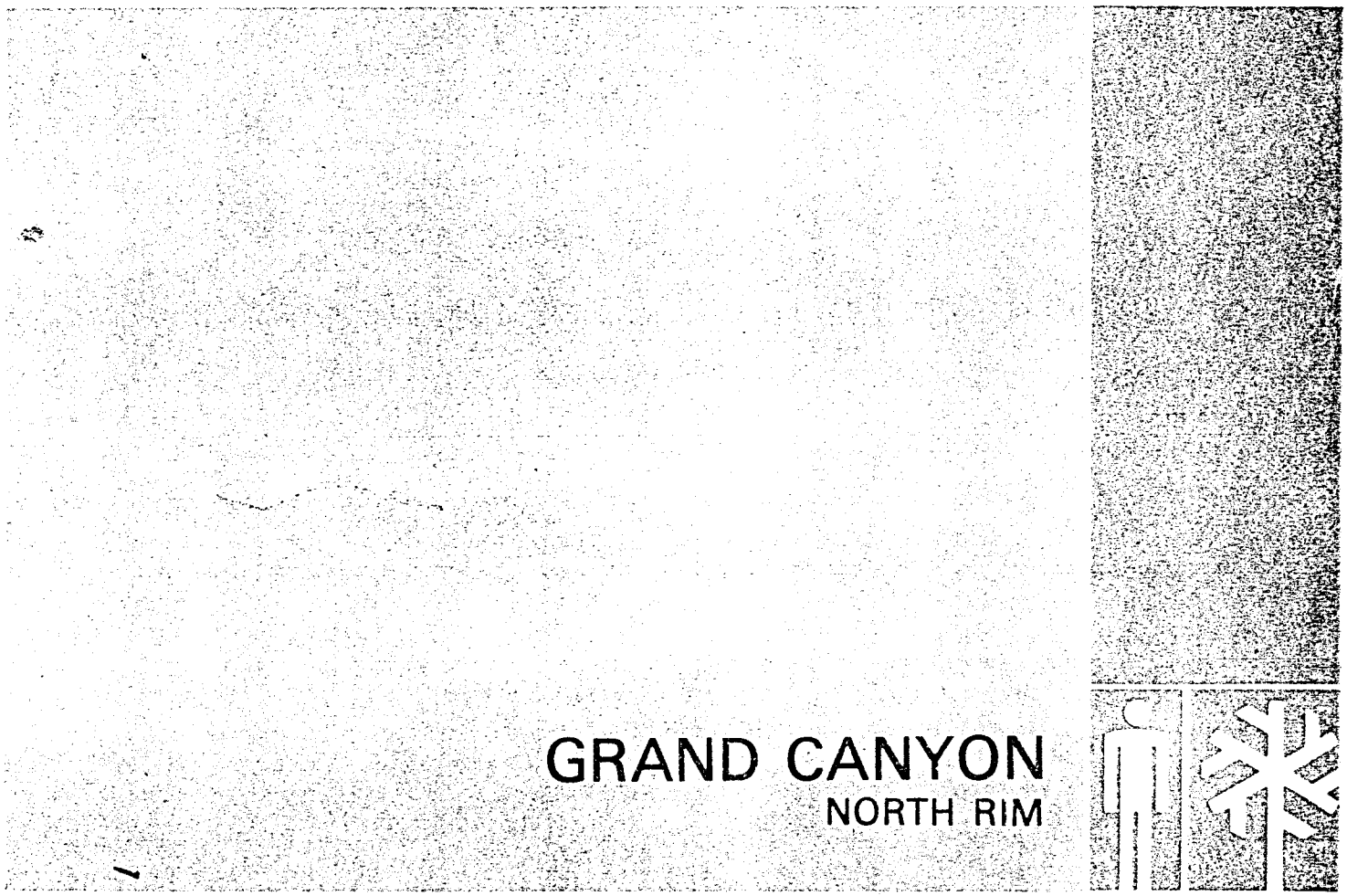
environmental assessment

water system improvement

march 1977



GRAND CANYON

NORTH RIM

NATIONAL PARK / ARIZONA

ENVIRONMENTAL ASSESSMENT

WATER SYSTEM IMPROVEMENT

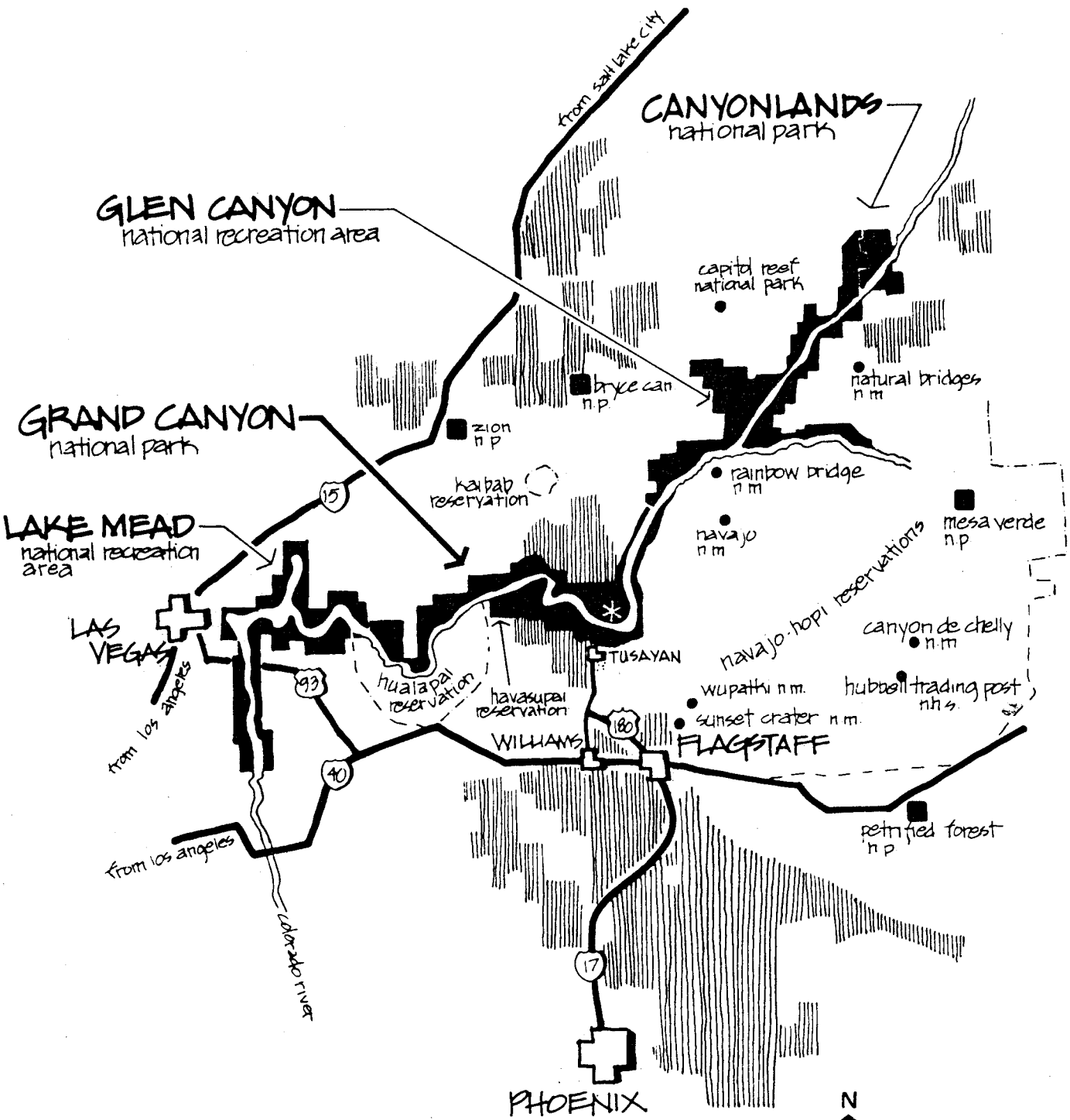
NORTH RIM

GRAND CANYON NATIONAL PARK

Prepared by
Denver Service Center
National Park Service
United States Department of the Interior

C O N T E N T S

M A P S



the region

north rim water system

grand canyon national park

united states department of the interior
national park service

113	40,047
DSC	SEPT 76

I. PROBLEM STATEMENT

The existing water system for the North Rim of Grand Canyon National Park is adequate as to the quality and quantity of water provided, but because the system is over 45 years old, it is in need of extensive rehabilitation. As visitation increases, the quantity of water that the system can deliver will not meet demands unless future park management decisions limit day visitation to a level within the delivery capabilities of the system. The present water system needs rehabilitation because it lacks reliability due to power interruptions, pipeline breaks, and mechanical failures that cause frequent shutdowns of pumping operations. Power outages will still be the cause for major disruptions, and replacement of pumps will take the longest time before service can be restored. The extremely adverse conditions under which repairs must be made and the absence of standby provisions also contribute to the system's undependability.

A. DESCRIPTION OF THE EXISTING SYSTEM

The existing water system consists of the following components:

1. Water supply from Roaring Springs Cave

The cave is located near the junction of Roaring Springs Canyon and Bright Angel Canyon at an elevation of approximately 5,200 feet. The water is of good quality, although during periods of high flow it contains a great deal of fine sediment that causes wear on mechanical equipment. The quantity of water is more than adequate to satisfy the present combined demands of both the North Rim and the South Rim Village, but if day visitation is allowed to increase at the same rate as in the last few years, with a proportional increase in water demands, the quantity of water available with the present system will be inadequate before the year 2000.

2. Transcanyon pipeline

The pipeline begins at the Roaring Springs intake and supplies water to the Roaring Springs powerhouse (residence for pump station operators), Cottonwood Campground, Phantom Ranch, Indian Gardens, Grand Canyon Village, and water points on a few trails. The 6- to 8-inch line follows the North Kaibab and Bright Angel Trails, except for a section between Phantom Ranch and Indian Gardens and above Indian Gardens to the South Rim.

3. Roaring Springs pump station

Located near the junction of Bright Angel and Roaring Springs Canyons, the pump station takes water from an overflow pipe originating at a diversion box at the mouth of the cave and by means of three positive displacement pumps transmits the water through the pipeline to the North Rim, a lift of about 3,500 feet.

