SIX COMPANIES RAILROAD
Six Companies Aggregate Facilities and Railroad District
6 to 8 miles northeast of Boulder City
Boulder City vicinity
Clark County
Nevada

HAER NV-44
NV-44

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

FIELD RECORDS

HISTORIC AMERICAN ENGINEERING RECORD
PACIFIC WEST REGIONAL OFFICE
National Park Service
U.S. Department of the Interior
1111 Jackson Street, Suite 700
Oakland, CA 94607

HISTORIC AMERICAN ENGINEERING RECORD
SIX COMPANIES RAILROAD
HAER No. NV-44

Location:	6 to 8 miles northeast of Boulder City, Nevada Clark County, Nevada USGS Quad – Boulder Beach, Nevada Zone 11, 700400E 3990630N (at NW junction of wye)
Date of Construction:	1931 - 1932
Engineer:	Six Companies, Inc. (Kaiser Paving Company, Ltd.)
Builder:	Six Companies, Inc. (Kaiser Paving Company, Ltd.)
Present Owner:	Bureau of Reclamation, Department of the Interior
Historic Use:	Railroad
Present Use:	None – facility decommissioned in 1935
Significance:	The Six Companies, Inc. Railroad was one of three railroads built to facilitate construction of Hoover Dam. It was used to haul muck (waste rock) away from extensive excavations at the dam base for disposal, to haul raw aggregate to the aggregate screening and washing facility known as the Gravel Plant, to haul equipment to the dam site, and to haul Portland cement and finished aggregate to the lower of two concrete mixing plants at the dam. In operation from mid 1932 to the end of 1935, the railroad was instrumental to the successful and timely completion of Hoover Dam.
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Report Date:	July 2009

I. PHYSICAL DESCRIPTION

Hoover Dam is a concrete arch-gravity dam in the Black Canyon of the Colorado River, on the border between the Arizona and Nevada. Construction of the dam required the placement of 4.36 million cubic yards of concrete, all of which was mixed on site at one of two batch plants. Concrete consists of four ingredients – Portland cement, sand, crushed rock aggregate, and water. Portland cement was shipped in via rail, while water was taken from the Colorado River. Aggregate was mined locally and sorted at a single Aggregate Classification Plant, located midway between the Arizona Gravel Pit and the dam site. This was, at the time, the largest aggregate classifying and washing plant for a single construction operation in the world. In just under three years it produced all of the aggregate needed to make all the concrete used to construct Hoover Dam. It also produced smaller quantities of aggregate for purposes as diverse as sand for sandblasting steel and providing stone to riprap railroad grades.

Given the state of technology at the time, it wasn't possible to move the amount of raw material and equipment required to build the dam by road. Only a railroad could do the job. First, a line had to be constructed from Las Vegas to Boulder City, where shops and other facilities were located. This line was known as the Boulder City Branch Railroad. Another line had to be built from Boulder City to the top of the dam. This line was called the U.S. Construction Railroad. Both railroads were required for long-term operation and upgrading of the dam. As fairly permanent appendages to dam operation, they were built to high standards specified by Reclamation. The last generator was installed it Hoover Dam in 1961. With that chore completed, the U.S. Construction Railroad was dismantled. These two parts of the dam railroad system are highly publicized and still see some use. Tourist trains chug along a portion of the Boulder City Branch Railroad from Railroad Pass to Boulder City. The abandoned U.S. Construction Railroad and its tunnels now providing a walking trail through the desert, starting with interpretive panels at the Visitor's Center at what was once Government Junction (Lawler).

There was a third element to the Hoover Dam railroad system that is all but forgotten today. The third line was intended to serve several related but distinct functions. It had to haul machinery and materials stockpiled at Boulder City down to the lower levels of the dam. It had to haul muck (waste rock) from the extensive excavations at the dam out of Black Canyon for disposal. It needed to haul raw aggregate to the aggregate screening and washing facility known as the Aggregate Classification Plant, and it had to haul finished aggregate to concrete mixing plants at the dam. It was acknowledged from the onset that this would be a temporary line, doomed to be drowned by the waters of Lake Mead. Reclamation did not provide specifications to project bidders. Although not detailed in the specifications, general requirements for such ancillary works were recognized in planning documents as early as the beginning of 1930. By May of that year a detailed engineering evaluation was prepared, including approximate costs for building the construction railroad. A critical early decision endorsed at all levels of Reclamation was to build the construction railroad on the Nevada, rather than the Arizona, side of the canyon.[1] [2] [3] Instead of close Reclamation control, the design, construction, and

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[1] Mead, Elwood. Cover Letter for Memorandum on *Boulder Dam Construction Railroad* to Secretary of the Interior, June 16, 1930. On file at National Archives and Records Administration, Denver, RG115 Colorado River Project, Entry 7 Correspondence, Box 306, 300.41, 1930.

operation of this railroad system was entirely in the hands of the contractor – Six Companies, Inc. Although Reclamation reviewed plans for this railroad, they were not thought important enough to be retained in government archives. The line became known as the Six Companies, Inc. Railroad (SCIRR).

Alignment

Surveys of the route took place starting in early 1931 and continued through much of the year. The chosen route departed from the U.S. Construction Railroad at a place called Government Junction, or Lawler. Shortly after leaving Government Junction (Lawler) was the tiny station house at Crowe, located at the line's intersection with the Hemenway Wash Road. Located at Crowe was a series of spurs that facilitated the storage of finished aggregate above the projected high water line of Lake Mead. These materials were destined for the Himix concrete mixing plant. Remnants of the main line grade, spurs, and aggregate piles at Crowe can still be seen. After making the turn in a large circle above the Lake Mead Marina (as shown on USGS maps), the grade gently dropped down slope, traversing present-day Boulder Beach.

At the west foot of a ridge now called the Boulder Islands the track reached the nexus of the system, accurately called 3-Way Junction, or more fancifully – since there were no buildings in sight – Junction City. A right turn to the southeast at 3-Way Junction led across the lower reaches of Hemenway Wash to the base of Promontory Point. This place, which would serve as the resting spot for most of the muck from the dam, was given the name Shea. It overlooked the boat landing that was used to reach the dam site before roads could be constructed. Early on, it was the site of a temporary camp used by construction workers until more suitable housing could be built at Boulder City.

Grade work began in June 1931 and track laying started in September. With passage beyond the gateway leading into Black Canyon, the subgrade work became difficult, and by the time the grade passed a promontory called Cape Horn, it had become a monumental effort. Getting the railroad to the dam site precluded an orderly advance from north to south. Instead, in a move likened to a military amphibious invasion, Six Companies loaded boats and barges with men and equipment and landed them anywhere they could get a foothold to start cutting benches. At least 5 miniature beachheads were attacked simultaneously and gradually linked to form first a construction road and then a contiguous railroad grade.

By good fortune, a steep side canyon in the cliff face provided just enough space to cut and fill a bench large enough to build Lomix, which Six Companies specially designed to fit into the extremely limited space. Initially, trucks hauled finished concrete from Lomix to the dam. This continued until the final stretch of what was known as the Canyon Railroad was completed to the face of the dam. Not quite a mile long, the Canyon Railroad was spectacular. It required excavation of two tunnels, construction of two steel truss bridges over the gaping mouths of the Nevada-side river diversion tunnels, and construction of extensive wood trestles that

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[2] Bureau of Reclamation. *Boulder Canyon Dam Project: Memorandum on Boulder Dam Construction Railroad.* On file at National Archives and Records Administration, Denver, RG115 Colorado River Project, Entry 7 Correspondence, Box 306, 300.41, May 1930.

[3] Walter, Raymond F. "Controlling the Colorado – Engineering Plans and Construction." *Engineering News-Record*, Feb. 6, 1930.

enabled the trains to work along the sheer canyon sides. Tiny electric locomotives and modified flatcars hauled 8 cu-yd concrete buckets to a spotting point at the face of the dam. There, overhead cranes exchanged empty for full buckets and moved the concrete to be poured wherever needed.

A left turn at the 3-way Junction led to the gigantic Aggregate Classification Plant, the heart of Six Companies operations in Boulder Basin. For nearly half of a square mile, spurs and sidings reached out to aggregate piles and interpenetrated the plant itself. Trains of eight to ten cars delivered raw aggregate from the Arizona Gravel Pit into a track hopper, or dumped it onto an area intended to handle up to 1,500,000 tn of material for later processing. The Aggregate Classification Plant also housed repair shops and served as the switchyard for the railroad, although major repairs still had to be done at Union Pacific shops in Las Vegas.

Leaving the Aggregate Classification Plant and heading north, the main line passed five miniature man-made mountain ranges – one for each size of finished aggregate. Called Hart, this place served as temporary storage for excess finished aggregate. The railroad continued northward, sweeping around the bottom of Boulder Basin on a gradual downgrade toward the Colorado River, which it reached after crossing Las Vegas Wash. After skirting a large bend in the river, the railroad crossed a 1,140 ft wood trestle bridge to reach the Arizona shore. Despite repeated floods during its years of operation, the bridge survived the entire project without damage. Almost immediately after crossing the river, one encountered a spur and turning wye for the Arizona Gravel Pit. The mainline into the pit was constantly shifted to keep up with excavations. Two spurs entered the pit. Empty trains were backed in on one spur and then pulled forward on the other to be loaded. This allowed non-stop loading and a continuous flow of aggregate to the Aggregate Classification Plant.

Construction

The SCIRR had 19.4 mi of main line, of which 4.5 mi in Black Canyon were double-tracked. Total single track and sidings amounted to about 45 mi. The cost of the SCIRR was $1,094,552, of which plant costs were $872,736 and track costs were $221,816. The initial railroad equipment (12 locomotives, 40 gondola cars, 50 side dump cars, 4 flat cars) cost $414,942.[4] These costs were hard for the company to bear. As William H. Wattis observed, "We've got to lay that track and furnish locomotives and heavy cars at our own expense. It's all dead outlay – expenses we've got to meet before we can even begin work" (*Pacific Builder* March 28, 1931).

Frank Crowe, the Six Companies' Construction Manager for the dam project, arrived in Las Vegas in March of 1931. One of the first things he did was to select alignments for the construction railroad.[5] The entire route was surveyed starting early in April 1931. Preliminary surveys of all the lines were finished by May 18. By this time final location surveys had also been completed of selected sections, including those from Junction City to the Arizona Gravel

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[4] Ayers, A.H. *Summary of Plant & Equipment: Boulder Dam Contract.* February 1, 1937 letter to H.W. Morrison, Utah Construction Company, Ogden, Utah. On file at National Archives and Records Administration, Denver, RG115 Engineering and Research Center Project Reports, Box 107, BC-562.00-36-12-29, 1937.

[5] Bureau of Reclamation. *Annual Project History: Boulder Canyon Project, Hoover Dam.* On file at Bureau of Reclamation, Hoover Dam Archives. 1931, pp. 46.

Pit, from Junction City to the connection with the canyon line grade at the Gateway, and about a quarter of the line from Junction City to the junction with the U.S. Construction Railroad. By that time Six Companies had drawn up specifications for grading of the railroad, excepting the canyon section. By June 15, crews had finished the final location survey of 16 mi of the line in Hemenway Wash, and 7 mi between Government Junction (Lawler) and Junction City were cross-sectioned. During this time they also began construction of timber culverts.[6] The Six Companies Engineering Department began engineering of the bridge across the Colorado River, loading facilities at the Arizona Gravel Pit, and for the entire SCIRR by mid-July.[7]

Given the immense amount of railroad construction expertise within the consortium, it is somewhat amazing that Six Companies subcontracted a major part of building the railroad to two subcontractors. Six Companies did the subgrade work for the Canyon Railroad and all structure construction along the entire line (culverts, trestles, and bridges). John C. Phillips Company (Phillips) of San Francisco, a subcontractor and lowest of the four bidders, did the grade work for the rest of the line. The contract was for $49,300. Of this total, $1,200 was for clearing 120 ac at $10.00 per ac; $10,000 for 10,000 cu yd of solid rock excavation at $1.00 per cu yd; $33,000 for 240,000 cu yd of common excavation at $0.14 per cu yd, and overhaul of 300 yd at $0.015 per cu yd for $4,500. Six Companies signed the contract with Phillips on June 1, 1931, giving the company 100 days to complete the work. Phillips started mobilizing equipment and workers for 3 shifts by mid-June, and was about 3/4 done by mid-September, at which time the company had a crew of 30 on the job (*Las Vegas Age* 10/23/1931; *Review Journal* 6/18; 9/17, 18/1931).

Six Companies awarded Shanahan Brothers Construction Co. (often spelled Shannahan in both official and unofficial sources) the subcontract for track laying. In the contract, signed on September 2, 1931, Shanahan agreed to perform all the work of laying track from Government Junction (Lawler) to Junction City (Aggregate Classification Plant) and on to the Arizona Gravel Pit. It also included the portion of railroad from Junction City via Gateway and into Black Canyon toward the dam as far as Six Companies had completed the subgrade work. The contract also included installing the sidings and other railroad facilities at Junction City and the Gravel Pit.

To facilitate Shanahans' work, Six Companies provided use of a locomotive crane, gasoline-engined Plymouth locomotives, and freight cars. The contract required work to start within 10 days of August 26, 1931 and be completed within 60 calendar days. Payment for the work was $960 per mile for track laying, $15 per turnout, and $5 per derail. In all, Shanahan received about $20,000 for the track work, out of nearly a million dollars total cost for building the railroad. In mid-September, Shanahan had 13 employees working on the project (*Review Journal* 9/18/1931). In 1932, 60 men were engaged in track construction. When operations people are added, the total number of railroad workers was as high as 120 (*Las Vegas Age* 2/12/1932).

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[6] Six Companies, Inc. *Six Companies, Inc. Minute Book.* Volume 1 February 18 through August, 1931. Bancroft Library, 77/195. 1931, pp. 160,187,206.
[7] Six Companies, Inc. ibid. 1931. pp. 268.

The entire line was standard-gauge 90-pound rail with ballasted Oregon fir ties laid at intervals of 16 per rail (rail length was 39 ft) except for temporary spurs, some of which had far fewer ties to expedite constant moves. Rail was purchased used from United Commercial Company with its hardware (except washers and tie plates) for $26.45 per gross ton. Spikes and 15 sets of switches were purchased new from Columbia Steel Corporation (*Review Journal* 2/19/1932).[8] Although this was only a temporary construction railroad, due to the planned heavy volume of traffic and individual weight of cars (most of which ended up being hauled overweight, at least on the flatter portions of the grade), the railroad was built to mainline construction standards, except for spurs.

A requisite for operating the railroad, Aggregate Classification Plant, and the Arizona Gravel Pit was electrical power. Southern Sierras Power ran a line from Victorville, California to a substation located in a small bowl above and northwest of the dam site. Additional local lines ran out from there. The power company connected the high-tension lines in April 1931 (*Review Journal* 5/2/1931). The substation was dismantled after Hoover Dam began producing its own power. A small substation on the Arizona side of the dam that dates to the same period remains in operation today. The major substations built to receive power from Hoover Dam were located in the same area as the older substation. The high-tension lines to the switchyard were designed to remain in place after construction as part of the dam's electrical distribution network. Lines built in the 1930s have all been decommissioned and power is now routed through the Mead Substation located south of Boulder City.

It is convenient to describe the railroad and its construction history as 4 distinct units based on topography and construction constraints. That history begins at Government Junction (Lawler) and works downhill first to the dam, then toward the Gravel Pit. This was basically the course that construction took, except for completion of the railroad near the dam, which took a long time due to difficulties encountered in the steep terrain. Early in planning, the portion of the SCIRR from Government Junction (Lawler) all the way to the dam was called the "Hemenway Wash branch line" or the "LA" line.

Government Junction (Lawler) to Aggregate Classification Plant

The Six Companies Railroad departed the U.S. Construction Railroad at Government Junction, also called Lawler, where the railroad maintained a siding 6.25 mi from Boulder City. The railroad headed gently downhill from an elevation of 1,580 ft. It continued across Hemenway Wash, skirting the base of the River Mountains. It then looped back to head southeast, heading back toward Hemenway Wash.

