12.8. WATER USE

12.8.1. Introduction

How water is used is in great part framed by how water has been used in the past as well as being a response to the topography and climate. Comparing supply with use, or demand, gives a water budget of inflows and outflows. The challenge is the lack of specific data. As John Shomaker wrote in his study,

> This report does not intend to imply that water demand within the Río Puerco and Río Jemez subregions is unimportant with respect to the Middle Río Grande Valley subregion, which contains New Mexico's largest metropolitan area, as well as the productive agricultural zone located within the Río Grande floodplain. Part of the reason why the Río Puerco and Río Jemez subregions are less populated and less extensively farmed may be because surface- and ground water are, and historically have been, relatively scarce when compared to the water supplies of the Middle Río Grande Valley. For example, the Río Jemez has "no flow for many days" beneath the Río Jemez Canyon Dam, and the Río Puerco has, "no flow for many days," to, "no flow for extended periods," along most of its length (Waltemeyer, 1989). *Therefore, a thorough understanding of those subregions' water use and demand remains extremely important, especially if they are experiencing growth*. (Shomaker 2000, emphasis added)

Water administration affects how water is used and is discussed in Section 11, Issues and Constraints.

12.8.2. Water Usage

12.8.2.1. Data Sets

An attempt has been made to collect and set out data from various sources. Some of it may seem contradictory, but may well represent collection for different purposes or from different points. Every five years, the New Mexico Office of the State Engineer (NMOSE) publishes water uses for nine categories. These include irrigated agriculture, livestock, public supplied water, reservoir evaporation and the self-supplied categories of domestic, commercial, industrial, mining, and power. Shomaker notes that for the years 1975, 1980, and 1985, withdrawal and consumptive use data for self-supplied categories was available only by county. However, the NMOSE meter record database for 1990 and 1995 included the addresses of the individual water users (not including domestic), allowing withdrawals to be subdivided into the appropriate subregions (see Appendix in Shomaker and further information in appendices to this chapter). Use was made of the NMOSE work sheets for 2000 usage. The data from the NMOSE does not include riparian usage, nor open water evaporation unless from a reservoir. USGS reports water usage for the Río Puerco and Río Jemez for 1990. Bureau of Reclamation includes a portion of the Río Jemez in the ET Toolbox. While every attempt has been made to ensure accuracy, better data will certainly assist future planners.

Of note is the questionnaire sent out to obtain information from water providers in the area. The form and responses are included in the appendices.

12.8.2.2. Terms

See the Glossary for terms such as withdrawal, depletion, return flow. For further information, check out Section 12.14 Bibliography, as well as the appendices.

12.8.2.3. NMOSE Consumptive Water Uses

In the Regional Water Planning Handbook, consumptive use (evapotranspiration) is defined as the "quantity of water used in a given area in transpiration, building of plant tissue, and evaporated from adjacent soil, water surface, snow or intercepted precipitation in a specific period of time."

Consumptive water uses include *evapotranspiration* by irrigated crops and riparian species; open water evaporation from the river, conveyance channels and reservoirs; and consumption of water for domestic, municipal and industrial use. Data sets for these consumptive uses have been obtained from sources described below.

New users include encroaching non-native species such as salt cedar and Russian olive, and providing water for endangered species.

> Santa Ana Pueblo and the OSE/ISC have reached agreement regarding the storage of native water within Tamaya Reservoir (formerly Jemez Reservoir) to provide water for the Río Grande Silvery Minnow. (Special Assistant on Indian Water Resources Río Grande Basin Issues, Office of State Engineer's 2000 - 2001 Annual Report)

12.8.3. Río Jemez

> Riparian vegetation and irrigated agriculture constitute the largest consumptive uses in Sandoval County. However, the withdrawals and consumptive uses for public water supply have been steadily increasing since 1975, due to the increasing population of towns like Rio Rancho and Bernalillo. Industrial use has also increased due to Intel Corporation, currently the largest single self-supplied water user. (Shomaker 2000)

As noted above, the NMOSE classifies water use in nine categories. Major water uses include the public, irrigation, and reservoir evaporation. Self-supplied power has no water use recorded in the basin. In 1995, referring to NMOSE data, Shomaker reported that public water suppliers withdrew about 126 acre-feet in the Río Jemez subregion. Irrigated agriculture accounted for a withdrawal of 4,610 acre-feet. (85) In 2000, withdrawals for public and domestic water supplied equaled 466 acre feet, with 341 acre feet considered depleted. In 2000, agriculture withdrew

4,566 acre feet and depleted 1,821. Riparian usage and open water evaporation, reported by the Bureau of Reclamation, amounted to 8,068 acre feet depletion. Reservoir evaporation that year amounted to 5,863 acre feet, although the Jemez Reservoir currently is dry. The major water users -- riparian and open water, reservoir and agriculture-- account for approximately 93% of the water consumed in the basin.

12.8.3.1. Public and Domestic Water Supply

Public water suppliers within the Río Jemez subregion include Jemez Springs, San Ysidro, Cañon and Ponderosa. The 2000 population served was 1,215, out of a total of 4,073. Jemez Springs Mutual Domestic Water Consumers' Association (MDWCA) and Ponderosa MDWCA withdraw water from springs. Shomaker followed the convention of the NMOSE to consider spring flow as surface water, even though it is clear that the source of the springs is ground water. (Shomaker 15) In Shomaker Appendix 4, Public Water Systems, a list of Community Water Systems reported by the EPA together with the population served, includes Cañon (420), Jemez Pueblo (3,000), Ponderosa MDWCA (300), San Ysidro (300) and Zia Pueblo (750). (Note**:** There seem to be several other Mutual Domestics not mentioned in Wilson's data.)

Table 12.8-1 Surface Water Use for Public Supply, Río Jemez, 1970 to 1995

Public Supply	Jemez Springs	Ponderosa		Public Supply	Jemez Springs	Ponderosa
1970				**1990**		
population	356			population	413	500
gallons per capita per day				gallons per capita per day	139	45
af withdrawn	27.96			af withdrawn	64.16	25.05
af depleted				af depleted	30.8	12.52
1980				**1995**		
population	316	300		population	516	320
gallons per capita per day	138	45		gallons per capita per day	161	91
af withdrawn	49	15		af withdrawn	93.25	32.7
af depleted	24	8		af depleted	44.76	16.35
1985						
population	316	500				
gallons per capita per day	138	60				
af withdrawn	49	34				
af depleted						

Source: Shomaker, Appendix Public Water Supply & Self-Supplied Domestic

Table 12.8-2 Summary of Public Water Use in Río Jemez, 2000 (acre-feet)

USER	POP	GPCD	WSW	WGW	SEWAGE	DFSW	DFGW	DSW	DGW
Cañon MDWUA	250	129	0.00	36.14	0.00	0.00	0.50	0.00	18.07
Jemez Springs Water Co-Op	375	239	100.50	0.00	70.57	0.30	0.00	30.15	0.00
Ponderosa MDWCA	350	84	32.77	0.00	0.00	0.50	0.00	16.39	0.00
San Ysidro	240	149	0.00	40.07	0.00	0.00	0.50	0.00	20.03
Total	**1,215**		**133.27**	**76.21**				**46.54**	**38.10**

Key: WSW=withdrawal, surface water; WGW=withdrawal, ground water; DFSW=depletion factor, surface water; DFGW=depletion factor, ground water; DSW=depletion, surface water; DGW=depletion, ground water.
Source: Wilson 2003.

In addition to public water suppliers, approximately two-thirds of the watershed's residents (2,858, see assumptions at end of chapter) obtain water from private wells, otherwise known as self-supplied domestic water.

12.8.3.2. Irrigated Agriculture

Irrigation in the region has been practiced for at least the past 1,000 years. More information about land usage can be found in Section 12.5 Land Use. Again, different sources show somewhat different data for different users. In 1987, 1,233 acres were reported to be served by *acequias*, or community irrigation ditches. Applying a consumptive use of 2 acre feet per acre, the estimated consumption equaled 2,447 acre feet. (Shomaker 61, and Appendix 7, citing Saavedra, 1987). In 1988, Shomaker reports irrigable acreage of Jemez Pueblo to be 1,828 acres, of which 301 were irrigated. In 2000, 1,655 acres were irrigated, of which 1,585 utilized surface water (Wilson 2003). In a recent proposal by the Pueblo of Jemez, it was stated that "the land use consists of 2,100 acres irrigated cropland, 6,500 acres grazing land and 21,900 acres of mountain mixed conifer." (Environmental Assessment of Environmental Quality Incentives Program for Pueblo of Jemez Tribal Trust Lands GPA 2002.)[1]

Table 12.8-3 Río Jemez Basin Irrigated Agriculture (acre feet)

	1985	1990	1993	1994	1995
Irrigated Acres	1,933	1,700	1,570	1,570	1,600
Withdrawals	6,086	6,314	8,424	6,653	7,580
Depletions		1,752	3,385	2,673	3,045

Source Shomaker Appendix; Wilson 1992 Tables 8 & 9

Table 12.8-4 Río Jemez Basin Irrigated Acreage

1970		1975		1980		1985		1990	
Irrigated acreage	acres irrigated	Irrigated acreage	acres irrigated	Irrigated acreage	acres irrigated	Irrigated acreage	acres irrigated	Irrigated acreage	acres irrigated
2,480	1,252	2,655	1,340	3,410	1,683	3,600	1,933	3,600	1,700

Note: Irrigated acreage includes idle and fallow land
Source: Shomaker Appendix, citing Middle Río Grande Assessment Documents

On December 1, 2000, a Partial Final Judgment and Decree on Non-Pueblo, Non-Federal Proprietary Water Rights in the Jemez River Stream System was entered. Discussed further below, this adjudication established the rights to water available to be diverted or impounded and to beneficially use the public surface and underground waters. Remaining substantive claims

[1] Presumably the recreational and entertainment attractions at Pueblo of Santa Ana --including the Santa Ana Star Casino, the Prairie Star Restaurant, two golf courses, a 22-field soccer complex, and the Tamaya Hyatt resort-- utilize water from the Río Jemez system, but the use and impact are not mentioned. Likewise, results from impact on the Río Jemez from groundwater pumping by Rio Rancho are not readily available.

have yet to be settled. (U*nited States et al. v. Abousleman, et al; Jemez River Adjudication*, United States District Court CIV. NO. 83-1041 JC)

Table 12.8-5 Río Jemez Acequias Irrigated Acreage and Consumptive Use, 1987

Ditch	Acres Irrigated	Consumptive Use, acre feet
Ponderosa Community	319.1	638.2
San Ysidro	484.5	969
Cañon Community	192.5	385
East Lateral	10.6	21.2
West Side	9.12	18.24
Jemez Springs	43.9	87.8
South Upper	15.6	31.2
West	9.8	19.6
Upper West	54.3	108.6
La Cueva	53.4	106.8
East and West Sandoval Ditch	30.5	61
Totals	**1,223.32**	**2,446.64**

Source: Shomaker Appendix 7, citing Saavedra, 1987

12.8.3.3. Riparian and Open Water Evaporation

Other major categories of water users are riparian vegetation along streams, open water evaporation and reservoir evaporation. All are dependent upon water availability. The Jemez Reservoir is completely dry at this time.[2]

Table 12.8-6 Río Jemez Riparian Acreage & Consumptive Use, and Open Water Acreage

	acres	acre feet
Average riparian vegetation consumptive use in Río Jemez (1935 - 1994)[1]		11,500
Río Jemez River Riparian Acreage & Consumptive Use (Average from 1985 - 1998)[2]	1,971	9,624
Open Water acreage[3]	1,260.10	
Riparian acreage (Includes Bosque)[3]	710.7	
Total URGWOM Water Use in 2000[3]		8,068.40

Sources: Shomaker Table 28, citing Kinkel, 1995a; Papadopulos Table 3.7 & 3.8; ET Toolbox; URGWOM Reach 2 (Río Jemez River) , Vegetation classification: Land Use Trend Analysis 1992/93

[2] The Jemez Canyon Dam and Reservoir Project was authorized by the Flood Control Acts of 1948 (P.L. 80-858) and 1950 (P.L. 81-516) for flood damage reduction and sediment retention. Construction of the dam began May 1950 and the facility was completed and placed into operation in October 1953. All lands associated with Project (approx. 6,711 ac.) are held in trust by the United States for the benefit and use of the Pueblo of Santa Ana.

