

Supporting Document S

Placitas Water Demand Study

December 2002

**HISTORICAL AND CURRENT WATER USE IN THE PLACITAS AREA,
SANDOVAL COUNTY, NEW MEXICO**

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EXECUTIVE SUMMARY

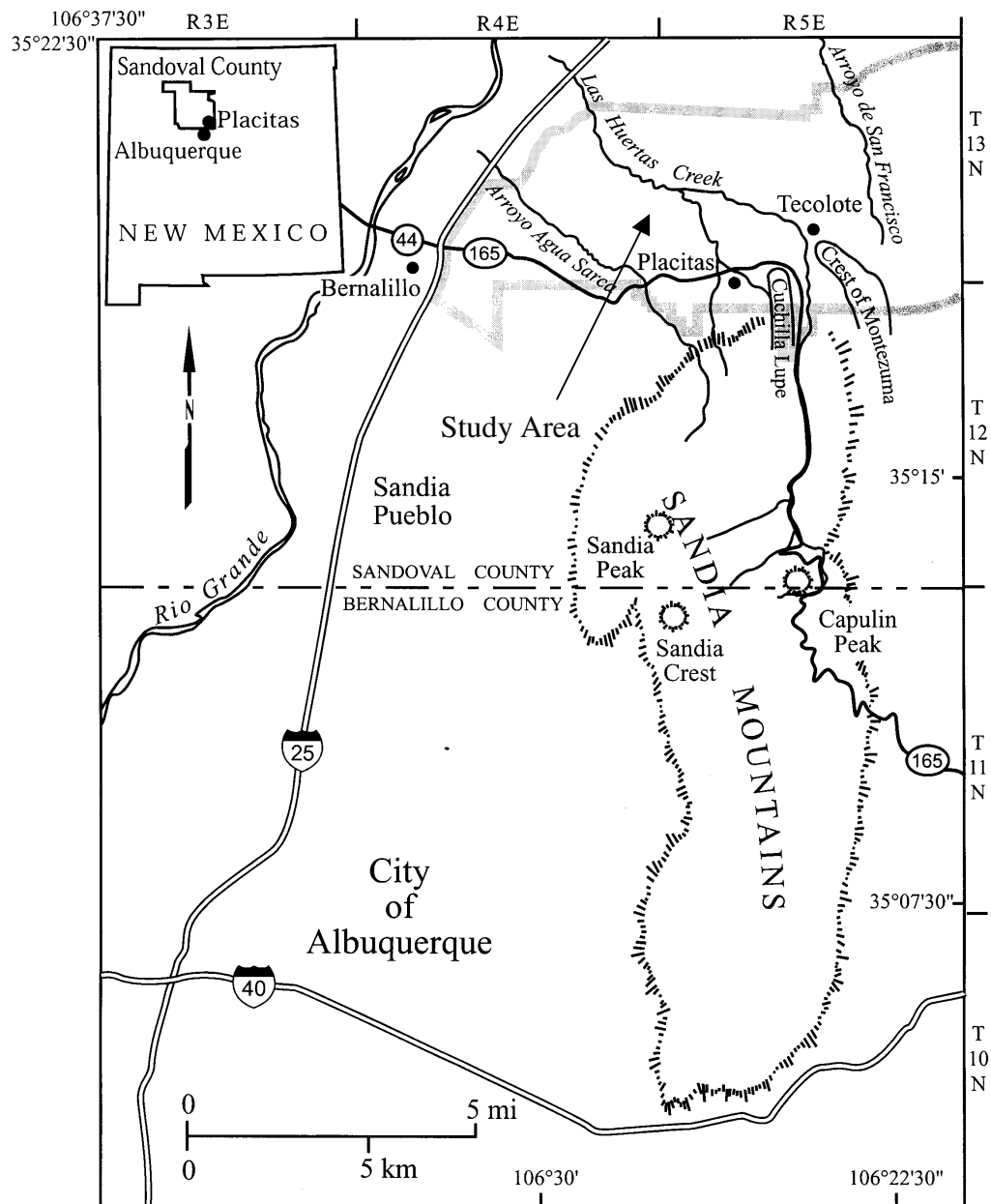
The Placitas area is situated between the north flank of the Sandia Mountains and eastern margin of the Rio Grande basin in north central New Mexico (Figure 1). A recent study determined the presence of three complex and different hydrogeologic regimes in the area (Johnson, 2000). Water resources stemming from these complex regimes vary in quantity and quality. A number of perennial springs in the Placitas area are important from both water resources and cultural aspects. Local acequias continue to operate today in much the same way as a century ago.

This study has calculated total consumptive use in the Placitas area for the year 2000 to be approximately 1,747 acre-feet (af). The distribution of consumptive use within the Placitas area in the year 2000 was as follows: irrigated agriculture accounted for 41.1 per cent; community water systems (CWS) 16.0 per cent; self-supplied industrial 13.2 per cent; self-supplied mining 11.1 per cent; riparian evapotranspiration 9.8 per cent; individual domestic wells 7.4 per cent; shared wells 1.2 per cent and self-supplied commercial 0.2 per cent (Figure 2).

Data sources for this study include publications and publicly available data from the New Mexico Office of the State Engineer (NMOSE), the U.S. Census Bureau, and public water suppliers within the Placitas area. Water-use data are presented in the form of withdrawal (water pumped from ground water or diverted from surface water) and where applicable, consumptive use or depletion which is removed from the surface and ground water systems via evaporation, transpiration, or other processes (Shomaker, 2000).

The available data on consumptive use (e.g. documented historical and current consumptive use) allowed for graphical trend analysis, and showed an increasing trend for the water used by CWS and self-supplied mining. Based on these trends it is likely that the Placitas area consumptive use will continue to increase as the area further develops.

HISTORICAL AND CURRENT WATER USE IN THE PLACITAS AREA,
SANDOVAL COUNTY, NEW MEXICO



**Figure 1. Location of the Placitas study area,
Sandoval County, New Mexico
(modified from Johnson, 2000)**

*Estimated Total Consumptive Use in Placitas area in year 2000
was approximately 1,747 acre-feet*

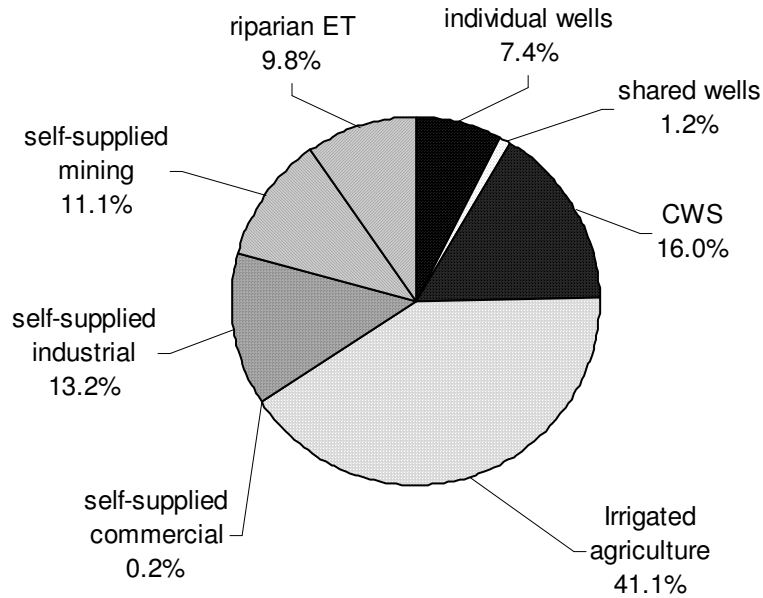


Figure 2. Estimated Consumptive Use Values for the Placitas area, year 2000.

