

1 INTRODUCTION AND BACKGROUND INFORMATION

REGIONAL WATER PLAN • RIO CHAMA WATERSHED

CHAPTER 1

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INTRODUCTION

On June 16, 1995 Rio Arriba County was awarded a grant by the New Mexico Interstate Stream Commission for regional water planning in the Rio Chama watershed, Region 14 of the Interstate Stream Commission regional water planning areas in New Mexico. The Rio Chama watershed encompasses about 56 percent of the land area, and over 65 percent of the total water use within Rio Arriba County. The only areas of the county that are not included in this water planning region are the San Juan River watershed west of the Continental Divide and the extreme southeastern part of the county that lies within the Rio Grande mainstem drainage.

CONTENTS AND ORGANIZATION

The Water Plan is presented in the following seven chapters, along with a separate Executive Summary.

Chapter 1: Introduction and Background Information

Chapter 2: Community Involvement

Chapter 3: Legal Analysis

Chapter 4: Water Supply

Chapter 5: Water Demand

Chapter 6: Water Budget

Chapter 7: Planning Alternatives

The chapters on Community Involvement, Water Supply, and Water Demand include Appendices A, B, and C respectively at the end of the Water Plan.

PURPOSE AND SCOPE OF THE WATER PLAN

This Regional Water Plan has two primary purposes: to provide information to the Interstate Stream Commission on water supplies, water demands, and preferred alternatives to ensure a secure water future for the region; and to provide information to residents and water users within the region to help us understand our water management situation and be able to make informed decisions about water in the region. The Plan includes a summary of all available

information on the water supplies within the region, how water is used at present, projections of water demand into the future, and an analysis of potential alternatives that can help ensure an adequate water supply for future needs.

The Plan recommends the kinds of infrastructure, water management, and social institutions that will best ensure adequate water for our future as a watershed and a planning region. It cannot, however, be a substitute for detailed hydrological or other technical analyses of the needs of individual communities or situations. The plan may recommend, for example, additional storage reservoirs or improved watershed management as the best ways to enhance the reliability of water supplies, but it has not been possible to specify the exact location of new reservoirs or where to begin improving watershed conditions. A great deal of local investigation and decision making remains to be done, but the Regional Water Plan will help suggest the best alternatives to consider in the light of local conditions.

INDIVIDUALS INVOLVED IN PREPARING THE PLAN

Rio Arriba County arranged for the Rio de Chama Acequias Association (RCAA) to coordinate the planning work. Fred Vigil, the President of the RCAA, supervised planning activities including the data gathering, public participation, and administrative oversight. He was assisted in this task by other officers of the RCAA, especially Vice President Aubrey Owen, Secretary Agapita Martinez, Treasurer Joseph M. Salazar, and Records Manager Fidel Trujillo. David Morgan of La Calandria Associates, Inc. and Linda Fluk, a geological consultant, were primarily responsible for the research, technical analysis, and writing, with assistance from Dr. William J. Stone, Cipriano Martinez, Sabino Rivera, Miguel Santistevan, and Dr. William O. Sayre. Legal consultation, including the chapter on **LEGAL ISSUES**, was provided by Fred Waltz, Esquire. A Citizens' Advisory Committee, whose membership is listed in the **COMMUNITY INVOLVEMENT** chapter, was established in July of 1995 and provided oversight of the entire process.

THE WATER PLANNING PROCESS

In 1992 the North Central New Mexico Economic Development District (NCNMEDD) received the first Interstate Stream Commission (ISC) grant for regional water planning in the Rio Chama watershed. At that time the planning region was defined as northern Rio Arriba County rather than the Rio Chama basin, and therefore included parts of what are now other regions. A report on the work funded by this grant, entitled Northern Rio Arriba County Regional Water Plan was prepared by Resource Technology, Inc. of Albuquerque and submitted to the NCNMEDD in 1993. This report, however, predated the 1994 water planning template and so did not follow template organization and did not conform to current technical standards and guidance in many areas.

On June 1, 1995 Rio Arriba County was awarded a grant by the ISC to continue the process of regional water planning for the Rio Chama watershed. The first step in the water planning process was to establish a Citizens' Advisory Committee, with fifteen members drawn from throughout the region, selected because of their interest and involvement in both community and water issues. The Citizens' Advisory Committee, along with other interested residents, participated in a workshop led by staff from the ISC and Western Network (a nonprofit facilitator), to become familiar with the process of regional water planning. Following the workshop, additional Advisory Committee meetings were held to identify common concerns about water in the region, and to set the agenda for the technical work to be done.

In the years that followed, discussions about the water plan took place in numerous settings: at meetings of acequia commissioners and parciantes; at meetings held to discuss the Rio Arriba County General Plan; at public meetings held in communities around the Rio Chama watershed specifically to discuss regional water planning; and in individual meetings and other personal communication with key stakeholders such as elected officials, Rio Arriba County staff, water system operators, and acequia association officials. These meetings identified principal concerns and desires for the future among residents and water users in the Region, and set the planning goals that the Water Plan has addressed.

Four community meetings were held specifically for Water Plan discussion during the summer of 2003, in Medanales, Gallina, El Rito, and Tierra Amarilla. Many community members, both those who attended meetings and those who could not, responded to questionnaires pertaining to water issues and needs in their locality. Final public meetings were held at Ghost Ranch, Tierra Amarilla, and Chama in the spring of 2006.

