CHAPTER 1 - INTRODUCTION

PURPOSE AND SCOPE

At the request of the US Environmental Protection Agency (USEPA), the New Mexico Water Resources Research Institute (NMWRRI), New Mexico State University (NMSU), and California State University, Los Angeles (CSULA) undertook this study to characterize binational aquifers in southwestern New Mexico (Figure 1-1) and prepare data for an international data exchange with the Republic of Mexico. This project is a continuation of joint efforts by the governments of the United States and Mexico to identify transboundary aquifers, quantify the natural and induced chemical quality of each aquifer, determine the direction of groundwater flow, and develop Geographic Information System coverages. The first phase of the initiative focused on the transboundary aquifers in the El Paso/Ciudad Juarez/Las Cruces area, which resulted in an international data exchange with the Republic of Mexico for a portion of the area (Hibbs et al. 1997).

Many of the surface and groundwater resources along the transboundary corridor are shared between both nations, yet little binational study, with the exception of the two recently completed reports, of the resources has been undertaken. A number of environmental and hydrologic problems have been identified that will require the continuing cooperation of both nations. Solutions to water-related problems can be achieved only when a better understanding of transboundary water resources is attained. This study is an important step toward attaining a better understanding of the binational resources.

The border region is growing rapidly, with a population of more than 3 million people projected by the year 2015. Groundwater levels in portions of the region have experienced declines and the projected water demands in this border region will put additional strain on an already scarce resource. Local, state and federal agencies recognize the problems facing this region and there is a general consensus that a better understanding of shared transboundary water resources is needed. This is particularly important in view of significant national attention now given to questions of environmental and economic impacts of the North American Free Trade Agreement (NAFTA).

Information on water quality and quantity in the region has been gathered by numerous public entities over the years and it exists in various formats, differs in degree of resolution and data quality, has been generated for different purposes and is not located in a readily accessible or centralized location. Because of the importance of water quality and quantity to the region, aggregation and analysis of the existing data/information base is vital. Much concern has been focused on the historical and potential future growth along the U.S./Mexico international border. Of particular interest is the increased level of development in the population centers that occupy adjacent sides of the border, commonly referred to as "twin cities." Rapid population expansion is also evident in the numerous new neighborhoods, called "colonias," with inadequate water and sewer facilities. Further concerns about future development and its impacts upon the regional environmental and water resources have been heightened by the possible effects of the NAFTA. While much of the debate over likely impacts has been focused on basic infrastructure needs and surface water resources, it is equally important to recognize the potential for significant effects that this development might have upon the groundwater resources of the region. Much of the U.S./Mexico border region relies primarily on local transboundary groundwater resources for all uses. It is necessary to have an adequate understanding of these shared aquifers to address properly the variety of issues involved in good resource management and problem avoidance at the local, state, and federal levels.

Principal customers of the results of this study include those having a vital interest in water such as cities, farmers, and various water dependent industries. Also, government officials at all levels who have an interest in water resources management will find this data useful in the decision making process.

To complete this study, data from several sources had to be combined into databases for use by the project participants and for data exchange. The following discussion places the challenges facing this region, such as physical, cultural and economic diversity, into an historical perspective.

