Building the East Park Reservoir, Dam, and Spillway

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Building the East Park Reservoir, Dam, and Spillway—Part 1

The U.S. Bureau of Reclamation was created in 1902 by an Act of Congress. A group that became known as the Orland Water Users Association was formed in 1906 by ranchers, farmers, and citrus growers along Stony Creek. Stony Creek is a major stream in northern California. It rises in the coastal range and converges with the Sacramento River at Hamilton City, just east of Orland.

In 1907 this group of water users petitioned the Bureau of Reclamation for a dam and reservoir to manage Stony Creek. The bureau agreed and established the Orland Water Project. The East Park Dam and Reservoir were the first of the two dams and reservoirs included in the project: Stony Gorge Dam and Reservoir was the second, in 1928.

This piece supplements an earlier 2008 *Wagon Wheels* article (Volume 58, pages 8-12) by providing information about the reservoir's land acquisitions, and the movement of three structures and two cemeteries.

This article is in three parts: Part 1, Reservoir, provides details about the purchase and preparation of the land for use as a reservoir. Part 2, Dam Construction, provides construction details attendant to building the East Park Dam, and Part 3, Spillway Construction, provides construction details for the spillway.

The primary sources for Part 1 are a copy of a U.S. Bureau of Reclamation (USBR) map that appeared in a report from the files of the Orland Unit, Water Users Association[1], and deeds from the Colusa County Hall of Records (see Table 1).

Parts 2 and 3 use USBR official reports as sources for the text and period photographs as illustrations. The reports and photographs were provided to the Stonyford Museum by George Pendell, who is the water master for Stony Creek.

Part 1, Reservoir

In the beginning, the reservoir was a lovely, green, mountain valley with two creeks running through it (Little Stony and Indian). In 1908 the valley was populated by sixteen or more families, a Catholic church with its small cemetery, an adjoining larger cemetery, and a school. These properties and structures are shown in Figure 1. The names and property locations are approximate based on the land descriptions contained in their respective deed. Refer to Table 1 for their names and Section Number where their name appears on the map.

Table 1. Reservoir Land Transactions (All deeds are filed with the Colusa County Hall of Records in the Book and Page number shown (Bk/Pg).)

Date	Name(s)	Acreage	Amount ($)	Avg/Acre ($)	Map Section	Bk/Pg
06/22/1908	Alfred K. and Hattie Harbison	138.18	1,000	7.24	34	65/237
06/28/1908	David and Ellen Crossett	1040	16,500	15.87	14	65/236
08/07/1908	Elizabeth A. Rodgers , a widow	1125.1	9,000	8.00	15	65/306
10/06/1908	D.H. Rohrback, a widower	400	13,000	32.50	23	65/366
10/25/1908	Charles and Nellie Coleman and John K. and Margaret Weast	320	9,000	28.13	3	65/369
10/26/1908	Robert A. and Anna Gordon	110.71	2,500	22.58	3	65/365
11/20/1908	Jochim and Cecilia Bruggmann	480	9,500	19.79	3	65/397
11/20/1908	Bettie Cheney, Single	120	310	2.58	3	65/399
11/20/1908	Johnson and Harriett Fender	280	2,750	9.82	2	65/398
11/20/1908	Rev. Thomas Grace and Michael Wallrath, Roman Catholic Church	10	4,000	400.00	3	65/403
12/06/1908	R.E. Phelps and Peoples Savings Bank or Sacramento	6	15	2.50	2	65/425
12/07/1908	Mary E. Marshall and Jane M. Parton	41	1200	29.27	24	65/415
12/29/1908	The German Savings and Loan Society	14	140	10.00	10	65/458
01/11/1909	Frank S. Reager	160	1	.01	14	67/146
02/10/1909	Orland Water User's Assoc.	3	1	.33	23	67/147
02/10/1909	A.A. Stafford, Single	160	700	4.38	23	69/52
	Totals	4408	69,617	593		

Settlement in this valley began in the 1850s and '60s, and became known as Little Stony[2]. A U.S. post office was moved here from Ashton in 1879[3]. (Ashton was a copper town located on Little Stony Creek, in the North Coast Range above Lodoga that had been abandoned when the copper boom went bust[4].) The post office was located in the home of a Mr. Schuckmann, and the first postmaster was James R. Davis[5].

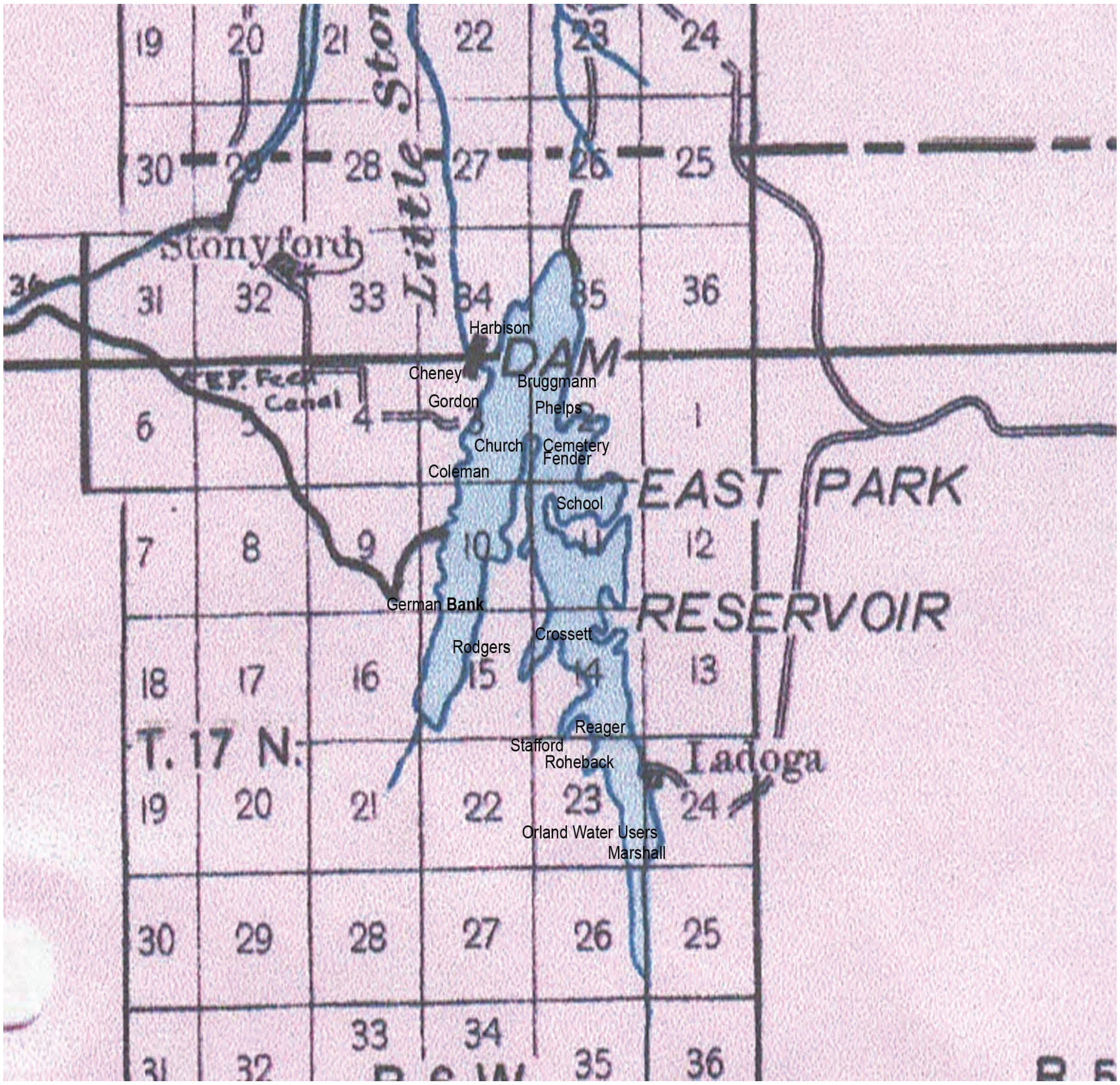

Figure 1. USBR 1908 map showing land sections and seller's names and approximate property locations.

A Catholic church was dismembered in Sutter and rebuilt here in 1895 by Father Michael Wallrath. Its first name was *Mt. Saint Mary's*, which was later changed to *Mt. Saint Zachary*, for a celebrated 8th century pope. After the church's dedication in 1897, its name was changed again to *Our Lady of the Visitation*[6].

Father Wallrath had obtained the land from J.F. Easton and built the church as part of a summer retreat for the Ursuline Sisters, who were then teaching at the St. Aloysius Convent School, in Colusa. The retreat was down the ridge from the church, on the east bank of Little Stony Creek. To gain access, Ernest Phelps (1883-1963) and Denny O'Leary (1882-1959) dug a tunnel in the shape of a cross. The retreat had a swimming pool that was fed by a natural spring. Beulah VanLandingham (1897-1993) recounts that "As a child I was there once and I definitely remember it as being so very cool and refreshing….[7]"

The Mt. Hope School was built here in 1897. A cemetery had been placed here before 1868, according to Sharky Moore[8]. It was located on land adjoining the Fender property (shown in Figure 1). Sharky said that the first two men buried here were killed in a gunfight and buried together in a single grave. The Lett brothers, who were killed by Peter Smith and John Hersey in a celebrated gun battle in 1877, were also buried here[9].

The first movement was the first post office (not associated with the dam). It was moved three miles away to Smithville in 1882, where it retained the name of Little Stony[10]. In 1890, the buildings in Smithville were moved from the marshy land alongside Big Stony Creek to higher ground and the town was renamed Stony Ford; the post office's name was also changed to Stony Ford. A new post office was reestablished a few years later, on May 21, 1900, in the Little Stony settlement and given the name of Zachary[11]. Likely, the settlement had come to be called Zachary, after the church's earlier name and the post office took that name; thereby, making it official.

In October 1907 a dam and reservoir had been officially approved for East Park[12]. The settlement, now known as Zachary, was located in the area that would be under water. Consequently, the church, school, and cemeteries, had to be moved. The post office had been moved earlier to Lodoga, on October 31, 1906, to provide better coverage for Leesville and other nearby mountain communities[13].

The church was moved to Stonyford in 1908. The history of this move and the church's later restoration are told in the Spring 1980 issue of *Wagon Wheels*, pgs. 24-25, and on the Stonyford web site at *www.stonyfordca.org/history.* The Mt. Hope school was moved in 1910 (Figure 2).

Bodily remains from the two cemeteries were moved in 1908. Those from the main cemetery were moved to Lodoga, while those from the small Catholic cemetery were moved to the Indian Valley Cemetery in Stonyford (now known as Stonyford

Figure 2. Movement of Mt Hope School in 1910.

Cemetery) [14]. These remains were likely Hannah Kearney O'Leary (1820-1897) and John J. O'Leary (1878-1903). Bodily remains from the main cemetery were moved to a newly created cemetery in Lodoga, which is now named Cypress Hill. A local history reports that there were thirty graves moved to Lodoga[15].

The properties in the reservoir area were deeded to the U.S. Government, Bureau of Reclamation, in 1908 and 1909 (Table 1, above). All were sold intact. Each deed included this language: "Together all and singular the tenements, hereditaments, and appurtenances thereunto belonging, or in anywise appertaining, and its rents, issues, and profits thereof."