The first volume of a report to the ISC, the Rio de Chama Regional Water Plan (draft, Vol. I), with an Introduction and sections on Background Information, Public Participation, and Water Demand, was submitted to the ISC for review in April, 1997. A Water Supply Assessment was submitted for review in January, 2001. Comments from ISC staff were received in April, 2001, and a revised Water Supply Assessment was submitted in April of 2002. A draft Water Budget was submitted in December of 2002. A draft of the proposed final Water Budget was submitted for ISC staff review May, 2004. The final Water Plan was submitted to the ISC for acceptance in May of 2006.

BACKGROUND INFORMATION

LOCATION AND BOUNDARIES

Water Planning Region 14 encompasses the entire Rio Chama watershed within New Mexico. The watershed straddles the New Mexico/Colorado border and covers approximately 3,157 square miles. The northern boundary of the watershed lies north of the village of Chama, New Mexico in the southern San Juan Mountains. The western boundary is the Gallina-Archuleta Arch. The eastern boundary is formed by the Tusas Mountains. The southern boundary of the watershed is the confluence of the Rio Chama and the Rio Grande, just north of Española, New Mexico. The location of the planning region within New Mexico is shown in Figure 1-1.

With the exception of insignificant incursions into Sandoval and Taos Counties, the Rio Chama watershed in New Mexico is located entirely within Rio Arriba County, and covers over half the land area of the county. Almost all the land in Rio Arriba County that is not within the Chama basin is located west of the Continental Divide in the San Juan or Navajo River basins. This area is included within Water Planning Region 2, the San Juan Basin. A geographically small but important part of Rio Arriba County, the southeast corner of the county including much of Española and Santa Cruz, falls within the Rio Grande basin and Region 12, the Jemez y Sangre planning region.

GEOGRAPHY AND LANDSCAPE

Figure 1-2 in the Water Plan shows an overview of the region, including topography, principal tributaries, and communities. Elevations in the planning region range from 11,410 feet at the top of Brazos Peak to 5,620 feet at the confluence of the Rio Chama and the Rio Grande. The great majority of the landscape within the Rio Chama watershed is rugged, hilly to mountainous, and wooded. Woodland types vary from piñon-juniper, sparse at lower elevations, through mixed conifer including ponderosa pine, fir, and some Douglas fir at intermediate elevations, to alpine spruce-fir forest and montane grassland meadows at the higher elevations above Chama and Tierra Amarilla. There are substantial aspen groves in the highlands above Canjilon and Vallecitos. (Figure 1-3 illustrates vegetation types). Irrigated agriculture takes place in

the valley bottoms of the Rio Chama and thirteen perennial tributaries, wherever topography and water supplies have made it possible to build acequias and irrigate land. Elevations of irrigated fields range from over 8,000 feet in the area above Chama and nearly 7,500 feet in large areas near Tierra Amarilla, to about 5,650 feet around Hernandez and Chamita. Because of this difference in altitude, the growing season varies from about 105 days in Chama and Tierra Amarilla to over 140 days near Española.

CLIMATE

The climate, while certainly warmer at the lower elevations and wetter in the higher areas, does not vary enormously over the inhabited areas of the region. The long-term annual average temperature at the Chama weather station is 42 degrees F., and 50 degrees F. at the Española and Abiquiu Dam stations. Maximum 24-hour average temperatures, which occur in July, are 65 degrees F. in Chama and 73 degrees F. in Española; while minimum 24-hour average temperatures, in January, are 22 degrees F. in Chama and 28 degrees in Española. Annual average precipitation varies from 9.5 inches in Española to 20.5 inches in Chama. (Climate information from the Western Regional Climate Center web site, www.wrcc.dri.edu). Winter precipitation occurs mostly in the form of snow, especially in the northern part of the county; and summer precipitation normally comes in brief but often intense thunderstorms.

NATURAL RESOURCES

Land use, agriculture, and livestock

The most consistently utilized natural resource of the Rio Chama region, at least since Spanish colonial times, has been the farmland of the valley bottoms where irrigation has been possible. Until the 1920's or 1930's, much of the farming in the region was primarily for subsistence and involved a combination of animal husbandry, arable crops such as corn and wheat, orchards, and household gardens. Subsistence farming has declined steadily since then, and now most of the commercial agricultural production in the region involves livestock. Almost all of the land that has historically been used for agriculture is still