12.8.3.4. Computed Water Use

Shomaker reported that in 1985, Río Jemez basin withdrawals were 7,092 from surface water sources and 219 acre feet from ground water (Shomaker Appendix, citing OSE). As noted above, data for the subregions are incomplete. Self-supplied domestic usage and livestock usage, for example, is reported on a county-wide basis by NMOSE. The USGS has compiled a water use budget for the Río Jemez basin for 1990, though it lacks riparian usage.

Table 12.8-7 Open Water Evaporation (acre feet)

	1990	1995	2000
Río Jemez Canyon Reservoir	5,238	7,990	5,863

Sources: Shomaker Appendix, citing OSE; 2000 data from Wilson 2003
Note that the USGS reports 1990 evaporation to equal 5,870 acre feet, below.

Table 12.8-8 1990 Water Use for Río Jemez (acre feet)

Category	Surface Water Withdrawals	Ground Water Withdrawals	Total Withdrawals	Consumptive use, total	Conveyance losses	Returns
4,250 total population						
Domestic Self Supplied - 3,340 population		313.64	313.64	179.22		
Per-capita use = 83.33 gal/d						
Public Supply - 910 population served[1]	67.21		67.21			
Per-capita use = 65.93 gal/day						
Returns by public wastewater facilities[2]						33.60
Commercial, self supplied	11.20	78.41	89.61	44.81		
public supplied	22.40		22.40			
Per-capita use with commercial = 87.91/d						
Industrial	0.00	0.00	0.00	0.00		
Mining use		123.22	123.22	89.61		
Livestock (stock) use	33.60	100.810	134.42	134.42		
Irrigation use for 1,700 acres	6,306.40		6,306.40	2,531.52	1,893.04	
Reservoir evaporation	5,869.55		5,869.55			
Reservoir surface area = 1,130 acres						
Totals	**12,310.36**	**616.08**	**12,926.44**	**2,979.58**	**1,893.04**	**33.60**

Source: http://water.usgs.gov/cgi-bin/wuhuc?huc=13020202
[1]Number of facilities = 5 [2]Number of wastewater facilities, total = 3

With the caveat that several assumptions were made, which can be found at the end of this section, the following chart includes all water uses reported in 2000:

Table 12.8-9 Summary of Water Use in Río Jemez Watershed, 2000 (acre feet)

Category	Withdrawal Surface Water	Withdrawal Ground Water	Total Withdrawal	Depletion Surface Water	Depletion Ground Water	Total Depletion	Return Surface Flow	Return Ground Flow	Total Return Flow
public	133.27	76.21	209.48	46.54	38.10	84.64	86.73	38.11	124.84
domestic	0.00	258.62	258.62	0.00	258.62	258.62	0.00	0.00	0.00
commercial	10.00	67.99	77.99	10.00	67.99	77.99	0.00	0.00	0.00
industrial	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
mining	0.00	3.00	3.00	0.00	3.00	3.00	0.00	0.00	0.00
livestock	15.27	148.22	163.49	15.27	148.22	163.49	0.00	0.00	0.00
power	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
agriculture	4,429.00	137.00	4,566.00	1,749.00	72.00	1,821.00	2,680.00	65.00	2,745.00
Río Jemez reservoir	5,863.00	0.00	5,863.00	5,863.00	0.00	5,863.00	0.00	0.00	0.00
riparian & open water*	8,068.40	0.00	8,068.00	8,068.40	0.00	8,068.40	0.00	0.00	0.00
Totals	**18,518.94**	**691.04**	**19,209.58**	**15,752.21**	**587.93**	**16,340.14**	**2,766.73**	**103.11**	**2,869.84**

Source: Except for *, comes from Wilson 2003. * comes from the ET Toolbox

Figure 12.8-1 Río Jemez Withdrawals, 2000

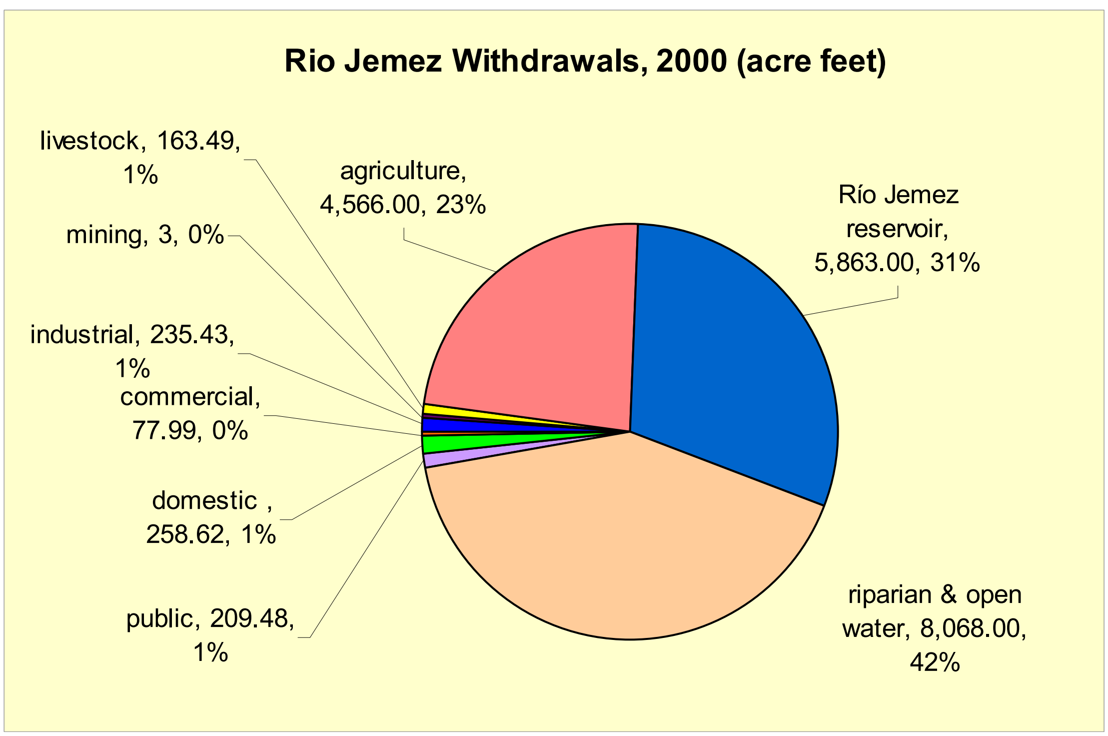
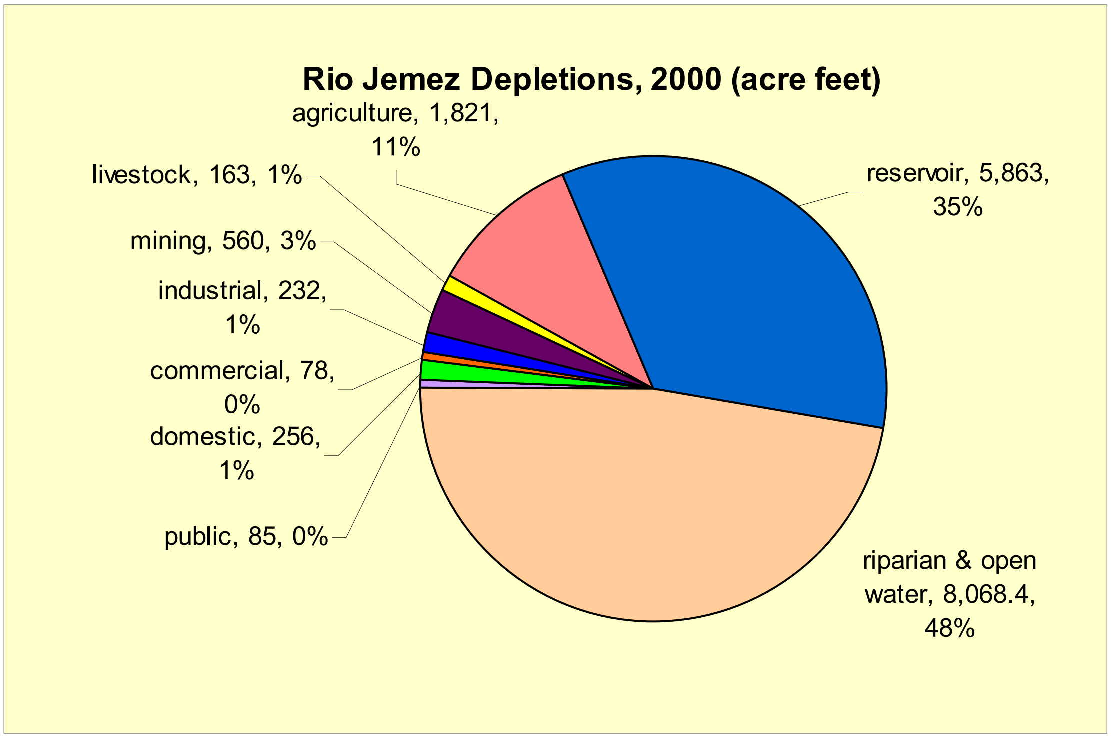


Figure 12.8-2 Río Jemez Depletions, 2000



12.8.3.5. Water Use in Río Jemez Watershed According to FWUP

As also mentioned in Section 12.10 Quantifying Future Water Demand, one of the regional water planning products is the Future Water Use Projections for the Middle Río Grande Water Planning Region (FWUP) produced by the Mid-Region Council of Governments (MRCOG) in January 2002. MRCOG prepared a regional land-use map with 18 land-use categories. Using Shomaker's water use categories, as reported in Historical and Current Water Use in the Middle Río Grande Region (2000), for the year 1995, water withdrawal and depletions coefficients were derived for the land use categories. Table 12.8-10 includes the areas of existing land uses and water withdrawals for the Río Jemez.

The report does note the discrepancy in irrigated acreage between that reported by Shomaker, using a 1987 report, and that derived from the MRCOG land-use map. The latter is nearly half. "Shomaker reported acreages of 1,223 . . .for irrigated agriculture in the Río Jemez . . . subregion. The discrepancy could be due to errors in the Middle Río Grande Council of Government's existing land-use map, or it could be that irrigated acreage in the Río Jemez and Río Puerco subregions has decreased since the State Engineer collected data for the report it published in 1987." Yet in the 1990 Water Use Report published by the State Engineer in July 1992, the acreage is mentioned to be 1,700. The updated report by the NMOSE published in 2003 said that 1,655 acres were irrigated, of which 1,585 utilized surface water.[3] Of note,

[3] Such discrepancies suggest that the figures used for the other land use categories and the calculated coefficients may also be inexact.

