2005 Colorado River Symposium

Sharing the Risks: Shortage, Surplus, and Beyond

Present Day Drought Conditions in the Colorado River Basin

Greg Smith, Hydrologist

Colorado Basin River Forecast Center / NWS / NOAA

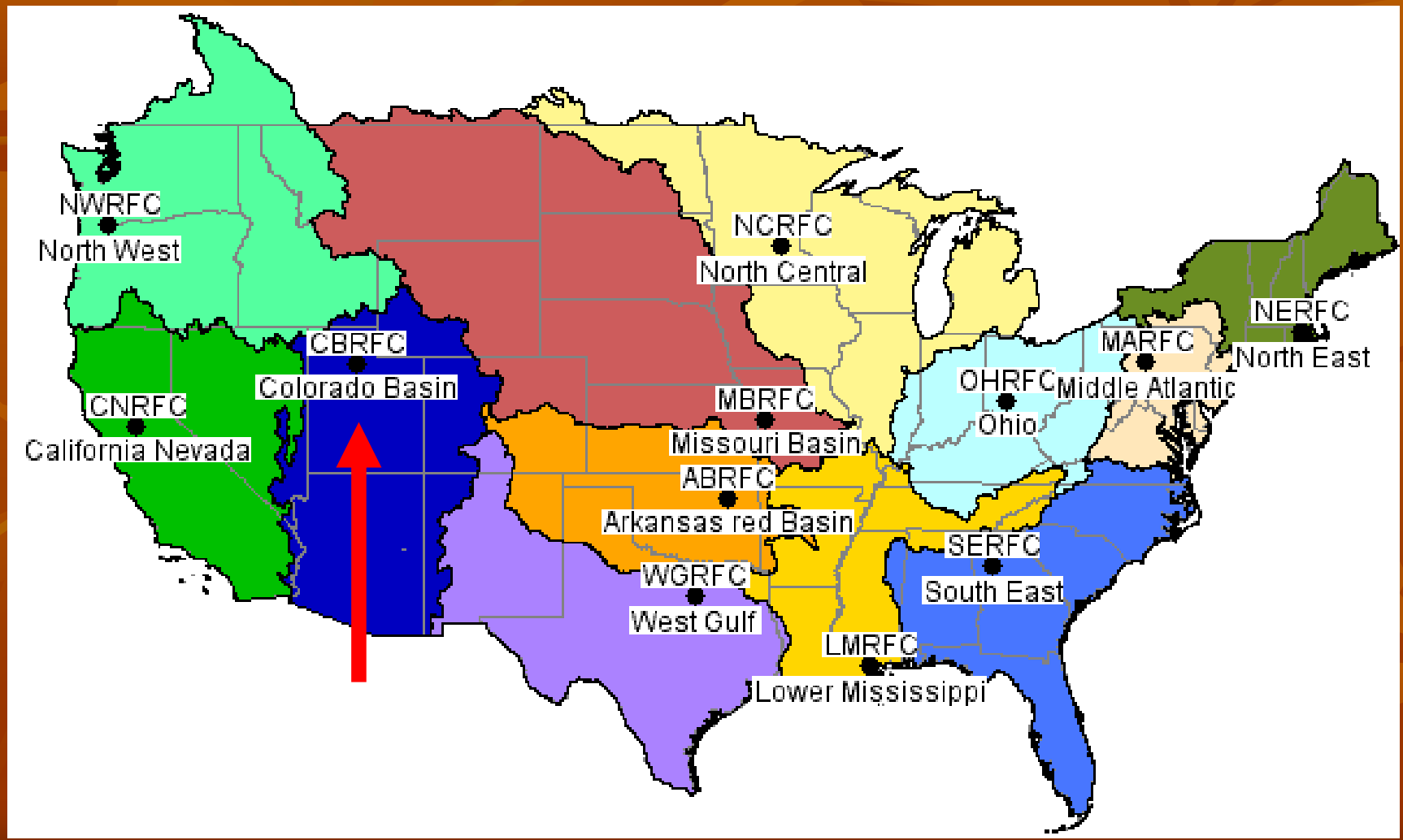
September 28-30, 2005

Bishops Lodge, Santa Fe, New Mexico

NOAA

NWS

Location: Salt Lake City, Utah



NOAA

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Mission: Protection lives/property-Enhance national economy

Event Driven (rain, snowmelt) River Forecasts => Warnings

Flash Flood Guidance => Warnings

Recreational Forecasts (River trends – Peak Flows)

Water Supply => Reservoir Management

Colorado River

Colorado River

Hite Bay looking upstream

Full Pool Elevation

Five Year Historic Drought

2000 - 2004

Lake Powell

3/9/2003

Bureau of Reclamation

Drought: How Severe ?

- Drought is in the eye of the beholder -

- Common occurrence & normal part of climate variability -

Drought is a function of:

- Spatial Extent & Duration
- Magnitude of:
  - Precipitation Deficits
  - Water Supply Deficits
  - Impacts (environmental, social, economic)

Drought: How Severe ?

Hydrologic Stats

Five consecutive years of below average inflow to Lake Powell (Colorado River Basin) 2000-2004.

Average inflow 2000-2004 lower than “dustbowl years” of 1930-1937.

Lowest Inflow on record (observed data) occurred in 2002.

Lake Powell / Lake Mead System storage decreased 45% from 1999 to 2004.

USGS: Dendrochronology suggests recent drought largest in 500 years.

