

**Thirty-Fifth
Annual Report**
of the

Board of Water and Power

Commissioners

of the
City of Los Angeles



Fiscal Year Ending June 30, 1936

Bureau of Water Works and Supply

H. A. VAN NORMAN
Chief Engineer and General Manager

THE HONORABLE BOARD
OF WATER AND POWER COMMISSIONERS,
BUILDING.

July 1, 1936.

Gentlemen:

In presenting the Thirty-fifth Annual Report of the Bureau of Water Works and Supply, the various phases of the subjects are so well covered by my assistants in their detail reports, attached hereto, as to afford a very complete and comprehensive study of the work of the Bureau for the past fiscal year. However, I might bring out a few points in connection with our major construction activities in the Mono Basin and Long Valley.

The progress on the Mono Craters Tunnel during the year was 21,840.5 feet, as follows:

Heading No. 1 (West Portal).....	8,502	feet
Heading No. 4 (west from Shaft No. 2).....	4,616	feet
Heading No. 5 (east from Shaft No. 2).....	2,669.5	feet
Heading No. 6 (East Portal).....	6,053	feet

The total tunnel driven from the beginning of the project to and including June 30, 1936, is 30,689.7 feet, which represents 51% of the total footage to be excavated. Good progress was made, considering the difficulties encountered which consisted of large quantities of water and carbon dioxide gas. The gas was first encountered in small quantities approximately 7,900 feet from the portal. A second gas area was met at about 11,000 feet, near Test Hole 3 J. and a third at about 12,500 feet from the portal. The presence of this gas necessitated the sinking of Shaft No. 3, which was located at Test Hole 3 J. This shaft, to be used for the ventilation of the tunnel and as an exit for water encountered beyond, is 5 feet by 10 feet in size, and 535.5 feet in depth to tunnel grade. Sinking operations on the same were begun May 16 and completed June 30, the work being carried on from both the top and bottom of the shaft. The amount of water encountered in the tunnel has varied from 2,500 gallons per minute to a maximum flow of 5,521 gallons per minute.

Heading No. 4 was begun in October, 1935, west from the bottom of Shaft No. 2. Considerable water and heavy ground have been met throughout the drilling of this heading and have retarded the work to a considerable extent. In sections of very heavy ground it was found advisable to modify the shape of the concrete lined portion from the horseshoe section to one practically circular. The same forms that were purchased for the horseshoe section were changed slightly, and this has been accomplished. Heading No. 5 was started in October, 1935, east from the bottom of Shaft No. 2. On February 17, 1936, a pocket of water of approximately 4,000,000 gallons was encountered about 1,325 feet from Shaft No. 2, which flooded Headings Nos. 4 and 5 and rose about 200 feet in Shaft No. 2 to within 91 feet of the collar. When work was resumed on March 25, it was found necessary to replace the supports over a considerable portion of this heading. At Heading No. 6 (East Portal), 6,053 lineal feet was excavated, of which 3,080 feet was supported. Swelling ground necessitated extra heavy supports and some areas of quicksand were encountered which delayed progress to some extent. The flow of water in this heading varied from about 1,300 gallons to 2,000 gallons per minute throughout the year.

Shaft No. 1 has been difficult to sink because of fine, running sand, and varying quantities of water under high pressure. During the year a total of 224 feet of shaft was excavated and timbered throughout up to February 21, 1936, when, due to these adverse conditions, work was finally suspended. Since that date, drifts have been excavated at different levels in an effort to intercept the water and running sand. This work has been successful, for we now have the water and sand under control and it is estimated that the shaft will be sunk to tunnel grade by about the latter part of April or the first part of May, 1937.

Shaft No. 2, which is 359 feet deep, was completed and put in operation July 9, 1935. Excavations for the transformer station, battery charging station, pump station, and surveyors' drift, were completed early in October, 1935, and driving of Headings Nos. 4 and 5 started.

