# Upper Rio Grande Basin Focus Area Study

## Groundwater Component

## In Cooperation with: USGS Water Availability and Use Science Program

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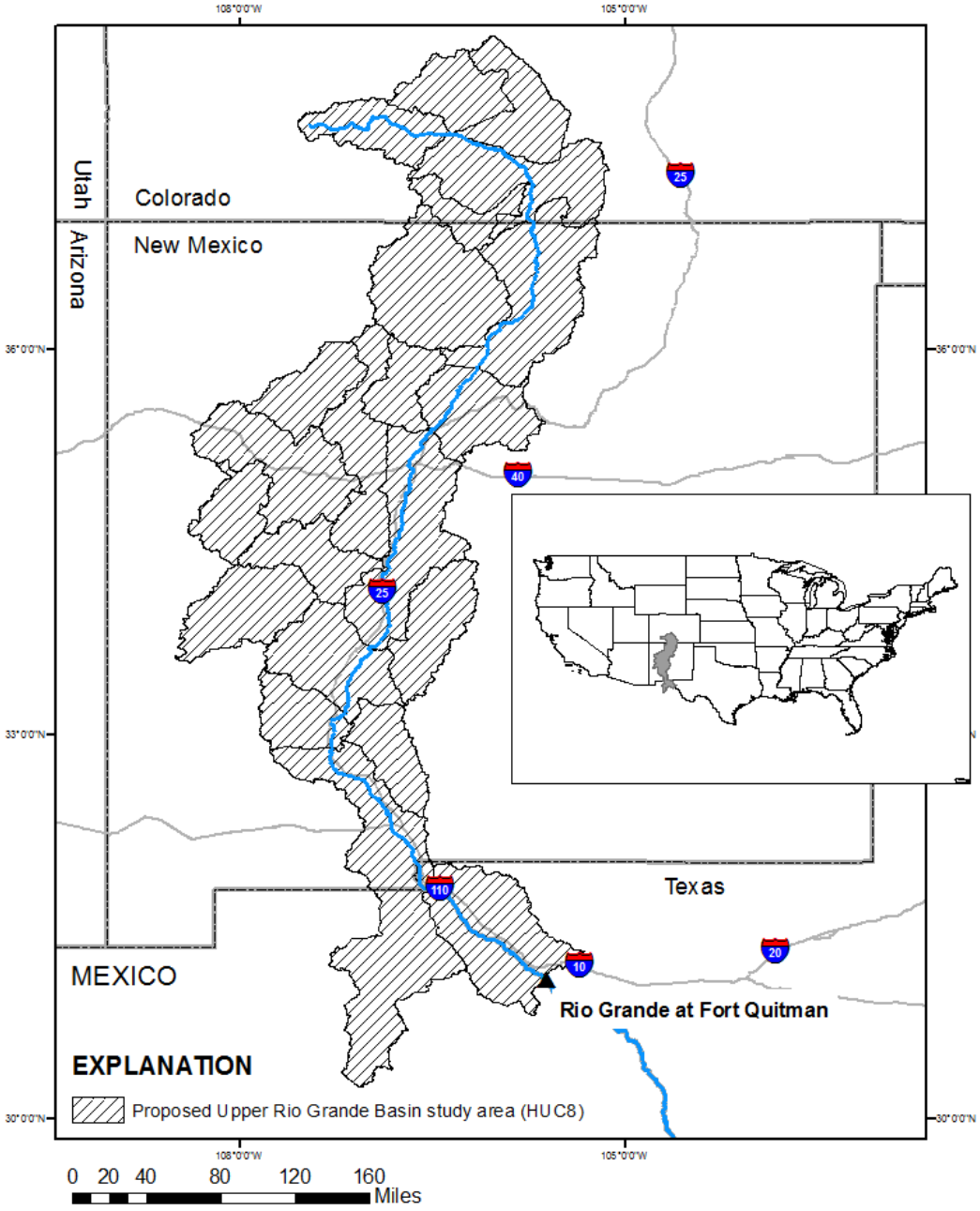
New Mexico Water Science Center

# Project Area

- Colorado, New Mexico, Texas, and Mexico
- 670 miles draining about 46,000 sq mi
- Located in the Southern Rocky Mountains and Basin and Range physiographic provinces

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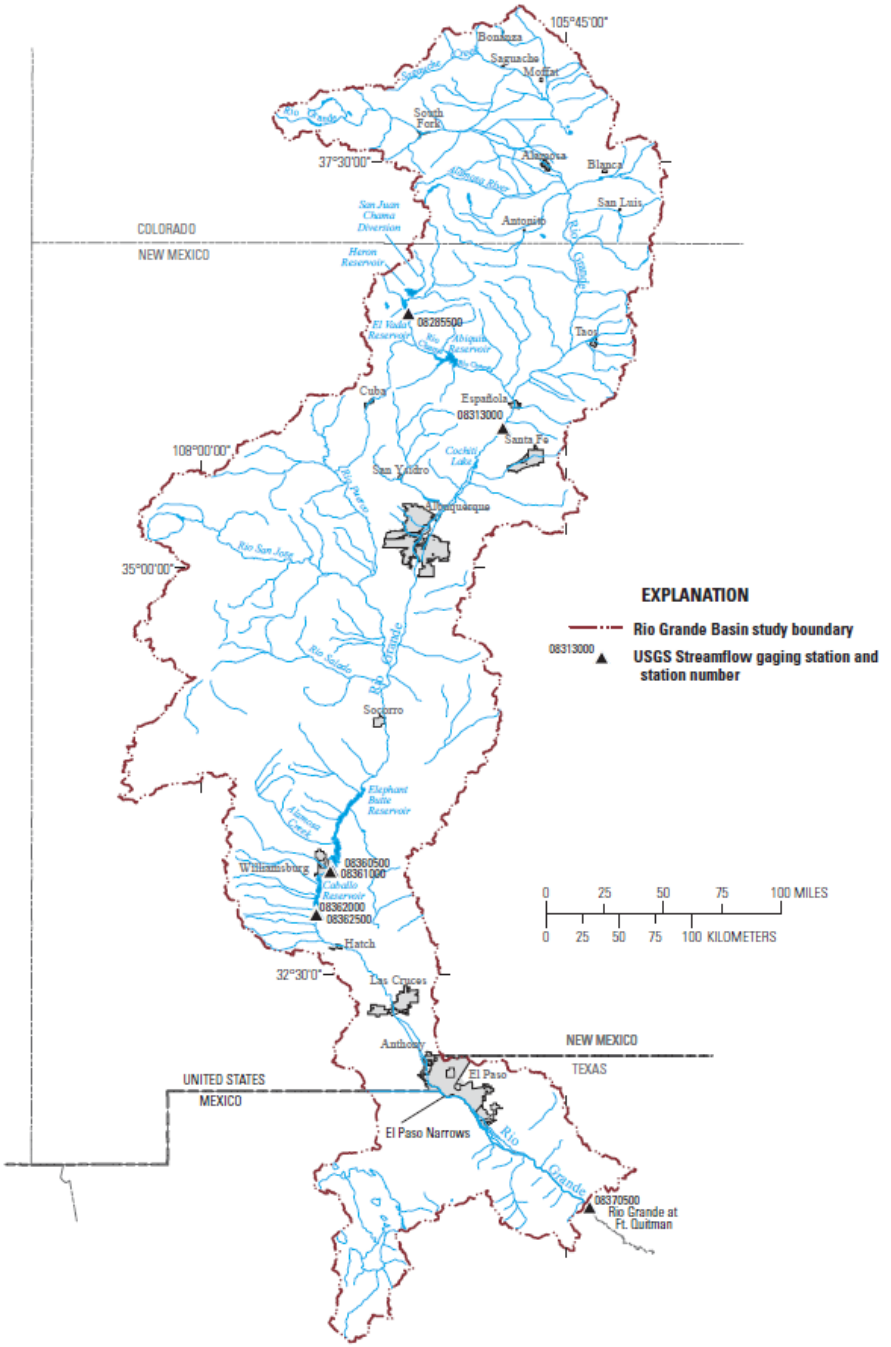
# Hydrologic Features

- Surface water in the Rio Grande Basin is highly managed by reservoirs, diversions, and irrigation canals

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# Interbasin Transfer
# San Juan-Chama

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# Discussion Points

- How is water availability changing in the basin?
- Using components of the water budget to answer questions
- Synthesizing disparate studies to develop a basin-wide framework, data will be reviewed and published in Data Release and Scientific Investigations Report
- No preliminary findings yet, in collection and compilation phase
- Challenging aspect - Size of the study area along with complex geology
- Unique approach - Status and Trends study, will talk more about later

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# Hydrogeologic Setting

- 330-mile Rio Grande Rift composed of linked sedimentary basins
- Bounded on the east and west by areas of uplift (Precambrian crystalline or Paleozoic sedimentary bedrock)
- Basins filled with alluvial and lacustrine sediment and range in depths from 13,000 ft to less than 100 ft

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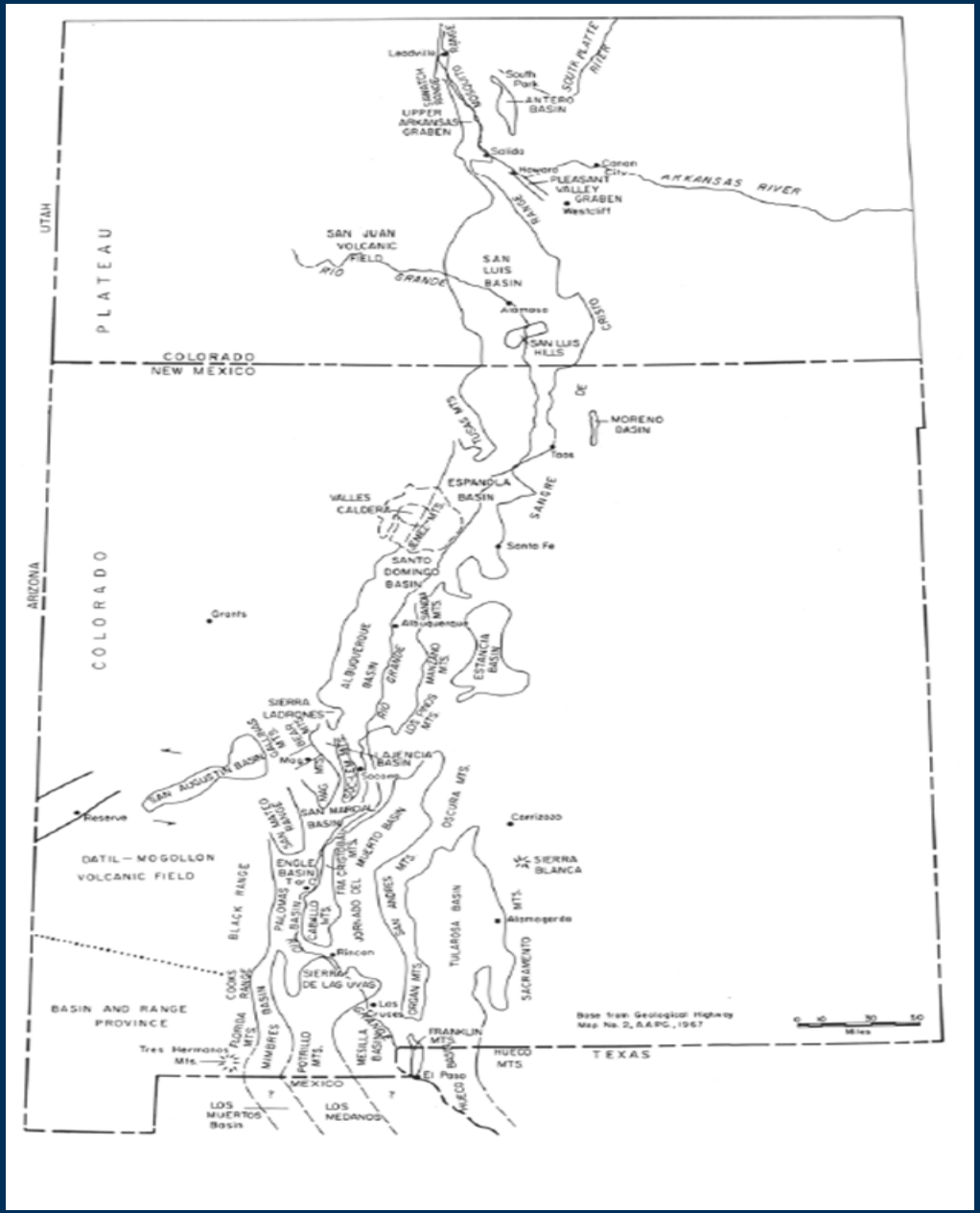
UTAH
COLORADO PLATEAU
COLORADO
NEW MEXICO
ARIZONA
BASIN AND RANGE PROVINCE
TEXAS
MEXICO
Leadville
South Park
ANTERO BASIN
SOUTH PLATTE RIVER
UPPER ARKANSAS GRABEN
Salida
Howard
Canon City
PLEASANT VALLEY GRABEN
Westcliff
ARKANSAS RIVER
SAN JUAN VOLCANIC FIELD
RIO GRANDE
SAN LUIS BASIN
Alamosa
CASTO
SAN LUIS HILLS
SANGRE DE CRISTO MTS
MORENO BASIN
Taos
ESPAÑOLA BASIN
VALLES CALDERA
JEMEZ MTS
Santo Fe
SANTO DOMINGO BASIN
SANDIA MTS
Albuquerque
ALBUQUERQUE BASIN
MANZANO MTS
ESTANCIA BASIN
Grants
SIERRA LADRONES
LOS PINOS MTS
LOS PINOS
SAN AUGUSTIN BASIN
SOCORRO
Reserve
DATIL — MOGOLLON VOLCANIC FIELD
SAN MATEO MTS
SAN MATEO
SAN MARCIAL BASIN
MAGDALENA
OSCURA MTS
Carrizozo
SIERRA BLANCA
ENGLE BASIN
TIERRA BLANCA MTS
JORNADA DEL MUERTO BASIN
SAN ANDRES MTS
Alamogordo
BLACK RANGE
PALOMAS BASIN
CARRIZO MTS
Rincon
TULAROSA BASIN
SACRAMENTO MTS
SIERRA DE LAS UVAS
COOKS RANGE
Los Cruces
ORGAN MTS
FRANKLIN MTS
HUECO MTS
El Paso
MIMBRES BASIN
FLORIDA MTS
Tres Hermanos Mts.
POTRILLO MTS
MESILLA BASIN
HUECO BASIN
LOS MUERTOS Basin
LOS MEDANOS
Base from Geological Highway Map No. 2, A.A.P.G., 1967
0 10 30 50
Miles