1.0 INTRODUCTION

In 1987, the New Mexico Legislature recognized the state's need to balance water supply and demand, and created and funded New Mexico's Water Planning Program. The objective of the legislation was to address the reservation of any unappropriated water for a region's future (Follingstad 2001). The legislature directed that water planning is most effectively done at the local level (New Mexico Interstate Stream Commission, 1994). This planning initiative is overseen by the NMOSE and the Interstate Stream Commission (ISC), and funded through the Commission. Local water planning is now ongoing state-wide (New Mexico Interstate Stream Commission, 1994).

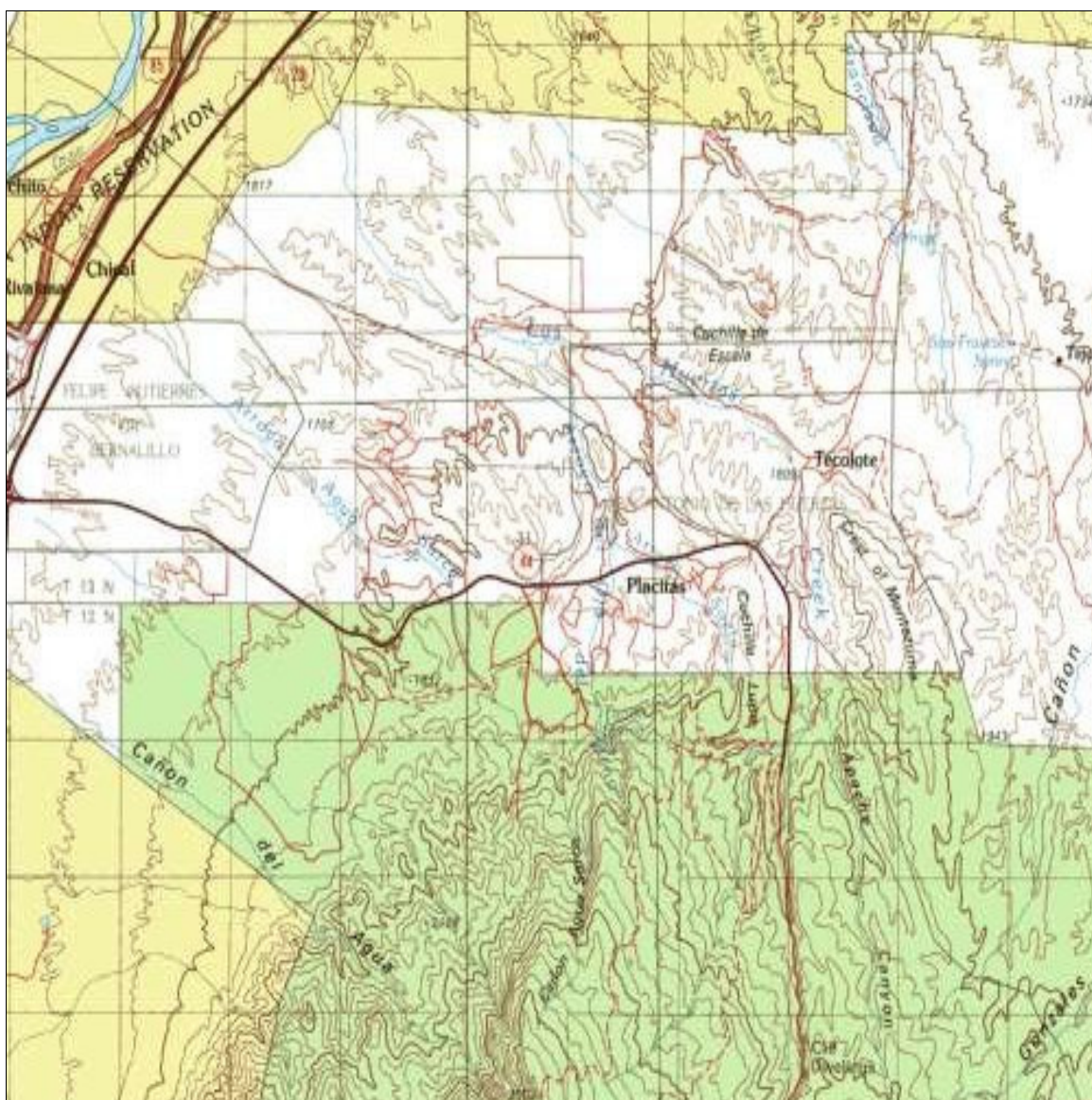
The ISC developed a regional water-planning handbook (Handbook) in 1994 as a set of guidelines and a template for regional water planning efforts in New Mexico (ISC, 1994). The water planning process addresses five basic questions: 1). What is the region's water supply? 2). What is the region's water demand (now and future)? 3). What alternatives exist to balance supply and demand? 4). Which alternatives fit the community's values? 5). What strategies will implement the accepted alternatives? Although the ISC promotes regional water planning, it has no enforcement powers and local governments are responsible for implementing plans. The ISC is responsible for consolidating regional plans into a state water plan. The regional and state water plans will serve as a basis for creating policies and regulations that balance water demand with available supply, now and into the future, within the context of existing local and state water use laws and regulations, and inter-state compacts. Given its structure as a local community-based process, regional water planning incorporates local stakeholder input on alternative water management strategies.

New Mexico must complete its regional and state planning so that the future use of water can be anticipated in any water right administration or water management scheme (NMOSE /ISC, 2001). Without adequate planning, there is no surety that New Mexico's water resources can be developed, preserved, or protected (NMOSE /ISC, 2001).

Current water planning efforts in New Mexico reflect the complexities of balancing the state's finite water supply with a host of competing demands for the resource. Many of these complexities affecting various portions of the state come together in Placitas, New Mexico (Wessely, 2001). The impetus of regional, state, and local water planning has led the Del Agua Institute (DAI) and Placitas Water Planning Group (PWPG) to adopt the ISC template and move forward with the development of a Water Plan for the Placitas area of the Middle Rio Grande Water Planning Region.

1.1 STUDY AREA

The area addressed in this analysis is defined by boundaries determined by the consensus of the PWPG and are a mix of political and physiographic boundaries (Figures 1 and 3). All but the eastern boundary coincide with the area addressed in the New Mexico Bureau of Mines year 2000 study, referred to therein as the "Placitas Development Area" (Johnson, 2000). The eastern boundary has been extended to include the boundary of the watershed feeding the Arroyo de San Francisco, an important ground water recharge feature in the area.