The main line did not go directly to the Aggregate Classification Plant. Instead, to avoid traffic congestion for trains going from Boulder City directly to the dam, it contoured farther south to 3-Way (Three-way) Junction, known early-on as Junction City (despite the fact that no buildings ever existed there), at an elevation of 1,003 ft. The total length of this part of the line was 7.3 mi and the maximum grade was 1.75 percent.

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[8] Six Companies, Inc. Ibid. 1931. pp. 195.

Phillips started work on June 17 under their contract of June 5, 1931. The company completed about 6 percent of their work in June and an additional 7 percent during the first half of July. Except for rocky sections, rough grading had been completed from Government Junction (Lawler) to about Mile 3 leading toward Junction City. By that time, Six Companies' forces had completed timber structures from Government Junction (Lawler) to Gateway near the Boat Landing.[9] Initially, Phillips only had one machine at work. Six Companies determined that Phillips would not complete the work on time, and demanded that they increase their level of effort. Responding to pressure from Six Companies, Phillips increased the amount of equipment to 2 draglines, 1 shovel, 4 MacMillan scrapers, a scarifier, and a bulldozer; the company increased the work crew to 30. As a result, during July Phillips completed about a third of their contract. By August 17, grading was nearly complete from Government Junction (Lawler) to Junction City.[10] With completion of subgrade work by Phillips, Shanahan started laying rails starting at Government Junction (Lawler) in mid-September 1931, with a crew of 13 (*Review Journal* 9/17/1931). No major engineering problems were encountered along the grade as it dropped down to the bottom of Boulder Basin. In most areas the track was raised slightly with occasional small cuts, fills, and culverts. This portion of the railroad was completed in November 1931.[11]

One portion of the grade deserves special attention. Just under a mile from Government Junction (Lawler) the grade crossed the Hemenway Wash Road. A single building at this crossing made up the station of Crowe. For a half mile to the north, the desert surface immediately downhill of the track was covered by five piles of sorted aggregate. Sidings connected to a track parallel to the main line serviced these piles. The piles provided a place to store finished aggregate prior to when the Arizona Gravel Pit and Aggregate Classification Plant were inundated by Lake Mead. Reclamation purchased this portion of the SCIRR from Six Companies in 1936 for $6,000. It was used in conjunction with the U.S. Construction Railroad for continued delivery of aggregate to the dam.[12]

By May 31, 1931, Six Companies expended $3,011.90 for railroad grading and associated items, and $565.61 for labor in Hemenway Wash (including some work as far as Gateway). By June 30 the company had spent $2,701.28 for grade and excavation and $4,836.30 for structures between Government Junction (Lawler) and Junction City.[13]

3-Way Junction to Black Canyon

With a right turn at 3-Way Junction, trains headed toward the 720-ft level of Hoover Dam. For the first mile-and-a-half, the track ran along the base of the Boulder Islands before crossing Hemenway Wash to the base of the Hemenway Wall and flanks of Promontory Point.

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[9] Six Companies, Inc. Ibid. 1931. pp. 266.
[10] Six Companies, Inc. Ibid. 1931. pp. 295.
[11] Bureau of Reclamation. *Annual Project History: Boulder Canyon Project, Hoover Dam.* On file at Bureau of Reclamation, Hoover Dam Archives. 1931. pp. 54.
[12] Bureau of Reclamation. *Record of Execution of Contract* Oct. 26, 1936 with Six Companies, Inc. for purchase of a portion of the Six Companies, Inc. railroad in Hemenway Wash. On file at National Archives and Records Administration, Denver, RG115 Colorado River Project, Entry 7 Correspondence, Box 306, 300.41. 1936.
[13] Six Companies, Inc. Ibid. 1931. pp. 285.

Grading became much more intensive as the railroad began to circle the flanks of Promontory Point on the way to the Colorado River above the Boat Landing, River Camp located just upstream of Cape Horn, and the entrance to Black Canyon. This was the location of Shea Station. The grade in this area required a major cut and fill. The railroad had a maximum grade of 3.4 percent in this area. It served an important secondary purpose as a place to dump excess muck from excavations and tunneling at the dam site. Construction specifications set severe limits on the amount of muck that could be disposed of in the river channel. Muck disposal within Black Canyon was limited to amounts needed to build terraces for access roads and railroads, cofferdams, and terraces for support facilities. The muck gradually widened the railroad grade in the vicinity of Shea.

By August 17, grading was nearly completed from Junction City to Gateway, as the entrance to Black Canyon was called. Phillips, in completing their grading contract, finished the subgrade to River Camp located just upstream of Cape Horn on October 23, 1931. Shanahan finished track laying later in October, almost completing their contract. The subcontractors finished this portion of the railroad in November 1931 (*Las Vegas Age* 10/23/1931; *Review Journal* 10/23/1931; SixCo 1931a:295).

The Canyon Railroad

Black Canyon was so steep that from the Gateway, located at the confluence of Hemenway Wash and the Colorado River, the only access downstream to the dam site was by boat and barge. Construction along the steep northeast face of Promontory Point was arduous but comparatively simple compared with passing around the near-vertical point called Cape Horn and construction beyond that point.

Due to the extreme time limits of the construction schedule (and severe penalties for exceeding those limits), Six Companies worked on the combination road and railroad in Black Canyon at five locations simultaneously. Initially, these construction areas could only be reached by boat, and heavy equipment had to be transported by barge. Survey of the railroad began in mid- March, 1931. The alignment was identified by paint marks on the canyon wall. On March 30, 1931 about 20 Six Companies crewmen and their equipment (including a large compressor to run drills) assembled at the mouth of the canyon in preparation for work on the railroad in Black Canyon. Drilling started the following day, using at least 5 portable compressors until the large compressor could be brought on line, which was possible only after electrical power was extended to the site. Rock bombarding the river from blasting soon curtailed the popular tourist boat trips down the river to the dam site. Construction of this critical piece of the railroad continued 24 hours a day. To save commute time, the company built a dormitory and mess hall for railroad construction workers adjacent to the grade downstream of the landing: this became known as River Camp. During this period, crews of scalers, blasters, and power shovels were scattered along the route, working at any place where a weakness could be found and expanded, even if not quite at the right elevation for the final grade (*Review Journal* 3/23, 30; 4/1, 7, 30/1931).

"BOOM" (*Review Journal* 10/5/1931). The 10 a.m. blast on Sunday, October 4 created by about 8 tn of powder (which newspapers inflated to 20 tn) at Cape Horn was a true media event, witnessed by swarms of reporters, still photographers, artists, and even a film crew from Paramount. The entire face had been drilled with 225 holes to a maximum depth of 25 ft. The

blast dropped about 600,000 cu yd of rock at the base of the cliff. This was one of the areas where the legendary high-scalers and drillers did their dangerous and spectacular work on the canyon walls (*Western Construction News* 11/10/1931).

Many sections of the Canyon Railroad could be constructed as cut and fill bench work, with wide spots enhanced for support areas and sidings. Overviews from the top of the canyon show the steepness of the canyon wall between Cape Horn and Lomix, and how muck was used to enhance the width of the usable terrace between Cape Horn and Boat Landing. Even before the big blast, 2 shovels and about 135 men worked on rough grading downstream of the obstacle, allowing truck traffic to reach all the way to the diversion tunnel portals by mid-May. This traffic was possible because the truck road could follow a lower line below the cliffs than the railroad, which had to maintain the 720-ft grade. By that date crews had excavated several benches and driven 450 ft of tunnel. Over 2½ months these crews and their shovels excavated 146,000 cu yd of material, removing 8,000 yards from the tunnels alone.[14]

Amid all of these difficulties, nature granted the builders only a few small favors. One was a minor side canyon off the southeast side of Promontory Point. Backfilling the bottom of this canyon with muck and cutting terraces into its base provided a place large enough (barely) for the Lomix concrete batching plant, which was specially designed to fit into the constrained space. As noted earlier, concrete for the dam had to be mixed as dry as possible, making a very short run to the dam site essential. This location solved that problem for lower levels of the dam. Another plant, called Himix would provide concrete for higher levels of the dam. Construction of the Lomix plant started on October 22, 1931 and the plant went into operation March 3, 1932, using trucks to haul small amounts of concrete until the railroad system to the dam could be completed (*Review Journal* 10/23/1931; 3/3/1932).

The SCIRR served three main purposes at Lomix. It transported bulk cement to the plant in boxcars and aggregate in hopper cars. It also carried concrete from the plant to the dam. The principal railroad-related feature associated with Lomix was the track hopper for unloading aggregate. Use of 5 aggregate sizes at the plant required the same number of compartments in the hopper. Built of reinforced concrete with steel framing and a timber bottom and partitions, the hopper supported 2 tracks so cars could unload directly into the top of the hopper without a need for conveyors. Ten cars could be spotted on the bin at once for unloading. Each of the compartments was 39 ft long and held 10 rail carloads (about 300 cu yd) of material. The interior of the hopper was 30 ft tall. Feed from the hopper onto the conveyors was by motor-operated chute gates, 4 per compartment for a total of 20 gates.[15]

The final mile of the Canyon Railroad to the dam site was the most difficult to build. Two tunnels, each about 1,000 ft long, had to be driven through the canyon walls to approach the dam. Tunnel 1 started just downstream of Lomix, while Tunnel 2 was closer to the dam, immediately downstream of 2 truss bridges that spanned diversion tunnel inlets, and just upstream of the Nevada intake towers. Unlike several tunnels along the U.S. Construction Railroad, but like the lower tunnel excavations at the dam itself, the railroad tunnels required no timbering. In general, the mostly volcanic bedrock increased in hardness with larger and better

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[14] Six Companies, Inc. Ibid. 1931. pp. 185, 187, 263.

[15] Yates, J. Perry. "Low-Level Concrete Plant for Hoover Dam." *Western Construction News and Highways Builder.* June 10, 1932. pp. 319.

cemented blocks down toward the level of the river. Tunnel 1 was driven through complexly-faulted Older Volcanic Series (mainly dark andesitic or latitic lava flows with some breccias and intrusives) and some Dam Breccia (reddish sedimentary deposit, made up largely of monzonite porphyry fragments), both dating roughly to the Early Tertiary. This faulting caused some difficulties driving Tunnel 1, as seen in the faulting and joints where blocks have dropped out of the cliff face directly above the portals. Tunnel 2 was more fortunate, being entirely in Middle Tertiary Latite Flow-Breccia (lava flows with some latite) with little faulting.[16]

By mid-May, crews had driven 450 ft of Tunnel 1. Work continued into June, working from both upstream and downstream. Opening of the downstream portal was necessary when danger from rock slippage above the upstream portal caused the Nevada Mining Inspector to close down that part of the operation. Work on Tunnel 2 began in late May or early June. To expedite the work, tunneling was done not only from portals, but from multiple adits. Work was started by opening an 8 x 16-ft top heading, then enlarging the heading to full size. Ultimately, the tunnels both had double tracks.[17] [18]

As an aside related to this section, extreme care had to be taken while researching the progress and description of the two 720–ft level tunnels. Sources often discussed the tunnel work at length without distinguishing with any clarity whether they were describing the diversion tunnels (massive documentary coverage), U.S. Construction Railroad tunnels (heavy coverage), or the railroad tunnels built by Six Companies (minimal description). Making the distinction even more confusing is the fact that the U.S. Construction Railroad was merged into the SCIRR operationally after it was built.

After a short trial, tunnel operations were altered somewhat by changing from a full heading to a smaller 8 x 10-ft top heading, then expanding the heading by bench work. By July 20, the heading was holed through on Tunnel 1 and was within about 60 ft of the lower end of Tunnel 2. Starting on June 29, a Conway 36-in, 50 hp electric mucking machine started bench excavation at Tunnel 1 at a rate of about 18 ft per day. This machine had a capacity of about 100 cu yd per shift.[19]

Work on the canyon railroad grade prior to August 17 was confined largely to excavating the bench at Tunnel 1 and holing through of the top heading of Tunnel 2. Excavation of Tunnel 1 was practically complete, and bench excavation at Tunnel 2 was planned to start as soon as possible without interfering with progress or use of equipment on diversion tunnel top headings. A little work was done on the bench grade between Tunnels 1 and 2. Additional rock had been shot down below Cape Horn to build up the grade at this point. Along the 720-ft level, crews had extended the grade up river near the Boat Landing, widening and clearing it of rocks and sliding material at several points.[20]

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[16] Ransome, F. L. Report on the Geology of the Hoover Dam Site and Vicinity. *Consultants Reports on Boulder Dam*, Volume 6. On file at National Archives and Records Administration, Denver, RG115, Engineering and Research Center Project Reports, Box 107, BC-510.00-HD-v.6. 1931

[17] Six Companies, Inc. Ibid. 1931. pp. 185, 204, 207.

[18] Yates, J. Perry. Ibid. 1932. pp. 319.

[19] Bureau of Reclamation. *Annual Project History: Boulder Canyon Project, Hoover Dam.* On file at Bureau of Reclamation, Hoover Dam Archives. 1932. pp. 187.

[20] Six Companies, Inc. Ibid. 1931. 293.

After emerging from Tunnel 1, the railroad was able to perch on a bench cut for a short distance before launching onto a timber trestle and 2 steel Pratt truss bridges which spanned the entry ports for the river diversion tunnels on the Nevada side of the dam. The trestle and bridges were under construction in early October, 1932 (*Review Journal* 10/7/1932).

After passing through Tunnel 2 (an additional track circled the outside of the cliff to rejoin the trestle above the diversion inlets) the railroad extended across trestles pinned to the sheer wall below the Nevada intake towers, more than 80 ft above the level of the river. Initially all wood, portions -- particularly those that would be engulfed by the concrete dam -- were replaced with steel trestles. The line from Lomix to the dam was completed in 1933.[21]

Within Boulder Canyon the railroad line maintained a constant contour at the 720-ft level, and the Canyon Railroad is often referred to as the 720 Foot Railroad in engineering documents to distinguish it from extension of the U.S. Construction Railroad line to Himix, also built by Six Companies. Unlike most of the SCIRR, the Canyon Railroad had 2 tracks. Construction on the double-tracking began on January 1, 1932. A 2-lane truck road ran parallel to the tracks (*Review Journal* 1/8/1932).

By May 31, 1931, Six Companies had spent $82,946.87 on tunnels, grade, and other items and $36,583.32 on labor for work in the canyon. By July 20, $158,520.48 had been spent on grade and excavation and $694.72 on structures between Junction City and the dam, most of which was expended in the canyon. During this time 146,345 cu yd were handled at a unit price of $1.085 per cu yd.[22] According to E. O. Wattis, railroad work in Black Canyon "…required some of the heaviest construction work possible, costing as much as $300,000 a mile" (*San Francisco News* 1/6/1932).

3-Way Junction to Arizona Gravel Pit

The mainline ran northwest from Junction City, passing a little west of the Aggregate Classification Plant, itself reached by a siding which split further into a series of other sidings and spurs. The switchyard for the SCIRR was located at the northwest end of the Aggregate Classification Plant. Discussion of the railroad in the plant area is deferred to the later interpretation of the Aggregate Classification Plant in Chapter 5. The Aggregate Classification Plant Station -- regarded as the "Union Depot" of the railroad -- stood on the east side of the mainline, just west of the Aggregate Classification Plant. The station was a 2-storey, wood clapboard, side-gable building with extended porches on two sides and a landing adjacent to the railroad. Abundant double-hung windows provided natural lighting for the building. It is likely that buildings at other stations were of similar design, though smaller.

North of the Aggregate Classification Plant the railroad contoured northward a little over 3 mi to the confluence of Las Vegas Wash and the Colorado River. The wash, which was normally dry, had a propensity for flash floods, so crews built the railroad on a raised grade with a wooden trestle across the wash. The first trestle washed out and was washed out again while undergoing repair on July 10-11, 1932. The trestle was replaced a second time.[23] Much of the

[21] Bureau of Reclamation. Ibid. 1933. pp. 161.
[22] Six Companies, Inc. Ibid. 1931. pp. 214, 253, 285.
[23] Bureau of Reclamation. Ibid. 1932. pp. 18, 131.

remaining grade to the crossing of the Colorado River was on a raised grade. The railroad reached the Nevada side of the Colorado River crossing by mid-October, 1931 (*Las Vegas Age* 10/23/1931).