FWUP reports riparian usage to be nearly 25,000 acre feet, or double what the ET Toolbox reported.

Table 12.8-10 Summary of Water use (in acre-feet) in Río Jemez Watershed from FWUP, 2000

Category	Land Use in Río Jemez in 2000 (acres)	Adjusted Withdrawal Coeff. (gpa/d)	Calculated Withdrawals in 2000 (ac-ft/year)	Adjusted Depletion Coeff. (gpa/d)	Calculated Depletions (ac-ft/year)
Residential - Single Family	1,400	1,026	1,609	559	877
Multi-Family Residential	0	2,372	0	850	0
Major Retail Commercial	0	1,967	0	1,361	0
Mixed and Minor Commercial	131	1,967	289	1,361	200
Office	0	1,967	0	1,361	0
Industrial/Wholesale	80	623	56	431	39
Institutions	109	685	84	474	58
Schools/Universities	10	685	8	474	5
Airports	0	685	0	474	0
Transportation/Utilities	8	685	6	474	4
Agriculture - Irrigated	586	6,709	4,404	2,227	1,462
Rangeland/Dry Agriculture	432,055	0	0	0	0
Major Open Space & Parks (w. water use)	0	685	0	474	0
Major Open Space & Parks (no water use)	207,724	0	0	0	0
Natural Drainage/Riparian	7,012	3,109	24,419	3,109	24,419
Urban Vacant/Abandoned	98	0	0	0	0
Landfills/Sewage Treatment	8	685	6	474	4
Other Urban Non-residential	19	685	15	474	10
	649,240		**30,895**		**27,078**

Source: Future Water Use Projections - Tables 3, 8 and 17, MRGCOG

12.8.4. Río Puerco

As noted above, the NMOSE classifies water use in nine categories. Major water uses include the public, irrigation, and riparian evapotranspiration. Self-supplied power has no water use recorded in the basin. In 1995, referring to NMOSE data, Shomaker reported that public water suppliers withdrew about 231 acre-feet in the Río Puerco subregion. Irrigated agriculture accounted for a withdrawal of 7,580 acre-feet (85.) In 2000, withdrawals for public and domestic water supplied equaled 470 acre feet, livestock 548.87,and agriculture 6,384.81 of which 3,013.18 was consumed. No riparian usage data was available.

12.8.4.1. Public and Domestic Water Supply

Public water suppliers within the Río Puerco subregion include Cuba, La Jara and Regina MDWCA. In Appendix 4, Public Water Systems, of the Shomaker study, a list of Community

Water Systems reported by the EPA, together with the population served, includes Cuba (765), La Jara (536), and Regina MDWCA (510).

Table 12.8-11 Summary of Public Water Supply in Río Puerco, 1970-1985

Public Supply	Cuba	La Jara		Public Supply	Cuba	La Jara	Regina
1970				**1990**			
population	1500			population	760		300
gallons per capita per day				gallons per capita per day	260		60
af withdrawn	193.56			af withdrawn	221.24		20.32
af depleted				af depleted	110.62		10.16
1980				**1995**			
population	609	410		population	726		489
gallons per capita per day	154	45		gallons per capita per day	248		53
af withdrawn	105	21		af withdrawn	202		28.9
af depleted	52	10		af depleted	101		14.45
1985							
population	609	494					
gallons per capita per day	227	60					
af withdrawn	155	33					
af depleted							

Source: Shomaker, Appendix Public Water Supply & Self-Supplied Domestic

Table 12.8-12 Summary of Public Water Supply in Río Puerco, 1965-1999

subregions	1965 (ac-ft)	1970 (ac-ft)	1980 (ac-ft)	1985 (ac-ft)	1990 (ac-ft)	1995 (ac-ft)	1999 (ac-ft)
Cuba	39	194	105	155	221	202	151
La Jara			21a	33			
Regina					20	29	
Río Puerco Subregion total	39	194	126	188	241	231	151

Source: Shomaker Appendix 1

Table 12.8-13 Summary of Public Water Use in Río Puerco, 2000 (acre feet)

	POP	GPCD	WSW	WGW	SEWAGE	DFSW	DFGW	DSW	DGW
Cuba Water System	765	127	0.00	108.78	15.60	0.00	0.50	0.00	54.39
La Jara	350	44	17.30	0.00	0.00	0.50	0.50	8.65	0.00
Regina MDWCA	500	44	0.00	24.90	0.00	0.00	0.50	0.00	12.45
Totals	**1615**		**17.30**	**133.68**				**8.65**	**66.84**

Key: WSW=withdrawal, surface water; WGW=withdrawal, ground water; DFSW=depletion factor, surface water; DFGW=depletion factor, ground water; DSW=depletion, surface water; GW=depletion, ground water.
Source: Wilson 2003.

In addition to public water suppliers, approximately two-thirds of the watershed's residents [2,858 - see assumptions at end of section] obtain water from private wells, otherwise known as self-supplied domestic water.

12.8.4.2. Irrigated Agriculture

As discussed more fully in Section 12.3 and in a subsequent subsection below, irrigation in the upper Puerco valley has been in existence for centuries. Settlers instituted an *acequia* system, and there are several ditches still in use today. In 1987, 3,267 acres were reported to be served by *acequias*. Applying a consumptive use of 2 acre feet per acre, the estimated consumption equaled 6,533 acre feet (Shomaker, 61, and Appendix 7, citing Saavedra, 1987). In 1990, 1,590 acres were reported as irrigated (Wilson 1992) and in 2000, 2,040 acres were reported as irrigated (Wilson 2003). Again, different sources show somewhat different data.

Table 12.8-14 Río Puerco Irrigated Acreage and Acres Irrigated

Year	Irrigated acreage	Acres Irrigated		Year	Irrigated acreage	Acres Irrigated
1935	1,863	1,317		1965	1,585	1,120
1940	1,815	1,282		1970	1,481	1,048
1945	1,598	1,129		1975	1,585	1,120
1950	1,582	1,118		1980	2,040	1,407
1955	1,582	1,118		1985	2,150	1,616
1960	1,582	1,118		1990	2,150	1,590

Note: Irrigated acreage includes idle and fallow land
Source: Shomaker Appendix on Irrigated Agriculture

On December 1, 2000, a Partial Final Judgment and Decree on Non-Pueblo, Non-federal Proprietary Water Rights in the Jemez River Stream System was entered. Discussed further below, this adjudication established the rights to water available to be diverted or impounded and to beneficially use the public surface and underground waters, including the Nacimiento Ditch, some of which headwaters come from the Río Jemez. The Nacimiento Ditch in turn includes several sub-ditches. [4] The Nacimiento's acreage has been adjudicated to be 715.62. La Jara claims to irrigate 1,610 acres (La Jara Geographical Priority Area Application, 2002).

[4] Transbasin Diversion: (1) Clear Creek, a tributary of the Rio de las Vacas and (2) Rio de las Vacas, a tributary of the Rio Guadalupe, which is a tributary of the Jemez River. (Clear Creek and the Rio de las Vacas are the sources for the transbasin diversion.) A ditch that diverts surface water from Clear Creek and a ditch that diverts water from the Rio la Vacas. Nerio Montoya diverts from the Nacimiento Creek, which is a tributary of the Rio Puerco. Comments: The Nacimiento Community Ditch Association (NCDA) may divert water from the Jemez Basin no more than 2,332.92 acre-feet per annum, as measured at the BIA gauge, so long as that amount does not violate the 1,335 acre-feet six-year rolling average. For complete details on the amount of water see Consent Order filed May 4, 2000 (Docket No. 3919). Note NCDA includes the following ditches: Domingo Vigil, Nerio Montoya, Francisco Chavez # 6, Gabriel Montoya # 7, Nacimiento, Ballejos # 1, Copper City and Madalena Atencio # 2 (U*nited States, et al. v. Abousleman, et al; Jemez River Adjudication*, United States District Court CIV. NO. 83-1041 JC)

Table 12.8-15 Río Puerco Acequias Irrigated Acreage and Consumptive Use, 1987

Ditch	Acres Irrigated	Consumptive Use, acre feet
Nacimiento Community Ditch	713.50	1,427
Acequia de La Jara	1,400	2,800
Los Pinos Community	397	794
Acequia de Los Utes	40	80
Garcia-Lucero	400	800
Lagunitas Ditch	92	184
Vallecitos Ditch	117	234
Río Puerco	100	200
Ortiz	7	14
Totals	**3,266.50**	**6,533**

Source: Shomaker, Appendix 7, citing Saavedra, 1987

12.8.4.3. Riparian and Open Water Evaporation

Other major categories of water users are riparian vegetation along streams and open water evaporation. All are dependent upon water availability. Data was not available for riparian consumption in the Río Puerco, but as shown in Figure 12.8-3, same is a usage.

Figure 12.8-3 Riparian Vegetation

Source: Río Puerco near Bernardo, *Papadopulos Water Supply Study*, 2000.

12.8.4.4. Computed Water Use

As noted above, data for the subregions is incomplete, with the Río Puerco being less complete of the two. Self-supplied domestic usage and livestock usage, for example, is reported on a county-wide basis by NMOSE. The USGS has compiled a water use budget for the Río Jemez basin for 1990, though it lacks riparian usage.

Table 12.8-16 1990 Water Use for Río Puerco (acre feet)

Category	Surface-Water Withdrawals	Ground Water Withdrawals	Total Withdrawals	Consumptive use, total	Conveyance losses	Returns
Population, 3,500						
Domestic, self-supplied - 2,440 population	0	224.03	224.03	235.23		
Per-capita use = 81.97 gal/d						
Public Supply - 1,060 population served[1]	0	246.43	246.43			
Per-capita use = 207.55 gal/d						
Returns by public wastewater facilities[2]						44.81
Commercial	0	0	0	0		
Industrial	0	0	0	0		
Mining		11.2		11.2		
Livestock	44.81	504.06	548.87	515.27		
Irrigation[3]	5,063.04	1,321.77	6,384.81	3,013.18	1,478.59	
Totals	**5,107.85**	**2,307.49**	**7,404.14**	**3,774.88**	**1,478.59**	**44.81**

Source: USGS, http://water.usgs.gov/cgi-bin/wuhuc?huc=13020204
[1]Number of facilities = 3 [2]Number of public wastewater facilities = 1
[3] Irrigated land = 2,040 acres (sprayed = 200 acres; flooded = 1,840 acres)

With the caveat that several assumptions were made, which can be found at the end of this section, the following chart attempts to include all reported water uses in 2000:

Table 12.8-17 Summary of Water Use in the Río Puerco Watershed, 2000 (acre feet)

Category	Withdrawal Surface Water	Withdrawal Ground Water	Total Withdrawal	Depletion Surface Water	Depletion Ground Water	Total Depletion	Return Surface Flow	Return Ground Flow	Total Return Flow
public	17.30	133.68	150.98	8.65	66.84	75.49	8.65	66.84	75.49
domestic	0.00	256.08	256.08	0.00	256.08	256.08	0.00	0.00	0.00
commercial	0.00	3.54	3.54	0.00	3.54	3.54	0.00	0.00	0.00
industrial	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mining	0.00	1.40	1.40	0.00	1.40	1.40	0.00	0.00	0.00
livestock	303.64	31.29	334.93	303.64	31.29	334.93	0.00	0.00	0.00
agriculture	5,733.00	0.00	5,733.00	2,303.00	0.00	2,303.00	3,430.00	0.00	3,430.00
riparian ?									
Totals	**6,036.64**	**422.45**	**6,479.93**	**2,606.64**	**355.61**	**2,974.44**	**3,438.65**	**66.84**	**3,505.49**

