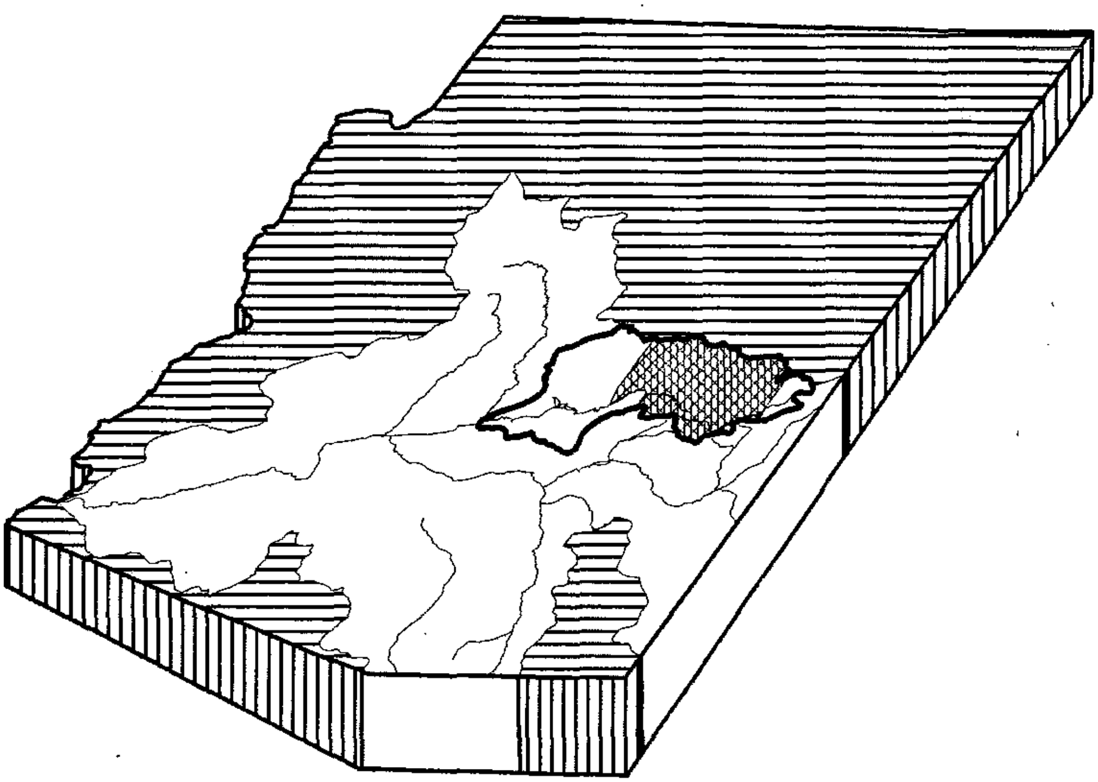
381

PRELIMINARY
HYDROGRAPHIC SURVEY REPORT FOR THE UPPER SALT RIVER WATERSHED

Volume 1: General Assessment

In Re The General Adjudication of the
Gila River System and Source



Arizona Department of Water Resources
Submitted for Review and Comment
December 1992

CHAPTER 3: WATER USES

This chapter describes the occurrence and general characteristics of natural and cultural water uses within the Upper Salt River watershed. Irrigation, water exports and imports, municipal, mining, industrial, power generation, stockwatering and domestic uses comprise the cultural uses discussed. A particular focus on principles and methods of quantifing irrigation water use and the characteristics of mining water use is provided. A hydrologic evaluation of natural and cultural uses and their interrelationship with water supplies and watershed outflow is presented in Chapter 4.

The information contained in this chapter is based primarily upon the results of the Arizona Department of Water Resources' (DWR) investigations within the Upper Salt River watershed. This investigation was conducted between 1985 and 1992 to provide the information which appears in this report. This chapter is divided into four sections: 1) natural uses within the non-Indian portion of the watershed, 2) cultural uses within the non-Indian portion, 3) uses within the Indian portion, and 4) summary and conclusions.