Nevertheless, the Catholic Church was moved to Stonyford. The Bruggmann house was retained intact and moved to the dam's construction site, where it was used as a headquarters building (Figure 3). Except for the Mt. Hope School, mentioned in an earlier paragraph, no records can be found that describes the movement of any other structures.

When full in 1910, the reservoir covered 1900 acres and had a storage capacity of 40,000 acre-feet. (Later work on the spillway in 1915 added a total of three inches to its height, and increased the reservoir's capacity to 51,000 acre-feet.) The 1910 report total for the land was $86,047[16]. The deeds listed in Table 1 total $69,617, a difference of $16,430. Obviously, all of the deeds were not found.

The surviving historical records are mostly silent on the persons involved in these land transactions; however, a few details were uncovered:

- Jochim and Cecilia Bruggmann bought their property in 1897 and raised stock and alfalfa. He was born in Hamburg, Germany, on June 18, 1857 and moved to Colusa County, California, in 1881. He died in Orland, California, on June 4, 1945[17].
- D.H. Rohrbach (spelled Rohrback on the deed) was a Union Civil War veteran who fought in several campaigns. He was mustered out in 1863, in Pennsylvania, and came overland to California the following year. He settled on his East Park property that he named "Rohrbach Ranch". He married twice and fathered five children. He died at age 90 and is buried in the Colusa Community Cemetery, in Colusa, California[18].
- Johnson Fender was born August 20, 1834, and died on December 24, 1915. He is buried in the Stonyford Cemetery[19].

Figure 3. The J. Bruggmann house before being moved to the dam site to be used as a headquarters, June 1, 1909.

- Alfred Kitchen Harbison was born in Nebraska on May 10, 1860, and died at the Colusa Memorial Hospital on March 4, 1949, after a 28-day stay. As a child, he crossed the plains in a covered wagon with his parents, the Andrew Harbisons. They settled in the Sacramento Valley. He retired to Maxwell, after selling his ranch. He was a Mason and an Odd Fellow and a member of the Maxwell Methodist Church. He is buried in the Maxwell Cemetery[20].

- Robert A. Gordon was born in 1864 and died in1938. He is buried in the Williams (California) Cemetery[21].

- Charles Coleman is buried in the Colusa Community Cemetery, Section D, Lot 5. Grave 9 with no headstone. Rhoby Coleman, wife of Charles Coleman, died on September 20, 1904, and is buried in the Colusa Community Cemetery, in Colusa, California[22].

Notes

1. Report, "History, Orland Project, California, Calendar Year 1914," np, nd, Frontispiece.
2. Video-recorded interview between Joyce Bond and Lawrence (Sharky) Moore, c.1985. Sharky (1901-1995) and his sister, Beulah VanLandingham (1897-1993) are local legends for their encyclopedic knowledge of the Stonyford area. Joyce, Sharky, and Beulah are co-authors of *Back In Time, Stonyford Community History*.
3. Joyce Bond, Sharky Moore, Beulah VanLandingham. *Back In Time, Stonyford Community History.* n.p., May 1993, pgs. 20 and 406.
4. *Ibid,* pg. 249.
5. *Ibid,* pg. 20
6. *Ibid,* pg. 171.
7. *Ibid,* pg. 182.
8. Interview, Bond and Moore
9. *Back In Time*, pg. 275.
10. *Ibid,* pg. 20.
11. Interview, Bond and Moore and *Back In Time,* pg.406.
12. *Orland Project*. Autobee, Robert. Bureau of Reclamation, 1993. pg. 7
13. Interview, Bond and Moore. *Back in Time*, pg. 406.
14. *Back In Time,* pg. 254.
15. *Ibid*, pg. 324
16. *United States Reclamation Service, Orland Project California Cost Report of East Park Dam, Spillway, and Dikes*, n.p., September 30, 1910, pg. 18.
17. "Death Claims J. Bruggman at Age of 88," *Colusa Sun Herald,* Tuesday, June 5, 1945.
18. Colusa Cemetery Inscriptions, Volume 3, Pg. 75
19. Colusa Cemetery Inscriptions, Volume 2, Pg. 45
20. Colusa Sun Herald, Monday, March 29, 1949 & Harbison Family History
21. Colusa Cemetery Inscriptions, Volume 2, Pg. 81
22. Colusa Cemetery Inscriptions, Volume 3, Pgs. 8 & 107

Part 2
Building the Dam

A site on Little Stony Creek, near where it merges with Indian Creek, called East Park was chosen as a good location for a dam and reservoir, by a survey team in 1903[1]. Little Stony Creek is a tributary of Stony Creek. It rises in the coastal mountains, flows down the mountain, across a valley, through a gorge, and joins Big Stony Creek about three miles downstream from the dam site (Figure 1).

The ridge through which the creek cut a gorge is conglomerate. Conglomerate is a clastic sedimentary rock that contains large (greater than two millimeters in diameter) rounded clasts. The space between the clasts is generally filled with smaller particles and/or chemical cement that binds the rock together.[2] It has little commercial value, but as a surface to attach cement at East Park, it was ideal[3].

The formation on the ridge was extremely hard and well cemented, making it "an ideal location for a concrete structure." The gorge is 150 feet wide at the top and 45 feet wide at the bed of the stream; it's 120 feet high[4]. When completed the dam's thickness will be ten feet at the top and eighty-six feet at the bottom. Its length at the top will be 249 feet.

The main outlet for the water will be a single five-foot conduit, twenty feet up from the creek bed, and controlled by two 4x5-foot-sluice gates. These gates will be opened and closed by double ball-bearing stands that will be operated from a pagoda-like concrete tower located at the dam top's mid-point.

The dam itself will be a curved, thick-arch-gravity structure, with a 275-foot radius, and which represented the most elegant design for a dam at that time. The elegance of the promise was realized in the finished product (Figure 2).

In October 1908, the U.S. Reclamation Service (USRS), after evaluating sixteen bids, awarded the Stanley Contracting Company, of San Francisco, with the project. The winning bid was $79,881.65 ($1,941, 839.41 in 2016 dollars)[5]. The contractor's team consisted of thirty-eight men, including eight teamsters and twenty teams of mules. An additional four men made up an engineering and inspection force[6]. In the fall of 1908, the contractor began work by

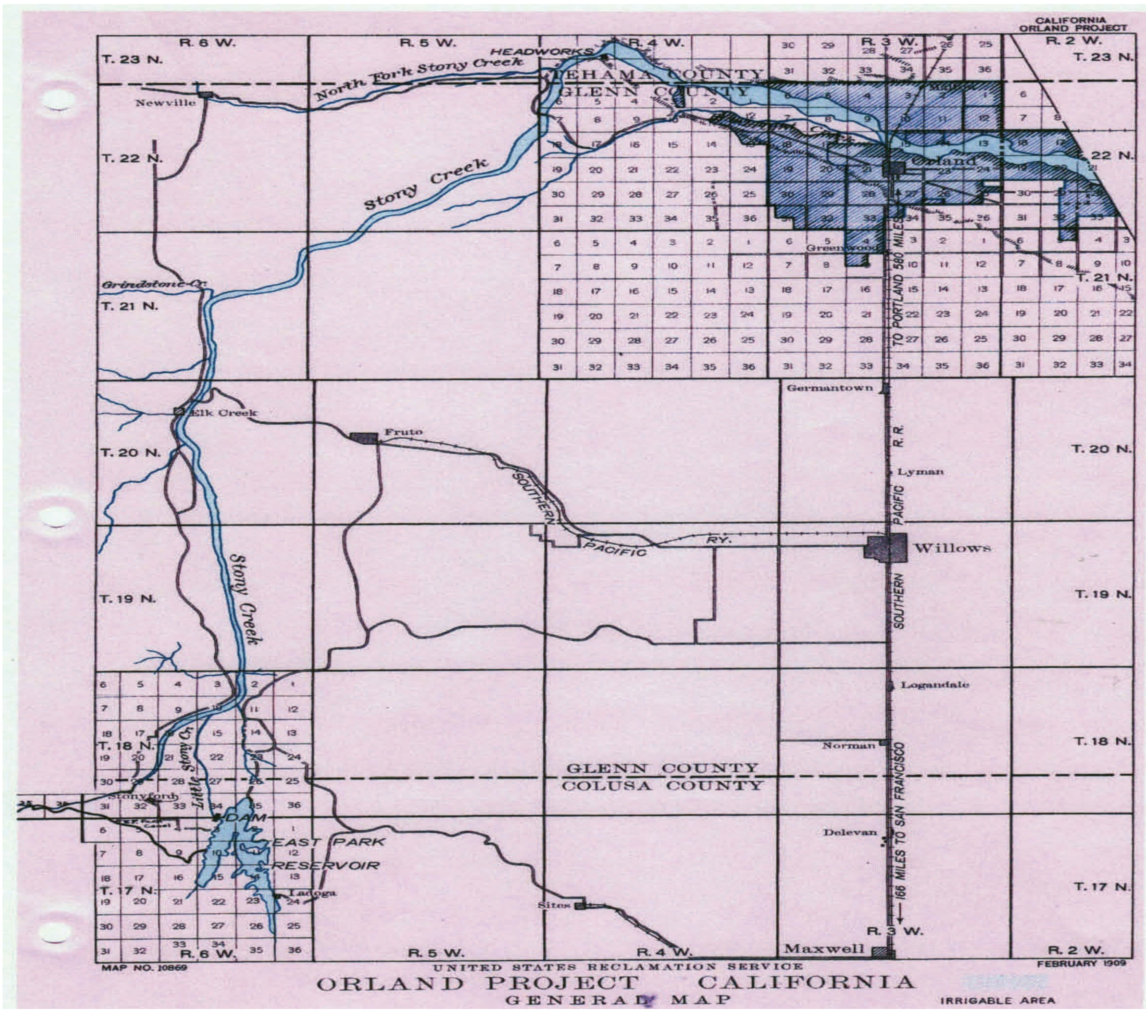

Figure 1. Orland Water Project Map, circa 1910. Note: Little Stony and Big Stony Creeks both rise in nearby locations in the North Coast Range. Little Stony flows into the west side of the reservoir, through the dam, and into Stony Creek. While Big Stony flows past Stonyford and into the main stream. Today, Big and Little Stony Creeks merge near the junction of County Roads 303 and 401. Also today, the main stream flows through Stony Gorge Dam and Reservoir, at Elk Creek, and into the Black Butte Dam and Reservoir, east of Newville. North Stony Creek, a different stream, also flows into the Black Butte Reservoir. Waters from Black Butte, which retain the name of Stony Creek, then flow into the Sacramento River, east of Orland and just south of Hamilton City. Stony Gorge Dam and Reservoir are part of the Orland Water Project, built in 1928; Black Butte Dam and Reservoir were built by the U.S. Army Corps of Engineers in 1963.

Figure 2. East Park Dam and Reservoir. Note the water coming from the outlet, 20-feet above the creek bed, and the pagoda-shaped control house at the dam's top. (Photographer and date taken are unknown.)

starting a cofferdam, which is a water-tight construction that allows work in an area normally under water. This work was begun "by driving wooden sheet piling along a seam in the conglomerate a short distance upstream from the dam. The first high water came before it was completed and carried the cofferdam and pile driver downstream. No further work was done until April 1909[7].

During April 1909, improvements were made to the 18 miles of mountain road between the railroad junction at Sites and the dam site. Eight-up mule teams hauled the equipment and supplies to the dam site at a cost of 3.3 cents per mile ($.73 in 2016 dollars)[8]. Resident Sharky Moore (1901-1995), who was then a student at Mt. Hope School, remembers that mule teams came in loaded with supplies every day about 4 p.m., and that they made a return trip the following day carrying large-oak timbers[9].

