

# Progress of Construction On Colorado Aqueduct

---

That more than a third of the total amount of construction work on the Colorado River Aqueduct's main line, or approximately \$58,000,000 worth, is actually under way or has been contracted for was announced this week by Assistant General Manager J. L. Burkholder, of the Metropolitan Water District.

This work under way and contracted for, it was pointed out, includes eighty-four miles of tunnels, sixteen feet in diameter, the largest tunnel job ever carried forward at any one time in the history of the world; construction of Parker dam at the aqueduct intake on the Colorado River, to be built by the United States Government for the District; Pine Canyon dam and reservoir, more than half completed, to be used as an aqueduct storage basin.

Latest employment figures show that more than 2,200 men are already engaged on the aqueduct job, with new crews being added every day. The number of men on the project now in progress is to be increased by approximately 500 per month until peak employment of 15,000 is reached.

Burkholder's report revealed that the District's vast program of preliminary construction work is all rapidly nearing completion. This work includes the following:

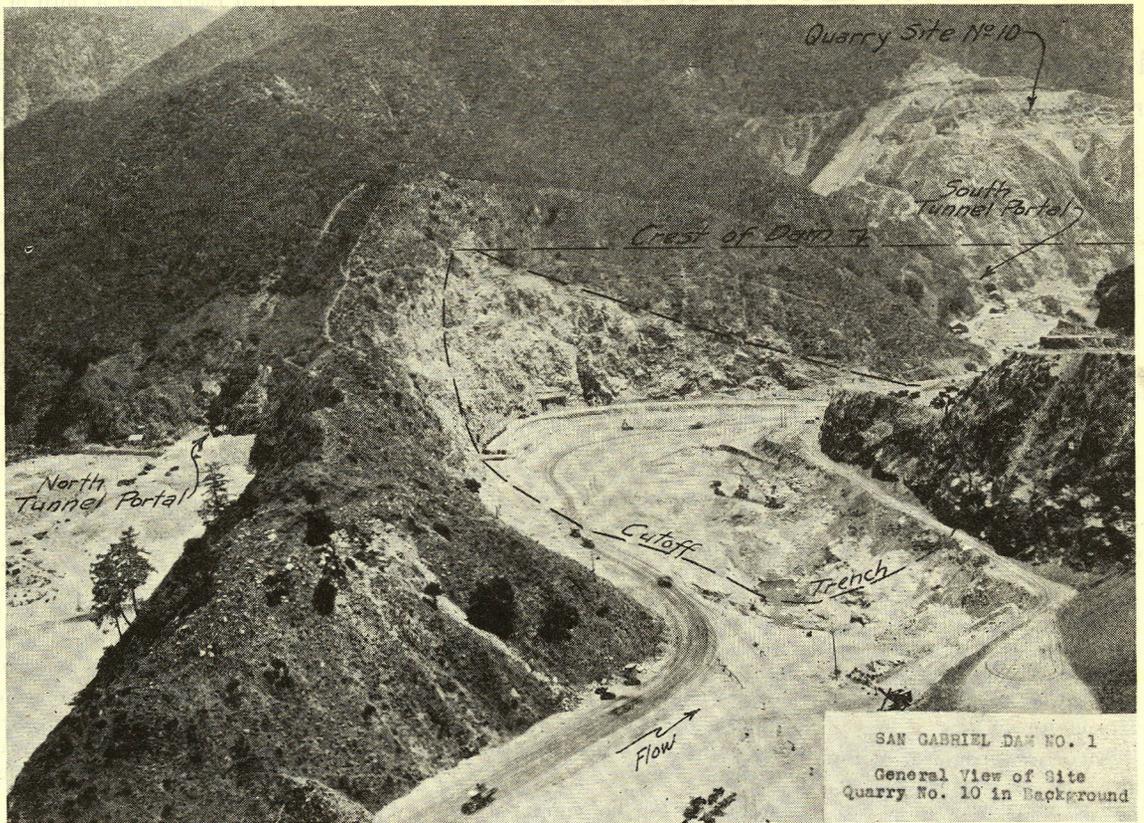
Construction of 220 miles of high voltage power transmission lines to supply electricity for construction purposes and camp use. These lines extend along the route of the aqueduct from Colton to the river. More than half of this line has been completed and is in use. The remainder is well along toward completion.

