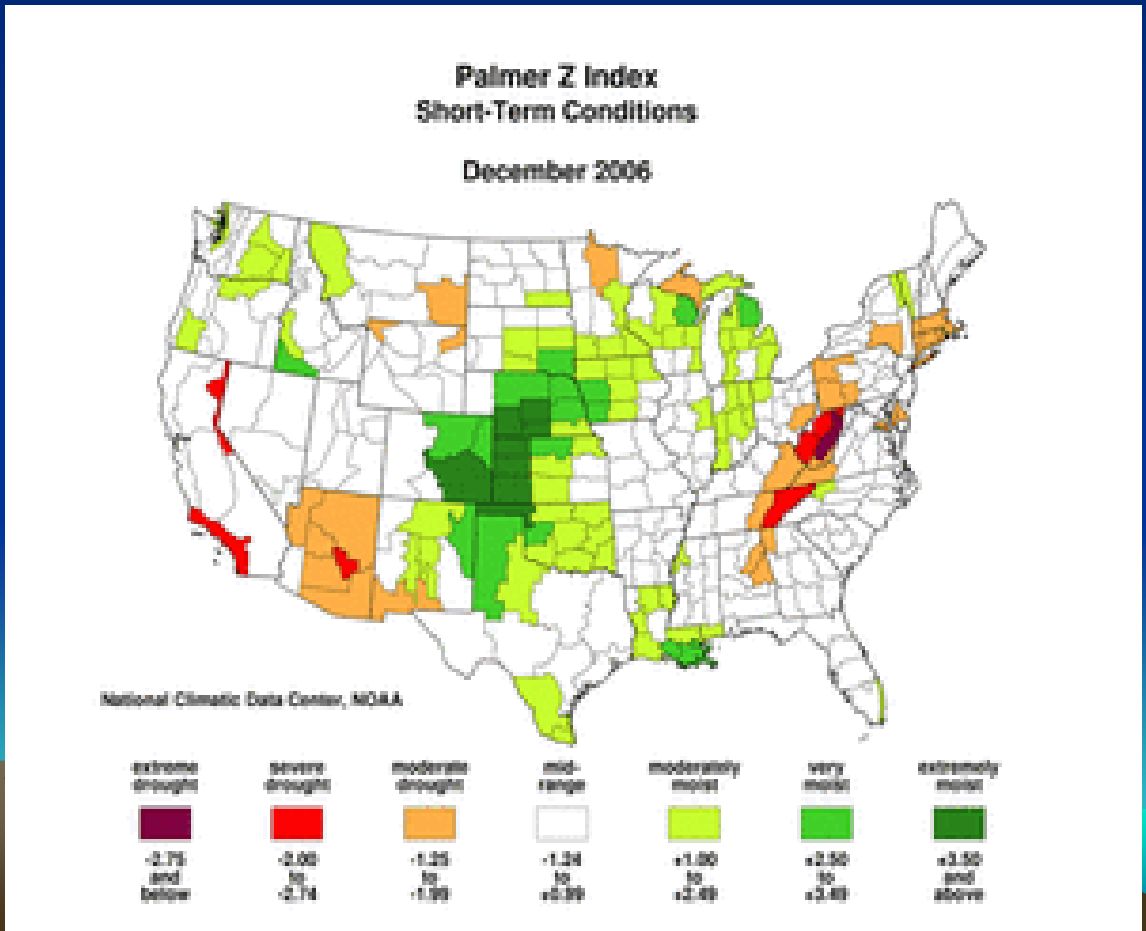
# Arizona Drought Task Force
# Monitoring Technical Committee
# Methods for Determining Drought Status

Nancy J. Selover, Ph.D.
Assistant State Climatologist
Office of Climatology
Arizona State University

# Palmer Z Index

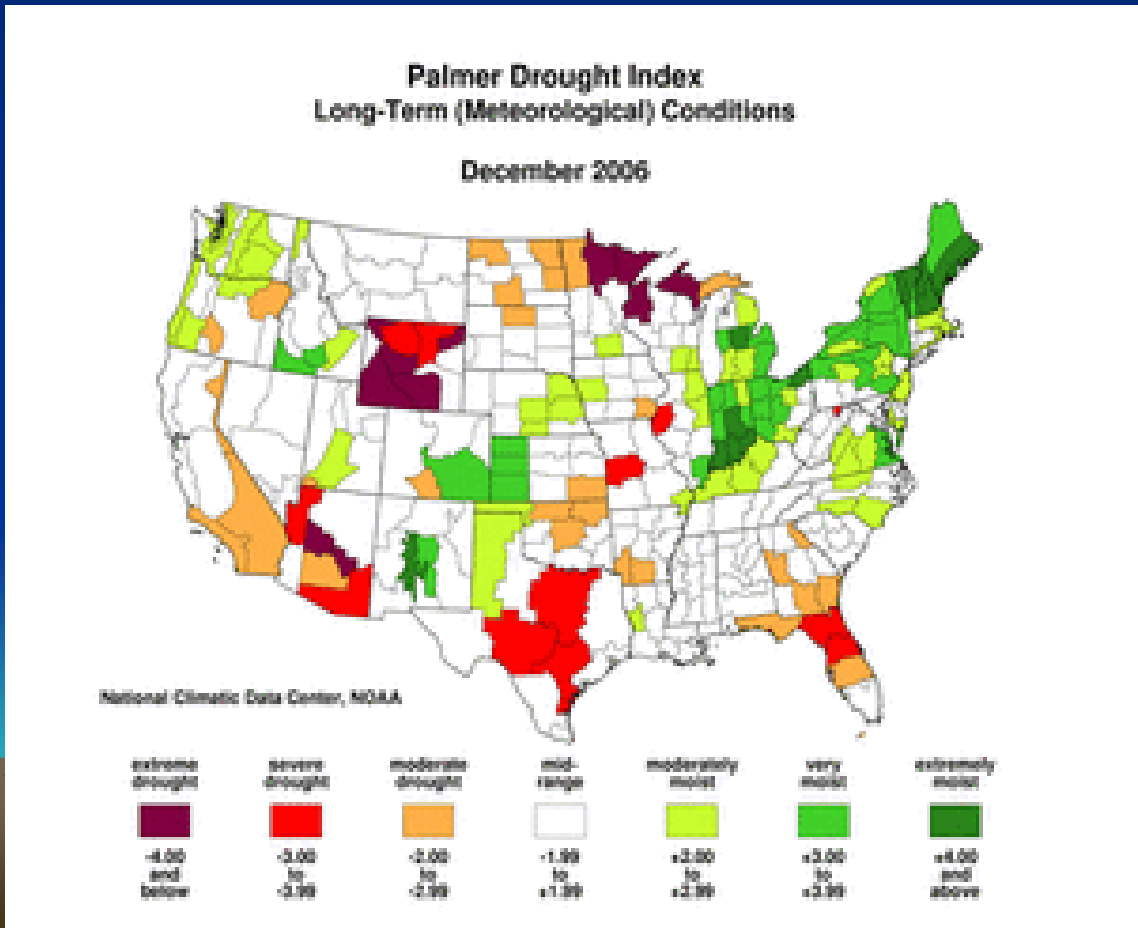
- Departure from normal of monthly moisture supply
- Short-term drought and wetness