With supplies and equipment piling up, and with the steady arrival of supplies now guaranteed, work was restarted on May 6, 1909. By June 1, a new cofferdam was well underway (Figure 3); now they used pilings made from steel I-beams having clamps driven through the creek-bed gravel and deep into the conglomerate bed-rock. A 700-foot long, 4x2-foot-wide bypass flume (Figure 4) had also been constructed[10]. Later, in February 1910, the cofferdam began leaking so badly that another 1x2-foot-wide flume was added at a point 600 feet above the cofferdam, where water passed over on a sandstone-and -shale-rock outcropping, and where a small back-flow dam had been built; the flume was extended out 200 feet downstream to prevent back-flow pressure on this small dam[11].For now, at the start of construction, with the cofferdam pumped dry, the men could begin digging down to bedrock (Figure 5).

On June 11, 1909, excavation of the creek bed's sand and gravel, called Class 1 material, began. The creek bed was termed Elevation 100, which was 1,111.68 feet above sea level. Class 2 material was termed as that located below Elevation 100, and Class 3 material as that above Elevation 100[12].To excavate the creek bed, a special scraper with a 1/3 cubic yard (c.y.) capacity was rigged between a steam-driven, double-drum hoist (winch) located downstream from the dam site and a fixed site located upstream. The fixed site was a horizontal cable with a movable pulley that was attached between the

Figure 3. Constructing the cofferdam.

Figure 4. Looking east from upstream side of dam, showing locations for cofferdam and bypass flume

Figure 5. Getting down to bedrock.

walls of the canyon[13]. The cables attached to the two drums of the hoist pull in opposite directions; consequently, as the hoist turns, one drum is engaged to pull the scraper in one direction, while the other drum is engaged to pull it in the opposite direction. The waste material was then loaded into Koppel dump cars and moved on rails to a dump downstream. (Note: The term Koppel may be generic for a type of mine car likely produced in the 1890s by the German firm of Orenstein & Koppel.)

Most of the Class 1 material was excavated using this scraper. The bulk of the Class 2 material, and all of the Class 3 material, was excavated by hand using drills, hammers, shovels, and "gads." (A gad is a rectangular 18-inch bar with a sharp spike on one end and a chisel tip on the other.) No explosives were allowed [on the abutments to prevent weakening them[14]]. Explosives were likely allowed in the creek bed, however, for in a subsequent paragraph a large boulder is described as being "blasted. "

The report is contradictory in that it says all three classes were being "carried on" at the same time[15], while, in the same paragraph, it says that Class 3 excavation commenced on June 16, 1909, and Class 2 on July 12, 1909.

Excavations below the creek bed (Class 2 material) ran into a problem on August 3, 1909: a large boulder was encountered at Elevation 82 (18 feet below the creek bed). The existence of this boulder delayed the Class 2 excavations such that the contractor went to double shifts on August 12, 1909. Apparently, all went well thereafter: all excavations were completed on September 14, 1909. The entire foundation, the report reads, "is of the hardest kind of conglomerate." Its center contains a round "pot hole" whose diameter is 25 feet and depth is 20 feet (Figure 6). "The whole foundation bottom," continues the report, "is irregular and full of pot holes[16]." These pot holes added depth to the foundation, and when filled with concrete, added strength to the dam[17].Bedrock was found fifty feet below the creek bed—at Elevation 50[18].

The excavation of Class 3 material, states the report, "consisted mostly of cutting channels 6" deep and 4' wide vertically up the abutments from Elevation 80 to the point where the particular

Figure 6. Foundation showing pot hole

channel intersected the slope line of the dam The channels were spaced ten feet apart[19]." The channels increased the adherence property of the concrete[20].

With the excavation to bed rock completed, it was time for concrete work. Cement is a key ingredient of concrete, and it had to be brought in by wagons, pulled by eight-up mule teams, and stored (Figure 7). It cost 33-1/3 cents per ton/mile ($7.80 in 2016 dollars) to get the cement from Sites to the dam site. Other ingredients in the concrete mix are sand and gravel, which were initially available on site. Later, starting in January 1910, they had to be hauled six miles from the "Moore place" (actually, the then-Brown , later Garland, and now-Stonyford ranch)—Richard "Dick" Moore (1854-1926), Sharky's father, was the foreman of the large Brown Ranch from 1909 until his death in 1926 (Figure 8).

The local sand and gravel were obtained using Fresno scrapers and loaded into rail-mounted Koppel cars using a specially constructed trap (Figure 9).

> The Fresno scraper is a machine pulled by horses used for constructing canals and ditches in sandy soil. Prior scrapers pushed the soil ahead of them, while the Fresno scraper lifted it into a C-shaped bowl where it could be dragged along with much less friction. By lifting the handle, the operator could cause the scraper to bite deeper. Once soil was gathered, the handle could be lowered to raise the blade off the ground so it could be dragged to a low spot, and dumped[21].

The sand and gravel was then transported to a bucket elevator, which moved the material up and dumped it onto a revolving screen. The screen had circular openings of 1/4 inch, 1 inch, and 3 inches. The gravel was thus sized and deposited in individual bins. (During the dry season, this process worked very well. During the wet season, however, when the material was saturated with moisture, a workman had to continually hammer on the screen to prevent clogs[22].)

Each bin held 6-1/2 cy of its size of aggregate. Either, when the bins were full or a workman pulled a lever (the report isn't clear), each bin released its material through a chute into a wedge-shaped-steel

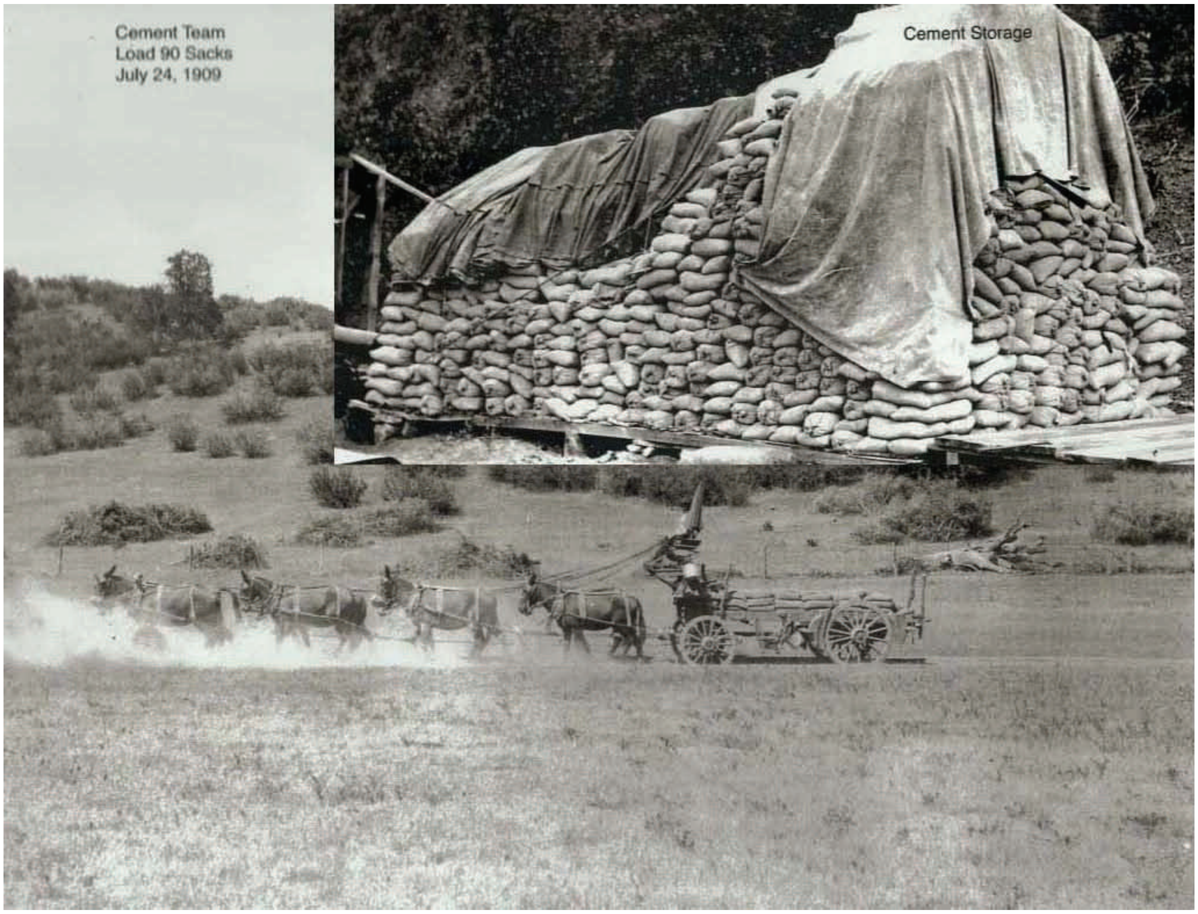

Figure 7. Hauling and storing cement. A maximum of 130 bags could fit in a wagon. The round-trip time from the rail head at Sites to the dam site was three days. The insert shows the cement storage area.

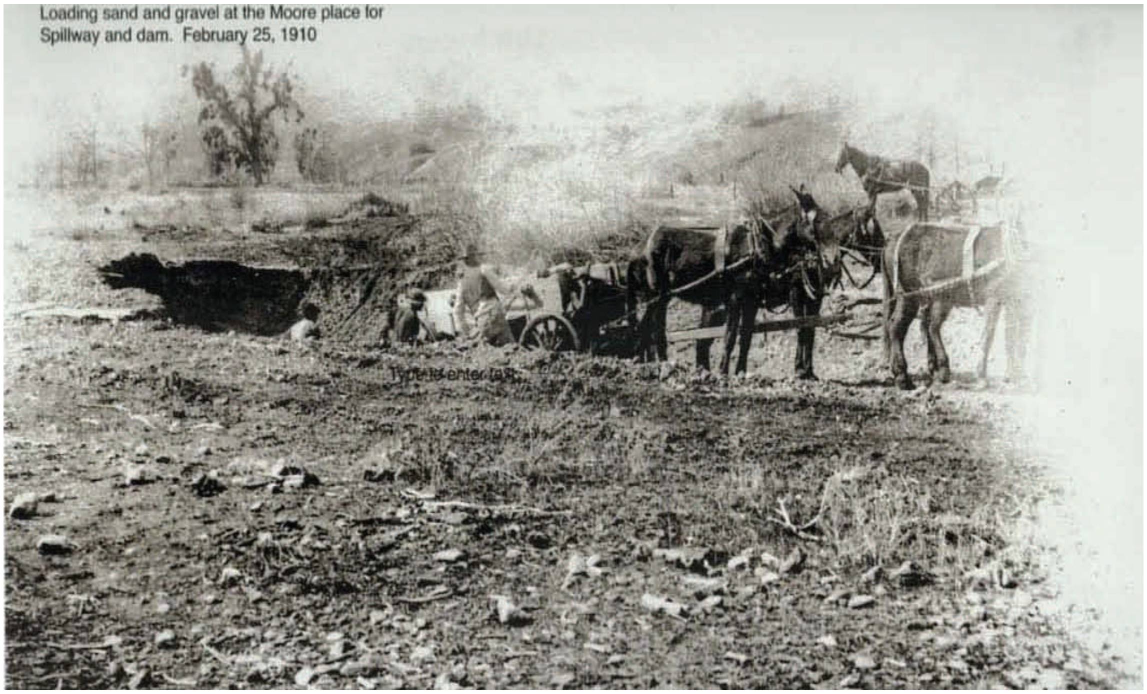

Figure 8. Hauling sand and gravel from the Moore place.