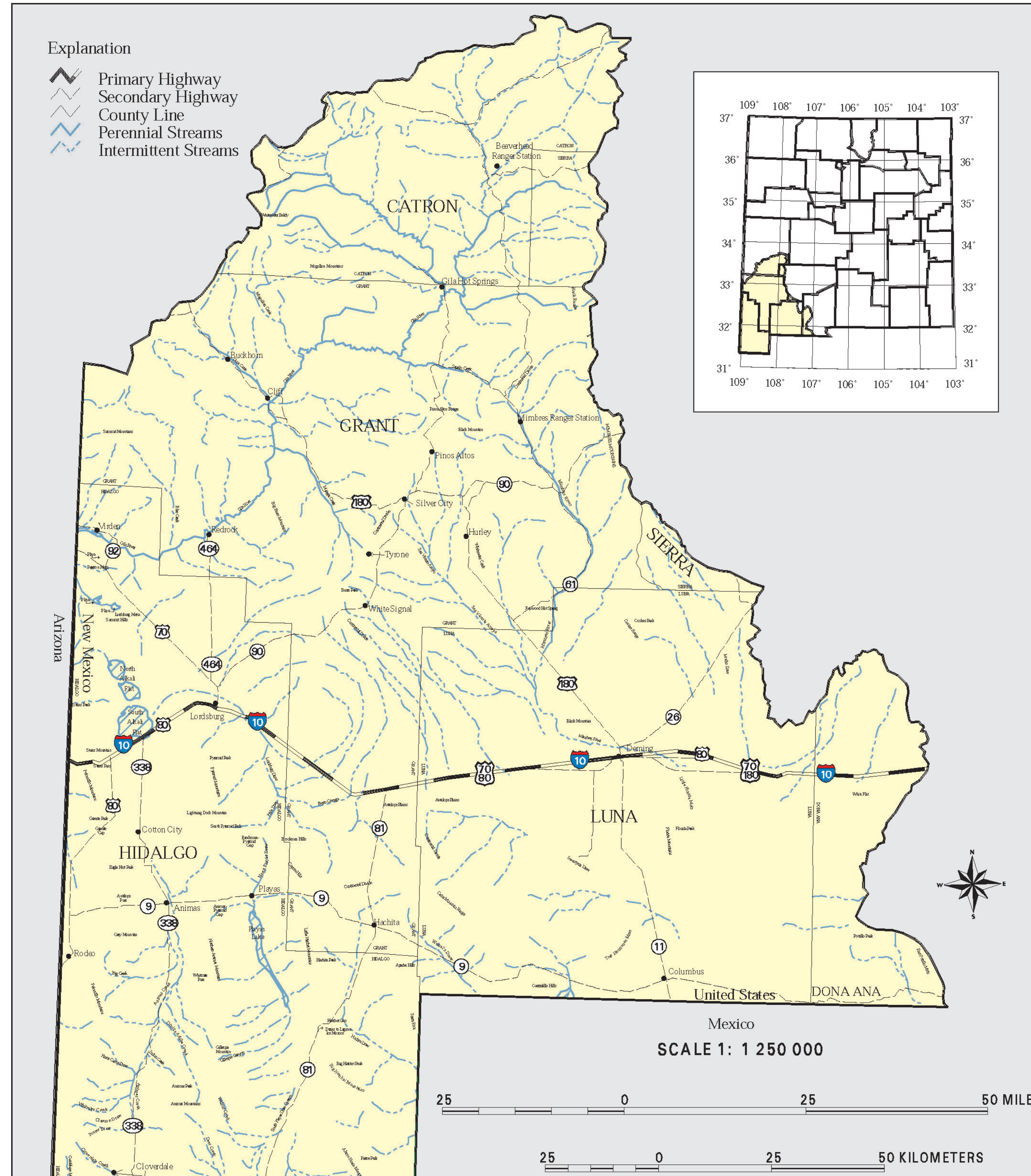

Figure 1- 1. Study area

HISTORY OF REGIONAL DEVELOPMENT

Introduction

Spanish explorers referred to the area as "Apacheria" because they found it habited by Apache Indians. Apache habitation is estimated to date from about 1600. Early Spanish trade routes traversed the area, but were not considered safe. Spanish settlement began around 1800 for mining of copper ore. In 1822 the area came under the administration of the Mexican government. In 1825 mountain men from the U.S. began fur trapping in the area. One of these trappers was responsible for profoundly influencing the attitude of the Apaches toward white settlers when, in 1835, he enticed a number of the Indians to a party near Cliff and then killed them all. Thereafter, the Apaches intensified warfare against any and all white settlers (Borton and Sorensen 1967).

The area came under U.S. control by two separate actions. The northern third of the area was acquired by the Treaty of Guadalupe Hidalgo in 1848 and the remainder acquired in 1853 by the Gadsden Purchase (Bailey 1963, James 1969). By 1858, the Butterfield Stagecoach Trail connecting Texas and New Mexico with Arizona and California crossed the area (Conkling and Conkling 1947). During the early American occupation, mining was the principal economic activity. Grant County was established in 1868, and this area continues to be a major center of mineral production today, with a long history of copper, lead, zinc, silver and gold mine/mill activity (Orris et al. 1993). About 1880, livestock operations were established and became increasingly important. In 1881 shortly after the Southern Pacific Railroad reached the area, Lordsburg was established. Later the Santa Fe Railroad extended a branch line from the Rio Grande Valley into Deming and Silver City. Luna County was formed in 1901 and Hidalgo County in 1919 (Borton and Sorensen 1967). Early agricultural development was limited to lands adjacent to the rivers and, by 1890, most land suitable for irrigation with surface water was under cultivation, much of it in the upper Mimbres River. Development of groundwater for irrigation began in the Deming area of the Mimbres Basin in 1908 and expanded rapidly thereafter. Hale and others (1965) reported irrigated acreages in the Mimbres area at 8,800 (3,561 ha) in 1936, 11,730 (4,747 ha) in 1940, 16,000 (6,475 ha) in 1945, 25,800 (10,441 ha) in 1950, 33,500 (13,557 ha) in 1955, and 37,000 (14,974 ha) in 1960. Pumping for large-scale farming was initiated in the basins west of the Mimbres in 1948, east of Lordsburg in 1955, and in the Columbus area in the early 1960s. Irrigated acreages reported by Hale and others (1965) were 7,900 acres (3,197 ha) in the Animas Valley and 1,250 acres (506 ha) in the Playas Valley in 1950.

