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THE SOUTHERN PACIFIC AND THE GREAT SALT LAKE

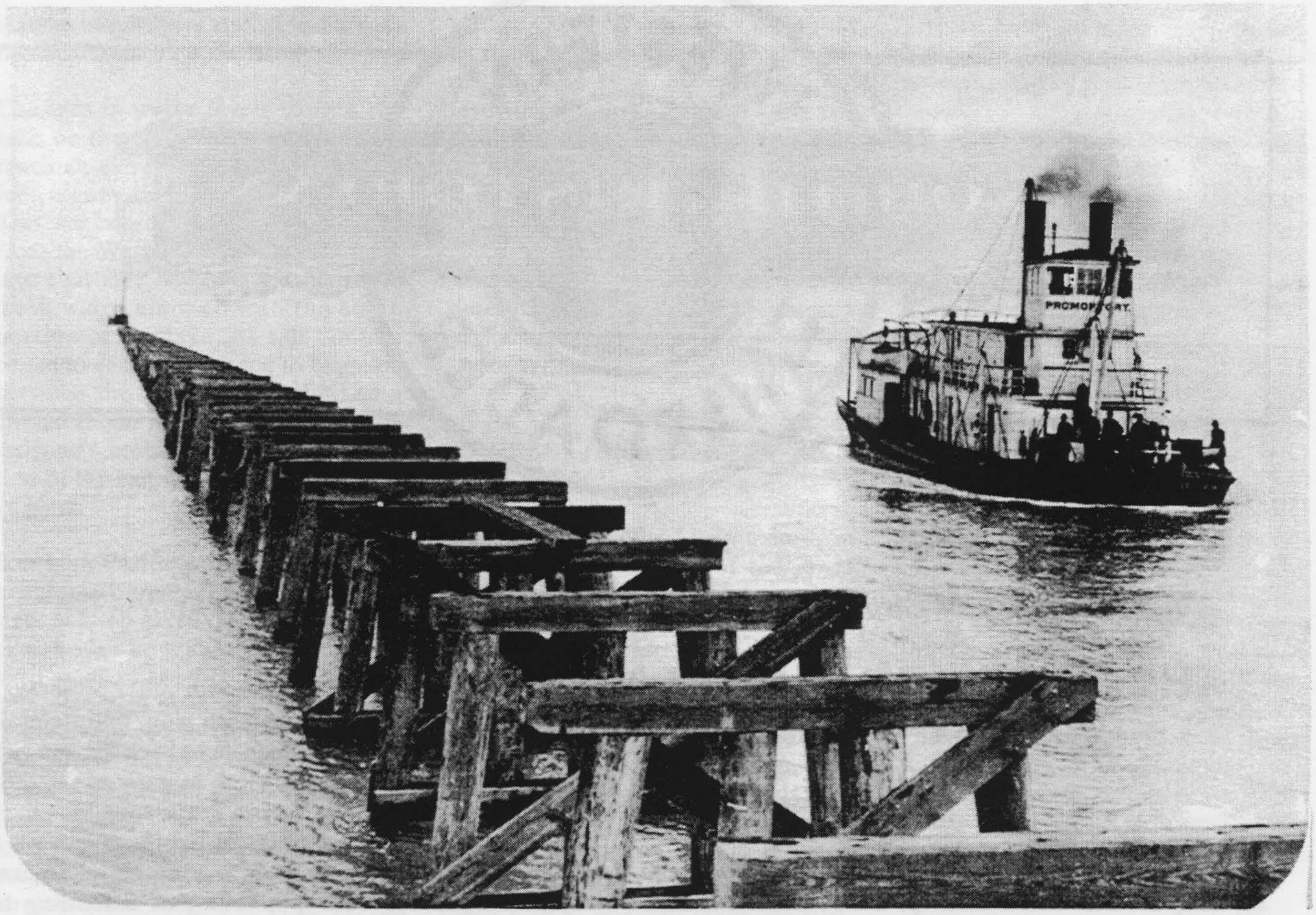
by
Lynn D. Farrar

Utah's Great Salt Lake, saltier than any body of water on earth except the Dead Sea, is a terminal lake with no outlet to the ocean. The Great Salt Lake lies within the Great Basin, and is currently about forty miles from east to west, and seventy-five miles from north to south, with an average depth of twenty-two feet. A small remnant of Lake Bonneville (named for Captain Bonneville who explored the region in the 1830s), it covered about 20,000 square miles in Utah, Nevada and Idaho during the most recent ice age. Lake Bonneville began to form some 26,000 years ago, and about 10,000 years later reached a peak of 1,000 feet above the current level of the Great Salt Lake.