Cain Ranch camp, headquarters for Grant Lake Dam construction activities, has been enlarged and is now equipped to feed and house approximately 165 men.

Because of the severe weather conditions, stripping operations at the dam site were suspended in September, 1935, and resumed in April, 1936; and at the close of the past fiscal year a total of 334,120 cubic yards had been excavated, which includes 3,400 cubic yards excavated during the previous fiscal year, and which represents 90% of the total yardage to be stripped.

Excavation of the outlet tunnel from Grant Lake was completed. This tunnel is 3,412 feet long and was started in December, 1935, and holed through on May 24, 1936. The tunnel was supported throughout with tunnel steel rib sets and portable lagging. Equipment has been installed for mixing and placing the concrete lining, which work will soon be in progress.

Construction is well advanced on the earth ditch to divert water from East Portal back into Rush Creek for irrigation purposes. Excavation from this ditch was 18,600 cubic yards at the end of the fiscal year. The by-pass ditch to divert Rush Creek during dam construction was completed. Total excavation is 9,580 cubic yards, of which 6,650 cubic yards was excavated during the previous fiscal year.

To provide sand and gravel for concrete work in connection with Grant Lake Reservoir and other points on the Mono Basin Project, a portable crushing and screening plant with an output capacity of 400 cubic yards for an eight-hour day was erected approximately three miles east of Cain Ranch camp. In connection with the operation of this plant, it was necessary to construct two miles of road, and a twenty-ton bridge across Rush Creek.

In connection with the construction of the Long Valley Dam, the work of reconditioning the old buildings and the erection of the new ones was completed.

Stripping operations at dam site No. 1 disclosed unfavorable conditions, and operations were suspended September 10, 1935, after 81,749 cubic yards of rock had been removed. A more favorable site was located 2,000 feet upstream, and stripping operations at this location, which is known as dam site No. 2, were begun immediately. Some 372,300 cubic yards of earth and rock have been removed as of June 30, 1936.

Water for hydraulic stripping purposes was pumped directly from the Owens River by two pumps installed in a compressor house. Excavation is under way on the spillway and diversion tunnel, 425 feet having been driven to date. The tunnel is supported, where required, by steel or timber sets on five-foot centers, with timber lagging. A total of 6,630 cubic yards of earth and rock have been removed from the approach cut to this tunnel, and 5,800 cubic yards of rock have been excavated from the spillway forebay.

The work of trimming, regrading, and concrete lining the outlet tunnel and adit No. 1 is completed. The repairing and remodeling of the rock and gravel plant was completed, including the erection of a new hoist house. The output of this plant for the fiscal year was 19,833 cubic yards, which was used in various concreting operations.

In October, 1935, notice was received from the Federal Emergency Administration of Public Works that the President had approved the Department's application for a grant, and on April 11, 1936, an offer was received from the United States of America to aid in financing the construction of additions and improvements to the distribution system and Owens River Aqueduct supply line of its City waterworks system by making a grant to the City of Los Angeles in the amount of 45% of the cost of the project upon completion, as determined by the Federal Emergency Administrator of Public Works, but not to exceed, in any event, the sum of \$2,195,361. The cost of the project was estimated at \$4,878,000.

This work is well under way and it is anticipated that all of the items included thereunder will be completed early in 1937. The project consists of necessary additions and betterments to the system which ordinarily would be carried on over a period of three or four years. The performance of this project has been of great benefit in relieving the unemployment situation during the period of economic depression, and has resulted in a financial benefit to the Department as well.

In conclusion, I will state that from a standpoint of service, the collecting and distribution system of the Bureau of Water Works and Supply is in far better condition than it has ever been in the history of the Department, due to the Department's policy to constantly improve both its service and its relations with the public.

Respectfully submitted.

