BISHOP CREEK HYDROELECTRIC SYSTEM,
HILLSIDE DAM
(South Lake Dam)
Spanning the South Fork of Bishop Creek
Bishop Vicinity
Inyo County
California

HAER No. CA-145-7

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

FIELD RECORDS

Historic American Engineering Record
National Park Service
Pacific West Regional Office
Department of the Interior
Seattle, WA 98104-1060

HISTORIC AMERICAN ENGINEERING RECORD

BISHOP CREEK HYDROELECTRIC SYSTEM, HILLSIDE DAM
(South Lake Dam, Spanning the South Fork of Bishop Creek)

HAER No. CA-145-7

Location: Hillside Dam is located at latitude: 37.17236, longitude: -118.56522. This coordinate represents the structure's east end. It was obtained on April 15, 2011, using the USGS 7.5 minute topographic map for Mount Thompson, California. The coordinate's datum is North American Datum 1983. The Hillside Dam location has no restriction on its release to the public.

In descriptive terms, Hillside Dam is located along the South Fork of Bishop Creek in Inyo County, California, in the eastern Sierra Nevada Mountains, approximately 20 miles southwest of Bishop. Bishop is located approximately 222 miles due north of Los Angeles.

Present Owner: Southern California Edison Company
2244 Walnut Grove Avenue
Rosemead, California 91770

Present Use: Dam

Significance: Hillside Dam is significant because of its role in the early engineering concept and construction of the Bishop Creek Hydroelectric System. The engineering used in its excavation and the creation of a tunnel system beneath the dam for use as a pressure pipe was innovative for its time. The dam is essentially unchanged from its date of construction, with the exception of the replacement of some of the timber facing.

Historian(s): Laura O'Neill, Associate Architectural Historian
Galvin Preservation Associates
1611 S. Pacific Coast Highway, #104
Redondo Beach, CA 90277

Project Information: The documentation has been prepared for Southern California Edison (SCE) because of proposed modifications to the dam. The modifications include installing a Geomembrane liner on the upstream side of the dam to stop current leakage and to prevent or minimize future leakage from the dam.

PART I. HISTORICAL INFORMATION

A. Physical History

1. **Date of Construction:** Hillside Dam was constructed between 1909 and 1911. It replaced a previous dam, which was constructed in 1890. In 1907, the Nevada-California Power Company acquired the site from the Hillside Water Company. In 1908, the new owner enlarged the existing dam and the next year began construction on the current, much larger dam in its place.[1]

2. **Engineers:** The engineering firm of Manifold and Poole is credited with the design of the dam.[2] Richard G. Manifold and Charles O. Poole were principals of the engineering and consulting firm located in the Central Building at 108 W. 6th Street, Los Angeles.[3] The firm worked on several large Nevada-California Power Company projects, including the Silver Lake Power Plant in 1916. They also did work for affiliated power companies, such as the Southern Sierras Company.

   Richard Going Manifold was born on March 12, 1866, in Ireland.[4] He immigrated to the U.S. in 1890. Around the time of the Hillside Dam construction, he resided in Los Angeles at 2635 Hobart Boulevard.[5] He moved around somewhat, residing in Riverside, California in 1920, and Glendale, California in 1930, according to census records. He was married to Charlotte Poole and had two children. He died at the age of 86 on March 8, 1952.[6]

   Charles Oscar Poole was born on June 17, 1859, in Salisbury, Massachusetts. He married Margaret A. Egan in 1888.[7] Around the time of the Hillside Dam construction, the couple resided at 2118 W. 28th Street, Los Angeles.[8] They later moved to Crenshaw Boulevard, where Poole resided at the time of his death at age 66 on April 30, 1925. Poole was a member of the City Club, Chamber of Commerce, and American Society of Civil Engineers.[9]

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[1] Diamond, Valerie H., Stephen G. Helmich, and Robert A. Hicks. "South Lake Dam Historic Resources Inventory Form." *Bishop Creek Hydroelectric System Historic District Report*. Unpublished report by Theodoratus Cultural Research, Inc.: January 11, 1988; p. A-187; Charles O. Poole. "Hydroelectric Development on Bishop Creek, Cal.," *Electric World*, 1914; p. 7.
[2] Ibid; p. A-188.
[3] Los Angeles City Directory, 1909.
[4] U.S. Census data, 1930.
[5] Los Angeles City Directory, 1909.
[6] California Death Index, 1940-1997.
[7] U.S. Census data, 1900.
[8] Los Angeles City Directory, 1909.
[9] "Member of Local Engineering Firm Paralysis Victim." *Los Angeles Times*. April 3, 1925; p. A7.

3. **Builder:** Nevada-California Power Company [10]

4. **Original Plans:** There are no original plans remaining on file for Hillside Dam; however, there are several later drawings on file in the Southern California Edison offices, as well as early photographs of its resurfacing in the Southern California Edison Company Collection at the Huntington Library in San Marino, California**.** The following information was gathered from a study of those drawings and photographs and from a Historic Resources Inventory Form prepared for the dam in 1988.

   Hillside Dam was designed as a rock-filled structure with timber sheathing on the upstream face. The downstream face was left as exposed rock fill. The dimensions of the dam were 645’ long x 81’- 6” high. It was 11’ wide at its apex. The timber sheathing consisted of redwood and was spaced at 6’ on center and attached to 8” Douglas fir stringers spaced at 5’- 4“ on center. There were three different thicknesses of plank as the depth increased. The bottom of the sheathing was sealed into a concrete-filled trench. The slope of the upstream face of the dam was 0.75 horizontal to 1 vertical. The downstream slope was 1.25 horizontal to 1 vertical. The elevation of the dam was 9,708’, and the floor of the spillway was 6’ lower. The spillway, excavated through solid rock at the east end of the dam, was 40’ wide. Two 24” still waste pipes were laid through the base of the dam to provide an emergency outlet. The inlet to one of these pipes was located at the toe of the dam and the other was carried through the rock tunnel 200’ into the lake. The draw-off valves for the outlet pipes were located at the heel of the dam and were protected by a concrete gatehouse.[11]

   An outlet tunnel was also constructed through bedrock below the lowest point in the dam’s foundation to create additional storage below the original lake. The unlined tunnel measured 1,980’ in length with a 5’ x 7’ opening within the reservoir. The elevation was 9,571’ at its upper end and 9,560’ at its lower portal.

5. **Alterations and Additions:** The dam and outlet tunnel have undergone few changes. The two 24” emergency waste pipes were abandoned and encased in concrete during the 1950s. Also during the same period, a 24” steel valve pipe was added to one end of the outlet tunnels**.**[12]

   Portions of redwood facing were replaced in 1932, 1938, 1950, 1951, and possibly more recently.[13]

[10] Diamond; p. A-188.
[11] Poole; p. 6 – 7.
[12] Ibid; p. A-188.
[13] Ibid.

A metal handrail was added to the top of the dam along the upstream edge at an unknown date.

B. Historical Context

Hillside Dam is significant for its role in the early engineering concept and construction of the Bishop Creek Hydroelectric System. The Bishop Creek Hydroelectric System has been determined eligible for the National Register of Historic Places as a historic district, and Hillside Dam is a contributor to the district. The system as a whole is significant for its roles in the expansion of hydroelectric power generation technology, in the development of eastern California and western Nevada, and in the development of long-distance electrical power transmission and distribution.[14] Hillside Dam itself is significant for its use of innovative engineering methods used to excavate a tunnel beneath the dam for use as a pressure tunnel.

<u>Overview of the Bishop Creek Hydroelectric System and Hillside Dam</u>[15]

The Bishop Creek Hydroelectric System consists of five sets of independent, high-head, impulse water wheel, electricity-generating power plants at various elevations along the south, middle, and north forks of Bishop Creek. It is a typical run-of-the-river type system that was built to exploit the geography of the eastern slopes of the Sierra Nevada Mountains. Bishop Creek starts at the 13,000-foot crest of the Sierra Nevada Mountains and drops over 4,000’ over a horizontal distance of 14 miles to the Owens Valley. For the most part, Bishop Creek flows in steep-sided canyons with the north wall of the canyon composed of a glacial moraine, which forms a natural, almost continuous ridge paralleling the creek. This ridge was used as the backbone for most of the Bishop Creek Hydroelectric flowlines. The Bishop Creek system consists of five powerhouses, one control station, two gauging stations, ten flowlines, ten intakes, seven penstocks, four diversions, four reservoirs, four dams, worker housing, and other associated support buildings. Most of the Bishop Creek project area falls within the rain shadow of the Sierra Mountains, and the vast majority of the precipitation in the area falls as snow in the high mountains. The snow fields furnish an abundant water supply during the summer, but the stream flow dwindles in the fall when water is drawn from the reservoirs.

South Lake (originally Hillside Reservoir) was designed to regulate flow, rather than to create head, along the creek. In conjunction with Bluff Lake, South Lake confines the headwaters of the South Fork of Bishop Creek. Like the other lakes in the system, South

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[14] Taylor, Thomas T. *Bishop Creek Hydroelectric System, Bishop Creek, Bishop Vicinity, Inyo County, California*. Historic American Engineering Record No. CA-145. From Library of Congress. *Built in America Collection: Historic American Buildings Survey/Historic American Engineering Record/Historic American Landscapes Survey, 1933-Present*. February 7, 1994; p. 1.

[15] Excerpted from Taylor, *Bishop Creek Hydroelectric System*, HAER No. CA-145; p. 3-4.

Lake stores snow-melt from the high Sierra Nevada Mountains crest near 13,000'. Its capacity is 14,000 acre feet. The water in the reservoir is kept ready for release when needed. Thus, water stored during high flow, which is usually during winter and spring, can be released during summer and fall low-flow periods.

Waters from Green Creek and Bluff Lake are diverted to South Lake on the South Fork of Bishop Creek. From South Lake Dam (originally Hillside Dam) to Coates Meadow, a distance of seven and one half miles, the stream travels the natural channel toward its confluence with the Middle Fork. At Coates Meadow the South Fork Bishop Creek Dam and flowline diverts a portion of this water into Intake 2, a stabilizing reservoir.

From below Intake 2, the water transportation pattern is repeated from plant to plant: water is taken from an intake or equalizing pond and transported via flowlines and penstock to the next plant. In this way, the water of Bishop Creek is used five times on its journey down the steep canyon to the edge of the Owens Valley. From Intake 2 to Plant 6, the water drops 3,590'. After leaving Plant 6, the water is used for irrigation before final disposition into Owens River.

<u>History of the Bishop Creek Hydroelectric System and Hillside Dam</u>[16]

Word of the discovery of economic minerals at Tonopah and Goldfield in western Nevada drew numerous fortune seekers, including Loren B. Curtis, a hydraulic engineer, and Charles M. Hobbs, a former official in the Denver and Rio Grande Railway, in 1904. Curtis and Hobbs had come for the mineral prospects but realized that the economic boom could not continue without adequate power. Although the locally owned and operated Tonopah Light and Power Company and Goldfield Electric Light and Power Company had generated electricity by the burning of fuels, their power was too expensive and unreliable. Curtis and Hobbs recognized the potential market for hydroelectric power and identified Bishop Creek in California as the best location for the generators.

The Nevada Power, Mining and Milling Company was incorporated on December 24, 1904. Construction began on the first power plant (Plant 4) in January 1905. A contract for delivery of power was signed with the Combination Mines Company in May 1905. By August 1905, water rights had been secured from the Hillside Water Company, and on September 19, 1905, hydroelectric power was delivered to the Goldfield Substation, and two days later to Tonopah.

System additions were undertaken in 1906-07 after new ore discoveries in Manhattan, Bullfrog, and Rhyolite, Nevada portended an expanding power market. These included an enlarged South Lake, a new reservoir (Sabrina) on the Middle Fork of Bishop Creek, a new transmission line to Tonopah and Goldfield, a new general office in Goldfield, and expansion

[16] Excerpted from Taylor, *Bishop Creek Hydroelectric System*, HAER No. CA-145; p. 13-15.

of Plant 4. In addition, the Nevada Power, Mining and Milling Company reorganized as the Nevada-California Power Company, and all capital stock of Hillside Water Company was purchased in order to guarantee adequate water supplies for electric power generation and permit the construction of additional plants along the course of Bishop Creek.

In 1908-09, the Nevada-California Power Company purchased the assets of the Bishop Light and Power Company and the capital stock of the Rhyolite Light, Heat and Power Company. Another unit was added to the Plant 4 powerhouse, and Plants 2 and 5 were constructed (1908 and 1909, respectively). The existing facilities were now capable of producing twice the power for which there was a market.

