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WATER USE AT GRAND CANYON  
A HISTORY

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Report compiled (except as noted) by  
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Water Use at Grand Canyon - A Chronological Summary

- 1890 (approx.) Sanford H. Rowe digs well south of present Grand Canyon Village. Later operates campground.
- 1901 First passenger train (September) also hauls water. Practice continues until 1932.
- 1916 U.S. Forest Service providing free water to campers at Grand Canyon.
- 1917 Proposal to pipe to Grand Canyon water collected at San Francisco Peaks and stored in craters.
- 1922 Colorado River Compact - provides for equitable distribution of Colorado River water.
- 1926 Opening of water reclamation plant, May 29.
- 1931 Santa Fe Railway feasibility study for Indian Gardens pipeline.
- 1932 Construction and opening of Indian Gardens water system. "Last" trainload of water, August 27.
- 1954 AT&SF Railway utilities (electricity, steam heat, water), transferred to NPS by donation in March.
- 1958 Storage tanks for 4,300,000 gallons of water built on South Rim.
- 1960-1967 Water shortages and increased visitation; hauling by train resumed.
- 1960's Increasing growth of Tusayan community brings requests for park water.
- 1965 Contract awarded for construction of transcanyon waterline to utilize source at Roaring Springs.
- 1966 Record December flood destroys much of pipeline.
- 1967 Two 3-million gallon storage tanks erected.
- 1970 Transcanyon waterline dedicated July 24.
- 1970 Enactment of Public Law 91-383 provides restrictions on sale of park water to users outside park.

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- 1971 Tusayan Water Development Association incorporated May 13.
- 1971 Water supplied to TWDA and Moqui Lodge on emergency basis, mid-May to mid-October.
- 1972 Water permits to Tusayan curtailed; supplied twice in emergencies.
- 1972- Pipeline problems; falling rocks, corrosion.  
1973
- 1974 Fire at Canyon Squire Motel; park supplies potable water and tanker trucks.
- 1974 Water supplied to Airport and Moqui Lodge in response to several emergencies.
- 1981 (?) Projected demand from Tusayan would equal park's unused pumping capacity.
- 1985 (?) Park demand for water will probably equal pumping capacity.

## WATER USE AT GRAND CANYON

### A HISTORY

#### Introduction

The history of water use at Grand Canyon has been a long demonstration of man's ingenuity pitted against an inhospitable environment.

Virtually no surface water exists on the South Rim of Grand Canyon because of the permeable nature of the Kaibab Limestone. Earliest inhabitants of the area managed to trap or delay runoff from seasonal storms to support minimal agriculture, and pioneers who attempted to wrest a living from the area's mineral or tourist resources constructed catchments or "tanks," or hauled water from sources below the rim.

Perhaps one of the earliest wells in the vicinity of the village was that dug about 1890 by Sanford H. Rowe, about three miles from the present railroad depot. He claimed the surrounding land by right of discovery and eventually, with Ed Hamilton, developed an automobile campground. One of its advertised attractions was its free water.<sup>1</sup>

#### Rail Transport Begins

The first passenger train reached Grand Canyon on the new railroad branch in September 1901. That train also carried tank cars of

water,<sup>2</sup> and until 1932 the greater part of all water used on the South Rim was supplied in this manner.<sup>3</sup> For a long time it was hauled from as far away as Del Rio (over 100 miles south), but sometime prior to 1916 the railroad built a reservoir in Flagstaff which shortened the trip a little.<sup>4</sup>

In 1916 the U. S. Forest Service recorded that water delivered in this way cost \$50 for a 10,000 gallon carful, including \$45 freight charges. Average consumption was 5 cars a day, but during the rush season this might double "for weeks at a time." There was concern about providing water for campers. At first they were permitted to get all the water they wanted at the Company garage. When this resulted in petty thievery at the garage, the campers were sent to the power house, "where there was a faucet and nothing loose nearby." With an increase of tourist travel just before World War I, it finally became necessary to charge 25¢ a day and place the water distribution in charge of the railway agent. It was not considered a satisfactory solution to the problem.<sup>5</sup>

#### Other Solutions Considered

A number of alternatives were being explored during this period. Perhaps the most ambitious was a plan (1917) to collect surface and subsurface water from the San Francisco Peaks near Flagstaff, pipe it to the craters of small extinct volcanic cones nearby, which would serve as natural reservoirs, and then deliver it by pipeline. It was

believed that the altitude of the storage craters was sufficient to permit gravity flow to campsites along the South Rim of the Canyon.<sup>6</sup> Because of problems with water rights and pipeline construction, the project was dropped.<sup>7</sup>

