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Glen Canyon Unit

The Glen Canyon Unit, located along the Colorado River in north central Arizona and south central Utah, is one of the more geographically isolated, largest, and most expensive reclamation units ever constructed by the Bureau of Reclamation. It took nearly eight years for crews to top the dam at its height of 710 feet, and another two years for completion of the powerplant. One of four major storage reservoirs along the Colorado and its tributaries as part of the Colorado River Storage Project Act of 1956 (or CRSP), the dam impounds 27,000,000 acre feet—nearly the storage capacity of Hoover Dam—and generates enormous amounts of hydroelectric power for the West.

In addition to its remarkable construction, Glen Canyon Dam is interesting because of its rich and controversial social and political history. This is in large part because Glen Canyon Dam means different things to different people. To people who reflect a postwar environmental ethic, the dam and the flatwaters of Lake Powell unnecessarily defile a canyon with striking beauty and serenity, but others believe, with Commissioner Floyd Dominy, that Lake Powell is the “Jewel of the Colorado” and a needed resource for storing water and producing electric energy. The differences in perspective have resulted in much conflict and continue to the present day. Few, if any, large-scale reclamation projects have generated as much controversy and emotion as Glen Canyon Dam and its reservoir, Lake Powell.

Project Location

The canyon country of the Colorado Plateau is about as remote as you can get in the contiguous United States. In the 1950s and 1960s, San Juan County—the county directly east of Glen Canyon in southeastern Utah—had only a few paved roads, and most of these lay on the northern end of the county. The country west of the Colorado River where it flows through Glen Canyon is even more inaccessible than that—a terrain of broken plateaus and barren desert. The region surrounding Glen Canyon is lonely and desolate, with only intermittent signs of human activity.

However remote, this is a majestic and breathtaking place. Clear, dark-blue starlit skies, vast vistas, monumental geologic formations—the project construction engineer of the Glen Canyon Unit, L. F. Wylie, called it “an area unmatched for pure scenic beauty”:

The long geologic evolution of the Colorado Plateau has produced colorful valleys punctuated by towering monoliths, craggy-toothed edges of eroded monoclinical folds, domes, and uplifts—all occasionally shattered open by gorges gouged hundreds of feet deep into the earth. Nature’s paintpot has splashed the panorama with colors ranging the spectrum from Vermillion Cliffs to chalk-white Castle Rocks, with changing colors each hour of the day—at night turning into a weird, spectral goblinland under moonlight.ⁱ

Such a description is hardly hyperbole—the region cut by the flow of the Colorado today boasts an international reputation and a half dozen national parks and numerous national monuments.

The real centerpiece of the Colorado Plateau is the river itself, 2000 miles long, originating in its tributaries in Colorado, New Mexico, Utah, and Wyoming and reaching all the way to Mexico. Over many stretches of the river—notably through Cataract Canyon and the Grand Canyon—the flow is rough, but through Glen Canyon the river quite calm. River

afficionados laud its “serene” and “placid” qualities (its mild elevation drop is the reason a large reservoir at Glen Canyon would extend 180 miles upstream), but they also point out that its current is deceptively strong. As river runner Dick Sprang said, “The Colorado in Glen always found a channel through the broad areas of the river where many underwater sandbars existed. You really had to be on your toes and a darn good water reader in low water stages to find the channel through that morass of barely-below-the-surface sand bars, and when you did find that channel the river was swift in there and extremely powerful.”ⁱⁱ

The site of the dam, 15 miles north of Lee’s Ferry, Arizona, is a narrow gorge cut by the Colorado, its canyon walls and foundation made of sandstone and shale.

Historic Setting

Human occupation of north central Arizona dates back to prehistoric times when nomadic and semi-nomadic bands of hunter-gathers roamed through the region. Occasionally these people planted crops along the streams and rivers of the area, but the success of their agricultural endeavors were less than certain in this desert country. The Fremont and Anasazi farmed on a small scale in the region but were gone by 1300 A.D., probably due to drought or war. Navajo and Hopi Indians either lived or visited the region, the latter sometimes making religious visits to Navajo Mountain region, though it is unlikely that they made forays into the canyon before the 1800s.ⁱⁱⁱ

Generally, the canyon and the surrounding region remained uninhabited, formidable barriers through harsh and unforgiving land, even for indigenous peoples who sometimes

inhabited the river bottom. The earliest white people who stumbled upon the canyon and the Colorado passed through as quickly as possible. The first Europeans to see the canyon were probably Francisco Atanasio Dominguez and Silvestre Velez de Escalante, Franciscan Fathers who in 1776 set out from Santa Fe to forge an overland route to the California missions at Monterey. By fall, due to early snowfall, the Catholic party decided to turned back near Cedar City in a southeasterly direction. The Spaniards made two unsuccessful attempts to cross the river at what is now Lee's Ferry in Marble Canyon. So they traveled upstream and, at the mouth of Padre Creek, found a suitable place to cross. The descent to the river was steep, so they carved steps into the stone to enable the company and pack animals to descend down the steep slope. For many years, before John D. Lee established his ferry in 1872, the site known as the Crossing of the Fathers was sometimes used by Indians, Mexican traders, and American fur trappers.^{iv}

The famed, one-arm geologist and explorer John Wesley Powell made two trips down the Colorado River, the first in 1869, and again in 1871-72. Powell and his men welcomed the mild currents through Glen Canyon after a tiring and harrowing ordeal through Cataract Canyon, but the party spent little time in the canyon. Some of their place names stuck: Dirty Devil River, Music Temple, the Henry Mountains, and Glen Canyon itself. Intrigued with the geologic formations and historic artifacts of Glen Canyon, Powell cached one of his boats near the Dirty Devil to be used in 1872 for a scientific survey.^v

Mormons, the religious group which created an empire in the inter-mountain West, also passed through. Jacob Hamblin forded the Colorado at the Crossing of the Fathers en route to

preaching the gospel to the Hopis. In the late 1870s, Brigham Young and his successor, John Taylor, set in motion the first Mormon settlement in southeastern Utah and northern Arizona. A company of hardy pioneers—about 250 people including women and children—set out from the small community of Escalante, Utah, in a southeasterly direction, skirting the Kaiparowits Plateau to their destination at Montezuma Creek on the east side of the Colorado. The company crossed the Colorado at a place now known as Hole-in-the-Rock, where it took six weeks in late 1879 and early 1880 to construct a road through a steep, narrow channel and to lower the wagons one by one down to the river bottom. In all, their travels took six months, finally ending when it was decided to settle at what they would call Bluff City on the San Juan River.^{vi}

Mormons established several settlements in the southeastern corner of the Territory of Utah, but not until the late nineteenth century were attempts made to establish permanent or semi-permanent settlement in Glen Canyon. Cass Hite set up a crude shelter in the canyon in September 1883. Hite found what he was looking for—gold—and sparked a small-scale gold rush that brought a few hundred miners into the region. The historian C. Gregory Crampton estimates that “hundreds, perhaps thousands, of men prospected the whole length of Glen, the canyons above and all the tributaries in the decade between 1890 and 1910.”^{vii}

A few of these were starry-eyed entrepreneurs who went to enormous expense and effort to develop the resources of the canyon. In 1889, for instance, Robert B. Stanton looked into the possibility of building a railway from Grand Junction, Colorado, to the Gulf of California through the broken canyon country of the Colorado Plateau. For two years he even surveyed the land, but investors refused to back his enterprise. So in 1897 he established the Hoskaninni

Company, named in honor of a Navajo chief, and built a dredge—but operations failed, lasting no longer than a few months in 1901. Another man, Charles H. Spencer, established an operation at Lee's Ferry where he attempted to extract gold from Chinle shale nearby. One problem was that he needed fuel to power the steam pumps used to extract the gold. So he constructed a large steamboat, ninety-two feet long and twenty-five feet wide, that he would use to ferry coal deposits from the mouth of Warm Creek to Lee's Ferry—a distance of twenty-seven miles. But his efforts were short lived after the steamer was found to be too difficult and impractical to operate. Spencer abandoned his gold operation in 1912.^{viii}

The mining rush lasted only a short period. Some miners, traders, and ferrymen like Stanton and Arthur L. Chaffin maintained a lifetime interest in Glen Canyon, but most left the country, never to return. In the 1920s some oil prospecting and drilling took place; in the 1950s, with the onset of the uranium boom in southeastern Utah, prospectors staked out claims, but few of these were within Glen Canyon. Over time, recreation became the dominant human activity in Glen Canyon, but its development was slow. Some natural formations—like Natural Bridges, set apart as a national monument by Theodore Roosevelt in 1908, and Rainbow Bridge, which received monument status in 1910 by William Taft—were well known but highly inaccessible. River running as a sport did not catch on until the 1930s, though before then explorers, prospectors, and surveyors would run the river for fun. Bert Loper, a boat man for the U.S. Geologic Survey during trips down the San Juan in 1921 and the Green River in 1922, later took trips down in the 1930s. Other runners included Ellsworth Kolb, Harry Aleson, and Dave Rust.

