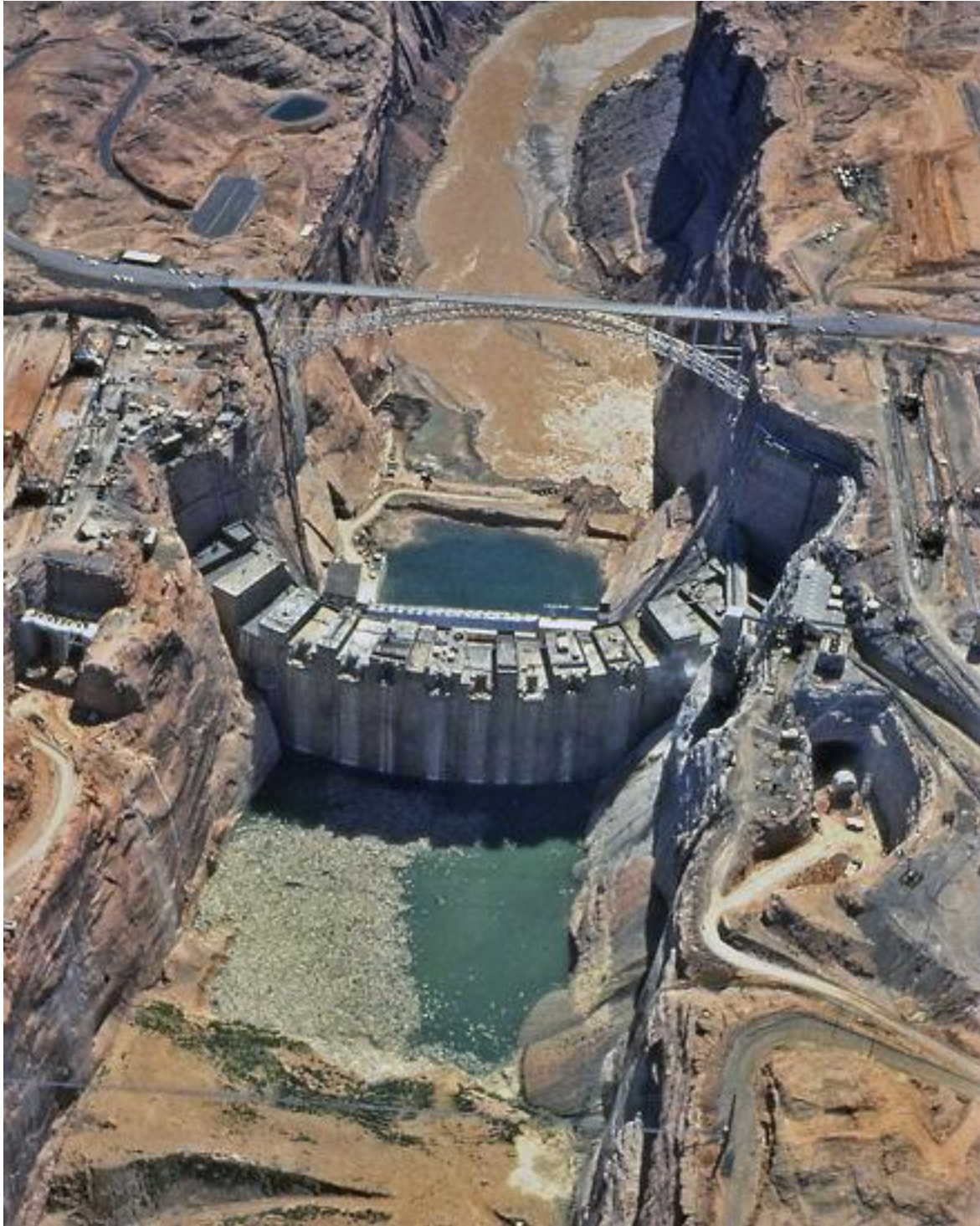


The photographic history of construction at Glen Canyon Dam Site - 1956 to 1966

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BY JOHN S. WEISHEIT



1962 - Glen Canyon Dam construction site; upstream and downstream coffer dams and the rising superstructure.

