DRAFT

BAK619

Big Chino Subbasin

Historical and Current Water Uses and Water Use Projections

Yavapai County Water Advisory Committee

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Acknowledgements:

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A huge portion of this report was prepared with the help of Jack McCormack from the Arizona Department of Water Resources – Prescott AMA. The report could not have been completed without his help.

Survey of Historically Irrigated Lands
Big Chino Subbasin

Introduction

This study was initiated to address two water related questions about the Big Chino sub-basin. The first of these concerns the right associated with certain lands to transfer water out of the Big Chino Sub-basin to the Prescott AMA. According to Arizona Revised Statutes, § 45-555, lands that were irrigated with groundwater at any time between January 1, 1975 and January 1, 1990 are eligible for a right to transfer up to 3 acre-feet per acre retired to the Prescott AMA. To date, lands irrigated during this time period have not been comprehensively identified.

The second question this study addresses is to provide additional information about the water uses within the Big Chino sub-basin for purposes of defining the potential impacts to the groundwater levels and outflow. Although several estimates have been made in the past regarding the cultural use of water in the Big Chino, estimates from separate sources are not in agreement and do not include the more contemporary or more historic uses that are addressed in this study.

The lands investigated and mapped in this report constitute an effort to calculate historic water uses for planning purposes and should not be construed as a recommendation of a water right.

Methodology: Investigations of the historically irrigated land in the Big Chino Subbasin initially began with an examination of the available historical aerial photography of the area. Aerial imagery of the subbasin began in 1940 and ranged to 2000 for this study – the list of historical photography is provided in Table 1 below. The recent 2000 imagery is rectified geo-referenced digital satellite imagery obtained by Yavapai County. This digital imagery provided the base map upon which irrigated polygons from the historical

imagery were delineated based on visual reference points in common between the historical and digital images. It is estimated that this method is at least as accurate as obtaining visual reference points from topographic maps and then digitizing and re-scaling the mapped polygons since the process error is reduced to one step.

Table 1
Historical Aerial Photography used to investigate Historically Irrigated Lands in the Big Chino Subbasin

Year Flown	Contracted by	Description of Coverage
1940	SCS	Majority of Irr. Lands
1953/54	SCS	Majority of Irr. Lands
1966	ADOT	Portion of Paulden Area(1 photo)
1968	USFS	Paulden & Williamson Valley
1969	NASA	Portion of Paulden Area (1 photo)
1973	USGS	East 1/2 of Basin
1977	USFS	West 1/2 of Basin
1980	NHAP	Majority of Irr. Lands
1985	ADWR	Portion of Paulden Area
1988	ADWR	Portion of Paulden Area
1989	Yavapai Co. Flood District	Portion of Paulden Area
1990	ADWR	Majority of Irr. Lands
1995	ADWR	All irrigated lands shown on 1990 photography
2000	Yavapai County	Yavapai Co. portion of Basin

In some cases, interpretation of the imagery was based on an interpretation of whether the land was irrigated in the year shown. For example, the 1953/54 imagery was flown either in late November of 1953, or in February of 1954. In this case, the photography was interpreted for irrigation activity that occurred in 1953 because the February date of the 1954 photos was generally too early to show evidence of irrigation that would likely have occurred in the summer of 1954. Experienced personnel from Yavapai County and ADWR reached agreement on the subjective interpretation phase in order to provide a better product.

ADWR personnel collected additional information about the existing cropping patterns and irrigation systems during field investigations in 1996 and 1998. The result of these investigations is published in the report “Verde River Watershed Study” in 2000. It should be noted that this study focused on lands with potential water rights for consideration by the General Adjudication Court. In part, this criterion created acreage results that are higher than the acreage listed in this report. In addition, the interviews and site visits made during this study revealed nearly 600 acres of land in the Williamson Valley area that was mapped in the 2000 study as irrigated pasture but is in fact watered by a high water table and not through a man-made irrigation system. However, much of this acreage had been irrigated at one time in past decades. The same photographic base data for years 1990 and 1995 were used in both the ADWR 2000 study and this study.

In addition to interpretation of aerial photography, field investigations were conducted during the summer and fall of 2003. Personnel either observed active irrigation uses and noted crop type, irrigation system type and water source, or in the case of inactive lands, staff looked for signs of historic irrigation activity. In most cases, old ditches, irrigation wells, pipes or other signs of past activity were discovered to verify that the field had been irrigated. In some cases, aerial photography revealed a field that appeared to have been cultivated in the past, but it did not look active on any historical photos. If a field investigation found evidence of historic irrigation activity, it was assumed that the field had been irrigated for up to five years prior to its first appearance on the historic photography. The total length of time that it was assumed irrigated could be limited to less than five years if time span between a photo without the field showing and a photo with the field showing was less than five years. The five-year span is subjective and is partially based on the typical time required to pay back the cost of installing an irrigation system.

Personnel also conducted interviews with landowners and persons with historic knowledge of the area to provide a field-by-field summary of the historic irrigation activities. This interview process has not been completed for all lands in the Big Chino due to difficulty in scheduling interviews or finding anyone who remembers the history of some lands. This process has provided information about the majority of the irrigated acreage in the Big Chino subbasin.

Other written historical information was also examined, and although helpful for general water budget purposes, this information did not identify specific field boundaries or provide written detail about how the estimates were derived. A comparison table of the historic diversion or consumptive use estimates can be found in Appendix A.

Because this report attempts to develop an irrigation history for each irrigation parcel there are some large increases or decreases in the amount of acreage irrigated between certain successive years. In fact, the increase in irrigated land was probably much more gradual. In most cases this jump is due to the aerial photography interpretation process. For instance the data in this report shows an increase from 1,500 acres in 1947 to 3,500 acres in 1948. This is due to assumptions for deriving irrigation activity that occurred between aerial photo flights. In this instance, 1948 is mid way between the 1940 and 1953/54 aerial imagery. The interpretation of irrigation activity between 1948 and 1953 depended on the 1953/54 imagery. The interpretation from 1941-1947 depended on the activity found on the 1940 photo. If there was no aerial coverage for a certain field, the interpretation depended on the activity found on the next nearest in time set of aerial imagery. These “jumps” are ameliorated in later years with the information obtained from interviews.

Although the calculated annual acreage could be smoothed to reduce these inconsistencies, one would have to arbitrarily determine when specific fields were irrigated in that time period between photo years. Since pumping impacts within and outside of the basin are geographically related, it was decided to accept the acreage

"jumps" in favor of having a geographic reference for where the pumping occurred and then smooth the information using 10 year averages.

General Description of Irrigated Lands: The majority of the irrigated lands exist in four general locations in the Big Chino Subbasin; near the community Paulden, along Big Chino Wash approximately 15 miles northwest of Paulden (Upper Big Chino), along Williamson Valley Wash approximately 17 miles northwest of Prescott and along Walnut Creek. Other small parcels of irrigated lands are scattered throughout the area, primarily in the mountain valleys rimming the southern portion of the subbasin. Figure 1 displays the location of these four areas.

Much of the irrigated lands in the Big Chino subbasin are used for raising livestock. Pasture is and has been a common crop, as are grass and clover mixtures and alfalfa for baling. Other common crops are small grains, alfalfa and corn. These crops are typical for the irrigated lands along Big Chino Wash, approximately 15 miles northwest of Paulden.

The Paulden area once had several thousand acres of irrigated land but much of this has been abandoned and split into smaller parcels for residential development. One interesting historic water use is the establishment of 11 groundwater-supplied lakes that were filled from the late 1950s to the mid 1960s to attract residential development. The total surface area of these lakes was 128 acres as mapped in this report, although old promotional pamphlets state that there were to be "over 400 acres of lakes". This is not supported by the limited historical information available for this time period. Most of these lakes were also mapped on the USGS Paulden 1:24,000 Quadrangle produced in 1973. A combination of historical photography, flood plain mapping, and the Paulden Quadrangle were used to map these lakes.

Irrigation system types include almost every possible system used to flood or sprinkler irrigate. A small number of surface water diversions are located in the higher elevation portions of the subbasin, hand move and sideroll sprinkler systems are common along Williamson Valley Wash, and furrow or border supplied by gated pipe along with center pivot irrigation systems are found on the lands in the Upper Big Chino. The irrigated lands near Paulden are typically sprinkler irrigated; historical evidence shows that this was also common in the past.

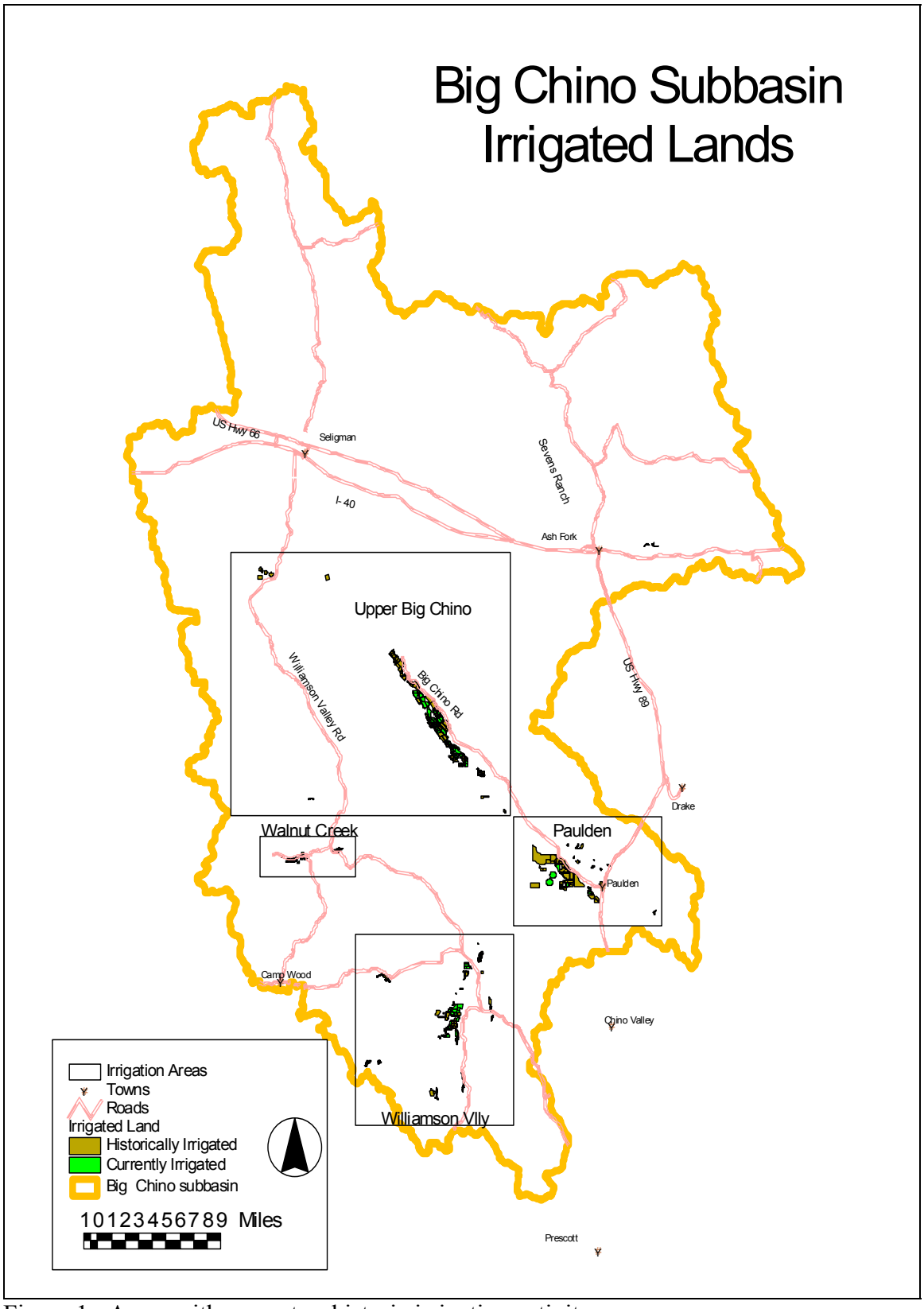


Figure 1: Areas with current or historic irrigation activity.

Results of 2003 Field Investigations:

During the 2003 field investigation, approximately 6826 acres out of 8197 total possible acres of land were site visited to determine whether the field was actively or historically irrigated. If it was actively irrigated, the crop and irrigation system types and water source were noted. The vast majority of actively irrigated lands were investigated based on a review of 2000 satellite imagery. Based on this imagery, there is a high degree of confidence that the majority of actively irrigated lands were investigated in the field. Approximately 2,550 acres were being actively irrigated; the results of the findings are displayed in the tables below.