H. A. VAN NORMAN,
Chief Engineer and General Manager.

an estimated 1.5 p.p.m. to an average of 0.60 p.p.m. A twenty-four hour survey was made to determine the daily fluctuations of Aqueduct and Los Angeles River water within the mixed water zones in the City proper. Routine determinations of the aluminum staining properties of water were made on all samples brought into the laboratory for complete mineral analysis.

3. COOPERATIVE ACTIVITIES WITH OTHER DIVISIONS OF THE DEPARTMENT. Elaborate analyses were made on gas and water samples collected from Mono Craters Tunnels. In addition, considerable assistance was also rendered in the selection of equipment and furnishing of chemicals used for gas and water analyses. Analyses of soluble soil salts were made on samples submitted by the Electrolysis Division. The periodic examination of samples furnished by the Underground Water Development Division in connection with studies of sea water intrusion were continued during the past year. A considerable number of rapid sanitary chemical determinations were made on waters collected by the Meter and Service Division for its guidance in repair work. The chemical examination of samples from construction camps in the Boulder Transmission Line was continued this year.

4. CONSULTING SERVICE TO WATER USERS. During the past year this laboratory continued to offer information and advice on many problems involving water quality submitted by individuals, as well as commercial and industrial establishments. These included development of colored pictures at motion picture studios, electroplating, brewery, soda water bottling, and many other processes. A study was also made to determine whether or not activated clays in reservoirs would be of any assistance in keeping down algal growths. So far the results have not been satisfactory.

Mono Craters Tunnel

HUGH MULHOLLAND, *General Foreman*

THE Mono Craters Tunnel has a total length of 59,811.7 feet from portal to portal, 24,446.59 feet from West Portal to Shaft No. 1, 22,629.91 feet between Shaft No. 1 and Shaft No. 2 and 12,736.20 feet from Shaft No. 2 to East Portal. The tunnel section is 9'0" in height and 9'7½" wide, of the wide horseshoe type, and has a cross-sectional area of 72.3 square feet inside the concrete lining. On account of very heavy ground encountered as the tunnel progressed, it was found advisable to modify the shape of the concrete lined portion from the horseshoe section to one practically circular in those sections.

Excavation work at West Portal began on September 22, 1934, and at East Portal on November 23, 1934, using hand equipment only. Use of mechanical equipment, consisting of drill carriages, mucking machines, electric locomotives, and muck cars was started in February, 1935, and the progress of the excavation work was greatly accelerated. The sinking of Shaft No. 2, including the excavation for the muck pocket and surveyors' drift, was finished in October, 1935, and drifting in Heading No. 4, westerly from the shaft, and in Heading No. 5, easterly toward East Portal, began immediately.

TUNNEL EXCAVATION—HEADING NO. 1 (WEST PORTAL)

A total of 8,502 feet of tunnel was excavated during the fiscal year ending June 30, 1936, of which 929.5 feet was supported. Carbon dioxide gas in small quantities was first encountered approximately 7,900 feet from

the portal. A second gas area was met at about 11,000 feet, near Test Hole 3 J, and the third area when 12,500 feet from the portal. The presence of this gas necessitated sinking Shaft No. 3, which was located at Test Hole 3 J. This shaft, to be used for ventilation of the tunnel and as an exit for water encountered beyond, is 5 feet by 10 feet in size and 535.5 feet in depth to tunnel grade. After installing blowers and air pipe in the shaft, it is expected that the gaseous condition will be sufficiently relieved to permit the resumption of work at the face. The sinking of this shaft was begun on May 16, and finished on June 30, the work being carried on both from the top and bottom of the shaft.

A small flow of water was encountered on August 19, 1935, approximately 7,000 feet from West Portal. The amount of water since the middle of October has varied from 2,500 gallons per minute to 4,500 gallons per minute on June 30, reaching a maximum flow of 5,521 gallons per minute on May 27.