Beginning in 1948, Boy Scout groups made annual pilgrimages down the Colorado. And no one rafted it more times than Art Greene and Ken Sleight.^{ix}

River runners knew better than anyone that this was not virgin land; everywhere, on canyon walls and river bottoms, were poignant reminders of a rich history—Moki Indian remains, rock steps carved by the Dominguez-Escalante party, inscriptions left by Powell's men on the walls of Music Temple, the wagon ruts forged at Hole-in-the-Rock by hardy Mormon pioneers, the partial remains of Spencer's ninety-two-foot steamboat.^x Many people would come to lament the loss of these human remains, just as they would the canyon. Reclamation officials did what they could to help record the history before it was lost. But salvaging the history of the canyon before the dam went up was secondary to the primary concern at hand: building a dam, a storage reservoir, and a hydroelectric plant.

Project Authorization

Congress authorized Glen Canyon dam on April 11, 1956, with passage of the Colorado River Storage Act, but interest in a dam at Glen Canyon dated back more than three decades. The long road to authorization reflects the prime location of Glen Canyon as a site for a large-scale Reclamation project as well as the controversy that it engendered for technical and aesthetic reasons. The first recognition of Glen Canyon as a possible site for a dam was probably in 1916 by E. C. LaRue, a hydrologist working for the U.S. Geological Survey. In 1921, the USGS teamed up with the Southern California-Edison Company to conduct several surveys along the Colorado as far south as Lee's Ferry. One was headed by LaRue, the other by

Kelly Trimble, a topographic engineer with the USGS.^{xi} The Reclamation Board of Engineers looked at two sites, one four miles upstream from Lee's Ferry and one nine miles from it. The survey crews even did some drilling into the sandstone, but not very deep. Their main concern was the strength of the rock, especially when wet. As the four-man team reported, "[the sandstone] crumbles under shock, such as that of ordinary blasting, and small fragments can be crushed to sand between the fingers." High evaporation was another cause for concern.^{xii}

The Colorado River Compact of 1922, which evenly divided the waters of the Colorado and its tributaries between the so-called upper (Colorado, New Mexico, Utah, and Wyoming) and lower (California, Arizona, and Nevada) basin states, specified construction of a big dam somewhere along the Colorado. Californians wanted it in Boulder or Black Canyon, while Arizona Senators and others like E. C. LaRue wanted it in Glen Canyon. For various reasons, Black Canyon was considered the superior site. Reclamation reports in 1920, 1921, 1924 said as much, while its 1924 report of Glen Canyon was less positive.

Having lost the battle for the first big dam on the Colorado, Arizonans devised other schemes to channel the waters of the Colorado to farms and cities of their home state. In 1922, George H. Maxwell had a "Mad Man's Dream" of building a major diversion canal into Arizona. Fred T. Colter's plan for irrigating the agricultural land of central Arizona was similar to that of Maxwell, but his position was more resolute. Primarily responsible for Arizona's rejection of the Colorado River Compact, believing that his state had sole proprietary rights to the waters of the Colorado, Colter called for the construction of a reservoir above Lee's Ferry with a storage capacity of sixteen million acre-feet. Water could then be conveyed through a delivery system

nearly 150 miles long to agricultural lands in central and southwestern Arizona. Under Colter's plan, six million acres of land would be irrigated by transported Colorado River water.^{xiii}

The proposal to plug Glen Canyon may have been deferred, but it remained very much alive in the minds of some. Reportedly, in 1943, an army engineer revived the idea of a dam in Glen Canyon before a committee of the Arizona State legislature. The dam would cost upward of \$800 million. Senator James Babbitt feared the dam would flood Rainbow Bridge National Monument, but he agreed it would "be a wonderful thing for our State if water could be brought into Arizona from the Colorado River by means of the Glen Canyon-Verde tunnel"—a project that had been partly surveyed.^{xiv} This idea piqued the interest of influential people like Arizona Senator Carl Hayden and the caution of people like Robert Sterling Yard of the Wilderness Society. Though taking no part, Reclamation officials acknowledged that investigations were under way but issued the assurance that it was highly unlikely the project would be undertaken "in the near future."^{xv}

But with the war at an end, Reclamation made development of the Colorado River a top priority. In 1946 the Bureau of Reclamation sponsored and prepared a major publication on the Colorado River—dubbed the "blue book"—which identified 134 potential reclamation sites in the Colorado River Basin. Glen Canyon made the list. The "blue book" located the proposed site four miles upstream of Lee's Ferry, with an estimated price tag of over \$100 million—as much as Animas-La Plata in Colorado but less than a proposed dam in Dark Canyon, also along the Colorado, 186 miles upstream of Lee's Ferry.^{xvi} Also in the postwar era, the 80th Congress appropriated more money for reclamation than any other Congress had before. Moreover, the

Republican platform in 1948 called for the construction of a dam at Glen Canyon. As one Reclamation official wrote, “That structure is one which we believe will inevitably be needed in the not too distant future.” First on the list would be at Bridge Canyon within the geologic boundaries of the Grand Canyon in northern Arizona, though not within the boundaries of Grand Canyon National Park, then ones at Echo Park and Glen Canyon.^{xvii}

As it turned out, the proposed dams at Bridge Canyon, Echo Park, and Glen Canyon would all come under heavy cross-fire from conservationists who reflected a postwar environmental ethic. None generated more determined opposition than Echo Park, which would have flooded parts of Dinosaur, a little-known national monument on the eastern edge of Utah near Vernal. David Brower, executive director of the Sierra Club, and Olaus J. Murie and Howard Zahniser of the Wilderness Society, initiated a large-scale wilderness campaign that brought national attention to little-known Dinosaur National Monument. Wallace Stegner wrote the text of a tract, *This is Dinosaur*, which, when published, contained full-page color photos and reached the desk of every congressman. Conservationists during the late Forties and early Fifties put their whole hearts and souls into the campaign on a scale unparalleled since the fight over Hetch Hetchy.^{xviii}

Mark Harvey argues that people took interest in Echo Park not necessarily to protect wilderness but to protect a venerated park system, which stood at the core of conservation. Thus, Dinosaur National Monument and the Echo Park became a “symbol of wilderness” because it was part of the park system, though the obscure Glen Canyon was probably no less majestic. Conservationists convinced Congress to insert a proviso in the Colorado River Storage Project (CRSP) that “no dam or reservoir constructed under the authorization of this Act shall be

within any national park or monument.” A major victory for the park system and conservation, this proviso nonetheless reinforced the notion that only land partitioned with boundaries and established by Congress as national parks was worth saving. The fight over Echo Park also reflected a growing rift that had developed between the National Park Service and its “sister” agency, the Bureau of Reclamation.^{xix}

When the dust settled over Echo Park, and after much deliberation and some objections, Congress authorized the CRSP in April 1956. The Glen Canyon Unit was one of four major projects, but it was by far the largest and most expensive—a “cash register” that would finance the other three and several smaller participating projects. These were mostly located in western Colorado, thanks to the efforts of Wayne Aspinall, the Colorado congressman and chairman of the House Interior and Insular Affairs Committee, and shared in the power revenues of the four main CRSP units, using those revenues to repay project development costs. Congress authorized additional participating projects in 1964 and 1968.^{xx}

The Glen Canyon project—nor any of the others, for that matter—was never meant to be a large-scale irrigation project. It would store upwards of 34 million acre feet of water, but little of that would water the thirsty crops of agriculturalists living in the high desert. Even the water that did would be heavily subsidized; as C. B. Jacobsen, chief of hydrology of Reclamation, told the Congressional committee, “The [upper basin] farmers can’t pay a dime, not one dime.”^{xxi} Instead, the dam’s major purposes were to store water for future use by the lower basin states and provide hydroelectric power to a booming West. The plan resonated with westerners and easterners alike: the dam would not only ensure that the upper basin states got their fair share,

but it would pay for itself—that is, the sale of hydroelectric power would, in time, cover the costs of construction.