A decline to the current lake level began approximately 11,000 years ago. When Mormon pioneers arrived in Utah in 1847, the surface of the lake was roughly 4,200 feet above sea level. Since that time it has fluctuated between a high of 4,215 feet in 1873 to a low of 4,194 feet in 1963. At the time of the construction of the Central Pacific Railroad in the late 1860's, engineers considered crossing the Great Salt Lake by means of a trestle, but because of rising water (very close to the levels of 1986(87), and an inability to drive the long pilings such a project would have required, a land route around the north end of the lake was chosen.

After 1873, the level of the lake began to decline, and by 1900, it had dropped nearly fifteen feet. During this period, it became clear to the management of the Central Pacific and its eventual parent, the Southern Pacific Company, that it had a rather inefficient route around the north end of the lake. As a result of hurried construction in an attempt to gain as much federal subsidy as possible, the Central Pacific avoided hills which could have been breached by tunnels or cuts, and canyons which could have been spanned by bridges. The subsidy had been in the form of government bonds, which had to be repaid. The railroad and the United States government, however, had been arguing over this repayment. When the bonds were repaid, it left the company with little money for other projects. Steel rails replaced iron, but maintenance just adequate to keep the line running. Nevertheless, as early as 1892, Southern Pacific President Collis P. Huntington instructed the company's Chief Engineer, William Hood, to examine the possibility of extending tracks across the lake. A financial panic the following year, however, laid these plans to rest, and only by the skin of its teeth did the railroad itself avoid bankruptcy.

Collis P. Huntington died in 1900, and financier Edward H. Harriman acquired his interest in the Southern Pacific and succeeded to its presidency. Harriman wanted his newly acquired railroad properties put in first class condition. In effect, he told Hood to build him the best railroad money could buy. Hood obliged. Beginning in 1901, the Central Pacific Railway (successor to the Central Pacific Railroad, and a subsidiary of the Southern Pacific) commenced a series of line changes between Reno, Nevada,and Ogden, Utah, the most important being a crossing of the Great Salt Lake. Harriman initially opposed this idea, but investigations of alternate routes, including one around the south end of the lake used by the Western Pacific Railway a few years later, convinced him of the benefits of



The sternwheeler *Promontory*, part of Southern Pacific's Great Salt Lake "fleet" steams alongside a temporary trestle during construction of the Lucien Cutoff. (*California State Railroad Museum, Sacramento.*)

a direct line from Lucin, west of the lake, to Ogden.

In June, 1902, the first trainloads of rails reached the lake. The following month came the wooden piles, many so long that three flat cars had to be coupled and chained together to carry them. In the meantime, the railroad began assembling a construction fleet, consisting of the sternwheel steamboat *Promontory*, seven tugboats and several smaller launches. These vessels carried supplies, crews and messages and floated logs to the construction site. They also corralled logs scattered by occasional fierce storms. In addition to regular maintenance, the boats had to be constantly docked and washed off with steam to remove salt buildups which corroded the machinery.

Construction began on August 21, 1902, and the lake came alive with over 3,000 men at work on the crossing. At night, electric lights illuminated the gravel pits so the project could continue on a twenty-four hour basis. Each day the pile drivers advanced, and each night the pit men loaded hundreds of cars of gravel. Work proceeded through the cold of winter and the heat of summer. There was no stopping this army at work in a salt desert, even though all supplies, including some 1,680 tons of fresh water a day, had to be brought by train from points up to 130 miles away.

