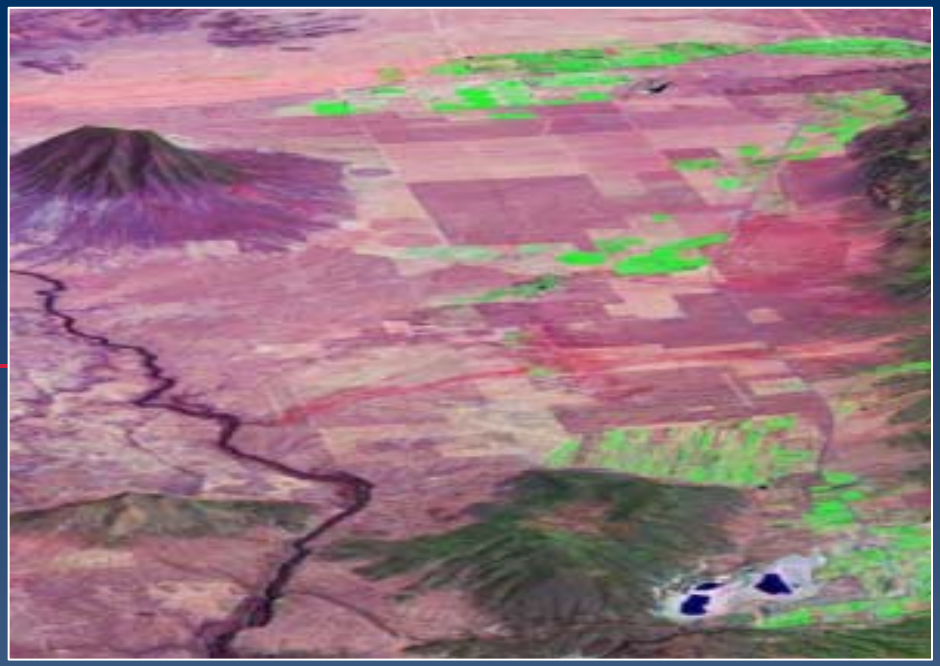
Santa Fe County Regional Model Development and Application

Public Meeting

Santa Fe County Community College

March 13, 2006



Presentation Outline

- Background
- Data Evaluation
- Model Development
- Decision Analysis Approach
- Results of Analysis
- Questions

Background

Geohydrologic Study and Aquifer Evaluation

- Conduct data evaluation
- Prepare diagnostic of the data
- Review existing models
- Recommend appropriate model
- Interim and Final Reports
- Make presentation of results to BCC

Background

Construct Groundwater Availability Model

- Groundwater/aquifer sources and location according to depth, flow and water quality
- Existing well locations by density and well depth, yields and classifications
- Water quality, areas of highest concern based on available information
- Identification and mapping of current and proposed County water and wastewater facilities

Background

Final Tasks

- Install model and train County personnel
- Use model to make recommendations on optimal locations for water supply wells
  - Greatest potential to produce sustainable yields
  - Least long term impact to the aquifer and area springs
  - Lowest expected impairment to area wells
  - Reasonable costs for permitting and infrastructure
- Final report and presentation to BCC
- Public meetings

Data Evaluation

Data Evaluation

Data Evaluation

Development of Conceptual Model

Data Types

- Physiography and Climate
- Geology and Hydrology
  - Structure and Faulting
  - Recharge and hydraulic properties
  - Surface water/ground water interactions
  - Hydrostratigraphy – Aquifers
- Groundwater Pumping – aquifer stresses
- Stream gauge data and spring data
- Water Balance – water inputs – water outputs

Data Evaluation

Data Sources

- County In-house resources
  - Published consultant reports
  - Geologic logs
  - Pumping test results
  - Infrastructure data
- City In-house resources
  - CDM reports and other consultant reports
  - Buckman Pumping data
- Española Basin Technical Advisory Group
- New Mexico Bureau of Geology
- Office of the State Engineer
- USGS – Denver Meeting

Data Evaluation

The primary digital data used for development of the hydrogeologic conceptual model are the following:

- Base of the Ancha – digital data from Johnson et al. (2004)
- Base and the Tesuque – digital data from Johnson et al. (2004) and Grant (1998)
- Base and thickness of the Tesuque – digital data from Phillips and Grauch (2004)
- 1:500,000 digital geologic map of New Mexico (Anderson et al., 1997)
- 1:50,000 digital geologic map – digital data from Johnson et al. (2004)
- Digital geologic map derived from Grant (1998) by the OSE
- Digital geologic map of the Tetilla Peak quadrangle – digital data from Sawyer et al. (2002)
- Fault locations:
  - 1:500,000 digital geologic map of New Mexico (Anderson et al., 1997)
  - Johnson et al. (2004) digital line data

Data Evaluation

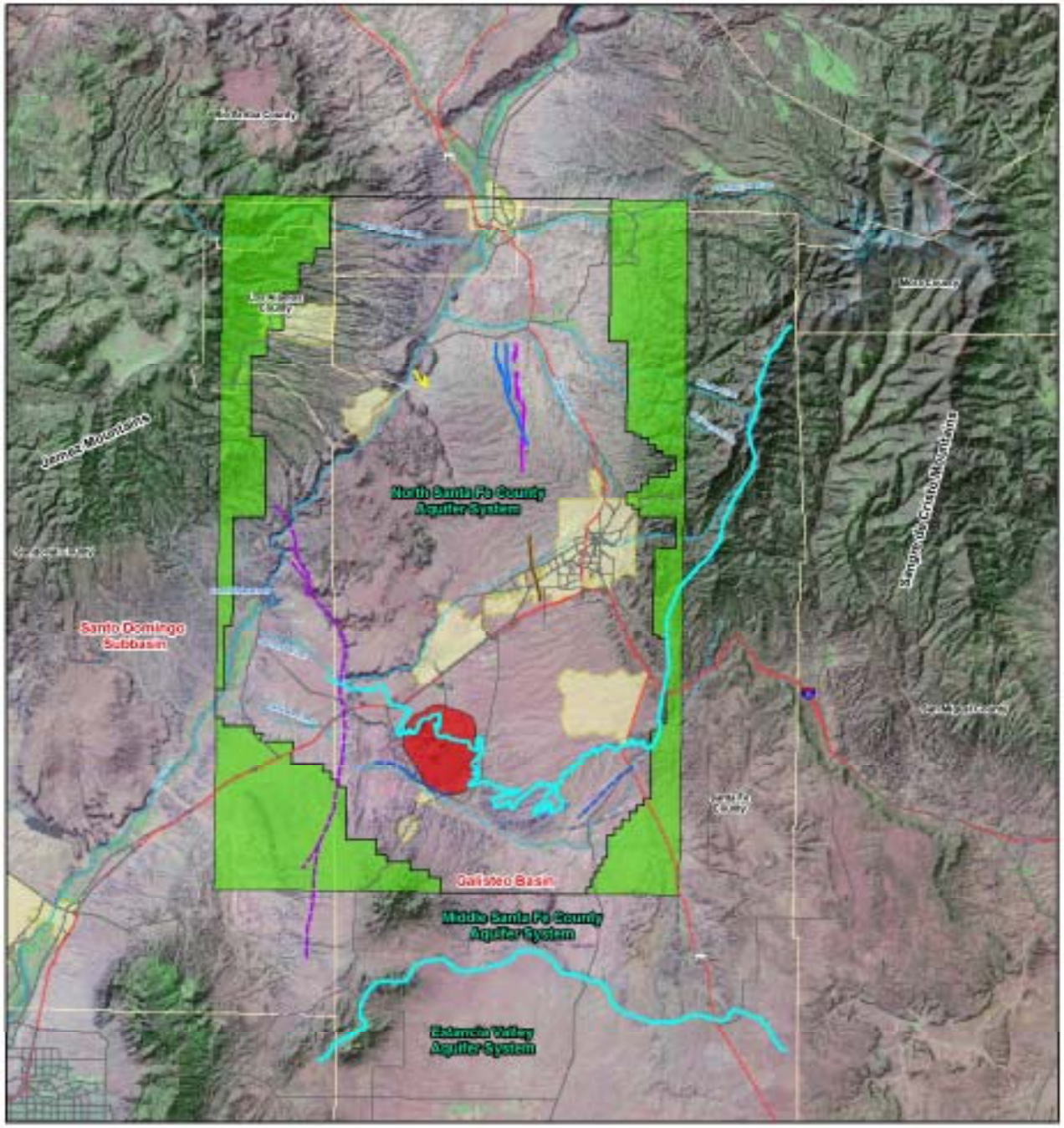
We also utilized the following draft 7.5-minute geologic quadrangles from the New Mexico Bureau of Geology:

- Captain Davis Mountain (Lisenbee and Maynard, 2002)
- Galisteo (Lisenbee, 1999)
- Glorieta (Ilg et al., 1997)
- Golden (Maynard, 2002)
- Madrid (Maynard et al., 2002b)
- Picture Rock (Maynard et al., 2002a)
- San Felipe Pueblo NE (Black et al., 2000)
- Santa Fe (Read et al., 2000)
- Seton Village (Read et al. 1999)
- Turquoise Hill (Koning and Hallett, 2001)

Data Evaluation

Spring data were compiled from the following sources:

- Duke Engineering and Services (2000) – GIS shapefile of spring locations
- White and Kues (1992) – Inventory of springs in New Mexico
- Shomaker et al. (2001) – Tabulated spring data for the Eldorado area
- U.S. Geographic Names Information System (http://geonames.usgs.gov/gnishome.html) – Point data for spring locations from USGS 7.5-minute topographic quadrangles
- Blake et al. (1995) – Tabulated spring data for the Los Alamos area
- Purtyman et al. (1980) – Tabulated spring data for the Los Alamos area
- Purtyman et al (1993) – Tabulated spring data for the Los Alamos area
- U.S. Army Corps of Engineers (2000) – Upper Rio Grande Water Operations Model (URGWOM) data



NORTH

Legend

- Buckman Fault System
- Jacona Fault System
- Las Dos Fault System
- San Isidro Crossing Fault
- La Bajada fault
- Tijeras/Canoncito fault group
- Divisions of Lewis and West (1995)
- Cerrillos Intrusion
- Model boundary with inactive areas shaded

