# ESTIMATING TRAFFIC
# ON MICHIGAN HIGHWAYS

MICHIGAN STATE HIGHWAY DEPARTMENT
JOHN C. MACKIE, COMMISSIONER

MICHIGAN
STATE HIGHWAY DEPARTMENT
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# ESTIMATING TRAFFIC
# ON MICHIGAN HIGHWAYS

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Estimating Traffic on Michigan Highways

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# ESTIMATING TRAFFIC
# ON MICHIGAN HIGHWAYS

## Purpose

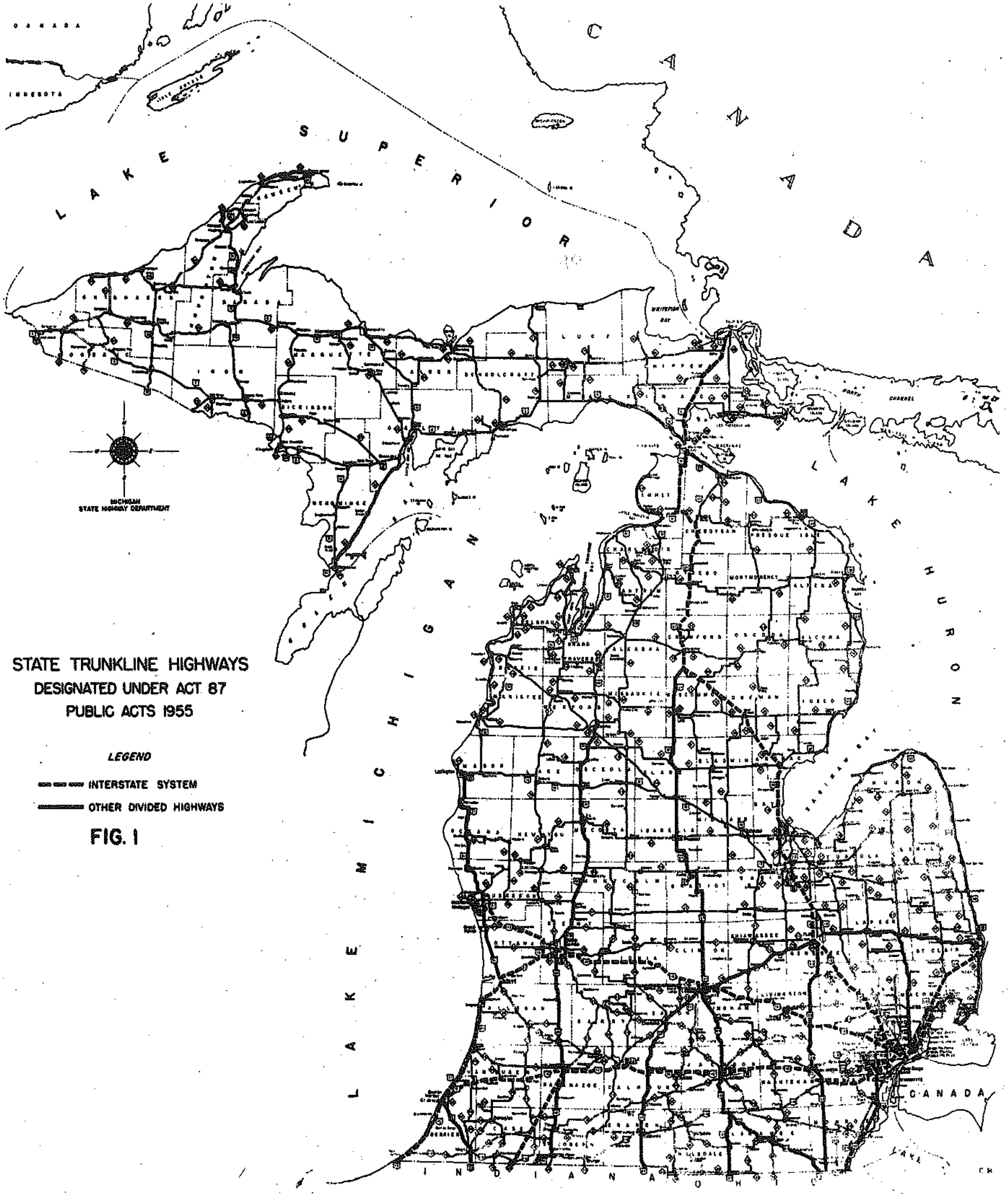
The primary purpose of this manual is to establish and briefly explain the methods and procedures now followed when estimating future traffic on the state trunkline systems in Michigan. The methods and procedures may be changed after enough limited access highways are opened and traffic land development studies have been made so that it will be possible to re-evaluate our present thinking of what will occur twenty years hence.

## Area

Large cities in the South, recreational areas in the North and the geographical location between four major bodies of water limits major transportation in the State to a few key trunklines. Some of the routes of travel have a terminus at one of the four bodies of water namely, Lake Superior, Lake Michigan, Lake Huron and Lake Erie.

The majority of the motorists when traveling on the trunkline system are faced with the problem of deciding which facility will take them to their destination by the shortest route and in the quickest possible time. The map on the following page, Figure 1, shows the principal highways of travel for the State as designated under Act 87, Public Acts of 1955.

Northbound traffic entering the Upper Peninsula bound for the western states and Canada must use the Bridge at the Mackinac Straits. In the first full year of operation of the bridge, (1958), the traffic increased 50% over the previous year. (Ferries discontinued and bridge opened November 1, 1957.) Coverdale and Colpitts (Traffic Consultants) predicted that in 1975 the bridge would have an average daily traffic (ADT) of 9926. Figure 2 (Page 3) shows the anticipated traffic that will be crossing the Mackinac Bridge from 1958 to 1993.

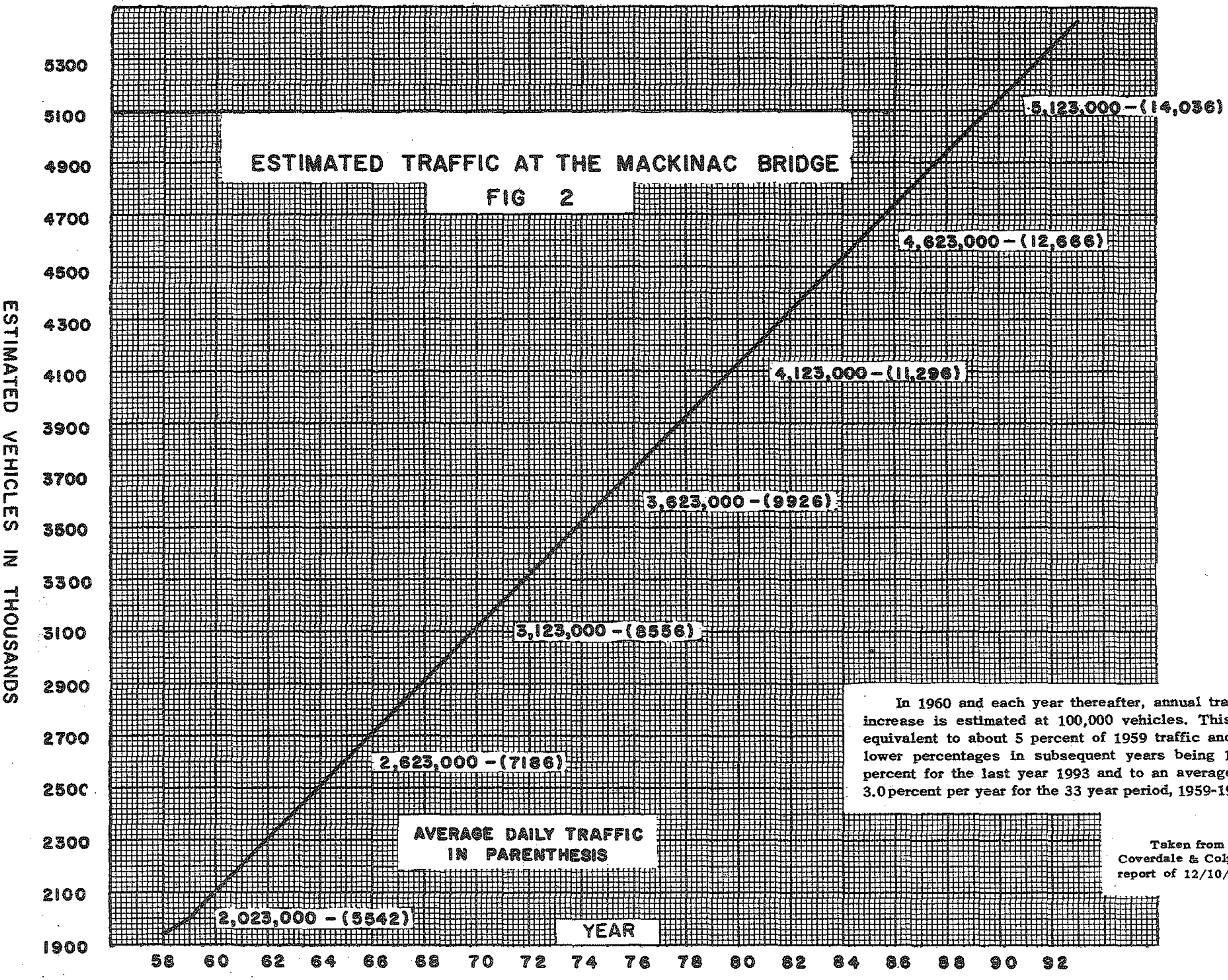


STATE TRUNKLINE HIGHWAYS
DESIGNATED UNDER ACT 87
PUBLIC ACTS 1955

*LEGEND*

▬ ▬ ▬ INTERSTATE SYSTEM
▬▬▬ OTHER DIVIDED HIGHWAYS

FIG. 1



ESTIMATED TRAFFIC AT THE MACKINAC BRIDGE

FIG 2

In 1960 and each year thereafter, annual traffic increase is estimated at 100,000 vehicles. This is equivalent to about 5 percent of 1959 traffic and to lower percentages in subsequent years being 1.93 percent for the last year 1993 and to an average of 3.0 percent per year for the 33 year period, 1959-1993.

Taken from
Coverdale & Colpitts
report of 12/10/53.

Since the Ohio-Indiana turnpike was opened to traffic, the majority of the trunkline routes leading into Michigan have shown a decline in traffic for 1958, although Interstate 75 (formerly US-24A) has shown a decided increase. Interstate 75 is the only major route leading into the Detroit area from Ohio that is constructed to limited access features. This increase on Interstate 75 has occurred even though the Detroit area was undergoing a recession in 1958. Until the improvement is completed on roads leading into Michigan from the Ohio-Indiana turnpike, the expected potential traffic will not be reached. Motorists are traveling further to avail themselves of better facilities. Michigan will also experience this change of travel habits as the present highway building program nears its goal.

It must be remembered that Michigan is not only an industrial state but also one of the nations leading vacation areas. Vacationers enter Michigan in great numbers during the May to October period. Since skiing and other winter sport facilities have developed rapidly in the past few years, they must be taken into consideration as a traffic problem during what was formerly an off peak season of the year. Figure 3 shows winter resort areas for the northern lower peninsula of Michigan. There are many similar areas in the upper peninsula and in the southern part of the State.

## Population-Registration-Travel (Past-Present-Future)

It is impractical to base the improvement of highways (new and existing) on present traffic volumes alone. It is also necessary to take into consideration the future traffic that is expected to use these facilities. A highway should be designed to accomodate the traffic that might occur within the life of the facility under reasonable maintenance. A period of twenty years is widely used as a basis for design. All available estimates of future population, registration and travel must be utilized and kept up to date. For example, if new roads were to

# TOP SKI SPOTS

## in Outstate Michigan's

### NORTHERN LOWER PENINSULA

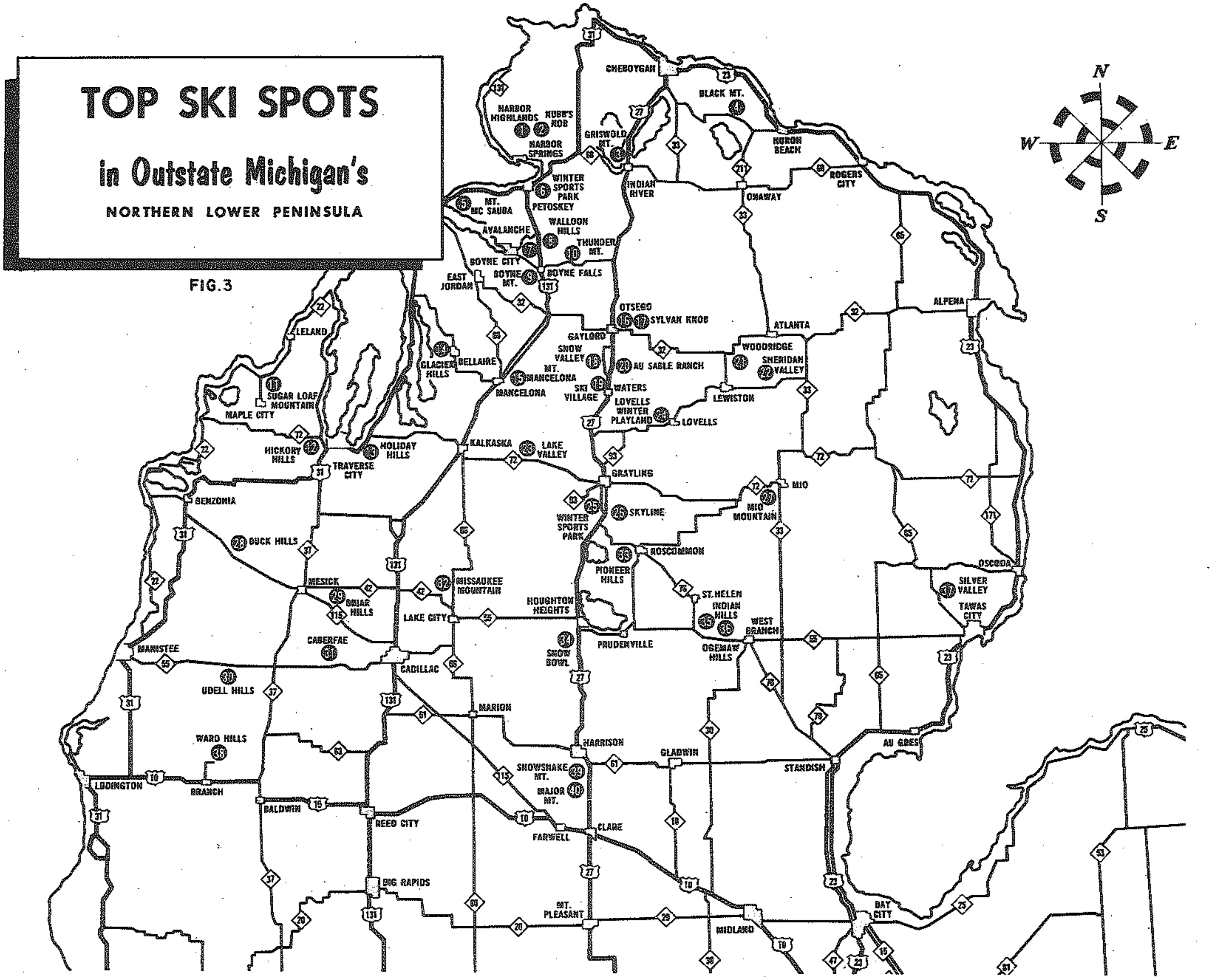


FIG.3

be constructed on the basis of traffic estimates of twenty years ago, few if any would be needed. If they were built on the basis of estimates of ten years ago, they would be obsolete before they were finished.

Listed below are projections of U.S. population by the Bureau of Census.

Projection of U.S. Population *
(in Thousands)

| Projected to Year | Year Reported | | | |
|---|---|---|---|---|
| | 1947 | 1955 | 1957 | 1958 |
| 1950 | 145,460 | 151,677 | 151,677 | 151,677 |
| 1960 | 153,375 | 177,426 | 179,358 | 181,154 |
| 1965 | 156,692 | 189,916 | 193,346 | 198,950 |
| 1970 | 159,847 | 204,222 | 209,380 | 219,474 |
| 1975 | N.R. | 220,982 | 228,463 | 243,880 |
| 1980 | 163,877 | N.R. | N.R. | 272,557 |

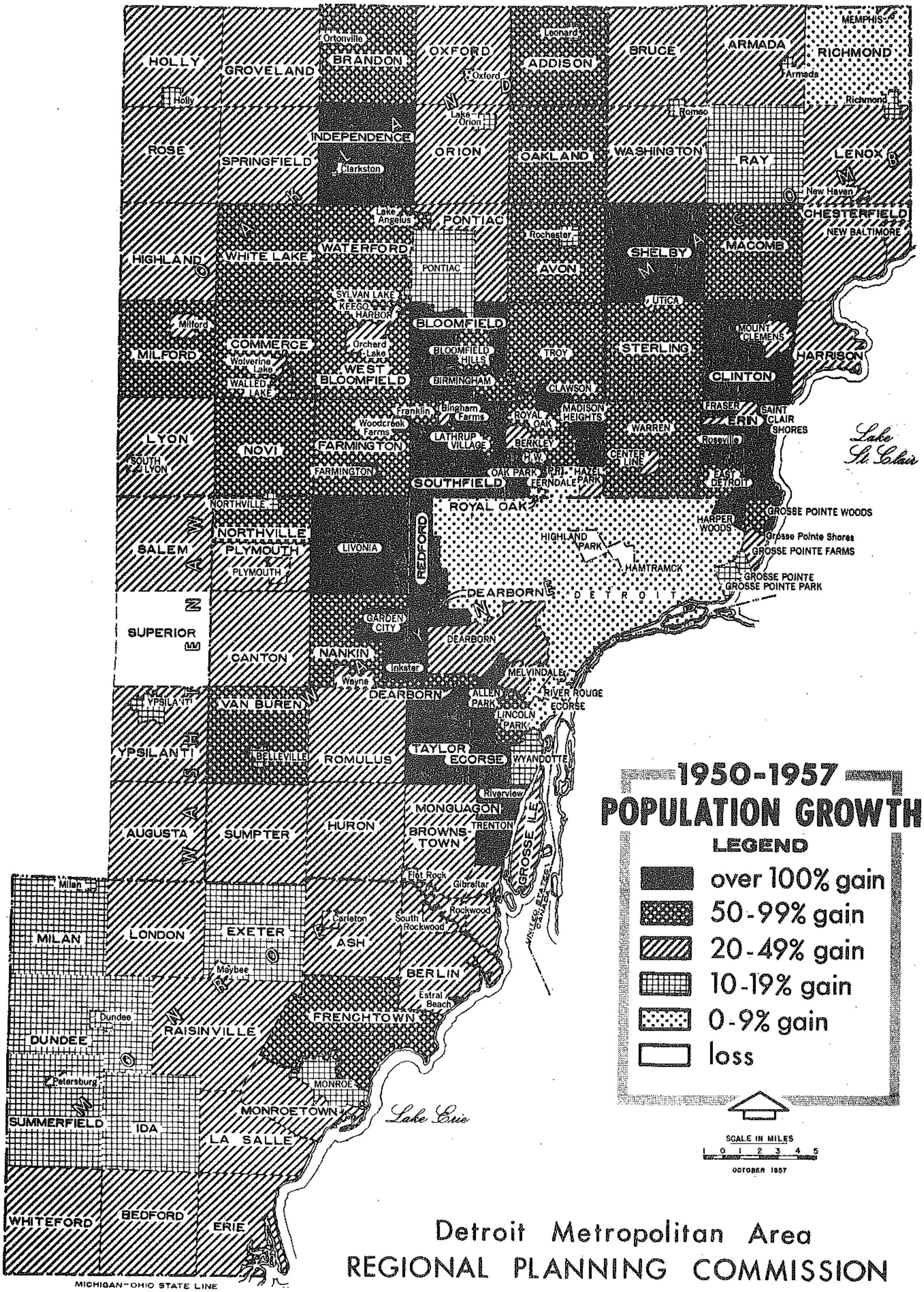
Projection of Michigan Population **
(in Thousands)

| | |
|---|---|
| 1950 | 6,372 |
| 1955 | 7,326 |
| 1960 | 8,355 |
| 1965 | 9,380 |
| 1970 | 10,483 |

The Metropolitan Area of Detroit anticipates a population in 1970 of 4,824,000 and a manufacturing employment of 862,000. In 1950 this area had a population of 3,136,000 with 649,000 people in manufacturing employment. Figures 4 and 5 (1956-1957 REGIONAL PLANNING, by Detroit Metropolitan Area Regional Planning Commission).

* Compiled from "Statistical Abstract of the United States" for years shown.

** Data taken from U.S. Department of Commerce, Bureau of Census Publication, P-25 series No. 160. (August 9, 1957).



Detroit Metropolitan Area
REGIONAL PLANNING COMMISSION
FIG 4

# POPULATION GROWTH in the DETROIT REGION

## 1920 - 1980

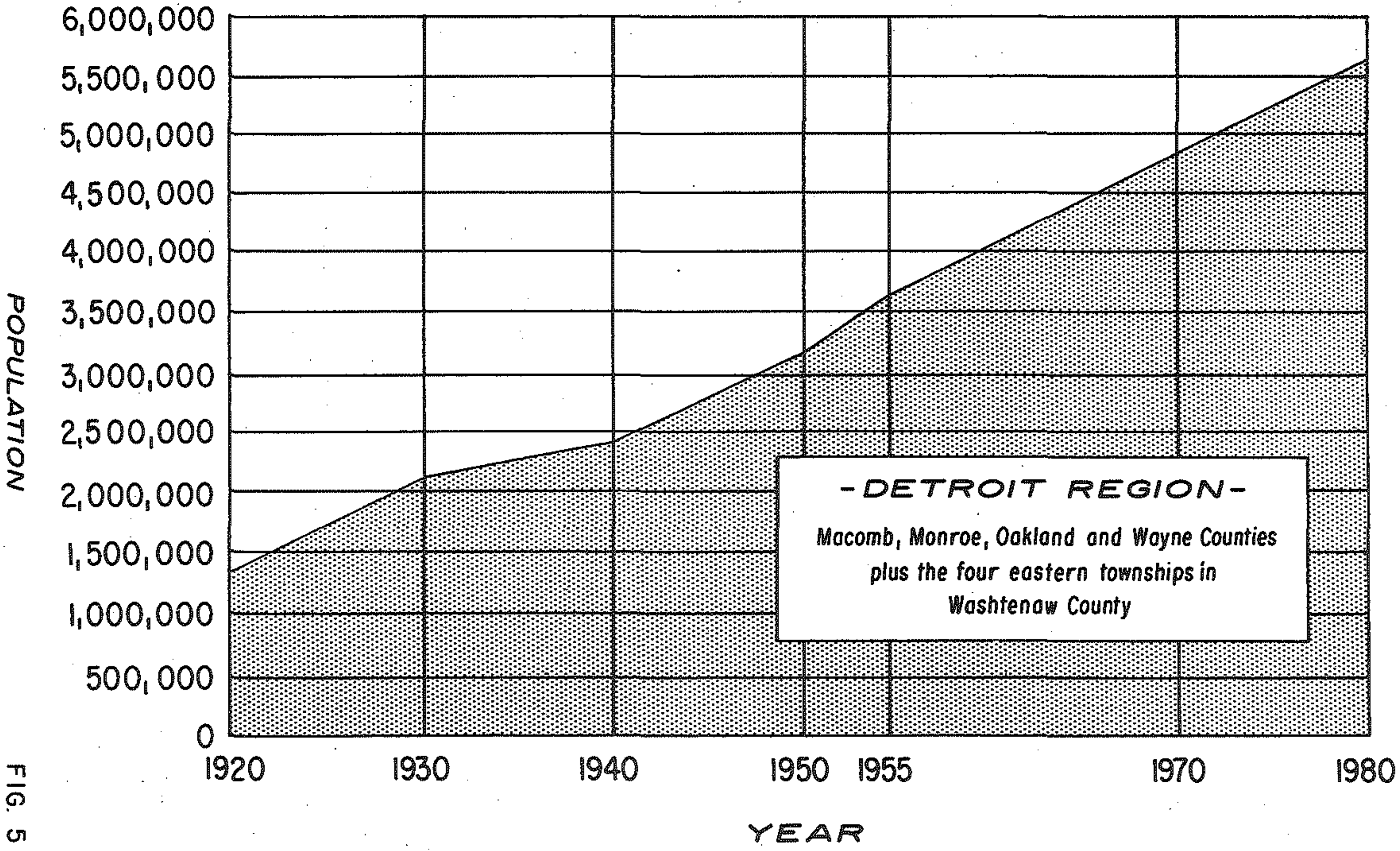


FIG. 5

### The Motor Vehicle Registration and Vehicle Miles of Travel in Michigan Since 1920 and Forecast to 1985

(Estimated by Michigan State Highway Department June, 1956)

| Year | Registration Motor Vehicles | Travel Thousands of Miles |
|---|---|---|
| 1920 | 412,717 | 2,061,295 |
| 1925 | 990,709 | 5,592,545 |
| 1929 | 1,397,672 | 9,573,385 |
| 1930 | 1,330,582 | 9,755,697 |
| 1935 | 1,242,022 | 10,349,847 |
| 1940 | 1,554,775 | 14,595,610 |
| 1945 | 1,475,152 | 11,918,155 |
| 1950 | 2,413,583 | 22,010,034 |
| 1955 | 2,916,974 | 28,093,373 |
| 1960 | 3,327,117 | 33,034,945 |
| 1965 | 3,718,045 | 37,816,231 |
| 1970 | 4,128,115 | 42,787,909 |
| 1975 | 4,573,412 | 48,116,869 |
| 1980 | 5,013,600 | 53,374,786 |
| 1985 | 5,451,399 | 58,580,734 |

Vehicle miles of travel have been re-estimated since the inception of the accelerated highway construction program. (See Appendix A, table on page xiii).

In 1915 there were approximately 2½ million automobiles in the U.S. By the end of 1952 the motor vehicle registration had risen to over 53 million. Motor vehicle travel has followed a similar trend, increasing from approximately 50 billion vehicle miles in 1920 to about 460 billion vehicle miles in 1950. It was estimated in 1952 that 550 billion vehicle miles would be reached by 1954. Actually 1954 showed over 561 billion vehicle miles of travel.

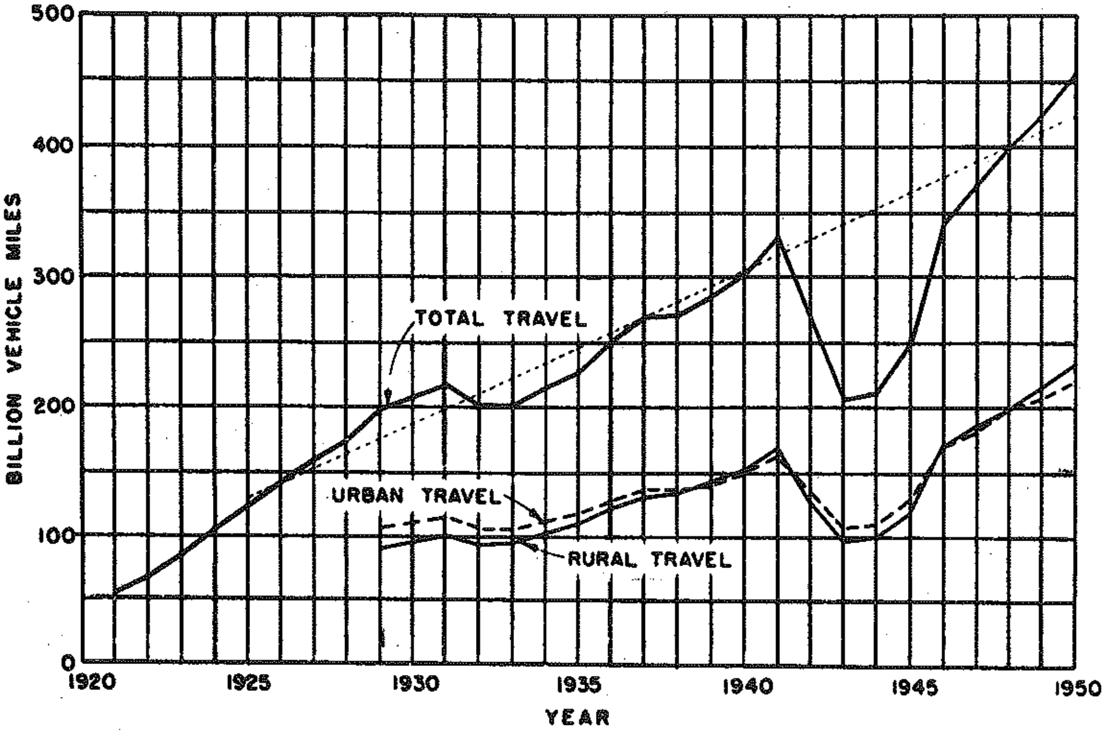
Indications are that this general upward trend will continue into the future. Despite predictions that motor travel will reach a saturation point, traffic has repeatedly pushed through each expected ceiling.

Figure 6 shows total estimated motor vehicle travel in the United States, 1921-1950 and estimated rural and urban travel, 1929-1950. Except for the dip during World War II (1941-1946) the upward trend has been maintained. Between 1946 and 1950 the increase has been about 30 billion vehicle miles per year. The increase will in all probability be slightly less in future years.

From the past trend, the motor vehicle travel may be projected to the future years for which the highway is to be designed. This may be done by plotting a curve of total vehicle miles against years, similar to figure 6 and projecting the curves on the basis of population forecasts, registration forecasts and miles of travel per vehicle.

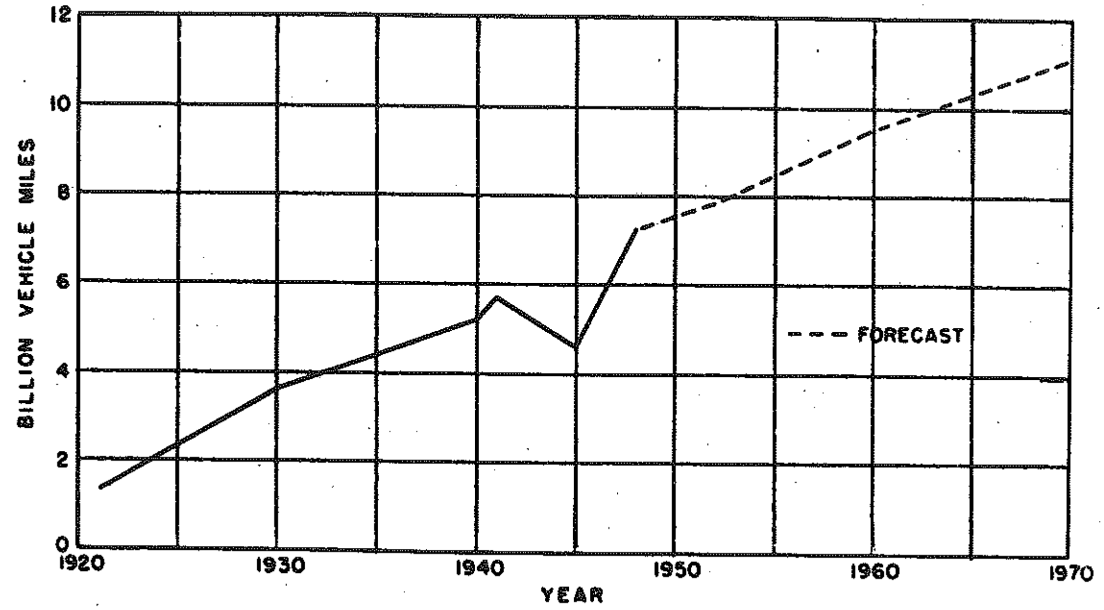
Figure 7 (Page 12) is Michigan's projection of vehicle miles by system taken from data shown in the 1957 report of Section 210 study,1/ part C-2 as submitted to the Bureau of Public Roads. Data to plot these graphs are taken from tables in Appendix A (Pages i-xiii). These tables were developed to show the vehicle miles of travel by years, from the year 1956 to the year 1985, on the various road systems of the State.