Table 2
Irrigation System Types

System Type	Acres	Irr. Efficiency
Sprinklers	1165.5	60%
Gated Pipe	1250.4	50%
Flood	131.6	50%
Drip	4.8	75%
	2552.2	

Table 3
Crop Types

Crop Type	Acres	Net Consumptive Use (acre-feet/acre)
Native Pasture	167.7	0.9
Pasture	426.7	3.65
Small Grain	581.9	1.37
Corn	696.5	1.45
Hay	236.9	2.82
Alfalfa	373.2	2.82
Sod	63.4	2.82
Landscape	1.2	3.65
Nursery	4.8	1.65
Total	2552.2	

Irrigation efficiency:
Estimates of irrigation efficiency were based largely on the opinion of the researchers who have familiarity with the irrigation systems and their efficiencies from other areas in rural Arizona. Although more data about the irrigation efficiency in the subbasin would improve the confidence of the values presented in this report, it is felt that the values used are acceptable and present an accurate overall picture.

Weighted average irrigation efficiencies for each of the 4 irrigation areas were calculated and then applied to the historic acreage irrigated in each area to compute the total volume of water diverted. A summary of these weighted irrigation efficiencies are displayed in

Table 4; more detail about the acreage of each system type discovered in the field can be found in Appendix B.

Table 4
Summary of Irrigation Efficiencies by Irrigation Area

Irrigation Area	Weighted Efficiency
Paulden	58.6%
Williamson Valley	59.7%
Upper Big Chino	50.9%
Walnut Creek	56.0%
Basin Weighted Average	54.7%

Crop Type:
Interviews with individuals who farmed large portions of the upper Big Chino lands in the 1950's, 60s and 70's revealed that the crop mix was similar to the current crop mix and that the average application was between 4 and 4.5 acre-feet per acre. The average water duty calculated from the 2003 crop mix is 3.95 acre-feet per acre - reasonably close to the historical estimates.

Based on the crop and irrigation system types investigated in 2003 and average crop consumptive use values, the total volume of groundwater pumped in 2003 is approximately 9,500 acre-feet, and the total water use including surface water was approximately 10,000 acre-feet. It should be noted that these average Net ET values are for an "average" year. The drought conditions of the last several years have severely reduced the amount of effective precipitation and have likely driven up the crop consumptive use. A rough estimate of the actual volume of groundwater pumped in 2003 is probably closer to 12,000 acre-feet based on these considerations.

Crop Consumptive Use:
Seasonal variability in crop consumptive use was not calculated for each year of the study. Rather, average crop consumptive use values used in the Prescott AMA were chosen to be applicable to the Big Chino subbasin. Because of the data availability, the primary intent of this report is to represent pumping on a 10-year basis, rather than on a year-to-year basis, using average consumptive use values is acceptable. A previous report by the US Bureau of Reclamation attempted to calculate consumptive use on a year-to-year basis but these estimates were made using the Blaney-Criddle consumptive use model in the TR-21 computer program written by the Soil Conservation Service. In the US Bureau of Reclamation report, annual crop consumptive use estimates were multiplied by the acreage estimates to derive the total consumptive use by crops. This method would be acceptable if there was a high degree of confidence in the historically irrigated acreage. The Bureau report does not describe how the historically irrigated acreage estimates were derived, but the values listed appear to be subjective estimates based on a review of only 1980 aerial imagery. The annual variability of weather impacts on crop water use is lost in the uncertainty of the amount of land irrigated

Now that more sophisticated weather stations are in place in the watershed and better methods of calculating crop consumptive use are available, a more accurate estimate of crop consumptive use could be made at a later time and used with the acreage estimates generated in this report. However, even given the much broader review of historical imagery and interviews with land managers that were used to generate acreage estimates in this report, a 10-year average or moving average is as detailed as can be recommended in all but the most recent years. The variability in weather patterns thus derived may point out some general trends, such as pumping due to long-term wet or dry periods. It is recommended that a crop survey be conducted on an annual basis from this point forward to develop better estimates of water use in the subbasin.

Weighted average crop consumptive use for each of the 4 irrigation areas were calculated and then applied to the historic acreage irrigated in each area as part of the computation of total volume of water diverted. A summary of these crop consumptive use values is displayed in Table 5, more detail about the acreage of each system type discovered in the field can be found in Appendix B.

Table 5
Summary of Weighted Crop Consumptive Use
By Irrigation Area

Area	Weighted CU (feet)
Paulden	1.87
Williamson Valley	2.42
Upper Big Chino	1.96
Walnut Creek	2.90
Basin Weighted Average	2.16

Water Transfers from Historically Irrigated Lands

Examination of the historically irrigated lands in the Big Chino subbasin provides answers to two important questions: the amount of water that was historically pumped from the aquifer and helps identify the quantity of water that may be eligible for water rights transfer under ARS §44-555. According to this statute, lands that were irrigated with groundwater at any time between January 1, 1975 and January 1, 1990 can be retired and the water transferred to the Prescott AMA. Based on the photo record, only three sets of aerial imagery are available to directly determine which lands are eligible for water transfer, 1977, 1980, and 1989. Of these three, only the 1980 imagery provides complete coverage of the basin, 1977 imagery covers approximately ½ of the lands known to be irrigated, and 1989 imagery covers only a small portion around Paulden. Using this method of examination, 3,681 acres appear to have been irrigated between 1975 and 1990.

A second method to determine eligible lands would be to infer irrigation activity based on evidence from the 1973 imagery, which roughly covers the ½ of the basin that 1977

imagery does not, and 1990 imagery. Based on this second method, 4,195 acres appear to match the statutory criteria.

At 3 acre-feet per acre allowed under the ARS §44-555 transfer provisions, between 11,000 and 12,600 acre-feet per year could conceivably be transferred to the Prescott AMA from the retirement of irrigated lands in addition to the statutory allotment of up to 14,000 acre-feet for the City of Prescott. Current plans are to limit this water export to approximately 8,700 acre-feet per year.

Historically Irrigated Acreage

The average quantity of lands irrigated in the Big Chino by geographic area is shown in the Table 6 below. This includes all irrigated acreage from groundwater and surface water sources, but does not include reservoirs. Average reservoir surface area is displayed in Table 7. It should be noted that the Paulden area had nearly 130 surface acres of reservoirs supplied by groundwater during the early 1960s, although the decade average shown here is much smaller since pumping to fill these recreational lakes ceased in the mid-60s. These lakes consumed approximately 580 acre-feet/year, pumping to replace seepage loss was not considered in this report. More detailed tables showing the minimum and maximum number of acres irrigated and reservoir surface areas are displayed in the Appendices.

Table 6
Land Irrigated in the Big Chino Subbasin
Average Value by Decade (Acres Irrigated)

Decade	Upper Big Chino	Williamson Valley	Paulden	Walnut Creek	Total
1940s	866.1	611.9	244.9	114.6	1837.5
1950s	1656.5	780.9	820.2	115.7	3373.3
1960s	1830.6	805.0	1017.9	131.8	3785.4
1970s	2383.4	561.1	288.7	130.7	3363.9
1980s	1688.6	615.3	184.7	114.1	2602.7
1990s	1292.9	532.8	146.1	89.4	2061.3
'00-'03	1399.6	581.1	338.0	107.7	2426.5

Table 7
Reservoir Surface Area in the Big Chino Subbasin
Average Value by Decade (Acres)

Decade	Big Chino	Williamson Valley	Paulden	Walnut Ck	Ashfork	Total
1940s	1.9	4.1	0.2	1.8	20.3	28.2
1950s	1.9	6.9	13.7	2.1	20.3	44.9
1960s	3.5	5.7	84.9	2.6	20.3	117.0
1970s	4.8	10.3	5.1	2.7	20.3	43.2
1980s	3.1	11.8	1.0	2.4	20.3	38.6
1990s	3.1	11.9	1.5	2.7	20.3	39.5
'00-'03	3.1	11.5	1.8	2.7	20.3	39.4

Historical Water Application:
To calculate the amount of water historically pumped or diverted in the Big Chino subbasin, the weighted water duty computed for 2003 was applied to the historically irrigated acreage. Based on interviews with individuals with historic knowledge of the crops irrigated, the 2003 crop mix appears to be similar to those crops that were historically irrigated. Based on this methodology, the average historic irrigation water use by decade was computed as displayed in Table 8 and Figure 2.

Table 8
Big Chino Subbasin
Estimated Historical Water Use by Decade

Decade	Groundater Use (acre-feet/yr)	Total Water Use (GW and SW acre-feet/yr)
1940s	6253.4	7227.7
1950s	11365.0	12872.7
1960s	13132.0	14679.8
1970s	12197.9	13161.1
1980s	9412.6	10264.3
1990s	7464.2	8158.3
'00-'03	8841.3	9470.9

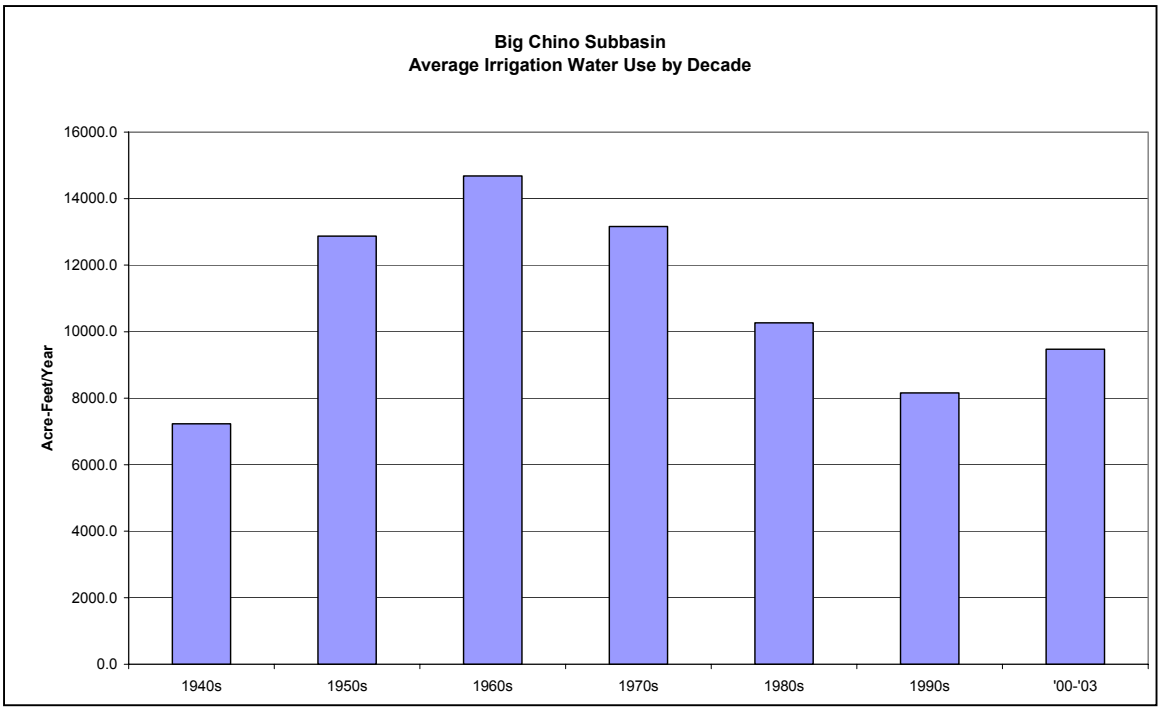


Figure 2: Estimated average volume of water pumped for irrigation.

Electrical use records were also collected from Arizona Public Service Company (APS) for irrigation accounts in the Big Chino subbasin. Because of the concern for client confidentiality, APS supplied total electrical use by township and range. Records for only the period 1998-2002 were available. However, 2003 field investigations revealed that a significant number of supply wells are powered by sources other than electricity (diesel, gas, liquefied petroleum). Since the exact number of wells on electricity verses other power sources is unknown, coupled with the uncertainty of determining the volume of water pumped based on power records made using the electrical records highly unreliable for calculating water use.

Other researchers have also made estimates of the water use in the Big Chino subbasin. A comparison of these estimates along with those made in this report is provided in Appendix A.

