GRAND CANYON VILLAGE UTILITIES
Grand Canyon National Park
Grand Canyon National Park
Grand Canyon Village
Coconino County
Arizona

HAER AZ-76
AZ-76

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

FIELD RECORDS

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240-0001

HISTORIC AMERICAN ENGINEERING RECORD

GRAND CANYON VILLAGE UTILITIES

HAER No. AZ-76

Location: Grand Canyon National Park, Grand Canyon Village, Coconino County, Arizona

UTM: Grand Canyon Village is located at latitude 36.0566, longitude -112.136. The coordinate represents the approximate center of the rail yard. It was obtained on March 10, 2009 by plotting its location on the Grand Canyon, AZ USGS Digital Raster Graphic in ESRI ArcGIS 9.2. The accuracy of the coordinate is +/- 12 meters. The coordinate datum is North American Datum 1927 CONUS.

Dates of Construction: Various, see report

Builder/ Engineer: Atchison, Topeka & Santa Fe Railway Company; National Park Service

Significance Statement: The Atchison, Topeka & Santa Fe Railway Company (ATSF) was largely responsible for the development of Grand Canyon Village throughout the first half of the twentieth century. The railroad company constructed and owned the majority of the utility infrastructure, as well as buildings, in the village from 1901 to 1954. The ATSF ended its involvement in the tourist industry in 1954 and donated the Grand Canyon utilities to the National Park Service (NPS). The utility system promoted the development of tourism in the park and supported the expanding infrastructure of the village.

Historian: Kate McConnell, 2006

Project Information: Documentation of the Grand Canyon Village Utilities was undertaken by the Historic American Engineering Record (HAER), part of Heritage Documentation Programs, National Park Service, Richard O'Connor, Manager, in 2006-2007. The project was completed for Grand Canyon National Park, Steve P. Martin, Superintendent, under the direction of Amanda Zemen, Cultural Resource Specialist. Field recording and measured drawings were produced under the direction of Christopher H. Marston, HAER Architect. Architect interns Dominic Duran and Michael Lee, both from the University of New Mexico, produced the drawings. HAER Photographer Jet Lowe produced the large format photographs. Kate McConnell wrote the draft history, which was edited for transmittal by Justine Christianson, HAER Historian.

For related documentation of the Grand Canyon Village, see:

HAER No. AZ-2	Grand Canyon Power Plant
HAER No. AZ-3	Grand Canyon Water Reclamation Plant
HAER No. AZ-35, A-G	Grand Canyon National Park Roads (particularly HAER No. AZ-35-A, Village Loop Retaining No. 1)
HAER No. AZ-41	Village Loop Drive
HABS No. AZ-11	Railroad Depot
HABS No. AZ-74	El Tovar Hotel
HABS No. AZ-136, A-O	Bright Angel Lodge

Table of Contents

Introduction……..…...3

I. Development of Potable Water and Fire Suppression Infrastructure in Grand Canyon Village….....10

II. The Development of the Grand Canyon Village Sewer and Reclaim Water Systems….32

III. Power and Steam System Development and Use at Grand Canyon Village……....54

IV. Ice and Ammonia…….....76

Appendix A: Inventory of Intact Infrastructure Resources……...……..80

Appendix B: Images……84

Bibliography……...129

Introduction

The Grand Canyon attracts visitors from all over the world, but settlement of the canyon was slow. The vast chasm precluded most economic endeavors typical of the southwest, especially logging and cattle or sheep herding. Nonetheless, entrepreneurs who realized the Grand Canyon's potential mining and tourism opportunities arrived there in the 1880s and 1890s. The initial settlers were individuals, quickly supplanted by corporate interests, namely the Santa Fe and Grand Canyon Railroad, which later became the Atchison, Topeka & Santa Fe Railway Company (hereafter referred to as ATSF), who led the commercialization of the South Rim.

With the tourist market in mind, the Santa Fe and Grand Canyon Railroad began building a spur north from Williams, Arizona in 1897. The railroad went into receivership in 1900, with only 8 miles to go before reaching the canyon's South Rim. Nonetheless, with less than 10 miles to travel by stage instead of the arduous two-day stage ride from Flagstaff, the number of visitors traveling to the Grand Canyon via railroad in 1900 amounted to 1000.[1] After a year of negotiation, the ATSF purchased the bankrupt line and reorganized it as a subsidiary company, the Grand Canyon Railway. In 1901, the ATSF completed the line to Grand Canyon with the vision of developing the South Rim as a tourist destination for their train passengers. That year rail passengers to the South Rim increased by 600 persons.[2]

In the meantime, one of the most notorious settlers, Ralph Cameron, partnered with his brothers Niles and Pete Berry to establish mining claims throughout the inner canyon from 1890-92. The men appropriated a Havasupai trail in the Bright Angel Fault to facilitate their mining exploits. To secure both mining and tourism pursuits, the partners later registered the improved Bright Angel Trail as a toll road.[3]

James Thurber also envisioned the potential tourist opportunities on the Grand Canyon's South Rim. He established the Bright Angel Hotel in 1896 after lengthening the Flagstaff-Grandview stage route through Long Jim and Shoski Canyons. The extended road ended near the Bright Angel trailhead. Thurber did not file a mining claim, the method used to claim western land in the nineteenth century, and simply made a living operating the hotel and guiding customers down to Indian Gardens and the Tonto Platform on the Bright Angel Trail.[4] Thurber incorporated the William Owen "Buckey" O'Neil's cabin (Building No. 508) into the complex. Dating to the early 1890s, the cabin remains as the oldest building in Grand Canyon Village.

Recognizing that the ease of transport offered by the Grand Canyon Railway would quickly drive his stage line and Bright Angel Hotel out of business, Thurber sold both to Martin Buggeln just

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[1] Gordon S. Chappell, "The Grand Canyon Depot and Railroad Yard, 1901-1984," Draft, National Park Service, Western Regional Office, San Francisco, 1984, unpaginated, available at Grand Canyon National Park Museum Collection 87730 (hereafter cited as GRCA); Michael F. Anderson, *Polishing the Jewel: An Administrative History of Grand Canyon National Park* (Grand Canyon: Grand Canyon Association, 2000), p. 5.
[2] Chappell, "Grand Canyon Depot and Railroad Yard," np.
[3] Anderson, *Polishing the Jewel*, p. 4.
[4] Anderson, *Polishing the Jewel*, p. 4.

opportune for lodging its passengers. The Grand Canyon Railway had the legal authority to survey a 20-acre depot site at the end of the new line. Since Buggeln had entered into a contract with the railway company to supply lodging to its riders, the company included his hotel in the new depot site.[5]

The ATSF built the first Grand Canyon Railway Depot, a small, frame, gable-roofed building, just south of the Bright Angel Hotel. Train passengers disembarked at the depot and faced only a short uphill walk to the hotel. In addition to customers, the railroad transported much needed water and provisions to Bright Angel Hotel. The railway company also funded capital improvements, including additions to the hotel and the establishment of Bright Angel Camp, a complex of tent cabins east of the hotel. In return, the contract required that Buggeln pay the railway nearly half of the hotel profits.[6]

The contract between Buggeln and the Grand Canyon Railway infuriated Ralph Cameron and marked the beginning of a quarter century feud between Cameron and the ATSF. Initially, in 1898, the Santa Fe and Grand Canyon Railway had agreed to end the new line at the head of the Bright Angel Trail. After reorganization, however, the new Grand Canyon Railway did not pursue this agreement with Cameron. In the meantime, expecting to benefit from the new depot, Cameron staked the Cape Horn mining claim at the Bright Angel trailhead and made various expensive improvements, including establishing Cameron's Hotel & Camp in 1903.[7]

Located just west of the Bright Angel Hotel, Cameron added a stage line station, known as Red Horse Station (Building No. 526), that he moved from 16 miles south of the rim in 1902 to his complex. Today this building is known as the Cameron Cabin, and it is the only remnant of Cameron's hotel. In 1903, Cameron and Berry also erected a gate at the Bright Angel trailhead and began charging a toll of $1 per person and $0.50 per mule.[8]

Ralph Cameron allowed brothers Emery and Ellsworth Kolb to establish a photography studio on his Cape Horn claim. The Kolb Brothers first set up a tent next to the Cameron Hotel in 1903. The following year they built a small building, Kolb Studio (Building No. 533), on the South Rim at the Bright Angel Trailhead. Over the next twenty-three years, Kolb Studio underwent various additions, reaching its final form in 1926. Throughout the years, the Kolb brothers also squabbled with ATSF and Fred Harvey Company, as well as the Forest Service, and later the National Park Service.

Meanwhile, John Verkamp established a curio store on the east end of what was slowly becoming Grand Canyon Village. He first set up a tent in the west end of the village in the 1890s, but became frustrated by slow sales. At the end of the summer, he sold his inventory to

[5] Anderson, *Polishing the Jewel*, p. 5.
[6] Anderson, *Polishing the Jewel*, p. 6.
[77] F.E. Landon, "Section of L.C., Ways Map of South Rim Grand Canyon, Arizona Showing Plotted Positions of the Golden Eagle and Cape Horn Mining Claims in Relation to the Grand Canyon Nat'l Monument Boundary," August 13, 1814, GRCA 34290a; Anderson, *Polishing the Jewel*, p. 6.
[8] Anderson, *Polishing the Jewel*, p. 6.

Thurber. After learning of the increased visitation to the South Rim, Verkamp returned in 1905 and built his curio shop (Building No. 574) with a second story apartment for his family.[9]

The buildings associated with these four small concessioners represent some of the early development of Grand Canyon Village, but only a small portion of the built environment on the South Rim, both extant and non-extant. The ATSF constructed, owned and maintained nearly all buildings, structures and infrastructure in Grand Canyon Village from 1901 to 1954.[10] The company opportunely developed a tourist destination that could most easily be reached by its trains. In partnership with the ATSF, the Fred Harvey Company operated the buildings, as well as the Bright Angel Hotel, as a corporate concessioner from 1904 to 1954.[11]

Development by the ATSF of this tourist destination began with the El Tovar Hotel (Building No. 542). Even though the Bright Angel Hotel provided lodging for railroad passengers, the company wished to offer a "first class hotel" and consequently began construction of the expansive lodge in 1903.[12] Designed by architect Charles Whittlesly, the new hotel resembled a European lodge and at the time became the most expensive log building ever constructed. To the east, across the El Tovar entrance circle, the railway company built the Hopi House (Building No. 545) in 1905. The new gift shop, as designed by Mary Colter, resembled a Hopi dwelling, and Hopi artisans lived in the upper story. Built around the same time as Verkamp's Curios, the ATSF did not view the independent concessioner as a competitor.[13]

The ATSF also built utilitarian buildings in the developing village for their employees and clientele. In 1905, the company built a power and boiler house south of El Tovar. The following year, they built a sewage treatment plant in the railroad wye. In 1906 they also built two nearly identical stables, a mule shed (Building No. 562) and a horse livery (Building No. 563), since tourists rode into the Grand Canyon on mules in the early twentieth century. In order to house a growing staff, the ATSF built two dormitories west of El Tovar Hotel, the Indian Dormitory (Building No. 538) in 1906 and the Victor Hall Annex (Building No. 578) in 1913, for Fred Harvey Company employees.[14]

Next, the ATSF moved the railroad depot further east to better serve El Tovar's patrons. During 1904 and 1905, the railway company extended the railroad tracks to the base of the hill below the hotel. This area became commonly known as the "passenger" or "coach" yard.[15] In 1909 construction began on the Grand Canyon Depot, a massive log station designed by architect

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[9] Gordon S. Chappell, National Register of Historic Places Inventory-Nomination Form for Federal Properties: "Verkamp's Canyon Souvenir Shop," September 6, 1974, p. 3.
[10] The railroad donated all utilities to the Park Service in 1954.
[11] Fred Harvey Company continued to operate the buildings in contract with the National Park Service from 1954-1968, after the railroad sold the buildings to the concessioner.
[12] Anderson, *Polishing the Jewel*, p. 6.
[13] Anderson, *Polishing the Jewel*, p. 14.
[14] The railroad moved Victor Hall Annex to a location behind Victor Hall in the mid-1930s to make way for the construction of Colter Hall and demolished the Indian Dormitory in 1969 in anticipation of the construction of Kachina Lodge.
[15] Chappell, "Grand Canyon Depot," np.

Francis W. Wilson.[16] Throughout the next half century, the railroad built and altered several buildings in the depot area for utilitarian purposes. These buildings included an icehouse (Building No. 550) built in 1910, the Sanitary Can Storage Building (Building No. 568) built in 1930, and the Transformer Building (Building No. 548) built in 1950/1956.[17]

While the ATSF developed the Grand Canyon Village into a tourist destination, progressive federal lawmakers recognized the importance of the Grand Canyon as a natural resource. In 1907 the land became the Grand Canyon National Forest, and the following year, President Theodore Roosevelt proclaimed part of this forest as the Grand Canyon National Monument. With this designation, the U.S. Forest Service began management and protection of the natural resources in these reserves. In addition, the Forest Service built two administrative buildings on the east side of the village around 1917.[18]

During the mid-1910s, the ATSF continued to expand its tourist business in Grand Canyon Village. Company officials may have felt confident that the Hopi House was not in competition with the independent concessioner, Verkamp's Curios. However, the Kolb Studio offered photography for Grand Canyon tourists, a service that the railroad and its partner, Fred Harvey Company, did not. In direct competition with the Kolb Brothers photography studio, the company built Lookout Studio (Building No. 532) in 1914. Not unlike Kolb Studio, the railroad located the building on the rim, but west of Kolb Studio –between El Tovar and the competition. The railroad again hired Mary Colter to design a building that harkened to the western landscape and Native American building techniques. The railroad company also built the Fred Harvey garage in 1914. This garage mainly serviced Fred Harvey Cars that provided tours for canyon tourists; however, it also sold gas and offered vehicle repair to the increasing number of drivers who ventured on the unmaintained roads leading to the Grand Canyon.

Around this time, Grand Canyon Village had 300-400 permanent residents and over fifty permanent buildings.[19] To support the inhabitants, as well as the people visiting Grand Canyon, the growing village needed an actual municipal infrastructure, such as a "sanitary system, water-supply system, telephone system and electric light system."[20] Visitors experienced unsanitary conditions due to the limited utilities, yet employee conditions were considerably worse, because the ATSF and the Fred Harvey Company invested in profit-making improvements rather than in

[16] Based on a 1909 map by Mattoon, which shows only two hotels, El Tovar and Bright Angel, it is believed that Cameron's Hotel had closed by this time. The shift of the depot further away from Ralph Cameron's hotel, as well as competition from El Tovar, likely caused his business to fail and close by 1909. See W.R. Mattoon, "A Working Plan for Grand Canyon National Monument," U.S. Department of Agriculture, Forest Service, June 28, 1909, GRCA 58395.
[17] Either the railroad or the Park Service demolished these three buildings.
[18] Neither building is still standing. H.D. Burall, "Working Plan Map Grand Canyon Tusayan Nat. For. Rim Area," August 1917 in Don P. Johnston and Aldo Leopold, "Grand Canyon Working Plan: Uses, Information, Recreational Development," December 1916, Revised March 17, 1917, Approved April 9, 1917, GRCA 28855.
[19] Michael P. Scott, Gordon Chappell, Robbyn Jackson, Jamie Donahoe, Susan Begley, and Ethan Carr, National Historic Landmark Nomination: "Grand Canyon Village, Grand Canyon National Park," Washington, DC: National Park Service, 1996, p. 45.
[20] Scott, et al., "Grand Canyon Village," p. 35.

employee housing and amenities.[21] A 1916 plan first introduced the idea of zoning and suggested improvements for employee housing.[22] Previously, the Forest Service had proposed several plans for controlled development of Grand Canyon Village. Neither the railroad nor the concessioner nor the federal government implemented the plans. [23]

In 1919, the Grand Canyon became a national park. The National Park Service (NPS) recognized the importance of the transportation, utility and hospitality services provided by both the ATSF and the Fred Harvey Company. Since the NPS had little interest in developing and maintaining tourist accommodations at Grand Canyon, or other national parks for that matter, the NPS entered into a working agreement that served both the concessioner and the park for the next twenty years. In order to encourage the ATSF to make improvements, the NPS contract allowed "very considerable exemptions" for capital improvements and only a small percentage of gross receipts paid in franchise fees. In return, these improvements would first be reviewed and approved by the Park Service for architectural design, location and materials.[24]

The NPS also began developing a Master Plan for the Grand Canyon Village in the early 1920s that included a division between Fred Harvey Company areas and Park Service areas. Designed by Daniel P. Hull and approved in 1924, the NPS has followed the main ideas of the Master Plan since its inception and the basic components are still visible today.[25] Hull also designed the first building built by the NPS in the Grand Canyon Village. This building, constructed in 1921, is a prime example of National Park Service Rustic Architecture, used throughout the national park system.[26] First serving as the park administration building (Building No. 1) in 1921, the building later became the home of the park superintendent in the early 1930s.[27]

The division of the Grand Canyon Village into zones of service is a major component of Hull's 1924 Mater Plan and of park planning in general. These zones included the commercial area, the NPS administration area, and residential and utility areas for both Fred Harvey Company and the Park Service. Almost immediately, new construction followed Hull's plan. The ATSF began building a new Powerhouse (Building No. 58) in the Fred Harvey utility area to serve the

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[21] Generally, employee's homes were wooden shacks, tents, or boxcars surrounded by pit toilets and trash heaps. Anderson, *Polishing the Jewel*, p. 9.
[22] Don P. Johnston and Aldo Leopold, "Grand Canyon Working Plan: Uses, Information, Recreational Development," December 1916, Revised March 17, 1917, Approved April 9, 1917, GRCA 28855 and Denver Service Center, Technical Information Center 113-D445.
[23] The U.S. Forest Service developed at least five planning documents between 1908 and 1918, none of which saw much success in improving the neglected conditions of Grand Canyon Village. Those plans included W.R. Mattoon's "A Townsite Plan for Grand Canyon National Monument," 1910; Don Johnston and Aldo Leopold's "Grand Canyon Working Plan: Uses, Information, Recreational Development," 1916; and Frank A. Waugh's *A Plan for the Development of the Village of Grand Canyon, Arizona*, 1918.
[24] Anderson, *Polishing the Jewel*, p. 14.
[25] The Secretary of the Interior designated Grand Canyon Village as laid out in Daniel P. Hull's 1924 Master Plan a National Historic Landmark on February 18, 1997.
[26] For more information on National Park Service architecture and planning, see Linda Flint McClelland, *Building the National Parks: Historic Landscape Design and Construction* (Baltimore: The Johns Hopkins University Press, 1998) and Ethan Carr, *Wilderness by Design: Landscape Architecture & The National Park Service* (Lincoln: University of Nebraska Press, 1998).
[27] Building No. 1 now serves as Xanterra offices.

growing population of both employees and visitors in the village in 1925. The following year, they built a laundry facility (Building No. 569) just west of the Powerhouse. A third building constructed in the Fred Harvey Utility Area was the Paint Shop (Building No. 572), built in 1931. Part of this construction boom also included a new activated sludge treatment plant (Building No. 333) built outside the village core.

The ATSF undertook its last major construction project, the construction of Bright Angel Lodge, in 1934-1935. This project required the demolition of the 1896 Bright Angel Hotel that the railroad had initially incorporated into its 20-acre depot area and that Fred Harvey had operated since 1904. Again, Mary Colter designed the new building complex for the railroad. She recognized the historical value of the "Buckey" O'Neil Cabin and the Cameron Cabin and incorporated both into her plans for the new Bright Angel Lodge. In place of the old hotel the railroad built the Bright Angel Lodge proper (Building No. 507), additions to the Buckey O'Neil Cabin, Powell Lodge, and a complex of cabins (Building Nos. 510-525 and 527-531). Mary Colter also designed the final major building, a woman's dorm, which was constructed by the ATSF. Now known as Colter Hall (Building No. 539), this dorm replaced the southern-most of the two El Tovar dorms, Victor Hall Annex, along the rim in 1937.

In 1936 the ATSF built two utilitarian buildings inside the wye track. Both were balloon frame, gable roof buildings clad with plank siding that were devoid of any NPS Rustic details. The larger and easternmost of the two was a Tool House (Building No. 579). Just southwest of this building stood a small gasoline storage shed (Building No. 580) used to fuel automobiles.[28]

Meanwhile, the Works Progress Administration (WPA) provided money and manpower through emergency relief funds for work in Grand Canyon National Park. Two Civilian Conservation Corps (CCC) camps were stationed at Grand Canyon Village between 1933 and 1942. Camp NP-2A was located at the southeast of the Park Service utility area, while Camp NP-4A was encamped south of the wye track. Much of the work completed by the CCC in Grand Canyon Village included work on the utility infrastructure, as well as trail and road building, conservation projects, and construction of the Community Building and buildings in the Park Service utility area. The majority of the labor took place outside the village core since it had been almost fully developed by the ATSF.

With the onset of World War II in 1945, new construction came to a virtual halt. Once the CCC left there were no large projects undertaken in Grand Canyon Village until after the war. The ATSF still maintained utilities, which was more of a trial during the war than during the Depression, but spent next to nothing on infrastructure maintenance. The War Department ordered services cut, which included the closing of Lookout Studio and Bright Angel Lodge in 1942, as well as Hopi House for a period of time. Additionally, the railroad ceased passenger service to Grand Canyon during the war.[29]

[28] The National Park Service tore down both buildings in 1971, see Chappell, "Grand Canyon Depot," np.
[29] Anderson, *Polishing the Jewel*, p. 43.

Following the war, Grand Canyon National Park experienced another boom, similar to the rest of the country. While inundated with visitors, the NPS lacked substantial appropriations as Congress tried to fund more essential government services.[30] Fred Harvey Company and the ATSF reopened all South Rim transportation facilities and accommodations in 1946. Yet, the hordes of visitors coming to Grand Canyon repeatedly found deficient accommodations and signs of an outdated infrastructure.

Consistent with their original position, Park Service personnel were not interested in utility operations and expected the ATSF to make much needed upgrades to the Grand Canyon utilities. However, the railroad experienced decreased passenger counts in the decade after the war. The railroad company also balked at expanding outside of its 20-acre depot for fear of losing investments if the NPS did not renew the contract.[31] Ultimately, the ATSF decided not to renew its contract with the NPS in 1954. Instead, the company sold all of the buildings that Fred Harvey Company had been operating to the concessioner and donated all of the utilities to the park.[32] Although this transaction ended the railroad's direct involvement in the tourism business at Grand Canyon Village, the railroad continued to operate passenger trains to the canyon until 1968.

The cessation of the ATSF's involvement in the development of Grand Canyon as a tourist destination marked the end of private concerns investing large amounts of money in the utility infrastructure of the national park. Since that time, AmFac, who bought out Fred Harvey Company in 1968, has invested in the construction of two lodges on the rim, Thunderbird (Building No. 1300) and Kachina (Building No. 1320). The NPS entered into an agreement for power with the public utility company, Arizona Public Service (APS), in 1954. Otherwise, the National Park Service has invested in upgrades and maintenance of both the water and sewer infrastructure at Grand Canyon since the mid-1950s.

[30] Anderson, *Polishing the Jewel*, p. 43.
[31] Anderson, *Polishing the Jewel*, p. 48.
[32] F.G. Gurley, "Instrument of Donation from the Atchison, Topeka and Santa Fe Railway Company to the United States of America," March 9, 1954, GRCA 49259; Anderson, *Polishing the Jewel*, p. 49.

I. Development of Potable Water and Fire Suppression Infrastructure in Grand Canyon Village

As is well documented, water on the Grand Canyon's South Rim in the village developed by the Atchison, Topeka and Santa Fe Railway Company was scarce. Generally, digging wells on the canyon rim was not feasible because of the depth of the water table. Sanford Rowe established the closest and only viable well, which provided "clear cool water" in the early 1890s.[33] Rowe operated a small tourist camp near his well, known as Rowe's Well, and a livery service between Williams and his camp.[34]

The next closest consistent and safe water source was located at Indian Springs (later renamed Indian Gardens), 4-½ miles down the Bright Angel Trail in the depths of Grand Canyon. Native Americans first established the route to this water source, hence the name. Later, Ralph Cameron opportunely took control of the Bright Angel Trail by establishing several mining claims that encompassed it. He reconstructed the trail, made it into a toll road, and later set up a tourist camp at the springs. In agreement with Cameron, both Sanford Rowe and James Thurber guided their customers down Bright Angel Trail to this oasis in the canyon.[35] In exchange for access to the trail, Rowe traded fresh water from his well with Cameron.[36] Most likely, Cameron hauled and stored this water in barrels, as was customary at the time.

In addition to Rowe's Well and Indian Gardens, Grand Canyon residents acquired water, albeit not potable, from the Rain Tanks, approximately 7 miles away over relatively flat terrain. Though longer, this was an easier trek than to Indian Gardens and many of Grand Canyon's early settlers obtained their water from this pond.[37] The Kolb Brothers used this water for their dark room.[38] The only other nearby sources of water were a "nearly permanent" pool of stagnant water about 4 miles down Bright Angel Wash along the railroad, and a tank that filled up during monsoon season about a quarter mile west of the ATSF rail yard, "near the fork of the road to Hopi Point." However, none of these water sources were safe for human consumption.[39] The earliest inhabitants of Grand Canyon Village, such as William Owen "Buckey" O'Neil, likely hauled water from these sources for uses other than human consumption.

Martin Buggeln's 1901 contract with the Santa Fe and Grand Canyon Railroad included free water delivery to Bright Angel Hotel (Building No. 507), but it is unknown how the former owner, James Thurber, had obtained water for his guests since the hotel's establishment in 1896.[40] Initially, Thurber may have hauled water up from Indian Gardens, especially since he

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[33] Rowe's Well still continues to be a viable fresh water source.
[34] Mattoon, "Working Plan"; Anderson, *Polishing the Jewel*, p. 4.
[35] Anderson, *Polishing the Jewel*, p. 4.
[36] Personal communication with Michael Anderson, Park Service Trails Historian, August 10, 2006.
[37] Located near today's Grand Canyon Airport in Tusayan, the Rain Tanks still exist.
[38] Anderson, personal communication.
[39] Mattoon, "Working Plan," pp. 99-100; W.R. Mattoon, "A Townsite Plan for Grand Canyon National Monument, also Drift Fence and Other Improvements, Tusayan National Forest," U.S. Department of Agriculture, Forest Service, July 18, 1910, GRCA 17460; Anderson, personal communication.
[40] Letter from A.G. Wells, General Manager, Atchison, Topeka & Santa Fe Railway System, to Mr. Martin Buggeln, August 6, 1902, p. 1, GRA 80085.

offered tours into the canyon on the Bright Angel Trail as part of his business, but this would not have been very efficient. More likely, he too hauled water from the nearby tanks. According to a letter from W.A. Drake, Chief Engineer of the Santa Fe, Prescott & Phoenix Railway Company to Mr. E.B. Gage of the Santa Fe and Grand Canyon Railroad Company about the status of the bankrupted railway, Thurber did obtain water from the railroad company at least during his last year of ownership. Drake stated that the company still supplied water "and everything required for the furnishing and operation" of the Bright Angel Hotel even though the line stopped 8 miles short of the canyon's South Rim in 1900.[41]

By 1903 Buggeln had entered into a deal with the ATSF for the extension of water lines and improvements to the Bright Angel Hotel. The railroad recognized Buggeln's business success during his first year of operation since the train arrived and asked for one half of Buggeln's net profits.[42] The two parties instead agreed the following year that the railroad would "pipe" water to the "kitchen, bunk house and stables," as well as an extension of the dining room. In return, the railroad company would receive 75 percent of Buggeln's net earnings.[43]

Ralph Cameron may have also acquired water from the railroad as early as 1900. However, based on the ensuing dispute between Cameron and the railway the following year, one could conclude that the acquisition of water may have stopped, or was at least tenuous, after this time. Cameron continued to obtain water from Sanford Rowe. He probably hauled water in barrels to his Cameron Hotel & Camp from the Rain Tanks 7 miles to the south.[44] He may have collected rainwater in this cistern as well.[45]

In 1916, the Forest Service recorded that all independent concessioners in Grand Canyon Village obtained at least part of their water by catching rain in a cistern.[46] This included only Verkamp's Curios (Building No. 546), Kolb Brothers Studio (Building No. 533), and Cameron's Livery (Building No. 526) by this time.[47] It has long been known that John Verkamp installed a concrete cistern beneath the front porch when he built Verkamp's Curios in 1905. In order to catch rainwater and snow melt, he constructed each of the three roofs on the building in a nearly flat "V" shape with a downward angle toward the north elevation (front) of the building. The top roof spilled onto the middle roof, which in turn spilled onto the porch roof. The water flowed from the porch roof, angled down toward the northeast corner, to a down spout hidden in a porch post, and into the cistern. The family pumped water from this cistern using a hand pump located on the east side of the porch.[48]

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[41] Letter from W.A. Drake, Chief Engineer, Santa Fe, Prescott & Phoenix Railway Company to Mr. E.B. Gage, Santa Fe and Grand Canon [sic] Railroad Company, Prescott, Arizona, September 6, 1900, GRCA 66101.
[42] Wells to Buggeln, 1902, p. 2.
[43] Letter from A.G. Wells, General Manager, Atchison, Topeka & Santa Fe Railway System to Mr. Martin Buggeln, August 20, 1903, p. 1, GRCA 80085.
[44] Anderson, personal communication.
[45] This presumption that Cameron had a cistern cannot be verified; however, the area historically serving as his compound has been heavily disturbed and built upon over time.
[46] Johnston and Leopold, "Grand Canyon Work Plan," A-10.
[47] These were the only independent concessioners in the study area for this project.
[48] During a remodeling of Verkamp's Curios that occurred in the mid 1960s, workers filled in the cistern because of "rodent infestation and other health concerns." In addition, they changed the angle of the porch roof so that water

Emery Kolb stated in an oral interview that his family collected water from the roof and stored it in a cistern.[49] Kolb was referring to the westernmost tank of the two tanks located to the east side of Kolb Studio (Building No. 533) in the late-1910s.[50] A circa 1912 photograph shows spouting leading from the roof of the studio to a wooden tank adjacent to the building's east façade (see Appendix B, Figure 1: Kolb Brothers Studio with cistern, GRCA 7731).

In order for the Kolb Brothers Studio to develop film, which required an ample, reliable water supply, the brothers created a film-developing studio at Indian Gardens circa 1904. After photographing the mule trains, Emery or Ellsworth Kolb would run into the canyon with the film in order to develop and print the photographs for the mule riders to purchase upon return. The Kolb brothers did this daily until 1932. Prior to the construction of their house on the rim in 1904 and the studio at Indian Gardens, the Kolbs hauled water from the Rain Tanks to use for processing film in what Emery Kolb referred to as a root cellar for film developing.[51] Actually, the root cellar was a prospecting hole dug by Ralph Cameron as part of his Cape Horn mining claim around the turn of the twentieth century.[52] The mine shaft still exists today.

From the outset, Grand Canyon Railway hauled water to the nascent Grand Canyon Village. The number of annual visitors to Grand Canyon Village had reached more than 1,000 in 1900, so water was already a necessity. More than likely, the first train to travel the newly completed line was an unscheduled freight train. The first scheduled train to Grand Canyon arrived on September 21, 1901. A photograph of this train reveals that three empty water tankers, as well as a tender loaded with coal, had already left the new depot at the South Rim and returned to Williams earlier that same day. One tanker full of water remained on the track, probably for later use.[53] These water tankers and coal cars likely shipped supplies to the Grand Canyon in preparation for the relative onslaught of rail passengers destined to arrive in late September.

The Grand Canyon Railway located its first station just south of the present-day Bright Angel Lodge. There, the railroad company built the first depot, a small, frame, gable roof building (Building No. 573). The company also built a siding track that served as the staging area for unloading water tank cars. It connected with the northern passing track near its west end and extended east parallel to this track. This is where the lone water tanker remained after the first

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flows down the northwest porch column and exits through spouts at the porch level. They also changed the pitch of the second story roof so that it is a very low angle gable roof instead of a "V." The "V" roof on the first story roof and the pump on the porch are both still intact. See Anthony Brown, Historic Structures Report: "Verkamp's, Building 546, Grand Canyon National Park," Draft, June 2002, p. 30; personal communication with Dan Ashley, Verkamp's Curios General Manager, July 24, 2006.

[49] Gordon S. Chappell, National Register of Historic Places Inventory-Nomination Form for Federal Properties: "Kolb Studio," September 6, 1974, p. 2.

[50] The Kolbs likely filled the other tank with heating oil.

[51] Chappell, "Kolb Studio," p. 2; National Park Service, U.S. Department of the Interior, Grand Canyon National Park Informational Brochure, "Grand Canyon, Kolb Studio," 2004.

[52] Landon, "Ways Map of South Rim Canyon."

[53] Chappell, "Grand Canyon Depot," np.

train left Grand Canyon Village in the fall of 1901. Through 1904 water tankers parked on what later became known as Track No. 4.[54]

Within a few years, the ATSF had shifted its center of activity east of Bright Angel Hotel. This began with the construction of El Tovar Hotel (Building No. 542) from 1903 to 1905. In connection with this project, the railroad company moved the Grand Canyon Railway yard, known as the passenger yard, to the east just south of El Tovar. This location change made the new hotel more accessible to railway passengers and allowed the company to expand its infrastructure. By 1905, the new passenger yard had been enlarged to eleven parallel tracks.[55] In 1905, the railroad company also began construction of a stone power plant (Building No. 37) south of El Tovar to supply steam heat and electricity for the new hotel.[56]

The new Grand Canyon station also facilitated water delivery to the newly constructed buildings. The Grand Canyon Railway Company, in their contract with Fred Harvey Company for the operation of El Tovar, specified that the railway company would "furnish on cars on tracks as convenient to said hotel as practicable all ice, fuel and water necessary for use in operation of the business."[57] The railroad did so by laying a spur to the northeast, later known as the "water track." The "water track" crossed what is today Village Loop Road between today's depot and El Tovar, past the stone power plant (see Appendix B, Figure 2: Grand Canyon Railway, "Arrangement of Pipe Lines for Use of Treated Water at Grand Canyon, Ariz.," Drawing No. 100-6894, 1909, GRCA 66101-28).

In all probability, the water delivered to Grand Canyon Village by water tank car flowed by gravity from the cars into the stone power plant. There, pumps forced the water up El Tovar hill through a 6" line to a water storage tank (Tank No. 1, Building No. 39). For $4,000 the railroad company built the 43' high cylindrical steel water tank off the southwest corner of El Tovar as part of the original hotel facilities in 1905 (see Appendix B, Figure 3: El Tovar with one water tower, GRCA 9824).[58]

Charles Whittlesly, architect of El Tovar, also incorporated other means for storing water at El Tovar. Whittlesly designed the building with its own 10,000-gallon steel water tank hidden inside the tower in the southwest corner of the central third story roof.[59] In addition, a circular

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[54] Wells to Buggeln, 1903, p. 1; Chappell, "Grand Canyon Depot," np.
[55] After construction of the Grand Canyon Depot (Building No. 549) in 1909, only ten tracks existed in the Passenger Yard. The northernmost track was likely removed to make way for the new building. Chappell, "Grand Canyon Depot," np.
[56] Atchison, Topeka & Santa Fe Railway Company, "Building Record-Albuquerque Division, Grand Canyon Ry," circa. 1915, GRCA 66101.
[57] Grand Canyon Railway Company, "Agreement between the Grand Canyon Railway Company and the Trustees Under the Will of Frederick H. Harvey, Deceased, Relating to the Grand Canyon (El Tovar) Hotel," October 15, 1904, np, GRCA 66101.
[58] ATSF, "Building Record," ca. 1915, np.
[59] There is some speculation that this water tank was never constructed, since the 43' water tank would have had enough capacity and *force* to serve El Tovar plus additional buildings in the village. However, the galvanized metal base and pipes that would connect to the tank still exist inside the tower. Personal communication with Bob Baker, Xanterra Director of Engineering regarding El Tovar, July 6 and 16, 2006. See also Charles F. Whittlesly, "Hotel

catch basin, presumably for rainwater, was depicted on the El Tovar plans just south of the west wing. It is not known if this structure was ever built. Based on plans dating as early as 1910, it seems that a septic tank and a semi circular "yard" extending from the west wing were also planned in the same general location as the catch basin but were never constructed. Therefore, it can also be presumed that the catch basin, which is not depicted on any successive plans, was not constructed either.[60]

Though documentary evidence is lacking, in all probability the 43' tall, 23' diameter water tank (Tank No. 1, Building No. 39) at El Tovar held water for other buildings in Grand Canyon Village as well the hotel. A 12.2' x 48.4' frame pump house (Building No. 131?) with a shingle roof built off the southeast corner of El Tovar in 1909 almost certainly forced water into the tank on the roof of the hotel. Water from this tank had enough pressure to adequately serve the facilities in the hotel, including hot and cold running water in each room, a bath on every floor, and kitchen facilities, at an average cost of $90 per day.[61] The pump house, with its Knowles Steam Pump and two Morse pumps, likely propelled water elsewhere in the village, particularly since two more water tanks (Tank No. 2, Building No. 38; and Reclaimed Water Tank No. 3, Building No. 42) were installed on the hill behind El Tovar between 1911 and 1917 (see Appendix B, Figure 4: El Tovar plan from ca. 1915 Grand Canyon Building Record and Figure 5: Three water tanks at El Tovar, GRCA 9904).[62] Moreover, this location was the highest point north of the railroad tracks, so gravity facilitated this water distribution system.

The three water tanks at El Tovar, therefore, also served buildings along the South Rim, including the Bright Angel Hotel, El Tovar's accessory buildings, Hopi House (Building No. 545), Grand Canyon Depot (Building No. 549), and Lookout Studio (Building No. 532), during the first fifteen to twenty years of the twentieth century.[63] These tanks and the pump house also supplied water for the fire suppression system in this area. By 1917, the ATSF had installed several fire plugs, some with a hose reel, around the village. This included seven fire plugs (one with a hose reel) and a hose house in and around the El Tovar complex; one fire plug near the power house; and two fire plugs (one with a hose reel) in the Bright Angel Hotel complex. The

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Building at the Grand Canyon for the Santa Fe," also known as "The Grand Canyon Railway Co. Drawing No. 78-3989," June 24, 1903, Sheet 5 and elevation, GRCA 28715.

[60] A review of early photos of El Tovar does not reveal if any of these structures were constructed because most views are of the east (front) elevation. Whittlesly, "Hotel Building at the Grand Canyon for Santa Fe," Sheet 2, GRCA 28715.

[61] W.H. Peters, "Superintendent's Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," 1920, p. 4, GRCA 54706; John Willy, "Fred Harvey's Facilities and Service at the Grand Canyon: El Tovar and Bright Angel Camp—The Public Camps—Transportation—A Visit to the Tomb of Charles Brandt," *The Santa Fe Magazine* XXIII, no. 1 (December 1928): p. 23, GRCA Gordon Chappell/Uncataloged Items 02-0195, Box 1.

[62] ATSF, "Building Record," ca. 1915, np.

[63] The ATSF contracted with A.W. Anson of Albuquerque, New Mexico, to build the new Grand Canyon Depot, completed in 1909. Following architect France Wilson's specifications, Anson installed a 2" galvanized pipe water supply pipe, which likely entered the building on the north elevation. The railroad also paid $327 for excavation of a 180' dry masonry-lined well in 1911, but it is doubtful that this was a potable water source for the depot. The use for the well, which was filled in during 1940, remains unknown. Francis W. Wilson, "Specifications of Labor, Material and Mechanical Workmanship to be used and employed in the erection and completion of a Railway Station at Grand Canyon, Arizona for the Grand Canyon Railroad Company," ca. 1909, p. 29; Chappell, "Grand Canyon Depot," np.

railroad built the 10' x 10' frame hose house (Building No. unknown) for $30 in 1906 (see Appendix B, Figure 4: El Tovar plan from ca. 1915 Grand Canyon Building Record and Figure 6: Hydrant, GRCA 11984).[64]

In 1916, the ATSF updated its fire suppression system in Grand Canyon Village by constructing a new pump house just south of the large El Tovar water tank and west of the first pump house. Corrugated iron clad this steel framed 9'x 24' pump house (Building No. 131?), which also had a concrete floor. It housed two Fairbanks Morse Underwriter Pumps, one with the capacity to pump 1,000 gallons per minute and the other 500 gallons per minute. A 4" steam line and a 4" water line connected this new pump house with the northwest corner of the power plant at the base of the hill.[65]

To supply water to the buildings on the south side of the railroad tracks, the ATSF built another water tank on a hill approximately 300' south of the Fred Harvey utility area by 1908. The 24' x 16' tank was built of wood with a corrugated iron roof. It is not clear how water was pumped into this tank. This water tank solely served the mule shed (Building No. 562) and livery (Building No. 563) both built in 1906, as well as a non-extant mess house (Building No. Unknown) and a workshop (Building No. 564), via a 2-½" galvanized pipe. In addition, the water line fed two fire hydrants located in this complex of buildings (see Appendix B, Figure 7: Site Plan, Drawing No. 113-8021, 1908, GRCA 67622).[66] In 1916 the company dismantled the water tank and presumably abandoned the water lines in place (see Appendix B, Figure 8: The Grand Canyon Railway Co., "Abandon Water Pipe at Grand Canyon," Drawing No. 100-8663, 1916, GRCA 66101-48).

As part of the Passenger Yard expansion in 1904-05, the ATSF also installed a water column to fill locomotives with water.[67] A cistern off the southwest corner of the power plant stored water, in all likelihood for tending the steam locomotives. The company also installed an 8" Page brand water column costing $240 to fill the tender tanks of the locomotives in 1904, but the exact location of this water column is not known.[68] Presumably, by 1909 the railroad company had replaced the Page brand water column with another located on the Main Line track approximately 330' southwest of the power plant. A pump inside the southwest corner of the

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[64] ATSF, "Building Record," ca. 1915, np.

[65] In addition to the new pump house, the ATSF (as part of this fire protection project) installed twenty-four fire alarm stations, including eleven in El Tovar, two in the large dormitory to the north (Building No. 538), one each in the smaller dormitory to the south (Building No. 578), Hopi House, the depot, the El Tovar laundry, the livery, the mule shed, the blacksmith shop, and four of the five buildings in the Bright Angel Hotel complex. Much of the visible fire suppression system is no longer extant; however, two post indicator valves (PIV), one at the southwest corner of Hopi House and one at the southwest corner of El Tovar, may be part of this 1916 system. It is not known when these PIVs were installed. Atchison, Topeka & Santa Fe Railway Coast Lines Field Engineers Notebook, "Closeout Fire Protection Grand Canyon," December 20, 1916, pp. 1-3, GRCA 66101.

[66] ATSF, "Building Record," ca. 1915, np.

[67] A water column fills the locomotive's tender, or water and fuel storage area at the rear of the engine, with water. At the Grand Canyon station, the water was pumped through an underground pipe from the power plant to the water column, a vertical pipe along the railroad track. A water column has a long spout that the train's fireman swings into position over the tender to fill it with water. The fireman opens a valve and releases the water into the tender. An example can be seen at http://www.catskillarchive.com/rrextra/water.html.

[68] ATSF, "Building Records," ca. 1915, np.

power plant forced water through a 6" "Column Line" that ran west along the Main Line track to the water column.

In 1909, the ATSF replaced the 6" column line as part of an initiative to use reclaimed septic water to tender locomotives. However, the use of reclaim water apparently did not work, as the railroad company proposed moving the entire water column system the following year, returning its connection to the pump inside the southwest corner of the power plant and moving the water column south of the power plant. The new column stood on the north side of Track 2 approximately 90' south of the power plant. Water was pumped from the power plant to the new column via an 8" pipe (see Appendix B, Figure 9: The Grand Canyon Railway Company, "Showing Pro. Change of Water Column, Grand Canyon," Drawing No. 100-7016, 1910, GRCA 34990).[69]

In the meantime, the lack of water presented "the most serious natural drawback" to the Forest Service as the agency attempted to establish a presence in Grand Canyon Village.[70] In 1909 the Grand Canyon Division of the Forest Service planned to establish a centrally located "District Ranger Headquarters." Though a point located approximately 1/8 mile southeast of the railroad station was proposed, no water, except for that purchased from the ATSF, was available at this location. Instead, the Forest Service suggested maintaining the district ranger quarters (Building No. 361?) that was established at Rowe Well, as there was an "ample supply of water of excellent quality."[71] This well was the only one for miles around; therefore, people often stopped there for water and rest making it an ideal location for a ranger station.[72]

The Forest Service also realized that the scarcity of fresh water at the Grand Canyon's South Rim limited growth, as well as camping, in the developing village.[73] The Forest Service proposed to deny any new permits for residences at the South Rim; however, they did not expect many applications because of the dearth of water. Similarly, the Forest Service did not receive many requests for camping in or near Grand Canyon Village due to limited water availability. This was reinforced by the ATSF's refusal to sell water to the general public.[74]

In 1911, the ATSF changed the method by which tank cars delivered water at Grand Canyon. The company constructed a water flume beneath the southernmost track in the Passenger Yard, which ended at a 30' x 22' concrete cistern with a plank roof (NHL Structure No. L-22). The new system cost $4,100 to build.[75] This system made unloading water much easier, since water tank cars needed only to line up on the flume track and allow gravity to empty the water into an open wooden trough, or flume, beneath the railroad track.[76] The flume led west on a downgrade to the subsurface cylindrical cistern partially located beneath the flume track (see Appendix B, Figure 10: The Grand Canyon Railway Company, "Track Changes Account Addition to Power

[69] None of these water columns exist today.
[70] Mattoon, "Working Plan," p. 92.
[71] Mattoon, "Working Plan," pp. 91-92.
[72] Mattoon, "Working Plan," p. 94.
[73] Mattoon, "Working Plan," p. 92.
[74] Mattoon, "Working Plan," pp. 99-100.
[75] ATSF, "Building Records," ca. 1915, np.; Chappell, "Grand Canyon Depot," np.
[76] Later, this track became known as Track 21, see Chappell, "Grand Canyon Depot," np.

House at Grand Canyon," showing water cistern and flume track, Drawing No. 100-8097, 1914, GRCA 87923). The railroad company built a small pump house (Building No. 131?) directly southeast of the cistern.[77] A pipeline ran northeast from the concrete cistern and beneath the rail yard to pumps at the power plant where it fed the boilers. These pumps also forced water further up the hill to the water tank behind El Tovar, where the water fed other buildings along the Rim. Upon completion of this new water delivery system, the railroad company tore up the water delivery track located adjacent to the power plant, leaving room for additions to be made to the building during the next couple of years.[78]

In addition to hauling enough water to Grand Canyon Village to supply the ATSF and Fred Harvey Company facilities, as well as the Forest Service after 1908, the ATSF agreed to sell water at cost to Grand Canyon residents. The company began shipping water from a reservoir in Flagstaff that had been constructed in agreement with the city in the mid-1910s. Prior to that time the company hauled water from Del Rio, near Prescott and over 125 miles south of Grand Canyon Village. The change to the reservoir in Flagstaff decreased the trip by a little more than 15 miles. In 1916 it cost the railway $50 per tank car to ship water from Flagstaff, and the company sold water to the Forest Service and local residents for the same amount.[79] By the time Don Johnston and Aldo Leopold of the Forest Service described water acquisition in their plan for managing the development of the Grand Canyon Village, the sale of water to independents had already been well established.

Based on an account by Johnston and Leopold of a speech given to the public by Emery Kolb criticizing the ATSF and the Forest Service, it is known that Kolb purchased water from the railway. Kolb stretched the truth when he stated that the company charged him and his brother $66 a tank for water. The Forest Service investigated this statement and found that water did cost the Kolb Brothers $66. However, their tank held more water than contained in a tank car and therefore cost $16 extra to fill. Furthermore, the railroad "pumped and delivered [the water] to Kolb's tank free of charge," which he did not acknowledge during his speech.[80] No plans have been located during the research for this report that demonstrate how the railroad "pumped and delivered" water to the Kolbs. A field visit revealed two vitreous clay pipes leading to the general locations of the two tanks, the westernmost of which held water, depicted on the 1917 plan of the village. Still, there is no documentary evidence confirming that a water delivery pipe ran from the railroad tracks to Kolb's tanks. The Kolbs also installed a water heating system in 1916.[81]

It is implicitly known based on the Forest Service's statements in the Working Plan that Verkamp, and even Cameron, bought water from the railroad. Yet, they probably had to fill

[77] The ATSF removed the flume track and pump house; however, a portion of the concrete cistern still exists and is a contributing structure (L-22) to the Grand Canyon Village National Historic Landmark. It is assumed that the railroad left the water lines beneath the tracks in place. See Scott, et al., "Grand Canyon Village," p. 12.
[78] Chappell, "Grand Canyon Depot," np.
[79] Johnston and Leopold, "Working Plan," A-10.
[80] Johnston and Leopold, "Working Plan," A-10.
[81] Johnston and Leopold, "Working Plan," A-3.

containers at the water tank instead of having it pumped.[82] Johnston and Leopold noted that "it would be comparatively easy for [the railroad] to throttle competition" by cutting off the small concessioner's water supply, but that "there has been no disposition on the part of railroad officials to do this."[83] They later stated: "the Company could undoubtedly have complicated the furnishing of water to such an extent that the 'independents' would long ago have left this field, but [the railroad] did not."[84] Although the small concessioners were generally critical and dissatisfied with the ATSF, as was the Forest Service, they still continued to buy water from the railroad. In turn, the railroad did not preclude the independent businesses in the village by withholding access to potable water.

In addition to selling water to independent concessioners, the ATSF finally began selling water to Grand Canyon campers in the mid-1910s. At first, the railroad company provided water free of charge to campers at the Fred Harvey garage (Building No. 551); however, petty thievery caused the company to move the water station to a faucet by the power plant. During the 1916 tourist season water consumption by campers increased to "two barrels" (possibly two tank cars) per day, a great financial commitment by the railroad. The company then initiated the sale of water within the year, charging tourists 25 cents per day for access to the power plant faucet. Still, this did not prove a satisfactory return for the railroad.[85]

With the ever increasing visitation, the ATSF needed to ship more and more water to Grand Canyon Village. Initially, the railroad tank cars made weekly shipments of water, but this soon changed to daily deliveries. In 1917 five cars hauling 10,000 gallons per day served the average consumption of water in the Grand Canyon Village. Yet, during the busy season consumption reached 100,000 gallons per day for "weeks at a time."

