UPPER GILA RIVER WATERSHED

The upper Gila River watershed is located in southwestern New Mexico and in southeastern Arizona above Coolidge Dam at San Carlos Reservoir. The watershed drains a total of 12,890 square miles which represents only one-fifth of the entire Gila watershed. The river originates in the Mogollon Mountains in western New Mexico and flows easterly through Arizona before flowing into the San Carlos Reservoir.

In Arizona, the upper watershed drains 7,430 square miles and is within the Morenci, Duncan Valley, Bonita Creek, and Safford groundwater basin boundaries. Major tributaries of the Gila River within the area are the San Francisco River, Eagle Creek, Bonita Creek, San Simon Creek, and the San Carlos River.

Agriculture is the major use of surface water in the watershed. Irrigation water is obtained from the Gila River at several diversion points and from wells pumping groundwater. Diversions from the river above Coolidge Dam have been regulated by the Gila Decree since 1936.

Streamflow Characteristics

The Gila River is intermittent as it enters Arizona from New Mexico through the Duncan-Virden Valley. The river does maintain a 35-mile perennial stretch beginning approximately 20 miles downstream from where it enters Arizona. Table 26 lists all perennial streams reaches in the upper Gila watershed. The locations of these reaches are shown on Figure 18.

TABLE 26

PERENNIAL STREAM REACHES IN THE UPPER GILA RIVER WATERSHED

Perennial Stream Reaches	Length (miles)
Gila River (two reaches)	43
San Francisco River	33
Cold Creek	3
Eagle Creek	42
Bonita Creek	15
Markham Creek	2
Diamond Bar Canyon	2
San Carlos River	22
Marijilda Wash	4
unnamed reach	3
Deadman Canyon	2
Frye Creek	2
Ash Creek	6
Tributaries to the San Francisco River	
Dix Creek - Left Prong	4
Dix Creek	2
Dix Creek - Right Prong	2

Coal Creek	3
Harden Cienega Creek	2
Blue Creek	43
Trout Creek	7
Romero Creek	2
Pace Creek	4
Jackson Creek	3
Coleman Creek	5
Campbell Blue Creek	16
Castle Creek	2
Turkey Creek	2
Pigeon Creek	4
Turkey Creek	4
Squaw Creek	5
Thomas Creek	5
Little Blue Creek	3
Ash Creek (two reaches)	4
Hannah Springs	2
Strayhorse Creek (two reaches)	2
Raspberry Creek	4
KP Creek	7
unnamed reach	3
unnamed reach	2
Grant Creek	8
Lanphier Canyon	6
Foote Creek	4
Tributaries to Eagle Creek	
Cienega Creek	4
Willow Creek	11
Chitty Canyon	4
East Eagle Creek	6
Tributary to San Carlos River	
Blue River	10
Tributaries to San Simon Creek	

Cave Creek	5
unnamed to Cave Creek	2
South Fork Cave Creek	4
TOTAL PERENNIAL STREAM REACHES	389

Source: Brown and others, 1981

During periods of low flow, all of the water above Duncan, Arizona, may be diverted for irrigation; any flow in the Gila River at Duncan when upstream diversions are occurring is attributed to groundwater inflow. Springs appear along the Gila River above Duncan discharging water from the older alluvial fill into the river. There are more diversions for irrigation below Duncan, however, groundwater contributes very little to flow for approximately 15 miles. At this point the river becomes perennial again from groundwater inflow (Hem, 1950).

Throughout the next 35 miles the Gila River maintains a perennial stretch (Brown and others, 1981) largely because of the inflow of three of its major tributaries: the San Francisco River, Bonita Creek, and Eagle Creek. A number of springs also occur along this course of the river. The largest spring, Gillard Hot Springs, consists of a series of small seeps where geothermally-heated water rises from deep fractures. The seeps which extend 150 feet along the north bank of the river, have a combined discharge estimated at 400 gallons per minute (Hem, 1950). The 181·F temperature is considerably higher than any of the other springs in the watershed.