Projected Water Uses:

Historic water uses other than for agriculture were not examined in this study. It was assumed that water usage for residential and commercial purposes in the Big Chino subbasin were insignificant prior to the 1990's. Although exact residential use data for 1990 was not readily available, there were approximately 2,900 people living in the basin according to the 1990 census. Estimating average use per person to be approximately 0.132 acre-feet per year, approximately 383 acre-feet of water was being consumed per year during this time period. By 2000, the population in the subbasin had grown to 6,470, a 223% increase. Demand for housing is anticipated to increase in the area since the subbasin has ample space, land is relatively inexpensive, and groundwater is readily accessible in many locations. The table below displays a "best guess" water demand

projection for the Big Chino subbasin in consideration of current trends for housing, agriculture, and exportation water demands. Based on this projection, overall demand for water will increase from the current calculated demand of 10,900 acre-feet per year to 17,600 acre-feet per year by the year 2050. It is assumed that residential and commercial uses will make up the majority of the new demand while the agricultural demand is assumed to remain steady through this time period. In addition to in-basin uses, it is also assumed that water users in the Prescott AMA will begin to export water from the Big Chino subbasin into the Prescott AMA. This will increase overall water demands to over 26,000 acre-feet per year by 2050, nearly double the peak groundwater use of the 1960's. Table 9 and Figure 3 summarize the historic and projected groundwater uses in the Big Chino subbasin. These values do not represent the net consumption of water from the subbasin, additional information about the assumptions and return flows can be found in Appendix C.

Table 9
Water Use Projections within the Big Chino Subbasin

	2000-02	2010	2020	2030	2040	2050
Residential	1,107	2,087	3,523	4,933	5,812	6,319
Agriculture	9,471	10,364	10,364	10,364	10,364	10,364
Golf Courses	441	882	882	882	882	882
GW Export	0	4,000	8,700	8,700	8,700	8,700
Total	11,019	17,333	23,469	24,879	25,758	26,265

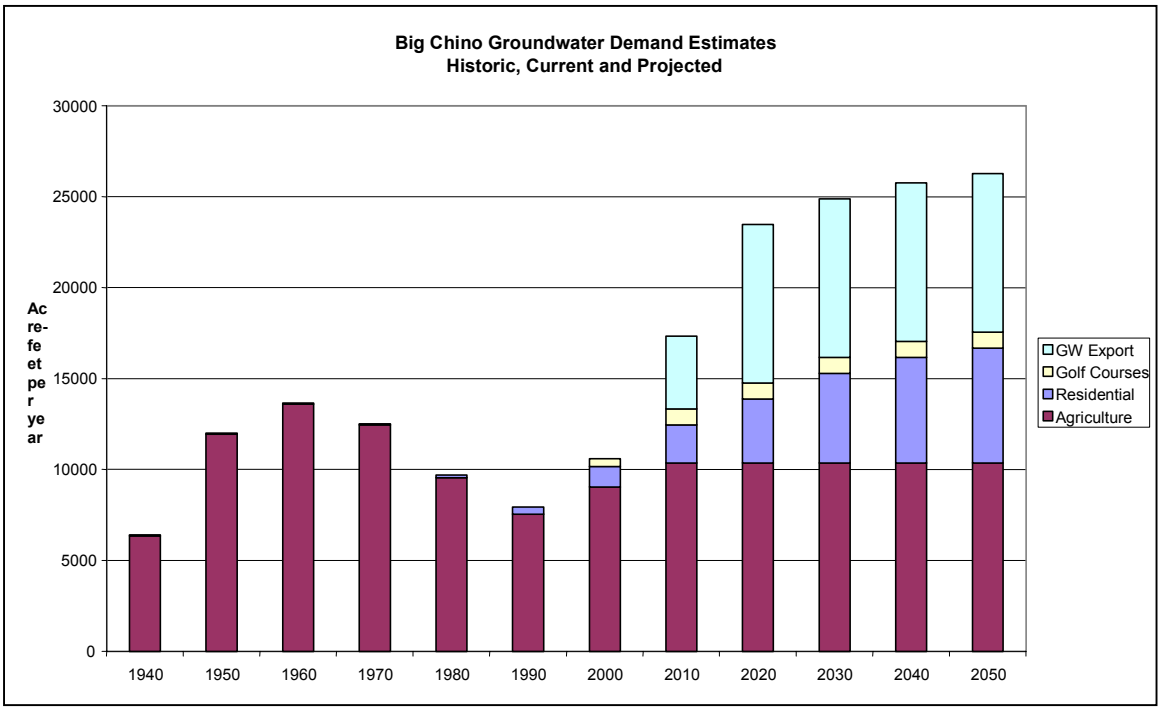


Figure 3: Groundwater demand projections for the Big Chino subbasin.

Appendix A: Comparison of groundwater pumping estimates

Comparison of Estimated Groundwater Pumping in the Big Chino Sub-basin (values in thousand acre-feet)

Year	Schwab - (1)	Az. State Land Dept. (2)	Wirt (3)[2]	WAC (4)
1940	nd	nd	nd	6.4
1941	nd	nd	nd	6.4
1942	nd	nd	nd	6.4
1943	nd	nd	nd	6.4
1944	nd	nd	nd	6.4
1945	nd	nd	nd	6.4
1946	nd	nd	nd	6.4
1947	nd	nd	nd	6.4
1948	nd	nd	nd	6.4
1949	nd	nd	nd	6.4
1950	22	(22)[1]	nd	11.9
1951	22	(22)[1]	nd	11.9
1952	22	(22)[1]	nd	11.9
1953	22	(22)[1]	nd	11.9
1954	22	(22)[1]	nd	11.9
1955	22	(22)[1]	nd	11.9
1956	22	(22)[1]	nd	11.9
1957	22	(22)[1]	nd	11.9
1958	22	(22)[1]	nd	11.9
1959	22	(22)[1]	nd	11.9
1960	22	(22)[1]	nd	13.6
1961	22	(22)[1]	nd	13.6
1962	22	(22)[1]	nd	13.6
1963	22	(22)[1]	nd	13.6
1964	22	22	nd	13.6
1965	22	22	nd	13.6
1966	22	22	nd	13.6
1967	11	11	nd	13.6
1968	11	11	9	13.6
1969	11	11	9	13.6
1970	11	nd	9	12.5
1971	11	nd	9	12.5
1972	10	nd	8	12.5
1973	10	nd	8	12.5

[1] From Annual Report on Groundwater in Arizona #36

1974	13	nd	11	12.5
1975	14	nd	12	12.5
1976	12	nd	10	12.5
1977	11	nd	9	12.5
1978	8	nd	6	12.5
1979	7	nd	5	12.5
1980	7	nd	5	9.5
1981	8	nd	6	9.5
1982	2	nd	0.5	9.5
1983	2	nd	0.5	9.5
1984	3	nd	1	9.5
1985	5	nd	3	9.5
1986	nd	nd	5	9.5
1987	nd	nd	3	9.5
1988	nd	nd	3	9.5
1989	nd	nd	4	9.5
1990	nd	nd	4	7.6
1991	nd	nd	nd	7.6
1992	nd	nd	nd	7.6
1993	nd	nd	nd	7.6
1994	nd	nd	nd	7.6
1995	nd	nd	1.8	7.6
1996	nd	nd	nd	7.6
1997	nd	nd	nd	7.6
1998	nd	nd	nd	7.6
1999	nd	nd	nd	7.6
2000	nd	nd	nd	9.1
2001	nd	nd	nd	9.1
2002	nd	nd	nd	9.1
2003	nd	nd	nd	9.1

(1) From Schwab, K.J., 1995, Maps Showing Groundwater Conditions in the Big Chino Sub-basin of the Verde River Basin, Coconino and Yavapai Counties, Ariziona –1992, Arizona Department of Water Resources Hydrologic Map Series Report Number 29. Phoenix, Arizona, Prepared in cooperation with the U.S. Geologic Survey.

(2) From Arizona State Land Department, 1956-1970, Water Resource Reports, Annual Reports on Ground Water in Arizona, Prepared by Arizona District Water Resources Division, U.S. Geological Survey.

(3) From Wirt, L. and Hjalmarson, H.W.,2000, Sources of spring supplying base flow to the Verde River headwaters, Yavapai County, Arizona, Open File Report 99-0378, U.S. Geologic Survey.

(4) Values from this report averaged for each decade.

Summary of information related to the Big Chino subbasin water uses from:

Water Resource Reports
Arizona State Land Department
Annual Reports on Ground Water In Arizona 1956-1970

Report Number 2: Annual Report on Groundwater 1956 to 1957

The groundwater levels in Yavapai County declined during 1956. Water level measurements in Chino Valley displayed fluctuations ranging from no change to a decline of approximately 9 feet. Water levels in the deeper wells in Yavapai County displayed a definite downward trend. The water level in well B(16-1)7, in Chino Valley, displayed a downward trend. The Prescott Airport reported 5.75 inches of precipitation for the year. Chino Valley reported 6.49 inches of precipitation for the year.

Report Number 5: Annual Report on Groundwater 1957 to 1958

Water level fluctuations in Chino Valley ranged from a rise of approximately 7 feet in the lower end of Chino Valley to a decline of less than 1 foot in the upper end of the area. The water levels in non-flowing irrigation wells ranged from approximately 5 to 258 feet below land surface at the end of 1957. Well B(17-2)6 displayed a slight decline in the water level. The Prescott airport reported 14.9 inches of precipitation for the year. Chino Valley reported 10.71 inches of precipitation for the year.

Report Number 6: Annual Report on Groundwater 1958 to 1959

Water level fluctuations in Chino Valley ranged from a rise of 3 feet in the lower end to a decline of 2 feet in the upper end. In the spring of 1959, the water levels in non-flowing irrigation wells ranged from approximately 4 to 255 feet below land surface. Well B(17-2)6 displayed a slight increase in the water level. The Prescott airport reported 13.7 inches of precipitation for the year. Chino Valley reported 13.42 inches of precipitation for the year.

Report Number 7: Annual Report on Groundwater 1959 to 1960

The water level fluctuations in Chino Valley ranged from a rise of less than 1 foot to a decline of more than 9 feet. Well B(17-2)6 displayed a slight increase in the water level. In the spring of 1960, water levels in irrigation wells ranged from approximately 4 to 257 feet below land surface. The Prescott airport reported 12.82 inches of precipitation for the year. Chino Valley reported 14.17 inches of precipitation for the year.

Report Number 10: Annual Report on Groundwater 1960 to 1961

Water level fluctuations in Chino Valley ranged from a rise of approximately 4 feet to a decline of approximately 8 feet. In the spring of 1961, depths to water in the area ranged from approximately 5 feet to more than 300 feet below the land surface. Well B(17-2)6 displayed a decline in the water level. The Prescott airport reported 8.33 inches of precipitation for the year. Chino Valley reported 9.86 inches of precipitation for the year.

Report Number 11: Annual Report on Groundwater 1961 to 1962

Chino Valley is described as extending from just north of Watson Lake to approximately 5 miles north of Paulden in the north-south direction; in the east-west direction it is an irregularly shaped area bounded roughly by a low-lying extension of the Black Hills on the east and the Juniper Mountains and Sierra Prieta Mountains on the west. The valley is not highly developed, but some groundwater is used for irrigation in two areas, the Chino Valley artesian area and the Paulden area. The southern part of the area is within the Chino Valley Irrigation District, which obtains a limited supply of surface water from Willow and Watson Lakes. **During the last 10 years, there has been little change in the area irrigated with artesian water. The survey of 1961 indicated slightly more than 3,600 acres of cropland under irrigation.** Considering the altitude and the kind of crops grown, it is believed that water requirements are high. **Using an average value of 3.5 acre-feet per acre for crop requirements resulted in a computed withdrawal of water for irrigation in 1961 of almost 13,000 acre-feet from the artesian aquifer. The City of Prescott reported pumping 1,840 acre-feet from the artesian basin in Chino Valley for part of its municipal supply.** Well B(17-2)6 had an increase in the water level. Well B(16-2)34 had a decline in the water level. Well B(16-2)21 had a slight decline in the water level. Well B(16-2)3 had a slight decline in the water level. Well B(16-1)14 had a decrease in the water level. Water level fluctuations in the Paulden area ranged from a rise of approximately 8 feet to a decline of approximately 7 feet. In the spring of 1962, depths to water in the Paulden area ranged from approximately 7 feet to more than 355 feet below land surface. The Prescott airport reported 11.38 inches of precipitation for the year. Chino Valley reported 11.15 inches of precipitation for the year.

