



Upper and Middle Verde River Watersheds

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ARIZONA RURAL WATERSHED INITIATIVES

Detrital Basin

Hualapai Basin

Coconino Plateau
study area

Flagstaff

Upper and middle
Verde River
watersheds
study area

Mogollon
Highlands
study area

Sacramento
Basin

Phoenix
Metropolitan area

Middle
San Pedro
Basin

Yuma

Tucson

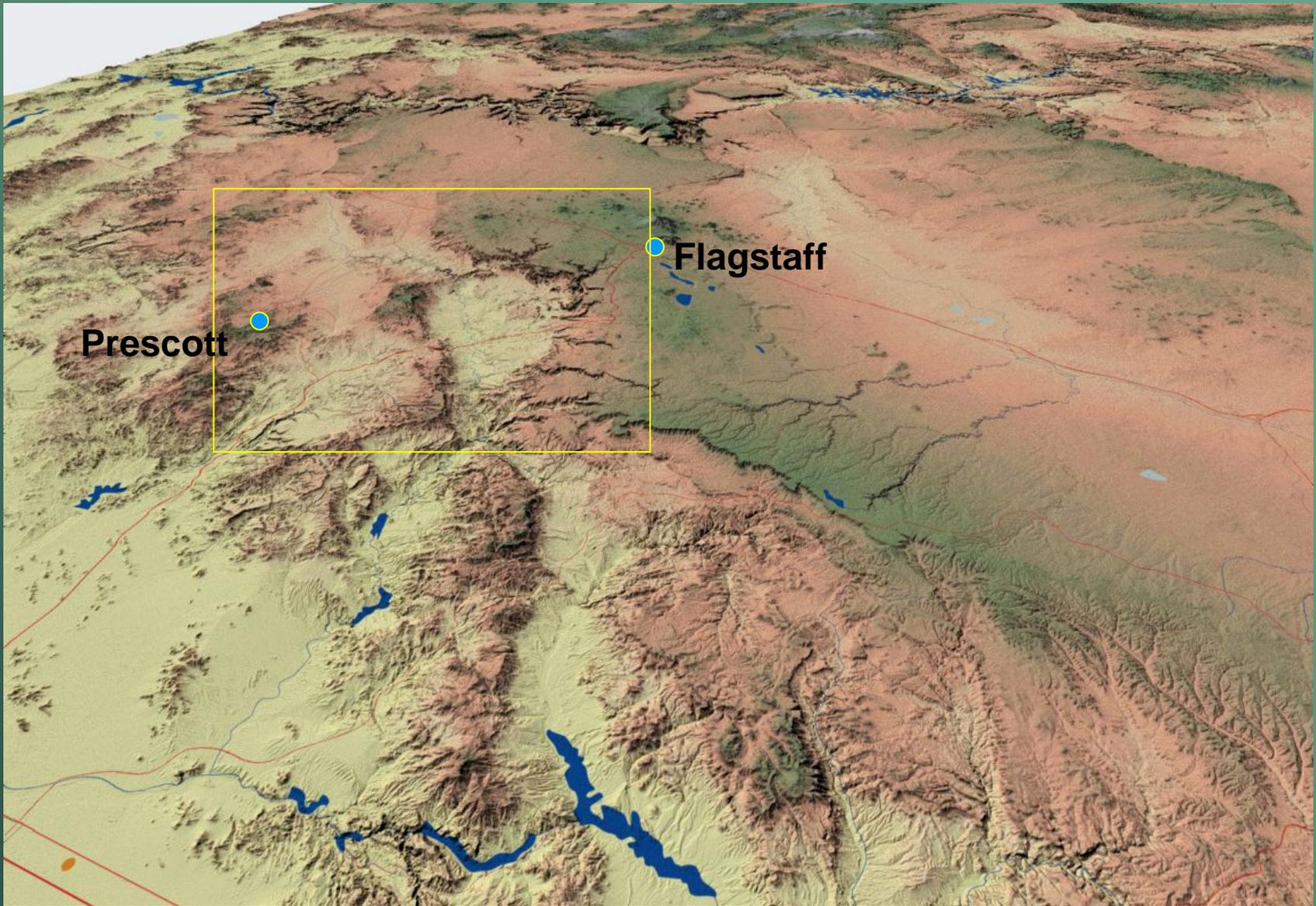
Willcox

Willcox Basin

Douglas Basin

0 50 MILES
0 50 KILOMETERS





Prescott

Flagstaff



Base from U.S. Geological Survey digital data, 1:100,000, 1982
 Universal Transverse Mercator projection, Zone 12



EXPLANATION

- NATIONAL FOREST LAND
- STATE LAND
- PRIVATE LAND

Issues

- Impact of pumping on base flow
- Availability of water
- Arsenic in ground and surface water
- Endangered species habitat preservation