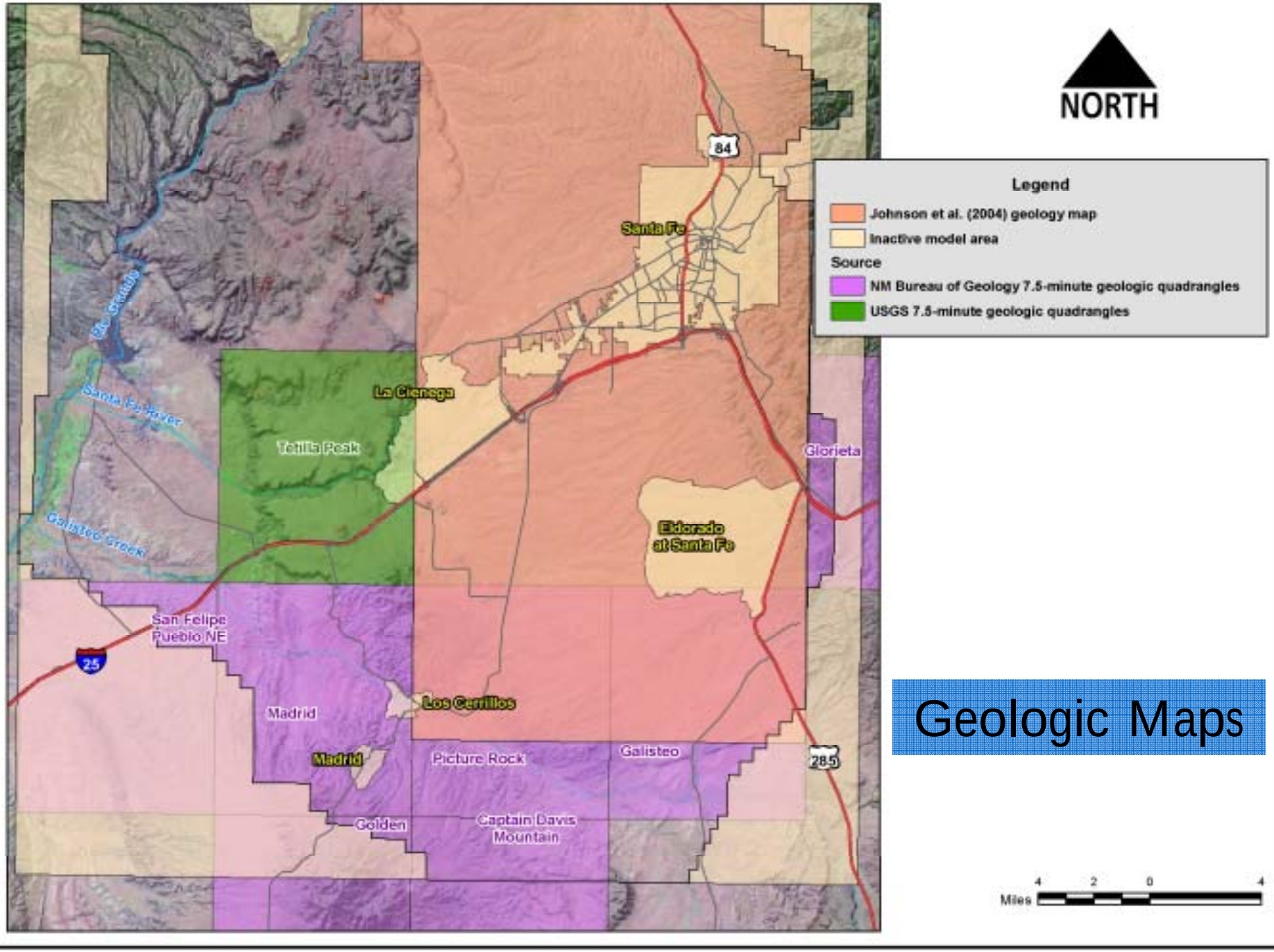
Regional Overview

9 4.5 0 9

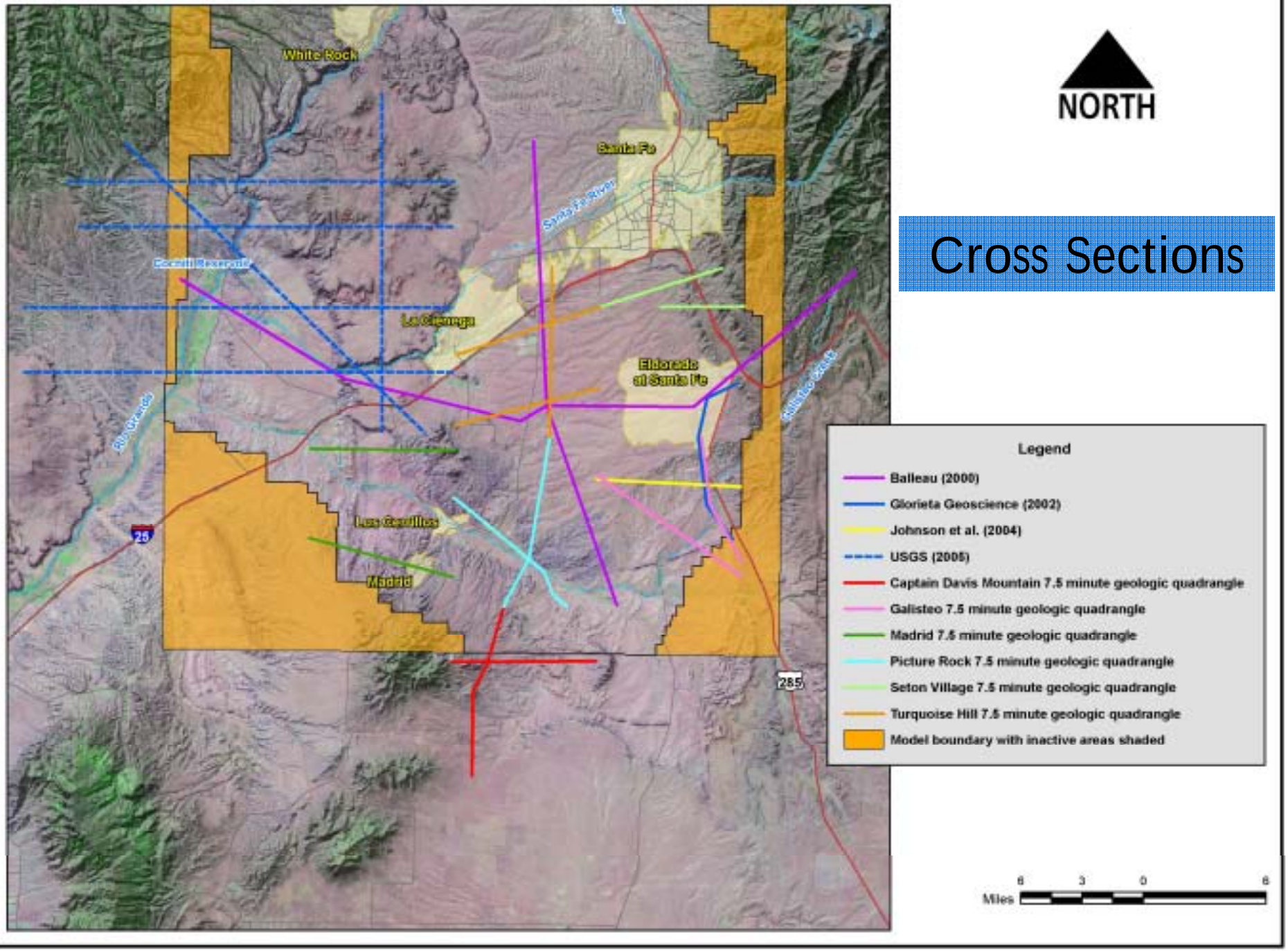
Miles

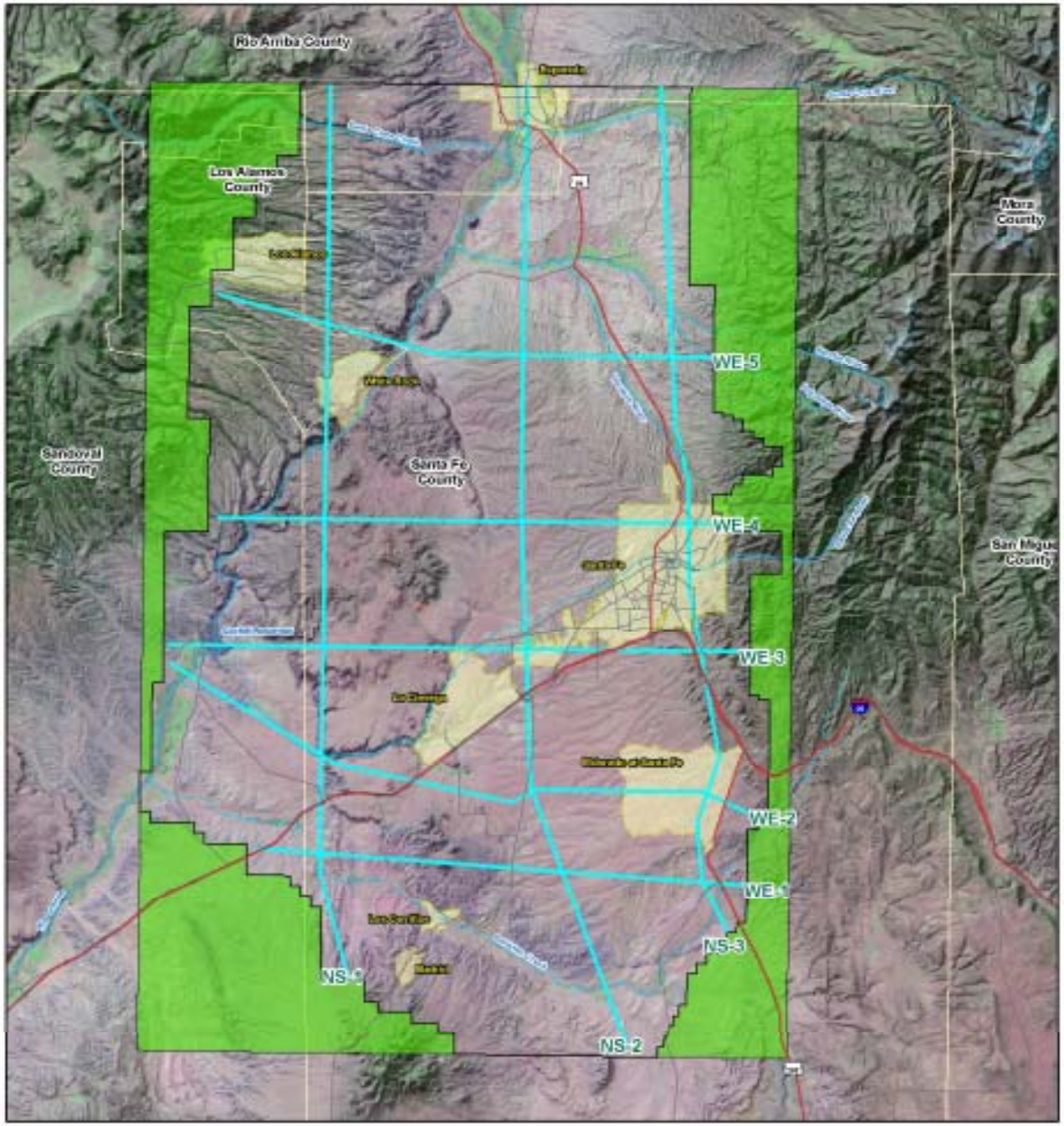
Data Evaluation

- 3D Geologic Model for Area
  - GMS – based
  - Incorporated new geologic mapping USGS and NMBGMR
  - Used to guide Model Parameterization



Geologic Maps


NORTH
Cross Sections
White Rock
Santa Fe
Santa Fe River
Cochiti Reservoir
La Cienega
Eldorado at Santa Fe
Rio Grande
Galisteo Creek
Los Cerrillos
Madrid
25
285
Legend
Balleau (2000)
Glorieta Geoscience (2002)
Johnson et al. (2004)
USGS (2005)
Captain Davis Mountain 7.5 minute geologic quadrangle
Galisteo 7.5 minute geologic quadrangle
Madrid 7.5 minute geologic quadrangle
Picture Rock 7.5 minute geologic quadrangle
Seton Village 7.5 minute geologic quadrangle
Turquoise Hill 7.5 minute geologic quadrangle
Model boundary with inactive areas shaded
6
3
0
6
Miles