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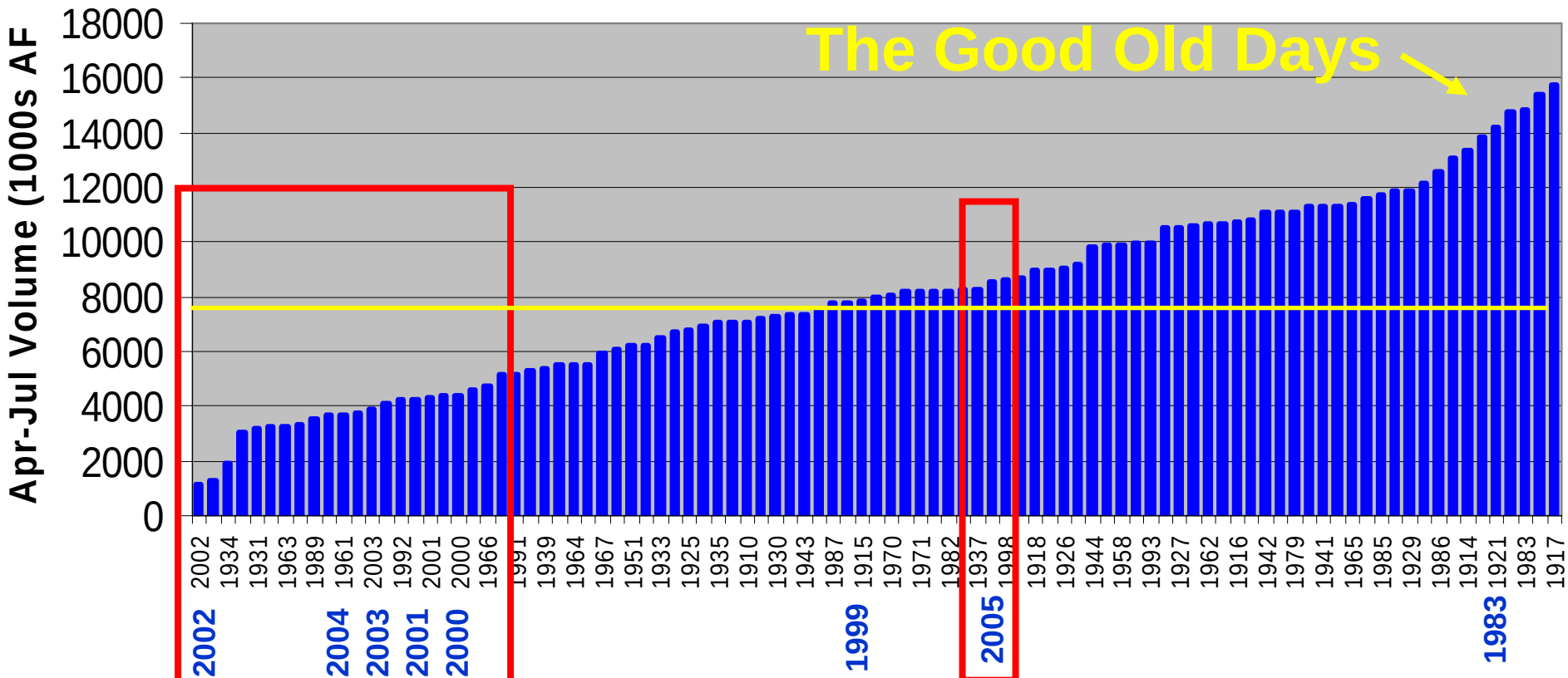
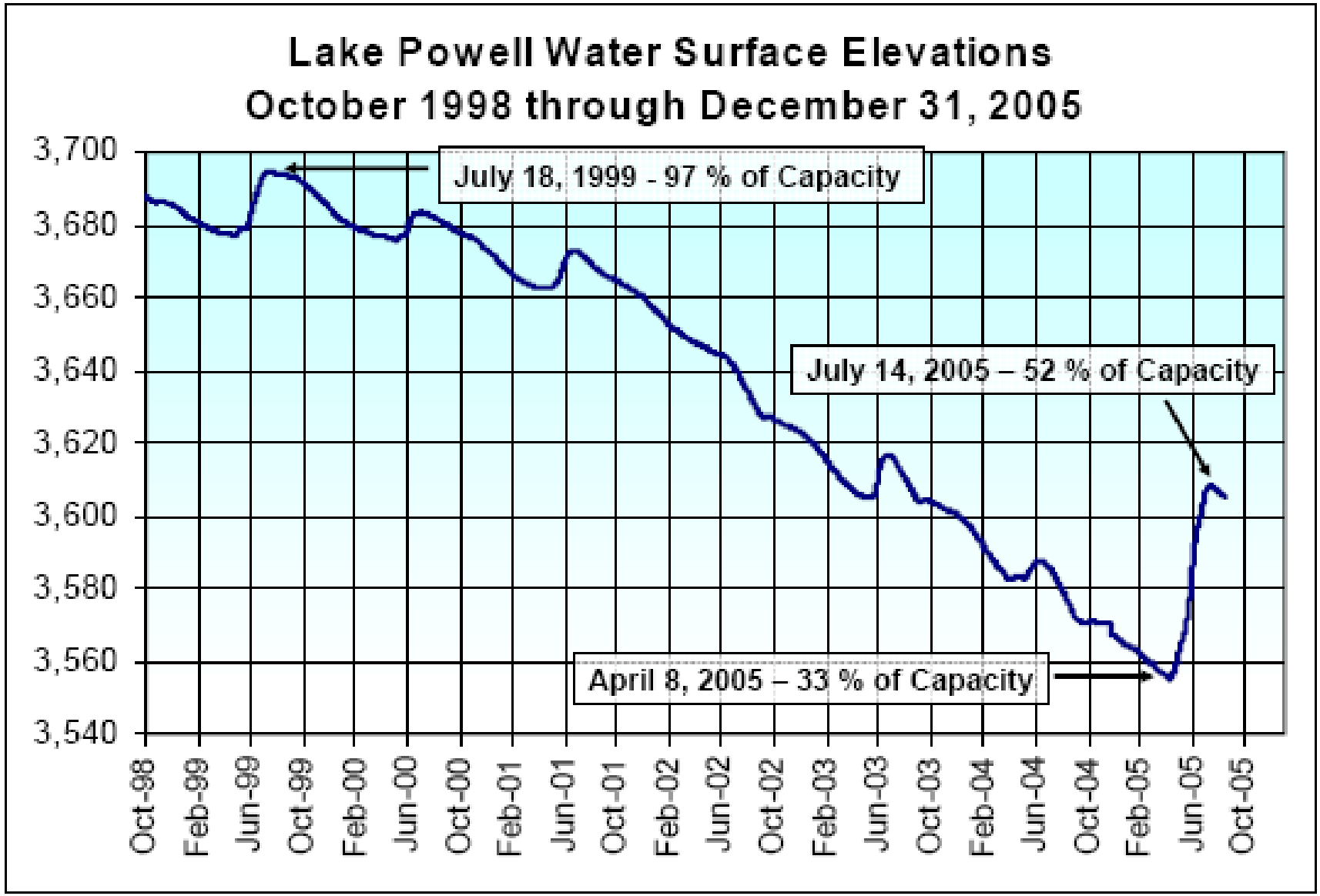
INFLOW TO LAKE POWELL
(96 YEARS OF RECORD)

Inflow Volume To Lake Powell For April-July Period
Ranked From Smallest to Largest Volumes