A 1,140-ft wood trestle bridge on six-pile bents carried the railroad over the Colorado River floodplain. As a guard against flash-flooding, a 3-in steel cable bridle tied to concrete dead-men anchored each bent of the trestle. Although Six Companies fully expected to replace it on occasion, the bridge somehow managed to survive the entire project intact. At first, thought was given to using an aerial tramway or conveyor to move aggregate over the river out of reach of floods. However, the company estimated that it was cheaper to replace the bridge than to construct any such alternative, which would require an additional transfer of material. A Six Companies crew, under the direction of Tom Price, constructed the bridge using a railroad pile driver. Pile driving was underway from late November to early December, and the bridge was completed later that month (*Engineering News Record* 12/3/1931; *Review Journal* 3/27/1931:1). The Arizona Gravel Pit, at an elevation of 765 ft, was only a short distance east of the bridge over nearly flat terrain, with a maximum grade of 1.75 near the river. The grade first passed a turn-around wye before entering the pit.

Six Companies completed all the structures between Junction City and Las Vegas Wash by August 17, 1931. By that date, part of Phillips' equipment had been moved to the Arizona Gravel Pit from Junction City. The railroad to the bridge was essentially finished by October 1931, however Reclamation did not consider the line as complete until November. The line to the pit was under construction at the beginning of 1932 and completed early in February of that year (*Review Journal* 10/31/1931).[24] [25] [26]

Operations

Six Companies was responsible for operating all of the railroad links between Boulder City and the dam construction site, including the U.S. Construction Railroad, switchyards, warehouses, and shops at Boulder City, and other minor extensions of the railroad network. The first subdivision was the mainline from Boulder City to the base of the dam via Lomix. The second subdivision was from the Aggregate Classification Plant to the Arizona Gravel Pit. The third ran from Government Junction (Lawler) to Himix. For the most part, archival information about operation of the SCIRR is subsumed into overall operations, particularly with regard to traffic on the U.S. Construction Railroad. Such general information is not included in the following discussion, which focuses as much as possible on operation of the SCIRR-constructed portion of the overall system, starting at Government Junction (Lawler).

Despite the way Six Companies organized subdivisions of the railroad, it is easiest to describe operations of the SCIRR in the order of acquiring and processing its principal freight – aggregate and concrete; in other words, from the Arizona Gravel Pit to the dam. Other parts of the line are addressed as a supplemental issue. This order emphasizes the central position and prominence of the Aggregate Classification Plant to the SCIRR. It also removes the problem of the first subdivision containing a part of the U.S. Construction Railroad.

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[24] Bureau of Reclamation. Ibid. 1931. pp. 54, 208A.
[25] Bureau of Reclamation. Ibid. 1932. pp. 10.
[26] Six Companies, Inc. Ibid. 1931. pp. 266, 295.

In the course of its operations, the volume of freight moved along the Hoover Dam railroad system was greater than any western mainline railroad. It moved a total of about 33,000,000 tn of live load (440,000,000 tn mi of combined live and dead load). "The locomotives will travel an aggregate distance of 700,000 miles and will haul 63,000 trains whose combined 600,000 cars would make a solid line 4,500 miles long." [27]

In 1932 the system had a total of 13 locomotives. Three Union Pacific (UP) surplus Mikado (2-8-2 wheel arrangement) and 4 Consolidation (2-8-0 wheel arrangement) steam locomotives were in use, along with a 70-tn 10-wheel (4-6-0 wheel arrangement) steam locomotive, a 40-tn Shay geared steam locomotive, and four 30-tn Plymouth gasoline locomotives for switching. A track shifter (a tiny open locomotive) supplemented the Shay at the Aggregate Classification Plant.[28] An additional track shifter was used elsewhere. Railroad locomotive cranes assisted with switching aggregate cars about the Aggregate Classification Plant track system. A Bull Frog locomotive was added to the system in 1933.[29] By the end of the project 29 locomotives were in use, including 10 small Baldwin electric locomotives at the dam, 3 cranes, 2 additional Mikados, and 9 Consolidation steam locomotives, all purchased from the UP.[30]

Rolling stock included 50 bottom-dump hopper cars, 34 new and 32 older 30-cu yd Western side-dump cars, 6 flat cars, and a tank car. The new Western cars were purchased from Western Wheeled Scraper Co., of Aurora, Illinois for $65,000. Used equipment was obtained whenever possible, such as gondolas from General Construction Company and side-dump cars from McDonald and Kahn (*Review Journal* 11/3/1931; 1/8; 2/19/1932). As of 1934 the rolling stock inventory included 50 hopper cars, 66 side-dumps and 42 Hart selective-type hopper cars.[31] The railroad had no passenger cars; specially-modified trucks handled the workplace commuter traffic (*Review Journal* 2/19/1932).

Other equipment included an American gasoline locomotive crane, 2 Industrial Brownhoist diesel cranes used at the Aggregate Classification Plant, 1 Standard American 30-tn gasoline-operated locomotive crane purchased from American Hoist and Derrick Company for $16,000, 4 McCann spreaders, and a Jordan spreader.[32] [33] Fueling the various locomotives called for additional support. For example, the Plymouth gasoline switch engines were fueled from Union Motor Oil tank trucks (*Union Oil Bulletin* October 1932:7). Six Companies paid United

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[27] Gallison, Norman S. "Construction of the Hoover Dam: An Account of the Extensive Railroad System and of the Important Work It is Doing." *The Story of the Hoover Dam.* Volume 3:3-7. Reprinted from *Compressed Air Magazine*, Sept. 1932, pp. 61.

[28] Nelson, Wesley R. "Classification of Concrete Aggregates for Hoover Dam." *Pit and Quarry.* Oct. 19, 1932, pp. 24.

[29] Bureau of Reclamation. Ibid. 1933. pp. 159.

[30] Heinman, Ed. *Six Companies Inc. Plant and Equipment.* On file at National Archives and Records Administration, Denver, RG115 Engineering and Research Center Project Reports, Box 107, BC-562.00-36-12-29. 1936. pp. 5, 6.

[31] Price, Thomas M. "Aggregate Production at Hoover Dam." *Transactions of the American Institute of Mining and Metallurgical Engineers.* Volume 109:397-417. 1934, pp. 417.

[32] Six Companies, Inc. Ibid. 1931. pp. 195.

[33] Heinman, Ed. Ibid. 1936. pp. 6.

Commercial Co. of San Francisco $251,000 for rail, cars, and locomotives. The initial railroad equipment (12 locomotives, 40 gondola cars, 50 side dump cars, 4 flat cars) cost $414,942.[34]

Along with his other tasks, Tom Price was in charge of railroad operations from his command post at the Aggregate Classification Plant. Hence, the SCIRR was sometimes jokingly referred to as "Tom Price's Little Union Pacific" (*Review Journal* 8/21/1933). Grant "Red" Allen was Assistant Superintendent. He took care of day-to-day operations and served as Chief Dispatcher. The other dispatchers were L.A. Grubbs and T.J. Kelly.

Dispatching was by telephone, for which purpose telephone lines ran to all stations along the line. After construction of Boulder City was completed, a large supply of wooden outhouses was no longer needed. Frank Crowe would not waste them, so he kept the outhouses in a huge pile at the shops and ordered all of the superintendents to use them in any way possible. Acting on a moment of inspiration, Price proceeded to recycle them as telephone dispatch huts at sidings along the railroad, an action that occasionally caused some confusion on the part of visiting dignitaries. During a tour of the Arizona Gravel Pit, he used the telephone and his explanation of the nature of his business inside was disbelieved upon emerging.[35]

Generally, 10-12 train crews with 3-4 men each were on the line every day. Occasionally, as many as 17 crews were busy in a single shift. According to a newspaper account, engineers and conductors were paid $6.00 a day. Firemen and brakemen were paid $5.00. This contradicts an undated mimeographed data sheet from the project[36] which lists the following railroad-related occupations and what is presumed to be their hourly wage:

- Brakeman (Railroad, standard gauge, 30 miles long) - $1.15
- Conductor (Railroad, Standard gauge Railroad 30 miles long) - $1.25
- Fireman, Locomotive - $1.05
- Labor, Unskilled - $0.75
- Locomotive Engineer - $1.65
- Pile Driver Engineer - $1.65
- Pile Driver Man - $1.375

Figures on the size of the railroad workforce vary considerably. In January 1932 the railroad had a crew of 90. In February 1932, the railroad had 55 trainmen and enginemen, and a further 15 maintenance crewmen in the shops. According to another source, the railroad employed 71 men in 1932 (*Las Vegas Age* 2/12/1932). Due to hazardous grade -- up to 3.5 percent -- the railroad employed only very experienced and competent trainmen and enginemen.[37] A.H. "Gus" Ayers, chief engineer, supervised two 30-man track repair gangs.

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[34] Ayers, A.H. *Summary of Plant & Equipment: Boulder Dam Contract.* February 1, 1937 letter to H.W. Morrison, Utah Construction Company, Ogden, Utah. On file at National Archives and Records Administration, Denver, RG115 Engineering and Research Center Project Reports, Box 107, BC-562.00-36-12-29. 1937.
[35] Price, Thomas M. *Anecdotes.* On file at the Bancroft Library, 83/42c Box 259 Folder 15 Tom Price, 1950, pp. 3.
[36] Kaiser, H. J. Untitled field book with mimeographed data sheet enclosed with job titles and hourly wages. On file at the Bancroft Library, 83/42c Carton 269 Folder 14, no date.
[37] Price, Thomas M. "Aggregate Production at Hoover Dam." *Transactions of the American Institute of Mining and Metallurgical Engineers.* Volume 109:397-417. 1934. pp. 417.

In 1932, trains ran 24 hours a day with no breaks. As an example of the traffic load on the system, 127 mainline trains ran on March 27, 1933. In that one day the trains ran 2,166 mi (this is for the entire 29-mi system, including the U.S. Construction Railroad). To facilitate interaction with the Union Pacific line at Boulder City, the SCIRR ran under the UP rule book. The railroad had many derailments, but few severe accidents and no train collisions. A trainload of cement for Lomix tore up 10 rail lengths of track when a wheel flange came off (*Las Vegas Age* 7/31/1932).

Stations were named after either places, such as the Aggregate Classification Plant, or after Six Companies directors. Two stations within the Six Companies portion of the railroad were essentially only names on the map. These are Morrison (between Crowe and the Aggregate Classification Plant) and Kahn (between Hart and Bridge).

Arizona Gravel Pit to the Aggregate Classification Plant

The railroad transported a total of 8,586,000 tn of raw aggregate from the pit to the Aggregate Classification Plant. Raw aggregate moved from the pit in 8- to 10-car trains, with the cars generally overloaded to 35 cu yd. This allowed transport of about 700 tn per train. Generally the round trip took about 2 ½ hours, 1 hour of which was traveling and the rest for unloading and other tasks. Ultimately, the railroad moved 139,952 carloads of aggregate out of the pit. From 200 to 250 train cars unloaded at the Aggregate Classification Plant daily during the summer of 1932. In August 1933, 5,096 cars of gravel were hauled from the pit.[38] At the end of each run from the pit, the trains unloaded their aggregate either directly into a track hopper at the Aggregate Classification Plant, or deposited it at a nearby raw storage area. The train passed through the storage area for finished aggregate just before entering the plant area. This place was called Hart, sometimes incorrectly spelled Harte.[39] [40] Initially, starting February 6, 1932, Consolidation locomotives were used for this run, but these were soon phased out in favor of larger Mikado locomotives. Four locomotives were generally in use at any time on this run.

Within the Arizona Gravel Pit, track locations changed constantly, but were always organized as a pair of tracks linked in such a way that one train could be loading, while another full train was leaving the pit without interruption. Either full-size trains could be loaded or individual cars could be loaded using a Plymouth switch engine.

Debris accumulation above the bridge occasionally threatened the structure. The setting during a flood was spectacular:

> With 20 feet of roaring, turbulent flood water beating at the pilings and swirling tons of debris at the footing of the trestle, the structure was still standing fast this afternoon, with a good possibility that it would weather the flood. The

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[38] Bureau of Reclamation. Concrete Manufacture, Handling, and Control. *Boulder Canyon Project Final Reports* Part IV Design and Construction, Bulletin 4. Denver, Colorado. 1947. pp. 44.
[39] Bureau of Reclamation. *Annual Project History: Boulder Canyon Project, Hoover Dam.* On file at Bureau of Reclamation, Hoover Dam Archives. 1932. pp. 129.
[40] Bureau of Reclamation. Ibid. 1934. pp. 153.

> locomotive crane, on the trestle, is making good headway clearing the debris from the pilings…..
>
> And with the wild waters of the river roaring beneath them, the gravel trains are making the precarious crossing regularly, their schedule never having been interrupted, despite the threat of disaster. (*Review Journal* May 20, 1932)

This problem was solved by equipping two railroad cranes with large grapnels made of old rails which lifted the material out of the water on the upstream side and dropped it into the river on the downstream side of the bridge. Cranes using clamshell buckets were used in the same way. Small sidings installed at each end of the bridge allowed the cranes to get out of the way, insuring that they would not interfere with the gravel train crossing the single track bridge. Frequent inspections of the bridge minimized the chance of losing a train to the river during flood time operations.[41] [42]

There were remarkably few accidents on the line. One turned out to be a non-event. On December 16, 1931 a car of bridge timbers hauled by one of the Plymouth switching locomotives escaped and started rolling toward the bridge, which was under construction. A phone call to the bridge alerted Tom Price and the crew of the destruction hurtling their way. They moved the pile driver off the line and secured a flat car on the track to brake the runaway car as it approached - which it never did. The car had stopped by itself -- and was the very same flatcar that they secured in place to block the runaway (*Review Journal* 1/22/1932). A Shay geared locomotive purchased from the Mount Tamalpais & Muir Woods Railway was used for switching at the plant until it was foolishly sent to Lomix with a train of 10 cars. The load proved too much, and going down a grade it stripped its gears and was demolished. Its replacement came from the East Butte Copper Mining Co. Another locomotive ran off the end of a spur at the plant and continued to travel across the desert for 300 ft until finally stopping. This locomotive was almost undamaged by its adventure (*Las Vegas Age* 7/31/1932).

Aggregate Classification Plant

"The Gravel Plant…was both figuratively and literally the center of the railroading operations." [43] The Aggregate Classification Plant had four functions in relation to the SCIRR. It was the central control point, it was the site of the switchyard and repair shops for rolling stock, it was the destination for raw aggregate from the pit, and it was the source of finished aggregate to be transported to the dam site.

A 252-ft shop building at the switchyard was used to maintain rolling stock. Smaller maintenance buildings were also scattered about the switchyard area. The 25-man shop crew was supervised by Master Mechanic, Harry Eck. Only minor repairs and modifications occurred at the Aggregate Classification Plant, with major repairs relegated to Union Pacific

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[41] Bureau of Reclamation. Concrete Manufacture, Handling, and Control. *Boulder Canyon Project Final Reports* Part IV Design and Construction, Bulletin 4. Denver, Colorado. 1947. pp. 43.
[42] Bureau of Reclamation. *Annual Project History: Boulder Canyon Project, Hoover Dam.* On file at Bureau of Reclamation, Hoover Dam Archives, 1932. pp. 130.
[43] Heinman, Ed. Ibid. 1936.

shops at Las Vegas. Price[44] observed that, "The roundhouse, which is at the gravel plant, consists of a competent crew of boilermakers, air-brake men, machinists and mechanics, who take care of all minor repairs to locomotives. A rip track is also maintained here for the repair of railroad cars."

To keep ahead of construction schedules, the first priority was to pull aggregate out of the Arizona Gravel Pit as rapidly and continuously as possible regardless of other considerations. The Aggregate Classification Plant could not keep up with this flow of raw material, so a simple semaphore train order signal was established on top of the control room at the plant where it was easily seen by oncoming train crews. If the blade on the signal was in the clear position, the train would come into the plant and unload in the track hopper, which took about 10 minutes with the side-dump or belly-dump cars. Then the train turned on a wye and the locomotive was topped off with fresh water held in a tank regularly replenished by the clarifier on the hillside. While watering the locomotive, the crew received their orders for the next run at the dispatcher's office. If, as was often the case, the plant could not accept raw gravel, the signal was set in the stop position and the crew instead backed their train onto one of two spurs into a raw aggregate storage area. The two spurs were lightly-built with eight ties per rail, without ballast. When the areas next to the tracks were piled as high as possible with raw aggregate, the top of the pile was flattened, the track shifted to the top of the pile, and the depression where the tracks were formerly located was filled by subsequent trains.