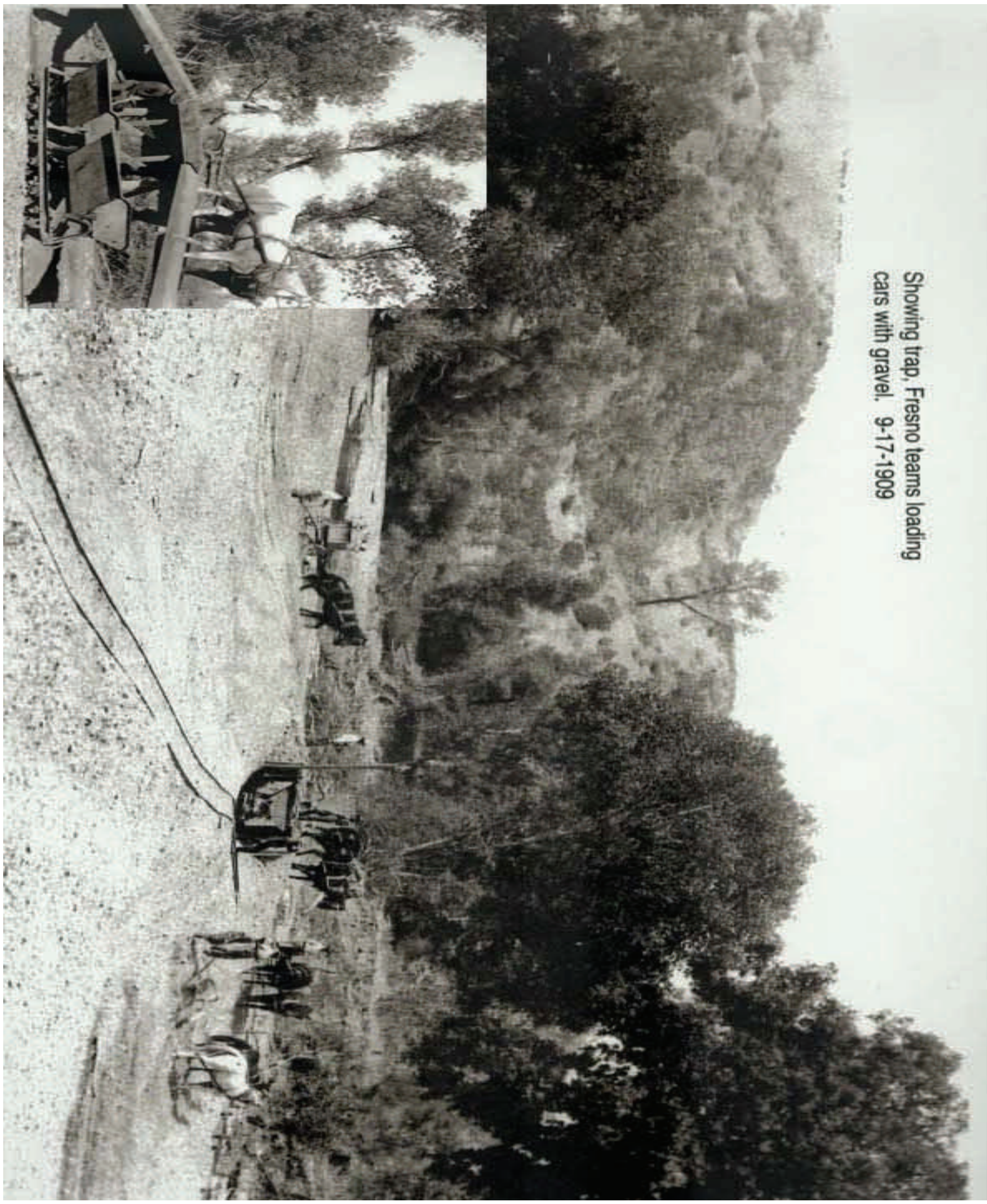

Figure 9. Fresno scrapers loading gravel in cars. The Fresnos scraped up a load of sand and gravel, held it, and then released it into the 1 c.y. Koppel cars using the specially built trap.

hopper, where it was proportioned according to aggregate size. The hopper had partitions that were arranged into three different-sized compartments (Figure 10). The cement was added by hand.

The final ingredient was water. It was supplied from a small, measuring tank located next to the mixer. The water was released using a hand-operated-rubber-stop valve that contained a water gauge. This tank was refilled from the central, 3,000 gallon water tank located on an outcropping two feet above the top of the gorge, at Elevation 192[23].

This was the age of steam. Therefore, all of the machinery was steam driven using a 40 horsepower boiler fired by cord wood. Similarly, as we today run an electrical extension cord to power an external device, the workmen at the dam would run a small steam pipe out to a winch or other piece of outlying equipment. Figure 11 shows an overall view of the concrete plant.

These ingredients were turned into concrete using a 20 cubic foot Ransome Mixer. (This mixer was named for its inventors, Arthur W. and Ernest Leslie Ransome, who manufactured their mixers between 1909 and 1940[24].)

From the mixer output, the concrete flowed into a hopper and then into wooden rail cars (Figure 12). These cars were specially made to have slopping bottoms and an inside lining of sheet iron. They were mounted on Koppel trucks. Two such cars went back and forth between the mixer and the forms—one man to each car. The cargo was discharged at the form using a hand-lever-operated-sliding door[25].

Figure 10. Concrete mix plant and boiler

Figure 11. Overall view of concrete-mixing plant.

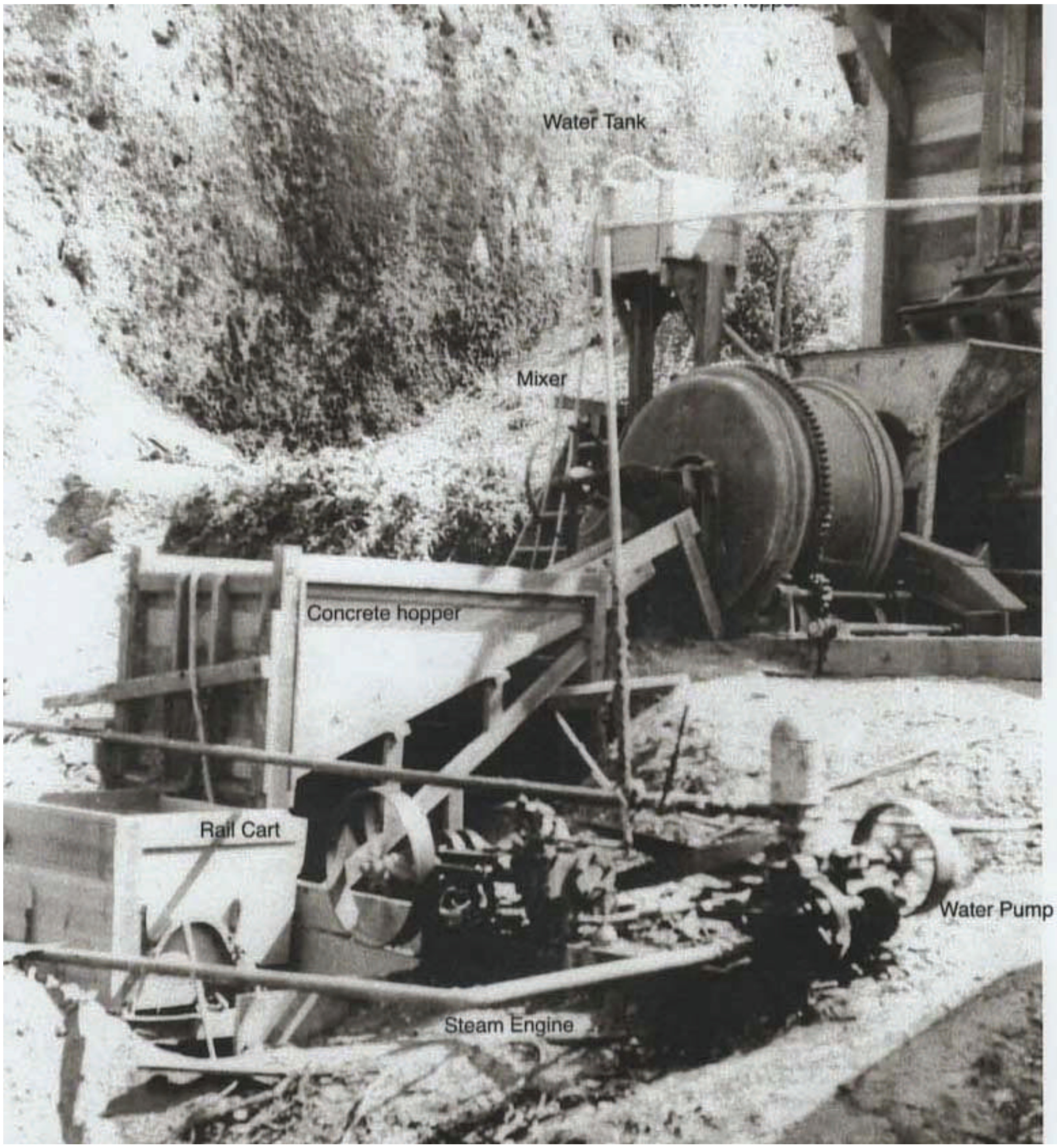

Figure 12. Output of concrete mixer.

Up to Elevation 100 (creek bed), the mixer was connected to the forms via 30-inch-gauge rails laid on a trestle connected to rock along the north abutment (Figure 13). Between elevation levels 50 (bedrock) and 100 (creek bed), the concrete was poured using sectional iron tubes. As the concrete level rose, sections were removed. Above Elevation 100, a Wallace Hoist was used to move the concrete[26].

This hoist was attached to the north abutment approximately 50 feet from the mixer. The special rail cars moved the concrete over to the bucket on the Wallace Hoist. The double-drum hoist (winch) pulled the Wallace bucket up to the level where needed and the concrete was automatically dumped into a "mud box." "From the 'mud box' the concrete was taken in ore cars on track laid on trestle to the different portions of the dam[27]." Above Elevation 155, hand buggies and wheel barrows were used in place of the ore cars (Figure 14).

As the dam progressed upward, the trestle was elevated as necessary. The track on which the ore cars moved [across the dam] was supported by rails or pipe placed directly on the concrete; they were left there permanently as the height increased (Figure 15).

Figure 13. Pouring the foundation, 9/21/1909. Shows cars discharging concrete into the forms at Elevation 100 and below.

