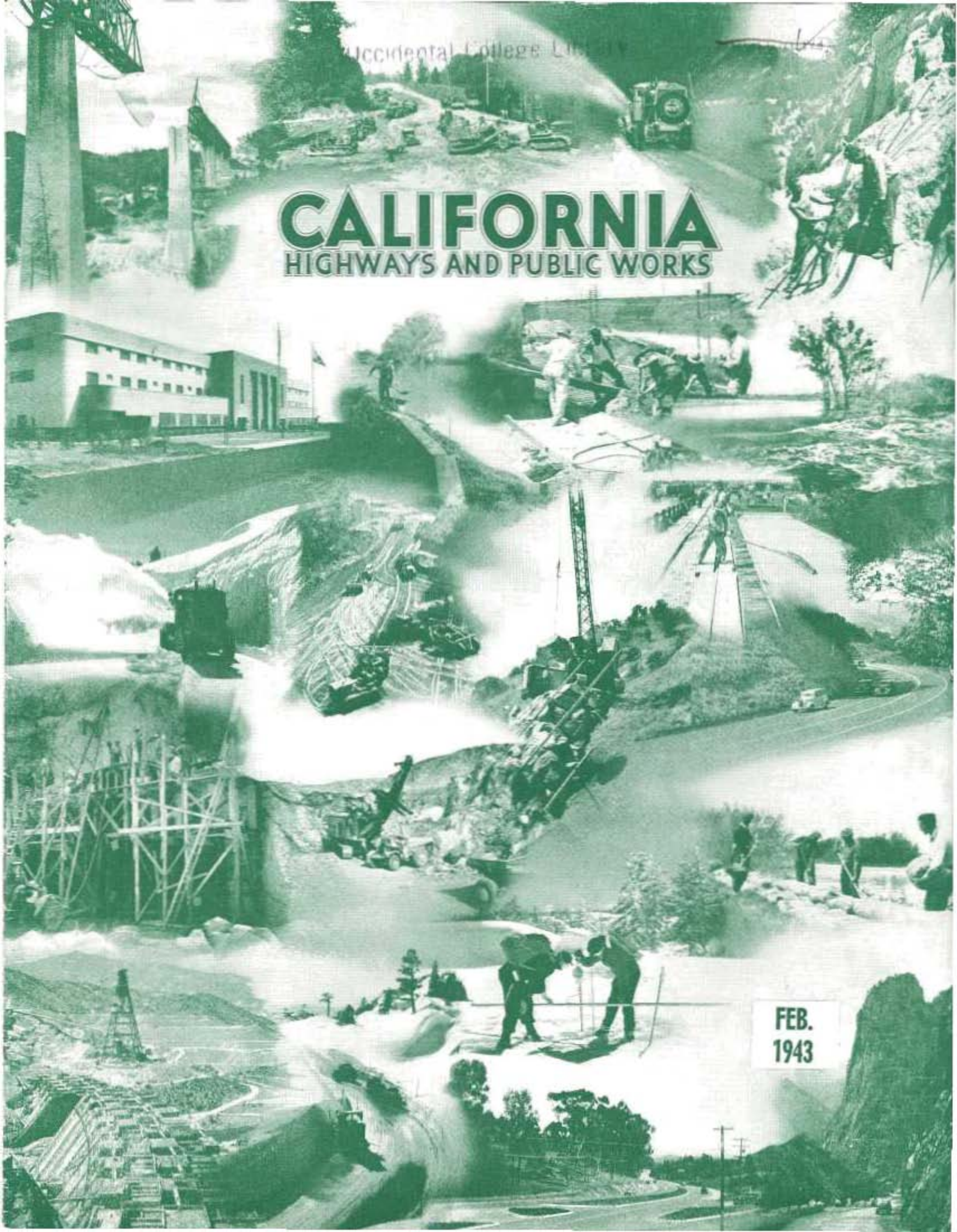

CALIFORNIA
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CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California [PRINTED IN U. S. A.]

C. H. PURCELL, Director GEORGE T. McCOY, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

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Relocation of U. S. 99, Around Shasta Dam Reservoir Site Completed and Opened to Public Traffic

By E. J. BASSETT, District Office Engineer

THE opening to public traffic of the relocated U. S. Highway 99 around Shasta Dam Reservoir on January 8th without fanfare of ceremony or publicity, marked the completion by the United States Bureau of Reclamation of a vast engineering project costing approximately $7,245,000.

The project included the Pit River Bridge, the highest double-deck highway and railroad structure in the world, which was designed and constructed by the U. S. Bureau of Reclamation engineers at an approximate cost of $5,075,000.

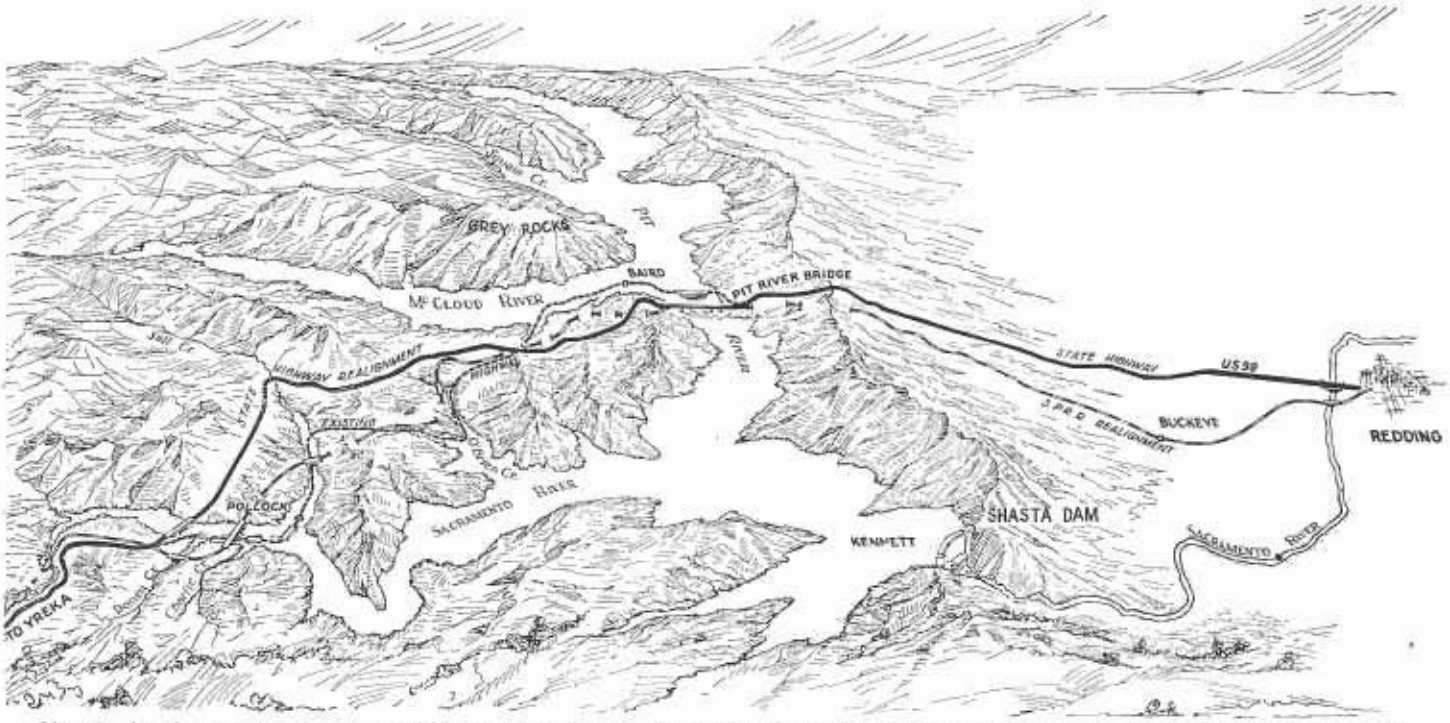
The California Division of Highways located and constructed approximately 15.5 miles of highway, including the Antler Bridge, which was designed by Division of Highways' engineers. The Department of Public Works cooperated with the U. S. Bureau of Reclamation by furnishing a percentage of the cost of relocating a portion of this historic old route, known for decades as the Oregon Trail.

LED TO SACRAMENTO VALLEY

It was used by the pioneers who came over the northern routes to California. They followed the beaten path of the early days which led across the Siskiyous and down through the Sacramento Canyon to Redding, and thence into the Sacramento Valley.

What was once little more than two tracks through the wilderness has been transformed by successive improvements to a modern highway. Its terminals and branches have been extended to embrace a comprehensive transportation system which covers the coastal States and even its name has been changed to the all inclusive designation of Pacific Highway.

And now, on a portion of this route has been built the great Shasta Dam, which will store up the waters of the Sacramento and Pit rivers behind its barriers, waters that will eventually obliterate not only the remaining vestiges of the old overland route but much of the existing highway which spans the area within the confines of the great lake to be. So, to maintain our transportation lines for the requirements of the present and with consideration for future needs, within economic limitations, a new highway has been built through the mountains and across the rivers to replace the pres-



Sketch showing routes of relocated highway and railroad around lake that will be formed by river waters behind Shasta Dam

Photograph of Pit River Bridge, a double-decked structure carrying a railroad on the lower deck and the highway on top 350 feet. The existing

ent road which soon will be no longer available for use.

So much has already been printed regarding the technical elements of this great undertaking that little has been left untold. We have read of the massive Pit River Bridge, the highest of its type, with its lower double-track deck for the use of railroad trains and its four-lane highway sitting atop the cantilevered trusses; of the Sacramento River Bridge at Antler, somewhat dwarfed by its big sister on the Pit, but interesting nevertheless because of its complicated design on both vertical and horizontal curves; its hollow piers through which the water may circulate for increased stability to the structure; of the high standard of the highway alignment, with its 700-foot minimum radius of curvature, unequalled in this section of the State and the exceptionally heavy grading through rough, mountainous terrain where excavation quantities on the southerly four miles averaged 344,000 cubic yards per mile.