**Figure 3. Location and topography of the Placitas study area,
Sandoval County, New Mexico**

Placitas study area represented by white boundary of map
(modified from USGS Bernalillo, Placitas and Hagan New Mexico Quadrangles)

1.2 TERMINOLOGY

Water-use data are presented in the form of withdrawal (water pumped from ground water or diverted from surface water) and where applicable, consumption, consumptive use, or depletion (terms that refer to water that is removed from the surface) and ground water systems via evaporation, transpiration, or other processes (Shomaker, 2000). Diversion or water withdrawal is a transfer from the source of either ground water or surface water to the location of use (Shomaker, 2000). This report provides both withdrawal and consumptive use data when available. Water quantities are expressed in acre-feet (af), the volume of water necessary to cover an acre to the depth of one foot. An acre-foot is equivalent to 325,851 gallons (Hornberger, et al. 1998).

A glossary containing pertinent terms used in this report, as well as terms that may be generally useful to the reader is included as Appendix A.

2.0 SETTING

2.1 *HYDROGEOLOGY*

The Placitas area lies at a geologically complex transition zone between the Albuquerque Basin and the Sandia Mountains uplift (Johnson, 2000). This complex transition is characterized by structural deformation, resulting in abundant faults and highly variable aquifer rock and sediment types. The Placitas area contains three distinct aquifer systems: the Sandia Mountains, the Placitas foothills (known as the Mesozoic ramp), and the Albuquerque Basin (Johnson, 2000). The geologic variability and complexity of this hydrologic system is the basis for the high variability of water availability and quality in the area (Johnson, 2000).

2.2 *SURFACE WATER HYDROLOGY*

Three principal drainage basins have been identified in the Placitas area; Las Huertas Creek, Arroyo Agua Sarca, and Arroyo de San Francisco. Most streams draining the major basins in the area are intermittent or ephemeral and flow primarily in response to spring snowmelt or heavy storm runoff (Johnson, 2000). However, there are perennial spring-fed reaches of the Las Huertas Creek and Arroyo de San Francisco. These springs are a critical surface water resource for the Placitas area. Three acequias, the Las Huertas-La Jara Ditch Association and the Las Acequias of the Community of Placitas, and the Rosa de Castilla Ditch Association rely on spring discharge and/or creek flow for irrigation and/or domestic water supplies.

2.3 POPULATION

Recent population projections indicate that by 2050 New Mexico's current population of 1.8 million will grow to 3.3 million people, an increase of 85% (OSE/ISC 2001). The Placitas area has evolved from a sparsely populated, rural agricultural area to a mixed suburban environment. Population growth in the Placitas area increased by 85% during the 1970's and from 20% to 30% during the 1980's and early 1990's. The 1990 and 2000 Census population data lists the total population for the Placitas area as 1,611 and 3,452, respectively - a 114 % increase (U.S. Department of Commerce, 2002)¹. The Placitas area has relied primarily on ground water for a domestic water supply and the escalating population of the area is represented by the number of permitted wells drilled in the Placitas area between 1958-2000 (Figure 4).

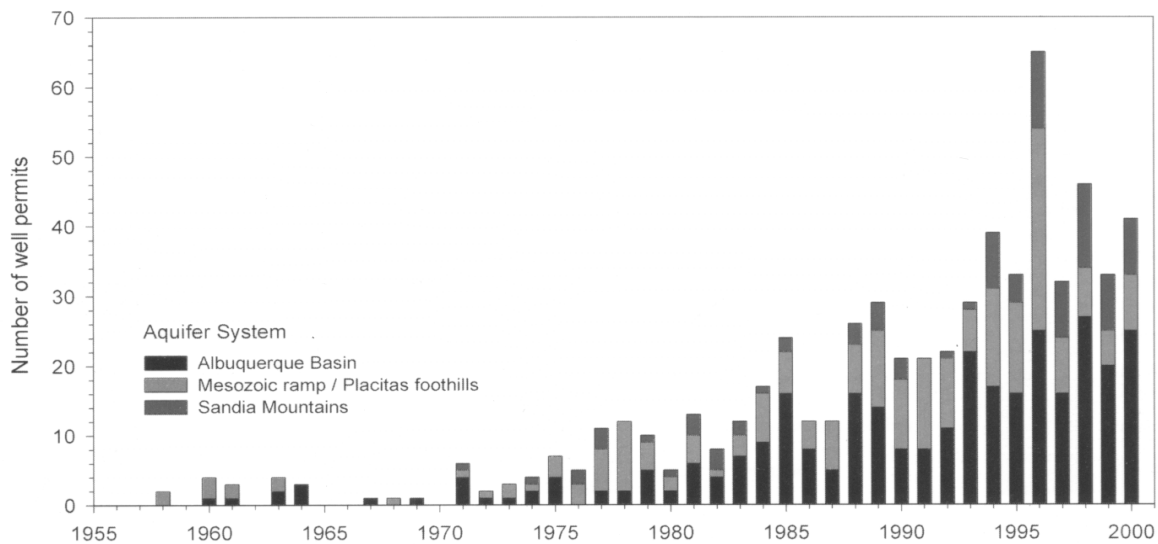


Figure 4. Number of permitted wells drilled annually in the Placitas area, 1958-2000. (Johnson, 2001)

¹ Census data for Placitas Census Designated Places (CDPs). CDPs are closely settled, named, unincorporated communities that generally contain a mixture of residential, commercial, and retail areas similar to those found in incorporated places of similar sizes. Each CDP will contain an identifiable core encompassing the area that is associated strongly with the CDP name and contains the majority of the CDP's population, housing, commercial structures, and economic activity.

3.0 WATER USE BY CATEGORY

3.1 INDIVIDUAL DOMESTIC WELLS

According to the definition of an individual domestic well presented in Section 72-12-1 of the New Mexico Statutes Annotated (NMSA) 1978, groundwater is diverted from one well to serve one residential connection, which may be a single-family dwelling or a multi-family dwelling (Wilson, 1996). Totalizing meters are not required on individual domestic wells. The annual permitted diversion from the well is limited to 3 af.

3.1.1 Methods

Using the boundary coordinates of the study area, Township 12 and 13 North, Range 4 and 5 East, a domestic well search was conducted by Sections, utilizing the NMOSE Water Administration Technical Engineers Resource System (WATERS) located on the Internet (NMOSE, 2002). The web site displays the following disclaimer: *The data provided from this Web Query System is furnished by the New Mexico Office of the State Engineer/Interstate Stream Commission (OSE/ISC) and is accepted for use by the recipient individual or entity with the expressed understanding that the OSE/ISC and author(s) of the data make no warranties, expressed or implied, concerning the accuracy, completeness, reliability, usability, or suitability for any particular purpose of the data. The OSE/ISC and author(s) of the data shall not be liable to any individual or entity by reason of any use made thereof.* There was a general lack of consistency among the data accessed through the WATERS database, and most of the Placitas Study Area data coverage begins in 1999.

3.1.2 Results

Based on a report from the WATERS database, a total of 501 permitted individual wells were counted within the study area as of January 21, 2002. The Placitas Water Planning Group (PWPG) performed a preliminary water budgeting exercise during 2001 (PWPG, 2001). Based on this exercise, approximately 1,500 built-out lots were counted in the Placitas study area as of June 2000. Five hundred and one domestic wells are approximately one-third of the total households within the study area, based on the PWGP exercise. As stated previously, the annual diversion for these wells is limited to 3 af annually.

