

*Sixth Biennial Report  
of the State Engineer  
of the State of Arizona*

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SIXTH BIENNIAL REPORT  
OF THE  
STATE ENGINEER  
TO THE  
GOVERNOR  
OF THE  
STATE OF ARIZONA



For the Period  
July 1, 1922, to June 30, 1924





## The Road Builder

I am the road builder.  
 I construct each link in the almost  
 endless chain that forms the great  
 National Highway System. I plan and  
 carry out the great feats of engineering  
 that makes possible automobile travel  
 from Maine to California, from the Canadian  
 border to the Rio Grande. In winter and  
 summer, in storm and calm, I build. My  
 hours are long and my labors never -  
 ending. I face perils and hardships with-  
 out murmur. My work is constructive,  
 never destructive, for although I fell mighty  
 trees and blast out great boulders, I am al-  
 ways building. My identity is lost in my  
 work, but the roads of the Nation are my  
 monument.

I am the road builder.

-- Anonymous --







C. M. ZANDER  
Director

W. C. LEFEBVRE  
State Engineer

W. W. LANE  
Chief Engineer

V. A. WOOD  
Chief Clerk

# ARIZONA HIGHWAY DEPARTMENT

PHOENIX, ARIZONA



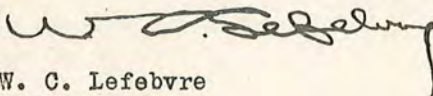
Gentlemen:

The State Engineer has the honor of transmitting herewith the Biennial Report of the operations of the Arizona Highway Department for the fiscal years ending June 30, 1923, and June 30, 1924.

Wherever practicable additional data, of the activities of the Highway Department, has been included to extend the information to a later date for the enlightenment of both yourselves and the State Legislature.

During this biennial there have been two State Engineers. Mr. F. R. Goodman resigned in April, 1924, and was succeeded by myself. As we have both served under your administration, the statements herein cover the two year period without division.

Respectfully yours,



W. C. Lefebvre  
State Engineer

Honorable Geo. W. P. Hunt,  
Governor of Arizona.

Honorable C. M. Zander,  
Director Highway Department.

Phoenix, Arizona.

# Arizona Highway Department

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## DEPARTMENTAL HEADS To April, 1924.

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F. R. GOODMAN, State Engineer  
W. W. LANE, Assistant Engineer  
C. C. SMALL, Chief Locating Engineer  
W. J. JAMIESON, Office Engineer  
B. M. ATWOOD, District Engineer  
C. L. JENKEN, District Engineer  
W. R. HUTCHINS, District Engineer  
ED TEN EYCK, District Engineer  
R. A. HOFFMAN, Bridge Engineer  
D. E. BLAKE, Testing Engineer  
  
S. B. JONES, Chief Clerk  
J. L. DUNNE, Traveling Auditor  
M. MONAHAN, Chief Accountant  
  
GEO. V. EBERLE, Purchasing Agent  
C. M. ZANDER, Superintendent of Equipment

# Arizona Highway Department

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## DEPARTMENTAL HEADS

June 30, 1924

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C. M. ZANDER, Director of Highway Department

W. C. LEFEBVRE, State Engineer

W. W. LANE, Chief Engineer

B. M. ATWOOD, District Engineer

E. M. WHITWORTH, District Engineer

T. S. O'CONNELL, District Engineer

GEORGE B. SHAFFER, Paving Engineer

R. A. HOFFMAN, Bridge Engineer

B. A. McNELLY, Testing Engineer,

C. C. SMALL, Location Engineer, (Associated)

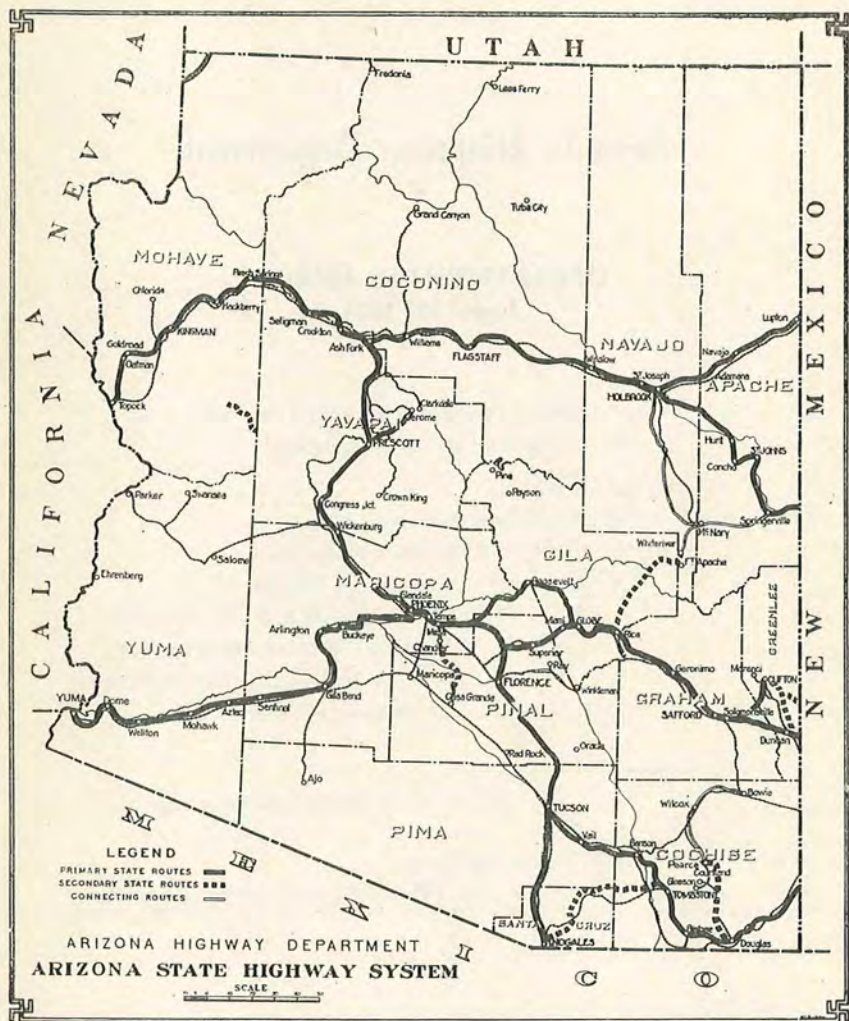
V. A. WOOD, Chief Clerk

R. E. L. WEBB, Chief Accountant,

GEO. V. EBERLE, Purchasing Agent

C. R. JONES, Superintendent of Equipment





## Foreword

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UPON the assumption of the duties of the operation of the Arizona Highway Department on January 2, 1923, it was found that a large construction program was in force, both by contract and State forces. Several large projects, upon which work had not been started, were under contract; there was a large outstanding indebtedness and the available funds were inadequate to meet the current necessities such as payrolls, contractors' estimates and the like.

The Legislature convened early in January but its activities were such as to render immediate operations more difficult to the extent of complete cessation on some of the projects, and giving only partial assistance late in the session.

In the closing cyclonic hours, the Legislature enacted the Highway Bill—without the emergency clause—which became a law June 9, 1923. This bill, with its limiting and conflicting restrictions, with the virtual impossibility of reaching accurate interpretations of its provisions, while providing funds for operation, has rendered operation a problem.

In addition to this, the resignation of the former State Engineer, F. R. Goodman, in April 1924, and my appointment as his successor, which required a limited reorganization, added confusion and delays of more or less consequence due to the uneasiness of the personnel, but this was quickly adjusted.

Despite the foregoing, the Arizona Highway Department has made exceptional progress during your administration, as evidenced by the statements contained herein, and which compares most favorably with preceding biennial periods in accomplishments of this department, physically and financially.

The Highway Department is the largest branch of the State Government and is surpassed in magnitude by only a very few companies operating within the confines of Arizona. Its wide range of operations, both in territory and duties, renders it peculiarly

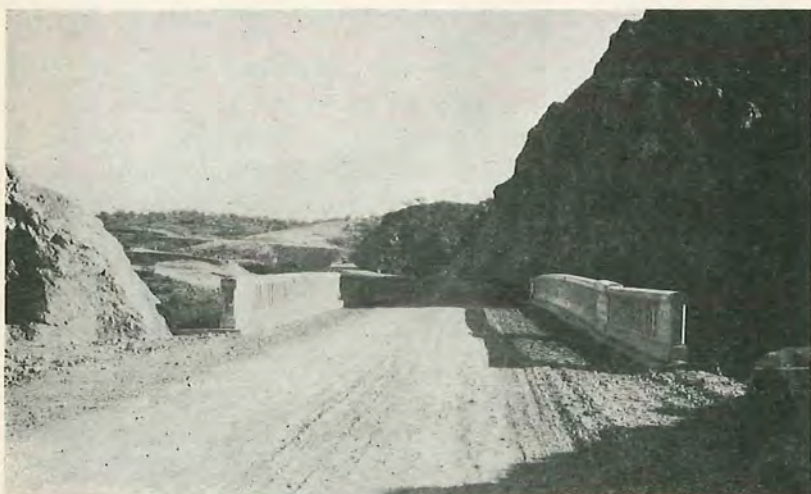


difficult of management and makes the inter-departmental coalition most essential.

Highway construction and operation has become a big business, one very essential to State and Community progress, requiring highly specialized employes familiar with local conditions. It has been the endeavor under your administration to give the best possible service to the public by very intense attention to highway maintenance; to keep pace with the rapid developments of highway construction methods and materials; and to obtain the best highway of its type possible.

A study of traffic conditions is being conducted for the basis of present maintenance and for future betterments and improvements.

#### PHOENIX-WICKENBURG HIGHWAY



SAN DOMINGO ARCH BRIDGE



## Highway Legislation

### Sixth Legislature, 1923

The highway legislation passed by the Sixth Legislature in regular session, 1923, has very little in its favor. As permanent legislation only one measure out of the three passed has any value whatever. Of the other two measures, one was intended to be purely temporary, and the other, or the major measure, failed hopelessly in its original intent.

Several of the members of this legislature were extremely diligent in behalf of progressive and constructive legislation for better highways and efficiency in the Highway Department. Their efforts were greatly appreciated by those interested in the highways of Arizona, but the majority of the members, for some unaccountable reasons, were adverse to Highway progressiveness,—at least at that time,—as evidenced by their final legislation.

The first measure that was enacted in behalf of the Highway Department was House Bill No. 159. This act was purely temporary in effect, and was to pay long overdue payrolls of the employees of the Department and to insure the delivery of materials on contract jobs. This latter provision was made necessary by the fact that there were many outstanding obligations, some of long duration, which had rendered the credit of the State questionable. This act was not passed until February 19, almost one and one half months after the Legislature had convened, and further credit would not be extended on the part of the railroads, or the advancement of freight on the part of the merchants.

The second measure enacted was Senate Bill No. 66, approved March 5, 1923. This measure might rightly be classed as constructive legislation, as it provides funds for highway maintenance on State Highways for the State System as a unit, and irrespective of the County lines.

The third and last measure enacted by this Legislature was Senate Bill No. 156, famously known as the "Highway Bill." The

measure as introduced, and as it now stands, is primarily an appropriation bill, and therefore for only a limited period of time. While the bill as originally drawn contained restrictions that were drastic and would require extreme caution to carry out, it also was constructive and progressive in its distribution of the funds to be appropriated thereby.

The Bill was introduced in the last hours of the session and from the very moment of its introduction it was the subject of the bitterest attack. Sections were stricken, changed and amended without regard to other sections that might be conflicting, the emergency clause was stricken out, and the bill passed on for approval without being given the consideration of being engrossed. This resulted in a piece of Legislation virtually incapable of accurate interpretation, and subject to the referendum and litigation.

As this act was not delivered to you for your consideration until the very closing hours of the session a veto of the bill in its entirety would have meant no relief whatever of the chaotic finances of the Highway Department. Your approval of the bill, subject to your veto of certain sections of it, would have been a very material help in the operations of the Department during this biennial, and it is regrettable that the courts did not sustain your veto, during the gauntlet of litigation to which the measure was subjected.

The measure became a law June 9, 1923, as passed by the Legislature, five months after that august body had convened and virtually that long after they were more or less conversant with the finances and activities of the Department. During this period deserving creditors of the State and contractors on highway work were suffering financially because of the inability of the Department to meet its legitimate obligations at an earlier date, due to the lack of prompt and comprehensive legislation.

Legislation of this nature is not conducive to efficiency on the part of the Highway Department and to the credit and confidence the State deserves. It reflects materially higher prices for a lower class of workmanship in the construction and maintenance of the highways of the State.

The following is the legislation enacted by the Sixth Legislature assembled in regular session, 1923, and the approval and veto of certain sections of Senate Bill No. 156.



**LEGISLATIVE BILLS**

(House Bill No. 159.)

**AN ACT**

TO DEFRAY THE CURRENT EXPENSES OF THE STATE HIGHWAY DEPARTMENT, AND APPROPRIATING THE SUM OF \$136,000.00 FOR THE PURPOSE OF PAYING THE PAYROLLS OF THE OFFICE OF THE STATE ENGINEER OF THE STATE OF ARIZONA AS OF FEBRUARY 20, 1923; AND THE SUM OF \$15,000.00 TO DEFRAY FREIGHT BILLS AND EXPENSES OF THE OFFICE OF THE STATE ENGINEER ON ACCOUNT OF FREIGHT AND EXPENSE ON MATERIALS FURNISHED STATE CONTRACTORS; AND DECLARING AN EMERGENCY.

**Be it Enacted by the Legislature of the State of Arizona:**

Section 1. For the purpose of defraying the current expenses of the office of the State Engineer of the State of Arizona, there is hereby appropriated out of the General Fund of the State of Arizona, the following sums of money, to be expended by the said office of State Engineer for the purposes hereinafter set forth, to-wit:

The sum of \$136,000.00, or as much thereof as may be necessary, for the purpose of paying the payroll account of said office of State Engineer accrued as of the 20th day of February, 1923.

The sum of \$15,000.00 or as much thereof as may be necessary, for the purpose of paying freight bills upon materials to be supplied to the contractors of the State by the State of Arizona subsequent to the effectiveness of this Act.

Said monies shall be paid as aforesaid upon presentation of duly certified claims of said office of State Engineer to the State Auditor, who shall draw his warrants therefor on the State Treasurer, who shall pay the same out of the General Fund of the State.

Section 2. Whereas, the preservation of the public peace, health and safety makes it necessary that the provisions of this Act shall become immediately operative, an emergency is hereby declared to exist, and this Act is hereby exempted from the operation of the



referendum provisions of the State Constitution and shall take effect and it shall be in full force and effect from and after the passage by the legislature and its approval by the Governor.

Approved February 19, 1923.

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(Senate Bill No. 66)

AN ACT

PROVIDING FUNDS FOR THE MAINTENANCE OF STATE ROADS; PROVIDING FOR THE DISPOSITION OF ALL FUNDS NOW IN CUSTODY OF THE STATE TREASURER, RECEIVED FROM AUTOMOBILE AND OTHER MOTOR PROPELLED VEHICLE LICENSES; PROVIDING FOR THE DISPOSITION AND EXPENDITURE OF ALL FUTURE LICENSE FEES RECEIVED BY THE STATE TREASURER FROM AUTOMOBILE AND OTHER MOTOR PROPELLED VEHICLES; AND REPEALING ALL ACTS AND PARTS OF ACTS IN CONFLICT WITH THE PROVISIONS OF THIS ACT.

**Be it Enacted by the Legislature of the State of Arizona:**

Section 1. That all monies in the State Treasury, and under the control and custody of the State Treasurer, received by him prior to the effectiveness of this Act, as fees paid for license of automobiles or other motor propelled or driven vehicles and all such monies by him so received subsequently to the effectiveness of this Act, shall immediately upon the effectiveness of this Act or upon receipt of such monies subsequently to the effectiveness of this Act, be immediately placed in and credited to a separate account in the general fund to be known and designated as State Highway Maintenance Account, to be subject to the control and disposition of the Board of Directors of State Institutions, and by them to be expended through the State Engineer for the exclusive use and purpose of the maintenance of State Highways and roads.

Section 2. All Acts and parts of Acts in conflict with the provisions of this Act are hereby repealed.

Section 3. Whereas, the preservation of the public peace, health and safety makes it necessary that the provisions of this Act shall become immediately operative, an emergency is hereby declared to exist, and this Act is hereby exempted from the operation of the referendum provisions of the State Constitution, and shall take effect and it shall be in full force and effect from and after its passage by the legislature and its approval by the governor.

Approved March 5th, 1923.

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### ***The Highway Bill.***

EXECUTIVE OFFICE

State House

Phoenix, Arizona

March 20, 1923

My Dear Mr. Kerby:

I am sending you with my signature and approval, with the exception of certain items which I have enumerated and which are listed in detail below, Senate Bill No. 156, An Act:

“TO PROVIDE FUNDS FOR THE CONSTRUCTION AND COMPLETION OF CERTAIN DESIGNATED HIGHWAY PROJECTS, WITHIN THE STATE OF ARIZONA, INITIATED OR AUTHORIZED, BUT NOT COMPLETED BY THE BOARD OF DIRECTORS OF STATE INSTITUTIONS AND OFFICE OF STATE ENGINEER, PRIOR TO JANUARY FIRST, 1923; AUTHORIZING THE REFUNDING, FOR USE ON ANY SPECIFIC OR DESIGNATED HIGHWAY PROJECT, OF FUNDS PAID BY ANY POLITICAL SUBDIVISION OF THE STATE OF ARIZONA, TO THE STATE OF ARIZONA, FOR THE USE OF THE BOARD OF DIRECTORS OF STATE INSTITUTIONS AND OF SAID OFFICE OF STATE ENGINEER OF THE STATE OF ARIZONA, FOR THE CONSTRUCTION OF SUCH SPECIFIC AND DESIGNATED HIGHWAY PROJECTS AND DIVERTED PRIOR TO JANUARY FIRST, 1923, BY SAID BOARD OF DIRECTORS OF STATE INSTITUTIONS AND OF SAID OFFICE OF STATE ENGINEER, TO PURPOSES



OTHER THAN SUCH SPECIFIED AND DESIGNATED PROJECTS; MAKING AN APPROPRIATION THEREFOR; PROVIDING FOR THE RAISING OF FUNDS TO MEET SUCH APPROPRIATION BY MEANS OF 25% AP-PORTIONMENT OF STATE ROAD TAX, TAX UPON PAS-SENGER CAPACITY PER MILE, UPON DESIGNATED COMMON CARRIERS; A TAX UPON TRUCK TONNAGE OF MOTOR TRUCKS AND TAX UPON GASOLINE AND OTHER DISTILLATES OF CRUDE PETROLEUM; REGU-LATING AND PROVIDING FOR THE DEPOSIT, USE, ACCOUNTING FOR AND DISBURSEMENT OF MONEYS PAID TO THE STATE OF ARIZONA BY SUCH SUBDIVI-SIONS OF THE STATE OF ARIZONA FOR THE CON-STRUCTION OF DESIGNATED ROAD PROJECTS AND MONEYS PAID TO THE STATE OF ARIZONA BY THE UNITED STATES OF AMERICA BY VIRTUE OF CO-OP-ERATIVE AGREEMENTS BETWEEN THE STATE OF ARIZONA AND THE UNITED STATES OF AMERICA PURSUANT TO AN ACT OF THE CONGRESS OF THE UNITED STATES OF AMERICA ENTITLED 'AN ACT TO PROVIDE THAT THE UNITED STATES SHALL AID THE STATES IN THE CONSTRUCTION OF RURAL AND POST ROADS, AND FOR OTHER PURPOSES, OR OF ANY AMENDMENT THERETO, OR PURSUANT TO ANY OTHER ACT ENACTED BY THE CONGRESS OF THE UNITED STATES OF AMERICA FOR LIKE PURPOSES; PROVIDING FOR THE ISSUANCE OF, REGISTRATION AND PAYMENT OF NEGOTIABLE STATE WARRANTS AND PROVIDING FOR THE ISSUANCE OF NEGOTIABLE TREASURER'S CERTIFICATES OF THE STATE OF ARIZONA IN ANTICIPATION OF THE COLLECTION OF THE TAXES AUTHORIZED BY THIS ACT; PRESCRIB-ING THE FORM OF SUCH WARRANTS AND CERTIFI-CATES, THE DUE DATE AND RATE OF INTEREST THEREON; DEFINING OFFENSES IN VIOLATION OF THIS ACT AND PROVIDING PENALTIES THEREFOR;''

Analysis of the condition of the State Highway finances, as such information has been made available to this office, proves con-clusively the requirement of emergent provision of funds, in an



amount approximately of one and one-half millions of dollars, to complete road projects to which the State, has been, heretofore committed.

In the light of further eliminations of appropriations contained in this act, which I am constrained to make for the reasons herein-after set forth, and in the appreciation of the fact, that our State is at this time most unfortunately unable to bear the burden of new and additional taxes for road or other purposes, I have determined, to meet the emergency, that the levy of ten cents upon each one hundred dollars of assessed valuation, shall be used exclusively in the construction and for the completion of those road projects to which the State has been committed. These projects lie in and through each of the counties of the State, and the expenditure of this fund for such purposes, to the exclusion of any division to the 75% apportionment account, is certainly in the interest not only of relieving the present chaotic condition of State highway finances but in the direct interest of road construction for the benefit of each of the counties of the State. To continue the 75% apportionment during the present emergency would entail one of two consequences; either, a tax must be paid in excess of the ten cent levy to finance State Work, which I believe would add a burden unbearable at this time upon the people of the State, or, the State Highway Department must limit itself in the construction of those projects to which the State has been committed, to use of the 75% fund within the confines of the respective counties. In some of the counties the apportionment is more than sufficient, and in others it is far too small, to enable the desired construction to be done,—which on the whole would result in an utter lack of provision to meet the existing emergency.

Without committing myself to an expression of an opinion upon the desirability of a permanent elimination of the 75% fund or account, the following ideas occur and are pertinent in this connection. The reasons which dictated the establishment of the 75% fund have ceased to exist or are of little relative importance. Apprehension was formerly entertained, that if provision were not made by statute for the equitable division among counties of road monies, political manipulation would work to the undue advantage of the larger and more politically powerful counties and to

the disadvantage of their weaker and smaller sisters. But the advent of federal cooperation in the building of State roads and the consequent supervision by the Federal Government, resulting in the establishment of the 7% system and providing for the construction of an unified State system of roads, running through and benefiting all of the counties of the State, have entirely assured the respective counties of a fair and equitable division and expenditure of road monies, which is at once to the interest of the several counties and of the entire State of Arizona.

I disapprove and veto for reasons stated, that portion of Section 10, beginning after the “,” after the word “bridges” in the last line of Subdivision “a” Section 10, down to and including the word “account” in the last line of paragraph 2 of Section 10 which reads as follows:

“as follows: 25% of said tax, hereinafter provided, for, shall be as paid into the treasury of the State of Arizona, deposited by the Treasurer of the State of Arizona, in a separate account, in the General Fund of the State, to be known and designated as the 25% apportionment account.”

Paragraph 3 of Subdivision “a” of Section 10 beginning with the word “seventy” in line 1 and ending with the word “responsibility” in the last line of the paragraph which reads as follows:

“Seventy-five (75%) of such “State Road Tax Fund,” herein provided, for, shall be apportioned to the several counties in the amount to each county of 75% of the taxes collected under this act by said county, and such amount shall be subject to be paid out for the construction, reconstruction, repair, improvement and maintenance of public highways, roads and bridges in the manner as in this act, provided for the work in this act provided for within such county upon the authority and under the direction of the County Board of Supervisors of such county and the State Engineer who are hereby charged with such responsibility.”

I also disapprove of and veto Paragraphs (a) and (b) of Subdivision 11, Section 10 which reads as follows:

(a) “There hereby is authorized to be levied and collected (one-half mill) tax per each scheduled passenger capacity mile, which hereby is defined to mean a tax of (one-half mill) on each and every



unit of seating capacity operating over each and every mile between fixed termini, or otherwise, in the State of Arizona, as per schedules on file with the Corporation Commission, or otherwise.

(b) "There is hereby authorized to be levied and collected a (two-mill tax) per each scheduled truck ton capacity or fraction of truck ton capacity mile, which hereby is defined to mean, a tax of (two mills) on each and every actual truck ton or fraction of truck ton capacity load operating over each and every mile between fixed termini, or otherwise, in the State of Arizona, as per schedules on file with the Corporation Commission or otherwise."

This tax is a non-economic tax. The amount assessed is too low and the cost of collection too high to justify the levying and collection of this tax.

I also veto and disapprove Paragraph (a) Subdivision 111 of Section 10, which reads as follows:

"That each and every dealer, as defined in this Act, who is now engaged or who may hereafter engage in his own name, or in the name of others, or in the name of his representatives or agents of this State in the sale, use or distribution, as dealers and other distributors of gasoline or other distillates of crude petroleum shall not later than the fifteenth (15th) day of each calendar month render a statement to the Secretary of the State of Arizona of gasoline and other distillates of crude petroleum sold, used or distributed by him or them in the State of Arizona during the preceding calendar month, and collect a license tax of three (3) cents per gallon on all gasoline and other distillates of crude petroleum so sold, used or distributed for use in motor propelled or motor driven vehicles, as shown by such statement in the manner and within the time hereinafter provided, which tax shall be added to the sale price of the dealer as herein defined when sold, used or distributed for the use in said motor propelled or motor driven vehicles only."

I believe that a gasoline tax can be justified for the maintenance of roads, but I am very skeptical of the advisability of inaugurating the policy of paying the cost of constructing roads by taxing gasoline. I also think the tax of three cents is too high under present conditions.

I also veto and disapprove of that part of Paragraph (d) of Sub-



division 111 of Section 10 beginning after the “,” in the 4th line down to and including the word “fund” in the 5th line, which reads as follows:

“and the State Treasurer shall place one-quarter of the same in said 25% apportionment account of the General Fund,”

That portion of Paragraph (d), Subdivision 111 of Section 10 beginning with the word “and” in the 5th line and ending with the “,” after the word “fund” in line Six, which reads as follows:

“and one-quarter of same to the account of the seventy-five per cent apportionment account of the General Fund,”

That portion of Paragraph (d), Subdivision 111, Section 10 beginning with the word “and” in the 6th line and ending with the “)” in the 11th line, which reads as follows:

“and said Secretary of State shall promptly pay the remaining one-half of such tax to the several county treasurers of the State of Arizona, in proportion to the amount of such tax received from the respective counties, which shall be used by the said several counties as may be determined by the Board of Supervisors thereof, for the maintenance of county roads and highways.)”

Very sincerely yours,

(Signed) GEO. W. P. HUNT,

GOVERNOR.

Hon. James H. Kerby,  
Secretary of State,  
Phoenix, Arizona.

House Bill No.  
Senate Bill No. 156

Introduced by Joint Committee of Investigation of  
State Highway Department and Affairs

AN ACT

TO PROVIDE FUNDS FOR THE CONSTRUCTION AND COMPLETION OF CERTAIN DESIGNATED HIGHWAY PROJECTS, WITHIN THE STATE OF ARIZONA, INITIATED OR AUTHORIZED, BUT NOT COMPLETED BY THE BOARD OF DIRECTORS OF STATE INSTITUTIONS AND OFFICE OF STATE ENGINEER, PRIOR TO JANUARY 1, 1923; AUTHORIZING THE REFUNDING, FOR USE ON ANY SPECIFIC OR DESIGNATED HIGHWAY PROJECT, OF FUNDS PAID BY ANY POLITICAL SUB-DIVISION OF THE STATE OF ARIZONA, TO THE STATE OF ARIZONA, FOR THE USE OF THE BOARD OF DIRECTORS OF STATE INSTITUTIONS AND OF SAID OFFICE OF STATE ENGINEER OF THE STATE OF ARIZONA, FOR THE CONSTRUCTION OF SUCH SPECIFIC AND DESIGNATED HIGHWAY PROJECTS AND DIVERTED, PRIOR TO JANUARY 1, 1923, BY SAID BOARD OF DIRECTORS OF STATE INSTITUTIONS AND OF SAID OFFICE OF STATE ENGINEER, TO PURPOSES OTHER THAN SUCH SPECIFIED AND DESIGNATED PROJECTS: MAKING AN APPROPRIATION THEREFOR: PROVIDING FOR THE RAISING OF FUNDS TO MEET SUCH APPROPRIATION BY MEANS OF 25% APPORTIONMENT OF STATE ROAD TAX, TAX UPON PASSENGER CAPACITY PER MILE, UPON DESIGNATED COMMON CARRIERS; A TAX UPON TRUCK TONNAGE OF MOTOR TRUCKS AND TAX UPON GASOLINE AND OTHER DISTILLATES OF CRUDE PETROLEUM; REGULATING AND PROVIDING FOR THE DEPOSIT, USE, ACCOUNTING FOR AND DISBURSEMENT OF MONIES PAID TO THE STATE OF ARIZONA BY SUCH SUB-DIVISIONS OF THE STATE OF ARIZONA FOR THE CONSTRUCTION OF DESIGNATED ROAD PROJECTS AND MONIES PAID TO THE STATE OF ARIZONA BY THE UNITED STATES OF AMERICA, BY VIRTUE OF COOPERATIVE AGREEMENTS BETWEEN THE STATE OF ARIZONA AND THE UNITED STATES OF AMERICA PURSUANT TO AN ACT OF THE CONGRESS OF THE UNITED STATES OF AMERICA ENTITLED "AN ACT TO PROVIDE THAT THE UNITED STATES SHALL AID THE STATES IN THE CONSTRUCTION OF RURAL AND POST ROADS, AND FOR OTHER PURPOSES" OR OF ANY AMENDMENT THERETO, OR PURSUANT TO ANY OTHER ACT ENACTED BY THE



CONGRESS OF THE UNITED STATES OF AMERICA FOR LIKE PURPOSES; PROVIDING FOR THE ISSUANCE OF, REGISTRATION AND PAYMENT OF NEGOTIABLE STATE WARRANTS AND PROVIDING FOR THE ISSUANCE OF NEGOTIABLE TREASURER'S CERTIFICATES OF THE STATE OF ARIZONA IN ANTICIPATION OF THE COLLECTION OF THE TAXES AUTHORIZED BY THIS ACT; PRESCRIBING THE FORM OF SUCH WARRANTS AND CERTIFICATES, THE DUE DATE AND RATE OF INTEREST THEREON; DEFINING OFFENSES IN VIOLATION OF THIS ACT AND PROVIDING PENALTIES THEREFOR; ~~AND DECLARING AN EMERGENCY.~~

**Be It Enacted by the Legislature of the State of Arizona:**

Section 1. For the purpose of construction and completion of those certain highway projects hereinafter specified, within the State of Arizona, initiated or authorized but uncompleted by the Board of Directors of State Institutions, and by the Office of State Engineer, of the State of Arizona, prior to January 1, 1923, and for the purpose of refunding for use on specific and designated highway projects of funds paid by political sub-divisions of the State of Arizona to the State of Arizona, for the use of said Board of Directors of State Institutions and of said office of State Engineer of the State of Arizona, for the construction of such specific and designated highway projects, and diverted, prior to January 1, 1923, by said Board of Directors of State Institutions and said office of State Engineer, to purposes other than such specific and designated projects, the following appropriations, transfers and funds, limitations and authorizations of expenditure of funds and appropriations are made.

Section 2. For the purpose of refunding for use on the specific and designated highway projects, hereinafter named, of funds paid by the counties of the State of Arizona, hereinafter named to the State of Arizona, for the use of said Board of Directors of State Institutions and said State Engineer, for the construction of such specific and designated projects, and diverted prior to January 1, 1923, by said Board of Directors of State Institutions and said office of State Engineer, to purposes other than the construction of said specific and designated projects, the State Treasurer is hereby authorized and directed, immediately upon the pass-



age of this Act and its approval by the Governor, to make transfers out of any monies in the 25% apportionment account in the General Fund of the State of Arizona, as follows:

a. The sum of 9,061.79 dollars, which shall be deposited by the State Treasurer in a segregated account within the General Fund in favor of Federal Aid project of the State of Arizona, No. 51, now in course of construction, or to be constructed in Coconino County.

b. The sum of 103,219.84 dollars, which shall be deposited by the State Treasurer in a segregated account within the General Fund in favor of Federal Aid project of the State of Arizona, Nos. 61 and 62 now in the course of construction, or to be constructed in Yavapai County.

c. The sum of 98,759.73 dollars, which shall be deposited by the State Treasurer in a segregated account within the General Fund in favor of Federal Aid Project of the State of Arizona, No. 55, now in the course of construction, or to be constructed in Yuma County.

d. The sum of 64,817.19 dollars, which shall be deposited by the State Treasurer in a segregated account within the General Fund in favor of Federal Aid project of the State of Arizona, No. 43, now in the course of construction, or to be constructed in Graham County.

e. The sum of 42,316.07 dollars, which shall be deposited by the State Treasurer in a segregated account within the General Fund in favor of Federal Aid Project of the State of Arizona No. 56, now in the course of construction, or to be constructed in Maricopa County.

f. The sum of 123,863.78 dollars, which shall be deposited by the State Treasurer in a segregated account within the General Fund in favor of Federal Aid Project of the State of Arizona No. 59, now in the course of construction, or to be constructed in Maricopa County.

g. The sum of 15,262.64 dollars which shall be deposited by the State Treasurer in a segregated account within the General Fund in favor of Federal Aid project of the State of Arizona, No. 60, now in the course of construction, or to be constructed in Apache County.

Section 3. All monies received from the United States of America, by virtue of any cooperative agreements for the construction of any of the projects named in Section 2 of this Act, between the State of Arizona, and the United States of America, pursuant to the terms of the Act, of the Congress of the United States of America, entitled, "An Act to provide that the United States shall aid the States in the construction of rural and post roads, and for other purposes," or of any amendment thereto, or pursuant to any other act of the Congress of the United States of America, enacted for like purposes, shall, when received by the Treasurer of the State of Arizona, be by him deposited to the credit of the respective segregated accounts within the General Fund of the State, of the project or projects, named in Section 2 of this Act, on account of which such monies were so paid by the United States of America.

Section 4. The monies in any of such segregated accounts, as provided in Sections 2 and 3, of this Act, shall be paid out, for and only for, the purposes as following:

First: The reimbursement of the State of Arizona for any expenditures by it in the construction of such project, which reimbursement shall be to the account within said General Fund from which said expenditures by the State of Arizona were made.

Such reimbursement shall be made by appropriate transfers upon the books of the Auditor and Treasurer of the State of Arizona, and such monies, so transferred, shall immediately, upon such transfer, be available for expenditure from the account, to which transferred, for the purposes of such account, as authorized by law.

Second: For the construction and completion of such project, and for such purpose, shall be paid out, upon vouchers of said office of State Engineer, hereinafter in this Act designated, "State Engineer" approved by said Board of Directors of State Institutions, hereinafter in this Act designated as "Board," to the State Auditor, who shall draw his warrant therefor, which shall show on account of which of said projects, named in Section 2 of this Act, such warrant is drawn, to the State Treasurer, who shall pay the same out of the said segregated account of such project, in the General Fund, and not otherwise.

Provided, that, when the above purposes are fully satisfied, any balance remaining in such segregated account, shall be transferred,



by the Auditor and Treasurer of the State of Arizona, to the 25% apportionment account, within said General Fund, and may thereafter be available for expenditure for the purposes of such account, as authorized by law except there shall have been an agreement between the State of Arizona and the political subdivision of the State of Arizona respecting the disposition of any such balance remaining of the funds so paid to the State of Arizona after the completion of the road project to which applicable, in which event, such balance shall be paid out in accordance with such agreement, upon vouchers of said State Engineer, approved by said Board, to the Auditor of the State of Arizona, who shall draw his warrant therefor reciting the account out of which payable to the State by the Treasurer, who shall pay the same out of such balance remaining in such account, and not otherwise.

Section 5. There is hereby appropriated from the funds and monies hereafter in this Act created or designated, the sum of 1,550,000.00 dollars, which shall be paid when and as available to the credit of said 25% apportionment account, in said General Fund, to be expended for, and only for the following purposes:

First: The refunding for use on any specific or designated highway project, of funds paid by any political subdivision of the State of Arizona, to the State of Arizona, for the use of said Board and said State Engineer, for the construction of such specific and designated highway project, and diverted prior to January 1, 1923, by said Board and said State Engineer, to purposes other than the construction of such specific and designated project.

At any time the Board shall discover any funds so to have been diverted, immediately upon the ascertainment of the amount thereof, other than those mentioned in Section 2 of this Act, it shall so certify to the Auditor and Treasurer of the State of Arizona, who shall immediately transfer from said 25% apportionment account, such sum of money which shall be credited forthwith to the segregated account within the General Fund in favor of the specific and designated highway project for the construction of which such funds of such political subdivision were originally paid to the State of Arizona, and shall be expended only, as provided in Section 4 of this Act.

Second: For the construction and completion of those certain



highway projects, within the State of Arizona initiated or authorized, but not completed by the Board of Directors of State Institutions, and by the office of State Engineer of the State of Arizona prior to January 1, 1923, named and described as follows:

a. Federal Aid Project No. 19, Prescott Jerome Lonesome Valley. Located Jaeger Canyon to Granite Dells.

b. Federal Aid Project No. 20, Town of Winslow, paving.

c. Federal Aid Project No. 22, Winslow to Coconino County Line, located West of City limits of Winslow to West boundary of Navajo County.

d. Federal Aid Project No. 23, Florence Superior, A. B. C. D. E. F., located north end of Florence Bridge to Superior.

e. Federal Aid Project No. 25, Tucson Nogales Bridges.

f. Federal Aid Project No. 36, Prescott-Jerome, located City Limits of Prescott to end of Project No. 19.

g. Federal Aid Project No. 39, Topock-Oatman Section 1, located Topock to twenty-three miles northerly.

h. Federal Aid Project No. 40, Holbrook-Winslow, Schedules 1, 2, 3, 4, located Winslow to Holbrook.

i. Federal Aid Project No. 42, Holbrook St. Johns, located Station 0 plus 00 to 566 plus 00.

j. Federal Aid Project No. 43, Geronimo-Solomonville, located Central to one-half mile Southeast of Safford.

k. Federal Aid Project No. 48 Glendale-Marinette, located City Limits Glendale to Martinette.

l. Federal Aid Project No. 53, Phoenix-Yuma, located Gila Bend to Gillespie Dam.

m. Federal Aid Project No 54, Kingman-Oatman (Kingman Goldroads), located Sacramento Wash to Little Meadows.

n. Federal Aid Project No. 55, Yuma-Phoenix Section 1 and 2 located Welton to County Line.

o. Federal Aid Project No. 56, Phoenix-Yuma, located Gila Bend to Piedra.

p. Federal Aid Project No. 57, Ash Fork-Seligman, located Eight miles east of Pineveta to one mile West of Crookton.

q. Federal Aid Project No. 59, Phoenix-Prescott - Phoenix-Wickenburg), located Hot Springs Junction to East end of Wickenburg bridge.

r. Federal Aid Project No. 60, St. Johns-Springerville, located St. Johns to thirteen and one-half miles south.

s. Federal Aid Project No. 61, Prescott Ash Fork, Schedules A, B, C, D, located End of Project No. 36, to Forest Boundary.

t. Federal Aid Project No. 62, Prescott Ash Fork, Schedules 1, 2, 3, 4, located End of Project No. 61, Ash Fork.

u. Federal Aid Project No. 63, Geronimo Solomonville, located Mathews Wash to Central.

v. Federal Aid Project No. 64, Gillespie Dam-Hassayampa River, located Gillespie Dam to Hassayampa River.

w. Federal Aid Project No. 65, Mesa Superior, located Eastern Canal to four miles east.

x. Federal Aid Project No. 66, Tucson Nogales Bridges.

y. Federal Aid Project No. 67, Geronimo-Solomonville, located Safford to Solomonville.

z. Federal Aid Project No. 68, St. Johns-Springerville located End of Federal Aid 60 to Springerville.

aa. Federal Aid Project No. 69, Phoenix-Yuma, located County Line to Piedra.

bb. Federal Aid Project No. 70, Phoenix Wickenburg, located Marinette to four miles West.

cc. Federal Aid Project No. 71, Phoenix-Yuma, located Buckeye to Hassayampa River.

dd. Federal Aid Project No. 72, White-Spar-Congress Junction (Phoenix Prescott) located White Spar to Congress Junction.

ee. Federal Aid Project No. 73, Springerville-New Mexico State Line, located Springerville to a point ten miles East.

ff. Federal Aid Project No. 74, Flagstaff-Winslow. located Cocino County Line to Canyon Diablo Bridge.

gg. Non-Federal Aid Project Adamana Lupton, located from Adamana to Lupton.



hh. Non-Federal Aid Project, Apache Trail, from Highway Junction about fourteen miles east of Mesa to Roosevelt Dam.

ii. Non-Federal Aid Project, Ash Fork-Pineveta, from Ash Fork to Pineveta.

jj. Non-Federal Aid Project, Holbrook St. Johns, Concho bridge, at Concho (about 60 foot bridge).

kk. Non-Federal Aid Project, Kingman East, Kingman Hackberry Section, one and one-half miles Northeast from Kingman.

ll. Non-Federal Aid Project, Phoenix Yuma Arlington Bridge. Over Hassayampa River about two miles East of Arlington.

mm. Non-Federal Aid Project, Holbrook Lupton Allentown Bridge, Fifteen Miles West of Lupton or four miles from Allentown.

nn. Non-Federal Aid Project, Tucson Florence, Pima County, from Tucson to County Line.

oo. Non-Federal Aid Project, Tucson Florence, Pinal County from County Line to Florence.

pp. Non-Federal Aid Project, Holbrook Lupton Rio Puerco Bridge at Sanders, nine miles West of Lupton.

qq. Non-Federal Aid Project, Nogales Fairbanks Patagonia Bridge, at Patagonia over the Sonoita River.

rr. Non-Federal Aid Project, Chandler Casa Grande, six miles South of Chandler to eight miles North of Casa Grande.

ss. Non-Federal Aid Project, Douglas Rodeo Dips, over various washes on Douglas Rodeo highway.

tt. Non-Federal Aid Project, Nogales Willows paving, extending six miles North of Nogales.

uu. Non-Federal Aid Project, Holbrook Lupton, Lupton Bridge at Lupton.

vv. Non-Federal Aid Project, Mesa Superior resurfacing from Florence, Superior Mesa Junction, five miles Northwest.

Section 6. Said Board is hereby authorized to enter into agreements with any political subdivision of this State, by and through the proper governing body thereof, for the use by the State of Ari-

zona, of bond or other monies of such political subdivision, for the construction and completion of the road projects, enumerated in Section 5, of this Act, or for other projects as may be approved by such Board; provided that such road project is situated within the corporate boundaries of such political subdivision and not otherwise.

Such agreement shall be in writing, executed in duplicate, and shall specifically recite:

(a) By suitable designation, each road project so to be constructed, and the amount of money to be paid by such political subdivision to the State of Arizona for the construction of each of such road projects.

(b) That the money so to be supplied by such political subdivision shall on, or before, a date or dates specified in such agreement be paid by such political subdivision to the Treasurer of the State of Arizona, to be held and disposed of by him, as hereinafter in this section provided.

(c) All monies received from the United States of America, by virtue of any cooperative agreement, under the authority mentioned in Section 3 of this Act, for the construction of such road project between the State of Arizona and the United States of America, shall be deposited with the Treasurer of the State, to be held and disposed of by him, as hereinafter in this section provided.

On or before the date or dates provided in such contract, for the payment of such political subdivision of such monies, such political subdivision shall cause to be deposited the amount of money agreed upon with the Treasurer of the State of Arizona, who shall deposit the same in a segregated account within said General Fund, in favor of such road project.

All monies received by the Treasurer of the State of Arizona from the United States of America, by virtue of any cooperative agreement, under the authority mentioned in Section 3 of this Act, for the construction of any such road project, between the State of Arizona and the United States of America, shall be deposited by such Treasurer in the Segregated account within the said General Fund, in favor of the road project, on account of which such monies were so paid by the United States of America.



The monies in any of said segregated accounts, as provided in this section, shall be paid out for and only for, the purposes as follows:

First: The reimbursement of the state of Arizona for any expenditures by it in the construction of such project, which reimbursement shall be to the account within said General Fund from which said expenditures by the State of Arizona were made.

Such reimbursement shall be made by appropriate transfers upon the books of the Auditor and Treasurer of the State of Arizona, and such monies so transferred, shall immediately, upon such transfer, be available for expenditure from the account to which transferred, for the purposes of such account, as authorized by law.

Second: For the construction and completion of such project, and for such purpose, shall be paid out, upon vouchers of said office of State Engineer, approved by said Board, to the State Auditor, who shall draw his warrant therefor, which shall show on account of which of such projects such warrant is drawn, to the State Treasurer, who shall pay the same out of the said segregated account of such project in the General Fund, and not otherwise.

Provided, that, when the above purposes are fully satisfied, any balance remaining in such segregated account, shall be transferred, by the Auditor and Treasurer of the State of Arizona, to said 25% apportionment account, within said General Fund, and may thereafter be available for expenditure from that account, for the purpose of such account, as authorized by law; except there shall have been an agreement between the State of Arizona and the political subdivision of the State of Arizona respecting the disposition of any such balance remaining of the funds so paid to the State of Arizona, after the completion of the road project to which applicable, in which event, such balance shall be paid out in accordance with such agreement, upon vouchers of said State Engineer, approved by said Board, to the Auditor of the State of Arizona, who shall draw his warrant therefor, reciting the account out of which payable, to the State Treasurer, who shall pay the same out of such balance remaining in such account, and not otherwise.

Section 7. All monies received subsequent to the time this Act takes effect either by way of bond or other monies of any political

subdivision of the State of Arizona, for the construction of specified and designated highways, under agreement executed by and between said Board and such political subdivision, prior to the passage of this Act, and its approval by the Governor, and all monies received by the Treasurer of the State of Arizona from the United States of America, by virtue of any cooperative agreement, under the authority mentioned in Section 3 of this Act, for the construction of such specific and designated highway between the State of Arizona and the United States of America, shall be deposited with the Treasurer of the State of Arizona, who shall deposit the same in a segregated account, within said General Fund, and in favor of such specified and designated highway, and shall be held and disposed of by such treasurer upon all the terms and conditions applicable thereto, and set forth in Section 6 of this Act.

Section 8. It shall be unlawful for the said State Engineer, Board, Auditor or Treasurer of the State of Arizona to receive, employ, use, dispose of, deposit, or otherwise handle any bond or other monies of any political subdivision of this State, for the purpose of highway construction, or any monies received from or paid by the United States of America, by virtue of any cooperative agreement, under the authority mentioned in Section 3 of this Act, executed between the State of Arizona and the United States of America, and paid by the United States of America, on account of the construction of any such highway as defined in this section, except as authorized and provided in this Act.

Section 9. All monies paid to the Treasurer of the State of Arizona, by the United States of America, by virtue of any cooperative agreement under the authority mentioned in Section 3 of this Act, between the State of Arizona and the United States of America, for the construction of any road or highway project in the state of Arizona, and for the construction of which no monies of any political subdivision of the State of Arizona have been used, applied or provided, shall immediately, upon receipt by the Treasurer of the State of Arizona, be, by the Treasurer and Auditor of the State of Arizona, transferred to said 25% apportionment account within such General Fund, and, thereafter shall be available for expenditure for the purposes of such account, as authorized by law.

Section 10. For the purpose of providing said sum of \$1,550,-



000.00, appropriated in Section 5 of this Act, the following monies, funds and license taxes are hereby designated and created:

*Sub-Division I.*

(X) (a) There shall be annually levied and collected in the manner in which other State Taxes are levied and collected, by a levy of the officials provided by law, a tax of ten (.10) cents on each one hundred (\$100.00) dollars, of the assessed valuation of taxable property within the State, for the purpose of the construction, reconstruction, repairing, improving and maintaining State Highways and bridges, as follows:

25% of such tax, herein provided, for, shall be as paid into the treasury of the State of Arizona, deposited by the Treasurer of the State of Arizona, in a separate account, in the general fund of the State, to be known and designated as 25% apportionment account.

Seventy-five per cent (75%) of such "State Road Tax Fund, herein provided, for, shall be apportioned to the several counties in the amount to each county of seventy-five per cent of the taxes collected under this act, by said county, and such amount shall be subject to be paid out for the construction, reconstruction, repair, improvement and maintenance of public highways roads and bridges in the manner as in this act provided for the work in this act provided for within such county upon the authority and under the direction of the county board of supervisors of such county and the State Engineer who are hereby charged with such responsibility.

(X) SUB-DIVISION II.

(a). There hereby is authorized to be levied and collected a (one-half mill) tax per each scheduled passenger capacity mile, which hereby is defined to mean a tax of (one-half mill) on each and every unit of seating capacity operating over each and every

~~seating capacity operating over each and every mile~~ between fixed termini, or otherwise, in the State of Arizona, as per schedules on file with the Corporation Commission, or otherwise.

(b) There hereby is authorized to be levied and collected a ~~(two mill tax)~~ per each scheduled truck ton capacity, or fraction of truck ton capacity mile, which hereby is defined to mean, ~~(a tax of two mills)~~ on each and every actual truck ton or fraction of truck ton capacity load operating over each and every mile between fixed termini, or otherwise, in the State of Arizona, as per schedules on file with the Corporation Commission or otherwise.

(c) Such ~~(one-half mill)~~ tax per each scheduled passenger capacity mile and such two mill tax per each scheduled truck ton, or fraction of truck ton, capacity mile, shall be levied only upon those common carriers operating motor vehicles ~~(over improved or portions of improved State)~~ County or Municipal highways, within the State of Arizona, and shall be remitted to the office of the Corporation Commission of the State of Arizona, on or before the 15th day of each month, for the next calendar month preceding, which said money so received by the Corporation Commission, shall be immediately when received, transferred by said Corporation Commission to the Treasurer of the State of Arizona, who shall deposit the same in said 25% apportionment account in the General Fund of State.

X Every common carrier operating motor vehicles over improved or portions of improved State, County or Municipal highways within the State of Arizona, against whom such taxes are hereinbefore in this Subdivision defined, are levied, shall submit to the office of the Corporation Commission, together with such taxes, or forms prescribed, prepared and furnished by the Corporation Commission, a sworn statement reciting, the seating capacity of each and every motor vehicle operated, the mileage over which such seating capacity was operated, the truck ton capacity, or fraction of truck ton capacity of each and every truck operated and the mileage over which such truck ton capacity, or fraction of truck ton



(X) capacity was operated.

SUB-DIVISION III.

(a) That ~~(in addition to the taxes now provided by law,)~~

each and every dealer, as defined in this Act, who is now engaged or who may hereafter engage in his own name, or in the name of others, or in the name of his representative or agents of this State in the sale, use or distribution, as dealers and distributors of gasoline or other distillates of crude petroleum shall not later than the fifteenth (15) day of each calendar month render a statement to the Secretary of State of the State of Arizona of gasoline and other distillates of crude petroleum sold, used or distributed by him or them in the State of Arizona during the preceding calendar month, and collect a license tax of three (3) cents per gallon on all gasoline and other distillates of crude petroleum so sold, used or distributed for use in motor propelled or motor driven vehicles, as shown by such statement in the manner and within the time hereinafter provided, which tax shall be added to the sale price of the dealer as herein defined when sold, used or distributed for such use in said motor propelled or motor driven vehicles only.

(b) All dealers in gasoline and other distillates of crude petroleum in the State of Arizona shall file a duly acknowledged certificate with the Secretary of State of the State of Arizona, on forms prescribed, prepared and furnished by the Secretary of State, which shall contain: The name under which such dealer is transacting business within the State of Arizona; such certificate shall state the place or places of business and location of distributing stations of the dealer in the State of Arizona; the name and address of the managing agent; the names and addresses of the several persons constituting the firm or partnership, and if a corporation, the corporate name under which it is authorized to transact business and the names and addresses of its principal officers, resident general agent and attorney in fact. If such dealer is an association of persons, firm, partnership or corporation organized under the laws of another state, territory or country

if it has not already done so it must first comply with the laws of Arizona relating to the transaction of its, appropriate business therein. No dealer as herein defined, shall, after this law goes into effect, sell or distribute any gasoline or other distillates of crude petroleum until such certificate is furnished as required by this Act.

(c) Every dealer in gasoline and other distillates of crude petroleum shall render to the Secretary of State of the State of Arizona, on or before the fifteenth (15) day of each month, on forms prescribed, prepared and furnished by the Secretary of State, a sworn statement of the number of gallons of gasoline and other distillates of crude petroleum sold or used by him or them during the preceding calendar month together with the number of gallons of gasoline or other distillates of crude petroleum sold or used by him or them during the preceding calendar month for use in motor propelled or motor driven vehicles as defined herein, which statement shall be sworn to by one of the principal officers in case of a domestic corporation or by the resident general agent, or attorney in fact in case of a foreign corporation; by the managing agent or owner in case of a firm association, and shall contain the total number of gallons of gasoline and other distillates of crude petroleum, sold, used or distributed. Bills shall be rendered to all purchasers of gasoline or other distillates of crude petroleum by dealers, as herein defined. Said bills shall contain a statement printed thereon in a conspicuous place that the dealer in gasoline has assumed the liability to the State for the license tax herein imposed and that he or they will pay said license tax on or before the fifteenth (15) day of the following month. In addition to the statement herein prescribed, the dealer shall present to the Secretary of State, on a form prescribed, prepared and furnished by the Secretary of State, a statement signed by the purchaser of any gasoline or other distillates of crude petroleum purchased for any other purpose than use in motor propelled or motor driven vehicles as herein defined, showing the number of gallons of gasoline or other distillates of crude petroleum so purchased, and the purpose of use for which such gasoline or other distillates of crude petroleum is purchased. Failure to present such statement, so signed by said purchaser shall be prima facie evidence that the gasoline or other distillates of crude petroleum was sold or distributed by said dealer for use in motor propelled or motor driven vehicles as herein defined, and the dealer



shall pay the license tax herein prescribed on all such gasoline and other distillates of crude petroleum not accounted for by such statement from such purchaser.

(d) Said license tax shall be paid on or before the fifteenth (15th) day of each month to the Secretary of State, who shall receipt to the dealer therefor, and promptly turn over to the State Treasurer as are other receipts of his office, and the State Treasurer shall place one-quarter of the same in said 25% apportionment account in the General Fund and one-quarter of the same to the account of the 75% apportionment account of the General Fund, and said Secretary of State shall promptly pay the remaining one-half of such tax to the several county treasurers of the State of Arizona, in proportion to the amount of such tax received from the respective counties, which shall be used by the said several counties as may be determined by the board of supervisors thereof, for the maintenance of county roads and highways.

(e) Every dealer in gasoline and other distillates of crude petroleum as in this Act defined shall keep a record of all purchases, receipts, sales and distribution of gasoline and other distillates of crude petroleum; such records shall at all times during the business hours of the dealer be subject to inspection by the Secretary of State or his deputies, or such other officers as may be duly authorized by said Secretary of State.

(f) Said license tax shall not be imposed upon gasoline and other distillates of crude petroleum when sold for exportation from the state of Arizona to any other state or nation, or when sold to the government of the United States or when sold or distributed for use in motor propelled or motor driven farm tractors or other motor propelled or motor driven farm machinery and implements, or motor propelled or motor driven vehicles running only upon rails or tracks.

(g) Any dealer, association or person, firm or corporation violating any of the provisions of this Act shall be deemed guilty of a misdemeanor and upon conviction thereof shall be punished by a fine not to exceed one thousand dollars (\$1,000.00) or by imprisonment in the county jail for a period not to exceed six (6) months, or by both such fine and imprisonment.

(h) Whenever any dealer as defined herein shall fail to pay such license tax as herein provided for a period of thirty (30) days from and after the date when the same should have been paid as required by this Act, the attorney general shall commence and prosecute to final determination an action at law to collect the same.

(i) The following words, terms and phrases used in this subdivision are, for the purposes thereof, defined as follows:

The term "dealer" is hereby defined as any person, firm or corporation who imports or causes to be imported gasoline or other distillates of crude petroleum for use, distribution or sale in, and after the same reaches the State of Arizona; and also any person, firm or corporation who produces, refines, manufactures or compounds such gasoline or other distillates of crude petroleum in the State of Arizona for use, distribution or sale in this State.

"Motor propelled or motor driven vehicles" is defined to mean all vehicles propelled or driven by power, other than muscular power, except farm tractors and farm machinery and implements, and such motor propelled or motor driven vehicles as run only upon rails or tracks.

Section 11. Any monies remaining in said 25% apportionment account, in the General Fund, after the performance of all things required to be done in this Act and after the construction and completion of all road projects enumerated in this Act, and all monies accruing to said 25% apportionment account thereafter, shall be available for the purpose of such account, as authorized by law.

Section 12. Whenever there shall not be in said 25% account, in said General Fund, sufficient money to pay in cash the expenses provided for by said appropriation of \$1,550,000.00, provided in Section 5 of this Act, as such expenses shall occur, then the State Auditor hereby is authorized to issue from time to time his warrants for registration, in an aggregate amount of \$1,550,000.00, inclusive of the aggregate amount of warrants issued and paid out of said 25% apportionment account in the usual course and without registration or issuance of Treasurer's certificates, as herein provided, and inclusive of the aggregate amount of interest paid or to be paid thereon, as hereinafter provided, and upon duly verified claims therefor presented by the State Engineer, and approved by



the Board of Directors of State Institutions for the payment of expenses authorized by this Act. Each of such warrants for Registration shall be issued in the form and manner as provided by law in the case of other warrants and in conformity with the provisions of this section of this Act; and shall specifically recite that it is issued in anticipation of certain State taxes heretofore levied, viz: 25% apportionment of State road tax authorized and provided for in subdivision 1 of Section 10 of this Act, one-half mill tax on passenger capacity per mile of motor vehicles and two mill tax upon the truck ton or fraction of truck ton capacity of motor vehicles, as authorized and provided in subdivision II of Section 10 of this Act; one-quarter of the gasoline tax authorized and provided for in subdivision III of Section 10 of this Act; and that it is payable solely from the proceeds of such taxes and is issued pursuant to this Act, naming the chapter thereof and the Session Laws of Arizona, 1923, Regular Session; and that such warrant is issued for presentation to and registration by the Treasurer of the State of Arizona in conformity with the provisions of this Section of this Act.

Said warrants shall bear interest at the rate of not to exceed five and one-half per cent per annum from date of presentation, said interest to be fixed by the State Loan Board as hereinafter provided.

Said warrants shall be payable at a date fixed by said Auditor, not to exceed six months from the date of issuance.

Upon presentation to the State Treasurer of any of said warrants for Registration, if he has not the funds in hand to pay the same, he shall endorse the date of its presentation upon the back of such warrant and register the same in his office for payment upon the due date named therein and on or before the due date named therein shall pay the same, together with the interest accrued thereon and charge the amount of such warrant, principal and interest, to said 25% account in said General Fund.

If at any time any holder or holders of such warrants for Registration in an aggregate amount of \$500.00 or more, shall present the same for registration to the Treasurer of the State of Arizona, he shall take up and cancel as paid such warrants and in lieu thereof issue and deliver to such holder his Treasurer's certificate in the principal sum of the aggregate amount of such warrants, to bear

interest at the rate specified in such warrants from the date of their presentation to the Treasurer, and which shall recite that the State of Arizona will pay to the order of (naming such holder) the sum of (naming the aggregate sum of such warrants), on or before, (naming the due date of such certificate, which shall not exceed six months from the date of presentation of said warrant) with interest thereon at the rate of not to exceed five and one-half per cent per annum as fixed by the State Loan Board until paid, as payment in full of warrants for Registration of the State of Arizona, (inserting the numbers of such warrants); and each of said Treasurer's certificates shall specifically recite that it is issued in anticipation of certain State taxes heretofore levied, viz: 25% apportionment of State Road tax, authorized and provided for in subdivision I of Section 10 of this Act; one-half mill tax on passenger capacity per mile of motor vehicles and two mill tax upon truck ton or fraction of truck ton capacity of motor vehicles as authorized and provided in subdivision II of Section 10, of this Act; and one-quarter of gasoline tax, authorized and provided in subdivision III of Section 10, of this Act; and that it is payable solely from the proceeds of such taxes and is issued pursuant to this Act, naming the chapter thereof, and the Session Laws of Arizona, 1923, Regular Session. Such certificates shall be signed by the Treasurer of the State of Arizona and countersigned by the Governor of the State of Arizona, and on or before the due date named therein the Treasurer shall pay the same, together with the interest accrued thereon and charge the amount of such certificates, principal and interest, to said 25% account in said General Fund.

When such warrants are issued in anticipation of the collection of said taxes and are registered as provided herein and when such Treasurer's certificates are issued in anticipation of the collection of such taxes, then all such taxes collected, shall be kept by the State Treasurer and used by him solely for the purpose of paying such warrants so registered with him and the interest thereon and of such certificates so issued by him, until all of such warrants so issued and registered and all of such certificates so issued in anticipation of such tax collections shall be paid in full, both principal and interest.

Section 13. The Corporation Commission shall prescribe all



proper rules and regulations for carrying into effect and as supplemental to the provisions of subdivision II of Section 10 of this Act.

Section 14. Every act done or omitted to be done in violation of the provisions of this Act is declared to be unlawful. Every officer, person, firm, corporation or association of persons who does or omits to do any act so declared to be unlawful shall be deemed guilty of a misdemeanor, and upon conviction thereof, shall be punished under the provisions of the penal code provided in cases of misdemeanor.

The penalties provided in this Act shall be cumulative and in addition to all rights of action which may be provided for the recovery of money used or appropriated by said officers without authority of law.

Section 15. All acts and parts of acts in conflict with the provisions of this Act are hereby repealed.

Section 16. The monies herein appropriated, and provided to be paid in to said 25% apportionment account except as provided in Section 11 of this Act, shall be paid out in payment of the costs of construction, including overhead and engineering, of the Road projects herein enumerated, either in aid of, or in co-operation with monies of political subdivisions of the State of Arizona, under agreements as herein authorized, or without such aid and co-operative monies, upon the sworn vouchers of the said State Engineer, approved by said Board, to the State Auditor, who shall draw his warrants therefor on the State Treasurer, who shall pay the same out of said 25% apportionment account in the General Fund.

~~Section 17. WHEREAS, the preservation of the public peace, health and safety makes it necessary that the provisions of this Act shall become immediately operative, an emergency is hereby declared to exist, and this Act is hereby exempted from the operation of the referendum provisions of the State Constitution, and shall take effect and it shall be in full force and effect from and after its passage by the Legislature and its approval by the Governor.~~

Passed the Senate *May 10, 1923*

BY THE FOLLOWING VOTE: *14* AYES

*3* NAYS, *2* ABSENT, *0* EXCUSED.

*Margaret Wilson*  
PRESIDENT OF SENATE

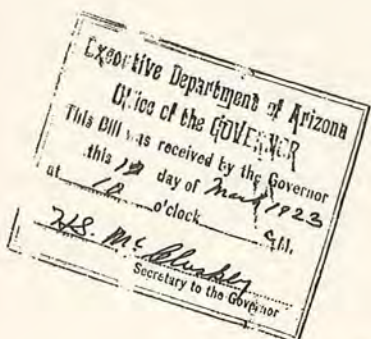
*L. H. Miller*  
SECRETARY of S. N. A.

Passed the House *May 10, 1923*

BY THE FOLLOWING VOTE: *30* AYES, *14* NAYS

*Sam P. Jones*  
*May Belle Craig*

*The passage of Section 17, I hereby certify was made prior to and before the passage and signing of this Bill.*  
*L. H. Miller*  
*Secretary of the Senate.*



*Approved with the exceptions which I have voted and which are set out in detail in letter & transmittal*

*March 20 - 1923*  
*Geo. M. P. Heerich*  
*Gov.*



March 20, 1923.

Honorable Geo. W. P. Hunt,  
Governor of Arizona,  
State House, Phoenix, Arizona.

Dear Sir:

This is to advise you that on this 20th day of March, 1923, at 11:50 o'clock A. M., I received from your office Senate Bill No. 156, with notations as follows:

Page 2, in the title, line 8, the words "and declaring an emergency" were crossed out with lead pencil.

Page 13, short page, contains part of Section 8; all of Section 9, and three lines of Section 10, numbered 13 with lead pencil.

Page 14, in margin opposite line 1, "cross in circle" with lead pencil. Line 1, the letter "a in parenthesis" with ink. Sub-division II, Paragraph (a) in line 2, the words "one-half mill" enclosed in parenthesis, with lead pencil; line 3, same subdivision and paragraph, the words "one-half mill" enclosed in parenthesis, with lead pencil; also opposite sub-division II, in margin "cross in circle" with pencil.

Page 14-a, in line 1, the words "seating capacity operating over each and every" were crossed out with ink. Paragraph (b), in line 2 of said paragraph the words "two mill tax" were enclosed in parenthesis, with lead pencil; the same paragraph in line 3 and 4, the words "a tax of two mills" were enclosed in parenthesis, with pencil; paragraph (c) in line 1 of said paragraph the words "one-half mill" were enclosed in parenthesis in pencil; same paragraph (c), in line 4, the words "over improved or portions of improved," were enclosed in parenthesis, with lead pencil.

Page 15. Opposite subdivision III, in margin, "cross in circle" with lead pencil. Under subdivision III, paragraph (a), in line 1 of said paragraph the words "in addition to the taxes now provided by law" were crossed out with ink; same subdivision and paragraph in line 11, the word and figure "(3) cents" were enclosed in parenthesis, with lead pencil.

Page 16, in line 21, after the word sold the word "used" was inserted in ink.

Page 17. Paragraph (d) enclosed in parenthesis with lead pencil. Paragraph (f) in line 5 of said paragraph, the word "motor" was inserted on typewriter, after the word other and before the word propelled.

Page 19. Opposite Section 12, line 1, in margin, "cross in circle" with pencil. Section 12 in line 3, the words "said appropriation of \$1,550,000.00" were under-lined with pencil.

Page 20. Opposite first paragraph on page "cross in circle" in margin, with pencil. In line 28, second paragraph on page, the word "mill" was inserted on typewriter, after the word one-half and before the word tax.

Page 22. All of Section 17 was crossed out with ink, see notation by Secretary of the Senate.