One of the interesting engineering features of the work, to which little attention has been drawn, is the variety of methods used in developing the five grade separations between the highway and the railroad. Because of the greater flexibility of its alignment and grade, the highway, throughout the greater part of the relocation, was placed at higher and more economical levels than the railroad.

In the early studies of the Pit River Bridge design a single deck to carry both railroad and highway was considered, but, as this involved grade crossings at one or both ends of the bridge, the double-deck type was selected and the question of grade interference removed for all time.

The highway approaches the bridge from the left at its southerly end and departs to the right at the northerly

Relocated section of U. S. 99 around Shasta Dam Lake site near O'Brien Summit, photographed before road was opened

deck. It is 3,587 feet long and 500 feet above river bed. Two of its piers are the highest concrete piers in the world, exceeding bridge is seen in background

end. The railroad approaches from the left in a tunnel beneath the highway and departs to the left from its own deck, 60 feet below the highway level.

HIGHWAY OVER TUNNELS

Three other grade separations in the southerly four miles of the work were solved by the simple expedient of locating the highway over tunnels through which the railroad passes deep in the bowels of the mountains. These might be termed "naturals," as the surveyed lines fit the configuration of the country to best advantage and did not involve any unusual location problems.

The fifth separation is located near the northerly end of the work, on Antler Flat, where a four-lane underpass typical of such construction is located.

The future has been built into this new highway to a degree consistent with good engineering practice and evident added problems and costs. Realizing the probability of multiple lane requirements at some later time, when the demands of traffic make it necessary and the availability of funds make it possible to widen the graded section, the four major bridge structures were designed and built with these essentials provided for, to avoid subsequent excessive expense.

PROVIDES FOR FUTURE WIDENING

Widening of the graded roadbed and the construction of additional lanes of pavement at some future time will cost no more relatively than at present, and no greater engineering problems will be involved. The widening of the structures would, however, not only entail proportionately greater cost but would present extremely difficult engineering problems, particularly at Pit River where the pier foundations are over 400 feet

(Continued on page 5)

Section of relocated U. S. 99 highway around Shasta Dam Reservoir site near Black Oak Summit before it was opened to traffic

Utilization of Siphon Principles in California Culvert Practice

By G. A. TILTON, Jr., Assistant Construction Engineer
R. ROBINSON ROWE, Assistant Engineer, Bridge Department

FOREWORD

This is the sixth of a series of technical abstracts from a joint departmental review of culvert practice of the California Division of Highways, by a committee composed of Clarence F. Woodin, Assistant Maintenance Engineer; Robert L. Thomas, Assistant Engineer, Surveys and Plans; and the writers.

The utilization of siphon principles in California highway drainage practice is comparatively new, although "sag-pipe" culverts (commonly called inverted siphons) have been used since the inception of the Highway System in 1912.

The purpose of this article is to foster and encourage development and design of siphon culverts and point out practical advantages and adaptations. The committee is of the opinion that the principles involved will be applied frequently if the advantages and techniques are compiled for designers. The subject is treated in detail: definitions, theory, design and application.

IN ancient times, engineers found that gravity-borne water could be led over depressions by pressure conduits connecting their gradetour canals, supplanting more expensive works, such as a circuitous canal or a trestled flume. Unfortunately, engineers were less inventive of words than of works, for such a pressure conduit became known as an "inverted siphon."

Functionally a siphon ceases to be a siphon when inverted, so that the term was self-contradictory. At the time, the true siphon was seldom, if ever, used by civil engineers, so that the expression was reduced to "siphon," a corruption which still persists. Hence, we had two "siphons,"—the true siphon of the wine sampler and the false siphon of the hydraulic engineer.

Subsequently engineers found useful applications of the true siphon,—notably in automatic spillway controls. To erase the conflict, the American Society of Civil Engineers (1)* recommends that false siphons be called "sag pipes." Since culverts may take either form, the Committee conformed to this recommendation, naming and defining several specific types.

Sag Culvert Defined

Generally, the adjective "sag" will be used to qualify a conduit structure or portion thereof for which the flow line is depressed below a uniform grade line. Depending upon its section, the conduit will be designated a "sag pipe," "sag box," or "sag arch," and structures will be called "sag-pipe culverts," etc. When flowing full, the culvert crown will be below the hydraulic grade line, so no vacuum will exist (Fig. 38e).

For simplicity, these terms will not be employed unless the sag is significant in the hydraulics of the structure, either because of pressure on conduit crown or adverse gradient of flow line. Thus, canal flow may pass under a highway through a "sag-box culvert," but a pipe laid on nonuniform gradient in a natural channel may be more appropriately called a "channel-grade pipe culvert."

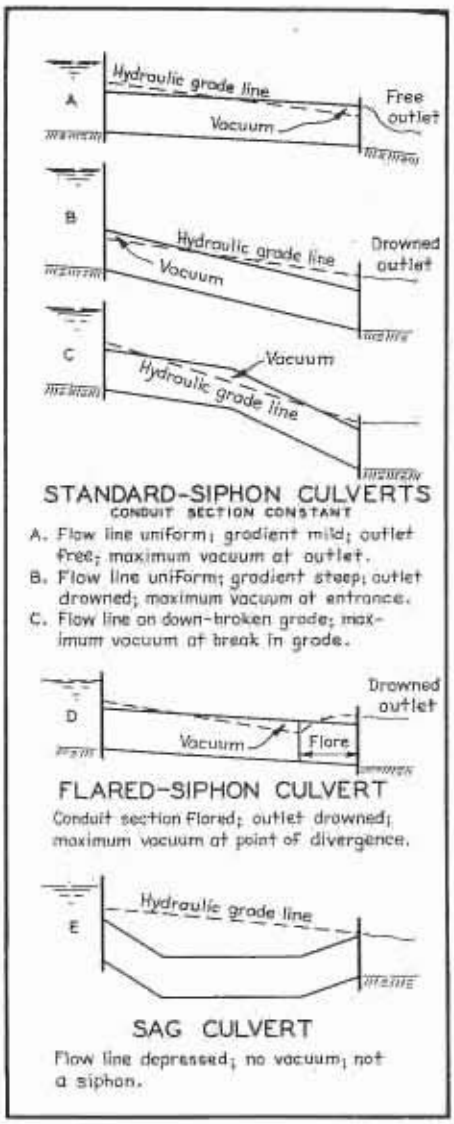


Fig. 38. Classification of siphons and sag culverts

Siphons Classified and Defined

Generally, a siphon is any conduit within which the absolute pressure falls below atmospheric, at some point or at some stage. At such points, the relative pressure is negative and is usually expressed in terms of equivalent "vacuum head." For culverts, the unit of vacuum head is the negative hydrostatic head in feet.

As usually pictured, the siphon has a uniform hydraulic gradient below an elevated crown line, as for the wine sampler. It will be shown that standard culverts can act in this way. If the siphon action is important, functionally, it will be called a "standard-siphon culvert" (Fig. 38a-c).

On the other hand, the siphon may have a depressed hydraulic grade line below a uniform crown line. This is true, substantially, of venturi tubes, pump intakes, draft tubes, etc. Culverts may act in this way if the down-

* Figures in parenthesis refer to bibliography at end of article.

stream end is divergent, which type we have named the "flared-siphon culvert" (Fig. 38d). This, and its most economical form, the "ideal-flared-siphon culvert, will be discussed in detail.

In combination of the two principles, a siphon may have a depressed hydraulic grade line below an elevated crown line, as in the siphon spillway. This combination does not appear to offer any advantage in culvert design.

Sag Culvert Practice

Sag culverts of pipe or box section are used extensively to pass irrigation canals under the highway. Because of the interest of water users in maintaining an efficient section, little difficulty is ever experienced. Design principles are available in many texts, but one point is frequently overlooked.

The initial design usually provides a constricted section under a narrow roadbed, so that hydraulic gradient is much steeper than for the canal as a whole. If the roadbed is widened the culvert must be extended, and the friction in the extension will increase canal stage at the entrance or reduce its capacity.

The change will be greater if the widening is in the form of a divided highway with two sag culverts in series, doubling the entrance and outfall losses of head. In such improvements the designer should provide generous extensions to assure against loss of capacity, using smooth-bore conduit with section 25 to 50 per cent larger than the existing section.

CLEANING COST INVOLVED

Sag culverts are also used to minimize culvert width under low roadbeds, particularly to pass local drainage via tule sloughs. These are reasonably successful, as span is minimized, stagnancy is no worse than in the sloughs, and little silt is borne by such streams. Even where the bed is not paved, tule seldom impairs the waterway.

Standard culverts have become sag culverts because of general aggradation of the streambed. Higher velocities through the culvert tend to maintain a fair section, but many of these are choked each year by material deposited on a falling stage. The cost of cleaning these culverts is an unreasonable maintenance item.

Sag culverts should be avoided on ephemeral or intermittent streams if the consequent stagnation will be objectionable. Short periods of stagnation are tolerable but long periods will be objectionable in many ways.

Standard-Siphon Culverts

Contrary to general belief, a culvert of constant section on a uniform gradient may siphon. The phenomenon was demonstrated by the Iowa Tests (2), particularly (Plate XIX, Tests 213, 291) for smooth-bore pipes with submerged entrances and free outfalls. In the latter test, vacuum head on crown of pipe varied uniformly from 0.15 foot at entrance to 0.75 foot at outfall.

