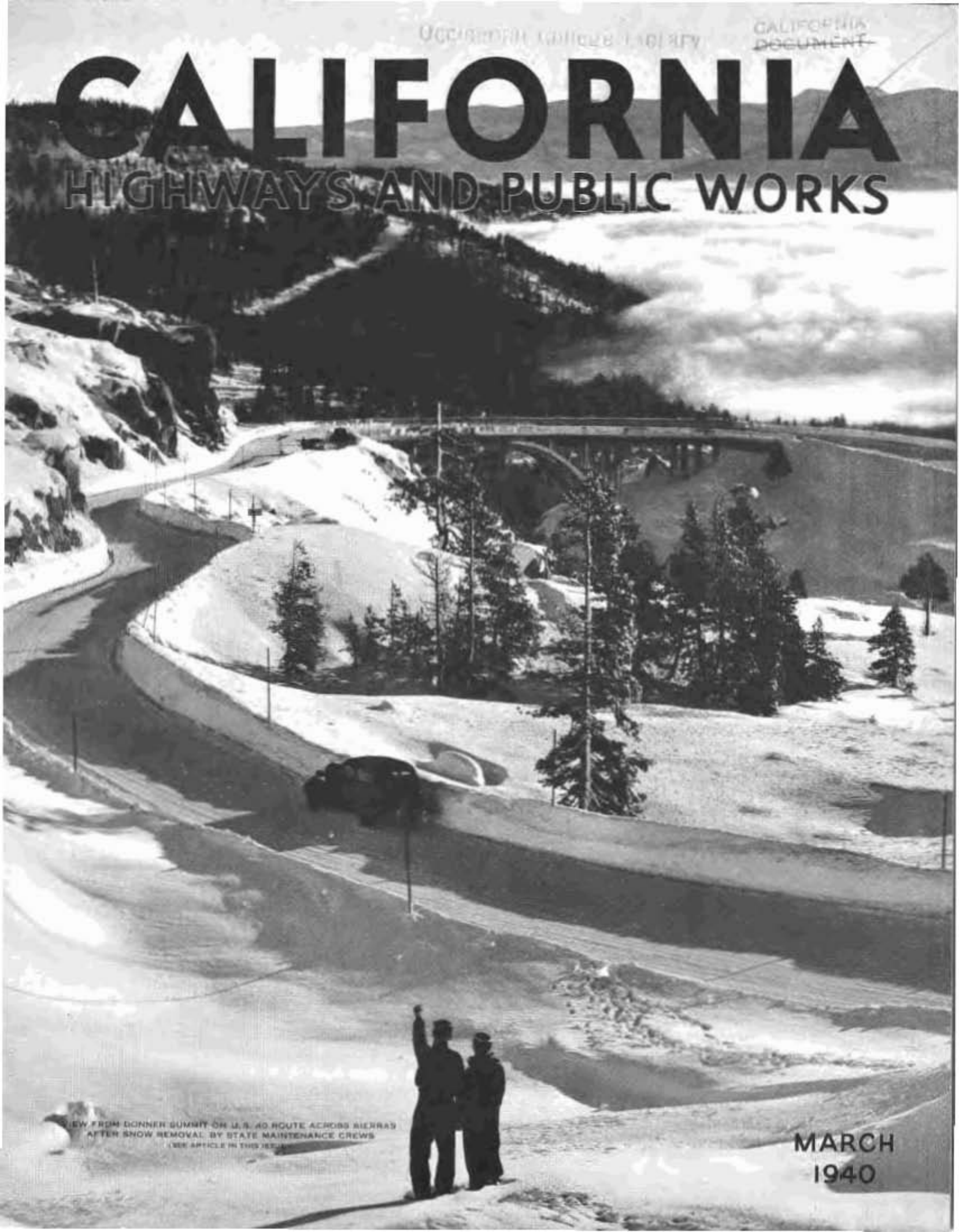
CALIFORNIA

HIGHWAYS AND PUBLIC WORKS



VIEW FROM DONNER SUMMIT ON U.S. 40 ROUTE ACROSS SIERRAS AFTER SNOW REMOVAL BY STATE MAINTENANCE CREWS
(SEE ARTICLE IN THIS ISSUE)

MARCH
1940

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways of the Department of Public Works, State of California

FRANK W. CLARK, Director C. H. PURCELL, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

Published for information of the members of the department and the citizens of California

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Address communications to California Highways and Public Works, P. O. Box 1499, Sacramento, California

Vol. 18 MARCH, 1940 No. 3

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Flood waters of Sacramento River pour through break in levee north of Colusa.

Storm Damage $16,000,000

RAIN storms, which in some sections attained cloudburst proportions, wrought havoc to highways, levees and rich agricultural lands in northern California during the period February 25 to 29 and caused damage variously estimated at from $14,000,000 to $16,000,000.

When it became evident that the torrential downpours in the Sacramento Valley had created a catastrophe of major magnitude, Governor Culbert L. Olson took personal command of the situation, mobilizing forces of the Department of Public Works, National Guard, Highway Patrol, State Department of Public Health and other State agencies for relief work, the evacuation of flood refugees, protection of the levee systems on the Sacramento, Feather, American and Eel Rivers and other waterways and for the prevention of epidemics among thousands of persons made homeless by raging waters.

The Governor requested and obtained from Washington W. P. A. emergency relief funds totaling $130,000; ordered the National Guard out in Yolo County to rescue several hundred stranded migrants in the vicinity of Winters and provide them with housing, food and clothing at the State Fair Grounds in Sacramento; directed the Division of Water Resources to assign 650 W. P. A. employees to levee patrol duty to augment State and Federal forces engaged in this work; sent doctors, nurses and sanitary engineers of the Department of Health into flooded areas where water for domestic use had become polluted to guard against disease and appointed an Emergency Council to study requests for assistance from flood-stricken communities to make immediate use of $1,129,000 of State Emergency Fund monies made available under the Governor's Proclamation (see page 3) that a state of emergency exists.

Director of Public Works Frank W. Clark flung the maintenance crews of the Division of Highways and the entire force of the Division of Water Resources into the battle with the elements. Men of the Maintenance Department in five northern California Highway Districts labored night and day during the storm period with only a few hours time out for sleep. Some crews worked for twenty-four hours and thirty-six hours at a stretch.

As this magazine goes to press, twenty-five northern California counties, including the great Sacramento Valley and the rich Delta lands of San Joaquin are emerging from the disaster and counting the toll of their losses.

Highway Damage Totals $1,267,200

IN FIVE northern California Highway Districts, flood damage to State highways and bridges during the storms of February 25 to 29 amounted to $1,267,200 as nearly as can be estimated at this time by Director of Public Works Frank W. Clark.

The damage was concentrated in the twenty-five northwesterly counties. It was particularly severe in the upper and central portions of the Sacramento Valley and was occasioned by waters which surged over banks and levees of the Sacramento, Feather, American, Eel, Trinity and Russian rivers and their tributaries, Cache and Putah creeks in Yolo County and by-passes in Sutter and Colusa counties and by landslides and slip outs.

The entire Peninsula area south of San Francisco also suffered considerably.

The severity of the storm is indicated by data from the records of the Sacramento office of the United States

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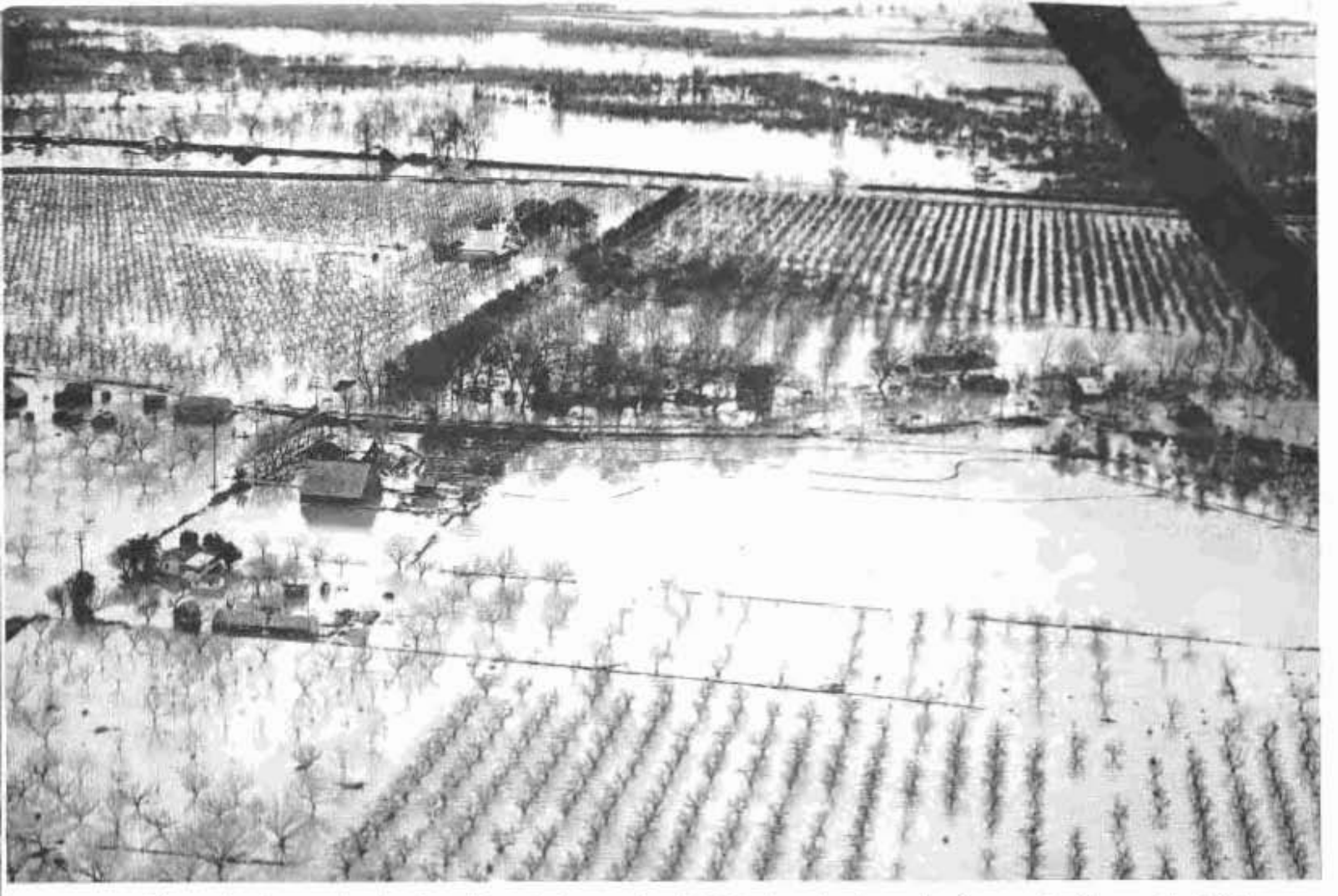
Flood Waters Cover 500,000 Acres

FOUR days of torrential rains, beginning on February 25th sent the rivers of Northern California out of their banks, flooding approximately 275,000 acres of farm land and 225,000 acres of by-pass and overflow areas in the Sacramento Valley causing damages to levees estimated at $500,000. Estimates of the total damage to crops and property range variously from $10,000,000 to $16,000,000. Until complete surveys have been made accurate estimates of the total storm damage are impossible.

Beginning with moderately heavy rains, the storm increased in intensity until February 27th when the heaviest rainfall figures were recorded. The full force of the storm centered in the Sierra Nevada along the watershed of the Yuba, Feather and Sacramento rivers. Heavy rainfalls were also recorded along the north coast. South of the American River watershed the storm raged



Thousands of acres of orchards and farm lands were inundated by levee breaks on the Sacramento River north of Colusa.

in short torrential downpours of cloudburst proportions.

As the intensity of the storm increased and it became evident an emergency was imminent, every available engineer in the State Division of Water Resources was assigned to the direction of emergency repair crews, river patrol work and stream gauging. State Engineer Edward Hyatt obtained the services of 650 W.P.A. workers for emergency work on levees and patrol work. In addition hundreds of others volunteered for patrol duty and aided in sandbagging weakening levees.

SACRAMENTO RIVER ON RAMPAGE

Chief destructionist of the storm was the mighty Sacramento River which went on a rampage of record proportions. As the crest of the flood waters swept southward, new high water records were set by the Sacramento at all points from Kennett to Knights Landing where the by-pass system took the brunt of the burden.

The four days of rains, the heaviest of which struck the watershed above Kennett, where Shasta Dam is now under construction, sent the Sacramento River stage to 36.3 feet at the Kennett gauge of the United States Weather Bureau. This is 3.1 feet above the highest stage ever recorded by the bureau at that point, which was in 1907, when the gauge recorded 33.2 feet, and 7.3 feet above the 29-foot crest at Kennett in the 1937 flood.

First city to feel the full force of the raging river was Redding, where 500 people were forced to flee from homes in the low-lying sections in the outskirts of the city. The city filtration plant was temporarily put out of commission, the new Southern Pacific railroad bridge and highway bridges leading into the city damaged, and portions of Anderson-Cottonwood Irrigation Canal washed out.

In the Sacramento River canyon between Redding and Dunsmuir slides on the Southern Pacific right-of-way blocked rail traffic until March 5th.

FARM LANDS INUNDATED

As the crest of the flood surged southward it broke through levees inundating many thousands of acres of fertile farm lands, driving hundreds from their homes, drowning stock that was caught in the lowlands and wreaking general havoc. It is estimated that 6,000 people were forced to flee from their homes.

However, not all of the damage came from the Sacramento River. Orland and Hamilton City were caught in the overflow of Stony Creek and flooded. The water following the main highway into Orland spread out through the residential and business district. Families west of Orland were evacuated in boats. The water reached a depth of eight feet in parts of that area.

On the east side of the Sacramento River, Mill and Deer Creeks left their banks flooding large areas of wheat lands adjoining the Sacramento Highway, traffic on 99E was completely cut off at Vina for three days. Below Chico flood waters from Butte Creek and from Feather River overflow above Honcut spread out over hundreds of acres of land and the highway from Durham south to Biggs was under water most of the distance. Butte Creek also fanned out into the Butte Basin.

MIGRANTS DRIVEN OUT

At Marysville, the swollen Yuba River drove 450 migrants from a government migrant camp located in the river bottom. The Feather River effectively blocked rail traffic on the Southern Pacific when the water poured over the railroad bridge between Marysville and Yuba City.

There were sixteen breaks in the Sacramento River levees above Princeton—five on the east side and eleven on the west side. All of the breaks were in levees which were below standard either as to grade section or both, and are scheduled for completion under the project construction program.

Water from the breaks on the east side of the river went into the Butte Basin, isolating Butte City although there was no damage in the town. Much of the land in the Butte Basin is devoted to gun clubs and grazing lands. The state owns flowage rights through the basin and comparatively little crop damage is anticipated. Some rice and grain lands were inundated along Butte Creek.