In 1910, the Nevada-California Power Company decided to diversify their market by expanding into Southern California. In June 1911, the Southern Sierras Power Company was formed as part of the expansion efforts. It purchased and operated the equipment installed at Plant 5 and began construction of a transmission line from Plant 5 to San Bernardino, California. Also in 1911, Plant 3 was built by the Nevada-California Power Company. It was during this period that the company also completed construction of the new Hillside Dam.

In 1913, the Southern Sierras Power Company completed construction of Plant 6 on lands downstream from Plant 5 and the system was essentially complete. (Plant 1 was to have been built at the present site of the Plant 2 intake, but was never built because of the vulnerability of the site to avalanches.) The combined power generated by the Bishop Creek system was now 24, 350 kilowatts.

In 1914, the Nevada-California Electric Corporation was formed as a holding company for the associated companies. In addition to the Nevada-California Power Company and the Southern Sierras Company, the associated companies included the Sierras Construction Company, the Corona Gas and Electric Company, the Bishop Light and Power Company, the Interstate Telegraph Company, the Hillside Water Company, the Elsinore Electric Light Company, and the Barstow Utilities Company.

In 1936, the Nevada-California Electric Corporation reorganized as an operating company and changed its name to the California Electric and Power Company, or CalElectric. CalElectric was absorbed by the Southern California Edison Company in a merger/takeover in 1964.

Significance of the Bishop Creek Hydroelectric System and Hillside Dam[17]

The Bishop Creek Hydroelectric System is significant for its position in the expansion of hydroelectric generation technology, its role in the development of eastern California and western Nevada, and the development of long-distance power transmission and distribution. Hillside Dam is significant as a contributor to the system, which is credited with several early long-distance transmission records. The system contributed vitally to the success of the Tonopah and Goldfield mining ventures and the overall economic independence of western Nevada. Additionally, along with the associated companies, the Bishop Creek system provided power to run large-scale ice producing machines in the San Bernardino, Coachella, and Imperial Valleys.

[17] Excerpted from Taylor, *Bishop Creek Hydroelectric System*, HAER No. CA-145; p. 15.

PART II: STRUCTURAL/DESIGN INFORMATION

A. General Description

Hillside Dam is a rock-filled structure with timber sheathing on the upstream face. The downstream face is exposed rock fill. The timber sheathing consists of redwood planks oriented horizontally and spaced at 6’ on center. There are three different thicknesses of plank as the depth increases. The planks have been covered with plywood panels in some locations to address current leakage issues. The bottom of the sheathing is sealed into a concrete-filled trench.

An unpaved path travels along the top of the dam. A metal handrail was added along the upstream side of the path at an unknown date. The handrail consists of thin, round, vertical posts with thin, round top and center rails. The posts are bolted directly to the redwood planks at the top of the upstream face. A fire protection system was installed at an unknown date to protect the dam during periods when the water level was low in the reservoir. Its pipe with holes through which water could spray runs along the length of the metal handrail at the top of the dam.

1. **Character:** Hillside Dam has a rustic, earthy character due to its natural materials palette. As a result, it blends easily into the landscape. When the water level in the lake is high, only a few feet of the upstream face are visible above the surface. In winter and early spring, the downstream face is typically covered with snow and not visible at all.

2. **Condition of Fabric:** The dam exhibits evidence of leakage near the center of the upstream face. To address the leakage, portions of the timber sheathing have been covered with plywood panels. It is otherwise intact and in good condition.

B. Construction

The dam was constructed with approximately 83,733 yards of cubic rock fill composed of granite taken from a quarry near the dam site.[18] The fill was built up to a maximum height of approximately 81’- 6”. Douglas fir timber stringers spaced at 5’- 4” on center were affixed to the upstream face of the dam and tied into the fill with iron rods. The rods were 6’ long, spaced at 6’ on center, and anchored to the fill by 5’ T-rails. Joints between the stringers were lapped and reinforced with creosoted scabs spiked on each side.[19]

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[18] Fowler, Frederick Hall. *Hydroelectric Power Systems of California and Their Extensions into Oregon and Nevada*. Washington, D. C.: Government Printing Office, 1923; p. 780; Poole; p. 4 – 5.
[19] Undated drawing titled, “Hillside Dam.” Southern California Edison Co. Reduced copy of drawing included at the end of this report.

The stringers were faced with redwood planks. The plank ends were grooved and fitted with steel splines 1/8" thick and 2" long. From the base of the dam to an elevation of about 9,719', there are three layers of 3" plank for a total facing thickness of approximately 9". From 9,719' to about 9,745', there are two layers of 3" plank for a total facing thickness of approximately 6". From 9,745' to the top of the dam, there is one layer of 2" plank atop one layer of 3" plank for a total facing thickness of approximately 5". At the base of the dam, the sheathing is sealed into a 3' x 3' concrete trench.[20] The second layer of planks at the base of the dam was covered with heavy sail cloth and hot pitch, followed by the third layer of planks.[21]

The 40' spillway was excavated through solid granite, as was the outlet tunnel. The bedrock of the ridge on which the dam was constructed was at a higher level than the bottom of the former natural lake. In order to create the outlet tunnel and get the benefit of the storage below the old lake surface, it was necessary to tunnel through bedrock below the lowest point in the dam's foundation. The upper portal of the tunnel was in the lake about 1,380' upstream. The lower portal was 600' downstream from the dam.[22] Taylor explained this construction process thusly:

> "Perhaps the most striking engineering feat [of the Bishop Creek system] performed was tapping the south lake reservoir from 600' below the site of the dam, driving a tunnel into the solid granite, coming up to the lake, and breaking through the lake bottom to convert the tunnel into a pressure pipe. The end of the tunnel being 65' under water, the task of cutting through involved some rather unusual work. It was actually accomplished by excavating very cautiously within about 20' of the lake bottom and then cutting short laterals to provide a powder chamber for blowing up the bottom and admitting the water. The tunnel was tamped for 30' with muck back of the powder, and when the 5,200-lb charge was fired, the end of the tunnel was blown out into the lake."[23]

C. *Mechanical Operation*

Operational components of the dam included the two waste pipes and the outlet tunnel. The two original 24" steel waste pipes, which have been filled in and are no longer operational, were controlled by hand-operated gate valves located at the toe of the dam. Flow through the outlet tunnel was also manually controlled. The components included a 3' x 5' gate at the foot of the vertical shaft and a 3' x 5' hinged gate in the lower end of the tunnel. The hinged

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[20] Ibid.
[21] Poole; p. 6.
[22] Fowler; p. 780.
[23] Taylor, William Thomas and Daniel Harvey Braymer. "Chapter XXVII – Hydroelectric Developments of Nevada-California Power Company and Southern Sierras Power Company on Bishop Creek, Inyo County, Cal." *American Hydroelectric Practice*. New York: McGraw-Hill Book Company, Inc., 1917; p. 117.

gate was just above a 36' concrete bulkhead pierced by a 36" pipe fitted with a 36" hand-operated gate valve.[24]

The dam was outfitted with a fire protection system in place. A description of the system comes from Gary Lloyd, a Bishop Creek Hydroelectric system employee whose father worked for CalElectric. Water was routed from Green Creek south of the dam into a tank located south of the dam. The water was then routed from the tank up to the dam's handrail, which has openings that could spray water over the length of the dam in case of a fire during periods when the water level in the reservoir was low. It is not know at what date the fire prevention system was installed. The system is not currently in use.

D. Site Information

Hillside Dam is accessed from South Lake Road, which runs southeast from its intersection with Highway 168. The dam is located to the west of South Lake Road and south of Weir Lake. It stretches on a roughly east-west axis across the north end of South Lake. The terrain in the immediate vicinity is rocky and rugged due to the region's history of Pleistocene glacial activity. It is particularly steep and jagged as it rises to the west of South Lake. Vegetation in the area includes evergreen trees, as well as low-lying chaparral and scrub. The low-lying vegetation is covered by snow during winter and early spring.

There are two small structures associated with the dam – an access bridge and a gauging station. The bridge is constructed of wood and metal and stretches from South Lake Road across a shallow canyon. There is a hinged metal gate at the bridge's east end.

The gauging station is located at the east end of the dam. It faces east toward South Lake Road. It is a small shed constructed of wood framing covered with corrugated metal siding. It has a square plan, a front-gabled roof, and a metal door on its east façade. The door has a single light that has been filled in with plywood. There are two photovoltaic panels on the building – one on the roof and one just above the door. There is also a large antenna on the roof. A single metal pipe extends upward beyond the roofline on the west façade.

A sawmill was built near the dam site to mill the wood required for the dam and camp buildings.[25] The sawmill no longer remains but the bottom of the lake is graded where the mill likely stood, and there are extant rails at the same location that were used for carting lumber. Also located south of the dam site is the quarry from which the rock for the construction of the dam was taken.

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[24] Fowler; p. 780.
[25] Poole; p. 7.

PART III: SOURCES OF INFORMATION

"City Claims Big Pine." *Los Angeles Times*. March 25, 1914; p. II1.

Clerico, Robert and Ana Beth Koval. *An Architectural and Historical Evaluation of Structures Associated with the Bishop Creek Hydroelectric Power System, Inyo County, California*. Unpublished report prepared for Southern California Edison by Intermountain Research: December 1986.

Diamond, Valerie H., Stephen G. Helmich, and Robert A. Hicks. "South Lake Dam Historic Resources Inventory Form." *Bishop Creek Hydroelectric System Historic District Report*. Unpublished report by Theodoratus Cultural Research, Inc.: January 11, 1988.

Fowler, Frederick Hall. *Hydroelectric Power Systems of California and Their Extensions into Oregon and Nevada*. Washington, D. C.: Government Printing Office, 1923.

Los Angeles City Directories, 1909, 1915, and 1925.

Low, George P. "The Generating, Transmission and Distribution Systems of the Edison Electric Company of Los Angeles, Cal." *The Journal of Electricity, Power and Gas*. Vol. XIII, no. 1. January, 1903.

"Member of Local Engineering Firm Paralysis Victim." *Los Angeles Times*. April 3, 1925; p. A7.

Myers, William A. *Iron Men and Copper Wires: A Centennial History of the Southern California Edison Company*. Glendale, California: Trans-Anglo Books, 1986.

Pollock, Katherine H. *Bishop Creek Hydroelectric System, Power Plant 2, Lake Sabrina Dam, Bishop Creek, Bishop Vicinity, Inyo County, California*. Historic American Engineering Record No. CA-145-2-A. From Library of Congress. *Built in America Collection: Historic American Buildings Survey/Historic American Engineering Record/Historic American Landscapes Survey, 1933-Present*. October 5, 2007.

Poole, Charles O. "Hydroelectric Development on Bishop Creek, Cal.," *Electrical World*, 1914; p. 3 – 7.

"Power for Ryholite." *Los Angeles Times*. September 1, 1907; p. III6.

