MP-1409

Horseshoe Dam
Name of Property

Maricopa, AZ
County and State

United States Department of the Interior
National Park Service

National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations for individual properties and districts. See instructions in National Register Bulletin, *How to Complete the National Register of Historic Places Registration Form*. If any item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, architectural classification, materials, and areas of significance, enter only categories and subcategories from the instructions. **Place additional certification comments, entries, and narrative items on continuation sheets (NPS Form 10-900a).**

1. Name of Property

Historic name Horseshoe Dam

Other names/site number

2. Location

street & number On the Verde River, approximately 58 miles east-northeast of Phoenix ☐ not for publication

city or town Phoenix ☒ vicinity

State Arizona code AZ county Maricopa code 013 zip code

3. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act, as amended,

I hereby certify that this X nomination __request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60.

In my opinion, the property X meets __ does not meet the National Register Criteria. I recommend that this property be considered significant at the following level(s) of significance:

__ national __X__ statewide _local

George Herbst — Signature of certifying official

11/22/2016 — Date

Federal Preservation Officer — Title

BOR, DOI — State or Federal agency and bureau

In my opinion, the property __ meets __ does not meet the National Register criteria.

Signature of commenting official

Date

Title

State or Federal agency and bureau

Horseshoe Dam
Name of Property

Maricopa, AZ
County and State

United States Department of the Interior
National Park Service

National Register of Historic Places Registration Form

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1. Name of Property

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street & number On the Verde River, approximately 58 miles east-northeast of Phoenix ☐ not for publication

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In my opinion, the property _X_ meets ___ does not meet the National Register Criteria. I recommend that this property be considered significant at the following level(s) of significance:

___ national **_X_ statewide** **___ local**

Signature of certifying official — Date 11/22/2016

Federal Preservation Officer, Bureau of Reclamation, DOI
Title — State or Federal agency and bureau

In my opinion, the property X meets ___ does not meet the National Register criteria.

Signature of commenting official — Date 17 Feb 2017

SHPO
Title — Arizona State Parks
State or Federal agency and bureau

Horseshoe Dam
Name of Property

Maricopa, AZ
County and State

4. National Park Service Certification

I, hereby, certify that this property is:

Signature of the Keeper — Date of Action

✓ entered in the National Register — 8/7/2017

___ determined eligible for the National Register

___ determined not eligible for the National Register

___ removed from the National Register

___ other (explain:)

5. Classification

Ownership of Property
(Check as many boxes as apply)

	public - Local
	public - State
X	public - Federal
	private

Category of Property
(Check only **one** box)

	district
	site
X	structure
	building(s)
	object

Number of Resources within Property
(Do not include previously listed resources in the count.)

Contributing	Noncontributing	
		sites
1	1	structures
		objects
		buildings
1	1	**Total**

Name of related multiple property listing

Salt River Project, Arizona

Number of contributing resources previously listed in the National Register

0

6. Function or Use

Historic Functions
(Enter categories from instructions)

Industry/Processing/Extraction, Waterworks
Government/Public Works

Current Functions
(Enter categories from instructions)

Industry/Processing/Extraction, Waterworks
Government/Public Works

7. Description

Architectural Classification
(Enter categories from instructions)

Other/earth-fill dam

Materials
(Enter categories from instructions)

foundation: Earthfill, Rockfill

walls:

roof:

other: Concrete (spillway, outlet tunnel, intake tower)

Narrative Description

Summary Paragraph

Horseshoe Dam, the final dam built as part of the Salt River Project, is associated with the evolution of the Project, World War II materials production, and the physical and economic growth of the Phoenix metropolitan area in the post-World War II era. The contributing feature consists of the dam proper, including the concrete spillway and earth and rockfill abutments, and outlet tunnel first drilled in the late 1890s then rehabilitated in 1944, and the outlet tunnel's intake tower. The name of the dam is derived from a prominent bend in the Verde River called Horseshoe Bend. The dam is the first earthfill and rockfill dam constructed for the Project. The structure is located on the Verde River approximately 58 miles northeast of Phoenix, and about 40 miles north of the Verde River's confluence with the Salt River. The Horseshoe Dam meets the Registration Requirements set forth in the Salt River Project MPS for Property Type I: Storage-Regulation Dams.

Narrative Description

Phelps-Dodge Copper Products Company constructed Horseshoe Dam on the Verde River from 1944 to 1946, as part of a water exchange agreement with the Salt River Valley Water Users' Association (Association). It is an earthfill and rockfill structure and the first of its kind built on the Project. The dam is a 194 feet high with a crest length of 1,140 feet, and has a total volume of 1,082,000 cubic yards. The dam was built with a relatively conservative 3:1 slope on both the upstream and downstream faces. It ranges in cross-section from 50 feet at the crest to 710 feet at the base. Its interior consists of an earthen core with a base width of approximately 170 feet and top width of 39 feet. A concrete cutoff wall extends into the bedrock foundation along the dam's centerline. The spillway is a concrete-lined channel at the right (west) abutment, controlled by three 35- by-114-foot radial gates, added in 1949 by the City of Phoenix (City) to increase domestic water supplies. The river outlet works consisted of a 126-foot-high circular outlet tower located at the left (east) abutment, controlled by a 9-foot-diameter cylinder valve. Water from the reservoir is normally released through a 730-foot-long tunnel that extends through bedrock under the right (west) abutment. This 14-foot-diameter tube was originally drilled as part of an aborted irrigation project undertaken in the 1890s. It remained unused for a half century until work began on Horseshoe Dam in the mid-1940s. In 1944 the tunnel was cleaned out and lined with reinforced concrete. A 220-foot-high, freestanding reinforced concrete tower situated immediately upriver from the dam forms an intake for water into the tunnel. Water releases were controlled by a steel, 9-foot-diameter cylindrical plug within the tower. In 2015, the river outlet works discharge plug was removed and a new river outlet works valve house was constructed in its place. An access roadway crosses the downstream face of the dam and runs across the lower lip of the spillway apron with a separate walkway underneath the spillway.

Horseshoe Dam was modified by Reclamation in 1993 to address concerns about its safety in the event of a Probable Maximum Flood or Maximum Credible Earthquake. Modifications included a 148,000 cubic-yard stability berm (non-contributing) constructed at the downstream toe of the dam to help stabilize it in the event of an earthquake. The dam was raised 8 feet to enable the spillway to withstand the Probable Maximum Flood. To prevent overtopping of the structure from wave action, an additional 4-foot parapet was built on the dam's crest. Other work included modifying the service spillway gates, and the construction of an auxiliary spillway, closure dike and training dike. A fuse plug auxiliary spillway with an erodible embankment and a concrete foundation 2,000 feet west of the existing spillway was also constructed at this time. This last feature is not within the bounds of the nominated property and is not listed in the

Resource Count. These recent modifications, while substantial, do not materially impact the ability of the structure to convey its significant historic character in both materials and overall construction design.

Its backwater, Horseshoe Reservoir, has a maximum capacity of 139,238 acre-feet and is 5 miles long, with 27 miles of shoreline. It covers more than 2,700 acres, and provides year-round recreational opportunities. Like its downstream neighbor Bartlett Dam, Horseshoe Dam has no hydropower generation capabilities.

8. Statement of Significance

Applicable National Register Criteria
(Mark "x" in one or more boxes for the criteria qualifying the property for National Register listing)

- [X] A — Property is associated with events that have made a significant contribution to the broad patterns of our history.
- [ ] B — Property is associated with the lives of persons significant in our past.
- [ ] C — Property embodies the distinctive characteristics of a type, period, or method of construction or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.
- [ ] D — Property has yielded, or is likely to yield, information important in prehistory or history.

Criteria Considerations
(Mark "x" in all the boxes that apply)

Property is:

- [ ] A — owned by a religious institution or used for religious purposes.
- [ ] B — removed from its original location.
- [ ] C — a birthplace or grave.
- [ ] D — a cemetery.
- [ ] E — a reconstructed building, object, or structure.
- [ ] F — a commemorative property.
- [ ] G — less than 50 years old or achieving significance within the past 50 years.

Areas of Significance
(Enter categories from instructions)

Politics/Government

Community Planning and Development

Period of Significance

1944–1951

Significant Dates

1944–1946 – Horseshoe facility built

1949–1951 – Horseshoe spillway gates added, dam modified

Significant Person
(Complete only if Criterion B is marked above)

Cultural Affiliation

Architect/Builder

Arundel Corporation and L.E. Dixon, Baltimore, MD (dam and spillway)

R.B Langdon Co., Minneapolis, MN; Douglas Grant Co., Fairbault, MN; and Vinson and Pringle Co., Phoenix (outlet tunnel)

Period of Significance (justification)

The period of significance is associated with Horseshoe facility's construction (1944–1946) and immediate spillway modification (1949–1951).

Statement of Significance Summary Paragraph

Horseshoe Dam qualifies for the National Register of Historic Places under Criterion A. It is associated with the evolution of the Salt River Project, one of the first five federally-sponsored western water projects authorized under the National Reclamation (Newlands) Act of 1902. This act created the United States Reclamation Service (Reclamation), whose purpose was to design and construct storage and irrigation projects to aid in the settlement and economic development of western America's arid lands. Previous efforts by individuals and private irrigation concerns were inadequate and often unsuccessful. With the Reclamation's creation, the federal government assumed a lead role in developing large-scale western water projects.

Narrative Statement of Significance

Under Politics, Government, and Community Planning and Development, Horseshoe Dam is significant as the only Project dam associated with strategic materials production during World War II. The dam's construction was financed by Phelps-Dodge Copper Company and the U.S. Defense Plant Corporation to increase Phoenix's domestic water supply, in exchange for water delivered to Phelps-Dodge's copper mines in Morenci, Arizona. Unfortunately, by the time Horseshoe Dam was completed, the War had ended. With the addition of the spillway gates, the City supplemented its municipal water supply.

Developmental history/additional historic context information

With all the attention focused on Bartlett Dam site, interest in building a dam at Horseshoe Bend site took on secondary importance in the 1930s. After the completion of Bartlett Dam, the Salt River Valley Water Users' Association (Association) was in a strong position to claim water rights to the entire Verde River as the only viable entity that could utilize the Horseshoe Bend site's storage potential. Although the Association was not against constructing a dam at the Horseshoe Bend site, in the wake of the debt they assumed to build Bartlett Dam (80 percent of the costs), as well as the added debt of building Roosevelt Dam, Granite Reef Dam, and the Project's three hydropower dams, Horse Mesa Dam, Stewart Mountain Dam, and Mormon Flat Dam, the Association was in a poor financial position to construct another dam. During World War II, the Phelps Dodge Copper Company needed water to expand their mining and processing operations in support of the war effort, which eventually benefited the Association.

One of Arizona's largest copper mining concerns, the Phelps Dodge Copper Company dates back to the early 19th century. After the War of 1812, New York City mercantilist Anson Greene Phelps began a lucrative business exporting southern cotton to Europe and importing metals such as copper, brass, tin, and lead to the United States. Soon he developed an expertise in copper that would eventually lead to the development of the company that bears his name. In 1832, he reorganized his business, established a partnership with his son-in-law William Dodge, and by the time the latter died Phelps Dodge and Company had become an American industrial giant, with substantial holdings in railroads, coal, mineral mining, and lumber. Included among these holdings were copper mines in Arizona Territory, which became the core of the company's business in the 20th Century. The firm's purchase of what was known as the "Atlantic Claim" in Bisbee proved lucrative in the short run, especially after this claim was merged in 1885 with the nearby Copper Queen mine to form Copper Queen Consolidated Mining Company. The decision to invest in the Morenci District also provided long-term dividends, especially in the 20th century when technological advances allowed profitable smelting of relatively low-grade ores. It was the search for water needed to process the low grade ore at Morenci that fueled Phelps Dodge's interest in building a dam on the Verde River.

