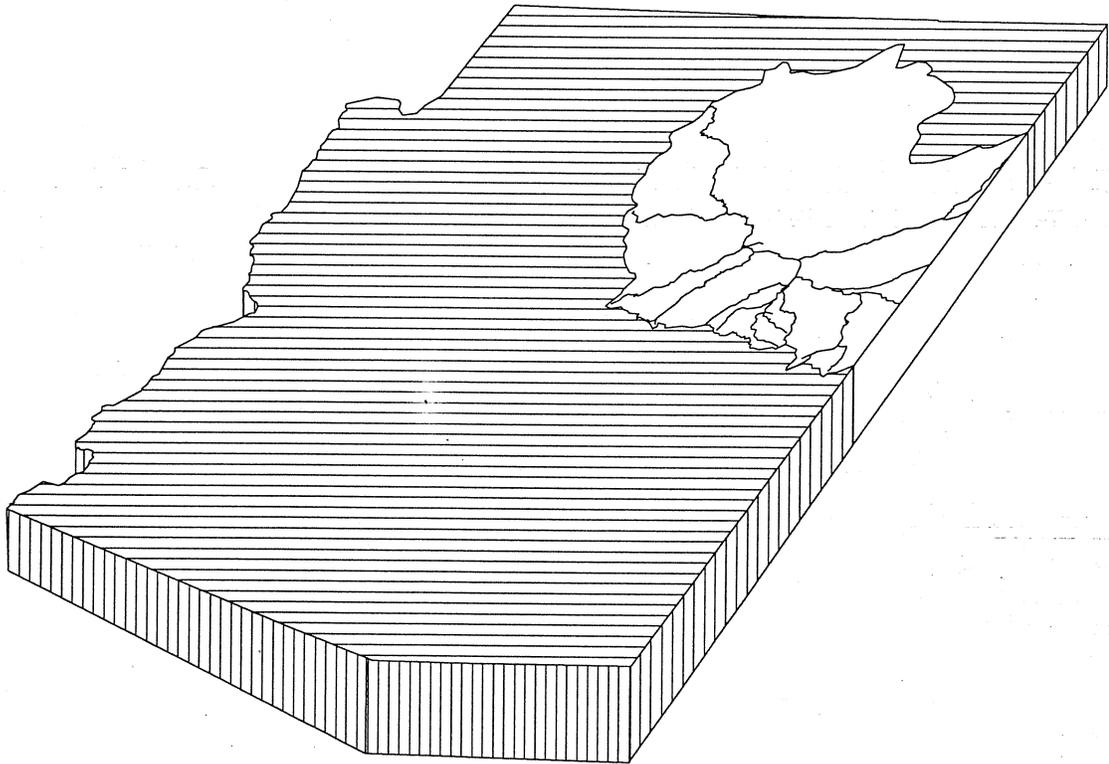


TECHNICAL REPORT ON DE MINIMIS ADJUDICATION
OF USES SUPPLIED FROM WELLS
IN THE LITTLE COLORADO RIVER SYSTEM

*In Re The General Adjudication Of The
Little Colorado River System And Source*



Arizona Department of Water Resources

April 1994

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CHAPTER 1: INTRODUCTION

In the general stream adjudications of Arizona, concern is being expressed over the burden of litigation imposed upon small water users, particularly those withdrawing water from wells. Complaints have been lodged with the courts and legislature that small water users are being forced to engage in litigation at a level far exceeding their relative impact on the river system and source. The courts have turned their attention to these complaints by considering the possibility of a streamlined adjudication for these small water users. By informal convention, the rights to be adjudicated in this streamlined fashion are referred to by the Latin words *de minimis*.

The concept of *de minimis* water rights is accepted in several western states. In Arizona, however, controversy exists over whether our surface water code would allow such a concept to be implemented in a meaningful fashion. Some parties have also expressed the belief that a streamlined adjudication of *de minimis* rights would make the overall proceedings noncomprehensive. This would jeopardize the waiver of sovereign immunity by the federal government granted under the McCarran Amendment, 43 U.S.C. § 666(a).

In light of this controversy, proponents of a streamlined adjudication for *de minimis* rights were encouraged by the opinion of the Arizona Supreme Court issued in July, 1993.¹ While perhaps not the final word on the subject, the state Court has indicated a preference that streamlined proceedings be considered by the adjudication courts:

We believe that the trial court may adopt a rationally based exclusion for wells having a *de minimis* effect on the river system. Such a *de minimis* exclusion effectively allocates to those well owners whatever amount of water is determined to be *de minimis*. It is, in effect, a summary adjudication of their rights. A properly crafted *de minimis* exclusion will not cause piecemeal adjudication of water rights or in any other way run afoul of the McCarran Amendment. Rather, it could simplify and accelerate the adjudication by reducing the work involved in

¹*In re The General Adjudication of All Rights to Use Water in the Gila River System and Source*, 175 Ariz. 382, 857 P.2d 1236 (1993).

preparing the hydrographic survey reports and by reducing the number of contested cases before the special master.²

At the request of the courts, the Arizona Department of Water Resources (DWR) has studied the possibility of a streamlined adjudication for *de minimis* rights. The study resulted in three reports published by DWR analyzing alternative methods of uniform quantification and the cumulative hydrologic impact of actual uses deemed to fit within proposed *de minimis* standards. The first report considered the stockwatering and stockpond uses supplied by surface water in the Silver Creek watershed of the Little Colorado River system.³ The second report also considered stockpond and stockwatering uses supplied by surface water, but was expanded to include domestic uses supplied by both surface water and groundwater in the San Pedro River watershed in the Gila River system.⁴ This report, prepared at the request of the Honorable Allen G. Minker of the Greenlee County Superior Court, considers uses throughout the entire Little Colorado watershed, exclusive of Indian lands, but considers only uses supplied from underground wells. No direct surface water diversions are considered.

The most controversial aspect of the *de minimis* reports issued to date has been the thresholds proposed by DWR to define which water uses will be classified as *de minimis* and which will not. The controversy has resulted, in part, from too much emphasis being placed on the significance of the *de minimis* thresholds. The thresholds, in DWR's view, serve only to identify the members of the class. The thresholds do not attempt to define how much water will be used, and particularly not what type of right will eventually be given to the class members.

In this report, DWR considers the hydrologic impact of all uses supplied from underground wells in the Little Colorado River system which meet DWR's definition of

²175 Ariz. at 394, 857 P.2d at 1248.

³Technical Report on De Minimis Adjudication of Stockpond and Stockwatering Uses in the Silver Creek Watershed, filed September 1, 1993, *In re the General Adjudication of All Rights to Use Water in the Little Colorado River System and Source*, Apache County Superior Court Civil Cause No. 6417-033-9005 (consolidated).

⁴Technical Report on De Minimis Adjudication of Domestic, Stockpond, and Stockwatering Uses in the San Pedro River Watershed, filed November 1993, *In re The General Adjudication of All Rights to Use Water in the Gila River System and Source*, Maricopa County Superior Court Cause Nos. W-1 thru W-4 (Consolidated).

"domestic," "other irrigation," or "municipal" use. In addition, DWR employs two quantity thresholds: a 10 acre-foot threshold is used to define which domestic or other irrigation uses will be included in a smaller *de minimis* class, and a 56 acre-foot threshold is used to determine which domestic, other irrigation, and municipal uses will be included in a larger *de minimis* class.

These quantities, 10 acre-feet and 56 acre-feet, are borrowed from the Arizona Groundwater Code provisions on exempt wells.⁵ DWR is aware that controversy exists over any suggested correlation between the Groundwater Code and the general stream adjudications, but in the absence of express legislative directive in the adjudication statutes, the Groundwater Code statutes still provide a natural starting point for defining a class of *de minimis* uses supplied by wells in the pending adjudications. The consistency gained from borrowing existing statutory guidelines, even if borrowed from Groundwater Code statutes, is particularly desirable as the state moves inevitably toward more conjunctive management of groundwater and surface water.

In considering the hydrologic impact of small uses supplied by wells, it is noted that the hydrology of the Little Colorado River system is markedly different than the hydrology of the Gila River system. It is DWR's belief that the legal concept of appropriable subflow, an issue of much concern in the Gila River system, will have very limited application in the Little Colorado River system.⁶ If that is true, many of the uses described in this report will be beyond the reach of parties objecting to those uses on the basis of their prior state law water rights.

Likewise, the uses described in this report may be found to have only a *de minimis* impact on the claimed reserved rights of the federal government and Indian tribes within the watershed. The Coconino Aquifer, which underlies most of the river system, is so large that cultural uses to date have had only a local impact on regional

⁵A.R.S. § 45-454.

⁶The issues of appropriable subflow are considered in detail in DWR's report, *Technical Assessment of the Arizona Supreme Court Interlocutory Appeal Issue No. 2 Opinion*, filed December 15, 1993.

water levels.⁷ The hydrologic analysis contained within this report also demonstrates that the uses considered have an almost undiscernible impact on the surface flows of the Little Colorado River. Given these facts, the state and federal courts may decide that the uses described here are outside the necessary jurisdiction of the adjudication and regulated only under the appropriate provisions of the Groundwater Code. In light of these possibilities, it becomes all the more apparent that small groundwater uses should not be forced to bear the burden of extensive litigation to prove a water right which may never be recognized in the adjudication.

DWR has not yet concluded its investigations for the entire Little Colorado River system and has not yet published its hydrographic survey reports for the entire region. Thus, DWR does not have at its disposal the extensive data base available in the Silver Creek and San Pedro River watersheds. Accordingly, the hydrologic analysis of existing uses in this report is based largely upon claims submitted in the proceedings. Criteria for evaluating these claims were established, as explained in the following chapters, by which clearly erroneous claim information was eliminated from the data base. Verification of the remaining data was accomplished by selecting and investigating representative samples, then projecting conclusions across the watershed.

Much attention has been paid to detail in constructing the data set used in this report, in order to minimize statistical aberrations and eliminate errors. Any assumptions made in the analysis have been consciously adjusted to overestimate, rather than underestimate, the impact of the uses on the river system. With this highly conservative approach, DWR is confident that the results of this analysis are reliable and responsive to the needs of the court in resolving the factual issues surrounding the streamlined adjudication process.

⁷See DWR's report, Hydrology of the Little Colorado River System, Special Report to the Settlement Committee, In re The General Adjudication of All Rights to Use Water in the Little Colorado River System and Source, October 1989.

CHAPTER 2: DEFINITION OF THE DE MINIMIS CLASS

The first step in any *de minimis* analysis is to create working definitions of *de minimis* rights, based upon the nature of the use, or the maximum quantity of the use. This report uses both criteria. The definitions of *de minimis* uses adopted in this report are taken up in Section 2.1.

The next step is to identify all potential members of the *de minimis* class. Because the Arizona Department of Water Resources (DWR) has not yet completed its hydrographic survey reports (HSRs) for the entire Little Colorado River system, this step involves statistical consideration of known data and projection of known trends across areas where information is missing or questionable. The methods used by DWR to complete this data set, and the results obtained, are explained in Section 2.2.

The final step in the demographic analysis is to determine the reasonably anticipated use by each member of the class. These "reasonably anticipated uses" are not the same as the thresholds used to identify the class members; in fact, they are significantly less than the thresholds. Assignment of "reasonably anticipated use" amounts are also based in part on statistical projections. The methods used and the results obtained are taken up in Chapter 3.

The end result of the analysis is to determine the total projected use of the *de minimis* class. That use can then be used to analyze the impact of this class on the surface water resources of the river system.

2.1 DEFINITION OF DE MINIMIS USES

The goal of a streamlined adjudication for *de minimis* rights should be to include as many water uses as possible, so long as it can be demonstrated with reasonable certainty that the cumulative effect of those uses is now, and can be predicted to be in the future, relatively inconsequential to the available water supply. Therefore, it is not the desire of DWR to be overly restrictive in limiting types of uses which can qualify for

de minimis status. At the same time, it is recognized that many *de minimis* uses will be currently withdrawing much less water than the maximum threshold. Therefore, it is important to select uses that are not likely to expand solely on the basis of relaxed *de minimis* standards of quantification. With these goals in mind, DWR proposes three categories of uses within the streamlined adjudication of *de minimis* rights:

1. "Domestic" - residential, gardening, and small commercial uses;
2. "Other Irrigation" - small landscape or aesthetic uses; and
3. "Municipal" - small municipal water providers.

Each of these categories will be considered separately in the following sections.

DOMESTIC USES

Domestic use is a category open to definition. Some would contend that only interior water use in the home should qualify for "domestic" use. Others would argue that domestic use also includes incidental exterior use for lawns and small gardens. Some would insist that all commercial enterprises be excluded from the domestic category. Others would recognize that it is appropriate to include small "mom and pop" businesses as relatively stable *de minimis* uses. In the Silver Creek Watershed Hydrographic Survey Report (Silver Creek HSR), DWR defined "domestic" use as:

Domestic (DM) - water used for household needs and small commercial establishments, including small businesses and restaurants. Trailer parks are also included in the domestic use category. Associated irrigation of less than two acres from groundwater is included in a domestic use.⁸

This definition was created, in part, of necessity. While investigating the nature of water uses in several watersheds throughout the state, DWR found it difficult to distinguish between pure "domestic" use and uses by small businesses, particularly those businesses conducted on the same premises as the proprietor's principal place of

⁸Silver Creek Watershed Hydrographic Survey Report, Vol. 1, p. 312 (1990).

residence. In preparing the HSRs for these watersheds, DWR decided to broaden its definition of "domestic" use to include many such enterprises, thereby relieving the field investigator from separately accounting for in home use and commercial use. In the context of *de minimis* rights, DWR concludes that this definition is appropriate and serves the need of including as many uses as possible within the *de minimis* standard.

"OTHER IRRIGATION" USES

When conducting investigations for its hydrographic survey reports, DWR has frequently come across a type of water use which does not fit readily into common categories. It is the use of water for aesthetic landscape purposes not associated with a residential structure. This occurs, for example, in the landscaped areas around businesses. It also occurs routinely in cemeteries and other irrigated areas maintained by a variety of public and private entities. To accommodate this type of use, DWR created the use category "other irrigation" which is abbreviated "OT" in the hydrographic survey reports. In the Silver Creek HSR, the use is defined as:

Other Irrigation (OT) - water used to produce plants used primarily for landscaping, aesthetic value, erosion control, and similar purposes. Common examples of other irrigation include cemeteries and landscaping around businesses and along highways. Also included in this category is irrigation of land by surface water sources less than two acres associated with a domestic use.⁹

Because other irrigation uses are typically small, DWR has elected to include them as a class of *de minimis* uses.

MUNICIPAL USES

The *de minimis* reports issued by DWR to date have only included uses which are self supplied; uses supplied by irrigation districts or private water companies have

⁹Silver Creek Watershed Hydrographic Survey Report, Vol. 1, p. 312 (1990). The last sentence of this definition has no bearing on this report, as surface water supplied uses are not being considered here.

been categorically excluded. In preparing this report, however, DWR has elected to examine the concept of including small water providers in the *de minimis* program. The typical small water company generally supplies single family residences and small businesses which, other than their source of supply, would be considered prime examples of *de minimis* uses. It seems appropriate, therefore, to consider the small municipal water provider for inclusion in the streamlined adjudication process.