The NMOSE estimates an average daily consumption value ranging from 50 to 150 gallons per capita daily (gpcd) within the regional water planning area, based on varying water requirements for indoor use, landscape irrigation, and evaporative cooling (Shomaker, 2000). Note that data on climatic conditions are not included in the NMOSE estimated daily consumption values. It is expected that the average consumptive use (CU) for permitted individual wells within the study area ranges between 1.5×10^{-4} and 4.6×10^{-4} af per capita daily. Based on data reported in the year 2000 U.S. census, the average household in Placitas includes 2.32 people (U.S. Department of Commerce, 2000). Therefore, the average annual CU for permitted individual domestic wells within the study area (501 wells) ranges between 63.68 and 195.29 af (example calculation below).

$$\begin{aligned} & (501 \text{ wells} * 2.32 \text{ people/well} * 365.25 \text{ days/year}) * (1.5 \times 10^{-4} \text{ af/day-person}) \text{ to } (4.6 \times 10^{-4} \text{ af/day-person}) \\ & = 63.68 \text{ af/yr to } 195.29 \text{ af/yr} \end{aligned}$$

3.2 PUBLIC WATER SUPPLY

Public water supply systems include community water systems which rely upon surface and/or ground water diversions other than wells permitted by the NMOSE under Section 72-12-1 NMSA, 1978, and which consist of common collection, treatment, storage and distribution facilities operated for the delivery of water to multiple service connections (Shomaker, 2000). Essentially, public water-supply providers in the Placitas area consist of water associations, water cooperatives, and community wells for subdivisions. These water providers are termed community water systems (CWS) for purposes of this report. All diversions must be metered at the source, and it is recommended that each service connection be metered (Wilson, 1996). The actual annual diversion must not exceed the legal water right for the system.

3.2.1 Methods

Water use data for public supply providers were collected from four different sources:

- 1). NMOSE WATERS website by the methods outlined in section 3.1.1;
- 2). NMOSE meter records;
- 3). water system surveys; and
- 4). correspondence via telephone, electronic mail, and personal interviews.

Water system surveys were delivered to 12 of the identified 18 water CWS on November 3, 2001. Five surveys were returned to the author. An example of the Surveys sent to the CWS is included in Appendix B. According to Tom Morrison, Water Resource Manager of the NMOSE Hydrology Bureau (personal communication, 06 February, 2002) CU for CWS in the Placitas area is considered to be 100 per cent of total withdrawal based on the prevailing hydrogeologic conditions of the area.

The Placitas Village domestic water system (Las Acequias de Placitas) serves approximately 190 households and is derived from springs emanating from the Sandia Mountains. The Village water system is considered to be a single CWS. Connections to the Las Acequias de Placitas are not metered at individual connections and are not required to report usage to the NMOSE. Estimated CU for the Las Acequias de Placitas is based on the individual well methods presented in section 3.1.1.

3.2.2 Results

The period of record for data utilized to calculate water withdrawal and consumptive use ranged from 2 to 32 years. Clearly, CWS with a longer or more established period of record have a higher withdrawal and subsequent CU value. Table 1 presents the average annual withdrawal and CU for the period of record 1996 through 2001 for the identified CWS. The estimated average annual CU for the Village water system ranges between 24.15 and 74.06 af (example calculation below).

$$(190 \text{ households} * 2.32 \text{ people/household} * 365.25 \text{ days/year}) * (1.5 \times 10^{-4} \text{ af/day-person}) \text{ to } (4.6 \times 10^{-4} \text{ af/day-person}) = 24.15 \text{ af/yr to } 74.06 \text{ af/yr}$$

**Table 1. Average Annual Withdrawal and Consumptive Use Values for Placitas area
Community Water Systems (1996-2001)**

Community Water System	Average Annual Withdrawal (af)^a
Calle del Sol	0.07
Cedar creek	7.80
Home Owners Assoc. Corral	0.66
La Mesa - Sundance	58.75
La Puerta	6.11
Ranchos de Placitas Water and Sanitation Dist.	40.62
North Ranchos (units 4,5,6,7)	37.40
Overlook	11.56
Placitas Trails	37.02
Placitas West	13.05
Puesta del Sol	2.97
Tierra Madre well #1	2.09
Tierra Madre well #2 (Los Vecinos)	2.58
Tierra Madre well #3	2.22
Tierra Madre well #4 (Agua Sarca)	NA
Vista de la Montana	2.04
Vista del Oro de Placitas	4.98
Placitas Village Water System ^b	49.1
Total	279.02

^a withdrawal = consumptive use (Tom Morrison, Water Resource Manager of the NMOSE Hydrology Bureau, personal communication, 06 February, 2002).

^b estimated value

NA = Not Available

Generally, available meter files were complete to date for the 18 CWS with reporting requirements. However, some files were either missing partial or entire years of data, or the data reported in the NMOSE file was incomplete. The period 1996 through 1999 was particularly problematic in this regard. A data summary table of CWS reported withdrawals and CU is presented as Appendix D (excluding the Village water system). The summary indicates where the data is missing or incomplete for selected CWS during 1994-2001. These data gaps have produced a misleading decreasing trend in total withdrawal and CU at various time intervals

within this period (excluding Las Acequias de Placitas), as evident in Figure 5. Overall, water withdrawal and CU use has increased between 1967 and 2001 with an evident rapid increase starting in the early 1990's.

3.3 *SHARED WELLS*

A domestic well that has been equipped to serve from 2 to 4 households is conventionally termed a “shared well” (Wilson, 1996). Regulations governing the use of shared wells are presented in Section 72-12-1 of the NMSA. A water meter is required at the wellhead, and the annual diversion from each well is limited to 3 af or less in any year.

3.3.1 *Methods*

The total number of shared wells was obtained by a domestic well search in the OSE WATERS database utilizing the methods discussed in section 3.1.1. The number of wells listed with the primary purpose prefix “MUL”, meaning multiple domestic households, was subtracted out of the search results and tabulated to determine the number of shared wells in the study area. Diamondtail, a planned development with the intention of using shared well systems as the water supply, was not included in this category. Information for the Diamondtail development was obtained from the Internet web-site (Diamondtail, 2002). As of January 31, 2002, development of the Diamondtail subdivision was minimal. However, with a planned full-buildout of 290 lots, Diamondtail will become a significant residential water user in the coming years.

3.3.2 Results

Twenty-eight shared wells were tabulated in the study area, excluding Diamondtail². Estimating daily consumptive values using the method described in Section 3.1.2, the average annual CU for the study area (assuming 28-shared wells) was calculated. The estimated average CU for the study area ranges between 10.68 and 32.74 af per year (example calculation below).

$$(28 \text{ wells} * [3 \text{ households} * 2.32 \text{ people/household}] * 365.25 \text{ days/year}) * (1.5 \times 10^{-4} \text{ af}) \& (4.6 \times 10^{-4} \text{ af}) \\ = 10.68 \text{ af/yr to } 32.74 \text{ af/yr}$$

3.4 IRRIGATED AGRICULTURE

Irrigated agriculture includes all diversions of water for the irrigation of crops grown on farms and ranches.

3.4.1 Methods

Actual current and historical measurements for irrigation water diversions are not available for the Placitas area. Agricultural diversions may be estimated based on water right Declarations and Licenses on file at the OSE (Table 2).