NORTH

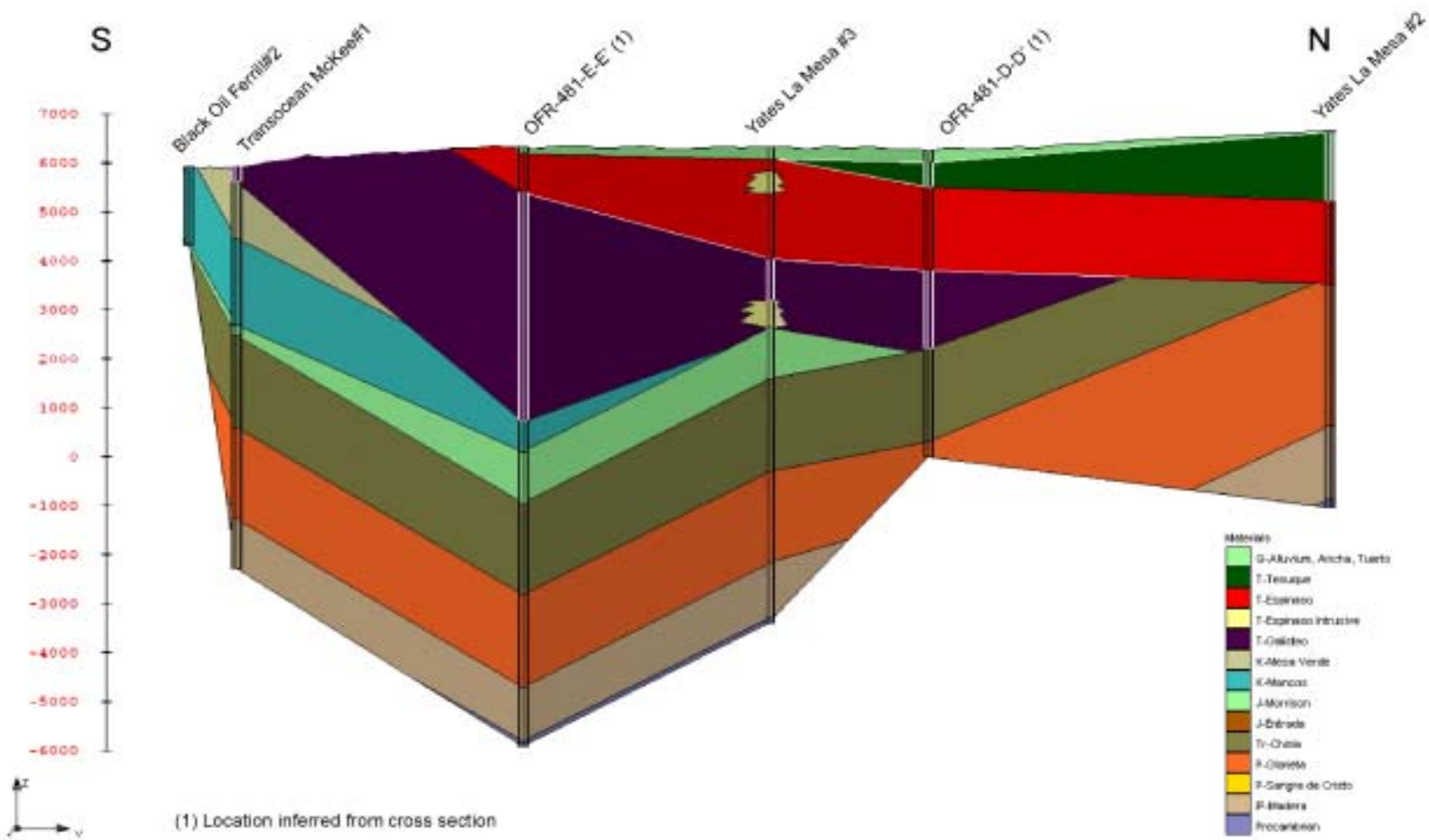
Legend

- Cross section location
- Model boundary with inactive areas shaded

Cross Section Locations

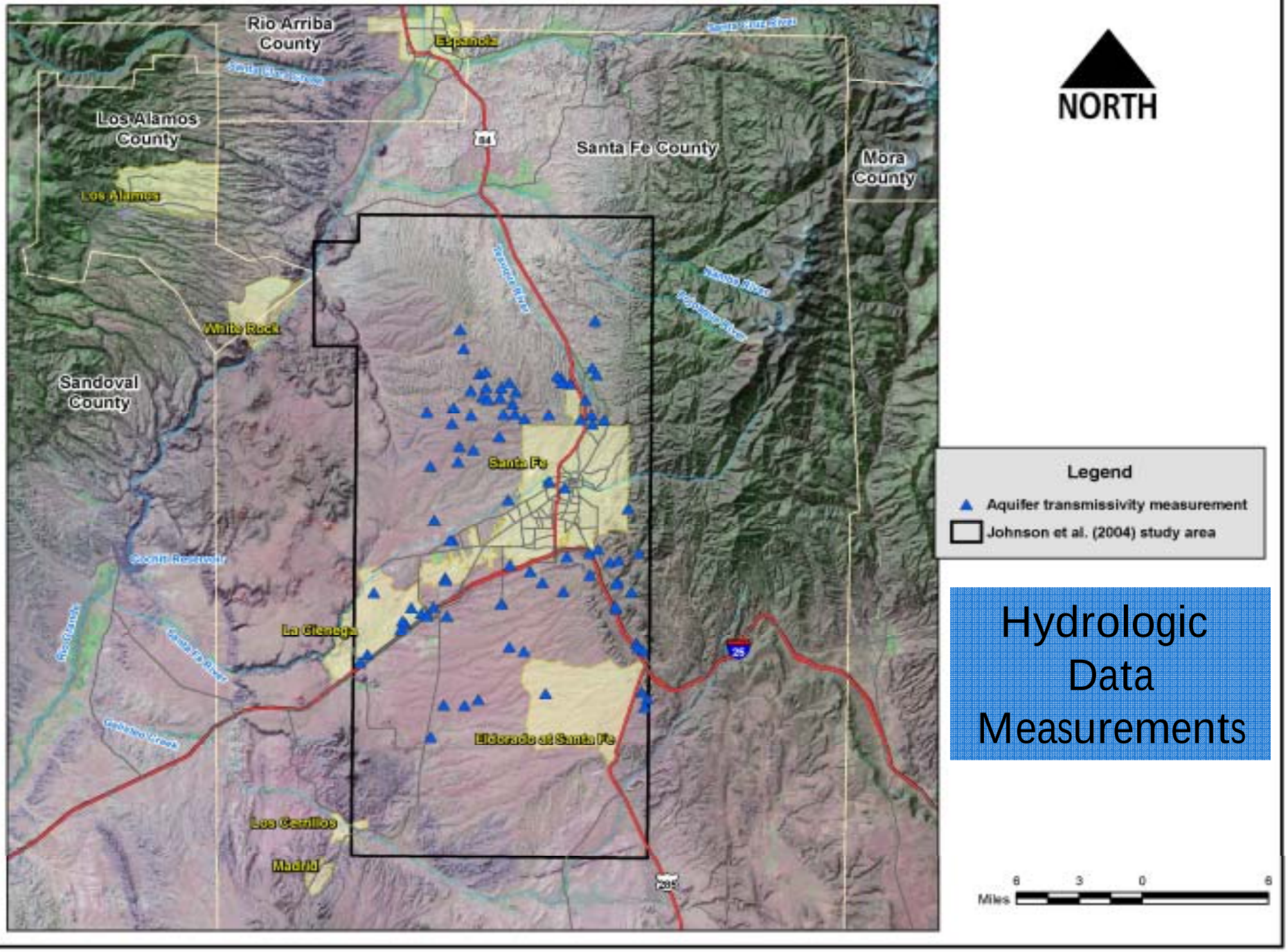
7 3.5 0 7

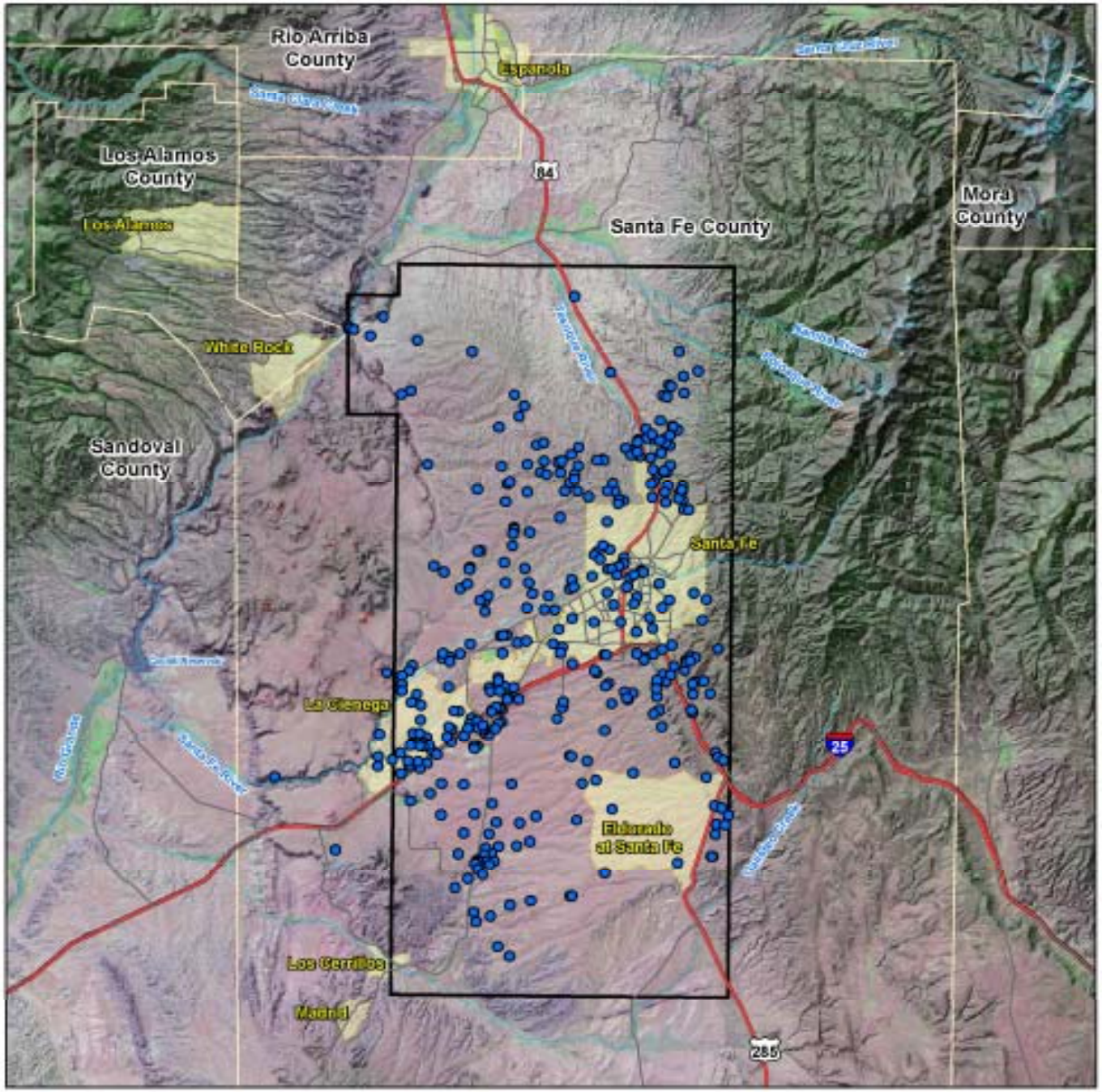
Miles



(1) Location inferred from cross section

NS-2 Cross Section


Rio Arriba County
Espanola
Los Alamos County
Los Alamos
Santa Fe County
Mora County
84
White Rock
Sandoval County
Santa Fe
La Cienega
25
Eldorado at Santa Fe
Los Cerrillos
Madrid
285
NORTH
Legend
Aquifer transmissivity measurement
Johnson et al. (2004) study area
Hydrologic Data Measurements
6 3 0 6
Miles



NORTH

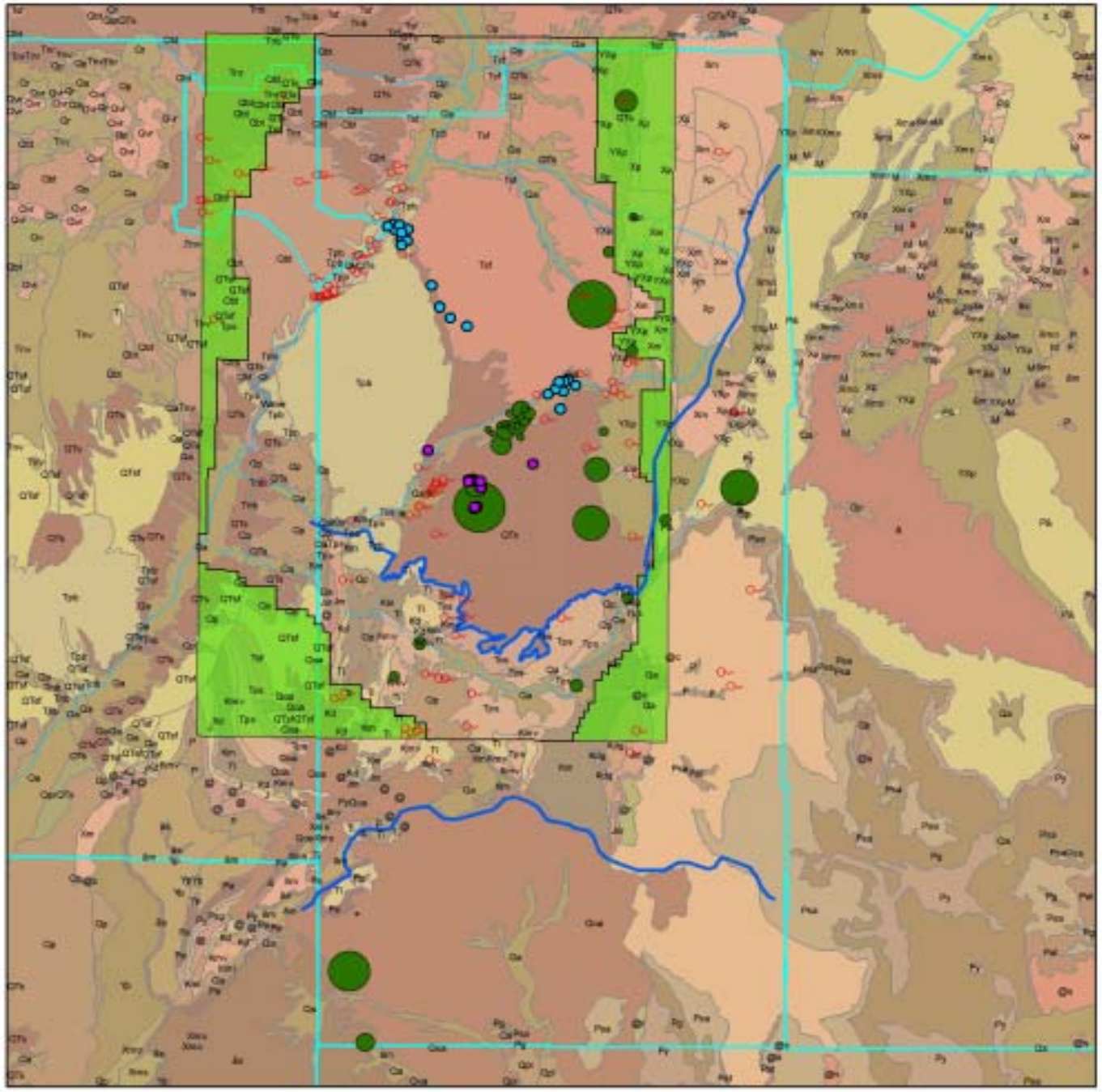
Legend

- Water level location
- Johnson et al. (2004) study area

Water Level Data

8 3 0 8

Miles



NORTH

Legend

- County well
- City well
- Spring
- Divisions of Lewis and West (1995)
- Model boundary with inactive areas shaded

Public water supply system

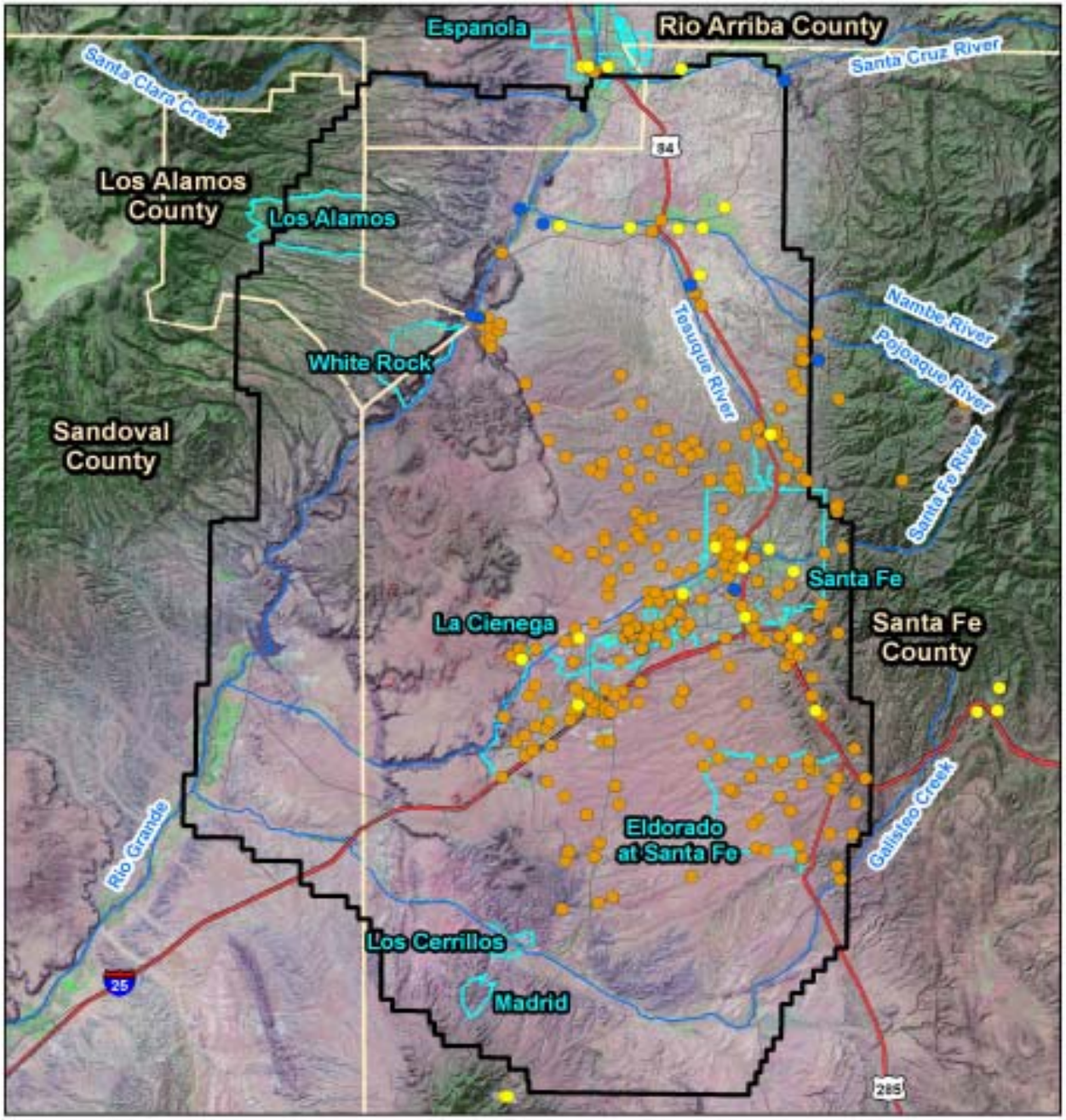
Water Right (AFY)