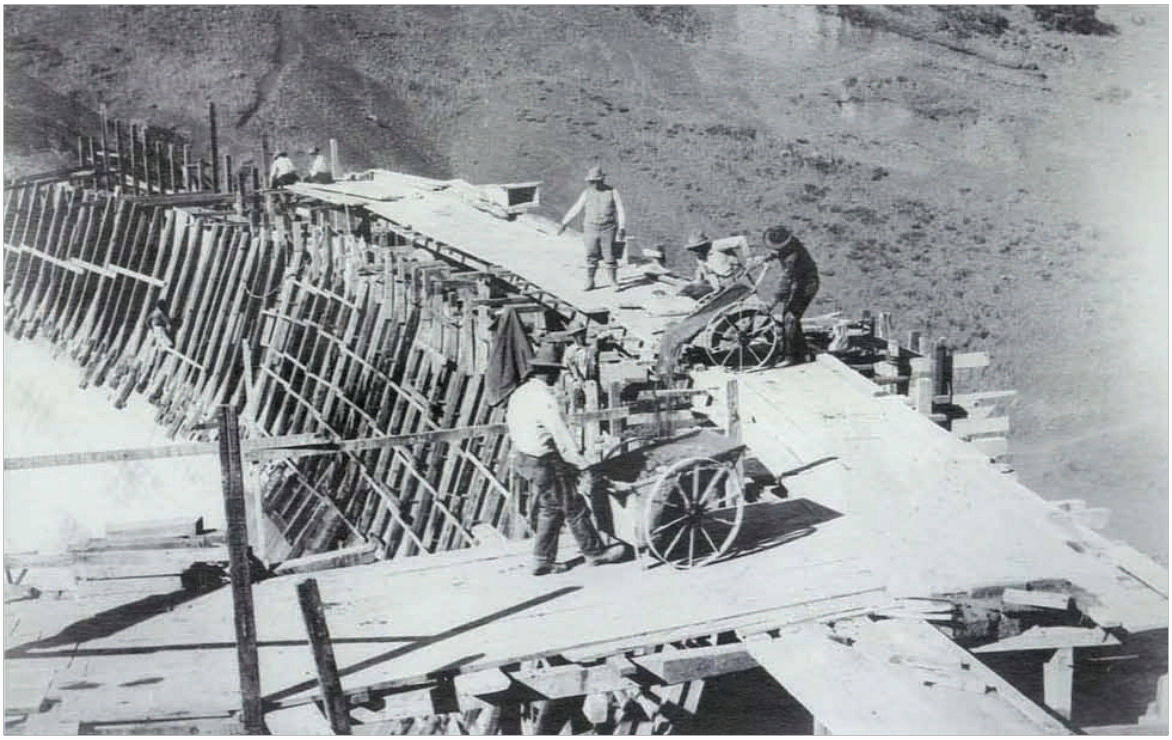

Figure 14. South end of dam with forms up to Elevation 180.

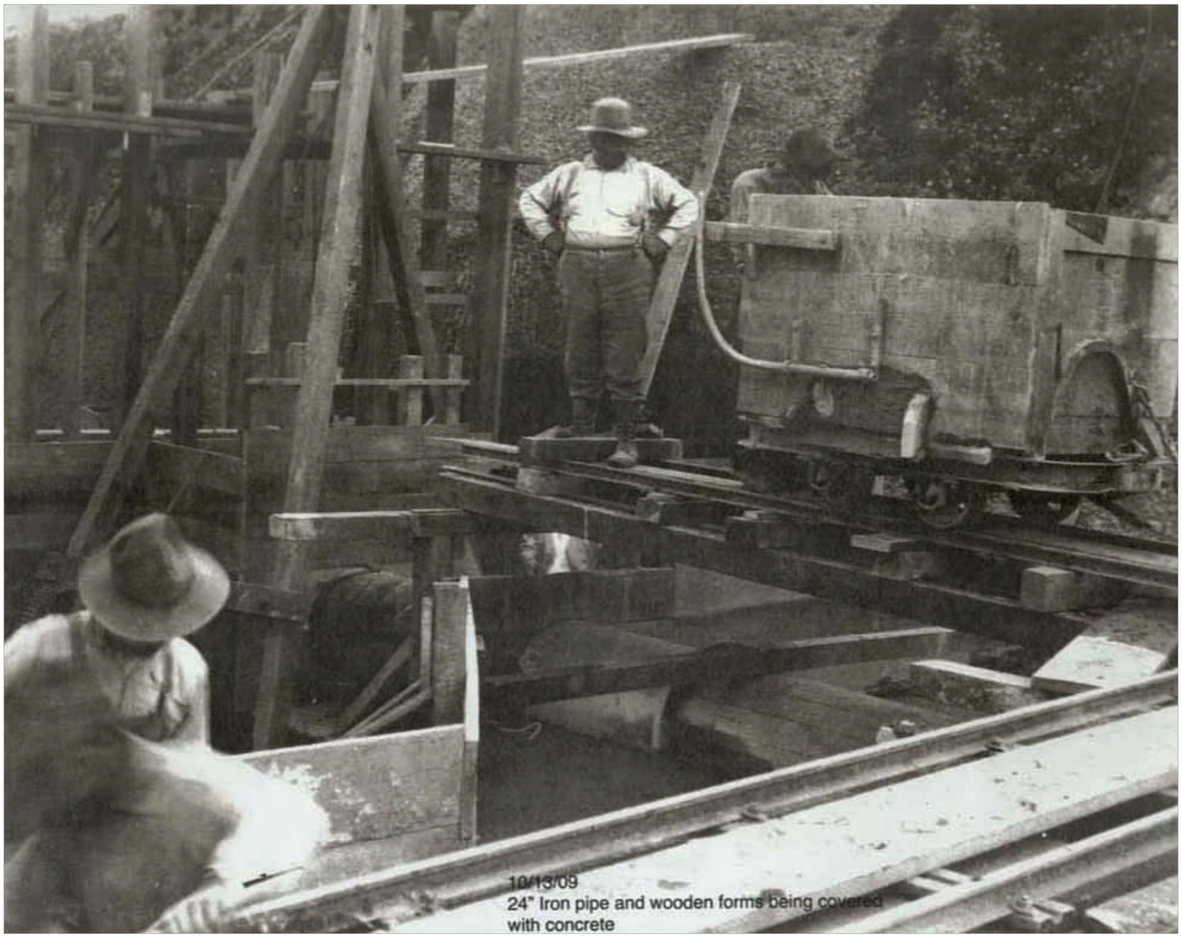

Figure 15. Concrete cart and iron pipe being laid into concrete.

As stated at the top of this section, the dam was to be a curved, thick-arch-gravity structure. This means that the lower portion of the dam (from bedrock to the top of the outlet conduit, 25-feet above the creek bed) will be a gravity dam; that is, one that is designed to hold back water by primarily using the weight of the material alone to resist the horizontal pressure of water pushing against it[28]. From the top of the gravity portion, at Elevation 125, to the top of the dam, at Elevation 187, the dam will be arched. An arch dam is curved in its upstream face. It is designed such that the force of the water against it thus compresses and strengthens the structure as it pushes into its foundation or abutment[29] (Figure 16).

In the gravity section, the base of the dam is 45-feet wide, at the creek bed, and 80-feet wide at Elevation 125. The thickness of the concrete at "the bottom" is 86 feet[30]. It is built as a "monolith"[31], *i.e.*, a large, seamless block of concrete. The arch section, between Elevations 126 and 155, is built in sections 40-feet wide, and between Elevations 156 and 187, the sections are 20-feet wide, and go all the way through from front to rear faces. Where the sections abut is called an expansion joint. These joints are held together by a single dowel for each section. This dowel is 4-feet wide and 6-inches deep and tapered on both edges. They are placed three inches back from the front face of the dam (reservoir side).

To provide for drainage in the expansion joints, vertical and horizontal channels were installed. The vertical channels were placed two feet back from the dowel and are formed using 2x6-inch boards having a V shape at the top. The horizontal drains are 4-inch tiles laid in the concrete between the dowel and the vertical drain[32]. The vertical drains extend up to the top of the dam and are capped with removable iron plugs. Any water captured by the drains is routed to the main output conduit[33].

The dam's forms were made from 4x6-inch posts and lagged by 2x8-inch pine lumber beveled on the edge next to the concrete. From the report: "The surface of the concrete was entirely satisfactory. The posts were spaced 2-1/2 feet apart. The forms were built continuous across the dam and upwards, being held in place by No. 8 wire attached to the posts and to iron pins set in previously placed concrete. The forms were carried to the required radius and carefully aligned by tape and transit deflections. Front and back forms at all times were carried up the entire length of the dam. At

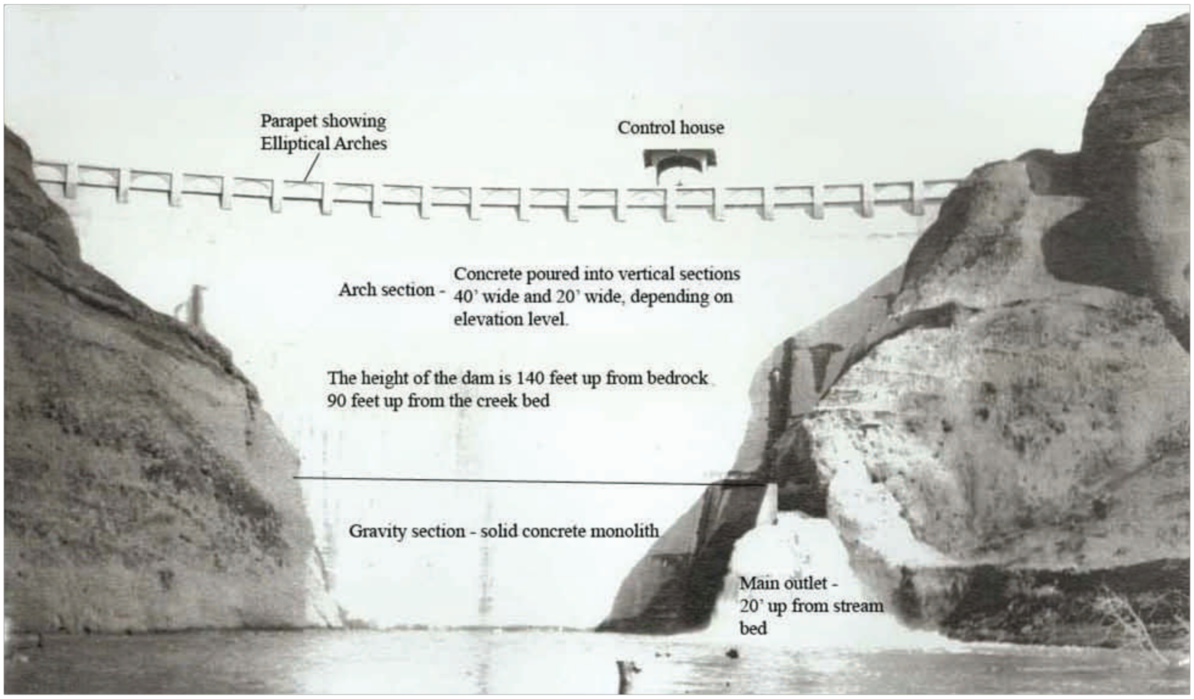

Figure 16. Rear face of dam showing construction details.

and above elevation 125 forms were built across the dam every 40 feet and above 155 every 20 feet[34]."

Concrete began to flow on August 31, 1909. First thing was to control the creek water. To this end, a "curtain wall" was raised up over a portion of the upstream part of the dam. A temporary pipe was installed to allow water to flow over the dam. While the curtain was going up, the creek water was pumped into the wooden flume. As soon as the dam reached Elevation 100, on October 17, 1909, the temporary pipe was replaced with a permanent 2-foot pipe that allowed positive control of the creek water[35].

The concrete was mixed wet, and below Elevation 125, it was poured into suitably sized sections so that the concrete would not set up and dry out over a thin layer. When the dam reached Elevation 120, forms were built and the five-foot-main-outlet conduit was put in place (Figure 17). That occurred at the end of November; then, bad weather struck. On December 4 and 5, 1909, the creek flooded and the high water rushed through the newly laid forms (Figure 18). The flooding also washed out the Wallace Hoist.

