6. CITY OF TOMBSTONE'S WATER AND WASTEWATER SYSTEMS

This section describes the City of Tombstone's water and wastewater systems. Included below is a description of how the City has supplied, distributed, and stored its public water, followed by discussion of the City's past and future water demands, and current water user fees. The section ends with a description of how the City has processed and discharged its wastewater.

Much of the information presented here is taken from two master plans completed by Stanley Consultants, Inc. (SCI) in March 2000. Funding for the plans was provided by the Border Environment Cooperation Commission. This information should be useful in understanding which water supplies have already been developed for the area, how these supplies have been used and paid for, and how the City's management of its wastewater may have impacted local water quality. This information should also be useful in analyzing the engineering and economics of developing a new water supply in the adjacent Tombstone District.

6.1 WATER SUPPLY

SCI (2000a, pp. 12-14 and 47-48) describes the City of Tombstone's water supply as follows:

> The City's water supply is a combination of surface water and groundwater. The original water system consisted of 2 spring catchment areas in the Huachuca Mountains and a steel aqueduct that transported water from these springs, 25 miles away, to a 1 million gallon concrete reservoir on a hill on the south side of the townsite. The City still uses these springs as (its primary) water source, but they no longer provide water year round. In wet years, the city receives water from the springs between the months of December and July. When the steel aqueduct is running, flows from the springs can approach 400 gpm...The surface water is filtered through a two stage, automatic backwashing giardia filter system...(and) chlorinated before entering...two water storage tanks...
>
> The City originally operated three wells. Well No. 1 (drilled in 1941) was removed from service in 1982 because of nitrate contamination. The capacity of Well No. 1 was 225 gpm. Well No. 2 (installed in 1967) is the primary water source for the City (during dry years and when the reservoir is emptied). The capacity of the well is 300 gpm...The capacity of Well No. 3 (installed in 1976) is (also) 300 gpm. This well is used as a backup

> source, when needed to meet peak daily demands, or when Well No. 2 is out of service for repairs or maintenance...Well No. 1 is equipped with a Franklin Submersible turbine pump with a 60 hp motor. Well No. 2 is equipped with a 300 gpm capacity Simflo pump with an electric motor...Well No. 3 is equipped with a 300 gpm Simflo pump with 60 hp electric motor...Both Well No. 2 and Well No. 3 are equipped with booster pumps...Over time, the booster pumps broke down, and the City opted to connect the well pumps directly into the system...Chlorination is not provided at either well. Chlorination at Well No. 2 is proposed, and funding was obtained from (the U.S. Department of Agriculture Rural Development) in February of 1999...At this time, the operation of the wells is fully manual. An operator turns the well pump(s) on every day, and checks on the level of water in the storage tanks...
>
> There is no shortage of water supply in the Tombstone area at this time, nor is there expected to be a shortage in the next 20 years. In addition to Wells No. 2 and 3 and the surface water source, Well No. 1 may be eligible to be put back into service. Sampling for nitrates would have to be done and submitted to (the Arizona Department of Environmental Quality). The State has indicated to the City that Well No. 1 could be put back into service if a mixing plan were provided. A plan to mix the water from Well No. 1 with the rest of the system water seems feasible. A dedicated line exists from Well No. 1 to the surface water filtration site. The water could be mixed within the storage tanks before being distributed to users.
>
> Tombstone Development Company owns one well south of the City, which tested at 225 gpm, according to ADWR records. This well is not being used at this time, but the company tests the well once a year. This well is another potential source of supply for the City in the future.
>
> Additional storage is (also) available at Wells No. 2 and 3. The storage tank at Well No. 2 has been rehabilitated, and would probably require only an inspection before returned to service. The tanks at Well No. 3 would require rehabilitation before being returned to service.

ADWR (1991, pp. 297-299) reported that the City of Tombstone began using surface water from the springs in the Huachuca Mountains in 1881 and until 1977, water was diverted from Clark, Miller, and Gardiner Springs in Miller Canyon, and Carr and Rock Springs in Carr Canyon through a special use permit with Coronado National Forest. Forest fires and heavy storm runoff in 1977 damaged portions of the aqueduct and reportedly the City has used only Miller and Carr Springs since that time. The City also installed an instream pump along the San Pedro River, but reportedly it has only been used once, in 1945, as an emergency source during a drought period.

Attachment L presents maps from ADWR (2003b) that show the approximate location of the spring catchments in the Huachuca Mountains, the 25-mile steel aqueduct, the pump station on the river, and three wells used by the City for its water supply. Also presented in Attachment L are well registration and equipment reports from ADWR (2003c) for the City's wells.