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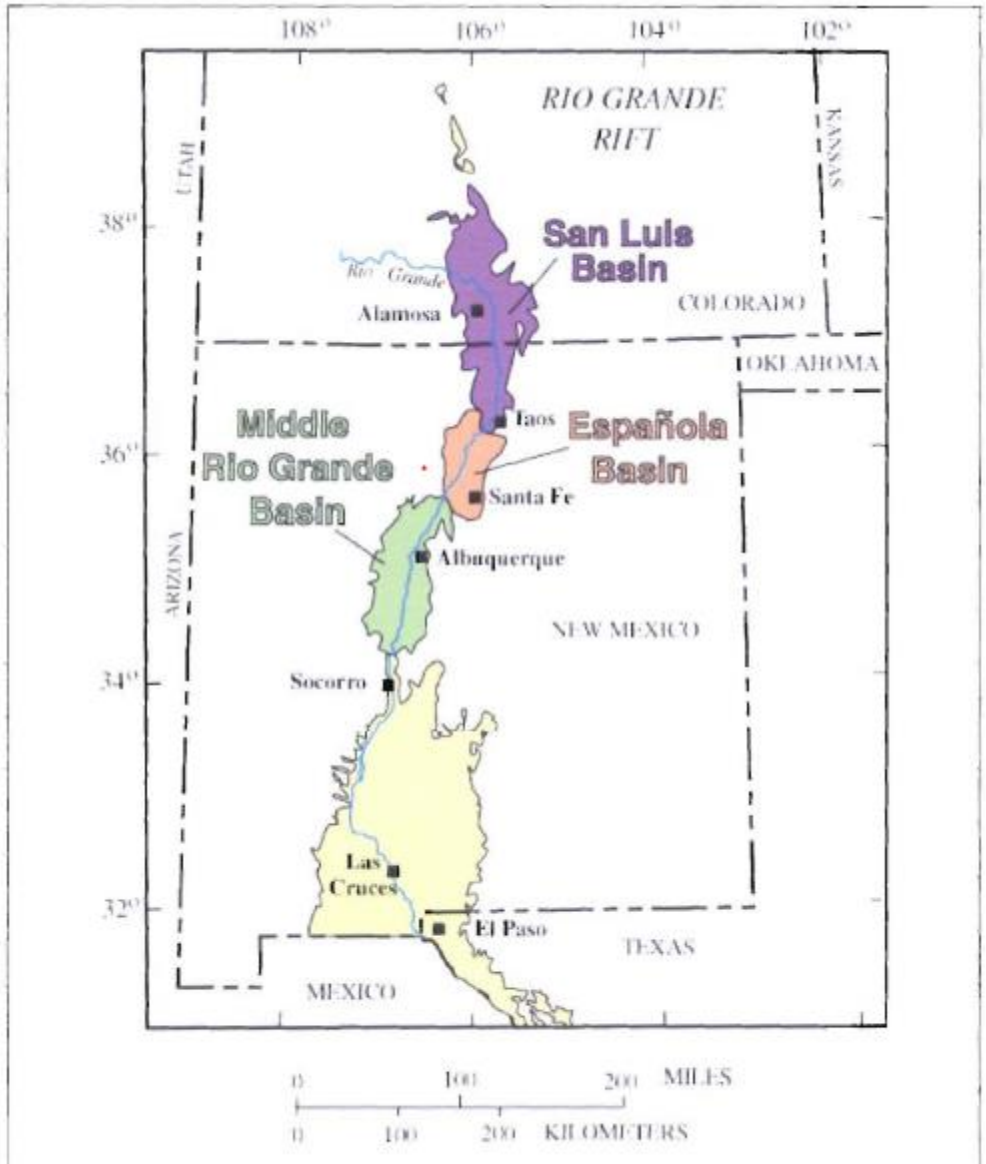


**Figure 1. The Rio Grande Basin (Image source: Grauch, 2003a).**

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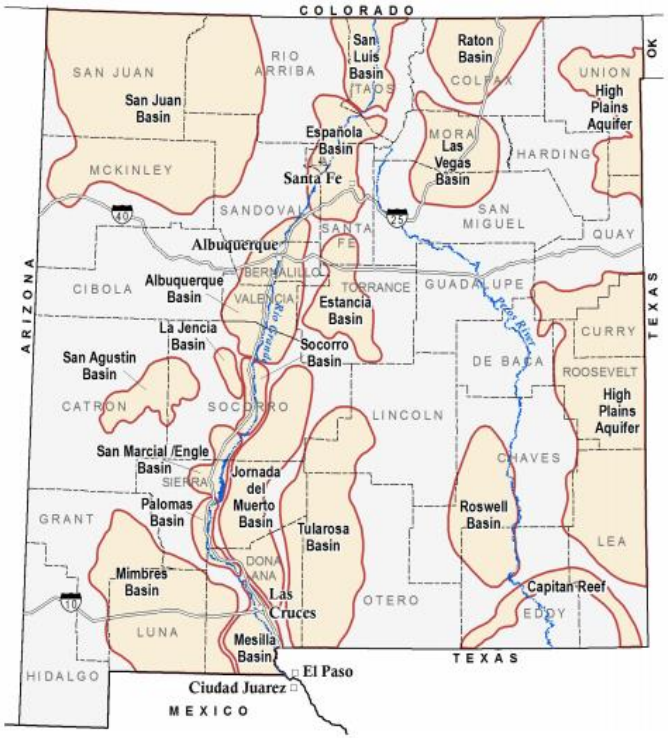
# Overview of Fresh and Brackish Water Quality in New Mexico

Lewis Land

Open-file Report 583
June 2016

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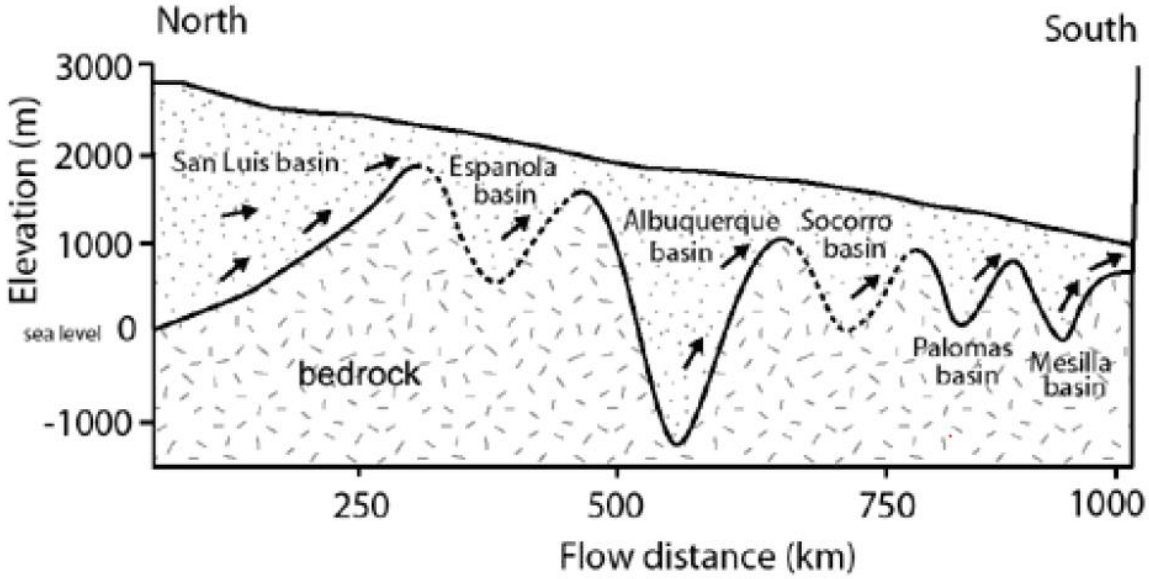


**Figure 2.** Schematic hydrogeologic cross section of the Rio Grande Rift, parallel to the path of the river (from Phillips and others, 2003; used with permission).

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# Approach

- Synthesize various project-specific data on geology and hydrogeology of the basin
- Map water-level surfaces for the URGB and water-level changes in selected subbasins
- Complete status and trends analysis
- Evaluate groundwater in storage using water-level data, flow models, and (or) other techniques


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# Status – compilation phase

- Data mining/literature review to identify existing cross sections, “picks”, and hydraulic data
- Created a stratigraphic table by subbasin
- Compiling/evaluating water-level data
- Building a geodatabase
- Constructing/compiling groundwater basin boundaries (subbasins)
- Acquiring existing groundwater flow models for storage estimation task