NOAA

# Palmer Drought Index - PDI or Palmer Drought Severity Index - PDSI

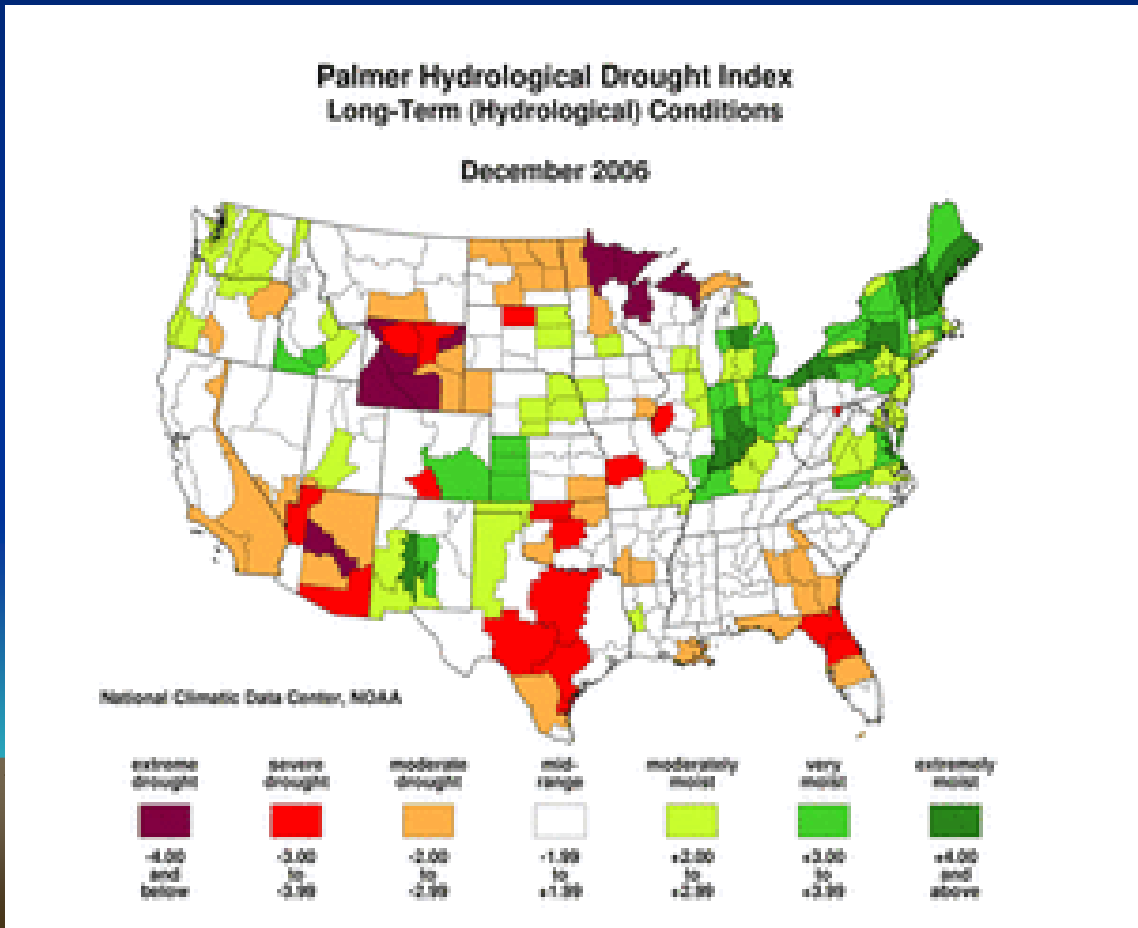
- Departure from normal of 12-month moisture supply
- Long-term meteorological conditions – cumulative
  - weather patterns