1/ Study of equity in Federal taxation for Highways.



TOTAL MOTOR VEHICLE TRAVEL — UNITED STATES

—A—

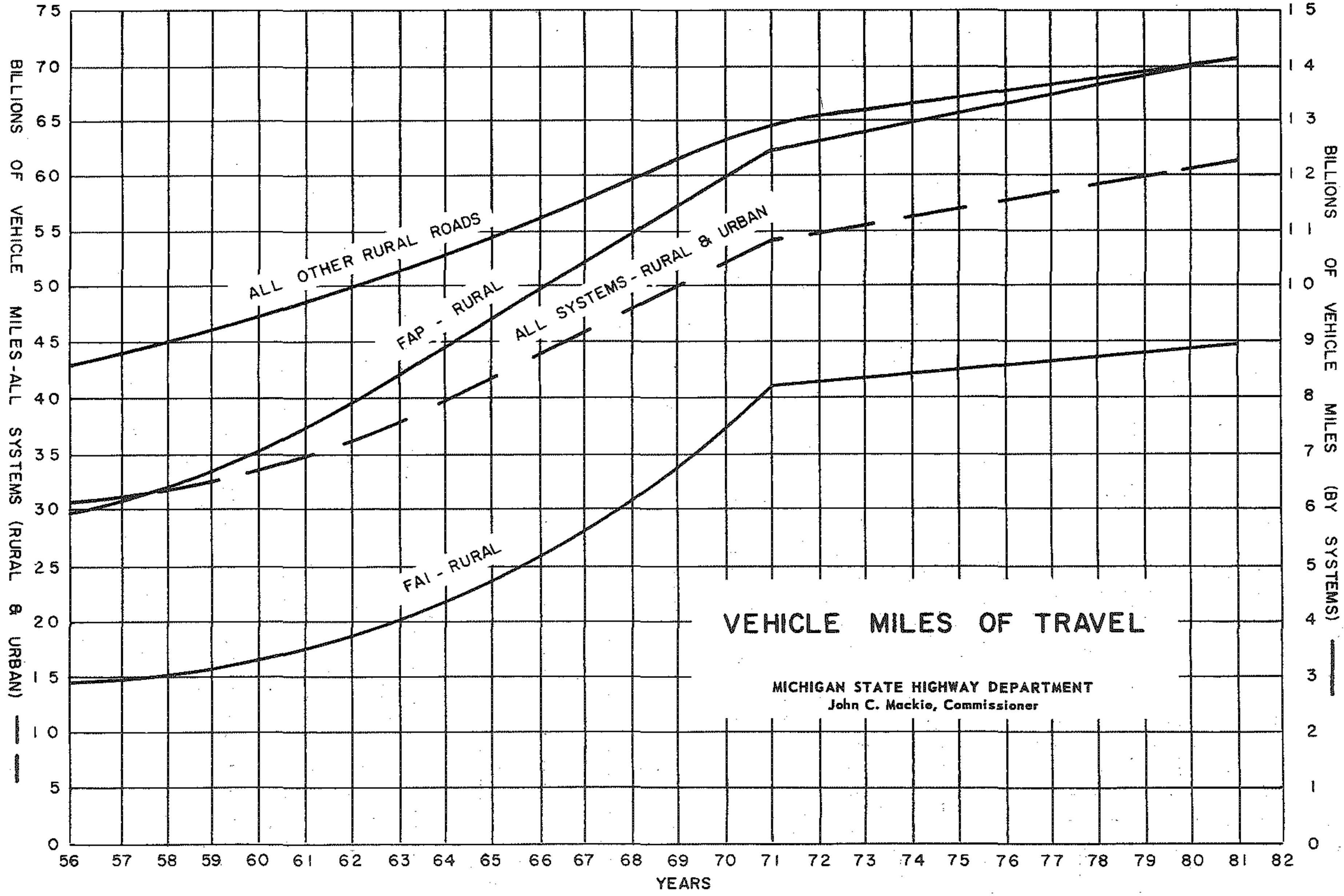


TOTAL MOTOR VEHICLE TRAVEL AND FORECAST—SELECTED STATE

—B—

MOTOR VEHICLE TRAVEL TRENDS

FIG 6


VEHICLE MILES OF TRAVEL
MICHIGAN STATE HIGHWAY DEPARTMENT
John C. Mackie, Commissioner
ALL OTHER RURAL ROADS
FAP - RURAL
ALL SYSTEMS - RURAL & URBAN
FAI - RURAL
BILLIONS OF VEHICLE MILES-ALL SYSTEMS (RURAL & URBAN)
BILLIONS OF VEHICLE MILES (BY SYSTEMS)
YEARS
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
56
57
58
59
60
61
62
63
64
65
66
67
68
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70
71
72
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74
75
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79
80
81
82

FIG. 7

At the time of the Section 210 Study no attempt was made to determine the future changes in incorporated areas in the State. As a consequence, the projected roads that were in rural areas in 1956 were considered to be in rural areas twenty years later.

No attempt has been made to predict what suburban areas will become incorporated within the next 20 years.

As a result of changes in rural-urban areas and changes in road systems due to the relocation of many miles of highway both on the Interstate System and the Federal Aid Primary System as well as transfers to the Federal Aid Secondary System, it is impossible to use these tables as a base for expansion of traffic on any given section of road.

Even if the mileage from 1956 to 1985 were to remain the same, these tables could not be used, as they are average conditions for the entire State. For example, when a F.A.S. road interchanges with a limited access highway its traffic increase will be much more rapid than a F.A.S. road removed a distance from the new road.

The history of traffic surveys in the State dates back to 1918, during World War I. The first comprehensive survey was conducted in 1936; this survey included continuous counts supplemented with periodic density counts on the more important roads to determine traffic patterns, blanket counts on all roads except the very low volume local roads, an O-D survey that covered all the rural state highways, a road use survey covering both the rural and urban areas, and pitscale and loadometer surveys to obtain weights and dimensions of vehicles. In 1936 the first permanent automatic traffic recorder was installed; more were installed in 1937 and in later years. Several of these early installations are still being operated. In 1940, the first portable traffic counters were placed in operation, and after World War II (1946) the present series of O-D studies started. Many turning movements covering most trunkline and some county road junctions have been taken over the past twenty years.

From this wealth of information the various turning movements at interchanges can be estimated with reasonable accuracy. The trend of 30th high hour values also extends back to the year 1936, and from past experience can be projected twenty years with reasonable accuracy. The projector cannot, however, expect to predict abnormal occurrences that may occur in remote areas.

Figure 8 is a graphic method of illustrating an actual 8-hour turning movement at a six legged intersection in the southeast part of the State.

Since 1945 the Michigan State Highway Department has conducted 10 comprehensive O-D studies, 7 External Interview studies, 81 short O-D studies and 85 Colored Card studies. In addition the Michigan State Highway Department was a participating agency in the Detroit Metropolitan Area O-D study.

The comprehensive O-D study entails the obtaining of internal and external interviews. These studies are usually done for metropolitan areas of 25,000 population and over.

External interview studies are for urbanized areas of under 25,000 population. By placing a cordon line around the area, roadside interviews are obtained at these locations on both state highways and county roads. No internal interviews are obtained.

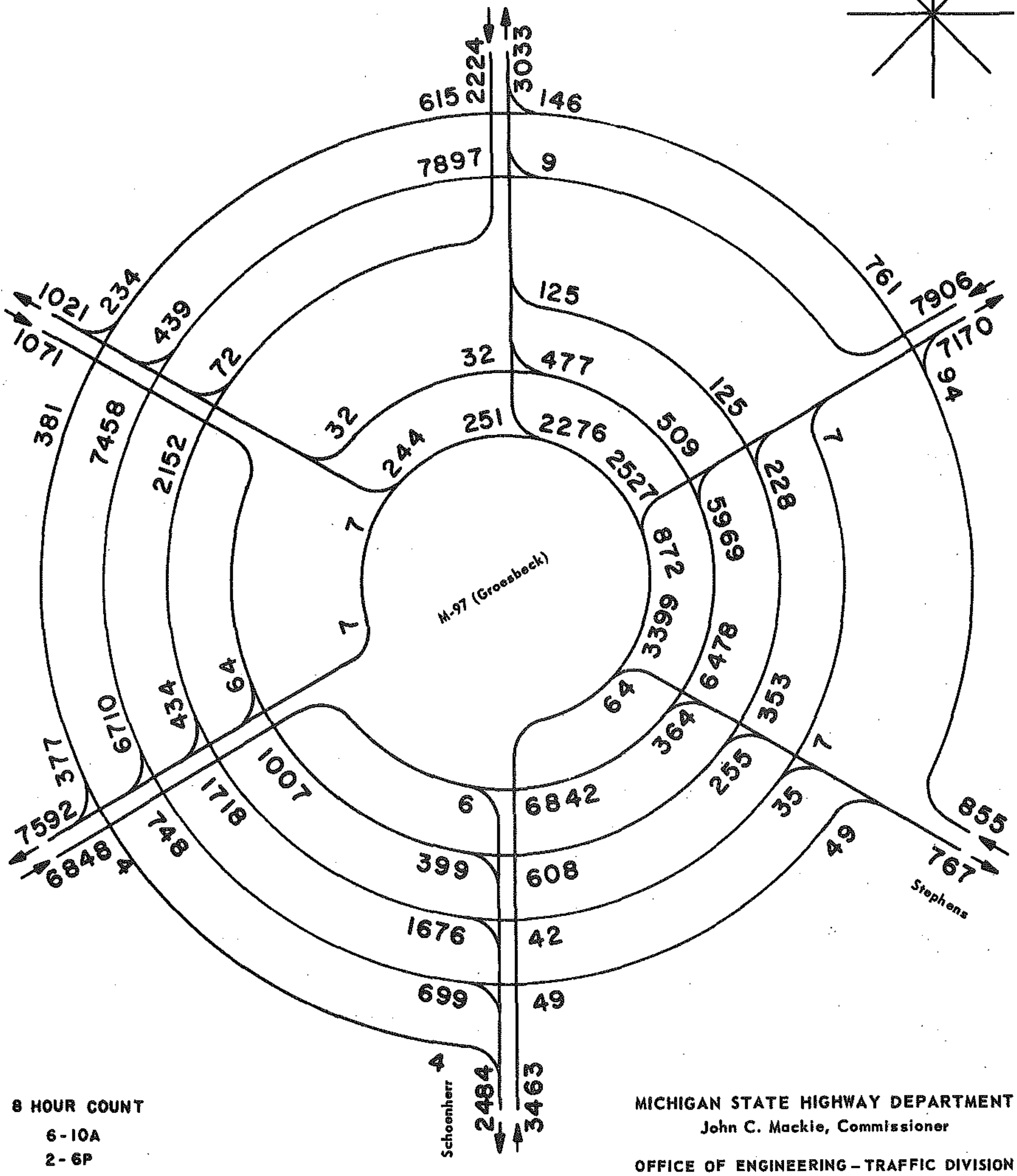
A short O-D could be taken on either the State trunkline system or county roads. The location of the station is dependent on the type of information desired for the particular route or locality.

Colored card studies involve a cordon line around smaller communities with stations selected on major routes of travel. All state trunklines regardless of traffic volumes are covered. Traffic entering the area is issued a colored card which is later picked up by interviewers as the motorist leaves the area.

DATE: 4-15-58

INDICATE NORTH

FIG. 8



8 HOUR COUNT
6-10A
2-6P

MICHIGAN STATE HIGHWAY DEPARTMENT
John C. Mackie, Commissioner

OFFICE OF ENGINEERING – TRAFFIC DIVISION

## SCHEMATIC VEHICLE VOLUME MULTIPLE LEGS

INTERSECTION OF M-97 (GROESBECK) AND SCHOENHERR RD. & STEPHENS ST.

Each leg of the study is designated by a color - blue, red, green etc. The color designation will indicate route of entrance with the route of exit determined by the station at which the card is picked up.

Figures 9 and 10 show by diagrams the results of colored card studies at Brighton and Albion. For actual office use the diagrams are colored to correspond to the colored cards issued on the various legs sampled. Figures 11a-11b (Pages 18 and 19) depict the result of an O-D study taken on US-31 - US-33 at the Indiana state line. From studies of this type it is possible to obtain data on desire movements of traffic necessary to determine future traffic patterns for the area.

At some of the permanent traffic recorder locations the traffic growth in the ten year period 1948 to 1958 was as follows:

| Route | Location | Percent Increase |
|---|---|---|
| US-12 | New Buffalo | 7.1% |
| US-12 | Marshall | 22.0% |
| US-16 | Fowlerville | 34.1% |
| US-16 | Cascade | 15.6% |
| US-25 | Port Sanilac | 39.1% |
| M-53 | Marlette | 9.9% |
| US-23 | Alpena | 70.0% |
| US-27 | Wolverine | 90.3% |
| M-28 & US-41 | Champion | 35.7% |
| M-115 | Farwell | 25.0% |
| M-78 | Perry | 47.4% |
| US-27 | St. Johns | 64.8% |
| US-23 | Brighton | 151.7% |

US-23 at Brighton increase due to opening of Fenton - Clio Expressway. No improvement was made on the section of road at the recorder.

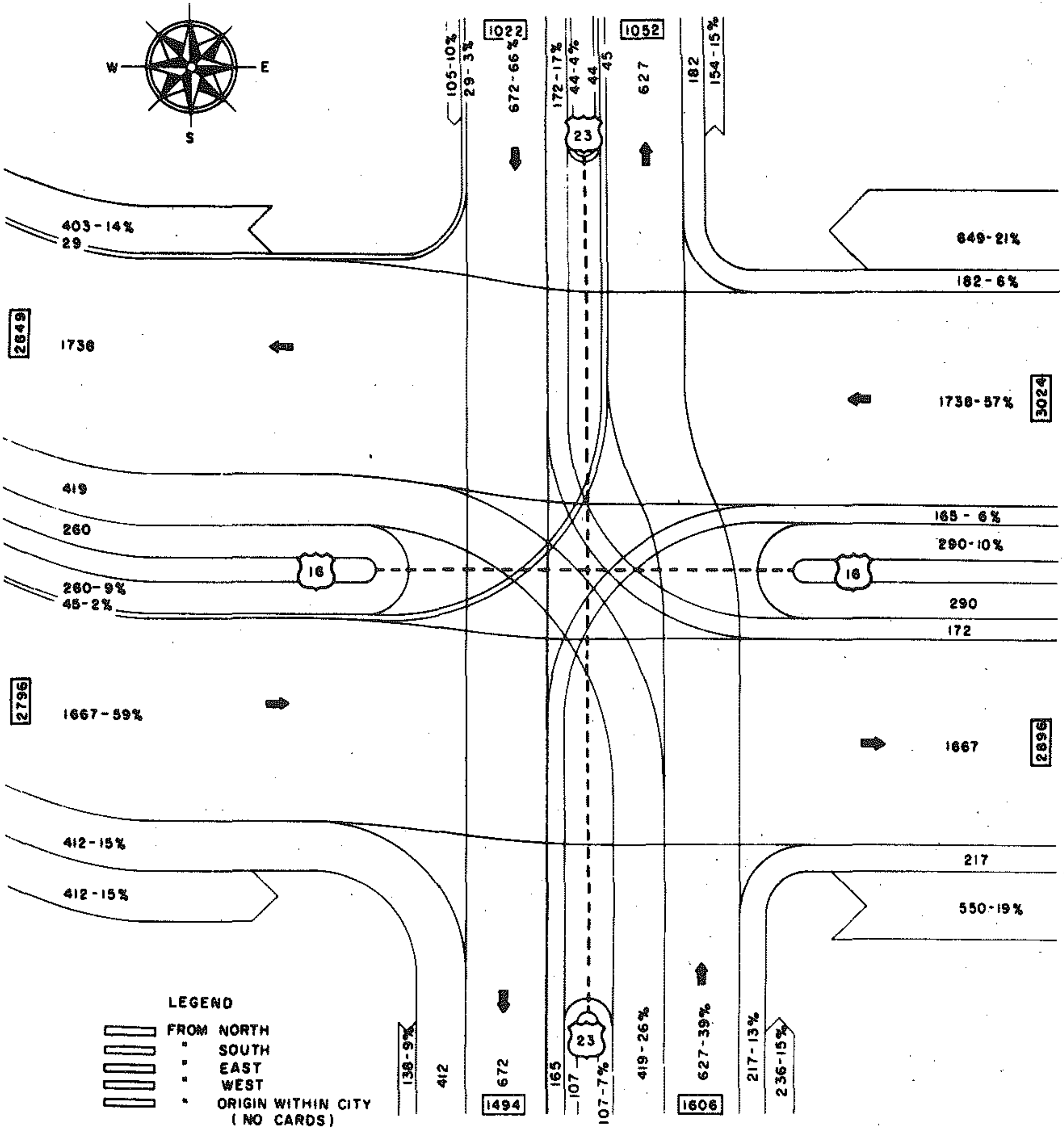
US-27 at St. Johns and M-78 at Perry increase can be credited to improved highway facilities.

US-23 at Alpena and US-27 at Wolverine are due to the Mackinac Bridge.

US-16 at Fowlerville is within 30 miles of the Farmington - Brighton

# DISTRIBUTION OF TRUNKLINE TRAFFIC IN THE BRIGHTON AREA

**THURSDAY JUNE 28, 1956**
8:00 A.M.-12:00 P.M. & 2:00 P.M.-6:00 P.M.

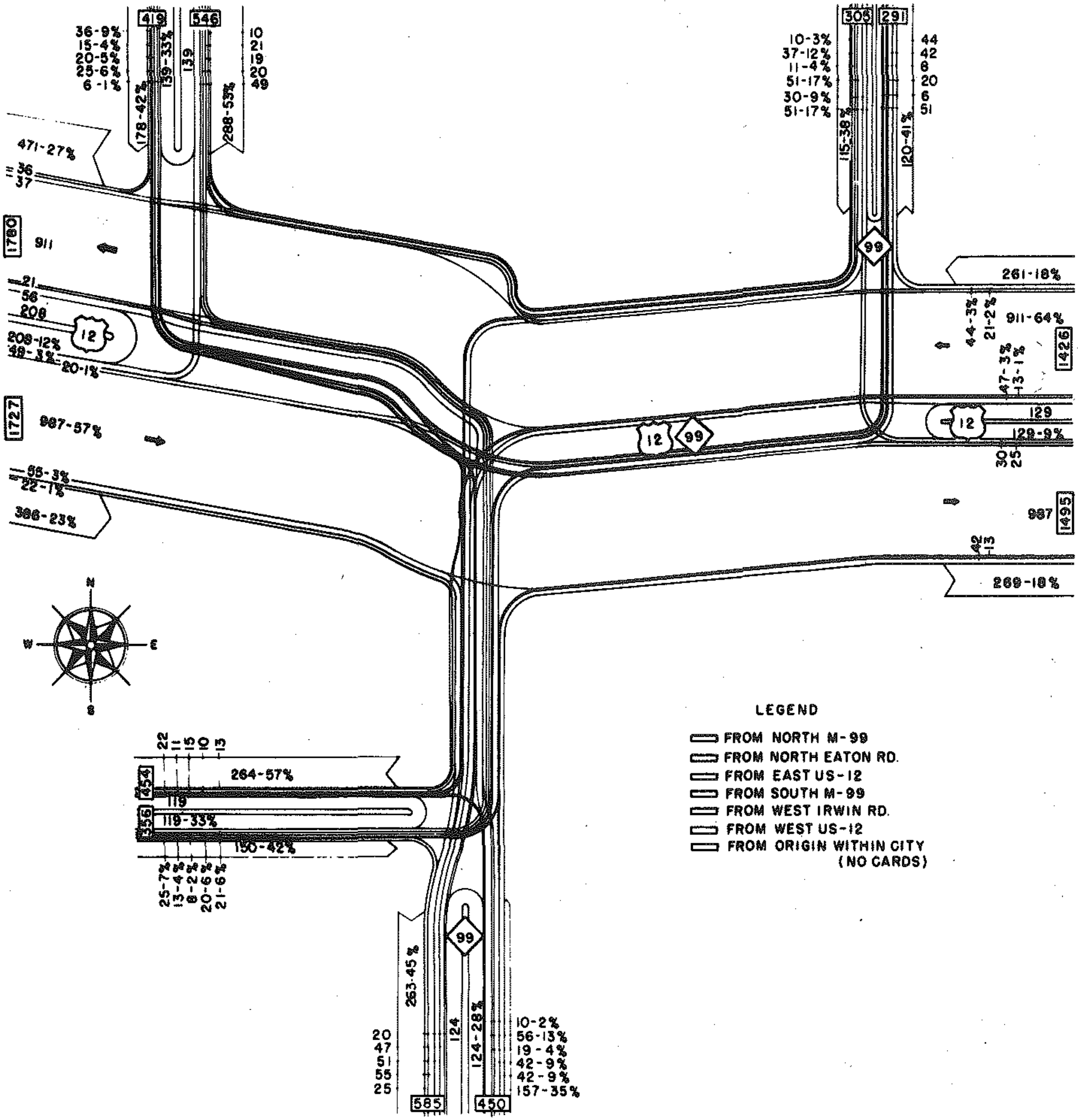


**MICHIGAN STATE HIGHWAY DEPARMENT**

FIG. 9

# DISTRIBUTION OF TRUNKLINE TRAFFIC IN THE ALBION AREA

THURSDAY JULY 26, 1956
8:00 A.M. - 12:15 P.M. & 2:00 P.M. - 6:15 P.M.



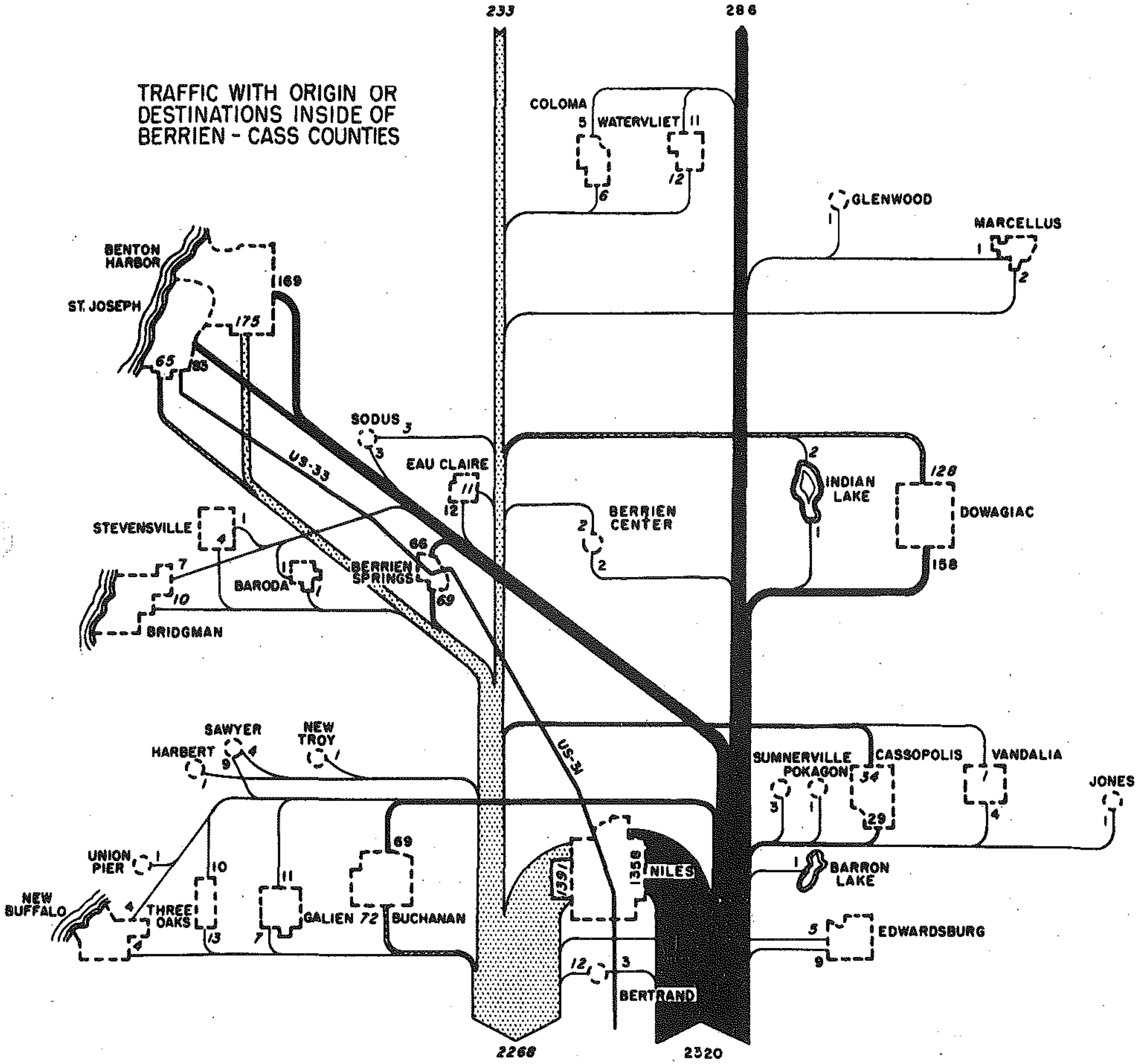
MICHIGAN STATE HIGHWAY DEPARTMENT

FIG. 10

## ORIGIN-DESTINATION STUDY

## US-31 & US-33 AT INDIANA STATE LINE

8:00 AM – 12:00 NOON    2:00 PM – 6:00 PM
WEDNESDAY JUNE 18, 1958



1958 AVERAGE DAILY TRAFFIC-13600

ACTUAL VOLUME: INBOUND-2900
OUTBOUND-2596

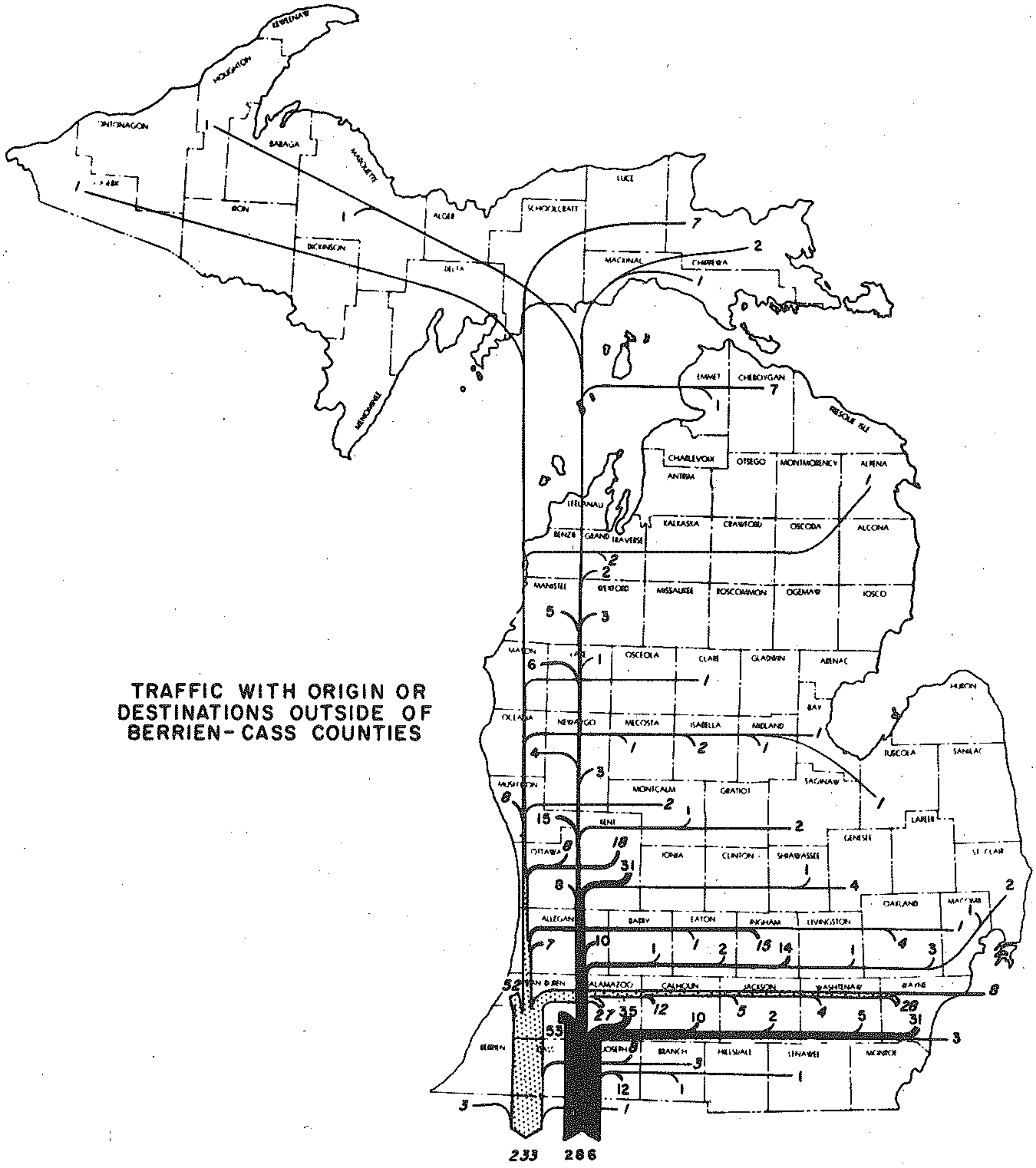
MICHIGAN STATE HIGHWAY DEPARTMENT
John C. Mackie, Commissioner

FIG 11a

## ORIGIN-DESTINATION STUDY

## US-31 & US-33 AT INDIANA STATE LINE

8:00 A M – 12:00 NOON     2:00 P M – 6:00 P M
WEDNESDAY JUNE 18, 1958



TRAFFIC WITH ORIGIN OR DESTINATIONS OUTSIDE OF BERRIEN-CASS COUNTIES

**MICHIGAN STATE HIGHWAY DEPARTMENT**
**John C. Mackie, Commissioner**

FIG 11b

limited access highway.

US-25 at Port Sanilac is a low volume and highly seasonal route on the shores of Lake Huron.