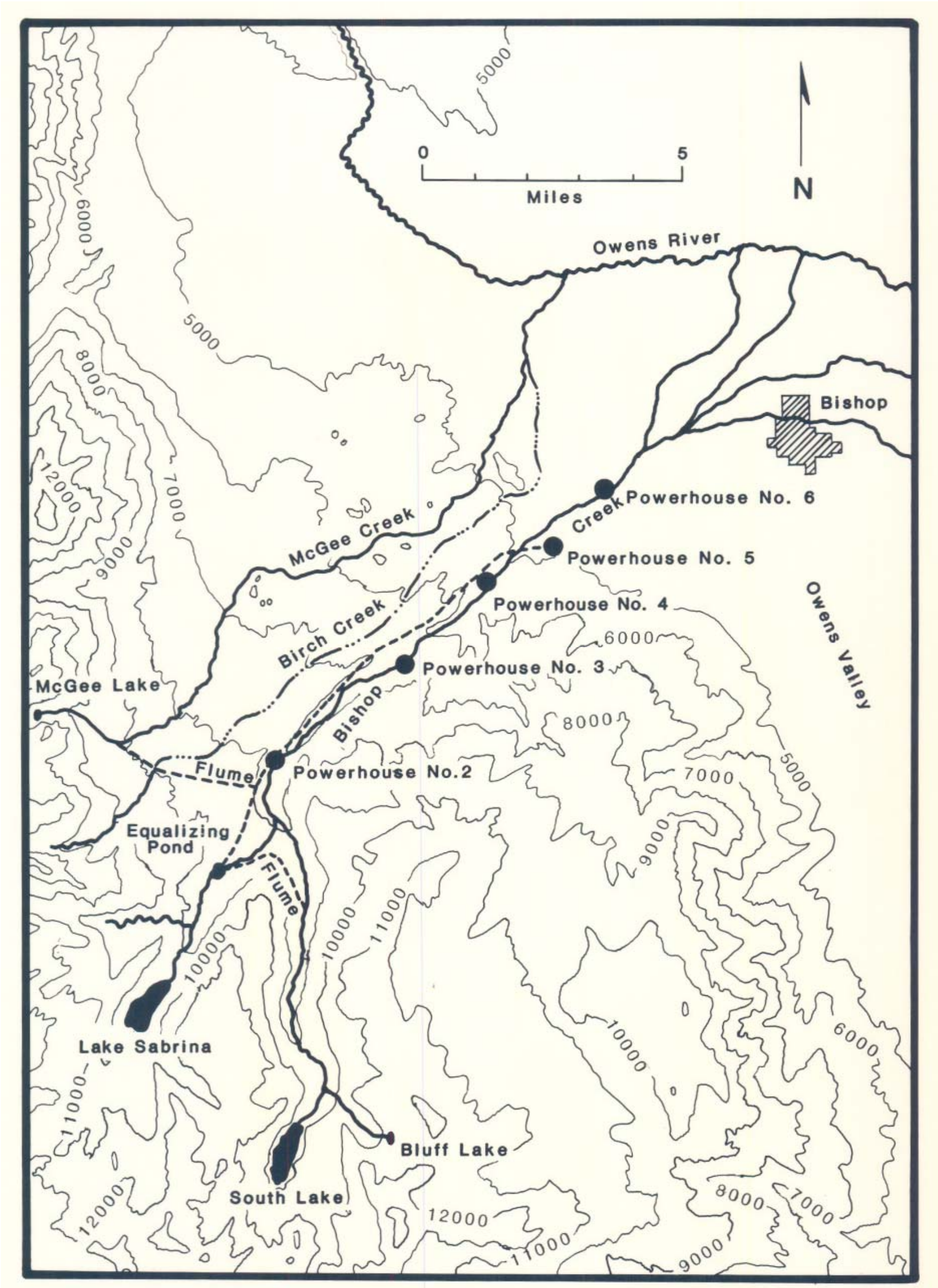
Taylor, Thomas T. *Bishop Creek Hydroelectric System, Bishop Creek, Bishop Vicinity, Inyo County, California*. Historic American Engineering Record No. CA-145. From Library of Congress. *Built in America Collection: Historic American Buildings Survey/Historic American Engineering Record/Historic American Landscapes Survey, 1933-Present*. February 7, 1994.

Taylor, William Thomas and Daniel Harvey Braymer. "Chapter XXVII – Hydroelectric Developments of Nevada-California Power Company and Southern Sierras Power Company on Bishop Creek, Inyo County, Cal." *American Hydroelectric Practice*. New York: McGraw-Hill Book Company, Inc., 1917.

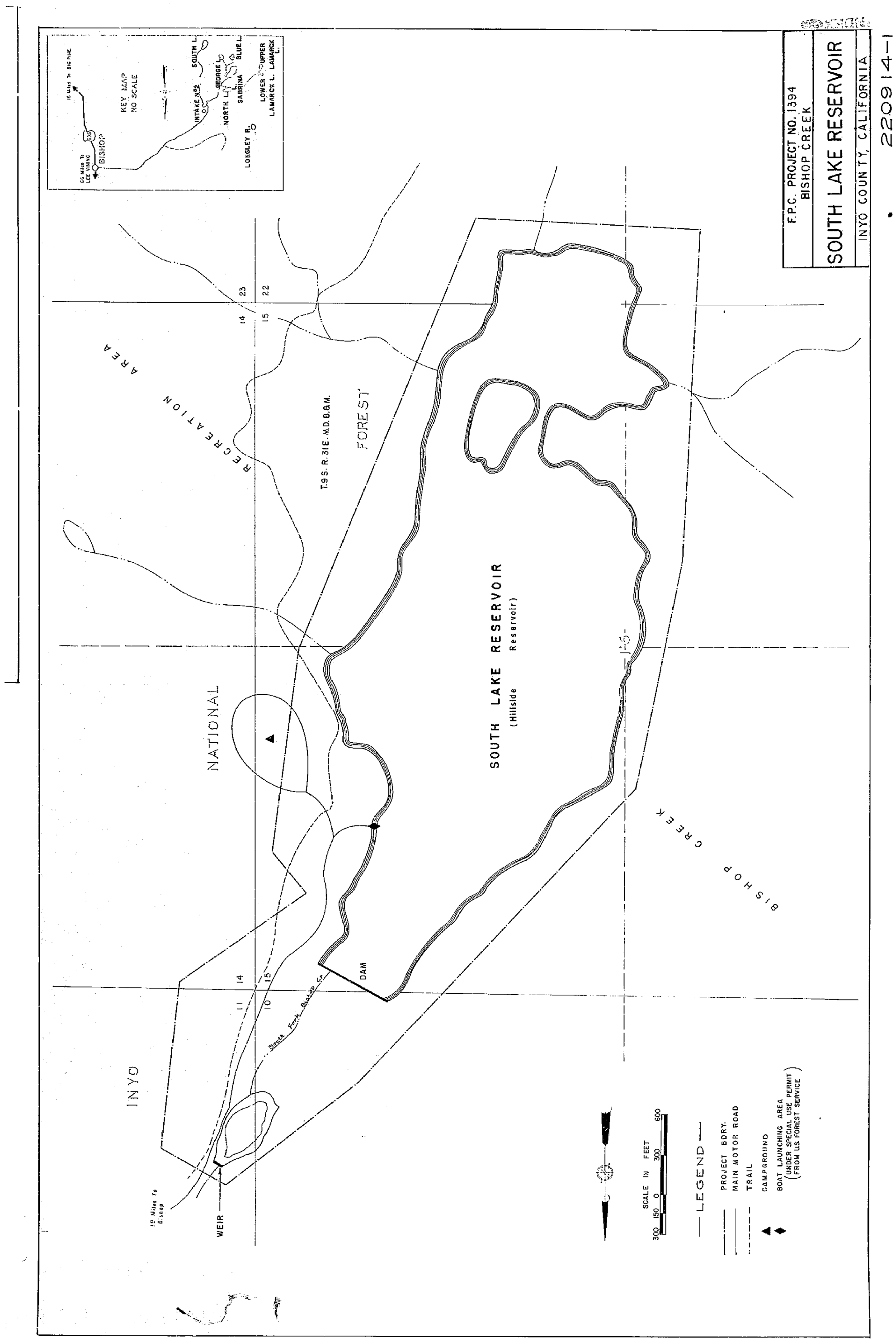
"The Thousand Wonders of Productive Owens Valley." *Los Angeles Times*. August 13, 1911; p. VI2.

United States Census data, years 1900, 1910, 1920, and 1930.

"Wonderful Waterfall a Sacrifice to Thor." *Los Angeles Times*. August 13, 1916; p. II1.



Overview map of the Bishop Creek Hydroelectric System taken from *An Architectural and Historical Evaluation of Structures Associated with the Bishop Creek Hydroelectric Power System, Inyo County, California*; p. 14. See bibliography for complete reference.



Undated, overview map of South Lake Reservoir. Courtesy of Southern California Edison Co.

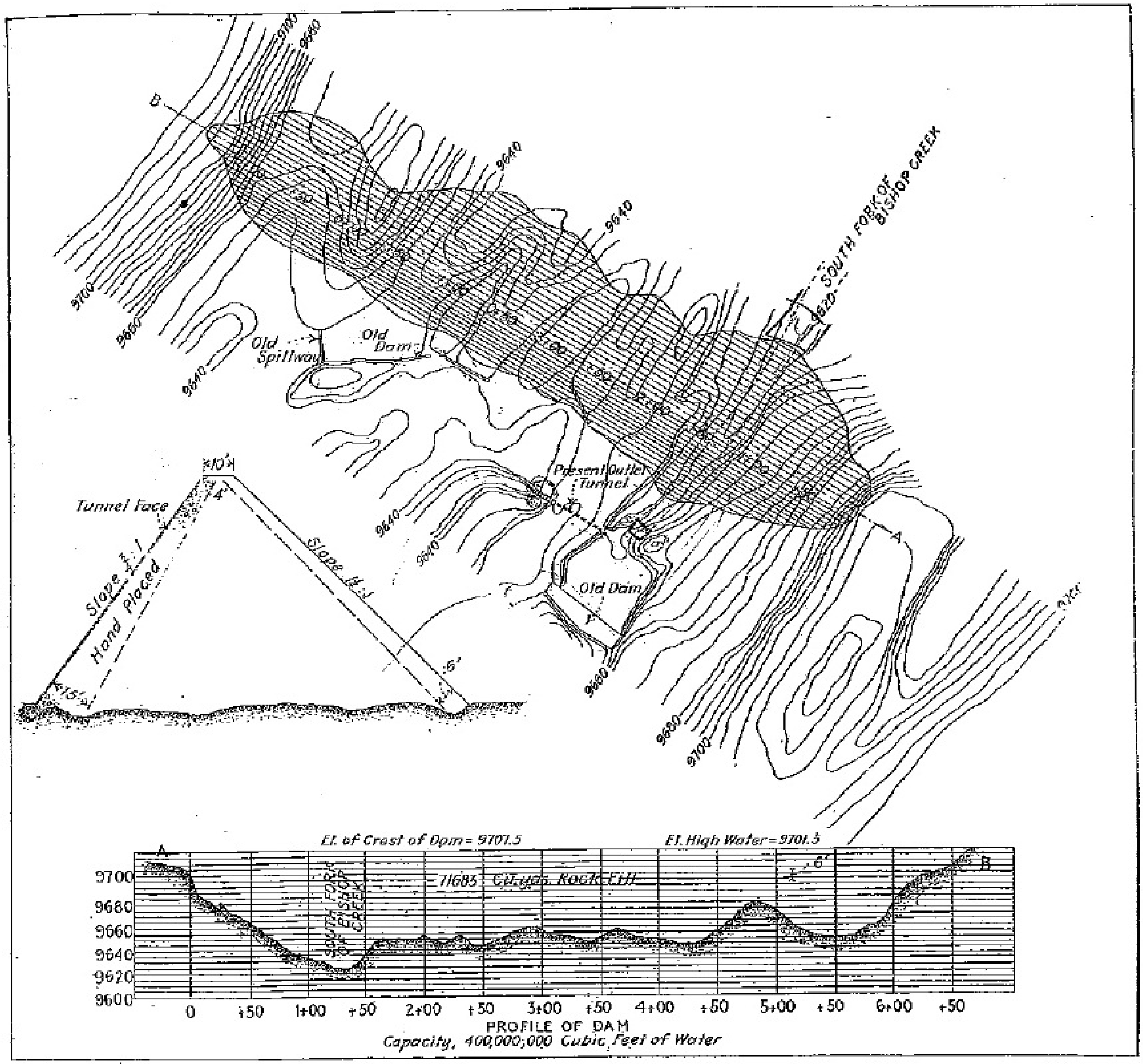
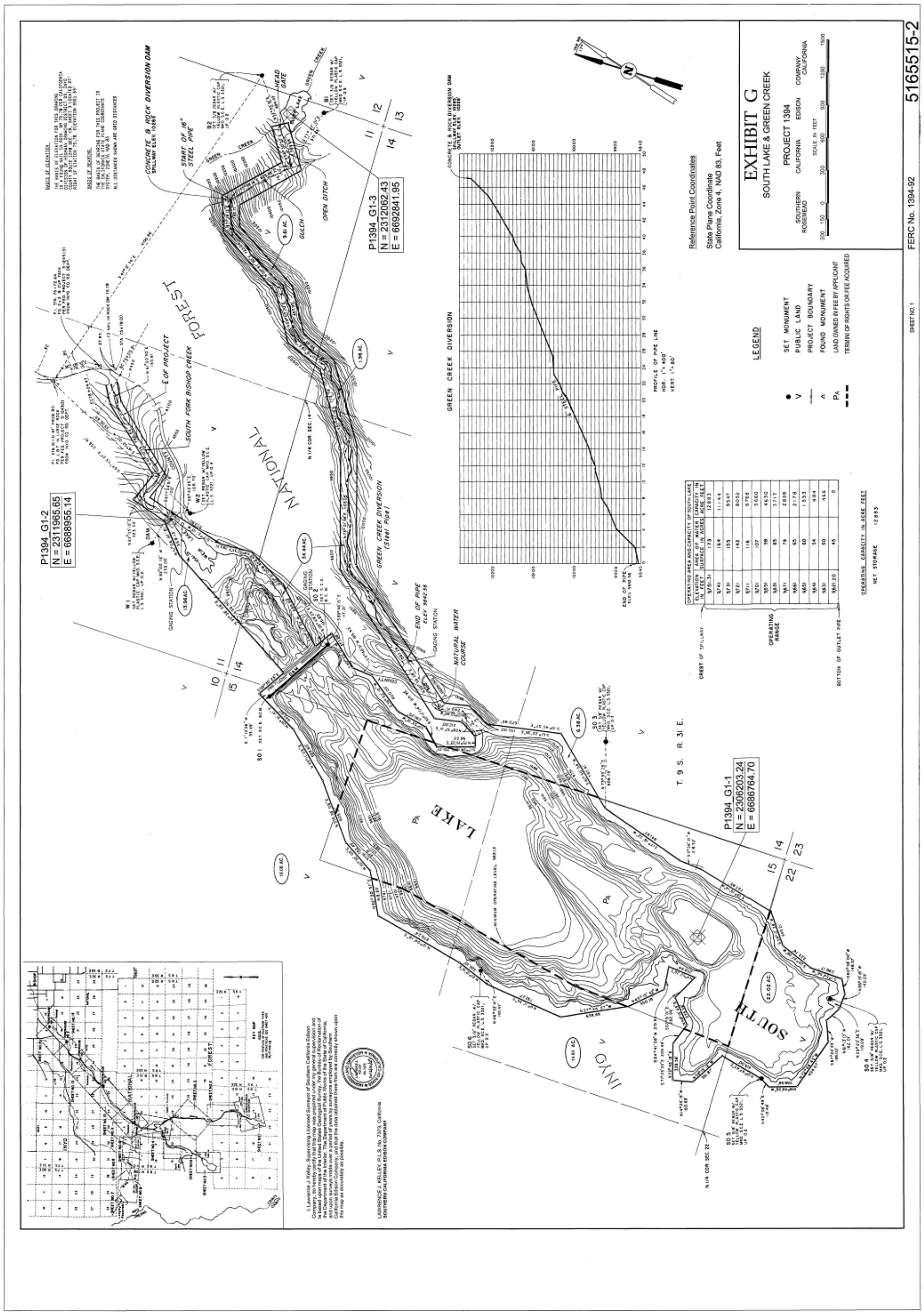
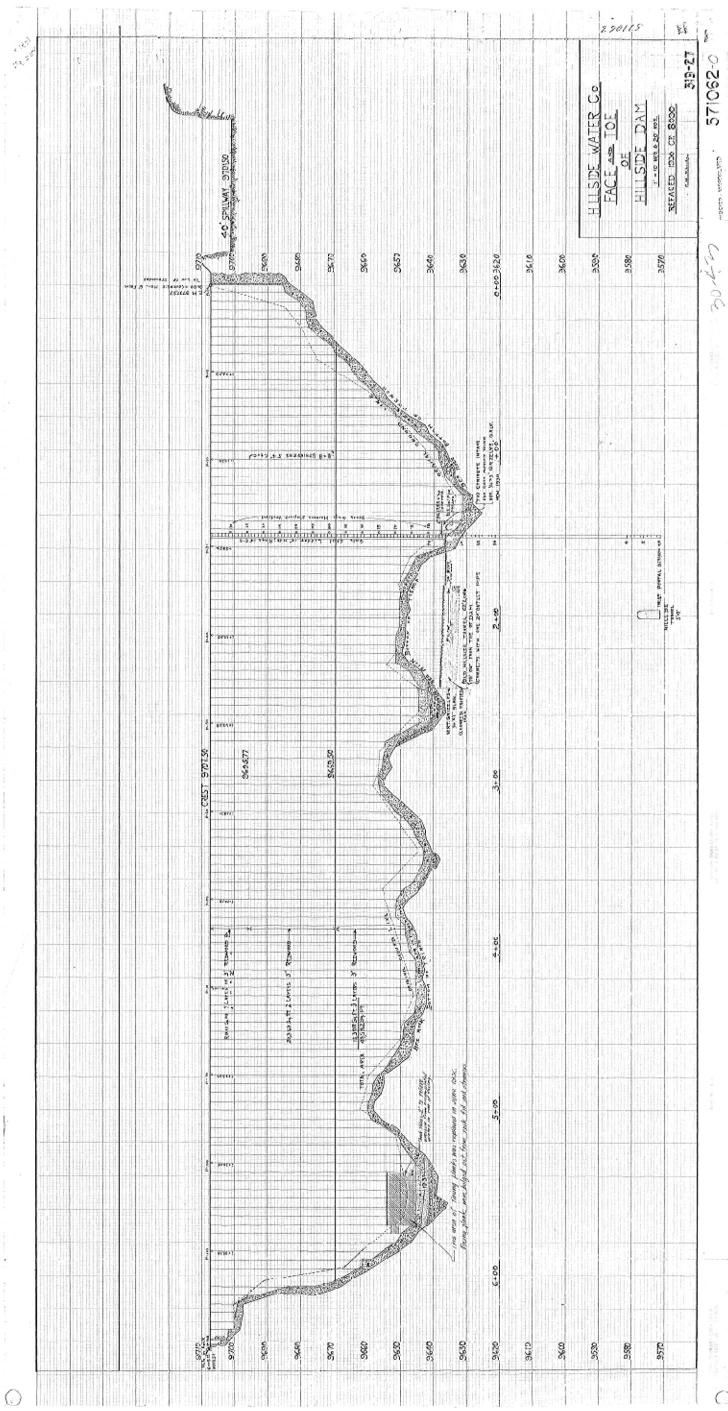