Source: Wilson 2003

Figure 12.8-4 Río Puerco Withdrawals, 2000

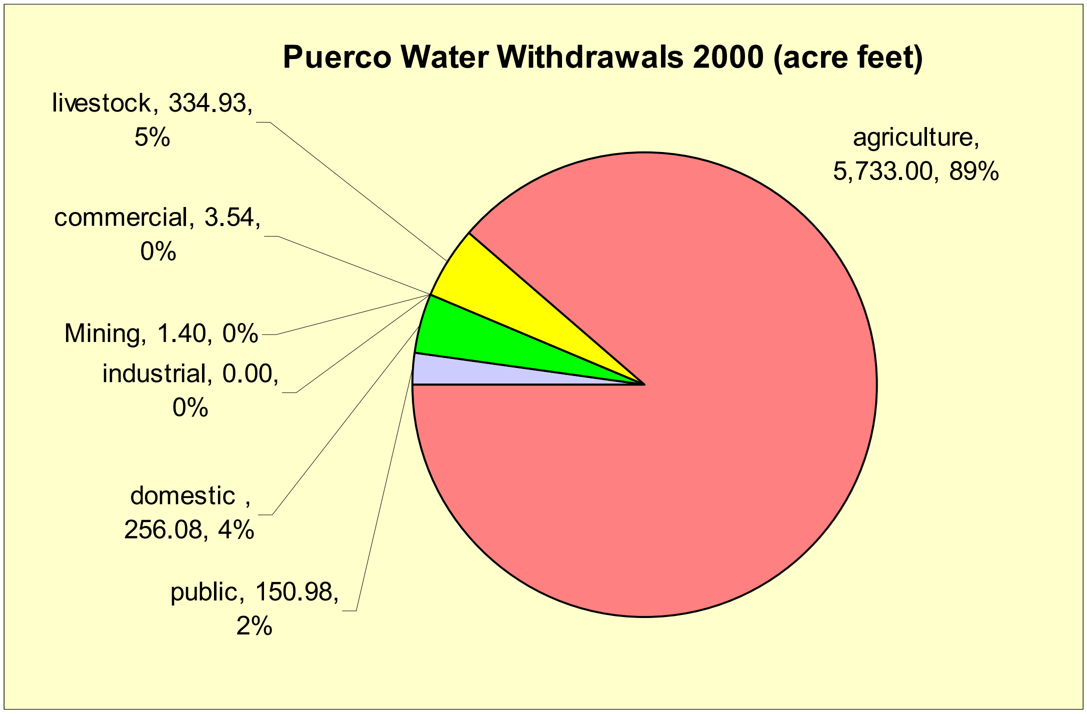
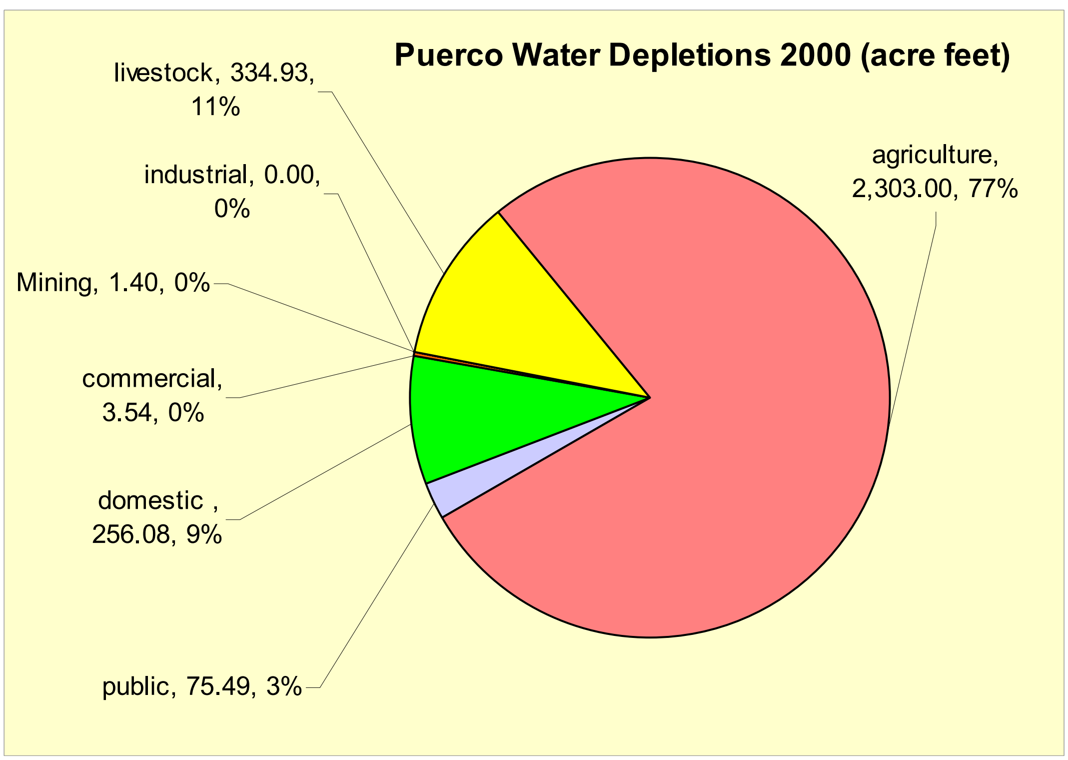


Figure 12.8-5 Río Puerco Depletions, 2000



For comparison, following are charts of Río Jemez water withdrawals and depletions without riparian and open water, and reservoir evaporation. While agricultural water usage is 10% of the overall usage, it is well over 50% if riparian and open water (47%) and reservoir (34%) evaporation are removed. Knowing that there is riparian usage in the Río Puerco yet be accounted for is an indicator of data needs.

Figure 12.8-6 Río Jemez Withdrawals Without Reservoir Evaporation And Riparian Usage, 2000

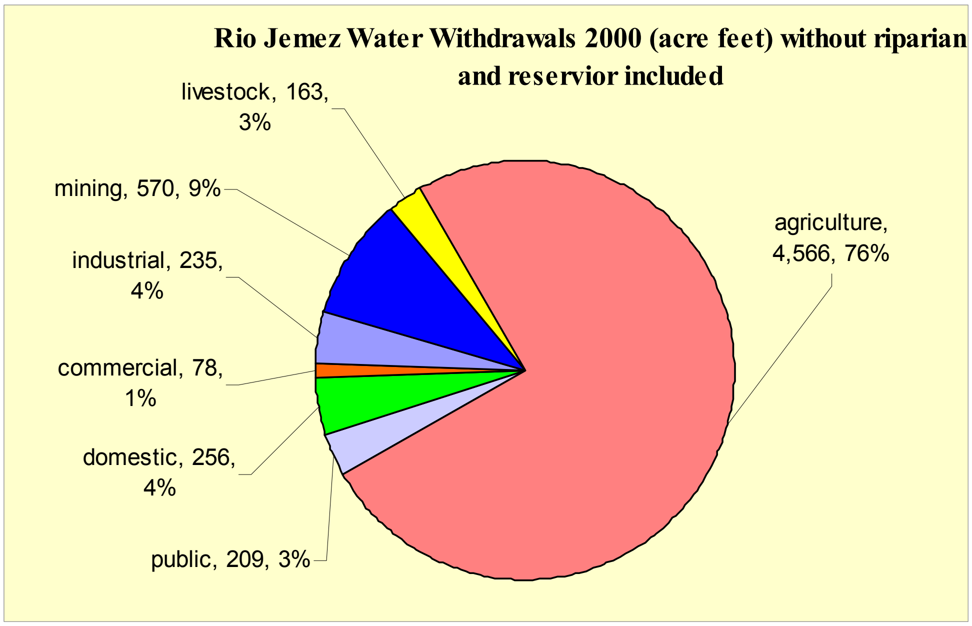
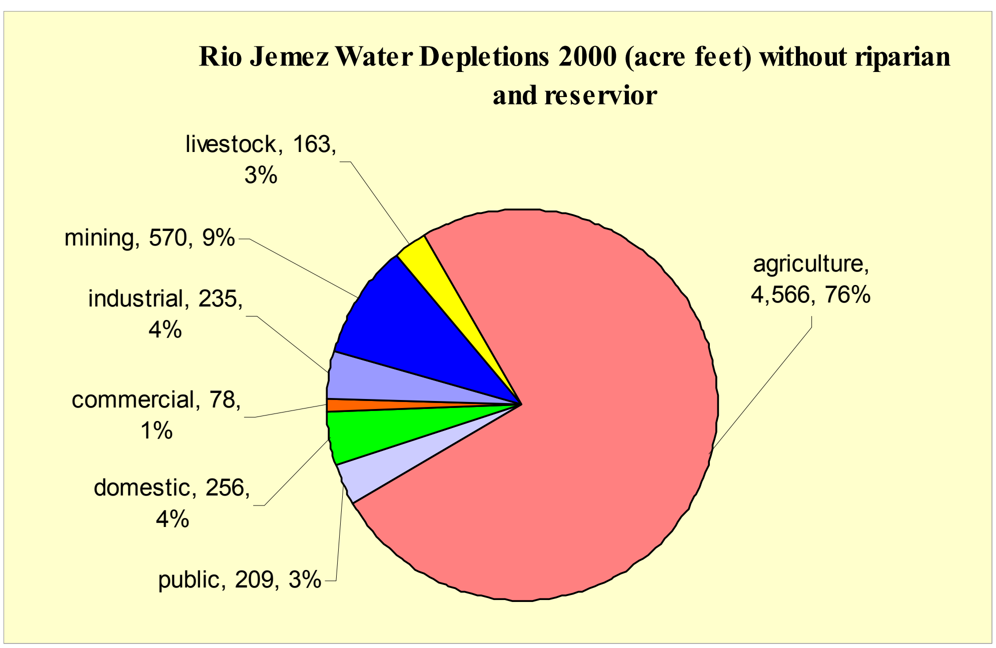


Figure 12.8-7 Río Jemez Depletions Without Reservoir Evaporation And Riparian Usage, 2000



12.8.4.5. Water Use in Río Puerco Watershed According to FWUP

As mentioned above, one of the regional water planning products is the Future Water Use Projections for the Middle Río Grande Water Planning Region (FWUP) produced by the Mid-Region Council of Governments (MRCOG) in January 2002. MRCOG prepared a regional land-use map with 18 land-use categories. Using Shomaker's water use categories, as reported in Historical and Current Water Use in the Middle Río Grande Region (2000), for the year 1995, water withdrawal and depletions coefficients were derived for the land use categories. Table 12.8-18 includes the areas of existing land uses and water withdrawals for the Río Puerco.