One hundred eighty miles of water line, also paralleling the aqueduct, is practically finished. This water system, constituting a major job in itself, is being built for construction and domestic uses in the various aqueduct camps. The water is being secured from wells, drilled by District engineers along or near the aqueduct line, which will provide sufficient water to meet construction needs for the six year building period.

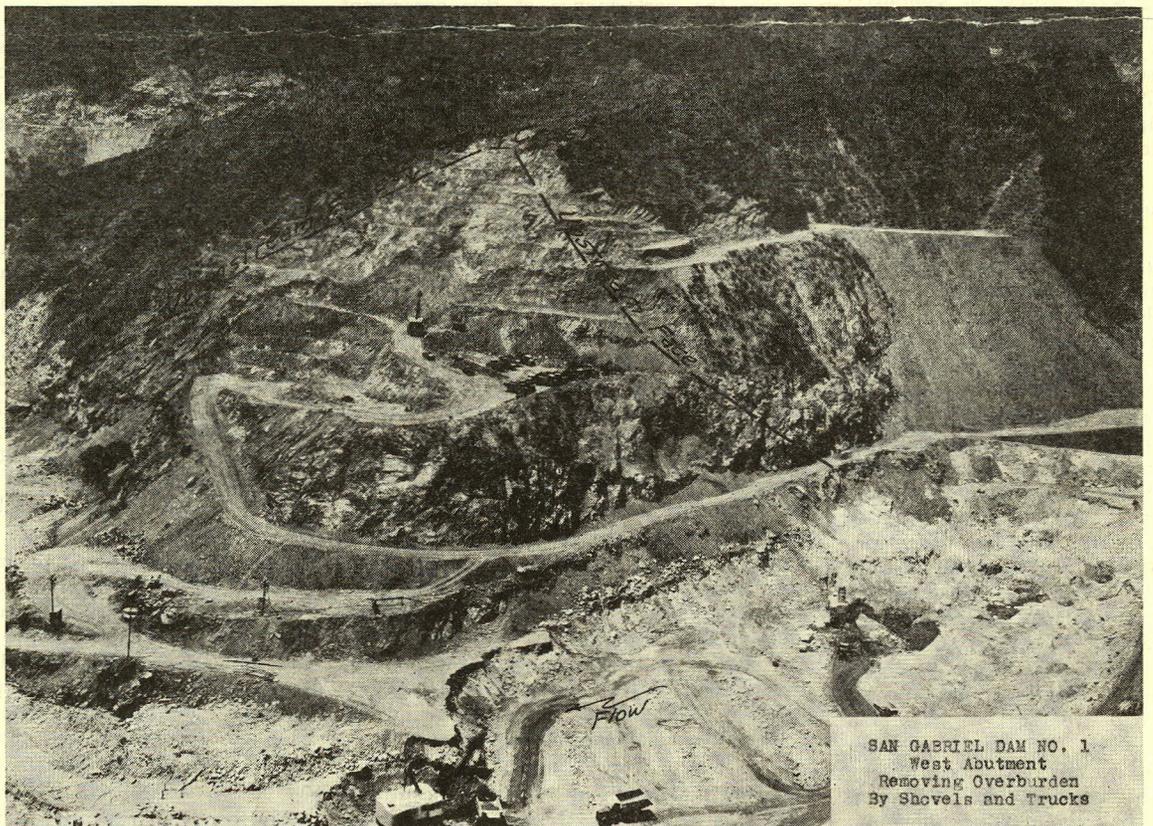
One hundred fifty miles of surfaced highway, under construction for the past six months, is nearing completion, and approximately 130 miles of this road is now in use. This job, one of the most spectacular units of preliminary aqueduct work, is said to be one of the largest single highway construction programs ever carried forward over a similar period in the road building history of California.

Built primarily for the transportation of millions of pounds of materials and supplies required in the construction of the aqueduct, this highway will also serve to open up to the motorists of the United States several thousand square miles of heretofore inaccessible mountain and desert country. A complete system of road signs is being installed with the cooperation of the Automobile Club of Southern California.