Knowledge of the mineral deposits present at what would become the Morenci District, sometimes known as the Clifton-Morenci District, in reference to the nearby town of Clifton, was the result of prospecting in the San Francisco River drainage (a tributary of the Gila River) in the immediate post-Civil War period. Prospectors discovered copper ore deposits rich enough to develop near the confluence of Eagle and Chase Creek with the San Francisco River. Between 1872 and 1873, entrepreneur Henry Leszensky and his partners built a small furnace to smelt ore, and by 1879 the Longfellow Copper Company (controlled by Leszensky) had built a large smelter with a daily production capacity of nearly four tons.

>See Section 8 Continuation Sheet<

9. Major Bibliographical References

Bibliography

Please refer to the SRP MPL Cover Document, Section I, for a comprehensive bibliography

Previous documentation on file (NPS):

____preliminary determination of individual listing (36 CFR 67 has been requested
____previously listed in the National Register
____previously determined eligible by the National Register
____designated a National Historic Landmark
____recorded by Historic American Buildings Survey #_____
x recorded by Historic American Engineering Record # AZ-24

Primary location of additional data:

____State Historic Preservation Office
____Other State agency
____Federal agency
____Local government
____University
____Other
Name of repository: Bureau of Reclamation, Denver, Colorado

Historic Resources Survey Number (if assigned): _____

10. Geographical Data

Acreage of Property 27.77 acres

UTM References (See Section 11 Continuation Sheet)

	Zone	Easting	Northing		Zone	Easting	Northing
1	12	434215	3760704	5	12	434485	3760328
2	12	434614	3760669	6	12	434376	3760336
3	12	434731	3760559	7	12	434348	3760339
4	12	434724	3760541	8	12	434254	3760573

Verbal Boundary Description

The boundary is comprised of the dam structure including the dam, the concrete spillway and earth and rockfill abutments, an outlet tunnel first drilled in the late 1890s then rehabilitated in 1944, the intake tower, and the stability berm (non-contributing).

Boundary Justification

The boundary is defined by the limits of the eligible structure consisting of the dam, the concrete spillway and earth and rockfill abutments, an outlet tunnel first drilled in the late 1890s then rehabilitated in 1944, the intake tower, and the stability berm (non-contributing). The newer spillway is non-contributing and because of its physical separation from the historic components it is excluded from the nominated property. This is consistent with the boundary delineated for this cultural feature on the attached map (Section 11, Page 2, Map 2).

11. Form Prepared By

Horseshoe Dam
Name of Property

Maricopa, AZ
County and State

name/title Jim Bailey, Ph.D., Historian

organization Bureau of Reclamation date October 1, 2010

street & number 6150 West Thunderbird Road telephone (623) 773-6263

city or town Glendale state AZ zip code 85306

email ljelinek@usbr.gov[i]

[i] All contact information is for the Phoenix Area Office Archaeologist.

Additional Documentation

Submit the following items with the completed form:

- **Maps:** An aerial map indicating the property's location.
- **Continuation Sheets:** 8 (context, photos), 11 (site map with UTMs and picture references)
- **Additional items:** None

Photographs:

Photo Log (See Section 8 Continuation Sheet)

Current Photographs

Name of Property: Horseshoe Dam
City or Vicinity: Carefree
County: Maricopa
State: AZ
Photographer: Salt River Project
Date Photographed: May 2009
Location of Original Digital Files: Salt River Project, Phoenix, AZ
Number of Photographs: 2

Photo 1 of 2 (AZ_Maricopa County_Salt River ProjectMPS_Horseshoe Dam_0001)
Horseshoe Dam looking north.

Photo 2 of 2 (AZ_Maricopa County_Salt River ProjectMPS_Horseshoe Dam_0002)
Horseshoe Dam spillway looking north.

Historic Photographs

Name of Property: Horseshoe Dam
City or Vicinity: Carefree
County: Maricopa
State: AZ
Photographer: Salt River Project
Date Photographed: unknown, 1944, 1945, 1950
Location of Original Digital Files: Salt River Project, Phoenix, AZ
Number of Photographs: 10

Historic Photo 1 of 10
Interior view of the tunnel as concrete lining was being installed. Photo taken on March 11, 1944.

Historic Photo 2 of 10
Interior view of the tunnel with concrete lining complete and water flowing through the tunnel. Photo taken on May 21, 1944.

Historic Photo 3 of 10
View to the west showing preparations for the construction of Horseshoe Dam's west abutment on August 29, 1944. The river channel is in the foreground.

Historic Photo 4 of 10
View to the west showing a part of the contractor's camp at the Horseshoe Dam construction site. Photo taken on November 10, 1944.

Historic Photo 5 of 10
Laborers working on foundation excavation for Horseshoe Dam. Photo taken on November 25, 1944.

Historic Photo 6 of 10
Construction of the Horseshoe Dam outlet base tower base. Photo taken on February 13, 1945.

Historic Photo 7 of 10
Construction of the Horseshoe Dam outlet tower. Photo taken on April 5, 1945.

Historic Photo 8 of 10
Construction of the left spillway sidewall at Horseshoe Dam. Photo taken on June 8, 1945.

Historic Photo 9 of 10
Installation of the Horseshoe Dam spillway gate control system. Photo taken on February 21, 1950.

Historic Photo 10 of 10
View to the west showing the crest of the Horseshoe Dam and spillway outlet works. Date of photo unknown.

United States Department of the Interior
National Park Service

National Register of Historic Places Continuation Sheet

Horseshoe Dam
Name of Property
Maricopa, AZ
County and State
Salt River Project
Name of multiple listing

Section number 8 Page 1

Context continued

During the 1870s other mines were developed in the Clifton-Morenci District, the most important being the Detroit Copper Company (Detroit) complex under the control of William Church and E.B Ward, both of Detroit. Because of the difficulties in obtaining a stable water supply, Detroit proposed to build a 6-mile-long pipeline to connect its smelter with Eagle Creek in the early 1880s. To finance the construction, Detroit sought help from Phelps Dodge which, in 1882, provided capital for the pipeline in return for a substantial stake in Detroit. Over the next decade, Phelps Dodge gradually increased their stakes in Detroit to the point that by the 1890s the operation was under the direct control of Phelps Dodge.

In the 1880s Longfellow Copper Company came under control of outside investors and was renamed Arizona Copper Company (Arizona). For the next 40 years, as productivity increased, the Detroit and Arizona companies comprised the major copper mining forces in the Clifton-Morenci District. One key event that helped boost mining output and the further development of the region's ores was the 1901 completion of an 18-mile-long railroad connection between Clifton-Morenci and the Arizona & New Mexico Railroad located to the south.

Shortly after the end of World War I, Phelps Dodge Corporation (incorporated in 1908) acted to take control of all Clifton-Morenci holdings. The key to this consolidation came with the Phelps Dodge Corporation's takeover of the Arizona late in 1921. Prior to this, Detroit had merged with Phelps Dodge and, beginning in the early 1920s, all district operations were referred to as the "Phelps Dodge Corporation – Morenci Branch," or just "Morenci." Always looking to expand its operations, in the late 1920s, Phelps Dodge began exploratory drilling around the region to determine the approximate size and geological form of the clay ore body deposits. From these studies it was determined that 200 to 300 hundred million tons of one percent copper ore lay at a depth of 200 to 500 feet below the surface. The company then set out to develop a means of processing this huge low-grade ore deposit at a scale that would make the enterprise cost effective.

The means to cost-effectively process this low grade ore were twofold. First Phelps Dodge abandoned the old method of mining via underground shafts in favor of digging a huge open pit accessible to rail cars that could be filled and sent to the processing plant. Phelps Dodge also developed a processing system that could extract the copper from the low grade ore cheaply and quickly for shipment via rail to their plant in El Paso, Texas for final smelting. The corporation experimented with a technique known as "flotation" as a means of separating the copper ore from the waste rock. This method involved crushing the ore to pebble size, after which it was mixed with water and ground into a fine paste-like material known as pulp. The wet pulp was then placed into long tanks, or flotation cells, in which it was mixed with oily chemicals to separate the ore from waste rock. Materials in the cells were constantly agitated so that the copper in the ore could become attached to air bubbles and then lifted, or floated, to the surface as part of an oily froth. As the waste rock sank to the bottom, the copper-rich froth was skimmed off the top. The waste rock was discarded, the water dumped into large tailing ponds, with the froth dried and delivered to the smelter where it was further refined in furnaces before being shipped from the site.

Ore from the open pit was delivered in 80-ton railroad cars and dumped into large crushers at a rate of about one car per minute. This process allowed ore with one percent copper concentration to be refined quickly into a froth ranging from 22 to 30 percent copper content. Flotation was not the only concentration process employed at Morenci, but it played an important role in supplying a high-grade concentrate that could be easily refined to 99 percent purity in the smelter's furnaces. Successful use of flotation technology required approximately 175 gallons of water for every ton of ore processed. Given the plant could handle 50,000 tons of ore daily, almost nine million gallons of water were required on a daily basis to operate the process. Much of this water was recycled, but substantial quantities were unavoidably lost in smelting the froth, requiring a constant availability of fresh water.

During the early 1930s, Arizona mining production, including that of Phelps Dodge, decreased as copper prices plummeted. By 1935, however, prices rebounded to the point that Phelps Dodge, through the sales of public securities, expanded their Morenci operations with $35 million worth of new open pits, a new crushing plant, new smelting facilities, and new housing for the thousands of workers the Morenci site would employ. Construction of the new facilities extended into the early 1940s, exactly the same time as World War II was erupting in Europe. Although the United States did not officially enter the conflict until December 8, 1941, in 1940 the federal government had initiated efforts to support a national defense buildup. In the interest of this buildup, America expanded its industrial and manufacturing capability.

To assist this expansion, the government formed the Defense Plant Corporation (DPC) in 1940 as an offshoot of the Reconstruction Finance Corporation. The DPC's purpose was to provide direct financial support to companies involved in military-related production, including aircraft and ship construction, engine assembly, machine tool production, and strategic metal extraction and production. Copper is a vital metal needed for electrical systems and devices and its supply was critical to these efforts. By the time the war ended in August 1945, the DPC had invested in some 2,300 American industrial plants, providing each with an average of $3 million to upgrade production capacities. This resulted in a government investment of $6.9 billion in private industry during the war years, which benefitted Phelps Dodge.

By April 1942, Phelps Dodge began copper production from its newly completed Morenci facility. At that time, the War Production Board (WPB), a federal agency charged with planning wartime American industrial development, directed the company to increase its overall copper production by 80 percent, from 27,000 tons to 50,000 tons of copper ore daily. This involved the construction of new processing equipment, housing, and other facilities that would eventually require the expenditure of $42 million in Phelps Dodge funds and another $26 million from the DPC. Despite the huge financial resources available, the one thing money could not directly buy was water. While Phelps Dodge had been drawing water for its Morenci operation, doubling the plant's output required a new major new source of water. In the fall of 1943, Phelps Dodge engineers began considering drawing this water from the upper reaches of the Salt River watershed.

Before approaching the Association, Phelps Dodge looked into tapping the San Francisco River as it passed near Morenci. However, this drew strong protests from residents in the Safford Valley and the San Carlos Indian Reservation, because they also drew water from the San Francisco River. After rejecting ideas to build storage dams on the Gila River, Phelps Dodge then considered diverting water from the Black River, the easternmost tributary of the Salt River, via pipeline to the headwaters of Eagle Creek and ultimately to the Morenci mines. The Association objected to large industrial developments drawing water from one of their primary headwater sources. Phelps Dodge then looked into buying a large tract of land in the Salt River Valley that was part of the Roosevelt Water Conservancy District, which received water from the Association. They would use their water rights from this tract to allow partial diversion of the Black River over the mountains to Morenci. In September 1943, the Association met to consider and deny their request. The Association was concerned that this action would jeopardize future develop plans. The Association was equally concerned when the Verde Power and Irrigation District attempted to draw water from the Verde River.