At about the same time, consideration was being given to pumping water from Bright Angel Creek, or from Indian Gardens. Some experimental drilling was also undertaken south of the Canyon, but without success.<sup>8</sup>

In 1922 the Colorado River Compact was drawn up, to provide for equitable distribution of the waters of the Colorado River System,<sup>9</sup> and in 1928 the Boulder Canyon Project Act provided for further apportionment of Colorado River water.<sup>10</sup>

#### Waste Water Reclaimed

An important step in relieving some of the demands on the potable water supply at Grand Canyon was the completion of a "recycling" plant for reclaiming waste water. The plant was put into operation on May 29, 1926, and the Superintendent's annual report declared it "an unqualified success."<sup>11</sup> It continues to be regarded as an excellent example of effective conservation of a precious resource. The plant produced water for general utility purposes at less than 1/5 the cost of the drinking water available in 1926.<sup>12</sup> The product was pumped through its own pipe system and used to flush toilets, as boiler feed water and cooling water in the power plant, for the steam locomotives that came to the Canyon at that time, and for irrigation.<sup>13</sup>

### Water from Indian Gardens

In 1931 it became imperative to develop an alternative to hauling water by rail. Annual park visitation was approaching 200,000 persons.<sup>14</sup> That year the Santa Fe Railway began a study to determine the feasibility of pumping water up from Indian Gardens, 3200 feet below the rim, where a generous supply was available. The decision was made to go ahead, a cable tramway was built to transport men and materials into the canyon, and construction of approximately two miles of six-inch pipe was begun.<sup>15</sup> A three-unit<sup>16</sup> pumping plant was built at Indian Gardens which lifted the water in one stage to the rim. The environmental impact was kept to a minimum by burying as much of the pipeline as possible and building the pump house of native materials. The project was completed and water was being pumped to the storage reservoir in August 1932; the "last" trainload of water arrived on August 27.<sup>17</sup><sup>18</sup>

Park travel was relatively stable for the next decade, never reaching a half million visitors a year, and dropping to less than 100,000 per year during World War II.<sup>19</sup> Water supply did not threaten to become a serious problem again until the late 1950's, when the park first recorded over one million visitors a year.

### Utilities Transferred to National Park Service

In March 1954, the Atchison, Topeka and Santa Fe Railway Company, which had been producing electricity and steam heat for use in Grand Canyon Village, as well as operating the water supply system,

transferred these utilities to the National Park Service by donation.<sup>20</sup>

One of the important points made in connection with this transfer was included in a letter drafted by NPS Southwest Regional Director

Tillotson.<sup>21</sup> In clarifying the position of the park, as to whether

commitments made by the concessioner could be regarded as binding

upon the United States, Mr. Tillotson wrote:

"If Mr. Dickson (note: Benjamin F. Dickson, Concession Management Division, NPS, Washington Office)<sup>22</sup> had in mind the obligation of a successor to a public utility company to continue service, it should be kept in mind that the railway company has never been a public utility with respect to supplying water, steam, or electricity in Grand Canyon, and the United States will not become such a public utility in the future. The railway company has been at all times a private utility, and service has been rendered under individual contracts. Those individual contracts are necessarily terminated when the company deprives itself of the power to perform, and the company may remain liable for breach of contract. However, the successor to the property interest does not succeed to the contract obligations unless it voluntarily agrees to do so. In accepting title from the railway company, the United States has made no such agreement."

#### Storage Increased

Water storage capacity was tripled in 1958 when three new tanks were built on the South Rim. Two of these were then the largest in the National Park System, 120 feet in diameter, 24 feet high, holding two million gallons each. The third tank, 48 feet across and the same height as the others, held 300,000 gallons.<sup>23</sup> Filling of these tanks began on February 20 and required about 30 days.<sup>24</sup>



The Sixties--More Trains, More Tanks

Despite the new storage, in the spring of 1960 it became apparent that demand might exceed supply that year. The Park Superintendent issued a memorandum to all residents, calling attention to the situation and urging conservation of water by all means possible. The situation was due to a combination of three factors: increased visitation, a decrease in production by the springs at Indian Gardens, and leakage from one of the 2-million gallon storage tanks.<sup>25</sup> In July, the old pipeline system that had been used for unloading tank cars up until 1932 was tested and sterilized, and the pumping system used in transferring water from railroad cars to the storage tanks was overhauled.<sup>26</sup> The Park Engineer reported in August that an average of 43,000 gallons of water per day was needed from storage to supplement what could be pumped from Indian Gardens. Santa Fe tank cars, usually in 15-car trains, hauled 1,468,000 gallons of water that month.<sup>27</sup>