There were likely several forces that contributed to passage of CRSP and authorization of the dam at Glen Canyon. Marc Reisner has argued that eastern politicians did not oppose the project because they wanted projects of their own to pass committee.^{xxii} Moreover, it has become almost lore that David Brower “sacrificed” Glen Canyon for Echo Park. Brower did participate in back-door negotiations and suggested that Reclamation heighten the dam at Glen Canyon to compensate for the lost storage at Echo, but there were other forces at work as well. As we have seen, plans to develop the Colorado had been long in the making, and Reclamation had always planned to build a dam at Glen Canyon, regardless of the outcome of the Echo Park debate.^{xxiii} But whatever forces were at work, Brower blamed himself for losing Glen Canyon. “Glen Canyon died, and I was partly responsible for its needless death. Neither you nor I, nor anyone else, knew it well enough to insist that at all costs it should endure. When we began to find out it was too late,” he lamented in his Forward to a book published by the Sierra Club, *The Place No One Knew*.

As would be pointed out, the Sierra Club’s Glen Canyon obituary was a misnomer. If Brower made his home near the Sierra Mountains in California and knew next to nothing about the canyon country of the Colorado Plateau, he was mistaken that no one knew the area well enough to insist on its preservation. But the people who could claim familiarity did not hold any political clout. As a young man in 1940, Barry Goldwater journeyed down the river and fell in love with it immediately.^{xxiv} The famed writer Wallace Stegner rafted that stretch of the Colorado in 1947 and later reported to Brower that

“[Echo] doesn’t hold a candle to Glen.” But generally the people who knew Glen had as yet attracted no attention nationwide. Before 1956, perhaps only a few hundred people had boated the river at Glen Canyon. Not every crevice and side canyon had been explored, but to people with an attachment to the area, this was the one of the tragedies: these unknown places would be lost forever under the lapping waters of a manmade lake.

Before 1956, there were a handful of people who protested Glen Canyon Dam, but it was much less vociferous than had been the fight over Echo Park. For one, Glen Canyon did not enjoy official designation as a national park or monument. Also, Brower did not make Glen his crusade as he had Dinosaur, in part because he had already given his acquiescence to the dam and in part because it was a forgone conclusion that the dam would be built. Not until after the project had been authorized did most conservationists put up vigorous opposition, but there efforts were too late. There was never any real debate within Congress or Reclamation to choose another site. Once Congress undid the Echo Park proposal, surveying and construction crews began immediately to prepare for the dam further south on the Colorado.

Pre-Construction

The task to oversee the construction of the dam fell to L. F. “Lem” Wylie, a longtime Reclamation engineer who had worked on Hoover and the All-American Canal, and in Alaska, and Amarillo, Texas, before landing the Glen Canyon position. Within five months of congressional authorization, with plans drawn up by designer Louis Puls, Wylie got to work.^{xxv}

The exact location of the dam site at Glen Canyon was in question right up to passage of the Colorado River Storage Project in 1956. Out of six possible sites, two were in the running—one 4 miles, the other 15 miles upstream of Lee’s Ferry. While Mile 4 site seemed at first most promising, Reclamation engineers selected the latter site for its superior rock foundation and easy access to gravel deposits at Wahweap. The site lay 13 miles south of the Utah-Arizona border, 370 miles upstream from Hoover Dam, and approximately 130 miles north of Flagstaff, Arizona.

The vast majority of land within the borders of the site and what would become Glen Canyon Recreation Area was public land owned by the Bureau of Land Management (BLM). Arizona and Utah owned several sections of school lands; the Navajo people owned the gravel deposits at Wahweap, and a few individuals like Arthur L. Chaffin owned private land in Glen Canyon. In 1958, Congress transferred to Reclamation, with the approval of the Navajo Tribal Council, about 53,000 acres of Indians lands “required for the damsite, townsite, and reservoir area.” The government paid ranchers and miners for the cancellation of grazing permits and mine claims staked in the area, though the majority of the claims—thousands of them—were left unclaimed and terminated.^{xxvi}

In some instances, land owners sold their property only reluctantly. On February 20, 1962, Reclamation approached Don E. Taylor with an offer to buy 120 acres of his father-in-law’s land in the Hall Creek area—an area of about 800 acres of privately owned land in several ownerships. He turned the offer down flat, claiming “he couldn’t buy the poorest B.L.M. or State for Bureau’s offer of approximately \$22 per acre.” Taylor insisted on \$100 per acre—an asking

price Reclamation officials felt reflected what “might be obtained if the parcels are sold for recreational development after the reservoir is formed.”^{xxvii} A similar complaint was raised by Art Greene when he learned that the State of Arizona was to withdraw land he had leased for almost five years near Cameron, Arizona. Green and his family reportedly had “built [their] lives and hopes on these leases,” having supposedly invested almost \$20,000 on improvements, including the building of the Cliff Dwellers Lodge. Both cases were eventually resolved—due to the intervention of senators from Utah and Arizona—but not without considerable controversy.^{xxviii}

Wylie and his men made other preliminary preparations directly following passage of CRSP. In September 1956, Reclamation closed off access to the stretch of water between Lee’s Ferry and Kane Creek, 16.5 miles upstream, “because of serious hazards to boat travel.” (The sign Reclamation placed at the mouth of Face Canyon read: “ATTENTION. YOU ARE APPROACHING GLEN CANYON DAM SITE. ALL BOATS MUST LEAVE RIVER AT KANE CREEK LANDING ONE MILE AHEAD ON RIGHT. ABSOLUTELY NO BOATS ALLOWED IN CONSTRUCTION ZONE. VIOLATORS WILL BE PROSECUTED. U.S. BUREAU OF RECLAMATION”^{xxix}). In mid-October, from his seat in Washington, D.C., 2000 miles away, Dwight D. Eisenhower initiated the first blast at the dam site.

Before construction could begin on the dam, two problems had to be solved—both related to accessibility. The country surrounding Glen Canyon was about as remote as possible. A car could make it to Hite or what would become Hall’s Crossing on a rickety dirt road. Highway 89 was paved, crossing the Colorado just below Lee’s Ferry, but there was no easy way to Glen Canyon, unless rafting is considered easy. Dirt or paved trails formed a giant circle from

northern Arizona and the Navajo Reservation, east into San Juan County, north up through Wayne and west through Garfield and Kane Counties, but there were few adequate trails into the heart of that circle where Glen Canyon Dam was to stand.

Reclamation began immediately to hire contractors to extend U.S. 89 north from Arizona to the eastern rim of the dam site. Another road ran from Kanab, Reclamation's temporary project base, to the western rim of Glen Canyon and was completed in August 1956. For the first few years these two roads were dirt, so access was still not easy, but possible. In short order, the States of Utah and Arizona and the Bureau of Public Roads put up money to help with the road construction. The Utah Highway Department funded a 56-mile stretch of highway linking the western edge of Glen Canyon with Highway 89 at Kanab, Utah. The Arizona Highway Department and the Bureau of Public Roads "modestly" financed part of the highway bridge over the Colorado River as well as a portion of the highway from Highway 89 at Bitter Springs to the dam site. Wylie, project construction engineer, estimated that every mile of road constructed between Bitter Springs, Arizona, and Kanab, Utah, cost on average \$127,000 (this figure included the \$4 million bridge over the Colorado). No railroad ever did lead to the site. Glen Canyon was the first large Reclamation project to do without.^{xxx}

Getting to the site of the dam was one problem, but getting across the 1,300-foot chasm was quite another. From one side of the canyon to the other required a trip of more than 190 miles. It was clear from the beginning of the design process that a bridge across the canyon was essential. Two options existed for spanning the canyon. The first, construction of a roadway along the crest of the dam, proved to be infeasible as that option would not be available until the dam was completed, rendering the crossing of little or no benefit during the construction period.