M-28 & US-41 at Champion in the western portion of the upper peninsula is also on a recreational route. This location is approximately 200 miles west of the Mackinac Bridge.

## Quotes from "Interurbia"

The J. Walter Thompson Company issued a booklet entitled "Interurbia - The Changing Face of America", from which two maps have been reproduced on the following pages (Figures 12 and 13) showing what is expected to happen in Michigan and surrounding states by 1975. Some interesting facts taken from this report follow:

"In 1946 the Census Bureau predicted 150 million people in the U.S. by 1955. Reports show 167 million in 1955. The 17 million difference is more than the entire population of Canada.

"In 1946, automotive economists forecast 36 million cars on the road by 1955--the fact is that 52 million cars were registered in 1955. This forecasting error of 16 million represents more cars than there were in all of Western Europe.

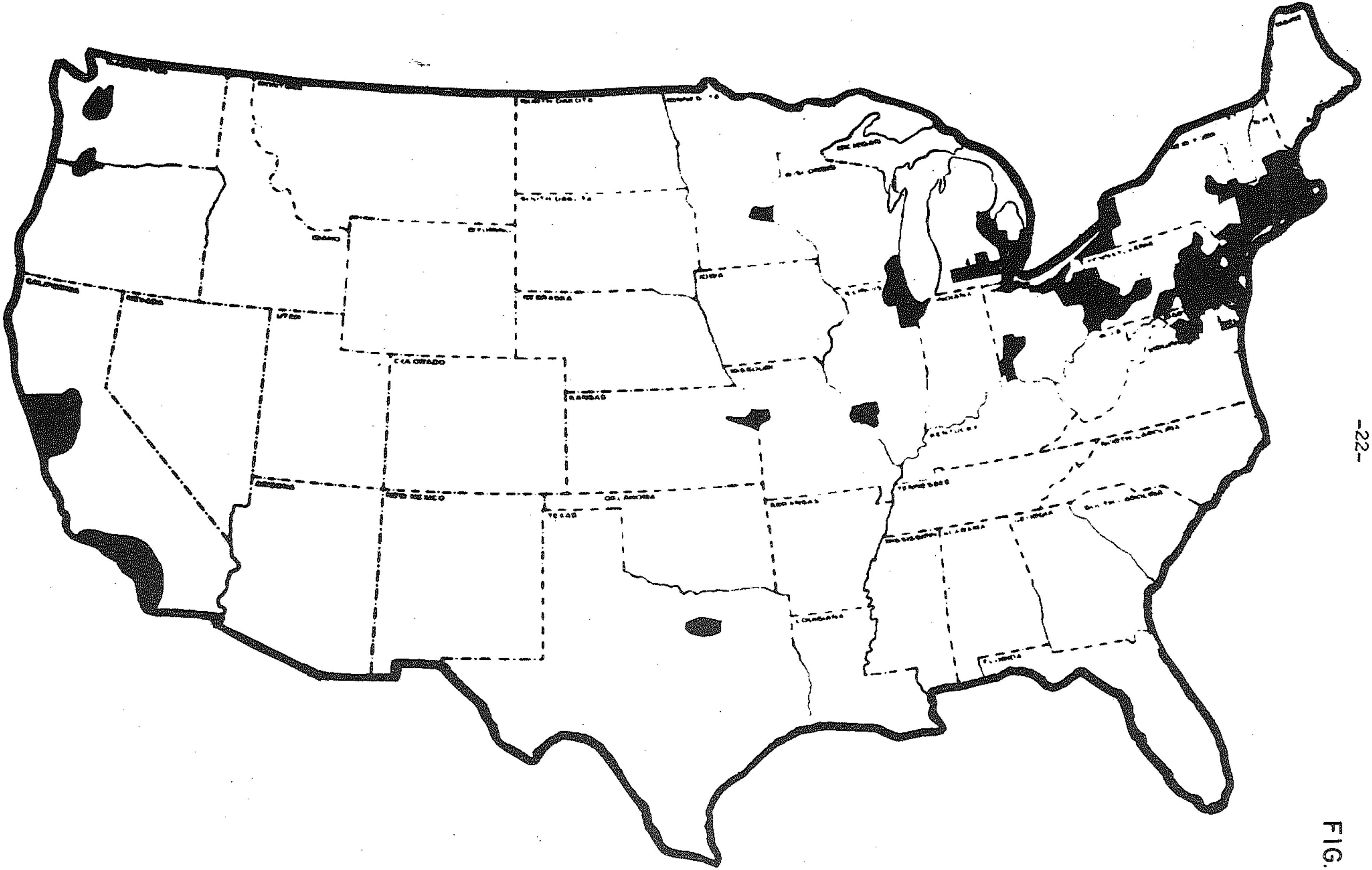
"In 1939 Detroit had 26 factories employing 100 people or more--in 1955 this increased to 218 factories employing 100 workers or more.

"So almost everywhere we look, we find we have been poor forecasters of America's fabulous growth. Faster than anticipated housing and factories have spread out over green fields, roads have been choked by traffic.

"Because we fail to realize the speed of what is happening to us, we are faced with a whole new order of serious problems.

"We must counteract what someone has so aptly referred to as--the almost total invisibility of the obvious."

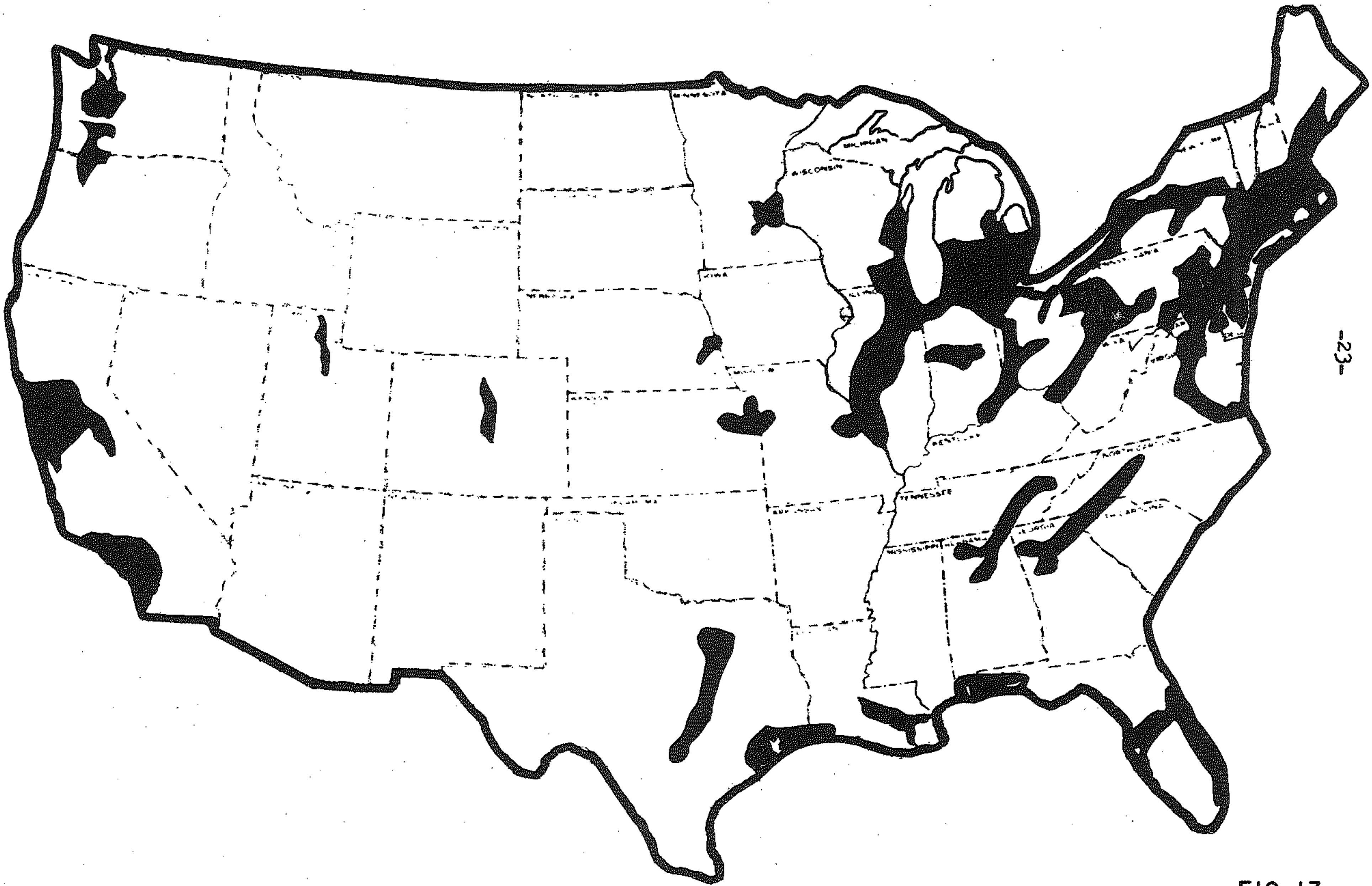
# INTERURBIA TODAY



J. WALTER THOMPSON COMPAN

FIG. 12

# INTERURBIA 1975



J. WALTER THOMPSON COMPANY

FIG 13

## Past Procedures

In the early years of the automobile era, most highway construction was undertaken to get the vehicles out of the mud. As certain roads became congested, they were improved on the basis of observation and judgment of the Highway Administrators. As more and more miles of roads were overloaded some method of priority had to be set up to determine which roads to reconstruct first. The first traffic counts in Michigan (starting on a state-wide basis during World War I) were taken for 14 hours on summer weekdays.

Early traffic counts were expanded to an average daily traffic for the year. The first estimates of expected future traffic used this average daily traffic expanded on the state-wide expected increase in vehicle miles of travel.

The following early thoughts on future traffic estimating were taken from the "Highway Engineers' Handbook" 4th edition published in 1927 by Wilson G. Harger and Edmund A. Bonney. Quote from Page 32 of a paper prepared by W. G. Harger for the Michigan A.A.E. in February, 1924. "Future traffic is largely a matter of judgment, but there is every reason to believe that we have enough data to make reasonable forecasts for the purpose of arriving at rational general conclusions. In making such forecasts more liberality is justified in connection with economic analyses of relocations and grade reductions than for pavement construction, as pavements are temporary at best. That is, an allowance for 50 years' growth is perhaps reasonable in connection with relocations, grading and bridges and for 15 years' growth in connection with pavement design. The percentage of increase for these periods will, of course vary for each road, depending largely on how near each locality has reached the saturation point for ton miles or car miles traveled on rural highways, and it is also affected by additional mileage of improved roads to be constructed during these periods which tend to reduce congestion".

Michigan and other states with a high volume of recreational traffic found that average daily traffic gave very little help in designing roads that were choked with traffic on summer Sunday and holiday afternoons and were low volume roads during the winter months.

As a result of 1936 planning survey data gathered in nearly all the states, a great deal of effort was expended throughout the country to develop the best possible criteria on which to base highway design. The first step away from average daily traffic was to the average of the ten highest days. Further analysis led to the use of an average of one hundred high hours, which evolved to the present 30th high hour. (For a detailed discussion of the 30th high hour and design hour volume see pages 50 to 63.)

When methods are perfected for the determination of the design hour volume (the 30th high hour volume of the design year) it will be possible to make DHV traffic estimates without the intermediate steps involved in making estimates of average daily traffic for twenty years in the future. At the present time there are numerous locations on certain ramps of interchanges near recreational or industrial developments where the DHV can be determined with much greater accuracy than the future ADT. For example a ramp to an industrial location that expects to have 2,000 cars entering the various plants between 7 and 8 A.M. on each weekday would have a DHV of 2,000. The traffic volumes during the remainder of the day on this ramp would be more difficult to estimate.

## Correlation between Office of Planning and Traffic Division

The following is an outline of the various steps necessary to complete the estimate of future traffic on and in the vicinity of a limited access highway.

1. Office of Planning submits a corridor for a limited access highway.
2. Traffic Division gathers and studies all past and present traffic

data and present and future land use data for all cross roads and parallel roads in the corridor area together with any future highways crossing the area or parallel routes that will affect the traffic on the proposed route.

3. Traffic Division prepares and submits present traffic on all roads and prelimary estimates of future traffic on the important roads to the Office of Planning. (The estimate is approximate until a determination is made of locations of road closures, grade separations and interchanges.)

4. Office of Planning submits detailed location of the route together with detailed location of grade separations, interchanges and road closures or requests additional studies of traffic desires to aid in selection of grade separation and interchange sites.

5. Traffic estimate made showing desire movements on route, cross roads and interchanges. Submitted for interchange layout.

6. Reassign traffic to proposed Geometric layout.

If the project lies dormant for some time and greatly changed ideas of development of the area takes place, it may become necessary to completely revise the traffic estimate. The estimate may also have to be revised if any of the following changes occur.

a - change of route corridor,

b - relocation of interchanges,

c - changes in other routes within the area.

7. Reassign traffic to final approved layout if any changes are made.

8. Estimate made of current traffic on the old trunkline if it is to be returned to the jurisdiction of the county.

## ESTIMATING FUTURE TRAFFIC

It is necessary to have the following data when estimating future traffic volumes:

a.-Past and present traffic for the highway being studied and all cross roads and important parallel routes; including turning movements at key locations.

b.-Origin and Destination studies.

c.-Present and expected future land use and zoning.

d.-Studies of what has occurred at similar locations after limited access highways have been constructed.

Future traffic volumes for design are derived from the current traffic and the traffic increase expected by the end of the period of time selected for design. Components of future traffic, in their logical steps of derivation, are as follows:

1. Current Traffic
    a. Existing traffic.
    b. Diverted traffic.

2. Traffic Increase
    a. Normal traffic growth.
    b. Generated traffic.
    c. Development traffic.

### Current Traffic

Current traffic is defined as the volume of existing and diverted traffic that would use a new or improved facility if it were open to traffic. The determination of current traffic is one of the first steps in estimating future traffic. (See page 32.) It usually is not measurable in the field on limited access highways because some generated traffic (see page 37) and some development traffic (see page 39) will be using the new highway as soon as it is opened. Also some long distance diversion will not occur immediately on short sections of new highway but will transfer shortly after the entire route is completed.

## Existing Traffic

Traffic counts must be adjusted to an average daily traffic. Using the method devised by Mr. Boris Petroff, of the Bureau of Public Roads, it was found that Michigan had 16 different ADT traffic pattern groups on its trunkline system.

From these patterns, adjustments are made from a 24-hour traffic count to ADT regardless of the time of the year the count was made. Figure 14 is a table of factors to convert a weekday count to an average weekday for the current month. These factors were established by the above method and were found to be sufficiently accurate for all traffic pattern groups. The factors in Figure 14 are identical to the "Factors for Converting Actual 24-Weekday Highest Hour Counts to Average Weekday Highest Hour," Figure 28, page 61. They are included as separate factors for ease of reference. Also further analysis (now in progress) may reveal that the difference in the factors is large enough to be significant. Figure 15 (Page 30) is a table of factors to convert average weekday and average of Saturday and Sunday counts to ADT for the 16 pattern groups on the trunkline system. (All factors are checked and revised periodically.) Figure 16 (Page 31) is a sketch map for district 6 that illustrates the different ADT pattern groups on trunklines for this area. For office use each pattern group is shown in color.

## Diverted Traffic

This is traffic that will be diverted from parallel routes to the new facility due to its design, such as divided four-lane roads, by-passes around metropolitan areas, ease and safety of movement, etc. Where road closures are involved at a limited access facility, traffic will be diverted to the cross roads that remain open, either to cross or enter the main highway.

From origin and destination studies (both the comprehensive, external types, and colored card surveys) and turning movements, determinations are made of the amount of traffic which will divert from one highway to another because of the major improvement.

MICHIGAN STATE HIGHWAY DEPARTMENT
John C. Mackie, Commissioner

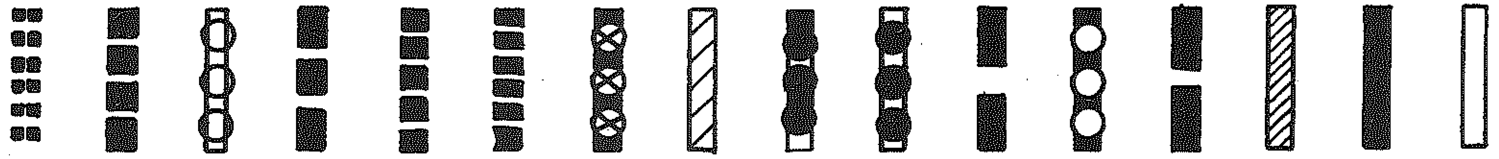
## FACTORS FOR CONVERTING ACTUAL 24-HOUR WEEKDAY COUNTS TO AVERAGE WEEKDAY

| | | | Factors |
|---|---|---|---|
| Monday | | | 0.995 |
| Monday | Tuesday | | 1.029 |
| Monday | Wednesday | | 1.024 |
| Monday | Thursday | | 1.015 |
| Monday | Tuesday | Wednesday | 1.044 |
| Tuesday | | | 1.066 |
| Tuesday | Wednesday | | 1.061 |
| Tuesday | Thursday | | 1.049 |
| Tuesday | Friday | | 0.963 |
| Tuesday | Wednesday | Thursday | 1.052 |
| Wednesday | | | 1.056 |
| Wednesday | Thursday | | 1.044 |
| Wednesday | Friday | | 0.959 |
| Wednesday | Thursday | Friday | 0.994 |
| Thursday | | | 1.033 |
| Thursday | Friday | | 0.949 |
| Thursday | Friday | Monday | 0.941 |
| Friday | | | 0.879 |
| Friday | Monday | | 0.933 |

An example of the use of Figures 14 and 15: A traffic count taken on a Wednesday in January and in the silver pattern group (No. X) would be multiplied by 1.056 for average weekday then by 1.188 for the average daily traffic.

FIG 14

# FACTORS TO CONVERT AVERAGE WEEKDAY AND AVERAGE OF SATURDAY AND SUNDAY COUNTS TO AVERAGE DAILY TRAFFIC



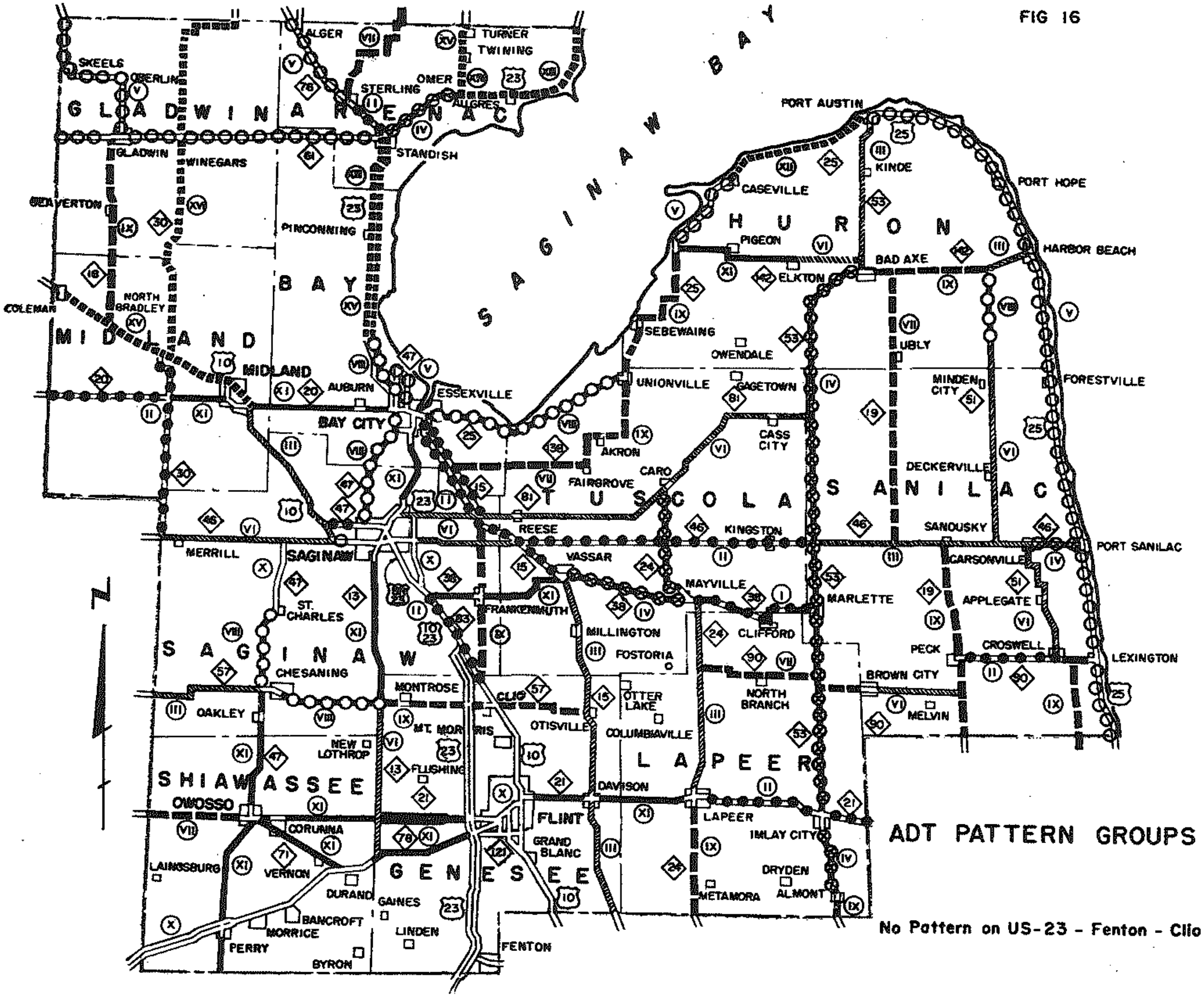
| | XIII Green Bar | XII Blue Bar | V Orange | XVI Orange Bar | XV Red Bar | XIV Purple Bar | IV Black | III Yellow | II Green | I Blue | IX Red | VIII Verdent Green | VII Purple | VI Pink | XI Brown | X Silver |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **WEEKDAYS** | | | | | | | | | | | | | | | | |
| Jan. | 2.471 | 1.955 | 1.936 | 1.827 | 1.641 | 1.461 | 1.608 | 1.503 | 1.357 | 1.368 | 1.480 | 1.432 | 1.288 | 1.253 | 1.215 | 1.188 |
| Feb. | 2.536 | 2.154 | 1.986 | 1.722 | 1.672 | 1.343 | 1.634 | 1.497 | 1.427 | 1.341 | 1.419 | 1.345 | 1.256 | 1.229 | 1.253 | 1.157 |
| Mar. | 2.011 | 2.063 | 1.681 | 1.610 | 1.481 | 1.408 | 1.466 | 1.339 | 1.255 | 1.180 | 1.266 | 1.262 | 1.214 | 1.134 | 1.196 | 1.083 |
| Apr. | 1.702 | 1.716 | 1.569 | 1.421 | 1.362 | 1.223 | 1.337 | 1.217 | 1.141 | 1.135 | 1.234 | 1.165 | 1.102 | 1.031 | 1.095 | 1.007 |
| May | 1.236 | 1.349 | 1.389 | 1.188 | 1.117 | 1.089 | 1.191 | 1.129 | 1.024 | .998 | 1.147 | 1.039 | 1.014 | .965 | 1.028 | .969 |
| June | .950 | .937 | 1.022 | 1.093 | .947 | .917 | 1.067 | .971 | .994 | .918 | 1.068 | .984 | .958 | .966 | .999 | .937 |
| July | .528 | .490 | .605 | .735 | .672 | .669 | .833 | .794 | .835 | .785 | .904 | .889 | .866 | .854 | .939 | .895 |
| Aug. | .519 | .471 | .666 | .695 | .679 | .699 | .852 | .815 | .787 | .849 | .891 | .874 | .853 | .842 | .890 | .902 |
| Sept. | .997 | .896 | 1.104 | .995 | .954 | .953 | 1.052 | 1.030 | .953 | .951 | 1.071 | .984 | .973 | .922 | .965 | .974 |
| Oct. | 1.223 | 1.046 | 1.230 | 1.156 | 1.053 | 1.077 | 1.113 | 1.092 | 1.032 | 1.038 | 1.094 | 1.081 | 1.037 | .991 | 1.030 | .990 |
| Nov. | 1.423 | 1.379 | 1.634 | 1.364 | 1.287 | 1.171 | 1.349 | 1.240 | 1.205 | 1.097 | 1.200 | 1.154 | 1.104 | 1.110 | 1.129 | 1.017 |
| Dec. | 1.931 | 2.160 | 1.725 | 1.672 | 1.462 | 1.344 | 1.541 | 1.378 | 1.296 | 1.236 | 1.361 | 1.272 | 1.230 | 1.159 | 1.185 | 1.101 |
| **SATURDAYS AND SUNDAYS** | | | | | | | | | | | | | | | | |
| Jan. | 1.596 | 1.651 | 1.151 | 1.113 | 1.229 | 1.338 | .992 | 1.184 | 1.171 | 1.375 | 1.068 | 1.132 | 1.183 | 1.318 | 1.167 | 1.181 |
| Feb. | 1.808 | 1.940 | 1.354 | 1.136 | 1.232 | 1.187 | 1.009 | 1.056 | 1.113 | 1.252 | .937 | 1.011 | 1.105 | 1.203 | 1.150 | 1.129 |
| Mar. | 1.413 | 1.746 | 1.094 | .999 | 1.106 | 1.309 | .898 | .958 | 1.040 | 1.094 | .842 | .909 | 1.061 | 1.158 | 1.077 | 1.069 |
| Apr. | 1.167 | 1.538 | .956 | .900 | 1.042 | 1.147 | .857 | .923 | .877 | 1.034 | .802 | .874 | .933 | 1.013 | 1.039 | 1.014 |
| May | .865 | 1.021 | .806 | .738 | .886 | .924 | .691 | .773 | .794 | .920 | .750 | .785 | .829 | .931 | .942 | .942 |
| June | .640 | .798 | .575 | .679 | .765 | .821 | .614 | .691 | .790 | .796 | .686 | .763 | .764 | .887 | .933 | .872 |
| July | .388 | .434 | .344 | .457 | .514 | .588 | .482 | .560 | .650 | .665 | .587 | .633 | .696 | .770 | .889 | .860 |
| Aug. | .376 | .384 | .375 | .445 | .544 | .601 | .498 | .592 | .630 | .649 | .597 | .651 | .715 | .789 | .857 | .875 |
| Sept. | .733 | .741 | .668 | .683 | .748 | .838 | .656 | .719 | .776 | .837 | .698 | .774 | .809 | .830 | .945 | .913 |
| Oct. | .845 | .917 | .798 | .717 | .776 | .972 | .655 | .768 | .839 | .935 | .750 | .815 | .854 | .912 | .975 | .961 |
| Nov. | 1.075 | 1.158 | 1.164 | .881 | .998 | 1.088 | .916 | .944 | .990 | 1.042 | .779 | .871 | .914 | .997 | 1.052 | .993 |
| Dec. | 1.431 | 1.923 | 1.308 | 1.060 | 1.099 | 1.194 | 1.035 | 1.014 | 1.186 | 1.152 | .937 | .975 | 1.091 | 1.102 | 1.115 | 1.117 |

FIG 15

MICHIGAN STATE HIGHWAY DEPARTMENT
JOHN C. MACKIE, COMMISSIONER

DISTRICT 6

FIG 16



ADT PATTERN GROUPS

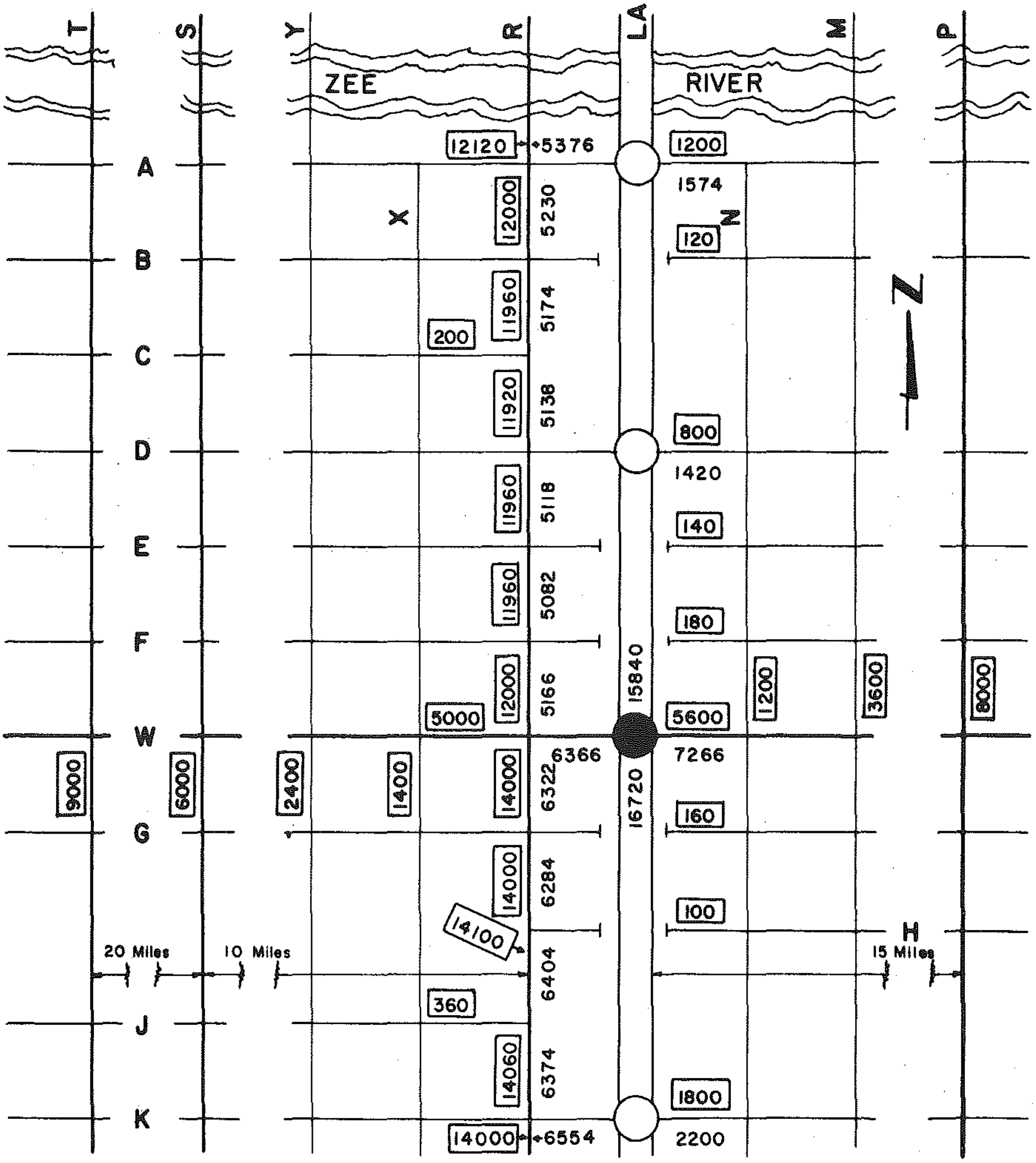
No Pattern on US-23 - Fenton - Clio

## Estimating Current Traffic

The current traffic on a new highway is made up entirely of traffic diverted from existing roads. The majority of the current traffic on a limited access facility that is closely parallel to an existing congested free access highway will be diverted from this unsatisfactory route. Substantial amounts may also be diverted from other distant trunklines and from neighboring county roads. In making a traffic estimate it is also necessary to compute traffic on all roads that cross the main highway both at interchanges and at grade separations. Frequently it is necessary to estimate the future traffic on the road the limited access highway replaces. (Current traffic must be estimated on all trunklines that are to revert to county jurisdiction.)