Pages Nos. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 14-A, 15, 17, 18, were numbered with lead pencil.

I am calling this to your attention because this is the first bill that has come to this office with such corrections. I presume, however, that the reason for this was because the bill in all probability was not engrossed.

I hereby certify that the foregoing is a true and correct copy of the notations on Senate Bill No. 156, when received in this office.

(Signed) JAMES H. KERBY,

JHK-FC.

Secretary of State.

(Seal of Secretary)

Delivered this letter to Governor March 20, 1923, at 3:30 P. M.



Office of  
SECRETARY OF STATE  
Capitol Building  
Phoenix.

March 21, 1923.

Mr. L. S. Williams,  
Secretary of the Senate,  
State House, Phoenix, Arizona.

Dear Sir:

Attached hereto please find copy of letter to the Governor, dated March 20, 1923, relative to Senate Bill No. 156, and would ask if this is the form in which the bill was delivered to the Governor.

If your records show otherwise, kindly advise me.

Very truly yours,

(Signed) JAMES H. KERBY,

Secretary of State.

JHK—FC.

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Arizona State Senate  
Sixth Legislature

Hon. James H. Kerby,  
Secretary of State,  
Phoenix, Arizona.

Dear Sir:

Permit me to acknowledge receipt of your favor of today calling attention to the physical condition of Senate Bill 156 and asking if its present form is that in which it was delivered to the Governor.

In reply I will state that Senate Bill No. 156 was, during the closing hour of the Sixth Legislature, amended in certain respects by the House. The Senate accepted the House amendments, and as there was not sufficient time remaining in which to engross the Bill and return the same to the Senate, the House transmitted the Bill to the Senate in the form it now presents.

The pencil and ink notations enumerated by you appeared on the Bill when it was returned to the Senate by the House, as I recall it.

Very truly yours,

L. S. WILLIAMS,  
Secretary of the Senate

Phoenix, Arizona,  
March 21st., 1923.

Office of  
SECRETARY OF STATE  
Capitol Building  
Phoenix.

March 21, 1923.

Mrs. May Belle Craig,  
Chief Clerk of the  
House of Representatives,  
State House, Phoenix, Arizona.

Dear Madam:

Attached hereto please find copy of letter to the Governor, dated March 20, 1923, relative to Senate Bill No. 156, and would ask if this is the form in which the bill was delivered to the Governor.

If your records show otherwise, kindly advise me.

Very truly yours,

(Signed) JAMES H. KERBY,

Secretary of State

JHK—FC.

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House of Representatives  
Sixth Legislature  
Phoenix.

March 30, 1923.

Hon. James H. Kerby,  
Secretary of State,  
State House,  
Phoenix, Arizona.

Dear Sir:

I have your letter of the 21st inst., with attached copy of your letter of March 20, 1923, to the Governor, concerning the form in which Senate Bill No. 156 was delivered to the Governor.

As the bill in question is a Senate bill, and was therefore delivered to the Governor by the Senate, my reply can only convey information covering the form in which the bill was delivered to the Senate by the House.

The bill came to the House in the final hours of the session and, while materially amended by the House, the need for speed was



so urgent that there was no time allowed to engross the bill properly after all of the amendments were finally adopted. Hence the insertions, eliminations, etc., noted by you.

The notations listed in your letter to the Governor check with our records, showing that the bill was delivered to the Senate in such form, except as to the following:

The words enclosed in parenthesis on pages 14, 14-A, 15 and 17.

The "cross in circle" on margins of pages 14, 14-A, 15, 19 and 20.

The pencil underlining of the words and figures "said appropriation of \$1,550,000.00", on page 19, Section 12, line 3.

Very truly yours,

MAY BELLE CRAIG,

Chief Clerk.

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Office of  
SECRETARY OF STATE  
Capitol Building  
Phoenix.

April 23, 1923.

Hon. John W. Murphy,  
Attorney General,  
State House,  
Phoenix, Arizona.

My dear Sir:

I am attaching hereto a certified copy of Senate Bill No. 156, together with copy of the Governor's veto on certain portions thereof, and correspondence from this office pertaining to the condition of the bill as it was transmitted to this office.

It is a duty of this office to publish the session laws, and this duty, of course, relates to Senate bill No. 156 as to all other laws. It is also incumbent upon this office, under the terms of the bill as it passed the legislature, to administer certain of its provisions. So many questions arise, which would seem to bear upon the publication, and perhaps affect the administration of the measure, that

it becomes necessary, in order that the proper procedure may be followed, to have your official opinion on a number of questions:

Senate Bill No. 156, as it came to this office and, according to the correspondence with the chief executive, a copy of which is attached, as it was delivered to the Governor upon its passage by the legislature contained numerous marks, interlineations and corrections. As to this phase of the situation, these questions arise:

1. Should Senate Bill No. 156 be published showing the exact condition of the bill as received by this office, with all the irregularities, stricken words, lines and sections, together with pencil and ink notations, set out?
2. Is it essential, when alterations and amendments have been made to a bill, that the legislature correctly engross the same before presenting it to the Governor for his approval or disapproval?
3. What effect does it have, if any, upon the validity of a bill, when changes and amendments, alterations and corrections in both pencil and ink are shown upon the official copy thereof and it appears by the Journal of the legislature that such changes and amendments, alterations and corrections were authorized? And what effect if the Journals do not show them to have been authorized?

As set out in the message accompanying the filing of Senate Bill No. 156 in this office, the Governor purported to veto certain provisions, paragraphs and words thereof. In order that this office may know in what form the bill should be published, I should like to have your answer to the following questions:

1. To what extent, if any, does the constitution of Arizona confer upon the Governor the power of legislation, or, in other words, the power to amend a bill passed by the legislature?
2. Assuming that the act of the Governor, in vetoing certain provisions, paragraphs and words of the bill was based upon the power given him by the constitution to object to one or more items of appropriation, is Senate Bill No. 156, in your opinion, such a bill?
3. Do the several provisions, paragraphs and words by him vetoed, namely, (a) the imposition of a tax on gasoline, (b) the



imposition of a tax on passenger carrying motor vehicles, (c) the imposition of a tax on freight carrying motor vehicles, (d) the allocation of the direct tax for highway purposes into what are commonly known as the twenty-five per cent and seventy-five per cent funds—or any of them, constitute “items of appropriation?”

4. By what rules, both as to construction and form, are “items of appropriation” to be identified?

5. Specifically, can such an item begin in one paragraph and end in another, as in the case of at least one provision of Senate Bill No. 156 which comes under the Governor’s veto?

6. If the Governor exceeded his constitutional power in attempting to veto the provisions, paragraphs and words set out in his message accompanying the filing of the bill in this office, what is the status of the bill and of such provisions, paragraphs and words?

7. Should the bill be published as a law, in the form in which it passed the legislature, or as it would be, after eliminating the portions vetoed?

In the absence of the filing of a referendum petition against the measure it will become effective June 9th. As bearing upon the administration of its provisions the following questions suggest themselves:

1. If the Governor was exercising a constitutional power in vetoing the certain provisions, paragraphs and words embraced in his message, what is the effect of the veto upon those provisions of the bill which relate to the subjects embraced in the veto, but are not included therein?

2. If the Governor was exercising a constitutional power, will the present one cent tax on gasoline be and remain in effect?

3. In the event that it will, should the allocation of the receipts from such tax be in conformity with the existing law or with the provisions of Senate Bill No. 156?

4. If the Governor was exercising a constitutional power, what will be the exact reading of the gasoline tax law, considering the parts of this measure not affected by the veto and the law now in effect, Chapter 24, Session Laws of Arizona, 1922?

5. If the Governor exercised a constitutional power in his veto, does Section 12 of Senate Bill No. 156 restore, or in any way affect, the vetoed portion of Section 10 relating to the gasoline tax?

6. If the Governor exercised his constitutional right of veto, should Senate Bill No. 156, as of the date of June 9th, be administered upon the theory that all of its provisions, as the measure passed the legislature, are in full force and effect?

7. What effect would it have upon the administration of the law should a court action be instituted to test its validity, or to test the validity of the Governor's action thereon?

8. If the Governor exceeded his constitutional power in vetoing the provision for the imposition of a three cent gasoline tax, will both the three-cent gasoline tax and the one cent gasoline tax now provided by law be in effect?

9. In the event that they should be, what portion of the monies collected from the two taxes will go to the State Treasurer and what portion to the treasurers of the counties in which the gasoline is sold?

It is apparent under the peculiar and extraordinary circumstances so many confusing situations might arise, that this series of questions could be further continued. I believe, however, that the questions asked are valid and pertinent, as they directly relate to actions which should be taken by this office in the performance of duties devolving upon it.

For whatever purpose taxation may properly have, its fundamental purpose is to provide revenue which, it will be agreed, ought to be raised as adequately, conveniently and economically as possible. Therefore, I heartily endorse the Governor's veto of the Three (3) cent gasoline tax, inasmuch as the original bill only provided for a further additional tax burden on the one class of property, and did not eliminate the license tax or property tax in lieu thereof.

I shall highly appreciate your prompt consideration.

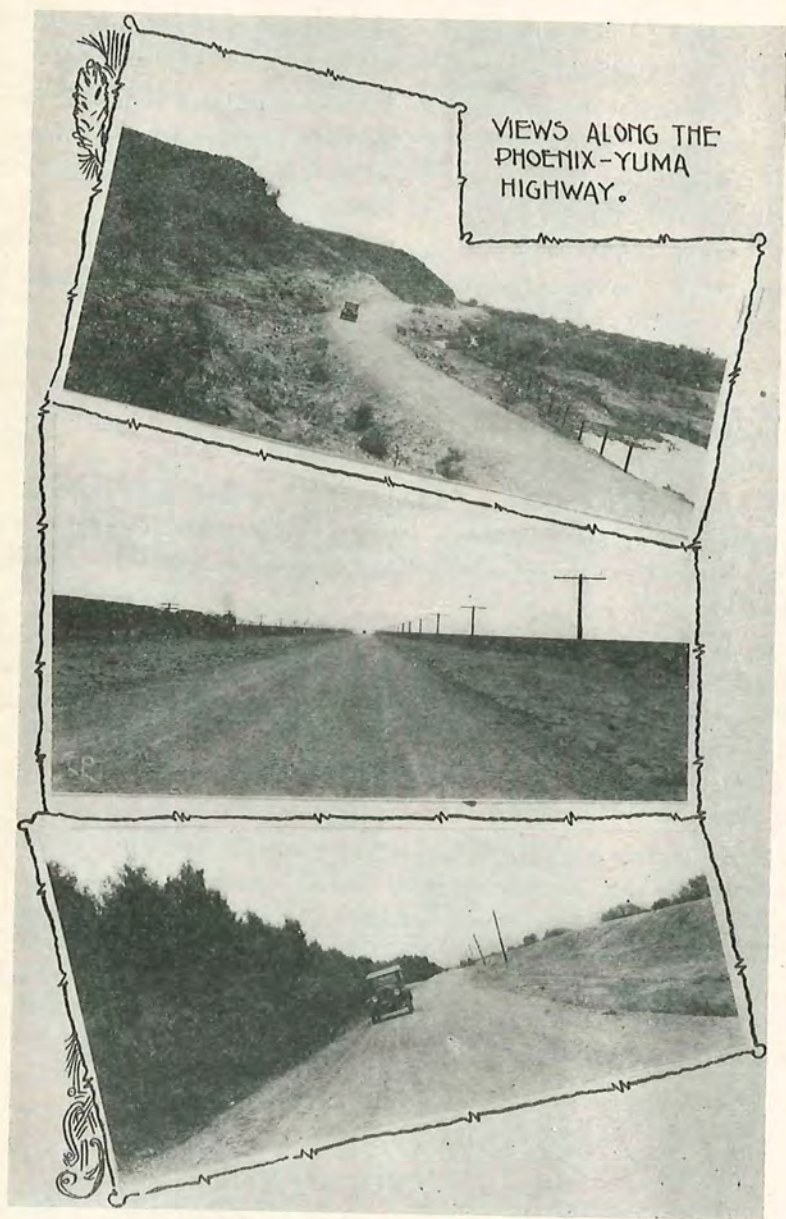
Very truly yours,

(Signed) JAMES H. KERBY,

Secretary of State.

JHK—FC.





ROADS THAT SHOW THE PROGRESS OF CIVILIZATION

## Civilization and Highways

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CIVILIZATION follows the highway. The cow trails of yesterday, over which countless herds of cattle thundered in wild stampede, or beside which they grazed peacefully, herded onward by that once picturesque figure of the Old West,—the cowboy,—now are improved highways crowded with traffic.

Great cities have risen along these old trails, their greatness depending in a large measure upon the paved highways branching out from them in all directions. Without these arteries to sustain it, the city, like the human body, becomes paralyzed, a victim of the deadly sleeping sickness.

Without highways the city is surrounded by a Chinese wall, shut off from civilization. The morning sun that rises over Tamalpais looks down upon the walled in city by the Golden Gate, for San Francisco, with its lone road down the Peninsula and its great dream of "Bridge the Bay" still a golden phantasy, has lost years of progress through its inadequate highway system.

With all its natural advantages by water, this "Gateway to the Orient" must remain at a standstill until it builds its highway across San Francisco Bay, for bridges like paved roads are part of a regular highway system.

Highway building was recognized as essential to development by the Caesars of the Great Roman Empire two thousand years ago. Roads today in Britain stand as a living monument to the Roman Emperor's engineers. Roads in France and Italy testify to the greatness of the old Roman engineers. It was only when the Emperors of Rome abandoned the pursuits of war and the consequent road building necessitated by warfare, to live in idleness and luxury, that the decline and finally the fall of the empire was brought about.

Her paved roads saved Paris in the first Battle of the Marne. As Von Kluck's victorious hordes swept on toward the city, Joffre



marshaled one hundred and fifty thousand men in thirty thousand taxicabs and sent them to the front, halting the German advance.

Paved roads stand for progress. Each year thousands of tourists from the eastern cities journey to the warm climates of Arizona or California. Many travel the entire distance in their automobiles, and since the advent of the automobile, the necessity for a high class highway system has become more and more apparent to the general public.

Arizona has made wonderful progress from the cow trails of yesterday, and has rent sections from the Chinese wall, but much of the wall still exists.

Will this wall be slowly worn away with a pick and spade or will it be removed with a steam shovel? This is a problem that must be solved by intelligent legislation? Which will it be?

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#### PHOENIX-WICKENBURG HIGHWAY



ONCE A COW TRAIL

## Recommendations for Legislation

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**A**RIZONA is in extreme need of adequate and intelligent highway legislation, formulated from a thorough study of present conditions, future conditions that are now evident, and the experience of states more advanced and much older in highways than this, the Baby State. Those familiar with the operation of Arizona's present highway laws are in accord that revisional and additional legislation are essential. This is a fact that must and will be met. If it is faced now, the highway construction and maintenance that conditions require and must have, may immediately be carried on efficiently and intelligently, thereby providing economic and adequate highways for the present without undue burden now or upon posterity. This necessary legislation should be provided at an early date. Any procrastination by the state legislature will be greatly detrimental to efficiency in highway development, to economic transportation for the present, and will mean a greater burden passed on to posterity.

The following recommendations are submitted for your consideration.

### Injured Employees

A measure should be enacted providing that the State Highway Department or some other State Agency, or that contracts may be entered into with insurance companies, to care for those injured while in the employment of the State. It is now compulsory by law that indemnity be paid immediately to injured employees; or if the injury prove fatal to their dependents, whether the employer be a corporation or an individual. State, County or municipal employees are excepted from the provisions of this law.

An employe of a municipal corporation in this State should be accorded the same protection that the state laws accord all other employes. If employment in the municipal corporations of this State is hazardous, then the State or the other municipal corporations should pay the indemnity, and do so immediately following



the accident. That such employment is hazardous, in the sense that the term is used, is recognized, and every past legislature has considered such payments legitimate indebtedness, as evidenced by the passage of many relief bills for such causes.

This, however, does not meet the situation, as the employe or his dependents need the assistance immediately following the accident, and relief appropriations by the legislature means long delays, expense, and lobbying with the impending results very uncertain. For this reason many deserving injured employes do not care to risk ordeals of collecting compensation, though their causes are equally if not more meritorious than some of those that have received compensation under the present method.

Also under the appropriation method, payments are made from the general funds, when they are legitimate charges against the funds for the work involved. If treated as an insurance, the carrying charges would place the burden where it belongs, and justice be done to the unfortunate employes.

### Finances

Owing to the magnitude of the highway construction that is now required, and the period of time required to construct the larger projects, maintenance and other services required and demanded by the public and the present and rapidly increasing traffic, it is imperative that adequate finances be provided. If efficiency in the operation of the Highway Department and economic results are to be obtained from the funds expended for highway work, it is absolutely essential that the funds be provided in such manner that a comprehensive program may be outlined in advance with reasonable assurance of its completion.

At the present writing the Department has nothing tangible whatever to "carry on" in the matter of future finances that is positive, and its future is entirely dependant upon legislation by the incoming legislature. Such absence of a financial program is conducive to temporary expenditures which either may be immediately followed by work of higher standard or abandoned. This, in itself, is an economic waste and can not help but reflect in the efficiency of the operations of the Department.

Therefore, it is recommended that legislation be enacted that will insure finances for highway work, sufficient to meet the requirements for at least a three to five year program. This should be done either by taxation or by a State Bond Issue, payable from the receipts of the three cent gasoline tax, or a combination of both.

### **Ten Cent Levy**

The ten cent levy upon each one hundred dollars of assessed valuation should remain in force for State Highway purposes. Adequate highway facilities materially aid in the development of communities; give greater range to business within the cities and towns, increase the value of rural property by virtue of lower operating cost; and make better schools and social life a reality and a pleasure rather than a dream and a burden.

The railroads also are materially benefited by the development of adjacent property, and by the highways acting as feeders to them. The railroads are taking advantage of the highways by the installation of truck lines to handle their short haul package freight.

The larger mining companies are probably not affected so much directly, but adequate highways reflect in lower costs and more pleasant living conditions for their employees. This enables the corporations to maintain a capable and contented personnel with a very small turnover, which reflects very materially in their cost of production. Therefore this tax seems just and reasonable, and is an asset to the State.

### **Motor Vehicle Fee**

The Motor Vehicle Fees for all of the States of the Union average little more than \$12 per car. The average fee per car collected under the Arizona law is approximately \$5.80. The basis for rating cars for the payment of fees in this State has become unfair, due to the change in engine designs of the past few years. A car that has a purchase value of \$500 under our present law may pay as much for a license fee as one that has a purchase value of \$2,000 or more.

It is recommended that the Motor Vehicle License Law be revised to equalize better the taxation, and also to include a proper tax on



tractors and trailers used upon the highways for hauling purposes, both of which are not now included in the present law but should be required to pay their proportional tax.

### Gasoline Tax

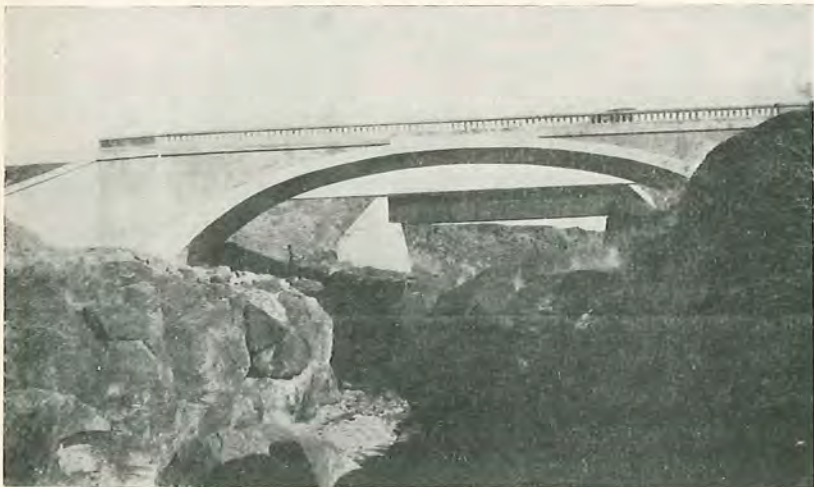
The gasoline tax is the fairest tax that may be placed upon a motor vehicle. It has been adopted by thirty-six states and the District of Columbia, and nine additional states now have it under consideration.

This tax actually places a meter on the use of the highways, and it is paid in such small amounts that it is not noticeable. Tourists traveling in the State also pay their proportionate tax, but in return they receive lower operating cost and greater comfort, if the funds are used to the greatest advantage.

The exemptions allowed in the present law have apparently been grossly misused, as the gasoline that has been exempted since the enactment of this law has approximated 16 per cent of the total gasoline sold. All available records of machinery entitled to the exemption does not begin to approximate that amount of legitimate fuel oil exemption.

The division of the receipts of the gasoline tax as now provided follows: 25 per cent to the State Road Tax Fund, 25 per cent ap-

### PRESCOTT-ASH FORK HIGHWAY



VERDE RIVER BRIDGE

portionment; 25 per cent to the State Road Tax Fund, 75 per cent apportionment; and 50 per cent to the county from which the tax is collected, to be expended for the maintenance of county roads and highways only, does not permit of the most beneficial use.

The Statutes further provide, that in the preparation of the County Budget for the road fund, it can not exceed ten per cent of the previous year's budget, which must include all receipts from sources other than County taxation. In Maricopa County the receipts from the gasoline tax are extremely heavy, (see tax dollar chart). When deducted from the budget for maintenance only it leaves but a very small amount for the construction of other necessary roads, for the County Road Department expense, and for other necessary expenses, a circumstance which must result in the delay in the development of the roads of the County or a disregard of the law.

In the other Counties the amounts are small, and their coming in month by month is not conducive to making the most economic and beneficial use of the receipts. There has been \$405,000 distributed to the various Counties since this law went into effect, and it is believed that many of the Counties can not give an accurate accounting of its distribution. Certainly there is not that much new work to show for the expenditure.

Due to the budget law on the Statutes, the gasoline tax that goes to the counties does not add money for road work, but takes that much out of road work, by its being applied to reduce the levy of the Counties, through its receipts from other sources. This to the County is so small that it is not noticeable, but the State must raise large amounts from some source. This actually means that the public is being taxed three cents on each gallon of gasoline, but the roads gain only the amount that is applied to the State Funds, or one and one half cents per gallon. If the entire three cent tax were placed in a State Highway Fund, the fund would be sufficient to be of material value in the Highway Development of the State. The State Highways are now carrying approximately eighty per cent of the total traffic of the State, and serve as the main trunk highways of every County in the State.

Therefore it is recommended that a measure be enacted placing a tax of three cents on each gallon of fuel oil used for any kind of transportation upon the highways, and the receipts be placed into



a State Highway Fund, with particular safeguards around the exemptions, if any are allowed.

### **Abolish 75 Per Cent Fund**

The reasons which dictated the establishment of the 75 per cent apportionment fund at the time of the drafting of the laws for the establishment of the Highway Department, and the resultant Highway System, have ceased to exist. At that time there were no State Highways and no State Highway Department. In making the start, apprehension was entertained that if provision were not made by Statute for the equitable division of road monies, political manipulation would work to the undue advantage of the larger and more politically powerful counties, and to the disadvantage of their weaker and smaller sisters.

That condition does not now exist. During the intervening years, the wise selection of the routes that constitute the present Highway System with the expenditure of State monies there upon, and the advent of the Federal Cooperation, with its selection of the seven per cent System has resulted in the construction to the present status, so that every mile of the system is either under construction or passably constructed to varying degrees of highway standards.

The issue of today is not the selection and the initial construction for the opening to traffic of the routes of the system as of yore. The issue of paramount importance is the reconstruction, betterment and maintenance of the present recognized system to which the present distribution of monies by the 75 per cent apportionment fund is not in any way comparable nor equitable from the viewpoint of the State Highway development.

The county interest in State Highways has long since ceased to be limited by its own boundary lines. Its citizens and business expansion demand that the highways be no respecter of county lines, nor even state lines. The limitation by county lines is directly adverse to the very principle of a State Highway System.

It is therefore recommended that the 75 per cent apportionment of highway funds be abolished, and no limitation by counties be made in the distribution of State Highway funds.

## Bus and Truck Lines

The bus and truck lines are appearing in increasing numbers upon the highways, and are essential to Arizona's development. They should, however, pay a fair tax, much in addition to their present mileage tax, to compensate in a measure the other tax payers of the state for supplying them their road bed over which they operate for a profit.

Their constant and heavy duty usage also adds much to the maintenance burden of the state. Such a tax would naturally be passed on to the patrons of the lines, but the better highways resulting from this tax will eventually materially reduce the operating cost of the bus and truck lines, which also will reflect in a reduction of their fares.

## Right of Way

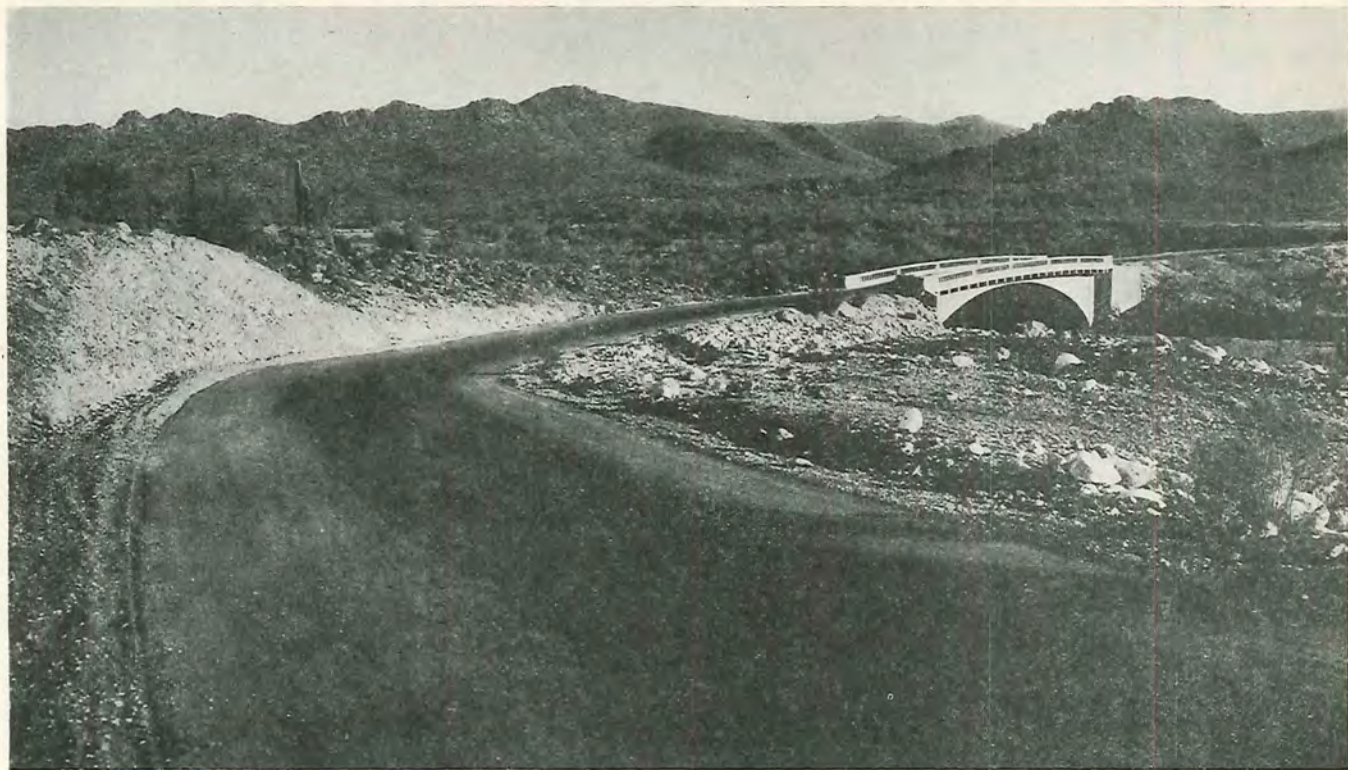
It is recommended that legislation be enacted that the State Engineer be empowered to obtain the necessary right of way for highway purposes, but permitting the property owners the right of legal appeal to the courts, as now possessed in the method provided for securing county road rights of way. The present method of depending upon the several County Boards of Supervisors who only meet occasionally, and who are not particularly interested in this matter, often results in costly delays in the construction and sometimes in unnecessary disputes with property owners.

This legislation would not result in any more expense to the Department, and since it is now necessary to maintain a right-of-way department such a provision would simplify the work, rather than increase the same.





ASPHALTIC CONCRETE ON MESA-SUPERIOR HIGHWAY AT QUEEN CREEK



AN ARIZONA APPIAN WAY

## "Going Rome One Better"

Condensed from Collier's, The National Weekly  
November 15, 1924

By **EARL C. REEVES**, In the **READER'S DIGEST**

**R**OME sat upon her seven hills and ruled the world over her highways. In the wilds of Macedonia their ruins may be found. In England I have driven over them, resurfaced with modern materials. A marvelous system for that age, but they took centuries of building.

Uncle Sam is building 11 Appian Ways of Solid concrete this year.

In the comparatively recent days when the whip was the only accelerator most of us knew, a "best road" cost the county around \$1,500 to \$2,000 a mile to build. A mile of the 1924 De Luxe highway costs \$45,000. The statistician says commercial trucks average 47-mile trips; while the farmer now drives 18 miles to market his produce, instead of five or six. In the United States there are now more than 1,600,000 trucks, and a full three quarters of them started hammering our roads to pieces in the last six years. We are spending four and a half billions on operation of motor vehicles—cars and trucks—this year. Four years of civil war during the sixties cost us just that.

Here we have one of the greatest material changes taking place within a period of 20 years in all the history of the world.

Clifford Older, state highway engineer in Illinois, supervises the building of 1,200 miles of the highest type of paved roadway during the year 1924. I have been wondering how we are going to do such things as this, and eat. We will spend a billion dollars this year on road building, reclaiming, and maintaining. Personally I get quite a jolt out of that, because my family-of-four share of that sum approaches \$400; and in some way the tax man is going to collect that from me, or from my sons—or theirs.



At the end of ten years I shall be a shareholder in a system of major highways connecting every county seat in the nation. I ought to get better acquainted with this investment.

A mile of 1924 highway costs \$45,000. Money involves interest charges. The price of that bit of highway at six per cent is \$2,700 a year. That is annual charge number one. It will cost very little to keep the roadway in repair the first few years, but costs will amount later. The average will be \$800 a year. That is annual charge number two.

But a road wears out eventually. In honesty to the next generation we should not count upon it lasting more than 20 years. But we do not pay for it all necessarily, say the engineers. For this reason: Eighteen cents of every dollar you invest in a brand-new road is spent in building culverts and bridges and drainage systems. Nearly a quarter of the cost of the road is spent for grading. Once a road is properly drained and graded, the grade becomes a permanent feature of the landscape. Forty-six cents of this road dollar I am spending will be serving not only my son but my great-great-grandson.

Twenty-five thousand dollars of that forty-five thousand ought to be wiped clean off the slate in 20 years. To do this it will be necessary to lay aside \$1,250 a year as a replacement fund, and that becomes annual charge number three. Adding these three annual charges, I get \$4,750 as the annual cost of a single mile of highway.

Unless that road earns about \$5,000 a year you and I have no right to build it.

How shall we decide whether we have a right to build it? By traffic surveys. A ton of freight can well afford to pay one quarter of a cent for its use of one mile of road. A railroad figures a much larger amount as the roadbed's share of the freight bill. On this low basis of figuring Connecticut found that two main highways paid their way with truck traffic alone.

This is what the Iowa State College tells me: Yesterday I paid 20 cents a gallon for gas. At that price I can drive my ton-and-a-half carload one mile over paved roads for 97 cents, but it will



SURFACING PHOENIX-YUMA HIGHWAY FROM GRAVEL PIT

cost me 1.42 cents on a gravel road, and the dirt-road gas consumption will amount to 2.14 cents.

I use up tires and car as well as gasoline. Kentucky says the dirt road taxes me two and a half cents a mile more than a paved road in total driving cost. If only two or three of us live on that

the question of its improvement is of little public concern. But if the equivalent of 300 flivver loads of traffic passes over that road each day it will be cheaper to build a gravel road, while if traffic increases to about 500 flivver loads density, it will cost so much to keep the pike in repair that it will be more expensive than pavement.

You and I might as well get ready to live with such facts as these:

1. Whether we like it or not, our highways are going to become freight carriers on a constantly increasing scale. Small tramp truck lines are giving way to great corporations, operating under scientific management. The truck, which was "going to run the railroad out of business" has been adopted by the railroads to combat the short haul and package department congestion that causes the



freight car to spend nine-tenths of its life in cities. The Pennsylvania Railroad will not carry less than carload lots between the cities of Wilmington and Philadelphia except aboard its own motor trucks. The New York Central saves two days on freight shipments westward by giving all towns north of New York truck service to Yonkers. Similar units have been established elsewhere. In New England the steamship lines are developing truck lines as "feeders." These are mere beginnings.

2. Traffic in many areas is going to become so intensive as to involve great expansion in road facilities. In some instances there will be parallel roads, one for trucks and one for motor cars. We will shortly be building detours around all sizeable towns.

3. We are going to learn to build roads scientifically. Illinois has built a road two miles long that contains 63 different kinds of surface. Time will tell which one is best.

4. Through sheer economic necessity we are going to have to put pneumatic tires on our heavy trucks and use six wheels instead of four. Trucks hammering from above and frost and water and shifting soil below are the great road enemies.

5. We are going to work out a way for paying for this thing that we must have. We must collect the road bill on the basis of service rendered. The "modern toll gate" already has been erected. It is the gasoline tax. This tax is operative in 37 states, and although collections are so low that the total yield is only \$36,000,000, it is a beginning. The road has one thing to sell—ton-miles of service. When there is a gasoline tax I can stop at a filling station and buy just as much or little of the "commodity" which the highway "produces" as I happen to be needing at the moment. That doesn't seem like taxation at all; it seems to me like merchandising.

## Arizona's Highways of the Future

THE requirement curve for Arizona's Highways of the Future may be projected now from the motor vehicle registration chart, traffic census tabulations and a study of the wear resistance of the local road materials now on Arizona's improved highways in proportion to the traffic flow.

A study of the motor vehicle registration chart, herein contained, reveals a very marked increase in the motor vehicle registration in the past with a very perceptible increase the past two years. The governing feature of this curve is the increase in population of the State and the point of automobile saturation, or the ratio of automobiles to the population.

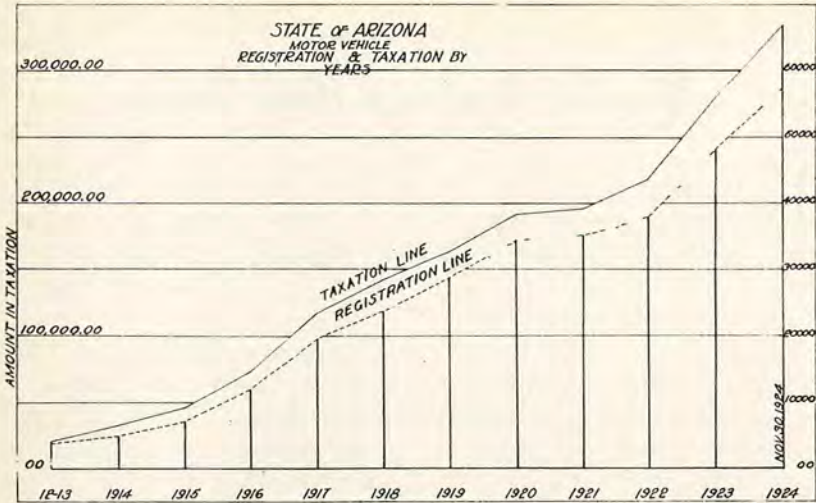
The increase in the population of Arizona from 1910 to 1920 was approximately 63 per cent, the average increase for a decade from 1890 to 1920 was 56 per cent. With the assured and pending development of this State, it is reasonable to believe that the increase for the present decade will not fall below 50 per cent.

### Point of Saturation

The automobile point of saturation in this state is now about one car to every eight persons. California has now reached the high point of one car for approximately every three and six tenths persons. Arizona now ranks about twenty fifth among the states in this respect. From the statistics on the question of automobile saturation it is evident that one car to every four persons is not a far distant high average. A projection of these two factors, population and automobile saturation, indicates a continual high rate of increase with the probable automobile registration in Arizona for 1930 of 120,000 cars.

A study of the traffic flow over the sections of the highway system is now being conducted by means of a traffic census or count. This is interesting and also valuable information for several purposes. From the segregated count there may be determined the amount of foreign traffic, the wear resistance of the various classes of road surfacing materials under actual conditions of traffic and weather, the ratio of maintenance and mainten-





ance cost to the traffic flow and the approximate earning capacity of a given section of highway.

### Data Essential

This data is essential in the economic planning of future highway improvement and betterment. Tabulations of the traffic census taken in November 1924 are contained herein. This census is not an average count, but rather a minimum count of the traffic, as November is not the month of the heaviest travel; and in the northern counties, the weather conditions on the day of the count were adverse to travel. It is indicative, however, of the traffic flow of the various sections of the highways.

From traffic census taken in the past, and a close observation of the maintenance upon the various surfacing materials used upon the highways, it has been noted that the materials that have been used for road surfacing vary in traffic flow capacity from 200 vehicles per day to 500 vehicles per day. This is based upon the ability, through maintenance, of keeping the surface in a smooth riding condition without keeping the roadway in a sufficiently disturbed stage to offer undue traction resistance, which cuts down the earning capacity of the highway by a reflection in the higher operating cost to the motorist.

This, of course, is partly due to climatic conditions. But that condition is one over which human power has no control and therefore, it must be taken into consideration.

Some of the detrimental climatic factors may be lessened to some degree, by experiments in surface treatments, methods of maintenance and equipment. By a systematic study of the mineral, chemical and other components of the several surfacing materials now in use, together with the service they actually give under a known traffic condition, a selection of materials, may be made within limits of an economic haul, that will also add to the duty of the surface of the highways constructed from the selected local materials, more commonly called gravel surfacing.

### **Limits Exceeded**

Efforts along these lines are now being conducted by the Highway Department. The fact remains, however, that the service of the so-called gravel surfaced highway, is limited. These limits are now exceeded in several sections of Arizona's highway system, which demand immediate hard surfacing, and an annual increase for several years to come for like demands.

The State system of highways as now outlined, with the possible additions of one or two connections, serves the State exceptionally well. Any additions that may be made should be very carefully selected and selected only as a benefit to the State, and not for local benefit. The fact should be remembered that a limited mileage of improved state highways, serving the state and communities as trunk highways, is far more beneficial than a greater mileage which will require considerably more time and funds to improve, and of which a large portion may be solely of local benefit.

Arizona has made remarkable progress in her highway construction, but she is still confronted with the problem of constructing many miles of grading. For economic construction, and financial reasons many more miles of selected material or gravel surfaced roads must be constructed. Many miles of the highway system however, will adequately serve the traffic demands for years and probably indefinitely, but on the other hand, many miles of such highways will necessarily require hard surfacing within a few years.

In addition to this contemplated construction, the state is confronted with the immediate necessity of paving approximately per annum 75 to 100 miles of highway for the next four to six years to provide for only the imperative requirements of traffic demands of the State which are now plainly evident.



# PHOENIX—YUMA ROUTE—LENGTH 204.56 MILES

Traffic Census Taken November 12-13, 1924—24 Hour Count

Project and Location	Ariz.	Ariz.	Foreign	Foreign	Ariz. Trans.		Foreign Trans.		Misc.	Total
	Cars	Trucks	Cars	Trucks	Cars	Trucks	Cars	Trucks		
Phoenix-Yuma at Mile 14 .....	521	85	148	10	3	2	....	1	21	791
Buckeye-Hassayampa R. at Buckeye .....	194	29	147	19	2	....	....	....	12	403
Hassayampa-Gila Bend at Gillespie Dam .....	44	9	125	10	1	2	....	....	....	191
Piedra-Gillespie at Gila Bend .....	60	12	133	4	1	....	....	....	8	219
Wellton-Aztec at Mohawk .....	41	1	162	2	3	....	....	....	....	209
Yuma-Wellton at Dome .....	30	9	152	12	3	....	....	....	....	296

NOTE: Percentage of foreign traffic over this Route is 87.92 per cent. Weather conditions on date census taken: Cloudy and threatening. Tourist travel exceptionally light at this season of the year.

# PHOENIX—TUCSON ROUTE—LENGTH 35.8 MILES

Phoenix-Tempe ½ Mi. E. City Lim. 3065	330	696	9	67	4	1	7	74	4163
Tempe-Mesa 12 Mi. from Phoenix. 1972	293	330	17	49	....	1	....	31	2693
Mesa-Superior 21 Mi. from Phoenix 469	91	181	11	13	10	4	....	26	893
Apache Trail Junction .....	344	98	165	7	15	3	1	12	655
Mesa-Superior at Flo-Sup. Jet. .... 300	80	160	15	8	9	4	1	7	584
Tucson-Florence at Florence .....	135	8	95	....	7	3	....	12	260
Tucson Florence 31 Mi. S. of Flo... 107	10	93	7	4	2	2	....	8	233
Tucson-Florence at Steam Pump .... 164	11	87	4	11	7	....	1	11	296

NOTE: Foreign travel on this Route is 23.58%. Local travel slightly above normal due to Arizona State Fair. Weather conditions south, stormy with high wind.

# FLORENCE—JUNC. TO DUNCAN—LENGTH 176.51 MILES

## Traffic Census Taken November 12-13, 1924—24 Hour Count

Project and Location	Ariz.		Foreign		Ariz. Trans. Lines		Foreign Trans. Lines		Misc.	Total
	Cars	Trucks	Cars	Trucks	Cars	Trucks	Cars	Trucks		
Florence-Superior at Junction .....	195	52	60	14	5	15	....	....	2	343
Superior-Miami at Sup. Brg. ....	274	44	80	11	15	25	8	....	1	458
Miami-Superior at Plaza School ....	257	78	84	2	5	86	1	2	12	527
Globe-San Carlos 2 Mi. E. of Globe..	100	15	77	0	4	10	6	2	10	224
San Carlos-Solomonville at Ft. Thomas .....	108	8	38	0	2	3	1	....	15	175
Safford-Pima near Central .....	245	16	58	6	9	40	1	....	12	381

NOTE: Percentage foreign travel over this route is 28.24%. Weather cloudy with light rains.

# PHOENIX—ASH FORK PRESENT ROUTE—LENGTH 193.96 MILES

Phoenix-Glendale at Mi. 3 .....	1893	261	265	6	24	2	....	....	37	2488
Phoenix-Wickenburg F. A. 70 .....	386	41	68	1	8	4	....	....	50	558
Wickenburg-Congress Junction .....	137	26	54	10	3	2	....	....	7	239
Prescott-Jerome at Granite Creek Bridge .....	361	19	59	4	23	51	3	....	5	525
F. A. 61 at Willow Creek Bridge ....	74	11	23	3	....	4	....	1	....	119
F. A. 62-11 Mi. S. Ash Fork .....	36	2	29	3	....	....	....	....	1	71

NOTE: Percentage foreign travel over this route is 15.79%. Travel slightly increased due to Arizona State Fair. Weather conditions: Prescott north cloudy and cold. Phoenix and vicinity. Clear.



**HOLBROOK—LUPTON ROUTE—LENGTH 76.00 MILES**

Traffic Census Taken November 12-13, 1924—24 Hour Count

Project and Location	Ariz.	Ariz.	Foreign	Foreign	Ariz. Trans.		Foreign Trans.		Misc.	Total
	Cars	Trucks	Cars	Trucks	Cars	Trucks	Cars	Trucks		
Adamana-Lupton at Chambers .....	10	1	102	....	....	....	....	....	....	113
Lupton-Adamana at Houck .....	11	....	111	....	....	....	....	....	5	127

NOTE: Percentage of foreign travel 89.68%. Weather conditions: Stormy and snowing. Tourist travel very light at this season of the year.

**HOLBROOK—SPRINGERVILLE ROUTE—LENGTH 112.08 MILES**

Holbrook-St. Johns near Holbrook	26	10	32	2	12	12	....	....	....	82
Holbrook-St. Johns at Milky Bridge .....	12	4	15	2	....	16	....	2	....	51
Holbrook-St. Johns at Hunt .....	17	7	19	1	....	19	....	1	....	64
St. Johns-Springerville at St. 1883	37	6	20	1	....	2	....	1	7	74

NOTE: Percentage of foreign travel over this route is 57.14%. Travel below normal. Weather condition: Cold and windy.

**PRESCOTT—JEROME ROUTE—LENGTH 33.3 MILES**

Prescott-Jerome at Granite Creek ..										
Bridge	361	19	59	4	23	51	3	....	5	525
Prescott-Jerome at Mingus Mt. ....	153	24	28	....	12	....	....	....	34	251

NOTE: Percentage of foreign travel on this route is 14.62%. Weather condition: Cloudy and Cold.

**TUCSON—RODEO ROUTE—LENGTH 178.94 MILES**  
**Traffic Census Taken November 12-13, 1924—24 Hour Count**

Project and Location	Ariz.	Ariz.	Foreign	Foreign	Ariz. Trans.		Foreign Trans.		Misc.	Total
	Cars	Trucks	Cars	Trucks	Cars	Trucks	Cars	Trucks		
Tucson-Benson at Junction .....	156	19	120	14	3	2	....	4	20	338
Tucson-Benson at Pantano .....	96	3	115	4	4	1	1	2	4	230
Benson-Tombstone .....	167	21	82	6	....	4	4	2	12	298
Bisbee-Tombstone at Thomas ranch .....	128	19	80	8	4	4	....	....	7	250
Bisbee-Douglas at Forest Sta. ....	215	28	90	4	8	18	....	3	....	366
Douglas Rodeo at Silver Creek .....	31	....	63	....	2	....	....	1	....	97
Douglas-Rodeo at Apache .....	30	3	71	4	4	2	6	....	3	123

NOTE: Percent of foreign travel on this route is 70.37%. Weather: Clear and Cold

**TUCSON—NOGALES ROUTE—LENGTH 7.5 MILES**

Tucson Nogales at Junction .....	440	38	34	3	3	1	....	4	27	546
Tucson-Nogales at Calabasas .....	144	5	26	1	10	21	....	....	24	231

NOTE: Percentage foreign travel on this route is 10.43%. Weather: Cloudy—Threatening rain.

**NOGALES—TOMBSTONE ROUTE—LENGTH 68.8 MILES**

Nogales-Patagonia at Santa Cruz Bridge .....	100	12	7	1	6	1	....	....	18	145
Tombstone-Nogales at Fairbank .....	77	10	15	....	4	11	....	....	10	127
Tombstone-Nogales at Sonoita .....	84	5	10	....	11	....	....	....	....	110

NOTE: Percentage of foreign travel over this route is 10.28%. Weather: Cloudy.

**ROOSEVELT ROUTE—LENGTH 76.30 MILES**

Apache Trail near Mormon Flat ....	106	31	16	....	2	....	....	....	1	156
Apache Trail at Fish Creek .....	22	3	10	....	2	....	....	....	1	38
Globe-Roosevelt at Birch .....	361	10	19	1	18	43	....	....	4	456

NOTE: Percentage foreign travel over this route is 8.79%. Weather: Cloudy. Phoenix end of Apache Trail—Travel slightly above normal due to construction Mormon Flat Dam.



**ASHFORK—TOPOCK ROUTE—LENGTH 169.808 MILES**  
**Traffic Census Taken November 12-13, 1924—24 Hour Count**

Project and Location	Ariz.	Ariz.	Foreign	Foreign	Ariz. Trans.		Foreign Trans.		Misc.	Total
	Cars	Trucks	Cars	Trucks	Cars	Trucks	Cars	Trucks		
Ashfork Seligman 12 Mi. W. Ashfork..	34	9	129	7						179
Seligman-Nelson 22 Mi. W. Seligman..	10		121	2					2	135
Kingman-Oatman at ½ Mi. E. Goldroad	44	3	106	2					2	157
Oatman-Topock 3 Mi. W. Oatman ....	66	11	152	4		2			1	236

NOTE: Percentage of foreign travel over this route is 71.27%. Tourist travel very light at this season of the year. Weather conditions  
 Ash Fork west: Cloudy Seligman; west towards Kingman; Snowing: Oatman, Cloudy and threatening.

**ASH FORK—HOLBROOK ROUTE—LENGTH 145.462 MILES**

Ashfork-Williams 7 Mi. W. of Williams	40	4	111	1					1	157
Flagstaff-Williams 3 Mi. W. of Riordan	35	9	93	3		5				145
Holbrook-Winslow, Winslow end.....	52	5	124	5		5				191
Holbrook-Winslow, Holbrook end.....	87		131	3	4	7		1	1	234

NOTE: Percentage of foreign travel 53.60%. Travel exceptionally light and far below normal. Weather condition: Stormy and snowing.

# Principles of Highway Administration and Finance

## *Report of the Highway Transport Committee of the American Society of State Highway Officials*

**T**HIS report is submitted by the Joint Committee on Highway Transport of the American Association of State Highway Officials and the National Automobile Chamber of Commerce. Since this committee was appointed in 1922 many sessions have been held. Each principle here presented has been the subject of searching scrutiny by the membership of the joint committee and by experts and officials from many fields and public bodies such as the National Tax Association, The Investment Bankers Association, and the American Automobile Association. The committee has received much assistance and advice from Prof. Richard T. Ely of the Institute for Research in Land Economics and Public Utilities, Prof. Jacob Viner, University of Chicago, and Messrs. Trumbower and McKay, economists of the Bureau of Public Roads. The advice and criticism of such organizations as the National Grange, the American Farm Bureau Federation and others of like character are now being sought.

The Joint Committee is considering other phases of the highway transport problem, which will be the subject of subsequent reports.

### **Joint Highway Transport Committee**

#### **American Association of State Highway Officials**

**Thos. H. MacDonald, Chairman**

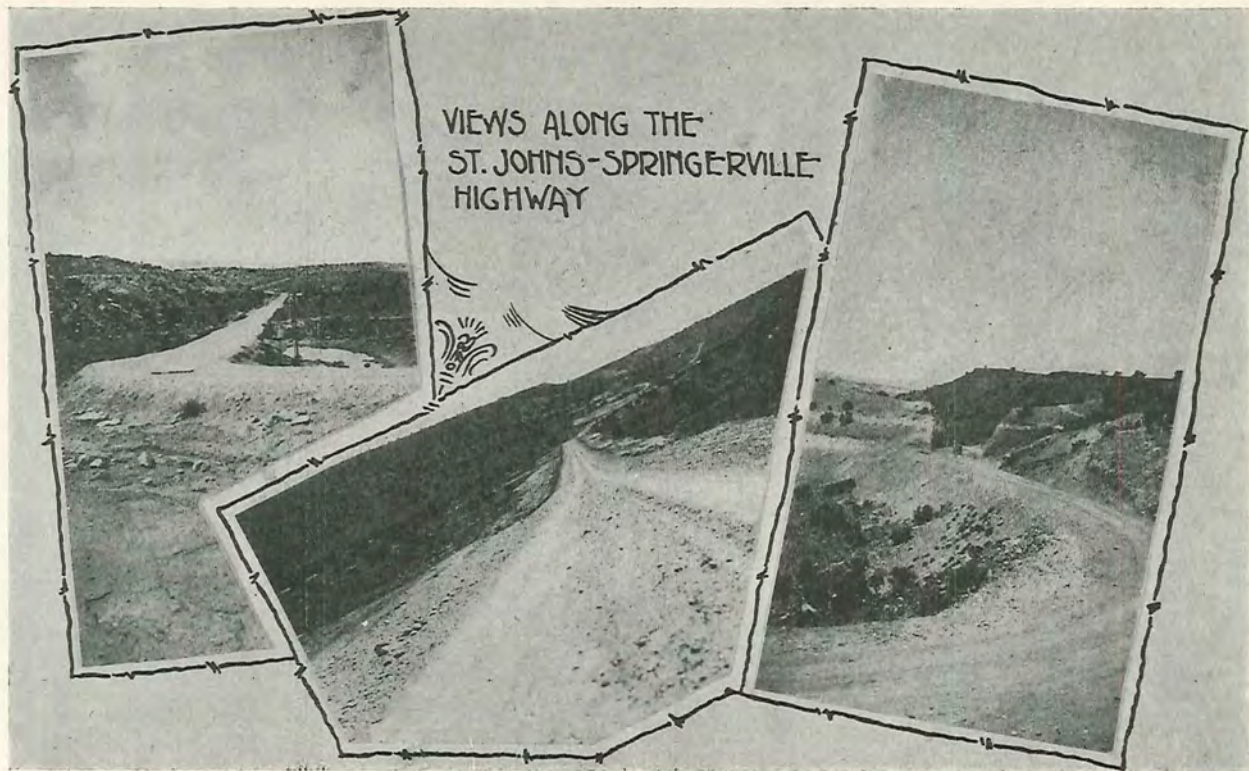
W. H. Connell	J. N. Mackall
W. O. Hotchkiss	J. H. Mullen
John A. MacDonald	F. T. Sheets

#### **National Automobile Chamber of Commerce**

**R. D. Chapin, Chairman**

George M. Graham	Windsor T. White
Alvan Macauley	A. J. Brosseau
Edward S. Jordan	Pyke Johnson





## Preface

A new system of transportation, **Highway Transport**, has been established, and is being operated on a vast scale. Its relationship to other forms of transportation and its great utility within its recognized fields have been defined in their major aspects.

With the extensive and universal distribution of the motor vehicle, the general utilization of highway transport with satisfaction and relative economy is dependent upon the mileage of suitable highways. The suitability of highways, in turn, is determined by the adjustment of the public roads to the vehicles, or conversely, the vehicles to the roads. This objective raises at once all the big major problems of highway administration, equitable taxation of real property, public income and expenditures, regulations of motor vehicles and many others. All of these received the earnest consideration of the Committee, and this report upon administration and finance is predicated upon the recognition and acceptance of the following general principles of outstanding importance:

1.—The public demand for highways is now so great, and the funds involved so large, that it is not possible to meet all demands in a limited period without too great a burden upon the public finance. Therefore, State funds available for new construction should be devoted first, to the class of highways of greatest importance to the public under the jurisdiction of the State Highway Department.

2.—The sum total of public roads should be considered, for financing purposes, in two major divisions; group one, general service motor highways, i.e., general traffic flow lines; group two, local service roads.

3.—Notice is taken of the extensive conversion of land that is taking place especially in populous districts, I. E., the changes in the actual or potential utilization of land in which the establishment or available ability of motor transport is a major factor by which its value or its potential earning capacity is increased.

4.—Notice is also taken of the special benefits which result from extraordinary highway undertakings in congested districts which may properly be financed, in part at least, by the formation of improvement districts with special assessments. As defined here,



this principle is limited to conditions that are not average or normal, and does not apply to rural districts.

It is evident from the above that there are many conditions that will require special consideration. Also, the Committee fully recognizes the fact that we have as yet the experience of only a few years available upon which to formulate sound and enduring policies. The situation is not crystallized. One new development succeeds another. It is certain, however, that the following statement of principles records and outlines those policies which have already proven sound, and which at this time embody the best practice.

### Highway Finance

1.—The highway budget is defined as the total annual expenditures in each state for highway purposes.

2.—The annual highway budget should be adjusted to the relative needs for other public purposes.

3.—No road should be improved by expenditure of public funds in excess of its earning capacity. The return to the public in the form of economic transportation is the sole measure of the justification for the degree of improvement.

4.—Broad surveys made by the United States Bureau of Public Roads have determined conclusively that from forty to sixty per cent of the average costs of highway construction is expended in permanent improvements, such as grading, draining, structures, engineering and rights-of-way-of the remaining costs, all but a small percentage of the surface can be salvaged in reconstruction and constitutes a definite addition to the capital facilities of the community which is passed on to the succeeding generations. from all these studies it thus appears that highway bond issues are justified where the "Pay-as-you-go" plan does not promptly provide the highways economically necessary, and where adequate engineering and economic control is assured.

5.—The wide variance in the present status of highway development in the several States prevents the adoption of uniform policies for securing the funds necessary for the annual budget. Generally speaking, however, these principles may be set forth:

- (A) States in the initial stage of highway development should issue bonds to defer that portion of the annual charge for construction which would over burden either property or the road user.
- (B) States where original construction programs are well under way, can, in the main, finance normal new construction from current funds utilizing bond issue funds to defer the cost of special projects.
- (C) States where original construction is largely completed are concerned chiefly with maintenance and reconstruction, and should depend on current funds save in cases of emergency.

6.—State highway bond issues should be serial in form and should mature over a period not exceeding thirty years.

7.—Highway bonds issued by political subdivision of a State should be serial in form and should mature over a period not exceeding twenty years.

8.—Serial maturities should be arranged so that the annual requirements of principal and interest will be as nearly uniform as practicable.

9.—Sound public financing requires that where motor vehicle or other special levies are allocated to defray the costs of State highway bond issues, the full taxing power also of the State shall be authorized to guarantee principal and interest in event of failure of such special levies to provide sufficient revenue.

### Highway Administration

1.—The large sums involved in highway expenditures and the broad training and experience required in handling them demand that political patronage be eliminated in all highway administration. Stable organizations and policies are essential to the orderly progress of the highway program.

2.—Highways of general motor use in each State should be classified into systems of like importance such as interstate, state and county highways. All others should be classified as local roads.

3.—For the purpose of securing uniformity and economy, all ex-



penditures on these systems should be correlated under adequate engineering and economic supervision.

4.—The order, kind and extent of improvement for each class and for individual projects in each class should depend upon the relative traffic requirements, present and future.

5.—A much larger mileage of highways than at present should be immediately placed under adequate and continuous maintenance and made available for traffic the year 'round.

### **Distribution of Costs**

1.—The cost of building and maintaining adequate systems of highways should be distributed in an equitable relation to the benefits derived. These may be summarized as follows:

- (A) Benefits to society in general, such as influence on education, recreation, health, fire prevention, police protection, the national defense, the postal service, living and distribution costs.
- (B) Benefits to definite groups, such as agriculture, manufacture, labor railroads, mining, forestry and waterways.
- (C) Benefits to property served.
- (D) Benefits to the road user.

2.—For the purpose of apportioning costs in relation to benefits received, all highways may be divided into two classes; first, those used by the general motoring public, and second, those which perform a purely local service function.

3.—Special motor vehicle taxes should be levied and used only for the improvement and maintenance of highways used by the general public, I. E., for general highway traffic flow lines. They should be expended under the direction of the state highway department.

4.—The wide variance in valuations, tax burdens, number of motor vehicles in use and the status of highway development in the several states prevents the adoption of any fixed formula as to the proportion of the total costs of highways of general use which should be paid for from motor vehicle funds. Generally speaking, however, these principles may be set forth:

- (A) In states where the income from motor vehicles is insufficient to meet all of the maintenance costs of highways of general motor use without undue burden to the individual motorist, such funds should be applied first to the maintenance of inter-state and state highway systems.
- (B) In states where the income from motor vehicles is sufficient to meet all maintenance costs of highways of general motor use without undue burden to the individual motorist, any surplus should be used for this class of highway reconstruction and administration costs.
- (C) In states where the number of motor vehicles will bring in large sums in excess of maintenance without placing undue burdens upon the individual motorist, such surplus should be used to defray all the costs of maintenance and a substantial share of all of the other costs of highways of general motor use.
- (D) In those states where the motor vehicle income is more than sufficient to meet maintenance costs of highways of general motor use without undue burden to the individual motorist, it may be found advisable to use such surplus for the purpose of defraying all or part of the costs of bond issues to expedite construction of economically desirable motor highways.

5.—Roads of a purely local interest, serving only local needs, should be financed out of local revenues obtained from local general tax revenues. Special assessments on adjoining land to defray a portion of the costs of such roads may be justified.

6.—Where extraordinary improvements are undertaken in the vicinity of or serving congested areas of population the increment, if any, in property valuation following the improvement should be drawn upon to defray an equitable portion of the cost.

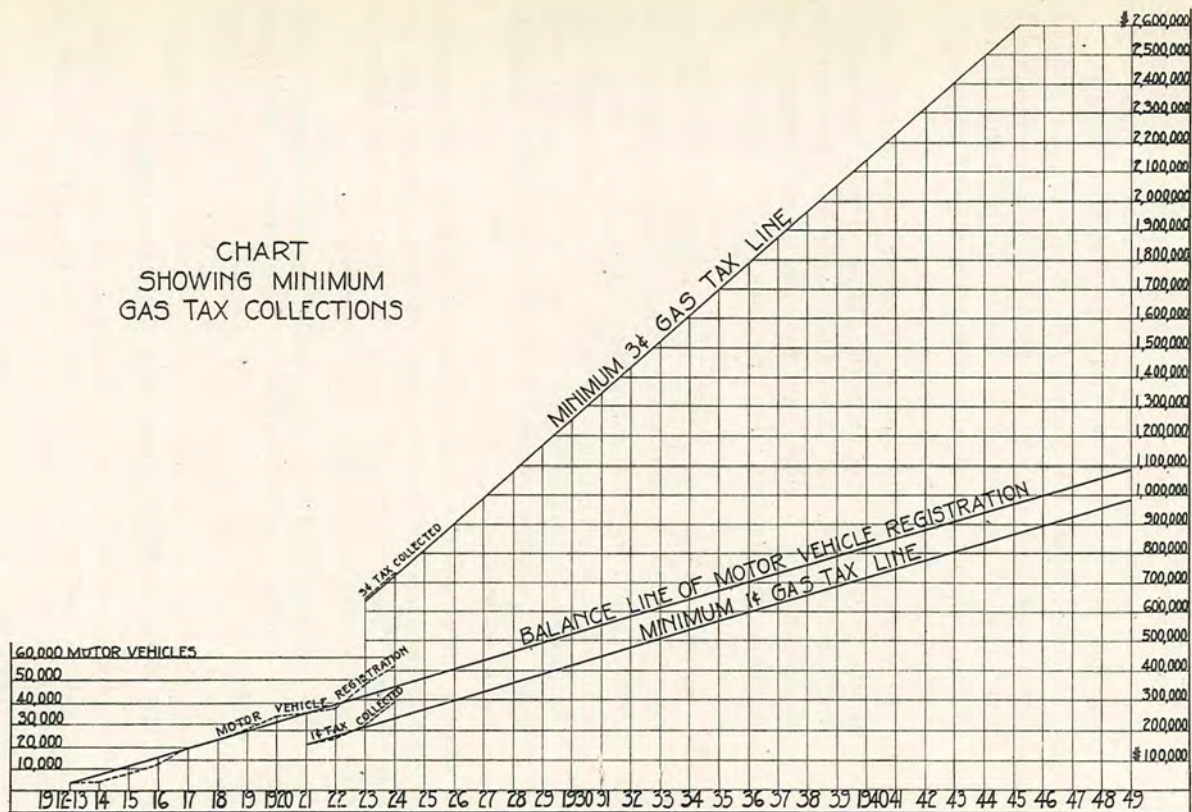
### **The Form of Motor Taxes and Collection Methods**

1.—The motor vehicle tax should be simple in form and distributed in equitable and just proportion between the different types of motor vehicles.

2.—The State should be the sole agency levying special taxes upon the motor vehicle or the highway user.



CHART  
SHOWING MINIMUM  
GAS TAX COLLECTIONS



## Finances

ARIZONA is a progressive state, rich in resources, and its development, in reality, has just begun. The development that is now assured, pending, and under consideration will alone double its valuation and population when completed. Subsequent development will follow and entirely new and now unthought of projects will spring into existence and become a reality. In the wake of this progression many large industries that are but vaguely seen on the distant horizon will come into being within the confines of this State and the potential wealth of Arizona will gradually crystallize into reality.

To make a potential project a reality it is necessary to determine first, its physical feasibility; second, its probable cost; third, its earning capacity, and fourth, its estimated earnings balanced against its cost, including the cost of its operation after construction.

### Financing Carefully Planned

If the resultant net earnings are sufficient to assure the success of the project, the financing and construction is undertaken. The financing is carefully planned utilizing strictly business methods, and often requiring the assistance of more adequate legislation. With the exception of Federal Government projects, the method employed is invariably the issuance of bonds, whether it be for a municipal, private or industrial corporation. This is good business as in some instances the "pay as you go" plan would reflect in much higher cost, and greatly reduce the earning capacity, while in most instances, it would render the project utterly impossible.

A system of highways, and particularly, of main trunk highways, such as the State Highway System, is in every respect a project, and one more far reaching than any other that could be projected within the State. A system of adequate trunk highways is not only a necessity to the other projects completed and pending,



but its very existence will make possible many other developments of varying magnitude, that would otherwise be impracticable.

### State's Greatest Project

Therefore, the Arizona system of highways is the foremost project confronting the state today and certainly should receive the serious and business like consideration that is accorded the other projects. Such consideration must reflect in legislation, as the entire future progress of the highways is dependent upon impending legislation.

The physical feasibility of the State Highway System project is already an established fact. The probable cost of the system, as now outlined to the necessary standard to meet the now evident requirements, is approximately \$25,000,000 based upon a five to six year construction program. From the traffic data now available the net earnings of the system for the minimum life of the highways is far in excess of its cost. A projection of the present traffic data together with the additional estimated traffic that would be created by the completion of the unimproved sections of the system reveals a net earning over the period of the estimated life of the surface that is astounding, absolutely assuring posterity an asset with sufficient earning capacity for renewals, betterments and extensions. This conclusion is based upon the highways alone, without giving consideration to subsequent development which will naturally follow along the routes of the highway improvements and by virtue thereof.

### Comparison Given

A project of main highways is similar to that of a combination hydro-electric and irrigation project, in that each has two distinct classes of earnings. By the construction of a hydro-electric irrigation project the included property is materially increased in value, and by far the largest earning is the combined earning of the individual farmers. The amount of this earning is entirely dependent upon the activity of the individuals, and as no complete record may be kept of this earning it may be only roughly estimated.

To defray the construction, operation and maintenance cost of the project, in part, a tax is levied upon the property owners either

through the sale of water to them, or a direct tax levy or both, which is a very small percent of the net earnings of the individuals. This also adds to the earnings of the towns and cities in and adjacent to the project, but while these earnings are known to be considerable in proportion to the project, they are not susceptible of accurate estimation.