TUNNEL EXCAVATION—HEADING NO. 4 (WEST HEADING FROM SHAFT NO. 2)

Begun in October, 1935, a total of 4,616.0 feet of tunnel was excavated in this heading to July 1, 1936, of which 3,639.5 feet was supported. Considerable water has been met throughout the drilling of this heading, but it has not seriously retarded the work. Excavation progress ceased from February 17, 1936, to March 6, because of water encountered in Heading No. 5 which flooded Headings No. 4 and 5 and Shaft No. 2.

TUNNEL EXCAVATION—HEADING NO. 5 (EAST HEADING FROM SHAFT NO. 2)

Since October, 1935, when work started, a total of 2,669.5 feet has been excavated, including 2,315 feet of supported ground. On February 17, 1936, a pocket of water, approximately 4,000,000 gallons, was encountered about 1,325 feet from Shaft No. 2, which flooded both Headings No. 4 and 5 and rose about 200 feet in Shaft No. 2 within 91 feet of the collar. When work was resumed on March 25, it was found necessary to replace support over a considerable portion of this heading.

TUNNEL EXCAVATION—HEADING NO. 6 (EAST PORTAL)

During the fiscal year 1935-1936, 6,053 lineal feet was excavated in this heading, of which 3,079.8 feet was supported. Swelling ground, necessitating extra heavy timber support, and some areas of quicksand were encountered which retarded the progress to some extent. The flow of water varied from about 1,300 to 2,000 gallons per minute throughout the year.

TIMBER AND STEEL SUPPORT

It was found necessary, due to the heavy formation in different portions of the tunnel, to use heavier support than the 8"x8" timber sets called for in the original plans. In some cases, 14"x14" timber sets replaced the standard size sets, while in other cases 5" "I" beams, 6" "I" beams, or 6" "H" beams were used. When exceptionally heavy ground was encountered, it became necessary to weld two 5" "I" beams together side by side, pour concrete between the two beams, and then place the double beams outside of 14"x14" timber sets, 415 feet of tunnel being supported in this manner. The supports, either timber or steel, were usually spaced 5'0" center to center, although in some portions of the tunnel they were placed on 2'6" centers. The following table gives the number of sets of special support used in the four headings during the past fiscal year:

5" "I" beams	2,117 sets
6" "I" beams	478 sets
6" "H" beams	716 sets
14"x14" timber	11 sets
14"x14" timber inside double 5" "I" beams	32 sets

SHAFT SINKING—SHAFT NO. 1

Shaft No. 1 has been difficult to sink because of fine, running sand, and varying quantities of water under high pressure. During the year a total of 224 feet of shaft was excavated and timbered throughout up to February 21, 1936, when, due to these adverse conditions, work was finally suspended. Since that date, drifts have been excavated at different levels in an effort to intercept the water and running sand. This work has been successful, for we now have the water and sand under control and it is estimated that the shaft will be sunk to tunnel grade by about the latter part of April or the first part of May, 1937.

SHAFT SINKING—SHAFT NO. 2

This shaft, 359 feet deep, was completed on July 9, 1935, to the bottom of the muck pocket, 18.5 feet being excavated since July 1. Excavation for the transformer station, battery charging station, pump station, and surveyors' drift were completed early in October, 1935, when excavation work was started in Headings No. 4 and No. 5.

SUMMATION OF TUNNEL PROGRESS:

MONTHLY PROGRESS

EACH HEADING

Feet

Month	Heading No. 1	Heading No. 4	Heading No. 5	Heading No. 6	Total
1935					
July	1,230.0	.....	.....	460.0	1,690.0
August	975.0	.....	.....	745.0	1,720.0
September	467.0	.....	.....	925.0	1,392.0
October	240.0	210.5	272.5	757.3	1,480.3
November	521.0	536.0	371.0	918.0	2,346.0
December	864.0	566.0	263.0	407.7	2,100.7
1936					
January	988.0	331.5	231.0	437.0	1,987.5
February	1,043.0	181.5	188.0	294.0	1,706.5
March	1,120.0	634.5	30.0	360.8	2,145.3
April	810.0	780.0	483.0	126.2	2,199.2
May	244.0	553.0	476.0	277.0	1,550.0
June	No Work	823.0	355.0	345.0	1,523.0
Total	8,502.0	4,616.0	2,669.5	6,053.0	21,840.5