In the Silver Creek HSR, DWR defined municipal use as:

Municipal (MU) - water supplied by a city, town, or private water company through its distribution system for any use. Cooperatives or joint ventures involving 4 or more users are included in this category.¹⁰

Obviously, this is a broad category which could include uses not appropriate for *de minimis* treatment. There is a need for further refinement of the status of municipal uses before the entire system is included in a streamlined adjudication. Rather than look at each individual use within the municipal system, however, DWR believes that adequate safeguards can be built in if the overall use of the small water provider is used to limit the members of the *de minimis* class.

In fact, DWR believes that this is good strategy for all proposed *de minimis* uses. Therefore, for each of the categories listed above, DWR has proposed maximum use quantities as a second test for *de minimis* status.

MAXIMUM QUANTITY FOR DE MINIMIS STATUS

To prevent large uses from taking advantage of the *de minimis* status based solely on type of use, it is appropriate to establish maximum quantities, or "threshold" values in the definition of *de minimis* uses. In this report, DWR has selected two such threshold values for consideration by the court. They are, respectively, 10 acre-feet per year maximum use and 56 acre-feet per year maximum use.

¹⁰Silver Creek Hydrographic Survey Report, Vol. 1, p. 312 (1990).

Concern has been expressed that DWR's recommended thresholds for *de minimis* uses, in this case, 10 and 56 acre-feet per year, are too high. There has also been some confusion between the threshold set for a *de minimis* use, and the amount of water actually assigned to that use for purposes of conducting the hydrologic analysis. These different concepts deserve explanation in greater detail.

The *de minimis* thresholds are not intended to be a quantification of actual uses within the watershed. In fact, it is exceedingly rare to find a self-supplied domestic use in rural Arizona which uses anywhere near 10 acre-feet per year. Rather, the threshold is intended to determine only the number of uses which will be assigned to the *de minimis* class. From that group, the actual water use characteristics are studied, and an average, or typical, quantity of use will be assigned to each member of the class. As more fully explained in Chapter 3 of this report, that typical quantity is then used to perform the hydrologic analysis.

The question will naturally arise why DWR chose these thresholds for a supposed *de minimis* use, rather than a 1, or 2, or 5 acre-foot threshold. The answer is straightforward. DWR borrowed, by analogy, the concept of *de minimis* uses expressed in the Arizona Groundwater Code, A.R.S. §§ 45-401 *et seq*, when dealing with uses supplied by underground water.

In the existing Active Management Areas designated within the Groundwater Code, where groundwater overdraft within the state is the most severe, small nonirrigation wells are statutorily exempted from many of the requirements otherwise placed upon groundwater users. These small wells, characterized by a maximum pumping capacity of 35 gallons per minute, are entitled to use up to 10 acre-feet per year for commercial purposes. A.R.S. § 45-454(B)(2). If the use fits the statutory definition of "domestic" found in subsection (l)(1), or if the use is supplied by a well built before the 1983, the use is limited only by the maximum pumping capacity of 35 gallons per minute, which could be as much as 56 acre-feet per year.

DWR concludes that the exempt well thresholds are appropriate for use in the general stream adjudications, notwithstanding the fact that the Arizona Groundwater Code does not govern these proceedings. The pronouncement in A.R.S. § 45-454 is certainly some indication of what the Arizona Legislature considered a class of use with

insignificant impact on groundwater reserves. In DWR's study of the hydrology of the river system, impact on groundwater reserves is the most important consideration for small wells in the Little Colorado River system. Therefore, in conducting the analysis required under this report, DWR will look at *de minimis* uses within the Little Colorado River system in two sets: all proposed *de minimis* uses believed to be 10 acre-feet or under per year; and all proposed *de minimis* uses believed to be 56 acre-feet or under per year.

In the classification of domestic use, there is little possibility that interior residential use would even remotely approach 10 acre-feet per year, much less 56 acre-feet per year. Inclusion of small businesses within the domestic definition, however, does create potential for large uses to be included within the *de minimis* category. To correct this problem, DWR has examined each domestic use to determine whether it includes any type of commercial enterprise. Those that do have been set aside for more intense examination, with emphasis on the reasonably anticipated quantity of use. Any previously classified "domestic" use which includes a commercial enterprise anticipated to use more than 10 or 56 acre-feet per year, respectively, is excluded from the list of potential *de minimis* rights.

In a similar fashion, some quantification of the amount of outdoor landscaping and gardening must be established in the definition of *de minimis* domestic rights. Again, DWR believes that the definition of domestic use used in the Silver Creek HSR, remains appropriate for *de minimis* uses. That definition includes up to 2 acres of outdoor landscaping and gardening which, in most areas of Arizona, would require approximately 10 acre-feet per year to maintain. Domestic uses with less than 2 acres of landscape are therefore be identified as *de minimis* for the 10 acre-feet per year threshold.

In the Silver Creek HSR, any residential use which included more than two acres of landscape was identified as both a domestic use (including the first 2 acres of landscape) and as an associated irrigation use (including the remaining landscape). This method was followed despite the fact that the landscape may have been clearly aesthetic, with no agricultural purpose. It is possible, then, to argue that some of these uses should be included in the domestic category when the threshold is raised to 56 acre-feet per year. DWR has elected not to attempt this inclusion, however, as it is

very difficult to determine, from existing data, which domestic uses with associated irrigation of greater than 2 acres are non-agricultural. Therefore, domestic uses in the 56 acre-feet per year *de minimis* threshold were still limited to self-supplied residential uses with less than 2 acres of outside irrigation, and no new domestic uses were added to the class.

When the quantity threshold was increased to 56 acre-feet per year, however, there were an additional 29 multi-domestic and nonresidential domestic uses added to the total. There were no additional other irrigation uses identified with amounts of annual use between the 10 and 56 acre-feet per year limits.

For the municipal use class, DWR elected not to include these types of uses within the 10 acre-feet per year class, even though some small water providers would qualify under that standard. The anticipated controversy surrounding the inclusion of any municipal use in a proposed *de minimis* class led DWR to conduct at least one hydrologic analysis without any municipal uses included. Municipal uses are only included in the 56 acre-feet per year class of proposed *de minimis* uses.

2.2 TABULATION OF WATER USES SUPPLIED BY WELLS

Once the standards are set for the class of *de minimis* uses, it is then necessary to identify the members of the *de minimis* class. In areas where DWR has completed its HSRs, this is a relatively simple task because a comprehensive data base of actual uses already exists. In areas where the data base does not exist, the class membership must be projected. This requires a series of assumptions, and analysis of those assumptions, to produce a reliable estimate of the class size.

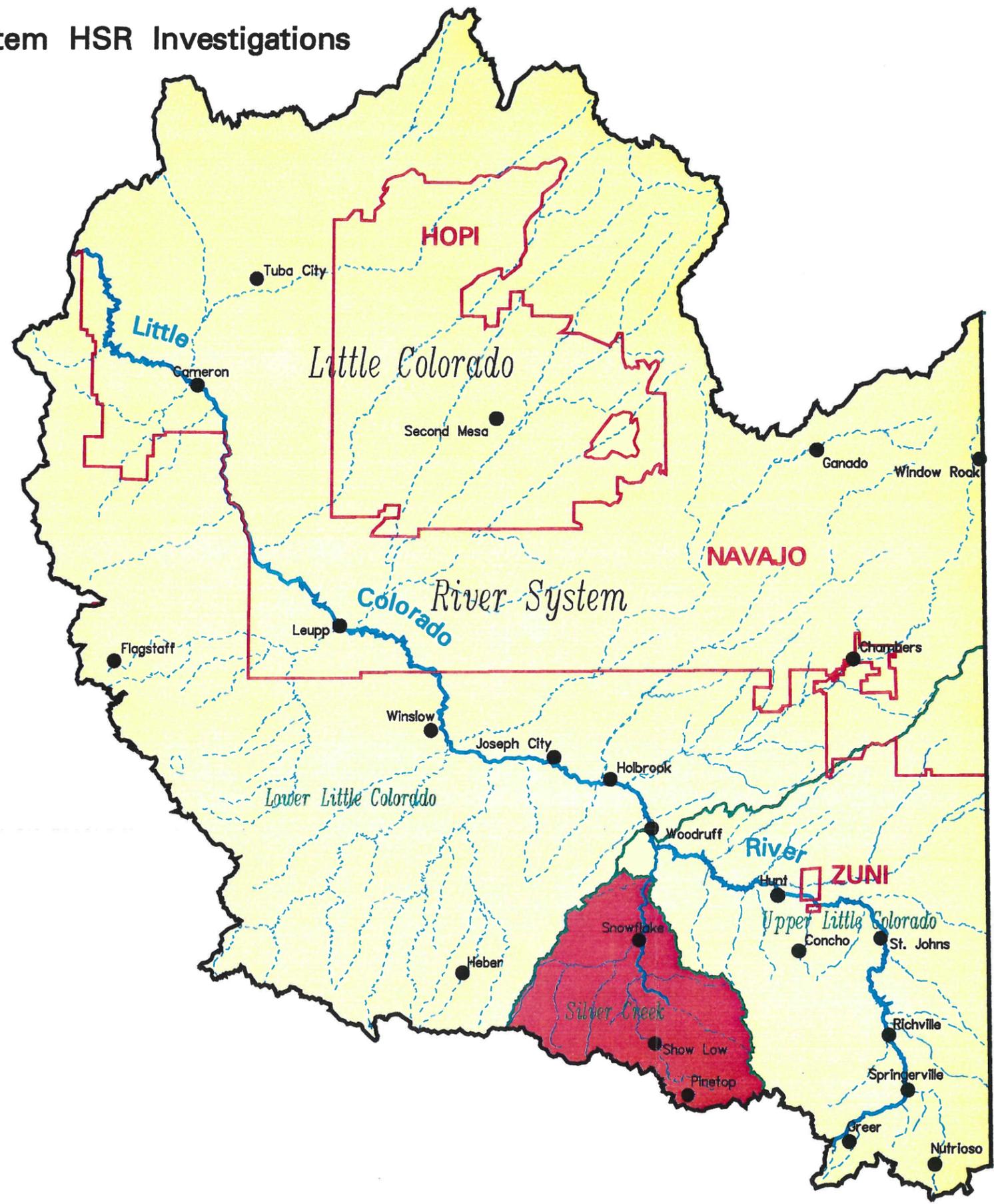
Within the Little Colorado River system, as shown in Figure 2-1, DWR has completed water use investigations in the Silver Creek watershed and published the Silver Creek Watershed Hydrographic Survey Report. DWR is currently investigating water uses in both the Upper and Lower Little Colorado River watersheds, as well as the Navajo, Hopi, Zuni, Fort Apache, and the San Juan Southern Paiute tribal lands within the river system.

Because water use investigations for the entire Little Colorado River system have not been completed, the first step in evaluating groundwater uses that fit the *de minimis* concept was to identify classes of water use statements of claimant (SOCs) whose range of water use is below a *de minimis* threshold. DWR examined all 11,220 SOC in the Little Colorado River system and determined that the only class of claims whose range of use could fit within reasonable *de minimis* thresholds were domestic SOC.

DWR then identified all SOC claiming domestic water use and located them by watershed, as shown in Table 2-1. For this report, DWR did not evaluate the water source claimed in the SOC, assuming that any domestic SOC relied upon groundwater. Only 11% of the 3,228 domestic SOC (367 SOC) include any water source information whatever, and DWR's experience in the Silver Creek watershed has shown that of the 1,071 domestic uses identified in the watershed 99.44% of those uses rely upon groundwater. The SOC located on Indian lands were not included in the analysis, and SOC with incomplete location information were excluded from this report.

Figure 2-1 Status of Little Colorado River System HSR Investigations

- HSR Complete
- Currently under investigation
- Indian Reservation Boundary
- Watershed Boundary



12 0 12 24 Miles

TABLE 2-1

**LITTLE COLORADO RIVER (LCR) SYSTEM
DOMESTIC USE STATEMENTS OF CLAIMANT (SOCs) BY WATERSHED**

WATERSHED	DOMESTIC USE SOCs
Upper LCR	926
Silver Creek	757
Lower LCR	1,410
Indian lands	50
Incomplete	85
TOTAL	3,228

During the course of DWR's investigations, many more domestic places of use are identified than claimed by an SOC. Therefore, to provide the most complete analysis possible, it is necessary to adjust the number of domestic uses above the number of SOCs. To make this adjustment, DWR relied upon the water use data compiled in the Silver Creek HSR to develop a relationship between the number of domestic SOCs and the number of domestic places of use supplied by groundwater actually identified by DWR investigations. The relationship was determined to be the 1.4 domestic uses per domestic SOC. A complete discussion of this relationship is shown in APPENDIX A.

It is assumed that the relationship developed in the Silver Creek watershed between domestic SOCs and domestic places of use identified by DWR is relevant in the Upper and Lower Little Colorado River watersheds. This assumption was qualitatively evaluated by comparing the number of domestic SOCs per square mile for each of the watersheds, exclusive of Indian lands, as shown in Table 2-2. The table shows that the number of domestic SOCs per square mile in the Silver Creek watershed is almost four times greater than the other watersheds. This will likely serve to overestimate the number of domestic uses in the Little Colorado River system.

TABLE 2-2

**LITTLE COLORADO RIVER SYSTEM
NUMBER OF DOMESTIC USE SOCs PER SQUARE MILE PER WATERSHED**

WATERSHED	NUMBER OF DOMESTIC SOCS	DOMESTIC SOCs PER SQUARE MILE
Upper LCR	926	0.29 SOC/mi ²
Silver Creek	757	0.81 SOC/mi ²
Lower LCR	1,410	0.25 SOC/mi ²

Using this relationship, DWR projects that a total of 4,335 domestic water uses supplied by wells will be identified in the LCR system. The distribution of projected domestic uses in the LCR system is shown in Table 2-3.

TABLE 2-3

**LITTLE COLORADO RIVER SYSTEM
DOMESTIC USE SOCs AND PROJECTED DOMESTIC USES**

WATERSHED	DOMESTIC USE SOCs	PROJECTED DOMESTIC USES
Upper LCR	926	1,300 ¹
Silver Creek	757	1,065 ²
Lower LCR	1,410	1,970 ¹
Indian Lands	50	N/A
Incomplete	85	N/A
TOTAL	3,228	4,335

¹Rounded to the nearest 10 domestic uses.

²Actual number of domestic places of use supplied by groundwater identified by DWR.

Of the 1,065 domestic places of use identified in the Silver Creek watershed, 35 were discovered to serve nonresidential or multi-domestic uses. Each member of this subset of domestic uses was evaluated individually to see if they met the *de minimis* concept. Of the 35 uses, 27 were determined to have annual water uses less than 10 acre-feet. The average annual use for these domestic uses was 2.3 acre-feet per year with a depletion of 2.0 acre-feet per year (APPENDIX A). To evaluate the number of multi-domestic or commercial uses in the entire Little Colorado River system, a relationship was developed between the number of multi-domestic or nonresidential uses and the number of domestic SOC's (APPENDIX A). The relationship was determined to be 0.035 multi-domestic or nonresidential use per domestic SOC. The projected number of multi-domestic or nonresidential uses per watershed that fit the less than 10 acre-feet *de minimis* concept is shown in Table 2-4.