The sale of the power of the project is determinate, and is, in such projects, applied to construction, operation and maintenance. The receipts from the sale of the power and water, and the taxes levied for the project, make the project possible, and the fact that these receipts are recorded and thus are evident, usually in large amounts, they overshadow the much larger, though unrecorded, or non-evident earnings.

### **Property Value Enhanced**

The completion of the Highway project enhances the value of the property, by rendering it accessible, by the reduction of operation expense, by bettering living conditions and by bringing it closer, as it were, to its market. This likewise benefits the cities and towns, for the development of the surrounding country must reflect in their development and the resultant property increase. This renders nominal property taxation justifiable and desirable for early and adequate highway development.

The largest earnings of the highway project, like that of the hydro-electric and irrigation project, is that of the individuals through their motor operating expense, without considering the time saving and convenience. This earning of the improved highways is only dependent upon the usage that the individual makes of them. The more he uses them the more he saves in operating expense, which is an earning over that of the unimproved roads. This earning is generally accepted as a matter of course, without any thought whatever given to its magnitude. It is a very rare thing indeed that an individual ever keeps a record of this nature, but a glimpse into the records of some stage company that has operated over both unimproved and improved highways and has kept records of their operation cost will reveal savings that are in reality earnings due to the improvements that are almost unbelievable.



But the smaller earnings of the highway project, the receipts from the motor vehicle fees, gasoline and the bus and truck taxes,—like that of the sale of water and power of the other project,—together with the property tax, are all that are applicable to the construction, operation and maintenance of the project, and likewise due to their visible totals, they far overshadow those of the much greater earnings.

### Highways Universal Necessity

Highways being a universal necessity and means of development have become municipal property. Any funds for such purposes must be in the form of a tax, and all taxes have come to be looked upon as necessary evils. In reality, such taxes if equally imposed, are an investment, and one that returns a much greater yield than any other that can be imagined.

To be consistent in the development of this state,—which Arizona must be in order to be progressive,—the finances for the development of a main trunk or State highway system must be given the same businesslike and serious consideration. The same consideration must be given to the potential earnings as well as the present, of such a system that is given other meritorious projects.

The Arizona State Highway System is capable of paying for its own development by its own earnings through this taxation without an increase in the present taxation for such purposes, if proper and adequate legislation is enacted.

Of the statutes governing the finances of the State Highway system, the law governing the motor vehicle fees is clear in its meaning but should be revised to equalize better the payment of such fees with relation to the various classes of vehicles, as previously recommended in this report. The statute governing all other finances for this purpose, is not only questionable as to its interpretation, but also as to its actual existence as a statute at this time. Therefore new legislation must be enacted if the State Highway System is to remain as such.

### Requirements Reviewed

In review of the proper and possible finances for State highway purposes it is apropos that a review also be made of the requirements now evident for the highways. In making this review it is

proper that it be considered in the manner that the development would progress, therefore the consideration is based upon a five year highway program.

The minimum requirements that are evident now for a five year program, and as previously mentioned in this report under the heading, "Arizona's Highways of the Future," necessitate an expenditure of not less than \$5,000,000 per annum, segregated as follows: Maintenance, \$700,000; grading, additional gravel surfaced roads, and bridges, \$1,500,000; hard surfacing or paving, \$2,500,000; general overhead, renewal of equipment, etc., \$300,000.

This is not a large highway program for Arizona. In fact it is very little in excess of the average highway program of the past five years. In the event of a bond issue for this purpose, this program should be increased, particularly as to new construction and paving to a total of from \$6,000,000 to \$7,000,000 per annum to permit of its maximum earning capacity as early as possible and to retard the increased maintenance that will be required by the slower development method.

To meet this requirement from current funds, or the "Five Million Per Annum" program, the probable Federal Aid may be deducted. It is believed that the amount available and to be made available annually for the five year period will be about \$1,200,000, leaving approximately \$3,800,000.00 to be raised annually by taxation in some form, for State highway purposes.

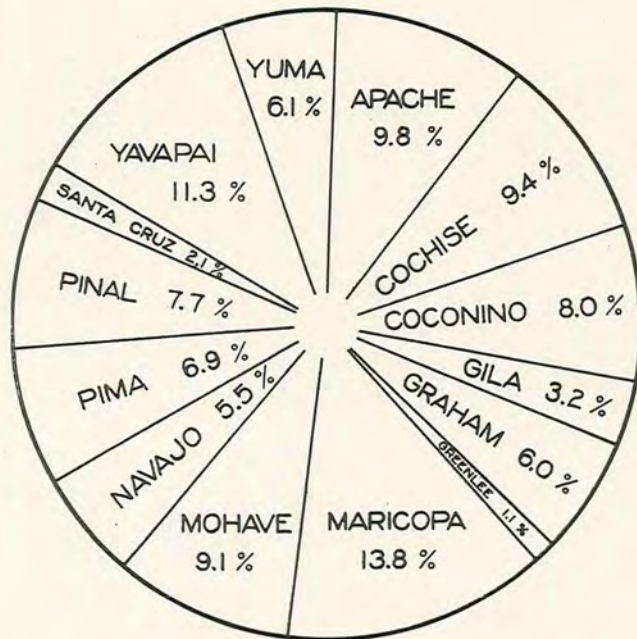
### **Finances Inadequate**

The finances now levied and raised by the state for highway purposes are inadequate, and hopelessly so under the present distribution. In the past the State levies were very materially augmented by donations from the county bond issues, which are now exhausted, and additional funds from such sources are unlikely and it is unfair to the counties to expect such additional aid.

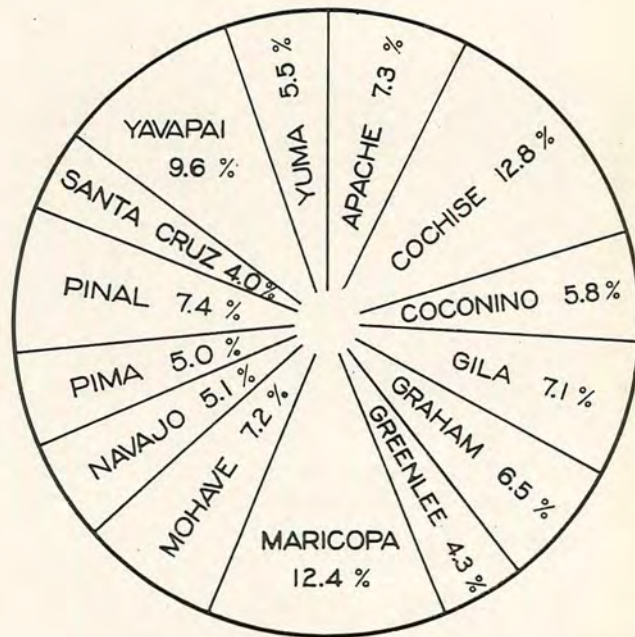
In addition to this source, special appropriations by the legislature were made. Financing of the system by special appropriations is temporary at best, only rendering relief for the immediate time and does not permit of comprehensive planning with any assurance of a continuation or completion of even a relatively small portion of the system. This method would be hazardous in the de-



PERCENTAGE OF  
**7% SYSTEM**  
 BY COUNTIES

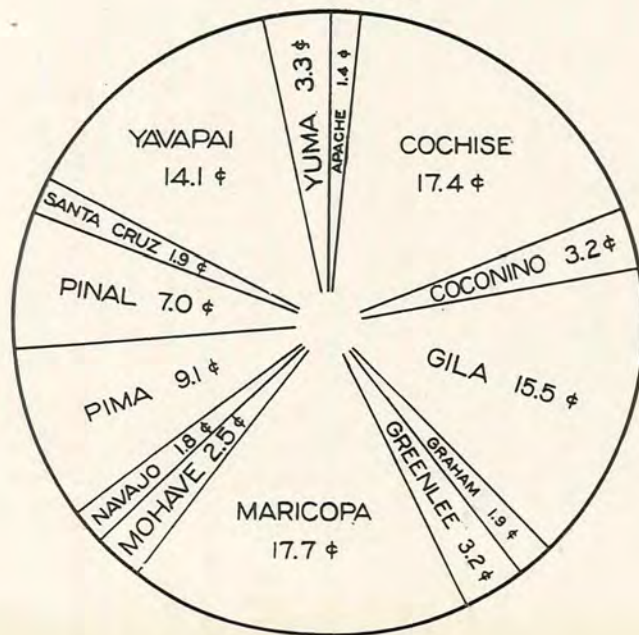


PERCENTAGE OF  
**STATE HIGHWAY SYSTEM**  
 BY COUNTIES



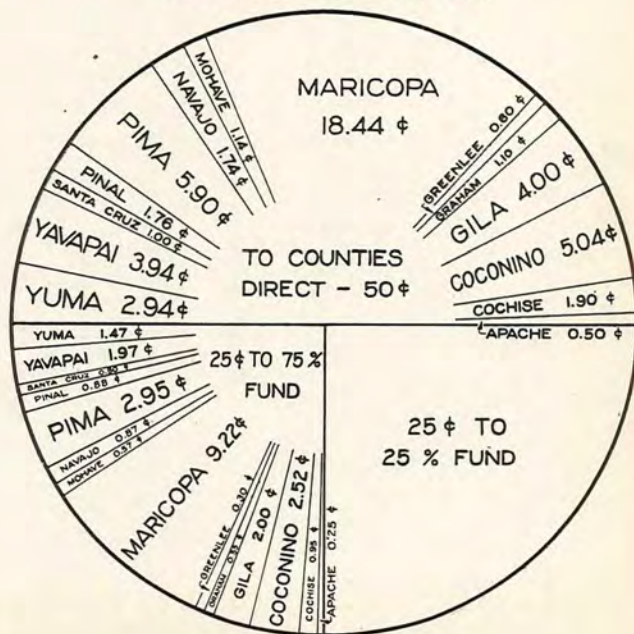
# 75% DOLLAR OF 10¢ LEVY

1924 - 1925



# GAS TAX DOLLAR

DEC. 1, 1923 - NOV. 30, 1924.





velopment of any other class of projects, and is equally unbusiness-like in highway development.

I wish at this point to consider the present distribution of the State receipts for highways or by virtue of the highways, particularly the gasoline tax and the ten cent tax levy. The three cent gasoline tax is levied upon each gallon of fuel oil used by the motorist upon the highways and is in reality a meter upon his use thereof. It is a fair and equitable tax but it is ostensibly levied for additional funds for road purposes.

### Unfair to Auto Owner

Fifty per cent of this tax, or one and one-half cents for each gallon of fuel oil used, is returned to the county from which it is collected and to be used for maintenance of the county roads. Due to the fact that the county budget law provides that the budget can not exceed 10 per cent of that of the previous year, and all receipts from other sources than county taxation must be deducted from the amount of the budget and a tax levy made for the balance, this half of the gasoline tax does not in reality apply to roads, but in the summation of the county budget it is deducted from the total budget, thereby reducing the general county levy. Thus the automobile owner is actually adding this much to defray the general expenses of the entire county government, in addition to the fact that he has already paid a property tax on his automobile proportionate to that of all other property. This is not only manifestly unfair to the automobile owner, but it is actually taking that amount of money paid with the belief that it is helping to improve the highways of the state in general, to apply it to the relief of the county taxes, though the relief is so small that it is hardly noticeable in the total taxes.

The county highway budget remains just the same with or without this distribution of the gasoline tax. This amount of money placed in the State highway fund would reflect very materially in the highway betterment, and be fair and as intended by the highway users. A study of the Gas Tax Dollar chart herein, will also show that in most of the counties the amount received by the counties is too small, when received in monthly payments, to be of any great benefit, while in others it is proportionately too high to be applied to maintenance only.

### Funds Explained

Of the other half of the gasoline tax, half is placed in what is called the "twenty-five per cent apportionment fund," of the State road tax fund, and the other half is placed in the "seventy-five per cent apportionment fund" of the State road tax fund.

Of the ten cent levy upon each \$100 of the assessed valuation of the state, 25 per cent is placed in the "twenty-five per cent apportionment fund" and 75 per cent is placed in the seventy-five per cent apportionment fund" of the State road tax fund. The "twenty five per cent apportionment fund" is for use upon the State highways of the State irrespective of the county lines. The "seventy-five per cent apportionment fund" may be expended upon state highways only within the county from which the taxes are derived, and is also a distribution that should be considered. This law was essential in beginning the Arizona highways. It caused the distribution of the state construction to open the state system to its present status, and was a very decided controlling factor of highway expenditures. Therefore, this provision, by virtue of its early existence, and creation of the highway system, has obviated its necessity for the future. A study of the Seventy-five Per Cent Fund Dollar Chart in comparison with the charts showing the per cent of mileage of both the state highway system and the Seven Per Cent system by Counties included herein will clearly indicate the utter impossibility of ever completing a comprehensive State highway system if this basis of distribution is adhered to.

The State highway system of the State is today carrying approximately 80 per cent of the total traffic of the state, by virtue of the fact that this system is the main trunk system of the State, and practically all of the local highways feed into it at some point. All taxes collected by the state for highway purposes should therefore be applied to the state system until such time that such receipts exceed the State highway requirements.

In resuming the discussion of finances with relation to the minimum essential highway program of \$5,000,000 per annum, it will be assumed that State taxes will be applied to State highways as a system and not apportioned to and by counties.

At the present time the ten cent levy is raising approximately



\$650,000 per annum; the gasoline tax \$800,000; the motor vehicle \$350,000 and the bus and truck taxes about \$21,000, or a total of approximately \$1,821,000. Were all of this applied to the State system it would still be \$2,000,000 short of the required amount.

### **Bus and Truck Lines**

By a more rigid provision governing the exemptions now permitted in the payment of the gas tax, it would increase its present rate of collection to \$900,000. By a more equitable means of rating the cars for the motor vehicle fee collections, and the inclusion of tractors used upon the highways and the trailers that are not now included, this collection would probably be increased to \$500,000 per annum. The taxes now levied upon the bus and truck lines is ridiculous, but a proper tax upon them would probably net \$200,000 per annum.

With these revisions and including the ten cent levy the total would be approximately \$2,250,000 per annum or \$1,550,000 less than the requirements. To raise this difference by an additional tax levy upon property would require an additional levy of approximately 23 cents upon each one hundred dollars of assessed valuation, or a total tax levy of 33 cents. This of course is unreasonable.

It is true that within a few years or by 1930 the increase in the gasoline tax collections, motor vehicle fees, and other increases will return an amount per annum equal to the amount now required, and that the collections will increase thereafter, but to delay the work now required for that period of time will cause tremendously increasing outlays for maintenance without the desired results. The then immediate requirements will be as much more in advance of the collections at that time with the maintenance outlays still ascending, that the outlook will be as hopeless as it now appears.

### **Facts Should be Faced**

With these facts evident, why not face them as they are faced for other projects within the State, sanctioned and approved by the State, and as other states are doing. The gasoline tax alone with the rapidly increasing receipts if applied to a bond issue will amortize a \$20,000,000 serial bond issue together with interest within 20 years or less, leaving the other State taxes for highway purposes, for

maintenance, general overhead and additional construction. A bond issue of this size together with \$5,000,000 to \$6,000,000 of Federal Aid funds that would, in all probability, be received in the course of a five year program, would give this State the highways that it not only desires but requires for its progress and development. Also these highways would greatly enhance its earning capacity, especially from the increased tourist traffic, which by this form of finance, will pay a large proportion of the cost of the highway development.

In this connection I wish to mention from public print a prophecy by the world's greatest economist and statistician:

"The most active American industry in 1925 will be the construction of roads, according to Roger W. Babson, well known economist. He points out that money is now available at very cheap rates for road construction purposes and that the States will take increasing advantage of these easy terms next year. This pending road building program will not only employ a great many thousands of men at good wages, but will benefit several important industries, said Babson.

#### PHOENIX-WICKENBURG HIGHWAY



NEWLY GRAVELED ROAD NEAR NADABURG



"THE WILLOWS"



TUCSON-NOGALES HIGHWAY

## Arizona State Highway System

THE Arizona State Highway System was designed with a view of connecting all of the County seats of the State and to supply an east and west route across the northern part of the State, a like route across the southern part, and a north and south highway. All of the County seats not only have a connection but are on a through route. Since its inception there have been additions made with the view of connecting the larger industrial centers and making the inter-County travel more convenient.

The system, as originally planned, is now the trunk of the present system. Only a very few changes have been made in its routing. Those were caused by topographical conditions, or the receipt of more adequate funds to overcome such conditions, or a combination of the two, the main control points of the system remaining as originally planned. The additions have been connections to and between points on this system.

This fact is more to the credit to the planners of the original system, when it is considered that a State Highway in Arizona has no permanent standing as such. There is no provision for the designation of a State Highway in this State other than the expenditure of State Highway funds thereupon by the State Engineer. Likewise if he or some successor elects to abandon any section as a State Highway, apparently the only action necessary is to refuse to expend additional State Highway funds upon the highway for betterment and maintenance, and in the course of time it loses its identity as such. This procedure for abandonment has been followed in the past.

### Permanency Needed

The State Highway System is of vital importance to the State. Large sums of money have been expended for its construction to its present status and many millions more will be expended within the years to come. The monies necessary for the creation of this system have been in the past, and will be in the future, taken from



the taxpayers of this State, or by virtue of their taxes, and the same permanency should be accorded this expenditure as other public or private expenditures for improvements.

The State Highway System should be legally established and divided into roads of primary and secondary importance, the total mileage of which should not at any time exceed 12 per cent of the total road mileage of the State. In making this selection for an established system, the highways that are now classed in the system should be very carefully considered and if any of them now included are found to be of minor or only local importance, except in the matter of the connection of important industrial or thickly populated centers to the main system, they should be eliminated now to prevent additional expenditures being made, only to have the section of the system abandoned at a later date. In the initial outline of such a system, the entire allowable mileage need not and therefore should not be taken up. The future will naturally bring forth new demands. In formulating this outline the **first** thing that should be done is the drafting of the qualifications of a primary State Highway and for the secondary State Highway. These qualifications should be clearly defined and also be the only qualifications upon which future additions will be considered and included.

In addition to this qualification, no addition to the established system should be made unless it is constructed or funds are available and not needed for the established system, or in the case of special provisions being made for its construction. Every mile that a highway system is increased deducts the cost for the increase from the highway system already established, thereby delaying usually, the completion of the most important highways of the State.

### **Status Explained**

The status of the present highway system is that the entire mileage as the system is now outlined, either is constructed to a standard road, or a sufficient amount of work has been done to some standard to open it to traffic, or is now under construction. A statement of the status of the State Highway System is herein included together with a tabulation of the system by types which

gives the mileage of the system, and the mileage of each class of construction.

Under the column of "Graded and Drained" the mileage shown is only to a lower type of construction and will eventually require probable relocation additional construction and gravel surfacing or paving.

The 1183 miles shown in the Selected Surfacing column also includes highways constructed of self surfacing material, or the natural material encountered is of sufficient grade to make a good surface of this mileage approximately 350 miles needs paving at this time, or its condition is such that it will require paving in the near future.

A Recapitulation of the periods of the construction of the system to its present status is shown by counties.

### **Status by Counties**

In the following outlines of the Arizona State Highway System by Counties, a brief description of the projects, as to length, type and condition, that constitute the different highways in the counties has been given. More detailed information on the construction accomplished during 1923-1924 may be obtained by referring to the tabulations of contracts in this report.

The projects mentioned in this outline are on the Federal Aid Seven Per Cent System unless otherwise designated.

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## **APACHE COUNTY**

### **Holbrook-St. Johns Highway**

This highway is a good gravel surfaced road extending from the Navajo County line for 18 miles. It was constructed in 1915 by the State but does not meet the Bureau of Public Roads standards on account of its narrow width.

The next 12.6 miles into Concho is Federal Aid Project No. 6, constructed in 1922, and is in good condition. From Concho to St. Johns is Federal Aid Project No. 78, 16 miles in length. This pro-



ject will make some line changes and will give a standard gravel surfaced road into St. Johns. Construction on Federal Aid Project No. 78 will start in the early part of 1925.

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### **St. Johns-Springerville Highway**

Federal Aid Project No. 60, a gravel surfaced road completed in 1923, covers the 11.5 miles out of St. Johns. From the end of Federal Aid Project No. 60, for a distance of 8.5 miles, extends Federal Aid Project No. 68A, constructed during 1923-24. Federal Aid Project No. 68B, 9.65 miles in length, which ends in Springerville, is under a project agreement, but due to litigation on the right-of-way was delayed.

The difficulty has been adjusted and bids will be asked on this project in January 1925. When this section is constructed it will complete a standard gravel surfaced road from St. Johns to Springerville.

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### **Springerville-New Mexico Line**

This road is classified as unimproved as no State work has been done on it. During the summer months the traffic on this road is very heavy. It is considered a fair road.

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### **Adamana-Lupton Highway**

This road, 54 miles long, also is classified as unimproved, although in 1923-24 the State graded part of it and in 1923-24 two bridges were constructed. A relocation of this road is now being made and a standard highway eventually will be constructed.

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## **COCHISE COUNTY**

### **Benson-Vail Highway**

This highway, Federal Aid Project No. 18, 10 miles in length, was constructed in 1921. It is a standard gravel surfaced road.

### **Benson-Tombstone Highway**

This project, 26.3 miles in length was improved by the County and State forces and is a good gravel surfaced road, although not up to the Bureau of Public Roads standards. This section required a relocation in part, particularly between Benson and St. David. During 1923 many of the old fords were paved by State forces.

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### **Tombstone-Bisbee Highway**

The first 10 miles out of Tombstone is a two inch asphaltic concrete pavement, constructed in 1922. The next seven miles is Federal Aid Project No. 79A, which will be constructed of asphaltic concrete during the first part of 1925. The remaining 9.3 miles is a gravel surfaced road in fair condition, except for the existing heavy grades.

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### **Bisbee-Douglas Highway**

This section consists of 24.16 miles of 18 foot concrete pavement, including Federal Aid Project No. 11, 8.5 miles in length. The Federal Aid section is in good condition, but the remainder of the paving is in bad condition, badly cracked and uneven, due apparently, to the fact that the original roadway was widened just prior to the laying of the pavement, without allowing proper settlement of the new embankment before laying the slab.

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### **Douglas-Rodeo Highway**

This highway, 49.13 miles long, includes Federal Aid Projects Numbers 14 and 38. It is a standard gravel surfaced road in good condition. There are, however, several railroad grade crossings that eventually will require elimination by relocation or separation.

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### **Tombstone-Santa Cruz County Line**

This section, 19.5 miles long, is a gravel surfaced highway and includes Federal Aid Project No. 49, 15 miles in length. This section is not on the Federal Aid Seven Per Cent System.



### **Douglas-Safford Highway**

This project, 97.8 miles long, is not on the Federal Aid Seven Per Cent System. Forty-seven miles have been graded and drained but the remainder is unimproved.

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## **COCONINO COUNTY**

### **Williams-Ash Fork Highway**

From the County line west of Williams into Williams there is a standard gravel surfaced road, which includes Federal Aid Projects Numbers 51, of 4.81 miles, and 37 of 2.83 miles. This road was constructed in 1921-22.

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### **Flagstaff-Williams Highway**

From Williams east 18 miles to Maine, there is a cinder surfaced road in good condition, but it contains some narrow places not up to standard width and has some sharp and dangerous curves. From Maine to Flagstaff, a distance of 14.61 miles, is Federal Aid Project No. 24, a standard cinder surfaced road. Through the city of Flagstaff, for a distance of 1.1 miles, asphalt paving was placed. All these sections were completed prior to January 1, 1923.

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### **Flagstaff-Navajo County Line**

From Flagstaff east is a forest project, 23.43 miles in length, under construction. It is a standard gravel surfaced road, 75 per cent completed. Federal Aid Project No. 81 of 12.20 miles in length is under agreement and probably will be constructed in 1925. Federal Aid Project No. 74 is under construction. It is a standard gravel surfaced road, 50 per cent completed.

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## **GILA COUNTY**

### **Superior-Globe Highway**

From the County line east is part of Federal Aid Project No. 16 with 9.6 miles of standard gravel surfaced heavy mountain road. From Miami to Globe, a distance of 7.8 miles, there is a paved road constructed by Gila County in 1915.

### **Globe-Rice Road**

This section, 28.55 miles in length, includes Section A and B of Federal Aid Project No. 15, a standard gravel surfaced road 18.05 miles long. The remaining 10.5 miles is in good condition with five miles gravel surfaced. This work was done prior to January 1, 1923. Due to the proposed construction of the San Carlos Dam, it may be necessary to relocate several miles of this highway near Rice.

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### **Globe- Roosevelt Highway**

This road is 32.3 miles long, 24.3 miles of which have been widened and surfaced. The remaining eight miles will be improved in 1925. This road is not on the Federal Aid Seven Per Cent System.

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### **Rice-Springerville Highway**

This project is 63 miles in length. Some work has been done in the past year on this road, consisting of temporary repairs and maintenance on the present old road, but it is classified as unimproved. It is not on the Federal Aid Seven Per Cent System.

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## **GRAHAM COUNTY**

### **Rice-Geronimo Highway**

The first 27.3 miles of this highway is a fair dirt road, but the construction of the San Carlos Dam will necessitate practically an entire change of the route and a reconnaissance survey has been made. The next 5.3 miles is Section D. of Federal Aid Project No. 15, a standard gravel surfaced road.

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### **Geronimo-Solomonville Highway**

The first 14 miles of this road is a graded, drained and surfaced section. It is a good road but does not meet the standards of the Bureau of Public Roads. The next 7.46 miles is a six inch asphalt pavement 18 feet in width comprising Federal Aid Project No. 63. It was constructed during 1923-24. Federal Aid Project No. 43



covers the next 6.14 miles. This is a concrete paved highway 18 feet in width constructed in 1923. The remaining 7.06 miles are in Federal Aid Project No. 67, a concrete paved highway 18 feet in width now under construction and 76 per cent complete.

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### **Solomonville-Duncan Highway**

This road covers a distance of 20.59 miles. Federal Aid Project No. 77, comprising 12.09 miles, is included in this section and is 75 per cent complete. The remaining 8.5 miles, extending east to the Greenlee County line, is an unimproved dirt road.

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### **Solomonville-Clifton Highway**

This section is a gravel surfaced road, 12.2 miles in length, extending from Solomonville northeast to the County line, and is in fair condition. The surfacing on this section was done by State forces in 1923. This road is not on the Federal Aid Seven Per Cent System.

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### **Safford-Douglas Highway**

This is an old unimproved road, 29.5 miles long and is not on the Federal Aid Seven Per Cent System. The county did some work in this vicinity in 1924, part of which was on alignment that may be utilized as this route.

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## **GREENLEE COUNTY**

### **Solomonville-Duncan Highway**

This stretch of road, 15.99 miles long, extending from the County line to the State line, is a fair, improved dirt road from the County line to Duncan, but it must be greatly improved to meet the standards of the Federal Aid Seven Per Cent System, now completed or under construction in Graham County.

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### **Clifton-Franklin Highway**

This section, 34 miles in length, comprising Federal Aid Project No. 13, is a gravel surfaced road. It is not on the Federal Aid Seven Per Cent System.

### **Clifton-Solomonville Highway**

This section is 16.3 miles of gravel surfaced road in good condition. It was resurfaced in part in 1923. It is not on the Federal Aid Seven Per Cent System.

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### **Mule Creek Road**

Seventeen and one-half miles in length, this road was constructed in 1921-22 to connect with a proposed highway in New Mexico. However, the New Mexico road was never built and for this reason this road is virtually unused. It is not on the Federal Aid Seven Per Cent System. It was graded to a narrow section and partly drained. Additional drainage was effected in 1923-24.

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## **MARICOPA COUNTY**

### **Yuma-Maricopa County Line to Gila Bend**

From the County line east for 21.82 miles is Federal Aid Project No. 69, constructed during 1924 by State forces. It is a standard gravel surfaced road. The next 14.94 miles also is a standard gravel surfaced road constructed as Federal Aid Project No. 56 and completed in 1923.

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### **Gila Bend-Gillespie Dam**

This section, 23.26 miles in length, is Federal Aid Project No. 53. It is a standard gravel surfaced road and is described in the Fifth Biennial Report. The construction was completed in 1923.

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### **Gillespie Dam-Hassayampa River**

This section, 9.92 miles long, comprising Federal Aid Project No. 64A, was constructed during 1923-24 by contract. It is a standard gravel surfaced road on an entire new location. Federal Aid Project No. 64B, when constructed, will cover the remaining 1.6 miles and will consist of a bridge across the Gila River with a new road from the west end of Federal Aid Project No. 64A to the bridge. This road is now a temporary road over the Mesa to the apron of the dam. The apron is now used for crossing the river.



### **Hassayampa River-Buckeye**

This section, comprising Federal Aid Project No. 71, is now being constructed by contract. It is a concrete pavement 9.2 miles in length and is 18 feet wide.

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### **Buckeye-Phoenix**

This section constitutes Federal Aid Projects Numbers 46 A and B, and is a concrete pavement 16 feet in width. It was constructed as a part of the Maricopa County Highway Board Program. It is discussed in detail in the Fifth Biennial Report.

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### **Phoenix-Mesa Highway**

Except for three miles of asphalt paving, comprising Federal Aid Project No. 30, all this section is concrete pavement, 18 feet wide, and includes Federal Aid Projects Numbers 2 and 8.

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### **Mesa-County Line**

This section, comprising Federal Aid Project No. 47, 4.10 miles in length, extends from the east city limits of Mesa to the Eastern Canal. It is a 16 foot concrete pavement. From the Eastern Canal east for 3.97 miles is an asphaltic concrete pavement, 18 feet wide, known as Federal Aid Project No. 65. It was constructed by contract in 1923-24. From the end of Federal Aid Project No. 65 to the County line is six miles of gravel surfaced road constructed by the State but not up to standard construction.

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### **Phoenix-Prescott Highway**

From Phoenix to Marinette is a concrete pavement constructed in 1921-22 and 23, comprising Federal Aid Projects Numbers 33 and 48. From Marinette northwest for 3.91 miles is Federal Aid Project No. 70, a concrete pavement constructed in 1923-24 by contract. From Federal Aid Project No. 70 for 14.6 miles is Federal Aid Project No. 84, now under construction. It will be a standard gravel surfaced road. From Federal Aid Project No. 84 north to

Hot Springs Junction, is Federal Aid Project No. 76, comprising seven miles of standard gravel surfaced road now under construction. From Hot Springs Junction to Wickenburg is a standard gravel surfaced road, which is Federal Aid Project No. 59, constructed in 1923-24. From Wickenburg to the County line is a gravel surfaced road nine miles in length.

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### **Apache Trail Highway**

State forces in 1922 reshaped and widened this road, with the exception of the sections that would be inundated by the construction of the Mormon Flats and Horse Mesa dams. They also did construction and replacement work on several bridges on improved section. Five bridges were constructed on the improved section in 1923-24 and the relocation around the Mormon Flats reservoir is now about 90 per cent complete. The section to be affected by the Horse Mesa reservoir probably will be constructed in 1925. This will complete the road to Roosevelt and also to the County line.

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### **Chandler-Casa Grande Highway**

From the end of the pavement south of Chandler to the County line is a dirt road, 5.3 miles long. This road is being improved by the State and construction on this road in Pinal County is now being carried on, moving toward Chandler. A surfacing crew will be moved to this section at an early date. This highway will cross the Gila River on a bridge constructed on the division dam near Sacaton, when this structure is completed.

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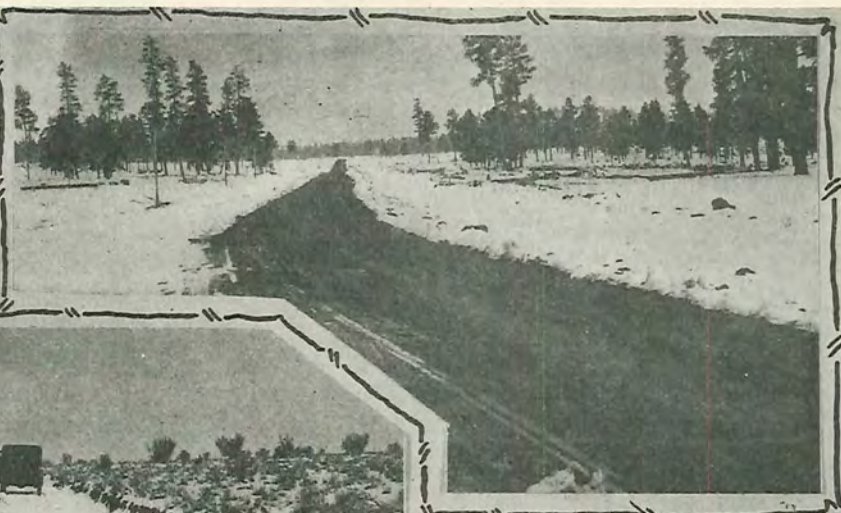
## **MOHAVE COUNTY**

### **Topock-Oatman**

From Topock east, the first 21.7 miles is Federal Aid Project No. 29, started in 1921-22, but due to a railroad crossing the first one-half mile was not completed until 1923-24. This is now a standard gravel surfaced road. The remaining 3.16 miles is a fair dirt road but does not meet the requirements of the Federal Aid Seven Per Cent System. A relocation is now being made of this section and will be Federal Aid Project No. 85A.



WINTER SCENES  
BETWEEN  
FLAGSTAFF AND KINGMAN



### **Oatman-Goldroads**

This highway, 2.65 miles in length, was constructed under two Federal Aid Projects. Federal Aid Project No. 5, comprises 2.19 miles and Federal Aid Project No. 44 comprises .46 miles. This is a standard gravel surfaced highway, constructed prior to January 1, 1923.

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### **Kingman-Goldroads**

This section covers a distance of 26.15 miles. Approximately four miles of the road was started as Federal Aid Project No. 54 but due to some changes in construction, this project was withdrawn and was constructed by the State alone. Including the four miles, there are 11 miles of gravel surfaced road on this project but it is not up to standard. The remaining 15.15 miles is a good dirt road.

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### **Kingman-Hackberry Highway**

This section covers 28.1 miles two miles of which is a gravel surfaced road but narrow. The remaining 26.1 miles is a first class self-surfaced road but does not meet the requirements of a standard surfaced road.

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### **Hackberry-Yavapai County Line**

This section is a first class road located over a stretch of excellent material, but does not meet the requirements of the Federal Aid Seven Per Cent System. Federal Aid Project No. 80 covers 15 miles of the section and it will be a relocated standard gravel surfaced road through the Hualpai Indian reservation. It will probably be a 100 per cent Federal Aid Project.

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### **Arrowhead Trail Highway**

This section, a part of the Arrowhead Trail is 19 miles in length, extending to the Utah-Nevada State lines. It is an unimproved dirt road.



### **Hillside-Kingman Highway**

This section, 12.7 miles long, has been graded to a narrow section only, and drained, with several new changes in location. The work was done during 1924 by State forces. It is not on the Federal Aid Seven Per Cent System.

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## **NAVAJO COUNTY**

### **County Line-Winslow**

This distance of 2.72 miles is now under construction as Federal Aid Project No. 22. It is a standard gravel surfaced highway with several changes in location. This work is being done by contract and is virtually completed.

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### **Winslow Paving**

This section, .95 miles of the Old Trails Highway through the city of Winslow was paved with asphalt during 1922-23.

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### **Winslow-Holbrook Highway**

This section, comprising Federal Aid Project No. 40 of approximately 32 miles, a standard gravel surfaced road, was constructed by contract in 1922-23. Due to heavy rains in 1923, which caused a washout at St. Joe, Federal Aid Project No. 40 was reopened, and one-half mile of standard gravel surface, including a concrete bridge at St. Joe, is now under construction.

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### **Holbrook-Apache County Line**

This section, extending toward Adamana, covers a distance of 22 miles. During 1921-22 the road was graded, drained and surfaced in parts, but it is not up to the standards required by the Bureau of Public Roads.

### **Holbrook-St. Johns Highway**

From Holbrook southeast for 6.6 miles is a good gravel surfaced road, but not up to Federal Aid requirements. The remaining 10.54 miles to the Apache County line is a standard gravel surfaced road, constructed in 1923 by contract as Federal Aid Project No. 42.

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## **PIMA COUNTY**

### **Tucson-Florence Highway**

From Tucson north to the Pinal County line, a distance of 19.8 miles, includes Federal Aid Project No. 9, the first 3.8 miles out of Tucson, which is a concrete paved highway 18 feet in width, and 16 miles of a standard gravel surfaced road, constructed in 1922-23 by State forces.

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### **Tucson-Benson Highway**

From Tucson to the Cochise County line, a distance of virtually 40 miles, includes 22 miles of a good dirt road, gravel surfaced in places but needs a partial relocation to meet Federal Aid requirements, and Federal Aid Project No. 18, covering 18 miles, which is a gravel surfaced road described in the Fifth Biennial Report of the State Engineer.

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### **Tucson-Nogales Highway**

This section extends south from Tucson to the Santa Cruz County line, a distance of 37.25 miles. The first 8.85 miles out of Tucson is Federal Aid Project No. 29, a concrete paved highway, 18 feet in width. The next 13.5 miles will be Federal Aid Project No. 86. This project will be a new location, gravel surfaced standard highway, keeping on the west side of the railroad for the entire distance, eliminating two bad railroad grade crossings. The plans on Federal Aid Project No. 86 are now under way, and construction should begin some time in the early part of 1925. The remaining 14.8 miles includes Federal Aid Projects Numbers 25, 25B, and 75, all of which are concrete structures with gravel surfaced approaches only.



Project No. 25 was constructed in 1922, Project No. 25B in 1923-24, and Project No. 75 is now under construction. This entire road is gravel surfaced, in good condition and with the exception of several short curves meets the requirements of Federal Aid.

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## **PINAL COUNTY**

### **Mesa-Superior-Highway**

From the County line at Apache Trail Junction, the first 8.5 miles were constructed by the State in 1919-20 as a standard surfaced road, but due to the heavy traffic the State found it necessary to scarify and resurface during 1923-24. The remaining 11.7 miles to Superior Junction comprising Federal Aid Project No. 7 was a standard gravel surfaced road constructed in 1919-20. In 1923-24 the State resurfaced the first 6.7 miles of this road and the remaining five miles, an asphalt surfacing of two inches in thickness was constructed by contract.

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### **Florence-Superior Highway**

This section is covered by Federal Aid Projects Numbers 1 and 23, described in the Fifth Biennial Report of the State Engineer. The project was not completed, however until 1924.

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### **Superior-Miami Highway**

From Superior to Gila County line, a distance of 10.1 miles, is a standard gravel surfaced heavy mountain road and is part of Federal Project No. 16.

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### **Ray-Superior Highway**

This section comprises Federal Aid Project No. 28, a standard gravel surfaced road not on the Federal Aid Seven Per Cent System.

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### **Apache Trail**

The 4.3 miles of this highway in Pinal County is in first class condition. It is not on the Federal Aid Seven Per Cent System.

### **Chandler-Casa Grande Highway**

This project consists of 27 miles in Pinal County now under construction and 50 per cent completed. It is not on the Federal Aid Seven Per Cent System.

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## **SANTA CRUZ COUNTY**

### **Tucson-Nogales Highway**

This section extends from the Pima County line to Nogales, a distance of 29.75 miles. From the County line for 25.68 miles is a gravel surfaced road, originally constructed by the State in 1917-18. It includes Federal Aid Projects Numbers 25, constructed in 1921-22; 25B, constructed in 1923-24; and 66, constructed in 1923-24. All of these Federal Aid Projects were concrete structures with gravel surfaced approaches. The next 2.32 miles of highway is a concrete pavement, a non-Federal Aid Project, constructed in 1921-22. This connects with the Nogales street, 1.75 miles of graded and partly surfaced roads.

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### **Nogales-Fairbanks Highway**

From the junction on the Nogales-Tucson road to the Cochise County line is a distance of 49.3 miles. The first 22 miles is now being improved and is 70 per cent complete. When completed it will be a good gravel surfaced road. The next 13.1 miles is now a good self surfaced road. The remaining 14.20 miles, comprising Federal Aid Project No. 27, is a standard gravel surfaced road. This section of 49.3 miles is not on the Federal Aid Seven Per Cent System.

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## **YAVAPAI COUNTY**

### **Mohave County Line-Ash Fork**

The section from the County line to Seligman, a distance of 24 miles, is a good dirt road that is partly self surfacing. From Seligman, the first 96 miles is a good gravel surfaced highway but does not meet the requirements of the Bureau of Public Roads. The



next 9.35 miles is a standard gravel surfaced highway known as Federal Aid Project No. 57, constructed in 1922. The remaining 6.2 miles of highway to Ash Fork is also a good gravel surfaced road but not up to the requirements of the Bureau of Public Roads.

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### **Ash Fork-Williams**

The section from Ash Fork east to the Coconino County line, a distance of 2.4 miles, is a cinder surfaced road in good condition but is not up to the requirements of the Bureau of Public Roads. A relocation of the railroad crossing on this project has been made and the project is expected to be constructed to Bureau requirements during 1925-26.

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### **Prescott-Ash Fork Highway**

The first 6.42 miles out of Prescott comprise Federal Aid Projects Numbers 19, 36 and 36B. Projects Numbers 19 and 36 were constructed in 1921-22, and Project No. 36B, which is an underpass under the A.T.&S.F. Railway, is under construction. It will be completed by February 1, 1925. This 6.42 miles is a standard gravel surfaced highway described in detail in the Fourth and Fifth Biennial Reports of the State Engineer.

Federal Aid Project No. 61 comprises the next 22.26 miles, which is a standard gravel surfaced road constructed in 1922-23. The remaining 23.85 miles to Ash Fork is Federal Aid Project No. 62. This is a standard gravel surfaced road and includes two large bridges namely the Hells Canyon and Little Hells Canyon bridges. It was constructed in 1923-24 by contract.

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### **Prescott-Phoenix Highway**

The first 15.58 miles out of Prescott is a Forest Project under construction, which is 50 per cent complete. This will be a standard gravel surfaced highway. The next 27.88 miles is covered by Federal Aid Project No. 72, which is divided into two sections. Section A, covering a distance of 18.84 miles from the south end of the Forest Project south, is 75 per cent complete. Section B, covering a distance of 9.04 miles, is being advertised for bids to be opened January 26, 1925 and the construction will be completed by July

31, 1925. Both of these sections will be made a standard gravel surfaced road. The remaining 15.1 miles to the Maricopa County line is a gravel surfaced highway, but not up to the requirements of the Bureau of Public Roads.

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### **Prescott-Jerome Highway**

This section, 26.8 miles in length, from the Junction on the Prescott-Ash Fork Highway to Jerome, is a gravel surfaced road in excellent condition and includes Federal Aid Projects Numbers 12 and 17 and a part of No. 19. This road has been described in the Fourth and Fifth Biennial Reports of the State Engineer. It is not on the Federal Aid Seven Per Cent System.

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## **YUMA COUNTY**

### **Yuma-Phoenix Highway**

Paving of the Yuma streets, 1.2 miles in length with asphalt is now under contract. The first seven miles out of Yuma is now under Project Statement as Federal Aid Project No. 82A. The next 8.74 miles is Federal Aid Project No. 26B constructed in 1921-22 as a standard surfaced highway, but at present is in bad condition. The 13 miles between Federal Aid Project No. 26B and Federal Aid Project No. 26D, is a cinder surfaced highway but not up to the standard of the Federal Aid Seven Per Cent System.

Federal Aid Project No 26D covers 9.73 miles and was constructed as a standard gravel surfaced highway in 1921-22, but like Federal Aid Project No. 26B is in bad condition at present. The remaining distance of 49.57 miles to the Maricopa County line is known as Federal Aid Project No. 55. This project is divided into Sections 1 and 2. Section No. 1 was started in 1922 and completed in 1923 by contract. Section No. 2 was constructed by State forces in 1924. This is a standard gravel surfaced road in fine condition.

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### **Parker-Bouse Highway**

This highway, 19 miles in length, was constructed in 1921 and was gravel surfaced. It is not on the Federal Aid Seven Per Cent System.



## STATUS OF ARIZONA HIGHWAY SYSTEM

County	Total Miles	Graded & Drained	Selected G. Surfacing	Asphalt Paving	Concrete Paving	Under Construction	Unim- proved
Apache	145.226	31.650	50.570				63.000
Cochise	254.190		158.880	11.000	24.160	2.699	57.541
Coconino	115.500		81.520	1.100	.475	17.205	15.200
Gila	141.250		56.956		7.800	8.000	68.500
Graham	129.270	27.290	40.290	7.010	11.540	5.149	38.000
Greenlee	84.390	17.500	50.300				16.596
Maricopa	245.206	1.900	125.460	11.250	73.640	31.310	2.600
Mohave	143.358	41.106	49.188				53.070
Navajo	101.922	22.500	54.577	.950		1.395	22.500
Pima	99.820		82.560	3.000	13.940	.320	
Pinal	146.160	2.000	124.660	5.600	1.000	13.500	
Santa Cruz	79.650	1.750	67.210		3.090	7.000	
Yavapai	190.838	3.100	141.100		.700	12.880	33.058
Yuma	108.240	1.290	100.040				7.000
TOTALS	1984.408	149.090	1183.245	39.310	136.345	99.359	377.059

**CONSTRUCTION—RECAPITULATION**

County	Total Miles	Construction	Constructed 1923-1924	Incomplete & Unimproved
		Prior to Jan. 1, 1923		Nov. 30, 1924
Apache	145.220	62.250	19.970	63.000
Cochise	254.190	149.390	44.650	60.150
Coconino	115.500	56.520	26.575	32.405
Gila	141.250	40.450	24.300	76.500
Graham	129.270	46.320	39.810	43.140
Greenlee	84.390	67.800		16.590
Maricopa	245.200	121.050	90.240	33.910
Mohave	143.358	76.790	13.498	53.070
Navajo	101.922	67.002	11.025	23.895
Pima	99.820	98.690	.810	.320
Pinal	146.160	103.510	29.150	13.500
Santa Cruz	70.050	56.470	15.580	7.000
Yavapai	190.838	85.902	58.998	45.938
Yuma	108.240	56.640	44.600	7.000
<b>TOTALS</b>	<b>1984.408</b>	<b>1088.784</b>	<b>419.206</b>	<b>476.418</b>

During the period from January 1, 1923, until November 30, 1924, a total road mileage of 419.206 miles was constructed. This mileage includes the following: 378.726 miles of Selected Surfacing; 15.980 miles of asphalt paving; 24.500 miles of Portland Cement Concrete. Under incomplete and Unimproved, there is 99.359 miles under construction.



## Appreciation

### *To The Bureau of Public Roads*

I N behalf of the people of the State of Arizona, the Governor and the Board of Directors of State Institutions of the State of Arizona, and the Arizona Highway Department, I wish to express our appreciation of your efforts and fairness in your administration of Federal Aid cooperation in Arizona.

In the establishment and construction of a state highway system many complex and intricate problems arise, some of which involve the rights of the Nation, State and individuals, as well as the technical details of construction. In planning a system of Federal Aid Highways within a State, consideration must be given to its coordination with those of adjoining states, so that upon the completion of the Federal Highway System as a whole, each State's system will be a complete unit in that system, thereby unifying all of the State systems into one complete and connected National system. In all of this you have been manifestly fair.

The advent of Federal Cooperation to the States brought with it not only financial assistance to enable us to construct roads but also your insistence, for highways of higher standards. This has not only been beneficial to the State in Federal Aid Highways, but has reflected in the standard of all other construction in the State.

Your study of our local conditions, consultation and advice in our planning and construction, though much of it has been unofficial, has been invaluable to us.

## Federal Aid

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THE Federal Aid Act, passed by Congress in 1916, creating a Federal Bureau of Public Roads, under the Secretary of Agriculture, and making available Federal Funds for the assistance of the construction of main State highways in the several States, has done much to advance the standard as well as the construction of our highways. The act also provides that the several States are obligated for the proper and adequate maintenance of the highways so constructed.

Since the passage of the original act many revisions have been enacted, also many regulations have been made by the Secretary of Agriculture, affecting the administration of this act. One of the revisions was the creation of the Seven Per Cent Federal Highway System. Upon the completion of the Seven Per Cent Federal Highway System by the several States, they will coordinate into a connected system of Federal Highways of some 180,000 miles of highly improved trunk highways serving the entire Nation. Thus in assisting the several States to finance their individual systems, a National highway system is also being constructed.

### Provides Allotment Basis

The act provides a basis of allotment to the several States of appropriations made by Congress for such highway purposes, after deducting a sufficient amount for the administration of the act on the part of the Bureau of Public Roads. Of the present appropriation of \$75,000,000 per annum Arizona receives \$1,053,003 per annum. This amount is credited to Arizona.

The act further provides that the Government will participate in the construction of the highways on the basis of 50 per cent of the actual construction up to a total of \$30,000, per mile only, exclusive of structures over 20 feet clear span. In the Western, or public land States, however, an additional percentage of participation is added, based on the per cent of public lands in the state. Under



this provision, Arizona's participation on the cost of the construction is increased to approximately 61.11 per cent.

This however does not increase the allotment to the State nor to the maximum cost per mile upon which the participation is based. If the states do not use all of the appropriations within two years after its having been made available the balance unencumbered is withdrawn from the states allotment and apportioned to the other states on the same basis of their other apportionments.

### **Encumbering Methods**

Until a recent regulation by the Secretary of Agriculture these funds could be encumbered by the States by two processes. The first one is by the presentation of a Project Statement. This statement was a request for the approval of a section of highway, very briefly drawn up, and stating an approximate estimate. This required no detail and could be hurriedly and inexpensively presented. Upon its receipt and approval by the Secretary of Agriculture the amount of money requested was immediately deposited to that project and was considered encumbered, although nothing further might be done on the project for two years.

The second method was to follow the presentation of the Project Statement with a request for the approval, accompanied by the plans, specifications and estimates in detail.

This method termed Plans, Specifications and Estimates Submission requires the performance both in the field and in the office of all engineering work preliminary to construction. The approval obtained thereupon meant the approval of the construction in detail, and therefore a Project Agreement between the State officials and the Secretary of Agriculture was drawn up and jointly executed.

Upon the execution of this document an adjustment was made in the allotment to this project, using the agreement, with its estimate in detail, as the basis.

### **New Ruling Made**

By the first method, or that of the Project Statement, the States were enabled to tie up their allotments far in advance of their anticipated construction, at very little expense to them and thereby

hold their allotment over a much longer period of time than the act intended. Arizona, like many of the other States, took advantage of this provision. By a recent ruling of the Secretary of Agriculture, however, the Project Statement now includes an entire route, which may be covered by several Project Agreements later. It has only a general bearing upon the construction, and does not in any way encumber the funds.

Our only method of setting up the fund now is limited to the presentation of the Plans, Specifications and Estimates, and upon their approval, the execution of a Project Agreement. This means the completion on the part of the State of the surveys, plans and all details ready for the construction, all of which can not be carried out unless State money is available wholly or in part for the project.

Since the advent of Federal Aid Arizona has constructed many miles of Federal Aid Highways and has received \$5,458,534.14 in Federal Aid funds. The State has under Project Agreement for projects under construction and ready for construction \$851,428.81, and is now making surveys and preparing plans, specifications and estimates for the remaining \$1,185,738.05. of the total allotments to Arizona of \$7,495,701 including the allotment for 1925 of \$1,053,003.56.

Tabulations follow showing a recapitulation of the Federal Aid Funds to date, comprising Projects completed prior to January 1st, 1923, Projects completed during 1923 and 1924 and Federal Aid Projects under construction.



## FEDERAL AID PROJECTS UNDER CONSTRUCTION

F. A. No.	Name of	Type	Per cent Federal Aid		
			Length Complete	Received	
19—B	Prescott-Jerome	G. Surf.	3.976	80	\$ 33453.98
22	Winslow Coconino				
	County Line	G. Surf	2.720	63	5012.90
36—B	Prescott-Jerome				
	Underpass	G. Surf.	.028	30	None
40—Reo.	Holbrook-Winslow	G. Surf.	.500	23	None
55	Yuma-Phoenix	G. Surf.	49.570	99	151756.73
63	Geronimo-Solomonville	Asphalt	7.460	94	126433.84
67	Geronimo-Solomonville	Concrete	7.060	76	85043.87
69	Phoenix-Yuma	G. Surf.	21.820	98	58234.16
71	Phoenix-Yuma	Concrete	9.210	70	107867.53
74	Winslow-Flagstaff	G. Surf.	20.350	50	26738.25
72	Prescott-Phoenix	G. Surf.	18.840	73	83320.05
75	Tucson-Nogales Br.	Con. Br. & G. App.	.610	47	4874.55
76	Phoenix-Wickenburg	G. Surf.	7.010	74	25648.67
77	Solomonville-Duncan	G. Surf.	12.090	75	27064.51
					\$735,449.04

Under Federal Aid received we include \$94,184.48 that has been vouchered but not received from the government.

## FEDERAL AID PROJECTS COMPLETED 1923-1924

F. A. No.	Name of Project	Federal Aid Received
19—A	Prescott-Jerome Highway	\$ 43,393.97
20	Winslow Paving	24,488.97
23—A.C.E.F.	Florence-Superior Highway	124,699.37
25—B	Tucson-Nogales Bridges	22,134.01
36—A	Prescott-Jerome Highway	48,380.47
39	Topock-Oatman Highway	81,547.17
40	Holbrook-Winslow Highway	852,073.89
42	Holbrook St. Johns Highway	41,319.88
43	Geronimo-Solomonville Highway	99,553.20
48	Glendale-Marinette Highway	156,263.23
39	Nogales-Fairbanks Highway	62,732.29
51	Williams-Ash Fork Highway	12,819.27
53	Phoenix-Yuma Highway	95,962.83
56	Phoenix-Yuma Highway	42,793.59
57	Ash Fork-Seligman Highway	64,974.08
59	Phoenix-Wickenburg Highway	216,168.69
60	St. Johns-Springerville Highway	47,611.49
61	Prescott-Ash Fork Highway	129,287.15
62	Prescott-Ash Fork Highway	186,301.80
64	Phoenix-Yuma Highway	49,823.63
65	Mesa-Superior Highway	85,684.66
66	Tucson-Nogales Bridges	11,323.60
68—A	St. Johns-Springerville Highway	28,582.21
70	Phoenix-Wickenburg Highway	72,565.13
		\$1,820,884.58

## PROJECTS COMPLETED PRIOR TO JAN. 1, 1923

F. A. No.	Name of Project	Federal Aid Received
1	Florence Bridge	\$ 55,982.23
2	Phoenix-Tempe Highway	46,249.81
3	Holbrook-St. Johns Highway	13,990.46
5	Oatman-Goldroads Highway	33,517.64
6	Holbrook-St. Johns Highway	27,857.75
7	Mesa-Superior Highway	62,910.04
8	Tempe-Mesa Highway	103,209.54
9	Tucson-Florence Highway	58,009.00
10	Agua Fria Bridge	30,138.78
11	Bisbee-Douglas Highway	137,361.77
12	Prescott-Jerome Highway	37,260.00
13	Clifton-Franklin Highway	72,312.68
14	Douglas-Rodeo Highway	40,618.27
15	Globe-Geronimo Highway	87,657.38
16	Superior-Miami Highway	422,349.50
17	Prescott-Jerome Highway	99,539.16
18	Benson-Vail Highway	156,712.01
21	Flagstaff-Paving	24,205.97
23—B&D	Florence-Superior Highway	112,614.54
24	Flagstaff-Williams Highway	87,249.80
25—B	Tucson-Nogales Bridge	20,165.77
26	Yuma-Wellton Highway	73,922.16
27	Nogales-Fairbanks Highway	47,700.38
28	Ray-Superior Highway	29,204.09
29	Tucson-Nogales Highway	128,103.17
30	Phoenix-Tempe Highway	47,245.51
31	Wickenburg Bridge	34,816.38
33	Phoenix-Glendale Highway	124,763.45
37	Williams-Ash Fork Highway	30,606.77
38	Douglas-Rodeo Highway	80,301.76
44	Oatman-Goldroad Highway	5,557.29
46	Phoenix-Yuma Highway (Phoenix to Buckeye)	502,230.43
47	Mesa-Superior Highway	67,837.03
		<hr/>
		\$2,902,200.52

## RECAPITULATION

Total Federal Aid Appropriations (Inc. 1925)	\$7,495,701.00
Total Federal Aid Received	
Under Construction	\$ 735,449.04
Completed 1923-1924	1,820,884.58
Completed Prior to Jan. 1, 1923	2,902,200.52
	<hr/>
Balance Federal Aid	\$2,037,166.86
Federal Aid Allotted to Projects	851,428.81
	<hr/>
Federal Aid Available for New Projects	\$1,185,738.05





ARIZONA HIGHWAY DEPARTMENT  
FEDERAL AID 7% HIGHWAY SYSTEM

SCALE  
1:100,000

## THE SEVEN PERCENT SYSTEM

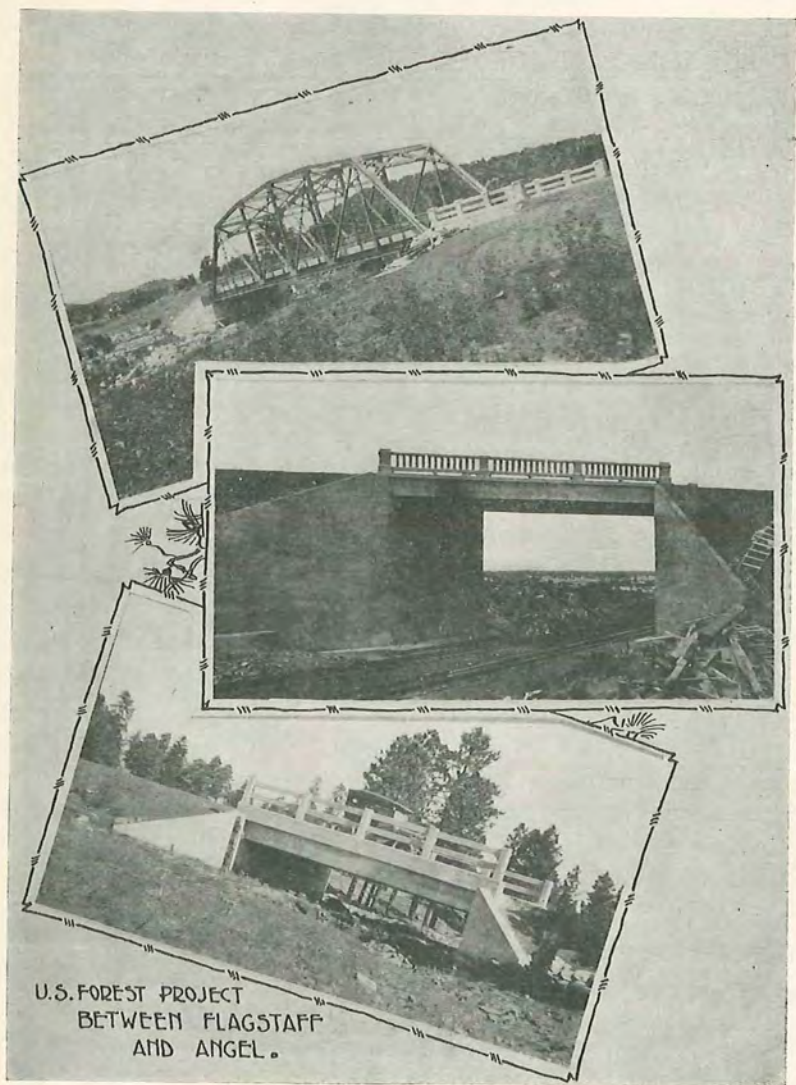
Following the passage of the Federal Aid Road Act by Congress in 1916, approval was given and Federal Aid applied by the Bureau of Public Roads upon any meritorious highway that was approved and requested by the State Engineer.. This proved to be entirely unsatisfactory as it was causing the construction of a disconnected group of highways, without the semblance of a main trunk highway system. The Act later was amended by Congress creating what is known as the Seven Per Cent System of Federal Highways.

This amendment provided that each State should determine the total mileage of all classes of roads within its confines. After such determination, the number of miles equal to seven per cent of the total mileage was taken, which amount would constitute the maximum mileage within the State upon which Federal Aid would participate. In addition to this, it was further provided that a main trunk system of State highways should be established to connect with the systems of adjoining States. It was provided that this system be approved by the Secretary of Agriculture.

Upon the adoption of this amendment, Arizona obtained the total of all classes of roads from each county, with the resultant total of 21,400 miles for roads of all classes within the State. Seven per cent of this total or 1,498 miles therefore constitutes the maximum mileage of the Federal Aid Highway System for Arizona and known as the Seven Per Cent System. Following this, a system of main trunk highways was outlined consisting of the 1498 miles, which not only serves this State as a main trunk highway system, but connects with New Mexico on the east at three points, and California on the west at two points.

No connections, however, are made with either Nevada on the northwest nor Utah on the northern boundary. A map showing the Seven Per Cent System together with the interstate connections, and the possible points of connection, is included herein. The system, as shown by the map, has been agreed upon and approved by the Secretary of Agriculture.





U.S. FOREST PROJECT  
BETWEEN FLAGSTAFF  
AND ANGEL.

## FOREST HIGHWAYS ON SYSTEM

The term Forest Highways used in connection with the Seven Per Cent System of Highways, has reference to those sections of the Seven Per Cent System lying within the forest reserves of the State and constructed by the Bureau of Public Roads from the Federal Forest Highway funds, or included in the Forest Highway Fund construction program.

In addition to the \$75,000,000 per annum as now appropriated by Congress for the Federal Aid Highways \$6,500,000 is appropriated for the construction of Forest Highways upon the forest reserve. Based on this apportionment Arizona receives \$216,507 per annum. This fund, however, is not limited to the Seven Per Cent System, nor to State highways, but may be expended in connection with the Counties upon County roads in or adjacent to forest reserves. In fact, a considerable amount of this fund is now being expended upon county forest roads in this State at the present time.

Although many miles of the Seven Per Cent System lie within the boundaries of the forest reserves in this State only two, though expensive, projects are financed from this Fund. These two projects aggregate 39.01 miles in length, The first comprises the Flagstaff-Angel project, 23.43 miles in length, or that section of the Flagstaff-Winslow highway beginning at Flagstaff and extending easterly to Angel, all in Coconino County. The second is the Prescott-White Spar Project, 15.58 miles in length, or that section of the Prescott-Phoenix Highway, beginning at Prescott and extending southwesterly to White Spar, all in Yavapai County.

Both projects are now under construction by the Bureau of Public Roads, financed from the Forest Highway Fund, and are expected to be completed during 1925.

## PRIMARY AND SECONDARY DIVISIONS

The amendment to the Federal Aid Road Act which provided for the establishment of the Seven Per Cent System also provided for the division of the system into primary and secondary systems. In making this division three-sevenths of the mileage of the Seven Per Cent System is to be designated as primary and four-sevenths of the mileage as secondary. After this designation not more than sixty



per cent of the allotment of the Federal Aid to the States may be expended upon the primary system until provision has been made for the improvement of the entire system, except with the special approval of State Officials and the Secretary of Agriculture.

Up to this writing this designation has not been made. This is due partly to the fact that the Secretary of Agriculture has not yet advised as to the standards of construction that will be required for the primary and secondary divisions, and partly to the fact that there is still some small differences of opinion existing between the State and the Bureau of Public Roads officials as to the part of the Seven Per Cent System that should be classed as primary.

There has been a slight apprehension felt by the Arizona Highway Department that should the standard for the primary system be established to an exceptionally high type, the finances of the State, that may be available for sections of this system, would not permit of its construction, thereby causing delays in the construction until more adequate finances were available, when a lesser type might serve the purpose for the present. In this event it might be necessary for the State to construct even a lower type at its sole expense, rather than allow the section to go entirely unimproved.

Efforts have and are being made, however, to designate the primary system. Tentative or suggestive outlines have been submitted by both the Highway Department and the Bureau of Public Roads, and have been discussed and approved in part until only a small mileage now remains in question. Final approval of any part of the primary system can not be given, however, until the entire mileage is agreed upon. Upon the approval of the Primary System the remainder of the Seven Per Cent System will be approved as the secondary system.

### STATE CONNECTIONS

It will be noted from the map of the Seven Per Cent System that there are three connections with the New Mexico Seven Per Cent System on the eastern Arizona Boundary, and two connections with the California State Seven Per Cent System on the west. Of the connections shown all, with the probable exception of one are permanent, and the highways are being constructed to these points,

with the exception of the connection with the California System at Topock.

Due to the impending development of the Colorado River, with the uncertainty of the ultimate locations and heights of the probable dams, and the areas that will be inundated, it is not deemed expedient, nor is it likely that the Bureau of Public Roads will grant its approval, to construct a section of highway that may be inundated by this development or affected by the necessary relocation, due to the probable inundation, or to effect another river crossing from the one now at Topock. It is not probable, however, that such a change due to such a cause would be classed as a change of the Per Cent System, but would be a relocation, unless it would prove to be impractical to effect a satisfactory connection with either California or Nevada in this vicinity.

Another point that is worthy of attention is the extension of the Utah Seven Per Cent System to a point just north of the north boundary of Arizona near Fredonia. This is also shown on the map of the Seven Per Cent System. From the end of Utah's system, as shown, the Forest and Park Services of the Government have done considerable construction work, and are still working on a road south into Arizona and through Fredonia to the north rim of the Grand Canyon. This highway is on the Park to Park Highway which comes due south from Salt Lake City, and which is receiving a rapidly increasing traffic. The branch of the Seven Per Cent System of Utah that extends to Kanab, just north of Fredonia, may be noted on the map to connect with the Arrow Head Trail which crosses the extreme northwestern corner of Arizona. While it is not possible to extend the Seven Per Cent System from Flagstaff north via Lees Ferry to Fredonia, due to insufficient mileage, this connection however, is worthy of consideration as a part of the State Highway System.