To illustrate the methods used and the data required the following estimate of current traffic has been made for Limited Access highway LA (see figure 17) and other roads in the vicinity. Traffic counts have been taken on all roads in the area and the 1959 ADT entered on the map. In addition short O-D studies have been made over the past five years on state trunklines P, R, S, T and W. Eight hour turning movements have been taken at all important intersections having 400 ADT or more on the minor road. These turning movements have been expanded to a 1959 ADT and turning movements have been estimated for all minor roads that intersect roads R and N from machine counts on all roads and from patterns of the major intersections in the area.

To shorten the explanation the total traffic will be used in one direction only as all traffic is expected to return by the same route. For example, the explanation may say that 200 vehicles per day are going west over a certain route, actually 100 vehicles are going to the west and 100 vehicles returning from the west.



**ESTIMATE OF CURRENT TRAFFIC ON AND IN THE VICINITY OF LIMITED ACCESS HIGHWAY LA**

MICHIGAN
STATE HIGHWAY DEPARTMENT
John C. Mackie, Commissioner

FIG 17

The traffic will be rerouted and diverted from the roads in the following order:

a. Closed roads

b. Roads with grade separations

c. Road W

d. Road LA

e. Road R

A thorough knowledge of the area and of what has happened in similar locations after limited access highways have been constructed and opened to traffic is necessary to make a traffic assignment of this type.

The detailed procedure of assigning current traffic to this area is quite lengthy and it has been placed in a separate section of this manual as Appendix B. (See pages xviii - xxxiv.) The estimated values of current traffic are included on figure 17 on page 33 and the present and current traffic are shown in the following table:

Traffic On and Near Road LA

| | Present | Current |
|---|---|---|
| Road A | 1,200 | 1,574 |
| Road D | 800 | 1,420 |
| Road W | | |
| West of LA | 5,600 | 6,376 |
| East of LA | 5,600 | 7,266 |
| Road K | 1,800 | 2,200 |
| Road LA | | |
| North of W | -- | 15,840 |
| South of W | -- | 16,720 |
| Road R | | |
| North of A | 12,120 | 5,376 |
| A-B | 12,000 | 5,230 |
| B-C | 11,960 | 5,174 |
| C-D | 11,920 | 5,138 |
| D-E | 11,960 | 5,118 |
| E-F | 11,960 | 5,082 |

Traffic On and Near Road LA (Cont.)

| | Present | Current |
|---|---|---|
| Road R | | |
| F-W | 12,000 | 5,166 |
| W-G | 14,000 | 6,322 |
| G-H | 14,000 | 6,284 |
| H-J | 14,000 | 6,404 |
| J-K | 14,060 | 6,374 |
| South of K | 14,000 | 6,554 |

## Traffic Increase

After the current traffic that will be on the new facility has been established, it is then necessary to determine the probable traffic in some future year selected for design. The increase consists of traffic growth, generated traffic and development traffic. Figure 18 (Page 36) is a composite of these potential traffic increases on a new highway for a period of 20 years after construction.

### Normal Traffic Growth

Normal traffic growth is the increase in traffic volumes due to general increase in number and usage of motor vehicles.

In estimating normal traffic growth, care must be taken to determine the proper percentage increase for the particular future year. Traffic data for the latest available year should be used as a base and the proper rate of traffic increase from that year to the selected design year should be established.

Normal traffic growth on and adjacent to limited access highways is much greater than the state wide average. Many low volume roads that are closed will have little or no traffic growth and in many instances may decrease in volume. The Michigan state wide average increase for all road systems combined is expected to be from 75% to 80% from the year 1958 to the year 1975. (This includes normal traffic growth, generated traffic and development traffic).

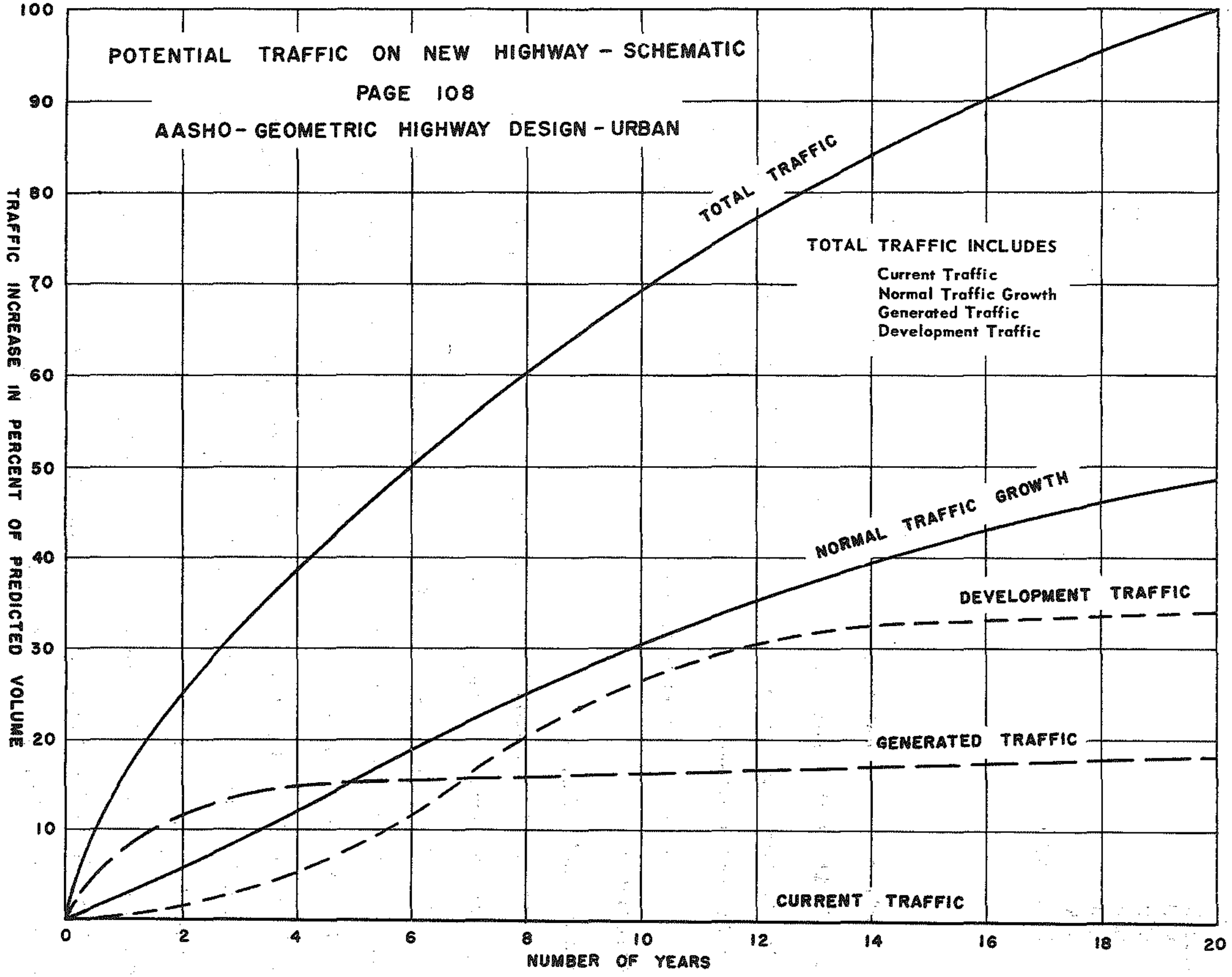

POTENTIAL TRAFFIC ON NEW HIGHWAY - SCHEMATIC
PAGE 108
AASHO - GEOMETRIC HIGHWAY DESIGN - URBAN
TOTAL TRAFFIC
TOTAL TRAFFIC INCLUDES
Current Traffic
Normal Traffic Growth
Generated Traffic
Development Traffic
NORMAL TRAFFIC GROWTH
DEVELOPMENT TRAFFIC
GENERATED TRAFFIC
CURRENT TRAFFIC
TRAFFIC INCREASE IN PERCENT OF PREDICTED VOLUME
100
90
80
70
60
50
40
30
20
10
0
2
4
6
8
10
12
14
16
18
20
NUMBER OF YEARS

FIG 18

It is anticipated that the normal traffic growth on a limited access highway will be 100% or more by 1975.

Generated Traffic

Generated traffic consists of motor vehicle trips (other than by public transit) that would not have been made if the new facility had not been provided. Generated traffic is made up of four categories:

1. New trips not previously made by any mode of travel.
2. Trips that were previously made by public transit.
3. Trips that were made to a different destination, but for which the change is attributable to the attractiveness of the improved highway and not to change in land use.
4. Long trips diverted from distant routes less attractive.

Trips of class four are not really generated, but are so classed because of the impossibility of including them with diverted trips and because they may not occur until sometime after the facility is opened.

Most of this generated traffic develops within the first few years after the entire length of the new facility is opened. However, as other roads in an area become more congested the limited access highway will continue to increase in use because of being a shorter distance (time wise) to the place of the former destination. Generation traffic in remote areas may be made up almost entirely of trips that are much longer in mileage but no longer in time spent on the highway.

The amount of generated traffic that materializes on any one improvement may vary considerably, depending primarily on the type and extent of improvement, character of other highways in the area, and land use. Traffic on a new facility to a resort development may be composed almost entirely of generated traffic. If, however, the resort area undergoes a larger than normal increase in development, the resulting traffic increase will be considered to be development traffic. On controlled access highways, where it is relaxing and safe to drive, there will be more generated traffic than a route with frequent interference, annoyance, and hazards. The amount of generated traffic may depend upon the capacity as related to the volume on existing roads that are relieved by the improved highway.

An example of generated traffic is on US-16 near Kensington Park. At this location it was estimated that in 1975 the ADT would be 38,000. On three successive Sundays during July, 1958 the volume exceeded 40,000 vehicles per day and this particular summer was rather cool and not exactly conducive to swimming and picnics. The eastern section of this highway is still a free access, traffic signal controlled, congested highway. Peak daily volumes of 40,000 were not expected for nearly ten years.

Coverdale and Colpitts predicted the Mackinac Bridge would carry 1,927,000 vehicles during its first year of operation. Of this amount 826,000 was expected to be generated traffic. They did not reach this total due to the recession and the fact that the vastly expanding highway construction program has not reached its final goal.

Generation Percentages

Circular memorandum from E. H. Holmes, Deputy Commissioner, Department of Commerce, Bureau of Public Roads, dated October 15, 1956, headed Generation Percentages stated "Study of a number of situations indicates that generation on a free, limited access highway calculated in the manner which has been described, normally ranges from about 30 percent to about 60 percent with an average of about 45%. The lower figure is for situations where the old road is reasonably adequate and attractive, and the higher one where it is very unattractive because of high congestion or other reasons. There are however, cases where the generation percentages fall outside of these limits in either direction.

"Situations in which generation higher than 60% might occur are as follows:

1. Extreme congestion on the old routes with no satisfactory alternate route.

2. The road serves territory that was not previously served directly as, for example, an outer belt where there was none before.

3. The old road was comparatively lightly traveled and the traffic resulting from generation of long trips, or diversion from distant routes, is high in proportion to the old road.

"Situations in which generation lower than 30% might occur are as follows:

1. The traffic diverted to the new route is a relatively small percentage of the total traffic through the corridor: in other words, the new route does not assume as much relative importance as in the case where it is the dominating facility.

2. Highway improvements in the area have kept exceptionally well abreast of traffic needs in the past.

3. There is a parallel freeway which, though at some distance away, adequately serves the long trips through the area."

## Development Traffic

Development traffic is that which is due to improvements on adjacent land over and above the development which would have taken place had not the new or improved highway been constructed. This component of future traffic, unlike that of generated traffic, continues to develop for many years after a new facility is constructed. Experience with many improved highways indicates that adjacent land is developed more rapidly than land elsewhere. The traffic resulting there-from must be accounted for in estimating future traffic volumes.

Maps showing present and probable land use, improvements, and zoning, if any, are needed to estimate future land development. Once the location and type of proposed highway are indicated on such maps, estimates may be made of probable changes in land use and likely developments on adjacent land. Land near railroads and water courses will encourage industrial development.

Several locations in Michigan have experienced this type of development brought about by an improved or proposed new facility.

To better understand the problem the following quote is presented from a paper by Dr. Frank W. Suggitt, Head of the Department of Resource Development, of Michigan State University, entitled--Expressways: Their Effect on Real Estate Values, presented to, "Lecture series on Real Estate Problems, Marquette University, College of Business, and Milwaukee Board of Realtors", on March 25, 1959.

## Detroit-Brighton Corridor

"Please permit me to take you on a brief but dramatic travelog along one of Michigan's newest and most significant expressways. We will traverse the 35 miles, southeasterly from Brighton to Detroit. Our route on a modern express-type highway will parallel old US-16, or Grand River Avenue, which was once the Plank Road which linked Detroit with Lansing, Grand Rapids and Muskegon; and from there of course, via the Clipper, to Milwaukee.

"Brighton, located near the intersection of two limited access routes, is 35 long miles from Detroit, and 20 miles from Detroit's 'fringe area'. Yet Brighton currently is experiencing the most dramatic real estate activity of any area in Michigan and that speaks for quite a lot, as Michigan is the fastest-growing state east of the Rocky Mountains and north of Florida. As a result of one residential real estate decision, the population and tax base of Brighton is in the process of being doubled. Outside the city limits of this small town, additional subdivisions are springing up almost daily. A number of small factories are locating in the area. There is talk of a new motor-transport terminal and trans-shipment facility.

"All of this has happened since the announcement of the immediate construction of two expressways which will intersect at Brighton. Interviews with the land developers and the realtors involved, prove conclusively that the expressways now place Brighton within easy commuting range of Detroit to the southeast, of Ann Arbor to the south and of Flint to the north. Without the expressways, Brighton would continue to be the rather indolent little farmer and resort service center that it has been for the century of its existence.

"Significantly, the subdivision developers who are doubling the population of the corporate city of Brighton are, out of their own pockets, contributing to the modernization and expansion of the city's sewer and water systems,-are contributing land for the new school and civic sites,-and are incorporating a new shopping center into their development area. In short, Brighton is being rebuilt, and it would not have happened had it not been for the expressways.

"Proceeding southeasterly from Brighton toward Detroit on the fine new expressway, we note a sudden upsurge in pressure upon the Island Lake State Park and Recreation Area and upon nearby Kensington Park of the Huron-Clinton Metropolitan Parkway Authority. The expressways have enabled Detroit people to have much more rapid, more safe and more convenient access to the recreational facilities. <u>The pressure has reached such a point that the parks are overloaded and so too is the expressway on weekends</u>.

"Proceeding on toward Detroit we are stopped in our tracks by the mammoth Lincoln-Mercury Plant which rises right out of the rural countryside. Three years ago the land upon which this (the second largest plant in the Ford empire) stands was planted to corn. Even today most of the land all around it for miles is being farmed, or is used for scattered rural residences. After conferring at length with company officials, it is obvious why Ford selected such a location.

"Very simply, the close-in downtown Detroit or Dearborn areas did not offer as many advantages as did this site 28 miles from Detroit's city center and from the Dearborn nerve center of the Ford enterprises. All of the usual criteria of industrial location were employed before this location was selected:

Availability of good rail service, water supply, labor supply, tax rates, distance to market centers and to raw material sources. But the final deciding factor was that the remote site was soon to be serviced by a brand new controlled-access expressway. So the decision was made, the land was bought, the plant was built;-for the expressway would permit economical flow of labor, raw material and finished product.

"Expressways Encourage Decentralization. At this point I must sidetrack from my verbal journey from Brighton to Detroit to indicate other trends which couple with the influence of the expressway to virtually dictate a decentralization from the central city. This digression further supports my conviction that the question of expressways and associated land values is as broad as our dynamic society itself. In simple terms, our old central cities cannot accommodate the modern, sprawling, single-storied ranch-type factories and administrative offices with their acres of neatly-manicured greensward, parking lots and motor-truck storage and trans-shipment facilities. The cost of land in old urban centers virtually precludes modern, automated factory construction, and this cost is compounded by the cost and inconvenience of traffic congestion for both factory products and factory labor. The same trend is manifested in the ranch-type home on a spacious suburban or rural lot, the modern shopping center, and the rambling single-storied school plants that are turning farm fields to new and higher uses.

"Expressways make such decentralization feasible. Without them, industrial, residential, commercial and recreational decentralization would have been impossible, and it is frightening to forecast what the situation might have been. Expressways permit and encourage new development to leap-frog right over the shin-tangle of decandent and blighted urban areas and shabby suburban sites in quest of the light, space and economy which remote rural locations afford.

"<u>Back to the Detroit-Brighton Corridor</u>. Returning to our junket along the new US-16 Expressway from Brighton to Detroit, we can already note that the decision of the Ford Motor Company to locate in this remote rural area at Wixom has set into motion a whole train of associated land developments. Several new enterprises associated with the automobile assembly plant have become established. An industrial subdivision has been created, complete with new rail sidings and near to the service road, the Ford Plant and the Expressway. Virtually all land in at least a five-mile radius from the factory has assumed speculative value; farming has practically ceased; and everyone is waiting to see what will happen next.

"Directly across the expressway from the auto plant, fronting on the former trunkline route, a 700-acre tract is being developed as a self-sustaining, planned community for 7,200 residents. A forty million dollar development,-perhaps the largest in the Detroit region,-will include 2,000 homes, an apartment complex, a shopping center, restaurant, motel, and park and recreational facilities for the residents. According to the developers, this would not have been feasible had it not been for the expressways which will reduce the trip to downtown Detroit to a pleasant thirty minute drive when the urban expressway connections have been completed. Land values on bare undeveloped land in this tract increased about five-fold between the time the expressway was surveyed and the time it was acquired for subdivision purposes. There will be another forty-fold increase in value within the next four or five years when the housing and commercial construction is completed. The sequence of change in land value goes like this: About $300 per acre as farmland before the expressway was constructed; about $1,500 per acre as undeveloped subdivision land; about $57,000 per acre when the subdivision construction is completed."

Dr. Suggitt also stated that the same type of development will take place at most locations of major interchanges and that it has also already taken place at interchanges and all along limited access highways that have been completed in other states.

A large residential area was developed west of the Willow Run Bomber Plant shortly after World War II. Since this plant is now one of General Motors transmission centers this area is continually being subdivided for residential use. Again the nearness to a limited access roadway converted farms to residential areas.

When the J. L. Hudson Company built the Northland Shopping Center it was due to accessability to the proposed extension of John C. Lodge Expressway to connect with Northwestern Highway.

The same could be said of the Eastland Shopping Center. This area is near the Edsel Ford Expressway.

The Oldsmobile Division of General Motors is constructing a 100 million dollar warehouse west of Lansing near Interstate 96. Again the nearness to a proposed limited access facility was a major factor in locating this warehouse.

From the above examples it can readily be seen that industries and businesses are attempting to utilize these facilities to the fullest.

Michigan with its availability to large bodies of water will definitely play an important part in securing new industries. With the opening of the St. Lawrence Seaway, ocean going ships are able to load and unload within 85 miles of any major industry located in Michigan. Detroit is closer to Europe by water than New York City; 346 miles closer to London and Antwerp, and 549 miles closer to Stockholm.

Highways are part of the assembly line of all industries. Besides incorporating the truck and the highway into its production process, the automotive industry sends more than half of its finished products over the road to market.

The labor supply of Michigan factories is made up of anyone who lives within a commuting radius of an hour or so. One out of every five workmen in Detroit lives more than ten miles from his place of employment. Three out of four workers use automobiles for transportation to work.

Types of development that can take place with a few of the reasons are as follows:

1. Commercial development such as food, lodging and gas stations can service the traffic on the main road as well as the local traffic in the area. If any of the other three types of development occur, general commercial development will take place.
2. Residential development depends on travel time to places of employment. In some instances this can be in all four directions from a main interchange. In many cases this distance can be more than twice as far from the areas of employment as areas that are served by congested local streets. In the latter case, approximately half the travel time is spent waiting for traffic signals and controls. Overall travel speeds may be only one quarter as high as on the limited access highway.
   A. If industrial expansion takes place in the area, residential development in the area is inevitable and a city may develop.
3. Industrial development can take place if there is suitable land available. Many industries no longer depend on railroads for transportation even though the railroad is within a short distance.

   Industry located near the interchange of two limited access highways can receive numerous benefits such as labor, material and distribution of the finished product to or from four directions. These locations will be ideal sites for future large or small industries.

4. Recreational development depends upon area features that are suitable for this type of development. Lakes and streams that were inaccessible due to distance from a good highway will soon become recreational areas. Some recreational areas are now being used by the majority of owners as summer homes and these may in all probability be converted to year-round dwellings. This will come about when travel time is greatly reduced by the limited access features of highway, or by the availability of work in nearby areas, created by industrial development either near the main interchange or at any of the other interchanges in the immediate area. The development of short-period recreation such as picnics, bathing, fishing, boating, etc., that occur on summer weekends can generate very high design hour volumes. Winter sports are increasing rapidly and if this type of development continues, volumes may become large for all seasons of the year.

When projecting development traffic it is absolutely essential that the projector have a thorough knowledge of the area under study and a great deal of experience in the analysis of what has actually occurred under like conditions in various other parts of the state or country.

Interurbia predicts that in 1975 the area south of the Bay City - Muskegon line would all be suburban development.

The Detroit Metropolitan Area Regional Planning Commission suggests (Page 9 of 1956-57 REGIONAL PLANNING) that it is desirable to use 8,300 people per square mile for urban areas and 1,500 people per square mile for suburban residences to serve this anticipated growth in population.

A shopping center, an industry, or a recreational area can easily develop ten to twenty thousand trips per day.

In the section of this manual, Development Traffic near the Interchange of

Two Limited Access Highways, (Page 92) a full discussion is presented of a method of computing development traffic.

Traffic Projection Factor

The traffic projection factor is a ratio of future traffic to current traffic. The traffic increases that this factor reflects combine those due to normal traffic growth, generated traffic and development traffic, previously discussed. The future year (for design) should be specified with every traffic projection.

A given value for a traffic projection factor can only apply for a section of highway between two interchanges except in the extremely rare cases where the cross road traffic at the interchange occurs in the precise manner so that the various turns result in the same projection factor on both sides of the interchange.

Circular Memorandum to Division Engineers by the Department of Commerce, Bureau of Public Roads, "Guide for Forecasting Traffic on the Interstate System." dated October 15, 1956, with supplements dated November 8 and 21, 1956, is useful in determining the approximate traffic for long sections of highway as used in the Section 108-D and Section 210 studies. However, it has been determined that the same general formula "1975 Average Daily Traffic = AG (1 + SLI)" can be applied to each of the six movements involved at any four-legged interchange, but it is much simpler to use the actual values of current traffic, traffic growth, generated traffic, and development traffic, than to compute the formula for each movement.

A = Current traffic (1958 or 1959). (Includes traffic diverted from other roads)

G = Generation factor.

S = Statewide percentage increase forecast for the 20 years hence (or any other) period.

L = Factor to convert statewide percentage increase (S) to the percentage increase for a particular location.

I = Factor to reflect more rapid rate of growth along interstate system when improved to interstate standards.

To obtain the value for "A" of the above formula, two or three of the steps of the method illustrated on Page 65 would have to be included in the formula method. "G" would vary for the six movements. "S" would be constant for the main highway but could vary for each cross road. "L" would vary for each of the movements and can be computed much easier on an actual volume basis as development traffic, than on a percentage basis. "I" might remain constant for a given location, but could vary substantially for different parts of the State.

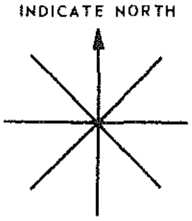
Detailed examples of projection factors are included in a section of this manual on "Estimating Traffic Movements at an Interchange" (See pages 74, 80 and 88.)

## Directional Traffic

Traffic estimates are made for each direction of travel on both the main highway and the cross roads at interchanges. On minor cross roads with grade separations, it is usually sufficient to show the total traffic both for ADT and DHV.

The ADT will normally be the same in each direction between interchanges except for places where the traffic entering the main highway is several miles away from the point where the return traffic leaves. However, the traffic within an interchange area is rarely the same in each direction. Figure 19 shows the 1978 estimated traffic at a proposed cloverleaf interchange of an interstate route and a Federal-Aid Primary route in the southwest part of the State. This figure is presented in a graphic manner to show the movements on all sections of roadway and all of the ramps. (The same form can be used to show traffic movements at most types of interchanges.)

FIG 19



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**JOHN C. MACKIE- COMMISSIONER**
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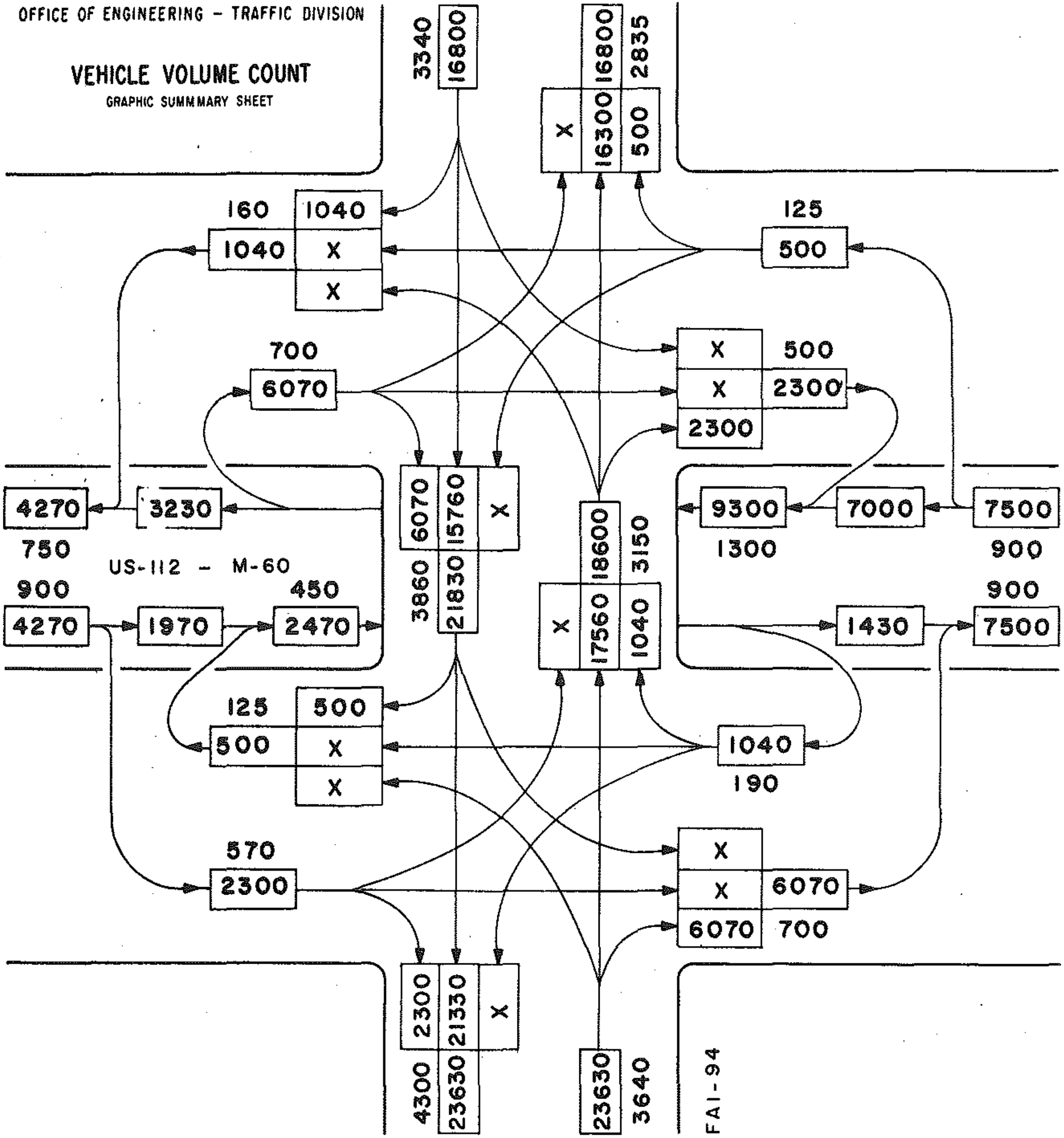
## VEHICLE VOLUME COUNT
GRAPHIC SUMMARY SHEET



LEGEND

1978 ESTIMATED TRAFFIC

ADT INSIDE OF BLOCKS
DHV OUTSIDE OF BLOCKS
X MOVEMENTS MADE AT OTHER LOCATIONS ON A CLOVERLEAF

CLOVERLEAF
INTERCHANGE

## 30th High Hour and Design Hour Volume

All highway capacity studies that have been made recently are on the basis of hourly volumes. When design decisions were made on the basis of the difference between 50 cars per day and 500 cars per day, average daily traffic was sufficient. On limited access highways the design decisions cannot be made on the Average Daily Traffic that may vary from under 5,000 to over 50,000 vehicles per day.

In a report by L. E. Peabody and O. K. Norman entitled "Application of Automatic Traffic Recorder Data in Highway Planning", they recommend that highways be designed to accommodate a volume of traffic at least as great as that which would occur during the 50th highest hour of the year, but no greater than that for the 30th highest hour.

AASHO adopted the policy that highways should be designed for the 30th highest hourly volumes of the year for which the highway was built. It has been found that the difference in volumes in metropolitan areas for the 30th and the 100th highest hour is very slight. In some cases less than 200 vehicles or 1 to 2 percent. In recreational areas the difference is greater but again the actual volume is smaller and would not affect the original design of a 4-lane divided pavement.

The following paragraph is taken from "A Policy on Geometric Design of Rural Highways" of the American Association of State Highway Officials, "Traffic distribution data indicate that the relation between the maximum hourly volume of the year and 30 HV on roads with seasonal fluctuation is not materially different from that on other roads. For instance, the ratio of the maximum hourly volume to 30 HV on an average highway is nearly 1.7, and on seasonal roads it is between 1.5 and 1.8. It would seem to follow that 30 HV likewise is a desirable criterion for design of highways with seasonal fluctuation but on these roads the high hourly volumes occur during a few weeks only and substantially lower volumes are experienced during most of the year. Economic conditions dictate the use of lower volumes than 30HV for these roads, perhaps volumes corresponding to the 80th to 100th highest hourly volume. Due to abnormal traffic fluctuation these volumes are higher than 30HV of normal fluctuation roads with the same ADT. During seasonal peaks, traffic on roads so designed may have to operate under conditions less satisfactory than on highways with average fluctuation, but such operation should not be too severly restricted even if it occurs only a few times a year. The design should be checked to see that even the highest hourly volumes do not exceed possible capacity".