The waters receded, the hoist was replaced, and work continued on the dam's gravity portion to Elevation 125 (the top of the outlet conduit, at 25 feet above the creek bed). From here on up, the arch section began. The forms were built 40-feet wide and 30-feet up to Elevation 155. Expecting more storms, management decided not to build up the middle 40-foot section beyond Elevation 125. Work continued, however, on the adjacent sides[36]. The concrete pouring was in progress when Mother Nature again displayed her wrath. On January 24, 1910, another storm blew in producing high water and more flooding. Rushing water at 1200-feet-per-second passed over the center section (Figure 19).

Figure 17. Laying forms for outlet conduit, Nov. 23, 1909

Figure 18. Flood waters flowing around conduit, 12/6/1909

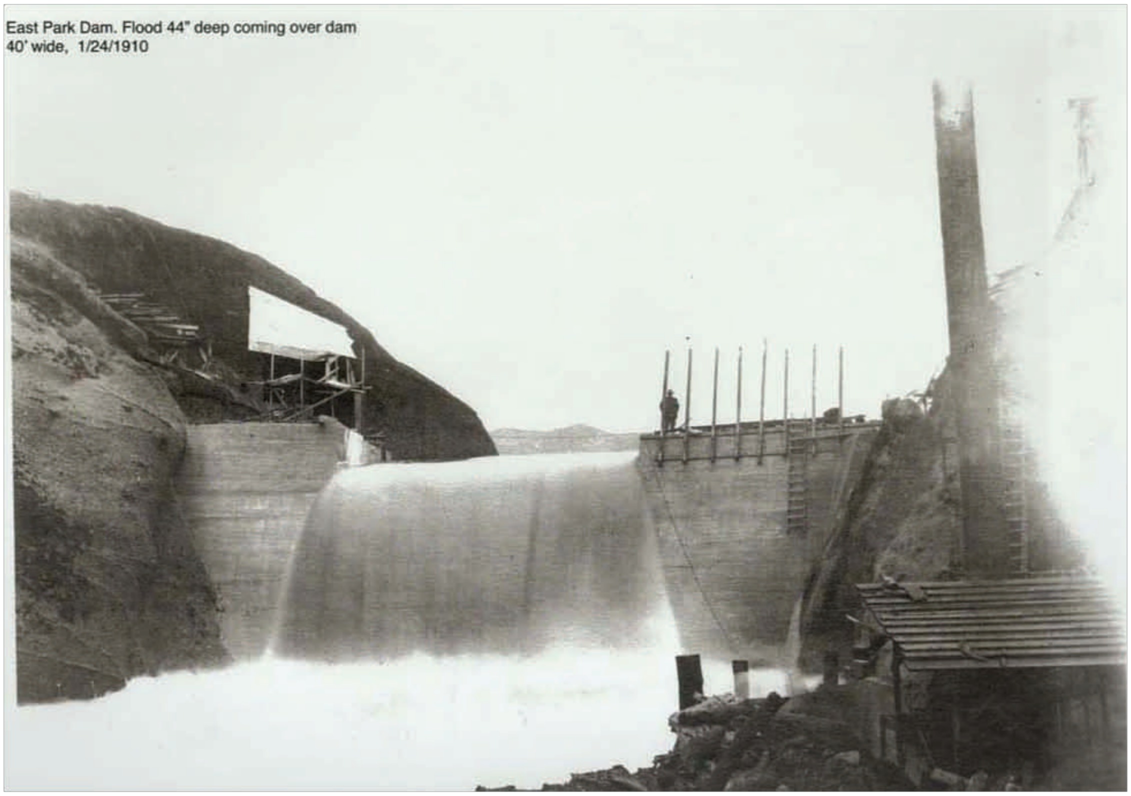

Figure 19. Flood water coming over dam, 44-inches deep, 40-feet wide, 01/24/1910.

At that point, the concrete level north-of-center was at 133 feet, and the level south-of-center was at 130 feet (Figure 20)[37].

A third storm happened on March 19-22, 1910. This one didn't hurt, however. The forms were in place to concrete-in the center section. To relieve the expected high water pressure, some of the forms were removed. Very little damage was done, and from this point on there was no trouble from water or weather[38].

Because of the summer heat, after May 10, 1910, the men poured the concrete between 7 p.m. and 7 a.m.. During the day, the concrete was well covered and kept wet. The summer heat also affected the gravel; consequently, a sprinkler was added to the bins to keep the gravel cool.

The concreting was completed on June 10, 1910, and all work on the dam was done by July 31, 1910[39].

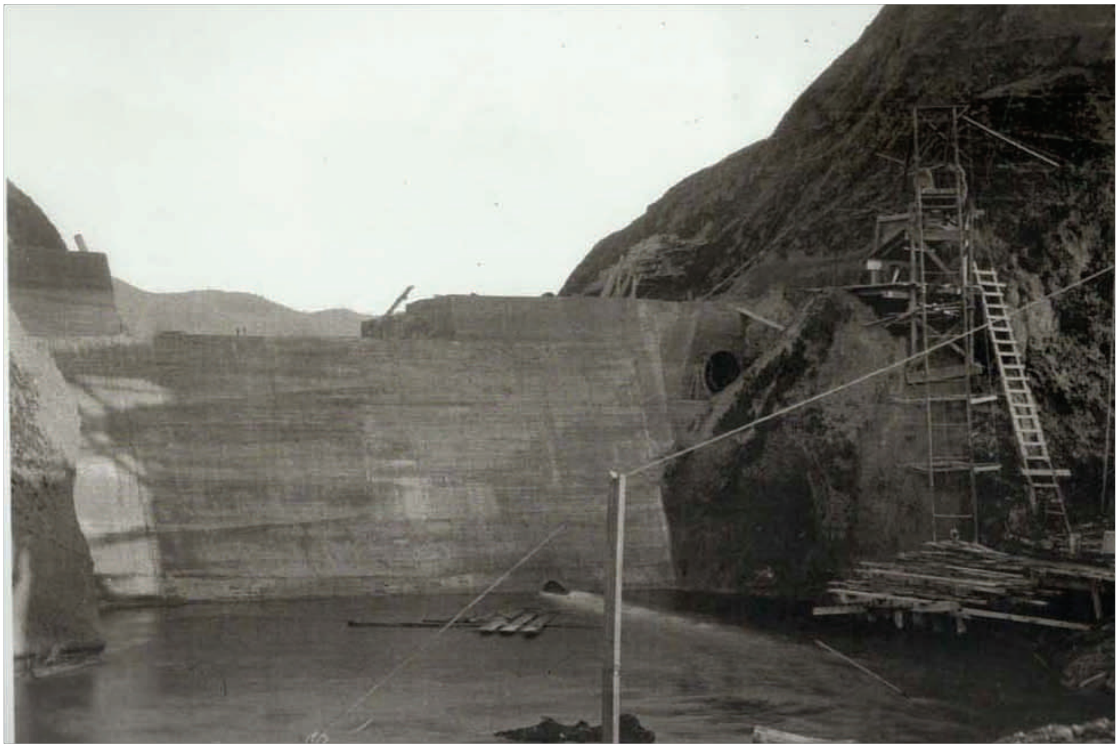

Figure 20. Upstream face after the high water on 01/24/1910. Note the heights of the north and south sides

Notes

1. *Storage Reservoirs on Stony Creek*, California. Burt Cole. Department of the Interior, U.S. Geological Survey, GPO, Washington, 1903, pgs. 47-60
2. http://geology.com/rocks/conglomerate.shtml
3. *United States Reclamation Service, Orland Project California Cost Report of East Park Dam, Spillway, and Dikes*, n.p., September 30, 1910, pg. 1.
4. *Ibid.*
5. *Orland Project*. Autobee, Robert. Bureau of Reclamation, 1993. pg. 8.
6. *Ibid*.
7. *United States*, pg. 5
8. *Ibid,* pg. 6.
9. Video-recorded interview between Joyce Bond and Lawrence (Sharky) Moore, c.1985. Sharky (1901-1995) and his sister, Beulah Van Landingham (1897-1993) are local legends for their encyclopedia knowledge of the Stonyford area. Joyce, Sharky, and Beulah are co-authors of *Back In Time, Stonyford Community History*.
10. *United States*, pg. 6.
11. *Ibid,* pg. 7.
12. *Ibid,* pgs. 1, 2, 7, 8.
13. *Ibid,* pg. 7.
14. *Ibid,* pg. 8.
15. *Ibid,* pg. 7.
16. *Ibid,* pg. 8.
17. *Ibid,* pg. 1.
18. *Ibid,* pg. 11.
19. *Ibid,* pgs. 8, 9.
20. *Ibid,* pg. 1.
21. https://en.wikipedia.org/wiki/Fresno_scraper.
22. *United States*, pg. 10.
23. *Ibid,* pg. 11.
24. http://archives.hcea.net/?p=collections/findingaid&id=331&q=
25. *United States*, pg. 11.
26. *Ibid,* pgs. 11, 12.
27. *Ibid,* pg. 12.
28. https://en.wikipedia.org/wiki/Gravity_dam.
29. https://en.wikipedia.org/wiki/Arch_dam.
30. *United States*, pg. 2.
31. *Ibid,* pg. 3.
32. *Ibid,* pg. 13.
33. *Ibid,* pg. 4.
34. *Ibid,* pg. 12.
35. *Ibid,* pg. 14.
36. *Ibid*.
37. *Ibid,* pgs. 14, 15.
38. *Ibid,* pg. 15.
39. *Ibid*.

Part 3
Building the Spillway

The spillway at East Park is located in a natural "saddle" in the conglomerate ridge one-quarter mile south of the dam[1]. A saddle is a low spot through which the reservoir waters can escape. This was a natural place for the spillway.

What is a spillway? According to the online encyclopedia, Wikipedia:

> A spillway is a structure used to provide the controlled release of flows from a dam or levee into a downstream area, typically being the river that was dammed. … Spillways release floods so that the water does not overtop and damage or even destroy the dam. Except during flood periods, water does not normally flow over a spillway[2].

Why is a spillway needed at East Park? It was needed to accommodate the differences between designed discharge capacity and flood rate. Because the dam was designed with a discharge capacity of 500 cubic feet-per-second (cfs), which is well below the flood rate of 10,000 cfs, a spillway with a width of around 500 feet was needed; however, the natural width of the saddle was only 300 feet. To provide this additional length, the spillway uses a series of nine piers and semicircular arched weirs. The piers are eight feet wide and the arched weirs are on a radius of 13-feet, 6-inches wide. The whole structure has a radius of 474 feet. This provides a total length of 459.9 feet. After reducing for curvature and "incomplete approach," the available length is 414 feet[3].

The water overflowing the spillway merges with Little Stony Creek about 500 feet downstream from the dam. The foundation for the spillway is hard blue shale that is close to the surface of the ground; conglomerate is encountered only at the north abutment[4].

Excavation on the spillway began on August 16, 1909, and construction followed and occurred apace with the construction of the dam. The bedrock for the spillway foundation was hard, blue shale. The top soil was removed using two- and four-horse Fresno scrapers (Figure 1), and the foundation was excavated using picks and shovels. Concrete operations began on December 10, 1909. The concrete was mixed in a 10-cubic-foot "New York mixer"[5] that was powered by a tractor engine. The mixer plant was placed near the center of the spillway. Wheelbarrows pushed along on wooden runways were used to deposit the concrete in the forms. The sand and gravel used in the mix came from Little Stony Creek, one-half mile away, and were hauled to the mixer in wagons. The cement was added by hand, and the water came from a nearby redwood tank "that was filled from the main pumping unit at the dam"[6].