### STATUS OF SEVEN PER CENT SYSTEM

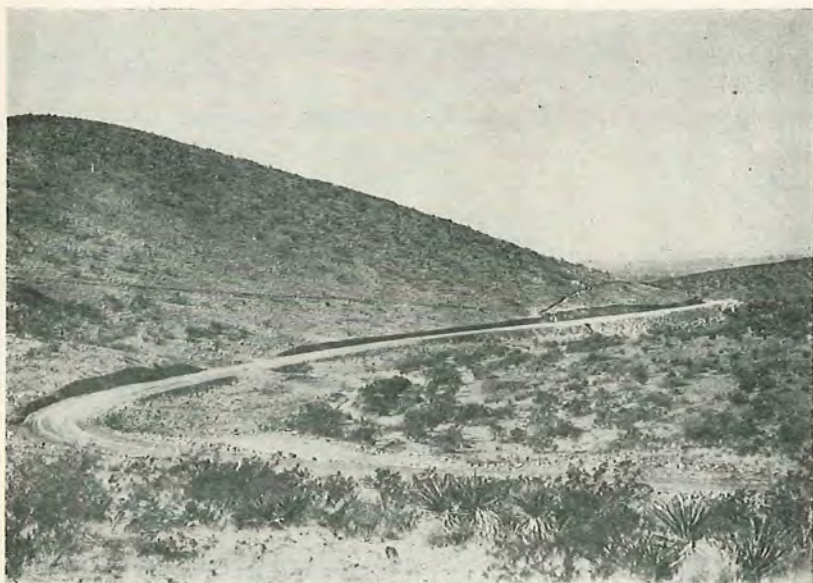
The detailed status of the Seven Per Cent System is included in the description of the status of the State Highway System, but a tabulation of the Status of the Seven Per Cent System of Arizona is made a part hereof.

At the time of the establishment of the Seven Per Cent System



within the State the mileage of the roads as they were then traveled was naturally used as the basis. Due to relocation for construction to a higher standard of highways to serve the traffic requirements, the resultant mileage was less than the mileage used in many instances. This fact, together with the fact that the mileage through the incorporated cities and towns which, due to limitations of the Federal Aid Road Act are ineligible to be included in Federal Aid Projects, the system as outlined now consists of 1,452.708 miles, thus leaving 45.292 miles unapplied. This may be largely taken up however in relocations yet to be made, additional mileage in towns and the like.

#### SOLOMONVILLE-DUNCAN HIGHWAY



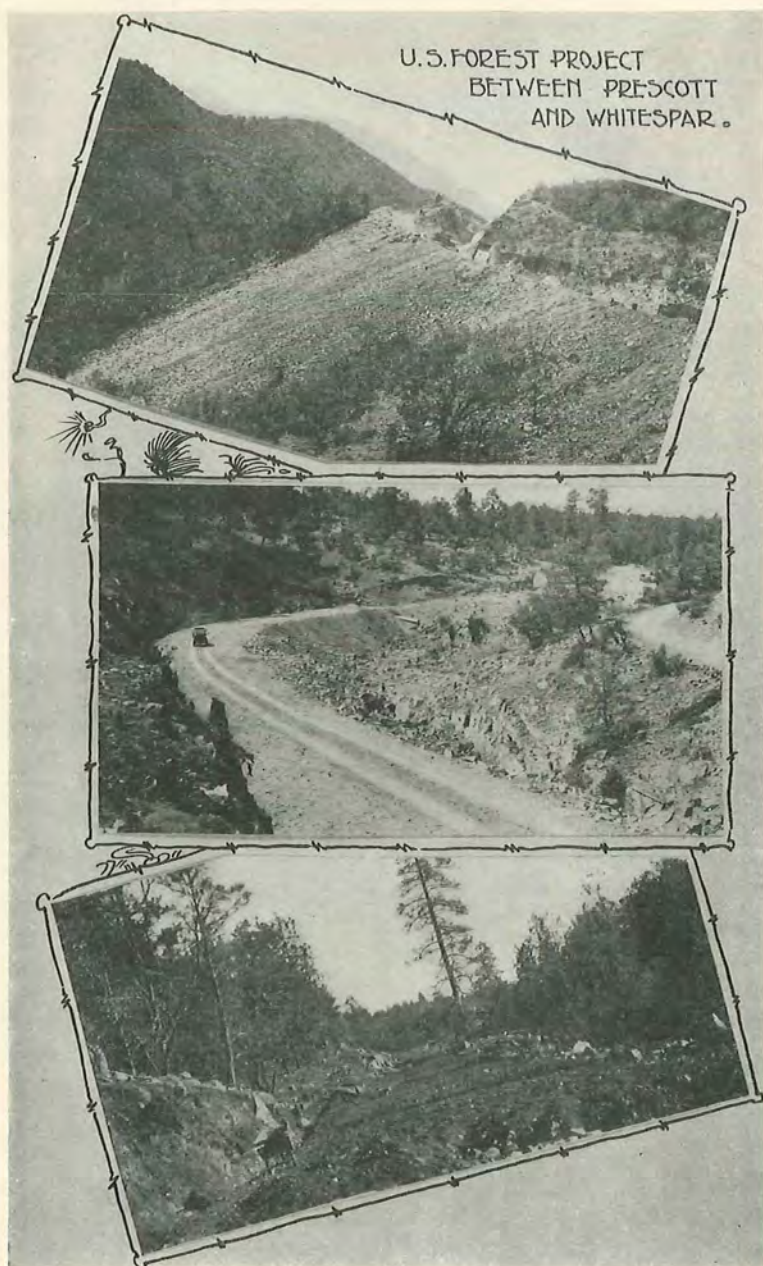
FEDERAL AID PROJECT NO. 77—STATE CONSTRUCTION

### STATUS OF SEVEN PER CENT SYSTEM OF ARIZONA

County	Total Miles	Forest Roads Miles	Gravel Surfaced Miles	Asphalt Pavement Miles	Concrete Pavement Miles	Total Improved Miles	Under Construct'n Miles	Under P.S.&P.A. Miles	Future De- velopment Miles	Total Unimp. Miles
Apache	145.220		50.570			50.570		35.650	59.000	94.650
Cochise	136.896		66.430	11.000	24.166	101.590		7.000	28.300	35.300
Coconino	115.500	23.430	48.820	1.100	.475	50.395	17.205	15.200	32.700	65.105
Gila	45.950		32.650		7.800	40.450			5.500	5.500
Graham	87.570		14.090	7.010	11.546	32.640	5.140		49.790	54.930
Greenlee	15.990								15.990	15.990
Maricopa	200.400		97.100	11.250	73.640	181.900	14.810		3.600	18.410
Mohave	130.658		37.248			37.248			93.410	93.410
Navajo	79.422		47.977	.950		48.927	1.395		29.106	30.495
Pima	99.826		47.130	3.000	13.940	64.070	.320	13.500	21.930	35.750
Pinal	112.260		104.260	5.006	1.000	110.260			2.000	2.000
Santa Cruz	29.750		24.910		3.090	28.000			1.750	1.750
Yavapai	164.038	15.580	83.400		.700	84.100	12.880	9.038	58.620	79.938
Yuma	89.240		68.040			68.040			21.200	21.200
<b>TOTALS</b>	<b>1452.708</b>	<b>39.010</b>	<b>722.625</b>	<b>39.310</b>	<b>136.345</b>	<b>898.280</b>	<b>51.750</b>	<b>80.388</b>	<b>422.290</b>	<b>554.428</b>

The approved mileage of the Seven Per Cent System in Arizona is 1,498 miles but due to line changes and the mileage through the incorporated cities, the mileage of the roads that comprised the System were shortened to the above figures of 1452.708 miles, thereby leaving 45.292 miles yet to be applied.





## Forest Highways

THE Forest Highways are not confined to the Seven Per Cent System, nor to the State System, but may be in connection with a county road, or purely a Forest road, but must be upon a Forest Reserve or adjacent thereto. There is a total of 862 miles of such highways in Arizona.

The Seven Per Cent System of Arizona includes 140 miles of Forest highways. Of this amount the State has constructed 74.5 miles without Forest Aid, but did receive Federal Aid in the same manner as on other roads of the system. Thirty-nine miles are now under

### PHOENIX-PRESCOTT HIGHWAY



BRIDGE ACROSS THE HASSAYAMPA RIVER

construction by the Bureau of Public Roads entirely from Federal Funds. The remaining 27 miles are somewhat improved and in fair condition, but are not up to standard.

As the Forest Highways are involved to some extent in the State Highway System it is desired to include such data in this report. The expenditures, therefore the records, being under the jurisdiction of Federal Agencies, mainly the Bureau of Public Roads, they were requested to furnish us with the status of this highway system and the funds involved. This they have kindly done and a letter from Mr. E. S. Wheeler, District Engineer of the Bureau of Public Roads, accompanied by the necessary tabulations follow:



## UNITED STATES DEPARTMENT OF AGRICULTURE

Bureau of Public Roads

District No. 13

File No. 486 Arizona General

January 2, 1925

Phoenix, Arizona.

Arizona Highway Department,

Phoenix, Arizona.

Attention: Mr. W. W. Lane

Gentlemen:

In compliance with your request of December 29, we are enclosing tabulations showing Status of Forest Roads on Federal Highway System and Status of All Forest Highways in Arizona.

We regret that at the present time we cannot furnish the contemplated 1925-26 program, since this matter is dependent upon a triangular conference between your department, the District Forester, and the Bureau, to be held in January.

It is also impossible to furnish a statement showing total funds expended and available for Forest Road Construction, since we have had no reports from the Forestry showing Forest Development expenditures. We are forwarding a statement showing total expenditures, including cooperation and contractual obligations on projects handled by the Bureau. As noted, all Forest Highway Funds, including Fiscal Year 1925, are expended or obligated, excepting a contingent fund of \$13,287.00.

Very truly yours,

(Signed) E. S. WHEELER,

District Engineer.

**UNITED STATES DEPARTMENT OF AGRICULTURE  
BUREAU OF PUBLIC ROADS**

District No. 13  
Phoenix, Arizona

December 31, 1924

**STATUS OF FOREST ROADS ON FEDERAL HIGHWAY SYSTEM  
ARIZONA**

Project	Length	Miles completed 1-1-23	Miles completed 1923-24	Under Construction Miles	% Completed
Ash Fork-Flagstaff-Angel	(a) 75	23.85	0	23.44	(1)48
Prescott-Ash Fork	22.40	0	22.70	0	
Prescott-White Spar	15.58	0	0	15.58	55
Superior-Miami	(a) 28	18	10	0	
Totals	140.28	41.85	32.70	39.02	

(a) Programmed length.

(1) Stage construction, structure 100% complete, grading 80% complete.

**U. S. DEPARTMENT OF AGRICULTURE  
BUREAU OF PUBLIC ROADS**

District No. 13

Phoenix, Arizona

TOTAL FUNDS EXPENDED OR UNDER CONTRACTUAL OBLIGATION BY BUREAU OF PUBLIC ROADS ON FOREST HIGHWAY SYSTEM (including co-operation).

Project	Expended
Flagstaff-Angel	\$ 199,771.00
Prescott-White Spar	564,783.00
Oak Creek	45,645.00
Salt River-Pleasant Valley	298,489.00
Salt River Bridge	48,433.00
Snowflake-Pinetop	116,320.00
Clifton-Springerville	862,788.00
Young-Holbrook (Survey)	26,202.00
Camp Verde-Fossil Creek (Survey)	12,661.00
Strawberry-Fossil Creek (Survey)	9,703.00
TOTAL	\$2,184,195.00

**FUNDS EXPENDED ON PROJECTS NOT INCLUDED IN FOREST HIGHWAY  
SYSTEM**

Apache Camp-Soldier Camp	\$ 73,574.00
Oracle-Apache Camp	185,373.00
Jacobson Canyon (S. P. E.)	10,122.00
TOTAL	\$ 269,069.00

All Forest Highway funds are now obligated with the exception of contingent in the amount of \$13,287.00



**UNITED STATES DEPARTMENT OF AGRICULTURE  
BUREAU OF PUBLIC ROADS**

District No. 13  
Phoenix, Arizona

**STATUS OF ALL FOREST HIGHWAYS IN ARIZONA**

December 31, 1924

Project	Length	Miles Completed 1-1-23	Miles Completed 1923-24	Under Construction Miles	% Completed	Miles Unimp.	Miles Forest Funds	Miles Other Funds
Ash Fork-Flagstaff-Angel	(a) 75	23.85	0	23.44	48	27.71	23.44	23.85
Prescott-White Spar	15.58	0	0	15.58	55	0	15.58	0
Prescott-Ash Fork	22.70	0	22.70	0		0	0	22.70
Superior-Miami	(a) 28	18	10	0		0	0	28
Maine-Grand Canyon	(a) 60	0	0	0		60	0	0
Williams-Grand Canyon Jet.	(a) 25	0	0	0		25	0	0
Fredonia-Grand Canyon	(a) 70	0	0	0		70	0	0
Seligman-Prescott	(a) 30	0	0	0		30	0	0
Oak Creek	(a) 60	34.8	0	0		25.2	2.86	31.94
Clarkdale-Globe	(a) 150.0	89	0	(1) 38.4		23	0	127.0
Payson-Holbrook	(a) 70	0	0	0		70	0	0
Salt River-Pleasant Valley	55	26.09	8.29	16.52	50	4.1	32.04	18.86
Salt River Bridge	.04	.64	0	0		0	.02	.02
Roosevelt Dam-Goldfield	(a) 30	30	0	0		0	0	30.
Globe-Ray	(a) 12	0	0	0		12	0	0
Snowflake-Pinetop	37.72	37.72	0	0		0	28.02	9.70
Clifton-Springerville	89.82	33.32	38.75	17.75	7	0	56.50	33.32
Alpine-Reserve	7	0	7	0		0	7	0
Solomonville-Willecox	(a) 18	0	0	0		18	0	0
Mule Creek	(a) 6	6	0	0		0	0	6
Totals	861.86	298.82	86.74	111.23		365.01	165.46	331.39

(a) Programmed length.

(1) Estimated work under construction Yavapai & Gila Counties—Distance approximate.

# *An Arizona Paving Project*

GERONIMO-SOLOMONVILLE HIGHWAY



PREPARING SUBGRADE FOR PAVEMENT



FINISHING CONCRETE PAVEMENT



## The First Road Builder

**T**HE man who was first to take from the trail  
Made only by plodding feet,  
A rock or a root that had hurt his foot  
Performed a marvelous feat.

**H**E never did know when he stubbed his toe,  
The service he did for man,  
By moving a rock or a stumbling block.  
His was a road building plan.

**O**F course this man's work was crude at its best,  
But he gave to man the first road;  
And though he knew naught the deed he had wrought,  
For man he lightened the load.

**S**O as you ride to-day o'er a paved highway  
Thank the man that stubbed his toe.  
Had he done naught but talk we still would walk  
Like men who lived long ago.

—IRA L. WOOD.



## Engineering Department

W. W. Lane, Chief Engineer

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THE Engineering Department of the Arizona Highway Department, under the direction of the Chief Engineer, has jurisdiction over all engineering work of the Highway Department. Its work consists of the location and surveys of proposed highways, the making of all designs; the preparation of plans, specifications and estimates; the preparing and advertising of contracts; the testing of materials, the collecting and tabulation of statistics; the custody of records; and the supervision of all engineering work of the highways of the State System.

All preliminary and location surveys necessary for the design and preparation of plans, estimates and the like are under the direct supervision of a chief location engineer, whose duties are to make the necessary reconnaissance surveys; to direct and supervise the location of the highways; to direct the operation and methods of the several location survey parties, thereby standardizing the locations and methods; and to make final check upon location, gradient, drainage and the like.

Upon Construction, the engineering work is under the direct supervision of the district engineers within their respective districts, or the paving engineer, as the case may be, with the aid of resident or project engineers. Upon all highway contract work, in addition to the engineering work and inspection, the Engineering Department has supervision over the compliance of the terms of the contract on the part of the contractors.

Upon construction work done by State forces on Federal Aid Projects, bridge work and other highway construction, work deemed of sufficient importance to require engineering supervision, the engineering work and inspection is carried out in the same manner as upon contract, work without jurisdiction over the construction forces other than as to the compliance of the specifications.



This department, through the direct supervision of the district engineers and the paving engineer, has supervision as to requirements and methods of the maintenance of the State highway System.

The Engineering Department is further divided into sub departments for the purpose of more systematic handling of the office engineering. The sub divisions include the bridge department, testing department, estimating department, department of plans, statistical department, right of way department, filing department and blue print department. The duties of these sub departments are described in detail under their respective heading. The Blue Print Department activities, however, are included in the statement of the General Office Stock Room.

It is the further duty of the Chief Engineer to prepare, transmit or receive all documents required of the State in the execution of the Federal Aid Road Act; to handle all communications with the Bureau of Public Roads and do all work necessary or expedient to the carrying on of Federal Aid in Arizona, insofar as it pertains to the State Highways. The Chief Engineer also maintains a status of all Federal Aid work and funds; prepares and transmits vouchers for Federal Aid monies as earned; and is the custodian of all Federal Aid records.

It is incumbent upon the Chief Engineer to budget the receipts and resources of the Highway Department to the projects and sub departments through the medium of the "Authority For Expenditure", which is described in the statement of the Chief Clerk in this report.



## BRIDGE DEPARTMENT

**R. A. HOFFMAN, Bridge Engineer**

The Bridge Department has come to be an important factor of the Arizona State Highway Department. The volume of work turned out now requires the services of three Engineers, all of whom are registered under the laws of the State Board of Registration.

The chief duty assigned to the Bridge Department is the preparation of plans for bridges and other structures. The work involved is more or less of a routine for each structure. First comes the inspection of the site with the idea of selecting the proper type and obtaining such general information as may be of value, in addition to that furnished by the location party. Then follow in regular order, the design drawings, stress sheets, details, tracings, quantity computations, and a thorough checking of the completed work.

A complete list of reinforcing steel for all structures on a project is furnished the resident engineer. Such a list is also furnished to the purchasing agent for buying the steel in the exact lengths required, and in the majority of cases, it is necessary for this department to issue the requisitions authorizing the purchase of such materials,—when furnished by the State,—in order to eliminate delay.

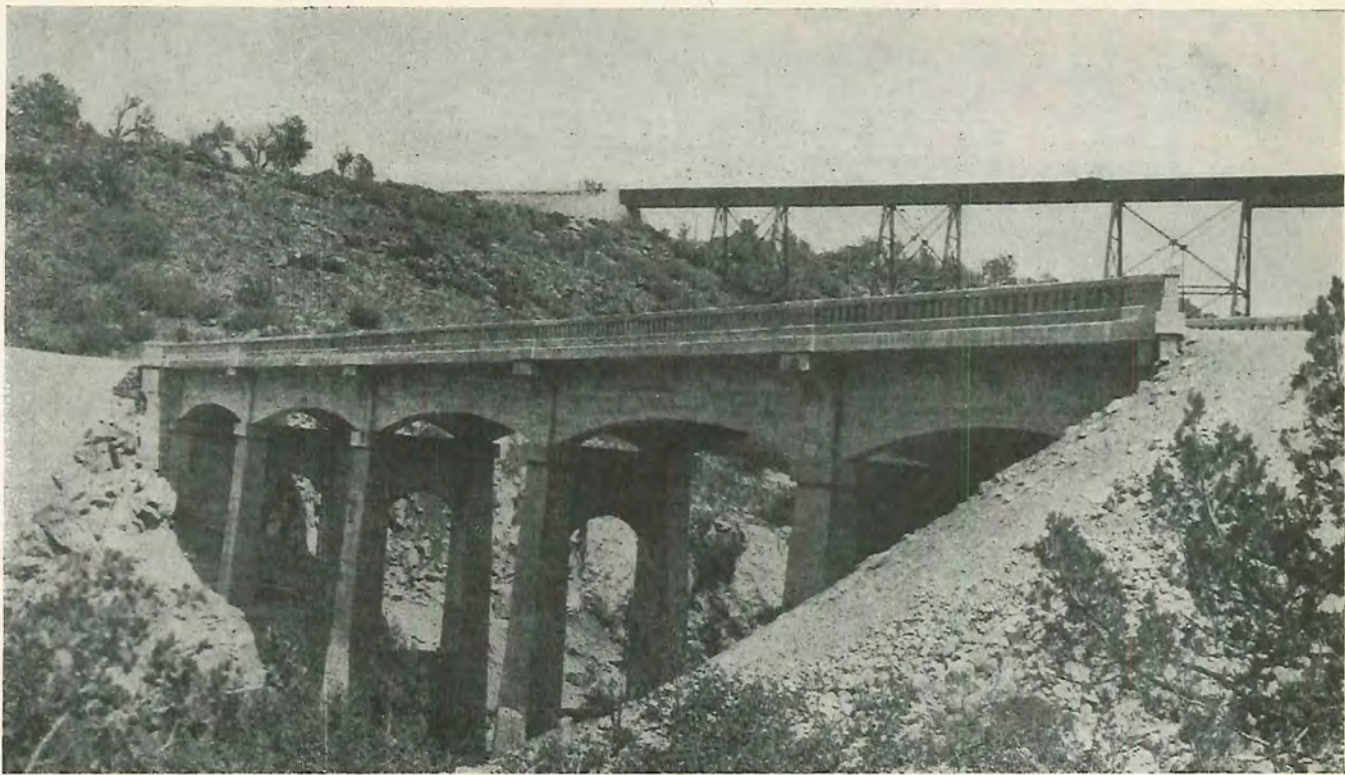
Other duties include the inspection of construction, the checking of and approving of orders for additional work, and the checking of all construction reports on structures.

### Design

The aim of those connected with this department, in the past two years, has been economy in design. A former policy of the use of mass sections and excess materials has been discarded in favor of lighter sections with more reinforcement and less concrete, resulting in an appreciable saving. A greater number of special designs have been prepared, especially for structures consisting of spans of 20 to 40 feet.

Structural Design is governed largely by the class of road on which the bridge is located. There are three such classes of State roads in Arizona, namely the primary and secondary Highways of





HELL CANYON BRIDGE—FEDERAL AID PROJECT NO. 62

the Seven Per Cent Federal Aid System and the non-Federal Aid State roads. Up to the present time, however, only two types of design have been used, as no distinction has been made between the two classes of Federal Aid Highways.

In addition to the dead weight of the structure itself, the following live loads have been adopted for Federal Aid work: For concrete bridges, a uniform load of 125 pounds per square foot or two 15-ton trucks plus an impact factor of 30 per cent: for steel bridges a uniform load varying from 64 to 80 pounds per square foot plus 30 per cent impact or two 15-ton trucks plus 30 per cent impact.

The load giving the greatest stress on the member is used. The member resulting from such calculations, often seems large as compared with similar members on some of our older bridges, but a thorough inspection of these old bridges will usually show the destructive action of modern traffic on light bridges. Highway loads have increased rapidly in the last ten years and we cannot be certain that the limit has been reached, unless regulation is provided by legislation.

The new specifications recently adopted by the American Association of State Highway Officials and approved by the Bureau of Public Roads will be a decided benefit in standardizing the loads and the method of their application. These specifications have been prepared by some of the foremost designing engineers and there is little likelihood that there will be any hesitancy in their adoption by this State.

### **Special Plans**

During this biennium, 40 special bridges have been completed or are under construction from special plans prepared by this department. Of these bridges, 10 are steel trusses, four are reinforced concrete arches, and the remaining 26 are of the slab or girder type. The estimated cost of these structures, without engineering charges, is about \$510,000. The expense, to the State, of preparing these special plans has been so small as to be almost negligible, being less than one and one-half per cent as compared with the usual two and one-half per cent fee charged by engineering firms for similar work. In addition to the special structures listed in the table in-



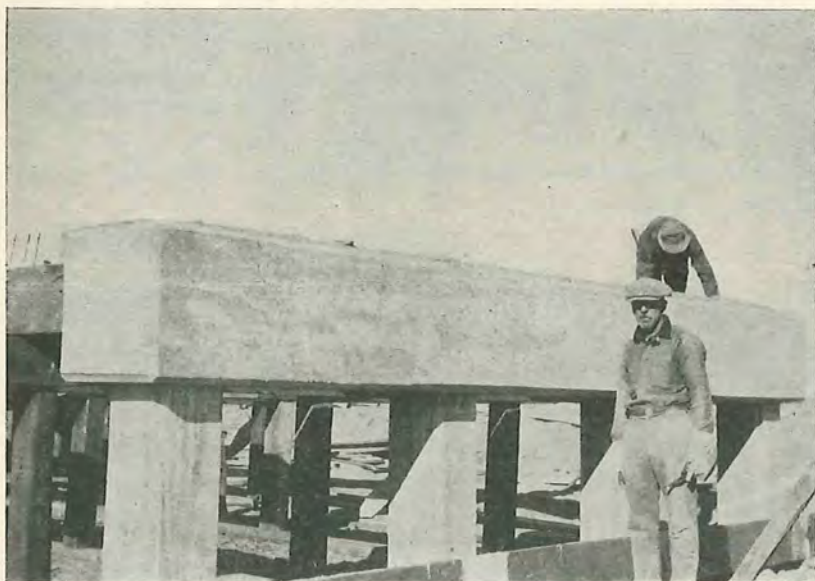
cluded in this report there have been innumerable special plans and alterations of standard plans, for culverts and small bridges, made to fit specific locations.

### New Types

Among the special design bridges listed are types (of design) which are new in this State, such as the Concrete Pile Trestle, the Overflow Bridge, and the tied U-Abutment.

The Concrete Pile Trestle is a type which is adapted to some of the Arizona streams. Two such bridges are now under construction; one at Joseph City, Federal Aid Project No. 40; and the other at Continental, Federal Aid Project No. 75. Where no suitable foundation material is found within reasonable depth, as was the case in the two jobs mentioned, it is often possible to drive concrete pile bents. After thorough investigation at each of these sites, it was proven that the concrete pile trestle was the most economical type of permanent structure to build.

#### CONCRETE PILE BENT



NEAR CONTINENTAL, ARIZONA

## APACHE TRAIL



73-FOOT LOW TRUSS OVER FISH CREEK

Some difficulty was encountered on the Continental job due to the lack of experience of the first contractor and his failure to provide proper equipment. The work is now in the hands of a competent contractor. All the piles are driven and the work is progressing satisfactorily. It is expected that the job will be completed without further delay. The contract price on the Joseph City bridge was higher than the other, owing to the location and the scarcity of local materials, but a considerable saving was shown in the selection of the trestle, as the alternate proposal bid received for a steel bridge was approximately \$6,300 higher than the accepted bid on the trestle.

The Overflow Bridge built near Pima, on the Geronimo- Solomonville Highway, was designed as a combination low bridge and ford to accommodate an unusual flood condition. It is estimated that it would have required a 180 foot bridge at a cost of 50 per cent more to accomplish the same purpose as this 80 foot bridge which will pass the ordinary flood waters. The contract price of the com-



pleted structure was \$21,131.40 which should be divided as follows: bridge \$7,370.85 and concrete overflow approaches \$13,760.55.

The U-Abutment has been introduced for abutments of extreme height. Because of the small footing area required in comparison to the height, the type has been used economically on high abutments with pile foundations. Three of the latter are under construction and a fourth on steel cylinders. The locations are as follows: San Simon at Safford; Continental; Joseph City; and Kirkland Creek on Federal Aid Project No. 72-A.

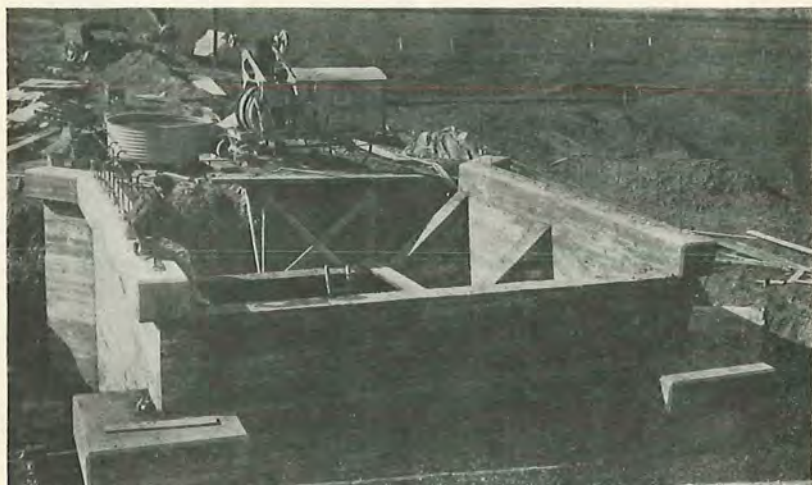
The San Simon Bridge abutment was changed to the U-type during construction. The original design was for spread footings on clay, as reported by the location, but the clay was found to exist only in large pockets. Timber pile foundations were deemed necessary and consequently it was desired to reduce the area of the base to a minimum. The solution was the use of the U-Abutment. A satisfactory agreement was reached with the contractor and these difficult footings were placed by a special crew of State forces

#### GERONIMO-SOLOMONVILLE HIGHWAY



OVERFLOW BRIDGE

## SAN SIMON BRIDGE



"U" ABUTMENT

with State equipment, at a considerable saving. The actual cost over the original was \$991.62.

The Hell Canyon Bridge on the Prescott-Ash Fork Highway is another bridge worthy of special mention. The original design, completed and under contract when the department was taken over by this Administration, was for a 154 foot open spandrel arch on solid rock foundation. A showing of rock on the surface at the south abutment was found to be a boulder slide of large dimensions and unsatisfactory for the foundation of an arch of this size. A series of two girder deck spans—two 40 feet and three 50 feet—on high piers, was the most economical solution, using most of the steel purchased for the original arch. This high trestle has a very pleasing effect, with the arched girders on the high, slightly tapered piers. It was completed at approximately the same contract price as was bid for the arch and compares favorably with it, in every respect.

### Standards

New standard plans for various structures have been prepared and old ones revised in the interest of economy and advanced requirements. Some of the new ones include a set of 17 sizes of rein-



# TABULATION OF SPECIAL BRIDGES

## 1. Federal Aid Projects

Name or Location of Bridge	Highway	Fed. Aid Project	Structure	Length	Actual or Estimated Cost Without Engineering	Status
Queen Creek	Florence-Superior	23-E	4-36' R. C. Girder	153'-9"	23,125.60	Complete
Joseph City	Holbrook-Winslow	40-Reo	3-34' R. C. Girder	108'	16,373.65	Under Const.
New River	Glendale-Marinette	48	6-60' R. C. Thru Girder	360'	46,185.15	Complete
Near Mohawk	Phoenix-Yuma	55-1	2-16' R. C. Slabs	55'	6,307.08	Complete
Canal Bridge	Phoenix-Yuma	56	2-20' R. C. Slabs	44'-6"	4,160.00	Complete
San Domingo	Wickenburg-Hot Springs	59	1-65' R. C. Arch	75'	9,011.93	Complete
Chino Wash	Prescott-Ash Fork	61	6-30' R. C. Girder	207'-5"	13,480.00	Complete
Verde River	Prescott-Ash Fork	61	1-100' R. C. Arch	127'	18,380.90	Complete
Willow Creek	Prescott-Ash Fork	61	1-100' R. C. Arch	110'	12,374.66	Complete
Little Hell Canyon	Prescott-Ash Fork	62	2-80' Steel Deck Truss	174'-2"	25,851.76	Complete
Hell Canyon	Prescott-Ash Fork	62	(2-40' & 3-50' ) (R. C. Arch Girder )	230'	34,165.54	Complete
Overhead R. R. Crossing	Prescott-Ash Fork	62-B	3-32 R. C. Girder	102'	30,403.65	Plans Comp.
Cottonwood Wash	Geronimo-Solomonville	63	(7-12' R. C. Slab ) (Comb. Bridge & Ford)	92'-8"	7,370.85)* 13,760.55)**	Complete Complete
Eastern Canal	Mesa-Superior	65	R. C. Slab Skew	22'-3"	3,124.61	Complete
San Simon	Geronimo-Solomonville	67	Steel Low Truss	109'	20,945.40	Under Const.
Drainage Canal	Geronimo-Solomonville	67	R. C. Girder	26'	2,789.64	Complete
Drainage Canal	Geronimo-Solomonville	67	2-16' R. C. Slabs	36'-6"	4,305.52	Complete
Springerville	St. Johns-Springerville	68-B	2-30' R. C. Girder	64'	8,930.70	Plans Comp.
Agua Fria	Phoenix-Wickenburg	70	4-30' R. C. Girder	128'	10,209.82	Complete
Kirkland Creek	Prescott-Phoenix	72-A	4-38' R. C. Girder	160'	31,348.02	Under Const.
Martinez Wash	Prescott-Phoenix	72-B	(2-32' & 2-36' ) (R. C. Girder )	144'	18,206.25	Plans Comp.
Tucker's Flat	Flagstaff-Winslow	74	2-30' R. C. Girder	64'	7,230.10	Under Const.
Burro Canyon	Flagstaff-Winslow	74	1-30' R. C. Girder	32'	4,645.10	Under Const.
Continental	Tucson-Nogales	75	4-30' R. C. Girder	128'	12,702.80	Under Const.
Nadaburg	Phoenix-Wickenburg	76	2-34' R. C. Girder	72'	5,246.48	Complete
Hot Springs Junction	Phoenix-Wickenburg	76	3-30' R. C. Girder	96'	5,589.32	Complete

\* Bridge

\*\* Ford

## 2. Non Federal Aid Projects

Sanders	Adamana-Lupton	Non F. A.	(2-20' Approaches (2-75' Steel Low (Truss	) 191'-4''	17,200.44	Complete
Allentown	Adamana-Lupton	Non F. A.	(2-20' Approaches (136' Steel Deck (Truss	) 170'	12,388.08	Complete
Lupton	Adamana-Lupton		(1-26' Approach (60' Steel Low (Truss	) 80'	6,782.80	Complete
Patagonia	Nogales-Fairbank	Non F. A.	(120' Steel Thru (Truss (2-24' R. C. Slabs	) 173'	16,071.10	Complete
Arlington	Phoenix-Yuma	Non F. A.	2-90' Steel Low Truss	186'	24,656.40	Complete
Ash Creek	Apache Trail	Non F. A.	60' Steel Low Truss	64'	5,449.97	Complete
Fish Creek	Apache Trail	Non F. A.	73'-6'' Steel Low Truss	77'-6''	5,207.45	Complete
Lewis & Pranty Cr.	Apache Trail	Non F. A.	55'-6'' Steel Low Truss	59'-6''	3,573.92	Complete
Wash	Apache Trail	Non F. A.	29' I Beam	32'	2,253.17	Complete
Willow Creek	Apache Trail	Non F. A.	160' Steel Thru Truss (20' Approach	) 182'-9''	13,000.00	Plans Comp.



forced concrete box culverts, a steel rail cattle guard, and a wire guard fence. A set of 4- girder reinforced concrete decks, ranging in span from 20 feet to 40 feet, have been worked up and are being used in the place of the old 3-girder standard which has become obsolete. These new spans, although designed for heavier loads than the old, are more economical in materials and have been used exclusively in the past two years where such spans were required.

#### TYPICAL 4-GIRDER BRIDGE



FOUR 30-FOOT SPANS NEAR MARINETTE

#### Proposed Work

The accomplishments of the Department, in the past two years, have been very gratifying to the members and the future looks bright with new and interesting work of greater dimension. A bridge over the Gila River near the Gillespie Dam is practically assured. This bridge will be a Federal Aid Project costing approximately \$300,000. The moving of the San Carlos Bridge on the Gila River to a point above the new dam and the proposed bridges on the Colorado River are other interesting projects.

Repairs are contemplated on the Tempe Bridge, chiefly in replacing the expansion joints. A paint crew is being sent out, with an air brush outfit, to paint all of the old steel bridges which are badly in need of such work. The first of these will be the San Carlos Bridges.

## LABORATORY

**BENJ. A. McNELLY, Testing Engineer**

The rapid development of the Highway, the vast amount of money invested and the extremely severe duty required of them, has rendered science an essential factor in their construction and maintenance.

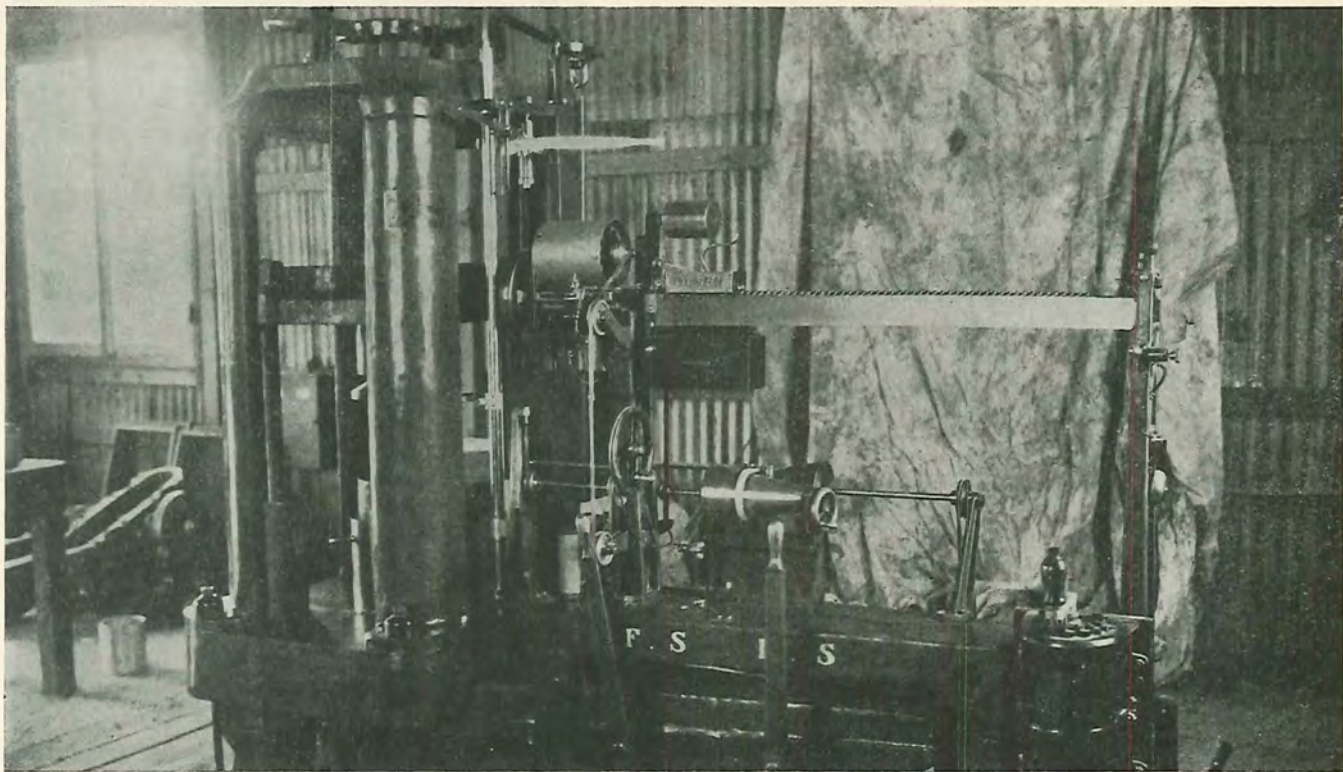
Through the medium of the testing of materials as aggregates and after their fabrication, and the conducting of scientific research into the foundation, methods and effects, a safeguard of the investment and an insurance of the durability of the highway for the duty it is designed, are obtained. This is done at a cost that is infinitesimal when compared to the investments safeguarded.

The laboratory of the department in the basement of the administration building is one of the best equipped laboratories west of the Mississippi River for the testing of road materials, steel, lubricating oils and gasoline.

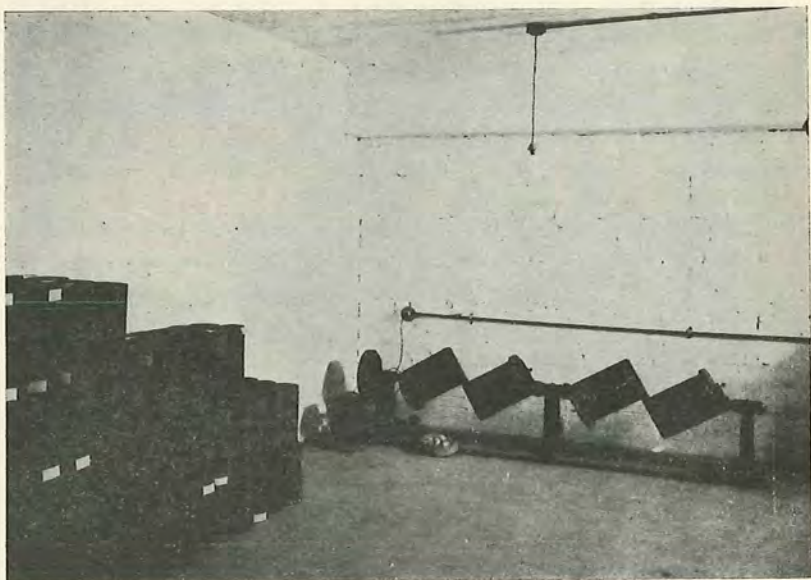
### LABORATORY OFFICE







OLSEN UNIVERSAL TESTING MACHINE—200,000 POUND CAPACITY



STANDARD ABRASION MACHINE

In the testing of steel and in the compression test on concrete, an Olsen Universal Testing Machine with an automatic beam, with a capacity of 200,000 pounds and a direct motor drive, is employed.

In the sand and cement tests the department uses two Tyler Rotap Sieve Shakers with Stop-Rite time switches, for grading in small aggregate; a complete set of sieves, screens and molds; two Vicat Needles for determining the set on cement, and two Fairbanks Tensile Strength Machines for the briquettes of sand and cement.

### Gravel and Rock Tests

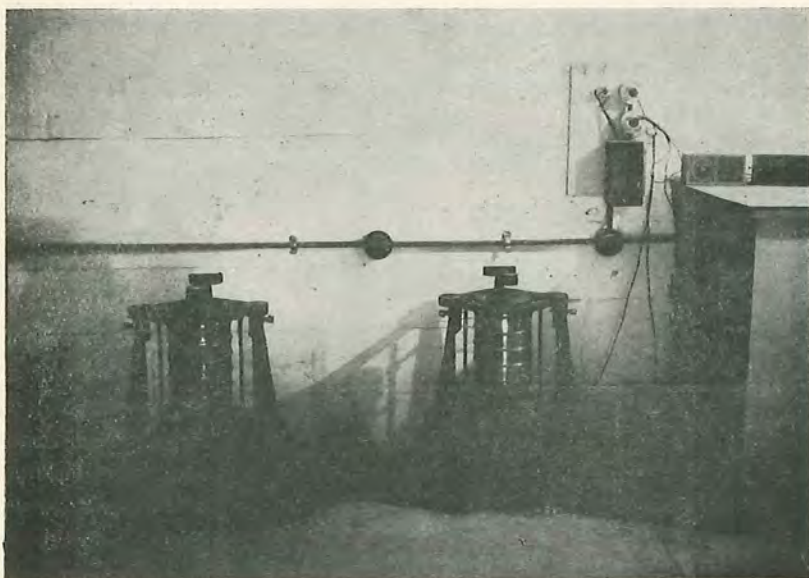
In its tests of gravel and crushed rock, the department uses a Dorry Harness Testing Machine, an Olsen Standard Diamond Core Drill, an Olsen Combined Diamond Saw and Grinding Lap, an Olsen Standard Impact Tester and an Olsen Standard 4-Gang Abrasion Machine. With these machines the toughness, hardness and the percentage of wear of gravel and crushed rock can be determined.



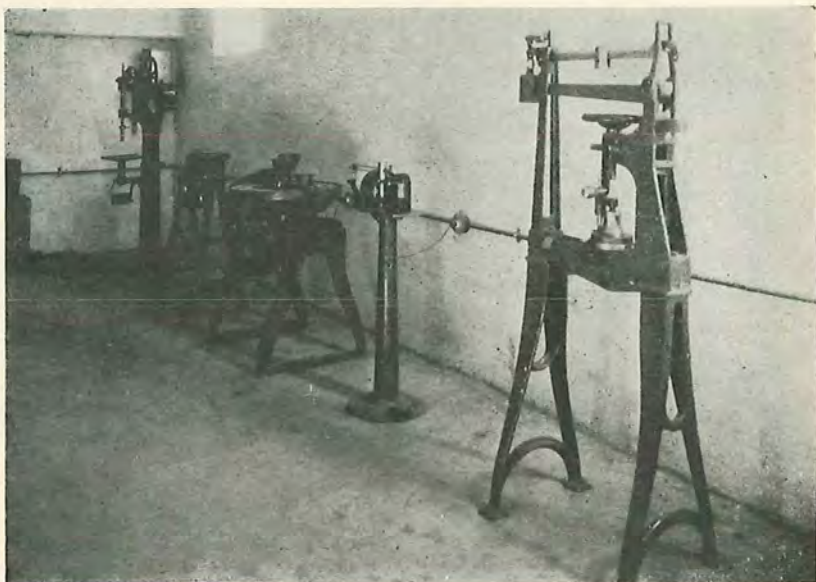
The department employs in its tests of surfacing material an Olsen Standard Briquette Former, an Olsen U. S. Standard Impact Test-Testing Machine and an Olsen U. S. Standard Ball Grinding Mill. With these machines, together with the sieves and screens for grading, the surfacing value of selected local materials can be determined.

For the testing of asphalt and asphalt mixtures the department has a motor driven Roterex Separator of 1,000 grams capacity, a motor driven Ductility Machine, a Standard New York Laboratory Type Penetrometer, two electric ovens and equipment for determining ash in mixes, flash, fire, gravity and the like.

Lubricating oils and gasoline are tested by the use of a Saybolt Universal Viscosimeter, a motor driven centrifuge, a Conrodson Carbon Residue apparatus, a Tag-Robinson Colorimeter, a gasoline still, an open cup, flash and fire apparatus, and smaller equipment.



MECHANICAL SIEVE SHAKERS



STANDARD TESTING MACHINERY

### Must Meet Specifications

All material purchased by the department for the construction of roads, such as steel, asphalt, cement and culvert pipe, is tested in the laboratory, and must meet State specifications before it is passed and used. Likewise, all other material, such as rock, gravel, sand and surfacing material, must meet specifications as determined by tests in the laboratory before they are used in road construction.

These materials again are checked in the laboratory by concrete cylinders made in the field of actual mixtures being used, by core samples drilled from finished pavement by asphalt mixtures taken at the time it is being poured, and by slabs of asphaltic pavement cut at 1,000 foot intervals from the finished pavement. In this manner, the department has a double check on the majority of road materials.

At present, samples are taken and sent to the laboratory by the district and resident engineers. There is not the uniformity in



taking samples that there should be and it is believed that better results would be obtained were all materials and sampling, as well as all testing under the laboratory head, thus making the testing engineer the material engineer.

This is contemplated and will be put into effect at an early date. When this is accomplished local materials can be sampled and tested in the laboratory. The best mixtures can be determined by experiments, and when bids are to be let, it will be known where materials are to be obtained and how treated to gain the best results.

Also this will cut down the element of chance for the contractor, and it is believed that in many cases the amount of the bid for the job will be less, which is an important item.

#### DRAFTING ROOM



## ESTIMATES OF COST

**J. S. MILLS, Estimator**

The methods used by the Arizona Highway Department in arriving at a fair price to pay for work done, are approximately the same as used by estimators for all large engineering companies. However, there are some phases more minutely investigated by the Department than is done in general engineering practice, as will develop. Some of the factors taken into consideration by the Highway Department in preparing its estimates are:

- 1—Nature and location of work.
- 2—Season of the year.
- 3—Condition of material market including. Structural steel, reinforcing steel, cement, lumber, corrugated metal pipe, etc.
- 4—Kind and number of laborers available.
- 5—Probable equipment required.
- 6—Kind of material to be excavated.
- 7—Location of construction materials including; Sand, gravel, crushed rock, water, etc.
- 8—Condition of roads adjacent to job.
- 9—Type of vehicles to be used for transporting materials. On difficult mountain work it is sometimes necessary to pack in supplies and materials on burros.
- 10—An allowance for Engineering and Contingencies.
- 11—A fair profit.

With these factors in mind a detailed "estimate sheet for structures" is prepared, showing the location of all structures, their size, length, type and design number, the amount of excavation, sand, gravel, lumber, steel and cement required for each, and the location of all structural materials. The length of haul from source of material to structure is then computed for each ingredient. The hauls thus found are transformed into ton—, cubic yard, pound or M. B. M., etc. Miles, as the case requires and by Alligation or "Moment," they are further transformed into "Average Hauls."

An analysis of the cost of one unit (cubic yard, ton, pound, lineal foot, etc.,) of each of the different items that are to appear on the final estimate is made, and from this analysis a fair price to pay for the unit considered is found.



### Concrete Analysis

A typical analysis sheet for any class of concrete would show the elements: sand, crushed rock or gravel, cement, water and lumber, their shipping points, their cost at source, their delivery points freight charges, cost of transfer from cars to wagons or trucks, length of average haul and the hauling charge per unit mile, and the number of times the lumber will be used for forms.

It would also show the charge for mixing and placing one cubic yard, making and stripping forms, finishing, curing, backfilling around the completed structure, and a fair allowance for profit.

The charges for the items enumerated are derived from various sources. Freight rates are secured from the rate department of the Corporation Commission. The cost of structural materials is taken from monthly quotations published in the Engineering News Record, with a liberal allowance made for normal fluctuations. The direct labor charges are computed from wages paid. The rental

### TUCSON-NOGALES HIGHWAY



DOUBLE BOX CULVERT

charges on equipment are taken from a nationally approved published Rental Schedule.

In computing the labor charge for mixing and placing, making and stripping forms, finishing, backfilling, transfer, etc., reference is had to the amount of work that has been done by a man, team or machine on work of the same kind. An amount equal to 20 per cent of the unit cost is added to take care of profit, interest on investment, taxes, loss, bonding, insurance, etc.

### **Excavation and Borrow**

While it is customary for the Highway Department to let its contracts for excavation and borrow on an unclassified basis, it still becomes necessary to take into consideration the nature of the materials likely to be encountered, and so, in order to arrive at fair prices to pay for these two items, a classification sheet is made in the following manner:

An inspection of the materials along the right-of-way of the proposed roadway is made by the locating engineer and his report sets forth between what stations solid rock, loose rock, hard pan, common earth, caliche, etc. is likely to be found. This information is shown on the final classification sheet made by the Phoenix office. The number of cubic yards of excavation and borrow is computed for each kind of material encountered, and multiplied by the unit price for that class. The total amount of money thus figured for excavation is divided by the total cubic yards of excavation giving a composite unit price. The process is long and laborious, but it has been found to pay.

### **Surfacing**

It has been found that on a large percentage of the State roads the cost of the surfacing is more than 50 per cent of the total cost of the completed road. This being the fact, the surfacing and surfacing hauls are thoroughly investigated. To determine the most economic way to handle these two items a Haul Chart is drawn to scale—generally one inch to the mile showing the location of all fords, bridges over 20 foot clear span, the portions of the road that are to be surfaced, the width and thickness of the surfacing, the location of surfacing pits with the kind of material and probable yardage contained in each.



The distance—dead haul—from the pit to the roadway along the most direct practical hauling route is determined and shown. The center of gravity of each component haul is computed and marked on the chart. There are also shown cross-sectional drawings of the surfacing sections to be used. This chart, besides being valuable as a record, has many advantages. It visualizes clearly the work to be done and at a glance shows which pits are too far away to be economically used.

With the above information set down, the work of computing the cubic yards of surfacing required and the overhaul is carried on by making a tabulation showing the stations at the beginning and end of each component part, its length, the number of cubic yards of surfacing required, the location of the pit nearest to the part under consideration, the average haul in stations or miles, and the cubic yard stations or miles.

The Arizona Highway Department has two unit measurements applying to overhaul. The station-yard—one cubic yard hauled 100 feet—is used in measuring all haul on earthwork quantities, but is used on surfacing only when the hauls are short. The cubic yard-mile—one cubic yard hauled a mile—is used in measuring the haul on surfacing when the hauls are long. It is a fact, that a lower price is obtained from the contractor when long hauls are based on the latter unit of measurement. The station-yard carries a 500 foot free haul limit, while on the cubic yard-mile no free haul is included.

There are several ways of computing the average haul in stations but the method in use by the Arizona Highway Department is thought to be the fairest and best. It is determined by subtracting the free haul limit from the total distance measured from the center of gravity of the pit to the end of the part to be surfaced and dividing the remainder by two. In the event the dead haul exceeds the free haul limit, the average haul is computed by dividing the distance to be surfaced by two and adding the difference between the dead haul and the free haul.

The tabulation referred to is then completed by multiplying the cubic yards required for each portion by its average haul, producing cubic yard-stations. The average haul in station-yards for the whole work is then derived by dividing the total number of cubic

yard-stations by the total number of cubic yards of surfacing required, giving the number of station-yards overhaul.

The unit prices ascertained from the analysis and classification sheets are transferred directly to the final estimate and there used to compute the cost of the work. An amount equal to 10 per cent of the cost of the work is added to take care of engineering expense and unforeseen contingencies.

### **Estimates Prepared**

Since January, 1923, this department has prepared estimates for 36 Federal Aid Projects involving \$4,500,000 for the construction of 38 miles of pavement; 321 miles of gravel surfaced highways; 12 miles of graded and drained roads; 29 specially designed bridges; one overhead railroad crossing and two undergrade railroad crossings.

There have also been prepared estimates and costs on five non-Federal Aid Projects involving \$210,000 for the construction of two miles of pavement, 54.5 miles of graded and drained roads, 270 feet of concrete ford.

The amount of money set aside by the Federal Government, as its share of the cost, is incorporated in an agreement signed by the Secretary of Agriculture. This amount is usually based on this department's estimate. Sometimes considerable time elapses before this agreement is executed in Washington, owing partly to the number of officials interested, and to the detail involved.

As the Arizona Highway Department cannot recover any money until an agreement is executed, and as time and money are the essence of nearly all of our work, it is necessary for the Department to keep its estimate slightly higher than what the work will be contracted for, thus eliminating the necessity of a revised agreement with its entailing loss of time. Another reason for generous estimates is that the Arizona Highway Department can expect and get, without tiresome litigation, first-class work only from a contractor who has allowed a reasonable amount for contingencies and a fair profit. It is an economic fact that the lowest bid is not always the best or cheapest.

The estimates for non-Federal Aid work are figured somewhat closer to actual cost but are still sufficiently high to allow a fair profit to the contractor.





## DEPARTMENT OF PLANS

**E. V. MILLER, Chief Draftsman**

The preparation of plans for the State and Federal Aid highway projects in Arizona does not differ greatly from the general engineering practice followed by the several State Highway Departments.

Much of the preliminary drafting is done by the location parties in the field. Particularly in mountainous sections it is of advantage, and often a necessity, that not only the alignment be plotted, but that the cross sections be figured and plotted, and excavation and embankment quantities be balanced, to insure the making of all necessary and advantageous revisions while the survey party is still on the project. Upon the completion of the survey the locating engineer forwards to the office, all notes in loose leaf form; maps of alignment, topography and drainage areas; profiles of the line showing the recommended grade lines and structures; and the classification of materials and all other data necessary for the preparation of the plans and estimates.

### Preparation of Plans

Upon the receipt of these data, the notes are checked, the cross section plotted and computed and all quantities classified and computed. This process requires over 50 per cent of the total time necessary for the preparation of a set of plans.

After the checking of the plans and profiles they are traced upon standard plan-profile sheets of 22 by 36 inches in size to the scale of 200 feet to one inch, except for paving projects which are plotted to a scale of 100 feet to one inch. The profiles are inked and checked upon these tracings, but the grade line, structure notations and all construction data are put on in pencil. These are called the "Preliminary Plans".

Blue prints are then made of the plans and are sent out for final field check and revision. In the event it is a Federal Aid Project a Bureau of Public Roads Engineer makes a joint check with the location Engineer of the State and thereby all recommendations are considered and the necessary revisions are made before the inking of the final plans. Thus when submitted to the Bureau of Pub-



lie Roads, the final plans are assured of approval without further revision.

The finished plans consist of, in the manner in which they are given, title sheet with name, length and small sketch showing location of project; detail sheets of road sections, specially designed headwalls and culverts, list of structures, list of specifications for the project and all special detail or construction notations; the plan-profile sheets; and the special bridge designs. The drainage structures in general are State standard designs, and in which instances the standard number only is noted on the plans.

### **Progress Profile**

A construction or Progress Profile also is made up for each project. This is on a scale of one inch to 100 feet horizontal and one inch to 10 feet vertical, and is made upon tracing cloth. In addition to the data shown on the regular profile, there is shown also the alignment, topography within the right of way, balanced excavation and embankment quantities, overhaul, structures as planned with all quantities involved for each, and surfacing notations with location of pits. A mile of the project is taken as a unit and a detailed estimate made for each mile and placed thereon. At the beginning of the profile a typical cross section of the roadway is shown and at the end a complete quantity estimate of all materials is tabulated.

Upon a blue print of this profile the resident engineer on the construction of the project keeps a record of every change or deviation from the original plans as the work progresses. The progress of the work is also recorded upon this profile by the resident engineer on construction, using a different color for each month. At the end of the month the profile is forwarded to the office, the progress noted and transferred to the office plans, and the profile returned to the resident engineer on the project. The progress is a permanent record and upon the completion of the project is filed as such.

Plans more than 75 per cent complete and completed by this department since January 1, 1923, comprise 38.4 miles of paving construction, 140.1 miles of gravel or selected surfacing construction and 12.1 miles of graded and drained highway construction. The average cost per mile of highway for this work was \$56.13, or .031 per cent of the total estimated cost of the project.

## STATISTICAL DEPARTMENT

**H. C. HATCHER, Statistician**

This is a part of the engineering department and works under and in conjunction with the chief engineer. This department was originated primarily for the purpose of preparing and submitting the Federal Aid Vouchers and keeping a record of the Federal Aid appropriations in regard to the different Federal Aid projects in the State. In 1923-24 the work of this department was enlarged and at this time the following constitutes the duties of the Statistical Department:

### Construction and Vouchers

Tabulations of all bids received by the State by projects is compiled, and when awarded are mailed to different contracting, bonding, and equipment companies.

Copies of the proposal, contract and bonds of the successful bidder are made for the Bureau of Public Roads and Bonding House. After the beginning of construction, the monthly estimates of the resident engineer are checked and vouchers made from them on which the contractor is paid monthly. Also from these estimates, each month a Federal Aid Voucher of all quantities in detail is compiled and submitted to the Bureau of Public Roads for the pro rata share of Federal Aid. The engineering and contingencies on the project are shown in detail in the final Federal Aid Voucher which is submitted after checking the Resident Engineer's final estimate and field notes.

The office has available at all times, through a system of records and charts compiled in this department, a status of each project. Weekly construction reports which are submitted by the resident engineer, showing progress of all phases of work and a complete personnel report, are noted and plotted on a progress chart. Also all work done by the engineering department in the office is plotted daily on a progress chart, thereby showing at a glance the individual status of each phase of the project.

A complete record of the Federal Aid funds is kept in this Department. This record shows the appropriations by fiscal years, each project that is allotted to that year's funds and the amount of



Federal Aid allotted to each, thereby giving at all times that amount of Federal Aid that has not been allotted to projects.

### **Charts and Reports**

Each month a Traffic Census of the travel over the entire highway system is compiled from the traffic census taken by all maintenance and construction foreman in the State. Each of these reports is plotted separately, showing the location of the road, Arizona cars and trucks, foreign cars and trucks, transportation lines, and weather conditions.

A personnel report is compiled monthly showing the total number of employes and occupation of the Arizona Highway Department and contractor forces engaged on State Highway work.

A Gas Tax and Motor Vehicle Fees Chart is compiled each month from reports received from the Secretary of State Office. This chart shows the amount and percentage available to each county and funds, and also shows the amount available for construction and maintenance from these taxes.

A complete and authentic record is kept on all roads of the State Highway System. This record shows total mileage of the Seven Per Cent System and State Highway System by counties, Projects, Type and Construction. All data as to the condition of roads and detours and mileage of routes is available from this record.

Considerable time is spent in answering the daily inquiries from other states, magazine, automobile clubs and individuals regarding data pertaining to the Arizona Highway Department.

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## **RIGHT-OF-WAY**

### **IRA W. WAGNON, Right-of-Way Agent**

Rights-of-Way for highways to be constructed by the Arizona Highway Department are secured by Appropriation of Public Domain, Declaration by the County Board of Supervisors, Instruments of Conveyance and Condemnation.

Although the statutes of Arizona make no specific provisions under which the Highway Department may secure rights-of-way, and has made such acquisition a function peculiar to the particular county in which the road is situated, the department has found

it expedient and a matter of utmost economy, to maintain an agent for the purpose of looking after its rights-of-way.

The Right-of-way agent has jurisdiction over all affairs concerning rights-of-way of all State highways. He works in conjunction with the engineering department. It is also his duty to acquire for the state, rights and titles to lands used as a source of sand, gravel and other surfacing material, and Maintenance Camp Sites.

Owing to the inadequate provisions of the State laws for the securing of rights-of-way and their failure to prescribe the duty and power of the Highway Department, in defining the manner in which the State is to obtain rights-of-way, the department often meets with many perplexing problems, which are obstacles to rapid and efficient road construction.

Notwithstanding this serious handicap, the department, with the cooperation of the various county officials, has secured the rights of-way for all roads constructed by the State during the past two years, as well as settling many controversies regarding rights-of-way for roads constructed previously.

In all matters the department is governed by an unalterable policy based on the principles of justice and equity. In acquiring rights-of-way for proposed roads, the department does not ask for more acreage than is absolutely necessary for the actual construction of the road, and where property is damaged, the owner, in all cases, is adequately compensated. No signs, advertising matter, obstruction, or any business of a commercial nature is permitted on the right-of-way of any State highway. Safety to the traveling public is the paramount obligation, and all other matters are subservient to this end.

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## FILING

**Mrs. M. B. WHITE, File Clerk**

Engineering data from the surveys of State roads together with all data compiled in the drafting room is catalogued, properly recorded and placed in the files of the Engineering Department. This data is filed with reference to its respective county; the first number of all file numbers indicates the county in which the project is located.



The field data consists of transit, level and cross section notes of which there are more than 1,500 books; location profiles approximating 800 rolls from 12 to 24 inches in width, and representing from a few feet to five or more miles of location; 500 Hard Copy Maps 12 to 42 inches in width, varying from short contour and drainage maps to many miles of alignment. Many preliminary notes, and maps are received, carefully recorded and filed for office reference and comparison.

Plans of Federal Aid Projects compiled in the drafting room consist of more than 1,150 twenty-four by thirty-six inch, standard sheets of tracings and their corresponding cross sections numbering approximately 3,600 sheets, and also 1,000 sheets of tracings and 3,000 sheets of cross sections of other state projects.

There are approximately 5,000 blue print maps of forest, state, county and miscellaneous projects.

Steel cases of various sizes are used for filing field engineering books, profiles, tracings, estimates, specifications, contracts, agreements, vouchers, laboratory reports, all Federal Aid correspondence and that relative to road location and construction.



CONCRETE PAVEMENT ON GERONIMO-SOLOMONVILLE HIGHWAY

## Construction

THE Arizona Highway Department has conducted a construction program during this biennial that compares extremely favorably with any previous like period of its existence. For actual mileage credited it is a little under the previous maximum period, but practically all of the additional mileage of the high period is in the classification of graded roads, or the lowest and cheapest type constructed by the Department, and was not constructed with the idea of it being only temporary. When a comparison is made by comparing the mileage by types there is very little difference to the credit of the high period except in the lowest type, which involves a relatively small amount of money. This has been done in spite of the fact that the Department has been greatly handicapped by the chaotic condition of its finances, and the declining receipts from county bond issues, which made much greater expenditures possible.

The construction during this period has been generally distributed over the State, and has included all standards from the cheap grader temporary section to the highest paving, and specially designed large structures. The details of this work is set out in the tabulations included herewith, "Tabulation of Contracts awarded and constructed 1922-1924" and "Construction by State Forces 1923 and 1924."