TOTAL TUNNEL PROGRESS TO JULY 1, 1936

	Distance Excavated Feet	Distance Excavated Feet	Per Cent Excavated
Heading No. 1 to Shaft No. 1.....	24,446.59	13,561.0	55
Shaft No. 1 to Shaft No. 2.....	22,629.91	4,616.5	20
Shaft No. 2 to Heading No. 6.....	12,735.20	12,512.2	98
Total.....	59,811.70	30,689.7	51

Date Started	Distance Excavated Feet	Number of Shifts	Average per Shift Feet	Number of Working Days	Average per Working Day Feet
*Heading No. 1.....Feb. 1935	12,898.4	1242	10.39	441	29.25
Heading No. 4.....Oct. 1935	4,616.5	677½	6.81	249	18.54
Heading No. 5.....Oct. 1935	2,669.5	592½	4.51	237	11.26
*Heading No. 6.....Feb. 1935	9,620.0	1372½	7.01	493	19.51
Heading Totals.....	29,804.4	3884½		1420	
Rate of Progress per Heading.....			7.67		20.99
Rate of Progress (Four Headings).....			30.68		83.96
Shaft No. 1.....Nov. 1934	763	1490	0.51	542	1.41
Shaft No. 2.....Feb. 1935	362.5	290	1.25	132	2.75
**Shaft No. 3.....May 16, 1936	535.5	222	2.41	81	6.61

*Progress subsequent to installation of mechanical equipment.

**Includes Shaft sinking and Shaft raising.

A total of 3,305 cubic yards of muck was removed from the four headings during the fiscal year.

Major Construction Division

H. L. JACQUES, *Engineer of Major Construction*

GRANT LAKE RESERVOIR

STANLEY DUNHAM, *General Construction Superintendent*

DURING the current fiscal year, the enlargement of Cain Ranch camp was completed, including the erection of one additional single-family residence, one commissary, and two bath houses. All the camp buildings were furnished with heating stoves fitted to burn fuel oil supplied from central overhead storage. This camp is now equipped to house and feed approximately 165 men.

At the dam site, a carpenter shop and a blacksmith shop were built and equipped. A pumping plant was installed and pipe lines laid to furnish water from Grant Lake for construction purposes at the dam site and at other points as needed.

The by-pass ditch was completed, to divert Rush creek during dam construction; total excavation 9,580 cu. yds. of which 6,650 cu. yds. had been excavated during the previous fiscal year.

Because of the severe winter weather, stripping operations at the dam site were suspended in December, 1935, being resumed in April, 1936. At the close of the current fiscal year, a total of 334,120 cu. yds. had been excavated, of which 3,400 cu. yds. was excavated during the previous year. It is estimated that stripping operations were 90% completed at the end of the fiscal year.

The material removed in stripping was placed in a spoil bank for use later in the dam embankment, excepting 10,868 cu. yds. which was passed over and through a grizzly to screen out the large rocks. The finer material from the grizzly (7,200 cu. yds.) was placed in the central section of the dam embankment, the remainder being placed in the down-stream pervious section of the embankment.

Excavation was completed on the outlet tunnel from Grant Lake reservoir, length 3,412 ft., of which 3,401 ft. was driven from the East Portal. Work was begun in December, 1935, with the excavation of the East Portal approach cut, (5,000 cu. yds.), and the erection and equipment of a compressor house, blacksmith shop, and change house. The tunnel was holed through May 24, 1936. It was supported throughout with steel rib sets and timber lagging. Equipment has been assembled and installed for mixing and placing the concrete lining in the tunnel, and this work will soon be in progress.