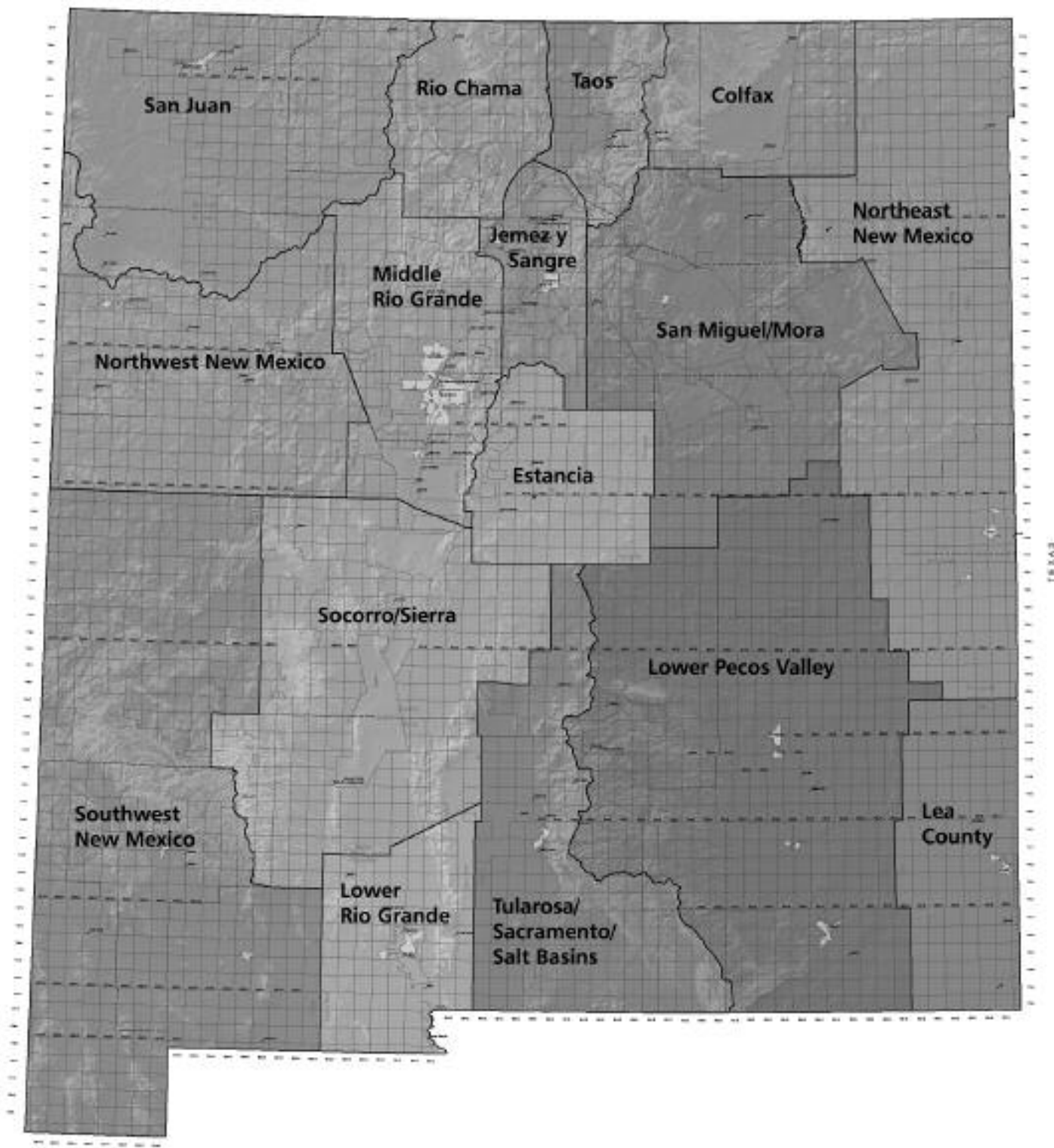


FIGURE 1-1: WATER PLANNING REGIONS

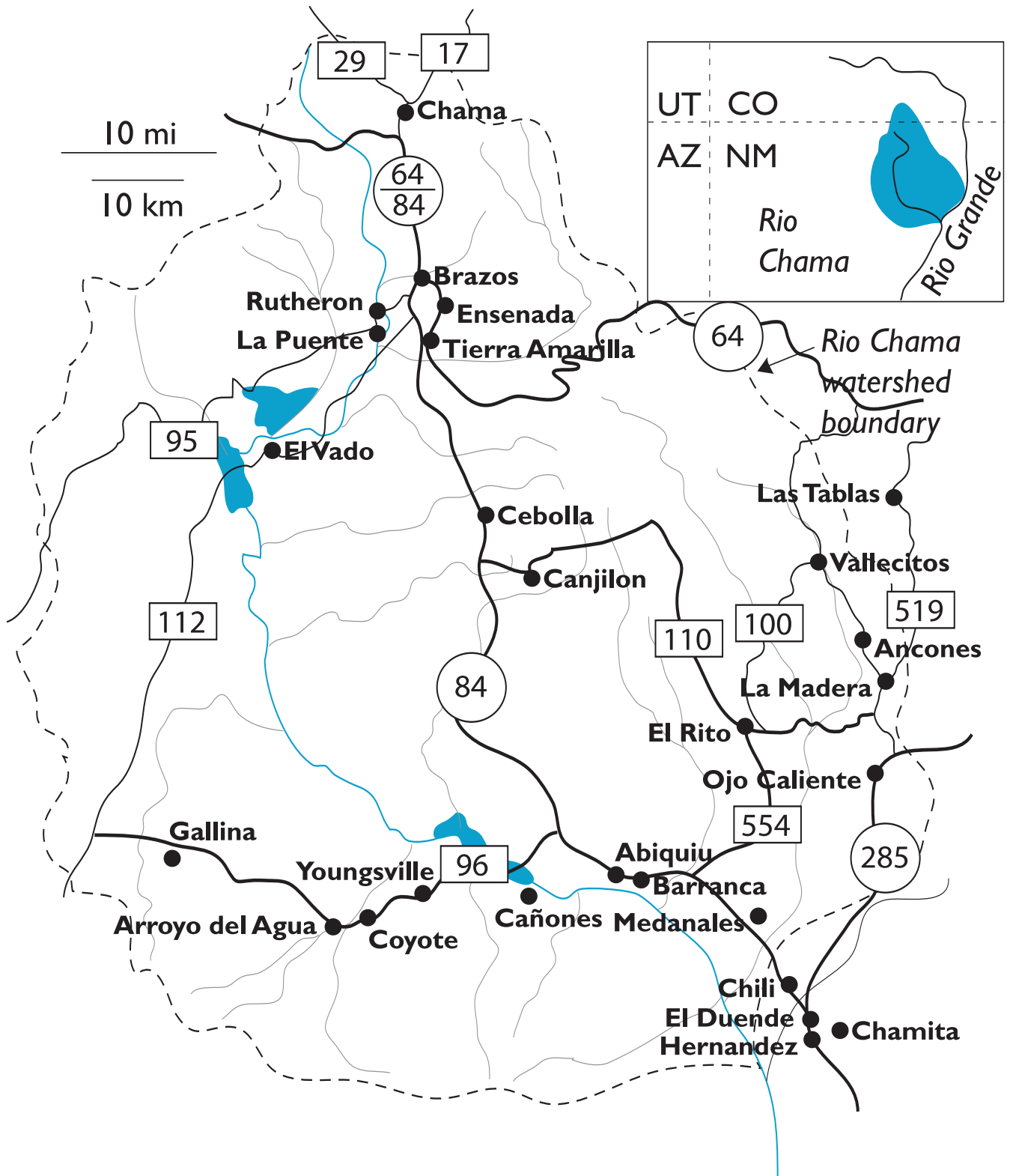


FIGURE 1-2: RIO CHAMA COMMUNITIES AND HIGHWAYS