Table 12.8-18 Summary of Water Use (in acre-feet) in Río Puerco Watershed from FWUP, 2000

Category	Land Use in Río Puerco in 2000 (acres)	Adjusted Withdrawal Coeff. (gpa/d)	Calculated Withdrawals in 2000 (ac-ft/year)	Adjusted Depletion Coeff. (gpa/d)	Calculated Depletions (ac-ft/year)
Residential - Single Family	1,502	1,026	1,726	**559**	940
Multi-Family Residential	0	2,372	0	**850**	0
Major Retail Commercial	0	1,967	0	1,361	0
Mixed and Minor Commercial	50	1,967	110	1,361	76
Office	0	1,967	0	1,361	0
Industrial/Wholesale	63	623	44	431	30
Institutions	2	685	2	474	1
Schools/Universities	47	685	36	474	25
Airports	29	685	22	474	15
Transportation/Utilities	0	685	0	474	0
Agriculture - Irrigated	553	6,709	4,156	**2,227**	1,379
Rangeland/Dry Agriculture	1,275,581	0	0	0	0
Major Open Space & Parks (w. water use)	0	685	0	474	0
Major Open Space & Parks (no water use)	69,554	0	0	0	0
Natural Drainage/Riparian	125	3,109	435	**3,109**	435
Urban Vacant/Abandoned	40	0	0	0	0
Landfills/Sewage Treatment	1,414	685	1,085	474	751
Other Urban Non-residential	28	685	21	474	15
Totals	**1,348,988**		**7,638**		**3,669**

Source: Future Water Use Projections - Tables 3, 8 and 17, MRGCOG

The report does note the discrepancy in irrigated acreage between that reported by Shomaker, using a 1987 report, and that derived from the MRCOG land-use map. The latter is nearly six times less. "Shomaker reported acreages of 3,267. . . for irrigated agriculture in the Río Puerco . . . subregion. The discrepancy could be due to errors in the Middle Río Grande Council of Government's existing land-use map, or it could be that irrigated acreage in the Río Jemez and Río Puerco subregions has decreased since the State Engineer collected data for the report it published in 1987." Yet in the 1985 and 1990 Water Use Reports published by the State Engineer, the irrigable acreage is mentioned to be 2,150, with 1,616 and 1,590 irrigated, respectively. In 2000, 2,040 acres were reported as irrigated (Wilson 2003). Of note is the riparian usage amount of 3,109 acre feet.

12.8.5. Assumptions

1. Domestic (self-supplied), 2000

Issue: not divided among the three watersheds

County	USER	POP	GPCD	WSW	WGW	DSW	DGW
Bernalillo	Rural self-supplied homes*	48,737	100	0.00	5,459.26	0.00	5,459.26
Sandoval	Rural self-supplied homes*	17,319	80	0.00	1,551.98	0.00	1,551.98
Valencia	Rural self-supplied homes	33,178	100	0.00	3,716.42	0.00	3,716.42
	Three County Total	**99,234**		**0.00**	**10,727.66**	**0.00**	**10,727.66**

* sans Corrales

A. To simulate, assumption is that Bernalillo County users were located in East Mountain area, North Valley, South Valley and Albuquerque Acres; and most Valencia County users were in the valley or east mesa. For Sandoval, figured about 1/3 were in Placitas, 1/3 were in Valley and 1/3 in Río Jemez and Río Puerco.

	USER	POP	WSW	WGW	DSW	DGW
Río Puerco & Río Jemez	Rural self-supplied homes	5,773	0.00	517.3	0.00	512.3

B. Split population and usage in half.

	POP	WSW	WGW	DSW	DGW
Rural self-supplied homes	2,886	0.00	258.62	0	258.62

2. Livestock, 2000

Issue: Not divided among the three watersheds

	WSW	WGW	DSW	DGW
Bernalillo	20.90	802.81	20.9	802.81
Sandoval	116.13	124.8	116.13	124.8
Valencia	48.09	869.05	48.09	869.05
Totals	**185.12**	**1796.66**	**185.12**	**1796.66**

A. Assumed that livestock usage is 1/4 of the whole for the two watersheds and that is split 1/3 for Río Jemez and 2/3 for Río Puerco.

Río Jemez, 2000

	WSW	WGW	DSW	DGW
Joint	46.28	449.165	46.28	449.165
Separated	15.27	148.22	15.27	148.22

Río Puerco, 2000

	WSW	WGW	DSW	DGW
Joint	46.28	449.165	46.28	449.165
Separated	31.01	300.94	31.01	300.94

3. Mining, 2000

Unsure as to allocation of usage, all from Sandoval County. Could not determine if any water usage connected with mining occurred in Valencia or Bernalillo County in the Río Puerco

Río Jemez, 2000

	WSW	WGW	DSW	DGW
Copar Pumice-San Ysidro (95dat)	0.00	3.00	0.00	3.00
	0.00	**3.00**	**0.00**	**3.00**

4. Commercial (self-supplied) 2000

	WSW	WGW	DFSW	DGFW	DSW	DGW
Fenton Lake State Park	0.00	49.00	0.00	1.00	0.00	49.00
Río Jemez Music Camp (Hummingbird)	0.00	3.00	0.00	1.00	0.00	3.00
Jemez Springs Bathhouse	0.00	2.89	0.00	1.00	0.00	2.89
La Cueva Lodge--Río Jemez Springs	0.00	3.00	0.00	1.00	0.00	3.00
La Cueva Steakhouse--Río Jemez Springs	0.00	2.00	0.00	1.00	0.00	2.00
La Cueva Tavern—Río Jemez Springs	0.00	0.50	0.00	1.00	0.00	0.50
San Antonio YCC--Río Jemez Springs	0.00	1.00	0.00	1.00	0.00	1.00
Seven Springs Fish Hatchery	10.00	0.00	1.00	1.00	10.00	0.00
Spanish Queen Picnic Ar--Río Jemez Spg	0.00	0.20	0.00	1.00	0.00	0.20
USFS--Battleship Rock Picnic Area	0.00	0.20	0.00	1.00	0.00	0.20
USFS--Horseshoe Spgs CG—Río Jemez S	0.00	1.00	0.00	1.00	0.00	1.00
USFS—Río Jemez Dam Overlook Picnic Ar	0.00	0.20	0.00	1.00	0.00	0.20
USFS--Río Jemez Falls Campground	0.00	1.00	0.00	1.00	0.00	1.00
USFS--Paliza CG--NE Ponderosa	0.00	1.00	0.00	1.00	0.00	1.00
USFS--Redondo CG--NE Río Jemez Sprin	0.00	1.00	0.00	1.00	0.00	1.00
USFS--San Antonio CG--NE Río Jemez S	0.00	1.00	0.00	1.00	0.00	1.00
Vista Linda Campground--Río Jemez Spgs	0.00	1.00	0.00	1.00	0.00	1.00
	10.00	**67.99**	**1.00**	**17.00**	**10.00**	**67.99**

12.8.6. Navajo Water Planning

The Navajo Department of Water Resources (NDWR) is completing chapter water plans for the Chapters within Regions 2 and 6. For such purposes, Torreon, Ojo Encino and Star Lake Chapter Houses have been included in Water Planning Region 2. Located in the Río Puerco basin, the communities are also linked with Cuba - economically and educationally (sixty percent of the children attending Cuba Schools are Navajo). If the population projections reported and the water plans for the Torreon region materialize, the Upper Río Puerco region as a whole will be impacted. The following information comes from *The San Juan Basin Regional Water Plan* (Draft Final, Revised, October 4, 2003). Section 9 deals with Water Plan Alternatives, and Subsection 9.9 contains Navajo Nation Water Plan Alternatives. It can be accessed at www.sjwc.org/PDF%20FILES/

Draft_Final/10-4-03%20Section%209%20Water%20Plan%20Alternatives.pdf. The NDWR provided the information for Section 9.9, from which the following synopsis is drawn, with the full text in the Water Use Appendix and the list of projects in Section 13.

> The Navajo Nation faces serious economic and social challenges. In 1999, the Navajo Division of Economic Development reported that the median family income was only $11,885 while the U.S. median family income was more than $30,000. The average per capita income for the Navajo Nation was less than $6,200 while the per capita income for the State of Arizona was approximately $25,000. More than 56 percent of the Navajo families on the reservation lived below the federal poverty levels, compared with less than 13 percent of the general U.S. population, making it among the most impoverished regions in the United States.
>
> The Navajo unemployment rate on the reservation is 54 percent, compared to an unemployment rate for the U.S. of approximately 5 percent. These disparities show no sign of narrowing, and while the surrounding regional economy has boomed, these gaps in income, unemployment, and poverty have widened. The Navajo Housing Authority estimated that the Navajo Nation has an immediate unmet need for more than 20,000 housing units.
>
> The Navajo Nation faces serious water resource problems. Many homes lack indoor plumbing. More than 50 percent of Navajo homes lack complete kitchens and between 20 and 50 percent of Navajo households rely solely on water hauling to meet daily water needs.
>
> Approximately 40 percent of the Navajo population hauls water to meet their daily household needs. They frequently drive long distances to the nearest public water source. The cost of hauling water in pickup trucks can exceed $16,000 per acre-foot compared to typical urban water rates, which are approximately $600 per acre-foot. This situation means that one of the poorest sectors of the New Mexico population has the most expensive water supply.
>
> Sanitation is also a concern for water haulers. If potable water sources are difficult to access, water haulers frequently get water from non-potable sources such as stock tanks.
>
> Access to adequate water is critical for economic growth and the survival of the Navajo culture
>
> In 2001, the Indian Health Service (IHS, the Navajo Nation domestic water development agency), identified $294 million in water system deficiencies, $78 million in sewer deficiencies, and $10.5 million in solid waste deficiencies. Approximately 40 percent of these deficiencies are in Region 2.
>
> For municipal water demand planning, NDWR recommends using the U.S. Census Bureau population count adjusted by an estimated undercount, a growth rate of 2.48

percent from the year 2000 through 2050, and a per capita municipal demand of 160 gallons per capita per day.

Per capita water use for Chapters depends on the accessibility of the water supply. An increase in per capita water use is correlated with community growth, development, and improved economic standards of living. Historic data for non-reservation communities in the region show that water use has increased over time and current average per capita use is at or exceeds 160 gallons per day. The 160 gallons per capita per day rate includes modest commercial and municipal demands comparable to cities such as Winslow, Arizona, or Gallup, New Mexico. By comparison, the nearby communities of Rio Rancho and Albuquerque use more than 200 gallons per capita per day (Brown et. al., 1996). Therefore, a municipal rate of 160 gallons per capita per day is used to determine the projected water demand. By the year 2040 the Navajo population on the Navajo Reservation within Region 2 will be approximately 150,000.

As challenging as the current circumstances are, without dramatically increased water resource development, the future may be bleaker. Based on an annual growth rate of 2.48 percent and a per capita water demand of 160 gallons per capita per day, the total annual municipal water demand on the reservation will exceed 89,000 acre-feet by the year 2040. The Navajo Nation requires a supplemental water supply to augment the groundwater and to promote economic development.

