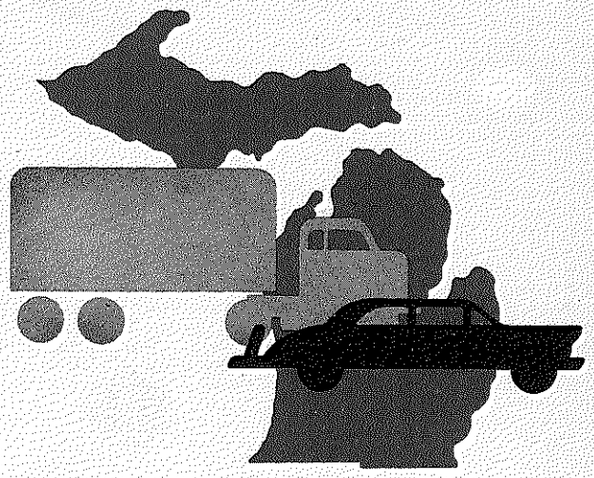

MODERN HIGHWAYS for MICHIGAN

AN ENGINEERING BASE FOR A FISCAL PLAN

MODERN HIGHWAYS FOR MICHIGAN

AN ENGINEERING BASE FOR A FISCAL PLAN

A REPORT TO THE

MICHIGAN LEGISLATIVE HIGHWAY STUDY COMMITTEE

PREPARED BY THE

AUTOMOTIVE SAFETY FOUNDATION

COOPERATING

MICHIGAN STATE HIGHWAY DEPARTMENT

AND THE

U. S. DEPARTMENT OF COMMERCE

BUREAU OF PUBLIC ROADS

LANSING, MICHIGAN

OCTOBER, 1955

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A NON-PROFIT ORGANIZATION

Automotive Safety Foundation

DEDICATED TO EDUCATION AND RESEARCH FOR SAFE, EFFICIENT HIGHWAY TRANSPORTATION

October 31, 1955

200 RING BUILDING
WASHINGTON 6, D.C.

Honorable Haskell L. Nichols, Chairman
Honorable Emil A. Feltz, Vice-Chairman
Legislative Highway Study Committee
State Capitol
Lansing, Michigan

Gentlemen:

It is a pleasure to present to you this report of our engineering analysis, "Modern Highways for Michigan."

Direction of this study by engineers of the Automotive Safety Foundation was done under the terms of the agreement between your Committee and J. O. Mattson, President of the Foundation, dated August 2, 1954.

This study carries forward major aspects of the comprehensive study, "Highway Needs in Michigan," made in 1947 which for the first time appraised Michigan's total highway problem. This 1955 study benefitted greatly from the data and experience obtained in the earlier study, the extremely helpful information provided by the municipalities and counties as required by Act 51 of the 1951 legislative session and the planning work carried on by the State Highway Department in the interim. A new base is now presented from which may be determined actions and programs necessary to meet highway demands which have so greatly increased in recent years.

At the direction of your Committee, fiscal aspects of the highway problem are being covered in a separate report by Mr. Richard M. Zettel. To be of greatest value, the findings and recommendations of this engineering analysis should be related to the fiscal study.

Another study is being made for your Committee by Mr. Louis R. Morony, Director of the Foundation's Laws Division, and his staff, in which Michigan's highway laws are being codified, reviewed and evaluated. That work will be of great value in fitting Michigan's legislative and administrative policies to modern highway transportation needs.

Foundation staff members and I are grateful for the cooperation extended by your Committee, by State Highway Commissioner Charles M. Ziegler, who served as agent for the Committee, the personnel of the State Highway Department, and by the many county and city engineers and officials.

Respectfully yours,

J. P. Buckley
Chief Engineer
Highways Division

Registered Civil Engineer
Michigan License No. 3763

AUTOMOTIVE SAFETY FOUNDATION

ENGINEERING STAFF, HIGHWAYS DIVISION

JAMES O. GRANUM, Deputy Chief Engineer
S. F. COFFMAN, Supervising Engineer
HOWARD BUSSARD, County Highway Engineer
TERRY J. OWENS, Urban Highway Engineer

EDITORIAL REVIEW

E. EARLE DUFFY, Publications Division

SPECIAL CONSULTANT

CARL E. FRITTS, Vice President in Charge of Engineering

PRINCIPAL PARTICIPANTS IN THE STUDY

State Highway Department

Deputy Commissioner—
Chief Engineer's Office

E. A. BELLENBAUM

Bridge Division

W. D. BULLEN

Maintenance Division

S. W. DUBEE

Right-of-Way Division

W. E. HOWLETT

Road Division

A. P. HOWELL
H. H. MORGAN
G. A. PETERMAN

Planning and Traffic Division

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HUGH A. BENNER, Saginaw
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RAY A. TREBILCOCK, Coldwater

HOWARD BACON, Staff Engineer

State Engineer Advisory Committee

C. A. WEBER, Deputy Commissioner—Chief Engineer
J. G. SCHAUB, Special Assignment Engineer
J. C. McMONAGLE, Director, Planning and Traffic Division
C. H. CASH, Road Engineer
E. A. BELLENBAUM, Assistant Chief Engineer
P. E. PLAMBECH, Road Design Engineer
H. R. PUFFER, Bridge Engineer
H. FERENZ*, Director, Right of Way Division
B. R. DOWNEY, Maintenance Engineer

C. S. CLAYCOMB, Staff Engineer

*deceased

County Engineer Advisory Committee

C. G. AHEARN, Menominee
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A. L. BURRIDGE, Consulting Engineer
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OSCAR GUNDERSON, Wayne
WILLIAM J. KARAS, Delta
ROBERT S. SCOTT, Consulting Engineer
J. T. SHARPENSTEEN, Genesee
H. L. SHROEGER, Marquette

A. C. SHERMAN, Staff Engineer

Contents

FOREWORD

This study of Michigan highways was authorized by the State Legislature through the adoption of Senate Concurrent Resolution No. 34, of the 1954 legislature and continued by Senate Concurrent Resolution No. 4 in 1955.

The resolution created the Legislative Highway Study Committee to make a statewide comprehensive engineering study and survey of the highway needs and deficiencies of the state, to prepare a plan for providing adequate highway, road and street facilities to serve the requirements of the people of the state and to prepare a codification of the highway laws of Michigan. The resolution states:

"Whereas, the Michigan Good Roads Federation in cooperation with a joint legislative committee made a comprehensive engineering study of Michigan highway needs and deficiencies in 1947 and 1948, which resulted in a quickening of public interest in the highway problem and the enactment in 1951 of modern, forward-looking highway legislation designed to produce needed highway facilities and improved administration thereof; and

"Whereas, Because of an increase in traffic volume and monetary inflation far in excess of that anticipated, and the delay in enacting the corrective legislation, the highway inadequacies are not being corrected rapidly enough to satisfy the public demand and properly serve the public interest, and therefore the study of highway needs in Michigan should be continued with particular emphasis on the fiscal requirements for a solution of the problem."

The committee was authorized to appoint a Citizens Advisory Panel, consisting of the State Highway Commissioner and twelve additional members to be appointed from the membership of the Michigan Good Roads Federation representing highway users, farmers, road builders, highway administrators, manufacturers, and material and equipment suppliers, and from among the membership of the Highway Users Conference of Michigan and other organizations and citizens interested in highway improvement.

The committee acting through the State Highway Commissioner entered into two agreements for technical services in carrying out the directives of the legislature. One agreement was with the Automotive Safety Foundation of Washington, D.C., to direct and supervise this engineering appraisal of the physical condition and needs of the highway and street systems of the state. The Foundation is a non-profit organization dedicated to the development of safe and efficient highway transportation.

The second agreement was with Richard M. Zettel, Research Economist, Institute of Transportation and Traffic Engineering, University of California, to conduct a finance study of highway revenue and distribution.

The engineering and fiscal study agreements were carried out as a Federal-aid Highway Planning Survey project with the state and Federal governments sharing the costs.

In addition to those two agreements the committee entered into another agreement for a codification, review and evaluation of all Michigan laws pertaining to highways by the Laws Division of the Automotive Safety Foundation.

The engineering appraisal was performed under the supervision of the Foundation engineering staff by personnel of the State Highway Department, the counties and municipalities. Three committees of state, county and city engineers were organized with members selected for their training, knowledge and experience in their particular fields of work. With the advice and counsel of these advisory committees, procedural manuals were prepared, outlining specific criteria and techniques for measuring deficiencies and determining needed improvements for each class of roads and streets. These manuals served as a basis for this appraisal.

The engineering staff acknowledges its sincere appreciation to all the engineers, the state and local highway agencies who participated in the study and to the members of the three advisory committees who gave generously of their time and valuable assistance in carrying out the objectives of the study. Without their help and cooperation the work could not have been accomplished.

SUMMARY

Michigan's motor vehicle transportation is drawing substantial benefits from the changes in highway finance and administration made in recent years. But these benefits are not commensurate with the demands which rapidly changing conditions have created.

In the eight-year period from 1946 to 1954—

- The number of motor vehicles registered in Michigan increased from 1,603,000 to 2,816,000, or 74 percent.
- Motor vehicle travel increased from 16 billion vehicle miles annually to 27 billion vehicle miles, or 70 percent.

Those factors have greatly increased the problems of providing highway facilities adequate for safe and efficient vehicular movement and the problems are becoming larger and more complex.

In the 20-year period to 1975 it is estimated that—

- Motor vehicle registrations will increase by 62 percent.
- Motor vehicle travel will increase by 78 percent.

This report summarizes the results of an engineering analysis of physical needs in the next 20 years on each road and street system. It provides the basis for a fiscal plan geared to the economy of the state and designed to meet the essential highway transportation requirements.

At 1954 price levels, the estimated cost of all improvements needed by 1975 on the major systems—state trunklines, county primary roads and major city streets—is $4.5 billion. An additional $1.2 billion is needed for local county roads and local city streets. Total cost of needed improvements for all roads and streets is $5.7 billion. Of this amount, $3.2 billion is for work in rural areas and $2.5 billion for work in municipalities. Maintenance and administration costs are in addition.

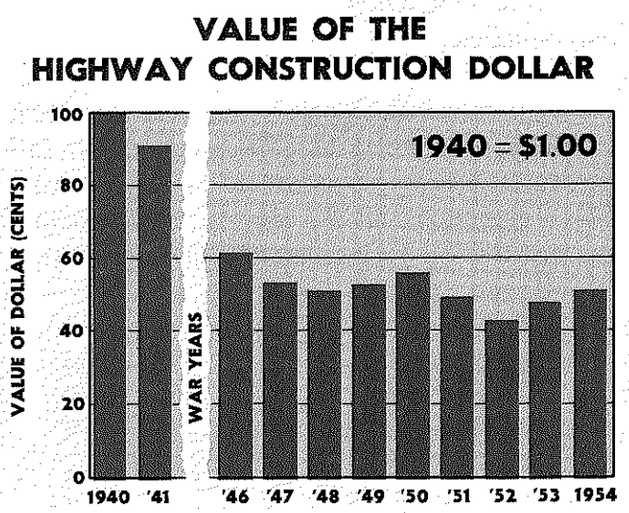
Road and street needs were grouped into four periods of five years each, according to the present degree of inadequacy and the relative urgency of the improvement from a traffic and service standpoint. It was found that 70 to 95 percent of the improvements needed on various systems, except local roads and streets, should be completed in the next 10 years.

STATE TRUNKLINES

To aid in the appraisal of needs and determination of priorities, the existing State Trunkline System was classified into three groups of routes based upon their service characteristics.

Routes selected as principal trunklines, totaling 2,950 miles, are of greatest statewide importance. They are planned for higher standards of improvement than other trunklines. Generally, traffic warrants their development as multi-lane divided highways.

The second group, other major routes, are trunklines in less populated areas which are of more than usual importance to the state as a



The highway dollar today buys only half as much construction as it did before the war. Using 1940 as a base, the construction dollar was worth 61 cents in 1946, but only 50 cents in 1954.

whole. Remaining trunkline routes are of lesser statewide importance, although some serve rather high traffic volumes.

The estimated total capital investment required for trunkline improvements in the next 20 years is $2.8 billion, of which $1.5 billion is for work in rural areas and $1.3 billion is in municipalities. Principal trunklines, rural and urban, need 70 percent of the total.

Right of way costs are about 22 percent of capital investment needs on the State Trunkline System. In view of the size of the right of way problems, the legislature should give consideration to the creation of a revolving advance right of way acquisition fund.

An important administrative operation, which should be given further emphasis within the State Highway Department, is program planning based on priority of need. The project work sheets of this engineering study are the basis for initial establishment of a program procedure, should the department elect to utilize them.

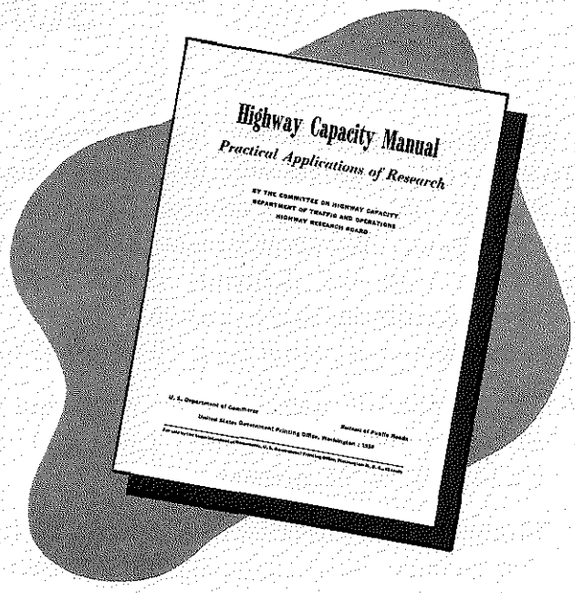
Rural Trunklines

A third of the existing rural trunkline mileage now lacks sufficient capacity to handle traffic safely at the average operating speeds of the design standards. Most of the remaining mileage is deficient in width, surface type, condition, or sight distance. Many miles include several deficiencies.

The $1.5 billion for rural trunkline improvements involves 2,471 miles on new location, including 911 miles of expressways with full control of access. Also needed are 5,772 miles of reconstruction on existing alignment, including resurfacing and widening. Over a 20-year period, costs include:

Right of Way	$ 271,897,000
Roadway	1,050,255,000
Structures	204,214,000
Total	$1,526,366,000

Of the total, $837,488,000 is for improvement of 2,579 miles of principal trunkline routes and $688,878,000 for 5,664 miles of improvements needed on other trunklines.



The total needs include 3,186 miles of divided multi-lane improvements of which 2,821 miles are needed now or within five years. Most, 2,234 miles, are on principal trunkline routes.

Top priority rural trunkline work is recommended for specific projects costing about half of the amount which should be done in the first 10 years; in turn, the 10-year total is about 82 percent of the total rural 20-year needs.

Urban Trunklines

The $1.3 billion for trunkline improvements within municipalities involves:

Right of Way	$ 337,640,000
Roadway	564,374,000
Structures	378,803,000
Total	$1,280,817,000

Needed improvements consist of 161 miles of expressway construction, 143 miles of it in the Detroit metropolitan area. Also required are 44 miles of arterials on new location and 721 miles of base and surface reconstruction or widening on existing streets. Right of way alone is estimated at $338 million.

Some 85 percent of all proposed urban trunkline work should be completed within 10 years, since the most severe problems of congestion occur on these main city streets.

Under present law cities participate, to varying degrees, in urban trunkline construction.

MUNICIPAL STREETS

Estimated construction cost of needed improvements in the next 20 years on the 13,902 miles of streets under the control of municipalities is $1.1 billion. Of this amount $675 million is for improvement of major streets and $432 million for needed improvements on local streets.

Major street needs of individual municipalities vary widely, both as to type of work and urgency. Of the following, 70 percent of the cost is in the 10 largest cities:

Type of Work	Miles	Cost
Expressways	22	$180,749,000
New Surface Arterials	87	25,251,000
Reconstruction	807	195,065,000
Resurfacing & Widening	2,313	152,288,000
Structures (303)	...	121,647,000
Total	3,229	$675,000,000

The $432 million for local streets provides for development in 20 years of 69 percent of the total system to curbed streets with intermediate type surfaces or better and 28 percent to bituminous surface treatments.

In all municipalities, a master street development plan, properly integrated with the State Trunkline System, should be officially adopted to preserve needed right of way and serve as a basis for long-range construction programs.

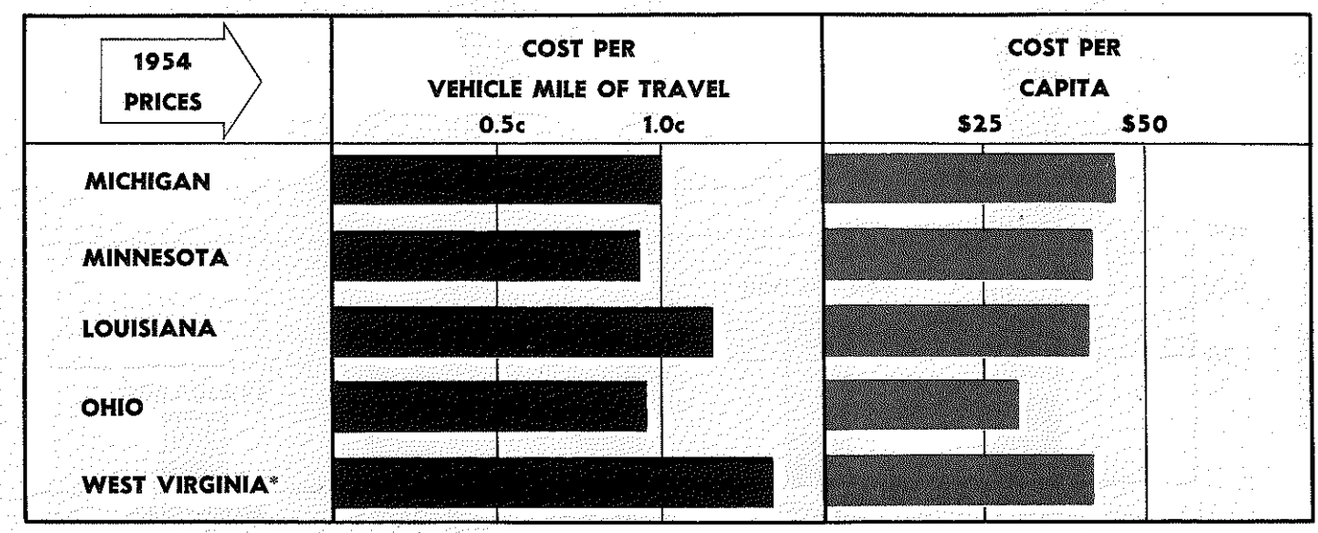
In many Michigan cities greater attention should be given to provision of off-street parking facilities and to intensifying effort in the traffic engineering field.

COUNTY ROADS

Cost of construction needs on the 22,900 mile county primary system during the next 20 years totals $980 million, of which $862 million is in rural areas and $118 million is on primary road extensions in municipalities. The construction requirements on 62,700 miles of local roads during the same period are $806 million. Total cost of needed improvements on all county roads is $1.8 billion.

Practically all rural county primary roads require some kind of improvement during the 20-year period. Needs range from a limited mileage of gravel surfaces to multi-lane divided highways. For the most part, needs consist of two-lane intermediate type surfaces.

COMPARATIVE COSTS, 20-YEAR PROGRAM ALL ROADS AND STREETS



*EXCLUDES LOCAL STREETS

Expressed in terms of cost per vehicle mile of travel and annual cost per capita, the Michigan 20-year cost is reasonable in comparison with some other states where similar studies have been made.

By type of work the rural needs are:

Type of Work	Miles	Cost
Widening and Resurfacing	6,551	$266,261,000
Base and Surface	2,597	56,346,000
Reconstruction	12,630	395,279,000
New Construction	397	19,908,000
Expressways	34	42,905,000
Structures (1,523)	...	81,657,000
Total	22,209	$862,356,000

The 20-year rural county primary needs include 753 miles of multi-lane highways in 20 counties. About 82 percent of this mileage is in Genesee, Kent, Macomb, Oakland and Wayne counties.

Nearly all of the 317 miles of proposed improvements on county primary extensions in municipalities are in Wayne, Oakland and Macomb counties.

The $806 million for needed improvements on local roads in the next 20 years provides for development of about 18 percent of all local road mileage to dustless surfaces of various types, and about 73 percent to gravel surfaces adequate for year around travel.

Counties which have not placed highway managerial authority in the hands of a full-time engineer responsible to the road commission should do so.

Each county should develop long-range construction programs based upon priority of need and revise them annually. Programs of adjacent counties should be properly integrated for maximum efficiency and benefit.

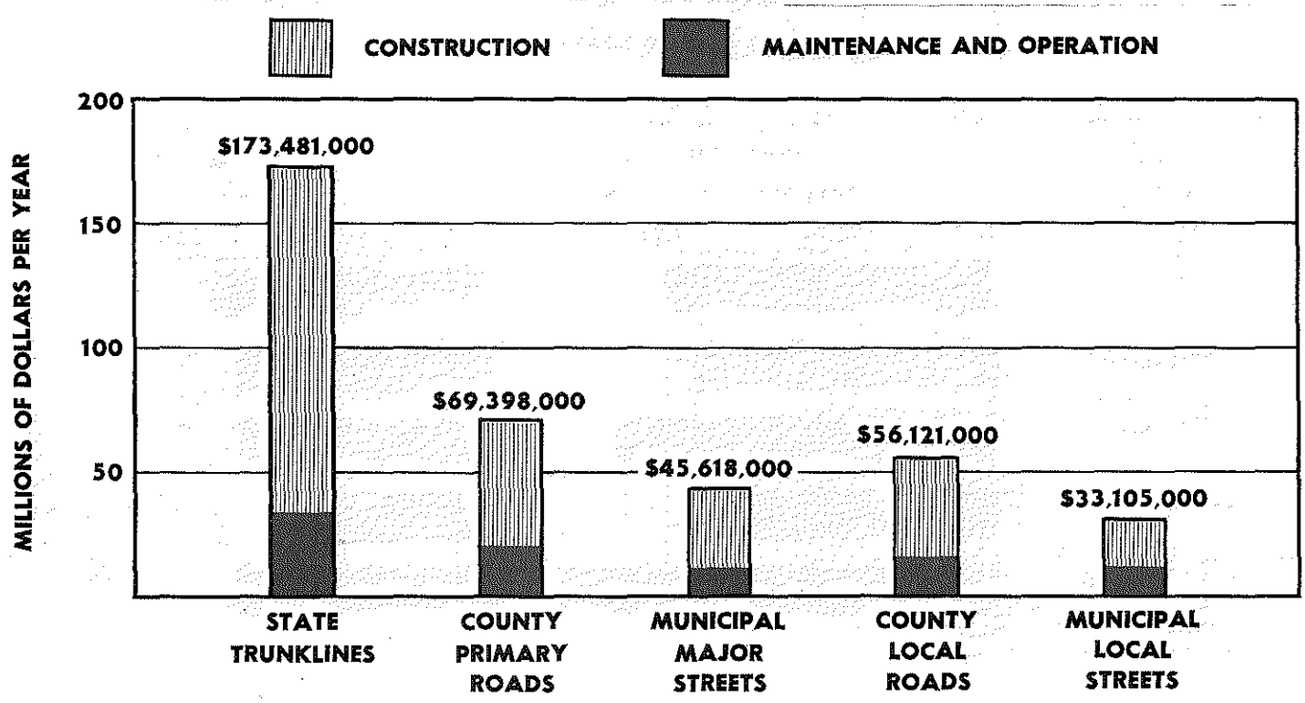
Counties, through their associations, should develop and adopt uniform standards of maintenance practice. Also there is need for more complete maintenance cost accounting.

FEDERAL-AID SYSTEM NEEDS

The hearings and debate in the national Congress during recent months indicate the probability of a greatly expanded Federal-aid highway program especially for rural and urban Interstate routes, in the relatively near future. When this happens, it will have a very material effect on the requirements at state and local levels to finance any of the alternative programs shown, except those for local roads and streets.

To permit evaluation of the effect of an expanded Federal-aid program, construction costs required for the next 20 years are summarized

AVERAGE ANNUAL 20-YEAR PROGRAM COSTS



This chart compares the average annual cost to develop and maintain each of the present road and street systems over a 20-year period.

AVERAGE ANNUAL PROGRAM COSTS

	First 10 years	Second 10 years of 20-year period	15 years	20 years
State Trunklines, rural and urban	$272,970,000	$ 73,833,000	$214,000,000	$173,481,000
Major Municipal Streets	62,424,000	28,825,000	52,278,000	45,618,000
County Primaries, rural and urban	90,281,000	48,503,000	78,526,000	69,398,000
Sub-Total Major Roads and Streets	*$425,675,000*	*$151,161,000*	*$344,804,000*	*$288,497,000*
Local Municipal Streets	33,105,000	33,105,000	33,105,000	33,105,000
County Local Roads	56,121,000	56,121,000	56,121,000	56,121,000
Sub-Total Local Roads and Streets	*$ 89,226,000*	*$ 89,226,000*	*$ 89,226,000*	*$ 89,226,000*
Total All Roads and Streets	$514,901,000	$240,387,000	$434,030,000	$377,723,000

in the accompanying table for each of the Federal-aid systems:

Interstate	$1,253,153,000
Primary	1,185,751,000
Secondary	870,556,000
Total	$3,309,460,000

Of the total, $1,192,373,000 is for needs in urban areas.

The Federal-aid system needs are a duplication of, and are not in addition to, needs previously discussed on existing state and local highway and street systems.

All Federal-aid funds allotted to Michigan total $30,153,061 for the current year.

BASIS FOR FISCAL PLANNING

On a 20-year basis, relative proportions of the total needs required by the several road and street systems remain about the same as found in the 1947 study. However, this study shows a total 20-year improvement cost about 3.5 times greater.

The tremendous increase in motor vehicle use and the higher standards and costs of construction required for present and future traffic support these estimates.

The $378 million annual cost for a 20-year program on all roads and streets is equivalent to one cent per vehicle mile of travel—about 12 percent of the total cost of owning and operating a motor vehicle.

The estimated revenue for 1956 from present sources for construction and maintenance of all roads and streets is equivalent to 0.87 cents per vehicle mile of travel.

To aid in consideration of various financing possibilities, alternative annual program requirements have been developed for each road and street system. The annual program costs, summarized in the table shown above, provide for needed improvements, maintenance and operation.

As shown in the table, on the major road and street systems varying high proportions of the 20-year improvement needs should be completed in the next 10 years. In the first 10-year program, accumulated needs and needs arising during that period are met. The annual costs for the second 10 years of the 20-year period are less, since the large backlog of needs would have been taken care of and only needs of the second 10-year period would have to be met.

The annual program costs for 15-year and 20-year periods are averages of all costs for each period. Under those programs some of the 10-year needs, except on local road and local street systems, would be deferred until later years. Average annual costs are reduced by spreading the program over a longer time. Benefits and savings to the users also would be deferred, and some added costs for stop gap measures might be expected.

The table provides several alternatives for consideration. Selection of the proper program period, or possibly different periods for the various road and street systems, must be related to the recommendations of the separate highway finance study. Each system currently has different sources of support in varying amounts from motor vehicle taxes, Federal aid and local funds.

The vast amount of data assembled and analyzed in this study, coupled with the findings of the fiscal study, form an adequate basis for legislative and administrative action needed to overcome the existing backlog of road and street needs and provide a modern highway transportation system in Michigan.

Provision should be made for continuous reappraisal of needs to meet changing conditions, provide a measure of progress made, and to insure that the greatest benefits possible are being achieved.

CHAPTER 1

HIGHWAY PROGRESS SINCE 1947

The report "Highway Needs in Michigan", published in February, 1948, under the auspices of the Michigan Good Roads Federation presented for the first time a comprehensive engineering study of the state's total highway and street problem.

The findings and recommendations of the first highway needs study brought enactment of new highway laws in June, 1951. That legislation contemplated development of the state's road and street systems to adequate standards within a 15-year period. However, the rate of construction progress from 1951 through 1954 dropped behind the essential transportation requirements of the state's dynamic and expanding economy.

The present report supplements data contained in "Highway Needs in Michigan." For information about highway development prior to 1947 reference should be made to that document.

Comparison of certain basic conditions today with those of eight years ago are summarized herein and new developments are discussed.

LEGISLATION

The 1951 laws provided for sweeping changes in highway finance and administration by:

- Establishment of a motor vehicle highway fund, consisting of proceeds from all state-collected highway users taxes
- Increasing the motor fuel tax from three to four and one-half cents a gallon
- Increasing the weight tax (license plates) for commercial vehicles on a graduated basis. The increase ranged upward to 100 percent on heavy vehicles and resulted in a net increase in total receipts from the weight tax of about 10 percent
- Requiring the Boards of County Road Commissions to act as an administrative body only, with the functions of the board limited to policy making and performance of duties imposed by law
- Requiring designation of County Primary Road Systems by County Road Commissions subject to approval of the State Highway Commissioner
- Requiring designation of Major Street Systems by all municipalities subject to approval of the State Highway Commissioner
- Requiring each County Road Commission and municipality to submit biennial highway and street construction programs to the State Highway Commissioner
- Distribution of the state motor vehicle highway fund:

  (a) 44 percent to state trunklines, with not less than 40 percent of the amount available for construction to be used on trunklines within the limits of municipalities

  (b) 37 percent to counties, with three-fourths of the county allotment for primary roads and one-fourth for local roads

  (c) 19 percent to municipalities, with seven-tenths of the allotment for major streets and three-tenths for local streets
- Requiring reporting by all highway agencies to the Governor and the Legislature on construction progress, and accounting for all expenditures from motor vehicle funds.

Bond Financing Authorized

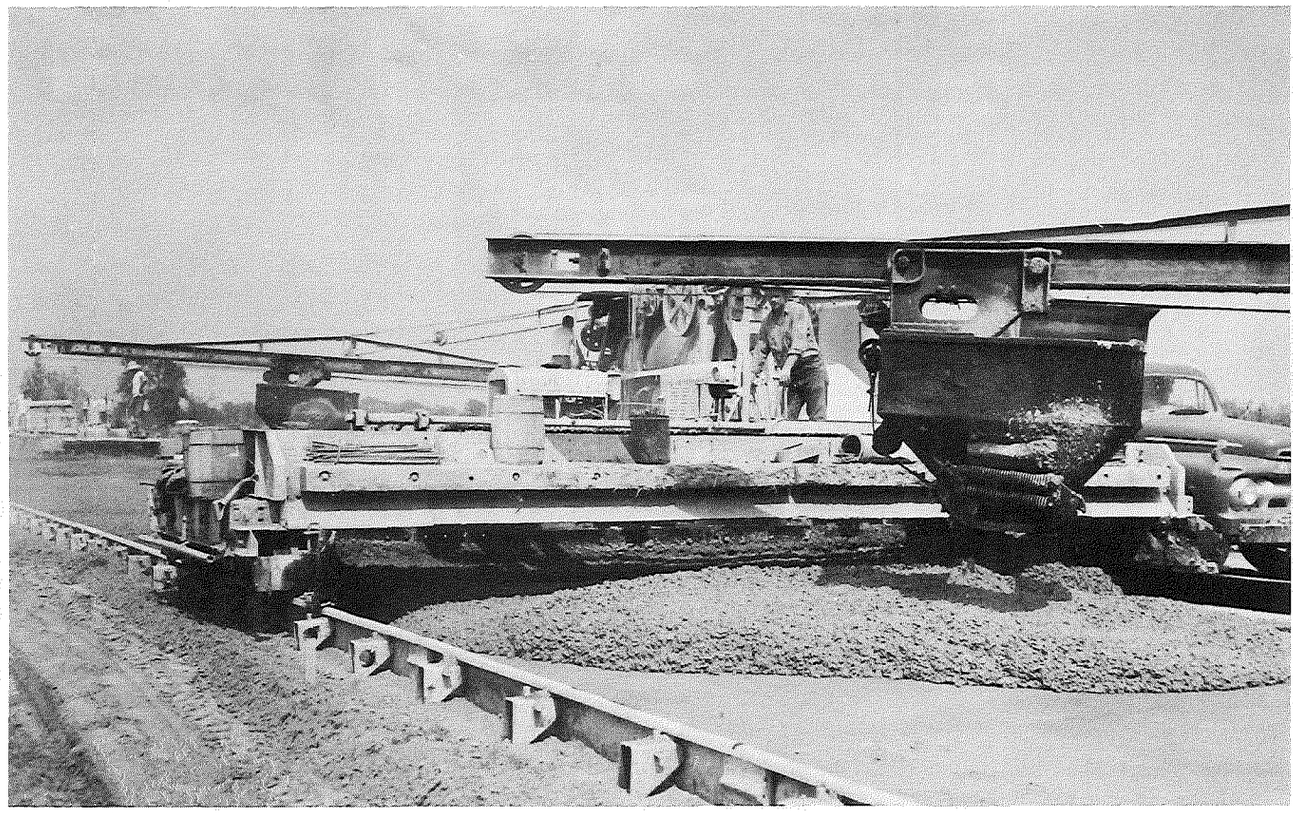
By several other acts since 1950, the legislature has provided for accelerating the construction of expressways by authorizing the State Highway Commissioner to enter into contracts with counties and municipalities for the construction of limited access highways to be financed by bond issues. The Acts were in the form of amendments to the original controlled access legislation authorized by Act No. 205 of Public Acts of 1941. Debt service on these bond issues is a first obligation on proceeds received by the state, counties and municipalities from their shares of motor vehicle fund revenues.

