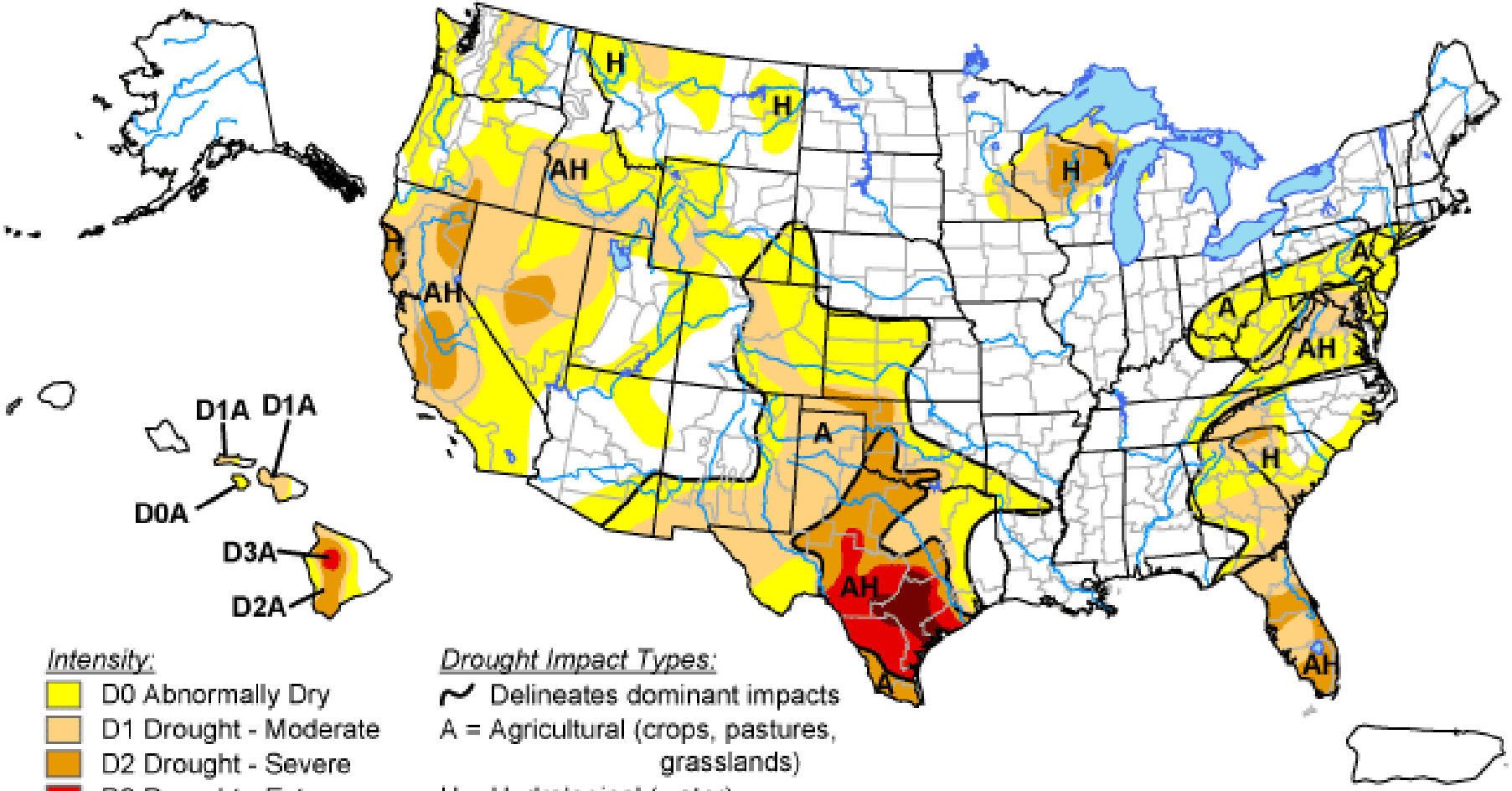
Storage Capacity of Corps Reservoirs



Over 550 Corps of Engineer Reservoirs

U.S. Drought Monitor

March 31, 2009
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

Released Thursday, April 2, 2009

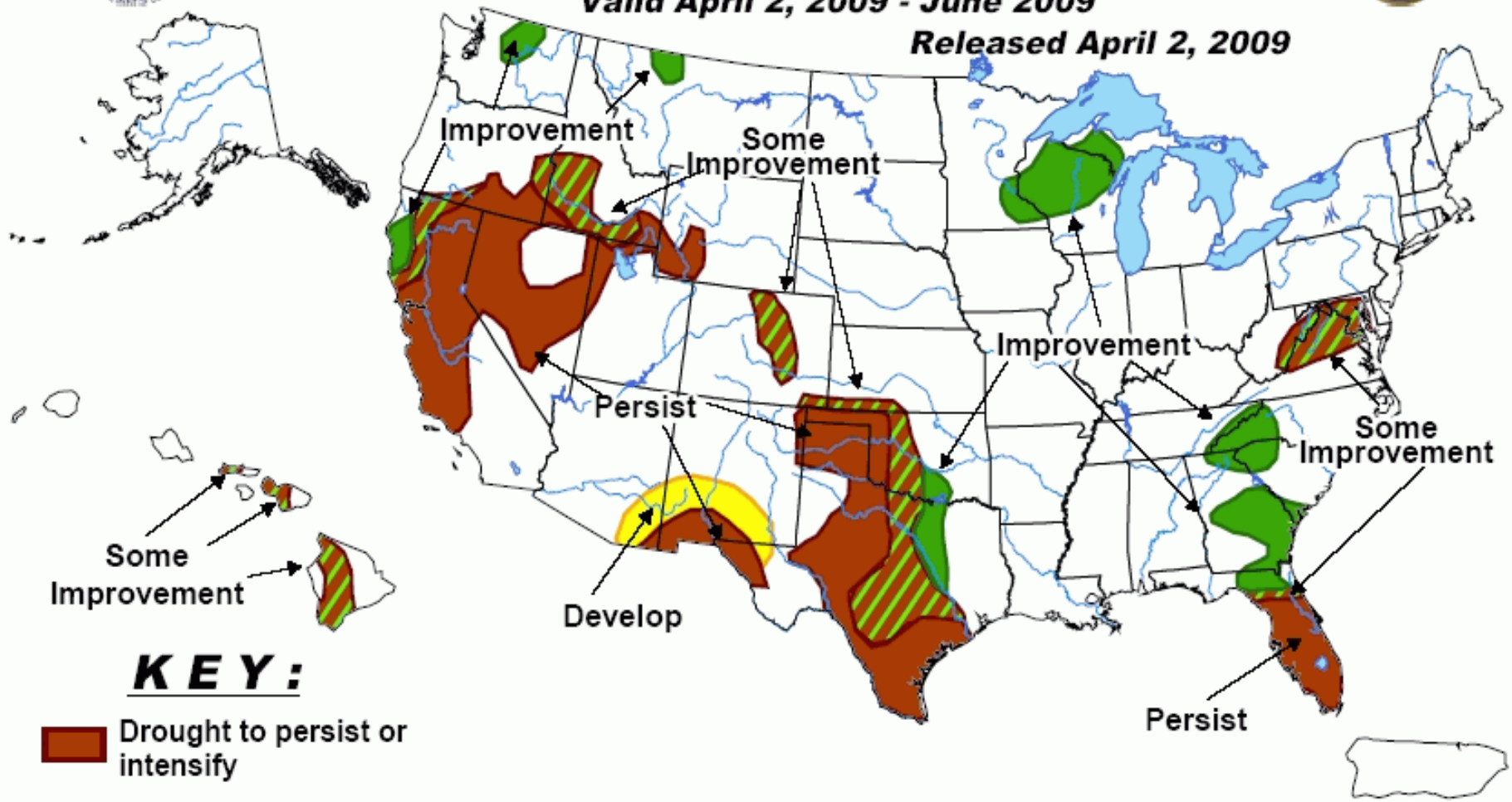
Author: Mark Svoboda, National Drought Mitigation Center

U.S. Seasonal Drought Outlook

Drought Tendency During the Valid Period

Valid April 2, 2009 - June 2009

Released April 2, 2009



KEY:

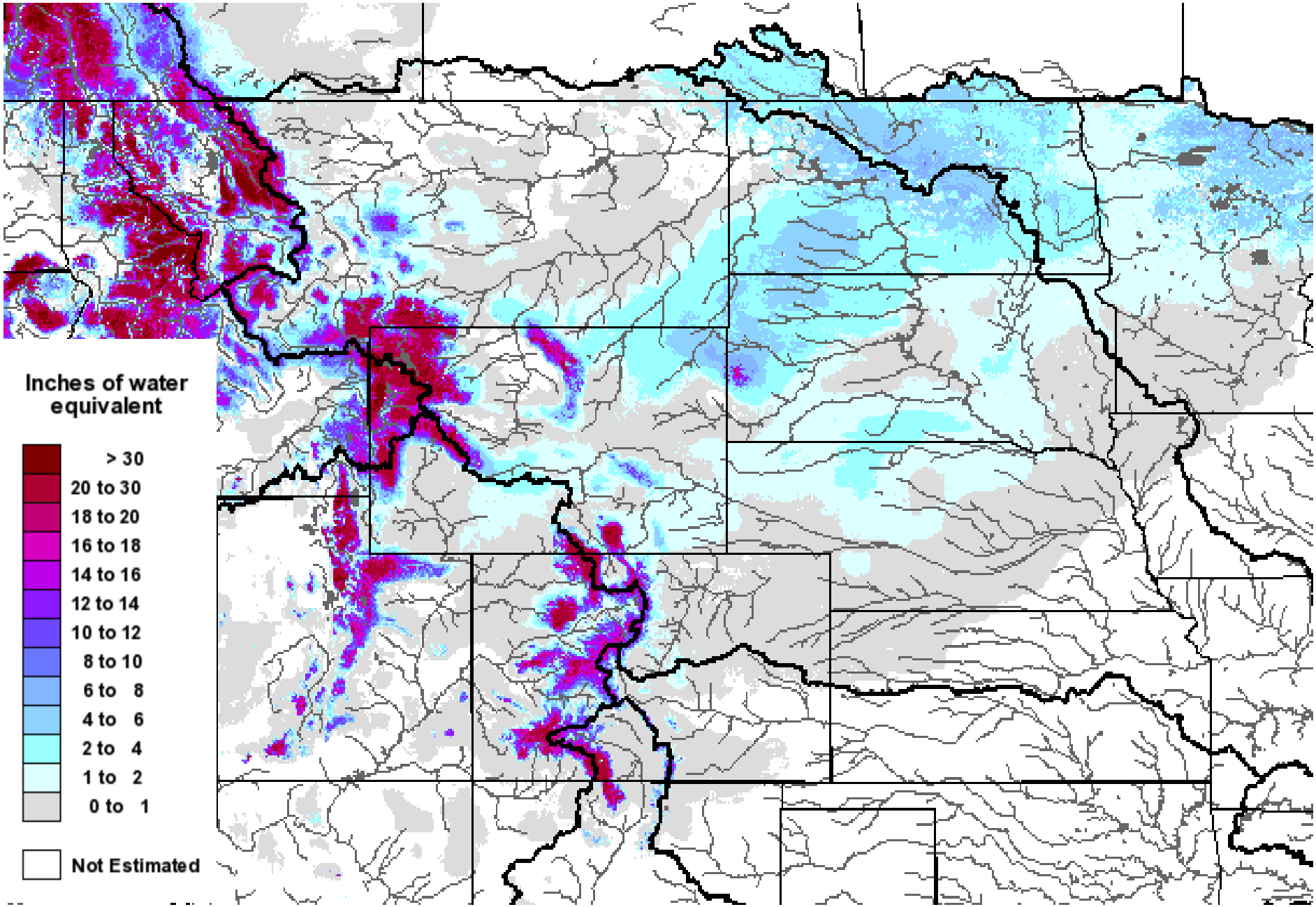
- Drought to persist or intensify
- Drought ongoing, some improvement
- Drought likely to improve, impacts ease
- Drought development likely

Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Short-term events -- such as individual storms -- cannot be accurately forecast more than a few days in advance. Use caution for applications -- such as crops -- that can be affected by such events. "Ongoing" drought areas are approximated from the Drought Monitor (D1 to D4 intensity). For weekly drought updates, see the latest U.S. Drought Monitor. NOTE: the green improvement areas imply at least a 1-category improvement in the Drought Monitor intensity levels, but do not necessarily imply drought elimination.

Mainstem System Storage Recovery Factors

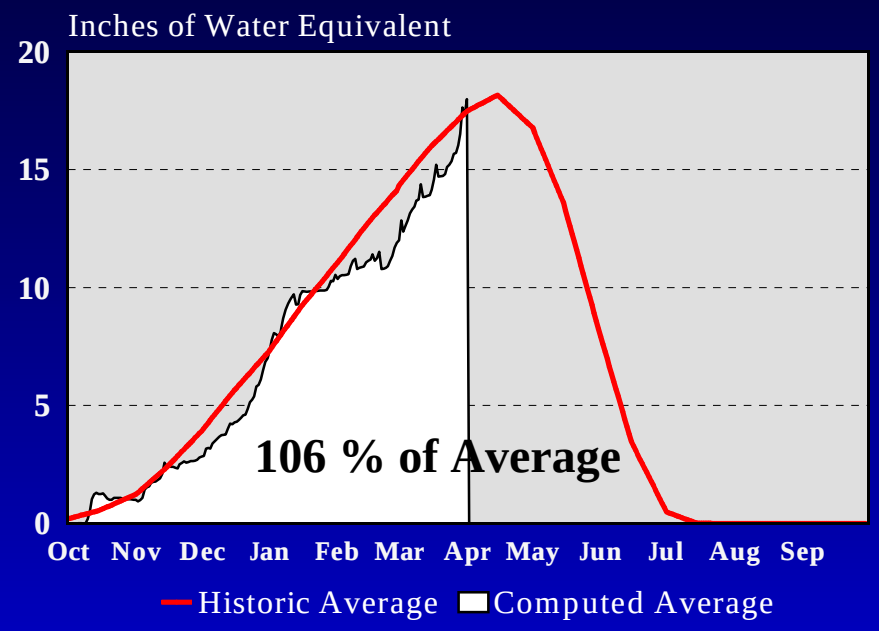
- *Plains Snowmelt*
- *Mountain Snowmelt*
- *Upper and Lower Basin Precipitation*
- *Mainstem System Releases*