# TABULATION OF CONTRACTS AWARDED AND CONSTRUCTED

## 1923 - 1924

F. A. No.	Name of Project	Section	Type	Contractor	Construction Started	Construction Completed	Percentage Complete	Amt. Con- tra
22	Winslow-Coconino Co. Line (Grad.)	T. 18'-B. 24'	G. Surf.	Tanner & Turley	7- 8-24	9-18-24	100	\$5,111
22	Winslow-Coconino Co. Line (Surf.)	T. 18'-B. 24'	G. Surf.	Rogers & Larson	10-24-24		63	2,930
23-A	Florence-Superior	T. 20'-B. 24'	G. Surf.	R. H. Martin	4-15-24	5-17-24	100	16,147
25-B	Tucson-Nogales Bridge	T. 18'-B. 24'	Conc. Brgs. Surf. Apprs.	Lown & Woods	11- 5-23	6-25-24	100	22,780
36-B	Prescott-Jerome (Underpass)		G. Surf.	Coleman & Day	11- 4-24		30	2,364
40-Reo.	Holbrook-Winslow (Grading)	T. 18'-B. 24'	G. Surface	Tanner & Turley	7- 8-24	9-18-24	98	2,428
40-Reo.	Holbrook-Winslow (St. Joe Bridge)		Conc. Br.	L. C. Lashmet	10- 4-24		05	540
42	Holbrook-St. Johns	T. 18'-B. 24'	G. Surf.	Frost & Winsor	10-16-22	1- 8-24	100	59,575
43	Geronimo-Solomonville	T. 18'-B. 30'	Concrete	Lee Moor Cont. Co.	12-12-22	5-31-23	100	91,741
55-1	Yuma-Phoenix	T. 16'-B. 24'	G. Surf.	Kisselburg & Schmidt	11-27-22	8-30-23	100	175,591
56	Phoenix-Yuma	T. 16'-B. 24'	G. Surf.	S. B. Shumway	10-12-22	7-11-23	100	54,565
60	St. Johns-Springerville	T. 18'-B. 24'	G. Surf.	Udall & Company	1- 3-23	1-31-24	100	58,173
61	Prescott-Ash Fork (Grad. & Surf.)	T. 16'-B. 22'	G. Surf. A	S. B. Shumway	10-12-22	12-31-23	100	20,903
61	Prescott-Ash Fork (Bridge)		B. & C	H. J. Mann	9-26-22	4- 2-23	100	19,655
61	Prescott-Ash Fork (Bridge)		D	L. C. Lashmet	10-16-22	3- 2-23	100	12,847
62	Prescott-Ash Fork (Structures)	T. 18'-B. 24'	G. Surf. 1	Daniels & Kennedy	6- 4-23	12-31-23	100	14,056
62	Prescott-Ash Fork (Structures)	T. 18'-B. 24'	G. Surf. 2	L. C. Lashmet	3-15-23	10-30-23	100	24,750
62	Prescott-Ash Fork (Bridge)	T. 18'-B. 24'	G. Surf. 3	Monarch Eng. Company	3-17-23	11- 5-23	100	20,976
62	Prescott-Ash Fork (Bridge)	T. 18'-B. 24'	G. Surf. 4	L. C. Lashmet	1-15-23	7-12-23	100	28,638
63	Geronimo-Solomonville	T. 18'-B. 32'	Asphalt 6"	El Paso Bitulithic Co.	6-13-23		94	180,555
64-A	Phoenix-Yuma	T. 18'-B. 24'	G. Surf.	Cashion & Caldwell	8-20-23	4-30-24	100	64,804
65	Mesa-Superior	T. 16'x6"-B. 24'	Asphalt	Phoenix-Tempe Stone Co.	8- 6-23	4-12-24	100	131,296
66	Tucson-Nogales Bridge	T. 18'-B. 24'	Conc. Brgs. G. Surf. Apprs.	Shumway Const. Company	10-27-23	3-29-24	100	12,283
67	Geronimo-Solomonville	T. 18'-B. 32'	Concrete (6"x9")	El Paso Bitulithic Co.	2- 7-24		76	80,271
68-A	St. Johns-Springerville	T. 18'-B. 24'	G. Surf.	H. T. Willis & Son	10-13-23	5-17-24	100	39,674
70	Phoenix-Wickenburg	T. 18'-B. 30'	Concrete	Lee Moor Cont. Company	7-25-23	2-20-24	100	111,081
71	Phoenix-Yuma	T. 18'-B. 32'	Concrete	Pacific Const. Company	5-19-24		70	118,910
72-A	Prescott-Phoenix	T. 18'-B. 24'	G. Surf.	Phoenix-Tempe Stone Co.	5-20-24		75	112,142
75	Tucson-Nogales Br.	T. 18'-B. 24'	Conc. Brgs. G. Surf. Apprs.	Shumway Construct. Company	11-27-23		47	6,920
76	Phoenix-Wickenburg (Grading)	T. 18'-B. 24'	G. Surf.	L. C. Lashmet	2- 8-24	5-26-24	100	28,513
76	Phoenix-Wickenburg (Surf.)			A. A. Ray	10- 6-24		30	2,870
Non	Allentown Bridge		Steel Bridge	Midland Bridge Company	1-17-23	7-11-23	100	11,675
Non	Apache Trail Bridges		Conc. Bridges	L. C. Lashmet	8-16-23	12-31-23	100	10,736
Non	Geronimo-Solomonville		Grading	N. J. Skousen	1- 7-23	5- 5-23	100	6,398
Non	Lupton Bridge		Steel Bridge	Midland Bridge Company	7- 1-23	8-15-23	100	5,999
Non	Mesa-Superior Paying	T. 18'-B. 20'	Asphalt	Pacific Const. Company	3-28-23	7- 2-23	100	75,463
Non	Sacaton-Florence Power Line		Trans. Line	Jasper-Stacy Company	7- 1-24	10-20-24	100	48,358
Non	Sanders Bridge		Steel Bridge	Monarch Eng. Company	5-22-23	9-10-23	100	15,005
Non	Tucson-Nogales Bridge	Apprs. T. 18'-B. 24'	Conc. Bridges	Lown & Woods	7- 1-24	8-25-24	100	3,358
Non	Patagonia Bridge		Steel Bridge	Lown & Woods	11- 8-22	5-22-23	100	12,931

# CONSTRUCTION BY STATE FORCES

## 1923 - 1924

F. A. No.	Name of Project	Section	Type	Construction Started	Construction Completed	Percentage Complete	Cost D.
55-2	Yuma-Phoenix.....	T. 16'—B. 24'	G. Surf.....	4-15-24	7-29-24	100	\$23,1
59	Phoenix-Wickenburg.....	T. 20'—B. 24'	G. Surf.....	11- 2-22	1-31-24	100	375,4
61	Prescott-Ash Fork (Part of Grading and Surf.).....	T. 18'—B. 22'	G. Surf.....	9- 4-22	9-15-23	100	149,0
62	Prescott-Ash Fork (Part of Grading and Surf.).....	T. 18'—B. 24'	G. Surf.....	12-27-22	2-12-24	100	276,5
69	Phoenix-Yuma.....	T. 14'—B. 24'	G. Surf.....	11- 7-23		99	183,1
74	Winslow-Flagstaff.....	T. 18'—B. 24'	G. Surf.....	8-19-24		50	71,9
77	Solomonville-Duncan.....	T. 18'—B. 24'	G. Surf.....	5-13-24		75	102,2
Non	Chandler-Casa Grande.....	24'	Graded.....	10-15-22		55	44,2
Non	Douglas-Safford.....	20'	Graded.....	4-5-24		96	82,4
Non	Hillside-Kingman.....	18'	Graded.....	8-12-24	12-14-24	100	41,6
Non	Nogales-Patagonia.....	20'	Graded.....	8-20-24		75	22,4
Non	Mormon Flat Bridges.....		Steel Bridge..	11-15-24		25	9,6
Non	Globe-Roosevelt.....	20'	Graded.....	7-14-23	10-31-24	100	67,8
Non	Nada-Beardsley.....	24'	Graded.....	4-1 -24	11- 8-24	100	9,5



PAVING THE PHOENIX-  
YUMA HIGHWAY  
BETWEEN BUCKEYE  
AND THE HASSAYAMPA  
RIVER.



## Construction By Contract

It is the principle of the Highway Department to contract the major portion of its construction work, particularly on Federal Aid projects. These contracts are prepared and advertised, and after their approval and award, are supervised by the engineering department.

The list of contractors was recently revised, by sending out questionnaires to all contractors of record operating in this State or vicinity, to be filled out as to class and size of contract that they were capable of handling or in which they would be interested. Upon the return of the questionnaires they were classified, and when a project is ready for submission for bids, notice is sent to all contractors interested in that class of contract. In addition to this advertisements are run in the periodicals that will be most advantageous as an advertising medium for the particular project. The sending of the notices is the surest medium of reaching the contractors, and reduces the necessity of extensive advertising. The advertising in the periodicals assures the possible unlisted contractor of the chance of submitting a bid.

### Advantages and Disadvantages

Contracting the construction work has its advantages and disadvantages. When a contractor with sufficient experience, equipment and capital is the successful bidder, the result is usually good work performed in a good, workmanlike and agreeable manner, whether or not his efforts produce a profit. Contracting is a hazardous business and occasionally the best contractors underestimate the work, or through some unforeseen contingency lose rather than profit by their contracts.

It is often the case, however, that the low bidder does not have all of the requirements of a contractor, but by some means obtains a surety bond from a reputable bonding company and is awarded the contract. This class of contracts usually result in more expensive engineering and inspection to the State, disagreeable relations, poor workmanship, mainly through the inability of the contractor to do good work or his antipathy to the work due to his losses, and frequently results in the ejection of such contractor or his giving



up the contract. In either event the work must be then carried on by the bonding company. While it is true a surety company is bonding the contractor, such actions can not help but reflect in higher cost to the State in addition to the delays occasioned.

### **Surety Companies**

All instruction to bidders and the basis of award of the contracts is that the contract may be awarded to the lowest responsible bidder. When a contractor presents a low bid the question of his responsibility arises. Before a Surety Bond Company will underwrite a contractor, it is supposed to investigate thoroughly his ability to perform the contract, his equipment and his bank account. Therefore when the contractor produces such a bond from a reputable bonding company, the State is placed in rather a difficult position as to rejection of the contractor on the grounds of irresponsibility. Evidently the bonding companies are not rigid enough in their investigation of the contractors, which is probably often due to the anxiety of the bond agent to get his per cent of the bond premium. This has resulted in several material losses to the bonding companies in this State, and has also cost the State money, delays and disagreeable dealings with some of the contractors.

If the surety bonding companies do not become more rigid in their investigation of the contractor before issuing a bond covering his contract, for their own protection and that of the State, it is evident, from the numerous contracts of this class that the State has had in the past two years and in other years, that the surety bonds will necessarily be eliminated and the State will be forced to provide its own means of determining the responsibility of the prospective contractor, and other means of bonding.

The bond premium of one and one-half per cent of the total cost of the work is sufficiently high to permit of a very thorough investigation on the part of the surety bond companies, and which is indirectly paid to them by the State through the contractor. It is not believed, however, that the premium charged is sufficiently high to continue to withstand the losses they have experienced in this State, and it is hoped that they will take the necessary precautions, at least for their own protection to remember this situation.

### Attitude Toward Contractors

It is not the intention nor desire of the Highway Department to break the contractors. On the contrary it is desired that a contractor earn a fair profit. A contractor that is making a profit is usually satisfied. His mind is on the prosecution of his contract in a workmanlike manner and he is gradually building a more efficient organization. This is sure to reflect in a saving to the State in engineering and inspection, and in the early use of the project. Very likely it will reflect in a lower bid to the State on the next contract, or at least it will have created or strengthened a contractor to insure more keen competition in future bids.

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### PRESCOTT-JEROME HIGHWAY



R. R. UNDERPASS UNDER CONSTRUCTION



**HIGHWAY DISTRICT NO. 1****B. M. ATWOOD, District Engineer****APACHE COUNTY****Adamana-Lupton Highway**

Since January 1, 1923, the Adamana-Lupton Highway has been built from a point near Navajo, west to the Navajo-Apache County line, a distance of 27 miles. Team work was carried on between Houck and Sanders, a distance of eight miles, in completing fills started prior to January 1, 1923. Twelve 24 inch C. M. P. culverts and nine 36 inch culverts were placed at various points where most needed.

While the road is not built up to the present Bureau standard, being mostly a grader section with few drainage structures placed, it has supplied a much needed want, a connection from Holbrook to Gallup, N. M.

Contracts had been let on January 1, 1923 for bridges at Allentown and Sanders over the Puerco River, and a bridge at Lupton over the Lupton Arroya. No Federal Aid had been asked for these structures, though on the Seven Per Cent System.

**The Allentown Bridge**

The Allentown Bridge is 162 feet long, consisting of a 130 foot riveted steel truss, resting on two reinforced concrete piers with a 90 foot clear span and a 20 foot cantilever on each end, and with a wooden deck, extending 16 additional feet, forming the approach, the outer end of which rests on a concrete mud sill. The north pier rests on solid rock and the south pier on pile foundation, consisting of 17 piling with 16 foot penetration, with the cut off seven feet below the stream bed. Work was started on this bridge January 17, 1923 and the bridge was completed July 11, 1923.

**The Sanders Bridge**

Work on the Sanders Bridge was started May 19, 1923 and was completed September 11, 1923. The bridge is 190 feet long and consists of two 75 foot spans and two 20 foot spans. The 75 foot spans

are riveted steel trusses with a wooden deck. The 20 foot spans are of timber and form the approaches, being a continuation of the bridge deck. The north end of the approach rests on a concrete mud sill and the south end on four piling, bent. The steel spans are supported by concrete piers with spread footings in sand- clay formation.

### **The Lupton Bridge**

Work on the Lupton Bridge was begun July 6, 1923 and was completed August 15, 1923. The bridge is designed on a skew of 59 degrees, 20 minutes, and consists of a 60 foot riveted steel truss span, with a wooden deck and 20 foot wooden approaches. The east support of the steel structure is a concrete pier. The west support is a concrete abutment with wing walls, both with solid rock foundation. The east end of the approach span rests on a mud sill.

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### **St. Johns-Springerville Highway**

#### **Federal Aid Project No. 60**

Work on this project, which is 11.5 miles long, with a standard 24 foot roadway and gravel surface and standard structures, was begun January 2, 1923 and completed November 20, 1923. Considerable difficulty was experienced in obtaining a finished grading job on account of inexperienced contractors, but the contractors cooperated with the State engineers and a very creditable section resulted.

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### **St. Johns-Springerville Highway**

#### **Federal Aid Project No. 68A**

Construction was started on this project September 15, 1923 and it was completed May 17, 1924. The section is 8.41 miles long, is a standard 24 foot roadway, with standard structures, 4.5 miles gravel surface and 3.91 miles cinder surface. Due to the extremely dry weather, the cinder surface is compacting very slowly, but numerous inspections indicate that winter snows and rains will bring about compaction satisfactorily.



At present, that portion of the road—about 12 feet in the center—which carries most of the traffic, has set up to within about one inch of the surface. This compaction from the bottom upwards would indicate a better wearing surface than if the cinder had a greater percentage of binder and was crusted over before the bottom was well compacted.

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## **COCONINO COUNTY**

### **Winslow-Canyon Diablo Highway**

#### **Federal Aid Project No. 74**

Work on the Winslow-Canyon Diablo Highway, 20.35 miles long, was begun by State forces August 20, 1924, and November 20, 1924 was 46 per cent complete for grading and structures. No contract has yet been let for surfacing. The road, it is contemplated, will be surfaced for the first 3.5 miles as soon as possible, for near Station No. 170 the old County road, still in public use, crosses the railway, and near Station No. 175 the Leupp Indian School has a road coming in from the north which gives the only connection possible with the city of Winslow during wet weather.

From Station No 175 west there is no traffic now, except for an occasional cowman and those going and coming from the construction camp. All other surfacing, it is contemplated, will be done before the road is opened to public traffic. The construction of grade and structures should be completed by the early summer of 1925.

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## **MOHAVE COUNTY**

### **Topock-Kingman Highway**

#### **Federal Aid Project No. 54, Cancelled**

Work on this project was started by the State forces several days prior to January 1, 1923, and the grading on the project, which is 4.2 miles in length, had been completed when it was learned that the work was being carried out from the wrong plans and there was only a 20 foot roadway. The Bureau of Public Roads asked that this be widened to 24 feet, but when this was accomplished it was discovered that the wrong plans still were being

used, as a bridge was designated for a dry wash where a dip had been placed.

The bureau had not been advised when work had begun and refused aid on the subgrade. It was decided that it would be cheaper for the State to complete the work at its own expense than to change the plans again, and, therefore, cancellation of the agreement was asked. Work was halted on this project February 15, 1923, prior to completion. The maintenance crew, however, has placed a retaining wall in the dip and has surfaced more than two miles, which virtually completes those portions of the road most needed.

Due to the double tracking of the Santa Fe railroad east of Kingman, a part of the State Highway was destroyed. Therefore, the Santa Fe, the County and the State joined in building a new standard road from the city limits of Kingman to a point about two miles east of the city. This work was carried out by the County forces and has the advantage of shortening the line and eliminating a railroad crossing.

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**Topock-Kingman Highway**  
**Federal Aid Project No. 39**

Work was started on this section February 1, 1924 and completed March 23, 1924. The first half mile of the road east of Topock was held up pending a decision on the underpass, as plans had been approved for a surface crossing. As the crossing was near the railway bridge where all trains have an eight hour slow-order and as grade separation would have been very expensive, due to the four tracks, it was decided to complete the project according to the original estimate. A new location was made reducing the curvature and easing the grade going up hill.

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**NAVAJO COUNTY**  
**Winslow Streets**  
**Federal Aid Project No. 20**

In the City of Winslow, .95 miles of bitulithic pavement on a four inch bituminous base was completed January 5, 1923.



### **Holbrook-Winslow Highway Federal Aid Project No. 40**

Construction work on this project, 32.23 miles in length was begun June 20, 1922 and completed April 1, 1923. It is a 24 foot standard roadway with standard small structures. The surface is of local material, very dissimilar, but classed as gravel. As the alignment was virtually that of the old road, the old bridges, the LaRue, Tanner, St. Joe, Manilla, Cottonwood and Little Colorado, were left in place and used.

In September 1924 the first four of these bridges and the approach to the Little Colorado bridge was carried away. The La Rue bridge was rebuilt and the Tanner and Manilla bridges were temporarily repaired. The Little Colorado bridge was repaired and protection work put in. Federal Aid Project No. 40 was reopened so as to change the location of the St. Joe bridge and to ask for Federal Aid for the construction of bridges and approaches.

### **St. Joe Bridge and Approaches Federal Aid Project No. 40, Reopened**

Work was begun on this structure September 20, 1924, and the approaches, which are one-half mile in length have been completed and surfaced. The bridge is now five per cent complete and should be completed by February 1925.

### **Holbrook-St. Johns Highway Federal Aid Project No. 42**

Work was begun on this section, 10.6 miles long, on October 16, 1922 and completed January 5, 1924. It is a standard 24 foot roadway, with standard structures, and full surfaced with gravel from the bad lands on the edge of the Petrified Forest. It has excellent binder and is making a good surface. The contractors did not have the equipment necessary to handle the work properly and the time was considerably in excess of the contract allowance.

### **Winslow-Coconino County Line Federal Aid Project No. 22**

The grading and structures contractor began work on this project, 2.72 miles long, June 28, 1924 and completed his work Septem-

ber 19, 1924. The surfacing contractor began work October 24, 1924 and November 27, 1924, the surfacing was 47 per cent complete. The work should be completed by January 1, 1924.

This road is a standard 24 foot roadway with standard structures, a "Class A" ford and is surfaced with gravel and sand and with lime and alumina binder. The cementation is very high and should make an excellent wearing surface.

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## **YAVAPAI COUNTY**

### **Prescott-Ash Fork Highway**

#### **Federal Aid Projects Nos. 61, 62, 36 and 36B**

Grading on this section which is 22.2 miles in length, was virtually completed in January 1923. In February 1923, the State surfacing crew moved on to the job and the highway was surfaced for its entire length, except for a few stations which the Bureau of Public Roads engineers thought self-surface. Maintenance crews have surfaced virtually all omitted sections since, however, as they were found to cut up badly when wet. The following bridges were finished in March 1923:

Willow Creek bridge—Lutin arch, 100 foot clear span, 110 feet total length.

Verde River bridge—Reinforced concrete arch, common design, 100 foot clear span, 125 feet total length.

Chino Wash bridge—Six 32 foot spans with standard girders and abutments.

Coyote Wash bridge—Three 16 foot spans, standard reinforced slab, reinforced abutments and piers.

The small structures and especially the dips, are open to considerable criticism as to the location and design. Some of them were changed but others could not be remedied due to the fact that they had already been placed. The Chino Wash bridge is open to criticism as to location and design.

#### **Federal Aid Project No. 62**

The contract was awarded and grading was begun on this project in December 1923 and the job was completed March 10, 1924. The



entire length, 23.8 miles, is surfaced, 15 miles with volcanic cinder and 8.5 miles with gravel. Federal Aid Project No. 62 is unlike Federal Aid Project No. 61. While the yardage on Federal Aid Project No. 62 was not great, the construction was expensive due to light cuts and fills in a mass of Malpai boulders. On Federal Aid Project No. 61 considerable mileage was done by grader section.

### **Hell Canyon Bridge**

Hell Canyon bridge is 230 feet long and consists of three 50 foot spans and two 40 foot spans. It is a reinforced concrete two-girder deck bridge, with concrete piers and no abutments.

### **Little Hell Canyon Bridge**

The Little Hell Canyon bridge is a riveted steel truss with a reinforced concrete deck. It consists of two spans, approximately 81 feet long, each resting on a concrete pier and gravity abutments. The bridge is on a 3.33 per cent grade.

### **Johnson Creek Bridge**

The Johnson Creek bridge is 60 feet in length, with three 20 foot spans of standard slab design.

### **Prairie Bridge**

The Prairie bridge is 20 feet in length, with one 20 foot span of standard slab design.

The plans on Federal Aid Projects Numbers 61 and 62 seem to have been hurriedly prepared, without due consideration having been given to drainage and bridge sites. Some dips also should have been eliminated, fills raised and small bridges or boxes substituted. Alignment and grade could have been improved by a closer study of these features before entering into the contract.

While some of the changes asked for were granted, others failed to receive approval on account of the progress of the work. Four contractors worked on this project. The State forces were on the grade and surfacing work, with two contractors on bridges and approaches and one on small structures.

**Federal Aid Project No. 36**

This project, 4.47 miles long, was completed in January 1924. The surfacing used contained a very large percentage of oversize, and a considerable excess in binder. Authority was given for its use but it was found to be unsatisfactory, and therefore, in March 1924, an extra gang resurfaced the entire project, putting on four inches of decomposed granite and lime. This was paid for from the 75 per cent portion of the State road tax fund. The alignment on this project is bad and the location poor.

**Federal Aid Project No. 36B**

The contract for the underpass was awarded October 14, 1924 and work was started November 4, 1924. This work was 30 per cent complete November 30, 1924, and should be completed by January 10, 1925, unless delayed by storms.

**Prescott-Jerome Highway****Federal Aid Projects Numbers 19A and 19B**

During 1923, the State forces surfaced 13,820 lineal feet of roadway on Section A, 12 feet wide on the top and 18 feet on the base, and 6,636 lineal feet on Section B, 16 feet wide on top and 22 feet on the base.

While this road, for the most part a grader section, had been finished some time prior to the assumption of office by the present administration, the surfacing had been omitted and was placed in order to obtain final approval from the Bureau of Public Roads.

An underpass, which is to be placed in the middle of Section B, will complete the project.





**HIGHWAY DISTRICT NO. 2****T. S. O'CONNELL, District Engineer**

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**MARICOPA COUNTY****Phoenix-Yuma Highway****Aztec-Stanwix Section, Federal Aid Project No. 55-2****F. B. Jacobs, Resident Engineer**

Construction on the Aztec-Stanwix section of the Phoenix-Yuma Highway, Federal Aid Project No. 55, Schedule 2, began April 15, 1924, at Maricopa-Yuma County line, by State forces. The line was relocated from Station 3075 to Station 3137-93.3, eliminating four 8 degree and 10 degree curves, and reducing the length by 354 feet, the grade line was raised .7 feet throughout the Project. The upper wall on all fords was eliminated by A. W. O. No. 2. All sand was obtained from a pit near the right-of-way one-half mile east of Aztec, and all water from the Southern Pacific Railway. Grading finished May 31, and surfacing July 15, 1924.

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**Phoenix-Yuma Highway****Stanwix to Piedra Section. Federal Aid Project No. 69****F. B. Jacobs, Resident Engineer**

This project was constructed by State forces. Construction started December 1, 1923. During the month of December progress was slow due to heavy rains. Throughout 40 per cent of the project the surface of the right-of-way was covered with malpais boulders—making it difficult to obtain borrow material. This section is 21.81 miles long. Surfacing began December 17, 1923. A. P. & H. shovel and traps were used to load surfacing. Wagons were used to haul material in short haul and 10-ton caterpillar trains on the long haul.

With the exception of the first five miles suitable surfacing material was hard to find. Most of the pits had an overburden of from one to three feet, then a thin layer of surfacing over malpais boulders. This caused the cost of surfacing to be very expensive. In some instances the surfacing failed, due to subgrade

conditions, which made it necessary to increase the thickness of surfacing for 5 miles, using a topping of gravel.

An additional five inches of surfacing was approved by the Bureau of Public Roads for a stretch of three miles just west of Stanwix. This surfacing was necessary due to poor subgrade material and also due to extreme dry weather. This surfacing was 60 per cent complete November 30, 1924. Water for all purposes was obtained from the S. P. Railroad and shipped in tank cars. Sand for all structures was shipped from Yuma.

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### **Phoenix-Yuma Highway**

#### **Piedra to Gila Bend Section. Federal Aid Project No. 56**

**L. A. Hicks, Resident Engineer**

**Geo. B. Shaffer, Resident Engineer**

The contract was awarded September 30, 1922 to S. B. Shumway for 14.94 miles of gravel surfaced road with concrete drainage structures. Actual construction was started October 12, 1922. The project was completed June 1, 1923. The entire contract was sub-let by Mr. Shumway to Robert Mackay. One half of the project was surfaced with material from local pits. The remainder was surfaced with material shipped by railroad from a point 14 miles east of Gila Bend. No unusual features were encountered during construction.

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### **Phoenix-Yuma Highway**

#### **Gila Bend to Gillespie Dam Section. Federal Aid Project No. 53**

**L. A. Hicks, Resident Engineer**

**Geo. Shaffer, Resident Engineer**

Actual construction was started by State forces in April 1922, and on January 1, 1923, there remained seven miles of surfacing, and about one-half mile of grading; also one small structure and several concrete headwalls on pipe culverts. Of the seven miles of surfacing, approximately  $2\frac{1}{2}$  miles of oversize gravel had been placed. This required a top course of granite to produce a satisfactory surface. This project is 23.45 miles in length.



Work continued on this project from January 1st, 1923, to February 15, 1923, when a shutdown was necessary on account of insufficient funds. Work was again started in April 1923, and the project was completed June 15, 1923.

This project, which was located through a silt soil, proved very expensive to operate trucks on the hauling of surfacing material. The side roads, used for hauling material, were very bad. Several pumps were set up along the adjoining canal and water was pumped on these roads, after which they were dragged. As the grading work was finished the stock used thereon were put on dump wagons, and these used on short hauls. This change in the method of hauling the surfacing greatly reduced the cost.

The oversize gravel used for surfacing the last eight miles of the project was found to be unsatisfactory for a wearing surface. This difficulty was overcome by placing a two inch layer of decomposed granite on top to serve as a wearing surface.

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### **Phoenix-Yuma Highway**

#### **Gillespie Dam Apron Approach**

This short stretch of road was built from the end of Federal Aid Project No. 53, to the end of the concrete apron just below the Gillespie Dam, and while it was constructed primarily for a road, it further protects the Gillespie Canal from erosion due to the sluice gates on the east end of the Dam. On account of this protection the Gillespie Dam company gave the State Highway Department \$500 worth of reinforcing steel to assist in the cost of the work.

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### **Phoenix-Yuma Highway**

#### **Gillespie Dam to Federal Aid Project No. 64NA**

Due to the fact that a final bridge site had not been established across the Gila River at Gillespie Dam, Federal Aid Project No. 64 was divided into two sections. Project No. 64A was completed to within 1.3 miles of the River and a temporary road built connecting this road with the crossing. About a mile of this temporary road was built by State forces prior to January 1, 1923, and the

remainder 0.3 mile by Cashion-Caldwell Construction Company, in conjunction with their contract for building Federal Aid Project No. 64-A.

**Phoenix-Yuma Highway**  
**Gillespie Dam-Hassayampa Section**  
**Federal Aid Project No. 64-A**

**H. N. Neighbours, Resident Engineer**

January 1, 1923, State forces started construction work on the mesa just west of the Hassayampa River. Construction was concentrated on the two miles just west of Hassayampa, pending approval of the Project by the Bureau of Public Roads. This project comprises 9.9 miles.

A new location of the west end of the project was found necessary, to avoid right-of-way and construction difficulties. This delayed approval by the Bureau, and due to the loss of Federal Aid, the State forces were laid off on February 15, 1923.

During this time the construction forces had rough graded approximately 2.2 miles of road, all of which was rather difficult, though light, construction. The location and right-of-way difficulties were overcome, and on August 20, 1923, Cashion-Caldwell Construction Company started work on the project. It completed the project on April 4th, 1924.

A state construction camp was also established near the Gillespie Dam end of the project in December, 1922. This camp was combined, January 20, 1923, with the camp just west of Hassayampa. On February 15, both camps were shut down. Very little construction was accomplished by this camp on the west end of the project.

The only unusual feature about this construction was a two-course surfacing. This surfacing consisted of a 4 inch base course of gravel, with a maximum size of  $2\frac{1}{2}$  inch stone, overlaid by  $2\frac{1}{4}$  inch course of gravel, with a maximum size of  $1\frac{1}{4}$  inch stone. This type of surfacing has not proven very satisfactory.

**Arlington Bridge**  
**M. H. Hasler, Inspector**

The contract was awarded to A. W. Daniel, March 4, 1922, to erect two 90-foot steel spans, with concrete floor, and to connect the old wooden approach on the west end to the new work.



On January 1, 1923, the construction work was being done by State forces, under an agreement with the United States Fidelity and Guarantee Company, the underwriters of the bond furnished by Mr. Daniel. On January 10, these forces were laid off, pending the arrival of a few pieces of structural steel for use in one of the steel spans. This steel had been delayed in shipment.

When the steel arrived, Mr. Daniel agreed to finish the work at his own expense, and was permitted to do so by both the State Highway Department, and the bonding company. Final construction was complete about March 1st, 1923.

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**Phoenix-Yuma Highway**  
**Hassayampa- Buckeye Section**

Construction, by State forces, started early in November, 1922. Forces were taken off about February 15, 1923. From November 1922, until January 1, 1923, about four miles of old county road was regraded. From January 1, 1923, until February 15, 1923, the remaining five miles was regraded.

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**Phoenix-Wickenburg Highway**  
**Nada-Beardsley Section**  
**Roy White, Resident Engineer**

This section is part of the Phoenix-Wickenburg Highway, fourteen miles in length, between end of the pavement north of Peoria and Nadaburg. Grading on this section by State forces, first building a grader road, which later was rebuilt as a standard road, 24 feet wide, with permanent waterways, in order to obtain Federal Aid on the surfacing and concrete work. All fords on this section will be paved.

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**Phoenix-Wickenburg Highway**  
**Nada-Hot Springs Junction Section**  
**Federal Aid Project No. 76**  
**Roy White, Resident Engineer**

This section comprises a part of the Phoenix-Wickenburg Highway, seven miles in length. The contract for grading and drainage structures let to L. C. Lashment. Construction was started Feb-

uary 8, 1924, and finished May 26, 1924. This was first accepted as a self-surfacing project, but after a few months' use it was thought advisable to surface four and one-half miles of it. The contract for this surfacing was let to A. A. Ray on August 20, 1924; work was started October 8, 1924, and is now about 45 per cent complete. An underground or overhead crossing of the Santa Fe tracks at Hot Springs Junction is contemplated.

### **Wickenburg-Hot Springs Junction Highway**

**Federal Aid Project No. 59**

**N. G. Hill, Resident Engineer**

**F. B. Jacobs, Resident Engineer**

Work was started on this project, 10.6 miles in length by State forces on November 22, 1922, and completed March 15, 1924. The location of this project cuts off 8 miles from the old road and parallels the Hassayampa for eight miles. Four miles of the location is through solid rock, with side hill cuts up to 72 feet. Prior to January 1, 1923, two construction camps had been organized, one near Hot Springs Junction, and one near the Garden of Allah. Both camps were equipped for grading only, and had barely begun work by January 1, 1923.

Material, such as lumber, cement and reinforcing steel, had not been ordered early enough to permit the starting of the concrete work before the middle of February. This delay seriously affected the efficiency of the grading work. Many line, grade and drainage changes were necessary during construction. Also the Bureau of Public Roads had not approved the project prior to the starting of actual construction, and did not approve it until February, 1923. Approximately 3,000 feet of heavy grading had been completed by this time. This was not included in Federal participation, due to the fact that this work was done prior to Federal approval.

Many changes in the method of construction were made, such as using lighter, more portable air compressors in place of heavier hot head compressors. Only one of these hot head compressors was used after January 1, 1923. This was set up in a place where considerable heavy work was to be done, and was not moved again. Fresnos were used as much as possible, even in solid rock.



Sand and gravel for concrete work was trapped. Concrete work was rushed in order to get ahead of grading operations. An average of 175 men and 125 head of stock was employed after January 1, 1923, and good progress was made.

### **Protection Jetty**

During the latter part of 1923 the Hassayampa River changed its low water course from the right to the left bank, causing the next flood head to strike almost at right angles to the center line of the highway, between Station 204 and Station 208 where it crosses the mouth of a canyon. At the time of this rise deep scouring took place, which caused half of the road way for a distance of about 200 feet to cave into the river. Bed rock at this point was later found to be 29 feet below stream bed, which depth was apparently the cause of the failure. The washout was backfilled with rock graded from No. 1000 to gravel, and reinforced additional width.

A 210 foot rock filled timber pile jetty was placed about 500 feet upstream from the washout, and in a position to deflect the current to the right and past the washed out area. To date there has not been sufficient rise in rise to prove the success of the jetty.

## **WHITE SPAR-CONGRESS JUNCTION HIGHWAY**

### **Federal Aid Project No. 72.**

#### **F. N. Grant, Resident Engineer**

Section A of the link of the Prescott-Phoenix highway connects with the Prescott-White Spar forest highway, now under course of construction by the Federal Government at the forest boundary, about 15.5 miles south of Prescott. From there it runs southwest for 18.8 miles to the top of Yarnell Mountain, at which point Section B begins.

Section B, on which construction work will probably begin not later than February 1925, will drop off the mountain and run into Congress Junction, a distance of nine miles, where it will connect with the Wickenburg highway. It should be completed by next fall, at which time the forest road out of Prescott should be completed.

The completion of these two sections will open to traffic an excel-

lent all-the-year-round highway from Phoenix to Prescott, eliminating the steep Copper Basin hill, and shortening the distance over the present route by approximately 20 miles.

The distance from Phoenix to Prescott by this route will be 115.5 miles, with a maximum grade of six per cent. Due to the fact that it goes through a low pass south of Prescott and is almost entirely on south slopes, it should never be closed by snow.

### **Contract on Section A**

The contract on Section A was awarded to the Phoenix-Tempe Stone company early in May 1924. Construction was begun May 20, to be completed by December 31, 1924. The Phoenix-Tempe Stone company sub-let the entire contract to three sub-contractors, —the grading and surfacing of the first 11 miles to one, the last 7.8 miles to another and all structure work to the third. One of these subcontractors sub-let the surfacing on 7.3 miles, but this sub-contractor relinquished his contract December 1.

The work comprises the grading of a 24 foot subgrade, construction of drainage structures, cattle guards and guard fences, the surfacing of 14.3 miles with disintegrated granite, 18 feet wide, of six inch thickness, tapered off three feet on each side.

### **Grading**

The grading, totaling 33,000 cubic yards of excavation and 112,000 cubic yards of borrow, was in granite sand-clay, disintegrated granite, malpais rock and adobe, and granite rock. Approximately 1.5 miles was rock work that was drilled with compressors and the remainder was ploughed.

The grading was 98 per cent complete December 10, and should be completed by December 31, except where openings are to be left for several drainage structures.

### **Surfacing**

The disintegrated granite surfacing has been taken from six pits of varying quality and is being done by two sub-contractors. That part under way in Peeples Valley, or the south end of the project, was 78 per cent complete December 10, and should be completed by December 31, except at the unfinished structure openings.



The surfacing on the north end, comprising about 7.3 miles, was 66 per cent complete November 30, at which time the sub-contractor gave up his contract. It is not likely that it will be completed before January 31, 1925.

### **Structures**

The drainage structures consist of 49 corrugated metal pipe, 22 concrete box culverts, seven gravel fords, one 16 foot bridge, one 40 foot bridge and one 160 foot bridge.

All of the pipes were in place and headwalls built on all but four December 10. Nine of the 22 box culverts, three of the seven fords, and the 40 foot bridge were completed by December 10. Five of the ten cattle guards were finished on that date.

Progress on the 160 foot bridge at Kirkland Creek and on the concrete box culverts has been very unsatisfactory, due to poor and inadequate equipment and continual wrangling and dissension on the part of the contractors.

Work on the Kirkland Creek bridge was begun in June, but to December 10 only 10 of the 14 steel cylinders for foundations had been sunk to bed rock, there being four for each abutment and two for one of the piers.

Both abutments are built up to bridge seat and false work and forms for two 40 foot spans of superstructure have been built. At this point, work was suspended pending an agreement as to payment for sinking cylinders extra depth to bed rock.

Although more than 60 per cent of the small structures are in the Peoples Valley or south end, concrete work was not begun until late in October, and with the present force and equipment it can hardly be completed before March 1925.

This slow progress in structures has delayed completion of sub-grade and surfacing, which can not be finished until all structures have been completed.

### **Apache Trail**

#### **Mormon Flats Project**

In the vicinity of Mormon Flats between Mile posts 28 and 31, construction forces were engaged, January 1, 1923, in building a

new road above the water line of the proposed Mormon Flats Dam, a structure to be constructed by the Salt River Valley Water Users' Association. On investigation of the records pertaining to the taking over as a State Highway that portion of the Apache Trail between the Apache Trail Junction with the Mesa-Superior Highway and Roosevelt, there was found a bona fide agreement between the State Highway Department and the Water Users' Association to the effect that the water line of both the proposed Mormon Flats Dam and Horse Mesa reservoir sites. This new road was to be equal in width, grades and curvature to that of the old road. Since that agreement was entered into, and prior to January 1, 1923, the State Highway Department had widened the old road from 10 and 12 feet to 14 and 16 feet, with more adequate drainage provision. Therefore, if the Water Users' were to construct a road equal to the old road it would be much too narrow and would not conform to the later improvement of the Trail.

This being the case, the Highway Department, instead of withdrawing the State forces from this new work, which the Water Users' Association themselves agreed to build, attempted to enter into a further agreement, where the Water Users' would advance to the State an amount equal to the cost of such a road under their agreement, and the State Highway Department would then go ahead and build a road that would conform to the other sections of the Apache Trail. Unfortunately the proposal was not accepted and there being no other recourse, the State Highway Department was compelled to shut down this construction work, which was done February 1. However, approximately one-half mile of road had been constructed.

In addition to this one-half mile of solid rock road construction on this new location, several places were widened at other points, and other finishing work, besides two drainage culverts were placed after January 1st. So that the entire amount of work done on the Apache Trail would amount to more than one mile of continuous construction.

After closing down the work a watchman was placed in charge of the State camp and equipment. At a later date some of the materials, such as powder, etc. and a part of the equipment, were transferred to other road work. The remainder of the camp be-



ing held intact, pending the action of the Water Users' Association, to go ahead and construct, either a narrow road, or a part of the road equal to the present new width, after which the State can finish the work.

On December 21, 1923, an agreement was entered into by the State Highway Department, and the Salt River Valley Water Users' Association, to complete this four miles of road, the State to pay the difference in cost between an 11-foot road and an 18-foot road. The Water Users' were to do the work. Two high wooden structures were to be built, one over the LeBarge Wash and the other over Willow Creek.

The work, with the exception of the Bridge over Willow Creek, was completed in October, 1923. The Highway Department decided to substitute a steel bridge over Willow Creek. This bridge should be completed by February 1925.

### **Apache Trail Bridges**

The five bridges constructed on the Apache Trail were the last link in the reconstruction of the Trail between Mormon Flats and the proposed Horse Mesa Dam. These bridges consist of two low truss steel spans, one 73 feet 6 inches and the other 55 feet 6 inches with concrete floors; one 60 foot steel low truss span with timber floor; a 32 foot steel I-Beam span; and a 9 foot bridge culvert constructed from elephant shelters.

The contract for the erection of these bridges was awarded to the L. C. Lashmet Company July 28, 1923. The contract on two of the steel spans had been awarded December 2, 1922 to the Missouri Valley Bridge & Iron Company for the delivery of the complete structural material F. O. B. Mesa, Arizona. The other steel span was diverted to Mesa from another project, and the other structural material such as the 32 foot I-Beams, elephant shelters, and reinforcing steel was furnished from stock in the yard.

Detours were provided by the contractor and traffic maintained at all times in these difficult locations, involving in some cases the construction of temporary trestles over the deep canyons and in one case the erection of the span under traffic.

The work was carried out under the inspection of M. H. Hasler and was completed and all structures opened to traffic on December 31, 1923.

**MOHAVE COUNTY****Hillside-Kingman Highway****Non-Federal Aid Project****Barksdale Hales, Resident Engineer**

The construction of this section of road was started by State forces on August 1, 1924, and completed on December 14, 1924. The location can be roughly described as follows:

Beginning at Station 1103-84, a point on the east bank of Burro Creek, at the end of the Old Burro Creek road, and about 42 miles west of Hillside, it extends thence in a westerly direction 12.74 miles to Station 431 a point at the end of an eight foot road about the ends of two third class roads and opens up a direct route from seven miles east of Big Sandy River. This construction connects the ends of two third class roads and opens up a direct route from Kingman via Big Sandy River, Burro Creek and Santa Maria River to Hillside.

The road was built with a minimum width of 12 feet and a maximum grade of 12 per cent. The elevation above sea level ranges from 1880 feet to 3130 feet. The country traversed is very rough and practically uninhabited, but is highly mineralized and comparatively well watered. All excavation was done by teams and hand labor, and all drilling by a two hammer air compressor. Equipment and supplies were hauled from Hillside by Liberty Trucks and water hauled by F. W. D. Tank trucks.

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**PINAL COUNTY****Florence-Superior Highway****Federal Aid Project No. 23****H. B. Wright, Resident Engineer**

Before the Bureau of Public Roads would accept this project, which was built prior to January 1, 1923, it was necessary for the State to build several concrete fords and box culverts and to replace several concrete pipe with corrugated iron pipe and concrete headwalls. It was also necessary to construct several storm ditches and to resurface approximately two miles of road. All this work was done on Section A.



State forces were moved in on this project in December 1923, and completed the work by April 1, 1924. On section F, the Queen Creek Bridge was built without any abutment on the Florence end, the last span being placed on a pier. The Bureau required that protection wings be added to this pier. The contract was awarded to R. H. Martin. Work started on this project in April 1924, and was finished in May 1924.

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### **Mesa-Superior Highway**

#### **Resurfacing from Apache Trail Junction**

##### **To Federal Aid Project No. 7**

The State forces on this project were engaged in resurfacing six miles of this section. On January 1, 1923, only three-fourths of a mile remained to be resurfaced. This was completed about January 20, 1923. The surfacing contained a large amount of over-size material, and was placed on the road without scarifying the old road bed. Due to the lack of bond between the new surfacing and the old road, and also due to the large amount of oversize, the resurfacing has proven very unsatisfactory.

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### **Chandler-Casa Grande Highway**

#### **J. R. Van Horn, Resident Engineer**

Construction on the Chandler-Casa Grande Highway, A. F. E. 569, was started May 5, 1924, by State forces. Project A. F. E. 569 is from the Pinal County line to the Southern Boundary of the Gila River Indian Reservation, or more particularly from Station 281-36.6 to 1204-00. On June 30, the Project was 9 per cent complete and November 30 was 29 per cent complete, with 5.86 miles of finished grade, Station 894 to 1204, and 1.3 miles of surfacing. The remainder of the finished grade is of decomposed granite and is self-surfacing. A greater part of the grading was done with caterpillar and blade and finished with small blade and fresnos. The cost of grading per mile was \$1900. Cost of surfacing per mile was \$5,548. The average haul was 2.3 miles. A mixer of decomposed granite and caliche was used for surfacing. Drainage is taken care of by dips and C. M. pipes.

There will be two bridges to be built; one across the San Tan Canal, and one across the Little Gila, which will also be used as a canal by the U. S. I. S. The Highway will cross the Gila River on a concrete bridge of 25-50 foot spans, now under construction by the U. S. I. S. in conjunction with the Sacaton Diversion Dam. This bridge will probably be completed by June 30, 1925. A canal will run south from the Dam to the Little Gila, Station 894, paralleling the Highway. Dirt taken from the canal will be used in the Highway grade.

The present location of the highway crosses the Southern Pacific main line survey at Station 603, and follows between it and the San Tan Canal to the Diversion Dam. There are numerous encroachments on the railroad's right-of-way, which will necessitate a relocation and a probable shifting of the San Tan Canal for an approximate length of 1500 feet.

At present the road is under construction from the Pinal County line to Station 591.

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## **YUMA COUNTY**

### **Yuma-Phoenix Highway**

#### **Wellton to Aztec. Federal Aid Project No. 55-1**

#### **H. M. Neighbours, Resident Engineer**

The contract was awarded to Kisselburg and Schmidt for 42.61 miles of gravel surfaced road. Actual construction was started on November 27, 1922. The actual construction was completed August 15, 1923. The contractors have brought suit for additional pay for surfacing. This suit is now pending.

The contractors employed a large force of men and stock and the work was rushed. The public was permitted to use the sections of the road as completed. This was a great benefit to the traveling public, as detours through the sand were practically impassable.

Several changes in the original plans were made on this project to shorten the road, and to reduce curvature and excavation quantities. One structure was shortened and several fords were reduced to small box culverts. Three fords were eliminated entirely. These changes were possible by reason of the size of railroad structures which controlled the drainage.



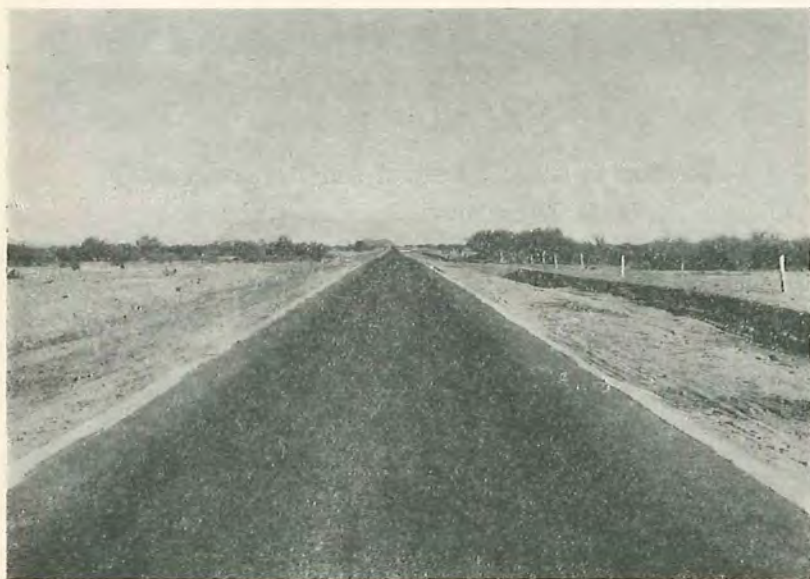
Approximately 10 miles of the surfacing was taken from local pits. The remainder was surfaced with material shipped from Kim by railroad. This material from the Kim pit has proven very satisfactory for road surfacing where the rainfall is as small as it is in this locality.

On June 15 a maintenance crew was placed on twenty-two miles of this project, relieving the contractor of any further expense in keeping up that part of the road under traffic.

This work is very well constructed, and has held up well under the severe drouth and the heavy traffic.

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#### MESA-SUPERIOR HIGHWAY



ASPHALT PAVEMENT WITH CONCRETE CURB

## **HIGHWAY DISTRICT NO. 2A**

### **GEORGE B. SHAFFER, Paving Engineer**

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#### **PINAL COUNTY**

##### **Mesa Superior-Florence Superior Junction Paving**

**Geo. L. Burns, Resident Engineer**

The section in Pinal County, which is part of the Mesa-Superior Highway, being constructed under contract by the Pacific Construction Company, is non-Federal Aid. It begins at Florence Junction and extends five miles toward Mesa. A two inch asphaltic concrete surface was applied in the early part of 1923.

The grading was done prior to this time and it was opened to traffic before the asphaltic concrete was applied. The subgrade, which was of caliche material, packed well under traffic, and asphaltic concrete, 18 feet in width, was then applied.

The road stands up well under the constant heavy traffic. Little or no maintenance has been given this section except for light shoulder work and at the approaches of the Queen Creek bridge, where the fills have shown some settlement.

The present condition of the road indicates that on this section the caliche base, confined as it is, is capable of carrying the heavy traffic with very little effect on the surface. A flush coat, if applied to the surface in the near future, no doubt will be of great benefit to the road and prolong its life materially.

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#### **MARICOPA COUNTY**

##### **Mesa-Superior Highway**

**Federal Aid Project No. 65**

**Geo. L. Burns, Resident Engineer**

The Mesa-Superior Paving section, Federal Aid Project No. 65, with George L. Burns as resident engineer, and the Phoenix-Tempe Stone Company as contractors, is 3.96 miles of 18 foot pavement. The specifications called for 16 feet of six inch two-course asphaltic concrete and 12X12 inch concrete headers or curb of a mixture of one part cement, two parts sand and three and one-half parts



crushed rock. The four inch base course was graded from two and one-half inch stone to sand and contained five and one-half per cent of asphalt. The average specific gravity of the base was 2.29.

The two inch surface course was graded from one and one-half inch stone to sand and contained six and one-half per cent of asphalt. The average specific gravity of the surface was 2.19. The pavement was completed with a squeegee coat, requiring one fifth of a gallon of asphalt to the square yard and covered with one fourth inch squeegee coat.

Rock for the pavement and curb was secured from Tempe Butte and the crushed river rock from the Salt River. Sand also was obtained from the Salt River. Owing to a trace of caliche, ten per cent cement was added to the curb. Cylinder tests on both structures tested to the above requirements.

The contract was signed August 4, 1923, rough grading was begun August 6, 1923, and was completed October 6, 1923. The work consisted of 332.4 cubic yards of excavation and 23,211.2 cubic yards of borrow. The road was planned with a seven foot shoulder on each side but these will average eight feet, owing to the quantity of dirt unnecessarily moved by the contractor. A well formed berme was constructed on each side.

The entire grade was ponded and thoroughly saturated, then rolled three times with a ten ton three wheel roller. The cost of ponding was somewhat excessive owing to the water being pumped east two miles from the canal and a well being developed at the east end of the project, so that water could be pumped west approximately two miles to connect with the ponding. The cost of drilling the well was \$750.

After ponding, the grade including shoulders was laprolled with a ten ton roller. The grade was then shaped with a scarifier, four foot blade and subgrader. The grade was then rolled again with a ten ton roller.

The 12X12 inch concrete curb contained 1,547 cubic yards of concrete. Work on the curb was started October 18, 1923, and completed February 29, 1924. A one sack mixer, mounted on a standard Ford, supplied both transportation and power for mixing.

Structures on the project comprised one 20 foot slab bridge, containing 74.06 cubic yards of concrete and 4,782 pounds of steel.

This structure was completed in seven days. Other structures were a double eight by three and one-half by  $33\frac{1}{2}$  foot, one six by two by  $33\frac{1}{2}$  foot, four double five by three by  $33\frac{1}{2}$  foot, two single five by three by  $33\frac{1}{2}$  foot, three four by three by  $33\frac{1}{2}$  foot and one three by two by  $33\frac{1}{2}$  foot culverts.

Pavement was begun November 20, 1923 and completed April 12, 1924. A 1,000 pound Bacon Steel semi-portable asphalt plant was used. The average haul was 20 miles, accounting for some of the time required to complete the pavement.

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**Phoenix-Wickenburg Highway**  
**Marinette to 4 Miles North Section**  
**Federal Aid Project No. 70**  
**Geo. B. Shaffer, Resident Engineer**

Construction on the Phoenix-Wickenburg Section, Federal Aid Project No. 70, was started by the Lee Moore Construction Company in August 1923 and completed in February 1924. The district engineer was the resident engineer.

This section, four miles long, was built of concrete paving 18 feet wide with five foot shoulders. The slab is of the Arizona type section, 18 feet with one and one eighth inch crown. The slab is six inches in depth from center line to a point seven feet on each side and thickening gradually to nine inches at the edges.

Expansion joints of an asphaltic material five eighths inch thick were placed at 40 foot intervals. These joints are of a disappearing type, extending from the subgrade to one half inch below the finished surface. This type of joint, although very favorable to finishing is very hard to place and hold in place so as to insure 100 per cent expansion space.

To cope with this difficulty, there was involved the idea of using some kind of material, the same length and about six times the width of the expansion joint material, so placed over the joint in place before the pouring of the concrete, so that it would serve as a "hold down" in the form of an inverted stirrup extending over the top and down the sides of the joint and extending out on the sub-grade adjacent to on each side of the joint.



Burlap was the material decided upon for these hold downs and served the purpose very well. The burlap was bought in large quantities at nine and one-half cents per pound. The scheme was an experiment and not included in the contractor's proposal, but it is declared by engineers, contractors and laymen, as being a success. It meets with the hearty sanction of the Bureau of Public Roads and is now being used in the construction of all concrete paving jobs throughout the State.

The subgrade was prepared in the following manner: Fills of a depth of more than one foot, were placed in layers of one foot, then ponded and rolled with a ten-ton roller. All fills after being brought to within one-tenth of a foot of finished subgrade, were wet down and rolled with a ten ton roller. Header boards were then set, and the finish subgrade was obtained by the use of a subgrade planer. The subgrade was protected by placing upon it two by twelve by twelve inch planking, upon which the sand and gravel was placed, ready to be delivered to the mixer. This proved to be satisfactory but added considerably to the first cost of the pavement.

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**Phoenix-Yuma Highway**  
**Buckeye-Hassayampa Section**  
**Federal Aid Project No. 71**

**Geo. L. Burns, Resident Engineer**

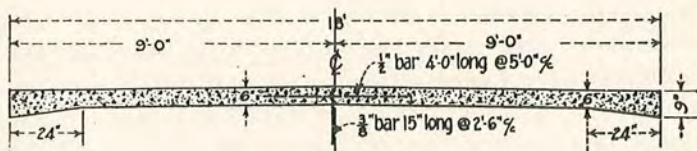
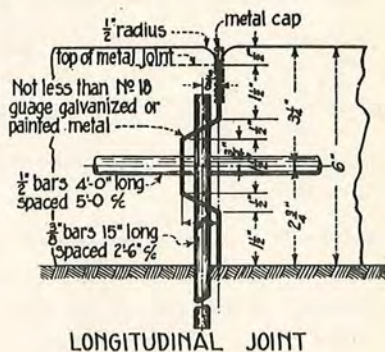
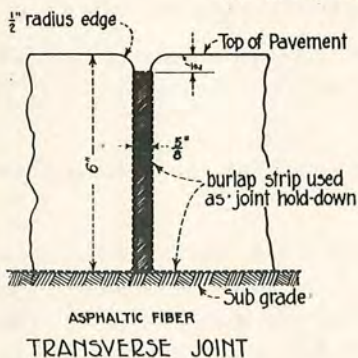
Construction work on the Phoenix-Yuma Highway, Federal Aid Project No. 71, was started by the Pacific Construction Company in May 1924 and was 70 per cent complete November 30, 1924. The project will be completed about January 10, 1925.

This section, 9.2 miles long, is being constructed substantially the same as Federal Aid Project No. 70, insofar as specifications and designs are concerned, it differing in the respect that a longitudinal center joint is being placed through the entire length of the project. The joint is of standard design and in common use.

In this part of the State, material, such as sand and gravel, is produced locally, and in the case of Federal Aid Project 71, proved to be a big undertaking. Suitable material was located in the flood plain of the Gila River about one and one-half miles from the center

of Mile No. 3. The material was taken from the pit by means of fresnos. The oversize passed through a crusher and to a chain bucket elevator to the screen, being separated here by the wet process. The coarse aggregate passed direct to the bins, while the sand dropped with the water through a spout to a twin auger laundry, and thence into the sand bin.

ARIZONA HIGHWAY DEPARTMENT  
STANDARD EXPANSION JOINTS  
FOR  
CONCRETE PAVEMENT



CROSS SECTION OF  
CONCRETE PAVEMENT  
THE (MARICOPA) ARIZONA SECTION



### Inspection and Testing

Before the gravel plant is finally located, samples of the pit run materials are collected and sent to the laboratory and tested. Providing these samples stand the test and are approved by the State and Bureau of Public Roads, the contractor is notified that he can use material from that particular locality and the plant is erected. When the plant is put into operation, samples are taken of the entire output for the project, each sample to represent not more than 100 cubic yards of the sand and rock respectively. This sampling is kept up incessantly through the job. Each batch of sand and gravel is measured at the bin at the gravel pit and is transported to the cement shed, where it receives its batch portion of cement, thence, to the mixer where the pavement is going into place.

Samples of cement, steel, metal pipe, and other materials are taken and sent to the laboratory, the approval of these tests being required before they go into the job.

To prove further the quality of the material, the following procedure is used:

First—During the process of mixing and at about 1,000 foot intervals along the pavement, three 6 by 12 inch cylinders are fabricated and cured in the same manner as the pavement. After 28 days curing, these cylinders are broken under compression, the required strength at that age being 3,000 pounds or more per square inch.

Second—By taking five inch cores from the semi-cured pavement as fabricated by the mixer and broken in the same manner as the hand fabricated cylinders, these breaks coming 28 days after fabrication. The location of the core station is identical with that of the hand fabricated cylinders, thereby showing a comparison of strength between the hand fabricated and machine fabricated concrete, which is of identically the same mixture of cement, sand, rock and water as the concrete that went into the hand fabricated cylinders.

The new pavement is cured under water by the ponding method. As soon as the concrete has set up so as to permit dykeing, the slab is dyked and ponded, remaining under water 10 days. The damp

earth is allowed to remain on the pavement from five to seven days, when it is cleaned off. The top portions of the expansion joints are then cleaned and filled with "grade D" asphalt, and at the end of 21 days the pavement is thrown open to traffic. The longitudinal center joint is also filled with asphalt, and as an aid to the traveling public and measure of safety to all, a traffic dividing line will be placed along the center line of the pavement. As soon as the necessary equipment is complete the zoning scheme will be carried out on all the pavements of this district.

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#### PHOENIX-YUMA HIGHWAY



CONSTRUCTION OF PAVEMENT JOINT



**DISTRICTS NUMBERS 3 AND 4****E. M. WHITWORTH, District Engineer****GILA COUNTY****Rice-Springerville Highway**

From Rice to Fort Apache and from Fort Apache to Cooley, the government had built a poorly drained, narrow road, with steep grades and sharp curves. This road was built primarily as an outlet to the north and south for the Army Post at Fort Apache, and the Indian Reservation Headquarters at Whiteriver. The Apache County Highway Commission has built a good road from Cooley to Springerville, with County Bond Issue money.

From Cooley to Fort Apache \$100,000 has been set aside by Congress to be matched by the State of Arizona. A survey was made over this stretch by the Highway Department in the winter of 1923. From Fort Apache to Rice, some 62 miles, a reconnaissance survey was made and it was finally decided that on account of the lack of funds, the work would be concentrated in widening and draining the present road. Gila County appropriated \$10,000 and the State a like amount, out of Gila County's 75 per cent Fund for this work.

On March 10, 1924, County forces, under James Parker, County Engineer, and Randolph Bone, Superintendent of Construction for Gila County, started work. The equipment consisted of two trucks, a five-ton caterpillar and an 8 inch grader, a No. 3 RR plow and the necessary picks and shovels. The unskilled labor consisted of Indians from the Indian Agency at San Carlos.

After work commenced it was found that the State had no right-of-way over the existing road. This was soon remedied, through the efforts of the Indian Agent at San Carlos. The agent also obtained authority to supply lumber from the agency's saw mill for all small culverts and bridges.

On July 1, the Board of Supervisors and the State Engineer authorized an additional \$10,000 to be spent on this project. Up to November 30, 1924, approximately 40 miles of this section had been regraded and drained.

### **Globe-Roosevelt Highway**

The State Highway Department and the Board of Supervisors of Gila County. entered into an agreement to spend \$25,000 widening the Apache Trail from the junction with the Miami-Globe Highway toward Roosevelt. About March 1, 1924, State forces under Hugh McKay, general foreman, started work. This piece of road was one of the first built by the State Highway Department. The road was very narrow, the grades steep and the curves very sharp. Furthermore, the road bed had lost its shape and was hard to maintain.

The forces started about two miles from the Miami Junction and worked toward Roosevelt, widening curves, reshaping, and in spots resurfacing the road. One major line change was made. On July 1, 1924, a further agreement was entered into by the State Highway Department, and the Board of Supervisors of Gila County for additional funds to carry on this work. One small portable compressor was used on this project. The material was moved by fresnos. On November 30, 1924, about 22 miles were completed.

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### **GRAHAM COUNTY**

#### **San Carlos-Solomonville Highway**

#### **Central-Safford Section, Federal Aid Project No. 43**

#### **E. M. Whitworth, Resident Engineer**

This portion of the San Carlos-Solomonville Section, all of which is contract work, including Federal Aid Projects 63, 67 and 43, extending from Mathews Wash, or the beginning of Federal Aid Project 63, to two miles east of Solomonville, or the end of Federal Aid Project No. 67, a distance of 20.7 miles. This section, when Federal Aid Project No. 67 is completed, will be a continuous paved section of 13.2 miles of cement concrete road and 7.5 miles of asphaltic concrete.

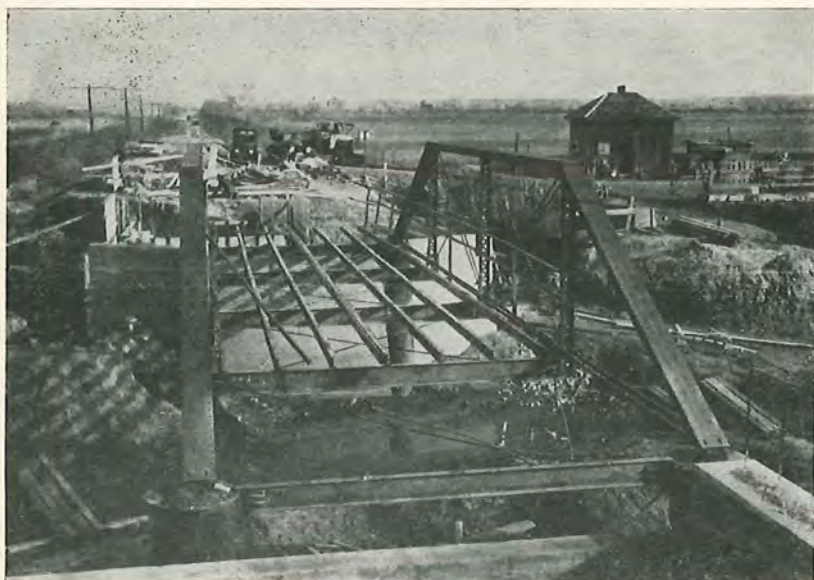
The first section to be completed was Federal Aid Project No. 43 in May, 1923. It is a standard 18 foot pavement section of cement concrete with five foot shoulders. It is six miles long and lies between Central and Safford.



**San Carlos-Solomonville Highway****Mathews Wash Central Section****Federal Aid Project No. 63****E. M. Whitworth, Resident Engineer**

Federal Aid Project No. 63, a standard 18 foot pavement section of asphaltic concrete 7.5 miles long, between Mathews Wash and Central, was completed July 15, 1924. On this project, at Cottonwood Wash, west of Pima, a combination ford and overflow bridge, 792 feet long, was constructed. This is the only structure of its type in the State.

The subgrade for this pavement was checked in place on a previous contract to N. J. Skousen, contractor, that it might take settlement in heavy fills before paving. Heavy rains washed out sections of the fills and as a result sufficient material was not available for the paving contractor to develop a seven foot shoulder as was originally planned.

**GERONIMO-SOLOMONVILLE HIGHWAY****REPLACING OLD SAN SIMON BRIDGE**

Ample material was at hand to maintain a shoulder which will protect the edge of the pavement. It is hoped that a satisfactory agreement can be reached with the Bureau of Public Roads for the department to construct a variable shoulder, the width being governed by local conditions as to borrow.

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### **San Carlos-Solomonville Highway**

#### **Safford-Solomonville Section**

#### **Federal Aid Project No. 67**

#### **O. H. Swaney, Resident Engineer**

This is a cement concrete paving contract, at present under construction. It is an Arizona type section, 18 feet wide, with a five foot shoulder. The contract was 11 per cent complete June 30, 1924, and was 80 per cent complete November 30, 1924. All structures, with the exception of the new San Simon bridge of 110 foot span and a box culvert in the Union Canal, are in place.

Satisfactory progress is being made in the forming of the abutments for the San Simon Bridge. Due to improper foundation material at the elevation shown on the plan for abutments, it was found necessary to change the design of the abutments and drive pile foundations. The piling was driven and the footing poured by State forces under supplemental agreement with the contractor.

The delay on the structure in the Union Canal was due to the need of farmers for water for irrigation purposes. This prevented the turning of the water out of the canal so that the culvert might be installed.

The pavement, the Arizona type section, is nine inches on the edge and six inches in the center. The submerged type of joint is being used and joints are being placed three to each 100 feet of pavement. Great care and interest have been taken in the development of this joint, which, it is believed, is as smooth riding as any developed in the State. The riding qualities of the pavement have occasioned considerable favorable comment from persons who travel over it constantly.



The eastern end of the project is complete for a distance of 3.2 miles and is open to traffic from Solomonville to the end of the project toward Clifton. The western end of the project is being traveled for a distance of one-half mile, but the pavement is in place and over the curing period as far as Lone Star. There is a short gap at the Union Canal that can not be detoured and hence the pavement is not being traversed.

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**Solomonville-Duncan Highway**

**Federal Aid Project No. 77**

**O. H. Swaney, Resident Engineer**

This project, 12.1 miles long, a roadway section of 24 feet, which in the main passes through natural road material, is known as the Solomonville-Duncan Highway. It is being constructed by State forces.

The project begins at a point eight miles east of Federal Aid project 67 on the Clifton-Solomonville Highway and extends toward

**SOLOMONVILLE-DUNCAN HIGHWAY**



**CONSTRUCTING A 20-FOOT SLAB BRIDGE**

Duncan. The road was seven per cent complete June 30 and 75 per cent complete November 30. It is a most important tie in the road east to Lordsburg, N. M., will eliminate a very bad section of road that exists between Solomonville and Duncan. The contract, it is estimated, will be completed about March 15.

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## **GREENLEE COUNTY**

### **Clifton Solomonville Highway, Resurfacing**

After the completion of the resurfacing of the Miami-Superior Highway the State Crew consisting of gas shovel, fleet of trucks and camp outfit was moved on to the Clifton-Solomonville Highway in Graham County and resurfaced about six miles to the Greenlee County line. The work was continued into Greenlee County surfacing about four miles from the County Line toward Clifton. This placed this highway in good condition.

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## **PINAL COUNTY**

### **Florence-Superior Highway**

#### **Federal Aid Project No. 23, Sections A. C. E. F.**

#### **H. B. Wright, Resident Engineer**

The Florence-Superior Highway, Federal Aid Project No. 23 is divided in sections lettered from A. to F. Sections A. C. E. & F. are grouped into a single project, however. On January 1, 1923, the section of this project was under construction by contract, and 80 per cent complete. This contract was for the grading and structures and was finished May 31, 1923. Following the completion of this contract the State surfaced this project, consisting of 4.5 miles, from the Queen Creek Bridge into Superior. This work was done with a gas shovel and a fleet of trucks and was completed June 26, 1923.