- 1
- 10
- 100

Geohydrologic Data Summary

9 4.5 0 9

Miles



NORTH

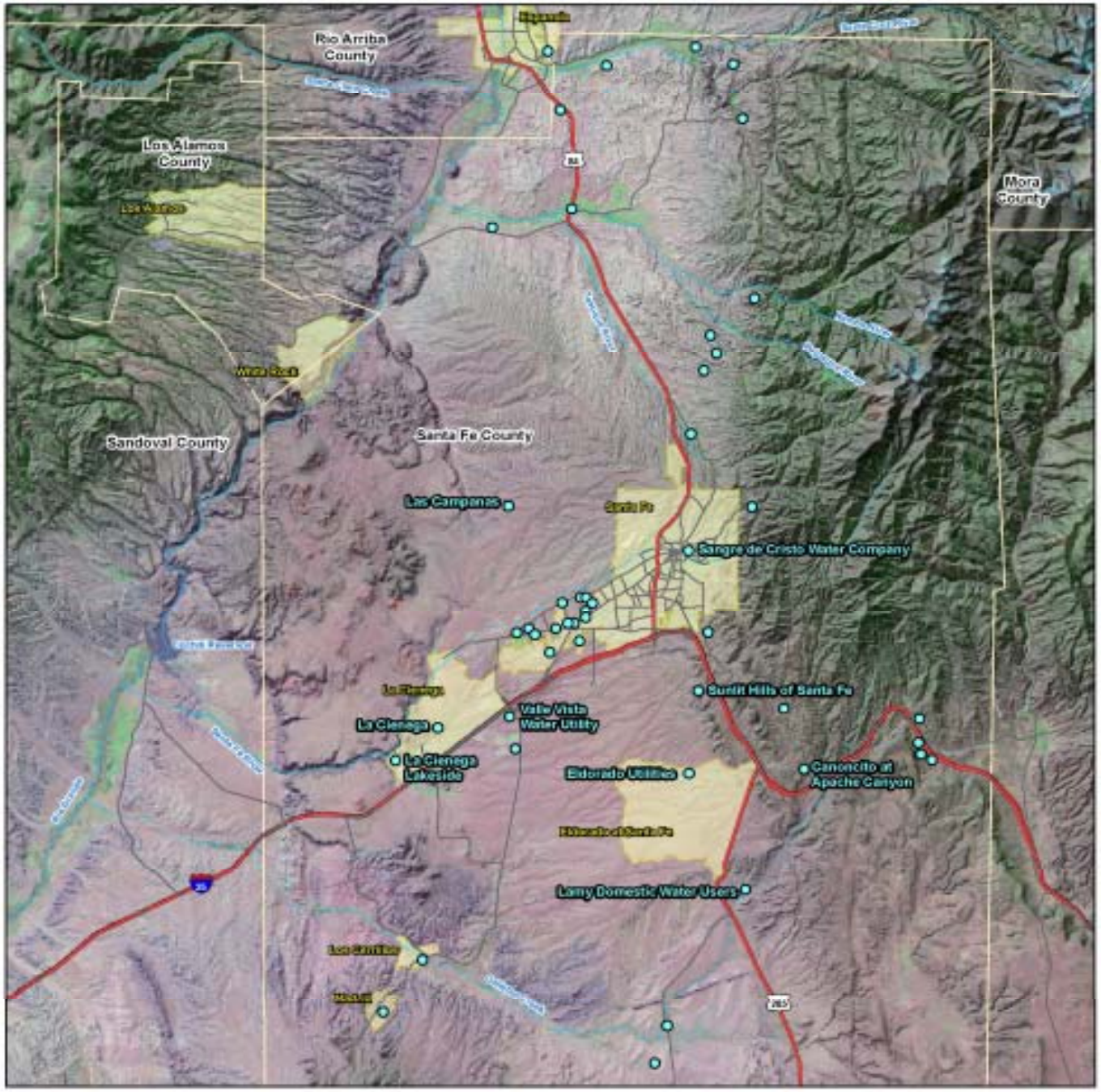
Legend

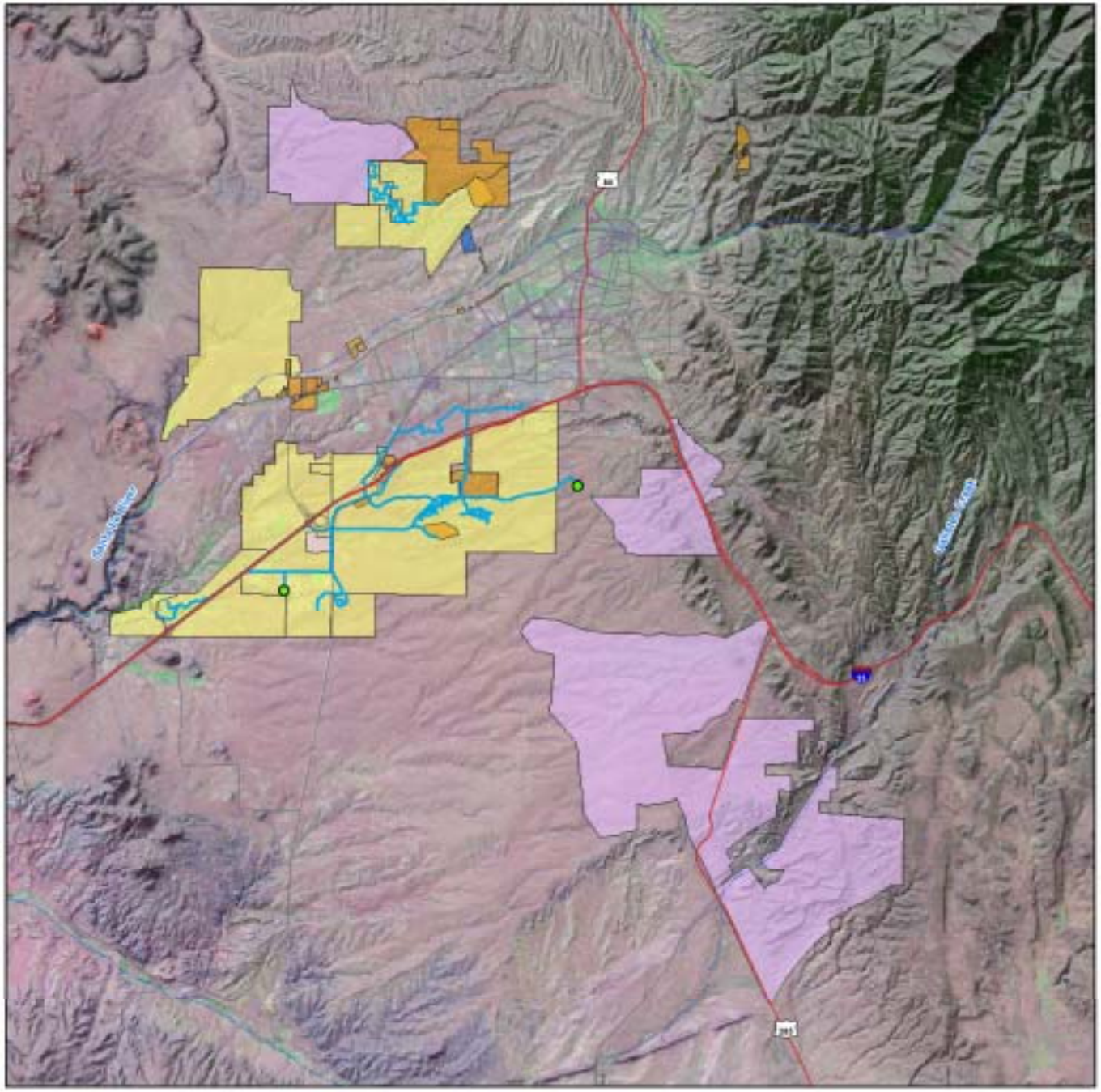
- Groundwater Contamination
- USGS NQWQA Water Quality Data
- Johnson Water Quality Data
- Active Model Boundary

Water Quality

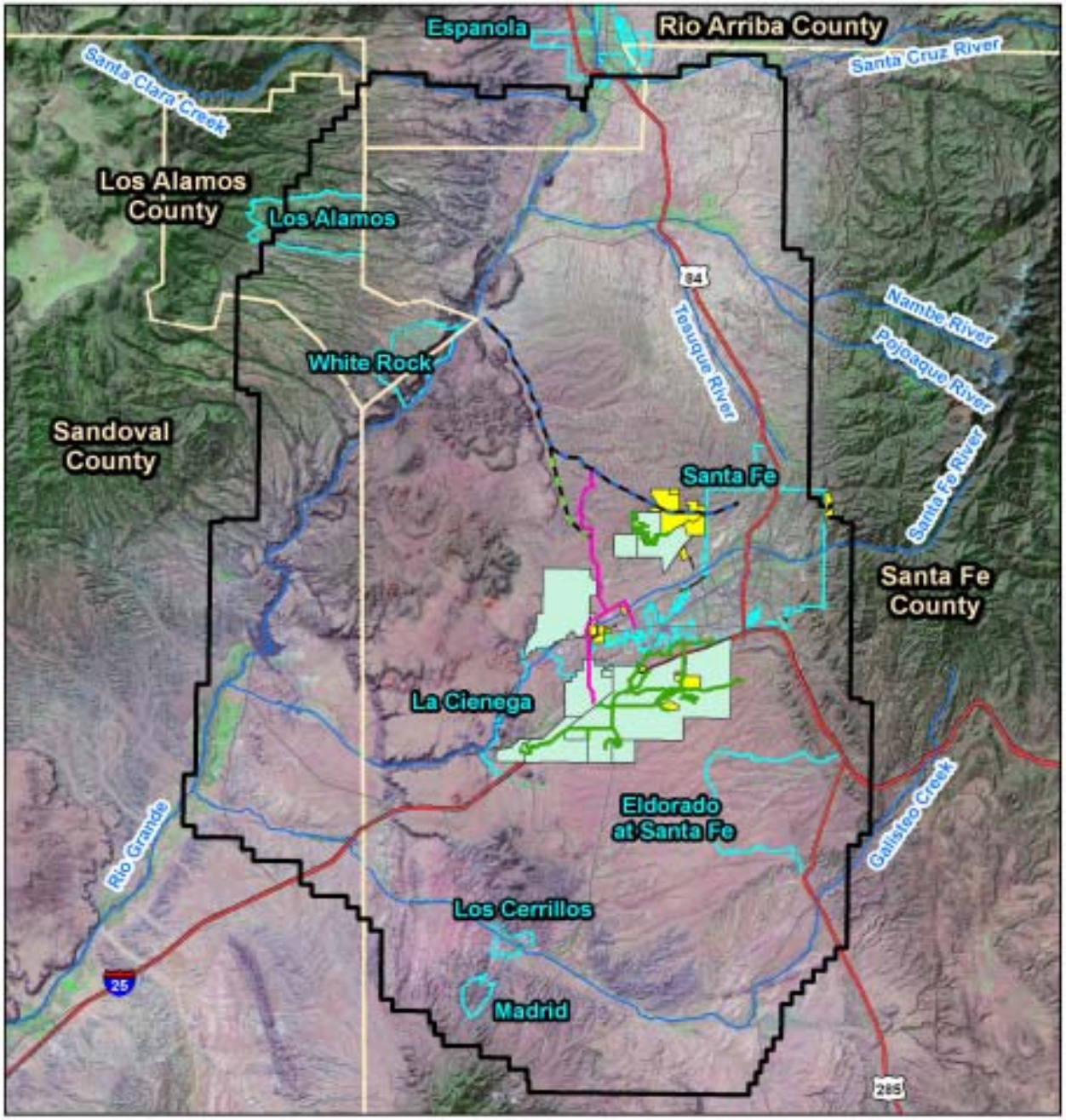
1 inch equals 6 miles

Miles 0 3 6 12


Rio Arriba County
Los Alamos County
Mora County
Sandoval County
Santa Fe County
White Rock
Las Campanas
Santa Fe
Sangre de Cristo Water Company
Sunlit Hills of Santa Fe
La Cienega
Valle Vista Water Utility
La Cienega Lakeside
Eldorado Utilities
Canoncito at Apache Canyon
Lamy Domestic Water Users
285
NORTH
Legend
Public water supply system
Public Water Supply System
6 3 0 6
Miles



County Infrastructure



NORTH

Legend

- Proposed Buckman Raw Water Piping
- Proposed Buckman Treated Water Piping
- Existing Buckman Piping
- Santa Fe County Existing Piping
- Santa Fe County Proposed Service Area
- Santa Fe County Existing Service Area
- Active Model Boundary