Aggregate Classification Plant to Dam Site

Muck (waste rock from tunnel and foundation excavations) was largely hauled by truck, but a significant portion (about 3 million tn) was also removed from the dam site by rail to be disposed along Hemenway Wash. Cuts along hillsides just outside the canyon proved perfect for this purpose, as the side-dump cars could drop the muck right off the main grade. Timing of this activity was excellent, since large numbers of the side-dump cars were not yet needed to haul aggregate to the Aggregate Classification Plant.

Trucks hauled muck to a loading platform opposite Lomix. This platform was long enough for 18 trucks to unload into six railway cars simultaneously. Three trains were usually employed hauling muck.[45] Prior to 1932, up to 600 cars of muck carrying 12,000 cu yd of material passed over the Canyon Railroad daily. By 1932, that quantity significantly decreased to about 2,300 cu yd daily. A muck train typically consisted of a steam locomotive and five cars. The cars were loaded with 3 ½-yd Marion electric shovels (*Review Journal* 1/15/1932). Hauling muck was entirely dead work, a necessary precursor to construction.

Going the other direction, from the Aggregate Classification Plant to the dam, enough raw material had to be hauled to make 4,293,400 cu yd of concrete. A total of 3,033,730 tn of finished aggregate was transported from the Aggregate Classification Plant to Lomix, which produced its first batch of concrete on February 28, 1932. During August 1933 alone, the railroad transported 5,154 cars of aggregate from the Aggregate Classification Plant to Lomix.

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[44] Price, Thomas M. "Aggregate Production at Hoover Dam." *Transactions of the American Institute of Mining and Metallurgical Engineers.* Volume 109:397-417, 1934. pp. 417.
[45] Bureau of Reclamation. Ibid. 1931. pp. 209A.

Cement hauled in boxcars from Boulder City was another major item. A total of 374,586 tn of cement arrived at Lomix, an average of about eight cars daily. About 400,000 tn of miscellaneous building materials and equipment also had to be hauled to the dam via one or the other of the lines. Haulage to Lomix ended on November 2, 1934 when the plant produced its last batch of concrete. Preparations were immediately made to dismantle the plant, most of which was sent to the Parker Dam project, although some equipment was shifted to Himix (*Review Journal* 1/15/1932; 9/11/1933; 11/3/1934).

Concrete moved from Lomix to the dam by means of battery-electric locomotives (specially modified at the shops at the Aggregate Classification Plant to 3-ft gauge) pulling flatcars modified to carry 4 8-cu yd buckets (8 ft tall and 6 ft in diameter, and only filled half way with 4 yards of concrete) which were hoisted and emptied by means of overhead cranes. Only one car was attached to each locomotive, and only 2 buckets were filled at a time to leave space for returning empties. In June 1933, the railroad from Lomix to the dam was electrified for the benefit of these locomotives using an unusual technique.

> D.C. current of 230 volts pressure was brought to trackside through installation of a third rail (except at switches, under cableways, and in the Lomix yards). Shoes on the battery operated locomotives contacted the third rail, and the current was used to recharge the batteries – not to power the locomotives. Thus the gaps in the third rail in no way affected the locomotive or railroad operations.[46]

Traffic congestion in this area was so high from the shuttling trains that a special dispatcher was dedicated to orchestrating traffic between Lomix and the dam.

Construction of Hoover Dam was not without its spectacular publicity stunts. Union Pacific had just put its new streamlined "Train of Tomorrow" named City of Salina into operation and was anxious to get the maximum publicity possible. The marketing plan was "…to take the train into the canyon and to the upstream face of the dam, where a picture could be obtained of the dam and train – one being the last word in dams and the other the last word in trains." After a flurry of inspections of contract details and liability issues, both the government and Six Companies agreed to the scheme and, amid their impossible deadlines, Young and Crowe had to orchestrate safe passage of this train to the dam site, which took place on March 9, 1934. On the way, the train drove right through one of the sections of penstock in the Boulder City yard awaiting transport to the dam (*Review Journal* 3/9/1934).

Aggregate Classification Plant to Government Junction (Lawler)

Most of the traffic uphill from the Aggregate Classification Plant to Government Junction (Lawler) consisted of about 5,124,730 tn of finished aggregate. When possible trains transported it directly to Himix, but the stockpiles at Crowe were filled to ensure a supply after the rising lake submerged first the Arizona Gravel Pit and then the Aggregate Classification Plant. Use of this storage facility introduced the need to handle the material one more time.

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[46] Myrick, David F. *The Railroads of Nevada and Eastern California Volume Two – The Southern Roads.* Howell-North, Berkeley. 1963. pp. 746.

This not only increased costs, but introduced problems with quality control over the aggregates, particularly a problem for sand. The stockpiles also served as insurance – if the Aggregate Classification Plant had to go out of operation or simply could not keep up with concrete production, the piles at Crowe could be used to ensure an uninterrupted flow of the critical material to the dam site.

Following shutdown of the Aggregate Classification Plant on November 29, 1934, Crowe became the center of aggregate operations for the duration of the project. Loading there took place during 3 shifts daily, except for 2 days at Christmas. The railroad also hauled from Crowe over 3 daily shifts before the Christmas break, reducing the haulage schedule to 2 shifts thereafter (though gravel loading still was kept up around the clock). The railroad shifts were unusually spaced during this time (7 am to 3 pm and 7 pm to 3 am), to equalize the period between shifts when ready-storage supplies of aggregate had to be used at the mixing plant.

Dismantling

The pile bridge to the Arizona Gravel Pit was dismantled late in July 1934 and shipped to Parker Dam, another Six Companies jobsite, in August. It was still in good condition when removed. Prior to taking down the bridge, railroad tracks in and near the Arizona Gravel Pit were removed which, along with tracks below Lomix, were the only major track demolitions in 1934.[47] [48] [49]

The dam engulfed the extreme south end of the Canyon Railroad. Steel trusses supporting the suspended grade were simply left in place – which is why steel was used in this area. Rails, ties, and wooden decking were removed as the dam advanced upward. Ties and rails on the portion of the Canyon Railroad from Lomix down to the dam were completely dismantled and removed by the end of 1934. With the water rising, the 2 steel truss bridges and wooden truss approaches were likely removed shortly after late February of 1935.

Dismantling Lomix started as soon as concrete production there ended on November 2, 1934. Except for a few items needed quickly at Himix, the dismantling process took place slowly, as it could be fit in around other more-pressing tasks. By the end of 1934 some of the plant still had not been removed from the site. Demolition of Lomix was finally completed on February 10, 1935.[50] [51]

The railroad line from the Arizona Gravel Pit, through the Aggregate Classification Plant, and on to the upper cofferdam, and from the Aggregate Classification Plant to Crowe was removed by the end of 1935.[52] Six Companies sold many of the locomotives to the Japanese government as scrap in 1937, although some remained in use locally into the 1960s

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[47] Heinman, Ed. Ibid. 1936, pp. 5.
[48] Bureau of Reclamation. *Annual Project History: Boulder Canyon Project, Hoover Dam.* On file at Bureau of Reclamation, Hoover Dam Archives. 1934. pp. 147, 188.
[49] Bureau of Reclamation. Concrete Manufacture, Handling, and Control. *Boulder Canyon Project Final Reports* Part IV Design and Construction, Bulletin 4. Denver, Colorado. 1947. pp. 41.
[50] Bureau of Reclamation. *Annual Project History: Boulder Canyon Project, Hoover Dam.* On file at Bureau of Reclamation, Hoover Dam Archives. 1934. pp. 157-158.
[51] Bureau of Reclamation. Ibid. 1935. pp. 129, 130.
[52] Bureau of Reclamation. Ibid. 1935. pp. 166.

(*Review Journal* 8/31/1937). It appears that no locomotives from the system survive today, though one of the dump cars is preserved at the Western Pacific Railroad Museum at Portola, California.

Present Condition

The portion of the railroad between Government Junction (Lawler) and Boulder Harbor has never been inundated and is still largely in excellent condition. This portion of the railroad has been documented elsewhere.[53] [54] The rest of the railroad lies beneath the waters of Lake Mead. Twichell et al.[55] reported on a multi-year geophysical mapping program designed to locate and estimate the depth of sediment that has accumulated in Lake Mead since the onset of impoundment. Examination of mapping provided by Twichell allows several suggestions regarding the present condition of various portions of the SCIRR and its associated features. They include the following:

- In the vicinity of the Arizona Gravel Pit, linear accumulations of post-inundation sediment are present along the bottom of Swallow Bay, along the face of Water Barge and Lovers Coves, and along the bottom of Callville Bay[56]. These locations act as reference points, allowing for a reasonable estimate as to the location of the Arizona Gravel Pit on the Twichell map. It would appear that Seismic-Reflection Profile D[57] provides a cross section of the Boulder Basin at a location about midway between the SCIRR trestle bridge and the Arizona Gravel Pit. That profile indicates that at the edges of the old river channel, post-inundation sediments range in depth from 12 to 15 m. On the south, this accumulation thins as it nears a break in slope reflective of an old floodplain terrace. Accumulations of post-inundation sediment on this terrace are much thinner (1 – 2 m) and do not extend far up slope. Examination of USGS topographic mapping suggests that the Arizona Gravel Pit operation took place on this first terrace up from the river channel. The gravel operation would have resulted in a topography marked by numerous borrow pits and trenches. Based on the Twichell mapping, it appears that most of the Arizona Gravel Pit is now covered by a layer of post-inundation sediment that is 1 to 10 m in depth. Project elements located south of the gravel pit (railroad lines, roadways, etc.) may be just far enough upslope that they have escaped burial up to this time. For example, linear traces are present that may represent one of the side tracks
- A sidescan sonar image is provided of the portion of Boulder Basin in which the Arizona Gravel Pit was located[58]. Based on landmarks, the pit area should be located along the right edge of and half way up the image. Examination of the image reveals that the post-inundation sediment in this area has a mottled appearance when compared

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[53] Associated Cultural Resource Experts. Integrity Evaluation and NRHP Reevaluation of Railroads Associated with the Construction of Hoover Dam. Littleton, Colorado. 2001.
[54] Schweigert, Kurt and Teela Labrum. Hoover Dam Railroads Non-Contiguous Historic District: National Register of Historic Places Nomination. Associated Cultural Resource Experts, Littleton, Colorado. 2003.
[55] Twichell, David C., VeeAnn A. Cross, and Stephen D. Belew. Mapping the Floor of Lake Mead (Nevada and Arizona): Preliminary Discussion and GIS Data Release. U.S. Geological Survey Open-File Report 03-320. 2003.
[56] Twichell, David C., VeeAnn A. Cross, and Stephen D. Belew. Ibid. 2003, Figure 9.
[57] Twichell, David C., VeeAnn A. Cross, and Stephen D. Belew. Ibid. 2003, Figure 10.
[58] Twichell, David C., VeeAnn A. Cross, and Stephen D. Belew. Ibid. 2003, Figure 8.

with other locations. This suggests that contours of the post-inundation sediment mirror the layout of borrow pits and trenches once present.

- From the Arizona Gravel Pit, across the trestle which bridged the Colorado River, and past Las Vegas Wash, the SCIRR grade is now covered by anywhere from 1 to 15 m of post-inundation sediment.
- No detectable accumulation of post-inundation sediment is present along the railroad alignment from a point about 1 mile south of Las Vegas Wash, around the Boulder Islands, and then east toward the Boat Landing area.
- Accumulations of post-inundation sediment along the northeast edge of Promontory Point (from Boat Landing to Cape Horn) are up to 25 m (82 ft) in depth. The railroad grade in this area sat at an elevation of 720 ft. Although a precise measurement is not possible, it is estimated that the elevation of the river bottom in this area was approximately 620 ft. These data suggest that in this area the post-inundation sediment may have a current surface elevation of approximately 702 ft. This suggests that the railroad grade (at 720 ft) may not have been covered by post-inundation sediment.
- Accumulations of post-inundation sediment in the Black Canyon area (from Cape Horn to the dam) are up to 30 m (98.4 ft) in depth. The railroad grade in this area sat at an elevation of 720 ft, while the elevation of the river bed near the coffer dam was 618 ft. These data suggest that in this area the post-inundation sediment may have a current surface elevation of approximately 716.4 ft. This suggests that the railroad grade (at 720 ft) may not have been covered by post-inundation sediment.

Short segments of mainline and sidings in the vicinity of the Aggregate Classification Plant were documented during underwater investigations.[59] Based on findings of those investigations, it appears that areas exempt from post-inundation sedimentation contain evidence of raised grade, cut-and-fill bench work, along with most subgrade and ballast. During side-scan surveys of Boulder Basin, the NPS SRC located and imaged remains of the tracks and followed them to the 200-ft depth level. Much of the railroad track was dismantled prior to the impoundment of water and in some areas pre-impoundment erosion is now becoming silted over, but the remains are still visible in several side-scan sonar images. As with all other metal structures in Lake Mead, the small sections of metal track that still remain on the site are becoming colonized by quagga mussels (*Dreissena rostriformis bugensis*), a subspecies of freshwater mussel (an aquatic bivalve mollusk). The quagga mussel is currently of major concern in the United States as an invasive species. Of greatest uncertainty is the status of the grade from Boat Landing to the dam face. It is unknown whether or not post-inundation sedimentation has covered the bench on which the railroad sat. If not, then it is possible that the railroad tunnels may remain intact and visible. Also, the track hopper at Lomix still may be largely intact.

II. HISTORICAL CONTEXT

In the last half of the nineteenth century, as American settlers moved west of the 100th meridian in ever-increasing numbers, they encountered a lack of water in a region characterized

[59] Harper, C., S. Eskenazi, H. Roberts, R. Ahlstrom, R. Gearhart, and D. Jones. Archaeological Inventory for the Systems Conveyance and Operations Program, Lake Conveyance System Pipeline, Clark County, Nevada. HRA, Inc. archaeological report 01-15B, Las Vegas, Nevada. 2005.

by Walter Prescott Webb[60] as "The Great American Desert." These conditions often defeated efforts to farm in a manner that worked well farther east. This problem was formally recognized in 1878 by John Wesley Powell[61] when he argued for a major reworking of the legal basis for obtaining ownership of the land due to lack of water. By 1900, despite the best efforts of the General Land Office to place the public domain into the hands of productive citizen farmers, over a third of the country remained vacant.

To many, managing the limited supply of water in the West was an obvious task for the federal government. It became a central aspect of demands for increased government involvement in local affairs that was to characterize Progressive Era politics toward the end of the century.[62] Under the general rubric of reclamation, supporters of major irrigation works often campaigned for their favorite projects with messianic fervor, arguing for nothing less than "the conquest of arid America."[63] At the urging of Theodore Roosevelt and many interest groups, the Reclamation Service was created in 1902 (it became the Bureau of Reclamation in 1923, specifically dedicated to constructing large-scale irrigation projects.[64] [65]

From the end of World War I until Franklin Roosevelt's election in 1932, conservative Republicans took a more cautious approach to conservation than had been advocated by the earlier Progressives. The Boulder Canyon Project was the one great exception, and its success was due mainly to another aspect of dam construction and use – hydroelectric power.