Objectives

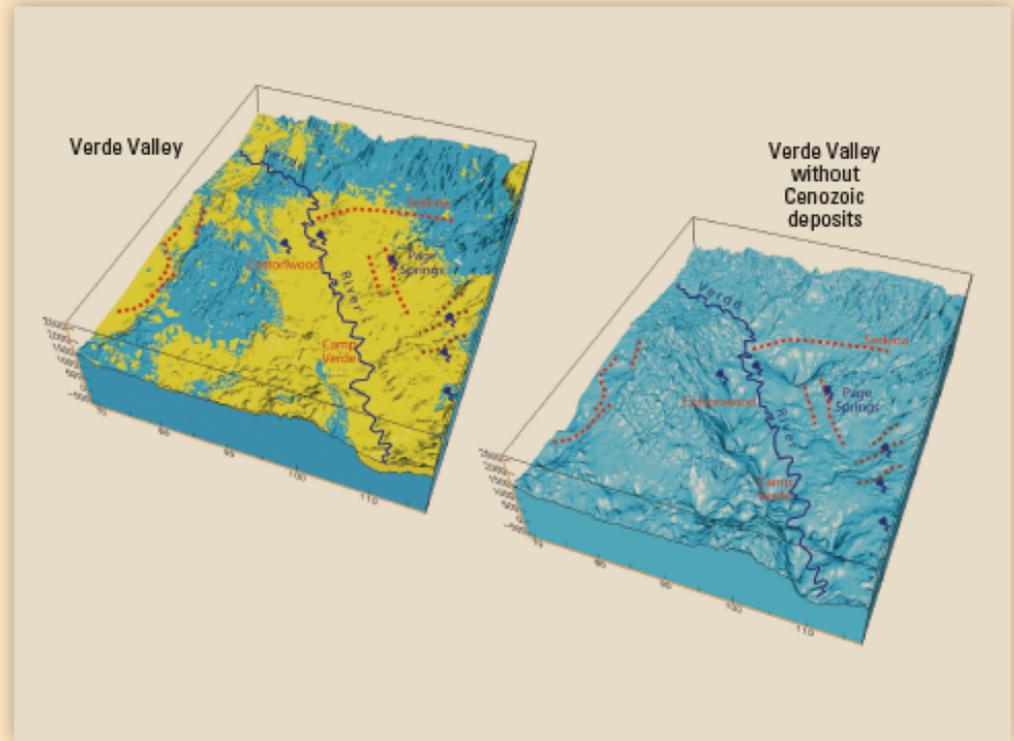
- Assimilate historical climatic, geologic, hydrologic, and water use data
- Describe the surface-water flow and ground-water flow systems
- Present a conceptual model of the occurrence and movement of water
- Provide an estimated water budget for the watersheds and regional aquifers



Content

- Basin aquifer extent
- Structural features

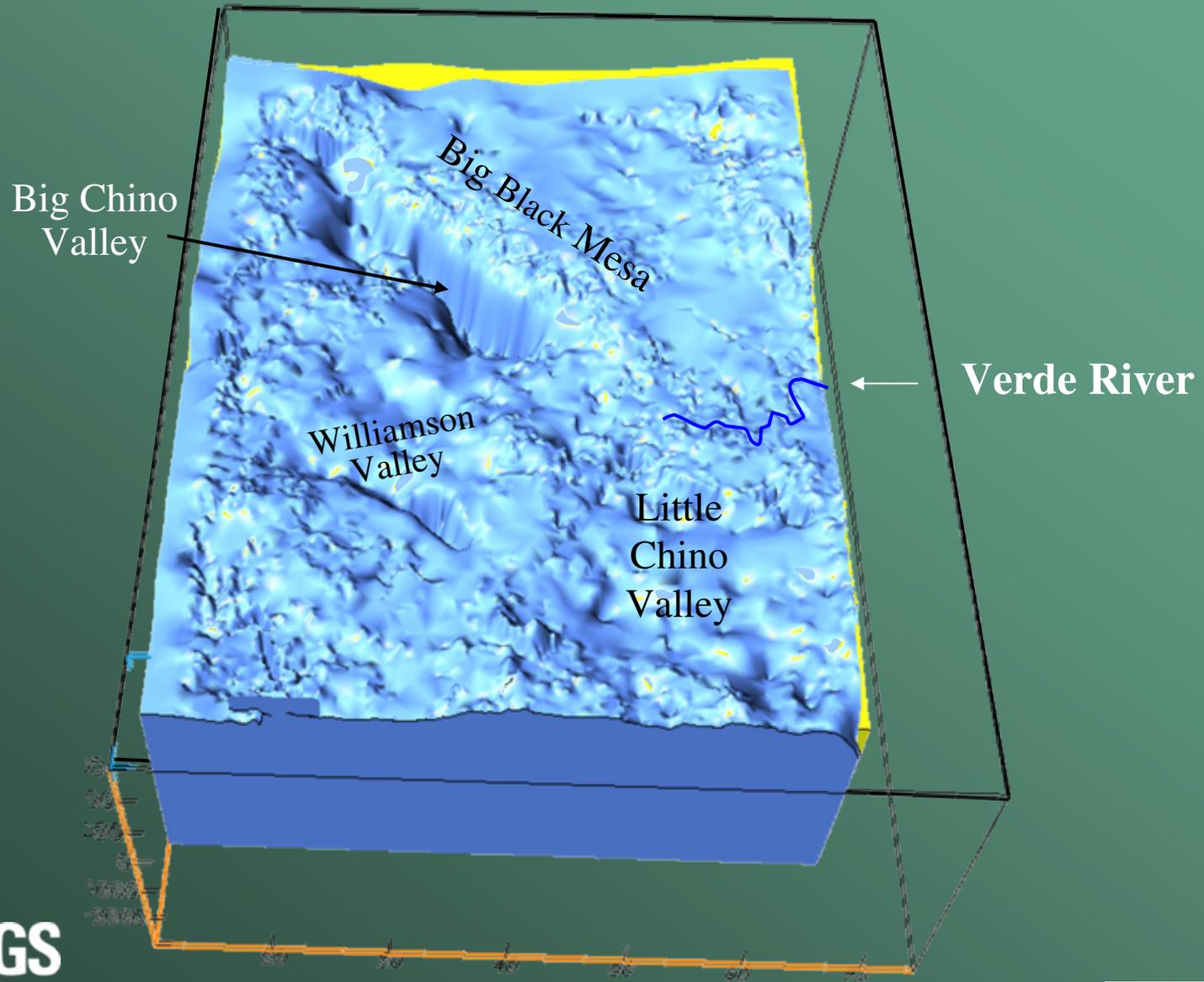
Geophysical Framework Based on Analysis of Aeromagnetic and Gravity Data, Upper and Middle Verde River Watershed, Yavapai County, Arizona



Scientific Investigations Report 2005-5278

U.S. Department of the Interior
U.S. Geological Survey

BASIN THICKNESS FROM GRAVITY DATA



Content

- Conceptual Flow Model
- Water Budget
- Water Quality

Prepared in cooperation with the
ARIZONA DEPARTMENT OF WATER RESOURCES and YAVAPAI COUNTY