Water and Wastewater Utilities

1 inch equals 6 miles

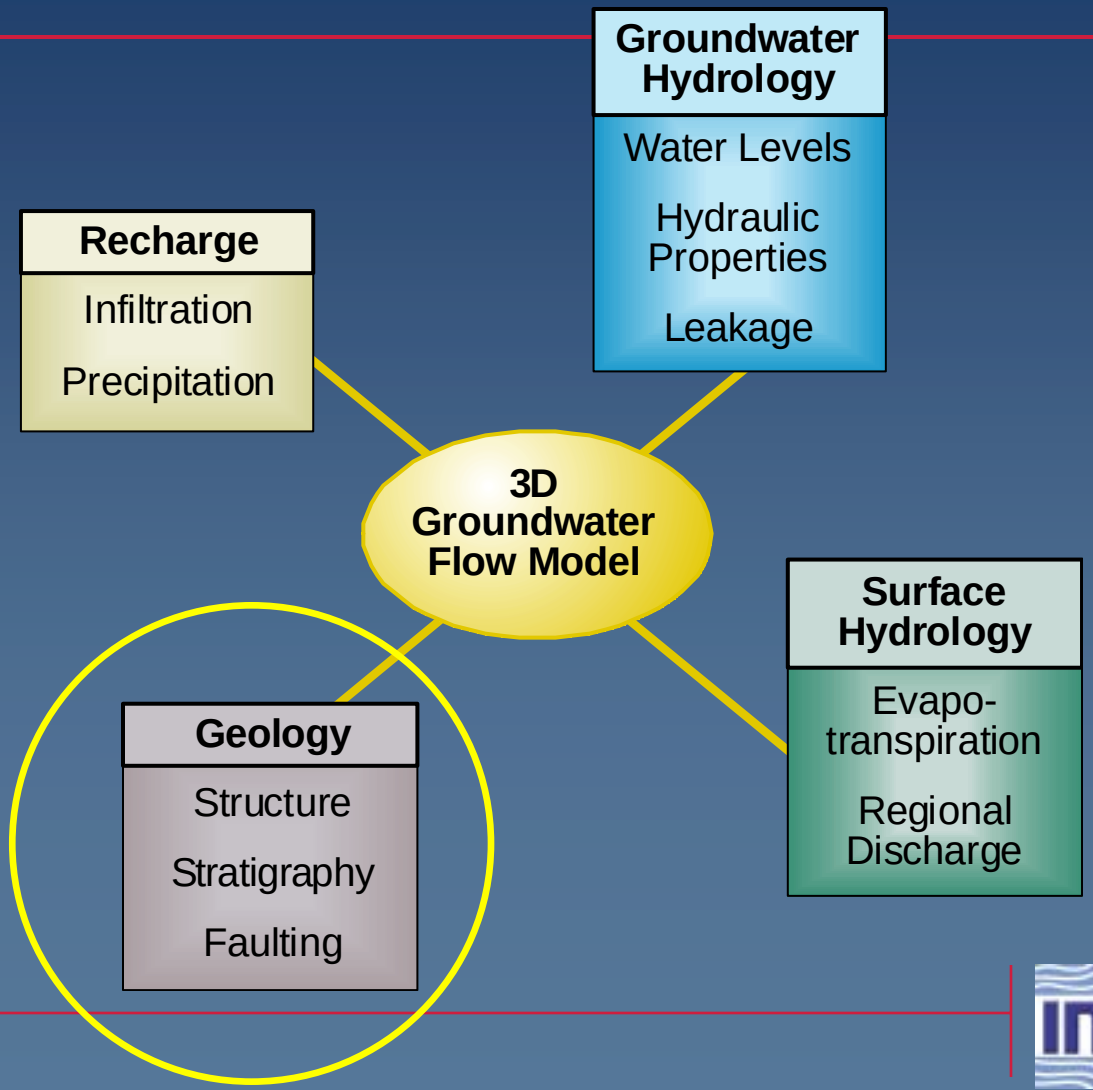
Miles 0 3 6 12

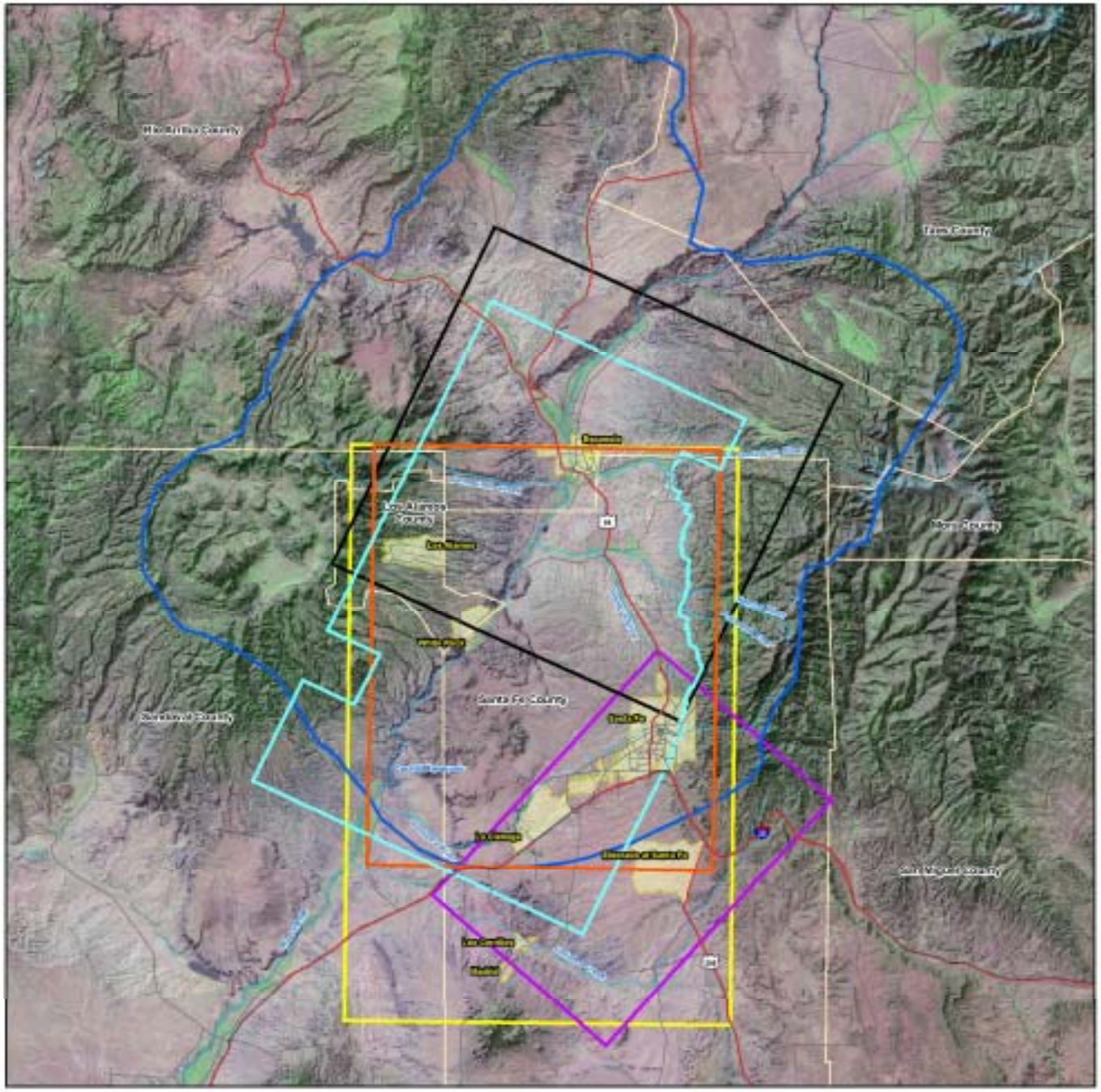
Model Development

Review of Existing Models

- Six models of the area
- City of Santa Fe – CDM Model
- All MODFLOW, all limitations

Model Development




NORTH
Legend
Hearne Model (1980)
McAda-Wasiolek Model (1968)
Barroli-Logan Model (1998)
Keating Model (2000)
Shomaker Model (2001)
SFCM Model Boundary
Model Boundaries
11 5.5 0 11
Miles

County/City Collaboration

Background

- City developed preliminary model in 2002
- County embarked on similar course in 2005
- City desired to upgrade their model 2005
- March, 2005 – County and City agree to collaborate
- Maximize benefit of scientific and economic resources
- Develop model of highest quality

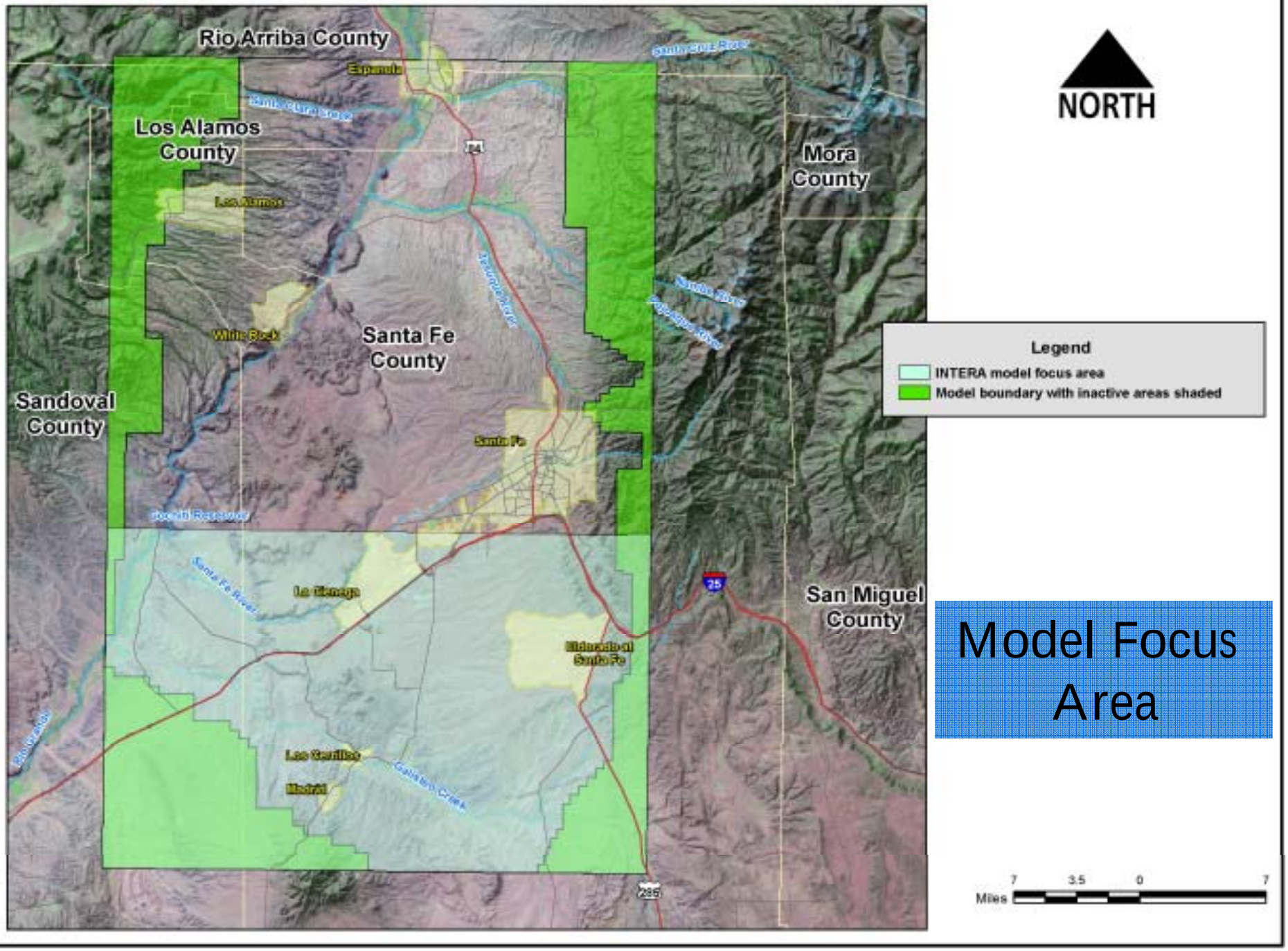
County/City Collaboration

Collaborative Approach

- Collaboration participants
  - Office of the State Engineer (OSE)
  - United States Geological Society (USGS)
  - New Mexico Bureau of Geology and Mineral Resources (NMBGMR)
  - Los Alamos National Laboratory (LANL)
- Kick-off meeting 3-30-05

Model Development

- MODFLOW 2000
- Publicly available code
- Used widely
- Recognized and used by Office of the State Engineer

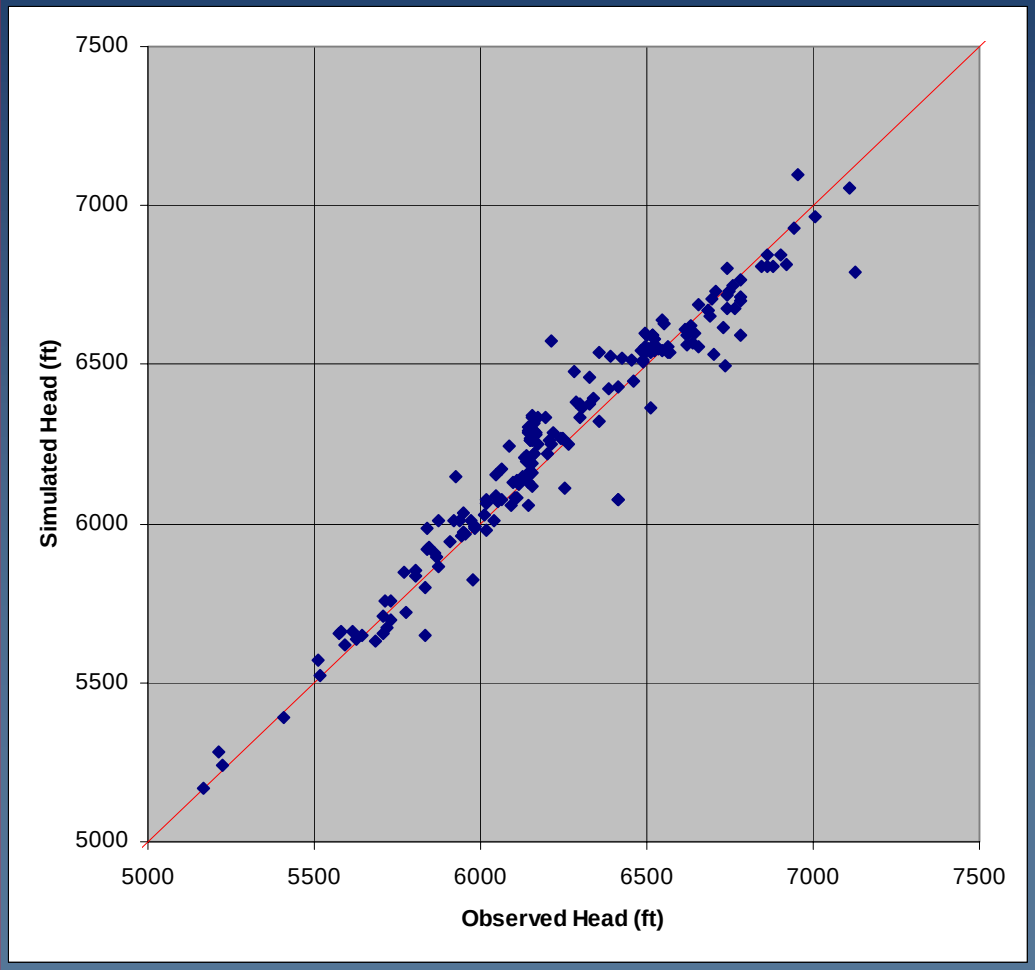

Rio Arriba County
Los Alamos County
Mora County
Santa Fe County
Sandoval County
San Miguel County
NORTH
Legend
INTERA model focus area
Model boundary with inactive areas shaded
Model Focus Area
7 3.5 0 7
Miles

Model Development

Calibration

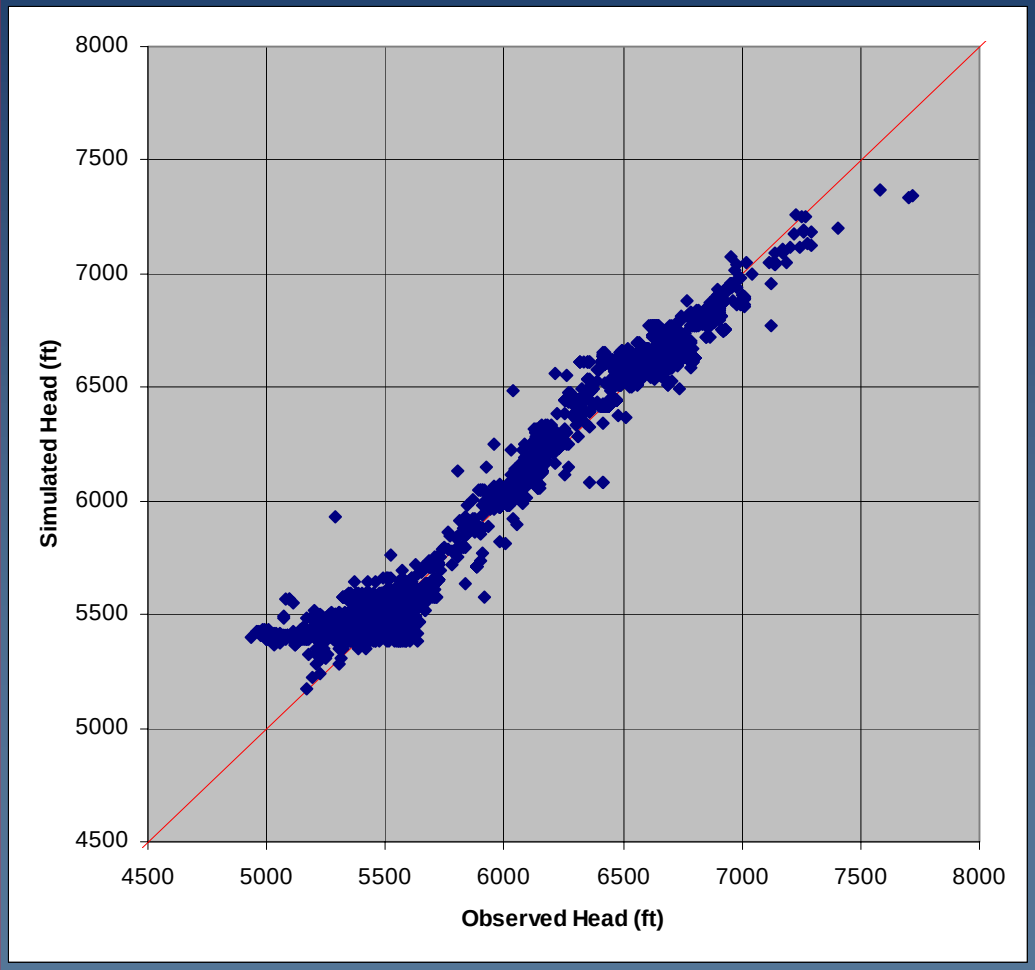
- Compare observed data to computed data
- Steady state – pre-pumping
- Transient – post-pumping
  - Important for predictive

Model Results – Steady-State Calibration



- The root mean square of the residual (RMSR) is 5% of the observed head drop across the model (< 10% is rule of thumb for calibration).