Thirteen construction firms have received tunnel contracts. Three are already well under way with tunnel construction, and the others are progressing rapidly with road and camp construction preparatory to the launching of the real job.

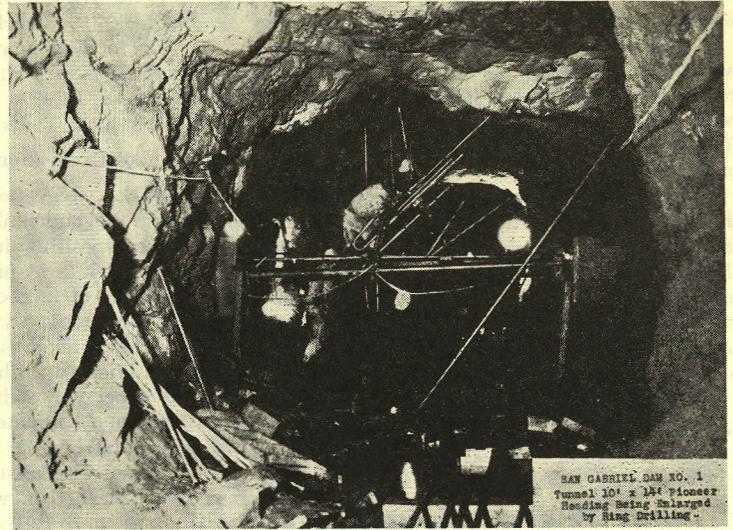


Picture above shows the east abutment, San Gabriel Dam No. 1, with dam as it will be built, outlined. Picture below shows west abutment with upstream and downstream lines of dam indicated. Excavation in the river bed is shown in the foreground. Rock in abutment is being cleared of loose material, shovels doing the excavating. These and other pictures used here taken by Los Angeles County Flood Control District.





SAN GABRIEL DAM NO. 1  
Tunnel 35 Foot Diameter  
Ready for Lining



SAN GABRIEL DAM NO. 1  
Tunnel 10' x 14' Pioneer  
Heading Being Enlarged  
by Ring Drilling

Left, 35-ft. Bore for Outlet Tunnel at San Gabriel Dam No. 1 Ready for Lining. Only 84 Lineal Feet of Timbering Needed in This 2000-ft. Tunnel.  
Right, Pioneer Tunnel, 10x14 Ft., Being Enlarged by Ring Drilling.

# Excavation for San Gabriel Rockfill Dam No. 1 Progresses Rapidly

## 10,500 Cubic Yards Being Taken Out Daily Bore for 30 Ft. Outlet Tunnel Ready for Lining

A contract was signed by the Board of Supervisors of the Los Angeles County Flood Control District January 16, 1933, for the construction of San Gabriel Rockfill Dam No. 1 on a unit price basis for \$8,600,527.

First work was started on March 15, 1933, on the 30-foot diameter 2000-foot long tunnel, which will ultimately serve as the main regulating outlet and during construction as a diversion tunnel.

The dam involves the excavation of an estimated total of 5,000,000 cubic yards; the placing of 5,600,000 cubic yards of rockfill and the placing of 120,000 cubic yards of concrete and gunite. Completion is called for in five and a half years. Under the contract the District furnishes steel, cement and valves which are placed by the contractors on a unit price basis.

Work at present is concentrated on excavation of the main tunnel; excavation of the east and west abutments, and in the streambed; and stripping of the quarry site. Under the contract the District specified a number of alternative quarry sites, the contractors bidding separate prices on each quarry. The District pays at unit prices for stripping, waste and the quarried rock placed in the dam.

### Outlet Tunnel Construction

The tunnel, which will be 30-foot inside diameter circular, has its inlet, or north portal, 500 feet upstream from the heel of the dam. The outlet, or south portal, is 1000 feet downstream from the toe of the dam. The inlet will be provided with a number of regulating valves at different elevations.

Tunnel excavation commenced on March 15 on the south portal and March 21 on the north portal using the pioneer heading method; a center heading 10 ft. x 14 ft. at the north portal and a bottom heading 14 ft. x 14 ft. proceeding inward from the south portal.