Report Number 15: Annual Report on Groundwater 1962 to 1963

Chino Valley is described as extending from just north of Watson Lake to approximately 5 miles north of Paulden in the north-south direction; in the east-west direction it is an irregularly shaped area bounded roughly by a low-lying extension of the Black Hills on the east and the Juniper Mountains and Sierra Prieta Mountains on the west. The valley is not highly developed, but some groundwater is used for irrigation in two areas, the Chino Valley artesian area and the Paulden area. **Chino Valley irrigated approximately 3,750 acres using approximately 13,000 acre-feet of water. The Chino Valley Irrigation District includes a little more than 2,500 acres in the south end of the area.** The district obtains a limited portion of surface water from Watson and Willow Lakes. **Two large new wells in the north end of the area were used to fill a number of manmade lakes in connection with a real estate subdivision or to irrigate pastures. The use of groundwater amounted to several thousand acre-feet. Pumping by the City of Prescott was slightly more than 1,900 acre-feet. Total estimated withdrawals for the area were approximately 15,000 acre-feet exclusive of what was withdrawn for the manmade lakes.** Paulden area water levels declined from ½ to 41/2 feet. Well B(17-2)6 displayed a decline in the water level. Well B(16-2)34 displayed a decline in the water level. Well B(16-2)21 displayed a decline in the water level. Well B(16-2)3 displayed a decline in the water level. Well B(16-2)14 displayed a decline in the water level. The Prescott airport reported 10.53 inches of precipitation for the year. Chino Valley reported 8.53 inches of precipitation for the year.

Report Number 19: Annual Report on Groundwater 1963-1964

In Chino Valley, a small amount of surface water was used for irrigation from Watson and Willow Lakes but for the most part, groundwater was used for irrigation and other purposes. The

City of Prescott obtained a part of its municipal supply from wells in Chino Valley. Groundwater occurred under water table and artesian conditions in Chino Valley. **The area in which groundwater was under artesian pressure was approximately 3 miles wide and extended from 3 miles south to 3 miles north of Chino Valley. Flowing artesian water was first discovered approximately 2 to 3 miles north of Chino Valley in 1930. The artesian pressure surface declined rapidly during the summer pumping season but generally recovered following the pumping season to within a few feet of the previous spring level.** From the spring of 1963 to the spring of 1964, water level declines in artesian wells generally ranged from 2 to 4 feet. In the south end of the area, well B(16-2)34 displayed a decline of approximately 3 feet. Well B(16-2)21 displayed a decline of approximately 4 feet. The water level in well B(16-2)3 declined approximately 2 feet. Well B(17-2)6 had an increase in the water level. Water levels in the water table near Paulden rose from spring of 1963 to spring 1964. The Water level in well B(16-1)14 displayed a continuous decline. The average precipitation for all weather stations in the North-Central region of Yavapai County was 14.69 inches.

Report Number 24: Annual Report on Groundwater 1964-1965

Chino Valley, as described in this report, consists of three alluvial areas in Yavapai County: Big Chino Valley, Little Chino Valley and Williamson Valley. **Approximately 20,000 acre-feet of groundwater was withdrawn for irrigation in Big Chino Valley. Well B(17-2)6 had a slight decline probably due to the withdrawal of groundwater to supply artificial lakes in the southern part of the valley in 1960, 1961, and 1962.** The depth to water in artesian wells near the center of the valley was approximately 30 feet below land surface in spring 1965. The depth to water in water table wells at the south end of the valley was approximately 130 feet below land surface. **In Williamson Valley, approximately 2,000 acre-feet of water was withdrawn for irrigation.** Water levels declined slightly between 1955 and 1965. The depth to water in artesian well B(16-4)14 was 7 feet below land surface in spring 1965. **In Little Chino Valley, approximately 12,000 acre-feet of water was withdrawn for irrigation and approximately 2,100 acre-feet for municipal use by the City of Prescott. Approximately 500 acres of land was irrigation with surface water from Watson and Willow Lakes.** Water levels in artesian wells in the central part of the valley declined at an average rate of approximately 3 feet per year from 1955 to 1965. The water levels in wells B(16-2)21 and B(16-2)35 displayed a decline.

Report Number 32: Annual Report on Groundwater 1965 to 1966

Chino Valley consists of three alluvial areas in Yavapai County north of Prescott: Big Chino Valley, Little Chino Valley and Williamson Valley. **Approximately 20,000 acre-feet of ground water was withdrawn for irrigation in Big Chino Valley.** The depth to water in artesian wells near the center of the valley was approximately 30 feet below land surface in spring of 1966. Well B(17-2)6 had a slight rise in the water level. Big Chino Valley had above normal precipitation for the year. **In Williamson Valley, approximately 2,000 acre-feet of water was withdrawn for irrigation.** Water levels in Williamson Valley tend to be shallow. Water levels between 1956 and 1966 have fluctuated slightly. Well B(16-4)14 had a four-foot rise in the water level and the depth to water in this well was 3 feet below land surface in spring 1966. **In Little Chino Valley, approximately 12,000 acre-feet of water was withdrawn for irrigation and approximately 1,600 acre-feet was used for municipal use by the City of Prescott. Furthermore, approximately 500 acres of land was irrigated with surface water**

from Watson and Willow Lakes. Well B(16-2)21 remained steady for the year. Well B(16-2)35 had an increase in the water level. **The amount of ground water withdrawn for all uses in Chino Valley was slightly more than 35,000 acre-feet in 1965.**

Report Number 36: Annual Report on Groundwater 1966 to 1967

Approximately 20,000 acre-feet of water was withdrawn for irrigation in Big Chino Valley. In Williamson Valley, approximately 2,000 acre-feet of water was withdrawn for irrigation. Approximately 14,000 acre-feet was withdrawn for irrigation in Little Chino Valley. The estimated annual pumpage between 1950 and 1966 was approximately 20,000 acre-feet in Big Chino Valley and approximately 2,000 acre-feet for Williamson Valley. Pumpage in Little Chino Valley ranged from 7,500 acre-feet in 1945 to a maximum of 15,000 acre-feet in 1961 and 1962. The water level appeared stable in well B(17-2)6. There was a slight decline in the water level for well B(16-4)14. Well B(16-2)35 displayed a slight decline in the water level.

Report Number 38: Annual Report on Groundwater 1967-1968

Approximately 9,000 acre-feet of water was withdrawn for irrigation in Big Chino Valley. In Williamson Valley, approximately 2,000 acre-feet of water was withdrawn for irrigation. Approximately 12,000 acre-feet of groundwater was pumped in Little Chino Valley. Approximately 2,000 acre-feet of the total water withdrawn in Little Chino Valley was for municipal use by the City of Prescott. In Big Chino Valley and Williamson Valley, a slight rise in the water level has occurred in the few years prior to 1968. In Little Chino Valley, the water levels continued to decline slightly. Well B(17-2)6 had a slight increase in the water level. Well B(16-4)14 had a slight increase in the water level. Well B(16-2)35 displayed a decrease in the water level.

Report Number 42: Annual Report on Groundwater 1968-1969

Approximately 9,000 acre-feet of water was withdrawn for irrigation in Big Chino Valley. In Williamson Valley, approximately 2,000 acre-feet of water was withdrawn for irrigation. Estimate groundwater withdrawal for irrigation in Little Chino Valley was 12,000 acre-feet. Well B(17-2)6 had a slight increase in the water level. Well B(16-4)4 had a slight increase in the water level.

Report Number 43: Annual Report on Groundwater 1969 to 1970

Approximately 9,000 acre-feet of water was withdrawn for irrigation in Big Chino Valley. In Williamson Valley, approximately 2,000 acre-feet of water was withdrawn for irrigation. Approximately 12,000 acre-feet of groundwater was withdrawn for irrigation in little Chino Valley. Well B(17-2)6 had a slight decline in the water level. Well B(16-4)14 had a slight decline in the water level. Well B(16-1)7 displayed a decrease in the water level.

Groundwater Withdrawn for Irrigation in acre-feet					
Report	Years	Big Chino Area	Williamson Valley	Little Chino Area	Comments
2	1956 to 1957				precipitation & well data only
3	1957 to 1958				precipitation & well data only
6	1958 to 1959				precipitation & well data only
7	1959 to 1960				precipitation & well data only
10	1960 to 1961				precipitation & well data only
11	1961 to 1962			13,000(1)	City of Prescott (COP) pumped 1 af
15	1962 to 1963			13,000(2)	COP 1,900 af; CVID 2,500 acres
19	1963 to 1964				precipitation & well data only
24	1964 to 1965	20,000(3)	2,000	12,000	COP 2,100 af; CVID 500 acres
32	1965 to 1966	20,000(4)	2,000	12,000	COP 1,600 af; CVID 500 acres
36	1966 to 1967	20,000(5)	2,000	14,000	
38	1967 to 1968	9,000	2,000	12,000	COP 2,000 af
42	1968 to 1969	9,000	2,000	12,000	
43	1969 to 1970	9,000	2,000	12,000	

(1) Chino Valley is described as extending from just north of Watson Lake to approximately 5 miles north of Paulden in the north-south direction; in the east-west direction it is an irregularly shaped area bounded roughly by a low-lying extension of the Black Hills on the east and the Juniper Mountains and Sierra Prieta on the west. Groundwater withdrawn was based on 3,600 acres at 3.5 acre-feet per acre.

(2) Chino Valley is described as extending from just north of Watson Lake to approximately 5 miles north of Paulden in the north-south direction; in the east-west direction it is an irregularly shaped area bounded roughly by a low-lying extension of the Black Hills on the east and the Juniper Mountains and Sierra Prieta on the west. Total estimated withdrawals for the area were approximately 15,000 acre-feet exclusive of what was withdrawn for the manmade lakes.

(3) Chino Valley, as described in this report, consists of three alluvial areas in Yavapai County: Big Chino Valley, Little Chino Valley and Williamson Valley. In Big Chino Valley, wells displayed a slight decline probably due to the withdrawal of groundwater to supply artificial lakes in the southern part of the valley in 1960, 1961 and 1962.

(4) Chino Valley consists of three alluvial areas in Yavapai County north of Prescott: Big Chino Valley, Little Chino Valley and Williamson Valley. The amount of ground water withdrawn for all uses in Chino Valley was slightly more than 35,000 acre-feet in 1965.

(5) **The estimated annual pumpage between 1950 and 1966 was approximately 20,000 acre-feet in Big Chino Valley and approximately 2,000 acre-feet in Williamson Valley.** Pumpage in Little Chino Valley ranged from 7,500 acre-feet in 1945 to 12,000 in 1970 with a maximum of 15,000 acre-feet in 1961 and 1962.

Comparison of Estimated Acres Irrigated

	Big Chino & Paulden		Williamson Valley		Walnut Creek		Total	
	USBR	WAC	USBR	WAC	USBR	WAC	USBR	WAC
Year	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres
1940		697		570		114	0	1381
1941		697		570		114	0	1381
1942		697		570		114	0	1381
1943		697		570		114	0	1381
1944		697		570		114	0	1381
1945		722		570		114	0	1406
1946		722		570		114	0	1406
1947		847		570		114	0	1532
1948		2668		780		116	0	3564
1949		2668		780		116	0	3564
1950		2642		780		116	0	3538
1951		2642		780		116	0	3538
1952		2517		780		116	0	3413
1953		2424		780		116	0	3320
1954		2424		781		116	0	3321
1955		2424		781		116	0	3321
1956		2424		781		116	0	3321
1957		2424		781		116	0	3321
1958		2424		781		116	0	3321
1959	2925	2424	1320	780	80	116	4325	3320
1960	2925	2665	1320	780	80	116	4325	3561
1961	2925	2857	1320	822	80	134	4325	3813
1962	2925	2857	1320	822	80	134	4325	3813
1963	2925	2857	1320	822	80	134	4325	3813
1964	2925	2857	1320	822	80	134	4325	3813
1965	2925	2857	1320	844	80	134	4325	3836
1966	2925	2708	1320	864	80	134	4325	3705
1967	2925	2942	1320	758	80	134	4325	3833
1968	2925	2942	1320	758	80	134	4325	3833
1969	2925	2942	1320	758	80	134	4325	3833
1970	2925	2942	1320	758	80	134	4325	3833
1971	1125	2942	1320	758	80	134	2525	3833
1972	1125	2942	1320	758	80	134	2525	3833
1973	1125	2382	1320	526	80	134	2525	3041
1974	1125	2571	1320	495	80	133	2525	3199
1975	1125	2571	1320	495	80	133	2525	3199
1976	1125	2571	1320	495	80	133	2525	3199
1977	1125	2633	1320	640	80	124	2525	3397
1978	870	2583	1320	623	80	124	2270	3330
1979	870	2583	1320	623	80	124	2270	3330
1980	870	2004	1320	583	80	91	2270	2678

