

**Thirty-Sixth
Annual Report**

of the

**Board of Water and Power
Commissioners**

of the

City of Los Angeles

00-CK



Fiscal Year Ending June 30, 1937

LONG VALLEY RESERVOIR

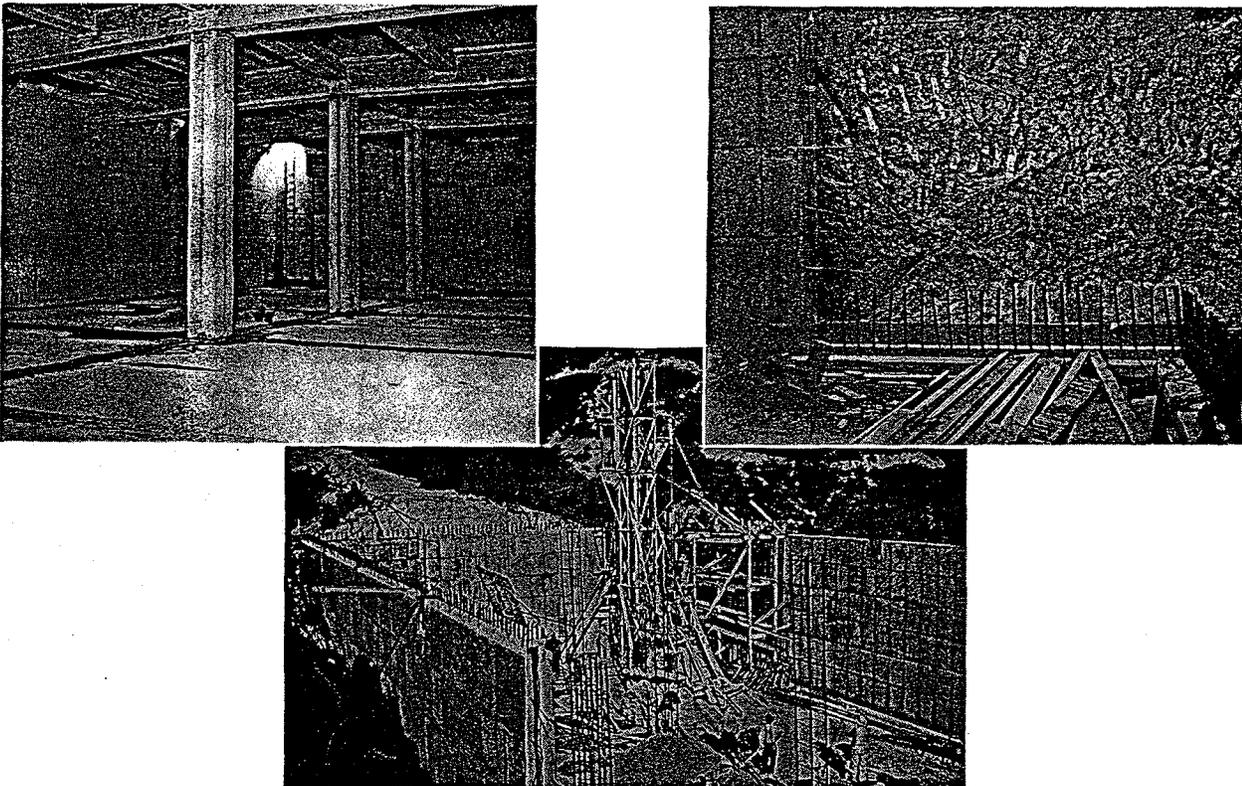
Stripping operations were continued, including the scaling of portions of each abutment; and during the fiscal year, 151,000 cubic yards of material was removed, making a total of 524,000 cubic yards stripped to date. Stripping operations were suspended October 17, 1936. Construction of the cut-off wall along the axis of the dam was started, the necessary trench being excavated across the bottom of the main channel and the concrete footing poured. Two rows of holes were drilled and grouted through and along this footing, and a few holes were drilled and grouted in each abutment. Also, many shallower holes were drilled and grouted within the foundation area. Work on the cut-off wall was suspended November 23, 1936. Excavation on the North Diversion and Spillway Tunnel, including a diversion ditch to the west portal, was completed, and concrete lining in this tunnel also was completed, with the exception of the spillway shaft. Work on this portion of the project was suspended December 30, 1936. Work on the spillway forebay was carried on down to lip elevation over the entire forebay area, and to invert elevation at the east end where it connects with the spillway shaft. This work was suspended in November, 1936.