In addition, the crest of the dam would be over 100 feet lower than the canyon rim, requiring large road cuts and tunnels in the canyon wall. The second option, constructing a bridge across the canyon, was clearly the best solution.^{xxxii}

Reclamation investigated construction of both temporary and permanent structures. To construct a temporary bridge which met requirements would have cost an estimated \$1.8 million. A permanent structure would either be a suspension bridge or a steel arch bridge. The estimated cost of the suspension bridge was just over \$3 million, while the estimate for the arch bridge was about \$2.9 million. Although the cost of the two designs was about the same, the arch offered greater flexibility in design of road approaches and was more aesthetically pleasing. Because of the benefits derived from the early completion of the bridge, specifications were issued ahead of those for the dam, and the construction period was limited to two years.^{xxxii}

A joint venture of Peter Kiewit Sons and Judson Pacific Murphy Company won the bid to build the bridge at just over \$4 million—almost \$1.2 million over the engineer's estimate. One of the first tasks was to erect a 12½-ton capacity cableway used to transport men and equipment from one side of the canyon to the other. The cableway was placed into service in early July. Excavations for the abutments began in mid-March with work on abutment no. 2, on the west side of the canyon. Excavation of abutment no. 1 and the pedestal on the east side began soon after. Excavations for the pedestal and both abutments was completed in May. When workers began excavations for the foundation of the arch on the west wall of the canyon—or skewback no. 2—they encountered a significant problem. The original design called for filling a large cavity just below the skewback with concrete, but investigations revealed that much of the rock was structurally weak and would need to be removed, forcing a re-design of

skewback no. 2. Mountain States Construction Company, in charge of digging the right diversion tunnel for the dam, removed over 9,000 cubic yards of material from the canyon wall. Work crews completed excavations in January 1957. They began concrete placement in early May 1957 and terminated in April 1958.^{xxxiii}

Erection of the steel arch section presented the builders with the problem of supporting the arch sections before they locked mid-way between the two canyon walls. The depth of the canyon prevented the use of false-work for support, requiring instead strong-steel cables for support. If the erection of the arch section was handled by cranes which rested and traveled on the assembled arch sections, the cables would have to support the weight of the cranes as well as the arch sections. If a cableway was used, the tie-backs would only have to support the arch. It was decided to adopt a cableway system, but even this presented some problems. In order for the cableway to set the sections of the steel arch, it would have to be able to provide coverage to the entire area. Engineers designed pivoting towers which could be tilted from side to side to enable the cableway to reach across the canyon.^{xxxiv}

Erection of the arch began in early May 1957 when the first arch sections were attached to the skewback bearing plates on the east canyon wall. When the first two sections of the lower chords were in place, the upper sections were lowered into place and assembled. As the arch moved out from the canyon wall, tie-back cables were attached to each newly placed section and removed from sections which had been previously set in place. Arch erection from the west side began in late-May and followed the same procedure as on the east side. Of course, working 700 feet above the river, safety was a major concern. Nets were installed along the entire length of

the arch sections, saving the life of many workmen. The arch section moved steadily out from the canyon throughout the summer of 1957 and was completed by August.^{xxxv}

Closure of the lower chord section took place on August 8, when the final two sections were allowed to come together and bear the load of the arch. Since the specifications required that the final closure be made when the temperature throughout the arch was fairly constant, the arch was allowed to rest for three days, and on August 11, the final sections were joined together. Final measurements showed that the builders were off their final assembly by only one-quarter of an inch—far less than the eight inches allowed for in the design.^{xxxvi}

In addition to providing road access, Reclamation personnel set out to create a living space for the labor force that began to build the dam. Theodore I. Geurts, a Salt Lake City businessman, proposed locating the townsite on the north side of the Colorado and naming it Canyon City. Neither idea came to fruition. The site chosen was 2 miles southeast of the dam site, named in honor of John C. Page, former Reclamation Commissioner, Page, Arizona.^{xxxvii}

Establishing a city from scratch in the middle of nowhere on wind-blown desert sand was no simple task. The new city first needed temporary shelters, then paved streets, water, drainage, electric power, and other amenities to sustain a permanent community. Creating a city also presented opportunities to businesses and enterprising individuals interested in providing goods and services to the workers and their families. L. F. Wylie offered business permits for \$25.00 per year, renewable by request, for the selling of encyclopedias, portrait sittings, automobiles, furniture, tupperware, laundry services, produce, and many other products, and to businesses ranging from Sears, Roebuck & Co. to the Berrett Music Company. The commercial area was to

be, in Wylie's own words, "a layout of buildings similar to the shopping-center type of development with each individual business erecting its own building on land purchased from the Bureau of Reclamation." J. C. Bowman and George W. Johnson of Parker, Arizona, for instance, bought a lot within a planned shopping center for \$13,661. In the case of Bowman and Johnson's drugstore, the permit was secured, in part, because of the insistence of Arizona Senator Barry Goldwater.^{xxxviii} At the beginning of 1959, the government had outfitted the new city with electricity, temporary homes, and a school that served 200 students. By mid-1961, the population of Page stood at 6,000, the tenth largest in Arizona, with a school enrollment of 1,500. In time the community boasted the amenities and comforts of any small city—including a jeweler, florist, drugstore, restaurant, hospital, airstrip, bowling alley, and several grocery and commissary stores.^{xxxix}

Construction

In tandem with the creation of access roads and the high steel-arch bridge over the Colorado, Wylie got started on construction projects more closely related to the dam. In the first years, he oversaw the construction of electric lines, cables spanning the height of the canyon walls to move men and equipment, diversion tunnels, earthwork and culverts, coffer dams, and right and left spillways. It took three and a half years to complete all of the so-called "preparatory work," and another two and a half to raise the 700-foot arch dam. In total, the project would require, according to one estimation, "five million barrels of cement, ten million

cubic yards of aggregate, three million board-feet of lumber, 130,000 tons of steel, 20,000 tons of aluminum, 5,000 tons of copper, and a peak workforce of 2,500 men.”^{xl}

Reclamation contracted various companies for odds-and-ends tasks, some relatively small, others multi-million dollar projects. In August 1956, Cannon Diamond Drilling Company from California received a contract to conduct exploratory drilling and water testing at the dam site; Strong Company from Springville, Utah, to construct earthworks and culverts; J. G. Shotwell of Mercer Island, Washington, to supply 220,000 tons of pozzolan for the dam; American Cement Company to haul cement to the dam site; and others to construct a sewage treatment plant in Kanab and Page and housing in Page.^{xli}

The Mountain States Construction Company (MSC) won the bid to complete the right diversion tunnel for just under \$2.5 million. MSC’s first dilemma was to get supplies to the bottom of the canyon. At first it tried transporting supplies by barge from the mouth of Wahweap Creek to the dam site, but they abandoned this undertaking after losing a barge and “a cat, hoist and miscellaneous tools” in the river. Instead, the company used a high line to lower equipment, including D-4 Cats, and men over the canyon rim. Other problems arose when it was found that the roof was “slabbing,” or caving, and required roof support bolts. Also, in the late spring and early summer months, the river ran high and some of it seeped through the canyon wall into the tunnel. Progress proceeded at a snail’s pace: by the end of 1956 only 1 percent of the work had been completed on the diversion tunnel, though 20 percent of time had elapsed.^{xlii}

Construction on the diversion tunnels continued into 1958 and 1959. On August 5, 1958, a rock slide above the left channel deposited 5,200 cubic yards of rock which had to be removed.

The loosen rock above that also had to be scraped away. Finally, on February 11, 1959, the right tunnel welcomed water; the left on May 19 of that same year. The Mountain States Construction Company had completed the tunnels nearly on time.^{xliii}

Beginning in 1957, a consulting board comprised of engineers and geologists annually inspected the dam site. If there was concern at all it was that a base of Navajo sandstone would crumble under the relentless force of reservoir water. Louis Puls, in fact, designed the dam with this in mind. Improvements in design construction allowed Puls to create a thin dam, but in order to compensate for the weakness of sandstone, he widened the dam where it jettisoned into the canyon walls. He also planned to strengthen the walls by inserting a “grout curtain.” The design was much like Hoover—a combination gravity and arch dam, “built out of blocks.”^{xliv} The consulting engineers and geologists found the Navajo sandstone at the foundation, though soft, to have high “compressive strength,” and “no known structural weaknesses.” They also advised that the maximum stress in the arch should be limited to 500 psi, “for the brief, infrequent, and unlikely combination of both a full reservoir and a full earthquake stress.”^{xlv}

For the honor of constructing the dam itself, bids opened on April 11, 1957. Major bidders were Morrison-Knudsen, one of the Six Companies that had contracted to build Hoover; based in California; and Merritt-Chapman & Scott Corporation. Merritt-Chapman & Scott Corporation (MC&S) won it at the incredibly low bid of 107,955,552 million, almost \$30 million under Reclamation’s estimate. But it was the largest single contract awarded by Reclamation to that time. With A. R. Bacon as project manager, MC&S had 2500 days to complete the dam and 1760 days to complete the powerplant.^{xlvi}

MC&S made final preparations to pour the concrete in early 1960. The upstream cofferdam closed off in February; cooling towers and a refrigeration plant neared completion. One setback was a labor strike in mid-1959. The issue was that MC&S refused to pay workers the subsistence pay now that housing and supplies were readily available in Page. Approximately 750 union workers stayed home; some, with their families, skipped town altogether in search of work elsewhere. For over five months construction ceased altogether. Finally, days before Christmas, MC&S and the construction unions came to an agreement. The agreement did not give workers the subsistence pay but it did give men working on the dam a 50-cent hourly raise—about \$4.00 per day. The arrangement was actually quite canny, since Reclamation promised to pay 85 percent of all pay increases. But in May 1960, the comptroller general ruled that MC&S would have to pay the wage increase because “it was a subsistence payment in poor disguise.”^{xlvi}