FIG. 5—PLAN OF DAM ON SOUTH FORK OF BISHOP CREEK

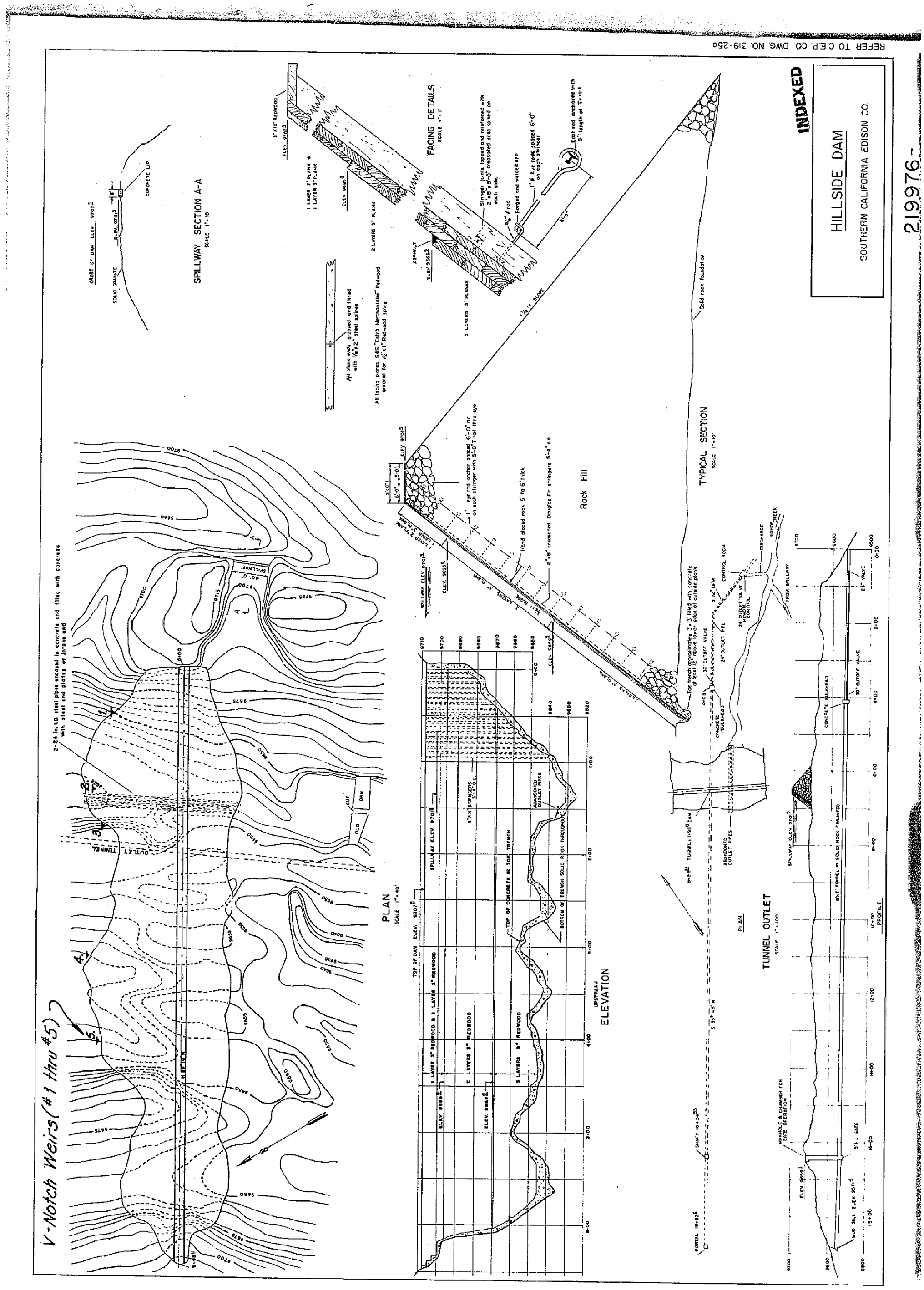
Drawing illustrating South Lake Dam and showing the location of the previous dams from Charles O. Poole, "Hydroelectric Development on Bishop Creek, Cal.," Electric World, 1914.



Undated, detailed map and system information for South Lake Dam. Courtesy of Southern California Edison Co.



Undated drawing titled, “Face and Toe of Hillside Dam,” prepared by the Hillside Water Company. Includes basic construction information. Courtesy of Southern California Edison Co.



Undated drawing titled, "Hillside Dam." Includes basic construction information. Courtesy of Southern California Edison Co.

ADDENDUM TO: HAER CA-145-7
BISHOP CREEK HYDROELECTRIC SYSTEM, HILLSIDE DAM *HAER CA-145-7*
(South Lake Dam)
Spanning the South Fork of Bishop Creek
Bishop vicinity
Inyo County
California

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

FIELD RECORDS

HISTORIC AMERICAN ENGINEERING RECORD
PACIFIC WEST REGIONAL OFFICE
National Park Service
U.S. Department of the Interior
333 Bush Street
San Francisco, CA 94104

HISTORIC AMERICAN ENGINEERING RECORD

BISHOP CREEK HYDROELECTIC SYSTEM, HILLSIDE DAM

This report is an addendum to an 18-page report previously transmitted to the Library of Congress in 2012.

Location: Hillside Dam is located along the South Fork of Bishop Creek in Inyo County, California, in the eastern Sierra Nevada Mountains, approximately 20 miles southwest of Bishop. Bishop is located approximately 222 miles due north of Los Angeles. The tunnel intake is located approximately 1,200 feet southwest of the dam wall. The South Lake Dam tunnel begins at the South Lake intake, travels under the dam, and exits about 600 feet below the dam. The tunnel is 1,980 feet long. A 90-foot-deep vertical shaft intersects the tunnel 370 feet downstream of the intake.

Hillside Dam is located at latitude: 37.17236, longitude: -118.56522. This coordinate represents the structure's east end. It was obtained on April 15, 2011, using the USGS 7.5 minute topographic map for Mount Thompson, California. The coordinate's datum is North American Datum 1983. The Hillside Dam location has no restriction on its release to the public. Today it is known as South Lake Dam.

Present Owner: Southern California Edison Company
2244 Walnut Grove Avenue
Rosemead, California 91770

Present Use: Intake and tunnel

Significance: The Southlake intake and tunnel is a contributing feature to the Southlake Dam, which is contributing element to the Bishop Creek Historic District (BCHD). The BCHD has been determined eligible for the National Register of Historic Places (NRHP) with a 1905 to 1938 Period of Significance. The BCHD consists of five powerhouse, one control station, two gauging stations, ten flowlines, ten intakes, seven penstocks, four diversions, four reservoirs, four dames (including the South Lake Dam), worker housing, and other associated support facilities.

Hillside Dam is significant because of its role in the early engineering concept and construction of the Bishop Creek Hydroelectric System. This addendum addresses only the intake opening and intake tunnel; the engineering used in its excavation and the creation of a tunnel system beneath the dam for use as a pressure pipe was innovative for its time. The intake and tunnel are essentially unchanged from their date of construction, with the exception of modification to the outlet pipe in the 1950s.

Historian(s):

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September 2014

Project Information:

Documentation of the Hillside Dam was prepared in 2012 for Southern California Edison (SCE) when they proposed to install a Geomembrane liner on the upstream side of the dam to stop leakage and to prevent or minimize future leakage from the dam.
The purpose of this addendum is to record the intake and intake tunnel, which have never been photographically documented because they are usually under the lake.