By the late nineteenth century electrical power was leaving the laboratories and beginning its explosive expansion for utilitarian purposes. Water power was an obvious means of turning the necessary generators, with the first two placed in operation in 1882. By the first decades of the twentieth century, it was obvious that any area without abundant and inexpensive electrical power was doomed to industrial and economic stagnation. Developers centered in the Los Angeles area of Southern California recognized this problem and lobbied hard for a source of hydroelectric power from the Colorado River, along with water for irrigation and urban purposes. The critical part of the Boulder Canyon Project Act of 1928 that gained conservative support was the provision that the hydroelectric power generated by Boulder Dam would be sold and revenue would be used to repay the government's construction costs. This formula became the model for many post-World War I projects.[66]

Some 70 possible dam and reservoir sites along the Colorado were investigated beginning in 1904. By 1919, attention focused on the Black Canyon and Boulder Canyon sites. Simultaneously, investigations were in progress regarding the feasibility of a major canal (the All-American Canal) from the Colorado to the Imperial Valley. These preliminary studies were

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[60] Webb, Walter Prescott. "The American West, Perpetual Mirage." *Harpers,* May, 1957.
[61] Powell, John Wesley. *Report on the Lands of the Arid Region of the United States*, 1878. Reprint edited by Wallace Stegner, Cambridge, Massachusetts. 1962.
[62] Hayes, Samuel P. Conservation and the Gospel of Efficiency: The Progressive Conservation Movement, 1890-1920. Harvard University Press, Cambridge, 1959.
[63] Smythe, William E. *The Conquest of Arid America.* McMillian, New York. 1899.
[64] Frederick, Kenneth D. Water Resources: Increasing Demand and Scarce Supplies, In, *America's Renewable Resources: Historical Trends and Current Challenges*, edited by K. D. Frederick and R. A. Sedjo, pp. 23-80. Resources for the Future, Washington, D. C. 1991.
[65] Newell, Frederick Haynes. *Irrigation in the United States.* Thomas Y. Crowell, New York. 1906.
[66] Frederick, Kenneth D. Ibid.

used by Reclamation to generate a series of technical reports to Congress starting in 1922. By 1928, Reclamation determined that from an engineering perspective the Black Canyon site was the best place for a dam.[67]

After extensive Congressional wrangling, President Hoover signed the Boulder Canyon Project Act, which authorized construction of Boulder Dam and the All-American Canal, on June 25, 1929. Major components of the water control and power generation system for the lower Colorado River ultimately included the dam, the impounded reservoir that would become Lake Mead, Parker Dam, the Colorado River Aqueduct, the All American Canal and Coachella Branch Canal, Imperial Dam, Laguna Dam, and a power transmission line from Los Angeles to the Black Canyon construction site. On July 3, 1930, Congress appropriated the first installment of the total $327 million in contracts for the Boulder Canyon Project.

Walker Young, an engineer with Reclamation, was put in charge of coordinating and monitoring contractors hired to build the project. Reclamation established a detailed scope of work for potential contractors to bid on.[68] On March 4, 1931, Six Companies, Inc., was awarded the contract for construction of Hoover Dam for $48,890,995.50.[69] This was the largest contract ever let by the federal government up to that date.

Six Companies was actually a consortium of seven companies incorporated on February 18, 1931, in Wilmington, Delaware, specifically to meet stringent demands of the project. The combination of companies was needed to pool sufficient capital to raise the immense -- and for the time unprecedented -- completion bond required by the government. Utah Construction Company of Ogden, Utah, had experience in railroad, irrigation, and reclamation construction. The Pacific Bridge Company of Portland, Oregon, worked mainly in bridge building and underwater foundations. W.A. Bechtel Company of San Francisco, California, worked in railroad, dam, and general construction projects. Kaiser Paving Company, Ltd., of Oakland, California, had extensive experience in paving and associated aggregate operations. MacDonald & Kahn Company of Los Angeles, California, was a building contractor. The Morrison-Knudsen Company of Boise, Idaho, built roads, railroads, dams, and miscellaneous other structures. The J.F. Shea Company of Portland, Oregon, specialized in tunneling. Corporate records relocated during archival research do not detail which firms contributed personnel to specific portions of the project (except at the highest supervisory levels), but it is easy to see that all of them may have been involved with the intricate excavation, construction, and operational problems of the Canyon Railroad. Kaiser's expertise in aggregate operations was showcased at the Aggregate Classification Plant.

Construction of Hoover Dam began on April 1, 1931 as workers called "high-scalers" began blasting loose rock off cliff faces using jackhammers, pneumatic drills, and dynamite. Others were laying railroad tracks so that gravel from the Aggregate Classification Plant could be carried to two concrete-mixing facilities being built at the dam site. On February 1, 1935, workers used a steel bulkhead to plug Diversion Tunnel Number 4, and the Colorado River

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[67] Bureau of Reclamation. *The Story of Hoover Dam.* Government Printing Office, Washington, D.C. 1976. pp. 8-12.
[68] Bureau of Reclamation. Specifications, Schedule, and Drawings: Hoover Dam, Power Plant, and Appurtenant Works, Boulder Canyon Project Arizona-California-Nevada. On file at Bureau of Reclamation, Hoover Dam Archives, Specifications No. 519. 1930.
[69] Vivian, C.H. "Construction of the Hoover Dam." in *The Story of the Hoover Dam* pp. 25-29. Reprinted from *Compressed Air Magazine*, 1931-1935. Nevada Publications, Las Vegas, Nevada, 25.

began to impound behind the dam. Six Companies completed concrete placement in the dam on May 29, 1935 and all features were completed by March 1, 1936 at which time Interior Secretary Ickes formally accepted the dam on behalf of the government. President Franklin D. Roosevelt presided over the dedication ceremony held on September 30, 1935. Beginning in 1937 the powerhouse began generation and transmission of hydroelectric power.

The engineering and construction of Hoover Dam was a tremendous and technologically-sophisticated feat. Up to 5,200 workers were employed at the peak of construction. They worked 24 hours a day, seven days a week. Working conditions were often deplorable. The dam was 726 ft high, 660 ft wide at its base, and 45 ft wide at its crest. At the time of its completion, the project resulted in the largest human-made reservoir in the world.

III. PROJECT DESCRIPTION

Highly treated municipal wastewater (effluent) in the Las Vegas Valley is currently discharged from regional wastewater treatment plants into the Las Vegas Wash, which flows into the Las Vegas Bay of Lake Mead. Treated wastewater has been discharged in this manner since 1956. The Las Vegas Wash is a tributary to the Colorado River, and the Las Vegas Bay and Lake Mead are part of the Colorado River System. The quantity of effluent treated and discharged from the Las Vegas Valley will increase as the population increases.

The Clean Water Coalition (CWC) is comprised of four agencies currently responsible for wastewater treatment in the Las Vegas Valley: the City of Las Vegas, the City of North Las Vegas, the City of Henderson, and the Clark County Water Reclamation District. The CWC proposes to implement the Systems Conveyance and Operations Program (SCOP). The SCOP will provide an alternate location for effluent currently discharged to Lake Mead through the Las Vegas Wash. The SCOP includes a combination of plant optimization, increased treatment processing, collection of treated effluent from the various treatment facilities, and a system of pipelines and tunnels that would discharge highly treated effluent to Lake Mead near the Boulder Islands, thereby obtaining better dispersion of the treated wastewater. Once implemented, the majority of flows would bypass the Las Vegas Wash.

The SCOP requires constructing a pipeline from the Las Vegas Valley into the Boulder Basin of Lake Mead. The pipeline is broken into two main segments: the Effluent Interceptor (EI) which connects various water treatment facilities in the Las Vegas Valley, and the Boulder Islands North Lake Conveyance System (LCS) which carries the treated effluent into Lake Mead. A majority of the EI will be installed using cut-and-cover trench techniques. A portion of Reach 3 of the EI will be placed in a tunnel located 45 to 90 feet (ft) below ground surface.

The Boulder Islands North LCS will be placed in a tunnel 200 ft below ground surface running to Lake Mead, and will terminate at a Hydroelectric/Pressure Regulating Station (HPRS) located northwest of Boulder Harbor above high water. Five pipes will exit the HPRS, extend into Lake Mead approximately 18,000 ft and terminate at an elevation of approximately 850 ft. The pipes will be 2 ft apart and each pipe will have an inside diameter of 63 in. The total width of the pipe configuration will be 55 ft. The pipe configuration will be placed in a trench and covered with sediment to an elevation of 1,000 ft to protect the pipes during periods of low water. At an elevation of 1,000 ft the 5 pipelines will transition to subaqueous pipelines that

will be installed on pylons anchored to the bottom of Lake Mead. Each pipeline will terminate in a single port diffuser. A pile foundation inserted into the ground at an elevation of approximately 850 ft will support each diffuser.

Archaeological investigations were conducted as part of the planning process[70] resulting in identification of the Six Companies, Inc. Railroad as site 26Ck4046B. Construction of pipelines associated with the Boulder Islands North LCS will impact portions of the railroad grade. A compilation of historical documentation regarding the plant was carried out as a treatment activity.[71] Information contained herein is drawn from this compilation. It should be noted that other elements of the infrastructure associated with construction of Hoover Dam have been documented as part of the same treatment process. They include the Arizona Gravel Pit Road (HAER No.NV-42) and the Aggregate Classification Plant (HAER No. NV-43).

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[70] Harper, C., S. Eskenazi, H. Roberts, R. Ahlstrom, R. Gearnart, and D. Jones. Archaeological Inventory for the Systems Conveyance and Operations Program, Lake Conveyance System Pipeline, Clark County, Nevada. HRA, Inc. archaeological report 01-15B, Las Vegas, Nevada. 2005.

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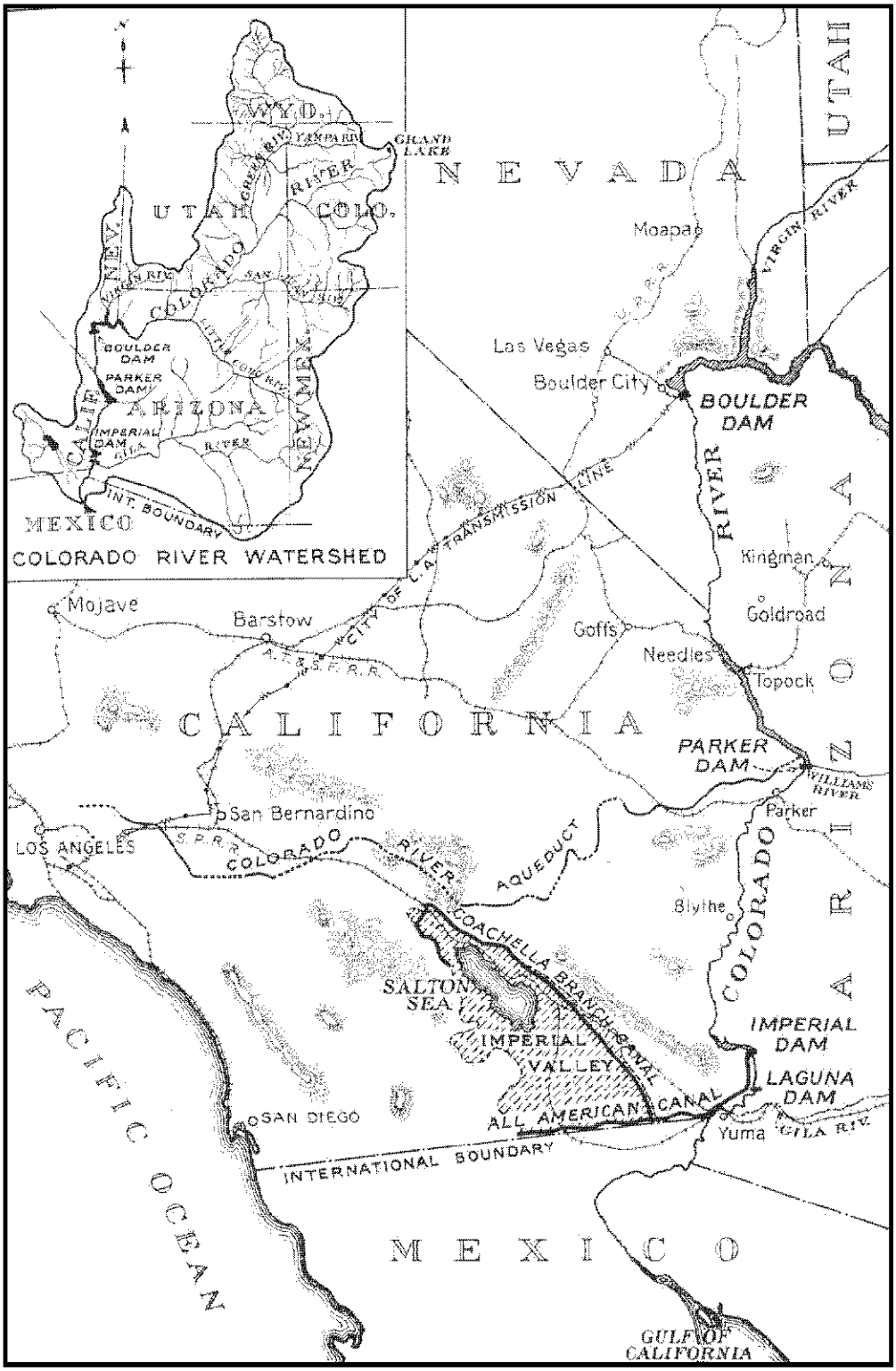
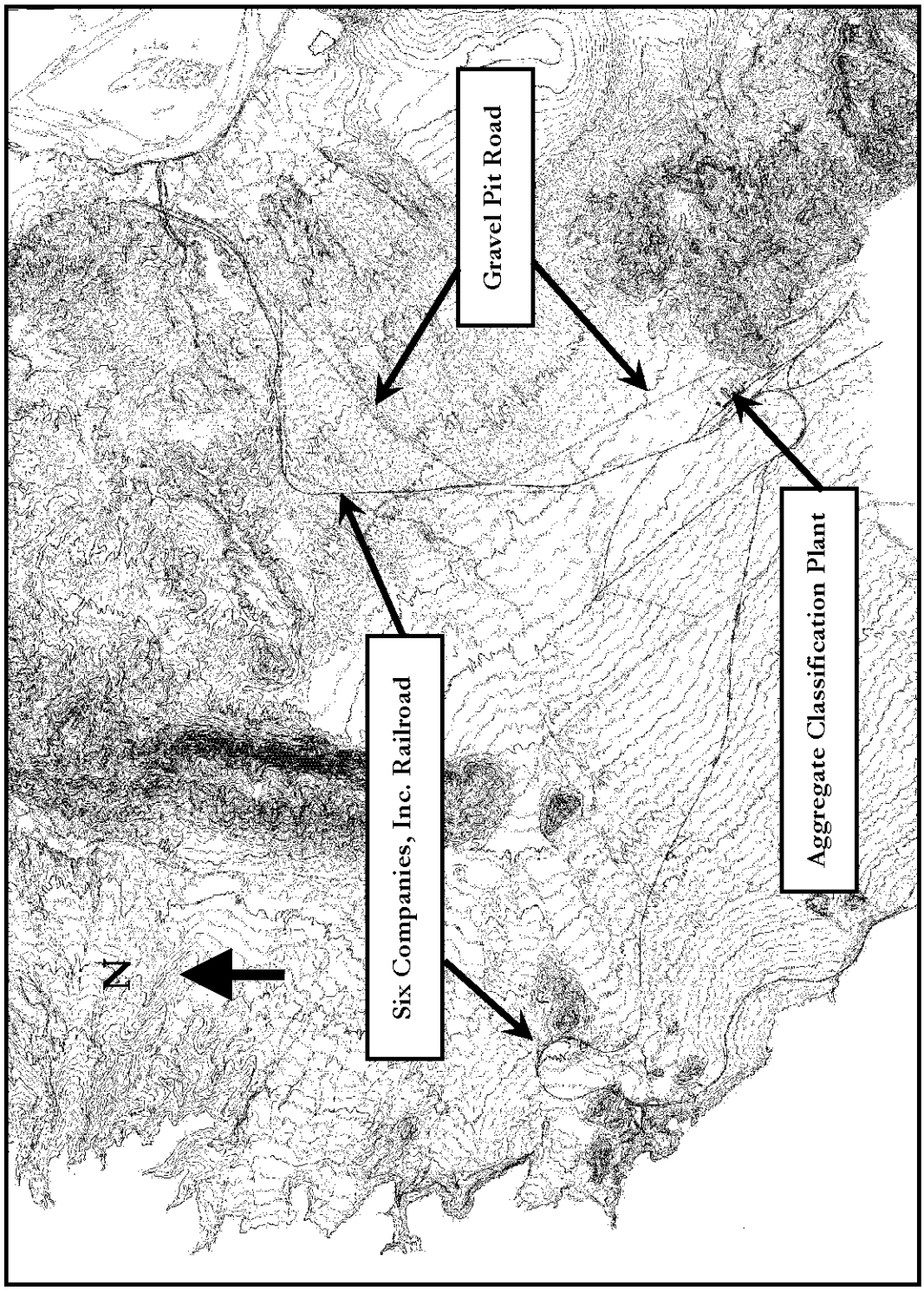
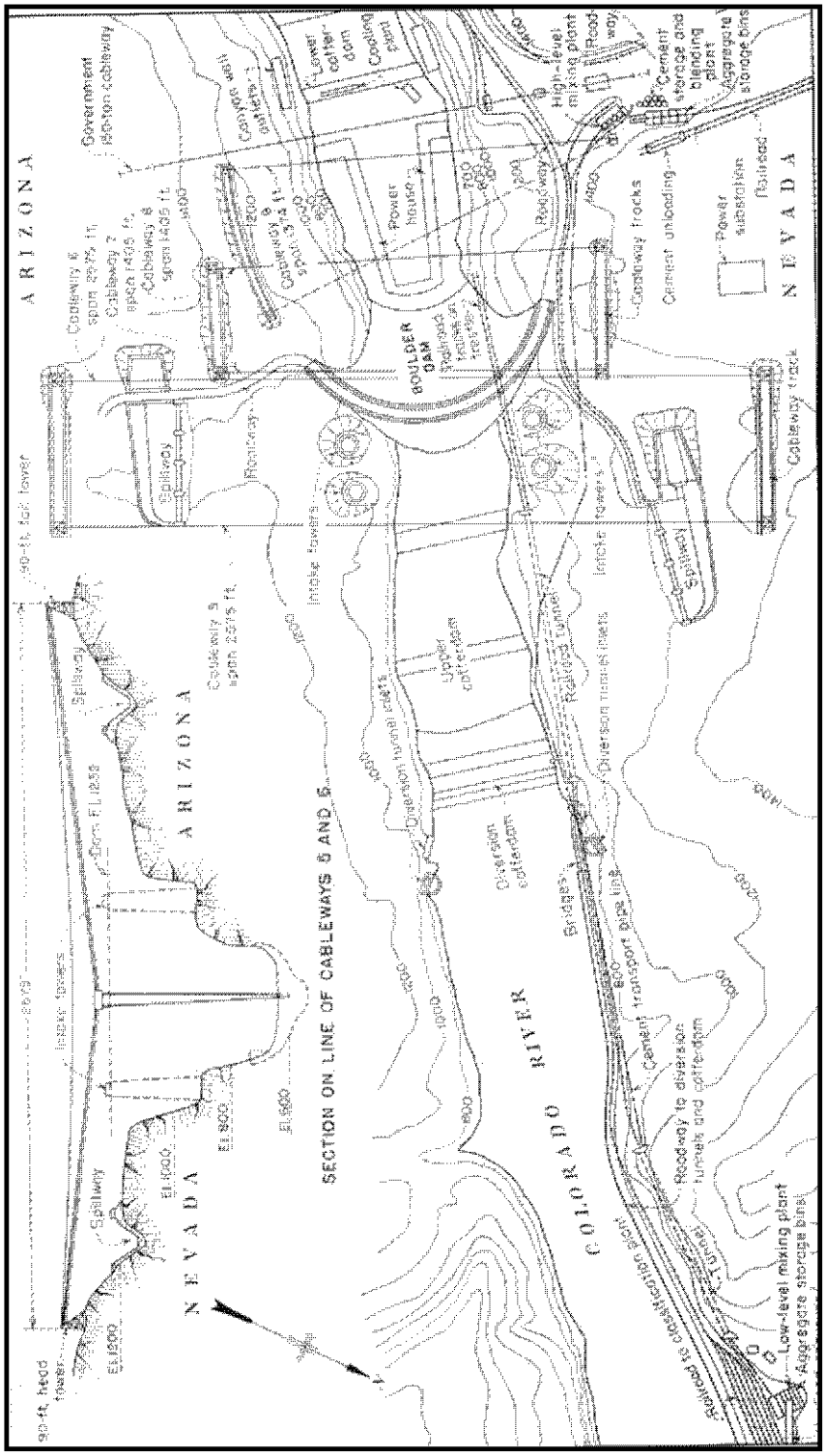