The most recent legislation, Act No. 197, Public Acts of 1955, continues to limit the total amount of such bonds outstanding at one time to $300 million but raised the annual commitment permitted by the State Highway Department for its share of the debt service to $12 million. The department's obligations at present for debt service on limited access highway bond issues total $4,645,000 annually.

Highway Construction Fund

Act No. 87, Public Acts of 1955, provided for a further increase in highway revenues by raising the motor fuel tax one and one-half cents a gallon to a total of six cents and increasing weight tax on commercial vehicles by 10 percent. Proceeds from these tax increases constitute a separate highway construction fund to be distributed 75 percent to the state and 25 percent to counties and municipalities. Counties and municipalities share their 25 percent allocation of the construction fund in the ratios established by Act No. 51, Public Acts of 1951.

Those additional revenues may be used only for construction purposes, or for debt service on bonds issued by the various governmental agencies for highway or street construction. The amount of the new revenues which may be pledged for debt service may not exceed one-half the amount of money received from the highway construction fund during the previous fiscal year. The state's share of the new funds is to be used for construction of a limited number of state trunkline routes described in the



Paving on the Detroit-Toledo Expressway near Hurd Road. Construction of this expressway is being financed by a bond issue under Act 205 of 1941, as amended.

Act. These routes total approximately 2,000 miles in length and include all routes of the National System of Interstate Highways within Michigan. Present traffic on all the designated routes justify the early construction of multi-lane divided facilities of four or more lanes.

Toll Facilities

Other legislation since 1947 of major importance to highway transportation was passage in 1952 of an act giving the Mackinac Bridge Authority powers to finance and build the Straits of Mackinac Bridge. Bonds to finance construction were sold late in 1953 and work on the bridge was started in May, 1954. Completion has been set for November 1, 1957. The estimated cost of construction and financing is $99,800,000.

Act No. 176, of 1953, created the Michigan Turnpike Authority. That Act designated two turnpike routes to be studied, surveyed and constructed if financing were found to be feasible by toll collections. Traffic studies have indicated that the portion of the specified north-south route from the vicinity of Saginaw to near Flat Rock is feasible and the Turnpike Authority is proceeding with plan development on this section. Bonds to finance construction have not been sold. Preliminary engineering studies have been made of the practicality of the Detroit-Chicago route, but the Authority has not announced the results of the study.

Act No. 99, Public Acts of 1954, authorizes the International Bridge Authority of Michigan, created by the legislature in 1935, to finance, construct and operate a bridge or tunnel between Sault Ste. Marie, Michigan, and Sault Ste. Marie, Ontario, Canada. Preliminary studies have indicated construction of a bridge to be feasible, but as of this time there are no definite plans for sale of bonds or starting construction.

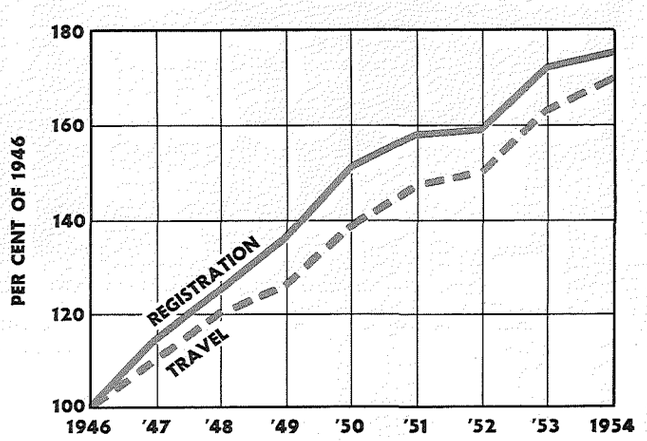
Federal Aid

Since the 1947 study Federal-aid allotments for highway construction have greatly increased. Total Federal aid for the current fiscal year amounts to $875 million, an increase of $300 million over that for the previous year and $375 million more than in 1947. Michigan's allotment this year has been increased from $19,364,000 to $30,153,000.

COMPARISONS

While highway revenues have increased substantially in recent years, the gain could not cope with several factors: the three-year lag in enactment of legislation, the vastly increased highway needs demanded by the unanticipated growth of traffic, and inflated construction costs.

TRAVEL AND REGISTRATION INCREASES SINCE 1946

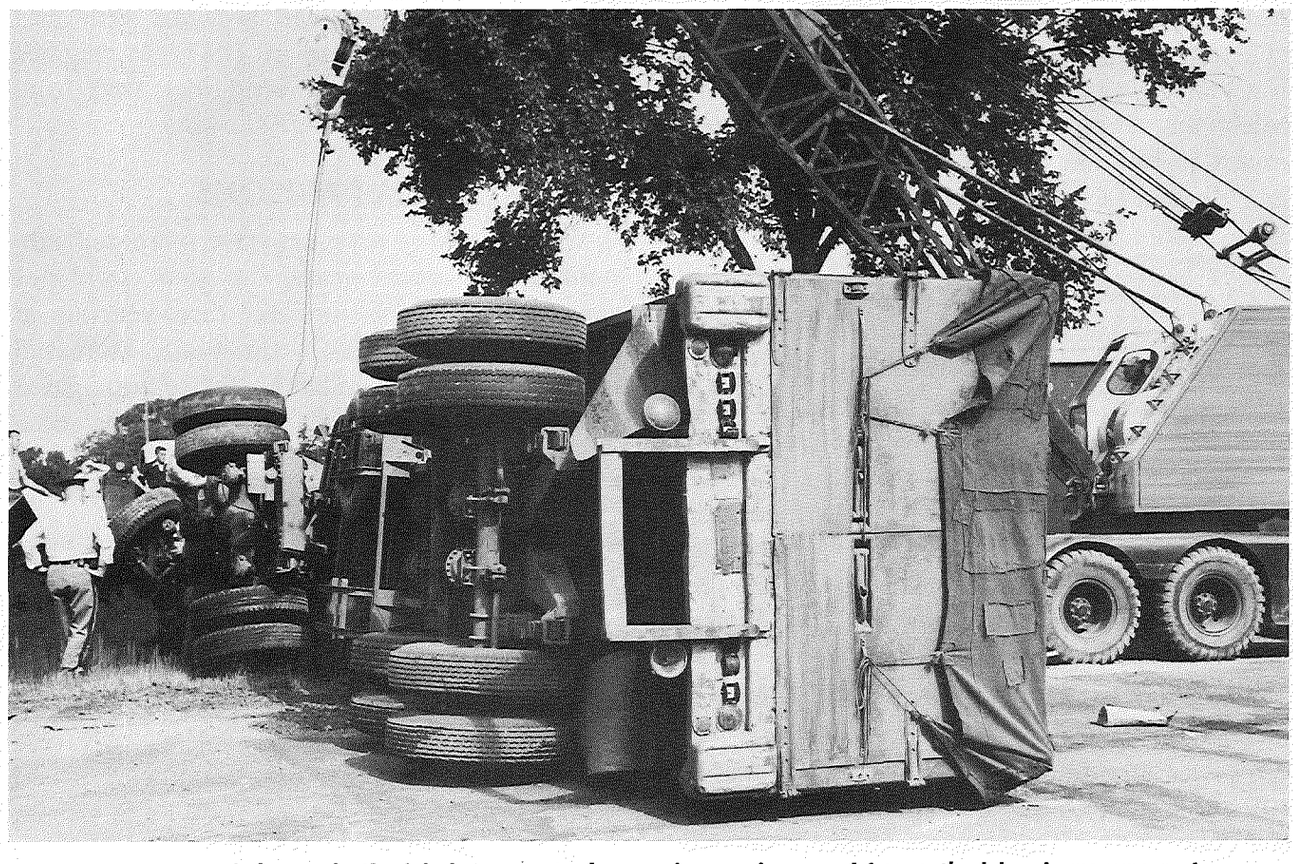


Motor Vehicle Registrations

The motor vehicle registration forecast made in 1947 estimated a total registration of 2,360,000 vehicles in 1970. Actual registration in 1954 totaled 2,816,000, a figure exceeding the 1947 study forecast for 1970 by 20 percent. Registrations increased 75 percent from 1946 to 1954. The 1954 registration represented one vehicle for each 2.5 persons of the state's population as against a national average of 2.9.

Travel

With the large increase in motor vehicle registrations has come an equally large increase in motor vehicle travel. The 1954 travel totaled 27 billion vehicle miles as compared with 16 billion in 1946, an increase of 70 percent. Forecasts made in 1947 estimated the total volume of travel would not reach 25 billion vehicle miles until 1970.



Huge economic losses, deaths, injuries, property damage, inconvenience, and frequently delay, in movement of commodities are the prices paid for accidents.

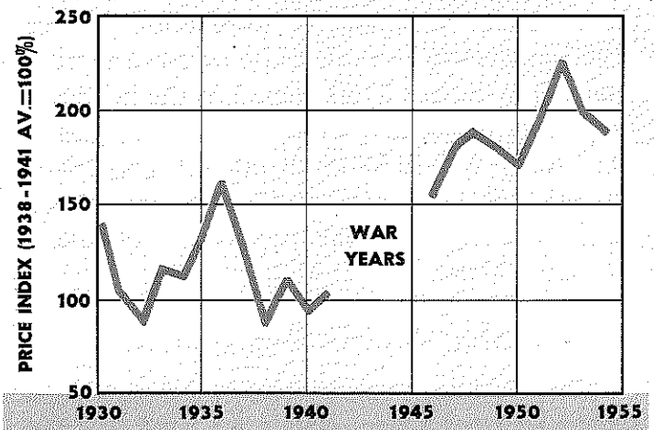
That tremendous growth in travel in an eight-year period has greatly increased the problems of providing highway facilities adequate for safe and efficient vehicular movement. The mileage of rural multi-lane roads needed today is about three times the amount found necessary in the 1947 study. Additional needed expressways in cities has increased the expressway cost by more than 500 percent. Highways which are congested and overloaded are not only more costly to the motorist because of delays and inconvenience, but contribute to accidents. In 1954, 1,785 persons were killed in traffic accidents on Michigan roads and streets. Fifty-six thousand others were injured. The economic loss from highway accidents, time losses and extra gasoline consumption and other vehicle operating costs is at least $270 million annually. That amount is about twice the 1954 construction expenditure for roads and streets by all state and local governmental agencies.

Highway Prices

In 1947 the Michigan highway construction price index was 180 based on the average of 1938-1941 prices as 100. At that time engineers and economists expected prices to rise through 1948 and then turn downward. By 1953 a relatively stable situation was expected at about 150 percent of base prices. Accordingly, annual program costs estimated in 1947 were adjusted to anticipated lower price levels.

Predictions in 1947 proved to be generally accurate for three years with the price index dropping to about 170 by 1950. However, the Korean conflict accelerated defense construction, and brought a shortage of steel, cement, other building materials and labor. The highway price index turned sharply upwards in 1950, reaching 223 in 1952. Since then the trend has again been downward with the 1954 index standing at 189. This is about five per-

HIGHWAY CONSTRUCTION PRICE INDEX TREND



Due to inflation the highway dollar today will buy only about half as much as it did in 1940. The trend of construction prices from 1930 to 1954 is shown in the chart above. Average prices between 1938 and 1941 have been used as a base.

cent above the 1947 level and about one-fourth above the level of the 1947 study adjusted annual program costs.

Thus, while state collected motor vehicle taxes rose from $59 million in 1946 to $142 million in 1954, higher construction costs have offset the increase materially. The construction dollar, using 1940 as a base, was worth 61.3 cents in 1946 but only 50.2 cents in 1954. In 1952 at the height of the post-war inflation the value of the construction dollar dropped to 42.4 cents.

The 1947 study estimated the total 15-year construction requirements for all roads and streets at $1.614 billion or $107.6 million per year. An additional $51 million annually was estimated for maintenance. For the period 1947-1953 highway and street construction expenditures totalled $612 million, an average of $87.4 million per year. The rate of construction progress has therefore been only about 80 percent of that necessary to meet the needs on the 15-year program basis originally contemplated, even at 1947 study prices.

Not all of the average $87.4 million annual construction expenditure represents capital improvements of the type contemplated by the 1947 study. Because of the shortage of funds it has been necessary to do considerable resurfacing and stop-gap betterments to keep highway and street facilities in service.

Currently the costs of needed improvements are much greater as will be shown in subsequent chapters.

FUTURE TRAVEL TREND

It is apparent from the foregoing, estimates of future registration and travel made for the 1947 study were too conservative. At that time leading economists believed a post-war recession would develop, returning the nation's economy to near pre-war levels. This did not materialize. Instead, over-all economy has continued on a high level. During the period 1940 to 1954 the gross national product, a measure of the Nation's economy, rose from $216 billion to $376 billion. This is an increase of 75 percent. Trends of the post-war period by now have been sufficiently established to serve as a better basis for travel projections than existed in 1947.

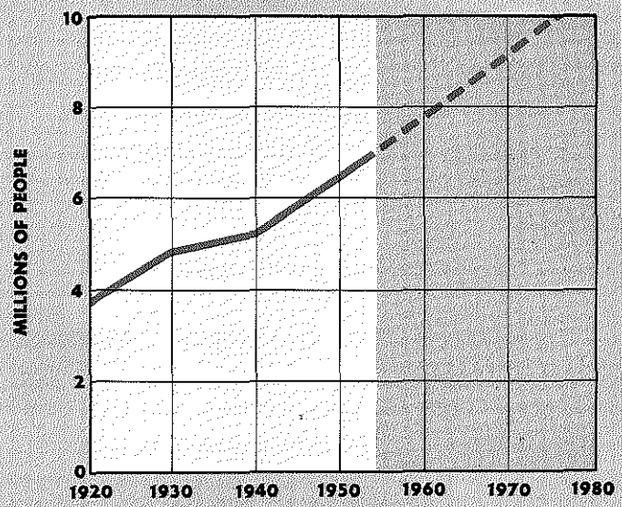
To accurately appraise both present and future highway needs it is necessary to develop the best estimates possible of future traffic. Funds for highway improvements are a capital investment for many years of service. If highway facilities are not designed to provide adequate service throughout their life, there is every likelihood they would become functionally obsolete even though their physical condition may still be relatively good.

In restudying the trend of future travel for this report, maximum use has been made of population forecasts by the U. S. Bureau of Census and of studies of motor vehicle registration and traffic growth by the Planning and Traffic Division of the State Highway Department.

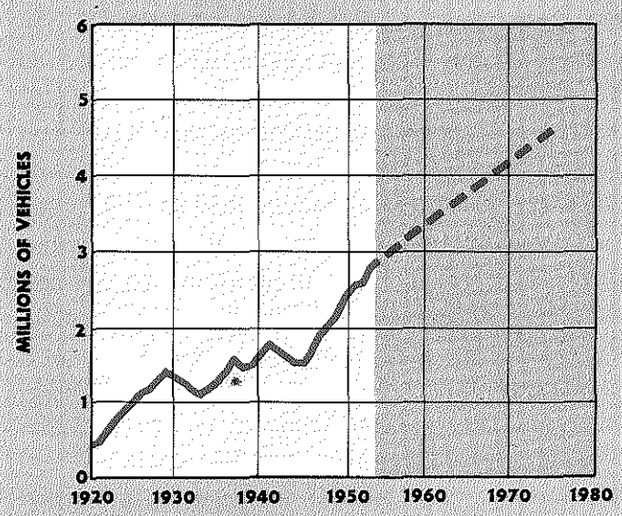
Population

The 1950 decennial census reported a population of 6,397,000 in Michigan, an increase of about 1,150,000 over the 1940 census. Since 1950 the Census Bureau mid-year estimates indicate Michigan's population has continued to grow at a rate slightly greater than from 1940

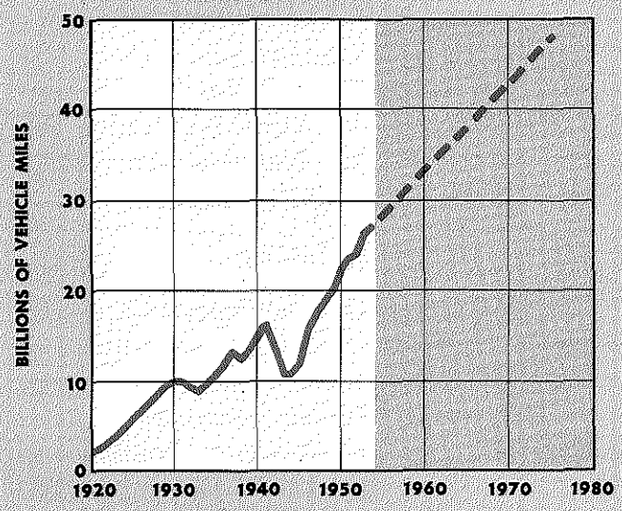
POPULATION TREND



MOTOR VEHICLE REGISTRATION TREND



TRAVEL TREND



to 1950. The post-war trend is expected to continue until at least 1965, which would bring Michigan's population to about 8,400,000 persons. Some estimates of population beyond 1965 predict an increased rate or upward trend starting in the late 1960's based on the increased birth rate of the mid 1940's. For purposes of this study the 1950-1965 rate of population growth has been projected on a straight-line basis reaching a total population of about 10,000,000 persons in 1975.

Motor Vehicle Registrations

The 1954 registration total of 2,816,000 vehicles represents one vehicle for each 2.5 persons. In 1941 this ratio was 3.1 persons per vehicle and in 1946 was 3.7 persons per vehicle.

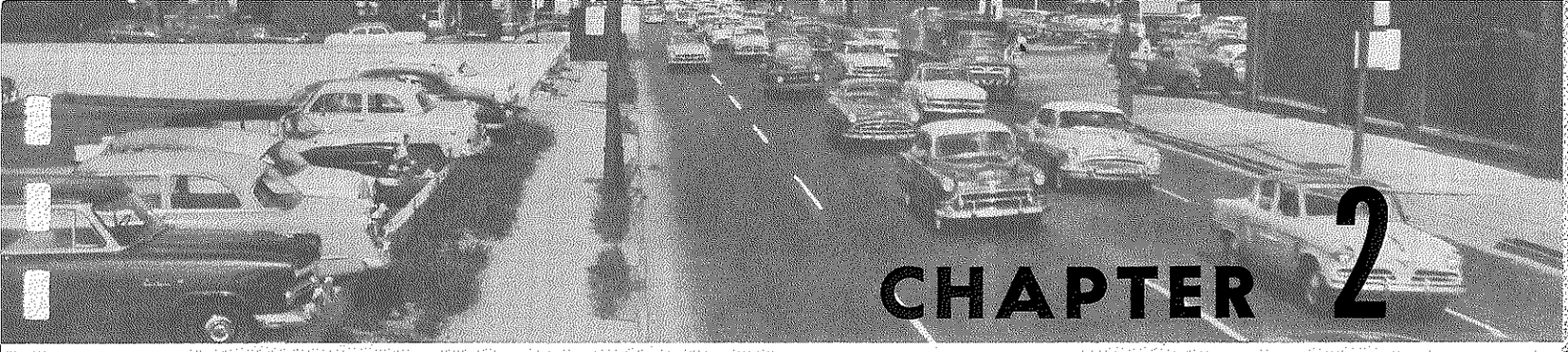
Michigan's economy is closely tied to the automotive industry. In view of this, and on the basis that highway facilities will continue to be improved to meet demands it is predicted that the rate of motor vehicle ownership will continue to increase, reaching about 2.3 persons per vehicle in 1965 and about 2.1 persons per vehicle in 1975. Based on these ownership ratios it is estimated that motor vehicle registration will reach 3,718,000 in 1965 and 4,573,000 in 1975. The 1975 estimate is a 62 percent increase over 1954 registrations.

Motor Vehicle Travel

The average annual travel of each registered motor vehicle in 1954 was 9,600 miles.

Assuming a continuance of present economic levels it is expected that average travel per vehicle will continue to increase at a moderate rate. For this study it has been conservatively estimated that average travel will rise to 10,500 miles per vehicle by 1975, an increase of 10 percent over the 1954 average.

Predicted trends in population, motor vehicle ownership and travel per vehicle forecast a sizeable increase in total travel. The combined factors result in an estimated 1965 total travel of 37.8 billion vehicle miles, an increase of 40 percent over 1954. For the year 1975 travel is estimated to reach 48.1 billion vehicle miles, or an increase over 1954 of 78 percent.



CHAPTER 2

BASIS FOR STUDY OF NEEDS

Michigan's huge highway plant consists of 108,000 miles of roads and streets as shown on the map on page 20. On them are slightly more than 9,000 bridges, including railroad and highway separation structures. The roads and streets are administered by 579 separate, independent highway agencies, yet all are a part of a single transportation network.

To make a sound, comprehensive, appraisal of needs it is essential that all pertinent data be analyzed and clear cut procedures be followed. Elements of this appraisal are:

- Facts about roads and streets
- Facts on motor vehicles use
- Uniform procedures and standards
- Review of road and street responsibility
- State Trunkline System classification.

STATUS OF THE SYSTEMS

Of the total mileage, 93,428 miles are in rural areas; 14,608 miles in municipalities. The network is comprised of 9,355 miles of state trunklines, 85,589 miles of county roads and 13,092 miles of streets controlled by municipalities. The mileages of rural roads and municipal streets by each of the presently established legal systems are shown in the accompanying table.

The status of improvement of rural roads varies widely between the various systems. Whereas 88 percent of the mileage of trunkline routes have dustless surfaces many are in poor structural condition. Most serious, there are severe problems of congestion which affect safe and efficient traffic movement. On the rural trunklines only 171 miles are divided multi-lane.

Fifty-one percent of the mileage of county primary roads and seven percent of the mileage of county local roads have been improved with all weather bituminous surfaces or higher. Congestion generally is not a problem in the county systems.

Almost one-third of all local roads are unsurfaced or unimproved; many are impassable several months of each year.

MILEAGE OF MICHIGAN'S ROADS AND STREETS TODAY

System	*Miles*
Rural State Trunklines	8,317
County Primary Roads	22,415
County Local Roads	62,696
Total Rural	93,428
State Trunklines within Municipalities	1,038
County Primary Roads within Municipalities	448
County Local Roads within Municipalities	30
Municipal Major Streets	3,609
Municipal Local Streets	9,483
Total Municipal	14,608
Total All Roads and Streets	108,036

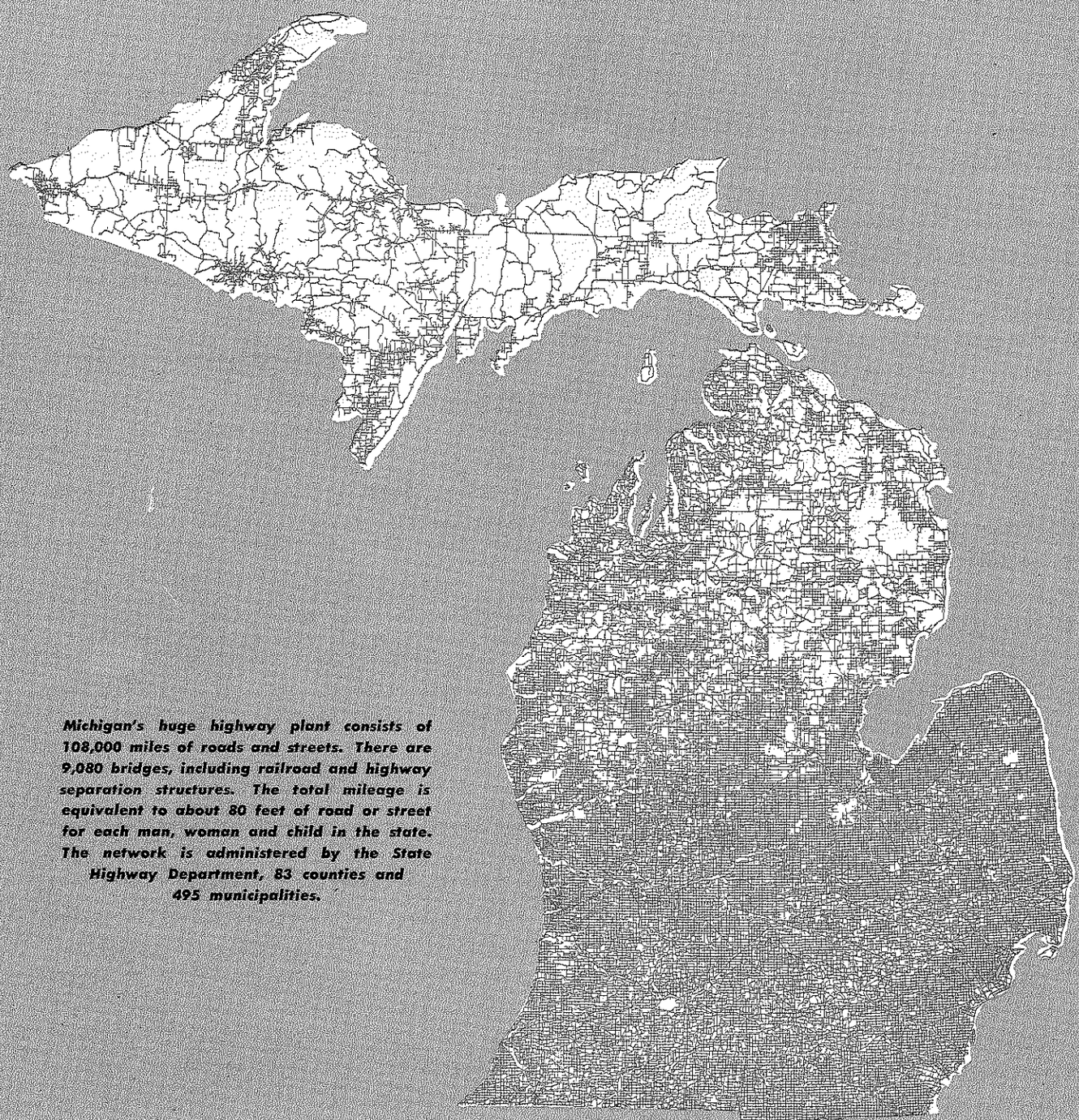
Development of Municipal Streets

The status of improvement of municipal streets also varies widely between the systems.

Some 35 percent of the local street mileage is gravel or earth surfaces. While most of such local streets are located in smaller municipalities there is an appreciable mileage in many of the larger cities. Detroit has 270 miles of local streets in this class.

In contrast 99 percent of state trunkline mileage, 90 percent of the county road extensions and 91 percent of major street mileage has intermediate or high type surfaces.

MICHIGAN'S ROAD NETWORK



Michigan's huge highway plant consists of 108,000 miles of roads and streets. There are 9,080 bridges, including railroad and highway separation structures. The total mileage is equivalent to about 80 feet of road or street for each man, woman and child in the state. The network is administered by the State Highway Department, 83 counties and 495 municipalities.

RURAL ROAD SURFACE TYPES

Type of Surface	State Trunklines		County Primary		Local Roads	
	Miles	Percent	Miles	Percent	Miles	Percent
High Type	4,771	57	1,194	5	277	—
Intermediate Type	2,535	31	10,195	46	3,560	7
Gravel	960	11	9,698	43	38,742	61
Unimproved	51	1	1,328	6	20,117	32
Totals	8,317	100	22,415	100	62,696	100

HIGHWAY AND STREET USE

On the rural portion of the trunkline system there are 1,525 miles carrying traffic in excess of 5,000 vehicles per day, including 350 miles carrying more than 10,000 vehicles per day. Maximum rural traffic is about 32,000 vehicles per day on the portion of U. S. 16 from Farmington to the city limits of Detroit.

At the other extreme there are 2,542 miles of rural trunklines carrying traffic of less than 1,000 vehicles per day, including 597 miles carrying traffic less than 500 vehicles per day.

Traffic on municipal sections of state trunklines ranges from a few hundred vehicles per day in small municipalities located on the lesser important routes to over 100,000 vehicles per day on the John Lodge and Edsel Ford Expressways in Detroit.

Traffic distribution on county primary roads is shown in the chart on page 25. The chart is based on a limited number of short period traffic counts made by the various county road commissions at the request of the engineering staff in 1954.

About four-fifths of the county primary roads are reported to serve traffic volumes of 500 vehicles per day and less. Only five percent carry traffic in excess of 1,000 vehicles per day. For the most part the heavier travelled roads are located in the more densely populated counties of southern Michigan.

Average daily traffic on municipal major and local street systems is not available from state records and most cities do not have current data. As a part of the appraisal procedure high-hour traffic counts were made in municipalities of over 5,000 population at locations where traffic congestion is a problem. These data were used in determining capacity requirements but no attempt has been made to expand the high-hour counts to average daily traffic or to summarize these data by volume groupings.

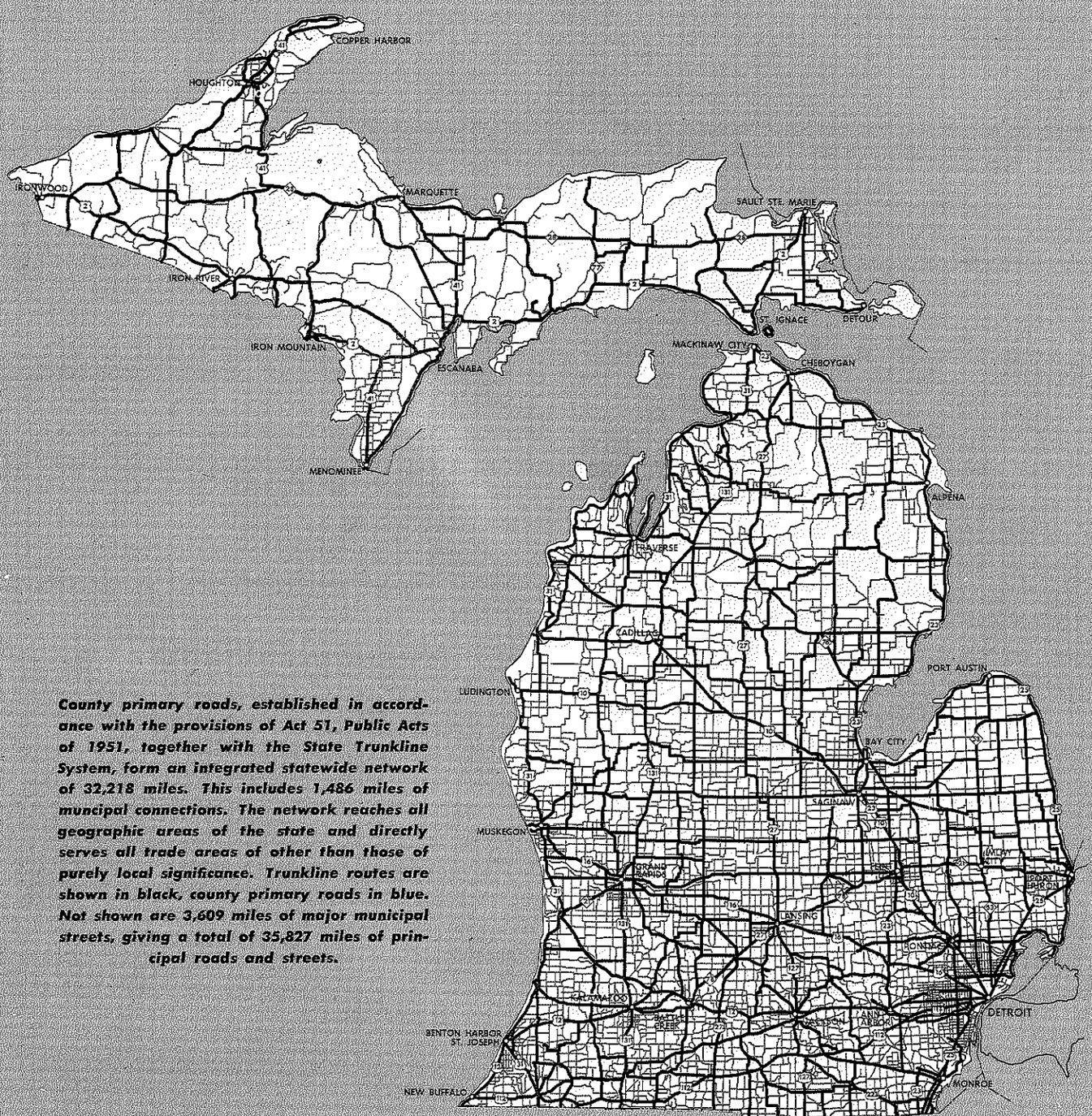
APPRAISAL PROCEDURE

With the counsel of the state, county and city engineering advisory committees, the engineering staff prepared procedural manuals outlining specific criteria and techniques for measuring deficiencies and determining the nature of improvements needed under various conditions of traffic volume, variations in usage and composition of the traffic flow. Separate manuals were prepared for appraisal of state trunklines, county roads and municipal streets. Procedures

MUNICIPAL STREET SURFACE TYPES

Type of Surface	State Trunklines		County Roads		Major Streets		Local Streets	
	Miles	Percent	Miles	Percent	Miles	Percent	Miles	Percent
High Type	929	90	369	77	1,856	52	3,211	35
Intermediate Type	92	9	61	13	1,407	39	2,871	30
Gravel	17	1	46	10	306	8	2,327	24
Unimproved	—	—	2	—	40	1	1,074	11
Totals	1,038	100	478	100	3,609	100	9,483	100

STATE TRUNKLINES AND COUNTY PRIMARY ROADS



County primary roads, established in accordance with the provisions of Act 51, Public Acts of 1951, together with the State Trunkline System, form an integrated statewide network of 32,218 miles. This includes 1,486 miles of muncipal connections. The network reaches all geographic areas of the state and directly serves all trade areas of other than those of purely local significance. Trunkline routes are shown in black, county primary roads in blue. Not shown are 3,609 miles of major municipal streets, giving a total of 35,827 miles of principal roads and streets.

used in appraising the needs of each class of roads and streets were fitted to the nature of the basic data available and the varying service demands on the several systems.