In conclusion, it might be stated that the Bureau has functioned in a very satisfactory manner in rendering the best possible service to its patrons, and in attempting at all times to improve both its service and its relations with the public.

Respectfully submitted,

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

Mead Reservoir construction scenes: (Left) Interior. (Right) Junction of side walls and bottom slab, with dowel steel for walls showing. (Bottom) Walls partially placed.



The total footage excavated as of June 30, 1937, represents approximately 60% of the total length of tunnel.

A report of the year's progress on this project would be quite misleading without mention of some of the difficulties encountered in the driving of the tunnel.

All tunnel operations were interrupted on January 26, 1937, by a strike of the miners. The strike was of short duration, but in the meantime a blizzard had blocked all roads and prevented the return of workmen until February 9.

HEADING No. 1: Carbon dioxide gas has continuously been encountered in excessive quantities averaging approximately 1,000 cu. ft. per minute. It was possible to confine about half of this gas to the water made in the heading, and this portion was pumped out along with the water. The remaining quantity of free gas necessitated increasing the ventilating facilities to approximately eight times the normal requirement, in order to dilute the gas to such proportions as would allow work to be carried on safely in the heading. Ventilating equipment is electrically driven, with stand-by gas engines to insure continuous operation in the event of power outage. On December 18, although the pilot holes had given no indication of excessive water ahead, a shot released a heavy flow of water which drowned the heading pumps and flooded the tunnel to within 2,500 feet of the portal. When the tunnel was sufficiently unwatered to permit, construction was started on an additional pumping station above tunnel grade at the foot of Shaft 3, approximately 11,000 feet from West Portal. This pumping station was put into operation April 23, and is used as the demand requires. Since April 1, no appreciable delays have occurred, although it was necessary to grout continuously at the face for the last 1,437 feet, the flow of water and gas having been heavy in this section. The normal flow of water made in this heading during the past year has averaged approximately 6,500 gallons per minute.

SHAFT No. 1: HEADINGS No.'s 2 AND 3: Shaft No. 1 was completed May 13, 1937, and by June 30 the muck pocket and other appurtenant works at the bottom of the shaft were well along toward completion. Headings 2 and 3 were started and excavated for a short distance, as shown on the foregoing tabulation. Heavy ground and lots of water presented two problems in the sinking of the shaft. The first problem was to relieve the hydrostatic pressure by intercepting the ground water flow. This was accomplished by drifting in around the shaft at the 632, the 709, and the 739-foot levels. The water, after being intercepted, was pumped to the surface by pumping stations installed at those levels. Pumping operations were carried on continuously from February to September, 1936, at which time the ground had become sufficiently stabilized to allow the resumption of other work in the shaft. The second problem was to stabilize the shaft. This was accomplished by concrete lining from the rock section to the existing bottom, 763 feet down, and by grouting behind this lining. This work was started September 11 and completed November 17, 1936. Shaft sinking, full section, was resumed November 17, 1936, and completed to final depth, 944 feet, May 13, 1937, the concrete lining having been carried down along with the sinking.

HEADING No. 4: The ground at this heading is very wet, and driving was suspended from July 7 to August 10, 1936, in order to install additional pumping facilities. The normal flow of water made in this heading is approximately 3,500 gallons per minute. Nearly 60% of this heading required support. Because of heavy ground encountered, it was decided to line this heading with concrete throughout, before advancing it further. This concrete lining was completed June 23, 1937, with the exception of approximately 1,300 feet of sides and arch, which was left unlined to afford necessary width for switches and passing tracks.

HEADINGS No.'s 5 AND 6: These headings were holed through July 7, 1936. Trimming and other work preparatory to concrete lining were then begun and carried on as rapidly as circumstances permitted, the work of lining Heading 4 having the right of way so that driving might be resumed there.

CONCRETE LINING

The following table shows the quantity of concrete lining placed during the year ending June 30, 1937:

Heading No.	Invert Placed		Sides and Arch Placed	
	Lin. Ft.	Cu. Yds.	Lin. Ft.	Cu. Yds.
4	5,693	2,359	4,399	8,495
5 & 6	4,866	2,808	806	1,255
Total	10,559	5,167	5,205	9,750

GRANT LAKE RESERVOIR

Due to freezing temperatures, it was necessary to suspend operations at Grant Lake Reservoir on November 9, 1936. During the year, 211,172 cubic yards of compacted earth fill was placed, making a total of 218,372 cubic yards of such fill placed to date.