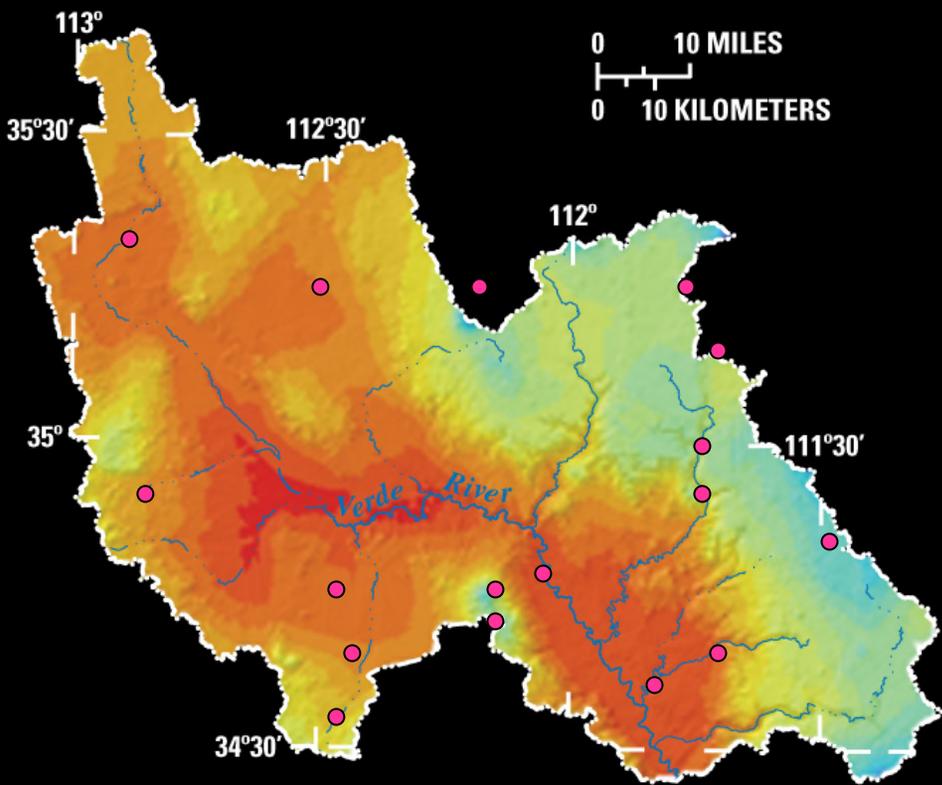
Hydrogeology of the Upper and Middle Verde River Watersheds, Central Arizona