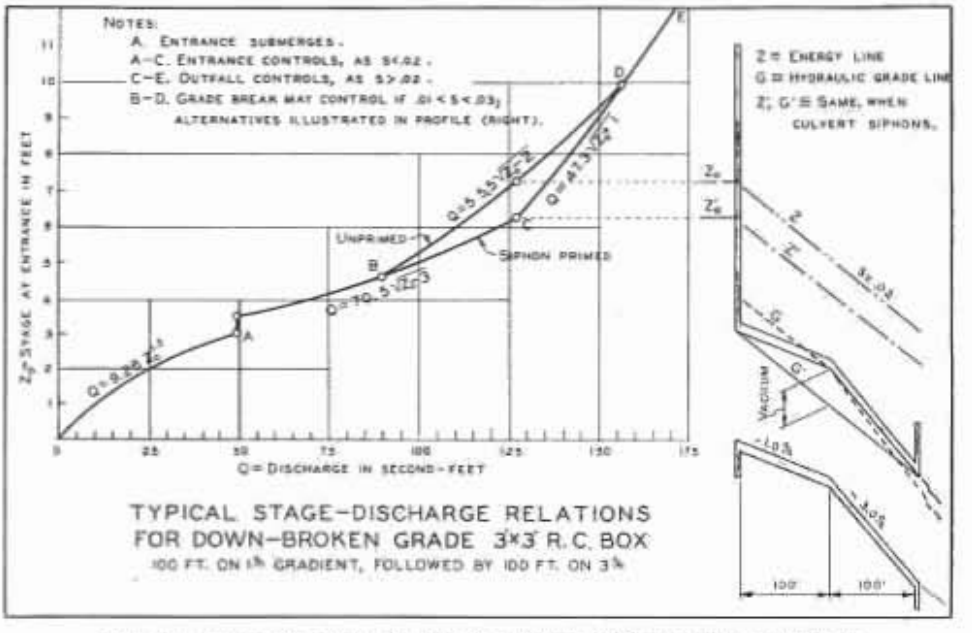
No theory has been presented to translate these experiments into design. The possibility of siphoning should be kept in mind whenever estimates of discharge are made from stage observed above a culvert. For example, if the flow of Test 291 had occurred in the field and discharge had been computed on the erroneous premise that the culvert could not siphon, the result would have been 19 per cent under the actual discharge.

SIPHONING CAPACITY UNCERTAIN

If siphoning could be counted on for certain proportions, it would be recommended that the extra capacity be used in design. However, it is doubted that this extra capacity could be depended upon for drift-laden flow. Obviously, if a vacuum forms in a standard culvert with a uniform gradient, the vacuum head must be a maximum at a culvert end (see Fig. 38a, b). The disturbance caused by drift passing that end would permit the admission of air to break or reduce the prime.

If the standard culvert siphons because of a down-broken grade (Fig. 38c), the vacuum head is a maximum at the break in grade,—not near an end. Once primed, this type will continue to discharge as if the grade were uniform between end flow lines.

The hydraulics of such a culvert are illustrated by Figure 39. The stage-discharge curve is the broken line OABDE for rising stage and EDCBAO for falling stage. While rising between B and D, the siphon may be partly or wholly primed by



TYPICAL STAGE–DISCHARGE RELATIONS FOR DOWN–BROKEN GRADE 3×3 R.C. BOX
100 FT. ON 1% GRADIENT, FOLLOWED BY 100 FT. ON 3%

Fig. 39. Hydraulic study of siphoning (Class C) in standard culvert on down-broken grade

air entrainment, reducing the stage relation to some point in the area BDCB: Limiting positions of energy and hydraulic grade lines for one discharge are shown in profile at the right.

Advantage of this design lies in the saving of excavation, and opportunity afforded to adjust the location and grade to insure adequate foundation and outlet conditions. Frequent floods will be carried without increase in stage (below B). Infrequent floods will have a higher stage on the rise but a normal stage on the fall. Peak stage of rare floods (above D) will

be unaffected. Since floods are usually quick to rise and slow to fall, the net effect of the grade break is small.

Flared-siphon Culvert

The flared-siphon (Fig. 38d) utilizes the principle of an expanding tube (Venturi) to salvage a large part of the water's kinetic energy. Ordinarily, the sudden enlargement at the outlet wastes 95 per cent or more of the velocity head. This waste is desirable for steep channels, but for cross drainage in broad valleys, the wasted energy is reflected in damaging stages above the culvert entrance.

If the flare is built to diverge on eased curves, little energy will be lost in the transition. The longer the flare and the larger the outlet, the greater the salvage of energy. Thus, if outlet area is doubled, the outfall velocity is halved and kinetic energy wasted at outfall will be quartered. In theory, it is possible to salvage 90, or even 99, per cent of the kinetic energy, but at a large structure cost.

In practice, the flare can be built with flat instead of curved walls and with outlet from 1.5 to 2.0 times the standard section in area, so as to salvage 60 to 70 per cent of the kinetic energy. For any particular site, the most economical flare dimensions will depend upon local factors,—requiring hydraulic computations. For reference, this most economical design is termed the "ideal flared-siphon."

TESTS SHOW ADVANTAGES

The University of Iowa tests (2) showed the hydraulic advantages of the flared siphon,—quantitatively for particular designs and generally for similar designs. For example, the report stated that capacity of a box culvert 36 feet long could be increased about 60 per cent by flaring the downstream 10 or 12 feet so as to double the outlet area. For the general case, the Committee has prepared a formula (Fig. 40) agreeable to all test data and extended by theoretical considerations. This formula is suitable for design, for the complicated expressions become quite simple when some proportions are determined arbitrarily.

Figure 41 is introduced to illustrate the methods of computation. Suppose the 10-year flood had determined the size of standard section as a 2 x 2 box and it was proposed to increase the capacity by flaring to a

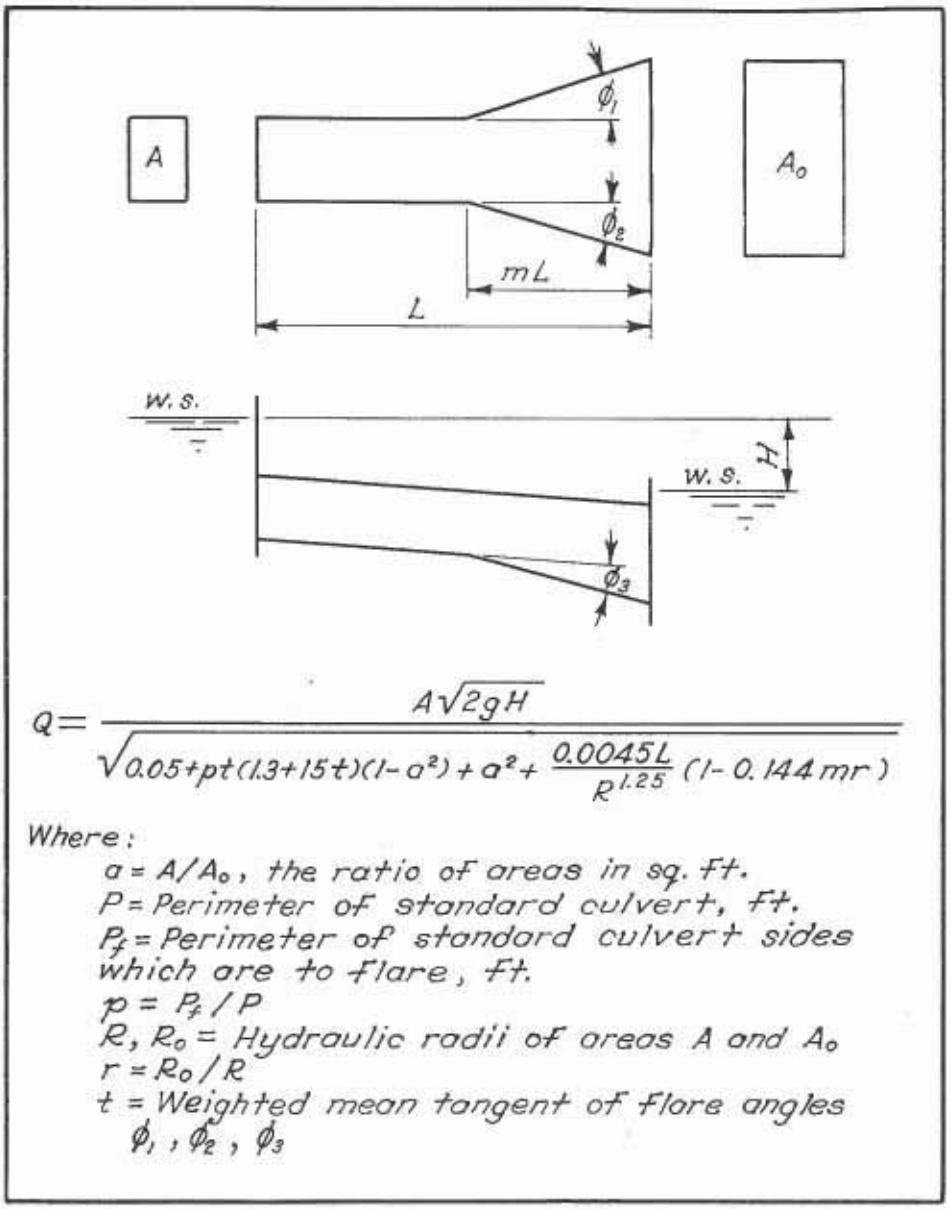


Fig. 40. Discharge formula for flare-siphon culvert

4 x 2 section in the last 6 feet of a total length of 30 feet. Then A = 2 x 2 = 4; P = 2 + 2 + 2 + 2 = 8; R = 4/8 = 0.5; L = 30; as in usual formulae.

At the outlet, the hydraulic radius is 0.667, so "r" = 0.667/0.5 = 1.33. Two sides of the box will be flared, so P′ = 2 + 2 = 4 + hence p = P′/P = 4/8 = 0.5. Also "a" is the ratio of the areas, 2 x 2/4 x 2 = 0.5; and "m" is the proportion of length to be flared = 6/30 = 0.2.

FLARE FORMULA FACTORS

The flare angle may be complicated for skew culverts or boxes flared on 3 or 4 sides. The top slab should never be flared, for that raises the stage (and discharge) for priming the siphon. Rarely will there be advantage in flaring the bottom slab; if a lower outfall flow line is practical, capacity can be obtained more economically by lowering the flow line to a uniform gradient. In the example, each side wall flares one foot in six, so "t" = 0.167.