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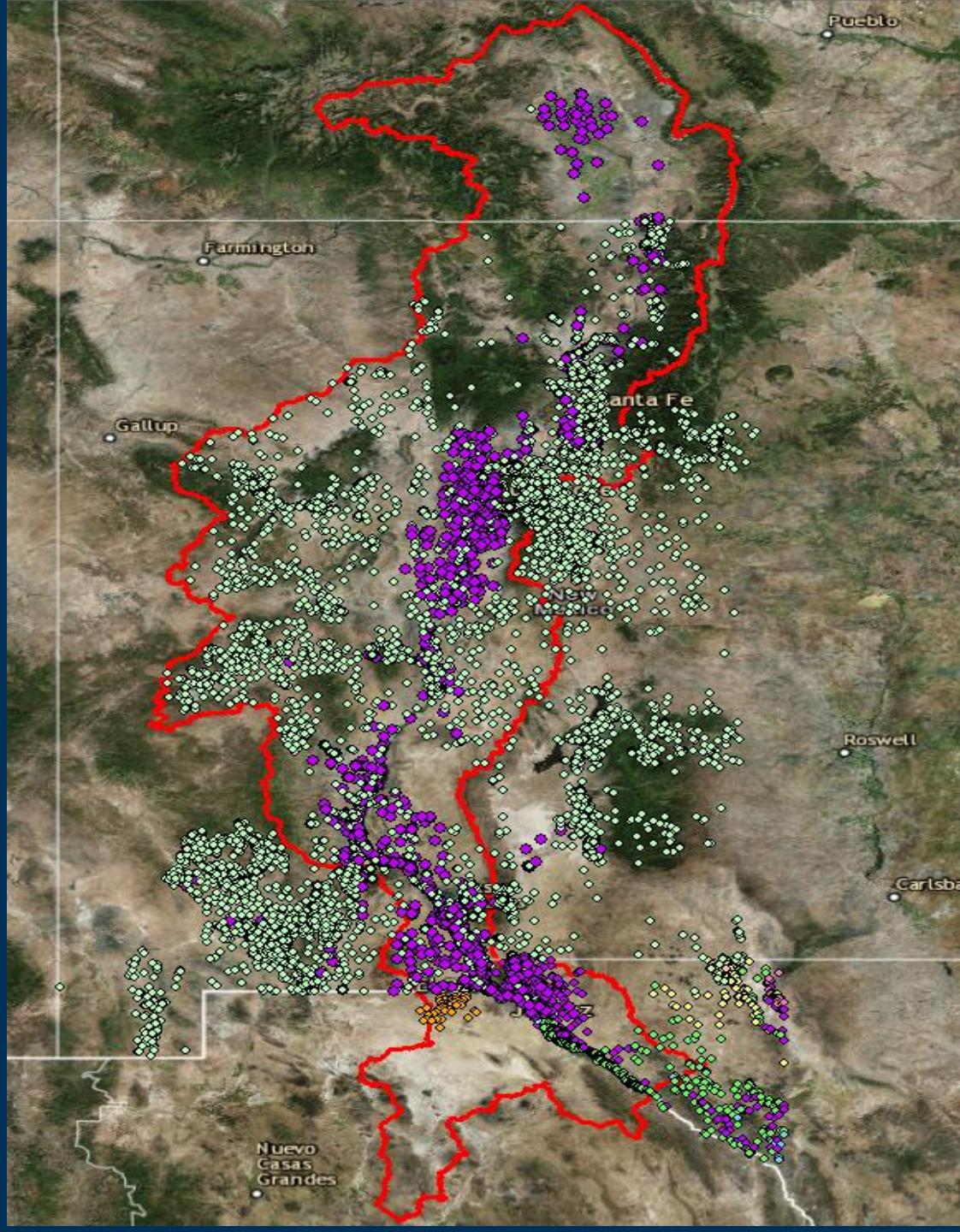
# Water Levels

- Wells with data
  - Alluvium and Bolson deposits in lime green
  - Santa Fe Group in purple

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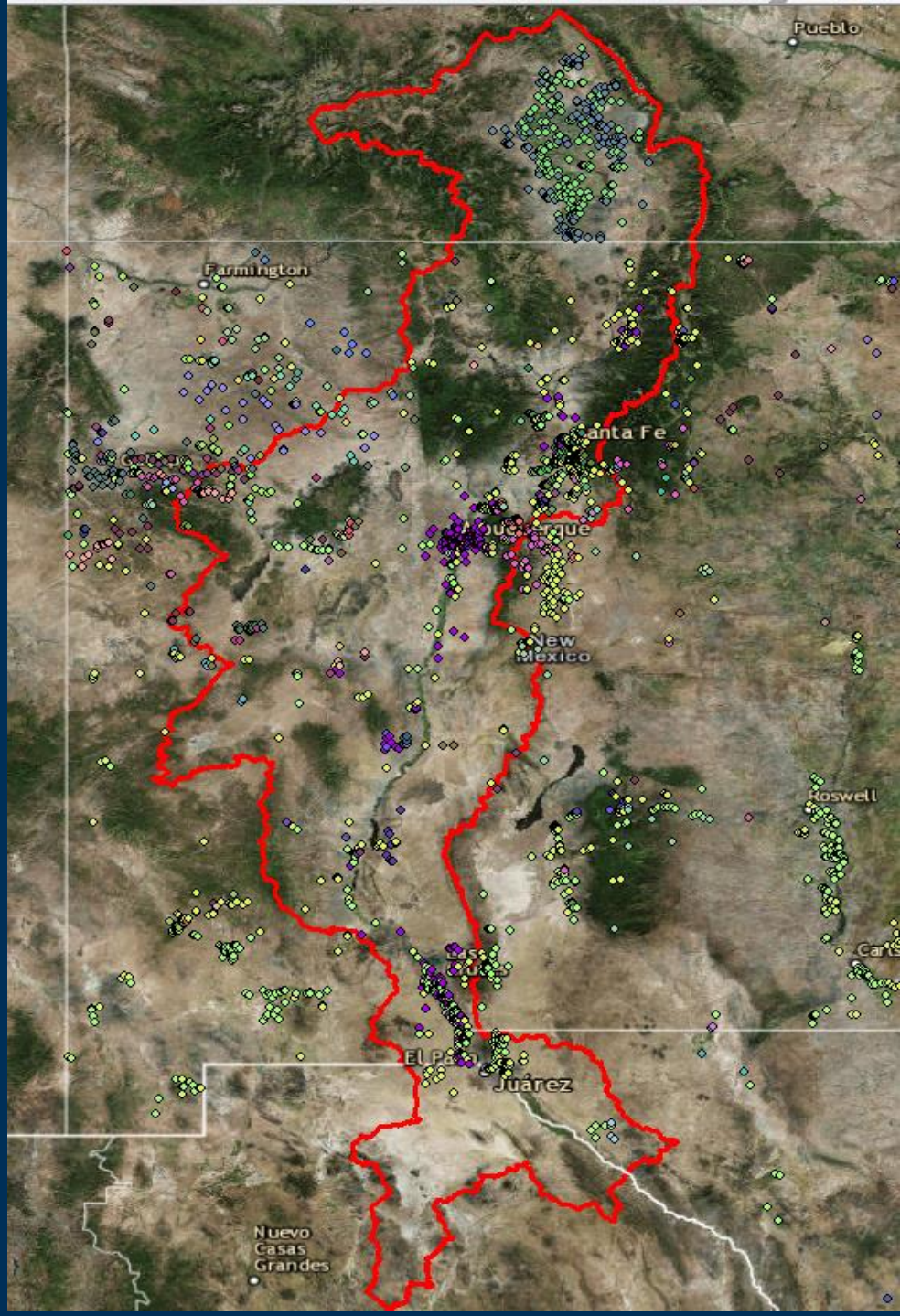
# Hydraulic Properties

- Wells with data
  - Santa Fe Group units are in purple
  - Bolson deposits are in lime green

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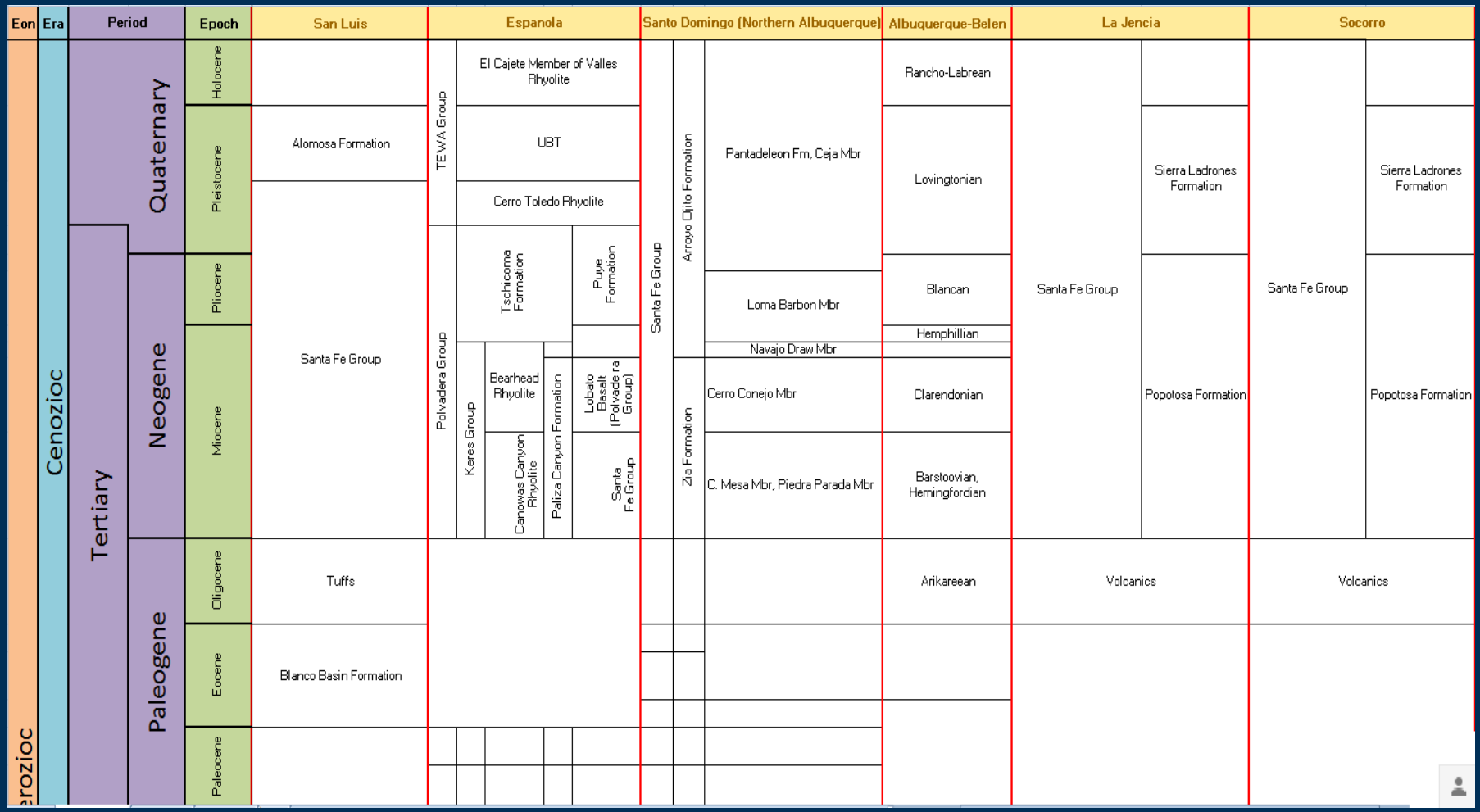
# Stratigraphic Table