Cars were brought into the wye near the Motor Lodge and connected to the old pipeline. The water was transferred with the aid of pumps located near the siding, to tanks nearby (which have subsequently been removed).<sup>28</sup> At one point that summer the entire supply of water for the South Rim reached a low of one million gallons. Fortunately there were no major breakdowns in the pumping system, or fires, and the critical period was safely passed.<sup>29</sup> The leaking tank was repaired in September, and the supply began to gain on the demand.<sup>30</sup>

During the next seven years it was frequently necessary to supplement the water supply by this means.<sup>3 2</sup> Annual visitation to the park was increasing by roughly 100,000 persons per year and was approaching two million.<sup>3 3</sup>

While in some years during this period no water was imported by train, in 1964 a crisis developed. Early that year two of the pumps at Indian Gardens broke down. The South Rim water dropped to less than a two-week supply in early April and an emergency was declared. Mather Campground was closed and the opening of the public showers and laundromat was delayed. The emergency situation was widely publicized and cooperation by residents and visitors was excellent.<sup>3 4</sup> During April and May, 3,895,000 gallons of water were brought in by rail and although pump trouble continued into June and we were still losing stored water,<sup>3 5</sup> repairs were effected and in July over seven million gallons were pumped from Indian Gardens and another crisis was past.<sup>3 6</sup> Between 1960 and July 21, 1967, when the last ten tank cars were delivered, the Santa Fe Railway hauled more than eleven million gallons of potable water to Grand Canyon.<sup>3 7</sup><sup>3 8</sup>

In 1967 a contract was awarded for the erection of two 3-million gallon water storage tanks.<sup>3 9</sup> These were completed, but by the following June a press release was issued warning of the prospect of empty water faucets. June visitation was showing an increase over the previous year of from 3 to 5 thousand people each day, and the pumping capacity

at Indian Gardens was about 50,000 gallons a day short of the demand caused by this increase in consumers.<sup>40</sup>

### The Transcanyon Pipeline

Meanwhile, the transcanyon waterline was hoped to be nearing completion, optimistically offering an extended solution to the water problems of the South Rim. Alternative sources of additional water supplies, such as Hermit Creek, Havasu Creek, and Haunted Spring, had been considered and studied at various times. The conclusion eventually was reached that Roaring Springs, already utilized by the North Rim, offered the best long term solution in spite of the difficulties in getting the water across the intervening miles of canyon.

In 1964, the Park Superintendent and a group of engineers and consultants completed an exploratory trip over the proposed route for a pipeline from Roaring Springs to Indian Gardens.<sup>41</sup> A contract was awarded the following January to Elling Halvorson, Inc. and Lents, Inc., of Seattle, Washington, to construct the 12.4 mile pipeline and associated facilities.<sup>42</sup> The work was scheduled to be completed on July 19, 1966.<sup>43</sup> The deadline passed without being met, and in December 1966, when the pipeline was nearly finished, an unprecedented 15-inch rain on the North Rim, draining principally into Bright Angel Canyon, turned its usually small stream into an unimaginable torrent that tore out about 80% of the pipeline and much of that portion of the North Kaibab Trail.<sup>44</sup> Following the flood, Congress provided additional funds

to repair the damage, and work was renewed. The \$2 million project eventually cost more like \$6 million, and the dedication ceremonies were held at Yaki Point on July 24, 1970, just over four years later than anticipated.<sup>45</sup>

Since 1970 several accidents or problems have occurred as reminders that the pipeline is a rather vulnerable lifeline. These include a failure due to falling rocks in 1972, one due to unknown causes in 1973 and another due to corrosion that year.<sup>46</sup> In 1973 it also became apparent that a seasonal difficulty could occur in years of heavy run-off on the North Rim. That spring, for awhile, water from Roaring Springs was so sediment-laden it could be pumped only after it was diverted into the Indian Gardens reservoir to allow sediment removal.<sup>47</sup>

## TUSAYAN

### Background and Growth

With the opening of the transcanyon waterline, a situation that had been growing with regard to non-park demands on the park water supply received new impetus. The community of Tusayan, south of the park boundary, had more or less come into existence since the early 1950's. Prior to that time, Moqui Lodge and the American Legion Hut were about the only existing buildings in the area. Later in that decade, when the Orphan Mine owners needed space for employee quarters,

a trailer community known as "Western Village" grew on the west side of the highway.<sup>48</sup>

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In 1965 the Grand Canyon Airport was opened and, during the years since that time, developments have expanded rapidly, to include at present two motels in addition to Moqui Lodge, several service stations, a visitor information office, scenic helicopter facilities, a grocery store and various other small enterprises.

