

## Water-Resource Issues in the Upper Verde River Watershed

By

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The Upper Verde River watershed consists of the Big Chino and Little Chino Ground-water Sub-basins (Fig. 1) and contains the city of Prescott, and the towns of Chino Valley and Paulden. Part of the town of Prescott Valley also lies within the watershed. Ground water within the Little Chino Sub-basin is presently the major source of water supply for the area, although the water demand for Prescott Valley is currently met by ground water from the Upper Agua Fria Sub-basin. Paulden obtains its supply from the Big Chino Sub-basin. The water demand on all three Sub-basins is expected to increase as their populations continue to grow.

Ground water in the Big and Little Chino Sub-basins naturally discharges to the Upper Verde River. This discharge of ground water begins near the river's confluence with Granite Creek, causing the river to change at that point from an intermittent to a perennial stream. The inflow of ground water from the Sub-basins continues below Granite Creek and comprises somewhere between 94 and 100 percent of the base flow (ground-water contribution to stream flow) presently measured at the Paulden streamgage (Wirt, 2005). Without this contribution, the Upper Verde River above Perkinsville would cease or nearly cease to flow on a perennial basis. Average annual base flow at the Paulden streamgage from 1963 (when the gage was installed) through 2003 was about 17,700 ac-ft/yr (Kyle Blasch, presentation to Yavapai County Water Advisory Committee, Feb. 15, 2006). Of this amount, the Little Chino Sub-basin contributes about 14 percent while the contribution from the Big Chino Sub-basin is at least 80 percent and possibly as much as 86 percent (Wirt, 2005). Thus, the contribution from the Big Chino Sub-basin presently equals from 14,160 to 15,220 ac-ft/yr.

There is well-founded concern that the existing demand on the ground-water system of the Little Chino Sub-basin combined with the existing and projected demand from the Big Chino Sub-basin will cause the ground-water contribution to the Upper Verde River from these basins to eventually cease altogether. Ground water in the Big Chino Sub-basin that is not removed by wells discharges to the Upper Verde River with the exception of a relatively small amount of ground water removed directly via transpiration by crops. Given this condition, two concepts stated by the United States Geological Survey (USGS) are important to understanding the relationship between base flow in the Upper Verde River and ground-water withdrawal in the two Chino Sub-basins and, therefore, to the continued existence of perennial flow in the Upper Verde River. First, pre-development ground-water discharge from a ground-water basin is equal to the natural recharge, and second, for ground-water basins wherein the discharge of ground water is solely to a stream, it can be stated that: *"In the long term, the quantity of ground water withdrawn (from the basins) is approximately equal to the reduction in stream flow that is potentially available to downstream users"* (Winter and others, 1998).

