FRESH WATER RESOURCES IN THE GALISTEO BASIN
EXECUTIVE ORDER 2008-038 ASSESSMENT
OFFICE OF THE STATE ENGINEER

December 1, 2008

Introduction

This report was prepared in response to Executive Order 2008-038, which requires the Office of the State Engineer (OSE) to undertake a site-specific analysis of the fresh water supplies in the Galisteo Basin (Figure 1). The OSE is required to designate waters requiring reasonable protection against contamination due to activities associated with oil and gas well drilling and production. The OSE has designated for protection all ground water in the state with 10,000 milligrams per liter (mg/l) or less total dissolved solids (TDS) content.

Due to the geologic complexity of the area, the formations within the basin contain ground water with a wide water quality range. Available data indicate that water supply wells within the Galisteo Basin are supplying water with a TDS content well below 10,000 mg/l. Until such time that it can be shown that water has been encountered with more than 10,000 mg/l TDS, all ground water in the basin is designated as requiring protection.

The June 2008 report prepared by the OSE for the New Mexico Energy, Minerals and Natural Resources Department provides an assessment of existing laws, rules, and policies of the OSE relating to oil and gas drilling. The report also contained an overview of the hydrology, geology, and the quality of water within the Galisteo Basin. Further discussion of the fresh water resources within the Galisteo Basin is provided below.

Groundwater Quality

Groundwater quality varies significantly throughout the Galisteo Basin and is influenced mostly by the characteristics of the substances in contact with water. In general, the longer ground water has been in contact with a geologic formation the greater the

concentration of dissolved solids. Shallower ground water generally has less dissolved solids content compared to water found at greater depths in the same area. Ground water flowing through rocks with low permeability, such as shale, is typically of poor quality compared to other ground water in more permeable sediments.

Studies prepared by the U.S. Geological Survey[1] were relied upon to characterize the TDS distribution of the upper saturated sediments within the basin. These studies were the last comprehensive surveys of ground water quality in the basin. Most of the wells in the Mourant (1980) data compilation are less than 500 feet deep. In comparison, oil and gas wells in the basin may exceed several thousand feet in depth.

A majority of the wells located north of the Galisteo Creek provide potable water containing less than 1,000 mg/l TDS (Figures 2 and 3). Water quality generally degrades south of this area and typically exceeds 1,000 mg/l TDS. The TDS drinking water standard in New Mexico is 1,000 mg/l.

Ground water north of Galisteo Creek is typically hard due to concentrations of calcium and magnesium. Ground water south of Galisteo Creek may exceed the New Mexico Water Quality Control Commission standards for iron, manganese, sulfate and TDS.

A discussion of all the geologic units within the basin is provided in the June report. Formations that are known to contain water with TDS levels less than 1,000 mg/l are discussed below.

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[1] Mourant, W.A., 1980, Hydrologic maps and data for Santa Fe County, New Mexico, U.S. Geological Survey Basic Data Report. White, W.E., and Kues, G.E., 1992, Inventory of springs in the State of New Mexico: U.S. Geological Survey Open-File Report 92-118.

Alluvium and basin-fill sediments

The more permeable formations within the basin include the Ancha and Tesuque Formation, which lie north of the area extending from Eldorado to about San Marcos Springs, and the alluvial sediments along Galisteo Creek and tributary arroyos. These sediments are of limited saturated thickness in the central basin and are composed of sand, gravel, clay, and silt. With the exception of a few wells, the TDS levels are usually less than 1,000 mg/l.

TDS levels as low as 250 mg/l have been observed from several alluvial wells located in the vicinity of the San Marcos Springs (about four miles northeast of Cerrillos). However, the alluvial wells that contain the highest TDS levels (up to 1,260 mg/l) are located just three miles southeast of Cerrillos along Galisteo Creek.

Igneous Rocks

Fractured igneous rock may provide water containing less than 1,000 mg/l TDS. These rocks include the Espinaso Formation, which outcrops in scattered areas between Cerrillos and Galisteo, and Precambrian rocks located along the southern margins of the Sangre de Cristo Mountains.