On the west side of the river the eleven breaks in the levees flooded many thousands of acres and isolated the towns of Princeton and Colusa. The waters fanned out in another al-

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Proclamation

WHEREAS, extraordinary floods have occurred on the Sacramento River and its tributaries, inundating populated areas and thousands of acres of highly developed farm lands and forcing hundreds of families from their homes; and

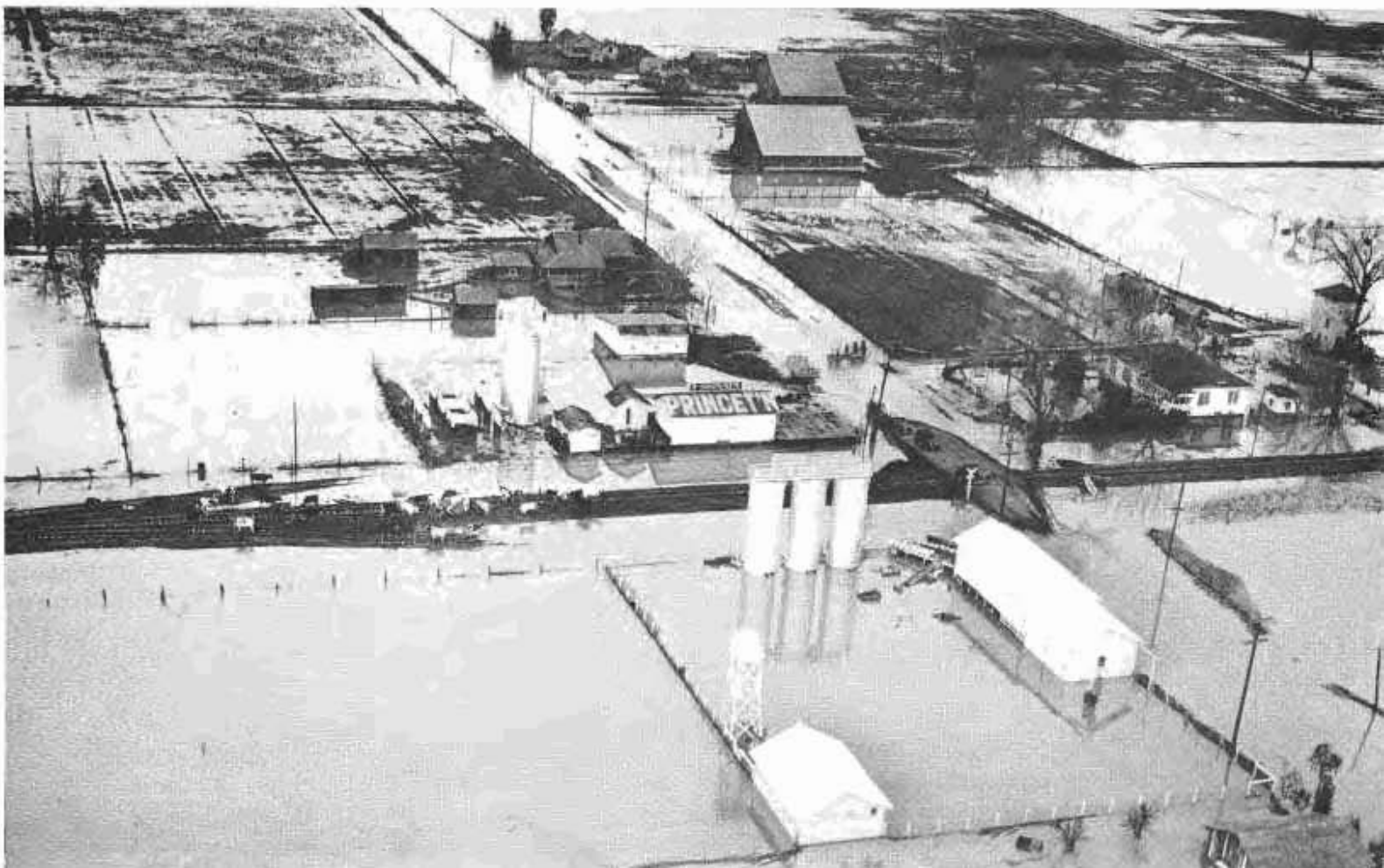
WHEREAS, there are many breaks in the levees protecting said areas; and

WHEREAS, unless said levees are repaired the normal spring freshets and melting snows will raise the rivers and streams in the Sacramento River basin and cause water to flow out through these levee breaks and further inundate parts of said lands and prevent their rehabilitation and the resettlement of their population thereon; and

WHEREAS, unless said levee breaks are repaired and the population of said areas returned to their homes and farms, they will be prevented from earning their livelihoods and will require public assistance,

NOW, THEREFORE, I, Culbert L. Olson, Governor of California, pursuant to the provisions of Chapter 662, Statutes of 1929, and pursuant to the recommendation of the State Emergency Council, do hereby declare an emergency to exist within the boundaries of the basin of the Sacramento River and its tributaries, and I hereby instruct the Director of the Department of Public Works of the State of California to make an immediate survey of said area, and to determine the location and extent of the damage caused by the past floods, of levee breaks, of the potential danger of further floods at the time of the spring freshets, and of the best method of rehabilitating the inundated lands within said area and restoring the population of said lands to their homes and farms, and to take such further steps as are necessary to rehabilitate said area and its population.

Flood waters surging through levee breaks inundated portions of Princeton. This photo shows cattle marooned on railroad tracks.



Governor Culbert L. Olson visits flood refugees housed at State Fair Grounds after their evacuation from Yolo County lowlands by National Guardsmen.

most unbroken stretch extending from Hamilton City south to Knights Landing where they drained into the Yolo By-pass.

SUTTER BY-PASS LEVEE BREAKS

On the east side of the river, the flood waters augmented by heavy run-offs from tributary streams formed a vast lake extending from Vina south to the Tisdale By-pass, an airline distance of approximately 65 miles and varying in width from three to five miles.

A break in the west levee of the Sutter By-pass north of Meridian flooded Reclamation District 70 despite the efforts of crews of workers who stayed on the job until marooned by the flood waters. They were forced to remain on the levee for 18 hours before being rescued. The State had 120 men on patrol duty on the east levee of the Sutter By-pass which held. The north levee of the Tisdale By-pass broke flooding Reclamation District 1660, which adjoins District 70 on the south. About 35,000 acres of fine farming and orchard lands were flooded by these two breaks.

As the crest of the flood moved south it continued to set new high records. At Colusa it reached a stage of 29.5 feet which was 2.7 feet above the crest at that point in 1937. At Knights Landing the river reached 34 feet, compared to the 32.6-foot crest in 1937.

SACRAMENTO WEIR OPENED

At Sacramento, on February 27th, Public Works Director Frank W. Clark ordered the flood gates of the Sacramento Weir opened when the river passed the safety stage at 28.3 feet. With the weir gates opened the river at Sacramento dropped to 26.5 feet and at no time seriously threatened the city. The flood gates between Sacramento and North Sacramento were closed on February 26th, shutting off traffic between the two cities.

Harold E. von Bergen, who lost his life in line of duty.

One of ten victims claimed by flood waters, Harold E. von Bergen, Assistant Hydraulic Engineer of the Division of Water Resources, lost his life in line of duty on February 28 while engaged with two other members of the Division staff in measuring the flow of water pouring through the Sacramento weir into the Yolo by-pass.

Fred Paget, Associate Hydraulic Engineer, and Duncan F. McCallum, Automatic Water Gauger Mechanic, escaped death in the turbulent by-pass, which was filled to capacity by the opening of the Sacramento weir on the Sacramento River. Paget swam ashore when the boat in which the three men were working capsized, and McCallum was picked up down stream by a boat in which United States army engineers were taking measurements.

When Paget reached shore, he saw von Bergen still afloat and then lost sight of him. The fact that von Bergen was a strong swimmer gave rise to faint hopes that he might have

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At top—The force of the flood waters is shown in the top picture, one of the breaks in the Sacramento River levee north of Colusa where the swirling waters covered thousands of acres of adjoining farm lands. Left center—Stephens concrete bridge, a county structure, that was wrecked when the flood waters of Cache Creek swept over its banks with unprecedented force. Right center—Street flooded and closed to traffic in Napa City, Napa County, when the Napa River rose and swept through the town. At bottom—State Highway 15, flooded by a break at Meridian, in Sutter County.

Wreckage of former county bridge on Sacramento River at Redding, State Route 44.

Highway slip-out on State Route 104 along Russian River near Guerneville.

U. S. Highway 99E flooded near Biggs, Butte County.

Weather Bureau at selected locations, and more particularly for the two days February 27 and 28.

Traffic was first inconvenienced when water overflowed the pavement at innumerable points. As the storm increased in intensity, it was necessary to close roads at certain points and eventually entire routes. This applied especially to roads crossing or immediately paralleling the Sacramento River in Glenn, Colusa and Yolo counties.

The Division of Highways forces made every effort to provide and sign detours, and to inform the public. All districts were coordinated in this respect. The newspapers, and particularly the radio stations—KFBK, KPO, KGO, KSFO, KROW and KROY—were very helpful in broadcasting information furnished them by the Division at almost hourly intervals.

Rainfall Records

Location	County	Rainfall in Inches Feb. 27 and 28	Rainfall in Inches Feb. 25 to 29 Inclusive
Montgomery Creek, Shasta*		4.78	9.02
Red Bluff, Tehama		3.60	4.10
Stirling City, Butte		15.20	20.07
Downieville, Sierra		11.30	15.98
Nevada City, Nevada		7.59	11.91
Gold Run, Placer		6.54	11.03
Middletown, Lake		10.73	12.98
Beegum, Trinity		12.30	16.00
Garberville, Humboldt**		6.36	9.50

It is also reported that 8.75 inches of rain fell in the Santa Cruz area in a 17-hour period.

* *Four days recorded.*

** *Division of Highways record.*

MAJOR ROUTES CLOSED

The major routes which were closed for periods of a few hours to two days by high water are as follows:

U. S. 40—At underpasses east of Sacramento; between the Causeway and Davis, and at Putah Creek.

U. S. 99W—Davis Wye to Tehama County line at points north and south of Woodland, Arbuckle, Williams, Willows and Orland; at bridge north of Redding; at Pollock.

U. S. 99E—North of Biggs; at Los Molinos and Cottonwood.

The following routes suffered major damage:

U. S. 101—Cloverdale to Hopland on account of slipout, and at Scotia on account of bridge failure.

Four hundred foot slip-out on Redwood Highway, U. S. 101, north of Cloverdale—*Photo courtesy San Francisco Examiner.*

State Sign Route 1—Santa Cruz to San Francisco, and from Jenner to Ft. Bragg, due to heavy slides.

State Sign Routes 12 and 29—All roads in vicinity of Napa due to high water in the Napa River.

State Sign Route 20—Redwood Highway to Williams and Williams to Yuba City, and east of Marysville due to flooded sections.

U. S. 299—Arcata to Weaverville, due to slides and washouts.

State Sign Route 44—The east timber approach to the former county Free Bridge east of Redding washed out on February 27.

State Sign Route 24—The Feather River route was closed by washouts and slides from about six miles west of the Butte-Plumas County line to Greenhorn Creek east of Quincy.

State Sign Route 12—Between Sebastopol and Monte Rio on the Russian River, due to floods and slip-outs.

State Highways 45, 47 and 88 in Glenn and Colusa counties are still flooded due to break in the levees of the Sacramento River, and there is a major break on Route 99 north of Rio Vista at Cache Slough.

(Continued on page 27)

Highway Damage Totals $1,267,200 In 5 Districts

Major highway routes in Northern California are open to traffic following the severe storms during the last week of February. The Scotia Bridge in Humboldt County on the Redwood Highway was put into service on March 4.

The flood damage to highways was confined principally to five highway districts as follows:

District I—Eureka	
Mendocino, Humboldt, Lake, Del Norte and portions of Trinity and Colusa counties	**$280,500**
District II—Redding	
Tehama, Shasta, Plumas, Trinity and portions of Siskiyou counties	**507,400**
District III—Marysville	
Glenn, Colusa, Yuba, Butte, Sutter, Yolo and Sacramento counties	**97,000**
District IV—San Francisco	
Sonoma, Napa, Marin, Contra Costa, Alameda, San Mateo, Santa Clara and Santa Cruz counties	**330,000**
District X—Stockton	
Portions of Sacramento, Solano and San Joaquin counties	**52,300**
	$1,267,200

Rough grading operations on Mint Canyon Cut-off, with tractors pulling 25 and 28 cubic yard carryall scrapers.

Building Mint Canyon Cut-off

By R. C. MYERS, Assistant District Office Engineer

CONSTRUCTION on the final contract of the "Mint Canyon Shortcut" in Los Angeles County is now well on its way toward completion and the benefits of this 5.2 mile saving in distance to users of the Mint Canyon Highway (U. S. Highway Routes 6 and 395) will begin to be realized during the latter part of next summer.

The entire project, which extends from Tunnel Station, about one mile southerly of the old Newhall tunnel, to Solamint on the Mint Canyon Highway, is being done under four separate contracts, actual construction work having been started in May, 1938.

The first of these contracts extended from Tunnel Station along the old San Fernando-Newhall Road to a point about four-fifths mile northerly of the tunnel and thence on a diagonal line toward Solamint, ending at Placerita Creek.

The letting of this contract was shortly followed by two other contracts, one being for a new reinforced concrete bridge across the Santa Clara River near Solamint and the other for an overhead crossing of the Southern Pacific railroad at Solamint.

THREE CONTRACTS COMPLETED

These three contracts have been completed, the immediate benefit being the elimination of the Newhall Tunnel by making an open cut through the summit of the Newhall mountains and the widening, straightening and improving alignment on two miles of the old San Fernando-Newhall road from Tunnel Station to the point where the "Short Cut" starts.

It remains for the fourth and present contract to "fill in the gap" from Placerita Creek to the Solamint Junction, thereby putting into service the new diagonal road which will save 5.2 miles in distance to automobile traffic (averaging 4000 cars daily) which uses the Mint Canyon Highway (U. S. Highways 6 and 395) between Los Angeles and Mojave and points northerly therefrom.

The project as a whole is essentially a large "dirt moving" job, there being 1,520,000 cubic yards of excavation along the 7.13 mile distance between Tunnel Station and Solamint handled under the two grading contracts.

The "Short Cut," which includes the present contract (3.40 miles) and 1.73 miles graded and paved under a previous contract, is being surfaced to a width of 33 feet (3 traffic lanes) except for 2000 feet at the summit of the hilly country which it traverses. Through this section, on account of somewhat impaired sight distance, the surfacing will be 46 feet in width (4 traffic lanes).

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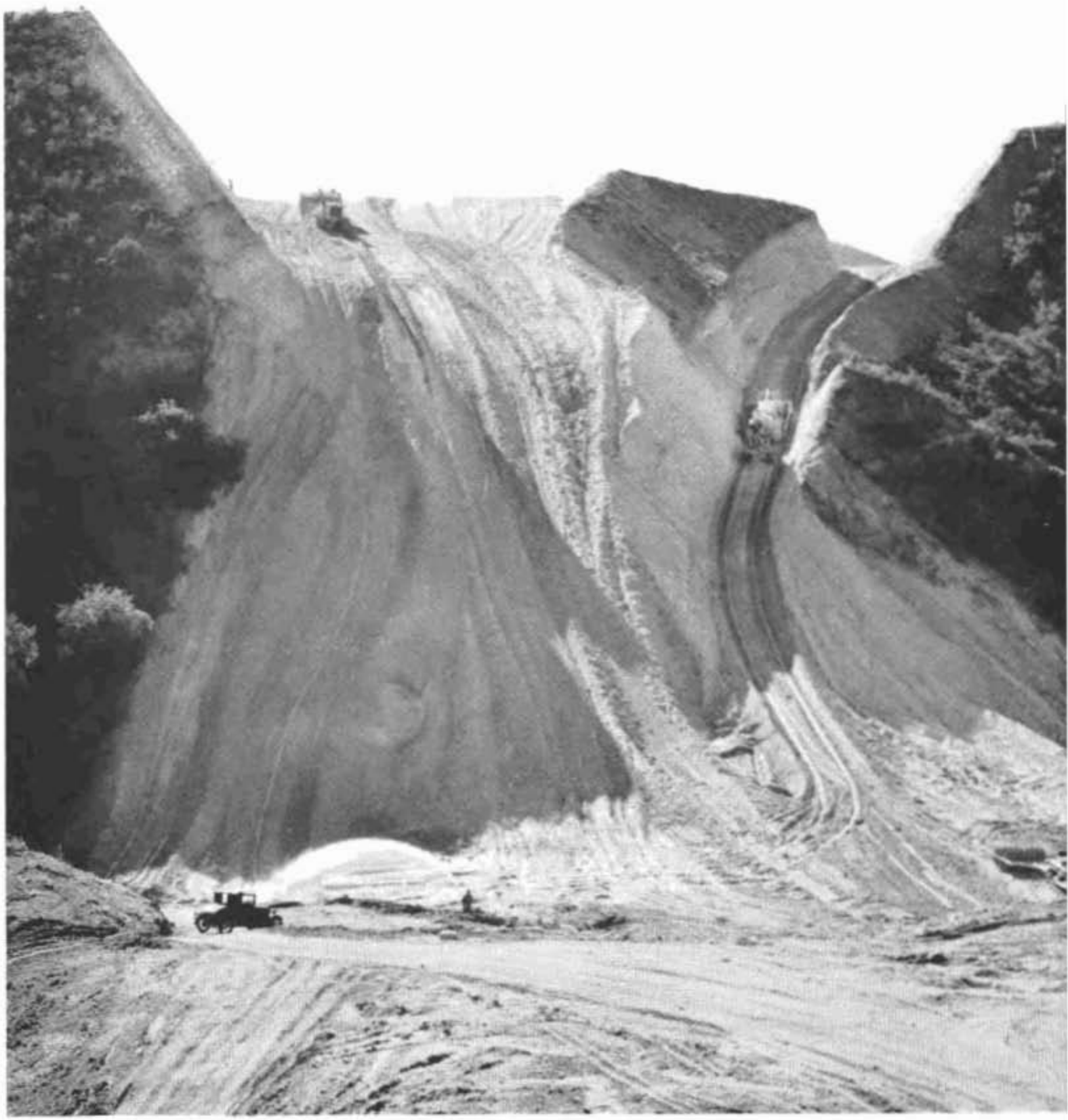


Pioneering 134-foot cut and 70-foot fill down natural slope of 5:4 in Mint Canyon Cut-off grading operations.