1981	870	2020	1320	583	80	91	2270	2694
1982	870	2020	1320	583	80	91	2270	2694
1983	870	2228	1320	583	80	91	2270	2902
1984	870	2230	1320	583	80	91	2270	2904
1985	870	1743	1320	770	80	137	2270	2650
1986	870	1727	1320	770	80	137	2270	2634
1987	870	1727	1320	770	80	137	2270	2634
1988	870	1519	1320	770	80	137	2270	2427
1989	870	1517	1320	770	80	137	2270	2425
1990	870	1509	1320	770	80	137	2270	2416
1991		1511		770		137	0	2419
1992		1511		770		137	0	2419
1993		1339		559		67	0	1964
1994		1339		559		67	0	1964
1995		1337		559		67	0	1962
1996		1337		559		67	0	1962
1997		1337		559		67	0	1962
1998		1585		555		75	0	2215
1999		1585		555		75	0	2215
2000		1585		555		75	0	2215
2001		1637		555		75	0	2267
2002		1926		833		141	0	2900
2003		1800		689		141	0	2630

Comparison of Consumptive Use Values

	Big Chino & Paulden		Williamson Valley		Walnut Creek		Total	
	USBR	WAC	USBR	WAC	USBR	WAC	USBR	WAC
Year	Acre-feet	Acre-feet	Acre-feet	Acre-feet	Acre-feet	Acre-feet	Acre-feet	Acre-feet
1940		1371		1395		339	0	3105
1941		1371		1395		339	0	3105
1942		1371		1395		339	0	3105
1943		1371		1395		339	0	3105
1944		1371		1395		339	0	3105
1945		1419		1395		339	0	3153
1946		1419		1395		339	0	3153
1947		1653		1395		339	0	3387
1948		5151		1920		345	0	7416
1949		5151		1920		345	0	7416
1950		5103		1920		345	0	7368
1951		5103		1920		345	0	7368
1952		4869		1920		345	0	7134
1953		4692		1920		345	0	6957
1954		4692		1923		345	0	6960
1955		4692		1923		345	0	6960
1956		4692		1923		345	0	6960
1957		4692		1923		345	0	6960
1958		4692		1923		345	0	6960
1959	4375	5272	2837	1920	135	345	7347	7537
1960	4916	5722	3045	1920	157	345	8119	7987
1961	4634	6085	2862	2008	149	400	7645	8492
1962	4568	6085	3061	2008	155	400	7784	8492
1963	4548	6085	2780	2008	144	400	7472	8492
1964	4622	6085	2860	2008	134	400	7615	8492
1965	3917	6085	2331	2062	116	400	6364	8546
1966	4819	5308	3115	2109	165	400	8099	7816
1967	4190	5809	2864	1874	123	400	7178	8082
1968	4392	5809	2905	1874	130	400	7428	8082
1969	4422	5809	2769	1874	116	400	7307	8082
1970	4249	5809	2589	1623	88	400	6926	7832
1971	2198	5809	2708	1623	127	400	5034	7832
1972	2284	5809	2791	1623	144	400	5219	7832
1973	2281	4693	2845	1311	160	400	5285	6403
1974	2296	5065	2813	1249	159	398	5268	6712
1975	2489	5065	3026	1249	149	398	5664	6712
1976	2431	5065	2978	1249	136	398	5545	6712
1977	2351	5156	2944	1401	155	373	5450	6930
1978	2037	5058	3158	1361	150	373	5345	6791
1979	2016	5058	3205	1361	157	373	5378	6791
1980	1839	3915	2949	1361	155	273	4943	5549

1981	2153	3946	3406	1361	169	273	5727	5580
1982	1864	3946	2932	1361	149	273	4945	5580
1983	1530	4354	2449	1361	134	273	4113	5988
1984	1823	4358	2906	1361	148	273	4877	5992
1985	2179	3437	3401	1724	154	410	5735	5571
1986	1900	3405	2994	1724	128	410	5022	5540
1987	1821	3405	2859	1724	144	410	4824	5540
1988	1822	2998	2813	1724	158	410	4793	5132
1989	2300	2994	3695	1722	173	410	6168	5126
1990	1651	2970	2643	1722	142	410	4436	5102
1991		2974		1722		410	0	5106
1992		2974		1722		410	0	5106
1993		2635		1195		205	0	4035
1994		2635		1195		205	0	4035
1995		2631		1195		205	0	4030
1996		2631		1195		205	0	4030
1997		2631		1195		205	0	4030
1998		3109		1148		229	0	4486
1999		3109		1148		229	0	4486
2000		3109		1148		229	0	4486
2001		3210		1148		229	0	4587
2002		3764		1821		420	0	6006
2003		3511		1717		420	0	5648

Appendix B: Summary of Findings

Calculated Weighted Average Consumptive Use and Irrigation Efficiency

Paulden Weighted Average CU					Paulden Weighted Average Eff			
Crop	Acres	Con. Use	Wtd CU		System	Acres	Efficiency	Wtd Eff.
Native Pasture	0.0	0.90	0.00		Sprinklers	346.5	0.60	0.50
Pasture	40.6	3.65	0.35		Gated Pipe	0.0	0.50	0.00
Small Grain	293.5	1.37	0.96		Flood	67.3	0.50	0.08
Alfalfa	16.3	2.82	0.11		Drip	4.8	0.75	0.01
Sod	63.4	2.82	0.43		Total/Avg.	418.6		0.59
Nursery	4.8	1.65	0.02					
Total/Avg.	418.6		1.87					
Williamson Valley Weighted Average CU					Williamson Valley Weighted Average Eff			
Crop	Acres	Con. Use	Wtd CU		System	Acres	Efficiency	Wtd Eff.
Native Pasture	167.7	0.90	0.23		Sprinklers	615.4	0.60	0.58
Pasture	185.9	3.65	1.05		Gated Pipe	17.2	0.50	0.01
Small Grain	41.0	1.37	0.09		Flood	0.0	0.50	0.00
Hay	236.9	2.82	1.04		Drip	0.0	0.75	0.00
Landscape	1.2	3.65	0.01		Total/Avg.	632.6		0.60
Total/Avg.	632.6		2.42					
Upper Big Chino Valley Weighted Average CU					Upper Big Chino Valley Weighted Average Eff			
Crop	Acres	Con. Use	Wtd CU		System	Acres	Efficiency	Wtd Eff.
Pasture	118.9	3.65	0.32		Sprinklers	121.5	0.60	0.05
Small Grain	213.6	1.37	0.21		Gated Pipe	1220.2	0.50	0.45
Corn	696.5	1.45	0.74		Flood	23.2	0.50	0.01
Alfalfa	335.9	2.82	0.69		Drip	0.0	0.75	0.00
Total/Avg.	1365.0		1.96		Total/Avg.	1365.0		0.51
Walnut Creek Weighted Average CU					Walnut Creek Weighted Average Eff			
Crop	Acres	Con. Use	Wtd CU		System	Acres	Efficiency	Wtd Eff.
Pasture	81.3	3.65	2.14		Sprinklers	82.1	0.60	0.36
Small Grain	33.8	1.37	0.33		Gated Pipe	13.0	0.50	0.05
Alfalfa	21.0	2.82	0.43		Flood	41.0	0.50	0.15
Total/Avg.	136.0		2.90		Drip	0.0	0.75	0.00
					Total/Avg.	136.0		0.56

Summary of Irrigated Acreage by Decade

Paulden - All Irrigated Lands						Paulden - GW Only Irrigated lands					
Decade	Average	Max	Max Yr	Min	Min Yr	Decade	Average	Max	Max Yr	Min	Min Yr
1940s	244.9	988.3	1948	33.8	1940	1940s	221.9	965.2	1948	10.8	1940
1950s	820.2	962.6	1950	777.0	1953	1950s	797.1	939.6	1950	754.0	1953
1960s	1017.9	1233.7	1961	629.8	1967	1960s	994.9	1210.7	1961	606.8	1967
1970s	288.7	629.8	1970	8.1	1974	1970s	279.5	606.8	1970	1.4	1973
1980s	184.7	316.3	1980	53.2	1985	1980s	184.7	316.3	1980	53.2	1985
1990s	146.1	254.5	1998	45.0	1990	1990s	146.1	254.5	1998	45.0	1990
'00-'03	338.0	424.5	2002	254.5	2000	'00-'03	338.0	424.5	2002	254.5	2000

Williamson Valley - All Irrigated Lands						Williamson Valley - GW Only Irrigated Lands					
Decade	Average	Max	Max Yr	Min	Min Yr	Decade	Average	Max	Max Yr	Min	Min Yr
1940s	611.9	780.4	1948	569.8	1940	1940s	503.2	572.5	1948	485.9	1940
1950s	780.9	781.4	1954	780.4	1950	1950s	573.0	573.5	1954	572.5	1950
1960s	805.0	863.8	1966	757.8	1967	1960s	593.1	640.2	1966	567.9	1967
1970s	561.1	654.4	1970	495.1	1974	1970s	474.6	567.9	1970	408.6	1974
1980s	615.3	690.2	1985	540.5	1980	1980s	528.4	603.7	1985	453.1	1980
1990s	532.8	689.3	1990	452.4	1998	1990s	455.8	603.7	1990	382.4	1998
'00-'03	581.1	730.5	2002	452.4	2000	'00-'03	524.3	672.0	2003	382.4	2000

Upper Big Chino - All Irrigated Lands						Upper Big Chino - GW Only Irrigated Lands					
Decade	Average	Max	Max Yr	Min	Min Yr	Decade	Average	Max	Max Yr	Min	Min Yr
1940s	866.1	1679.5	1948	662.7	1940	1940s	866.1	1679.5	1948	662.7	1940
1950s	1656.5	1679.5	1950	1646.7	1953	1950s	1656.5	1679.5	1950	1646.7	1953
1960s	1830.6	2312.1	1967	1604.3	1966	1960s	1830.6	2312.1	1967	1604.3	1966
1970s	2383.4	2563.3	1974	2266.7	1978	1970s	2383.4	2563.3	1974	2266.7	1978
1980s	1688.6	1913.5	1984	1463.8	1989	1980s	1688.6	1913.5	1984	1463.8	1989
1990s	1292.9	1466.0	1991	1173.5	1995	1990s	1292.9	1466.0	1991	1173.5	1995
'00-'03	1399.6	1503.4	2002	1330.9	2000	'00-'03	1399.6	1503.4	2002	1330.9	2000

Walnut Creek - All Irrigated Lands						Walnut Creek - GW only Irrigated Lands					
Decade	Average	Max	Max Yr	Min	Min Yr	Decade	Average	Max	Max Yr	Min	Min Yr
1940s	114.6	115.7	1948	114.4	1940	1940s	61.1	67.3	1940	36.1	1948
1950s	115.7	115.7	1950	115.7	1950	1950s	36.1	36.1	1950	36.1	1950
1960s	131.8	133.6	1961	115.7	1960	1960s	47.0	48.2	1961	36.1	1960
1970s	130.7	133.6	1970	124.4	1977	1970s	47.3	48.9	1974	44.5	1977
1980s	114.1	137.4	1985	90.8	1980	1980s	44.1	57.3	1985	30.9	1980
1990s	89.4	137.4	1990	66.5	1993	1990s	40.5	57.3	1990	33.3	1998
'00-'03	107.7	140.7	2002	74.7	2000	'00-'03	56.5	79.7	2002	33.3	2000

Summary of Reservoir Surface Area by Decade
(Values in Acres)

Paulden - Reservoirs, GW and SW					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	0.2	0.9	1948	0.0	1940
1950s	13.7	129.7	1959	0.9	1950
1960s	84.9	129.7	1960	17.1	1967
1970s	5.1	17.1	1970	0.0	1973
1980s	1.0	2.0	1985	0.0	1980
1990s	1.5	2.2	1993	0.0	1990
'00-'03	1.8	2.0	2000	1.1	2003

Big Chino Reservoirs, GW and SW					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	1.9	1.9	1940	1.9	1940
1950s	1.9	1.9	1950	1.9	1950
1960s	3.5	4.8	1967	1.9	1960
1970s	4.8	4.8	1970	4.8	1970
1980s	3.1	3.1	1980	3.1	1980
1990s	3.1	3.1	1990	3.1	1990
'00-'03	3.1	3.1	2000	3.1	2000

Williamson Valley Reservoirs, GW and SW					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	4.1	6.9	1948	3.4	1940
1950s	6.9	6.9	1950	6.9	1950
1960s	5.7	8.6	1967	4.0	1961
1970s	10.3	11.8	1977	8.6	1970
1980s	11.8	11.8	1980	11.8	1980
1990s	11.9	12.0	1993	11.8	1990
'00-'03	11.5	11.8	2000	10.9	2003