² Based on information reported on the Diamondtail web-site, 59 lots are planned for the Phase I development. Water is planned to be supplied by shared wells serving 4 to 6 lots each. Based on these numbers, 10 to 15 shared wells would supply Phase I. An additional 231 lots would be developed in ensuing phases, requiring an additional 39 to 58 shared wells. www.diamondtail.com

**Table 2. Summary of Agricultural Diversions and
Consumptive Use for the Placitas Study Area.**

Declaration No.	Diversion (af)	Irrigated Acreage	Priority Date	Source
597	432.96	144.32	1866	Las Huertas-La Jara Community Ditch
949	3.00 ^a	212	1863	Las Acequias de Placitas
1644	^b	3.5		Rosa de Castilla Spring
1644		80.42		Rosa de Castilla Spring
2276		29		San Francisco Springs
4358		5.5	1906	San Francisco Springs
License No.				
1350	40.00	20	1920	March 1 to October 1; Arroyo de las Placitas
Total Declared Irrigated Acreage 494.74				

^aDiversion for Declaration 949 is stated on a per-acre basis.

^bShaded area represents limited or missing information.

Approximate irrigation diversion in planning area: **1484.22 ac-ft per year** (assumes uniform irrigation diversion of 3.0 af per acre per year) less average village domestic use of **49.10 af per year**

Approximate net irrigation requirement in planning area: **717.56 af per year** (assumes uniform on-farm irrigation efficiency of 50%, and a uniform net irrigation requirement of 1.45 af per acre per year).

Several terms are used to describe various components of agricultural water use, and are defined in the Glossary. Declarations and Licenses on file for the Placitas area are structured in various ways. The Las Huertas-La Jara Community Ditch declares a total diversion right of 432.96 af per year, based on a declared irrigated acreage of 144.32 acres, which works out to a diversion of 3.0 af per acre. The Las Huertas - La Jara Community Ditch diverts water from Las Huertas Creek. The Placitas Community Ditch declares a total diversion of 3.0 af per acre on a total of 212 acres. The Las Acequias de Placitas Community Ditch diverts water from a series of springs emanating from the base of the Sandia Mountains near the Village of Placitas. Others simply list the total acreage declared for irrigation. For purposes of estimated agricultural water

use in the Placitas area, a total diversion of 3.0 af per irrigated acre was assumed, consistent with the major irrigation associations of the area.

3.4.2 Results

As indicated in Table 2, a total of 494.74 irrigated acres is declared in OSE records. Assuming a diversion allotment of 3.0 af per acre per year, a total of 1,484.22 af per year would be diverted. The Placitas village declaration indicates that part of its declaration applies to the domestic water system. Assuming an average of 49.10 afy is used for domestic application in the village (based on estimated year 2000 water use - see Section 3.2.1), a total of 1,435.12 af per year is available for irrigation. Total CU by crops is comprised of both irrigation water and precipitation. The total CU minus the portion of natural precipitation available to crops (termed “effective precipitation”) is termed the Net Irrigation Requirement (NIR). Based on an assumed farm irrigation efficiency of 50%, a total of 717.56 af per year is available to service the NIR, or approximately 1.45 afy per acre. Effective precipitation would augment the 1.45 afy per acre for consumptive use.

An allotment of 1.45 af per year per acre to service the NIR in Placitas is generally consistent with that described in OSE Hydrographic Surveys performed in conjunction with the adjudication process in northern New Mexico. As such an adjudication has not yet been performed in the Middle Rio Grande (or therefore Placitas) area, specific figures for agricultural water use have not been finalized. During the adjudication process, detailed analyses are performed to determine site-specific levels of crop consumptive use, effective precipitation, on-farm irrigation efficiency, and net irrigation requirement.

Detailed evaluation of these quantities will depend on historical irrigation and growing practices, and site-specific climate and soil conditions. Additional factors such as irrigation system conveyance efficiency may also be evaluated. During adjudication, additional historically irrigated acreage that is not currently declared in OSE files may be assigned water rights. Adjudication is a rigorous and extensive process that will result in specific assignments of agricultural water rights to area irrigators. Until such a process is performed, these estimates of agricultural water use in the Placitas area will remain approximate.

3.5 *SELF-SUPPLIED COMMERCIAL*

According to Shomaker (2000) self-supplied commercial users include self-supplied businesses (e.g. motels, restaurants, recreational resorts and campgrounds) and institutions (e.g. schools, churches, and hospitals). Permitted users are restricted to withdrawal of no more than three af annually and must submit monthly or quarterly meter readings to the NMOSE.

3.5.1 Methods

Twelve permitted self-supplied commercial users were identified in the Placitas area through NMOSE meter files and “purpose of use codes” in WATERS database searches. Two permitted users, the Placitas Community Center and Anasazi Fields Winery, are recognized as “COM” or commercial users and have submitted monthly meter readings to the NMOSE for the years 2000 and 2001. The remaining ten users were noted as “SAN” or sanitary use in the WATERS database and lacked meter files. The “SAN” designation denotes sanitary use in conjunction with a commercial use. Table 3 presents a summary of the identified self-supplied commercial users. According to the NMOSE, 50%-60% of permitted self-supplied commercial

users (both “COM” and “SAN”) in New Mexico do not comply with the required meter reporting requirements (personal communication, Brian Wilson, Water Resource Manager I - NMOSE Water Use and Conservation Bureau, 06 February, 2002).

Generally, consumptive use estimates for self-supplied commercial users are based on the numbers of employees and per capita water use for individual businesses. However, the lack of information about the permitted sanitary self-supplied commercial users (e.g. number of employees and/or complete meter files) prevented such an estimation. Consumptive use estimates were based on methods presented in Section 3.1.2. The NMOSE concurs that basing CU for self-supplied commercial users on methods derived for individual wells is a valid and reasonable approach (personal communication, Brian Wilson, Water Resource Manager I - NMOSE Water Use and Conservation Bureau, 06 February, 2002). CU estimates for the two commercial self-supplied users were based on the meter files available.

3.5.2 Results

Besides the two permitted commercial users, ten permitted sanitary wells are likely a combination of schools, churches and other private and public commercial users. The annual estimated consumptive use for each of the twelve sanitary and/or commercial self-supplied users in the Placitas area is between 0.127 and 0.389 af. The average of this range is 0.258 af per year.

$$(2.32 \text{ people/well} * 365.25 \text{ days/year}) * (1.5 \times 10^{-4} \text{ af/day-person}) \text{ to } (4.6 \times 10^{-4} \text{ af/day-person}) \\ = 0.127 \text{ to } 0.389 \text{ af/yr}$$

Based on available meter files for the two commercial self-supplied users: The Placitas Community Center (year 2000) and the Anasazi Fields Winery (year 2001, personal

communication, Jim Fish, 22 April, 2002), the reported CU is 0.05 af and 0.03 af, respectively. Permitted supplemental irrigation diversion is also included under the Anasazi Fields permit. Self-supplied commercial use will likely increase as the Placitas area continues to grow and develop.

Table 3. Summary of Permitted Commercial and Sanitary Self-Supplied Commercial Users for the Placitas Study Area.