Cropland

The acreage of irrigated cropland by source of water (surface, ground, combined surface and ground) is reported in Table 1-1 for Grant, Hidalgo, and Luna counties for 1990, 1995, and 1998. The total acreage for the three counties has remained almost constant at about 120,000 acres (48,600 ha). The cropland in Grant County is located primarily along the Gila and San Francisco rivers and their tributaries. The cropland in Hidalgo County is mostly in the Animas Basin and is irrigated from groundwater. There are small scattered surface/ground-supplied cropland areas in the Virden Valley. In Luna County, the majority of the cropland is in the Deming area of the Lower Mimbres Basin irrigated from groundwater. The surface-irrigated and surface/ground acreage is located along the Mimbres River. These cropland areas along with other land uses are shown on Figure 1-2.

Table 1-1. Irrigated cropland acreage by water source for Grant, Hidalgo, and Luna counties, New Mexico 1990, 1995, and 1998.

County/water source	1990 (acres)	1995 (acres)	1998 (acres)
Grant			
Surface	1,840	3,690	3,690
Ground	3,380	1,840	1,840
Surface & ground	1,730	1,420	1,420
Total	6,950	6,950	6,950
Hidalgo			
Surface	0	0	0
Ground	37,640	36,370	36,370
Surface & ground	2,780	2,050	2,050
Total	40,420	38,420	38,420
Luna			
Surface	10,670	10,670	10,670
Ground	61,970	61,970	61,970
Surface & ground	1,310	1,310	1,310
Total	73,950	73,950	73,950
Total	121,320	119,320	119,320

Source: Lansford and others 1997; Lansford and others 1993; and Hawkes and Libbin 1999.
Metric conversion of acres: 1 acre=.4047 hectare; 1 acre=4,047 m^2

Population and Economy

The region includes all of Luna and Hidalgo counties, and parts of Catron, Grant, Sierra, and Doña Ana counties. Since only small portions of Doña Ana, Catron, and Sierra counties are included in the region, population information for these counties is not presented.

Luna County ranked as the state's 18th most populous county with a population density of 7.8 persons per square mile (3.01 persons/km^2), accounting for 1.3% of the state's population. Table 1-2 reports the population for Luna County in 1980, 1990, 1996 estimate, and projection for 2000. The population is projected to increase to 25,041 persons for the year 2000, accounting for 1.4% of New Mexico's population.

Hidalgo County ranked as the state's 27th most populous county with a population density of 1.8 persons per square mile (0.695 persons/km^2) and accounts for 0.4% of the state's population. Hidalgo's population is projected to increase from 6,328 in 1996 to 6,487 in 2000 (Table 1-2).

Table 1-2. Census population, estimates and projections for Luna, Hidalgo, and Grant counties for 1980, 1990, 1996, and 2000.

County	1980	1990	1996 est.	2000 projection
Luna	15,585	18,110	23,089	25,041
Hidalgo	6,049	5,958	6,328	6,487
Grant	26,204	27,676	30,700	31,655
Total	47,838	51,744	60,117	63,183

Source: New Mexico Dept. of Health 1998, *1996 New Mexico Selected Health Statistics Annual Report*, Santa Fe, pp 91, 97, and 105.

Grant County ranked as the 14th most populous county with a population density of 7.8 persons per square mile (3.01 person/km^2), accounting for 1.8% of the state population. Grant County was projected to increase from 30,700 in 1996 to 31,655 in 2000 (Table 1-2).

Water Use

Water use in the principal counties in the region (Grant, Hidalgo, and Luna) are reported in Table 1-3 for the period 1990 and 1995. Water use patterns reflect the population and economic activity in each of the counties.