TABLE 2-4
LITTLE COLORADO RIVER SYSTEM
PROJECTED NONRESIDENTIAL OR MULTI-DOMESTIC USES
LESS THAN 10 ACRE-FEET

WATERSHED	DOMESTIC USE SOC's	PROJECTED DOMESTIC USES¹	PROJECTED NONRESIDENTIAL OR MULTI-DOMESTIC USES^{1, 2}
Upper LCR	926	1,300	30 ²
Silver Creek	757	1,060	30 ²
Lower LCR	1,410	1,970	50 ²
Indian Lands	50	NA	NA
Incomplete	85	NA	NA
TOTAL	3,228	4,330	110¹

¹Rounded to the nearest 10 uses.

²Included in domestic total.

Other irrigation (OT) uses to be evaluated for this report include outdoor landscaping and gardening. The investigations in the Silver Creek watershed show that only three OT uses are supplied solely from a well. The average acreage per OT supplied from a well is 0.6 acres of irrigation. A relationship between the number of OTs supplied by a well and total number of domestic SOC was developed and applied across the Little Colorado River system as shown in Table 2-5. The relationship was found to be 0.004 OTs per domestic SOC (APPENDIX A).

**TABLE 2-5
LITTLE COLORADO RIVER SYSTEM
PROJECTED OT USES**

WATERSHED	DOMESTIC USE SOC_s	PROJECTED DOMESTIC USES¹	PROJECTED NONRESIDENTIAL OR MULTI-DOMESTIC USES^{1,2}	PROJECTED OT USES
Upper LCR	926	1,300	30 ²	4
Silver Creek	757	1,060	30 ²	3
Lower LCR	1,410	1,970	50 ²	6
Indian Lands	50	NA	NA	NA
Incomplete	85	NA	NA	NA
TOTAL	3,228	4,330	110	13

¹Rounded to the nearest 10 uses.

²Included in domestic total.

Municipal uses to be evaluated in this report include only those municipal water providers that provide less than 56 acre-feet per year to their customers. DWR investigated all municipal claims in the Little Colorado River system. The investigation process included the tabulation of water use data from the Arizona Corporation Commission records for the municipal water providers. For those water providers with incomplete water use data, DWR used a formula based on the number of connections

to the water system and the 150 gallons per capita per day use to estimate the annual water use. This process is more fully explained in APPENDIX C.

To provide a complete analysis of the 56 acre-feet threshold, DWR evaluated the nonresidential and multi-domestic class of uses greater than 10 acre-feet per year for Silver Creek. DWR calculated the relationship between these domestic uses and the domestic SOCs in the watershed. The relationship was found to be 0.0092. This value was used to project those uses across the river system. The projected uses are shown in Table 2-6. DWR investigated and quantified all claimed municipal water uses in the river system to determine the number which met the 56 acre-feet criteria. These are also shown in Table 2-6. The table shows that 78 additional nonresidential and multi-domestic uses, and municipal uses will be captured under the expanded threshold. No additional residential domestic or OT uses were captured under the expanded threshold.

TABLE 2-6
LITTLE COLORADO RIVER SYSTEM
ADDITIONAL DOMESTIC AND MUNICIPAL USES
WITHIN A 56 ACRE-FEET THRESHOLD

NUMBER OF USES	UPPER LITTLE COLORADO RIVER WATERSHED	SILVER CREEK WATERSHED	LOWER LITTLE COLORADO RIVER WATERSHED	TOTAL
Additional Domestic Uses ¹	9	7	13	29
Municipal Uses	13	23	13	49
Additional OT Uses	0	0	0	0
TOTAL	22	30	26	78

¹Nonresidential and multi-domestic uses.

The statistical analysis of this chapter allows DWR to determine how many uses of each type will be included within the 10 acre-foot and 56 acre-foot *de minimis* class. The next step is to determine how much water the classes use on an annual basis. This analysis is taken up in the following chapter.

CHAPTER 3: HYDROLOGIC IMPACT AND ANALYSIS

This chapter will focus on the impact of the uses identified in the preceding chapter. First, the surface water resources of the Little Colorado River system will be outlined. Next, the anticipated use of the proposed *de minimis* classes are calculated. Then, an undepleted flow analysis using a water budget approach is applied to evaluate the impact of the *de minimis* uses on the surface water resources of each watershed in the river system, and on the surface water outflow to the Navajo Indian Reservation.

3.1 SURFACE WATER RESOURCES

The Little Colorado River system surface water resources are characterized by highly variable seasonal and annual flows. In general, the system has peak runoff in the spring and late summer and low flow seasons in June and November (ADWR, 1989). To evaluate the impact of *de minimis* groundwater uses on the surface water resources of the system, the surface water outflows from the Silver Creek and Upper Little Colorado River watersheds were calculated as were the outflows from the Lower Little Colorado River watershed to the Navajo Indian Reservation boundary. Because the United States Geological Survey (USGS) surface water gages in the region do not provide a consistent, lengthy period of record at the watershed boundaries as well as at the outflow to the Navajo Indian Reservation, a regression analysis was performed to extend the data to a base period from 1927 to 1993 (APPENDIX B).

The average annual outflow data used in this analysis is shown in Table 3-1. The table shows a departure from data used in the Silver Creek Watershed Hydrographic Survey Report (Silver Creek HSR). This analysis uses a much longer period of record which may more accurately represent long term discharge trends for the river system, than the shorter period used in the Silver Creek HSR. The Silver Creek HSR can be updated to reflect a base period consistent with the other watersheds in the Little Colorado River system upon completion of the remaining HSRs in the system. The methods used to calculate these values are outlined in APPENDIX B.

TABLE 3-1

**LITTLE COLORADO RIVER (LCR) SYSTEM
AVERAGE ANNUAL OUTFLOW FROM THE SYSTEM'S WATERSHEDS
BASE PERIOD 1927 TO 1993¹**

LITTLE COLORADO RIVER SYSTEM WATERSHEDS	USGS GAGE LOCATION	AVERAGE ANNUAL OUTFLOW (ACRE-FEET PER YEAR)
Upper Little Colorado River	LCR at Woodruff ² (USGS Gage No. 0939450)	21,040
Silver Creek	Silver Creek at Snowflake (USGS Gage No. 0939350)	15,650
Lower Little Colorado River at the Navajo Indian Reservation Boundary	Synthetic Gage ³	197,600

¹Base period record extended for gages by regression analysis, shown in APPENDIX B.

²Outflow from the Upper LCR watershed calculated by subtracting Silver Creek at Snowflake from LCR at Woodruff.

³Synthetic gage calculated as shown in APPENDIX B.

3.2 CUMULATIVE IMPACT OF WATER USES LESS THAN 10 ACRE-FEET

As identified in Chapter 2, there are 4,330 domestic and 13 OT uses supplied by less than 10 acre-feet of groundwater in the Little Colorado River system. Table 3-2 shows the distribution of these uses across the river system. The table also shows the distribution of nonresidential and multi-domestic uses in the watershed that are below the *de minimis* 10 acre-feet per year use threshold.

TABLE 3-2
LITTLE COLORADO RIVER SYSTEM
DISTRIBUTION OF DOMESTIC AND OT USES LESS THAN 10 ACRE-FEET

WATER USE TYPE	UPPER LITTLE COLORADO RIVER WATERSHED	SILVER CREEK WATERSHED	LOWER LITTLE COLORADO RIVER WATERSHED	TOTAL
Residential Domestic Uses ¹	1,270	1,030	1,920	4,220
Nonresidential and Multi-domestic Uses	30 ²	30 ²	50 ²	110
OT Uses	4	3	6	13
TOTAL	1,304	1,063	1,976	4,343

¹Projected uses based upon Silver Creek Watershed HSR data.

²Uses less than 10 acre-feet, subset of domestic uses, included in the total.

To examine the impact of these uses on the surface water outflow to the Navajo Indian Reservation boundary, a water budget approach was used. A water budget is a hydrologic balance sheet used to account for the amount of water supply available in the watershed, the amount used, and the amount which flows out of the watershed to another area. On the balance sheet, these supply, use, and outflow categories are separated into their component parts. When all components are properly taken into account, the water budget becomes a conceptual model of the watershed's hydrologic system. Such a model provides the means to analyze the effect that one component has on another, such as the effect that cultural uses might have on the outflow. In this

report, the water budget is used to analyze the effect of domestic, other irrigation, and small municipal providers on the Little Colorado River system.

The water budget approach used here assumes that these groundwater uses have an immediate effect on the surface water outflows from the watersheds. Due to the geohydrology of the river system, most wells will never have such a direct impact on surface water flows of the Little Colorado River upstream of Blue Springs. Blue Springs on the Little Colorado River, located a few miles upstream from its confluence with the Colorado River is the point at which groundwater discharges directly to the stream. The assumption of immediate effect used in this report, therefore, serves to significantly overestimate the impact of groundwater uses on the surface water system in the foreseeable future.

DOMESTIC USES

In the water budget approach, each residential domestic use is assumed to use 0.7 acre-feet per year, of which 87% (0.6 acre-feet per year) is depleted from the surface water system. The residential domestic use value was determined by using a per capita domestic water use value of 150 gallons per day (gpcd) and an average household size of 4 persons (ADWR, 1990). The domestic use value represents both inside and outside use. It should be noted that these self-supplied domestic uses are constrained by economic and hydrogeologic considerations that result in water uses that usually are less than those found in urban areas supplied by municipal water providers. In actuality, DWR believes that self-supplied domestic uses average less than 0.7 acre-feet per year of use.

To evaluate the 0.7 acre-feet per year domestic use assumption, DWR analyzed the water uses supplied by small rural water providers in the Little Colorado River system. The average annual water use for these small water providers is 0.3 acre-feet per connection per year. Therefore, DWR believes that the 0.7 acre-feet domestic use value used for residential domestic water use is reasonable, and in fact serves to overestimate the actual domestic uses in the river system.

In the course of DWR's investigations, several domestic uses were found to

supply nonresidential (small commercial) or multi-domestic uses. Each of these nonresidential or multi-domestic uses were quantified individually and included in the water budget analysis. For those projected nonresidential or multi-domestic uses less than 10 acre-feet of groundwater that have not yet been completely investigated, a value of 2.3 acre-feet per year was assigned based on DWR's investigations in the Silver Creek watershed. For more information regarding quantification of this subset of domestic uses, refer to APPENDIX C.

The water budget for domestic uses supplied by less than 10 acre-feet of groundwater is shown in Table 3-3. The water budget shows that these uses require 3,210 acre-feet of pumpage per year or 1.6% of the average annual outflow to the Navajo Indian Reservation. The total depletion from these uses under this type of analysis is 2,800 acre-feet per year or 1.4% of the average annual outflow to the Navajo Indian Reservation.

However, to more accurately evaluate the true impact of these uses on the surface water system, an undepleted flow analysis was conducted. The undepleted flow analysis attempts to determine the fate of water pumped for domestic use, if that water was allowed to reach the Little Colorado River system under water budget assumptions. The analysis calculates that amount of groundwater that would actually reach the watershed outflow as additional surface water. The governing water budget assumption for undepleted flow analysis requires that depletions have an instantaneous impact on the surface water outflow from each watershed. Therefore, the undepleted domestic uses become an instantaneous addition to surface water flowing out of the watershed.

The additional surface water must be transmitted in the mainstem of the Lower Little Colorado River watershed to the Navajo Indian Reservation boundary. During the transmission process, a portion of the additional surface water is consumed by surface evaporation and riparian evapotranspiration. Initially then, the 1,060 domestic uses in the Silver Creek watershed could provide an additional 690 acre-feet per year of surface water to the Little Colorado River. However, only 72% of that water (500 acre-feet per year) would reach the reservation boundary. The undepleted flow analysis portion of the water budget is shown in Table 3-3. The table shows that the impact of all 4,330 domestic uses in the system is 2,370 acre-feet per year or 1.20% of the average

annual outflow to the Navajo Indian Reservation. The values for transmission loss in the mainstem of the Little Colorado River in the Lower Little Colorado River watershed are shown in Table 3-3. For a more complete discussion of transmission losses, see APPENDIX C.

TABLE 3-3
LITTLE COLORADO RIVER SYSTEM
WATER BUDGET FOR DOMESTIC USES LESS THAN 10 ACRE-FEET PER YEAR

WATER BUDGET	UPPER LCR	SILVER CREEK	LOWER LCR³	TOTAL
Number of Domestic Uses	1,300 ²	1,060 ²	1,970 ²	4,330
Estimated Domestic Water Use ¹	960	790	1,460	3,210
Estimated Domestic Depletion ¹	840	690	1,270	2,800
UNDEPLETED FLOW ANALYSIS	UPPER LCR	SILVER CREEK	LOWER LCR³	TOTAL
Additional Watershed Outflow ¹	840	690	1,270	2,800
Transmission	72%	72%	100%	
Additional Outflow to the Navajo Indian Reservation ¹	600	500	1,270	2,370
Percentage Increase Outflow to the Navajo Indian Reservation Boundary	0.30%	0.25%	0.64%	1.20%
WATERSHED TRANSMISSION	UPPER LCR	SILVER CREEK	LOWER LCR³	
Watershed Outflow ¹	21,040 ⁴	15,650 ⁴	197,600 ⁴	
Additional Watershed Outflow ¹	840	690	2,370	
Increased Watershed Outflow ¹	21,880	16,340	199,970	
Percentage Increase	3.99%	4.41%	1.20%	

¹Acre-feet per year, values rounded to the nearest 10 acre-feet per year.

²Projected number of domestic uses, including nonresidential and multi-domestic uses supplied by groundwater.

³Lower Little Colorado River watershed to the Navajo Indian Reservation boundary.

⁴Outflow for base period from 1927 to 1993, as described in APPENDIX B.

OTHER IRRIGATION (OT) USES

There are 13 OT uses supplied by less than 10 acre-feet of groundwater in the Little Colorado River system. The total irrigated acreage served by OT uses is 7.8 acres. The quantification of OT uses follows the methodology outlined in the Silver Creek HSR. An annual water duty of 5.0 acre-feet per acre was assigned to each OT use. The depletion factor used is 0.67 which includes the irrigation efficiency as well as unrecoverable losses of return flow. For a complete discussion of OT use quantification, refer to APPENDIX C.

A water budget for OT uses is shown in Table 3-4. The total water use for OT uses supplied by groundwater is 39 acre-feet per year, or 0.02% of the average annual outflow to the reservation. The total depletion for these uses is 26 acre-feet per year, or 0.01% of the average annual outflow to the reservation. An undepleted flow analysis for the OT uses is shown in Table 3-4 and follows the same methodology as discussed previously. The undepleted flow analysis shows that the total impact of OT uses is 0.01% of the average annual outflow to the reservation.