The water delivery systems will require a six-fold increase in capacity. Overcoming the legacy of economic neglect and the readily apparent deficits in the infrastructure will require a very aggressive water development program - the *Water Resources Development Strategy for the Navajo Nation* (Strategy Document, NDWR, 2000). That document broadly describes the steps that the Navajo Nation can take to address municipal water development. Summarized, such are:

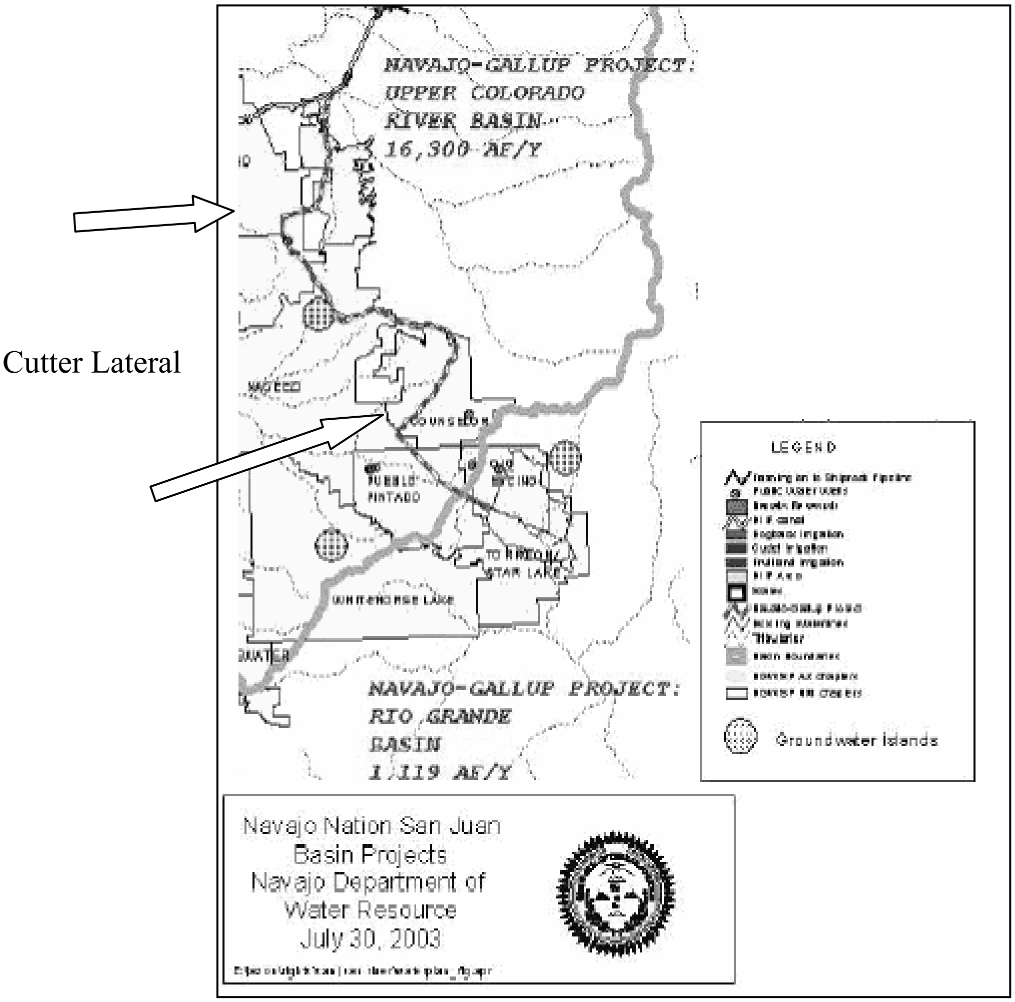
1. Establishing a Water Resource Development Task Force, which will coordinate technical and fiscal resources of the Navajo Nation and federal agencies
2. Preparing a reservation-wide needs assessment and prioritizing water projects
3. Developing regional water supply projects
   a. Farmington to Shiprock Pipeline -
      - will supply water to meet most of the 2020 municipal water demands of seven Navajo Chapters along the San Juan River
      - The 2020 municipal water demand is expected to exceed 5,100 acre-feet per year. The projected municipal water demands for these Chapters in 2040 will be 16,842 af.
      - This pipeline was authorized for construction by the Colorado Ute Settlement Act amendments of 2000 (Public Law 106-554).
      - The pipeline will divert up to 4,680 acre-feet of Animas La Plata Project water per year .
      - In April 1999, Reclamation estimated that the project cost would be approximately $24 million.

b. Navajo-Gallup Water Supply Project

- To provide additional domestic, municipal and industrial water for the eastern portion of the Navajo Nation, the Navajo-Gallup Water Supply Project will deliver San Juan River water to the forty-three Navajo Nation Chapters, the southern portion of the Jicarilla Apache Nation, and the City of Gallup, New Mexico.
- To better characterize the water supply and demand of the region and of the Project's service area, the City of Gallup and the Navajo chapters were grouped into twelve municipal subareas. Each subarea has a common public water supply system and water supply option. Subarea 9 is the Torreon Area, which includes Counselor, Ojo Encino, Pueblo Pintado, and Torreon, all of which are considered to be in Region 2
- According to the study, *Navajo Gallup Water Supply Project Appraisal Level Designs and Cost Estimates*, the surface water components of the project have an estimated cost of $441 million.
- The Project will divert approximately 37,700 acre-feet and deplete approximately 35,800 acre-feet of San Juan River Water. Based on the preferred alternative, the Project will divert 15,100 acre-feet water and deplete 13,229 acre-feet of San Juan River water for use within the Upper Colorado River Basin on the Navajo Nation within Region 2. The Project also includes 1,200 acre-feet of depletion that will be used within the Upper Basin by the Jicarilla Apache Nation at the Teepee Junction. The Project also includes 1,119 acre-feet of depletion that will be used in the Torreon Area within the Rio Grande Basin.
- The Cutter Lateral[5] diverts the balance of the Project water from the Cutter Reservoir in Largo Canyon. Cutter Reservoir is an existing component of the Navajo Indian Irrigation Project. The annual demand of the Cutter Lateral will be 3,000 acre-feet in 2020 and 4,760 acre-feet in 2040. The peak demand of this lateral will be 3.7 MGD (or 5.78 cfs) in 2020 and 5.4 MGD (or 8.3 cfs) in 2040.
- The Torreon Subarea includes the chapters of Counselor, Ojo Encino, Torreon, and Pueblo Pintado. The annual projected municipal demand of the Torreon Subarea in the year 2040 is 2,317 acre-feet, with groundwater meeting 77 acre-feet of this demand.
- In April 2002, Reclamation completed an appraisal level design and cost estimate of the surface water component of the Project. The estimated cost of the surface water components of the Project is $441 million.

[5] The Cutter Lateral begins at the Cutter Reservoir. This lateral will proceed south toward U.S. Highway 550 (State Highway 44) where it will connect with the Huerfano and Nageezi NTUA public water systems. The route follows State Highway 44 for approximately 30 miles to Navajo Route 46. At this junction the Jicarilla Apache Nation will be able to convey water to the Teepee Junction. The route follows Navajo Route 46 south toward Navajo Route 9 serving the Counselor NTUA public water system. From Counselor the route proceeds south to Ojo Encino where it will provide water for the NTUA public water system serving Ojo Encino, Pueblo Pintado, White Horse Lake, and Torreon. Huerfano Subarea includes the chapters of Huerfano and Nageezi which will also be served from the Cutter Lateral.

- According to Reclamation, Reclamation anticipates that the Environmental Impact Statement and the Record of Decision should be completed in early 2004.[6]



Municipal Water Demand for Subarea 9 for the Navajo-Gallup Water Supply Project

Municipal Subarea	Basin of Use	1990 Census Pop.	2040 Pop.	2040 Demand (AF/yr)	2040 G.W. Production (AF/yr)	2040 SJR Diversion (AF/yr)	2040 SJR Depletion (AF/yr)
Torreon	**UC/RG**	**3,797**	**12,924**	**2,316**	**77**	**2,240**	**2,240**
Jicarilla	UC	1,200	1,200	1,200			
Huerfano	UC	1,492	5,078	910	46	864	864
N.M. Rio Grande	RG ?	1,960	6,672	1,196	77	1,119	1,119

[6] In 1984, Bureau of Reclamation completed a draft Environmental Impact Statement. In the late 1980s, the Project stalled in part due to the Navajo Nation's concerns over the failure to complete the Navajo Indian Irrigation Project, and limitations to the Project's proposed service area. It also stalled in part due to Reclamation's concern over the long-term availability of water, the lack of quantified water rights for the project, difficulty in complying with the Endangered Species Act, and difficulty in financing the Project.

4. Develop and Rehabilitate Local Public Water Systems

Six proposed large Navajo regional water supply projects, including the Farmington to Shiprock Pipeline and the Navajo Gallup Water Supply Project, will convey domestic, municipal and industrial water to approximately 67 of the 110 chapters on the reservation, and they will serve approximately 80 percent of the projected reservation wide population of 500,000 by the year 2040. For the 20 percent not served, the proposal is to:

- Improve Public Water Systems Connected with the Regional Projects
- Improve Public Water Systems Not Connected to the Regional Projects
- Improving Water Service to Water Users Without Direct Access to Public Water Systems

5. Completing the Navajo Indian Irrigation Project

- The Navajo Indian Irrigation Project (NIIP) was jointly authorized with the San Juan Diversion in 1962 by Public Law 87-483.
- Authorized is 508,000 acre-feet of irrigation water for approximately 110,630 acres of land. Seven of 11 blocks have been completed with portions of Block 8 are now being irrigated.
- The Department of the Interior has a 1956 State Water Use Permit for NIIP for the diversion of 640,000 acre-feet of water from Navajo Reservoir and the Navajo Nation has a 1970 Secretarial water contract to divert 508,000 acre-feet of water for agricultural use. With a unit depletion of 2.4 acre-feet per acre, when it is completed, NIIP will divert 360,000 acre-feet and, at equilibrium, deplete 270,000 acre-feet of San Juan River water per year. NIIP currently diverts approximately 200,000 acre-feet per year and depletes approximately 160,000 acre feet per year.
- To date, NIIP has not realized its full economic potential. After more than 40 years, the project is farming less than 60 percent of its authorized project land.

6. Other projects

- Small Agricultural Irrigation Projects
- Water Conservation and Water Reuse
- Power Generation
- Coal Mining

12.8.7. To'hajiile Chapter Water Supply Project

To'hajiile is in the Río Puerco basin, although being in Bernalillo County was not actively included in the current subregional planning effort.[7] The following synopsis is drawn from the To'hajiile Chapter Water Supply Project, Final Draft Technical Memorandum, prepared by the Navajo Nation Department of Water Resources Water Management Branch, April 04, 2002:

Introduction - Objective of the Technical Memorandum is to develop a conceptual design and appraisal level cost estimate for a public water system. The proposed project will convey municipal water from either the existing Albuquerque municipal water supply system, a proposed Rio Grande intake or a proposed Jemez Reservoir intake.

Water Demand

	2000	**2010**	**2020**	**2030**	**2040**
Population [1]	1,727	2,207	2,819	3,602	4,601
Water Demand					
Annual Demand (acre-feet) [2]	310	395	505	646	825
Average Flow (gallons per day)	276,346	353,057	451,061	576,271	736,237
Average Flow (cubic feet/second)	0.43	0.55	7	0.89	1.14
Peak Demand (cubic feet/second) [3]	0.56	0.71	0.91	1.16	1.48
Five-day Storage (gallons) [4]	1,381,730	1,765,283	2,255,306	2,881,355	3,681,187

[1] 2000 Census adjusted for 4.74% undercount; annual growth is 2.48%
[2] Per capita water use is 160 gallons/day
[3] Peak demand is 1.3*(average flow)
[4] Storage = population*5 days * 160 gallons

Existing Facilities

Current facility (three wells) has an estimated pumping capacity of 196 gallons per minute - hardly sufficient to meet the 2000 demand. In 1994, the system had 271 connections with 328,000 gallons of storage.