The pumps were installed when the station was built in 1928 and each pump is capable of delivering 30 gallons per minute (gpm) at 1,690 pounds per square inch (psi). Each pump is powered by a 2,300-volt, 50-horsepower motor. The motors were overhauled in 1967 and are still in good condition. An operator must be present when pumps are running to ensure continuous operation and to stop pumps in case of problems. Consequently, the amount of pumping that can be done is dependent on the manpower available to monitor the pumps. Frequent mechanical failures due to wear of the moving parts cause shutdowns for repairs lasting several days.

A wood-frame, 12-foot by 12-foot helicopter pad is located at the pump station. The pad's size and the poor condition of the supports make it unsafe. Trees are beginning to block the normal approach path, and during windy conditions they pose a very serious flight hazard.

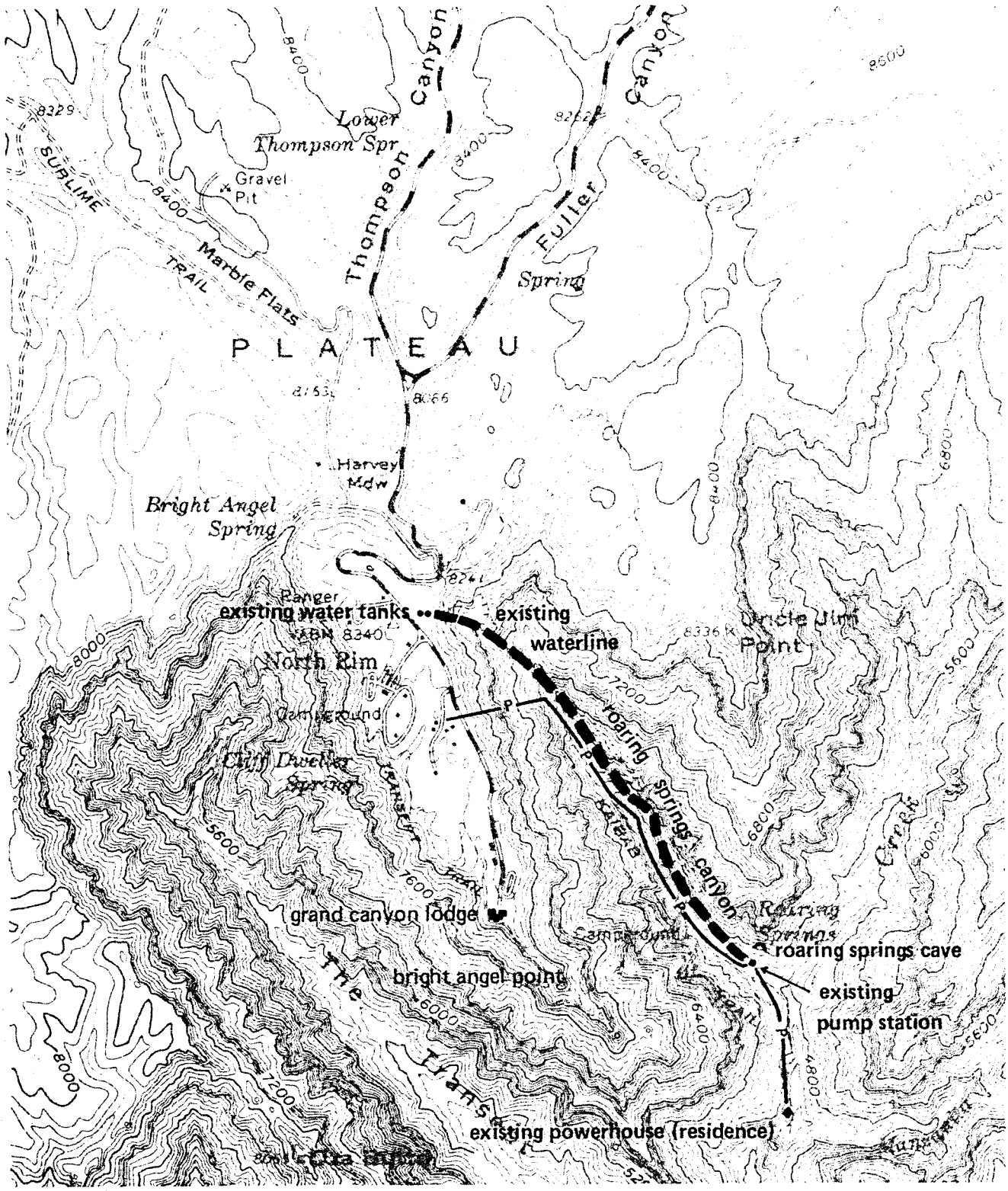
4. Roaring Springs waterline

This 3½-inch diameter steel pipe, which rises approximately 3,500 feet over a 12,500-foot length, transports water from the pump station up Roaring Springs Canyon to the storage tanks on the North Rim. It was constructed in 1928, and it is generally in good condition. Exposed portions of the pipeline are frequently damaged by falling rocks, and resulting breaks and leaks must be located and repaired by crews on foot and assisted by a helicopter. In many of the exposed sections, there are either too few supports or the supports are in poor condition; as a result, there is a noticeable movement of the pipe during pumping operations, causing it to wear against rocks.

5. Two water storage tanks

Located near the head of the Kaibab Trail on the North Rim, there are a 2-million-gallon storage tank and a 500,000-gallon tank. The 2-million-gallon tank, 93 feet in diameter and 40 feet high, was constructed of welded steel in 1963, and it is in need of repair due to structural failures caused by snow loads on the roof exceeding design loads and by rust inside above the high waterline. The 500,000-gallon tank, with a diameter of 47 feet and a height of 45 feet, was relocated from California to the North Rim in 1937 by the Union Pacific Railroad. It is constructed of steel panels with riveted and welded joints. The top is covered by a sloped roof of wood construction. The tank's interior surfaces are extensively corroded and the exterior surfaces show signs of small leaks and blistering paint. For these reasons, it is not feasible to repair this tank.

The existing storage capacity of 2.5 million gallons is adequate to meet current domestic and fire-protection demands and



existing system

north rim water system

grand canyon national park

united states department of the interior
national park service

113 | 40,049
DSC | SEPT 76

can provide up to 20 days of domestic service at current demand levels if the tanks are full when either the pumps or the pipeline is removed from service.

6. Electrical power system for the Roaring Springs pump station

Power is obtained by the National Park Service from the Garkane Power Association, Inc., facilities on Bright Angel Point. Power to the pump station is carried by overhead lines, which are owned and maintained by the Park Service and are approximately parallel to the pipeline route. The overhead system feeds the transformer substation at the powerhouse, then returns to the pumphouse. The power lines are strung on wooden poles that are old and rotting and, therefore, a hazard to the maintenance crews. Occasional interruptions in power occur when the lines become twisted or are broken by falling rocks, trees, or the weight of ice in the winter. Location and repair of the damaged lines is a difficult, time-consuming task, resulting in a shutdown of pumping operations for periods of a few days. No standby system is provided.

7. A potable water distribution system and sewage collection system

Constructed in 1928, this system provides domestic and fire-protection water. Major improvements have been the addition of a booster pump and 6-inch water main in 1936 for fire protection, the addition of waterlines in 1954 to serve the campground area, and water and sewer improvements in 1963 to serve the National Park Service headquarters area. The booster pump installed in 1936 is still in use, but the one installed in 1963 was never connected to the distribution system. A standby pump driven by a gasoline engine has been provided at each booster pump; the older standby is reputed to be operational, but the condition of the newer standby pump is unknown. The water pressure varies considerably depending on the storage tank level and service location.

As-constructed drawings indicate an average burial depth of 30 inches for waterlines in the existing distribution system, and therefore, it does not appear that they would be suitable for winter use. The heavy snow and low temperatures prevailing at this altitude during winter indicate a possible frost depth of 3 feet, sufficient to freeze small lines and larger lines if inactive.

The sewage collection system has undergone extensive rehabilitation, including replacement of two pumping stations, numerous manholes, and sewers, in addition to a new 110-gallon-per-minute secondary treatment facility. The system should be adequate for the next 15 to 20 years and adaptable to possible upgrading of treatment requirements.

An 8-inch reclaimed waterline with fire hydrants is being built from the new sewage treatment plant to Grand Canyon Lodge. This supplemental system is strictly for fire protection and includes a 300,000-gallon ground storage tank. Existing buildings have not been plumbed to use reclaimed water.

A pit toilet is located at the pump station, and there is a cesspool at the powerhouse residence.

8. Operator's Quarters

The existing quarters for the operator are such that separate bedrooms and baths are provided for two operators and their families, but common kitchen, dining, and living areas must be shared. A structural investigation of the building, which was constructed in 1927-28, has indicated probable damage by termites; and costs for replumbing, heating, rewiring, and interior remodeling would be comparable to constructing new quarters and demolishing the existing residence.

The structure is located in a hazardous zone and has a long history of rockfall and storm runoff damage from the cliff immediately behind it.

B. SUMMARY OF DEFICIENCIES

The existing storage tanks have the capacity to meet current needs, but the present condition of the tanks, especially the structural damage to the 2-million-gallon tank, indicates a need for immediate repairs. Because of the poor condition of the 500,000-gallon tank and increasing visitor demand, the storage reserve is reduced to the minimum, posing a threat of running out of water during major power or pumping failures. The 2-million-gallon storage tank is strictly for reserve capacity to compensate for long pumping outages and delays by providing gravity flow to the North Rim water system. This tank also provides water for higher demands resulting from an increased occupancy of the cabins, from an upgrading or replacing of standard cabins and other existing facilities according to master plan proposals, or from a projected increase in daytime visitor use. The existing 500,000-gallon storage tank is beyond its economic service life.

The poor condition of both tanks indicates an immediate need for new storage facilities because the 2-million-gallon tank must be taken out of service while repairs are made, and the 500,000-gallon tank cannot meet anticipated domestic and fire-protection needs during the repair period. The pumping rate cannot be increased due to hydraulic conditions. Pumping in excess of 20 hours per day would further advance the critical wear on the pumps.

The 44-mile overhead electrical power distribution system through Kaibab National Forest is subject to extended outage periods due to both the condition of the system and natural causes. Without power, pumps cannot be operated.

Other items that the system lacks include flow monitoring devices and security precautions at Roaring Springs Cave; adequate housing for operators; connection of all fire hydrants to reclaimed water storage; a method of sediment removal at the pump station; and activation of the unused booster pump on the rim to ensure a safe level of pressure for fire protection.