#### Problems

The earliest files to which the writer had access in the matter of water requests from Tusayan were those of late 1966.<sup>50</sup> In December --ironically just when the pipeline was being torn to bits by the flood--an attorney for the owners of Moqui Lodge was appealing to Congressman Morris Udall on behalf of his clients.<sup>51</sup> Moqui at that time was hauling water from the City of Williams and wished to end this arrangement by tying into the new supply that was expected to be available momentarily at Grand Canyon. In exchange for water they offered to build the necessary pipeline, to pay any reasonable water charge, to hold their usage at an agreed figure and not increase the size of their facility beyond a planned 400 units without approval of the National Park Service. Newspaper reports of the flood, appearing in the next few days, probably made obvious the reply they later received--Grand Canyon itself was likely to be hauling water for at least another year or two.<sup>52</sup>

Correspondence between the attorney and the Congressman was renewed early in 1969,<sup>5 3</sup> but the pipeline had still not been completed. Director Hartzog, when contacted by the latter, regretfully concluded that although increasing visitation was demanding expanded facilities in the park, these would have to be limited by the availability of water and "there is no excess water that can be made available for non-park uses."<sup>5 4</sup>

Public Law 91-383

The waterline had been opened in July 1970. That same year, on August 18, Public Law 91-383 was enacted. It provided guidelines and restrictions that related to the Grand Canyon water situation as follows:

"Sec. 3. In order to facilitate the administration of the national park system, the Secretary of the Interior is authorized, under such terms and conditions as he may deem advisable, to carry out the following activities:

\*\*\*\*\*

(e) enter into contracts which provide for the sale or lease to persons, States, or their political subdivisions, of services, resources, or water available within an area of the national park system, if such person, State or its political subdivision--

(1) provides public accommodations or services within the immediate vicinity of an area of the national park system to persons visiting the area; and

(2) has demonstrated to the Secretary that there are no reasonable alternatives by which to acquire or perform the necessary services, resources, or water;"

\*\*\*\*\*

In the spring of 1971, a crisis developed when the City of Williams, which had been selling water to Tusayan users, was faced with a shortage and had to inform out-of-town users that the service would be discontinued as of May 15, and possibly as early as May 1.<sup>55</sup> The Tusayan users petitioned the park on April 19 "for access to and the use of the domestic water supply developed by the National Park Service within the boundaries of the Park. . ."<sup>56</sup> The Park Superintendent requested more detailed information in support of the requirements of P.L.91-383, particularly as to the "absolute unreasonableness" of all alternate sources, and suggested formation of a legal entity to represent all the parties involved.<sup>57</sup>

In response to this, on May 13, 1971, the Tusayan Water Development Association was incorporated. Its stated purpose was "to secure a supply of water for the Tusayan, Arizona, area and to provide and maintain the necessary facilities to provide water to area residents in a safe and efficient manner."<sup>58</sup>

On the following day a Temporary Use Permit was issued to the new corporation, authorizing it "to take water of the United States and Grand Canyon National Park to meet emergency needs to fulfill domestic water requirements. . .for a period of 30 days beginning May 16, 1971. . ."<sup>59</sup>

Subsequent requests and park responses are summarized chronologically in Appendix A.<sup>60</sup>

Looking Ahead

(The attached tables and figure were prepared by Park Engineer Bill Matteson.)

Table I demonstrates the current (1974) capacity of the park pumping system (186.8 million gallons per year), monthly and annual water use, and unused pump capacity (i.e., capacity that could be utilized if more storage were available or if water were exported from the park). Projections for 1979 and 1985 are included, which show that by 1985 estimated annual use will equal pump capacity.

Table II records Tusayan use in 1973 and indicates the amount of storage (5.9 million gallons) that would be needed there to meet their summer demands and thus limit their requirements for park water to that which could be spared from "off-season" unused pump capacity. A projection for 1979 (12.7 million gallons of storage) is included.

Figure 1 graphically shows the point at which Tusayan demand would probably equal unused pumping capacity (approximately 1981) and at which park demand alone will require all the water that can be pumped (1985).