Palm Springs Relocation Includes Grade Separation and Underpass

By A. EVERETT SMITH, Assistant Highway Engineer

IN ADDITION to normal traffic increase, the ever growing popularity of the desert recreation and resort areas in Southern California has presented definite traffic demands for improved highway facilities to such areas. This is especially true of the portion of the State highway between U. S. Highway 99 and Palm Springs in Riverside County. This portion is on State Sign Route No. 111 and branches from U. S. 99 a little over one mile west of Whitewater. It forms an alternate route to Indio via Palm Springs and Cathedral City.

U. S. Highway No. 99, going easterly from Los Angeles, proceeds through the San Gorgonio Pass, and passes through Banning, Whitewater and Indio. Due to the rugged mountain ranges, a number of major highways converge and use the San Gorgonio Pass in common. They are U. S. Highways 99, 60 and 70.

This causes a heavy concentration in traffic through this portion and traffic congestion is accentuated by freight and produce trucking to and from the Coachella and Imperial Valleys on one side and the Los Angeles metropolitan and harbor areas on the other. To this at seasonal periods are added throngs of motorists who seek the warm desert sunshine, the beauties of the lavish beds of wild flowers, or a visit to their favorite desert resort.

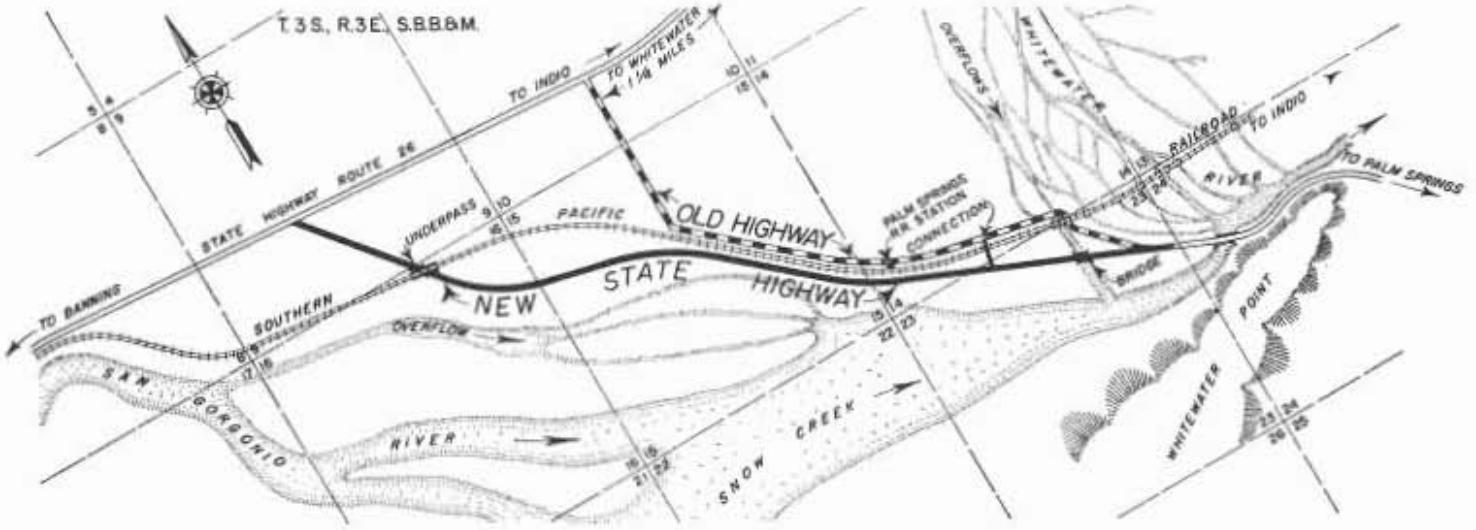
At the junction of U. S. Highway 99 and State Sign Route 111 the "Magic Eye" traffic counter has recorded over 15,000 vehicles in a single day. Traffic flow charts show that a large portion of this traffic goes to Palm Springs.

As the portion of the Palm Springs road between Whitewater and Snow Creek was substandard, a section of new highway was constructed from Snow Creek northwesterly to an intersection with U. S. 99 about a mile west of the old Whitewater Junction. This improvement, 3.15 miles in length, is on new alignment and forms the hypotenuse of a triangle reducing the distance of the old road representing the two legs of the triangle, by three-fourths of a mile. The southeasterly end of this project connects with an improvement completed in 1937 a unit of which was a new modern bridge structure across Snow Creek. A standard type highway was cut through Whitewater Point.

The superseded portion of the old road had numerous sharp curves and an irregular grade that followed the natural ground line. Abrupt turns on each side of a grade crossing over the tracks of the Southern Pacific Company constituted a traffic menace.

This old road is replaced by the new project which follows along the south side of the railroad to a vantage point and crosses under the tracks by an underpass structure.

The project, in general, consists of a 38-foot graded roadbed surfaced with oil-mix, the underpass structure, a bridge across an overflow channel of the Whitewater River, and a connecting road across the tracks to Palm Springs Station.



As the native material used in constructing the graded roadbed did not contain adequate binding properties to form a stable subgrade, a road-mix surface treatment was applied to the entire width of the roadbed to a depth of four inches. This was topped with a riding surface of plant-mixed surfacing.

Storm drainage originates on the slopes of the San Bernardino Mountain range to the north and flows southerly to the foot of San Jacinto Mountain where it unites with Snow Creek and flows to the Salton Sea. This drainage is intermittent, occurring with storms and subsiding soon after. The overflow channel of the Whitewater River is usually a dry wash but with a typical desert cloudburst may become a torrent.

Over this channel was constructed a bridge consisting of seven, thirty-foot reinforced concrete slab spans on reinforced concrete piers and two, eight-foot cantilever spans. The bridge provides a clear roadway width of 26 feet. Roadway embankments adjacent to the bridge were protected from storm damage by rock riprap. The rock was obtained from a point of the mountains east of Snow Creek Bridge.

The grade separation structure consists of three forty-six-foot eight-inch steel beam track spans with ballasted steel deck on concrete piers and abutments with wing walls. This structure also provides a clear roadway width of 26 feet. To protect the underpass from the cross flow, large ditches and dikes were constructed to intercept and divert the storm water.

During the construction of the underpass the railroad traffic was carried on a shoofly track. Highway traffic used the old road and was maintained at each end while the connections were being constructed.

Engineer McBroom Wins Bridge Design Prize

For a timber bridge design submitted in a nation-wide contest sponsored by the National Lumber Manufacturers' Association, the American Forest Products Industries and the Timber Engineering Company, E. H. McBroom, Associate Bridge Engineer of the Division of Highways, has been awarded second prize of $200.

At top—Underpass beneath railroad on Palm Springs realignment. Below—Reinforced concrete slab bridge on reinforced concrete piers over Whitewater River overflow channel and view at southeast end of project where road crosses Snow Creek and cuts through point of San Jacinto Mountain. At bottom—View of portion of highway looking toward San Jacinto Mountain en route to Palm Springs. Snow Creek on left.

Snow Clearing Job On the Donner Summit Highway

THE main transcontinental highway from northern California to the East, known as U. S. 40, crosses the summit of the Sierra Nevada Mountains through Donner Pass at an elevation of 7,130 feet. This pass is named for the Donner Party, which met disaster during the winter of 1847 while attempting to cross the mountains to reach California. Deep snow on the summit is no longer an impassable barrier. The route which the old Emigrant Trail followed is now traversed by a modern highway, which is kept open to all year travel.

The high Sierras however, still offer definite winter hazards, and the Donner Summit road is kept open under as severe climatic conditions as are encountered anywhere in the United States. During the winter of 1937-1938 the total snowfall at Soda Springs was 592 inches. The season 1938-1939 was regarded as a mild winter, the fall being only 284 inches. The fall at Soda Springs during the present season up to March 2, 1940, has been 321 inches.

Maintenance of the Donner Highway as an all-year route dates from 1931, and since that time travel over the summit has been halted or delayed only during periods of exceptionally heavy storms. During the winter of 1938-1939 the road was closed to heavy trucking a total of only 39 hours, the longest single period being twenty-two hours during the blizzard of February 7 and 8, 1939. So far, during the present season, trucking has been held up for only six hours during the storm of February 17.

Snow removal equipment assigned to this highway consists of five rotary snow plows, six four-wheel-drive push plows and several graders and small miscellaneous units. The value of this equipment is about $125,000.

The cost of keeping the Donner Highway open to winter travel, including the sanding of icy pavement, varies with the severity of the winter, the high point being reached during the season 1937-1938, when expenditures amounted to $86,130. The average cost of the last three winters has been $82,706 per season.

MORGAN KEATON

Travel on the Donner Highway includes both through traffic and, at certain times, a considerable volume of recreational travel, which is attracted by the high Sierra snow sport areas. The average Monday traffic over the summit during January, February and March of 1939 was 480 vehicles per 24 hours, and the average Sunday traffic was 960 vehicles. Monday traffic at Baxters is about the same as at the summit, but a Sunday count at Baxters has shown as many as 1429 vehicles at that point during the eight hour period from 8.00 a.m. to 4.00 p.m.

A recent analysis of snow clearing expenditures shows that the cost of this work on the Donner Highway has averaged $12.52 per 1000 vehicle miles of travel on the route. When it is remembered that the present State gasoline tax of 3¢ per gallon is equivalent to $2.22 per 1000 vehicle miles of highway travel, and that only half of this, or $1.11 per 1000 vehicle miles is available for State highway purposes, it is obvious that highway travel through snow country does not, of itself, provide the money which is necessary to keep the highway open to winter travel.

Morgan Keaton Takes Office as Deputy Director

Veteran of the World War and former Adjutant of the American Legion, Department of California, Captain Morgan Keaton on February 17 was given a civil service appointment as Deputy Director of the Department of Public Works by Public Works Director Frank W. Clark, a position he formerly held from November, 1932, to August, 1934.

Keaton, whose home is in San Francisco, was a member of the State Assembly during the 1927 and 1929 sessions, representing Long Beach and Los Angeles County. Since the formation of the American Legion, Keaton has been active in veterans' affairs. He was Adjutant of the California Department of the Legion from October, 1921, to July, 1924.

Born in Copper Hill, Virginia, October 21, 1891, Keaton was educated in the grammar school of Floyd County, Virginia, the Roanoke College of Salem, Virginia, and majored in political science and political economy at the Washington and Lee University of Lexington, Virginia. At the conclusion of the World War, Keaton, who had served one year overseas, took a political economy and law course in the University of Paris in France. Prior to the World War, Keaton was a newspaper man in St. Paul, Minnesota, and gave up his profession in 1916 to join the National Guard, First Minnesota Infantry, for service on the Mexican border, 1916-1917. Enlisting as a private, Keaton was discharged in August, 1919, as a captain, Infantry Reserve Corps.

In 1921 Keaton engaged in the real estate business in Sacramento, and from 1924 to 1930 was in the insurance and real estate business in Long Beach. As secretary and managing director of the California Highway Council, 1935-1936, he managed a campaign for an initiative measure to place in the State Constitution a requirement that all highway funds must be used for highway purposes.

Since 1937 to February 17 he was merchandising counselor of the California Retail Grocers and Merchants Association.

Realignment of U.S. 40 Between Sacramento and Dixon Started

By R. E. PIERCE, District Engineer

WITH the awarding by Director of Public Works Frank W. Clark on March 1 of a contract to Fredrickson Bros. of Emeryville for the grading of 7.3 miles of roadway and installation of drainage facilities, a start was made on a much-needed improvement of an important cross-state highway in the northern part of California; namely, U. S. 40, extending from San Francisco and the East Bay metropolitan area through Sacramento and over Donner Pass to the State line and beyond.

The Frederickson contract was for $127,301.35.

The location of the present highway between Dixon and Sacramento, in common with most of the early built State highways, was largely controlled by the then existing county roads which, in turn, were often laid out along section lines. This, as indicated on the map, introduced a number of right angle turns and considerable adverse distance.

Between the limits of the proposed work, the present highway curves total 617 degrees, whereas the proposed highway will have but 144 degrees.

WILL BY-PASS DAVIS

As long ago as 1920 this condition was criticized in the report presented in that year by the then United States Bureau of Public Roads to the California Highway Commission and Highway Engineer entitled "A Study of the California Highway System."

The last paragraph on page 118 of the report reads as follows: "Solano 7 and Yolo 7—(Benicia-Sacramento). There are some locations on this road that indicate too close an adherence to the old right of way, notably between Fairfield and Vacaville. North of Dixon are two right angle turns in order to follow section lines, and this is repeated north of the Yolo County line."

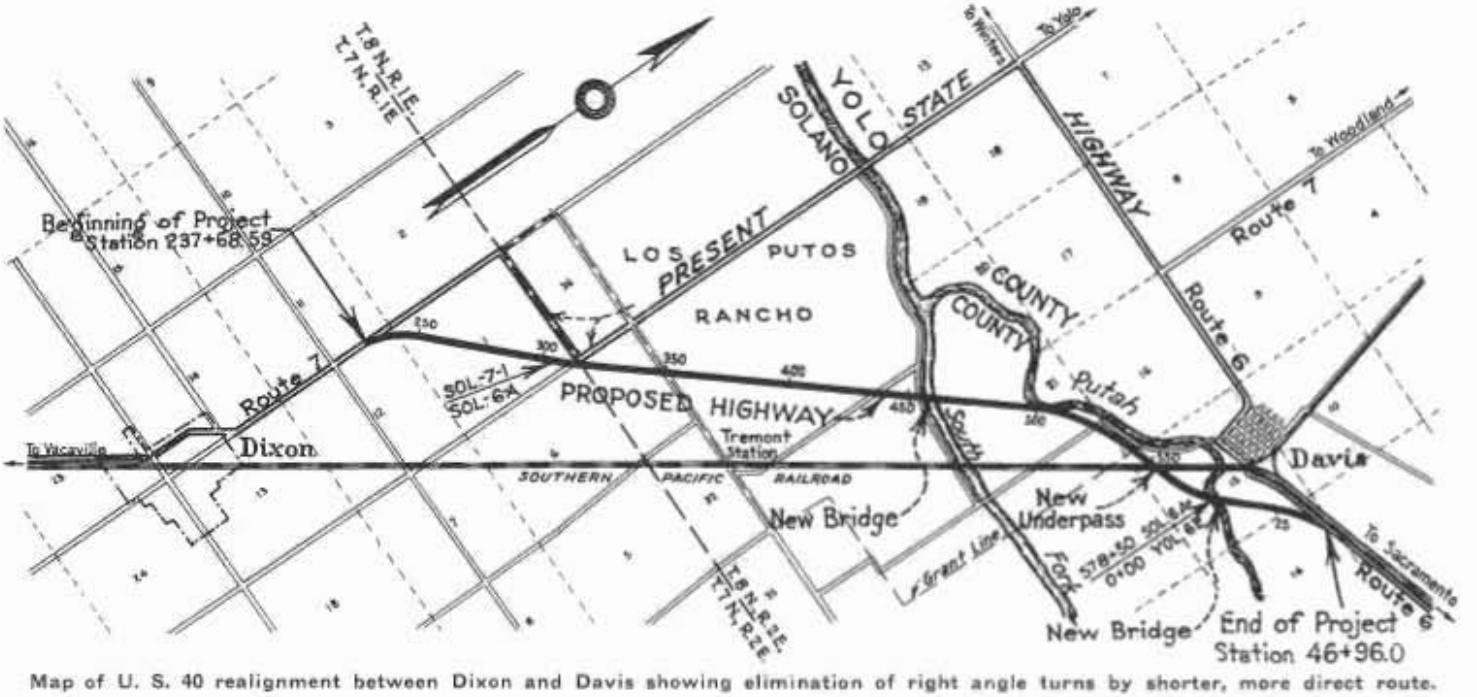
The present project includes grading and minor drainage structures on a new location which, as indicated on the map, will eliminate all the undesirable alignment between Dixon and Sacramento, as well as by-pass the town of Davis, and shorten the distance 3.25 miles.