C. RELATED PROPOSALS

The Final Environmental Statement, Proposed Master Plan, Grand Canyon Complex (FES 75-97) was made available for public review in November 1975. The final master plan was approved in June 1976. The plan proposes that the North Rim area be managed to retain the existing quiet, relaxed atmosphere. Future developments would only improve the efficiency of existing facilities. If any replacement of existing lodging units was made, it would be accomplished without loss of aesthetic or environmental values. An additional 100 campsites is the only proposed expansion.

A negative declaration of impact was issued in June 1973 for an environmental assessment for a helicopter landing pad adjacent to Roaring Springs Cave in Roaring Springs Canyon.

An environmental assessment for a preliminary development concept plan for the North Rim was drafted in 1975, but was deferred pending approval of the master plan. The preliminary plan proposed reorganization and upgrading of existing facilities and development of not more than 100 new campsites. Although development capacities for the area were not set, no significant increase is expected.

A negative declaration of impact was issued for an environmental assessment for the sewage treatment plant and sewerage system for the North Rim in April 1974.

The Draft Environmental Statement, Proposed Wilderness Classification for Grand Canyon National Park (DES 76-28, July 1976) recommends that the North Rim developed area and the transcanyon corridor be excluded from wilderness designation. No conflict is anticipated between wilderness designation and the water system proposals.

Forms to nominate the Grand Canyon Lodge Historic District (including the Roaring Springs pump station) and the Cross Canyon Historic District to the National Register of Historic Places were prepared in May 1975, in compliance with Executive Order 11593.

II. DESCRIPTION OF THE ENVIRONMENT

A. DEVELOPMENT AND USE

1. Grand Canyon National Park

Grand Canyon National Park lies in the midst of a network of national parks and national forests, and it is one of four contiguous units of the National Park System that stretch for approximately 550 miles along the Colorado River, from the north border of Canyonlands National Park to the south border of Lake Mead National Recreation Area.

The North Rim of Grand Canyon National Park is relatively isolated. The long drives through the desert, which separate the North Rim from major population centers and principal transcontinental routes, act as a filter that limits visitation. The park is bordered on the north by the 500,000-acre North Kaibab District of the Kaibab National Forest, and beyond that by the desert environment of the Arizona Strip. The principal towns in the vicinity are Fredonia, Arizona (65 miles north of the park boundary), Kanab, Utah (73 miles north), and Page, Arizona (110 miles northeast). These towns have populations less than 5,000 and provide only limited visitor services.

The North Rim receives about 15 percent of the park's total number of visitors. Most visitors enter the park from the north through Fredonia along U.S. Highway 89, which intersects Interstate 15, a major vacation route from the Los Angeles metropolitan area. Access from the south is principally along U.S. 89, which originates south of Flagstaff, Arizona, and intersects Interstate 40, a major east-west vacation route. Although the North Rim lies just 10 air miles away from Grand Canyon Village, the two developments are 215 highway miles apart. To the east, U.S. Highway 160 is fast becoming a primary vacation route for travelers coming from the Rocky Mountains and the Four Corners area.

On the South Rim, Grand Canyon Village, with overnight accommodations for more than 3,000 people, has a more urban atmosphere than the North Rim. The village is connected to Bright Angel Point on the North Rim by the Kaibab and Bright Angel Trails, which provide access from the rims to the inner canyon for about 40,000 hikers and mule riders annually. There are 40 campsites at Cottonwood, 15 at Roaring Springs, 75 at Indian Gardens, and 75 at Phantom Ranch; all are limited by the permit system. In addition, Phantom Ranch has overnight accommodations for mule trips and hikers and provides full meals and snack bar services.

About 2,900 visitors can be accommodated overnight within 120 miles of the North Rim. Overnight accommodations are listed below:

Location	Capacity	Miles from North Rim
Kaibab Lodge	90	18
Jacob Lake	200	43
Cliff Dwellers	30	71
Fredonia	100	73
Marble Canyon	20	81
Kanab	1,000	82
Lees Ferry	32	87
Page	700	118
Wahweap	700	120

In addition to these accommodations, 50 campsites are located at Jacob Lake and 25 at De Motte Park in Kaibab National Forest.

2. North Rim

Most visitor use at the North Rim occurs within the visitor service areas and overlooks at Bright Angel Point, the overlooks at Cape Royal and Point Imperial, and the road corridors. Visitor facilities at Bright Angel Point include the Grand Canyon Lodge and 214 cabin rooms, the North Rim Inn and 41 cabin rooms, an 82-site campground, a 5-site group campground, a store, a laundry, a horse-and-mule riding concession, a gas station, and a public shower facility. The cabins can accommodate an average of 620 people per night. Because the North Rim is isolated and nearby accommodations are limited, many visitors who cannot stay in the park stay on the Kaibab Plateau on Forest Service lands.

Visitation to the North Rim varies on a year-by-year basis, primarily a result of whether there are late spring and early fall snowstorms. North Rim facilities and access routes are closed during the winter. In 1975, the North Rim received 420,058 recorded visits. Between May and October 1975, 38,729 visitors camped at the North Rim, and an additional 61,215 stayed overnight in the cabins. Based on these visitation figures, occupancy of the campground averaged 87 percent over the entire season, and the campground was usually full during the summer months. Occupancy of the rim cabins averaged 40 percent, but this figure is misleading because some of the cabins housed concession personnel and some of the cabins are so old that it is difficult to maintain them in a usable condition. Generally, the cabins were full during the summer months.

National Park Service residential housing at the rim includes 12 single-family units, 7 trailers for seasonal employees, and a dormitory for 8 people. In addition, 140 concession employees can be housed in a men's dormitory and a women's dormitory, each of which accommodates 70 people.

B. CULTURAL ENVIRONMENT

1. Prehistory

Apparently the first people who spent time in the Grand Canyon made split-twig figurines that have been found in caves below the rim. Dates for these figurines produced by the Desert Culture people range from 2,000 to 1,000 B.C. Although man's history at Grand Canyon began fairly early, there is no evidence of use or occupation from the time of the Desert Culture until A.D. 700.

Around A.D. 700, the term Pueblo I is used to refer to the Anasazi (Ancient Ones) because of a number of changes that occurred in the culture. Pit houses became smaller and deeper, and some appeared to have been used as ceremonial structures. Improved ceramic technology resulted in white pottery in addition to the earlier gray ware.

The Pueblo II period lasted from around A.D. 900 to 1100 and is marked by a great geographical expansion of the Kayenta. The canyon received a great population increase at this time, and hundreds of sites dating from this period can be found. Many sites are small surface pueblos with storage rooms and sometimes kivas. Various food procuring activities were conducted in the canyon's different environmental zones. Deer hunting was a major activity on the rims, while mountain sheep and rabbits were hunted below. Wild food plants were gathered on the rims as well as in the canyon.

Most of the people living in and near the canyon seem to have abandoned the area by A.D. 1150 or 1200. This probably was due to changes in the climate that no longer made the area well suited for intensive farming. The appearance of a new group from the west, the Pai-speaking Cerbat, may have been another reason for this exodus. People abandoned the North Rim to move to the South Rim and occupied sites such as the Tusayan Ruins during their movement out of this area.

2. Archaeological Surveys

A number of site surveys have been conducted in the North Rim region. However, much of this work has been of a reconnaissance nature and does not represent an accurate evaluation of the archaeological resources. The first systematic survey was conducted by E.T. Hall at Walhalla Glades in 1937. During 6 weeks of surveying, a total of 273 sites were located in an area of 6 square miles. The Walhalla Glades area was resurveyed by D.W. Swartz during the summers of 1969 and 1970 (Swartz, 1969; U.S. Department of the Interior, National Park Service, 1970); several sites were tested, and five sites were fully excavated. These have been the only comprehensive studies of any of the sites on the North Rim, except for very brief surveys on Powell Plateau by E. Haury in 1930 and Dr. Robert Euler, park archaeologist, in 1971. Habitation sites on the North Rim consist of surface pueblos ranging in size from

small rooms, either circular or rectangular, to larger, more complex structures. These sites occur almost anywhere below an elevation of 8,100 feet in the ponderosa/grassland area. Above this elevation, there are a number of small deposits of chipped stone suggestive of early Basketmaker II campsites. In addition to habitation sites, granary structures, storage cists, and features related to agricultural terracing and erosion control have been reported. Most of these sites date from A.D. 600 to 1200, during which time the region was inhabited by Anasazi agriculturalists.

A 1974 archaeological survey conducted by the Museum of Northern Arizona did not find any archaeological sites at or near the Roaring Springs pump station (USDI, NPS, 1974; the nearest site, NA12825, is situated about ¼ mile south of the Kaibab Trail; however, it does not meet National Register criteria). A 1975 survey on the North Rim was conducted by Dr. Euler; he discovered no sites at or adjacent to the proposed water storage development on the rim nor any sites in the other proposed development areas. In June 1976, Dr. Euler inspected the Roaring Springs pump station area and reported that no archaeological sites or other cultural remains were found in the area; he recommended archaeological clearance for the area. Clearance to proceed with construction activities was provided by the Western Archaeological Center, July 1976.

3. Historical Resources

There are no properties located on the North Rim or in the inner canyon listed on the National Register of Historic Places as published on February 1, 1977, in the Federal Register. The South Rim Village Historic District is being nominated to the National Register by the Western Region of the National Park Service, but it is at least 10 miles from the proposed development. In May 1975 a historian and an architect from the National Park Service's Denver Service Center conducted a site survey in accordance with Executive Order 11593 along the transcanyon corridor and at the North Rim. As a result of their investigations, two historic district nominations are being prepared. One of the proposed districts encompasses the Grand Canyon Lodge, cabins, and other affiliated structures, including the Roaring Springs pump station. The other district is the Cross Canyon Corridor District. The Arizona historic preservation officer has not identified any other potential National Register nominations.

The Roaring Springs pump station and power generating house were constructed in the winter of 1927-28 by the concessioner – Utah Parks Company, a subsidiary of Union Pacific Railroad – to supply the arid North Rim with a reliable source of water and power. At the time it was built, Utah Parks claimed that the Roaring Springs facility lifted water to a higher elevation than any similar project in the world. This system continued to provide

water and power for the Grand Canyon Lodge complex for amost 40 years. A flood destroyed the dam and penstock in December 1966, but the Roaring Springs facility was repaired to service the North Rim water needs. Commercial power had been brought in from Jacob Lake 4 years earlier.