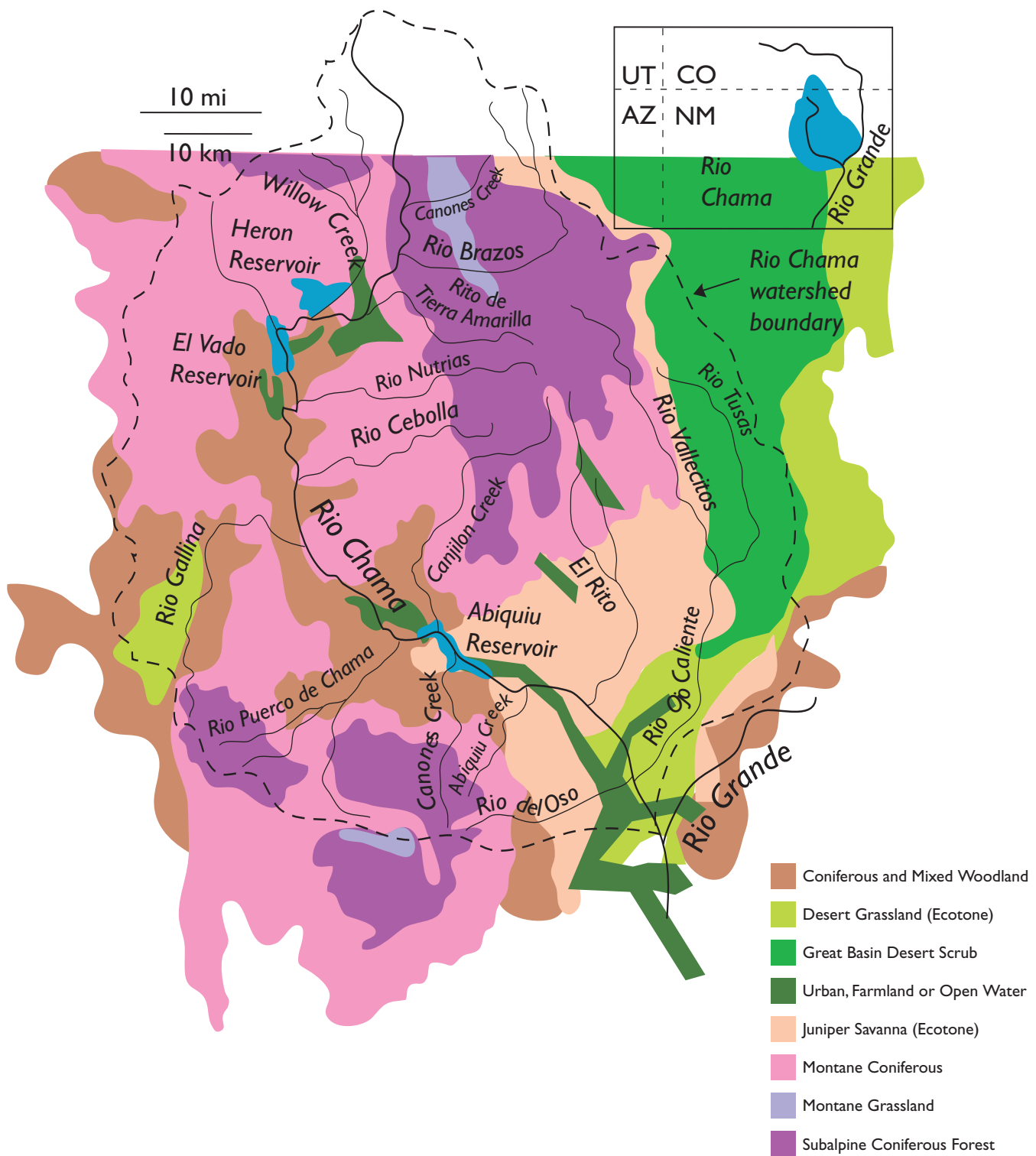


FIGURE 1-3: VEGETATION MAP

irrigated, either for forage crop production or for residential yard and garden space.