TOTAL IMPACT OF DOMESTIC AND OT USES LESS THAN 10 ACRE-FEET

As shown in the cumulative water budget in Table 3-5, the total pumpage required to supply the 4,343 proposed domestic and OT *de minimis* uses in the system is 3,250 acre-feet per year. The water budget table is a combination of Tables 3-3 and 3-4. The total depletion from the hydrologic system attributable to these uses is 2,830 acre-feet per year. The undepleted flow available from these uses is 2,390 acre-feet per year, or 1.21% of the average annual surface water outflow to the Navajo Indian Reservation.

The undepleted flow analysis shows that without the domestic and OT uses less than 10 acre-feet per year, an additional 2,390 acre-feet per year (1.21%) of additional surface flow in the Little Colorado River could reach the Navajo Indian Reservation.

TABLE 3-4

LITTLE COLORADO RIVER SYSTEM
WATER BUDGET FOR OT USES LESS THAN 10 ACRE-FEET PER YEAR

WATER BUDGET	UPPER LCR	SILVER CREEK	LOWER LCR ⁴	TOTAL
Number of OTs	4 ²	3 ³	6 ²	13
Estimated OT Water Use ¹	12	9	18	39
Estimated OT Depletion ¹	8	6	12	26
UNDEPLETED FLOW ANALYSIS	UPPER LCR	SILVER CREEK	LOWER LCR ⁴	TOTAL
Additional Watershed Outflow ¹	8	6	12	26
Transmission	72%	72%	100%	
Additional Outflow to the Navajo Indian Reservation ¹	6	4	12	22
Percentage Increase Outflow to the Navajo Indian Reservation Boundary	0.0%	0.0%	0.01%	0.01%
WATERSHED TRANSMISSION	UPPER LCR	SILVER CREEK	LOWER LCR ⁴	
Watershed Outflow ¹	21,040 ⁵	15,650 ⁵	197,600 ⁵	
Additional Watershed Outflow ¹	8	6	22	
Increased Watershed Outflow ¹	21,048	15,656	197,622	
Percentage Increase	0.04%	0.04%	0.01%	

¹Acre-feet per year rounded to the nearest 1 acre-feet.

²Projected number of OT uses supplied by groundwater.

³Actual number of OT uses supplied by groundwater.

⁴Lower Little Colorado River watershed to the Navajo Indian Reservation boundary.

⁵Outflow for base period 1927 to 1993, as described in APPENDIX B.

TABLE 3-5

**LITTLE COLORADO RIVER SYSTEM
WATER BUDGET FOR DOMESTIC AND OT USES
LESS THAN 10 ACRE-FEET PER YEAR**

WATER BUDGET	UPPER LCR	SILVER CREEK	LOWER LCR³	TOTAL
Number of Domestic and OT Uses	1,304 ²	1,063 ²	1,976 ²	4,343
Estimated Domestic and OT Water Use ¹	970	800	1,480	3,250
Estimated Domestic and OT Depletion ¹	850	700	1,280	2,830
UNDEPLETED FLOW ANALYSIS	UPPER LCR	SILVER CREEK	LOWER LCR³	TOTAL
Additional Outflow ¹	850	700	1,280	2,830
Transmission	72%	72%	100%	
Additional Watershed Outflow ¹	610	500	1,280	2,390
Percentage Increase of Watershed Outflow to the Navajo Indian Reservation Boundary	0.31%	0.25%	0.65%	1.21%
WATERSHED TRANSMISSION	UPPER LCR	SILVER CREEK	LOWER LCR³	
Outflow ¹	21,040 ⁴	15,650 ⁴	197,600 ⁴	
Additional subwatershed Outflow ¹	850	700	2,390	
Increased Subwatershed Outflow ¹	21,890	16,350	199,990	
Percentage Increase	4.04%	4.47%	1.21%	

¹Acre-feet per year, all values rounded to the nearest 10 acre-feet per year.

²Projected number of domestic and OT uses, supplied by groundwater.

³Lower Little Colorado River watershed to the Navajo Indian Reservation boundary.

⁴Outflow for base period 1927 to 1993 as shown in APPENDIX B.

3.3 CUMULATIVE IMPACT OF DOMESTIC, OT, AND MUNICIPAL USES LESS THAN 56 ACRE-FEET

If a threshold of up to 56 acre-feet per year of pumpage for domestic or municipal uses supplied by groundwater were used to capture uses into a *de minimis* class, an additional 78 uses would be included in the hydrologic analysis. DWR quantified each municipal use as shown in APPENDIX C. The additional domestic uses were quantified using an average use value of 30.6 acre-feet per year, derived from the Silver Creek nonresidential and multi-domestic uses between 10 and 56 acre-feet. Table 3-6 shows the distribution and volume associated with the additional uses that could be captured under 56 acre-feet per year threshold. Depletion from these uses is 0.87.

TABLE 3-6
LITTLE COLORADO RIVER SYSTEM
ADDITIONAL DOMESTIC AND MUNICIPAL USES
WITHIN A 56 ACRE-FEET PER YEAR THRESHOLD

NUMBER OF USES	UPPER LCR	SILVER CREEK	LOWER LCR	TOTAL
Additional Domestic Uses	9	7	13	29
Number of Municipal Uses	13	23	13	49
TOTAL USE	22	30	26	78
ADDITIONAL WATER USE	UPPER LCR	SILVER CREEK	LOWER LCR	TOTAL
Estimated Additional Domestic Water Use ¹	280	210	400	890
Estimated Municipal Water Use ¹	160	450	220	830
TOTAL USE	440	660	620	1,720
DEPLETION	UPPER LCR	SILVER CREEK	LOWER LCR	TOTAL
Estimated Additional Domestic Depletion ¹	240	180	350	770
Estimated Municipal Depletion ¹	140	390	190	720
TOTAL DEPLETION	380	570	540	1,490

¹Acre-feet per year, all values rounded to the nearest 10 acre-feet per year.

A water budget and undepleted flow analysis was again used to evaluate the impact of these additional uses on the surface water system. The additional domestic and municipal uses were quantified, then added to the domestic and OT uses that were captured by the 10 acre-feet threshold. Table 3-7 shows the results of the analysis. The table shows that the total number of uses included in the class is 4,421 which use 4,970 acre-feet per year and deplete 4,320 acre-feet per year. The total impact of these uses under undepleted flow conditions is 1.83% (3,620 acre-feet) of the average annual outflow to the Navajo Indian Reservation. A more complete discussion of the quantification of these uses is included in APPENDIX C.

This analysis shows that while the magnitude of the threshold may change, the impact of the domestic, OT and small municipal use class of uses supplied by groundwater on the surface water resources of the Little Colorado River system is slight. Further, the water budget assumption that all well uses are a 100% depletion from the surface water system serves to calculate the maximum possible hydrologic impacts of these uses. Therefore, given that the impacts calculated here represent the maximum possible impact on the Little Colorado River, the uses captured by either *de minimis* threshold have, in DWR's opinion, an insignificant impact on the Little Colorado River system.

TABLE 3-7

LITTLE COLORADO RIVER SYSTEM
 WATER BUDGET FOR DOMESTIC, OT, AND MUNICIPAL USES
 WITHIN A 56 ACRE-FEET PER YEAR THRESHOLD

WATER BUDGET	UPPER LCR	SILVER CREEK	LOWER LCR ³	TOTAL
Number of Domestic, OT, and Municipal Uses	1,326 ²	1,093 ²	2,002 ²	4,421
Estimated Total Use ¹	1,410	1,460	2,100	4,970
Estimated Total Depletion ¹	1,230	1,270	1,820	4,320
UNDEPLETED FLOW ANALYSIS	UPPER LCR	SILVER CREEK	LOWER LCR ³	TOTAL
Additional Outflow ¹	1,230	1,270	1,820	4,320
Transmission	72%	72%	100%	
Additional Watershed Outflow ¹	890	910	1,820	3,620
Percentage Increase Outflow to the Navajo Indian Reservation Boundary	0.45%	0.46%	0.92%	1.83%
WATERSHED TRANSMISSION	UPPER LCR	SILVER CREEK	LOWER LCR ³	
Outflow ¹	21,040 ⁴	15,650 ⁴	197,600 ⁴	
Additional subwatershed Outflow ¹	1,230	1,270	3,620	
Increased Subwatershed Outflow ¹	22,270	16,920	201,220	
Percentage Increase	5.85%	8.12%	1.83%	

¹Acre-feet per year, all values rounded to the nearest 10 acre-feet per year.

²Projected number of domestic, OT, and municipal uses supplied by groundwater.

³Lower Little Colorado River watershed to the Navajo Indian Reservation boundary.

⁴Outflow for base period 1927 to 1993, as described in APPENDIX B.

CHAPTER 4: SUMMARY

Judge Minker's September 7, 1993 minute entry, requested the Arizona Department of Water Resources (DWR) to:

". . . prepare a report, similar in format to its September 1, 1993, report on *de minimis* stockpond and stockwatering uses, on what other uses, particularly pumping wells, may qualify as *de minimis* uses."

DWR interprets this request to be inclusive of the entire non-Indian portion of the Little Colorado River system, and not limited to uses located only in the Silver Creek watershed. The scope of this request required DWR to consider uses in areas without a complete HSR data base. With this limitation, DWR elected not to include any surface water uses within this report, but rather restricted its analysis to uses supplied by wells, which also appears to be the primary emphasis of the Court's request.

DWR built a data base of uses supplied by wells in the Upper and Lower Little Colorado River watersheds from counting and evaluating claims filed in the two watershed areas, and then adjusting the total number higher on the basis of claimed to actual use ratios found from the Silver Creek HSR data. In order to compensate for the weaknesses in the data base, DWR took the approach of liberally estimating the numbers of uses that occur within the two *de minimis* scenarios evaluated, and then deliberately overstating the hydrologic relationship that occurs between wells and streams in the Little Colorado River system. DWR believes that any possible errors that result from extending claims data and Silver Creek data to a river system wide evaluation are more than compensated for by these assumptions.

In determining which uses may qualify as *de minimis*, DWR looked for categories of water use types that are individually small, and accumulatively have an insignificant impact on the surface water supply. Since the type of use considered *de minimis* is judgmental, DWR elected to evaluate two thresholds of uses and attendant impacts in this report. The first threshold encompassed all domestic uses and other irrigation uses of less than 10 acre-feet per year. The term "domestic use" is applied according to the

definition in the Silver Creek Watershed Hydrographic Survey Report, and includes small multi-domestic uses and nonresidential uses for commercial purposes. "Other irrigation" uses are also included in this category, encompassing up to 2 acres of landscape irrigation not associated with a domestic residence.

The second threshold was established at 56 acre-feet per year. For this second, higher threshold, DWR not only included the domestic and other irrigation uses believed to be less than 56 acre-feet per year, but also included municipal uses that individually do not exceed 56 acre-feet per year. This is a departure from the previous reports issued by DWR on the *de minimis* subject, but justified by the idea that municipal uses of this size are generally just an accumulation of uses which would otherwise qualify for *de minimis* treatment if self-supplied.

The quantities used in these thresholds (10 and 56 acre-feet per year) are derived from DWR's interpretation of legislative intent in establishing the exempt well category in the Groundwater Code--essentially, in DWR's view, the equivalent of a *de minimis* classification. The Code allows commercial uses to be initiated in existing Active Management Areas after 1982 without the need to obtain a permit or file an annual report, and without the imposition of groundwater withdrawal fees, as long as the annual use is no more than 10 acre-feet. Domestic uses, as defined in the statute, are allowed to use up to 56 acre-feet per year under the exempt status.¹¹

Once the threshold values were set, the number of domestic and other irrigation uses were determined for each of the three HSR watersheds. Nonresidential and multi-domestic uses in the three watersheds were evaluated individually and the amount of their reasonably anticipated use projected on the basis of Silver Creek watershed investigations. After the members of the *de minimis* class were identified for each HSR watershed and the amount of their reasonable anticipated annual withdrawal estimated, DWR was able to consider the hydrologic impact of the class on the river system.

In making the hydrologic analysis, DWR had to make an important decision concerning how it would estimate the amount of streamflow depletion that results from these well uses. One approach would be to discount the total use by some factor or range of factors that reflect the potential interconnection between groundwater and

¹¹See A.R.S. § 45-454.

surface water in the river system. However, this approach would require complex hydrologic determinations applied to a limited data base on stream/aquifer parameters and locations of withdrawals. DWR concluded that it could provide a determination for the Court with a higher level of reliability by simply making the assumption that 100 percent of the withdrawal from the proposed *de minimis* class will result in stream depletion. The amount of depletion derived from this method, therefore, represents not the predicted actual depletion, but rather the maximum possible streamflow depletion resulting from these well uses.

After the amount of streamflow depletion was determined for each of the HSR watersheds, the amount of depletion for the Silver Creek and Upper Little Colorado River watersheds was reduced by 28 percent. This adjustment represents transmission losses for runoff produced in the two upper watersheds as it flows through the Lower Little Colorado River watershed downstream to the Navajo Indian Reservation boundary.

The results of the hydrologic analysis show a reduction in surface water supply at the reservation boundary of 1.21% for the 10 acre-feet per year *de minimis* threshold and a reduction of 1.83% for the 56 acre-feet per year *de minimis* threshold. Except for the adjustment for transmission losses, these percentages represent the maximum possible impacts from these wells. Either of these two levels of impact are beyond the accuracy of streamflow measuring devices, even when operating at their optimum precision.

BIBLIOGRAPHY AND REFERENCES

- Arizona Department of Water Resources, 1989, Hydrology of the Little Colorado River System - Special Report to the Settlement Committee, In Re The General Adjudication Of The Little Colorado River System And Source: Phoenix, 160 p.
- _____, 1990, Hydrographic Survey Report for the Silver Creek Watershed, Volume 1: General Assessment: Phoenix, 351 p.
- _____, 1993a, Technical Report on De Minimis Adjudication of Stockpond and Stockwatering Uses in the Silver Creek Watershed, In Re: The General Adjudication Of The Little Colorado River System And Source: Phoenix, 50 p.
- _____, 1993b, Technical Report on De Minimis Adjudication of Domestic, Stockpond, and Stockwatering Uses in the San Pedro River Watershed, In Re: The General Adjudication Of The Gila River System And Source: Phoenix, 115 p.
- _____, 1993c, Technical Assessment of the Arizona Supreme Court Interlocutory Appeal Issue No. 2 Opinion, In Re: The General Adjudication Of The Gila River System And Source: Phoenix, 130 p.

APPENDICES

	<u>COLOR</u>
APPENDIX A: PROJECTION OF DE MINIMIS USES IN THE LITTLE COLORADO RIVER SYSTEM	BLUE
APPENDIX B: REGRESSION ANALYSIS OF SURFACE WATER RECORDS IN THE LITTLE COLORADO RIVER SYSTEM	GREEN
APPENDIX C: QUANTIFICATION OF DE MINIMIS WATER USES IN THE WATER BUDGET ANALYSIS	YELLOW

**APPENDIX A: PROJECTION OF DE MINIMIS USES IN THE
LITTLE COLORADO RIVER SYSTEM**

The evaluation of *de minimis* uses for the Little Colorado River system from groundwater sources required the analysis of all potential uses that fit under the *de minimis* thresholds. The Arizona Department of Water Resources (DWR) has a complete water use data base for the Silver Creek watershed but has not completed water use investigations in the Upper and Lower Little Colorado River watersheds. Therefore, a method of projecting water uses from existing statement of claimant (SOC) data was devised.