General

State trunklines, county primary roads and municipal major streets were appraised section by section to determine their construction needs and estimated cost of bringing them up to standards adequate to serve estimated 1975 traffic requirements. Construction needs were determined by comparison of the geometric and physical features of each road and street with appropriate design standards. Improvements proposed are based on obtaining maximum salvage value from the existing investment wherever possible.

All cost estimates were based on 1954 prices. Construction requirements reflect conditions as of January 1, 1955. Roads and streets under construction on that date were appraised on the basis of their condition when completed.

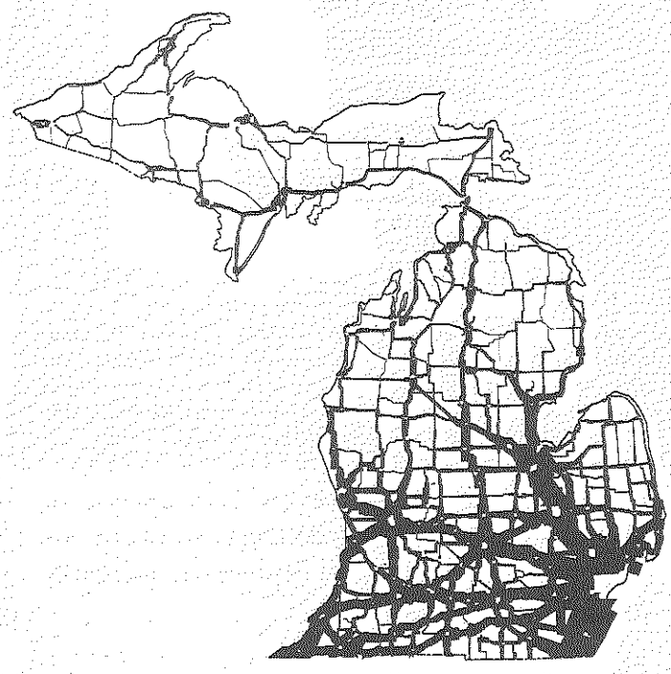
Needed improvements were grouped into time periods of 1 to 5 years, 6 to 10 years, 11 to 15 years and 16 to 20 years, based upon the present degree of inadequacy of the existing facility and the relative urgency of the improvement from a traffic and service standpoint.

The appraisal of local road and local street needs was accomplished by statistical analysis to determine the annual costs required to develop and maintain such roads and streets over a 20-year period to adequate standards. The analyses were based on the annual road and street inventory and condition reports by counties and municipalities required by Act 51 of 1951 and supplemental information from each county relative to the traffic service characteristics of their local roads.

State Trunkline Appraisal

Information on current physical condition of trunkline routes was obtained by field crews who inspected every mile of the Trunkline System to observe and rate structural condition of existing surfaces. These crews also measured

AVERAGE DAILY TRAFFIC FLOW ON STATE TRUNKLINE SYSTEM



Rural traffic volumes shown on this traffic flow map are about one-third of the total travel in the state.

and recorded rural trunkline sections deficient in safe-passing sight distance, since passing opportunity is a most important element in determining traffic capacity. It was recognized early that provision for adequate capacity would be a major factor in the total trunkline needs.

Basic data on present traffic usage of trunklines, both average daily flows and near-peak hour volumes, were obtained from records of the Planning and Traffic Division of the Highway Department, also much data pertaining to geometric features of existing facilities.

In special cases existing traffic was adjusted to a probable value on assumption that certain facilities now under construction, or expected to be built, will change the traffic pattern. Examples of such special cases are the Straits of Mackinac Bridge, which is predicted to have a substantial traffic impact on trunklines serving

DISTRIBUTION OF RURAL TRUNKLINE TRAFFIC

Traffic on rural trunklines ranges from a minimum of about 100 vehicles per day to a maximum of 32,000 vehicles per day on the portion of U.S. 16 from Farmington to limits of Detroit. About one-third of the rural mileage carries traffic in excess of 3,000 vehicles per day.

it and communities in the northern portion of the state, the Detroit-Toledo expressway and the proposed Chicago-Detroit expressway generally paralleling U.S. Route 12.

Classification

To aid in the appraisal of needs and determination of priorities, the engineering staff classified the Trunkline System into three groups of routes based upon their service characteristics. The study classification utilized basic data from studies made by the Planning and Traffic Division. The first group was identified as principal routes and includes the routes of the National System of Interstate Highways in Michigan, the second as other major routes, and the third group was the remainder of the Trunkline System.

The principal routes are ones of greatest statewide importance. They reach all geographic areas of the state and interconnect major trade centers. In serving the majority of the long-trip intrastate travel they form a network that gives major traffic movements adequate access from rural areas and communities to the industrial, commercial and marketing centers within and outside the state. The principal routes, including urban connections, total about 2,950 miles in length. Their locations are shown on the map on page 26.

Because of their traffic importance the principal routes are planned for generally higher standards of improvement than the balance of the Trunkline System. In general, future traffic warrants their development as multi-lane divided highways. On about 345 miles, however, modern two-lane construction will provide adequate service over the 20-year study period. Eventually, most of this mileage will require four lanes.

While comprising only 31 percent of total rural trunkline mileage it is estimated the selected principal routes carry 48 percent of all travel on the Trunkline System in rural areas.

The other major routes, while secondary in importance to the principal routes, are identified as being of more than usual importance to the state as a whole. They serve as main feeders of the principal routes and interconnect adjacent trade areas.

The third group, the remainder of the trunkline routes, for the most part are of lesser traffic importance. However, a few serve rather high traffic volumes. Generally, they provide interconnections between small municipalities and the less populated areas of the state and act as feeders to the routes comprising the first two groupings.

Besides permitting a planned development of the principal routes to higher standards commensurate with their traffic importance, classifying of the existing system into groupings serves as a primary basis for establishing priorities for programming purposes, as shown in Chapter 3.

County Primary Appraisal

The county road commissions were responsible for the field appraisal of county primary roads in their respective counties based on the uniform procedures and standards set forth in the county manual. Individual report forms were prepared by the county engineers, or road superintendents, for each section of continuous road having uniform physical characteristics and about the same volume and type of traffic over its entire length. The report forms provided a description of the existing facility, the type of surface, its condition, its width, road-

way width, traffic data and other pertinent information necessary to evaluate needs. Construction needs were determined by comparison of the geometric and physical features of each road section with the design standards established for use in the study. In general, some kind of construction improvement was found necessary on each road section in the 20-year study period.

Municipal Street Appraisal

In determining municipal street needs the principal objective was to provide an adequate arterial street system, including state trunklines, major streets and county primary road extensions, consistent with modern engineering practice and good city planning. Consideration was given as to how best fit present street facilities into the desirable future plan at least cost.

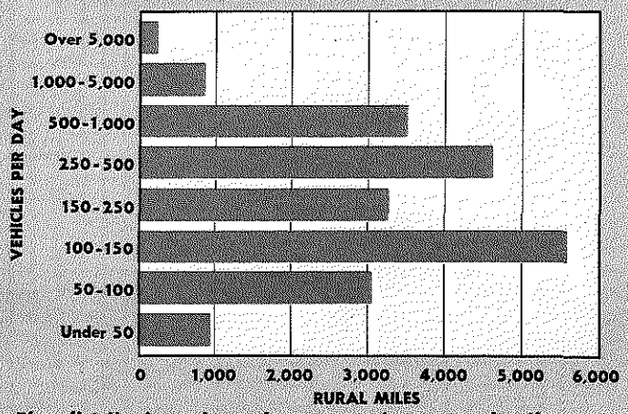
Full use was made of all available information including origin and destination studies, traffic studies, current programs and planning, and local knowledge of existing problems. Every effort was made to avoid destruction of real property because this is both expensive and removes property from the tax roll.

Improved operational control such as better signal timing, turning controls, removal of curb parking at peak hours, and one-way streets were studied before street widening and other construction projects were proposed.

For each of the 93 municipalities of over 5,000 population conferences were held to study the problems and reach decisions as to how the development of an adequate arterial street plan could be best achieved. Conferences were attended by representatives of the Highway Department, county engineers, city engineers, city officials, and members of the engineering staff. During these conferences work sheets were prepared covering each improvement agreed upon as necessary. Cost estimates were later prepared by the agencies having jurisdictional responsibility for the street system.

State trunkline routes in municipalities of less than 5,000 population were analyzed and needs determined in conjunction with the rural trunkline appraisal. Similarily, urban county primary roads were analyzed and needs reported by county engineers in connection with the rural county primary road appraisal.

DISTRIBUTION OF RURAL COUNTY PRIMARY TRAFFIC



The distribution of rural county primary road mileage by traffic volume groups shown in this chart is based on a limited number of short period traffic counts. About 80 percent of rural county primary roads carry traffic of less than 500 vehicles per day. About five percent carry traffic in excess of 1,000 vehicles per day.

Major streets in a scientifically selected sample of all municipalities under 5,000 population were studied and needs determined by engineers working directly under the supervision of the Foundation engineering staff. This sample was expanded to represent major street needs in all municipalities under 5,000 population.

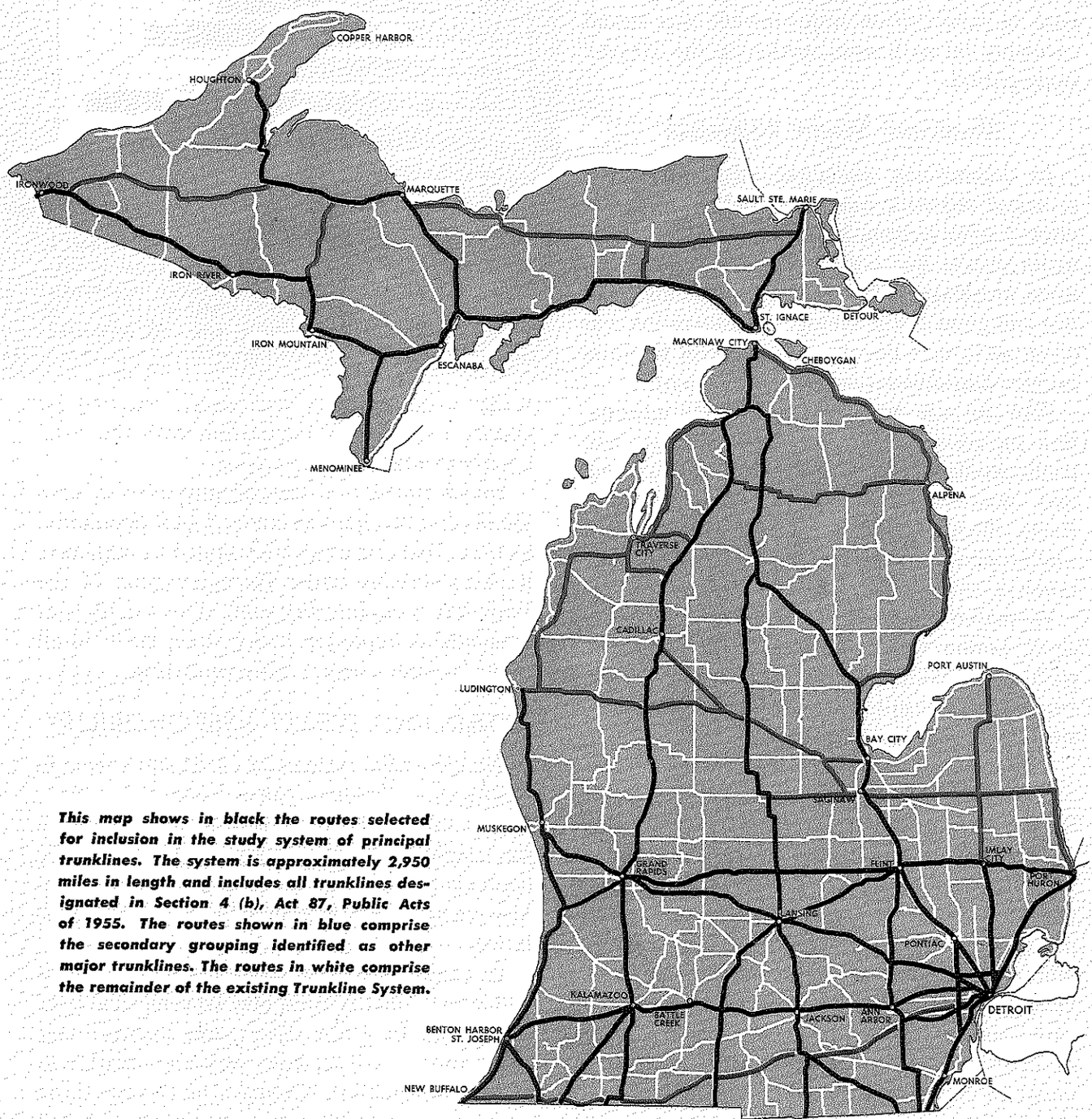
ROAD AND STREET RESPONSIBILITY

Existing legal systems of roads and streets in Michigan are based on the provisions of Act 51, Public Acts of 1951. Review of the systems by the engineering staff indicates they generally conform to the objectives and principals of system classification intended by the 1951 legislation.

In certain instances county primary systems and major street systems may be somewhat over expanded. In a few other cases counties and cities appear to have been very conservative in system designation. Changes to correct those situations are being progressively worked out cooperatively by the Highway Department and the counties and municipalities involved.

The Highway Department has under study a long-range reclassification plan for the Trunk-

PRINCIPAL AND OTHER MAJOR TRUNKLINE ROUTES



This map shows in black the routes selected for inclusion in the study system of principal trunklines. The system is approximately 2,950 miles in length and includes all trunklines designated in Section 4 (b), Act 87, Public Acts of 1955. The routes shown in blue comprise the secondary grouping identified as other major trunklines. The routes in white comprise the remainder of the existing Trunkline System.

line System which would return some lesser used trunklines to the counties and add to the system some of the more important county primary roads. The intersystem transfers proposed together with some projected new trunklines would reduce the existing trunkline system by about 300 miles.

Changes in existing classification will come about gradually over a long period of time as a result of detailed studies of individual routes or areas. Since it could not be factually determined when specific system classification changes would occur and since the net change in mileage will be small in relation to the total road and street network, the possible effect of such changes on the needs estimates by systems has not been covered in this study.

Periodically it would be profitable to evaluate the impact of future intersystem transfers to determine the changes in financial requirements necessary to meet changes in jurisdictional responsibility.

STANDARDS

State trunklines, county roads and municipal streets while having certain characteristics in common serve traffic of widely varying volumes, patterns and composition. On some rural roads traffic in a single hour on a summer week end is equal to one-third of the average annual daily traffic—on the other roads as low as one-tenth, or even less.

Commercial traffic density ranges from less than 10 percent of average daily traffic to as high as 35 percent. Obviously, the same kind of highway facility is not a proper solution for these differing conditions. A highway adequate for an average daily traffic of 500 vehicles would be grossly inadequate for traffic of 10,000 vehicles per day. Conversely a highway adequate for 10,000 vehicles per day would not be economically warranted for low traffic volumes.

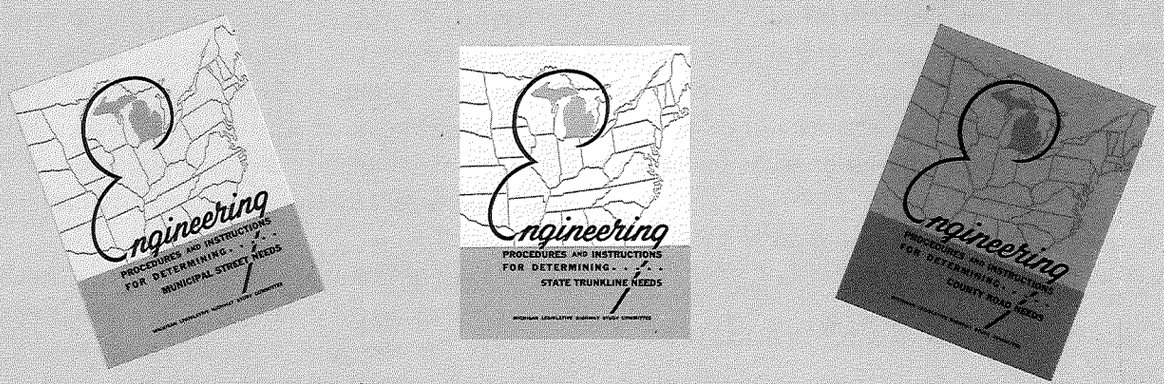
Highway standards are the engineering yardstick used to evaluate these differences in traffic service and to determine the kind and extent of improvement required for safe and economical travel.

Design standards established for use in this study are shown in the appendix. They are based on nationally accepted standards developed by the American Association of State Highway Officials, U.S. Bureau of Public Roads, Highway Research Board and other agencies. They coincide generally with the design policies now in use by the Highway Department, counties and municipalities.

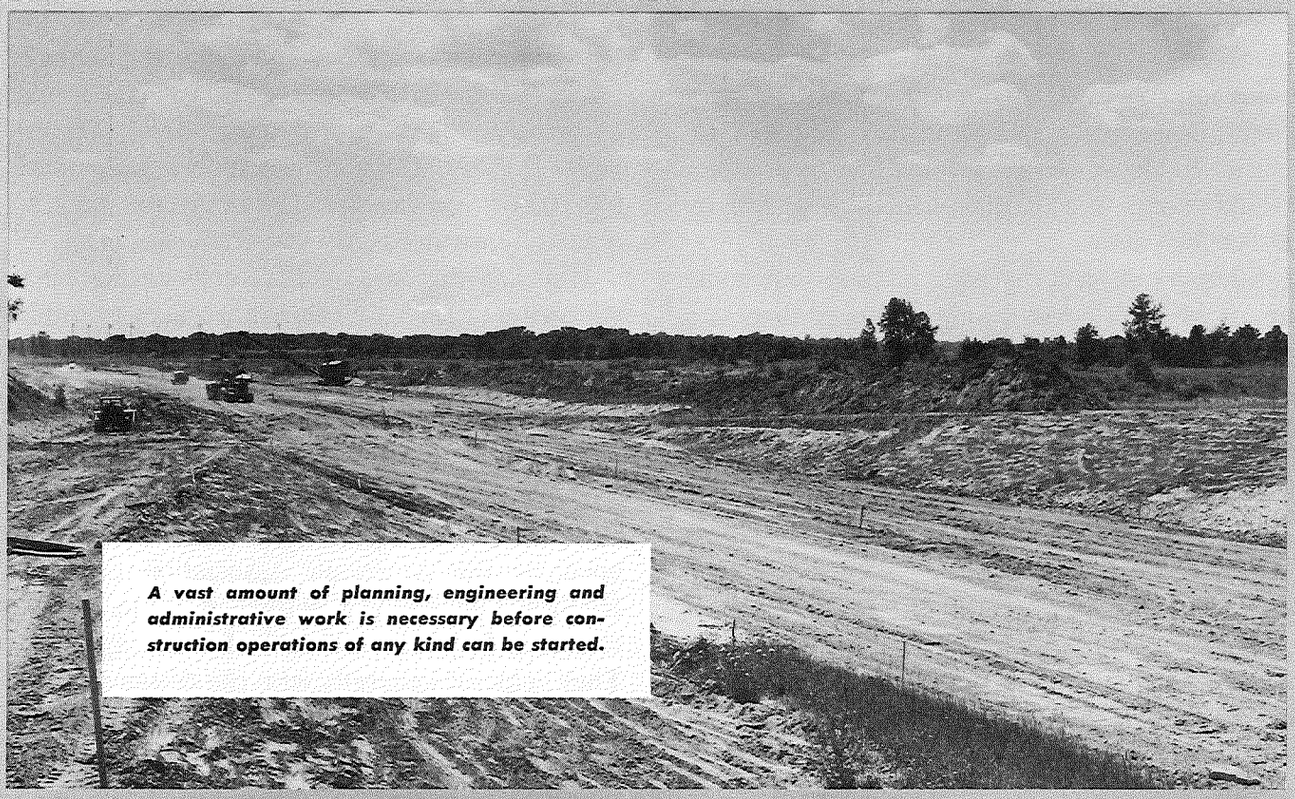
Rural Trunkline Standards

The chief factors controlling rural trunkline standards were system classification, estimated 1975 traffic requirements, and terrain.

For the selected system of principal routes standards for width, curvature, grades and passing opportunities permit average safe operating speeds of 50 to 55 miles per hour during periods of near maximum traffic. On other trunkline routes standards are set to permit average speeds of 45 to 50 miles per hour except for a relatively few hours per year when traffic is unusually heavy.



Procedural manuals helped to produce a high degree of uniformity and accuracy in the appraisal of road and street needs.



A vast amount of planning, engineering and administrative work is necessary before construction operations of any kind can be started.

High type pavements were estimated for principal routes and all other trunklines carrying traffic of over 2,000 vehicles per day. Trunklines with traffic of less than 2,000 vehicles per day should have intermediate type surfaces. The analysis was based on replacement of all existing gravel surfaces within 10 years because of the high cost of maintenance and vehicle operation.

Bridge Standards

For bridges on principal trunkline routes the design standards call for full approach roadway width on structures under 100 feet in length and for approach pavement width, plus six additional feet on structures over 100 feet long. On other trunklines all structures will be at least six feet wider than the approach pavement width.

For all cases a minimum vertical clearance of 14.5 feet is to be provided.

County Primary Road Standards

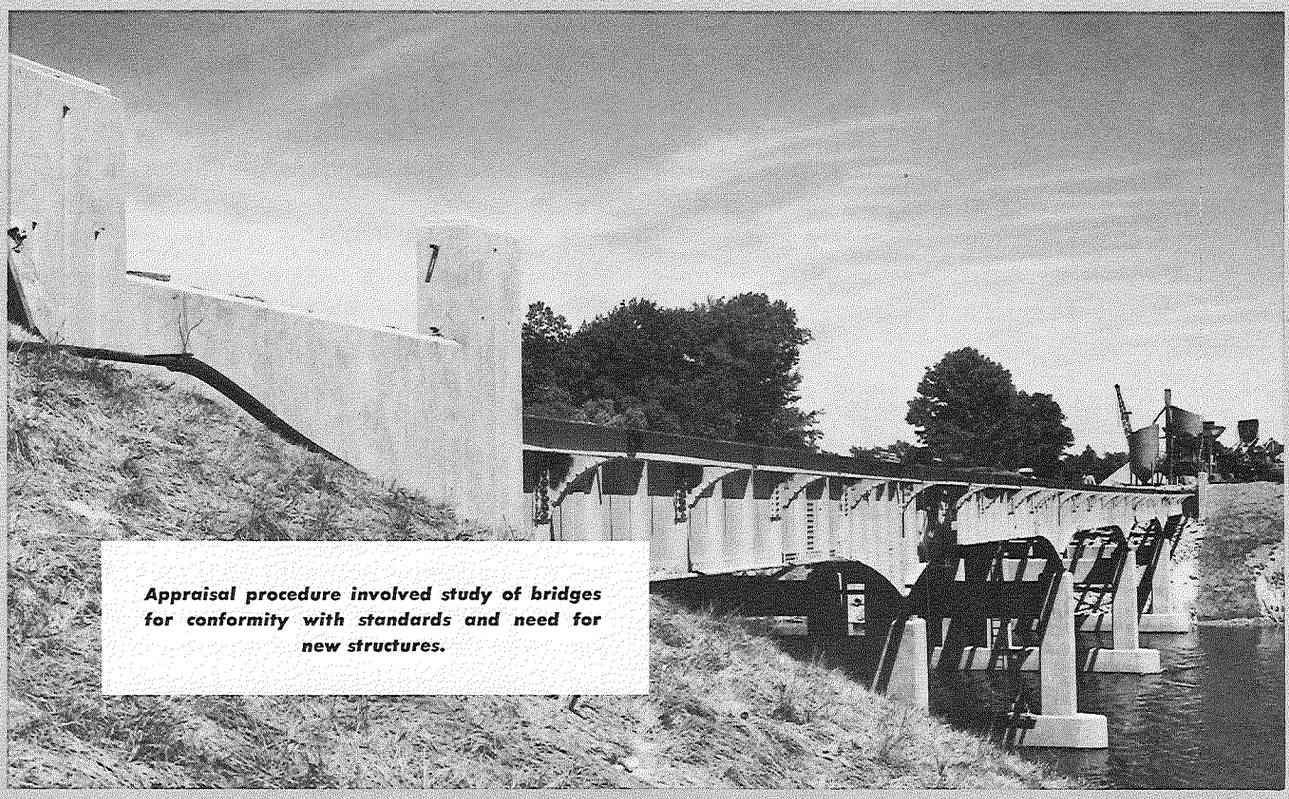
Design standards for county primary roads provide for development of substantially all of the system with intermediate type surfaces, or higher, within the 20-year program period.

The study was based on geometric design features, such as gradients, curvature, sight distance, etc., equal to or above minimum values of the American Association of State Highway Officials for secondary roads.

Municipal Street Standards

In many municipalities the width of right of way on existing major streets and state trunklines is restricted to 66 feet, based on the old "four-rod" criterion in vogue when streets were originally platted. In developed areas property values are generally high and costs of acquiring additional right of way are expensive. For this reason strict adherence to a rigid set of urban arterial street design standards would not be practical.

As an adjunct to urban design standards a number of basic principles were established as guides for the joint arterial street study. The more important of those principles are:



Appraisal procedure involved study of bridges for conformity with standards and need for new structures.

1. Reasonable freedom from delay should be provided, varying in degree in each community, depending on time losses. Special attention should be given to delays at major intersections.
2. The arterial plan should anticipate the probable direction and extent of population, industry, business and traffic growth.
3. Traffic control measures should be provided to the maximum extent to keep the existing street system at top efficiency.
4. Through and local traffic should be considered jointly — not independently. Since main arteries are usually state trunklines, development plans should be keyed heavily to trunklines.
5. Rural by-passes should be considered when large volumes of through traffic are encountered and where the need for other internal improvements within the municipality would be lessened.
6. Adequate by-passes for established central business districts should be provided wherever there is sufficient through traffic, particularly where little physical improvement within such areas is possible to aid traffic circulation.
7. The best modern engineering practices should be followed in new designs. Widening of existing streets where feasible, should produce at least one added full traffic lane, or at least the estimated 1975 capacity requirement.
8. Parking should be banned at peak periods, or at all times, to gain sufficient capacity to satisfy or improve traffic movement. No construction project should be considered where it is proposed to retain diagonal parking, nor should a construction project be considered where provision for parallel parking will require additional right of way involving extensive property damage.

Local Road and Street Standards

The design standards for local roads and local streets are based on service and area char-

acteristics. Traffic volumes for the most part are relatively low and capacity problems do not exist. Consideration was given primarily to the elements of highway safety in establishment of surface and roadbed widths. Provision of at least gravel surfaces was specified on all regularly used local roads and streets as a matter of economic necessity. Higher standards of surfaces were called for where traffic volumes warranted.

Other General Features

Design standards were supplemented by other factors which in good engineering practice would provide sound, realistic cost estimates. Cost of correcting excessive maintenance requirements, low grade lines, poor drainage and other like conditions which could not be adequately defined in tabular form, were among such factors considered.

Rural standards were used in estimating improvement costs within small cities between corporate limits and the beginning of the built-up areas.

Rural trunkline bypasses of municipalities were planned where necessary for a large volume of through traffic, to solve a traffic congestion problem with the city or where control of access was required by the design standards. This applied particularly to routes of the National System of Interstate Highways.

Bypasses were not proposed wherever major geometric changes on the existing route through the city would be required to solve city traffic problems regardless of the bypass facility.

Control of Access

Control of access is the condition where the right of owners or occupants of abutting land, or other persons, to have access to a highway is fully or partially controlled by public authority. Full control of access gives preference to through traffic by providing access connections only with selected public roads and streets. Local traffic is carried to these connections by local or service roads. Partial control of access gives preference to through traffic, but, in addition to access connections with selected public roads and streets, there may be some crossings at grade and some private driveway connections.

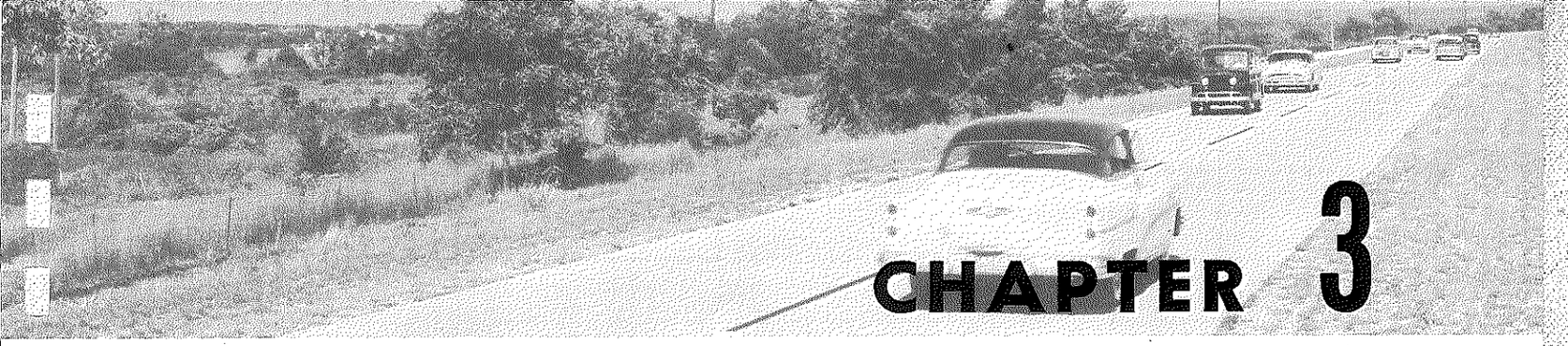
The safety, efficiency and mobility of motor vehicle operation depends greatly upon limitation of interference from the roadside and from traffic entering, leaving, or crossing at intersecting roads and streets. Many recent studies show the value of controlling access as a means of eliminating accidents, providing maximum freedom of movement, improving property values and preserving costly investments.

As a case in point, the 1954 death rate per 100 million vehicle miles of travel on the rural portion of the Detroit Industrial Expressway was 6.7 in comparison with 15.0 on U.S. Route 112, a parallel facility without control of access. The 1954 death rate of the portions of the Ford and Lodge Expressways in Detroit open to traffic was 3.0 in contrast to 7.3 on major surface facilities in Detroit.

The design standards, rural and urban, proposed full control of access on all proposed expressway facilities of the National System of Interstate Highways, in accordance with Federal policy, and partial control of access for all improvements on principal trunkline routes to be built on new locations. Partial control of access was also specified for other state trunklines carrying traffic in excess of 3,000 vehicles per day wherever the proposed improvements were to be on new location. The standards also suggested provision for partial control of access for improvements on existing location where its provision was found to be economically feasible.

The procedures and standards for appraisal of each of the various classes of roads and streets were established on a practical and conservative basis. Throughout all phases of the study, care was taken to insure the highest degree of uniformity in application of the procedures, consistent with good engineering practice.

The results of the engineering appraisal of state trunklines, county roads and municipal streets are presented in the next three chapters.



CHAPTER 3

STATE TRUNKLINES

Findings of the engineering appraisal of the State Trunkline System are summarized in this chapter to show the extent and character of deficiencies and estimated costs of needed improvements.

Alternative annual programs are included which show annual financial requirements to meet construction needs and provide for maintenance and administration. Alternatives should be considered in relation to the findings and recommendations of the separate concurrent fiscal study.

The estimated total capital investment required for trunkline improvements in the next 20 years is $2.8 billion. Of this amount $1.5 billion is for work needed in rural areas and $1.3 billion for work within the limits of municipalities. Maintenance and administraton costs are in addition to those amounts.

Some of the needed improvements included in the programs are being accomplished under this year's construction program. The total of trunkline construction contracts, including bond issue projects to be awarded in 1955 is currently estimated, by the state, to be $75 million.

PHYSICAL NEEDS

In the 20-year study period all but 270 miles of rural trunklines will require some kind of improvement. This is to be expected because the average life of high type pavements is about 25 years and less for intermediate types. Needs range from minor widenings and resurfacing to construction of expressways. Only 43 miles of the selected system of principal trunklines described in the preceding chapter were found to be adequate for 20 years.

Many needs are critical in nature and improvements urgently required. Some 64 percent of the miles needing improvement and 73 percent of the improvement costs on rural trunklines, for the 20-year study period, are needed within five years to overcome present deficiencies and those estimated to occur within that time period. This is an indication of how far present trunkline development has lagged behind requirements for adequate traffic service.

Nature of Rural Trunkline Deficiencies

All rural trunklines were rated in the study on their present degree of adequacy to meet design standards with regard to five major factors:

Hills, curves and passing opportunities
Capacity to handle traffic
Surface type
Structural condition
Surface width.