RECLAMATION

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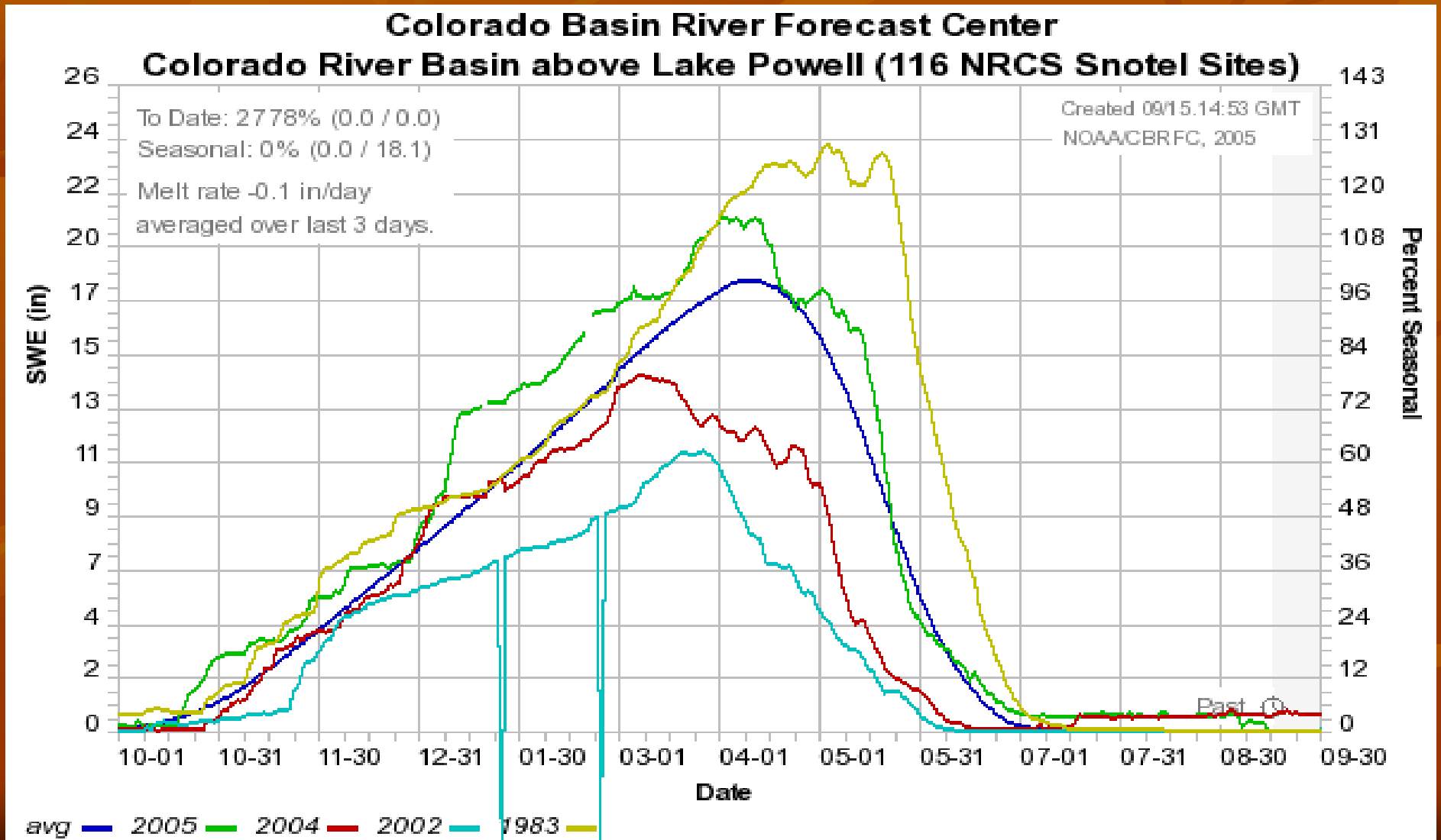
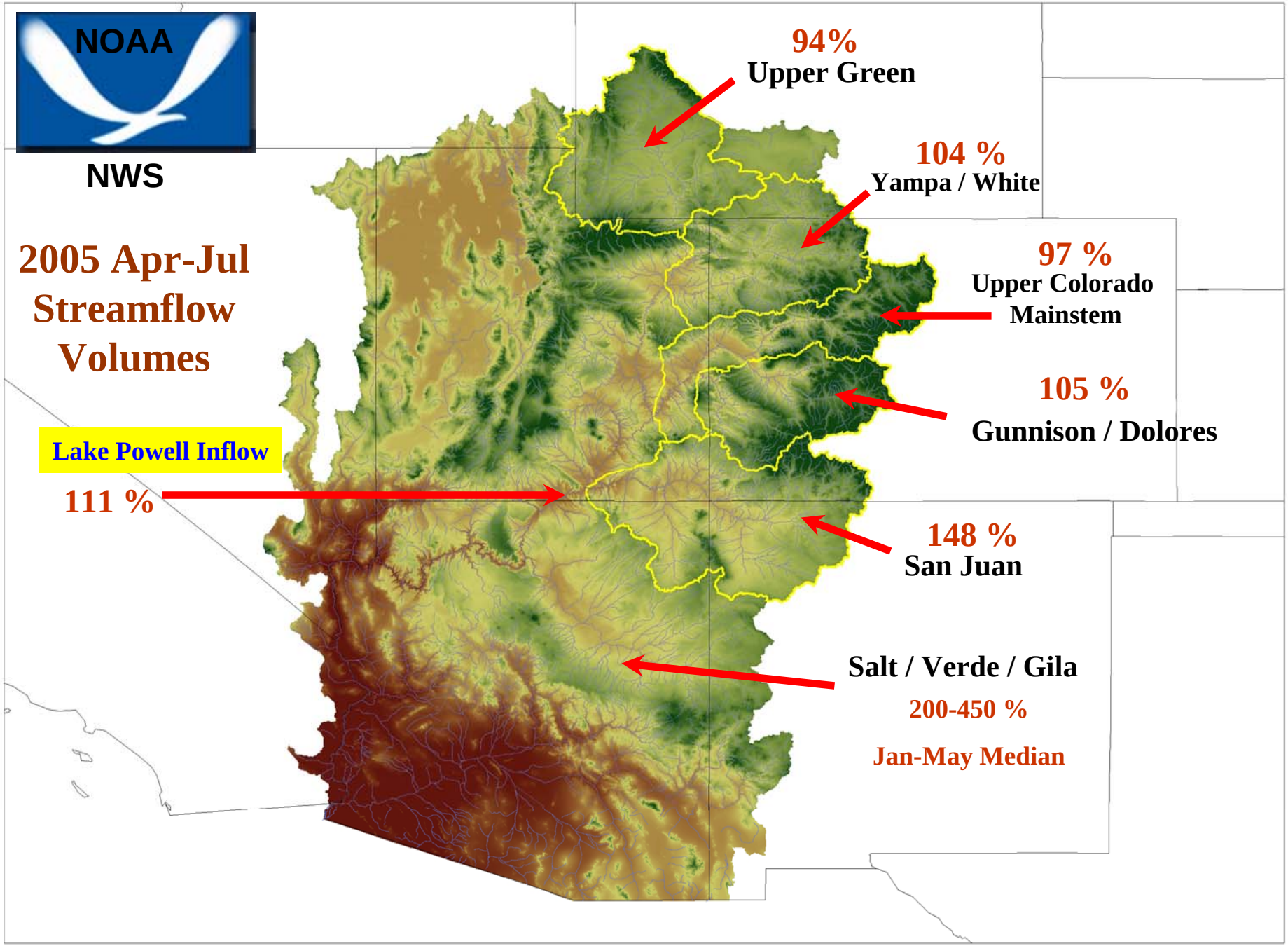
Snow Water Equivalent From 116 Stations Above Lake Powell