On November 27, 1923 a contract was entered into with R. H. Martin of Tucson for the construction of the drainage structures, mostly paved fords on Section A. of this project. This contract was completed March 19, 1924. At the same time and in connection



with this contract the State with State forces did some additional grading work adjoining the paved fords, and constructed additional and much needed drainage ditches.

Upon the completion of this contract by R. H. Martin an additional contract was awarded him on section E. of this project for the construction of concrete wing walls on the bridge across Queen Creek. Upon the completion of this contract May 17, 1924, the entire project from Florence to Superior was completed. The previous construction work on the project was reported in the Fifth Biennial of the State Engineer.

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### **Miami-Superior Highway, Resurfacing**

After the completion of the surfacing of Federal Aid Project No. 23F, by the State forces the same outfit without moving its camp and from the same pit resurfaced 4.5 miles of the Miami-Superior Highway beginning at Superior and extending the work toward Miami. This work was completed in July 25, 1923, and the outfit moved to the Clifton-Solomonville Highway.



**DISTRICT NO. 4****COCHISE COUNTY****Douglas-Rodeo Highway**

A total number of thirty-seven concrete dips have been constructed by State forces on this Highway. Those with a width of 22 feet total 2,198 lineal feet; those with a width of 18 feet total 2,342 lineal feet.

On this project the railing of the Silver Creek Bridge, 117 feet long, was replaced with a solid reinforced concrete hand rail. 3,224 lineal feet of paving between the side walls in place was paved, amounting to 1,439 cubic yards of concrete.

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**Safford-Douglas Highway**

This highway is at present under construction with State forces. It is approximately 30 miles in length, 18 feet in width, with all necessary drainage structures. The project passes through satisfactory road material, with the exception of a distance of between five and six miles. It is impossible to judge exactly what some of this material will do until it has been dragged after the rains. It may be possible to reduce this mileage of surfacing as we have not actually started this operation, and we are bound to have some rains soon, at which time the entire section will be dragged.

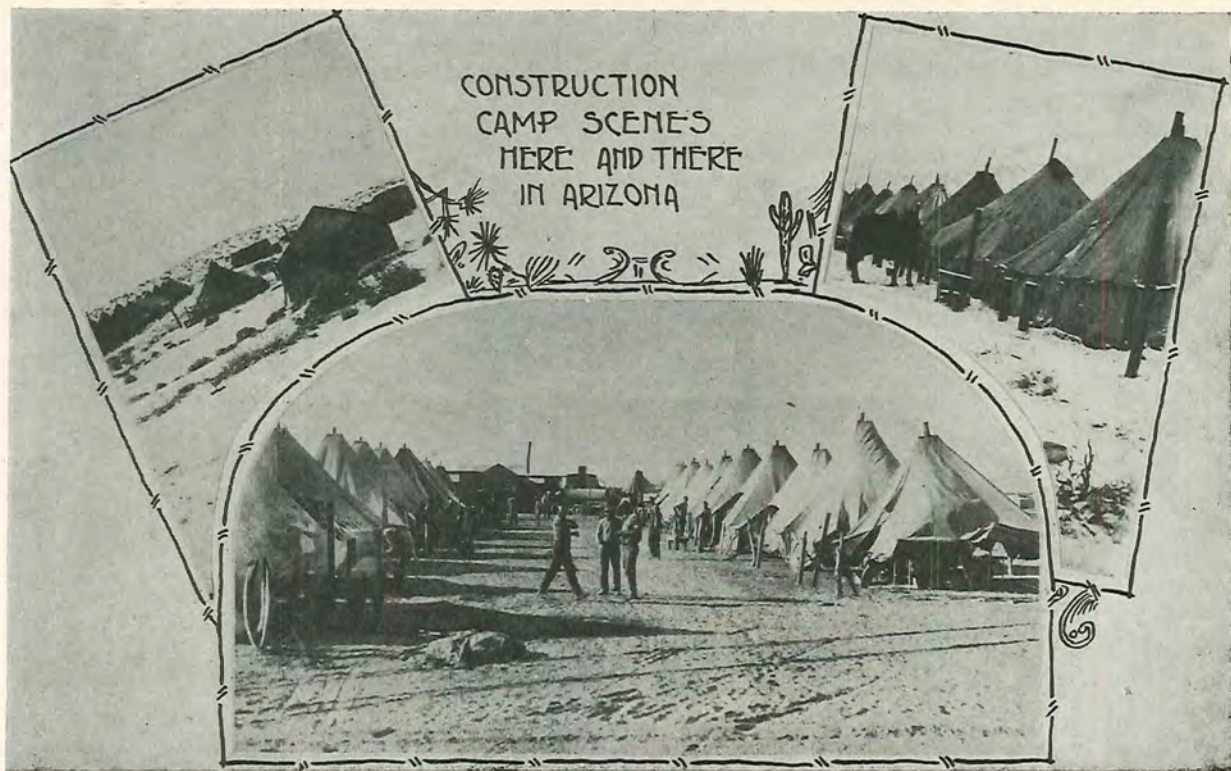
The surfacing will be started immediately. The drainage structures and cattle guards are complete in place from Pearce to a point two miles south of Elfrida. All grader section has been completed to the end of the project. Team work is moving satisfactorily. We hope to have the work completed by the last of February.

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**Benson-Tombstone Highway**

Upon the completion of the paved fords on the Douglas-Rodeo Highway, the State crew employed upon that work was moved over to the Benson-Tombstone Highway and paved the fords with concrete, as was done on the Douglas-Rodeo Highway. This work was completed in March 1924.





**PIMA COUNTY****Florence-Tucson Highway**

On January 1, 1923, there were three State construction camps, two of which were in Pima County and one in Pinal County, working on the Florence-Tucson Highway. There remained at that time eight miles of highway to be completed and several concrete structures, most of the remaining work being in Pinal County.

Although the camps were stationed in the two counties, and operating partly from the county's 75 per cent funds; the three camps were under one head and no comprehensive distribution as to the county's funds being kept. Therefore, it was deemed advisable to consolidate the camps, and thereby reduce the overhead in both the camp and the engineering expense.

On March 15, 1923, due to shortage in the finances of the Department, this project was entirely closed down, there remaining approximately four miles of highway to be completed. However, after July 1, 1923, this work was resumed and completed, also additional drainage structures were constructed on the part of the Highway between the Pinal County line and Florence, that had been previously constructed.

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**TUCSON-NOGALES BRIDGES****Federal Aid Project No. 25B**

**J. W. Larimore, Resident Engineer**

This contract is a portion of the one of which the 37 foot six inch bridge awarded to Lown and Woods, in Santa Cruz County, is a part. It consists of four structures in Pima. The installation of these structures did much to improve a situation that was most serious in nature. Prior to the construction of these structures traffic was oftentimes held up during rainy seasons, due to insufficient waterways in dips.

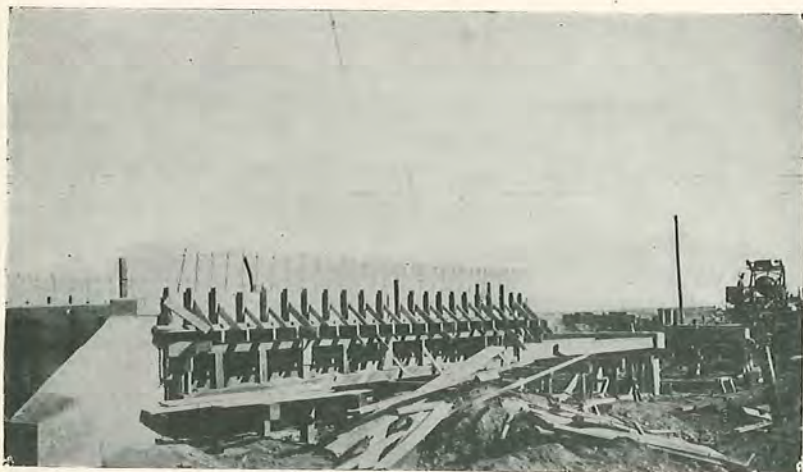
The new structures consist of three bridges of 109 feet, 33 feet-six inches and 57 feet, respectively, together with a double barrel culvert 9X8 feet. The contract was completed in June, 1924.



**Continental Bridge****Federal Aid Project No. 75****J. W. Larimore, Resident Engineer**

This is one of the most needed structures on the Nogales Highway, and with its completion, which should be about February 15, 1925, the Department will have taken care of all needed drainage on this highway. The structure is one of four 32 foot spans. The contract was originally awarded the Shumway Construction Company, who excavated the east abutment. The raise in grade of the roadway was made for approach to the east of the bridge, and Page Hi Way Guard Fence placed for a distance of 2,097 feet on either side of the fill.

As the progress of the work on the bridge was unsatisfactory, a Supplemental Agreement was entered into with L. C. Lashmet, who is at present making satisfactory progress on the structure. The length of the project is .0614 miles which, in addition to the Bridge, consists of the necessary approaches. Of this total contract the Shumway Construction Company was credited with 42 per cent as of June 30th, 1924.

**TUCSON-NOGALES HIGHWAY****CONCRETE PILE TRESTLE ON FEDERAL AID PROJECT NO. 75**

Under the Lashmet contract the total project was 47 per cent complete November 30, 1924. On this date the east abutment was complete in place, the west abutment is excavated and piles in place. The bridge proper, on November 30, was 32 per cent complete. The detour is in a satisfactory condition and being well maintained.

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## **SANTA CRUZ COUNTY**

### **Tucson-Nogales Bridges**

#### **Federal Aid Project No. 25B**

**J. W. Larimore, Resident Engineer**

This project consists of five structures, one of which is in Santa Cruz County. The contract was awarded to Lown and Woods. Work on this contract was commenced November 1, 1923, and was completed in the latter part of June 1924. This bridge is 37 feet six inches in length and eliminates what was a bad crossing in the old dip which had inadequate waterway, causing overflow to adjacent roadway and washing out approaches to the dip in rainy seasons.

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#### **Federal Aid Project No. 66**

**J. W. Larimore, Resident Engineer**

This project was awarded to the Shumway Construction Company. It consists of three bridges of 36 feet six inches, 32 feet six inches and 80 feet six inches in length. They rectify all the previous drainage faults that existed in their respective locations. Contract completed.

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#### **Structures Adjacent to Federal Aid Project No. 66**

**J. W. Larimore, Resident Engineer**

This contract is comprised of three culverts, viz: 6X4, 5X3, and 5X3 respectively. In addition to this there are three single wall dips, with a total length of 400 feet. The contract was awarded Lown and Woods and was completed in the latter part of August 1924.



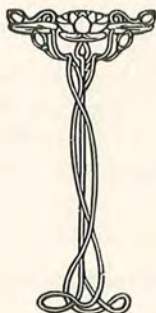
### Patagonia Bridge

On January 1, 1923, the Patagonia Bridge, spanning Sonoita Creek, a steel structure 170 feet in length, was under contract to Lown and Woods, contractors, and was 21 per cent completed. This structure was completed and opened to traffic June 1, 1923.

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### Nogales-Patagonia Highway

Under an agreement with Santa Cruz County, the State began the reconstruction and repairs of the Nogales-Patagonia Highway with two camps of State forces. The first camp began at Patagonia and to date has reconstructed seven miles of the heaviest part of the work, and about four miles of the lighter section. The second camp began on the Nogales end and has repaired about seven miles toward Patagonia. The total mileage involved in this project is 21 miles, and with its completion, together with the present Tombstone-Patagonia Section, will mean a good road from Tombstone to Nogales.



## SACATON-FLORENCE POWER LINE

The Arizona Legislature in 1917 appropriated \$50,000. for the purpose of constructing an electric power transmission line from the transmission line of the Roosevelt Project in the vicinity of Sacaton to the Arizona State Prison at Florence. The amount of the appropriation was insufficient to construct the line, but the appropriation was reappropriated and maintained, and in 1919 negotiations were begun with the Government for a right of way across the Sacaton Indian Reservation.

In 1923 Electrical District No. 2, Pinal County, was formed and voted bonds for the construction of electrical power transmission lines in the valley. After considerable negotiations, an agreement was entered into between this district and the State, whereby the State would construct a given mileage of sufficient capacity to carry both the district's power and that of the State, and would grant it free transmission over the State's portion, provided that it would complete the line into the prison at Florence. The necessary contracts with the Salt River Valley Water Users' Association were then entered into for the power supply.

The District entered into a contract with the Jasper-Stacy Company, contractors of San Francisco, for the construction for its transmission system, including the line into the prison. Following this and under the date of July 1st, 1924 the State entered into a contract with the same contractors for the construction of its line consisting of 11.7 miles of a 40 K. V. A. Electrical Transmission Line, including a crossing of the Gila River near the Sacaton Diversion Dam. This line begins near the Sacaton Sub Station and extends easterly 11.7 miles.

This contract was completed October 20, 1924, and power turned into the line about November 22, 1924.



PHOENIX-WICKENBURG HIGHWAY



TYPICAL MAINTENANCE EQUIPMENT

## Maintenance

A highway is no better than its maintenance. The maintenance of the Arizona State Highway System presents many varied and difficult problems. The territory traversed extends from the snow capped, forested mountain summits and wind swept plains of the northern part of the State to the arid deserts of the southern part. The materials encountered are of many classifications and are ever varying. Equipment must necessarily vary and neither standard equipment nor methods may be applied. Each section of the highway must be studied and equipment and methods planned accordingly.

In the last decade engineers and the public have been educated to the fact that proper maintenance is as important as proper construction and location of the roads. The three branches of highway construction should go hand in hand. When considering the design for the construction of a highway, particularly the surface, the engineer of today gives very careful consideration to the problem of future maintenance.

Less than a decade ago, highway construction and operation suddenly advanced into the largest development program that this country has ever known. Engineers skilled in this branch of the profession were pitifully few, and in filling the ranks they were naturally drawn from the railroads, that line being the most similar.

While the location and construction of the subgrade and drainage of the highways is somewhat similar to that of the railroads, the surface and maintenance of highways is extremely dissimilar. The absence of precedence in this work, and the economic necessity of utilizing local material for surfacing caused many mistakes which have added materially to the problems and cost of maintenance.

The principal errors were:

First—The use of inferior surfacing



Second--The use of an excessive amount of large size material.

Third--The placing of surfacing upon uneven subgrading and the uneven placing of surfacing.

Fourth--By not providing stock piles for the future maintenance at convenient locations.

The fact however that these mistakes were made in the earlier construction is now and will be invaluable in the future construction of the highways of the State. This has afforded the opportunity of combining practical with scientific study, which is resulting in the betterment of the design and construction of the highways, and the maintenance and operation, both physically and economically.

In addition to the past construction mistakes, the Department, in the past two years has been confronted with the extreme dry weather, and the phenomenal increase in traffic. Some of the gravel surfaced highways are now carrying traffic in excess of the economic endurance of such surface material, and others rapidly reaching that stage. This also has required experiments in maintenance equipment.

Highway maintenance is now and is becoming more and more a problem requiring special ability and experience, together with the aid of laboratory research work. This fact is recognized by the Department and every effort is being exerted to attain the highest degree of economic maintenance and render the public the best service possible.

**HIGHWAY DISTRICT NO. 1**

Comprising the Northern, Northeastern and  
Northwestern Counties

B. M. ATWOOD, District Engineer

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**APACHE COUNTY****St. Johns-Springerville Highway**

W. E. Wiltbank, Foreman. Length 20.5 Miles

This section includes Federal Aid Projects numbers 60 and 68A. The foreman is equipped with one F. W. D. truck, a small grader, three iron drags and a wooden leveler as well as the usual small tools. The wooden leveler is being used on cinder surfacing during compaction.

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**Holbrook-St. Johns Highway****Section 2.**

R. L. Overson, Foreman. Length 11.0 Miles

This section joins the other Holbrook-St. Johns section at the Navajo County line and extends east 11 miles. It includes the Milky Wash bridge. The equipment consists of an F. W. D. truck, a small grader, three drags and a 600 gallon water tank on a trailer.

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**Holbrook-St. Johns Highway****Section 3**

Sanford Hunt, Foreman. Length 19.5 Miles

This section includes 21.1 miles on Federal Aid Project No. 6, and 7.5 miles of State road running west. It includes also the Concho, the Beaver Dam and the Hunt steel bridges over the Little Colorado. The equipment comprises one F. W. D. truck, a small grader, three iron drags and the usual small tools.



**Adamana-Lupton Highway****Sanders-State Line Section****J. N. Overson, Foreman. Length 22.5 Miles**

This section begins at the New Mexico State line on the Adamana-Lupton Highway and extends west 22.5 miles to Sanders. It includes the Lupton, Allentown and Sanders bridges. The equipment comprises an F. W. D. truck, a small grader and three drags.

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**Adamana-Lupton Highway.****Navajo County Line, Sanders Section****L. E. Grimes, foreman. Length 35.1 Miles.**

This division of the Adamana-Lupton section extends from Sanders, on the Adamana-Lupton Highway a distance of 35.1 miles to the Navajo County line. The foreman is equipped with a 10-ton Holt Caterpillar, one No. 10 Adams grader, three drags and one G. M. C. truck with a Michigan anti-chatter bump machine attached.

During the summer and fall of 1923 unusually hard rains caused considerable damage to the roads and bridges in this section, necessitating the putting on of an extra bridge gang to build pile trestle at Beaver Dam, where the concrete bridge failed, due to poor foundation. The small structure, one mile west of Milky Wash, which was lost in the flood of September 1923, also was replaced.

The cost of replacing these two structures was \$1,458.81, but this, as well as other work of betterment, improvement and reconstruction, was charged to maintenance.

The maintenance crews, up to July 1924, not only carried on the regular maintenance work but lightly surfaced many miles of State road, widened old fills, built dips where old culverts were too small, replaced old wooden boxes, widened curves and conducted other work of this character.

Since July 1924, this has been changed, so that a more comprehensive report of maintenance cost can be given in the future by the use of A. F. E. forms.

**NAVAJO COUNTY****Holbrook-St. Johns, Highway****Section 1****John De Witt, Foreman. Length 22.4 Miles**

This section extends from Holbrook east 11.3 miles, including six miles of State road, the west 5.3 miles of Federal Aid Project No. 42 and the Little Colorado River bridge. From Holbrook west, it embraces the east 11.1 miles of Federal Aid Project 40 and the LaRue and Tanner Wash bridges.

The equipment on this section consists of an F. W. D. truck, three drags, small tools and one Superior two-way maintainer.

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**Holbrook-St. Johns Highway****Section 2A****R. L. Overson, foreman. Length 9.0 Miles**

This section begins at the Apache County line on the Holbrook-St. Johns Highway and extends west. It includes Federal Aid Project 3 and the east 5.3 miles of Federal Aid Project 42. The foreman is equipped with an F. W. D. truck, three drags, a grader, small tools and a 600 gallon water tank on a trailer.

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**Holbrook-Winslow Highway****Ambrose Hunt, Foreman. Length 20.4 Miles**

This section extends from Winslow east to Federal Aid Project No. 40, reopened and includes the St. Joe bridge, the Little Colorado River bridge at Winslow, and the Cottonwood and Manilla bridges. The equipment comprises one F. W. D. truck, a grader, three drags and small tools.

On each of the maintenance sections in this county, considerable damage was caused by rains and floods during the summer and fall of 1923. Federal Aid Project No. 40 suffered most on account of the old wooden bridges and improper drainage.

In the fall of 1923, an extra gang on Federal Aid Project 42 made the repairs to damaged structures. They built new storm



ditches and repaired shoulders, fills and all Class B fords at an expense of \$4,589.90. In 1924 another extra gang was used on virtually the same class of work at an expense of \$2,287.20.

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## COCONINO COUNTY

### Flagstaff-Williams Highway

#### Section No. 1

**E. Newberry, Foreman. Length 16.5 Miles**

This section includes 15.1 miles of Federal Aid Project No. 24 and 1.4 miles of State road, all of which is of cinder surface. Considerable damage was caused to this section by a logging company near Riordan in the spring of 1923.

After agreeing to co-operate in the cost of resurfacing, the logging company refused to meet payment. The matter was taken up with the Forest Service and the company's permit to use the road was revoked. Under a present agreement the company pays a stipulated amount per thousand feet board measure for all logs hauled over the road, but this makes it difficult to enforce the load limit per width of tire. However, since the last agreement was made there has been no trouble, as the company officials seem willing to co-operate.

Repair of the damage to the road before the permit was revoked, necessitated the putting on of an extra gang at a cost of \$3,829.80, which was charged to maintenance.

The foreman on this section is equipped with one 10-ton Holt caterpillar with snow plow, one F. W. D. truck, one No. 7 Road King grader, three drags, one 600 gallon water tank on a trailer and small tools.

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### Flagstaff-Williams Highway

#### Section No. 2

**Harry Wade, Foreman. Length 16.5 Miles**

This section extends from Williams, east 16.5 miles and is all State road. In the spring of 1923 this road also was damaged by the logging company. Extra trucks were employed and the road

repaired at a cost of \$490. The greater part of this old State road is only 16 feet wide, but it is all surfaced, three miles gravel and 13.5 miles cinder. The equipment on this section comprises one F. W. D. truck, one grader, three drags and a 600 gallon water tank on a trailer.

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### **Williams-Ashfork Highway**

**Charles Ralph, Foreman. Length 16.3 Miles**

The Williams-Ashfork Highway extends from Williams west 16.3 miles and includes 4.8 miles of Federal Aid Project No. 51, with 2.8 miles of Federal Aid Project No. 37 and 8.7 miles of State constructed road.

Considerable difficulty has been experienced in keeping this road in repair for the following reasons:

- 1—On account of the quality and size of the surfacing used.
- 2—The absence of proper graded and selected material with which to resurface and patch.
- 3—Heavy grades.

Equipment on this section consists of one F. W. D. truck, one grader, three drags and one 600 gallon water tank. More suitable equipment is contemplated for this section.

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### **Ash Fork-Kingman Highway**

**Seligman-Nelson Section**

**H. S. Kerby, Foreman. Length 8.8 Miles**

This section begins 23.3 miles west of Seligman and extends to the Mohave County line, a distance of 8.8 miles. This is of State construction and is not up to present bureau standards. The equipment comprises a 10-ton Holt Caterpillar, one No. 10 Adams grader, five drags, one F. W. D. truck and one 600 gallon water tank on a trailer. This equipment also is used by two other sections.



**MOHAVE COUNTY****Topock-Kingman Highway****Kingman-Oatman Section****A. W. Johnson, Foreman. Length 15.0 Miles**

This section begins at the foot of the Seventeen Mile Hill (Federal Aid Project No. 54, cancelled) and extends south and west through the towns of Goldroad and Oatman to the north end of Federal Aid Project No. 39, including Federal Aid Project No. 5, Federal Aid Project No. 44 and 11.4 miles of State and County construction.

The maintenance crew completed Federal Aid Project No. 54 and has built some retaining wall on the mountain, also erecting some guard rail. The foreman is equipped with one F. W. D. truck, a grader, two drags and a 200 gallon water tank.

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**Topock-Kingman Highway****Topock-Oatman Section****E. M. Schottmiller, Foreman. Length 21.6 Miles**

This section includes Federal Aid Project No. 39. It is 21.6 miles long, extending from Topock north and east to Boundary Cone.

Considerable damage was caused to this section by heavy rains during November 1923. All Class B. fords were damaged, surfacing was washed out and in some instances concrete walls were destroyed. At Four Mile Wash approximately three-fourths of a mile of fill was carried away and the roadway was destroyed.

An extra gang was employed to make repairs and to construct extra storm ditches. This crew was kept at work until January 1924 with the expense totaling \$3,468.41.

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**Ash Fork-Kingman Highway****Seligman-Nelson Section****H. S. Kerby, Foreman. Length 6.0 Miles**

This section extends from Peach Springs east six miles to the Coconino County line. This road, on the Hualpai Indian reserva-

tion, is of State construction, not surfaced but good natural formation. The equipment used on this section is the same as that used on the other two Seligman-Nelson sections.

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## **YAVAPAI COUNTY**

### **Williams-Ash Fork Highway**

#### **Ash Fork-County Line Section**

**Charles Ralph, Foreman. Length 2.4 Miles**

This section extends from Ash Fork east to the County line. It has one railroad crossing and two small wooden bridges on the east boundary of Ash Fork. These bridges are old and have been repaired several times in the past two years. A survey has been made with the idea of using one structure for grade separation and both bridges, and to rebuild east to the county line. The equipment that is used on the other Williams-Ash Fork section is also used on this section.

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### **Ash Fork-Kingman Highway**

#### **Ash Fork-Seligman Section**

**James T. Cook, Foreman. Length 26.0 Miles**

This section extends from Ash Fork west to Seligman, a distance of 26 miles, including Federal Aid Project No. 57. Only a small portion of this road has been surfaced and little of the construction, other than Federal Aid Project No. 57, is up to standard.

Three standard cattle guards have been constructed by the maintenance crew in the past two years. Some curves have been widened, and in addition to the patch work and regular maintenance, about a mile has been resurfaced. The equipment comprises one F. W. D. truck, a small grader, and two drags.

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### **Ash Fork-Kingman Highway**

#### **Seligman-Nelson Section**

**H. S. Kerby, Foreman. Length 23.3 Miles**

This section extends from Seligman 23.3 miles west to the Cocino county line. It is an unsurfaced dirt road, crossing Audley Valley where the material is adobe and except for a short time af-



ter rains and snow the road stands up well. The maintenance crew has installed three standard cattle guards and carried on some surfacing work in addition to the usual maintenance. The equipment is the same used on the other two Seligman-Nelson sections.

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### **Prescott-Ash Fork Highway,**

#### **Section 1**

**Pete Travers, Foreman. Length 23.5 Miles**

This section comprises Federal Aid Project No. 62, from Ash Fork south 23.3, and including the Hell Canyon, Little Hell Canyon, Prairie and Johnson Creek bridges. Fifteen miles of this section has been surfaced with volcanic cinders and 8.3 miles with gravel.

Extreme care has been given to this road while in the process of setting up, and as specifications required that the maximum size of gravel should pass one and one-fourth circular openings, the material is uniform, making an excellent road.

The roadway is 24 feet but the surfacing is only 12 feet on the crown and feather edged out 18 feet on the base. With a smooth surface, it has made a dangerous speedway, for regardless of the law, many cars drive from Ash Fork to Prescott, a distance of 53 miles in an hour and some have made lower records. In driving off the 12 foot crown to pass other cars, many drivers have lost control of their automobiles and some accidents have proven fatal.

In addition to the regular maintenance, the crew has built and surfaced a road and graded a section from near Station 918 into the village of Drake, a distance of one-half mile.

The equipment comprises an F. W. D. truck, three drage, one 600 gallon water tank on a trailer and a Weir one-man grader. The one-man grader has proven very successful for this type of road and maintenance, using less labor, less gas, less oil, less interest on the money invested and will do more work than a truck and grader at almost double the expense.

The Fordson one-man grader not only handles the blade to advantage in keeping the feather edged surfacing shaped up, but pulls a three blade Good Roads drag at the same time.

**Prescott-Ash Fork Highway****Section 2****W. B. Wren, Foreman. Length 22.2 Miles**

This section comprises Federal Aid Project No. 61, extending from Granite Creek bridge on Federal Aid Project No. 19B to the south end of Federal Aid Project No. 62.

Maintenance of this section includes the Willow Creek, Chino Wash, Verde River and Coyote Wash bridges. The majority of the south 17.5 miles is surfaced with decomposed granite and a sort of sand-clay mixture. The north five miles is surfaced with gravel.

The surfaced section on this road is a 14-foot crown with a 16-foot base. It is impossible, as well as dangerous to the traveling public, to try to maintain this section on a 24-foot roadway, where all cars travel at a high rate of speed. Therefore the road had been feather edged.

The majority of the sections on this road, where surfacing was omitted—thinking them self-surfacing—have been lightly surfaced by the maintenance crew. There still remains about a half mile of this work to be carried on.

The few rains since the completion of the road have washed virtually all surface out of the dips, making it necessary to resurface those portions after each rain. This is caused, for the most part, by the upper wall in the Class B standard fords. Some of the trouble, however, is caused by the fact that the vertical curve is not properly designed.

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**Prescott-Jerome Highway****Section 1****William Singleton, Foreman. Length 19.3 Miles**

This section includes Federal Aid Project No. 36, 36B, 19A and 19B. It extends from Prescott, northeast, for a distance of 19.3 miles and includes the Upper and Lower Granite Creek and Fort Whipple bridges.

During the summer months the traffic over this road is extremely heavy, and on some days, it is estimated, more than 1,500 cars trav-



el over it. The winter traffic is approximately one-third that of the summer months.

Virtually all of Section A and part of Section B is grader built road. Most of it is surfaced, but for only 12 or 14 feet in the center, while the road in some places is 40 feet in width. The surfacing has feathered out, the road has too much crown, and as the profile and cross-section was bad at the beginning, especially at curves where the road has the same section as on a tangent, it has been difficult to correct it with regular maintenance.

In the past two years an effort has been made to correct these faults by properly directed maintenance, but without proper equipment the results have not come up to expectations, though considerable progress has been made.

Equipment on this section consists of an F. W. D. truck, a grader, four drags and small tools.

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### **Prescott-Jerome Highway**

#### **Section 2**

**Given Teel, foreman. Length 14.0 Miles**

This section includes Federal Aid Project Nos. 12 and 17 and 7.1 miles of State constructed road. It extends from Jerome southwest over Mingus Mountain to the northeast end of Federal Aid Project 19A, a distance of 14 miles. Approximately 11 miles of this section is mountain road, with many curves and grades ranging from one to six per cent. Without crushing, surfacing of proper size is scarce. However, as the subgrade is mostly rock, it does not rut badly except in a few places.

As the elevation of the road at the summit is 7,025 feet, considerable trouble is caused by snow during the winter months.

The equipment consists of a 10-ton Holt caterpillar, three drags, small tools and an F. W. D. truck.

**HIGHWAY DISTRICT NO. 2**

Comprising the South Central and Southwestern Counties

**T. S. O'CONNELL, District Engineer**

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**MARICOPA COUNTY**

**Phoenix-Yuma Highway**

**Stanwix-Piedra Section**

**R. L. Mitchell, Foreman. Length 21.8 Miles**

This section was completed in July 1924, and with the exception of three miles just east of Stanwix, is a high type of selected material road. The three miles east of Stanwix failed, due to poor subgrade, combined with extreme dry weather. A surfacing crew is now placing five inches of caliche gravel on this section of the road. Aside from this no great maintenance problems are now noticed.

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**Phoenix-Yuma Highway**

**Piedra-Gila Bend and Gila Bend-Gillespie Dam Section**

**Con Harrington, Foreman. Length 24.4 Miles**

This section extends from Piedra on the west to Gila Bend, thence north toward Gillespie Dam for a distance of 9.5 miles. The material on the west end was hauled in on the railroad and no provision was made for stock piles for maintenance. The remainder of the section is easily maintained as suitable material can be obtained from pits along the road.

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**Phoenix-Yuma Highway**

**Gillespie Dam-Hassayampa Section**

**C. J. Moon, Foreman. Length 25.2 Miles**

From a point 9.5 miles north of Gila Bend to Gillespie Dam, the road was surfaced with gravel containing a large percentage of oversize. The surfacing was placed on very unevenly, especially just south of the dam. A portion of this was capped with two inches of granite sand-clay surfacing in the spring of 1923. How-



ever, on account of the long, dry spell, most of the binder has blown away, leaving a layer of granite sand over the oversize gravel.

From Gillespie Dam north for 1.3 miles a temporary road has been built connecting Gillespie Dam and Federal Aid Project 64A. This road will be used until the bridge across the Gila is constructed.

The remainder of this section was completed in May 1924. This consists of a two course gravel surfacing. The west end is in first class shape, but the east end is rather loose, due to the continuous dry weather. The winter rains of 1924 should pack a portion of this, but it will probably be necessary to scarify approximately one and one-half miles and add sufficient binding material. This work will not be done, however, until there has been sufficient rainfall to make it reasonably certain that the road will set up.

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### Phoenix-Prescott Highway

#### Wickenburg-Hot Springs Junction Section

**J. E. Barnette, Foreman. Length 11.4 Miles**

This section is a very high type of gravel surfaced mountain road, and for the most part well drained and easily maintained. During the winter of 1923-24, the Hassayampa River cut into the bank just south of the "Garden of Allah" and washed out a dry wall protecting the toe of the slope of the road. In the spring of 1924 a double row of piling was driven into the stream and rock and brush were placed between the piling. It is believed that this jetty will relieve the situation.

The maintenance crew, at present, is resurfacing several sections on the Wickenburg end that have worn down to bedrock.

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### Phoenix-Prescott Highway

#### Marinette-Hot Springs Section

**No Foreman. Length 21.6 Miles**

This section consists of Federal Aid Projects Nos. 76 and 84, and is now under construction. A maintenance crew is sent out from the Phoenix office when needed. When completed, a permanent maintenance crew will be established.

**Mesa-Superior Highway****Frank Dana, Foreman. Length 5.9 Miles**

This section is a wide "turnpike" section through a granite sand-clay country and is unsurfaced. It starts at the east end of Federal Aid Project No. 65, eight miles east of Mesa and continues east to the Maricopa-Pinal County line. The road is poorly drained and temporary in character, and on account of the excessive traffic is especially hard to maintain. This road should be paved in the near future.

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**Apache Trail Highway****Tortilla Flats Section****Henry Mitchell, Foreman. Length 20 Miles**

This section begins at the Maricopa-Pinal County line and extends to Mile Post No. 40. It is a crooked mountain road, 18 feet in width and is used extensively by the Salt River Valley Water Users' Association in hauling heavy material for their dams at Mormon Flat and Horse Mesa.

The road is poorly drained and badly surfaced. The surfacing material in the vicinity is of poor quality and was put on very thin. In construction, not enough care was taken in shooting out rock to a suitable depth below subgrade to allow for a cushion, and consequently the road bed has a very uneven riding surface. This can be overcome only by extensive rebuilding or adding not less than six inches of surfacing.

It is impractical to do this as the traffic would not warrant the necessary expenditure. Due to the extreme grades and sharp curves, the maximum speed over this road should not exceed 20 miles an hour, so the road, with what improvements a normal maintenance crew can make, will suffice for some time.

The maintainer is gradually overcoming the drainage situation by placing pipes, obtained from the old State road from Mesa to Apache Junction.



**Apache Trail Highway****Fish Creek Section****Lee Ellsworth, Foreman. Length 19.5 Miles**

This section starts at Government Mile Post No. 40 and extends to the Maricopa-Gila County line at Roosevelt Dam. There are 11 miles of 18 foot road, with sharp curves and heavy grades. The famous Fish Creek Hill is on this section. Approximately eight miles of this portion is through rotten granite, which makes an excellent road surface. The drainage, however, is inadequate.

The remaining 9.5 miles is a narrow one-way road, following the Salt River. This section will be changed prior to the completion of the Horse Mesa Dam as it will be under water when this dam is built.

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**PINAL COUNTY****Apache Trail Highway****Apache Trail Junction-Maricopa County Line Section****Frank Dana, Foreman. Length 5.2 Miles**

The 5.2 miles of the Apache Trail portion of this section begins at Apache Trail Junction and connects with the Apache Trail-Tortilla Flats section at the Pinal-Maricopa County line. This section is for the most part, a wide "turn-pike" section road through a granite sand-clay country. A portion of the road contains a large amount of oversize rock, but on the whole the road is in very good condition and suitable for present traffic. There are three sharp curves in this section that are very dangerous and it is contemplated that they will be lengthened at some time in the future.

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**Mesa-Superior Highway****Apache Trail-Florence Junction Section****Frank Dana, Foreman. Length 15.2 Miles**

This 15.2 miles of the Mesa-Superior Highway begins at Apache Trail Junction and extends to Florence-Superior Junction. This section is a narrow, graveled road through an undulating country and offers some of the most difficult maintenance problems in the

district, due to the extremely heavy traffic and the very dry weather. Portions of this section were scarified and resurfaced during the fall of 1923. The road at present needs resurfacing, but traffic is too heavy for a gravel surfaced road.

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### **Florence-Superior Highway**

#### **Florence-Queen Creek Bridge Section**

**J. A. Cardin, Foreman. Length 25.6 Miles**

This section extends from the northern end of Florence Bridge to Florence Junction, a distance of 14.8 Miles, thence 10.8 miles toward Superior to the Queen Creek Bridge.

It is a well kept gravel road and is in good condition as to surface, although portions of the road on the Florence end contain a large amount of oversize. In the Spring of 1924, concrete fords and storm ditches were constructed on 9.6 miles of this section, beginning at the Florence end. Also approximately 1.75 miles of new surfacing was placed on the same end. Construction of additional drainage structures and storm ditches are contemplated on the 5.2 miles just south of Florence Junction and on the eastern end of this section.

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### **Miami-Superior Highway**

**Tom Reed, Foreman. Length 15.5 Miles**

This section begins at Queen Creek Bridge, 4.5 miles west of Superior on the Florence-Superior Highway, and extends through the town of Superior to the Pinal-Gila County line on the Superior-Miami Highway.

This section consists of 4.5 miles of gravel road in excellent condition from Queen Creek Bridge to Superior and 11 miles of mountain road from Superior to the Gila County line. The entire section is in excellent condition. In the winter of 1923-24, a slide of considerable yardage occurred at the tunnel on this section, blocking traffic, but was speedily removed. During the past two years the maintenance crew has added numerous drainage structures, so that now the road is well drained.

Widening of the sharp curve just above the prison camp is contemplated in the near future.



**YUMA COUNTY****Phoenix-Yuma Highway****Yuma-Wellton Section**

**O. F. DeBerry, Foreman. Length 39.2 Miles**

This section consists of 7.4 miles of county built, crushed stone road; 8.2 miles of Federal Aid, crushed stone road, known as Federal Aid Project No. 26B; 13.2 miles of old narrow county road, which utilizes an abandoned Southern Pacific embankment; and 9.9 miles of gravel road known as Federal Aid Project No. 26D.

Due to the fact that suitable material for maintaining this section is available only at Dome, midway between the two extreme ends, the entire section was placed under the care of one foreman. This foreman was given two Liberty trucks with trailers and one F. W. D. truck.

This section excepting the 13.2 miles of narrow road, was surfaced with crushed granite, or a poor grade of gravel, containing

**PRESCOTT-ASH FORK HIGHWAY**

**CHINO WASH BRIDGE**

a large amount of oversize. This surfacing was placed on a grade line that lay practically on the natural ground. The subgrade was made of "blow sand."

This type of road proved very unsatisfactory. First, the large amount of oversize made it impossible to form a smooth riding surface, and second, the fact that the grade line was so low caused the road to be covered with blow sand.

The rainfall for 1924 was less than 0.3 inches, and consequently the surfacing broke under the heavy traffic—approximately 200 cars a day—and blow sand became mixed with the loosened surfacing causing a condition that can not be repaired without resurfacing. This is impractical at present as Project 82 is to be built in the near future. This project goes through Telegraph Pass, and not only cuts off approximately eight miles but places surfacing material nearer the two ends of the project.

It is doubtful if any gravel surfaced road can stand the long dry spell to which this section is subjected. However, it is impractical to pave the entire section at present so probably it would be advisable when Project 82 is built, that, with the exception of the mountain section, a clay plating be placed under the surfacing, or an effort be made to obtain a surfacing material with a minimum of metal and with a binding material with a high cementation value, such as was found at the Kim Pit. In other words, the road should be built with the idea of protection against damage by drouth, rather than protection against damage by rainfall or floods.

A test was made with calcium chloride, using approximately four pounds to the square yard, but no benefit was derived from the use of this material, demonstrating that there was not sufficient moisture in the air to be of any benefit.

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### Phoenix-Yuma Highway

#### Wellton-Aztec Section

Arthur Renner, Foreman. Length 42.6 Miles

This section is one of the best in the district, the surfacing seeming to be very suitable for the long dry spells to which the section is subjected. It was necessary to make this a long section for the



same reason found in dealing with the Yuma-Wellton Section. The only material available to resurface is at Kim. This foreman also has double equipment.

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### **Phoenix-Yuma Highway**

#### **Aztec-Stanwix Section**

**R. L. Mitchell, Foreman. Length 7.0 Miles**

This section was completed in the fall of 1924 and is one of the higher types of selected material roads. No great maintenance problems are encountered in this section.

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### **PHOENIX-WICKENBURG HIGHWAY**



**CONCRETE PAVEMENT NEAR MARINETTE**

## HIGHWAY DISTRICT NO. 2A

Comprising Paving in Maricopa and Pinal Counties

**GEORGE B. SHAFFER, Paving Engineer**

This district, entirely a paving district, comprises approximately 78 miles of various types of pavement, 73 miles of which, in a general way, are connected with and radiate from Phoenix as a center. Included in this district are the Phoenix-Mesa and Mesa-Superior Highways to a point eight miles east of Mesa; the Mesa-Superior Highway, beginning at Florence Junction and extending five miles toward Mesa; the Phoenix-Wickenburg Highway to a point four miles west of Marinette; and the Phoenix-Yuma Highway to Buckeye.

Of the Phoenix-Mesa and Mesa-Superior Highways, Federal Aid Projects Numbers 47 and 65 were completed during this biennium. Federal Aid Project No. 47, constructed jointly by the State and Maricopa County with Federal cooperation, is four miles of 18 foot concrete paving, six inches thick at the center, with a nine inch edge of Arizona type, with earth shoulders.

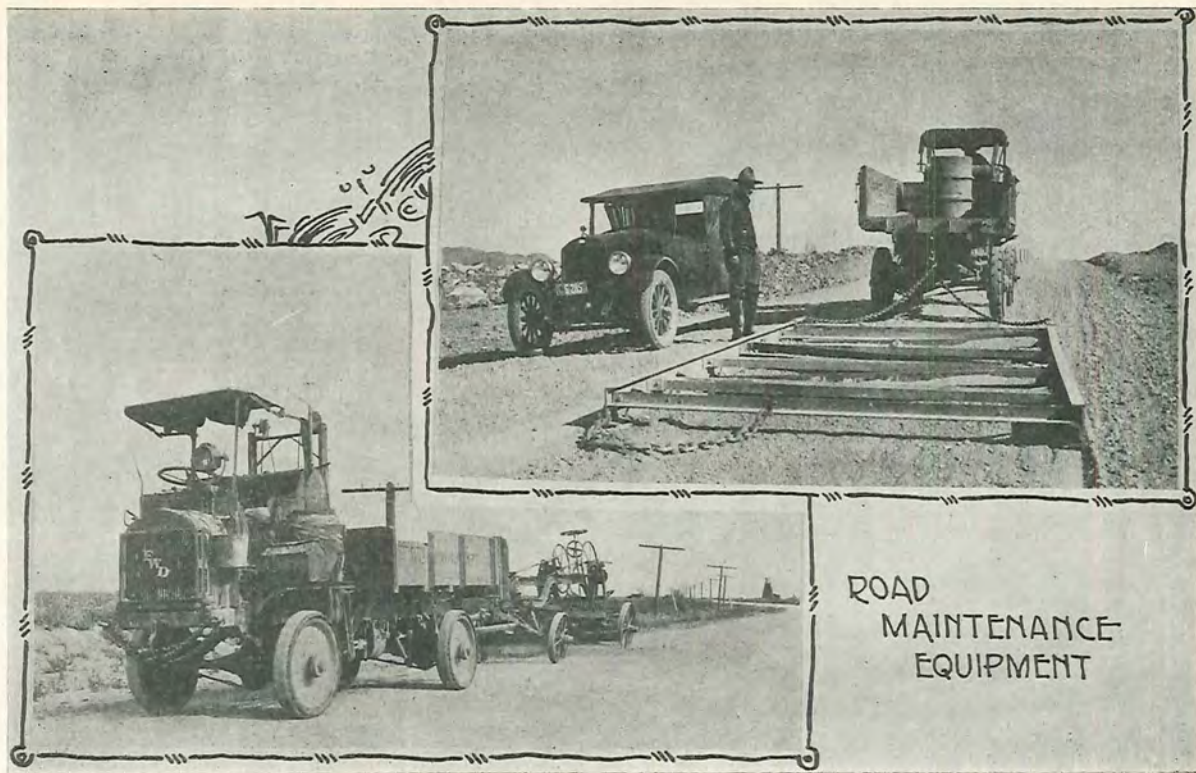
Federal Aid Project No. 65 is four miles of asphaltic pavement, with a four inch asphaltic base and two inch wearing surface. The asphalt is 16 feet wide with a 12 X 12 inch concrete curb on each side, making it 18 feet in width over all, with six foot shoulder. This section also was constructed by the State and Maricopa County, with Federal cooperation.

Federal Aid Project Numbers 48 and 70 on the Phoenix Wickenburg Highway were completed during this term, by the State and Maricopa County with Federal cooperation. With the exception of the New River Bridge approaches, Federal Aid Project No. 48, from Glendale to Marinette, 7.8 miles in length, was opened to traffic prior to June 30, 1924.

Federal Aid Project No. 48 is an 18 foot concrete pavement, Arizona type.

Federal Aid Project No. 70, extending from Marinette four miles west, is an 18 foot concrete pavement, six inches thick at the center, with a nine inch Arizona type edge.





Federal Aid Project No. 46B on the Phoenix-Yuma Highway was completed in June 1923. It is a 16 foot concrete pavement, constructed by the State and Maricopa County with Federal cooperation.

### MAINTENANCE

#### L. W. Statler, Foreman. Length 78 Miles

This maintenance district comprises 73 miles of concrete pavement and six miles of asphaltic concrete pavement in Maricopa County, radiating from Phoenix, and five miles of asphaltic concrete pavement in Pinal County.

The Phoenix-Mesa Highway, with three miles of asphaltic concrete and 11 miles of cement concrete pavement; the Phoenix-Wickenburg Highway, with 19 miles of cement concrete; the Phoenix-Yuma Highway, with 32 miles of cement concrete; and the Mesa-Superior Highway, with nine miles of asphaltic concrete and four miles of cement concrete, are under the care of a maintenance foreman with five to eight helpers.

From one to two heavy trucks and one eight foot blade, and picks, and shovels constitute the equipment required to keep the shoulders, except, however, when an emergency calls for additional or different types of equipment. For the slab treatment a one and one-half ton White truck, equipped with a water proof top and trailing hot pot is used.

Maintenance of the concrete pavement is, at the present time, largely confined to the expansion joints and the longitudinal and bias cracks which occur about a year after the pavement has been put into use. These cracks are treated by filling them with heated "Grade D" asphalt from time to time as needed to preserve the surface of the pavement.

There has been no special procedure to date in the maintenance of the asphalt pavements. The mileage is so small that the same force and equipment that is caring for the concrete pavement is answering present requirements. The asphalt pavement is holding up well. Many signs of settlement have occurred, which have and are being brought to grade by maintenance with fair satisfaction.



Some raveling at the edges is in evidence, now in its incipient stage, but with increased traffic, owing to the narrow roadway, will no doubt reach an injurious stage. This condition, however, does not apply to Federal Aid Project No. 65, which has a bordering curb. The surface of Project No. 65 shows an unequal settlement at the line of union between asphalt and curb. It is difficult to estimate how long the settlement will continue but a flushing of the surface from time to time should correct it.

### EXPANSION JOINTS

The value of expansion joints for pavements seems to be a disputed question among engineers. The allowance of expansion areas in the pavement is conspicuous by its variety. The expansion areas range from merely a construction joint to a two inch joint, replaced by an asphaltic filler.

Pavements laid with either of the two extreme dimensions used for expansion areas are at present under constant heavy traffic and the surface of the concrete remains in very good condition. In other instances where the expansion area allowed was from one-half inch to an inch, considerable chipping of the concrete adjacent to the joint have occurred and longitudinal and bias cracks have appeared.

A great deal of the maintenance mens' time is taken up repairing these chipped areas and filling the longitudinal and bias cracks. Comparatively much less time has been spent on the joints of extreme dimensions.

The conclusion at this time and place is, in the case of no expansion area, foreign matter such as mineral dust, sand and small gravel, can not enter the joint to any great extent, thereby allowing the bearing to remain equal at all points along the joint where strain takes place at the time of great temperature change.

In the case of a two-inch joint, another condition exists which is favorable to the life of the pavement and that is—a two inch joint is a workable area and can be entered with an ordinary pick or special tool and all foreign material along with the old filler can be removed and a new filler inserted. This operation can be repeated as often as is considered necessary to insure the safety of the pavement which depends largely upon the character of the shoulder material.

Another probable advantage in the wider expansion joint is that it actually allows space for more foreign material to collect at the edges and wheel ways before unequal pressure occurs at time of expansion.

The following arguments regarding expansion joints less than two inches will emphasize the advantage of the wider joint regardless of its longitudinal interval:

Regarding narrow joints, from one-fourth inch to one inch and assume them to be perfect; such a joint cannot be removed for replacement without great difficulty, the result being that at places all of the material has not been removed. Foreign material brought on to the pavement by wind, water and in many other ways is whirled into the joint by automobiles and other forms of traffic, and being of a mineral and metallic nature, its specific gravity is much greater than asphalt, it enters the joint and when packed to a state of replacement of the filler, actually sets up in to a solidified mass. The fact that this happens most generally at the wheel-ways and at the edges, causes an unequal bearing at the time of expansion, resulting in chipping at the top surface at the wheel-ways and bias cracking at the edges. This same condition might also start longitudinal cracks, which will more than likely continue to a stage dangerous to the life of the pavement under heavy traffic.

Now the fact that a good or poor joint depends largely upon the human equation supplied at the time the joint is made, proves beyond doubt that our joints are not perfect and if wider joints are made, up to two inches, less danger exists by poorly made joints.





## **HIGHWAY DISTRICTS NUMBERS 3 AND 4**

Comprising the East Central and Southeastern Counties

**E. M. WHITWORTH, District Engineer**

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### **GREENLEE COUNTY**

The State maintains 41.2 miles of highway in this County, all of which is mountain road and in excellent condition, despite the long drouth. Two maintenance crews are employed.

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#### **Clifton-Mule Creek Road**

**S. W. Dunagan, Foreman      Length 17.5 Miles.**

The Clifton-Mule Creek section begins at a point about 10 miles from Clifton on the Duncan road and extends 17.5 miles to the New Mexico line. The highway was constructed during 1921-22 and the original construction left this road without surfacing or sufficient drainage. The maintenance crew has been surfacing portions of the road where this was necessary and those sections that formerly were heavy in rainy weather will be a fast road during the rainy seasons.

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#### **Clifton-Solomonville Highway**

##### **Clifton-Greenlee County Line Section**

**Charles Perry, Foreman.      Length 23.7 Miles**

The Clifton-Solomonville section begins at the city limits of Clifton and extends 23.7 miles toward Solomonville to the Greenlee County line. This is a gravel mountain road, portions of which have been resurfaced with cinders. The Gila River bridge is on this section.

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### **GRAHAM COUNTY**

#### **Clifton-Solomonville Highway**

##### **Solomonville, Greenlee County Line Section**

**Charles Perry, Foreman.      Length 6.3 Miles**

This section begins at the Greenlee County line and extends 6.3 miles toward Solomonville. It is a mountain road which has been resurfaced with cinders, and is in first class condition, considering the continued dry weather.

**San Carlos-Solomonville Highway**  
**Solomonville-Mathews Wash Section**  
**No Foreman. Length 20.7 Miles**

This portion of the San Carlos-Solomonville section includes Federal Aid Projects Numbers 63, 67 and 43. It is a pavement section, extending from Solomonville to Mathews Wash, a distance of 20.7 miles. Extensive work has been done in the hauling of gravel for shoulders on Federal Aid Project No. 43.

The maintenance crew is equipped with a portable asphalt kettle and the necessary tools for the treatment of expansion joints and cracks. All joints have been treated recently and the section is in first class condition.

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**San Carlos-Solomonville Highway**  
**San Carlos-Mathews Wash Section**  
**James H. Fine, Foreman. Length 26.1 Miles**

From Mathews Wash west 19.5 miles is an improved gravel surfaced road, which needs rain badly that the section may be reshaped. Installation of culverts are contemplated to replace dips used as irrigating ditches.

From the end of the improved section, the road passes through the San Carlos reservation to the San Carlos River bridge. This section, which is in the area of the San Carlos dam reservoir, in part, must be abandoned, and consequently does not justify more expenditure than necessary to maintain traffic. The wooden culverts and bridges on this section have been provided with guard rails and runners by the State, the Indian Service furnishing the lumber.

The Gila Bridge deck has been repaired by placing two-way runners throughout its length. The San Carlos Bridge floor was strengthened and improved by one-way runners. These bridges will be painted.

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**Globe-San Carlos Highway**  
**J. H. Thompson, Foreman. Length 28.6 Miles.**

This section extends from the San Carlos bridge to the city limits of Globe. From the San Carlos bridge to Rice, the road is through the reservation. Sufficient maintenance is given this section to maintain traffic. The wooden culverts and bridges have been repaired and guard rails placed on all bridges.

From Rice to Globe is an improved graveled road. As oversize material was used in the surfacing and the binding is granular, this section is difficult to maintain.



**GILA COUNTY****Globe-Roosevelt Highway****J. M. Sanders, Foreman. Length 33 Miles**

This section begins at a point on the Globe-Miami Highway, midway between Globe and Miami and extends to the Maricopa County line at Roosevelt Lake. A construction camp has been at work over this section, due to the fact that the work has been of a reconstruction nature. Alignment has been improved, the roadway widened and resurfaced, additional drainage provided and several guard rails and retaining walls built. The work was completed to a point 11 miles from Roosevelt, where it was necessary to stop on account of lack of funds. Further work in the vicinity of Roosevelt Lake is contemplated as the road is very narrow in some sections.

The maintenance crew is caring for the entire mileage and with the arrival of the rainy season the road will be in excellent shape.

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**White River Highway****Rice Section**

This road is being reconstructed jointly with Gila County. It extends from Rice to White River Agency. The improvement consists principally of surfacing the old road bed, and in some instances, straightening the alignment.

Wooden box culverts are being installed at necessary places, the lumber being furnished by the Indian Service. The work has proceeded to a point 41 miles from Rice toward Cooley. Due to prohibitive grades and the need for relocation of portions of the road, it is not advisable to expend a large sum on this project.

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**Miami-Superior Highway****Miami-Gila County Line Section****J. H. Davis, Foreman. Length 9.5 Miles**

This section begins at the west city limits of Miami and extends to the Pinal County line. It comprises 9.5 miles of scenic mountain road. Portions of this section have been resurfaced with decomposed granite. Due to the heavy truck and passenger traffic, other portions are to be resurfaced, but the road is well maintained and fast.

## HIGHWAY DISTRICT NO. 4

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### COCHISE COUNTY

#### Douglas-Rodeo Highway

##### Douglas-State Line Section

**Guy Davis and Bert Click, Foremen. Length 50 Miles**

This section, 50 miles in length, extends from Douglas to the New Mexico line. Two crews, each comprising a caretaker and two men, are keeping the road in good condition. Many places in the road would be benefited by surfacing the entire width of the roadway.

The need for surfacing is due to poor construction, oversize material having been used in light fills, leaving a rough surface which has been further exaggerated by the continued dry weather making binder dust and "blow away." The short sections that were in clay formation have been sanded. The normal crew is gradually surfacing the rough places and all dips in this section have been concreted.

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#### Bisbee-Douglas Highway

##### Bisbee-Douglas Section

**E. E. Thomas, Foreman. Length 24 Miles**

This section is 24 miles of concrete pavement, 18 feet wide with three foot shoulders. State forces constructed 8.4 miles of this section and the Cochise County Highway Commission constructed the remainder. Portions of the sections constructed by the Cochise County Highway Commission are badly cracked longitudinally and entire sections have taken settlement. This is due to insufficient settlement of the embankment prior to laying the pavement. Three hundred feet of pavement, full width, have been replaced. Work on filling the cracks will begin immediately.

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#### Bisbee-Tombstone Highway

##### Bisbee-Tombstone Section

**E. E. Thomas, Foreman. Length 26 Miles**

Ten miles of this section is paved with asphaltic concrete. It has received no maintenance, but it is contemplated that it will be flush



coated and the shoulders of the original section widened. Approximately six miles south from the end of the present pavement will be paved. The portion of the road through the canyon and over the divide is in as perfect condition possible, considering the long, dry period.

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### **Benson-Tombstone Highway**

#### **Benson-Tombstone-Section**

**E. H. Tilton, Foreman. Length 24 Miles**

This section, in the main, is a fast road. Portions are being re-surfaced by the regular maintenance crew. On the south end of the section, binder is lacking, due to the dry weather and the high speed traffic, which make it difficult to maintain a cushion.

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### **Tombstone-Nogales Highway**

#### **Tombstone-Santa Cruz County Line Section**

**R. J. Cornelius, Foreman. Length 25 Miles**

Portions of this section needed surfacing badly and the maintenance crew has succeeded in surfacing all parts in need of gravel to mix with the clay formation. The entire section is in excellent condition despite the dry weather.

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### **Tucson-Benson Highway**

#### **Benson-Pima County Line Section**

**J. I. Archer, Foreman. Length 10 Miles**

Considerable surfacing and ditching was necessary in this section but this was accomplished without any additional men being employed. The highway now has been sufficiently surfaced to make it a fast road.

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## **PIMA COUNTY**

### **Tucson-Benson Highway**

#### **Tucson-Cochise County Line Section**

**A. V. Lemons and J. I. Archer, Foremen Length 42 Miles**

Of the 42 miles of this highway in Pima County, that portion

south of Vail is all fast road and in good condition. The section between Vail and Tucson was scarified and reshaped. The material is sandy in formation and does not bind readily in dry weather. Some sections are corduroy. When funds are available it is contemplated that this section will be relocated, eliminating numerous bad curves.

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### **Vail-Empire Highway**

**Jack Anderson, Foreman. Length 17 Miles**

The entire mileage of this section has been reconstructed by State forces. The greater portion of the road is of decomposed granite. Due to lack of rain the roadway is somewhat heavy. The road will be in excellent condition after it has received some moisture and has been dragged and bladed.

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### **Tucson-Florence Highway**

#### **Tucson- Rillito Creek Section**

**J. W. Horton, Foreman. Length 3.8 Miles**

This section, a cement concrete pavement, 18 feet wide, beginning at the north city limits of Tucson, extending to and including the bridge across Rillito Creek, is maintained by State forces. Maintenance has been given to the shoulders.

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### **Tucson-Florence Highway**

#### **Rillito Creek-Pinal County Line**

**H. B. Hall, Foreman. Length 22 Miles**

Owing to excessive drouth, this section in some places for short distances shows appearance of corduroy but not sufficiently to interfere with fast traffic. As a whole the entire distance is in good condition.

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### **Tucson- Nogales Highway**

#### **Continental-Santa Cruz County Line Section**

**A. V. Lemons, Foreman. Length 8.9 Miles**

On this section the state maintains 8.9 miles of 18 foot cement concrete highway. The cracks and expansion joints recently have been treated and the pavement is in excellent condition.



Pima County, at present, maintains 21.7 miles of road from the end of the paving south of Tucson to a point two miles south of Continental. A survey has been made by the State Highway Department which proposes the abandonment of the section maintained by the County. The department's survey eliminates two railroad crossings. Should the contract be awarded for this line change, the State will take over the entire maintenance between Tucson and Nogales.

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## **SANTA CRUZ COUNTY**

### **Tucson-Nogales Highway**

#### **Pima County Line, Nogales Section**

**Wm. Lowe, Foreman. Length 27 Miles**

This section is in excellent condition despite the dry weather. Numerous short sections have been resurfaced by the regular maintenance crew. Where the highway passes through the Santa Cruz Valley there are numerous blind curves and their elimination is contemplated. Numerous dips have been eliminated and replaced by concrete bridges and culverts. The two-mile section of 18 foot cement concrete from the city limits of Nogales north soon will be treated by filling cracks with asphalt.

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### **Tombstone-Nogales Highway**

#### **Nogales-Patagonia Section**

**J. C. Shields and James Parker, Foremen. Length 22 Miles**

A construction crew, doing reconstruction work, has been on this section, following generally the old alignment. Dangerous curves have been widened, the roadbed reshaped and some portions of the road have been resurfaced. Additional drainage has been provided and the roadway ditched. The reconstruction work covers a stretch of 15 miles.

At present, two maintenance crews are caring for the sections that were worked over by the construction forces. Due to continued dry weather this work will be necessary until sufficient

rainfalls set up the loose material. The maintenance crews are using teams instead of trucks, and when not engaged in the dragging of new sections, are improving generally those portions not covered by the construction forces.

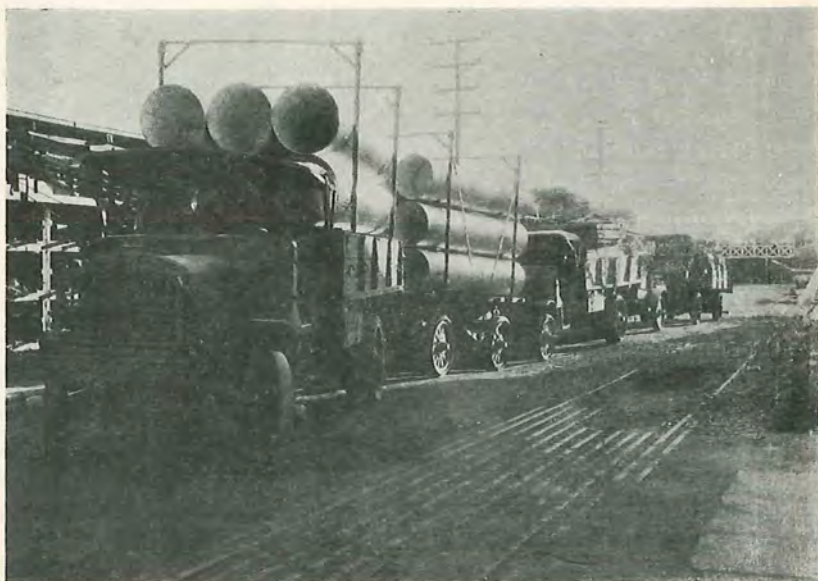
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**Tombstone-Nogales Highway**  
**Cochise County Line, Patagonia Section**  
**W. H. Collie, Foreman. Length 26 Miles**

Portions of this section needed surfacing badly and the maintenance crew has surfaced all parts in need of gravel to mix with the clay foundation. The entire distance is in excellent shape despite the dry weather.

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**PHOENIX YARD**



**SHIPPING MATERIALS**



## Storehouse and Shops

### C. R. JONES, Superintendent of Equipment

THE warehouse of the Arizona Highway Department, centrally located in the yard, is a two-story structure of galvanized iron, 50 by 96 feet in plan. A spur track runs alongside the 10 foot concrete platform, which extends from the first floor of the warehouse, enabling the easy loading and unloading of material from the cars which run up the track to the platform.

The warehouse is used principally for the storage of implement and motor vehicle parts, which are placed in bins, with the equipment classified and a card record on each bin, showing the location of each part, its number and its price. A cutting machine is now installed for making stencils for various uses such as altering bins and marking iron shipments to the different camps. During the present administration the number of bins has been increased from 3,000 to 6,500.

A magneto room has been installed on the second floor of the warehouse, and the equipment on that floor is arranged in an orderly manner according to the card index, so that each part may be readily found when needed.

### Harness Room

A stairway has been constructed to the attic, which has been made a third floor for the housing of harness.

On the main floor of the building is the office of the superintendent of equipment, where a force of clerks keep the card index system. One innovation of the equipment force is the index on trucks and automobiles, which have been lettered and numbered according to their classification. This system is of particular advantage in regard to trucks in the field, for when a truck arrives in the yard its number is viewed and a check of the records immediately gives the history of the truck.

Opposite the warehouse, extending the entire length of the yard, and on the east and west ends are large bins which house oil drums

and heavier parts. The oil bins are in three tiers and are so arranged that one man can place in them a 50 gallon drum of fuel oil, weighing 400 pounds.

### **Reclamation Department**

The reclamation department for parts of trucks, automobiles, caterpillars and the like, prevents waste and saves the State considerable expense. Old parts of machinery before being junked are taken to the reclamation department for inspection. Parts that have any value are reclaimed by, repairs and the remainder, which are of no economic use, are placed on the junk pile.

The present administration has paid particular attention to this department and is getting the fullest possible value from its trucks from the largest to the smallest part. Old springs are placed in a huge pile and are reclaimed in the new spring furnace. Thus the highway department builds and rebuilds its own springs.

### **Blacksmith Shop**

Since the advent of the new administration an addition of 1,344 square feet has been built to the blacksmith shop. The blacksmith shop houses the new spring furnace, by means of which the State builds and reclaims its springs. The shop is equipped with facilities for all general work, including a huge air hammer, used for heavy welding. The tools are electrically driven and this feature saves both time and expense. A new rack for blacksmith materials, such as iron bar, rod, angles and the like, has been constructed.

The department has installed electric blowers which have done away with the old time hand blowers. Also, an Oxweld Acetylene Generator has been installed for cutting and welding, through the use of the oxy-acetylene torches. The department is making its own tar pots, which are of an exceptionally superior quality. These tar pots can not be procured outside, for none having the same superior quality are to be found on the market.

The general work of the blacksmith shop varies from taking care of vehicle equipment to road machinery.

### **The Machine Shop**

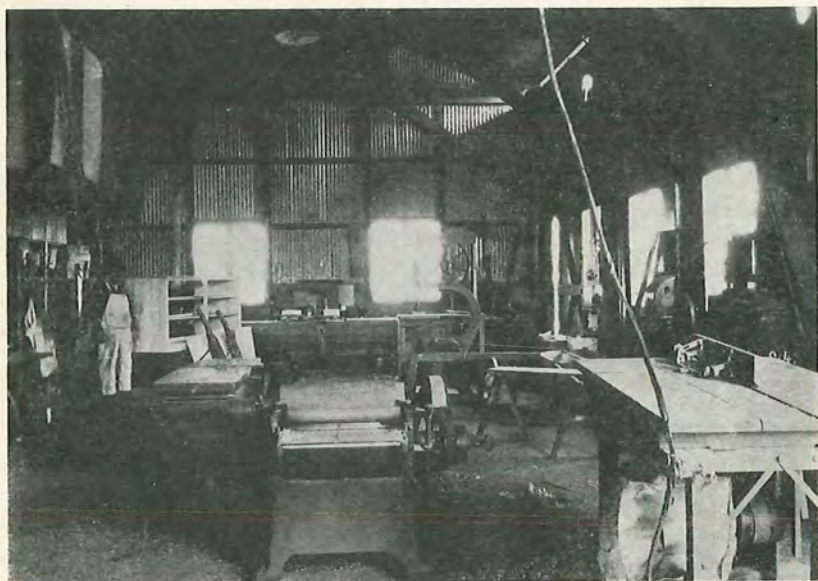
The machine shop has been equipped with 100 lineal feet of metal benches; an air compressor, which furnishes air for the entire plant,



# ***Shops at Phoenix***



BLACKSMITH SHOP



CARPENTER SHOP

including the blacksmith shop and spring furnace; and a new cylinder grinder, which enables the department to grind out its own cylinders, effecting a saving of \$20 per motor.