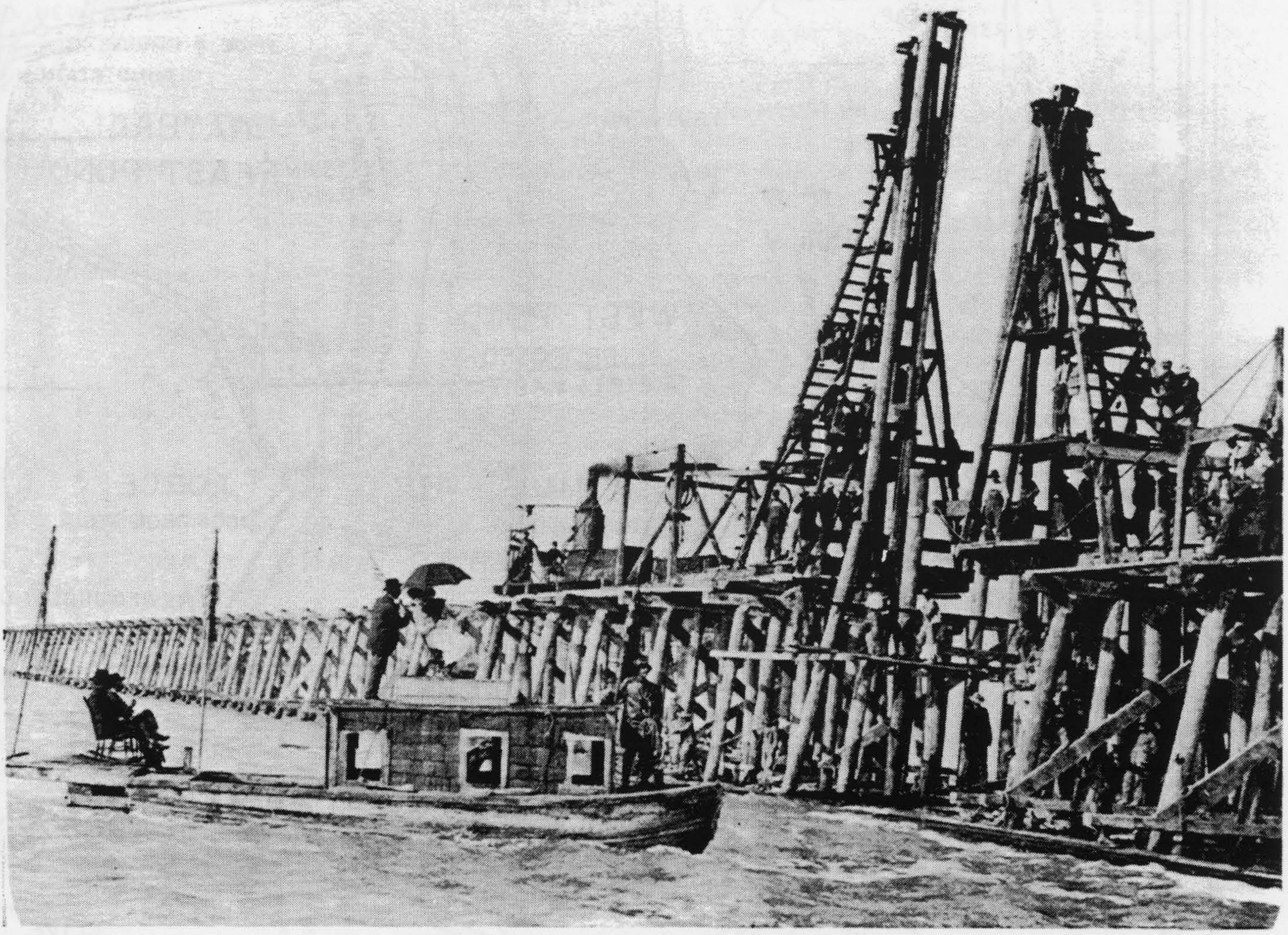
In all, 38,256 trees fell to make piles for the great trestle. A forest of two square miles was transplanted into the Great Salt Lake. Placed end to end, the pilings would have reached from Chicago to Buffalo. Every fifteen feet, five piles in a row were driven crosswise to the track. Heavy timbers, four to eight inches thick, fastened them together. Across their tops, workmen placed beams eighteen feet long and a foot square. Connecting these beams with the next set of piles were eleven timbers (called stringers) laid lengthwise with the track. Above the stringers, a plank floor three inches thick received a thick coat of asphalt and a foot or more of rock ballast on which the ties and rails would be laid. The floor of the trestle was sixteen feet wide, and the grade from Lucin to Ogden varied only five inches to the hundred feet.