PROJECT: Colorado River Storage Project Act (1956); Glen Canyon Dam (GCD) & Glen Canyon Reservoir (now Lake Powell) in northern Arizona; principal agency is Bureau of Reclamation (Reclamation).

The first picture of the damsite, by coincidence, was taken in 1889 by Franklin Nims of the Stanton & Brown Expedition of 1889. This photo was matched in 1992, by Robert H. Webb. [Click here](#) to view this fine example of repeat photography.

Special thanks to Tom Martin at River Runners for Wilderness for taking the time to build this photographic collection from federal archives.

- Commissioner of Reclamation in 1957: Wilbur A. Dexheimer
- Commissioner of Reclamation in 1959: Floyd Dominy ([oral history](#))
- Chief Engineer (on site) for GCD Project: [Lemuel \(Lem\) M. Wylie](#)
- Chief Design Engineer of Concrete Dams: Ernest R. Schultz ([design features](#))
- Public Affairs Officer for GCD Project: W.L. (Bud) Rusho ([oral history](#))
- Contractor: Merritt-Chapman & Scott Corporation, New York City.
- A six-month dispute from the labor force emerged in the second half of 1959.
- The Merritt-Chapman & Scott Corporation suffered bankruptcy and by 1971, operations were dissolved. [Wikipedia](#).
- Oral History: [Commissioner Daniel Beard](#) & repurposing operations at Glen Canyon Dam.

There were nine baseline objectives to complete the construction of Glen Canyon Dam:

- 1. Geology:** Navajo sandstone as bedrock for this facility was the greatest challenge for the design engineers. GC Dam is the first dam by Reclamation to utilize computer programming to calculate the stress load of a cantilevered arch dam. GC Dam is not a gravity dam. To qualify as a gravity dam, the dam's weight must exceed the load and the hydraulic lift potential of a full reservoir.
- 2. Community:** Build a community (Page, Arizona) with utilities (water, power and sewage), provide [housing](#), warehouses and office space for a federal bureaucracy and for contractor and sub-contractor employees.
- 3. Mobility:** Build a [highway bridge](#) to connect the western and eastern rims of a wide and entrenched Glen Canyon. This included the placement of various suspended footbridges, and various suspended mobile cable and pulley assemblies (vertical and horizontal positioning) to lift and lower workers, heavy equipment and materials from the canyon rim to canyon bottom. Build a vented, switchback tunnel system for vehicles to drive from rim to powerhouse station.

4. **Foundation:** Preparations to [dewater the river](#) and expose the bedrock below the sand and gravel beds ([photos of paleoflood scour](#)).
5. **Concrete:** Preparations to build forms to accept a matrix of reinforced steel and concrete, and then circulate refrigerated water through pipes to dissipate the heat of setting concrete. This includes the batching of sand, gravel, portland cement and pozzolan (a binder of volcanic origin).
6. **Grouting and rock bolts:** (1) Drill holes into bedrock to install rock bolts to prevent the delamination of Navajo Sandstone. (2) Drill holes through the hardened concrete and/or bedrock to [inject grout](#) to seal the voids and cracks and prevent seepage and hydraulic lift of the superstructure (two phases of injection: low-pressure & high-pressure). **Note:** The dam does leak and sandstone slabs do exfoliate ([AGU paper](#)); this will be discussed at a later time.
7. **Electric power and transmission:** Preparations to build a powerhouse of turbines and a network of transmission lines and towers to distribute electrical power. Revenues from power production was the political priority for authorizing the projects of the Colorado River Storage Project Act of 1956, and why Commissioner Floyd Dominy popularized the term: "cash register dam."
8. **Reservoir filling:** Seal (plug) the diversion tunnels with concrete and fill the reservoir, which took 17-years, and more on that subject at a later time. [General Principles to Govern, and Operating Criteria for, Glen Canyon Reservoir \(Lake Powell\) and Lake Mead During the Lake Powell Filling Period](#). **See also:** [Reservoir elevation data from 1963 to 2023](#).
9. **Public relations:** Control the narrative of the project; build a Visitor Center; and organize a dedication ceremony by [Lady Bird Johnson](#).