DWR projected the number of *de minimis* water uses supplied by less than 10 acre-feet of groundwater in the Upper and Lower Little Colorado River watersheds by counting and evaluating claims filed in the two watersheds and then adjusting the number of claims upward on the basis of the claims to actual water uses found in the Silver Creek HSR data. Table A-1 shows the total number of claims for domestic uses in the Little Colorado River system. Table A-2 shows the number and type of domestic uses found in the Silver Creek watershed. Table A-3 shows the ratio of water uses to domestic SOC's in the Silver Creek watershed. The ratios in Table A-3 were then applied to the number of SOC's in each watershed to project the number of uses in each watershed. The results of the projections are shown in Table A-4.

TABLE A-1

**LITTLE COLORADO RIVER (LCR) SYSTEM
DOMESTIC USE STATEMENTS OF CLAIMANT (SOCs) BY WATERSHED**

WATERSHED	DOMESTIC USE SOC's
Upper LCR	926
Silver Creek	757
Lower LCR	1,410
Indian lands	50
Incomplete	85
TOTAL	3,228

TABLE A-2

**LITTLE COLORADO RIVER SYSTEM
DOMESTIC AND OT WATER USES IN THE SILVER CREEK WATERSHED**

DOMESTIC WATER USES BY CATEGORY	NUMBER OF USES
SUPPLIED BY SURFACE WATER	6
SUPPLIED BY GROUNDWATER	
Residential Domestic Uses	1,030
Total Multi-domestic Uses ¹	18
Total Nonresidential Domestic Uses ²	17
Subtotal	35
Nonresidential and Multi-domestic Uses Less than 10 Acre-feet	27
GRAND TOTAL³	1,071
NUMBER OF OTs SUPPLIED BY GROUNDWATER	NUMBER OF ACRES
3	1.9

¹Mobile home parks, apartment buildings, 2-3 domestic uses supplied by the same well.

²Hospitals, businesses, commercial/industrial uses.

³Total includes residential domestic use + nonresidential and multi-domestic + domestic uses supplied by surface water.

TABLE A-3

**LITTLE COLORADO RIVER SYSTEM
RATIO OF WATER USES TO CLAIMS IN THE SILVER CREEK WATERSHED**

DOMESTIC WATER USES SUPPLIED BY GROUNDWATER	RATIO OF WATER USES TO CLAIMS
Residential Domestic Uses	1.4
Nonresidential and Multi-domestic Uses Greater than 10 acre-feet and less than 56 acre-feet	0.0092
Nonresidential and Multi-domestic Uses Less than 10 acre-feet	0.035
OTs Supplied by Groundwater	0.004

TABLE A-4

LITTLE COLORADO RIVER SYSTEM
PROJECTED DOMESTIC AND OT USES LESS THAN 10 ACRE-FEET

WATERSHED	DOMESTIC USE SOCs	PROJECTED DOMESTIC USES	PROJECTED NONRESIDENTIAL OR MULTI-DOMESTIC USES	PROJECTED OT USES
Upper LCR	926	1,300	30	4
Silver Creek	757	1,060	30	3
Lower LCR	1,410	1,970	50	6
Indian lands	50	NA	NA	NA
Not located	8	NA	NA	NA
TOTAL	3,228	4,330	110	13

DWR used the following assumptions: that all observed uses would be supplied from groundwater, and that the SOCs on Indian lands and with incomplete location information would not be included in the analysis. The assumption that all uses would be supplied from groundwater is substantiated by observations in the Silver Creek watershed where 99.44% of all domestic uses are served by groundwater. Also, for an evaluation of domestic *de minimis* uses supplied by less than 56 acre-feet of groundwater, DWR used the total ratio of multi-domestic and nonresidential domestic uses to SOCs to project those uses. The ratio was found to be 0.0092 use per SOC. All municipal SOCs in the entire river system were evaluated under the 56 acre-feet per year threshold. DWR took the approach of overestimating rather than underestimating these uses in order to provide the court with a maximum possible impact analysis.

APPENDIX B: REGRESSION ANALYSIS OF SURFACE WATER RECORDS IN THE LITTLE COLORADO RIVER SYSTEM

To evaluate the impact of *de minimis* uses on the surface water resources of the Little Colorado River system, the surface water outflow of each watershed and the outflow at the Navajo Indian Reservation boundary was calculated. Because the surface water records are not a consistent long period data base for this analysis, the Arizona Department of Water Resources (DWR) used linear regression analysis techniques to extend the period of record for the surface water gages in the river system from 1927 to 1993. DWR also calculated inflow from the Little Colorado River to the Navajo Indian Reservation. By lengthening the period of record, the analysis should reflect the impact of these uses on the long term discharge trends in the river system.

DWR chose to use average annual outflows from the gages to be consistent with the assumptions used in the quantification of water uses. The quantification of water uses in this report relies on average use data, because median use values imply that every value has been quantified. Because DWR does not have complete water use data base, median water use values are inappropriate. Therefore, DWR chose the average use values and used average outflows to be consistent with that approach.

The base line gage that was used to conduct the analysis against was the Little Colorado River at Grand Falls (USGS Gage No. 094010). The period of record for this gage was calculated against the Little Colorado River at Cameron (USGS Gage No. 094020). The results are shown in Table B-1. Using the extended record for Little Colorado River at Grand Falls, the outflow of the Silver Creek watershed as measured at Silver Creek at Snowflake (USGS Gage No. 093925) was extended to the base period as shown in Table B-2. Using the Grand Falls gage, the Little Colorado River at Woodruff was extended to the base period as shown in Table B-3. It should be noted that because Silver Creek at Snowflake is tributary to the Upper Little Colorado River at Woodruff, the outflow of the Upper Little Colorado River watershed was calculated by subtracting the Silver Creek from Woodruff.

The inflow from the Little Colorado River to the Navajo Indian Reservation was

calculated by adding the flow in the Little Colorado River at Holbrook and the gaged tributaries of Chevelon and Clear Creeks, and ungaged tributaries below Holbrook, and subtracting the estimation of cultural and natural uses along the Little Colorado in below Holbrook. This is the same procedure that DWR used in its 1989 report entitled "The Hydrology of the Little Colorado River System." The results of the process are shown in Table B-4. The calculation of gaged flow is the same as for Woodruff and Silver Creek. The ungaged tributaries values were taken directly from the 1989 report as were values for natural and cultural uses below Holbrook.

TABLE B-1

**LITTLE COLORADO RIVER (LCR) SYSTEM
DATA EXTENSION OF THE LITTLE COLORADO RIVER AT GRAND FALLS
(USGS GAGE NO. 094010)**

CALCULATED RECORD AT GRAND FALLS		CALCULATED RECORD AT CAMERON	
Year	Outflow (Acre-feet per year)	Year	Outflow (Acre-feet per year)
1927	393,743.00	1927	472,303.80 ²
1928	87,562.00	1928	91,852.51 ²
1929	510,789.00	1929	617,741.70 ²
1930	189,316.00	1930	218,289.00 ²
1931	165,146.00	1931	188,256.10 ²
1932	465,850.00	1932	561,901.80 ²
1933	129,233.00	1933	143,631.60 ²
1934	70,979.00	1934	71,246.98 ²
1935	215,439.00	1935	250,748.60 ²
1936	165,068.00	1936	188,159.10 ²
1937	339,507.00	1937	404,911.80 ²
1938	170,233.00	1938	194,577.00 ²
1939	83,250.00	1939	86,494.55 ²
1940	132,246.00	1940	147,375.50 ²
1941	586,867.00	1941	712,273.90 ²
1942	149,040.00	1942	168,243.20 ²
1943	102,996.00	1943	111,030.30 ²
1944	129,021.00	1944	143,368.20 ²
1945	159,523.00	1945	181,269.10 ²
1946	116,438.00	1946	127,733.00 ²

TABLE B-1 (Continued)

CALCULATED RECORD AT GRAND FALLS		CALCULATED RECORD AT CAMERON	
Year	Outflow (Acre-feet per year)	Year	Outflow (Acre-feet per year)
1947	127,077.00	1947	140,952.70 ²
1948	182,234.00	1948	201,085.00
1949	268,423.00	1949	287,270.00
1950	52,899.88 ¹	1950	47,055.00
1951	46,191.00	1951	50,203.00
1952	295,424.30 ¹	1952	352,516.00
1953	62,225.76 ¹	1953	58,801.00
1954	107,506.00	1954	108,557.00
1955	152,326.00	1955	195,568.00
1956	18,664.00	1956	19,343.00
1957	169,776.00	1957	174,955.00
1958	161,059.00	1958	167,250.00
1959	47,855.00	1959	51,392.00
1960	169,699.60 ¹	1960	194,165.00
1961	46,314.76 ¹	1961	38,761.00
1962	140,794.70 ¹	1962	157,759.00
1963	82,442.41 ¹	1963	84,264.00
1964	151,231.30 ¹	1964	170,904.00
1965	194,888.90 ¹	1965	225,891.00
1966	176,298.20 ¹	1966	202,476.00
1967	166,728.60 ¹	1967	190,423.00
1968	185,285.90 ¹	1968	213,796.00
1969	126,574.00 ¹	1969	139,848.00
1970	79,564.30 ¹	1970	80,639.00
1971	77,189.56 ¹	1971	77,648.00
1972	120,801.10 ¹	1972	132,577.00
1973	663,298.70 ¹	1973	815,856.00
1974	37,979.75 ¹	1974	28,263.00
1975	104,799.60 ¹	1975	112,423.00
1976	100,944.90 ¹	1976	107,568.00
1977	70,777.52 ¹	1977	69,572.00
1978	157,527.40 ¹	1978	178,834.00
1979	390,852.20 ¹	1979	472,708.00
1980	280,185.80 ¹	1980	333,323.00

TABLE B-1 (Continued)

CALCULATED RECORD AT GRAND FALLS		CALCULATED RECORD AT CAMERON	
Year	Outflow (Acre-feet per year)	Year	Outflow (Acre-feet per year)
1981	48,210.74 ¹	1981	41,149.00
1982	196,227.50 ¹	1982	227,577.00
1983	272,212.80 ¹	1983	323,281.00
1984	184,246.60 ¹	1984	212,487.00
1985	233,619.10 ¹	1985	274,672.00
1986	92,425.69 ¹	1986	96,838.00
1987	144,122.90 ¹	1987	161,951.00
1988	159,348.00 ¹	1988	181,127.00
1989	44,499.76 ¹	1989	36,475.00
1990	21,859.00	1990	36,135.00
1991	136,021.00	1991	124,564.00
1992	187,274.00 ¹	1992	216,300.00
1993	534,600.00	1993	674,500.00
AVERAGE	176,608.30	AVERAGE	202,553.90
MEDIAN	151,231.30	MEDIAN	168,243.20

¹These values are calculated from the following regression analysis:

- X = Little Colorado River at Cameron
- Y = Little Colorado River at Grand Falls
- Regression Output:
 - Constant : 15,540.09
 - Standard Error of Y Estimation : 17,264.78
 - R Squared : 0.986463
 - Number of Observations : 12
 - Degrees of Freedom : 10
 - X Coefficient(s) : 0.793962
 - Standard Error of Coefficient(s) : 0.029411
 - Regression Equation : $Y = 0.793962 X + 15,540.09$

²These values are calculated from the following regression analysis:

- X = Little Colorado River at Grand Falls
- Y = Little Colorado River at Cameron
- Regression Output:
 - Constant : -16,949.40
 - Standard Error of Y Estimation : 21,597.42
 - R Squared : 0.986463
 - Number of Observations : 12
 - Degrees of Freedom : 10
 - X Coefficient(s) : 1.242457
 - Standard Error of Coefficient(s) : 0.046025
 - Regression Equation : $Y = 1.24257 X + (-16,949.40)$

TABLE B-2
LITTLE COLORADO RIVER SYSTEM
DATA EXTENSION OF SILVER CREEK AT SNOWFLAKE (USGS GAGE NO. 093935)

CALCULATED RECORD FOR SILVER CREEK			
Year	Outflow (Acre-feet per year)	Year	Outflow (Acre-feet per year)
1927	35,818.17 ¹	1961	2,610.00
1928	7,372.12 ¹	1962	10,422.00
1929	46,692.45 ¹	1963	7,651.00
1930	16,825.68 ¹	1964	11,297.00
1931	14,580.14 ¹	1965	6,060.00
1932	42,517.34 ¹	1966	19,550.00
1933	11,243.60 ¹	1967	7,928.00
1934	5,831.46 ¹	1968	15,554.00
1935	19,252.66 ¹	1969	10,190.00
1936	14,572.89 ¹	1970	5,616.00
1937	30,779.32 ¹	1971	14,916.00
1938	15,052.75 ¹	1972	15,691.00
1939	6,971.51 ¹	1973	42,361.00
1940	11,523.53 ¹	1974	2,254.00
1941	53,760.55 ¹	1975	7,035.00
1942	13,083.79 ¹	1976	7,548.00
1943	8,806.29 ¹	1977	5,194.00
1944	11,223.91 ¹	1978	15,912.00
1945	14,057.73 ¹	1979	50,119.00
1946	10,054.87 ¹	1980	35,746.00
1947	11,043.30 ¹	1981	3,843.00
1948	16,167.72 ¹	1982	7,486.00
1949	24,175.19 ¹	1983	16,086.00
1950	4,151.80 ¹	1984	14,659.00
1951	8,278.00	1985	33,277.00
1952	45,153.00	1986	3,289.00
1953	6,113.00	1987	9,473.00
1954	10,353.00	1988	6,711.00
1955	11,593.00	1989	2,831.00
1956	4,163.00	1990	2,017.00
1957	4,401.00	1991	8,318.00
1958	11,731.00	1992	11,310.00
1959	3,545.00	1993	60,550.00
1960	23,565.00	AVERAGE	15,645.04
		MEDIAN	11,243.60

TABLE B-2 (Continued)

¹These values are calculated from the following regression analysis:

-	X = Grand Falls	
-	Y = Silver Creek	
-	Regression Output:	
	Constant	: -762.917
	Standard Error of Y Estimation	: 7,217.849
	R Squared	: 0.731921
	Number of Observations	: 43
	Degrees of Freedom	: 41
	X Coefficient(s)	: 0.092906
	Standard Error of Coefficient(s)	: 0.008781
	Regression Equation	: $Y = 0.092906X + (-762.917)$