When the Grand Canyon became a national park in 1919, the NPS immediately recognized the need for more water and a more efficient supply at Grand Canyon Village. That year, the NPS paid the ATSF an average of 75 cents per 1,000 gallons of water.[86] This high cost of water also impacted energy costs in the village as the railroad used steam to generate electricity.[87] In addition to high cost, the lack of available water precluded development in the village. The service was able to build a park administration building (Building No. 1) in 1921, but afterward only a few minor projects were completed. From 1922-23, the National Park Service made minor extensions of the water lines to the residential area. They also rearranged a few lines in

[82] Verkamp did not have water pipes installed to his store until 1924.
[83] Johnston and Leopold, "Working Plan," p. 1.
[84] Johnston and Leopold, "Working Plan," p. A-10.
[85] In order to monitor the sale of water, two proposals were made in 1916. First, slot machines were suggested, but the ATSF feared they would become jammed with "slugs and washers." The second solution was to install a faucet in a different location near the garage where a worker could observe the tourists obtaining water and charge the appropriate fee. Lack of funds prohibited the achievement of either suggestion. See Johnston and Leopold, "Working Plan," p. A-11.
[86] Peters, "Superintendent's Annual Report," p. 5.
[87] W.W. Crosby, "Superintendent's Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," 1922, p. 11, GRCA 54706.

order to increase efficiency and avoid waste. These were the only water related projects undertaken until the mid- to late-1920s.[88]

This insufficient water supply lasted until 1925, when ATSF made major changes to the rail and track alignments in the Grand Canyon Passenger Yard and wye track. During this period of construction, the railroad built a new water delivery track, Track No. 35, east of, but parallel to, the tail of the relocated wye track. Instead of simply parking over a flume that flowed into a cistern, a train crew spotted the arriving water tankers to align with a series of fourteen riser pipes spaced at train car-length intervals along the east side of Track No. 35. The train crew connected the water tank cars via hoses to the risers. The risers were connected to an 8" cast iron pipe that transitioned to a 10" cast iron pipe. Two motor-driven centrifugal unloading pumps located in a 13' x 21' reinforced concrete pump house (Building No. 131?), constructed circa 1925, unloaded the water into two cylindrical storage tanks standing to the east (see Appendix B, Figure 11: Water Service Record, showing pump house and three water tanks, Drawing No. 113-70091, Sheet 3 and Figure 12: Water unloading, GRCA 3605).[89]

Construction of this new water delivery track was part of the ATSF's major update to the utility infrastructure in Grand Canyon Village. The railroad company built a new Powerhouse (Building No. 58) in 1925 with the ATSF's Water Service Department laying the pipe needed for the new building.[90] Moving the Powerhouse and the water delivery system to their new positions also conformed to the Master Plan developed by Daniel P. Hull and adopted by the National Park Service in 1924.[91] In cooperation with the NPS, the company also completed construction of a new activated sludge treatment plant (Building No. 333) the following year. The new treatment plant supplied ample amounts of reclaimed water for industrial use throughout the village by the railroad, the Fred Harvey Company, and the National Park Service.

In addition to relocating the water delivery track, the ATSF refurbished the water delivery and storage system by moving the two water tanks at the east of the wye from a different location in Grand Canyon Village. In 1926 the railroad contracted with C.H. Basore of Pasadena, California to move two water tanks and three oil tanks to new points in the village by early spring.[92] The contractor was to stage the relocation of the water tanks, first moving a septic water tank, Tank No. 3, to high ground about 1,700 feet south of the Powerhouse.[93] Several months afterward, the contractor was to move a potable water tank, Tank No. 1, about 900 feet southwest of the

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[88] Crosby, "Annual Report," 1922, p. 7; 1923, p. 8.
[89] The railroad occasionally used the water delivery system at the wye track when the Grand Canyon Village needed a supplementary water source into the late 1960s. This mainly occurred when the Indian Gardens pipeline or pumps required repairs or Indian Gardens could not supply enough water to meet consumption needs. This system has been completely obliterated. See Chappell, "Grand Canyon Depot," np; Willy, "Fred Harvey's Facilities," p. 25.
[90] Mr. Ransom led the pipe laying project. The 1926 "Powerhouse" will be referred to as such in order to prevent confusion with the 1905 "power plant." See Chappell, "Grand Canyon Depot," np.
[91] Daniel P. Hull, "Grand Canyon National Park, General Plan: Community Development," June 24, 1924, GRCA 63411 and Denver Service Center, Technical Information Center 46.
[92] It is unknown from where the oil tanks came or where they were relocated.
[93] The railroad raised Tank 3, the septic water tank, several feet to increase capacity in 1923. See "Atchison, Topeka & Santa Fe Railway—El Tovar Hotel," *Santa Fe Magazine* XVII, no. 12 (November 1923): p. 69; ATSF, "Water Service Record," ca. 1932, p. 9.

Powerhouse.[94] Though not specifically stated, the water tanks that C.H. Basore relocated were two of the three water tanks behind El Tovar. The 1928 pipeline plan shows that the tanks behind El Tovar had been removed by that time.[95] Moreover, the railroad's Water Service Record confirms that Tank No. 1, a potable water tank built in 1905, was moved in 1927, and that Tank No. 3, a septic water tank built in 1917, was relocated in 1927. Tank No. 1 (Building No. 39), a 300,000-gallon capacity a freshwater tank, was the first water tank built behind El Tovar in 1905. Contractor, C.H. Basore, moved Tank No. 1 to a location east of the wye track and Tank No. 3 to a location near the recreational fields.[96] The Water Service Record also notes that the railroad built Tank No. 2 (Building No. 38), an 800,000-gallon potable water tank, in 1927. They located this tank next to Tank No. 1 (see Appendix B, Figure 13: Three water storage tanks from utility facilities at Grand Canyon Village, GRCA 59005, Photo 8080). All tanks were built on rubble masonry foundations.[97] Tanks 1 and 2, located near the end of the wye track, stored water for Grand Canyon Village for many years.[98]

A 12" cast iron water pipe carried the water delivered by the train from the tanks to the east end of the Powerhouse. From the Powerhouse, an automatic motor-driven centrifugal pump forced the potable water to various locations throughout the village for both domestic use and fire suppression (see Appendix B, Figure 14: Water Service Record, Drawing No. 113-70091, Sheet 2).[99]

Fresh water had to be used for the fire suppression lines because reclaim water became stagnant after sitting in the lines for long periods of time, clogging the system. Therefore, one pipe often served both domestic and fire suppression purposes, such as the 6" line leading north to the Bright Angel Hotel complex, or the line leading east from the Powerhouse and branching to these Fred Harvey mule barn, livery stable, mess hall and beyond. The water line to the Fred Harvey utility buildings replaced a 4" pipe from the tanks at El Tovar that the railroad likely installed after abandonment of the wood water tank and associated lines in 1916.

In other locations separate pipes for potable water and fire suppression were installed in Grand Canyon Village. This included the main 6" cast iron potable water line that fed branch lines to El Tovar, Hopi House, Verkamp's Curios, the Depot, the park administration building (Building No. 1), and the Fred Harvey garage, which was paralleled by a 10" cast iron fire line. The ATSF had added a branch line to Verkamp's Curios by 1924, when the independent store received a

[94] Santa Fe, General Contract, Short Form, between C.H. Basore and Atchison, Topeka & Santa Fe Railway Company, February 3, 1926, GRCA 66101.
[95] Atchison, Topeka & Santa Fe Railway Company, "Pipeline Map of Grand Canyon, Ariz.," May 16, 1928, Denver Service Center, Technical Information Center 113-70179.
[96] Eddie Newman, "Moving a Tank from El Tovar to the Recreation Grounds at Grand Canyon," 1925.
[97] ATSF, "Water Service Record," ca. 1932, p. 9.
[98] The new water tanks also directly supplied a series of carbodies [sic] positioned directly south of the tanks for Mexican worker housing with domestic water and fire suppression via a ¾" pipe. Neither tank exists today. See AT&SF Railway Company, "Water Line to Mexican Carbodies at Grand Canyon," Drawing No. 100-12708, July 30, 1928, GRCA 34990.
[99] Willy, "Fred Harvey's Facilities, p. 25.

license from the railroad for water and sewer lines.[100] Oftentimes, the independent fire suppression line would encircle a particular building or a group of buildings, such as the Fred Harvey Garage, the El Tovar complex, or the Powerhouse and Fred Harvey laundry.

In 1927, the ATSF built a 150,000-gallon water tower, Tank No. 4 (Building No. 36), mainly for fire suppression in Grand Canyon Village. In connection with this project, they extended the main water and fire suppression main from Fred Harvey garage south to the top of Juniper Hill where the new tower stood.[101] The majority of water in this tower was reserved for fire suppression and only the top 6' was permitted to be drawn down for domestic use.[102] The 10" fire line associated with this system connected to as many as nine hydrants around El Tovar, the depot, and along the canyon rim. Since a pump at one end and gravity at the other pressurized both lines, the fire line could maintain 150 pounds of pressure in case of fire.[103]

ATSF also moved the water column used for filling the locomotive tender tanks during the reconstruction and reconfiguration of the rail yard in 1925. The railroad relocated the water column on the Main Track opposite the old sewage treatment plant. This water column likely filled engines with potable water until the completion of the new activated sludge treatment plant in 1926, which filtered the reclaim septic water adequately enough for use in train engines.

With the new water delivery system, the NPS began supplying free water to campers in the summer of 1925. Park officials continued to purchase the water from the railroad at cost but believed providing it free to campers to be a more economical alternative than installing potable water lines to the public campground. Moreover, park officials saw this solution as a simple and cheap way to make "friends," as campers forced to purchased water at the railroad station generally did not have adequate containers and typically were indignant about paying even after it was explained to them that the water had been hauled from Flagstaff or beyond. In 1931, the

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[100] This installation corresponds with John Verkamp's request to have sewer, water, and heat installed to his building in 1923. See Letter from John Verkamp to J.D. McCully, Superintendent, AT&SF Railway Company, July 12, 1923, GRCA 49363; AT&SF Railway Company, "Grand Canyon Station Plat, the Grand Canyon Railway Operated by the Atchison, Topeka & Santa Fe Railway Co.," January 10, 1938, Denver Service Center, Technical Information Center 113-70056.

[101] Contractor S.C. Hichborn of Los Angeles, California poured the concrete platform for the water tower. The ATSF contracted with Hichborn previously to construct a concrete platform at the depot and made an addendum to the contract for the water tower platform work. The Chicago Bridge and Iron Works later assembled the 150,000-gallon water tank on the new foundation. The NPS "obliterated" this tower in 1966. Most likely, the buried water lines were left in place and used as part of the existing water system. See Letter from R.B. Ball, Chief Engineer, Atchison, Topeka and Santa Fe Railway Company Engineering Department to Mr. S.C. Hichborn, October 11, 1927, GRCA 66101; AT&SF Railway Company, "150,000 Gal. Elevated Steel Tank for Fire Protection System, Grand Canyon, Ariz.," October 29, 1927, rev. 1966, Denver Service Center, Technical Information Center 113-9001.

[102] Willy, "Fred Harvey Facilities," p. 25.

[103] As part of the fire protection system, the railroad also installed two fire pumps, a Duplex steam and a Dayton-Dowd electric, centrifugal, each with a capacity of 1,000 gallons per minute, a Gamewell System fire alarm with twenty-one pull boxes and an indicator to show the location of an activated alarm, and a La France chemical hose cart operated by a seven man team. Since this description is completely different than the fire protection system installed by the railroad in 1916, it is assumed that this is an update to that system. See Willy, "Fred Harvey Facilities," p. 25.

NPS also extended the water and fire protection lines to the park service administration area, presently Ranger Operations (Building No. 103).[104]

In the meantime, the ATSF added another building to the Fred Harvey utility area. In 1931, the company constructed a paint shop (Building No. 572) south of the laundry building for maintenance of the Fred Harvey Company Transportation Department. The plumbing for this building tied into the laundry's utility lines that ran from the Powerhouse to the northeast corner of the laundry. Beginning near that corner, the ATSF excavated a pipe trench along the east side of the laundry building to the northeast corner of the paint shop. In addition to a 2" cast iron pipe for domestic water, the trench also held an effluent line, a sewer line, a steam line, and air line for a compressor, and a drain pipe leading to an oil reclaiming sump.[105]

Even with the new system, the delivery of water by train did not supply enough water to meet the mounting demands of the new buildings in the park and the increasing number of visitors to the South Rim. During 1928, 164,665 people came to the Grand Canyon, nearly 31,000 more than two years prior. Water costs continued to rise, reaching $3.09 for 1,000 gallons by 1928.[106] Facing continued water shortages, the ATSF considered the springs at Indian Gardens as a potential water source for several years. In 1927, with permission from the NPS, the railroad undertook work at the spring to see if the water supply would be sufficient for daily use. After increasing the flow to approximately 576,000 gallons per day, the railroad company decided to pursue construction of a pipeline between Indian Gardens and Grand Canyon Village.[107] Four years later the ATSF began construction of such a system.[108] On August 26, 1932, one year after construction commenced, the railroad placed the new pipeline from Indian Gardens to the Rim into service.[109]

The 6" pipeline rose from Indian Gardens, 3,400' to the canyon's rim, crested the South Rim near the eastern most building in the Bright Angel Hotel complex and led below grade south across Bright Angel Wash to the south side of the Powerhouse.[110] There, pumps pushed the water though separate 6" cast iron pipes to the two relocated storage tanks at the end of the wye

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[104] In 1927 the NPS opened a new Public Campground west of the wye track. This area is presently known as Maswick Motor Lodge. The pump house at the water delivery track pumped water west directly to the Public Campground (Building No. 130?). The following year, the park rebuilt the entire water system in the park headquarters area, the residential area southeast of the village, to provide more pressure and supply. See J.R. Eakin, Preface to "Superintendent's Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," 1925, p. 4, GRCA 54706; M.R. Tillotson, "Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," 1927, p. 7, GRCA 65017; M.R. Tillotson, "Superintendent's Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," 1928, p. 7, GRCA 54706; M.R. Tillotson, "Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," 1931, p. 21, GRCA 54706.

[105] Atchison, Topeka & Santa Fe Railway Company, "Auto Paint Shop for Transportation Department, Grand Canyon, Arizona," April 1, 1931, revised November 30, 1931, GRCA 68485.

[106] Willy,"Fred Harvey's Facilities," p. 24.

[107] Tillotson, "Annual Report," 1927, p. 7; Anderson, *Polishing the Jewel*, p. 16.

[108] The Indian Gardens Pipeline is outside of the study area for this project and will not be elaborated upon in this report.

[109] Chappell, "Grand Canyon Depot," np.

[110] "Map Showing Location of Pipe Line and Description of Land at Grand Canyon, Arizona in the Grand Canyon National Park," September 19, 1932, GRCA 68422.

(Building No. 38 & 39), as well as to the hotels and the relocated water tower atop Juniper Hill (Building No. 42). A 10" cast iron fire line continued to parallel the potable water line to the hotels and Juniper Hill water tower. In addition, a 3" cast iron pipe exited the north side of the Powerhouse and led west to supply the laundry and the spray ponds. After 1932, a 2" cast iron pipe connected with the brine tanks (Building No. 232) on the south side of the Powerhouse.[111] Around 1932, the ATSF began softening the water from Indian Gardens with brine.[112] That year, the railroad proposed to locate two aboveground, 5.25' diameter brine tanks south of the Powerhouse and just northeast of four buried oil tanks.[113] Pipes between the south elevation of the Powerhouse and the brine tanks include 3" brine, 2" water, and 2 ½" conduit, which entered a valve box on the north side of the tanks. This system of water softening required periodic cleansing. The used brine water, also known as "blow down," could not be dispensed of into the sewage treatment plant or it would upset the water reclamation process. Therefore, the railroad diverted this used brine water to a blow off tank near the southwest corner of the Powerhouse. From there, the brine blow down pipe led into the settling tank of the old sewage treatment plant via an 8" clay tile pipe, and then exited the settling tank via a 6" clay tile pipe. This pipe connected with the abandoned 8" vitreous clay laundry bypass located in the drainage ditch in Bright Angel Wash that was constructed in 1926.[114] Just west of the oil sump, the oil drain line connected with the brine drain, which led to the activated sludge treatment plant.[115]

Although the water supply changed from train delivery to the local source at Indian Gardens, domestic lines in Grand Canyon Village remained unchanged. The new water source did not reduce the need for water conservation; therefore, the concessioners and the NPS continued to use reclaimed water for industrial purposes as much as possible.[116] Establishment of this permanent water source at Grand Canyon reduced the price of water from $3.09 to $1.66 per thousand gallons. Yet, it took the ATSF until April 1934 to begin charging the Park Service that price. The railroad company reimbursed the NPS for overpayment retroactive to September 1, 1932.[117]

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[111] Atchison, Topeka & Santa Fe Railway Company, "Grand Canyon, Ariz.—Albuquerque Division: Water Service Record," ca. 1932, rev. January 1933, rev. February 1936, rev. November 1941, Sheet 2, Denver Service Center, Technical Information Center 113-3405, GRCA 87749.

[112] The railroad company also used chlorinators and a zeolite plant inside the Powerhouse for water treatment, though it is unclear when these were installed. ATSF, "Water Service Record," Sheet 10.

[113] Atchison, Topeka & Santa Fe Railway System, "Proposed Brine Tanks in Connection with Water Softening System," June 8, 1932, Denver Service Center, Technical Information Center 113-3034.

[114] At first, Sanitary Engineer H.B. Hommon thought that soaps in the laundry wastewater would cause foaming of the reclaim water, preventing its use in the boilers, so the engineers bypassed the gray water around the sewage treatment plant. However, the new activated sludge treatment plant filtered the water so well that the laundry's gray water did not affect the quality of the reclaimed septic water, after which the railroad simply abandoned the bypass line in place.

[115] The NPS abandoned this line a second time when they ceased using the pumps and water softening plants in the Powerhouse in 1970 upon establishment of a new water source and delivery system. The brine tanks are no longer extant. See Atchison, Topeka & Santa Fe Railway Company, "Grand Canyon Pipeline and Building Map," November 30, 1937, Denver Service Center, Technical Information Center 113-5713.

[116] M.R. Tillotson, "Superintendent's Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," 1932, p. 34, GRCA 54706.

[117] M.R. Tillotson, "Grand Canyon National Park, Construction and Operation Activities in Grand Canyon National Park and Grand Canyon National Monument," 1934, p. 3, GRCA 54706.

The arrival of the Civilian Conservation Corps (CCC) in 1933 provided Grand Canyon National Park with an unlimited labor force for nearly a decade. Two camps stationed at the Grand Canyon Village, Camps NP-2A and NP-4A, undertook multiple improvement projects in and around the village until they were decommissioned in 1942. Although the CCC laborers worked on numerous projects in the village, like extending water, fire, sewer and electric lines, many of these construction projects were outside of the study area for this report.[118] When the CCC installed water and sewer utility lines, crews worked under supervision of the park's plumber.[119]

While the CCC labored on Park Service projects, the ATSF began the major redevelopment of Bright Angel Hotel.[120] In 1934-35, the railroad followed Fred Harvey company architect Mary Colter's design and demolished most of the old Bright Angel Hotel. The new Bright Angel Lodge complex was built in its place. Based on Colter's design, the railroad retained the Buckey O'Neil Cabin and the Cameron Cabin, incorporating them into the new lodge complex.[121] The railroad constructed Bright Angel Lodge proper (Building No. 507), as well as a large flagstone patio, over top the Indian Springs pipeline and trench.[122]

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[118] These CCC projects occurred in the public campground, the employee campground, the park service utility and residential areas, and both CCC camps. Usually twenty men from each camp worked on these utility installation projects, which involved excavating a trench, oftentimes blasting through solid rock, and laying water, sewer, reclaim and electric conduit pipes. See J.W. Haines, "Narrative Report for the Period October 1, 1934 to December 31, 1934 [corrected by hand to March 31, 1935] ECW Camp NP 2-A Powell South Rim, Grand Canyon National Park, Arizona," March 1935, GRCA 29844; H.A. Montgomery, Monthly Report Letter to Mr. Kittredge, March 5, 1935, p. 4, GRCA 29865; J.V. Lloyd, "Special Report of Accomplishments of Civilian Conservation Corps, 1938," 1938, p. 3, GRCA 29870; W.H. Wirt, "Report to the Chief Forester on Emergency Conservation Work at Grand Canyon National Park," June 17-20, 1935, pp. 2, 4, GRCA 29858.

[119] Carl A. Taubert, "Record of Inspection," April 24 & 25, 1942, GRCA 29860.

[120] Myers Brothers of Los Angeles, California served as the general contractor for the Bright Angel Lodge construction (see Santa Fe Building Contract between Myers Brothers and Atchison, Topeka & Santa Fe Railway Company, September 1, 1934, GRCA 66101). Also of Los Angeles, Wm. P. Niel Company, Ltd. served as the general contractor for the construction of the "west area of Bright Angel Lodge," which included the addition to Buckey O'Neil Cabin, Powell Lodge, and the Bright Angel Cabins (see Santa Fe Building Contract between Wm. P. Neil Company, Ltd. and Atchison, Topeka & Santa Fe Railway Company, March 9, 1935, GRCA 66101). The general contract for Bright Angel Lodge proper included moving the Brown Building, built in 1913 as the eastern dormitory in the Bright Angel Hotel complex, approximately 200' to the east. The ATSF arranged the reconnection of the plumbing for this building; however, the details of this project are not known. The railroad proposed to move the Brown Building again in 1937, but did not follow through. The Brown Building was finally moved to its current location sometime between 1951 and 1967 (see Building Contract, September 1, 1934; Atchison, Topeka & Santa Fe Railway Company, "Specifications for Concrete Masonry & Log Lodge at Grand Canyon, Arizona for the Atchison, Topeka & Santa Fe Railway Company (Coast Lines)," ca. 1934a, Sheet 2, GRCA 66101; "Inventory of Water, Reclaimed Water and Steam Meters on AT&SF Railway Company and NPS Lines in Grand Canyon Village," ca. 1953, GRCA 49259).

[121] The CCC peripherally assisted with this project by excavating and installing the Bright Angel cabins sewer main, connecting it with the government trunk line to the southwest.

[122] The National Historic Landmark Nomination states that the CCC built the "flagstone esplanade" in 1939, yet the list of contributing structures in the nomination attributes the patio to the ATSF. The specifications for Bright Angel Lodge indicate that the general contractor, Myers Brothers, completed the flagstone paving in and around the lodge. No evidence of repair to the water pipe beneath the patio is apparent, as the contiguous flagstone and matching mortar show no signs of removal. The Indian Gardens pipeline beneath Bright Angel Lodge proper and the patio was abandoned in place and still exists today. See Scott, et al., "Grand Canyon Village," p. 9.

When excavating for the potable water and fire lines for Bright Angel Lodge, the ATSF did not reuse many of the existing trenches. While the railroad company excavated trenches outside the new buildings, the plumbing and heating contractor, Howe Brothers of Los Angeles, California installed the pipes for the Bright Angel Lodge complex.[123] The railroad and Howe Brothers shifted the branch from the main water line north of the previous branch and divided it into separate domestic and fire lines. The 8" cast iron fire line extended west along the south side of Bright Angel Lodge, supplying two hydrants, to a point where it crossed the Buckey O'Neil Lodge sewer line. From that point, the fire line ran north between Buckey O'Neil and Powell Lodge (Building No. 509) and then turned west to join in a utility trench excavated by the railroad circling through the Bright Angel Cabins (Building Nos. 510-525 and 527-531). The fire line also branched north to the canyon rim from the section between the two buildings to supply one hydrant.[124]

The Bright Angel Lodge's domestic line, a 4" cast iron pipe, paralleled the fire line for a short distance and then connected to an existing pipe chase previously excavated between the Powerhouse and the eastern dormitory of the former hotel. It then distributed potable water inside the Bright Angel Lodge, the Buckey O'Neil Cabin, and Powell Lodge through pipes in the steam tunnels excavated by the Bright Angel Lodge general contractor, the Myers Brothers, beneath these three buildings.[125] The line then exited the north leg of the cross-shaped Powell Lodge and circled through the Bright Angel Cabin complex parallel to the fire line in the railroad excavated utility trench. This line serviced a stone drinking fountain in the cabin area as well.[126] Additionally, from the water line in the cabin complex branched a ¾" pipe to Lookout Studio buried in a 2' trench excavated by the railroad and a pipe to Kolb Studio in an extended mining shaft.[127]

While the ATSF was building the new Bright Angel Lodge, the NPS commenced construction of a new road, Hermit Rim Road, which avoided the hill up to El Tovar. The new road passed just north of the depot and traveled east along the railroad to provide access to the new Bright Angel Lodge. Today this road is the northern portion of Village Loop Road. New Deal money and the CCC made this project possible. During road construction in 1934, the CCC laborers had to

[123] Santa Fe Building Contract between Howe Brothers and Atchison, Topeka & Santa Fe Railway Company, October 1, 1934, GRCA 66101; Letter from Chief Engineer M.C. Blanchard of Atchison, Topeka & Santa Fe Railway Company to Howe Brothers, March 29, 1935, GRCA 66101.
[124] The hydrant locations are still in use; however, the hydrants have been replaced. One PIV that may be original is located in the western portion of the Bright Angel Cabin area.
[125] Santa Fe Building Contract, September 1, 1934; Santa Fe Building Contract between Wm. P. Neil Company, Ltd., and Atchison, Topeka & Santa Fe Railway Company, March 9, 1935, GRCA 66101.
[126] The stone drinking fountain (L-10) is a contributing structure in the Grand Canyon Village National Historic Landmark, see Scott et al, "Grand Canyon Village," p. 10.
[127] The mining shaft was from Ralph Cameron's Cape Horn claim. The shaft had probably been extended to access the utilities installed by the railroad by 1930, when Emery Kolb received a license from the railroad for a steam line. Landon, "Ways Map of South Rim Grand Canyon"; Atchison, Topeka & Santa Fe Railway Company, "Grand Canyon Station Plat, the Grand Canyon Railway Operated by the Atchison, Topeka & Santa Fe Railway Co.," January 10, 1938, Denver Service Center, Technical Information Center 113-70056.

reconstruct a steam tunnel to El Tovar.[128] In addition, they likely found the main domestic water and fire lines beneath the road and had to construct appropriate trenches for them.

Two years after completion of Bright Angel Lodge, the ATSF built a new female dormitory, Colter Hall (Building No. 539), southwest of El Tovar. Also designed by Mary Colter, the new dormitory replaced and enlarged the dormitory built in 1913 for Fred Harvey employees working at El Tovar.[129] The railroad's water department reused the same potable water trench leading to the old dormitory for the new building. A 3" galvanized line ran south from the main line along the rim to a pump in the west end of El Tovar. A 4" line then exited El Tovar near its entry point and flowed south to Colter Hall.

Although the Depression caused economic hardship in the United States throughout the 1930s, Grand Canyon National Park only experienced a decrease in visitation during 1932 and 1933. In 1934, 146,850 people came to the park. Afterward, the number of tourists increased at a faster rate than the prior decade. In three years that number more than doubled to 304,794.[130] With improvements, additions, and repairs made by ATSF, Fred Harvey Company, and the CCC, Grand Canyon Village was able to handle the onslaught of sightseers that came to the park until the beginning of World War II.[131] Based on the ever-growing number of visitors, such investments, like the installation of a sprinkler system in El Tovar, Hopi House, and the Fred Harvey Garage in 1937 and El Tovar's sheds three years later, could be justified.[132]

While the ATSF made improvements to Grand Canyon Village, the CCC completed additional utility projects in the village core. The CCC assisted Park Plumber Mott in laying new water lines to Park Superintendent Tillotson's House (Building No. 1) in 1937 after an unreachable leak apparently caused a large loss of water (see Appendix B, Figure 15: CCC crew constructing water pipe trench to Building No. 1, ca. 1935, GRCA 6610). The CCC laid the new water line in a service tunnel excavated by the US Bureau of Public Roads beneath the east end of Village Loop Road. This new tunnel made the water lines more accessible for repair work.[133]

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[128] This steam tunnel is still extant and the previously buried lines were presumably abandoned in place. J.H. Brannon, "Final Construction Report, Grading and Subgrade Reinforcement, Route 8, Hermit Rim Road, Grand Canyon National Park Project Nr. 8, Grading and Subgrade Reinforcement, Grand Canyon National Park, Coconino County, Arizona," United States Department of Agriculture, Bureau of Public Roads, District No. Two, September 25, 1936, pp. 4 and 9, Denver Service Center-Technical Information Center 113-459.

[129] Colter Hall replaced the Victor Hall Annex (Building No. 578), which was moved next to Victor Hall in the mid-1930s to make way the new dormitory construction.

[130] Anderson, *Polishing the Jewel*, p. 90.

[131] M.R. Tillotson, "Monthly Report to the Director of Activities at Grand Canyon National Park," July 2, 1937, GRCA 719.32/Monthly Reports-1937; M.R. Tillotson, "Annual Report for the Fiscal Year Ending June 30, 1937, Grand Canyon National Park, Grand Canyon, Arizona," July 20, 1937, GRCA 54706; H.C. Bryant, "Annual Report for the Fiscal Year Ending June 30, 1939, Grand Canyon National Park, Grand Canyon, Arizona," November 10, 1939, p. 12, GRCA 54706.

[132] Tillotson, "Monthly Report," July 2, 1937; Tillotson, "Annual Report," July 20, 1937; Alfred C. Kuehl, "Monthly Narrative Report to Chief Architect," April 20-May 20, 1937, GRCA 29864.

[133] Willard Bradley, "Monthly Summary, Grand Canyon National Park, Grand Canyon, Arizona," May 1937, p. 2, GRCA 29865.

A large leak in the main water line in 1937 inspired the Park's Assistant Engineer, Willard Bradley, to revise the water system in Grand Canyon Village and the Public Campground. In June 1937, he uncovered the entire system in the village, including domestic and septic water lines "to determine the locations of leaks, condition, size and location of pipes, fitting, valves, meters, etc." Workmen repaired all of the located leaks. Additionally, Bradley made surveys so that this information could be correctly mapped and used to make a plan of recommended changes, revisions, and additions to reduce water loss.[134] Superintendent Tillotson approved Bradley's plans for improvements to the water line in the fall of 1937, which included work in the government residential and industrial area.[135]

During World War II, construction nearly ceased in Grand Canyon Village and many of the concessioner services were discontinued. The CCC completed a few water and sewer line extensions to new houses in the ATSF residential area before being decommissioned in 1942. That year, beyond completion of this housing, the railroad only cleaned and painted the water tanks east of the wye and painted and landscaped with plantings the exposed 1925-26 pipeline and stanchions to El Tovar.[136] The railroad ceased daily passenger service and Fred Harvey Company closed all public buildings at Grand Canyon Village except El Tovar from mid-1942 to mid-1946.[137]

In addition to limited building supplies, the numerous men leaving their positions for the war effort caused a detrimental decrease in staff, affecting the ability not only to build, but also to maintain the buildings and systems in Grand Canyon Village. The NPS experienced a particular problem in this regard when the plumber, presumably Mr. Mott, left in 1944. It was not until at least 1946 that the park was able to replace him.[138]

During World War II a severe drought caused the ATSF to resume water delivery to the South Rim. Although the village did not need the water, cattleman outside the park purchased this water for their livestock as their cattle tanks had gone dry. From 1945 to 1946, the train made weekly deliveries and the cattleman hauled the water from the Grand Canyon Depot to their herds outside the park.[139]

Since the park could not undertake construction projects during World War II, park officials began planning for improvement projects to initiate after the war and updating records. They

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[134] Tillotson, "Monthly Report," July 2, 1937, p. 5.
[135] Willard Bradley, "Monthly Summary, Grand Canyon National Park, Grand Canyon, Arizona," September 1937, p. 1, GRCA 29865.
[136] In 1937 the ATSF added a third water tank for reclaim water storage (Building No. 42) to the tank farm at the end of the wye track. It is no longer extant. The pipe stanchions are still extant, but the pipes have been removed.
[137] H.C. Bryant, "Annual Report for the Fiscal Year Ending June 30, 1942, Grand Canyon National Park, Grand Canyon, Arizona," 1942, pp. 4-5, GRCA 54706; H.C. Bryant, "Annual Report for the Fiscal Year Ending June 30, 1943, Grand Canyon National Park, Grand Canyon, Arizona," 1943, p. 2, GRCA 54706.
[138] H.C. Bryant, "Superintendent Annual Report, 6-30-44, Grand Canyon National Park, Grand Canyon Arizona," 1944, p. 1, GRCA 54706; H.C. Bryant, "Annual Report (Superintendents), Grand Canyon National Park, Grand Canyon, Arizona," 1945, p. 1, GRCA 54706.
[139] Bryant, "Annual Report," 1945, p. 3; H.C. Bryant, "Annual Report (Superintendents), Grand Canyon National Park, Grand Canyon, Arizona," 1946, p. 1, GRCA 54706.

made extensive plans to move the NPS utility area and more. The park engineer updated the utility plans and inventoried all of the buildings in the park. Most likely, the water, fire, and reclaim line plan from 1944-45 is one of these updated drawings. Early in 1946 park officials also began scouting for new water sources, as they realized that expansion to meet the growing number of visitors could only happen with an increased water supply. They made reconnaissance trips to springs such as those at the head of Phantom Creek Canyon and Bright Angel Creek.[140]

As soon as World War II ended, people came to visit the Grand Canyon in "hordes," yet lack of funding from Congress and the residual wartime staff-level limited the park's ability to handle such crowds.[141] The concessioner's lodging and the park's campsites could not accommodate all the travelers wishing to stay overnight. In addition, the facilities and physical plant were not able to meet the demands of the growing number of visitors.[142]

At Grand Canyon Village these conditions continued into the 1950s, exacerbated by the limited improvements made by concessioners. In 1951 only the ATSF had a current contract with the NPS; therefore, Fred Harvey Company and the independent concessioners were disinclined to undertake new projects.[143] Moreover, since ridership had generally been on the downswing, fluctuating wildly between just over 34,000 and nearly 64,500 passengers per year from 1946 to 1953, the railroad could not justify the major utility upgrades needed for expansion of the village.[144] The most costly improvement that park officials expected the ATSF to make was the establishment of a new water source.

The need for an expanded water supply for Grand Canyon Village became increasingly apparent as water use consistently reached historic highs. In June 1951, a record-breaking 7,282,500 gallons of water from Indian Gardens was consumed at the village. The following summer, use in July rose to 8,032,500 gallons or an average daily use of 83 gallons per person, breaking the previous record.[145] Yet, the railroad company did not seek an entirely new inner canyon source, probably figuring that the resumption of hauling water from Flagstaff at $3.00 per 1,000 gallons

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[140] Bryant, "Annual Report," 1945, pp. 2, 5; Bryant, "Annual Report," 1946, p. 1.
[141] Bryant, "Annual Report," 1946, p. 1.
[142] H.C. Bryant, "Annual Report (Superintendents), Grand Canyon National Park, Grand Canyon, Arizona," June 12, 1947, p. 1, GRCA 54706; H.C. Bryant, "Annual Report (Superintendents), Grand Canyon National Park, Grand Canyon, Arizona," July 1, 1948, p. 1, GRCA 54706; Lemuel A. Garrison, "Annual Report (Superintendents), Grand Canyon National Park, Grand Canyon, Arizona," 1948, p. 2, GRCA 54706; Lemuel A. Garrison, "Superintendent's Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," June 5, 1950, p. 1, GRCA 54706.
[143] H.C. Bryant, "Superintendent's Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," May 28, 1951, p. 6, GRCA 54706; H.C. Bryant, "Superintendent's Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," June 28, 1952, p. 8, GRCA 54706.
[144] In 1947, ridership reached 64,369, up from 36,248 the previous year. But then it dropped to 49,065 in 1948 and never reached that number again until 1953, when 54,919 people rode the train to Grand Canyon Village. The following year, the railroad transported only 35,904 riders to the canyon, a number never attained again during the remaining twelve years that the railroad provided passenger traffic. See Chappell, "Grand Canyon Depot," np.
[145] The average daily use of 83 gallons per person included the operation of utilities and trains. H.C. Bryant, "Superintendent's Annual Report [Supplement], Grand Canyon National Park, Grand Canyon, Arizona," July 12, 1951, p. 10, GRCA 54706; Bryant, "Superintendent's Annual Report," 1952, p. 8.

was a cheaper alternative.[146] As a possible temporary solution to the water supply problem, park officials proposed locating two new water tanks south of the three tanks at the end of the wye track in 1954.[147]

In 1954, the ATSF all but pulled out of its Grand Canyon investments, as the company could not justify making costly infrastructure improvements while ridership continued to decrease.[148] The ATSF sold all of its buildings, including El Tovar, Bright Angel Lodge, Hopi House, and Lookout Studio, as well as the Fred Harvey garage, laundry, mule barn, and livery to the concessioner, Fred Harvey Company for $1.5 million.[149] The National Park Service received a donation of the Powerhouse and associated steam and electrical conduit lines, and the utility systems including water, reclaim, and sewer, valued at nearly $1.1 million.[150] A plan of the water and fire lines was attached to the instrument of donation. As Regional Director Tillotson noted, "Quite possibly [the need for a improved water supply was] one of the factors that influenced the ATSF in donating the system."[151] The ATSF maintained ownership of the rail yard, track, and depot, as well as employee housing on Avenues A, B, and C.[152]

The NPS had no desire to operate utilities at Grand Canyon Village; however, they did operate the water system's control equipment and maintained water and fire lines throughout the village.[153] In turn, Fred Harvey Company maintained water lines on the service side of the water meters, which were mapped on the 1944-45 water line plan.[154] The railroad used several different brands for water meters in Grand Canyon Village, including a 2" Trident and a 3" Trident at Bright Angel Lodge and a 1" Nash at the Brown Building. The NPS provided water to Fred Harvey Company at cost – a rate acceptable to the concessioner.[155]

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[146] Anderson, *Polishing the Jewel*, p. 61.
[147] U.S. Department of the Interior, National Park Service, "Site Plan for Proposed New Water Tanks, South Rim, Grand Canyon National Park," June 1954, Denver Service Center, Technical Information Center 113-2260; U.S. Department of the Interior, National Park Service, "Utility Layout of Water and Sewage at Proposed New Water Tanks, South Rim, Grand Canyon National Park," July 1, 1954, Denver Service Center, Technical Information Center 113-2261.
[148] The railroad also balked at expanding outside of their 20-acre depot for fear of losing investments if the National Park Service did not renew the contract, see Anderson *Polishing the Jewel*, p. 48.
[149] Anderson, *Polishing the Jewel*, p. 49.
[150] This donation included utilities at Phantom Ranch, Hermit's Rest, Yaki Point, and Desert View. Still, the utilities for areas outside the village proper encompassed just over $14,000 of the appraised value. Exhibit A of the appraisal compiled by representatives from the Park Service and the ATSF provides a detailed list of all of the utilities built by the railroad for their operations in Grand Canyon. J.R. Lassiter, H.J. Cameron, J.H. Conn, F.B. Baldwin, G.B. Stearns, George L. Davenport, Jr., and L.A. Hughes, "Utility Facilities at Grand Canyon, Report on Joint Appraisal by Representatives of National Park Service and the Atchison, Topeka and Santa Fe Railway Company," September 10, 1953, Summary, Exhibit A, GRCA 59005; Gurley, "Instrument of Donation."
[151] M.R. Tillotson, "Report of the Evaluation of Utilities, Grand Canyon National Park," October 5, 1953, p. 2.
[152] Anderson, *Polishing the Jewel*, p. 49.
[153] Anderson, *Polishing the Jewel*, p. 49.
[154] Perhaps as an exhibit for the instrument of donation, a list of all of the water, reclaim water and steam meters, including location, size, brand, and owner, in Grand Canyon Village was compiled, see "Inventory of Water, Reclaimed Water and Steam Meters," ca. 1953.
[155] Howard J. Cameron, "Memorandum to Chief Engineer, Subject: Public Utilities—Grand Canyon National Park," November 18, 1953, p. 5, GRCA 40259; Sessions Engineering Company, "Fred Harvey Grand Canyon Cost of Utilities," ca. 1954, p. 2, GRCA 49259.

During the reorganization of park operations and responsibilities in Grand Canyon Village, the NPS adopted a service-wide initiative known as Mission 66. Director Conrad Wirth initiated this program in 1956, with the goal to improve the facilities for projected visitor increases at parks nationwide and to complete these improvements in time for the NPS's fiftieth anniversary in 1966. Meanwhile, officials at Grand Canyon National Park had already recognized the need to provide improved facilities for the growing number of tourists and created a Master Plan in 1950 in response. Many of the needs and goals identified in the Master Plan, including an improved water source, were simply transferred to the Mission 66 Prospectus.[156]

Although the park had ample funding for its Mission 66 projects beginning in 1956, it was not until 1965 that the park commenced construction of the Transcanyon Pipeline, the new water source for the South Rim. The new Transcanyon Pipeline used Roaring Springs on the North Rim as its water source.[157] This became possible after the Union Pacific Railroad donated its water system to the park.[158] In the interim, as an effort to defer the establishment of a new water source, the Park Service installed new water tanks, two 2 million gallon tanks (Tanks A and B) and one 30,000-gallon tank in 1957. The 2 million gallon tanks were constructed near Mather Point instead of the location in the village proposed three years prior. During the 1960s the park also built three 3 million gallon tanks (Tanks D, E and F) next to Tanks A and B (see Appendix B, Figure 16: Aerial view of 1957 and 1961 water tanks, GRCA 18822).[159]

The park initially connected the Transcanyon Pipeline (finished in 1970) with the Indian Gardens pipeline that was constructed in 1931-32.[160] The newly completed Transcanyon Pipeline delivered 190-million gallons of water to the South Rim annually. Instead of pumping water to the Powerhouse, the pipeline connected to a new water main installed by the park. This line extended east from the rail yard along Village Loop Road to Market Plaza and beyond to the tank farm at Mather Point.[161] This new water delivery system allowed the park to abandon the pumps and water softening equipment in the Powerhouse.[162]

In 1986-87, the park developed a new water delivery method for the South Rim that avoided using the Indian Gardens pipeline as the main line. This change was made because the exposed

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[156] Amanda Zeman, National Register of Historic Places, Multiple Property Determination of Eligibility: "Grand Canyon Village Mission 66 Planning Effort," 2003, p. 9.
[157] The water is chlorinated at Roaring Springs. Personal communication with Mike Martin, Park Service Engineer, August 10, 2006.
[158] The relationship between the concessioner, Union Pacific Railroad, and the National Park Service, Utah Parks, was a similar arrangement to the one between the ATSF and the Grand Canyon National Park on the South Rim.
[159] The storage tanks cost $376,000 in 1957, and $148,390 in 1961. The 30,000 gallon tank is the reclaimed tank at the athletic fields. Anderson, *Polishing the Jewel*, pp. 59 and 103; personal communication with Mike Martin, Park Service Engineer, August 10, 2006.
[160] The project was nearly completed in 1966; however, a 500-year flood destroyed the pipeline and it took until 1970 to rebuild the pipeline. See Anderson, *Polishing the Jewel*, p. 61.
[161] Personal communication with Martin, August 10, 2006.
[162] The plant had stopped generating electricity in 1955 and steam in 1956, but the park continued operating water related equipment in connection with the Indian Gardens pipeline until the completion of the Transcanyon Pipeline in 1970. Most likely, the entire Indian Gardens' line has been abandoned in place. The portion rising from the inner canyon and extending beneath the Bright Angel patio and lodge is still extant.

Indian Gardens' pipe often froze during the winter resulting in a need to drain the pipe when not in use. The park hired an oil-drilling rig to bore through the upper layers of the Canyon near Yavapai Observation Station down to the Indian Gardens (see Appendix B, Figure 17: Drilling pipeline, GRCA 12115). The park then connected an 8" line to the Transcanyon Pipeline, retaining the connection with the Indian Gardens pipeline. The Indian Gardens pipeline remains operational, but only as a gravity-fed line that services 1.5-Mile and 3-Mile Rest Houses.[163] Since most of Grand Canyon Village's historic core had already been developed, the only Mission 66 projects completed within this project's study area were two new hotels on the South Rim. These projects were not completed until Amfac, Inc., purchased Fred Harvey Company, who was facing serious financial trouble in 1968.[164] Amfac provided the financial backing for both Thunderbird (Building No. 1300, built 1968) and Kachina (Building No. 1320, built 1971) Lodges. Pipelines leading south from the main line along the rim supply domestic water for both buildings.[165]

Water use on the South Rim exceeded the Transcanyon Pipeline's capacity of 190 million gallons in 1980. The attendant upgrades to pipelines, pumps, and distribution system started in the mid-1980s and the addition of a 13-million gallon storage tank have made little difference because of the increased demand. Presently, the park continues to maintain this system with relatively good success by quickly fixing leaks and occasional conservation measures.[166]

[163] Personal communication with Martin, August 10, 2006.
[164] Zeman, "Grand Canyon Village, Mission 66 Planning Effort," p. 12.
[165] Atchison, Topeka & Santa Fe Railway Company, "Grand Canyon Pipeline and Building Map," November 30, 1937, revised April 1951, revised circa 1971, Denver Service Center, Technical Information Center 113-70069B; Mel C. Ensign, "Kachina Lodge for Fred Harvey, Grand Canyon, Arizona," November 21, 1969, Denver Service Center, Technical Information Center 113-41943.
[166] Anderson, *Polishing the Jewel*, pp. 78-79; personal communication with Martin, August 10, 2006.

II. The Development of the Grand Canyon Village Sewer and Reclaim Water Systems

In addition to acquiring adequate amounts of water for the developing Grand Canyon Village, the disposal of waste was an issue for the ATSF from the outset. Initially, the earliest and independent inhabitants, such as Ralph Cameron, James Thurber, John Verkamp, and the Kolb Brothers likely dug pit toilets. However, these probably were unsatisfactory since the limestone bedrock located just below grade would have made these toilets quite shallow while also preventing proper drainage. Visitation to the village increased in the first decade of the twentieth century, taxing the pit toilets serving the Bright Angel Hotel (which did not have indoor plumbing).

The ATSF constructed the first septic tank in Grand Canyon Village in conjunction with the El Tovar Hotel (Building No. 542). Actually located south and down the slope from the hotel, this site does not seem to be the position proposed by the architect, George Whittlesly, when he conceived of the building and its grounds in 1903. A plan from that year shows the septic tank just west of a semicircular "yard" that extended from the west wing.[167] Based on plans as early as 1910, it appears that the railroad did not construct the yard or the septic tank as planned. Instead, the ATSF built a larger concrete septic tank to the south on the side of El Tovar hill.[168]

It is not known how long this circa 1905 septic tank served El Tovar Hotel, but presumably it only functioned independently for a year or so. The Hopi House (Building No. 545), built around the same time, also connected to the tank. This small septic tank must have quickly been overloaded, since the hotel could accommodate as many as 175 guests in ninety-three rooms.[169] With visitation nearly doubling from 1902 to 1903, when almost 13,000 people came to the village, one can also assume that visitors complained a great deal about the inadequacy of the pit toilets built around the village, particularly at Bright Angel Hotel. With visitor totals increasing 5,000 more by 1907, the ATSF desperately needed to solve both the growing waste and water issues at Grand Canyon Village.[170]

The 1977 HAER report recording the Grand Canyon National Park Water Reclamation Plant (Building No. 333) dated the first sewage treatment plant (Building No. 207?) to circa 1913, but in all likelihood the ATSF built this larger sewage treatment plant just after completing El Tovar.[171] George Davenport, an assistant engineer for the ATSF, noted in an unpublished report on the reclaimed water use at the Grand Canyon that the ATSF built the first sewage treatment plant in 1906.[172] The 1953 appraisal of the utilities in Grand Canyon Village also dated this

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[167] Whittlesly, "Hotel Building at the Grand Canyon for the Santa Fe," Sheet 2.
[168] Grand Canyon Railway, "Drawing No. 83-7770, Proposed Depot at Grand Canyon, Arizona," September 1907.
[169] Though each room had hot and cold running water, the hotel initially installed only one bathroom on each floor. Use of the bath required a reservation. By 1920, forty-six of the ninety-three rooms had private baths. The septic tank is no longer extant. Fred Harvey, "Grand Canyon of Arizona" (Chicago: Rand McNally, 1911); Peters, "Superintendent's Annual Report," 1920, p. 4.
[170] Chappell, "Grand Canyon Depot," np.
[171] The HAER report did not provide a source for the circa 1913 date, see Dennis M. Zembala, "Grand Canyon Water Reclamation Plant," HAER No. AZ-3, 1977, p. 2.
[172] George Davenport, "The Use of Reclaimed Sewage Water at Grand Canyon, Arizona," Unpublished Report, May 3, 1938, p. 1.

sewage treatment plant to that year.[173] Moreover, Superintendent Eakin wrote in his 1924 Annual Report that the ATSF built the current sewage disposal plant about nineteen years prior, or circa 1905.[174] The station plan from 1907 that shows El Tovar's septic tank depicts a sewer line leading from the southwest corner of the tank southwest below the power plant (Building No. 58) to the railroad track and then west, presumably to the sewage treatment plant. Regardless, the railroad definitely completed the plant by the spring of 1908 based on Grand Canyon Railway as-constructed plans.[175]

The ATSF constructed a new sewage treatment plant in the wye of the Grand Canyon Station tracks. This location, downhill from the village in Bright Angel Wash, allowed sewage to flow by gravity to the treatment plant from three directions. An 8" sewer pipe from the east arrived from El Tovar and Hopi House (see Appendix B, Figure 18: The Grand Canyon Railway Company, "Pro. Renewal of Sewer from Hopi House to Main Sewer at Grand Canyon," Drawing No. 100-7100, 1910, GRCA 66101-34). A second pipe led down from Bright Angel Hotel. The third pipe collected waste from the south where the Fred Harvey livery stable (Building No. 563) and trail stock stable (Building No. 562), as well as a Fred Harvey work shop (Building No. unknown), mess hall (Building No. unknown), and bunk house (Building No. 557) stood.[176] The three pipes, made of vitrified clay, joined at a manhole approximately 270' northeast of the plant.[177]

Obviously, the new sewage treatment plant offset the strain on El Tovar's septic tank, as well as some of the pit toilets. Just as importantly, the ATSF designed the plant to reuse wastewater from the village. Since water supply was limited and shipments were increasingly expensive, the ATSF intended to use effluent reclaimed from the treatment plant for irrigating El Tovar's lawns, tending locomotives, and boiler use in the power plant.[178] The railroad also used the effluent for washing carriages and cleaning stable floors.[179] Even though the plant was constructed circa 1913, this plant was considered a progressive and early approach to water conservation and "one of the pioneer water reclamation systems in the semi-arid American West."[180]

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[173] Lassiter, et al., "Utility Facilities at Grand Canyon," Exhibit A-4, p. 7.
[174] J.R. Eakin, "Superintendent's Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," 1924, p. 10, GRCA 54706.
[175] The plans show proposed hog corrals relative to the location of the as-constructed sewage treatment plant. For the purposes of this report, the date circa 1906 will be used for the sewage treatment plant, since the railroad built an addition to the power plant to treat effluent for boiler use in 1906 and two legitimate sources provide this precise year. See Grand Canyon Railway Company, "Drawing No. 83-8021, Proposed Hog Corrals at Grand Canyon, Arizona," March 10, 1908, GRCA 67622.
[176] The Fred Harvey trail stock stable is currently referred to as the mule barn. The Fred Harvey mess hall no longer exists; it was torn down circa 1981. The bunkhouse exists today and is commonly referred to as Shirley Hall (Building No. 557).
[177] Manufacturers developed a method to make extruded vitrified clay pipe for sewers in 1865, after which time the production and use of this pipe intensified. The heavy, cumbersome pipe had to be transported by train, like the Grand Canyon Railway, or over water.
[178] H.B. Hommon, "Sewage Treatment at the Grand Canyon National Park," in U.S. Treasury Department, Public Health Service, *Public Health Reports* XLIII, no. 40 (October 5, 1928): p. 2585, GRCA 66101.
[179] Johnston and Leopold, "Grand Canyon Working Plan," A-11.
[180] T. Lindsey Baker, "The Grand Canyon Water Reuse System, A Pioneer in Western Effluent Reclamation," Unpublished Report, 1973, p. 1, GRCA 66101: 17 of 103.