At Hollywood Reservoir, the concrete retaining wall which was begun and partially completed some time ago by S. E. R. A. labor, was completed around the east side of the reservoir. By the completion of this portion of the wall, the reservoir is now entirely enclosed with a reinforced concrete retaining wall. A 5-foot chain link fence was installed on top of the entire length of the wall. The existing roadway on the east side was graded and paved with asphaltic concrete to form a natural drainage channel discharging into a storm drain constructed below the Mulholland Dam. These improvements entirely eliminate the possibility of polluted storm water entering the reservoir.

A storm drain was constructed on Holly Drive below the Mulholland Dam, connecting to the City Storm Drain System to provide an adequate spillway outlet and also to handle the diverted storm waters in connection with the road improvements of the Hollywood Reservoir.

Greater use of the Ivanhoe and Silver Lake Reservoirs, in the northeastern sections of the City, was made possible by the construction of the Ivanhoe Tunnel and Outlet, and the Fletcher Drive Pumping Station with its connecting inlet and outlet lines. The Fletcher Drive Pumping Station is the most modern plant of its kind in the City, and incorporates all the latest modern automatic features of operation and control.

Service in the Eagle Rock Section was improved by the construction of the York Boulevard Automatic Pumping Plant and the Highland Park Reinforced Concrete Tank, together with the construction of numerous water mains in this section.

The chlorinating equipment in the Bureau's chlorinating plants was completely modernized, thereby rendering the City water system one of the most modern, from the standpoint of chlorination, in the United States.

SAN FERNANDO VALLEY AREA:

Extensions and betterments to the distribution system included the installation of 85,000 lineal feet of major trunk lines (over 12 inches in diameter), and 187,000 lineal feet of minor mains (12 inches and under in diameter), at a total construction cost of \$1,143,000. The installation of these mains made it possible to serve municipal water to areas in the San Fernando Valley which could not formerly be served by the Bureau, one of which areas is known as the Calabasas District, and another as the Sunland-Tujunga District.

P.W.A. Regulations governing the employment of labor were incorporated in all contracts and on all force account work. These Regulations provide that at least 90% of the persons employed on any project shall be taken from the public relief rolls. In this connection, the Bureau provided gainful employment for 2,084 persons, exclusive of those employed by the contractors.

MONO BASIN CONSTRUCTION PROJECT

Fair progress was made during the year in the excavating and lining of the Mono Craters Tunnel, considering the many difficulties encountered.

The following tabulation shows the year's excavation progress in each heading, and the total excavation progress to date:

TUNNEL EXCAVATION		
Heading No.	Footage Excavated During Present Year	Total Footage Excavated To June 30, 1937
1	3,032.0	16,593.0
2	19.0	19.0
3	30.0	30.0
4	1,836.0	6,502.5
5	139.0	2,808.5
6	84.0	9,926.7
Totals	5,190.0	35,879.7
Total length of Mono Craters Tunnel.....		59,812 Ft.
Total excavated to June 30, 1937 (as shown above).....		35,880 Ft.
Remaining footage to be excavated.....		23,932 Ft.

Major Construction Division

H. L. JACQUES, *Engineer*

MONO CRATERS TUNNEL

DURING the year ending June 30, 1937, fair progress was made in excavating and lining this tunnel, considering the many difficulties encountered.

The following tabulation shows the year's excavation progress in each heading, and the total excavation progress to date.

TUNNEL EXCAVATION		
Heading Number	Footage Excavated During Present Year	Total Footage Excavated To June 30, 1937
1	3,032.0	16,593.0
2	19.0	19.0
3	30.0	30.0
4	1,886.0	6,502.5
5	139.0	2,808.5
6	84.0	9,926.7
TOTALS	5,190.0	35,879.7

Remainder to be excavated, 23,932 feet.

A report of the year's progress would be quite misleading without mention of some of the difficulties that had to be overcome in driving this tunnel.

All tunnel operations were interrupted on January 26, 1937 by a strike of the miners. The strike was of short duration, but in the meantime a blizzard had blocked all roads, which prevented the return of workmen until February 9.