The San Francisco River is the largest tributary to the upper Gila River. It is a perennial stream with an average annual discharge of 154,931 acre-feet at the U.S. Geological Survey gaging station #094445 at Clifton (U.S. Geological Survey, 1991). Chase Creek, an intermittent stream until just above Clifton, becomes perennial at Clifton Hot Springs. These springs discharge from 404 gallons per minute to 1,302 gallons per minute (Hem, 1950), resulting in perennial flow in the creek to its confluence with the San Francisco River. Many other hot springs occur in the San Francisco River above Clifton. The public water supply of Clifton is obtained from the San Francisco River.

Eagle Creek, another perennial stream, flows into the Gila River about two miles downstream of the mouth of the San Francisco River. There is a series of small hot springs in the canyon of Eagle Creek near the Phelps Dodge Corporation pumping plant. In 1944, Phelps Dodge Corporation made an agreement with the Salt River Valley Water Users Association to divert up to 14,000 acre-feet of water annually from the Black River, a tributary to the Salt River. The water is pumped from the Black River over the watershed divide into Eagle Creek, where it is pumped to Morenci for mining operations (Hem, 1950).

Bonita Creek, a perennial stream in its lower reaches, enters the Gila River about five miles below the mouth of Eagle Creek and about two miles above the head of the Safford Valley. Approximately five miles above the mouth of Bonita Creek, an infiltration gallery collects water for a 24-mile long pipeline that extends down the creek and across the Gila River Valley to Solomon, Safford, and Thatcher for public supply (Hem, 1950).

The Gila River gains in flow as it passes through the Safford Valley primarily due to groundwater inflow. Even with these inflows, the Gila River is intermittent throughout the Safford Valley because of heavy agricultural pumping of groundwater and use by encroaching phreatophytes (Turner & others, 1941). The cities of Safford and Thatcher supplement their public supply with water from reservoirs on Frye Creek which originates in the Pinaleno (Graham) Mountains.

Artesian wells discharging water at the land surface occur in the vicinity of Artesia, south of Safford, in the floodplain of Stockton Wash. Other flowing wells are located in large washes and on terraces sloping toward the valley from the base of the Pinaleno Mountains. The poor quality water is unsuitable for use in some cases. Total dissolved solids concentrations ranged from 39 to 480 milligrams per liter (mg/l) and fluoride concentrations ranged from 0.1 to 1.0 mg/l in samples collected between 1985 and 1990 (Black, 1991). Several seeps and springs, also of poor quality, flow in the floodplains of the larger washes and near terrace scarps along the sides of valleys. Total dissolved solids concentrations ranged from 288 to 3,000 mg/l (Black, 1991). The largest group, Indian Hot Springs, are located on the north side of the valley near Eden. Altogether the springs have been reported to discharge approximately 360 gallons per minute (Hem, 1950).

A hydraulic connection exists between the Gila River and the shallow aquifer in the younger alluvial fill. A rise in the river level during floods corresponds to rises in water levels in nearby wells. This effect usually is of short duration. Groundwater levels decline as surface flow in the river decreases (Halpenny & others, 1946). During periods of intensive groundwater pumping and high phreatophyte use, the Gila River becomes a losing stream in reaches where the water level in the shallow aquifer is lower than the river. Table 27 lists average annual flows for selected gaging stations in the upper Gila watershed. The location of these gages are shown on Figure 18.

Reservoirs

The San Carlos Reservoir, formed by Coolidge Dam, is the only reservoir on the Gila River within the upper watershed. The current storage capacity of the reservoir is approximately 885,000 acre-feet (U.S. Bureau of Reclamation, 1993). The dam was constructed in 1928 to store water for irrigation of the San Carlos Irrigation Project lands and to provide power development if allowed by irrigation demands. Water supply studies originally prepared for the San Carlos Irrigation Project overestimated the amount of surface water available for storage in the reservoir. As a result, the surface water supply has never been adequate for irrigation of all of the project lands (U.S. Department of Interior, 1963).