Though the ATSF's objective was to create a reusable effluent, the type of sewage treatment plant that the company installed did not produce reclaim water entirely adequate for its anticipated uses. Using septic tanks, crushed rock contact filters, and a secondary pressure sand filter, the new system only produced the kind of filtered effluent that could be discharged into a nearby stream or river (see Appendix B, Figure 19: The Grand Canyon Railway Company, "Portion of Station Grounds Showing Location of Pro. Engine Shed, at Grand Canyon," Drawing No. 100-7008, 1910, GRCA 66101-30, and Figure 20: Sewage treatment plant just before conversion to spray ponds and during realignment of wye track, ca. 1924-25, GRCA 13641). This method of sewage treatment was different than what would produce effluent that could be reused for more practical purposes. Moreover, the conservative use of water in Grand Canyon Village created a high proportion of solid material in the waste water, making it harder to treat with this method.[181]

Apparently, the effluent filtered from the circa 1906 sewage treatment plant was useable for the first few years in the power plant (Building No. 58) boilers. However, the ATSF found it necessary to further treat the effluent used at the power plant shortly after completion. In 1906 the ATSF added a treating house to the north side of the power plant to house two treating tanks. These tanks likely further filtered the reclaim water for use in the boilers. By 1910 the reclaimed water was pumped to the power plant via a 4" line running between the Main Line track and Track 2 South. South of the power plant, the line turned north to the building and flowed into the treating house (see Appendix B, Figure 2: Grand Canyon Railway, "Arrangement of Pipe Lines for Use of Treated Water at Grand Canyon, Ariz," Drawing No. 100-6894, 1909, GRCA 66101-28 and Figure 19: The Grand Canyon Railway Company, "Portion of Station Grounds Showing Location of Pro. Engine Shed, at Grand Canyon," Drawing No. 100-7008, 1910, GRCA 66101-30).

It seems that the ATSF also intended to use the treated water to fill locomotives. This is based on a proposed 4" line leading to the existing water column located on the main track approximately 330' southwest of the power plant. In 1909 the proposed pipe was constructed from the newly installed treating tanks, parallel to the north side of the water spur, and then along the existing 6" line connecting with the water column. The use of reclaim water to tender locomotives apparently did not work, as within the year the ATSF proposed moving the water column to just south of the power house on Track 2 and to return the water source connection to the pump located inside the southwest corner of the building (see Appendix B, Figure 9: The Grand Canyon Railway Company, "Showing Pro. Change of Water Column, Grand Canyon," Drawing No. 100-7016, 1910, GRCA 34990).

The ATSF's initial use of reclaimed water for irrigation was around El Tovar Hotel, where the railroad installed a system of 2" "septic water lines" around the building to water the hotel's lawns and gardens. Based on later plans, the system irrigated some grounds on the south side of El Tovar around a non-extant studio, but mainly branched out to the east between El Tovar and

[181] Zembala, "Grand Canyon Water Reclamation Plant," p. 3.

Hopi House. The reclaim water also extended northwest, opposite the north wing of El Tovar to irrigate landscaped areas along the rim.[182]

In terms of sewer lines, the Santa Fe Railway logically connected all subsequent construction to the sewage treatment plant. This included the Grand Canyon Depot (Building No. 549), under construction from 1909 to 1910. The depot's architect, Francis W. Wilson, prepared detailed specifications for the building, in which he specified that the sewers and drains were to be laid of vitrified sewer tiles, at an even grade, in "neat" cement. The main sewer was to have a 6" diameter and all branches 4" diameter pipe.[183] Plans depicted the sewer pipe exiting the depot on the northwest corner of the building, which corresponded to the location of the public restrooms on the first floor.

ATSF awarded A.W. Anson of Albuquerque, New Mexico the general contract for construction of the Grand Canyon Depot.[184] Though Anson installed all of the interior plumbing and ran the pipes through the exterior walls, in all likelihood, the ATSF dug the trench and laid the sewer pipe between the depot and the sewage treatment plant as a more economically sensible approach. The line, a 6" vitrified clay pipe, exited the northeast corner of the building, near the junction with a large covered porch on the west elevation, and turned southwest at the end of the porch to meet the railroad track, where it traveled west to the sewage treatment plant.[185]

In the meantime, the Cameron Hotel/Red Horse Cabin (Building No. 526), which became the Post Office in 1907, Kolb Studio (Building No. 532), and Verkamp's Curios (Building No. 546) continued to deal with sewage waste disposal independently. Three "toilets" are depicted on a 1917 plan map of Grand Canyon Village in the vicinity of the Post Office and Cameron's compound. These "toilets" are undoubtedly privies, as they are only shown in proximity to dwellings, both railroad and independent, west of the village core and in the Bright Angel Camp (see Appendix B, Figure 21: Section house with privy in background, 1910, GRCA 87370). Undoubtedly, the "earth or rock vaults" of these privies had to be regularly cleaned. Similar "toilets" were proposed in the 1910 Forest Service townsite plan for Grand Canyon Village.[186]

It is not clear whether the Kolb Brothers used an outhouse or simply disposed of their sewage and wastewater over the rim. Burrall depicted a privy west of the Kolb's garage (Building No.

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[182] Atchison, Topeka & Santa Fe Railway Company, "Proposed New 3" & 1 ¼" Septic Water Lines at Grand Canyon, Ariz.," May 10, 1928, Denver Service Center, Technical Information Center 113-824.
[183] Francis W. Wilson, "Specifications of Labor, Material and Mechanical Workmanship to be used and employed in the erection and completion of a Railway Station at Grand Canyon, Arizona for the Grand Canyon Railroad Company," ca. 1909, p. 29.
[184] The contract required Anson to complete all of the building work except for heating, electric light wiring and fixtures. A separate contractor, Eugene Murray of Los Angeles, California, installed the heating, while the Grand Canyon Railway electrician and his crew completed the wiring and light fixture installation. Santa Fe, General Contract, Short Form, between A.W. Anson of Albuquerque, New Mexico and the Grand Canyon Railway Company, October 27, 1909, p. 2; Santa Fe, General Contract, Short Form, between Eugene Murray and the Grand Canyon Railway Company, February 1, 1910, p. 1.
[185] ATSF, "Pipeline Map," 1928.
[186] Mattoon, a forest supervisor, also suggested common toilet houses for each block in the proposed residential section and the use of a "deep mining shaft" for this purpose in one area. Mattoon, "Townsite Plan," p. 6.

617) with a path leading between the studio and the outhouse; quite a long walk for such an amenity. Since the Kolbs built their studio on the rim of the canyon, it is possible that they had to locate the outhouse some distance away to find relatively percable, as well as digable, ground. They may also have installed a septic tank for their use. During a field visit in 2006, a rectangular rock structure with a vitreous clay pipe and a valve protruding from the north side was located off the northwest corner of the studio. An existing septic tank is depicted in this location on a 1973 plan for the new lift station, but it is not known when the Kolbs constructed the tank or if this structure is indeed the septic tank (see Appendix B, Figure 22: From 1973 existing conditions drawing for sewer system, p. 15, Drawing No. 113-41043A).

Initially, the Verkamps used an outhouse that collected waste in a can inside the privy. When the can became full, the contents were "buried in shallow holes" wherever one could dig into the ground surface. Usually, these holes were dug on the south side of the hill along the Grand Canyon rim. Waste water from the kitchen simply flowed out onto the ground a few feet from the building.[187]

Use of outhouses was not limited to independent concessioners. The ATSF owned at least eleven privies in Grand Canyon Village circa 1915. Generally known as water closets, most were one room buildings, though three water closets had two rooms. Most were probably associated with railroad employee housing (also known as section houses), but one stood in the Bright Angel tent house complex. Construction dates are unknown for most of the water closets; however, the railroad built two one-room outhouses in 1905 for $15 each. In 1910, the ATSF spent $40 to construct a two-room water closet, probably similar to the "proposed double toilet" depicted in the vicinity of the wye in 1912.[188] These frame, shingle-roofed privies simply rested on a sill.[189] In 1917, the ATSF moved a number of section houses along the wye track to new locations and connected them to the sewer line.[190]

The Fred Harvey Company built a garage (Building No. 551) in 1914 when the company began providing tours by automobile to Grand Canyon visitors. The garage also repaired motorist's vehicles and sold gas. Over the years, the building was expanded many times. When first constructed, the sewer line, a 6" vitreous clay tile pipe, exited the building near the northwest corner of the building. In 1917, the ATSF installed a new sewer line for the garage. The company located this line, also a 6" vitreous tile pipe, on the south side of the Passenger Yard in the railroad's right of way.[191]

In order to compete with the Kolb Brothers, the ATSF built a second building in 1914. Fred Harvey's architect, Mary Colter, designed Lookout Studio (Building No. 532) to blend in with

[187] Letter from G.F. Manning, Coconino County Superintendent of Public Health to Col. W.W. Crosby, Superintendent, Grand Canyon National Park, November 27, 1923, p. 1, GRCA 49363.
[188] Grand Canyon Railway, "Drawing No. 100-7437, Showing Location of Pro. Double Toilet to Serve Section House at Grand Canyon," January 9, 1912, GRCA 34990.
[189] ATSF, "Building Record," ca. 1915, np.
[190] The ATSF moved houses according to a handwritten note in the margin of the 1916 Working Plan reading, "moved 1917," and initialed T.E.W. See Johnston and Leopold, "Grand Canyon Working Plan," 1916, A-11.
[191] Atchison, Topeka and Santa Fe Railway Coast Lines Field Engineers Notebook, "Location Proposed 6" Sewer Line at Grand Canyon [Garage]," July 15, 1917, GRCA 66101.

the rim of the Grand Canyon, where it was strategically located between El Tovar and the Bright Angel Trailhead. When mapping the pipelines of Grand Canyon Village in 1928, the ATSF did not include this building. However, this building has changed little over time. Therefore, the sewer connection depicted on the west side of the building on a plan made a decade later is likely original.

Even with new sewer connections at Lookout Studio, the Fred Harvey Garage, and several residences, the sewage treatment plant remained "sufficiently large" and no odor could be detected around the plant in 1916.[192] The plant reached its maximum capacity just a few years later, particularly due to a major increase in the number of tourists visiting the Grand Canyon.[193] An addition to the sewage treatment plant by the Forest Service in 1917 to accommodate new construction south of Verkamp's Curios did not significantly offset growing demands on the sewer facility.

To deal with the overload, the ATSF built a sludge line in 1918 to discharge excess effluent when it exceeded the capacity of the pressure sand filter in the sewage treatment plant. The sludge line consisted of an 8" tile pipe extending west along the railroad right-of-way in the Bright Angel Wash.[194] The trench for the pipe required excavating through solid rock.[195] After the railroad started discharging sludge into the wash, the area around the plant began to have a "decided odor." Moreover, the treated effluent from the overloaded sewage treatment plant contained increased amounts of hydrogen sulfide, making it "always putrescible" and not fit for watering El Tovar's lawns or even for using in boilers.[196]

In the early 1920s the ATSF began adding the El Tovar original laundry's (Building No. unknown) water to this overflow, which probably exacerbated the sanitary problems at the sewage treatment plant. The Forest Service recorded complaints in 1916 regarding El Tovar's disposal of waste steam and laundry water over the rim just north of the laundry building. Most likely, the ATSF did this because gray water could not be reclaimed, as the residual soaps caused foaming in the boilers.[197] Despite the complaints, it was not until September 1922 that the ATSF connected El Tovar's laundry with the sewage treatment plant overflow. They built a 4" vitreous clay pipe that exited the south end of the laundry building, turned west just north of the girls dormitory, and then southwest toward and beneath the railroad tracks to the sludge line in Bright Angel Wash. The railroad abandoned the gray water line leading to the canyon rim in place.[198]

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[192] Johnston and Leopold, "Grand Canyon Working Plan," A-11.
[193] In 1920, over 71,000 people visited the Grand Canyon, nearly 25,000 more than the prior year. Davenport, "Use of Reclaimed Sewage Water," p. 2; Baker, "Grand Canyon Water Reuse System," p. 2.
[194] The railroad likely abandoned this line in place. There are several sections of vitreous clay tile pipe in the ditch in Bright Angel Wash; however, none of them seem to specifically be the sludge line.
[195] Atchison, Topeka and Santa Fe Railway Coast Lines Field Engineers Notebook, "Close Out Sludge Line from Septic Tanks," March 31, 1918, GRCA 66101.
[196] Hommon, "Sewage Treatment," p. 2585.
[197] Johnston & Leopold, "Grand Canyon Working Plan," A-11; Hommon, "Sewage Treatment," p. 2585.
[198] Since the El Tovar laundry was no longer needed after construction of the new laundry (Building No. 569) in 1926, the railroad presumably abandoned this line upon demolition of the old laundry. This demolition occurred sometime between 1928 and 1937, when ATSF razed several accessory buildings west of El Tovar to make way for a new addition. The razed buildings included three sheds (Building Nos. unknown), a coal shed (Building No.

The inadequacy of the sewage treatment plant hindered park development at Grand Canyon at the time of its designation as a national park in 1919. In 1921, the NPS built the first Park Administration Building (Building No. 1) at the east end of the rail yard. The sewer line for that building exited the west elevation and connected with the government sewer built for the 1917 Forest Service building to the north. After that time, park expansion possibilities remained limited. The only other sanitation project the service undertook was in 1923, when minor sewer extensions were made.[199]

Independent concessioners were also hampered by the limited capacity of the sewage treatment plant. During the summer of 1923, John Verkamp wrote to the ATSF requesting a connection to their plant, as well as water and steam line connections, particularly since the park superintendent's house was connected only about 100' to the south.[200] Initially, the railroad denied Verkamp's request because of the inadequacy of the sewage treatment plant.[201] After this refusal, Verkamp wrote to Park Superintendent Crosby asking for assistance.[202] At first, park officials decided to let "nature take her course" in terms of sanitation issues.[203] After Superintendent Crosby received a letter from the Coconino County Superintendent of Public Health noting that the inhabitants of Verkamp's were burying raw sewage on the hillside just above his house, the issue gained momentum.[204] Crosby wrote to the ATSF's Acting General Manager, W.K. Etter, explaining the situation and persuaded the ATSF to allow Verkamp to connect to the sewage treatment plant. Etter relented and stated that John Verkamp was required to pay for the connection and $5 per month for use of the sewer. However, Etter did not initially grant permission for Verkmp's connection to the fresh water and steam lines, but remarked that he would work out these matters with the railroad superintendent.[205] Nevertheless, J.G. Verkamp received a license from the ATSF for both sewer and water lines in 1924.[206]

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unknown), the studio (Building No. unknown), the first green house (Building No. 543), a pump house (Building No. 131?), and an incinerator (Building No. 464), as well as the laundry (Building No. unknown). Atchison, Topeka and Santa Fe Railway Coast Lines Field Engineers Notebook, "Close Out Sewer Line from Laundry at El Tovar," July 18, 1922, GRCA 66101.

[199] Peters, "Superintendent's Annual Report," p. 10; W.W. Crosby, "Superintendent's Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," 1923, p. 8, GRCA 54706.

[200] The first park superintendent's house stood on the hillside between the first park administration building (Building No. 1) and Verkamp's. The Forest Service constructed this building in 1917, and it was demolished by 1937. Letter from J.D. McCully, Superintendent, Atchison, Topeka & Santa Fe Railway Company, to John G. Verkamp, July 14, 1923, GRCA 49363.

[201] Letter from Verkamp to McCully, July 12, 1923.

[202] Letter from John Verkamp to Col. W.W. Cosby, Superintendent, Grand Canyon National Park, July 27, 1923, GRCA 49363.

[203] Letter from W.W. Crosby, Superintendent, Grand Canyon National Park to the Director, National Park Service, August 2, 1923, p. 1, GRCA 49363; Letter from Arno B. Cammerer, Acting Director, National Park Service to W.W. Crosby, Superintendent, Grand Canyon National Park, August 13, 1923, p. 1, GRCA 49363.

[204] Manning to Crosby, p. 1.

[205] Letter from W.K. Etter, Acting General Manager, Atchison, Topeka & Santa Fe Railway Company to Col. W.W. Crosby, Superintendent, Grand Canyon National Park, December 24, 1923, pp. 1-2, GRCA 49363.

[206] Etter did not think that connection with the fresh water line would be a problem but remarked that the power plant was "already quite heavily taxed" and doubted that Verkamp could be connected to the steam line. The 1938 Grand Canyon Railway Station Plat lists all parties that have a license, lease, or contract with the ATSF. Etter to Crosby, p. 2; ATSF, "Grand Canyon Station Plat"; ATSF, "Pipeline Map," 1928.

In the meantime, the increasing amount of overflow discharged by the ATSF into the ditch in Bright Angel Wash became a public health issue. Park administrators started employing Public Health Service inspectors as early as 1921 due to this problem. The railroad even attempted to clean the sewage treatment plant in 1923 and 1924 but to no avail.[207] One of the inspectors, H.B. Hommon, recognized the continued need for water reclamation and designed a state-of-the-art activated sludge treatment plant that more successfully filtered and reclaimed waste water. With federal funds appropriated in 1925, construction of the new plant located over 1 mile southwest of the village core and set well back from the west side of Rowe Well Road began the following year.[208]

The new activated sludge treatment plant (Building No. 333), built as a partnership between the National Park Service and the ATSF, began operating in 1926.[209] Electricity from the new power plant (Building No. 567) constructed by the railroad in 1925 powered the new wastewater treatment plant. The park service hired a skilled operator, while the railroad paid for laborers. During that first year of operation, the plant reclaimed 99 percent of the wastewater from Grand Canyon Village. After one year, it cost 57 cents to reclaim 1,000 gallons of water--a vast difference from $3.09, the charge for the same amount of water hauled to the canyon by train.[210] By 1930, the plant was reclaiming 120,000 gallons of water per day at a production cost of 35 cents per thousand gallons. Fred Harvey Company mostly used the reclaimed water for steam generation, flush toilets, and irrigation, while the NPS reserved 10 percent of the reclaim for campground toilets and irrigation.[211]

Of course, new wastewater pipes had to be installed in order to connect the new activated sludge treatment plant to Grand Canyon Village. The government agreed to construct a new 10" vitrified clay trunk line that ran west from the south side of the contact bed along the south side

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[207] "Atchison, Topeka & Santa Fe Railway-Grand Canyon Sewage Treatment Plant," *Santa Fe Magazine* XVIII, no. 6 (May 1924): p. 65; Zembala, p. 5.

[208] Since HAER recorded this wastewater treatment plant in 1977, this report will not go into detail regarding the construction and operation of the plant. See HAER No. AZ-3 for more information.

[209] To avoid confusion, the first plant (Building No. 207?) built circa 1906 has and will continue to be called the "sewage treatment plant." The second plant built in 1926 (Building No. 333), will be called the "activated sludge treatment plant."

[210] Apparently, El Tovar, and perhaps all Grand Canyon Village buildings, also collected rainwater and combined it with the reclaim water. It is not clear if this means that spouting directed the rainwater into the reclaim lines or into sewer lines for treatment first. This collection system may have also been at the plant itself, as "artificial catchment areas and concrete underground storage basins" were built in the vicinity for the "utilization of rainwater" in 1928. Hommon, "Sewage Treatment Plant," p. 2597; Willey, "Fred Harvey's Facilities," p. 24; Tillotson, "Superintendent's Annual Report," 1928, p. 7.

[211] In conjunction with the new activated sludge treatment plant, the ATSF built a trash incineration facility (Building No. 332) to dispose of the garbage generated in the Grand Canyon Village. Built in 1926 near the treatment plant, the facility used heated reclaimed water to dry the garbage before burning. Additionally, a can crushing and baling machine helped to reduce waste. By 1927 the incinerator disposed of 100 tons of garbage daily during the busy summer months. Eakin, Preface, 1925, p. 4; J.R. Eakin, "Superintendent's Annual Report, Grand Canyon National Park, Grand Canon, Arizona," 1925, p. 5, GRCA 54706; "Tentative Agreement Covering the Construction and Operation of Sewage Treatment Plant, and Use and Division of Effluent Recovered Therefrom, at the Grand Canyon National Park, Grand Canyon, Arizona," ca. 1925, GRCA 49363; Anderson, *Polishing the Jewel*, p. 16; Tillotson, "Annual Report," 1927, p. 8; Baker, "Grand Canyon Water Reuse System," p. 3.

of the railroad track to the new activated sludge treatment plant.[212] The NPS also installed a new 6" effluent water line parallel to the new sewer line. Additionally, the ATSF built a new sewer line in its right of way from the "laundries, kitchens, and stables" toward the new plant.[213] Once beyond the old sewage treatment plant in the wye, the railroad's 8" vitrified clay sewer pipe ran west along the south side of the railroad tracks. All three lines connected at a manhole in the railroad right of way and then continued further west before turning south toward the new plant. In total, the government and the railroad laid over 4 miles of new pipe.[214]

The ATSF initially bypassed laundry wastewater from the Fred Harvey Laundry (Building No. 569) around the activated sludge treatment plant since Hommon believed, as with the previous sewage treatment plant, that soap remaining in the effluent would cause foaming and preclude use of reclaimed water in the boilers.[215] Therefore, the company installed a separate 6" sewer line parallel to the 10" main between a settling tank at the new treatment plant and the laundry.[216] This gray water bypass line also exited the laundry at a different point than the sewer line. The 6" tile gray water pipe exited from a point near the middle of the west side of the building, while the 8" tile sewer pipe departed near the northwest corner of the building.[217] It was soon realized, however, that the activated sludge treatment plant filtered soaps with little difficulty.[218]

Mainly, the ATSF used the reclaimed water from the activated sludge treatment plant for steam generation. When the new Powerhouse (Building No. 567) began using reclaimed water from the plant to feed its boilers, a noticeable absence of smell resulted. For the few months prior, the company continued to use effluent from the old sewage treatment plant, which created a "musty" smell. Additionally, because of the superior filtering system, the railroad could again use reclaimed water for locomotive boilers.[219] Since the ATSF razed the old power plant circa 1926, the railroad moved the water column for filling the engines west down the tracks to just north of the abandoned sewage treatment plant.[220]

The ATSF also used the reclaimed sewage water to indirectly cool equipment in the Powerhouse. In 1925 the railroad converted the contact bed in the former sewage treatment plant into a spray

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[212] Portions of this government sewer line are still intact and visible in the ditch in Bright Angel Wash.
[213] "Tentative Agreement," p. 1.
[214] Zembala, p. 5; ATSF, "Pipeline Map," 1928.
[215] Atchison, Topeka & Santa Fe Railway Company, "Site Plan-Railroad Sewage Disposal Plant, Laundry Water Settling Tank," October 1, 1925, Denver Service Center, Technical Information Center, 113-41907; Hommon, "Sewage Treatment," p. 2591.
[216] Portions of this laundry bypass line are still intact and visible in the ditch in Bright Angel Wash. See ATSF, "Pipeline Map," 1928.
[217] Atchison, Topeka & Santa Fe Railway Company, "Laundry Building," June 16, 1926, p. 1, GRCA 68486.
[218] This extra sewer line became useful later when the railroad installed an oil sump, a brine water softener, and zeolite plant to soften fresh water. Byproducts of the water softeners, the salt wash water and the stationary blow-down water, as well as the oil, could not be expelled in the sewage treatment plant because of "detrimental" effects to the reclaim effluent; therefore, the railroad reused this old sewer bypass line for disposal. Davenport, "Use of Reclaimed Sewer Water," p. 8; M.R. Tillotson, "Superintendent's Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," 1928, p. 6, GRCA 54706.
[219] Davenport, "Use of Reclaimed Sewage Water," p. 5.
[220] ATSF, "Pipeline Map," 1928.

pond (see Appendix B, Figure 23: Conversion to spray ponds, GRCA 13127).[221] Effluent circulated through this spray pond for cooling. A pump on the west side of the spray pond pumped the cooled effluent through a 4" cast iron pipe on the north side of the pond into the north side of the Powerhouse. There, the effluent circulated through heat exchangers, which cooled distilled water for circulation through the engine cooling systems of the two 560 horsepower diesel engines in the Powerhouse. The effluent water returned via a 6" cast iron pipe, discharging into the spray pond on the east side, to be cooled again. The railroad also used reclaimed sewage water, cooled in the cooling tower (Building No. 59), as condenser water for a 500 KVA steam turbine generator.[222]

The other two main uses of the effluent from the new activated sludge treatment plant were, and remain, supplying public toilets, which was an ideal use as the essentially closed loop circuit lost little water, and watering lawns and gardens in Grand Canyon Village. For irrigation Fred Harvey Company used reclaim water from the activated sludge treatment plant with much more success, because it did not have an unpleasant odor like the effluent from the prior plant.[223] A plan from 1928 suggests that the railroad connected public toilets in the Grand Canyon Depot to the reclaimed water line. That year the railroad proposed adding a 1-¼" line leading to a midpoint on the north elevation of the depot in the general location of the public restrooms. The plan also shows a 3" septic water line leading to a midpoint on the south elevation of El Tovar, but later plans demonstrate that the railroad did not extend the line inside the building to serve toilets until the early 1940s.[224] A septic water line also served two freestanding public toilets that stood off the southeast corner of the eastern dormitory, currently known as the Brown Building (Building No. 537), in the tent house area of the Bright Angel Hotel complex (see Appendix B, Figure 24: Tent frames with privies, GRCA 9542A). It is unclear whether or not the toilets were connected to the sewer line, but in all likelihood they were. It seems that the Brown Building, however, was not connected to the sewer line until the mid 1930s.[225]

Additionally, the railroad installed several more reclaim water lines in Grand Canyon Village. Of unknown use, a new 6" effluent water pipeline extended south from the spray pond along the west side of Coconino Street and stopped opposite Boulder Street. The new laundry (Building No. 569), built in 1926 to the west of the Powerhouse, also used effluent water via a 2" cast iron pipe entering the east side of the building. Later, this line continued south in a 3-½' pipe trench

[221] Atchison, Topeka & Santa Fe Railway Company, "Spray Pond for Cooling Engine Jacket Water at Grand Canyon, Ariz.," October 24, 1925, Denver Service Center, Technical Information Center 113-70194.
[222] The spray ponds were obliterated by circa 1971. Atchison, Topeka & Santa Fe Railway Company, "Grand Canyon Pipeline and Building Map," November 30, 1937, revised April 1951, revised ca. 1971, Denver Service Center-Technical Information Center 113-70069B.
[223] Davenport, "Use of Reclaimed Sewer Water," pp. 5-6.
[224] Atchison, Topeka & Santa Fe Railway Company, "Proposed New 3" & 1 ¼" Septic Water Lines at Grand Canyon, Ariz.," May 10, 1928, Denver Service Center-Technical Information Center 113-824; "Proposed Reclaimed Sewage Water Lines to Service Toilet Facilities in El Tovar Hotel, Grand Canyon, Arizona in the Grand Canyon Nat'l Park," March 7, 1938, rev June 27, 1941, GRCA 68521.
[225] The contractor for Bright Angel Lodge moved the Brown Building 200 feet east before constructing the lodge. Sometime between 1951 and 1967, the Brown Building was moved to its current location on west Apache St. to make way for Thunderbird Lodge (Building No. 1300), constructed in 1968.

where it served the Fred Harvey paint shop (Building No. 572) completed in 1931. There, employees might have used the reclaim water to wash cars.[226]

The ATSF took several precautions to differentiate the reclaimed sewage water lines from potable water pipes in Grand Canyon Village. First, the ATSF topped all main and distributing lines with a half round of vitrified clay sewer pipe in the vicinity of the village. This assured that if a workman dug up a line he would assume it to be a sewer pipe and not a potable water line. The railroad painted all reclaimed water lines red and labeled the valves with metal tags inside buildings. Irrigation hydrants were concealed in boxes below ground so that people would not try to drink from them. Finally, the reclaim was chlorinated so that if a person did drink this water they would not become overly sick.[227]

In terms of new sewer lines, it does not seem that the ATSF or the government laid a lot of additional line in the core of Grand Canyon Village after completion of the activated sludge treatment plant. Most of their buildings were already connected to the former sewage treatment plant. However, to serve visitors staying at Bright Angel Camp, the railroad built two new "comfort stations," (Building No. 520 and 524) each with six toilets and four sinks, on the west side of the building complex.[228] The sewer line ran north/south between the buildings and then connected to the railroad's sewer line via a 6" pipe running southeast from the southeast corner of the southernmost comfort station (Building No. 524). This line did not extend further north to Kolb Studio or west to the Cameron Cabin at this time.[229]

The ATSF also constructed a sanitary can storage building (Building No. 568) off the northwest corner of the Powerhouse inside the east leg of the wye circa 1928.[230] In this building, men emptied and cleaned the sanitary cans used to catch waste when passenger cars stood in the rail yard. Though one can surmise that a preceding facility existed, the location is unknown. Rustic in design, the new 16-½' x 29' one-story, concrete building had a gable roof and rubble stone veneer. Park Superintendent Tillotson, Park Landscape Engineer Vint, and Public Health Service Sanitary Engineer H.B. Hommon approved plans for the building. Initially, a 4" drain in the northeast corner of the sanitary can storage building connected by a new line from the south side of the building to the railroad's 8" sewer line to carry the wastewater from the building. The railroad used reclaim water to wash the cans and the new reclaim water line leading to the building paralleled the sewer line.[231]

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[226] Baker, "Grand Canyon Water Reuse System," p. 3; ATSF "Pipeline Map," 1928.
[227] Tillotson, "Annual Report," 1927, p. 8; Davenport, "Use of Reclaimed Sewer Water," p. 6.
[228] Both comfort stations were incorporated into Mary Colter's Bright Angel Cabins; however, only the southern-most of the two (likely Building No. 525) exists today as part of the Bright Angel Lodge and Cabins complex. Atchison, Topeka & Santa Fe Railway Company, "Comfort Station for Bright Angel Camp, Grand Canyon, Ariz.," February 12, 1925, GRCA 68496.
[229] ATSF, "Pipeline Map," 1928.
[230] A blueprint for this building, "Sanitary Cans Storage Building at Grand Canyon, Arizona in the Grand Canyon National Park," is in the Grand Canyon Museum Collection; however, it is very brittle. A smaller version of the building plan was also found. See "Sanitary Cans Storage Building at Grand Canyon, Arizona in the Grand Canyon National Park," March 21, 1930, rev. August 7, 1957, GRCA 68538.
[231] The NPS demolished the sanitary can storage building in 1968 to make way for the Village Loop Road short cut.

After construction of the activated sludge treatment plant in 1926, most changes made to the sewer lines in Grand Canyon Village related to maintenance or the demolition and construction of buildings. One such job included the relocation and renewal of the laundry by-pass sewer line in the winter of 1932-33. In this project, the ATSF made minor changes to the alignment of the 8" vitrified tile by-pass sewer between the laundry and the government trunk line, replacing the realigned section with 6" vitreous tile pipe. The ATSF also replaced 344' of existing 6" vitreous tile pipe in kind.[232]

Serving the constantly increasing number of Grand Canyon visitors also necessitated improvements to sanitary facilities. In 1929 Superintendent Tillotson recognized the need for additions to these facilities. In the next two years, the park extended the sewer line, as well as other utilities, on the South Rim; however, much of this extension occurred outside the village core. They also began to use reclaimed water "more freely," as tests continuously showed that the activated sludge treatment plant produced safe effluent. As Tillotson noted, the modern facilities that had been installed in park were "extremely worthwhile."[233]

Major improvements to the Grand Canyon Village infrastructure finally began as a result of the National Recovery Act enacted by Congress in 1933 to create jobs for the unemployed during the Depression. The Civilian Conservation Corp (CCC) arrived at Grand Canyon that same year to perform Emergency Conservation Work in the park. "From a purely mercenary point of view," Superintendent Tillotson viewed the CCC and the National Recovery Act as a "fair way" for the park "to gain more in the form of physical improvements . . . than would have transpired for a number of years – in some instances not at all – under normal park affairs."[234]

From 1933 to 1942, the entire time the CCC had encampments at the South Rim of the Grand Canyon, enrollees installed, replaced, or maintained sewer lines in the Grand Canyon Village. The two main camps that conducted this work were Camp NP-2A, encamped southeast of the park industrial area, and Camp NP-4A, stationed south of the wye track. Generally, about twenty CCC enrollees from each camp, headed by park plumber Mott, worked on sewer line excavation and installation projects.[235] In conjunction with many of these projects, the CCC also installed other utility lines, including reclaim and potable water pipe and electrical conduit, in the excavated trenches.

Installation of the utility lines in Grand Canyon Village was "hard and slow," as the men had to blast trenches through the bedrock located just below grade. Men excavated trenches about 2' wide and from 3' to about 6' deep, below the frost line, through the solid rock (see Appendix B,

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[232] "Relocate and Renew Portions of By-pass Sewer at Grand Canyon, Arizona in the Grand Canyon Nat'l Park," January 14, 1939, Denver Service Center-Technical Information Center 113-5316.
[233] M.R. Tillotson, "Superintendent's Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," 1929 from *Annual Report of the Department of the Interior, 1929* (Washington, DC: U.S. Printing Office, 1929), p. 80, GRCA 65017; Tillotson, "Annual Report," 1931, pp. 19, 26; Tillotson, "Superintendent's Annual Report," 1932, p. 25.
[234] M.R. Tillotson, "Annual Report for 1933 Travel Year Covering Activities in Grand Canyon National Park and Grand Canyon National Monument," 1933, p. 2, GRCA 65017.
[235] Wirt, "Report to the Chief Forester," June 17-20, 1935, p. 2; Carl A. Taubert, "Record of Inspection," March 6 & 7, 1942 and "Record of Inspection," April 24 & 25, 1942, both in GRCA 29860.

Figure 25: Trench blasting for new water system, 1934, GRCA 29844).[236] Additionally, at the request of the Associate Forester, L.F. Cook, the men attempted to avoid damaging trees while blasting and trenching the new pipelines. Early in construction Cook noted that during trench excavation men cut large roots that undermined trees, particularly in high winds, and that blasting "badly shook" and scarred trees. Though Cook realized that water and sewer lines needed to be as straight as feasible, he suggested that "as much care be exercised as possible in this work to protect the trees, especially in camps and along roadsides" where the trees were most visible to the public.[237]

The CCC conducted several major sewer line installation jobs to meet increased demands of waste disposal in Grand Canyon Village, and improve the reclaim system. Four of these projects occurred within the confines of this study area. They included installing sewer lines for the new Bright Angel Lodge and Cabins (Job No. 633), moving and replacing the trunk sewer (Park Project No. 429), and replacing the sewer line to the first Park Administration Building (Building No. 1) that had served as the superintendent's residence since circa 1931. The CCC completed thousands of feet of additional vitreous tile sewer line and galvanized iron reclaim water line extensions, which comprised the majority of this type of work in Grand Canyon Village. Many of these jobs extended into the NPS industrial and residential areas to the south and are thus located outside the study area for this project.[238]

To serve the ever-increasing number of motorists visiting the park, the men in Camp NP-4A built a comfort station annex to Ranger Operations (Building No. 103) (Job No. 26b) during the

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[236] W.H. Wirt, "Report to the Chief Forester on Emergency Conservation Work at Grand Canyon National Park," June 17-20, 1935, pp. 2, 4, GRCA 29858.

[237] L.F. Cook, "Memorandum for the Superintendent, Grand Canyon Nat'l Park re: Forestry, Fire Protection & ECW notes during inspection of Dec. 14-16, 1934," p. 3, GRCA 29860.

[238] The remaining CCC major sewer line jobs in the village involved installing sewer lines to and around the park service residential and industrial areas (Job Nos. 63 and 143) and extending the lines through the free public campground (now the western portion of Maswick Lodge) and to the newly established employee campground (in the vicinity of today's Mission 66 NPS utility area) (Job Nos. 26a and 633). See J.V. Fish, "Narrative Monthly Report for Period Ending December 31st, 1933: ECW Camp No. 2-Powell-Located on South Rim of Grand Canyon National Park, Arizona," December 1933, p. 7, GRCA 29835; Wirt, "Report to the Chief Forester," June 1935, p. 2; W.H. Wirt, "Report to the Chief Forester on Emergency Conservation Work at Grand Canyon National Park," February 11-15, 1935, p. 3, GRCA 29858.; Haines, "Narrative Report," 1935, np; Harry Langley, Alfred C. Kuehl, and R.E. Riggs, "Report to the Chief Architect through the Superintendent of Grand Canyon National Park," April 1935, p. 5, GRCA 29863.

Job No. 633 was a joint project coupled with the Bright Angel complex. See W.H. Wirt, "Report to the Chief Forester on Emergency Conservation Work at Grand Canyon National Park," April 5-11, 1936, pp. 1-2, 4, GRCA 29859; H.A. Montgomery, Monthly Report Letter to Mr. Kittredge, June 29, 1935 and H.A. Montgomery, Monthly Report Letter to Mr. Kittredge, March 28, 1936, p. 1, both in GRCA 29865.

Camp NP-4A also built comfort stations and a laundry in the employee campground in early winter 1935 as Park Project 2-113 and 36-120 respectively. See Harry Langley and Alfred C. Kuehl, "Report to the Chief Architect through the Superintendent of Grand Canyon National Park," April 1935, pp. 5, 6, GRCA 29863.

Job No. 138 related to 1500' of sewer line extensions in unspecified areas. See J.W. Haines, "Narrative Report for the Period April 1, 1935 to September 30, 1935, E.C.W. Camp N.P. 2-A, South Rim, Grand Canyon National Park, Arizona," September 1935, np, GRCA 29854.

The CCC also constructed additions and alterations to the activated sludge treatment plant, as well as a 30,000-gallon concrete reclaim water storage tank (Building No. 334) southeast of the plant, under direction of the park. See Tillotson, "Monthly Report," July 20, 1937, p. 14.

winter of 1934-35. The men removed rock piers from the west elevation of the building to make way for the new addition, a logical location as the sewer line entered the building at the southwest corner. Prior to the completion of the comfort station in March, all motorists had to use restrooms in the hotels, the Harvey Garage, or the public campground because of the lack of park-maintained public facilities in the village.[239]

The CCC Camp NP-2A completed the sewer disposal main for the new Bright Angel Lodge (Job No. 633) in July 1935 after a push in June to avoid delays opening new units.[240] Construction of Mary Colter's Bright Angel Lodge by the ATSF was the largest project the company undertook after completion of the activated sludge plant, Powerhouse, and Fred Harvey laundry in the mid-1920s. Started in the fall of 1934, this project involved the demolition of the original Bright Angel Hotel complex and building the Bright Angel Lodge (Building No. 507), Powell Lodge (Building No. 509), multiple cabins (Building Nos. 510-25, 527-531, 534-536), and an addition to the existing Buckey O'Neil Cabin (Building No. 508).[241] In addition to maintaining the Buckey O'Neil Cabin, Colter incorporated the Cameron Cabin/Red Horse Cabin (Building No. 526) and the two 1925 comfort stations (Building No. 520 and 524) into her design.

The ATSF contracted with Howe Brothers of Los Angeles, California to install the plumbing, heating, and ventilation in Bright Angel Lodge for $17,281.50 in the fall of 1934. The following spring, the two companies signed a second contract for "plumbing, heating and outside service line installation" in Buckey O'Neil Cabin, Powell Lodge, and the Bright Angel cabins for $17,640.[242] The general contractor for the Bright Angel Lodge proper, Myers Brothers, also of Los Angeles, excavated the trenches for these utilities beneath the three large buildings, while the ATSF did the same in the Bright Angel Cabin area.[243] In addition, the railroad used some existing trenches. Excavation began in the fall of 1934 and continued into the following year.

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[239] Louie McGavic, "Narrative Report for the Period October 29, to December 31, 1934, E.C.W. Camp N.P. 4-A, South Rim, Grand Canyon National Park, Arizona," December 31, 1934, np, GRCA 29851; U.S. Department of the Interior, National Park Service, "Grand Canyon National Park (South Rim) Comfort Station (Addition to Administration Building)," May 21, 1932, Denver Service Center, Technical Information Center 113-3029.

[240] Montgomery, Monthly Report Letter, June 29, 1935, p. 5; Harry Langley and Alfred C. Kuehl, "Report to the Chief Architect through the Superintendent of Grand Canyon National Park," July 1935, np, GRCA 29864.

[241] The ATSF moved many of the tent cabins from the old Bright Angel Hotel complex to the public campground (today's Maswik Lodge Auto Cabins), where the CCC connected these cabins to the sewer line also as part of Job No. 633.

[242] Santa Fe, Building Contract between Wm. P. Neil Company, Ltd. And Atchison, Topeka & Santa Fe Railway Company, October 24, 1934, GRCA 66101; Blanchard to Howe Brothers, March 29, 1935.

[243] The Myers Brothers general contract was for $67,146.00 (see Santa Fe, Building Contract, September 1, 1934). The contract also included moving the Brown Building (Building No. 537), built in 1913 as the eastern dormitory in the Bright Angel Hotel complex, approximately 200' to the east. The ATSF arranged the reconnection of the plumbing; however, the details of this project are not known. The company proposed to move this building again in 1937, but did not follow through. The Brown Building was moved to its current location on west Apache St. after 1951 (see Santa Fe, Building Contract, September 1, 1934; Atchison, Topeka & Santa Fe Railway Company, "Specifications for Concrete Masonry & Log Lodge," ca. 1934a, 2). The Myers Brothers excavated the trenches beneath Powell Lodge and Buckey O'Neil Cabin but did not construct these buildings. Instead, Wm. P. Neil Company, Ltd. of Los Angeles, California served as the general contractor for the "west area of Bright Angel Lodge," which included these two building and the Bright Angel Cabins. Their contract was for $60,677 (see Santa Fe, Building Contract, March 9, 1935).

Myers Brothers followed specifications and plans for the utility tunnels provided by the ATSF engineers. They excavated the main tunnels beneath Bright Angel Lodge proper, Buckey O'Neil Cabin and Powell Lodge to a minimum height of 6' and a minimum width of 5'. Branches extending off the main tunnel ranged from this height and width to crawl spaces. Main utility pipes entered Bright Angel Lodge on the southeast corner of the building at a point almost directly north of the Powerhouse. Inside the building, branch lines disseminated to appropriate locations, while the main line continued through a tunnel under Buckey O'Neil Cabin and on to Powell Lodge.[244]

Although the utility tunnel ran beneath all three buildings, the sewer line followed an independent route when connecting the lodges and cabins of Bright Angel. The initial plans for the new lodge proposed using much of the existing Bright Angel Hotel sewer line. This existing line included the connection between the western dormitory and the hotel, the pipe between the Buckey O'Neil Cabin and the trunk line, and the pipe between the eastern dormitory and the trunk line. However, the railroad only maintained the existing 6" sewer line that connected the east dormitory to the sewer line after 1928 for the Bright Angel Lodge proper, and the section of existing sewer line closest to the Buckey O'Neil Cabin. After 1928, the railroad abandoned a large section of the 8" sewer pipe that served as the main connection for the central Bright Angel Hotel building sewer and trunk line, as well as the 4" sewer pipe between Buckey O'Neil Cabin and what would become the future location of Powell Lodge.[245]

In 1935, park and ATSF crews excavated trenches to reroute the Buckey O'Neil Cabin and Powell Lodge sewer lines in order to connect them with a new sewage disposal main to the west, rather than the line to the east as in previous years. The new Bright Angel Cabins also linked with this system. CCC labor excavated trenches for the new sewer main along the southern limit of the Bright Angel Cabins and approximately 700' west to a manhole on the trunk line in the ATSF right of way (see Appendix B, Figure 26: Bright Angel Cabins' sewer main, 1936, GRCA 292). They also installed 6" vitreous tile pipe in those trenches, as well as additional 6" vitreous tile sewer pipe around the western and northern limits of the cabin complex, and reinforced concrete manholes at grade breaks and alignment changes. The project cost the Park Service just over $5,610.[246] The ATSF excavated the remaining pipe trenches, including numerous laterals to the cabins. In these trenches, the Howe Brothers installed 6" main sewer lines and 4" lateral sewer lines, as well as water and fire lines.[247]

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[244] Atchison, Topeka & Santa Fe Railway Company, "Add's. and Alt's. to Buckey O'Neil Cabin, Grand Canyon, Arizona," October 16, 1934, GRCA 68543.
[245] ATSF, "Pipeline Map," 1928; Department of the Interior, National Park Service, "Grand Canyon National Park, Showing Proposed Sewer Lines to be Constructed to Serve the New Bright Angel Lodge Development," Grand Canyon: Office of the Park Engineer, April 22, 1935, Denver Service Center, Technical Information Center 113-41043A.
[246] C.M. Carrel, "Final Construction Report on Project FP 633, Sewer Line Project Extension, Bright Angel Lodge and Auto Camp Areas," April 7, 1937, GRCA 75264; Tillotson, "Annual Report," 1936.
[247] Although the mining shaft at Kolb Studio had probably been extended around 1930 for installation of a steam line, the Kolbs had not yet connected with the activated sludge treatment plant when the Bright Angel cabins utility project was underway. Only a water line, steam lines, and electrical conduit ran through the old mine shaft in 1937. "Plot Plan Showing Bright Angel Buildings, Pipe Lines, Etc.," October 28, 1935, Denver Service Center, Technical

As part of the Bright Angel sewer main project, the men of Camp NP-2A had to run the new 8" line connecting with the trunk line underneath the railroad's double track. Most likely, this was near the west end of the wye, where the wye track joined with the mainline track. Project superintendent, J.W. Haines, thought this an "outstanding achievement," as the men completed this project, consisting of excavation through nine feet of fill and blasting through two additional feet of solid rock, without interfering with the train traffic on the double track. Haines noted that the blasting and excavation for the remainder of the Bright Angel sewer line job also required skill and that the "men assigned to this job gained a thorough knowledge of powder work and of practical construction methods" (see Appendix B, Figure 27: Trench under railway tracks, 1935, GRCA 341).[248]

Several of the sewer line projects completed by the CCC outside this project's study area resulted in connections with the existing sewer line within the study area. These projects included connecting the new post office (Building No. 166) and the new Community Building (Building No. 44), both completed in 1935, to the sewer line running parallel to the tracks in the rail yard during the winter of 1934-35.[249] Also, the sewer and reclaim water lines were extended to the park owned industrial area east of Center Road between 1933 and 1935, which joined the east end of the trunk line.[250] Conversely, the remaining portion of Job No. 633, extension of the sewer line to the public campground, connected at the west end of the trunk line (see Appendix B, Figure 28: Sewer trenching under railroad tracks, 1935, GRCA 253).

By the spring of 1936 the park had made so many connections to the ATSF's trunk line that the pipe could not handle the increased amount of wastewater discharge when coupled with the railroad's facilities on the north side of the tracks. These additional Park Service connections to the trunk line included the sewer line extensions into the residential and industrial areas east of Center Road, as well as connections for the new Post Office (Building No. 166), the new Administration Building (Ranger Operations, Building No. 103) and two post office employee residences (Building Nos. 809 and 810) on the south side of the railroad tracks. In order to relieve the strain on the railroad's trunk line, the park installed a second 10" trunk line on government land along the south side of the ATSF's right-of-way.[251]

CCC Camp NP-4A laid the new 10" sewer main in Grand Canyon Village from May to July 1936 using an allotted budget of $12,000. The men laid 1,352' of pipe in the ditch along the south side of the rail yard, between a point south of the depot and a point northeast of the Powerhouse where it connected with the existing sewer trunk line.[252] They installed five

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Information Center 113-5100; "Revised Part of General Plat of Bright Angel Lodge, Grand Canyon, Arizona," March 21, 1935, Denver Service Center, Technical Information Center 113-70157.

[248] Haines, "Narrative Report," September 1935, p. 2.