Various other books, pamphlets, reports, etc. suggest that the thirtieth highest hour be used. Some suggest a fiftieth or eightieth high hour in high recreational areas. A design hour of lesser volume than the thirtieth will result in the facility handling traffic beyond its design capacity for more hours. The following table and graphs, figures 20 through 25 show that the differences in high hour values 30, 50 and 80 are slight.

Below is a table showing the percent of Average Daily Traffic for certain high hours at several permanent traffic recorder locations.

High Hour Percent of 1958 ADT

| | ADT | 30th | 50th | 80th | 100th |
|---|---|---|---|---|---|
| 507 - US-16 Cascade | 4872 | 12.3 | 11.7 | 11.2 | 10.8 |
| 403 - US-27 Wolverine | 2749 | 26.4 | 25.1 | 22.8 | 21.9 |
| 813 - US-12 EB-D.I.E. | 9867 | 12.9 | 12.0 | 11.0 | 10.6 |
| 814 - US-12 WB-D.I.E. | 10064 | 10.5 | 10.0 | 9.6 | 9.4 |
| 603 - US-25 Pt. Sanilac | 1429 | 27.3 | 25.3 | 21.8 | 20.4 |
| 201 - US-2 Brevort | 2238 | 25.9 | 24.4 | 23.3 | 22.7 |
| 409 - US-27 Houghton Lake | 2940 | 22.5 | 21.0 | 19.7 | 19.0 |

As can be seen from the above table the difference between the 30th and

# RELATION BETWEEN PEAK HOURLY FLOWS AND AVERAGE DAILY TRAFFIC AT STATION 507, US-16 & M-50, 1.8 MILES WEST OF EAST JCT. OF M-50, EAST OF CASCADE LOWELL TWP., KENT CO.

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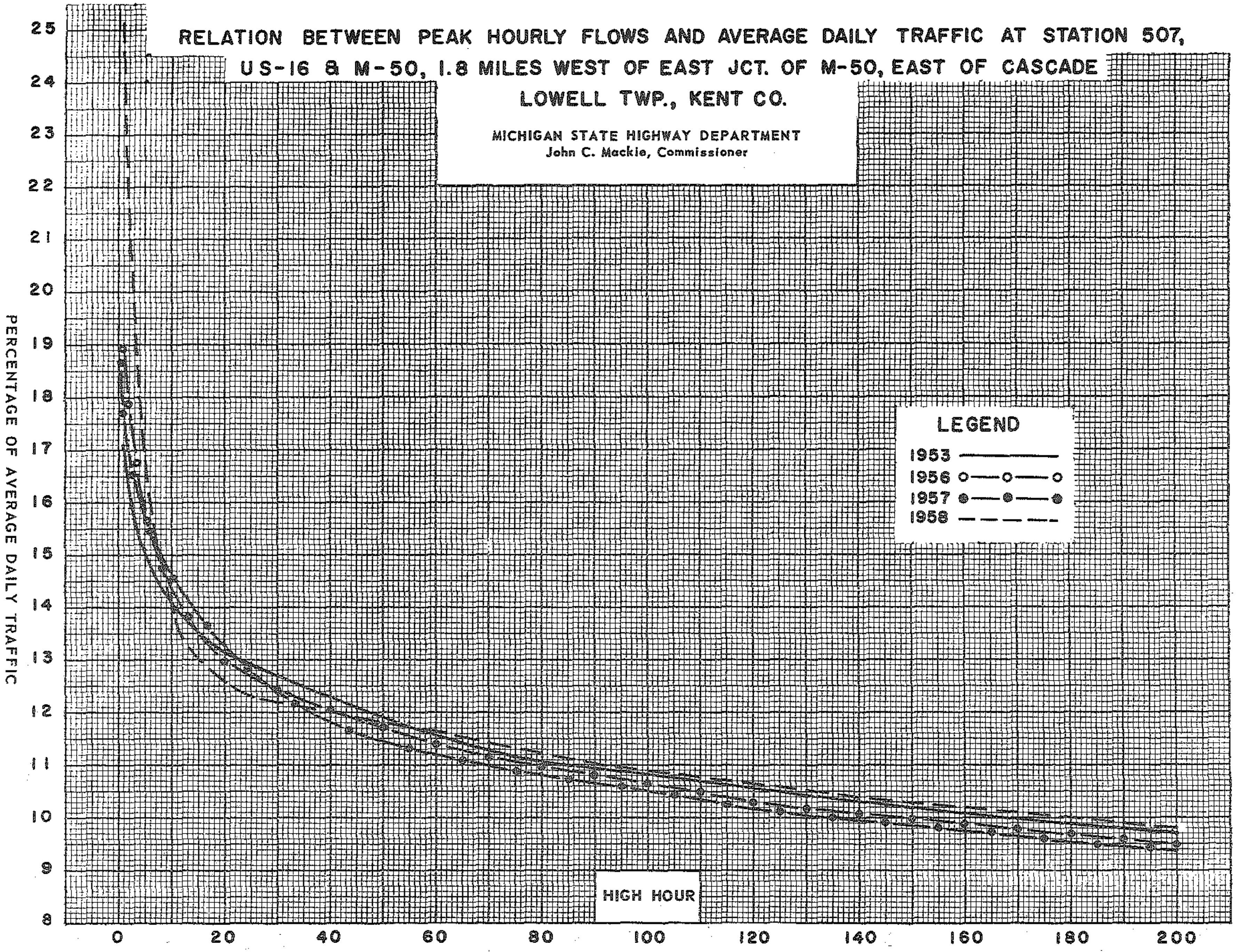
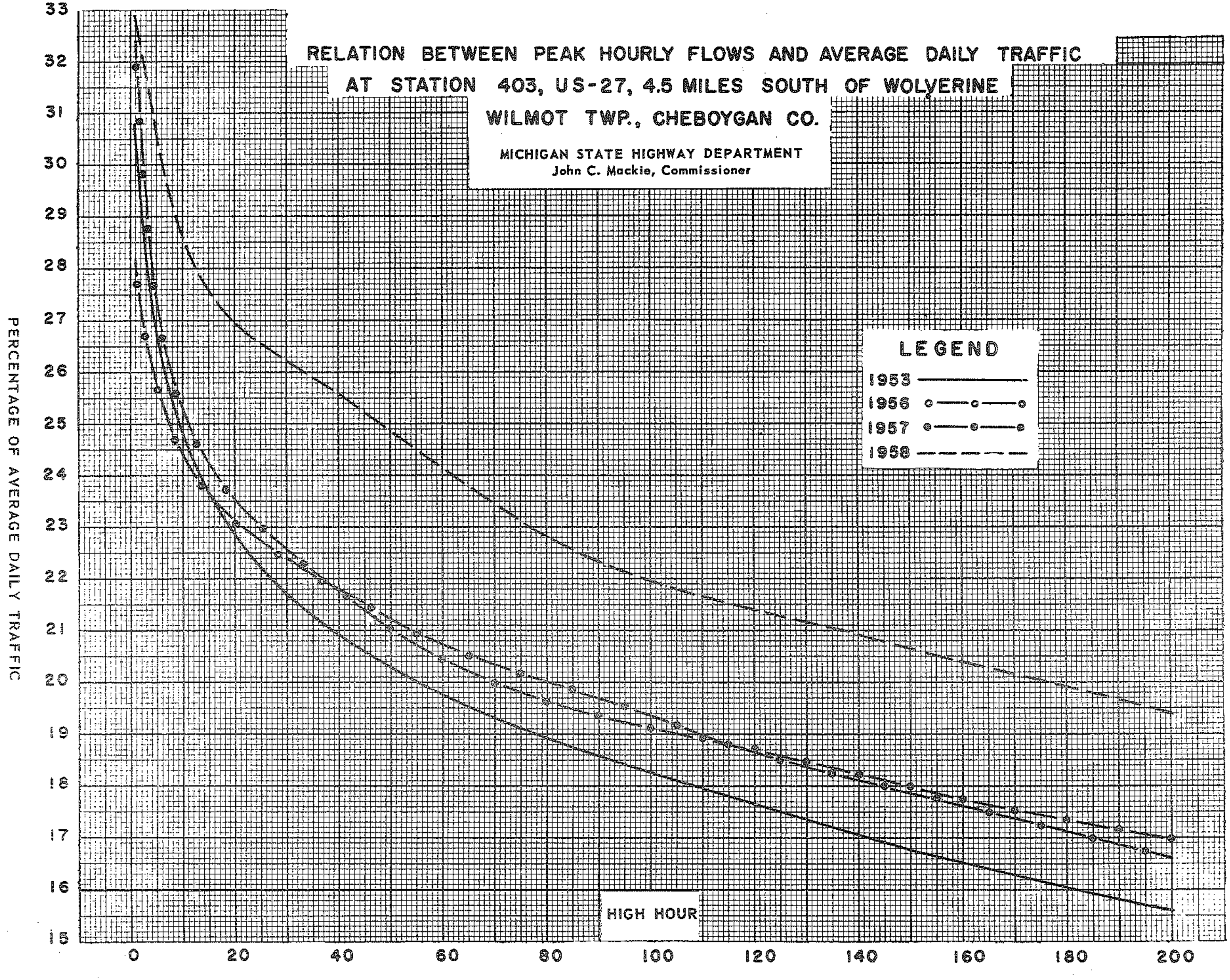


FIG 20



RELATION BETWEEN PEAK HOURLY FLOWS AND AVERAGE DAILY TRAFFIC AT STATION 403, US-27, 4.5 MILES SOUTH OF WOLVERINE WILMOT TWP., CHEBOYGAN CO.

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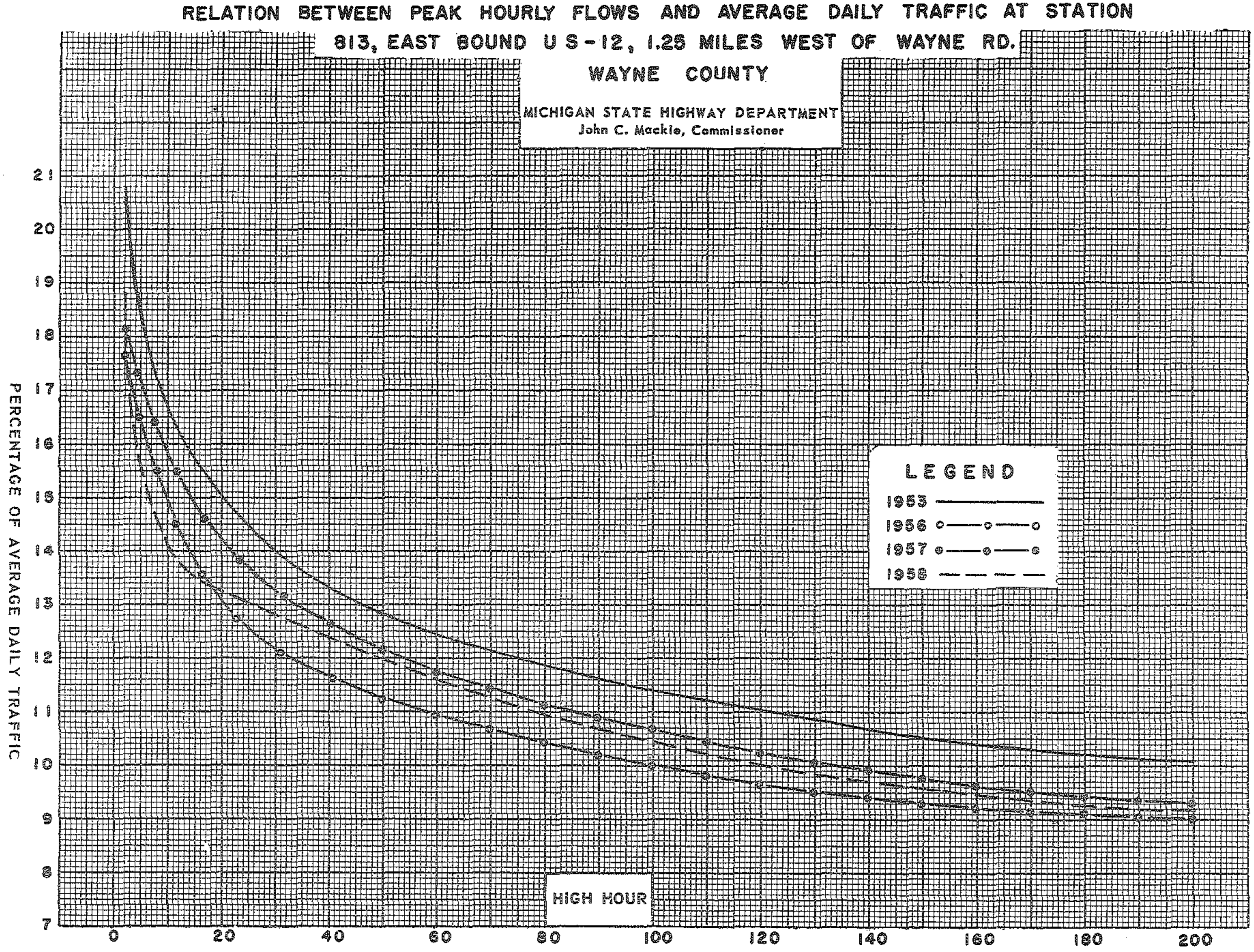
FIG 21



RELATION BETWEEN PEAK HOURLY FLOWS AND AVERAGE DAILY TRAFFIC AT STATION 813, EAST BOUND U S-12, 1.25 MILES WEST OF WAYNE RD. WAYNE COUNTY

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FIG 22

# RELATION BETWEEN PEAK HOURLY FLOWS AND AVERAGE DAILY TRAFFIC AT STATION 814, WEST BOUND US-12, 1.25 MILES WEST OF WAYNE RD.

## WAYNE COUNTY

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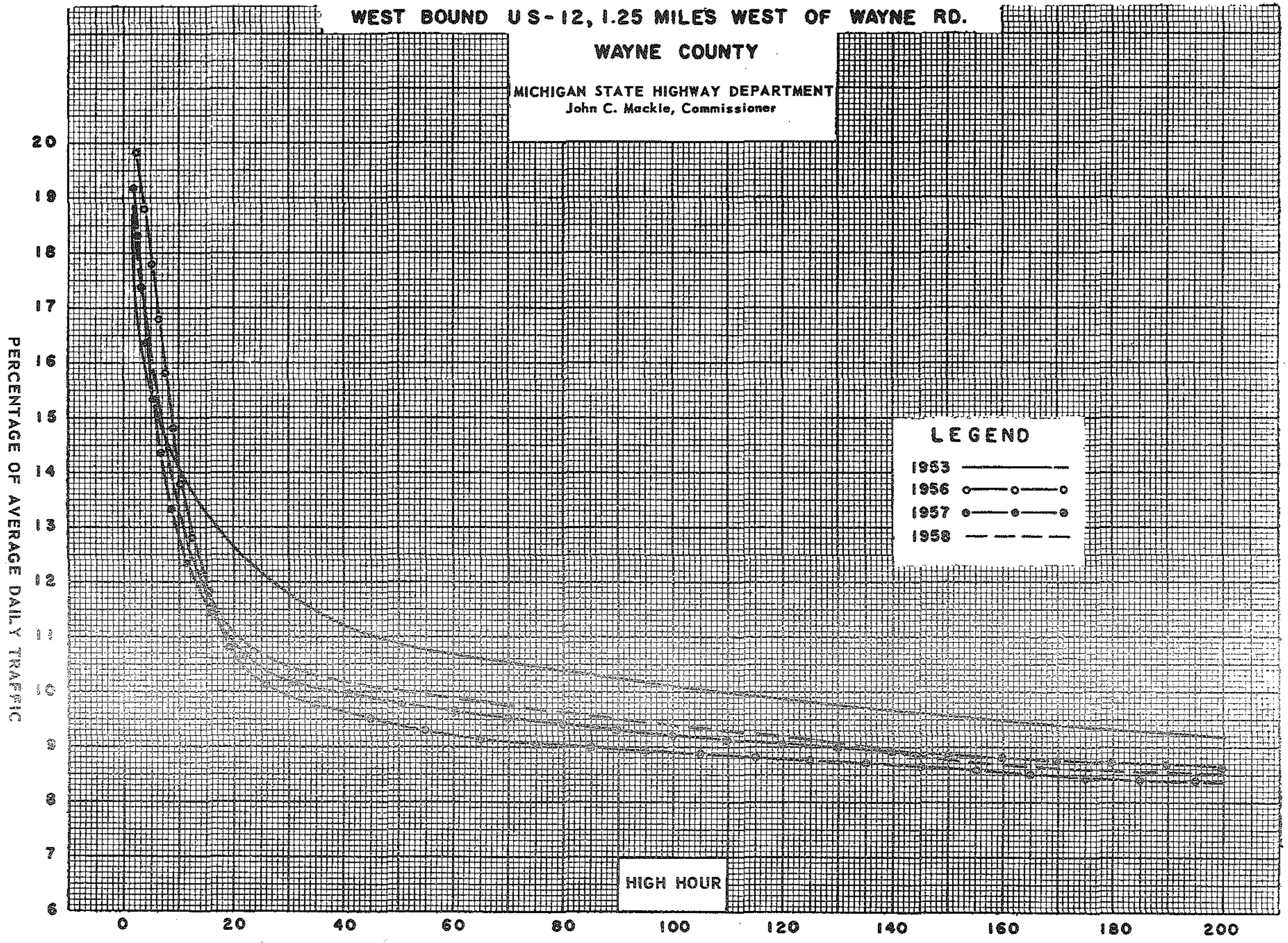

FIG 23

# RELATION BETWEEN PEAK HOURLY FLOWS AND AVERAGE DAILY TRAFFIC AT STATION 603, US-25, 4.7 MILES SOUTH OF JCT. M-46

## SANILAC COUNTY

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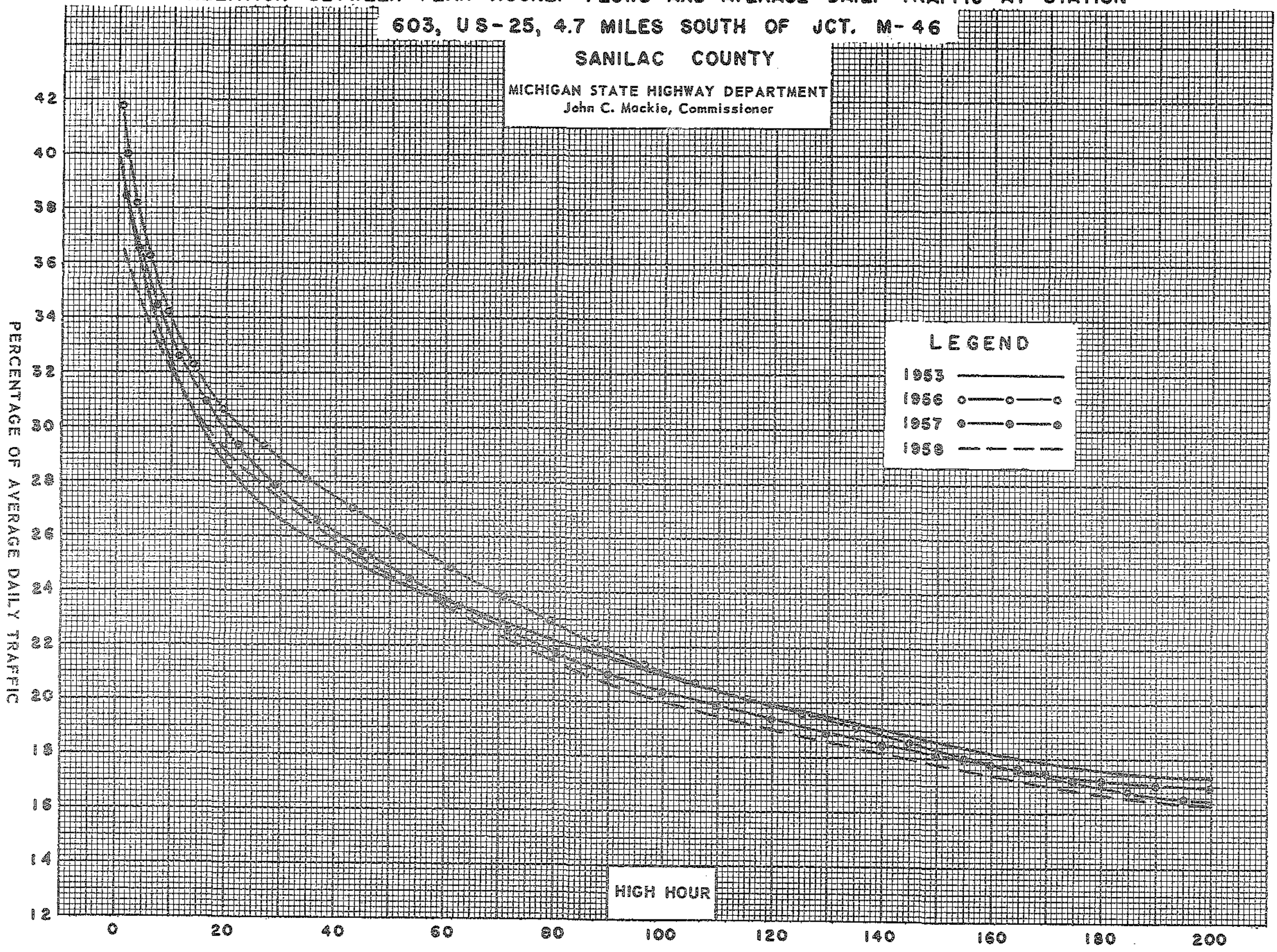
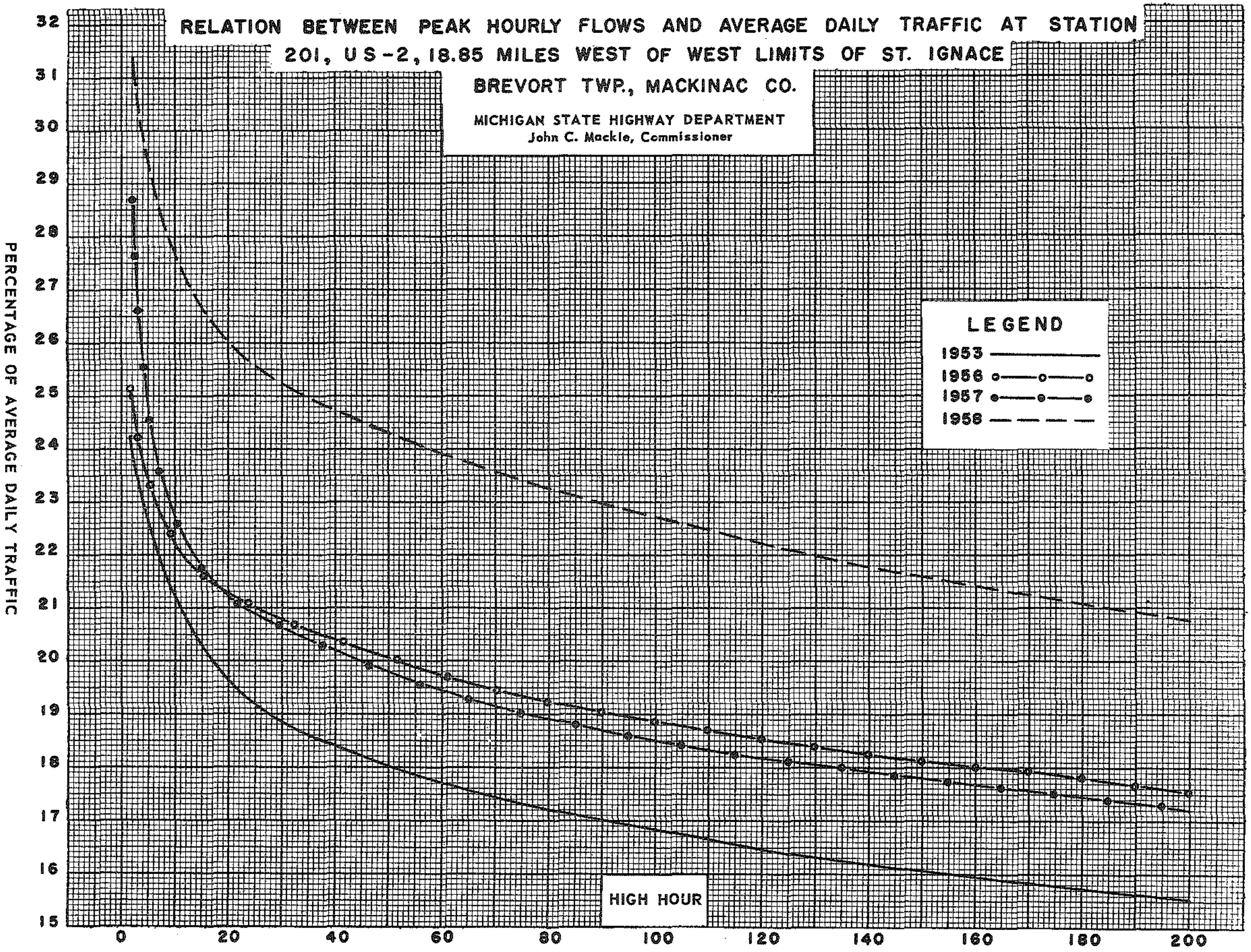


FIG 24


RELATION BETWEEN PEAK HOURLY FLOWS AND AVERAGE DAILY TRAFFIC AT STATION 201, US-2, 18.85 MILES WEST OF WEST LIMITS OF ST. IGNACE

BREVORT TWP., MACKINAC CO.

MICHIGAN STATE HIGHWAY DEPARTMENT
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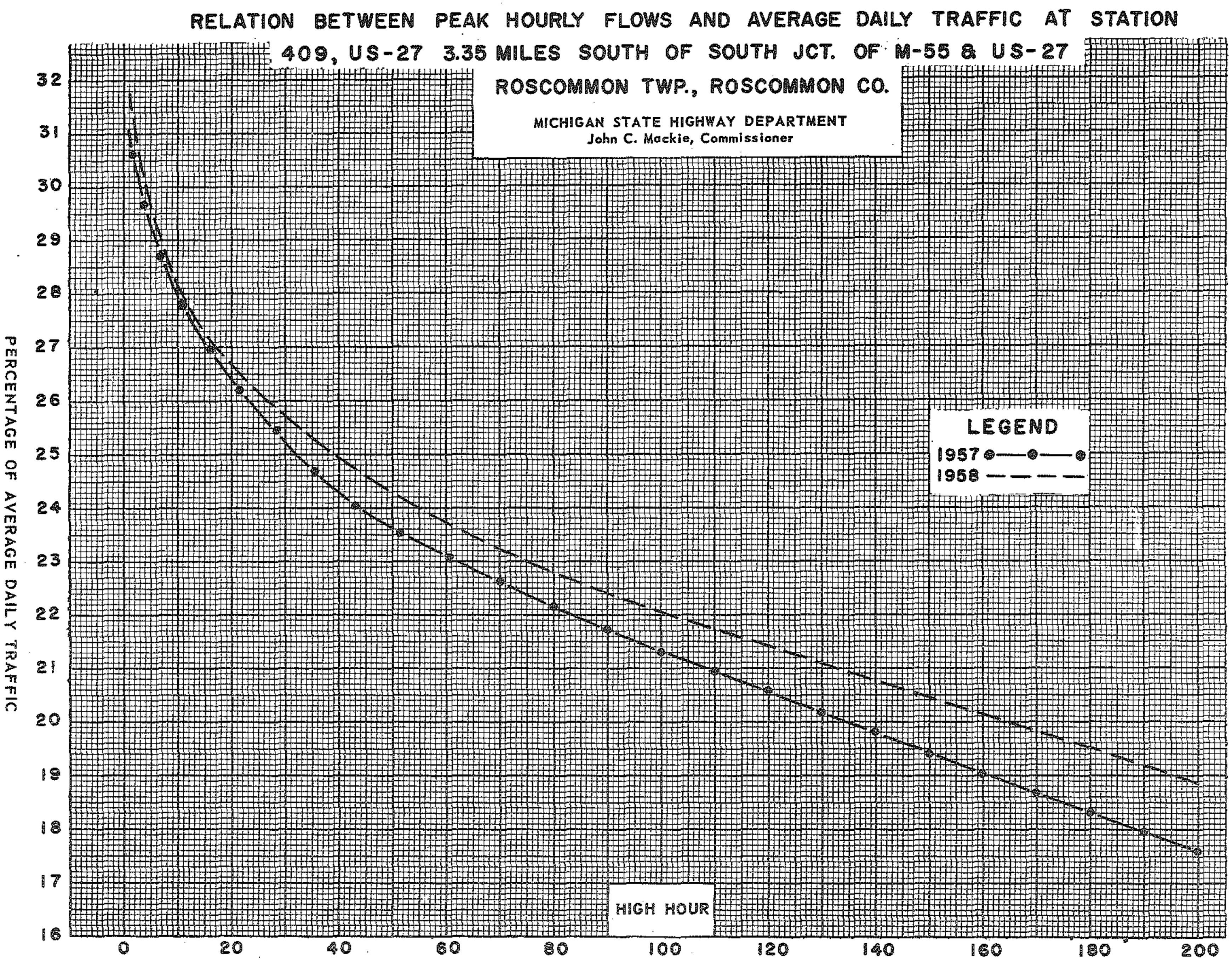
FIG 25



RELATION BETWEEN PEAK HOURLY FLOWS AND AVERAGE DAILY TRAFFIC AT STATION 409, US-27 3.35 MILES SOUTH OF SOUTH JCT. OF M-55 & US-27

ROSCOMMON TWP., ROSCOMMON CO.

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FIG 26

80th hour is slight except at 403, 409, 603 and 201. These stations are in high recreational areas. At 403 the volumes are 726 and 626 for 30th and 80th hour. At 409 the 30th and 80th volumes are 766 and 670. At 603 the 30th and 80th volumes are 390 and 312. At 201 the 30th and 80th volumes are 570 and 521.

A method has been developed by the State to determine the 30th high hour on the rural state trunklines. The trunklines are placed into 30th high hour pattern groups on the basis of permanent traffic recorder and control station data. Eight pattern groups have been established for the rural trunklines. Figure 27 (Page 60) is a 30th high hour pattern group map for District 6. Figure 28 (Page 61) is a table of factors to convert the observed high hour of a weekday to the average weekday high hour of the month in which the count is taken. Figure 29 (Page 62) is a table of the eight pattern group factors to convert average weekday, Saturday or Sunday observed high hour to 30th high hour for the year.

The present analysis of automatic traffic recorder data for rural highways reveals that the 30th hour factor exhibits a tendency to decline slightly with the passing of time. The average decline in the percent of the average daily traffic has been at the rate of 0.11 per year.

On the average, the roads carrying relatively low volumes had the highest hourly percent, and those carrying the heaviest volumes had the lowest percent. On many high volume roads, high hourly volumes are very near possible capacity at certain key congestion points. Motorists have had to adjust their travel habits to the times of lesser traffic volumes. This has resulted in six to ten hours of each summer Sunday afternoon having nearly the same hourly volumes instead of one or two much higher volumes.