Natural uses are those which occur without intentional diversion. They include evaporation of streamflow and the use of water by riparian vegetation along the major stream channels. Cultural uses are comprised of man's activities which result in either the diversion and/or consumption of water such as: irrigation, municipal, domestic, mining, industrial, stockwatering, reservoirs, recreation, power generation, and other uses. The locations of the primary cultural water uses within the Upper Salt River watershed are shown on Plates 2 through 5.

Natural water uses are reported in this chapter as depletions while cultural uses are primarily reported as diversion amounts, from which some water is usually depleted. Cultural use depletions are estimated for the purpose of the water budget analysis found in Chapter 4. Depletions are the amount of water consumptively used and no longer available as a water source. Diversions are the total amount of water diverted from the source (groundwater and/or surface water system). Many of the reported uses divert more water than they consumptively use, so a portion of the diverted water may return to the hydrologic system. Therefore, depletions represent diversions minus return flows. Stated another way, diversions and depletions represent gross and net withdrawals from the hydrologic system, respectively. Natural uses such as channel evaporation and evapotranspiration from phreatophytes are believed to deplete all of the water which they divert. Therefore, the diversions and depletions for natural uses are considered to be equal. Within the non-Indian portion of the Upper Salt River watershed, it is estimated that 10,590 acre-feet is diverted for natural uses and 140,090 is diverted for cultural uses for a total diversion of 150,680 acre-feet per year.

Return flows may result in the exchange of waters between the surface water and groundwater systems and vice versa. For example, excess water from a surface water diversion may either return to the stream channel, percolate to the groundwater system, or evaporate. Groundwater withdrawals also can result in return flows to surface water systems.

The total depletion volume within the Upper Salt River watershed for some natural and all cultural uses as estimated in this report is 133,310 acre-feet per year which includes the cultural depletion from the Indian portion of the watershed of 8,330 acre-feet per year (see the water budget analysis in Chapter 4, Section 4.7 and APPENDIX E). Not included in the estimate for natural uses is the amount of water consumed by phreatophytes. In most of the watershed, population levels and corresponding development related water uses are relatively stable but, mining water uses are increasing in conjunction with new mineral extractions techniques in the Globe-Miami area. Although annual water supply within the Upper Salt River watershed fluctuates with the yearly variations in available precipitation, water uses exhibit less variation due to the dependability of supply provided by pumpage from wells within the watershed.

for 89.3 acres, or 63 percent of the actively irrigated district total. Second are pecan and fruit tree orchards with about 24.7 acres, or 17 percent of the total.

The majority of irrigated lands in the Upper Salt River watershed are farmed by individuals not associated with an irrigation district or association. The nondistrict actively irrigated acreage totals nearly 1,112.8 acres, or 89 percent of the 1,255.1 actively irrigated acres found in the Upper Salt River watershed. The most common crop types are pasture related crops totaling about 683.8 acres, or approximately 61 percent of the nondistrict total. Multiple crops and turf account for the next greatest amount of acreage in the nondistrict portion of the watershed with 91.9 and 86.8 acres, respectively, or a total of 178.7 acres (16 percent). No double cropped acreage was found in the Upper Salt River watershed. However, winter pasture and small grains are often grown and the field left fallow for the remainder of the year.

The next section describes and quantifies all of the major surface water diversions within the Upper Salt River watershed and the irrigated acreage served by them.

Quantification of Major Surface Water Diversions

DWR has also developed information pertaining to the two irrigation associations and nineteen privately owned diversion systems, as shown in Table 3-9.

The maximum theoretical discharge has been determined for each diversion system. This discharge sets an upper limit to the physical capacity of the existing diversion structure and canal to divert water from the stream.