Water User/ NMOSE File Number	Use Category
Placitas Community Center / RG 51025	COM
The Anasazi Fields Winery / RG 61343	COM
RG 58614	SAN
RG 59333	SAN
RG 61623	SAN
RG 65080	SAN
RG 65081	SAN
RG 65912	SAN
RG 66450	SAN
RG 67042	SAN
RG 60024	SAN
RG 18360	SAN

3.6 SELF-SUPPLIED INDUSTRIAL

Self-supplied industrial includes enterprises engaged in the processing of raw materials (organic or inorganic-solids, liquids or gasses) or the manufacturing of durable or non-durable goods (Shomaker, 2000).

3.6.1 Methods

Data for self-supplied industrial use were obtained from NMOSE meter files. CU values were reported to the NMOSE by the permittee and used in this report.

3.6.2 Results

One self-supplied industrial user, Centex American Gypsum Company (Centex) was identified in the Placitas area. Annual CU values for Centex's two wells located in the study area (a third well is located outside the study area within the Albuquerque city limits) were complete for the years 1990 through 2001. The annual average CU for this twelve-year period of record is 186.61 af. A data summary table of self-supplied industrial reported withdrawals and CU is presented in Appendix D.

3.7 *SELF-SUPPLIED MINING*

As described in Shomaker (2000), self-supplied mining includes enterprises engaged in the extraction of minerals occurring naturally in the earth's crust, water used for oil and gas well drilling, and processing done on the mine site.

3.7.1 Methods

Reported CU values from NMOSE meter files were used to determine annual CU values for self-supplied mining operations in the Placitas area.

3.7.2 Results

One self-supplied mine was identified in the Placitas area, that of M.T. Industries (LaFarge). LaFarge's most complete meter records were from 1994 to 2001. Therefore, annual average CU values were determined from this eight-year period of record. The annual average CU for the period of record is 217.57 af. A data summary table of self-supplied mining reported withdrawals and CU is presented in Appendix D.

Figure 6 presents annual CU values for combined self-supplied industrial and mining operations in the study area (dashed line represents missing or incomplete data). The average annual CU for both self-supplied commercial and mining for 1994 through 2001 is 416.93 af.

3.8 RIPARIAN EVAPOTRANSPIRATION

Riparian evapotranspiration is considered a consumptive use of both surface and ground water sources in the study area.

3.8.1 Methods

Estimates of annual evapotranspiration (ET) of water associated with perennial riparian areas in the Placitas area were prepared based on current ecology research in the Middle Rio Grande (MRG) region of New Mexico. Recent work in riparian evapotranspiration performed by University of New Mexico (UNM) researchers combines analysis of Landsat imagery along a 320 mile reach of the Middle Rio Grande with localized field studies using canopy and understory (ET) instrumentation to estimate typical riparian ET rates (Dahm, et al, 2002). The study addresses ET from both the predominant native MRG riparian species, such as cottonwoods (*Populus* spp.), coyote willow (*Salix exigua*.), and seep willow (*Baccharis*

salicifolia), in addition to predominant exotic species such as salt cedar (*Tamarix chinensis*) and Russian olive (*Elaeagnus angustifolia*).

Based on observations of riparian areas in the Placitas study area, this profile of native and exotic species is applicable to the perennial stream reaches of the Arroyo Ojo del Orno, Arroyo Agua Sarca, Arroyo del Oso, Arroyo Suela, Las Huertas Creek and Arroyo de San Francisco. Typical annual rates of ET determined by the UNM researchers ranged from approximately 75 - 125 centimeters per year, or approximately 1 meter per year on average (Dahm et al, 2002).

3.8.2 Results

Reaches of perennial riparian vegetation were mapped during the extensive evaluation of Placitas area hydrogeologic conditions by the New Mexico Bureau of Mines and Mineral Resources (NMBMMR) during 1998 - 2000 (Johnson, 2000). Evaluation of maps of surface water features presented in this report indicate approximately 8.6 miles of perennial stream reaches that sustain riparian vegetation in the study area. Aerial photographs of the Placitas area obtained from the UNM Earth Data Analysis Center were used to determine that the average width of the riparian growth area along the perennial stream reaches was approximately 50 feet. Combining typical ET rates from the UNM study with riparian area estimates yields a typical annual growing season ET of approximately 171 af per year for the Placitas area (example calculation below).

$$\begin{aligned} &8.6 \text{ miles} * 5,280 \text{ feet/mile} * 50 \text{ ft} * (2.296 \times 10^{-5} \text{ acres/ft}^2) * 1 \text{ meter/year} * 3.281 \text{ feet/meter} \\ &= 171.0 \text{ af/yr} \end{aligned}$$

4.0 ESTIMATED TOTAL CONSUMPTIVE USE FOR THE PLACITAS AREA FOR YEAR 2000

Estimated consumptive use for the Placitas area during the year 2000 was calculated by tabulating the consumptive use results from sections 3.1 through 3.6. The year 2000 was selected as it is the most recent year for which relatively complete records were available. When the annual consumptive use was calculated as a range in the previous sections, the mean value of this range was used in the calculation for the Placitas area totals. For instance, the estimated consumptive use of an individual domestic use well is between 63.68 and 195.29 af per year, therefore, the mean value of this range, 129.48 af, was used as a value for individual domestic wells in the calculation for total consumptive use in year 2000.

Total consumptive use in the Placitas area for year 2000 was 1,747.13 af. Table 4 presents the use category and the associated estimated year 2000 CU. The distribution of consumptive use within the Placitas area in year 2000 is as follows: irrigated agriculture accounted for 41.07 per cent, CWS 15.97 per cent, self-supplied industrial 13.19 per cent; self-supplied mining for 11.15 per cent; riparian evapotranspiration 9.79 per cent; individual domestic wells 7.41 per cent; shared wells 1.24 per cent; and self-supplied commercial 0.18 per cent.

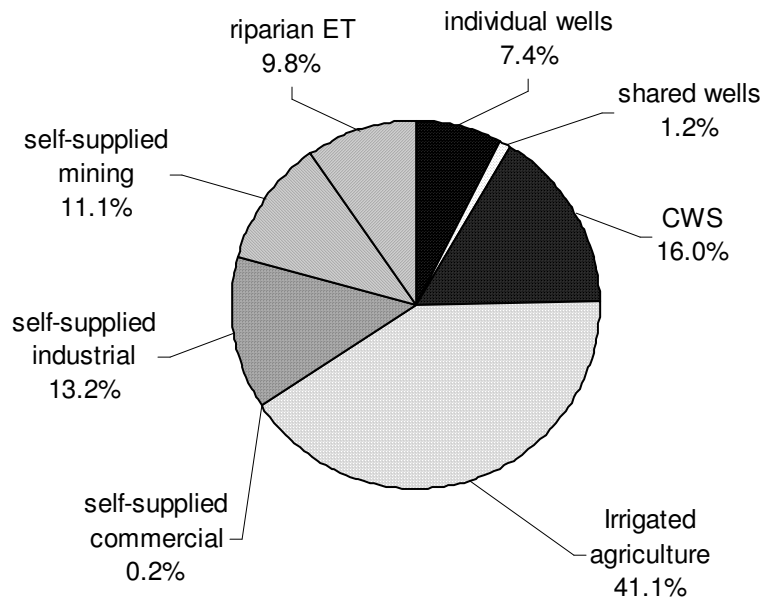
**Table 4. Use Categories and Estimated Consumptive Use Values
for the Placitas Study Area -Year 2000.**

Water Use	Consumptive Use (af)	Per cent Total
Individual wells	129.48*	7.41
Shared wells	21.71*	1.24
CWS	279.12*	15.97
Irrigated agriculture	717.56*	41.07
Self-supplied commercial	3.1*	0.18
Self-supplied industrial	230.41	13.19
Self-supplied mining	194.75	11.15
Riparian evapotranspiration	171.00*	9.79
Total	1747.13	100

*estimated value

The per centage distribution of total CU for these categories is illustrated in Figure 2 (reprinted, following page). The per centage allocations in Figure 2 have been rounded to a single place past the decimal point.