Galisteo Formation

The Galisteo Formation is composed of sandstone, mudstone and conglomerate. Wells producing from the formation yield water ranging from less than 500 mg/l TDS to over 1,500 mg/l TDS. The outcrop extends from Cerrillos to Lamy on both sides of Galisteo Creek. Numerous wells produce from the Galisteo Formation but most are low yielding.

Triassic and Permian Rocks

These rocks are composed of sandstone, mudtstone, or limestone. Most of the wells producing from these rocks are located east of Highway 285. TDS levels general exceed 1,000 mg/l but a small portion of wells have encountered water meeting the TDS drinking water standard. One of these wells was recently completed for the Rancho San

Lucas subdivision located about two miles north of Lamy. The well was completed to a depth of 1,560 feet below land surface and reportedly encountered water with a TDS level of 560 mg/l in the Triassic and Permian age rocks.

Surface Water Quality

A number of springs are present in the basin and their occurrence is usually due to the pinching out of alluvial sediments upon underlying low permeability rocks. Spring water TDS levels are generally less than 600 mg/l (Figure 4). No information was found pertaining to the water quality of Galisteo Creek. Creek water TDS levels are probably close to the levels encountered in nearby alluvial wells. Shallow ground water along the creek may vary from less than 500 mg/l TDS near Lamy to about 1,260 mg/l TDS just southeast of Cerrillos.

Contamination Sites

Only a few contamination sites lie within the study area. These include:

- Cyanide and metals contamination have been detected at the Ortiz Mountain mine site.
- The herbicide Altazine has been detected in wells located near Canoncito and Lamy.
- Gasoline contamination has been detected near Galisteo.

Conclusions

Due to the geologic complexity of the area, formations within the basin contain ground water with a wide water quality range. Existing water wells have been drilled to relatively shallow depths with respect to the depths anticipated for oil and gas wells. Most of the existing water wells are less than 500 feet deep. Since water quality generally degrades with depth, information from the existing data set will probably reveal the most promising water quality outlook.

The alluvial and basin fill materials generally contain water of good quality but these supplies are limited. These sediments, where saturated, cover a small portion of the

Galisteo Basin and are of limited thickness. Fractured igneous rocks may also contain good quality water but securing a sufficient yield may be difficult. Relatively few wells produce from these rocks. The most widespread water bearing formations within the Galisteo Basin include a combination of sandstone, shale, mudstone, or limestone units. Due to their chemical makeup, ground water exposed to these rocks will typically be of poorer quality relative to the supplies derived from the alluvial and basin fill sediments. The quantity of ground water in the basin meeting New Mexico's water quality standard of 1,000 mg/l TDS probably represents a very small fraction of the total quantity in storage.

New Mexico's statutes are designed to protect fresh water from contamination resulting from oil and gas activities. The OSE is mandated to designate water requiring protection so the Oil Conservation Commission may regulate oil and gas activities to prevent contamination to these waters. The OSE has designated all ground water containing less than 10,000 mg/l TDS as water requiring protection.

Available water quality information indicates that all water wells in the study area have encountered water with TDS levels well below 10,000 mg/l. All formations within the basin have the potential to contain water within this limit. In the absence of site-specific data, all ground water in the basin will be considered to fall within the OSE's designation of protected water.