Scientific Investigations Report 2005–5198

U.S. Department of the Interior
U.S. Geological Survey



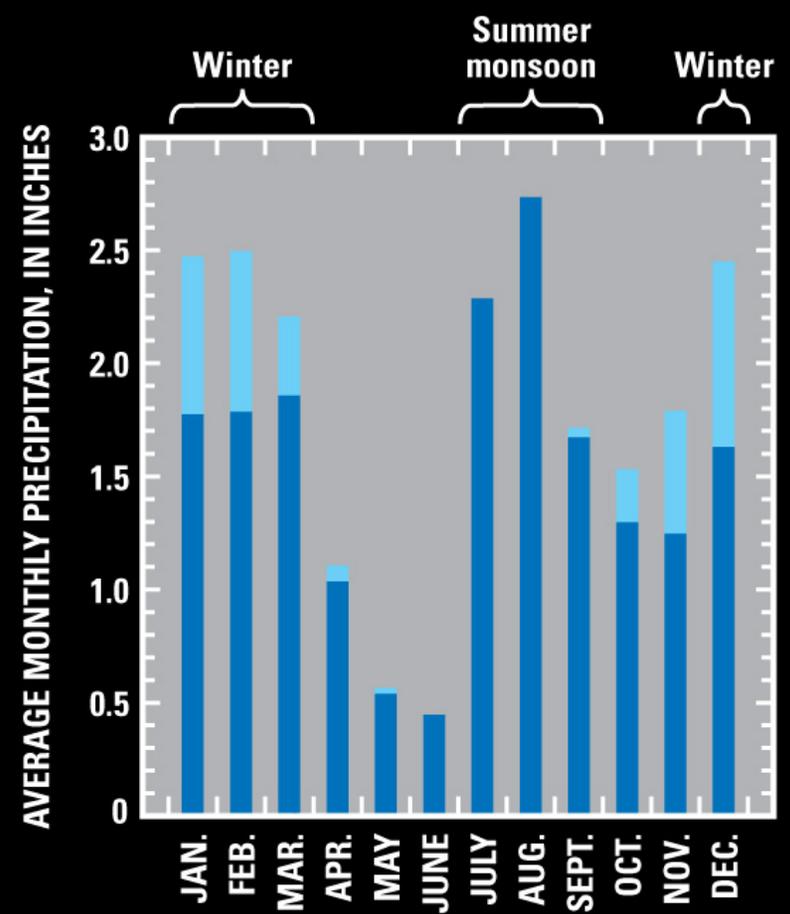


EXPLANATION



Precipitation, in inches

• Measurement locations

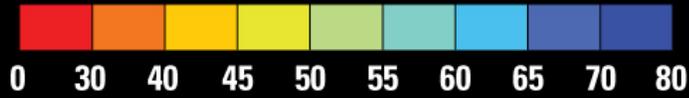


EXPLANATION

- Snow as precipitable water
- Rain

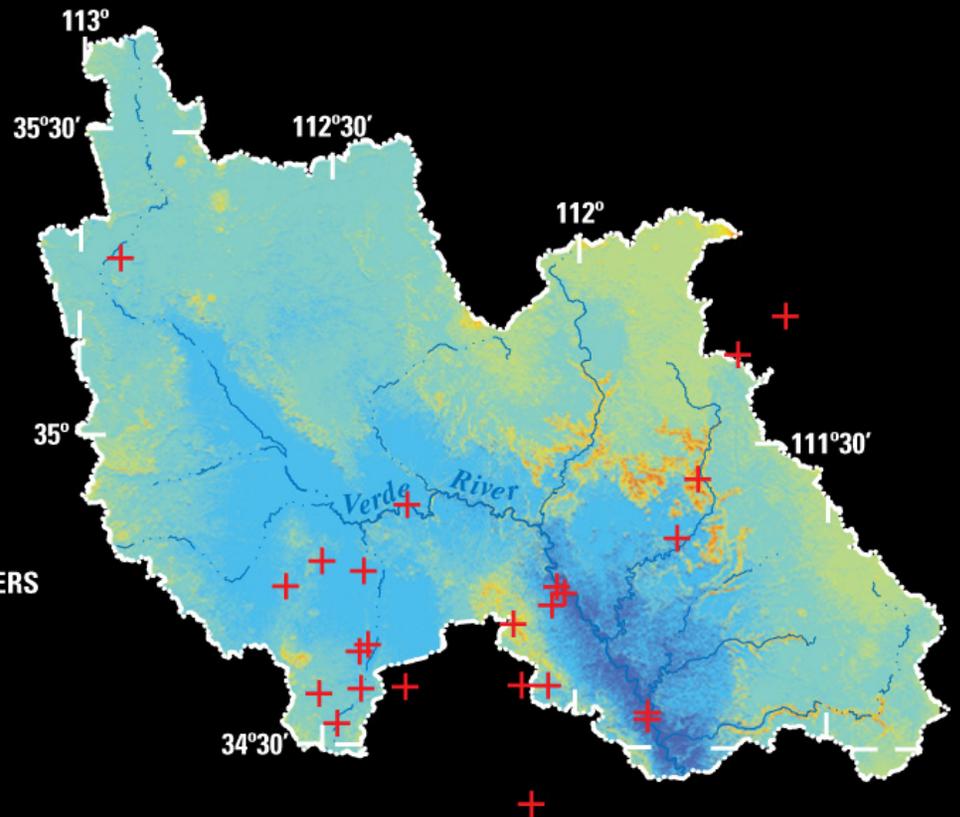
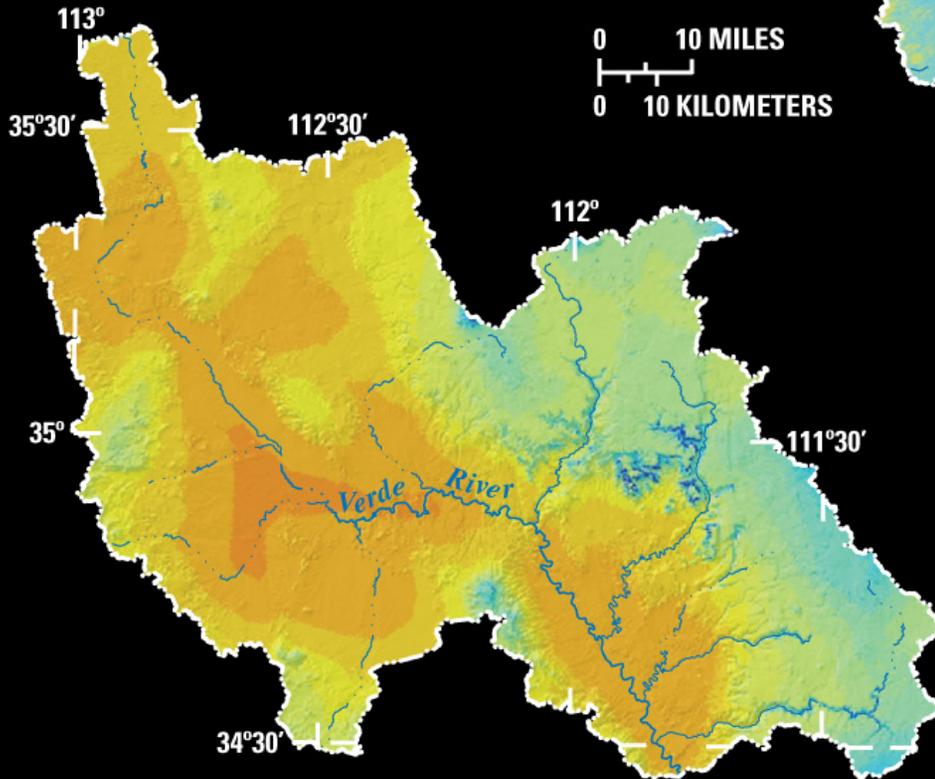
AREAL AND MONTHLY PRECIPITATION IN THE STUDY AREA