BY E. C. EATON

Chief Engineer Los Angeles County Flood Control District; Progress Report to Board of Supervisors.

Average progress on the pioneer tunnel was 20 lineal feet per shift per heading.

Ring drilling is being used for enlargement to the full diameter of 34 feet from the north portal heading, and mucking by means of a 1¼-yard air-operated shovel loading into 10-yard trucks.

From the south heading enlargement is being done by means of stoping into mine cars, each of 3 yards capacity.

At the present time (July, 1933) only 84 lineal feet of timbering has been required in the entire 2000 foot length of tunnel. No timbering was needed at either portal. Completion of the enlargement of the entire tunnel is scheduled for August 15.

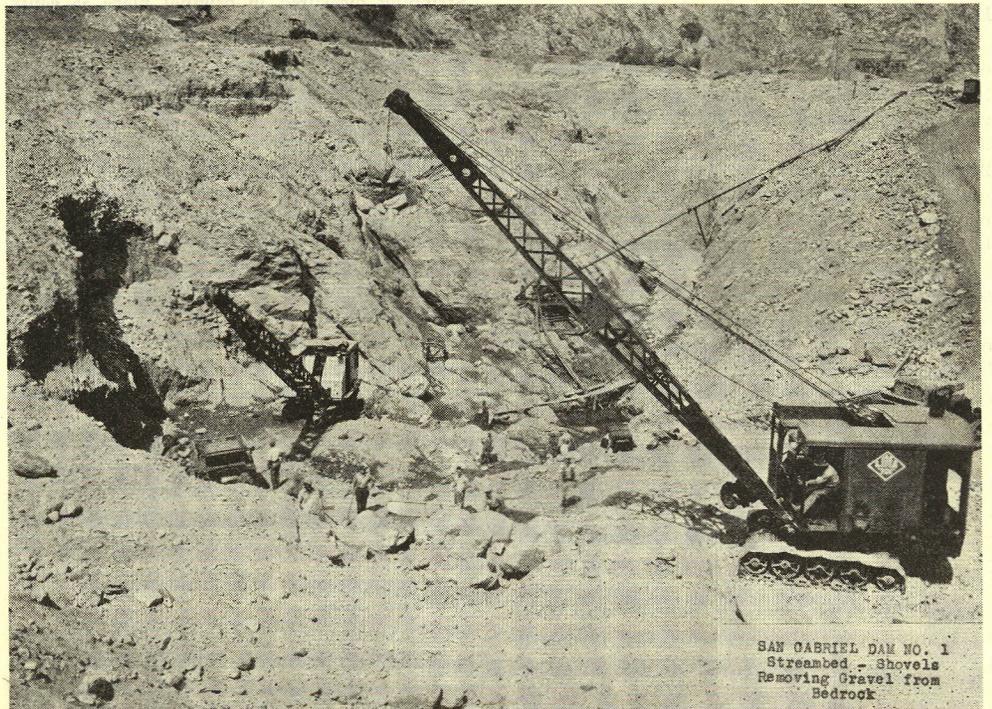
Rock is of excellent character having an average weight of 175 lbs. per cubic foot and an average strength of 12,000 lbs. per square inch as shown by 3 inch cubes sawn from representative samples.

### Concrete Lining for Tunnel

The concrete plant for lining of the tunnel is now being erected and consists of two 1-yard mixers provided with weigh batchers for proportioning. River bed gravel from the vicinity of the tunnel will be used and screened.

Lining will commence the latter part of July. Metal tunnel forms in 30-foot long sections will be used. These will be mounted on carriers running on tracks.

Placing of concrete will be by means of a concrete gun delivering concrete through a



SAN GABRIEL DAM NO. 1  
Streambed - Shovels  
Removing Gravel from  
Bedrock

Shovels Removing Gravel from Bedrock in Streambed at San Gabriel Dam No. 1. Excavation Here Carried to a Depth of 20 to 70 Feet.

pipe to the crown line of the tunnel from which it will pass by chutes down the sides.