Phelps Dodge's next proposal was even more ambitious, and the Association listened carefully. It involved compensation for its diversions from the Black River by financing the construction of a new storage facility on the Verde River that would capture flood flows in excess of the capacity of the recently completed Bartlett Dam. This new dam, to be built at the already investigated Horseshoe Bend site upriver from Bartlett Dam, would be financed by the DPC. In October 1943, the Association's Board of Governors met and agreed in principle, under four conditions: Black River diversions never exceed a cumulative total of 250,000 acre-feet; the new dam's reservoir would have a storage capacity of 60,000 acre-feet; the Association would be financially compensated for the electric power revenues that would be lost because of upstream diversions; and project approval must be ratified by the Association's shareholders. Thus, with the prospect of greater profits and increased control over the

region's water resources, the Board of Governors found little reason not to support the war effort.

The negotiations proceeded swiftly. Diversion totals were clarified and no more than 40 acre-feet annually could be diverted from the Black River by Phelps Dodge. Water rights were established in terms of a "water exchange" with floods impounded on the Verde River. After the completion of Horseshoe Dam, any water stored along the Verde River that exceeded the existing capacity of Bartlett Dam (180,000 acre-feet) would be considered water that Phelps Dodge would have the right to "exchange" for purposes of replacing water diverted from the Black River. This provided a legal framework for justifying Phelps Dodge's right to use Salt River basin water. It also served the Association's interest in providing a mechanism for limiting, or even stopping, the Morenci diversions during periods of drought when little water could be stored on the Verde River. In the event of a persistent drought, Phelps Dodge would have no rights to such exchange water.

By November 1943, Phelps Dodge had agreed, with financial help from the DPC, to build Horseshoe Dam. By contract, title to the dam and dam site would remain in federal hands, with operation and maintenance (O&M) controlled by the Association. This was similar to the O&M agreements for the Project's other dams. Phelps Dodge was responsible for designing the dam, subject to review by Reclamation's Chief Engineer and the Association. The agreement was to be signed by Phelps Dodge, the Association, the DPC, and the Secretary of the Interior. Phelps Dodge and the DPC agreed to have the facility finished by February 1945. In the event of flooding, like that which plagued Bartlett Dam's early construction, Phelps Dodge would receive a one year extension. Because the contract seemed a certainty, Phelps Dodge entered into an agreement in December 1943 to have a Phoenix company clear out the old diversion tunnel and line it with concrete. After all, this was something that did not require review by Reclamation engineers or Association approval. Phelps Dodge and the DPC were so anxious to increase copper production by starting on the diversion tunnel that it seemed a worthwhile risk.

In concern for their interests, the Association objected to contract language that might allow the Verde Power and Irrigation District the ability to draw excess water from the Verde River in the future if the dam's height was raised to provide more storage in the reservoir. Reclamation and the Department of the Interior purposefully worded the contract so that Horseshoe Dam's base, as designed, could support a higher structure if needed. Because the federal government held title to the facility, any proposals to raise the dam would have to be approved by the Secretary of the Interior. Negotiations over the wording of the contract continued well into 1944. The Association agreed to revised wording that excluded "other interests" in the Verde River, and that any additional facility capacity would not exceed 240,000 acre-feet. All parties agreed, and after two shareholder votes, on April 4, 1944, Horseshoe Dam was finally authorized. This occurred less than one and half years before the end of World War II.

There was concern about whether an earth and rockfill dam on the Project would be safe. The reasons for the misapprehensions were twofold. First, all the other major Project storage dams were concrete and masonry. Second, the failures of northern Arizona's rockfill Walnut Grove Dam in 1889, as well as the 1915 failure of Lyman Dam on the Little Colorado River, were still fresh in the minds of locals. Overtopping, as well as water seeping through the structure, are the primary culprits of earth and rockfill dam failures. Thus, Phelps Dodge's consulting engineer's submitted two designs. The first, and more expensive option, was a rockfill dam with an impervious concrete slab built across the entire upstream face. The second was a rockfill dam with an impervious core of dense earthfill built across the dam's centerline, and a thick pile of rockfill placed along the upstream and downstream sides of the dam. Between the earth core and the rockfill there was to be a layer of sand and gravel, otherwise known as "fines," which would help bond the earth and rock sections into a relatively monolithic mass.

Reclamation engineers approved both designs, which were opened for bid on February 21, 1944. Both were to use the outlet tunnel drilled by the Rio Verde Canal Company in the 1890s, and featured a 320-foot-wide spillway

designed to handle 250,000 cubic feet of water per second, almost twice the capacity of the largest known Verde River flood. The spillway was also designed to accommodate future installation of movable gates as a means of raising the facility's capacity. Perhaps the spillway's most notable aspect was that it did not include a concrete apron to direct water for several hundred feet downstream before re-entering the stream bed. Instead, it featured a tee-lip that would propel water in a cascade onto a bedrock channel that would then carry it back to the Verde River. To ensure that the overflow would be concentrated in the center of the spillway, the design also featured a bowl-shaped floor and sloped side walls. Sheltered by this lip on the dam's downstream side was a narrow concrete walkway with a concrete parapet wall. This walkway was incorporated into the designs to facilitate sheep herding across the dam while water was being spilled over the apron. Not surprisingly, because it was cheaper, the rock and earthfill dam emerged the winner. A first attempt at bidding resulted in expired, non-binding bids. This was due to the extra time it took all parties to negotiate the final contract. The L.E. Dixon Company and the Arundel Corporation of Baltimore, Maryland, (Contractor) secured the contract with a low bid of $1,656,349. The previous year, Vinson and Pringle Company of Phoenix was awarded $164,000 to clean out and reinforce the outlet tunnel. They completed this work by May 1943.

After establishing a construction camp, the Contractor's first task was excavation work on the abutment's upper elevations. This work started in late August 1944, and by late October clearing out the streambed's lower elevations was being conducted. Due to the relatively stable geology, it was not necessary to excavate the entire area of the dam to bedrock, only the foundations of the center earthfill section were taken down to bedrock. Then overburden, such as small rocks, trees, shrubs, etc., were washed from the earth core's "contact area" via high pressure water sluicing. As part of the foundation excavation, a small diversion channel was blasted along the streambed's east side. This 30-foot-wide, 800-foot long channel, working with the completed diversion tunnel, directed the river around the worksite. About 25,000 cubic yards of rock dynamited for the channel were used for the dam's rockfill sections. Yet once the overburden was removed, the Contractor noticed subsurface seepage from the foundation area, enough to delay or jeopardize the project. Immediately, the Contractor constructed two 14-foot-high concrete walls on the bedrock on the upstream and downstream sides that sandwiched the earth core contact area, and dug deep pits adjacent to these walls to concentrate the seepage, estimated at 500 gallons per minute. Electric pumps then pumped the seepage out of the pits. Next, more than 100 holes between 25 to 100 feet deep and 1.5 inches in diameter were drilled across the foundation's surface, cleaned out with compressed air, and grouted with over 1,000 sacks of cement. By forcing cement grout deep into the foundations, it was possible to fill in bedrock cracks, thus eliminating the passageways through which the subsurface water flowed.

Before earth core placement could begin, two more procedures were necessary. The first, as part of the original dam design, was to build a concrete cutoff wall along the earth core's centerline. This wall extended 100 feet into the foundation, and rose ten feet above the bedrock surface. Three feet thick at the base, it tapered up to a minimum thickness of 1.5 feet at the top. The second procedure, as part of the subsurface water issue, involved the construction of an eight-foot-thick concrete slab at the foundation's deepest section. Referred to as the "gorge," this area was approximately 60 feet wide and 120 feet long, and occupied the very bottom of the streambed. Because the extensive grouting had not been able to eliminate all foundation seepage, it was considered advisable to encase the bottom of the gorge in concrete as a precaution against any possible erosion of the earth core.

Once the foundation was cleared and grouted and the gorge covered with concrete, in mid-December 1944 the Contractor began placing the earth core. Using borrow pits 3,000 feet downstream, dump trucks began the process of transporting excavated dirt for the earth core. The earth core's construction logically started in the gorge, and worked its way upward. Once dumped by the trucks, the dirt, or "loam," was compacted to increase its density and insure its imperviousness. Workers used tampers and five-foot-diameter rolling drums filled with water to compact the loam. Work proceeded smoothly without serious incident.

The core's construction was accompanied by the placement of the "fines" sand and gravel transition zones along the core's upstream and downstream faces. Materials for this zone were delivered wet so it could be compacted into a relatively tight mass. During the process, the specs were altered to enlarge the transition zones, in order to reduce the amount of rockfill needed. Most of the rockfill for the dam core was to be taken from the excavated spillway, but rock proved inferior to the materials taken from supplemental quarries downstream. Much like the earth core, large dump trucks delivered the quarried rock to the site, where it was bulldozed into layers from three to 15 feet thick. High pressure water compacted the rockfill, to ensure that the gaps between larger rocks were filled by smaller rocks, thus creating a tight and dense fill. Work on this proceeded without serious incident through 1945, despite the worksite being a haven for poisonous diamondback rattlesnakes.

Great care was taken to design and build a spillway that would prevent overtopping. Measuring 320 feet across, the spillway's lip reached an altitude of 1,993 feet above sea level, while the earth and rockfill section's crest topped at 2,040 feet. Phelps Dodge's consulting engineers sized the spillway so that under a head of 40 feet (i.e. elevation 2,033 feet) it would discharge 250,000 cubic feet per second. The Contractors excavated approximately 540,000 cubic yards of rock for the spillway opening, of which about 400,000 cubic yards, or 75 percent, proved suitable for use in the structural rockfill section. Much like the foundation, once the complete length of the spillway reached 1,993 feet, the area surrounding the spillway crest was grouted with pressurized cement, 3,000 sacks worth, in order to check leakage.

Upstream from the spillway crest the bedrock was left uncovered, but below the crest a substantial concrete channel was built to divert the water downstream. Aggregate for the concrete was taken from river streambed deposits located 4,000 feet downstream, then trucked to a concrete mixing plant built near the spillway. This concrete was very high quality (averaging a strength of 3,500 pounds per square inch) and generally spillway construction proceeded smoothly. The spillway design is very distinctive in that the lower lip carries a roadway that extends across the dam's downstream face and up to the crest at the structure's east end. To provide access across the spillway during flooding, workers erected a walkway under the lip to take the roadway's place. In this way, it was always possible to reach the top of the outlet tower regardless of flooding.

By the end of 1945, practically all work at Horseshoe Dam was complete. The Contractors finished their work early in 1946 in accordance with the terms of the project agreement. The facility began impounding water in spring 1946. A stout, sturdy structure, Horseshoe Dam contains approximately 290,000 cubic yards of rolled earthfill, 146,000 cubic yards of fines, and 670,000 cubic yards of rockfill. In addition, 8,700 cubic yards of concrete were poured into the cutoff wall and spillway, while slightly more than 25 tons of steel were used to reinforce the intake tower and spillway design. It is somewhat ironic that a dam built to help the war effort would not see completion until well after the war had ended.

Within a year after the facility began impounding water, the Association, again mindful of other interests and wishing to draw water from the Verde River, proposed to increase the reservoir's (Horseshoe Lake) capacity. To prevent any outside interest in the water, the Association penned an agreement with the City in November 1946 calling for the City to finance the construction of movable spillway gates in exchange for rights to use the enlarged reservoir's water. This benefited both parties. The Association befitted by the agreement because the City was within the Project's delivery area. The City's allotment of water from the Verde River would be used in areas already receiving Project water. The City could use their allotment to help support urban development and commercial growth, thereby increasing land values within the Project's service area. The Verde Power and Irrigation District protested, but they lacked enough political sway to derail the agreement. By May 1948 the City had advanced $20,000 to the Association to pay for the final spillway gate plans, and soon the Secretary of the Interior stamped his approval.

Gate design and construction was awarded to Leeds, Hill, and Jewitt, with Raymond Hill acting as project

manager. The purpose of the gates was to provide a means to block the spillway opening intermittently to raise and control reservoir levels. These movable spillway gates more than doubled Horseshoe Lake's capacity, from 67,000 to 139,000 acre-feet. Completed in 1951, at a total cost of $925,000, the spillway was now closed off by three Taintor gates, each a little more than 106 feet long and supported by two reinforced concrete piers anchored to the spillway's base. The 33-foot-high Taintor gates consisted of riveted steel plates shaped with a slightly curved cross-section that extends toward the reservoir. The gates are attached to 2 steel frames that are each connected by a trunnion pin to the front of the reinforced concrete piers. At the downstream end of these hinged steel frames are massive concrete counterweights designed to balance the weight of the gates around the hinges. This feature means that very little motive power is required to raise and lower the gates. A steel walkway extends across the top for operation and maintenance.