Modeled Snow Water Equivalent (Hourly) for 2009 April 5, 6:00 Z

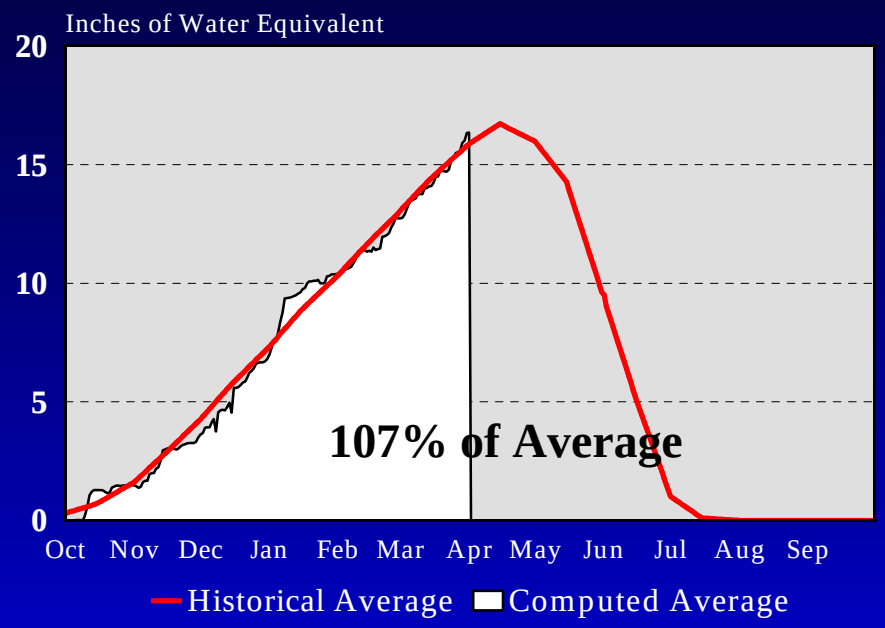


Missouri River Basin Mountain Snowpack Water Content 2008-2009

Total Above Fort Peck



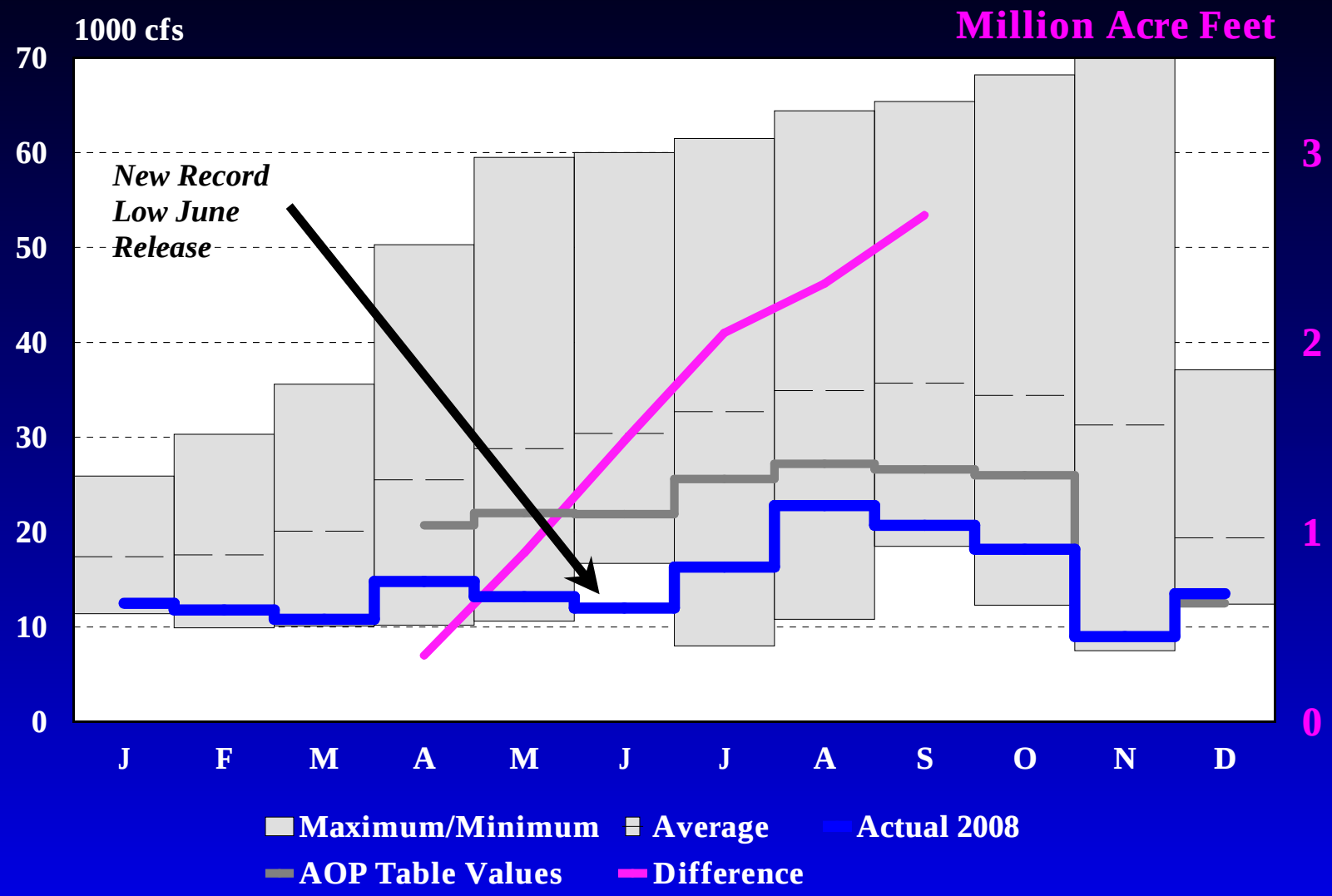
Total Fort Peck to Garrison



The Mountain Snowpack normally peaks near 15 April.

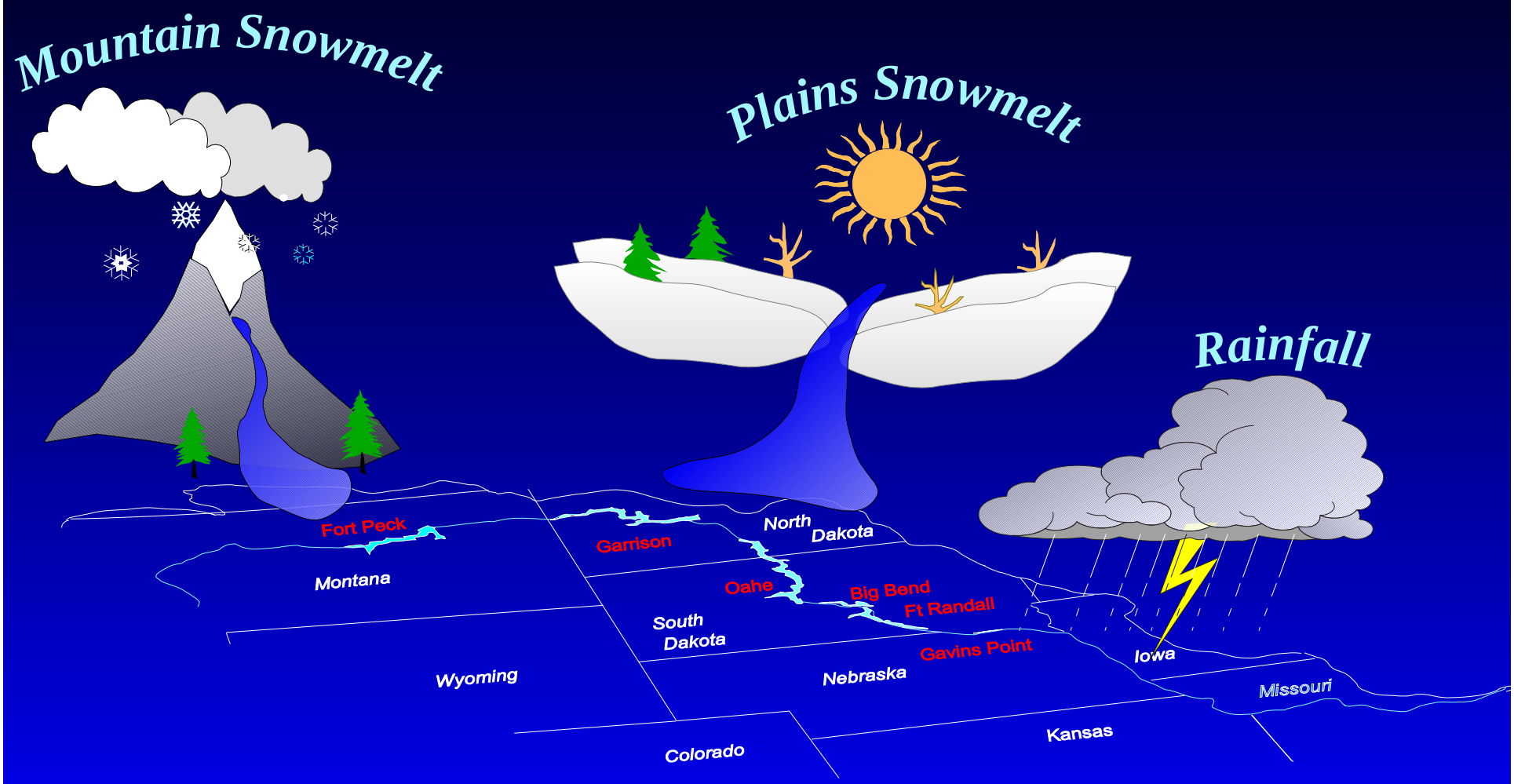
April 2, 2009

Gavins Point Monthly Releases

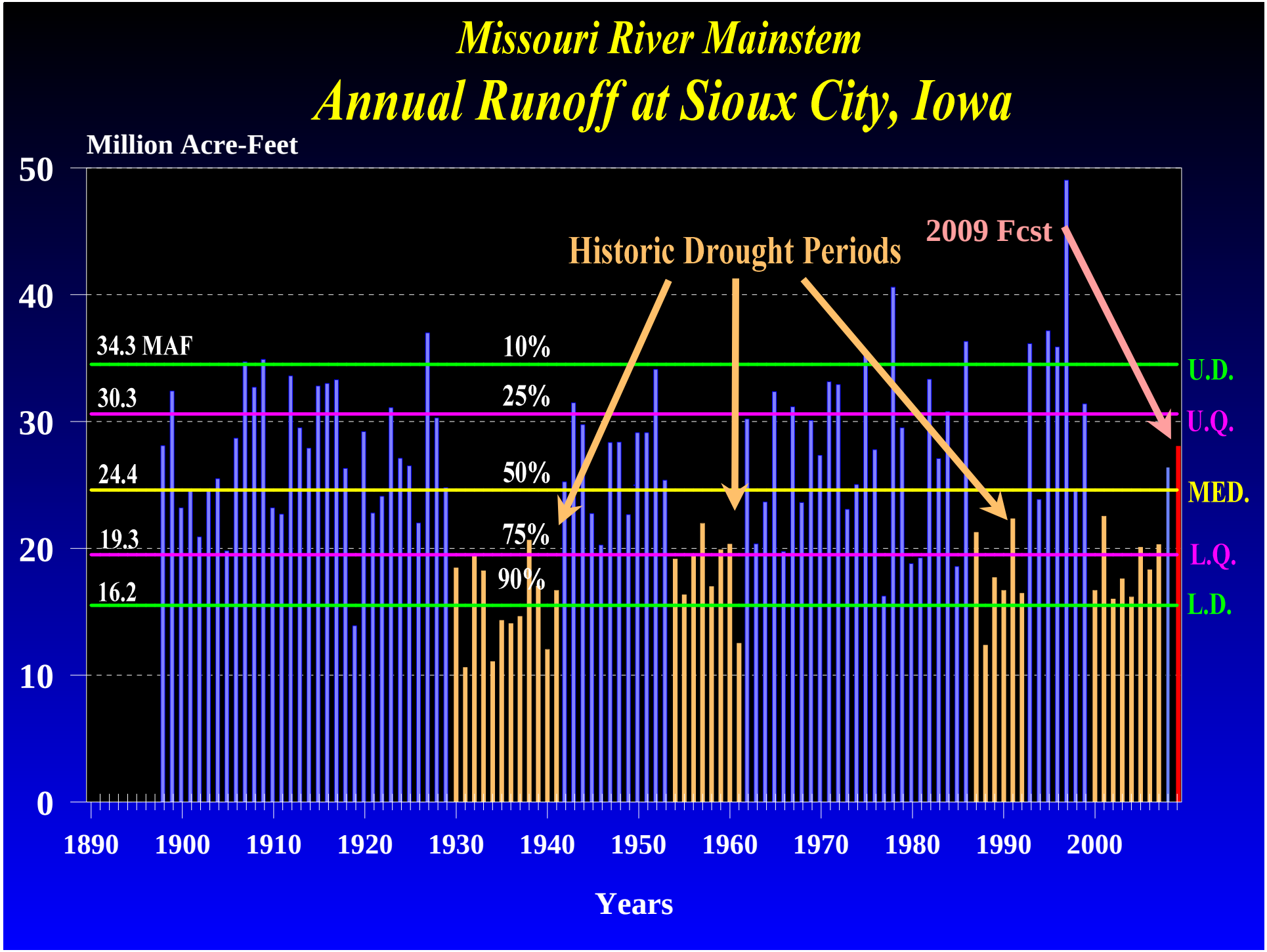


Max, Min, and Avg 1967-2007

Types of Missouri River Basin Runoff

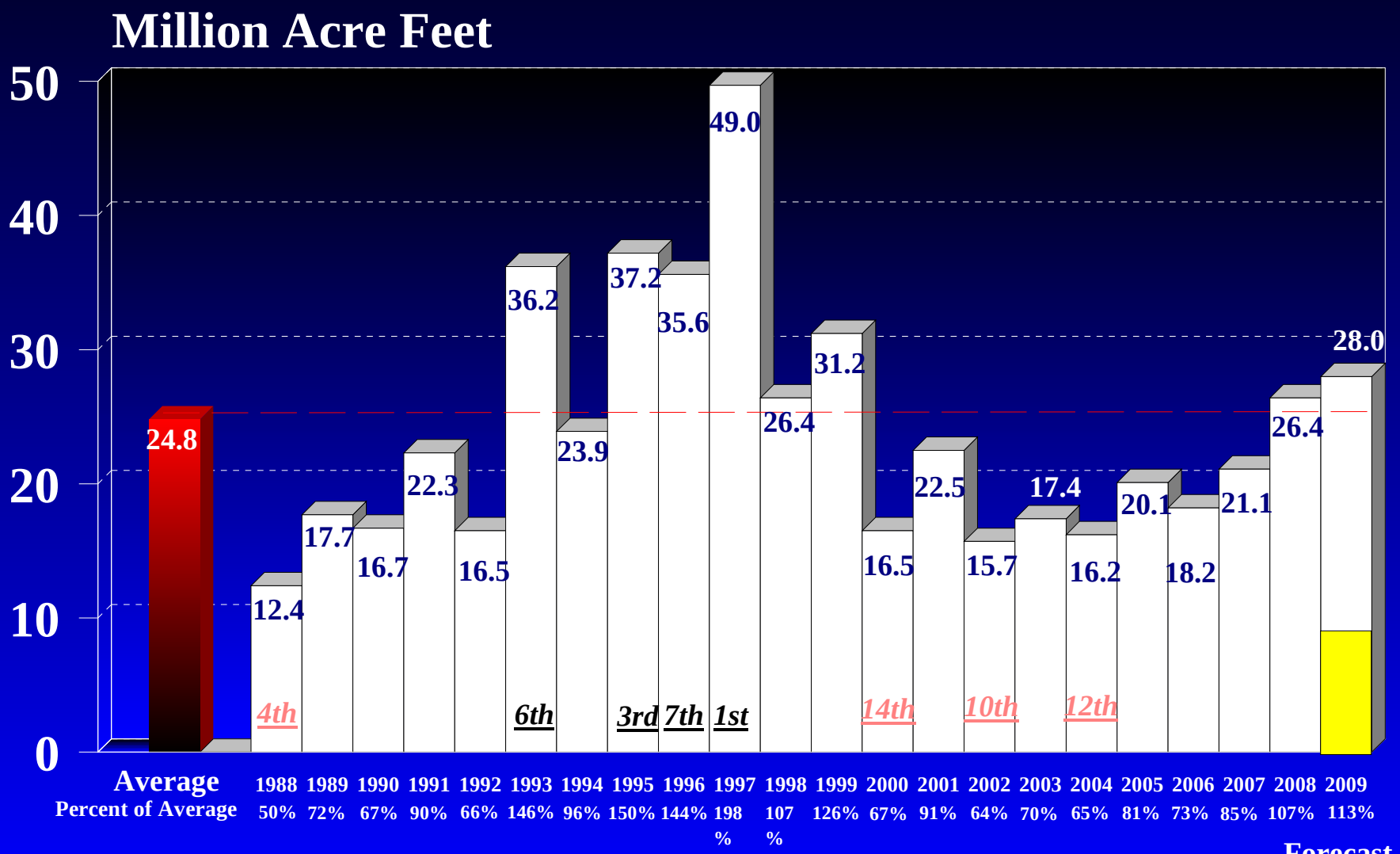


Mountain Snow	+	Plains Snow	+	2009 Rainfall	=	28.0 MAF
107 %		Significant plains snow runoff		Generally wet in basin		113% of Normal


Missouri River Mainstem
Annual Runoff at Sioux City, Iowa
Million Acre-Feet
50
40
30
20
10
0
34.3 MAF
30.3
24.4
19.3
16.2
10%
25%
50%
75%
90%
Historic Drought Periods
2009 Fcst
U.D.
U.Q.
MED.
L.Q.
L.D.
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
Years