The maximum demand rate shows the amount of water which needs to be diverted to optimally supply the gross irrigation requirement (GIR) after accounting for canal system losses during the month of peak demand. The maximum demand rate can be compared to the maximum theoretical discharge and the maximum and average measured discharges to evaluate whether the diversion system is capable of fully meeting all demands during the course of a growing season. It is, in other words, one of several standards utilized to evaluate whether a particular diversion is diverting more water than needed to meet crop demand, or conversely, whether the present

TABLE 3-9

UPPER SALT RIVER WATERSHED
CHARACTERISTICS OF MAJOR SURFACE WATER DIVERSIONS

DIVERSION NAME	ACRES SERVED	MAXIMUM THEO-RETICAL DISCHARGE (CFS)	MAXIMUM DEMAND DISCHARGE (CFS)	MAXIMUM MEASURED DISCHARGE (CFS)	AVERAGE MEASURED DISCHARGE (CFS)	ACRES/ CFS DIVERTED	TOTAL VOLUME DIVERTED (AC-FT)[1]	TOTAL AC-FT /ACRE DIVERTED	CONVEY-ANCE LOSSES (AC-FT)	NET VOLUME DELIV'RD (AC-FT)	NET AC-FT /ACRE DELIV'RD	AVERAGE FLOW DELIV'RD (CFS)	ACRES /CFS DELIV'RD
Tonto Creek Estates	3.7	0.6	0.0[2]	0.0[3]	0.0[3]								
Gisela Community Ditch	143.6	23.1	2.7	15.0	7.1	20.2	3444.2	24.0	116.0	3328.2	23.2	6.9	20.9
Martin, Deer Ck.	21.5	2.4	0.0[2]	0.0[4]	0.0[4]								
Martin, Rye Ck.	34.4	1.0	0.0[2]	0.0	0.0[4]								
Wheeler	56.2	1.8	1.1	1.0	0.3	187.3	145.5	2.6	32.5	113.0	2.0	0.2	241.2
Hamman	2.3	1.4	0.0[2]	0.0[3]	0.0[3]								
Connolly	10.1	2.8	2.0	0.9	0.2	50.5	97.0	9.6		97.0	9.6	0.2	50.5
Chapman	19.3	0.9	0.3	0.8	0.4	48.3	158.4	8.2		158.4	8.2	0.4	48.3
OW Ranch	45.9	13.2	1.2	3.7	1.2	38.3	475.2	10.4	68.6	406.6	8.9	1.0	44.7
Speers	13.8	2.2	0.3	0.5	0.4	34.5	194.0	14.1		194.0	14.1	0.4	34.5
Powder River	4.8	1.3	0.2	0.5	0.3	16.0	118.8	24.8		118.8	24.8	0.3	16.0
Neal	5.3	8.7	0.1	0.0[4]	0.0[4]								

[1]Assumes a 200 day diversion period for higher elevations and a 245 diversion period for lower elevations.
[2]Less than 0.05 cfs.
[3]DWR was unable to measure flow rates due to physical constraints.
[4]No flow was observed during field visits.

TABLE 3-9 (cont'd)

DIVERSION NAME	ACRES SERVED	MAXIMUM THEO-RETICAL DISCHARGE (CFS)	MAXIMUM DEMAND DISCHARGE (CFS)	MAXIMUM MEASURED DISCHARGE (CFS)	AVERAGE MEASURED DISCHARGE (CFS)	ACRES/ CFS DIVERTED	TOTAL VOLUME DIVERTED (AC-FT)[1]	TOTAL AC-FT /ACRE DIVERTED	CONVEY-ANCE LOSSES (AC-FT)	NET VOLUME DELIV'RD (AC-FT)	NET AC-FT /ACRE DELIV'RD	AVERAGE FLOW DELIV'RD (CFS)	ACRES /CFS DELIV'RD
Gressley	91.9	8.6	1.8	3.0	1.6	57.4	776.2	8.4	40.9	735.3	8.0	1.5	60.6
Morris	42.9	6.2	0.8	4.0	1.6	26.8	776.2	18.1	35.5	740.7	17.3	1.5	28.1
Hat Ranch	14.0	1.0	0.2	0.9	0.3	49.7	145.5	10.4		145.5	10.4	0.3	46.7
Trachta	4.5	0.3	0.1	0.0[3]	0.0[3]								
Ellison	7.1	1.4	0.2	1.4	0.6	11.8	237.6	33.5		237.6	33.5	0.6	11.8
Smith	20.2	1.3	0.3	1.0	0.6	33.7	237.6	11.8		237.6	11.8	0.6	33.7
Armer	5.4	2.8	0.2	0.7	0.6	9.0	237.6	44.0		237.6	44.0	0.6	9.0
McGowen, D1	3.3	0.6	0.1	0.0[4]	0.0[4]								
McGowen, D2	2.0	2.6	0.1	0.0[4]	0.0[4]								
P.S. Ditch	135.8	7.8	4.0	0.0[4]	0.0[4]								
AVERAGE	32.8	4.4	0.7			52.8		14.8			14.2		60.7
TOTAL	688.0	92.0	15.6		15.2		7,043.8			6,750.3			