HEADING No. 1

Carbon dioxide gas, encountered in this heading early in May, 1936, has continued in excessive quantity, averaging approximately 1,000 cubic feet per minute. It was possible to confine about half of this gas to the water made in the heading, and this portion was pumped out along with the water. The quantity of free gas remaining made it necessary to increase the ventilating facilities to approximately eight times the normal requirement, in order to dilute the gas to such proportions as would allow work to be carried on safely in the heading. The auxiliary ventilating facilities were put into operation August 10, 1936, and the driving of the heading resumed, there having been no advance within the previous three months. Ventilating equipment is electric driven, with stand-by gas engines to insure continuous operation in the event of power outage.

On September 28, 1936, a run occurred in the heading, backfilling the tunnel for 264 feet from the face, delaying further advance until November 5.

When driving was resumed, pilot holes were drilled 40 feet ahead of the face at all times to test the ground ahead, and systematic grouting was carried on to seal off as much water and gas as possible. However, on December 18, although the pilot holes had given no indication of excessive water ahead, a shot released a heavy flow of water which drowned the heading pumps and in turn flooded the tunnel to within 2,500 feet of the portal. When the tunnel was sufficiently unwatered to permit, construction was started on an additional pumping station above tunnel grade at the foot of Shaft 3, approximately 11,000 feet from West Portal, consisting of two 5,000 G.P.M. high head units for lifting water to the surface through Shaft 3; and two 5,000 G.P.M. low head units acting as boosters on the line discharging through West Portal. This pumping station was put into operation April 23, and is used as the demand requires.

The heading was sufficiently unwatered by March 9 so that driving could be resumed. After advancing only 20 feet, diamond drill explorations 100 feet ahead of the face indicated the necessity of additional pump-

ing capacity at the face, 15,250 feet from West Portal. Accordingly, a pumping station was excavated there and two 4,500 G.P.M. units installed, which will discharge through either the West Portal line or the Shaft 3 lift. This installation will be ready for operation about August 1.

Driving operations were resumed April 1, and since that date no appreciable delays have occurred, though it was necessary to grout continuously at the face for the last 1,437 feet, the flow of water and gas having been heavy in this section. The normal flow of water made in this heading during the past year has averaged approximately 6,500 G.P.M.

SHAFT No. 1

HEADINGS Nos. 2 AND 3

Shaft 1 was completed to final depth May 13, 1937, and by June 30 the muck pocket and other appurtenant works at the foot of the shaft were well along toward completion. Headings 2 and 3, driven west and east respectively from the shaft, were excavated for a short distance, as shown in the foregoing tabulation.

The sinking of Shaft 1 presented two problems, due to the ground conditions encountered after passing through the overlying rhyolitic tuff. The first problem was to intercept the ground water flow, in order to prevent the building up of excessive head, which had previously caused numerous ground runs in the shaft. By drifting out from and around the shaft at the 632, the 709, and the 739-foot levels, the ground water courses were intercepted, and a large portion of the water removed through pumping stations installed at those levels. These operations were carried on continuously from February to September, 1936, by which time the ground had become sufficiently stabilized to allow the resumption of other work in the shaft.

The second problem was to stabilize the shaft itself, which was accomplished by concrete lining from the rock section to the existing bottom, 763 feet down, and by grouting behind this lining. This work was started September 11 and completed November 17, 1936.

Shaft sinking, full section, was resumed November 17 and completed to final depth, 944 feet, May 13, 1937, the concrete lining having been carried down along with the sinking.

HEADING No. 4

Nearly 60% of Heading 4 required support. The ground was very wet, and driving was suspended from July 7 to August 10, 1936 in order to install increased pumping facilities, including an additional discharge line. The normal flow of water made in this heading during the past year has averaged approximately 3,500 G.P.M.

On November 18, 1936 there was a failure of support, 6,186 feet west of Shaft 2 and 316 feet back of the face, causing a run which blocked the tunnel and backfilled a portion of the heading between the point of failure and the face. It was then decided to concrete line the heading throughout before advancing it further. This concrete lining was completed June 23, 1937, excepting about 1,300 feet of sides and arch in a hard rock section, which was left unlined to afford necessary width for switches and passing tracks. Driving will be resumed as soon as the back-filled portion of the heading is cleared and retimbered, which work is under way.