The last pile on the trestle was driven on October 26, 1903, and eighteen days later, rails from the east and west met at Midlake. Of course, signals and water, fuel, maintenance of way and other facilities still had to be installed. It would not be until March 8, 1904, almost two years since the start of construction, that the line opened to through traffic. The cutoff extended across the northern arms of the Great Salt Lake, shortening the Southern Pacific's Overland Route by 43.5 miles. Seventy two miles of new track were laid on land, with the line across the lake consisting of seventeen miles of rock fills, five miles of track on land at Promontory Point and twelve miles of trestles. The new line had cost, together with track, signals, etc., $8.9 million. It was estimated that with ten trains per day each way, the Lucin Cutoff, as the trestle and its approaches were called, would produce savings of $214,000 annually. Had the $8.9 million been invested at the prevailing four percent interest rate, however, it would have earned $356,000 a year. It is evident, therefore, that speed and efficiency of operation, not rate of return, had influenced Harriman's plans.

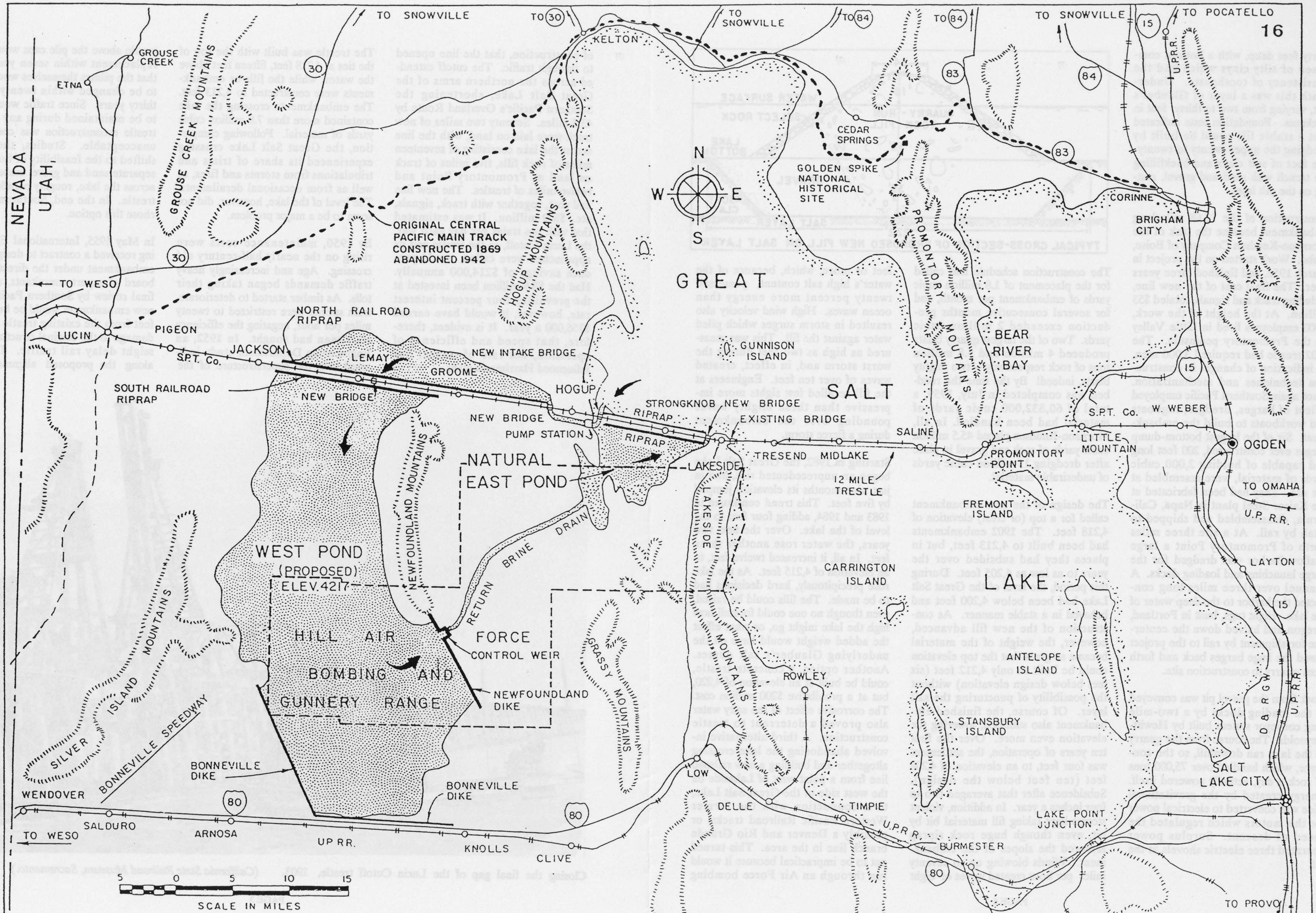
The trestle was built with the top of the ties at 4,218 feet, fifteen feet above the water, while the fills or embankments were constructed to 4,213 feet. The embankments crossing the lake contained more than 7.8 million cubic yards of material. Following completion, the Great Salt Lake crossing experienced its share of trials and tribulations from storms and fires, as well as from occasional derailments. The level of the lake, however, did not seem to be a major problem.