Walnut Creek Reservoirs, GW and SW					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	1.8	2.1	1948	1.7	1940
1950s	2.1	2.1	1950	2.1	1950
1960s	2.6	2.7	1961	2.1	1960
1970s	2.7	2.7	1970	2.7	1970
1980s	2.4	2.7	1985	2.1	1980
1990s	2.7	2.7	1990	2.7	1990
'00-'03	2.7	2.7	2000	2.7	2000

Summary of Consumptive Use Estimates
(Values in acre-feet)

Paulden - CU, GW & SW					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	457.6	1847.3	1948	63.0	1940
1950s	1591.7	2033.2	1959	1453.2	1953
1960s	2281.1	2885.1	1961	1251.9	1967
1970s	561.7	1251.9	1970	15.0	1974
1980s	349.1	590.0	1980	108.1	1985
1990s	279.3	483.7	1998	83.9	1990
'00-'03	638.5	800.8	2002	483.7	2000

Paulden, CU GW only					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	414.6	1804.4	1948	20.1	1940
1950s	1548.8	1990.2	1959	1410.3	1953
1960s	2238.1	2842.2	1961	1209.0	1967
1970s	544.5	1209.0	1970	2.6	1973
1980s	349.1	590.0	1980	108.1	1985
1990s	279.3	483.7	1998	83.9	1990
'00-'03	638.5	800.8	2002	483.7	2000

Williamson Valley, CU, GW & SW					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	1499.8	1920.4	1948	1394.6	1940
1950s	1921.6	1922.8	1954	1920.4	1950
1960s	1974.4	2109.0	1966	1873.5	1967
1970s	1404.8	1623.1	1970	1248.6	1974
1980s	1542.4	1723.8	1985	1361.4	1980
1990s	1343.4	1721.7	1990	1148.2	1998
'00-'03	1458.8	1821.5	2002	1148.2	2000

Williamson Valley, CU, GW only					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	1197.0	1364.8	1948	1155.0	1940
1950s	1366.1	1367.3	1954	1364.8	1950
1960s	1426.9	1528.6	1966	1364.8	1960
1970s	1169.7	1394.6	1970	1009.0	1974
1980s	1300.8	1484.2	1985	1117.3	1980
1990s	1120.9	1484.2	1990	948.2	1998
'00-'03	1292.1	1650.6	2003	948.2	2000

Upper Big Chino, CU, GW &SW					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	1707.4	3303.2	1948	1308.5	1940
1950s	3258.1	3303.2	1950	3238.8	1953
1960s	3607.0	4557.4	1967	3161.3	1966
1970s	4697.2	5050.0	1974	4468.3	1978
1980s	3326.8	3767.9	1984	2885.7	1989
1990s	2550.5	2890.0	1991	2316.1	1995
'00-'03	2759.8	2963.5	2002	2625.0	2000

Upper Big Chino, CU, GW only					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	1707.4	3303.2	1948	1308.5	1940
1950s	3258.1	3303.2	1950	3238.8	1953
1960s	3607.0	4557.4	1967	3161.3	1966
1970s	4697.2	5050.0	1974	4468.3	1978
1980s	3326.8	3767.9	1984	2885.7	1989
1990s	2550.5	2890.0	1991	2316.1	1995
'00-'03	2759.8	2963.5	2002	2625.0	2000

Walnut Creek, CU, GW & SW					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	340.4	344.9	1948	339.3	1940
1950s	344.9	344.9	1950	344.9	1950
1960s	394.0	399.5	1961	344.9	1960
1970s	391.0	399.5	1970	372.6	1977
1980s	341.6	410.4	1985	272.7	1980
1990s	271.4	410.4	1990	205.0	1993
'00-'03	324.3	419.9	2002	228.7	2000

Walnut Creek, CU, GW only					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	110.8	126.4	1940	48.7	1948
1950s	48.7	48.7	1950	48.7	1950
1960s	71.7	74.3	1961	48.7	1960
1970s	76.4	77.9	1974	74.3	1970
1980s	77.4	99.2	1985	55.7	1980
1990s	77.6	99.2	1990	65.5	1993
'00-'03	114.4	153.3	2002	75.5	2000

Summary of Total Diversion Estimates
(Values in acre-feet)

Paulden - Volume Diverted					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	780.8	3151.7	1948	107.6	1940
1950s	2674.3	3070.0	1950	2478.8	1953
1960s	3624.6	4513.5	1961	2083.2	1967
1970s	942.7	2083.2	1970	25.6	1974
1980s	592.9	1007.5	1980	178.3	1985
1990s	472.2	819.6	1998	143.2	1990
'00-'03	1084.7	1361.0	2002	819.6	2000

Paulden - GW only					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	707.5	3078.4	1948	34.2	1940
1950s	2600.9	2996.6	1950	2405.4	1953
1960s	3551.3	4440.1	1961	2009.9	1967
1970s	913.3	2009.9	1970	4.5	1973
1980s	592.9	1007.5	1980	178.3	1985
1990s	472.2	819.6	1998	143.2	1990
'00-'03	1084.7	1361.0	2002	819.6	2000

Williamson Valley - Volume Diverted					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	2498.6	3194.2	1948	2324.6	1940
1950s	3196.3	3198.3	1954	3194.2	1950
1960s	3288.5	3519.0	1966	3110.5	1967
1970s	2320.7	2691.2	1970	2056.7	1974
1980s	2546.7	2850.4	1985	2243.7	1980
1990s	2213.1	2846.8	1990	1886.6	1998
'00-'03	2407.3	3013.9	2002	1886.6	2000

Williamson Valley - GW Only					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	2001.3	2282.3	1948	1931.1	1940
1950s	2284.4	2286.4	1954	2282.3	1950
1960s	2382.0	2556.4	1966	2282.3	1960
1970s	1940.9	2318.0	1970	1672.4	1974
1980s	2158.9	2466.1	1985	1851.7	1980
1990s	1857.4	2466.1	1990	1568.6	1998
'00-'03	2145.1	2747.4	2003	1568.6	2000

Upper Big Chino - Volume Diverted					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	3347.1	6482.9	1948	2563.2	1940
1950s	6394.3	6482.9	1950	6356.3	1953
1960s	7072.7	8934.7	1967	6198.5	1966
1970s	9209.5	9902.7	1974	8759.7	1978
1980s	6523.7	7390.5	1984	5656.9	1989
1990s	4998.2	5665.3	1991	4537.7	1995
'00-'03	5409.6	5809.7	2002	5144.5	2000

Upper Big Chino - GW only					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	3347.1	6482.9	1948	2563.2	1940
1950s	6394.3	6482.9	1950	6356.3	1953
1960s	7072.7	8934.7	1967	6198.5	1966
1970s	9209.5	9902.7	1974	8759.7	1978
1980s	6523.7	7390.5	1984	5656.9	1989
1990s	4998.2	5665.3	1991	4537.7	1995
'00-'03	5409.6	5809.7	2002	5144.5	2000

Walnut Creek - Volume Diverted					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	601.2	608.0	1948	599.5	1940
1950s	608.0	608.0	1950	608.0	1950
1960s	693.9	703.5	1961	608.0	1960
1970s	688.2	703.5	1970	655.5	1977
1980s	601.1	722.9	1985	479.3	1980
1990s	474.8	722.9	1990	356.3	1993
'00-'03	569.3	740.0	2002	398.6	2000

Walnut Creek - GW only					
Decade	Average	Max	Max Yr	Min	Min Yr
1940s	197.5	225.5	1940	85.4	1948
1950s	85.4	85.4	1950	85.4	1950
1960s	126.0	130.5	1961	85.4	1960
1970s	134.2	137.0	1974	130.5	1970
1980s	137.1	174.9	1985	99.4	1980
1990s	136.4	174.9	1990	114.8	1993
'00-'03	202.0	271.4	2002	132.5	2000

Total Estimated Volume of Water Pumped or Diverted by Year
(Average Annual Values in acre-feet)

	Big Chino	Paulden	Williamson Valley	Walnut Creek	Total
Year	Acre-feet	Acre-feet	Acre-feet	Acre-feet	Acre-feet
1940	2563	108	2325	599	5595
1941	2563	108	2325	599	5595
1942	2563	108	2325	599	5595
1943	2563	108	2325	599	5595
1944	2563	108	2325	599	5595
1945	2563	189	2325	599	5677
1946	2563	189	2325	599	5677
1947	2563	588	2325	599	6076
1948	6483	3152	3194	608	13437
1949	6483	3152	3194	608	13437
1950	6483	3070	3194	608	13355
1951	6483	3070	3194	608	13355
1952	6483	2671	3194	608	12956
1953	6356	2479	3194	608	12637
1954	6356	2479	3198	608	12641
1955	6356	2479	3198	608	12641
1956	6356	2479	3198	608	12641
1957	6356	2479	3198	608	12641
1958	6356	2479	3198	608	12641
1959	6356	3059	3194	608	13217
1960	6356	3827	3194	608	13985
1961	6274	4513	3350	703	14840
1962	6274	4513	3350	703	14840
1963	6274	4513	3350	703	14840
1964	6274	4513	3350	703	14840
1965	6274	4513	3441	703	14931
1966	6198	3603	3519	703	14024
1967	8935	2083	3111	703	14832
1968	8935	2083	3111	703	14832
1969	8935	2083	3111	703	14832
1970	8935	2083	2691	703	14413
1971	8935	2083	2691	703	14413
1972	8935	2083	2691	703	14413
1973	9111	78	2169	703	12061
1974	9903	26	2057	701	12686
1975	9903	26	2057	701	12686
1976	9903	26	2057	701	12686
1977	8952	1007	2310	656	12925
1978	8760	1007	2242	656	12665
1979	8760	1007	2242	656	12665
1980	6520	1007	2244	479	10251

1981	6582	1007	2244	479	10312
1982	6582	1007	2244	479	10312
1983	7383	1007	2244	479	11114
1984	7390	1007	2244	479	11121
1985	6527	178	2850	723	10279
1986	6466	178	2850	723	10217
1987	6466	178	2850	723	10217
1988	5664	178	2850	723	9416
1989	5657	178	2847	723	9405
1990	5657	143	2847	723	9370
1991	5665	143	2847	723	9378
1992	5665	143	2847	723	9378
1993	4546	531	1964	356	7397
1994	4546	531	1964	356	7397
1995	4538	531	1964	356	7388
1996	4538	531	1964	356	7388
1997	4538	531	1964	356	7388
1998	5145	820	1887	399	8249
1999	5145	820	1887	399	8249
2000	5145	820	1887	399	8249
2001	5343	820	1887	399	8448
2002	5810	1361	3014	740	10925
2003	5341	1338	2842	740	10261