[249] Harry Langley, Alfred C. Kuehl, and R.E. Riggs, "Report to the Chief Architect through the Superintendent of Grand Canyon National Park," November 1934, p. 4, GRCA 29863.

[250] Harry Langley, Alfred C. Kuehl and R.E. Riggs, "Report to the Chief Architect through the Superintendent of Grand Canyon National Park," January 1935, p. 2, GRCA 29863.

[251] J.V. Lloyd, "Project Application and Accomplishment, Emergency Conservation Work, National Park Service, Grand Canyon National Park, Sewer Line, 10'," April 25, 1936, np, GRCA 29867.

[252] Lloyd, "Project Application," np.

manholes along the new trunk line and disconnected the residential and utility areas and the two residences from the railroad's trunk sewer line, reconnecting these buildings to the new government line (see Appendix B, Figure 29: Men laying 10" trunk line, 1936, GRCA 338).[253] Customary of CCC practice when excavating trenches and building roads and walks in the Grand Canyon National Park, the new pipeline purposely avoided a large yellow pine in the area. The park tested the line and placed it into service in September 1936.[254]

The CCC also replaced the sewer, as well as other utility lines leading to the park superintendent's house (Building No. 1) in 1937. Willard Bradley, Assistant Engineer, reported field and office work on the extension of sewer and steam lines to the park superintendent's residence in September.[255] The project involved replacing these utilities in a new tunnel built by the US Bureau of Public Roads. The Park Engineer also rerouted a 6" sewer pipe and steam lines for Verkamp's Curios through this new tunnel, which started in the stone wall at the east end of the rail yard and traversed beneath Village Loop Road.[256]

When the CCC crew constructed sewer lines beneath roads in Grand Canyon Village, they probably excavated and backfilled the trenches in a similar manner. Construction plans used by the CCC in 1937 for the extension of the sewer line east beyond Fred Harvey Garage provide a trench profile that may have been used in other comparable CCC projects. Sewer lines for El Tovar and Bright Angel Lodge, as well as the new pipe trench for the first Park Administration Building (Building No. 1), all ran beneath Hermit Rim Road, presently the north side of Village Loop Road, which the CCC constructed in 1936. Additionally, the new Bright Angel Lodge west sewer main also ran beneath the road to the public campground. Although the trench depth could vary, it had to be deep enough for a 6" sewer pipe in the bottom of the trench lined with rocks to be covered with a maximum of 5" of concrete cover poured over 6/6 to 10/10 wire mesh, followed by a minimum of 3" of road subgrade made from salvaged material, and 3" of bituminous top pavement. "Common and rock material" comprised the remainder of fill between the concrete cover and the subgrade. The minimum width of the trench was 2'-6" (see Appendix B, Figure 30: Sewer line construction detail, Drawing No. 113-5710, 1937). It is quite likely that sewer trenches beneath roads constructed by the CCC all followed this method of construction.

While the CCC crews continued their work extending and maintaining the sewer and reclaim water lines in Grand Canyon Village, the ATSF was also making improvements. By the fall of 1937, the ATSF and the park recognized the need for better storage facilities for reclaim water in the village. The revisions resulted from concerns of possible cross contamination when a lack of pressure required Fred Harvey Company to supplement reclaim water with fresh water to make hotel toilets operate properly. The lack of pressure often resulted during the peak season when

[253] Several of these manholes are still intact in between the rail yard and the southern section of Loop Road.
[254] Charles D. Carter, "Report to the Resident Landscape Architect, Grand Canyon National Park," May 1936, p. 4, GRCA 69864; Willard Bradley, "Monthly Summary, Grand Canyon National Park, Grand Canyon, Arizona," September 1936, p. 1, GRCA 29865.
[255] Bradley, "Monthly Summary," September 1937, p. 1.
[256] This tunnel in the stone wall at the east end of the rail yard is still extant.

the railroad transported large amounts of reclaim water from the storage tank (location unknown) to other places along the Grand Canyon line.[257]

In order to maintain adequate pressure for facilities using reclaim water in Grand Canyon Village, the ATSF proposed building a new reclaim water storage tank, Tank No. 5, for filling tank cars and locomotives in 1937. After two years of planning and negotiation with the park, the ATSF constructed the 24' x 43.5' (160,000 gallon) reclaim water tank (Building No. 42) adjacent to two existing fresh water storage tanks (Building Nos. 38 and 39) near the southern end of the wye track.[258] Although the park, as reiterated by the landscape architect, Alfred Kuehl, did not advise that new storage facilities be constructed close to the village, this location, clustered with the other water tanks near the railroad track, seemed the logical and least objectionable solution.[259] Construction of the new reclaim water storage tank required the railroad to extend a 4" reclaim water line south from the Powerhouse. At that time, the ATSF also constructed a 10" cast iron main leading to a new water column on the wye tracks.[260]

During the Depression, the ATSF also continued the extension of water reclaim lines to Fred Harvey buildings, mainly for use in public toilets. Completion of the auxiliary tanks obviously worked in conjunction with these projects as the tank increased the pressure needed for toilet use in Grand Canyon Village. In 1938 the railroad completed the reclaim water connection to the newly built Colter Hall (Building No. 539), for an unknown use.[261] Possibly, the railroad intended to use reclaimed water in the new woman's dormitory toilets, as plans from 1938 demonstrate the railroad's intent to use the reclaim water for toilets in three separate additional buildings: the Fred Harvey laundry (Building No. 569), El Tovar (Building No. 542), and the Bright Angel Lodge (Building No. 507) complex. World War II delayed the completion of the last of these projects for several years.

First, the ATSF installed a second 2" reclaimed water line to the Fred Harvey laundry building. It connected to a line that ran along the east side of the laundry to the Fred Harvey Auto Paint Shop (Building No. 572) at a new manhole just off the northeast corner of the laundry. From there, they routed the line a short distance west to the existing pipe tunnel between the Laundry basement and the Powerhouse (Building No. 567). Inside the basement, the reclaim water served men's and women's employee bathrooms. The pipe also led to a riser for the dry cleaning machine on the first floor.[262]

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[257] Alfred C. Kuehl, "Technical Comment-Landscape, Subject: Grand Canyon-Ninth Period, Job Number 72-134, Power Lines-Underground," April 14, 1937, GRCA 29895.
[258] Atchison, Topeka & Santa Fe Railway Company, "Grand Canyon, Ariz.-Albuquerque Division: Water Service Record," ca. 1932, rev. January 1933, rev. February 1936, rev. November 1941, Sheet 9, Denver Service Center-Technical Information Center 113-3405 and GRCA 87749.
[259] These water tanks have since been demolished. Kuehl, "Technical Comment."
[260] Bryant, "Annual Report," November 10, 1939, p. 13.
[261] M.R. Tillotson, "Monthly Report to the Director of Activities at Grand Canyon National Park," April 5, 1938, p. 5, GRCA 719.32/Monthly Reports-1938.
[262] "Proposed Reclaimed Sewage Water Line to Serve Toilet Facilities in Laundry, Grand Canyon, Arizona in the Grand Canyon Nat'l Park," March 3, 1938, rev. December 31, 1938, GRCA 68527.

As mentioned earlier, the ATSF laid a 3" reclaimed sewage water pipe to the south elevation of El Tovar in 1928. In the early 1940s, the railroad connected this line to a 2" pipe inside the basement to serve a men's restroom. From the men's room, a 1-1/2" pipe continued to a riser that connected with the women's restroom on the first floor.[263]

It was not until after World War II that the ATSF completed the final reclaimed water line project as planned in 1938.[264] This comparatively large project involved connecting the reclaim line to toilets throughout the Bright Angel Lodge complex. During the original construction, the ATSF had connected two sets of public toilets in Bright Angel Lodge with the reclaim line. A pump in the Powerhouse forced, and continues to do so, the reclaim water to the Lodge through a 4" cast iron pipe entering the building near the east end of the south elevation.

Once inside the lodge, the pipe turns west and continues through the tunnels beneath the building and on to Buckey O'Neil Cabin. In that building, the reclaim water line branched to the north to served two toilets, while the main line continued through a pipe tunnel to Powell Lodge. The pipe in Powell followed the east/west axis of the building and exited in a new pipe trench dug solely for the reclaim line. This 2" cast iron pipe extended west through the cabins before splitting into a "T" that led to the two 1925 comfort stations and ended.[265]

As evidenced by the ATSF's halt of the reclaim sewage water line extension project for Bright Angel Lodge in 1938, little to no major utility construction occurred in Grand Canyon Village after the start of World War II. The federal government decommissioned the CCC from the park in mid-1942.[266] Later that year, a park employee (possibly an engineer) undertook one important project, the completion of a plan map of the sewer lines in Grand Canyon Village.[267] In addition, Park Engineer C.M. Carrel made a map of the water lines, including water, reclaim, and fire in 1944-45. Still, Park Service employees could complete only the most necessary of maintenance projects during the following three years as many of them "left to undertake war work."[268]

The ATSF and Fred Harvey Company also discontinued most of the services at Grand Canyon Village in 1942, limiting construction and maintenance. Daily passenger train service ceased between Williams and the Grand Canyon, and Fred Harvey only opened El Tovar and a few rooms at the Bright Angel Lodge for overflow during the summer months.[269] The ATSF did undertake one small project in 1942, the cleaning and painting of the ATSF water tanks, and the painting of and planting of trees and shrubs along the exposed pipelines paralleling the railroad

[263] "Proposed Reclaimed Sewage Water Lines."
[264] "Proposed Reclaimed Sewer Water Line to Outside Toilets at Bright Angel Camp for Future Guest Room Unit, Grand Canyon, Arizona in the Grand Canyon National Park," April 11, 1938, GRCA 68493.
[265] Atchison, Topeka & Santa Fe Railway Company, "Reclaimed Sewage Water Lines, Serving Bright Angel Area, Grand Canyon, Ariz," Drawing No. 113-21797, rev. October 1946, GRCA 68491.
[266] Taubert, "Record of Inspection," March 6&7, 1942.
[267] U.S. Department of the Interior, National Park Service, "Village Sewer System, Grand Canyon National Park," November 15, 1942, Denver Service Center, Technical Information Center 113-60542.
[268] Bryant, "Supt. Annual Report," 1944, p. 1; Bryant, "Annual Report (Superintendents)," 1945, p. 1; Bryant, "Annual Report (Superintendents)," 1946, p. 1.
[269] Bryant, "Annual Report," 1943, p. 2.

en route to El Tovar.[270] Painted an "unobtrusive gray," Park Superintendent Bryant noted that the project "resulted in a decided improvement" in the visual appearance of the village.[271]

Although the NPS, Fred Harvey Company, and the ATSF limited construction and maintenance projects around Grand Canyon National Park, the NPS and its concessioners began planning for post war projects. The water line plans from 1944-45 likely resulted from this activity. The park proposed a new utility area for its use in Grand Canyon Village, as well as a new residential area, both on the south side of the village.[272]

Though the park and concessioners diligently formulated a plan, they experienced such an onslaught of visitors to Grand Canyon National Park immediately following the end of the war and for the next few years, that they were scarcely able to maintain the existing infrastructure. Moreover, the Fred Harvey Company hotels and Park Service campgrounds could not sustain the increased park visitation during the tourist season and repeatedly turned people away.[273] Nevertheless, the ATSF was able to complete a few projects in order to slightly increase the amount and quality of accommodations, but nothing pertaining to sewer or reclaim water systems within this project's study area[274]

Several factors contributed to the inability of the Park Service and the Grand Canyon concessioners to quickly recover in the initial post-war years following a period of limited maintenance and construction during World War II. First, Congress greatly limited appropriations for the park during those years. Second, increased labor costs were coupled with a general lack of skilled craftsmen, as a post-war building boom was taking place across the entire nation. In fact, it took the Park Service several years to increase the maintenance staff levels back to pre-war numbers. Third, the post-war housing boom caused a scarcity of building materials. Finally, in the early 1950s the end of Fred Harvey Company's contract was nearing expiration; therefore, the company was unwilling to invest in capital improvements.[275]

Few alterations were made during the first half of the 1950s in Grand Canyon Village. The number of tourists consistently broke or nearly equaled the prior year's record. In 1951 attendance increased 8 percent with 654,348 park visitors.[276] That year, the park made a map of the sewer system in the village as part of a new master plan.[277] The antiquated sanitary facilities could no longer handle the large crowds and the park experienced numerous complaints. The

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[270] It seems that some of these plantings are extant today and include older growth desert rose and pines. The pipe stanchions (L-25) are still extant and are contributing elements to the Grand Canyon NHL District, but the pipes have been removed.
[271] Bryant, "Annual Report," 1942, p. 5.
[272] Bryant, "Annual Report," 1945, p. 2.
[273] Bryant, "Annual Report," 1946, p. 1; Bryant, "Annual Report," 1947, pp. 1, 5; Bryant, "Annual Report," 1948, pp. 1-2.
[274] Bryant, "Annual Report," 1947, p. 5.
[275] Bryant, "Annual Report," 1947, p. 5; Garrison, "Superintendent's Annual Report," 1950; Bryant, "Superintendent's Annual Report," 1951, p. 1.
[276] Bryant, "Superintendent's Annual Report," 1951, p. 1.
[277] U.S. Department of Interior, National Park Service, "Utility Layout Plan, Sewerage, South Rim Village Concessionaire Area," November 1951, Denver Service Center, Technical Information Center 113-5336A.

activated sludge treatment plant did, however, prove invaluable as record water use occurred in the summers of both 1951 and 1952.[278] In June 1951, the plant reclaimed 5,858,400 gallons, of which ATSF and Fred Harvey Company used 5,252,500 gallons and the park service used 281,900 gallons. The remaining 325,000 gallons were bypassed due to lack of storage facilities. The following year, the plant reclaimed 6,298,200 gallons of water for industrial use in July. A reduction in the use of reclaimed water resulted after the railroad replaced its steam engines with diesel in 1953.[279] Still, neither the park nor the concessioners performed much construction related to utilities. For the park, this related to a general lack of funds and limited personnel.[280] For the concessioners, it related to the decrease in passenger travel on the ATSF to the Grand Canyon.[281]

The major cost involved in improving the accommodations and updating the infrastructure at Grand Canyon Village proved too much for the ATSF. With passenger travel almost non-existent, the railroad could not conscientiously make the needed investments in the village. Therefore, in 1954, the ATSF sold most of its buildings to Fred Harvey Company and donated the remaining to the National Park Service.[282] Buildings donated to the Park Service related to utilities and included the Powerhouse and the activated sludge treatment plant, which the railroad continued to operate for some time after the transfer.[283] Additionally, the NPS followed standard public utility practices in this agreement by taking ownership of all the main sewer and water lines in the village. Fred Harvey, in turn, assumed maintenance of lateral lines on the service side of newly installed meters.[284] The plan made in 1944-45 of the water utility lines shows the location of meters in the village.[285] The instrument of donation also included plans of the utilities.

The park continued to operate the activated sludge plant until March 1972, when the new wastewater treatment plant (Building No. 467) was brought on-line. This new plant tied into the existing septic water line from the 1926 activated sludge treatment plant to convey the reclaim to and throughout Grand Canyon Village. In the meantime, the NPS built Thunderbird Lodge (Building No. 1300) in 1968, and Kachina Lodge (Building No. 1320) in 1971, resulting in the

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[278] In June 1951, Grand Canyon Village used 7,282,500 gallons of fresh water. The following June the total used during the month reached 8,032,500 gallons. Bryant, "Superintendent Annual Report," 1951, p 10; Bryant, "Annual Report," 1952, p. 8.

[279] In 1953, the cost to reclaim water also began to increase. H.C. Bryant, "Superintendent's Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," June 2, 1953, p. 5, GRCA 54706.

[280] Bryant, "Superintendent's Annual Report," 1951, p. 7; Bryant, "Superintendent's Annual Report," Supplement, July 12, 1951, p. 10; Bryant, "Superintendent's Annual Report," 1952, pp. 5, 7-8; H.C. Bryant, "Superintendent's Annual Report [Supplement], Grand Canyon National Park, Grand Canyon, Arizona," July 15, 1952, p. 4, GRCA 54706; Bryant, "Superintendent's Annual Report," 1953, pp. 2, 4, GRCA 54706.

[281] The railroad also balked at expanding outside of their 20-acre depot for fear of losing investments if the Park Service did not renew their contract. Anderson, *Polishing the Jewel*, p. 48.

[282] Gurley, "Instrument of Donation"; Anderson, *Polishing the Jewel*, p. 49.

[283] P.P. Patraw, "Working Memorandum to Accompany Permit," May 28, 1954, and P.P. Patraw, Memorandum to Regional Director, Region Three, April 2, 1954, both in GRCA 49295.

[284] Tillotson, "Report of the Evaluation of Utilities," pp. 1-2.

[285] Perhaps as an exhibit for the instrument of donation, a list of all of the water, reclaim water and steam meters, including location, size, brand, and owner, in Grand Canyon Village was compiled. "Inventory of Water, Reclaimed Water and Steam Meters," ca. 1953.

construction of new sewer lines to both buildings. Additionally, new reclaim lines irrigated lawns around these hotels, as well as the east addition to Bright Angel Lodge.

After building the new sewage treatment plant in 1972, the National Park Service rehabilitated the sewer system throughout Grand Canyon Village. This included building a lift station on the west side of Kolb Studio (Building No. 533) in 1973, as no prior plans show this building being connected to the village sewer system.

The Park Engineer is planning to evaluate all active sewer lines in Grand Canyon Village by using fiber optic cameras. This process, which will help determine the exact location and condition of the in-use and abandoned sewer lines in the park, is slated to begin during the winter of 2007. Currently, park plumbers use an AutoCAD drawing made by park personnel in 2001 that shows a best guess as to the location of these lines. As of this writing, a project to replace reclaim water lines in the village is in the planning stages.

III. Power and Steam System Development and Use at Grand Canyon Village

The first major electric generation at Grand Canyon Village began in 1905 with the completion of the "Boiler House and Pumping Plant," built by the Santa Fe and Grand Canyon Railway in conjunction with El Tovar Hotel (Building No. 542). Prior to that time, residents ingeniously adapted railroad equipment to their needs. A photo of Teddy Roosevelt's visit to the Grand Canyon in May 1903 shows an obsolete oil locomotive "box" headlight mounted on a post to illuminate the footpath between the first Railroad station and the Bright Angel Hotel (Building No. 507).[286] Otherwise, the first visitors to and residents of the burgeoning Grand Canyon Village spent their evenings by candlelight (see Appendix B, Figure 31: Bright Angel Hotel without power lines, ca. 1898, GRCA 5115). One such resident was Buckey O'Neil, who is depicted in an early photograph reading by candlelight in his cabin (Building No. 508), the earliest extant building in Grand Canyon Village.

Since the Santa Fe and Grand Canyon Railway wanted to attract wealthy clientele to its new tourist destination, the company began construction of a "first class" El Tovar Hotel (Building No. 542) in 1903 and the stone Boiler House and Pumping Plant, herein known as the Power Plant (Building No. 37), the following year.[287] The new luxury lodge boasted electric lights, steam heat, and indoor plumbing.[288] The power plant provided steam heat and DC current electricity for the hotel, as well as Hopi House (Building No. 545) constructed in 1905. Since Fred Harvey Company also operated the Bright Angel Hotel by this time, the company likely strung above-ground power lines to the hotel shortly after completion of the Power Plant (see Appendix B, Figure 32: Historic photo of Bright Angel Hotel with power lines, ca. 1915, GRCA 11813).

Although the Power Plant provided steam heat for El Tovar, the railroad company may have installed boilers in the basement of El Tovar as well. El Tovar's architect, Charles Whittlesly, prepared boiler plans for the basement of the hotel.[289] The specific use of these boilers is not known, but they may have heated water for the kitchen or the associated laundry built in 1906. It is also possible they were never installed.

The "Boiler House and Pumping Plant" stood south of El Tovar, between the hotel and the railroad's Passenger Yard. A railroad spur led from the main line northeast up El Tovar hill passing on the south side of the power plant. There, tank cars unloaded water for the Power Plant boilers into a water tank (Tank No. 1, Building No. 39) behind El Tovar at the top of the hill. Tankers also unloaded fuel oil into a tank (Building No. 44a) located on the south side of the Power Plant for use in the boilers.[290] Though the type of boiler installed in the power plant is unknown, two engines were installed on cement foundations to generate electricity: a 100 KW

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[286] Chappell, "Grand Canyon Depot," np.
[287] Anderson, *Polishing the Jewel*, p. 6; Grand Canyon Railway, "Drawing No. 80-[55]01, Plan Showing Location of Buildings and Contour Lines at Grand Canyon, Arizona," July 19, 1904.
[288] Harvey, "Grand Canyon of Arizona."
[289] Whittlesly, "Hotel Building at the Grand Canyon," Drawing No. 2.
[290] The Grand Canyon Railway Company, "Drawing No. 100-8097, Track Changes Account Addition to Powerhouse at Grand Canyon," August 31, 1914, GRCA 34990.

and a 50 KW National Electric Generator made by Ridgeway Dynamo and Engine Company in Ridgeway, Pennsylvania comprised the engines (see Appendix B, Figure 33: Foundation Plan for 10x12 Engine, 1904, GRCA 30035BC; Figure 34: Foundation Plan for 11x18x14 Compound Engine, 1904, GRCA 30035AP; Figure 35: Steam generator in Power Plant, 1906, GRCA 9464; Figure 36: Equipment inside Power Plant, 1905, GRCA 12947A; and Figure 37: Equipment inside Power Plant, 1906, GRCA 12947B).

For a short time potable water likely fed the "Boiler House and Pumping Plant" boilers, a costly use since all water had to be hauled in by train to the South Rim. With the construction of a sewage treatment plant, circa 1906, the railroad was able to use effluent reclaimed from the plant. However, this reclaim water had to be filtered again once it reached the power plant. The reclaim water passed through treating tanks installed in an addition to the north side of the power plant in 1906. A 20' x 36.3' frame treating house with a stone foundation and a shingle roof comprised the addition, which was henceforth known as the treating house (see Appendix B, Figure 38: Power Plant's west elevation, GRCA 11989).[291]

Following the El Tovar and Hopi House construction, ATSF built two service buildings for Fred Harvey Company in 1906, the mule barn (Building No. 562) and the livery stable (Building No. 563). Since the ATSF already provided electricity to Bright Angel Hotel and Fred Harvey and Santa Fe employee housing via the power plant, it undoubtedly provided the same for these new facilities. The company maintained its own crew of electricians under the Chief Engineer, who likely wired these new buildings.[292]

In-house railroad electricians were certainly used during construction of the new Grand Canyon Depot (Building No. 549) in 1909-10. The Grand Canyon Railway's electricians were already responsible for maintaining the steam powered generators and electrical system in the "Boiler House and Pumping Plant," so they could easily accomplish this part of the depot's building contract.[293] The electricians ran the wiring from the main switchboard at the power plant, located a short distance to the northwest, to the depot via buried iron conduits. There, two distributing boxes disseminated the wiring into and throughout the building, which the electricians also installed. Specifications called for feeders that provided 220 volt service and distributing circuits that proved 110 volt service.[294]

The ATSF used an outside contractor to install heating in the new Grand Canyon Depot.[295] Eugene Murray of Los Angeles, California entered into a contract with the railroad on February 1, 1910 to install the heating system for $800.[296] Specifications called for a two pipe vacuum

[291] ATSF, "Building Record," ca. 1915, np; Grand Canyon Railway Company, "Drawing No. 100-6894, Arrangement of Pipe Lines for Use of Treated Water of Grand Canyon, Ariz.," September 22, 1909, GRCA 34990.
[292] Chappell, "Grand Canyon Depot," np.
[293] Chappell, "Grand Canyon Depot," np.
[294] Wilson, "Specifications of Labor, Material and Mechanical Workmanship," pp. 25-26.
[295] The ATSF awarded A.W. Anson of Albuquerque, New Mexico the general contract for the Grand Canyon Depot. Santa Fe, General Contract, Short Form, between A.W. Anson of Albuquerque, New Mexico and The Grand Canyon Railway Company, October 27, 1909, p. 1.
[296] Santa Fe General Contract, Short Form, between Eugene Murray and The Grand Canyon Railway Company, February 1, 1910, p. 1.

heating system with the main and return connecting with the boiler room main in the power plant. The wrought iron, 2-1/2" pipe was covered with asbestos and protected in vitrified clay pipe with cement joints. The pipe, graded to the depot, connected with the low pressure main at the boiler room. The return connection to the boiler room was graded to connect with the boiler room.[297]

The ATSF paid $1,522 for piping the steam lines to the new Grand Canyon Depot; however, this cost was nearly double Murray's contract for $800. It could be that at least part of that cost went toward piping the rail yard. The contract does not indicate if the cost was only for the new lines to the depot or if it included steam lines in the Passenger Yard.[298] A plan from 1909 indicates that the Grand Canyon Railway Company proposed installing a 1-¼" steam line between the power plant and the southeast corner of the platform in the Passenger Yard (see Appendix B, Figure 39: The Grand Canyon Railway Company, "Proposed Steam Line to serve Pullman Coaches at Grand Canyon, Ariz.," between Power Plant and Passenger Yard, Drawing No. 100-6899, 1909, GRCA 66101-29).[299] This steam line installation could have been in preparation for later improvements made to the yard.

Other buildings in Grand Canyon Village used coal for heat during the winter months. Either Buggeln or the Grand Canyon Railway constructed the coalhouse for Bright Angel Hotel, a two-room frame building with a stone foundation and a shingled roof, for $181 in 1901. The coal shed stood off the southeast corner of the main hotel building. In addition, the Grand Canyon Railway built a one room frame coal house for $50 in 1906 for use by El Tovar's accessory buildings and a wood coal box for $20 in an unknown location by 1915, though probably much earlier.[300]

By 1911, the ATSF needed to expand the power plant to serve the growing village at Grand Canyon. That year the ATSF built a 21.8' x 34.8' addition with a concrete block foundation and corrugated iron siding and roofing on the south side of the stone Power Plant (see Appendix B, Figure 40: Addition to Power Plant from AT&SF Ry Co Building Record, ca. 1915). The ATSF completed the new flume track and water delivery system on the south side of the passenger yard that same year. This new system allowed the company to tear up the water delivery track located south of the power plant. Also that year, the ATSF proposed a 2" steam line, apparently not fed by the power plant, from the pump house at the sewage treatment plant (circa 1906) north to the

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[297] Francis W. Wilson, "Specifications for Steam Heating, New Grand Canyon Depot at Grand Canyon, Arizona for AT&SFRR," 1910, p. 1.
[298] Chappell, "Gran Canyon Depot," np.
[299] Heating passenger cars with steam began around the turn of the twentieth century as a safety precaution. Formerly, stoves that burned coal, wood, and sometimes oil, heated passenger cars; however, during derailments, these cars often caught on fire, forcing state legislatures to outlaw this type of passenger car. In 1904, the ATSF began using passenger cars heated by low-pressure steam-fed radiators manufactured by the Chicago Car Heating Company. Steam from the locomotive heated the cars while running. To service an engine, mechanics had to uncouple the locomotive from the passenger cars, thus disconnecting them from their heat source. In order to keep the passenger cars warm, railroads outfitted yards with steam pipes beneath the tracks. Using flexible couplings, the steam pipes could be connected to the cars to maintain heat. See Chappell, "Grand Canyon Depot," np.
[300] ATSF, "Building Record," ca. 1915, np; Grand Canyon Railway Company, "Drawing No. 78-3989, Laundry, Coal House, Sidewalk & Fence," October 8, 1904, GRCA 30035BA.

railroad track. This steam heat pipe would be connected with locomotives laying over in the yard (see Appendix B, Figure 41: The Grand Canyon Railway Company, "Portion of Station Grounds at Grand Canyon Showing Pro. Steam Heat Pipe Line for Septic Tank Pump House," 1911, Drawing No. 100-7189, GRCA 66101-36). The ATSF may have also added a small coal fired boiler adjacent to the north side of the pump house as well as a coal shed.

Removal of the water spur provided space for the ATSF to add a second addition to the south elevation of the Boiler House and Pumping Plant in 1913. The ATSF expanded the plant again to increase the steam generating capacity of the boiler room. The Santa Fe employee magazine publicized that the railroad approved $6,790 for the improvement built mainly to serve new steam heated passenger cars parked in the rail yard.[301] Though the railroad probably piped the Grand Canyon Depot rail yard for steam circa 1909 as part of depot construction, it definitely occurred by 1914 after the second power plant expansion. That year the Santa Fe magazine reported that the company allotted $1,500 for the installation of steam and air lines required for the new passenger car heating system, as well as the installation of water lines to clean the passenger cars standing in the yard.[302] At the very least, this project improved upon the existing steam line to the yard.

Still, the ATSF consistently used coal to heat passenger cars into the late 1920s. In the summer of 1917, the ATSF added a coal bin "for passenger car use" to the west side of the freight and ice house (Building No. 550) that stood east of the depot at the end of the Passenger Yard. The 18.3' x 12.4' windowless addition clad with horizontal tongue and groove siding and ready rock roofing maintained the width and gable roof line of the existing building (see Appendix B, Figure 42: Freight House on east side of Depot, post 1926, GRCA 2051).[303]

The ATSF also built Lookout Studio (Building No. 532) and the Fred Harvey Garage (Building No. 551) in 1914. Undoubtedly, the increased generating power of the plant served these new buildings. The power line was extended to Lookout Studio, after installation of a light fixture at point north of the building. The ATSF also extended steam lines to this building for heat.[304]

The increased steam generation by the Boiler House and Pumping Plant also benefited other building in Grand Canyon Village. During the summer of 1917 the ATSF ran a steam line to the Fred Harvey Company transportation buildings, including the "mule barn," "driving barn," "mess house," "shops," and "Shirley's."[305] The line extended south from the power plant, under

[301] Chappell, "Grand Canyon Depot," np.
[302] Chappell, "Grand Canyon Depot," np.
[303] Beginning with the ice house, the ATSF constructed the ice, freight, and coal house in three episodes between circa 1910 and 1917. The coal house and ice house flanked the freight house at center. The National Park Service razed this building in 1971. See Chappell, "Grand Canyon Depot," np; Atchison, Topeka, and Santa Fe Railway Coast Lines Field Engineers Notebook, "Close Out Hard Coal Bin for Passenger Car Use at Grand Canyon," April 15, 1918, 2 pages, GRCA 66101.
[304] Peters, "Superintendent's Annual Report," 1920, p. 5.
[305] Today, the "transportation buildings complex" encompasses the Fred Harvey utility area, the "mule barn" is the livery (Building No. 563), the "driving barn" is the mule barn (Building No. 562), the "mess house" (Building No. unknown) was torn down circa 1981, the "shops" are the blacksmith shop (Building No. 564), and "Shirley's" is now known as Shirley Hall (Building No. 557).

the railroad yard and drainage ditch, and then west to the transportation buildings complex, where it branched to each building. The cast iron pipe decreased in size, from a 4" pipe to a 1 - ½" pipe as it moved away from the power plant. The same was true of the return line, although the diameters ranged from 1-½" to 3". The railroad covered all of the outside steam lines with Michigan wood pipe coverings.[306]

The previous year, the ATSF had extended steam lines in the Bright Angel Hotel complex. The railroad ran a 2" vacuum heating line and a one pipe steam system via a 3" pipe between Bright Angel Hotel and Bright Angel Annex (Building No. 509). Since the engineer did not include an overview of the Bright Angel buildings and the power plant in his plans, it is unclear if steam from these new lines came from the power plant or a separate boiler that may simply have been installed in the Bright Angel Hotel in 1911. The railroad proposed a coal-fired boiler to serve a kitchen added to the hotel around that time as well. It is possible that this boiler later served the entire Bright Angel Hotel (see Appendix B, Figure 43: The AT&SF Ry Co., "Showing Location of Pro. Boiler House for Kitchen-Bright Angel Hotel at Grand Canyon," Drawing No. 100-7212, 1911, GRCA 66101-38).[307] All of the cottages at Bright Angel Hotel had steam heat and electric lights by 1919.[308]

The ATSF installed electric lights in the Bright Angel Hotel as part of a larger electrification project undertaken by 1919. That year, the railroad put in "open wiring," most likely surface-mounted wire with no conduit, for electric lights in the hotel cottages. In addition to the cottages, the railroad also wired the Bright Angel "Dormitory," now known as the Brown Building (Building No. 537), west of the hotel.[309] New open wiring in both the El Tovar's laundry building and the "old dormitory," also known as the Indian Dormitory (Building No. 538), was similarly installed.[310] Built simultaneously with El Tovar, these buildings undoubtedly had electric lights from initial construction, and this project must have simply been an update.

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[306] Atchison, Topeka and Santa Fe Railway Coast Lines Field Engineers Notebook, "Plan Showing Location of Steam Line Outside Transportation Buildings," September 10, 1917, 1 page, GRCA 66101.
[307] Atchison, Topeka and Santa Fe Railway Coast Lines Field Engineers Notebook, "Steam Line to Bright Angel Camp Heating System, 1 page, October 31, 1916, GRCA 66101.
[308] Atchison, Topeka and Santa Fe Railway Coast Lines Field Engineers Notebook, "Location of Lights with Open Wiring, Old Dormitory, El Tovar," October 4, 1919, GRCA 66101; Peters, "Superintendent's Annual Report," 1920, p. 5; "Open Wiring, Bright Angel Dormitories," October 4, 1919, 2 pages, GRCA 66101.
[309] The Brown Building was moved south of the railroad tracks sometime between 1951 and 1967.
[310] The Indian Dormitory was demolished in 1969. Atchison, Topeka and Santa Fe Railway Coast Lines Field Engineers Notebook, "Location of Lights with Open Wiring, Old Dormitory, El Tovar," October 4, 1919, GRCA 66101.

Independent concessioners in Grand Canyon Village generated their own power and heat. John Verkamp, installed a "power pla[n]t" just south of his building, Verkamp's Curios (Building No. 546) by 1917. Simply a generator housed in a small building (Building No. 546), the "plant" powered the curio shop, as well as a light fixture along the sidewalk leading to the rim from the front of his curio store.[311] The Verkamps used coal delivered by the railroad to fuel the generator.[312]

Likewise, Kolb Brothers Studio (Building No. 533) did not obtain power from the ATSF's 1905 Boiler House and Pumping Plant. Instead, the Kolbs installed their own "electric light plant" on the east side of their building in 1915.[313] Most likely, the Kolbs fueled their "electric light plant" with oil, evidenced by two tanks located in proximity to the "power house," or generator, on the 1917 village plan. The tank to the east most likely held fuel oil since the other tank held water.[314]

By 1916 ATSF realized that the Boiler House and Pumping Plant, even with its two additions, could not adequately fulfill the growing needs of Grand Canyon Village. Additionally, the Forest Service considered the design, location, and color of the power plant "unfortunate."[315] Over the next decade, the burden on the power plant progressively increased. The number of visitors to the Grand Canyon steadily rose after World War I. When the National Forest became a National Park in 1919 this number accelerated. Railroad passenger traffic increased 8 percent between 1920 and 1925 from 56,075 to 68,267 riders. Tourists coming to the newly established National Park in automobiles multiplied even more rapidly during those five years. Whereas approximately 15,000 people arrived by vehicle in 1920, the number of train passengers and automobile drivers were nearly equal in 1925.[316]

Not only was the power plant overloaded in the early 1920s, the ATSF charged a very high rate, probably five or six times the normal rate, for electricity. Since the power plant generated electricity with steam, the railroad transferred the high cost of water in Grand Canyon Village to their customers by charging a lot for electricity. In 1922, this equated to 30 cents for one kilowatt hour. The limitations of the power plant and the high energy costs caused Park Superintendent Crosby to suggest that the NPS construct its own power generation station.

Superintendent Crosby recommended a separate, explosion-engine generating station for several reasons. As with the inadequate sewer and water infrastructure in Grand Canyon Village during

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[311] The generator building is still standing off the southwest corner of Verkamps Curios; however, the Verkamps removed the generator, enveloped the building with new construction, and converted to storage space. Personal communication with Dan Ashley, Xanterra Director of Engineering regarding Bright Angel Lodge Utilities, July 24, 2006.
[312] Brown, "Verkamp's," p. 17.
[313] The following year, the Kolbs added a water heating system as well. Johnston and Leopold, "Grand Canyon Working Plan," A-3.
[314] None of these features exist today, but based on a field visit in 2006 that revealed two separate pipes leading toward the general location of the former tanks, one can deduce that each tank held a different substance.
[315] Johnston and Leopold, "Grand Canyon Working Plan," A-1.
[316] Anderson, *Polishing the Jewel*, p. 90.

the first half of the 1920s, the overloaded power plant limited the NPS's ability to develop the park, for both the government and public benefit. Crosby also expressed concern regarding the need to improve living conditions for employees residing in Grand Canyon Village. He feared that the railroad's escalating use of power might preclude the park's ability to purchase electricity in the future. Finally, Crosby believed that if the park generated its own electricity, costs could be reduced to one fifth or one sixth that being charged by the railroad.[317] Nevertheless, in 1925 the NPS entered into two contracts for the purchase of electricity from the ATSF.[318]

Although both the ATSF and the NPS recognized that the Boiler House and Pumping Plant was obsolete, it was not until the winter of 1924-25 that the ATSF began planning a new Powerhouse.[319] The delay largely resulted from the time it took the National Park Service, Fred Harvey Company, and the railroad to approve the Master Plan devised by Park Service landscape architect, Daniel P. Hull, in 1923-24. Once the National Park Service approved Hull's plan, the ATSF proceeded in the summer of 1925 with construction of a new Powerhouse (Building No. 58) on land leased from the park. The new plant, which cost $600,000 to build, went into service in 1926 under the supervision of Chief Engineer Elmer Nelson.[320]

Hull's "Grand Canyon National Park General Plan, Community Development" located the new Powerhouse south of the Passenger Yard and east of the wye track. The plan designated this area as No. 12, in an industrial zone for Fred Harvey Company. The master plan also designated an industrial area and administration area for the Park Service, a tourist area, and Fred Harvey Company and Park Service residential areas for future development.[321]

As was typical, the ATSF contracted construction of the new Powerhouse. The general contractor, McKee, worked "a big gang of men to complete [the] new Powerhouse as soon as possible." Meanwhile, a concurrent railroad project--the realignment of the wye track to the east--allowed the construction of the Powerhouse in Hull's designated location.[322] Realignment of the wye included grading and the excavation of limestone, which the railroad used for the rustic stone veneer on the new Powerhouse at the behest of the NPS. This project also included construction of a spur, Track No. 37, to serve the new Powerhouse. The railroad also laid new track, extended track in the yard, and added heavier rail in the yard around this time.[323]

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[317] Crosby, "Superintendent's Annual Report," 1922, p. 11; W.W. Crosby, Preface to "Superintendent's Annual Report, Grand Canyon National Park, Grand Canyon, Arizona," 1923, p. 1, GRCA 54706; Crosby, "Superintendent's Annual Report," 1923, p. 12.
[318] The reason for two separate contracts is unknown.
[319] Plans were underway as early as 1917 for a Powerhouse; however, it is not known if these plans pertained to the same Powerhouse. Johnston and Leopold, "Grand Canyon Working Plan," A-1.
[320] To avoid confusion between the Boiler House and Pumping Plant ("Power Plant," Building No. 37), constructed in 1905, and the new Powerhouse (Building No. 58) built in 1926, they will be referred to as such for the remainder of this report. Crosby, "Superintendent's Annual Report," 1923, p. 9; Willy, "Fred Harvey's Facilities," p. 24.
[321] Daniel P. Hull, "Grand Canyon National Park, General Plan: Community Development," June 24, 1924, GRCA 63411 and Denver Service Center, Technical Information Center 46.
[322] The use of more modern locomotives with longer wheelbases necessitated that the railroad build a wye track with less curvature to provide for a longer turning radius.
[323] Chappell, "Grand Canyon Depot," np.

Upon completion of the new Powerhouse, the ATSF razed the 1905 Boiler House and Pumping Plant (Building No. 37), which was outside the newly designated industrial zone. In place of the old power plant, the railroad constructed a large rubble stone vault with a shed roof (NHL Building No. B-1). Likely, a manifold was installed inside this vault to provide the connection to the new utility lines coming from the new Powerhouse with the existing lines leading to buildings north and east of the old power plant.[324] The company also moved the original 1901 depot (Building No. 573), which served as Chief Engineer Nelson's office, from its location between the demolished power plant and the Depot to southeast of the new Powerhouse. This small building continued to serve as Nelson's office for many more years.[325]

While the ATSF overhauled the rail yard, the railroad's Water Service Department simultaneously laid pipelines for steam, electricity and water between the Powerhouse and facilities on the north side of the railroad tracks.[326] To run these lines, the ATSF Water Service Department excavated a pipe trench north from the north elevation of the Powerhouse beneath the tracks (see Appendix B, Figure 44: Powerhouse construction with open pipe trench, ca. 1926, GRCA 13115 and Figure 45: Powerhouse and steam lines under construction, 1925, GRCA 13203). The pipe trench contained an 8" low pressure steam line and a 6" high pressure steam line, as well two cork covered ammonia lines (a 2-½" and a ¾" pipe). Near the top of the hill opposite the Powerhouse, the pipes branched to the north and to the east. The utility lines leading north continued in a pipe trench to the eastern dormitory (Brown Building, Building No. 537) of Bright Angel Hotel. They included a 6" low pressure steam line and a 2 ½" high pressure steam line.[327] The pipes leading to the east serviced El Tovar, the Grand Canyon Depot, the Hopi House, and the Fred Harvey garage (Building No. 551).

In order to run the steam and electrical pipes to El Tovar and beyond, the ATSF Water Service Department devised a rack system that carried the pipe along the hillside between the Powerhouse and the hotel. These stanchions were made of two upright sections of varying lengths of rail set in concrete.[328] A 4" iron crosspiece welded to the verticals held boards spanning each pair of racks. On the boards, in between the uprights, rested a 6" low-pressure steam line and a 6" high pressure steam line both insulated by asbestos covered with sheet metal. To one side were two cork-covered ammonia lines, one ¾" and one 2-½". A 2" strap iron hanger attached to the crosspiece held two 2-½" electrical conduits below the crosspiece and separated the two steam pipes above the crosspiece. In addition, cast concrete stanchions with a half circle surface in the top were also used for the pipes between the two buildings (see Appendix B, Figure 46: Steam lines and light post near railyard, ca. 1934, GRCA 7306).[329]

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[324] The assumption that there is a manifold inside the vault comes from the fact that this is what presently exists inside the existing vault based on a field visit with Xanterra Director of Engineering, Bob Baker in July 2006.
[325] Chappell, "Grand Canyon Depot," np.
[326] Mr. Ransom headed the ATSF's Water Service Department during this pipeline project.
[327] ATSF, "Pipeline Map," 1928.
[328] The rail used in constructing the stanchions, imprinted C.F.&I. Co. SEC 853 11 .08, was likely the old, smaller gauge rail that the railroad removed during renovation of the Passenger Yard in the mid-1920s.
[329] The specific use of the cast concrete stanchions is unknown, because the "Pipeline Map of Grand Canyon," from May 16, 1928 has been folded and torn in the location of the stanchion drawing on the plan. Nonetheless, based on the concave top, the stanchions must have been used for a pipe that expanded and contracted, such as a steam pipe.

These utility lines continued east along the hillside on the pipe stanchions to the south of the El Tovar dormitories. There, the lines, which remained above grade until this point, turned northeast and ran underground toward the stone vault. From the vault, the steam lines split in several directions, most likely lying in the existing pipe trenches associated with the 1905 Powerhouse. One set of steam lines and the ammonia lines went north in a concrete conduit to the southwest corner of El Tovar, while another pair of steam lines led east to the depot. A final steam line and return served the passenger yard to the south before turning east to extend to the Fred Harvey Garage. The electrical conduit mounted on the pipe stanchions continued northeast past the stone vault to a concrete transformer vault.[330] From there, the line divided into two lines, both of which served El Tovar.[331]

In addition to the electrical conduit servicing El Tovar, the ATSF maintained both buried and above ground electrical lines. The above ground lines located throughout Grand Canyon Village serviced street lamps and interior lighting (see Appendix B, Figure 47: Electrical lines west of El Tovar, ca. 1934, GRCA 9652 and Figure 48: Electrical lines and transformer (bottom center), 1956, GRCA 3181). The majority of these lines were likely in place before construction of the new Powerhouse. However, the ATSF buried four additional main conduit lines in conjunction with the new plant. Two buried lines, one on each side of the railroad tracks, led east from the Powerhouse to the Fred Harvey garage. Two other buried lines led west from the plant to the spray pond.[332]

The new Powerhouse also supplied steam and electricity to two new buildings, the new Fred Harvey laundry building (Building No. 569) built to the west of the plant in 1926 and the circa 1930 sanitary can storage building (Building No. 568) approximately 50 feet northeast of the Powerhouse. For the laundry, the railroad laid all of the utility lines in a concrete conduit located between the north side of the Powerhouse and the northeast corner of the laundry. The conduit held four wrought iron pipes – a 1-[¼]" steam return, a ¾" air line, a 4" steam line, and a 3" fresh water line. The railroad also laid a 3" fresh water line to the spray pond in this same pipe trench. An individual line from the north side of the plant to the east side of the sanitary can storage building provided the steam for this building.[333]

The ATSF equipped the new Powerhouse with combination diesel and steam power. During the warmer months, the plant generated electricity using diesel engines. In the colder months, the plant used steam turbines to generate current and the exhaust to heat the buildings. Equipment in the new power house included: two Fairbanks-Morse 360 horsepower diesel engines, two General Electric 100 horsepower steam turbines, 300-foot air compressor, two Casey-Hedges

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Some of these concrete stanchions, as well as most of the metal pipe rack, still stand adjacent to the south side of the stone retaining wall along the north side of the Passenger Yard. One section still retains the boards spanning two pipe stands. Also, one rack has an aluminum tag stamped "B:16.1008" attached to the base. Another aluminum tag imprinted, "A.S.T.M. A-[5]5," was located nearby and left in place. The pipe rack stanchions, both metal and concrete, have been determined contributing structures (L-25) to the Grand Canyon Village National Historic Landmark. See Scott et al., "Grand Canyon Village," p. 11.

[330] This transformer vault is still extant.

[331] ATSF, "Pipeline Map," 1928.

[332] ATSF, "Pipeline Map," 1928.

[333] ATSF, "Pipeline Map," 1928.

516 horsepower water-tube boilers equipped with a Merritt automatic stoker system, and one Sterling 250 horsepower boiler. All of the boilers were automatically fired and had automatic water control.[334] The price of steam used to generate electricity and to heat buildings dropped to one-fifth the former cost due to the more efficient system. The new Powerhouse delivered AC current to the village center via a high-tension underground cable.[335]

Fuel and diesel oil delivery for the Powerhouse occurred via the new spur, Track 37, leading east from the northern end of the wye. Tank cars dispensed the fuel through an 8" wrought iron pipe that led to four 20,000-gallon oil tanks submerged beneath the ground off the southwest corner of the Powerhouse. Three of the tanks (Tanks 2, 3, and 4) held fuel oil, while the fourth held diesel (Tank 1). Lines between the Powerhouse and these fuel tanks included a ¾" conduit, a ¾" steam return, a 2" wrought iron steam heat to the oil tanks, a 2" wrought iron from Tank 1, a 1-¼" wrought iron from Tanks 2 and 3, a 4" wrought iron from Tanks 2, 3 and 4, a 2" wrought iron steam line from a large pump, a 1-½" wrought iron steam line from a small pump, a 1-½" wrought iron steam line to a diesel tank, and a 2" steam return to standard for tank cars, all laid in one concrete conduit. During the summer, the plant used 1,080 gallons of fuel oil daily, which increased to 3,000 gallons per day in the winter, and 700 gallons of diesel. The oil was preheated before delivery to the boilers.[336]

In connection with the fuel use by the Powerhouse, the ATSF installed an oil sump and an oil pump shelter (Building No. unknown) west of the old sewage treatment plant (Building No. 207?). The oil from the Powerhouse went into the 22' tall sump via a 6" vitreous tile oil drain. The drain was buried in and extended beyond the utility trench lying between the Powerhouse and the spray ponds to the sump. West of the sump the oil drain connected with the abandoned 8" clay tile laundry bypass line installed in 1926.[337] A buried conduit between the pump house and the spray pond supplied electricity to the sump.[338] The ATSF also built a cooling tower (Building No. 59) just west of the buried oil and diesel tanks in association with the new Powerhouse. This cooling tower, equipped with ammonia lines, cooled water for the ice and refrigeration equipment.[339] A concrete conduit from the north side of the cooling tower to a mid point on the west side of the Powerhouse held multiple lines including a ¾" column gauge, a 3"

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[334] Additional equipment included a 50-ton Vilter ice machine, Maxim silencers for the diesel lines, and a metered switchboard so that the cost to each department could be determined each month. Apparently, the power plant underwent an equipment upgrade, as some of the later equipment listed later included two 500 horsepower boilers and one 250 horsepower boiler, each fueled by diesel and/or two 560 horsepower diesel engines and a 500 KVA steam turbine generator. Willy, "Fred Harvey's Facilities," p. 25; Davenport, "Use of Reclaimed Sewage Water," p. 5.

[335] Anderson, *Polishing the Jewel*, p. 16.

[336] Willy, "Fred Harvey's Facilities," p. 26; ATSF, "Pipeline Map," 1928.

[337] At first, Sanitary Engineer H.B. Hommon, thought that soaps in the laundry wastewater would cause foaming of the reclaim water and prevent its use in the boilers so the engineers bypassed the gray water around the new activated sludge treatment plant (Building No. 333). However, the new treatment plant filtered the water so well that the laundry's gray water did not affect the quality of the reclaimed septic water. The railroad simply abandoned the bypass line in place until it was used again for the oil drain, as well as brine blow down from the water softening system. The line extended to the activated sludge treatment plant. The railroad abandoned it in place, and some parts of the vitreous tile pipe are still extant (though broken in places) in the ditch in Bright Angel Wash.

[338] ATSF, "Pipeline Map," 1928.