By 1950, maintenance costs were rising on the nearly half-century old crossing. Age and increasingly heavy traffic demands began taking their tolls. As timber started to deteriorate, train speeds were restricted to twenty miles per hour, negating the efficiency Harriman had sought. In 1952, an Engineering Department study indicated that the superstructure of the trestle above the pile caps would need replacement within seven years, and that the pilings themselves would need to be changed within twenty-five to thirty years. Since traffic would need to be maintained during any repairs, trestle reconstruction was considered unacceptable. Studies, therefore, shifted to the feasibility of building a separate sand and gravel embankment across the lake, roughly parallel to the trestle. In the end, Southern Pacific chose this option.

In May 1955, International Engineering received a contract to design a new embankment under the direction of a board of expert consultants, and with final review by Southern Pacific. The new embankment would be built 1,500 feet from the existing trestle to avoid damage to the original structure which might delay rail traffic. The lake along the proposed alignment was



Closing the final gap of the Lucin Cutoff trestle, 1903. *(California State Railroad Museum, Sacramento.)*


16
TO SNOWVILLE
TO 30
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TO 84
TO SNOWVILLE
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15
15
KELTON
GROUSE CREEK
ETNA
TO WESO
GROUSE CREEK MOUNTAINS
NEVADA
UTAH
ORIGINAL CENTRAL PACIFIC MAIN TRACK CONSTRUCTED 1869 ABANDONED 1942
HOGUP MOUNTAINS
CEDAR SPRINGS
GOLDEN SPIKE NATIONAL HISTORICAL SITE
N
S
E
W
PROMONTORY MOUNTAINS
CORINNE
BRIGHAM CITY
U.P.R.R.
GREAT
SALT
LAKE
NORTH RIPRAP
RAILROAD
LUCIN
PIGEON
JACKSON
S.P.T. Co.
LEMAY
GROOME
NEW INTAKE BRIDGE
GUNNISON ISLAND
BEAR RIVER BAY
SOUTH RAILROAD RIPRAP
NEW BRIDGE
HOGUP
STRONGKNOB
NEW BRIDGE
RIPRAP
EXISTING BRIDGE
RIPRAP
NEW BRIDGE
PUMP STATION
SALINE
TRESEND
MIDLAKE
LITTLE MOUNTAIN
S.P.T. Co.
W. WEBER
OGDEN
NATURAL EAST POND
LAKESIDE
PROMONTORY POINT
12 MILE TRESTLE
TO OMAHA
U.P. R.R.
FREMONT ISLAND
NEWFOUNDLAND MOUNTAINS
LAKESIDE MOUNTAINS
RETURN BRINE DRAIN
WEST POND (PROPOSED) ELEV. 4217
CARRINGTON ISLAND
LAYTON
SILVER ISLAND MOUNTAINS
HILL AIR FORCE BOMBING AND GUNNERY RANGE
CONTROL WEIR
GRASSY MOUNTAINS
ROWLEY
ANTELOPE ISLAND
NEWFOUNDLAND DIKE
STANSBURY ISLAND
BONNEVILLE SPEEDWAY
BONNEVILLE DIKE
BONNEVILLE DIKE
SALT LAKE CITY
LOW
D&RGW
U.P.R.R.
WENDOVER
SALDURO
ARNOSA
DELLE
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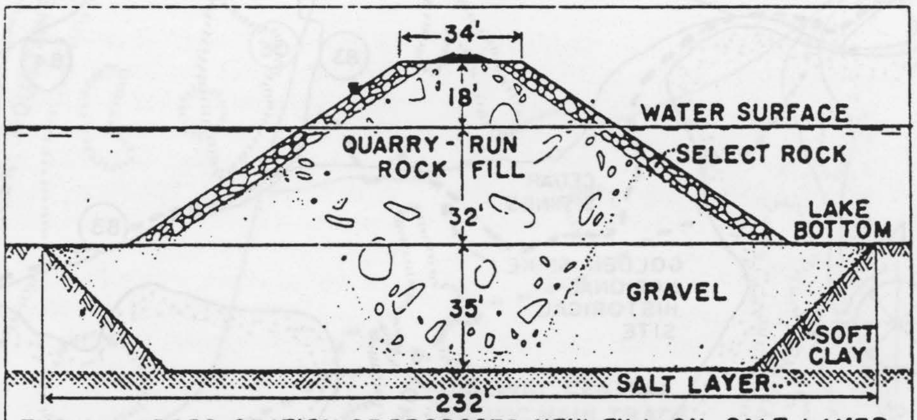
thirty feet deep, with a bottom composed of silty clays which had the consistency of toothpaste. Underneath this was a layer of Glauber's salt, varying from two to thirty feet in thickness. Foundation tests indicated that a stable fill could be built by dredging the upper twenty to twenty-five feet of soft clays and backfilling the trench with sand and gravel, resting on the salt layer.