The present contract starts on the existing State highway 1.3 miles north of Dixon and extends over new rights of way for approximately 7.3 miles to the existing State highway about 1.0 mile east of Davis.

The first 5.0 miles are to be graded for two lanes located off the center of the right of way so as to conform to an ultimate four-lane divided highway. The balance of the grading will be for a four-lane divided highway.

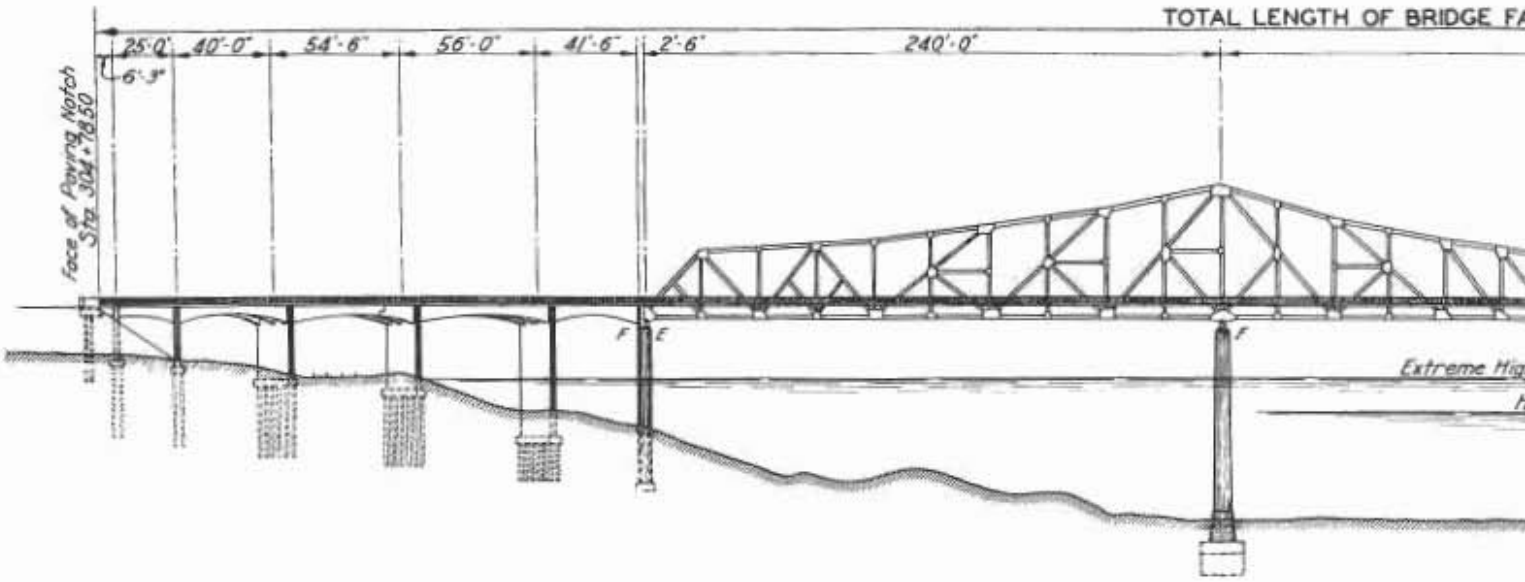
About 1.5 miles from the beginning of this project, the new location is close to the second right angle turn north of Dixon. It is planned here to grade a section of divided highway extending a short distance on either side of the intersection, to make it possible to better care for traffic.

(Continued on page 24)



Map of U. S. 40 realignment between Dixon and Davis showing elimination of right angle turns by shorter, more direct route.

Two Steel Bridges Under Construction Across Eel



By A. J. MEEHAN,

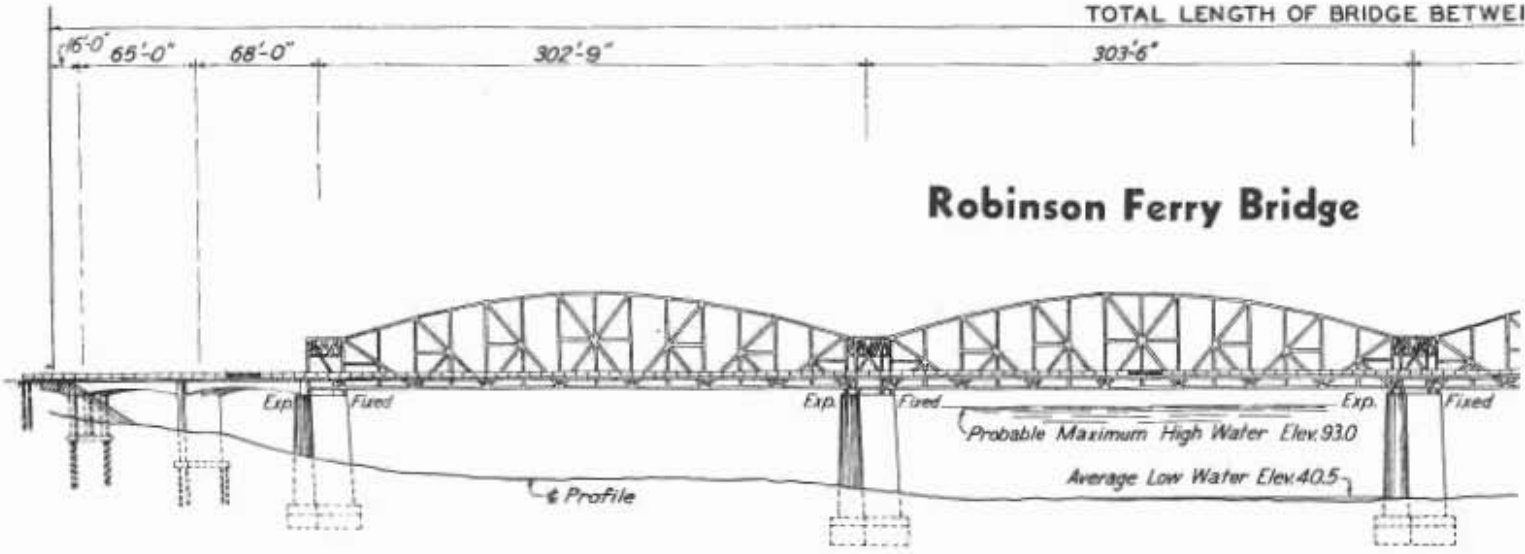
MOTORISTS driving north from the town of Scotia in Humboldt County on the Redwood Highway in July, 1941, will have the pleasure of traversing two new State bridges across the Eel River, contracts for which were awarded by Director of Public Works Frank W. Clark, last month.

One of the structures will be known as the North Scotia Bridge, crossing both the river and the railroad tracks of the Northwestern Pacific Railroad and the Pacific Lumber Company. The second structure, at a point about a mile farther on, will span the river at Robinson's Ferry. Between the two will be approximately three quarters of a mile new straight highway, which will materially shorten the existing roadway between the present antiquated bridges at Scotia and Robinson's Ferry, failure of which, due to truck overloading or speeding, would paralyze traffic, as there is no convenient detour.

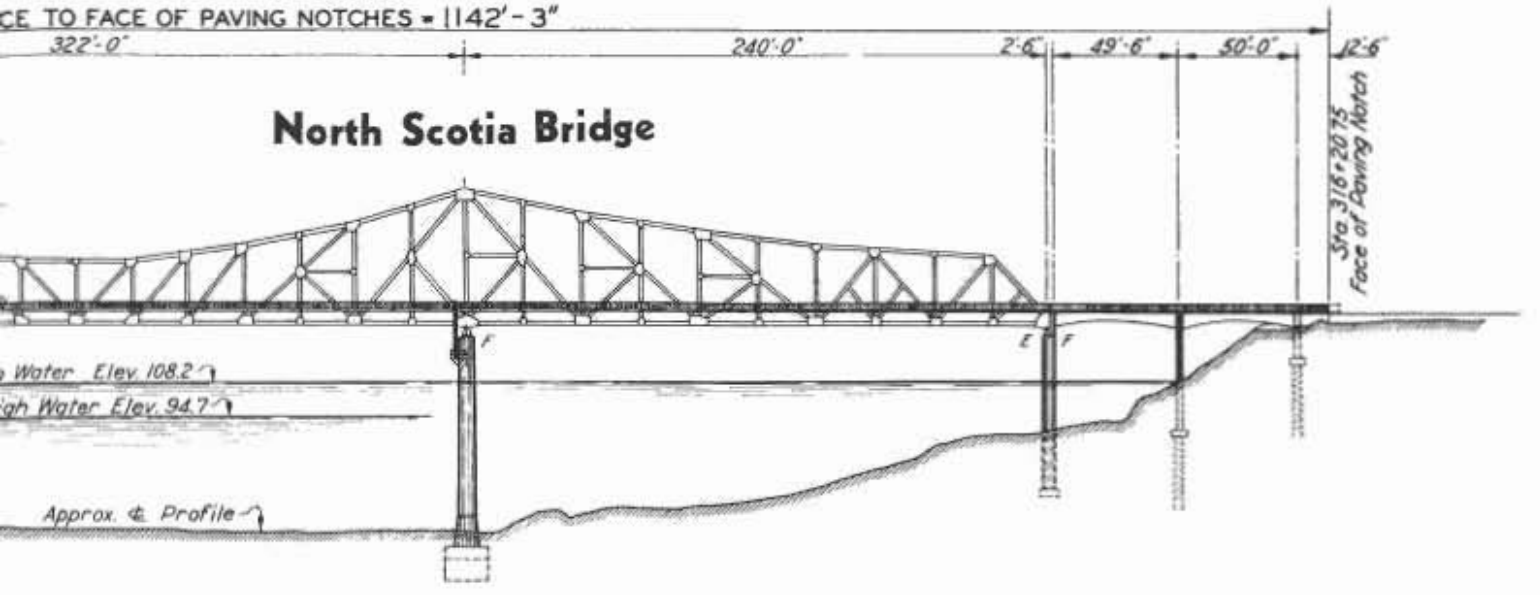
For financing the new bridges approximately equal amounts of money will be contributed from Federal Aid and State funds. Incidental work will provide for grading, the installation of a conduit system for future lighting on the North Scotia Bridge and the ultimate removal of both the original bridges after detour use.

The bridge work was let in two contracts since each job was big enough to attract responsible bidders. Separate contracts attract more bidders and thus increase competition to the benefit of the State. They also speed up construction operations and open the projects earlier for public use.

On January 24, 1940, the low bid for the Robinson Ferry Bridge of



River on Redwood Highway in Humboldt County



Senior Bridge Engineer

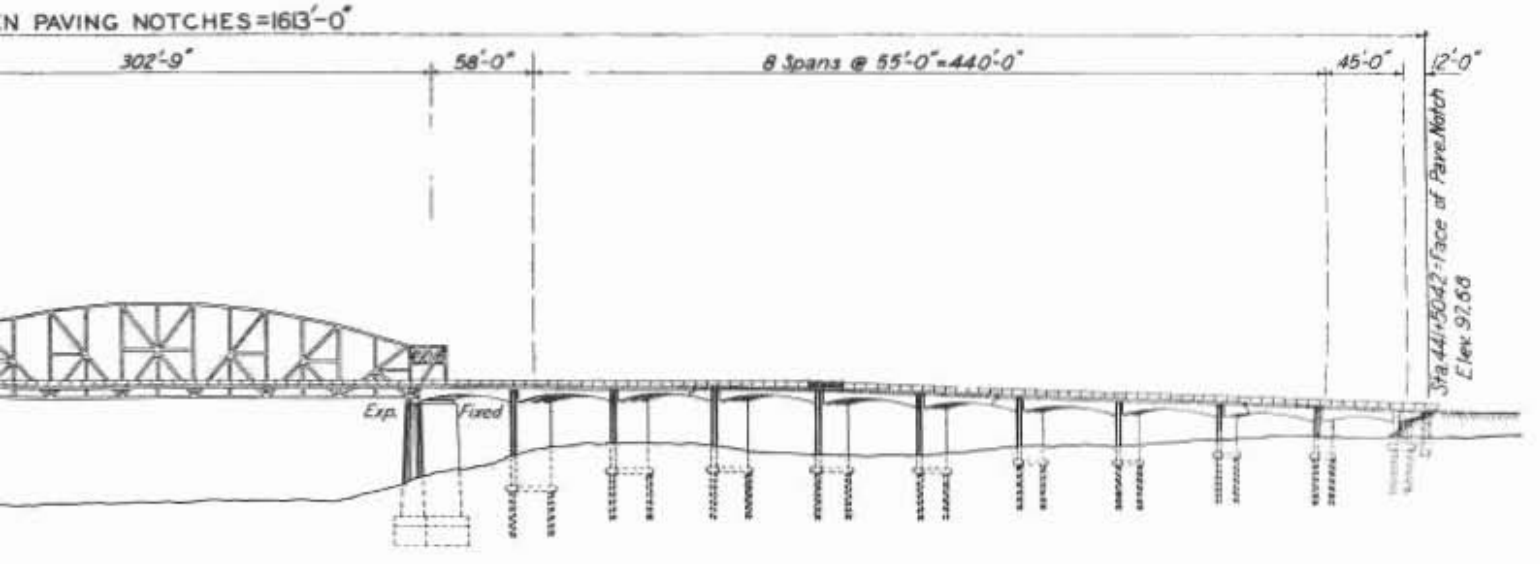
$455,580 was submitted by the contracting firm of Engineers Limited of San Francisco. On February 15, 1940, the low bid for the North Scotia Bridge of $330,000 was received from A. Soda & Son of Oakland.

In a rugged and almost inaccessible area five thousand feet above sea level in the San Hedrin Mountains of California's northwestern coastal range, the Eel River starts winding its way to the sea. The drainage basin of the Eel River is approximately 3100 square miles, much of which, being generously timbered, presents a drift problem at bridges. Normally the annual rainfall is one hundred inches in the upper fringes of the watershed. The casual observer is apt to judge the "might" of a stream by its width and in the case of the Eel River would easily overlook its potentialities.

However, Bridge Department hydrologists, after a detailed study of the region, report that the natural phenomena there are capable of startling possibilities. For example, with a simultaneous runoff from all forks of the river, the discharge forecast is the rather large, but not improbable, flow of 370,000 cubic feet per second for one hundred year cycles.