###



APPENDIX A

Tusayan  
Chronology of Water Requests and Responses  
(and related exchanges)

<u>Request Date</u>	<u>Response Date</u>	<u>Details</u>
Apr. 19, 1971	May 14, 1971	Tusayan users' petition (Group became incorporated May 13). Permit issued for 30 days, beginning May 16.
May 6	May 14	Moqui Lodge.* Permit, same as above, issued.
June 2	June 15	TWDA** 30-day extension requested. Permit issued, 30 days beginning June 15.
June 11	June 15	Moqui. Same as TWDA above.
July 12	July 16	TWDA. Requested 60 or 90 days; given 30 days, beginning July 16.
July 20	July 20	Moqui. Same as TWDA above.
Aug. 4	August 15	Moqui. 30 days, beginning 8/15.
Aug. 10	August 12	TWDA. 30 days, beginning 8/15.
August 4		Moqui requested a review of the \$6/1,000 gal. rate on grounds they are on Federal land. Question referred to WASO.
Sept. 8	Sept. 14	TWDA. 30 day permit, with condition that if City of Williams releases water before expiration of permit it will be revoked automatically.
Sept. 8	Sept. 15	Moqui. 30 day permit issued.
October 8		City of Williams notifies TWDA and Moqui (and NPS) that "Water is now available at the rate of \$3 per thousand gallons."

\*Because of its location on U.S. Forest Service land and its operation under a Special Use Permit, Moqui had not joined the TWDA.

\*\*Tusayan Water Development Association, Inc.

APPENDIX A (cont.)

<u>Request Date</u>	<u>Response Date</u>	<u>Details</u>
Oct. 8, 1971		NPS notifies TWDA and Moqui that Williams water is available and "we now have no authority to furnish you water after October 13, 1971, in accordance with Temporary Permit."
Oct. 8		TWDA writes Supt. "that it is neither practical nor possible for. . .Tusayan to purchase water from the city of Williams at a price of \$3 per thousand gallons and transport it..."
	October 12	Supt. replies to TWDA to effect that the emergency is over; "I have no alternative but to cease the sale of water. . ."
Oct. 19	Oct. 26	Hughes Airwest requests continuation of supply for employees because of Williams price. Supt. replies--request denied.
March 6, 1972		TWDA writes Supt., providing estimate of water requirements for 6 months (May-October); 9,993,100 gallons.
March 29		City of Williams informs NPS of reduction in price of water effective April 1, from \$3 to \$2/1,000 gal.
	April 28	Supt. writes TWDA in response to their 3/6 request; WRO has concluded "we are not able to sell water on a non-emergency or interim basis."
April 12		A "Utilities Committee" of the Grand Canyon Chamber of Commerce submits a report on development plans for Tusayan.
May 1972		Congressional help is being sought by various Tusayan users.
July 3	Verbal reply	TWDA. Two trucks broken down, a few hours' water on hand. 5-day permit issued, beginning July 2. (Phone call preceded letter.)
July 13	July 14	TWDA. Emergency--road construction on Hwy. 64 causing delays. Park responded: we have discussed with District Highway Engineer; road will be open, this is not a true emergency.

APPENDIX A (cont.)

<u>Request Date</u>	<u>Response Date</u>	<u>Details</u>
	July 21, 1972	NPS to TWDA. Your request for 6,000 gallons approved. (Request apparently verbal) "This letter also confirms our verbal understanding that this would be the last time you would request and we would supply water under 'emergency conditions' such as breakdown of equipment."
(Sept. 1972)		NPS has learned water is available from Bellemont (McClain's) if City of Williams cannot supply.
Sept. 22, 1972		City of Williams notifies NPS water will be cut off Sept. 22.
Sept. 21		TWDA. Notifies NPS that Williams will cut off supply, assumes we will again sell.
Sept. 22		Moqui. Notifies NPS of Williams cutoff and high costs of obtaining water from Bellemont.
	Oct. 11	NPS replies to Moqui (after exchange of correspondence with WRO) - "request denied."
	Oct. 19	NPS replies to TWDA - "request denied."

\* \* \* \* \*

(The files contain no specific applications nor permits during 1973. In November the TWDA requested a meeting with NPS to reconsider its denial of water, using the fuel shortage and related environmental concerns as an argument. The meeting was held, added data on anticipated needs was supplied, and the park notified TWDA in January 1974 that the request for water was denied, on the basis of the restrictions of P.L.91-383.)

May 13, 1974		On the morning of May 13, 1974, fire destroyed a two-story, 52-unit building at the Canyon Squire motel at Tusayan. Because the tankers available to carry water for fire suppression were those routinely used to carry potable water, they were serviced at the standpipe at the NPS warehouse instead of utilizing reclaimed water. The 6,000 gallon tanker made 7 trips; the 2,000 gallon tanker, 9 trips, and a 7,000 gallon tanker from Moqui made 4 trips.
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APPENDIX A (cont.)