Excavation was completed on the outlet valve control shaft, 78.3 ft. from shaft collar to tunnel grade. The concrete lining of this shaft is being carried down from the collar, 24.5 ft. having been concreted at the end of the fiscal year. The plug valve regulating the discharge from reservoir will be located in a concrete chamber at the foot of this shaft, the shaft providing access to the valve control mechanism.

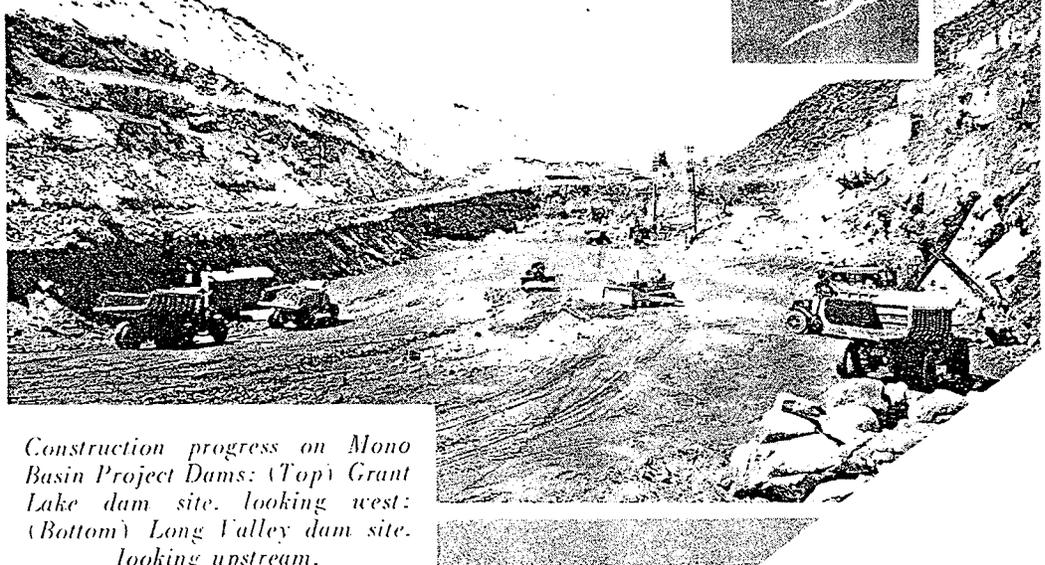
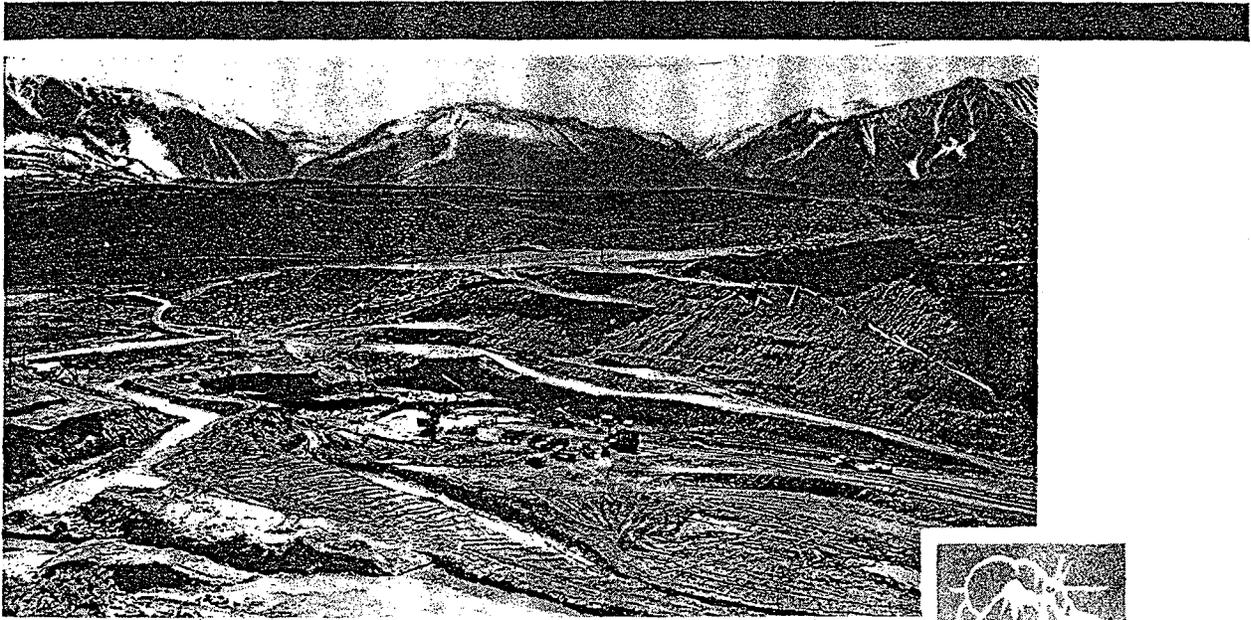
Construction was well advanced on an earth ditch to divert water from the East Portal of the outlet tunnel back into Rush creek, for irrigation purposes. Excavation from this ditch was 18,600 cu. yds. at the end of the fiscal year.