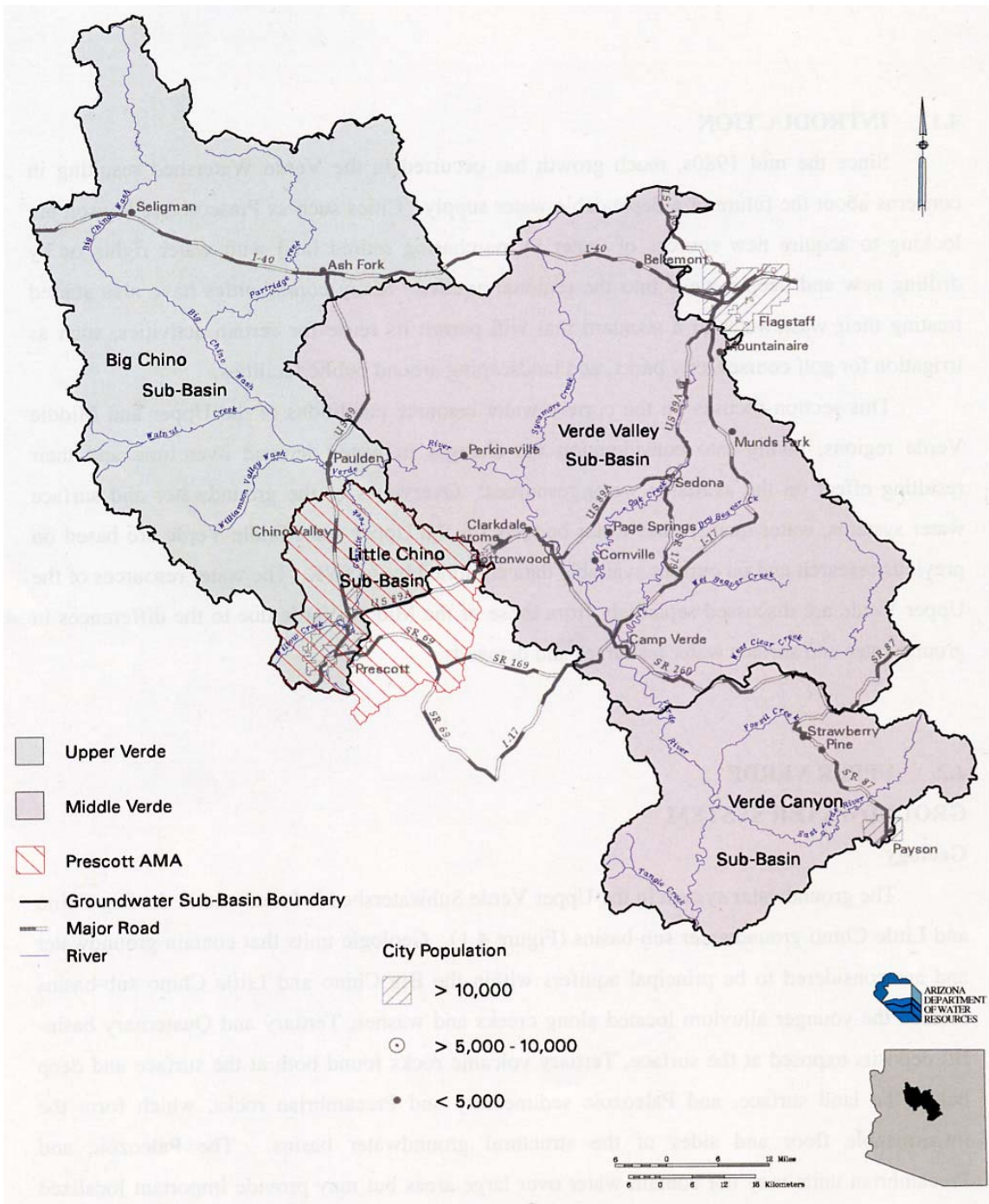


Figure 1. Map showing the Big and Little Chino Sub-basins, the Middle Verde Sub-basin, and Prescott Active Management Area (Prescott AMA). From ADWR, 2000.

Substantial ground-water withdrawal from the Little Chino Sub-basin that began in about 1940 has already reduced ground-water outflow from the basin by about 3,900 ac-ft/yr (Nelson, 2002). This outflow would have discharged to the Upper Verde River. Ultimately, attainment of safe yield in the Prescott Active Management Area or continued overpumping will eliminate ground-water discharge from the Little Chino Sub-basin to the Upper Verde River altogether. This reduction represents a total eventual loss of base flow in the Upper Verde River of about 7,500 ac-ft/yr from pre-development conditions (Nelson, 2002).

Substantial ground-water withdrawal from the Big Chino Sub-basin also began in about 1940 and has reduced ground-water outflow from this basin to the Upper Verde River as well. As noted by the USGS (Fig. 2), (Kyle Blasch, presentation to Yavapai County Water Advisory Committee, Jan. 26, 2006), “Base flow in the Verde River near Paulden stream gage is directly linked to precipitation and storage changes in the Big Chino Valley... Water level altitudes in the middle and eastern parts of Big Chino Valley rose from the early 1950s through the early 1990s. This period is succeeded by a decline through 2003 of about 0.5 to 0.75 ft/yr”. As shown in figure 2, a striking correlation exists between changes in water level (depth to water) and changes in base flow.

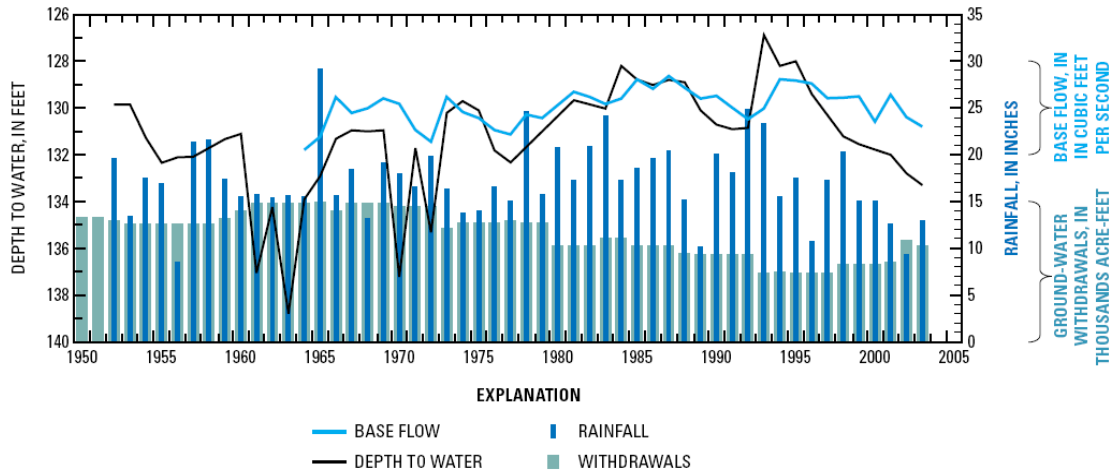


Figure 2. Diagram showing the relationship among ground-water withdrawals in the Big Chino Valley, base flow measured at the Paulden streamgage, depth to water, and precipitation (Kyle Blasch, presentation to Yavapai County Water Advisory Committee, Jan. 26, 2006),

Average annual ground-water withdrawal from the Sub-basin for 1990–2003 was about 11,800 ac-ft/yr with the largest ground-water withdrawals (11,300 ac-ft/yr) for agriculture (Kyle Blasch, presentation to Yavapai County Water Advisory Committee, Feb. 15, 2006). This usage includes sub-irrigation, wherein crops are rooted below the water table. Estimated Incidental recharge—primarily irrigation return flow—is 4,300 ac-ft/yr. Thus, the average net withdrawal from the Sub-basin for 1999-2003 was on the order of 7,500 ac-ft/yr. This net withdrawal will ultimately reduce base flow of the Upper Verde River by an amount nearly equal to the withdrawal.