EXPLANATION



Potential evapotranspiration, in inches

+ Measurement site



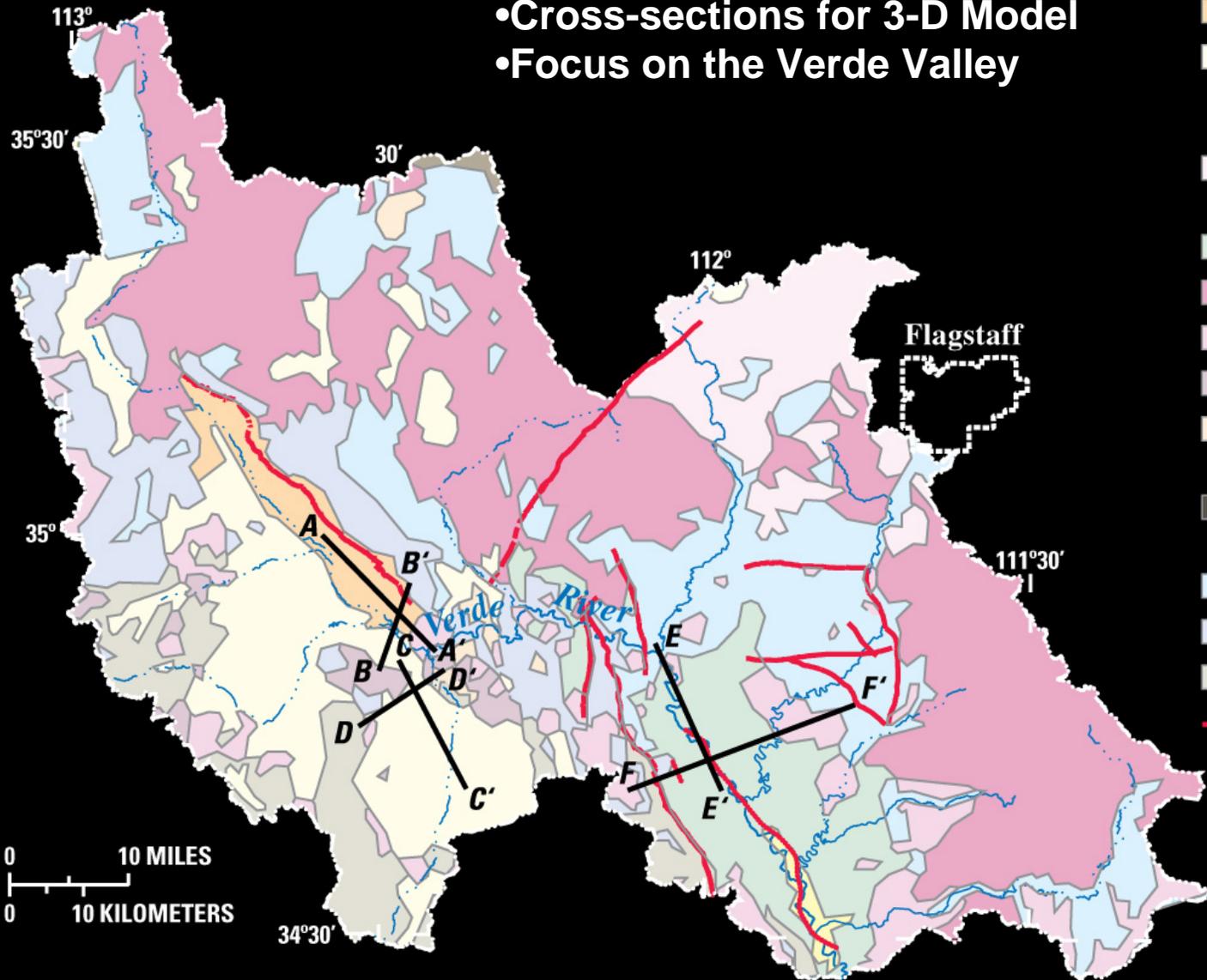
EXPLANATION



Aridity, in inches divided by inches

GEOLOGY

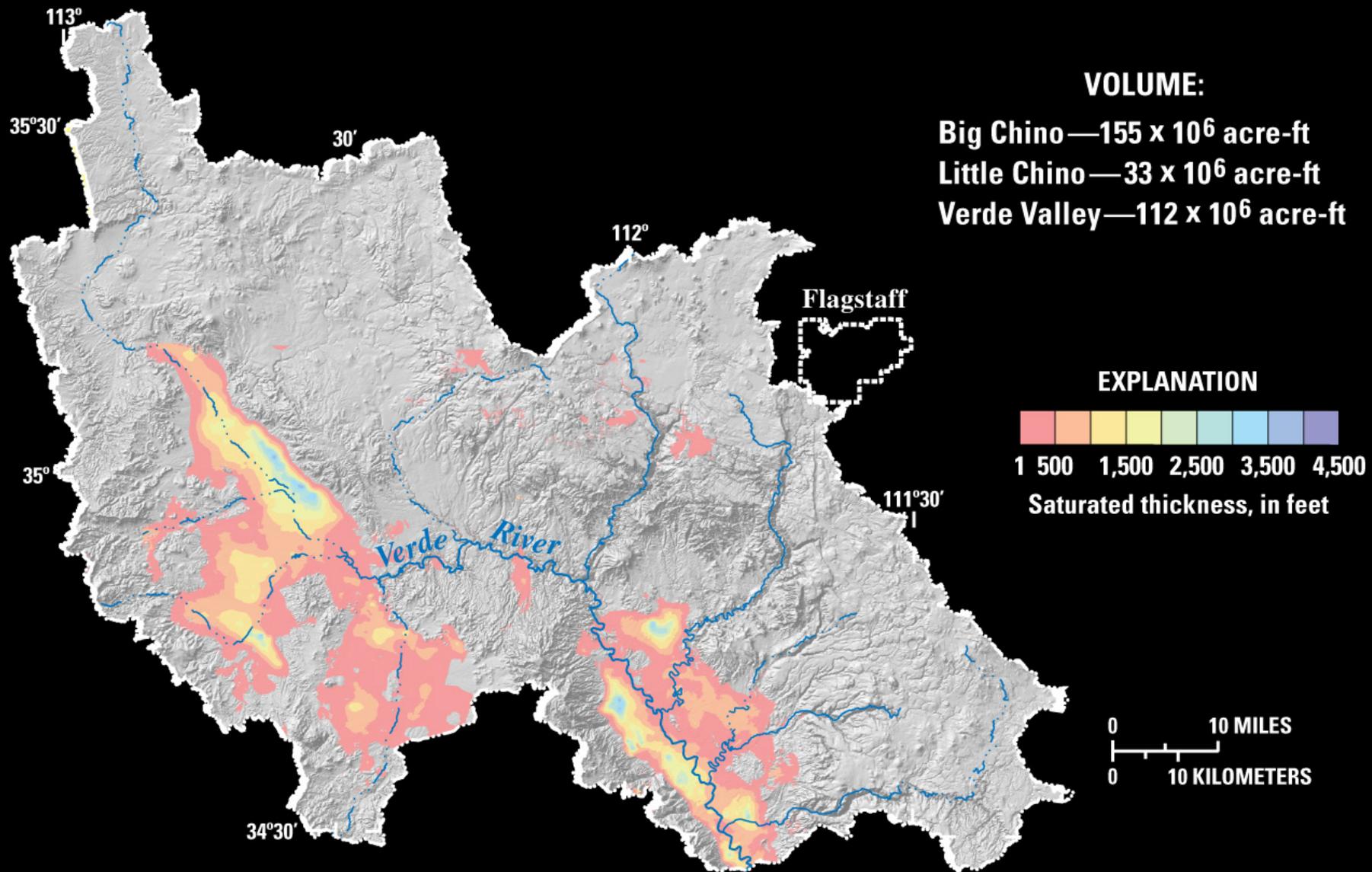
- Cross-sections for 3-D Model
- Focus on the Verde Valley



| EXPLANATION | |
|-------------|--|
| | Quaternary alluvium |
| | Quaternary fanglomerate |
| | Undifferentiated Quaternary and Tertiary sediments |
| | Holocene–Pliocene basaltic rocks |
| | Tertiary verde formation |
| | Tertiary basalt flows |
| | Tertiary basalt |
| | Tertiary lati-andesite |
| | Tertiary fluvial gravel and alluvial fans |
| | Triassic Moenkopi Formation |
| | Late Paleozoic rocks |
| | Early Paleozoic rocks |
| | Precambrian rock |
| | Fault |