In estimating DHV for 20 years in the future, it is expected that the travel habits of the motorist will revert to conditions that exist on low volume roads, as the volume even in the peak hour may be low in comparison with

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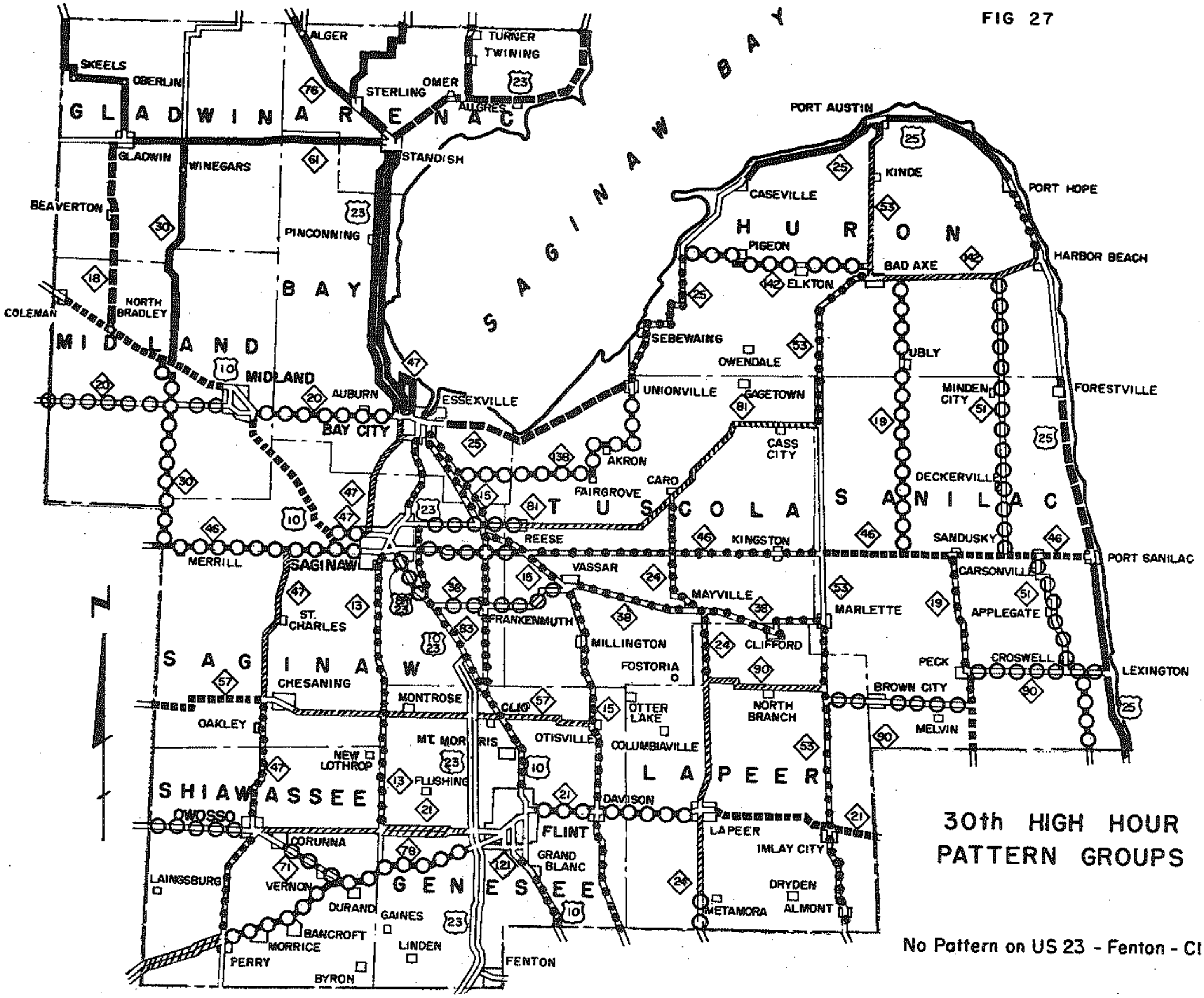
DISTRICT 6

FIG 27



30th HIGH HOUR PATTERN GROUPS

No Pattern on US 23 - Fenton - Clio

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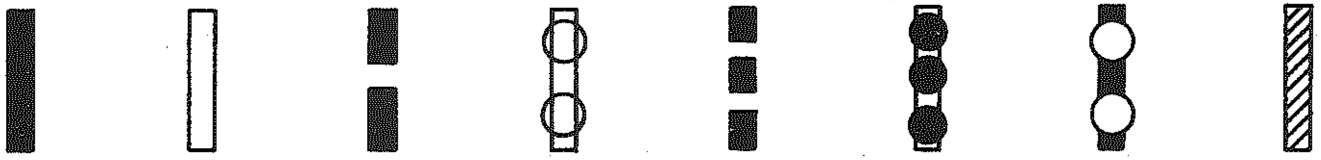
## FACTORS FOR CONVERTING ACTUAL WEEKDAY HIGHEST HOUR COUNT TO AVERAGE WEEKDAY HIGHEST HOUR

| | | | Factors |
|---|---|---|---|
| Monday | | | 0.995 |
| Monday | Tuesday | | 1.029 |
| Monday | Wednesday | | 1.024 |
| Monday | Thursday | | 1.015 |
| Monday | Tuesday | Wednesday | 1.044 |
| Tuesday | | | 1.066 |
| Tuesday | Wednesday | | 1.061 |
| Tuesday | Thursday | | 1.049 |
| Tuesday | Friday | | 0.963 |
| Tuesday | Wednesday | Thursday | 1.052 |
| Wednesday | | | 1.056 |
| Wednesday | Thursday | | 1.044 |
| Wednesday | Friday | | 0.959 |
| Wednesday | Thursday | Friday | 0.994 |
| Thursday | | | 1.033 |
| Thursday | Friday | | 0.949 |
| Thursday | Friday | Monday | 0.941 |
| Friday | | | 0.879 |
| Friday | Monday | | 0.933 |

FIG 28

# FACTORS TO CONVERT AVERAGE WEEKDAY AND SATURDAY AND SUNDAY HIGH HOURS TO 30TH HIGH HOUR OF THE YEAR



## WEEKDAY

| | I Blue | II Pink | III Purple | IV Orange | V Black | VI Dk. Green | VII Lt. Green | VIII Red |
|---|---|---|---|---|---|---|---|---|
| January | 6.716 | 5.172 | 4.637 | 2.732 | 2.485 | 2.727 | 1.936 | 1.935 |
| February | 5.966 | 4.185 | 5.152 | 2.295 | 2.494 | 2.358 | 1.807 | 1.714 |
| March | 5.791 | 4.349 | 4.123 | 2.375 | 2.279 | 2.522 | 1.722 | 1.688 |
| April | 4.813 | 3.652 | 3.018 | 1.879 | 1.917 | 2.068 | 1.686 | 1.476 |
| May | 3.720 | 3.251 | 3.484 | 1.882 | 1.758 | 1.797 | 1.599 | 1.446 |
| June | 2.767 | 2.757 | 2.701 | 1.552 | 1.627 | 1.809 | 1.471 | 1.428 |
| July | 1.674 | 2.126 | 1.688 | 1.097 | 1.300 | 1.515 | 1.400 | 1.415 |
| August | 1.744 | 2.116 | 1.957 | 1.087 | 1.196 | 1.500 | 1.387 | 1.346 |
| September | 2.620 | 3.030 | 3.563 | 1.681 | 1.749 | 1.765 | 1.466 | 1.410 |
| October | 3.428 | 3.239 | 2.896 | 1.652 | 1.744 | 1.829 | 1.636 | 1.408 |
| November | 4.110 | 4.091 | 2.937 | 1.893 | 1.988 | 1.873 | 1.594 | 1.434 |
| December | 5.867 | 4.149 | 4.836 | 2.090 | 2.458 | 2.204 | 1.734 | 1.654 |

## SATURDAY

| | I Blue | II Pink | III Purple | IV Orange | V Black | VI Dk. Green | VII Lt. Green | VIII Red |
|---|---|---|---|---|---|---|---|---|
| April | 3.365 | 3.163 | 2.758 | 1.691 | 1.850 | 2.129 | 1.711 | 1.598 |
| May | 3.394 | 2.653 | 2.798 | 2.193 | 1.775 | 1.962 | 1.758 | 1.455 |
| June | 2.237 | 2.214 | 2.574 | 1.741 | 1.633 | 1.730 | 1.474 | 1.585 |
| July | 1.426 | 1.643 | 1.083 | 1.066 | 1.211 | 1.311 | 1.420 | 1.401 |
| August | 1.317 | 1.410 | 1.155 | 1.082 | 1.104 | 1.387 | 1.304 | 1.312 |
| September | 2.759 | 2.467 | 3.069 | 1.836 | 1.657 | 1.937 | 1.657 | 1.471 |
| October | 3.073 | 2.227 | 2.373 | 1.813 | 1.606 | 1.634 | 1.455 | 1.524 |
| November | 3.593 | 3.719 | 2.570 | 2.041 | 1.825 | 1.761 | 1.522 | 1.517 |

## SUNDAY

| | I Blue | II Pink | III Purple | IV Orange | V Black | VI Dk. Green | VII Lt. Green | VIII Red |
|---|---|---|---|---|---|---|---|---|
| April | 2.050 | 2.013 | 1.271 | 1.762 | 1.220 | 1.206 | 1.215 | 0.940 |
| May | 1.919 | 1.530 | 1.240 | 1.711 | 1.257 | 1.175 | 1.213 | 1.009 |
| June | 1.539 | 1.294 | 1.436 | 1.445 | 1.252 | 1.132 | 1.202 | 1.113 |
| July | 1.062 | 1.034 | 0.950 | 0.985 | 1.017 | 1.010 | 1.053 | 1.078 |
| August | 1.128 | 0.978 | 1.048 | 1.060 | 0.908 | 0.988 | 1.055 | 1.030 |
| September | 1.779 | 1.479 | 1.844 | 1.650 | 1.366 | 1.175 | 1.165 | 1.056 |
| October | 2.115 | 1.317 | 1.067 | 1.659 | 1.211 | 1.125 | 1.156 | 0.937 |
| November | 2.390 | 2.311 | 1.316 | 2.042 | 1.483 | 1.280 | 1.264 | 1.127 |

FIG 29

MICHIGAN STATE HIGHWAY DEPARTMENT
John C. Mackie, Commissioner

the capacity, in the rural areas on limited access highways.

In many recreational areas the present two-way 30th high hour is now between 25 and 30 percent of the ADT. The 30th high hour traffic on a two-way roadway may be from 60 to 90 percent in one direction. The following table shows the relationship between two-way and one-way design hour percentages.

| Two-Way DHV Percent | One-Way DHV Percent with the Following Percent in the Major Direction -- | | | | | | |
|---|---|---|---|---|---|---|---|
| | 60 | 65 | 70 | 75 | 80 | 85 | 90 |
| 10 | 12.0 | 13.0 | 14.0 | 15.0 | 16.0 | 17.0 | 18.0 |
| 15 | 18.0 | 19.5 | 21.0 | 22.5 | 24.0 | 25.5 | 27.0 |
| 20 | 24.0 | 26.0 | 28.0 | 30.0 | 32.0 | 34.0 | 36.0 |
| 25 | 30.0 | 32.5 | 35.0 | 37.5 | 40.0 | 42.5 | 45.0 |
| 30 | 36.0 | 39.0 | 42.0 | 45.0 | 48.0 | 51.0 | 54.0 |

In computing, it must be remembered that design hour values do not necessarily occur at the same hour of the day or the same day of the week or even the same month of the year. Also, the southbound design hour in recreational areas may be a higher percentage of total traffic than the northbound design hour. Many times the traffic in one direction may reach a peak in the morning and in the other direction in the evening. At interchanges the various ramp movements may reach their peaks at different times. Therefore, the design hours on the various movements do not add directly to the leg totals except on rare occasions and the leg totals do not add to the design hour of both roadways.

Wherever possible, a determination is made of numerical design hour volumes, especially on ramps or roadways where the high hours consist of industrial or recreational traffic. In areas of this type comparisons can be made with similar existing locations where actual counts have been made. If no other data is available, the design hour will have to be computed as a percent of the ADT.

## Commercial Traffic

The estimating of future commercial traffic is in its infancy. It is only recently that its consideration has become necessary. Commercial vehicles are considered by AASHO to be single unit trucks with dual rear tires, tractor-semitrailer combinations, combinations involving full trailers and busses. Pick-ups and light panel trucks are included with passenger cars as they have the same operating characteristics.

The two main reasons why the amount of commercial vehicles in the traffic stream are important in highway design are size and speed. The size is considered to be both the heavier axle weights and the larger dimensions. The heavier axle weights concern type and thickness of pavements. For example a ramp that would warrant only a low type pavement on the basis of low total volume may require a high surface type if a large percentage of the traffic is commercial. Large dimensions require wider pavement and on ramps longer radii of curves as well as occupying twice as much space on the roadway. Speed is not too important a factor on level roadway although most states have a restriction on the speed of heavy commercial vehicles. However, steep up grades of ramps will slow heavy commercial vehicles and reduce ramp capacity. Again heavy commercial vehicles will require much longer acceleration lanes. (Heavy commercial vehicles can decelerate much easier than accelerate.)

In most rural areas of the State the design hour occurs on summer Sundays and holidays when the amount of commercial traffic is very low and does therefore have little effect on capacity.

The commercial traffic that is presently being estimated is for average future conditions at the location. When the design hour occurs on weekdays the values shown would be sufficiently accurate for the DHV.

# ESTIMATING TRAFFIC MOVEMENTS AT AN INTERCHANGE

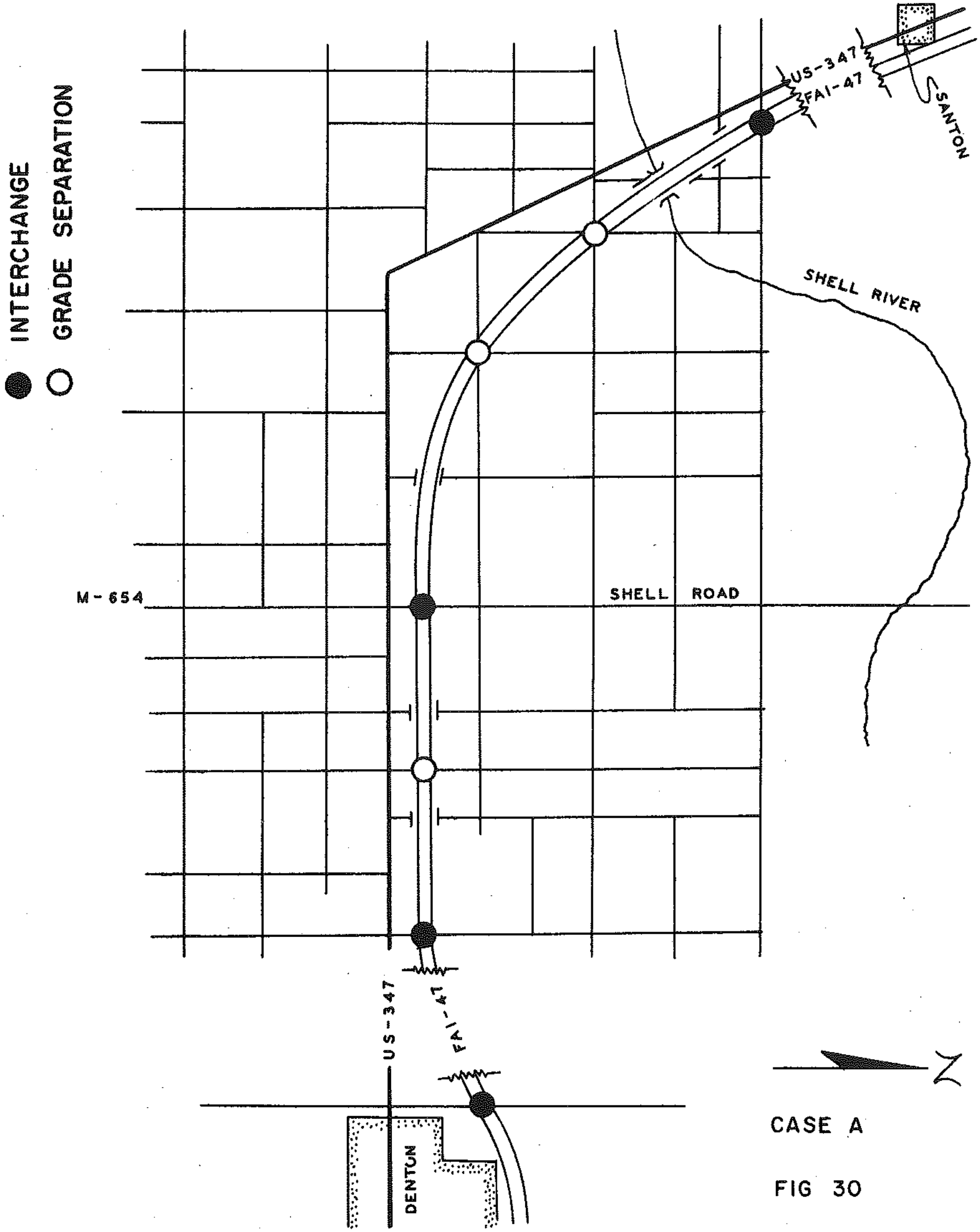
For illustration purposes three separate cases will be used to indicate the method followed when estimating traffic at an interchange. These cases are hypothetical and should not be inferred to represent any location now existing in the State. Conditions are a composite of actual locations where traffic data have been obtained prior to and after construction of portions of the limited access system or other related highways.

## Case A

This interchange is to be built in a rural area approximately 180 miles from the nearest city with a population of over 50,000, see figure 30. The county road starting at the terminus of M-654 and running in a northerly direction will not be developed to any great extent since it serves a sub-marginal farming area. F.A.I. 47 will lie 1/2 mile north of present US-347. Local traffic will continue to use US-347 which will revert to a county road upon completion of F.A.I. 47. M-654 will be extended north for 1/2 mile to connect with F.A.I. 47. Development along all of these routes will be minor, as the area has few recreational possibilities (determined from land use maps of the area), very little potential industrial or residential development as it is too far from a supply of either labor or raw materials. Some commercial development will take place to service thru traffic which will increase due to recreational areas farther to the northwest.

For simplicity of explanation, the same 1958 turning movement for US-347 and M-654 and Shell Road will be used for all the three cases discussed.

Figure 31 shows the actual turning movement at the intersection of US-347 and M-654 and Shell Road after adjustment to the 1958 ADT. It was necessary to use the tables shown in figures 14 and 15 (Pages 29 and 30) and to make the



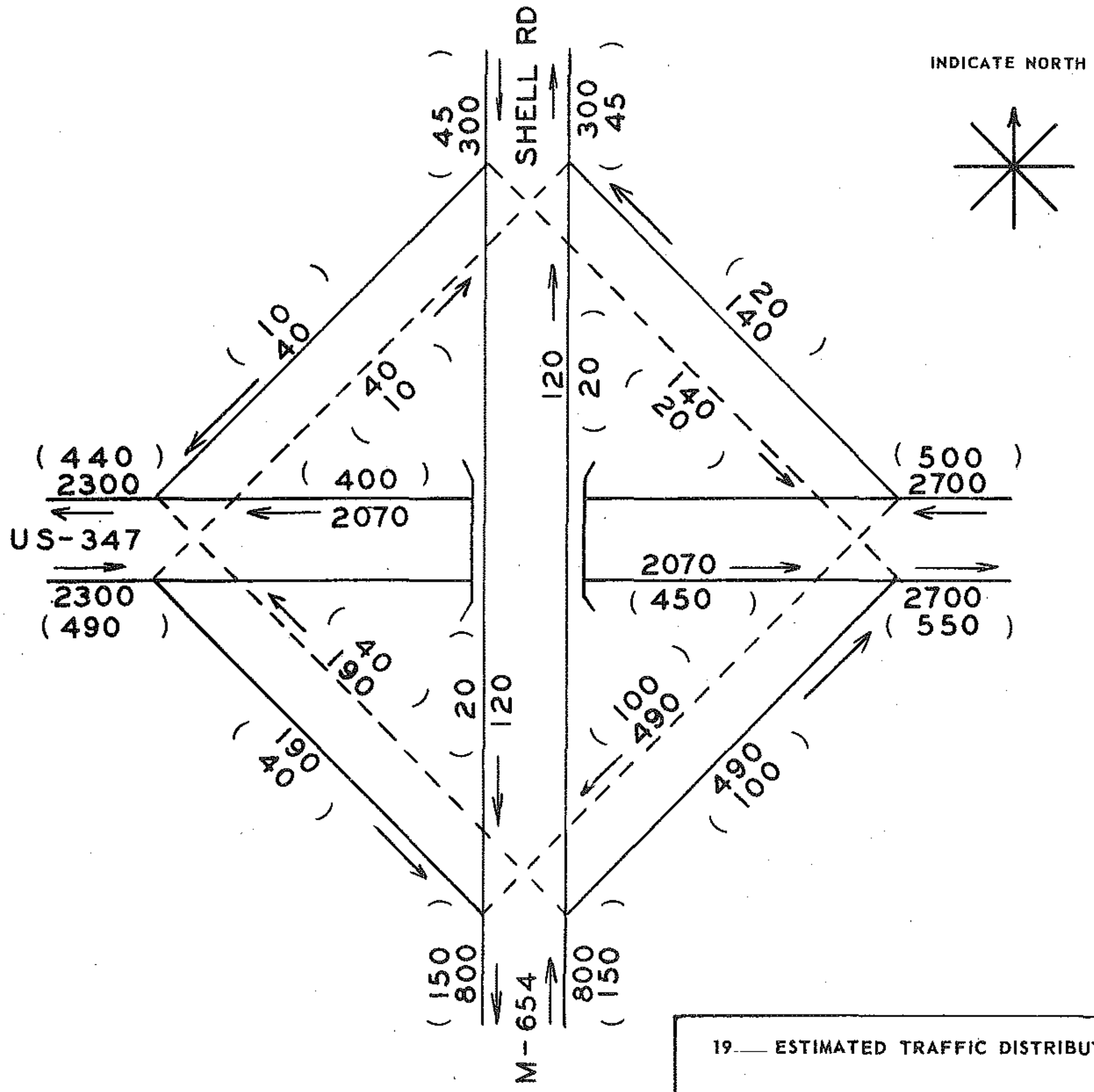
CASE A

FIG 30

**MICHIGAN**
**STATE HIGHWAY DEPARTMENT**
**JOHN C. MACKIE, COMMISSIONER**
**TRAFFIC DIVISION**

FAI - 47
DENTON TO SANTON

AUTH. NO.
CONT. SEC.
REF.
SHEET OF PLAN
DRAWN LJ
DATE 4-1-59
SCALE NONE



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19___ ESTIMATED TRAFFIC DISTRIBUTION

LEGEND

| | |
|---|---|
| 0000 | Average Daily Traffic |
| (000) | Design Hour Volume |
| 00.0% | Commercial |
| 000 | 19 58 Average Daily Traffic |

Design hour volume of less than 100 is not shown.
AM & PM Design hour volume considered and only the highest one is shown

FIG 31

**SCHEMATIC**
**VEHICLE VOLUME**

PROJECT DENTON TO SANTON FAI - 47

INTERCHANGE OF US - 347 WITH M - 654 & SHELL RD.

proper adjustments, to obtain the 1958 ADT.

To simplify the discussion, movements through the intersection or interchange were assigned numbers, see figure 32. This designation will be used to show the various steps in the expansion of the traffic volumes of movements involved.

Figure 33 (page 70) shows the completed 1975 traffic expansion for Case A on a "double diamond" schematic vehicle volume diagram. This type of diagram is used on all preliminary traffic estimates as the volumes can be easily transferred to any type of interchange without losing the identity of the basic movements.

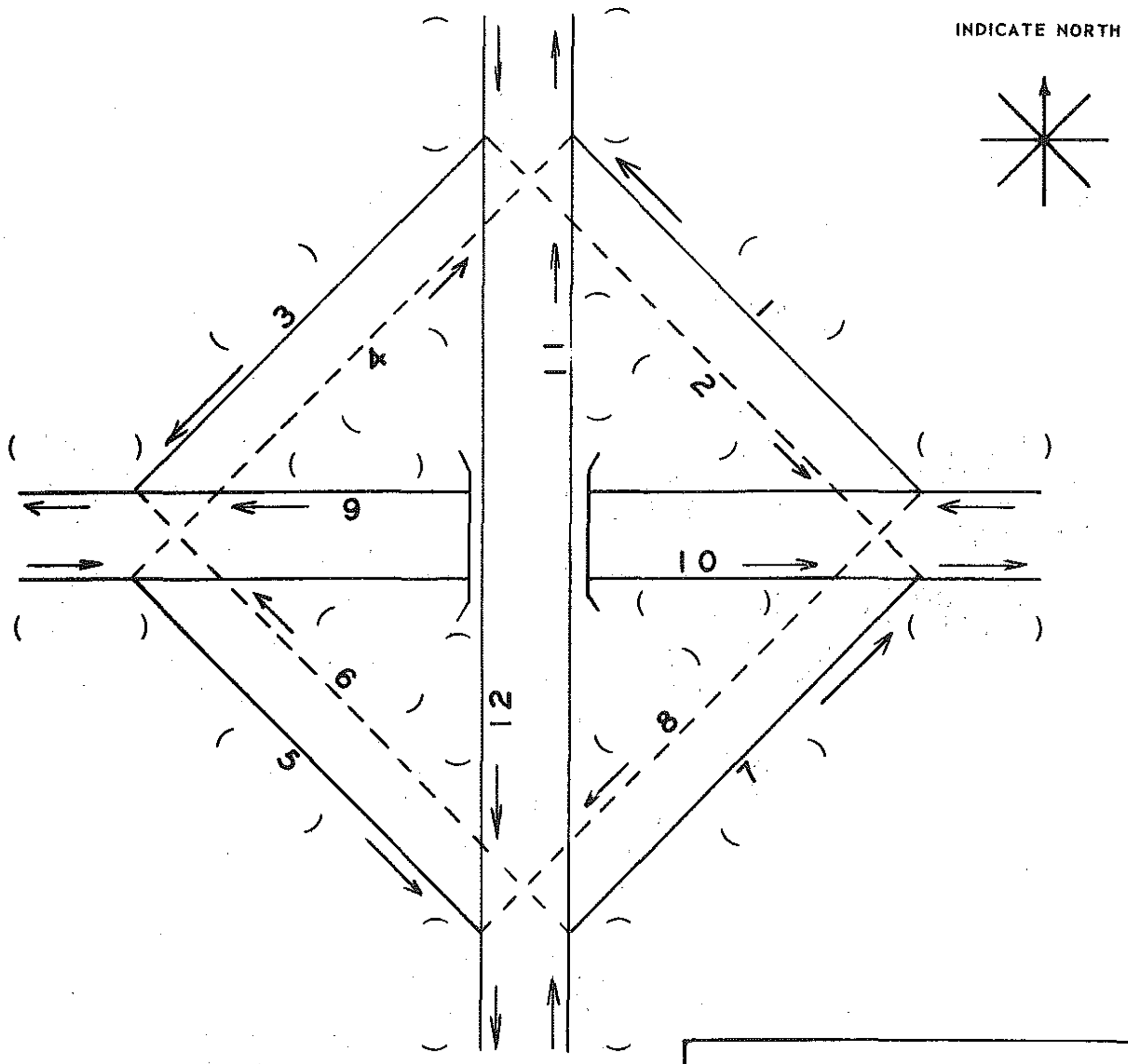
Procedure followed in expanding Case A to a 1975 volume for the interchange located at F.A.I. 47 and M-654.

Movements 3 and 4 (N to W and W to N)

| | | |
|---|---|---|
| Present Traffic (1958) | 40 | |
| Traffic Diverted to New Road | | 32 |
| Traffic Diverted from Other Roads | | 16 |
| Traffic Growth | | 32 |
| Generated Traffic | | 0 |
| Development Traffic | | 0 |
| | Total | 80 |

In 1958 movements 3 and 4 were 40 VPD. 32 VPD will use the new facility as their destination is beyond this interchange and will enter, leave, or pass thru the next interchange to the west (the others will continue to use the old road). Since several county roads are to be closed in the area, it will be necessary for 16 VPD to use this interchange. Traffic growth is expected to be 32 VPD brought about by low normal growth. Little or no Generated or Development traffic is expected.

30th high hour in 1958 was 10 or 25% of movements 3 and 4. The design hour estimate is 20 or no change from the 1958 percentages, as determined from the 30th high hour traffic pattern developed from similar turning movements of intersections on US-347.



19___ ESTIMATED TRAFFIC DISTRIBUTION

LEGEND

| | |
|---|---|
| 0000 | Average Daily Traffic |
| (000) | Design Hour Volume |
| 00.0% | Commercial |
| 000 | 19___ Average Daily Traffic |

Design hour volume of less than 100 is not shown.
AM & PM Design hour volume considered and only the highest one is shown

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**JOHN C. MACKIE, COMMISSIONER**
OFFICE OF ENGINEERING – TRAFFIC DIVISION

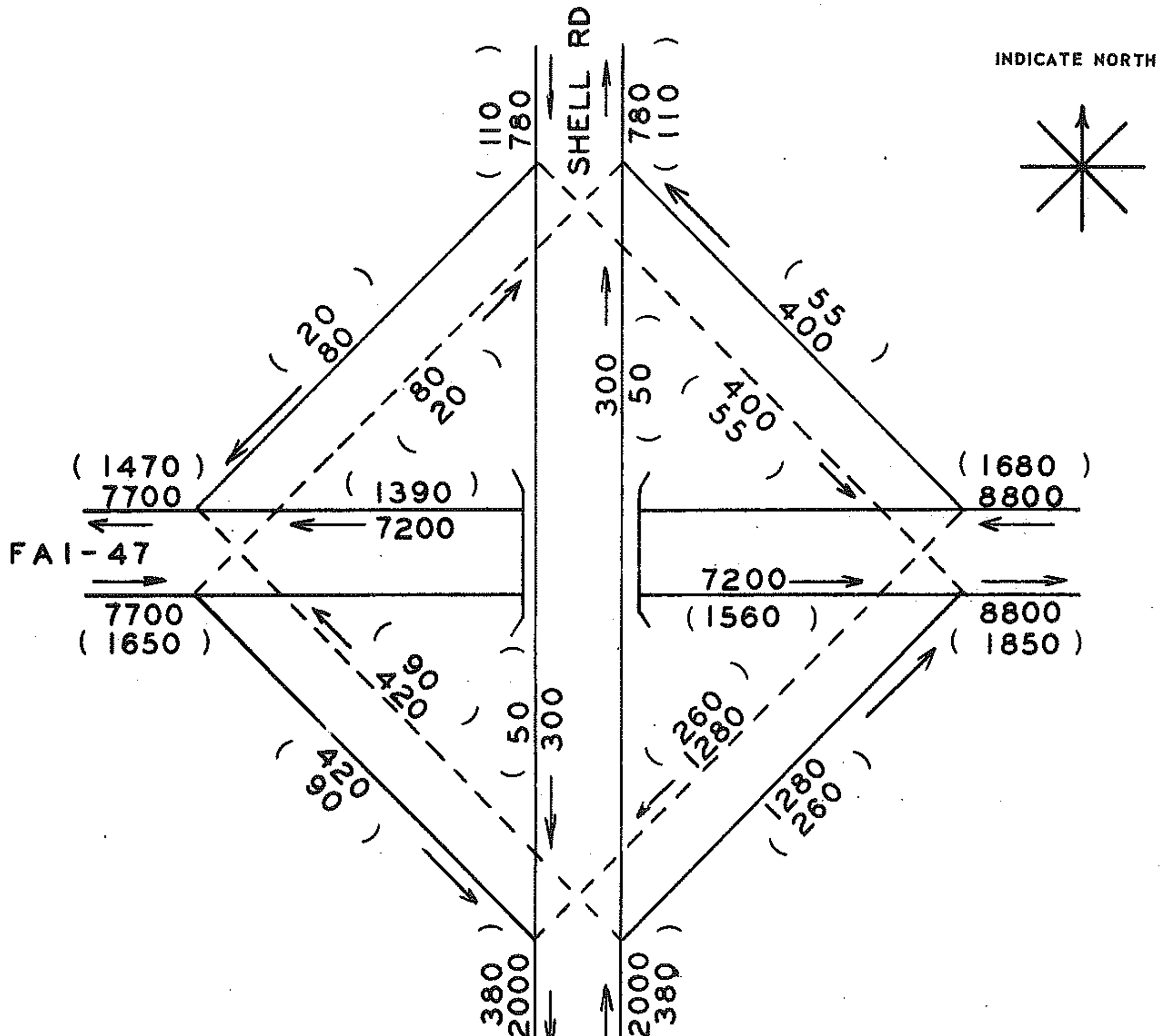
## NUMBERING SYSTEM USED FOR TRAFFIC MOVEMENTS AT AN INTERCHANGE OR INTERSECTION.