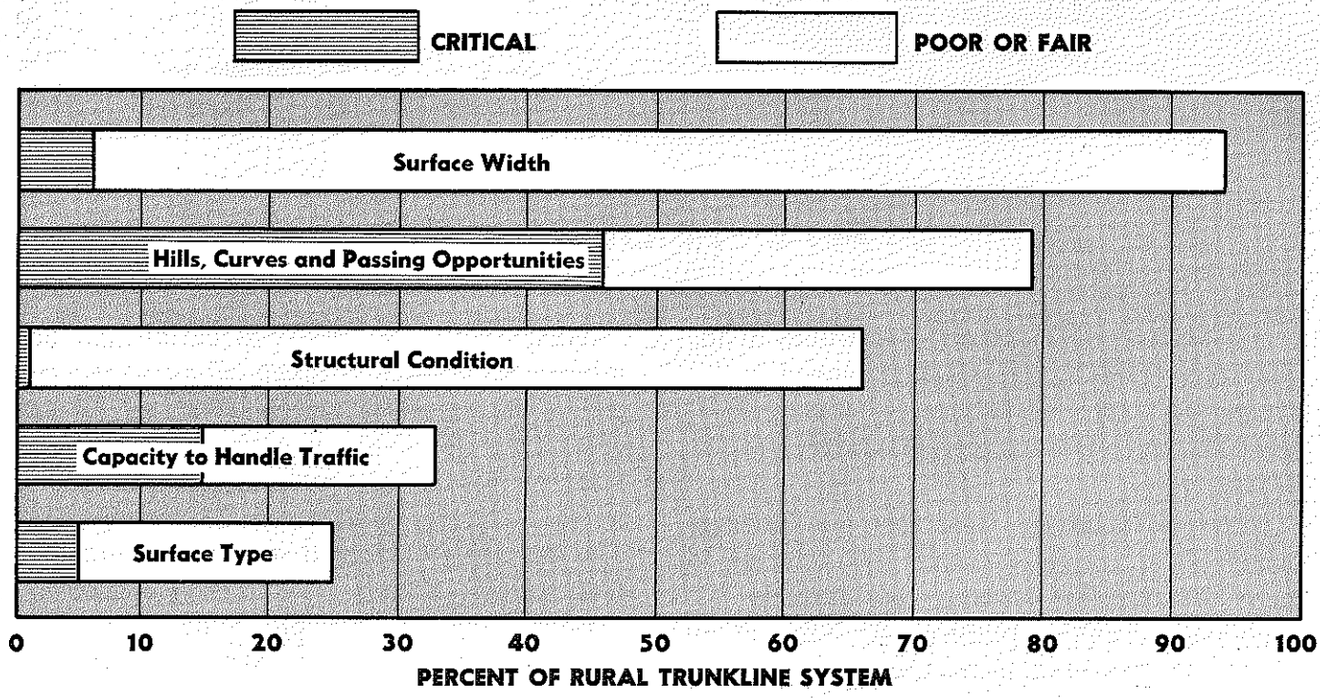
Rural trunkline bridges were similarly rated as to:

Load carrying ability
Height and width clearances.

Results of these ratings are summarized in charts on page 32. Details of the rating procedure, too voluminous to include here, may be found in the State Trunkline appraisal manual.

A third of the existing rural trunkline mileage does not now have sufficient capacity to handle traffic safely at the average operating speeds of the design standards. Trunklines with capacity deficiencies rated as critical carry more than twice as much traffic than they should in high-volume hours. This means congestion, slow

NATURE OF RURAL TRUNKLINE DEFICIENCIES



speed and hazardous driving conditions. For the most part, capacity deficiencies can only be corrected by new divided multi-lane construction. For a limited mileage, modern two-lane construction will provide adequate capacity for estimated 1975 traffic.

Alignment deficiencies largely reflect lack of adequate passing opportunties. The mileage rated as critical consists of trunkline sections on which over 60 percent of the length is restricted to 1,500-foot sight distance or less.

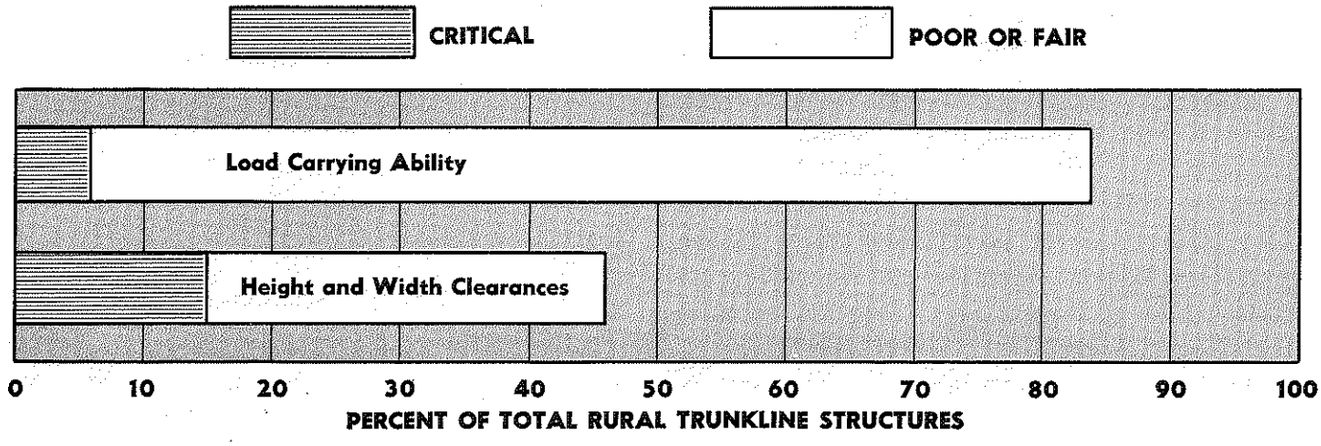
Critical surface-type deficiencies include all trunklines with gravel surfaces carrying traffic in excess of 500 vehicles per day. Critical surface-width deficiencies are those where the existing lane width is more than two feet below design standards.

Many miles include more than one type of deficiency and the urgency of correction is thereby increased.

Municipal Trunkline Deficiencies

As explained in Chapter 2, trunklines within the limits of larger municipalities were appraised in conjunction with the major street systems. Municipal trunkline deficiencies are discussed

NATURE OF RURAL TRUNKLINE STRUCTURE DEFICIENCIES



in Chapter 4 to better define the complex nature and size of the whole urban transportation problem. Further under present law larger municipalities are required to participate in cost of trunkline improvements.

TRUNKLINE IMPROVEMENT COSTS

Total costs of construction needs, rural and urban, on the Trunkline System by five-year intervals for the 20-year period are shown in the table on page 34.

The $1.5 billion for rural trunkline improvements involves the following:

	Miles	Percent	Cost	Percent
Principal Routes	2,579	31	$ 837,488,000	55
All Other Trunklines	5,664	69	688,878,000	45
Total Rural ...	8,243	100	$1,526,366,000	100

Construction improvements on principal trunkline routes involve 1,697 miles on new location and 882 miles of reconstruction on existing alignment, including resurfacings and widenings.

Work on new location includes 911 miles of expressways with full control of access on routes of the National System of Interstate Highways, discussed in more detail in chapter 6.

On other trunkline routes only 774 miles of new construction are needed. Surfacing and widening together with reconstruction on existing location will correct deficiencies on 4,890 miles.

Of the total rural trunkline improvement cost, $204 million is for structures and $146 million for future replacement of pavements. More than half of the structure cost—55 percent—is for highway and railroad separations and stream crossings on the Interstate System and another 10 percent is for necessary structures on other new divided multi-lane highways with partial control of access.

Rural Multi-Lane Requirements

Rural 20-year construction needs include 3,186 miles of divided multi-lane improvements of which 2,821 miles are needed now or within five years. Most needed multi-lane facilities, 2,234 miles, are on the selected system of principal routes, including the entire mileage of Interstate routes.

Of the total rural multi-lane facilities needed 3,044 miles are divided four-lane, 137 miles divided six-lane, and five miles divided eight-lane.

Municipal Trunkline Costs

The cost estimate of $1.3 billion for trunkline improvements within municipalities involves the following:

	Miles	Percent	Cost	Percent
Prinicipal Routes	329	36	$1,125,088,000	88
All Other Trunklines	597	64	155,729,000	12
Total Municipal .	926	100	$1,280,817,000	100

Improvement costs on principal urban trunkline routes cover 161 miles of expressway construction, 16 miles of surface arterials on new location and 152 miles of surfacing and widening or reconstruction of base and surface to correct structural deficiencies and overcome minor capacity deficiencies.

Improvements needed on the remainder of the Trunkline System in municipalities consist mainly of base and surface reconstruction or widenings on existing streets. Only 28 miles of new construction is needed.

Effect of Proposed Toll Roads on Trunklines

The cost estimates for improvements of the Trunkline System provide for construction of expressways from Detroit to Bay City and Detroit to the Indiana line near New Buffalo as free facilities. Those expressways generally parallel toll road locations under study by the Michigan Turnpike Authority.

At the time of this study it was not certain whether the proposed Flat Rock - Saginaw toll road would be built and a precise location had not been determined. While a preliminary engineering study has been made of the practical-

ity of the Detroit - Chicago route the Authority has not announced the results.

Should the Authority proceed with construction of either or both of those toll roads further study should be made to determine the effect on needs and programs presented in this chapter.

AVERAGE COSTS

Cost per mile for expressway improvements averages $449,200 in rural areas. This includes structures and provision for full control of access. The cost per mile ranges from approximately $300,000 per mile in sparsely populated northern areas of the state to over $1,000,000 per mile in heavily developed rural areas adjacent to Detroit.

Urban expressway costs average $6,560,000 per mile. Of this amount about 30 percent is for right of way. The urban expressway cost per mile ranges from approximately $525,000 for an Interstate System route in the outlying area of St. Ignace to over $12 million on portions of several routes in Detroit. Despite this high average cost per mile, expressway construction is economically warranted. Per vehicle mile of travel, the cost is less than for construction of the average rural county primary road.

The average cost of rural trunkline improvements, exclusive of expressways, is $152,400 per mile. By number of lanes, the average cost per mile, including right of way but excluding structures, are as follows:

2-lane	$ 70,400
4-lane divided	248,400
6-lane divided	362,800

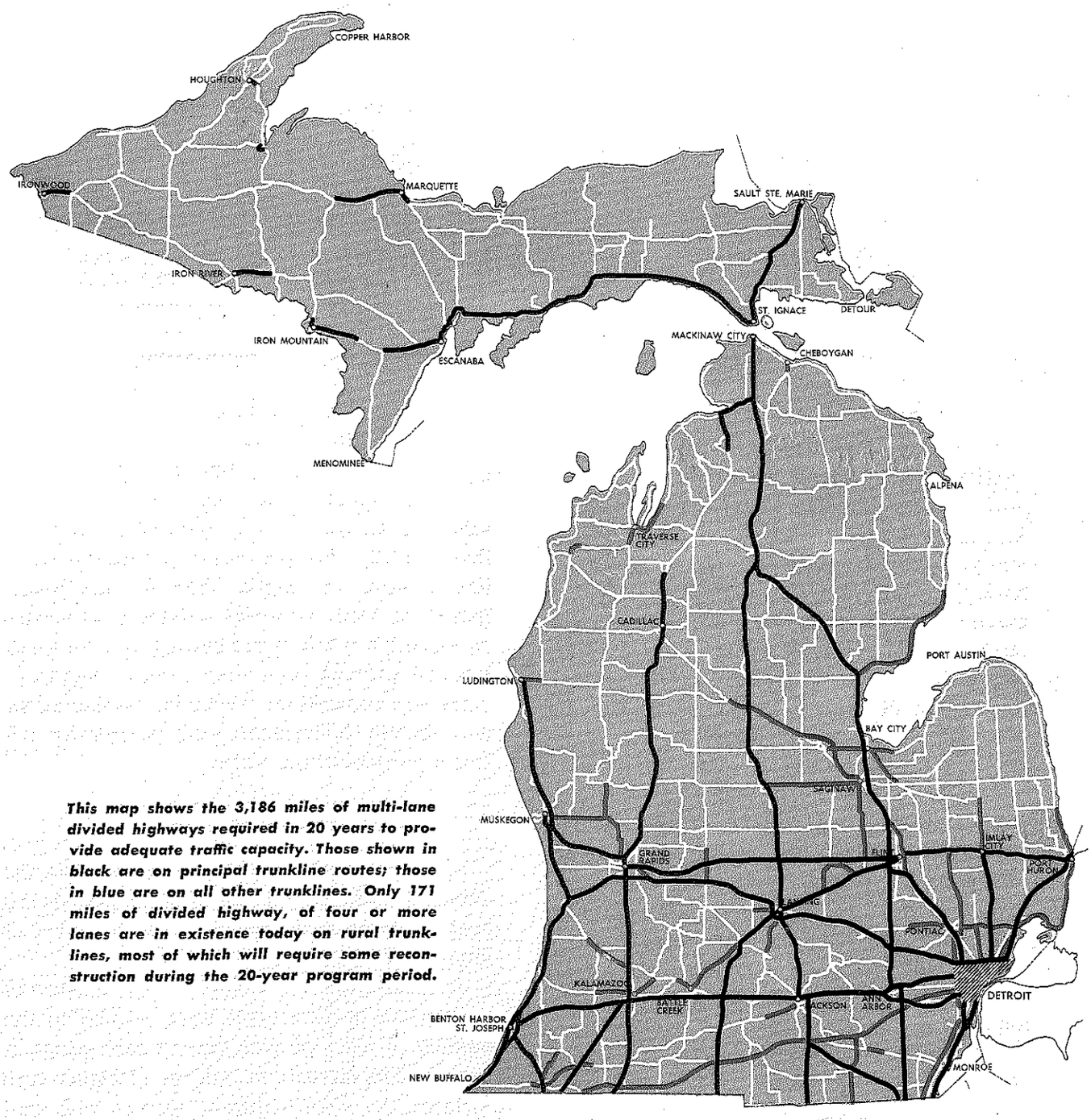
The average cost per mile for municipal trunkline improvements, excluding expressways, is $158,500. The average cost in cities under 5,000 population is $112,700, in cities from 5,000 to 50,000 population is $156,500 and in cities over 50,000 population is $352,800.

CONSTRUCTION NEEDS

STATE TRUNKLINES

	Rural	Urban	Total
5-year period			
Right of Way	$ 229,126,000	$ 196,339,000	$ 425,465,000
Roadway	699,685,000	330,528,000	1,030,213,000
Structures	186,134,000	232,271,000	418,405,000
Total	$1,114,945,000	$ 759,138,000	$1,874,083,000
10-year period			
Right of Way	$ 251,525,000	$ 281,655,000	$ 533,180,000
Roadway	810,684,000	482,418,000	1,293,102,000
Structures	192,425,000	328,339,000	520,764,000
Total	$1,254,634,000	$1,092,412,000	$2,347,046,000
15-year period			
Right of Way	$ 269,655,000	$ 337,610,000	$ 607,265,000
Roadway	945,480,000	550,037,000	1,495,517,000
Structures	199,894,000	378,353,000	578,247,000
Total	$1,415,029,000	$1,266,000,000	$2,681,029,000
20-year period			
Right of Way	$ 271,897,000	$ 337,640,000	$ 609,537,000
Roadway	1,050,255,000	564,374,000	1,614,629,000
Structures	204,214,000	378,803,000	583,017,000
Total	$1,526,366,000	$1,280,817,000	$2,807,183,000

NEEDED RURAL MULTI-LANE DIVIDED HIGHWAYS



This map shows the 3,186 miles of multi-lane divided highways required in 20 years to provide adequate traffic capacity. Those shown in black are on principal trunkline routes; those in blue are on all other trunklines. Only 171 miles of divided highway, of four or more lanes are in existence today on rural trunklines, most of which will require some reconstruction during the 20-year program period.

10-YEAR PROGRAM

STATE TRUNKLINES

(Based on catching up in 10 years and meeting needs as they occur)

	Average Annual Costs	
CONSTRUCTION	10-year period	Second 10 years of a 20-year period
Rural		
Principal Routes	$ 74,486,000	$ 9,263,000
All Other Trunklines	50,977,000	17,910,000
Total Rural	$125,463,000	$27,173,000
Municipal		
Principal Routes	$95,994,000	$16,515,000
All Other Trunklines	13,247,000	2,326,000
Total Municipal	$109,241,000	$18,841,000
TOTAL CONSTRUCTION	$234,704,000	$46,014,000
MAINTENANCE AND ADMINISTRATION	38,266,000	27,819,000
TOTAL ANNUAL PROGRAM COST	$272,970,000	$73,833,000

ANNUAL PROGRAM COSTS

Average annual program amounts, to meet existing and accruing improvement costs and provide for maintenance and operation of the Trunkline System, are presented in the tables on this and the next page for various periods of time. The table on this page shows average annual costs to meet the needs of the first 10-year period and to meet the lesser needs during the second 10 years of the 20-year study period. In the first 10-year program accumulated needs and needs arising during that period are met. In the second 10 years annual costs would be greatly reduced because construction would be needed only for new requirements and replacements. Amounts are shown separately, rural and urban, for the selected system of principal routes and for all other trunkline routes.

The table on the next page shows average annual costs spread over a 15-year period and for a 20-year period. If the 10-year program is not found feasible either on a pay-as-you-go or credit financing basis then costs will have to be spread over a longer term. If either the 15 or 20-year programs are adopted, work needed in the first 10 years would have to be deferred although total needs would finally be met in the program period.

The two tables provide several alternatives for consideraton. Selection of the proper program period, or possibly different periods for the various elements of the total system, must be related to the recommendations of the separate finance study. For the shorter program periods, annual costs are higher than for the longer periods studied. However, deferment of needed construction would mean putting up with losses suffered through poor road service, accidents, delay and congestion. Financial considerations may dictate different program periods for different portions of the system.

Maintenance

Allowance for maintenance included in the annual costs for the various program periods has been based on experience and the character of improvements proposed.

Average costs per mile for maintenance of the various surface types were applied to the number of miles of each type in each program period. The increase in mileage of higher type surfaces, the wider widths of right of way, road bed and surfaces resulting from construction of scheduled improvements, will increase future total maintenance expenditures. However, replacement of older pavements which are in poor

15 AND 20-YEAR PROGRAMS

STATE TRUNKLINES

(Based on catching up in 15 or 20 years)

	Average Annual Costs	
CONSTRUCTION	15-year period	20-year period
Rural		
Principal Routes	$ 52,751,000	$ 41,874,000
All Other Trunklines	41,584,000	34,444,000
Total Rural	$ 94,335,000	$ 76,318,000
Municipal		
Principal Routes	$ 74,567,000	$ 56,254,000
All Other Trunklines	9,834,000	7,786,000
Total Municipal	$ 84,401,000	$ 64,040,000
TOTAL CONSTRUCTION	$178,736,000	$140,358,000
MAINTENANCE AND ADMINISTRATION	35,264,000	33,123,000
TOTAL ANNUAL PROGRAM COST	$214,000,000	$173,481,000

structural condition together with retirement of all existing gravel surfaces will partly offset the increases resulting from the proposed new construction. It is estimated the net effect of these factors will increase present maintenance costs on the Trunkline System by about 20 percent, on the average, over the 20-year period.

Administration

Direct costs of surveys, plans and construction engineering were included as a part of the computed improvement costs. Administrative and overhead expenses for general management, personnel, research, traffic and planning, legal services, stores and buildings and the like, have been computed separately in the program calculations as administration and operation expense. The estimated amount was computed as six percent of the total estimated cost of construction and maintenance in each program period. While this percentage is somewhat less than the current percent of total state trunkline expenditures for general administration it is considered reasonable for the increased outlays.

PROGRAM ANALYSIS

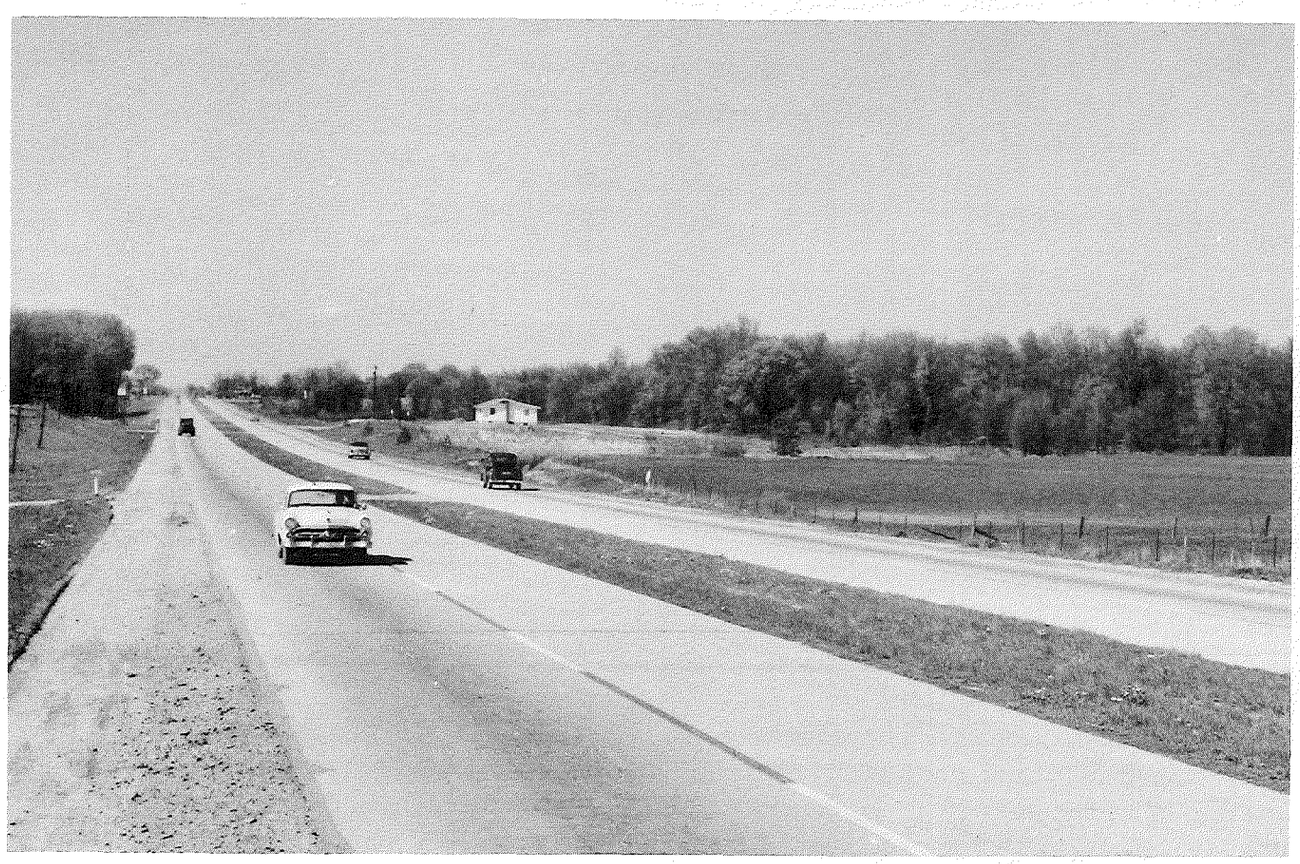
Each of the alternative programs shown in the tables represent a considerable increase in current state trunkline expenditures. To overcome the backlog of present needs and provide for needs accruing in the next 10 years will require an average annual 10-year expenditure of about two and one-half times estimated 1956 revenues, assuming no increase in Federal aid or motor vehicle revenues. Should the Federal-aid program be greatly expanded as proposed it would affect this relationship materially; motor vehicle revenues should increase somewhat in proporton to the estimated travel increase—40 percent by 1965.

These relationships call for serious consideration of various program alternatives, financing plans, priorities of work and efficient management, particularly in the fields of advance programming and right of way acquisition.

Comparison of the various annual trunkline program requirements with similar alternatives for county roads and city and village street systems are presented in Chapter 7.

PRIORITIES OF IMPROVEMENTS

Establishment of proper priorities of trunkline improvement is of more than usual importance in Michigan because of the large proportion of needs arising in the first five years of the 20-year study period. There will be a con-



Rural trunkline needs include 3,186 miles of divided multi-lane construction. Facilities of the kind shown here have a traffic capacity of approximately four times a modern two-lane highway.

siderable time-lag in putting a greatly accelerated highway improvement program underway: time required to secure necessary personnel, prepare plans, acquire right of way, let contracts and meet special problems. This time-lag during the early years of the program makes the question of choosing projects with regard to urgency and benefit of paramount concern.

Factors influencing establishment of priorities involve: (1) the relative importance of routes of the system and their rural and urban portions and (2) the relative importance of individual projects and the order in which their construction should be undertaken.

The first category is one for consideration by the Highway Study Committee and the legislature. The second is the responsibility of the State Highway Commissioner. Selection of specific projects for annual construction programs involves variables which cannot be expressed realistically through legislation.

The provision of Act 51 of 1951 requiring not less than 40 percent of the funds available to the State Highway Department to be used on trunklines within the limits of municipalities is an example of priority control by legislation. The provision of Act 87 of 1955, restricting the use of the state's share of the highway construction fund to designated routes, is another example.

Rural-urban program requirements shown in the program tables point up the need for greater emphasis on trunkline construction within municipalities. The improvement cost relationship of the selected system of principal routes to all other trunkline requirements shows the desirability of expanding the routes designated in Act 87 to include all the principal trunkline routes shown in the map on page 26.

Basic Elements for Project Priorities

It was not the purpose of this study to establish individual project priorities as a basis for annual programs and no attempt has been made

Increased efficiency results from proper signing and marking of routes. Overhead signs which can be seen from a distance, are particularly effective for travelers unfamiliar with an area.

to do so. The section-by-section appraisal procedure used, however, includes several broad priority indices which can and should be used by the Highway Department for program development. The individual work sheets provide basic priority values for selection, by the department, of projects for inclusion in annual programs.

First, the study procedure separated improvement projects, both rural and urban, by time periods based on relative urgency of need. First priority should be given to projects scheduled in the one to five-year period as they represent the more critical needs.

Second, it was recognized early in the study that the needs of the first five-year period would constitute a high proportion of the total 20-year needs. Also recognized was that the size of this group of projects would be larger than could be feasibly undertaken within a five-year period.

Third, the importance of the selected system of principal trunkline routes has been stressed. Regardless of whether there may be further legislative action, system classification as established for this study provides a primary basis for segregation of the first five-year needs into distinct priority groups.

Fourth, all first period rural trunkline improvement projects were rated individually during the appraisal on the following priority indices:

Structural condition
Traffic capacity
Minimum geometrics
Improvement cost per vehicle mile of travel.

The structural condition rating reflects the ability of a road to carry traffic loads imposed upon it. The capacity rating reflects the ability to carry traffic at reasonable speeds without undue congestion. The minimum geometrics rating provides a measure of the relative safety of each road. The improvement cost per vehicle mile of travel rating measures user benefits since

RURAL STATE TRUNKLINES
TOP PRIORITY SECTIONS

Based on a special analysis of structural condition, traffic capacity, minimum geometrics and improvement cost per vehicle mile of travel, the trunkline sections shown on this map warrant early improvement. It must be recognized, however, that other factors such as availability of right of way and construction plans are valid reasons for advancing other projects to construction during early years of an accelerated program. The sections shown in black are on principal trunkline routes, the sections shown in blue on the second and third groupings of trunklines described on page 24.

the less expensive projects (per vehicle mile of travel and not necessarily per mile of construction) will provide increased traffic service for the same total construction cost.

Based on an analysis of these ratings in various combinations, the engineering staff has selected a list of top priority projects from the proposed first-period improvements. The location of this top priority work is shown on the accompanying map.

Top priority projects account for about $684 million in improvement costs, about half of the work on rural trunklines proposed in the 10-year improvement program. About 78 percent of that cost is for projects on the selected system of principal routes, nine percent on other major trunklines and 13 percent on all other trunkline routes.

A similar rating system was not used for urban trunkline projects because of the large number of municipalities involved. To the extent possible, first period urban improvements connecting with top priority rural projects should be given early consideration. The trunklines included in the expressway plan for the Detroit area, discussed in Chapter 4, should be developed on the basis of route priorities in order to minimize disruptions to traffic.

PROGRAM PLANNING

To permit scheduling of surveys, plan preparation and right of way acquisition well in advance of construction, an important operation that should be given further emphasis within the State Highway Department is program planning. Construction programs should be developed at least five years in advance and reviewed annually to keep a program for that period constantly ahead and to make adjustments required because of right of way problems, emergencies, relationships with other agencies, etc.

Such advance planning permits full co-ordination of all functions, saves time and money and avoids confusion. Each division of the department knows what its job is for a long period ahead and can schedule its workload efficiently and to best advantage. Engineering personnel requirements can be predetermined and most effectively assigned. The process of long range program planning serves also as a continual means of evaluating progress in relation to needs.

Many improvements in programming techniques have been developed in recent years, and others are bound to occur. In the development of advance construction programs, full use should be made of all basic traffic, inventory and related data which will give logical priority to the scheduling of projects. The project work sheets of this engineering study are the basis for initial establishment of a program procedure should the department elect to utilize them.

RIGHT OF WAY ACQUISITION

Right of way costs for trunkline construction needed during the 20-year study period total $610 million. This is about 22 percent of the total cost. Of the total, $338 million is in municipalities.

In view of the size of the right of way problem the legislature should give consideration to the creation of a revolving advance right of way acquisition fund. This fund would be for use in purchase of right of way on established locations well in advance of construction. Such a procedure insures protection from costly housing or building projects and reserves the land necessary for future highway development. The fund would be replaced from the Highway Department's regular revenues at the time of construction, thus remaining continually available for its purpose.

California has established an advance right of way acquisition fund of $30 million which in four years, with an outlay of $19 million, has brought an estimated saving of $100 million. The savings have come through purchase of land before addition of buildings.

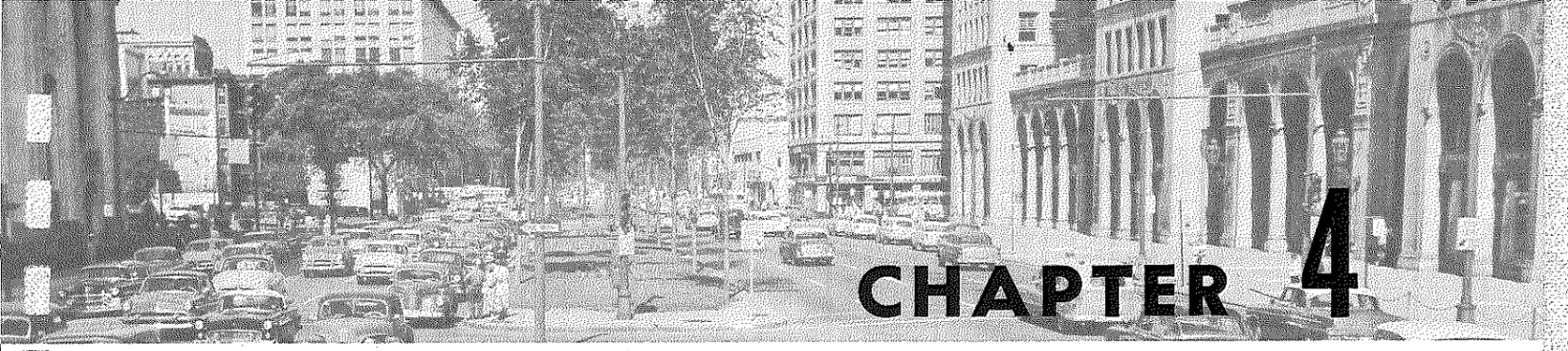
CONCLUSIONS

The alternative programs for development of the Trunkline System presented in this chapter afford a sound base for the adoption of a fiscal plan geared to current and future needs. The

best planning and the most able engineering cannot meet needs if the fiscal plan is not adequate. In the interest of the state's economy the more important elements of the system should be brought to standard as quickly as the finance plan permits.

The vast amount of data assembled and analyzed in this study should be utilized for the establishment of advance construction programs. Provision should be made for continuous re-appraisal of needs in order to meet changing conditions, provide measurement of the progress being made in overcoming the large backlog of deficiencies, and to insure that the greatest benefits possible from expenditure of highway revenues are being achieved.

Expressway construction, such as this portion of the Lodge Expressway in Detroit, offers the most practical means of relieving congestion on some heavily traveled urban trunklines. Experience shows expressways move well over twice as many vehicles per lane as arterial surface streets, with three times the average speed and safety.



CHAPTER 4

MUNICIPAL STREETS

The entire street network of each municipality serves motor vehicle transportation without regard to jurisdictional responsibility and, to be fully effective, all new street facilities must be developed on an integrated basis. Therefore, costs of construction required to meet present and future needs on all classes of municipal streets are summarized in this chapter.

Annual program requirements for construction, maintenance and operation are presented also for the 13,902 miles under exclusive jurisdiction of the municipalities. Annual costs for urban state trunklines and county primary routes within municipalities are shown in Chapters 3 and 5 respectively.

Municipal streets represent about 14 percent of the total road and street mileage in the state. Estimated construction cost of all needed street improvements in the next 20 years is $2.5 billion, or 44 percent of total road and street needs. By present legal systems, construction requirements are:

TOTAL MUNICIPAL STREET NEEDS

20-year period

System	Cost
State Trunklines	$1,280,817,000
Major Streets	675,000,000
County Primary Roads	117,638,000
Local Streets	432,240,000
Total	$2,505,695,000

PHYSICAL NEEDS

In the post-war era all highway agencies have lost ground in the battle to keep up with the ever increasing traffic produced by growing populations and more intensive motor vehicle use. This has been particularly true in cities because of the concentration of population and vehicles. Economic losses from traffic delays, accidents, extra gasoline consumption and other excessive motor vehicle operating costs continue to increase.

Relief for both present and future traffic can only be accomplished through provision of additional capacity. In smaller cities this means widening of main arterials and, in some cases, rural bypasses to remove through traffic from the city.

In large cities, particularly in Detroit, widenings to provide additional traffic lanes can provide necessary capacity in some instances. For the most part however, solution to capacity needs lies in bold planning and provision of new facilities both of surface arterial and expressway type.

In the appraisal of arterial municipal streets (state trunklines, county primary and major streets) each street was considered first on its adequacy to serve estimated 1975 traffic requirements and second on its structural condition or load carrying ability. Mileages of improvements found necessary as a result of the appraisal are shown in the table at the bottom of page 44, by system and type of work.