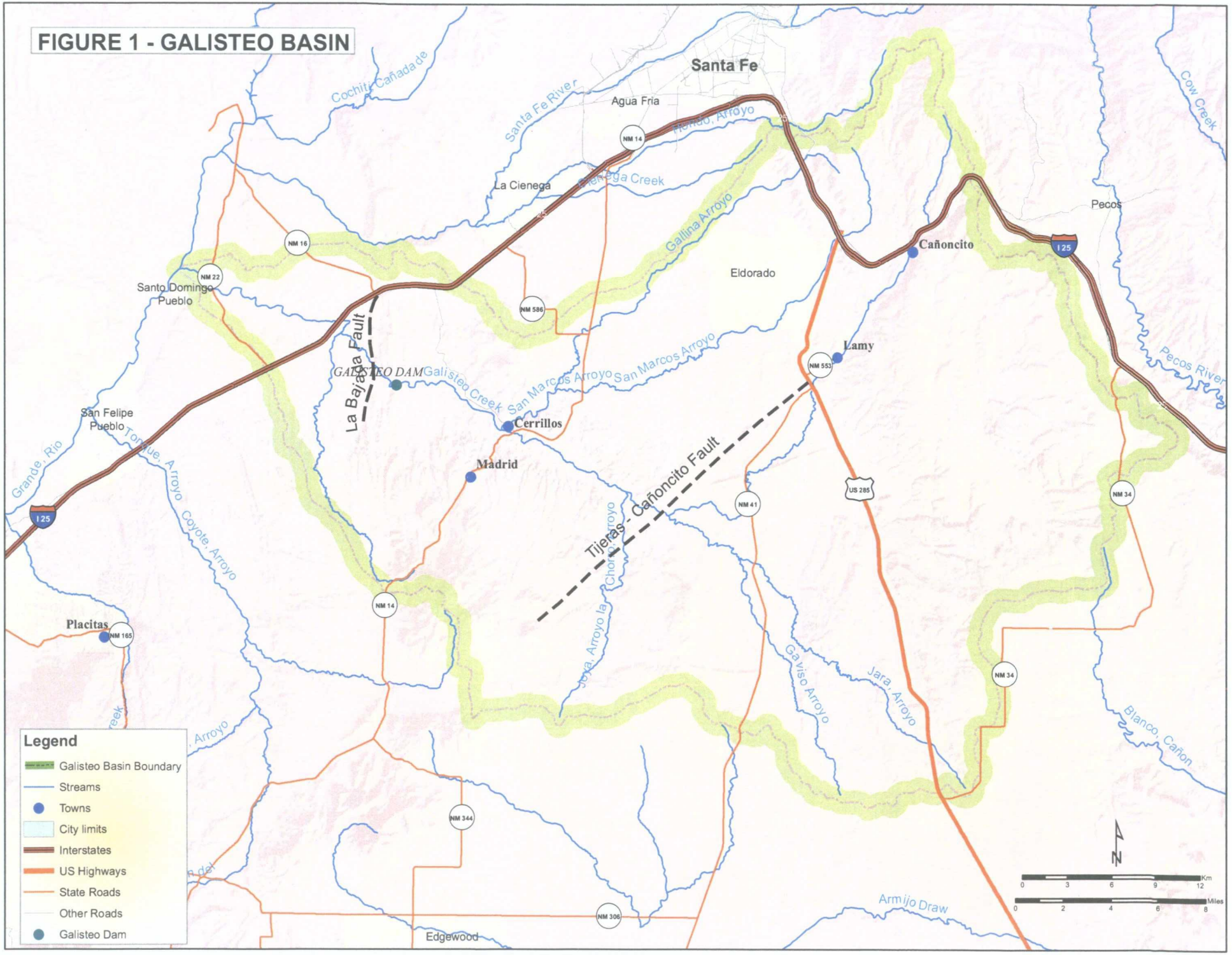
FIGURE 1 - GALISTEO BASIN
Santa Fe
Agua Fria
Cochiti Cañada de
Santa Fe River
Arroyo Hondo
La Cienega
Cienega Creek
Gallina Arroyo
Pecos
Cow Creek
Cañoncito
Eldorado
Santo Domingo Pueblo
La Bajada Fault
GALISTEO DAM
Galisteo Creek
San Marcos Arroyo
Lamy
Pecos River
San Felipe Pueblo
Cerrillos
Madrid
Tijeras - Cañoncito Fault
Grande, Rio
Tonque, Arroyo
Coyote, Arroyo
Placitas
Chorro, Arroyo
Jara, Arroyo
Gaviso Arroyo
Blanco, Cañon
Armijo Draw
Edgewood
NM 14
NM 16
NM 22
NM 586
NM 553
NM 41
NM 34
NM 165
NM 344
NM 306
US 285
I 25
Legend
Galisteo Basin Boundary
Streams
Towns
City limits
Interstates
US Highways
State Roads
Other Roads
Galisteo Dam
N
Km
0 3 6 9 12
Miles
0 2 4 6 8