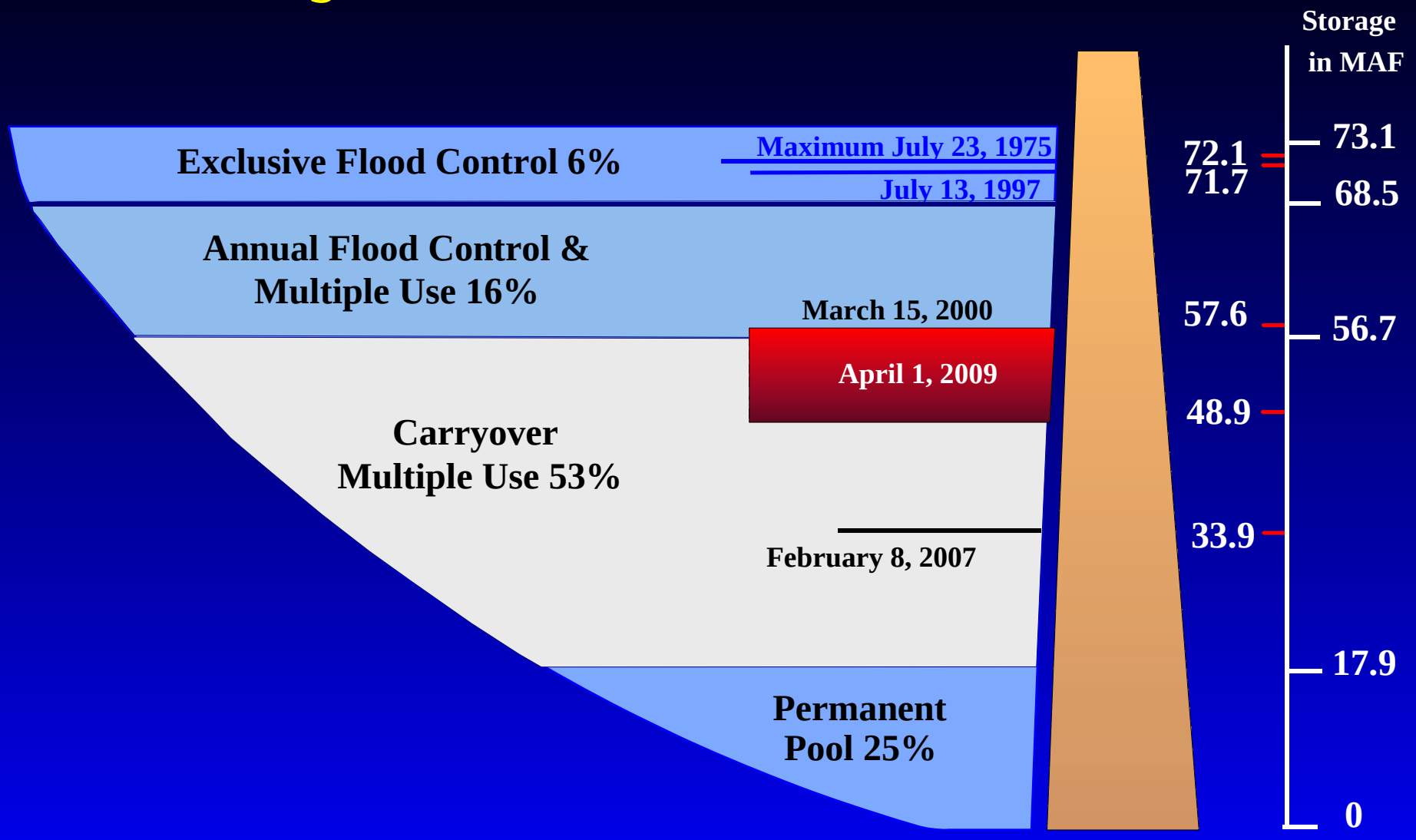
Missouri River Runoff Above Sioux City

1988-2009 vs Average



April 2009

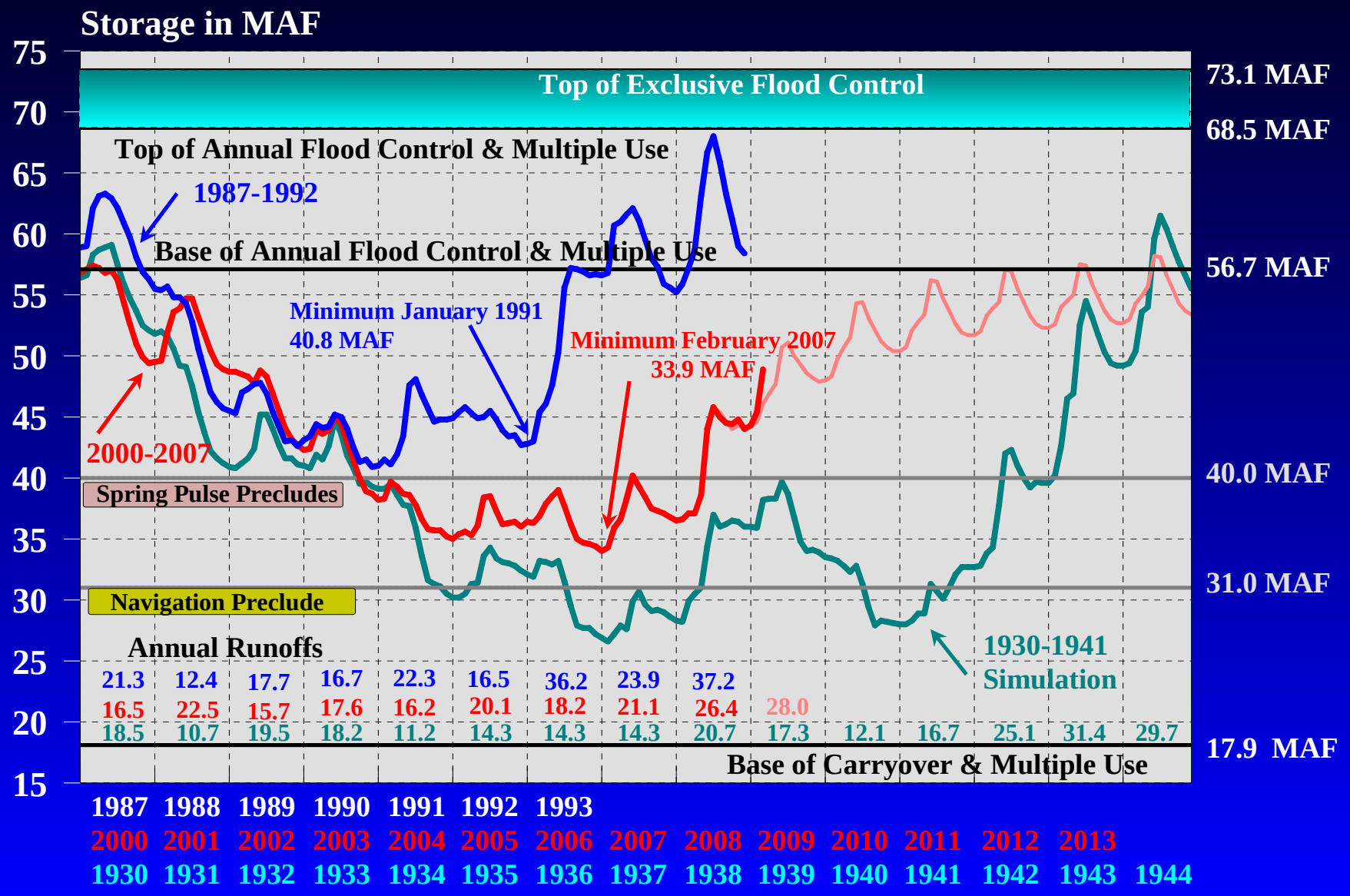
Missouri River Mainstem System Storage Zones and Allocations



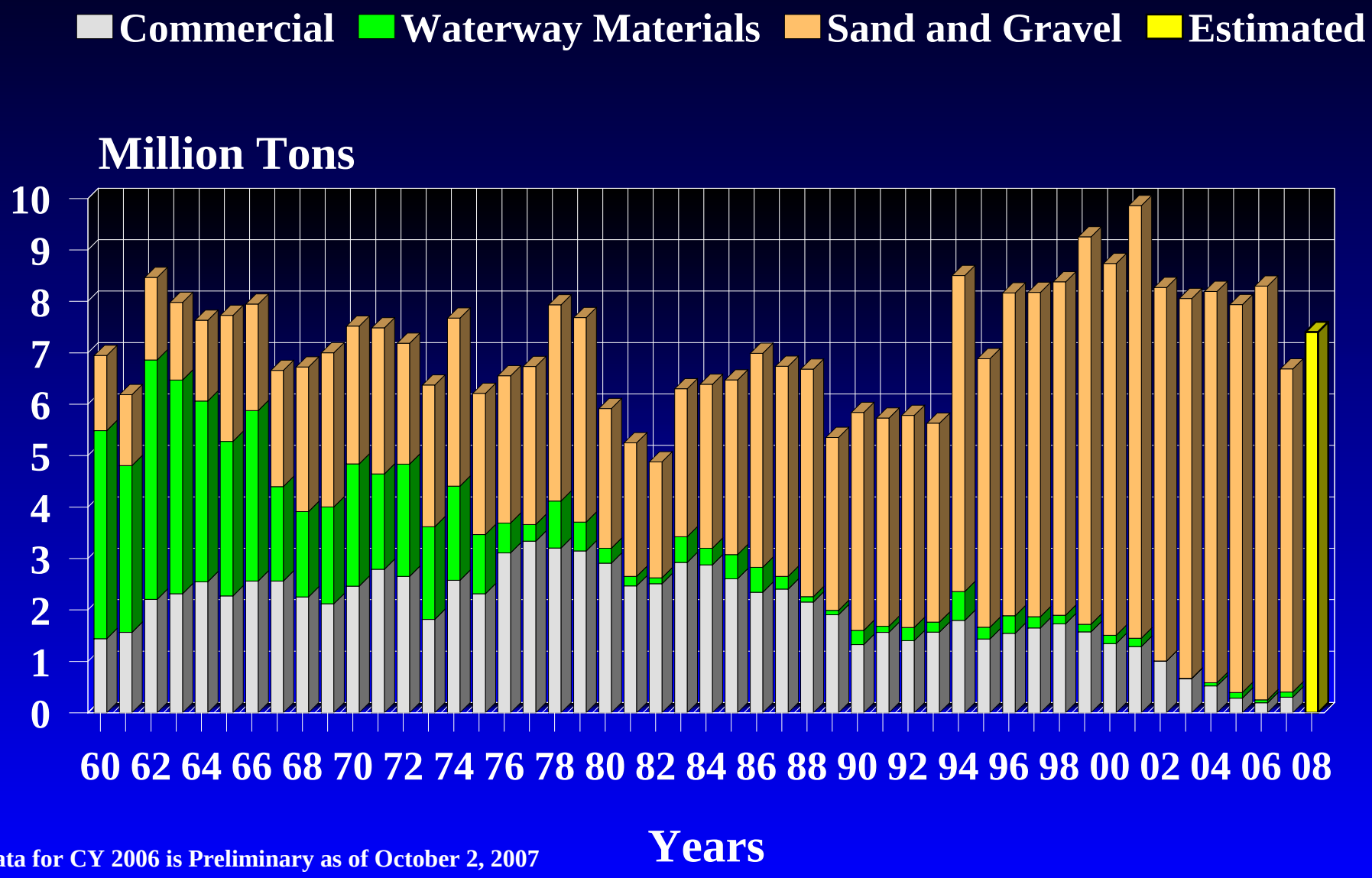
Total Storage = 73.1 MAF

Missouri River Mainstem Historic Drought Comparisons

1930-1941 1987-1992 2000-2007

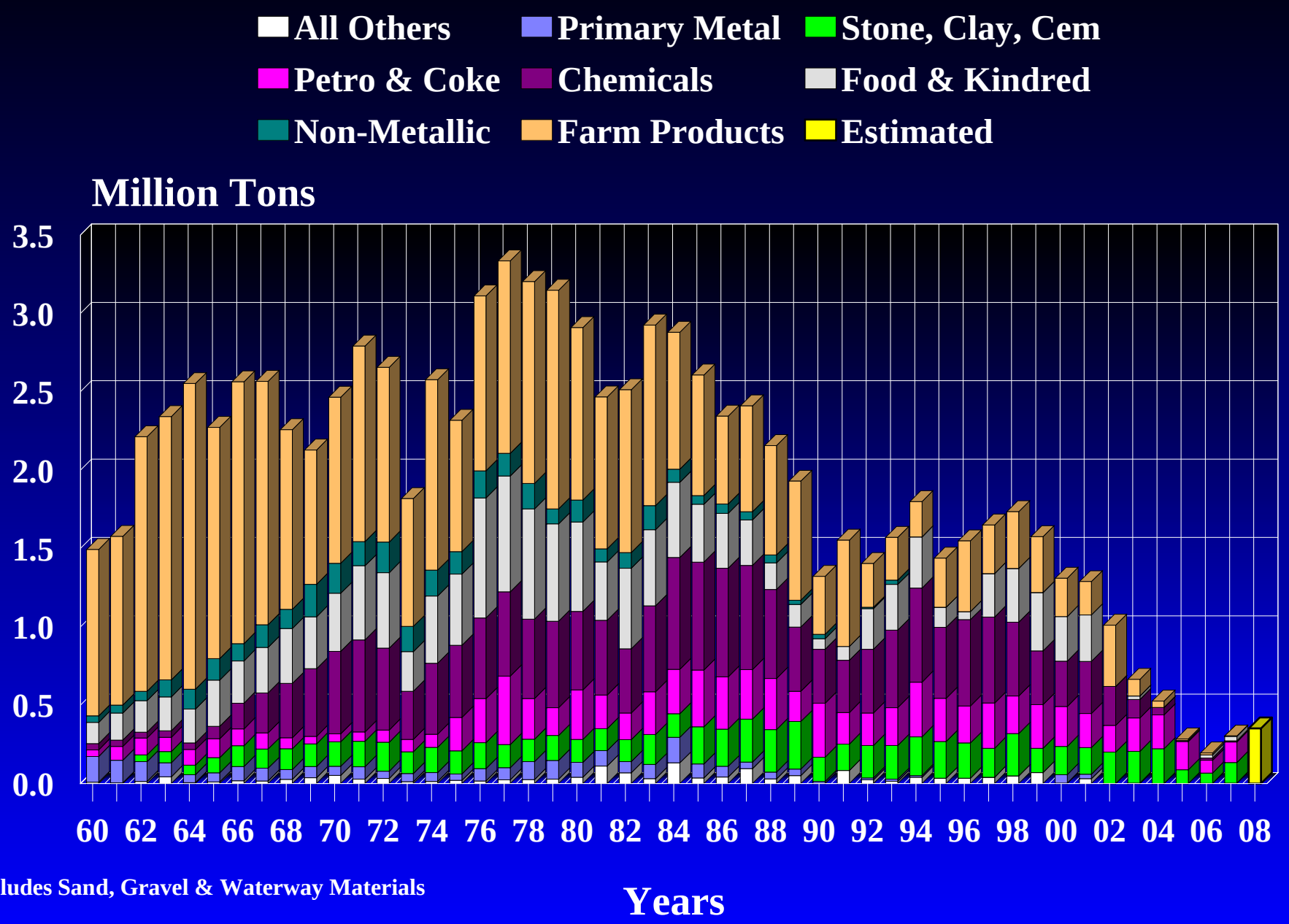


Missouri River
Total Navigation Tonnage



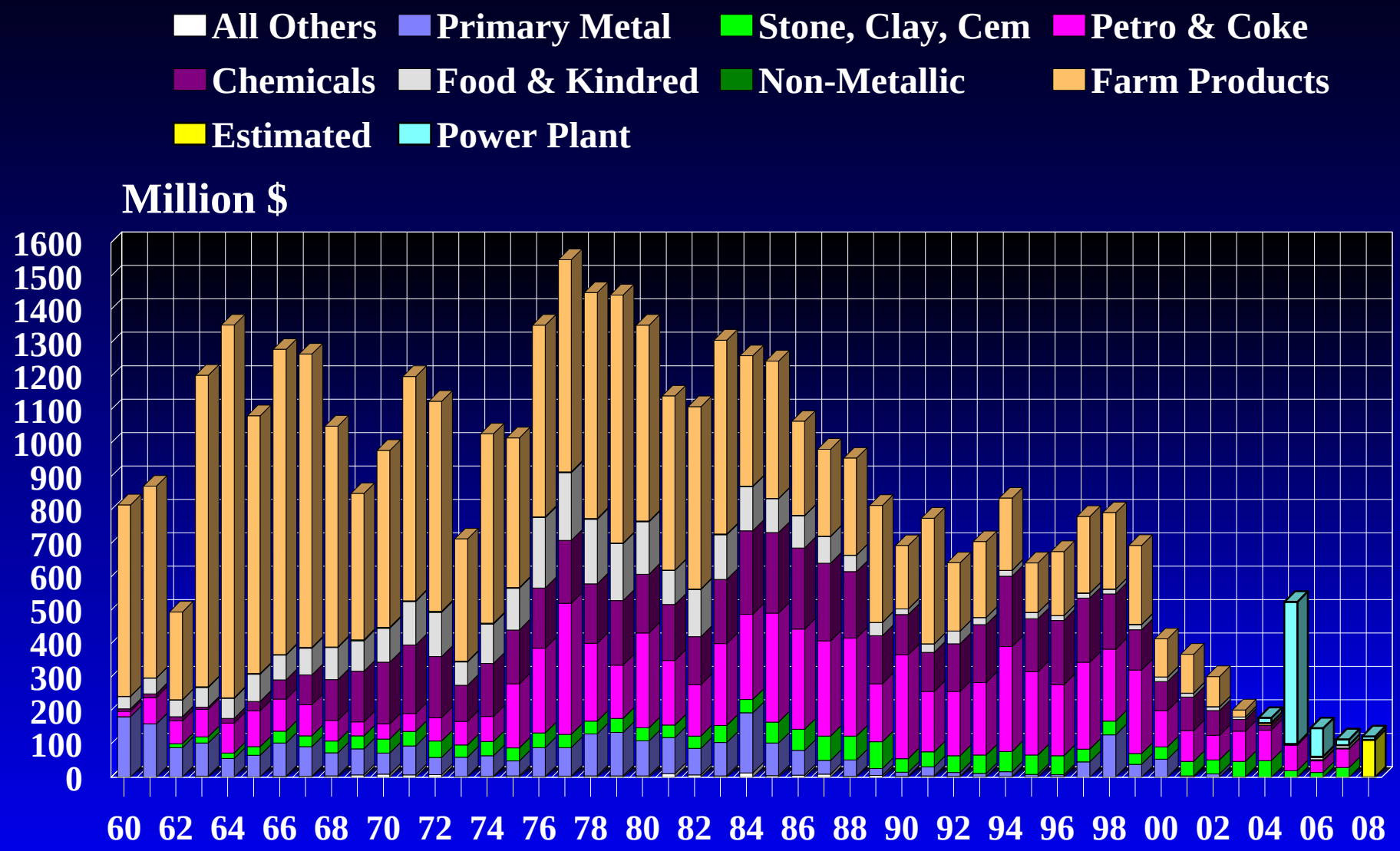
Data for CY 2006 is Preliminary as of October 2, 2007