WEIGHTED AVERAGE ACRES PER CFS DIVERTED = 60.7
[1]Assumes a 200 day diversion period for higher elevations and a 245 diversion period for lower elevations.
[2]Less than 0.05 cfs.
[3]DWR was unable to measure flow rates due to physical constraints.
[4]No flow was observed during field visits.

configuration of the canal system or available supply is capable of meeting the needs of those who are provided water.

The maximum and average measured discharges for the twenty one surface water diversions are based upon measurements made by DWR for the period 1989 to 1992. In many instances, DWR did not observe ditch flow during field investigations or was unable to measure the flow in conveyance system due to physical constraints of the flow measuring devices.

Under the totals found in Table 3-9, the sum of all of the measured average surface water deliveries is 15.2 cubic feet per second (cfs). A commonly used method for quantifying diversion rights in western states adjudications is to specify a maximum acres per cfs diversion rate. Utilizing a weighted average diversion rate based upon the acreage served, yields an irrigation season average diversion of about 52.8 acres per cfs. In most decrees which employ this standard of quantification, these values usually fall within a range of fifty to ninety acres per cfs. If the system losses such as

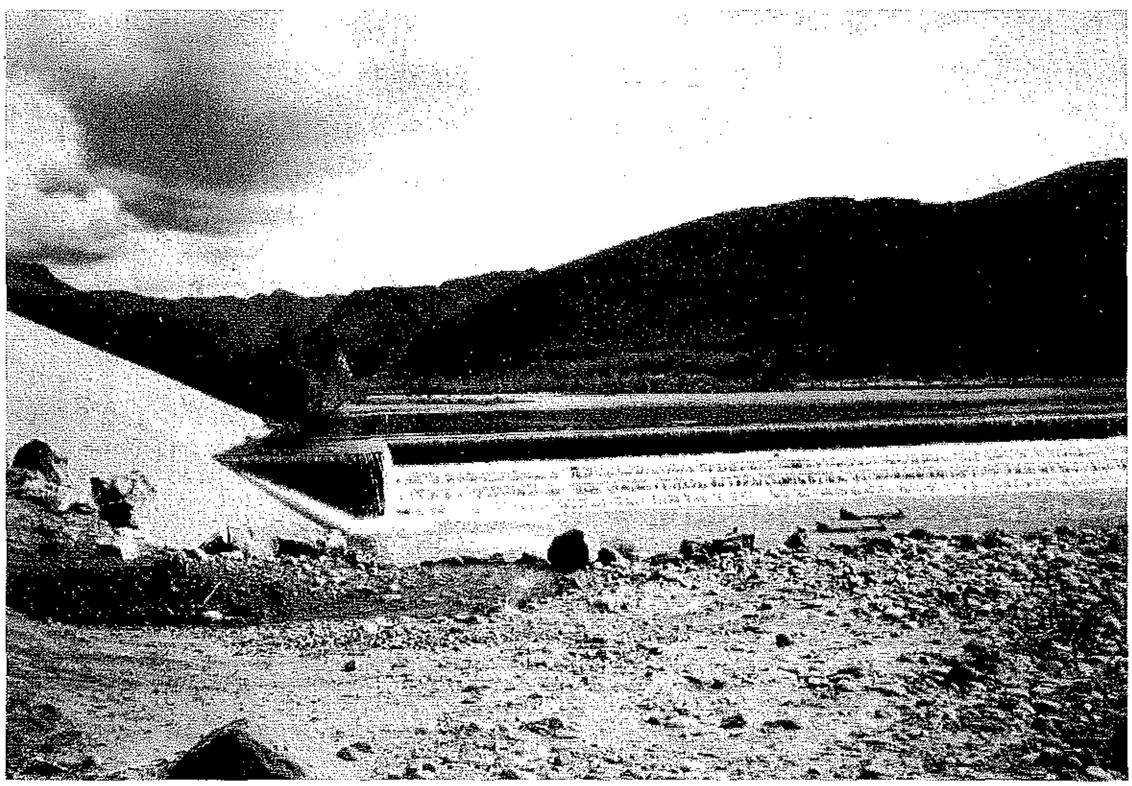


Figure 3-12. One of the more elaborate surface water diversions in the watershed serves a dual purpose in blocking migration of non-native fish species upstream. Note that much of the diverted water is being returned (left foreground).