COST OF LIVING IN 1961

- Minimum hourly wage - \$1.15
- Median annual income - \$5,700
- Average cost of a new car \$4,300
- Median total cost of modest home - \$18,000
- Median cost for a dozen eggs - \$0.57
- Median cost for a gallon of fuel - \$0.31
- Median cost for a pack of cigarettes - \$0.25
- Median cost for a six pack of beer - \$1.71

MODERN ISSUES ABOUT THE ENGINEERING OF GLEN CANYON DAM

- [2023 - Low Head Hydropower Modifications and Alternatives At Glen Canyon Dam](#). Presentation by Engineer Nick Williams for USBR.

- [2023 - Officials study overhauling dam: Lake Powell's low level imperils the ability to generate power, release water & Front Page Edition](#). Ian James for *The Los Angeles Times*.
- [2023 - Re-engineering Glen Canyon Dam](#). By Jonathan P. Thompson.

FACTS ABOUT GLEN CANYON DAM AND RESERVOIR

- Daily average discharge of hydropower turbines: 22,548 acre-feet.
- Daily average reservoir evaporation: 1,452 acre-feet.
- Daily average sediment load into reservoir: 12,164 tons or 101 acre-feet.
- Annual accumulation of turbidity flows (fine-grain sediment) at forebay of Glen Canyon Dam: 2.7 inches

DAM SPECIFICATIONS

Bureau of Reclamation

- [1961 - Design features of Glen Canyon Dam](#). Ernest Schultz; Denver Office of Chief Engineer.
- [1970 - Glen Canyon Dam technical record of design and construction; searchable doc; for reading the horizontal pages](#).
- [Chronology](#); [Intro](#); [Geology](#);
- [Foundation](#); [Dam](#);
- [Spillways](#); [River Outlets](#); [Penstocks](#);
- [Powerplant](#); [Switchyard](#);
- [Visitor Center](#);
- [Construction](#), [Appendix](#).

TRADE MAGAZINES

- [1957 - Glen Canyon Dam: Pre-bid look at site and construction problems](#). McClellan for Western Construction.

PROGRESS REPORTS

- [1957 to 1966 - Photos for Progress Report by Bureau of Reclamation](#)
- [1965 - Photos not used in the Progress Reports](#)

RECLAMATION MAPS

Glen Canyon National Recreation Area

- Topography below the 3,700 feet contour; [download this very large zip file](#).
- 1922 - USGS Dam Survey Maps from confluence with Green River to Lee's Ferry; [download this zip file](#).
- Note: The USGS elevations of 1922 have a deviation near Glen Canyon Dam of +5 feet. The deviation near the Big Drop Rapids of Cataract Canyon is +10 feet.

GEOLOGIC HAZARDS - During and after reservoir filling and dewatering 1963 to 2023: Photos and movies