Geology modified from Reynolds, 1988 and DeWitt and others, in press

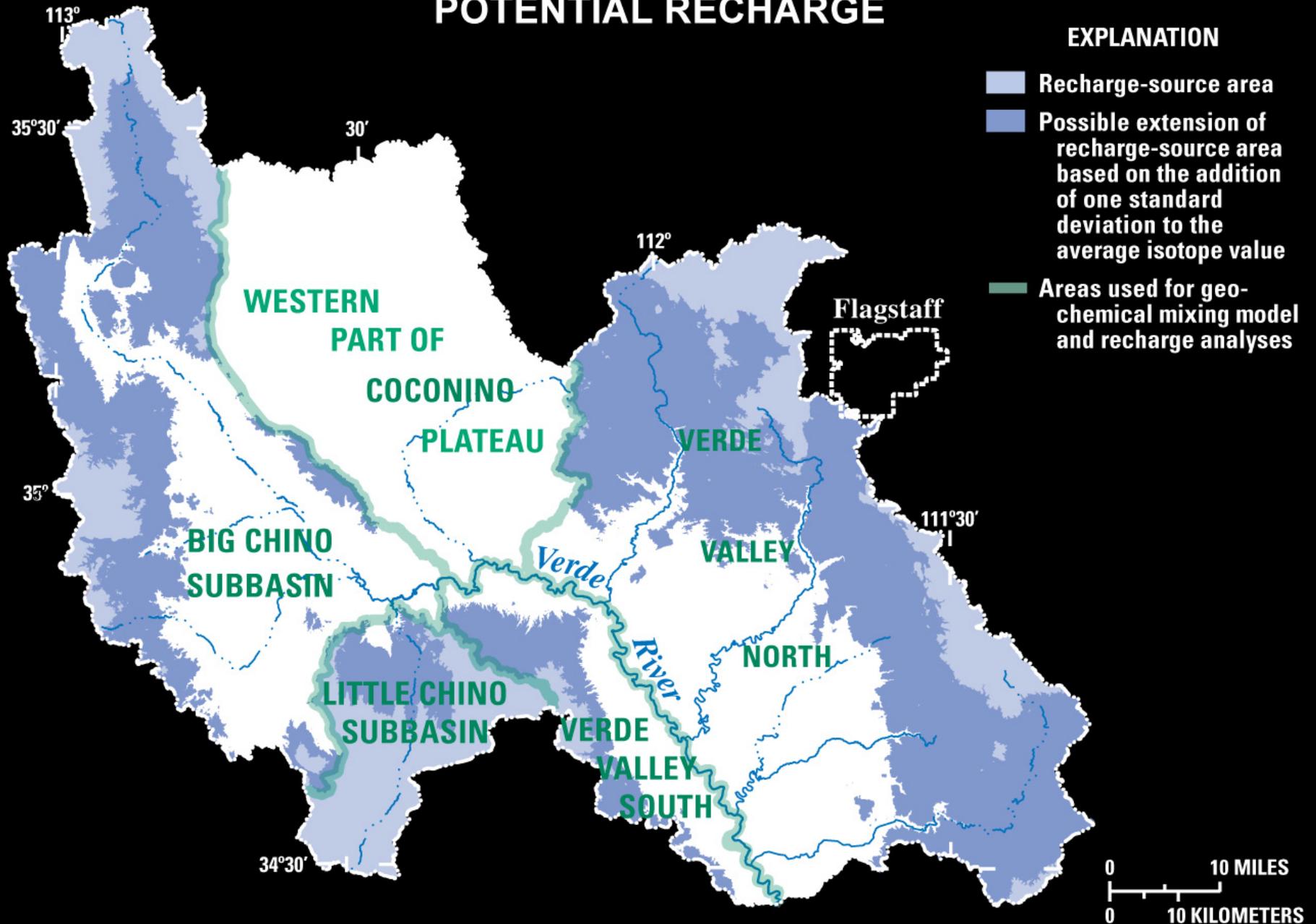
THICKNESS AND VOLUME OF CENOZOIC SEDIMENTS AND VOLCANIC ROCKS



POTENTIAL RECHARGE

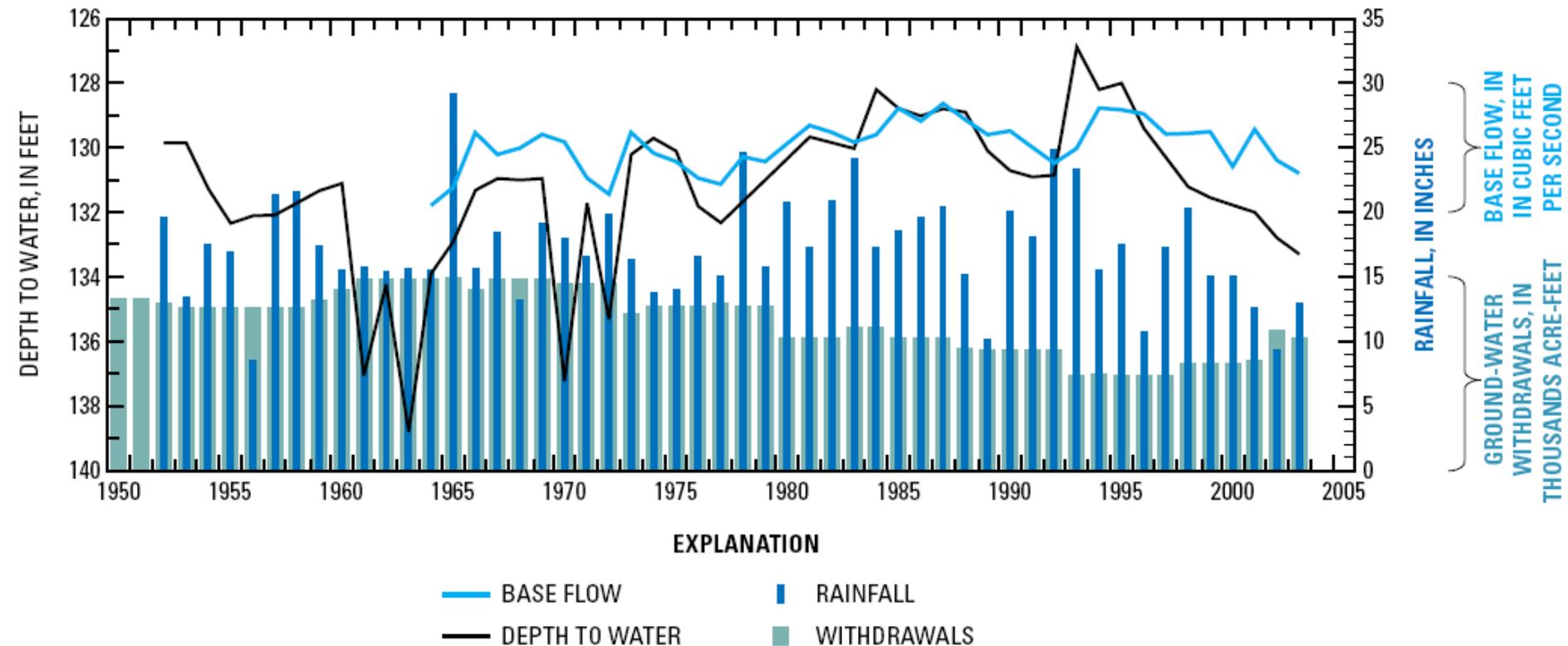
EXPLANATION

-  Recharge-source area
-  Possible extension of recharge-source area based on the addition of one standard deviation to the average isotope value