Grant County water depletions declined from 34,195 ac-ft (4.2 x 10^7 m^3) in 1990 to 31,515 ac-ft (3.9 x 10^7 m^3) in 1995, a decrease of about 8.5%. Over the period, mining sector water use decreased about 16.6%. The uses in the county were still dominated by the mining sector with 72% of the total in 1990 and 65% in 1995. Irrigated agriculture accounted for 17% in 1990 and 21.9% in 1995. Public and domestic water use accounted for 6.8% in 1990 and 9.5% in 1995.

The water use in Hidalgo County increased during the 1990-95 period by about 14%. Irrigated agriculture accounted for 76% of the water use in 1990 and 77% in 1995. The next most important use was for mining with 16% in 1990 and 17% in 1995. Public and domestic water use accounted for 2.93% in 1990 and 2.87% in 1995.

Table 1-3. Total water depletions by sector of use and county, 1990 & 1995.

Sector of Use	Grant (acre-feet)	Hidalgo (acre-feet)	Luna (acre-feet)
1990			
Public Water Supply	2,037.99	666.99	1,754.96
Domestic (self-supplied)	299.83	60.88	128.04
Irrigated Agriculture	5,813.00	18,844.00	60,986.00
Livestock (self-supplied)	626.19	556.43	517.72
Commercial (self-supplied)	90.18	231.54	118.26
Industrial (self-supplied)	1.72	0.96	125.15
Mining (self-supplied)	24,680.89	3,961.22	110.86
Power (self-supplied)	645.36	477.81	0.00
Reservoir Evaporation	0.00	0.00	0.00
Total	34,195.16	24,799.83	63,740.99
1995			
Public Water Supply	2,636.14	734.06	2,105.04
Domestic (self-supplied)	370.35	79.68	364.69
Irrigated Agriculture	6,894.00	21,770.00	81,404.00
Livestock (self-supplied)	654.30	441.49	447.34
Commercial (self-supplied)	103.87	298.84	138.65
Industrial (self-supplied)	6.54	37.56	43.95
Mining (self-supplied)	20,567.00	4,913.88	66.00
Power (self-supplied)	282.52	0.00	0.00
Reservoir Evaporation	0.00	0.00	0.00
Total	31,514.72	28,275.51	84,569.67

Source: Wilson 1992 and Wilson 1997.
Metric conversion of acre-feet: 1 acre-foot = 1,233.5 m^3

The water use in Luna County increased by about 33% during the 1990-95 period with irrigated agriculture accounting for the increase. Irrigated agriculture also accounted for most of the water use in the county with more than 95% in 1990 and more than 96% in 1995. Public and domestic uses were next with about 2.95% in 1990 and 2.92% in 1995.