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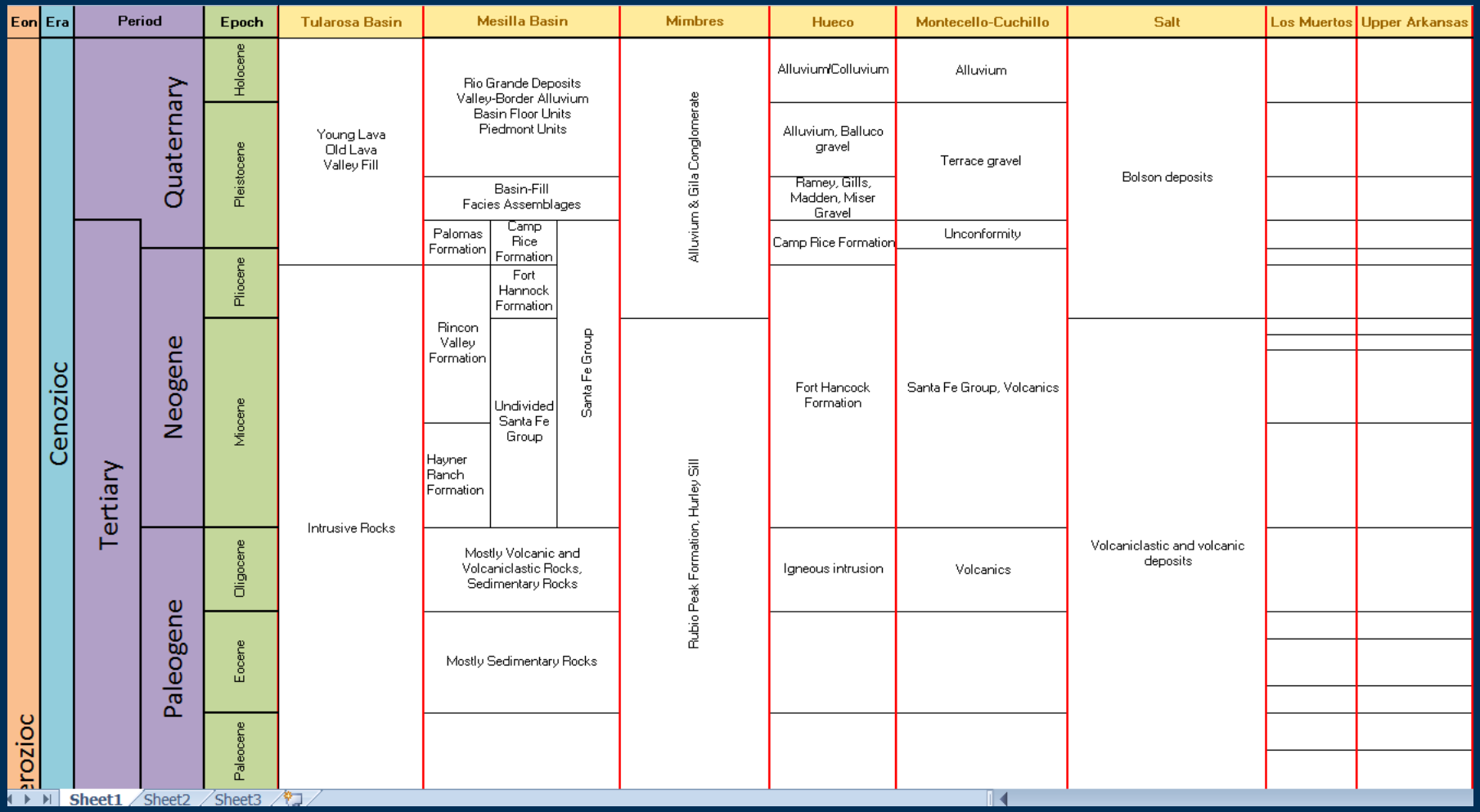


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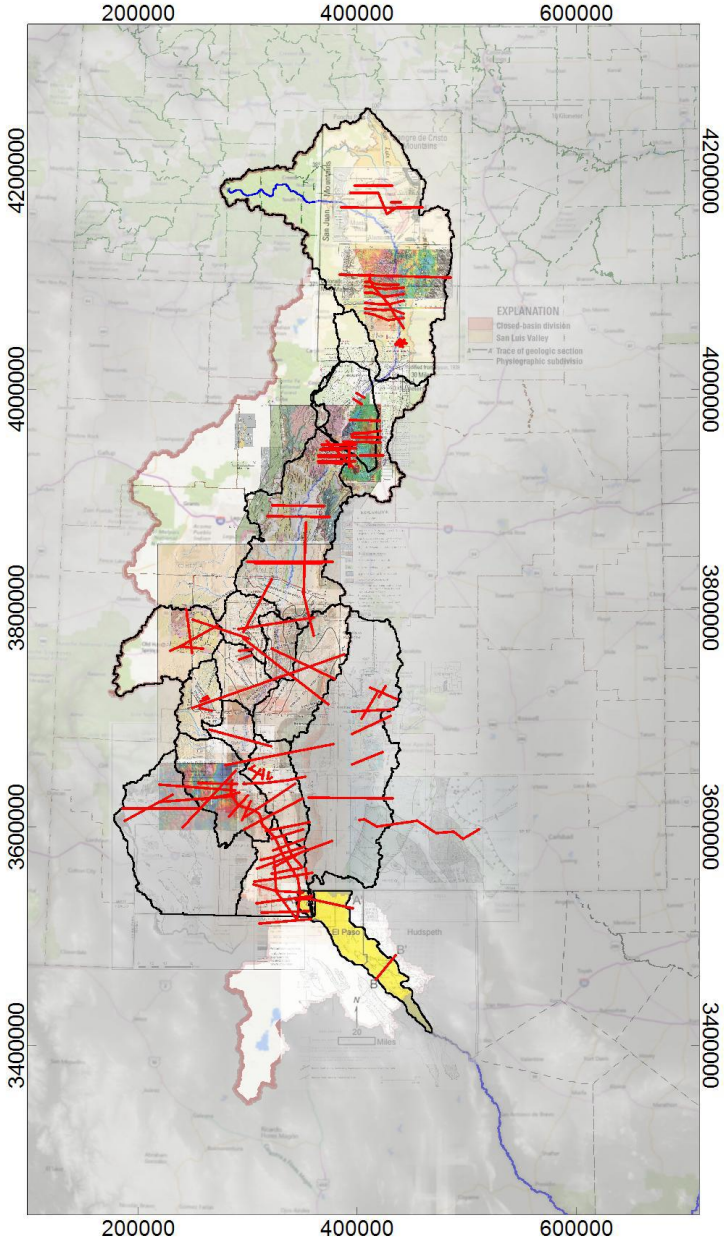
# Rio Grande Focus Area Study
# Cross Section Map

**Explanation**

- Compiled Cross-Section Locations
- Upper Rio Grande River Basin
- Rio Grande River
- Basin Boundary
- Colorado County Line
- New Mexico County Line
- Texas County Line




100000 0 100000 200000

(meters)

*NAD83 / UTM zone 13N*

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# Rio Grande Focus Area Study Cross Section Map

**Explanation**

- Compiled Cross-Section Locations
- Selected Cross-Section Locations
- Upper Rio Grande River Basin
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- Colorado County Line
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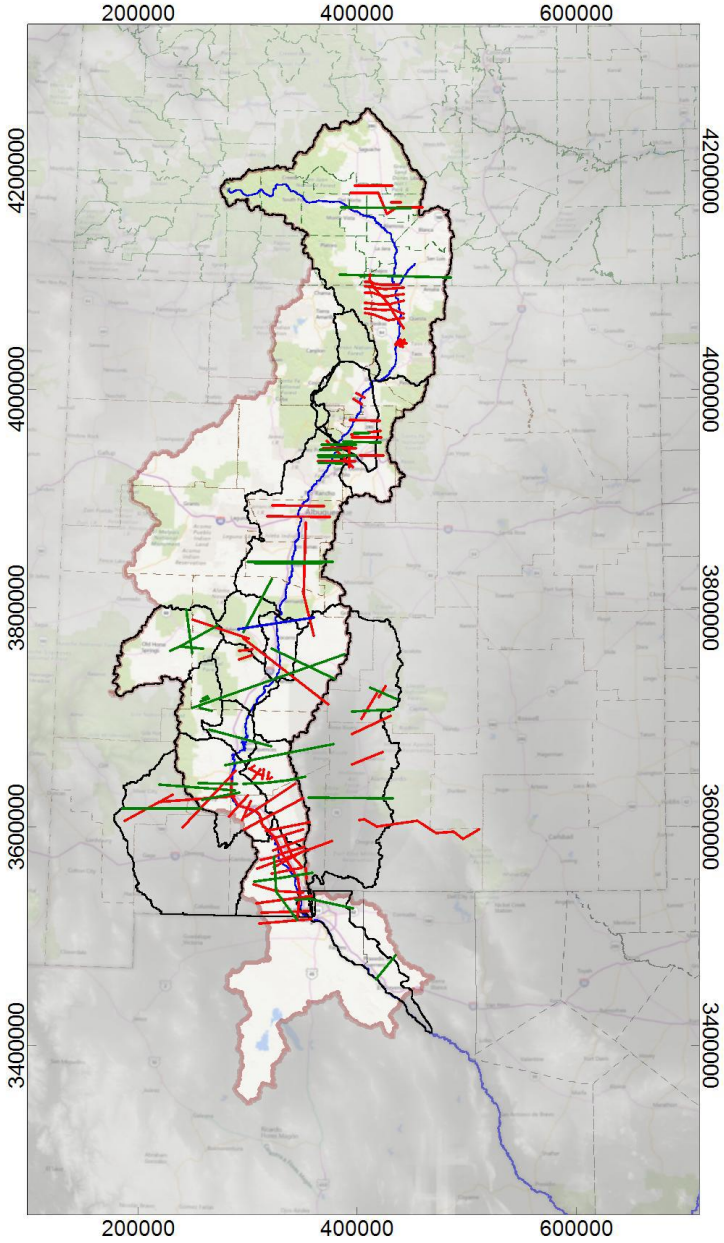


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(meters)

*NAD83 / UTM zone 13N*

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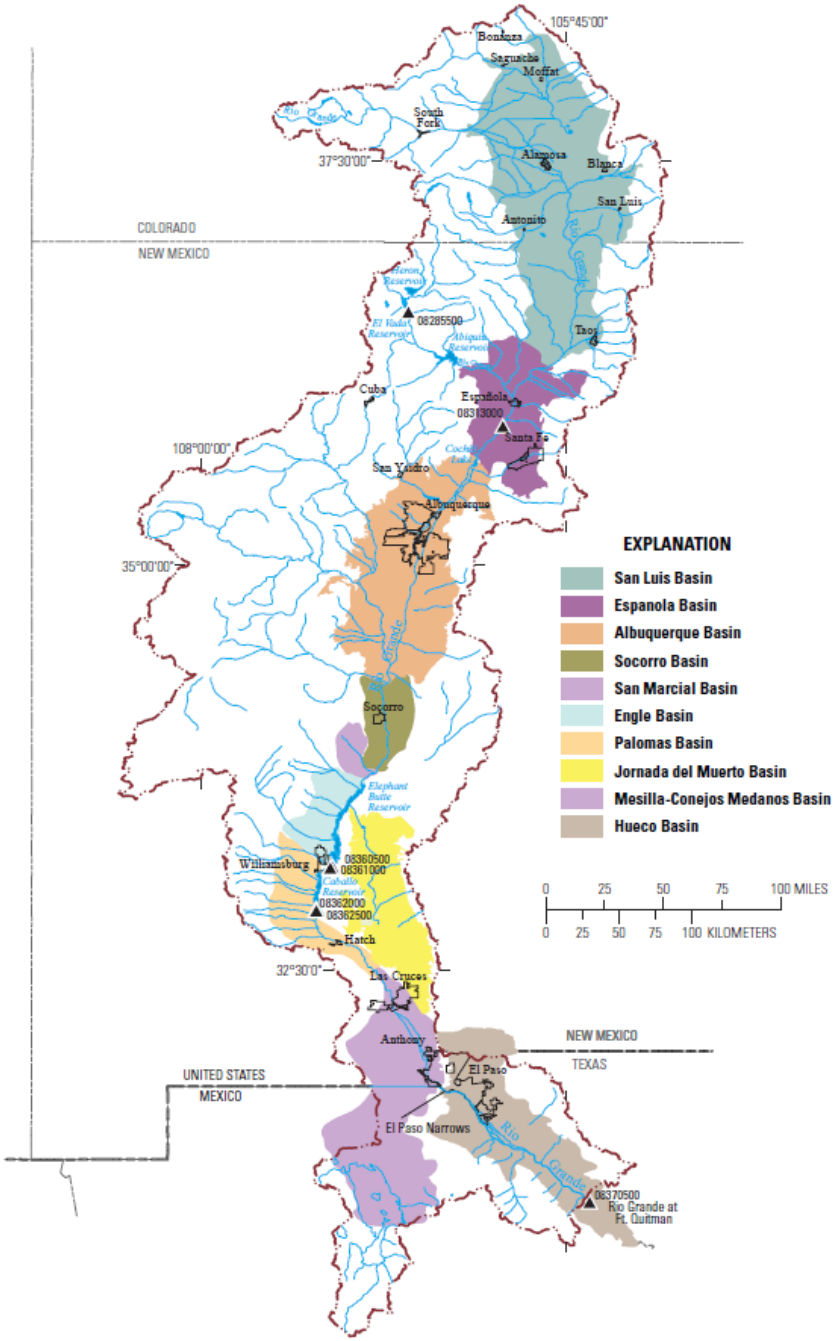
# Subbasins

- Albuquerque or (Middle Rio Grande)
- Not shown: the Upper Arkansas, San Agustin, Salt, Mimbres, and Tularosa