Commercial Navigation Tonnage



Excludes Sand, Gravel & Waterway Materials

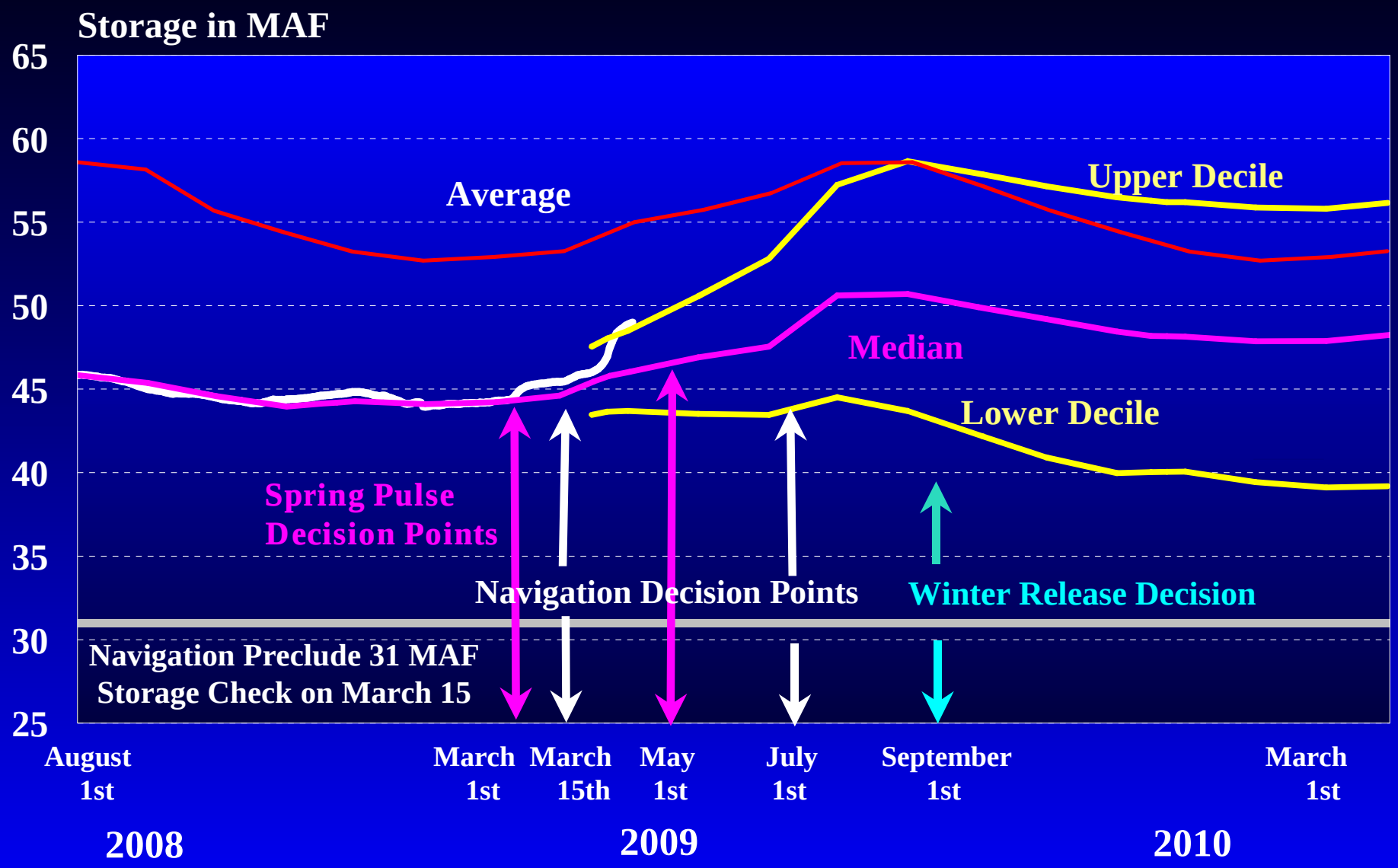
Commercial Navigation Tonnage Value Based on 2009 Present Worth



Excludes Sand, Gravel & Waterway Materials
Data for Calendar Year 2007 & 2008 is Estimated
as of September 25, 2008

System Storage Decision Points

2008-2009 AOP vs Actual



Misssouri River Navigation Season
2009 Opening Dates with Minimum Service Flow Targets

Sioux City	**March 23**	**25,000 cfs**
Omaha	**March 25**	**25,000 cfs**
Nebraska City	**March 26**	**31,000 cfs**
Kansas City	**March 28**	**35,000 cfs**
Mouth near St. Louis	**April 1**	

Missouri River Downstream Flow Support

Support for 2009 Navigation Season

Runoff Scenario	Annual Runoff Volume (MAF)	July 1 System Storage (MAF)	Flow Level Above or Below Full Service (in CFS)		Length of Shortening (Days)
			Spring	Fall	
Upper Basic	35.7	58.0	-6,000	0	0
Basic	28.0	53.1	-6,000	-3,300	0
Lower Basic	21.3	48.8	-6,000	-6,000	16

Missouri River Mainstem Reservoirs
2009 AOP Downstream Flow Support

Non navigation season flows reduced to as low as 9,000 cfs as per Master Manual ***Done***

Winter System releases scheduled at minimum levels (12,000 cfs) to conserve water but still met downstream requirements. ***Done***

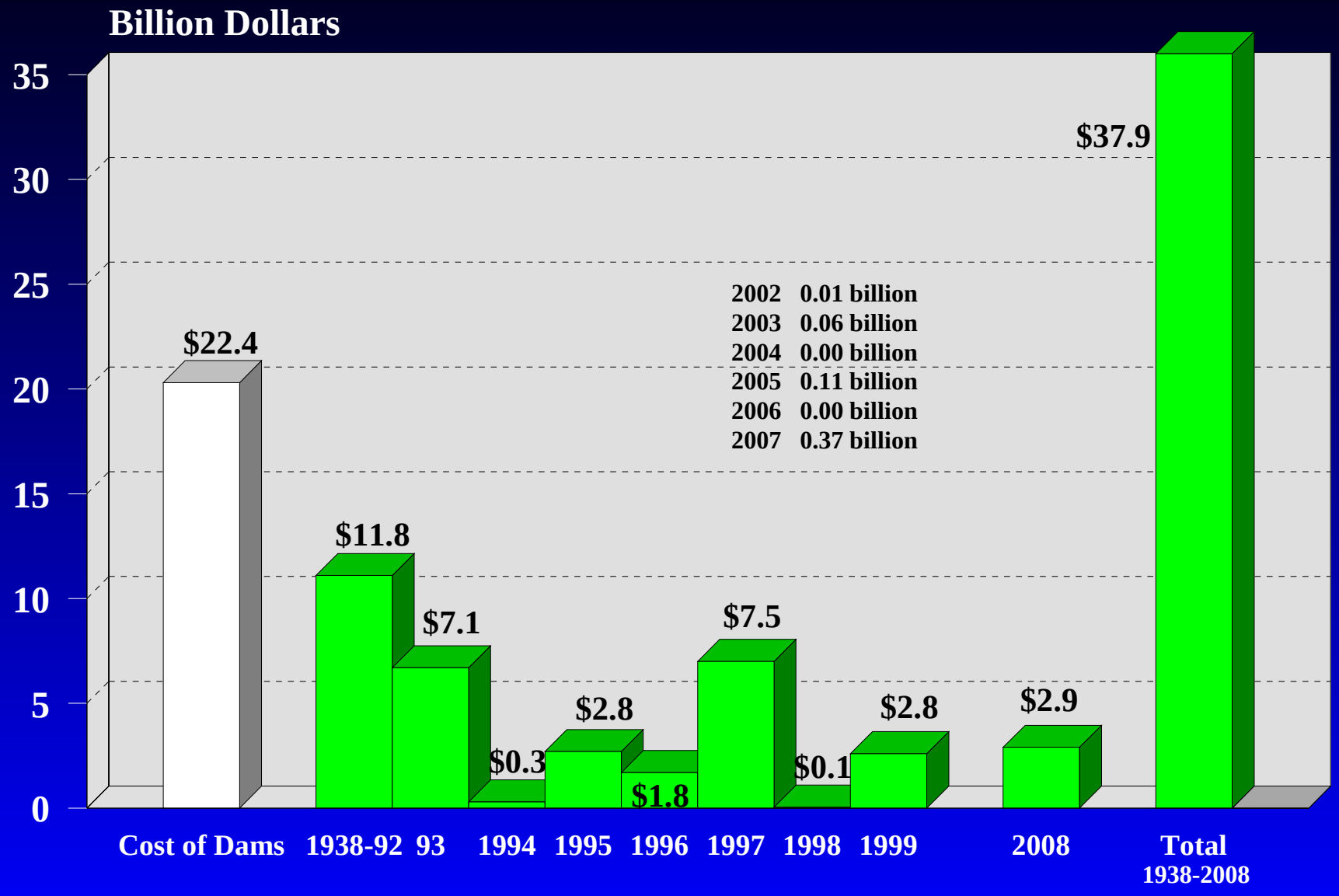
Near minimum service flows likely all navigation season ***Change***

Navigation Target flows not supported if commercial navigation is not using the reach to conserve mainstem system storage. ***OK***

Season shortening based on 1 July System storage check 0-30 days of shortening with 5 days forecasted for median. ***Change***

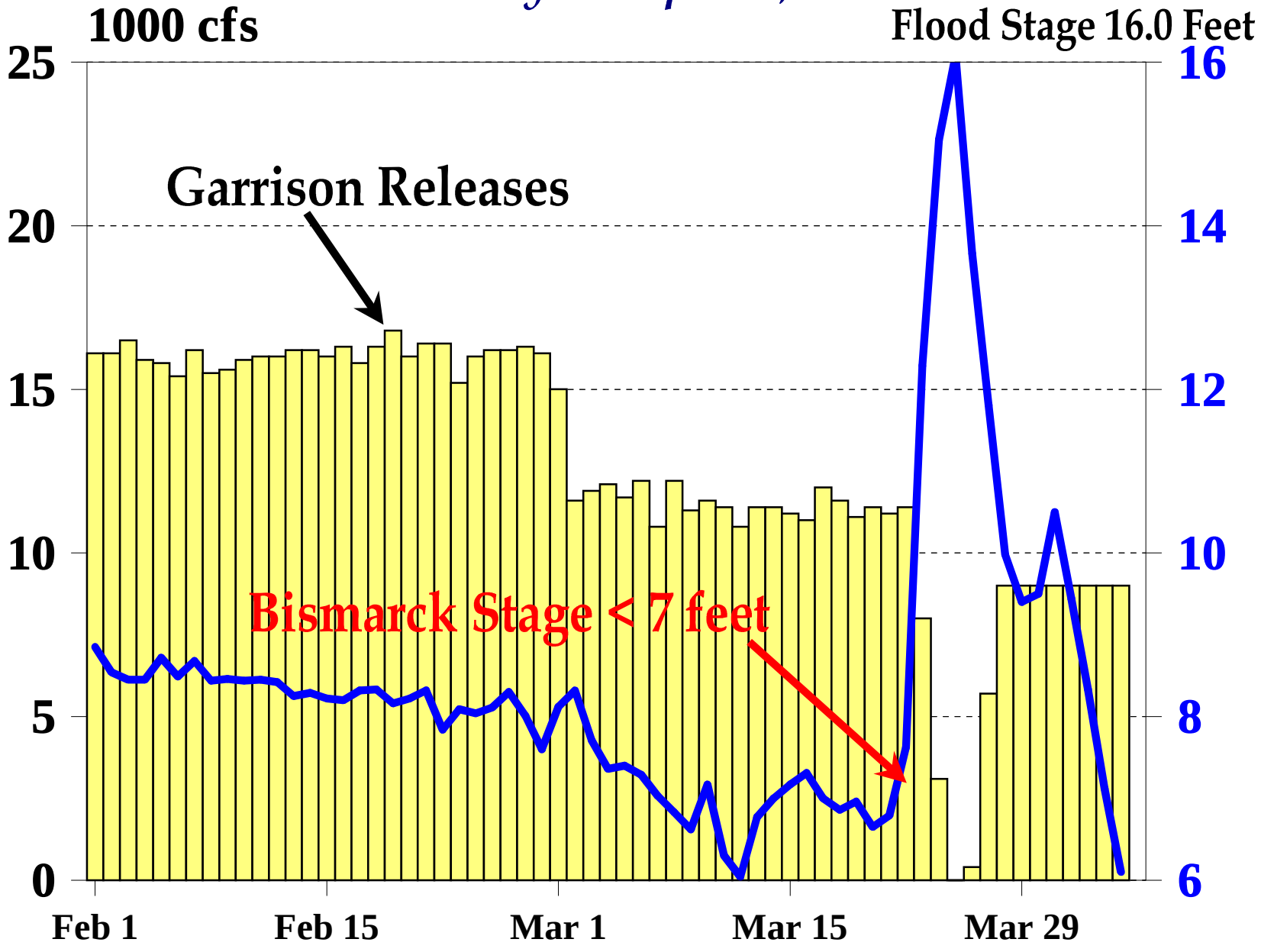
Missouri River navigation flow support from Kansas River reservoirs will be utilized as water conservation measure. ***?***

Missouri River Mainstem Reservoirs
Flood Damages Prevented Indexed to 2008



Garrison Releases and Bismarck Stage

February 1 - April 5, 2009



RCC Missouri River Flow Forecasting

We have added NWS Multi-sensor Precipitation Estimates (MPE) into Corps' Hydrologic Modeling System (HMS) forecasting procedures for all forecasts since 2006

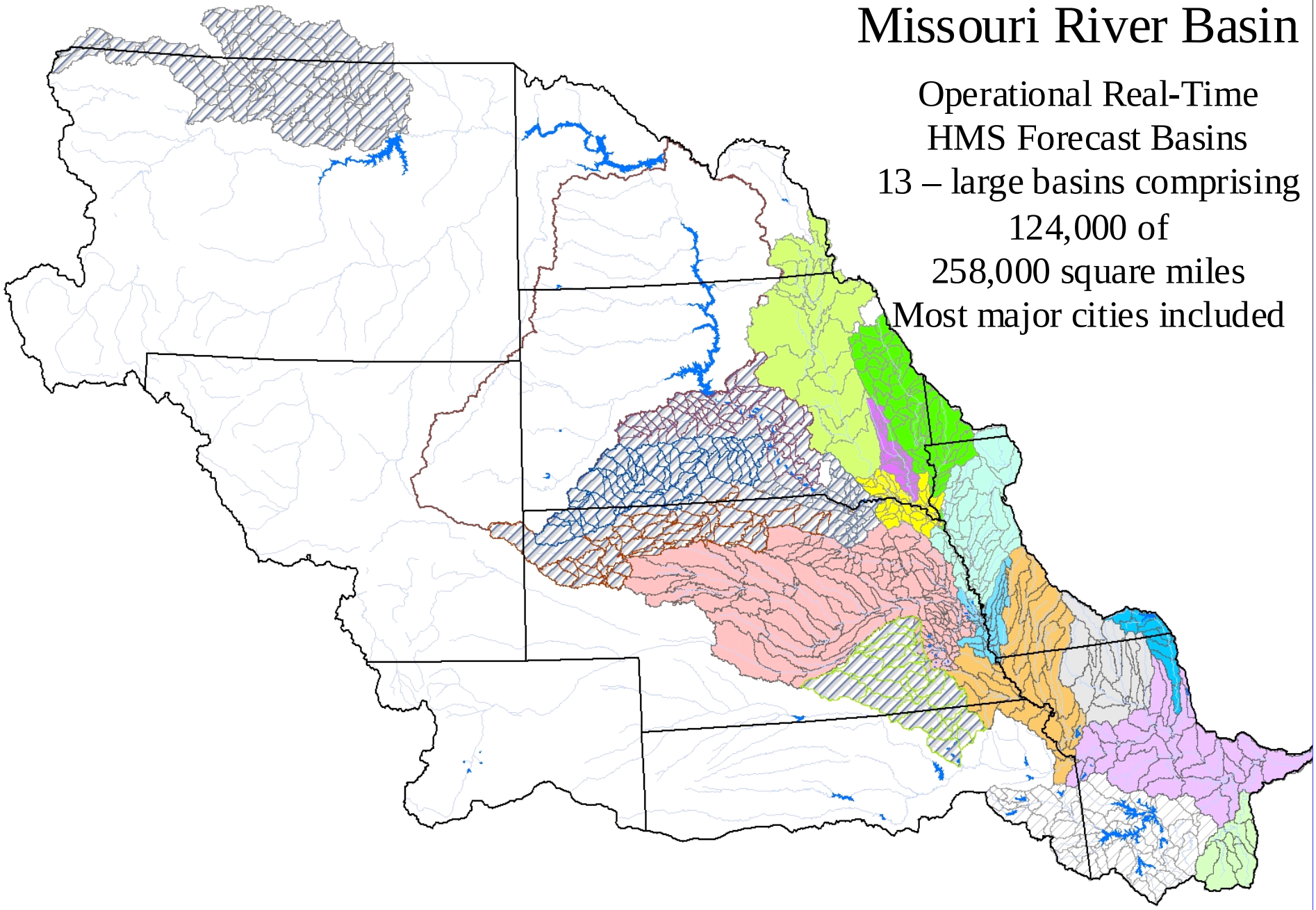
Forecasting for Spring Pulses:
We have added NWS Quantative Precipitation Forecasts (QPF) to Corps' HMS forecasts during the Spring Pulses.

120 Hours of QPF integrated into Corps forecast.

Comparison between Corps HMS downstream forecast with NWS MBRFC forecast including 120 Hours of QPF.