As a measure of flow comparison, the Sacramento River at the Capital City has an estimated maximum discharge at irregular intervals of approximately 100,000 cubic feet per second. Near Needles, California, the unregulated flow (unpublished) of the Colorado River is about 370,000 cubic feet per second at 65-year intervals.

The winding course of the Eel River



has been the arch foe of the motorist and the highway engineer alike by impeding the direct travel of the motorist and by presenting natural obstacles, costly to overcome, to the engineer who has the welfare of the motorist at heart, but whose efforts to help are woefully handicapped by insufficient highway funds.

Throughout the years, the Division of Highways has built and maintained the Redwood Empire Highway as it crosses and recrosses the Eel River and traverses many areas subject to slides. As funds became available, numerous improvements have been effected.

Previous to 1914, the crossing north of Scotia, in Humboldt County, was effected by means of ferrying and fording the river. Subsequent to this, were the county-built steel structures at North Scotia and at Robinson Ferry, one and a half miles north. These have long since outlived their usefulness. They have 17-foot roadways and for the past several years have been unreasonably expensive to maintain from the combined standpoint of painting, load and speed restrictions and the full-time employment of three shifts of watchmen on each of the two existing structures to enforce the posted limitations.

Both of the new bridges will have 26-foot roadways, ample for the next 20 years' traffic development in their vicinity. There will be a 4-foot sidewalk on either side of each bridge to accommodate the pedestrian traffic between the communities of Scotia and Rio Dell. The sidewalks on the truss portions will be cantilevered with the outer edges of the walks protected by steel railings of the baluster type.

The North Scotia Bridge will have three channel spans of structural steel, flanked by approach spans of concrete, whose footings will be supported on concrete piles. Access is provided to the interior of one of the main piers, where a self-recording water level gauge of the U. S. Geological Survey will be installed.

There is a certain similarity of layout in the plans of both bridges but the Robinson Ferry Bridge will be skewed throughout its entire length. Right angle crossings, as studied, revealed that while such a bridge would cost less in itself, the roadway approaches would be longer and introduce undesirable alignment conditions. The skew condition necessitated the use of "simple" type channel spans of steel, one end of each of which is "free" to move a small amount longitudinally. The floor panel lengths of these steel spans are so related as to secure "square" framing. This simplicity feature, and that obtained by masking the skew in vertical portals, has effectively reduced shop costs.

The river channel at both sites is bedrock overlaid with a shallow cover of gravel and cobbles. The original bridges here and in the vicinity have yielded long-time records which have been invaluable in determining the requirements of the new, as to adequacy of span lengths, foundation behavior, etc.

Due to the existence of developed real estate properties adjoining the bridge ends, it was impossible to raise the new grade sufficient for the adoption of the deck type of steel span.

Aside from the Robinson Ferry steel spans, all parts of both bridges will be of the "continuous" rigid frame type. This means that groups of spans—by the efficient disposal of a minimum amount of material in their make-up—will be so constituted, that their substructures and superstructures mutually interact to sustain loads.

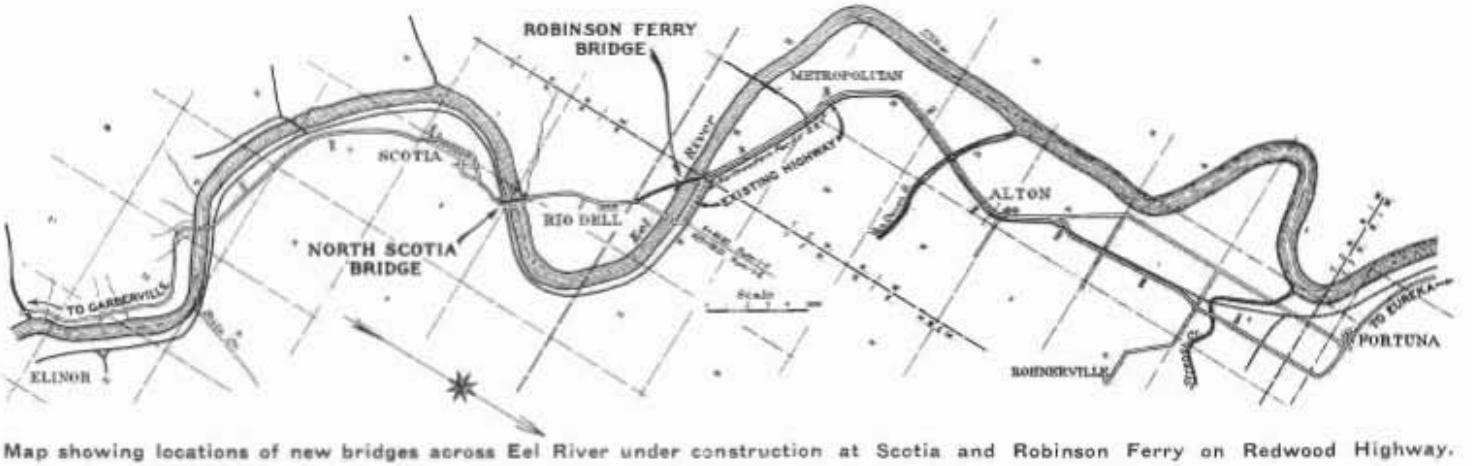
These structures were designed to support the maximum loading permitted by statute. The area in which they are situated has been the origin of numerous earthquakes, but these bridges will shake off earthquakes and laugh at "Ole Man River."

The contractors will be permitted to erect the main spans in the manner they choose, dependent upon their equipment and also upon the river stage at the time of field assembly. The spans are adaptable to erection by cantilevering, or by the use of falsework or a combination of these methods.

A new epoch of structural steel is at hand, employing alloy steels in a wide variety of uses. With sufficient price competition now procurable for these steels from nation-wide producers, most of the structural steel for these bridges has been selected from the alloy classification.

While this material initially costs more per pound than inferior steels, its adoption was predicated upon such ruling factors as self-liquidation from a corrosion resistant standpoint of less maintenance cost and reduction in dead weight due to its higher stress carrying capacity. Technically, numerous qualities may be enumerated in its behalf and difficulties of shop fabrication are not increased.

All bridge work is under the general direction of F. W. Panhorst, Bridge Engineer. The Designing Engineer of Bridges is L. C. Hollister, to whom the writer is assistant.



Map showing locations of new bridges across Eel River under construction at Scotia and Robinson Ferry on Redwood Highway.

Channelized intersection along Lakeshore Avenue, Oakland. Note utilization by traffic of turning lanes and protection for pedestrians.

Highway Intersections at Grade

L. A. WEYMOUTH, Assistant Highway Engineer, Surveys and Plans

IN RECENT years the motoring public has been introduced head-on and otherwise to channelized intersections. The reaction has been varied and not entirely complimentary, if one can believe recent cartoons showing bewildered motorists in a maze of traffic islands and channels. To say that these are entirely without justification would be evading the facts. However, with the aid of past experience and constant research, objections are gradually being overcome and the channelized intersection is more and more proving its worth in the reduction of accidents and congestion.

The fact that approximately one out of every four accidents on rural highways and nearly all the congestion (assuming sufficient width and number of lanes to accommodate maximum traffic) can be attributed directly to intersecting traffic illustrates the importance of the problem. The ideal intersection, of course, would be one with all the various through and turning lanes separated by underpass or overhead structures which utilize the so-called clover-leaf or braided intersection design. Under these conditions there would be no possible conflict between various traffic movements and each vehicle could pass through on easy flowing alignment without danger of collision or loss of time.

This braided type of intersection involves large expenditures so that its construction can be justified only where large volumes of traffic conflict. Modifications of the braided intersection where only the main traffic streams are separated are more in evidence but these, too, require high traffic volume to justify their cost.

VARIED TYPE INTERSECTIONS

It is unfortunate that the same amount of protection against accidents and loss of time can not be incorporated in all intersections, regardless of the traffic volume. However, all intersections are entitled to consideration, at least commensurate with the traffic volume. In this field comes the varied treatment of intersections at grade which includes the ordinary open intersections, channelized intersections, signal controlled intersections and various combinations of the above. All have their place in the general scheme and intelligent initial planning can make each type a stage construction which can be readily adapted to a more advanced type as traffic volume warrants and funds become available.

Since the two primary considerations of any intersection design are the safe and expeditious movement of traffic it is important to know the factors which affect these considerations. The three principal factors are the performance characteristics of the vehicle operated on the road, the physical conditions presented at the intersection and the volume and character of traffic for which it is to be designed.

RESEARCH STANDARDS

The American Association of State Highway Officials, with the cooperation of the Federal Public Roads Administration and other interested groups, has made considerable prog-

ress toward the solution of the intersection problem. By correlating the past experiences of the various states and the results of the many separate research ventures, they have taken a large amount of the guesswork out of intersection design and established reasonable standards dependent on performance characteristics of the operated vehicle. Performance characteristics, as used herein, refer to the performance of the operated car in stopping, decelerating, accelerating, turning, etc. Because of the many variations in vehicles it was necessary to establish composite vehicles, called assumed design vehicles, having performance characteristics that would include the majority of vehicles in a particular classification. Only two general classifications, passenger cars and trucks, were considered.

Standards developed by the association include minimum radii for the edge of pavement of 30 feet for passenger cars and 50 feet for trucks. Their centered compound curves fit the path of the vehicle more closely but the refinement is not justified when the interior angle is greater than 90 degrees.

MINIMUM RADII FOR TURNING

The minimum radii developed for turning at various speeds are as follows:

Turning Speed m.p.h.	Minimum Radius Feet
20	50
30	130
40	250
50	500

The widths of pavement for separate turning lanes vary with the radius, type of traffic, and number of lanes and relative direction of traffic in the lanes. For instance, the width developed for a single one-way lane varies from 17 feet for a 50-foot turning radius for truck traffic, to 12 feet for a 300-foot turning radius for passenger traffic.

The use of additional lanes for turning traffic to accelerate to the speed of through traffic before moving into the high speed lanes or for moving out of high speed traffic before decelerating to the required turning speed is still a controversial question. However, the association has developed lengths for speed change lanes to satisfy performance characteristics of the assumed design vehicles and has recommended further research and study by the States before they are finally adopted.

INTERSECTION DESIGN

Other standards dependent on performance characteristics which have been developed or are being evolved include sight distance, alignment and grades, signing, warrants or justification for various types of intersection treatments, etc. All are important and form the fundamentals of intersection design.

The above applies to intersections in general. For a specific intersection design, it is necessary to know, first, the physical characteristic, such as the number of intersecting roads together with their angles of approach and grades and alignment, the general topography or lay of the land, the extent and character of adjacent improvements as affecting land values, and other pertinent information; and second, the traffic data such as present and probable future speeds, type of traffic whether truck or passenger, traffic pattern or periodic variations in flow, existing and probable future traffic density for all turning movements, and accident experience on the existing intersection. Figure 1 illustrates a typical traffic flow diagram.

Physical limitations will often prevent the use of the type of intersection which experience might dictate as best suited for the traffic conditions. In some cases minor traffic movements will have to be penalized to expedite the free and safe flow of the main movements of traffic. In developing the final design to be built into the highway system, the engineers must consider all of the above items together with the important consideration of the amount of funds available.

CHANNELIZED INTERSECTIONS

Although the above is generally applicable to all types of intersections, the balance of this discussion will be limited to channelized intersections.

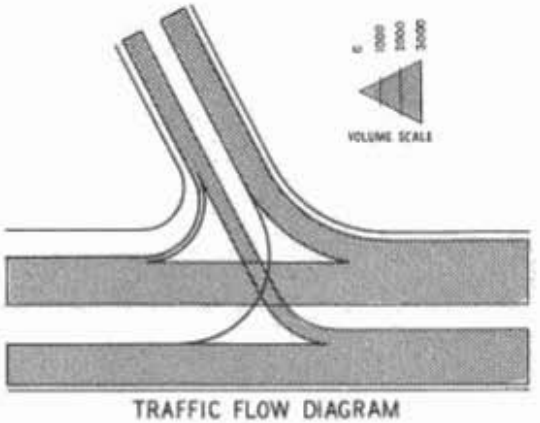
By confining traffic to definite channels which will bring turning and through traffic to favorable angles of intersection, by providing protecting islands where vehicles may stop between lanes or before entering lanes of through traffic and by separating the various turning movements, channelizations are accomplishing much in the reduction of congestion and accidents. Mr. Guy Kelcey aptly states, in a recent paper in the Proceedings of the American Society of Civil Engineers, that it has not been possible "to educate or force each driver to keep in his own place or channel and keep out of wrong ones because most roadways permit and often invite wrong movements. * * * if proper directional channels are made logical, easy and inviting to use, and if others are made unattractive and difficult, drivers (who, in the main, are surprisingly competent anyway) will follow the lines of least resistance and use the right ones."

Another important benefit of channelized intersections which should not be overlooked, especially in urban areas, is pedestrian protection. The channels make it possible for the pedestrian to confine his attention to traffic in one direction while crossing a lane and the islands give him a protected zone between channels.

SINGLE CHANNELIZATION

Contrary to popular belief, a channelization need not be complicated to be effective. One simple type that has proven quite effective is illustrated in Figure 2. In this case road A is of secondary importance to road B-C. By deflecting traffic from road A to a right angle approach, many accidents of the head-on type caused by entering traffic from A, making a wide left turn against traffic from C, can be eliminated. The short channelizing lane is for left turning traffic from B to A, which for this initial treatment should be of light volume. If the traffic from B to A were so small as to be negligible, the design could be further simplified to a single island by the elimination of the short channel.

The above simple channelization is well adapted to future expansion as traffic conditions warrant, without sacrifice of the initial investment. For instance, one of the first steps in expansion might be the construction of a four-lane divided highway on road B-C. If the islands on road A are properly designed they can be adapted to the new conditions without change by providing proper openings in the division strip (Fig. 3). The short lane within the dividing strip parallel to B-C is a speed change or accelerating lane which should be long enough to allow turning traffic to accelerate to approximately the average speed of traffic along the through road before merging. In this case, left turning traffic from B to A and right turning traffic from A to B



TRAFFIC FLOW DIAGRAM

FIG. 1

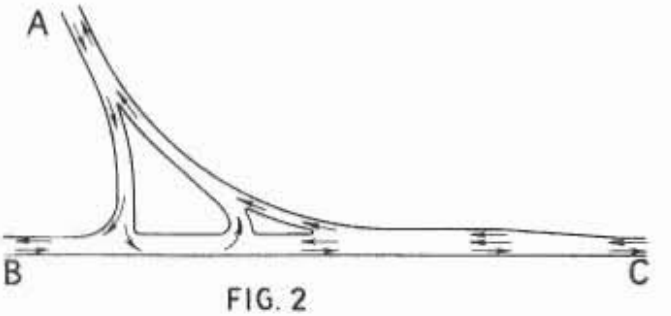


FIG. 2

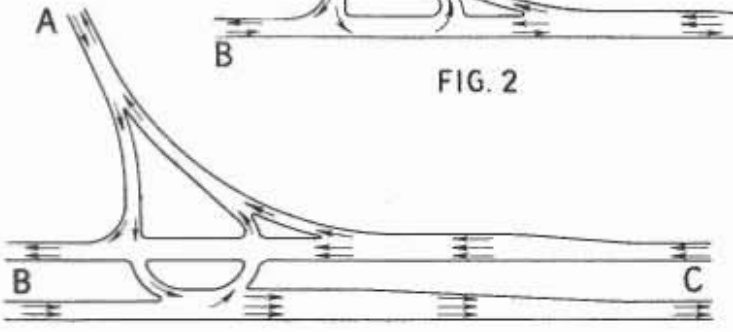


FIG. 3

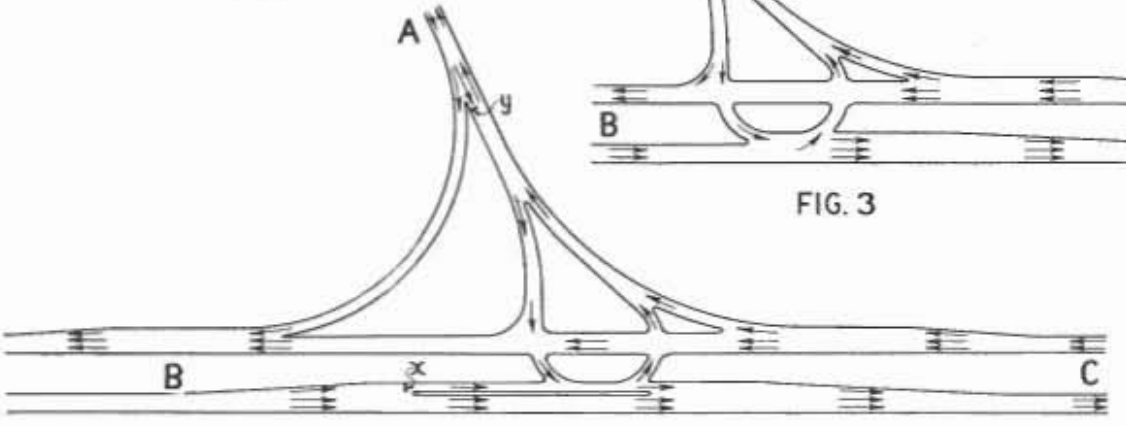


FIG. 4

Illustrating stages in the expansion of the simple "Y" type intersection at grade to keep pace with increasing traffic volume.

is assumed of minor importance not warranting additional expenditures.