evaporation and seepage are included, then these losses decrease the amount of water actually available for application at the field. This results in a diversion rate of about 60.7 acres per cfs needed to make up these losses. The value of 60.7 acres per cfs indicates that most of the irrigators utilizing surface water in the Upper Salt River watershed can meet the gross irrigation requirement with surface water alone. Examining the results on a diversion-by-diversion basis reveals significant variations from the average. The net average surface water delivery to the fields varies from a low of 2.0 acre-feet per acre for the Wheeler Diversion to a high of 44.0 acre-feet per acre for the Armer Diversion. Eight of the privately operated diversion systems have a net average surface water delivery value of 0.0 acre-feet per acre. This is the result of DWR not having been able to physically measure the diversions when surface water was actually present. A maximum theoretical discharge value was calculated for all diversions based upon field measurements of the diversion systems.

Table 3-9 also quantifies losses for five of the measured diversion systems. Losses to a diversion system typically are seepage losses and evaporation of water in the canal or ditch. Many of the private diversion systems have no conveyance loss listed in Table 3-9 because these systems have short runs from the point of diversion to the point of application at the field. DWR considers that the field application efficiency encompasses conveyance losses from these small systems. Several conveyance ditches have long conveyance systems consisting of unlined canals and ditches which incur substantial losses due to seepage and evaporation.

Overall, there are some conclusions which may be drawn from the data presented in Table 3-9. All systems have a theoretical maximum capacity in excess of the maximum demand placed on the system by crops and conveyance losses. Most irrigators who divert more than the actual gross irrigation requirement probably do not apply water to their fields but turn the water back into the natural surface water channel. Ten irrigators have been found to divert more than the maximum demand requirements. These higher than necessary diversion rates are probably induced by the needs for a higher flow rate required by the irrigation system. Although nine of the systems were not measured, three of these were observed to have water flowing in them. Five of the nine unmeasured diversions probably divert an adequate amount of water to meet requirements. Because of the intermittent nature of the streams which supply the Martin Rye Creek, Martin Deer Creek, and McGowen diversions, it is unlikely that adequate water is available to meet crop water requirements on the lands served by these diversions.

For a more detailed analysis of the GCDA and Tonto Creek Estates Homeowners Association quantifications of use, see Chapter 5, Section 5.2 of this volume of the HSR. Table 3-10 describes all of the surface water diversion systems within the Upper Salt River watershed. These diversions are described by the number of acres served, whether surface water is supplemented with well water, apparent first use date, and applicable watershed file report numbers.

The following sections discuss the remaining categories of cultural uses which are: water exports, municipal, mining, industrial/commercial, power generation, reservoirs, stockponds, and domestic uses.

WATER EXPORTS

Water is exported from the Upper Salt River watershed for mining and municipal water use as part of a water exchange agreement between the Salt River Project (SRP) and the Phelps Dodge Corporation (PDC). Water is pumped from the Black River over the Natanes Plateau into Willow Creek in the Upper Gila River watershed. The water is conveyed to the PDC mining operations near Morenci.

An average of 8,360 acre-feet are exported in this exchange. The water export is a 100 percent depletion from the hydrologic system. A detailed discussion about the effects the export has on the Upper Salt River watershed can be found in Chapter 4 while a detailed discussion of the entire SRP-PDC water exchange can be found in Chapter 7.

Additional water exports from the Upper Salt River watershed occur on a very limited basis for stockwatering purposes. One rancher, for instance, exports water from a spring in the Upper Salt River watershed to a stock tank in the Upper Gila River watershed. These exports are insignificant and are not quantified.