[339] Lassiter, et al., "Utility Facilities at Grand Canyon," np.

wrought iron drain for feed water, a 3" ammonia discharge line, a 1- ½" ammonia return, and an electrical conduit.[340]

From the time the ATSF put the new Powerhouse on line, the railroad used reclaimed water for several processes in the plant. For a short time, the railroad used effluent from the circa 1906 sewage treatment plant to feed the boilers, which caused "much complaint from the musty odor." The smell disappeared when use of reclaim water from the new plant began later in 1926.[341] In addition, the ATSF used reclaim to indirectly cool the two 560 horsepower diesel engines in the Powerhouse, and as condenser water for a 500 KVA steam turbine generator.[342]

The ATSF used reclaim water to cool equipment by converting the contact bed in the former sewage treatment plant into a spray pond in 1925. Effluent circulated through this spray pond for cooling. A pump on the west side of the spray pond pumped the cooled effluent through a 4" cast iron pipe on the north side of the pond into the north side of the Powerhouse. There, the effluent circulated through heat exchangers, which cooled distilled water for circulation through the engine cooling systems of the Powerhouse. The effluent water returned via a 6" cast iron pipe, discharging into the spray pond on the east side, to be cooled again.

Shortly after construction of the new Powerhouse, the remaining independent vendors, Kolb Studio and Verkamp's Curios, entered into utility agreements with the ATSF. Although John Verkamp requested a steam line connection in 1923, the railroad denied him, as the power plant was "already quite heavily taxed."[343] In 1928, the railroad finally granted John Verkamp a license for "pipelines and electrical conduit to the Curio Store." Two years later, Emery C. Kolb received a license from the railroad for a steam line to his studio. In addition, the NPS entered into a new contract for electricity and steam heat in 1931.[344]

During the Great Depression, Grand Canyon National Park experienced an increase in infrastructure development because of the Works Progress Administration. From 1933 to 1942 Civilian Conservation Corp (CCC) camps stationed in Grand Canyon Village, as well as other locations in the park, completed numerous Emergency Conservation Work projects, including the extension of utility lines to Park Service areas. Although several of the CCC's utility projects occurred within the study area for this report, the men completed many more projects in the industrial and residential areas of the village, as well as the public and employee campgrounds.[345] The two camps that completed work in the village were Camp NP-2A, located

[340] ATSF, "Pipeline Map," 1928.
[341] Davenport, "Use of Reclaimed Sewage Water," p. 4.
[342] Davenport, "Use of Reclaimed Sewage Water," p. 5.
[343] Letter from Etter to Crosby, December 24, 1923, p. 2.
[344] The Park Service extended electric street lighting to their residential and industrial areas in Grand Canyon Village in 1931. Tillotson, "Annual Report," 1931, p. 19.
[345] During their time at Grand Canyon Village, the men of CCC Camps NP-2A and NP-4A laid several miles of electrical conduit and thousands of feet of steam lines; unfortunately, records from these projects often do not indicate where these utility projects took place. Some of the utility projects completed by the CCC outside the project area include the trenching and burying of conduit in the Park Service Headquarters (residential) area (Job No. 72-134), as well as the construction of three concrete vaults (Job No. 4-134) in 1936, reconditioning the lighting system in the public campground (Job No. 10) in 1934, extending the underground conduit to the Community Field

south of the park service utility area, and NP-4A, encamped southeast of the wye track. They worked under the park plumber and park electrician on all of the relevant jobs.

One of the first utility projects completed by the CCC in Grand Canyon Village was the construction of an access tunnel to the steam line laid under a cement floor in the new Administration Building (Ranger Operations, Building No.103). During the winter of 1934 and spring of 1935, the men completed a "heating access tunnel" and replaced some of the pipes and valves for the steam heating system in Ranger Operations.[346]

Also in the winter of 1935, the CCC relocated a portion of El Tovar's steam, ammonia and electrical lines in connection with the construction of Hermit Rim Road, another CCC project.[347] The CCC men extended the pipe rack (NHL, L-25) further east to just south of the large stone vault (NHL Building No. B-1) as part of Project No. 227G. The lines then turned north and went under the road through a 5' x 5' x 32 ½' box culvert with masonry walls and a reinforced concrete deck constructed by the laborers (see Appendix B, Figure 49: Steam line to El Tovar, 1935, GRCA 6175; Figure 50: Pipe chase to El Tovar beneath Hermit Rim Road (Village Loop), 1935, GRCA 6174; Figure 51: Pipe chase beneath road to El Tovar, 1935, GRCA 6170; Figure 52: CCC-constructed pipe chase for El Tovar carrying steam and ammonia lines, 1935, GRCA 6171; Figure 53: CCC extension of steam and ammonia lines to pipe chase, 1935, GRCA 330; Figure 54: New retaining wall constructed by CCC where old steam lines crossed Hermit Rim Road, 1935, GRCA 7820; and Figure 55: Steam/ammonia/conduit to El Tovar after realignment, also note electrical lines and aboveground water pipe, GRCA 653). Crews also built a structure that allowed access to an existing manhole in the steam line.[348] A delayed delivery of material suspended the project in June 1935, during which time the men "placed temporary supports and moved permanent supports to their new locations." This project increased the cost of the Hermit Rim Road project by $1563.16, although the Park Service secured $3000 for the supplemental project.[349]

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in 1935 and to the public and employee campgrounds in 1935-36, and extending both underground conduit and steam lines to the new Community Building (Job No. 263a) and the new Post Office (Job No. 263b) in 1935. The CCC laid the electrical conduit in sewer trenches excavated by blasting through solid rock below the frost line. Tillotson, "Grand Canyon National Park, Construction and Operation Activities," 1934, p. 10; F.L. Boissonnault, "Underground Secondary Power Distribution System, South Rim Headquarters Area," May 1, 1935, GRCA 29865; Langley and Kuehl, "Report to the Chief Architect," June 1935, p. 7; Letter from M.R. Tillotson to F.A. Kittredge, Chief Engineer, Branch of Engineering, National Park Service, July 12, 1935, GRCA 29895.

[346] Louie McGavic, "Narrative Report for the Period October 29, to December 31, 1934, E.C.W. Camp N.P. 4-A, South Rim, Grand Canyon National Park, Arizona," December 31, 1934, GRCA 29851; Letter from Montgomery to Kittredge, March 5, 1935, p. 1; "Access Tunnel, Administration Building," August 2, 1935, Denver Service Center, Technical Information Center 113-60126.

[347] Demolition of the old power plant (Building No. 37) allowed for the construction of a new road, Hermit Rim Road, which avoided the hill up to El Tovar. In 1934, the Park Service, using CCC labor, commenced construction of this road, which passed just north of the depot and traveled east along the railroad to also provide access to the new Bright Angel Lodge under construction. Today this road is the northern portion of Village Loop Road.

[348] Many of the extended stanchions and pipe chase are still extant. Most likely, both the box culvert and the pipes beneath the road were abandoned in place, as both are visible from the pipe chase.

[349] Tillotson, "Grand Canyon National Park, Construction and Operation Activities," np; Harry Langley, "Report to the Chief Architect though the Superintendent of Grand Canyon National Park," February 1935, p. 1, GRCA 29863; Letter from Montgomery to Kittredge, June 29, 1935, p. 4; Harry Langley and Alfred C. Kuehl, "Report to the Chief

In addition, the Hermit Rim Road project included the erection of a masonry retaining wall on the steep slope of Bright Angel Wash along the north side of the above-grade pipeline. Three pipe chases had to be configured in the new wall to allow pipelines to pass beneath Hermit Rim Road. The eastern chase coincided with the new El Tovar box culvert, the middle chase provided for the main domestic water and fire lines, and the western chase for steam lines and electrical conduit to Bright Angel Lodge (see Appendix B, Figure 56: Steam pipes through wall leading to Bright Angel Lodge, 1935, GRCA 6172).[350]

Most likely, the ATSF's Water Service Department laid the new utility lines beneath Hermit Rim Road for the new Bright Angel Lodge. The railroad undertook the redevelopment of Bright Angel while the CCC built the new road. Using architect Mary Colter's designs, the ATSF retained the Buckey O'Neil Cabin (Building No. 508) and the Cameron Cabin (Building No. 526) but demolished and rebuilt the rest of the complex. Foreman Les Wolfe led the project, which may have included replacement of the lines beneath the railroad track as well.[351] The railroad maintained the original pipe trench north of the new road, which connected with the new steam tunnels beneath the Bright Angel Lodge proper. The railroad contracted with Howe Brothers of Los Angeles, California to install the remaining heating and plumbing lines for the new hotel complex. The railroad hired the Los Angeles based Myers Brothers as the general contractor for Bright Angel Lodge proper (Building No. 507) and Wm. P. Neil Company Ltd., also of Los Angeles, as the general contractor for Buckey O'Neil Cabin (Building No. 508), Powell Lodge (Building No. 509) and Bright Angel cabin complex (Building Nos. 510-531, 534-536). Myers Brothers excavated the utilities trenches for the three main buildings, and the railroad dug the trenches in the cabin complex.[352]

Myers Brothers followed specifications and plans for the Bright Angel Lodge utility tunnels provided by the ATSF engineers. They excavated the main tunnels beneath Bright Angel Lodge proper, Buckey O'Neil Cabin and Powell Lodge to a minimum height of 6' and a minimum width of 5'. Branches extending off the main tunnel ranged from this height and width to crawl spaces.[353] Main utility pipes entered Bright Angel Lodge at the southeast corner of the building at a point almost directly north of the Powerhouse. Inside the building branch lines disseminated to appropriate locations, while the main line continued through a tunnel under Buckey O'Neil

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Architect through the Superintendent of Grand Canyon National Park," July 1935, GRCA 29864; Brannon, "Final Construction Report," September 1936, pp. 4, 9.

[350] These pipe chases are still extant. Most of the exposed sections of the abandoned pipes have been removed.

[351] Chappell, "Grand Canyon Depot," np.

[352] The general contract for Bright Angel Lodge also included moving the Brown Building, built in 1913 as the eastern dormitory in the Bright Angel Hotel complex, approximately 200' to the east. The ATSF arranged the reconnection of the plumbing; however, the details of this project are not known. The ATSF proposed moving this building again in 1937, but did not follow through. The Brown Building was moved to its current location on west Apache Street sometime between 1951 and 1967. Atchison, Topeka & Santa Fe Railway Company, "Specifications for Concrete Masonry & Log Lodge," p. 2; Atchison, Topeka & Santa Fe Railway Company, "Building Record-Albuquerque Division, AT&SFRY," ca. 1953, p. 178; "Moving Officer's Bld'g & Brown Bld'g for Dormitory Use in Dormitory Area in Grand Canyon National Park," October 19, 1937, GRCA 68095; Santa Fe, Building Contract, Myers Brothers, September 1, 1934; Letter from Blanchard to Howe Brothers, March 29, 1935; ATSF, "Pipeline Map," 1928.

[353] All of the utility tunnels beneath Bright Angel Lodge are still extant.

Cabin and on to Powell Lodge.[354] The railroad constructed 16" deep reinforced concrete wells or installed 12" split tile conduit to house the utility lines in the pipe trenches within the cabin complex.

The Howe Brothers performed the heating and plumbing work for Bright Angel Lodge under two contracts with the ATSF. The first contract for $17,281.50 included work at Bright Angel Lodge proper where they installed 8" cast iron steam pipes.[355] The second contract for $17,640.00 included heating and plumbing installation in Buckey O'Neil Cabin, Powell Lodge, and the Bright Angel cabin complex. Howe Brothers installed steam lines and returns and potable, fire and reclaim water lines throughout the western portion of the hotel complex. Four-inch wrought iron steam lines and copper returns ranging in size from 2-½" to ¾" provided the heat for the cabin complex. The contract also included installation of a 2-½" steam line to meet the steam line serving Lookout Studio (Building No 532); however, this steam pipe is not depicted on the 1937 pipeline plan. The ATSF used its own labor to wire the new Bright Angel Lodge complex.[356]

To access the utility lines serving the Bright Angel cabins, several vaults were constructed along the trench. One of these vaults was attached to the east side of the transformer house (Building No. 535) that was constructed in 1935 (see Appendix B, Figure 57: Telephone and transformer house near Bright Angel Lodge, ca. 1936, GRCA 9943). A heat exchanger inside the vault likely used steam from the line leading from Powell Lodge to heat water. A pump was also located in the vault that forced this hot water around the cabins, likely for heat. [357]

The CCC also completed a project burying overhead utility lines, both power and telephone, around the Grand Canyon Village area. Some of the power lines served circa 1920 streetlights along the rim walk leading to Kolb Studio on the north side of the Bright Angel Lodge.[358] Power lines were placed in conduit and laid along the rim opposite the CCC-built retaining wall.

In conjunction with the major CCC project to install underground electrical conduit in the Park Headquarters Area (Job No. 72-134), the Assistant Engineer, Willard Bradley recommended that new cable be installed between the Powerhouse and the main vault in the Park Headquarters Area. Bradley made this recommendation at the suggestion of the Park Electrician, as the

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[354] Atchison, Topeka & Santa Fe Railway Company, "Add's and Alt's to Buckey O'Neil Cabin, Grand Canyon, Arizona," October 16, 1934, GRCA 68543.

[355] The steam pipe is abandoned in place although some sections have been cut and removed. Also, there are several valves (?) integrated into the system. One is marked, "American District Steam Co. No[rth] Tonawanda, NY, 12.5, SX D08, SX 608A." The steam pipes rest on concave pipe holders that allow for the pipes to expand and contract without damage.

[356] Santa Fe, Building Contract, Myers Brothers, September 1, 1934; Santa Fe, Building Contract, Howe Brothers, October 24, 1934; Letter from Blanchard to Howe Brothers, March 29, 1935.

[357] This is mapped incorrectly on the 1937 Pipeline and Building Map, as the drawing shows the vault and the transformer house independent of each other. This equipment is abandoned in place inside the existing vault next to Building No. 535. The proposed use of this equipment is based on a field visit and conversation with Bob Baker, the Xanterra Director of Engineering on June 30, 2006.

[358] The streetlights (L-52) are contributing structures in the Grand Canyon Village National Historic Landmark. The conduit is still intact and often visible as the soil has eroded away from the trenches. Scott, et al, "Grand Canyon Village," p. 13.

increased demands on the existing electrical line from the government industrial and residential areas was overloading the cable. The new cable, measuring approximately 1,800', was buried in the same trench as the old conduit, which ran along the south side of the railroad tracks and then southeast to the Park Service residential area. The old cable was left in place "to provide an auxiliary circuit" and insure continuous service.[359] Landscape Architect Kuehl and Assistant Forester Bill approved this job, but stressed the avoidance of trees, as well as their roots, when trenching.[360] The CCC completed this project, laying a 2,300-volt primary cable in the proposed location, during 1938.[361]

One of the final utility projects completed by the CCC in Grand Canyon Village was the extension of the steam line to the Park Superintendent's House (Building No. 1) in 1937. The men extended a 2" steam line and a 1 ¼" return, as well as a 6" sewer line, in concrete conduit. The lines lead from a pipe chase in the stone retaining wall at the east end of the rail yard, north along the west side of superintendent's residence, and up the hill to Verkamp's Curios.[362] A short branch off this line connected to the first Administration Building (see Appendix B, Figure 58: Trench to Old Superintendent's Residence, GRCA 29870).[363]

During 1936-37, the CCC also constructed oil and gasoline tanks and a pump house (Building No. 219) at the south end of the wye track (Job No. 157). Train tankers delivered the oil and gas via 4" unloading pipes from the railroad tracks to the storage tanks. A Blackmer Pump pumped the fuel or gas to a standpipe on the side of a road to the east. "Fire prevention dikes" and a fence surrounded the tanks, each of which held 10,530 gallons and rested on concrete piers (see Appendix B, Figure 59: Gas and oil tanks during construction, 1936, GRCA 9257 and Figure 60: Gas and oil pump during construction, 1937, GRCA 1937 415-157).[364]

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[359] Assistant Engineer Bradley also suggested that underground conduit to the new post office (Building No. 166) and postal employee residences (Building No. 809 & 810) be included in this project, since the ATSF charged a 15 percent surcharge when their system was used to serve government buildings. Willard Bradley, "Technical Comment-Engineering, Subject: Underground Power Lines, Job 72-134, Ninth Period, Camp NP-2-A, South Rim," March 5, 1937, GRCA 29895.

[360] Kuehl, "Technical Comment-Landscape, Subject: Grand Canyon-Ninth Period, Job Number 72-134," April 14, 1937; H.L. Bill, "Technical Comment-Forestry, Subject: ECW-Grand Canyon, Ninth Period, Job Number 72-134, Power Line-Underground," April 15, 1937, GRCA 29895.

[361] This conduit was abandoned in place, and some of it is exposed in the vicinity of drainage ditches flowing into the Bright Angel Wash drainage ditch on the south side of the rail yard. Lloyd, "Special Report, 1938," p. 2; Bryant, "Annual Report," 1939, p. 12.

[362] The ATSF built the stone wall at east end of rail yard (L-31) in 1930 to divert water flowing down the wash to the south of the rail yard into a drainage ditch constructed about 1905. The NPS, probably using CCC labor, rebuilt the wall in an arc in 1934. This wall, as well as the pipe chase and pipes inside the chase, still exists today and is contributing to the Grand Canyon NHL District.

[363] Bradley, "Monthly Summary," September 1937, p. 1.

[364] Nothing related to this structure exists today. Willard Bradley, "Monthly Summary, Grand Canyon National Park, Grand Canyon, Arizona," November 1936, p. 1; Willard Bradley, "Monthly Summary, Grand Canyon National Park, Grand Canyon, Arizona," December 1937, p. 2; Bradley, "Monthly Summary," May 1937, p. 1; Willard Bradley, "Monthly Summary, Grand Canyon National Park, Grand Canyon, Arizona," August 1937, p. 1. All summaries are in GRCA 29865. See also U.S. Department of the Interior, National Park Service, "Gasoline & Oil Pump House and Piping, Job No. 453-157, Grand Canyon National Park," March 3, 1957, Denver Service Center, Technical Information Center 113-3029.

The Grand Canyon National Park experienced record attendance from 1935 to 1939, providing the justification for the ATSF to continue making improvements to the village. In 1936, the ATSF built two utilitarian buildings inside the wye track. Both balloon frame, gable roof buildings clad with plank siding, these buildings did not incorporate the rustic style in their design. The larger and easternmost of the two was a tool house (Building No. 579). Just southwest of this building stood a small gasoline storage shed (Building No. 580) used to fuel automobiles.[365] That year, the smaller of the two dorms (Indian Dorm, Building No. 538) located west of El Tovar was torn down and Colter Hall (Building No. 539) was built in its place. A 3" steam line in a 12" trench and a 2" return in a 4" trench branched from the main line leading to El Tovar to heat this new building.[366]

Improvements made by the ATSF during the late 1930s and early 1940s also included some upgrades to El Tovar's utilities. First, the railroad built sheds for storing coal and wood behind the hotel (see Appendix B, Figure 61: New coal and wood shed behind El Tovar, 1938, GRCA 9634). Immediately afterward, the hotel converted from wood to coal fired baking ovens. A fuel oil line was also added to the kitchen from aboveground tanks, most likely for stoves.[367] In early 1941, the railroad installed new electrical conduit for El Tovar, as well as Hopi House and the depot.[368]

The ATSF also undertook numerous repairs and improvements related to the Powerhouse around this time. The railroad began construction of another water cooling tower (Building No. 104) in the powerhouse area, just south of the buried fuel tanks, in 1937 and completed the project in the spring of 1938 (see Appendix B, Figure 62: Water cooling tower, 1937-38, GRCA 3259 and Figure 63: Both water cooling towers, 1953, GRCA 1953_report_14-15). They also installed a 500 kilowatt steam turbine that year.[369] The cooling tower used fans to cool the water that was in turn presumably used to cool the newly installed steam turbine equipment. They also made "extensive repairs," the extent of which are not known, in the Powerhouse, as well as repairs to the oil storage tanks and smoke stack in 1940. In 1942, the railroad reconditioned the Powerhouse's two diesel engines.[370]

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[365] Neither of the buildings exists today; however, the foundations and pipes for these buildings remain in place.
[366] Alfred C. Kuehl, "Monthly Narrative Report to Chief Architect," October 20-November 24, 1937, and "Monthly Narrative Report to Chief Architect," November 23-December 31, 1937, both in GRCA 29864.
[367] Xanterra converted from diesel to propane around 2000. Since that time, the above ground fuel oil tanks have been removed according to personal communication with Bob Baker, Xanterra Director of Engineering, 2006. Tillotson, "Monthly Report," April 5, 1938, p. 7; M.R. Tillotson, "Monthly Report to the Director of Activities at Grand Canyon National Park," June 3, 1938, GRCA 719.32, Monthly Reports-1938.
[368] F.A. Kittredge, "Monthly Report to the Director of Activities at Grand Canyon National Park," March 6, 1941, p. 5, GRCA 719.32, Monthly Reports-1941.
[369] Kuehl, "Monthly Narrative Report," October 20-November 24, 1937 and November 23-December 31, 1937; Tillotson, "Monthly Report," April 5, 1938, p. 7.
[370] These are not the same repairs and/or upgrades referred to earlier, as the mention of different equipment is from an unpublished article from 1938 and these improvements, except for the cooling tower, did not take place until after this time. "Atchison, Topeka & Santa Fe Railway-Grand Canyon Power House," *Santa Fe Magazine* XXXIV, no. 2 (February 1940): p. 50; "Atchison, Topeka & Santa Fe Railway-Grand Canyon Power House," *Santa Fe Magazine* XXXIV, no. 4 (April 1940): p. 65; "Atchison, Topeka & Santa Fe Railway-Grand Canyon Power House," *Santa Fe Magazine* XXXV, no. 2 (January 1941): p. 50; "Atchison, Topeka & Santa Fe Railway-Grand Canyon Power House," *Santa Fe Magazine* XXXVI, no. 9 (September 1942): p. 55.

The Park Service and independent concessioners purchased steam for heating at what they probably believed to be a reasonable cost from the ATSF. However, in February 1940, perhaps as a result of the Powerhouse repairs, the railroad discovered that errors made in reading the steam consumption meters had caused them to charge for only one-tenth of the steam used. Not only did this result in a vast increase in the charge for steam, but also the ATSF attempted to obtain years of back payment from its customers, although billable rates were slightly decreased to ease the burden of increased costs.

In response to the great increase in the price of steam, the Park Service and independent concessioners purchased and installed more economical individual heating systems. The park purchased such heaters for the superintendent's residence (Building No. 1), as well as the park administration building (Building No. 103), the ranger dormitory (Building No. 76), and the physician's residence (Building No. 9). Nevertheless, the Park Service continued to purchase steam heat from the railroad for some buildings, evidenced in the renewal of the contract in September 1940. Emery C. Kolb had a fuel shed located east of Kolb Studio erected in 1941 and started heating his own residence with a furnace instead of buying steam from the railroad.[371]

The Park Service also considered running independent electric cable to some of its buildings to reduce costs. The railroad charged an extra 15 percent, sometimes $25 to $30 per month, for electricity delivered by their main lines. In order to save money, the park electrician, Joe Gausted, suggested the park run lines to the park superintendent's house (Building No. 1), as well as the public and employee campgrounds. This was suggested as a CCC project; however, no records have been found that indicate that it was ever implemented.[372]

With the start of World War II, the improvement projects in Grand Canyon Village nearly ceased. In 1942, CCC enrollment had reduced, and the government decommissioned the camps. One of the ATSF's bigger projects for that year consisted of painting and landscaping with plantings the lines on the pipe rack along the railroad tracks, as well as the tank farm at the south end of the wye, to decrease their visibility.[373] As wartime restrictions tightened, the concessioners discontinued many of their services. Fred Harvey Company closed all of its facilities except for the El Tovar and the railroad stopped all passenger trains. Still, Kolb Studio and Verkamp's Curios remained open.[374]

Instead of major construction projects, the park minimally maintained facilities in Grand Canyon Village and began planning for post war development. Since the village core had already been built out, most of the newer plans involved areas south of the rail yard. In addition, the park

[371] The Kolb fuel shed no longer exists. "Exhibit A, Site of Kolb Occupancy," April 14, 1941, Denver Service Center, Technical Information Center 113-70084.
[372] Memorandum for Superintendent Kittredge, January 27, 1941, GRCA 75253.
[373] It seems that much of these plantings still exists today, including mature desert rose bushes and pine trees, along the pipe rack stanchions. Bryant, "Annual Report," 1942, p. 5.
[374] Bryant, "Annual Report," 1943, p. 2.

engineer updated utility plans.[375] A lack of staff and appropriations precluded new Park Service construction projects, and the ATSF experienced similar circumstances.

With the end of World War II, Grand Canyon National Park immediately experienced visitor numbers greater than prewar years. In 1946, attendance reached a record 486,834 visitors--over 50,000 more than in the last record-breaking year, 1941. The following year attendance increased by an additional 135,500 tourists.[376] Neither the Park Service nor the ATSF could keep up with the increased visitation. A deficit in lodging was a major concern for both Fred Harvey Company and the Park Service. Additionally, repairs could not keep up with deterioration of the physical plant.[377]

The ATSF made several small repairs and upgrades in order to increase lodging capacity and improve services in the Fred Harvey facilities, as well as their own. One of these projects involved converting the coal burning ranges in the Bright Angel Lodge kitchen to oil burning. The railroad also installed oil tanks near the building as a result.[378] In 1950 the ATSF also built an Electric Transformer and Battery Service Building (Building No. 548) approximately 100' west of the depot and south of the Village Loop Road retaining wall.[379] This gable roof building with rusticated stone corner piers housed the transformers that powered new electric passenger cars as they stood in the passenger yard (see Appendix B, Figure 64: Transformer and Battery Building, 1953, GRCA 2571).[380]

The park continued to plan for development in Grand Canyon Village. In 1950, park officials devised a new master plan, which included drawings of the utilities in the village. One such drawing depicted the location of overhead and underground power lines owned by both the Park Service and the railroad.[381] The park also considered establishing natural gas service from Southern Union Gas Company to Grand Canyon in 1952. However, the company rejected the park's proposal. Though Park Superintendent Bryant hoped for a new agreement, this project apparently stalled.[382]

Limited construction continued into the early 1950s. Park Superintendent Bryant believed that this was due in part to the fact that the contracts of all but one of the concessioners, probably the ATSF were expired or about to expire.[383] This assumption does not acknowledge the reality that the railroad was the main, if not only, concessioner that undertook major construction in Grand Canyon Village. A more likely explanation could be that the NPS expected the railroad to make the improvements to the village infrastructure. In the early 1950s this included locating and

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[375] Bryant, "Annual Report (Superintendents)," pp. 2, 5.
[376] Anderson, *Polishing the Jewel*, p. 90.
[377] Garrison, "Annual Report," 1948, p. 2; Bryant, "Superintendent's Annual Report," 1948, p. 1.
[378] Bryant, "Annual Report," 1947, p. 5.
[379] The National Park Service demolished the transformer building (Building No. 548) in 2003.
[380] Atchison, Topeka & Santa Fe Railway Company, "Electric Transformer & Battery Service Building, Grand Canyon, Arizona," March 1950, GRCA 68410.
[381] U.S. Department of Interior, National Park Service, "Utility Layout Plan, Electric Power, South Rim Village Concessionaire's Area," November 1951, Denver Service Center, Technical Information Center 113-5339A.
[382] Bryant, "Superintendent's Annual Report," 1952, p. 17.
[383] Bryant, "Superintendent's Annual Report," 1951, p. 6.

developing another water source and building the delivery system, as well as replacing the obsolete power plant (Building No. 37) and the antiquated activated sludge treatment plant (Building No. 333).[384] Each of the projects represented a major investment and did not solve the shortage of lodging at Grand Canyon Village, though one could not occur without the other. The ATSF was probably not willing to undertake such major projects since passenger traffic had generally been on the decrease since 1947.[385]

Installation of new power lines to the passenger yard lights in 1954 was one of the last maintenance projects that the ATSF undertook in Grand Canyon Village.[386] That year, the ATSF all but pulled out of its Grand Canyon investments. Although the company maintained ownership of the rail yard, track, and depot, it sold El Tovar, Bright Angel Lodge, Hopi House, and Lookout Studio, as well as the Fred Harvey garage, laundry, mule barn, and livery to the concessioner, Fred Harvey Company, for $1.5 million.[387] In addition, the railroad donated all of the utilities, including the Powerhouse, activated sludge treatment plant, Indian Gardens pipeline, and all other lines, valued at $1.1 million to the Park Service.[388] These utilities were mapped and included as part of the instrument of donation.[389]

Although the Park Service took ownership and responsibility for the Grand Canyon utilities, they were neither equipped nor interested in entering into this business. Moreover, NPS policy recommended the use of public utility company services whenever possible.[390] In fact, Regional Director Tillotson hoped that the park would want to have the power company that served northern Arizona "bring service and perhaps even operate the power plant at Grand Canyon."[391]

Regional Director Tillotson and the park were in luck. Within one month of Tillotson's suggestion, NPS officials met with Arizona Public Service (APS) representatives to discuss the possibility of the public utility company providing electricity to Grand Canyon Village. The two

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[384] Garrison, "Annual Report," 1948, p. 2; Bryant, "Superintendent's Annual Report," July 1951, 10; Bryant, "Superintendent's Annual Report," 1953, p. 2.
[385] The railroad also balked at expanding outside of their 20-acre depot for fear of losing investments if the Park Service did not renew their contract. Anderson, *Polishing the Jewel*, p. 48.
[386] These lights are no longer extant. A power pole with sign brackets for the telegraph station at the Grand Canyon Depot (SR28) dating to circa 1930 and standing in the southeast corner of the depot parking lot was identified as a contributing structure in the Grand Canyon Village National Historic Landmark. As of August 2006, this pole had been removed. Scott, et al., "Grand Canyon Village," p. 11.
[387] Anderson, *Polishing the Jewel*, p. 49.
[388] This donation included utilities at Phantom Ranch, Hermit's Rest, Yaki Point, and Desert View. Still, the utilities for the properties outside the village core encompassed just over $14,000 of the appraised value. Exhibit A of the appraisal compiled by representatives from the Park Service and the ATSF provides a detailed list of all of the utilities built by the railroad for their operations in Grand Canyon. What also might be an exhibit for the appraisal or the instrument of donation is a list of all of the water, reclaim water and steam meters including location, size, brand, and owner, in Grand Canyon Village. "Inventory of Water, Reclaimed Water and Steam Meters," 1953; Lassiter, et al., "Utility Facilities at Grand Canyon"; Gurley, "Instrument of Donation."
[389] L.H. Powell, "Exhibit 'B' Attached to and Made Part of Conveyance from the Atchison, Topeka and Railway Company to United States of American, Utilities in Grand Canyon National Park: Steam, Air, Electrical, Ammonia, & Oil," November 1, 1935, GRCA 49259.
[390] Tillotson, "Report of the Evaluation of Utilities," p. 4; Department of the Interior, Information Science, "Commercial Power Comes to Grand Canyon," January 29, 1955, p. 1, GRCA 76016.
[391] Tillotson, "Report of the Evaluation of Utilities," p. 4

entities reached an agreement wherein APS would provide electric service at rates comparable to or less than neighboring communities; APS would furnish the primary transmission line and substation, as well as maintain distribution lines in the park; APS would maintain the Powerhouse for standby service; and APS would operate the existing steam plant for heating and laundry purposes for a period of five years.[392] The Park Service would retain ownership but would not maintain their buried lines. These buried lines would be available to APS for their use if desired.[393] After more negotiation with Fred Harvey Company, the main consumer of steam produced by the plant, the concessioner agreed to operate the steam generating plant until it could be replaced.[394]

On June 22, 1954, APS and the National Park Service entered into an Agreement for Purchase of Electric Service.[395] Upon signing the agreement, APS began construction of approximately 60 miles of 69,000-volt, three-wire, three-phase transmission line and a substation to reduce the voltage for distribution throughout the village.[396] Located adjacent to the west side of the Powerhouse, this substation siting apparently allowed APS to connect directly into the existing village power lines (see Appendix B, Figure 65: From APS Substation Plan, Drawing No. 113-8697, 1953 and Figure 66: Powerhouse and transformer/substation, GRCA 3249).[397] In the meantime, the ATSF agreed to continue operating the Powerhouse until completion of the power line under permit with the Park Service.[398]

At a project cost of $700,000, APS completed the construction of the power line from Williams to Grand Canyon Village in the winter of 1954-55.[399] On December 28, 1954, the NPS transferred its overhead electrical distribution system at Grand Canyon National Park to APS.[400] The following month, on January 29, 1955, the Grand Canyon National Park first used commercial power. Park Superintendent, P.P. Patraw, flipped the switch that turned off the Powerhouse generators, and APS President, Harry Sargent, closed the switch that brought commercial power to Grand Canyon National Park.[401] Still, the Powerhouse continued to operate one generator to produce steam for the Fred Harvey laundry year round and for heat in the winter.

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[392] Cameron, "Memorandum to Chief Engineer, Subject: Public Utilities," pp. 2, 5.
[393] Letter from Conrad Wirth, Director, National Park Service, to Arizona Public Service Company, December 11, 1953, p. 1, GRCA 49259.
[394] Letter from Daggett Harvey, Fred Harvey Company to Conrad Wirth, Director, National Park Service, June 30, 1954, p. 1, GRCA 76016.
[395] Arizona Public Service, "Contract No. 14-10-0100-290, Agreement for Purchase of Electric Service," June 22, 1954, GRCA 49259.
[396] Department of Interior, "Commercial Power"; Anderson, *Polishing the Jewel*, p. 49.
[397] The 1954 transformer, updated circa 1970, and chain link fence (L-54) are non-contributing structures in the Grand Canyon Village National Historic Landmark. Scott et al., "National Historic Landmark Nomination: Grand Canyon Village," 14..
[398] P.P. Patraw, "Working Memorandum to Accompany Permit," May 28, 1954; P.P. Patraw, Memorandum, Assistant Director to Regional Director, Region 3, April 2, 1954, both in GRCA 49295.
[399] Department of Interior, "Commercial Power," p. 1.
[400] Letter from Thomas C. Vint to Assistant to M.C. Titus, Executive Vice President, Arizona Public Service, January 25, 1955, Exhibit A, GRCA 49259.
[401] Department of Interior, "Commercial Power," p. 1.

Although the Powerhouse stopped generating power early in 1955, Fred Harvey Company continued to operate the steam plant for one more year. During that time, Fred Harvey Company built individual heating units for its newly acquired buildings. Frank R. Fazio, an architect from Phoenix, designed the new boiler enclosures and H&J Construction Co., also from Phoenix, constructed them. The company built additions to El Tovar, Bright Angel Lodge proper, and the Fred Harvey laundry, paint shop and garage to house the new oil burning boilers. They also built a standalone boiler house (Building No. 541) southwest of the Cameron Red Horse cabin to serve the Bright Angel cabins.[402] In this building, a Crane 41 boiler (Boiler No. AZ 07672) fed the steam radiators in the Bright Angel cabins. It operated on a closed loop system, as a condensate return tank collected condensation to re-circulate with the rest of the water for the boiler. Upon completion of the new independent boilers, Fred Harvey Company ceased steam generation on October 15, 1956.[403]

The cessation of steam production by the Powerhouse in 1956 also affected the ATSF. Although the railroad began to phase-out the use of steam-powered locomotives for passenger trains and converted many of their passenger cars to electric in the early 1950s, some passenger cars standing in the rail yard still required steam heat from an external source when disconnected from the engine. In addition, the railroad needed steam power to operate some of the mechanical equipment used in the railroad yard. Therefore, the railroad built a concrete block addition to the transformer house to house a small steam generating plant for specific rail yard and depot building use (see Appendix B, Figure 67: Transformer building with steam house addition prior to demolition, ca. 2003, GRCA DSCN0711 and Figure 68: Railroad depot with steam line attachments, 1963, GRCA 41306).

The ATSF had not completed the new plant by the middle of October 1956.[404] When the park shut down the Powerhouse, the steam generating plant for the rail yard had not yet been completed. By the middle of the month, temperatures at Grand Canyon had dropped to the mid-30s Fahrenheit. In order to heat the passenger cars in the yard, the ATSF had to park a tank car and an extra diesel unit at the end of the station platform to supply steam for the depot.[405]

Throughout the years, steam consumers in Grand Canyon Village have largely abandoned the steam pipes and associated returns in place. First, both Fred Harvey Company and the NPS had installed independent heating systems for their respective buildings by 1956, resulting in the

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[402] New boilers and enclosures were also added to Shirley Hall (Building No. 557), Maswick Motor Lodge (Building No. 618, heating plant – Building 630), the Men's Dorm (Building No.576, heating plant –Building No. 576A), and several residences (Fazio 1956). Though Fred Harvey Company subsequently replaced the boilers that are still used, the Bright Angel cabins boiler, which was abandoned in place, is original. Frank R. Fazio, "Boiler Enclosures, Fred Harvey Co.," February 11, 1956, Denver Service Center, Technical Information Center 113-8754; ATSF, "Grand Canyon Pipeline and Building Map," 1937, rev. 1951, rev. ca. 1971.

[403] Although the Powerhouse no longer generated steam or electricity, the Park Service still operated the water pumps in the building that disseminated water from Indian Gardens and reclaim water throughout the village. Anderson, *Polishing the Jewel*, p. 49; "Atchison, Topeka & Santa Fe Railway-Grand Canyon Steam Generating Plant," *Santa Fe Magazine* L, no. 11 (November 1956): p. 58.

[404] "Atchison, Topeka & Santa Fe Railway-Grand Canyon Steam Generating Plant," *Santa Fe Magazine* L, no. 10 (October 1956): p. 55.

[405] "Atchison, Topeka & Santa Fe Railway-Grand Canyon Steam Generating Plant," November 1956, p. 58.

abandonment of the majority of steam lines in the village. Upon the railroad's cessation of passenger service to Grand Canyon in 1968, the steam lines in the rail yard were abandoned. Fred Harvey Company finally ceased operating the boiler in Building No. 541 used to heat Bright Angel cabins in the 1970s. Today, the telephone company uses many of the abandoned steam lines to run telephone wires underground.[406]

Upon construction of Thunderbird Lodge (Building No. 1300) on the South Rim in 1968, APS located a transformer in an appendage to the south elevation (rear) of the building. There, the main distribution panel distributes electricity to Fred Harvey Company buildings on the north side of the railroad tracks. Three underground conduits lead west to Bright Angel Lodge. Underground conduit leading east supplies electricity to Kachina Lodge (Building No. 1320), built in 1971, and El Tovar.[407] In 1974, APS mapped the electric distribution lines in Grand Canyon Village.[408]

The Park Service published a new Master Plan in 1976, with the intent that this plan would accommodate visitor and resident needs for the year 2000. In the plan, the Park Service proposed to remodel the Powerhouse for "additional visitor services."[409] Although this plan has not yet come to fruition, there is still talk of adaptively reusing the Powerhouse as an interpretive center that would both provide visitor services and a museum relating to the development of Grand Canyon Village.

In the meantime, APS continues to provide power to the village and make improvements as needed. The power company's next large project involves relocating the transformer/substation on the west side of the Powerhouse to a new location outside of the village core. Moving this non-contributing structure standing in the middle of the National Historic Landmark District will vastly improve the historic character of Grand Canyon Village.

[406] ATSF, "Grand Canyon Pipeline and Building Map," 1937, rev. 1951, rev. ca. 1971.
[407] ATSF, "Grand Canyon Pipeline and Building Map," 1937, rev. 1951, rev. ca. 1971.
[408] Arizona Public Service, "Electric Distribution," 1974, Denver Service Center, Technical Information Center 113-70393.
[409] Zeman, "Grand Canyon Village Mission 66 Planning Effort," p. 14.

IV. Ice and Ammonia

Initially, the Grand Canyon Railway intended to transport ice to the Grand Canyon Village by train. The contract between the Grand Canyon Railway Company and the Fred Harvey Company for operation of the El Tovar Hotel agreed upon in 1904 specified that the railway company would "furnish on cars on tracks as convenient to said hotel as practicable all ice, fuel and water necessary for use in operation of the business."[410] For reasons unknown, the company constructed an ice and cold storage plant, as well as an ice storage house for the hotel (see Appendix B, Figure 69: The Grand Canyon Ry Co., El Tovar Ice House, Drawing No. 100-7191, shown 1911, GRCA 66101-37). Possibly, the ice melted too quickly during train shipment, the railroad found it too expensive to haul, or El Tovar's need for ice exceeded the railroad's shipping capacity.

The Grand Canyon Railway located the ice and cold storage plant in the basement of El Tovar Hotel. The plant was situated in the south end of the west wing basement.[411] An Atlas Plain Slide Valve Engine and a compressor powered the plant.[412] A brine cooler and an ice tank both insulated with granulated cork were used for storage.

Outside the west wing of the El Tovar, the Grand Canyon Railway located a distilling apparatus for the ice and cold storage plant.[413] Elevated on a second story platform, the distilling apparatus could filter a half ton of water daily. Also located on the platform was a steam condenser. They also constructed a gable roof building that housed a cold storage room and a cut meat refrigerator off the north side of the west wing.[414]

The El Tovar's ice storage house was a square, pyramidal roof building clad with drop siding and ready rock roofing.[415] Two sets of air spaces and a floor of cinders made up the insulation for the building. The interior walls and ceiling were finished with tongue and groove. The Grand Canyon Railway located the building just off the west wing of the hotel with a chute connecting the ice room in the basement with the ice storage building. An entrance to the ice room was a short walk north across a platform beneath the distilling apparatus.

Even though the ATSF did not deliver ice for El Tovar's use, they eventually delivered ice to Grand Canyon Village for other customers. These customers likely included the Bright Angel Hotel and the residents in the village. In 1910 the railroad completed an icehouse (Building 550)

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[410] Grand Canyon Railway Company, "Agreement," np.
[411] Grand Canyon Railway Company, "Drawing No. 78-3989, General Location Plan for Ice and Cold Storage Plant for Grand Canyon Hotel at Grand Canyon, Arizona," June 2[9], 1904, GRCA 30035AR.
[412] Grand Canyon Railway Company, "Drawing No. 78-3989, General Foundation Plan for Ice and Cold Storage Plant for Grand Canyon Hotel, at Grand Canyon, Arizona," June 2[3], 1904, GRCA 30035BD.
[413] Grand Canyon Railway Company, "Drawing No. 78-3989, Platform for Distilling Apparatus Capacity ½ Ton Daily at Grand Canyon, Arizona," May 19, 1904, GRCA 30035BC.
[414] Grand Canyon Railway Company, "Drawing No. 98-3989, Plan for Cold Storage Rooms for the Grand Canyon Hotel," April 11, 1904, GRCA 30035AE.
[415] Grand Canyon Railway, "Drawing No. 98-3989, Hotel El Tovar, Plan & Scale Details for Ice Storage House," September 26, 1904, GRCA 30035AL.

east of the Grand Canyon Depot. Contracted for in 1909, this frame gable roof building measured 12' x 19'.[416]

Upon construction of a new Powerhouse (Building No. 58) for Grand Canyon Village in 1926, the ATSF installed an ice plant.[417] The railroad equipped the Powerhouse with a 50-ton Vilter ice machine that used ammonia and brine for production. Located in the west end of the basement, the ice storage room had cork-lined walls. The ice plant also used a cooling tower (Building No. 59) in its system (see Appendix B, Figure 70: Water cooling tower for ice and refrigeration equipment, 1957, GRCA 3260).[418] Built in 1926, this cooling tower stood just southwest of the Powerhouse.[419] A concrete conduit from the north side of the cooling tower to a mid point on the west side of the Powerhouse held multiple lines, including a ¾" column gauge, a 3" wrought iron drain for feed water, a 3" ammonia discharge line, a 1-½" ammonia return, and electrical conduit.[420] The village used fourteen tons of raw ice per day, as Fred Harvey Company and Park Service, as well as campers, purchased ice from the plant.[421]

It is unclear whether or not El Tovar ceased making its own ice after the ATSF outfitted the new Powerhouse with an industrial ice machine. The railroad installed ammonia lines along with the new steam lines to El Tovar. The hotel needed to refrigerate the cold storage shed, but it is unknown if ice production continued. Nonetheless, two cork covered ammonia lines, one ¾" and one 2-½", were installed on the pipe stanchions that the railroad devised to carry the utility pipes to El Tovar.[422] The utility lines continued east along the hillside on the pipe stanchions to a point south of the El Tovar dormitories. There, the lines, which remained above grade, turned northeast to a large stone vault (Building No. SR55). The ammonia lines continued north in a concrete conduit to the southwest corner of El Tovar's basement.[423]

In connection with the construction of Hermit Rim Road in 1935 (a CCC project), laborers relocated a portion of El Tovar's ammonia, steam and electrical lines (Project No. 227G).[424]

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[416] By 1918 the railroad had added a freight house to the west side of the ice house. During 1918, the railroad added a coal bin to the west side of the freight house. It is possible that the railroad converted this ice house to a freight house after 1926, with the installation of the ice plant in the new power plant. The National Park Service tore this building down in 1971. Atchison, Topeka & Santa Fe Railway Coast Lines Field Engineers Notebook, "Close Out Hard Coal Bin," April 15, 1918; Atchison, Topeka & Santa Fe Railway, "Building Record," ca. 1953, p. 175.

[417] Apparently, the ATSF had built an ice plant just three years prior, but no evidence of this plant except for the following brief magazine entry has been located, "It seems useless that the company should install an ice plant here at this season of the year. But it will come in handy for the rush next summer, and the dudes will appreciate it then." "Atchison, Topeka & Santa Fe Railway-Grand Canyon Ice Plant," *Santa Fe Magazine* XVII, no. 2 (January 1923): p. 103.

[418] A cooling tower transfers heat from a fluid, generally water, which is used to cool something else, such as ice making or refrigeration equipment.

[419] The cooling tower, and hence the ice plant, had been abandoned by circa 1971, though probably earlier. ATSF, "Grand Canyon Pipeline and Building Map," 1937, rev. 1951, rev. ca. 1971.

[420] ATSF, "Grand Canyon Pipeline," 1928.

[421] Willy, "Fred Harvey's Facilities," p. 25.

[422] The pipe stanchions are still extant; however, the pipes were removed some time after 1956, when the Park Service ceased steam generation at the Powerhouse.

[423] ATSF, "Grand Canyon Pipeline," 1928.

[424] Today this road is the northern portion of Village Loop Road.

During the winter of 1935, CCC crews extended the pipe stanchions further east along a stone retaining wall built as part of the road construction. The pipes turned north at a point just south of the large stone vault and went under the road through a pipe chase. The CCC built a 5' x 5' x 32.5' box culvert with masonry walls and a reinforced concrete deck to house the pipes beneath Hermit Rim Road. This project increased the cost of the Hermit Rim Road project by $1563.16, although the Park Service secured $3000 for the supplemental project.[425]

In the meantime, the ATSF installed refrigeration equipment in the new Bright Angel Lodge that utilized brine as a cooling agent. Gay Engineering Corporation of Los Angeles, California installed the equipment, including a brine refrigerated drinking water cooler, in the new building.[426] The railroad company supplied and installed the brine mains with concrete conduit and insulation from the Powerhouse to the southeast corner of Bright Angel Lodge.[427] The pipes exited the west side of the Powerhouse in the vicinity of the brine pumps, turned north and extended to the lodge. Fred Harvey Company abandoned this system by early 1970, as all brine lines were marked as abandoned on a 1951 pipeline plan that was revised circa 1971.[428]

The ATSF decided to discontinue tourist investments in the early 1950s. In 1954 the railroad donated the Grand Canyon Village utilities to the Park Service and sold the buildings operated by Fred Harvey Company to the concessioner.[429] After receiving the donation of utilities, the park decided to turn over operation of the ice plant to Fred Harvey Company since it was the chief consumer of ice in the village.[430] The instrument of donation included a plan of the ammonia and brine lines.[431]

It is not known how long Fred Harvey continued to use the ice plant in the Powerhouse. Nevertheless, ice production surely stopped upon the development of more efficient ice making machines. Similarly, if El Tovar had continued making its own ice after 1926, the hotel had definitely stopped by 1955. Plans for redesigning the basement made in that year demonstrate

[425] Tillotson, "Grand Canyon National Park, Construction and Operation Activities," 1934; Langley, "Report to the Chief Architect," 1935, p. 1; Montgomery, "Monthly Report Letter," June 1935, p. 4; Brannon, "Final Construction Report," 1936, pp. 4, 9.
[426] The remaining refrigeration equipment installed in Bright Angel Lodge did not require brine or ammonia for cooling. Santa Fe, Building Contract, Gay Engineering Corporation, October 1, 1934; Letter from Norman H. Gay, Gay Engineering Company to M.C. Blanchard, Chief Engineer, Atchison, Topeka & Santa Fe Railway Company, September 12, 1934, p. 1 in GRCA 66101.
[427] Atchison, Topeka & Santa Fe Railway Company, "General Conditions and Specifications for the Installation of Pipe Lines and Coils for the Refrigerators in the New Bright Angel Lodge at Grand Canyon, Arizona," ca. 1934c, p. 3.
[428] Most likely, the brine lines were abandoned in place; however, the brine tanks have been removed.
[429] Gurley, "Instrument of Donation"; Anderson, *Polishing the Jewel*, p. 49.
[430] Tillotson, "Report of Evaluation of Utilities," p. 2.
[431] L.H. Powell, "The AT & SF Ry. Co. Coast Lines, Main Buildings and Utility Lines in Grand Canyon National Park at Grand Canyon Village, Part 1: Water and Sewer," January 13, 1953, Exhibit B, GRCA 49259.

that the ice and cold storage plant had already been removed.[432] Moreover, the ammonia lines had been abandoned by 1971.[433]

[432] Lester B. Knight & Associates, "El Tovar Basement Plan under Kitchen," November 1, 1954, Denver Service Center, Technical Information Center 113-8607.
[433] The above grade ammonia lines are no longer extant, but the underground lines were likely abandoned in place. ATSF, "Grand Canyon Pipeline and Building Map," 1937, rev. 1951, rev. ca. 1971.