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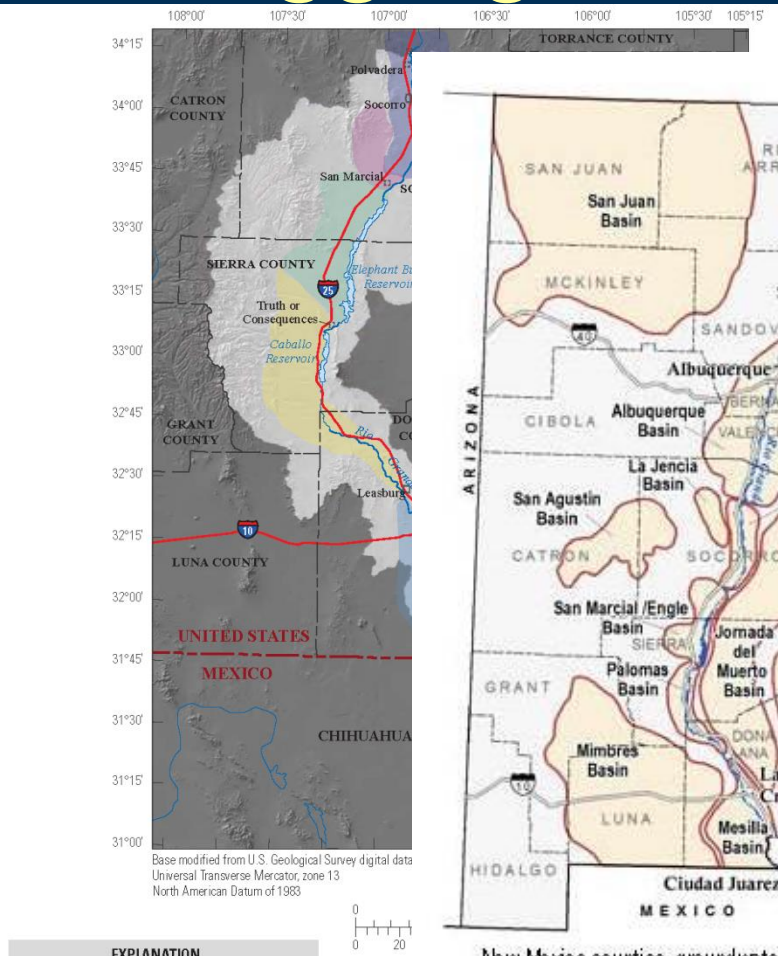
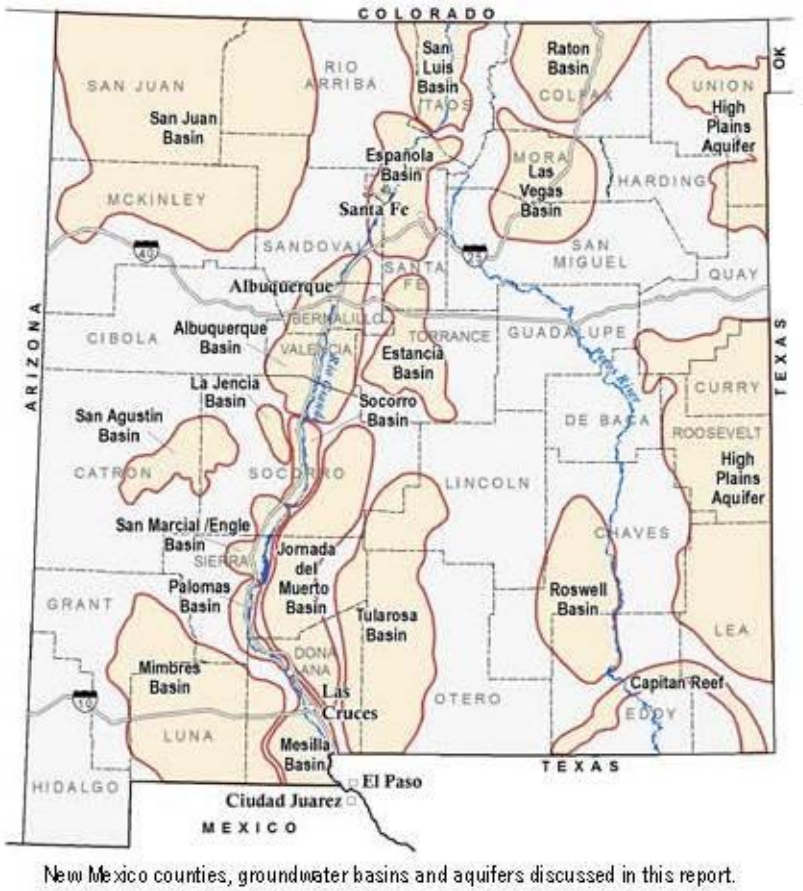
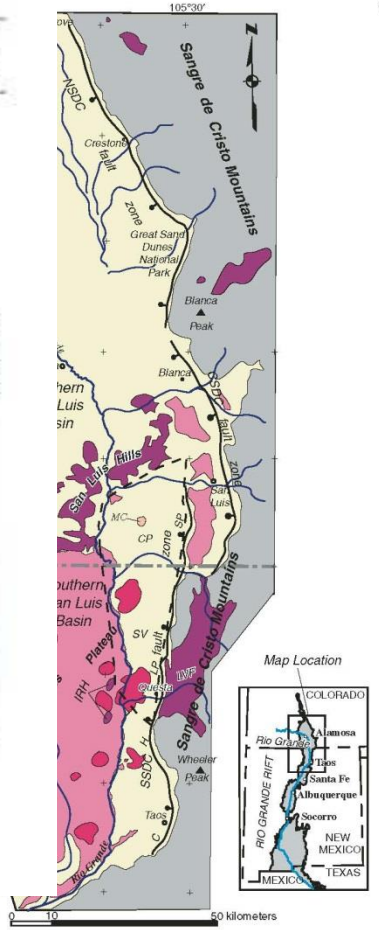
# Data Aggregation




New Mexico counties, groundwater basins and aquifers discussed in this report.

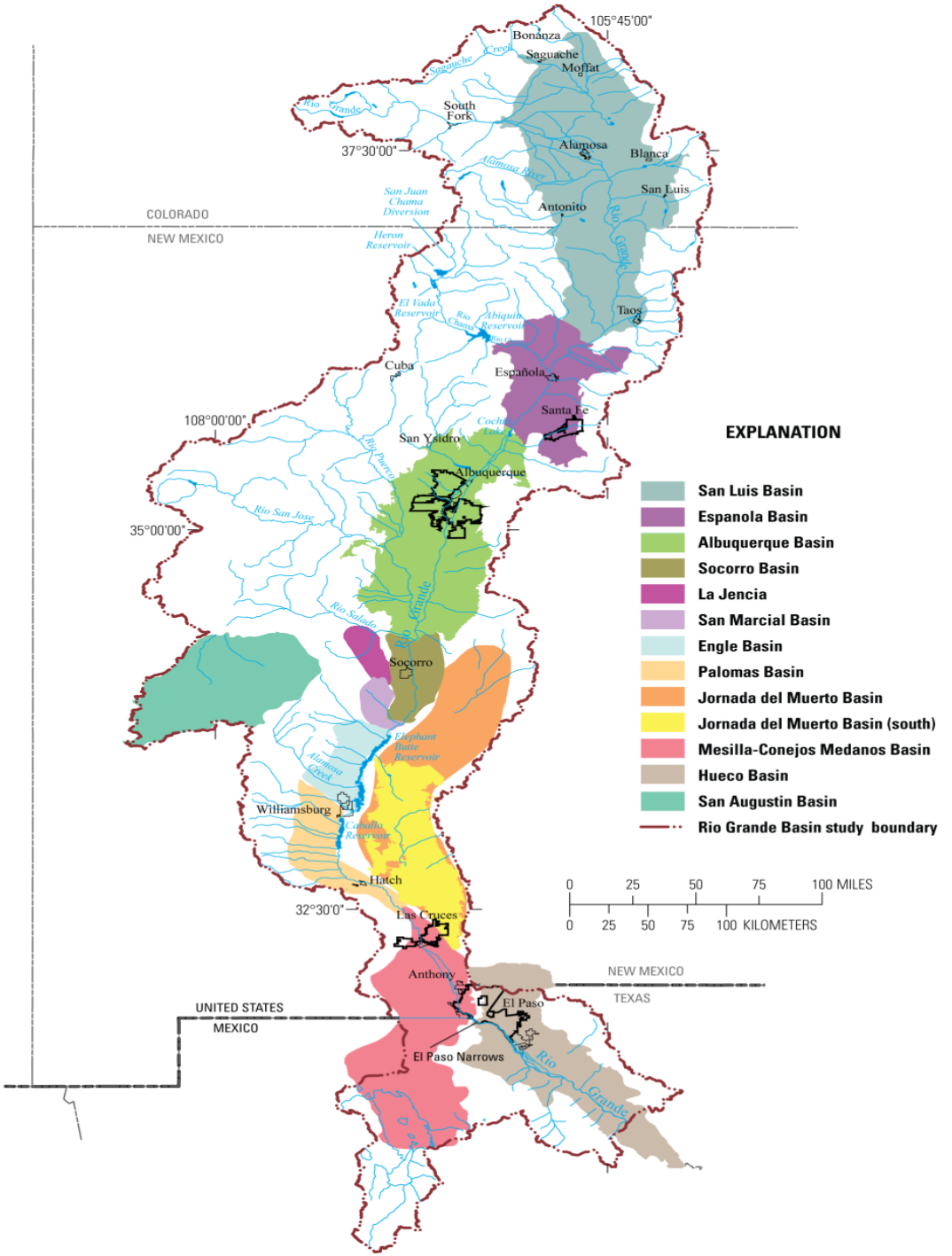



oximate location of the Sunshine Valley-Costilla Plain subbasin

eneralized geologic map of the San Luis Basin. Sunshine Valley and Costilla Plain locations shown as SV and CP, respec-
re de Cristo fault system is subdivided into zones: SSDC—southern; CSDC—central; NSDC—northern. The southern
ristо fault zone is subdivided into sections, from north to south: SP—San Pedro Mesa; LP—Latir Peaks; H—Hondo; C—
—intra-rift horst exposing Oligocene volcanic rocks; MC—early Pleistocene Mesita Cone; LVF—Latir volcanic field of
Reed (1989). Dashed line marks approximate location of Sunshine Valley–Costilla Plain structural subbasin.

Figure 1. Study area and alluvial-fill basins underlying the Rio Grande: Socorro, San Marcial, Engle, Palomas, Mesilla, and Hueco Basins. This study focuses on the Palomas, Mesilla, and Hueco Basins in New Mexico and Texas, from below Caballo Reservoir, N. Mex., to Fort Quitman, Tex.