<u>Request Date</u>	<u>Response Date</u>	<u>Details</u>
July 12, 1974	July 18	Airport. Storage tank and treatment reservoir "virtually dry." Special Use Permit issued, beginning July 18, shall not extend beyond present drought conditions.
Aug. 22, 1974	Aug. 22	Moqui. Trucks temporarily unable to cross Santa Fe tracks at Bellemont to obtain adequate water. Permit for emergency water needs, Aug. 22 to Aug. 31.
Aug. 29	Aug. 30	Moqui. Bellemont situation will not change until Sept. 28. Permit issued covering period Sept. 1 to Sept. 28.
Sept. 23	Sept. 24	Airport. Need more. Permit for emergency needs issued, beginning Sept. 23; not to extend "beyond present drought conditions."
Sept. 27	Sept. 30	Moqui. Extension requested, work at Bellemont not completed. Request was denied after determination that Moqui had not attempted to go to Bellemont after getting permit.
Oct. 19	Oct. 20	Moqui. Pump at Bellemont has failed; Moqui will be out of water next day. Three loads of water supplied.
June 25, 1975	June 25	Moqui. Breakdown of tank trailer, only 10-12 hours' supply on hand. Water was supplied without written agreement.
July 29	July 30	Moqui. Further trailer breakdowns, urgent need. Permit issued for July 30, not to extend beyond August 1.
Nov. 6	Nov. 6	Airport. Extended drought, need water. Permit issued, "not beyond current drought conditions."
Nov. 22	Nov. 22	Moqui. Truck down, need 21,000 gallons. Approved verbally by Asst. Supt. and water delivered.

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TABLE I

M WATER USE, MILLIONS OF GALLONS (INSIDE PARK ONLY)

	STORAGE LEVEL AT END OF MONTH	UNUSED PUMP CAPACITY	1979 ESTIMATED USE	DIFF	STORAGE LEVEL AT END OF MONTH	UNUSED PUMP CAPACITY	1985 ESTIMATED USE	DIFF
6	13.0	8.4	9.1	7.4	13.0	7.4	10.9	5.6
5	13.0	7.6	8.1	6.7	13.0	6.7	9.8	5.0
7	13.0	7.7	9.9	6.6	13.0	6.6	11.8	4.7
8	13.0	5.8	11.3	4.6	13.0	4.6	13.6	2.3
3	13.0	4.3	13.7	2.8	13.0	2.8	16.4	0.1
3	13.0	1.3	16.4	-0.5	12.5	- 0 -	19.8	-3.9
3	11.7	- 0 -	17.4	-3.1	9.4	- 0 -	21.1	-6.8
4	8.3	- 0 -	18.5	-5.3	4.1	- 0 -	22.5	-9.3
3	8.0	- 0 -	16.3	-2.0	2.1	- 0 -	19.6	-5.3
2	11.2	- 0 -	14.9	1.6	3.7	- 0 -	18.0	-1.5
2	13.0	4.4	10.9	5.0	8.7	- 0 -	13.1	2.8
9	13.0	8.9	8.5	8.0	13.0	3.7	10.2	6.3
4		48.4	155	31.8		31.8	186.8	- 0 -

TABLE II

TUSAYAN WATER USE, AND STORAGE NEEDS IF  
WATER WERE FURNISHED BY THE PARK (MILLIONS OF GALLONS)

	PRESENT			1979		
	TUSAYAN USE, 1973	PARK'S UNUSED PUMP CAPACITY	NEEDED STORAGE FOR TUSAYAN	ESTIMATED TUSAYAN USE	PARK'S UNUSED PUMP CAPACITY	NEEDED STORAGE FO TUSAYAN
January	0.6	8.4		1.0	7.4	
February	0.5	7.6		0.8	6.7	
March	0.7	7.7		1.1	6.6	
April	0.8	5.8		1.3	4.6	
May	1.1	4.3		1.7	2.8	
June	1.5	1.3	5.9	2.4	0	12.7
July	1.8	0	5.7	2.8	0	10.3
August	1.6	0	3.9	2.5	0	7.5
September	1.3	0	2.3	2.1	0	5.0
October	1.0	0	1.0	1.6	0	2.9
November	0.8	4.4		1.3	0	1.3
December	0.5	8.9		0.8	3.7	
<b>Total</b>	<b>12.2</b>	<b>48.4</b>		<b>19.4</b>	<b>31.8</b>	