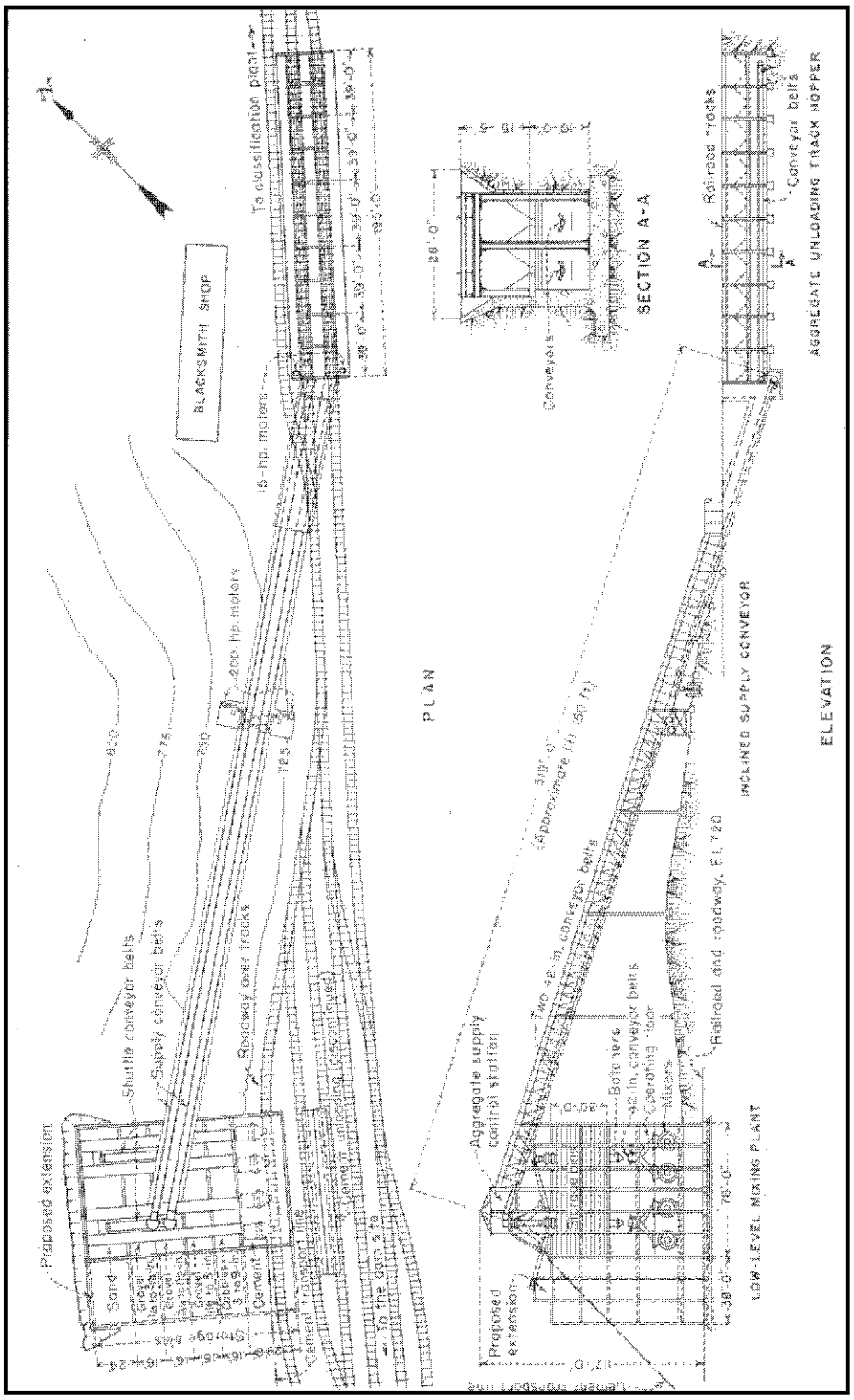
Location map for the Boulder Canyon Project.
Reprinted from Bureau of Reclamation (1947:v)



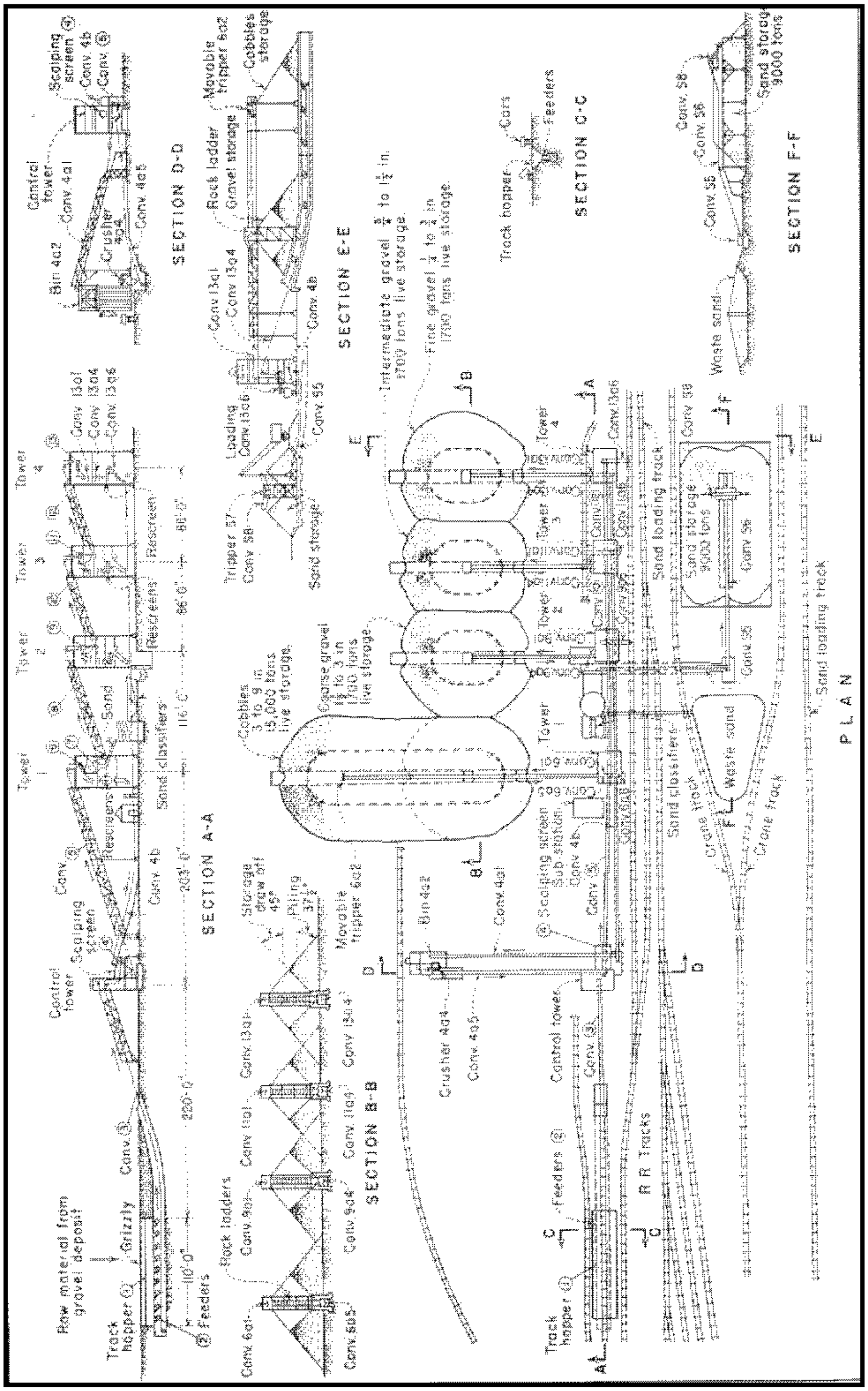
Boulder Basin topographic map (no scale).
Courtesy Lake Mead NRA



Details of Six Companies Railroad Downstream of Low Level Concrete Mixing Plant (Lomix). Reprinted from Bureau of Reclamation (1947 IV 4:23).



Low Level Mixing Plant details. Tracks, sidings, and the aggregate Unloading track hopper. Reprinted from Bureau of Reclamation (1947 IV 4:73).