# First Pass

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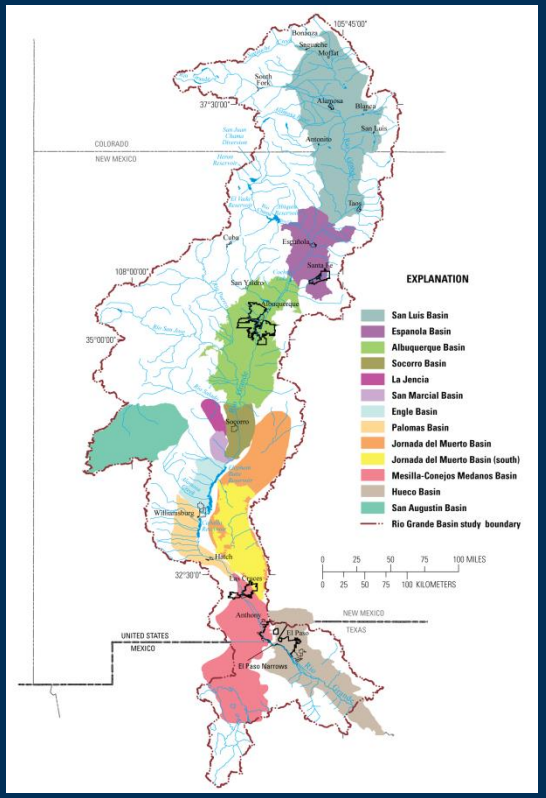
# Evaluated Basin Delineations

- Issues with digitized basins:
  - Varying scales
  - Generalized basin boundaries
  - Overlapping basin boundaries
  - Gaps between basins




- Combed through literature to figure out how each basin boundary was derived

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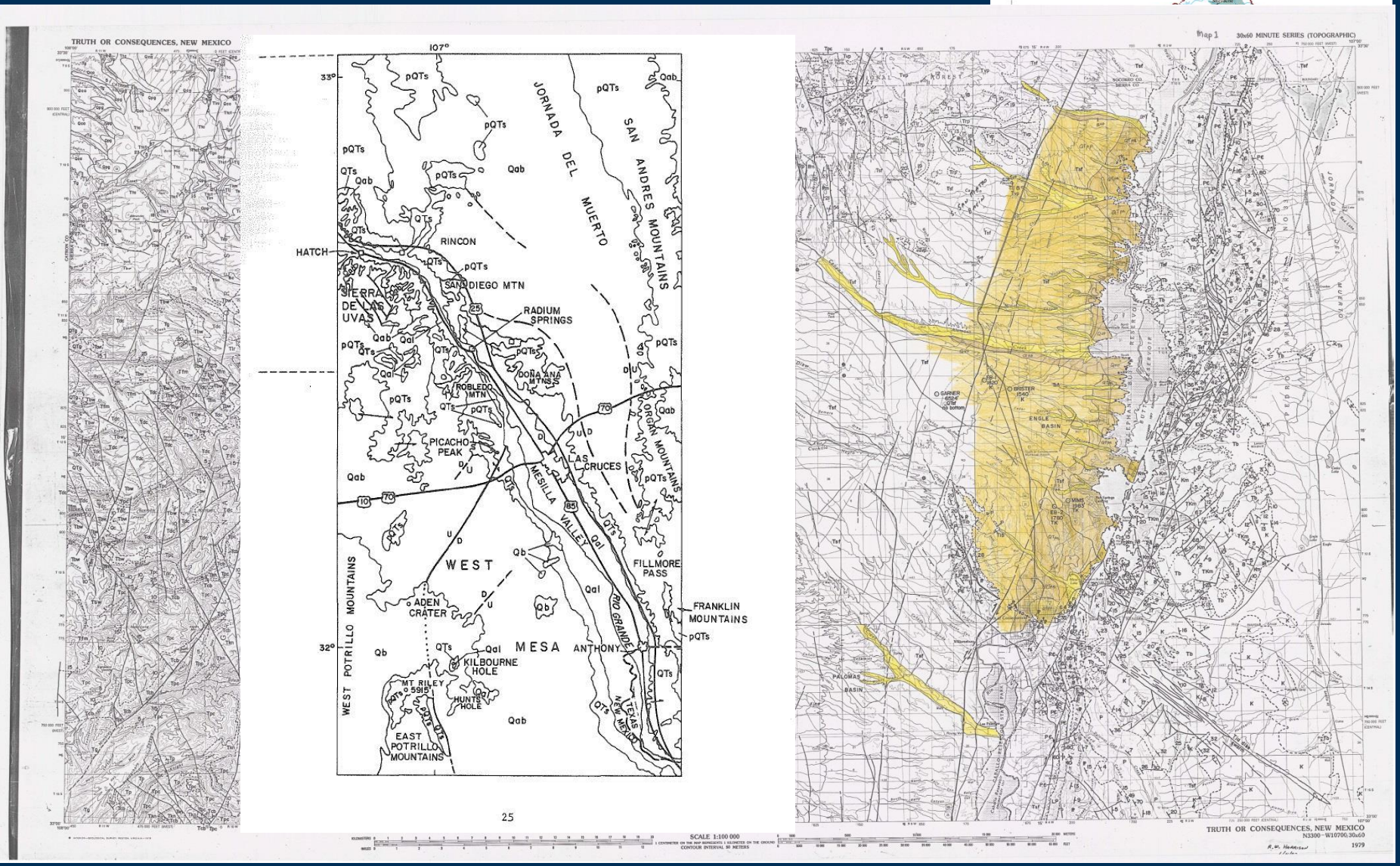
# Evaluated Basin Delineations



# Evaluated Basin Del

- Some key elements used:
  - Topography
  - Faulting
  - Groundwater movement

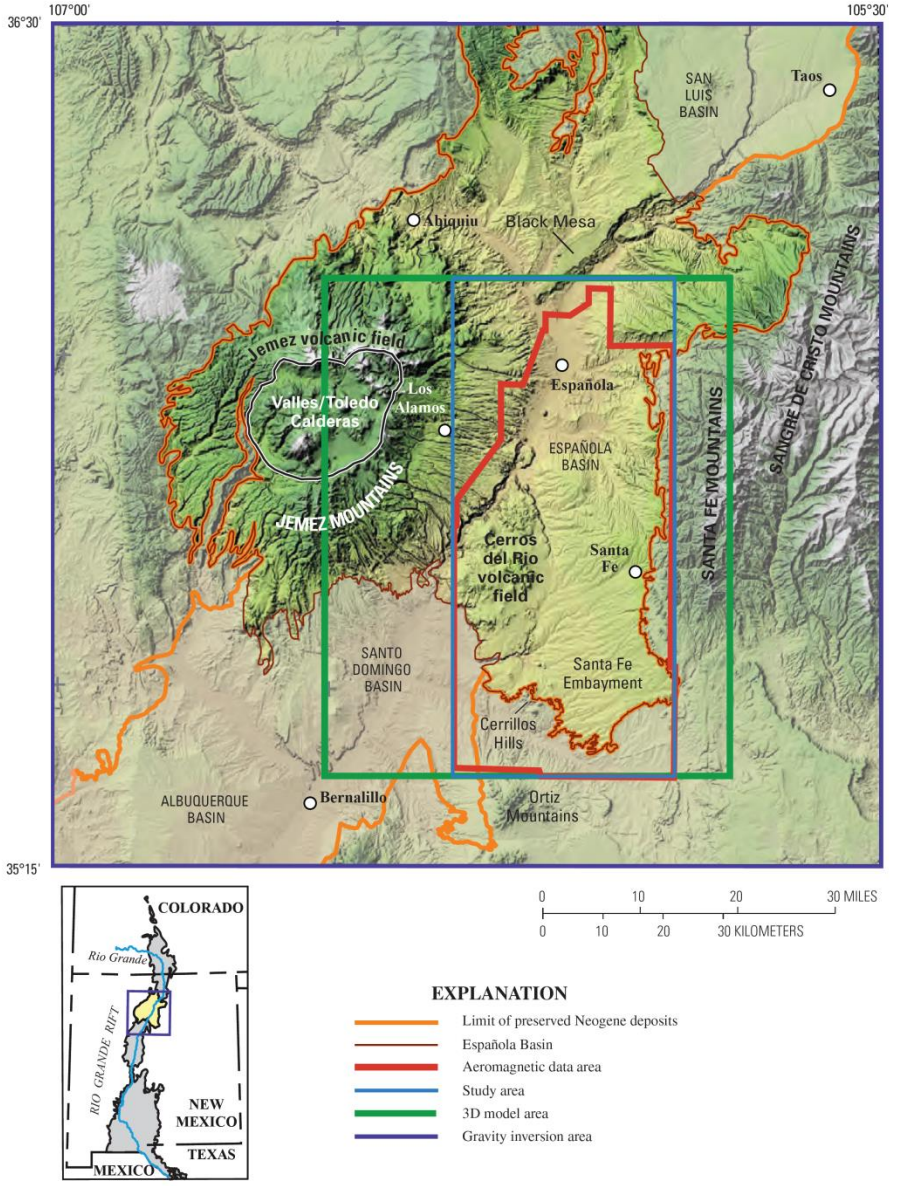



**Figure 1.** Española Basin and areas used for various analyses. Processed Landsat satellite imagery is from Sawyer (2004). Overall topographic relief within the study area is 1,145 m (3,750 ft).

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# Evaluated Basin De

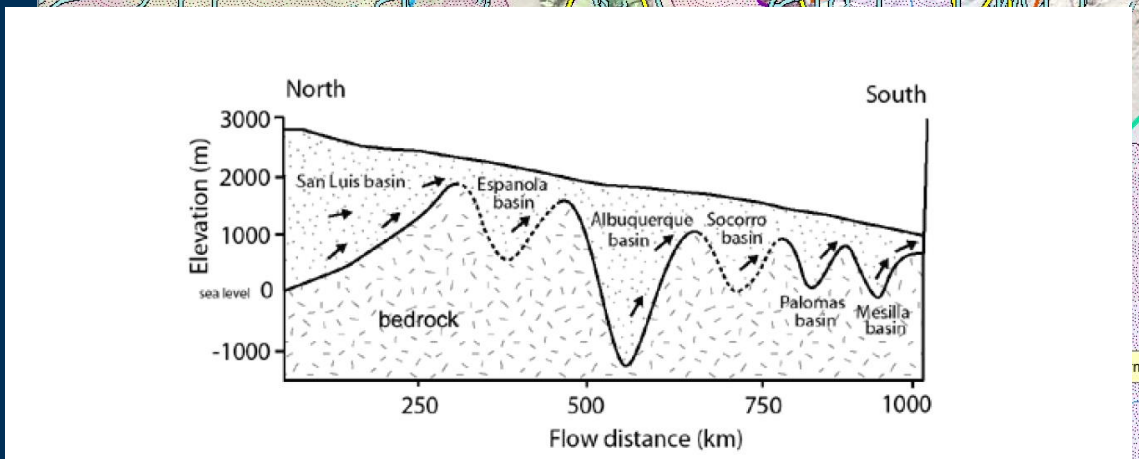


**Figure 2.** Schematic hydrogeologic cross section of the Rio Grande Rift, parallel to the path of the river (from Phillips and others, 2003; used with permission).

# Results of Second Pass (Ongoing)

- Considered elements such as topography, faulting, and groundwater movement to adjust the delineated boundaries
- Adjusted delineated boundaries, addressed the issues discovered in first pass of digitization:
  - Varying scales
  - Generalized basin boundaries
  - Overlapping basin boundaries
  - Gaps between basins