**TABLE B-3
LITTLE COLORADO RIVER SYSTEM
DATA EXTENSION OF THE LITTLE COLORADO RIVER AT WOODRUFF**

CALCULATED RECORD FOR THE LITTLE COLORADO RIVER AT WOODRUFF			
Year	Outflow (Acre-feet per year)	Year	Outflow (Acre-feet per year)
1927	71,766.87 ¹	1961	6,964.00
1928	22,055.33 ¹	1962	14,496.00
1929	90,770.46 ¹	1963	25,031.00
1930	42,649.00	1964	33,153.00
1931	31,651.87 ¹	1965	20,282.00
1932	59,093.00	1966	34,802.00
1933	51,612.00	1967	45,480.00
1934	19,362.91 ¹	1968	36,220.00
1935	42,817.44 ¹	1969	32,719.00
1936	42,719.00	1970	13,455.00
1937	46,103.00	1971	35,958.00
1938	15,117.00	1972	31,044.00
1939	10,370.00	1973	109,477.00
1940	46,103.00	1974	9,932.00
1941	115,438.00	1975	22,871.00
1942	14,562.00	1976	13,603.00
1943	20,223.00	1977	11,646.00
1944	14,845.00	1978	28,730.00
1945	35,864.00	1979	76,274.00
1946	49,805.00	1980	60,495.00
1947	30,128.00	1981	13,345.00
1948	30,937.00	1982	26,077.00
1949	53,679.00	1983	46,083.00
1950	7,904.00	1984	87,481.00
1951	21,846.00	1985	84,192.00
1952	56,125.00	1986	12,959.00
1953	13,188.00	1987	35,901.00
1954	25,145.00	1988	20,045.00
1955	70,406.00	1989	10,135.00
1956	9,935.00	1990	12,605.00
1957	30,901.00	1991	16,128.00
1958	32,094.00	1992	49,080.00
1959	9,866.00	1993	97,500.00
1960	42,008.00	AVERAGE	36,683.48
		MEDIAN	31,044.00

TABLE B-3 (Continued)

¹These values are calculated from the following regression analysis:

- X = Grand Falls
- Y = Little Colorado River at Woodruff
- Regression Output:
 - Constant : 7,838.761
 - Standard Error of Y Estimation : 14,059.01
 - R Squared : 0.699671
 - Number of Observations : 61
 - Degrees of Freedom : 59
 - X Coefficient(s) : 0.16346
 - Standard Error of Coefficient(s) : 0.013942
 - Regression Equation : $Y = 0.16346 X + 7,838.761$

APPENDIX C: QUANTIFICATION OF DE MINIMIS WATER USES IN THE WATER BUDGET ANALYSIS

The quantification of residential domestic, nonresidential and multi-domestic uses, OT irrigation, and municipal *de minimis* water uses for water budget and undepleted flow analysis is outlined below. Transmission losses and depletion factors are also analyzed. It should be noted that all assumptions used in all aspects of the analysis were selected to overestimate rather than underestimate the hydrologic impacts of the uses on the surface water flow in the Little Colorado River system.

RESIDENTIAL DOMESTIC USES

Each residential domestic use is assumed to use 0.7 acre-feet of groundwater per year, of which 0.6 acre-feet is depleted. Residential domestic uses were quantified using a formula of per capita estimated water usage multiplied by average household size as determined from Arizona Economic Security population statistics, then multiplied by a depletion factor. The per capita household size in the river system is estimated to be 4 persons per household. The estimated use per capita is 150 gallons per day per person. To calculate residential domestic water use for the water budget, the projected number of uses shown in Table 3-2 is multiplied by the use factor 0.7. For example, the Upper Little Colorado River (LCR) watershed has 1,270 projected residential domestic uses. When multiplied by 0.7, the total usage becomes 889 acre-feet per year. The depletion factor includes water lost to the system through usage and lost to the groundwater system through vertical leakage. The depletion factor is 0.87. To calculate the depletion for these uses, the total usage is multiplied by the depletion factor of 0.87. For example, in the Upper LCR watershed, the depletion is the total usage (889 acre-feet per year) multiplied by 0.87, which yields 773 acre-feet per year. In the water budget these values are added to the nonresidential and multi-domestic uses and rounded to the nearest 10 acre-feet.

NONRESIDENTIAL AND MULTI-DOMESTIC USES

The nonresidential and multi-domestic uses were investigated and quantified individually for the Silver Creek watershed. The results of the analysis are shown in Tables C-1 and C-2. Those uses less than 10 acre-feet have an average annual use of 2.3 acre-feet. The uses between 10 and 56 acre-feet have an average annual use of 30.6 acre-feet. The results of these investigations were projected across the watershed as discussed in APPENDIX A. To calculate the water use for this subset of domestic uses less than 10 acre-feet in the water budget, the projected number of uses as shown in Table 3-2 is multiplied by the average use of 2.3 acre-feet per year. The average annual use value was calculated from DWR analysis as shown in Table C-1 and C-2. For example the projected number of uses for this subset in the Upper LCR watershed is 30 uses, which when multiplied by the average annual usage of 2.3 acre-feet yields 69 acre-feet per year. To calculate the depletion from these uses, the total usage is multiplied by the depletion factor of 0.87. In the Upper LCR watershed, this yields 60 acre-feet per year. In the water budget, these values are added to the residential domestic uses and rounded to the nearest 10 acre-feet. The same approach was used for those uses between 10 and 56 acre-feet.

TABLE C-1

SILVER CREEK WATERSHED
MULTI-DOMESTIC POTENTIAL WATER RIGHT EVALUATION

WATERSHED FILE REPORT NUMBER	TYPE OF DM USE	CLAIMED AMOUNT (AFA)	ESTIMATED USE (AFA)	REMARKS
033-50-CAA-3, 033-50-CAA-4, 033-50-CAA-5	THREE DMs SUPPLIED BY ONE WELL	3.00	2.0	Supplied by groundwater. The estimated annual water use is based upon 4 persons per residence and a 150 gallons per capita per day (gpcd) rate for both inside and outside use.
033-56-AA-1	ONE DM CONSISTING OF FOUR RESIDENCES	NO CLAIM	2.7	Supplied by groundwater. The estimated annual water use is based upon 4 persons per residence and a 150 gpcd rate for both inside and outside use.
033-56-ABC-26	DM CONSISTING OF 140 MOBILE HOME SPACES	4.60	47.1	Supplied by groundwater. The estimated annual water use is based upon 4 persons per residence and a 75 gpcd rate for inside use only. All mobile home spaces are assumed to be occupied.
033-56-ACB-32	DM CONSISTING OF 60 MOBILE HOME SPACES	365.00	20.2	Supplied by groundwater. The estimated annual water use is based upon 4 persons per residence and a 75 gpcd rate for inside use only. All mobile home spaces are assumed to be occupied.
033-56-ACB-37, 033-56-ACB-38	TWO DMs SUPPLIED BY ONE WELL	0.85	1.3	Supplied by groundwater. The estimated annual water use is based upon 4 persons per residence and a 150 gpcd rate for both inside and outside use.
033-56-ACAC-38	DM CONSISTING OF TWO RESIDENCES	1.85	1.3	Supplied by groundwater. The estimated annual water use is based upon 4 persons per residence and a 150 gpcd rate for both inside and outside use.
033-56-ACAC-53	DM CONSISTING OF FIVE RESIDENCES	500,000.	3.4	Supplied by groundwater. The claimant may have intended to claim 500,000 gallons annually (1.5 acre-feet). The estimated annual water use is based upon 4 persons per residence and a 150 gpcd rate for both inside and outside use.
033-56-ACDB-30	DM CONSISTING OF 100 MOBILE HOME SPACES AND 5 RESIDENCES	NONE CLAIMED	37.0	Supplied by groundwater. The estimated annual water use is based upon 4 persons per residence, a 75 gpcd rate for inside use only for the mobile home spaces, and 150 gpcd rate for inside and outside use for the residences.
033-56-BAA-11	DM CONSISTING OF 60 MOBILE SPACES	NO CLAIM	20.2	Supplied by groundwater. The estimated annual water use is based upon 4 persons per residence and a 75 gpcd rate for inside use only. All mobile home spaces are assumed to be occupied.
033-56-BAA-12	DM CONSISTING OF A 132 UNIT CONDOMINIUM	NO CLAIM	44.4	Supplied by groundwater. The estimated annual water use is based upon 4 persons per residence and a 75 gpcd rate for inside use only. All condominium units are assumed to be occupied.
033-56-DBA-4, 033-56-DBA-5, 033-56-DBA-6, 033-56-DBA-16	FOUR DMs SUPPLIED BY ONE WELL	1.70	2.7	Supplied by groundwater. The estimated annual water use is based upon 4 persons per residence and a 150 gpcd rate for both inside and outside use.
033-56-DBA-20	DM CONSISTING OF SEVEN RESIDENCES	1.19	4.7	Supplied by groundwater. The estimated annual water use is based upon 4 persons per residence and 150 gpcd rate for both inside and outside use.

TABLE C-2

SILVER CREEK WATERSHED
NONRESIDENTIAL DOMESTIC POTENTIAL WATER RIGHT EVALUATION

WATERSHED FILE REPORT NUMBER	TYPE OF DM USE	CLAIMED AMOUNT (AFA)	ESTIMATED USE (AFA)	REMARKS
033-50-DBA-16	DM ASSOCIATED WITH THE BIBLE CLUB CHURCH SUMMER CAMP	10.00, 13.00	3.1	Supplied by groundwater. The estimated annual water use is based upon 100 persons using the camp, a 75 gallons per capita per day (gpcd) rate for inside use, and a 120 day camp season (May through August). Estimated use also includes the manager's residence, which is occupied all year.
033-51-100	DM ASSOCIATED WITH THE PEARCE CONSTRUCTION COMPANY	NONE CLAIMED	1.8	Supplied by groundwater. The estimated annual water use is based upon 30 employees, a 75 gpcd rate for inside use, and 260 work days per year.
033-51-CCA-50	DM ASSOCIATED WITH THE LINDEN VOLUNTEER FIRE DEPARTMENT	NONE CLAIMED	0.3	Supplied by groundwater. The estimated annual water use is based upon 3 employees and a 75 gpcd rate for inside use. Estimated use also includes domestic use for 25 firemen and 20 days of drills and/or firefighting.
033-51-DAB-1	TWO DMs ASSOCIATED WITH THE SILVER SPRINGS FISH HATCHERY	8.10	1.2	Supplied by groundwater. The estimated annual water use is based upon 5 buildings, 4 persons per building, a 75 gpcd rate for inside use, and 260 work days per year.
033-52-CA-10	DM ASSOCIATED WITH A FUTURE MUNICIPAL USE	NO CLAIM	NOT APPLICABLE	Landowner objects to the DM PWR classification. Planned future expansion may make this a municipal use. Assume 10 acre-feet annual use.
033-56-AAD-4	DM ASSOCIATED WITH 6 BUILDINGS AT THE WILDERNESS RANCH FACILITY	3.50	2.8	Supplied by groundwater. The estimated annual water use is based upon 100 persons using the facilities, a 75 gpcd rate for inside use, and a 120 season (May through August).
033-56-ABC-25	DM ASSOCIATED WITH THE NAVAPACHE HOSPITAL	3.40	14.9	Supplied by groundwater. The estimated annual water use is based upon a 50 bed hospital (assumed all filled), 127 persons per 8-hour shift, and a 75 gpcd rate for inside use.
033-56-ABC-27	DM ASSOCIATED WITH THE SHOW LOW LAKE CAMPGROUND	1200.00, 1.00	1.8	The claimed amount includes domestic, irrigation, and recreation/fish/wildlife uses. Supplied by groundwater. The estimated annual water use is based upon a yearly visitation rate of 20,000 persons and a 30 gpcd rate for campground use.
033-56-ACAC-37	DM ASSOCIATED WITH THE NAVAPACHE ELECTRICAL COOP OFFICES	NONE CLAIMED	4.8	Supplied by groundwater. The estimated annual water use is based upon 80 employees, a 75 gpcd rate for inside use, and 260 work days per year.
033-56-ACAC-45	DM ASSOCIATED WITH CABINS, APARTMENTS, RESTAURANT, AND LODGE	15.00	8.4	Supplied by groundwater. The estimated annual water use is based upon 100 persons and a 75 gpcd rate for inside use.
033-56-ACDB-28	DM ASSOCIATED WITH THE LAZY OAKS RESORT	NONE CLAIMED	5.9	The claimed amount is 40.00 acre-feet per year for irrigation and commercial/industrial uses. Supplied by groundwater. The estimated annual water use is based upon 15 units, 1 residence, 4 persons per residence, 4 part-time employees, a 75 gpcd rate for inside use for the resort rooms, and a 150 gpcd rate for inside and outside use for the residence.

TABLE C-2 (Continued)

WATERSHED FILE REPORT NUMBER	TYPE OF DM USE	CLAIMED AMOUNT (AFA)	ESTIMATED USE (AFA)	REMARKS
033-56-ACDB-31	DM ASSOCIATED WITH 12 APARTMENTS AND 5 STORES	NONE CLAIMED	5.5	Supplied by groundwater. The estimated annual water use is based upon 12 units, 4 persons per unit, and a 75 gpcd rate for inside use; and 5 stores, 5 persons per store, a 75 gpcd rate for inside use, and 260 work days per year.
033-56-ACDD-4	DM ASSOCIATED WITH A RETAIL NURSERY	0.34	0.7	Supplied by groundwater. The estimated annual water use is based upon 1 residence, 4 persons per residence, and a 150 gpcd rate for inside and outside use.
033-56-ACDD-7	DM ASSOCIATED WOODLAND LAKE PARK	NONE CLAIMED	0.9	The claim includes domestic, irrigation, and recreation/fish/wildlife uses. Supplied by groundwater. The estimated annual water use is based upon a yearly visitation rate of 10,000 persons and a 30 gpcd rate for park use.
033-56-ADD-1	DM ASSOCIATED WITH CABINS/RESORT	21.00	4.7	Supplied by groundwater. The estimated annual water use is based upon 7 resort dwellings, 4 persons per dwelling, and 150 gpcd rate for inside and outside use.
033-56-BAA-15	DM ASSOCIATED WITH RADIO STATION KVVM	NONE CLAIMED	0.8	The claimed amount of 0.35 acre-feet per year is for commercial/industrial use. Supplied by groundwater. The estimated annual water use is based upon 5 employees, and a 75 gpcd rate for inside use.

OTHER IRRIGATION (OT) USES

The quantification of OT irrigation uses was carried out in the manner outlined in the Silver Creek HSR for irrigation uses. An annual water duty of 5.0 acre-feet was assigned to each acre of OT irrigation. The depletion factor used was 0.67, which includes crop consumptive use requirements and losses associated with vertical leakage.

MUNICIPAL USES

The municipal uses were quantified individually based on DWR investigations. DWR investigated the number of service connections, and annual water use data provided to the Arizona Corporation Commission (ACC). DWR used the highest water use value provided to the ACC during the investigation period. If data provided to the ACC by the municipal water providers was incomplete, DWR used the same per capita

user per household formula that was used for residential domestic uses. This was then applied to the number of connections served by the water provider. The complete results of the investigations are shown in Tables C-3, C-4, and C-5. The total use supplied by the municipal water providers was calculated from DWR investigations, while the depletion was calculated by multiplying the usage by the depletion factor of 0.87

TRANSMISSION LOSSES

Transmission losses used in the water budget show the loss of water in the mainstem of the Little Colorado River from Holbrook to the Navajo Indian Reservation boundary. The transmission loss was calculated from a water balance used from the 1989 report. The transmission loss was calculated by taking the natural losses below Holbrook as calculated in the 1989 report (51,800 acre-feet per year) plus the cultural losses (3,660 acre-feet per year) divided by the calculated flow at the Navajo Indian Reservation boundary (197,600 acre-feet per year). This yields a transmission loss of 0.28. The calculation shows that 72% of the water flowing in the Little Colorado River below Holbrook can be expected to flow into the Navajo Indian Reservation. Transmission losses include natural as well as some surface water cultural uses in the mainstem of the Little Colorado River below Holbrook flowing to the Navajo Indian Reservation boundary.