NOAA

# Palmer Hydrological Drought Index - PDHI

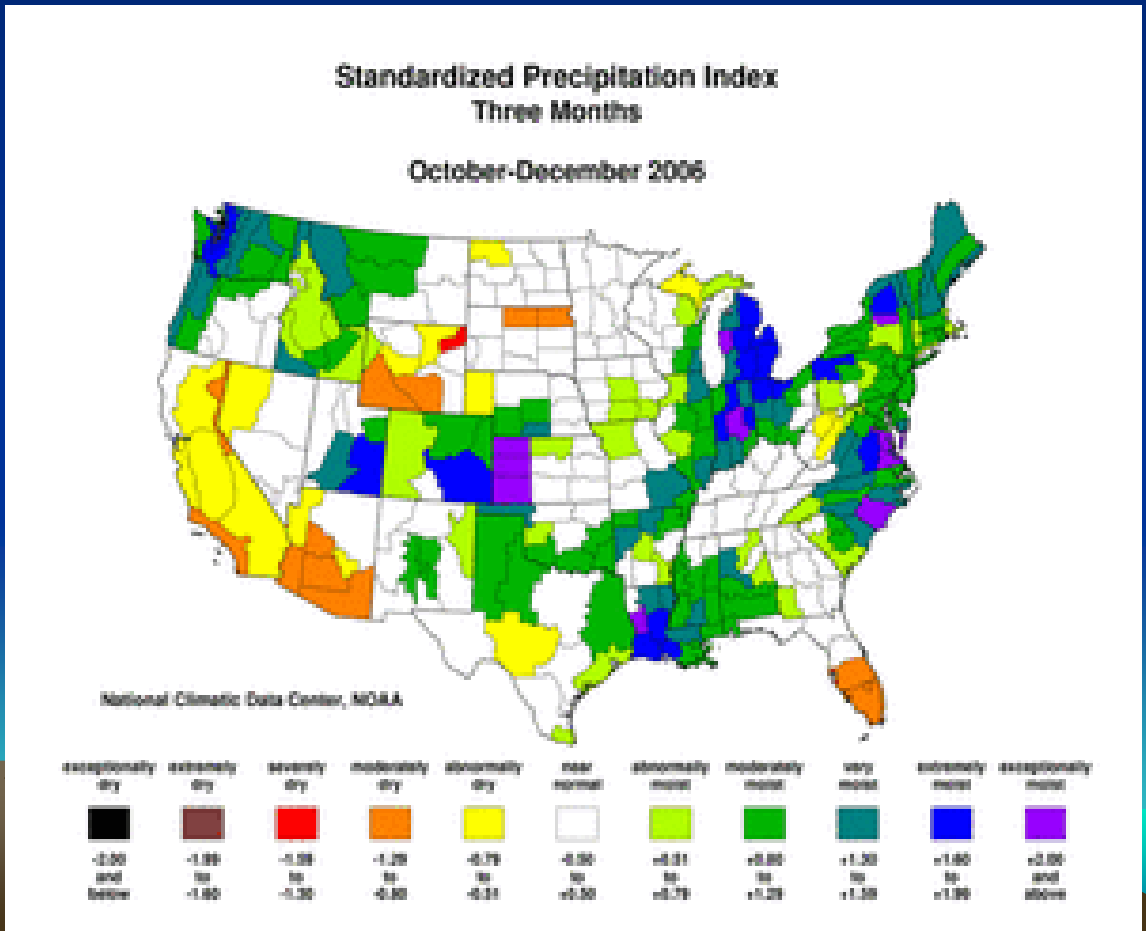
- Departure from normal of 12-month moisture supply
- Long-term hydrologic conditions - cumulative
  - reservoirs and groundwater




NOAA

# Standardized Precipitation Index - SPI

- Departure from normal probability of precipitation occurring over the selected time period




NOAA

# PDSI, PDHI, PZI– Palmer Indices

- Departure from Normal of Moisture Supply
- Based on Temperature and Precipitation
- Are water balance indices
  - –Incorporate supply (precipitation), demand (evapotranspiration), and water loss (run-off)
- Easy to calculate

- Drought severity categories are arbitrary
- May lag the drought conditions by several months
- No pre-determined time scale
- Poor results in extreme climates and mountainous areas

(Goodrich & Ellis 2006)