The Morenci mining operation still exists; however, the agreement allowing the Black River diversion in exchange for building the dam has been modified. Since 1951, Horseshoe Dam has functioned as part of the Project. With no hydropower capabilities, the facility is operated solely to serve the needs of water users in the Salt River Valley.

While a storage facility at Horseshoe Bend had been the vision of various valley water concerns since the late 19th century, it took three powerful outside sources--World War II, Phelps Dodge, and the DPC for it to become part of the Project and Reclamation. While Horseshoe Dam is significant for its tangential role in Phelps Dodge history and the war effort, its lasting importance rests with providing additional water for the Association shareholders and the City's use of the reservoir's water for municipal and commercial development and growth, which helped accelerate the valley's tremendous growth during the immediate post-World War II decades.[1]

[1] Text and photos excerpted from Donald C. Jackson and Clayton Fraser, *Horseshoe Dam: Historic American Engineering Record HAER No. AZ-24* (Loveland, CO: FRASERdesign, 1991.) The pre-Phelps Dodge section was excerpted from David Introcaso, *Bartlett Dam: Historical American Engineering Record HAER No. AZ-25* (San Francisco, National Park Service, 1990.) Please see cover document Section I for a comprehensive bibliography.

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Horseshoe Dam
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County and State
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Current Photographs

Name of Property: Horseshoe Dam
City or Vicinity: Carefree
County: Maricopa
State: AZ
Photographer: Salt River Project
Date Photographed: May 2009
Location of Original Digital Files: Salt River Project, Phoenix, AZ
Number of Photographs: 2

Photo 1. Horseshoe Dam looking north.

Photo 2. Horseshoe Dam spillway looking north.

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Horseshoe Dam
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Historic Photographs

Name of Property: Horseshoe Dam
City or Vicinity: Carefree
County: Maricopa
State: AZ
Photographer: Salt River Project
Date Photographed: unknown, 1944, 1945, 1950
Location of Original Digital Files: Salt River Project, Phoenix, AZ
Number of Photographs: 10

Historic Photo 1. Interior view of the tunnel as concrete lining was being installed. Photo taken on March 11, 1944.

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Historic Photo 2. Interior view of the tunnel with concrete lining complete and water flowing through the tunnel. Photo taken on May 21, 1944.

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Historic Photo 3. View to the west showing preparations for the construction of the Horseshoe Dam's west abutment on August 29, 1944. The river channel is in the foreground.

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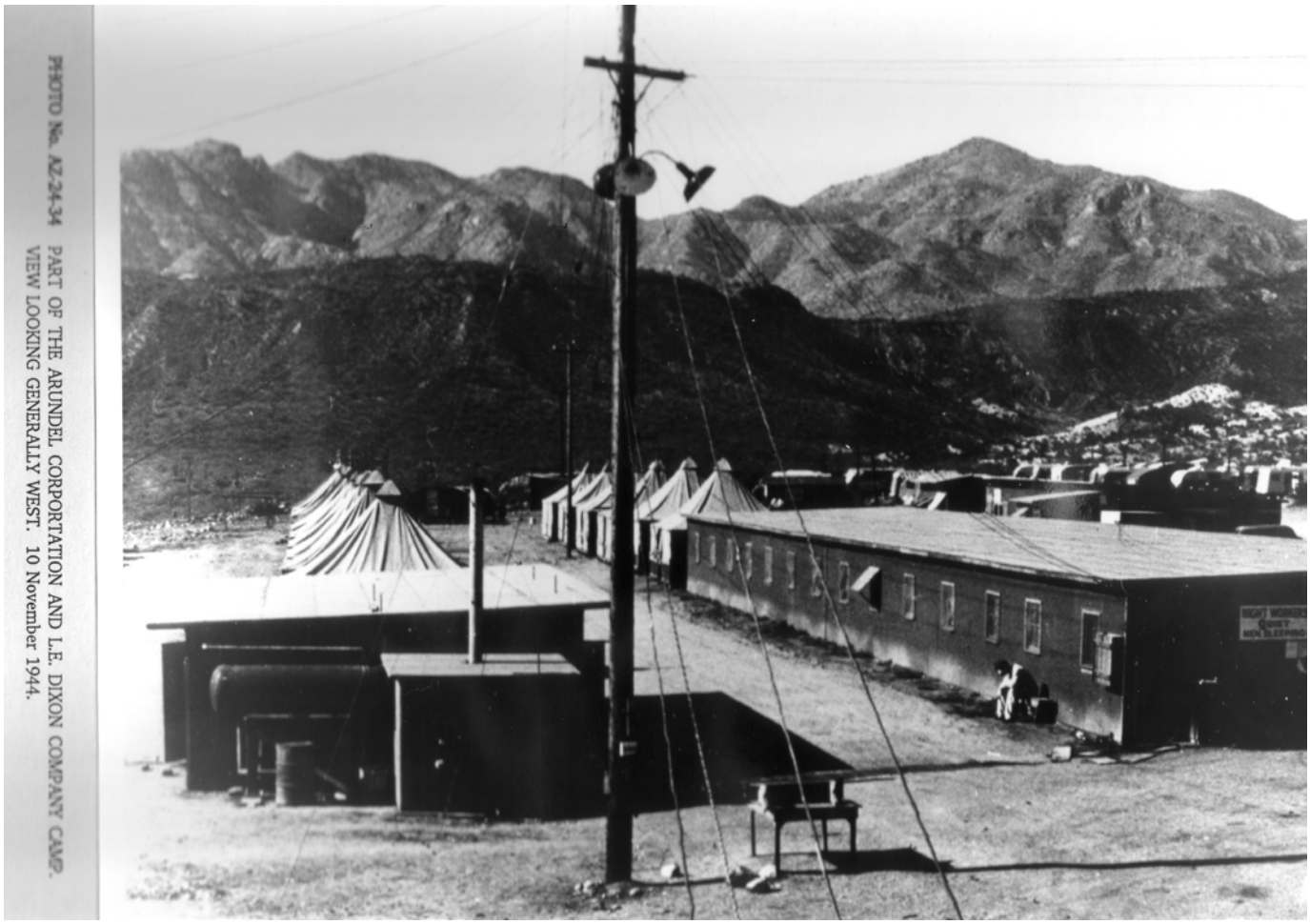

Historic Photo 4. View to the west showing a part of the contractor's camp at the Horseshoe Dam construction site. Photo taken on November 10, 1944.

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Historic Photo 5. Laborers working on foundation excavation for Horseshoe Dam. Photo taken on November 25, 1944.

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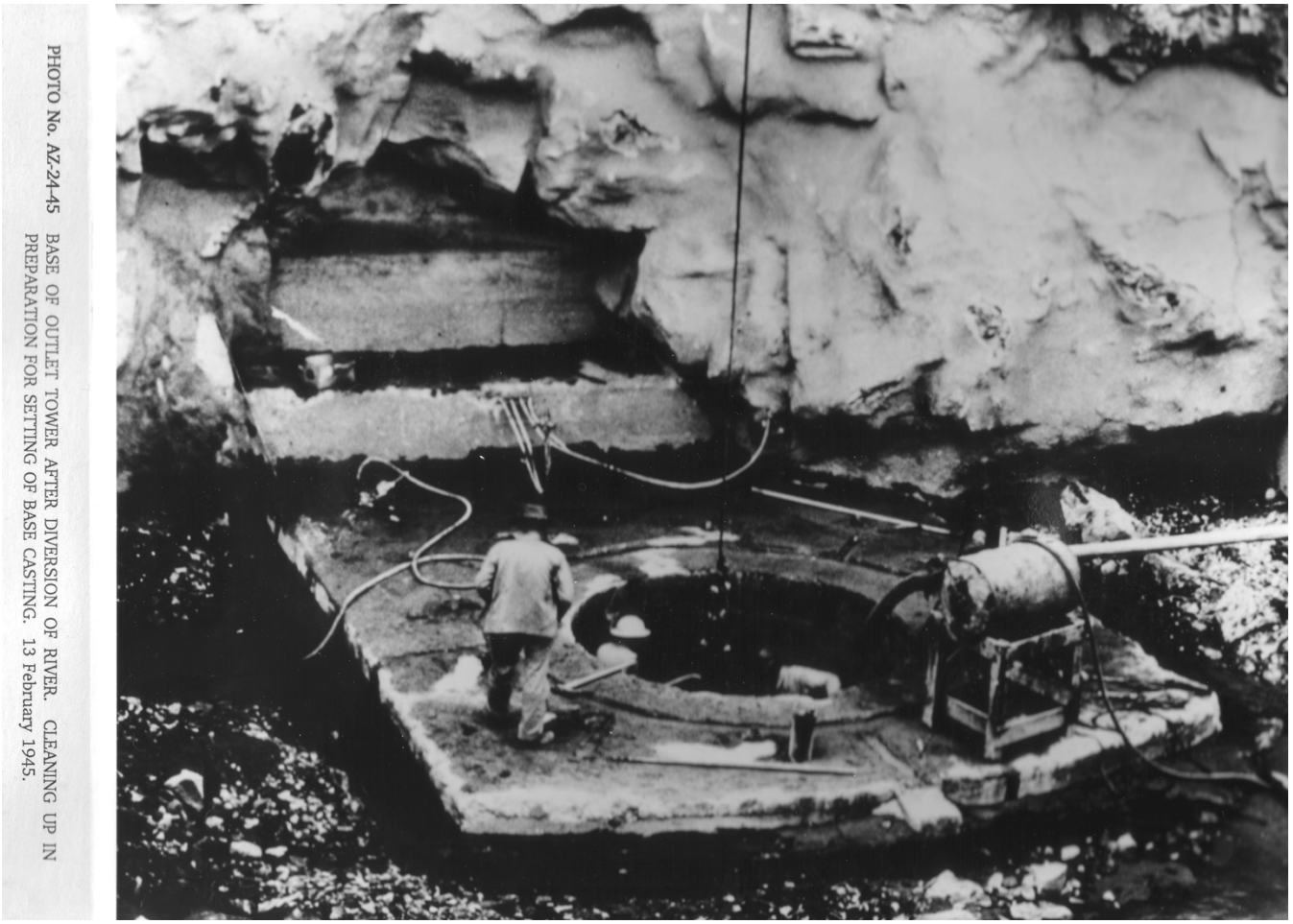

Historic Photo 6. Construction of the Horseshoe Dam outlet base tower base. Photo taken on February 13, 1945.