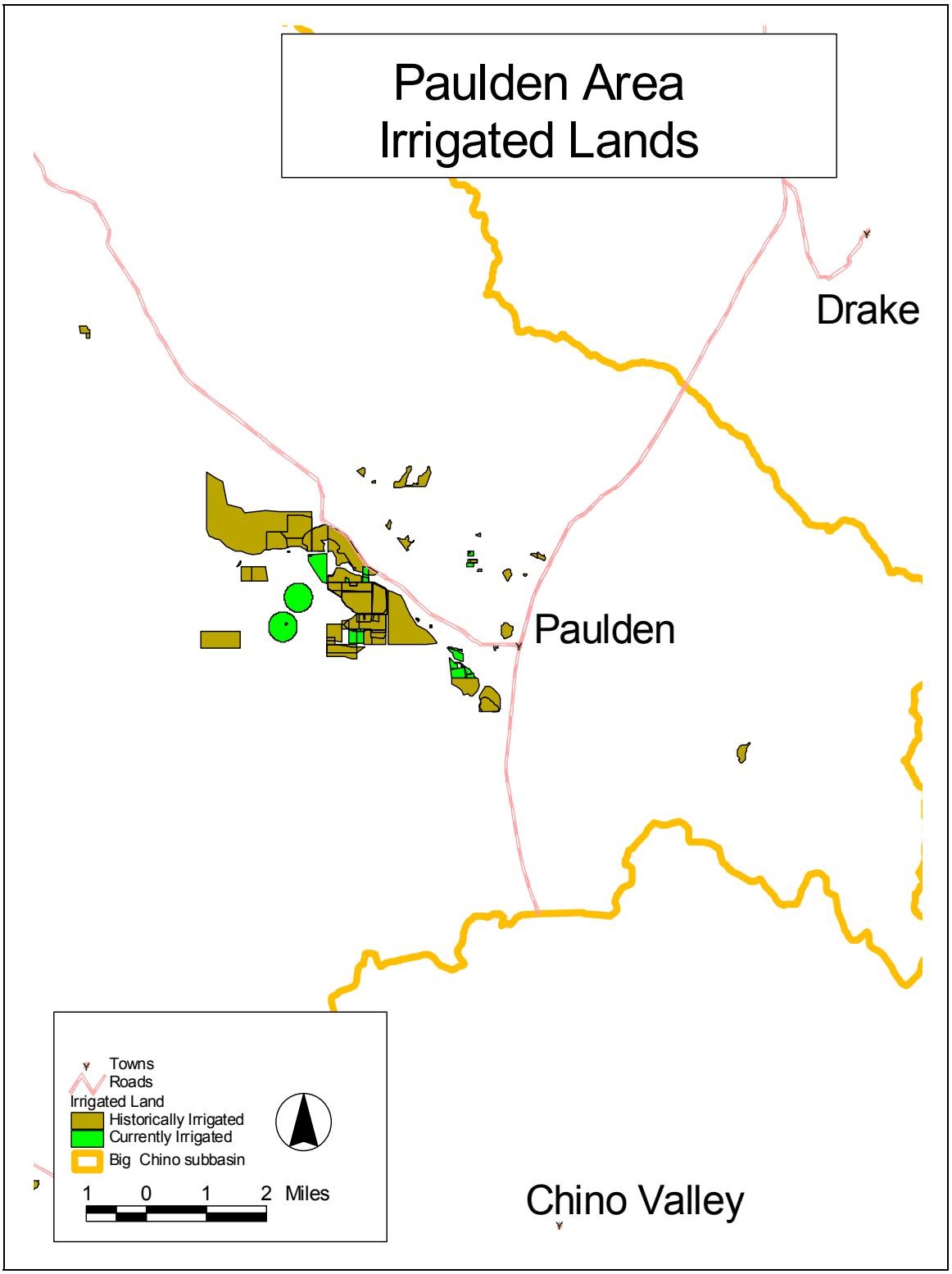
Appendix C: Water Use Projections

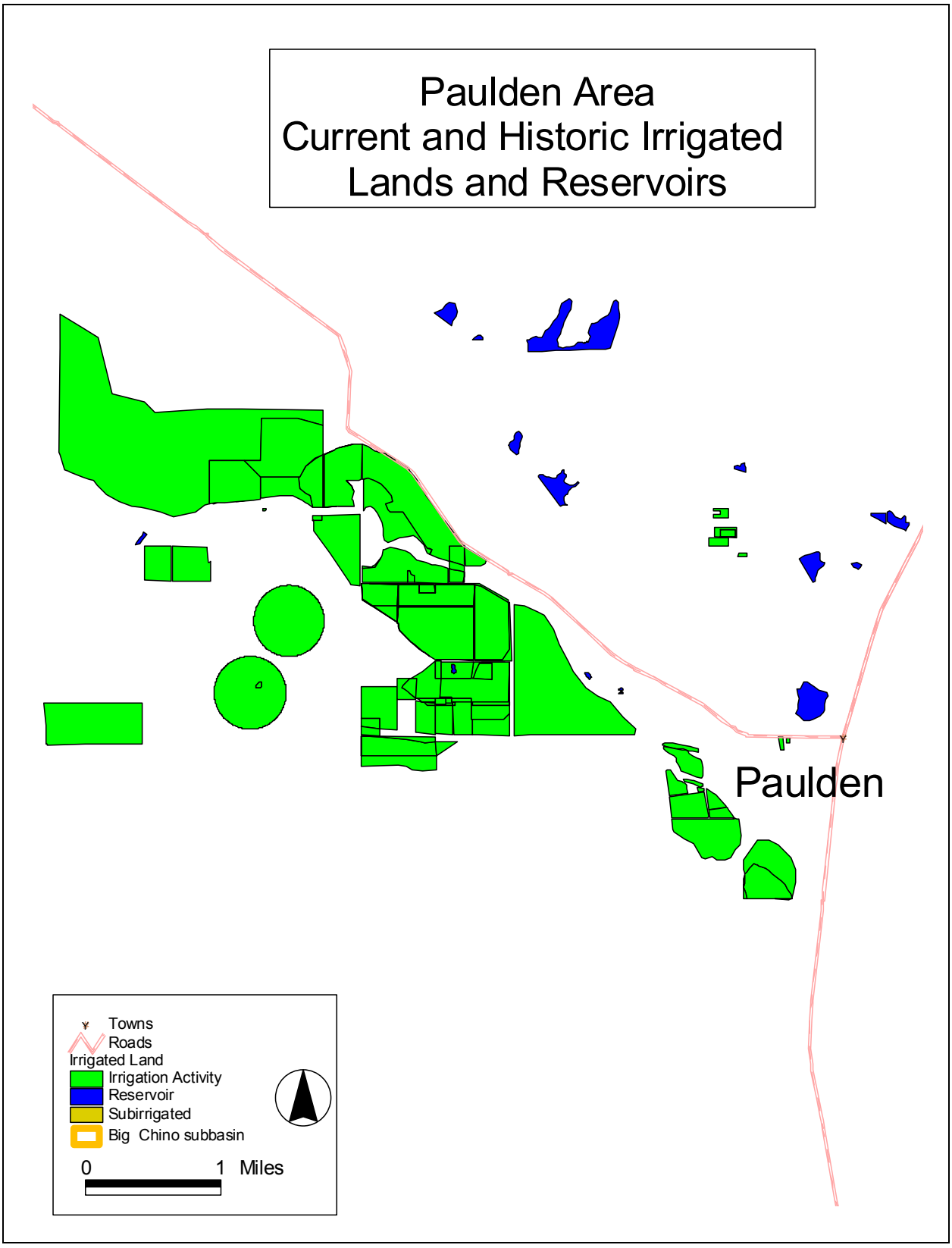
Big Chino		Projected	Projected	Projected	Projected	Projected	Projected	Projected	Projected	Projected	Projected
	2000-02	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Population Projection											
DES - Ash Fork (1997 Projection)	472	486	499	512	525	537	547	556	564	571	579
Growth Rate (%)	1.7%	3.0%	2.7%	2.6%	2.5%	2.3%	1.9%	1.6%	1.4%	1.2%	1.4%
DES - Chino Valley	7,810	9,184	10,445	11,602	12,771	13,900	14,928	15,804	16,580	17,351	18,230
Growth Rate (%)	12.4%	17.6%	13.7%	11.1%	10.1%	8.8%	7.4%	5.9%	4.9%	4.7%	5.1%
DES – Prescott	34,366	38,329	42,272	46,104	49,863	53,376	56,472	59,028	61,222	63,335	65,670
Growth Rate (%)	7.3%	11.5%	10.3%	9.1%	8.2%	7.0%	5.8%	4.5%	3.7%	3.5%	3.7%
US Census data - Big Chino (Yavapai Co)	6469										
Number of Water Users by Type											
Municipal Customers (# of hookups) Total	1,217	1,956	4,187	6,414	9,072	11,646	13,914	16,139	16,824	17,499	18,263
Abbra Water Company (1)	384	452	514	570	628	683	734	777	815	853	896
Ash Fork Water Company (2)	479	493	506	520	533	545	555	564	572	579	588
Aubrey Water Co. - Seligman (2)	235	242	248	255	261	267	272	277	281	284	288
Williamson Valley Rd - subdivisions (3)	0	500	1,500	2,500	3,000	3,500	3,703	3,871	4,014	4,153	4,306
ICR Water Users Assoc.	119	269	419	569	650	650	650	650	650	650	650
Paulden Area - predicted subdivisions (3)	0	0	1,000	2,000	4,000	6,000	8,000	10,000	10,491	10,979	11,535
Self Supplied (private wells)(4)	1,846	2,171	2,469	2,742	3,018	3,285	3,528	3,735	3,918	4,100	4,308
Self Supplied (haul water) (5)	315	370	421	468	515	561	602	637	668	699	734
Industrial/Mining	1	1	1	1	1	1	1	1	1	1	1
Agriculture (acres irrigated) (6)	2,500	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700
Reservoirs	10	10	10	10	10	10	10	10	10	10	10
Golf Course (acres) -Talking Rock + 1 additional	90	90	180	180	180	180	180	180	180	180	180
Quantity of Water Diverted (acre-feet/year)											
Municipal - Total	498	697	1,272	1,845	2,527	3,187	3,769	4,338	4,519	4,696	4,897
Abbra Water Company (7)	152	179	203	226	249	271	291	308	323	338	355
Ash Fork Water Company (7)	125	129	132	136	139	142	145	147	149	151	153
Aubrey Water Co. - Seligman (BN Leasing Corp) (7)	191	197	202	207	212	217	221	225	228	231	234
Williamson Valley Rd. Community (8)	0	126	378	630	756	882	933	976	1,012	1,047	1,085
ICR Water Users Assoc. (9)	30	67	105	142	163	163	163	163	163	163	163
Paulden-Big Chino (predicted event)(8)	0	0	252	504	1,008	1,512	2,016	2,520	2,644	2,767	2,907
Self Supplied (private well)(11)	609	716	815	905	996	1,084	1,164	1,233	1,293	1,353	1,422
Self Supplied (haul water)(2)(12)	26	31	35	39	43	47	51	54	56	59	62
Industrial/Mining (estimated) (13)	7	7	7	7	7	7	7	7	7	7	7
Agriculture(14)	9,545	10,309	10,309	10,309	10,309	10,309	10,309	10,309	10,309	10,309	10,309
Reservoirs (15)	55	55	55	55	55	55	55	55	55	55	55
Golf Courses - Talking Rock & predicted new (16)	441	441	882	882	882	882	882	882	882	882	882
Export to Prescott AMA (17)			4,000	8,700	8,700	8,700	8,700	8,700	8,700	8,700	8,700
Effluent Production (acre-feet/yr)											
Centralized Municipal System (65% of supply)	0	82	410	737	1,147	1,556	1,917	2,272	2,376	2,479	2,595
Septic Systems (65% of water supplied)	521	673	1,068	1,460	1,922	2,370	2,766	3,150	3,280	3,408	3,554
Return Flow (acre-feet/year)	4,385	4,729	4,817	4,817	5,523	5,932	6,293	6,648	6,752	6,855	6,971
Centralized Municipal System(17)	0	0	0	0	706	1,115	1,476	1,831	1,935	2,038	2,154
Septic Systems (0% return)	0	0	0	0	0	0	0	0	0	0	0
Industrial (20% return)	1	1	1	1	1	1	1	1	1	1	1
Agriculture (45% return)	4,295	4,639	4,639	4,639	4,639	4,639	4,639	4,639	4,639	4,639	4,639
Golf Course (20%)	88	88	176	176	176	176	176	176	176	176	176
Total Water Demand	11,181	12,257	13,375	14,042	14,819	15,571	16,237	16,877	17,121	17,361	17,634
Residential/Commercial (including small wells)	1,107	1,414	2,087	2,750	3,523	4,271	4,933	5,571	5,812	6,049	6,319
Other uses (Ag, Indust, Golf, Reservoirs)	10,074	10,843	11,288	11,292	11,296	11,300	11,304	11,307	11,309	11,312	11,315
Projected Population - Big Chino	6,469	8,611	13,553	18,430	24,139	29,667	34,555	39,278	41,000	42,700	44,630