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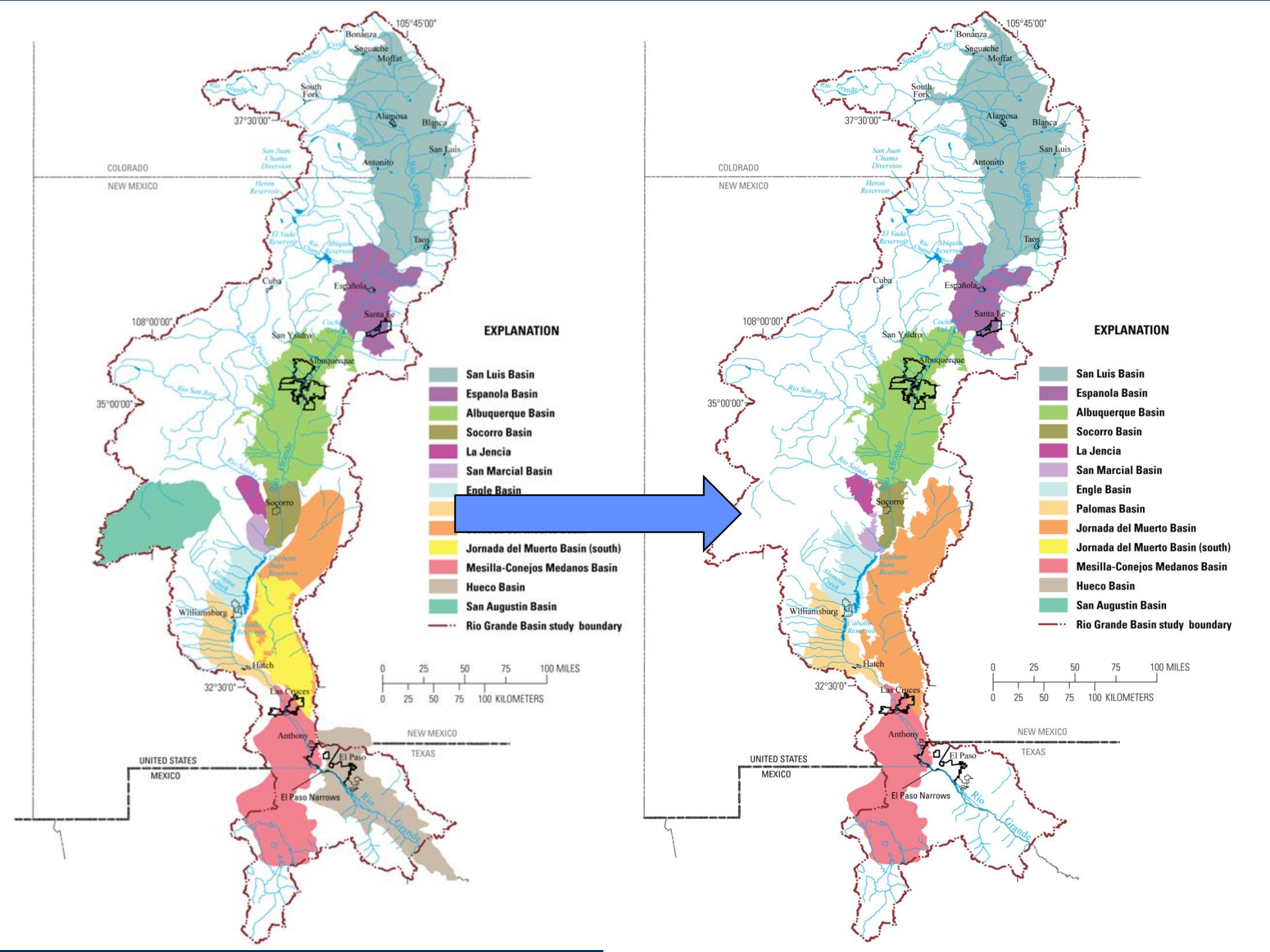
105°45'00"
Bonanza
Saguache
Moffat
South Fork
Alamosa
Blanca
San Luis
Antonito
37°30'00"
COLORADO
NEW MEXICO
Taos
Cuba
Española
Santa Fe
108°00'00"
San Ysidro
Albuquerque
35°00'00"
Socorro
Williamsburg
Hatch
Las Cruces
32°30'0"
Anthony
El Paso
El Paso Narrows
NEW MEXICO
TEXAS
UNITED STATES
MEXICO
0 25 50 75 100 MILES
0 25 50 75 100 KILOMETERS
EXPLANATION
San Luis Basin
Espanola Basin
Albuquerque Basin
Socorro Basin
La Jencia
San Marcial Basin
Engle Basin
Palomas Basin
Jornada del Muerto Basin
Jornada del Muerto Basin (south)
Mesilla-Conejos Medanos Basin
Hueco Basin
San Augustin Basin
Rio Grande Basin study boundary

# Second Pass (Ongoing)

- Comparison to Rio Grande aquifer system
- Ongoing evaluation of basin boundary delineations
- Using available resources:
  - Literature Descriptions
  - Map Figures
  - Geospatial Data

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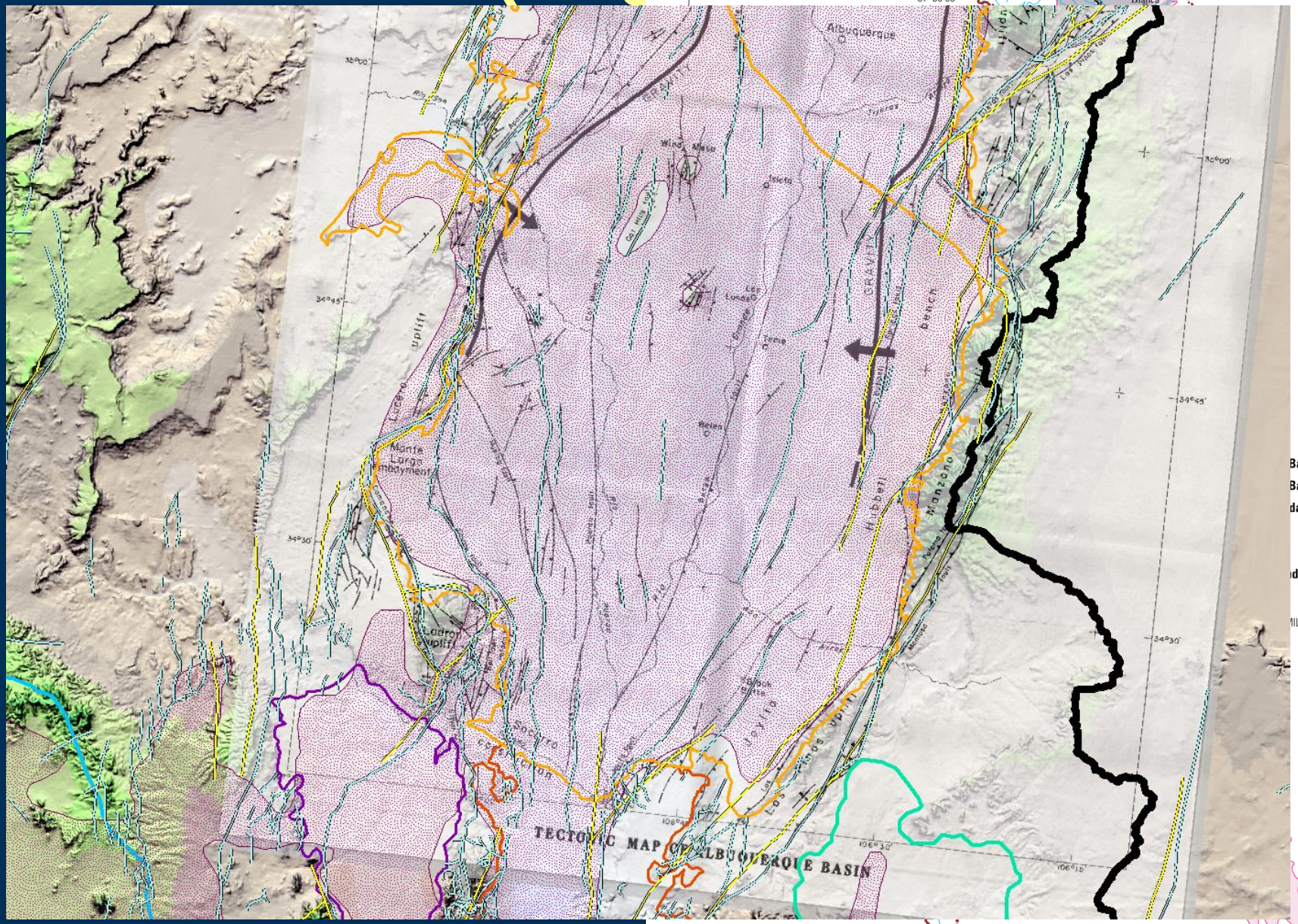
# Second Pass (Ong




# Status and Trends

**This sub task will use a technique developed by Erick Burns to evaluate the status and trends in water-level data by examining:**

- **The relation to hydrogeologic controls that influence the hydraulic properties of the aquifer(s)**
- **or hydraulic stresses by looking for spatial and temporal patterns in water-level data**

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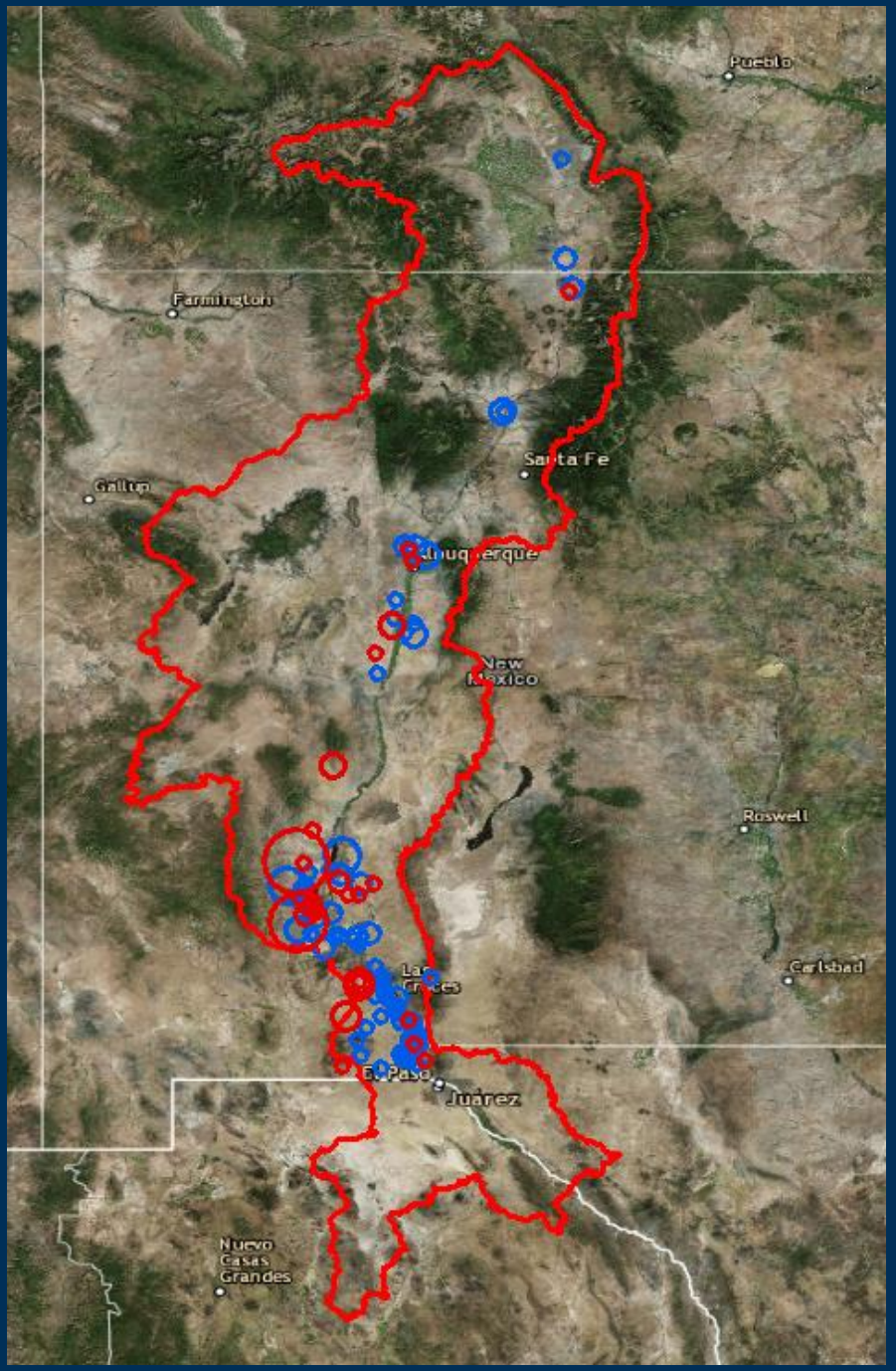
# Status and Trends Limitations

- Measurement accuracy
- Quality control on the data
- Local conditions and stresses
- Well construction
  - Physical and construction record