The machine shop also is equipped with lathes, drill presses, tool grinders, sharpeners and high speed hack saws, all electrically driven.

### **The Carpenter Shop**

The carpenter shop is equipped with all tools necessary to take care of wood work needed at the plant and the camps. In addition to the tools already on hand, the department installed a planer, a cut-off saw and a saw filing machine.

### **Automobile Department**

In the automobile department sufficient pits have been constructed to take care of all the trucks and cars which are in need of repairs. It is here that the motors are taken down, rebuilt or assembled. All equipment necessary for repairs is available to the skilled mechanics who handle this work.

One part of the work properly belonging to the automobile department is the new top shop where the tops of automobiles are rebuilt and the upholstery repaired. The top shop covers a space 24 by 24 feet. New tops also are constructed here, and tents are repaired and placed in stock.

The radiator branch of the automobile department repairs and rebuilds all radiators.

One of the new features properly belonging to the automobile department is the "Burning-In" machine by which bearings are burned in. This machine burns in bearings in six hours as compared to 28 hours by the old scraping-in method, or a saving in time and expense of 22 hours.

Swinging cranes are used by the department as time and labor saving devices.

### **Caterpillar Department**

The caterpillar department occupies 1,300 square feet of floor space. Here the caterpillars are repaired and rebuilt. One of the new innovations in the caterpillar department is the caterpillar trailer, which is used to haul the caterpillars about. Previous to the



installation of these trailers the caterpillars could be moved only at the rate of three miles per hour. Now, when loaded on the trailer, the caterpillar is moved at the speed of 18 miles per hour.

### **Steam Cleaning Plant**

In the steam cleaning plant all greasy machinery, covered with dirt and oil, is cleaned with a steam and hot water jet. This work is done with the highest speed and the jet is not only a time and labor saving device, but it eliminates considerable of the expense formerly attendant to the use of gasoline for cleaning.

All vehicles are thoroughly cleaned with the steam and hot water jet before going to the paint shop, thus insuring the removal of oil and dirt and providing a clean surface for painting.

Connected with the steam cleaning plant boiler are the engines of a large stiff leg derrick. Through the use of this derrick the heaviest machinery is loaded and unloaded from cars on the spur track.

### **The Paint Shop**

All vehicles, equipment, implements and tent houses are painted with the standard paint of the Highway Department by means of a compressed air spray gun. This system of painting penetrates every nook and crevice of the article and provides a thorough coating, evenly applied. The compressed air spraying machine is driven by a portable gas engine and can be moved from place to place. The varnish and sign painting room is dust proof.

### **Heavy Machinery**

All heavy machinery and equipment is being piled along the spur track so that it can be easily loaded on cars when necessary. New wheel racks have been constructed, three tiers high, and under this system by use of a chain hoist, one man can load a wheel weighing 1,000 pounds, into any of the racks. This work formerly required three or four men to carry out.

Also along the spur track there has been constructed new steel racks, five tiers high and extending for a distance of 105 feet, all containing reinforcing steel.

### **Innovations Planned**

The department is contemplating the installation of new and addi-

tional equipment at the shops at Ash Fork and Tucson. The blacksmith shops will be given more equipment and new motor rooms and garags will be constructed.

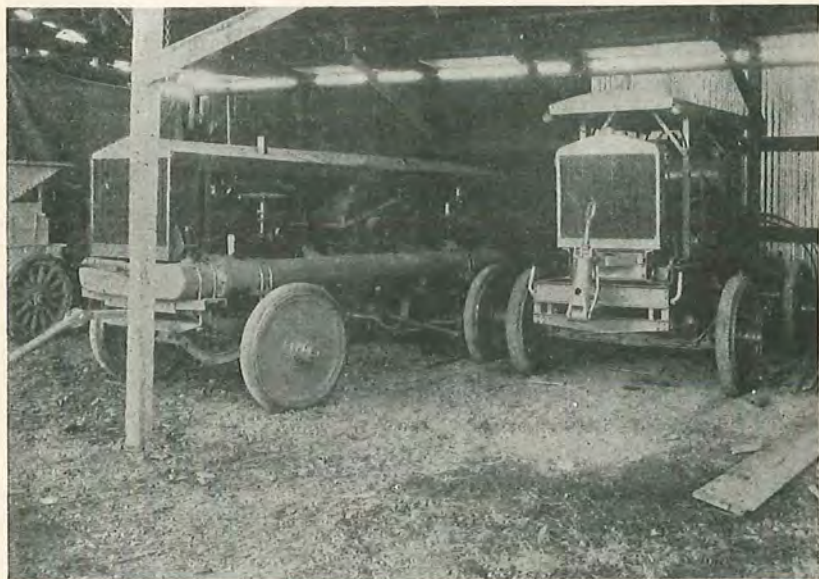
The department is planning to send a traveling paint shop and steam plant on tour so that the equipment at the various camps can be cleaned and painted without necessitating a trip to the shops. The traveling plant will have a compressed air gun for painting and the work which formerly consumed one half to one day, now can be completed in 10 or more minutes.

All compressors are to be mounted with rubber tires and springs to eliminate vibration and to double the life of the compressor.

All equipment is being standardized as far as possible, including caterpillars, trucks, road cleaners, graders and the like.

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#### AIR COMPRESSORS



MOUNTED ON TRAILERS



**DISTRICT NO. 1****Office and Shops, Ash Fork****B. M. ATWOOD, District Engineer**

During the previous administration, the Highway Department leased approximately three-fourths of an acre of land on the Harvey House spur in Ashfork, erecting on it a small warehouse. A blacksmith shop and sheds for a few cars, also had been staked out.

The yard has since been increased to three times its original size and surfaced with cinders. Two hundred and twenty-five feet of shed has been built, including two rooms, 10x18 feet, for quarters for the watchman and mechanics; an office, 15x20 feet; and a small shop, 18x40 feet.

The shop is equipped with a South Bend Lathe, No. 67D-15''; a power drill press; a grinding machine; a boring-in machine; acetylene and soldering machine outfit; an air pump; an overhead track and trolley with a one-ton crane; a blacksmith shop, two cement pits and necessary small tools.

All of the equipment not in actual use in the district is stored at this yard. A mechanic, one or two helpers and a watchman are employed at the yard.

Due to the fact that old war equipment is being used on maintenance, the mechanic has little time that he can devote to anything but this equipment. A G. M. C. truck with an ambulance attached is used by the mechanic, so that he can respond to telegraphic orders at once when a truck breaks down and make emergency field repairs. If the truck is badly damaged, it is towed into the yard at Ash Fork, and exchanged for one that has been overhauled.

No regular office man is kept in the office. An office assistant is employed for two to or four hours a day to receive all mail and telegrams, to attend to invoices, requisitions, payrolls and maintenance reports, and to keep the cost data on the maintenance work.

The yard and office was established at Ash Fork on account of the fact that it is a junction point of the Old Trails and the Grand Canyon-Nogales Highways, leading south, and a junction of the Santa Fe railroad leading south. It is the only railway connecting point between the north and south sections of the state.

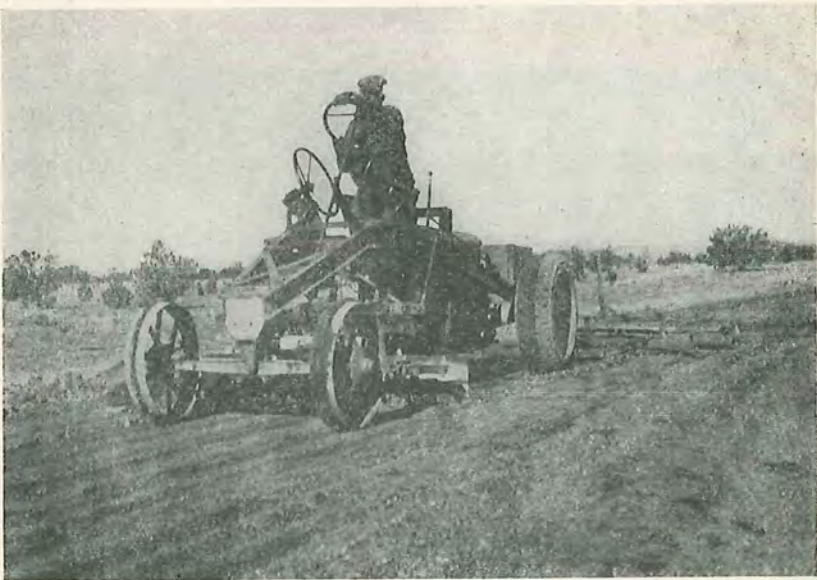
**DISTRICT NUMBERS 3 AND 4****Office and Shops, Tucson****E. M. WHITWORTH, District Engineer**

The office and shops of Districts Numbers 3 and 4 of the Arizona Highway Department are in Tucson. Located in the yard is a warehouse, a blacksmith shop and other necessary shops.

All equipment in the districts is repaired here. When a truck is badly damaged it is towed into the yards and replaced with one that has been overhauled.

Installation of new innovations for the Tucson shops is contemplated.

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**PRESCOTT-ASH FORK HIGHWAY****"ROAD MAINTAINER"**



## Accounting Department

**V. A. WOOD, Chief Clerk**

**I**n addition to auditing and accounting, the work of this Department covers payrolls, cost accounting, and purchasing of equipment, materials and supplies.

### Auditing and Accounting

This branch of the accounting department, in charge of the assistant chief clerk, audits all bills against the highway department, prepares and passes all claims for payment, and keeps fund and project records.

A copy of each requisition whether a general office purchase order, issued by the purchasing agent, or a field emergency requi-



ACCOUNTING DEPARTMENT

sition issued by the engineer or foreman in charge of a project, is entered in the project liability ledger and filed by the requisition clerk. The project liability ledger reflects, through its totals, the total liabilities incurred against all projects at all times. When invoices for purchases delivered are entered against the requisitions, the balances, as shown by this record, reflect the outstanding liabilities against all projects at all times.

The requisition files are so kept that duplicate payment of bills is impossible. From the requisition desk, bills are entered in the voucher register, the accounts payable ledger, are written into claim, entered in the claim register, project ledger and the cost records.

The voucher register serves as the control for accounts payable. The claim register has been extended under the present administration, in scope and usefulness, to show through its daily balances the status of all funds each day. This record now also reconciles monthly with the records of highway department claims passing through the office of the Board of Directors of State Institutions and the State Auditor's Office. An average of more than 900 claims are now written each month, covering bills amounting to an average of more than \$300,000.

Claims having passed our records are transmitted to the Board of Directors of State Institutions, thence to the State Auditor's Office for its record, approval, and issuance of warrants. Warrants are returned to the highway department through the same channels and are, after being entered in our records, mailed to payees.

### Accounting System

The system of accounting now in use is a general ledger system installed by Smart Gore & Co., certified public accountants of Chicago, under the direction of a joint investigating committee created by the Sixth Legislature.

With the exception of additions of new accounts, and the extending of the scope of the claim register to show balances in funds, the system as installed has continued in use and covers all records of the Highway Department from January 1, 1923 to the present time.



During the present administration many changes have been made to increase the efficiency of the accounting department and to furnish the State engineer with records upon which to base estimates of the cost of proposed projects, and to budget the expenditures of the highway department at the beginning of each fiscal year.

### **Payrolls**

In order to meet the requirements of the semi-monthly pay day law, employees of the highway department are paid through the State Engineer's Imprest Fund. The amount of this fund is \$50,000. Payrolls now amount to over \$80,000 and more than 3,000 checks are issued monthly. This is in addition to payrolls of contractors.

### **Aim of Department**

It is the aim of the accounting department to reduce the time necessary to pass a bill for payment to the minimum in order to maintain the best relations with creditors and to take advantage of discounts, where possible.

It now takes an average of about 30 days to secure record of receipt of purchases, approval of prices and amounts, auditing and passing bills for payment and transmitting warrants to payees. This average could be considerably reduced if it were not necessary to send claims drawn against County 75 per cent Funds to the boards of supervisors for approval.

The highway department is daily taking advantage of discounts offered for prompt payment of bills, notably bills for cement on which it is securing a discount of 5 cents per barrel. This, it is estimated, will save the Department \$1,400 on one paving project alone.

### **Authority for Expenditures**

Probably the most important addition to the accounting system is the "Authority for Expenditures," (A. F. E.), which was suggested by and installed through the cooperation of the Chief Engineer.

At the beginning of the fiscal year or upon opening new projects, the district engineer submits an R. A. F. E., (Request for Authority for Expenditures) to the State engineer for each project. When

approved by the State engineer, upon the recommendation of the chief engineer, the R. A. F. E. is passed to the accounting department and an A. F. E. (Authority for Expenditures) is issued over the signatures of the secretary of the Board of Directors of State Institutions, the State engineer, and the chief clerk.

The A. F. E. authorizes the expenditure of certain amounts, based on the estimated cost of the project, and designates the funds out of which the expenditure is authorized.

The expenditures for salaries, supplies and the like for the general office, drafting room, accounting department, laboratory, warehouse, and shops are all similarly authorized.

This gives the highway department all the advantages of a budget, covering all of the activities of the department.





**RECAPITULATION**  
**Status of Funds**  
**July 1, 1922 to June 30, 1924**

		Total Receipts	Claims Registered	Cancelled	In Transit June 30, '24	Auditor's Balance
Apache	75%	\$ 12,276.85	\$ 10,849.47	\$	\$	\$ 1,427.38
Cochise	"	147,930.76	117,146.54		7,383.14	38,167.36
Coconino	"	28,593.72	23,049.49			5,544.23
Gila	"	124,547.34	116,351.22		11,167.63	19,363.75
Graham	"	16,975.15	15,140.97			1,834.18
Greenlee	"	25,437.69	24,407.29			1,030.40
Maricopa	"	162,842.09	152,343.89		22.50	10,520.70
Mohave	"	21,836.20	18,028.15		23.91	3,831.96
Navajo	"	17,647.56	15,488.99			2,158.57
Pima	"	74,360.31	45,529.51		87.44	28,918.24
Pinal	"	59,955.67	52,284.41		109.04	7,780.30
Santa Cruz	"	14,559.23	13,803.83		527.83	1,283.23
Yavapai	"	110,341.93	70,126.83		195.00	40,410.10
Yuma	"	33,025.89	23,431.58		557.38	10,151.69
Federal Aid Road Account		2,373,351.90	1,998,906.54		61,930.71	436,376.07
Senate Bill 51		151,929.28	151,929.28			
House Bill 159		151,000.00	75,790.46	75,209.54		
State Highway Maintenance Account		433,771.72	359,035.58		827.21	75,563.35
25% Fund		3,070,848.69	3,121,319.07		70,465.04	19,994.66
Sacaton Prison Power Line		50,000.00				50,000.00
Chloride Mohave Co. Line		40,000.00				40,000.00
<b>TOTAL</b>		<b>\$7,121,231.98</b>	<b>\$6,404,963.10</b>	<b>\$ 75,209.54</b>	<b>\$ 153,296.83</b>	<b>\$ 794,356.17</b>

# RECAPITULATION Net Expenditure July 1, 1922 to June 30, 1924

County	Indirect	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	SHMA	H. B. 159	Totals
Apache.....		\$27,668.58	\$228,428.67	\$ 55,139.27	\$ 151,246.93	\$ 10,849.47	\$120,079.50		\$ 23,188.16	\$ 5,872.46	\$311,231.23
Cochise.....		8,480.89	179,017.85	168,499.63	186,490.53	117,146.54			52,361.30		355,991.42
Coconino.....		7,786.21	37,586.23	56,050.83	63,652.51	23,049.49	10.00		13,472.34	1,238.93	101,421.42
Gila.....		118.53	127,658.92	72,772.29	62,502.89	116,351.22			20,295.75	1,399.88	200,544.42
Graham.....		33,080.46	386,690.29	46,328.49	77,367.69	15,140.97	306,721.91	\$ 25,944.83	27,968.11	12,955.73	466,091.46
Greenlee.....			51,335.10	91,727.77	57,245.89	24,407.29			60,483.69	926.00	143,062.00
Maricopa.....		68,645.67	1,445,776.09	84,120.05	492,549.50	152,343.89	\$57,839.02	67,290.85	20,898.28	7,620.27	1,598,544.54
Mohave.....		3,614.09	40,479.43	50,255.99	40,265.16	18,028.15	15,283.85		14,678.85	6,093.50	94,341.34
Navajo.....		21,040.50	236,312.03	36,372.88	188,626.72	15,488.99	53,779.74	21,038.83	14,319.96	471.17	293,721.72
Pima.....		5,141.93	103,182.49	62,808.59	81,268.44	45,529.51	6,565.66	15,723.39	20,523.95	1,522.06	171,131.13
Pinal.....		20,693.83	383,779.60	107,772.52	330,828.95	52,284.41	62,051.55		64,170.35	10,800.34	520,131.34
Santa Cruz.....	7,889.65	8,900.74	103,904.90	37,723.16	103,411.76	13,803.83	6,200.88	17,904.84	7,921.75	1,285.74	150,521.52
Yavapai.....		27,324.57	788,607.37	115,691.71	426,271.05	70,126.83	414,330.04	2,458.97	11,542.08	6,894.68	931,621.62
Yuma.....		13,487.32	279,785.25	30,481.52	134,922.67	23,431.58	156,044.39		7,211.01	2,144.44	323,751.55
State Engineer's Salary.....	12,000.00				12,000.00						12,000.00
State Engineer's Expense.....	2,254.84				2,254.84						2,254.84
General.....	197,938.54				181,373.28					16,565.26	197,938.54
Transfer of Funds.....	253,684.63				252,117.06			1,567.57			253,684.63
Refunds.....	276,923.20				276,923.20						276,923.20
	\$750,690.86	\$245,983.32	\$4,392,544.22	\$1,015,744.70	\$3,121,319.07	\$697,982.17	\$1,998,906.54	\$151,929.28	\$359,035.58	\$75,790.46	\$6,404,900.46



**TWENTY-FIVE PER CENT FUND**  
**RECEIPTS AND DISBURSEMENTS**  
 July 1, 1922, to June 30, 1924

	Receipts	Claims Paid	Cash on Hand 6-30-24	Claims in Transit	Auditor's Balance
Balance July 1, 1922	\$ 271,792.00	\$	\$	\$	\$
Tax Apportionment 1922-23	91,502.66				
Tax Apportionment 1923-24	174,250.50				
Motor Vehicle Fees	169,338.51				
Motor Vehicle Mill Tax	13,471.55				
Gasoline Tax	352,721.75				
Peddlers' License	25.00				
Federal Aid	1,556,961.96				
County Aid	14,264.31				
Transfer of Funds	220,113.47				
Refunds—Deposited with Treasurer	206,466.98				
Refunds—Cash on Hand 6-30-24	1,400.91		\$ 1,400.91		
Apache County		151,246.43			
Cochise County		186,490.53			
Cocconino County		63,652.51			
Gila County		62,502.89			
Graham County		77,367.69			
Greenlee County		57,245.89			
Maricopa County		492,549.50			
Mohave County		40,265.16			
Navajo County		188,626.72			
Pima County		81,268.44			
Pinal County		330,828.95			
Santa Cruz County		103,411.76			
Yavapai County		426,271.05			
Yuma County		134,922.67			
General		195,628.12			
Transfer of Funds		252,117.06			
Refunds		276,923.20			
	\$3,072,249.60	\$3,121,319.07	\$ 1,400.91	\$ 70,465.04	\$ 19,994.66

**SEVENTY-FIVE PER CENT FUND  
RECEIPTS AND DISBURSEMENTS  
July 1, 1922 to June 30, 1924**

County—	Balance July 1, 1922	Tax Approp. 1922-23	Tax Approp. 1923-24	Tfr. of Funds or Refunds	Gasoline Tax	Total Revenue	Claims Registered	Claims in Transit	Balance June 30, 1924
Apache .....	\$	\$ 3,291.12	\$ 7,016.51	\$	\$ 1,969.22	\$ 12,276.85	\$ 10,849.47	\$	\$ 1,427.38
Cochise .....	2.04	44,851.75	86,778.25		16,298.72	147,930.76	117,146.54	7,383.14	38,167.36
Coconino .....		7,548.09	15,393.64	2.48	5,649.51	28,593.72	23,049.49		5,544.23
Gila .....		38,771.05	73,825.83		11,950.46	124,547.34	116,351.22	11,167.63	19,363.75
Graham .....		4,680.16	9,299.86		2,995.13	16,975.15	15,140.97		1,834.18
Greenlee .....		7,784.71	15,866.12		1,786.86	25,437.69	24,407.29		1,030.40
Maricopa .....		36,508.26	71,526.15		54,807.68	162,842.09	152,343.89	22.50	10,520.70
Mohave .....		6,285.51	11,550.17		4,000.52	21,836.20	18,028.15	23.91	3,831.96
Navajo .....	1,754.26	3,560.53	7,393.52		4,939.25	17,647.56	15,488.99		2,158.57
Pima .....	4,040.75	17,500.35	34,673.61		18,145.60	74,360.31	45,529.51	87.44	28,918.24
Pinal .....		16,503.09	30,401.16	7,889.65	5,161.77	59,955.67	52,284.41	109.04	7,780.30
Santa Cruz .....		3,754.32	7,701.76		3,103.15	14,559.23	13,803.83	527.83	1,283.23
Yavapai .....		33,721.66	64,828.92	279.12	11,512.23	110,341.93	70,126.83	195.00	40,410.10
Yuma .....	4,541.60	6,582.61	13,365.97		8,535.71	33,025.89	23,431.58	557.38	10,151.69
<b>TOTAL .....</b>	<b>\$10,338.65</b>	<b>\$231,343.21</b>	<b>\$449,621.47</b>	<b>\$8,171.25</b>	<b>\$150,855.81</b>	<b>\$850,330.39</b>	<b>\$697,982.17</b>	<b>\$ 20,073.87</b>	<b>\$172,422.09</b>



**SENATE BILL NO. 51**  
**RECEIPTS AND DISBURSEMENTS**

July 1, 1922 to June 30, 1924

	Balance July 1, 1922	Refunds	Claims Paid
Apache Trail	\$ 34,286.33	\$	\$ 34,286.33
Ash Fork-Nelson	2,458.97		2,458.97
Geronimo-Solomonville			
F. A. 43	25,944.83		25,944.83
Phoenix-Yuma	33,004.52		
Arlington-Gillespie Dam			21.33
Gila Bend Gillespie Dam.			
F. A. 53			27,907.74
Gila Bend-Piedra F. A. 56			168.35
Arlington Bridge			4,903.70
Piedra-Stanwix F. A. 69			3.40
Tucson-Nogales Bridges	33,628.23		33,004.52
Federal Aid 25B			19,540.98
Continental Bridge F. A. 75			90.61
Federal Aid 66			13,977.04
Structures Adj. to F. A. 66			19.60
Winslow Holbrook	21,038.83		21,038.83
D. I. Refunds		1,567.57	1,567.57
	<u>\$150,361.71</u>	<u>\$ 1,567.57</u>	<u>\$151,929.28</u>

**STATE HIGHWAY MAINTENANCE ACCOUNT**  
**RECEIPTS AND DISBURSEMENTS**

July 1, 1922, to June 30, 1924

	Receipts	Claims Paid	Claims In Transit	Auditor's Balance
Motor Vehicle Fees 1922-23	\$ 95,005.47	\$	\$	\$
Motor Vehicle Fees 1923-24	338,719.75			
Refunds	46.50			
Apache County		23,188.16		
Cochise County		52,361.30		
Coconino County		13,472.34		
Gila County		20,295.75		
Graham County		27,968.11		
Greenlee County		60,483.69		
Maricopa County		20,898.28		
Mohave County		14,678.85		
Navajo County		14,319.96		
Pima County		20,523.95		
Pinal County		64,170.35		
Santa Cruz County		7,921.75		
Yavapai County		11,542.08		
Yuma County		7,211.01		
<b>TOTAL</b>	<b>\$433,771.72</b>	<b>\$359,035.58</b>	<b>\$ 827.21</b>	<b>\$ 75,563.35</b>



# COUNTY AID RECEIVED

July 1, 1922 to June 30, 1924

	1922-23	1923-24	TOTAL	
APACHE COUNTY				
Adamana-Lupton	\$ 15,000.00		\$ 15,000.00	
Holbrook-St. Johns	8,000.00		8,000.00	
St. Johns-Springerville F. A. 60	27,644.55	\$ 2,148.98	29,793.53	
St. Johns-Springerville F. A. 68		44,159.10	44,159.10	\$ 96,952.63
COCHISE COUNTY				
Huachuca Siding	2,478.95		2,478.95	
Fairbanks to E. P. & S. W. Crossing	516.42		516.42	2,995.37
COCONINO COUNTY				
Winslow-Flagstaff F. A. 74		56,600.00	56,000.00	56,000.00
GILA COUNTY				
City of Miami	11,725.18		11,725.18	11,725.18
GRAHAM COUNTY				
Geronimo-Solomonville F. A. 43	66,731.44		66,731.44	
Geronimo-Solomonville F. A. 63	92,893.12		92,893.12	
Solomonville-Duncan F. A. 77		124,023.21	124,023.21	283,647.77

**COUNTY AID RECEIVED**  
**July 1, 1922 to June 30, 1924**

MARICOPA COUNTY	1922-23	1923-24	Total	
Gila Bend-Piedra F. A. 56	60,835.59		60,835.59	
Wickenburg-Hot Springs Jet. F. A. 59	165,000.00		165,000.00	
Mesa-Superior F. A. 65		145,234.86	145,234.86	
Piedra-Stanwix F. A. 69		102,677.33	102,677.33	
Phoenix-Wickenburg F. A. 70		125,129.09	125,129.09	
Gila Bend-Gillespie Dam F. A. 53		27.54	27.54	
Gillespie Dam-Hassayampa F. A. 64		127.11	127.11	
Apache Trail Bridges		12.00	12.00	599,943.52
NAVAJO COUNTY				
Holbrook-St. Johns F. A. 42	17,500.00		17,500.00	17,500.00
SANTA CRUZ COUNTY				
Patagonia Bridge		7,288.47	7,288.47	7,288.47
YAVAPAI COUNTY				
Prescott-Ashfork F. A. 61	133,727.30	3,221.86	136,949.16	
Prescott-Ashfork F. A. 62	73,903.22	114,147.62	188,050.84	
Phoenix-Prescott F. A. 72	75,000.00		75,000.00	
Seligman-Chino	14,061.83		14,061.83	
Ashfork-Nelson	86,234.53		86,234.53	
Wickenburg-Congress Junction	13,420.63		13,420.63	513,716.99
YUMA COUNTY				
Yuma-Wellton F. A. 55	128,850.95		128,850.95	
Yuma-Paving F. A. 82		20,000.00	20,000.00	148,850.95
TOTAL	\$993,523.71	\$744,197.17		1,737,720.88



**APACHE COUNTY**  
**July 1, 1922 to June 30, 1924**

Project	DISTRIBUTION			FUNDS						TOT
	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	S.H.M.A.	H. B. 159	
Adamana-Lupton Highway										
Adamana-Lupton.....	\$ 145.06	\$ 52,718.28	\$ .....	\$ 49,239.13	\$ .....	\$ .....	\$ .....	\$ .....	\$ 3,364.21	\$ 52,863
Allentown (Rio Puerco) bridge.....	253.49	12,244.40	.....	12,497.89	.....	.....	.....	.....	.....	12,497
Lupton (Rio Puerco) bridge.....	323.85	6,935.25	.....	7,259.10	.....	.....	.....	.....	.....	7,259
Sanders (Rio Puerco) bridge.....	238.23	16,118.83	.....	16,357.06	.....	.....	.....	.....	.....	16,357
Dead River Bridge F. A. 83.....	4,005.62	.....	.....	4,005.62	.....	.....	.....	.....	.....	4,005
Holbrook St. Johns Highway										
Holbrook-St. Johns Sec. 4B.....	309.72	272.32	.....	582.04	.....	.....	.....	.....	.....	582
Holbrook-St. Johns Sched. 3.....	.....	2,579.01	.....	.....	2,579.01	.....	.....	.....	.....	2,579
Concho Bridge.....	582.73	10,460.05	.....	11,042.78	.....	.....	.....	.....	.....	11,042
Concho-St. Johns F. A. 78.....	130.78	.....	.....	130.78	.....	.....	.....	.....	.....	130
St. Johns-Springerville F. A. 60.....	15,745.45	64,605.44	.....	6,446.39	.....	72,661.73	.....	.....	1,242.77	80,350
St. Johns-Springerville F. A. 68.....	5,927.10	47,495.09	.....	5,953.22	.....	47,417.77	.....	.....	51.20	53,422
Springerville-New. Mex. Line F. A. 73.....	6.55	.....	.....	6.55	.....	.....	.....	.....	.....	6
St. Johns-Zuni.....	.....	15,000.00	.....	15,000.00	.....	.....	.....	.....	.....	15,000
Maintenance										
Adamana-Lupton.....	.....	.....	16,856.47)	.....	.....	.....	.....	.....	.....	.....
Holbrook-St. Johns.....	.....	.....	36,296.84)	22,726.37	8,270.46	.....	.....	23,188.16	954.28	55,139
St. Johns-Springerville.....	.....	.....	1,985.96)	.....	.....	.....	.....	.....	.....	.....
Total.....	\$ 27,668.58	\$ 228,428.67	\$ 55,139.27	\$ 151,246.93	\$ 10,849.47	\$ 120,079.50	\$ .....	\$ 23,188.16	\$ 5,872.46	\$ 311,236

**COCHISE COUNTY**  
July 1, 1922 to June 30, 1924

Project	DISTRIBUTION			FUNDS						TOT
	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	S.H.M.A.	H. B. 59	
Benson-Vail, Sec. E.....	\$.....	\$ 275.00	\$.....	\$ 275.00	\$.....	\$.....	\$.....	\$.....	\$.....	\$ 275
Bisbee-Tombstone Paving.....	3,286.90	119,578.57	.....	122,865.47	.....	.....	.....	.....	.....	122,865
Douglas-Rodeo Dips.....	75.00	36,177.87	.....	17,630.48	18,622.39	.....	.....	.....	.....	36,252
Nogales-Fairbanks, F. A. 49.....	41.55	13,344.21	.....	13,385.76	.....	.....	.....	.....	.....	13,385
Benson-Tombstone, F. A. 79.....	1,202.13	.....	.....	536.19	665.94	.....	.....	.....	.....	1,202
Douglas-Safford, Sec. 1.....	3,875.31	9,642.20	.....	1,515.97	12,001.54	.....	.....	.....	.....	13,517
Maintenance:										
Benson-Tombstone.....	.....	.....	59,196.28)							
Bisbee-Douglas.....	.....	.....	8,023.07)							
Bisbee-Tombstone.....	.....	.....	29,999.94)							
Douglas-Rodeo.....	.....	.....	42,898.17)	30,281.66	85,856.67	.....	.....	52,361.30	.....	168,499
Tombstone-Nogales.....	.....	.....	21,598.68)							
Tucson-Benson.....	.....	.....	6,783.49)							
Total.....	\$ 8,480.89	\$ 179,017.85	\$168,499.63	\$186,490.53	\$117,146.54	\$.....	\$.....	\$ 52,361.30	\$.....	\$355,998



**COCONINO COUNTY**  
**July 1, 1922 to June 30, 1924**

Project	DISTRIBUTION			FUNDS						TOT
	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	S.H.M.A.	H. B. 159	
Flagstaff Paving—West.....	\$ 1,194.73	\$ 11,703.55	\$.....	\$ 12,652.44	\$ 245.84	\$.....	\$.....	\$.....	\$.....	\$ 12,898.28
Flagstaff-Williams Section A. & B. F. A. 24..	.....	8,482.80	.....	8,268.19	214.61	.....	.....	.....	.....	8,482.80
Williams-Ash Fork, Sec. B., F. A. 51.....	8.35	*6,139.35	.....	*6,131.00	.....	.....	.....	.....	.....	*6,131.00
Williams-Ash Fork, Sec. C, F. A. 51.....	24.55	22,181.74	.....	21,346.19	860.10	.....	.....	.....	.....	22,206.29
Ash Fork-Kingman, F. A. 80.....	489.78	.....	.....	489.78	.....	.....	.....	.....	.....	489.78
Winslow-Flagstaff Highway:										
Canyon Diablo-Canyon Padre, F. A. 81 .....	.....	513.30	.....	513.30	.....	.....	.....	.....	.....	513.30
Navajo Co. Line to Canyon Diablo,										
F. A. 74.....	6,068.80	844.19	.....	6,679.48	223.51	10.00	.....	.....	.....	6,912.99
Maintenance:										
Seligman-Nelson.....	.....	.....	3,704.62)	.....	.....	.....	.....	.....	.....	.....
Flagstaff-Williams.....	.....	.....	36,563.33)	9,834.13	21,505.43	.....	.....	13,472.34	1,238.93	56,050.83
Williams-Ash Fork.....	.....	.....	15,782.88)	.....	.....	.....	.....	.....	.....	.....
Total.....	\$ 7,786.21	\$ 37,586.23	\$56,050.83	\$ 63,652.51	\$ 23,049.49	\$ 10.00	\$.....	\$ 13,472.34	\$ 1,238.93	\$ 101,422.83

\*Credit.

**GILA COUNTY**  
**July 1, 1922 to June 30, 1924**

Project	DISTRIBUTION			FUNDS						TOT
	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	S.H.M.A.	H. B. 159	
City of Miami.....	\$.....	\$ 10,955.45	\$.....	\$ 10,955.45	\$.....	\$.....	\$.....	\$.....	\$.....	\$ 10,955
Globe-Geronimo Sec. A. & B.....	96.78			25.35					71.43	96
Superior-Miami, Sec. A. & G.....	21.75	84,756.79		29,065.45	55,713.09					84,778
Rice-Springerville.....		1,604.60			1,604.60					1,604
Globe-Roosevelt.....		30,342.80		5,435.09	24,906.99					30,342
Maintenance:										
Globe-Roosevelt.....			27,062.51)							
Globe-San Carlos.....			23,063.38)	17,021.55	34,126.54			20,295.75	1,328.45	72,772
Superior-Miami.....			21,746.40)							
Total.....	\$ 118.53	\$ 127,658.92	\$ 72,772.29	\$ 62,502.89	\$116,351.22	\$.....	\$.....	\$ 20,295.75	\$ 1,399.88	\$ 200,549



**GRAHAM COUNTY**  
**July 1, 1922 to June 30, 1924**

Project	DISTRIBUTION			FUNDS						TOT.
	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	S.H.M.A.	H. B. 159	
Geronimo-Solomonville:										
Central to Mathews Wash, F. A. 63.....	\$15,360.71	\$180,651.59	\$.....	\$ 7,449.56	\$.....	\$188,529.50	\$.....	\$.....	\$ 33.24	\$196,012.
Central to Safford, F. A. 43.....	8,995.56	157,816.64	.....	61,528.39	.....	66,600.99	25,944.83	.....	12,737.99	166,812.
Safford to 2 Mi. E. of Solomonville, F. A. 67.....	6,757.80	23,674.51	.....	1,203.34	250.00	28,978.97	.....	.....	.....	30,432.
Geronimo-Solomonville, F. A. 15, Sec. D.	46.10	.....	.....	46.10	.....	.....	.....	.....	.....	46.
Solomonville-Duncan, F. A. 77.....	1,920.29	24,547.55	.....	3,855.39	.....	22,612.45	.....	.....	.....	26,467.
Maintenance:										
Clifton-Solomonville.....	.....	.....	19,494.27)	.....	.....	.....	.....	.....	.....	.....
Geronimo-Solomonville.....	.....	.....	1,173.31)	3,284.91	14,890.97	.....	.....	27,968.11	184.50	46,328.
Solomonville-San Carlos.....	.....	.....	25,660.91)	.....	.....	.....	.....	.....	.....	.....
Total.....	\$ 33,080.46	\$386,690.29	\$ 46,328.49	\$ 77,367.69	\$ 15,140.97	\$306,721.91	\$ 25,944.83	\$ 27,968.11	\$ 12,955.73	\$ 466,099.

**GREENLEE COUNTY**  
**July 1, 1922 to June 30, 1924**

Project	DISTRIBUTION			FUNDS						TOT
	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	S.H.M.A.	H. B. 59	
Clifton-Mule Creek.....	\$.....	\$ 51,335.10	\$.....	\$ 45,685.75	\$ 5,649.35	\$.....	\$.....	\$.....	\$.....	\$ 51,335
Maintenance:										
Clifton-Mule Creek.....			14,653.20)							
Clifton-Solomonville.....			77,074.57)	11,560.14	18,757.94			60,483.69	926.00	91,727
Total.....	\$.....	\$ 51,335.10	\$91,727.77	\$ 57,245.89	\$24,407.29	\$.....	\$.....	\$ 60,483.69	\$ 926.00	\$ 143,062



**MARICOPA COUNTY**  
**July 1, 1922 to June 30, 1924**

Project	DISTRIBUTION			FUNDS						TOT.
	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	S.H.M.A.	H. B. 159	
Agua Fria Surfacing.....	\$.....	\$ 181.08	\$.....	\$ 31.08	\$ 150.00	\$.....	\$.....	\$.....	\$.....	\$ 181
Apache Trail Bridges.....	1,374.06	16,858.44	.....	18,232.50	.....	.....	.....	.....	.....	18,232
Apache Trail.....	734.42	201,678.87	.....	165,609.69	2,000.00	.....	34,286.33	.....	517.27	202,413
Apache Trail, Mormon Flats Sec.....	1,549.29	179.91	.....	1,729.20	.....	.....	.....	.....	.....	1,729
Chandler-Casa Grande.....	156.54	2,654.60	.....	2,283.52	527.62	.....	.....	.....	.....	2,811
Mesa Canal Pvg., F. A. 47, Sec. 2-B.....	359.89	1,429.16	.....	1,789.05	.....	.....	.....	.....	.....	1,789
Mesa Paving.....	227.01	12,169.02	.....	12,396.03	.....	.....	.....	.....	.....	12,396
Mesa-Superior, F. A. 65.....	9,572.67	133,066.81	.....	2,921.32	.....	139,718.16	.....	.....	.....	142,639
Mesa-Superior End F. A. 65 to Co. Line.....	.....	10,529.23	.....	5,812.55	4,716.68	.....	.....	.....	.....	10,529
Papago National Park Survey.....	67.69	.....	.....	67.69	.....	.....	.....	.....	.....	67
Phoenix:Wickenburg	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Glendale-Marinette, F. A. 48.....	2,494.89	2,979.00	.....	5,048.89	200.00	.....	.....	.....	225.00	5,473
New River Bridge, F. A. 48.....	751.37	.....	.....	713.87	.....	.....	.....	.....	37.50	751
Grand Ave. Paving.....	219.50	13,552.17	.....	13,771.67	.....	.....	.....	.....	.....	13,771
Marinette Bridge.....	.....	212.65	.....	212.65	.....	.....	.....	.....	.....	212
Marinette-Hot Springs Jct., F. A. 76.....	4,635.68	36,898.77	.....	445.58	21,333.77	19,755.10	.....	.....	.....	41,534
Marinette-Wickenburg, F. A. 70.....	7,084.04	115,738.18	.....	3,318.53	.....	119,503.69	.....	.....	.....	122,822
4 Mi. W. of Marinette to Nada.....	274.28	8,949.01	.....	507.16	8,626.13	.....	.....	.....	.....	9,229
Wickenburg Bridge.....	.....	*433.20	.....	*433.20	.....	.....	.....	.....	.....	*433
Wickenburg Hot Springs Jct., F. A. 59.....	12,001.91	363,412.44	.....	36,638.39	1,807.20	336,951.47	.....	.....	17.29	375,414

\*Credit.

**MARICOPA COUNTY**  
**July 1, 1922 to June 30, 1924**

Project	DISTRIBUTION			FUNDS						TOT
	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	S.H.M.A.	H. B. 159	
Phoenix-Yuma:										
Arlington-Gillespie Dam.....	\$ 2,509.74	\$ 7,257.32	\$ .....	\$ 9,241.44	\$ .....	\$ .....	\$ 21.33	\$ .....	\$ 504.29	\$ 9,767
Buckeye-Arlington Pav., F. A. 71.....	3,160.37	35,874.19	.....	24,497.61	981.94	11,719.28	.....	.....	1,835.73	39,034
Gila Bend-Gillespie Dam. F. A. 53.....	136.90	138,718.26	.....	74,568.59	25,497.59	8,303.40	27,907.74	.....	2,577.84	138,855
Gila Bend-Piedra, F. A. 56.....	4,673.13	68,871.49	.....	57,013.36	1,627.55	14,062.26	168.35	.....	673.10	73,544
Arlington Bridge.....	1,372.63	14,309.43	8,012.59	2,678.27	.....	4,903.70	.....	87.50	15,682.06	.....
Piedra-Stanwix, F. A. 69.....	4,698.22	179,552.88	.....	16,906.02	.....	167,341.68	3.40	.....	.....	184,251
Phoenix-Buckeye, F. A. 46.....	.....	1.75	.....	1.75	.....	.....	.....	.....	.....	1
Agua Fria Bridge.....	.....	300.00	.....	300.00	.....	.....	.....	.....	.....	300
Gillespie Dam-Hassayampa River, F. A. 64..	10,591.44	76,303.69	.....	4,911.52	41,499.63	40,483.98	.....	.....	.....	\$6,895
Gillespie Dam to Hassayampa R. Ext.....	.....	4,530.94	.....	1,284.64	3,246.30	.....	.....	.....	.....	4,530
Maintenance:										
Apache Trail.....	.....	.....	17,862.66)	.....	.....	.....	.....	.....	.....	.....
Gila Bend-Gillespie Dam.....	.....	.....	13,627.92)	.....	.....	.....	.....	.....	.....	.....
Hassayampa Bridge.....	.....	.....	302.31)	.....	.....	.....	.....	.....	.....	.....
Mesa-Superior.....	.....	.....	5,680.44)	.....	.....	.....	.....	.....	.....	.....
Maricopa County Paving.....	.....	.....	21,841.06)	.....	.....	.....	.....	.....	.....	.....
Buckeye-Hassayampa.....	.....	.....	4,123.76)	24,625.81	37,451.21	.....	.....	20,898.28	1,144.75	84,120
Wickenburg-Congress Jct.....	.....	.....	4,228.61)	.....	.....	.....	.....	.....	.....	.....
Agua-Fria Crossing.....	.....	.....	11,740.12)	.....	.....	.....	.....	.....	.....	.....
Marinette-Hot Springs Jct.....	.....	.....	170.57)	.....	.....	.....	.....	.....	.....	.....
Wickenburg-Hot Springs Jct.....	.....	.....	4,542.60)	.....	.....	.....	.....	.....	.....	.....
Total.....	\$ 68,645.67	\$ 1,445,776.09	\$ 84,120.05	\$ 492,549.50	\$ 152,343.89	\$ 857,839.02	\$ 67,290.85	\$ 20,898.28	\$ 7,620.27	\$ 1,598,541

\*Credit.



**MOHAVE COUNTY**  
**July 1, 1922 to June 30, 1924**

Project	DISTRIBUTION			FUNDS							TOTAL
	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	S.H.M.A.	H. B. 159		
Arrowhead Trail.....	\$.....	\$ *207.71	\$.....	\$ *207.71	\$.....	\$.....	\$.....	\$.....	\$.....	\$ *207.71	
Kingman-Hackberry.....	23.51	9,976.49	.....	10,000.00	.....	.....	.....	.....	.....	10,000.00	
Kingman-Oatman.....	.....	750.54	.....	750.54	.....	.....	.....	.....	.....	750.54	
Kingman-Oatman, F. A. 54.....	12.60	21,370.69	.....	16,049.88	23.91	.....	.....	.....	5,309.50	21,383.79	
Topock-Oatman, Sec 1, F. A. 39.....	292.54	7,520.58	.....	*12,435.83	4,965.10	15,283.85	.....	.....	.....	7,813.43	
Topock-Oatman, Sec. 2, F. A. 39.....	.....	1,068.84	.....	1,068.84	.....	.....	.....	.....	.....	1,068.84	
Ash Fork-Kingman, F. A. 80.....	2,448.93	.....	.....	2,448.93	.....	.....	.....	.....	.....	2,448.93	
Hillside-Kingman.....	836.51	.....	.....	836.51	.....	.....	.....	.....	.....	836.51	
Maintenance:											
Kingman-Oatman.....	.....	.....	24,469.34	.....	.....	.....	.....	.....	.....	24,469.34	
Topock-Oatman.....	.....	.....	24,056.66	21,754.00	13,039.14	.....	.....	14,678.85	784.00	50,255.99	
Seligman-Nelson.....	.....	.....	1,729.99	.....	.....	.....	.....	.....	.....	1,729.99	
Total.....	\$ 3,614.09	\$ 40,479.43	\$50,255.99)	\$ 40,265.16	\$18,028.15	\$ 15,283.85	\$.....	\$14,678.85	\$ 6,093.50	\$ 94,349.99	

\*Credit.

**NAVAJO COUNTY**  
**July 1, 1922 to June 30, 1924**

Project	DISTRIBUTION			FUNDS						TOT.
	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	S.H.M.A.	H. B. 159	
Holbrook-St. Johns, F. A. 42.....	\$ 7,193.93	\$ 62,711.62	\$.....	\$ 29,774.29	\$ 74.80	\$ 39,796.39	\$.....	\$.....	\$ 260.07	\$ 69,905.
Holbrook-Winslow, F. A. 40.....	9,594.91	130,875.43	.....	105,246.56	.....	13,983.35	21,038.83	.....	201.60	140,470.
Winslow Paving, F. A. 20.....	2,984.27	42,692.78	.....	45,677.05	.....	.....	.....	.....	.....	45,677.
Holbrook-Winslow, F. A. 40:										
St. Joseph Bridge.....	206.27	32.20	.....	238.47	.....	.....	.....	.....	.....	238.
Rice-Springerville:										
Ft. Apache to Cooley.....	761.08	.....	.....	761.08	.....	.....	.....	.....	.....	761.
Winslow-Flagstaff, F. A. 22.....	300.04	.....	.....	300.04	.....	.....	.....	.....	.....	300.
Maintenance:										
Holbrook-St. Johns.....	.....	.....	8,271.39)	.....	.....	.....	.....	.....	.....	.....
Holbrook-Winslow.....	.....	.....	28,101.49)	6,629.23	15,414.19	.....	.....	14,319.96	9.50	36,372.
Total.....	\$ 21,040.50	\$ 236,312.03	\$36,372.88	\$188,626.72	\$ 15,488.99	\$ 53,779.74	\$ 21,038.83	\$ 14,319.96	\$ 471.17	\$ 293,725.



**PIMA COUNTY**  
**July 1, 1922 to June 30, 1924**

Project	DISTRIBUTION			FUNDS						TOTAL
	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	S.H.M.A.	H. B. 159	
Benson-Vail, F. A. 18.....	\$.....	\$ *183.42	\$.....	\$ *183.42	\$.....	\$.....	\$.....	\$.....	\$.....	\$ *183.42
Tucson-Florence.....	51.68	75,353.63	.....	54,899.29	20,488.48	.....	.....	.....	17.54	75,405.35
Tucson-Nogales Bridges, F. A. 25B.....	2,961.17	18,917.59	.....	15.58	222.50	6,007.90	15,632.78	.....	.....	21,878.76
Continental Bridge, F. A. 75.....	2,129.08	8,865.83	.....	263.00	10,083.54	557.76	90.61	.....	.....	10,994.91
Tucson Warehouse.....	.....	228.86	.....	9.95	.....	.....	.....	188.91	30.00	228.86
Maintenance:										
Tucson-Benson.....	.....	.....	34,381.97	.....	.....	.....	.....	.....	.....	34,381.97
Tucson-Nogales.....	.....	.....	11,742.02	26,264.04	14,734.99	.....	.....	20,335.04	1,474.52	62,808.59
Tucson-Florence.....	.....	.....	16,684.60	.....	.....	.....	.....	.....	.....	16,684.60
Total.....	\$ 5,141.93	\$103,182.49	\$62,808.59	\$ 81,268.44	\$ 45,529.51	\$ 6,565.66	\$ 15,723.39	\$ 20,523.95	\$ 1,522.06	\$ 171,133.51

\*Credit.

**PINAL COUNTY**  
**July 1, 1922 to June 30, 1924**

Project	DISTRIBUTION				FUNDS					TOT.
	Indirect	Engineering	Construction	Maintenance	25%	75%	F. A.	S.H.M.A.	H. B. 59	
Chandler-Casa Grande.....	\$.....	\$4,889.46	\$ 8,242.80	\$.....	\$ 8,308.07	\$ 3,397.52	\$.....	\$.....	\$ 1,426.67	\$ 13,132.
Florence-Superior, F. A. 23.....		12,786.39	135,864.53		75,062.76	10,986.61	62,051.55		550.00	148,650.
Mesa-Superior, Sec. 2 B.....		123.39	21,705.73		21,380.71	100.64			347.77	21,829.
Mesa-Superior Paving.....		1,745.90	76,617.93		78,363.83					78,363.
Ray-Superior.....			993.06		993.06					993.
Superior-Miami.....		294.05	25,292.87		23,454.32	677.19			1,455.41	25,586.
Tucson-Florence.....		854.64	115,062.68		101,110.07	9,096.76			5,710.49	115,917.
Maintenance:										
Florence-Superior.....				32,904.29)						
Mesa-Superior.....				19,304.19)						
Superior-Miami.....				23,720.65)	22,156.13	20,136.04		64,170.35	1,310.00	107,772.
Tucson-Florence.....				31,843.39)						
Transfer of Funds.....	7,889.65				7,889.65					7,889.
Total.....	\$ 7,889.65	\$ 20,693.83	\$383,779.60	\$ 107,772.52	\$330,828.95	\$2,284.41	\$ 62,051.55	\$ 64,170.35	\$10,800.34	\$ 520,135.



**SANTA CRUZ COUNTY**  
July 1, 1922 to June 30, 1924

Project	DISTRIBUTION			FUNDS						TOTAL
	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	S.H.M.A.	H. B. 159	
Nogales-Fairbanks.....	\$ 11.00	\$ *1,555.83	\$ .....	*1,555.83	\$ .....	\$ .....	\$ .....	\$ .....	\$ .....	\$ * 1,555.83
Patagonia Bridge .....	1,239.49	17,746.50	.....	18,761.38	.....	.....	.....	.....	224.61	18,985.99
Nogales-Willows Paving.....	4,672.81	66,651.14	.....	71,323.95	.....	.....	.....	.....	.....	71,323.95
Tucson-Nogales Bridges, F. A. 25-B .....	740.44	4,716.77	.....	47.03	.....	1,501.98	3,908.20	.....	.....	5,457.21
Tucson-Nogales Bridges, F. A. 66.....	2,237.00	16,149.86	.....	*289.08	.....	4,698.90	13,977.04	.....	.....	18,386.82
Structures Adj. to F. A. 66.....	.....	196.46	.....	167.86	.....	.....	19.60	.....	.....	196.46
Maintenance:										
Nogales-Tombstone.....	.....	.....	16,389.22)	.....	.....	.....	.....	.....	.....	.....
Nogales-Tucson.....	.....	.....	21,333.94)	14,936.45	13,803.83	.....	.....	7,921.75	1,061.13	37,723.16
Total.....	\$ 8,900.74	\$103,904.90	\$ 37,723.16	\$103,411.76	\$13,803.83	\$ 6,200.88	\$ 17,904.84	\$ 7,921.75	\$ 1,285.74	\$ 150,528.86

\*Credit.

**YAVAPAI COUNTY**  
**July 1, 1922 to June 30, 1924**

Project	DISTRIBUTION			FUNDS						TOT
	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	S.H.M.A.	H. B. 59	
Prescott-Jerome, Yeager Canyon.....	\$.....	\$ *1,675.53\$	.....	\$ 9,824.89	\$ 8,149.36	\$.....	\$.....	\$.....	\$.....	\$ *1,675
Ash Fork-Nelson.....	.....	3,641.51	.....	865.29	317.25	.....	2,458.97	.....	.....	3,641
Ash Fork-Pineveta.....	.....	10,943.38	.....	10,943.38	.....	.....	.....	.....	.....	10,943.
Pineveta-Crookton, F. A. 57.....	11.25	86,282.92	.....	86,294.17	.....	.....	.....	.....	.....	86,294.
Prescott-Ash Fork, F. A. 61.....	438.03	215,855.34	.....	140,280.67	.....	75,845.58	.....	.....	167.12	216,293.
Prescott-Ash Fork, F. A. 62.....	5,783.32	363,491.34	.....	63,864.11	.....	301,074.59	.....	.....	4,335.96	369,274.
Prescott-Jerome, F. A. 19, Sec. A.-B.....	1.98	19,347.35	.....	18,377.37	.....	.....	.....	.....	971.96	19,349.
Prescott-Jerome, F. A., 36-A.....	2,031.07	34,994.91	30,180.66	.....	6,845.32	.....	.....	.....	.....	37,025
Prescott-Jerome, F. A. 36-B.....	589.35	15,083.38	.....	15,672.73	.....	.....	.....	.....	.....	15,672
Seligman-Crookton.....	.....	12,674.61	.....	12,674.61	.....	.....	.....	.....	.....	12,674.
White Spar-Cong. Jct., F. A. 72.....	18,460.57	27,031.58	.....	14,041.59	100.00	30,564.55	.....	.....	795.01	45,501.
Wickenburg-Congress Jct.....	.....	936.58	.....	872.58	64.00	.....	.....	.....	.....	936.
Maintenance:										
Ash Fork-Nelson.....	.....	37,906.38)	.....	.....	.....	.....	.....	.....	.....	.....
Prescott-Ash Fork.....	.....	16,631.60)	.....	.....	.....	.....	.....	.....	.....	.....
Williams-Ash Fork.....	.....	1,502.65)	.....	42,028.78	61,496.22	.....	.....	11,542.08	624.63	115,691.
Prescott-Jerome.....	.....	53,910.32)	.....	.....	.....	.....	.....	.....	.....	.....
Wickenburg-Congress Jct.....	.....	5,740.76)	.....	.....	.....	.....	.....	.....	.....	.....
Total.....	\$27,324.57	\$ 788,607.37	\$115,691.71	\$426,271.05	\$ 70,126.83	\$414,330.04	\$ 2,458.97	\$ 11,542.08	\$ 6,894.68	\$ 931,623

\*Credit.



**YUMA COUNTY**  
**July 1, 1922 to June 30, 1924**

Project	DISTRIBUTION			FUNDS						TOTAL
	Engineering	Construction	Maintenance	25%	75%	F. A.	S. B. 51	S.H.M.A.	H. B. 159	
Wellton-Aztec, F. A. 55.....	\$ 10,555.66	\$236,906.26	\$.....	\$ 96,990.35	\$.....	\$148,327.13	\$.....	\$.....	\$ 2,144.44	\$ 247,461.9
Yuma-Wellton, Sec. B. & D.....	1,204.57	16,792.41	.....	14,103.59	3,893.39	.....	.....	.....	.....	17,996.9
Antelope Hill Bridge.....	52.70	3,633.81	.....	122.10	3,564.41	.....	.....	.....	.....	3,686.5
Aztec-Maricopa Co. Line, F. A. 55.....	1,282.26	21,909.97	.....	15,474.97	.....	7,717.26	.....	.....	.....	23,192.2
Liguerta to Blaisdell.....	102.52	42.80	.....	145.32	.....	.....	.....	.....	.....	145.3
Wellington West 9.7 Mi., F. A. 26.....	.....	120.11	.....	59.78	60.33	.....	.....	.....	.....	120.1
Yuma East 7 Mi. F. A. 82.....	289.61	379.89	.....	669.50	.....	.....	.....	.....	.....	669.5
Maintenance:										
Parker-Bouse.....	.....	.....	7,288.29)	.....	.....	.....	.....	.....	.....	.....
Yuma-Wellton.....	.....	.....	14,851.64)	7,357.06	15,913.45	.....	.....	7,211.01	.....	30,481.1
Wellton-Aztec.....	.....	.....	8,401.59)	.....	.....	.....	.....	.....	.....	.....
Total.....	\$ 13,487.32	\$ 279,785.25	\$30,481.52	\$134,922.67	\$ 23,431.58	\$156,044.39	\$.....	\$ 7,211.01	\$ 2,144.44	\$ 323,754.0

## GENERAL ACCOUNTS

July 1, 1922, to June 30, 1924

## GENERAL OFFICE EXPENSE

Postage, Freight and Express	\$ 2,333.48	\$	\$
Telephone and Telegraph	4,012.24		
Drafting and Engineering Equipment	3,699.92		
Drafting and Engineering Supplies	1,686.95		
Engineering Office Salaries	74,477.35		
Accounting Office Salaries	74,362.62		
Traveling Expense	3,356.26		
Accounting Office Supplies	360.14		
General Office Supplies	7,992.46		

172,281.42

## GENERAL EXPENSE

Salaries not chargeable to Projects	\$ 555.00
Expense not chargeable to Projects	7,707.10
Auto Exp. not chargeable to Projects	4,479.55
Bonding, Premiums and Insurance	1,423.19
Blue Prints and Photographs	1,108.55
Magazines and Newspapers	171.30
Legal Expense	1,068.65

16,513.34

## GENERAL EQUIPMENT

Federal Equipment	\$117,042.32
Auto cars and trucks	13,164.36
Yard, Warehouse, Machine Shop Equip.	
Field Camp Equipment	132,679.92
Live stock, Horses and Mules	
Maintenance Camp Equipment	106,393.84
Rental of Equipment	217,717.35*

322,992.56†

10,227.51†

151,563.09

## GENERAL EQUIPMENT REPAIRS

Purchases, Camps, Account	\$240,235.53*
Freight Charges, Camps Account	3,717.50*
Federal Equipment, Parts & Accessories	16,300.57*
Warehouse Labor	49,243.47
Machine Shop Operation	98,940.28
Warehouse Expense	8,726.96
Oil and Gas	4,557.11
Parts and Accessories	368,603.35
Miscellaneous	28.39*
Tools	18.00
Outside Accounts	100,990.69*

168,816.49

## PLANT ACCOUNTS

Capitol Flagpole	\$ 258.86
Laboratory Building	793.11
Furniture, Fixtures & Partitions	2,141.53
Office Machinery	8,933.72
Tucson Warehouse Site	1,950.00

14,077.22

## INDIRECT

Paid by Counties	8,143.44*
County Loans Repaid	28,545.26
Cave Creek Dam	1,760.07

22,161.89

## TOTAL

\$545,413.45

\$333,220.07\*

\$212,193.28

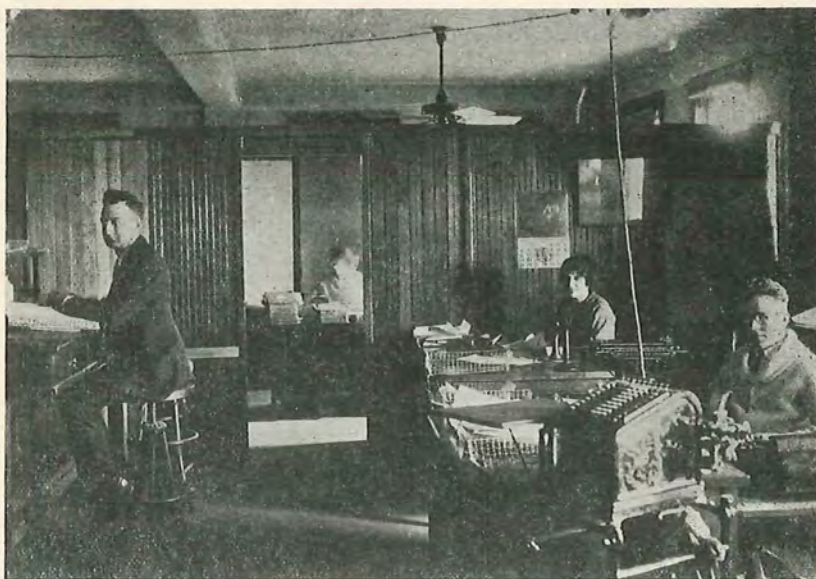
† Interdepartment transfers of equipment on department invoices, not proper credits to operation accounts.

\* Credit.





PURCHASING DEPARTMENT



IN THE ACCOUNTING DEPARTMENT

## The Purchasing Department

**GEORGE V. EBERLE, Purchasing Agent**

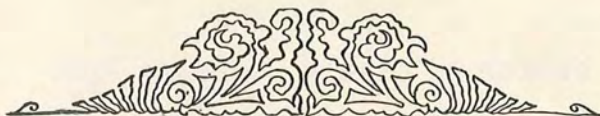
WITH the exception of approximately 10 per cent, which are emergency orders from the field, all supplies are purchased through this department.

Approximately 60 requisitions were handled daily by this department from July 1, 1922 to June 30, 1924, with 17,105 general purchase orders issued in that period. From July 1, 1924 to December 1, 1924, 4,007 general purchase orders were issued, with 40 general purchase orders each day and 70 requisitions handled daily.

The personnel of the department comprises the purchasing agent and a stenographer. Three forms of requisitions are used. Form No. 1, the general purchase order is used in making purchases from this department. Form No. 2 is the field emergency purchase order used by field engineers, general foremen and maintenance men to make emergency purchases. Form No. 3, the requisition to the purchasing department, is the form used by field men in requisitioning for supplies.

The purchases made cover a wide range. They include automobiles, cement, corrugated pipe, drugs, electrical equipment and supplies, explosives, engineering equipment, supplies and repairs, fuel, hay and grain, groceries, hardware, harness supplies and repairs, ice, lumber, leather, foundry castings, laboratory equipment and supplies, meats, oil and gas, printing, rock, sand, steel, fresh vegetables and parts for automobiles, trucks, tractors, trailers, road graders, cement mixers, steam shovels, steam hoists, jack hammers, compressors, pile drivers, grinding machines and magnetos.

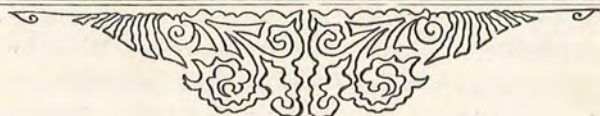




## MIAMI-SUPERIOR HIGHWAY



PANORAMA OF QUEEN CREEK BRIDGE



## Cost Accounting

**J. T. LAMBERT, Cost Accountant**

It is the purpose of the cost records to furnish the State engineer a complete and accurate record of unit costs on both construction and maintenance projects, on which to base future estimates.

The present method of computing costs in use by the State Highway Department is based upon a detailed field distribution schedule, which carries a distinct account for each class of work contemplated for highway construction and maintenance work, and a separate, detailed account for all classes of engineering, as required for reports submitted to the Federal Government in connection with Federal Aid work.

The distribution is obtained by the general office from approved invoices and payrolls received directly from the field-man in charge.

The entire cost system is directly tied in with the general accounting system through the claims, as all entries in both the construction and maintenance ledgers are made from the claims which are made up from invoices received direct from the field.

### CONSTRUCTION

The construction distribution is made up of engineering accounts, indirect accounts, direct working accounts, and a material and supply account. The following list shows the general headings of the accounts, each of which has a detailed distribution within itself:



- 200—215 Engineering Recon, Surveys
- 216—235 Engineering Preliminary
- 236—250 Engineering Bridge
- 251—270 Engineering Construction and Insp.
- 271—285 Mess House Operation
- 286—310 Corral Operation
- 311—325 Motor Vehicles
- 326—350 Steam and Gas Shovels
- 351—375 Compressor Operation
- 376—395 Hand Drilling
- 396—410 Blacksmith Shop Operation
- 411—430 Roller Operation
- 431—445 Field Superintendency
- 446—470 Camp Construction
- 471—480 Transportation of Equipment
- 481—495 Moving Camp
- 496—515 Camp Maintenance
- 516—530 Temporary Const., Shoo-Fly, Etc.
- 531—540 Equipment Rental and Repairs
- 541—560 Right-of-way
- 561—575 Clearing and Grubbing
- 591—620 Grading
- 621—650 Structural Excavation
- 651—679 Borrow
- 680—720 Concrete
- 721—735 Crusher Operation
- 736—755 C. M. Pipe Culverts
- 756—775 Cattle Guards
- 776—800 Rip-rapping
- 801—825 Ditches and Channel Changes
- 826—850 Surfacing
- 851—860 Guard Fence or Rail
- 900—930 Materials and Supplies
- 1001--1030 Steel Bridges

### **Data From Field**

On all construction jobs a timekeeper is put in charge of the distribution and the general clerical work. His duties, in regard to costs, are the daily distribution of labor, and a distribution on all invoices covering purchases for the project.

Each project under construction has a separate control account and distribution in the General Office construction ledger. The distributions are headed with the first number of each general account which shows the accounts in the ledger not detailed. The detailed distribution is made up in the field and forwarded to the General Office on feature sheets, Form 37, which are bound for permanent record. A Material and Supply record is kept in the camp with a direct check on the same account in the General Office construction ledger. At the end of each thirty day period an inventory is taken of material on hand in the field and a check is made against the daily charge-out record on each account. A report of this is then submitted to the General Office on Form 37, which is a complete report on labor and materials spent during the month.

### **Method of Computing**

At the time that the engineer in charge of the project submits his monthly report of yardage, etc., the timekeeper closes his records and submits his report of labor and materials spent, in order that unit costs may be computed by the Cost Accountant in the General Office. The unit costs are arrived at in the following manner: The total to date of each account, direct and indirect, shown by the Construction Ledger is taken, plus the outstanding from the field and used as a total spent. Materials and supplies are then transferred, indirect charges, including motors, teams, etc., are distributed per field reports, and the overhead is prorated. All of these transfers are made on a to date basis, the overhead being prorated per the labor spent on each working account to date, thereby, giving a fair distribution of indirect charges throughout the job. The totals finally reached are then divided by the yardage, etc., shown on the engineer's report which gives the unit cost to date. The reports are then bound for permanent record.