The bulk of capacity deficiencies requiring major new construction occur on urban trunklines since in all cities, large or small, trunklines constitute the major arteries of travel. New construction needs on major street systems, other than trunklines, fall into two classes: principal feeders to the trunkline routes and arterials needed for developing residential, business and industrial areas.

Projects involving reconstruction or widening and resurfacing are on present streets. In many cases those projects are for correction of both structural and capacity deficiencies.

IMPROVEMENT COSTS

While the State Highway Department is responsible for construction and maintenance of trunklines within municipalities the legislature has provided that cities and villages shall share in construction costs. Requirements for municipal participation are on a sliding scale ranging from 50 percent of the state's share of the total construction cost in cities over 50,000 population downward to 20 percent for municipalities in the 20,000 to 25,000 population group. Municipalities of less than 20,000 population contribute up to 15 percent only on bridge and grade separation projects.

A distribution of urban trunkline costs by population groups is shown in the following tables:

Population Group	Percent of Municipal Participation in Total Cost	Total Urban Trunkline Costs
Over 50,000	50	$ 996,953,000
45,000-50,000	45	35,642,000
35,000-40,000	35	21,415,000
25,000-30,000	25	8,182,000
20,000-25,000	20	13,819,000
15,000-20,000	0	31,681,000
10,000-15,000	0	46,627,000
5,000-10,000	0	47,150,000
Under 5,000	0	79,348,000
		$1,280,817,000

Population Group	Percent of Municipal Participation in Structure Costs Only	Urban Trunkline Structure Costs
15,000-20,000	15	$ 9,392,000
10,000-15,000	10	13,125,000
5,000-10,000	5	10,375,000
Under 5,000	0	18,878,000

There are no trunklines in the one city of the state in the 40,000-45,000 population group and there are no cities with populations between 30,000 and 35,000.

An indication of the possible extent of muncipal participation in urban trunkline construction, under existing legislation, can be determined from those tables. It should be recognized, however, that Federal aid will defray some part of the total costs and that city participation, in accordance with Act 29, Public Acts of 1955, is calculated as a percentage of the state's share of the cost excluding Federal aid. Also needs are not evenly distributed among cities within each population group nor will annual requirements be one-twentieth of the total 20-year cost in each city.

Major Street Costs

Cost of needed major street improvements over the 20-year period by type of work are:

Type of work	Miles	Cost
Expressways	22	$180,749,000
New Surface Arterials	87	25,251,000
Reconstruction	807	195,065,000
Resurfacing and Widening	2,313	152,288,000
Structures (303)		121,647,000
Total	3,229	$675,000,000

The total cost of major street improvements in the first 10 years is $502 million or 75 percent of the 20-year needs. This provides for overcoming all existing deficiencies together with those accruing during that 10-year period. Construction requirements for the second 10 years are for correction of structural and capacity deficiencies which will develop within that period plus future resurfacing of some improvements constructed in early years of the program.

NEEDED MUNICIPAL ARTERIAL STREET IMPROVEMENTS

Type of work	State Trunkline (Miles)	Major Streets (Miles)	County Primary Roads (Miles)	Total (Miles)
Expressways	161	22	4	187
New Surface Arterials	44	87	20	151
Reconstruction	130	807	132	1,069
Resurfacing and Widening	591	2,313	161	3,065
Total	926	3,229	317	4,472

Municipal County Primary Costs

By type of work, total 20-year cost of needed improvements on county primary roads in cities are as follows:

Type of work	Miles	Cost
Expressways	4	$ 14,900,000
New Surface Arterials	20	6,672,000
Reconstruction	132	53,124,000
Resurfacing and Widening	161	25,074,000
Structures (34)		17,868,000
Total	317	$117,638,000

First 10-year period costs total $90 million or 76 percent of the 20-year needs. As in the case of major streets this represents costs to overcome the backlog of deficiencies and meet all needs occuring in 10 years.

By agreement, municipalities participate in varying degrees in construction improvements on urban extensions of county primary roads.

AVERAGE COSTS

Cost of expressways on major streets and urban extensions of county primary roads average $8,190,000 and $3,470,000 per mile respectively. Most of the 22 miles of major street expressways are eight-lane facilities within Detroit and Hamtramck which accounts for the higher cost. The proposed four miles of county primary expressways are four-lane facilities.

The average cost per mile for major street improvements, excluding expressways and structures, is $116,200. The average cost in cities under 5,000 population is $56,100; in cities from 5,000 to 50,000 population, $88,500; and in cities over 50,000 population, $170,500.

The average cost per mile of urban extensions of county primary roads, excluding expressways and structures is $271,000. Most of this work is in the Detroit Metropolitan Area.

Average costs of municipal trunkline improvements are discussed in Chapter 3.

LOCAL STREETS

Total capital investment estimated to bring local streets up to standards in the 20-year period is $432 million or $21,612,000 annually.

Distribution of the total cost, by type of work, is as follows:

Type of Work	Cost
Gravel	$ 5,020,000
Bituminous Surface Treated	59,640,000
Intermediate Type	209,880,000
High Type	144,420,000
Structures	13,280,000
Total	$432,240,000

Those costs provide for development of 69 percent of the total local street system mileage to curbed streets with intermediate or high type surfaces; 28 percent to bituminous treated surfaces and four percent to gravel surfaces adequate for year round travel. The mileage of gravel surfaces is in outlying areas of small municipalities.

EXAMPLES OF ARTERIAL PROBLEMS

Needs of individual municipalities vary widely, both as to type of work and urgency. In the 10 cities of over 50,000 population where traffic problems are more complicated and needs are greatest, findings of the engineering appraisal have been analyzed and presented separately. In municipalities of less than 50,000 population the findings have been summarized by population groups. However, work sheets are available showing project by project arterial street needs for each of the 83 municipalities from 5,000 to 50,000 population.

In places of less than 5,000 population, work sheets are available for all trunkline and county primary projects and for major street projects in the 143 municipalities included in the sample of cities and villages selected for study by the engineering staff. The sample represented about 40 percent of all municipalities of less than 5,000 population.

To illustrate the nature of city arterial street problems in the larger cities the maps on pages 46 and 47 show the location and kind of major improvements found needed in the appraisal for Bay City, Flint, Jackson and Lansing. Projects calling for resurfacing or minor widenings are not shown. Similar maps are available for Dearborn, Grand Rapids, Kalamzoo, Pontiac and Saginaw. Problems in those cities are similar to those used for illustration.

EXAMPLES OF PRINCIPAL IMPROVEMENTS

BAY CITY

The arterial plan proposed for Bay City includes two major trunkline relocations, M 20 from the west and a new U.S. 23 business route from the south. Both connect with the Interstate System route bypassing the city on the south and west. Present locations of M 15 and M 25 are to be retained but improvements are proposed to provide four travel lanes on both routes.

Among the more important major street improvements needed is the development of a north-south arterial along Johnston and Belinda, including a new bridge over the Saginaw River and reconstruction of Saginaw, Water and Harrison from Cass to Center along the east side of the river.

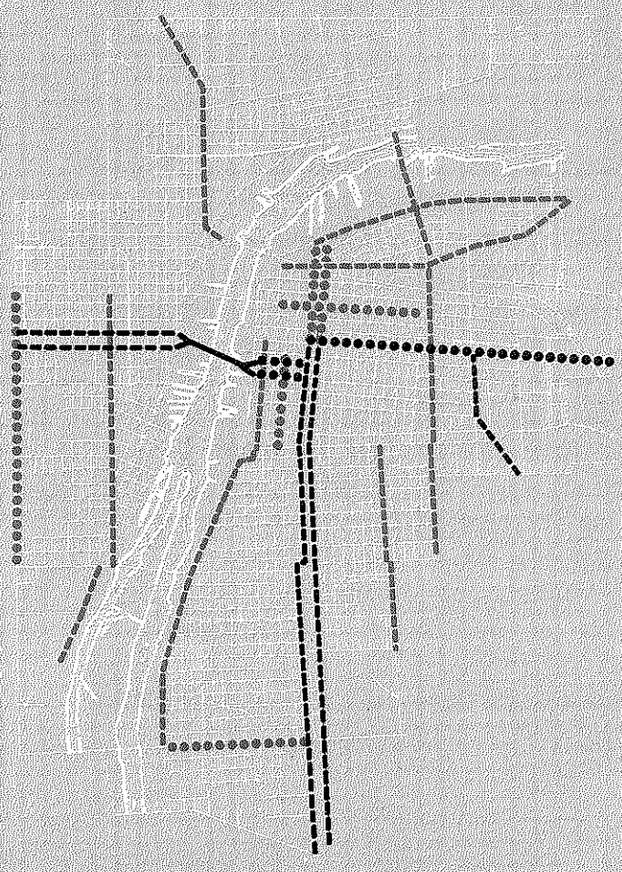
Under the study plan the present locations of M 20 and U.S. 23 revert to the major street system. Costs for needed improvements, including redecking the Third Street bridge and reconstruction of Euclid Avenue from Midland to Salzburg have been allocated to the major street system.

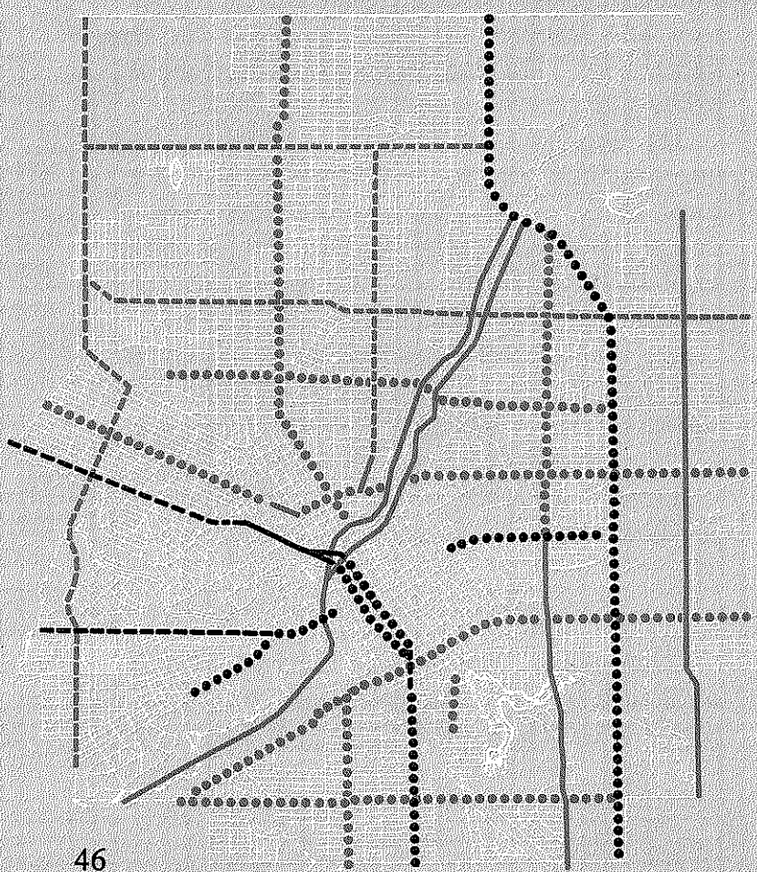
FLINT

Major needs in Flint consist of overcoming capacity deficiencies and provision of adequate east-west arterials in the northern part of the city, particularly in the industrial areas.

A new trunkline facility is proposed in the southwest quadrant of the city as a business route connection with Interstate System location of U.S. 10 bypassing on the south and west. This proposed new facility utilizes Deming Road from south city limits to 12th Street, Church and Traverse Streets as a one way pair on the west side of the business district, cuts diagonally on new location from Water Street to 6th Avenue and continues on Flushing Road to the west corporate limits.

Another major improvement proposed in the study plan is the development of boulevard drives along both sides of the Flint River from the Dort Highway south westerly through the business area and continuing along the line of Swartz Creek to the south city limits. This facility provides a much needed cross-town connection.





PROPOSED IN MUNICIPALITIES

JACKSON

Most through traffic movements will be eliminated in Jackson by the proposed relocation of U.S. 127 as an eastern bypass of the city. The Interstate System route U.S. 12, is already partially constructed as a northern bypass.

Principal needs are the development of adequate east-west arterials on High, Morrill and Bridge, Ganson, North and Monroe Streets.

It is proposed to eliminate the dog-leg intersection of Cooper, Michigan Avenue and Francis by opening up a new street north of Michigan Avenue along the line of Francis Street extended to Cooper and Detroit Streets. This street opening will permit utilizing Francis and Milwaukee Streets as a one-way pair to relieve traffic congestion in the business district.

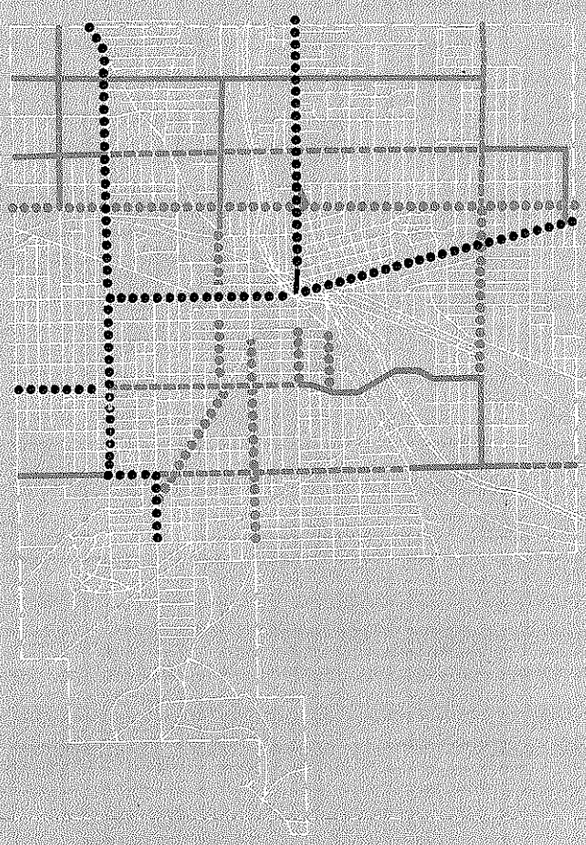
	STATE TRUNKLINES	MAJOR STREETS
WIDENING AND RESURFACING		
RECONSTRUCTION		
NEW CONSTRUCTION		

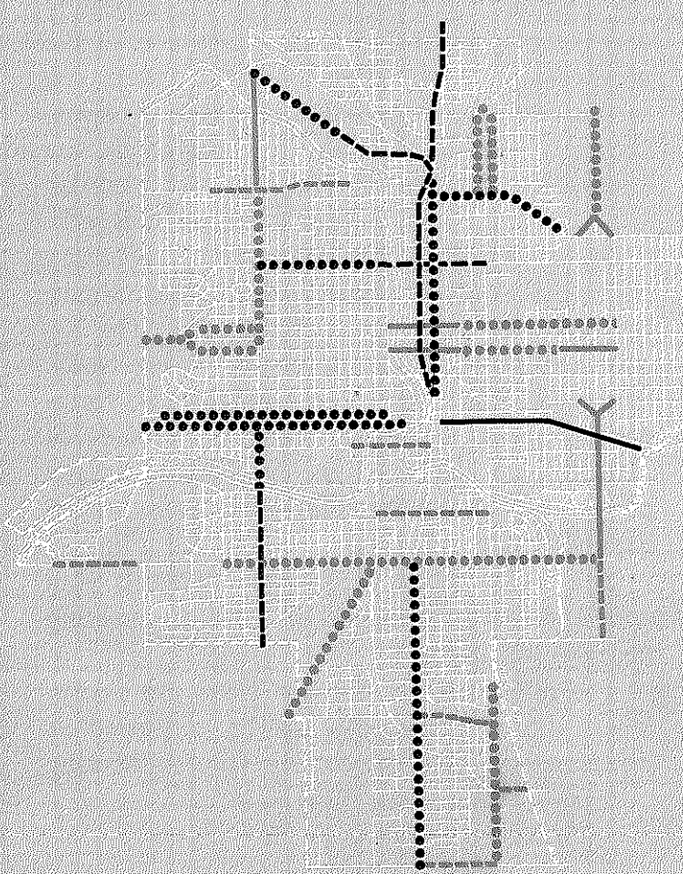
LANSING

The more important trunkline improvements proposed in Lansing are the development of St. Joseph and Main, and Cedar and Larch as one-way pairs to provide adequate capacity for traffic using U.S. 27. A new trunkline on East Main from Larch to Red Cedar River serves as a business route connection with the Interstate System location of U.S. 16 bypassing the city on the south and west.

To relieve East Michigan Avenue, development of Jerome and Eureka as a one-way pair is proposed as a part of the major street system connecting with the existing one-way operation on Ottawa and Allegan at Grand Avenue. This proposal involves two new river bridges as well as separations with the Chesapeake and Ohio Railroad.

Another major project is the extension of Logan Street north of Willow to a connection with North Grand River. This will provide a continuous north-south cross-town arterial. It also involves construction of a new river bridge.





DETROIT METROPOLITAN AREA

The greatest concentration of street needs is in the Detroit Metropolitan Area, one of the most highly industrialized in the world. It is almost entirely dependent on motor vehicle transportation for intra-area movements of workers and trucking to serve plant needs.

Traffic problems have been acute for many years and are steadily growing worse despite efforts of state, county and city highway authorities who have made outstanding progress in evolving plans and procedures to keep traffic moving.

Expressway Planning

A series of well developed long-range arterial street plans including expressways have been proposed for Detroit over a period of years. The need for an expressway network as a solution to congestion problems was recognized as early as the late '20's. Subsequent plans incorporated expansions to the original network, the last being the 1951 Detroit Master Plan.

To more precisely define the extent and location of the total expressway network needed, the Detroit Metropolitan Area Traffic Study was initiated in 1953. This study, one of the most comprehensive of its kind ever undertaken in this country, was conducted under the sponsorship of the State Highway Department, the City of Detroit, Wayne, Oakland and Macomb Counties and the U. S. Bureau of Public Roads.

In the Detroit area appraisal this engineering staff was fortunate to have available preliminary information from that traffic study. The expressway network plan developed by the traffic study staff and to be recommended in its forthcoming report, generally supports the City of Detroit plan approved in 1951 and previous proposals. Some modifications and further expansion are indicated.

The traffic study expressway network plan was adopted in principal for this engineering appraisal of needs.

The differences in the two plans are minor. These differences should not be construed as representing disagreement by the engineering staff with the basic findings of the traffic study. They stem from several reasons. The traffic study plan is based on traffic growth to 1980 whereas the cutoff date for the engineering study is 1975. In the engineering study some changes in location were found necessary in order to provide integration with planned developments in rural areas beyond the limits of the traffic study. Other modifications in design are based on engineering considerations but are intended to serve the same traffic desire of the traffic study plan. All revisions were worked out in cooperation with state, county and city engineers.

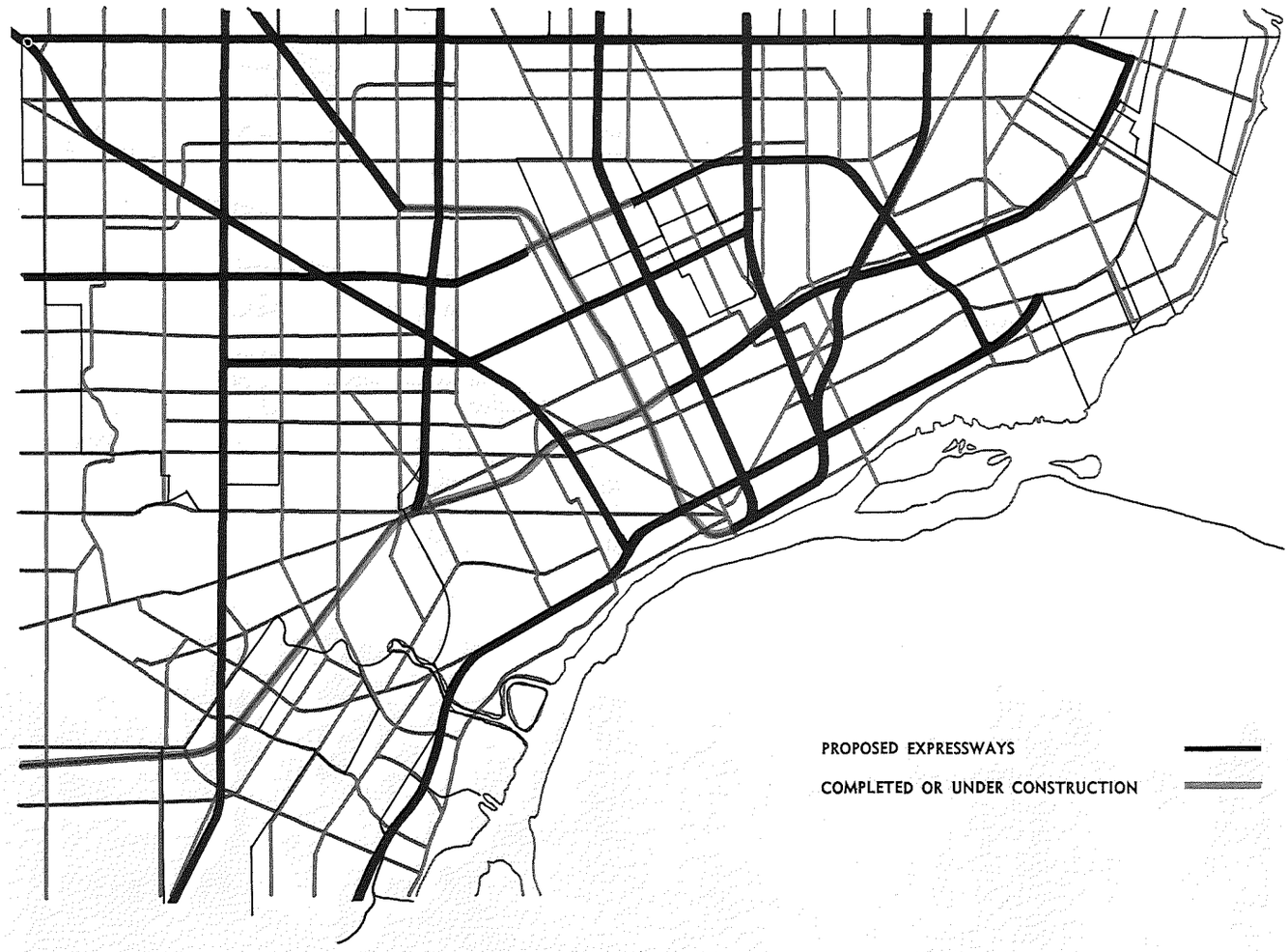
Study Plan

The expressway network used as a basis for this study, is shown in the map on page 49. It provides for expressways to carry the traffic of the five Interstate routes now serving Detroit, a circumferential distributor in the approximate location of Southfield Road and Eight Mile Road and an inner distributor belt along Livernois, Davison, and Conner. In addition connecting routes to serve heavy traffic movements have been included. Within Detroit, Harper Woods, Highland Park, and Hamtramck a total of 142 miles of expressways constitute the network. Of this, nine miles on the Davison, Ford and Lodge Expressways are complete and open to traffic.

Administrative jurisdiction for the various expressway routes has not been decided officially. However a major part of the network replaces existing trunklines. Other routes serve as important connectors and distributors. In this study, 128 miles of the network has been tentatively classified as trunklines and costs assigned to State Trunkline System needs. Costs for the remaining 14 miles are included as major street needs.

Portions of the Edsel Ford, John Lodge and Davison Expressways are in operation. Those facilities designed for 90,000 vehicles per day are now carrying as high as 118,000 vehicles per day on some sections. Analysis of estimated 1975 traffic volumes reveals that the majority

DETROIT METROPOLITAN AREA EXPRESSWAY PLAN



Construction of the expressway facilities shown on this map offers the most practical means of providing the additional capacity required to relieve the heavy traffic congestion in the Detroit area.

of the proposed new expressway routes will require six-lane initial construction. About 41 percent of the mileage should be constructed to eight lanes initially. When the estimated 1975 volumes approached 90,000 vehicles per day, the design limits for six traffic lanes, structures and right of way costs were estimated for future expansion to eight lanes.

Because of operational problems found on the Ford and Lodge expressways, improvements in design recommended by state, county and city engineers were considered in estimating costs on proposed expressways. In general, the design changes consist of a wider median between the opposing traffic streams and wider paved shoulders for disabled vehicles.

The Detroit area traffic study estimated that the expressway network would carry traffic in such volume that the arterial streets within the Grand Boulevard loop would carry only about 50 percent of existing traffic 20 years from now. From the Grand Boulevard loop to the Detroit city limits it is estimated that traffic volumes 20 years hence will be about the same as now or less. In this area the expressways diverge and more development will take place than in the core of the city.

Needs on existing surface facilities were estimated on the basis of the adjusted future traffic volumes. In the outer area of the city between the Grand Boulevard loop and the corporate limits considerable widening and reconstruction was found necessary to meet capacity problems even on the basis of the adjusted traffic forecast.

In the downtown area most widening is related to urban redevelopment projects or to the new civic center development. In several cases widening was recommended to overcome narrow sections of existing streets.

The table below summarizes the 20-year arterial street needs of the City of Detroit. These needs represent about 64 percent of all municipal arterial street improvements.

TOTAL ARTERIAL STREET NEEDS FOR DETROIT

System	Miles	Cost
State Trunklines	113	$ 914,760,000
Detroit Major Streets	659	379,291,000
Wayne County Primary Roads	80	17,791,000
Total	852	$1,329,842,000

By type of work the Detroit needs are:

Type of Work	Miles	Cost
Expressways	127	$1,076,860,000
Widening and resurfacing	592	66,758,000
Reconstruction	124	95,311,000
New surface arterials	9	11,628,000
Highway separations (7)		13,450,000
Railroad separations (43)		58,257,000
Bridges (7)		4,301,000
Intersection Improvements		3,277,000
Total	852	$1,329,842,000

Congestion and delay occur often on arterial streets in the larger municipalities. Peak traffic volume generally is reached during the homeward bound evening rush hour.

PROGRAM COSTS
MUNICIPAL STREETS

(Not including urban trunklines and county primary road extensions)

Item	Major Streets				Local Streets
	Average Annual Costs				Average annual cost for 20-year period
	10-year period	Second 10 years of 20-year period	15-year period	20-year period	
Construction	$50,201,000	$17,299,000	$40,318,000	$33,750,000	$21,612,000
Maintenance and Administration	12,223,000	11,526,000	11,960,000	11,868,000	11,493,000
Total Average Annual Program Cost	$62,424,000	$28,825,000	$52,278,000	$45,618,000	$33,105,000

The construction costs for municipalities would be increased by the amount of participation required for urban trunkline development under present or future legislation.

ANNUAL PROGRAM COSTS

Alternative annual program costs for major and local streets are shown in total in the table above. A breakdown of program costs for each system for each of the 10 cities of over 50,000 population and by population groups for smaller municipalities, is in the appendix.

The 10-year annual program cost for major streets provides for overcoming all backlog needs as well as those accruing during the first 10 years of the 20-year period. Since the needs of the first 10-year period are about 75 percent of total needs, annual construction requirements are approximately three times as great as for the second 10 years. The annual cost for the second 10 years cover only needs occurring during that time period and necessary maintenance and administration.

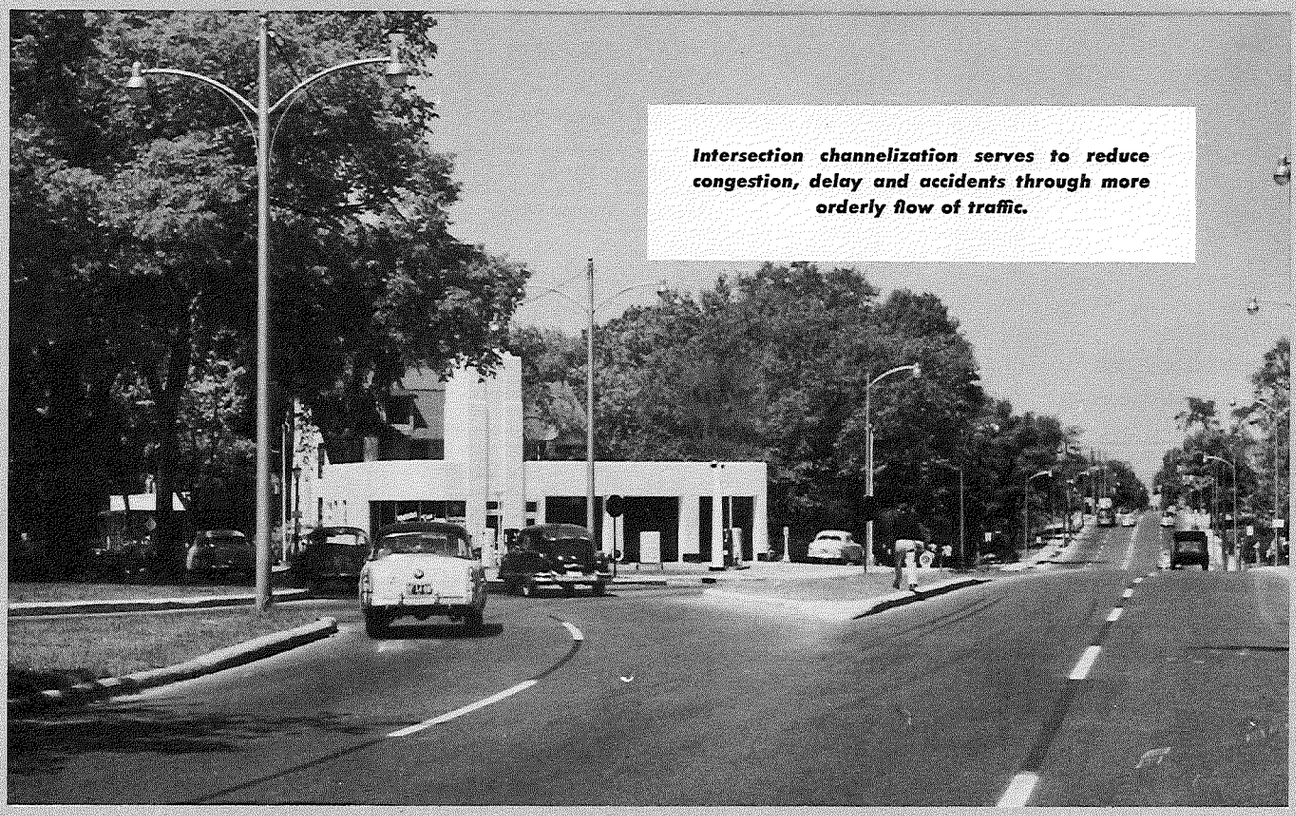
The program costs for 15 and 20-year periods are averages of all costs for the respective periods. Under either of these two programs some of the improvements needed in the first 10 years would have to be deferred until later years. While total 20-year costs are the same, annual costs are reduced by spreading the program over longer time periods. Benefits and savings to the user also would be deferred.

Maintenance

The amounts included for maintenance in the various programs have been based on an analysis of maintenance costs as reported in annual reports of municipalities to the State Highway Commissioner as required by Act 51 of 1951. Because of the increased mileages of higher type surfaces and because of widenings and new construction to relieve capacity deficiences it is estimated that major street maintenance costs will increase by about 15 percent and local street costs by about 10 percent on the average over the 20-year study period.

Administration

An allowance for administration and general overhead has been included in the program calculations. Costs for direct project engineering were included with construction requirements. The allowance for administration was computed as a percentage of construction and maintenance costs and ranged from three to five percent. The smaller allowance was used for the larger cities where overhead expenses could be spread over a larger volume of work. The percentage allowance was increased as population size decreased.



Intersection channelization serves to reduce congestion, delay and accidents through more orderly flow of traffic.