HEADINGS Nos. 5 AND 6

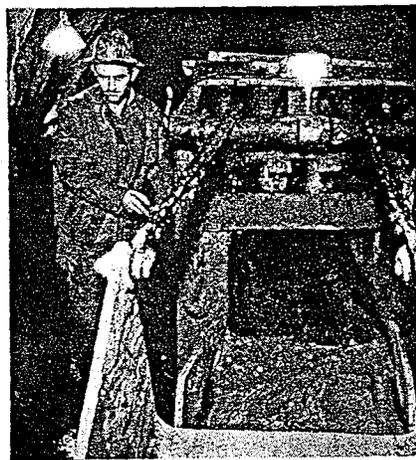
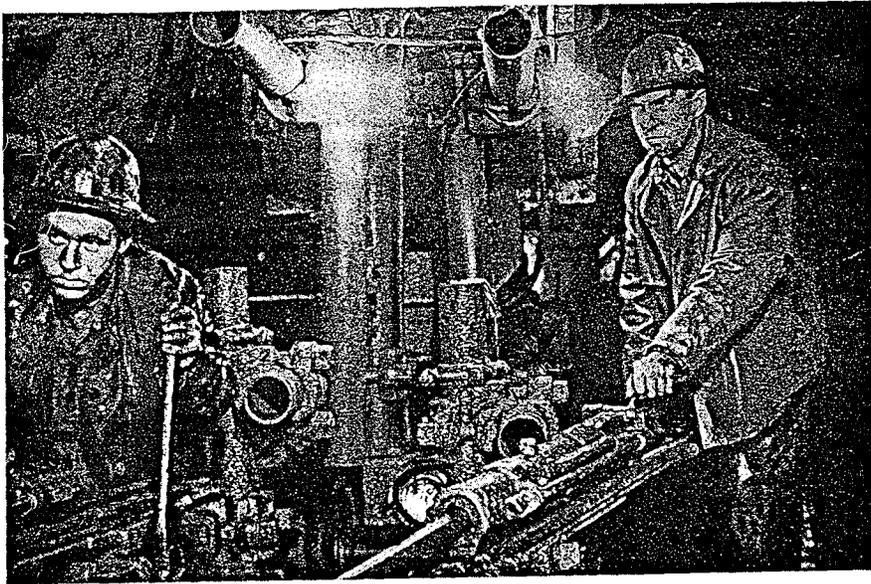
Headings 5 and 6 holed through July 7, 1936. Trimming and other work preparatory to concrete lining was then begun and carried on as rapidly as circumstances would permit, the work of lining Heading 4 having the right-of-way so that driving might be resumed there.

CONCRETE LINING

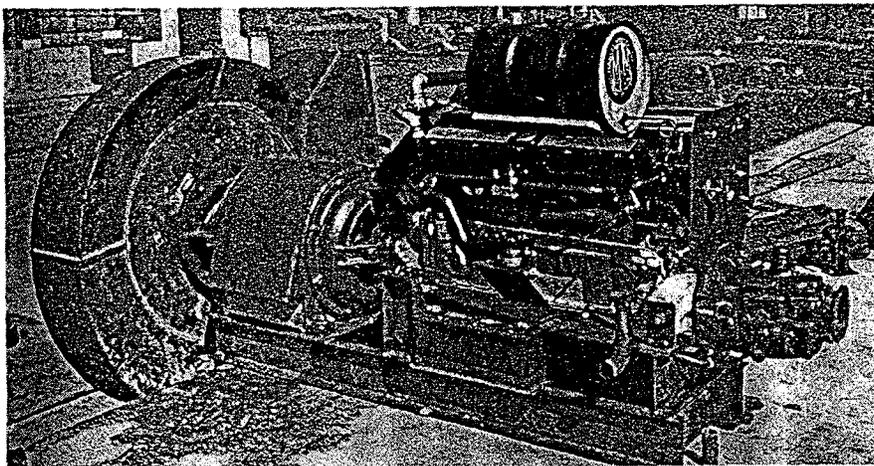
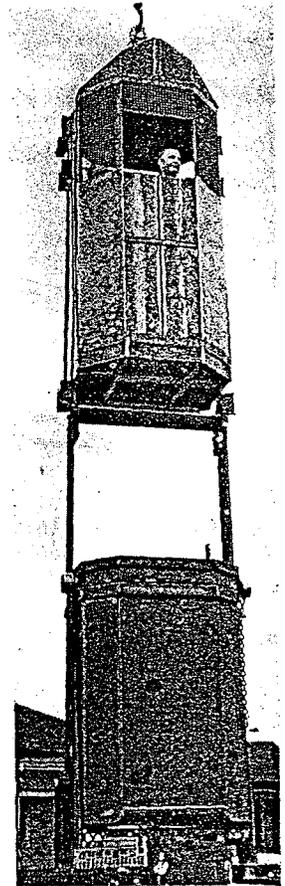
Dry aggregate was accurately proportioned through a batching plant at East Portal, and from there hauled through the tunnel to the mixer of special design, which discharged directly into a one-yard pneumatic gun, which placed the concrete. The mixer and gun were truck mounted and moved along the track as the work proceeded. The general procedure was to place the invert first and screed to finished grade. After the invert was completed, the sides and arch were placed behind collapsible steel forms.