# SPI – Standardized Precipitation Index

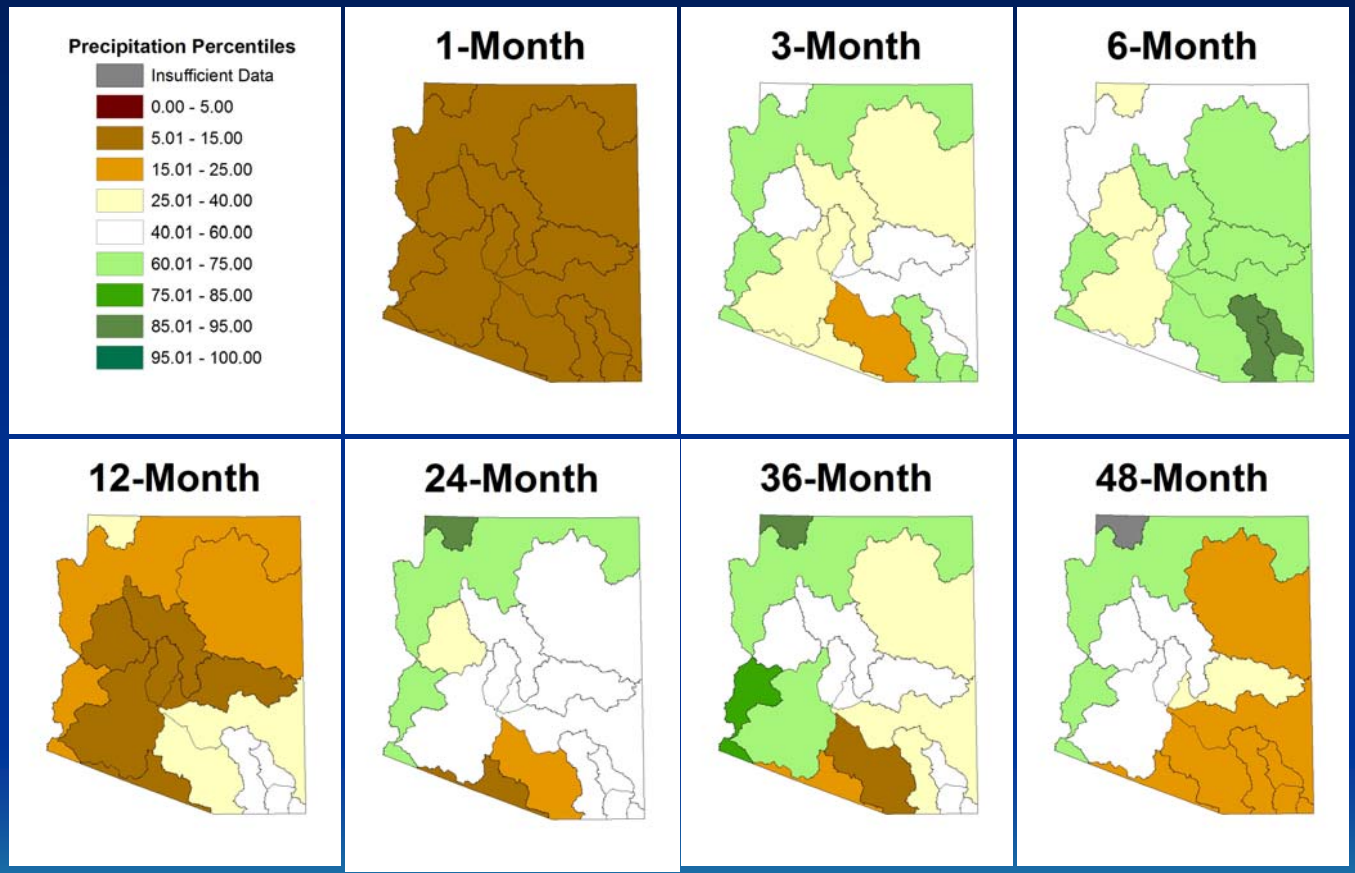
- Departure from median precipitation
  - (+ = greater than median, - = less than median)
- Uses long term precipitation records
- Can be applied at any monthly time-scale
  - 3-Month, 6-Month, 12-Month SPI are used for short-term drought by AZ.
  - 24-Month, 36-Month and 48-Month SPI are used for long-term drought by AZ, along with streamflow.
- Good detector of early drought potential.
- Does not consider evapotranspiration and other seasonal changes in the water balance.

(Goodrich and Ellis 2006)

# Arizona Drought Plan

- **Short-term Drought**
  - Measured by the departure of precipitation or another drought indicator from average conditions on a time-scale from one to several seasons. Typically related to soil moisture deficit and vegetation stress.
- **Long-term Drought**
  - When sustained precipitation deficits over time periods of one to several years affect surface and subsurface water supplies.