C. NATURAL ENVIRONMENT

1. Geology and Topography

The North Rim is a continuation of the Kaibab Plateau, one of the highest of the several Colorado Plateaus in southwestern Colorado, Utah, New Mexico, and northern Arizona. This plateau is underlain by a horizontal layer of Kaibab limestone approximately 250 feet thick. The sites for the alternatives are located on the narrow Bright Angel peninsula, which juts into Grand Canyon from the North Rim, and in Roaring Springs Canyon to the east. The elevation ranges from 8,300 feet at the rim to 4,600 feet at the pump station.

Bright Angel Point is fairly level, sloping slightly to the south and toward the canyon rims on both the east and west. The crystalline and coarse-textured soils derived from the Kaibab limestone are classified as grayish-brown podzolic soils. Although they are shallow, their coarse texture makes them very permeable. Mulch generally occurs only where there is an accumulation of pine needles or debris from trees.

Roaring Springs Canyon exposes the Hermit shale and the Supai formation of limestone and sandstone at the higher elevations, and the Redwall limestone, Temple Butte limestone, and Muav limestone in the vicinity of Roaring Springs Cave.

The central and eastern portions of the canyon are in areas of low seismic action. The probability of a destructive earthquake is low. Three minor earthquakes have occurred during this century; however, damage has been negligible. There has been no activity on the Bright Angel fault for several thousand years.

2. Climate

The climate of the North Rim is typical of that found at 8,000- to 9,000-foot elevations in many mountainous regions of the western United States. Winters are cold, with short, high-intensity storms. The average yearly precipitation, as recorded at the North Rim Ranger Station for a 30-year period, is 25.3 inches; the mean monthly temperature is 43.1 degrees Fahrenheit. Since 1973 weather records have been kept at Roaring Springs powerhouse between April and October when the pumping station is in operation. The 2-year average rainfall recorded for 7 months was 5.2 inches. The temperature range was from 38 to 98 degrees during the same period.

3. Vegetation

The forest surrounding the North Rim development is part of a montane forest, best characterized as a ponderosa pine/aspen association. At this elevation, white fir and spruce subdominants are beginning to invade this association. The forest is open, with scattered perennial grasses and forbs.

Warm, drying canyon updrafts at the rim provide a suitable environment for species such as pinyon pine, generally found in warmer, drier, lower environments. On the upper west-facing slopes of the canyon rim looking into Transept Canyon, this situation produces an abrupt change in species from those characteristic of semiarid climates to those characteristic of moist, humid areas (Merkel, 1962; Rasmussen, 1941; and Cooper, 1960).

Roaring Springs Canyon has abundant aspen and ponderosa pine at the upper elevations. Juniper trees and pinyon pines are found at slightly lower elevations. In the 5,000- to 6,000-foot elevations, manzanita and redbud are found, becoming predominant at about 5,000 feet. In the 4,000- to 5,000-foot elevations, agave and cactus of the prickly pear and barrel varieties are much in evidence; where water is present, some cottonwood and pinyon pine are found.

Some rare species of vegetation are known to exist in the Roaring Springs Canyon area. The pump station site was studied by park botanists and the only threatened species seen, though not positively identified, was Agave utahensis var. kaibabensis. Positive identification may have to wait until the plant blooms - once every 13 years. Prior to any construction, the park botanist should identify any rare plants to be avoided, or if large enough, to be transplanted to assure their safety. Plant lists are included in both the May 30 and July 22, 1976, reconnaissance reports.

4. Fauna

During the last 2 million years, the canyon and the river have been a barrier to the dispersal of some mammals. Another factor limiting dispersal has been climatic changes - for example, increased precipitation, periods of cold, and prolonged warm, dry periods during the Pleistocene epoch. Nevertheless, all but 11 species found on the North Rim are also found on the South Rim, the Kaibab squirrel being the most notable exception.

Some mammals common to the North Rim include the Kaibab squirrel, porcupine, red squirrel, Uinta chipmunk, deer mouse, mule deer, and bobcat. More complete descriptions of the total faunal representation are given by Bailey (USDI, NPS, 1939), Hoffmeister (1971), Dodge (1938), Rand (1958), and Gehlback (USDI, NPS, 1966).

Birds that can be classified as common or abundant on the North Rim include the sharp-shinned hawk, red-tailed hawk, sparrow hawk, blue grouse, mourning dove, great-horned owl, white belted swift, black-chinned hummingbird, broad-tailed hummingbird, red-shafted flicker, Williamson sapsucker, hairy woodpecker, violet-green swallow, Steller's jay, common raven, pinyon jay, Clark's nutcracker, mountain chickadee, common bushtit, white-breasted nuthatch, red-breasted nuthatch, pigmy nuthatch, rock wren, robin, hermit thrush, western bluebird, mountain bluebird, ruby-crowned kinglet, western tanager, black-headed grosbeak, evening grosbeak, rufous-sided towhee, green-tailed towhee, Oregon junco, gray-headed junco, chipping sparrow, and song sparrow.

The tiger salamander is found on the North Rim; however, it is found only in the vicinity of sinkholes such as Greenland Lake. No other amphibians are common. In the reptile class, the most common lizards in the area are the collared, tree, short-horned, sagebrush, fence, desert spiney, plateau, whiptail, and western skink varieties. Snakes include the gopher, garter, king, and rattlesnake.

III. DESCRIPTION OF THE ALTERNATIVES

A. NO ACTION

1. Description

Under this alternative, the existing system would continue to be used in its present condition, except that the damaged 2-million-gallon water tank would be repaired; the 500,000-gallon tank would continue in operation, but no repairs would be made. (A project to repair the larger tank is underway.) It is assumed that the reclaimed water system for fire protection would become operational.

2. Environmental Impacts

Continued use of the system in its present condition would perpetuate problems of unreliability due to unpredictable shutdowns for mechanical or electrical repairs. The waterline would continue to be exposed to damage by falling rocks and trees or by high winds and ice. Repair work causes minor environmental impacts because supplies must be delivered by helicopter to the work location and most areas are accessible only on foot. The inaccessibility, however, has resulted in unused equipment and materials being left at repair sites. If the system was shut down at a time when the storage tanks were at a low level, there might be insufficient water to meet demands, especially during the summer.

The transcanyon pipeline as well as the North Rim water system are plagued by sediment in the water, especially during periods of high runoff from Roaring Springs. The amount of sediment in the line has caused the park to utilize a settling tank system at Indian Gardens, which causes a loss in natural head and an increase in pumping loads. Even with the use of the settling tank, there are frequent pump failures caused by sediment loads and resulting in costly repairs. The age of the pumps at the Roaring Springs pump station requires full-time supervision and lubrication during operation. Parts must be made to order (none are stock items), requiring time-consuming delays.

3. Mitigating Measures

The 2-million-gallon water tank would be repaired to mitigate impacts of a shutdown caused by the condition of the tank.

The park would prohibit replaced and unused parts from being left at the work sites.

4. Unavoidable Adverse Impacts

The existing system would require repairs with increasing frequency, causing greater impacts on the environment. If a major breakdown occurred during the summer, and could not be repaired

quickly, the North Rim would have to be closed to visitors, with resulting economic loss to the concessioner and the government. Noise and visual intrusion by the helicopter during repair operations would be unavoidable.

5. Short-Term/Long-Term Relationships

The short-term effect of the no-action alternative would be to stabilize water system capabilities on the North Rim to permit visitor facilities to remain in operation; however, a major breakdown could force closure of facilities while repairs were underway. When the 500,000-gallon storage tank is eventually removed, the site would be restored to its natural condition. Continued environmental impacts would result from frequent repairs due to the unreliability of the existing system.

6. Irreversible and Irretrievable Commitments of Resources

All commitments of sites have been made; these sites could be restored to a natural condition at any time in the future. Money and materials spent in upgrading the 2-million-gallon storage tank would be irretrievably committed.