Appendix A: Inventory of Intact Infrastructure Resources, 2006, Grand Canyon Village, Grand Canyon, Arizona

I. WATER

1. Cistern - associated with flume track
   Constructed by ATSF in 1911
   South side of rail yard, near southeast corner of parking lot and foot bridge over Bright Angel Wash ditch (*See pp. 16-17/ fn. 77*).

2. Indian Garden Pipeline
   Constructed by ATSF in 1931-32
   Pipeline in situ beneath patio and inside utility tunnels of Bright Angel Lodge proper
   Likely in situ between Bright Angel Lodge and Powerhouse (*See pp. 22-23/fn. 108*).

3. Pipe chase in Village Loop Road retaining wall - for water and fire main leading to rim
   Chase built by CCC in 1934
   Main in place by 1928 (*See p. 26*)

4. Vault in Bright Angel Cabin complex
   Howe Brothers ca. 1934
   Northwest corner of complex, above Kolb tunnel (*See pp. 25-26*)

5. Verkamp's Hand Pump
   John Verkamp installed concrete cistern beneath front porch in 1905 to collect rain water from roof
   Cistern covered in 1960s; pump in northeast corner (*See pp. 11-12/fn. 48*)

6. Kolb Tanks
   Kolbs collected rain water in one of two tanks, located east side of Kolb Studio in late 1910s; Other tank likely filled with heating oil, retaining wall survives (*See p. 12/fn. 50*)

I. FIRE SUPPRESSION

7. Post Indicator Valves
   a. Bright Angel Cabin Complex - one on west side (*See p. 25/ fn. 124*)
   b. El Tovar - one off southwest corner (*See p. 15/fn. 65*)
   c. Colter Hall - one off southeast side
   d. Hopi House - one off southwest corner (*See p. 15/fn. 65*)

8. Bright Angel Lodge Fire Line - original location as evidenced by hydrant locations.
   Excavated/installed by Howe Bros., contractor for ATSF, in 1934/35 (*See p. 25/fn. 124*)

II. SEWER

9. Pipe chase in Village Loop Road retaining wall for abandoned sewer line leading to El Tovar
   Pipe abandoned in place in chase

Built by CCC in 1934 (*See pp. 25-26/fn. 128; p. 48/fn. 256*)

10. 10" Government Line (portions)
    Built by NPS circa 1926
    West of Fred Harvey Laundry (*See p. 40)*

11. 10" Government Line
    Built by CCC in late 1930s
    Located between Village Loop Road and south side of rail yard, generally from Ranger Ops to Powerhouse
    At least 2 associated manholes still extant (there were 5) (*See pp. 47-48/fn. 253/fig. 29*)

12. 8" Laundry Bypass - also known as brine and oil drain (portions-abandoned in place)
    Built by ATSF in 1926
    In Bright Angel Wash ditch
    Runs from laundry and activated sludge treatment plant (*See p. 40/fn. 216; p. 43/fn 232; p. 63/fn. 337*)

13. 8" Sewer line - on north side of tracks
    Built by ATSF in 1926?
    Exposed from erosion near metal stairs (*See p. 41?)*

14. Concrete vault and manholes
    Built by CCC in 1934 in association with Bright Angel cabins sewer main
    West of intersection of Village Loop Rd and RR tracks, north of tracks (*See p. 44/fn. 238*)

15. Kolb Sewer Vault
    Rectangular rock structure off NW corner of studio, date unknown (*See p. 36/fig. 22*)

II. RECLAIM

16. Reclaim line trench/location between Powerhouse and Bright Angel Lodge
    It is unknown if the line is original (*See pp. 49-50?*)

17. Reclaim line trench/location between El Tovar and Hopi House
    It is unknown if the line is original (*See pp. 49-50?*)

18. Vault - southeast of Colter Hall
    Reclaim line replaced with PVC
    Date of construction/builder unknown –possibly ATSF circa 1937 (*See p. 49*)

III. STEAM

19. Mining Shaft (Kolb Tunnel)
    Most likely constructed by Kolb (or a contractor) circa 1930
    On terrace west of Kolb Garage
    In addition to abandoned steam line, electrical conduit and water pipes abandoned in

place (*p. 25/fn. 127; p. 65*)

20. Pipe chase in Village Loop Road retaining wall and tunnel beneath road for abandoned steam line leading to El Tovar
    Built by CCC in 1934; pipes relocated by CCC as well
    Steam lines (and ammonia and conduit) abandoned in place inside tunnel (*See p. 65*)

21. Pipe chase in Village Loop Road retaining wall for abandoned steam lines to Bright Angel Lodge
    Built by CCC in 1934; pipes likely installed by railroad (*See p. 66/fn. 350/fig. 56*)

22. Pipe stanchions along Village Loop Road retaining wall for steam lines, as well as ammonia lines and electrical conduit
    Western portion of stanchions built by ATSF in 1925 in connection with Powerhouse
    Eastern portion built by CCC in 1934 in connection with Village Loop Road construction; pipes removed (*See pp. 61-62/fn. 328-29; p. 66/fn. 350*)

23. El Tovar Stone vault (Building No. SR0055)
    Constructed circa 1926 to replace 1906 power plant
    On hill south of El Tovar in the location of the former power plant
    Houses abandoned steam equipment, possibly a manifold (*See pp. 61-63/fn. 324, 330*)

24. Pipe chase and tunnel to Park Superintendent's House (Building No. 1)
    Constructed by CCC in 1937/38
    Pipes abandoned in place inside chase and tunnel (*See p. 68/fn. 362*)

25. "Steam tunnels" - beneath Bright Angel Lodge, Buckey O'Neil Cabin, and Powell Lodge
    Excavated by Meyers Brothers, the Bright Angel Lodge proper general contractor, 1934
    Additional utilities in tunnels, including reclaim water, domestic water, electrical conduit.
    Steam lines abandoned in place, cut in some locations (*See pp. 66- 67/fn. 353, 355*)

26. Bright Angel Cabin Stone Vault
    Constructed in 1934/35 by RR or contractor for RR (Howe Brothers?)
    Adjoined to east side of telephone building
    Heat exchanger and other equipment abandoned in place inside vault
    (*See p. 67/fn. 357/fig. 57*)

27. Steam lines and risers in rail yard
    Constructed by ATSF in 1914, added to in 1956?
    Located throughout rail yard (*See p. 57*)

28. Foundation for steam building
    Constructed by ATSF in 1950, added to in 1956
    West of depot, south of tracks (*See pp. 73-74/fig. 64, 67, 68*)

29. Bright Angel Boiler house
    Contractor for Fred Harvey Co., 1956
    Bright Angel Cabin complex, southwest corner (*See p. 74/fn. 402*)

30. Verkamp's Generator Building
    Built by John Verkamp, 1917 (*See pp. 59-60/fn.311*)

III. ELECTRICITY

31. Pipe chase in Village Loop Road retaining wall, leading to Bright Angel Lodge
    Built by CCC in 1934; still in use (*See p. 67*)

32. Concrete transformer vault
    Built by RR? Circa 1926 in relation to new Powerhouse?
    Southwest of El Tovar, between El Tovar and stone vault (*See p. 62/fn. 330*)

33. Powerhouse
    Built by ATSF 1925/26
    South of tracks in Fred Harvey utility complex
    Also generated steam (*See pp. 60-64*)

III. FUEL OIL

34. See sewer, laundry bypass (*See p. 63*)

IV. AMMONIA

35. See steam, pipe chase to El Tovar (*See p. 65; p. 77/fn. 422*)

IV. BRINE

36. Line to Bright Angel Lodge proper
    ATSF, circa 1935
    From west side of Powerhouse, likely abandoned in place (*See p. 78/fn. 426-28*)

UNKNOWN USE

37. Vertical pipes (3) - near metal stairs from railroad to Bright Angel Lodge
    North of Powerhouse
    Two on north side of tracks
    One on south side of tracks

Appendix B: Images from Grand Canyon National Park Museum Collection (GRCA)



Figure 1: Kolb Bros. Studio with cistern, GRCA 7731.

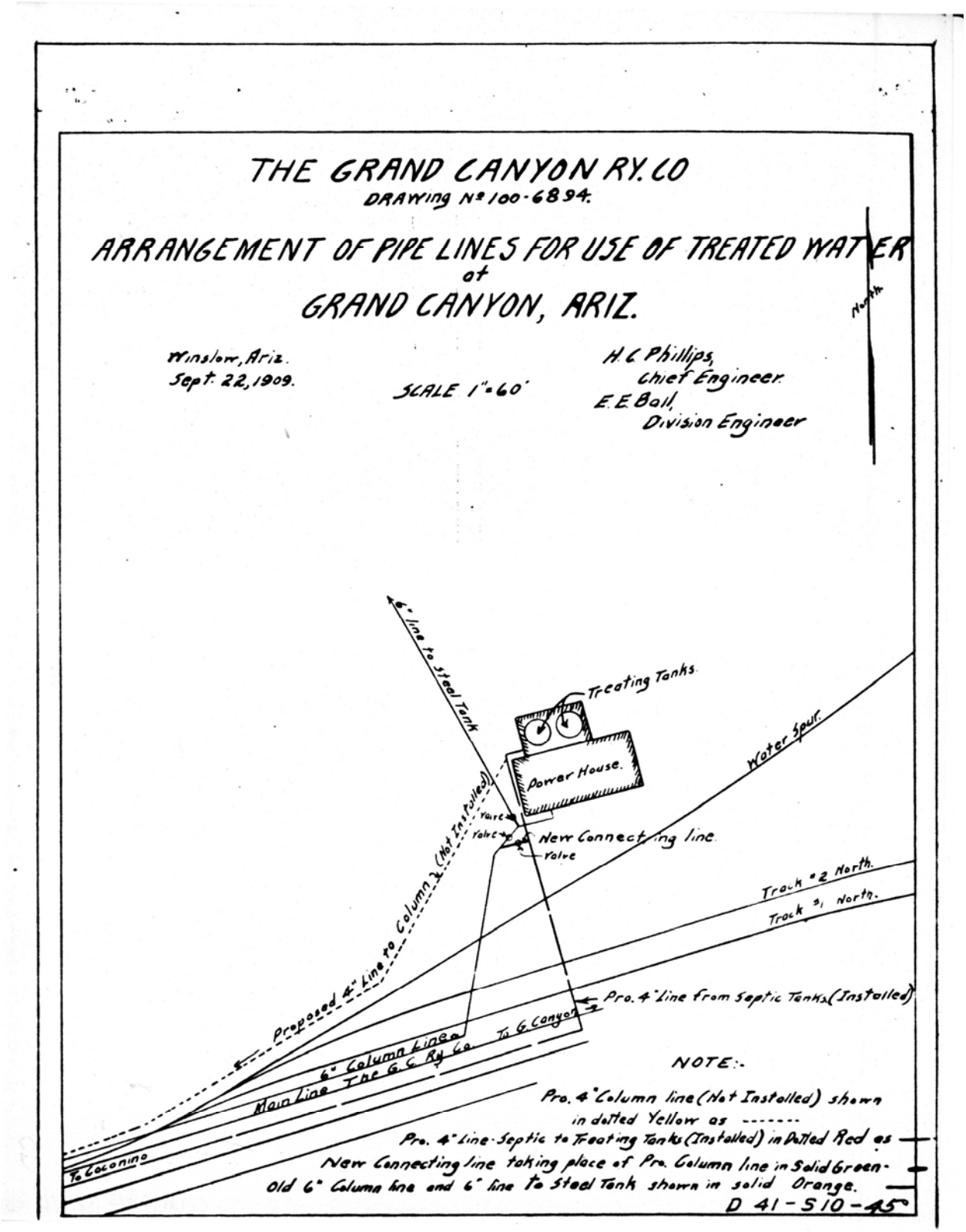


Figure 2: Grand Canyon Railway, "Arrangement of Pipe Lines for Use of Treated Water at Grand Canyon, Ariz.," Drawing No. 100-6894, 1909, GRCA 66101-28.

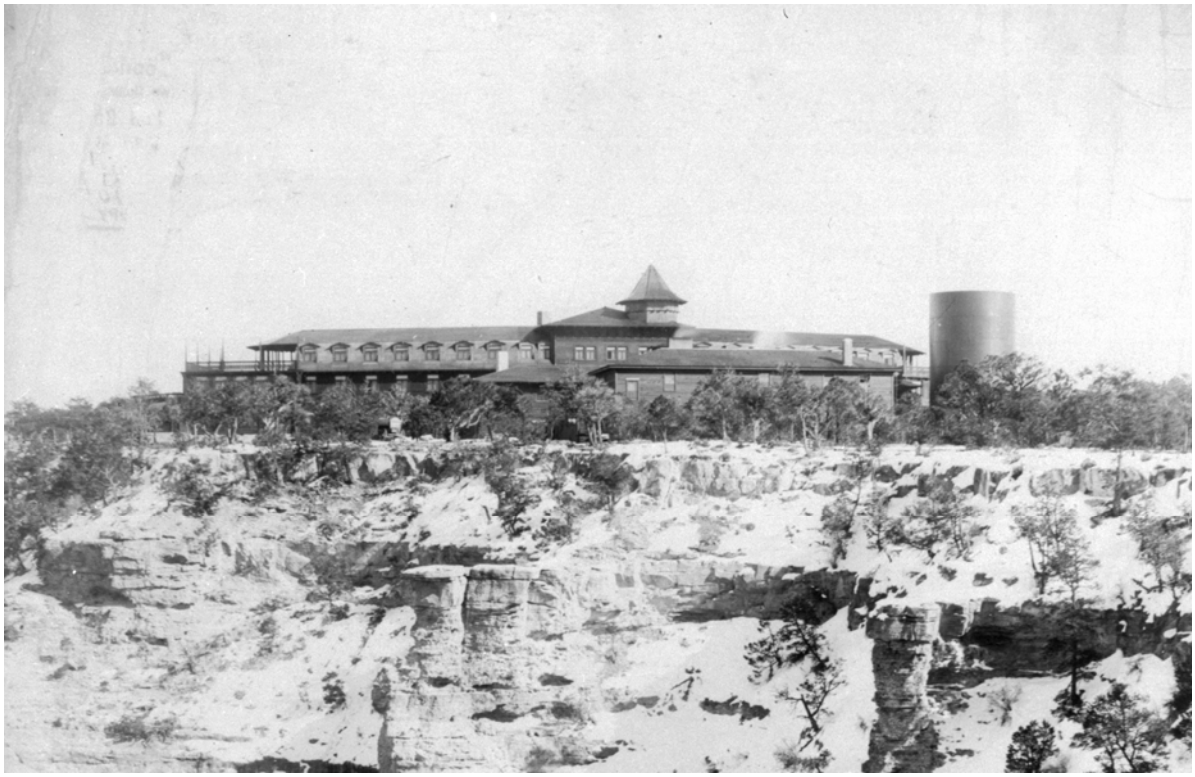


Figure 3: El Tovar with one water tower, GRCA 9824.

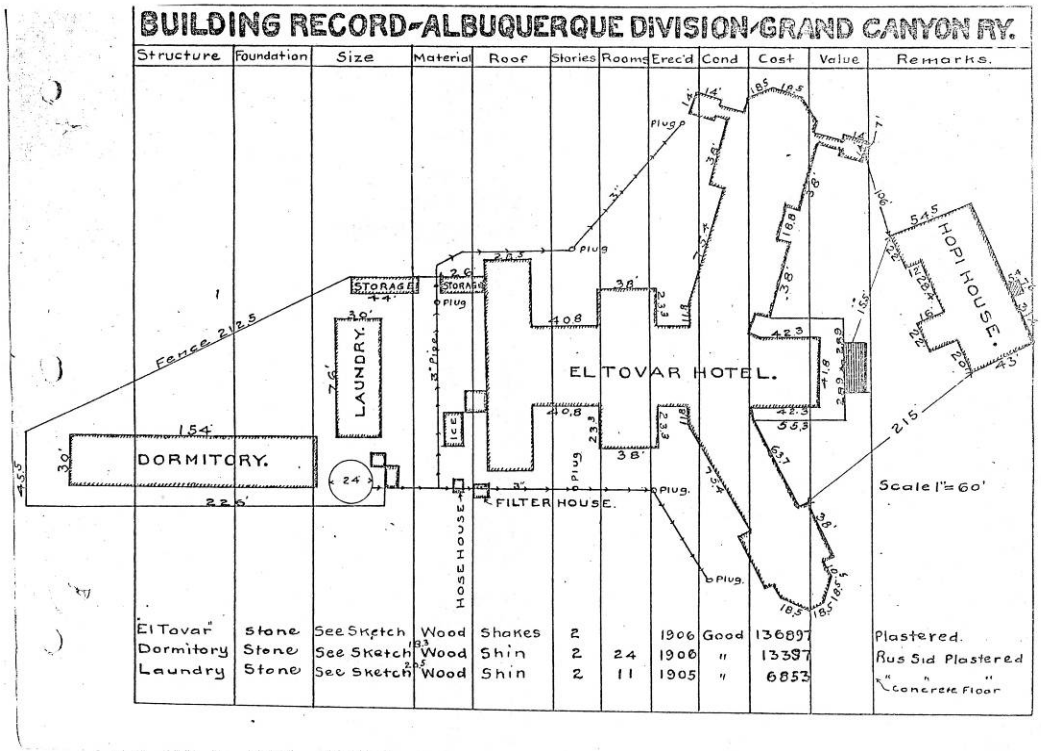


Figure 4: El Tovar plan from ca. 1915 Grand Canyon Building Record.



Figure 5: Three water tanks at El Tovar, GRCA 9904.



Figure 6: Hydrant, GRCA 11984.

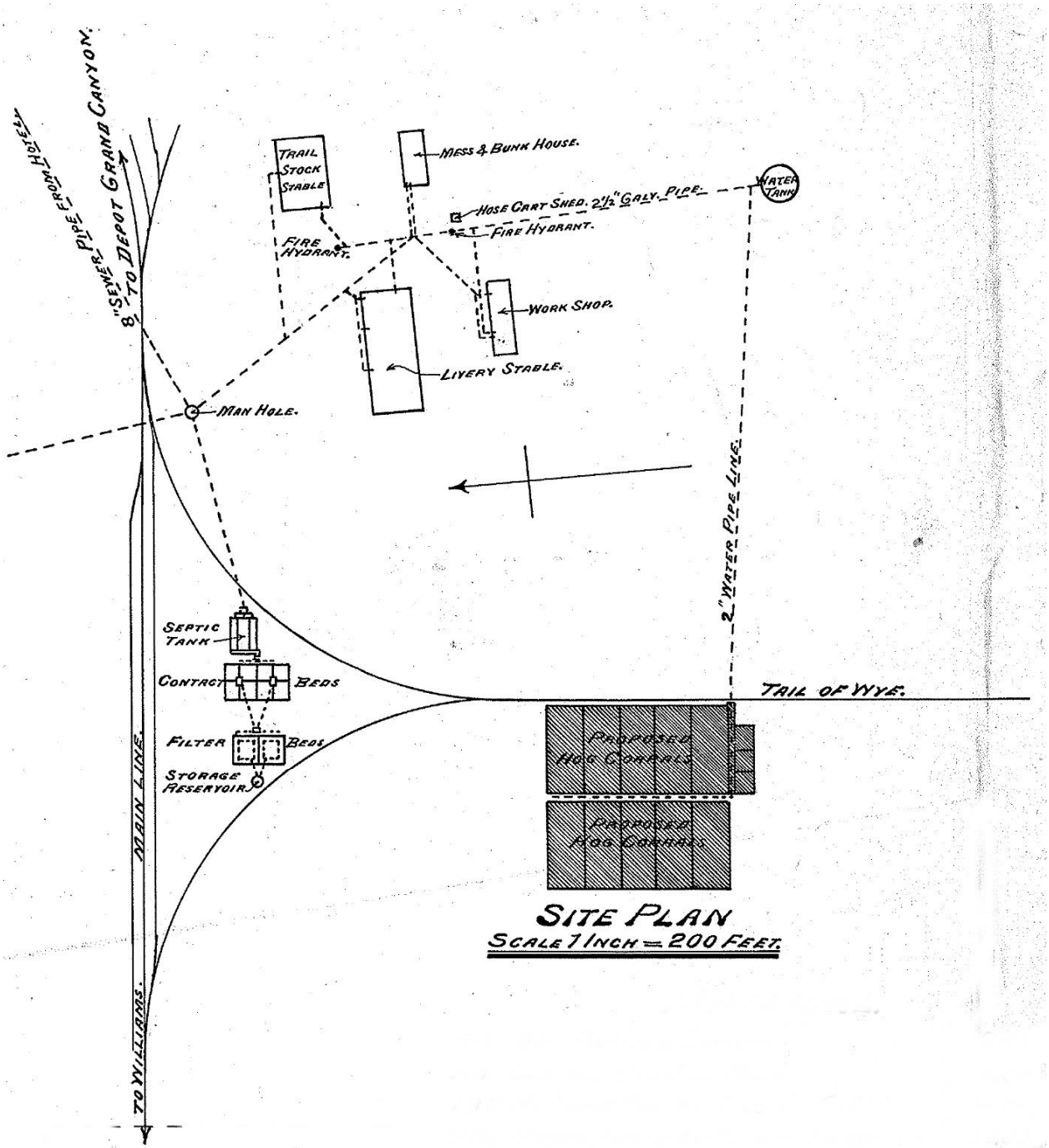


Figure 7: Site Plan, Drawing No. 113-8021, 1908, GRCA 67622.

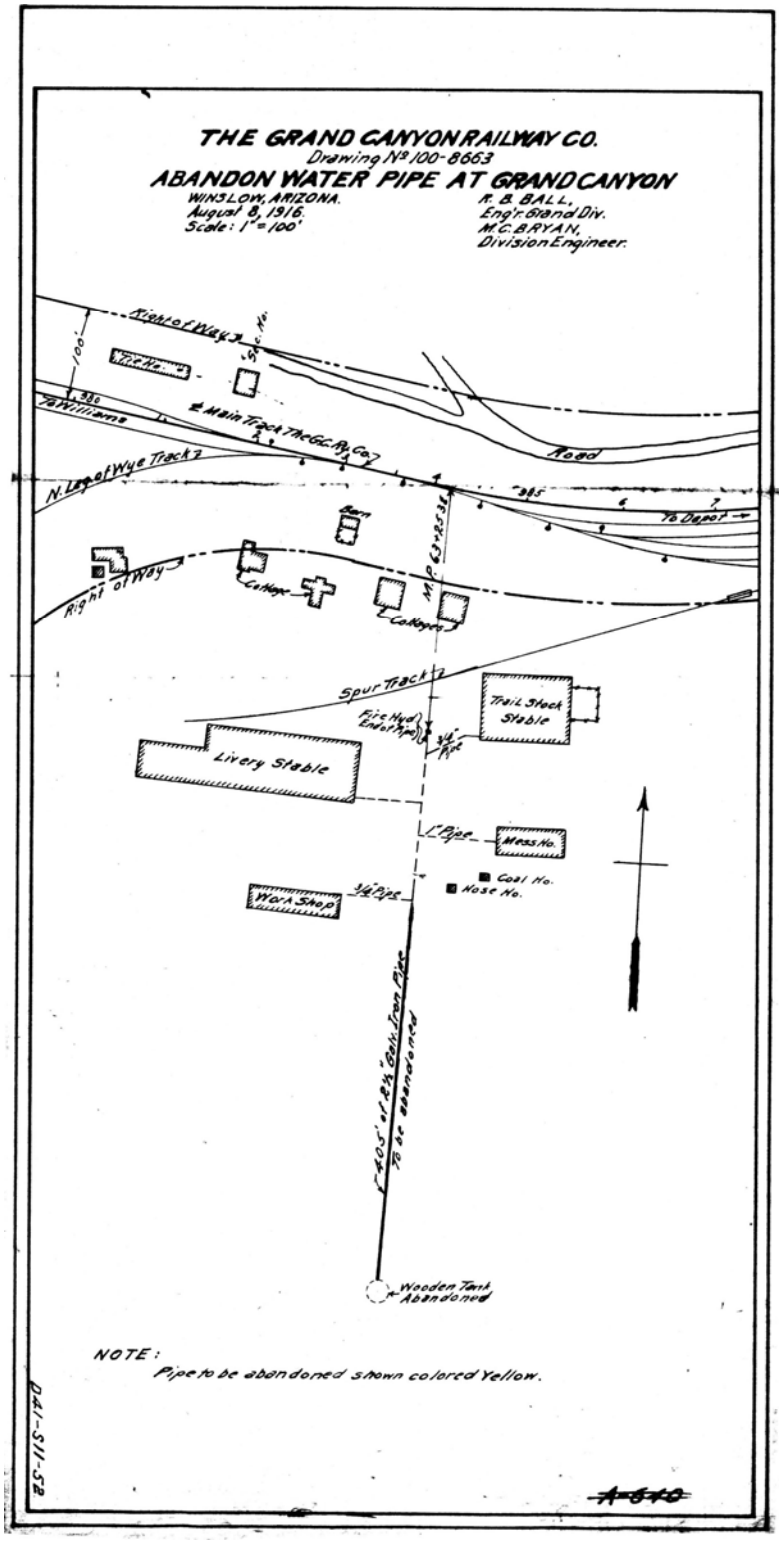


Figure 8: The Grand Canyon Railway Co., "Abandon Water Pipe at Grand Canyon," Drawing No. 100-8663, 1916, GRCA 66101-48.

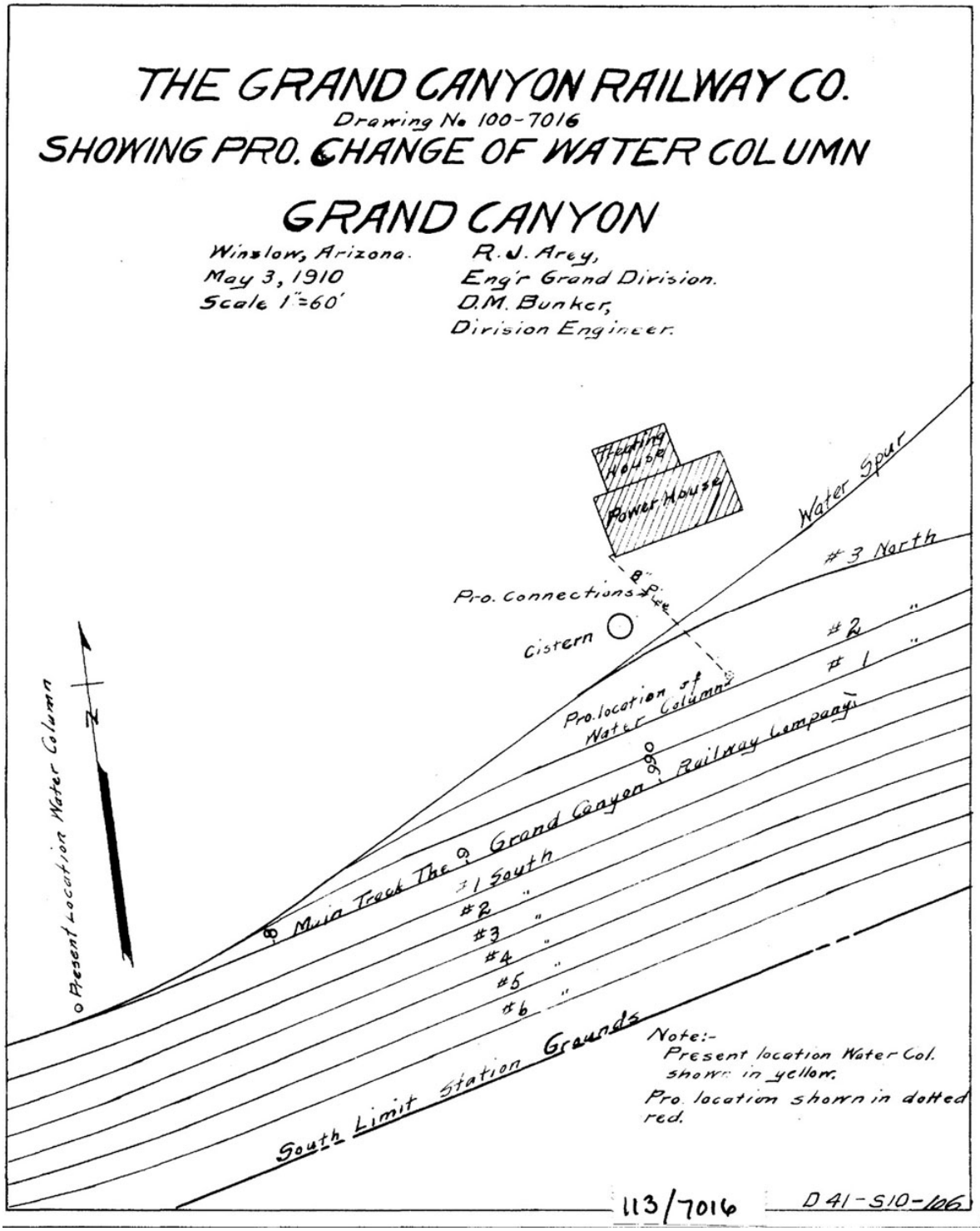


Figure 9: The Grand Canyon Railway Company, "Showing Pro. Change of Water Column, Grand Canyon," Drawing No. 100-7016, 1910, GRCA 34990.

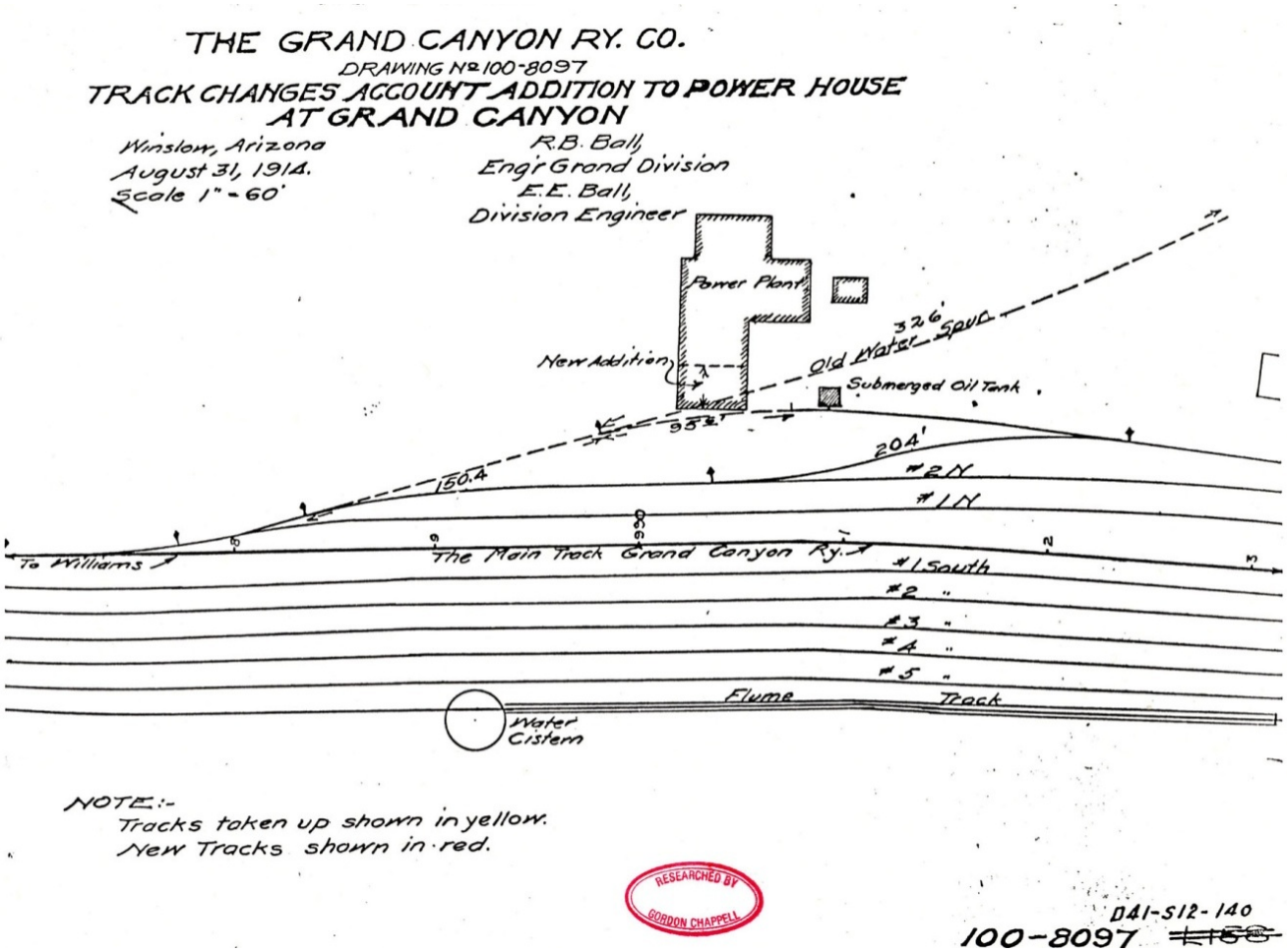


Figure 10: The Grand Canyon Railway Company, "Track Changes Account Addition to Power House at Grand Canyon," showing water cistern and flume track, Drawing No. 100-8097, 1914, GRCA 87923.

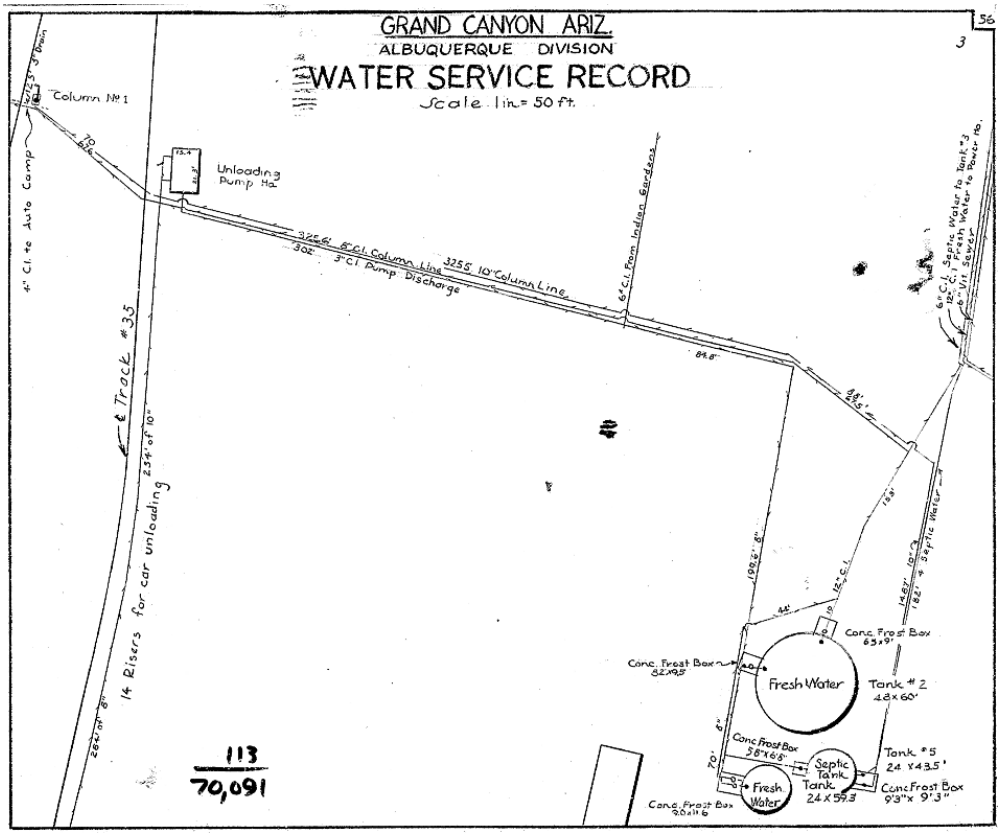


Figure 11: Water Service Record, showing pump house and three water tanks, Drawing No. 113-70091, Sheet 3.



Figure 12: Water unloading, GRCA 3605.



Figure 13: Three water storage tanks from utility facilities at Grand Canyon Village, GRCA 59005, Photo 8080.

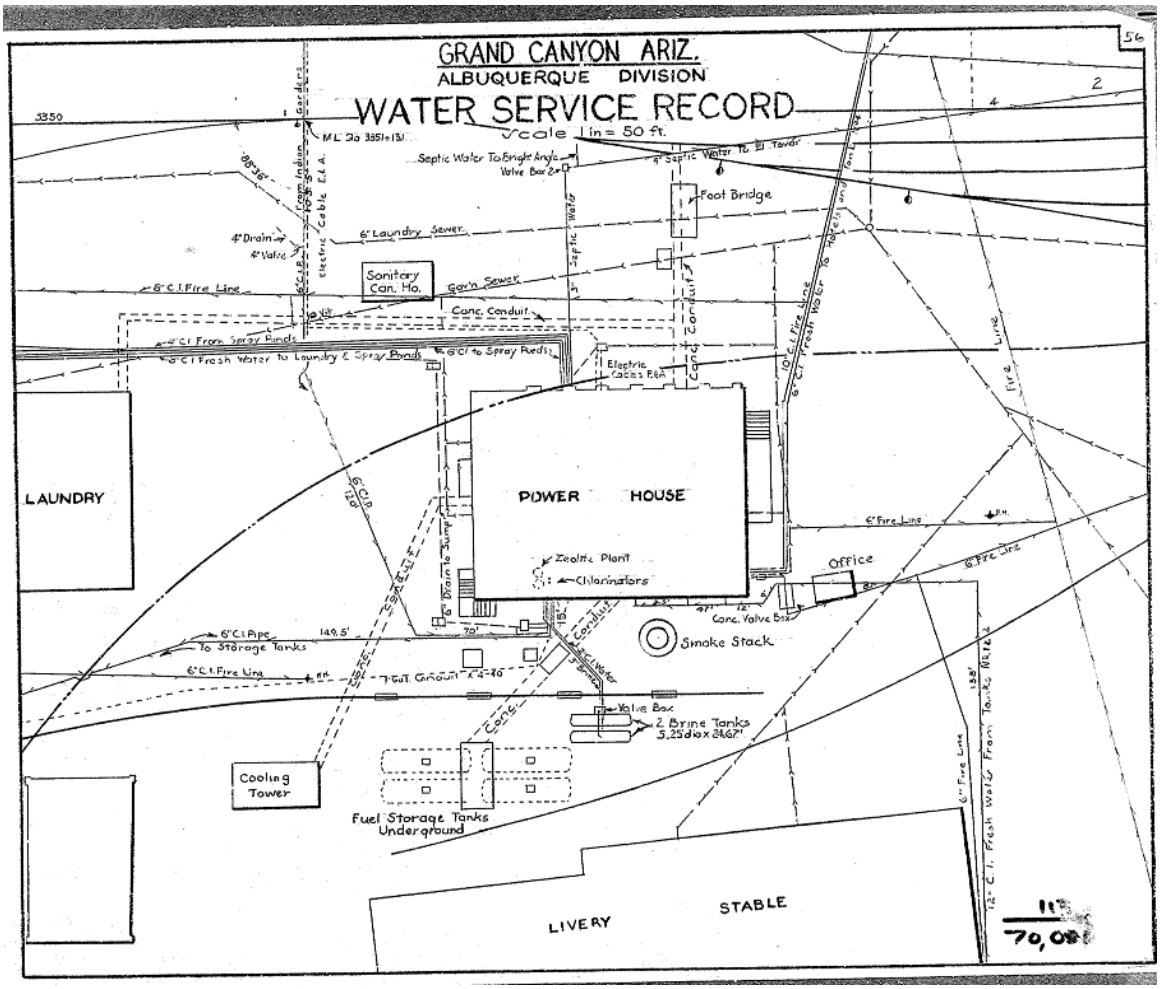


Figure 14: Water Service Record, Drawing No. 113-70091, Sheet 2.



Figure 15: CCC crew constructing water pipe trench to Building No. 1, ca. 1935, GRCA 6610.

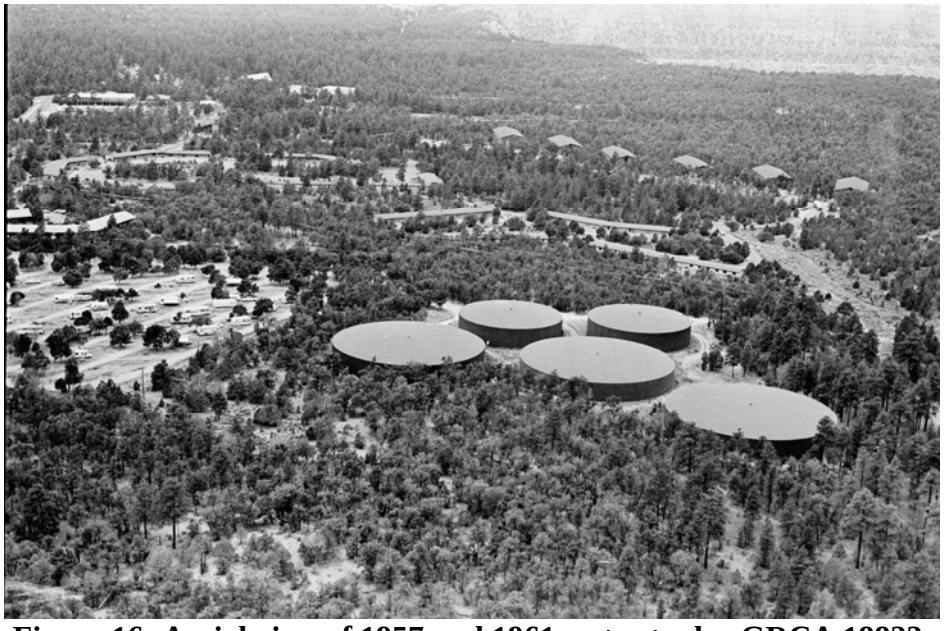


Figure 16: Aerial view of 1957 and 1961 water tanks, GRCA 18822.



Figure 17: Drilling pipeline, GRCA 12115.

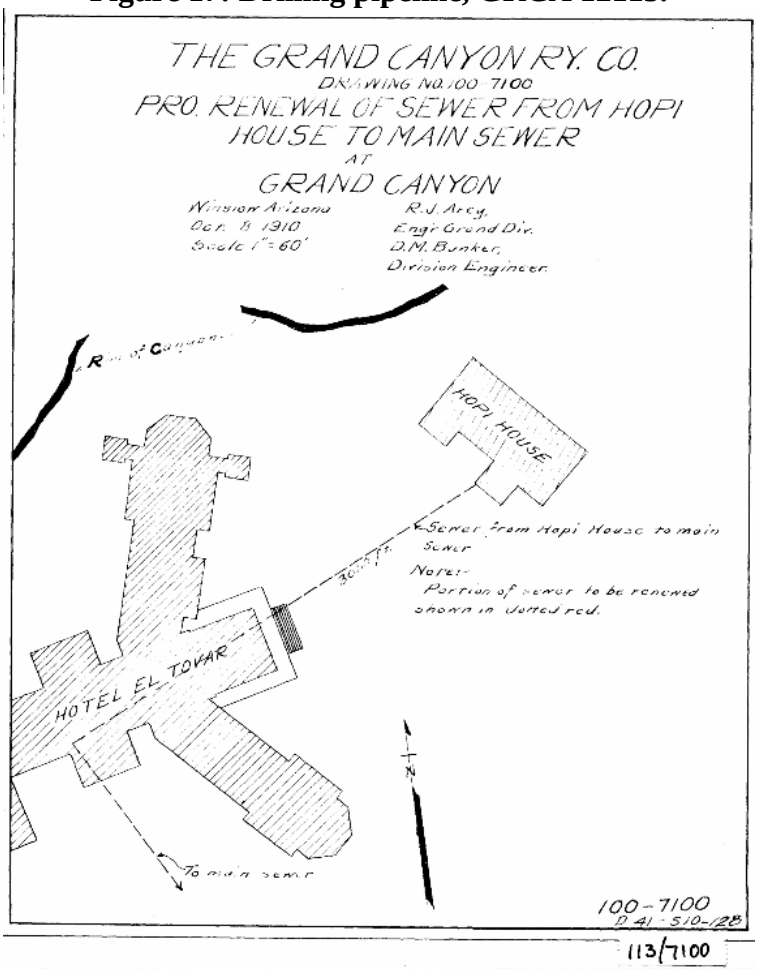


Figure 18: The Grand Canyon Railway Company, "Pro. Renewal of Sewer from Hopi House to Main Sewer at Grand Canyon," Drawing No. 100-7100, 1910, GRCA 66101-34.

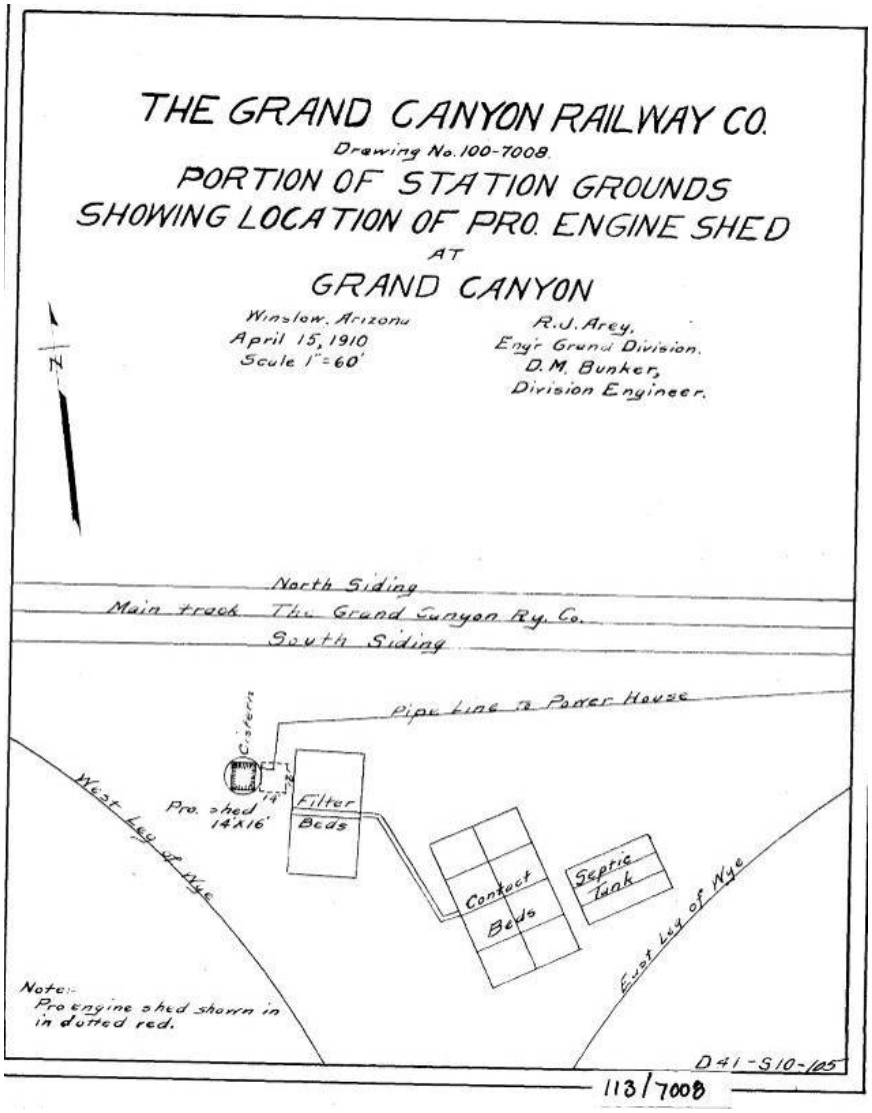


Figure 19: The Grand Canyon Railway Company, "Portion of Station Grounds Showing Location of Pro. Engine Shed, at Grand Canyon," Drawing No. 100-7008, 1910, GRCA 66101-30.



Figure 20: Sewage treatment plant just before conversion to spray ponds and during realignment of wye track, ca. 1924-25, GRCA 13641.



Figure 21: Section house with privy in background, 1910, GRCA 87370.

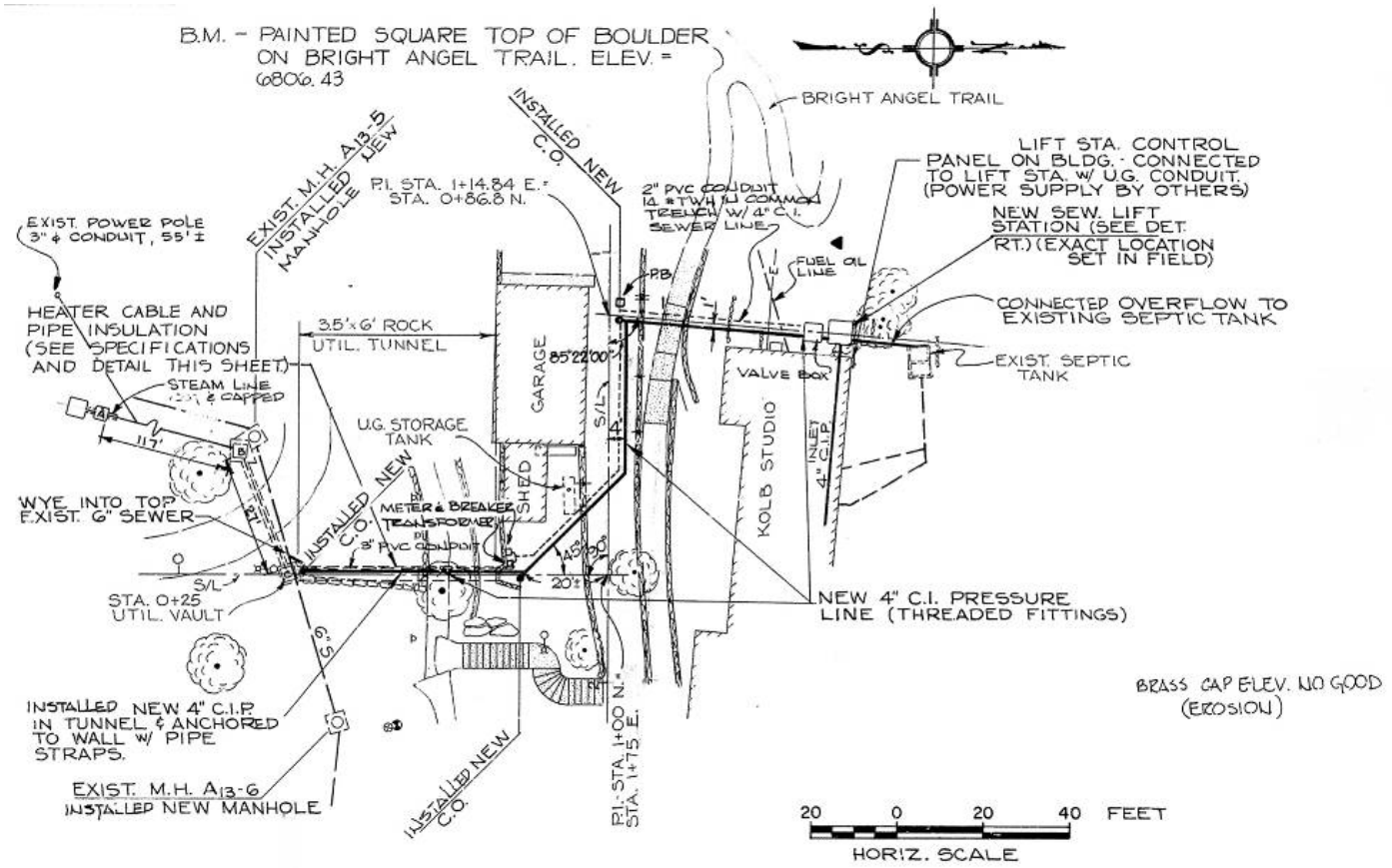


Figure 22: From 1973 existing conditions drawing for sewer system, p. 15, Drawing No. 113-41043A.