Substituting these simple values in the formula, the expression reduces to Q = 34.8 $\sqrt{H}$, where H is the difference in stage between forebay and tailwater. Without the flare, the relation would be Q = 27.4 $\sqrt{H}$. Assuming a typical tailwater stage, two stage discharge curves were drawn for comparison of the flared siphon with the uniform section.

At the right of Figure 41 are profiles of the hydraulic grade line and energy line, on which are shown the relative losses in the culvert. The total head "H" has 4 components. The flare design has little or no effect on entrance and friction components. The turbulence loss in the flare can be reduced by lengthening or curving that portion and the loss at outlet "h_o" depends on area of outlet section. These losses should be visualized by the designer, to avoid disproportionate loss of energy or increase in construction cost.

IDEAL FLARE DESIGN

In any case, the ideal flare-siphon culvert must be designed by cut and try, at least until a wider variety of governing factors have been analyzed. As a guide, the area ratio "a" will vary from 1.5 for moderate velocities to 2.0 for high velocities. The flare-length ratio "m" will vary from 0.1 for long culverts under moderate fills to 0.3 for short culverts under no fill. The flare angle tangent "t" should not exceed 0.2 for moderate velocities or 0.1 for high velocities, or the diverging jet will not wet the outer walls (causing a gurgling turbulence as prime is intermittently lost).

Flared Siphon Applications

The flared-siphon culvert is an ideal solution for many drainage problems. The first installation in California is shown diagrammatically in Fig. 42. At this site, an existing culvert had proved inadequate after a rural area had been developed into a residential suburb, crowding a stream of the meadow-overflow type. Economy demanded full capacity without exceeding the damage-incidence stage. The flared siphon proved much cheaper than standard culverts of the same capacity at limiting stage.

The design is experimental in that the flare was applied to a triple box. We hope to observe whether the outer boxes are as efficient as the central box. Fig. 43 shows the culvert during construction. In this case the slab over the flare had to carry the same loads as the standard section, which would not be true for a long culvert under a high fill.

The flared siphon should be considered in all widening plans in the broad valley areas, because existing culverts can be so extended as to increase their capacities. Submergence

(Continued on page 20)

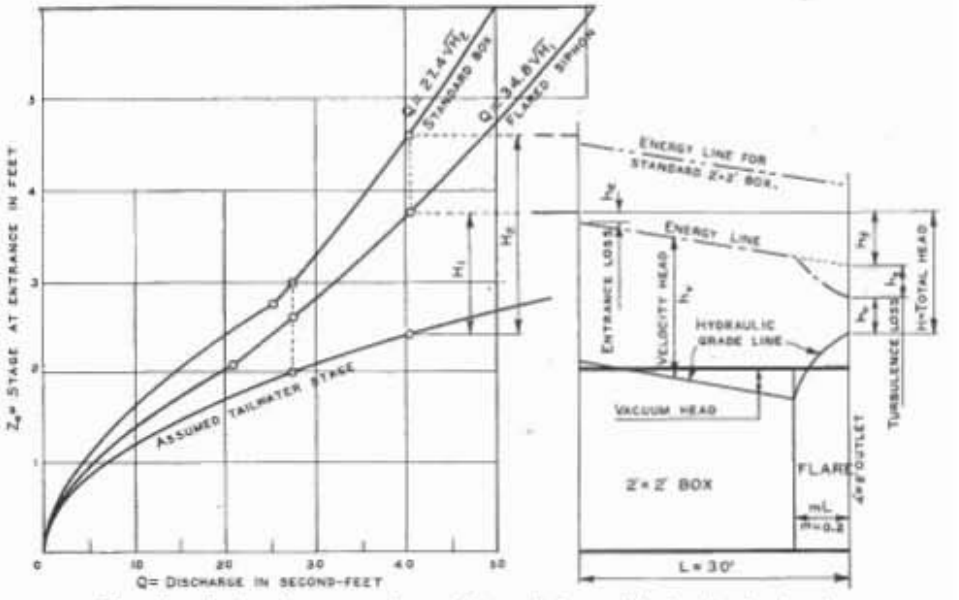


Fig. 41. Hydraulic comparison of flare-siphon with standard culvert

Fig. 43. Vallejo Creek. Construction of flare-siphon culvert

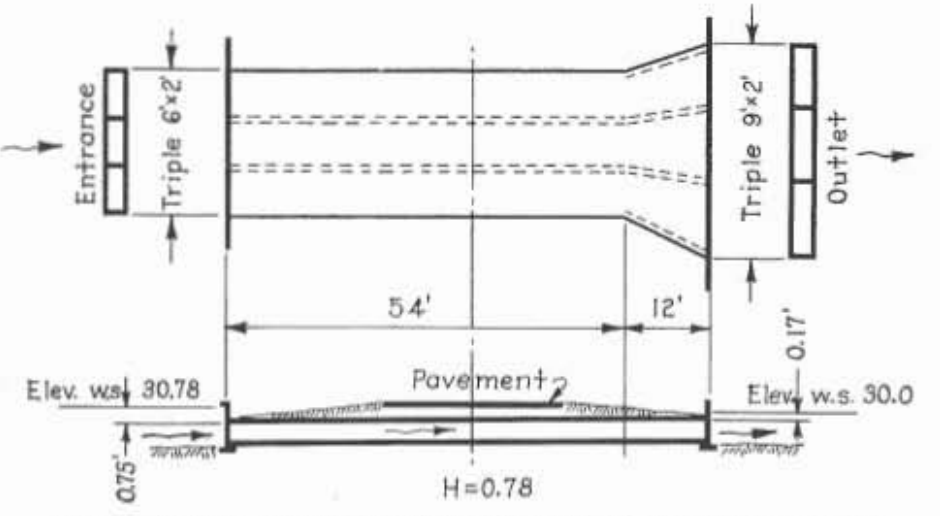


Fig. 42. Layout of experimental Vallejo Creek triple flare-siphon box culvert

Geo. T. McCoy Appointed State Highway Engineer of California

APPOINTMENT of George T. McCoy to be State Highway Engineer was announced January 4th by C. H. Purcell, Director of the Department of Public Works.

After serving 10 years as Assistant State Highway Engineer, McCoy takes the post vacated by Purcell. McCoy came to the California State Highway Department in 1927 as assistant office engineer under R. M. Norton, then State Highway Engineer. He was promoted to Assistant State Highway Engineer when Purcell accepted the job of State Highway Engineer under C. C. Young in 1928.

GEORGE T. McCOY

Born in Oregon in 1889, McCoy was raised on cattle ranches in central Oregon and Washington and from early youth herded cattle and horses on the range. He attended Whitman College in Walla Walla, Washington, and upon graduation completed a graduate course in civil engineering at Columbia University, New York City, paying his way by working in various minor engineering jobs during the summer vacations.

On completing his course at Columbia University, he was employed as assistant engineer on the great Catskill Aqueduct, a $300,000,000 project in New York which brings water from the Catskill Mountains via a tunnel under the Hudson River and down through the eastern part of the State to New York City.

McCoy was engaged on this project in the construction of the Valhalla Dam and several bridges which involved the relocation of many miles of State highway and the removal of a town that were flooded by the reservoir.

Returning to Washington, he became associated with the engineering staff of the United States General Land Office on work in the Cascade Mountains that included an irrigation project near the junction of the Snake and Columbia rivers in 1908 and 1909.

Following this employment, he had 30 years of State highway experience with the United States Bureau of Public Roads and with the States of North Dakota, Idaho, Washington and California.

During six of the 10 years service with the Washington Highway Department, he was Assistant State Highway Engineer.

Pit River Bridge and Highway Opened

(Continued from page 3)

below the ultimate lake level. Construction of the bridges to standards which will meet the exigencies of a coming day was therefore logical and economical.

The last contract to be let provided for the paving of the entire 15.3 miles. During the grading phase of the work very close attention was given to the selection and placing of subgrade material.

Excellent results were obtained with the native shales through which many of the cuts were made, and high bearing values were consistent throughout the work. On this very satisfactory subgrade a pavement was placed consisting of 0.5 foot crusher run base, full width of the roadbed, with 0.2 foot plant-mixed surfacing over the central 22 feet, topped with a plant-mixed nonskid surfacing applied at the rate of 55 pounds per square yard.

Shoulders were surfaced with plant-mix tapering to 0.15 foot at the outer edges and sealed with a Class "C-fine" seal coat. At the Southern Pacific underpass at Antler, a section 1,670 feet in length was paved with four lanes of portland cement concrete, with the shoulders treated as above.

Users of the new highway will perhaps never realize the saving of 3.7 miles in distance nor the appreciable reduction in adverse grade over the present road, but the decrease in travel time and the safety features built into the job are factors which the motorist can appreciate. Safe speeds over the present road were found by the Traffic Department to be as low as 25 miles per hour over considerable distances; whereas the design speed on the new construction is 60 miles per hour.

Without ceremony, because of military restrictions, this combination of projects, which has merited publicity because of its contribution to advancements in highway construction, was opened to public use on January 8, 1943. Originally scheduled for completion in early August, to meet the expected flooding of the present road along the Pit, the paving contract, upon which the opening hinged, was delayed because of difficulties engendered by the war. For the same reasons, progress on Shasta Dam was so retarded that the inundation of the old highway was delayed indefinitely, making it unnecessary for the State Division of Highway authorities to vacate the existing road for several months later than was expected.

For detailed descriptions of the grading and bridge construction, refer to California Highways and Public Works, dated November, 1939, January and June, 1940, January, March, April, August, October and December, 1941.

A. H. Henderson Promoted to Assistant Director of Public Works

TWENTY - FOUR years of State service by A. H. Henderson were rewarded when Director of Public Works C. H. Purcell recently appointed him Assistant Director of the Department of Public Works.

Henderson moves up from his civil service post as disbursing officer of the Department of Public Works which consists of the Division of Highways, Division of Architecture and Division of Water Resources.