**SCHEMATIC**
**VEHICLE VOLUME**

FIG 32

PROJECT ________________________________

INTERCHANGE OF __________________ WITH __________________



**MICHIGAN STATE HIGHWAY DEPARTMENT**
**JOHN C. MACKIE, COMMISSIONER**
OFFICE OF ENGINEERING - TRAFFIC DIVISION

**19 75 ESTIMATED TRAFFIC DISTRIBUTION**

LEGEND

| | |
|---|---|
| 0000 | Average Daily Traffic |
| (000) | Design Hour Volume |
| 00.0% | Commercial |
| 000 | 19__ Average Daily Traffic |

Design hour volume of less than 100 is not shown.
AM & PM Design hour volume considered and only the highest one is shown

CASE A

FIG 33

**SCHEMATIC**
**VEHICLE VOLUME**

PROJECT DENTON TO SANTON FA I - 47

INTERCHANGE OF FA I - 47 WITH M - 654 & SHELL RD.

Usually values less than 100 DHV are not shown on the final presentation of traffic estimates. On all work tables and diagrams, all design hours should be computed and used. For these illustrations, all design hour values will be shown.

Movements 9 and 10 (E to W and W to E)

| | | |
|---|---|---|
| Present Traffic (1958) | 2070 | |
| Traffic Diverted to New Road | | 1860 |
| Traffic Diverted from Other Roads | | 370 |
| Traffic Growth | | 2790 |
| Generated Traffic | | 1140 |
| Development Traffic | | 1040 |
| | Total | 7200 |

It is estimated that 1860 VPD will transfer to the new facility from old US-347. From an O-D study taken a few years earlier at a point on US-347, two miles east of M-654, it was found that 90% of the motorists would travel past this point for points further east or west of this location. Traffic that normally used other roads will transfer to this new facility, estimated to be 370 vehicles per day. Traffic growth along this route is expected to be 2790 vehicles. Generated traffic is estimated at 1140 VPD. Development traffic is estimated at 1040 VPD. This is due to development at other interchanges. As stated earlier, no major improvement is expected in this area for Case A.

The design hour values for 1958 for the westbound movement is 400 or 19.3% for eastbound 450 or 21.7%. It can be noted that 50 more vehicles desire to travel easterly than do westerly for the 30th high hour. (Same pattern exists along the entire road.) This pattern will be carried into the 1975 estimate. Using the same percentages, since it is not expected that any significant change in pattern will occur at this location, it was found that 1390 DHV or 19.3% of 7200 vehicles desire to go west. For the eastbound movement, 21.7% of 7200 is 1560 DHV. Numerous summer weekend counts have indicated that the westbound high hours occur in the morning along this route and the high eastbound volumes occur on Sunday evenings. At all locations counted the eastbound hours were higher than the westbound due to recreational traffic returning home.

<u>Movements</u> 5 and 6 (W to S and S to W)

| | | |
|---|---|---|
| Present Traffic (1958) | 190 | |
| Traffic Diverted to New Road | | 140 |
| Traffic Diverted from Other Roads | | 45 |
| Traffic Growth | | 140 |
| Generated Traffic | | 60 |
| Development Traffic | | 35 |
| | Total | 420 |

Since M-654 is to be extended to the new facility, no radical change is expected at this location. Some of the vehicles not diverted to this new facility (50 VPD) will continue to use old US-347 which will revert to a county road. 140 VPD will continue north on extended M-654 and use F.A.I. 47 to the west and also return by this route. Due to county road closures, 45 VPD will be entering at this interchange. Traffic growth is estimated to be 140 vehicles (same reason as for movements 3 and 4.) Generated traffic from points south is 60 VPD. Due to a very minor development, 35 VPD will make this movement.

Design hour value will be the same percentage as for 1958 or 90 DHV.

<u>Movements</u> 11 and 12 (N to S and S to N)

| | | |
|---|---|---|
| Present Traffic (1958) | 120 | |
| Traffic on Present Road | | 120 |
| Traffic Diverted from Other Roads | | 13 |
| Traffic <u>Not</u> Diverted on Movements 3 and 4 | | 8 |
| Traffic <u>Not</u> Diverted on Movements 1 and 2 | | 20 |
| Traffic Growth | | 120 |
| Generated Traffic | | 13 |
| Development Traffic | | 6 |
| | Total | 300 |

Since this is a straight-thru movement, on the cross road, there will be no diversion of the present 120 VPD. Traffic diverted by road closures is 13 VPD. In movements 3 and 4 from the N to W and W to N, 32 vehicles of the present 40 VPD are accounted for. The other vehicles desired to continue to the south and use old US-347 for their travel. Twenty vehicles not diverted on movements 1 and 2 (E to N and N to E) will also be using old US-347. Traffic growth is expected to be 120 VPD. Generated traffic is 13 VPD. Development traffic is 6 VPD.

Design hour values for 1975 will be the same percentage as for 1958 or 50.

<u>Movements</u> 7 and 8 (S to E and E to S)

| | | |
|---|---|---|
| Present Traffic (1958) | 490 | |
| Traffic Diverted to New Road | | 400 |
| Traffic Diverted from Other Roads | | 100 |
| Traffic Growth | | 400 |
| Generated Traffic | | 200 |
| Development Traffic | | 180 |
| | Total | 1280 |

Of the present traffic, 400 VPD will use the new facility. The balance, or 90, will continue to use old US-347 which will revert to a county road. Traffic diverted from other roads due to road closures, 100 VPD. It is expected that an increase of 100% in traffic growth will occur on this movement, or 400 VPD. Generated traffic in this movement will result in 200 VPD which is brought about by a better facility for eastward movement. Development traffic amounts to 180 VPD. Commercial establishments will be constructed south of the interchange.

Design hour percentage value for 1975 to be the same as for 1958 or 260 DHV.

<u>Movements</u> 1 and 2 (E to N and N to E)

| | | |
|---|---|---|
| Present Traffic (1958) | 140 | |
| Traffic Diverted to New Road | | 120 |
| Traffic Diverted from Other Roads | | 60 |
| Traffic Growth | | 120 |
| Generated Traffic | | 60 |
| Development Traffic | | 40 |
| | Total | 400 |

Of the original 140 vehicles making these movements at US-347, 120 VPD will now use F.A.I. 47. Diverted traffic due to road closures, 60 VPD. Traffic growth will be 100% or 120 VPD. Generated traffic will amount to 60 VPD. Development traffic will be 40 VPD.

Design hour percentage value for 1975 will be the same as for 1958 or 55 DHV.

To determine the above movements, it is necessary to know as much as possible about the area. Studies must be made of any land use data available, together with origin and destination studies that will affect the interchange. Studies also have to be made of the time of occurrence of the 30th high hour so that estimates can be made of the design hour on the various legs.

For example, on figure 33 (Page 70) the southbound DHV movements 2, 3 and 12 are 20, 55 and 50, which add to a numerical value of 125. These adjust to a DHV of 110. The same type of adjustment is made on all legs of the interchange. All these design hours in Case A occur at nearly the same time and differ only slightly from the numerical total, as determined from representative turning movement data in the area.

By referring to figures 31 (Page 67) and 33 (Page 70), it is found that the traffic on the west leg will increase from 4600 to 15400 or a traffic projection factor of 3.348. The east leg will increase from 5400 to 17600 or a traffic projection factor 3.259. The north leg will increase from 600 to 1560, projection factor 2.600. The south leg will increase from 1600 to 4000, projection factor 2.500.

## Case B

This interchange is to be built in a rural area approximately 15 miles west of a growing city with a 1955 population of 60,000, now being served by present US-347, see figure 34. The traffic development of both the county road and M-654 will be minor, but greater than in Case A. Figure 35 (Page 77) shows the completed 1975 traffic expansion for Case B.

<u>1975 traffic volume estimates for interchange F.A.I. 47 and M-654</u>.

<u>Movements</u> 3 and 4 (N to W and W to N)

| | | |
|---|---|---|
| Present Traffic (1958) | 40 | |
| Traffic Diverted to New Road | | 32 |
| Traffic Diverted from Other Roads | | 16 |
| Traffic Growth | | 32 |
| Generated Traffic | | 0 |
| Development Traffic | | 0 |
| | Total | 80 |

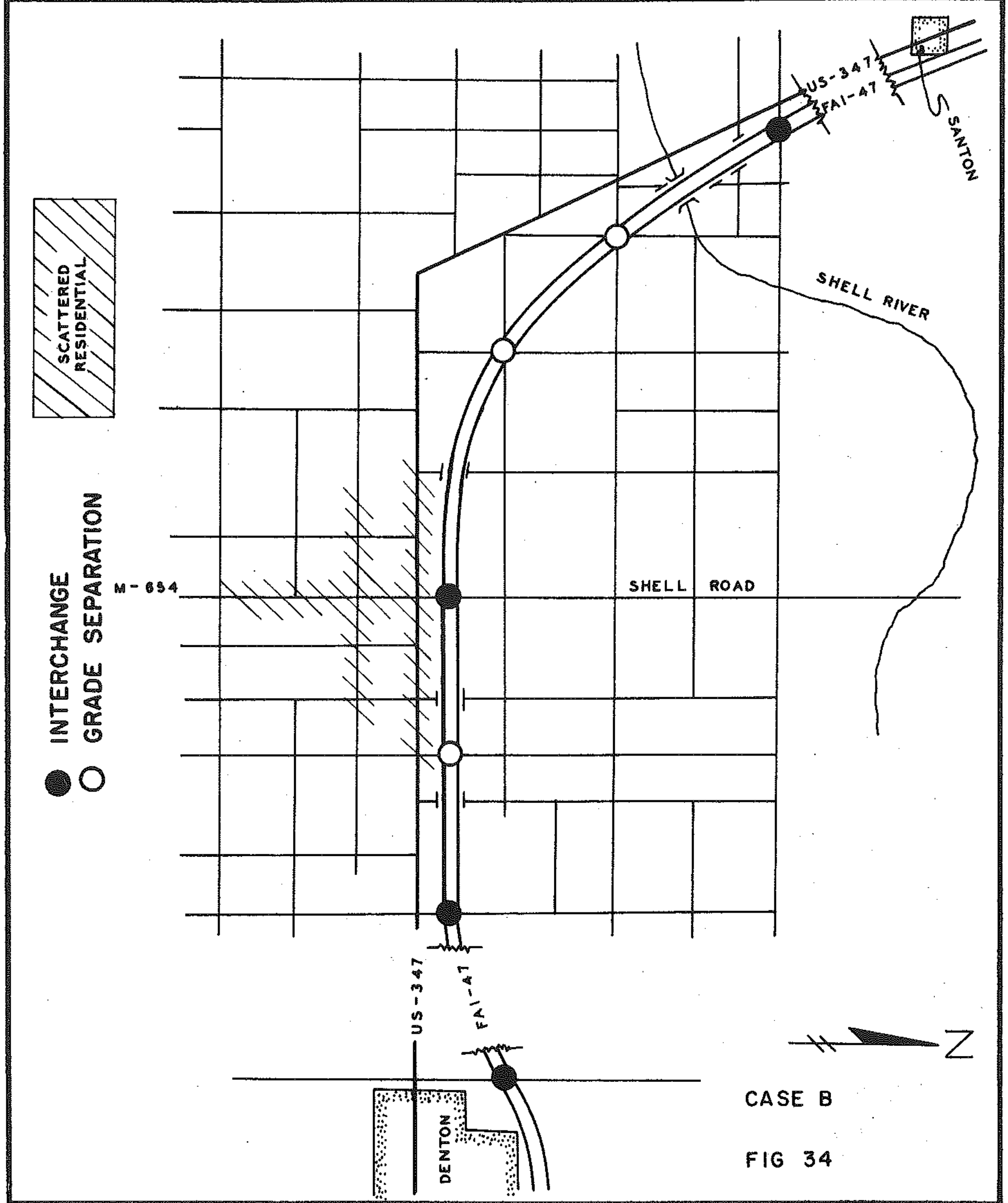
Design hour value 20 same as for Case A.

<u>Movements</u> 9 and 10 (E to W and W to E)

| | | |
|---|---|---|
| Present Traffic (1958) | 2070 | |
| Traffic Diverted to New Road | | 1860 |
| Traffic Diverted from Other Roads | | 370 |
| Traffic Growth | | 2790 |
| Generated Traffic | | 1140 |
| Development Traffic | | 1040 |
| | Total | 7200 |

Westbound design hour - 1250
Eastbound design hour - 1440

Design hour values in this instance are lower than Case A, due to the nearness of a city, thereby causing a more uniform traffic distribution and a lower percentage of ADT.



CASE B

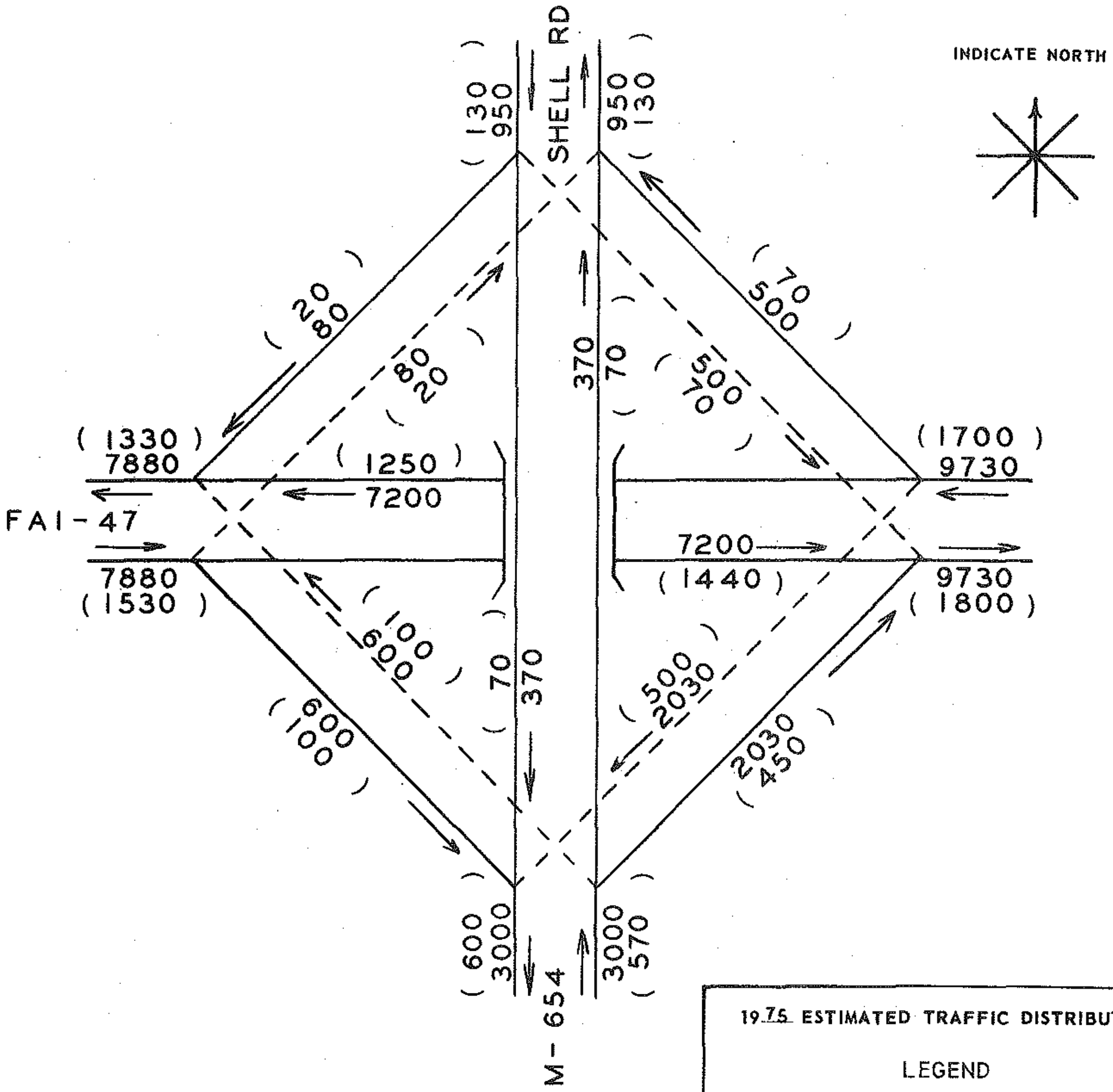
FIG 34

MICHIGAN
STATE HIGHWAY DEPARTMENT
JOHN C. MACKIE, COMMISSIONER
TRAFFIC DIVISION

FAI-47
DENTON TO SANTON

AUTH. NO.
CONT. SEC.
REF.
SHEET OF PLAN

DRAWN LF
DATE 4-1-59
SCALE NONE



**MICHIGAN STATE HIGHWAY DEPARTMENT**
**JOHN C. MACKIE, COMMISSIONER**
OFFICE OF ENGINEERING – TRAFFIC DIVISION

**1975 ESTIMATED TRAFFIC DISTRIBUTION**

LEGEND

| | |
|---|---|
| 0000 | Average Daily Traffic |
| (000) | Design Hour Volume |
| 00.0% | Commercial |
| 000 | 19___ Average Daily Traffic |

Design hour volume of less than 100 is not shown.
AM & PM Design hour volume considered and only the highest one is shown

CASE B

FIG 35

**SCHEMATIC**
**VEHICLE VOLUME**

PROJECT DENTON TO SANTON FAI - 47

INTERCHANGE OF FAI - 47 WITH M-654 & SHELL RD.

Movements 5 and 6 (S to W and W to S)

| | | |
|---|---|---|
| Present Traffic (1958) | 190 | |
| Traffic Diverted to New Road | | 140 |
| Traffic Diverted from Other Roads | | 85 |
| Traffic Growth | | 140 |
| Generated Traffic | | 130 |
| Development Traffic | | 105 |
| | Total | 600 |

Due to a more populous area, the traffic diverted from other roads and generated traffic is larger than for Case A. Development traffic larger than Case A due to residential development on south leg of M-654.

Design hour value 100.

Movements 11 and 12 (N to S and S to N)

| | | |
|---|---|---|
| Present Traffic (1958) | 120 | |
| Traffic on Present Road | | 120 |
| Traffic Diverted from Other Roads | | 50 |
| Traffic Not Diverted on Movements 3 and 4 | | 8 |
| Traffic Not Diverted on Movements 1 and 2 | | 20 |
| Traffic Growth | | 120 |
| Generated Traffic | | 40 |
| Development Traffic | | 12 |
| | Total | 370 |

Design hour value of 100. Increase in design hour due to facts listed in movements 5 and 6.

Movements 7 and 8 (S to E and E to S)

| | | |
|---|---|---|
| Present Traffic (1958) | 490 | |
| Traffic Diverted to New Road | | 400 |
| Traffic Diverted from Other Roads | | 300 |
| Traffic Growth | | 400 |
| Generated Traffic | | 300 |
| Development Traffic | | 630 |
| | Total | 2030 |

Diverted traffic and generated traffic larger, caused by populous area. Residential homes constructed in the area plus traffic commuting from a city to the east accounts for increase in development traffic.

Design hour for northeast bound - 450.
Design hour for southwest bound - 500.

<u>Movements</u> 1 and 2 (E to N and N to E)

| | | |
|---|---|---|
| Present Traffic (1958) | 140 | |
| Traffic Diverted to New Road | | 120 |
| Traffic Diverted from Other Roads | | 90 |
| Traffic Growth | | 120 |
| Generated Traffic | | 100 |
| Development Traffic | | 70 |
| | Total | 500 |

Reasons for increase in traffic same as for movements 5 and 6.

Design hour value of 70.

The ADT is computed by adding or subtracting volumes for each leg by movement. For example, westbound volume for Case B on east leg is 9730, minus 500 for northeast movement, minus 2030 for southwest movement equals 7200. This volume would enter the west leg, combined with 80 from the north to the west and 600 from the south to the west for a total of 7880. Same procedure can be followed for the remaining legs.

S to N    3000 - 2030 - 600 + 500 + 80 = 950

N to S    950 - 80 - 500 + 2030 + 600 = 3000

W to E    7880 - 600 - 80 + 2030 + 500 = 9730

The design hour listed for the legs beyond the interchange:

Design hour for the north leg.

Northbound - 130.
Southbound - 130.

Design hour for east leg.

Westbound - 1700.
Eastbound - 1800.

More uniform traffic, due to city to the east, resulted in a lower volume than Case A for eastbound movement. (Remembering that the same 1958 ADT is used for Case A, B and C).

Design hour for south leg.

Southbound - 600.
Northbound - 570.

Higher due to residential development.

Design hour for west leg.

Eastbound - 1530.
Westbound - 1330.

Lower than Case A due to more uniform movement of traffic due to city to the east of the interchange.

By referring to figures 31 (Page 67) and 35 (Page 77), it is found that the traffic on the west leg will increase from 4600 to 15760 or a traffic projection factor of 3.426. The east leg will increase from 5400 to 19460, traffic projection factor 3.167. The north leg will increase from 600 to 1900, traffic projection factor 3.167. The south leg will increase from 1600 to 6000, traffic projection factor 3.750.

## Case C

This interchange is to be built 15 miles from a city of 400,000 population, see figure 36. The city is located to the east of M-654 on US-347. Within three years, a large summer recreational area will be developed on Shell River, 3 miles north of this interchange. It is the intention of the development company to dam the Shell River and flood the low lands to form an artificial lake covering between 2000 to 2500 acres. In the vicinity of the existing US-347 and M-654 a large industrial development is in the process of being constructed. Employment to reach 3000 to 4000 by 1975. A residential development south and west has been started. Figure 37 (Page 83) shows the completed 1975 traffic expansion for Case C.

No attempt will be made to explain each movement, step by step, as the same reasoning and methods were used here as were used for Case A and B. Explanations will be shown where it is felt to be necessary.

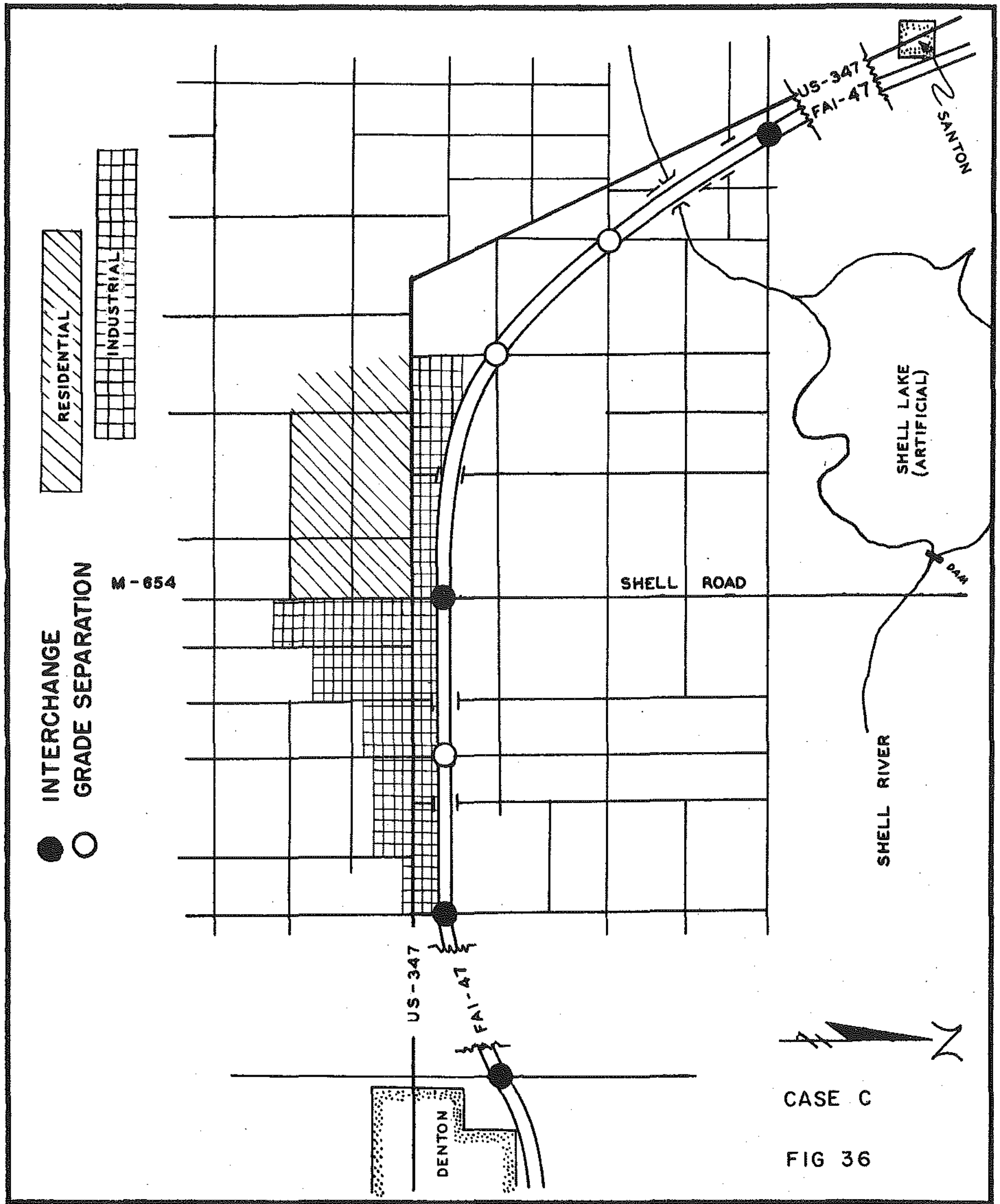
### 1975 traffic volume estimate for Interchange of F.A.I. 47 and M-654.

Movements 3 and 4 (N to W and W to N)

| | | |
|---|---|---|
| Present Traffic (1958) | 40 | |
| Traffic Diverted to New Road | | 32 |
| Traffic Diverted from Other Roads | | 16 |
| Traffic Growth | | 32 |
| Generated Traffic | | 0 |
| Development Traffic | | 20 |
| | Total | 100 |

Southwest bound design hour - 150.
Northeast bound design hour - 80.

DHV on all traffic movements to and from the north leg will be extremely high due to the intensive recreational area of Shell Lake. Southwest bound traffic of 150 or over is expected to occur on 60 or more hours, on summer



CASE C

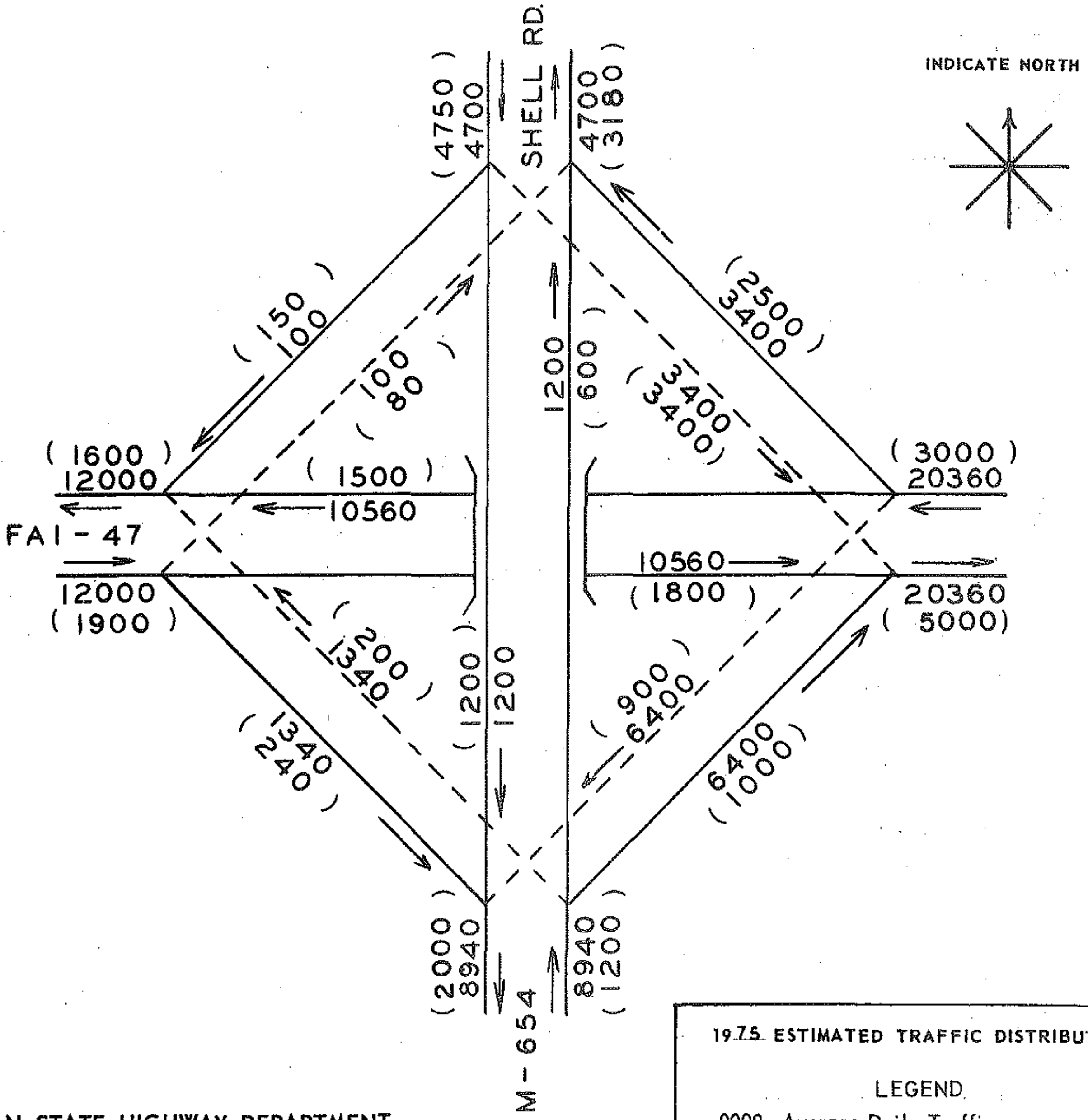
FIG 36

MICHIGAN
STATE HIGHWAY DEPARTMENT
JOHN C. MACKIE, COMMISSIONER
TRAFFIC DIVISION

FAI-47
DENTON TO SANTON

AUTH. NO.
CONT. SEC.
REF.
SHEET OF PLAN

DRAWN
DATE 4-1-59
SCALE NONE



19 75 ESTIMATED TRAFFIC DISTRIBUTION

LEGEND

| | |
|---|---|
| 0000 | Average Daily Traffic |
| (000) | Design Hour Volume |
| 00.0% | Commercial |
| 000 | 19___ Average Daily Traffic |

Design hour volume of less than 100 is not shown.