WHY URBAN EXPRESSWAYS

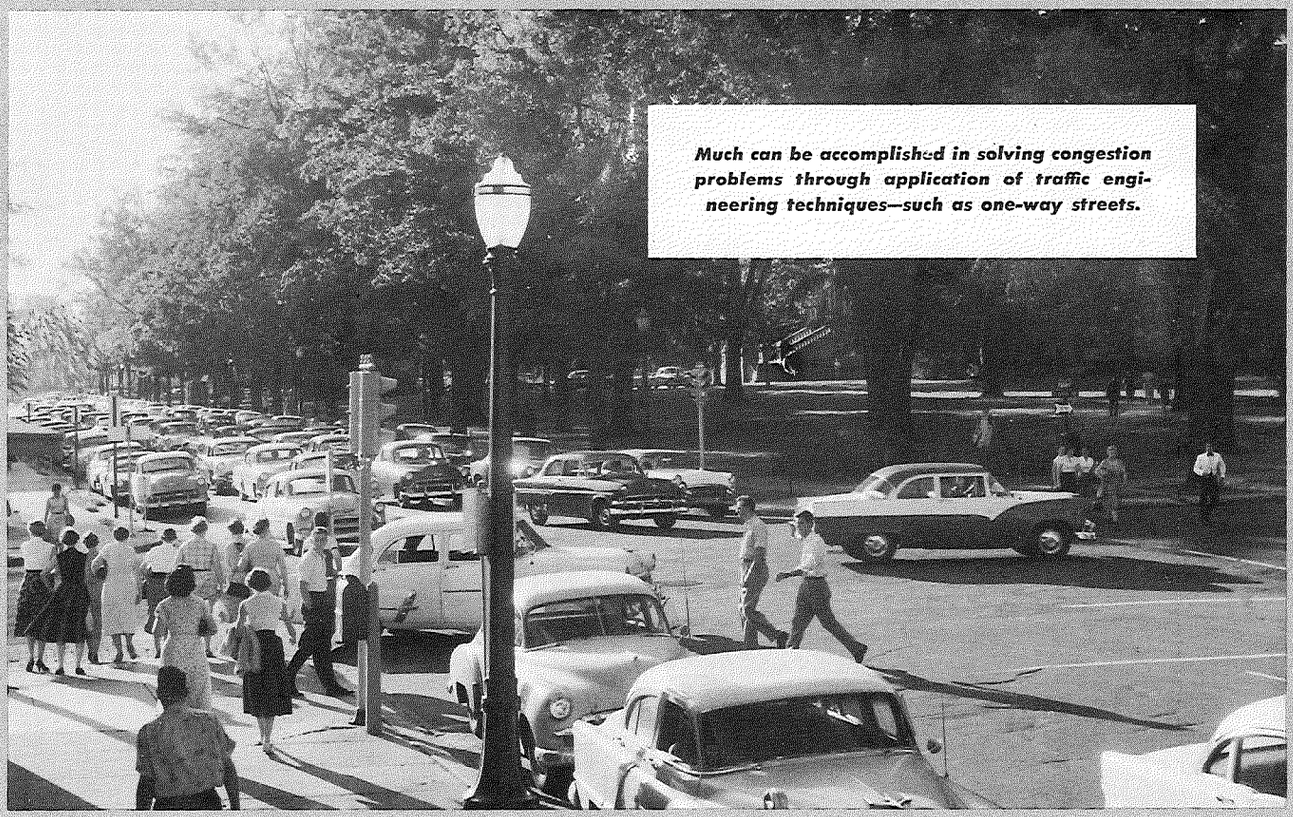
The question may arise as to why high cost expressways with control of access are proposed in some cities as a solution to capacity problems. Before answering this question it may be well to define the term expressway as used in this report. An expressway is a multi-lane arterial highway constructed in such manner that the opposing traffic flows are physically separated and on which ingress and egress is completely controlled through carefully designed ramps. This definition and usage of the term expressway conforms with Michigan practice. In other states such facilities are frequently referred to as freeways or parkways.

Reasons for constructing expressways fall into two general categories. The first, is the inability to reasonably develop existing streets to carry present or future traffic volumes without excessive delay and accidents. The second category is the desire to move large volumes of traffic at relatively high speeds. Each traffic lane on expressways can comfortably carry 1,500 vehicles per hour at nearly 50 miles per hour. By comparison, Detroit reports that lane capacity on arterial streets is between 600 and 700 vehicles per hour at much lower speeds.

Studies have been made in various cities to analyze the economic advantage of operating vehicles over expressways as compared to arterial streets. A study made in 1954 by the Automobile Club of Southern California covering expressways in the Los Angeles area gave the results shown in the table to the right.

The savings of 4.194 cents per vehicle mile were applied in the study to the estimated annual vehicle miles traveled on the 45.1 miles of completed expressways. The result was an estimated annual reduction in operating costs of $50 million. The approximate cost of the expressways was $143 million, or about 2.9 times the annual savings to the users. Many authorities question putting value on time saving except in the case of commercial vehicles. Even with this adjustment savings in operating costs are still tremendous.

In addition to savings in operating costs, expressways reduce accidents. A recent tabula-



Much can be accomplished in solving congestion problems through application of traffic engineering techniques—such as one-way streets.

tion of fatal accidents on selected expressways shows a fatality rate of 3.78 per 100 million vehicle miles in comparison with an average of 11.73 on parallel surface highways.

TEST RUNS ON EXPRESSWAYS AND SURFACE STREETS

	Via Expressways	Via Surface Streets
Distance	133.3 miles	123.8 miles
Time	165 minutes	380 minutes
Gasoline Used	6.88 gals.	8.57 gals.
Miles per gallon	19.38	14.44
Average speed	48.473 MPH	19.547 MPH
Number of signalized intersections	0	578
Average number of signals per mile	0	4.67
Number of stops made	0	298
Average number of stops per mile	0	2.41
Operation cost per mile		
(a) Gasoline	1.545 cents	2.076 cents
(b) Time at 2c per minute	2.476 cents	6.139 cents
Total cost	4.021 cents	8.215 cents

The economic justification for constructing expressways can be summarized as:

Moves well over twice as many vehicles per lane

At almost three times the speed

With three times the safety

With savings that quickly equal the cost.

While construction cost of expressways per mile is high, cost per vehicle mile of travel is generally the cheapest of all highway facilities.

OFF-STREET PARKING

A study of off-street parking requirements was not a part of this study. The arterial street appraisal assumed that curb parking should be removed during peak traffic hours as needed, thus creating additional demand for off-street parking. Provision of expressways and arterial streets to solve congestion problems cannot be fully effective unless terminal facilities also are provided. Property values in the central business district require the support of adequate off-street parking facilities.

More off-street parking facilities are needed in most of the larger municipalities. Lack of adequate off-street parking adds to congestion and traffic delays.

RELATED PROBLEMS

Since adoption of Act 51 of 1951, noticeable progress has been made in municipal street administration. Street systems have been established; many municipalities have active off-street parking programs; traffic conditions have been relieved by means of one-way streets and other traffic operation techniques. Much still remains to be accomplished however.

All cities should develop and keep current long-range master plans to control orderly and economic city growth through land use zoning for industrial, commercial, shopping, recreational, residential and multiple housing purposes. A master street development plan properly integrated with the State Trunkline System should be officially adopted to preserve needed rights of way and guide city officials in formulation of street construction programs.

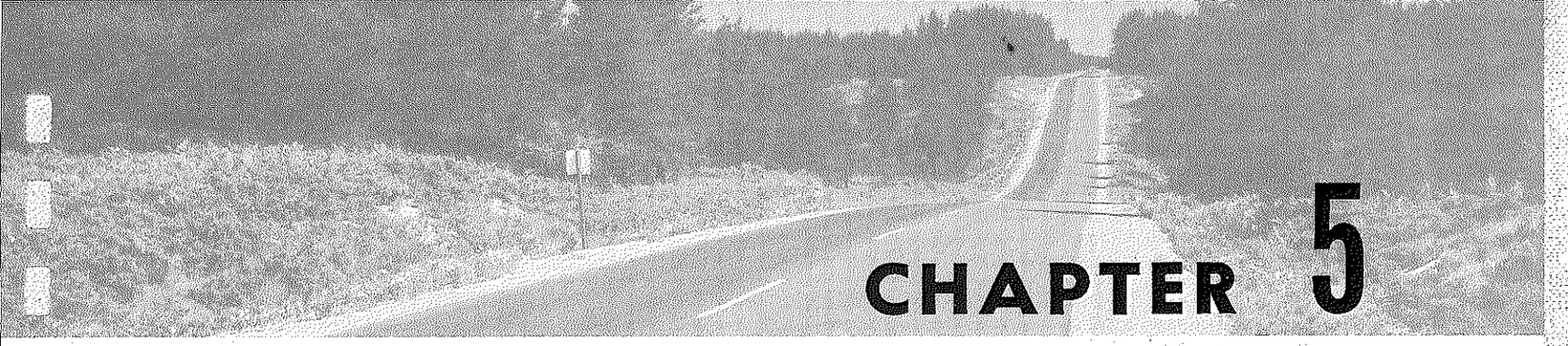
It is apparent that some Michigan cities should give greater attention to provision of off-street parking facilities.

Improvement is needed in street maintenance cost accounting, particularly by type of surface and object of expenditure.

Provision should be made for gathering of traffic volume information on a continuing basis. In many cities there is need for more intensified effort in the traffic engineering field. Much can be accomplished in solving congested intersection problems and expediting traffic flows through application of proven and established traffic operation techniques.

A street system adequate for present and future traffic is vital to the economic welfare of each city. Failure to provide for the orderly flow of vehicles to and from the central business district and other major traffic generators results in costly economic losses.

Within the limits of the finance plan adopted, cities should make every effort to overcome existing capacity deficiencies on major streets in the order of their seriousness in retarding traffic movement.



CHAPTER 5

COUNTY ROADS

This chapter discusses deficiencies and estimated costs of improvements required for a 20-year period on the 85,111 miles of primary and local rural roads under the jurisdiction of the 83 county road commissions.

Alternative average annual program requirements for construction, maintenance and operation are also presented for rural county roads and for county road extensions within the limits of municipalities.

The total estimated capital investment required on county primary road systems during the next 20 years is $980 million. Of this amount $862 million is on rural portions of the system and $118 million on municipal portions. The 20-year rural primary needs in the 10 heaviest populated counties total $368 million or 42 percent of the total.

The construction requirements for local roads during the same period are $806 million. Total cost of needed improvements on all county roads is approximately $1.8 billion.

While total needs expressed in dollars are large, it should be borne in mind that the mileages are great and that some multi-lane highways are included. The average annual cost for all needed improvements is $2200 per mile for primary roads and $660 per mile for local roads.

PHYSICAL NEEDS

Practically all rural county primary roads require improvement of some kind during the study period. Needs range from a limited mileage of gravel surfaces on adequately designed roadways to multi-lane divided highways. For the most part needed improvements consist of two-lane intermediate type surfaces. The total miles of each type of improvement proposed in the study period are:

Surface Type	Miles
Gravel	215
Bituminous Surface Treated	1,215
Intermediate Type	18,599
High Type, 2 lanes	1,427
High Type, multi-lane	753
Total	22,209

Nature of Rural County Primary Deficiencies

Rural county primary roads were rated by county engineers and road superintendents, under uniform study procedures, on their present degree of adequacy to meet design standards in the following categories:

Hills, curves and passing opportunities
Capacity to handle traffic
Structural condition or surface type
Surface width
Roadway width.

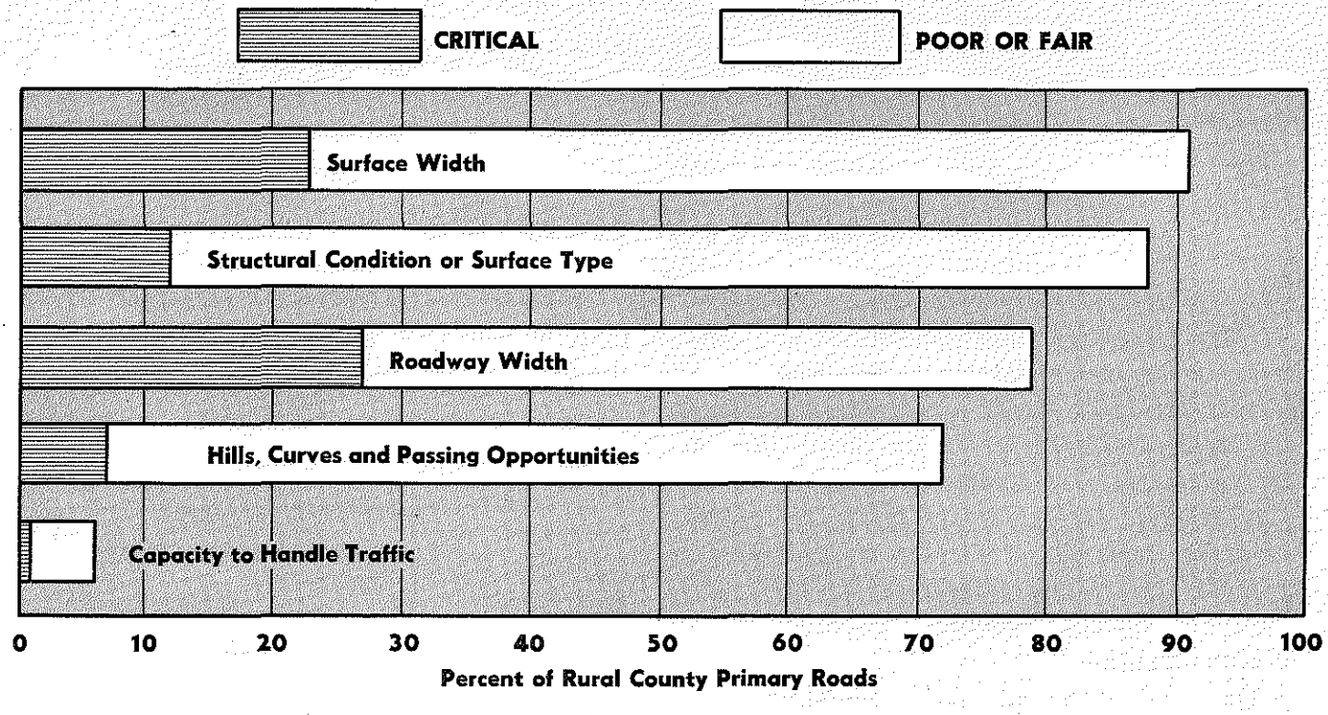
Rural county primary bridges were similarly rated as to:

Load carrying ability
Height and width clearances.

Results of these ratings are summarized in the charts on page 56.

Some road sections were found deficient in all elements rated. Most however were adequate from the standpoint of capacity to handle traffic, but deficient in one or more other respects. Deficiencies rated as critical occur principally in surface and roadway widths.

NATURE OF RURAL COUNTY PRIMARY DEFICIENCIES



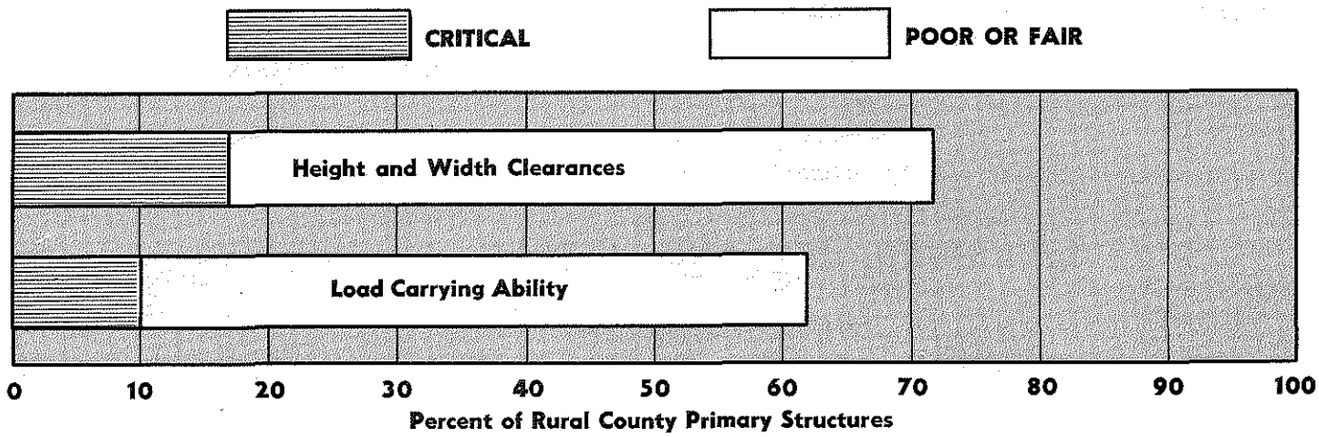
The character and degree of deficiencies vary widely among the 83 counties. In rural outstate counties most deficiencies are narrow roadways and surfaces, and surface types inadequate for the traffic served. In the metropolitan counties, particularly Wayne, Oakland and Macomb, capacity deficiencies are the major problem, from the standpoint of cost.

The urgency of needed improvements also varies widely by counties. In a few, as much as 90 percent of the primary mileage needs improvement within 10 years; in others only a little more than one-half. On the average, 41 percent of the mileage of improvements proposed are needed in the first five years, a total of 74 percent in 10 years and 92 percent in 15 years.

COUNTY PRIMARY IMPROVEMENT COSTS

Total costs of construction needs on county primary roads by five year intervals for the 20-year study period are shown in the table at the top of page 57.

NATURE OF RURAL COUNTY PRIMARY STRUCTURE DEFICIENCIES



CONSTRUCTION NEEDS COUNTY PRIMARY ROADS RURAL AND URBAN

(INCLUDING RIGHT OF WAY)

Period	Roadway	Structures	Total
5 Years	$358,995,000	$37,747,000	$396,742,000
10 Years	634,656,000	66,911,000	701,567,000
15 Years	785,643,000	88,210,000	873,853,000
20 Years	880,469,000	99,525,000	979,994,000

Needed improvements on county primary road extensions within municipalities would cost about 12 percent of the 20-year amount, and are covered in detail in Chapter 4.

The total 20-year needs of $862 million for rural county primary improvements involve:

Type of Work	Miles	Cost
Widening and Resurfacing	6,551	$266,261,000
Base and Surface	2,597	56,346,000
Reconstruction	12,630	395,279,000
New Construction	397	19,908,000
Modified Expressways	34	42,905,000
Structures (1,523)		81,657,000
Totals	22,209	$862,356,000

More than 70 percent of the total cost is for improvements needed within 10 years. This provides for overcoming all existing deficiencies together with those accruing during that time period.

The 20-year rural primary road needs in the 10 heaviest populated counties of the state total $368 million or 42 percent of the state-wide total.

Extent of Dustless Surface Development

Improvements proposed in the first 10 years provide for development of the county primary system, state-wide, with dustless surfaces on 90 percent of the mileage. By geographic areas, the system percentage to be so developed ranges from 85 percent in the Upper Peninsula to 94 percent in the heavy industrialized counties of southern Michigan. The table to the right affords a comparison of present and proposed dustless surfaces by areas.

The maps on pages 58 and 59 illustrate the extent of dustless surface development proposed within 10 years in Shiawassee and Missaukee counties. The mileage of dustless surface improvements proposed in that period is about the same in both counties. This program would bring the systems to about 90 percent dustless surface in each case. In both counties some reconstruction of existing surfaces would be necessary during the 10-year period. Only the less important county primary roads would remain as gravel or earth surfaces at the end of 10 years. Most of these would be developed in the second 10-year period. The development shown for these two counties is typical of that proposed in all counties.

Rural Multi-Lane County Primary Roads

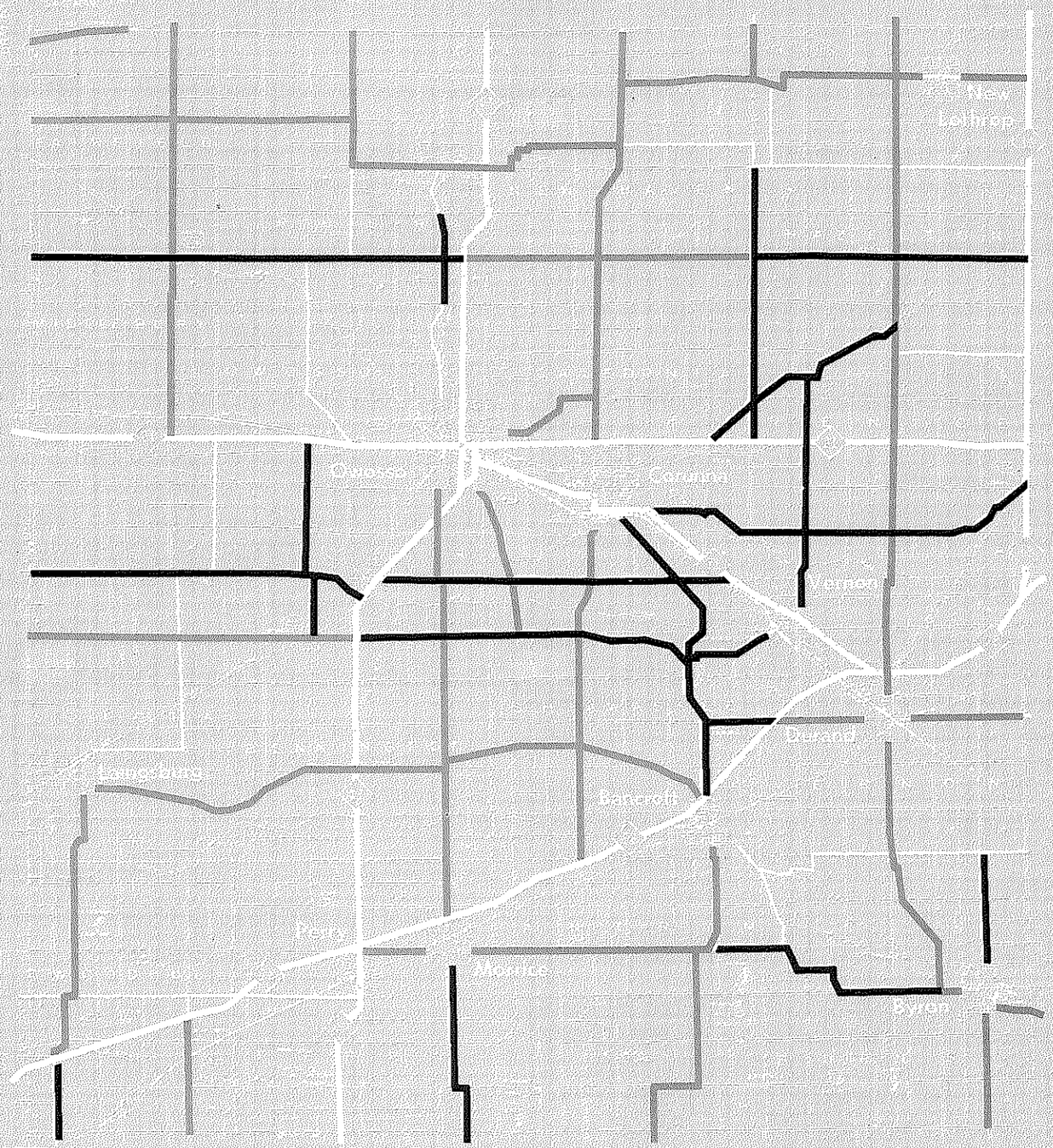
Rural multi-lane county primary requirements total 753 miles in the 20-year period. Of this mileage, 721 miles are four-lane and 32 miles are six-lane.

Extent of Dustless Surfaces County Primary Roads

Geographic Area	Percent of County Primary System with Dustless Surfaces: Present	Proposed at end of 10 years
Upper Peninsula Counties	27	85
Northern Michigan Counties	32	87
Southern Agricultural Counties	50	90
Light Industrial Counties	69	93
Heavy Industrial Counties	73	94
State Average	49	90

EXISTING AND PROPOSED DUSTLESS SURFACES

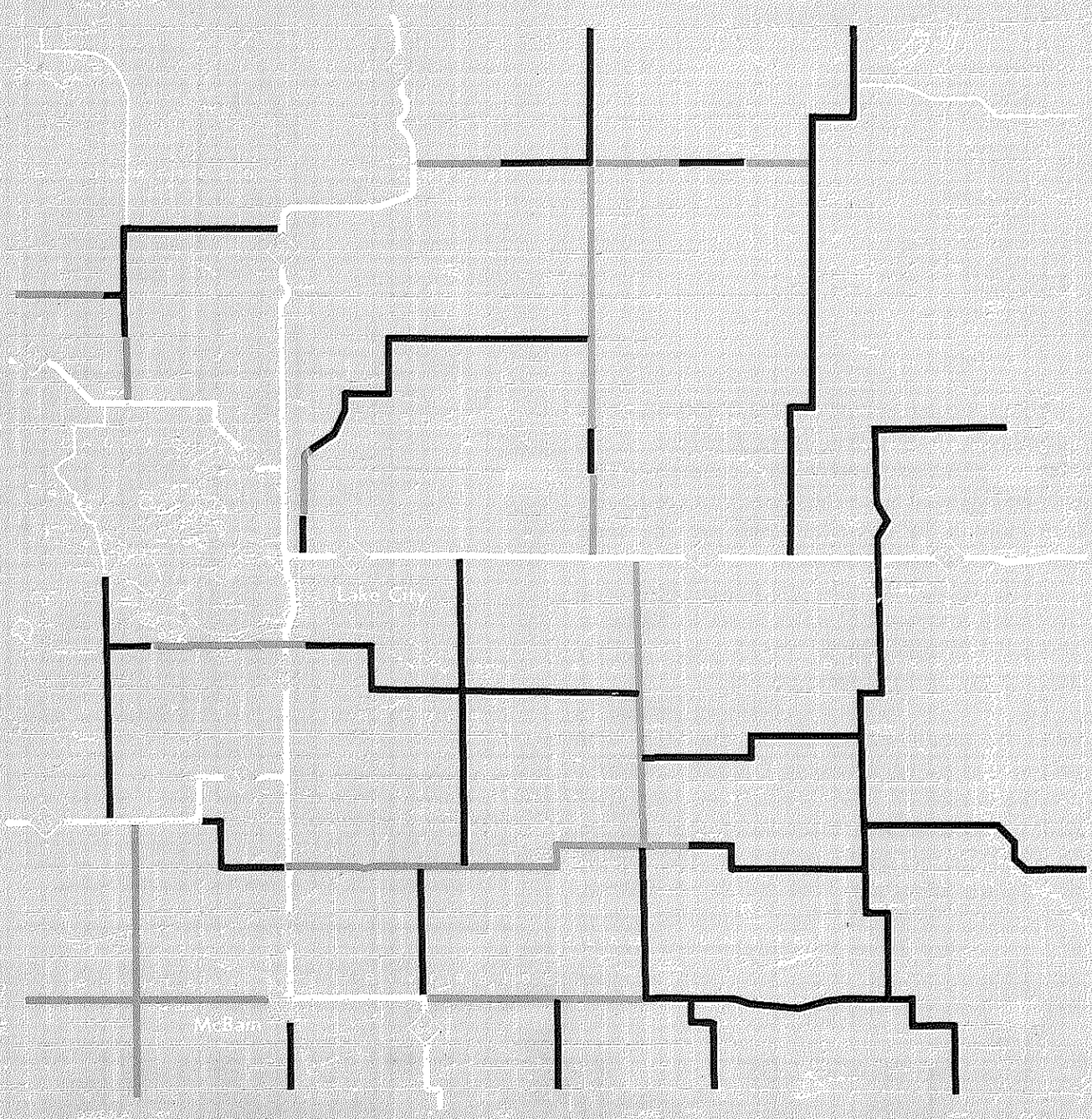
SHIAWASSEE COUNTY



Improvements proposed in 10 years would provide dustless surfaces on virtually all of the county primary system mileage. Only the lesser important county primary roads would remain as gravel or earth surfaces at the end of 10 years. The two counties illus-

COUNTY PRIMARY ROADS

MISSAUKEE COUNTY



trated above are typical of the development proposed in all counties. This means better service to agricultural, recreational and industrial areas. Existing dustless surfaces are shown in blue. Those proposed in 10 years are shown in black.

Multi-lane needs are confined to 20 counties. In 10 of these the requirements do not exceed eight miles in any county and average only three miles. The multi-lane facilities are generally short stretches of road through suburban unincorporated areas adjacent to municipalities.

In the remaining 10 counties rural county primary multi-lane requirements are:

County	Miles
Berrien	26
Genesee	122
Ingham	22
Jackson	14
Kalamazoo	32
Kent	62
Macomb	90
Oakland	164
Saginaw	12
Wayne	178
Total	722

About 82 percent of the rural multi-lane requirements, 616 miles, is in Genesee, Kent, Macomb, Oakland and Wayne counties. This is to be expected since these counties are largely metropolitan in character and are the most heavily populated in the state.

Of the total, 308 miles are needed now or in five years, another 222 miles in six to 10 years, another 136 miles in 11 to 15 years and 87 miles in the 16 to 20-year period.

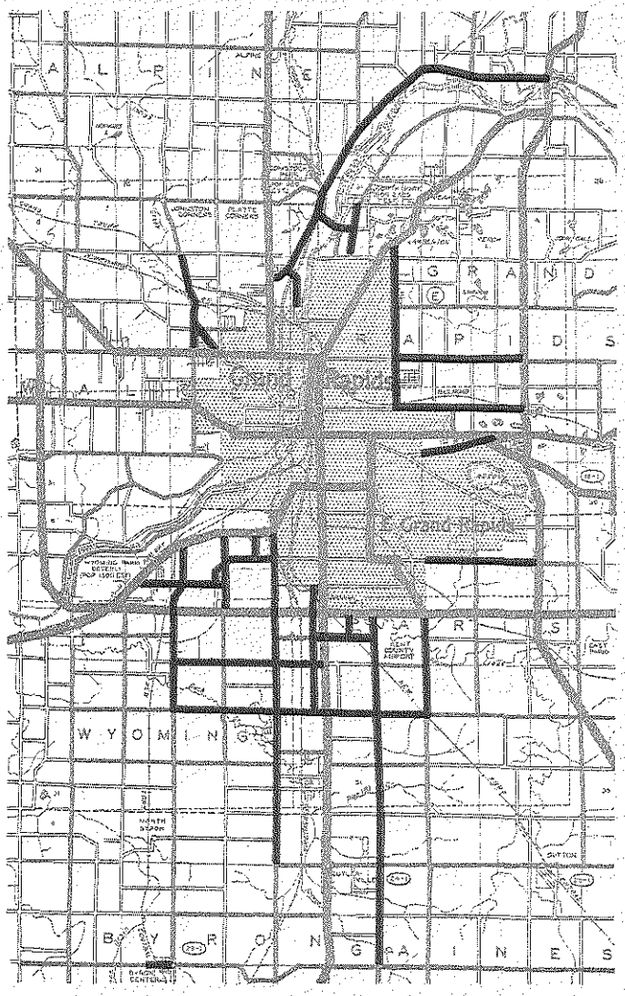
The rural multi-lane requirements include 34 miles of modified expressway facilities with partial control of access in Oakland and Macomb counties. These facilities are integrated with the Detroit area expressway plan and are required for adequate service in the rapidly developing suburban area north of Detroit. They do not fit into the State Trunkline System and since they represent replacements for existing county roads, costs have been assigned to the county primary system.

AVERAGE COSTS

Cost of the 34 miles of rural county primary expressways averages $1,285,000 per mile. The average cost for other multi-lane needs, exclusive of structures, is $158,000 for four-lane facilities and $236,500 for six-lane facilities.

RURAL MULTI-LANE NEEDS

KENT COUNTY PRIMARY ROADS



This map shows in blue the extent of multi-lane requirements on rural county primary roads in Kent County. All other roads of the primary system require only two-lane surfaces of dustless type or higher. The multi-lane requirements are on roads serving local traffic movements in suburban areas of Grand Rapids which do not fit into the Trunkline System.

By type of surface the average cost per mile of two-lane construction is:

Type of Surface	Cost per mile
Gravel	$14,850
Bituminous Surface Treated	17,160
Intermediate Type	22,320
High Type	74,110

These average cost exclude structures and future surface replacements.

PROGRAM COSTS
COUNTY ROADS

Item	Primary Roads — Average Annual Costs				Local Roads
	10-year period	Second 10 years of 20-year period	15-year period	20-year period	Average annual cost for 20-year period
Construction					
Rural	$61,170,000	$25,066,000	$51,053,000	$43,118,000	$40,321,000
Municipal	8,987,000	2,777,000	7,204,000	5,882,000	
Total Construction	$70,157,000	$27,843,000	$58,257,000	$49,000,000	$40,321,000
Maintenance and Administration	$20,124,000	$20,660,000	$20,269,000	$20,398,000	$15,800,000
Total Average Annual Program Cost	$90,281,000	$48,503,000	$78,526,000	$69,398,000	$56,121,000

LOCAL ROADS

Major types of deficiencies on local roads are narrow roadways and surfaces, lack of year-round stabilized surfaces, poor drainage and right of way clogged with brush and trees. Some counties have considerable mileages of bituminous surface treated roads laid with insufficient base. Other counties are attempting to maintain gravel surfaces without a suitable roadway or sufficient drainage. Proper maintenance under such conditions is difficult, if not impossible, and costs are excessive.

Total capital investment required to bring local roads up to standards in 20 years is $806 million or $40,321,000 annually. Distribution of the total cost is as follows:

Type of Work	Cost
Standard Gravel	$224,680,000
Minimum Gravel	130,040,000
Bituminous Surface Treated	98,040,000
Intermediate Type	38,880,000
Streets (Rural Subdivisions)	251,800,000
Structures	62,980,000
Total	$806,420,000

Those costs provide for development of about 18 percent of the total local road mileage with dustless surfaces of various types and about 73 percent to gravel surfaces adequate for year round travel. The remaining nine percent of local roads consist of seasonal trails to be kept up by maintenance and for which no construction improvements were estimated. The extent of dustless surface development proposed in counties varies widely depending on land use, density of population and amount of traffic.