The demand for ground water in the Big Chino Sub-basin is expected to increase substantially in the near future, thereby increasing the impact of pumpage on the flow of the upper river. The City of Prescott was granted the right to withdraw up to 14,000 ac-ft/yr of ground water from the Big Chino Sub-basin and transport this water to Prescott for the city's use under A.R.S. 45-555. A supplementary advisory opinion from the Arizona Department of Water Resources (Advisory opinion letter to Brad Huza, City of Prescott, from Herbert Guenther, Director, Arizona Department of Water Resources, August 21, 2003) stated that, owing to Prescott's sale of its Central Arizona Project allocation and participation in the Yavapai-Prescott Indian Water Settlement, the City of Prescott is entitled to withdraw and transport only 8,717 ac-ft/yr of ground water from the Big Chino sub-basin without retirement of historically irrigated acres within the sub-basin. Accordingly, the City of Prescott has purchased ranch land in Big Chino Valley and plans to eventually import 8,717 ac-ft/yr of Big Chino groundwater. That amount of pumpage, by itself, represents from 57 to 62 percent of the average base flow derived over the past four decades from the Big Chino Sub-basin.

In addition, A.R.S. 45-555 authorizes transfer to the Prescott Active Management Area of ground water representing retired irrigation in the Big Chino Sub-basin at the rate of three ac-ft/yr from each acre of retired historically irrigated land—i.e., land that was irrigated with ground water at any time between January 1, 1975 and January 1, 1990. The amount of such ground water legally available for exportation to the Prescott Active Management area is estimated by the Yavapai County Water Advisory Committee (YAVWAC, 2004) to be between 11,000 and 12,600 ac-ft/yr. Thus, the total amount of ground water that is legally available for transfer from the Big Chino Sub-basin to the Prescott Active Management Area totals between 19,700 and 21,300 ac-ft/yr.

The amount of water that can be transported from the Big Chino Sub-basin into the PAMA is only slightly below estimates for average annual recharge to the Sub-basin made by the United States Bureau Of Reclamation (approximately 23,690 ac-ft/yr, Ewing, Osterberg, and Talbot, 1994), ADWR (25,760 ac-ft/yr, ADWR, 2000), and the USGS (23,300 to 24,300 ac-ft/yr neglecting change in aquifer storage, Kyle Blasch, presentation to Yavapai County Water Advisory Committee, Feb. 15, 2006). As a result, importation of this water calls into question the long-term viability of the Big Chino Sub-basin as a source of water for the Upper Verde River and for existing requirements in the basin as well as its potential use to meet the demand associated with future population growth. Clearly, after importation of the legally available ground water to the Prescott Active Management Area, the amount of water available for existing uses and future growth within the Big Chino Sub-basin is extremely limited without ground-water mining.

The Yavapai County Water Advisory Committee report (YAVWAC, 2004) notes that the 1990 population of the Big Chino Sub-basin was approximately 2,900 and that by 2000 the population had grown to 6,470, a 223 percent increase. The report notes further that *“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”*. It seems a reasonable prospect that planned area developments on some of the large ranches in the sub-basin will add tens of thousands of homes in the coming years in addition to the piecemeal development of individual new homes as a consequence of “wildcat” lot splits. In addition, the Yavapai County Water Advisory Committee report predicts that 882 ac-ft/yr of groundwater will be committed to use for golf courses within the Big Chino Sub-basin by year 2010.

It is reasonable to expect that the water demands of the growing population of the Prescott Active Management Area will exert extreme pressure to import all of the legally allowed ground water from the Big Chino Sub-basin. Such importation requires extinguishment of historic irrigation rights; consequently importation would be expected to reduce but not necessarily eliminate agricultural irrigation in the Big Chino Sub-basin. At the same time, ground water is the only source of water available to support current and future development in the Big Chino Sub-basin. Even if safe yield is achieved within the Prescott Active Management Area, the long-term projection indicates the development of ground-water overdraft in the Big Chino Sub-basin and steadily declining ground-water supply throughout the entire Upper Verde Watershed. The seemingly inevitable growing demand for water to support development will assuredly eliminate perennial flow in the Upper Verde River. That means that the Verde River from Paulden through Perkinsville will be essentially dry except for periods of storms or snowmelt.

An important consideration for continued population growth in the Chino Sub-basins is whether environmental concerns and the concerns of downstream users of Verde River water will generate either litigation or legislation to protect perennial flow in the Upper Verde River.

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