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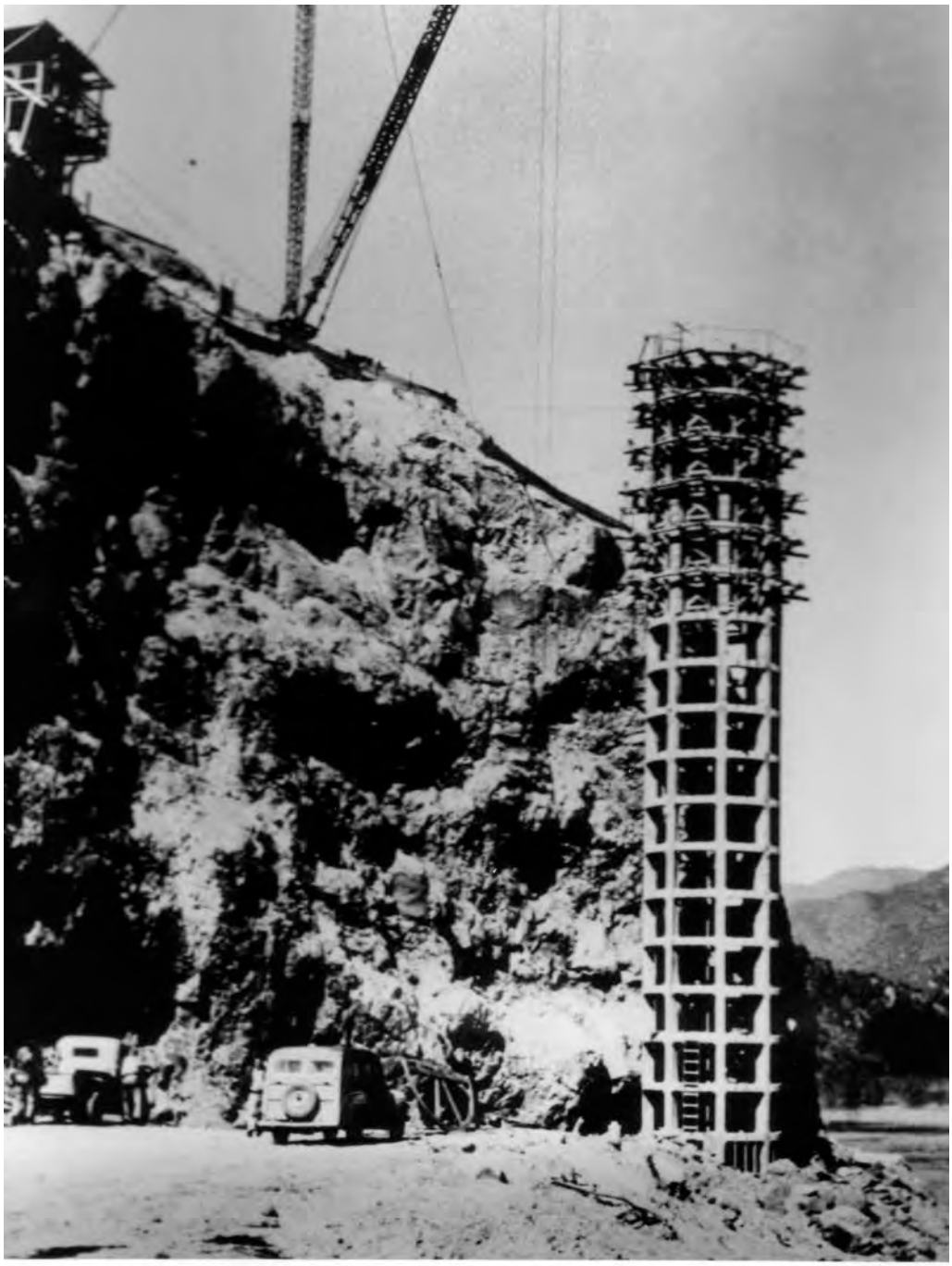

PHOTO No. AZ-24-49 OUTLET CONTROL TOWER LOOKING NORTH IN RESERVOIR AREA.
5 April 1945.

Historic Photo 7. Construction of the Horseshoe Dam outlet tower. Photo taken on April 5, 1945.

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Horseshoe Dam
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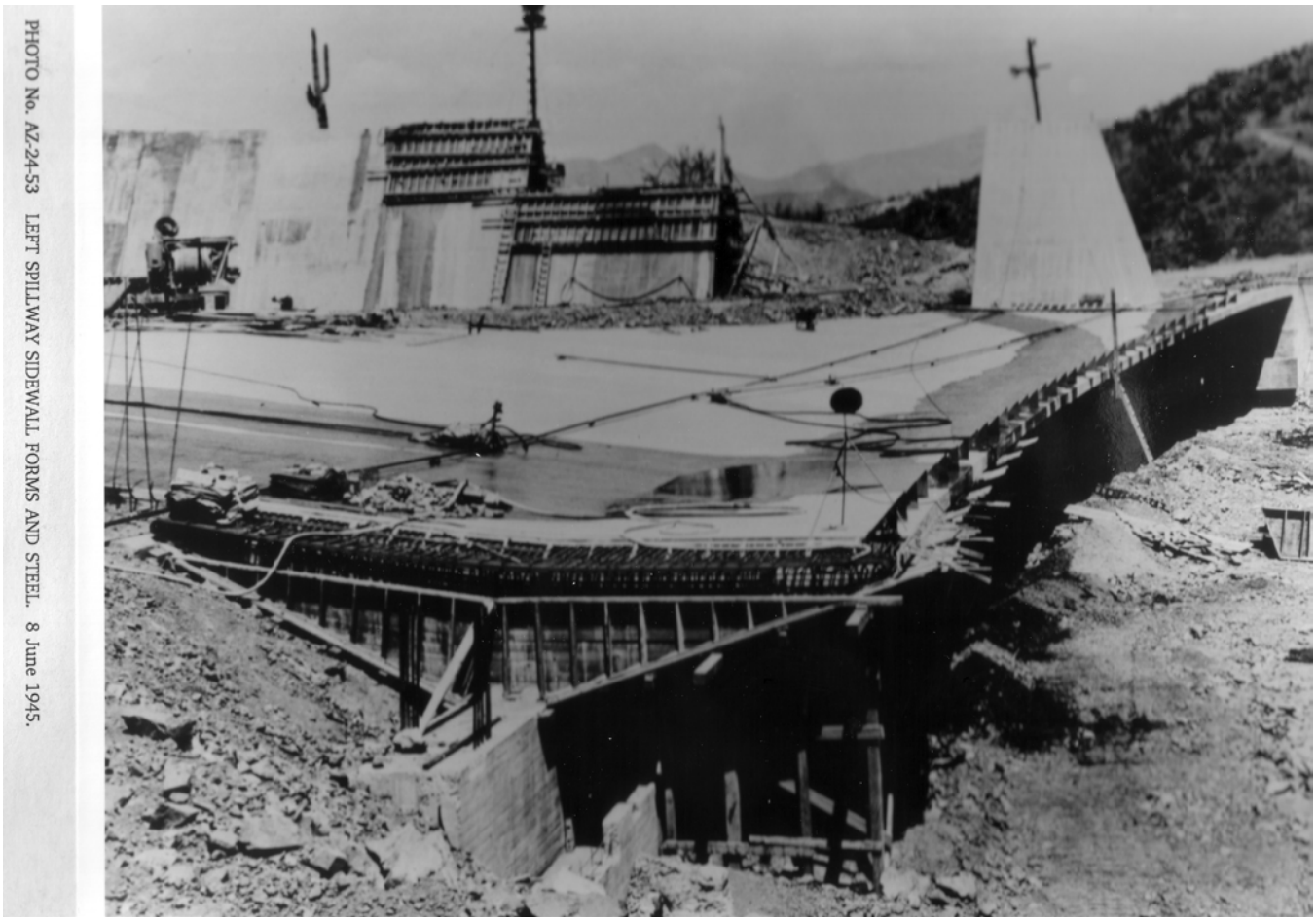

Historic Photo 8. Construction of the left spillway sidewall at Horseshoe Dam. Photo taken on June 8, 1945.

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National Park Service

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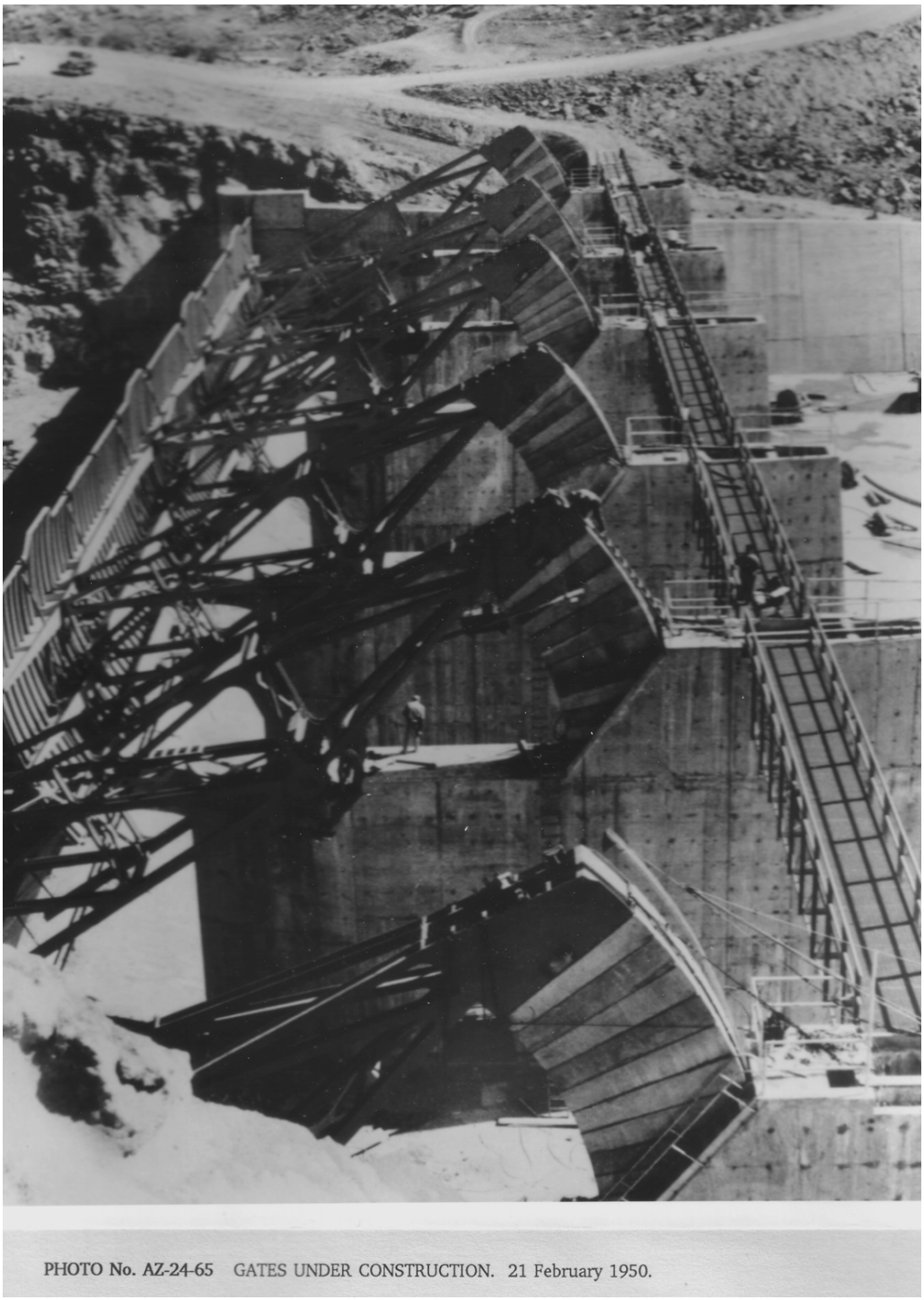

Historic Photo 9. Installation of the Horseshoe Dam spillway gate control system. Photo taken on February 21, 1950.

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PHOTO No. 10 HORSESHOE DAM, CONTEMPORARY VIEW OF DAM CREST.

Historic Photo 10. View to the west showing the crest of the Horseshoe Dam and spillway outlet works. Date of photo unknown.