Model Results – Transient Calibration



- The root mean square of the residual (RMSR) is 5% of the observed head drop across the model.

Decision Analysis

General Decision Criteria:

- Sustainable water supply
- Minimize impact to existing users
- Minimize impact to streams/springs
- Cost

Decision Analysis (cont.)

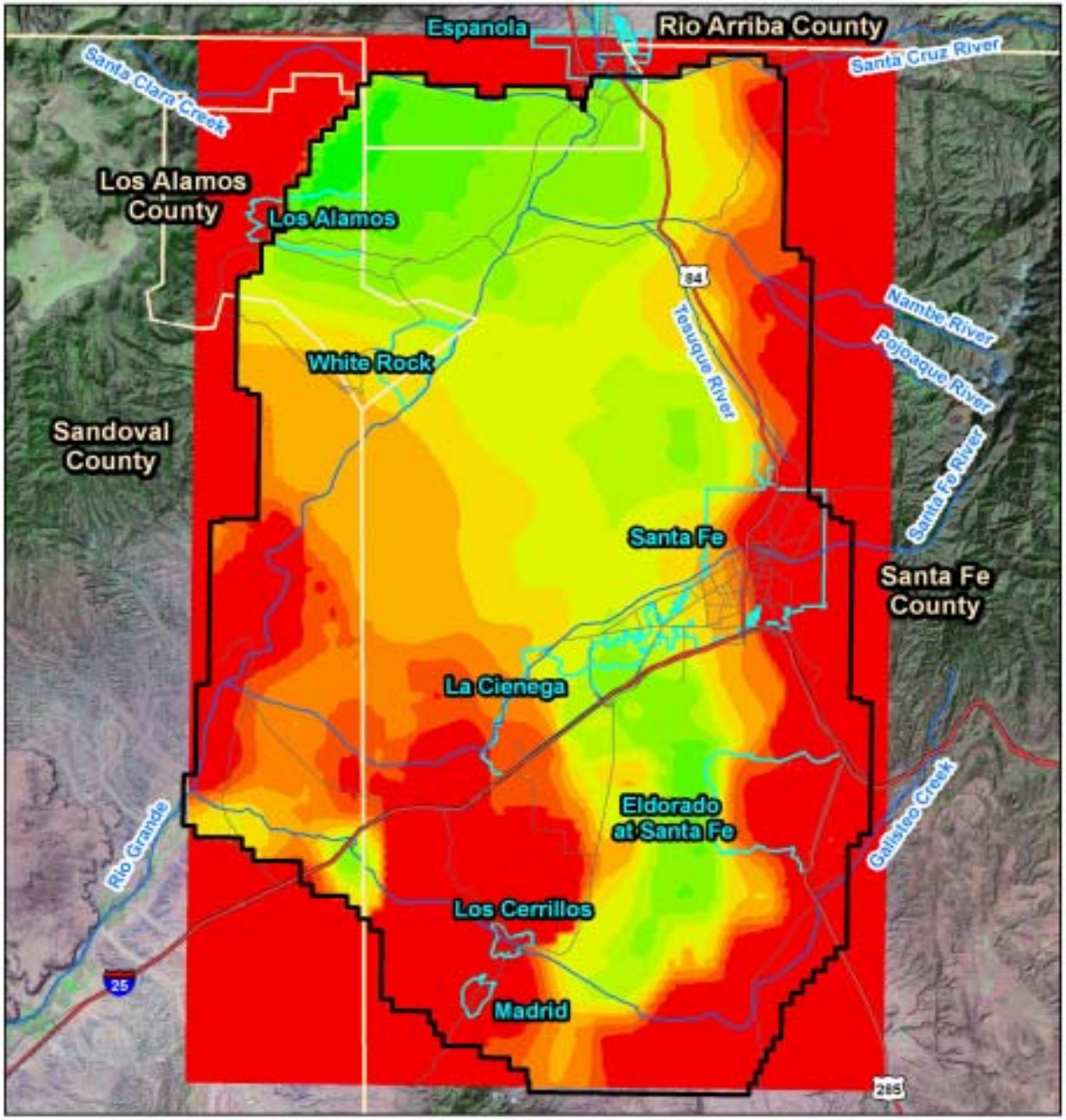
- Well site suitability analysis decision criteria
- Attributes
  - Areas of favorable hydrogeology
  - Existing population distribution
  - Existing infrastructure
  - Existing production wells and large water-right holders
  - Domestic wells

Decision Analysis (cont.)

- Attributes (cont.)
  - Streams
  - Springs
  - Areas of known groundwater contamination

Favorable Hydrogelogy

- Highest permeability and greatest thickness:
  - Ancha
  - Tesuque
  - Espinaso
  - Galisteo