*Estimated Total Consumptive Use in Placitas area in year 2000
was approximately 1,747 acre-feet*



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Where the available CU data (e.g., historical and actual consumptive use documented) allowed for graphical trend analysis, an increasing trend was observed for the CWS and self-supplied industrial and mining uses. Based on these trends, it is likely that the Placitas area consumptive use will continue to increase as the area further develops.

5.0 REFERENCES

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APPENDIX A

Glossary (NMOSE, 1994)

ACRE-FOOT:

Volume of water required to cover 1 acre of land (43,560 square feet) to a depth of 1 foot, equivalent to 325,851 gallons.

ALLUVIUM:

General term for deposits of clay, silt, sand, gravel, or other particulate material deposited by a stream or other body of running water in a streambed, on a flood plain, on a delta, or at the base of a mountain.

AQUIFER:

A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

ARTESIAN WATER:

Ground water under sufficient pressure to rise above the level at which the water-bearing bed is reached in a well. The pressure in such an aquifer commonly is called artesian pressure, and the formation containing artesian water is an artesian aquifer.

AVERAGE ANNUAL YIELD (WATER):

The average annual supply of water produced by a given stream or water development over a period of 12 months.

BEDROCK:

General term for consolidated (solid) rock that underlies soils or other unconsolidated material.

BENEFICIAL USE OF WATER:

The use of water by man for any purpose from which benefits are derived, such as domestic, municipal, irrigation, livestock, industrial, power development, and recreation. Under the New Mexico constitution beneficial use is the basis, the measure and the limit of the right to use water; therefore, beneficial use of public water diverted or impounded by manmade works is an essential element in the development of a water right.

BIOCHEMICAL OXYGEN DEMAND (BOD):

The quantity of oxygen utilized primarily in the biochemical oxidation of organic matter in a specified time and at a specified temperature.

CONJUNCTIVE WATER USE:

Combined use of ground water and surface water.

CONSUMPTIVE IRRIGATION REQUIREMENT (CIR):

The quantity of irrigation water, exclusive of precipitation, stored soil moisture, or ground water that is required consumptively for crop production.

CONSUMPTIVE USE (CU)

The amount of water consumed on a given area in plant transpiration, building of plant tissue, and evaporation from adjacent soil, surface water, snow, or intercepted precipitation in any specified time. Consumptive use may be expressed either in volume per unit area such as acre-feet per acre, or depth, such as inches or feet.

CONSUMPTIVE USE (EVAPOTRANSPIRATION):

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.

CONVEYANCE LOSS:

Water that is lost in transit from a canal, conduit, or ditch by leakage or evaporation. Generally, the water is not available for further use; however, leakage from an irrigation ditch, for example, can percolate to a groundwater source and be available for further use.

CUBIC FOOT PER SECOND:

The rate of discharge representing a volume of 1 cubic foot passing a given point during 1 second. It is equivalent to 7.48 gallons per second, or 448.8 gallons per minute.

DECLARED UNDERGROUND WATER BASIN:

An area of the state proclaimed by the State Engineer to be underlain by a ground water source having reasonably ascertainable boundaries. By such proclamation the State Engineer assumes jurisdiction over the appropriation and use of ground water from the source.

DEPLETION:

That part of a withdrawal that has been evaporated, transpired, incorporated into crops or products, consumed by man or livestock, or otherwise removed.

DISCHARGE:

Rate of flow at a given instant in terms of volume per unit of time; pumping discharge equals pumping rate, usually given in gallons per minute (gal/min); stream discharge, usually given in cubic feet per second (ft³/s). With respect to water underground, the rate of movement of water out of an aquifer. Discharge may be natural, as from springs, as by seepage, or it may be artificial as by constructed drains or from wells.

DIVERSION:

A turning aside or alteration of the natural course of a flow of water, normally considered physically to leave the natural channel. In some States, this can be a consumptive use direct from a stream, such as by livestock watering. In other States, a diversion must consist of such actions as taking water through a canal or conduit.

DOMESTIC WATER USE:

Water for normal household purposes, such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns, gardens and livestock supplied from a domestic source. Also called residential water use. The water can be obtained from a public supply or be self-supplied.

EFFECTIVE PRECIPITATION

Precipitation occurring during the growing period of a crop that becomes available to help meet the consumptive water requirements of the crop.

EPHEMERAL STREAM:

A stream or portion of a stream which flows only in direct response to precipitation. Such flow is usually of short duration. Most of the dry washes of the region may be classified as ephemeral streams.

EVAPORATION:

Process by which water is changed from the liquid state to the vapor state. See also Evapotranspiration; Transpiration.

EVAPOTRANSPIRATION:

The process by which water is returned to the air through direct evaporation or by transpiration of vegetation.

FRESH WATER:

Water that contains less than 1,000 mg/L (milligrams per liter) of dissolved solids; generally, more than 500 mg/L is considered undesirable for drinking and many industrial uses.

GROUNDWATER

Generally, all subsurface water as distinct from surface water; specifically, that part of the subsurface water in the saturated zone (a zone in which all voids, large and small, ideally are filled with water under pressure equal to or greater than atmospheric).

GROUND WATER MINING:

The condition that exists when the withdrawal of water from an aquifer exceeds the recharge causing a decline in the ground water level.

GROUND WATER RECHARGE:

The addition of water to the zone of saturation. Infiltration of precipitation and its movement to the water table is one form of natural recharge.

GROUND WATER RESERVOIR STORAGE:

The amount of water in storage within the defined limit of the aquifer.

HYDRAULIC GRADIENT (GROUND WATER):

The gradient or slope of the water table or potentiometric surface in a specific direction.

INTERMITTENT STREAM:

A stream which flows for only a part of the time. Flow generally occurs for several weeks or months in response to seasonal precipitation, due to ground water discharge, in contrast to the ephemeral stream that flows but a few hours or days following a single storm.

IRRIGATED AREA:

The gross area upon which water is artificially applied.

IRRIGATION:

Generally, the controlled application of water to arable lands to supply water requirements of crops not satisfied by rainfall. (See also Irrigation water use.) Systems used include the following:

Center-pivot:

Automated sprinkler irrigation achieved by rotating the sprinkler pipe or boom, supplying water to the sprinkler heads or nozzles, as a radius from the center of the circular field to be irrigated. The pipe is supported above the crop by towers at fixed spacings and propelled by pneumatic, mechanical, hydraulic, or electric power on wheels or skids in fixed circular paths at uniform angular speeds. Water, which is delivered to the center or pivot point of the system, is applied at a uniform rate by progressive increase of nozzle size from the pivot point of the system to the end of the line. The depth of water applied is determined by the rate of travel of the system. Single units are ordinarily about 1,250 to 1,300 feet long and irrigate about a 130-acre circular area.