Much of the land in the region is or has been used for grazing livestock, including federally owned land managed by the Forest Service or the Bureau of Land Management (BLM). There were approximately 25,000 cattle and 3,800 sheep in Rio Arriba County in 2000 (NMDA, 2000). A precise census of livestock in the planning region is not available, but it seems likely that livestock numbers in this instance are roughly proportional to land area. Because the Rio Chama watershed is about 56 percent of the land area of Rio Arriba County it would follow that there were about 14,000 cattle and 2,128 sheep in the region at the time of the count. Of course these numbers will change with climate and market conditions, and in a drought year such as 2001-2002, the numbers of livestock have decreased. In 1994, for instance, there were 31,000 cattle and 3,500 sheep in Rio Arriba County (NMDA, 1994), so the decline has not been precipitous.

As of April, 2004 the Santa Fe National Forest had 125 grazing permittees entitled to graze up to 5,125 animals for 30,642 head months (a head-month is a cow and calf grazing for one month), located on the Coyote, Cuba, and Española Ranger Districts (Santa Fe National Forest grazing staff, personal communication, April 2004).

The Carson National Forest reports that for 2004 grazing permittees on 27 allotments had permits for up to 8,323 cattle and 3,478 sheep, but because of range conditions following extensive drought the allowable stocking rate was reduced to 6,100 cattle and 2,369 sheep. Permitted total usage was 41,901 head-months for cattle and 11,961 head-months for sheep, but 2004 maximum allowable usage was 27,750 head-months for cattle and 7,590 for sheep. The El Rito and Canjilon Ranger Districts are entirely within the planning region, along with part of the Tres Piedras Ranger District (Carson National Forest grazing staff, personal communication, April 2004).

Timber and mining

Timber has been harvested on a subsistence basis, for firewood, vigas, latillas, and fencing, for centuries. Commercial logging in the Rio Chama watershed began in the 1880's when the Denver and Rio Grande Western Railroad extended lines from Antonito, Colorado to Chama and then to Española. The majority of the pon-

derosa and spruce-fir forests in the region have been cut over at least once since then. A substantial timber industry, by local standards, grew up in the Petaca – Vallecitos area at one time but declined to a single mill by the 1980's, and even that mill has closed, at least temporarily. Timber harvesting in the region is constrained in some areas by endangered species issues, and more generally by economic factors that negatively affect large-scale commercial forestry throughout the Southwest.

Commercial mining in the region began in the mid-1800's when mica deposits near Petaca were mined and split for window and stove glazing. By the late 1800s some gold, silver, and copper mining was taking place in the Tusas Mountains east of Tierra Amarilla in what became known as the Hopewell and Bromide mining districts. Ore bodies were limited, however, and mining tapered off quickly after the turn of the century. Quite a bit of prospecting has been undertaken for uranium in the Dakota and Chinle Formations between Abiquiu and Tierra Amarilla; and for copper in the area around Canjilon, but commercially viable quantities of ore have not been found. Sand and gravel extraction takes place periodically in alluvial areas.

Recreation

The Chama Valley has attracted hunters and fishermen, as well as hikers, other outdoor enthusiasts, and the occasional well-known artist, for decades. Not surprisingly, recreational use of the region continues to increase. Along the Wild and Scenic part of the Rio Chama, approximately 3000 people participated in BLM-permitted overnight river trips in 2003, as compared to less than 1,400 in 1996 – an increase of over 100 percent. For the 2003 river season over 1500 groups applied for about 300 available private launch dates, indicating that only about 20 percent of the people who wanted to float the Chama actually were able to. One-day river trips along the lower portion of the Wild and Scenic reach (below the Christ in the Desert Monastery) do not require a BLM permit and therefore are not tabulated, but BLM river recreation managers estimate double or triple the number of day users in that stretch as the permitted overnight use, suggesting 6,000 user-days for the overnight run and 6,000 to 9,000 user-days by boaters in the lower run, or a total of 12,000 to 15,000 user-days of boating visits by private, non-commercial boaters. The BLM restricts river access and launch opportunities, with private parties allocated 70 percent of the allowable launches and commercial outfitters allocat-

ed the remaining 30 percent. In recent years commercial outfitters have not filled their entire allocation because of low and unpredictable flows, but they have apparently used most of them and including commercial use, the total recreational boating use along the Rio Chama seems to be in the range of 17,000 to 22,000 user-days per year. River recreation use increased fairly steadily at 5 to 10 percent per year over the 1990's, and demand exists for a great deal more use if it were allowed. (BLM staff, personal communication, January 3, 1997, and April 8, 2004).