DEPLETION FACTORS

The depletion factors used in this report include two components: consumptive use and vertical leakage. Consumptive use depletion factor for domestic uses is assumed to be 0.80 of the total usage. This value was derived from the Silver Creek HSR, and applied to all domestic and municipal uses in this report. For OT uses, the consumptive use depletion factor, the Silver Creek HSR value of 0.60 was used.

Vertical leakage is that component of the groundwater recharged from cultural use that leaks below the Coconino Aquifer into the Supai Formation where it is no longer directly related to the groundwater system. The vertical leakage component

reduces the water eventually available to the surface water system. The vertical leakage was calculated from the Silver Creek HSR water budget by the calculating the ratio of vertical leakage to recharge. The ratio was then applied to the that portion of the groundwater uses assumed to be recharged. By doing so, the water budget and undepleted flow analysis show that portion of use that is actually depleted from the entire hydrologic system through consumptive use and leakage outside of the useable groundwater system. For all domestic, OT, and municipal uses the vertical leakage is 0.07.

The total depletion factor for all domestic and municipal uses is 0.87. For OT uses, the depletion factor is 0.67.

**TABLE C-3
SILVER CREEK WATERSHED
ANNUAL WATER USE INFORMATION FOR MUNICIPAL WATER SERVICE ORGANIZATIONS
1990 TO 1993**

WATER SERVICE ORGANIZATION	WATERSHED FILE REPORT NUMBER	1990		1991		1992		1993		REMARKS
		TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS							
ARIZONA WATER COMPANY (FOREST TOWNE) (CC&N)	033-41-18	N/D	The annual water use is less than 10 acre-feet.							
ARIZONA WATER COMPANY (LAKESIDE) (CC&N)	033-56-45	N/D	The annual water use is greater than 56 acre-feet.							
CLAY SPRINGS WATER COMPANY (CC&N)	033-50-55	20.6	113	19.6	115	20.0	116	N/D	N/D	The annual water use is less than 56 acre-feet.
COUNTRY LANE WATER COMPANY	033-51-56	N/D	The estimated annual water use is greater than 56 acre-feet. The annual water use of 98.7 acre-feet is based upon 135 connections, 4 persons per connection, and 150 gallons per capita per day (gpcd) rate for inside and outside use.							
DWIGHT WATER COMPANY	033-51-55	N/D	The annual water use is less than 10 acre-feet.							
FOOLS HOLLOW WATER COMPANY (CC&N)	033-51-57	19.3	252	23.2	255	25.5	285	N/D	N/D	The annual water use is less than 56 acre-feet.
HIGH COUNTRY WATER COMPANY (CC&N)	033-51-50	.2	4	.2	5	1.3	4	N/D	N/D	The annual water use is less than 10 acre-feet.
LINDEN CO-OP	033-51-77	N/D	The estimated annual water use is less than 10 acre-feet. The estimated annual use of 8.0 acre-feet is based upon 6 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use, and 4 acre-feet for a 2 acre Christmas tree farm.							
MOUNTAINDALE SUBDIVISION	033-50-82	N/D	The estimated annual water use is less than 10 acre-feet. The estimated annual use of 3.3 acre-feet is based upon 15 cabins, 4 persons per cabin, a 150 gpcd rate for inside and outside use, and a 120 day summer season.							
PAPA WATER COMPANY (CC&N)	033-51-54	45.7	195	47.9	198	N/D	N/D	N/D	N/D	The annual water use is less than 56 acre-feet.
PARK VALLEY WATER COMPANY (CC&N)	033-51-58	33.9	308	37.8	309	36.4	324	N/D	N/D	The annual water use is less than 56 acre-feet.

TABLE C-3 (Continued)
 SILVER CREEK WATERSHED
 ANNUAL WATER USE INFORMATION FOR MUNICIPAL WATER SERVICE ORGANIZATIONS
 1984 TO 1989

WATER SERVICE ORGANIZATION	WATERSHED FILE REPORT NUMBER	1984		1985		1986		1987		1988		1989	
		TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS										
ARIZONA WATER COMPANY (FOREST TOWNE) (CC&N)	033-41-18	N/D	N/D	0.6	4	0.7	4	0.8	4	0.8	N/D	1.2	N/D
ARIZONA WATER COMPANY (LAKESIDE) (CC&N)	033-58-45	373.0	2,693	521.3	2,921	561.6	2,921	650.3	2,921	609.8	N/D	690.6	N/D
CLAY SPRINGS WATER COMPANY (CC&N)	033-50-55	15.6	94	14.9	95	15.9	98	20.9	103	18.2	106	20.2	111
COUNTRY LANE WATER COMPANY	033-51-56	N/D	N/D	N/D	N/D	N/D	135	N/D	N/D	N/D	N/D	N/D	N/D
DWIGHT WATER COMPANY	033-51-55	6.8	68	6.6	68	7.4	65	6.6	68	6.8	68	N/D	N/D
FOOLS HOLLOW WATER COMPANY (CC&N)	033-51-57	18.9	213	N/D	233	33.1	272	24.8	239	24.7	239	24.5	248
HIGH COUNTRY WATER COMPANY (CC&N)	033-51-50	N/D	N/D	N/D	2	N/D	9	0	0	N/D	3	2.3	29
LINDEN CO-OP	033-51-77	N/D	6	N/D	N/D	N/D	N/D	N/D	6	N/D	N/D	N/D	N/D
MOUNTAINDALE SUBDIVISION	033-50-92	N/D	13	N/D	N/D	N/D	N/D						
PAPA WATER COMPANY (CC&N)	033-51-54	25.6	151	24.9	166	N/D							
PARK VALLEY WATER COMPANY (CC&N)	033-51-58	20.2	213	N/D	258	24.7	272	31.0	279	28.3	286	N/D	N/D

TABLE C-3 (Continued)
SILVER CREEK WATERSHED
ANNUAL WATER USE INFORMATION FOR MUNICIPAL WATER SERVICE ORGANIZATIONS
1990 TO 1993

WATER SERVICE ORGANIZATION	WATERSHED FILE REPORT NUMBER	1990		1991		1992		1993		REMARKS
		TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS							
PETERSEN WATER COMPANY (CC&N)	033-41-17	5.3	19	6.9	20	6.1	20	N/D	N/D	The annual water use is less than 10 acre-feet.
PINEDALE DOMESTIC WATER IMPROVEMENT DISTRICT	033-50-81	N/D	The estimated annual water use is less than 56 acre-feet. The estimated annual use of 41.7 acre-feet is based upon 62 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use.							
PINETOP WATER COMPANY (CC&N)	033-56-46	222.1	831	228.4	851	223.6	870	N/D	N/D	The annual water use is greater than 56 acre-feet.
PINEVIEW LAND AND WATER COMPANY (CC&N)	033-56-48	160.3	713	171.2	714	161.2	678	N/D	N/D	The annual water use is greater than 56 acre-feet.
PONDEROSA DOMESTIC WATER IMPROVEMENT DISTRICT	033-56-52	N/D	The annual water use is greater than 56 acre-feet.							
PORTER CREEK WATER COMPANY (CC&N)	033-56-50	8.7	79	17.1	79	N/D	N/D	N/D	N/D	The annual water use is less than 56 acre-feet.
PORTER MOUNTAIN DOMESTIC WATER IMPROVEMENT DISTRICT	033-56-61	N/D	N/D	10.2	92	7.5	93	8.5	94	The annual water use is less than 56 acre-feet.
RETAW WATER COMPANY	033-56-65	N/D	The estimated annual water use is less than 56 acre-feet. The estimated annual use of 18.1 acre-feet is based upon 27 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use.							
SHOW LOW	033-51-52	N/D	The annual water use is greater than 56 acre-feet.							
SHOW LOW LAKE WATER CO-OP	033-56-53	N/D	The estimated annual water use is less than 56 acre-feet. The estimated use of 11.4 acre-feet is based upon 17 connections, 4 persons per connection, and 150 gpcd rate for inside and outside use.							
SILVER WELL SERVICE CORPORATION (CC&N)	033-51-49	20.3	233	17.8	164	N/D	N/D	N/D	N/D	The annual water use is less than 56 acre-feet.

TABLE C-3 (Continued)
 SILVER CREEK WATERSHED
 ANNUAL WATER USE INFORMATION FOR MUNICIPAL WATER SERVICE ORGANIZATIONS
 1984 TO 1989

WATER SERVICE ORGANIZATION	WATERSHED FILE REPORT NUMBER	1984		1985		1986		1987		1988		1989	
		TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS										
PETERSEN WATER COMPANY (CC&N)	033-41-17	3.1	14	4.2	14	5.1	18	5.4	19	5.4	17	6.0	17
PINEDALE DOMESTIC WATER IMPROVEMENT DISTRICT	033-50-81	N/D	62	N/D	N/D	N/D	N/D						
PINETOP WATER COMPANY (CC&N)	033-56-46	192.0	752	218.2	813	239.1	799	277.8	825	220.9	936	237.1	944
PINEVIEW LAND AND WATER COMPANY (CC&N)	033-56-48	82.7	597	88.9	630	112.5	650	113.3	649	119.0	673	157.1	705
PONDEROSA DOMESTIC WATER IMPROVEMENT DISTRICT	033-56-52	288.7	1,246	247.9	1,300	239.6	1,388	294.3	1,390	285.7	1,400	377.1	1,410
PORTER CREEK WATER COMPANY (CC&N)	033-56-50	N/D	N/D	9.3	72	9.3	72	9.3	72	15.1	75	N/D	N/D
PORTER MOUNTAIN DOMESTIC WATER IMPROVEMENT DISTRICT	033-56-61	N/D	80	N/D	90	N/D	98	N/D	N/D	N/D	N/D	N/D	N/D
RETAW WATER COMPANY	033-56-65	N/D	27	N/D	N/D								
SHOW LOW	033-51-52	613.0	N/D	850.0	N/D	741.0	2,285	1025.4	N/D	719.5	N/D	N/D	N/D
SHOW LOW LAKE WATER CO-OP	033-56-53	3.4	17	4.1	17	3.6	17	N/D	N/D	N/D	N/D	N/D	N/D
SILVER WELL SERVICE CORPORATION (CC&N)	033-51-49	9.2	85	9.9	116	12.4	155	17.7	197	23.2	218	21.8	226

TABLE C-3 (Continued)
SILVER CREEK WATERSHED
ANNUAL WATER USE INFORMATION FOR MUNICIPAL WATER SERVICE ORGANIZATIONS
1990 TO 1993

WATER SERVICE ORGANIZATION	WATERSHED FILE REPORT NUMBER	1990		1991		1992		1993		REMARKS
		TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS							
SITGREAVES WATER COMPANY (CC&N)	033-50-58	2.7	48	2.9	48	2.8	44	3.1	44	The annual water use is less than 10 acre-feet.
SKI-HI WATER COMPANY	033-56-49	N/D	The estimated annual water use is greater than 56 acre-feet. The estimated use of 59.8 acre-feet is based upon 89 connections, 4 persons per connection, and a 150 gpd rate for inside and outside use.							
SNOWFLAKE	033-42-40	N/D	The annual water use is greater than 56 acre-feet.							
SUNRISE VISTA ESTATES WATER COMPANY	033-52-43	N/D	The estimated annual water use is less than 56 acre-feet. The estimated use of 32.2 acre-feet is based upon 48 connections, 4 persons per connection, and a 150 gpd rate for inside and outside use.							
TAYLOR	033-51-53	482.4	617	556.5	617	689.4	617	438.7	617	The annual water use is greater than 56 acre-feet.
TIMBERLAND ACRES DOMESTIC WATER IMPROVEMENT DISTRICT	033-50-77	13.5	170	12.8	174	12.4	181	15.7	184	The annual water use is less than 56 acre-feet.
UTILITY SYSTEMS GROUP/PINE OAK WATER COMPANY	033-56-47	N/D	N/D	N/D	N/D	17.4	182	23.6	182	The annual water use is less than 56 acre-feet.
WHITE MOUNTAIN LAKES ESTATES (CC&N)	033-51-51	48.2	394	56.7	397	58.9	479	N/D	N/D	The annual water use is greater than 56 acre-feet.
WHITE MOUNTAIN SUMMER HOME WATER IMPROVEMENT DISTRICT	033-56-54	N/D	The annual water use is less than 56 acre-feet.							
WHITE MOUNTAIN WATER COMPANY	033-51-59	5.8	34	8.8	43	10.0	49	12.2	52	The annual water use is less than 56 acre-feet.
WONDERLAND ACRES DOMESTIC WATER IMPROVEMENT DISTRICT	033-56-56	32.8	140	32.2	141	31.7	142	35.4	144	The annual water use is less than 56 acre-feet.

CC&N - CERTIFICATE OF CONVENIENCE AND NECESSITY ISSUED BY THE ARIZONA CORPORATION COMMISSION. N/D - NO DATA
 *NEW NAME OF COMPANY IS CEDAR GROVE WATER COMPANY (1992) AND WAS NOT INCLUDED IN THE FINAL HSR. DATE ON SOC IS 5/10/91; THERE WAS NO 1992 STATISTICAL DATA.