- Glen Canyon Dam diversion tunnel damages, 1965.
- Glen Canyon Dam spillway tunnel damages, 1983. We now understand that falling water from great heights in enclosed spillway tunnels cannot withstand the structural demands of a one-hundred year flood, which hasn't occurred on the Colorado River since 1862 ([a 43-day atmospheric river event](#)). Embarrassment is why this discussion is intentionally avoided. This website has a narrative about flood control, [HERE](#).
- [Video: mud rapids and mud islands above Farley Canyon](#). mov.
- [Video: methane gas eruptions near Sheep Canyon](#). mp4.
- [Video: roller tubing whitewater rafts near Hite Marina](#). mov.
- Subsidence features at Good Hope Bay.
- Slope failures at Good Hope Bay & bathymetry images.
- [Slope failures above Escalante River Arm](#) (east side; across from Pollywog Bench).
- [Rim rock collapse below full pool elevation; 2022 near Warm Creek](#).
- Massive rim rock collapse above full pool elevation at Ocean Point; 2004 lower Cataract Canyon.
- Exfoliation features in Lower Cataract Canyon
- Exfoliation at Tapestry Wall.
- [Rapids over Quaternary gravel deposits](#) above Farley Canyon in Spring of 2005.
- [Sediment storage at forebay of Glen Canyon Dam](#); 2017 bathymetry image (enlarged for text boxes). Modified by Weisheit.
- [Comparing 2017 bathymetry image and 1963 image of upstream coffer dam breach](#). Modified by Weisheit.
- [Comparing vertical and horizontal relief of the forebay at GC Dam](#). Modified by Weisheit (Note: west and east positions need to be reversed in this graphic).

ADDITIONAL INFORMATION AND REFERENCES

- J. Willard Marriott Library, University of Utah as Salt Lake City.
- [Digital Elevation Model of Glen Canyon Prior to the Flooding of Lake Powell from Historic Topographic Surveys, Utah and Arizona](#). USGS, Utah Water Science Center.
- [Lake Powell Coring Project](#). USGS, Utah Water Science Center.
- [Cavitation in Chutes and Spillways](#). 1990, Reclamation.

THE PHOTOGRAPHERS

Thirteen photographers total

J. L Digby

- **1958 - 29 photos:** Colorado River bridge; mobile cableway towers; concrete batching; diversion tunnels; employee housing; excavate spillway approach; excavate keyways.

- **1959 - 73 photos:** sandstorms; grouting; coffer dams; tunnel adit for service road to rim; concrete batching; excavate keyways; excavate powerhouse building; garage building.
- **All Digby photos combined**

J.H. Enright

- **1957 - 21 photos:** batching aggregate, cement & pollazon; excavate diversion tunnels; warehouse construction; lateral adit to left diversion tunnel.
- **1958 - 31 photos:** diesel-powered generators; highway bridge; water storage tank; sewer treatment plant; water treatment plant; mobile 50-ton highline cable span; excavate spillway approach; construct municipal building and laboratory; river crossing foot bridge; excavate foundation inspection tunnels.
- **All Enright photos combined**

Fred S. Finch (qualitative photos)

- **1956 - 31 photos combined:** Highway to Bitter Springs (89 southbound);
- **1957 - 111 photos combined:**
- **1958 - 34 photos combined:**
- **1960 to 1963 - 46 photos combined:**
- **1964 - 95 photos combined:**
- **1965 - 103 photos combined:**

L. E. Fine

- **1962 - 8 photos:** electric transmission towers
- **1963 - 2 photos:** communication towers & facilities
- **All Fine photos combined**

H. Freebury

- **1962 - 3 photos:** transmission towers & lines.
- **All Freebury photos combined**

R. C. Gaulke

- **1957 - 2 photos:** highway; small carriage lift at right diversion tunnel portal.
- **All Gaulke photos combined**

C. V. Gezelius

- **1959 - 19 photos:** pozzolan mining/processing; portland cement mining/processing.
- **1960 - 1 photo:** pozzolan mining/processing.
- **1961 - 6 photos:** pozzolan mining/processing.
- **1962 - 3 photos:** pozzolan mining/processing.
- [All Gezelius photos combined](#)

Owen Hill

- **1963 - 1 photo:** upper coffer dam breach during **reservoir filling criteria**.
- [Hill photo](#).