As with day-use boating, no statistics are kept on fishing use of the Rio Chama or its tributaries but use is substantial, especially in the upper reaches. The Corps of Engineers operates Abiquiu Reservoir and reports recreational use as visitor-hours, which are apparently not designed to be readily convertible to visitor-days. Since 1994, the visitor-hours reported for Abiquiu Reservoir have varied from 217,776 in FY 1997 (October 1996 through September 1997) to 820,934 in FY 2001. Even though the conversion is oversimplified, dividing these figures by 8 hours for an arbitrary visitor-day suggests a low of about 27,000 visitor-days for Abiquiu Reservoir in 1997, or perhaps over 100,000 visitor-days in 2001.

The Bureau of Reclamation operates El Vado and Heron Reservoirs, but recreational facilities are managed by the New Mexico Parks and Recreation Division. Ms. Connie Romero of the Division provided the following statistics on attendance at El Vado and Heron State Parks:

TABLE 1-1: VISITATION TO EL VADO AND HERON STATE PARKS

Reservoir/ Park	1999	2000	2001	2002	2003
El Vado	43,478	47,263	33,775	13,386	31,245
Heron	179,266	195,512	186,650	141,773	129,536

The town of Chama and the surrounding mountains attract a substantial winter industry of cross-country skiers and snowmobilers, as well as hunters in the autumn, and fishing and hiking participants in the rest of the year. The former Denver and Rio Grande Western railroad line has become a popular tourist attraction, the Cumbres and Toltec Scenic Railroad, that carries tourists in period steam trains between Chama and Antonito. The W. A.

Humphries State Wildlife Refuge is located just west of Chama.

In the village of Ojo Caliente, the hot springs along the Ojo Caliente River have attracted guests for decades. Recreational use of the BLM land near Ojo Caliente has increased considerably in the past few years and now includes a new bicycle/hiking/horseback trail, mountain bike races, and a commercial equestrian outfitter.

MAJOR SURFACE AND GROUND WATER SOURCES

The watershed of the Rio Chama and its tributaries define Planning Region 14, and hence are the only surface water sources present. The Rio Chama has 13 tributaries large enough to support any appreciable irrigated agriculture: Cañones Creek, the Rio Brazos, Rito de Tierra Amarilla, Rio Nutrias, Rio Cebolla, Rio Gallina, Rito de Canjilon, Rio Puerco de Chama, a second Cañones Creek, El Rito, Rio del Oso, Abiquiu Creek, and the Rio Ojo Caliente, which itself is fed by the Rio Vallecitos and the Rio Tusas. Willow Creek, although supporting little irrigation itself, assumed new importance after the San Juan-Chama Project since Heron Reservoir was constructed on Willow Creek immediately above its confluence with the Chama, and water from the San Juan drainage is diverted into Willow Creek via the Azotea Tunnel.

Ground water resources in the Rio Chama watershed are not as well explored as in most other parts of New Mexico because historic water use in the region has been much more oriented towards surface water. Lack of widespread dependence on ground water stems from several factors: there are no major urban areas within the planning region (Española is just outside it); agriculture and the entire community structure of the region have evolved over generations around the acequia system; and surface water resources are relatively more available than in much of New Mexico. However, even though most of the water diverted or intentionally consumed in the region is surface water (approximately 92 percent), the great majority of all households, institutions, and businesses derive domestic water from wells, either individually or through community water associations. Ground water accounts for approximately 90 percent of the water used for public and self-supplied domestic purposes. For that reason, communities

are highly dependent on their particular ground water sources. In some cases they are not plentiful, and in other cases they suffer from water quality problems.

DEMOGRAPHICS

According to the Census, the population of the planning region is considered “rural”, living in communities of less than 2500 residents. The 2000 census found a total of 41,190 persons living in Rio Arriba County. Census figures compiled along watershed boundary lines counted approximately 12,250 people in the Rio Chama water planning region in the 2000 census.

Population in the Rio Chama planning region grew by over 20 percent from 1990 to 2000, reflecting growth among long-time resident families, as well as retirement and migration from other states, spurred in part by proximity to Santa Fe, Los Alamos, and Española.

Population within the Rio Chama region was calculated by examining 2000 census block maps and then adding the population counts from tracts and blocks within the planning region. Because future population projections are uncertain and depend on social and economic conditions outside the region, both a low-range and higher, current-trends population projection were made for the period from 2000 to 2040. These projected populations (for both the CCDs and communities) were estimated using growth rates proposed by the Bureau of Business and Economic Research at the University of New Mexico (BBER), or actual growth rates observed over the past decade for different parts of the region, applied to the actual population counts developed from 2000 census data. Details of these projections can be found in the **WATER DEMAND** chapter.

The low range projected populations, presented in Table 1-2 below, are based on the BBER projected growth rates in a 2003 study that assumes a negative growth rate for communities distant from Española, and a positive but low growth rate for communities close to Española. The BBER projection presumably anticipates that lack of employment opportunities and distance from major urban areas or employment centers will cause a decline in the future population. The low-range projection suggests population trends dramatically different from recent experience, but is perhaps useful as an indication of what could happen given a significant economic downturn or severe lack of economic opportunity in the region.