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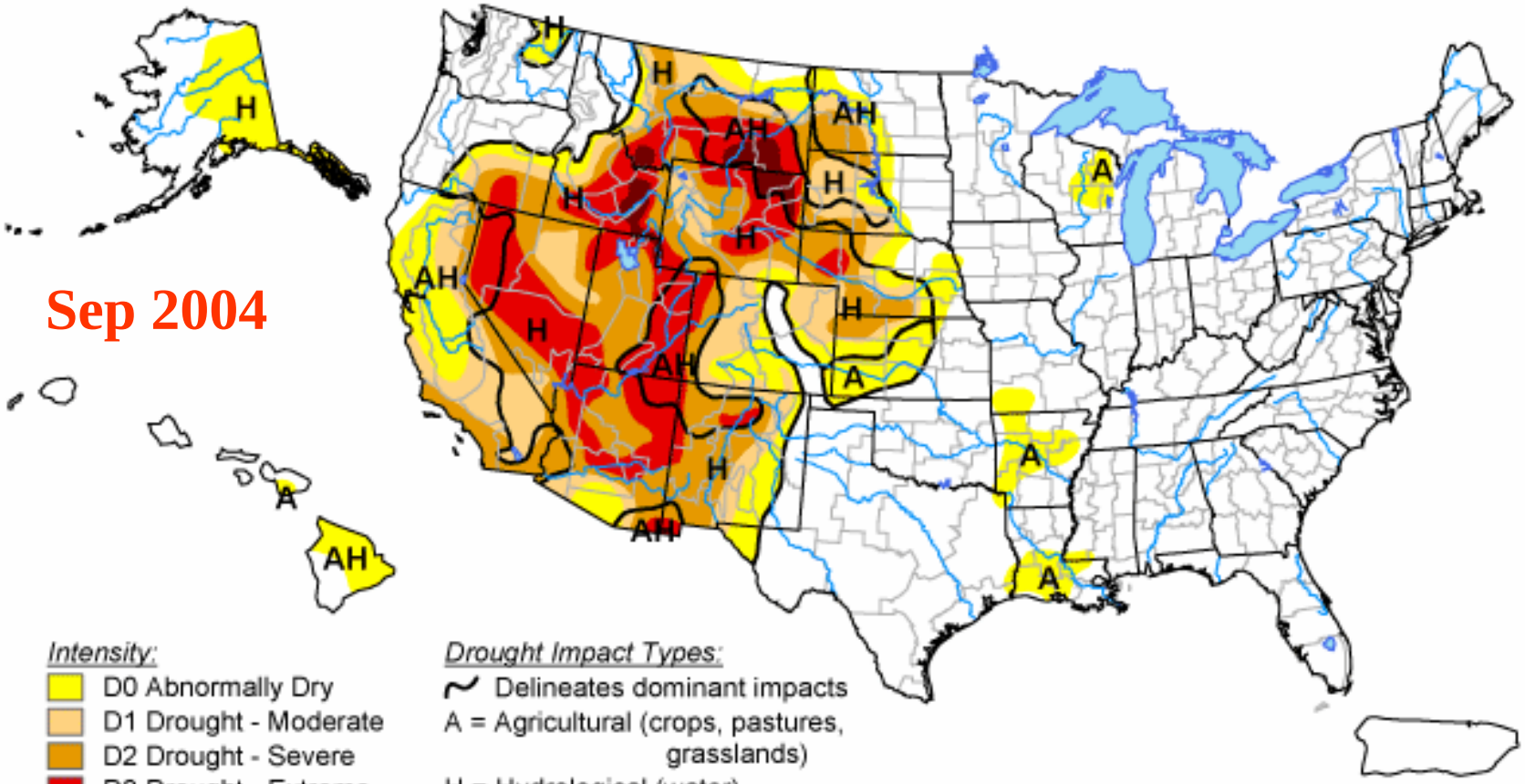
2005 Apr-Jul Streamflow Volumes
94%
Upper Green
104 %
Yampa / White
97 %
Upper Colorado Mainstem
105 %
Gunnison / Dolores
Lake Powell Inflow
111 %
148 %
San Juan
Salt / Verde / Gila
200-450 %
Jan-May Median

U.S. Drought Monitor

September 21, 2004
Valid 8 a.m. EDT



Sep 2004

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)
- (No type = Both impacts)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