To provide sand and gravel for concrete work in connection with Grant Lake reservoir, and at other points on the Mono Basin Project, a portable crushing and screening plant was erected approximately $\frac{1}{2}$ mile east of Cain Ranch camp, electric powered, output capacity 400 cu. yds. per 8-hour day. At the end of the fiscal year, approximately 7,000 cu. yds. of sand and gravel had been produced by this plant. The bulk of this output was hauled to the East Portal of Grant Lake outlet tunnel for concrete lining, the remainder having been used on Mono Craters Tunnel. The first gravel pit opened (at the plant site) proved unsatisfactory, yielding too much waste material. A more suitable deposit has been uncovered some $2\frac{1}{4}$ miles farther east, which now supplies the plant. In connection with the operation of this plant, it was necessary to construct 2 miles of road, and a 20-ton bridge across Rush creek.

LONG VALLEY RESERVOIR

S. L. PARRATT, *Assistant Civil Engineer*

The work of reconditioning the old camp buildings, and the erection of new buildings, was completed. A list of the existing buildings follows:



Construction progress on Mono Basin Project Dams: (Top) Grant Lake dam site, looking west; (Bottom) Long Valley dam site, looking upstream.

OLD BUILDINGS

- 1 Mess Hall, capacity 175 men
- 1 Mess Dormitory
- 1 Guest House, remodeled and enlarged
- 1 Office, remodeled and enlarged
- 1 Garage, remodeled and welding shop added
- 1 Warehouse, repaired and remodeled
- 1 Plumbing Shop, remodeled
- 2 Dormitories, total capacity 95 men, repaired and remodeled

NEW BUILDINGS

- 6 Dormitories, total capacity 98 men
- 1 Storage Garage, with concrete pit
- 1 Carpenter Shop
- 1 Commissary
- 1 First Aid Station
- 1 Bath House
- 1 Electrical Shop
- 1 Compressor House
- 1 Blacksmith Shop
- 1 Tool-Doctor's Shop
- 1 Change House

The machinery and equipment necessary for construction purposes were installed in the various buildings. The kitchen is equipped with an oil burning range, electric bake ovens, and electric refrigeration.

All buildings are lighted with electricity, and heated with wood and coal stoves.

Water for camp use is now obtained from a well (timbered and housed) approximately 100 yards below camp. From this well, water is pumped to two 6,000 gallon tanks on high ground to afford sufficient pressure throughout the camp. The tanks are housed and provided with heating units to prevent freezing. The distribution system comprises 1,402 ft. of 2", and 215 ft. of 3½" pipe.