Missouri River Basin

Operational Real-Time
HMS Forecast Basins
13 – large basins comprising
124,000 of
258,000 square miles
Most major cities included

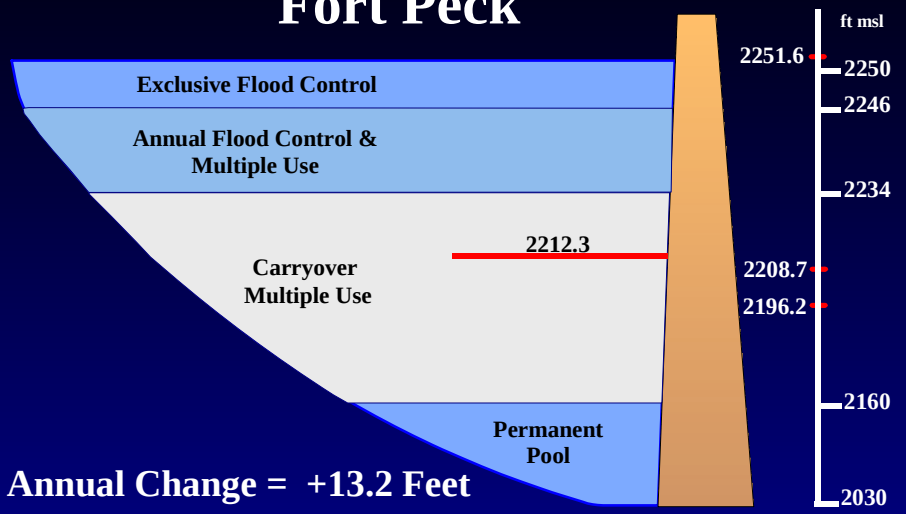


2008 - 2009 AOP Expected Results

Flood Control - significant flood control storage available
Navigation - Better prospects on service level and length
Hydroelectric Power
Irrigation -
Water Supply & WQ - will meet flow requirements
Recreation (below System) - longer season length but continued access problems similar to recent years with lower flow levels and flow support reduced if commerical navigation not schedule.
Fish and Wildlife -
Endangered Species

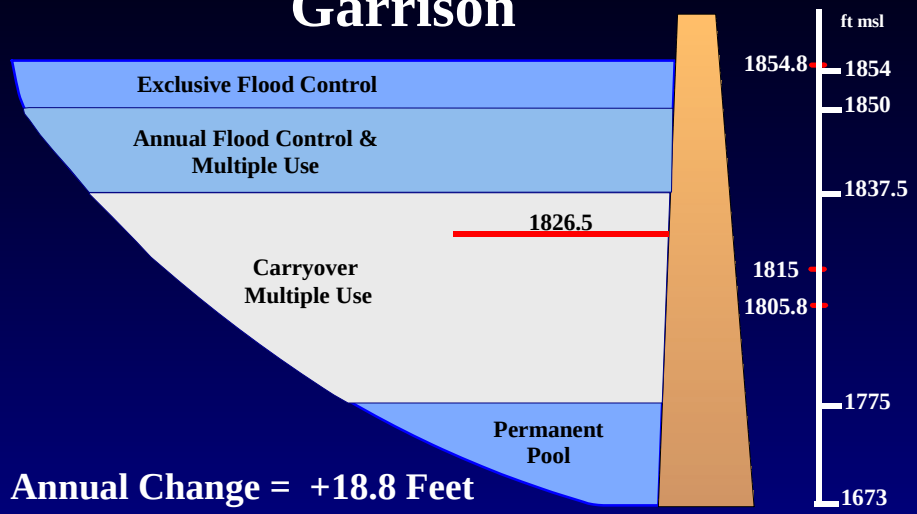
Current Reservoir Levels - April 5, 2009

Fort Peck



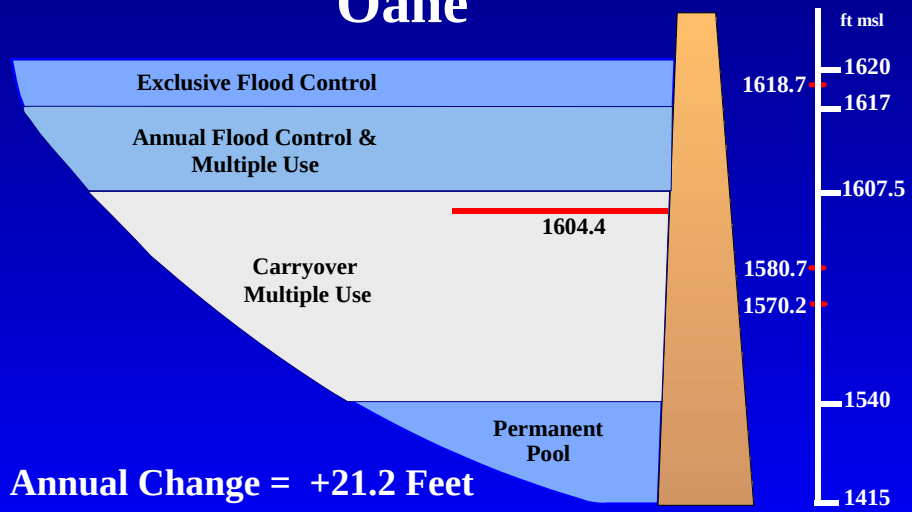
Annual Change = +13.2 Feet
21.7 feet below desired

Garrison



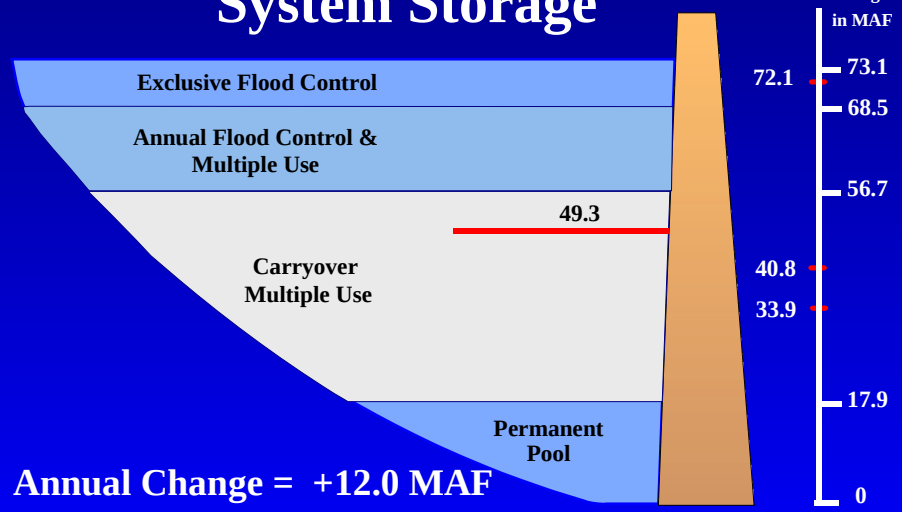
Annual Change = +18.8 Feet
11.0 feet below desired