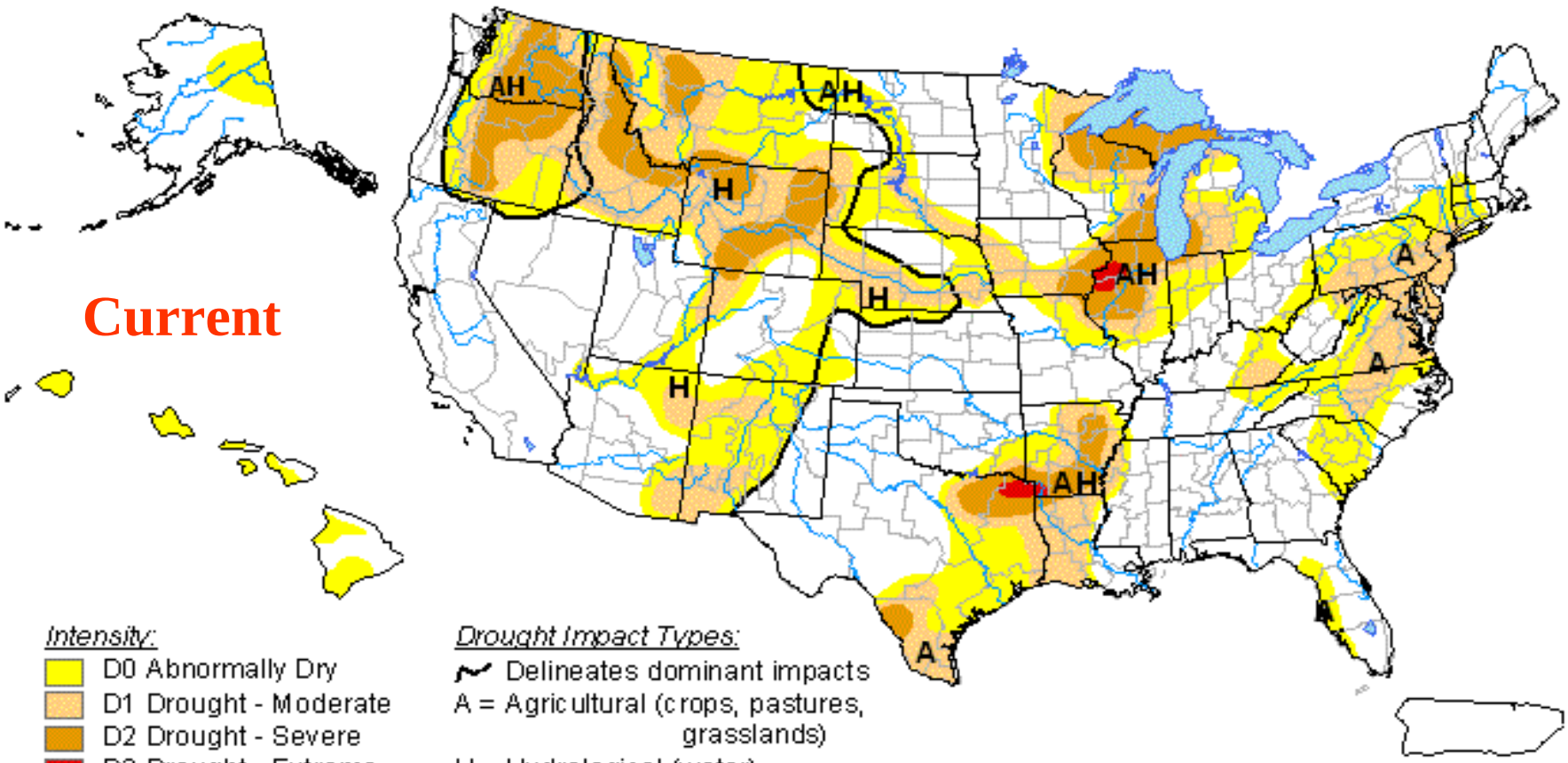
USDA National Drought Mitigation Center

Released Thursday, September 23, 2004

Author: Brad Rippey, U.S. Department of Agriculture

U.S. Drought Monitor

September 20, 2005
Valid 7 a.m. EST



Current

Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:
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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, September 22, 2005

Author: Douglas Le Comte, CPC/NOAA

Does this mean the drought is over

Have we turned the corner

?

What about 2006

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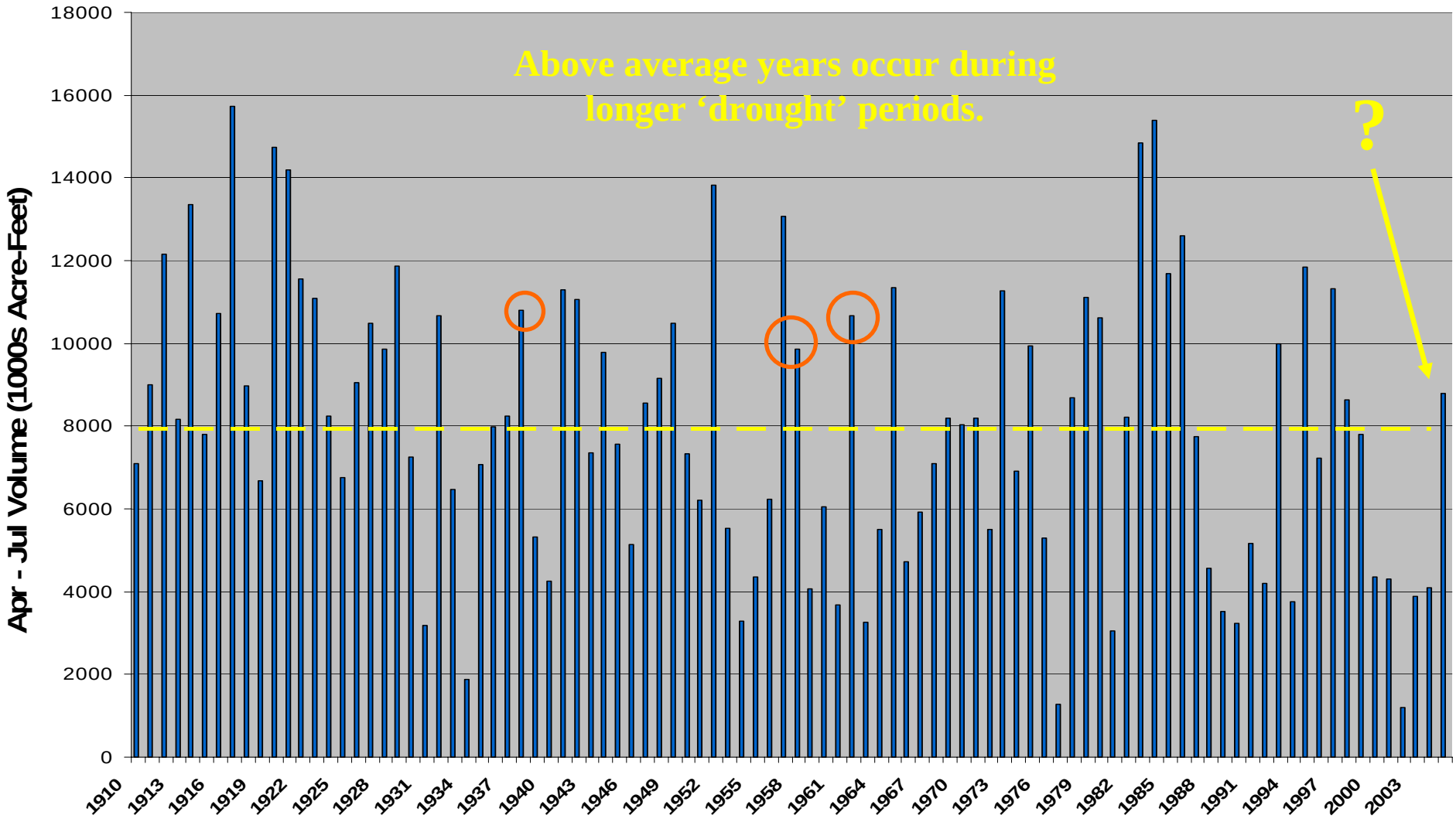
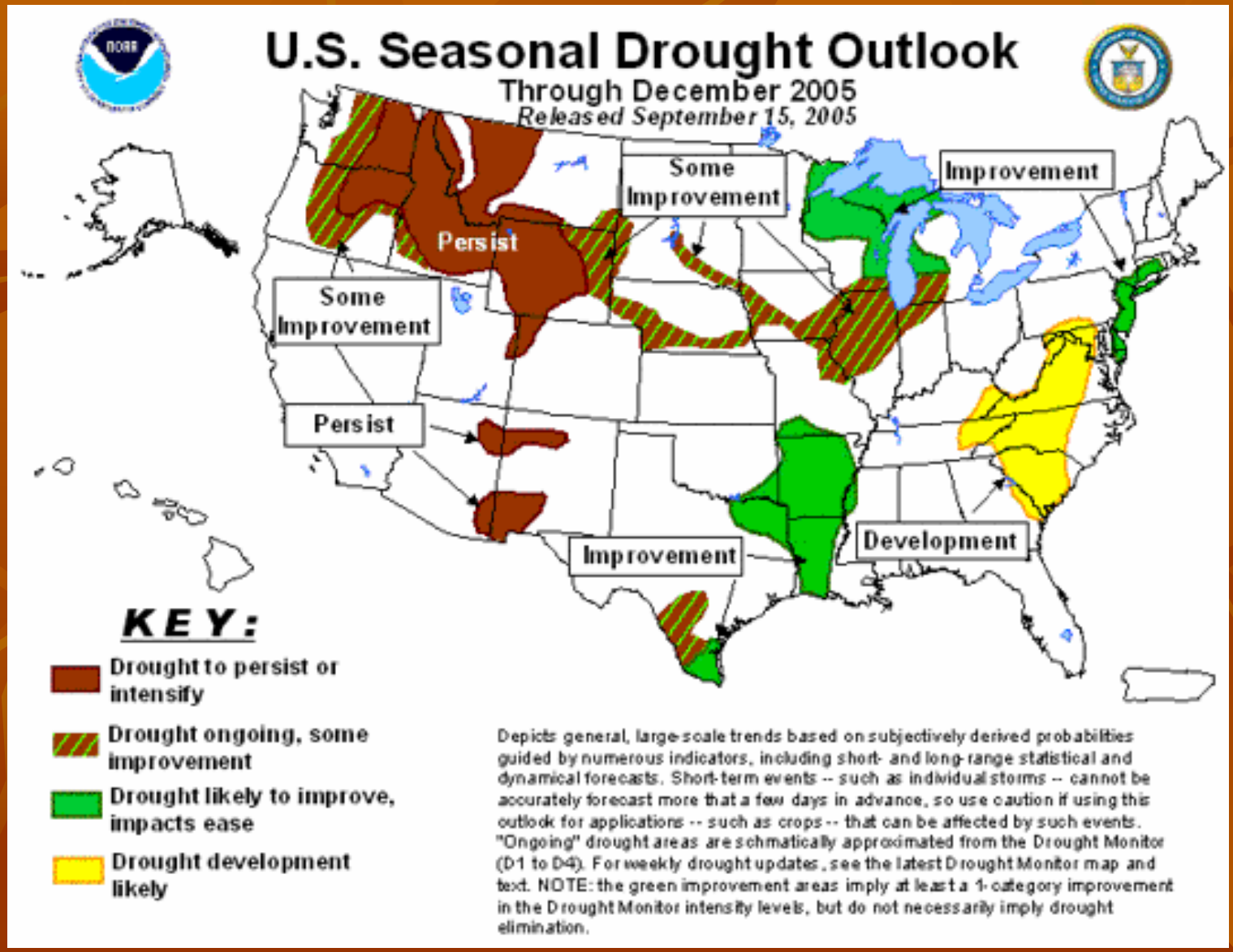
INFLOW TO LAKE POWELL
(96 YEARS OF RECORD)