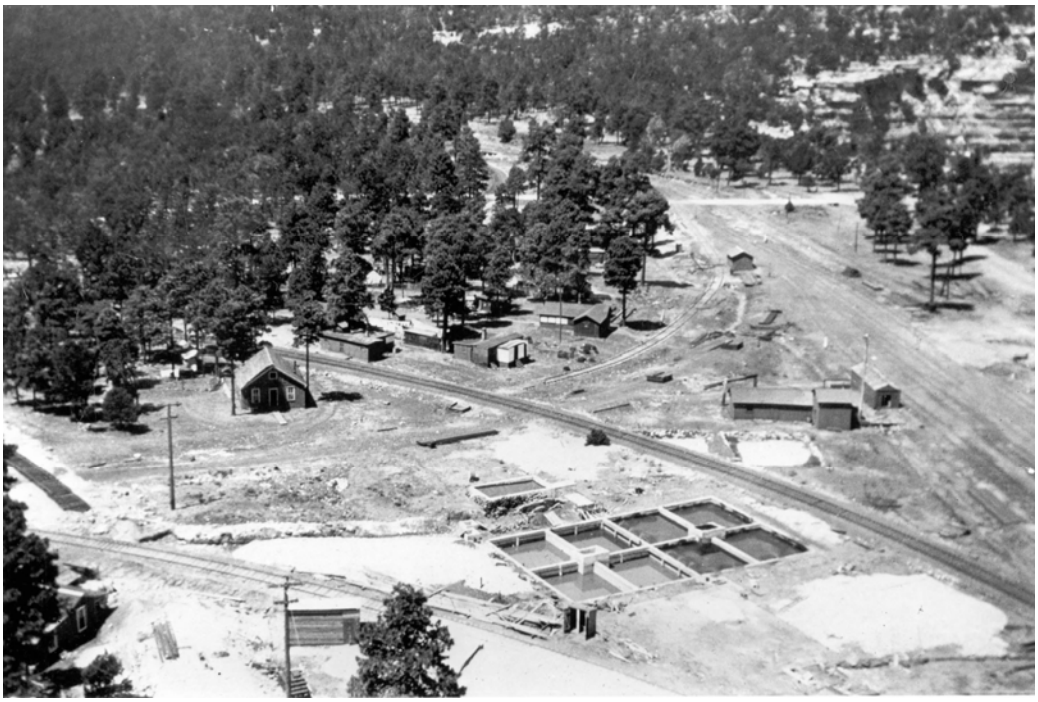


Figure 23: Conversion to spray ponds, GRCA 13127.



Figure 24: Tent frames with privies, GRCA 9542A.

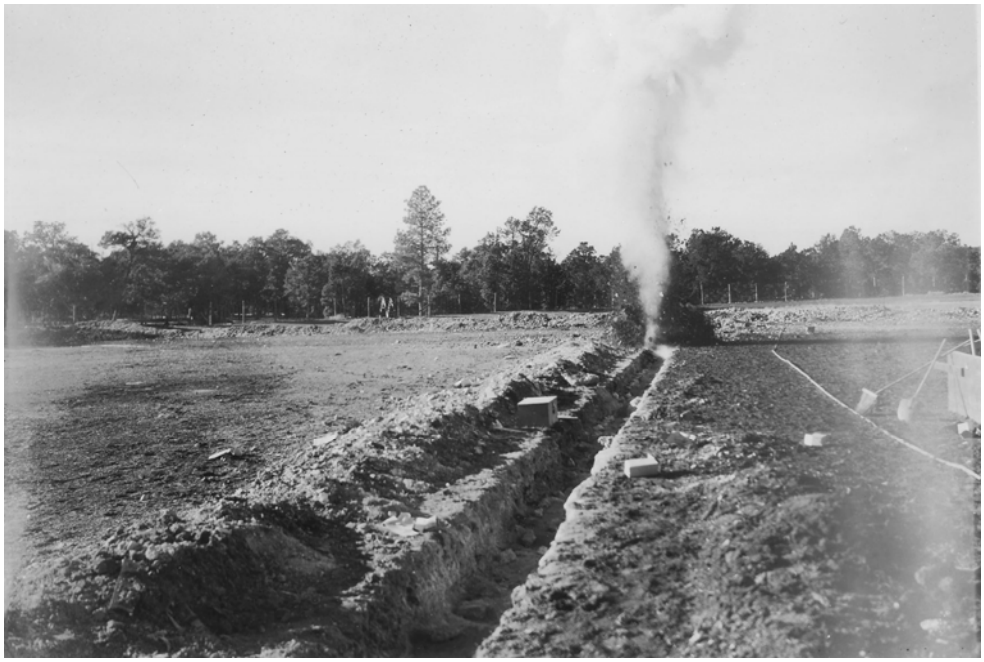


Figure 25: Trench blasting for new water system, 1934, GRCA 29844.



Figure 26: Bright Angel Cabins' sewer main, 1936, GRCA 292.



Figure 27: Trench under railway tracks, 1935, GRCA 341.



Figure 28: Sewer trenching under railroad tracks, 1935, GRCA 253.



Figure 29: Men laying 10” trunk line, 1936, GRCA 338.

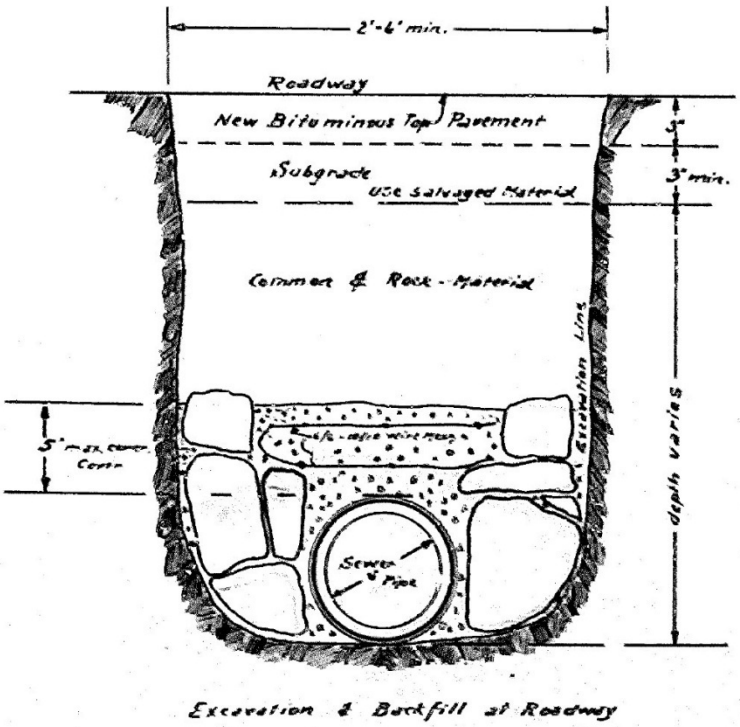


Figure 30: Sewer line construction detail, Drawing No. 113-5710, 1937.



Figure 31: Bright Angel Hotel without power lines, ca. 1898, GRCA 5115.

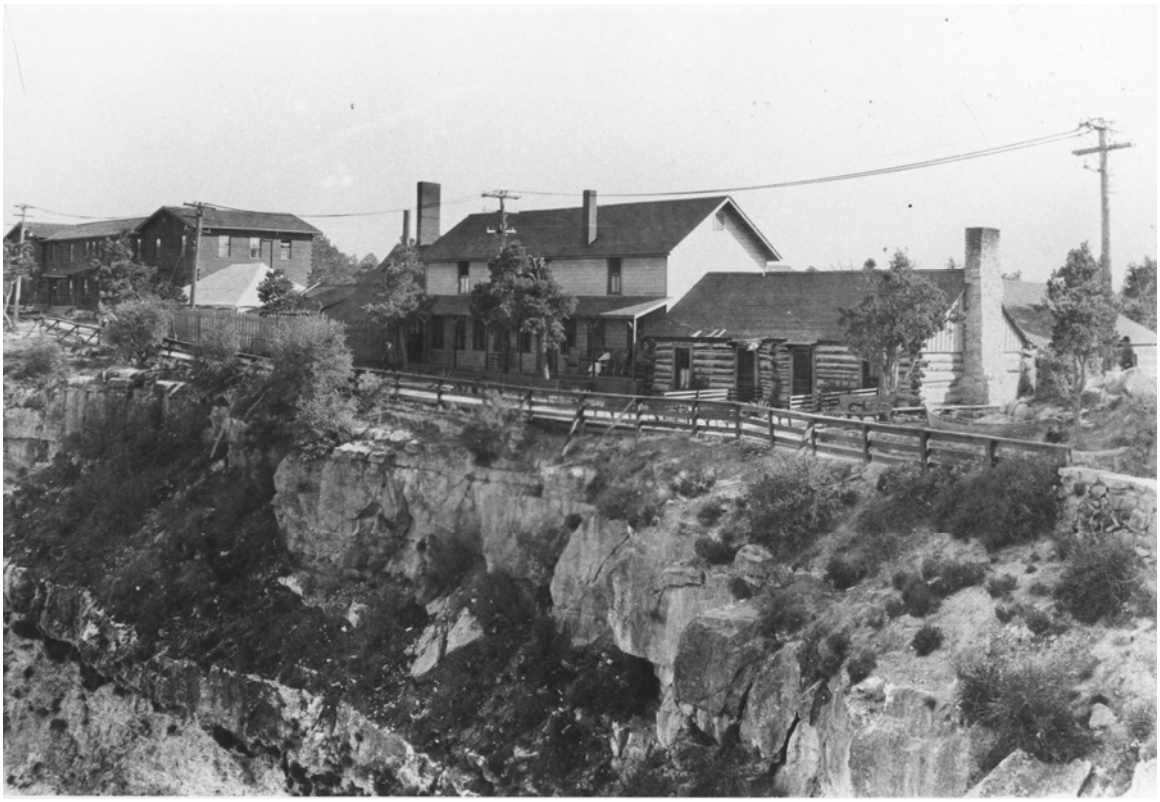


Figure 32: Historic photo of Bright Angel Hotel with power lines, ca. 1915, GRCA 11813.

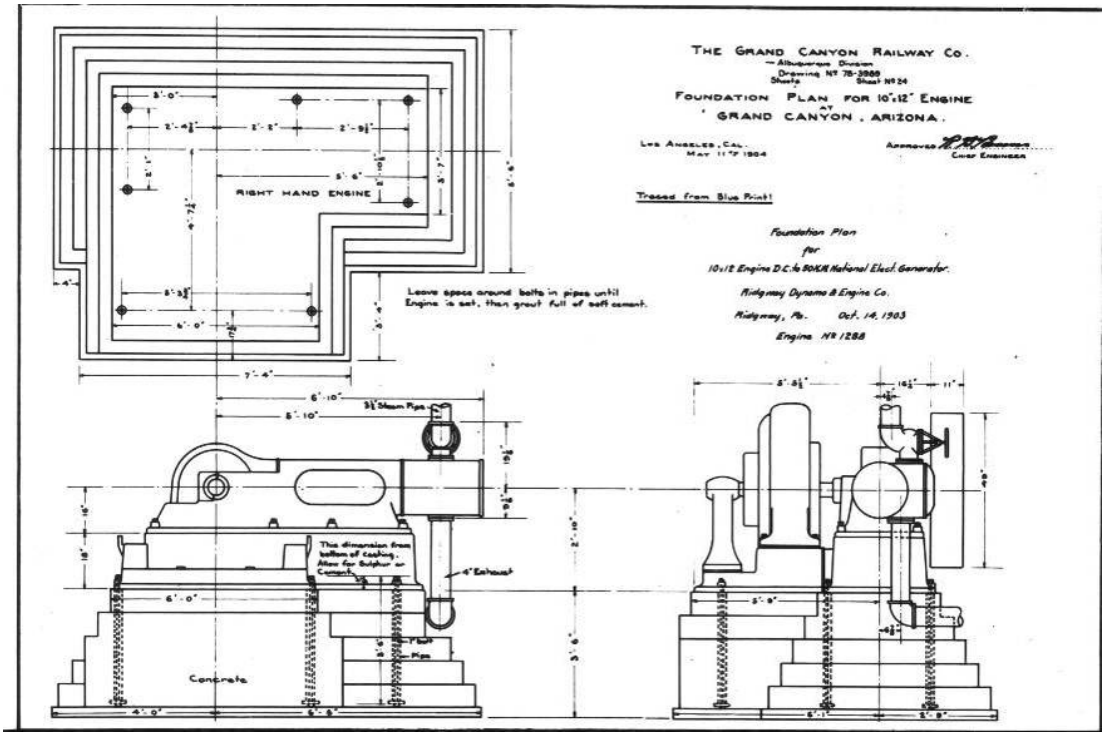


Figure 33: Foundation Plan for 10x12 Engine, 1904, GRCA 30035BC.

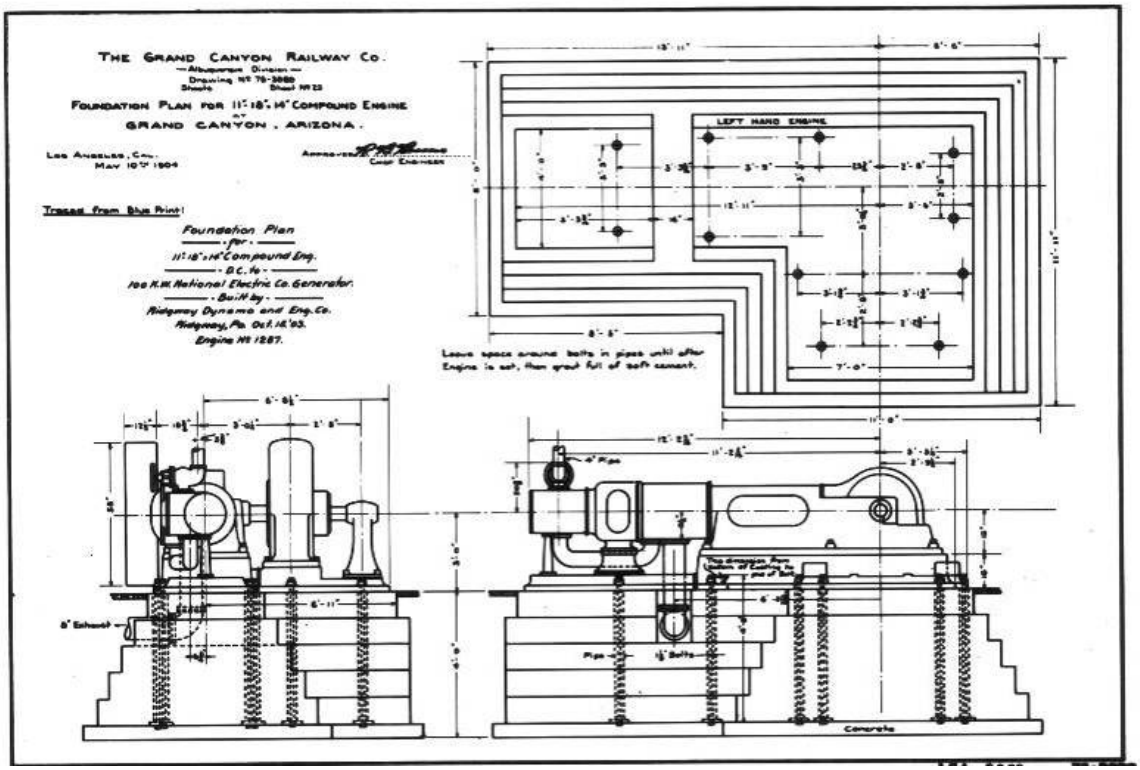


Figure 34: Foundation Plan for 11x18x14 Compound Engine, 1904, GRCA 30035AP.

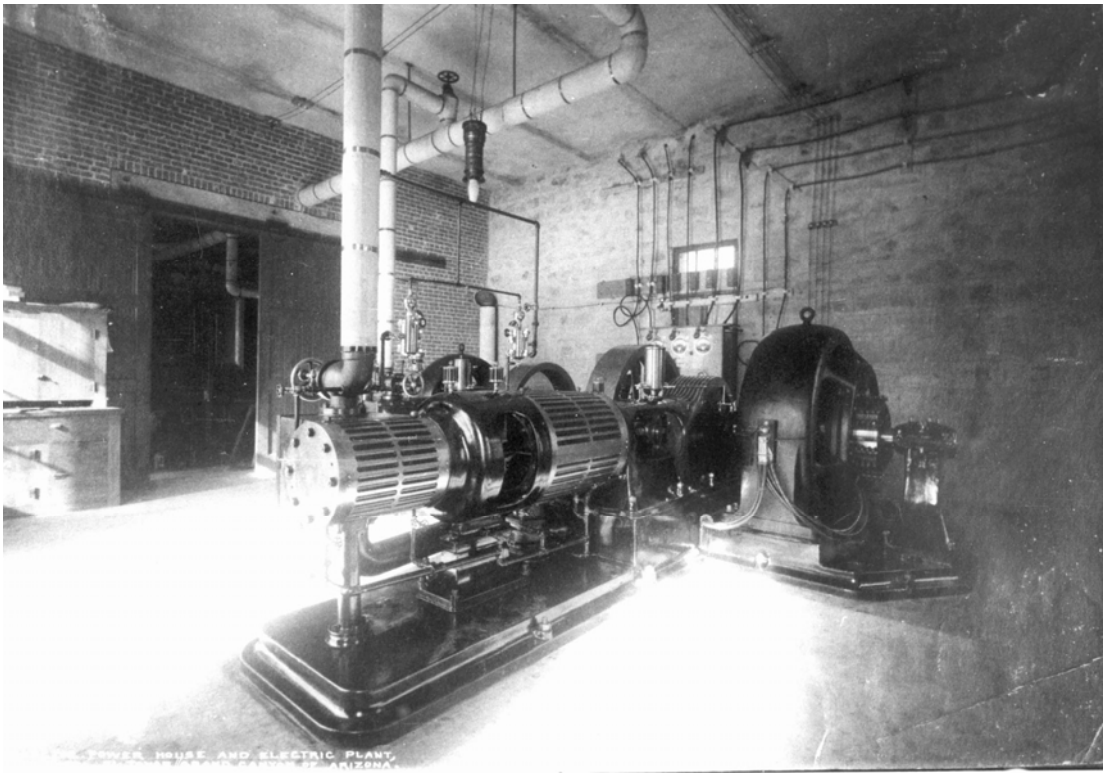


Figure 35: Steam generator in Power Plant, 1906, GRCA 9464.

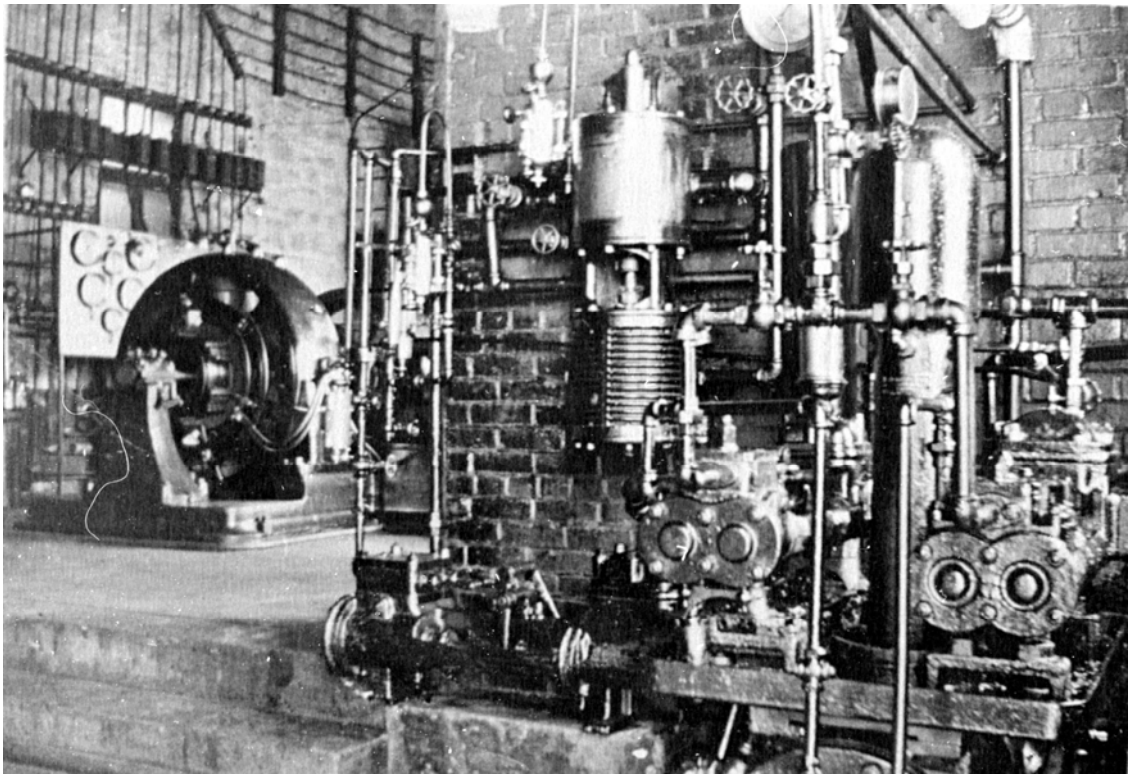


Figure 36: Equipment inside Power Plant, 1905, GRCA 12947A.

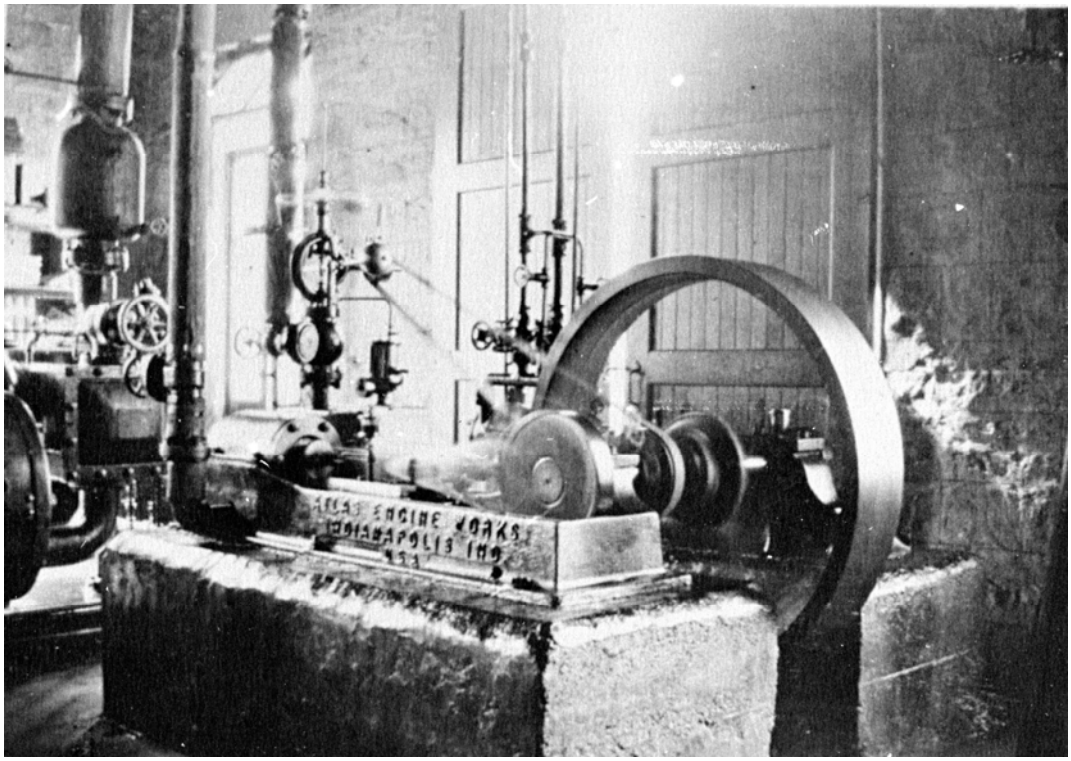


Figure 37: Equipment inside Power Plant, 1906, GRCA 12947B.



Figure 38: Power Plant's west elevation, GRCA 11989.

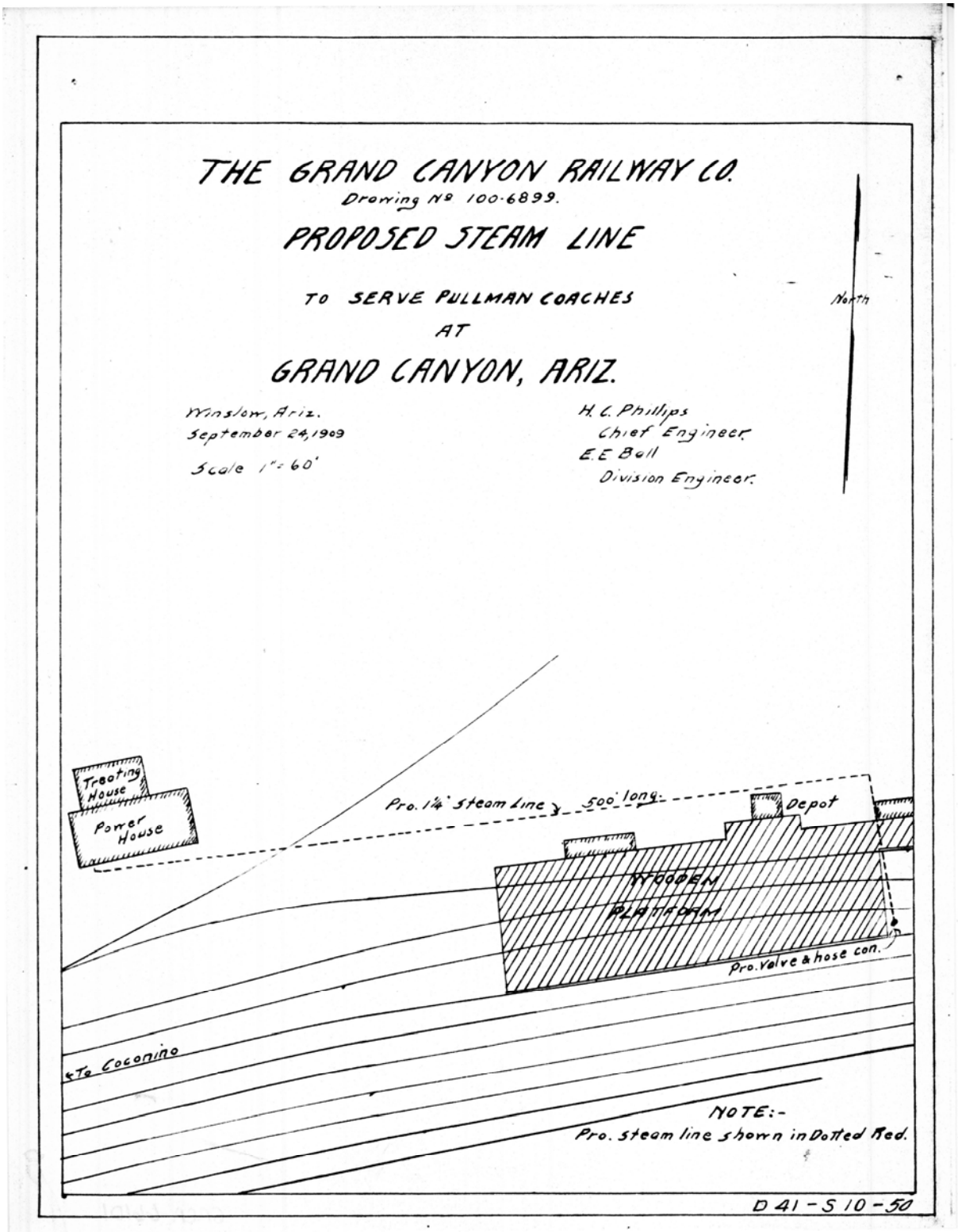
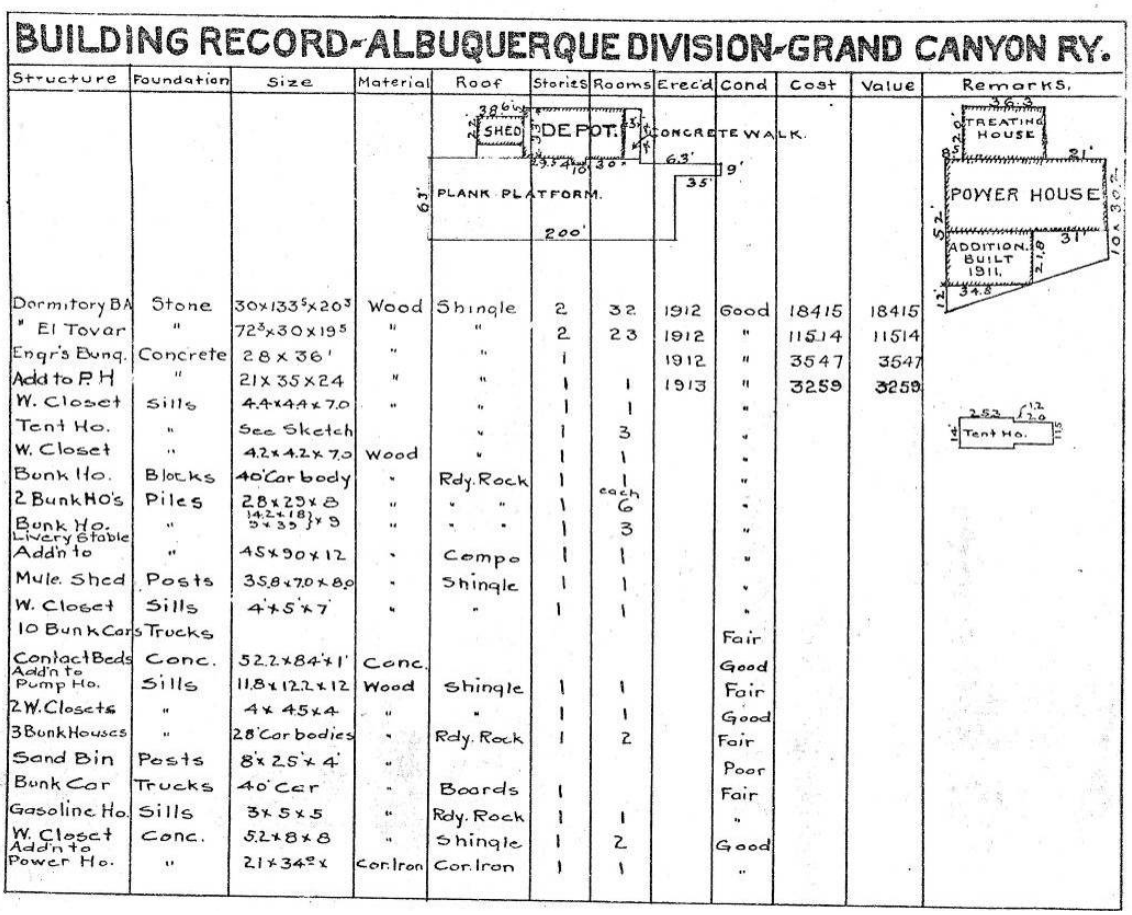


Figure 39: The Grand Canyon Railway Company, "Proposed Steam Line to serve Pullman Coaches at Grand Canyon, Ariz.," between Power Plant and Passenger Yard, Drawing No. 100-6899, 1909, GRCA 66101-29.



BUILDING RECORD-ALBUQUERQUE DIVISION-GRAND CANYON RY.

Structure	Foundation	Size	Material	Roof	Stories	Rooms	Erec'd	Cond	Cost	Value	Remarks.
Dormitory BA	Stone	30x133⅝x20³	Wood	Shingle	2	32	1912	Good	18415	18415	
" El Tovar	"	72³x30x19⁵	"	"	2	23	1912	"	11514	11514	
Engr's Bung.	Concrete	28 x 36'	"	"	1		1912	"	3547	3547	
Add to P. H	"	21x35x24	"	"	1	1	1913	"	3259	3259	
W. Closet	Sills	4.4x4.4x7.0	"	"	1	1		"			
Tent Ho.	"	See Sketch		"	1	3		"			
W. Closet	"	4.2x4.2x7.0	Wood	"	1	1		"			
Bunk Ho.	Blocks	40'Car body	"	Rdy. Rock	1	1		"			
2 Bunk Ho's	Piles	28x29x8	"	" "	1	6 each		"			
Bunk Ho. Livery Stable	"	14.2x18 3x35 ½x9	"	" "	1	3		"			
Add'n to	"	45x90x12	"	Compo	1	1		"			
Mule Shed	Posts	35.8x7.0x8.0	"	Shingle	1	1		"			
W. Closet	Sills	4'x5'x7'	"	"	1	1		"			
10 Bunk Cars	Trucks							Fair			
Contact Beds	Conc.	52.2x84'x1'	Conc.					Good			
Add'n to Pump Ho.	Sills	11.8x12.2x12	Wood	Shingle	1	1		Fair			
2 W. Closets	"	4x 4.5x4	"	"	1	1		Good			
3 Bunk Houses	"	28'Car bodies	"	Rdy. Rock	1	2		Fair			
Sand Bin	Posts	8'x 2.5'x 4'	"					Poor			
Bunk Car	Trucks	40'Car	"	Boards	1			Fair			
Gasoline Ho.	Sills	3x 5x 5	"	Rdy. Rock	1	1		"			
W. Closet Add'n to Power Ho.	Conc.	5.2x8x8	"	Shingle	1	2		Good			
	"	21x34.2x	Cor. Iron	Cor. Iron	1	1		"			

Figure 40: Addition to Power Plant from AT&SF Ry Co Building Record, ca. 1915.

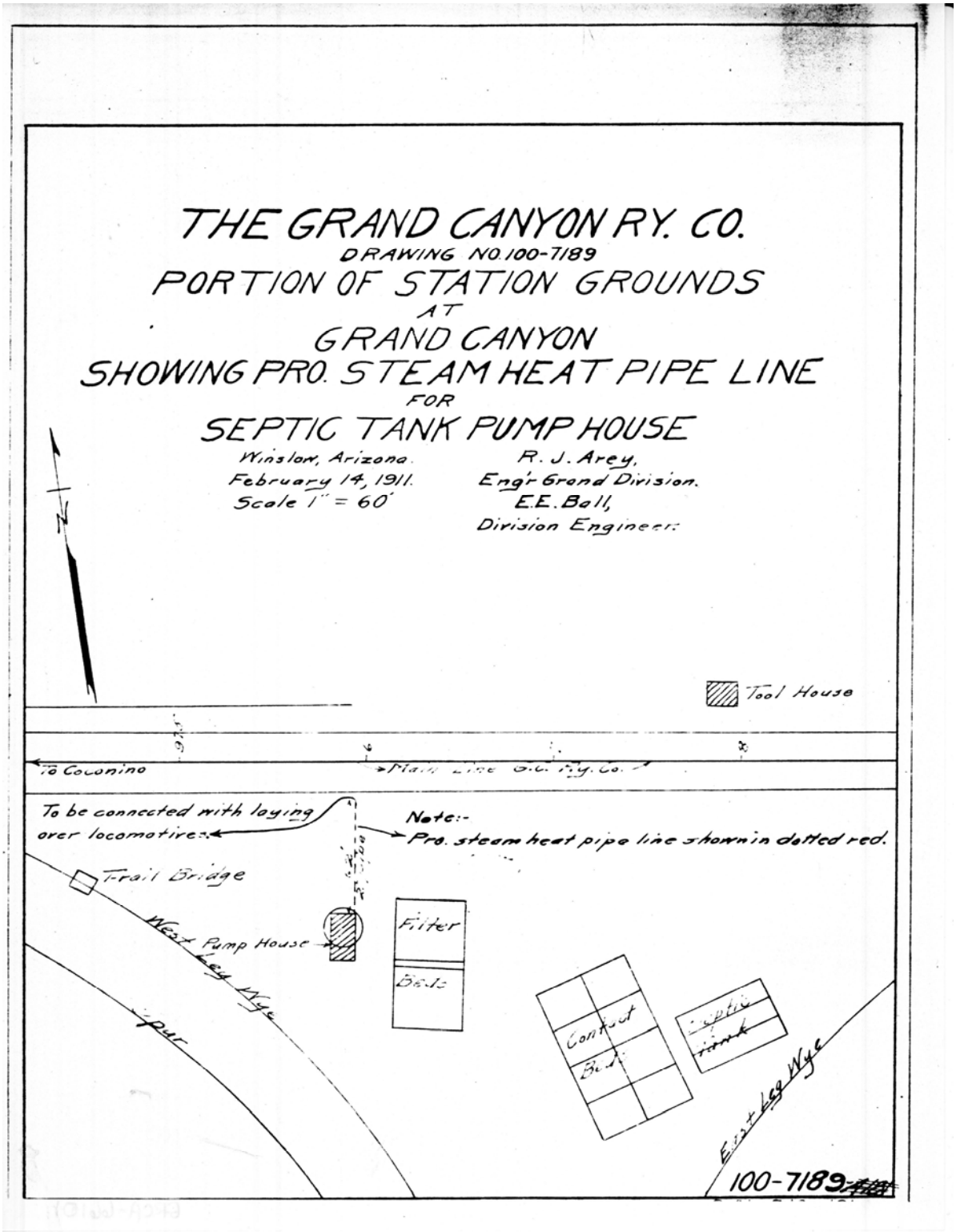


Figure 41: The Grand Canyon Railway Company, "Portion of Station Grounds at Grand Canyon Showing Pro. Steam Heat Pipe Line for Septic Tank Pump House," Drawing No. 100-7189, 1911, GRCA 66101-36.



Figure 42: Freight House on east side of Depot, post 1926, GRCA 2051.

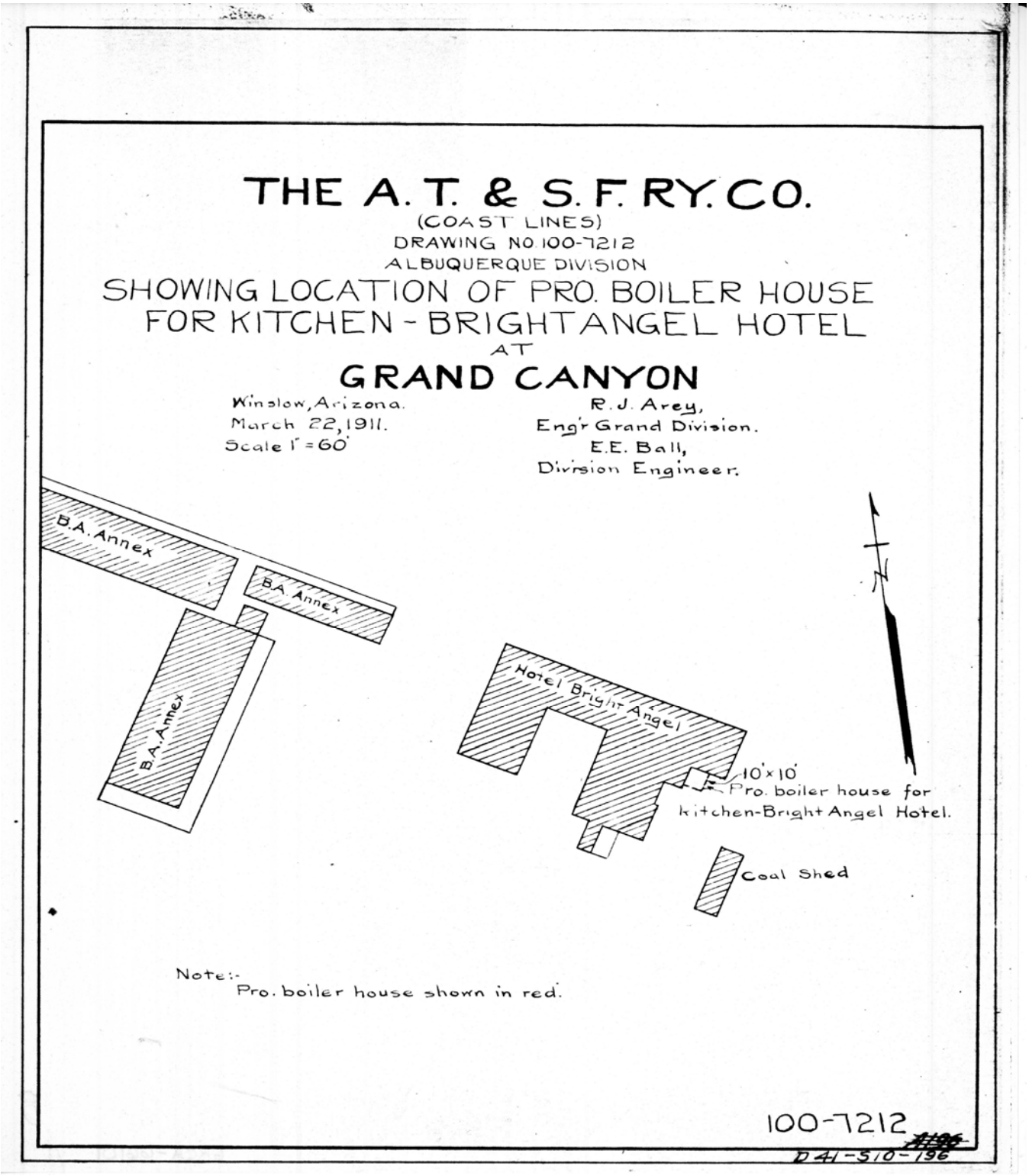


Figure 43: The AT&SF Ry Co., "Showing Location of Pro. Boiler House for Kitchen-Bright Angel Hotel at Grand Canyon," Drawing No. 100-7212, 1911, GRCA 66101-38.

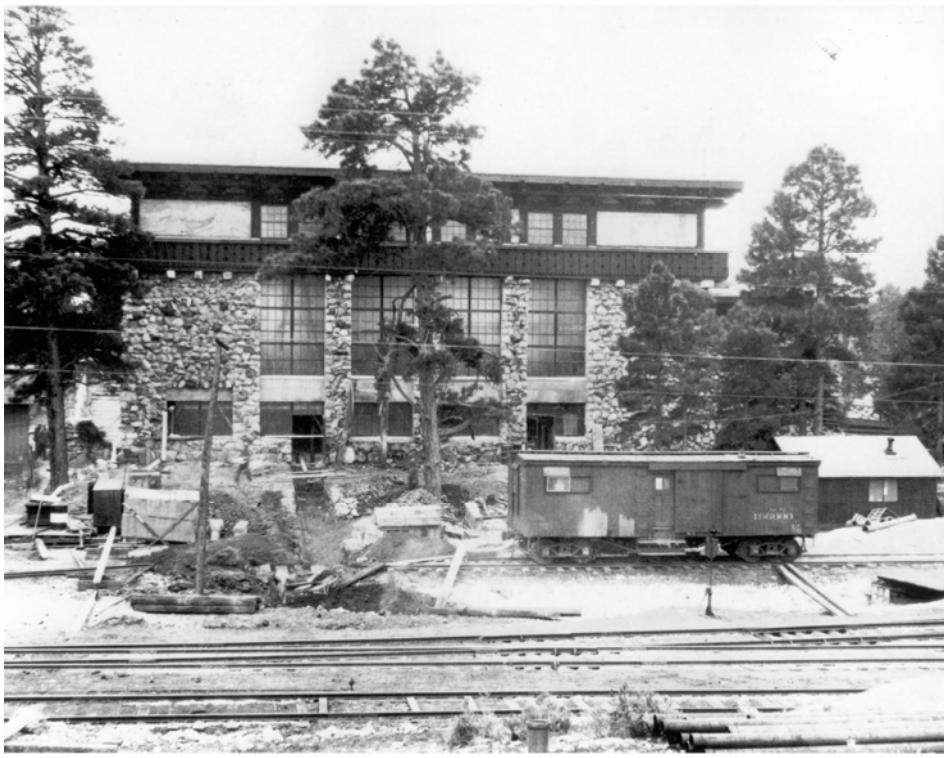


Figure 44: Powerhouse construction with open pipe trench, ca. 1926, GRCA 13115.



Figure 45: Powerhouse and steam lines under construction, 1925, GRCA 13203.



Figure 46: Steam lines and light post near railyard, ca. 1934, GRCA 7306.



Figure 47: Electrical lines west of El Tovar, ca. 1934, GRCA 9652.

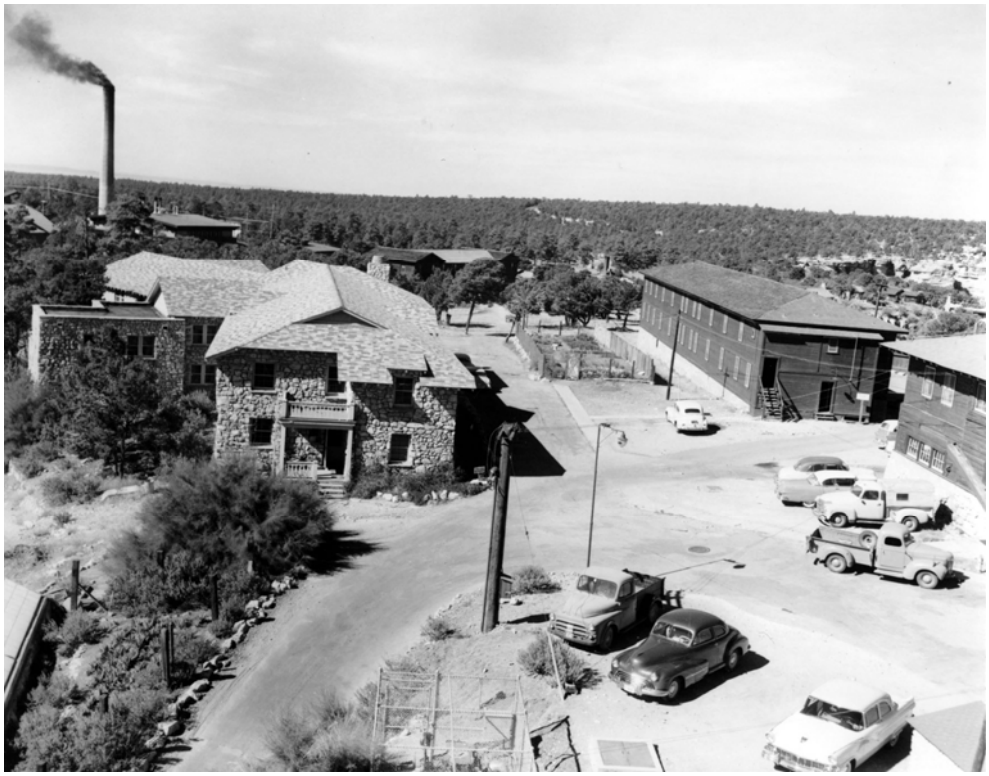


Figure 48: Electrical lines and transformer (bottom center), 1956, GRCA 3181.



Figure 49: Steam line to El Tovar, 1935, GRCA 6175.



Figure 50: Pipe chase to El Tovar beneath Hermit Rim Road (Village Loop), 1935, GRCA 6174.



Figure 51: Pipe chase beneath road to El Tovar, 1935, GRCA 6170.



Figure 52: CCC-constructed pipe chase for El Tovar carrying steam and ammonia lines, 1935, GRCA 6171.

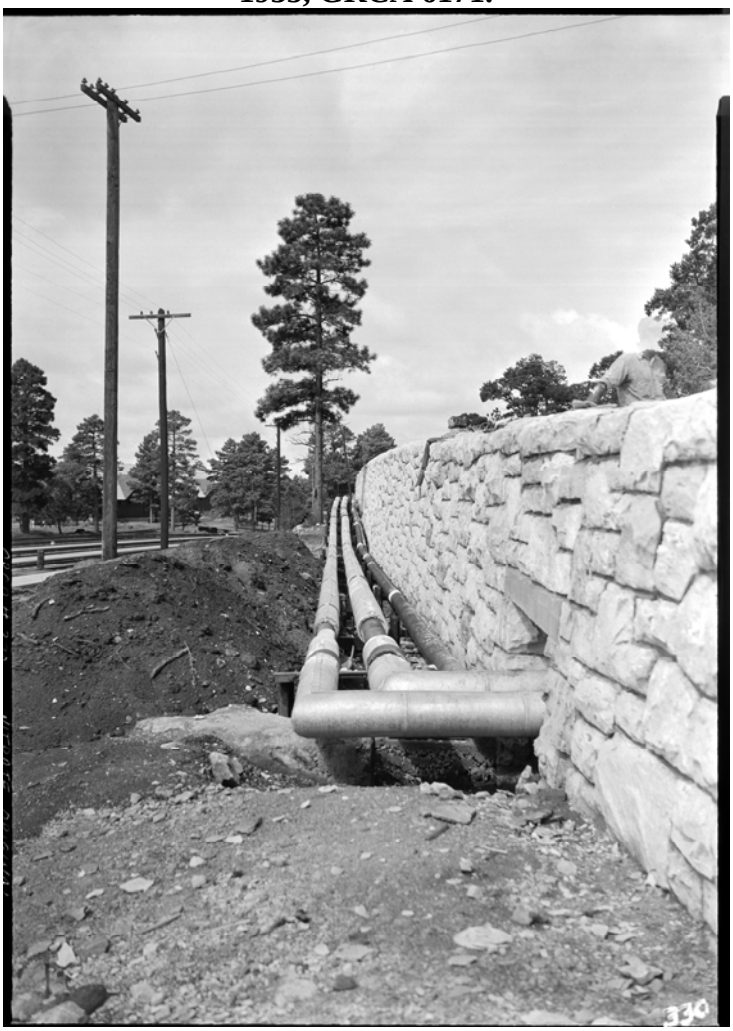


Figure 53: CCC extension of steam and ammonia lines to pipe chase, 1935, GRCA 330.