B. REHABILITATION OF THE EXISTING SYSTEM (proposed action alternative)

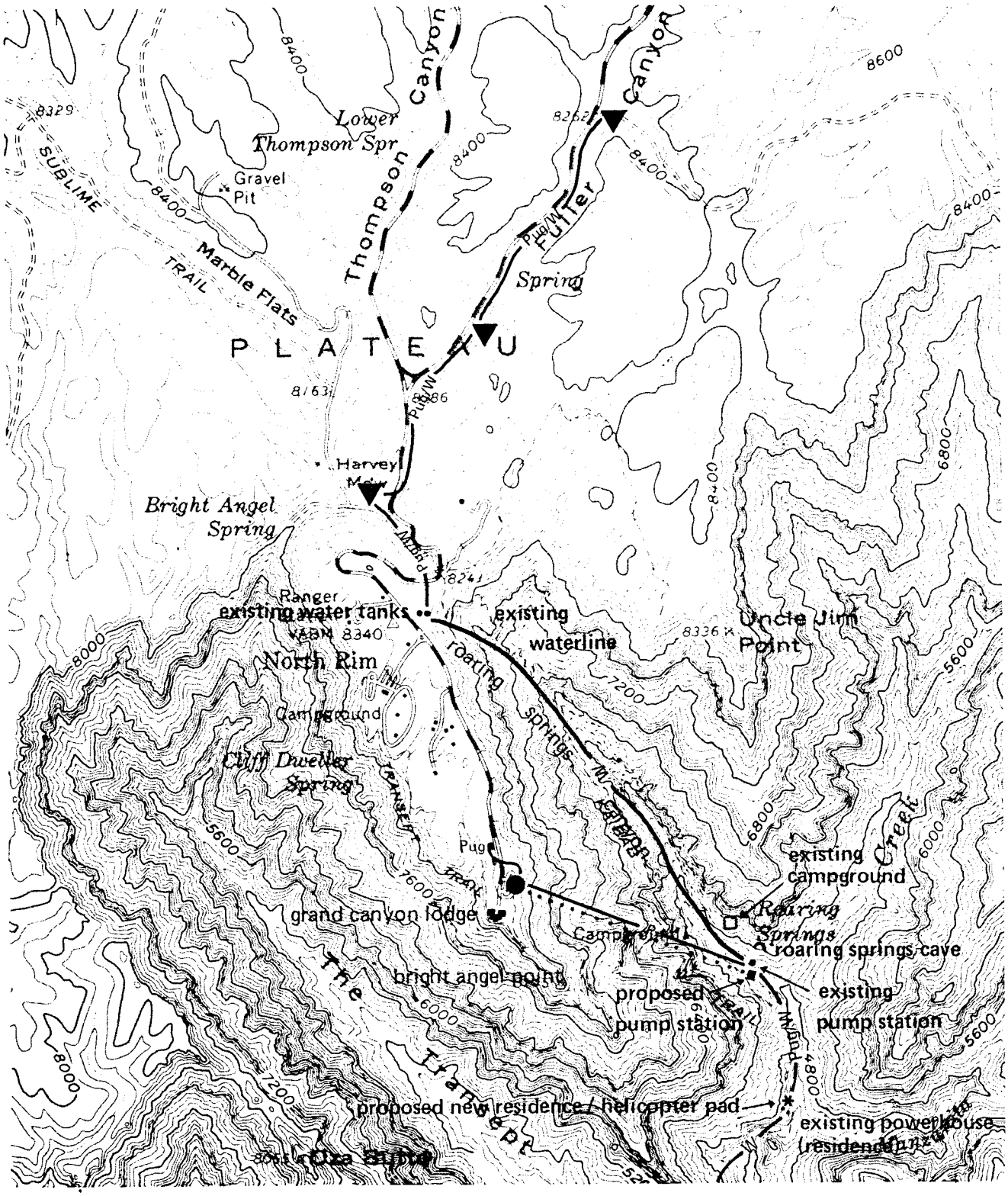
1. Description

This alternative would increase the total amount of water delivered to the North Rim storage tanks only to meet the demand level stipulated in the master plan. Total production would depend on the economics of pipe/pump capacities and operating time. Work would be accomplished in two phases: In Phase I, 110 gpm would be pumped for 82 percent of the pumping time per month; under Phase II, the rate would be increased to 150 gpm for 66 percent of the time per month (including reclaimed water pumped for fire protection). Net storage would be increased from 2.5 million gallons to 4 million gallons for potable supply. It is recommended that work to be done on the North Rim be performed during the off-season to minimize impacts on visitors.

a. Phase I

The first phase would consist of the following actions:

(1) Rehabilitation of the existing 2-million-gallon storage tank, including piping, modifications, interior painting, and cathodic protection. The top of the existing 2-million-gallon water tank was removed in the fall of 1975 to prevent further structural damage from snow load. Temporary protection of the water tank from contamination has been effected by a pressure sand filter, with temporary pumps on the line between the 2-million-gallon and 500,000-gallon tanks.



alternatives

north rim water system
grand canyon national park

N

0 1/2 1 mile

▼ potential deep-well site

● potential whipstock site and hole alignment

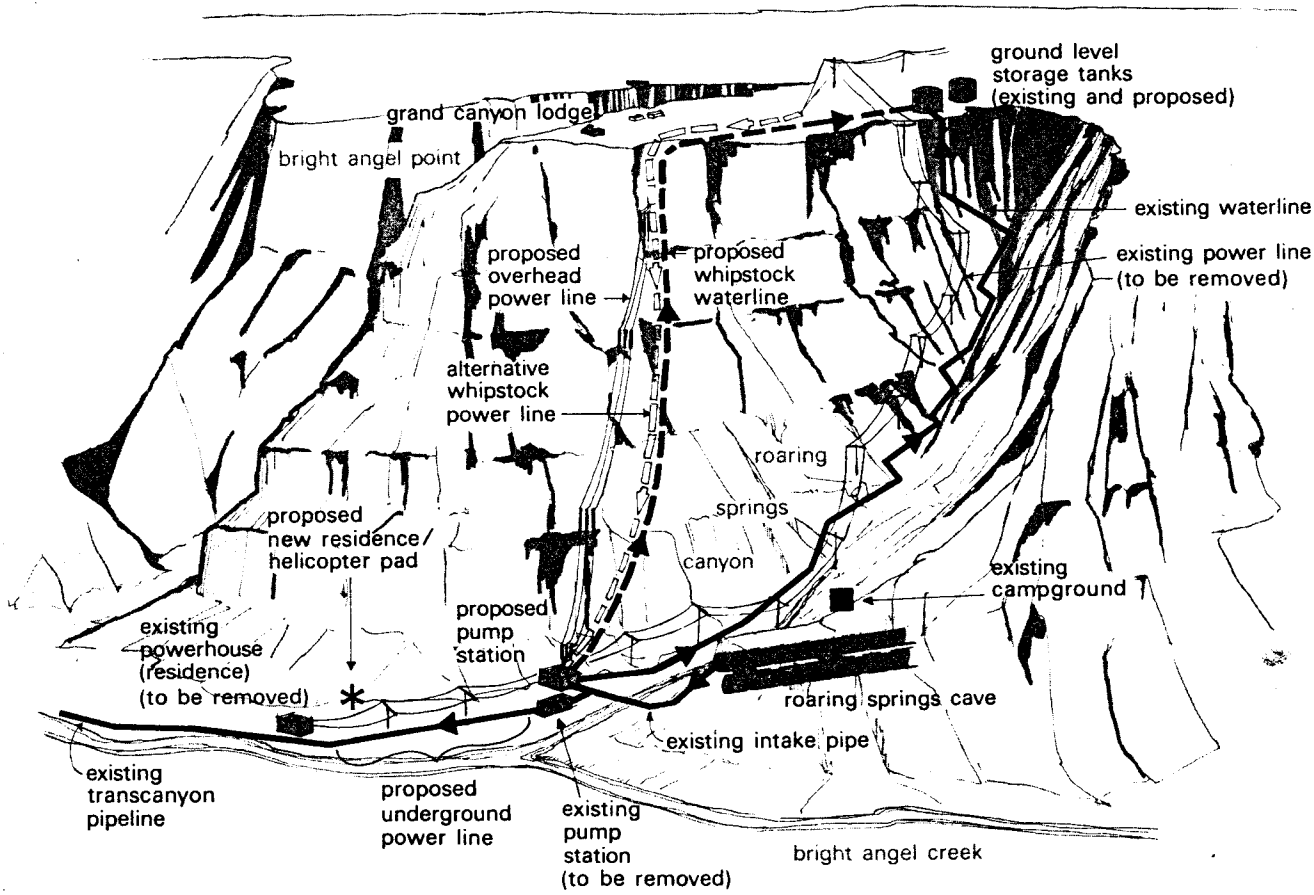
—— P —— overhead power line

—— Pug —— underground power line

—— W —— waterline

united states department of the interior / national park service

113	40,048 A
DSC	FEB 77



proposed action and whipstock power line alternative

north rim water system

grand canyon national park

united states department of the interior/national park service

(2) Construction of a new 2-million-gallon storage tank on the North Rim, including piping modifications. The proposed new 2-million-gallon water storage tank, approximately 90 feet in diameter and 40 feet in height, would be constructed immediately northwest of the present chlorinator and hydropneumatic pump building. The tank would be constructed of steel painted to minimize the visual intrusion. (The existing 500,000-gallon tank would be eventually removed after the new tank is in operation.)

(3) Construction of a new Roaring Springs pump station. The new pump station would include a new building, new pumps, relocated chlorinator, alarm system, and desanders. The pump station would contain approximately 1,500 square feet and be 12 feet to rooftop. The building would be designed with a helicopter landing pad adjacent to it. A tentative location for the new building would be immediately behind the existing pump station, farther up the slope out of the flood-hazard zone and in the general area of the existing wooden helicopter pad. The building would be designed for maximum ventilation without air-conditioning equipment. Some loose boulders upslope from the pump station might require anchoring for safety.

Two new pumps, each capable of handling the design pumping capacity, would be installed to provide 100 percent standby capacity. If the existing pipeline was reused, a pumping rate of approximately 110 gpm would be recommended, based on the line's practical hydraulic capacity.

A liquid cyclone desanding system would be provided for removal of suspended sediment from the Roaring Springs water prior to being pumped through the transcanyon pipeline to the South Rim or to the North Rim. The desanders would be capable of capturing more than 95 percent of the sediment with a size greater than 250 mesh (63 microns). Actual removal efficiencies and head losses (about 30 to 40 psi) would depend on the specific total flow rate of the combined North Rim and transcanyon flows that passed through the desanders. Blowoff of collected sediment would be intermittent and could be manually or automatically controlled. The desanders could be bypassed during the winter if it was determined that sediment loadings in the intake water were not significant. Such bypassing would eliminate requirements for regular maintenance and blowoff of sediment, thereby obviating the need during the winter for electrical power and resident operation. The sand and silt sediment removed would be returned to Roaring Springs Creek.

A new 20- by 25-foot steel structure with a wooden deck, or an earthfill pad of similar dimensions with wooden or Cor-Ten type cribbing for retaining walls on a 40 percent slope, would replace the existing helicopter pad near the pump station. Helicopter pad safety features would include a bright orange sphere

placed on the lower wire at tower D and a wind direction indicator on the pump station roof. Trimming of a large cottonwood across the stream and two to four pinyon and juniper trees north of the dry wash would be required. Grading to provide for building, drainage, walkway, and helicopter rotor clearance at the pump station would partially disturb approximately 6,000 square feet in this area.

The Roaring Springs campground, located in Roaring Springs Canyon approximately 1,000 feet northwest of the pump station, would be reserved for contractor personnel staying overnight in the canyon during construction. The contractor would provide a maximum of two tent cabins, a permanent water service and containerized sewage unit, and a second lean-to for workers (there is an existing lean-to). The permanent facilities would be left intact for future use by campers.

A system of containerized units would be provided to collect and transport refuse and human waste to the North Rim for treatment. Human waste from the pump station and Roaring Springs campground would be kept separate from refuse from the quarters and pump station.

(4) Construction of a new residence with efficiency apartment at the powerhouse site. A new 2-bedroom quarters (900 square feet) for the pump operator and his family would be constructed near Bright Angel Creek and west of the helicopter pad; it would include an information window and unisex toilet for visitors. A six-bunk overnight efficiency apartment (680 square feet) for trail crews, relief operators, maintenance crews, and research teams would be included in the same building. A small storage building (160 square feet) would be provided for maintenance materials. The wood-frame buildings would be located away from the cliff hazards and immediately north of the existing residence. The new buildings would have comparable architectural features to the existing residence. The buildings and utilities would be located above the known high waterline of the recent 700-year flood.