According to the U.S. Environmental Protection Agency (2003), the City of Tombstone is currently operating a "community water system" that serves a population of 1504 and uses surface water as its "primary water source type." Additional information including system violations and enforcement history is available from EPA's Safe Drinking Water Information System (SDWIS). The "water system ID" for the City is AZ0402033.

6.2 WATER DISTRIBUTION AND STORAGE

This part of Section 6 describes the City's water distribution and storage system. A general description of the distribution system is provided first, followed by more detailed information on the aqueduct and a summary of the storage system.

6.2.1 General

SCI (2000a, p. 13, 15, and 16) provides the following summary of the City's water distribution system:

> The City water system includes the 25 mile, 7" diameter steel aqueduct line from the spring catchment areas, and approximately 20 miles of distribution piping ranging in size from 1 ¼ " to 12" in diameter. The oldest pipelines in the system are steel and 2" or 3" in diameter. Newer areas, such as Territorial Estates are served by 6" diameter PVC pipe. Six inch diameter pipes in the original downtown area are primarily asbestos cement.
>
> In the 1970's new 6" and 8" diameter pipelines were installed in Allen and Toughnut Streets. The old pipelines were not taken out of service, however, so there exists parallel small and large diameter pipes in those streets.
>
> A new 12" diameter PVC pipe was installed in 1998 from the water treatment plant site to the downtown commercial area of the City. This line was installed to improve fire protection to the downtown area, and replace an existing 6" steel line…

> Overall, the condition of the public water system varies considerably. The oldest components of the system, the spring catchments, 25-mile aqueduct, surface water storage reservoir, and distribution lines within the older downtown area, are in fairly good condition considering the fact that they were installed over 100 years ago...
>
> The City reports operational difficulties in repairing broken pipes because of valve and pipe locations are unknown and many old valves are inoperable.
>
> Many small diameter, old pipes steel pipes are too shallow and undersized. In the winter, there are frequent incidences of pipes breaking due to freezing.

6.2.2 Aqueduct

SCI (2000a, p. 13, 15, and 16) provides more detailed information on the City's aqueduct:

> A 5" diameter threaded steel pipe transports water from the Miller Canyon Catchment to a point on the east side of Highway 92, where it joins the 7" diameter steel pipe from Carr Canyon. The aqueduct is 7" diameter from that junction to the concrete reservoir. The aqueduct line provides water by gravity to the concrete reservoir. It passes beneath the San Pedro River with an elevation of the river bank at the crossing of approximately 4,000'. The elevation of the reservoir is approximately 4860'. The elevation of the Miller catchment is approximately 6015' and of the Carr catchment is approximately 6090'...
>
> The steel aqueduct line at one time was equipped with a pressure reducing valve. That valve has been removed. Pressures in the aqueduct line can be extremely high at low points such as the San Pedro river crossing. However, this high pressure provides the head necessary for water to reach the reservoir...
>
> The steel aqueduct pipe is in good to fair condition, and the City typically repairs approximately six (6) leaks a year on the pipe. These leaks typically occur at the location of old plugs or joints, or when the pipe is disturbed in the course of private improvements. The spring catchments are in acceptable condition, but require cleaning on a periodic basis to maintain operation...
>
> There exist very few shutoff valves on the steel aqueduct. Valves exist at the springs, at the crossings on Highway 92 and at the reservoir. The City

> reports that the valves at the highway crossings are not operational...The valve on the 5"aqueduct at Highway 92 was leaking when SCI conducted field surveys...
>
> The 25-mile aqueduct is not accurately mapped. The USGS survey which shows the pipe alignment is not accurate, as demonstrated by the field survey, conducted by SCI with this project. The mapping completed with this project locates the line at critical locations (Highway 90 and 92 crossings and the San Pedro River crossing) but the line needs to be mapped accurately and marked in the field for operators.

6.2.3 Storage Facilities

SCI (2000a, p. 12 and 16) describes the storage system for the City's water supply as follows:

> The City's storage infrastructure consist of a 1.1 million gallon concrete reservoir, a 300,000 gallon at-grade steel water tank (installed in 1998), a 100,000 gallon at-grade steel water tank, and three 25,000 gallon at-grade steel water tanks. The three 25,000 gallon tanks are not in service at this time. Two 25,000 tanks are located at Well No. 3. One 25,000 gallon tank is located at Well No. 2. The two larger tanks are located at the site of the surface water filtration unit. The concrete reservoir is located on a hill south of the city and south of the surface water treatment facility...
> The concrete reservoir was lined with a plastic liner in 1972, and valves and piping from the reservoir to the treatment system and storage tanks were repaired and upgraded...in 1998. The liner has eliminated leaking from the reservoir...The reservoir roof was constructed approximately 20 years ago and is in good condition...
>
> As part of this project, the welded steel 100,000 gallon storage tank was inspected in March of 1999...The inspection revealed some corrosion over all interior surface of the tank, the most concentrated corrosion being on the floor of the tank. The welded seams were in good condition and the tank is considered to be structurally sound, although in need of rehabilitation. The tank was found to contain lead-based paint, making it financially impractical to rehabilitate.