Figure 54: New retaining wall constructed by CCC where old steam lines crossed Hermit Rim Road, 1935, GRCA 7820.



Figure 55: Steam/ammonia/conduit to El Tovar after realignment, also note electrical lines and aboveground water pipe, GRCA 653.

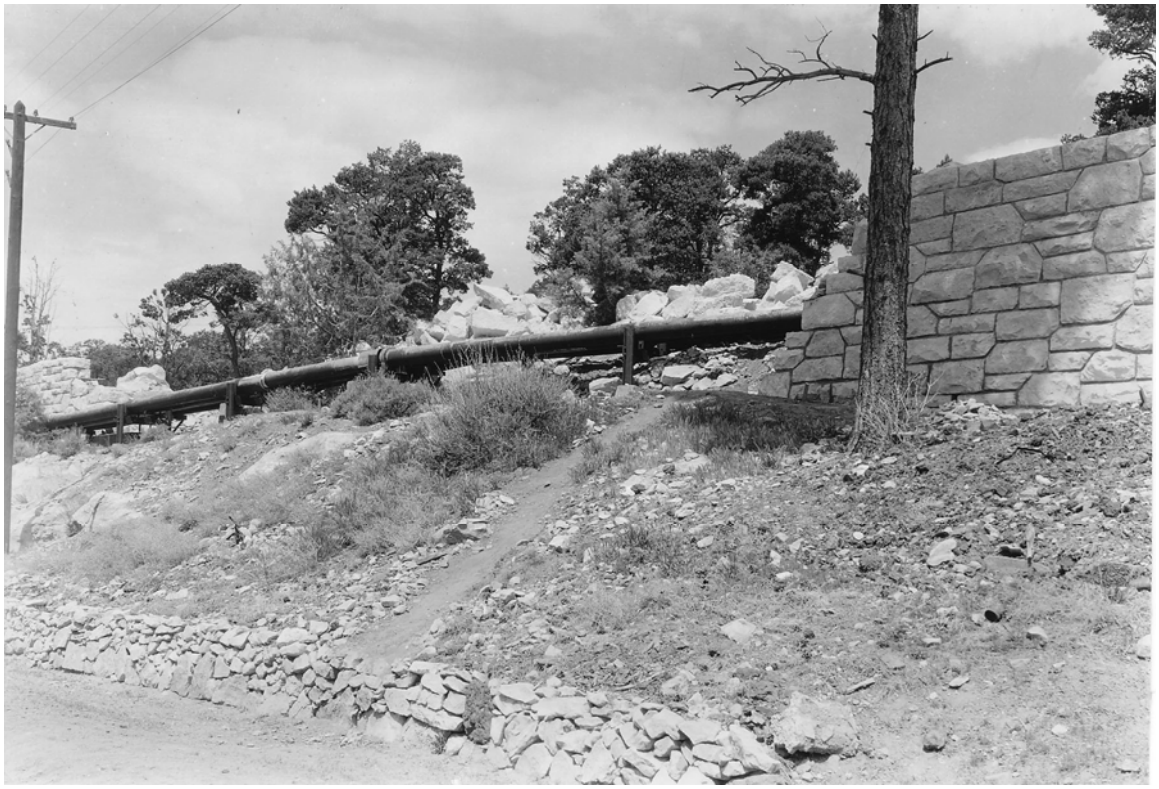


Figure 56: Steam pipes through wall leading to Bright Angel Lodge, 1935, GRCA 6172.



Figure 57: Telephone and transformer house near Bright Angel Lodge, ca. 1936, GRCA 9943.



Figure 58: Trench to Old Superintendent's Residence, GRCA 29870.



Figure 59: Gas and oil tanks during construction, 1936, GRCA 9257.



Figure 60: Gas and oil pump during construction, 1937, GRCA 1937 415-157.



Figure 61: New coal and wood shed behind El Tovar, 1938, GRCA 9634.



Figure 62: Water cooling tower, 1937-38, GRCA 3259.



Figure 63: Both water cooling towers, 1953, GRCA 1953_report_14-15.



Figure 64: Transformer and Battery Building, 1953, GRCA 2571.

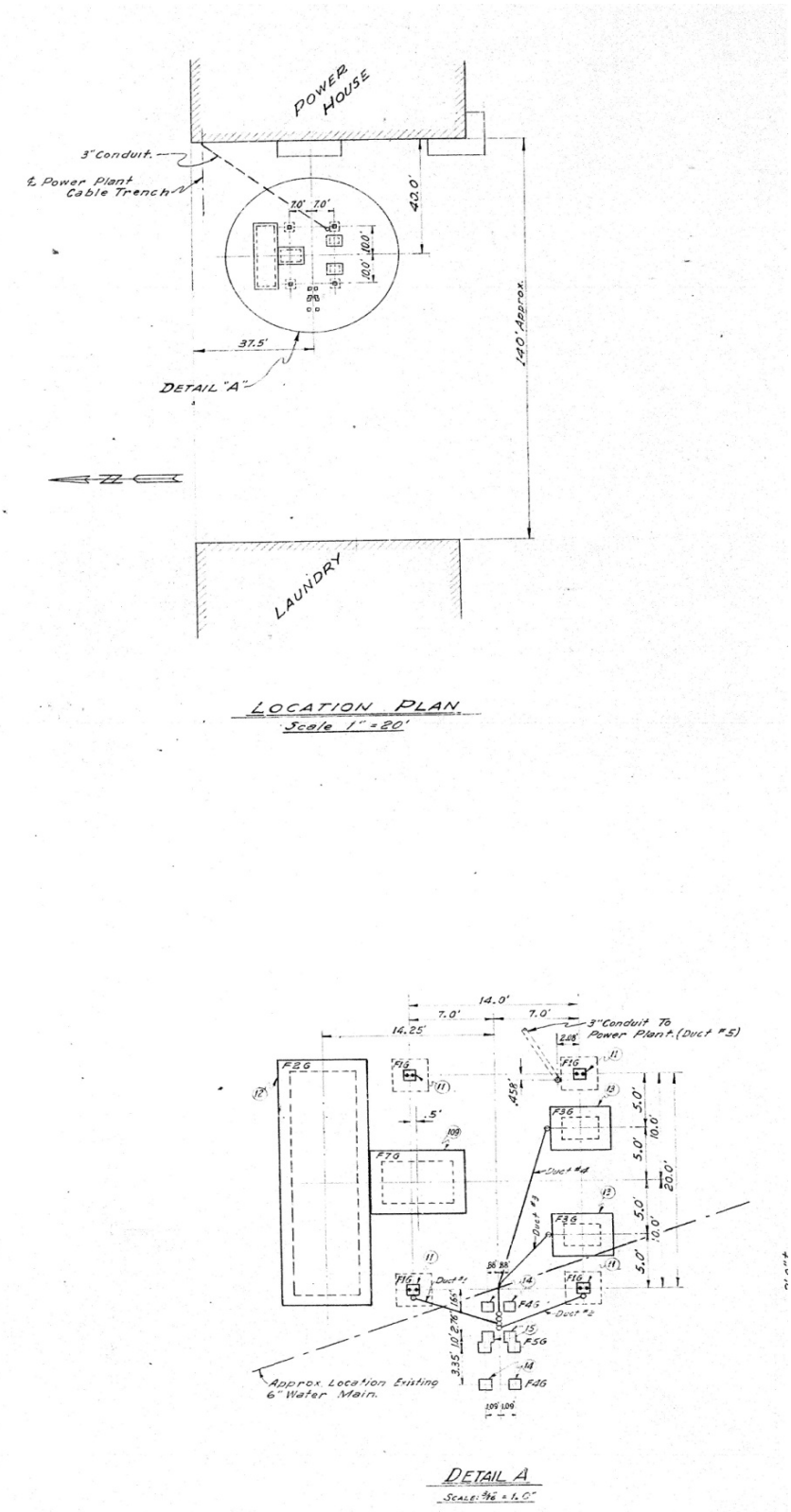


Figure 65: From APS Substation Plan, Drawing No. 113-8697, 1953.



Figure 66: Powerhouse and transformer/substation, GRCA 3249.



Figure 67: Transformer building with steam house addition prior to demolition, ca. 2003, GRCA DSCN0711.



Figure 68: Railroad depot with steam line attachments, 1963, GRCA 41306.

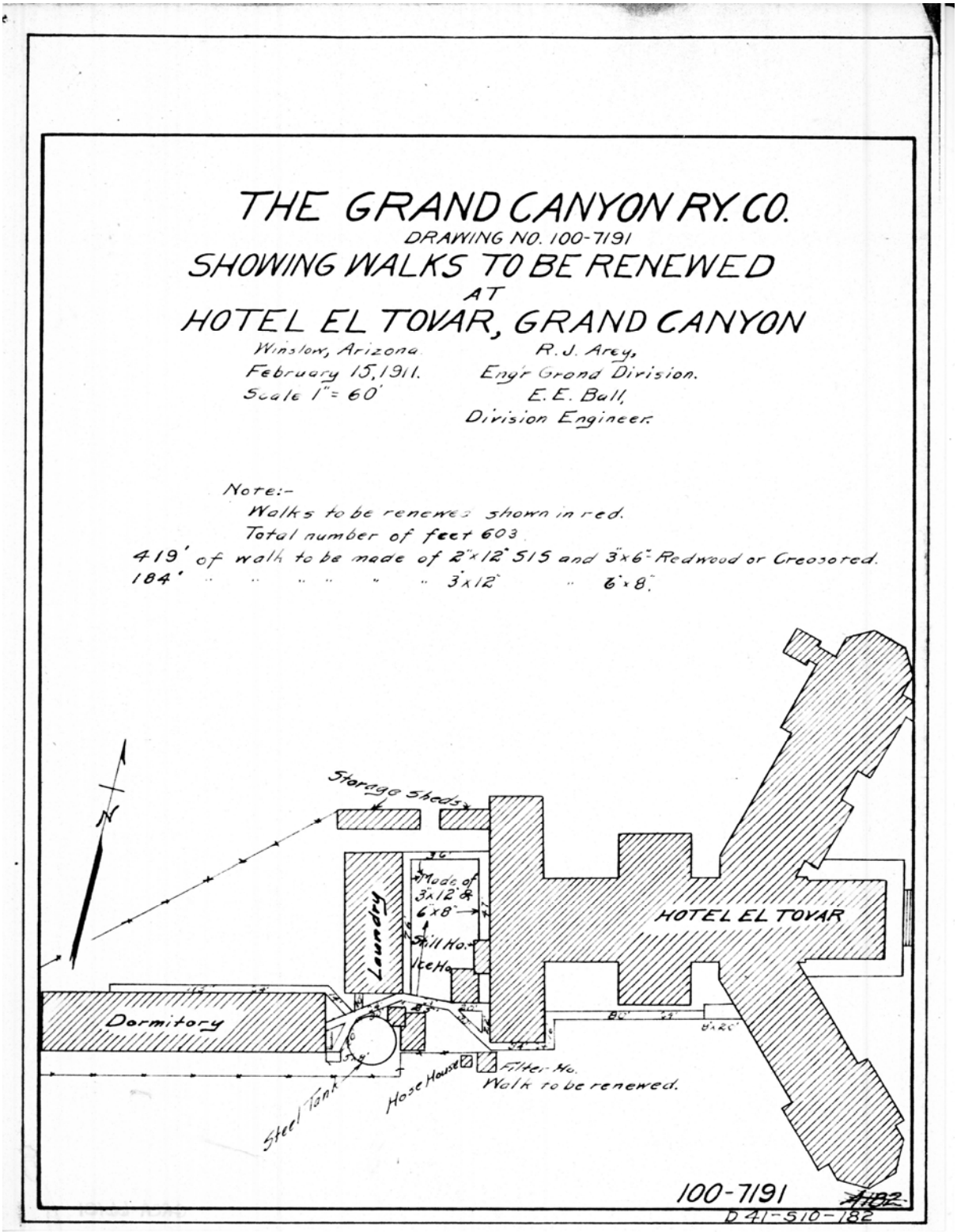


Figure 69: The Grand Canyon Ry Co., El Tovar Ice House, shown 1911, Drawing No. 100-7191, GRCA 66101-37.

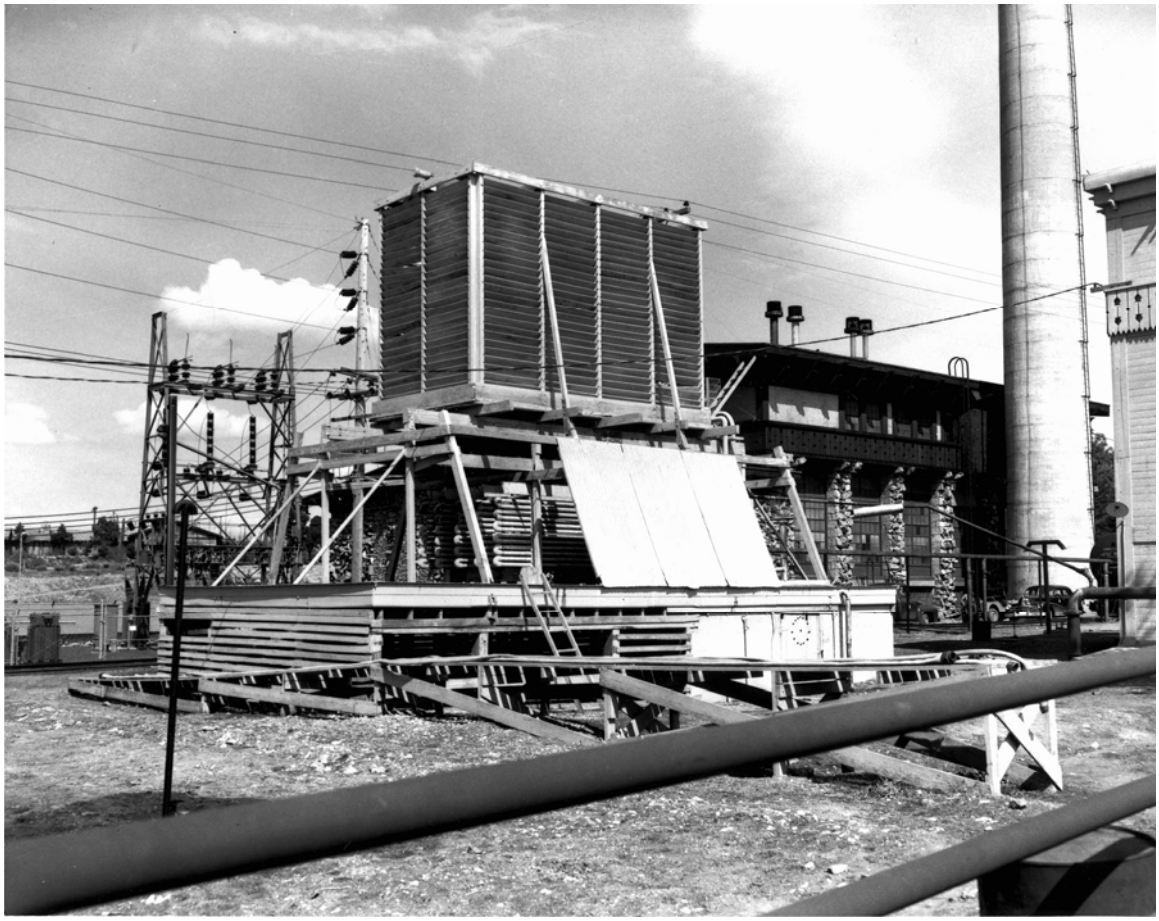


Figure 70: Water cooling tower for ice and refrigeration equipment, 1957, GRCA 3260.

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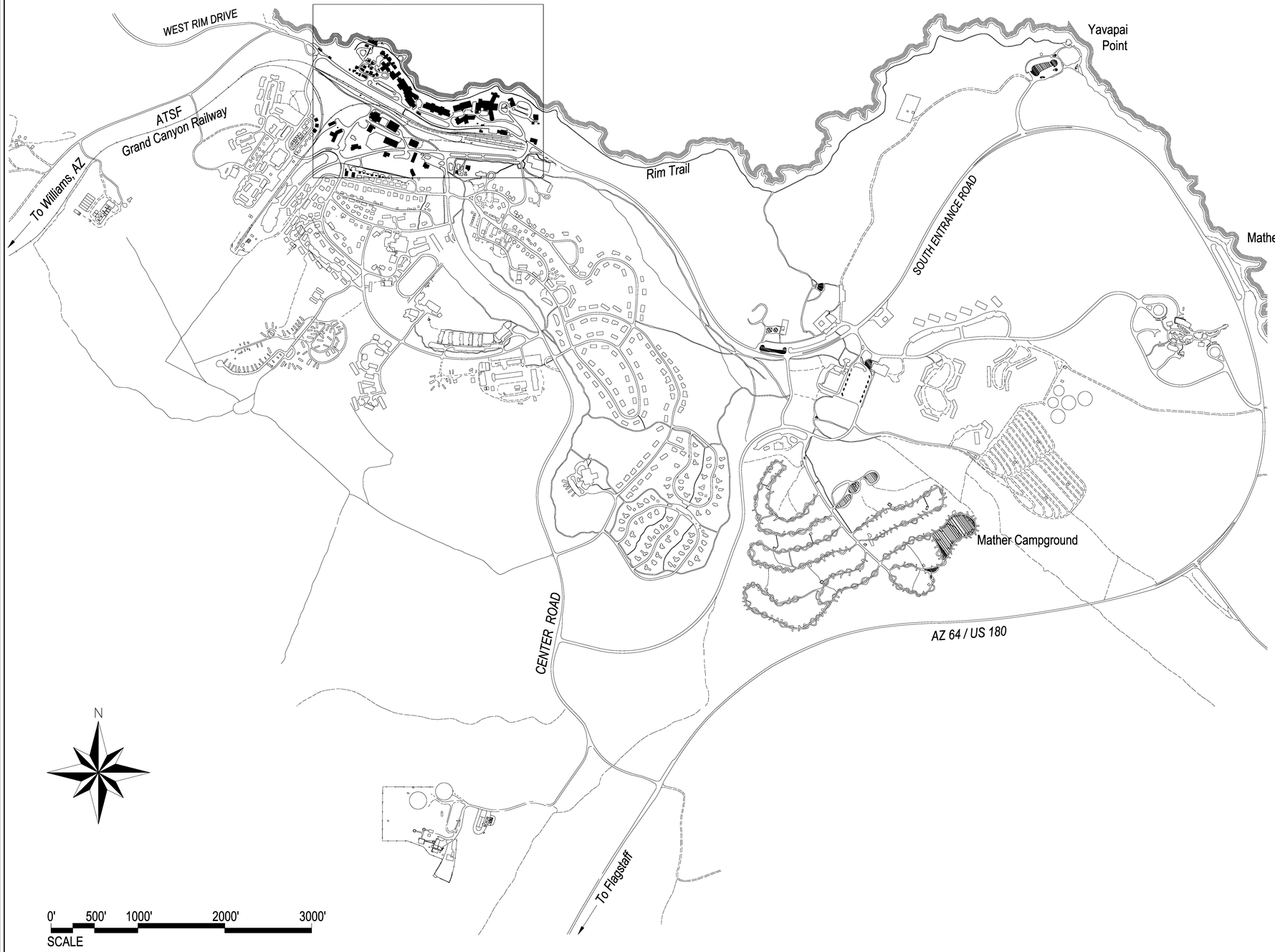
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GRAND CANYON VILLAGE UTILITIES





The Atchison, Topeka & Santa Fe Railway Company (ATSF) was largely responsible for the development of Grand Canyon Village throughout the first half of the twentieth century. The railroad company constructed and owned the majority of the utility infrastructure, as well as buildings, in the village from 1901 to 1954. The ATSF ended its involvement in the tourist industry in 1954 and donated the Grand Canyon utilities to the National Park Service (NPS). The utility system promoted the development of tourism in the park and supported the expanding infrastructure of the village.

The following maps and drawings reflect an inventory of historic utility structures found in Grand Canyon Village in 2006-07. Refer to the HAER historical report and the large format photographs for images of all features noted on the maps.

Documentation of the Grand Canyon Village Utilities was undertaken in 2006-2007 by the Historic American Engineering Record (HAER), part of Heritage Documentation Programs, National Park Service, Richard O'Connor, Chief. The project was conducted for Grand Canyon National Park, Steve P. Martin, Superintendent, under the direction of Amanda Zeman, Cultural Resource Specialist. Field recording and measured drawings were produced under the direction of Christopher H. Marston, HAER architect. Architect interns Dominic Duran and Michael Lee, University of New Mexico, produced the drawings. HAER Photographer Jet Lowe produced the large format photographs. Kate McConnell wrote the draft history, edited for transmittal by Justine Christianson, HAER Historian.

DELINEATED BY: DOMINIC DURAN, MICHAEL O. LEE, CHRISTOPHER H. MARSTON, 2007

GRAND CANYON VILLAGE ENGINEERING STUDY
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

GRAND CANYON VILLAGE

GRAND CANYON VILLAGE UTILITIES
GRAND CANYON NATIONAL PARK
COCONINO COUNTY
ARIZONA

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MAP OF EXTANT UTILITY RESOURCES

*Selected structures mapped May 2007 (Only **bold** sites mapped. For more information on inventory, see Appendix A, p. 80-83)*

I. WATER
1. Cistern
2. Indian Garden Pipeline
3. Pipe chase in Village Loop Road
4. Vault in Bright Angel Cabin complex
5. Verkamp's Hand Pump
6. Kolb Tanks
I. FIRE SUPPRESSION
7. Post Indicator Valves
- **a. Bright Angel Cabin Complex**
- **b. El Tovar**
- c. Colter Hall
- d. Hopi House

8. Bright Angel Lodge Fire Line
II. SEWER
9. Pipe chase in Village Loop Road
10. 10” Government Line
11. 10” Government Line
12. 8” Laundry Bypass
13. 8” Sewer line on north side of tracks
14. Concrete vault and manholes
15. Kolb Sewer Vault
II. RECLAIM
16. Reclaim line trench - nr Powerhouse
17. Reclaim line trench - nr El Tovar
18. Vault southeast of Colter Hall
III. STEAM
19. Mining Shaft (Kolb Tunnel)
20. Pipe chase in Village Loop Road
21. Pipe chase in Village Loop Road
22. Pipe stanchions
23. El Tovar Stone Vault
24. Pipe chase to Supt's House
25. Steam tunnels
26. Bright Angel Cabin Stone Vault
27. Steam lines and risers in rail yard
28. Foundation for steam building
29. Bright Angel Boiler house
30. Verkamp's Generator Building
III. ELECTRICITY
31. Pipe chase in Village Loop Road retaining wall
32. Concrete transformer vault
33. Powerhouse
III. FUEL OIL
34. See sewer, laundry bypass
IV. AMMONIA
35. See steam, pipe chase to El Tovar
IV. BRINE
36. Line to Bright Angel Lodge proper
UNKNOWN USE
37. Vertical pipes - nr ATSF yard stairs

15 Kolb sewer vault
6 Kolb tank wall
KOLB STUDIO
Kolb Tunnel
33
LOOKOUT STUDIO
BRIGHT ANGEL CABINS
PIV 7a
Bright Angel boiler house
29
26 Bright Angel stone vault
VILLAGE LOOP DRIVE
Rail yard foundations
BRIGHT ANGEL LODGE
RIM TRAIL
N
37 Vertical pipes
STAIRS
21 Pipe chase
31
THUNDERBIRD LODGE
KACHINA LODGE
EL TOVAR HOTEL
HOPI HOUSE
5 Verkamp's Hand pump
VERKAMP'S CURIOS
COLTER HALL
Pipe stanchions
22
El Tovar stone vault 23
Pipe chase
7b PIV
3
9
VILLAGE LOOP DRIVE
GRAND CANYON DEPOT
30 Verkamp's generator
33 POWER HOUSE
(See Sheet 3-4)
20
35
SUPERINTENDENT'S HOUSE
Pipe chase
24
1 Cistern
27 Rail yard steam risers
SOUTH ENTRANCE ROAD
VILLAGE LOOP DRIVE
VILLAGE LOOP DRIVE
CENTER ROAD
0' 250' 500' 1000'
SCALE

DELINEATED BY: MICHAEL O. LEE, DOMINIC DURAN, CHRISTOPHER H. MARSTON, 2007

GRAND CANYON VILLAGE ENGINEERING STUDY
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

GRAND CANYON VILLAGE UTILITIES
GRAND CANYON NATIONAL PARK
COCONINO COUNTY
ARIZONA

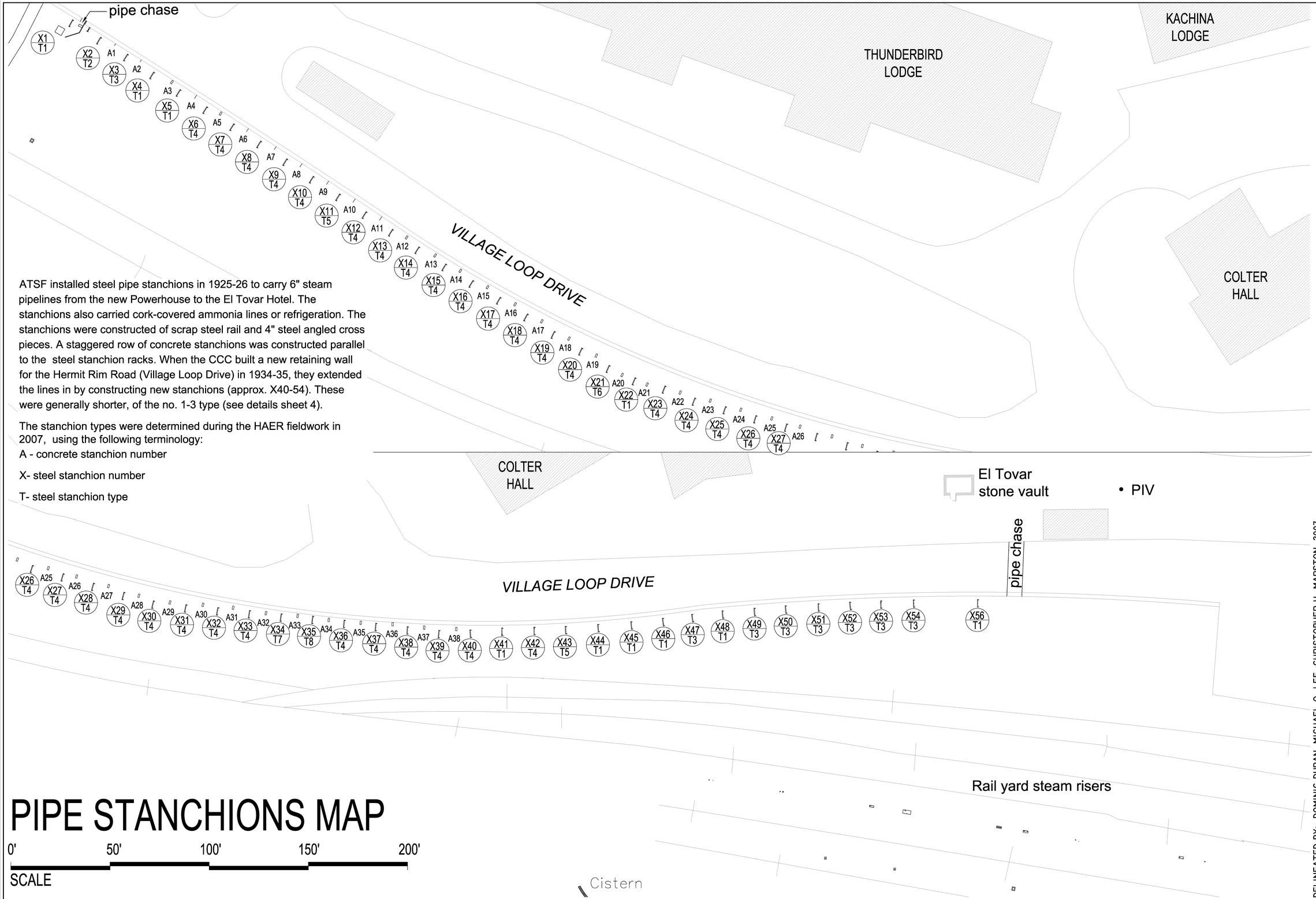
GRAND CANYON VILLAGE

SHEET 2 OF 4

HISTORIC AMERICAN ENGINEERING RECORD AZ-76

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ATSF installed steel pipe stanchions in 1925-26 to carry 6" steam pipelines from the new Powerhouse to the El Tovar Hotel. The stanchions also carried cork-covered ammonia lines or refrigeration. The stanchions were constructed of scrap steel rail and 4" steel angled cross pieces. A staggered row of concrete stanchions was constructed parallel to the steel stanchion racks. When the CCC built a new retaining wall for the Hermit Rim Road (Village Loop Drive) in 1934-35, they extended the lines in by constructing new stanchions (approx. X40-54). These were generally shorter, of the no. 1-3 type (see details sheet 4).

The stanchion types were determined during the HAER fieldwork in 2007, using the following terminology:

A - concrete stanchion number

X- steel stanchion number

T- steel stanchion type

PIPE STANCHIONS MAP

0' 50' 100' 150' 200'

SCALE

DELINEATED BY: DOMINIC DURAN, MICHAEL O. LEE, CHRISTOPHER H. MARSTON, 2007

GRAND CANYON VILLAGE ENGINEERING STUDY
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

GRAND CANYON VILLAGE

GRAND CANYON VILLAGE UTILITIES

GRAND CANYON NATIONAL PARK
COCONINO COUNTY
ARIZONA

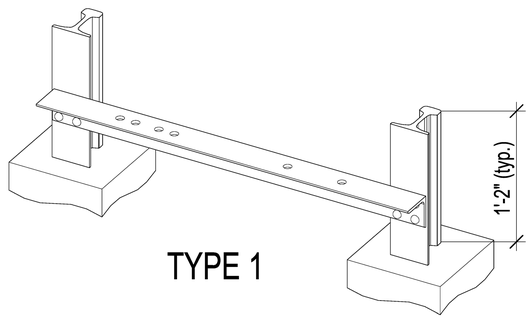
SHEET 3 OF 4

HISTORIC AMERICAN ENGINEERING RECORD
AZ-76

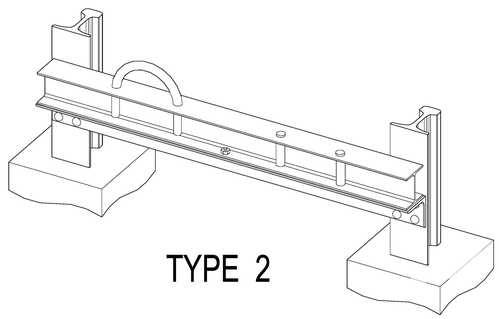
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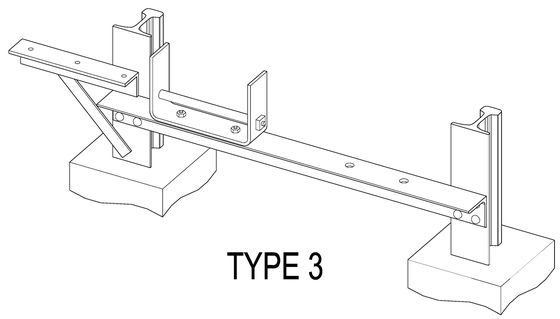
PIPE STANCHION TYPES



TYPE 1

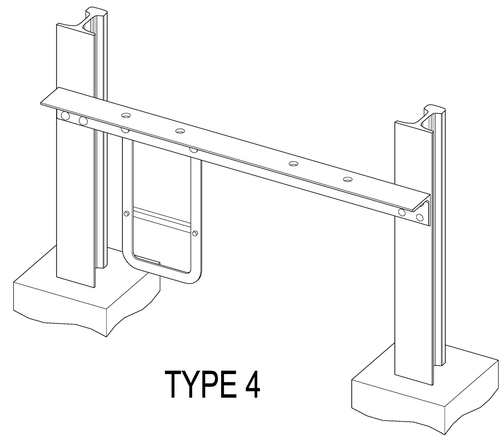


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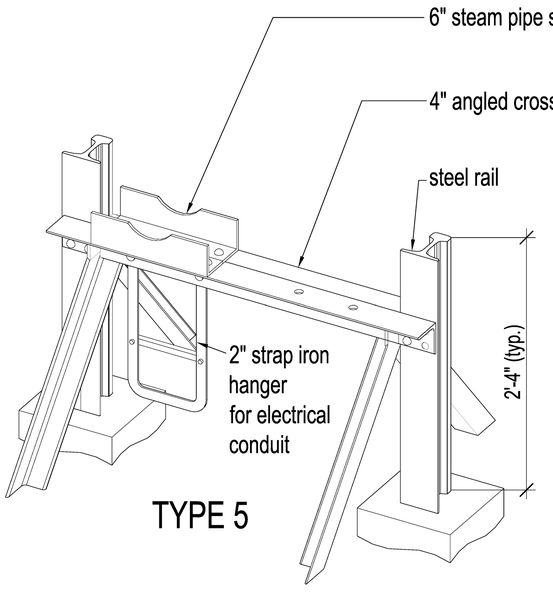
TYPE 3

Type 1-3 are from CCC-era construction (1934-1935)

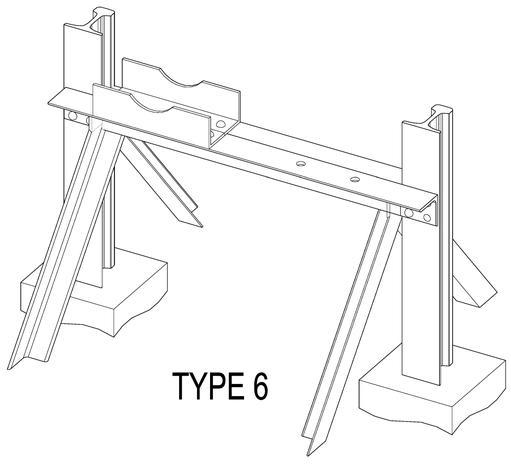


TYPE 4

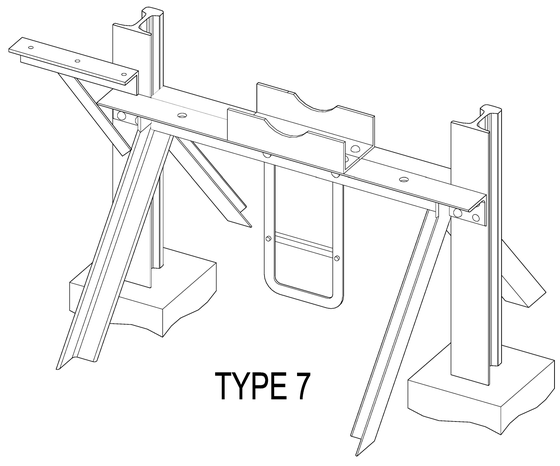
Most common type (1925-1926)



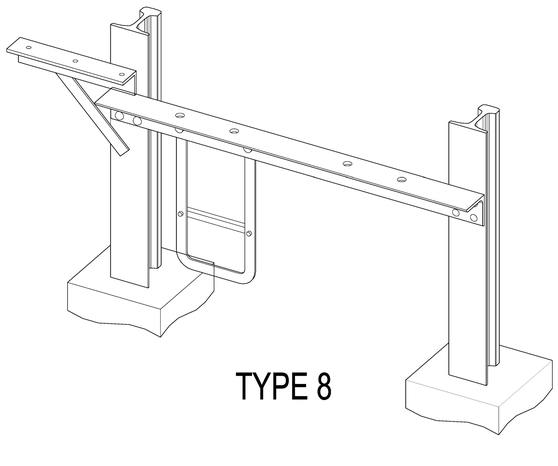
TYPE 5



TYPE 6



TYPE 7



TYPE 8

DELINEATED BY DOMINIC DURAN, 2007

GRAND CANYON VILLAGE
ENGINEERING STUDY
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GRAND CANYON VILLAGE

GRAND CANYON VILLAGE UTILITIES

GRAND CANYON NATIONAL PARK
COCONINO COUNTY
ARIZONA

SHEET 4 OF 4

HISTORIC AMERICAN ENGINEERING RECORD
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HISTORIC AMERICAN ENGINEERING RECORD

INDEX TO PHOTOGRAPHS

GRAND CANYON VILLAGE UTILITIES
Grand Canyon National Park
Grand Canyon National Park
Grand Canyon Village
Coconino County
Arizona

HAER AZ-76

HAER
AZ-76

INDEX TO BLACK AND WHITE PHOTOGRAPHS

Jet Lowe, photographer, 2007

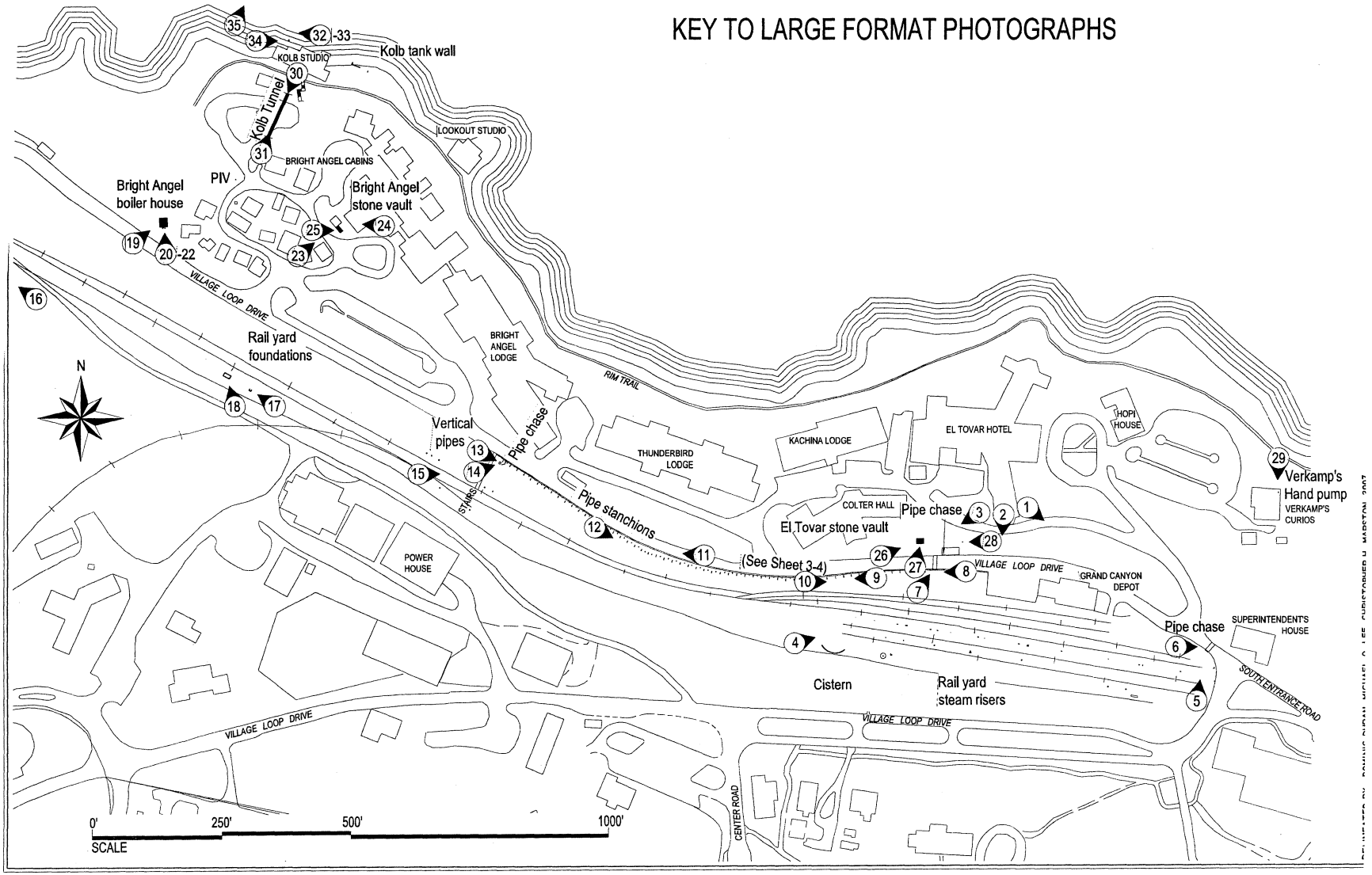
AZ-76-1	View of ATSF rail yard from top of El Tovar, view east. Note superindent's house (distant left) and Grand Canyon rail station (center).
AZ-76-2	View of ATSF rail yard and Grand Canyon Railroad train from top of El Tovar, view SE.
AZ-76-3	View of ATSF railyard. El Tovar stone vault in lower right foreground, view south.
AZ-76-4	Concrete cistern at west end of ATSF railroad yard, looking NE. El Tovar at left.
AZ-76-5	Curved limestone wall at east end of rail yard. Note cut off valves at base of stump in right foreground, and utility tunnel in middle distance, superindent's house at right, looking NW.
AZ-76-6	Utility tunnel at east end of yard. Superintendent's house in background.
AZ-76-7	El Tovar steam tunnel breaker box in foreground. Note El Tovar stone vault in alignment with tunnel.
AZ-76-8	Steel rail stanchions along retaining wall, view SW.
AZ-76-9	Stanchion rails and angle irons, view SW.

AZ-76-10	Detail of stanchion foundation with inscription "E.D.M. 6/17/35", facing N.
AZ-76-11	View of stanchions facing SW. The Grandluxe Express luxury train, formerly the American Orient Express, sits in foreground. Powerhouse in background.
AZ-76-12	Stanchions at pipe chase, facing E.
AZ-76-13	Yellow steam and electrical pipes across from Bright Angel Lodge. Note control valve to right of control box, view E.
AZ-76-14	Steam or water connection with remnant of concrete basin in foreground. Pipe connection located approximately 6' east of metal stairs leading to Bright Angel Lodge. Dry laid retaining wall in background.
AZ-76-15	Steam or water connection near Bright Angel Lodge stairs.
AZ-76-16	"Shower head" water connection for servicing railroad locomotives, perspective view looking NW across ATSF railyard.
AZ-76-17	Western end of ATSF rail yard with remnant of rail spur and dumping location. Concrete vault foundation in foreground. Stone foundation and wood foundation in background.
AZ-76-18	West end of rail yard where dump area presumably stood. Foundation wall and pipes in foreground. Wood foundation in background with railroad tracks beyond.
AZ-76-19	South and west elevations of Bright Angel boiler house. Red Horse log cabin visible in background.
AZ-76-20	Front elevation of Bright Angel boiler house.
AZ-76-21	Front elevation of Bright Angel boiler house, with boiler visible inside.
AZ-76-22	Bright Angel boiler house. Detail of Crane boiler.
AZ-76-23	Bright Angel stone vault, with HAER field team members Dominic Duran, Christopher Marston, and Michael Lee (l to r).
AZ-76-24	Perspective of Bright Angel stone vault, view south, with HAER field team measuring (Michael Lee and Dominic Duran foreground, Christopher Marston rear).

AZ-76-25	Detail of Bright Angel stone vault, containing condenser, Hoffman condensation pump, Jennings vacuum heating pump, and misc. pipes and valves.
AZ-76-26	Perspective of El Tovar stone vault, with El Tovar in background.
AZ-76-27	Interior of El Tovar stone vault.
AZ-76-28	Crane CU-1927 yellow PIV. Valve located east of El Tovar stone vault.
AZ-76-29	Cistern pump at Verkamp's Store.
AZ-76-30	Exterior view of north end of Kolb tunnel, looking south.
AZ-76-31	Interior view of Kolb tunnel.
AZ-76-32	Kolb sewer vault, view of lower half with stone facing and two protuding valves.
AZ-76-33	Kolb sewer vault, view of top two inlet pipes, showing concrete vault and stone facing.
AZ-76-34	Kolb drop box for sewer system. Perspective looking east.
AZ-76-35	View of Grand Canyon from the Bright Angel trail, near north end of Kolb tunnel, looking north.

MAP OF EXTANT UTILITY RESOURCES

KEY TO LARGE FORMAT PHOTOGRAPHS



HAER AZ-76 (Page 4)

et Lowe 6 70

HAER No. AZ-71-A


GRAND CANYON
GRAND CANYON
HAER No. AZ-96-2

E. Lowe G. '73

HABS No. AZ-76-3



HAER, Ariz., 26-


HAER No. AZ-26-5


HAER No. AZ-76-6


HAER NO. AZ-74-7





HAER No. AZ-76-10




ROCKY MOUNTAIN

ellowe 6 17
JAN

ellowe G 19

HAER No. AZ-26-14

el Lowe G
83




HAER No. AZ-76-16


HAER NO. AZ-76-17


HAER No. AZ-96-18


HAER No. AZ-76-19


HAER No. AZ-76-A-0
Joel Love G 78

HAER No. AZ-76-21



HABR. No. AZ-76-22.




HAER No. AZ-76-23


HAER No. AZ-76-ZH

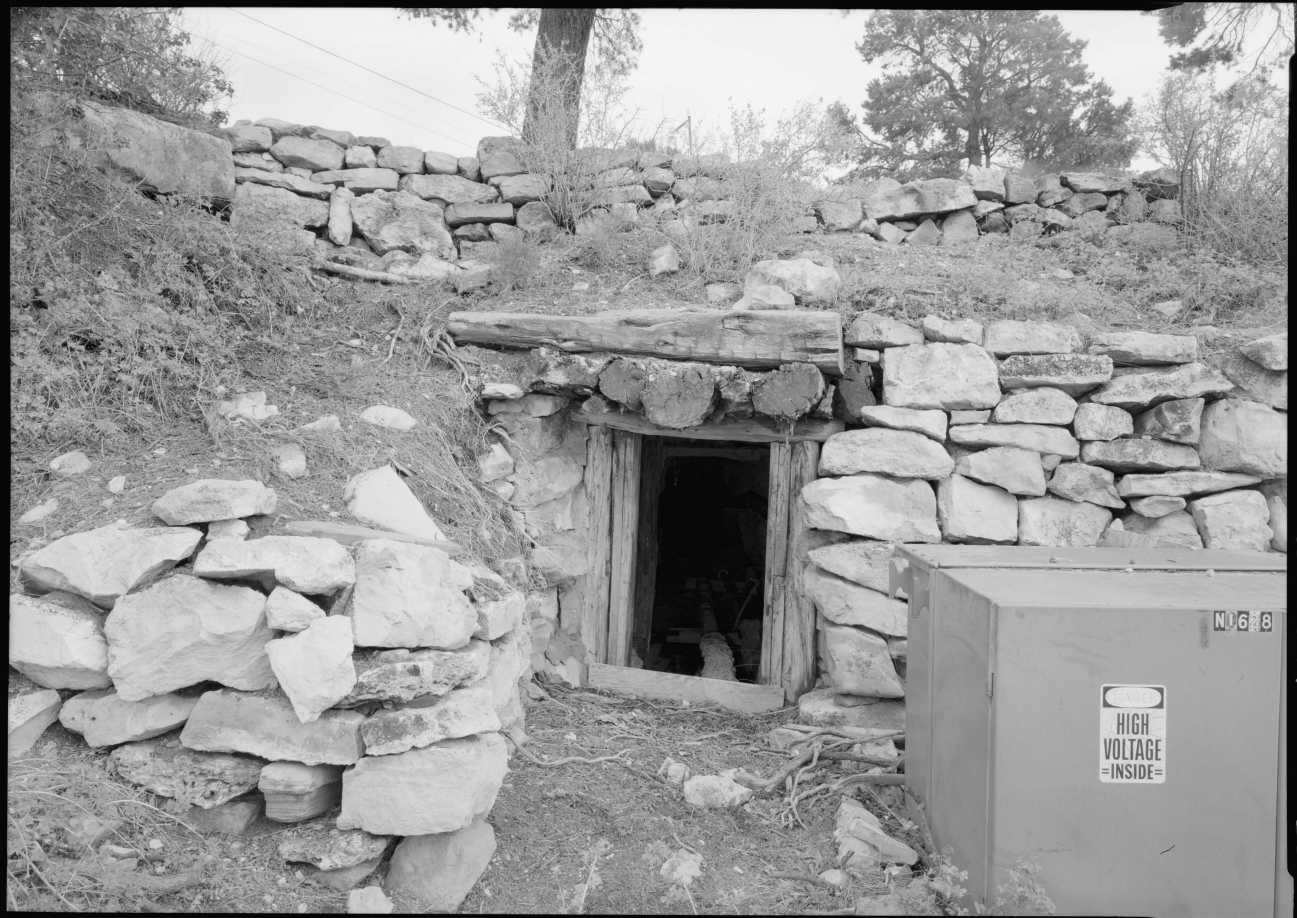

HAER No. AZ-76-25

HAER No. AZ-76-26


et Lowe
HAER G 10




HAER No.AZ-76-29
Jet Lowe
HAER G-106


HIGH
VOLTAGE
=INSIDE=

HAER No. AZ-76-31

T. Lowe
HAER G 98

HAER No. AZ-76-32

HAER No. AZ-74-43

HAER No. AZ-76-34



HAER No. AZ-76-35