U.S. Seasonal Drought Outlook
Through December 2005
Released September 15, 2005
Persist
Some Improvement
Improvement
Some Improvement
Persist
Improvement
Development
KEY:
Drought to persist or intensify
Drought ongoing, some improvement
Drought likely to improve, impacts ease
Drought development likely
Depicts general, large-scale trends based on subjectively derived probabilities guided by numerous indicators, including short- and long-range statistical and dynamical forecasts. Short-term events -- such as individual storms -- cannot be accurately forecast more that a few days in advance, so use caution if using this outlook for applications -- such as crops -- that can be affected by such events. "Ongoing" drought areas are schmatically approximated from the Drought Monitor (D1 to D4). For weekly drought updates, see the latest Drought Monitor map and text. 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.

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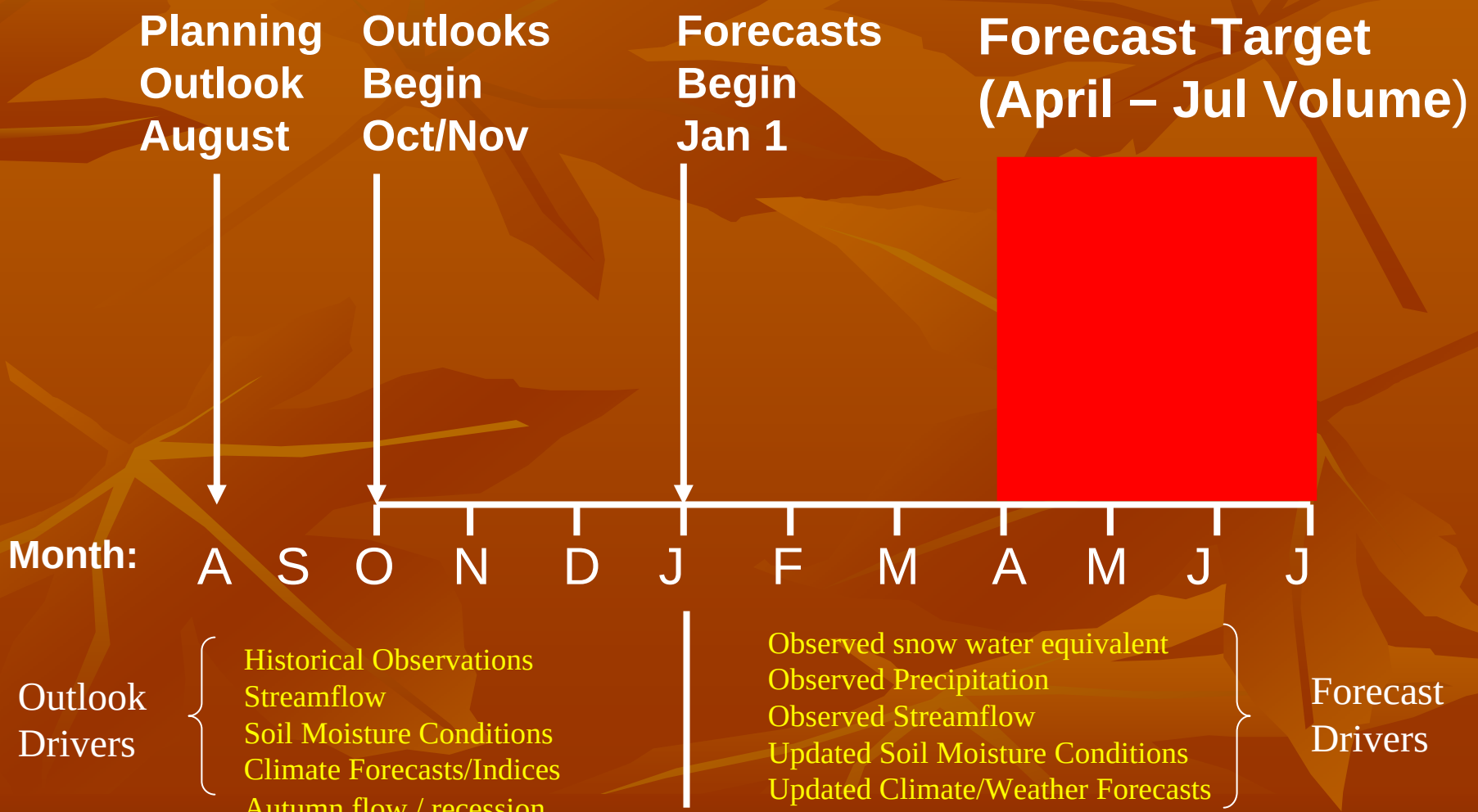
Time Line For Early Season Outlooks