The placing of sides and arch in Headings 5 and 6 was started June 26, 1937, working from Shaft 2 toward East Portal.

Concrete lining operations have been considerably retarded by the necessary preparatory work underground, and through having to maintain water, air, power and ventilation lines in operation at all times.



MonoCraters Tunnel Project scenes and equipment: (Above) Drill carriage with machines in operation at tunnel face. (Left) Mucking machine removing material from tunnel face. (Below) One of two tunnel ventilating blowers equipped with 150 horsepower auxiliary gasoline engine driven motor, ready for shipment to Project. (Right top) Ship and cage, designed and built in Department shops. (Right bottom) one of twelve special pumps used in tunnel.



The following tabulation shows the quantity of concrete lining placed during the year:

CONCRETE LINING, YEAR ENDING JUNE 30, 1937

Heading Number	Invert Placed		Sides and Arch Placed	
	Lin. Ft.	Cu. Yds.	Lin. Ft.	Cu. Yds.
4	5,693	2,359	4,399	8,495
5 & 6	4,866	2,808	806	1,255
TOTALS	10,559	5,167	5,205	9,750

GRANT LAKE RESERVOIR

The placing of the dam fill was continued until November 9, 1936, when freezing temperatures in the soil made it necessary to suspend operations. During the year, 211,172 cubic yards of compacted earth fill was placed, making a total of 218,372 cubic yards of such fill placed to date. The method of placing and laboratory control were the same as used with success in the construction of Bouquet dam.

As the fill increased in height, final stripping operations on the abutments were carried along, 32,080 cubic yards of material being so removed this year, making a total of 366,200 cubic yards stripped to date.

Between July 22 and October 6, 1936, the outlet tunnel (length 3,401 feet), the control valve chamber, and the control shaft were concrete lined, and a control house constructed of concrete at the top of the shaft. This work included also the installation of 580 feet of 96-inch welded steel pipe in the portion of tunnel west of the shaft. The pipe sections were welded together, encased in concrete and lined with gunite.

LONG VALLEY RESERVOIR

Stripping operations were continued, including the scaling of portions of each abutment, and the removal (this year) of 151,000 cubic yards of material, making a total of 524,000 cubic yards stripped to date. Additional unwatering lines and pumping facilities were installed, and the roads to each abutment were extended, widened and improved. This portion of the work was suspended October 17, 1936.

Construction was started on the cut-off wall along the axis of the dam, the trench for it being excavated across the bottom of the main channel and the concrete footing poured. Two rows of holes ranging from 50 to 150 feet deep (a few deeper) were drilled and grouted through and along this footing, and a few holes were drilled and grouted in each abutment. Also many shallower holes were drilled and grouted within the foundation area. Work on the cut-off wall was suspended November 23, 1936.

Excavation was completed on the North Diversion and Spillway tunnel, including a diversion ditch to the West Portal. Concrete lining in this tunnel also was completed, excepting the spillway shaft. The valve stem chamber was drilled and cased from this tunnel through to the ground surface to provide convenient control of the diversion gate. This portion of the work was suspended December 30, 1936, but some emergency concreting was done in March, 1937.

Excavation for the spillway forebay was carried down to lip elevation over the entire forebay area, and to invert elevation at the east end where it connects with the spillway shaft. This work was suspended in November, 1936.

On the south abutment, a road was constructed to the control shaft site above the main outlet tunnel, and the shaft was excavated to a depth of 43 feet, of which 20 feet was concrete lined, work here having been suspended December 19, 1936.

Test holes and pits were sunk over three sizable areas in search of a borrow pit from which to obtain suitable material for constructing the dam. Such material was found at the edge of the reservoir area about 2 miles west of the dam site. A power line was constructed to this borrow pit, and a high speed truck road about 70% completed between the pit and the dam site, when work was suspended in December, 1936.