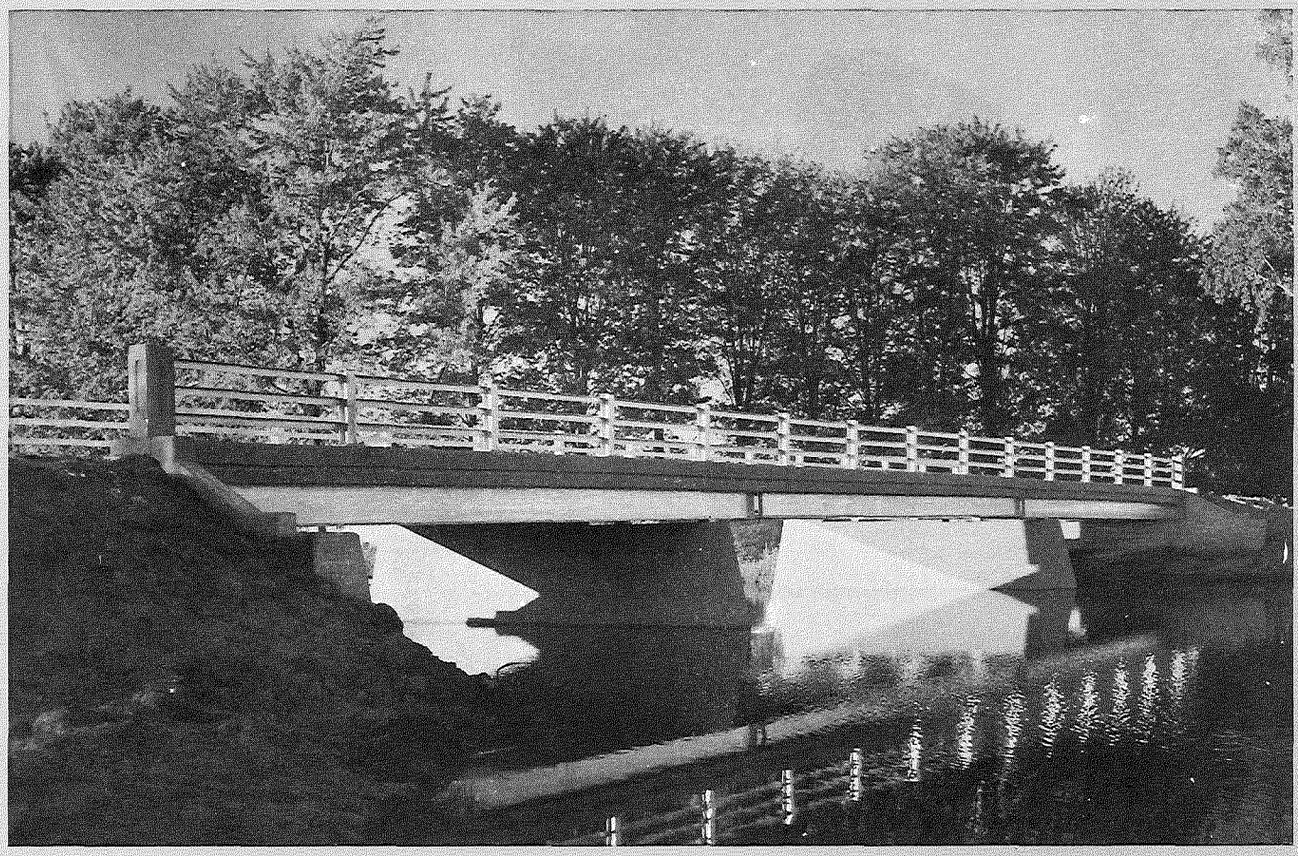
ANNUAL PROGRAM COSTS

Average annual program costs for primary and local roads are shown separately in the accompanying table for various periods of time. The program amounts provide for existing and accruing improvement needs and for maintenance and operation of each road system.

A breakdown of the total program costs for each system by each of the 83 counties is included in the appendix.

The 10-year annual program cost for primary roads provides for catching up on all existing deficiencies and meeting new needs as they occur during the 10-year period. The annual cost for the second 10 years would be less since the backlog of needs would have been taken care of and only needs of the second 10-year period would have to be met.

The program costs for 15-year and 20-year periods are averages of all costs for each period. Under those program alternatives some of the 10-year needs would be deferred until later years. While the average annual requirements



This recently constructed bridge over the Pine River in Arenac county meets county primary construction standards. The 20-year needs call for construction, or reconstruction of 1,523 bridges on the county primary system.

are smaller deferment of existing needs and those arising early in the program would mean deferring of benefits resulting from improved and adequate highways.

Maintenance

Amounts included for maintenance in the various programs have been based on a special analysis of maintenance costs by the engineering staff with the assistance of a committee of county engineers representing various geographic areas of the state.

All counties were requested to submit cost data separately for primary and local roads in as much detail as their records permitted. From those data average costs per mile for routine maintenance of various surface types were developed by areas of the state.

Increasing public dependency on highway transportation requires that more and more miles of road be kept open for travel the year round. Costs of snow plowing and ice control have become a substantial part of total maintenance expenditure.

Because of the extreme variations in winter conditions throughout the state allowances for winter maintenance were computed separately for each county based on experience of the 1951-1954 period. Allowances for snow and ice control ranged from $50 to $350 per mile on two-lane rural county primary roads and from $25 to $200 per mile for local roads. Average allowances, state-wide, were $125 per mile and $35 per mile for county primary and local roads respectively.

The individual county allowances per mile for snow and ice control were combined with the area allowances per mile for routine maintenance operations to determine average costs per mile for maintenance of the various surface types in each county.

Increased public dependency on highway transportation requires that more and more miles of road be kept open for travel the year round. Costs of snow plowing have become a substantial part of the total maintenance expenditure on county roads.

Because of the increased mileages of higher type surfaces, the wider widths of right of way, roadway and surfaces and provision for increased traffic services on county roads it is estimated that county primary and local road maintenance costs will increase by about 15 percent on the average over the 20-year period.

Administration

Direct costs for project engineering were included as a part of the construction requirements. An allowance for administration and general overhead has been included in the program calculations as operation expense. The estimated amount was computed as a percentage of construction and maintenance costs. The percentages ranged from three to five percent for the primary system programs and from one to five percent for the local road programs. The smaller allowances were used for the metropolitan counties where overhead expenses could be spread over a larger volume of work. The percentage allowances were increased as the total volume of work decreased.

RELATED PROBLEMS

Obsolete roads, unable to adequately accommodate today's traffic, are expensive to keep in service both to the highway agency responsible for their upkeep and to the users who must rely upon them.

The alternative programs presented in this chapter provide a sound basis for adoption of a fiscal plan geared to the economy of the state. An adequate fiscal plan, however, will not necessarily guarantee good roads. The improvement programs proposed can only be executed effectively and economically through sound management and engineering.

While progress has been made in county road administration since the adoption of Act 51 of 1951 much still remains to be accomplished. Counties which have not vested highway managerial authority in full-time engineers responsible to the road commission should do so.

Each county should develop construction programs at least two or three years ahead, based upon priority of need, and revise them annually to keep a program for that period constantly scheduled. The programs of adjacent counties should be integrated for maximum efficiency and benefit.

Improvement is needed in maintenance cost accounting particularly by surface type and object of expenditure. Counties through their associations should develop uniform standards of maintenance practice for more efficient operation.

During this study, traffic information was accumulated by many counties for the first time. Traffic data should be continually gathered so that up to date information is always available to aid in program development, design and in scheduling of traffic service maintenance functions. Provision should also be made for a continuous re-appraisal of needs in order to meet changing conditions and to measure the extent of progress in overcoming the large backlog of deficiencies.

CHAPTER 6

FEDERAL HIGHWAY AID

For nearly 40 years, Federal aid for highway construction has had a great and growing influence on highway development. The national interest in roads, although representing only a small part of all highway construction expenditures, encourages systematic improvement of high-priority routes to more uniform and modern standards, better administration, planning, programming and research. It serves as a catalyst to bring the states together for cohesive nationwide traffic service.

The hearings and debate in the national Congress during recent months indicate the probability of a greatly expanded Federal-aid highway program in the near future. When this comes, it will materially affect the requirements at state and local levels to finance any of the alternative programs presented in the preceding chapters, except those for local roads and streets.

To bring the Michigan picture into focus and permit an evaluation of the possible effect of an expanded Federal-aid program this chapter summarizes the construction requirements during the 20-year study period for each of the several Federal-aid Highway Systems. *Since those systems are administrative in nature and coincide with portions of established state, county and municipal systems of roads and streets, Federal-aid system needs are a duplication of, and not in addition to, the needs previously discussed.*

FEDERAL-AID SYSTEMS

Use of Federal-aid funds in Michigan, as elsewhere, is limited to approved construction work on fixed systems selected by the state and approved by the U. S. Bureau of Public Roads. Those systems are:

(a) The National System of Interstate Highways

(b) The Federal-aid Primary System, of which the Interstate System is a part, and

(c) The Federal-aid Secondary System.

The current annual apportionment of Federal-aid funds to Michigan is:

Interstate	$ 6,205,304
Primary	9,858,361
Secondary	6,017,283
Urban	8,072,113
Total	$30,153,061

Federal-aid Urban funds may be used only for projects on the Federal-aid Primary System, including Interstate routes, within urban areas as defined by Federal legislation.

The Secondary funds are allocated by agreement between the state and counties, 40 percent for projects on Federal-aid Secondary routes on state trunklines and 60 percent for projects on secondary routes on county roads.

Federal-aid funds, within the limits available from annual apportionments, may be used on a matching basis to pay up to 60 percent of the cost of construction and right of way on the Interstate System and up to 50 percent of the cost of construction on the remainder of the Federal-aid Primary System and the Federal-aid Secondary System. Under certain conditions Federal funds may be used to pay the entire cost of projects for the elimination of hazards at railway-highway crossings.

THE INTERSTATE HIGHWAY SYSTEM

Since 1938, when Congress first requested study of "transcontinental toll highways," there has been an ever increasing interest in a completely modern network of principal highways throughout the United States. First authorized by Congress in 1944, the National System of Interstate Highways has been "so located as to connect by routes, as direct as practicable, the principal metropolitan areas, cities and industrial centers, to serve the national defense, and to connect at suitable border points with routes of continental importance in the Dominion of Canada and the Republic of Mexico." Extent of the system is limited nationally to 40,000 miles. About 37,700 miles have been designated by the states and approved by the Federal government. Of this total 985 miles are in Michigan, of which 849 are rural and 136 are urban. The remaining 2,300 miles is being reserved for urban connections, circumferentials and distributor routes in the large metropolitan areas. These routes are now being selected by the states and the Bureau of Public Roads.

Several important engineering studies requested by Congress furnished a scientific basis for selection and development of the Interstate System. They included "Toll Roads and Free Roads" (1939); "Inter-regional Highways" (1944); "Highways for National Defense" (1949); and "Needs of the Highways Systems, 1955-84" (1955). After extensive hearings the President's Advisory Committee on a National Highway Program, submitted a report in January 1955 to the President entitled "A Ten-Year National Highway Program."

The latter two reports, in addition to studies by the states, crystallize the magnitude and importance of the total highway problem and suggest substantially increased Federal expenditures. Both reports emphasize the special significance of the Interstate System and its early development to fully modern design for economic reasons and for military and civil defense.

Most of the testimony before the Senate and House Road Committees stressed the importance of the Interstate System, the need for its early development and the necessity of greater Federal participation in cost. Both committees approved bills authorizing greatly expanded amounts of Federal-aid funds with 90 percent Federal participation in Interstate System improvement costs. The Senate bill passed in the Senate. The House did not take favorable action.

Nationally, it is estimated that one-seventh of all traffic, rural and urban, uses the system consisting of but one percent of the total mileage. Michigan data fit those estimates almost exactly. As shown by the accompanying map, the system is ideally selected in Michigan to serve and increase the state's maximum economic potential. The system connects international border points and serves the national defense by linking major industrial areas and nearby defense establishments.

To provide maximum service in terms of capacity, speed and safety, and to avoid early obsolescence, expressway design is required. Elimination of roadside and road crossing interference with through traffic would double the maximum traffic capacity of ordinary highways, provide for higher safe speeds, save an average of 10 lives and many accidents annually for each 100 miles in service, and greatly increase the life of the facility.

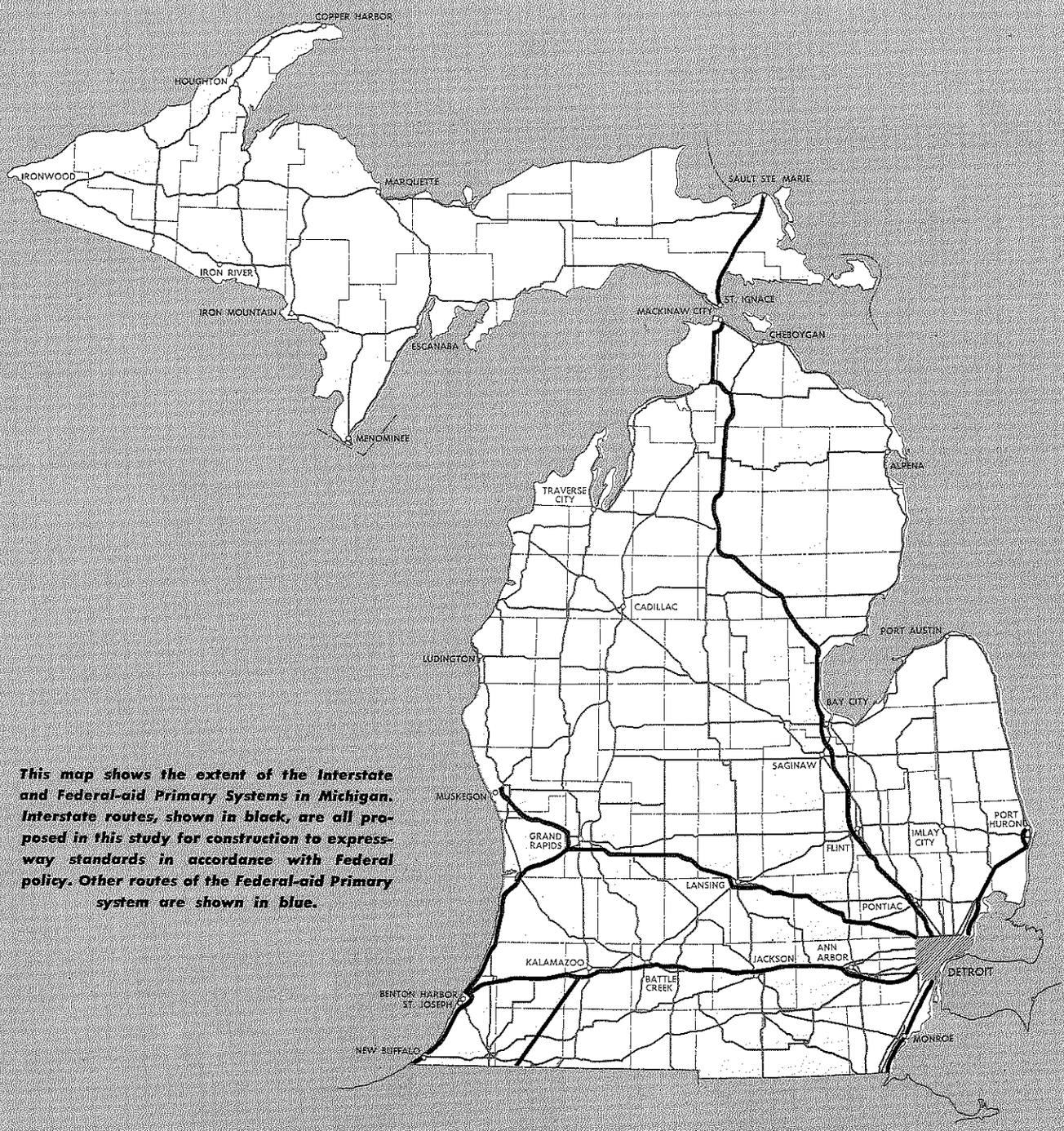
The Automobile Manufacturers Association has estimated the modernization of the Interstate System to expressway standards would save $2.1 billion annually in operating and accident costs and in time of commercial vehicles. On this basis, savings in Michigan would amount to about $100 million annually.

Recognizing those facts, developed by study of and experience with many such expressways or freeways, Federal policy requires all construction involving Federal aid on Interstate routes to fit into such design. Study of present and future traffic and existing conditions on Michigan's portion of the Interstate System confirms the necessity.

Interstate Needs in Michigan

Requirements for multi-lane divided highways with full control of access and no cross-

INTERSTATE AND FEDERAL-AID PRIMARY SYSTEMS IN MICHIGAN



This map shows the extent of the Interstate and Federal-aid Primary Systems in Michigan. Interstate routes, shown in black, are all proposed in this study for construction to expressway standards in accordance with Federal policy. Other routes of the Federal-aid Primary system are shown in blue.

traffic interference mean new locations for all Interstate rural and urban routes in Michigan, except for a limited mileage already built or under construction to such standards.

New locations of Interstate routes for the most part would bypass municipalities. The bypasses would be located as closely to the built-up area of the city as possible to provide a high order of traffic service on one hand, and on the other to avoid undue disruption to homes, businesses, communication and surface transportation. Only in the Detroit area, Grand Rapids, Monroe, Muskegon, Port Huron and a few other municipalities would Interstate routes be carried through or into the cities.

All of the urban streets now used as Interstate routes are heavily congested during daily peak hours. The state and the cities already are taking some steps to bypass or build new facilities for relief.

In rural areas, traffic on Interstate routes ranges from around 2,000 vehicles per day to about 32,000. Traffic on all rural mileage averages about 7,500 vehicles per day. The minimum average daily traffic occurs on the Interstate route from Standish to Sault Ste. Marie. However, this route carries high traffic peaks on summer week-ends which warrants its development to expressway standards.

This study determined that 814 miles, or 89 percent of all rural Interstate mileage, are currently so inadequate that they need improvement or replacement in the next five years.

Those facts call for top priority in the development of the entire Interstate System. In this study, substantially all of it is proposed for construction within the next 10 years.

Municipal Interstate Needs

Municipal Interstate needs consist of 141 miles of expressway construction at a total cost of $844 million during the study period. Most of this work is in the Detroit Metropolitan Area where, because of the high density of population, need is the greatest. About 18 miles are located in out-state cities. Routes in the Detroit area are shown on the accompanying map.

In Detroit and its suburban communities, the expressways selected for purposes of this study as the least which should be included in the Interstate System and its necessary urban connections involve 123 miles of construction during the next 20 years. Of the total expressway needs for Detroit, shown in the table on page 50, some 70 percent of the miles and 65 percent of the cost is for improvement of Interstate routes and proposed urban connections.

The state is working out the selection of routes and specific locations for the Interstate System and its urban connections with the U.S. Bureau of Public Roads. Extent of connecting routes finally approved for Detroit, and other cities as well, depends in part on mileage available within nation-wide limits set by Congress.

All Interstate urban mileage and costs shown in this report are based on current Federal policies, including requirements for full control of access, i.e. expressway design. Should these policies change, or mileage limits be revised, it is possible that some additional routes could qualify, and some revision in costs of the system would be made accordingly.

Interstate System connections are proposed in out-state cities where traffic needs are heavy and it is economically feasible to provide for expressway design through or into the community.

In Grand Rapids, the estimates are based on extension of the expressway now under construction along Division Street, north and west through the city tieing in with a proposed new location of U.S. 16 near the north city limits.

Interstate routes terminate at the Bluewater Bridge in Port Huron, the proposed International Bridge at Sault Ste. Marie and the Mart Dock in Muskegon.

Rural Interstate Needs

Of the total rural State Trunkline System 20-year needs, about 27 percent is on the Interstate System. Total cost would be $409 million, or about half of all costs on the principal state trunklines.

Complete new expressways would be provided tieing in with work already completed on the Detroit Industrial Expressway and partially complete on bypass locations at Ann Arbor,

INTERSTATE ROUTES AND URBAN CONNECTIONS

DETROIT AREA

This map shows in blue the expressways selected for purposes of this study as the least mileage which should be included in the Interstate System and its necessary urban connections in the Detroit Area.

Jackson, Kalamazoo, Saginaw and Flint. All together, they would total 911 miles.

All would be multi-lane divided highways with complete control of access, providing maximum safety at average operating speeds of 50-55 miles per hour in near-peak hour traffic.

Some sections are more urgently needed than others, but all are required within 10 years. Priority depends on many factors, but existing conditions and traffic demands point to the earliest possible development on most routes, as shown in the priority map in Chapter 3.

Costs and priorities are based on construction of all locations as free facilities, except for the Straits of Mackinac Bridge.

The Interstate routes from Detroit to Saginaw and Detroit to the Indiana line near New Buffalo generally parallel toll road locations under

COST OF INTERSTATE SYSTEM IMPROVEMENTS

(20-year period)

	Right of Way	Structures	Roadway	Total
Rural	$ 75,922,000	$111,167,000	$221,970,000	$ 409,059,000
Urban	241,289,000	262,909,000	339,896,000	844,094,000
Total	$317,211,000	$374,076,000	$561,866,000	$1,253,153,000

study by the Michigan Turnpike Authority.

Should the Authority proceed with the construction of either or both of those toll roads further study should be made in the light of Federal-aid policies and prospects, of the advantages and disadvantages of designating them as parts of the Interstate System.

Interstate Cost Summary

Urban portions of the Interstate System average $5,985,000 per mile of which 29 percent is for right of way alone. Cost ranges from $525,000 per mile in the outlying area of St. Ignace to over $12 million on parts of several Detroit routes involving expensive right of way, eight traffic lanes and many structures.

In rural areas where most mileage requires only four traffic lanes, fewer structures and less costly right of way, per mile cost averages $449,000. It ranges from $300,000 in the north to over $1,000,000 in heavily developed rural areas adjacent to Detroit.

Total cost during the 20-year period for construction on the Interstate System and its urban connections in Michigan are shown in the table at the top of this page.

Of the total 20-year costs, 94 percent or $1,179,720,000 are in the first 10-year period. Costs of the second 10 years include four miles of expressway in Detroit, 45 miles of widening of rural routes from four to six lanes and resurfacing of pavements previously constructed.

This is a portion of U.S. 12 near Kalamazoo which is being developed to Interstate System expressway standards by stage construction. Contracts for completion of this section as a four-lane divided facility with full control of access are presently scheduled for letting late this year.

FEDERAL-AID PRIMARY SYSTEM

The Federal-aid Primary System in Michigan totals 5,540 miles, in addition to the Interstate routes. The system was first established in 1921 within mileage limits set by Congress and has remained the backbone of the total rural and urban road and street network of the state.

The system carries about 84 percent of the rural trunkline traffic and connect all principal cities and areas. In cities, it includes the more important trunkline streets.

Federal-aid Primary Needs

Over a 20-year period, this study shows that $1,185,751,000 are needed to improve, to adequate standards, 5,107 miles of Federal-aid primary routes, both rural and urban, exclusive of the Interstate System. That is 42 percent of the total rural and urban state trunkline requirements in that period.

About 4,053 miles of the Federal-aid Primary System, excluding Interstate routes, will need some kind of improvement during the next 10 years. Total costs equal $890,093,000, or about 75 percent of the 20-year needs.

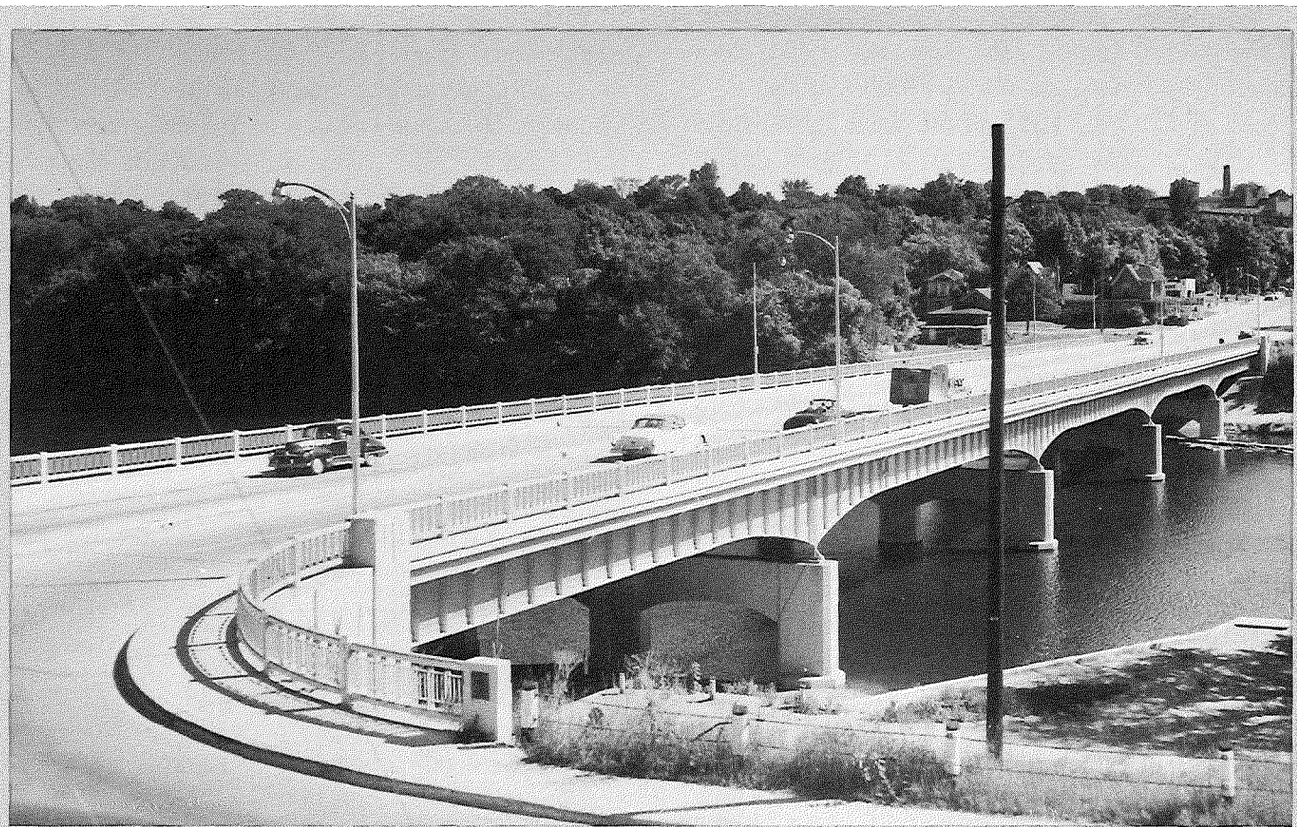
Standards for the system vary according to traffic needs and location from ordinary two-lane roads to multi-lane divided highways with partial control of access, including some highway grade separations. Standards applicable to the state trunklines as a whole, described in Chapter 2 and shown in the appendix, apply as well to the Federal-aid Primary System.

The following table summarizes the cost of needed construction improvements:

COST OF FEDERAL-AID PRIMARY SYSTEM IMPROVEMENTS

(Excluding the Interstate Routes)

	First 10 years	Second 10 years of 20-year period	Total 20 years
Rural	$672,156,000	$165,316,000	$ 837,472,000
Urban	217,937,000	130,342,000	348,279,000
Total	$890,093,000	$295,658,000	$1,185,751,000



This recently constructed bridge on M 37 over the Muskegon River in Newaygo was financed as a Federal-Aid Primary project.

COST OF FEDERAL-AID SECONDARY SYSTEM IMPROVEMENTS

	First 10 years	Second 10 years of 20-year period	Total 20 years
State trunklines	$195,514,000	$ 74,372,000	$269,886,000
Other roads and streets	438,950,000	161,720,000	600,670,000
Total	$634,464,000	$236,092,000	$870,556,000

FEDERAL-AID SECONDARY SYSTEM

The Federal-aid Secondary System in Michigan as of January 1, 1955, included about 20,100 miles of state trunklines, county roads and streets in municipalities of less than 5,000 population.

Since Congress required the selection of this system by the Federal-aid Highway Act of 1944, mileage has been growing as additional routes have been added. Some 300 miles have been added to the system this year. Eventually all properly selected county primary mileage in Michigan may qualify, along with most state trunklines not part of the other Federal systems. This would mean an ultimate Federal-aid Secondary System of about 25,000 miles.

As of January 1955, there were 2,943 miles of state trunkline routes and 17,078 of county roads and municipal streets included in the Federal-aid Secondary System, exclusive of mileage in municipalities over 5,000 population. Substantially all of the 17,078 miles on roads and streets other than trunklines are located on the county primary road system.

Standards for the Federal-aid Secondary System appraisal are the same as used for the various road and street systems of the state on which secondary routes are located.

Improvement cost estimates are shown above. Note that 73 percent of the total 20-year costs are needed in the first 10-year period.

SUMMARY

Total initial construction and future replacement needs of all Federal-aid systems in Michigan for the 20-year study period are summarized in the table at the bottom of this page.

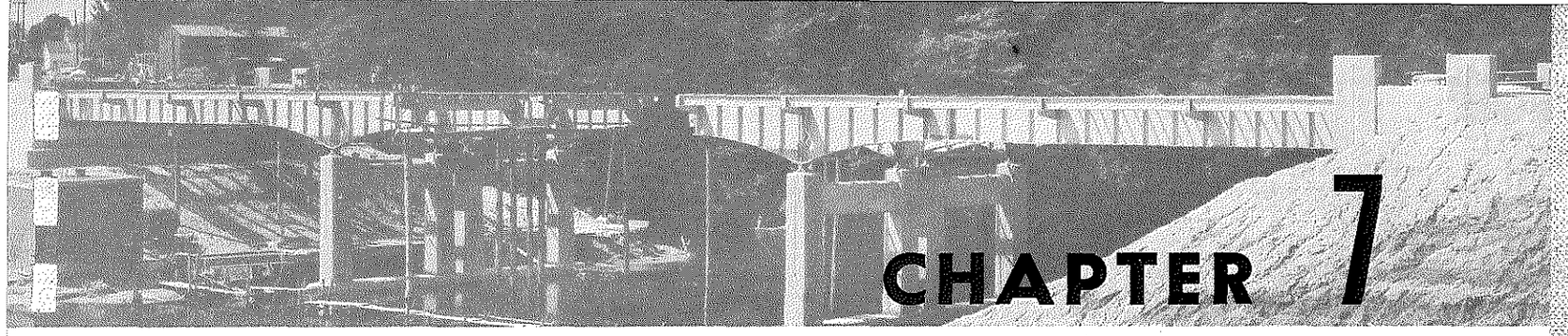
Of the amounts, urban construction needs total $1,192,373,000, or 36 percent of the grand total over 20 years.

It must be remembered that Federal aid has never been available in amounts required to meet all construction needs on the Federal-aid systems. Matching ratios and distribution formulas vary. But these tables indicate the extent of the problem on the systems in which the Congress has indicated some degree of Federal interest.

Action by future Congresses may alter the present status of funds and systems. If debate in recent months is a criterion for the future, increased Federal interest, particularly in the Interstate System, may be anticipated.

TOTAL FEDERAL-AID SYSTEM CONSTRUCTION NEEDS

	First 10 years	Second 10 years of 20-year period	Total 20 years	Percent
Interstate	$1,179,720,000	$ 73,433,000	$1,253,153,000	38
Other Federal-aid Primary	890,093,000	295,658,000	1,185,751,000	36
Federal-aid Secondary	634,464,000	236,092,000	870,556,000	26
Total	$2,704,277,000	$605,183,000	$3,309,460,000	100



CHAPTER 7

THE BASIS FOR FISCAL PLANNING

Although the three principal highway systems of Michigan—state, county and municipal —are administered by separate agencies, they function as an integrated network. Current state laws provide some degree of support from state collected motor vehicle revenues for all systems—ranging from full support of the rural state trunkline system to partial support of local roads and streets.

Accordingly, the program data separately described by systems in preceding chapters must be brought together for an understanding of the total highway problem.

This concluding chapter evaluates the total program requirements on a statewide basis and sets forth several alternatives to be considered in establishing a fiscal plan.

The separate fiscal study will evaluate need for tax revision and changes in distribution of state-collected revenues based on the needs determined by this engineering analysis. The fiscal study will take into account the proposed major increase in Federal aid and reduced state matching requirements on the Interstate System. Possibilities of credit financing to accelerate various phases of the program will also be reviewed.

PROGRAM RELATIONS

An average of $288 million annually, plus existing debt service, would be required through the next twenty years to meet construction, maintenance and administration needs on the major systems—state trunklines, county primary roads and major city streets.

An additional $89 million annually would be required if local county roads and local city streets are to be brought up to the standard contemplated by this study in a 20-year period. Actual expenditure and progress made on the local systems will vary and depends greatly on local desires and ability to finance beyond the levels of state interest set by the legislature.

Summarizing preceding chapters, the distribution of 20-year program requirements among systems is shown in the table on page 74.

Total receipts from all sources for 1956 are estimated at $260 million, not including borrowings, based on current fuel and motor vehicle tax rates and continued Federal aid and local support at present levels.

At present tax rates, annual receipts during the 20-year period should increase an average of $65-70 million above the $260 million estimated for 1956, because of growth in travel and motor vehicle registrations. Proposed increases in Federal aid and possible increases in local support would provide additional funds.

The relative proportions by systems of this 20-year program have changed very little from those determined in the 1947 study. However, it is now found that 70 to 95 percent of the 20-year construction needs on the major systems, should be completed in the next 10 years.

However, if the program is spread over 20 years about one-third of the first 10-year needs would have to be deferred. Benefits and savings to the users also would be deferred, and some added costs for stop-gap measures might be expected.

The table on page 75 shows the average annual cost if needs of the first 10 years are to be met in that period, and the distribution among systems. This table also shows that requirements of the second 10 years would be about half that of the first 10 years, since the backlog would have been overcome and the continuing program would be on a current basis.

20-YEAR AVERAGE ANNUAL PROGRAM COSTS

System	Construction	Maintenance and Operation	Total	Percent
State Trunklines				
Rural	$ 76,318,000			
Urban	64,040,000			
Total	$140,358,000	$ 33,123,000	$173,481,000	46
County Primary	49,000,000	20,398,000	69,398,000	18
Major Municipal Streets	33,750,000	11,860,000	45,618,000	12
Sub-Total Major Roads and Streets	*$223,180,000*	*$ 65,389,000*	*$288,497,000*	*76*
Local County Roads	40,321,000	15,800,000	56,121,000	15
Local Municipal Streets	21,612,000	11,493,000	33,105,000	9
Sub-Total Local Roads and Streets	*$ 61,933,000*	*$ 27,293,000*	*$ 89,226,000*	*24*
Total All Roads and Streets	$285,041,000	$ 92,682,000	$377,723,000	100

Between the above alternatives—catching up in 10 years or 20 years—is the possibility of a 15-year program shown in the table on page 76.