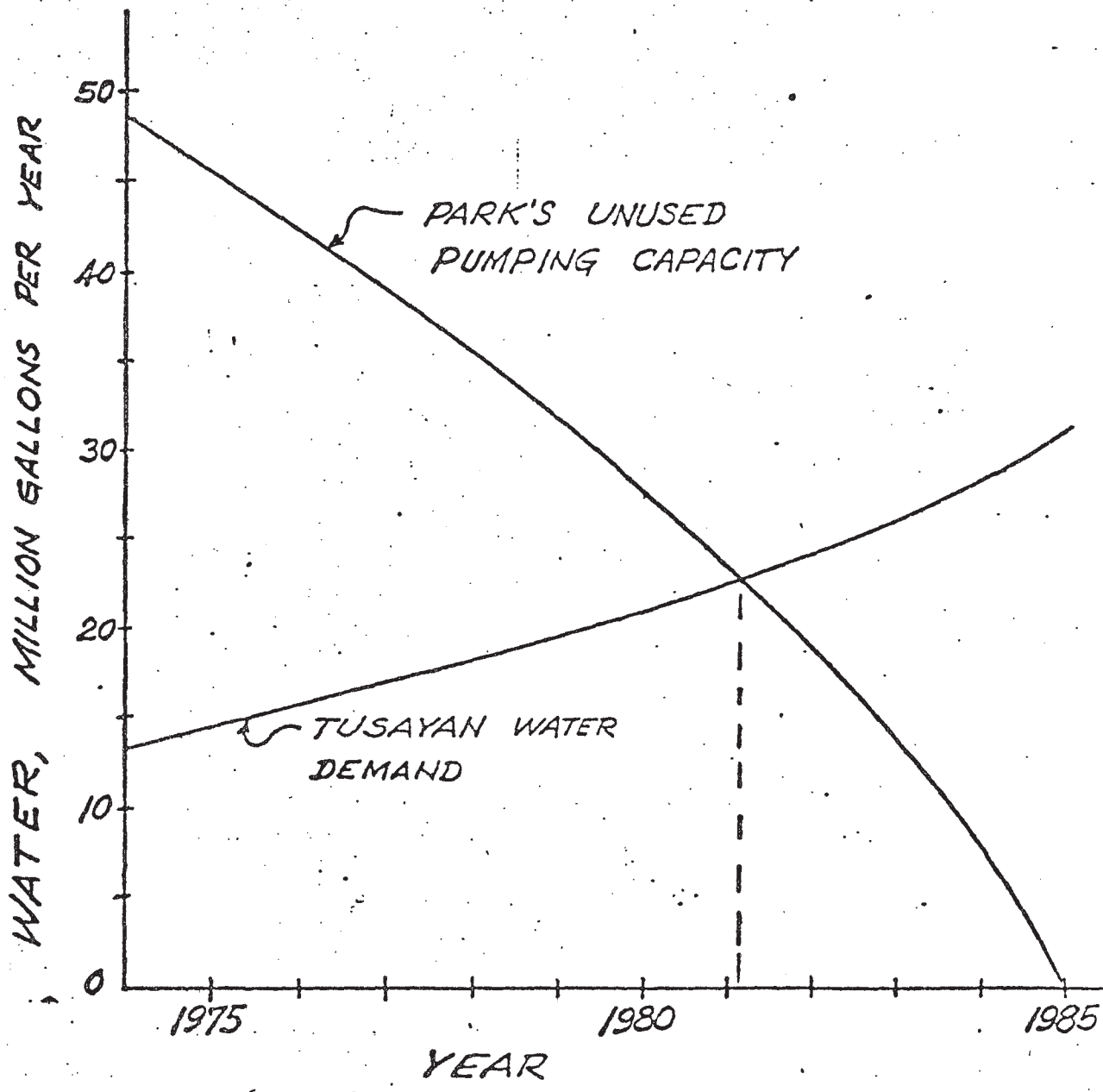


FIGURE 1

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Arizona Republic (Phoenix newspaper) - as above.

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- - - (Matteson) "A Report on Water Supply and Demand, South Rim, Grand Canyon National Park" 1973.

- - - General Files on Water Matters, 1967-1976, and Superintendent's files on related matters.

- - - Research Library history files on Water Supply, Rowe Well, etc.