Work resumed in 1960 at a feverish pace. Crews continued excavation on the keyways of the river bottom, the right spillway tunnel, and the foundation of the powerplant; they placed piers by the end of the year. On June 16, 1960, at a formal gathering attended by a few dignitaries, Secretary of the Interior Fred A. Seaton released the first 12 cubic yards of concrete at the “toe of the dam.”^{xlvi} In the remaining months of the year, placements were continuous—three shifts daily over five days per week—but rather slow. Efficiency was the end game. The first million cubic yards of cement took 11 months to lay; the next took only 5 months.^{xlix}

The operations at the Glen Canyon dam site proceeded rather smoothly. Construction crews used the world’s largest batch plant (as high as a twenty-story building) and concrete

buckets (12-cubic yards) supported by 50- and 25-ton capacity cable ways. The materials used for the concrete were mixed at the rate of 1,450 tons per hour and loaded onto trucks in only 10 seconds. An enormous refrigeration plant cooled the concrete below 50 degrees (otherwise it was more susceptible to cracking), and a laboratory in Page and four additional “field” laboratories tested its compression strength, temperature, weight, and moisture content. By 1963, the contractor reduced its workforce from over 2000 to 1600—all the while increasing productivity. New equipment—hauling trucks, air-controlled concrete buckets, hoppers, cranes, and conveyor lines—contributed to this achievement. The army of men laying the concrete did their job at near record pace thanks to these innovative construction technologies. But supervisors claimed they aimed not to set records but to maintain a steady, consistent pace. “Our feeling is that a good week this week and the next and the next accomplishes a lot more than frenzied burst of energy,” stated Jim Irwin, project manager for MC&S.¹

MC&S laid the four-millionth cubic yard of concrete in November 1962, with only one million cubic yards to go. At 8,000 cubic yards per day, the dam would be topped out by September 1963. The big day arrived on September 13, bringing the height of the dam to a towering 710 feet, just a few feet shy of Hoover Dam. That event did not signal the final completion of the project, however—crews had yet to complete the elevator shafts, abutment approaches, trash racks, and power plant—but by and large the work was done.^{li}

Meanwhile, as construction crews continued to place concrete, people from all over came to view a canyon that had become famous by the building of a dam. On July 4, 1962, Independence Day, the governors of Utah and Arizona, and 36 others, took a “farewell trip”

down the Colorado, beginning in Hite and ending at the dam site. The rush was especially urgent, beginning in 1957, to salvage archeological, historical, and cultural information. The Park Service sponsored three separate grants to recover cultural resources, beginning in 1957. One went to Jesse Jennings of the Department of Anthropology at the University of Utah who headed up efforts to excavate sites on the Colorado upstream of the mouth of San Juan River and on the right bank from the San Juan to the dam site. Another went to the Museum of Northern Arizona, with Alexander J. Lindsay, Jr., taking the lead, to study the area along the San Juan River and the left bank of the Colorado from the San Juan to the dam site. And another was granted to C. Gregory Crampton of the Department of History at the University of Utah to collect and record the history of the immediate region to be affected by Lake Powell.^{lii}

The academics and graduate students who took part in this salvage effort operated under severe time constraints, but the information they gathered was tremendous. Crampton, using crude anthropological techniques, compiled a catalogue of historic sites within the site area and eventually published no fewer than six books and numerous articles. Jennings's students eventually published 30 anthropological papers based on their field work. The efforts were also richly rewarding. "Learning the Glen and working in and near it for six or seven summers was a rich, emotionally charged period of my life," Jennings later stated. "The vastness, the isolation, the stillness, the overwhelming beauty of the land, even (especially) the heat, the still starlit nights, the blue and brassy midday sky, all combined to make me constantly aware of my good fortune."^{liii}

Just as the full weight of the rich history of Glen Canyon was coming to light through the efforts of Jennings, Lindsay, and Crampton, environmentalists heightened their objections to the now seemingly inevitable fate of Glen Canyon. Brower made a last-ditch effort to save Glen Canyon, but it was too little, too late. The Sierra Club publication, *The Place No One Knew*, authored by Eliot Porter, was effective in creating public awareness and outrage over the loss at Glen Canyon. A steady flow of people from all over the world came to see the place they had heard and read so much about. But *The Place No One Knew* was politically impotent to stop the inevitable rise of flood waters, which had already begun at the time of its publication in 1963.

Reclamation met the environmentalists on their own turf and launched a public relations campaign of their own to sell the dam to the public. The environmental opposition to the dam and the episode at Echo Park convinced Dominy that such a strategy was necessary. Films, articles for newspapers, thousands of photographs, and tours for dignitaries and VIPs—all this to showcase both the marvel of the dam itself and its myriad of uses. In April 1965, Reclamation printed its promotional *Lake Powell: Jewel of the Colorado* (Dominy himself supplied some of the words and color pictures) and distributed thousands of copies to dignitaries and politicians and made it available to the general public. Reclamation also prepared a film by the same title. As Dominy stated, “The need for films of this kind, for public information, is great, because of those who would have all forests and rivers remain pristine. People ignore facts and play on emotions.”^{liv}

An interesting side note is a story featuring a contest over the beauty of Lake Powell and the free-flowing Colorado. Dominy and Brower, the longtime antagonists, agreed to accompany

the other on a two-week vacation where they would share a houseboat on Lake Powell and a raft down the Colorado. The outing took place in 1966, just following the dam's dedication, featuring classic debates and confrontations between two very ideologically different men. Journalist John McPhee suggested the trip and recorded the discussions between the two men in his classic, *Encounters with an Archdruid*.^{lv}

Of most concern to environmentalist was the protection of the remote but highly vulnerable Rainbow Bridge, a 160-acre national monument created in 1910 by William Taft. Before passage of CRSP, mindful of what nearly happened to Dinosaur National Monument, conservationists made a point to insist on its protection, and Congress complied. In May 1955, Reclamation and Park Service personnel visited the natural arch and decided that a barrier dam would be feasible. So in the 1956 act was a provision that "as part of the construction, operation, and maintenance of the Glen Canyon unit the Secretary of the Interior shall take adequate protective measures to preclude impairment of the Rainbow Bridge National Monument." The act did not specifically state what these "protective measures" would be or when funding would be allocated for this purpose. Few, if any, members of Congress had actually visited the site and knew the full scale of what protection would entail.^{lvi}

If conservationists and National Park Service officials were committed to protecting Rainbow Bridge, by 1959 they had begun to be outflanked by others who believed protecting the monument from the reservoir was unnecessary. Shortly after becoming Commissioner of Reclamation, Dominy decided to visit the monument to determine the best course of action. "So we [Dominy and Wylie] went in, and I was

flabbergasted. Here is a remote canyon country with no access whatever, and you'd have to put a barrier dam below the monument. . . the violence to that scenic grandeur to perform this kind of construction would be so goddamn much more horrendous than to let a little water back in under the bridge."

A most unlikely congressman from Arizona, Stewart Udall, confirmed this assessment. In 1960 he decided it would be best to do nothing to protect the monument from the waters of Lake Powell. He believed the lesser crime was to let water seep below the arch—that is, "building either of the two proposed dams near the artificial 'boundaries' of the Monument would sacrifice the cardinal principal [that no works of man should intrude in the National Parks] in order to save its corollary [waters of a reservoir are invasive]." ^{lvii} Udall's decision to do nothing about the flooding of Rainbow Bridge is surprising since he originally insisted on a provision in CRSP that would protect the monument from intruding waters. Some environmentalists claimed that Udall gave into the demands of Reclamation officials and Senators who believed that the provision to protect the bridge was an unnecessary expenditure of federal resources. But Udall seemed sincere in his belief that intruding water would be far less of an impairment than a barrier dam. ^{lviii}

To convince Brower, Park Service officials, and other conservationists of the wisdom of this course, Udall and Dominy arranged a field trip to Rainbow Bridge. The logistics were formidable: the 66 people (Dominy originally suggested six) who took part in the excursion were flown by Navy helicopters and shuttled in smaller aircraft one-half mile to the site. The Secretary and Commissioner explained the rationale behind letting

the water flow to the arch, and he apparently succeeded in convincing Brower and the other conservationists who accompanied Udall and Dominy on the tour of Rainbow Bridge that doing nothing would be less damaging than constructing a dam. But on principle they did not step down; reservoir water within the boundaries of Rainbow Bridge National Monument would set a disturbing precedent and would compromise the integrity of national monuments and parks elsewhere.^{lix}