The following is an example of the final costs on a project computed in this manner:



**Typical Final Cost Report**  
**Wickenburg-Hot Springs F.A. 59 W.O. 20**

		Quantity		Unit Cost	Total
591	Exc. Roadway .....	142267.	cu. yds.	1.494	212,629.61
651	Borrow (gravel surf. for fords included) .....	73516.	"	.6315	45,168.73
621	Structural Exc. (unclass) .....	5690.)	"		
621-A	Spandrel Fill .....	260.)	"		
		<hr/>			
		5950	"	1.9647	11,690.32
1-801	Ditches & Channel Changes ....	4736	"	.4204	1,991.46
A-680	Concrete Class "A" .....	1667.3	"	17.456	29,105.65
B-680	Concrete Class "B" .....	495.7	"	19.842	9,835.79
C-680	Concrete Class "C" .....	691.9	"	22.679	15,691.79
D-680	Rubble Masonry .....	10.	"	6.477	64.77
736	24" CM Pipe (haul & Place).....	1349.	ft.	.75	1,011.75
736	30" " .....	148.	ft.	.90	133.20
736	36" " .....	462.	ft.	1.364	630.36
683	Reinforcing Steel (haul, Bend & place) .....	97803.	lbs.	.012	1,181.83
776	Rip Rap .....	910.	cu. yds.	5.289	5,362.52
776-A	Jetty .....				4,124.28
					<hr/>
					338,622.06

**State Furnished Material**

914	Cement .....	3963.	bbls.	3.661	14,510.98
916	Reinforcing Steel .....	97803.	lbs.	3.61	3,530.71
912	24" CM Pipe .....	1349.	Ft.	1.89	3,112.83
912	30" " .....	148.	Ft.	2.36	410.64
912	36" " .....	462.	Ft.	3.787	1,750.33
					<hr/>
					361,937.55
251	Engineering .....				12,001.91
					<hr/>
	Total Expenditures .....				373,939.46

## MAINTENANCE

The maintenance schedule of costs requires a direct distribution of all materials, labor and other items to the following accounts:

- 050 Dist. Engr's. Expense (Phoenix Office only)
- 051 Dist. Shop Expense (Phoenix Office only)
- 052 Payrolls
- 053 Caterpillar
- 054 Teams
- 055 Trucks
- 056 Miscellaneous Expense.
- 057 Equipment Rental and Repairs
- 058 Hospital, Doctors and Medicine.
- 059 Accident Compensation
- 060 Mess

In conjunction with this data from the field, a monthly report, designated as Form 6, is submitted by the maintenance foreman, over the approval of the District Engineer, showing the classes of work performed on each day of the period, the number of men working, the number of trucks, teams and caterpillars in use, and the average daily traffic. The classes of work shown by the report are Surface Work, Paving, Shoulders, and Ditches and Structures.

Finally, when the monthly maintenance report is received it is compared with the ledger accounts, and a man day cost, a truck day cost, a team day cost, and a caterpillar day cost are computed for each maintenance project. The unit cost is then applied to each class of work as reported from the field on Form 6, with the result that each project shows a total for each class of work done. From this is computed an actual mileage cost to date, and an estimated yearly cost per mile, all of which is shown on a recapitulation sheet on the monthly report. These reports are then bound for permanent record.

### Typical Report

The following is a copy of a typical maintenance report on District No. 2 for the period, July 1, 1924 to November 30, 1924, showing the method of application:



## MAINTENANCE

## Cost Report July 1 to

AFE	Project	County	Miles	052
351	Yuma-Wellton	Yuma	39.5	1041.25
352	Wellton-Aztec	"	42.6	347.75
353	Gila Bend-Gill.-Piedra	Maricopa	24.4	388.00
355	Agua Fria Crossing	"	1.0	33.75
356A	Mesa-Superior	"	5.9	120.52
356B	" "	Pinal	20.4	416.73
359	Apache Trail	Maricopa	20.0	466.00
360	" "	"	19.5	459.75
361A	Wickenburg-Hot Springs	"	11.4	217.78
361B	Wickenburg-Con. Junction	Yavapai	15.1	288.47
364	Hassayampa-Gila Bend	Maricopa	25.2	300.25
365	Marinette-Hot Springs	"	21.6	
367	Florence-Superior	Pinal	25.6	638.50
368A	Aztec-Piedra	Yuma	7.0	110.84
368B	" "	Maricopa	21.8	345.16
369	Superior-Miami	Pinal	15.5	718.00
CURRENT				5892.75
PREVIOUS				
TO DATE				

## DISTRICT No. 2

November 30, 1924

054	055	056	057	058	Total
	218.55	28.23	120.98		1409.01
	103.45	.23	309.92		761.35
	158.92	1.73	295.70		844.35
11.25					45.00
	39.38	.47	53.01		213.38
	136.15	1.64	183.35		737.87
		.38	123.42		589.80
	122.94	.62	135.13		718.44
63.88	90.27	19.09	107.09		498.11
84.62	119.57	25.26	141.86		659.78
	307.30				607.55
	153.15	63.27			854.92
	14.50	.58	5.11		131.03
	45.29	1.79	15.89		408.13
	190.82	7.52	126.85	5.00	1048.19
159.75	1700.29	150.81	1618.31	5.00	9526.91
					24981.73
					34508.64



AFE	SURFACE			SHOULDERS	
	Current	Previous	To Date	Current	Previous
351	1409.01	3915.24	5324.25		
352	761.35	1379.21	2140.56		39.00
353	844.35	1641.80	2486.15		37.75
355					
356A	213.38	360.06	573.44		16.69
356B	737.87	1244.79	1982.66		57.71
359	589.80	1347.91	1937.71		90.82
360	718.44	1639.14	2357.58		407.49
361A	331.62	718.46	1050.08		34.77
361B	439.20	953.39	1392.59		46.33
364	607.55	1478.45	2086.00		121.39
365		106.50	106.50		
367	751.37	2218.02	2969.39	67.13	298.90
368A	115.26	271.51	386.77		15.09
368B	359.65	845.57	1205.22		47.00
369	779.17	2217.76	2996.93	25.37	456.89
1000	8658.02	20337.81	28995.83	92.50	1669.83

DITCHES & STRUCTURES				Grand
To Date	Current	Previous	To Date	Total
				5324.25
39.00		42.17	42.17	2221.73
37.75		37.78	37.78	2561.68
	45.00	97.95	142.95	142.95
16.69		16.48	16.48	606.61
57.71		56.96	56.96	2097.33
90.82		126.51	126.51	2155.04
407.49		385.86	385.86	3150.93
34.77	166.49	317.78	484.27	1569.12
46.33	220.58	421.21	641.79	2080.71
121.39		38.40	38.40	2245.79
				106.50
366.03	36.42	489.58	526.00	3861.42
15.09	15.77	61.17	76.94	478.80
47.00	48.48	190.50	238.98	1491.20
482.26	243.65	691.74	935.39	4414.58
1762.33	776.39	2974.09	3750.48	34508.64



AFFE	Amount	Estimated		To Date	To Date
	Author-	Cost Per	Yearly	Man	Man
	ized Per	Mile 7-1-'24	Cost	Days	Day
	Mi. Per Yr.	to 11-30-'24	Per Mile		Cost
351	500.00	134.79	323.52	1014	4.00
352	300.00	52.15	125.16	357	3.50
353	400.00	104.99	162.00	477	3.38
355	400.00	142.95	343.08		
356A	500.00	102.81	246.72	427	4.00
356B	500.00	102.81	246.72		
359	450.00	107.75	258.60	404	3.75
360	400.00	161.59	387.84	485	3.82
361A	400.00	137.64	330.36	604 1/2	3.86
361B	400.00	137.79	330.72		
364	350.00	89.11	213.84	368	3.58
365	300.00	4.93	11.88	26	4.00
367	500.00	150.84	361.92	628	4.71
368A	300.00	68.40	273.60	335	4.35
368B	300.00	68.40	273.60		
369	600.00	284.81	683.52	744 1/2	4.43

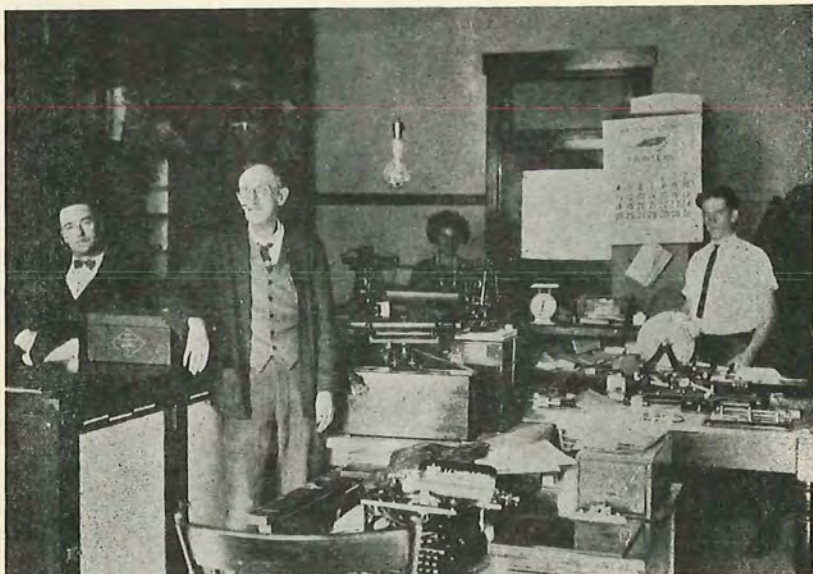
Average Estimated Yearly Cost per mile .....	285.817
Average Man Day Cost .....	3.948
Average Truck Day Cost .....	1.533
Average Team Day Cost .....	3.163

To Date Truck Days	To Date Truck Day Cost	To Date Team Days	To Date Team Day Cost	Average Daily Traffic		
				Teams	Cars	Trucks
320	2.33	147	.31	2	200	8
138	3.23			7	187	12
154	1.76	34½	4.06	9	187	12
154	3.15			25	600	175
95	2.64				1.40	16
125	2.22			1	45	2
144	3.65	29	5.12	10	200	40
152	2.62	41			175	25
140	2.92	9		5	350	50
143	1.83				125	
122	3.58			2	250	40

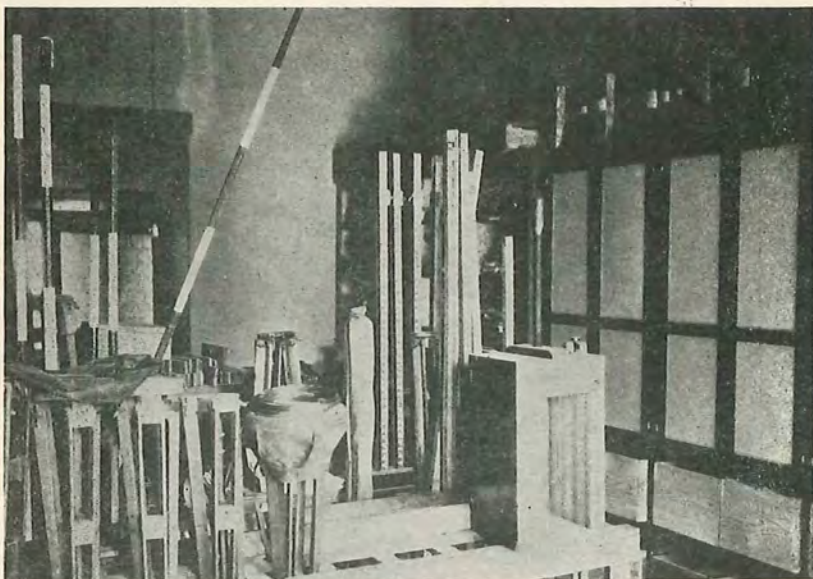
### BETTERMENT AND RECONSTRUCTION

Betterment and Reconstruction work is taken care of in the same manner as construction, but each piece of work of this class is handled on a separate A. F. E. in order that there will be no chance of confusion with general maintenance.





STOCK ROOM No. 1



STOCK ROOM No. 2

## General Office Stock Room

**E. H. DOTY, Stock Clerk**

THE stock room, in addition to preparing all mail, is the repository for all general office and camp supplies, including stationery, engineering equipment, office and camp forms, blue-prints and typewriters. This department has grown in two years from one room, with approximately 175 feet of shelving, to two rooms with more than 600 feet of shelving.

The mail matter prepared in the two years comprises 75,000 pieces of first class mail, 150 of which were registered; 1,950 pieces of parcel post, 350 pieces of which were insured. The monthly average cost for postage stamps, exclusive of stamped envelopes, was \$40, and the cost of postage for the two years approximates \$2,500.

The stock inventories approximately \$28,740. The inventory follows:

37 Transits, American make .....	\$11,000
32 Levels, American make .....	6,400
17 Transits and levels of foreign make obtained from the U. S. Government, approximately .....	340
Other engineering equipment, including tapes, level and line rods, stadia rods, and the like .....	2,000
38 Typewriters, approximately .....	3,000
Miscellaneous, as blueprint paper, tracing and cross-section paper, forms, stationery, etc., approximately .....	6,000
Total .....	\$28,740

As the transits and levels are the most essential and expensive articles of the stock room, a system of logging each instrument is to be installed. This system will show the first cost of each instrument, the expense of its upkeep, its durability, and the general adaptability of each instrument.



The cost to repairs for transits and levels for the two years was \$1,205.20. The cost to repairs for typewriters was \$231.

Two thousand requisitions for supplies were made on the purchasing agent in the two years.

Seventy-five separate and distinct printed forms are now being used by the department and in the field. The forms first are mimeographed by the stock clerk, and when found adequate for all purposes they are standardized and printed.

In the two years 800 stencils have been made, from which 750,000 sheets have been mimeographed, with a maximum expense of \$15 for cleaning and overhauling the mimeograph.

One of the features of the stock room is the 19 inch lever paper cutter, by means of which obsolete forms and other paper, which otherwise would be wasted, are cut to convenient sizes for use as scratch pads. Also, manuscript covers and odd sized paper are cut as required.

The blueprint room has printed approximately 8,000 standard and other size sheets, totaling in length nearly six miles. The cost of the paper and the making of the blueprints was three cents per square foot, or a total cost of \$1,440.



## State Certification Board

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THE State Certification Board, which comprises the Attorney General, the Superintendent of Banks and the State Engineer, passes on the organization of all irrigation districts and certifies to the bonds of all such districts, where such bonds are to be legal investments for funds of saving banks within the State of Arizona, or where such bonds are to be deposited to secure public money in the State of Arizona.

The importance of this work can be realized by a consideration of the projects passed on during the past two years, which aggregate \$23,000,000.

It is impossible for the State Engineer to give the time to this responsible assignment that would act to the best interest of the State. The greater part of the duties of the State Engineer on this Board are already assigned to the State Water Commissioner. It is believed, and therefore recommended, that you ask the Legislature to amend the law to include the State Water Commissioner, as the third member of the Board, rather than the State Engineer.

---

### *Irrigation Projects Under Consideration*

#### **Paradise Verde Irrigation District**

The lands located within the boundaries of the district, susceptible of irrigation from the proposed works of the district, comprise 109,019.71 gross acres.

The engineering plans were approved in part by the Certification Board December 30, 1922, subject to and with recommendation for the investigation of additional hydro-electric development possible within the project.



The State Certification Board July 3, 1923 approved the plans for the entire project including the recommended additional hydro-electric development, and the Board of Directors were ordered to proceed with their bond election. This involved an authorized bond issue in the sum of \$23,000,000. Since this approval the bonds have been voted but as yet have not been sold, thereby withholding development of the project.

#### **Buckeye Water Conservation and Drainage District**

The lands within the boundaries of the district, susceptible of irrigation from the proposed works of the district, comprise approximately 22,000 acres.

Upon the showing made by the directors of the district, the Certification Board approved a bond issue of \$1,000,000 February 13, 1924. An election, March 21, 1924, of the qualified voters, resulted in the defeat of the bond issue of \$1,000,000, and October 29, 1924, the Certification Board approved a bond issue of \$200,000, with the drainage features, which were objectionable to the voters, eliminated.

#### **Rillito Irrigation District**

The lands located within the boundaries of the district susceptible to irrigation from the proposed works of the district, comprise 644.7 acres. The Certification Board, February 20, 1924, approved a bond issue of \$55,000, upon proper showing made by the directors of the district.

#### **Woodruff Irrigation District**

The lands within the boundaries of the district comprise about 2,800 acres, of which but 1,100 acres, may be classed as strictly irrigable. The Certification Board approved a bond issue of \$25,000 December 20, 1923, upon proper showing made by the directors of the district.

#### **Roosevelt Water Conservation District**

The lands located within the boundaries of the district comprise about 41,000 acres. The Certification Board approved a bond is-

sue of \$2,000,000 November 7, 1924, upon proper showing by the directors of the district and the necessary investigation by the board.

### **Yuma Irrigation District**

The lands located within the boundaries of the district comprise about 10,000 acres. The Certification Board approved the issuance of \$60,000 of bonds to be certified May 21, 1923, upon proper showing by the directors of the district and the necessary investigation by the board.

### **Queen Creek Irrigation**

The Certification Board authorized a bond issue of \$300,000 on this project August 2, 1924, after proper showing by the directors of the district and satisfactory investigation by the board. Later it was decided to eliminate some of the construction features of the project, which reduced the requirements to \$125,000 and a bond issue for this sum was approved January 2, 1925.



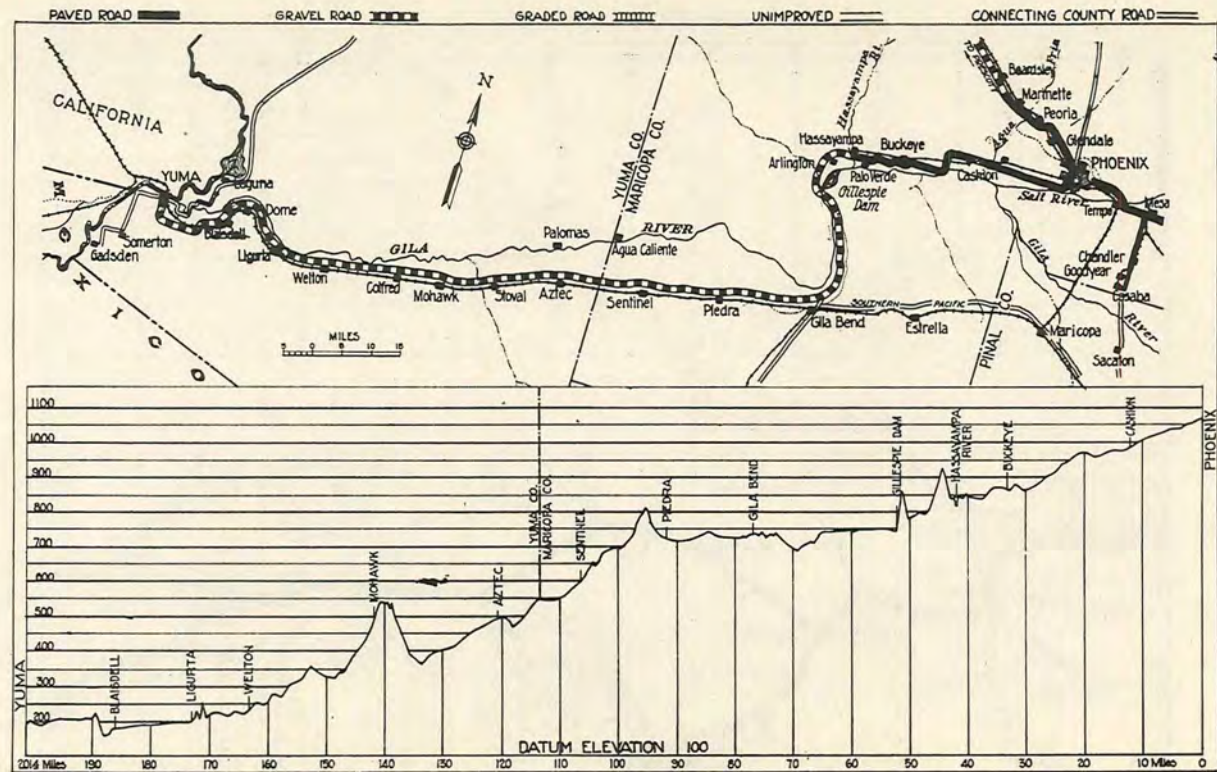


## Route Maps

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THE following maps cover the entire State Highway System, each map showing a route thereof. It is the purpose of these maps to show the System more in detail than can be shown upon a single map. Each map shows by legend, the legend being at the top of the map, the type of construction, in addition to the location and traverse of the route. If it is desired to determine further the position of an individual route with reference to the State as a whole it can be easily located by a comparison of its termini with the same points on the small map of the State Highway System as shown at the beginning of this report.

The lower half of these maps show a profile of a greatly distorted scale. This profile is for the purpose of showing the elevations along the route and for comparisons of elevations with other routes. The elevation datum being mean sea level. The profiles that are shown in the solid lines are from actual surveys and are therefore correct. Those shown in the dotted lines are sections where actual surveys were not available, but considerable care has been taken, and all available data utilized to determine the general profile of the route as accurately as possible.

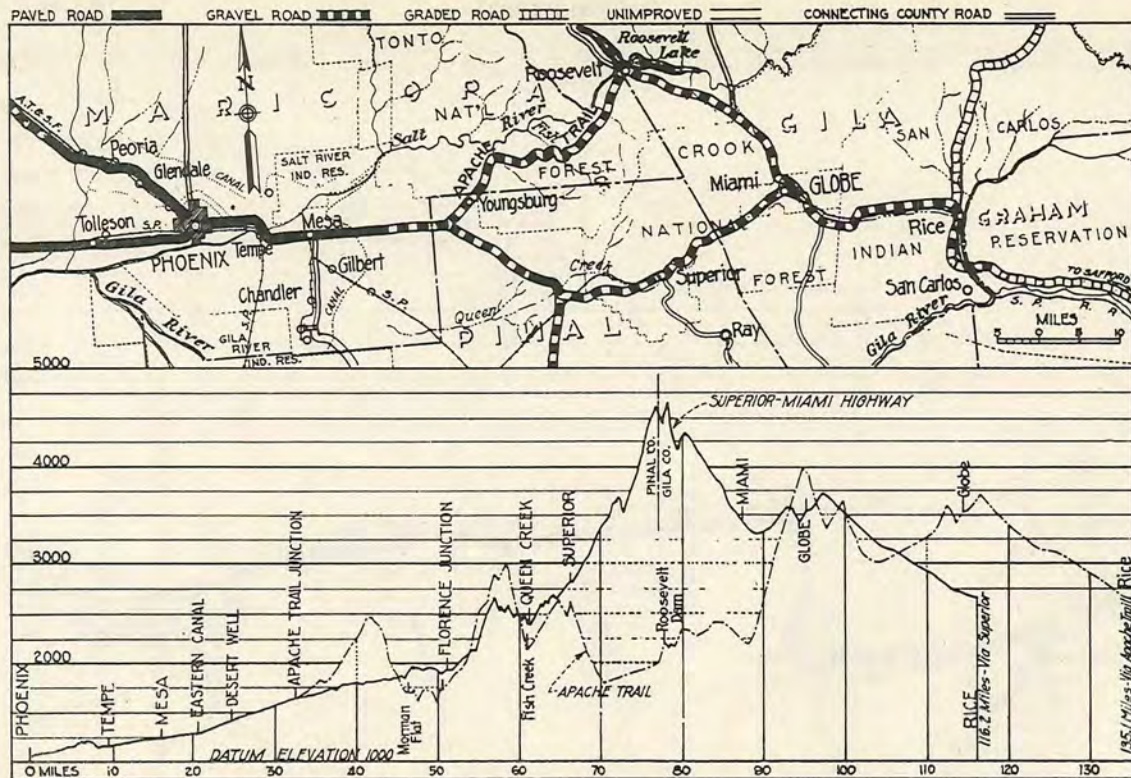


1/21

Map No. 1

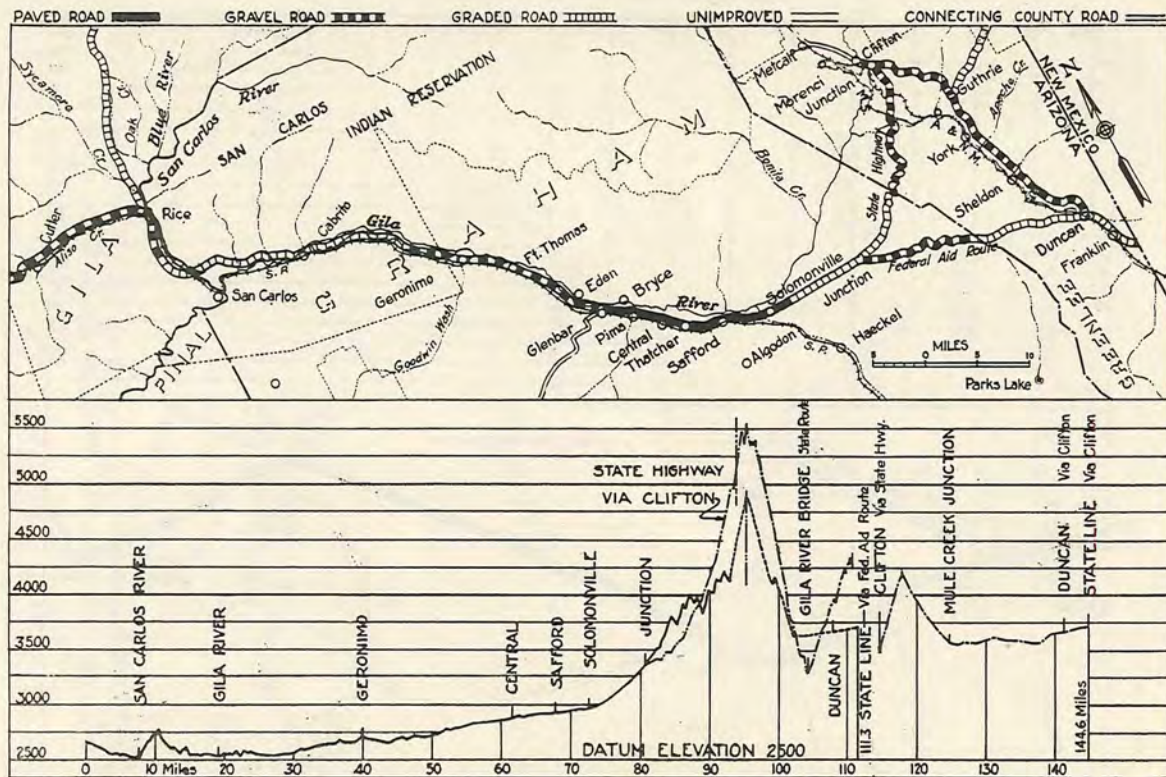
YUMA-PHOENIX





Map No. 2

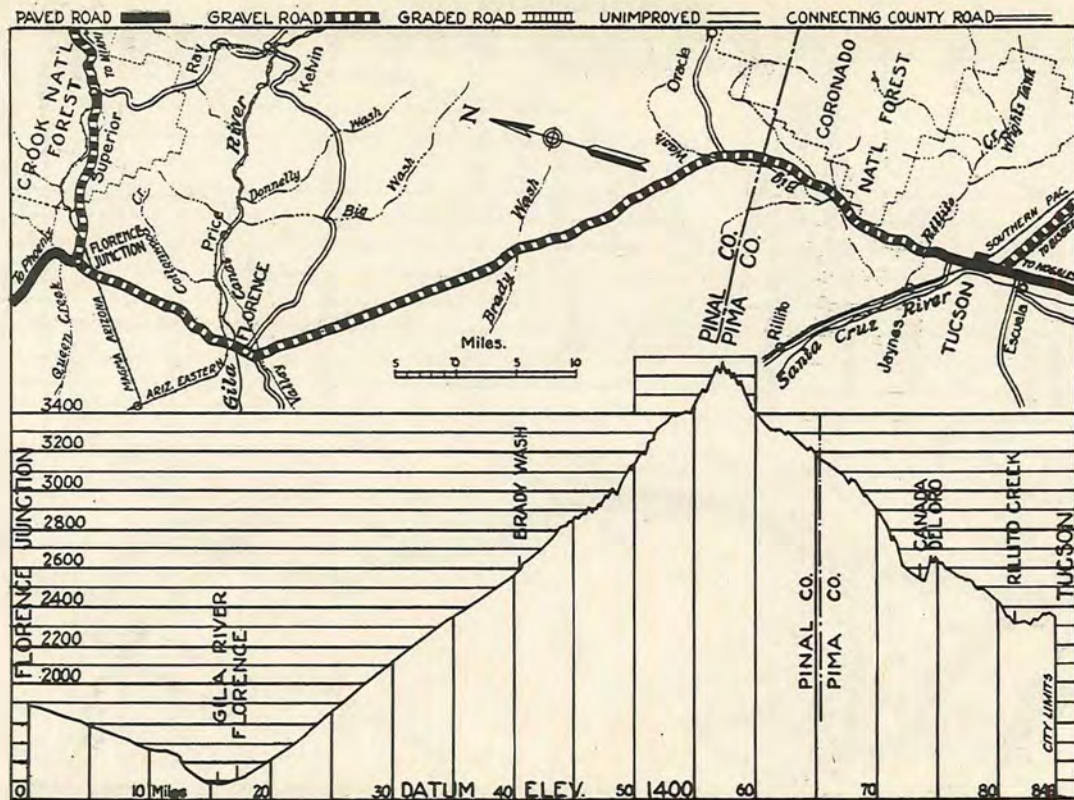
PHOENIX-GLOBE-RICE



Map No. 3

RICE-SAFFORD-DUNCAN



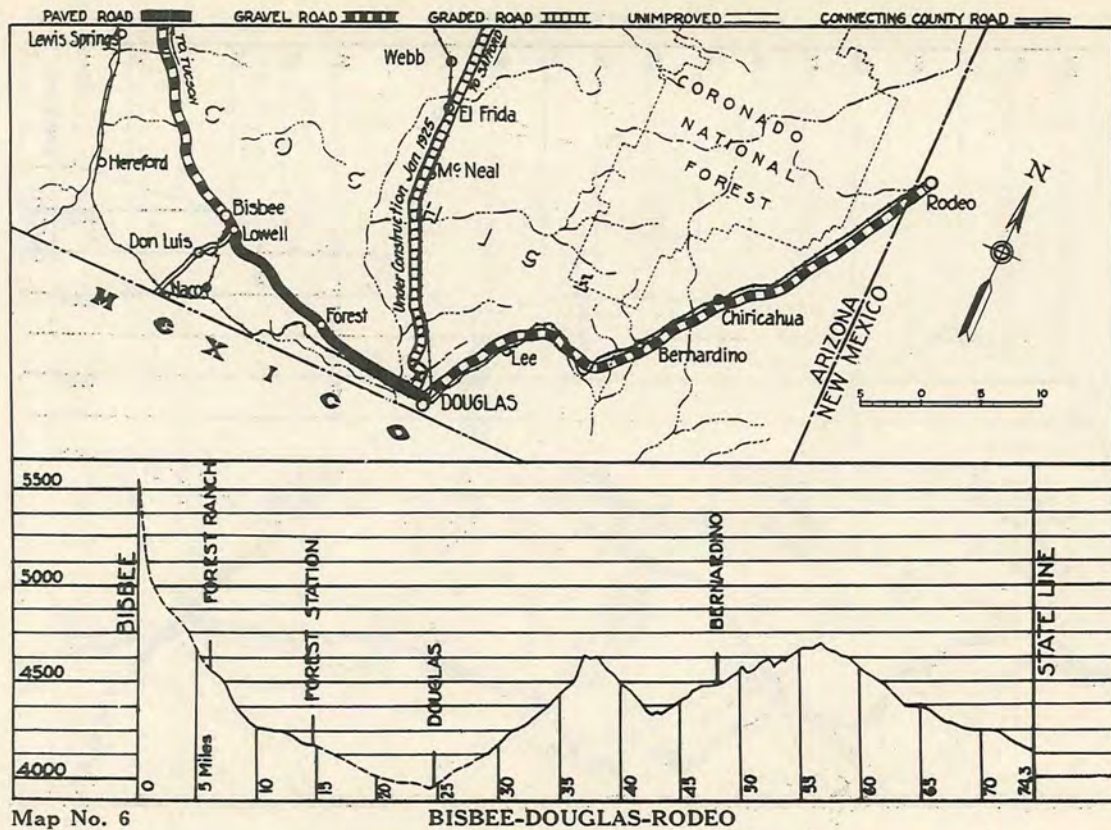


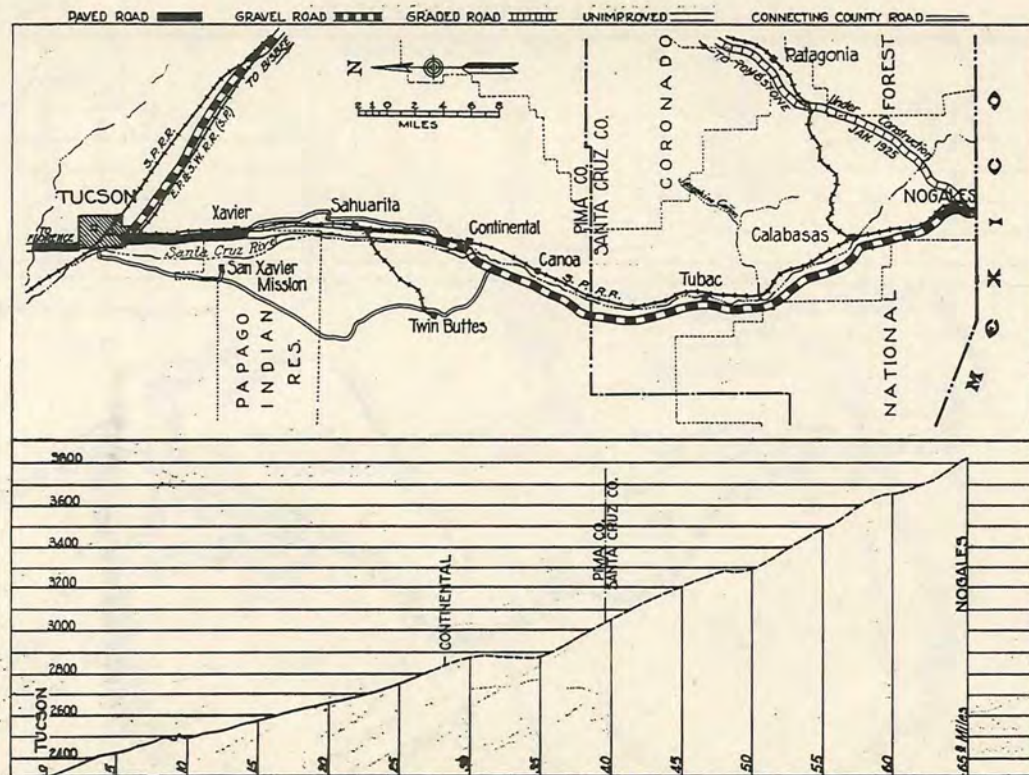
Map No. 4

FLORENCE JUNCTION-TUCSON





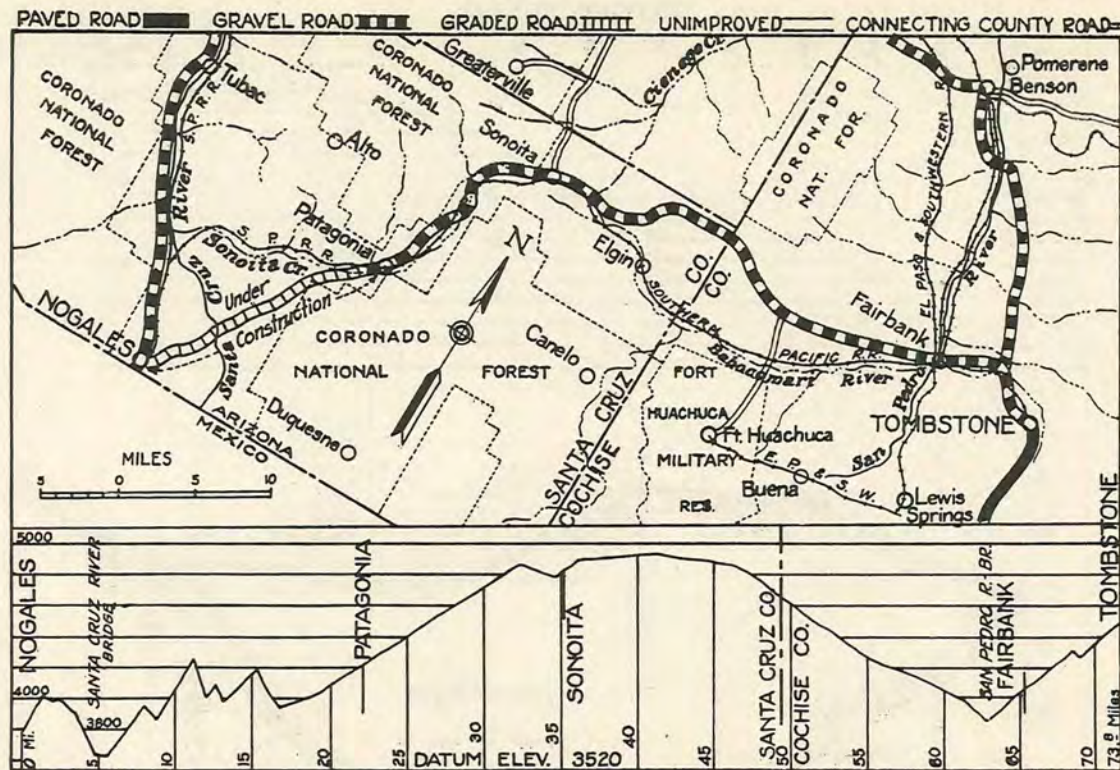




Map No. 7

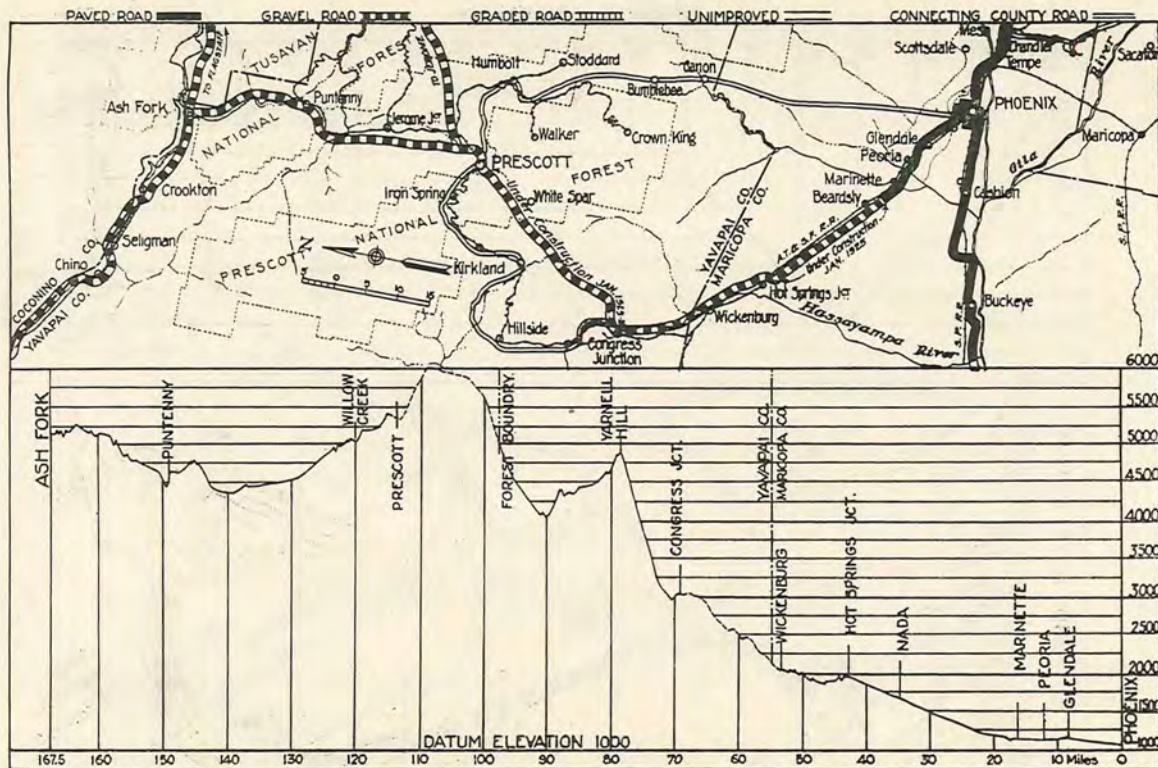
TUCSON-NOGALES





Map No. 8

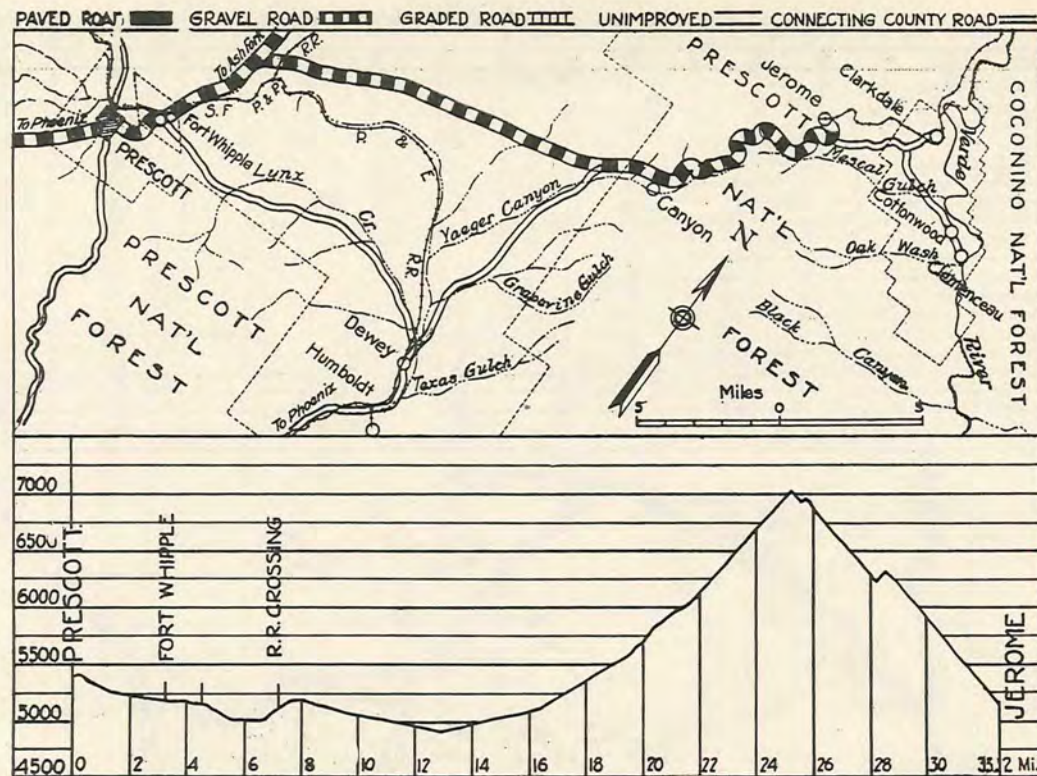
## NOGALES-FAIRBANK-TOMBSTONE

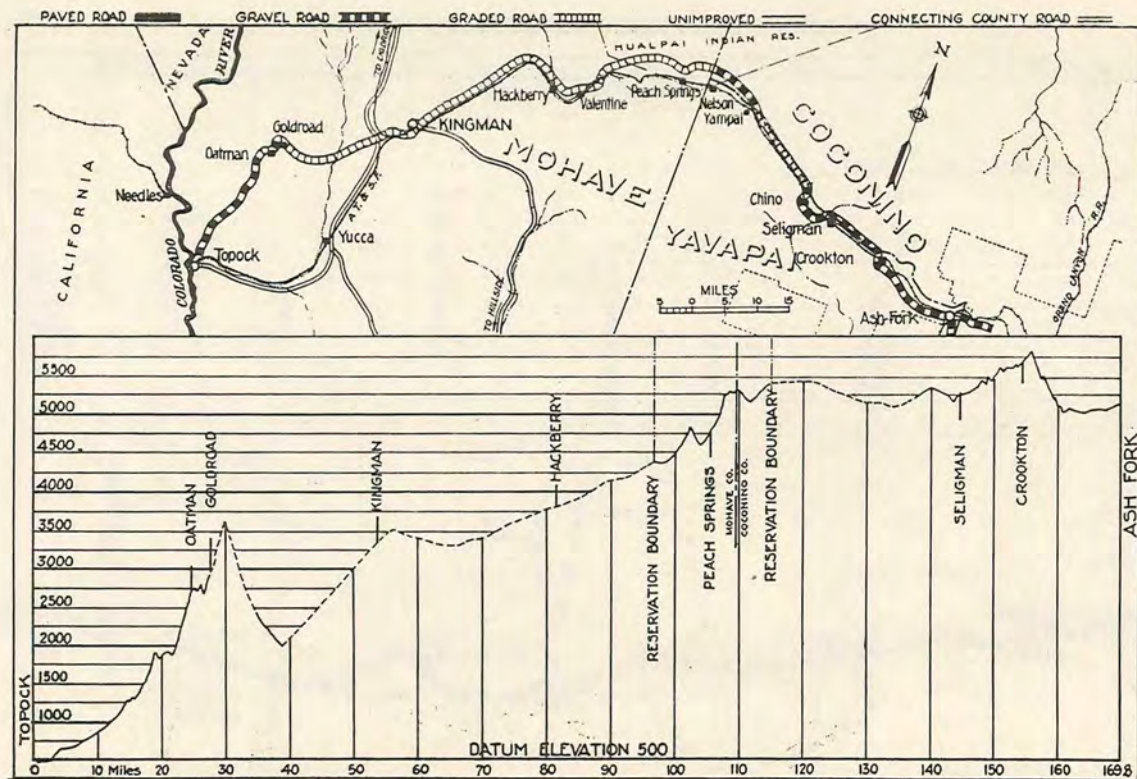


Map No. 9

PHOENIX-WICKENBURG-PRESCOTT-ASH FORK



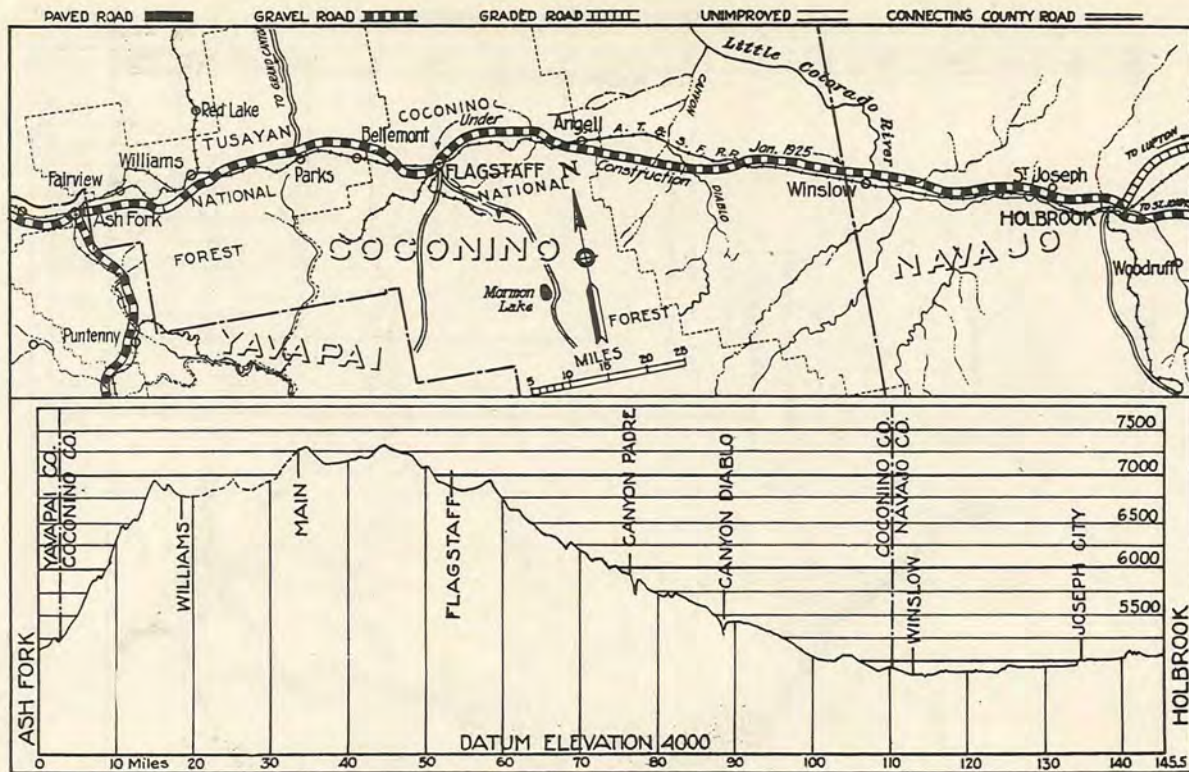




Map No. 11

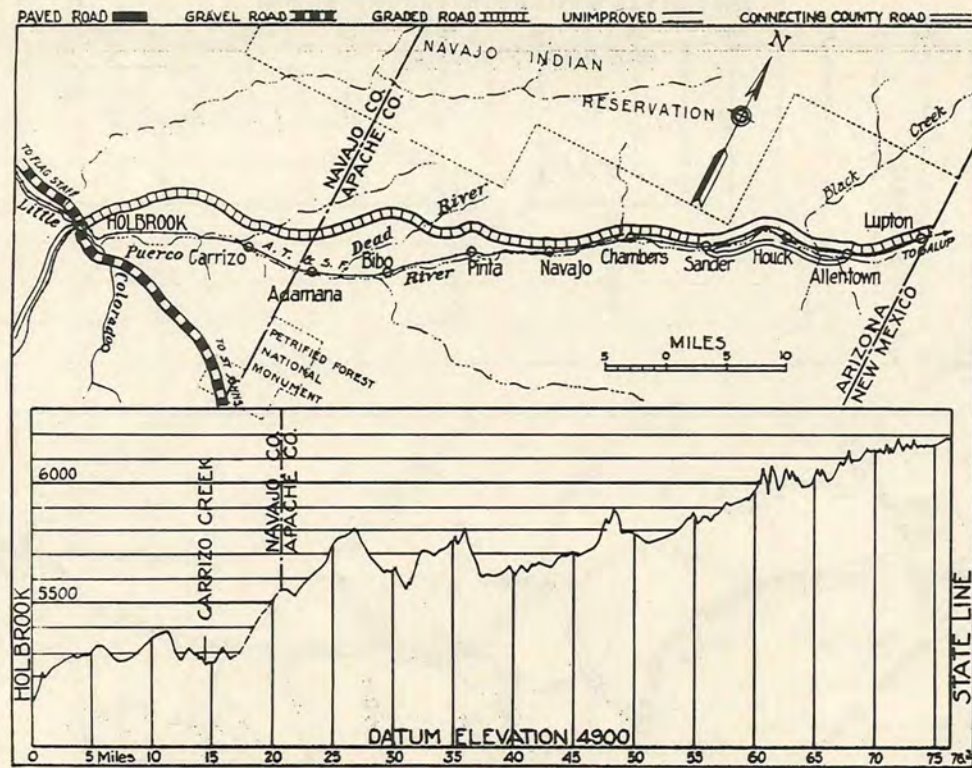
TOPOCK-KINGMAN-ASH FORK





Map No. 12

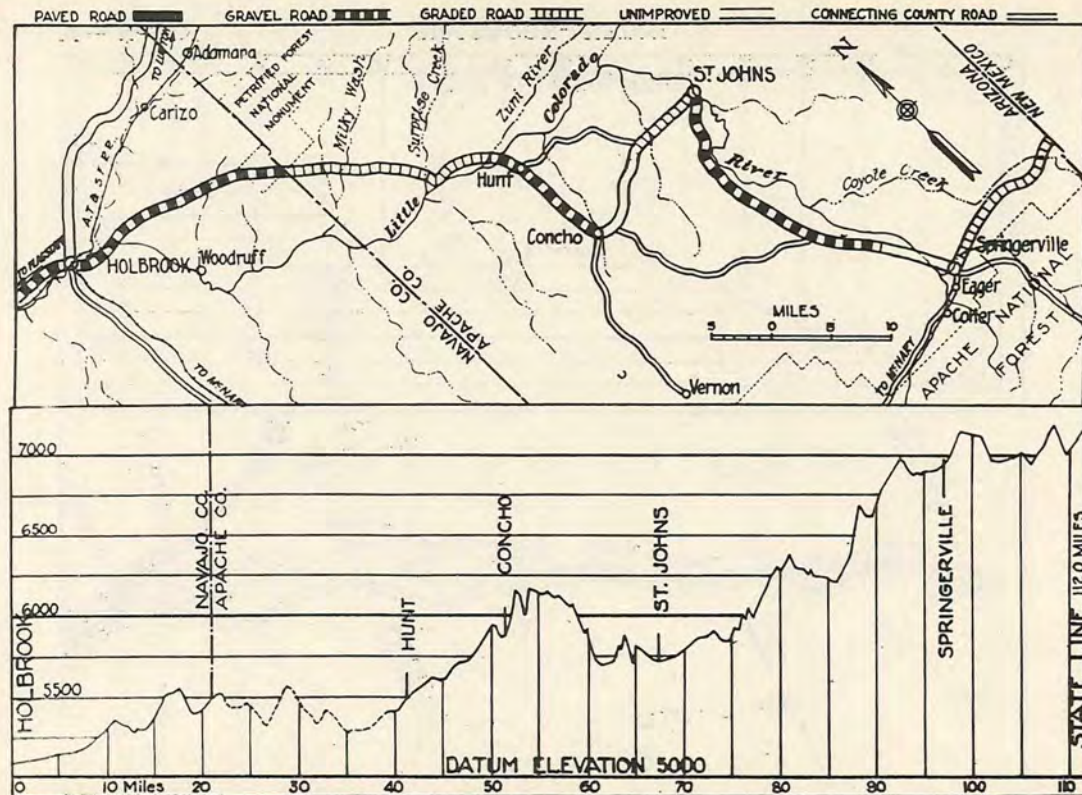
ASH FORK-FLAGSTAFF-WINSLOW-HOLBROOK



Map No. 13

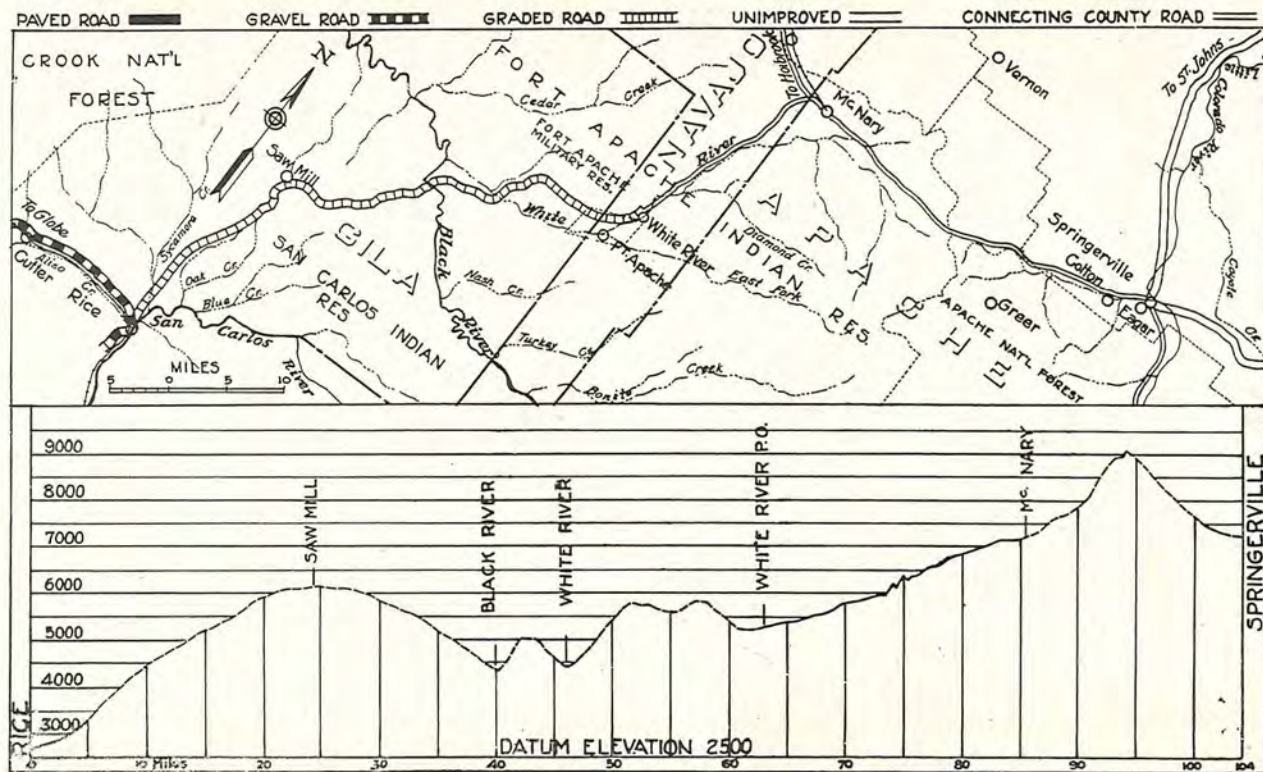
HOLBROOK-LUPTON





Map No. 14

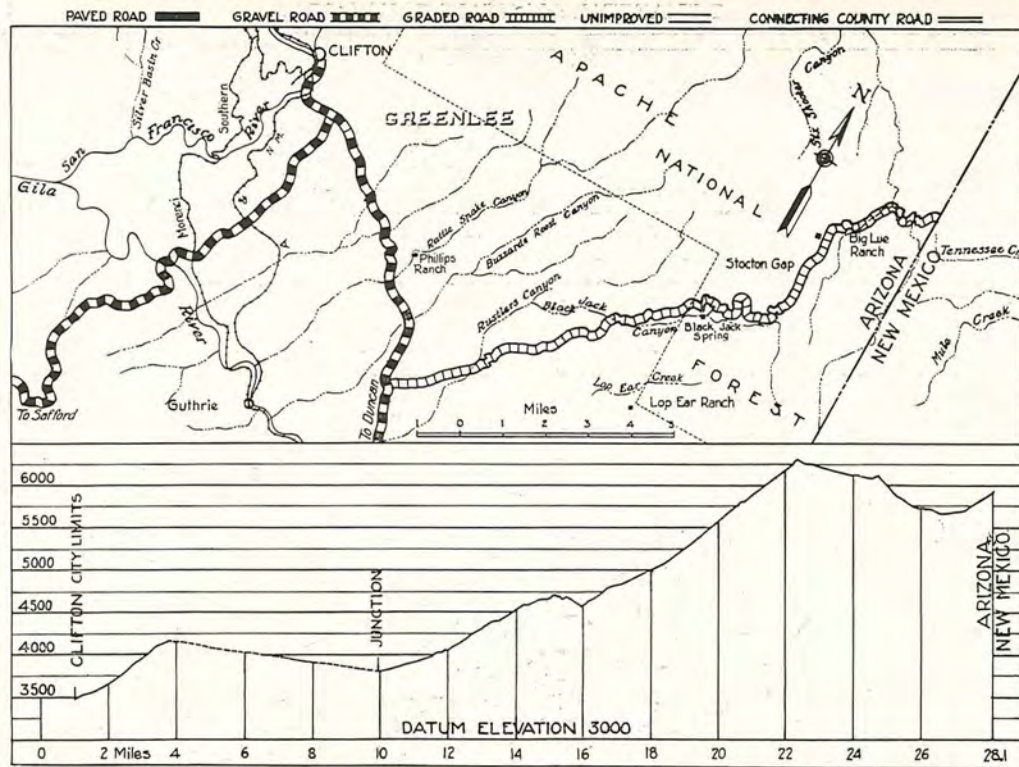
HOLBROOK-SPRINGERVILLE-STATE LINE

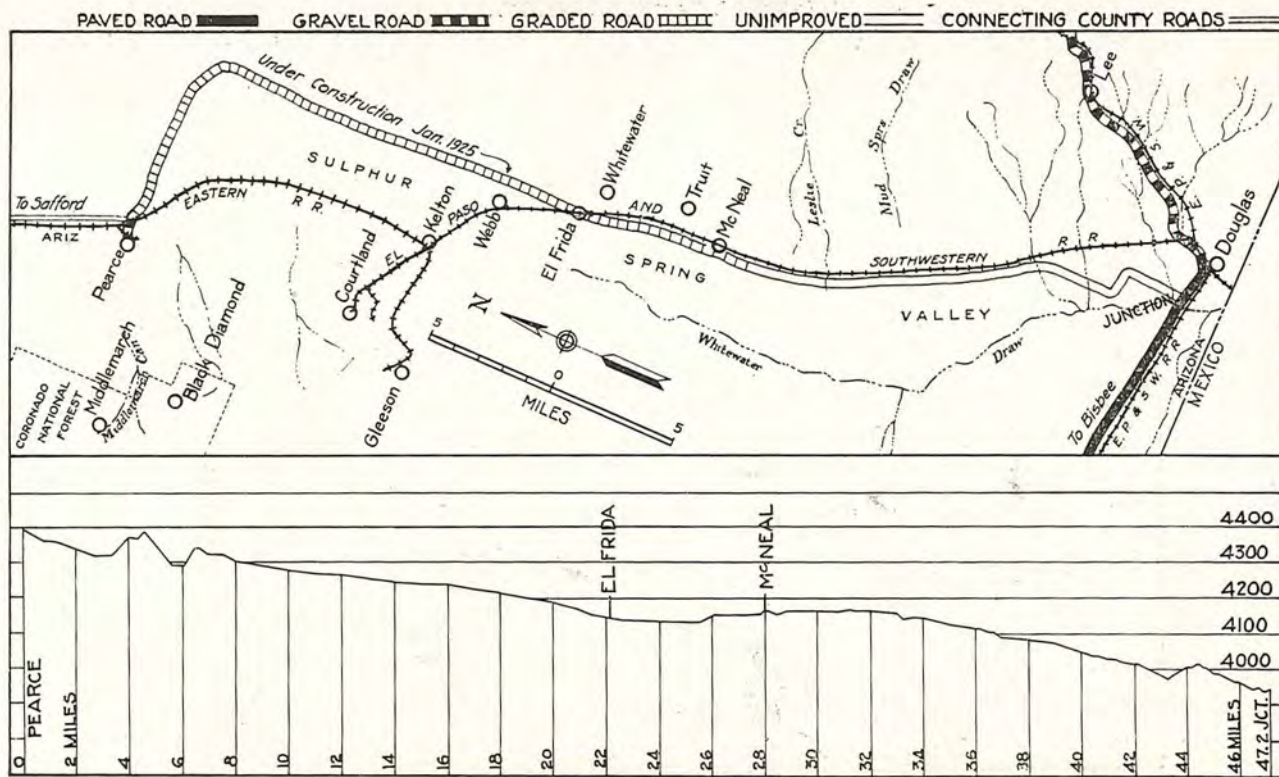


Map No. 15

RICE-WHITE RIVER-SPRINGVILLE



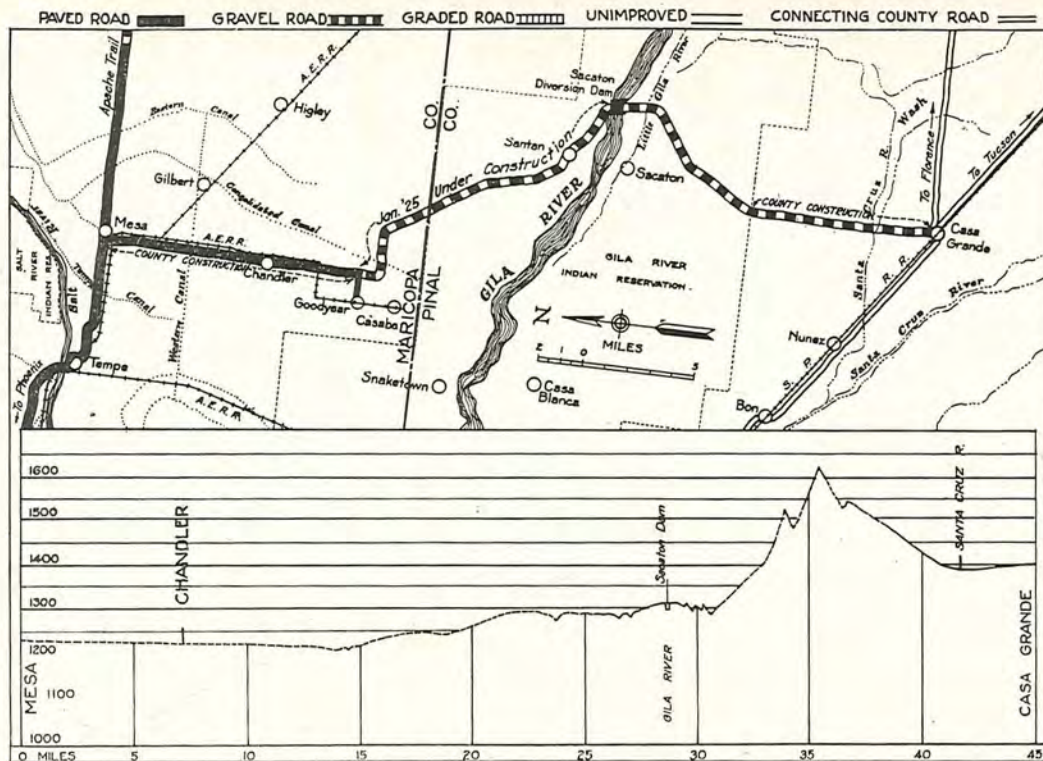




Map No. 17

DOUGLAS-PEARCE





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