Pyrene fire extinguishers are conveniently located in all buildings. Additional fire protection is provided by 2" fire hose and nozzles on racks inside and outside of warehouses and dormitories, connected with 392 ft. of 2" pipe lines for fire use only.

Latrines for general camp use have been enlarged and remodeled.

Sewage from inside flush toilets is discharged into an enlarged septic tank through 796 ft. of 4", and 172 ft. of 6" sewer pipe.

A road was constructed to the north abutment; length 1,350 ft., excavation 8,830 cu. yds. earth and rock.

Also a road was constructed to the south abutment; length 2,550 ft., excavation 22,200 cu. yds. earth and rock.

Two timber bridges were constructed across Owens river, one above and one below the dam site.

Water for construction uses, including hydraulic stripping, is pumped direct from Owens river by two pumps installed in the Compressor House. Pipe lines laid for this purpose comprise 5,175 ft. of 2", 120 ft. of 3½", and 1,700 ft. of 4".

Compressed air for construction requirements is delivered through 220 ft. of 2", and 4,070 ft. of 4" pipe.

The repairing and remodeling of the rock and gravel plant was completed, including the erection of a new hoist house. The output of this plant during the fiscal year was 19,833 cu. yds., which was used in the various concreting operations.

The work of trimming, regrading, and concrete lining the Outlet Tunnel and Adit No. 1 was completed.

Tunnel trimming.....	3,125 lin. ft.
Tunnel regrading.....	5,550 lin. ft.
Concreting, sides and arch.....	3,126 lin. ft.
Concreting, invert.....	6,433 lin. ft.
Adit trimming.....	650 lin. ft.
Adit regrading.....	739 lin. ft.
Concreting, sides and arch.....	644 lin. ft.
Concreting, invert.....	739 lin. ft.

A transition section, length 127 ft., was constructed of reinforced concrete, connecting the diversion canal with outlet tunnel; excavation 1,160 cu. yds. of earth.

Stripping operations at dam site No. 1 disclosed unfavorable conditions, and operations there were suspended September 10, 1935, after the removal of 81,479 cu. yds. of earth and rock.

Stripping operations were begun immediately at dam site No. 2, some 2,000 ft. upstream. At the end of the fiscal year, 372,800 cu. yds. of earth and rock had been removed at site No. 2, which is estimated to be 70% of the total stripping required.

Dewatering operations required the installation of 10 pumps, with 350 ft. of 2", 700 ft. of 4", and 730 ft. of 6" pipe.

For exploration purposes two Calyx drill holes were put down at site No. 2. Drill logs of these holes are on file; Hole No. 3-D, 178 ft. deep, Hole No. 4-D, 180 ft. deep.

A test shaft 3 ft. by 5 ft. was sunk to a depth of 45 ft. on the north bank of Owens river near the upstream toe of dam.

Also a test drift, length 36.5 ft., was driven into the north abutment, 110 ft. northwest of the axis.

A trench is under excavation for a cut-off wall near the upstream toe of dam, 182 cu. yds. having been excavated. Grouting is in progress along this trench; to date 40 holes have been drilled and grouted, average depth 20.6 ft. Grouting is by gravity pressure from a tank some 50 ft. above.

Excavation is under way on the Spillway and Diversion Tunnel, 524 ft. having been driven to date. The tunnel is supported where required by steel or timber sets on 5 ft. centers, with timber lagging.

From the East Portal approach cut to this tunnel, 6,630 cu. yds. of earth and rock were excavated.

From the spillway forebay, 5,800 cu. yds. of rock have been excavated.

A granite mountain in Little Round Valley was explored to ascertain if suitable rock could be obtained there for the construction of Long Valley dam. Four benches were quarried out and 15 drifts driven; excavation 1,179 cu. yds. Also the area on the north side of the mountain was explored by 10 surface shots. Suitable material for the construction of a rock-fill dam was not found.