Despite the environmentalists' constant vituperative attacks decrying the betrayal of CRSP, Udall and Dominy refused to budge. They took comfort in the fact that engineers and geologists from the Park Service and Reclamation agreed that water under Rainbow Bridge would not harm the feature, and that Lake Powell would provide access to thousands, even millions of people who otherwise would never have had a chance to see it. Not only did Dominy refuse to ask Congress for funding to build a barrier dam but he lobbied for an amendment that would allow water to come under the bridge. The amendment never materialized, but it did not matter because Congress refused to appropriate funding for the protective barrier. Nothing could be done after January 1963, when the diversion tunnels were closed and water inched its way up the side of Glen Canyon Dam.^{lx}

After 1963, when political wrangling over the fate of Rainbow Bridge had been decided and the dam topped out at 710 feet, the Glen Canyon Unit stood poised to fulfill its original purposes as a storage unit and a power generator. Large electrical towers were constructed on the canyon rim just above the dam. Ets-Hokin & Galvan received a \$13 million contract to run a 345-kv line 240 miles south to a substation at Pinnacle Peak in Arizona. From there, seven different lines ran to various corners of Arizona.^{lxi}

The dedication of Reclamation's newest dam did not take place until September 22, 1966, more than three years after waters had begun to rise. Lady Bird Johnson, who two years prior dedicated the dam on the Utah-Wyoming border at Flaming Gorge, spoke and dedicated the site. Two years later, on September 26, 1968, Secretary Udall dedicated the Carl Hayden Visitor Center.

Project Benefits and Uses of Project Water

Because the Glen Canyon Unit was not constructed to provide water in support of additional settlement, no lands were withdrawn for future settlement. But construction of the unit did boost settlement in the area through the development of the town of Page, Arizona. No water is pumped out of Lake Powell except to the town of Page and to the Navajo coal-firing generating station, which is about one-quarter owned by Reclamation. Reclamation distributes some water for agriculture, but the dam's primary purpose is to store water so the upper basin states can deliver water to the lower basin states and to power cities and towns in the Southwest.

And, of course, there are the recreational benefits created by the dam and its reservoir, Lake Powell.

The 180-mile-long reservoir was named after John Wesley Powell, rather than Dwight D. Eisenhower or Carl Hayden, as suggested by some.^{lxii} Its waters rose slowly, taking seventeen years before it filled for the first time. At full capacity, the waters reach only a few miles south of Canyonlands National Park near Cataract Canyon. Relatively unknown and inaccessible (except by boat) only a few years before, the Lake Powell National Recreation Area has since become familiar to millions.

Reclamation determined to showcase their new reservoir as a place of unmatched scenic beauty and unparalleled recreational opportunities. That was a primary purpose of *Lake Powell: Jewel of the Colorado*, a Reclamation publication that included writing and photos from Commissioner Dominy. In a speech delivered in April 1965, Dominy praised the reservoir for its many functions—drinking water, electric power, tax revenue—but reserved his most potent praise for its use as a recreational haven “for thousands who might never experience these thrills of the outdoors if engineers had not inserted between the steep walls of Glen Canyon a mammoth concrete slab to control and clear the erratic river.”^{lxiii}

More was needed than “a mammoth concrete slab”; the Department of the Interior spent millions on internal improvements, such as marinas on the lake. Ten thousand people visited the lake in 1963, and 500,000 in 1965.^{lxiv} People who enjoy the lake take annual pilgrimages and hang out with friends on boats. However, these intense recreation activities result in the need to manage the area’s sewage, trash, and water pollution issues.^{lxv}

An important issue also ensues: the presence of any dam presents challenges to the river system and its habitat. Whereas trout could not survive in the free-flowing muddy Colorado, for instance, they flourished in the reservoir. In the five years after 1963, twelve million trout and five million bass were dumped into Lake Powell. While trout survive in the cold waters of Lake Powell, the lake injures most native fish which require warm waters to spawn—temperatures that Lake Powell and the clear, cold waters released at the dam do not provide.^{lxvi} The adverse impact of the dam and its operations on the river system was not lost on the public. In the early 1980s, the public variously expressed concern over “beaches, endangered species, ecosystem,

fish, power costs, power production, sediment, water conservation, rafting/boating, air quality, [and] the Grand Canyon wilderness.” Especially acute was concern over the impact of daily fluctuation on the river system downstream.^{lxvii}

In response to environmental, tribal, and public pressure, Secretary of the Interior James Watt initiated what became the Glen Canyon Environmental Studies Phase 1 (GCES I), a series of scientific studies on the river headed by biologist David Wegner. GCES I aimed to evaluate current operations of the dam and its impact on the environment of Glen Canyon and the Grand Canyon. Wegner and his team began field work in the spring of 1983, just when the river flowed unusually high due to heavy winter runoff. In June the reservoir was already at capacity, releasing as much water as the penstocks could handle. Operators quickly realized that the spillways had to be opened to release the pressure on the penstocks. Over the next four years, the dam released 18.5 million acre feet, ten million acre feet more than the recommended discharge. The flood years caused some damage to the beach habitat downstream and historic sites within the Lake Powell region.^{lxviii} Though the next three years did not present ideal conditions to analyze “normal” fluctuations in the river’s flow, they did present an excellent opportunity to understand “the river system at higher flows.” The team of researchers concluded that heavy releases of cold, clear water from the dam had an adverse effect on the river system downstream.^{lxix}

The problem with GCES I, in the minds of environmentalists, was that Reclamation had no obligation to act on its recommendations. In August 1989, yielding to pressure from environmental organizations and activists, Secretary of the Interior Manuel Lujan called for an

Environmental Impact Statement (EIS). As the lead agency in charge of gathering the information at the core of the EIS, Reclamation initiated a GCES II, headed once again by Wegner. GCES II was to also collect information on the impact of power plant production. The power plant, with four units at 165 MW and four at 174 MW annually generating 3.87 billion kWh, serves 150 public utilities and 3 million customers—generating 1,356 MW of the 4,000 MW federal capacity along the Colorado River.

One Reclamation official deeply involved in seeing the EIS through commented that it was a “hugely complex process.” The early planning stages of the EIS were characterized by intense and heated debate, sometimes with very little to show for it. This improved somewhat after Secretary Lujan, at the behest of environmentalists, slowed down the flow of the Colorado to minimize beach damage—*interim flows*. Eventually, interested parties hammered out a compromise and drafted the EIS. Released in 1995, the EIS provided methods of preserving cultural artifacts, flood control, habitat, and encouraging new population growth in the Humpback Chub, an endangered species. More specifically, it proposed changes in flow and fluctuation, calling for the so called Low Fluctuating Flow.

Some environmentalists expressed disappointment with the EIS. While they considered the Low Fluctuating Flow to be a better alternative than past release from Glen Canyon, they still lamented the fact that Reclamation fluctuated “in response to power demand”—fluctuation that hardly represented the “naturalness” of the river’s flow. But overall, people greeted the EIS enthusiastically. In the words of Commissioner Daniel P. Beard, the EIS was “the demarcation line between the old way we have treated the river, and the way of the future.”^{lxx}

Despite the environmental safeguards that have been put into place, environmentalists will likely continue to debate the future of Glen Canyon and the river system. The flow of the dam and its impact on the habitat of the Colorado, fish populations and the temperature control programs are all topics of environmental concern.^{lxxi} In June 2006, for instance, two environmental groups said they would sue the Arizona Fish and Game Department if it resumed trout stocking at Lee's Ferry. Environmentalists argue that it is inconsistent policy to stock trout near the dam while at the same time killing them sixty miles downstream for endangering the humpback chub and other native fishes.^{lxxii}

Of greater concern to some environmentalists is the presence of the dam itself. In spring 1981, Earth First!, a radical environmental organization headed by Dave Foreman, staged a dramatic demonstration by unfurling a large plastic crack over the side of the dam. Since then, several environmental organizations, including the Glen Canyon Institute based in Salt Lake City and Living Waters based in Moab, Utah, have publically advocated draining Lake Powell and restoring the Colorado to its free-flowing form.^{lxxiii} These groups have also questioned the structural integrity of the dam and its foundation. All available evidence, however, including a comprehensive facility review in 1998, shows that, despite some cracking, the foundation and structure are in excellent form.^{lxxiv}

Reclamation will also likely confront problems of another sort: drought, for example. During a five-year period, 1999-2004, the Southwest received lower-than-average levels of rainfall. At its lowest, the unregulated inflow of the Colorado was 49 percent of average; in April 2005, the reservoir stood at a dismal 33 percent of capacity, revealing glimpses of well-

known sites like Cathedral of the Desert that had been submerged underwater for decades. The waterline rose 31 feet by the end of the year, but Lake Powell was at only 46 percent capacity.^{lxxv} The good news is that inflow in 2006 is higher than in the years since 1999—6.8 million acre feet, or 86 percent on average—though still below average. The Colorado river system, operating within a harsh yet fragile environment, is ever in flux, sometimes dramatically and quite unexpectedly.