DECELERATING LANE

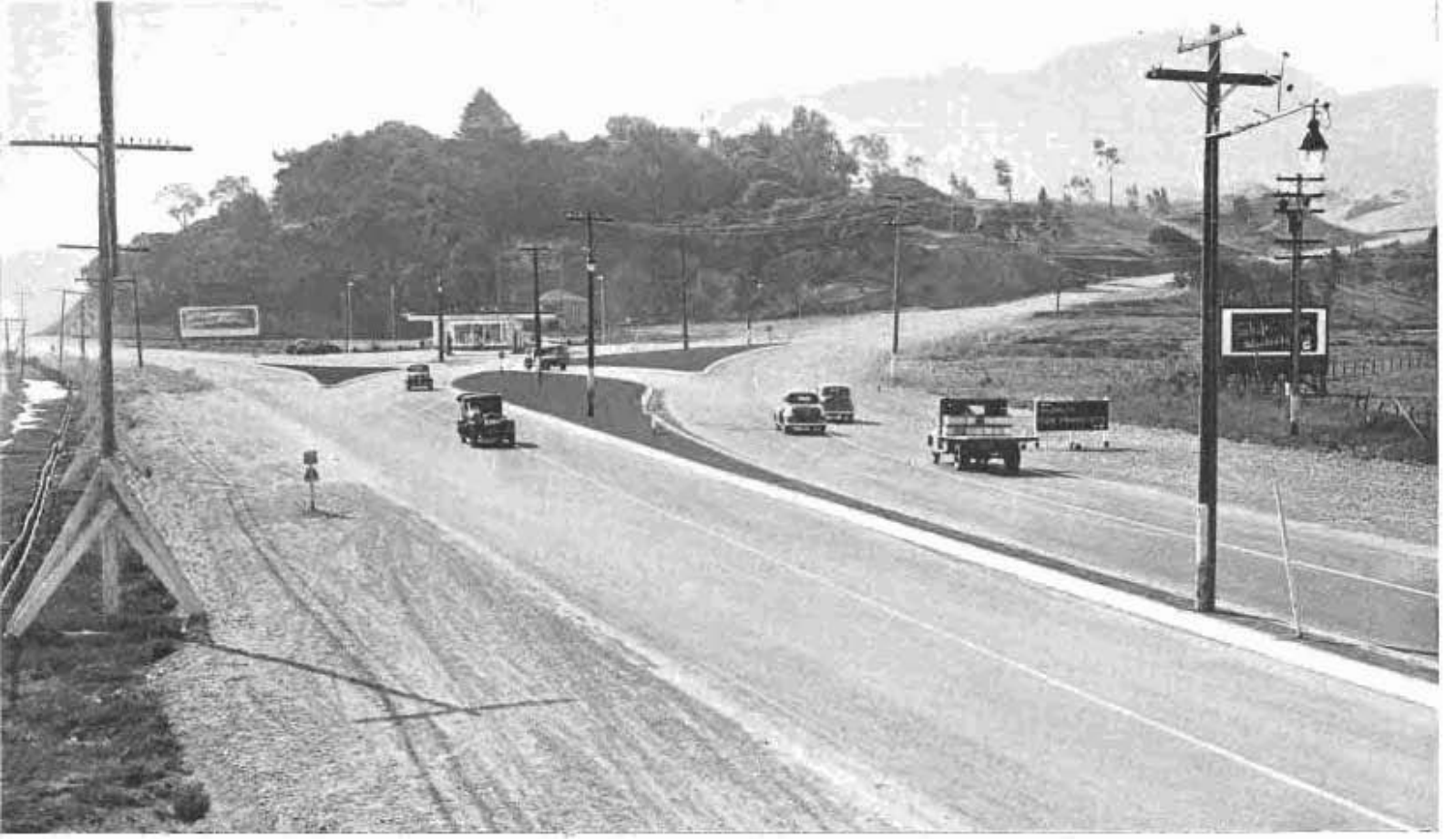
If, on the other hand, there is a considerable interchange of traffic between B and A, more adequate provisions should be provided. This is illustrated in Fig. 4, where a speed change or decelerating lane has been added for protection against rear end collision to vehicles slowing to make the left turn from B to A. Also a separate turning lane has been provided to expedite traffic turning right from A to B and to relieve the intersection proper. This lane should have a radius sufficiently long to permit free flow but should not be great enough to allow traffic to enter C-B at greater than the average speed along C-B. The long narrow island along B-C has a dual purpose in that it assures use of the speed change lanes by left turning traffic and prevents traffic from B to A from making a left turn from the right lane. Thus the possibility of wrong movements has been almost entirely eliminated while the correct movements are easy and natural.

Although the above is about the ultimate in channelization for the particular conditions described, the limit of expansion, without leaving the field of intersections at grade, has not been reached. The engineer still has recourse to traffic signals.

While the use of traffic signals comprises a huge field of study in itself, the full extension of the above type intersection can not be covered without mentioning them here.

This design is particularly adapted to traffic actuated signals which are a comparatively recent development in the intersection field. Simply explained, they consist of treadles so placed in traffic lanes that when passed over or actuated by a vehicle they will set the signal for a predetermined interval so that the vehicle or vehicles may proceed through the intersection while conflicting traffic is stopped. They could be used in conjunction with the channelization shown in Figure 4 when traffic on route B-C becomes so heavy that traffic from B to A and A to C would be unduly delayed waiting for a chance to cross. Initially, treadles could be placed at x or y or both, if required. The intersection is beginning to look complicated but it is not. Traffic from B to C, C to A and A to B can move through with no delay. Traffic from C to B moves through without delay at all times except when the right of way is lost to traffic from B to A or A to C. At first glance it might appear that the last two movements, although they might be light, could rob most of the "GO" interval from the heavier volume of through traffic from C to B. This is not the case because the traffic actuated signal lends itself to adjustment so that the least delay to the greatest volume of traffic results.

Thus the channelization has developed from a simple directional island costing around $300 to a more elaborate affair with signals at a total cost of several thousand dollars. However, if the initial design is intelligently planned and the steps in expansion are made only as traffic



Channelized "Y" type intersection of Waldo approach highway to Golden Gate Bridge and U. S. 101 to Sausalito in Marin County.

warrants, the taxpayer is getting the maximum returns from his investment.

The foregoing discussion has dealt with only one particular type of intersection because it illustrates what can and is being accomplished. Many different conditions will require as many different types of treatment. Even the simple "Y" type intersection illustrated above requires many variations to fit different angles of approach and varying traffic conditions. As the number of intersecting roads increase, the channelization usually must be expanded to meet the still greater increase in number of turning movements until a point is reached where channelization in itself is no longer the solution. In any case, it is usually possible by proper planning to fit the initial development into the ultimate whether the ultimate be signallization or a grade separation.

Although not a channelization in every sense of the word, the traffic circle or rotary has its place with intersections at grade. The rotary in its simplest form is merely a large circular island around which all traffic travels in the same direction and ingress and egress to the circle is limited to right turns. It is particularly adapted to intersections with four or more entering roads of nearly equal traffic volume. When properly constructed with sufficient advance warning signs and deflection islands to direct and slow entering traffic, the number of serious accidents at this type of intersection is very low. The reason for this is that the traffic, because of the comparatively small radii of rotaries, must proceed slowly and that all traffic is moving in approximately the same direction. The chief objection which may be brought against it is the loss of time element, as all traffic must slow to a reasonable speed and must travel a greater average distance of approximately 0.57 of the diameter of the circle each trip through. Thus a 180-foot radius circle which could be traveled under favorable conditions at 35 miles per hour would add about 205 feet to the length of each trip.

The principal functional difference between a rotary and an ordinary channelization is that channelization allows free movement of the larger traffic volumes at the expense of the smaller volume whereas a true rotary penalizes all traffic equally but possible to a lesser extent than the minor movements are penalized in the ordinary channelization.

While channelizations are not the solution for all intersection problems, they have proven themselves very effective in the reduction of accidents and congestion when properly applied within the limits of their warranted usage. Much progress has been made toward their perfection but more is both desirable and necessary and will come with further research and experience, especially through traffic behavior studies of existing installations.

Building the Mint Canyon Cut-off

(Continued from page 8)

Surfacing will be of bituminous plant mix and wide oiled shoulders will be provided. The only railroad crossing on the project will be on an overhead bridge over the Southern Pacific Railroad at Solamint. The entire project is being built to high standards of alignment and grade, with correspondingly high safety features. Sight distance (both vertical and horizontal) has been designed for a minimum of 800 feet. The minimum radius of curvature is 3500 feet.

(Continued on page 26)

Flood Waters Cover 500,000 Acres of Land

(Continued from page 4)

made shore several miles down stream. For this reason, Director of Public Works Clark directed State Engineer Hyatt to engage a plane and to send out boats and to patrol the shores on both sides of the by-pass.

Paget and his companions in a small outboard motor boat were following a line of telephone posts in the by-pass when the prow of the boat hit a post on the north side of the by-pass and capsized. Paget and von Bergen held on to the upright post until their combined weight uprooted it and threw them into the water. McCallum, meantime, had floated downstream and was picked up.

Von Bergen was 34 years of age and had been with the Division of Water Resources since March, 1930. He was married and had a wife and child in Sacramento. The family home is at 3101 Montgomery Way.

It is estimated that the combined maximum flow of the by-pass system and the river opposite Sacramento on March 1st, when the crest was passing, was 355,000 second-feet. This run-off exceeds the estimated flow in December, 1937, which was 262,000 second-feet and the later flood in February, 1938, of 271,000 second-feet.

To give an accurate picture of just what the by-pass system and the river were carrying at that time it is necessary to translate these figures into acre-feet. At the peak flow of 355,000 second-feet, had the system been suddenly dammed below Sacramento, the waters would have spread two feet deep over 355,000 acres in twenty-four hours.

IN BY-PASS SYSTEM

Below Sacramento, Prospect and Liberty Islands lying in the Yolo By-pass and over which the State has flowage rights were flooded when the water rose over the low tidal levees with which they are protected. The Little Holland Tract in the by-pass which is unprotected also flooded as did the Egbert Tract, Van Sickle Island and Upper Hastings. These areas, while subject to flooding in times of extreme high water, are ordinarily farmed and produce large crops of asparagus and sugar beets.

Flash floods on Cache Creek and Putah Creek damaged grain crops and sugar beet lands and drove 250 migrants from a Farm Security Administration Camp along Putah Creek near Winters. The water here came up so quickly during the night the migrants were forced to flee without even their scant belongings and were housed at the State Fair grounds in Sacramento, where they were cared for by the National Guard and the Red Cross. These flash flood waters quickly receded.

The Napa River had the heaviest overflow in 27 years, flooding areas from St. Helena to the bay. In many sections of Napa the water was four feet deep. Schools were closed and the city isolated. Thousands of acres of rich vineyard and orchard land between these two cities were under water and a lake that covered ten square miles lay south of Napa.

The Russian River, swollen by heavy rains, burst its banks, causing heavy damage to summer homes and resorts which line its edge for many miles. Farther north along the coast the chief damage reported was to highways.

In Berkeley a freak cloudburst caused an estimated damage of $100,000 within ten minutes. High tides and heavy rains combined to block Key System electric trains across the San Francisco-Oakland Bay Bridge. South of the bay district in Santa Cruz many homes in the lower section of the city were surrounded by overflow from the San Lorenzo River. Residents in low-lying areas were rescued in row boats.

As the storm passed and the flood waters receded several pertinent facts became evident.

The Sacramento River Flood Control Project proved itself effective and functioned as designed in han-

(Continued on page 27)

Traffic on the Bay Bridge Last Month Exceeded February, 1939

VEHICULAR traffic on the San Francisco-Oakland Bay Bridge was again ahead of that of February a year ago, Director of Public Works Frank W. Clark reported to Governor Culbert L. Olson.

A total of 842,070 vehicles crossed the bridge last month, of which only 13,741 stopped at Treasure Island, leaving a net through bridge traffic of 828,329. In February, 1939, the comparable figures were 753,687 with 146,317 vehicles going to Treasure Island, making the net through traffic 607,370. The 29th day this February helped regular bridge traffic somewhat, while the opening of the exposition on February 18, 1939, had its effect last year.

A year ago the average toll was 51.9 cents, producing a revenue of $390,807 while this year the average toll is down to 36.8 cents with a revenue of $309,669.

"On February 29," Clark reported, "the bridge deposited $1,666,500 to meet its semiannual interest payment of $1,406,500 and to pay off $260,000 of bonds that fell due. There remained $70,065,000 of bonds outstanding. The financial position of the structure is excellent and the market value of the bonds generally stands at about 109."

The heavy storms of February did not leave the bridge entirely unscathed. One leg of the Distribution Structure in the East Bay was closed by high water for almost a day and on two of the other legs traffic was handled under control for many hours. On Yerba Buena Island sand and debris was washed onto the lower deck, blocking drains and backing up water so that this deck had to be closed to traffic for several hours.

February traffic and comparative figures are:

Passenger autos and auto trailers	**767,371**	**673,134**	**772,440**	**29,212,099**
Motorcycles and tricars	**2,699**	**2,869**	**2,471**	**134,872**
Buses	**15,380**	**12,445**	**16,469**	**472,801**
Trucks and Truck Trailers	**40,984**	**46,832**	**41,798**	**1,401,831**
Others	**15,636**	**18,407**	**16,732**	**494,998**
Total vehicles	**842,070**	**753,687**	**849,910**	**31,716,601**

Portion of Funston Avenue approach to Golden Gate Bridge under construction through San Francisco Presidio looking toward 1300-foot tunnel.

Golden Gate Bridge Approach Construction Nears Completion

By JNO. H. SKEGGS, District Engineer

BEGUN in October, 1938, the Funston Avenue approach, extending from the intersection of Lake Street and Park Presidio Boulevard on the south side of the Presidio of San Francisco to the Marina approach to the Golden Gate Bridge, is rapidly nearing completion. Depending on weather conditions, it is tentatively scheduled for opening to public traffic about April 15, 1940.

Unique features and financing of the project were detailed in the June, 1939, issue of "California Highways and Public Works."

Although hampered somewhat by inclement weather during the latter part of 1939 and the early part of this year, progress has otherwise been very satisfactory.

Due to the necessity of completing various portions of the project before subsequent operations could be started, adherence to planned schedules for coordinating all construction operations was imperative, keeping in mind the speed with which the various contracts could be economically performed and the earliest possible date for opening the project to public travel.

Completion of the contract for grading, and the construction of the 1300-foot, 4-lane cut and cover tunnel section extending under the Presidio golf course, was accomplished without material delay in January, 1940.