A native Californian, born in Angels Camp, Calaveras County, on September 1, 1902, Henderson completed his schooling in Sacramento and on January 12, 1918, went to work in the then Department of Motor Vehicles.

From July, 1920, to September, 1932, he was employed in the Department of Engineering and the Division of Architecture. Since 1932 he has been with the Division of Highways, serving five years in the Fresno district office of that agency. He was appointed disbursing officer in January, 1939.

A. H. HENDERSON
Assistant Director of Public Works

Mr. Henderson devoted considerable time and effort to the preparation of a Time Keepers' Manual which established a uniform system of field accounting for the Division of Highways.

Since May 1942, Mr. Henderson has been in charge of car pooling, gas rationing and tire conservation affecting the Division of Highways and various other divisions of the department.

The use of all passenger automobiles of the Division of Highways, Division of Contracts and Rights of Way, San Francisco-Oakland Bay Bridge, Headquarters Shops, and Bridge Department of the Division of Highways has been under his supervision.

He is continuing his duties in this respect as Coordinator of Car Pooling, Gas Rationing and Tire Conservation for the Department.

In this connection he maintains close contact with the Office of Defense Transportation and the Office of Price Administration, acting as liaison officer between these Federal agencies and the Department of Public Works.

Highway Division Car Pool Saves 2,641,912 Miles of Tire Travel

DRASTIC curtailment of passenger car travel in line with tire conservation by the Division of Highways resulted in a saving of 2,641,912 miles during the period from May to December, 1942, Director of Public Works C. H. Purcell reported to Governor Warren.

A careful mileage check on the 715 automobiles operated by the Division of Highways showed that from May of last year, when a tire conservation program was inaugurated by the Division, to December 31, the total number of miles in passenger car travel registered was 5,332,448 as compared with 7,974,360 for the same period in 1941.

This is a decrease in mileage for the eight months' period of 33.13 per cent.

BIG CONSTRUCTION PROGRAM

While the Department of Public Works has had to economize for the sake of rubber conservation necessary to the conduct of the war, the Division of Highways during the last year fulfilled contracts for 142 State highway access road and flight strips at an aggregate cost of $26,353,200, which represents a substantial portion of the $55,420,800 program of construction carried out by the Division of Highways last year, Purcell stated.

These contracts were financed from State highway funds, allocations of Federal Aid funds apportioned to California from Congressional appropriations and from the special Federal appropriations provided by the National Defense Highway Act of 1941 for construction of access roads and of flight strips. In the interest of tire saving, Purcell said, means of transportation other than automobiles have been utilized.

Careful operation, speed limitation, and restrictions of the use of automobiles by travel on trains, buses or other means of transportation during 1943 are expected by State Highway Engineer George T. McCoy to considerably prolong the life of tires and equipment of the Division of Highways' cars and increase the percentage of decreased mileage.

The American Way of life is not just a fine phrase. It is a condition. It is another way of saying, "The rewards of democracy." If you think of all of the comforts, conveniences and luxuries we enjoy in this country, it becomes abundantly clear how tangible these rewards are, and how definitely worth while they are.—*Frederick W. Nichol.*

Rural traffic in 16 gasoline-rationed States dropped 41 per cent during November of 1942 compared with the same month in 1941, state U. S. statistical reports. Massachusetts started 1943 with a decrease of more than 100,000 car registrations. In Michigan, there were 93,452 fewer cars registered.

British Columbia reports that as of November 30, 1942, a decrease of 3,884 cars was shown in the registration ledgers of this province.

Completion of Central Valley Project Urged to Produce Food, Fiber, Rubber

THE first year of war has resulted in many drastic changes in the status of the Central Valley Project. A series of orders issued by the War Production Board has seriously curtailed construction work and postponed, for the time being at least, many of the objectives for which the project was undertaken.

The first and most far-reaching effect of these orders has been to stop work on all irrigation features of the project. Specifically, construction work on the Contra Costa and Madera Canals was halted. No construction can be done on the Delta Cross Channel, the Delta-Mendota Canal or the Friant-Kern Canal. Other orders held up installation of three large power generating units at Shasta and three smaller units at Keswick Dam.

GOVERNOR IS CONCERNED

Meanwhile the budget for the Bureau of Reclamation was sent to Congress with an allocation of only $2,000,000 for this year as compared to some $84,000,000 for last year. The $2,000,000 is sufficient only for administration and some survey work. Last year the bureau budget carried an item of more than $39,000,000 for Central Valley Project construction alone.

The need for appropriations to complete the project as part of the war effort was particularly stressed by Governor Earl Warren at a meeting of the Water Project Authority held January 26th. The Governor said:

"I have been concerned recently about the turn of affairs in connection with the Central Valley Project. I am informed that in all probability there will not be appropriations recommended for the continuation of the work. I hope this is not true. I hope the situation will develop differently because I think this is a time when the project should be pressed from the standpoint of the war effort.

FOOD PROBLEM INVOLVED

"We are talking about the scarcity of food, and I think everybody in California realizes that if things continue the way they are there will be a definite shortage. There is no place in America where food can be produced as it can in California. I think for the project to stand still and not be completed in these times would be a very bad thing, not only for California but for the Nation at large.

"Even when the war is over, the food problem for the world is going to be one of the world's gravest problems if I see the signs of the times right, and I think it is incumbent on us to do everything we possibly can to keep this project going and to keep Washington from believing that it is not a war essential."

The Authority took immediate action by authorizing that representations be made in Washington before the Congress, the War Production Board and other Federal agencies, showing the need for completion of the entire project so it could be operated effectively in all parts of the Central Valley.

LETTER FROM PAGE

A letter from Reclamation Commissioner John C. Page to C. H. Purcell, chairman of the Authority pointed out the need of Authority participation in a series of studies the Bureau of Reclamation has proposed dealing with project problems. One of the immediate problems concerns the order of the construction program to obtain maximum wartime utility.

"From this study," Page wrote, "I look for information and recommendations for a war construction program that will aid in unfreezing cease-construction orders of the War Production Board directed against irrigation and power features of the Central Valley Project."

Previously Page had told a Congressional committee if they would give him a green light he would bring 2,000,000 acres into production in two years and these 2,000,000 acres would be capable of producing foods and fibers in a volume normally obtained from 6,000,000 acres.

In this same connection California is being called upon by Secretary of Agriculture Wickard to produce more food, fiber and rubber as a part of the war effort. The successful growing of guayule in California has been so thoroughly demonstrated, that more and more importance is being given to its production. Completion of the irrigation features of the Central Valley Project would assist materially in providing lands on which the rubber shrub can be grown and additional food supplies produced.

CONSTRUCTION STATUS

At the year end, construction status of the project was as follows:

Friant Dam, which was to serve badly needed water to lands in the southern San Joaquin Valley, was complete except for control gates which must be installed before the dam can be made effective for any of its purposes.

An 8-mile section of the 30-mile long Madera Canal which extends north from Friant Dam is completed but unused. No construction work has been done on the Friant-Kern Canal to Bakersfield.

The Contra Costa Canal is completed except for an 11-mile section needed to bring water to Martinez and adjacent areas. It is the only unit of the project in operation at this time. Under a temporary agreement, water is being served to several cities and industries along the south shore of Suisun Bay.

SHASTA DAM

The War Production orders permitted continuation of work on Shasta Dam, and it is anticipated that it will be completed late in 1943 or early in 1944. As of December 10th, the dam was 77 per cent complete in dollar value. Out of a total of 6,000,000 yards of concrete to be poured at Shasta, 4,621,992 cubic yards had been poured on December 10th.

The powerhouse at Shasta was completed during the year and work is under way with the installation of two of the five proposed generating units. Two other units previously

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Top—Friant Dam on the San Joaquin River near Fresno, completed except for control gates. Bottom left: Five months old guayule seedlings in government nursery at Salinas. Bottom right: Machine transplanting guayule seedlings. Below—Planting guayule seed in the government nursery near Salinas.

fabricated were sent to Grand Coulee Power Plant for installation to meet a shortage in the power market of that area. At the end of the year there was no indication from the Federal Government when additional units for the Shasta plant would be installed.

Construction of major transmission lines from Shasta which were planned to carry power to load center at Antioch has been held up by various Congressional recommendations and lack of priorities for materials. When the Department of Interior budget bill was being considered by Congress, the Senate Appropriations Committee recommended that a stub transmission line be built to Oroville and existing facilities of the Pacific Gas and Electric Company be used to transmit that power to load center. Surveys for the line were still under way at the first of the year.

KESWICK DAM

Except for some reservoir clearing contracts which were still under way at Shasta, the only other unit of the project on which construction work is proceeding is Keswick Dam, nine miles downstream from Shasta. The War Production Board order halted the installation of three electric generating units which were planned for Keswick Dam, but authorized completion of the dam foundations and installation of such fish-trapping facilities as would be needed to meet the salmon spawning problem next year.

The importance of the project to California's war effort is so great, however, that various agencies are urging a reversal in War Production orders which will permit completion of certain portions of the project. In a recent letter to Senator Sheridan Downey, Chairman of the United States Senate Committee on Western Farm Problems, the Water Project Authority of California pointed out the advantages in food, fiber and guayule production which would result from putting the irrigation features of the project into operation. The letter said in part:

"In the Central Valley of California there are some 10,000,000 acres of good irrigable lands. At the present time only 3,500,000 acres are irrigated. These irrigated lands, over a long period of years, have proven exceedingly productive of highly specialized crops such as deciduous and citrus fruits, vegetables, nuts and vineyard products. More than 90,000 carloads of fresh fruits and vegetables alone are shipped outside of the state every year from the Central Valley, much of which is shipped in seasons when other areas in the nation are not producing.

"To maintain this present high level of production it is essential that the Central Valley Project be completed to remove the hazard of crop loss through lack of adequate water supplies due to a dry year or cycle of dry years. Present production has been reached only because the state has experienced a cycle of wet years during which irrigation reservoirs were filled each winter and there was sufficient rainfall to replenish in part the underground water supplies on which much of the irrigated land in the state now depends.