A low-flush sanitary system with a septic tank and absorption field would be provided above the floodplain. The soil is suitable for percolation. Accumulated sludge would be containerized for transport to the North Rim sewage treatment plant.

(5) Modification of the Roaring Springs intake. A modified intake would provide less disturbance of sand and water and would correct the existing situation where suspended sediment is funneled into the intake pipe. Excess flow would pass over the new weir dam at the mouth of the main cave, and a drain line in the bottom of the main channel dam would allow sediment removal and drainage of the intake area as necessary. A suspended catwalk would provide access for maintenance.

A direct-reading, in-line flow meter upstream of the existing diversion box would record the total flow being diverted. Weir (flow) readings at Roaring Springs Cave would be taken to provide total flow rates. An access platform and gates and fencing would prevent public access. The chlorine gas line from the pump station to the point of injection at the diversion box would be used when power was not available; otherwise, chlorination would be accomplished at the new pump station.

(6) Rehabilitation of sections of the Roaring Springs waterline to the North Rim. Repair crews would first repair key pipe supports and other identifiable problem areas. Pipe supports would be increased in number and designed to provide better support. Long spans of unsupported pipe would have to be braced or rerouted. Approximately 40 rock piers, 80 anchors, and 60 cables would have to be repaired or replaced. Approximately 20 supports would be added, principally in the area where the pipeline passes through the Redwall limestone and the Muav formations. A corroded section of pipe approximately 200 feet long located above Roaring Springs campground would be replaced with new pipe with corrosion-protective coating. Materials other than natural materials used would be selected for compatibility or painted to match the natural terrain.

(7) Construction of a new electrical power distribution line to Roaring Springs. A new electrical line would include an aerial line from near the Bright Angel parking lot to the Roaring Springs pump station, similar to the power service at Indian Gardens from Powell Point Mine. The upper terminus would be at the transformer bank near the men's dormitory and would be placed underground to a point east of the parking lot near the top of the Toroweap formation, where overhead lines and poles would be obtrusive to visitors on the rim or trail. From this point down to the pump station, the line would consist of three strands of three-phase cable – approximately ½ inch in diameter, with a steel core, and spectrally treated aluminum conductor – suspended from poles (one pole per strand). The horizontal distances of the three spans, from upper to lower, would be approximately 2,200, 1,450, and 1,300 feet. Two helicopter pads, each 12 feet square, would be built at the two intermediate pole locations in order to facilitate the movement of workers and materials during construction; the pads would be of either wood or earthen fill and cribbing and would be left for future maintenance work. The Roaring Springs terminus would be placed underground.

A new underground armored power cable and a separate control circuit cable approximately 3,250 feet long would be placed alongside the 8-inch transcanyon pipeline between the pump station and new residence. This would provide a reliable power source to the residence along with necessary communication, alarm, and monitoring circuits for pump station operations. The new line would consist of a 2½-inch nominal diameter power cable for 25 kilovolts, and the control circuit would be approximately 1.1-inch nominal diameter.

(8) Removal of existing powerhouse residence, storage building, power lines, and pump station. The removal of the residence and pump station would be accomplished in accordance with section 106 of the National Historic Preservation Act of 1966 and pertinent National Park Service policies. The existing power lines, poles, transformers, and appurtenances would be dismantled. The sites would be landscaped and restored to natural conditions with native vegetation. Material that could not be used in the canyon would be removed to the North Rim for disposal. Availability of funds would determine whether part or all of this action could be accomplished under Phase I (otherwise, it would be accomplished during Phase II).

b. Phase II

Phase II actions would depend on future funding and would probably be implemented within the next 5 to 15 years. The major Phase II action would be construction of a whipstock waterline. The existing canyon-routed pipeline would be abandoned and replaced by a drilled and cased hole. A whipstock hole (about 12 inches in diameter) would be drilled down from the lodge area on Bright Angel Point, and it would be angled to exit from the canyon wall in the vicinity of the Roaring Springs pump station. The hole would be cased with steel pipe and pressure grouted after placement, making it suitable for high pressure pumping. The inside diameter of the casing would be approximately 8¾ inches.

The best location for drilling would be the parking area just north of Grand Canyon Lodge. Several other areas farther back on Bright Angel Point are possible, but because of increased drilling distances they are not recommended. A working area of 1 acre would be required at the drilling site. Drilling would require about 4 months and could be accomplished during the winter, if necessary, to minimize impacts on park visitors.

2. Environmental Impacts

Phase I of the water system rehabilitation would have minor to moderate effects on the natural environment. Impacts would be confined primarily to the sites of the pump station, the new water tank, the existing waterline alignment, the electrical system, and Roaring Springs campground. Water quality would be improved due to the additional facilities to reduce sediment and would meet the primary drinking water standards, as required by the Safe Drinking Water Act (Public Law 93-253). Desander drawoff would be returned to Roaring Springs Creek.

Impacts resulting from construction of a new pump station at Roaring Springs would be essentially confined to the site. The design of the structure would ensure minimal visual impacts from the Kaibab Trail. Removal of vegetation, including some small trees and hazardous boulders, would be necessary. Excavation would be required for foundations and to recess the structure into the site. Some disturbance of wildlife might occur, but because the existing pump station already impacts an adjacent site, it is unlikely that any

animals depend on the proposed site for life support. No threatened or endangered animal species would be affected, nor would those plant species considered for threatened or endangered status be disturbed, except possibly one species of agave (not yet positively identified) within the 200-foot-square pump station site.

Impacts of construction would be temporary; they would be visible to visitors on the trail but only from Bright Angel Point on the rim. Construction of the helicopter pad would not involve removal of any major trees nor would it increase the disturbed area at the site. Safety provisions would necessitate trimming of a large cottonwood across the stream and two to four pinyon and juniper trees north of the dry wash. About 6,000 square feet of area at the pumphouse pad would be partially disturbed for building, drainage, walkways, and helicopter rotor clearance.

The new pump station would require less than full-time supervision, and consequently, there would be a reduction in the number of operating personnel required to live in the canyon. The desanders proposed would affect the transcanyon pipeline and pumping equipment by reducing pipe erosion and pump repairs caused by sediment. The energy requirements for the Indian Gardens pumps would be reduced by utilizing approximately 350 feet of net pump suction head now lost at the Roaring Springs pump station.

Construction of a new residence at the powerhouse site would disturb approximately 1/3 acre of land, including a septic tank system, utility lines (including a waterline), and access trail. The new residence would be an additional intrusion in the Roaring Springs powerhouse area. The structure would, to some extent, be visible from the Kaibab Trail. No adverse effect is anticipated on water quality. The new underground power line and control circuits from the pump station to the new residence would be placed alongside the existing 8-inch waterline or fastened to the pipe to minimize environmental and visual disruptions.

Modification of the Roaring Springs Cave water intake would not destroy plant life or disrupt wildlife permanently. Access protection would allow free discharge of water during periods of high flow, as well as prevent entry and possible vandalism to the water supply by unauthorized persons.

Rehabilitation of the existing pipeline would have environmental impacts similar to those occurring now for normal maintenance, but of greater magnitude. Some destruction of bushes and ground cover during repair operations would be inevitable, as well as noise and visual intrusion of the helicopter used to carry men and materials.

Construction of a new aerial power line, consisting of three spans, would take place between a point below the Grand Canyon Lodge parking lot and the pump station. Impacts on soils or vegetation would be restricted to areas where the cable was put underground or where poles

were required to support aerial wires, thus minimizing physical environmental impacts. The construction of new pole supports and anchor guys would necessitate the removal of some trees and bushes, but only in very small areas at widespread locations. The poles would blend in with the abundant trees at higher elevations, but at lower elevations, where vegetation is lower and sparser, the poles would be more noticeable. The existing wires are almost lost in the immensity of the canyon, but if they are seen from the trail, they detract from the enjoyment of the natural environment. New power lines would have a greater localized visual impact than existing power lines. (The existing lines are visible from about 4 miles of the North Kaibab Trail.)

Some scarring of the ground by trenching activities for the new power line, including those for construction of an access, might be visible from the trail or roadway on top. Noise levels would be high between Roaring Springs and the North Rim during construction. Conductor and helicopter access clearance would necessitate cutting approximately 10 ponderosa and 2 pinyon trees.

Because the Roaring Springs water system is located in the Grand Canyon Lodge Historic District, which has been recommended for nomination to the National Register of Historic Places, removal of the powerhouse residence and pump station would result in the loss of these historic features. Other cultural resources, such as archaeological sites, would not be affected. Due to distance and existing forest screening, construction of the water storage facilities would have no impacts on North Rim cultural resources.

Construction of the whipstock waterline during Phase II of the project would result in minor disturbances to the natural environment. Vegetation would not need to be removed for drilling operations because the parking area could be used. Some damage to vegetation could occur as a result of carelessness during construction. Wildlife in the area would probably change their habits because of the noise and activity of the construction, and perhaps many would leave the area permanently because of the long and continuous nature of the disruption.

The drilling rig, which would be similar to those used for oil wells, would require about 1 acre for operation and for storage of the drilling fluid. The drill would run continuously, day and night, for 3 to 4 months to complete the hole. If drilling was done during the winter, impacts on visitors would be minimized because the drilling site closest to Roaring Springs is the parking area near Grand Canyon Lodge. If work was carried out during the visitor season, the parking area would have to be closed to the public and temporary parking provided approximately ½ mile from the lodge, which would inconvenience lodge guests. In addition, the noise and visual impacts of the drilling operations would be very disturbing to both overnight and day visitors on Bright Angel Point. Also, if drilling was not done in the off-season, the North Rim concessioner would probably suffer some economic

loss due to reduced operations or closure. Winter drilling would, however, increase the cost because snow would have to be removed and winter accommodations would have to be maintained.

3. Mitigating Measures

All proposed actions would comply with the "Procedures for the Protection of Historic and Cultural Properties" of the Advisory Council on Historic Preservation (36 CFR Part 800), National Park Service Management Policies, and all other National Park Service historic preservation policies and procedures, including section 106 of the National Historic Preservation Act of 1966.

The Roaring Springs pump station is included in the Grand Canyon Lodge Historic District, which is being nominated to the National Register of Historic Places. Details of the construction of the powerhouse and pump station would be fully documented before removal of these structures, and details of historic engineering design features of the water system would be recorded for the Historic American Engineering Record in accordance with Executive Order 11593.