NORTH

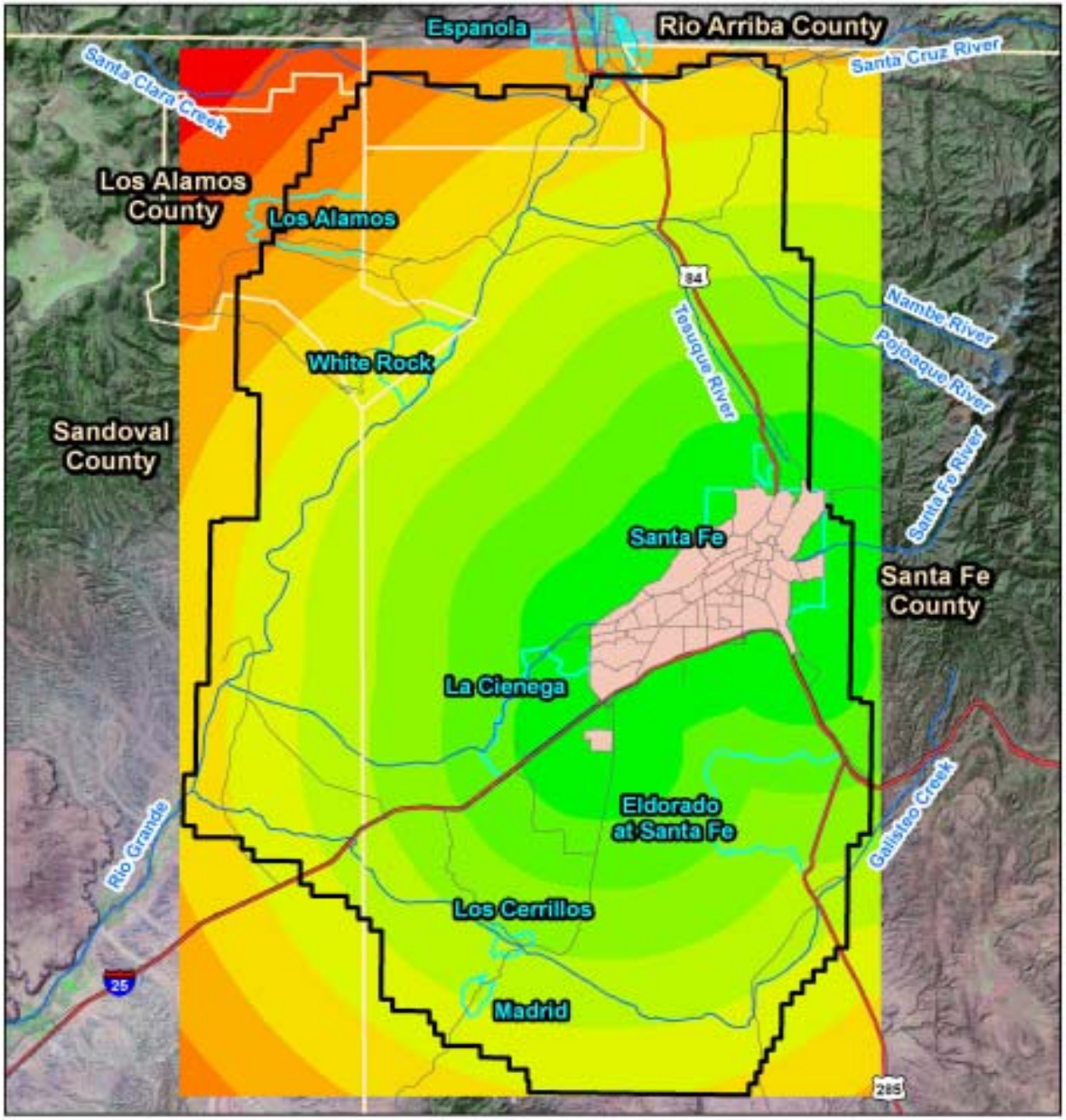
Legend

Active Model Boundary

Composite Aquifer Thickness

1 inch equals 6 miles

Miles 0 3 6 12



NORTH

Legend

- 2004 Population >= 300/sq mi
- Active Model Boundary

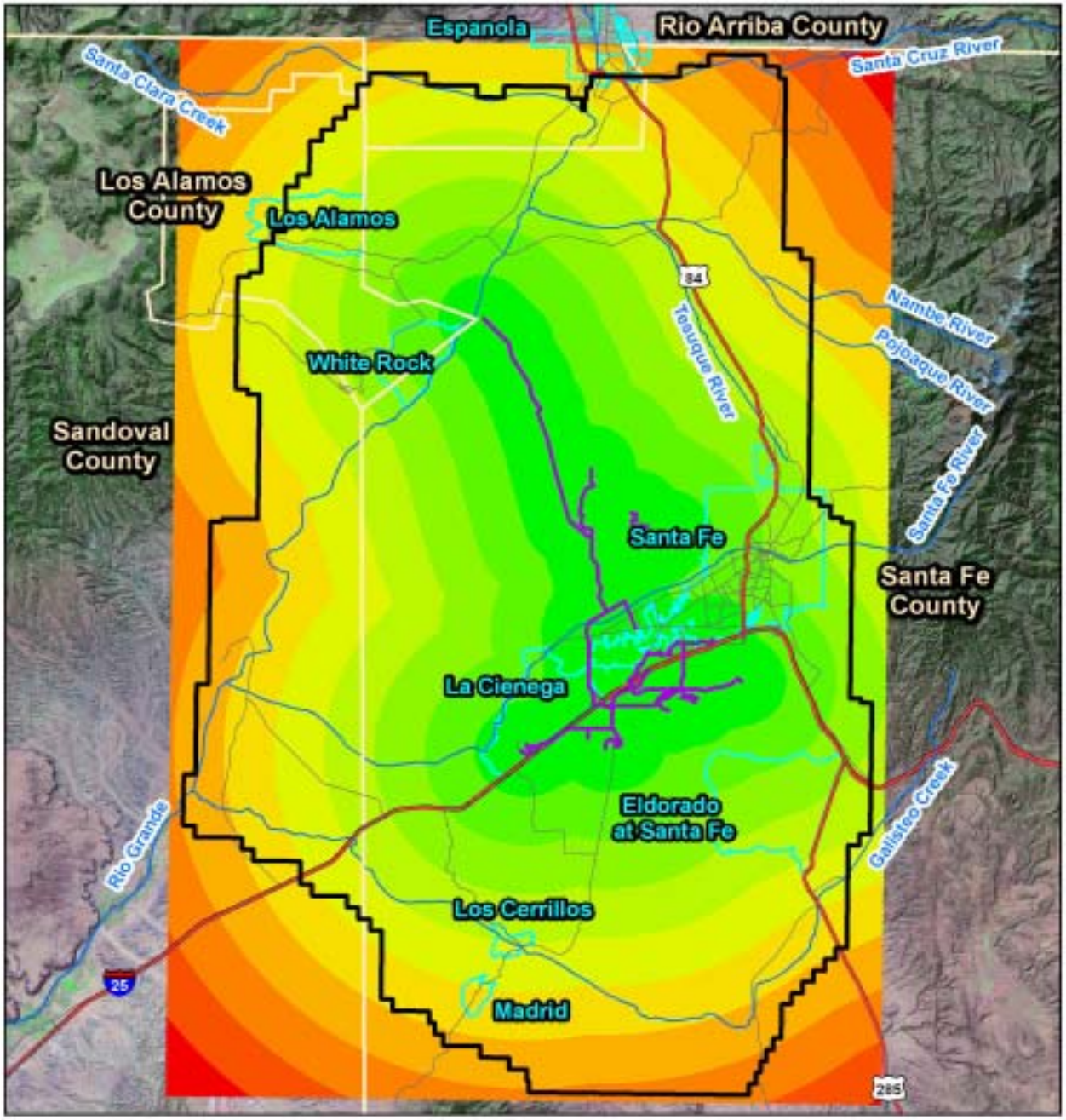
Normalized Distance to Populated Areas

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100

Distance to Most Populated Areas

1 inch equals 6 miles

Miles 0 3 6 12



NORTH

Legend

Water Service Areas

Active Model Boundary

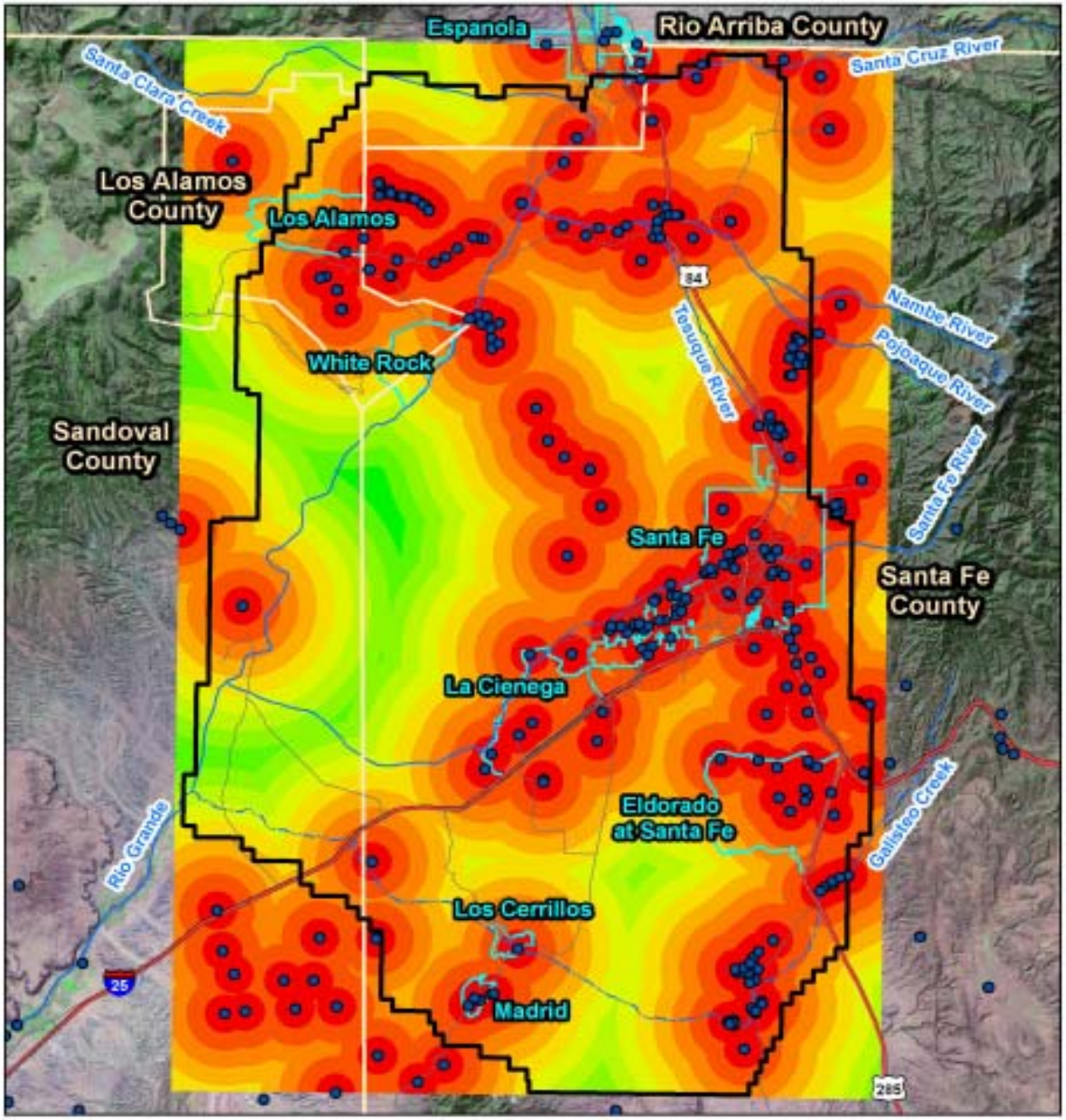
Normalized Distance to Water Service Areas