Well #1	23 gpm	850' depth
Well #2	45 gpm	525' depth
Well #3	126 gpm	763' depth

Proposed Alternatives

[7] In October 2003, a request was sent to the tribal office seeking comments on the draft plan, as was done for the other chapter houses in the subregion, together with a letter to the NDWR in Window Rock. Unknown is the extent that To'hajiile was included in Region 6 RWP.

a. existing Albuquerque municipal water supply system - diverted from a storage tank on the west side; no water treatment needed but pumps, regulating tanks, and storage tanks in addition to pipeline.

b. proposed Rio Grande intake (two configurations) - water treatment plus pumps, regulating tanks, and storage tanks in addition to pipeline.

c. proposed Jemez Reservoir intake (two configurations) - water treatment plus pumps, regulating tanks, and storage tanks in addition to pipeline.

Total Estimated Costs

Alternative	Total Capital Cost	Annual Amortized Total Cost at 5% over 40 years	Annual Power, O&M, Cost of Water, and Water Treatment	Unit Cost /acre foot	Unit cost/ 1000 gallons
Albuquerque	$7,481,200	$199,500	$555,000	$914	$2.81
Rio Grande 1	$11,632,300	$310,100	$599,600	$1,103	$3.38
Rio Grande 2	$11,497,500	$306,500	$597,200	$1,095	$3.28
Jemez River 1	$15,199,800	$405,200	$655,800	$1,286	$3.87
Jemez River 2	$15,211,400	$405,600	$656,000	$1,287	$3.87

for every one million dollars of capital expenditures, the annual amortized capital cost over a forty-year period at 6 percent is $66,461. At 6 percent the annualized costs range from $195,100 for the Albuquerque Alternative to $405,000 for the Jemez River Alternative.

Conclusion

The Albuquerque Alternative is the least expensive alternative in both capital and annual cost. Based on the unit cost of other comparable water projects, the estimated unit cost of $2.90 per thousand gallons is affordable to the consumer. Finally, the Albuquerque Alternative will encounter fewer environmental issues related to new diversions on the Rio Grande of Jemez River, factors which could delay the project and increase the costs significantly. The Albuquerque Alternative is the preferred alternative to provide a long term, high quality and sustainable water supply to Tohajilee.

Costs

a. intake structure plus pump - $250,000
or connection fee to Albuquerque - $165,000

b. water treatment - $1,000,000 for 1,000,000 gallons per day capacity (except for Albuquerque Alternative, which would cost approximately $1.30 per thousand gallons)

12.8.8. Drought

In addition to the variability of the climate under normal conditions, the region also regularly incurs drought conditions.

> Summer rains can do little to ease drought's stranglehold on the state as reservoirs recede, demands increase and communities like tiny Nogal wonder where they'll get their tap water (Frank Zoretich, Albuquerque Tribune, www.abqtrib.com/archives/news02/080302_news_water.shtml).
>
> Drought is a condition of moisture deficit sufficient to have an adverse effect on vegetation, animals, and man over a sizeable area. (USGS, http://nm.water.usgs.gov/drought)

The most commonly used definitions are based on meteorological, agricultural, hydrological and socioeconomic effects

* Meteorological Drought - usually defined by a period of substantially diminished precipitation
* Agricultural Drought - occurs whenever there is not adequate soil moisture to meet the needs of a particular crop at a particular time. Usually occurs during or after evidence of meteorological drought
* Hydrological Drought - refers to deficiencies in surface and subsurface water supplies. Evidence is provided by reductions in stream flow, snow pack, reservoir and groundwater levels. Occurrence is usually after meteorological and agricultural droughts have been identified
* Socioeconomic Drought - occurs when water shortages begin to affect the health, well-being, and quality of life of the people, or when the drought starts to affect the supply and demand of an economic product (New Mexico Drought Plan Definition)

As shown in Table 12.8-19, records indicate that for the two stations mentioned, substantially less precipitation has been received than normal. Through July, Jemez Springs received 55% of its normal amount in 2003, and 68%for the water year, which begins October 1. Wolf Canyon fared better, with results being 70% and 89%, respectively.

Table 12.8-19 Calendar Year 2003 and Water Year 2003 (thru Jul) Precipitation

	2003 (Jan - Jul)			Water Year 2003 (Oct - Jul 03)		
Location	**Obs**	**Normal**	**%Normal**	**Obs**	**Normal**	**% Normal**
JEMEZ SPRINGS	5.01	9.04	55%	8.46	12.5	68%
WOLF CANYON	8.72	12.47	70%	15.45	17.44	89%

Source: National Weather Service Albuquerque, NM, as reported by the Drought Monitoring Committee, http://weather.nmsu.edu/drought/Aug2003.pdf

12.8.8.1. Information Sources

<u>New Mexico Drought Planning</u>

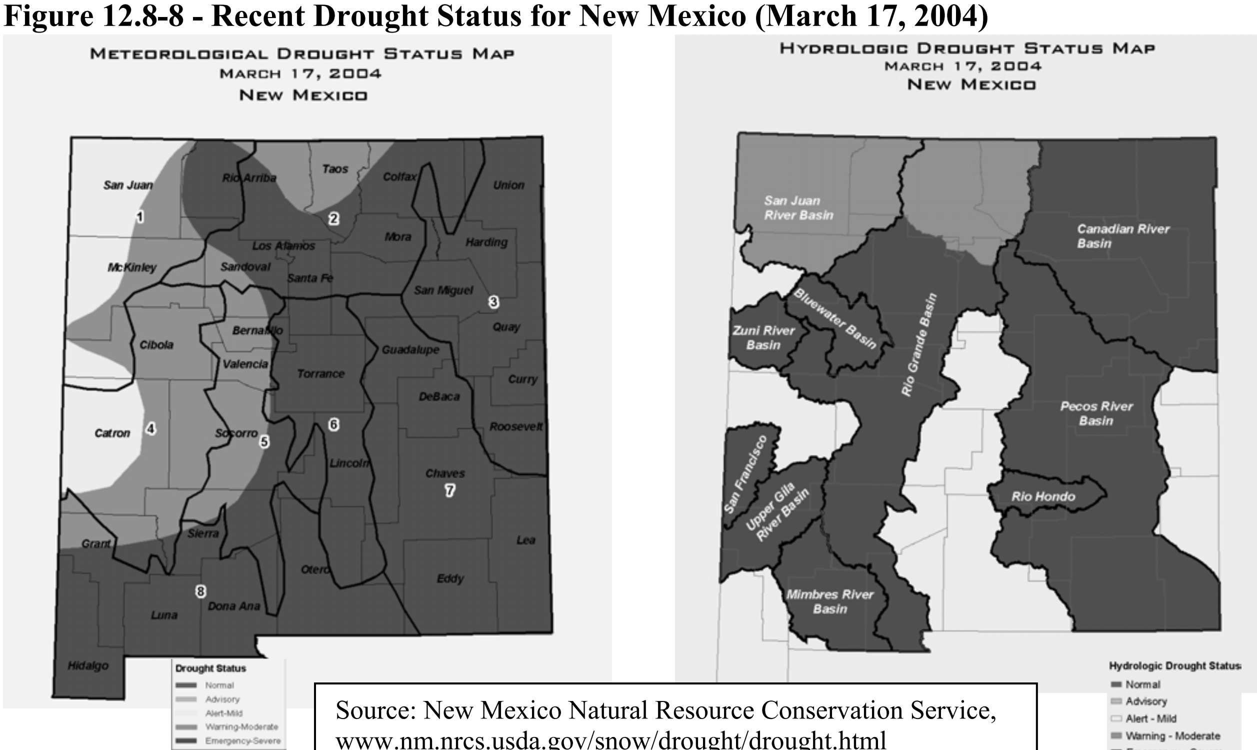
Information on past droughts, as well as current status, can be found at the New Mexico Drought Planning web site. As Table 12.8-20 shows, 2003 was one of the driest on record in the state. the period from March 2003 to February 2004 was the 7th driest in the past 100 years.

Table 12.8-20 - Statewide Precipitation Ranks for New Mexico , 2002-2003

Period	Rank
Aug	28th driest
Jul-Aug	1st driest
Jun-Aug	6th driest
May-Aug	5th driest
Apr-Aug	2nd driest
Mar-Aug	5th driest
Feb-Aug	12th driest
Jan-Aug	8th driest
Dec-Aug	16th driest
Nov-Aug	16th driest
Oct-Aug	28th driest
Sep-Aug	47th driest

http://www.ncdc.noaa.gov/oa/climate/research/prelim/drought/st029dv00pcp.html

Figure 12.8-8 - Recent Drought Status for New Mexico (March 17, 2004)



Source: New Mexico Natural Resource Conservation Service, www.nm.nrcs.usda.gov/snow/drought/drought.html

New Mexico drought status maps are updated by the New Mexico Natural Resource Conservation Service (NRCS) in conjunction with the New Mexico Drought Planning Team. As Figure 12.8-8 shows, drought status is mapped as short-term meteorological drought (left) and as long-term hydrological drought (right). The most recent New Mexico Drought Map can be accessed at www.nm.nrcs.usda.gov/snow/drought/drought.html. The New Mexico map is currently produced monthly, but when near-normal conditions exist, it is updated quarterly.

Monthly Report
Drought Monitoring Committee
August 19, 2003
http://weather.nmsu.edu/drought/Aug2003.pdf

A *Drought Monitoring Committee* operates from New Mexico State University. This committee issues a monthly report, from which the following information has been extracted.

> Long-range outlook: It appears we will enter the autumn and winter period with relatively "neutral" conditions in both the equatorial and northern Pacific. This means that there are equal chances for above, below, or normal autumn and winter precipitation. Since summer moisture usually has minimal impact on reservoir levels (especially the larger systems), substantial cold-season precipitation will be required to alleviate many aspects of the current drought. At the present time, it appears the current drought will continue for some time.

Drought Status for August 2003
National Weather Service, Albuquerque, NM

> Discussion: July 2003 was the driest July on record for the state of New Mexico and the 2nd hottest July on record. Those two factors together allowed drought conditions to deteriorate for most of the state.

Streamflow Conditions
For Selected Locations In New Mexico
U.S. Geological Survey, Albuquerque, NM

> Streamflow conditions for July 2003 remained below average to significantly below average State wide. The 2003 water year to date (YTD) percent of average streamflow volumes remained the same in some cases, and in most cases decreased since June, except for the Animas which increased. The YTD streamflow is significantly below average Statewide, except for the upper Pecos and Río Chama which is below average; of course other streamflows were augmented from releases from upstream reservoirs.

Streamflow for July 2003 compared to July 2002, in percent of average

Streamflow-gaging station	Jul-03	YTD	Jul-02	YTD
08324000 Jemez River near Jemez	41	53	54	27

Climate Assessment Project for the Southwest, CLIMAS
www.ispe.arizona.edu/climas/forecasts/swoutlook.html

The Climate Assessment Project for the Southwest, CLIMAS, from University of Arizona, publishes the Current Southwest Climate Outlook, which, while not an official forecast, reflects both the official Climate Prediction Center forecast and a reasonable assessment of the implications of the outlook for the region including New Mexico. The following information has been abstracted from the latest forecast, issued March 26, 2004.