# Precipitation Percentiles (Nov 2006)

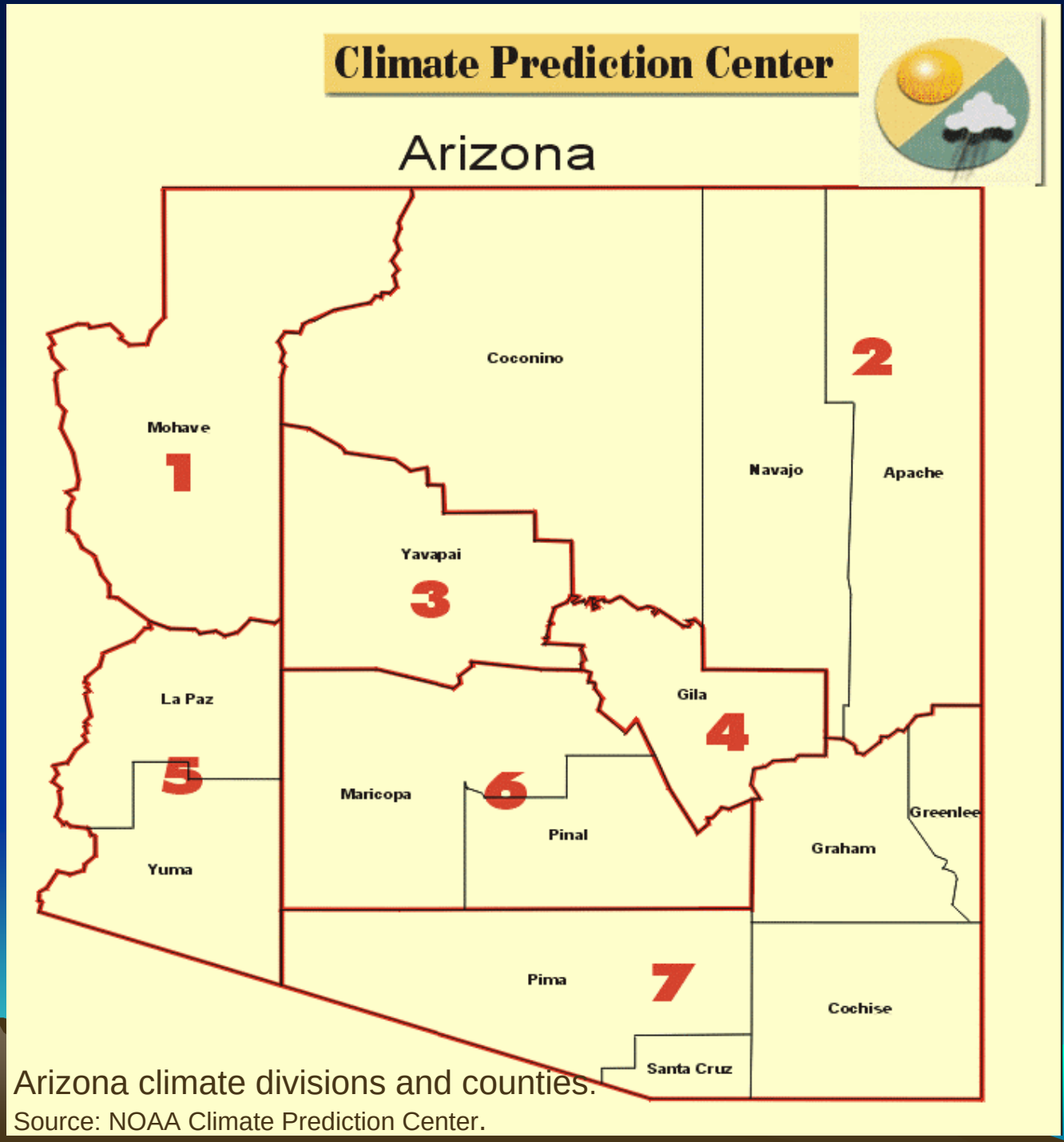


# Calculating the Drought Category

- Short-term
  - Calculate the SPI for 3-, 6-, and 12-months –each will be a value between +4 and -4. The three values are averaged and rounded to nearest whole integer.
  - If the result is a lower value than the previous month's calculation, it is a "drought in" indicator – meaning increasing drought. To increase the drought severity, the "drought in" indicator must be at that lower level for at least 2 consecutive months.
  - If the result is at a higher (more positive) value, it is a "drought out" indicator – meaning decreasing drought severity. To decrease the drought severity, it must be at the higher level for at least 4 consecutive months.

# Calculating the Drought Category

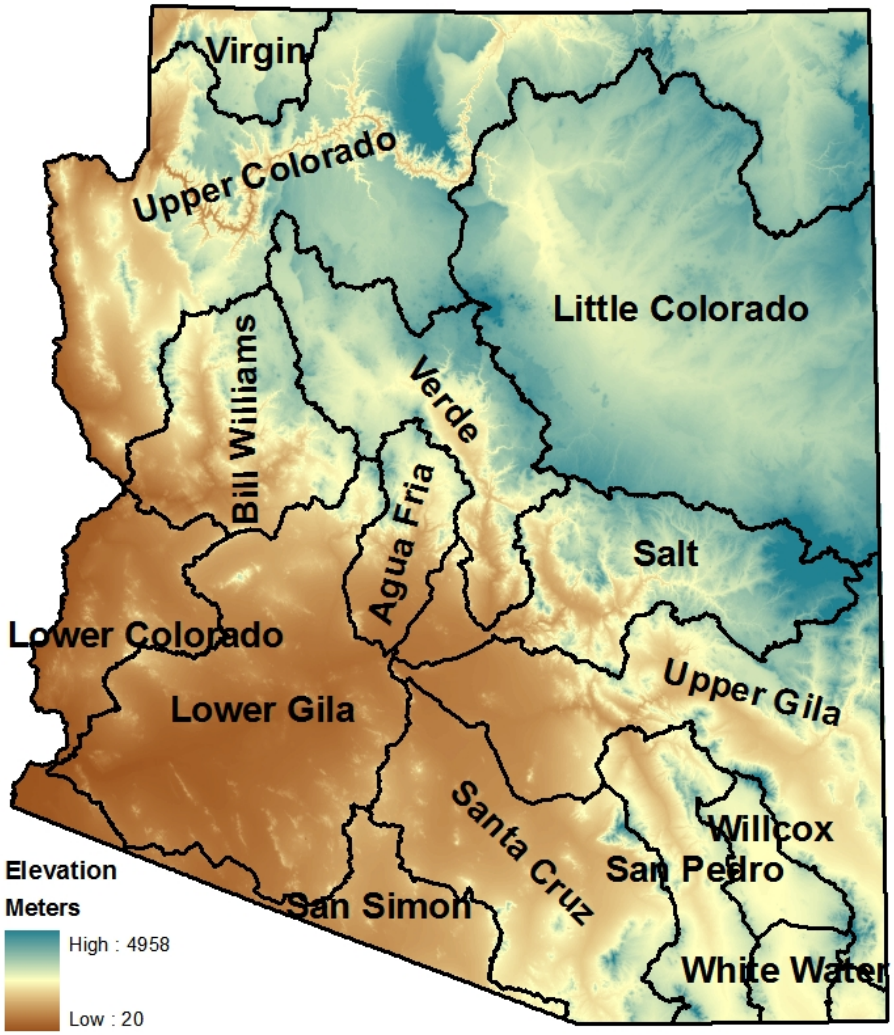
- Long-term
  - Calculate the SPI for 24-, 36-, and 48-months,
  - Calculate the streamflow percentiles and categorize the streamflows,
  - Average all the indicators, and round to nearest whole integer
  - Calculate the “Drought In” and “Drought Out” categories.
  - The maximum of the “drought in” or “drought out” is the final status




Arizona climate divisions and counties.

Source: NOAA Climate Prediction Center.