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Developing A Forecast

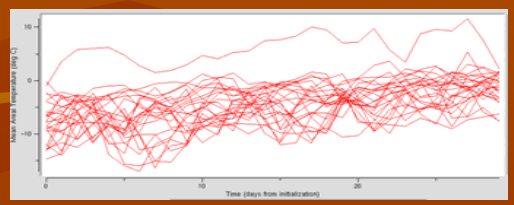
Today's Conditions
River / Res. Levels
Soil Moisture
Snowpack

Future Streamflow

1971
1972
1973
1974
1975

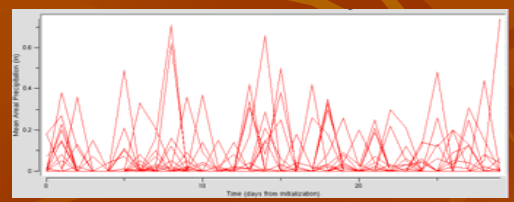
Past <- -> Future Time

72
73
74
75



Temperature

1971



Precipitation

Start with Today's Conditions - Create several possible future streamflow patterns - Based on historical climate.

Developing A Forecast

NWS

Today's Conditions
River / Res. Levels
Soil Moisture
Snowpack

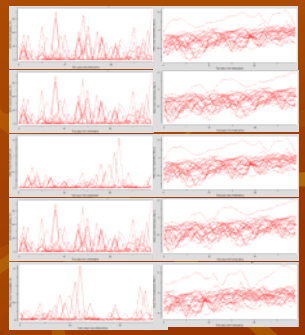
Near Term – **Blend Temperature / Precipitation (1-15 days)**

Flow Traces

1971
1972
1973
1974
1975

Past <- -> Future Time

71
72
73
74
75



Longer Term (months-year): Weigh analysis on Climate Prediction Center forecasts.

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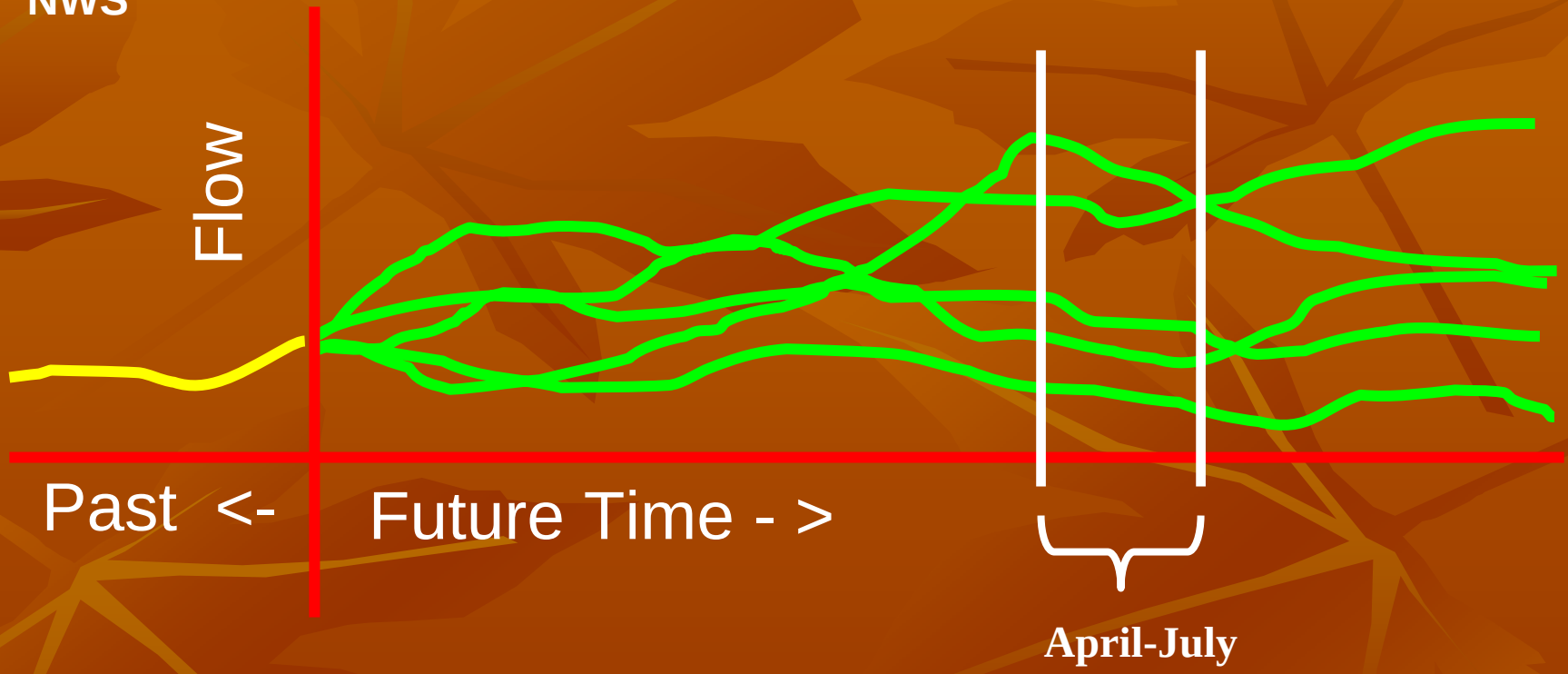
Developing a forecast