Two sections of steel form jumbos, which had been formerly used on the construction of the Bartlett Multiple-arch dam in Arizona, traveling on standard railroad rails, were used in constructing the tunnel arch. Each section above the spring line, consisting of twenty-eight lineal feet between expansion joints, was constructed in one continuous pour of concrete. Alternate pours at each jumbo placed at opposite ends of the tunnel made it possible to complete from two to three sections per week. Copper strips at each expansion joint were placed to prevent seepage of water into the tunnel.

Tunnel excavation was used to construct the embankment across Mountain Lake, excess material acting as a surcharge to displace soft underlying mud. Upon completion of the concrete tunnel section this surcharge was removed and placed as backfill over the tunnel section to the approximate original ground levels, permitting golf-course facilities to be replaced to their original state.

Construction of the viaducts, all rigid frame, continuous girder type structures, was carried on simultaneously with the tunnel and grading operations, being, however, under separate contracts. Construction was carried on continuously, forms and falsework being cleaned, oiled and used on succeeding work. Progress of pouring and curing of concrete in girders and deck made it possible to use again the timbers and forms, without the necessity of obtaining

At top—Completed south approach walls and portal of cut and cover tunnel under Presidio golf course. Adjacent slope areas to be planted with trees and shrubs. At bottom—Mechanical finishing float and paver at work surfacing 4-lane divided highway.

sufficient material to complete the structures simultaneously.

Construction of Viaducts "A," "B" and "C," over West Pacific Avenue, Kobbe Avenue, and Storey Street, respectively, all Presidio post roads, was accomplished under a single contract which was completed on December 22, 1939.

Viaduct "F," having a centerline radius of 299 feet and a height of 70 feet above the ground, provides a connection to the Golden Gate Bridge approach for traffic from San Francisco's Richmond District to the Marina District. This viaduct was designed for curved beams and was completed under separate contract on November 30, although the same contractor was the low bidder on both viaduct contracts. All viaducts on the project were, therefore, constructed by the same contractor.

In order to provide a means for traffic to have rapid access to the Richmond from the Marina District, it was necessary to construct a ramp from the north side of the Golden Gate Bridge approach, and construct an underpass across the approach.

During the construction of the underpass, it was necessary to close the southern half of the Golden Gate Bridge approach for approximately 150 feet, southbound traffic being diverted to the north lanes of the approach, and northbound traffic being detoured north of the approach for a distance of approximately two hundred feet.

Upon completion of the southerly end of the underpass, southbound traffic was permitted to assume its regular lanes, northbound traffic using the constructed detour until the north portion of the underpass was completed. No delay and little inconvenience was encountered while the detour was in use.

Included in the same contract for construction of the underpass were the approach walls, pedestrian underpasses accomodating pedestrian traffic of the Golden Gate Bridge, and drainage facilities connecting to the main system for the project. Final work on the contract was done on February 21, 1940.

As explained under previous articles on the project, all drainage within the limits of the project is disposed of by means of master drains terminating in the bay at the northerly end of the job, and into Mountain Lake on the southerly end. No drainage originating within the limits of the work is disposed of upon adjacent Presidio property.

Nearly simultaneous completion of the viaducts and tunnel and grading operations made it possible to begin paving and landscaping operations at about the same time.

Placing of crusher run base, concrete paving, curbs and gutters, electrical conduit and electrical fixtures for signs and lighting were included under one contract, which is still in progress.

Landscaping and beautifying of areas adjacent to the traveled way was covered under separate contract, which is still in process of execution.

A Rex 27-E paver in use on concrete pavement is augmented by an adjustable width Ord tamping machine and a Johnson finishing float, designed by an engineer of the Division of Highways. The newly developed float has proven its value on other paving contracts, in obtaining the desired finish and smoothness required by the Department of Public Works.

Owing to the fact that the project is a freeway, with the exception of two minor approaches for official use of the United States Army, openings are to be left in the curbs at convenient intervals and locations for access to emergency parking areas that are to be maintained within the shoulder area. Portions of the shoulder between the parking areas are to be planted with shrubs.

Noteworthy is the commendable cooperation by the United States Army authorities, the PWA Regional Director and the Resident Engineer for the PWA, in assisting the Division of Highways.

Construction consisted of six major contracts performed by:

Macco Construction Co. Grading and tunnel construction. 1 contract.

Union Paving Co. Viaducts "A," "B," "C" and "F" and paving, lighting and signs. 3 contracts.

M. J. Lynch. Highway Underpass and 2 pedestrian underpasses. 1 contract.

Leonard C. Coats. Landscaping. 1 contract.

Supervision of the project was under the direct control of T. E. Ferneau, Resident Engineer for the Division of Highways, and F. W. Moore, Resident Engineer Inspector for the Public Works Administration.

Accompanying pictures of the project indicate the progress that has been made during the period of construction to the middle of February, 1940.

Realignment of U. S. 40 Between Sacramento and Dixon

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which will enter and leave the new road here when using the present road leading to Woodland and up the west side of the Sacramento Valley.

The Southern Pacific Company's double track main line is crossed by this new location about 0.5 mile southwest of the existing subway at Davis. In anticipation of the construction of a divided four-lane subway here, funds being available from the Federal Aid Grade Separation Program, the present project includes the construction, adjacent to the railroad, of a grade to accommodate the two tracks of the railroad on a "shoofly" which will carry trains past the subway during the construction of the supports under the present tracks. The material for the "shoofly" will be obtained from the portion of the subway included in the grading contract.

Funds are also set up for the construction of three bridges; one over the South Fork of Putah Creek, which carries the bulk of the run-off of the drainage area; the other two will be parallel adjacent structures over Putah Creek, to meet the divided highway construction planned.

No paving is included in the funds set up in the present biennium, but it is hoped that money will be available in the next biennium to pave this important improvement.

A number of other projects completed during recent years are part of a planned program to bring this important road up to a standard commensurate with its importance.

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Administrative Problems of State Highway Maintenance

By T. H. DENNIS, Maintenance Engineer

This is the third and concluding installment of an address delivered by Mr. Dennis at the meeting of the Statewide Highway Committee of the California State Chamber of Commerce at the Palace Hotel in San Francisco.

THE collection of detail for the maintenance budget is given careful attention by the entire supervisory organization. Its preparation requires at least six months. In common with other State budgets, it is prepared some eight months in advance of its effective date. Each District Engineer is contacted who, through the District Maintenance Engineer and Superintendents, reviews each section of road. Estimates are prepared not only for the routine work, but also for such items as seal coats, restoring of base and innumerable similar items which must be taken care of during the ensuing two-year period. The District Engineers' recommendations are assembled and reviewed in Central Office. If doubt exists as to necessity for any work recommended, a field inspection is made.

THE MAINTENANCE BUDGET

Table 9 sets forth the respective items and amounts which make up the present Biennium Maintenance Budget. The relative percentage to the total is also shown.

There is shown below, for comparison, detail of the maintenance budget for the current and past bienniums:

TABLE 10

Comparison of Budgets

	89th-90th Fiscal Yrs.	91st-92nd Fiscal Yrs.	Per Cent Increase	Per Cent Decrease
General Maintenance	$9,818,472	$10,422,601	6.2	
Major Slides and Storm Damage	1,705,910	2,020,850	18.5	
Replacement	2,486,191	3,402,160	36.8	
Improvement Service	1,637,702	2,105,469	28.6	
Capital Investment	351,725	197,050		44.0
	$16,000,000*	$18,148,130	13.4	

**This amount does not include supplemental funds voted to care for extraordinary storm damage of 1937-38 winter season.*

It is noted that the net increase in the budget for the current biennium is 13.4 per cent, as compared to the amount provided for the previous period. The increases may be accounted for, in part, by three major items:

1. Increase in wages $754,000
2. Increase to cover deferred storm damage from previous biennium 300,000
3. Increase to take care of replacement work deferred in 1938 due to necessary transfer of all available funds to emergency storm damage repair.

Items 1 and 2 account for some 50 per cent of the increase. It is difficult to estimate exactly the increase due to the deferment shown under Item 3, though it is reasonable to presume a part of the $1,000,000 increase in such items as remixing and sealing oil surface, both traveled way and shoulders, restoration of subbase and repair of bridges was occasioned thereby.

In the above comparison, the General Maintenance item is some 6 per cent greater than that of the past period. The increase in labor cost, however, more than absorbs this difference so that actually work per-

TABLE 9

Summary of Biennium Maintenance Budget for 91st and 92d Fiscal Years July 1, 1939, to June 30, 1941

		Amount	Per Cent	Per Mile Per Year
1. General Maintenance		$10,422,601	57.43%	$413
2. Major Slide Removal		2,020,850	11.14%	80
3. Replacement & Improved Service				135
(a) Replacement Projects				
Renew Dust Oil (T. W.)	$141,165—0.78%			
Renew Dust Oil (Shldrs.)	31,300—0.17%			
Remix Oil Surface (T. W.)	923,543—5.09%			
Remix Oil Surface (Shldrs.)	346,906—1.91%			
Oil Sealing (T. W.)	629,506—3.47%			
Oil Sealing (Shldrs.)	101,540—0.56%			
Restore Sub-base (T. W.)	429,800—2.37%			
Restore Sub-base (Shldrs.)	81,250—0.45%			
Bridge Painting	201,555—1.11%			
Bridge Repairs	515,595—2.84%			
		3,402,160	18.75%	
(b) Improved Service Projects				83
Guard Rail Installation	54,100—0.30%			
Guard Rail Repairs	18,025—0.10%			
Weed Eradication	246,800—1.36%			
Traffic Striping	494,453—2.72%			
Signs & Signals	88,558—0.49%			
Snow Removal	1,033,462—5.70%			
Sanding Icy Pav'ts	98,371—0.54%			
Planning & Discing Surface	21,600—0.12%			
Non-skid Surfacing	27,300—0.15%			
Sodium Vapor Lights	22,800—0.13%	2,105,469	11.60%	
4. Capital Investment		197,050	1.08%	8
Total		$18,148,130		$719*

* (or $711 excluding the Capital Investment)

formed during this period will be somewhat less than in the previous two years. There are several items in the above costs which unduly affect the per mile cost of maintenance. A few of these items are listed below:

	Biennial Requirements
Operation of 23 movable span bridges	$200,000
Operation of two ferries	20,000
Operation and lighting of State's portion of Broadway Low Level Tunnel on Route 75	28,000
Lighting of Bay Shore Highway	16,000
Lighting of section of Waldo Approach	13,000
Funds required to supplement ½ cent funds for upkeep of State highway routes in incorporated cities where ½ cent funds are inadequate	86,000
	$363,000

The above amount, if available for routine maintenance alone, would provide for the annual care of some 450 miles of highway.

REPLACEMENT PROJECTS

Replacement projects, which represent 18.75 per cent of the total maintenance program, cover the renewal and sealing of oiled surfaces —both traveled way and shoulders— the restoration of subbase, as well as bridge repairs and painting. This work forestalls heavier expenditures which would be required for earlier reconstruction, but it is evident that such expenditures will increase in proportion to the delay in programming this needed reconstruction. This replacement or repair program insures the motorist of the continuing use of what, in many cases, are substandard facilities.

Improved service projects, which amount to 11.6 per cent of the total budget, include guard rail installation and repairs, weed eradication, traffic striping, signs and signals, snow removal, sanding icy pavements, discing and nonskidding surface. The major items of this type include snow removal, traffic striping and weed eradication. These are purely service projects, and their growth is indicative of the pressure made for their expansion. Snow is removed on 3500 miles of road, 15 per cent of which is for snow sports almost exclusively. The cost of snow removal on this 15 per cent is ten times the fuel tax revenue earned from the induced traffic.

TRAFFIC STRIPING

Traffic striping is one of the most worthwhile safety measures. The demand and the necessity for this type of work are increasing. In the past, it has been our practice to repaint most of the stripe once each year. This program no longer suffices, and it has been necessary to paint more often over a larger mileage, and to paint double and triple stripes.

The control of roadside vegetation is sponsored and advocated by many organizations. It is of benefit to adjoining property as protection from fires which may be started by highway traffic.

Provision for Major Slide Removal shows an increase of 18.4 per cent over that of the 89th-90th fiscal years. Actually, the increase is required for the restoration of certain mountain routes in the southern part of the State on which it was necessary to defer work last biennium due to lack of funds. The funds required for slide removal will, of course, vary with the severity of the winter. Recently, an unprecedented storm in Imperial and Riverside counties caused damage which would require in excess of $400,000 if complete restoration and protection were assured.

In the last analysis, the measure of service is the relation between cost and service rendered. Income for highway purposes is dependent on operation of motor vehicles. The measurement of service can therefore be made on the same basis. As mentioned in a preceding paragraph, 6,825,000,000 vehicle miles of travel are generated on the California rural State highway system. The cost of maintaining the roads for this traffic last year averaged 12.6 cents for every 100 miles of travel. A comparison has been made with similar service for the five Western States as shown in Table 11. It is noted that, as compared to California, the cost per vehicle mile varied from 1.45 times to 2.75 times greater for the four neighboring states.

Building the Mint Canyon Cut-off

(Continued from page 20)

The final contract was awarded September 8, 1939, and the time limit for completion is September 20, 1940. However, the contractor (N. M. Ball Sons) have made exceptionally rapid progress and it is now estimated by Resident Engineer M. L. Bauders that work will be completed some time during July.

The entire project from Tunnel Station to Solamint is 7.13 miles in length and the approximate cost will be $836,000. The saving of 5.2 miles to motorists will be sufficient to pay for the entire project in four years based on present traffic.

TABLE 11

Comparison of Maintenance Costs and Traffic on State Highways of Five Western States

	Miles Maintained	Amount of One Year Expenditures	Average cost per Mile	Annual Veh. Miles of Travel	Relative Cost of Maintenance Expressed in Cost and Per Cent by Vehicle Miles of Travel	
					%	Cost per vehicle mile
Arizona	3,460	$1,168,310	$338	635,070,800	145	$0.001839
California	12,622	8,618,178*	683	6,825,000,000	100	.001263
Nevada	2,806	831,000	197	239,653,000	275	.003468
Oregon	6,828	3,383,197	495	1,501,630,000	178	.002253
Washington	5,916	3,736,000	632	1,500,000,000	197	.002490

** This is the amount spent on rural State Highways only.*

Highway Damage Totals $1,267,200

(Continued from page 7)

The above is not a complete list of all closed routes, but is indicative of the general extent.

Bridge Damage

Aside from the delays and inconvenience to traffic, the direct damage is estimated as follows:

Bridges destroyed or damaged	**$192,000**
Fills washed or slipped out	**489,000**
Slides	**586,200**
Total	**$1,267,200**

Some of the major items of damage may be mentioned:

Redwood Highway—U. S. 101.

1. Failure of north approach span across Eel River at Scotia.
2. Slipouts at Greenlaw and Shively Bluffs.
3. Slipout two miles north of Cloverdale.
4. Slides at Waldo approach.

Bayshore Highway—U. S. 101 By-Pass.

5. Slide at Brisbane.

Huge rock slide on Feather River Highway east of Oroville blocked traffic.

6. Bulkhead failure at Francisquito Creek.

Russian River, State Sign Route 12.

7. Slides and slipouts, Guerneville to Monte Rio.

Tahoe-Ukiah, State Sign Route 20.

8. Washout at Cache Creek.

Pacific Highway, U. S. 99.

9. Damage to bridge north of Redding.

Feather River Highway, State Sign Route 24.

10. Severely damaged by washouts and slides at several points from west of the Butte-Plumas County line to east of Quincy.

Flood Waters Cover 500,000 Acres of Land

(Continued from page 21)

dling flood waters. In the project the only levees broken north of Princeton and in District 1660 and 70 were those not up to standards and are among those which the War Department has scheduled for reconstruction.