"The project when completed will furnish a greatly needed water supply to more than a million acres of rich, developed lands in the San Joaquin Valley and to nearly half a million acres in the delta region which produce a wide variety of crops needed to support the military and naval forces and the civilian population.

"Already many food products produced in large quantities in the Central Valley are being rationed or withheld from the civilian market. Dried fruits such as apricots, apples, peaches, pears, prunes, figs, raisins and nuts are among them. Sugar, beans, dairy products, meats and many of the vegetables are either under rationing or, as in some cases, the entire output has been frozen for military use.

FARM LABOR SHORTAGE

"It is apparent that present production, with increasing problems of farm labor shortage, is insufficient to meet our war needs. Secretary of Agriculture Wickard on November 29th outlined the 1943 farm production program calling for the largest output in history. If this program is effected, additional lands of high productive quality such as are to be found in the Central Valley will have to be used. Lands already in production, however, are causing a heavy overdraft on available water supplies. The obvious answer is that if additional lands are to be placed in production, additional water supplies will have to be developed. With the major portion of the heavy construction on the Central Valley Project completed, building of the irrigation works necessary to bring these lands into production and protect those which now are producing, provides the only immediate solution of the problem.

"In addition to the present need for additional food supplies, we are faced with the future problem not only of supplying our allies, to which we are committed, but of feeding starving populations throughout the world.

INCREASED CROPS POSSIBLE

"No adequate estimate of what will be required from the United States to feed these people is available. It can, however, be safely conjectured that our present production is far from sufficient, even with severe restrictions on American food consumption. The lands of the Central Valley of California have the fertility and the climate to produce highly specialized crops, with yield per acre under irrigation much greater than the national average. This has been adequately proven by present production. All that is needed to increase this production, and protect that which is under way is an additional water supply which can be provided by the Central Valley Project.

"One of the most pressing problems of today is that of transportation. Because raw rubber stocks were not purchased in sufficient quantity to carry on our military and civilian needs prior to the outbreak of war, various steps have been necessary which are seriously hampering our war effort.

"The basis of all these steps—reduction in speed limits, car pooling, gas rationing, etc.—is the lack of adequate raw rubber to keep our nation on wheels.

GUAYULE PLANT PRODUCTION

"Means of overcoming this basic deficiency is at hand and was recognized by the Congress. It is the production of rubber from the desert guayule plant. The Congress has authorized and is undertaking the planting of some 500,000 acres of that shrub. However, experiments carried on in the southwest over the last twenty years have proven that the guayule shrub under modern methods of forced production can only be grown in certain favored areas and on certain types of soil.

"The Federal Government, assisted by State departments, presently is making a survey of all lands in the

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Post-war Road Planning Imperative Now Says U. S. Highway Chief

By Thomas MacDonald
Commissioner, U. S. Public Roads Administration, San Francisco, Calif.

Road builders will undoubtedly agree (1) that the release of several million men from the armed forces after the war will tend to create serious unemployment; (2) that a highway public-works program could take up much of the slack in available manpower, and (3) that such application of labor is a constructive way to add to our National wealth.

They know from experience, however, that full-blown plans for such a desirable public-works program can not be produced overnight. They know it takes months of careful planning before construction can be started that will provide employment on any considerable scale.

PLANS MUST BE READY

The opportunity may knock, but it won't wait. If the highway-building industry isn't ready with jobs when the millions of job-seekers arrive, they'll be accommodated in other ways. No highway department, therefore, should be caught unprepared and taken by surprise if detailed plans for post-war highway construction are suddenly demanded as a constructive substitute for "boondoggling."

Detailed advance planning should be in progress now so that the highway departments will be ready to take advantage of every opportunity after the war to modernize this country's system of main highways. Expressly to help finance this detailed planning of post-war highway construction, Federal-aid funds totaling $10,000,000 have been apportioned to the 48 States, the District of Columbia, the Territory of Hawaii and the Island of Puerto Rico under the provisions of the Defense Highway Act of 1941.

LAND PURCHASE ADVISED

In some States, highway revenues may exceed during the war the amount which can be used for highways, due to material and labor shortages and other restrictions on highway work. It is suggested that these States apply their excess funds to supplement their Federal-aid advance-planning apportionment, either for financing additional detailed plans for post-war construction or for acquiring rights-of-way for post-war highway development. Well-planned purchases of land now will provide the most important basis for future application of the advance plans now in preparation.

FOR CITY AND URBAN AREAS

In approval of the advance-planning projects selected by the States, the Public Roads Administration is giving preference to those that will result in plans for wholly adequate facilities for the service of traffic in urban or metropolitan areas as well as in rural sections.

The urban improvements may include city entrance routes, circumferential and distribution routes, and terminal and publicly-owned off-street parking facilities.

The $10,000,000 Federal authorization for advance planning, plus an equal amount of matching State money, provides a fund sizeable enough to project a $500,000,000 post-war highway building program.—*Pacific Road Builder and Engineering Review.*

Fred J. Grumm Promoted to Post of Assistant State Highway Engineer

RECOGNITION of 20 years of service with the Division of Highways was accorded to Fred J. Grumm on January 6th, when State Highway Engineer G. T. McCoy elevated him from the post of Engineer of Surveys and Plans to the office of Assistant State Highway Engineer, succeeding Mr. McCoy, who was promoted to be State Highway Engineer.

FRED J. GRUMM

Mr. Grumm entered the employ of the State in February, 1922, when he became Assistant Engineer of the California Highway Commission with headquarters in Sacramento. He fulfilled these duties and those of Assistant Division Engineer of Division VI in Fresno until February, 1923, when he returned to Sacramento as Engineer of Surveys and Plans.

A native of Lyons, Iowa, Mr. Grumm completed his schooling in Wisconsin and Michigan and came to California in 1905. He began engineering work on the San Diego Cuyamaca and Eastern Railway in San Diego. From 1908 to 1910 he engaged in subprofessional work on the San Diego and Arizona Railway locations and on the engineering staff of the first San Diego County Highway Commission. In 1910, he was appointed Chief Deputy County Surveyor of San Diego and held that office until 1920, at which time he became Assistant Chief Engineer of the San Diego County Highway Commission, a post he held until January, 1922, when he resigned to enter State service with the Division of State Highways.

Mr. Grumm is a member of the American Society of Civil Engineers, Commonwealth Club, American Road Builders' Association and National Congress Surveying and Mapping.

Central Valley Project Completion an Urgent Need

(Continued from page 12)

State which are adaptable to the production of the guayule shrub. The exact amount of land on which the shrub can be grown has not yet been determined. However, the Department of Agriculture is known to look with great favor on the Central Valley of California and particularly the San Joaquin section of the valley for a large portion of the guayule acreage programmed, contingent upon an adequate water supply. Many thousands of acres now in crops, not vital to the war effort, could be diverted to the production of guayule, and relieve in part the farm labor shortage, if water sufficient for the irrigation of the shrub were provided.

NEED FOR ACREAGE

"The United States Department of Agriculture has on hand and available for transplanting some 300,000,000 guayule plants. To date, however, it has leased only about 35,000 acres of suitable lands for production of the shrub. The department has announced that it will need 180,000 acres under production by next fall.

"Numerous preliminary proposals for providing this additional acreage are under study by the State Division of Water Resources, which carries on all field work for the Water Project Authority. All of these contemplate completion of one or more of the irrigation features of the Central Valley Project, as it is the only project which immediately can supply additional waters to the Central Valley. Completion of the project and extension of its irrigation features to presently unirrigated lands in the Southern San Joaquin Valley would provide sufficient lands to carry out the entire program of guayule planting now contemplated by the Department of Agriculture. With a sufficient water supply these lands are known to be suitable for the growing of the guayule shrub. They have the proper soil, climate and drainage required. A dependable and adequate water supply only is lacking."

A hick town is one where there is no place to go that you shouldn't.

Five-day Storm Sweeps California Setting New 1943 Isohyetal Lines

A FIVE-DAY storm of major intensity accompanied by high winds caused widespread damage in some sections of California during the latter part of January. Heavy snow reaching to low elevations in northern California checked the runoff on all but the Bear and American rivers so that little damage occurred from flooding in the Sacramento River Basin.

In southern California, particularly in San Bernardino County, extensive damage was caused. It is reported that the damage to public properties alone in that county will total approximately $800,000. No report of the damage to private property has been made as yet. The City of Colton was the most severely affected. The sewer system, city water system and electric system were damaged and debris was left heaped in the streets.

Storms in January Did $350,000 Damage to State Highways

During the heavy rains of January 20th and 23d, approximately $350,000 worth of storm damage was occasioned on the State Highway System, states Director of Public Works C. H. Purcell. Of this amount $67,000 represents damage to bridge structures.

In the northern section of California the damage was caused by slides and high water. The Maintenance Department of the Division of Highways is engaged in restoration work and the major roads which were temporarily closed have been opened.

"While we anticipated considerable difficulty in obtaining equipment," Purcell said, "we were agreeably surprised at the response made by private operators. We were not so fortunate in hiring necessary labor and as a result the storm damage was handled by our maintenance forces."

The storm spread over northern California on the night of January 19th. Over the mountain area north of Redding the storm reached blizzard conditions. Snow fell on the floor of the valley as far south as Willows. Due to the snow only medium high stages were reached by the Sacramento River below Redding, the Feather and Yuba rivers and the Sutter and Yolo by-passes.

BLIZZARD AND HEAVY RAINS

Heavy rainfall on the headwaters of the American and Bear rivers caused rises that attained the proportions of flash floods. The American reached a stage which has been exceeded during the period of record only in 1907 and 1928 when large areas in the vicinity of North Sacramento were flooded. Since 1928, levees of the American River Flood Control Project have been extended and North Sacramento protected by a new levee. The project carried the flow without damage to property other than that in unprotected lands subject to overflow.