-  Areas used for geo-chemical mixing model and recharge analyses

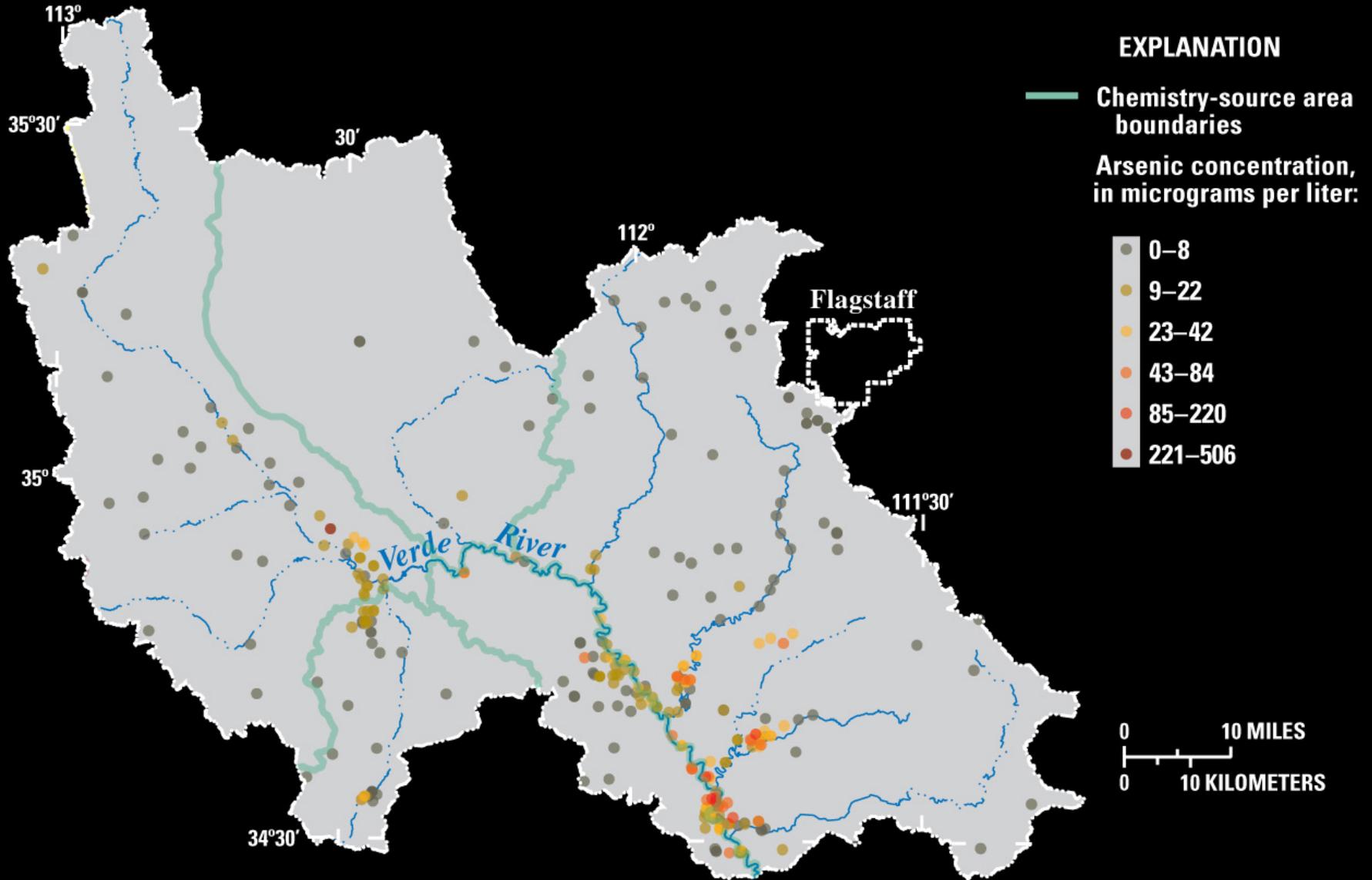


Ground-Water Flow Systems – Big Chino Subbasin

- Base flow in the Verde River near Paulden stream gage is directly linked to precipitation and storage changes in the Big Chino Valley