Conclusion

Much has been written about the story of Glen Canyon, before and after its damming. Most published writing is one-sided. River enthusiasts, nature writers, outdoor aficionados—some born after the dam was constructed—have recorded their impressions of the dam that flooded Glen Canyon. Some writing is angry and retributive. Katie Lee speaks of the Wreck-the-nation Bureau in her memoir, *All My Rivers Gone*. Perhaps most irreverent is Edward Abbey's *The Monkey Wrench Gang* about a band of saboteurs who plot to blow up Glen Canyon Dam.^{lxxvi}

Divisive feelings over the construction of the dam reflects the profound and varied meaning that people attach to Glen Canyon and its reservoir. Even the name Lake Powell, after John Wesley Powell, is subject to debate. Supporters of the dam found it a fitting tribute to a man who first suggested that the waters of the Colorado could irrigate an area “larger than was ever cultivated along the Nile.” But conservationists claimed it was ill-fitting and did damage to the name of a man who never would have envisioned such a large-scale project. If some people

remember the idyllic days of Glen Canyon without a dam, many more have become acquainted with its beauty because of the easy accessibility the reservoir provides. As Floyd Dominy said, “We didn’t destroy it; we changed it. We made it into a beautiful, beautiful lake and it’s now a worldwide attraction. It’s become the Taj Mahal of America.”^{lxxvii}

These sentiments point to the fact that the construction of Glen Canyon Dam stood at the center of the environmental debates of the postwar era. The Echo Park controversy may have jump-started the environmental movement, as Mark Harvey has argued, but Glen Canyon imbued it with a renewed determination. If some dams were necessary, the general sentiment was that others were not, or at least they did not belong in places of exquisite beauty.^{lxxviii} An argument could also be made that the combined impact of the fight for Echo Park, Glen Canyon, Rainbow Bridge, and the proposed dams at Bridge and Marble Canyons figured into the environmental movement of the 1960s and 1970s, reshaping the very purposes of the Bureau of Reclamation. Partly due to environmental opposition and partly because most of the major waterways were now controlled, Congress authorized the last major dam in 1968. By the 1970s, the authorization of large-scale storage reservoirs had come to an end, and Glen Canyon had played a prominent role in that transition.

But however people remember it or attach significance to it, Glen Canyon Dam and its reservoir continue to perform their original functions—to “control” the Colorado, to store water in a thirsty land, to generate hydroelectric power. At a price of \$244,870,550, the Glen Canyon Unit is one of Reclamation’s finest in terms of design and construction. Anyone would agree

that the dam, bridge, powerplant, visitor's center, and reservoir command an imposing presence against the deep hues and geologic features of the southwestern desert.

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- iv. Topping, *Glen Canyon*, 55-58.
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- xii. Colorado River, Glenn Canyon Damsite, Board of Engineers Report, Dec. 20, 1922, Box 274, Records of the Bureau of Reclamation, Record Group 115, Project Reports, 1910-1955, National Archives and Records Administration: Rocky Mountain Region, Denver, Colorado (hereafter NARA); Fradkin, *A River No More*, 194.

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- xiii. Rich Johnson, *The Central Arizona Project, 1918-1968* (Tucson: University of Arizona Press, 1977), 14, 16; "Colter and Party Go to Glen Canyon," *Garfield County News*, Oct. 30, 1931, as accessed through Utah Digital Newspapers, <http://www.lib.utah.edu/digital/unews/>.
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- xvi. U.S. Department of the Interior, Bureau of Reclamation, *The Colorado River, "A Natural Menace Becomes a National Resource": A Comprehensive Report on the Development of the Water Resources of the Colorado River Basin for Irrigation, Power Production, and Other Beneficial Uses in Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming* (Washington, D.C.: Government Printing Office, March 1946), 146-47; see also Russell Martin, *Story That Stands Like a Dam: Glen Canyon and the Struggle for the Soul of the West* (New York: Henry Holt and Company, 1989), 188-90.
- xvii. *Kane County Standard*, Oct. 15, 1948; Commissioner Voices Opinion As To Glen Canyon Construction," *Kane County Standard*, Nov. 11, 1949, as accessed through Utah Digital Newspapers, <http://www.lib.utah.edu/digital/unews/>.
- xviii. For a full treatment on the Echo Park controversy, see Mark W. T. Harvey, *A Symbol of Wilderness: Echo Park and the American Conservation Movement* (Albuquerque: University of New Mexico Press, 1994); also Martin, *Story that Stands Like a Dam*, 43-74.
- xix. Harvey, *A Symbol of Wilderness*, 283.
- xx. United States Department of the Interior, Bureau of Reclamation, *Technical Record of Design and Construction, Glen Canyon Dam and Powerplant* (Denver: Government Printing Office, 1970), 3; United States Department of the Interior, Water and Power Resources Service, *Project Data* (Government Printing Office, 1981), 355.
- xxi. Marc Reisner, *Cadillac Desert: The American West and Its Disappearing Water* (New York: Penguin Books, 1993), 140-44.
- xxii. Reisner, *Cadillac Desert*, 140-44.
- xxiii. Roy Webb makes this point in an interview by Ken Verdoia for *Glen Canyon: A Dam*,

Water and the West, produced by KUED, <http://www.kued.org/productions/glencanyon/>.

xxiv. Goldwater voted in favor of constructing Glen Canyon Dam but later came to regret it: “Of all the votes I have cast in the 20-odd years I have been in [the Senate], if there is one that stands out above all that I would change if I had the chance, it was a vote I cast to construct Glen Canyon Dam on the Colorado River.” “Goldwater Regrets Dam,” *Phoenix Gazette*, September 1, 1976, as quoted in Farmer, *Glen Canyon Dammed*, xxvii.

xxv. Martin, *Story that Stands Like a Dam*, 83.

xxvi. “Annual Project History, Glen Canyon Unit, Colorado River Storage Project,” Volume 3, 1958; “Annual Project History, Glen Canyon Unit, Colorado River Storage Project,” Volume 5, 1960, Records of the Bureau of Reclamation, Record Group 115, National Archives and Records Administration: Rocky Mountain Region, Denver, Colorado (hereafter NARA).

xxvii. Report on Negotiations between Don E. Taylor and the Bureau of Reclamation, February 20, 1962 and March 1, 1962; Brinkerhoff to Wallace F. Bennett, August 14, 1962; Bennett to Frank M. Clinton, August 27, 1962; Bennett to W. Darlington Denit, September 1962, Box 2, Records of the Bureau of Reclamation, Record Group 115-99-166, Land Acquisition Records, National Archives and Records Administration: Rocky Mountain Region, Denver, Colorado (hereafter NARA).

xxviii. Art Green to Carl Hayden, telegram, n.d.; Hayden to Fred G. Aandahl, May 24, 1956; C. H. Carter to Commissioner, June 1956; Wylie to Obed M. Lassen, July 18, 1957; Lassen to Wylie, July 24, 1957, Box 2, Land Acquisition Records, NARA.

xxix. “Annual Project History, Glen Canyon Unit, Colorado River Storage Project,” Volume 1, 1956; Martin, *Story that Stands Like a Dam*, 173.

xxx. Farmer, *Glen Canyon Dammed*, 34; Wylie, “Roads to Scenic Treasures,” 58-59.

xxxi. The initial research and writing on section on Glen Canyon Bridge was done by W. Joe Simonds.

xxxii. United States Department of the Interior, Bureau of Reclamation, *Technical Record of Design and Construction, Glen Canyon Dam Bridge* (Denver: Government Printing Office, 1959), 1-5; Martin, *Story that Stands Like a Dam*, 89-91.

xxxiii. *Technical Record of Design and Construction, Glen Canyon Dam Bridge*, 71, 77, 78, 84-86, 88-92.

xxxiv. Francis J. Murphy, “Building the Colorado River Bridge,” *Western Construction*,

December 1958, 32.

xxxv. *Technical Record of Design and Construction, Glen Canyon Bridge*, 95; “Spanning Glen Canyon at 700 Feet,” *Engineering News-Record*, December 4, 1958, 34.

xxxvi. *Technical Record of Design and Construction, Glen Canyon Dam*, 102, 106, 108; “Building the Colorado River Bridge.”

xxxvii. “Glen Canyon City Plans Announced,” *Arizona Republic*, November 28, [no year].