TYPICAL CROSS-SECTION OF PROPOSED NEW FILL ON SALT LAYER

Construction of the 12.68 mile-long embankment became the task of the Morrison-Knudsen Company of Boise, Idaho. Work started on the project in March 1956, and finished three years later. The final cost of the new line, including track and signals, totaled $53 million. At the height of the work, 1,300 employees lived in Little Valley on the Promontory peninsula. The 1902 trestle had required 3,000 men, an indication of changes in construction techniques and mechanization. Once again Southern Pacific employed a fleet of barges, dredges, tugboats and workboats to build the embankment. Six of the largest bottom-dump barges ever constructed, 200 feet long and capable of holding 2,000 cubic yards of material, were assembled at the site. They had been fabricated at the Kaiser Steel plant in Napa, California, disassembled and shipped to Utah by rail. At a site three miles north of Promontory Point a large shallow harbor was dredged for the barge launching and loading docks. A channel over three miles long connected the harbor to the deep water of the lake. Eight tugs, built in Portland, Oregon and halved down the centerline for shipment by rail to the project towed the huge barges back and forth from quarry to construction site.

Rock from the gravel pit was conveyed to the loading docks by a two-mile long conveyor system built by Hewitt-Reynolds. The course from the quarry to the lake ran downhill, so the conveyor, which handled over 75,000 tons of rock a day, actually powered itself. Energy created by the gravitational glide was converted to electrical power for the motors which regulated the speed of descent. Surplus power operated three electric shovels at the pit.

The construction schedule had called for the placement of 1.8 million cubic yards of embankment per month, and for several consecutive months production exceeded 2 million cubic yards. Two of the largest quarry blasts produced 4 million and 5.8 million tons of rock respectively -- two mighty blasts, indeed! By the time the roadbed was completed in July, 1959, a total of 60,832,000 cubic yards of material had been handled. In all, Morrison-Knudsen placed 45.5 million cubic yards of rock and gravel in place after dredging 15 million cubic yards of undesirable material.

The design of the new embankment called for a top (or crest) elevation of 4,218 feet. The 1902 embankments had been built to 4,213 feet, but in places they had subsided over the years to as low as 4,205 feet. During this period, the level of the Great Salt Lake had been below 4,200 feet and behaved in a stable manner. As construction of the new fill advanced, however, the weight of the material became so great that the top elevation could be built to only 4,212 feet (six feet below design elevation) without the possibility of puncturing the salt layer. Of course, the finished embankment also subsided, lowering the elevation even more. Over the first ten years of operation, the settlement was four feet, to an elevation of 4,208 feet (ten feet below the design). Subsidence after that averaged two to four inches a year. In addition, violent storms kept taking fill material bit by bit, even though huge rock riprap armored the slopes of the embankment. Winds blowing up to seventy miles per hour created waves of eight feet or more, which, because of the water's high salt content, possessed twenty percent more energy than ocean waves. High wind velocity also resulted in storm surges which piled water against the fill. This was measured as high as two feet during the worst storm and, in effect, created waves of over ten feet. Engineers at the fill recalled few sights more impressive than these mighty waves pounding over the embankment during a fierce storm.