> Summary – Hydrological drought continues in the Southwest.
>
> • New Mexico reservoirs are at well-below-average levels, although February and March snowfall resulted in gains at most reservoirs.
> • Temperatures - During the past 30 days, temperatures have been above average across the Southwest—breaking records at many stations.
> • Precipitation - Recent precipitation, while beneficial in the short-term, is not sufficient to overcome multi-year precipitation and soil moisture deficits. Prior to recent and rapid melt, Arizona and New Mexico snowpacks were below average—thus spring/summer streamflows across the region are projected to be below average. Moreover, current snowpack is below average throughout the Upper Colorado and Upper Rio Grande River Basins.
> • Climate Forecasts - Seasonal forecasts indicate increased probabilities of above-average temperatures across Arizona and New Mexico through the spring and summer months. Increased temperature implies increased evapotranspiration. Precipitation forecasts do not suggest strong probability anomalies for either above- or below-average precipitation. The U.S. Drought Outlook suggests persistent drought conditions for virtually all of Arizona and New Mexico.
> • Bottom line: In the absence of exceptional precipitation during the next month, hydrological drought will persist in the Southwest. Temperatures have been warmer than average and those soils are thirsty!

2003 New Mexico Drought Summit

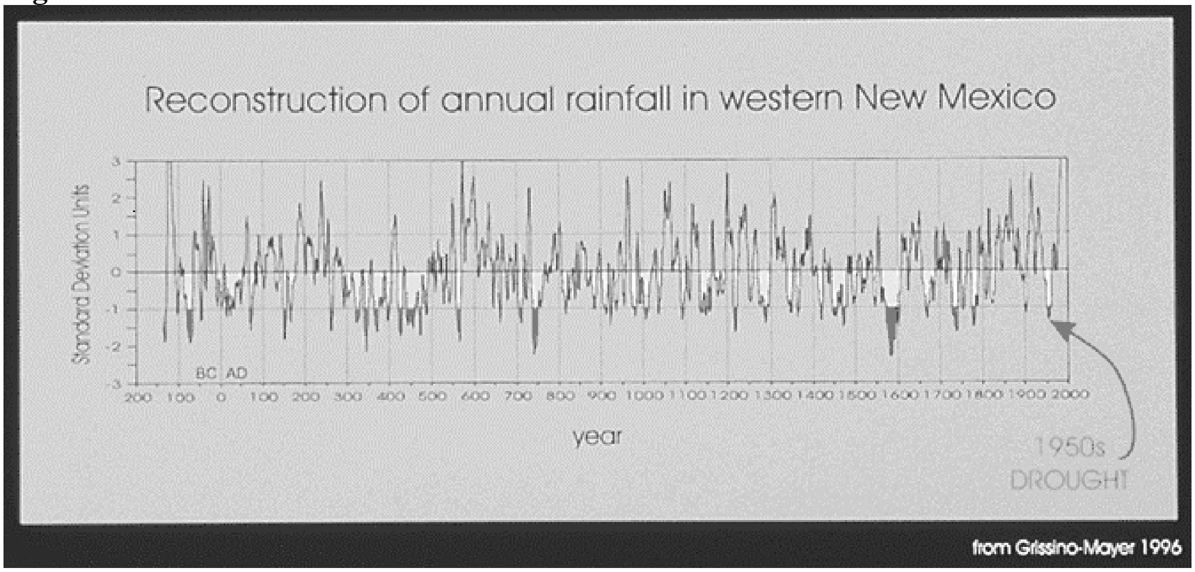
Several New Mexican agencies sponsored and participated in the 2003 Drought Summit. A full list of the presentations made is included in the appendices, and these can be accessed at www.seo.state.nm.us/doing-business/DroughtTaskForce/ Summit2003.html.

New Mexico Drought Conditions can be found at http://nm.water.usgs.gov/drought/

Tree Ring Data

What if current "drought" is more consistent with normal weather patterns? Tree ring data show that over the last 2000 years, the precipitation in the last twenty years has been the wettest in 200 years, as shown in Figure 12.8-9.

Figure 12.8-9 Reconstruction of Annual Rainfall in Western New Mexico



Graphic modified from Grissino-Mayer 1996, by Connie Woodhouse, NOAA Paleoclimatology Program

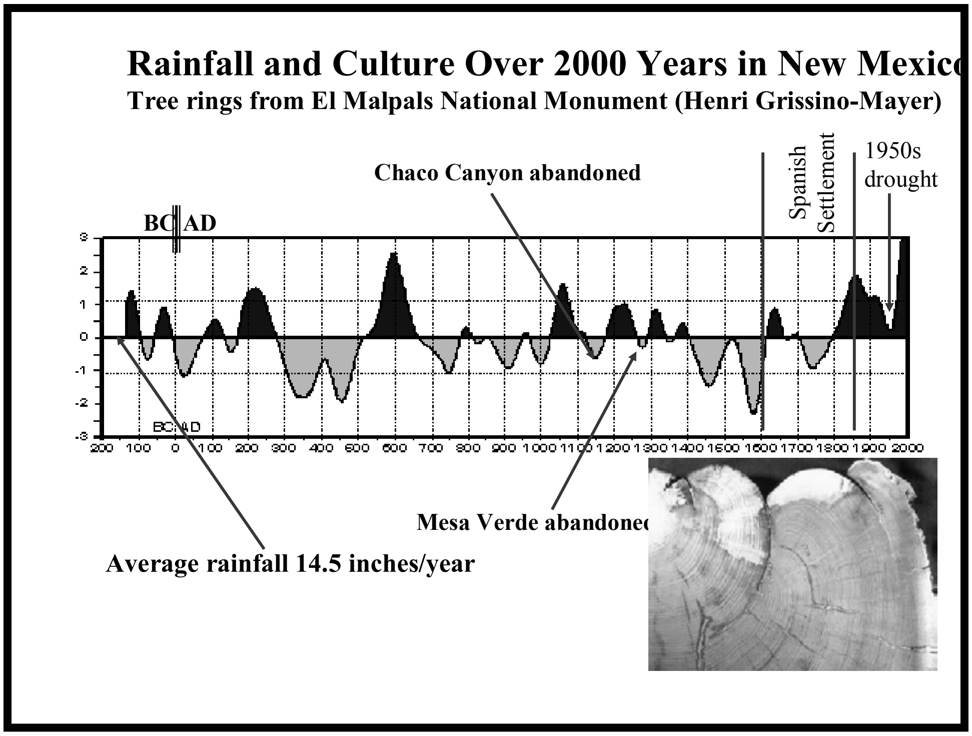
> "Variations in precipitation for the last 2,000 years can been seen in the tree-ring reconstruction of annual rainfall for western New Mexico. This reconstruction, from ponderosa pine and Douglas fir, dates back to AD 136 and shows how extremes in precipitation in the 20th century compare to those of the past. The graph in this figure shows the well-known drought of the 1950s, but it also shows droughts of much greater magnitude and length in the late 1500s, around 750, and between 425 and 500." Paleo Slide Set: Tree Rings: Ancient Chronicles of Environmental Change Precipitation reconstruction for western New Mexico from Grissino-Mayer, 1996, www.ngdc.noaa.gov/paleo/slides/slideset/18/18_372_slide.html.

As shown in Figure 12.8.10, when the reconstruction is smoothed out, the relation between rainfall and culture becomes more apparent.

> When viewed through a paleoclimate filter, in this case Grissino-Mayer's tree ring reconstructions from El Malpais National Monument for the past 2000 years, the first concentrated spread of occupation to the middle Río Puerco valley took place during a suggested higher rainfall period centered about 600 AD. The greatest number of sites, Pueblo II, correspond with a subsequent moist phase between 1000 and 1100 AD and represent the height of development at Chaco Canyon. The subsequent collapse at Chaco Canyon corresponds with drier period centered about 1150 AD. The general abandonment of the area during Pueblo IV (1300 - 1600 AD) also seems synchronous with a two-century shift to drier conditions as well as the entrance of Navajo and the Spanish to the area. The Spanish colonial period, which continued until Mexican independence in the early 19th century, appears to have corresponded with dominantly drier conditions. Rainfall apparently increased during the 19th and 20th centuries during the U.S. Territorial era, with clearly more

arid conditions in the mid 1900's and greater moisture frequency over the past half century. (Larsen and Herzog 2000)

Figure 12.8-10 Rainfall and Culture Over 2000 Years in New Mexico
Source: Grissino-Mayer et al. 1997.



Climatic Change, in review, Dec 2002

A project titled The Effects of Climate Change on Water Resources in the West: Introduction and Overview was conducted by Barnett et al.

This project did not examine the effects that growth in demand, due to population increase and economic growth, might have upon these [water] resources. These effects would be considerable, but they were simply outside the scope of the study. The emphasis here is on the effect of climate change on the system as it stands today. Growth is another stress that would be applied to a system that in many places may be approaching its current limits of adaptability.

Principal Results

The clearest change indicated by the climate-change simulations generated by this project is a general large-scale warming over the West – reaching an additional 1-2C, as compared to present, by the middle of the century. The most significant impact of this warming will be a large reduction in mountain snow pack and a commensurate reduction in natural water storage. The effects of global warming are already being seen in the West in terms of earlier melting of mountain snow packs and earlier dates for spring runoff

> (Dettinger et al. and Stewart et al., this issue). *What this work shows is that, even with a conservative climate mode, current demands on water resources in many parts of the West will not be met under future climate conditions – much less the demands of a larger population and a larger economy.* (emphasis added)

12.8.8.2. Drought Planning

In fulfillment of the requirements of the *Regional Water Planning Handbook*, drought planning is a necessary component. Most likely, this will require a plan which describes an agreed upon process to assess periodically water supply conditions and the options for responding to emerging drought based on pre-defined deficiencies or triggers. A sample Drought Plan has been included in the appendices.

In order to regionally plan for drought, certain steps need to be considered. The region will need to

1. agree upon a definition of "drought"
2. assess current measures which can be utilized or strengthened in order to minimize impact
3. know management of reservoirs, as well as current uses and needs, in order to maximize deliveries.

A number of resources are available to assist in planning for drought.

The Basics of Drought Planning: A 10-Step Process

The plan is available at http://drought.unl.edu/plan/ handbook/process.htm and explains the process:

> Because droughts are a normal part of virtually any climate, it is important to develop plans to reduce their impacts. The drought planning process outlined here was first published in 1990, as part of a research project funded by the National Science Foundation (Wilhite, 1990). Since 1990, it has been revised and updated several times to reflect greater state, national, and international experience in drought planning. Greater emphasis on mitigation and preparedness; recent workshops on drought planning; and a methodology for conducting risk analysis have also helped reshape the drought planning methodology. The process discussed in this paper is written for application at the state level, but the methodology is generic and can be adapted to any level of government in any country. (citation)

The ten steps are:

1. Appoint a Drought Task Force
2. State the Purpose and Objectives of the Drought Plan
3. Seek Stakeholder Participation and Resolve Conflict
4. Inventory Resources and Identify Groups at Risk
5. Develop Organizational Structure and Prepare Drought Plan

6. Integrate Science and Policy, Close Institutional Gaps
7. Publicize the Proposed Plan, Solicit Reaction
8. Implement the Plan
9. Develop Education Programs
10. Post-Drought Evaluation

New Mexico Drought Plan and Drought Task Force

New Mexico currently has a Drought Plan, revised May 31, 2002, which can be found at weather.nmsu.edu/drought/053102. Recognizing the effects that drought has upon the state, in July 2003, the governor declared a drought emergency and formed a Task Force. This 12-member Drought Task Force will recommend strategies for dealing with the drought and will build on work done by a Governor's Drought Task Force formed under the administration of former Governor Johnson. The task force is Chaired by the State Engineer and created from experts in financing, water project construction, water rights, water conservation and water quality. More information about their activities can be found at www.seo.state.nm.us/doing-business/DroughtTaskForce/DroughtTask-menu.html.

Further information about drought and drought planning is included in the appendices.