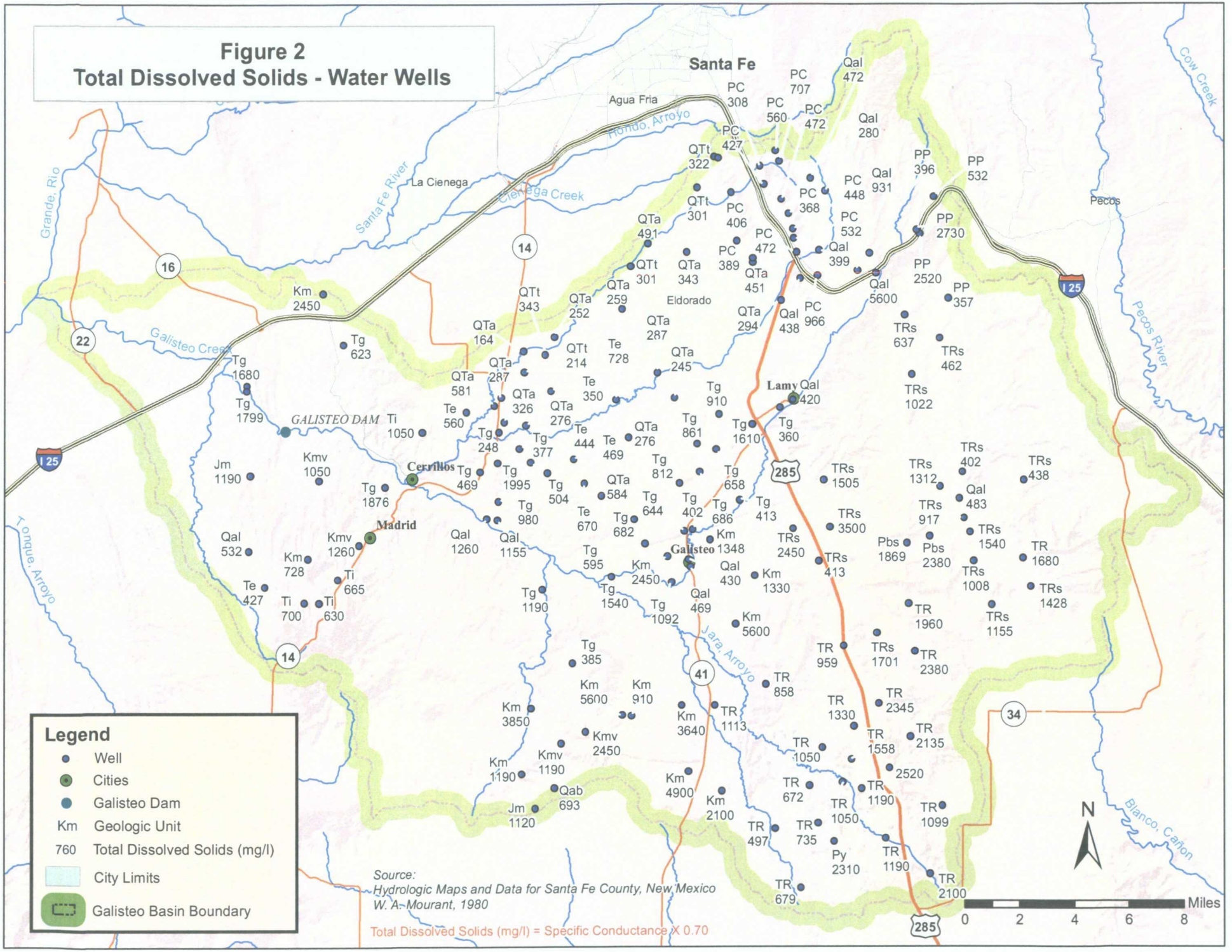
Figure 2
Total Dissolved Solids - Water Wells
Santa Fe
Agua Fria
Rondo, Arroyo
La Cienega
Cienega Creek
Santa Fe River
Grande, Rio
Galisteo Creek
GALISTEO DAM
Cerrillos
Madrid
Galisteo
Eldorado
Lamy
Pecos
Pecos River
Cow Creek
Tonque, Arroyo
Jara Arroyo
Blanco, Canon
I 25
285
14
16
22
41
34
Legend
Well
Cities
Galisteo Dam
Km Geologic Unit
760 Total Dissolved Solids (mg/l)
City Limits
Galisteo Basin Boundary
Source:
Hydrologic Maps and Data for Santa Fe County, New Mexico
W. A. Mourant, 1980
Total Dissolved Solids (mg/l) = Specific Conductance X 0.70
N
Miles
0 2 4 6 8