SCE proposes to modify the existing South Lake Dam intake by removing the existing intake structure, rubble-cover and timber-lined tunnel (located at the entrance only), which are currently in poor condition due to weathering and age. SCE proposes to replace 85 feet of the tunnel with a new 36 inch diameter stainless steel pipe from the intake downstream toward the dam into the rock tunnel and a new headwall to improve tunnel access and safety, and increase operating control at the intake. Therefore, SCE is documenting the intake and tunnel before these modifications are made.

PART I. HISTORICAL INFORMATION

A. *Physical History*

1. **Date of Construction:** In 1907, the Nevada-California Power Company acquired the site from the Hillside Water Company. Construction on the Hillside Dam tunnel began in the fall of 1908.[1] The Hillside Dam soon followed, which was constructed from 1909 to 1911. The new Hillside Dam replaced a previous dam, which was constructed in 1890.

2. **Engineers:** The engineering firm of Manifold and Poole is credited with the design of the dam.[2] Richard G. Manifold and Charles O. Poole were principals of the engineering and consulting firm located in the Central Building at 108 W. 6th Street, Los Angeles.[3] The firm worked on several large Nevada-California Power Company projects, including the Silver Lake Power Plant in 1916. They also did work for affiliated power companies, such as the Southern Sierras Company.

   Richard Going Manifold was born on March 12, 1866, in Ireland.[4] He immigrated to the U.S. in 1890. Around the time of the Hillside Dam construction, he resided in Los Angeles at 2635 Hobart Boulevard.[5] He moved around somewhat, residing in Riverside, California in 1920, and Glendale, California in 1930, according to census records. He was married to Charlotte Poole and had two children. He died at the age of 86 on March 8, 1952.[6]

   Charles Oscar Poole was born on June 17, 1859, in Salisbury, Massachusetts. He married Margaret A. Egan in 1888.[7] Around the time of the Hillside Dam construction, the couple resided at 2118 W. 28th Street, Los Angeles.[8] They later moved to Crenshaw Boulevard, where Poole resided at the time of his death at age 66 on April 30, 1925. Poole was a member of the City Club, Chamber of Commerce, and American Society of Civil Engineers.[9]

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[1] "Difficulties Encountered", from Power Development and Transmission Systems of The Nevada-California Power Company and The Southern Sierras Power Company, 1915, p. 8.
[2] Diamond, Valerie H., Stephen G. Helmich, and Robert A. Hicks. "South Lake Dam Historic Resources Inventory Form." *Bishop Creek Hydroelectric System Historic District Report*. Unpublished report by Theodoratus Cultural Research, Inc.: January 11, 1988; p. A-187; Charles O. Poole. "Hydroelectric Development on Bishop Creek, Cal.," *Electric World*, 1914; p. A-188.
[3] Los Angeles City Directory, 1909.
[4] U.S. Census data, 1930.
[5] Los Angeles City Directory, 1909.
[6] California Death Index, 1940-1997.
[7] U.S. Census data, 1900.
[8] Los Angeles City Directory, 1909.
[9] "Member of Local Engineering Firm Paralysis Victim." *Los Angeles Times*. April 3, 1925; p. A7.

3. **Builder:** Nevada-California Power Company [10]

4. **Original Plans:** There are no original plans remaining on file for Hillside Dam; however, there are several later drawings on file in the Southern California Edison offices. There is a description of the inlet and tunnel in a 1915 article in "*Power Development and Transmission Systems of The Nevada-California Power Company and The Southern Sierras Power Company*" (Poole). There are also plans drawn by the California Electric Power Company (Riverside California) dated 1954-1955 showing modifications made to the Hillside Reservoir (Bishop Creek) Outlet Pipe. The following information was gathered from a study of those drawings and current photographs and from a Historic Resources Inventory Form prepared for the dam in 1988.

   There were originally two 24-inch steel outlet pipes placed through the main fill of the dam. These pipes are partly in rock trench and partly covered with heavy concrete arches to protect them from crushing. The inlet to one of the pipes is situated at the toe of the dam in the low point, and the inlet of the other pipe is carried through a rock tunnel 200 feet into the lake, thus lessening the change of both outlet becoming clogged with debris at the same time. Both inlets are protected by heavy steel grizzlies (grates).[11] This report documents the inlet and tunnel of the second outlet pipe.

   The outlet tunnel was constructed through bedrock below the lowest point in the dam's foundation to create additional storage below the original lake. The unlined tunnel measured 1,980' in length with a 5' x 7' opening within the reservoir. The elevation was 9,571' at its upper end and 9,560' at its lower portal.

5. **Alterations and Additions:** A 24" steel valve pipe was added to one end of the outlet tunnel in the 1950s**.** [12] Originally, a large gate was operated from the top of the tunnel shaft to shut off the tunnel downstream to allow safe access to the tunnel. Currently, the gate (located at the bottom of the vertical shaft) is no longer operational.

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[10] Diamond; p. A-188.
[11] "Difficulties Encountered," p. 6.

B. Historical Context

Overview of the Bishop Creek Hydroelectric System and Hillside Dam[13]

The Bishop Creek Hydroelectric System consists of five sets of independent, high-head, impulse water wheel, electricity-generating power plants at various elevations along the south, middle, and north forks of Bishop Creek. It is a typical run-of-the-river type system that was built to exploit the geography of the eastern slopes of the Sierra Nevada Mountains. Bishop Creek starts at the 13,000-foot crest of the Sierra Nevada Mountains and drops over 4,000 feet over a horizontal distance of 14 miles to the Owens Valley. For the most part, Bishop Creek flows in steep-sided canyons with the north wall of the canyon composed of a glacial moraine, which forms a natural, almost continuous ridge paralleling the creek. This ridge was used as the backbone for most of the Bishop Creek Hydroelectric flowlines. The Bishop Creek system consists of five powerhouses, one control station, two gauging stations, ten flowlines, ten intakes, seven penstocks, four diversions, four reservoirs, four dams, worker's housing, and other associated support buildings. Most of the Bishop Creek project area falls within the rain shadow of the Sierra Mountains, and the vast majority of the precipitation in the area falls as snow in the high mountains. The snow fields furnish an abundant water supply during the summer, but the stream flow dwindles in the fall when water is drawn from the reservoirs.

South Lake (originally Hillside Reservoir) was designed to regulate flow, rather than to create head, along the creek. In conjunction with Bluff Lake, South Lake confines the headwaters of the South Fork of Bishop Creek. Like the other lakes in the system, South Lake stores snow-melt from the high Sierra Nevada Mountains crest near 13,000 feet. Its capacity is 14,000 acre feet. The water in the reservoir is kept ready for release when needed. Thus, water stored during high flow, which is usually during winter and spring, can be released during summer and fall low-flow periods.

Waters from Green Creek and Bluff Lake are diverted to South Lake on the South Fork of Bishop Creek. From South Lake Dam (originally Hillside Dam) to Coates Meadow, a distance of seven and one half miles, the stream travels the natural channel toward its confluence with the Middle Fork. At Coates Meadow the South Fork Bishop Creek Dam and flowline diverts a portion of this water into Intake 2, a stabilizing reservoir.

From below Intake 2, the water transportation pattern is repeated from plant to plant: water is taken from an intake or equalizing pond and transported via flowlines and penstock to the next plant. In this way, the water of Bishop Creek is used five times on its journey down the steep canyon to the edge of the Owens Valley. From Intake 2 to Plant 6, the water drops

[13] Excerpted from Taylor, *Bishop Creek Hydroelectric System*, HAER No. CA-145; p. 3-4.

3,590 feet. After leaving Plant 6, the water is used for irrigation before final disposition into Owens River.

History of the Bishop Creek Hydroelectric System and Hillside Dam[14]

Word of the discovery of economic minerals at Tonopah and Goldfield in western Nevada drew numerous fortune seekers, including Loren B. Curtis, a hydraulic engineer, and Charles M. Hobbs, a former official in the Denver and Rio Grande Railway, in 1904. Curtis and Hobbs had come for the mineral prospects but realized that the economic boom could not continue without adequate power. Although the locally owned and operated Tonopah Light and Power Company and Goldfield Electric Light and Power Company had generated electricity by the burning of fuels, their power was too expensive and unreliable. Curtis and Hobbs recognized the potential market for hydroelectric power and identified Bishop Creek in California as the best location for the generators.

The Nevada Power, Mining and Milling Company was incorporated on December 24, 1904. Construction began on the first power plant (Plant 4) in January 1905. A contract for delivery of power was signed with the Combination Mines Company in May 1905. By August 1905, water rights had been secured from the Hillside Water Company, and on September 19, 1905, hydroelectric power was delivered to the Goldfield Substation, and two days later to Tonopah.

System additions were undertaken in 1906-07 after new ore discoveries in Manhattan, Bullfrog, and Rhyolite, Nevada portended an expanding power market. These included an enlarged South Lake, a new reservoir (Sabrina) on the Middle Fork of Bishop Creek, a new transmission line to Tonopah and Goldfield, a new general office in Goldfield, and expansion of Plant 4. In addition, the Nevada Power, Mining and Milling Company reorganized as the Nevada-California Power Company, and all capital stock of Hillside Water Company was purchased in order to guarantee adequate water supplies for electric power generation and permit the construction of additional plants along the course of Bishop Creek.

In 1908-09, the Nevada-California Power Company purchased the assets of the Bishop Light and Power Company and the capital stock of the Rhyolite Light, Heat and Power Company. Another unit was added to the Plant 4 powerhouse, and Plants 2 and 5 were constructed (1908 and 1909, respectively). The existing facilities were now capable of producing twice the power for which there was a market.

In 1910, the Nevada-California Power Company decided to diversify their market by expanding into Southern California. In June 1911, the Southern Sierras Power Company was formed as part of the expansion efforts. It purchased and operated the equipment installed at Plant 5 and began construction of a transmission line from Plant 5 to San Bernardino,

[14] Excerpted from Taylor, *Bishop Creek Hydroelectric System*, HAER No. CA-145; p. 13-15.

California. Also in 1911, Plant 3 was built by the Nevada-California Power Company. It was during this period that the company also completed construction of the new Hillside Dam.

In 1913, the Southern Sierras Power Company completed construction of Plant 6 on lands downstream from Plant 5 and the system was essentially complete. (Plant 1 was to have been built at the present site of the Plant 2 intake, but was never built because of the vulnerability of the site to avalanches.) The combined power generated by the Bishop Creek system was then 24, 350 kilowatts.

In 1914, the Nevada-California Electric Corporation was formed as a holding company for the associated companies. In addition to the Nevada-California Power Company and the Southern Sierras Company, the associated companies included the Sierras Construction Company, the Corona Gas and Electric Company, the Bishop Light and Power Company, the Interstate Telegraph Company, the Hillside Water Company, the Elsinore Electric Light Company, and the Barstow Utilities Company.

In 1936, the Nevada-California Electric Corporation reorganized as an operating company and changed its name to the California Electric and Power Company, or CalElectric. CalElectric was absorbed by the Southern California Edison Company in a merger/takeover in 1964.

<u>History of the Hillside Dam Intake and Tunnel</u>[15]

As the South Fork reservoir of Bishop Creek is a natural lake formed by glacial action and filled by annual snow melt, hydrographic surveyors discovered that the lake was very deep and the low water level of the lake would be lower than the lowest level of the dam face. So the power company would have to engineer a method of getting water out of the natural lake once its surface had fallen below the bottom of the dam.[16] Due to these naturally occurring conditions, engineers decided to drive a tunnel from below the dam site and tap the lake at a considerable depth below the outlet pipes of the dam. Through calculations, they determined that a 2,000 foot tunnel could tap the lake at 65 feet below the base of the dam. Work on the tunnel began in 1908. The power company constructed a temporary water-power plant to that utilized the natural fall in the creek directly below the dam site and they constructed an auxiliary steam plant to drive air compressors, ventilating fans, etc. The tunnel was started in the bed of the creek, 600 feet below the dam site, at the foot of a granite cliff. Construction workers started to bore into the side wall of the cliff, driving into the ridge at an angle to insure that the rock wall could withstand the high water pressure that would run through it upon completion. The tunnel was dug five feet wide and six feet high and ran on a grade of 1

[15] Excerpted from ”*Difficulties Encountered and Overcome in Construction of the Hillside Tunnel”* pp. 8-11.
[16] Rudolph W. Van Norden. *System of Nevada-California Power Company and the Southern Sierras Power Company- Part 1*. p. 6.

½ feet per 1000 feet. It bends from the outlet to the center of the dam and then runs under the dam to the center of the lake bed.