Oahe



Annual Change = +21.2 Feet
3.1 feet below desired

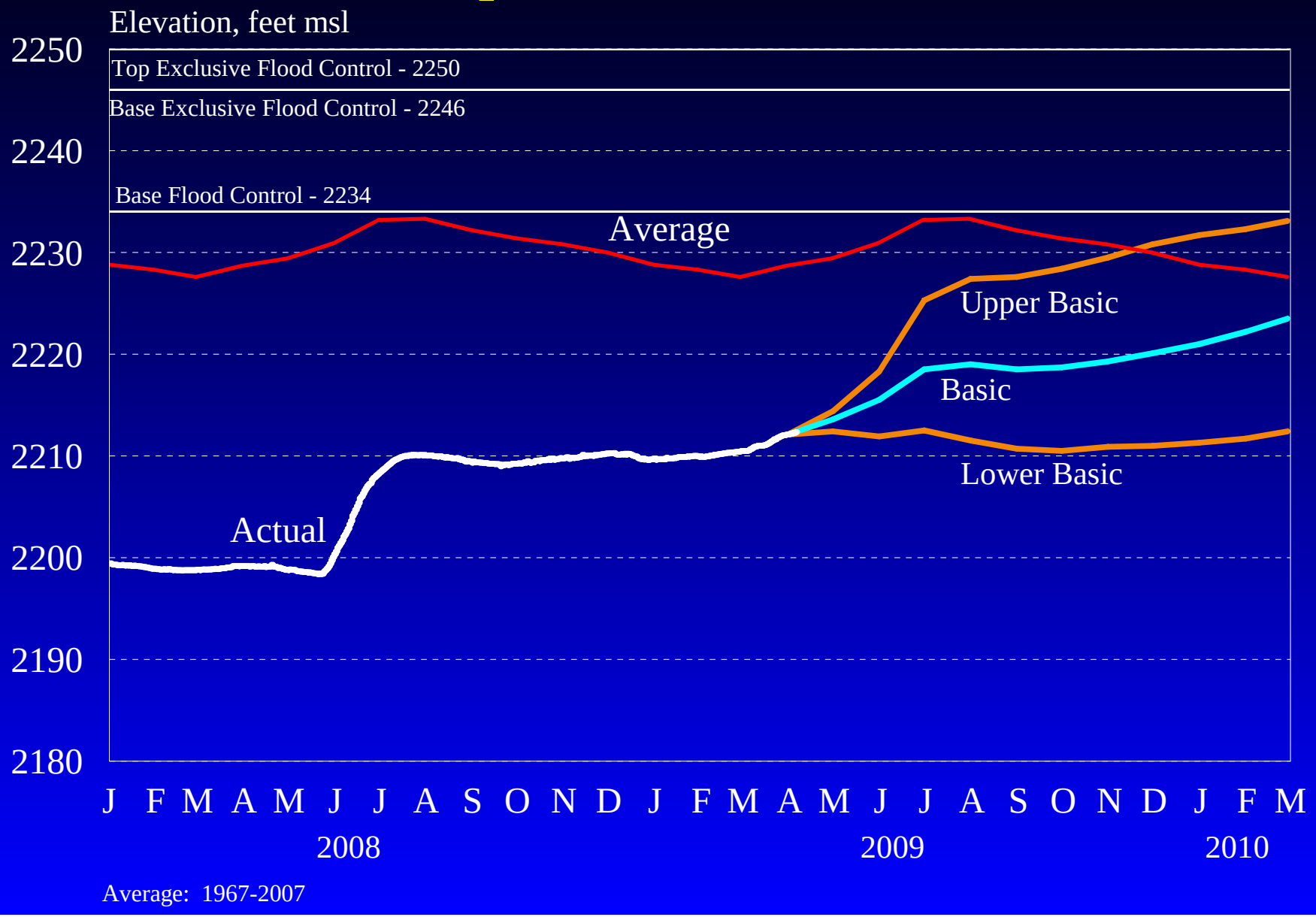
System Storage



Annual Change = +12.0 MAF
7.4 MAF below desired

Fort Peck

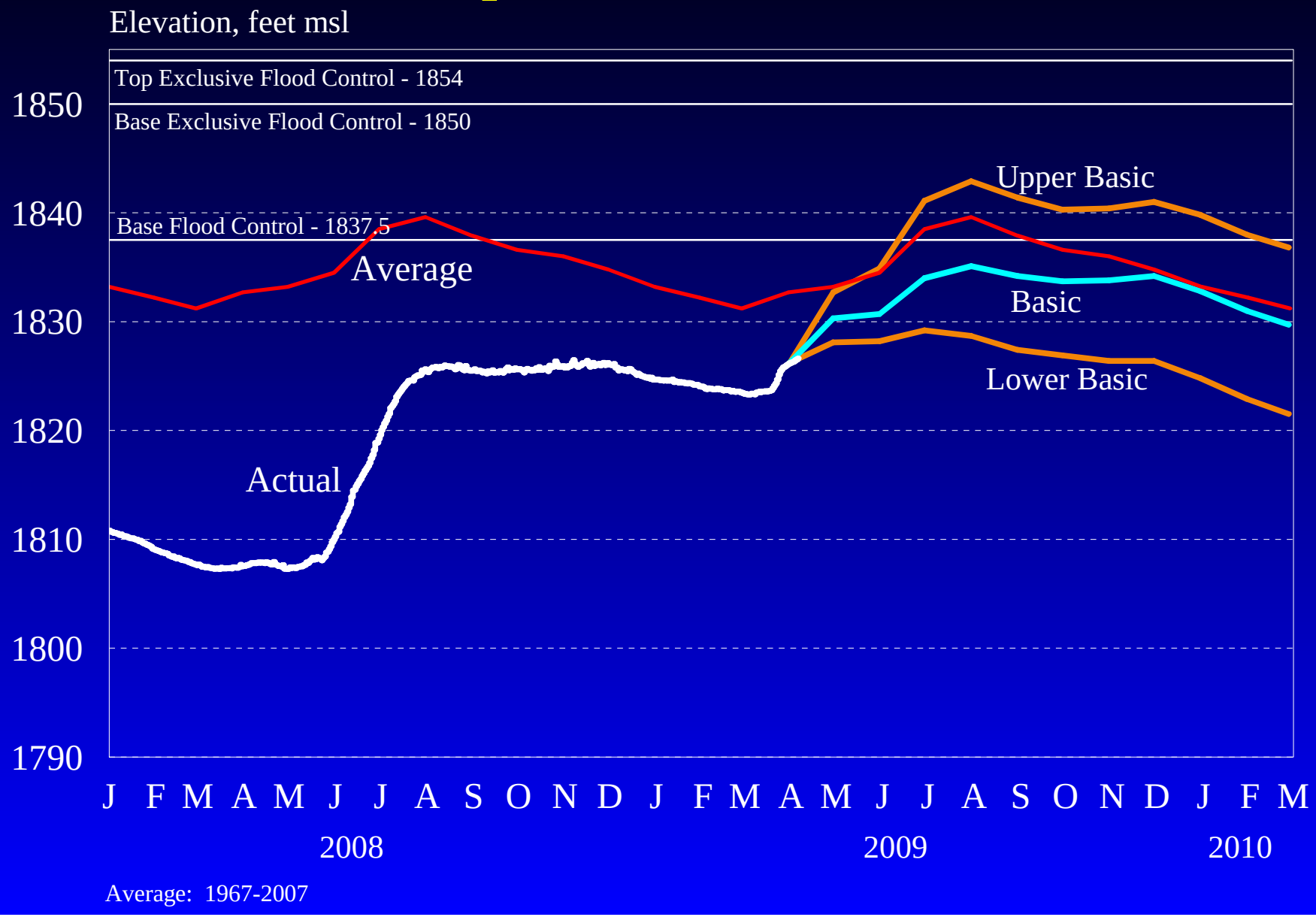
April 1 Forecast



Average: 1967-2007

Garrison

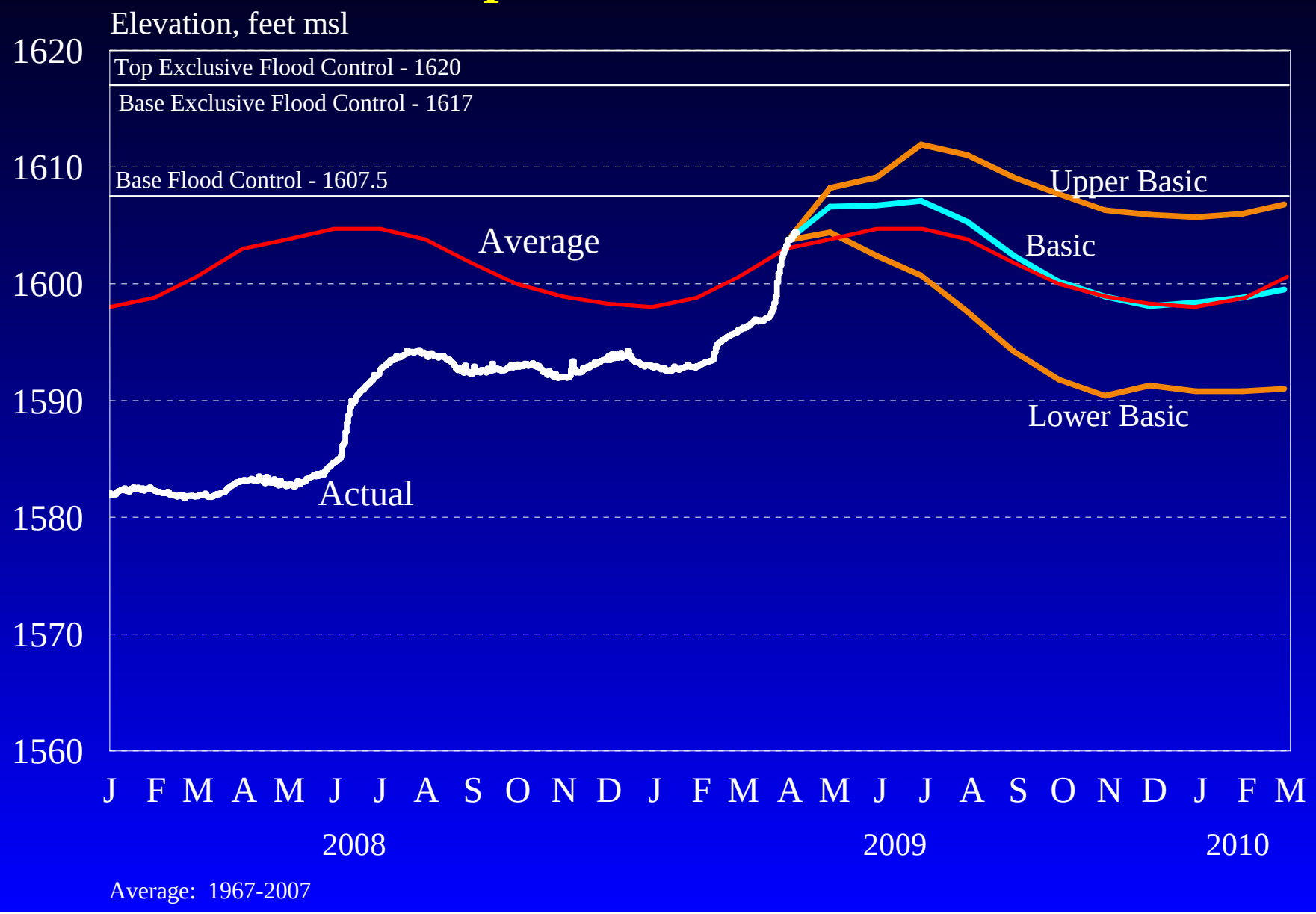
April 1 Forecast



Average: 1967-2007

Oahe

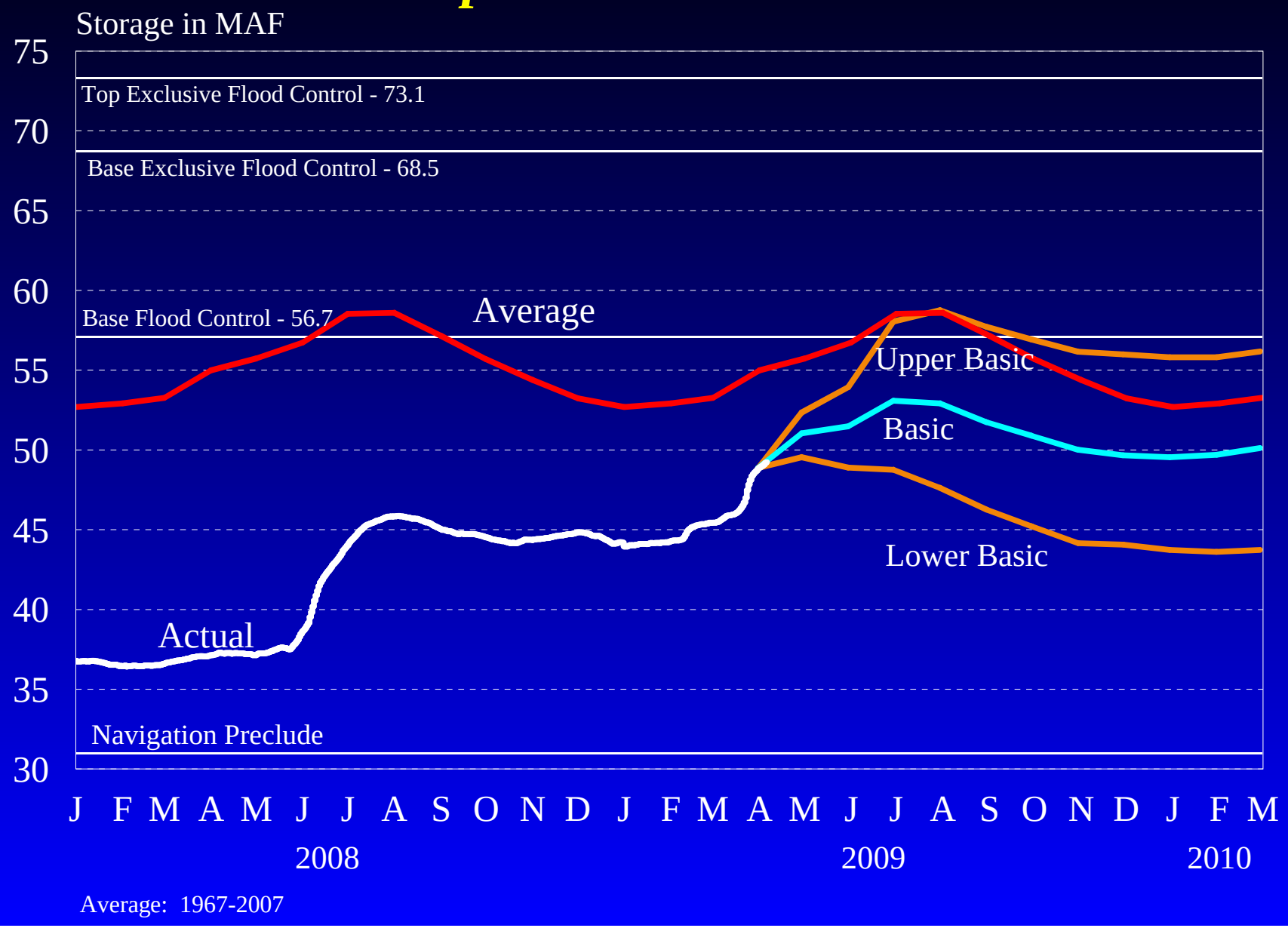
April 1 Forecast



Average: 1967-2007

System Storage

April 1 Forecast



Average: 1967-2007

Water Supply & Water Quality

- Improved access at municipal water intakes
- Fewer water quality issues expected on upper three reservoirs
- Better access for irrigation, except below Fort Peck due to low releases

2009 Reservoir Access Areas

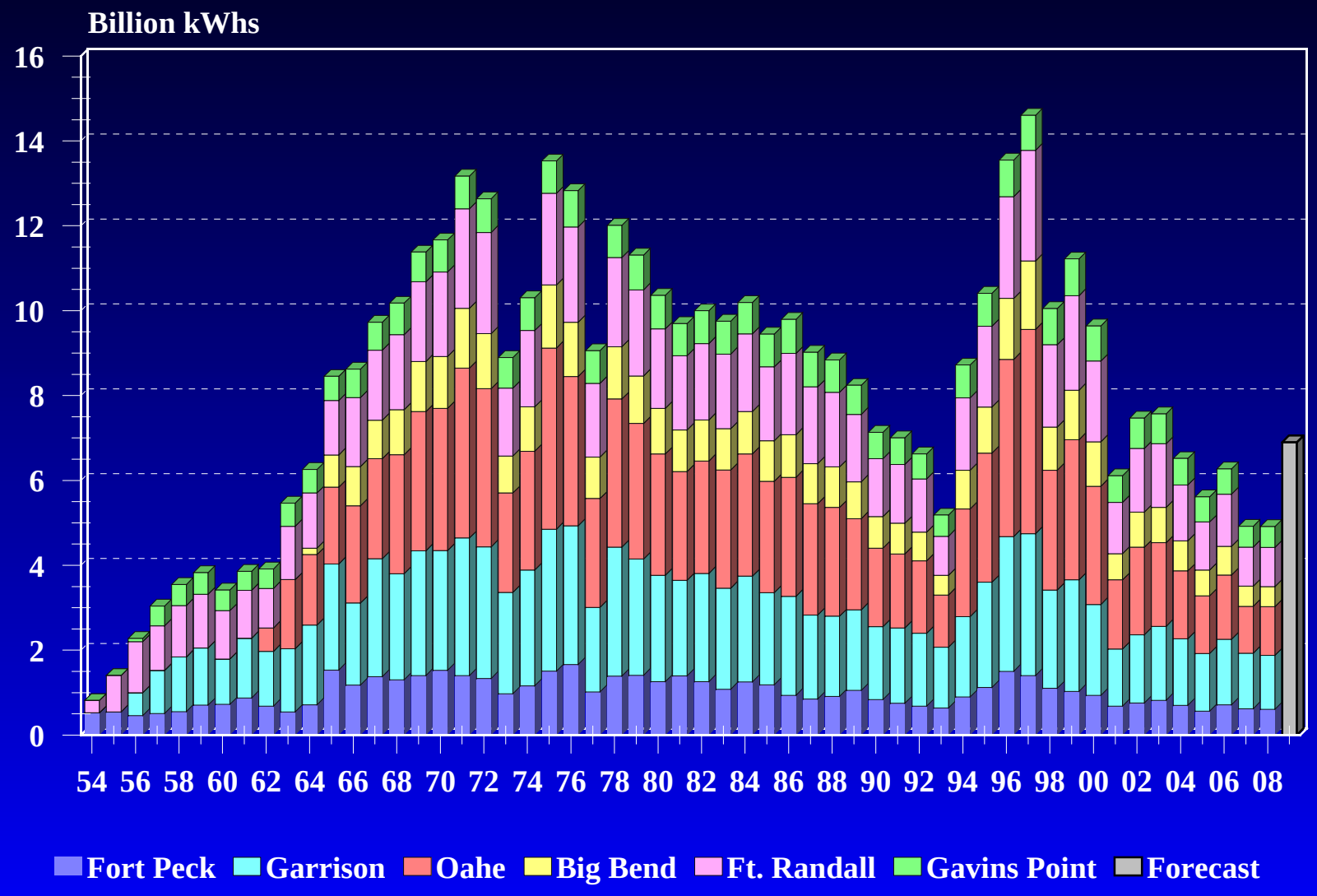
- Higher reservoir levels on upper three projects result in better access than in previous several years.
- Access issues remain on lower river due to reduced Gavins Point releases and not meeting navigation targets in reaches without commercial navigation

	Usable	Total
Fort Peck	9	11
Garrison	34	36
Oahe*		
- North Dakota	12	13
- South Dakota	25	27

*** At Oahe, 3 areas marginal in ND and 2 areas marginal in SD**

Mainstem Hydropower Generation

1954 - 2009



2009 Forage Fish Spawn

- Provide steady to rising reservoir levels at the upper three reservoirs from April to June

- Favor Garrison from April 20 to May 20 if runoff is not sufficient to keep all three reservoirs rising

- All reservoirs higher than previous years innundating vegetation

- Fewer issues with cold water habitat at Garrison due to higher reservoir level

Interior Least Tern

Piping Plover

Pallid Sturgeon

2009 Tern and Plover Nesting Seasons

- Steady release - flow to target
- Spring pulse from Gavins Point in May
- Cycle Gavins Point releases to conserve water: 1 day of higher releases followed by 2 days of navigation flows
- Intra-day peaking patterns established at Garrison and Fort Randall
- Target flows may not be met in reaches without commercial navigation
- Utilize Kansas River projects as authorized
- Likelihood of increased support for navigation after July 1 system storage check

Spring Pulses from Gavins Point Dam

- Part of a Reasonable and Prudent Alternative (RPA) in the USFWS 2003 Amended Biological Opinion to avoid jeopardy to the pallid sturgeon

- Master Manual revised in 2006 to include bimodal spring pulse from Gavins Point dam

Spring Pulses from Gavins Point Dam

- First ever May spring pulse in May 2006
    - Peak magnitude of 9,000 cfs for 2 days
- First ever March spring pulse in March 2008
    - Peak magnitude of 5,000 cfs for 2 days
    - Pulse eliminated downstream of the confluence with the Kansas River
- March and May pulses planned in spring 2009 under all runoff scenarios
- March spring pulse cancelled due to downstream flow limits

2009 May Pulse from Gavins Point

- Estimated peak magnitude
    - 12,400 to 16,000 cfs for 2 days depending on 1
    - May system storage and runoff forecast
- Timing between 1 May and 19 May
    - Water temperature
    - Nesting terns and plovers
    - Downstream flow limits

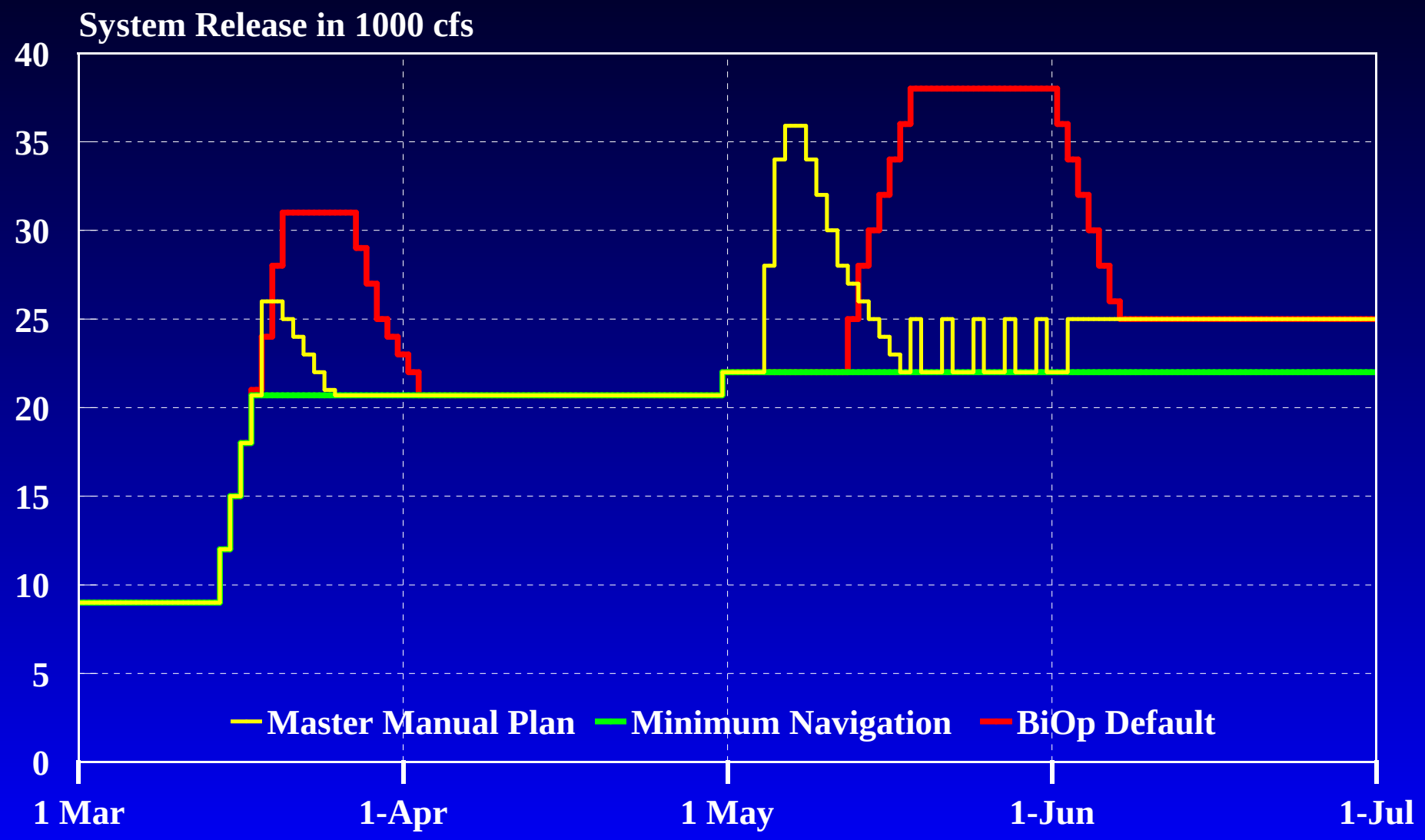
2009 May Pulse from Gavins Point

- Additional volume of water released during pulse
- 120,000 to 210,000 acre-feet
- Water source during event
    - 1.5 to 2.5 feet from Fort Randall
    - 1 to 1.5 feet from Gavins Point
- Impact at end of water year
    - Balance impact among upper three reservoirs
    - 0.2 to 0.3 foot lower than without May pulse

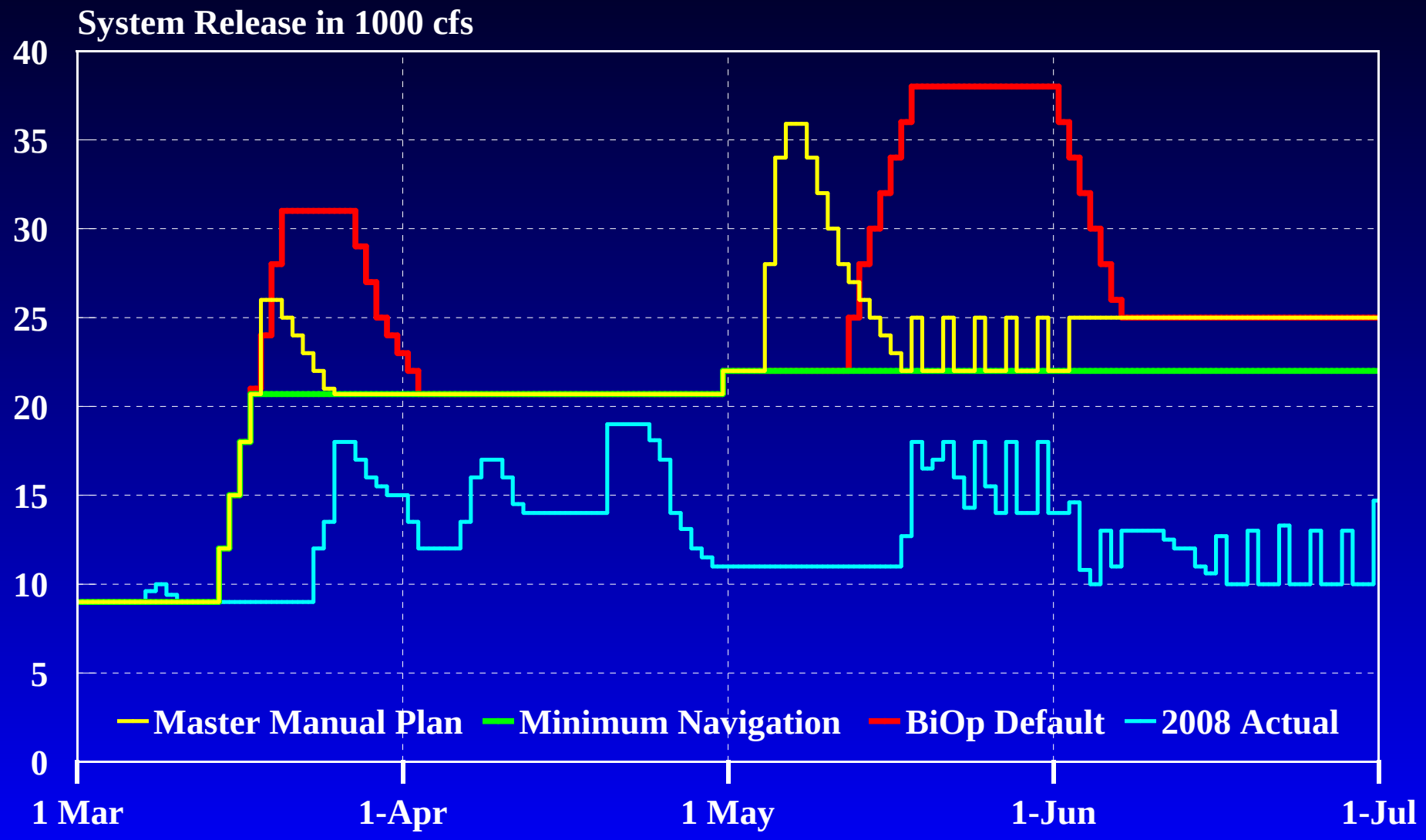
2009 May Pulse from Gavins Point

- Estimated downstream stage change
    - Sioux City to Omaha 2.5 to 4.5 feet
    - Nebraska City to Kansas City 2.0 to 3.5 feet
    - Boonville to Hermann 1.5 to 3.0 feet
- Downstream flow limits in effect to reduce risk of flood damages
- Monitoring in place
    - Biological
    - Socio-economic