ARSENIC DISTRIBUTION IN GROUND WATER



Average Annual Water Budgets (1990-2003) For Regional Aquifers
(Values in acre-ft, NC not calculated)

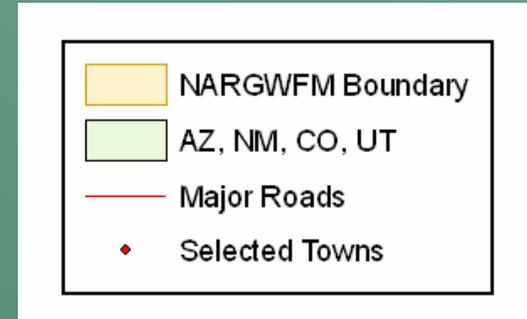
| Water Budget Component | Big Chino | Little Chino | Verde Valley |
|------------------------------------|------------------|---------------------|---------------------|
| Base flow in | 180 | 0 | 17,900 |
| Natural Recharge | 23,420 | 5,070 | 130,270 |
| Incidental and Artificial Recharge | 4,300 | 7,550 | 19,300 |
| Ground-water in | 2,400 | 0 | NC |
| Agricultural Irrigation | -7,900 | -4,900 | -120 |
| Agricultural Sub Irrigation | -3,400 | 0 | 0 |
| Domestic | -300 | -1,300 | -1,900 |
| Water Providers | -200 | -6,600 | -7,800 |
| Golf Course Irrigation | -30 | 0 | -1,500 |
| Industrial Use | -10 | -140 | -1,150 |
| Base Flow out | -17,900 | -1,800 | -144,100 |
| Vegetation Evapotranspiration | -560 | 0 | -10,800 |
| Ground-water out | NC | -1,980 | -100 |
| Change in storage | NC | -4,100 | NC |

Future Objectives

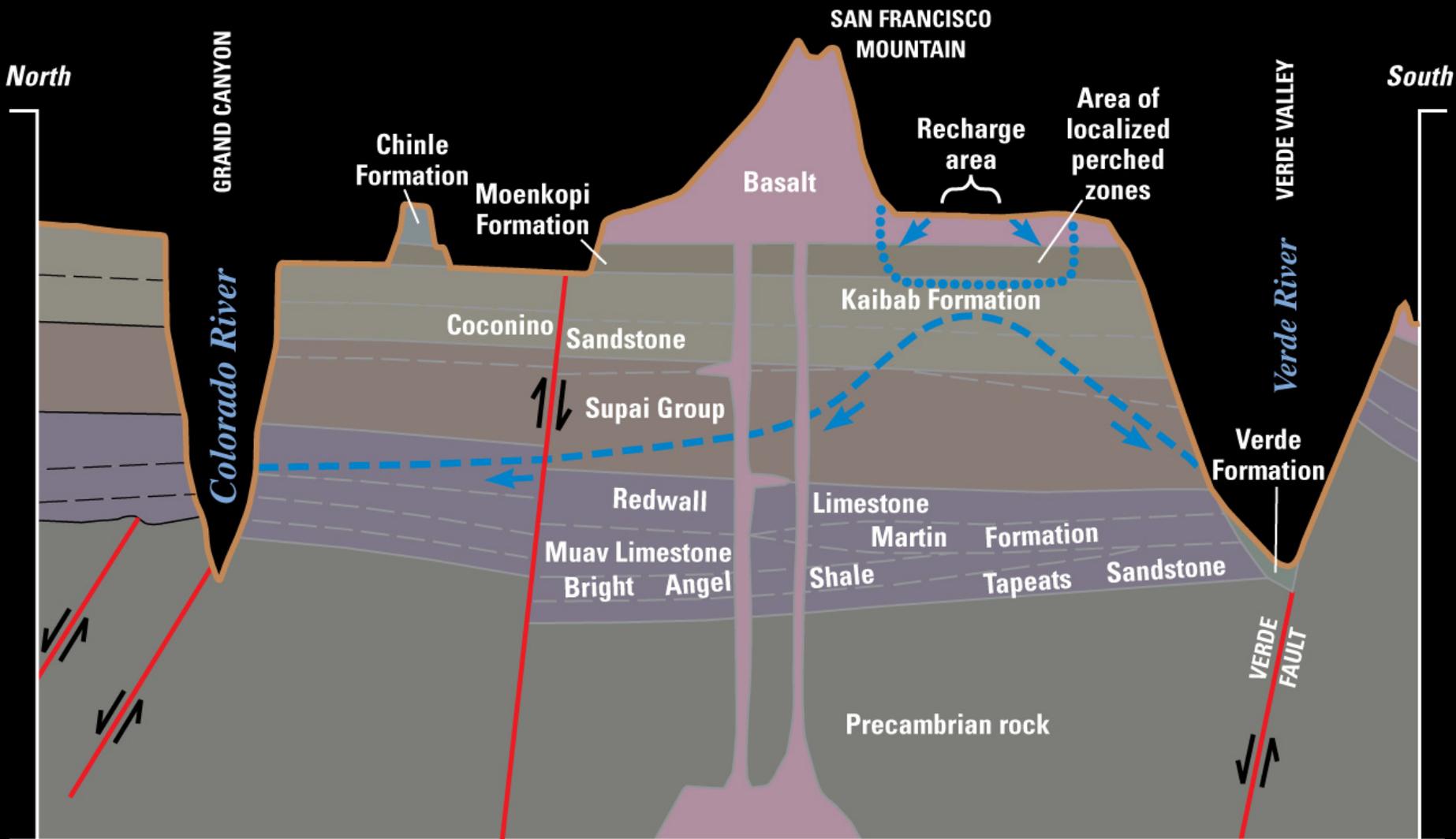
- Determine a numerical relationship between pumping and base flow
- Identify the ground-water divides and transfers between the Colorado, Salt, Little Colorado and Verde watersheds
- Continue long-term data collection



N AZ Regional Ground-Water Flow Model Geographic Extent of Model



CONCEPTUAL GROUND-WATER DIVIDE



Questions