Plan view and sections of the Gravel Plant and railroad sidings.
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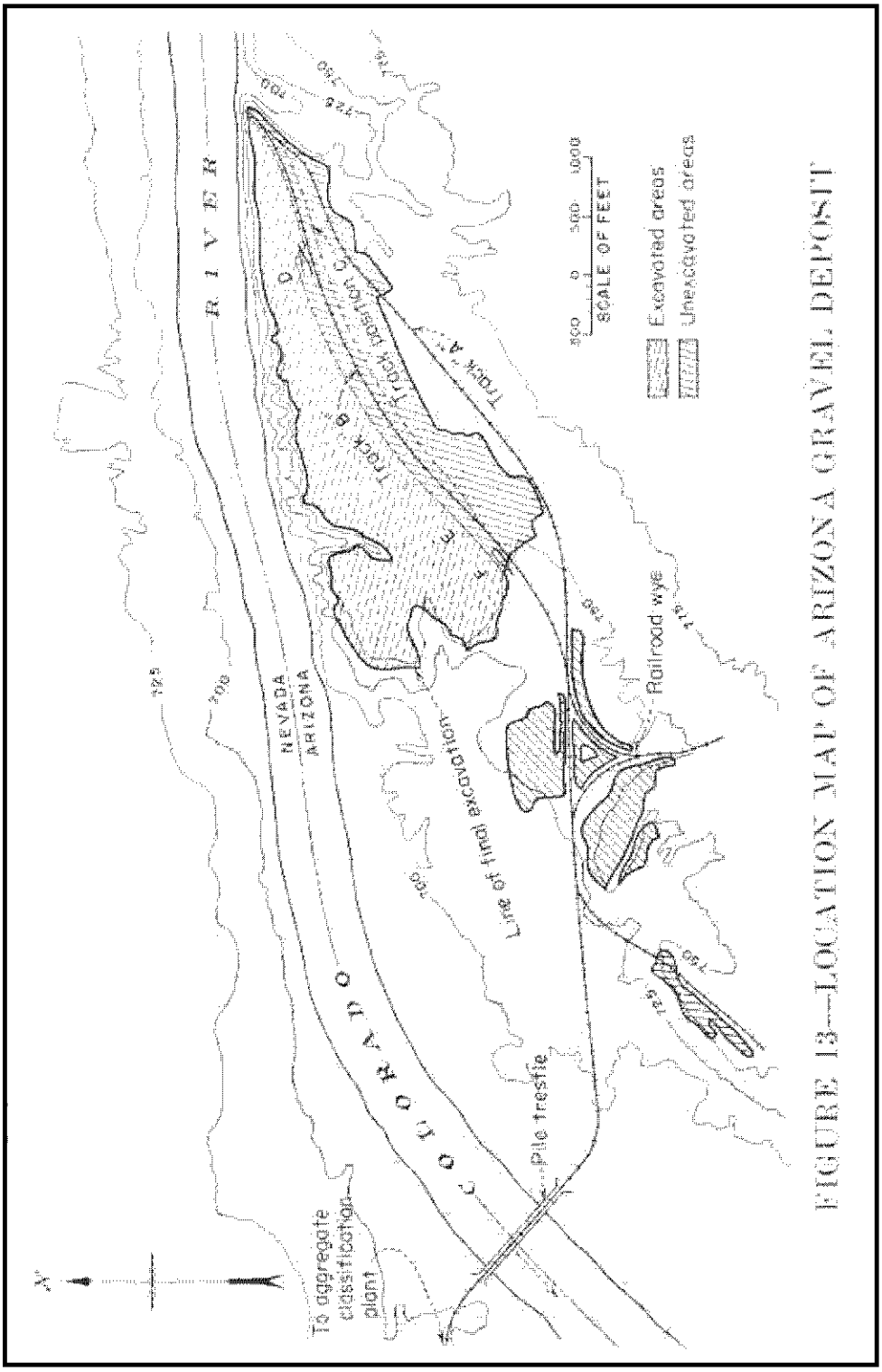
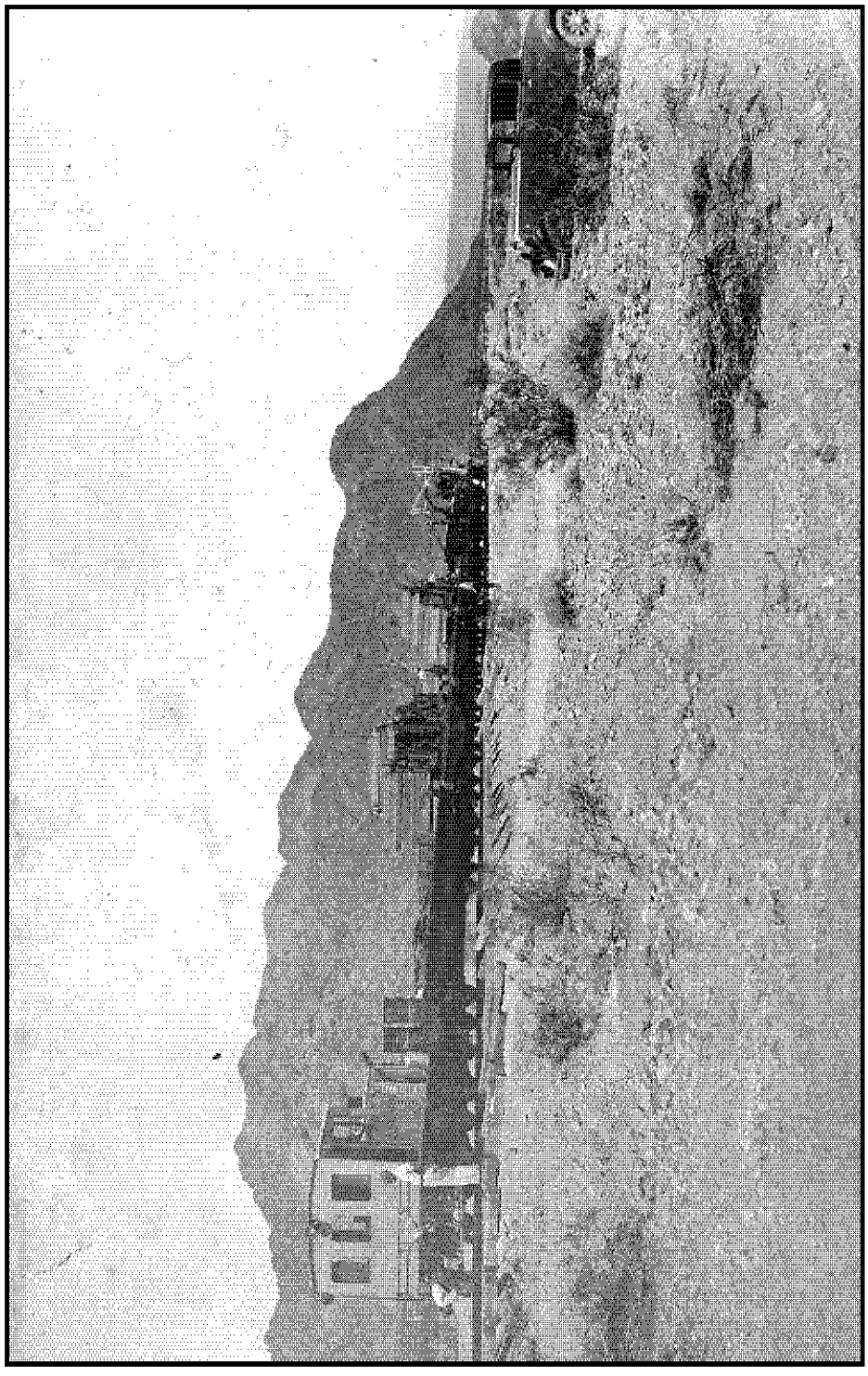
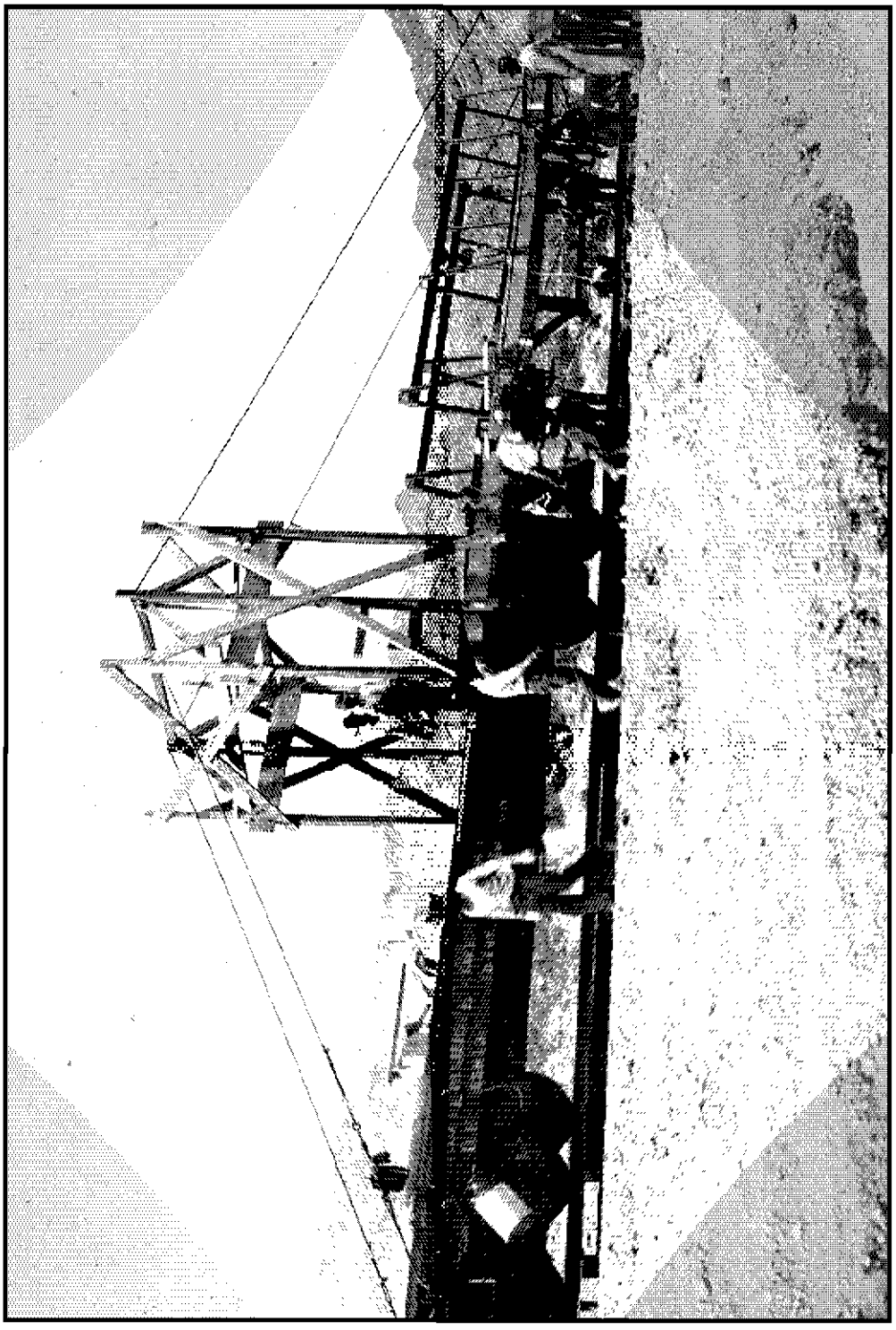


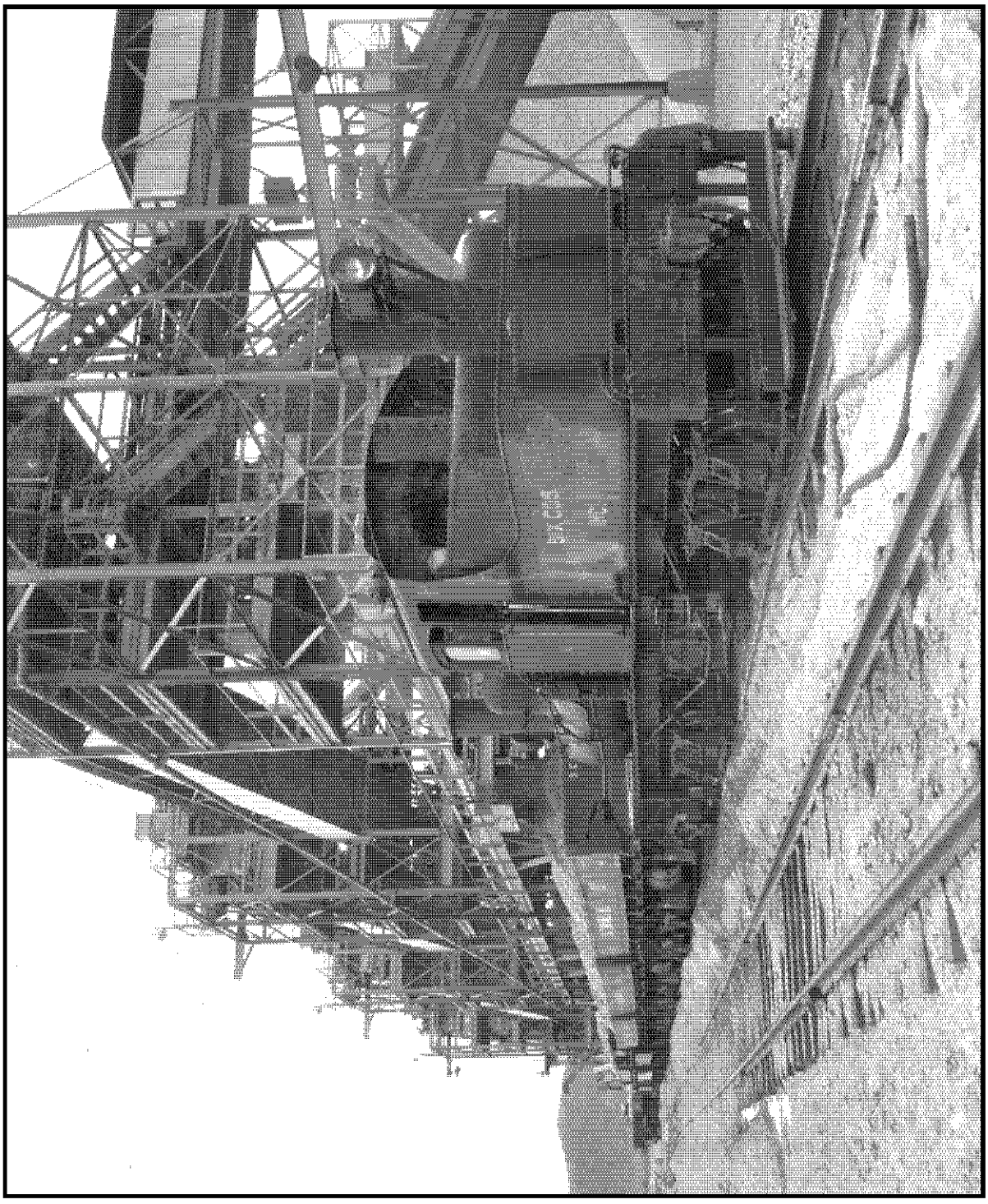
Map of the Arizona gravel deposit, railroad system, and trestle bridge. Reprinted from Bureau of Reclamation (1947 IV 4:43). The northern terminus of the Six Companies Railroad is at upper right.



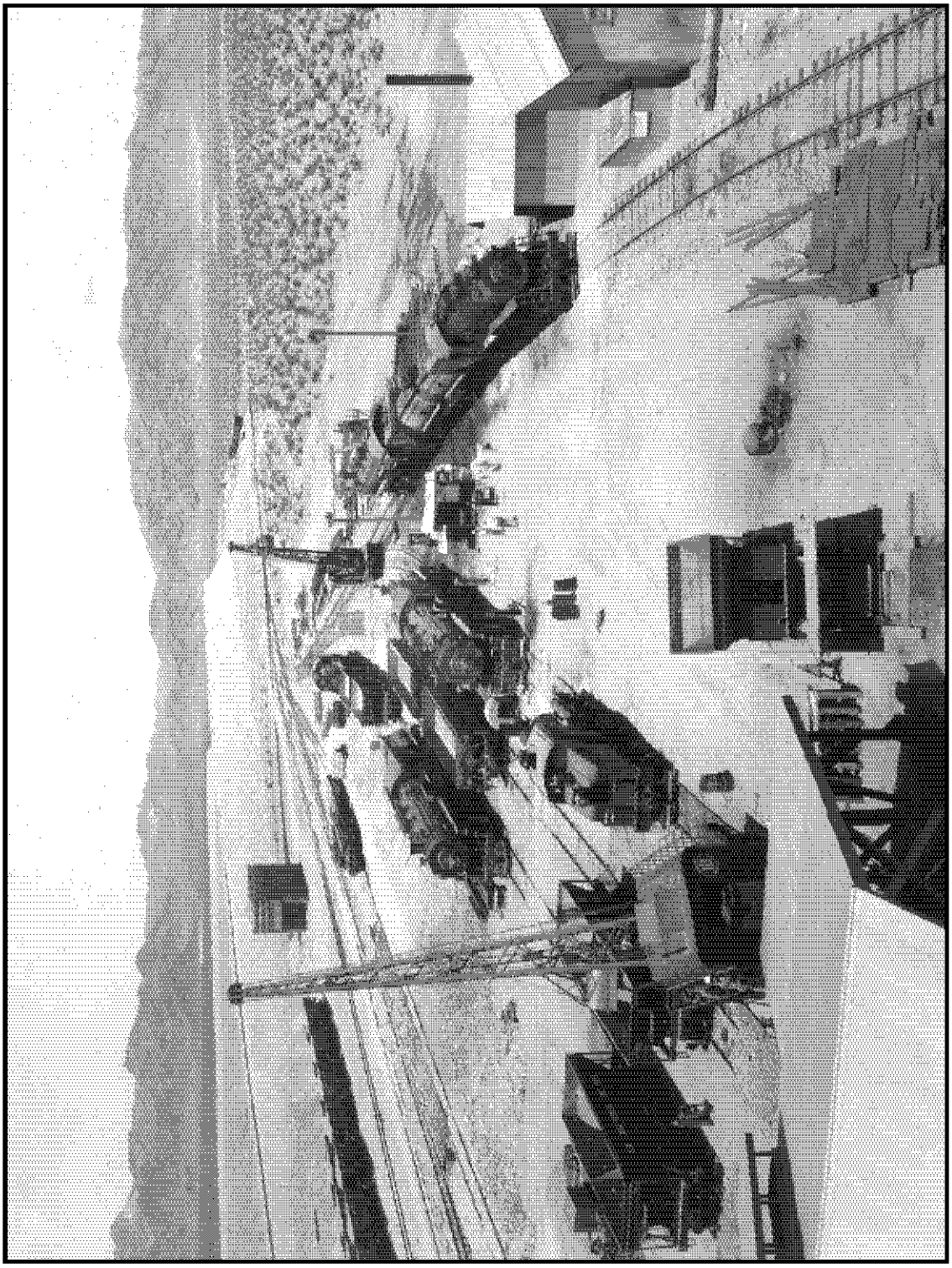
Work train on Six Companies Railroad (Shanahan Bros. Construction Co., subcontractors), 9/15/1931.
Courtesy of Bureau of Reclamation (Six Companies, Inc. photo PERM-No-814).