The forms for the abutments and piers were 2x6-inch posts lagged with 2x8-inch pine boards, just as described for the dam, in Part 2. The forms for the weirs were a bit more complex. Here's the description from page 16 of the report:

> The forms for the weirs consisted of 2" x 4" posts spaced 18 inches on centers with 1" x 3" sized pine lagging, the lagging running horizontally around the posts. The forms for three weirs were built in place true to the circle and before concrete was placed were sawed vertically into three sections, making six distinct movable sections, each unit being held to true line with spreaders firmly attached to 4" x 6" cross studs.
>
> As soon as concrete had been set sufficiently, the forms were removed, one section at a time, and set in place for another weir. Forms for three weirs constructed as outlined were used for the entire structure. The forms were well oiled with skid grease before placing concrete. Wire, spreaders, and outside bracing held the forms in place.

Concrete for the downstream cutoff wall was placed first, at an average depth of six feet below the hard, blue shale foundation, upon which the structure was built. (This is a wall of impervious material (e.g., concrete, asphalt concrete, steel sheet, piling, etc.) built into the foundation to reduce the seep rate under the dam [spillway][7].) Next came the piers, then the weirs. The floor (apron) was the last to be laid. It was leveled to a true and even surface, using men with screeds, before the concrete was set hard.

The spillway, on this contract, was completed in July 1910; however, it wasn't finished. Read on.

At the end of February 1911, it rained, and rained, and rained for seven days leaving behind an accumulation of nearly six inches (5.95) that, by March 7, 1911, had filled the reservoir to overflowing. The spillover caused a maximum flow of 1,820 fps over the crest of the spillway that lasted for 72 hours[8].

Figure 1. Beginning the excavation of the spillway in 1909

The volume and force of the spilled water washed away the surface of the creek bed below the spillway to expose the blue shale. Upon exposure, the force of the water cut deep channels in the shale back to within sixty feet of the apron of the spillway. The water also washed away surface dirt along the sides of the channel exposing the underlying conglomerate. In other words, the storm ruined the spillway's downstream channel, which resulted in another contract known as "East Park Spillway Extension." Work on this extension began in August 1911 and the work was completed in December of the same year.

The spillway extension is a giant half-funnel whose cone opens at the spillway and converges in "easy curves" to a conglomerate ledge 160 feet downstream that forms a channel whose output is a chute-like opening (Figure 2).

Due to eccentricities in the original spillway, water tended to build-up on the south wall creating run-off problems[9]. To prevent that build-up in the spillway extension, three guide walls leading from the south piers direct water to the throat of the channel at the conglomerate ledge.

Figure 2. Overflow of flood waters through the spillway extension, Feb. 8, 1915.

The excavation started on August 8, 1911. Four-horse-team Fresno scrapers were used to remove surface material (Figure 3), and a router-plow was used to break up the shale before removal by the Fresno teams[10]. Some of the shale, however, was too hard and required blasting to break it up. The bulk of this material was dumped in a cut above the south end. The material below the throat was shoveled into Koppel side-dump cars and hauled 250 feet to a point where the two cuts joined—about 700 feet from the spillway[11] (Figure 4).

Landslides were frequent and caused much trouble and time loss. The worst one happened on October 13, 1911, when 1900 cy of clay and gravel broke away from a hill on the north side and slid into the cut. Investigation showed that 10-to-15 feet had been removed from the base of a conglomerate rock that caused it to lean at a 2:1 angle toward the cut. After a time, the weight of the material caused the hillside to give away.

Excavation was completed by November 1, 1911. A total of 12,292 cubic yards, including backfill, were removed[12].

Concrete work was started on October 23, 1911, and was running full bore by November 1, 1911. As with the dam, the same three ingredients were needed for the concrete: cement, aggregate, and water. The cement had changed from Golden Gate to Portland and still came to the site from the railroad siding in Sites. The route, however, had lengthened from 18 to 25 miles to skirt the now-filled reservoir, and the cost of delivery had climbed from $0.33 to $8.70 per ton. Half of the cement was stored in an empty spillway bay and the remainder in a shed 1000 feet away[13].

The gravel (aggregate) was purchased under contract. It was taken from the bed of Big Stony Creek, near Stonyford, and hauled to the work site at a cost of $1.69 per cubic yard[14].

Water was the easiest to obtain. It was pumped from the reservoir into a 3,000 gallon storage tank located on the crest of the spillway.

The concrete mixer was a ten-cubic-foot Ransome Mixer powered by a ten horsepower Samson engine. The engine ran on a common

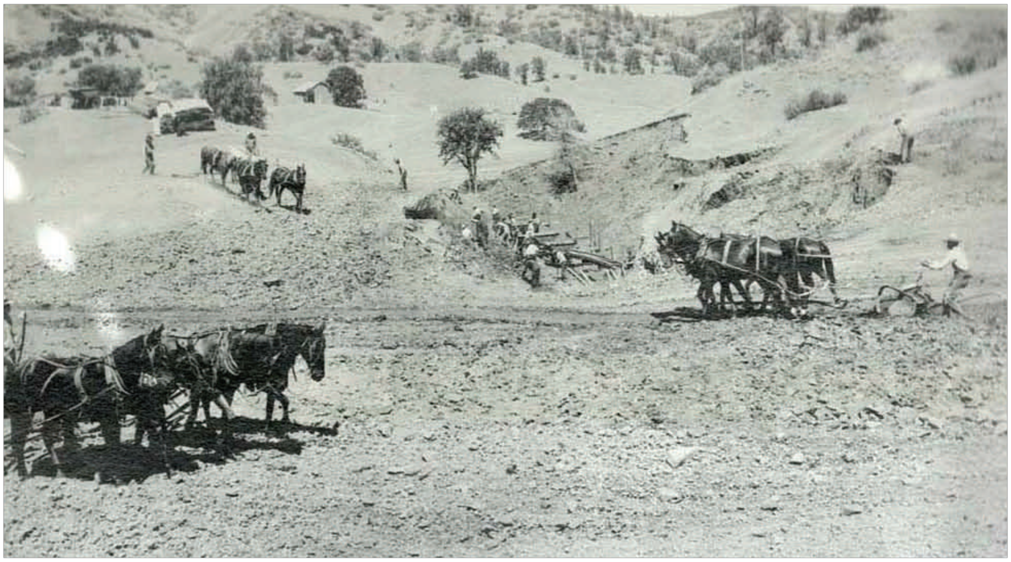

Figure 3. Fresno scrapers excavating for spillway extension in 1911.

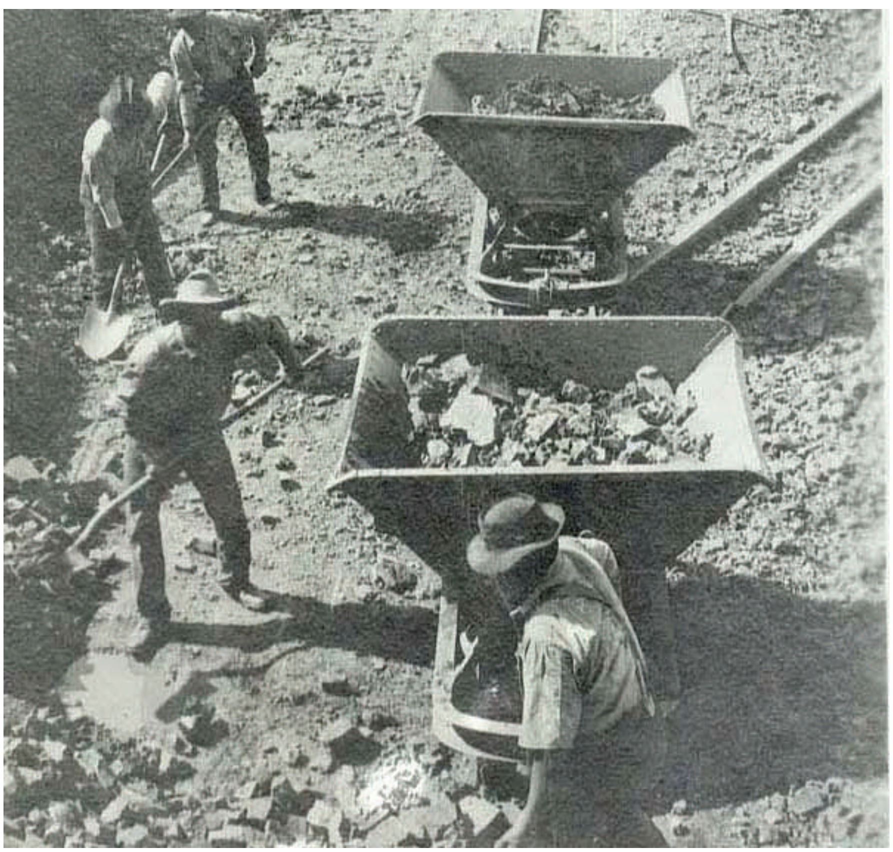

Figure 4. Loading cars in September 1911

distillate used for all engines on the work site; however, while running on this distillate all had to be started using gasoline.

The screening and mixing plant was located about fifty feet from the spillway. The rotating gravel screen was operated by a six horsepower Samson engine and, as described for the dam, contained circular openings of 3, 1, and ¼ inches. This screen was placed on top of three 3-1/2 cy bins. Gravel larger than 3 inches was pushed off, over the side of the screen. It was manually collected and about half was added to the concrete poured into the forms for the walls and floor. The front of each of the bins was fitted with an iron gate that led to a three-compartment measuring hopper. The cement was added to the hopper, and the contents were dumped into the mixer. The water was added through a 1-1/2-inch pipe coming from the storage tank[15].

The concrete was pushed to the forms (Figure 5) in Koppel cars over rails and trestles. The rails and trestles were ingeniously arranged such that manpower alone sufficed to push the Koppel cars about delivering concrete to both of the walls and to the floor. Here's how it worked: As shown in Figure 6, rails from the mixer (camera's location) ran along the apron, where cars could deliver concrete to the forms for the floor.