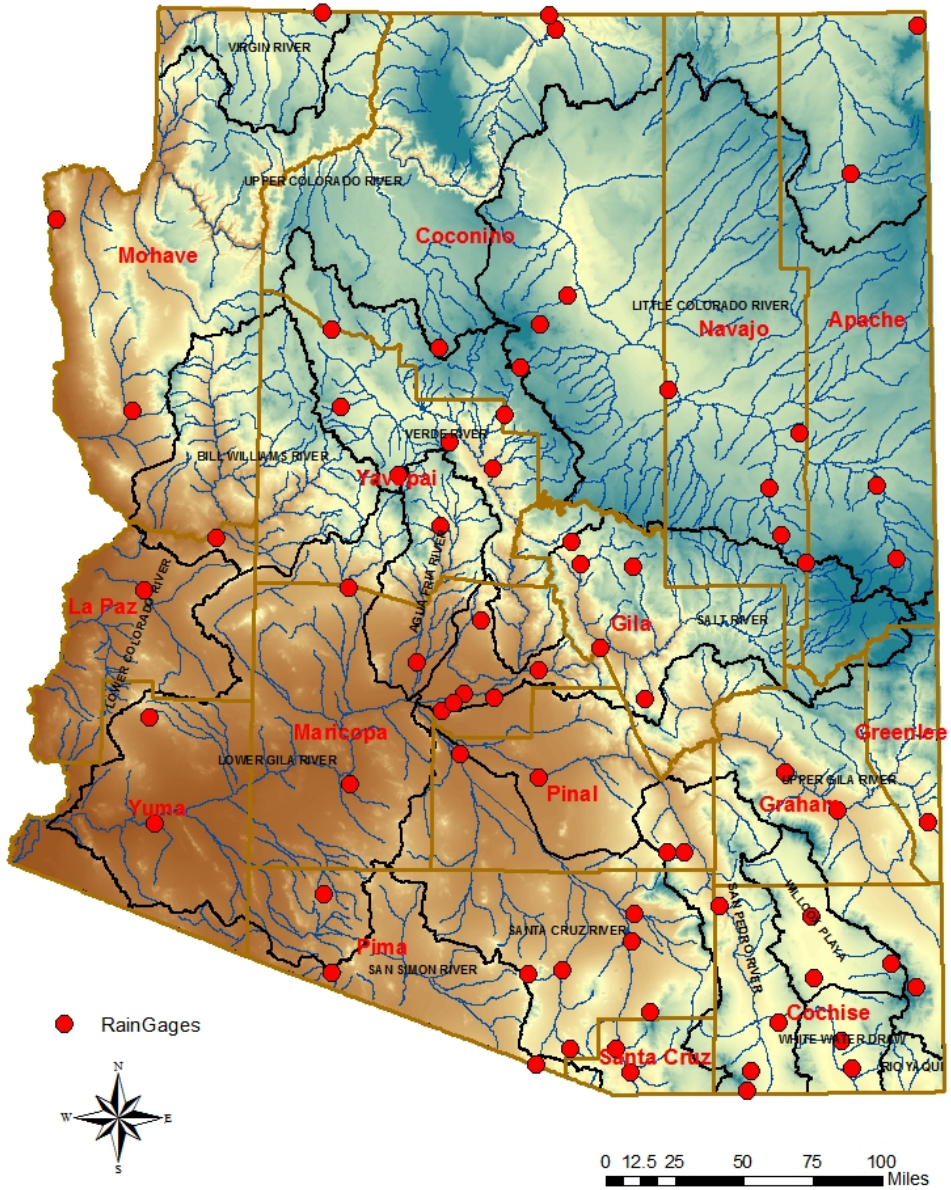
# Arizona Watersheds



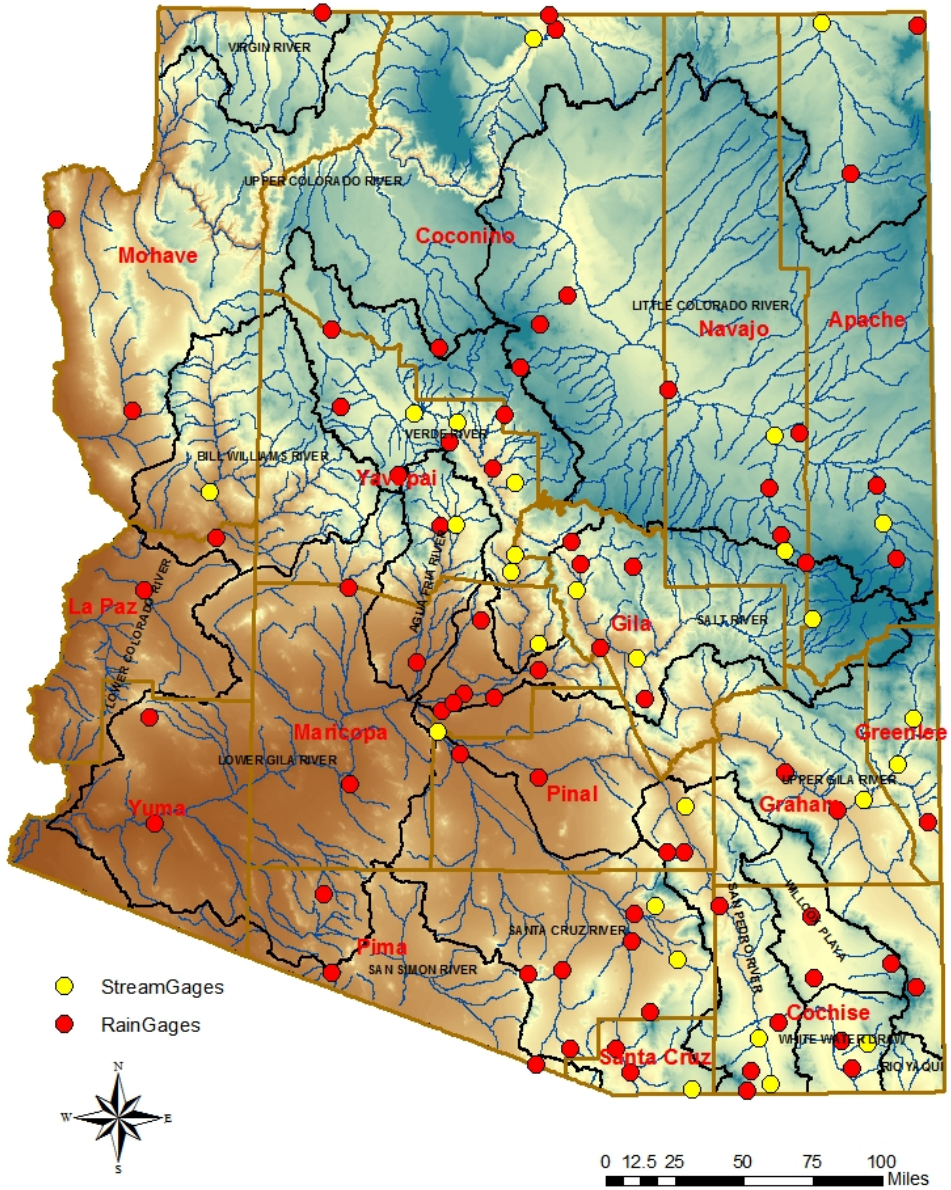
# Trade-offs in Temporal and Spatial Resolution