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2. Hughes, J. Donald, "The Story of Man at Grand Canyon," picture caption on page 89.
3. Ibid., p. 154. Various other sources agree.
4. U.S. Forest Service, "Grand Canyon Working Plan, Uses, Information, Recreational Development" December 1916, paragraph 65-A. (In Grand Canyon Study Collection, Catalog Number 18555.)
5. Ibid.
6. Spencer, C. H., letter of January 11, 1917, in Grand Canyon Study Collection, Catalog Number 21073.
7. Metzger, D. G., "Geology in Relation to Availability of Water Along the South Rim, Grand Canyon National Park, Arizona," U.S.G.S. Water-supply Paper 1475-C, page 109.
8. Ibid. Other sources confirm.
9. Olson, R. L., "The Colorado River Compact," published by author, 1926.
10. Park Superintendent's files, "Water Supply & Demand."
11. Superintendent's Annual Report, 1926.
12. Garthe, Edmund C., and Wilfred C. Gilbert, "Wastewater Reuse at the Grand Canyon" in Journal Water Pollution Control Federation, Sept. 1968, Washington, D.C., page 1583.
13. Ibid.
14. Research Library files, "Yearly Visitation to Grand Canyon National Park" (1919-1972)
15. Hughes, op. cit., page 154.
16. Personal interview May 20, 1976, with Park Engineer Bill Matteson.
17. Superintendent's Monthly Report, August 1932.

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21. Park Files, L1425, 1954-55, draft.
22. Superintendent's Monthly Report, June 1954.
23. Research Library files, "Water and Power," undated press release from U. S. Steel Corporation.
24. Superintendent's Monthly Report, February 1958.
25. Superintendent's Memorandum No. 9-60, July 1, 1960, to All Residents of Grand Canyon Village.
26. Superintendent's Monthly Report, July 1960.
27. Park Engineer's Monthly Report, July 1960.
28. Park Engineer's Monthly Report, August 1960.
29. Personal interview May 20, 1976, with Park Engineer Bill Matteson, plus personal knowledge.
30. Superintendent's Monthly Report, August 1960.
31. Superintendent's Monthly Report, September 1960.
32. Park Engineer's files on Water Hauling.
33. Research Library files, "Yearly Visitation..."
34. Superintendent's Monthly Report, April 1964, and Superintendent's Memorandum No. 5-64, April 14, 1964, to All Park Residents and Visitors.
35. Park Engineer's files.
36. Superintendent's Monthly Report, June 1964.
37. Superintendent's Monthly Report, July 1964.
38. Park Engineer's files.

39. Superintendent's Monthly Report, March 1967.
40. National Park Service (Grand Canyon) Press Release No. 6, June 19, 1968.
41. Arizona Daily Sun (Flagstaff), May 25, 1964.
42. NPS (Grand Canyon) Press Release No. 5, January 18, 1965.
43. Superintendent's Memorandum No. 2-65, February 5, 1965, to All Park Residents.
44. Arizona Daily Sun, July 22, 1970, and Williams News, July 30, 1970. (Note: Later statements indicate this is excessive; 30% would be more accurate. LMH)
45. Various sources, including personal recollection. The figure of \$6 million is from Arizona Daily Sun, June 20, 1970; reports of the dedication are from the sources used in Note 44 above.
46. Superintendent Stitt's files; reports from Park Engineer.
47. CH2M Hill, "Water Supply and Wastewater Reclamation, South Rim, Grand Canyon National Park, Arizona, a Study for the National Park Service," 1973, page 3-3. Also, Superintendent's Memo No. 3-73, To All Residents, and Grand Canyon News Release #7, June 11, 1973, quoting Superintendent Merle Stitt.
48. Personal recollection, for lack of other sources.
49. Arizona Republic (Phoenix), October 4, 1965.
50. Park files, L54, "Water Matters."
51. Ibid., letter of December 7, 1966.
52. Ibid., letter of January 5, 1967, to Udall from NPS Director George Hartzog.
53. Ibid., letter of March 13, 1969, from N. E. Green and referral to G. Hartzog of March 18.
54. Ibid., letter, April 21, 1969, Hartzog to Udall.
55. Ibid., letter April 6, 1971, from City of Williams to Grand Canyon Chamber of Commerce.
56. Ibid., 1971.

57. Ibid., letter, April 30, 1971, Superintendent Lovegren to B. F. Quinn, Chairman, Committee for Petitioners.
58. Ibid., copy of Articles of Incorporation. Also, Arizona Daily Sun, legal notice, May 22, 1971.
59. Park files, L54; also Arizona Republic, May 14, 1971.
60. Park files, L54, as of dates listed.

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