The value of the recently completed North Sacramento viaduct was fully demonstrated during the high water stage. During six of the past 12 seasons it has been necessary to close the ground level road passing under the tracks of the Sacramento Northern and the Western Pacific, which carried traffic from the north end of the Sixteenth Street bridge over the American River to North Sacramento. This traffic totaled from 25,000 to 30,000 motor vehicles per day.

In the Winter of 1937-1938, the road was closed for a total of 15 days. In the 1939-1940 season, it was closed for 10 days. When this road was closed, traffic was detoured by way of the Jibboom Street bridge at the mouth of the American River and about three miles along a narrow levee road and back into North Sacramento over Arcade Creek bridge.

H STREET DETOUR CLOSED

This route was about three miles longer and during the rush hours of morning and evening traffic the detour added from 30 to 60 minutes to the time required to travel from North Sacramento to Sacramento. Another detour available in the past was by way of the H Street bridge

over the American River, which was about eight miles longer. The H Street road was flooded during the January storm.

Traffic on U. S. 40 between Sacramento and North Sacramento flowed freely and rapidly over the new viaduct during the entire period of the storm.

ONE LEVEE BROKEN

The Bear River, reaching a stage two feet higher than ever before recorded, broke through a levee in Reclamation District 1001 near Wheatland. Some homes were washed from their foundations and several hundred acres of developed land flooded on the side of the river.

The Division of Water Resources issued warnings to farmers living in lowland areas and those on lands subject to overflow in the Yolo By-pass. On January 23d, four gates of the Sacramento Weir were opened to control a secondary rise in the American River. Liberty Island, Little Holland Tract and Prospect Island in the lower Yolo By-pass were flooded. The Egbert Tract was not inundated.

Flow in the Yolo By-pass at Lisbon reached a maximum of approximately 155,000 second-feet as compared to the maximum flow of 285,000 second-feet on February 8, 1942.

COAST HOMES WRECKED

Damage to public and private property was reported in the north coast area. Extent of the damage has not been determined.

High tides and gales along the southern California coast wrecked numerous beach homes and caused damage to small craft from Alamitos Bay to Santa Monica.

The Los Angeles County Flood Control District functioned, according to an announcement by a district official, "with no damage sustained." Flooding in the Van Nuys and Reseda Districts was attributed to lack of debris or flood control basins in Rubio Canyon.

The storm was not without its benefits, breaking a two-month drought in Southern California and bringing the season's total rainfall to 13.11 inches, nearly double the rainfall for the same period in 1942.

Young wife—"Harold is awful slovenly. Most of the time about half the buttons are missing from his clothes."

Aunt (sternly)—"Perhaps they aren't sewn on properly."

Young wife—"That's just it. He's very careless about his sewing."

Old section of U. S. 40 across American River overflow was flooded but 16th Street Viaduct opened Sept. 14, 1942, carried all traffic

Viaduct 50 feet above ground level, crosses channel and two railroads

Tracks of Sacramento Northern and Western Pacific railroads just escape submergence

Growing on the roadside of the San Jose-Oakland highway are the oldest rows of planted native California sycamore trees in the world.

Group of Rare Old Trees on State Highway Being Preserved

By E. S. WHITAKER, Assistant Highway Landscape Engineer

DIRECTLY north of San Jose, between Berryessa Road and Coyote Creek, scene of early settlement by pioneer families, an unusually interesting island of tree growth has been preserved and is flourishing.

Within a small area now stands one of the three largest specimens of eucalyptus in California, the Capt. Jos. Aram Blue Gum; one of the three or four tallest planted specimens of Sequoia sempervirens, the coast Redwood; a 70-year-old Camellia japonica, probably the oldest Camellia tree in California; a Quercus Suber tree, the cork oak of commercial value, known to have been planted more than 50 years ago.

There is also a row of Ulmus hollandica var. vegeta, the Huntingdon Elm, known to have been large enough in the early 1860's to overhang and shade the road; and two rows of Plantanus racemosa, planted by Chinese labor for the Dr. Townsend estate in the 1860's, these being the oldest rows of native California sycamore trees in the world.

ON MAIN HIGHWAY

The elms and sycamores line a portion of the old road between San Jose and the Mission San Jose de Guadelupe, and are now growing on State highway right of way, bordering a modern 3-lane roadway, portion of the main highway between San Jose and Oakland. In this location, the responsibility of their care and preservation lies with the Division of Highways and more directly with the tree maintenance crew operating under Maintenance Superintendent L. L. Robinson.

Other than an occasional trimming for the removal of heavy overhang and storm breakage, and such routine work as the removal of sucker growth and protection from fire, no beneficial work has been done on these trees. Accordingly, on November 13, 1941, a day labor work order was approved to finance tree reconditioning in District IV, and a portion of this fund was later allotted for work on the elm trees.

All of these tres are in vigorous growing condition and have not been infested with borers or elm leaf beetle, generally the two nemeses of elms in California. However, inspection showed that several large cuts made in the removal of low limbs were showing evidence of heart wood decay, at a number of old stub wound slime flux was present, and on one tree an old traffic wound had become infested with termites.

All of these injuries were on the trunks or main limbs, and it was apparent that early treatment was necessary to prevent further loss of sound wood and a subsequent weakening of the tree structure to a point

where collapse would result from wind storms.

As is generally the case when only surface inspection is made and no borings taken to accurately determine the extent of damage by decay, several cavities of large size were opened, after work was started showing a long time neglect. The largest cavity measuring 5 feet 9 inches by 2 feet 4 inches resulted from an old 12-inch cut and an untreated bark wound in which termites were working. Both of these injuries covered only an approximate one-quarter of the area of the finished cavity.

The Division of Highways was fortunate in this reconditioning and repair work in having the services of Highway Tree Maintenance Foreman A. E. Burnell, who has a background of over 20 years' experience in tree work in the east and in this State. All stages of the cavity preparation and filling show the workmanship of an intelligent craftsman, and this follows the policy of the Division of Highways in allowing this type of work to be performed only by trained men. Highway Tree Trimmer Leo Simoni, with 10 years' experience with the Division, ably assisted in the work.

A portion of the cavity preparation was done with electrically operated tools, power being supplied by a small portable gasoline generator of size to operate saws, augers and chisels. These tools were used for roughing out the decayed wood, and the finishing work was done by hand.

DRAIN TUBES INSTALLED

Mechanics of the cavity preparation include the installation of drain tubes in all openings showing signs of heart water, and the placing of lip bolts in all cavities over eight inches in depth and three feet in length.

The trees average 80 feet in height and this, with their spread and location, which is broadside to the prevailing wind flow, make them liable to damage from winds. The wood around an opening of any size in the trunk or main branches is therefore subject to the twisting action of the wind in the crowns, and under undue stress this action may cause severe cracking or splitting of the heart wood known as wind spreading.

The lip bolts when properly placed at right angles to the grain of the

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Tree doctors and their work. 1 and 2—Before and after views of elm tree trunk showing decayed heart wood in an old cut, and completed cavity, lip bolts and drain tube in place, ready for sectional concrete filling. 3—Tree Foreman A. E. Burnell, operating an electrically powered chisel for removal of decayed and infected heart wood. 4—Tree Trimmer Leo Simoni shaping a cavity with hand chisel and mallet.

View of unfinished realigned section of Prunedale-Castroville road showing straight tangent eliminating many curves and grades

Short Cut Highway to Coast Improved

THE recently completed section of Sign Route 156, 5.2 miles in length, between Castroville and Route 2 (U. S. 101) near Prunedale has opened a more direct route between the San Francisco metropolitan area and the picturesque Monterey Peninsula.

Improvement of the Roosevelt Highway, Sign Route 1, south from Castroville, for a distance of 7 miles, is now under way by current contracts covering the grading and paving with portland cement concrete and the construction of a five span structural steel girder bridge.

Irregularities, circuitous routing and narrow roadbed of the existing road, which was taken into the State Highway System in 1933, were not conducive to travel, resulting in traffic using the longer routes via Salinas or the Santa Cruz highway. With improvement of this section to modern standards, the route using the Prunedale Cutoff will become of growing importance, effecting a saving in distance of 6 miles over the most direct previous route and avoiding the traffic congestion of an intervening population center.

The new location traverses the rolling hills of Cienega del Cabilan to the Salinas Valley lands bordering the Moro Cojo Slough with fairly large cuts and fills. Alignment is of particularly high standard containing but four curves which have a minimum radius of 2,500 feet. Maximum grade is 5 per cent which occurs on a fairly short section; otherwise the grade is 4 per cent or less. Actual saving in distance over the existing road is 1.9 miles.

The project in general consisted of constructing a reinforced concrete girder overhead structure across the tracks of the Southern Pacific Company, grading a 36-foot roadbed and placing plant-mixed surfacing 22 feet wide x 0.25-foot thick on a crusher run base 24 feet wide x 0.5-foot thick. The low bearing value of the soils encountered in roadway excavation required that a subbase having a minimum thickness of 0.5-foot of imported borrow, with a minimum bearing value of 50 per cent minimum at 0.1 inch penetration on the compacted and soaked specimen, be placed the full width of the roadbed. The 7-foot shoulders were surfaced with imported material and bituminous surface treated.