A professional archaeologist would be on site or on call during construction to prevent damage to known or unknown archaeological resources and to assist in the recognition of any new resources that might be discovered, as deemed necessary by the regional director. The contracting officer and/or the archaeologist would have the responsibility and authority to halt any construction activities should historical, archaeological, or paleontological resources be exposed. Construction activities endangering the resources would remain halted pending the investigation and evaluation of the resources, as well as completion of the steps required by the procedures of the Advisory Council on Historic Preservation.

In addition, the contractor would be made specifically responsible in the contract documents to halt immediately construction activities and notify the contracting officer and/or the archaeologist if resources were discovered during the course of construction. The contractor would be briefed specifically on these provisions by the contracting officer prior to the start of construction.

New structures, facilities, and landscaping would be complementary in design, scale, color, materials, texture, and location and would be compatible with the natural resources and their settings. For example, wood siding rather than plywood would be used, shake or shingle roofing rather than aluminum composition, and exterior painted colors would duplicate historical colors.

If the endangered species Agave utahensis var. kaibabensis is identified as existing within the construction area, transplanting individual plants to suitable areas nearby would mitigate adverse impacts.

The design for the pump station would minimize the visual impact of the building by partly recessing it into the hillside and by constructing the exposed portion with natural materials such as stone and wood. Excavation for the building would be accomplished with mini-type front-end loader equipment and hand labor, with the stone being utilized for building walls and the excess material being scattered evenly in the adjacent area to minimize ecologic disruption. The National Park Service would require contractors to remove debris after construction and to restore the sites as closely as possible to their original condition. The new underground power line and control circuit between the pump station and new residence would follow the existing pipeline. The cables would be placed using a helicopter. Heavy mobile equipment would not be permitted to travel along the route, but might be necessary at either terminus.

The desanding equipment and modifications of the intake would be designed to remove 95 percent of the sediment to meet safe drinking water standards and to minimize wear on the pumps.

Construction of an access for modification of the Roaring Springs water intake would be confined to the existing helicopter landing pad and access path to minimize impacts beyond those associated with normal maintenance procedures. The fence at the mouth of the cave would be visually pervious, and the stair, access platform, and fence material would be selected to blend with the natural stone at the cave mouth. The access platform and the gates and fencing would be screened by vegetation from the Kaibab Trail, about ¼ mile away.

To minimize noise and adverse impacts of construction work on visitors, crews working on the pipeline would be scheduled in the off-season as much as possible. In addition, the contractor would have the option of using staging areas at either rim, under certain limitations imposed by the park, to minimize impacts on visitors and to reduce safety hazards. The North Rim surface access is open only from May through October due to snow closure of the road from Jacob's Lake. Staging areas for contractor use can be permitted at Yaki Point on the South Rim and the sanitary landfill at Harvey Meadow on the North Rim. The Grand Canyon Lodge parking area on the North Rim would also be available from October to April. Contractors would have to utilize the North Rim facilities from May through October, with emergency flights from the South Rim during the same period, subject to prior park approval. From October through May, unlimited access from the South Rim over a prearranged flight route, or from the North Rim Grand Canyon Lodge parking lot

could be permitted. All flights from the South Rim would have to be scheduled through the park's air operations officer. All drop loads would have to be removed and the site restored to preconstruction conditions.

The new aerial span would use the latest techniques for constructing power lines in remote, inaccessible areas, taking full advantage of helicopter services and hand labor to minimize environmental impacts. Closure of North Kaibab Trail from the North Rim to Roaring Springs would be a mandatory safety precaution when stringing cable or setting poles. The number of park visitors subjected to construction activity noise would be low, and they would be some distance away. Fresh cuts where trees had been felled for clearance would be painted to match surroundings; measures would be taken to ensure that helicopter pads would not appear intrusive.

The underground segment of power line on the North Rim would use the dense understory to provide visual screening. Revegetation would be pursued if there was not rapid recovery of trench scars by grasses and shrubs. The power line trench would be kept narrow (4 to 6 inches) and sufficiently deep to meet National Electrical Code standards, thus producing only a small amount of excess material. A zigzag alignment would eliminate long visible scars from the rim. Ground equipment would be restricted to a narrow construction access lane east of the entrance road, which would be restored to natural conditions. Power poles would be selected to blend with the surroundings, and all cables would be treated to minimize reflection.

The environmental impacts of whipstock drilling would be mitigated by the following measures: requiring the contractor to use tanks instead of an open reservoir to contain the drilling fluid and to minimize the chance of an accidental spill; requiring the last section of the hole to be drilled with compressed air to remove the chance of a drilling fluid blowout in the area of the pump station; and shielding lights to minimize visibility from the South Rim. This proposal would be reevaluated when funding became available and engineering designs were prepared. Further environmental documentation would be prepared, if necessary, on all or portions of the proposal.

4. Unavoidable Adverse Impacts

Some destruction of vegetation could be expected during repair of the waterline and construction of the pump station, power line, and residence. During construction, the noise and visual intrusion of the helicopter as well as construction activities would adversely affect the experience of visitors within Roaring Springs Canyon. Sections of the North Kaibab Trail would be closed for safety reasons during power line work. Visual impacts of the waterline would continue until the whipstock hole was in operation. The new

aboveground powerlines would possibly present an adverse visual intrusion to hikers on a short stretch of the Roaring Springs and North Kaibab Trails.

During the drilling of the whipstock hole, noise and construction activities would have an unavoidable effect on visitors to the North Rim and inner canyon down to Roaring Springs. The concessioner would be adversely affected economically if drilling was done during the visitor season. The National Park Service would have to absorb the costs of snow removal and accommodations if drilling was accomplished during the winter.

5. Short-Term/Long-Term Relationships

The adverse environmental impacts associated with this alternative would be primarily short-term in nature because they would be associated with construction activities. The major impacts would be the noise and visual intrusion of the work forces and equipment during construction. Some destruction of natural vegetation and disruption of wildlife habitat would occur.

The long-term effects would be to minimize the maintenance and repair costs of the existing pipeline and power lines, and to eliminate the environmental impacts of those maintenance and repair operations.

The desanding equipment would allow operation at optimum hydraulic gradient conditions in the pipeline at Indian Gardens, thus reducing the pumping head upon the equipment and conserving energy.

6. Irreversible and Irretrievable Commitments of Resources

The only irretrievable commitments would be of construction materials that could not be salvaged, the labor necessary for construction, and funding.

C. WHIPSTOCK DRILLING FOR A NEW WATER SUPPLY LINE AND POWER LINE

1. Description

This alternative would consist of the following actions:

Construction of a new 2-million-gallon storage tank on the North Rim, including piping modifications

Rehabilitation of the existing 2-million-gallon storage tank and demolition of the existing 500,000-gallon storage tank

Construction of a cased whipstock hole for use on the North Rim water supply pipeline

Construction of a new Roaring Springs pumping station equipped with desanding equipment

Modification of the existing Roaring Springs Cave water intake and access protection

Construction of a second cased whipstock hole for high voltage cables for electrical power supply to the pumps

This alternative would differ from the proposed action alternative in that instead of new overhead power lines, the power lines would be concealed in a second whipstock hole. As under the previous alternative, as much work on the North Rim as possible would be done during the winter when the area is closed.

2. Environmental Impacts

The construction impacts of this alternative would be similar to the proposed action alternative for the whipstock waterline.

If drilling was not performed during the off-season, the noise and visual impact of the drilling operations would be very disturbing to both overnight and day visitors on Bright Angel Point. The drill would run continuously, day and night, for 3 to 4 months to complete the first hole and for about 3 months to complete the second hole, a total of 6 to 7 months. Some of the drilling equipment would create a noise that would be unacceptable to visitors seeking a tranquil wilderness experience. The 24-hour operation would require lighting at night that would be visible from the South Rim.

Vegetation would not need to be removed for construction because the parking area could be used. Some damage to vegetation could occur as a result of carelessness during construction. Wildlife in the area would probably change their habits as a result of the noise and activity of the construction, and perhaps many animals would leave the area permanently because of the long and continuous nature of the disruption.

Although the construction impacts of this alternative would be great, once the system was in operation, the environmental impacts would be less than those of the proposed action alternative. Because the power line would be underground, it would not be exposed to damage by falling rocks and trees or by high winds and ice, thus it would not need periodic repairs that cause short-term environmental impacts. The visual impacts would also be less than those of the existing system and less than the proposed action alternative because the power line would be underground.

3. Mitigating Measures

The contractor would use tanks instead of open reservoirs to contain the drilling fluid to minimize the chance of an accidental spill.

The last section of the hole would be drilled with compressed air to remove the chance of a drilling fluid blowout in the area of the pump station.

Lights would be shielded to minimize visibility from the South Rim.

The park would prohibit the leaving of replaced and unused parts at the work sites.

Work on the North Rim during the off-season would minimize adverse impacts on visitors and the concessioner.

4. Unavoidable Adverse Impacts

During construction there would be unavoidable adverse impacts upon plant and animal habitats surrounding the parking area. The National Park Service would be obliged to keep the snow cleared on the 8 miles of road from the park entrance to the construction site, in addition to 36 miles of Forest Service road that would have to be cleared, so that the contractor would have access for supplies.

5. Short-Term/Long-Term Relationships

The short-term effects of this alternative would be the same as those of the proposed action alternative with the benefit that the new whipstock holes would give maximum reliability and protection and require minimum maintenance for the pipeline and power lines.

The long-term effects would be elimination of continual maintenance and repair costs of the existing pipeline and power lines, and elimination of environmental impacts associated with those maintenance and repair operations.

6. Irreversible and Irretrievable Commitments of Resources

The major commitment of resources under this alternative would be the cost in terms of labor, materials, and money of constructing two whipstock holes.

D. DRILLING DEEP WELLS FOR A NEW WATER SOURCE

1. Description

This alternative would consist of the following actions:

Construction of a new 2-million-gallon storage tank on the North Rim, including piping modifications

Rehabilitation of the existing 2-million-gallon storage tank and demolition of the existing 500,000-gallon storage tank

Drilling of three deep-well holes on the Kaibab Plateau

Insertion of submersible pumps in two deep wells for use as water sources for the North Rim (with alternate pumping from each well)

Construction of a force main from the well sites on the Kaibab Plateau to the North Rim storage tanks

Construction of a power line to the well pumps and controls.