Determine a most likely forecast (most probable 50/50)

Determine an upper boundary forecast (10% chance of exceeding)

Determine a lower boundary forecast (90% chance of exceeding)

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Skill: Improvement over climatology

~ 5-15% improvement over simply using climatology

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2006 Outlook for April-July Lake Powell Inflow

10 % Chance To Exceed:	**13.0 MAF**
25% Chance To Exceed:	**10.5 MAF**
Average:	***7.9 MAF***
50% Chance To Exceed:	**7.0 MAF**
75% Chance To Exceed:	**3.5 MAF**
90% Chance To Exceed:	**1.5 MAF**

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Other indicators we can use for the near term ?

Autumn 2004

Statistics: 5 years below average flow

Active Monsoon extending into Autumn

Higher autumn streamflow / soil moisture

Signs of a weak El Nino

Ocean/Atmospheric Adjustments ?

- 16th coolest summer on record
- 7th coolest august on record
- Wettest summer in TX, LA, MS, AK, OK, KS
- 8 Named tropical cyclones in August
- 3 Major Hurricanes hit Florida

Indications favoring a change

Today

Statistics: Even in droughts normal years occur

Less Active / Less extensive Monsoon

Greater variation streamflow / soil moisture

Neutral ENSO Conditions

Ocean/Atmospheric Adjustments ?

- June – August 10th warmest on record (lower 48)
- Warmest summer in NJ, 2nd warmest in NY, VT, MA
- All time summer high temperature records in Hawaii
- 3rd warmest summer on record in Alaska.
- 12 named Atlantic tropical cyclones through August
- Hurricanes Katrina and Rita

Less Clear: Near to below normal

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Any long term climate trend information ?

PDO: Pacific Decadal Oscillation

AMO: Atlantic Multidecadal Oscillation

} Sea Surface Temperature Anomalies

AMO positive since mid 1990's

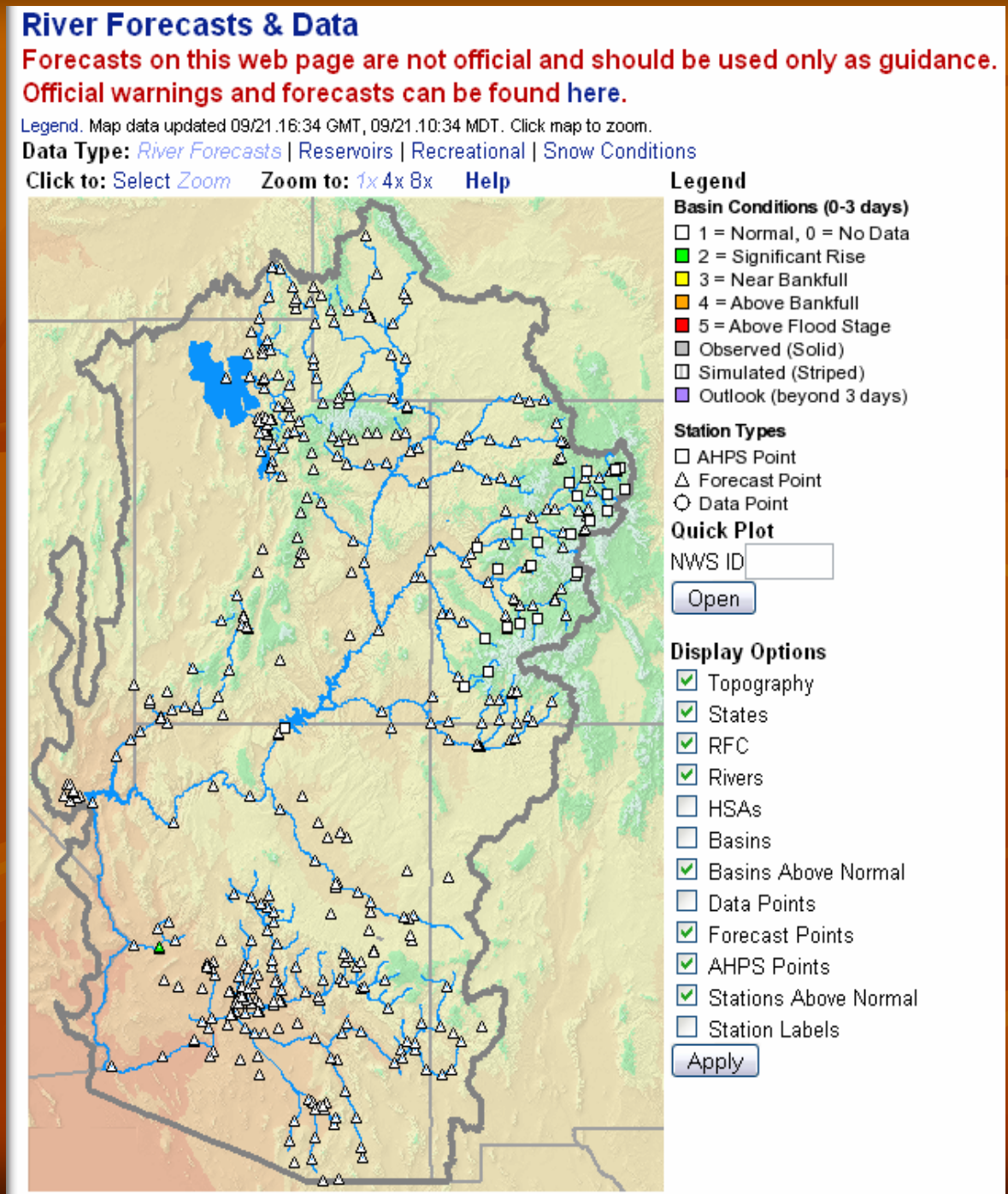
PDO Negative since late 1990s.

Complex relationships between climate indices (AMO, PDO, SOI, etc.), precipitation, and runoff volumes. Climate indices offer only a partial explanation.

Short time-scale atmospheric phenomena can have a significant effect on seasonal climate and streamflow

Sept 2004-February 2005 second wettest for Arizona. Record snowpack in southern Utah and sections of northeast Utah.

River flow records in the Colorado River Basin exhibit significant variability during multi-year periods of above/below average flows that are not explained by the present climate indices available.



Additional Information:

www.cbrfc.noaa.gov

greg.smith@noaa.gov

Thank You !