The approximate major quantities involved consisted of:

Roadway

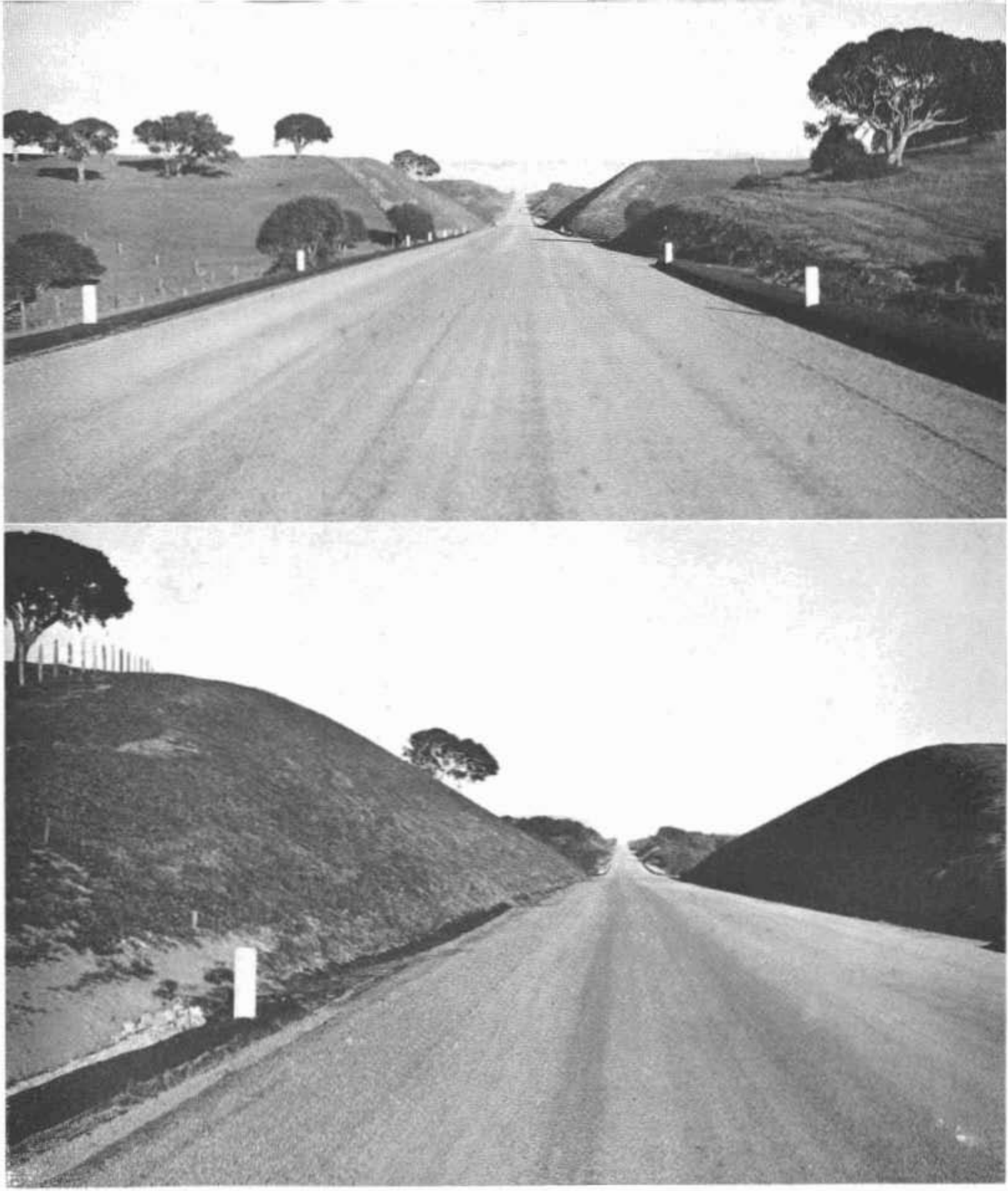
Excavation	**510,000 cu. yds.**
Overhaul	**3,000,000 sta. yds.**
Imported Borrow	**70,000 cu. yds.**
Crusher Run Base	**28,000 tons**
Plant-mix Surfacing	**14,000 tons**
Portland cement concrete (structures)	**1,400 cu. yds.**
Reinforcing Steel	**160,000 pounds**

SOIL PROBLEMS SOLVED

There are several areas traversed which preliminary soil investigation disclosed to be composed of saturated, unstable peaty material, particularly in the Moro Cojo Slough which is only 5 feet above sea level, where the unstable material extended to a depth of 22 feet. These areas were stabilized so as to support the proposed embankments by removing some 25,000 cubic yards of unstable material and backfilling the areas with beach sand.

The improvement was let as two contracts, one covering construction of the overhead structure to Kiss Crane Service, Berkeley, California, and the other covering the road construction to Harms Brothers, Sacramento, California.

The total cost of the project was approximately $475,000. The resident engineers for the State were G. W. Thompson for the overhead structure and F. C. Weigel for the road construction.



Two views of realigned and regraded sections of cut-off between U. S. 101 and coast taken before road was opened. Alignment is of high standard containing but 4 curves which have a minimum radius of 2500 feet. The 36 foot roadbed has a 22 foot plant mixed surfacing on a crusher run base and 7 foot shoulders, bituminous surface treated.

Rare Old Trees Being Preserved

(Continued from page 17)

heart wood aid considerably in counteracting the effects of wind stress and through their bracing action, assist the tree in overcoming the loss of structural wood.

CONCRETE FILLER USED

Filling material is made of 1 to 3 concrete put in in 8-inch sections, or of size to fit smaller or irregularly shaped cavities. The sections are separated with extra thick tarred fibre paper and the horizontal divisional cracks are sloped slightly out and down, to prevent water from entering the cavity. Fillings placed in this manner afford an overall strength that, aided by the lip bolts, nearly replace the loss of sound wood destroyed by decay.

The filling is brought to within ½-inch flush with the outer surface of the sap wood and thus provides an even durable surface for the growth of the callus. The concrete is impervious to insect damage or to any nominal destructive action, and so affords a stable wearing surface that only needs a yearly treatment of tree paint to last until it is entirely healed over by the callus.

When correct work is done the decay action is stopped and with complete regrowth of callus the tree resumes a nearly normal growing condition.

The district tree maintenance crews have long been active in corrective trimming and pruning of large roadside trees. It is understood, however, that while many large trees may need and would be benefited by reconditioning and repair work, the cost of such work usually can not be justified.

It is only in instances where trees, such as those described, have a historical value, or are particularly fine specimens, that reconditioning and repair work, including cabling, rod bracing, cavity construction and filling, can be economically justified.

This work above described in District IV provides a basis for consideration of future financing and accomplishment of this type of tree preservation, which will be continued in the future when and where it is determined advisable.

In Memoriam
Henry A. Sellers

The passing of Henry A. Sellers after but a few days of illness came as a shock to his many friends in District VI of the Division of Highways and throughout the State. His death occurred at his home on New Year's Day, following a heart attack.

He was a native of California, having been born in Antioch in 1877. For the past 22 years he had lived in Fresno County.

In February, 1931, Mr. Sellers became affiliated with the Division of Highways in the Right of Way Department at Fresno and for over 10 years served as District Right of Way Agent.

In his earlier years Mr. Sellers served for a period of five years as Engineer with the Pacific Mail Lines on runs to the Orient. Tiring of the sea, he engaged in farming and dairy ventures in the San Joaquin Valley. From 1909 to 1916 he operated a 250-cow dairy at Knightsen, California. During this period he promoted the idea of a Dairyman's Association with the resulting organization of the Central California Creamery in 1914, of which he was the head for the following three years.

In 1920 he disposed of his dairy interests, taking over for the next nine years the active management of the large Hotchkiss holdings in the San Joaquin Valley. He also engaged in cotton and wheat farming in the Firebaugh district.

He leaves his widow, Mrs. Pearl E. Sellers; three sons, Grove Sellers of Fresno, Milton K. Sellers of Walnut Creek, and Henry C. Sellers of Delano. A sister, Mrs. Herbert French of San Francisco, and five grandchildren.

Bids and Awards for January, 1943

SAN DIEGO COUNTY—Between San Luis Rey and Rancho Santa Margarita, about 4.3 miles to be graded and bituminous surface treatment applied. District XI. Denni Investment Corp., Wilmington, $128,388; Griffith Co. Los Angeles, $140,230; J. E. Haddock, Ltd., Pasadena, $175,545; Oswald Bros., Los Angeles, $182,079; Clyde W. Wood, Inc., Los Angeles, $191,491. Contract awarded to Basich Bros., Torrance, $126,301.

SAN MATEO COUNTY—On Butler Road in South San Francisco, about 0.4 mile to be graded and surfaced with plant-mixed surfacing on crusher run base. District IV. The Fay Improvement Co., San Francisco, $26,003; Union Paving Co., San Francisco, $26,103; A. J. Clausen, Berkeley, $26,407; Chas. L. Harney, San Francisco, $27,973; California Paving Co., San Mateo, $29,225; Guerin Bros., South San Francisco, $30,165; Peter Sorensen, Redwood City, $31,125. Contract awarded to L. C. Smith, San Mateo, $21,785.

SANTA CLARA COUNTY—On Hendy Avenue and East California Avenue in Sunnyvale, about 0.9 mile to be graded and surfaced with plant-mixed surfacing. District IV. A. J. Raisch, San Jose, $38,492; L. C. Smith, San Mateo, $38,698; California Paving Co., San Mateo, $38,932. Contract awarded to Union Paving Co., San Francisco, $37,053.

Siphon Principles in Culvert Practice

(Continued from page 7)

of outlet is a necessary condition, of course; if submergence is not natural, it can be obtained by building a sill or weir on the apron. There is great promise in this design, as otherwise the existing culvert may have to be reconstructed to avoid overtopping. The flare extension can be added without interruption to traffic.

Committee Recommendations

Summarizing the discussion of sag culverts and siphons, the Committee recommends generally that:

1. **Use of sag culverts should be restricted to sites where silt load is negligible and stagnation can not be objected to.**
2. **Sag culverts carrying canal water should not be extended without benefit of an hydraulic analysis of the effect on stage and capacity.**
3. **Culvert designers should be familiar with the true siphon as an economical drainage device and as a factor affecting estimates of discharge through existing culverts.**
4. **Standard culverts may be laid on down-broken grades to save excavation costs with assurance that siphoning will partly offset the impairment of grade. Particularly, the critical design stages may be unchanged by the impairment.**
5. **Flare-siphon culverts can be designed hydraulically by the formulae presented herein.**
6. **Flare-siphons offer great promise in the solution of cross drainage problems in broad valleys, particularly (a) if moderate stages will cause damage; (b) if roadway grade is low and likely to be overtopped; (c) if existing culverts on narrow roads are to be extended.**

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