xxxviii. Permit records are located in Box 2, Records of the Bureau of Reclamation, Record Group 115-00-006, Reclamation Camps & Project Areas, National Archives and Records Administration: Rocky Mountain Region, Denver, Colorado (hereafter NARA). For correspondence regarding the Bowman and Johnson drugstore, see Floyd Dominy to Goldwater, December 16, 1958; Goldwater to Dominy, December 23, 1958; Jess Bowman to Wylie, June 2, 1959; Wylie to Bowman and Johnson, July 28, 1959; Wylie to Bowman and Johnson, January 1960; Wylie to Bowman and Johnson, February 1960.

xxxix. “Glen Canyon Dam.” *Reclamation Era* 44, no. 1 (1958): 13-15.

xl. Martin, *Story that Stands Like a Dam*, 94.

xli. “Annual Project History, Glen Canyon Unit, Colorado River Storage Project,” Volume 1, 1956; “Annual Project History, Glen Canyon Unit, Colorado River Storage Project,” Volume 2, 1957.

xlii. “Annual Project History, Glen Canyon Unit, Colorado River Storage Project,” Volume 1, 1956; “Annual Project History, Glen Canyon Unit, Colorado River Storage Project,” Volume 2, 1957.

xliii. “Annual Project History, Glen Canyon Unit, Colorado River Storage Project,” Volume 3, 1958; “Annual Project History, Glen Canyon Unit, Colorado River Storage Project,” Volume 4, 1959.

xliv. David P. Billington, Donald C. Jackson, and Martin V. Melosi, *The History of Large Federal Dams: Planning, Design, and Construction* (U.S. Department of the Interior, 2005), 184-85; Martin, 189.

xlv. “Annual Project History, Glen Canyon Unit, Colorado River Storage Project,” Volume 2, 1957.

xlvi. “Annual Project History, Glen Canyon Unit, Colorado River Storage Project,” Volume 2, 1957.

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- xlvi. Martin, *Story that Stands Like a Dam*, 146-57.
- xlvi. "First Concrete Placed at Glen Canyon," *Reclamation Era* 46, no. 3 (1960): 72.
- xli. "Annual Project History, Glen Canyon Unit, Colorado River Storage Project," Volume 5, 1960; Martin, *Story that Stands Like a Dam*, 197.
- l. "The Glen Canyon Dam Project," *Western Construction* 36, No. 4 (April 1961): 38-39; "Production goes up at Glen Canyon," *Western Construction* 38, No. 4-C (April 1963): 23-24.
- li. *Navajo Times*, July 4, 1962, Sept. 12, 1963; *Salt Lake Tribune*, Nov. 20, 1962.
- lii. Martin, *Story that Stands Like a Dam*, 103-31; Topping, *Glen Canyon*, 339-46.
- liii. Quoted in Topping, *Glen Canyon*, 342-43. See Jesse D. Jennings, *Glen Canyon: An Archeological Summary* (Salt Lake City: University of Utah Press, 1998).
- liv. John McPhee, *Encounters with the Archdruid* (New York: Farrar, Straus and Giroux, 1971), 171.
- lv. McPhee, *Encounters with the Archdruid*, 174-208; Martin, *Story that Stands Like a Dam*, 293-97.
- lvi. The complete history of Rainbow Bridge is David Kent Sproul, *A Bridge Between Cultures: An Administrative History of Rainbow Bridge National Monument* (Denver: National Park Service, 2001), Ch. 6.
- lvii. Floyd Dominy, oral history interview, transcript of tape-recorded Bureau of Reclamation Oral History Interviews conducted by Brit Allan Storey, Senior Historian, Bureau of Reclamation, April 8, 1996, Boyce, Virginia. Transcription by Technitype Transcription of Davis, California. Edited by Brit Allan Storey. Repository for the record copy of the interview transcript is the National Archives and Records Administration in College Park, Maryland; Sproul, *A Bridge Between Cultures*, 279.
- lviii. For context behind Udall's proclivity as a conservationist, see Thomas G. Smith, "John Kennedy, Steward Udall, and New Conservation," *Pacific Historical Review* 64 (Aug. 1995): 329-62. Smith argues that the Kennedy administration was, "with the exception of Lyndon Johnson's Great Society, the most conservation-minded administration in the postwar era."
- lix. Dominy interview.
- lx. Floyd Dominy, interview by Ken Verdoia for *Glen Canyon: A Dam, Water and the West*,

produced by KUED. The National Parks Association, a private group organized to protect the national parks, sued Stewart Udall in 1962, but the Federal Circuit Court of Appeals and the Supreme Court upheld a district judge's ruling that the NPA and their fellow plaintiffs had no standing "to sue and that the discretionary powers of the Secretary were not a matter of judicial concern." In 1970, Brower initiated a new suit against the Commissioner of Reclamation and the Secretary of the Interior. In 1973, Chief Judge Willis W. Ritter ruled in favor of the environmentalists and ordered Reclamation to lower the waterline of Lake Powell. This ruling did not last long, however, as the U.S. Circuit Court of Appeals in Denver overturned the decision by ruling that Congressional actions "took precedence over the provisions of the 1956 act." Sproul, *A Bridge Between Cultures*, Ch. 6.; Fradkin, *A River No More*, 197.

In addition to environmentalists, Native Americans also brought several suits before the courts. Rainbow Bridge had long been a sacred site to ancient Pueblo Indians and contemporary indigenous peoples, including Paiutes and Navajos. In the early 1970s the Navajo Nation filed suit to stop the waters of Lake Powell from encroaching on Rainbow Bridge. There were two specific complaints. The first was that the water destroyed sites of historic significance to Native Americans. The second was that increased visitation of the bridge, as a result of Lake Powell, made it difficult for Navajos to perform religious activities or rituals at the bridge. In 1977, the judge ruled against the Navajos. Since the 1980s, the Park Service has made some attempts to limit visitation at the bridge, but by and large abuses continue and Native Americans have not received the protection they wanted. Sproul, *A Bridge Between Cultures*, 203-48.

Ixi. "240-mi. power line gets underway," *Western Construction* 38, No. 4-C (April 1963): 28-29; "Erecting Glen Canyon power lines," *Western Construction* 39, No. 4 (April 1964): 68-72.

Ixii. Ross R. Rice, *Carl Hayden: Builder of the American West* (Lanham, Maryland: University Press of America, Inc., 1994), 99-101.

Ixiii. Quoted in Farmer, *Glen Canyon Dammed*, 148.

Ixiv. Martin, *Story that Stands Like a Dam*, 249.

Ixv. Recreation is discussed at some length in Farmer, *Glen Canyon Dammed*, 158-81.

Ixvi. W. L. Rusho, "Out of the Blue ... Flying Fish," *Reclamation Era* 54, no. 2 (1968): 50-51; Operation of Glen Canyon Dam, Final Environmental Impact Statement Summary, Bureau of Reclamation, U.S. Department of the Interior, March 1995.

Ixvii. Final EIS Summary, 1995.

Ixviii. *Perspectives on the Glen Canyon Dam Environmental Impact Draft Statement* (Grand Canyon River Guides, Inc., February 1994), 3-5.

Ixix. *Perspectives*, 4.

lxx. *Perspectives*, 13, 2.

lxxi. For instance, Reclamation's Technical Service Center began to design a temperature control device in 1998, a multimillion dollar project. See *Glen Canyon Dam, Multilevel Intake Structure, Proposed Design Concept*, copy in library, Federal Center, Denver, Colorado.

lxxii. "Suit threatened over trout plan," *Arizona Republic*, June 8, 2006.

lxxiii. David R. Brower, "Let the River Run Through It," *Sierra*, March/April 1997.

lxxiv. Technical Service Center, Bureau of Reclamation, *Examination Report, Comprehensive Facility Review for Glen Canyon Dam*, Denver, Colorado, September 1999.

lxxv. "Lake Powell - Glen Canyon - Current Status,"
<http://www.usbr.gov/uc/water/crsp/cs/gcd.html>, accessed June 12, 2006.

lxxvi. See Katie Lee, "Excerpt from *All My Rivers Are Gone*," in Mathew Barrett Gross, ed., *The Glen Canyon Reader* (Tucson: University of Arizona Press, 2003); Edward Abbey, *The Monkey Wrench Gang* (Boston: Lippincott, 1975). A selection of other writings include Gross, ed., *The Glen Canyon Reader*; Fradkin, *A River No More*; and Eleanor Inskip, ed., *The Colorado River through Glen Canyon before Lake Powell: Historic Photo Journal, 1872 to 1964* (Moab, Utah: Inskip Ink, 1995).

lxxvii. Dominy interview.

lxxviii. This point is made in Charles F. Wilkinson, *Crossing the Next Meridian: Land, Water, and the Future of the West* (Washington, D.C.: Island Press, 1992), 275-76.