Drip:

An irrigation system in which water is applied directly to the root zone of plants by means of applicators (orifices, emitters, porous tubing, perforated pipe, and so forth) operated under low pressure. The applicators can be placed on or below the surface of the ground or can be suspended from supports.

Flood:

The application of irrigation water where the entire surface of the soil is covered by ponded water.

Furrow:

A partial surface flooding method of irrigation normally used with clean-tilled crops where water is applied in furrows or rows of sufficient capacity to contain the design irrigation stream.

Gravity:

Irrigation in which the water is not pumped but flows in ditches or pipes and is distributed by gravity.

Sprinkler:

A planned irrigation system in which water is applied by means of perforated pipes or nozzles operated under pressure so as to form a spray pattern.

Subirrigation:

A system in which water is applied below the ground surface either by raising the water table within or near the root zone or by using a buried perforated or porous pipe system that discharged directly into the root zone.

Traveling gun:

Sprinkler irrigation system consisting of a single large nozzle that rotates and is self-propelled. The name refers to the fact that the base is on wheels and can be moved by the irrigation or affixed to a guide wire.

IRRIGATION CONVEYANCE LOSS:

The loss of water in transit from a reservoir, point of diversion, or ground water pump to the point of use, whether in natural channels or in artificial ones, such as canals, ditches, and laterals.

IRRIGATION EFFICIENCY:

The per centage of the water diverted from a water source that is consumed. It is the product of the distribution efficiency and the farm efficiency.

IRRIGATION LEACHING REQUIREMENT:

The amount of water required to move residual salts out of the root zone and maintain an adequate soil-salt balance for crop production.

IRRIGATION REQUIREMENT:

The quantity of water, exclusive of precipitation, that is required for production of a specific crop.

IRRIGATION RETURN FLOW:

Part of irrigation water that is not consumed by evapotranspiration and that drains from the irrigated area to an aquifer or surface-water body.

IRRIGATION WATER USE:

Artificial application of water on lands to assist in the growing of crops and pastures or to maintain vegetative growth on recreational lands such as parks and golf courses. See also Irrigation.

LOSSES INCIDENTAL TO IRRIGATION:

The quantity of water depleted by irrigation in excess of the beneficial irrigation consumptive use.

MILLION GALLONS PER DAY:

A rate of flow of water of one million gallons per twenty-four hour period.

NET IRRIGATION REQUIREMENT (NIR)

The quantity of irrigation water, expressed as a depth or volume, exclusive of effective precipitation, that is consumptively used by plants or is evaporated from the soil surface during one calendar year. Some sources refer to NIR as the "Consumptive Irrigation Requirement." NIR may be numerically determined by subtracting the effective precipitation from consumptive use (Wilson, 1995).

ON-FARM IRRIGATION EFFICIENCY (FIE)

Is the per centage of the total diversion at the farm headgate available for irrigation of crops. This accounts for various losses that occur between the diversion and the field application, including ditch seepage, evaporation, and deep percolation losses. (Wilson, 1995)

PER CAPITA USE:

The average amount of water used per person during a standard time period.

PERENNIAL STREAM:

A stream that normally has water in its channel at all times.

PHREATOPHYTE:

A plant that habitually obtains its water supply from the zone of saturation, either directly or through the capillary fringe.

POROSITY:

The ratio of the total volume of pore space (voids) in a rock or soil to its total volume, usually stated as a per centage. Effective porosity is the ratio of the volume of interconnected voids to the total volume. Unconnected voids contribute to total porosity but are ineffective in transmitting water through the rock.

POTABLE WATER:

Water that is safe and palatable for human consumption.

POTENTIOMETRIC SURFACE:

An imaginary surface representing the static head of ground water in tightly cased wells that tap a water-bearing rock unit (aquifer); or in the case of unconfined aquifers, the water table.

PRECIPITATION:

Includes atmospheric hail, mist, rain, sleet and snow which descends upon the earth; the quantity of water accumulated from the above events.

RECHARGE:

The addition of water to an aquifer by infiltration, either directly into the aquifer or indirectly by way of another rock formation. Recharge may be natural, as when precipitation infiltrates to the water table, or artificial, as when water is injected through wells or spread over permeable surfaces for the purpose of recharging an aquifer.

RECOVERABLE GROUND WATER:

The amount of water which may be physically and economically withdrawn from the ground water reservoir.

RECYCLED WATER:

Water that is used more than one time before it passes back into the natural hydrologic system.

RETURN FLOW:

The part of a diverted flow which is not consumptively used and which returns to a water body.

RIPARIAN VEGETATION:

Vegetation growing on the banks of a stream or other body of surface water.

SPECIFIC CAPACITY:

In ground water hydrology, the yield of a well in gallons per minute per foot of drawdown after a period of sustained pumping.

STOCK POND/TANK:

Any manmade or natural catchment used exclusively for livestock watering. Generally, for purposes of determining permitting requirements, a stock pond/tank either within a water course or off-stream that is used exclusively for livestock, of 10 af or less regardless of height, does not require a permit. However, there are basins in the state that require permitting in any case, so checking with the State Engineer is advised.

STREAM, PERENNIAL:

A stream that flows continuously.

STREAM FLOW:

The discharge that occurs in a natural channel of a surface stream course.

SURFACE WATER:

An open body of water, such as a stream or a lake.

TRANSMISSIBILITY (GROUND WATER):

The rate at which water at the prevailing water temperature is transmitted through a unit width of the aquifer under a unit hydraulic gradient. It is generally expressed as gallons per day through a vertical strip of the aquifer 1 foot wide under a hydraulic gradient of 1 foot per foot, or more recently as cubic feet per day under the same conditions. It replaces the term "coefficient of transmissibility".

TRANSPIRATION:

Process by which water absorbed by plants, usually through the roots. The residual water vapor is emitted into the atmosphere from the plant surface. See also Evaporation; Evapotranspiration.

An accounting of the inflow to, outflow from, and storage changes of water in a hydrologic unit.

WATERS

The State Engineer's and Interstate Stream Commission's electronic information resource of paper files indexed as images of original papers < <http://www.seo.state.nm.us/> >

WATER EXPORTS:

Artificial transfer (pipe, canals) of water to one region or subregion from another.

WATER RIGHT:

Legal rights to use a specific quantity of water, on a specific time schedule, at a specific place, and for a specific purpose.

WATER TABLE:

The upper surface of zone of saturation. See also Potentiometric Surface.

WITHDRAWAL:

Water removed from the ground or diverted from a surface-water source for use.

APPENDIX B

Community Water Systems Survey Form

APPENDIX C

Public Water System Contact Database

APPENDIX D

CWS, Self-Supplied Industrial and Self-Supplied Mining Data Tables

ⁱ Survey of Hamilton County, Ohio. U.S. Department of Agriculture, Soil Conservation Service, 1980.

ⁱⁱ Bowknocker, J.A. Geologic Map of Ohio. State of Ohio, Department of Natural Resources, Division of Geological Survey, 1981 (Reprint).