TABLE C-3 (Continued)
SILVER CREEK WATERSHED
ANNUAL WATER USE INFORMATION FOR MUNICIPAL WATER SERVICE ORGANIZATIONS
1984 TO 1989

WATER SERVICE ORGANIZATION	WATERSHED FILE REPORT NUMBER	1984		1985		1986		1987		1988		1989	
		TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS										
SITGREAVES WATER COMPANY (CC&N)	033-50-56	N/D	N/D	1.8	39	3.6	47	2.2	48	2.4	48	2.9	48
SKI-HI WATER COMPANY	033-56-49	N/D	80	N/D	50	N/D	82	N/D	89	N/D	N/D	N/D	N/D
SNOWFLAKE	033-42-40	N/D	N/D	N/D	N/D	N/D	940	613.8	1,000	613.8	1,000	639.2	1,088
SUNRISE VISTA ESTATES WATER COMPANY	033-52-43	N/D											
TAYLOR	033-51-53	305.0	N/D	337.0	N/D	370.0	613	335.0	615	422.0	617	437.0	615
TIMBERLAND ACRES DOMESTIC WATER IMPROVEMENT DISTRICT	033-50-77	6.1	75	6.1	80	8.6	95	N/D	105	N/D	N/D	N/D	N/D
UTILITY SYSTEMS GROUP/PINE OAK WATER COMPANY	033-56-47	15.3	176	15.7	181	11.9	176	16.5	178	18.0	180	23.6	185
WHITE MOUNTAIN LAKES ESTATES (CC&N)	033-51-51	29.8	349	35.8	377	36.8	422	73.4	447	61.7	375	65.7	395
WHITE MOUNTAIN SUMMER HOME WATER IMPROVEMENT DISTRICT	033-56-54	39.3	451	42.4	453	44.8	454	N/D	N/D	N/D	N/D	N/D	N/D
WHITE MOUNTAIN WATER COMPANY	033-51-59	N/D	N/D	N/D	N/D	0.3	7	1.9	13	5.8	17	5.0	27
WONDERLAND ACRES DOMESTIC WATER IMPROVEMENT DISTRICT	033-56-56	N/D	N/D	N/D	N/D	29.8	133	N/D	133	30.1	130	36.0	140

**TABLE C-4
UPPER LITTLE COLORADO RIVER WATERSHED
ANNUAL WATER USE INFORMATION FOR MUNICIPAL WATER SERVICE ORGANIZATIONS
1988 TO 1993**

WATER SERVICE ORGANIZATION	WATERSHED FILE REPORT NUMBER	WATER SOURCE	1988		1989		1990		1991		1992		1993		REMARKS
			TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS											
CEDAR HILLS PROPERTY OWNERS	031-42-1 (39-87086 CLAIMS .27 ACRE-FEET - 1 DWELLING)	GROUND-WATER	N/D	The estimated annual water use is less than 10 acre-feet. The estimated use of 0.70 acre-feet is based on 1 connection, 4 persons per connection, and a 150 gallons per capita per day (gpcd) rate for inside and outside use.											
CONCHO WATER SUPPLY/REBUSH A.C.	031-53-1	GROUND-WATER	N/D	The estimated annual water use is less than 56 acre-feet. The estimated use of 10.1 acre-feet is based upon 15 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use.											
EAGAR	031-59-37	GROUND-WATER	55.2-61.4 ²	1200 ²	The annual water use is greater than 56 acre-feet.										
GREER HEIGHTS WATER USERS ASSOCIATION	031-60-9	GROUND-WATER	N/D	3 ³	The estimated annual water use is less than 10 acre-feet. The estimated use of 9.4 acre-feet is based upon 14 connections, 4 persons per connection, and 150 gpcd rate for inside and outside use.										
GREER WATER USERS ASSOCIATION	031-60-8	GROUND-WATER	N/D	11 ⁴	The estimated annual water use is less than 10 acre-feet. The estimated use of 7.4 acre-feet is based upon 11 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use.										
HUNT VALLEY WATER COMPANY* (CC&N)	031-43-48	GROUND-WATER	N/D	The estimated annual water use is less than 10 acre-feet. The estimated use of 3.4 acre-feet is based upon 5 connections, 4 person per connection, and a 150 gpcd rate for inside and outside use.											
LIVCO WATER COMPANY (CC&N)	031-52-1	GROUND-WATER	63.0	290	72.0	285	68.1	290	60.6	291	62.1	294	N/D	N/D	The annual water use is greater than 56 acre-feet.
LORD ARIZONA WATER SYSTEMS*	031-52-39	GROUND-WATER	1.4	12	0.8	30	3.1	29	4.2	44	4.6	38	N/D	N/D	The annual water use is less than 10 acre-feet.

TABLE C-4 (Continued)
 UPPER LITTLE COLORADO RIVER WATERSHED
 ANNUAL WATER USE INFORMATION FOR MUNICIPAL WATER SERVICE ORGANIZATIONS
 1988 TO 1993

WATER SERVICE ORGANIZATION	WATERSHED FILE REPORT NUMBER	WATER SOURCE	1988		1989		1990		1991		1992		1993		REMARKS
			TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS											
MOUNTAIN VIEW WATER COMPANY (CC&N)	031-53-2	GROUND-WATER	13.2	36	11.3	36	12.1	38	11.7	38	12.2	40	N/D	N/D	The annual water use is less than 56 acre-feet.
OJO BONITO WATER IMPROVEMENT DISTRICT	031-52-10	GROUND-WATER	N/D	16 ⁷	16 ⁷	16 ⁷	The estimated annual water use is less than 56 acre-feet. The estimated use of 42.3 acre-feet is based upon 63 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use.								
PARADISE ACRES PROPERTY OWNERS CO-OP	031-58-32	SURFACE WATER - SPRING	N/D	9	9	9	The estimated annual water use is greater than 3 acre-feet. The estimated use of 6.0 acre-feet is based upon 9 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use.								
PARADISE MOUNTAIN ACRES WATER USERS	031-58-33	SURFACE WATER - SPRING	N/D	5	5	5	The estimated annual water use of is greater than 3 acre-feet. The estimated use of 3.4 acre-feet based upon 5 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use.								
PINECREST WATER COMPANY (CC&N)	031-61-11	GROUND-WATER	3.3	31	3.9	32	3.3	32	3.2	32	2.5	31	N/D	N/D	The annual water use is less than 10 acre-feet.
SERVICEBERRY WATER COMPANY (CC&N)	031-52-5	GROUND-WATER	N/D	N/D	N/D	N/D	N/D	N/D	1.6	8	2.2	8	N/D	N/D	The annual water use is less than 10 acre-feet.
SPRINGERVILLE	031-59-35	SURFACE WATER - SPRING & GROUND-WATER	352.9	650 ²	650 ²	650 ²	The annual water use is greater than 56 acre-feet.								
ST. JOHNS	031-44-59	SURFACE WATER & GROUND-WATER	675.1 ²	150	561.7 ²	150	527.7 ²	150	568.8 ²	150	N/D	150	N/D	150	The annual water use is greater than 56 acre-feet.

TABLE C-4 (Continued)
 UPPER LITTLE COLORADO RIVER WATERSHED
 ANNUAL WATER USE INFORMATION FOR MUNICIPAL WATER SERVICE ORGANIZATIONS
 1988 TO 1993

WATER SERVICE ORGANIZATION	WATERSHED FILE REPORT NUMBER	WATER SOURCE	1988		1989		1990		1991		1992		1993		REMARKS
			TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS											
T.K.(TIMBER KNOLLS) WATER SERVICE (CC&N)	031-52-2	GROUND-WATER	4.1	31	4.5	31	N/D	N/D	3.8	32	3.6	33	N/D	N/D	The annual water use is less than 10 acre-feet.
VERNON WATER USERS, INC.*	031-52-3	GROUND-WATER	N/D	The estimated annual water use is less than 50 acre-feet. The estimated use of 19.5 acre-feet is based upon 29 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use.											
WOODRUFF DOMESTIC WATER IMPROVEMENT DISTRICT	031-33-2 (55-505737 CLAIMS 550 GPM)	GROUND-WATER	N/D	50 ²	N/D	50 ²	N/D	N/D	N/D	50 ²	N/D	50 ²	N/D	50 ²	The estimated annual water use is less than 50 acre-feet. The estimated use of 33.6 acre-feet is based upon 50 connections, 4 persons per connection, and a 150 gpcd rate for inside use and outside use.

CC&N - CERTIFICATE OF CONVENIENCE AND NECESSITY ISSUED BY THE ARIZONA CORPORATION COMMISSION.

N/D - NO DATA

¹CONCHO WATER SUPPLY IS IN A TRANSITIONAL STATE AT PRESENT

²ESTIMATE

³SOC NO. 39-80339 (FILING DATE 2/1/82) CLAIMS 14 DWELLINGS. IN A PHONE INTERVIEW WITH LEE SHERBON (1/13/94), HE CLAIMED 3 DWELLINGS.

⁴NINE CONNECTIONS ARE SEASONAL.

⁵HUNT VALLEY WATER COMPANY HASN'T SENT AN ANNUAL REPORT TO THE ARIZONA CORPORATION COMMISSION SINCE 1978, BUT THEY ARE STILL SERVING CUSTOMERS. THE CORPORATION COMMISSION HAS YET TO REVOKE THEIR CC&N.

⁶HUNT VALLEY IS ONE OF THE CORPORATION COMMISSION'S WORST REPORTERS. NO STATEMENT OF CLAIMANT FILED.

⁷IN A PHONE INTERVIEW (1/19/94) WITH TOM LORD, OWNER OF LORD ARIZONA WATER SYSTEMS, NO STATEMENT OF CLAIMANT HAS BEEN FILED AND MR. LORD STATED THAT WE COULD CALL BACK AT A LATER DATE FOR THE ANNUAL USE DATA.

⁸THREE CONNECTIONS ARE SEASONAL.

⁹THERE ARE 21 ACTIVE METERED CONNECTIONS AND THERE ARE A TOTAL OF 29 IN THE SYSTEM.

**TABLE C-5
LOWER LITTLE COLORADO RIVER WATERSHED
ANNUAL WATER USE INFORMATION FOR MUNICIPAL WATER SERVICE ORGANIZATIONS
1988 to 1992**

WATER SERVICE ORGANIZATION	WATERSHED FILE REPORT NUMBER	WATER SOURCE	1988		1989		1990		1991		1992		REMARKS
			TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS	TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS	TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS	TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS	TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS	
ARIZONA WINDSONG REALTY, INC. (CC&N)	NOT YET ASSIGNED	GROUNDWATER	44.8	54	N/D	N/D	N/D	N/D	44.8	54	N/D	N/D	The annual water use is less than 56 acre-feet.
DONEY PARK WATER (CC&N)	NOT YET ASSIGNED	GROUNDWATER	344.1	1509	398.2	1601	691.5	1645	410.5	1718	N/D	N/D	The annual water use is greater than 56 acre-feet.
FLAGSTAFF RANCH WATER COMPANY, INC. (CC&N)	NOT YET ASSIGNED	GROUNDWATER	N/D	N/D	12.1	1	The annual water use is less than 56 acre-feet.						
HEBER WATER WORKS (CC&N)	NOT YET ASSIGNED	GROUNDWATER	70.1	157	92.4	168	92.4	168	BECAME HEBER DOMESTIC WATER IMPROVEMENT DISTRICT				The annual water use is greater than 56 acre-feet.
HECKETHORN WATER COMPANY (CC&N)	NOT YET ASSIGNED	GROUNDWATER	8.0	31	7.9	36	10.1	36	9.5	37	12.4	42	The annual water use is less than 56 acre-feet.
HIGH COUNTRY PINES WATER COMPANY (CC&N)	NOT YET ASSIGNED	GROUNDWATER	1.6	25	2.3	30	2.5	29	3.7	32	3.2	36	The annual water use is less than 10 acre-feet.
JOSEPH CITY WATER SYSTEM (CC&N)	NOT YET ASSIGNED	GROUNDWATER	175.1	306	191.1	312	171.1	305	171.9	310	171.4	307	The annual water use is greater than 56 acre-feet.
KING WATER CO-OP COMPANY	NOT YET ASSIGNED	GROUNDWATER (39-91482 claims source - groundwater, & 40.3 acre-feet claimed amount)	N/D	N/D	N/D	N/D	The estimated annual water use is less than 10 acre-feet. The estimated use of 6.7 acre-feet is based upon 10 connections, 4 persons per connection, and a 150 gallons per capita per day (gpcd) rate for inside and outside use.						
MOGOLLON WATER COMPANY, INC. (CC&N)	NOT YET ASSIGNED	GROUNDWATER	6.2	74	6.3	92	7.0	125	7.2	125	10.1	124	The annual water use is less than 56 acre-feet.
MORMON LAKE WATER COMPANY (CC&N)	NOT YET ASSIGNED	GROUNDWATER	N/D	130	N/D	134	N/D	134	N/D	132	N/D	132	The estimated annual water use is greater than 56 acre-feet. The estimated use of 88.5 acre-feet is based upon 132 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use.

TABLE C-5 (Continued)
 LOWER LITTLE COLORADO RIVER WATERSHED
 ANNUAL WATER USE INFORMATION FOR MUNICIPAL WATER SERVICE ORGANIZATIONS
 1988 TO 1992

WATER SERVICE ORGANIZATION	WATERSHED FILE REPORT NUMBER	WATER SOURCE	1988		1989		1990		1991		1992		REMARKS
			TOTAL ACRE-FEET DELIVERED	TOTAL SERVICE CONNECTIONS									
MOUNTAIN DELL WATER, INC. (CC&N)	NOT YET ASSIGNED	GROUNDWATER	15.3	80	15.7	80	15.5	80	14.9	80	13.1	81	The annual water use is less than 56 acre-feet.
PONDEROSA UTILITY CORP. (CC&N)	NOT YET ASSIGNED	GROUNDWATER	N/D	N/D	54.6	408	58.3	422	59.9	431	89.0	438	The annual water use is greater than 56 acre-feet.
SUN VALLEY UTILITIES, INC. (CC&N)	NOT YET ASSIGNED	GROUNDWATER	N/D	71	N/D	72	N/D	59	N/D	N/D	N/D	N/D	The estimated annual water use is less than 56 acre-feet. The estimated use of 45.4 acre-feet is based upon 72 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use.
TALL PINE ESTATES WATER & IMPROVEMENT DISTRICT (CC&N)	NOT YET ASSIGNED	GROUNDWATER	N/D	41	N/D	44	N/D	44	N/D	47	N/D	48	The estimated annual water use is less than 56 acre-feet. The estimated use of 32.3 acre-feet is based upon 48 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use.
THREE-O-THREE DOMESTIC WATER IMPROVEMENT DISTRICT ¹	NOT YET ASSIGNED	GROUNDWATER	N/D	The estimated annual water use is less than 56 acre-feet. The estimated use of 10.1 acre-feet is based upon 15 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use.									
TRUE BLUE WATER CO-OP COMPANY	NOT YET ASSIGNED	GROUNDWATER [39-91461 claims source - groundwater, 37.1 acre-feet claimed amount]	N/D	The estimated annual water use is less than 10 acre-feet. The estimated use of 5.4 acre-feet is based upon 8 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use.									
WEST VILLAGE WATER COMPANY (CC&N)	NOT YET ASSIGNED	GROUNDWATER	16.3	58	16.2	63	16.0	62	N/D	N/D	15.3	52	The annual water use is less than 56 acre-feet.
WINSLOW WEST WATER COMPANY, INC. (CC&N)	NOT YET ASSIGNED	GROUNDWATER	N/D	N/D	N/D	6	N/D	6	N/D	6	N/D	6	The estimated annual water use is less than 10 acre-feet. The estimated use of 4.0 acre-feet is based upon 6 connections, 4 persons per connection, and a 150 gpcd rate for inside and outside use.

CC&N - CERTIFICATE OF CONVENIENCE AND NECESSITY ISSUED BY THE ARIZONA CORPORATION COMMISSION.

N/D - NO DATA
¹IN A PHONE INTERVIEW (1/29/94) WITH QUINT SHREEVE, NAVAJO COUNTY BOARD OF SUPERVISORS, THERE ARE ONLY ABOUT 15 PROPERTY OWNERS IN THE DISTRICT, AND NOT MORE THAN 10 ON THE SYSTEM. THESE 10 ARE NOT CONNECTIONS, THE WATER IS HAULED FROM THE WELLS IN BARRELS OR OTHER CONTAINERS.

CERTIFICATE OF MAILING

On April 28, 1994, the original of this report was mailed to the Clerk of the Superior Court of Apache County; copies were also mailed to all persons on the court approved mailing list this same date.

Amelia M. Margus Juenera