GEOLOGIC UNITS ENCOUNTERED BY WATER WELLS

Qal	Alluvium
QTa	Ancha Fomation
QTt	Tesuque Formation
Te	Espinaso Formation
Tg	Galisteo Formation
Ti	Intrusive Rocks
Km	Mancos Shale
Tr and Trs	Triassic Rocks
PP	Permian Rocks
PC	Precambrian Rocks

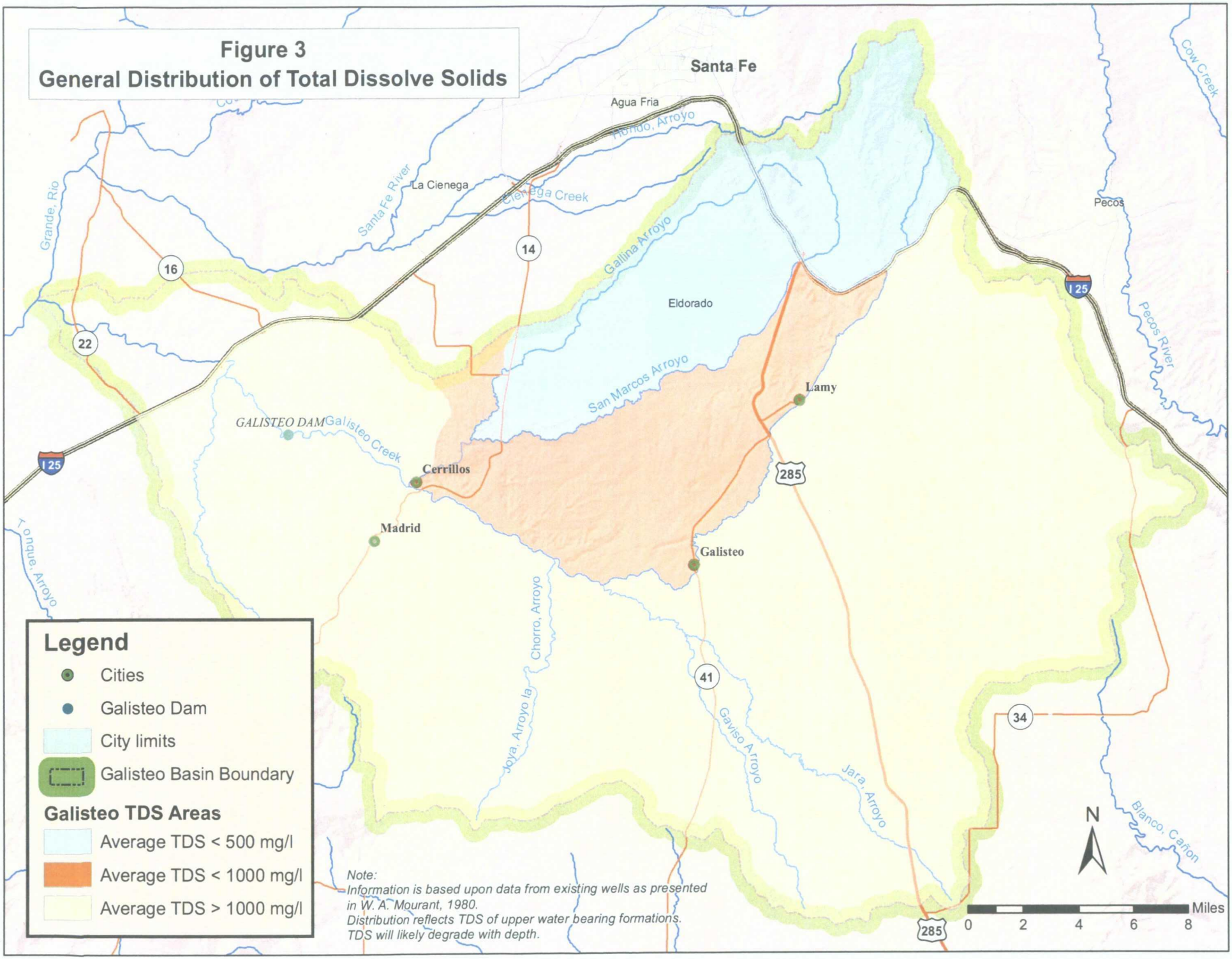
Figure 3
General Distribution of Total Dissolve Solids
Santa Fe
Agua Fria
Rondo, Arroyo
La Cienega
Cienega Creek
Santa Fe River
Grande, Rio
Gallina Arroyo
Eldorado
San Marcos Arroyo
Pecos
Cow Creek
Pecos River
Lamy
GALISTEO DAM
Galisteo Creek
Cerrillos
Madrid
Galisteo
Chorro, Arroyo
Joya, Arroyo la
Gaviso Arroyo
Jara, Arroyo
Blanco, Cañon
Tonque, Arroyo
I 25
14
16
22
285
41
34
Legend
Cities
Galisteo Dam
City limits
Galisteo Basin Boundary
Galisteo TDS Areas
Average TDS < 500 mg/l
Average TDS < 1000 mg/l
Average TDS > 1000 mg/l
Note:
Information is based upon data from existing wells as presented in W. A. Mourant, 1980.
Distribution reflects TDS of upper water bearing formations.
TDS will likely degrade with depth.
N
Miles
0
2
4
6
8