TABLE 27

ANNUAL FLOWS FOR SELECTED USGS STREAMGAGING STATIONS IN THE UPPER GILA RIVER WATERSHED (SOUTHEASTERN ARIZONA PLANNING AREA)

Station Name	Station Number	Period of Record	Mean Annual Flow (ac-ft)	Median Annual Flow (ac-ft)	Record Annual High Flow (ac-ft)	Record Annual Low Flow (ac-ft)
Gila River near Clifton	9442000	1912-1917 1929-1933 1936-1946 1949-1989	149,100	112,190	673,130	31,120
Blue River near Clifton	9444200	1969-1990	54,290	28,810	175,880	7,240
San Francisco River at Clifton	9444500	1914-1915, 1917 1928-1933 1936-1990	154,170	93,730	678,200	30,400
Eagle Creek above pumping plant near Morenci	9447000	1945-1990	41,260	26,640	172,990	12,300

Bonita Creek near Morenci	9447800	1982-1990	6,730	4,970	15,920	2,970
San Simon River near Solomon	9457000	1932, 1936-1982	8,690	6,400	27,500	1,010
Deadman Creek near Safford	9458200	1968-1976 1987 1989-1990	940	570	2,680	80
Gila River at head of Safford Valley near Solomon	9458500	1941-1946 1957-1965	205,560	126,670	810,660	62,970
Gila River at Calva	9466500	1930-1990	233,790	140,060	1,100,180	20,990
San Carlos River near Peridot	9468500	1930-1990	39,810	24,540	201,220	5,940

Source: U.S. Geological Survey, 1992, National Water Information System

Water Quality

The chemical character and concentration of water in the Gila River changes considerably from its headwaters to the San Carlos Reservoir. A progressive degradation is caused by irrigation-return flows and fault-generated springs and seeps which have their origin in the evaporite beds underlying the valley floor. Water entering Arizona from New Mexico is of low mineral content containing mostly calcium and bicarbonate. The concentration of dissolved solids at the Arizona-New Mexico state line averaged 305 milligrams per liter (mg/l) in a study done over a five year period by J.D. Hem (Hem, 1950). Inflows from the San Francisco River cause a large increase in sodium and chloride concentrations between the bridge at Highway 666 and the mouth of Bonita Creek. Water from Clifton Hot Springs has been found to have as much as 9,790 mg/l of total dissolved solids (Hem, 1950).

Below the gaging station near Solomon large amounts of water are diverted from the Gila River for irrigation and the river receives considerable inflow from groundwater and irrigation return flows. As a result large increases occur in the concentration of dissolved solids in the river water. The average concentration of dissolved solids at the head of the Safford Valley near Solomon is 562 mg/l (Earthinfo, Inc., 1991). The mineral matter of the water passing through the Safford Valley consists mostly of sodium, chloride, and sulfate. The average concentration of dissolved solids near Bylas was found to be 1,397 mg/l in the five year study done by J.D. Hem (Hem, 1950). High total dissolved solids values near Calva (about 10 miles downstream of Bylas) probably are the result of agriculture irrigation, rangeland management practices and mining activities (Arizona Department of Environmental Quality, 1990).

Generally, the water in the Gila River at low stages is highly mineralized, at times greater than 4,000 mg/l. The predominate constituents are sodium and chloride with high concentrations of fluoride and borate (Muller, 1973). During high stages, the water only contains small to moderate amounts of dissolved mineral matter, generally less than 500 mg/l of the sodium bicarbonate type (Culler and others, 1970).

The Arizona Department of Environmental Quality (1990) has reported exceedances of water quality standards for turbidity, metals, and ammonia along the upper reaches of the Gila River.

Additional water-quality problems include common exceedances for turbidity, dissolved oxygen and/or ammonia in the following stream courses: San Francisco River near Alpine, the Blue River near Clifton, and the San Carlos River above San Carlos Reservoir (Arizona Department of Environmental Quality, 1990). These problems are thought to be related to rangeland management practices, logging operations, and some mining activities.

The San Carlos Reservoir has had violations of fecal coliform bacteria standards and occasionally violations of dissolved oxygen, ammonia, and turbidity standards. Probable causes of contamination include recreation use and rangeland erosion.