Starting in 1982, the Great Salt Lake began an unprecedented rise, and in just nine months its elevation jumped by five feet. This trend continued in 1983 and 1984, adding four feet to the level of the lake. Over the next two years, the water rose another three feet. In all, it increased twelve feet, to an elevation of 4,215 feet. As the lake rose precipitously, hard decisions had to be made. The fills could be raised, even though no one could foretell how high the lake might go, or what effect the added weight would have on the underlying Glauber's salt domes. Another option, a concrete trestle, could be built at an elevation of 4,220, but at a prohibitive $200 million cost. The corrosive effect of the salty water also proved a deterrent to trestle construction. A third alternative involved abandoning the lake crossing altogether and building a new railroad line from a point west of Lakeside on the west side of the Great Salt Lake, to a connection with the former Western Pacific Railroad tracks, or possibly a Denver and Rio Grande branch line in the area. This turned out to be impractical because it would run through an Air Force bombing range. With the lake in an uncooperative mood, the environmental and bureaucratic problems were considered to be too time consuming.

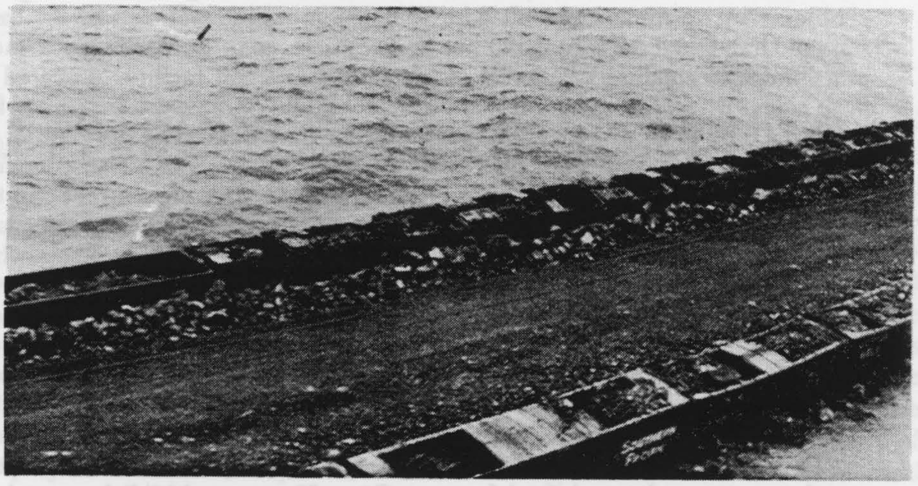
As the planners and engineers weighed the options, however, the lake continued to rise and spread. The fills which needed protection increased accordingly. By 1987, the thirty miles of fills to protect had doubled.

When the decision was reached to increase the height of the existing fills, the railroad found itself able to reactivate the quarry at Lakeside which had served in the 1902 and 1956 projects. Southern Pacific located permanent train crews and engineering teams at the quarry. A small community, not unlike those eight decades earlier, came into existence. Rock blasted from the Lakeside quarry was sorted into three sizes. The largest, over three feet in size, would serve as armor, or riprap. Mid-size rock of from one to three feet was used as an underlayer for the riprap, and rocks of less than one foot became part of the embankment's inner fill material, or were crushed for ballast.

As the lake rose rapidly in 1983, a struggle to protect the existing embankment's vulnerable north side developed. A quick fix in the form of the "boxcar seawall" was offered. Old hopper cars and boxcars, most with their tops removed were placed on the edge of the embankment and filled with rock. This barrier, it was hoped, would buy time for more raising. The cars are difficult to see today, having been buried by subsequent raises of the embankment. When first installed, however, they towered above the level of the fill.

With the lake lapping at just below grade level, any storms with winds proved devastating. Dense waves literally lifted the riprap from the sides of the embankment and placed it on the track. After severe storms, the track looked like a meandering strand of spaghetti. Sometimes track floated away from the crest of the fill, ripping the ties from the rails. The Southern Pacific's struggle to keep the line open and operating was dauntless, but occasionally nature won. On such in-

A passenger train crossing the 1903 trestle. *From a postcard in the collection of Dennis Beeghley.*



The "boxcar seawall" protecting Southern Pacific tracks across the Great Salt Lake during the high water of the 1980s. *Lynn Farrar photo.*

Southern Pacific track showing the three sizes of rock used to protect the fill. *Lynn Farrar photo.*

stances, dispatchers routed trains over the old Western Pacific line.