This alternative would separate the water systems of the North Rim and the South Rim and provide the North Rim with an independent system. It should be noted, however, that its implementation would allow abandonment of the existing pumping operation, but not of electrical service to the Roaring Springs powerhouse residence. The existing chlorination unit would still serve Cottonwood, Phantom Ranch, Indian Gardens, and the South Rim via the transcanyon pipeline. The desander for the transcanyon pipeline would still be required as close as possible to the Roaring Springs intake. Maintenance and ranger personnel, as visitor loads increased, would still be required to live at the powerhouse.

According to Dr. Peter Huntoon of the Geological Survey, there would be a 90 percent chance of one well producing a large quantity of water if three test wells were drilled, each to a depth of 3,000 feet. If these three exploratory wells failed, no further drilling would be justified. The drilling, which would be accomplished by means of drill rigs similar to those utilized for oil exploration, would require approximately 1 acre of space for operations and for drilling fluid storage. Construction would continue on a 24-hour basis, requiring 3 shifts of 8 to 10 men each. A 6-inch water transmission line and underground power line approximately 2 to 3 miles long would be constructed between the holes producing the most water. The power line and water transmission line would connect the submersible pumps in each of the wells to the storage tanks at the North Rim. Drilling would be scheduled during the winter when the area is closed. Anticipated water quality would be comparable to that of Roaring Springs, including sediment load.

In summary, total production capacity approximating that of the proposed action alternative would be sought in two or three wells. In addition, a 6-inch water transmission line and a three-phase power line would be buried in the same trench from the wells to the water storage tanks, and storage capacity would be increased from 2.5 million gallons to 4 million gallons.

2. Environmental Impacts

This alternative would not propose any new construction in Roaring Springs Canyon, but the environmental impacts of periodic inspection and maintenance of power lines and the transcanyon pipeline would still occur in Roaring Springs Canyon.

The construction impacts of this alternative would be similar to those of the other whipstock hole alternatives. Extensive clearing would be required for access as well as for preparation of each drill site. In addition to the loss of vegetation, native wildlife habitat in the area would be destroyed or diminished. Soil erosion would be caused in adjacent areas as a result of site grading and access road construction.

The power and water transmission lines would be constructed through dense forest and would require a cleared area sufficient in width for access of equipment, materials, and men. The power line would follow the waterline alignment, where possible. As with the drill sites, native habitat would be impacted as well as adjacent areas due to erosion.

The large work force would require additional housing, waste disposal, and other services at the North Rim. While the drilling work would be carried on during the off-season, the installation of the water mains would have to occur after the ground had thawed.

The impact of the operation of the wells would be minor as the primary equipment would be underground and therefore would be a negligible intrusion on the environment. The access roadways to the well sites would have to be maintained for maintenance and supervision of the pumps and controls.

3. Mitigating Measures

Archaeological clearance would be required for all drill sites and access.

Specific drilling sites would be located to minimize the number of trees to be removed.

The contractor would utilize reservoir tanks instead of open reservoirs to contain the drilling fluid.

Rights-of-way for the waterline would be selectively cleared to maintain as natural a forest profile as possible, and appropriate anti-erosion and/or reforestation procedures would be utilized depending upon terrain.

All clearing would be superivised by National Park Service personnel to minimize damage to the adjoining forest.

Work during the off-season would minimize adverse impacts on visitors and the concessioner.

4. Unavoidable Adverse Impacts

Destruction of vegetation and disruption of wildlife habitat at the sites of the force main, access road, and drilling operations would be unavoidable adverse impacts of this alternative.

During construction the unavoidable adverse impacts would be the noise of the drilling equipment. The National Park Service would be obliged to keep the snow cleared on the 8 miles of road from the park entrance to the construction site, in addition to 36 miles of Forest Service road that would have to be cleared, so that the contractor would have access for supplies.

Continuance of the maintenance/ranger quarters at Roaring Springs, including power supplied either by the existing line or by an electrical generator, would be necessary.

5. Short-Term/Long-Term Relationships

The short-term effects of this alternative would be disruption of the environment during construction. After completion, this alternative, if successful, would provide the North Rim with a water system independent from the Roaring Springs water source.

6. Irreversible and Irretrievable Commitments of Resources

The major commitment of resources of this alternative would be the cost of exploratory drilling, which might not produce an adquate water source.

IV. CONSULTATION AND COORDINATION WITH OTHERS

This environmental assessment was prepared as a summary of the major alternatives presented in the Grand Canyon National Park, North Rim Water System Study, Phase II developed by two consultant firms: Rockrise, Odermatt, Mountjoy, Amis; and Kennedy Engineers, Inc., both of San Francisco. During the course of this contracted study, information was obtained by Kennedy Engineers on whipstock drilling from Brinkerhoff Drilling Company, Inc., Denver, Colorado.

Dr. Peter Huntoon of the University of Nebraska in a letter of March 20, 1973, to the hydrologist of the Western Regional Office provided the hydrogeologic information used to develop the new deep-water wells alternative.

Carol A. Martin, chief of the Western Archaeological Center, gave archaeological clearance to the project on July 16, 1976 (clearance number 146-GRCA).

Park naturalist Kathy Keliher surveyed the proposed pump station construction area and identified flora of the area. The surveys were documented in memorandums to the North District manager of Grand Canyon National Park on May 30 and August 3, 1976.

Arizona Historic Preservation Officer Dorothy H. Hall stated in a letter of August 27, 1975, that there are no sites pending nomination to the National Register of Historic Places in the subject area.

During the preparation of this environmental assessment, consultations were held with the Department of Health, Coconino County, Arizona; Arizona State Health Department; and U.S. Department of Health, Education, and Welfare, Public Health Service.

This environmental assessment will be sent to the following for review:

Arizona Historic Preservation Officer

Arizona State Clearinghouse

Arizonans for a Quality Environment

Coconino County, Department of Health

Friends of the Earth

Garkane Power Association, Inc.

Northern Arizona Council of Governments

Sierra Club

Southern Arizona Hiking Club

TWA Services, Inc.

U.S. Environmental Protection Agency, Region IX

The North Rim Water System Study, Phase II is available for public review at the following locations:

Denver Service Center
755 Parfet Street, P.O. Box 25287
Denver, Colorado 80226

Grand Canyon National Park
P.O. Box 129
Grand Canyon, Arizona 86023

Southern Arizona Group
1115 North First Street
Phoenix, Arizona 85004

Western Regional Office
450 Golden Gate Avenue, Box 36063
San Francisco, California 94102

SELECTED BIBLIOGRAPHY

COOPER, C. F.
1960 "Changes in the Vegetation Structure and Growth of Southwestern Pine Forests Since White Settlement." Ecological Management, Vol. 30, pp. 129-164.

DODGE, W.
1938 Park. Grand Canyon Natural History Association Bulletin 9. Grand Canyon, AZ.

HOFFMEISTER, D. F.
1971 Mammals of Grand Canyon. Urbana: University of Illinois Press.

MERKEL, J.
1972 "An Analysis of a Pinyon Juniper Community at Grand Canyon, Arizona." Ecology, Vol. 43, pp. 698-711.

RAND, P. J.
1958 The Plant Communities of Grand Canyon National Park. Grand Canyon Natural History Association Bulletin 6. Grand Canyon, AZ.

RASSMUSSEN, D. J.
1941 "Biotic Communities of the Kaibab Plateau, Arizona." Ecological Monographs, Vol. 11, pp. 229-275.

SCHARFF, R.
1967 Grand Canyon National Park. New York: D. McKay Company.

SWARTZ, D. W.
1958 "Prehistoric Man in the Grand Canyon." Scientific American, Vol. 198, pp. 97-103.

1969 "Archaeological Exploration on the North Rim of Grand Canyon." Report to the National Geographic Society. Washington, D.C.

U.S. DEPARTMENT OF THE INTERIOR, NATIONAL PARK SERVICE
1939 Among the Birds in the Grand Canyon Country, by F. M. Bailey. Washington, D.C.: U.S. Government Printing Office.

1966 Grand Canyon Amphibians and Reptiles, by F. R. Gehlback. Field Checklist. Grand Canyon, AZ: Grand Canyon National Park.

1970 "A Preliminary Report on Grand Canyon Archaeological Research, by D. W. Swartz. File report. Grand Canyon, AZ: Grand Canyon National Park.

1974 "Archaeological Investigations, National Park Service, Grand Canyon National Park, Grand Canyon Cross Canyon Corridor Survey, Coconino County, Arizona." Report by Museum of Northern Arizona. Grand Canyon, AZ: Grand Canyon National Park.

1975 "Executive Order 11593 Survey – Cross Canyon Corridor and North Rim Developed Area," by Ronald W. Johnson and Tony Crosby. Denver, CO: Denver Service Center, Division of Quality Control and Compliance.

1975 Final Environmental Statement, Proposed Master Plan, Grand Canyon Complex (FES 75-97). San Francisco: Western Regional Office.

1975 Grand Canyon National Park, North Rim Water System Study, Phase II. Report by Kennedy Engineers. Grand Canyon, AZ: Grand Canyon National Park.

1976 Grand Canyon National Park Master Plan. San Francisco: Western Regional Office.

1976 Draft Environmental Statement, Proposed Wilderness Classification for Grand Canyon National Park. San Francisco: Western Regional Office.

1976 Grand Canyon National Park, North Rim Water System Study, Phase II, Supplement B. Grand Canyon, AZ: Grand Canyon National Park.

PLANNING TEAM

NATIONAL PARK SERVICE

Melvin Thuring, A/E Manager (retired)
Western Team, Denver Service Center

Don Zieman, Electrical Engineer
Pacific Northwest/Western Team, Denver Service Center

S. Lebrun Hutchison, A/E Manager
Pacific Northwest/Western Team, Denver Service Center

Richard Gale, North Rim Unit Manager
Grand Canyon National Park

Merle Stitt, Superintendent
Grand Canyon National Park

Astrid Schenk, Environmental Reviewer
Western Regional Office

CONSULTANTS

David Kennedy
Kennedy Engineers, San Francisco, California

Robert Odermatt and Gordon Dey
Rockrise, Odermatt, Mountjoy, Amis; San Francisco, California

Publication services were provided by the graphics and editorial staffs of the Denver Service Center. NPS 1096 A

As the nation's principal conservation agency, the Department of the Interior has basic responsibilities to protect and conserve our land and water, energy and minerals, fish and wildlife, and parks and recreation areas, and to ensure the wise use of all these resources. The department also has major responsibility for American Indian reservation communities and for the people who live in island territories under U.S. administration.