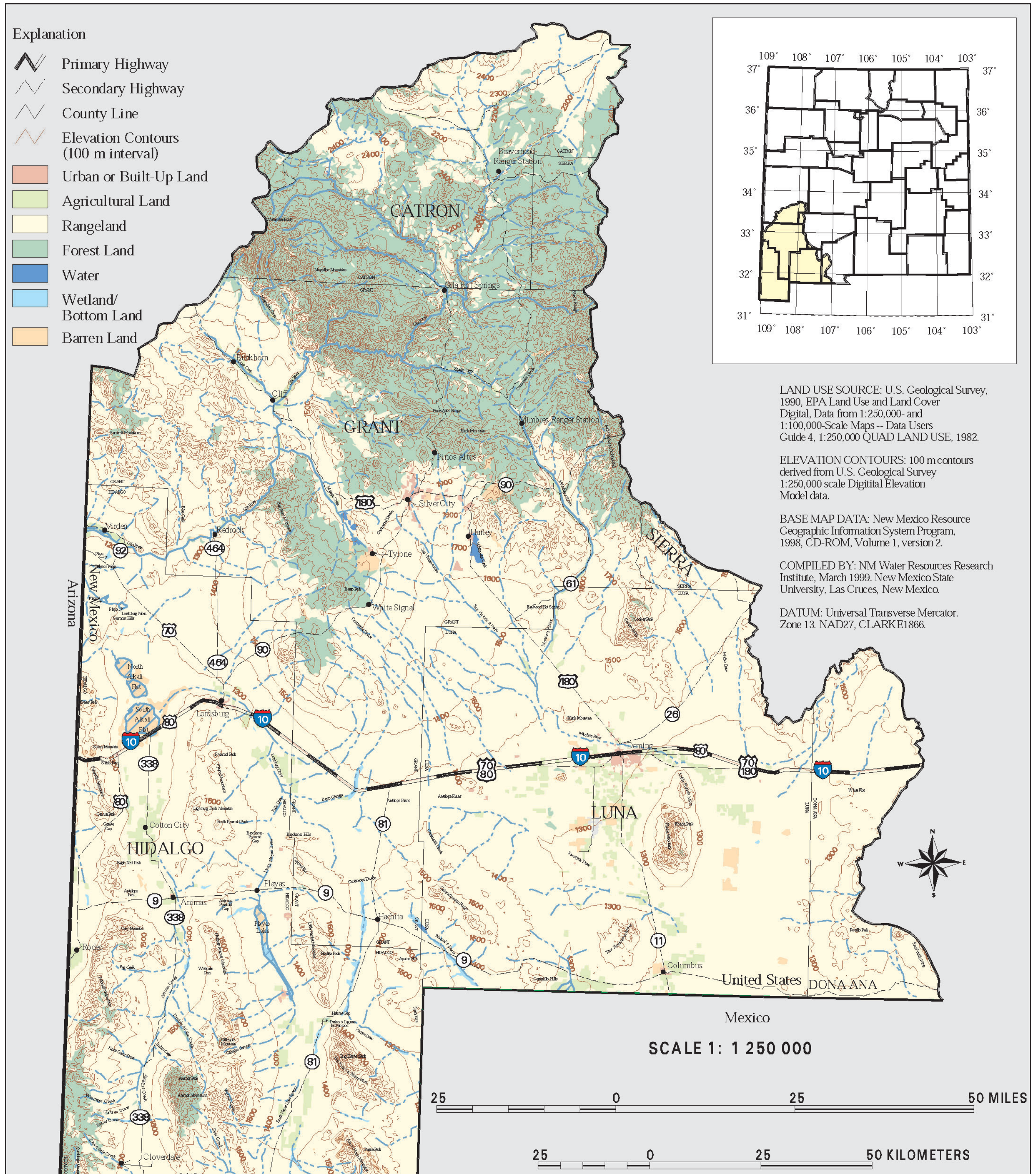

Figure 1- 2. Land Use in the region

HISTORY OF HYDROGEOLOGIC INVESTIGATIONS

Because of the major role groundwater plays in land use and water resources management in the border region, geologists, hydrologists, and other natural-resource specialists have always placed great importance on this area. In the late 19th century, the first generation of exploration geologists (e.g., Powell, King, Gilbert, Russell, Dutton) served the Federal Government in an era of "Manifest Destiny" and laid a solid foundation for work to come. Only after 1900 did advances in drilling technology and local availability of deep-subsurface data allow for mapping of basin and valley fills in the context of modern hydrogeologic models that integrate surface and subsurface information on the structural framework and general composition of basin-fill aquifers.

Early (1907-1918) hydrogeologic mapping and conceptual model development in the Basin and Range province (BRP) are illustrated by many USGS Bulletins, Water-Supply Papers, and Folios including those by N.H. Darton (1916), W.T. Lee (1907), O.E. Meinzer (1911, 1916), Meinzer and Hare (1915), S. Paige (1916), and A.T. Schwennenssen (1918). Tolman (1909) recognized the fundamental hydrogeologic distinction between depositional systems in aggrading basins with internal surface drainage and those with external surface and groundwater discharge (his bolson and semibolson systems). Bryan (1923, 1938) and Tolman (1937) were among the first to describe effectively the complex interplay between piedmont-slope and basin-floor depositional systems (fan, alluvial flat, lake, playa, and axial fluvial) in the context of the geohydrology and geomorphology of fault-block basins.

More recent studies that have furthered the understanding of the hydrogeologic setting of southwestern New Mexico include work by Reeder (1957), Doty (1960), Trauger and Herrick (1962), Trauger and Doty (1965), Trauger (1972), McLean (1977), O'Brien and Stone (1981, 1982a-b, 1983, 1984), Kernodle (1992a), Wilkins (1986, 1998), and Hanson and others (1994). The region also includes or is contiguous to areas that have been considered as sites for surface and subsurface disposal of various types of hazardous wastes (Bedinger et al. 1984; Hawley and Longmire 1992; Hibbs et al. 1998).

The conceptual model of the region's hydrogeologic framework described in Chapter 3 has been designed to integrate the vast amount of information contained in the above and many other cited publications, as well as from numerous unpublished data sources, including well records, other hydrologic information, and even anecdotal accounts of local groundwater conditions.