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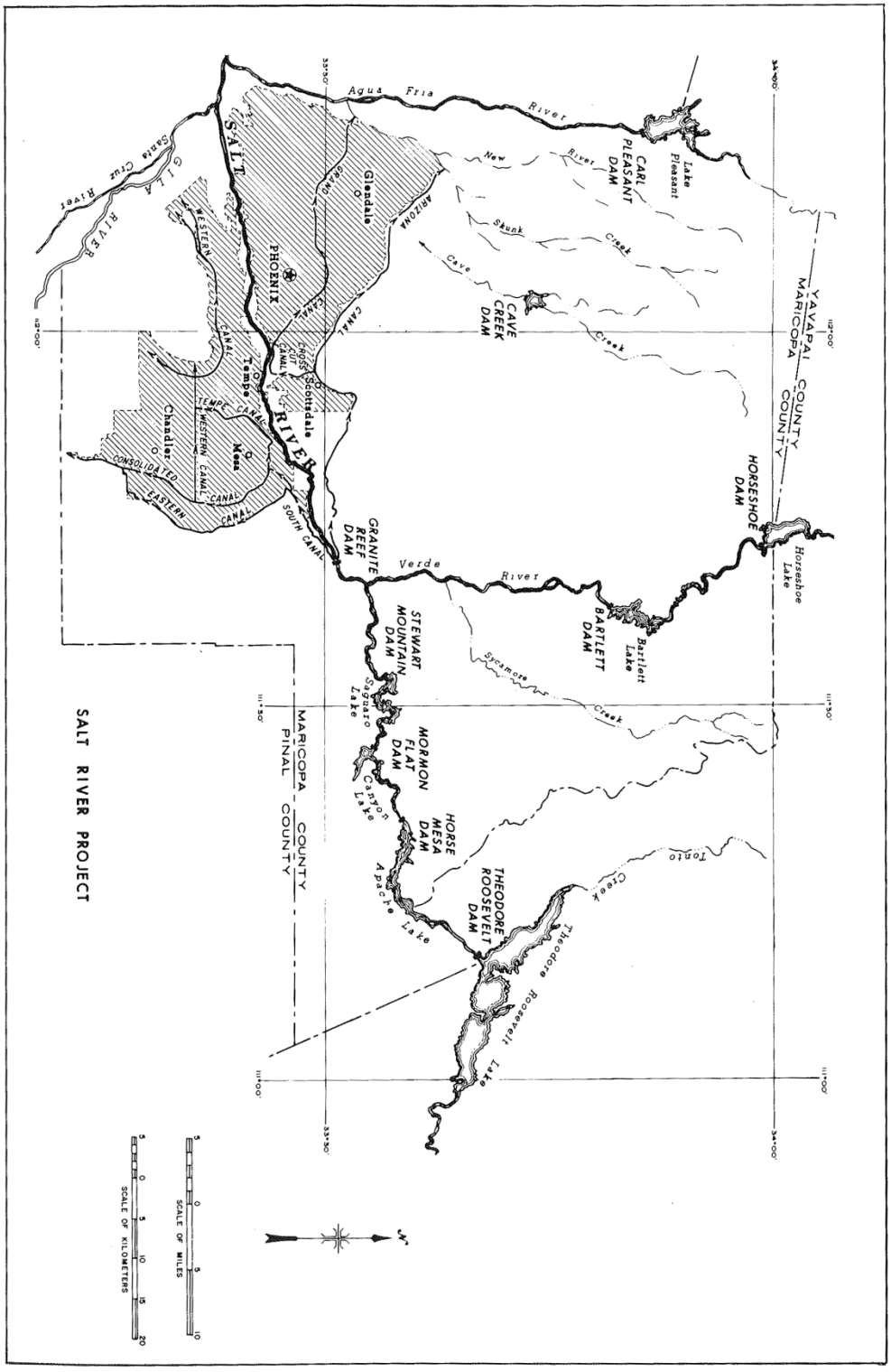
Section number 11 Page 1



Map 1. Location of dams in the Salt River Project.

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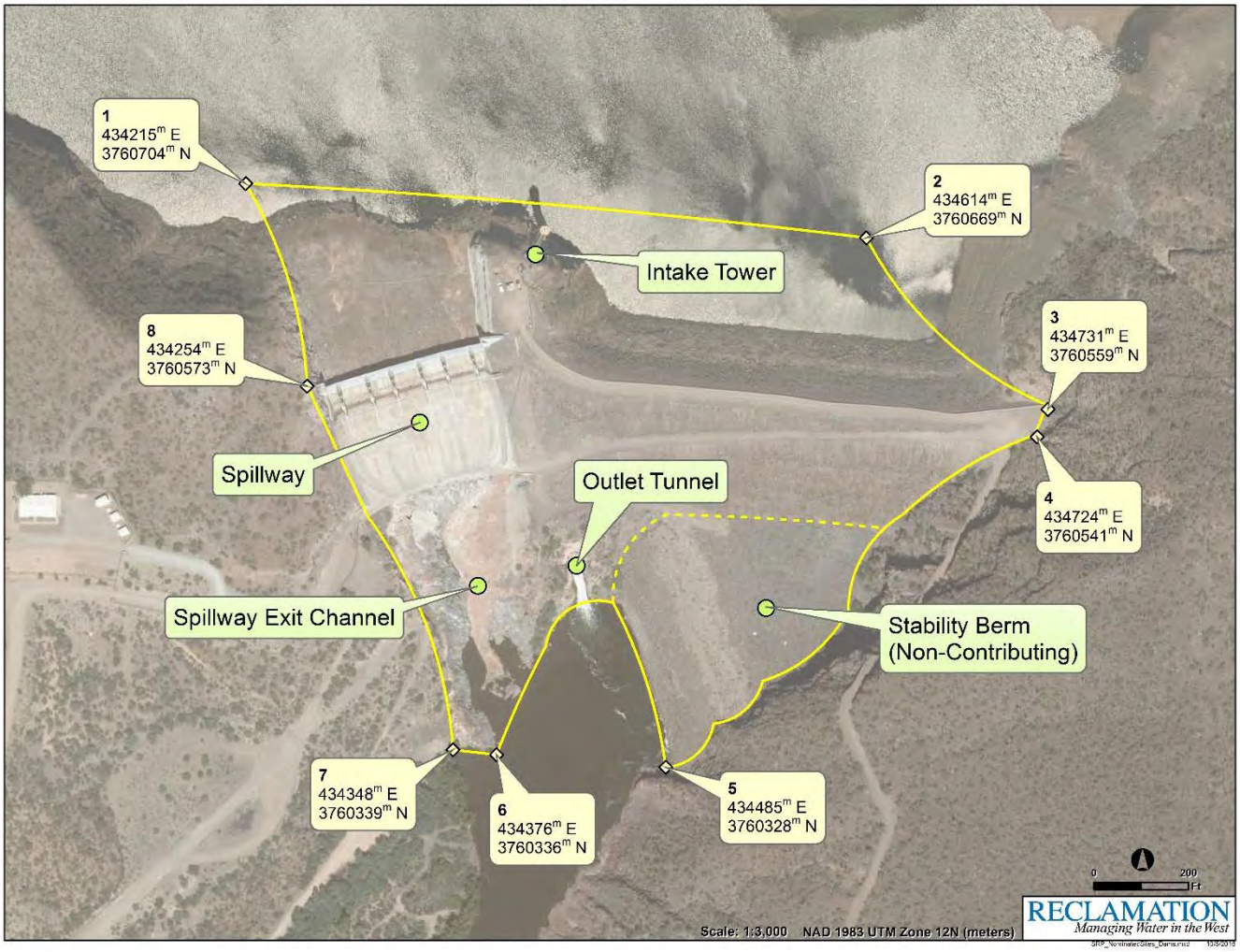

Map 2. Boundaries of Horseshoe Dam, spillway, and earth/rock filled abutments.

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Horseshoe Dam
Name of Property
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Map 3. Horseshoe Dam showing the orientation of photographs taken by Jim Bailey in 2009.

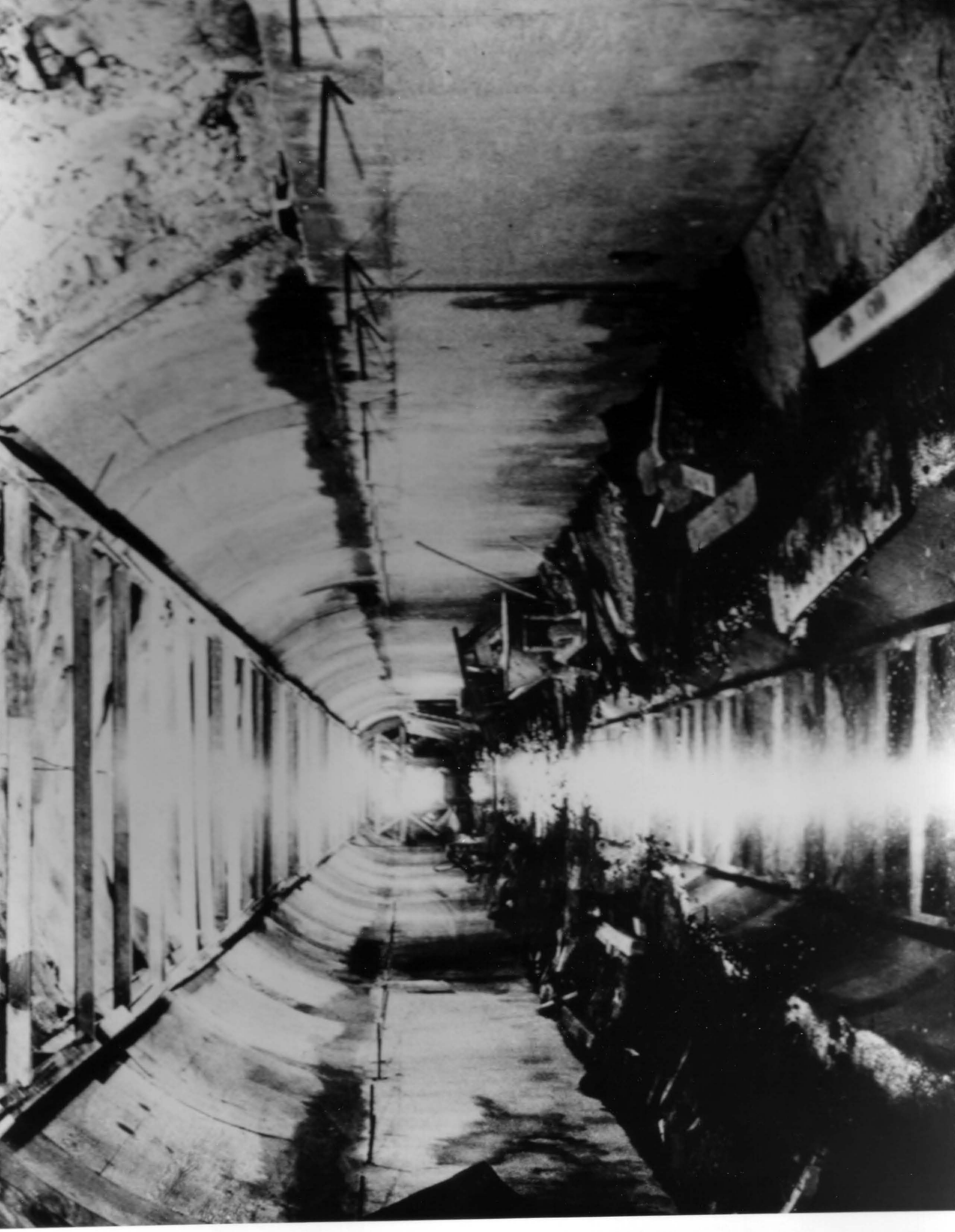

PHOTO No. AZ-24-28 INTERIOR OF TUNNEL LOOKING SOUTH. CONCRETED LINING COMPLETED ON INVERT AND WALLS, ARCH PARTIALLY COMPLETED. 11 March 1944.

PHOTO No. AZ-24-31 INTERIOR OF TUNNEL AFTER COMPLETION OF LINING. 21 MAY 1944.

PHOTO No. AZ-24-32 VIEW FROM POINT "A" DURING CLEANING AND SLUICING OF WEST ABUTMENT. SITE OF SPILLWAY CHANNEL ALSO CLEARED. 29 August 1944.