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100

Distance to Existing and Proposed County Water Service Areas

1 inch equals 6 miles

Miles 0 3 6 12



NORTH

Legend

- Well
- Active Model Boundary

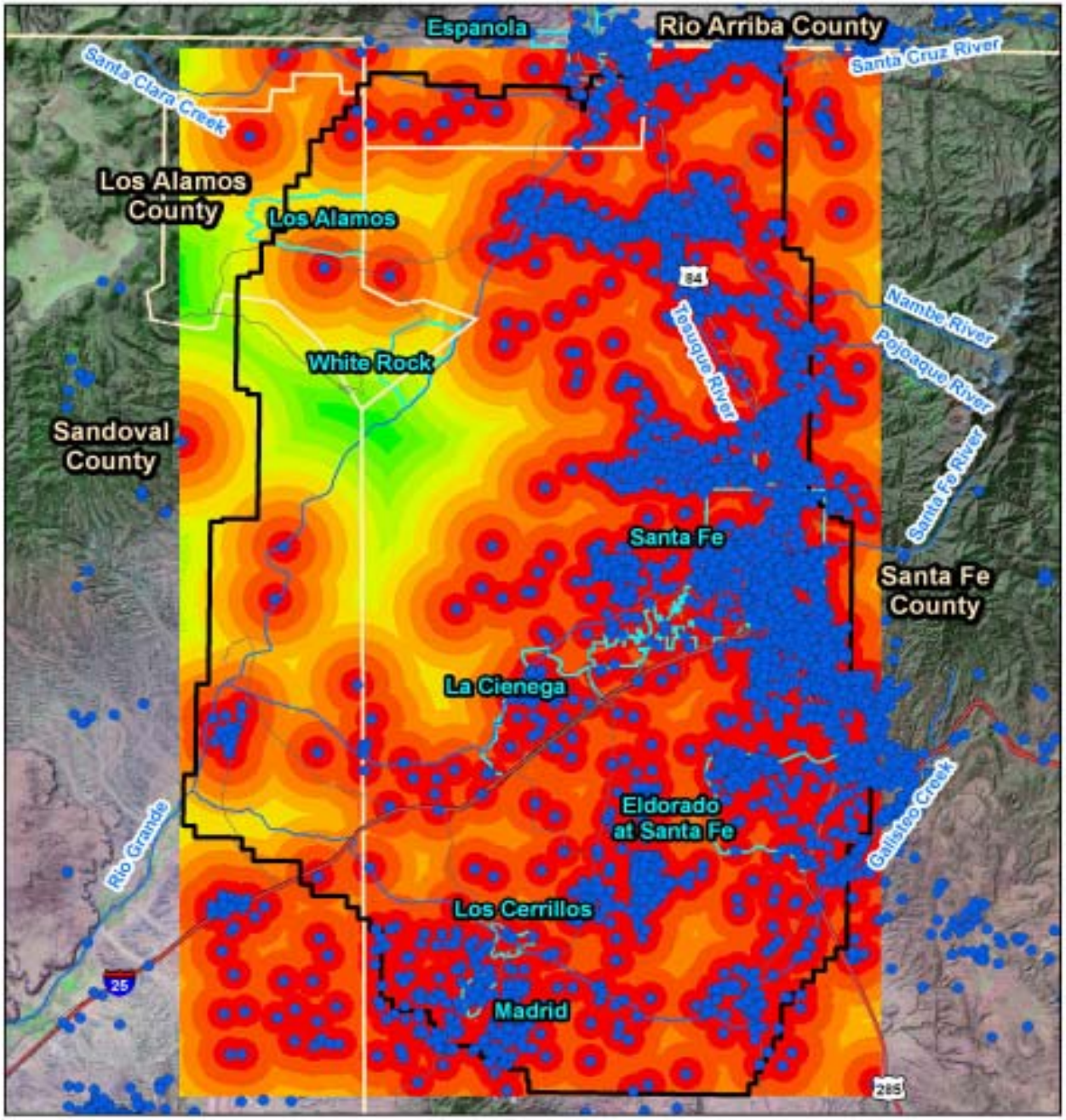
Normalized Distance to Wells

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100

Supply Wells and Large Water-Right Holders

1 inch equals 6 miles

Miles 0 3 6 12



NORTH

Legend

- Domestic Well
- Active Model Boundary

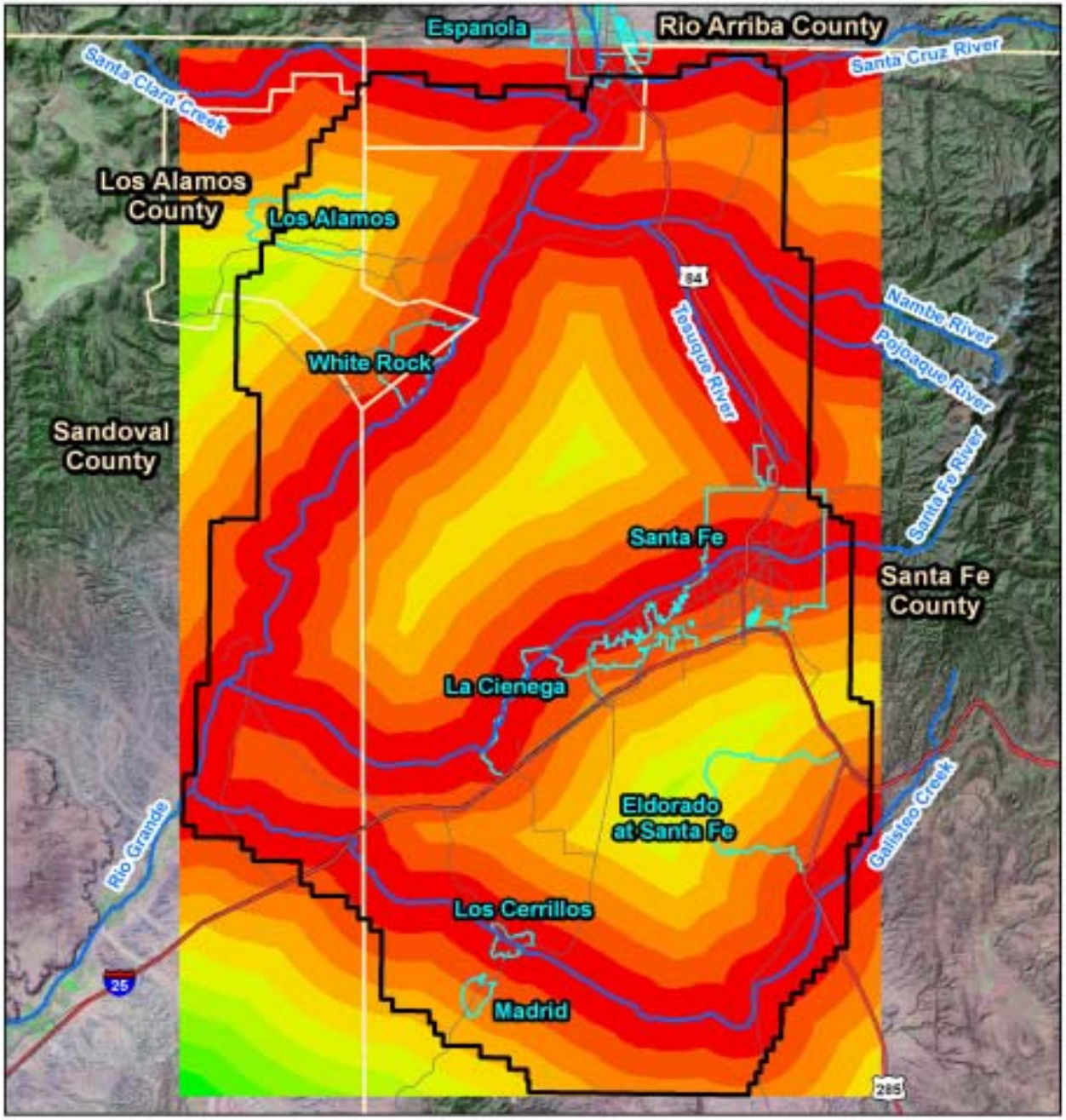
Normalized Distance to Domestic Wells

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100

Distance to Domestic Wells

1 inch equals 6 miles

Miles 0 3 6 12



NORTH

Legend

Stream

Active Model Boundary

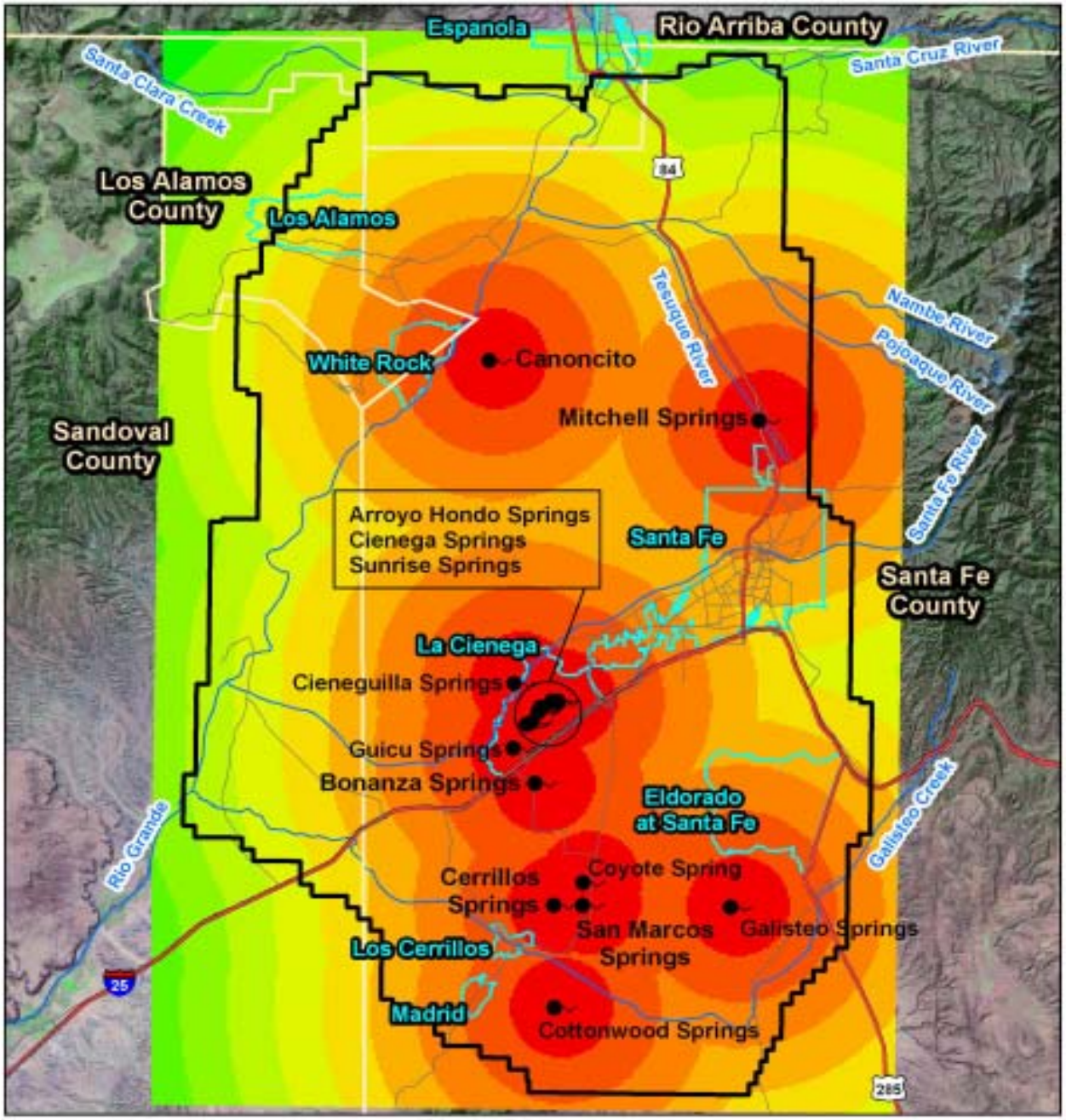
Normalized Distance to Streams

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100

Distance to Streams

1 inch equals 6 miles

Miles 0 3 6 12



NORTH

Legend

- Modeled Spring
- Active Model Boundary

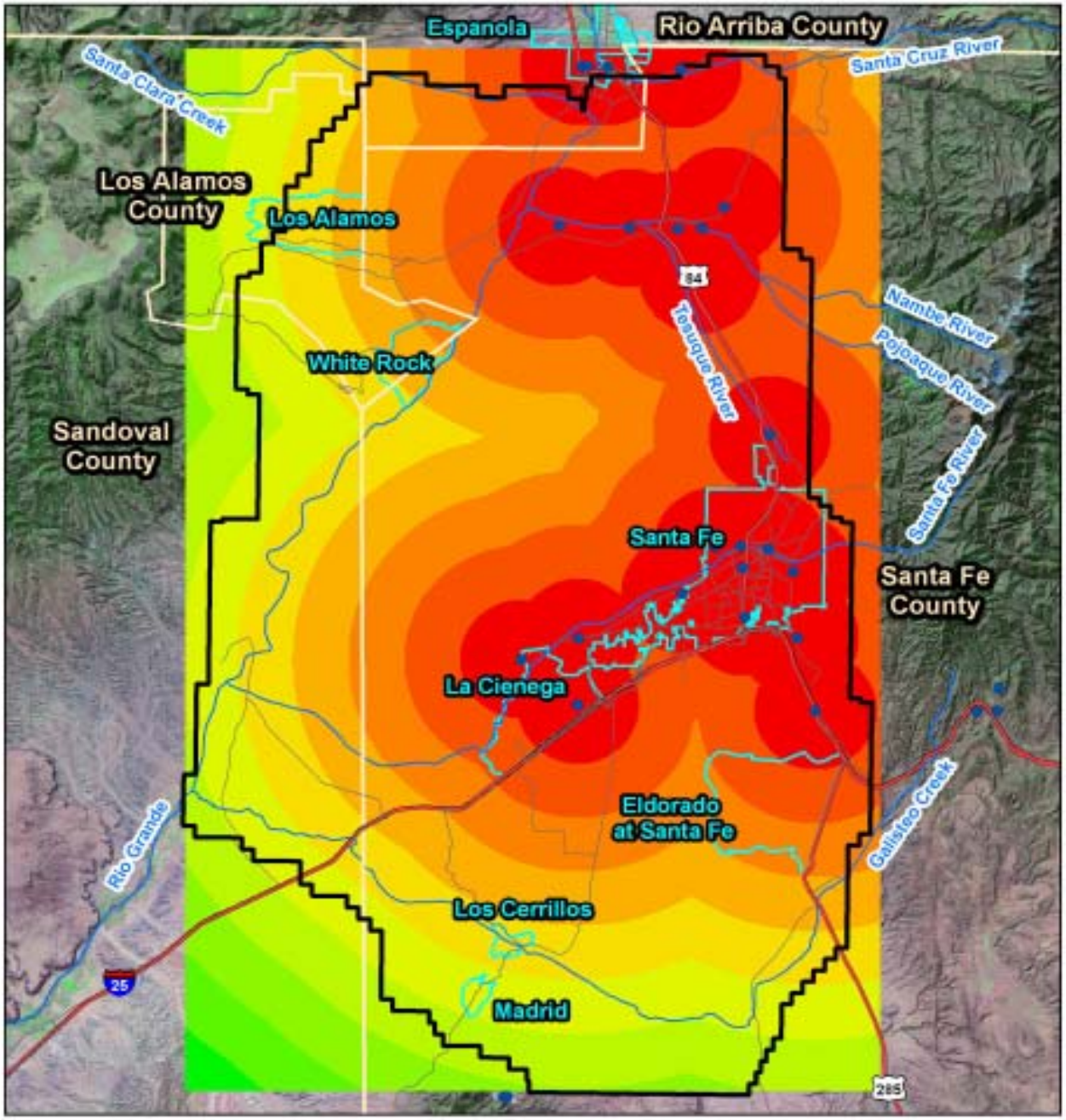
Normalized Distance to Modeled Springs

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100

Distance to Modeled Springs

1 inch equals 6 miles

Miles 0 3 6 12



NORTH

Legend

- Groundwater Contamination
- Active Model Boundary

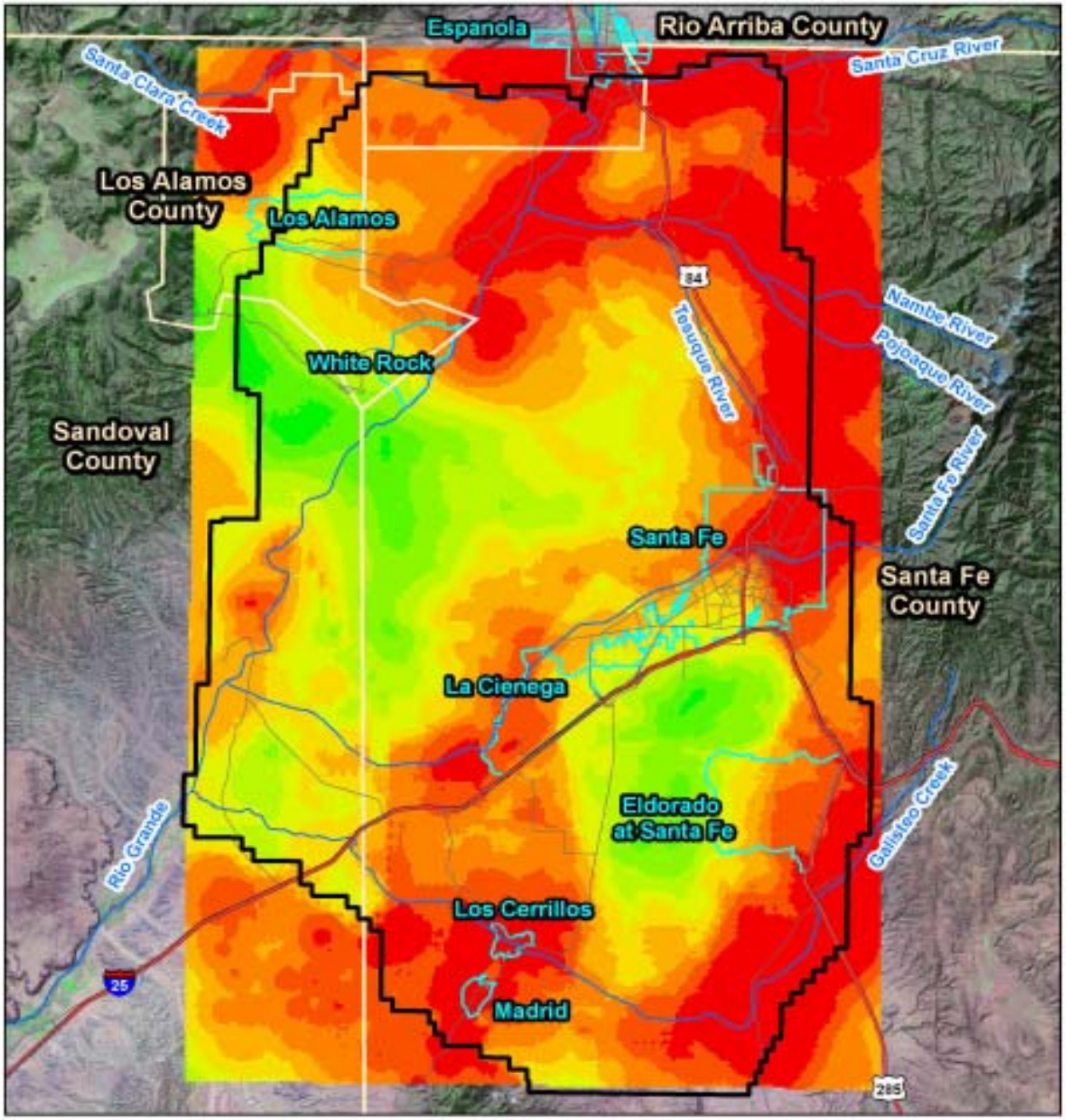
Normalized Distance to Groundwater Contamination

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100

Distance to Areas of Groundwater Contamination

1 inch equals 6 miles

Miles 0 3 6 12



NORTH

Legend

Active Model Boundary

Normalized Sum of Decision Analysis Layers

- 0 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- 85 - 90
- 90 - 95
- 95 - 100

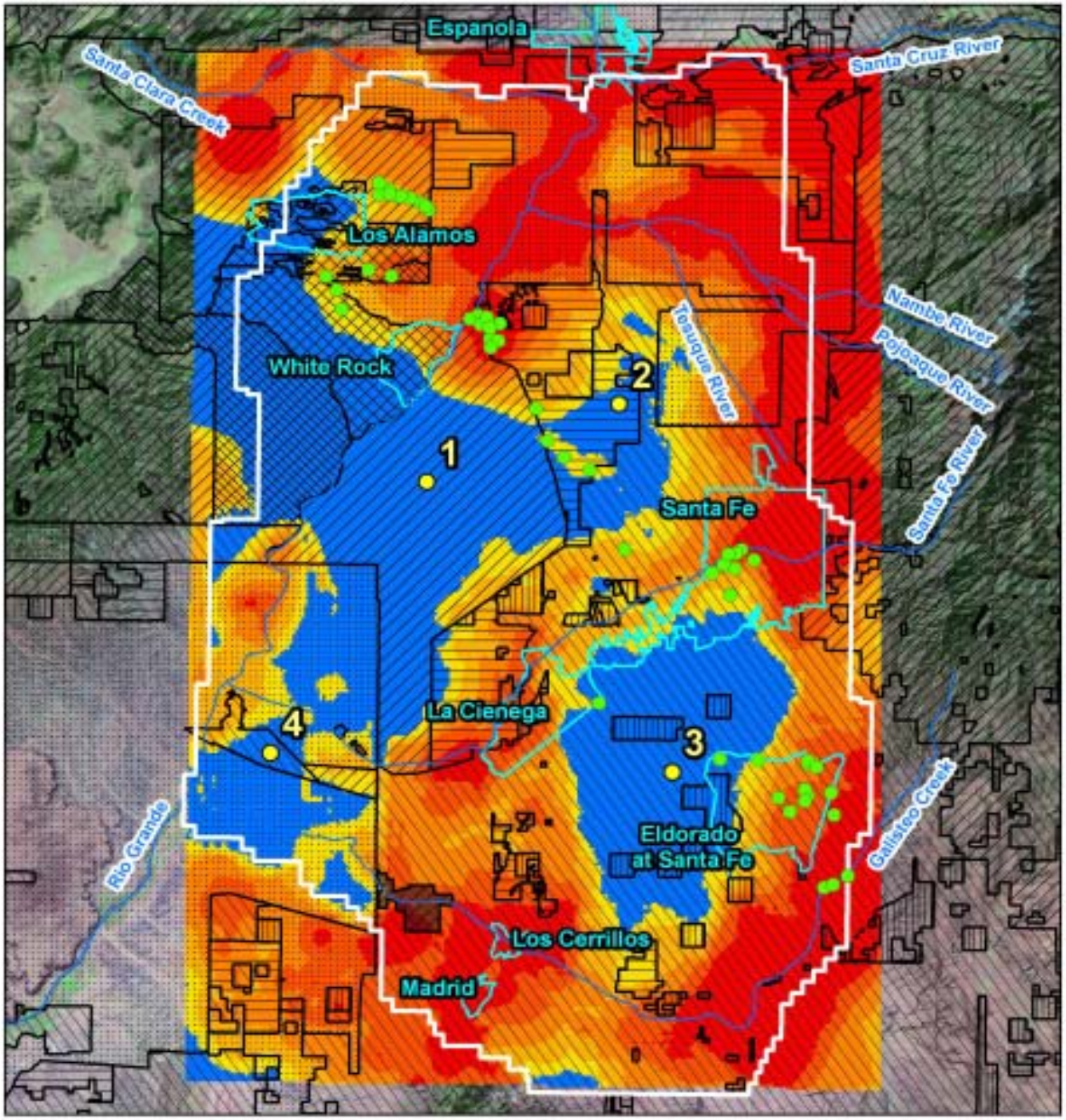
Sum of Decision Analysis Layers

1 inch equals 6 miles

Miles 0 3 6 12

Decision Analysis

- Promising well site areas were selected based on:
  - Decision analysis score >= 75
  - Property ownership



NORTH

Legend

- Proposed Well
- Existing Major Supply Well
- Active Model Boundary

Land Ownership

- BLM
- DOD
- DOE
- Forest Service
- Tribal
- National Park Service
- Private
- State

Selected Areas

- Score >= 75

Selected Areas (Score >= 75)

1 inch equals 6 miles

Miles 0 3 6 12

Model Simulations

- Wells were each pumped at 100 ac-ft/yr (approximately 60 gpm) for 40 years
- Wells 2, 3, and 4 were able to pump 100 ac-ft/yr for the entire 40-year period
- Well 1 was able to pump 80 ac-ft/yr

Model Results

Well	Impact to Springflow	Stream Depletion	Drawdown at Nearest Production Well
1	None	-2 ac-ft/yr @ 40 yrs (Rio Grande)	Negligible
2	None	Negligible	<1 ft @ 40 years (Buckman No. 13)
3	None	-2 ac-ft/yr @ 40 yrs (Santa Fe River, Galisteo Creek)	<1 ft @ 40 years (Eldorado No. 1)
4	None	-30 ac-ft/yr @ 40 yrs (Rio, Grande, Santa Fe River, Galisteo Creek)	No impact

Thank You

Questions?