At a point 1000 feet upstream above the dam there is a rock ridge that is 30 feet above the outlet pipes of the dam and forms an island in the lake, which is submerged about 40 feet when the reservoir is full. In order to expedite the work of driving the tunnel, engineers bore a vertical shaft from the center of this island (outcrop) and started to dig toward the dam from the opposite direction. The shaft also served as a safeguard for the men working in the tunnel. Workers dug cautiously as they were uncertain whether the end of the bank was solid or shattered rock. To help determine this, they made sounds at the end of the ridge where the tunnel was to break through. To make the sounds, they cut holes through 2 feet of ice and 65 feet of water. When the face of the tunnel was within a distance of 50 feet of the finish, a hole was drilled ahead of the face from 10 feet to 15 feet. In December, 1910, when the workers were within about 20 feet of the planned terminus of the tunnel, they encountered loose ground and mud and water came through the fissures in the rock. They determined it was unsafe to continue as the lake was frozen over with nearly 2 feet of solid ice and temperature was near zero.

In order to break through the remaining portion of tunnel into the lake bed, the engineers decided to use explosive powder. However, because the temperature of the water and air were below the congealing point of the explosive powder, they kept the powder house heated with steam to prevent the powder from freezing and they would have to be placed as quickly as possible into the rock bed when it was intended to be used. In preparation of blowing through the last 20 feet, the workers gouged out five additional feet on either side of the tunnel, leaving the end of the tunnel in the shape of a "T" 15 feet across the face. They laid four inch by four inch timbers across the tunnel at the face and placed the powder on the timbers to keep it away from the bottom of the tunnel and the water below. They placed 50-pound boxes of explosive on top of one another with the covers off. The explosive powder consisted of 40 percent giant, with about 1,000 pounds of 20 percent stump powder and about 500 pounds of 60 percent gelatin powder for a total of 5,200 pounds in all. The tunnel was tamped to a thickness of 20 feet, using the muck of the excavation. In order that the tamping would be loosened and removed to prevent its clogging the tunnel after the blast, they placed a considerable charge within the tamping and timed to fire slightly after the main charge.[17] Before placing the powder, they laid two three-inch pipes outside the tamping in the bottom of the tunnel for a distance of 40 feet to drain the water away from the powder.

The charge was primed by using twelve detonation caps placed in two sets of six each in a stick of 60 percent powder. Each of these sticks was placed in a box of the same kind of powder. Two sets of wires were carried out through tamping in two-inch iron pipes and the ends of the wires were carried through the shaft to a safe distance on shore and attached to separate exploders. In addition, as a backup, two additional sets of three fuses were

[17] Van Norden, p. 6.

connected to the explosives in case the battery failed, the charge could still be fired with fuses.

The decision to use explosives to clear the remaining portion of the tunnel was a dangerous operation. If the explosives were unsuccessful in removing the remaining rock and loose ground, then it would have been very dangerous for workers to clear the debris, thereby allowing water to flow into the tunnel uncontrolled. However, the explosion worked as planned; the main charge exploded the tamping charge on the first attempt. According to the Poole article "*Difficulties Encountered and overcome in construction of the Hillside Tunnel*," the shot threw a column of black mud, water and rock to a height of 300 feet.[18]

After the entrance to the tunnel had been broken through, it took considerable work to clear out the area around the opening to make it safe to be submerged under the lake. The rock had been badly shattered and decomposed from the explosion so the workers cut a deep trench in the cliff and framed in a tunnel out of heavy mine timbers and then surrounded the timbers with rock fill. The intake was covered by a metal grizzly (grate).

In order to control the water's flow, a side tunnel was driven into the solid rock wall for a distance of 35 feet, intersecting the main tunnel at an angle. The power company placed a 36-inch diameter bell-end steel pipe, which was secured in the rock tunnel with a cast-iron gate covering the outer pipe. There is a trap gate supported by a heavy cast iron frame embedded into the tunnel walls at about 10 feet into the intersection with the branch tunnel. The trap gate is made of 5/8 inch plate steel and reinforced steel "I" beams. The opening was three feet wide by five feet high, which was large enough for rock cars to pass through during construction of the tunnel. The trap gate was hinged at the top of the framework and opened toward the lake. It was held up against the roof with a 3/8 inch steel cable and wench.

When the explosive shot was fired, the trap gate was left wide open and the 36-inch outlet gate was left about half open. A man was stationed at each gate when the shot was fired and instructed to immediately spring the trap valve after the explosion and close the gate valve as soon as the water should start.[19] Each man waited until he heard water rushing in the tunnel and then closed the valve to trap enough air in the tunnel to prevent shock on the gates and to prevent the mechanisms from being carried away with the rushing water. The operation was successful as the water flowed through the tunnel without causing any damage to the tunnel gauging system.

An additional gate, measuring three feet by five feet was placed at the intersection of the tunnel and vertical shaft that rises to the top of the island (rock outcrop) in the center of the lake. The gate is operated from the top of the shaft. This gate helps keep water pressure off the tunnel. There is a water tight man hole at the top of the shaft to keep the water out of the

[18] "Difficulties Encountered," p. 10.
[19] Van Norden, p. 6.

shaft when the island is flooded. The man hole is taken off each season that the water is drained through the pipes and the lake is lowered.

Significance of the Bishop Creek Hydroelectric System and Hillside Dam[20]

Hillside Dam is significant for its role in the early engineering concept and construction of the Bishop Creek Hydroelectric System. The Bishop Creek Hydroelectric System has been determined eligible for the National Register of Historic Places as a historic district, and Hillside Dam is a contributor to the district. The system as a whole is significant for its roles in the expansion of hydroelectric power generation technology, in the development of eastern California and western Nevada, and in the development of long-distance electrical power transmission and distribution.[21] Hillside Dam itself is significant for its use of innovative engineering methods used to excavate the tunnel beneath the dam for use as a pressure tunnel.

The Bishop Creek Hydroelectric System is significant for its position in the expansion of hydroelectric generation technology, its role in the development of eastern California and western Nevada, and the development of long-distance power transmission and distribution. Hillside Dam is significant as a contributor to the system, which is credited with several early long-distance transmission records. The system contributed vitally to the success of the Tonopah and Goldfield mining ventures and the overall economic independence of western Nevada. Additionally, along with the associated companies, the Bishop Creek system provided power to run large-scale ice producing machines in the San Bernardino, Coachella, and Imperial Valleys.

[20] Excerpted from Taylor, *Bishop Creek Hydroelectric System*, HAER No. CA-145; p. 15.
[21] Taylor, p. 1.

PART II: STRUCTURAL/DESIGN INFORMATION

A. General Description

The Hillside Dam intake tunnel is a nearly 2,000 foot, unlined rock tunnel. The intake itself is a 5 foot by 7 foot trapezoidal opening in the rock, reinforced by heavy timbers. A cast iron metal grate is fashioned from individual members bolted in front of the timber opening. The opening is set into a sloping wall of natural rock and reinforced with heavy timbers for several feet into the tunnel. The intake with the metal grate is at the southwestern end of the tunnel. At its northeastern end, there is an outlet pipe.

The entrance to the tunnel is approximately 20 feet long and is supported by large wooden timbers surrounded by rock fill. The remainder of the tunnel is bore out of solid rock and measures five feet wide and seven feet tall. There is a gate, measuring three feet six inches by five feet ten inches[22] located at the intersection of the tunnel and vertical shaft that rises to the top of the island (rock outcrop) in the center of the lake.

1. **Character:** The majority of the intake and tunnel is not visible as it runs beneath South Lake Reservoir and Dam. The intake and the pipe outlet for the tunnel are its most visible components. Compared to the scale of its setting, the intake and outlet are small and inconspicuous, and made with rustic material, allowing them to blend easily into the surrounding landscape.

2. **Condition of Fabric:** Both the wood and cast iron of the intake opening are showing signs of water damage and exposure. The iron is heavily rusted and corroding, and the rust has transferred onto the wood. The wood is splitting and peeling.

B. Construction

In order to create the outlet tunnel and get the benefit of the storage below the old lake surface, it was necessary to tunnel through bedrock below the lowest point in the dam's foundation. The upper portal of the tunnel was in the lake about 1,380' upstream. The lower portal was 600' downstream from the dam.[23] Taylor explained this construction process thusly:

> "Perhaps the most striking engineering feat [of the Bishop Creek system] performed was tapping the south lake reservoir from 600' below the site of the dam, driving a tunnel into the solid granite, coming up to the lake, and breaking through the lake bottom to convert the tunnel into a pressure pipe. The end of the tunnel being 65' under water, the task of cutting through involved some rather

[22] Poole, p. 8.
[23] Fowler; p. 780.

unusual work. It was actually accomplished by excavating very cautiously within about 20’ of the lake bottom and then cutting short laterals to provide a powder chamber for blowing up the bottom and admitting the water. The tunnel was tamped for 30’ with muck back of the powder, and when the 5,200-lb charge was fired, the end of the tunnel was blown out into the lake.”[24]

C. Mechanical Operation

Water flow through the outlet tunnel was manually controlled. The components included a 3’ x 5’ gate at the foot of the vertical shaft and a 3’ x 5’ hinged gate in the lower end of the tunnel. The hinged gate was just above a 36’ concrete bulkhead pierced by a 36” pipe fitted with a 36” hand-operated gate valve.[25]

D. Site Information

Hillside Dam is accessed from South Lake Road, which runs southeast from its intersection with Highway 168. The dam is located to the west of South Lake Road and south of Weir Lake. It stretches on a roughly east-west axis across the north end of South Lake. The terrain in the immediate vicinity is rocky and rugged due to the region’s history of Pleistocene glacial activity. It is particularly steep and jagged as it rises to the west of South Lake. Vegetation in the area includes evergreen trees, as well as low-lying chaparral and scrub. The low-lying vegetation is covered by snow during winter and early spring.

There are two small structures associated with the dam – an access bridge and a gauging station. The bridge is constructed of wood and metal and stretches from South Lake Road across a shallow canyon. There is a hinged metal gate at the bridge’s east end.

The gauging station is located at the east end of the dam. It faces east toward South Lake Road. It is a small shed constructed of wood framing covered with corrugated metal siding. It has a square plan, a front-gabled roof, and a metal door on its east façade. The door has a single light that has been filled in with plywood. There are two photovoltaic panels on the building – one on the roof and one just above the door. There is also a large antenna on the roof. A single metal pipe extends upward beyond the roofline on the west façade.

A sawmill was built near the dam site to mill the wood required for the dam and camp buildings.[26] The sawmill no longer remains but the bottom of the lake is graded where the mill likely stood, and there are extant rails at the same location that were used for carting lumber. Also located south of the dam site is the quarry from which the rock for the construction of the dam was taken.

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[24] Taylor, p. 117.
[25] Fowler; p. 780.
[26] Poole; p. 7.

PART III: SOURCES OF INFORMATION

"City Claims Big Pine." *Los Angeles Times*. March 25, 1914; p. II1.

Clerico, Robert and Ana Beth Koval. *An Architectural and Historical Evaluation of Structures Associated with the Bishop Creek Hydroelectric Power System, Inyo County, California*. Unpublished report prepared for Southern California Edison by Intermountain Research: December 1986.

Diamond, Valerie H., Stephen G. Helmich, and Robert A. Hicks. "South Lake Dam Historic Resources Inventory Form." *Bishop Creek Hydroelectric System Historic District Report*. Unpublished report by Theodoratus Cultural Research, Inc.: January 11, 1988.

"Difficulties Encountered and Overcome in Construction of the Hillside Tunnel- The Layout and Equipment of Generating Stations A and No. 1." Power Development and Transmission Systems of The Nevada-California Power Company and The Southern Sierras Power Company (1915). Reprinted from Electrical World, New York 1914. p. 8-12.

Fowler, Frederick Hall. *Hydroelectric Power Systems of California and Their Extensions into Oregon and Nevada*. Washington, D. C.: Government Printing Office, 1923.

Los Angeles City Directories, 1909, 1915, and 1925.

Low, George P. "The Generating, Transmission and Distribution Systems of the Edison Electric Company of Los Angeles, Cal." *The Journal of Electricity, Power and Gas*. Vol. XIII, no. 1. January, 1903.

"Member of Local Engineering Firm Paralysis Victim." *Los Angeles Times*. April 3, 1925; p. A7.

Myers, William A. *Iron Men and Copper Wires: A Centennial History of the Southern California Edison Company*. Glendale, California: Trans-Anglo Books, 1986.

Pollock, Katherine H. *Bishop Creek Hydroelectric System, Power Plant 2, Lake Sabrina Dam, Bishop Creek, Bishop Vicinity, Inyo County, California*. Historic American Engineering Record No. CA-145-2-A. From Library of Congress. *Built in America Collection: Historic American Buildings Survey/Historic American Engineering Record/Historic American Landscapes Survey, 1933-Present*. October 5, 2007.