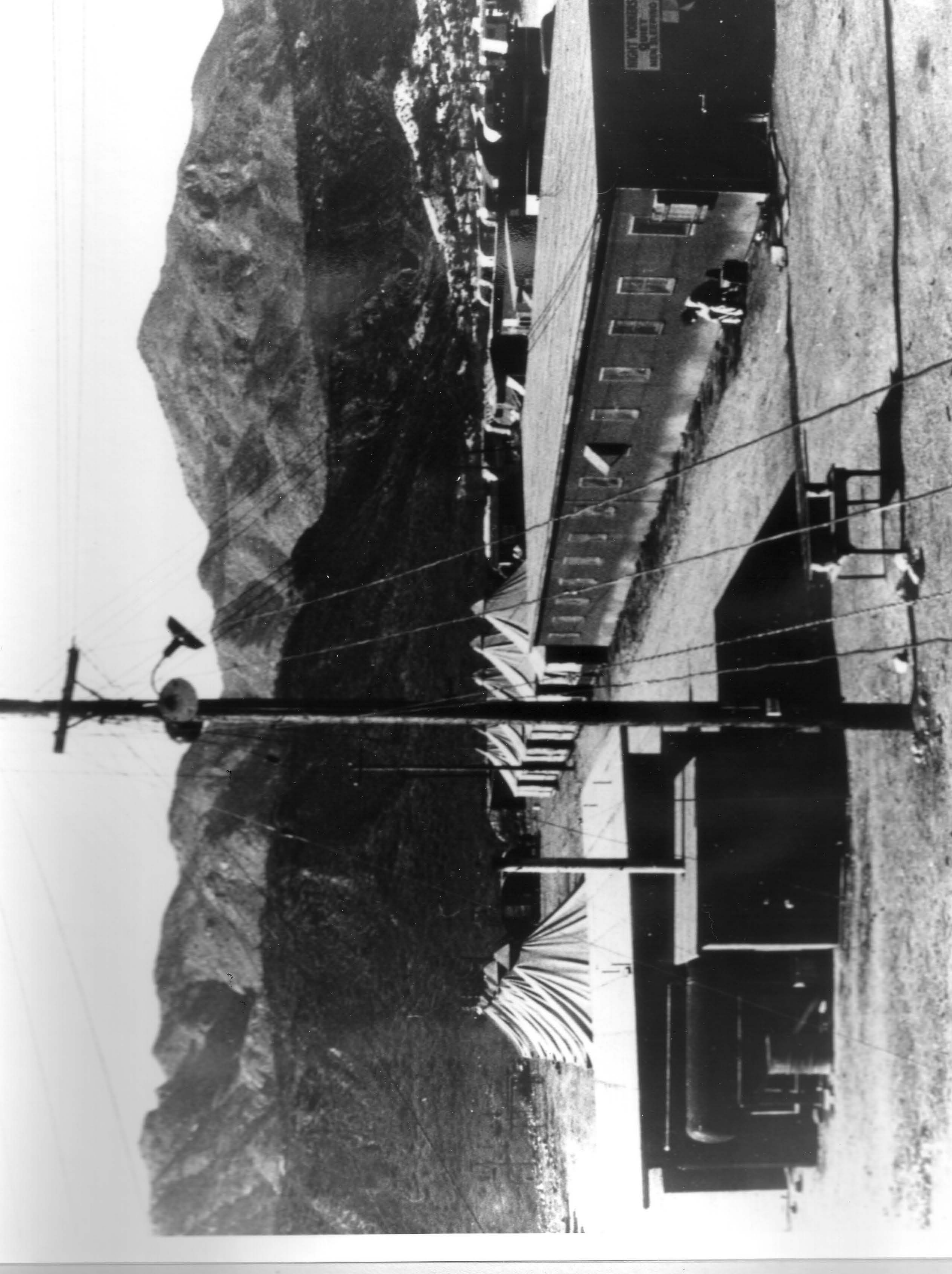

PHOTO No. AZ-24-34 PART OF THE ARUNDEL CORPORTATION AND L.E. DIXON COMPANY CAMP. VIEW LOOKING GENERALLY WEST. 10 November 1944.

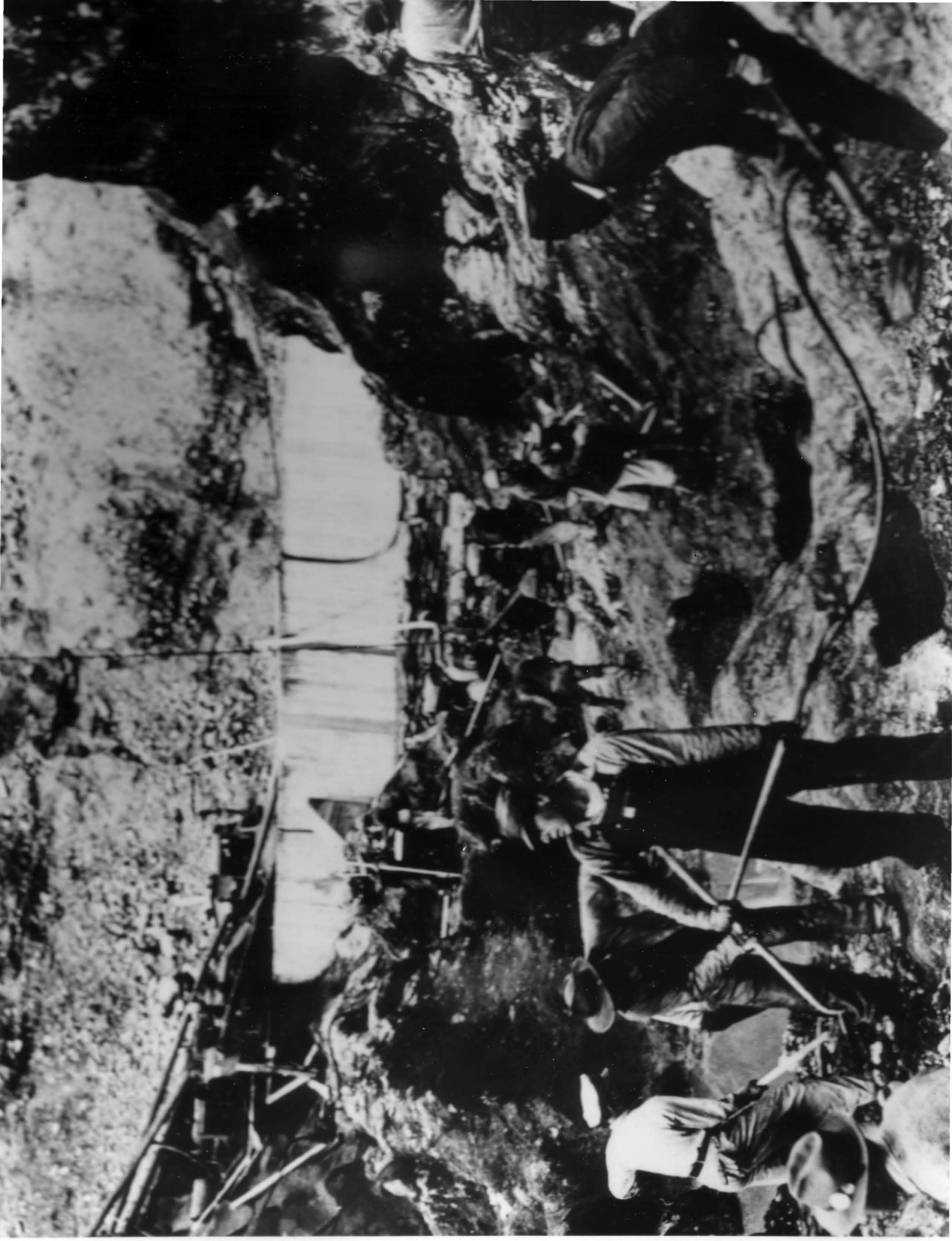

PHOTO No. AZ-24-36 FOUNDATION EXCAVATION, SHOWING CONCRETE CORE WALL IN CENTER BACKGROUND. 25 November 1944.

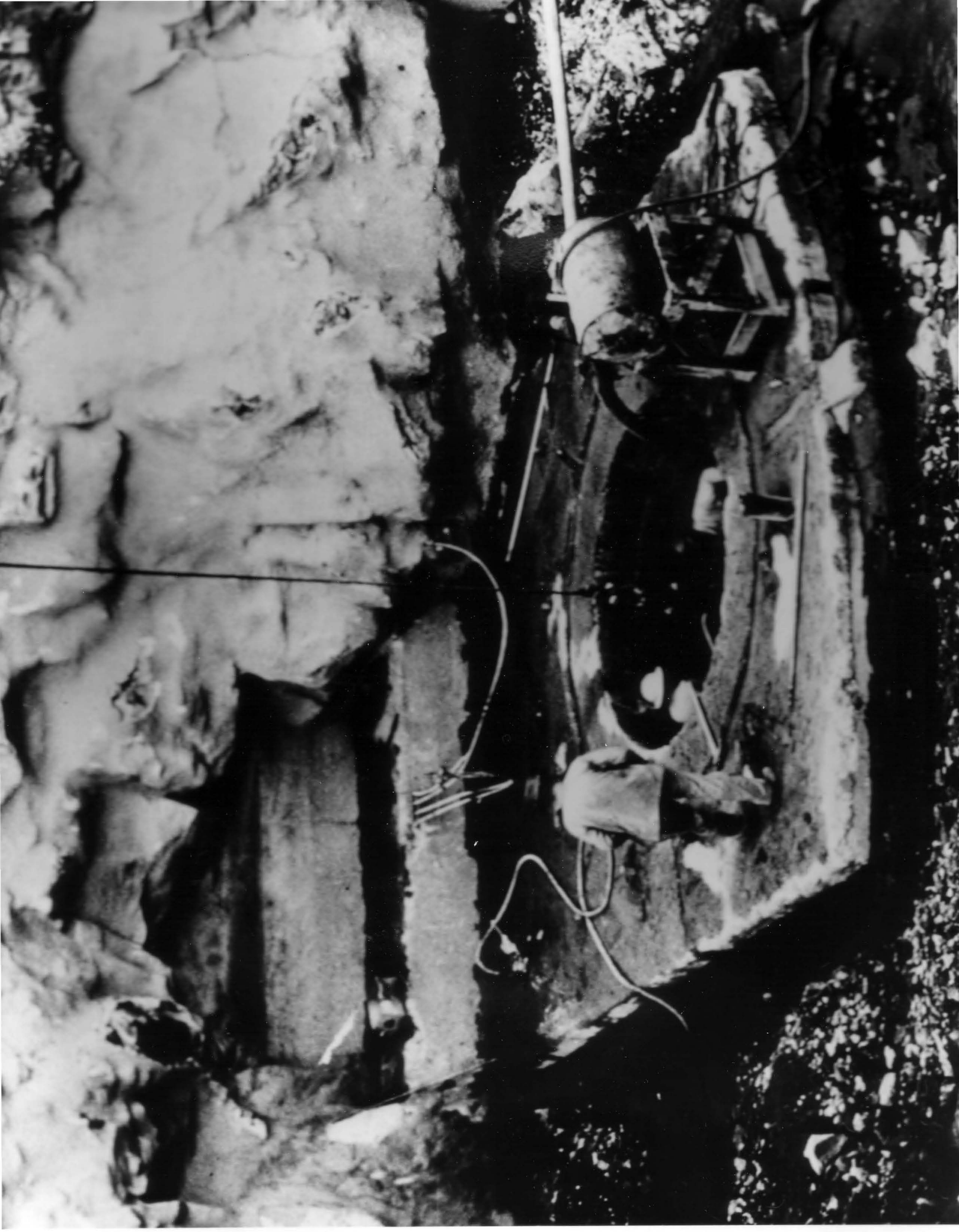

PHOTO No. AZ-24-45 BASE OF OUTLET TOWER AFTER DIVERSION OF RIVER. CLEANING UP IN PREPARATION FOR SETTING OF BASE CASTING. 13 February 1945.