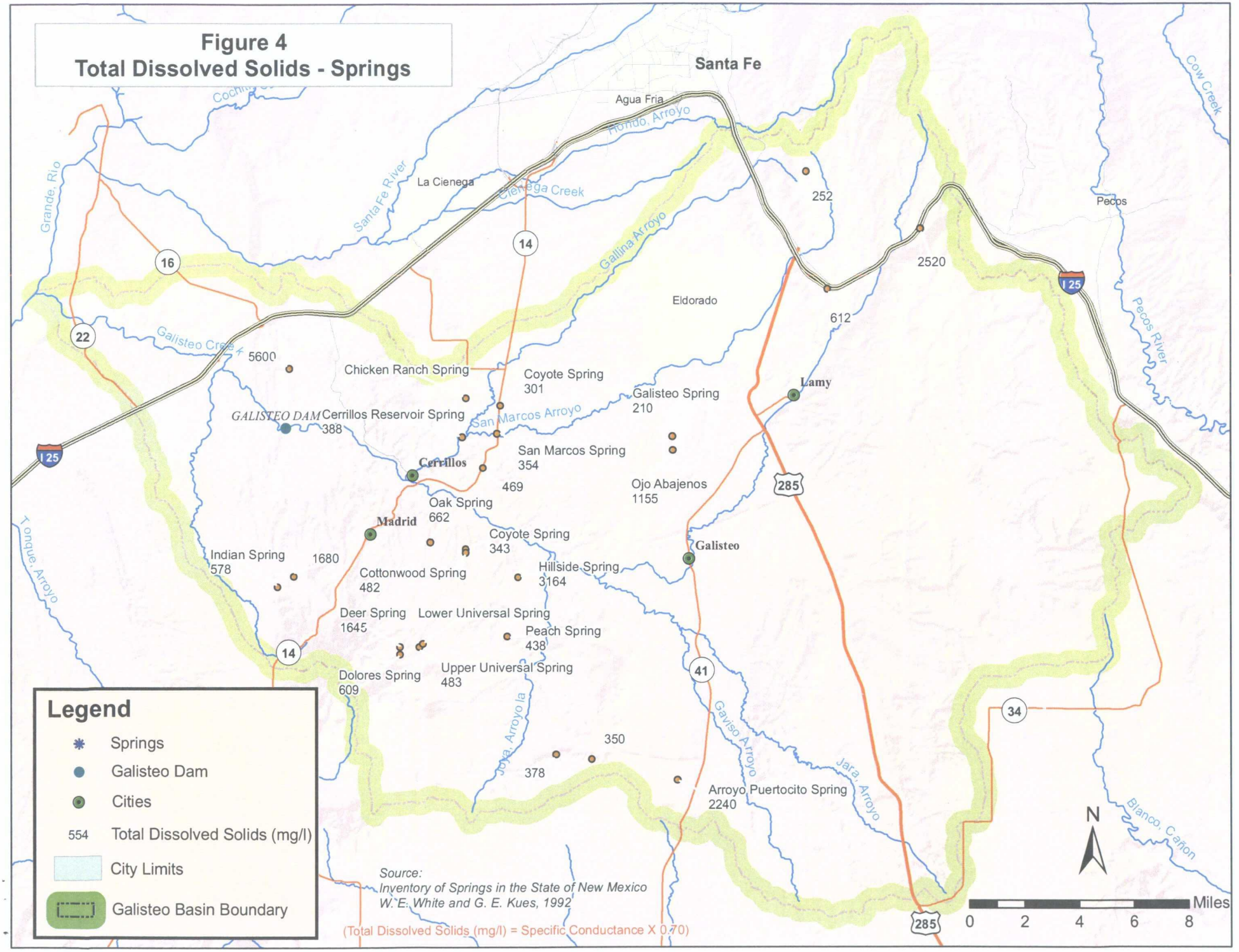
Figure 4
Total Dissolved Solids - Springs
Santa Fe
Agua Fria
Hondo, Arroyo
La Cienega
Cienega Creek
Santa Fe River
Grande, Rio
Gallina Arroyo
Cow Creek
Pecos
Pecos River
Eldorado
252
2520
612
Lamy
Galisteo Creek
5600
Chicken Ranch Spring
Coyote Spring
301
Galisteo Spring
210
GALISTEO DAM
Cerrillos Reservoir Spring
388
San Marcos Arroyo
Cerrillos
San Marcos Spring
354
469
Ojo Abajenos
1155
Oak Spring
662
Madrid
Coyote Spring
343
Galisteo
Indian Spring
578
1680
Cottonwood Spring
482
Hillside Spring
3164
Deer Spring
1645
Lower Universal Spring
Peach Spring
438
Upper Universal Spring
483
Dolores Spring
609
Tonque, Arroyo
Joya, Arroyo la
350
378
Gaviso Arroyo
Jara, Arroyo
Arroyo Puertocito Spring
2240
Blanco, Cañon
I 25
22
16
14
41
34
285
Legend
Springs
Galisteo Dam
Cities
554 Total Dissolved Solids (mg/l)
City Limits
Galisteo Basin Boundary
Source:
Inventory of Springs in the State of New Mexico
W. E. White and G. E. Kues, 1992
(Total Dissolved Solids (mg/l) = Specific Conductance X 0.70)
N
Miles
0 2 4 6 8