Poole, Charles O. "Hydroelectric Development on Bishop Creek, Cal.," *Electrical World*, 1914; p. 3 – 7.

"Power for Ryholite." *Los Angeles Times*. September 1, 1907; p. III6.

Taylor, Thomas T. *Bishop Creek Hydroelectric System, Bishop Creek, Bishop Vicinity, Inyo County, California*. Historic American Engineering Record No. CA-145. From Library of Congress. *Built in America Collection: Historic American Buildings Survey/Historic American Engineering Record/Historic American Landscapes Survey, 1933-Present*. February 7, 1994.

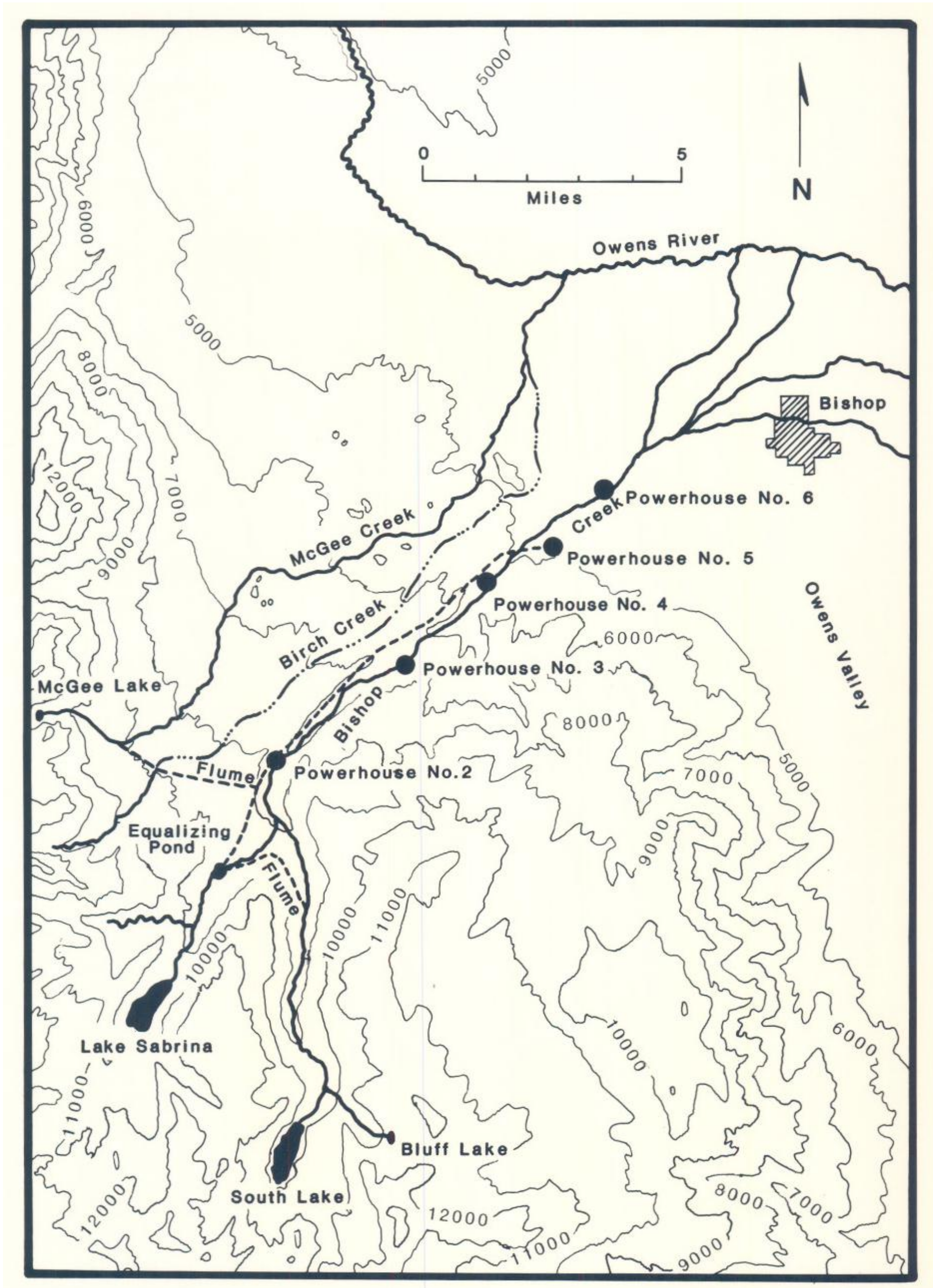
Taylor, William Thomas and Daniel Harvey Braymer. "Chapter XXVII – Hydroelectric Developments of Nevada-California Power Company and Southern Sierras Power Company on Bishop Creek, Inyo County, Cal." *American Hydroelectric Practice*. New York: McGraw-Hill Book Company, Inc., 1917.

"The Thousand Wonders of Productive Owens Valley." *Los Angeles Times*. August 13, 1911; p. VI2.

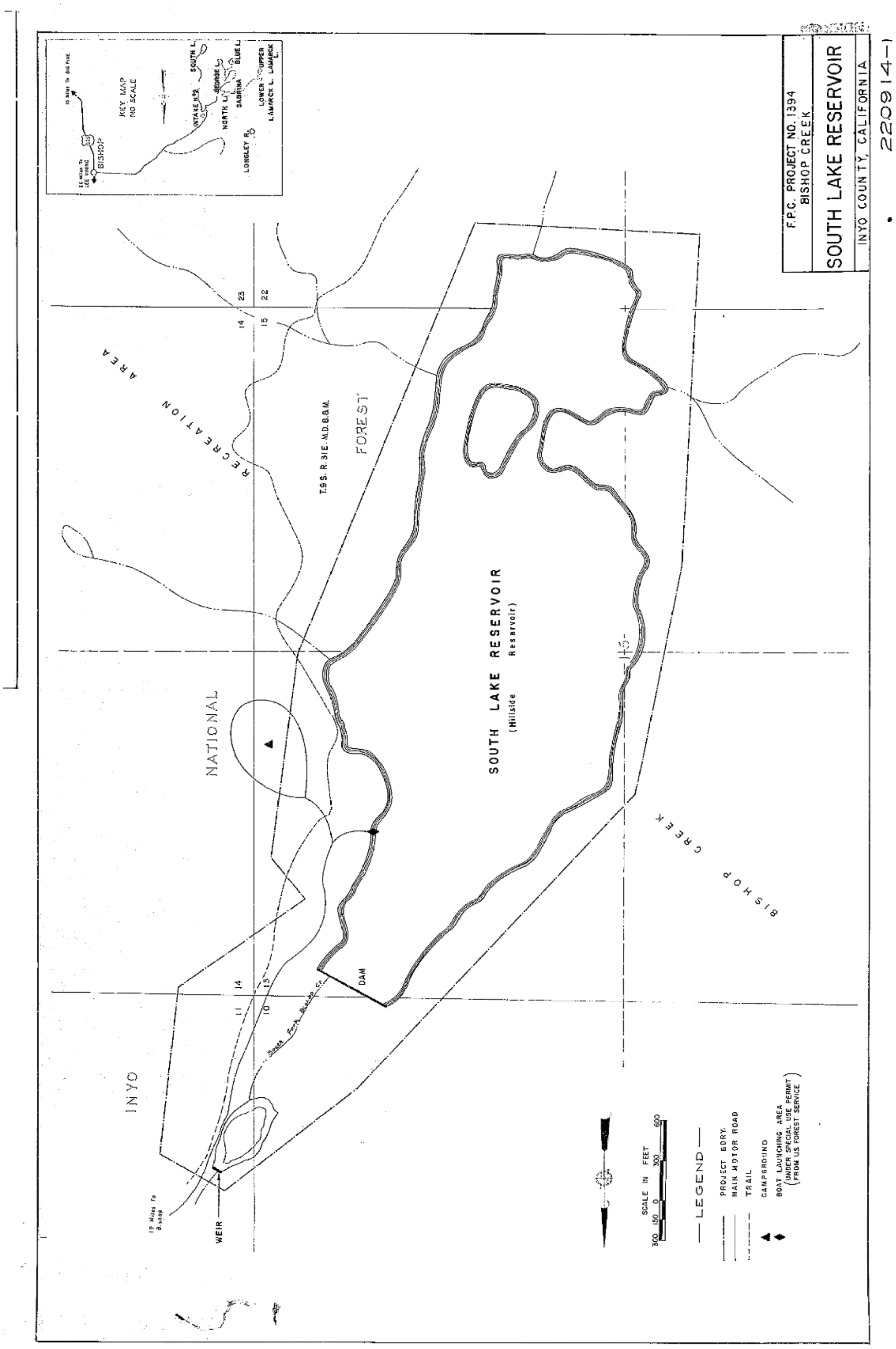
United States Census data, years 1900, 1910, 1920, and 1930.

Van Norden, Rudolph W. "System of Nevada-California Power Company and the Southern Sierras Power Company." *Journal of Electricity Power and Gas* 31, nos. 1-2. July 1913; p. 1-13.

"Wonderful Waterfall a Sacrifice to Thor." *Los Angeles Times*. August 13, 1916; p. II1.



Overview map of the Bishop Creek Hydroelectric System taken from *An Architectural and Historical Evaluation of Structures Associated with the Bishop Creek Hydroelectric Power System, Inyo County, California*; p. 14. See bibliography for complete reference.



Undated, overview map of South Lake Reservoir. Courtesy of Southern California Edison Co.