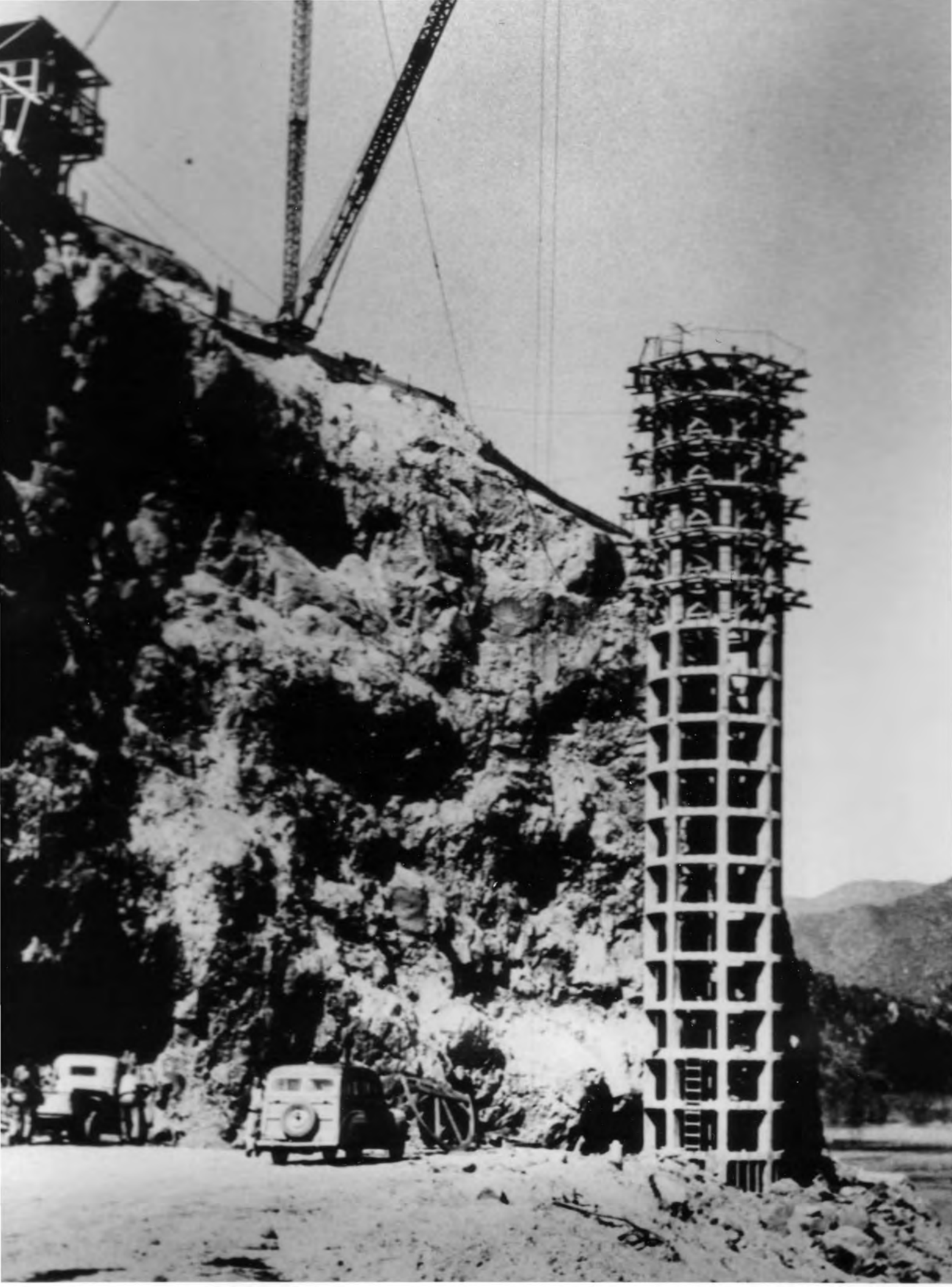

PHOTO No. AZ-24-49 OUTLET CONTROL TOWER LOOKING NORTH IN RESERVOIR AREA.
5 April 1945.

PHOTO No. AZ-24-53 LEFT SPILLWAY SIDEWALL FORMS AND STEEL. 8 June 1945.

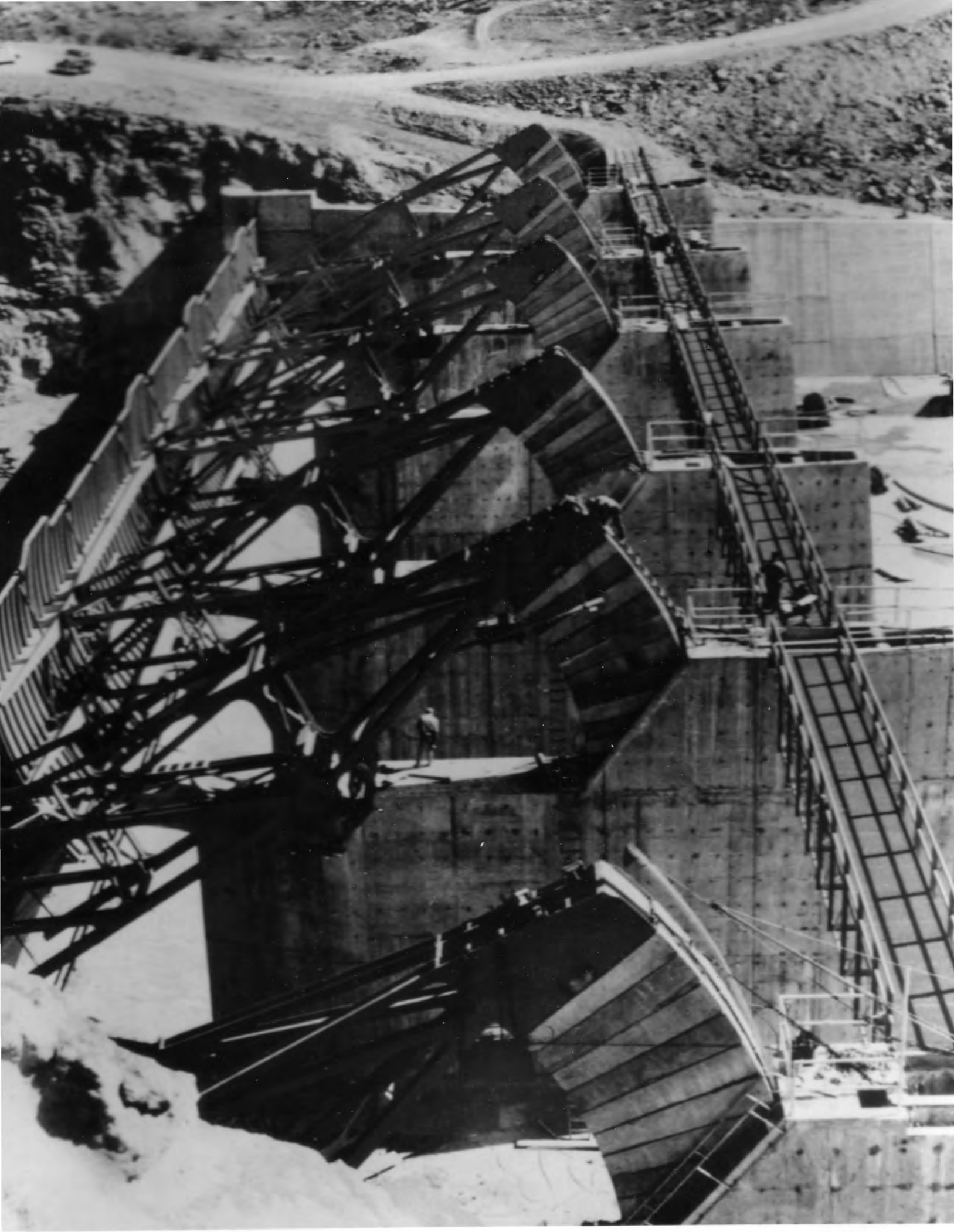

PHOTO No. AZ-24-65 GATES UNDER CONSTRUCTION. 21 February 1950.

PHOTO No. 10 HORSESHOE DAM, CONTEMPORARY VIEW OF DAM CREST.

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
EVALUATION/RETURN SHEET

Requested Action: Nomination

Property Name: Horseshoe Dam

Multiple Name: Salt River Project MPS

State & County: ARIZONA, Maricopa

Date Received:	Date of Pending List:	Date of 16th Day:	Date of 45th Day:	Date of Weekly List:
6/23/2017	7/18/2017	8/2/2017	8/7/2017	

Reference number: MP100001409

Nominator: State

Reason For Review:

__X__ Accept _____ Return _____ Reject **8/7/2017** Date

Abstract/Summary Comments: The Horseshoe Dam is of statewide significance under National Register Criterion A in the areas of Politics/Government and Community Planning and Development. Constructed in 1944-46, with historic modifications to the spillways in 1951, the earth and rock fill dam represents the evolving nature of the irrigation and municipal water supply programs of the Salt River Project--one of the first five federally sponsored western water projects. Financed by the Phelps-Dodge Copper Company and the U.S. Defense Plant Corporation, ostensibly to provide water exchange rights for their mining and processing operations in support of the war effort, the dam facility became an important component of the modern Salt River Project system. The resource meets the Registration Requirements of the SRP MPS.

Recommendation/ Criteria: Accept National Register Criterion A.

Reviewer Paul Lusignan Discipline Historian

Telephone (202)354-2229 Date 8/7/2017

DOCUMENTATION: see attached comments : No see attached SLR : No

If a nomination is returned to the nomination authority, the nomination is no longer under consideration by the National Park Service.

United States Department of the Interior

BUREAU OF RECLAMATION
P.O. Box 25007
Denver, CO 80225-0007

JUN 20 2017

IN REPLY REFER TO:

84-53000
ENV-3.00

MEMORANDUM

To: J. Paul Loether, Chief, National Register of Historic Places Program, National Park Service, 1201 Eye Street, NW (2280), Washington, DC 20005
Attn: Mr. Paul Lusignan

From: Roseann Gonzales
Director, Policy and Administration

Subject: Nomination of the Salt River Project (Project), Maricopa County, Arizona, as a Multiple Property Listing (MPL) in the National Register of Historic Places (National Register), and Nominations of Associated Properties under the MPL

The Bureau of Reclamation is pleased to nominate the Salt River Project as an MPL on the National Register. We are concurrently individually nominating five associated Project dams, and nominating the Project's diversion and conveyance system as a historic district. The multiple property documentation (MPD) form and associated property registration forms, with supporting information, are attached. All forms are submitted in electronic format on the two enclosed compact disks, with the required hard copy of the original signature sheet for each of the six property nomination forms. In order to provide an original signature for both the Federal Preservation Officer (FPO) and the State Historic Preservation Officer (SHPO), two copies of each signature page is attached. As is also required, I confirm that the enclosed compact disks contain the true and correct nomination forms for the Salt River Project MPD; for the Salt River Project Diversion and Conveyance System Historic District; and for Bartlett Dam, Horse Mesa Dam, Horseshoe Dam, Mormon Flat Dam, and Stewart Mountain Dam.

The nomination forms were submitted for review to the Arizona SHPO and the SHPO signed the forms without comment. In Arizona, the State Review Board does not review Federal nominations. Reclamation provided all seven forms to Maricopa County for review by their Board of Supervisors, who are the chief local elected officials. The 45-day comment period closed on May 25 without Reclamation receiving comment from the County. Although not required for Federal nominations, Reclamation also provided the MPD and historic district forms to the six Certified Local Governments (CLG) established within the greater Phoenix metropolitan area; they were not provided with the dam nomination forms because the Project dams lie outside of the jurisdictional boundary of a GLG. The comment period closed with only the City of Glendale responding to say they had no comment at this time, and that they found the "materials were very well put together."

The Project and the associated properties are important pieces of Western reclamation history. Although some modifications have occurred to keep the structures operational, in large part the nominated properties retain levels of design, materials, workmanship, feeling, and overall integrity sufficient to convey their historic character and function. They demonstrate the historic importance of this irrigation and hydropower system that was instrumental in the transformation of the Phoenix basin into one of the great regional centers of the West.

If you have any questions, please contact Mr. George Herbst, FPO, at 303-445-3311, or gherbst@usbr.gov, or Ms. Lynne MacDonald, cultural resources specialist, at 303-445-3206, or lmacdonald@usbr.gov.

Attachments - 14

cc: Archeologist, Bureau of Reclamation, 500 Fir Street, Boulder City, NV 89006-1470, Attn LC-2633 M. Slaughter
Archeologist, Bureau of Reclamation, 6150 W Thunderbird Road, Glendale AZ 85306-4001 Attn: PXAO-1500 D. Gifford
Supervisory Environmental Protection Specialist, Bureau of Reclamation 6150 W Thunderbird Road, Glendale AZ 85306-4001 Attn: PXAO-1500 S. Heath
Archeologist, Bureau of Reclamation, 6150 W Thunderbird Road, Glendale AZ 85306-4001 Attn: PXAO-1500 L Jelinek,
(all w/o att)