- 7 – climate divisions – records go back to 1895
  - Good temporal resolution with 111 years of data
  - Poor spatial resolution due to elevation variability within each climate division.
    - Water balance components all vary with elevation and land cover
- 15 watersheds – records go back to 1971
  - Marginal temporal resolution with only 36 years of data
  - Better spatial resolution with slightly more homogeneity
    - Still have vast elevation differences within the basins.
- Problem is insufficient monitoring sites within the basins

# Drought Monitoring Rain Gauges



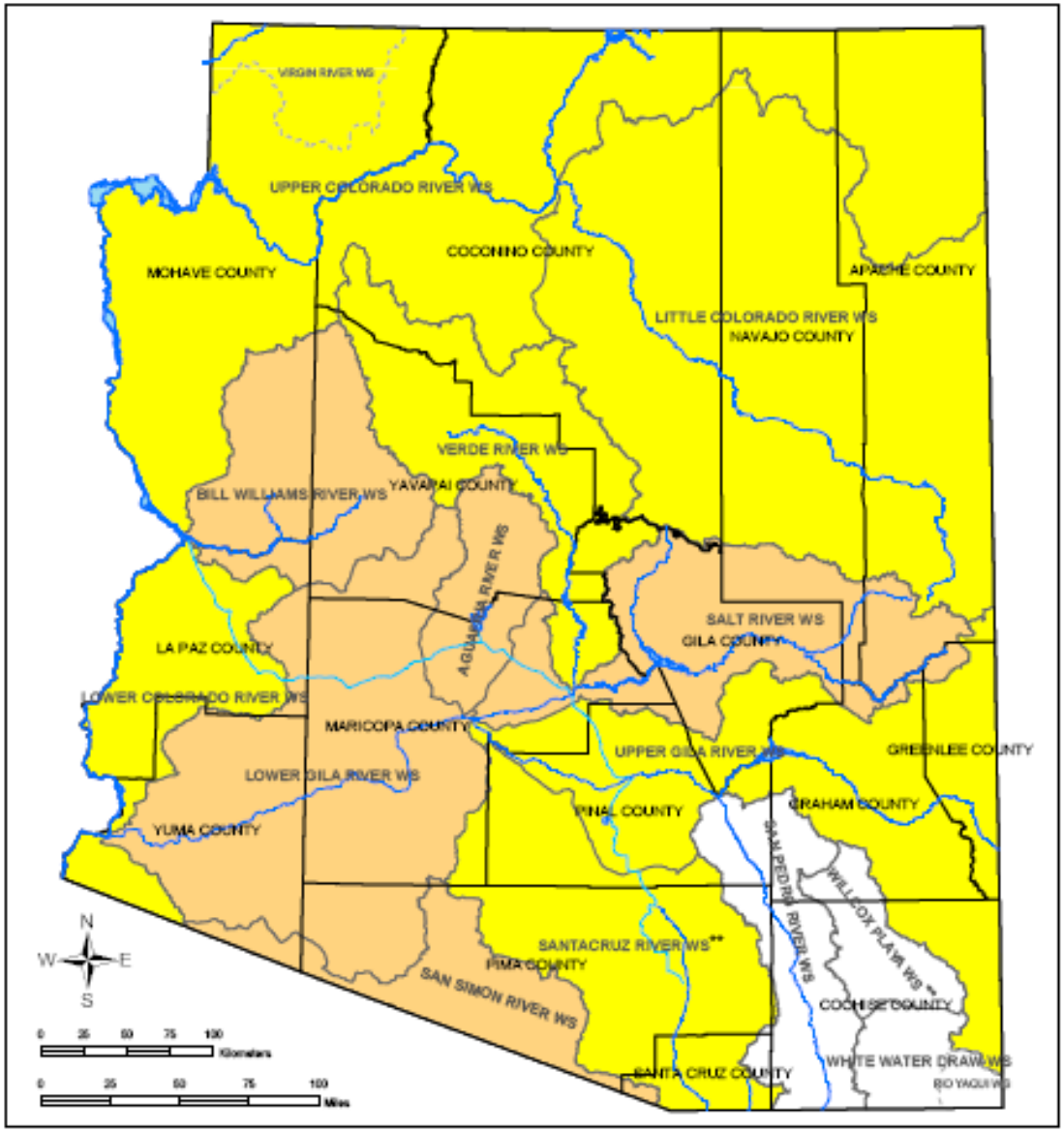
# Drought Monitoring Rain & Stream Gauges



# Feedback from You

- Once we calculate the short and long term drought conditions, we have to make sure the numbers are consistent with the conditions in the field. The only way to do that is to include observations from the agricultural, ranching, wildlife and forestry communities.