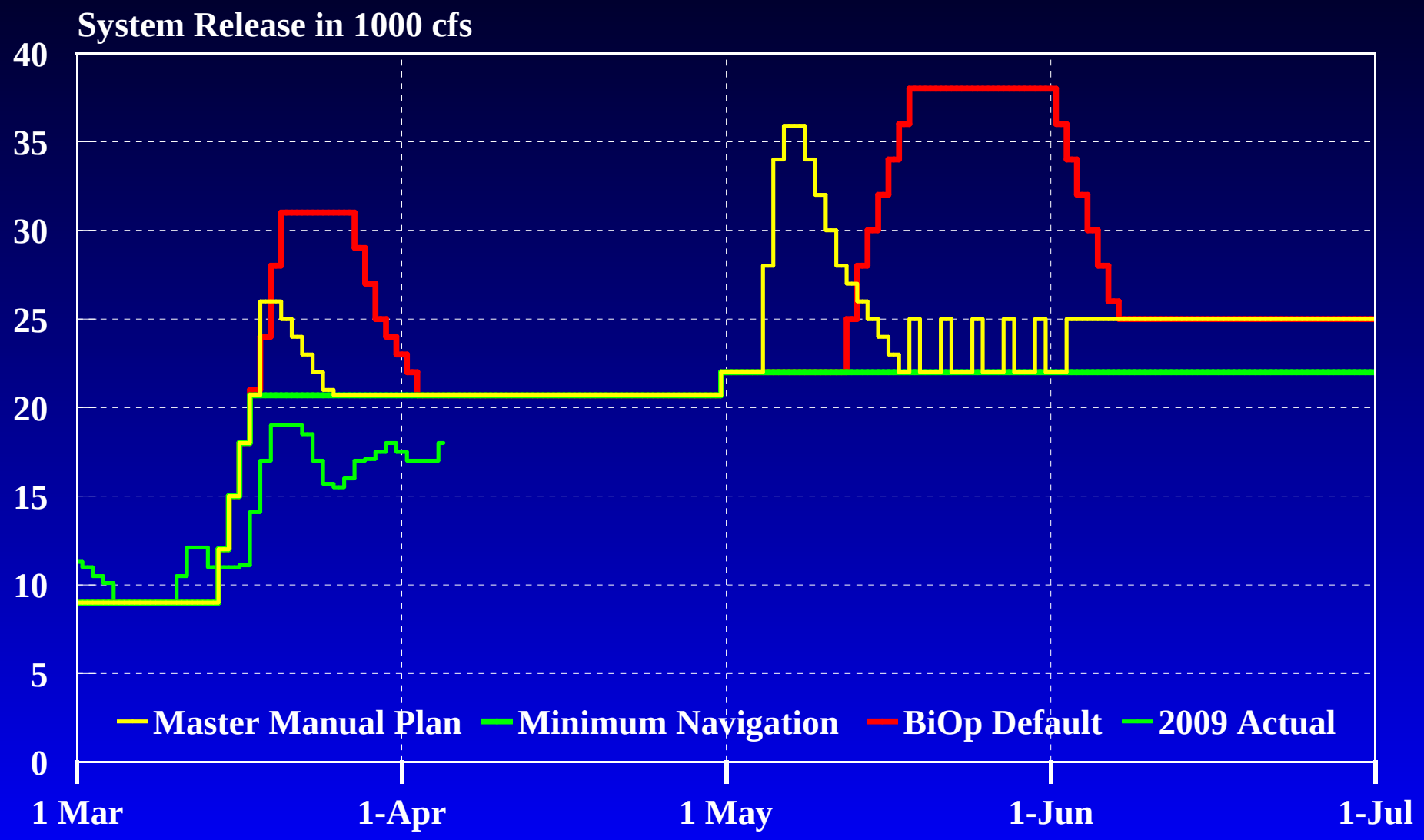
Gavins Point
Spring Pulse Releases



Gavins Point
Spring Pulse Releases



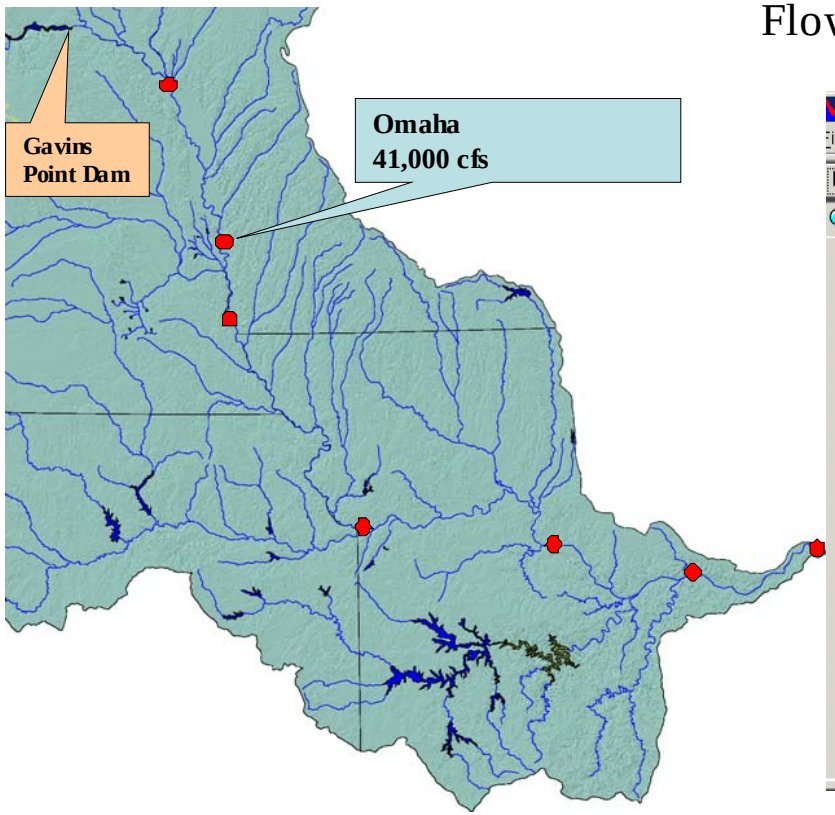
Gavins Point
Spring Pulse Releases



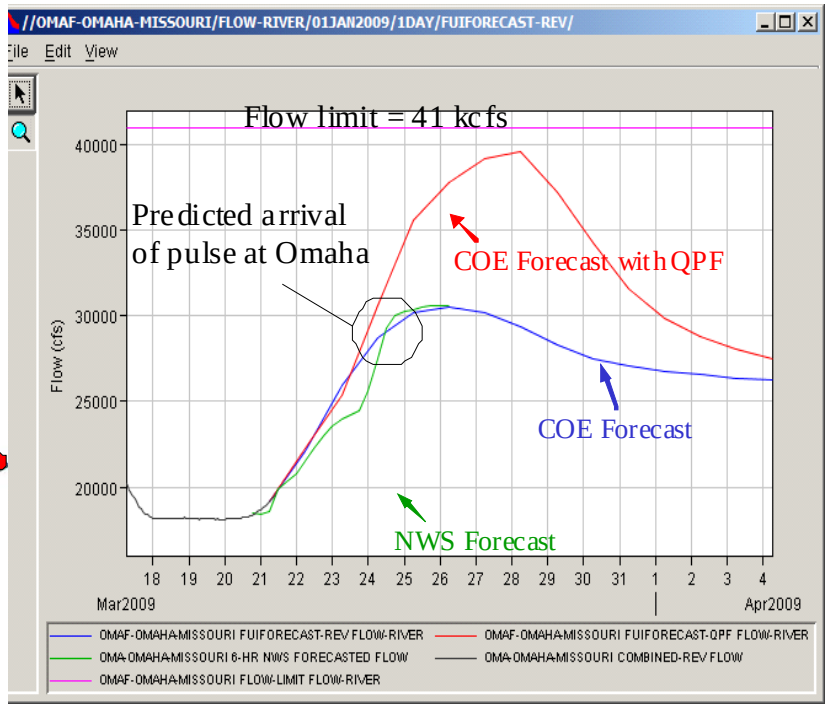
Navigation Targets and Downstream Flow Limits during Spring Pulses

	Minimum Service	Full Service	Downstream Flow Limit
Omaha	25 kcfs	31 kcfs	41 kcfs
Nebraska City	31 kcfs	37 kcfs	47 kcfs
Kansas City	35 kcfs	41 kcfs	71 kcfs

Omaha, Nebraska

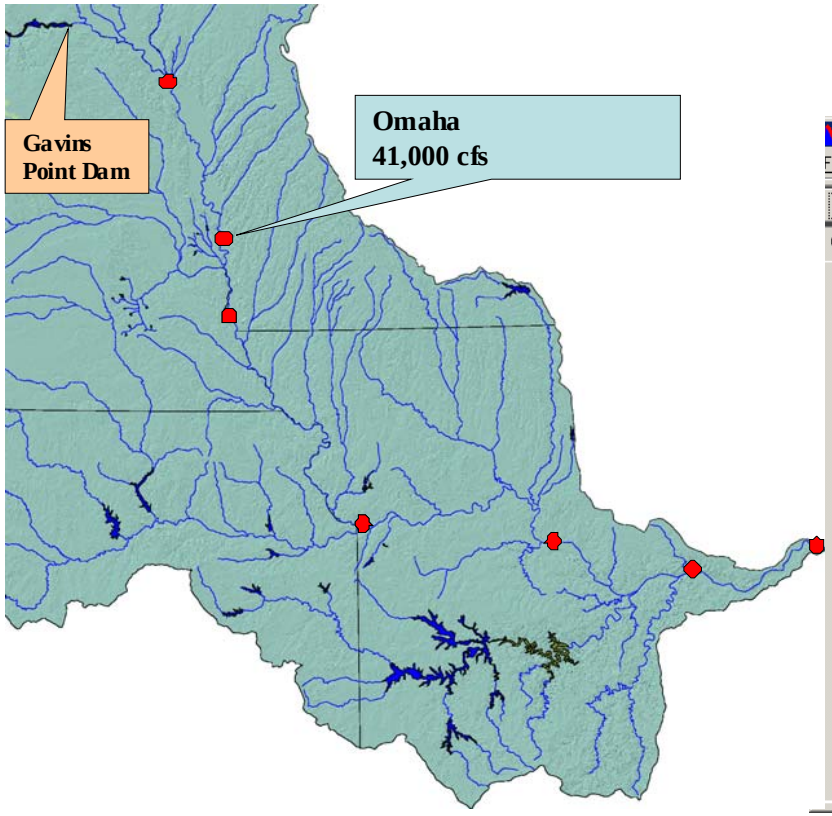


Flow prediction below 41 kcfs flow limit

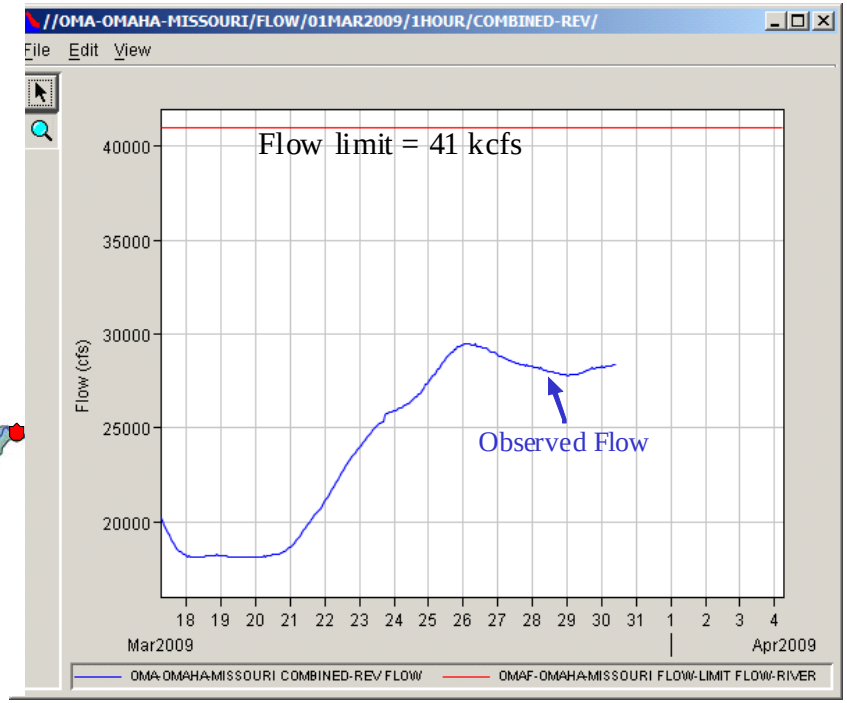


Flood Stage – 29 feet
Approximate Flow – 149,000

Omaha, Nebraska



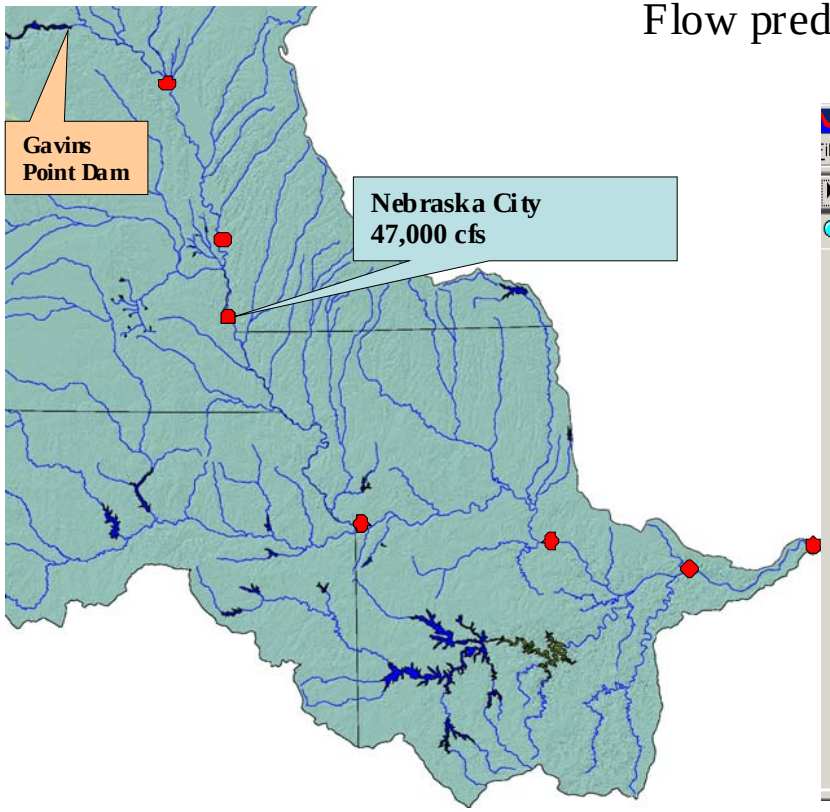
Flow peaked at 29.5 kcfs -
below 41 kcfs flow limit

