25

DRAFT

Big Chino Subbasin

Historical and Current Water Uses and Water Use Projections

Yavapai County Water Advisory Committee
February, 2004

Acknowledgements:

Many individuals and agencies provided data and assistance, our apologies to those who helped out but are not mentioned here. Historical aerial photography was provided by the Natural Resources Conservation District, the Arizona Department of Water Resources and the Yavapai County Flood Control District. Many hours of historical and current information on water use, fields irrigated and crops grown were provided by the many land owners and farm managers in the Big Chino subbasin, although these individuals are too numerous to name, special thanks goes to John Olsen, former farmer and Yavapai County Supervisor, and Dave Smith, former Soil Conservation Service agent, who both have first-hand historical knowledge of much of the basin.

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

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