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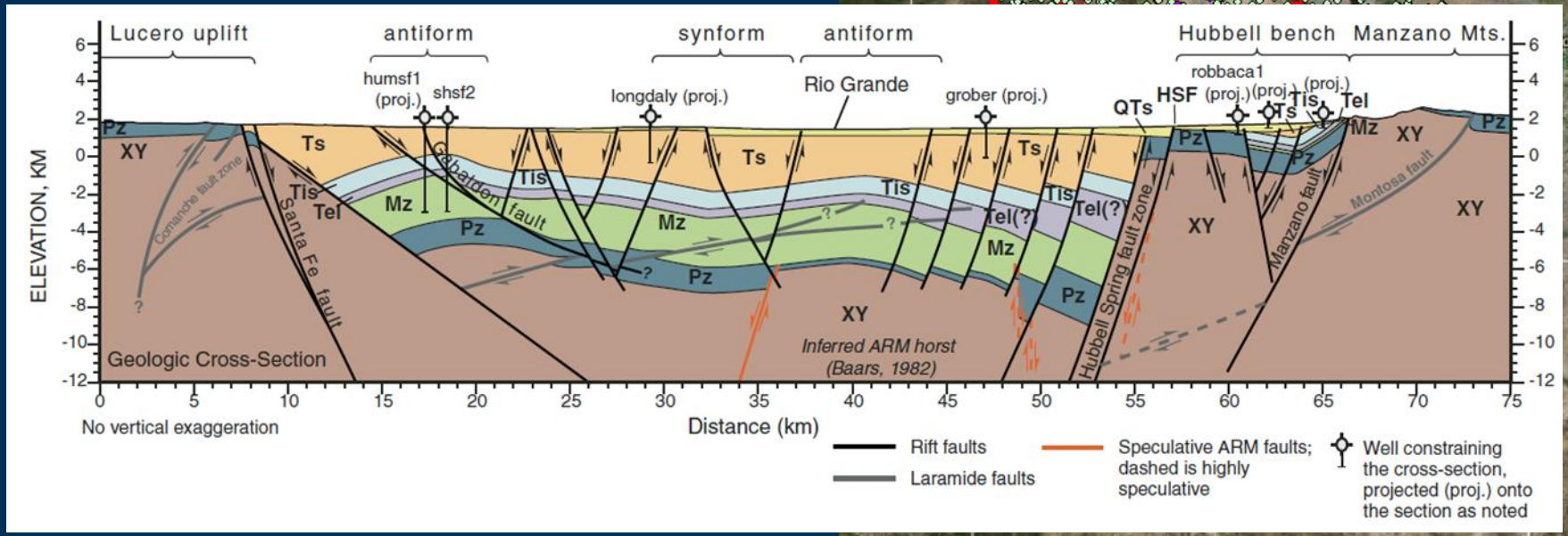
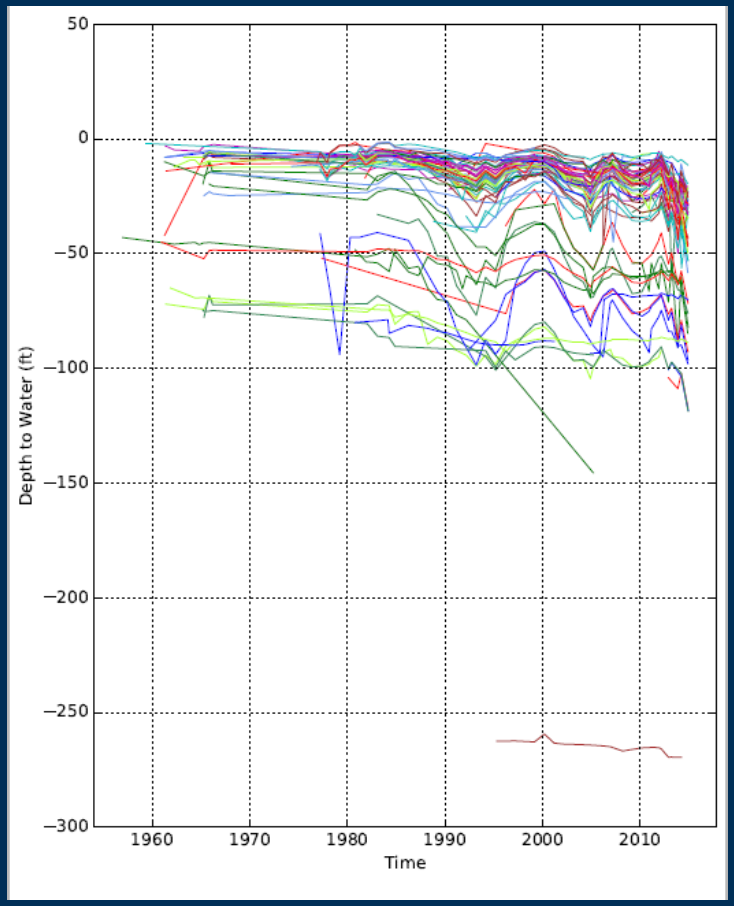
# Status and Trends Source Data

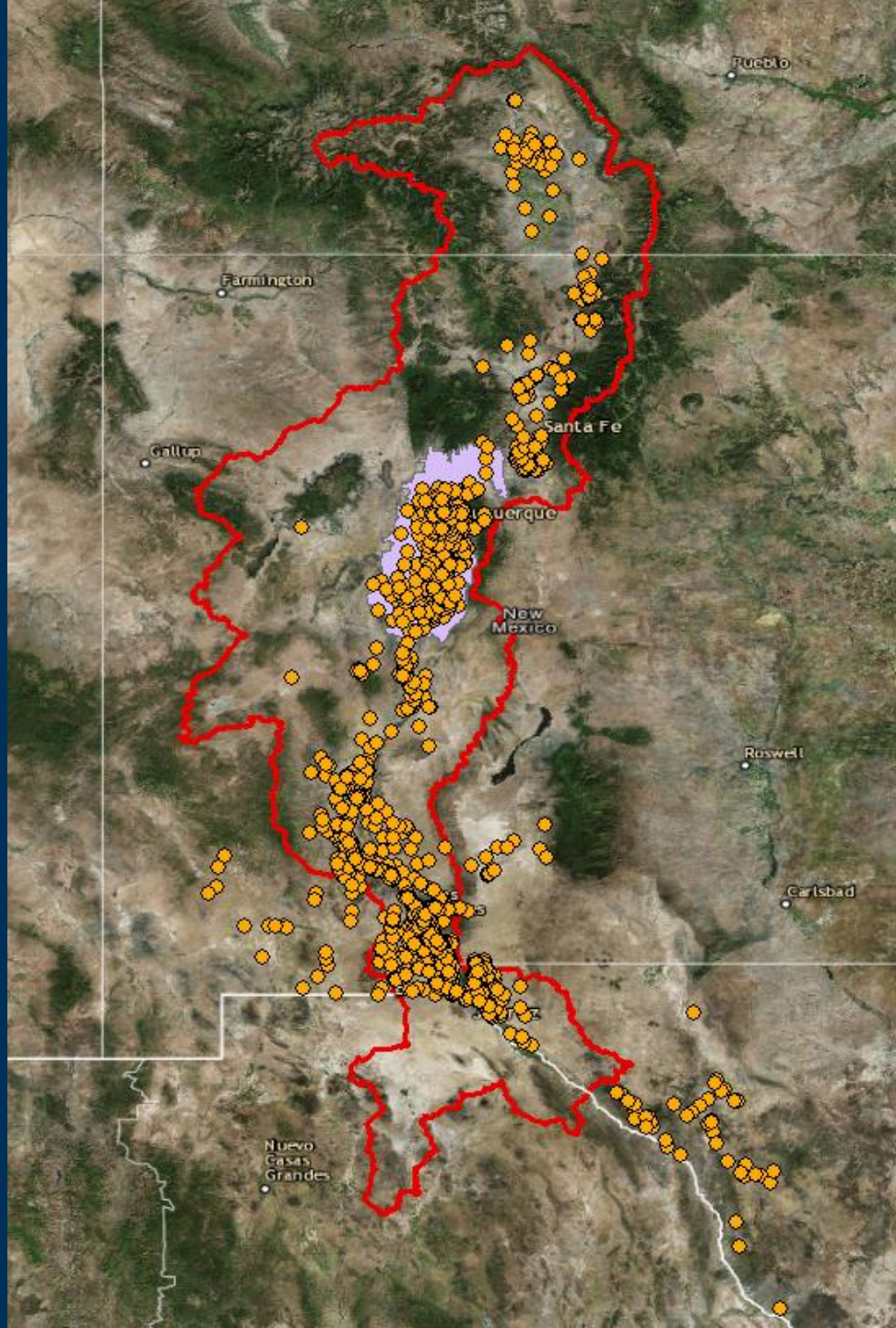
- Wells and associated data

- Hydrogeologic framework



# Status and Trends

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# Estimate Water in Storage

- Review several groundwater-flow models within study area
- Develop graphs of changes in storage throughout their simulated time periods (FloPy, python)
- Water in storage for modeled subbasins can be visualized in plan view using:
  - calibrated values of specific storage (Ss) and specific yield (Sy)
  - saturated thickness (for unconfined conditions)
  - aquifer thicknesses (for confined conditions)
- Spatial visualization of areas with the greatest changes in groundwater storage, or largest amounts of water in storage. Difference maps could be important for visualization here.

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# Estimate Water in Storage

- Calibrated values of storage parameters from existing models help us to understand the distribution of these parameters in the study area (*prior)*
- Storage “realizations” can be developed from drawing from this *prior* information (SGeMS)
- Combination of these “realizations” with water-level analysis can lead to developing a range of potential answers of available water in storage (or ΔS [change in storage])

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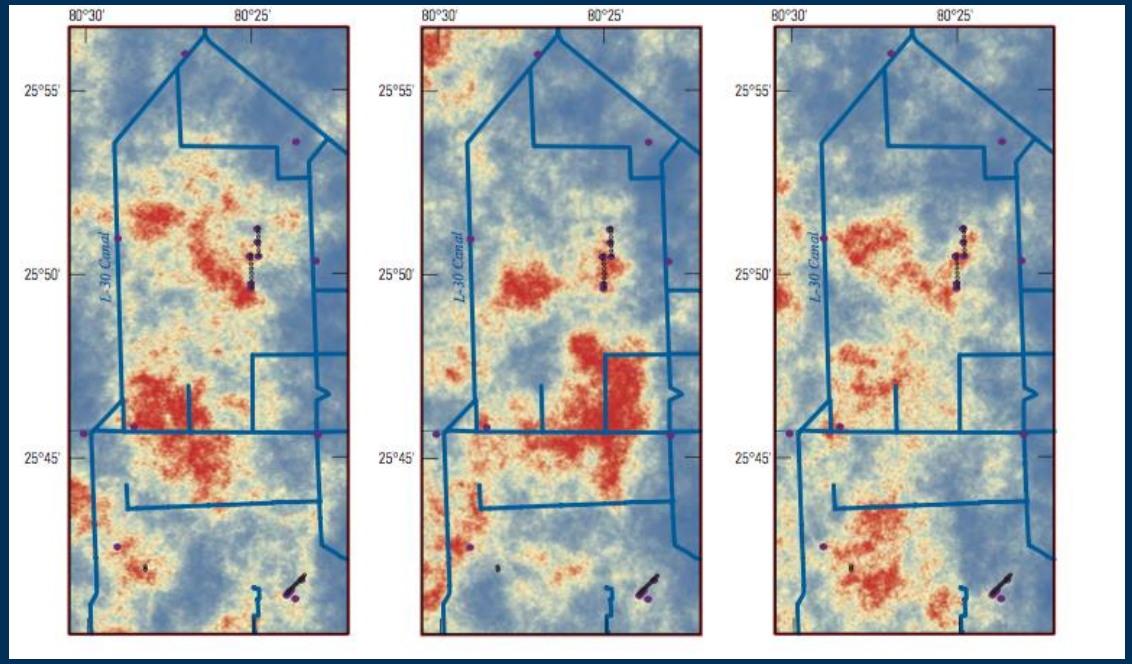
# Estimate Water in Storage

## Realizations

- could be uniform with a single value
- could be geostatistically described and created with SGeMS
- hundreds of realizations

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# Planned Information Products

- Data Release
  - File based geodatabase containing
    - Water-level data
    - Digital groundwater basin boundaries
    - Tabular structure data used for any new cross sections
    - Tabular hydraulic property data collected for storage estimation task
- Scientific Investigation Report
  - Water-level altitude and water-level change maps
  - Water in storage estimates
  - Status and trends statistical analysis images

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# Next Steps

- Continue cross-section construction for basins that have ample data but no current cross section
- Complete water-level data evaluation, begin water-level altitude map construction
- Complete geodatabase of subbasin boundaries, hydraulic properties, and water-level data
- Complete pilot study on water level status and trends task and move to Rio Grande Data

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# Timeline

| Groundwater | FY 2016 | | FY 2017 | | | | FY 2018 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Hydrogeologic Framework | x | x | x | x | x | x | | | | |
| Water Levels | | | | | | | | | | |
| Status and Trends Analysis | | | | | x | x | x | x | x | |
| Water-Level Surface | | | | x | x | x | x | | | |
| Water-Level Change | | | | | | x | x | x | x | |
| Changes in Groundwater Storage | | | | | | x | x | x | x | |
| Report/data release | | | x | x | x | x | x | x | x | x |
| | | | | | | | | | | |

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# Upper Rio Grande Basin Focus Area Study Groundwater Team


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