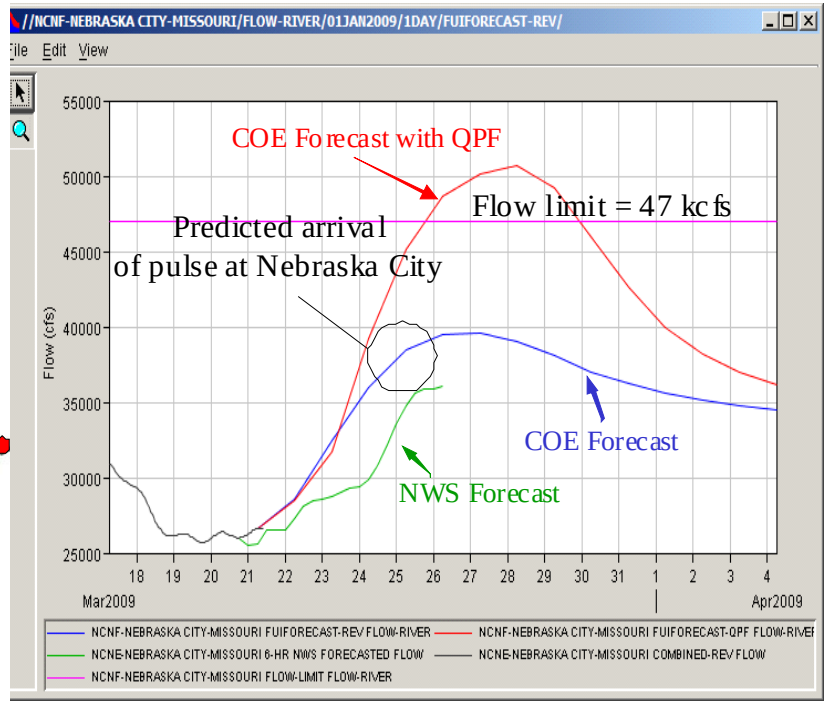


Flood Stage – 29 feet
Approximate Flow – 149 kcfs

Nebraska City, Nebraska

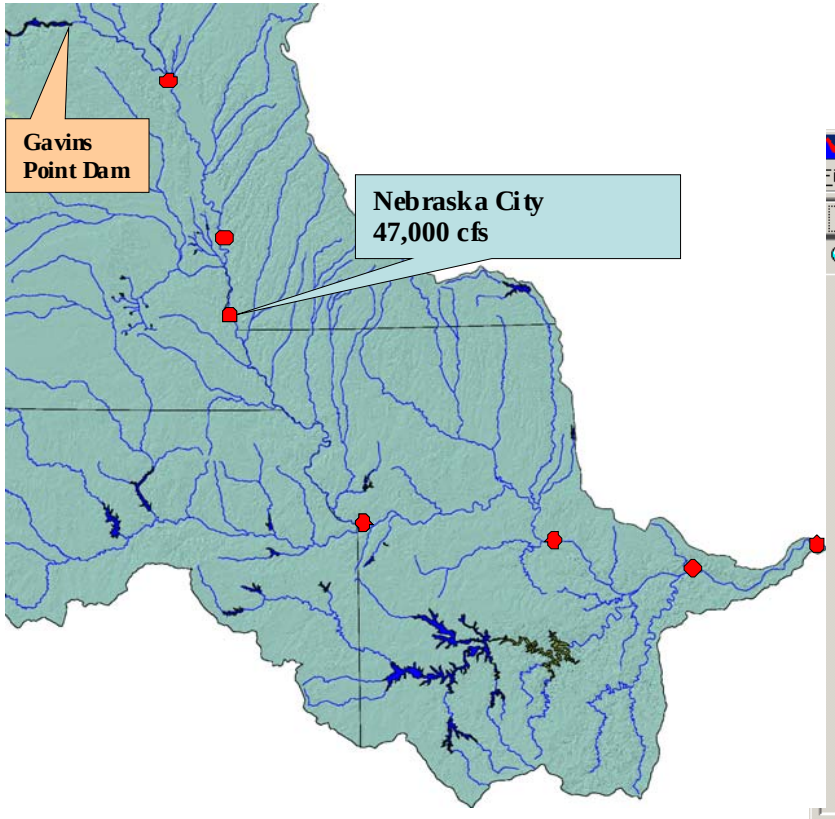
Flow prediction with QPF above 47 kcfs flow limit



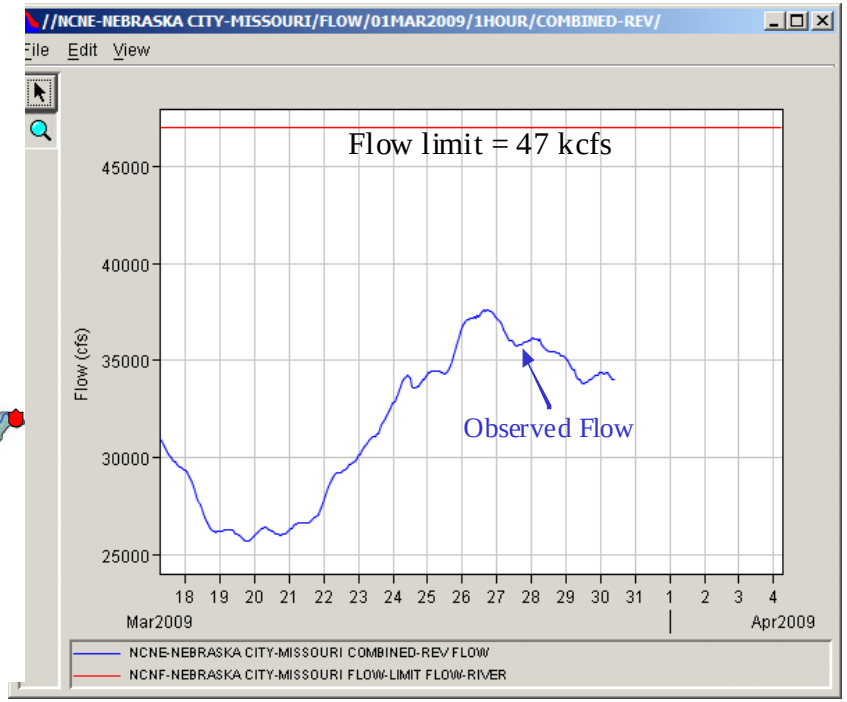


Flood Stage – 18 feet
Approximate Flow – 85,000

Nebraska City, Nebraska

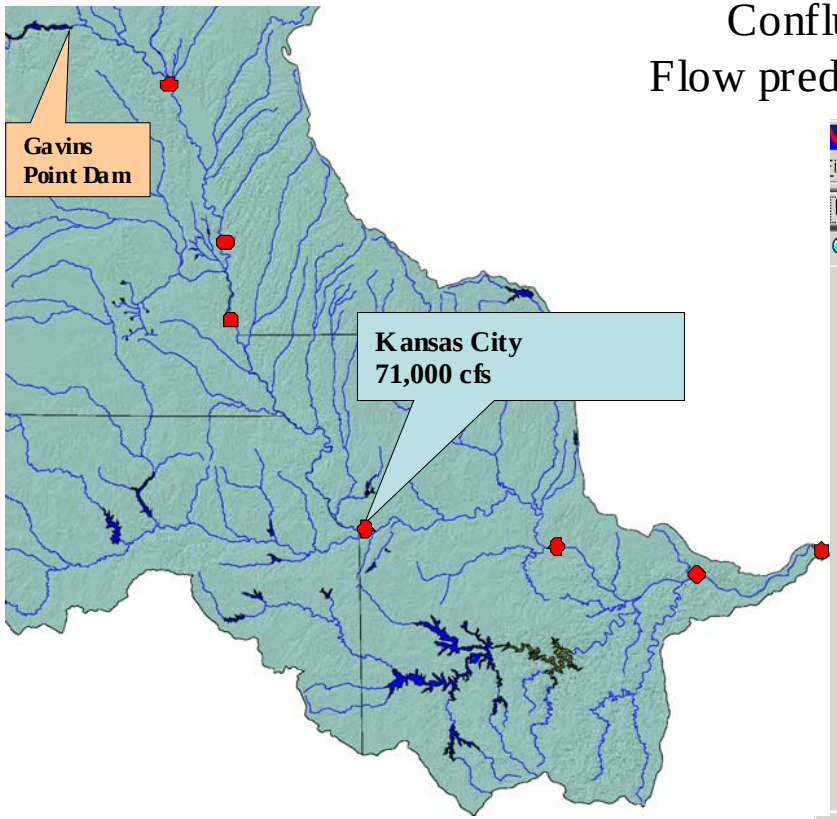


Flow peaked at 37.6 kcfs -
below 47 kcfs flow limit

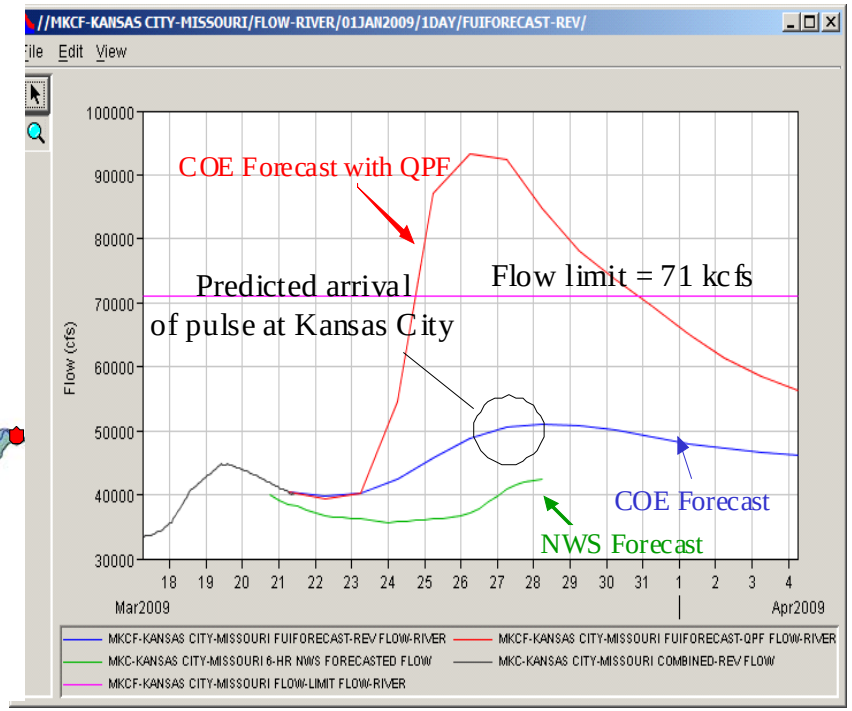


Flood Stage – 18 feet
Approximate Flow – 85 kcfs

Kansas City, Missouri

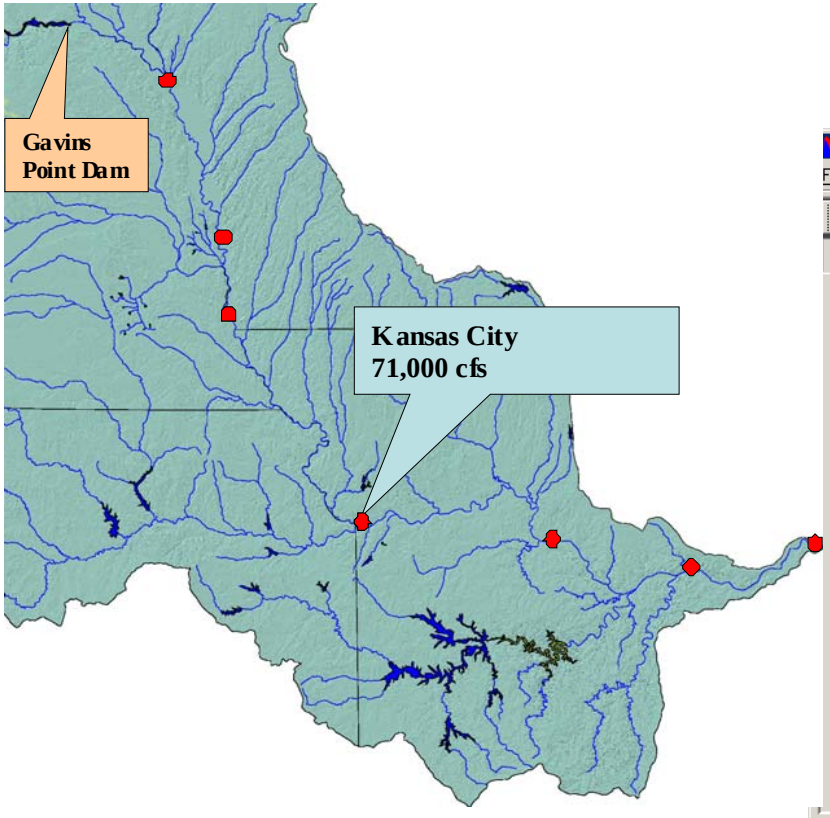


Confluence of Missouri and Kansas Rivers
Flow prediction with QPF above 71 kcfs flow limit

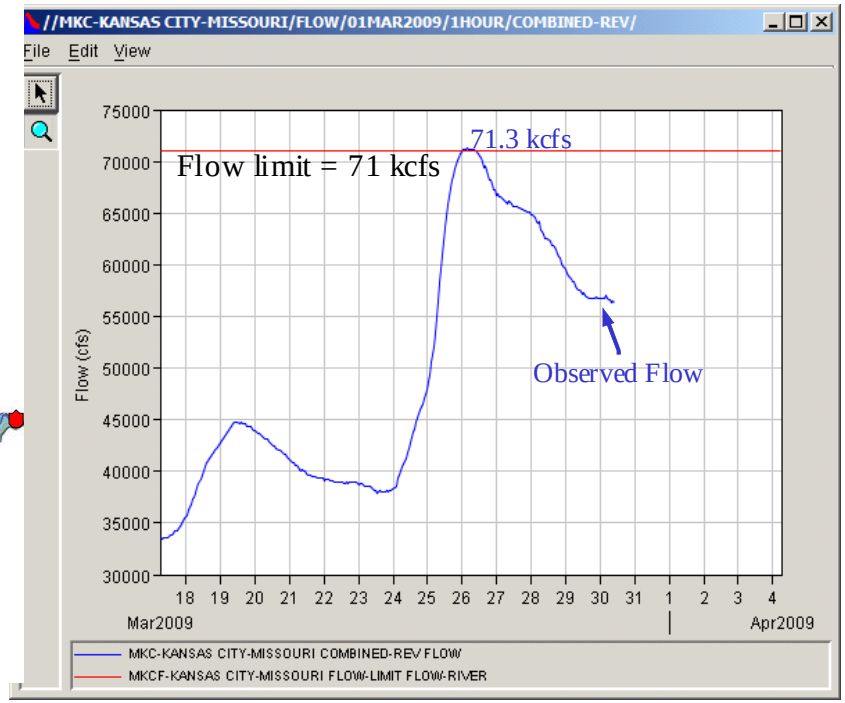


Flood Stage – 32 feet
Approximate Flow –249,000

Kansas City, Missouri



Confluence of Missouri and Kansas Rivers
Flow peaked at 71.3 kcfs –
above 71 kcfs flow limit



Flood Stage – 32 feet
Approximate Flow – 249 kcfs

Congressionally Authorized Project Purposes

2009 Expected Results

Flood Control

Navigation

Hydroelectric Power

- Forecast 69% of normal in 2009.

Irrigation

- Improved access due to higher reservoir levels and releases.

Water Supply & Water Quality

- Improved access & water quality due to higher reservoir levels.

Recreation

- Near normal access due to higher reservoir levels and releases.

Fish and Wildlife

- Endangered Species
  - March spring pulse from Gavins Point dam cancelled due to downstream flow limits.
  - May spring pulse planned.
  - Releases adjusted when birds begin nesting activities.
- Attempt to keep lakes steady to rising during fish spawn; favor Garrison if necessary.

Missouri River Basin

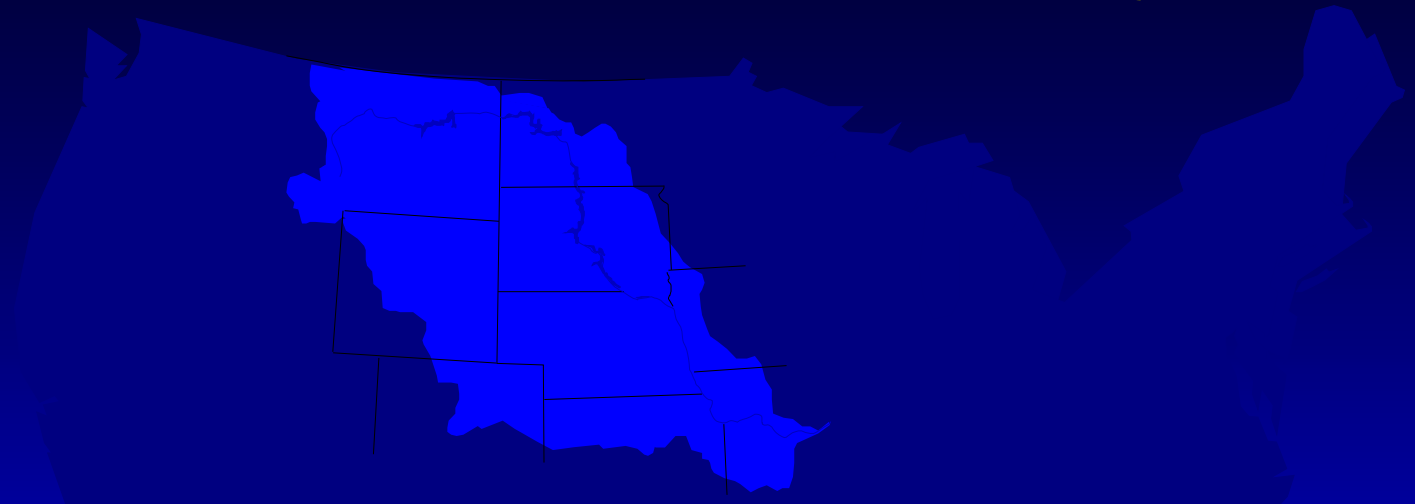
RCC

Since 1953

Water Management Division

US Army
Corps of Engineers

Missouri River Mainstem System



Spring AOP Public Meeting

Thank You