- When the numbers don't agree with the stakeholder observations:
  - the stakeholder observations are given more weight
  - We err on the side of caution not moving quickly out of drought




**Watershed Drought Level**

- Normal
- Abnormally Dry
- Drought - Moderate
- Drought - Severe
- Drought - Extreme

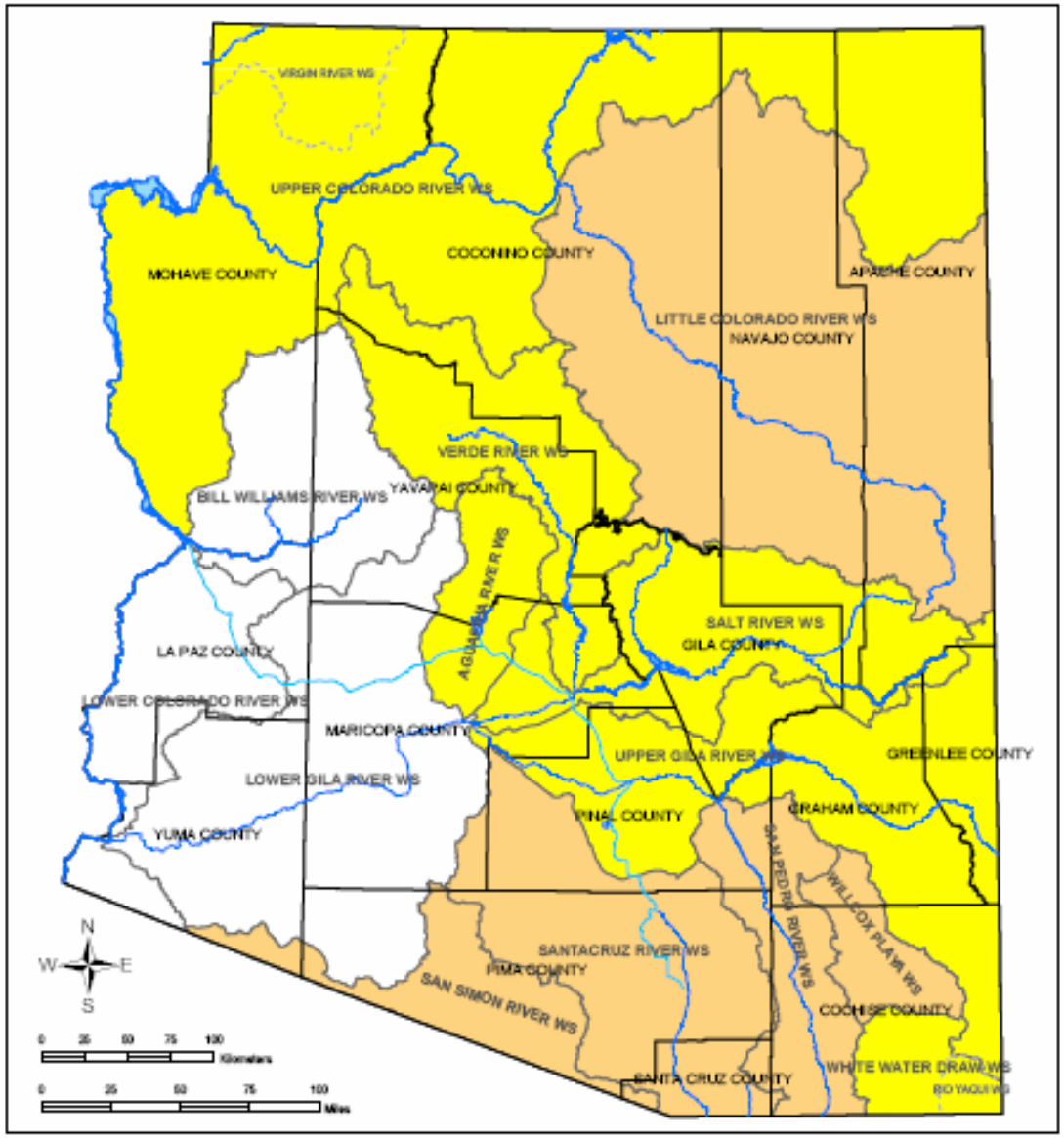
- Counties
- Lakes
- Rivers
- CAP Aqueduct
- Merged Watershed*

# December 2006 Short Term Drought Status

Data Through November 30th, 2006

## Arizona Drought Preparedness Plan Monitoring Technical Committee

* Watershed merged due to limited data.




**Watershed Drought Level**

- Normal
- Abnormally Dry
- Drought - Moderate
- Drought - Severe
- Drought - Extreme

- Counties
- Lakes
- Rivers
- CAP Aqueduct
- Merged Watershed*

# December 2006 Long Term Drought Status

Data Through November 30th, 2006

## Arizona Drought Preparedness Plan Monitoring Technical Committee

* Watershed merged due to limited data.

# Questions ??