V. E. Larson

- **1962 - 6 photos:** transmission towers; clearcut forested corridor.
- [All Larson photos combined](#)

C. R. Long

- 1961 - 6 photos: aggregate mining; foundation works of dam and powerplant.
- [All Long photos combined](#)

W. L. Rusho - Public relations officer and supervisor for the project photographers.

- **1960 - 4 photos:** test flow at right diversion tunnel; spillway gates; concrete transport buckets.
- **1961 - 1 photo:** aggregate hauling.
- **1962 - 1 photo:** massive bridge component for powerplant.
- [All Rusho photos combined](#)
- Note: Rusho has many photos in various collections.

F. B. Slote

- **1956 - 2 photos:** access road along river corridor; lowering heavy equipment into canyon.
- **1957 - 22 photos:** right diversion tunnel portal; housing for construction workers; highway construction; aggregate processing; bridge; construction of tower for highline cable lift; highscalers on cliff face removing loose rocks; groundwater drill rig; installing rock bolts; air compressor station.
- [All Slote photos combined](#)

A. E. Turner (quantitative photos)

- **1957 - 60 photos combined:** asphalt and concrete mixing plants; diversion tunnels; spillway intakes; Colorado River bridge; highway construction to Bitter Springs Junction (Hwy 89); water and sewage treatment plants; contractor housing; warehouse construction; vehicle tunnel from rim to powerplant; foot bridges; cable lifts for equipment and workers; diesel-powered generators
- **1958 - 140 photos combined:** Spillway approaches; diversion tunnels; vehicle tunnel; laboratory; telephone office; Colorado River bridge; water and sewer treatment plants; concrete batching and mixing; lining tunnels with concrete; vehicle tunnel; rock bolting; keyway excavation; hospital constructions; municipal admin building; residential homes; mucking materials for road base at canyon bottom and coffer dams;
- **1959 - 96 photos combined:** water refrigeration station; concrete and aggregate batching stations; armouring upstream coffer dam; diversion portals, gates and trashracks; foundation inspection tunnels; concrete lining of diversion tunnels; excavation of power plant machine shop; dedication of Colorado River bridge; administrative buildings; construction of perched concrete batch plant near right abutment; arrival of manufactured steel pipes/tubes; excavation of keyways; fire station and government garage; diversion tunnels and coffer dams completed; excavation of river bed to bedrock; 50-ton truck scale; police building; seismograph station;
- **1960 - 139 photos combined:** a pivotal year; workers strike has concluded; coffer dams will be completed; river diversion tunnels will be operational; Colorado River bridge is completed; excavation of river bed to expose bedrock is underway; excavation of keyways and powerhouse are nearly complete; preparations for massive concrete batching and delivery will be ready; Page is a functional community.
- **1961 - 227 photos combined:** public relations; construction of churches and amenities for Page; sand and aggregate processing and stockpiling at streambed of Wahweap Canyon; concrete placement for dam and power plant begins in earnest (day and night shifts); quality control laboratory for testing concrete integrity; placement of penstock steel tubes; armor downstream diversion tunnel portals with concrete to protect bedrock from erosion; install drain pipes to discharge seepage; placement of river outlet steel tubes; technical instruments and connecting cables installed into concrete blocks with adits for access; upstream coffer dam seepage (sump pumps not required as dam height increases); concrete lining of spillways; spillway radial gates installation; preparations for concrete aprons to control erosion from discharge portals (tailrace).
- **1962 - 216 photos combined:**
- **1963 - 145 photos combined:**
- **1964 - 136 photos combined:**

PHOTOGRAPHY BY SUBJECT

A. E. Turner

- **Foundation:** river bottom & power plant; keyway inspection tunnels.
- **City of Page:** critical infrastructure, offices, warehouses, camps, homes, streets, and services.

REPEAT PHOTOGRAPHY

- Damsite match; 1889 & 1992. Robert H. Webb.
- Penstock portals and concrete batching platform; west side. 2023 and 1963.
- River outlet portals; east side. 2023 and 1963.

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