The “current-trends” population projection in Table 1-2 assumes that the observed trends from 1990 to 2000 will continue through 2040, with a positive growth rate for the entire planning region. This scenario assumes that the region close to Española will continue to attract commuters from Española, Santa Fe, and Los Alamos, and that the commuting range may extend further north in the region. In addition, retirement in the region is anticipated to continue, and more rural areas may provide an attractive alternative to urban life. The current-trend projection utilizes the actual 1990-2000 growth rate for the Rio Chama, Tierra Amarilla, Vallecitos, and Coyote CCDs, which was 1.26 percent per year (BBER, 2003). For the area closer to Española (parts of the S. Rio Arriba and San Juan CCDs), the 1990-2000 growth rate of 2.13 percent per year was used for the projection.

In addition to the population projections done specifically for the Water Plan, the Rio Arriba County Planning Department has compiled population projections in the process of developing a county General Plan. County staff divided the county into watershed-based planning areas and aggregated population figures for groups of watersheds within the Rio Chama region as a whole. The County’s projection (which is the basis for their planning process) is somewhat higher than the current trends projection done for the water plan (26,150 residents in 2030 as compared to 22,278 in 2040). If the same overall regional growth rate projected from 2000 to 2030 were to continue to 2040, the total region population would be 32,529 people. County planning staff believe it is prudent to err on the side of caution, if anything, in planning for an adequate water supply as well as other infrastructure needs for future residents.

Table 1-2 shows 1990 and 2000 actual population for the region, based on census block maps, along with a comparison of the three projections for regional population in 2040.

TABLE 1-2: SUMMARY OF POPULATION PROJECTIONS

Census data		2040 Projections		
1990	2000	Low-range	Current trends	High range
10,170	12,247	11,218	22,278	32,529

Population in areas near Española has increased even more than predicted in the past by the Census Bureau and BBER. The Agua Sana Water Users' Association was formed in 1995 to construct a community water system for several communities along the Rio Chama from the Española city limits north about fifteen miles to the community of Rio Chama. This area includes a good portion of Hernandez, Salazar, Chili, and Chamita. In the process of planning the system, the Association commissioned an independent demographic study of the service area to accurately predict water demand. The study was performed by James D. Williams, PhD., of Williams Demographics in Las Cruces, and made an intensive count of both houses and inhabitants in the area (in Leedshill-Herkenhoff and Shomaker, 1996). While the Williams study found that the 1990 census tally for their area appeared to be largely correct, a much greater population growth had occurred since 1990 than the Census Bureau and BBER had predicted. The Agua Sana service area does not correspond neatly to CCDs, but is contained within portions of the Rio Chama, San Juan, and South Rio Arriba CCDs (Hernandez/Salazar, Chili, and Chamita). The Williams study reported that the 1990 census found 2,245 people in the Agua Sana service area, but by 1995 there were 4703 people in the same area – a growth of 109 percent in five years. According to Williams, the census population growth projection for the same period was 17 percent. Williams expects population in the Agua Sana service area to be approximately 9,000 people by 2035.

Regardless of precisely which growth rates occur in which particular communities over the next few decades, additional domestic and community water supplies will be

needed throughout the region. Even some of the most remote communities in the area have experienced population growth over the past decade, and failure to plan for and provide adequate drinking water will guarantee economic disadvantage, personal hardship, and declining population.

ECONOMIC CONDITIONS

It will surprise no one familiar with the area that Rio Arriba County, and the Rio Chama planning region within it, are not financially prosperous areas though they are culturally rich and geographically attractive. However the State of New Mexico as a whole is not financially affluent, and Rio Arriba County falls approximately in the mid-range of incomes within the state. Economic statistics are not readily available for the Rio Chama region, but conditions within the region are probably little different statistically from those in the county as a whole. Rio Arriba County ranks 18th (out of 33 counties in New Mexico) in per capita income: \$14,263 as compared to a state average of \$17,261 and a national average of \$21,587 (U.S. Census Bureau, web site database, 2000). Within the Rio Chama region, per capita income as reported on the U. S. Census Bureau's internet database (2000) varies from \$8,906 in the town of Vallecitos to \$15,337 in the town of La Madera. The relatively low figure in Vallecitos may be related to the difficulties in the declining timber industry. The reason for the high figure in the adjacent area of La Madera is not so readily apparent, although there are only about 75 people and 20 families in that area, so a single wealthy family or even individual could have a substantial effect on the average there. Table 1-3 shows

TABLE 1-3: ECONOMIC AND SOCIAL STATISTICS FOR NEW MEXICO, RIO ARRIBA COUNTY, AND FIVE PLANNING REGION CENSUS DISTRICTS

Description	State of New Mexico	Rio Arriba County	Coyote CCD	Rio Chama CCD	South Rio Arriba CCD	Tierra Amarilla CCD	Vallecitos CCD
Per capita income	\$17,261	\$14,263	\$12,302	\$15,601	\$15,445	\$16,490	\$12,886
Unemployment	4.4%	4.8%	3.4%	2.9%	5.9%	5.6%	3.6%
Individuals below poverty level	18.4%	20.3%	26.6%	12.9%	18.0%	17.1%	31.2%
High school graduates	70.5%	61.1%	67.1%	76.8%	50.1%	56.8%	61.5%
Persons enrolled in college	29.1%	23.4%	16.8%	33.2%	28.7%	17.8%	12.8%
Bachelors degree or higher	23.5%	15.4%	9.9%	21.0%	14.9%	17.0%	15.1%

Source: 2000 Census

per capita income for the State of New Mexico, Rio Arriba County, and the five census districts within the planning region.