The finished inside diameter of the tunnel will be 30 feet with a minimum permissible concrete thickness of 2 feet. Lining will be reinforced with 424 lbs. of steel per lineal foot of tunnel or 57.3 lbs. of steel per cubic yard of lining.

Immediately following the excavation of the full bore of the tunnel, the interior surface, as far down as the springline, was shot with a coat of gunite averaging 1 inch in thickness. The average placing of gunite during time of working of gun was 1000 square feet per hour. The mix employed was 1 to 4.

Based upon contract bid prices the tunnel cost will be:

Total length of tunnel, exclusive of open cut at portals, 1829 lineal feet.

Excavation 62,700 pay yds. at \$8.00 per yd	\$501,600
Lining 13,800 pay yds. at \$10 per yd	138,000
Placing steel 776,000 lbs. at \$0.013 per lb.	10,088
Cement 19,000 bbls. total at \$1.82 per bbl.	34,580
Steel 776,000 lbs. total at \$0.014875 per lb.	11,473

Total exclusive of guniting.....\$695,741

Average per lineal foot of tunnel \$380.00 per foot.

The tunnel excavation and lining was sub-contracted by the West Slope Construction Company which has the main contract for Dam No. 1 to Morrison and Knudsen,

The tunnel excavation program was exceptionally well carried out. Final figures on overbreak are not available but preliminary estimates indicate about 6% overbreak beyond pay lines.

The average use of explosives has been 4 lbs. per yard in the pioneer heading and 2½ lbs. per yard in the enlargement. In the pioneer heading an average round consisted of 27 drill holes 11 1/16-feet in depth.

Tunnel muck from the north heading is being used to construct a rockfill coffer-dam just downstream from the intake, or north portal. This coffer-dam will have a maximum height of 40 feet above bedrock and will have a concrete upstream face connecting to a concrete cutoff founded on bedrock. This coffer-dam will serve as a diversion for flood waters during the construction period.

#### East Abutment Excavation

The east abutment consists of a shear wall of rock, having an average slope of 6/10 to 1. Rough excavation to date has been accomplished by means of sluicing with an hydraulic giant under maximum pressure of 200 lbs. per square inch with a 2½ inch nozzle. The sluicing has been completed, the remainder of the excavation, consisting of benching for cutoffs, and trimming of rock will proceed ahead of the rockfill working progressively from the top of the rockfill.

Of the estimated total of 125,000 cu. yds. on this abutment 8000 cu. yds. or 6½% had been removed to July 1. The contract price for this material is 80 cents per cubic yard.

#### West Abutment

Work in progress on the west abutment has consisted of the removal by shovel and trucks of the loose overburden. During the month of June, one 2-yard shovel and ten 5-yard trucks removed an average of 1150 cu. yds. per 8-hour shift. The material is deposited upstream from the damsite and used to blanket the hillside below the proposed spillway cut which will be through the west or right abutment. The average haul has been about 1000 feet.

Rough excavation is about completed, the remainder to be removed progressively as

the rockfill rises using the top of each lift on the rockfill as working benches.

Of the total estimated 400,000 cu. yds. to be removed 178,410 cu. yds. or 45% has been taken off to July 1. The contract price of this work is 48 cents per yard.

#### Streambed Excavation

Streambed excavation involves the removal of sand, gravel and boulders from the streambed, and depositing just upstream from the damsite. Work is at present in progress with two 4-yd. electric shovels loading into four 10-yard and ten 20-yard dump trucks. The average haul at present is 1000 feet. The average removed with the above equipment is 2250 yards per eight hour shifts.

Of the total estimated quantity of 1,292,000 cu. yds., 231,917 yards or 18% has been taken off to date. The upstream cut-off area has exposed a hard firm waterworn granite base at from 20 to 70 feet below original streambed.

#### Quarry Site Development

It is expected that the first rockfill will be placed about March, 1934, this being the approximate date when streambed excavation is expected to be completed. Work at present is confined to the stripping of the over burden from the quarry.