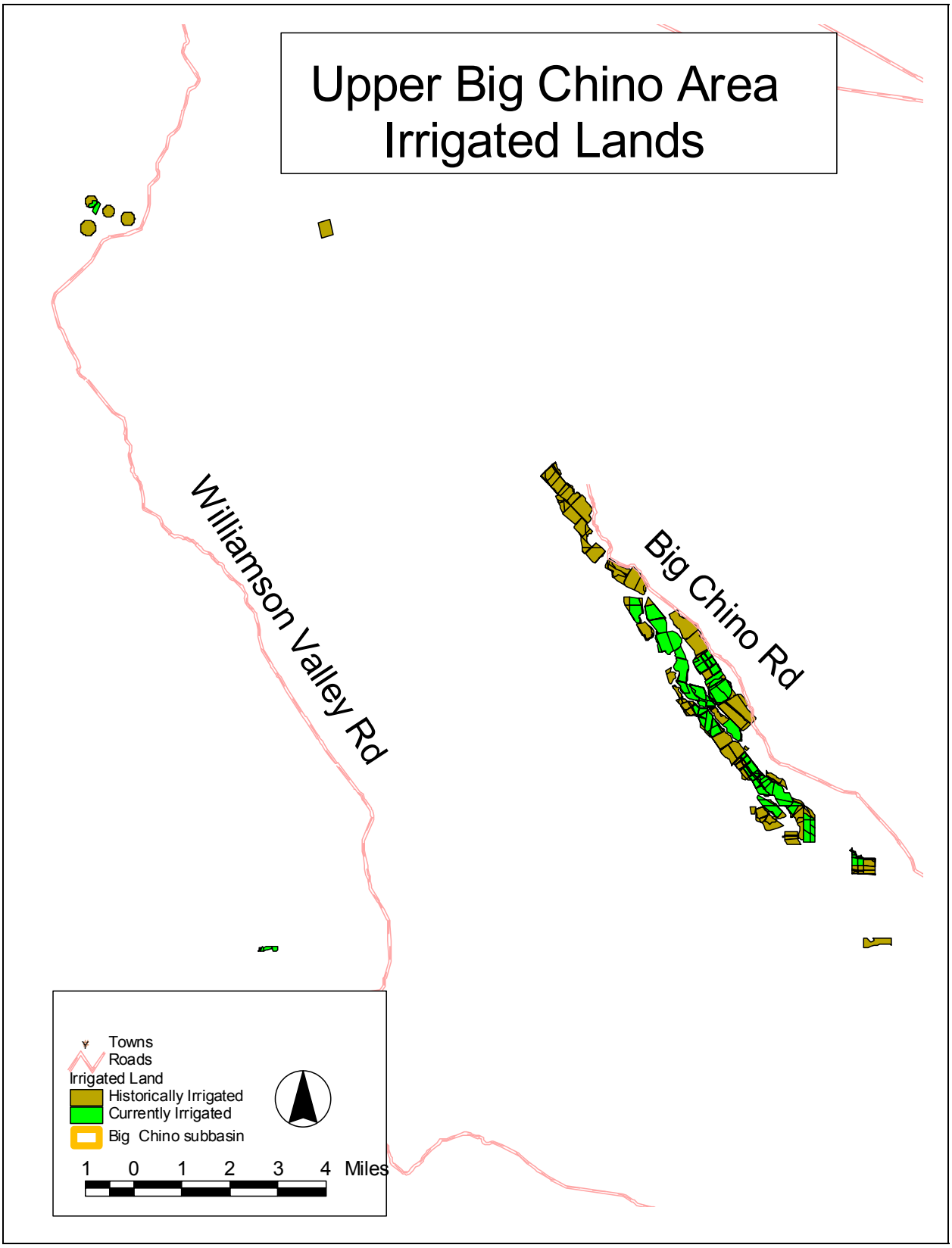
(1) Projection based on DES population projections for Chino Valley
(2) Projection based on DES population projections for Ash Fork
(3) Projection for planned subdivision based on speculation
(4) - There are 3259 residential, ag/res, commercial and comm/res in the basin. Subtract the 1098 muni customers to get 2161 units supplied by wells. ADWR well registry lists 1846 domestic water production wells
(5) There are approximately 2,161 water uses in the Big Chino and approximately 1846 domestic wells, assumed the difference is the number who haul water. There are 2,306 residential parcels in the area known for haul water (Juniper Heights)
(6) - From Yavapai County Water Advisory Committee Study
(7) Water Company data reported for 2000 from 2002 annual report
(8) Based on 225 gallons per day per household (90 gpcd and 2.5 persons/house)
(9) Calculated value based on number of homes*0.25 afa

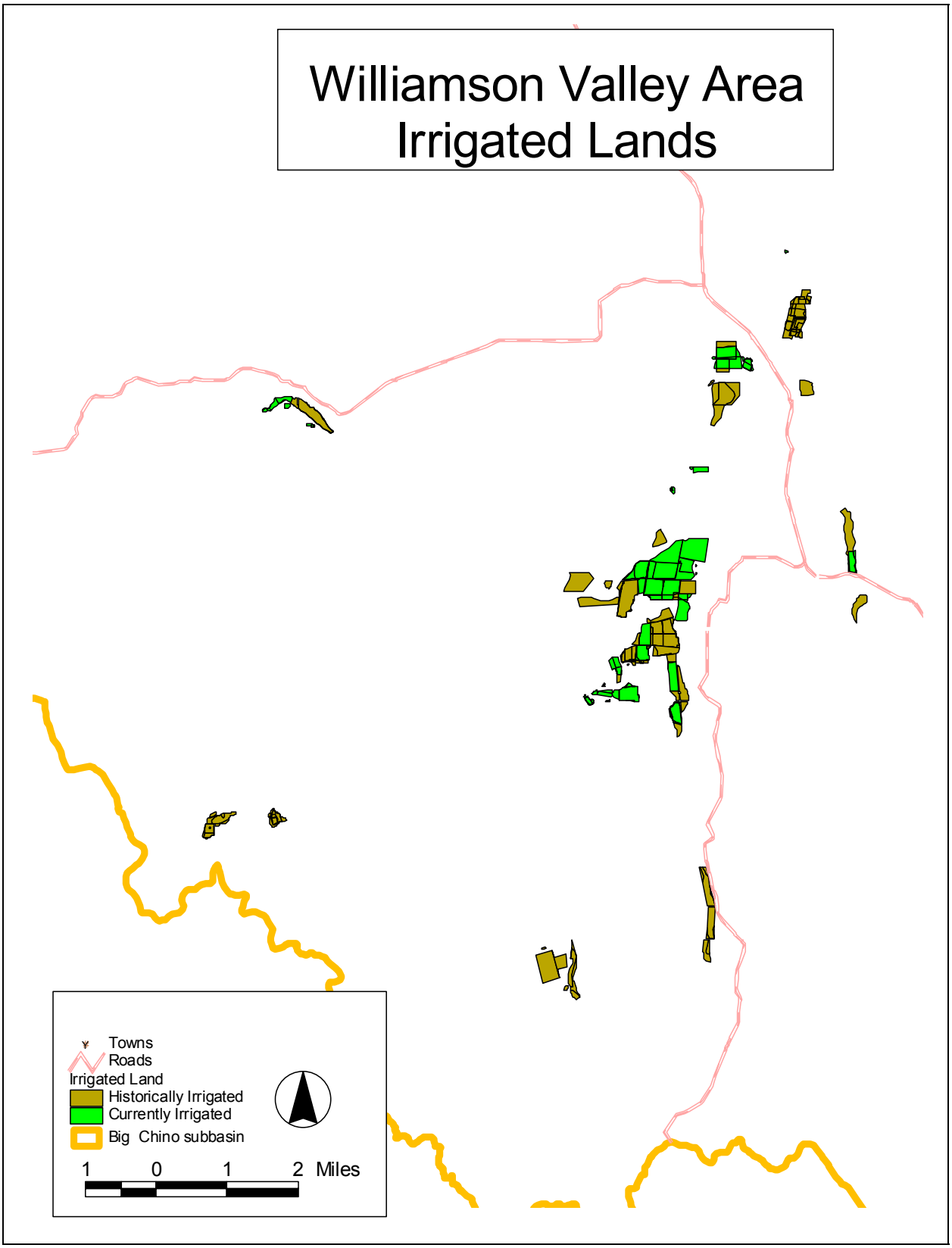
(11) Based on 0.33 acre-feet/yr useage per home.
(12) It is assumed that the users who haul water get that water from one of the water companies listed above and is not counted in the total demand.
(13) Data from Rinker Materials, estimated water requirements through 2008
(14) Ag water use is based on weighted average water use from this study (2.1 ft/acre), divided by an average 55% irrigation efficiency
(15) Reservoir water consumption is assumed to be 5.5 acre-feet/acre, groundwater returns are assumed to be neglible
(16) Water useage based on estimates for turf in the Prescott AMA of 4.9 acre-feet per acre.
(17) Recharge calculated as 50% of municipal effluent remaining after irrigation of the golf course

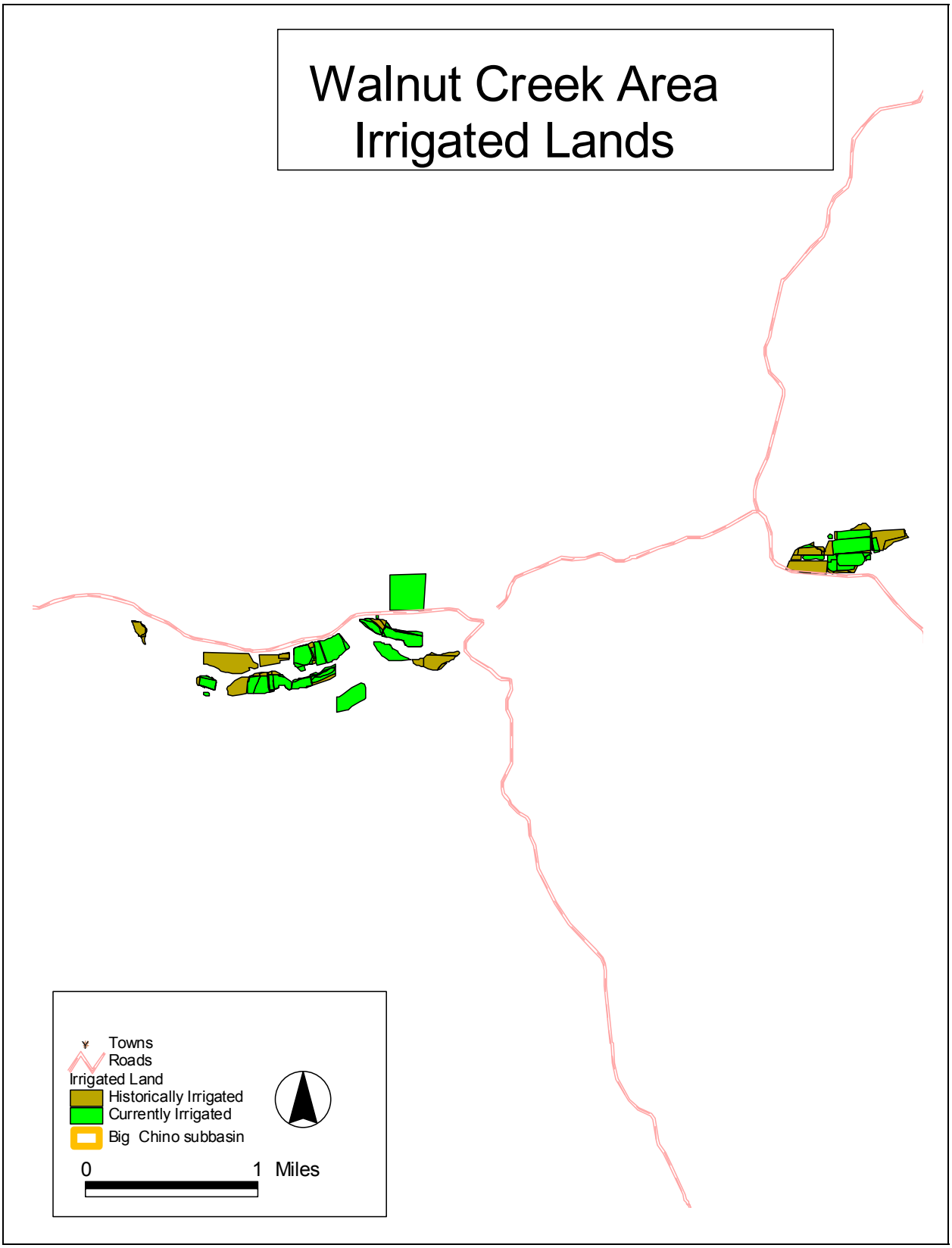
Appendix D: Location Maps




Paulden Area
Current and Historic Irrigated
Lands and Reservoirs
Paulden
Towns
Roads
Irrigated Land
Irrigation Activity
Reservoir
Subirrigated
Big Chino subbasin
0
1 Miles


Upper Big Chino Area
Irrigated Lands
Williamson Valley Rd
Big Chino Rd
Towns
Roads
Irrigated Land
Historically Irrigated
Currently Irrigated
Big Chino subbasin
1 0 1 2 3 4 Miles


Williamson Valley Area
Irrigated Lands
Towns
Roads
Irrigated Land
Historically Irrigated
Currently Irrigated
Big Chino subbasin
1 0 1 2 Miles


Walnut Creek Area
Irrigated Lands
Towns
Roads
Irrigated Land
Historically Irrigated
Currently Irrigated
Big Chino subbasin
0
1 Miles