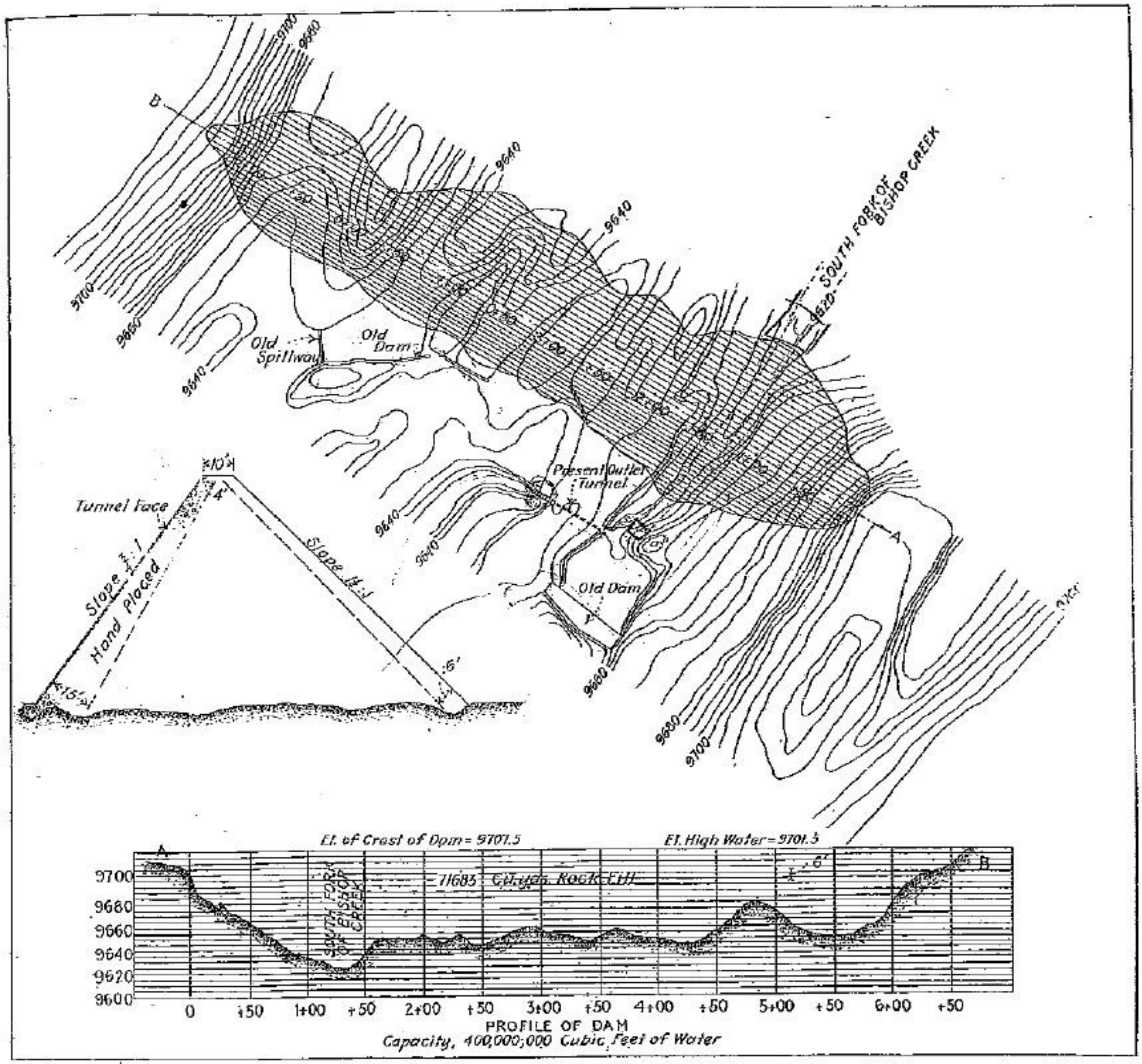
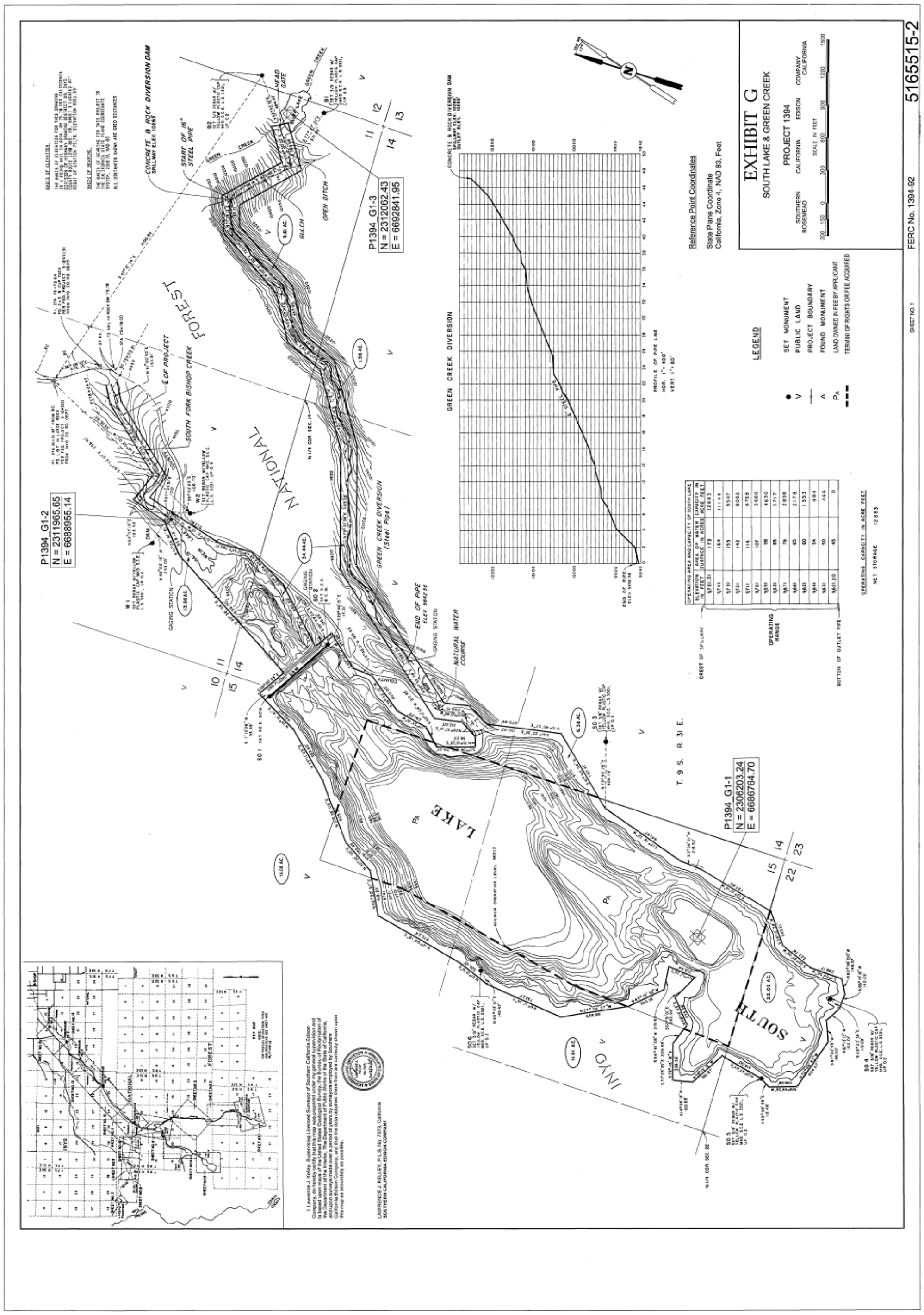
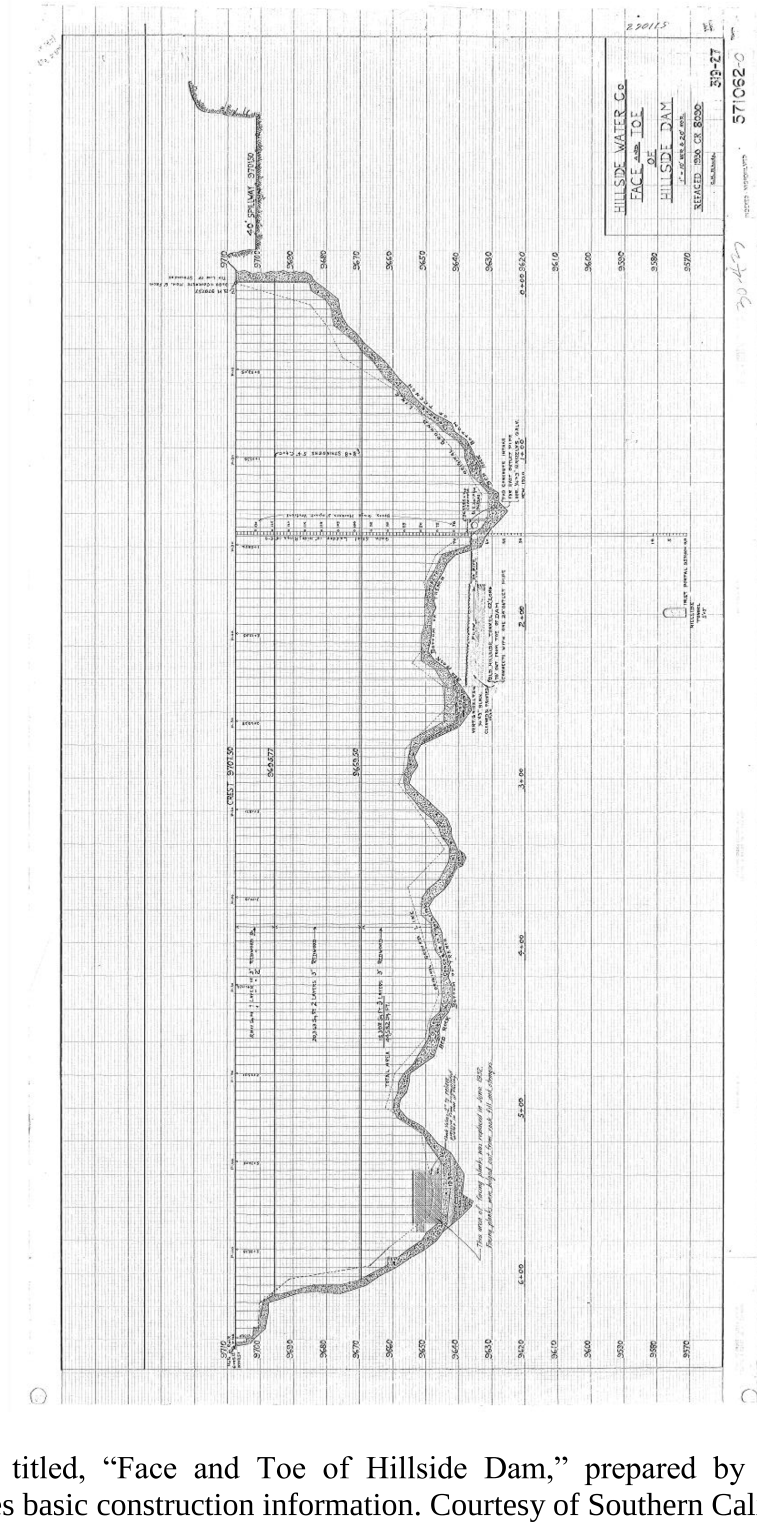


FIG. 5—PLAN OF DAM ON SOUTH FORK OF BISHOP CREEK

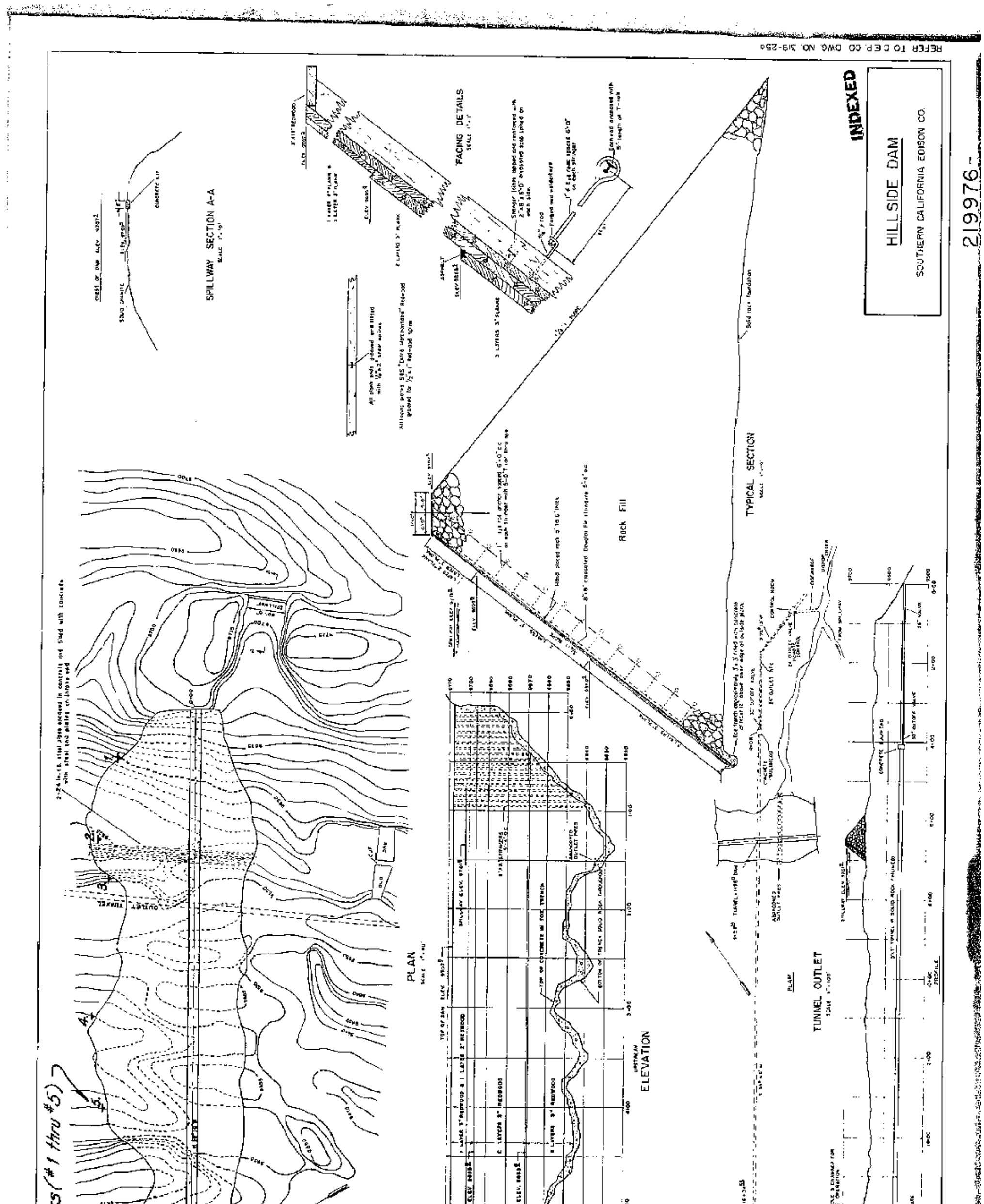
Drawing illustrating South Lake Dam and outlet tunnel, showing the location of the previous dams from Charles O. Poole, "Hydroelectric Development on Bishop Creek, Cal.," Electric World, 1914.



Undated, detailed map and system information for South Lake Dam. Courtesy of Southern California Edison Co.



Undated drawing titled, "Face and Toe of Hillside Dam," prepared by the Hillside Water Company. Includes basic construction information. Courtesy of Southern California Edison Co.



Undated drawing titled, "Hillside Dam." Includes basic construction information. Courtesy of Southern California Edison Co.