Quarry Site known as "No. 10" has been selected and is located ½ mile downstream from the axis of the damsite. This quarry site consists of a massive area roughly triangular in elevation rising as a sheer face from streambed level. The first unit of the site has a length, measured up and downstream of about 1000 feet at streambed level. The quarry site rises from this streambed level, as a sheer face for about 350 feet in height and from this height slopes back at a slope of about 1 to 1 to a point about 600 feet above streambed.

The roughly triangular section of the upper area is favorable toward a minimum amount of overburden.

Under the contract the District pays separate prices for stripping and waste and for the several classes of quarried rock as follows:

Stripping measured in original place	55 cents per cubic yard.
Waste measured in waste dump	40 cents per cubic yard.
Quarried Rock—Class A in body of dam	0.75 per cubic yard.
Quarried Rock—Class B in body of dam	0.40 per cubic yard.
Quarried Rock—Class C Downstream Face	1.20 per cubic yard.
Quarried Rock—Class D Packed Rock on Upstream Face	2.45 per cubic yard.

Allowing for the estimated swell in waste as measured in waste dump as compared to the measuring of stripping on original ground, the contract prices for stripping and waste are about equal.

Under the contract a shaker type grizzly is required in order to remove undesirable quantities of fine material from the quarried rock.

Of the estimated total 3,000,000 cu. yds. of combined stripping and waste there has been removed 137,865 cu. yds. or 4½% to July 1. A favorable exposure has already been uncovered at one point of suitable rock for the fill.

#### High Line Road

"Construction of Pasadena's Pine Canyon Dam and the District's Rockfill Dam No. 1 requires the relocation of about 9 miles of replacing the present streambed roads.

Of this length about 7 miles are under cooperative financing by the U. S. Bureau

of Public Roads; State of California Department of Public Works; Los Angeles County Road Department; City of Pasadena and the Los Angeles County Flood Control District.

"This 7-mile section is completed except for oiling and will be open to public use about August 1.

"The remaining section of about 2 miles is under construction by cooperative agreement between the U. S. Bureau of Public Roads and the Los Angeles County Flood Control District. Its completion is expected by September 1, 1933.

"In the entire road there is involved over 3,000,000 cu. yds. of excavation besides auxiliary structures, bridges, culverts, etc.

"The completed costs of the nine miles of road will be about \$1,500,000.

"The first section of the High Line Road was contracted to Guy F. Atkinson Company and the second section to J. E. Haddock.

"Road construction is under supervision of the U. S. Bureau of Public Roads with Mr. C. S. Bruening as resident engineer.

"Dam No. 1 is under the direct supervision in the field of Mr. K. J. Harrison, as resident engineer.

### NEWS OF BUILDING AND SAFETY COMMISSION

BY ROBERT H. ORR  
Chairman of the Board

Mayor Frank L. Shaw has appointed Mr. Frank McGinley to succeed himself as commissioner on the Board of Building and Safety Commissioners. Mr. McGinley has been a commissioner since the adoption of the charter authorizing a commission form of government.

Mr. Guy Sinks, motion picture examiner for motion picture projectionists under the board, has resigned. A new examiner will be appointed from a list of eligibles.

An ordinance regulating the sale of electrical materials, devices and equipment has been approved by the Commissioners and forwarded to the City Council for adoption.

General approval has been given the Truscon Steel Co. to use Metal plaster board weighing 5.2 lbs. per sq. yard with 3-8 inch deep ribs, 2 5-8 inch center to center for use wherever wood lath or gypsum plaster board is permitted by Ordinance with ½-in. thickness of plaster over the face of the lath.

The commissioners have approved a draft of an ordinance known as Section 115½ to be added to Building Ordinance N 28,700 (N.S.), regulating hollow reinforced concrete bearing walls and partitions as requested by Monolith Hollow Wall Co. of San Diego and forwarded the same to the City Council for adoption.

The commissioners approved the use of Dardelet rivet bolts, as requested by the Pacific Coast Steel Corporation, for any one particular job. Dardelet rivet bolts are fabricated from high tensile manganese steel for use in the same manner as provided by Ordinance for bolts with reamed holes and driven fit in fabricating steel structures. Dardelet rivet bolts are made having a shank the length of the thickness of the metal to be fabricated slightly larger than the punch