Changes in water levels caused the lake on the south side of the fill to reach an elevation three and one-half feet higher than that on the north. This was because more major streams from the Wasatch Mountains emptied into that side of the lake. As more fresh water emptied into the south portion of the lake, its salt content began to decline. This led to litigation between the Southern Pacific and a chemical company which blamed the railroad's embankment for the dilution of the salt water and flooding of its plant.

Southern Pacific won the suit, but its problems by no means ended. The state of Utah asked the railroad to put in a bridge to equalize lake levels on both sides of the fill. The company complied, and in short order the difference dropped to only eight inches. The Utah Division of Water Resources also began feasibility studies of permanently controlling the lake level. Alternatives included diking low areas around the lake, diverting upstream water, and pumping excess water into a natural basin west of the lake. This last option was selected. When put in operation, the pumps worked as planned, but because weather patterns have shifted from flood to drought, the pumps have not been needed.

What has the fight against the Great Salt Lake cost the Southern Pacific since 1982? To date, the rock work, track repairs, bridges, participation in the pumping plant and other expenses have totaled $80 million. In addition, there are unknown future costs for stabilizing the 1950s fill and restoring dikes once water levels drop to levels anticipated by long range weather forecasts.

This has been a rather quick review of the Great Salt Lake and its railroad history. Many stories have been told by those who worked on the projects of 1902 and 1956, but the author's favorites are those coming from the heroic battles of 1982 through 1987. Second guessers will always have a field day with the decisions made in the 1980's. Through it all, however, the Southern Pacific and its employees demonstrated the same spirit and determination which over a century earlier had overcome the Sierra and spanned the Southwest deserts.

* * *

Midlake, A Railroad at your Front Door

Construction of the Lucin Cutoff, in addition to being one of the great engineering achievements of the early twentieth century, produced a most unique railroad facility. Located in the middle of the western arm of the Great Salt Lake was the hamlet of Midlake, a town with a transcontinental railroad as its main street and the world's second largest salt water lake as its backyard. Midlake began when trestle construction started in 1902. Temporary camps for the workers were built at intervals along the trestle, and one of them, Camp 23, was located at the later site of Midlake. While the other camps disappeared with the completion of the trestle, Camp 23, renamed Midlake, remained as a train order station and maintenance of way facility. The town itself had a row of houses set on a platform atop the pilings. The platform area was about eighty yards long and forty feet wide. The single track mainline fanned out to three tracks through Midlake, with a siding and spur. The buildings consisted of the train order office, housing for its three telegraphers and their families, housing for section crews and tool storage. The population fluctuated, at one time reaching thirty. There were no stores, no post office, no police department, no jail, and, of course, no tax burdens. Groceries, newspapers, and mail arrived daily by train from Ogden. Educational and medical services had to be reached by similar conveyance.

Midlake operated for forty-one years, but the elimination of the semaphore block signals and installation of Centralized Traffic Control in April 1945 forced closure of the train order office. Its three telegraphers, all women, were transferred immediately. By August, the section crews and buildings had been relocated to Promontory Point where the structures served as living quarters for maintenance of way employees.

* * *

Going to Sea by Rail

From the time of its completion, the Great Salt Lake crossing served as a tourist attraction along Southern Pacific's Overland and Ogden Routes. Brochures pointed out the novelties of "Going to Sea by Rail" Midlake station was featured in illustrations, and evening scenes of solitary trains on the trestle, surrounded by waters of the Great Salt Lake, graced many of the railroad's promotional releases.

* * *

Sources

Much of the information presented in this essay is based upon the author's personal experiences during his employment with the Southern Pacific. Other sources include Guy L. Dunscomb, *A Century of Southern Pacific Steam Locomotives* (Modesto: Guy L. Dunscomb Publications, 1962); Don L. Hofsommer, *The Southern Pacific, 1901-1985* (College Station: Texas A&M University Press, 1986); Southern Pacific Transportation Company, "Welcome to the Great Salt Lake," (1987); Southern Pacific Railroad, "Great Salt Lake Cut-Off," (1921); "Farewell to Midlake," *Southern Pacific Bulletin*, (September, 1945); and "Salt Lake Fill," *Western Railroader*, No. 207 (January, 1957).

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