About midway between the two abutments, the rails branched into a trestle. Approximately 90 feet down from the spillway, the trestle "was offset 8-feet horizontally and 14-feet vertically, to avoid an otherwise excessive grade"[16]. The report continues: "As constructed, the track had only sufficient grade to make the cars

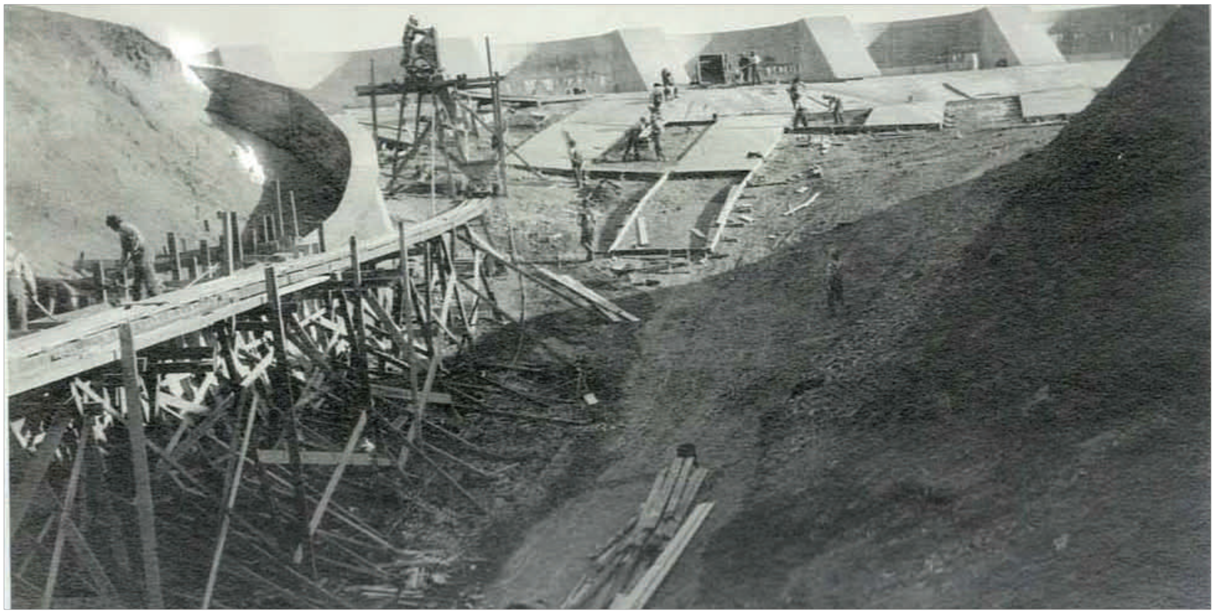

Figure 5. Pouring concrete in wall and floor, November 1911

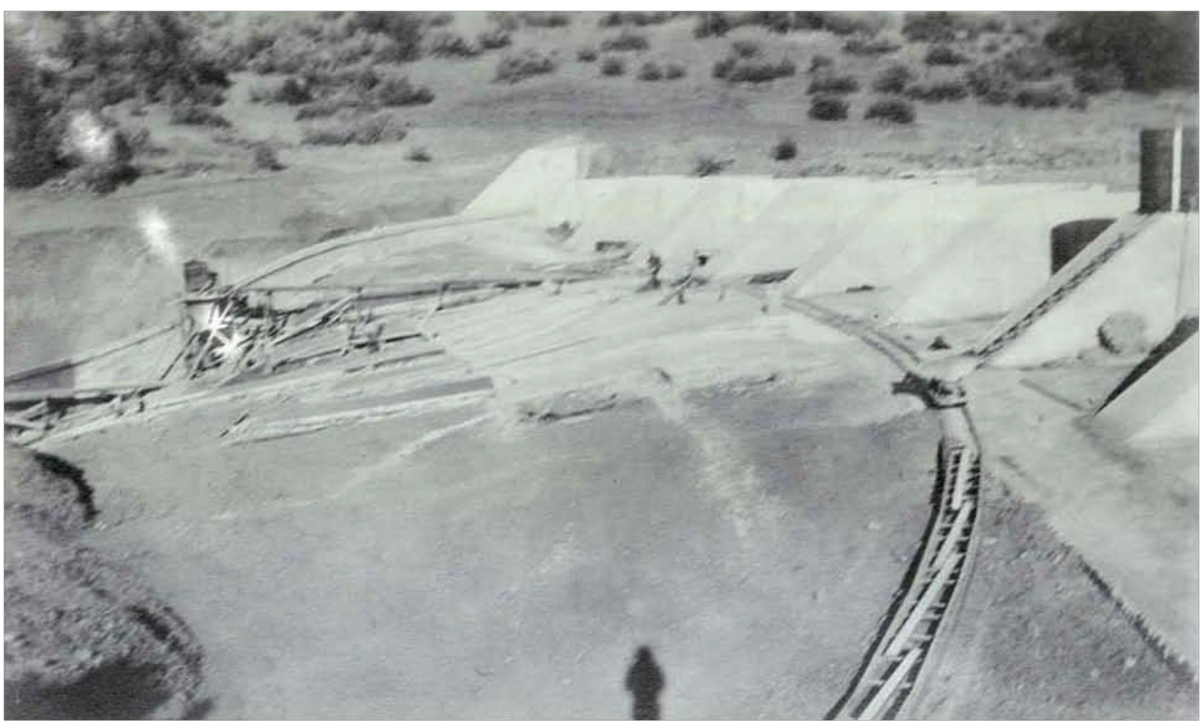

Figure 6. Spillway extension construction in 1911. View is from the south end looking north. Note the flooring (apron) at the base of the piers. The new flooring is extended out 160 feet and has sides that form a funnel-like structure

operate easily by hand." The lower trestle continued on to the end of the walls. The trestle for the north wall was erected first; then, when the pouring was complete on that wall, the trestle was disassembled and moved to the south wall[17]. Most of the floor was poured from the upper trestle (Figure 7).

The concrete for the upper sections was dumped directly from the cars into the wall and floor forms. The concrete in the floor forms was leveled and then finished with trowels[18].

The concrete for the lower portion of the floor was run out on the cars and then dumped through a chute to cars on the lower trestle; from these cars it was dumped on the floor through a moveable chute (Figure 8). On the lower walls, the concrete was dumped from the cars into a "mud box" that was even with the rails and then shoveled into the forms[19].

The wall forms used 2x6-inch studs placed 2-to-2-1/2 –inches apart. Where double forms were used on gravity-section walls, each opposing pair of studs was secured using 12-guage wires spaced 18-inches apart, vertically. All wall forms employed external bracing. Special brackets were bolted to the upper studs to provide for the 12-inch-high-and-wide coping forms[20].

Expansion joints were placed in the wall forms 25-to-30 feet apart. Where expansion joints were used, a temporary bulkhead (partition) was placed in the form. The concrete was poured in alternating sections. The bulkhead was removed after the concrete had setup for 24-hours; other forms, after 36-to-48 hours. The walls were wet down frequently after form removal[21].

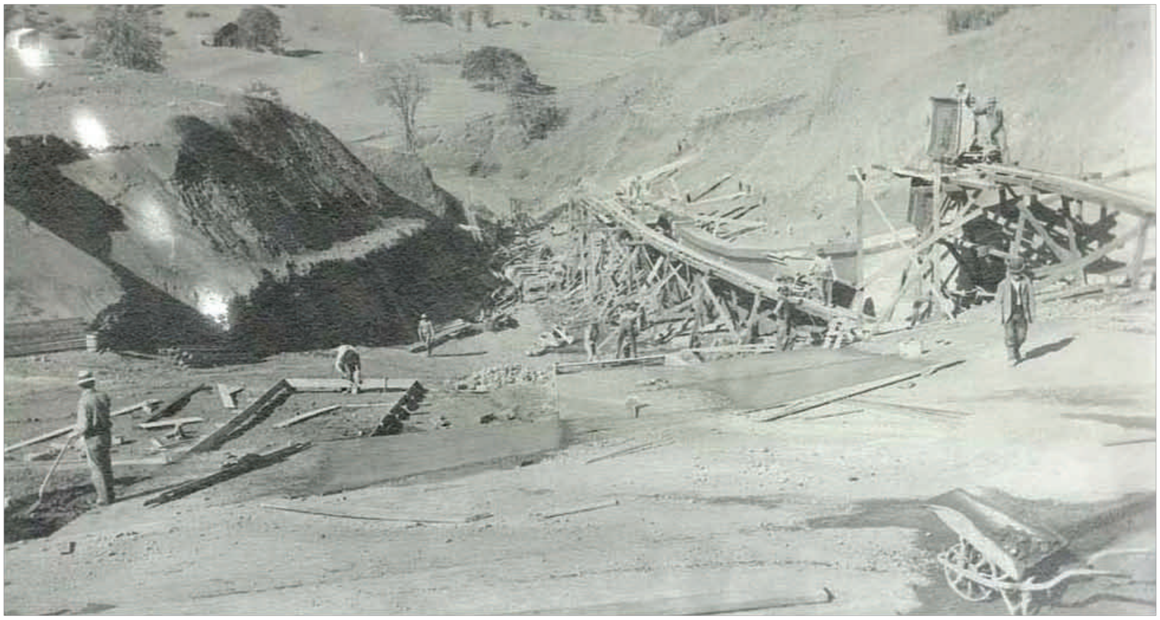

Figure 7. Workmen pouring concrete from the upper trestle. Also, note both the forms being constructed for the floor, and the coping atop the north wall. The coping is 12-inches wide and 12-inches high. Both sidewalls have this coping that is used to prevent splashing spillover.

Figure 8. Pouring concrete in lower floor.

The floor was formed in alternating sections measuring 10x16 feet and 10x30 feet. Special templates were used as side supports. They were nailed through the sidewall into the underlying shale, using ½-inch rods. The floor forms contained 3/8-inch reinforcing rods that ran through adjacent forms, except where an expansion joint was placed. Expansion joints were placed 20-to-30 feet apart, depending on the floor's slope and position[22].

Concrete was poured into the wall and floor forms at the same time. The north half was poured first, in alternating sections. After allowing the concrete to set for 36-to-48 hours, the forms were removed and reset on the south side. When the north side was completed, the south half was poured.

The joints in the floor forms that were at right angles to the line of flow were constructed as cutoffs. Trenches were made in the underlying shale, below these cutoff joints, that were 12-inches wide, 12-to-18-inches deep, and filled with gravel. Reinforcing rods extended into these trenches from the section below. When filled with concrete, these cutoffs not only prevented the serious underflow of water, they also locked the upper end of each section to the lower end of the section above[23].

The last of the concrete work was done by December 13, 1911. A total of 1,545 cubic yards of concrete had been placed. The average construction force consisted of 30 men and 14 horses—plus a clerical force of 3 men. This force does not count the men and horses used to haul in material and supplies[24].

The cost of the spillway extension was $27,938, which is $681,315 in 2016 dollars[25]. Some interesting numbers in this report were the average ***daily*** wages for the work force, as shown below[26]:

Superintendent	$6 (146.32 today)
Foreman	$3.20 ($78.04)
Timekeeper	$2.83 ($69.01)
Labor	$2.40 to $3.00 ($58.53 to $73.16)

Figure 9 shows a color photograph of the spillway as it looks today.

Figure 9. East Park Spillway, with flash boards in place. In 1914-1915, as a part of the East Park Feed Canal/Rainbow Diversion Dam project, the spillway was permanently raised 18 inches and provisions made for adding removable 18-inch flash boards, for a overall maximum height increase of three feet. This construction also lengthened the slope and added steps to the piers. This additional height raised the reservoir's capacity from 40,000 to 51,000 acre-feet.

Notes

1. *United States Reclamation Service, Orland Project California Cost Report of East Park Dam, Spillway, and Dikes*, n.p., September 30, 1910, pg. 4.
2. https://en.wikipedia.org/wiki/Spillway.
3. United States, pg. 4.
4. *Ibid*.
5. *Ibid,* pg. 15.
6. *Ibid*.
7. http://water.nv.gov/Engineering/Dams/Glossary.cfm.
8. A.N. Burch, Acting Project Engineer*;* Report: *East Park Spillway Extension*, Orland, CA, February 10, 1912, pg. 1.
9. *Ibid,* pg. 4.
10. *Ibid,* pg. 5.
11. *Ibid*.
12. *Ibid,* pg. 14.
13. *Ibid,* pg. 7.
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20. *Ibid*.
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23. *Ibid,* pg. 13.
24. *Ibid,* pg. 14.
25. *Ibid,* pg. 15.
26. *Ibid,* pg. 16.