Under the 15-year program a fifth of the first 10-year needs would be deferred.

Each system currently has different sources of support in varying degrees from motor vehicle taxes, Federal aid and local funds. Evaluation of the amount of revenue from each source, the degree of state interest in each system, and the proper distribution of state-collected revenue necessary to accomplish the required program, is the responsibility of the fiscal study.

Acceleration

Mile by mile study of present age, condition, and traffic needs on all major roads and streets points to a large backlog of work which should be completed within five years. As a practical matter, that is too short a period to be considered in long-range financing, nor is it feasible from a physical standpoint.

From an economic viewpoint, it would be highly desirable to meet the backlog of needs in 10 years and this appears to be feasible from a physical standpoint.

State policy, as expressed in several acts of the legislature since 1950, permits limited bond financing for some systems and types of improvement, with the bonds amortized from motor vehicle revenues.

The fiscal study may show the desirability of expanding the bond financing principle for completion of a 10-year program on at least a portion of the major roads and streets.

This study appraised needs over a 20-year period to permit a fiscal analysis of bonding possibilities. This was done since the total fiscal plan must meet continuing construction and maintenance requirements after the backlog has been met as well as bond principal and interest. Also, to be equitable, the fiscal plan should be geared to finance the total determined state interest in all systems in a given period, assumed to be 20 years, although construction may be accelerated on some portions of a system or systems.

State Trunklines

About 84 percent of the total 20-year trunkline improvement costs are for work needed in 10 years. This is due largely to existing capacity deficiencies requiring multi-lane construc-

AVERAGE ANNUAL COSTS FOR A 10-YEAR CATCH-UP PROGRAM

System	Construction	Maintenance and Operation	Total	Percent	Annual cost for second 10 years of a 20-year period
State Trunklines					
Rural	$125,463,000				
Urban	109,241,000				
Total	$234,704,000	$ 38,266,000	$272,970,000	53	$ 73,833,000
County Primary	70,157,000	20,124,000	90,281,000	18	48,503,000
Major Municipal Streets	50,201,000	12,223,000	62,424,000	12	28,825,000
Sub-Total Major Roads and Streets	*$355,062,000*	*$ 70,613,000*	*$425,675,000*	*83*	*$151,161,000*
Local County Roads	40,321,000	15,800,000	56,121,000	11	56,121,000
Local Municipal Streets	21,612,000	11,493,000	33,105,000	6	33,105,000
Sub-Total Local Roads and Streets	*$ 61,933,000*	*$ 27,293,000*	*$ 89,226,000*	*17*	*$ 89,226,000*
Total All Roads and Streets	$416,995,000	$ 97,906,000	$514,901,000	100	$240,387,000

tion. About 70 percent of the multi-lane needs are on the selected system of principal trunklines, including all Interstate routes. Because of the greater relative amount of urgent needs, it is recommended that any trunkline program acceleration found to be feasible by the fiscal study provide for taking care of principal trunkline routes first.

County Primary and Major Street Systems

The scope of the 10-year needs on the county primary and major street systems will require an increase in current construction programs if they are to be met even in a 15 or 20-year period. Priority attention, from a program acceleration standpoint, should be given in those counties and municipalities faced with the problem of correcting major capacity deficiencies.

Local Roads and Streets

This appraisal is based on development of local road and street systems to adequate standards in a 20-year period—a target agreed upon as reasonable. The actual rate and extent of development will depend on local desires and ability to finance beyond the levels of state interest set by the legislature.

EFFECT OF FUTURE PRICES

Costs herein are estimated at 1954 price levels. Should prices go down, programs could be completed sooner. If prices go up, the reverse would be true.

Use of the 1954 estimating base for future highway programs differs from the procedure used in the 1947 study, described in Chapter 1. Annual comparison of future price levels directly with the 1954 base should provide a reasonable adjustment factor in determining program progress.

EVALUATION AND COMPARISON

Program costs outlined in this chapter are unquestionably large and may appear, when viewed as a total sum, to be unrealistic. While translation into other units cannot change the very large sums involved, there are indices which serve to put the costs into focus and express them in more understandable units.

This engineering analysis has reported the nature and amount of needs on all systems of roads and streets, based on their present status related to the modern standards required for today's traffic and that anticipated by 1975

15-YEAR AVERAGE ANNUAL PROGRAM COSTS

System	Construction	Maintenance and Operation	Total	Percent
State Trunklines				
Rural	$ 94,335,000			
Urban	84,401,000			
Total	$178,736,000	$ 35,264,000	$214,000,000	49
County Primary	58,257,000	20,269,000	78,526,000	18
Major Municipal Streets	40,318,000	11,960,000	52,278,000	12
Sub-Total Major Roads and Streets	*$277,311,000*	*$ 67,493,000*	*$344,804,000*	*79*
Local County Roads	40,321,000	15,800,000	56,121,000	13
Local Municipal Streets	21,612,000	11,493,000	33,105,000	8
Sub-Total Local Roads and Streets	*$ 61,933,000*	*$ 27,293,000*	*$ 89,226,000*	*21*
Total All Roads and Streets	$399,244,000	$ 94,786,000	$434,030,000	100

Over the 20-year period, an average of $378 million annually is needed. Motor vehicle travel, as reported in Chapter 1, is expected to average 38 billion miles annually over that period. Thus, the average cost would be one cent per vehicle mile of travel—about one-eighth of the total cost of owning and operating a motor vehicle. Since funds other than motor vehicle and fuel taxes generally assist in paying for some systems—especially local roads and streets—the direct cost to motorists is less.

The National Safety Council estimates the total loss from motor vehicle accidents in the United States in 1954 at $4.3 billion which amounts to 0.8 cents per vehicle mile of travel, or four-fifths of the cost per vehicle mile of the needed program. In addition other economic losses occur from delay, extra gasoline consumption and other vehicle operating costs such as tires and brakes.

The average cost of one cent per vehicle mile of travel compares with 0.87 cents per vehicle mile estimated to be available from present sources for construction and maintenance of all roads and streets in 1956.

The chart on page 77 shows the trend of highway support in relation to travel since 1920.

Michigan's estimated total cost per vehicle mile is reasonable in comparison with some other states where similar studies have been made, as follows:

State	Costs per* vehicle mile (cents)
Michigan	1.00
Minnesota	0.93
Louisiana	1.13
Ohio	0.95
West Virginia (excludes local streets)	1.33

* Costs for other states adjusted to 1954 price levels.

Annual average total cost per capita is another guide to consideration of program feasibility. The Michigan cost in relation to some other states is as follows:

State	Annual* cost per capita
Michigan	45
Minnesota	42
Louisiana	41
Ohio	30
West Virginia (excludes local streets)	42

*Costs for other states adjusted to 1954 price levels.

The Michigan annual cost of $45 per capita is equivalent to about 12 cents a day. None of the other states, used for comparison, contemplated as high a degree of development of the Interstate System as is now found necessary.

LEGAL RESPONSIBILITIES

All costs reported in this study have been based on existing legal responsibilities for given systems of roads and streets. Any major change in system responsibilities would result in a shift of cost from one system and agency of government to another.

CONCLUSIONS

This engineering study supplements and brings up to date the results of the 1947 survey, which set the pace for improved administration and relationships between governmental units and for a better basis for fiscal planning.

Long range, relative proportions of the total cost required by the several road and street systems remains about the same as stated in the 1947 study, despite major changes in engineering techniques of measurement. However, the current study shows need for 3.5 times the amount of funds estimated in 1947.

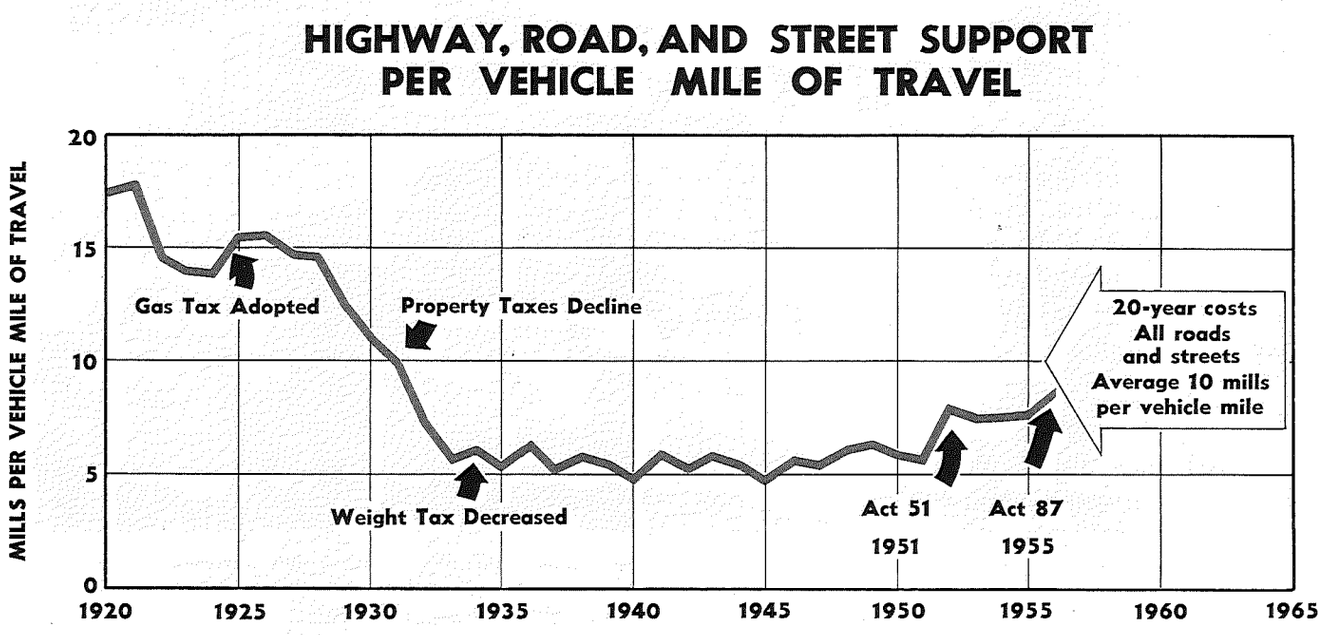
The unprecedented rise in motor vehicle use and the higher construction standards now known to be required for today's traffic as well as that of 1975, support the estimates now made. Further, these estimates are shown to be reasonable in the light of general price levels, the cost of operating motor vehicles and comparisons with other states.

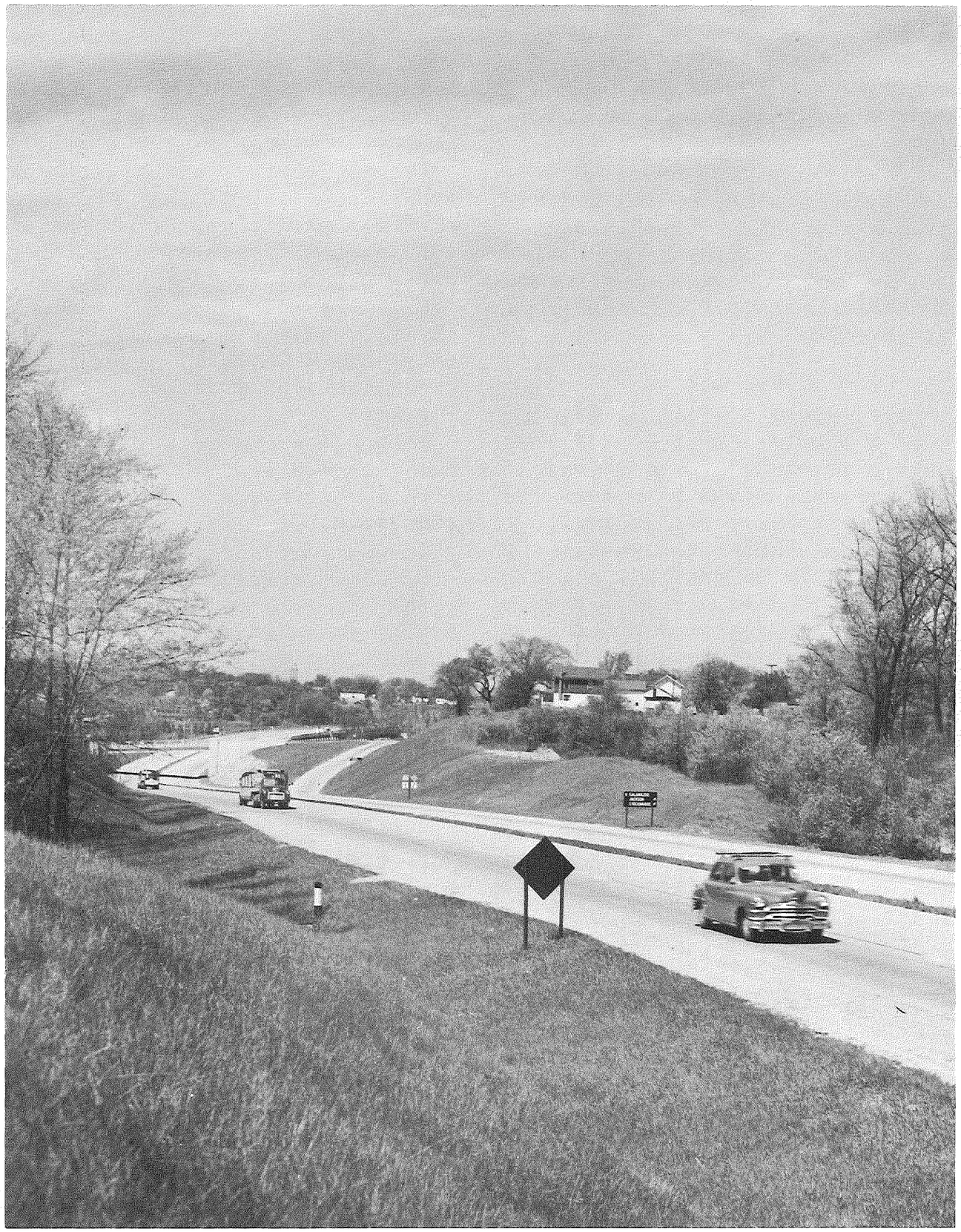
This study points out that the backlog of work needed is greater than ever. The urgency of accelerating certain programs is emphasized, with consequent alteration of fiscal formulas to provide for them.

Improved advance programming by all agencies of government is stressed. For the rural State Trunkline System, top priority projects are suggested as an aid to the State Highway Department.

The legislature remains the final authority for the broad policy decisions influencing priority of work between rural and urban areas and between systems.

The engineering facts reported here, coupled with the recommendations of the separate concurrent fiscal study, provide an adequate basis for legislative and administrative action. With care taken to re-appraise and readjust programs from time to time in the light of changing conditions and Federal policies, steady progress can be made toward achieving the benefits of modern highway transportation in Michigan.





Modern well designed highways save lives, time and money. Wide rights of way, heavy duty pavements, easy grades and curvatures, control of access, separation of cross traffic, all contribute to increased safety and efficiency. The above view is a portion of U.S. 12 near Jackson.

APPENDIX

DESIGN STANDARDS FOR RURAL STATE TRUNKLINES

			Principal System		All Other State Trunklines							
			2 lane	Multi-lane *Divided*	2 lane							Multi-lane *Divided*
1975 A.D.T.					Under 1000		1000-2000		2000-3000		3000-5000[1]	
Terrain			All	All	Flat	Rolling	Flat	Rolling	Flat	Rolling	All	All
Design Speed M.P.H.[3]			70	70	60	50	70	60	70	60	70	70
Operating Speed M.P.H.[3]			50-55	50-55	45-50	40-45	45-50	45-50	45-50	45-50	45-50	45-50
Maximum DHV Equivalent Pass. Vehicles	Percent 1500′ Sight Distance Available Per Mile	100%	600 Total	1000 Per Lane with Access Control 600 Per Lane Without Access Control	Not Applicable		Not Applicable		900 Total		900 Total	1200 Per Lane with Access Control 700 Per Lane without Access Control
		80%	550 Total						800 Total		800 Total	
		60%	495 Total						690 Total		690 Total	
Curvature Maximum Degree[3]			3	3	4	6	3	4	3	4	3	3
Stopping Sight Distance—Feet[3]			700	700	475	350	600	475	700	600	700	700
Gradient Maximum—Percent			3	3	4	6	3	4	3	4	3	3
Surface Type			High (F)	High (F)	Intermediate (E)		Intermediate (E)		High (F)		High (F)	High (F)
Lane Width—Feet			12	12	11		11		12		12	12
Roadbed Width—Feet[6]			48	(2)	38		38		40		44	(2)
Right of way—Minimum Width—Feet			150[4]	250[4]	120		120		120		150[4]	200[4]
	Design Load		H-20 S-16		H-20 S-16						H-20 S-16	
BRIDGES	Clearance Width—Feet		Under 100′ long Full Roadway Over 100′ Long, Pavement Plus 6′		28		28		30		Under 80′ Long Full Roadway Over 80′ Long Pavement Plus 6′	
	Vertical Clearance		14.5 FEET MINIMUM									
Grade Separations Basic Design as for Bridges			INTERSTATE SYSTEM—see note (5) Special study for warrants on other routes		None Required		Special Study for Warrants					

(1) For volumes in this range capacity studies may indicate need for 4 lanes.
(2) Pavement width plus 12 foot right side shoulders plus median. Median width 36 ft. or wider desirable. Minimum median 4 ft.
(3) In suburban congested areas design and operating speeds may be reduced 10 m.p.h. with appropriate curvature and stopping sight distances.
(4) On routes other than expressways, partial control of access on new locations and where feasible elsewhere.
(5) All mainline railroad crossings and on routes other than expressways all highway crossings where cross traffic exceeds 750 V.P.D.
(6) Shoulders should be constructed with sufficient stability to support vehicle loads in wet weather without rutting. On roads with traffic volumes in excess of 3000 V.P.D. or where dual-tired commercial traffic exceeds 150 V.P.D., and on other roads where surface water creates a maintenance problem bituminous shoulder construction is desirable.

DESIGN STANDARDS FOR COUNTY PRIMARY ROADS

Note: Geometric design features such as gradients, curvature, sight distance, etc., not specifically covered below are to be equal to or above minimum values of A.A.S.H.O. standards for Federal-aid secondary roads.

RURAL PRIMARY ROADS					STRUCTURES		
1975 Average Daily Traffic	Surface Type	Surface Width	Grade Width	Surface Type	Design Load	Clear Width	Vertical Clearance
Over 1000	Use Standards for Rural State Trunklines						
400 to 1000	E	22′-24′[1]	30′-32′[1]	Intermediate	H-20	28′	14′
100 to 400	E	22′	30′	Intermediate	H-20	28′	14′
50 to 100	D	22′	28′	Surface Treated Gravel	H-20	26′	14′
Under 50	C	20′	26′	6″ Compact Gravel	H-20	24′	14′
URBAN PRIMARY ROADS (in cities under 5,000 population)							
Built up residential areas	Minimum Standards						
Over 1000	Use State Trunkline Standards						
400 to 1000	E	22′	30′	Intermediate[2]			
Under 400	E	22′	30′	Intermediate			

Automatic railroad grade crossing protection devices should be provided when highway traffic times number of trains per day exceeds 3,500.

[1] Use the higher values for roads in agricultural areas or carrying heavy truck traffic.
[2] In business areas curb and gutter section should be used with a minimum pavement width for two travel lanes plus parallel parking.

NEW CONSTRUCTION STANDARDS FOR ARTERIAL STREETS

Design Features	All Cities			Cities of over 5,000 population			Cities of under 5,000 population		
	Controlled Access[1]			Arterials			Arterials		
				Downtown area	Intermediate area	Outlying area	Downtown area	Intermediate area	Outlying area
1975 Design Hour Traffic Volume Total for No. of Lanes Shown	7200 to 9000	Up to 6000	State trunkline by-passes only under 750[2]	*SEE BELOW*					
Surface Type	F			F	F-or-E[3]		F	F, E-or-D[3]	
Number of Lanes	6[4]	4[4]	2[4]	Controlled by anticipated 1975 traffic volumes and operating conditions determine required street width by consulting hourly capacity tables[5]					
Surface Width	72′	48′	24′						
Curbs and Sidewalks	Not required: Pedestrians not permitted Pedestrian Crossings to be provided where needed			Yes	Yes	Only as required	Yes	Yes	Only as required
Shoulder Width	12′	12′	10′	———	———	8′	———	———	8′
Median Width	Minimum 4′ if not mountable, otherwise 20′		———	4′ Median where design hour traffic volume exceeds 750 if feasible					
Parking	Not Permitted Except on Frontage Roads			For streets having a design hour traffic volume exceeding 750, parking generally to be discouraged, with the parallel parking permitted only during off-peak hours. Parallel parking permitted for lesser traffic volumes.					
Illumination	Continuous		at Intersec.	Continuous	At intersections		Continuous	At intersections	
Intersection Treatment 10% or more of Traffic on Intersecting Street	Full Access Control		([6])	Progressive traffic signal system or fixed time signal where warranted Stop sign control for lower traffic volumes					
Less than 10% of traffic on Intersecting Street			([7])	Traffic or pedestrian actuated signals where warranted or stop sign control.					
Structures Width	Under 100′ long—full roadway width over 100′ long—pavement width[8] plus 6′ plus median			Pavement plus sidewalks					
Vertical Clearance	14.5′			14.5′					
Loading	H-20 - S-16			For heavy commercial traffic H-20-S-16[9] Other H-20					
Railroad Crossing Separation	At all Railroad Crossings			Main Line crossings on streets carrying heavy traffic volume where practical and economically feasible.					
Railroad Grade Crossing Protection	———			Flashing light signals at all crossings without watchman or flagman and where average daily traffic x number of trains=3500 or more.					

[1] Standards for controlled access arterials based on 40 m.p.h. operating speed. Access permitted only at interchanges and intersections with other arterials. Access from abutting property by frontage streets where required.
[2] Applies specifically to new locations of 2-lane state trunkline routes by-passing business areas of municipalities.
[3] Character and amount of traffic should determine the type of surface required.
[4] 12 foot traffic lanes.
[5] Street width chosen should be divisible into even numbers of 11′ or 12′ lanes, except where one-way operation is planned.
[6] Grade separations where warranted and feasible otherwise channelized and signalized intersection at grade.
[7] Channelized and signalized intersection at grade.
[8] Includes shoulders of approaches.
[9] Heavy commercial traffic includes large numbers of tractor trailers.

DESIGN STANDARDS FOR MUNICIPAL LOCAL STREETS

Design Code	Service Characteristics	Surface Type	Type Curve	Surface Width
5	Heavy Traffic Close-in Areas	High	S_1–30 (over 25M pop.) S_1–40 (under 25M pop.)	36′ curbed section
4	Normal Traffic Developed Residential Areas	High	S_1–30 (over 25M pop.) S_1–40 (under 25M pop.)	30′ curbed section
3	Out-Lying Areas—Large Municipalities Normally Developed Areas— Intermediate Municipalities	Intermediate	S_1–25	30′ curbed section
2	Normally Developed Areas—Small Municipalities Out-Lying Areas— Intermediate Municipalities	Surface Treated Gravel	S_1–18	22′ plus two 8′ shlrs.
1	Out-Lying Areas—Small Municipalities	Gravel	L_1–14	22′ plus two 8′ shlrs.

DESIGN STANDARDS FOR COUNTY LOCAL ROADS

Service Characteristics	Design Code	Surface Type	Surface Width	Grade Width
A. Heavy Traffic Roads				
1. Over 1,000 ADT	40	Intermediate	22′	30′
2. 400 to 1,000 ADT	30	Intermediate	20′	30′
3. 100 to 400 ADT	20	Surface Treated Gravel	20′	28′
4. Under 100 ADT	10	6″ Gravel	20′	28′
B. Recreational Roads				
1. Heavily Developed Area	20	Surface Treated Gravel	20′	28′
2. Sparsely Developed Area	11	4″ Gravel		24′
C. Platted Streets				
1. Heavily Developed Urban Area	50	Intermediate	30′*	30′
2. Sparsely Developed Urban Area	30	Intermediate	20′	30′
3. Heavily Developed Resort Area	20	Surface Treated Gravel	20′	28′
4. Sparsely Developed Resort Area	11	4″ Gravel		24′
D. School Bus—Milk Route	10	6″ Gravel	20′	28′
E. Rural Mail Route	11	4″ Gravel		24′
F. Seasonal Trails				
1. Required as Public Road	—	To be kept up by maintenance		
2. Maintenance could be suspended	—			
G. All Other Local Roads	11	4″ Gravel		24′

* Curbed Section.

20-YEAR CONSTRUCTION COSTS

STATE TRUNKLINES

	Rural	Urban	Total
Right of Way	$ 271,897,000	$ 337,640,000	$ 609,537,000
Grade and Drain	393,082,000	322,010,000	715,092,000
Base and Surface	657,173,000	242,364,000	899,537,000
Structures	204,214,000	378,803,000	583,017,000
Total	$1,526,366,000	$1,280,817,000	$2,807,183,000

COUNTY PRIMARY ROADS

	Rural	Urban	Total
Right of Way	$ 25,808,000	$ 17,547,000	$ 43,355,000
Grade and Drain	276,576,000	24,799,000	301,375,000
Base and Surface	478,315,000	57,424,000	535,739,000
Structures	81,657,000	17,868,000	99,525,000
Total	$ 862,356,000	$ 117,638,000	$ 979,994,000

MAJOR STREETS

Right of Way	$149,023,000
Grade and Drain	170,374,000
Base and Surface	233,956,000
Structures	121,647,000
TOTAL	$675,000,000

PROGRAM COSTS COUNTY ROADS

COUNTY	COUNTY PRIMARY				LOCAL ROADS
	Average Annual Costs				Average annual cost for 20-year period
	10-year period	Second 10 years of 20-year period	15-year period	20-year period	
Alcona	$ 258,000	$ 120,000	$ 215,000	$ 189,000	$ 319,000
Alger	297,000	161,000	252,000	229,000	135,000
Allegan	1,727,000	626,000	1,370,000	1,178,000	1,221,000
Alpena	429,000	228,000	371,000	328,000	226,000
Antrim	415,000	239,000	349,000	327,000	367,000
Arenac	327,000	152,000	267,000	239,000	243,000
Baraga	419,000	144,000	327,000	283,000	228,000
Barry	631,000	316,000	529,000	476,000	640,000
Bay	733,000	657,000	812,000	696,000	596,000
Benzie	279,000	162,000	234,000	221,000	199,000
Berrien	1,358,000	823,000	1,223,000	1,090,000	1,069,000
Branch	807,000	393,000	685,000	600,000	474,000
Calhoun	1,074,000	984,000	1,113,000	1,029,000	1,080,000
Cass	519,000	403,000	504,000	462,000	411,000
Charlevoix	443,000	171,000	356,000	308,000	295,000
Cheboygan	472,000	296,000	434,000	384,000	309,000
Chippewa	907,000	510,000	801,000	709,000	527,000
Clare	384,000	259,000	352,000	323,000	379,000
Clinton	977,000	600,000	932,000	789,000	785,000
Crawford	375,000	240,000	347,000	308,000	207,000
Delta	783,000	343,000	647,000	564,000	350,000
Dickinson	445,000	205,000	379,000	325,000	339,000
Eaton	792,000	546,000	768,000	669,000	685,000
Emmet	488,000	356,000	480,000	423,000	397,000
Genesee	3,479,000	1,645,000	2,810,000	2,557,000	2,636,000
Gladwin	398,000	360,000	422,000	379,000	305,000
Gogebic	457,000	428,000	463,000	442,000	279,000
Grand Traverse	432,000	276,000	394,000	353,000	349,000
Gratiot	939,000	519,000	853,000	729,000	499,000
Hillsdale	716,000	420,000	625,000	568,000	499,000
Houghton	950,000	502,000	819,000	728,000	540,000
Huron	732,000	419,000	669,000	576,000	760,000
Ingham	1,379,000	1,050,000	1,317,000	1,214,000	991,000
Ionia	1,099,000	537,000	953,000	819,000	669,000
Iosco	349,000	171,000	284,000	259,000	400,000
Iron	479,000	275,000	418,000	377,000	239,000
Isabella	575,000	549,000	590,000	562,000	415,000
Jackson	1,288,000	886,000	1,190,000	1,087,000	891,000
Kalamazoo	1,738,000	1,074,000	1,591,000	1,406,000	1,205,000
Kalkaska	292,000	302,000	321,000	296,000	252,000
Kent	3,290,000	1,396,000	2,762,000	2,342,000	1,869,000
Keweenaw	195,000	224,000	244,000	209,000	65,000
Lake	452,000	235,000	394,000	344,000	367,000
Lapeer	854,000	526,000	796,000	690,000	659,000
Leelanau	251,000	127,000	210,000	189,000	319,000
Lenawee	1,485,000	728,000	1,275,000	1,106,000	868,000
Livingston	990,000	413,000	800,000	701,000	602,000
Luce	270,000	157,000	226,000	214,000	72,000
Mackinac	498,000	210,000	405,000	354,000	265,000
Macomb	2,894,000	1,296,000	2,502,000	2,095,000	1,580,000

PROGRAM COSTS COUNTY ROADS—Continued

COUNTY	COUNTY PRIMARY				LOCAL ROADS
	Average Annual Costs				
	10-year period	Second 10 years of 20-year period	15-year period	20-year period	Average annual cost for 20-year period
Manistee	481,000	300,000	442,000	390,000	359,000
Marquette	664,000	557,000	668,000	610,000	485,000
Mason	414,000	221,000	352,000	318,000	460,000
Mecosta	866,000	345,000	717,000	607,000	553,000
Menominee	1,002,000	517,000	891,000	759,000	481,000
Midland	1,044,000	373,000	826,000	710,000	381,000
Missaukee	427,000	280,000	372,000	354,000	429,000
Monroe	1,240,000	576,000	1,050,000	908,000	648,000
Montcalm	870,000	496,000	759,000	683,000	792,000
Montmorency	339,000	217,000	311,000	278,000	224,000
Muskegon	1,212,000	626,000	1,036,000	919,000	941,000
Newaygo	599,000	436,000	571,000	517,000	778,000
Oakland	10,630,000	2,300,000	7,966,000	6,464,000	5,043,000
Oceana	535,000	263,000	456,000	398,000	523,000
Ogemaw	589,000	303,000	473,000	446,000	305,000
Ontonagon	702,000	320,000	599,000	511,000	274,000
Osceola	425,000	265,000	400,000	345,000	493,000
Oscoda	243,000	171,000	238,000	207,000	192,000
Otsego	410,000	273,000	388,000	342,000	168,000
Ottawa	1,015,000	653,000	922,000	833,000	830,000
Presque Isle	532,000	215,000	416,000	373,000	299,000
Roscommon	192,000	173,000	203,000	183,000	358,000
Saginaw	1,646,000	786,000	1,365,000	1,216,000	1,723,000
Sanilac	541,000	327,000	496,000	434,000	918,000
Schoolcraft	375,000	204,000	330,000	290,000	113,000
Shiawassee	772,000	455,000	669,000	613,000	584,000
St. Clair	1,872,000	797,000	1,501,000	1,334,000	1,574,000
St. Joseph	768,000	467,000	688,000	618,000	493,000
Tuscola	545,000	359,000	462,000	452,000	808,000
Van Buren	1,049,000	433,000	868,000	742,000	628,000
Washtenaw	1,970,000	892,000	1,694,000	1,431,000	874,000
Wayne	14,144,000	10,055,000	13,025,000	12,099,000	3,955,000
Wexford	348,000	189,000	292,000	269,000	359,000
TOTALS	$90,281,000	$48,503,000	$78,526,000	$69,398,000	$56,121,000

PROGRAM COSTS MUNICIPAL STREETS

(Not including urban trunklines and county primary extensions)

Place or Population Group	MAJOR STREETS Average Annual Costs				LOCAL STREETS
	10-year period	Second 10 years of 20-year period	15-year period	20-year period	Average annual cost for 20-year period
Detroit	$33,413,000	$12,747,000	$26,587,000	$23,079,000	$ 8,680,000
Grand Rapids	1,085,000	652,000	936,000	868,000	1,270,000
Flint	1,603,000	1,514,000	1,852,000	1,558,000	1,764,000
Bay City	334,000	584,000	530,000	460,000	597,000
Dearborn	440,000	412,000	426,000	425,000	642,000
Jackson	532,000	294,000	496,000	413,000	540,000
Kalamazoo	760,000	201,000	571,000	480,000	358,000
Lansing	530,000	454,000	548,000	492,000	667,000
Pontiac	1,143,000	348,000	902,000	745,000	829,000
Saginaw	1,131,000	953,000	1,106,000	1,039,000	979,000
45-50,000	2,419,000	1,118,000	2,035,000	1,769,000	1,923,000
40-45,000	1,613,000	88,000	1,104,000	851,000	166,000
35-40,000	779,000	813,000	967,000	796,000	537,000
25-30,000	380,000	211,000	316,000	295,000	532,000
20-25,000	734,000	326,000	632,000	530,000	589,000
10-20,000	6,134,000	2,840,000	5,186,000	4,487,000	4,519,000
5-10,000	3,483,000	1,550,000	2,823,000	2,517,000	3,167,000
2,500-5,000	1,613,000	1,178,000	1,500,000	1,395,000	1,556,000
1,000-2,500	2,210,000	1,386,000	1,960,000	1,798,000	2,254,000
under 1,000	2,088,000	1,156,000	1,801,000	1,621,000	1,536,000
TOTALS	$62,424,000	$28,825,000	$52,278,000	$45,618,000	$33,105,000

The construction costs for municipalities would be increased by the amount of participation required for urban trunkline development under present or future legislation.