Unemployment in Rio Arriba County is also higher than state and national averages: 4.8 percent in Rio Arriba County as compared to 4.4 percent in New Mexico and 3.7 percent nationally. That places Rio Arriba County 20th out of 33 counties in terms of employment (two other counties have the same unemployment rate as Rio Arriba County). Rio Arriba County is ranked 18th out of 33 counties in terms of per capita income. The fraction of the population living below the federally defined poverty line in Rio Arriba County is 20.3 percent, compared to 18.4 percent for New Mexico and 12.4 percent nationally (Census Bureau, internet database, 2002).

Although there are fewer college graduates in Rio Arriba (15.4 percent of the population) than the state average (23.5 percent), the percentage of high-school graduates in the population is only slightly lower than the state as a whole. Rio Arriba County has a lower high school dropout rate than the state, and the Chama Valley's reported dropout rate of 1.8 percent compares very favorably to the New Mexico average of 8.2 percent (NMDOH, 1996).

While northern New Mexico in general, as well as the Rio Chama region, have been seriously affected by the decline of agricultural income and economic disadvantages of rural life in twentieth century America, it is rebounding. Specialty agricultural enterprises have emerged, including Christmas tree farms, herb and vegetable growers, and the Ganados del Valle and Tierra

Wools enterprises in Los Ojos. Tourism and recreation are important activities in parts of the region, as discussed previously. Northern New Mexico Community College, Highlands University, Los Alamos National Laboratory, Department of Energy, and other institutions have collaborated in various ways (such as training and economic development programs) to make use of traditional skills and to develop new skills and opportunities in emerging technologies. We are actively preparing for the future.

LAND OWNERSHIP AND USE

According to figures supplied by the Geographic Science Center in the state office of the Bureau of Land Management, there are 1,944,530 acres in the Rio Chama watershed within New Mexico. The Santa Fe and Carson National Forests combined comprise 961,662 acres of this, or 49.45 percent. The next largest category is private land, at 545,780 acres or 28.07 percent. Indian tribes control 210,007 acres, including recent purchases of formerly private ranches by the Jicarilla Apache tribe, for 10.80 percent of the total. The State of New Mexico owns 115,196 acres (state trust land, state parks, and wildlife areas combined), 5.93 percent of the basin. The Bureau of Land Management holds title to 111,885 acres, or 5.75 percent.

It is interesting to note that the approximately 30,000 acres of irrigated land in the watershed, all located along the alluvial valley bottoms, represents only 5.4% of the total *private* land in the Rio Chama watershed – a tiny ribbon of green that supports virtually all the settlement in the region.

HISTORIC OVERVIEW OF WATER USE IN THE REGION

The beginnings of irrigated agriculture in the Rio Chama region are not known with certainty. In fact, some aspects of the early history of farming and water use in the valley are under litigation as this is written, since water rights in the Rio Chama are currently subject to an adjudication suit. In the process of adjudication the priority date, or the date at which water was first diverted from the river for irrigation, is one aspect of the right to water that must be decided in court. Accordingly, considerable historical research has focused on the development of irrigation and farming in the region. The Spanish acequia irrigation system spread up the Rio

Chama area from Juan de Oñate's original settlement at San Gabriel near the confluence of the Rio Chama and Rio Grande. One historian, John O. Baxter, argues that the furthest downstream of the existing Chama ditches date from around 1714 (Baxter, 1994), while another historian, Stanley Hordes, has produced evidence that the earliest of these ditches – now known as the Chamita, Salazar, and Hernandez ditches – were actually begun shortly after Oñate's settlement in 1598 and thus have been in more or less continuous use since about 1600 (Hordes, 1996).

Whether the oldest surviving acequias date from the early seventeenth or the early eighteenth centuries, settlement and irrigation proceeded rapidly up the Chama valley in the eighteenth century, with a number of acequias between Hernandez and Abiquiu constructed in the 1720's or 1730's. By the late 1700's the basic irrigation pattern of the lower valley was probably much as it remains today.

Settlement upstream of the Abiquiu area apparently went a little slower. The area above the present Abiquiu Reservoir has not been as intensively researched in connection with the adjudication proceedings, although a historian for that area has been appointed by the court. The Tierra Amarilla land grant was made by the Mexican government in 1832 (DeBuys, 1985), and ushered in the era of permanent settlement and agricultural development of the upper Chama valley. While some settlement undoubtedly existed upstream of the canyon that has now been designated the Wild and Scenic portion of the river prior

to the land grant, major irrigation development probably took place after the grant.

While there are anecdotal references to areas that have gone permanently out of irrigation (Baxter, 1994), they are quite small if actually extant, and the acreage of irrigated land in Rio Arriba County, and thus apparently in the Chama valley, has remained essentially constant at least since the New Mexico Agricultural Statistics Service began publishing reports of irrigated acreage in the 1970's (USDA/NMASS, New Mexico Agricultural Statistics series). The New Mexico State Engineer series of technical reports estimating water use in the state by county every five years reported declining total withdrawals for irrigation in Rio Arriba County in the period from 1975 to 1990, but the figures for depletions do not show a similar trend, and have in fact increased since 1990. The need exists for more water: most importantly, to ease the chronic summer shortages that plague much of the region, and to expand irrigated acreage if possible.

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