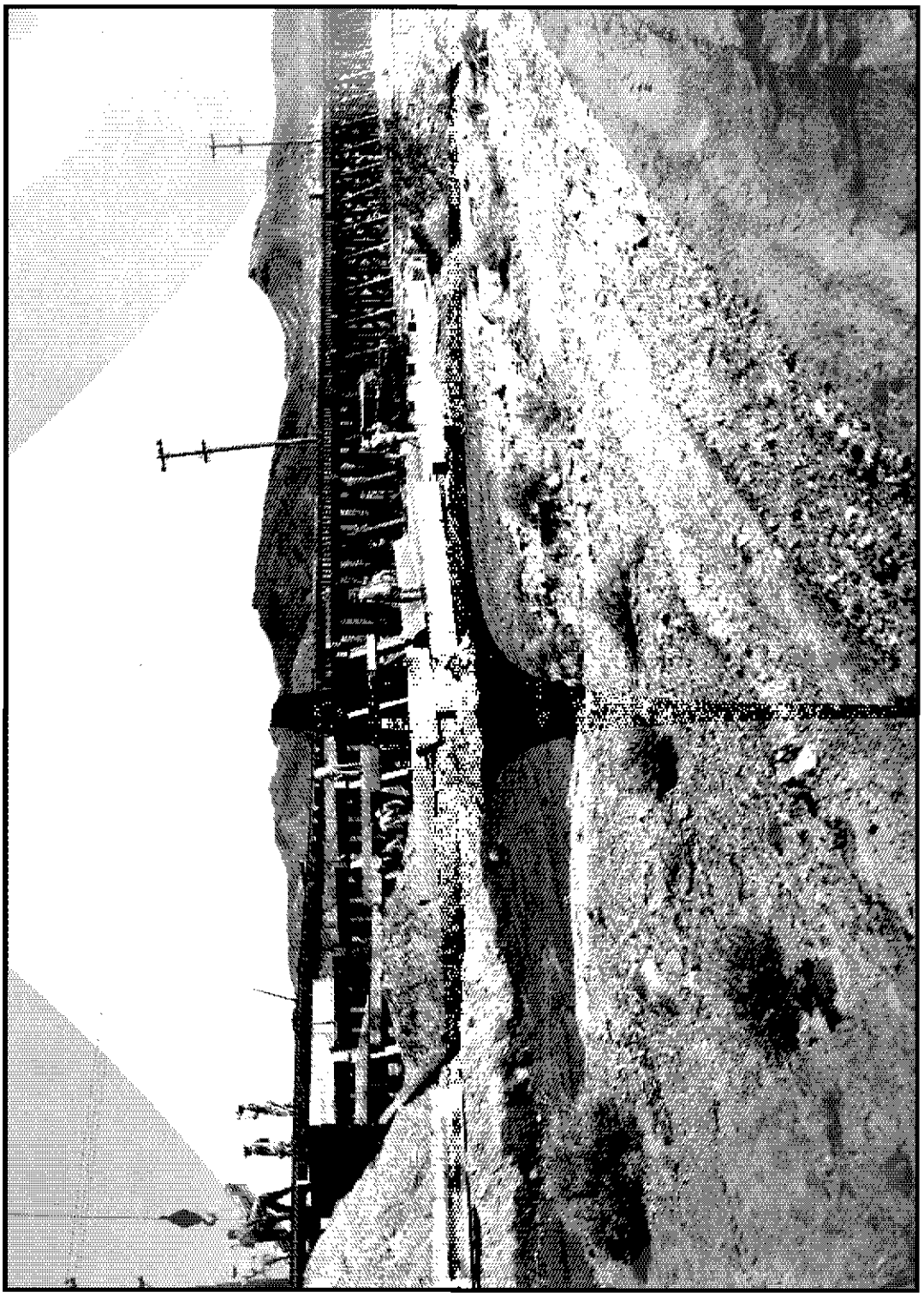
Laying rails on Six Companies Railroad (Shanahan Bros. Construction Co., subcontractors), 9/25/1931. Courtesy of Bureau of Reclamation (Six Companies, Inc. photo Perm-No-816).



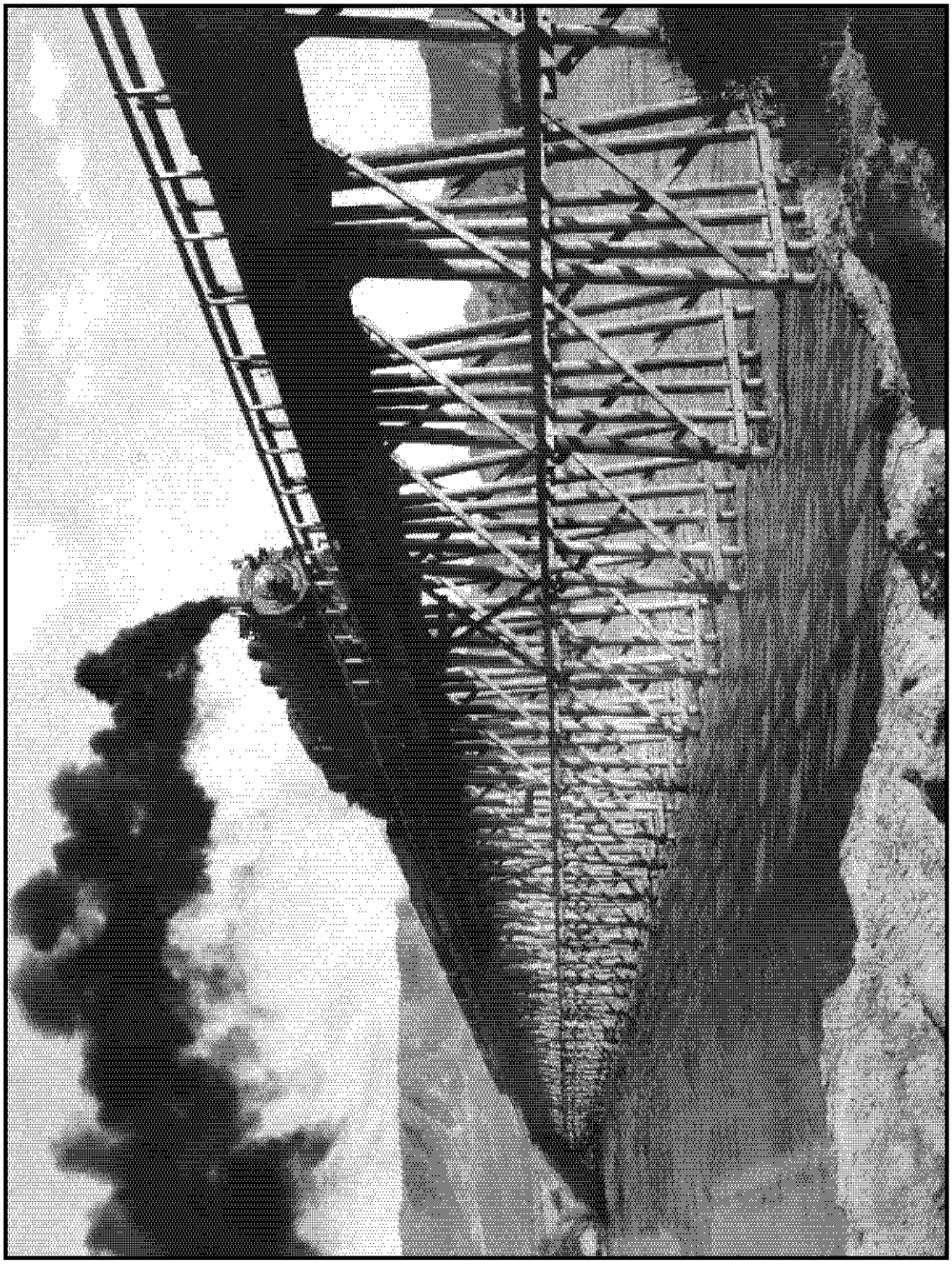
Ex-Mt. Tamalpais & Muir Woods Shay geared locomotive used as a switch engine in the Aggregate Classification Plant yards, 5/4/1932.
Courtesy of Bureau of Reclamation (Six Companies, Inc. photo 1146).



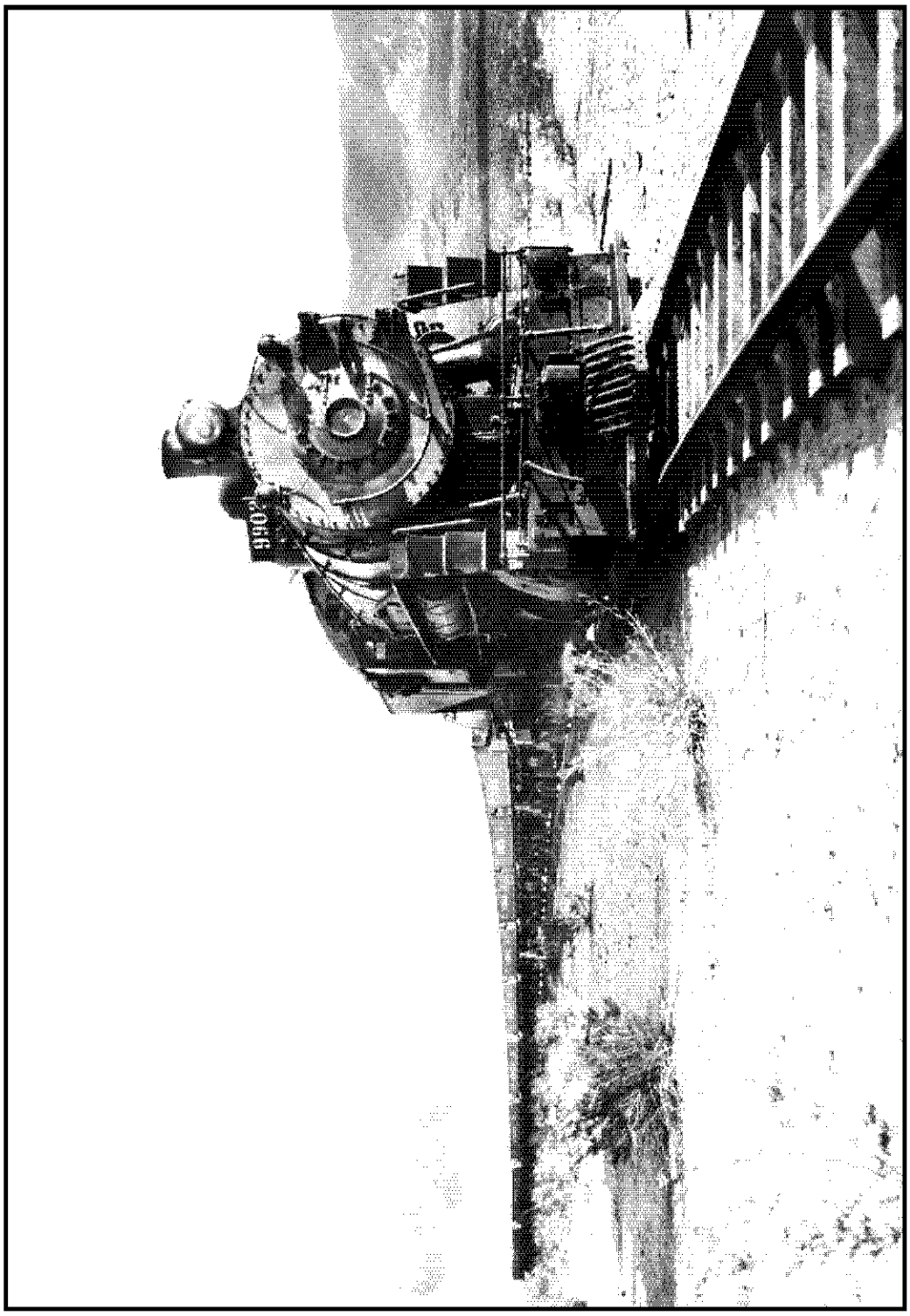
Looking north from the Aggregate Classification Plant crusher bin at the switchyard, 5/15/1932. Raw gravel storage piles are in the background. Courtesy of Bureau of Reclamation (Six Companies, Inc. photo 1192).



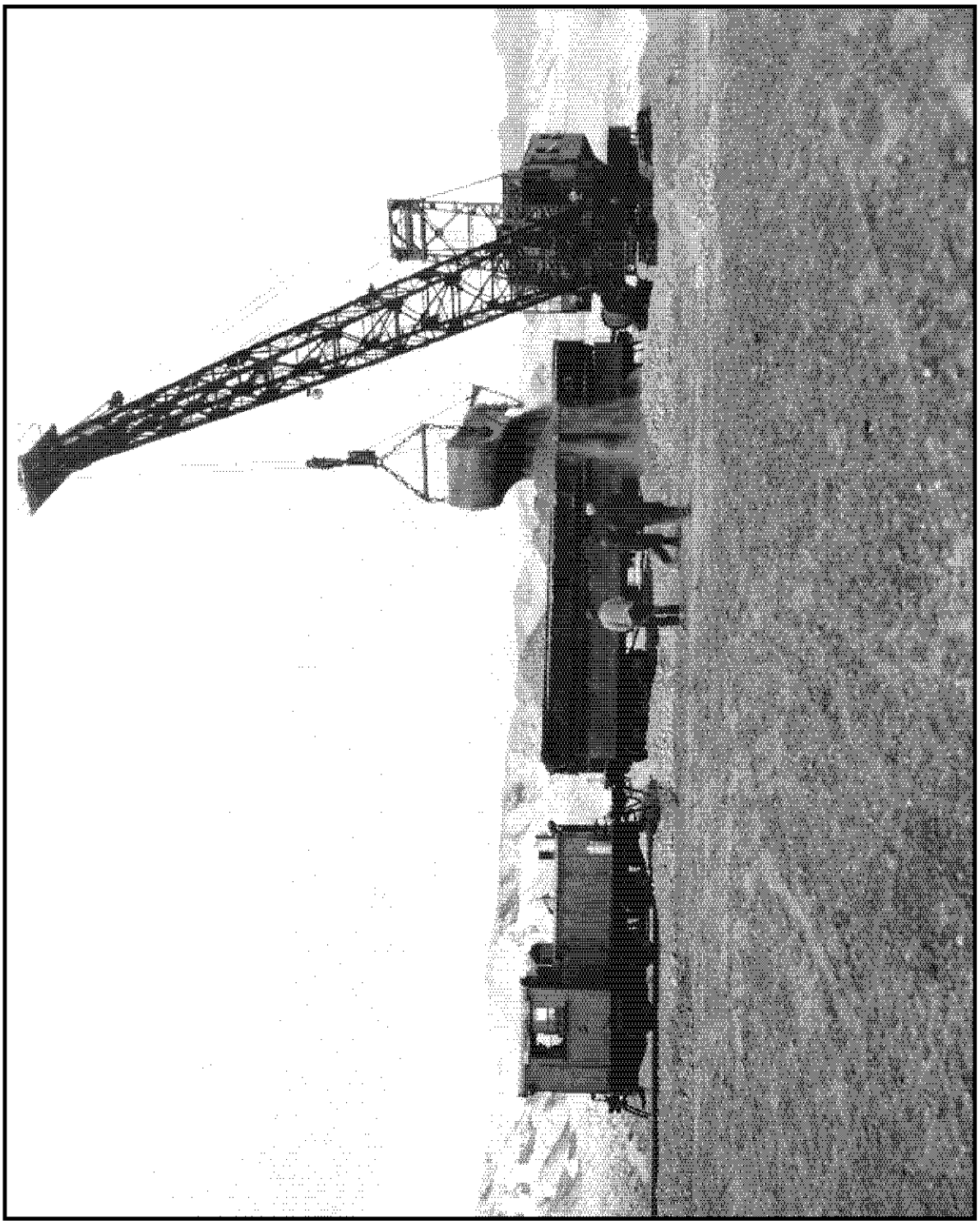
Workmen repair damage caused by cloudburst in Las Vegas Wash, 7/14/1932.
Courtesy of Bureau of Reclamation (Six Companies, Inc. photo 1307).



Ten car train of gravel crossing the 1140 ft trestle bridge and bound for the Aggregate Classification Plant, 5/15/1932. Courtesy of Bureau of Reclamation (Six Companies, Inc. photo 1144).



First train loaded with gravel leaving the Arizona Gravel Pit for the Aggregate Classification Plant, 2/10/1932. Courtesy of Bureau of Reclamation (Six Companies, Inc. photo 904).



Drag-line loading 30 cubic yard Western side-dump car, 2/10/1932. Plymouth gasoline locomotive switching. Courtesy of Bureau of Reclamation (Six Companies, Inc. photo 902).