6.3 WATER DEMAND

According to SCI (2000a, p. 11 and 35), all residents within the City of Tombstone are served by the public water system. The number currently served ranges from a low of about 1500 year-round residents to as many as 1700 people during the peak months of October and December through May. Recent water customers include:

- Residential
- Apartments and senior housing
- Trailer courts
- Commercial (restaurants, motels, campgrounds, print shop, etc.)
- Schools
- Churches
- City-owned property
- "Vacant"
- "Stand Pipe".

Table 9 lists measured and projected water demands by the City based on data provided by ADWR and SCI.

Table 9 – Water Demand by the City of Tombstone

Year	Water Demand (in acre-feet/year)	Data Type	Data Source
1985	389.7	Measured	ADWR (2003b)
1998*	223.7	Measured	SCI (2000, p. 35)
2010	237.6	Projected	SCI (2000, p. 36)
2030	246.6	Projected	SCI (2000, p. 36)
2050	266.5	Projected	SCI (2000, p. 36)

* Water demand was actually measured from November 1997 through October 1998.

Of the 389.7 acre-feet of water demand in 1985, 236.3 acre-feet (61%) were reportedly supplied by the mountain springs and 153.4 acre-feet (39%) were supplied by the City's wells. Of the three city wells, 147.3 acre-feet were pumped from Well No. 2, 6.1 acre-feet were pumped from Well No. 1, and no water was pumped from Well No. 3. A similar breakdown of the City's water supplies in 1998 was not available to the Department.

Review of the table shows that the City's water demand in 1985 was significantly higher than it has been in more recent years and expected in the future. The Department does not know for certain why this is the case, but one likely explanation is increased water use by the families of workers who were hired to develop the open pit and operate new mills and heap leaching facilities from 1979 through the 1980s. Population data analyzed by SCI (2000a, p.9) does indicate a rise and peak in Tombstone's population during this period. A population graph for Tombstone by SCI (2000a, p. 9) is presented in Attachment M.

<u>REVISED</u>

Table 9 - Water Demand by the City of Tombstone

Year	Water Demand (in acre-feet/yr)			Data Type	Data Source
	Springs	Wells	Total		
1966	na	4	na	Measured	ADWR (1988, p. 75)
1967	na	na	na	Measured	ADWR (1988, p. 75)
1968	na	37	na	Measured	ADWR (1988, p. 75)
1969	na	70	na	Measured	ADWR (1988, p. 75)
1970	na	59	na	Measured	ADWR (1988, p. 75)
1971	na	66	na	Measured	ADWR (1988, p. 75)
1972	na	150	na	Measured	ADWR (1988, p. 75)
1973	na	186	na	Measured	ADWR (1988, p. 75)
1974	>189	189	na	Measured	ADWR (1988, p. 26 and 75)
1975	>87	87	na	Measured	ADWR (1988, p. 26 and 75)
1976	na	175	na	Measured	ADWR (1988, p. 76)
1977	>254	254	na	Measured	ADWR (1988, p. 26 and 76)
1973-77	156 (avg)	178 (avg)	334 (avg)	Measured	ADWR (1988, p. 25, 26, and 76)
1978	na	113	na	Measured	ADWR (1988, p. 76)
1979	na	113	na	Measured	ADWR (1988, p. 76)
1980	na	171	na	Measured	ADWR (1988, p. 76)
1981	na	171	na	Measured	ADWR (1988, p. 76)
1982	na	144	na	Measured	ADWR (1988, p. 76)
1983	na	144	na	Measured	ADWR (1988, p. 76)
1984	na	150	na	Measured	ADWR (1988, p. 76)
1985	na	206	na	Measured	ADWR (1988, p. 76)
1985	236.3	153.4	389.7	Measured	ADWR (2003b)
1998*	na	na	223.7	Measured	SCI (2000, p. 35)
circa 1999	na	na	250	"Yield estimate"	FS/BBC (2002, p. 141)
2010	na	na	270	"Yield estimate"	FS/BBC (2002, p. 141)
2010	na	na	237.6	Projected	SCI (2000, p. 36)
2030	na	na	246.6	Projected	SCI (2000, p. 36)
2050	na	na	266.5	Projected	SCI (2000, p. 36)

* Water demand was actually measured from November 1997 through October 1998.

"na" indicates data were not available to ADWR.