It was also evident that had the Shasta Dam unit of the Central Valley Project been completed it would have served as an effective check on a flood of this type, as shown by stream flow figures already available. Provision has been made at Shasta Dam for storage space for 500,000 acre-feet of water for flood control purposes. However, engineers point out that at this time of year there might have been storage space for as much as a million acre-feet of flood waters. With this amount of storage available the crest of the flood could have been held back and effectively checked.

Comparison of figures on the flow at Kennett and at Red Bluff in the 1937 flood and the present storm reveal a much heavier run-off in the watershed above Kennett this year. During the 1937 peak run-off, the flow at Kennett was estimated at 132,000 second-feet and at Red Bluff at 262,000 second-feet. Thus approximately half of the flow of the river or 130,000 second-feet originated between Kennett and Red Bluff.

In the present storm, in which the river reached the highest mark ever recorded by the weather bureau gauge at Kennett, the flow was estimated at 182,000 second-feet and at Red Bluff at 292,000 second-feet, showing that the major portion of the run-off originated above Shasta Dam site and consequently could have been held in check.

The Emergency Council met on March 5 and ordered a survey of damage in the flooded areas. Members of the Council are: Finance Director John R. Richards, Public Works Director Frank Clark, Adjutant General P. J. H. Farrell, Dr. Walter F. Dickie, Chief E. Raymond Cato, Highway Patrol; Fred M. Carlson, Robert Beauchamp, American Legion; H. J. McCurry, Red Cross and Kerman Robson, San Francisco.

Highway Bids and Awards for the Month of February, 1940

ALAMEDA COUNTY—At Arroyo del Valle, about 2 miles south of Livermore, a reinforced concrete bridge having an overall length of 246 feet to be constructed and about 0.6 mile of approaches to be graded and surfaced with gravel and armor coat. District IV, Route 108, Section A. Earl W. Hepie, San Jose, $44,092; Scheumann & Johnson, Eureka, $47,752; Piombo Bros. & Co., San Francisco, $47,777; Harold Smith, St. Helena, $49,197; M. J. B. Construction Co., Stockton, $49,534; E. E. Smith & N. M. Ball Sons, Berkeley, $49,563; A. Teichert & Son, Inc., Sacramento, $49,913; John Rocca, San Rafael, $51,578; A. Soda & Son, Oakland, $52,154; Trewhitt-Shields & Fisher, Fresno, $54,859; L. D. Tonn, Lodi, $55,993; A. G. Raisch, San Francisco, $56,239; B. H. Miles, Hollister, $58,598; R. G. Clifford, San Francisco, $60,345; M. J. Lynch, San Francisco, $61,678. Contract awarded to Caputo & Keeble, San Jose, $43,463.

CONTRA COSTA COUNTY—About 21 miles west of Stockton at drainage canals, a reinforced concrete box culvert and two reinforced concrete slab bridges to be constructed and an embankment and approaches to be graded and surfaced. District IV, Route 75, Section D. E. E. Smith, Eureka, $18,733; John Rocca, San Rafael, $20,371; Caputo & Keeble, San Jose, $20,677; A. A. Tieslau, Berkeley, $21,249; A. Soda & Son, Oakland, $21,493; Albert H. Siemer and John Carcano, San Anselmo, $22,970; M. J. B. Construction Co., Stockton, $24,865. Contract awarded to Harold Smith, St. Helena, $18,043.

HUMBOLDT COUNTY — Across Eel River at Robinson Ferry, a bridge consisting of steel truss spans and reinforced concrete approach spans to be constructed and about 0.07 mile of roadway to be graded. District I, Route 1, Section E. John Rocca, San Rafael, $461,555; R. G. Clifford, San Francisco, $472,278; A. Soda & Son, Oakland, $474,363; United Concrete Pipe Corp. & Mercer Fraser Co., Eureka, $478,630; Heafey-Moore Co., Frederickson & Watson Construction Co., Oakland, $478,889; C. W. Caletti & Co., San Rafael, $491,568; W. A. Bechtel Co., San Francisco, $521,118; Guy F. Atkinson Co., San Francisco, $523,126; Macco Construction Co., Clearwater, $548,724; Sordal & Bishop, Long Beach, $557,326; Hanrahan-Connolly Co., San Francisco, $558,399; J. H. Pomeroy & Co., Inc., San Francisco, $568,270; Geo. Pollock Co., Sacramento, $593,194. Contract awarded to Engineers, Ltd., San Francisco, $455,580.

HUMBOLDT COUNTY—Across Eel River at Scotia, a bridge consisting of steel truss spans and reinforced concrete approach spans to be constructed, and about 0.24 mile of roadway to be graded. District I, Route 1, Section B. Engineers, Ltd., Sacramento, $334,203; R. G. Clifford, San Francisco, $335,763; Campbell Construction Co., Sacramento, $343,415; John Rocca, San Rafael, $344,555; Heafey-Moore Co.-Frederickson and Watson Construction Co., Oakland, $347,156; United Concrete Pipe Corp. & Mercer Fraser Co., Eureka, $349,743; C. W. Caletti & Co., San Rafael, $359,183; Barrett & Help, San Francisco, $371,225. Contract awarded to A. Soda & Son, Oakland, $329,989.

INYO COUNTY—Between Olancha & Cottonwood Creek, about 9.0 miles to be graded and surfaced with plant-mixed surfacing. District IX, Route 23, Sections I,J. Claude C. Wood and Frank B. Marks & Sons, Lodi, $87,895; G. W. Ellis, North Hollywood, $91,194; Griffith Co., Los Angeles, $91,244; Piazza & Huntley, San Jose, $95,520; Isbell Construction Co., Reno, Nevada, $96,458; Oswald Bros., Los Angeles, $98,705; Parish Bros., Hollywood, $106,294. Contract awarded to Basich Bros., Torrance, $78,765.

KERN COUNTY—Across Tule Canal, 29 miles west of Bakersfield, a reinforced concrete slab bridge to be constructed. District VI, Route 58, Section J. C. C. Gildersleeve, Berkeley, $5,998; John Jurkovich, Fresno, $6,078; Thomas Construction Co., Burbank, $6,261; Rexroth and Rexroth, Bakersfield, $6,302; E. G. Perham, Los Angeles, $6,404; Griffith Co., Los Angeles, $6,596; Albert E. Mangs & Associates, San Francisco, $6,962; Louis Biasotti & Son, Stockton, $7,614. Contract awarded to James E. Anderson, Visalia, $5,481.

KINGS AND TULARE COUNTIES—Two reinforced concrete slab bridges across branches of Cross Creek and one timber bridge with concrete deck across Tule River to be constructed. District VI, Route 135, Sections B,A. A. Frederick Anderson, Oakland, $33,564; Trewhitt-Shields & Fisher, Fresno, $33,956; E. G. Perham, Los Angeles, $34,553; John Rocca, San Rafael, $35,586; Rexroth & Rexroth, Bakersfield, $35,089; Albert H. Siemer and John Carcano, San Anselmo, $36,484; E. E. Smith, Eureka, $36,747; A. Soda and Son, Oakland, $37,648. Contract awarded to L. D. Tonn, Lodi, $33,220.

LASSEN COUNTY—Between Lake Leavitt and Rager's Corner about 5.9 miles to be graded; portions to be surfaced with road-mix surfacing; and penetration oil treatment to be applied to other portions. District II, Route 73, Section A. Dodge Construction, Inc., Fallon, Nevada, $30,798; Harms Bros., Sacramento, $31,604; Oilfields Trucking Co., Bakersfield, $32,358; Claude C. Wood, Lodi, $32,497; Parish Bros., Hollywood, $32,630; Lee J. Immel, Berkeley, $37,433; Poulos & McEwen, Sacramento, $37,920. Contract awarded to Isbell Construction Co., Reno, Nevada, $29,999.

LOS ANGELES COUNTY—The superstructure of an undergrade crossing under the tracks of the A. T. & S. F. Ry. Co. and the U. P. R. R. Co. and over the Arroyo Seco and Arroyo Seco Parkway near Avenue 35, consisting of steel track spans. District VII, Route 205, L.A. Bethlehem Steel Co., Los Angeles, $122,740; Consolidated Steel Corp., Ltd., Los Angeles, $126,494. Contract awarded to Columbia Steel Co., Los Angeles, $118,695.05.

MADERA-MERCED COUNTIES—Between one-half mile north of Ash Slough and Dutchman Creek about 4.4 miles to be graded, surfaced with road mixed and plant mixed surfacing and a reinforced concrete bridge to be constructed. District X, Route 4, Sections C,A. Valley Construction Co., San Jose, $79,604; M. J. B. Construction Co., Stockton, $82,419; Louis Biasotti & Son, Stockton, $82,722; A. S. Vinnell Co., Alhambra, $84,150; Trewhitt-Shields & Fisher and Stewart & Nuss, Inc., Fresno, $84,480; Marshall S. Hanrahan, Merced, $87,283; Daley Corp., San Diego, $89,679; Piazza & Huntley, San Jose, $90,599; Claude C. Wood, Lodi, $90,791. Contract awarded to A. Teichert & Son, Inc., Sacramento, $75,963.

RIVERSIDE AND SAN BERNARDINO COUNTIES—Between the county line and Santa Ana River bridge, traffic islands and separation strips to be constructed. District VIII, Route 43, Sections C-F. George Herz & Co., San Bernardino, $2,965; Matich Bros., Elsinore, $2,708; Edward Green, Los Angeles, $2,310. Contract awarded to A. L. Gabrielson, Arlington, $2,260.

SACRAMENTO COUNTY—Between Emmaton and Freeport, about 1.5 miles riprap slope protection to be constructed. District X, Routes 11 and 53, Sections DEFC, A I St. Hutchinson Co., Oakland, $32,583. Contract awarded to Basalt Rock Co., Inc., Napa, $31,166.78.

SAN BERNARDINO COUNTY—Near Cajon Station, about 0.3 mile approaches to two bridges to be graded and surfaced with plant-mixed surfacing. District VIII, Route 31, Section B. A. S. Vinnell Co., Alhambra, $7,652; W. E. Hall Co., Alhambra, $7,808; Matich Bros., Elsinore, $7,816. Contract awarded to Geo. Herz & Co., San Bernardino, $7,234.90.

SAN BERNARDINO COUNTY—Between Mount Andreson and Crestline, about 1.2 miles to be graded and road-mix surface treatment applied. District VIII, Route 188, Section A. Claude Fisher Co., Ltd., Los Angeles, $58,412; Geo. Herz & Co., San Bernardino, $59,871; Rexroth & Rexroth, Bakersfield, $64,931; Daley Corp., San Diego, $65,494; Denni Investment Corp., Wilmington, $65,528; A. S. Vinnell Co., Alhambra, $69,216; W. E. Hall Co., Alhambra, $73,826; Dimmitt & Taylor, Los Angeles, $73,990. Contract awarded to Matich Bros., Elsinore, $57,210.

STANISLAUS COUNTY — Grade 0.3 mile and pave with Portland cement concrete and asphalt concrete at south approach to Turlock overhead. District X, Route 4, Section A. M. J. B. Construction Co., Stockton, $14,548; S. M. McGaw, Stockton, $14,143. Contract awarded to Union Paving Co., San Francisco, $12,345.

TEHAMA COUNTY—On Sand Slough Bridge, about ¼ mile east of Red Bluff, portions of existing bridge to be removed; reinforced concrete curbs to be constructed. District II, Route 3, Section D. Liston Ehorn, Red Bluff, $6,179; M. A. Jenkins, Sacramento, $6,573; C. C. Gildersleeve, Berkeley, $7,211; J. P. Brennan, Redding, $7,558; L. D. Tonn, Lodi, $7,724; Stanley P. Cooley, Palo Alto, $7,904; A. Soda & Son, Oakland, $8,534. Contract awarded to Frank Embleton, Albany, $5,735.50.

Realignment Between Sacramento and Dixon

(Continued from page 24)

Further contemplated changes will clip off another 2.20 miles, adding up a total of 13.45 miles which will eventually have been cut from the distance upon the completion of the program.

It is estimated that the annual total saving due to the shortening of distance in the present project will be 5,200,000 vehicle miles. Using 3 cents per mile, which is considered a very conservative figure, the total annual saving will amount to $156,000, which considerably exceeds the contract price of $127,300 of the present grading project.

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printed in CALIFORNIA STATE PRINTING OFFICE
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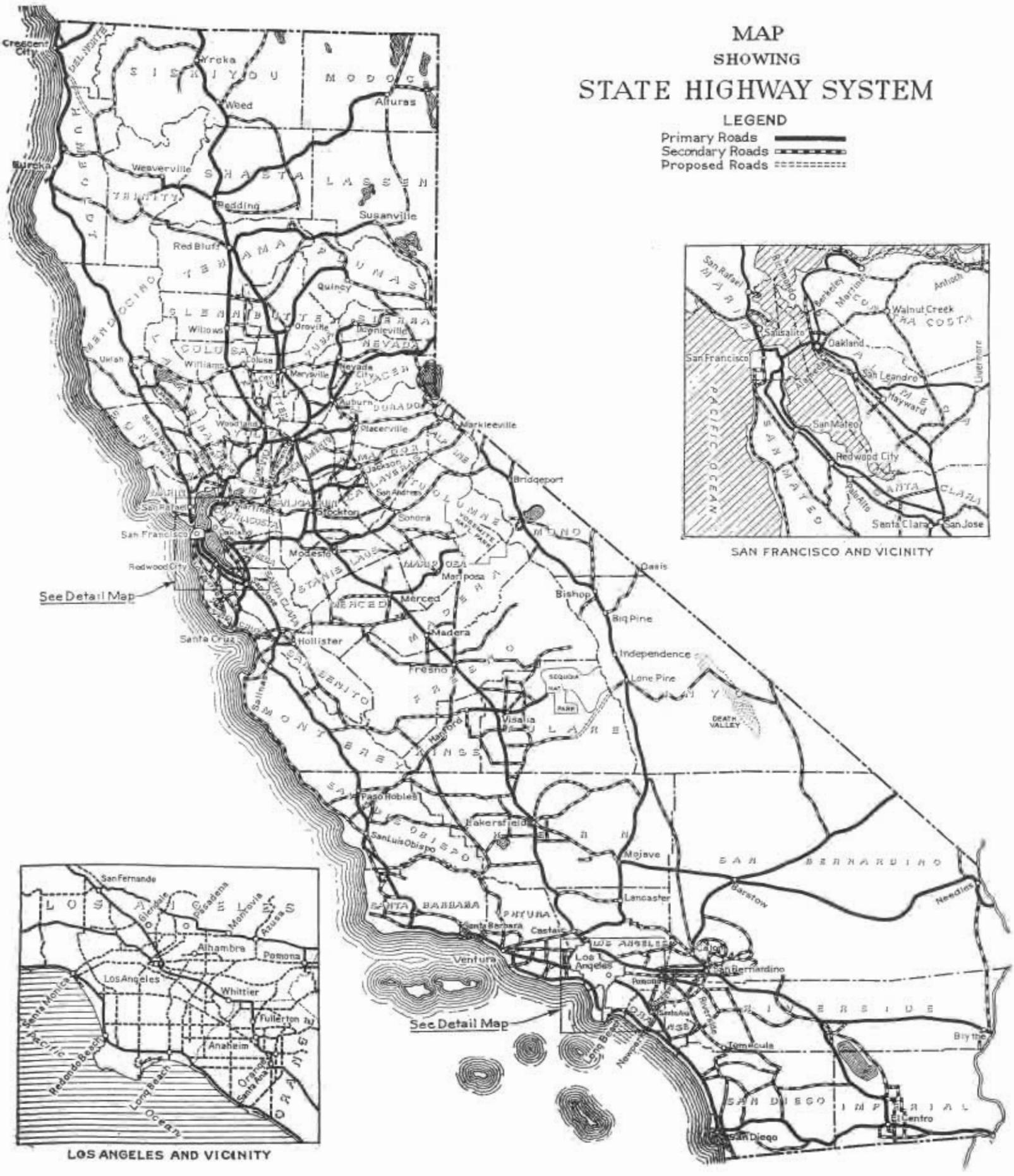

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