AM & PM Design hour volume considered and only the highest one is shown

**MICHIGAN STATE HIGHWAY DEPARTMENT**
**JOHN C. MACKIE, COMMISSIONER**
OFFICE OF ENGINEERING – TRAFFIC DIVISION

CASE C

FIG 37

**SCHEMATIC**
**VEHICLE VOLUME**

PROJECT DENTON TO SANTON FAI - 47

INTERCHANGE OF FAI - 47 WITH M - 654 & SHELL RD

Sunday and holiday afternoons. This is a volume equal to 150% of the average daily traffic. The following table (predicted from actual traffic recorder and turning movement data collected at similar existing recreational areas) shows the daily traffic and high hour by groups of days, for the 365 days of the year for movement 3.

| | DAYS | ADT | 30th HIGH HOUR | TOTAL TRAFFIC |
|---|---|---|---|---|
| | 300 | 70 | 10 | 21,000 |
| | 55 | 100 | 15 | 5,500 |
| | 10 | 1000 | 150 | 10,000 |
| TOTAL | 365 | 100 | 150 | 36,500 |

Similar analysis is required for all other movements, (not included).

Movements 9 and 10 (E to W and W to E)

| | | |
|---|---|---|
| Present Traffic (1958) | 2070 | |
| Traffic Diverted to New Road | | 1860 |
| Traffic Diverted from Other Roads | | 930 |
| Traffic Growth | | 3250 |
| Generated Traffic | | 1860 |
| Development Traffic | | 2660 |
| | Total | 10560 |

Development traffic on this movement caused mainly by industrial development to the south of the next two interchanges to the west.

Design hour values

Westbound design hour - 1500.
Eastbound design hour - 1800.

Occurs on most weekdays. Factory employees combined with other traffic.

Movements 5 and 6 (W to S and S to W)

| | | |
|---|---|---|
| Present Traffic (1958) | 190 | |
| Traffic Diverted to New Road | | 140 |
| Traffic Diverted from Other Roads | | 140 |
| Traffic Growth | | 210 |
| Generated Traffic | | 210 |
| Development Traffic | | 640 |
| | Total | 1340 |

Traffic growth and generated traffic of 150% each, caused by general regional growth and a better highway. Development traffic of 450% caused by industrial and residential development.

Design hour values.

Southeast design hour - 240.
Northwest design hour - 200.

Weekday work pattern.

<u>Movements</u> 11 and 12 (S to N and N to S)

| | | |
|---|---|---|
| Present Traffic (1958) | 120 | |
| Traffic on Present Road | | 120 |
| Traffic Diverted from Other Roads | | 120 |
| Traffic <u>Not</u> Diverted on Movements 3 and 4 | | 8 |
| Traffic <u>Not</u> Diverted on Movements 1 and 2 | | 20 |
| Traffic Growth | | 180 |
| Generated Traffic | | 120 |
| Development Traffic | | 632 |
| | Total | 1200 |

Development traffic increase of 525% brought about by residential development to the south and recreational area at Shell Lake to the north. This is anticipated to occur mainly on summer and holiday weekends.

Design hour values.

Northbound design hour - 600
Southbound design hour - 1200

High southbound design hour is the result of heavy movement on summer weekends and holidays.

<u>Movements</u> 7 and 8 (S to E and E to S)

| | | |
|---|---|---|
| Present Traffic (1958) | 490 | |
| Traffic Diverted to New Road | | 400 |
| Traffic Diverted from Other Roads | | 400 |
| Traffic Growth | | 600 |
| Generated Traffic | | 400 |
| Development Traffic | | 4600 |
| | Total | 6400 |

Development traffic of 1150% is the result of an industry to be located south of this interchange employing 3000 to 4000. Majority of these employees come from the incorporated area of Denton with a population of 400,000. This movement will occur mostly on weekdays. Other small industries will contribute to the development traffic.

Design hour values.

Northeast bound design hour - 1000
Southwest bound design hour - 900

Occurs mostly on weekdays. Higher northeast DHV due to afternoon movement occuring when other traffic is also using the facility. Lower southwest movement occurs in early daylight hours.

<u>Movements</u> 1 and 2 (E to N and N to E)

| | | |
|---|---|---|
| Present Traffic (1958) | 140 | |
| Traffic Diverted to New Road | | 120 |
| Traffic Diverted from Other Roads | | 240 |
| Traffic Growth | | 180 |
| Generated Traffic | | 240 |
| Development Traffic | | 2620 |
| | Total | 3400 |

Development traffic is the result of the nearness of Denton (400,000 population) to the Shell Lake Recreational area. Surrounding areas will contribute to this factor also. Occurs mostly during warmer weather and not confined to weekends.

Design hour values.

Northwest bound design hour - 2500
Southeast bound design hour - 3400

The southeast movement is much higher since this will occur when the motorists are leaving the recreational area to return to their homes on summer Sundays and holidays. The northwest movement will be spread over more hours. The daily traffic in off peak seasons of the year will be only slightly higher than the traffic movement of Case "B".

Design Hour Values for the legs beyond the interchange:

North Leg

Northbound Design Hour - 3180
(All movements at the same time)

Southbound Design Hour - 4750
(All movements at the same time)

Movements 2, 3 and 12 occur simultaneously on summer Sundays and holidays.

West Leg

Westbound Design Hour - 1600

Eastbound Design Hour - 1900
(Movements 9 and 10 predominate Westbound AM, Eastbound PM)

South Leg

Southbound Design Hour - 2000
(Movements 7 and 8 predominate)

Northbound Design Hour - 1400
(Movements 5 and 8 predominate)

East Leg

Westbound Design Hour - 3000

Eastbound Design Hour - 5000
(Movements 1 and 2 predominate)

These design hour movements occur on summer Sundays and holidays which are created predominately by movements 1 and 2. The sum of the movements 7, 10 and 2 are:

| | | |
|---|---|---|
| 7 - Eastbound | 1000 | |
| 10 - Eastbound | 1800 | |
| 2 - Eastbound | 3400 | |
| Total | 6200 | DHV used is 5000. |

By referring to figures 31 (Page 67) and 37 (Page 83) it is found that the traffic on the west leg will increase from 4600 to 24000, or a traffic projection factor of 5.217. The east leg will increase from 5400 to 40720, traffic projection factor 7.541. North leg will increase from 600 to 9400, traffic projection factor 15.667. South leg from 1600 to 17880, traffic projection factor 11.175.

## Weaving and Merging

After the traffic estimate for F.A.I. 47 and M-654, Case C, was completed, the Geometrics Section requested the following information to determine the weaving and merging movements at a proposed cloverleaf interchange.

1. Sunday P.M. - hourly volumes when movement 2 is at the time of the DHV.
2. Sunday A.M. - hourly volumes when movement 1 is at the time of the DHV.
3. Weekday P.M. - hourly volumes when movement 7 is at the time of the DHV.
4. Weekday A.M. - hourly volumes when movement 8 is at the time of the DHV.

These four estimates require an examination of all available data concerning the amount of traffic on the other 11 movements when one weaving or merging movement is at the 30th high hour value for the year 1975.

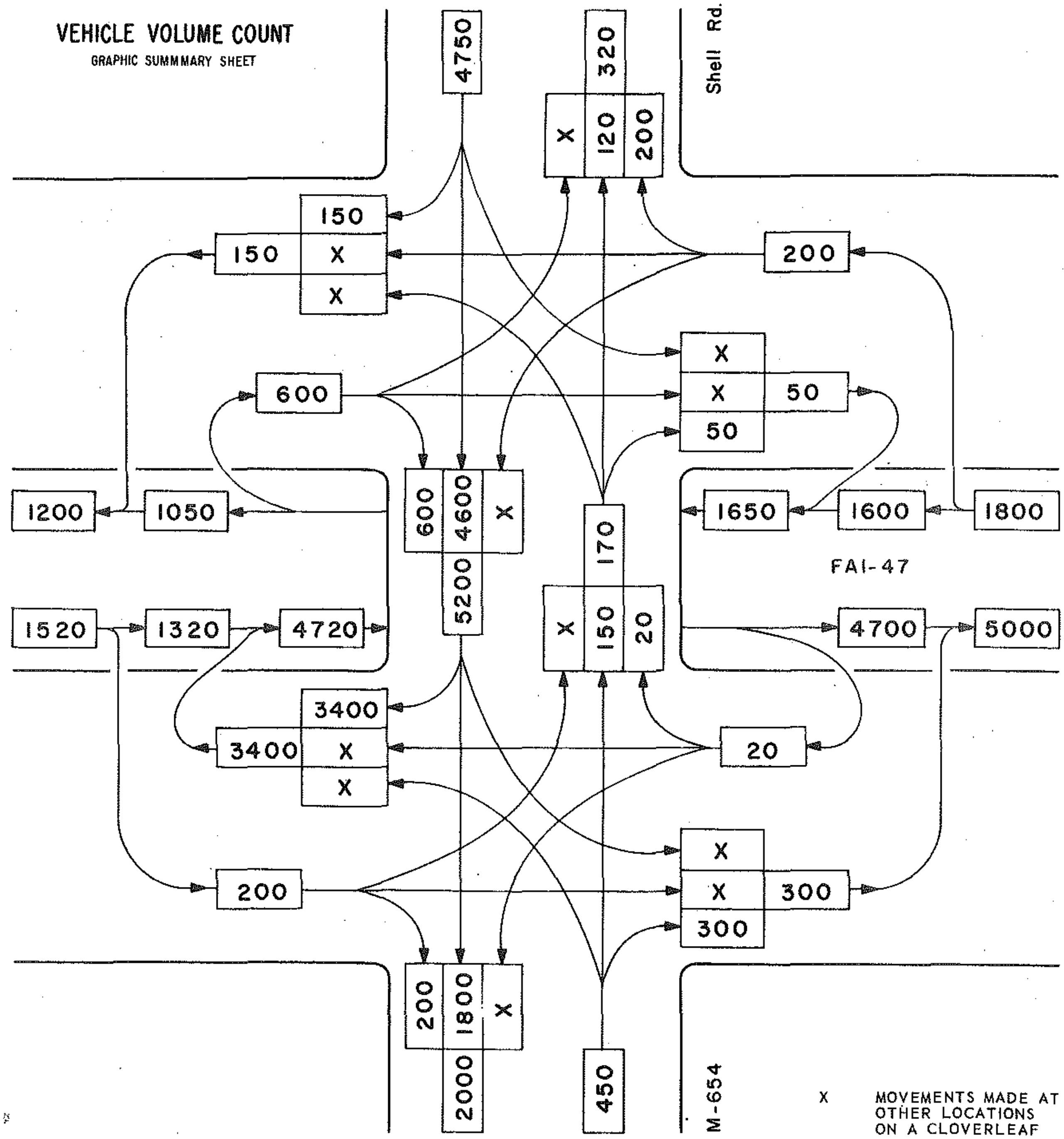
Figure 38 shows the Sunday P.M. 1975 hourly volumes when movement 2 is at the 30th high hour on a cloverleaf interchange. Movements 3 and 12 occur at the same time as movement 2 and need no explanation. All other Sunday P.M. movements are lower than the DHV and will be explained. Movement 1 is low. It would consist of local traffic returning from Denton and some late evening Shell Lake trips. As all values can be determined from figure 38 they will not be included in this explanation. Movement 4 would consist of local area residents returning from the west and a few late evening Shell Lake trips. Movement 5 would consist of trips returning home to the new residential area south of old US-347 and would be only slightly less than the DHV. Movement 6 would be low, consisting of visitors to the residential area and evening westbound trips from M-654. Movement 7 would be

FIG 38

INDICATE NORTH

MICHIGAN STATE HIGHWAY DEPARTMENT
JOHN C. MACKIE- COMMISSIONER
OFFICE OF ENGINEERING – TRAFFIC DIVISION

VEHICLE VOLUME COUNT
GRAPHIC SUMMMARY SHEET



PROPOSED CLOVERLEAF INTERCHANGE AT FAI-47, M-654 AND SHELL ROAD

1975 Sunday P.M. High Hourly Volumes at the Time the North to East Movement is at the D.H.V.

low consisting of trips from M-654 and the residential area south of old US-347 returning to Denton. Movement 8 would also be lower than the DHV consisting of residential area and M-654 trips returning from Denton. Movement 9, trips returning from Denton. Movement 10, trips returning to Denton, slightly lower than DHV. Movement 12 will be low consisting of late trips to the Shell Lake area and local trips returning home from M-654.

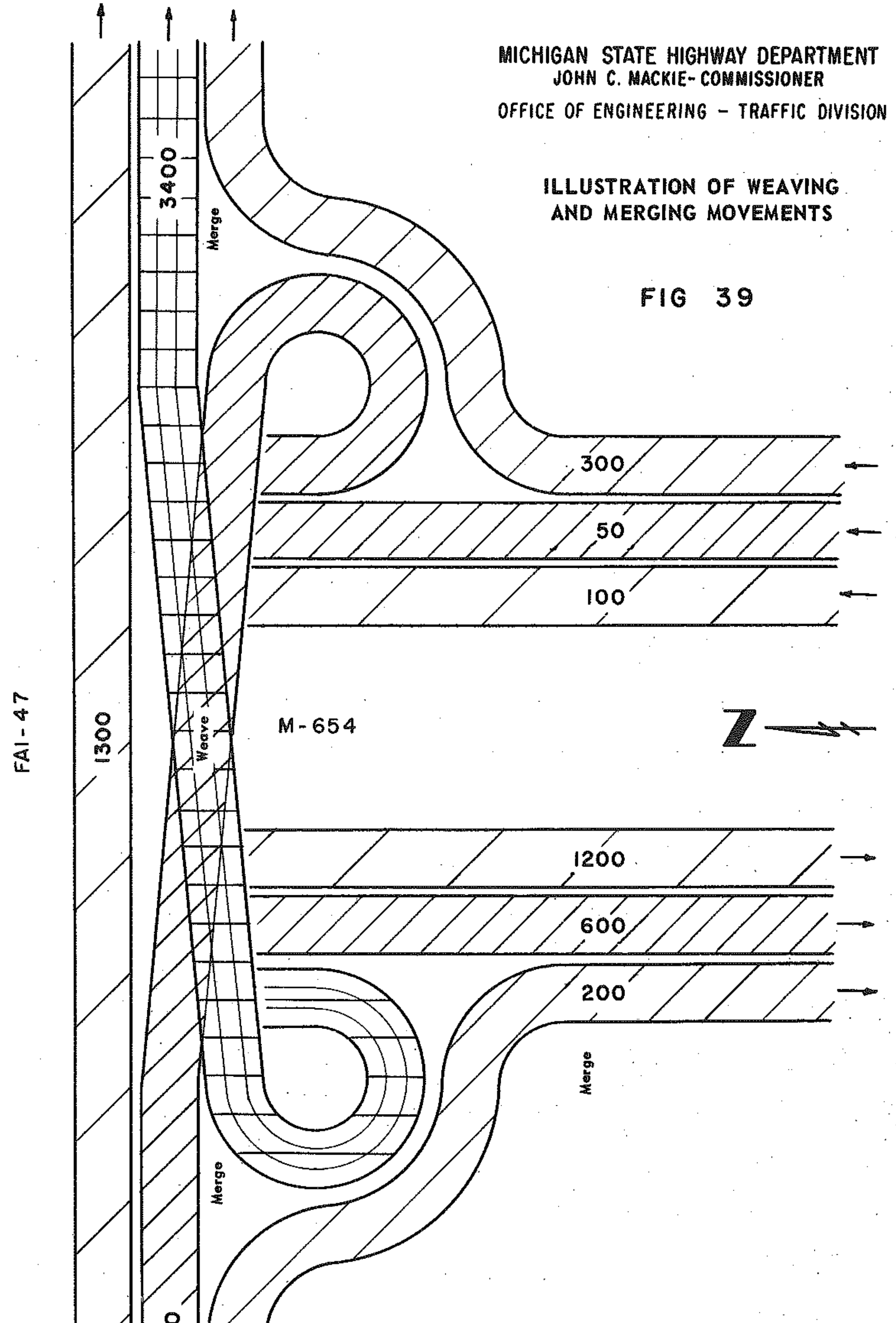
Figure 39 is a graphic presentation of the traffic movements on the south half of a cloverleaf interchange at F.A.I. 47 and M-654 during the time of the Sunday evening DHV. Shown is the weave between the north to east movement and the west to north movement together with the merges in this half of the interchange.

The actual presentation to the Geometrics Section would include the entire interchange for all time periods. A similar analysis would be prepared for each time period requested.

MICHIGAN STATE HIGHWAY DEPARTMENT
JOHN C. MACKIE- COMMISSIONER
OFFICE OF ENGINEERING - TRAFFIC DIVISION

## ILLUSTRATION OF WEAVING AND MERGING MOVEMENTS

FIG 39



SOUTH HALF OF PROPOSED CLOVERLEAF INTERCHANGE
AT FAI-47, M-654 AND SHELL ROAD

1975 Sunday P.M. High Hourly Volumes at the Time the North to East Movement is at the D.H.V.

## DEVELOPMENT TRAFFIC NEAR THE INTERCHANGE OF TWO LIMITED ACCESS HIGHWAYS

Planning, location and design of interchanges are in all cases based on traffic estimates. In many instances traffic estimates are requested for several alternate locations. This discussion will be limited to a location at the crossing of two limited access highways and the first interchange in each direction from the main one.

The area near the interchange of two limited access highways in many cases becomes the focal point for potential development. Traffic estimating in this type of location must be based upon a thorough study of as many similar areas as are available to enable the estimator to make reasonable predictions of future traffic volumes.

As no traffic can enter the limited access highway at the direct site of the main interchange the focal points of entry and egress of this development traffic is at the interchanges adjacent to the main interchange.

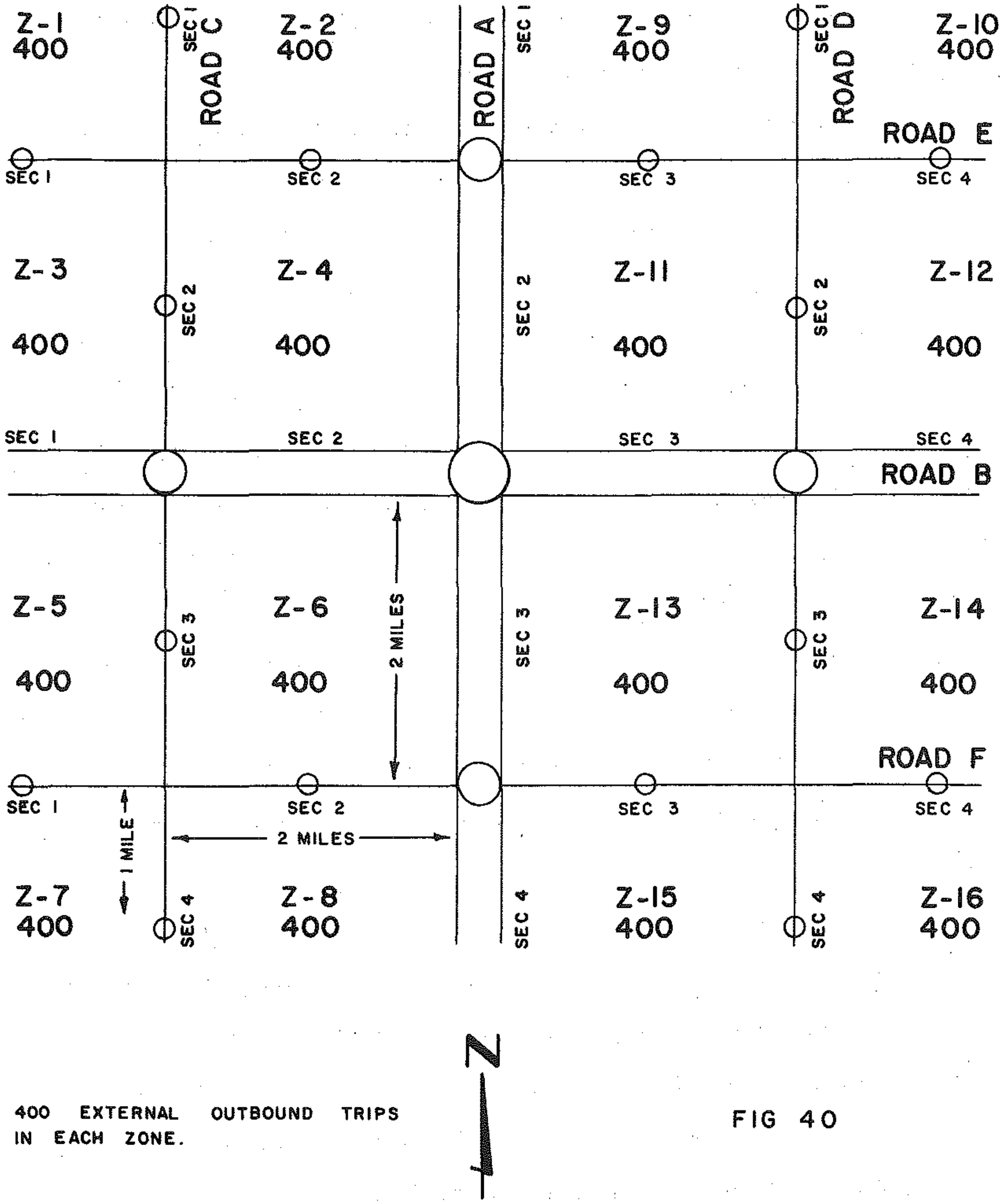
In estimating development traffic, care must be taken that no future developments be overlooked. In many cases, present traffic in the area may not seem to be high enough to warrant four interchanges near the main one. However, it must be remembered that the main interchange serves no local area traffic directly. Analyses of like conditions indicate that future traffic development in most cases will be best served by four interchanges; one on each leg a reasonable distance from the hub. For example, if either one or two interchanges were constructed on separate legs, near the hub with the remaining two interchanges eight or ten miles from the center, the resulting traffic movements at the two interchanges that are near the hub may be doubled or even trebled. (Certain ramp movements may be from four to eight times as high.)

The following study has been conducted to illustrate the method of computing the amounts of traffic caused by the various types of development at the site of the interchange of two limited access highways in the southern part of the State. This study was conducted in such a manner so as to illustrate resulting Highway User Benefits by the construction of the four interchanges (one in each direction from the main interchange) on the basis of traffic desires developed within the area. The traffic desires used in this study have been kept small and uniform for ease of presentation and to more clearly illustrate the traffic movements. Actual conditions will vary, but most locations in the southern part of the State will develop several times the traffic desires presented.

Figure 40 shows the area at the interchange of limited access highways A and B and with the roads C, D, E and F two miles in each direction from highways A and B. The development in the area has been divided into 16 zones with a uniform daily density of 400 external out-bound trips desiring to use the limited access highways with 100 trips going in each direction.

(The external trips, through the area on all roads, the intra-zone trips and the inter-zone trips are not studied in this report. The inter-zone trips that might save distance by using the limited access highways are merely mentioned in the final portion of the discussion but have not been included on the figures or tables).

It is assumed that the above trips will use the interchange or interchanges shown in figure 40. Each trip will follow the shortest route to leave the area on a limited access highway. In cases where two alternate routes are of equal length, the trip will be made in such a manner that travel through the main interchange A-B will not change direction. The trip origins will be considered to be the midpoint of the zones adjacent to roads C, D, E or F, as indicated by the small circles on figure 40. In cases of equal distance fifty trips are considered to be from each side of the zone. (As this is an illustration, the travel distances within the zones are neglected.) To follow the movements each



400 EXTERNAL OUTBOUND TRIPS IN EACH ZONE.

FIG 40

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**TRAFFIC DIVISION**

AREA AT THE INTERCHANGE OF HIGHWAY A AND B.

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DATE 7-24-59
SCALE

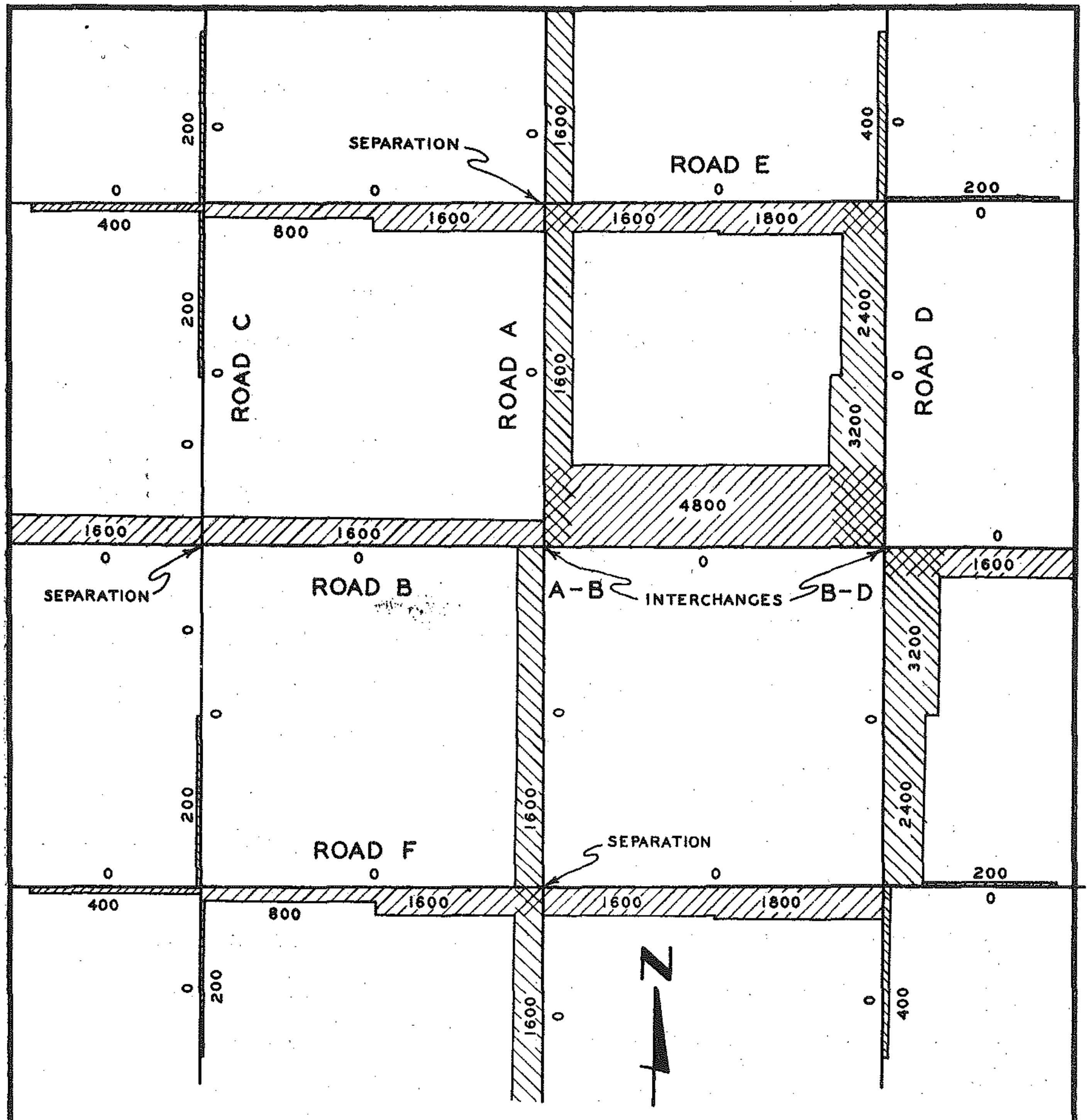
section of road is numbered. The same numbering system of the movements at an interchange is employed as were used in a previous section of this report, see figure 32, page 69.

The tables in Appendix A (Pages xiv, xv, xvi and xvii) show the movements from each zone in each direction with the amount of traffic on each road section and interchange movement for the case where only <u>one</u> interchange B-D is provided in addition to the main interchange A-B. For this illustration A-E, A-F and B-C are grade separations only.

In explanation of the tables, the trips from Zone 1 that are going north are explained in detail as are those going west from Zone 14. Case 1-- Northbound trips from Zone 1. Fifty trips will use road section C-1, 50 trips on section E-1; they will combine and will be 100 trips on road section E-2, E-3, and D-2; 100 trips will make movement 3 on interchange B-D, 100 trips on section B-3, 100 trips on movement 1 interchange A-B and 100 trips will leave the area on sections A-2 and A-1. Case 2-- Westbound trips from Zone 14. One hundred trips will use road section D-3, interchange B-D movement 6, section B-3, interchange A-B movement 9, section B-2 and B-1. In examination of figure 41 (Page 96) it is found that 800 trips use the west mile of road section E-2 while the total trips using road section E-2 on the table is 1600, the 800 trips that did not use the west one-half of road section E-2 originate in Zones 2 and 4.

Figure 41 shows a traffic flow map of this area for the external outbound movements only. Figure 42 (Page 97) shows these same movements through the main interchange A-B. Figure 43 (Page 98) shows these same movements for interchange B-D.

In computing the vehicle miles of travel (see tables, pages xiv-xvii) the trips were considered from the zone boundary to the point where the trip left the area on a limited access highway. (i.e. Outside limits of the external interchanges).



EXTERNAL OUTBOUND TRAFFIC FLOW ONLY, USING LIMITED ACCESS HIGHWAY TO LEAVE THE AREA. WITH MAIN INTERCHANGE A - B AND INTERCHANGE AT B - D. GRADE SEPARATIONS AT AE, AF, AND BC.

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**TRAFFIC DIVISION**

FIG 41

YEAR 1975

AUTH. NO.
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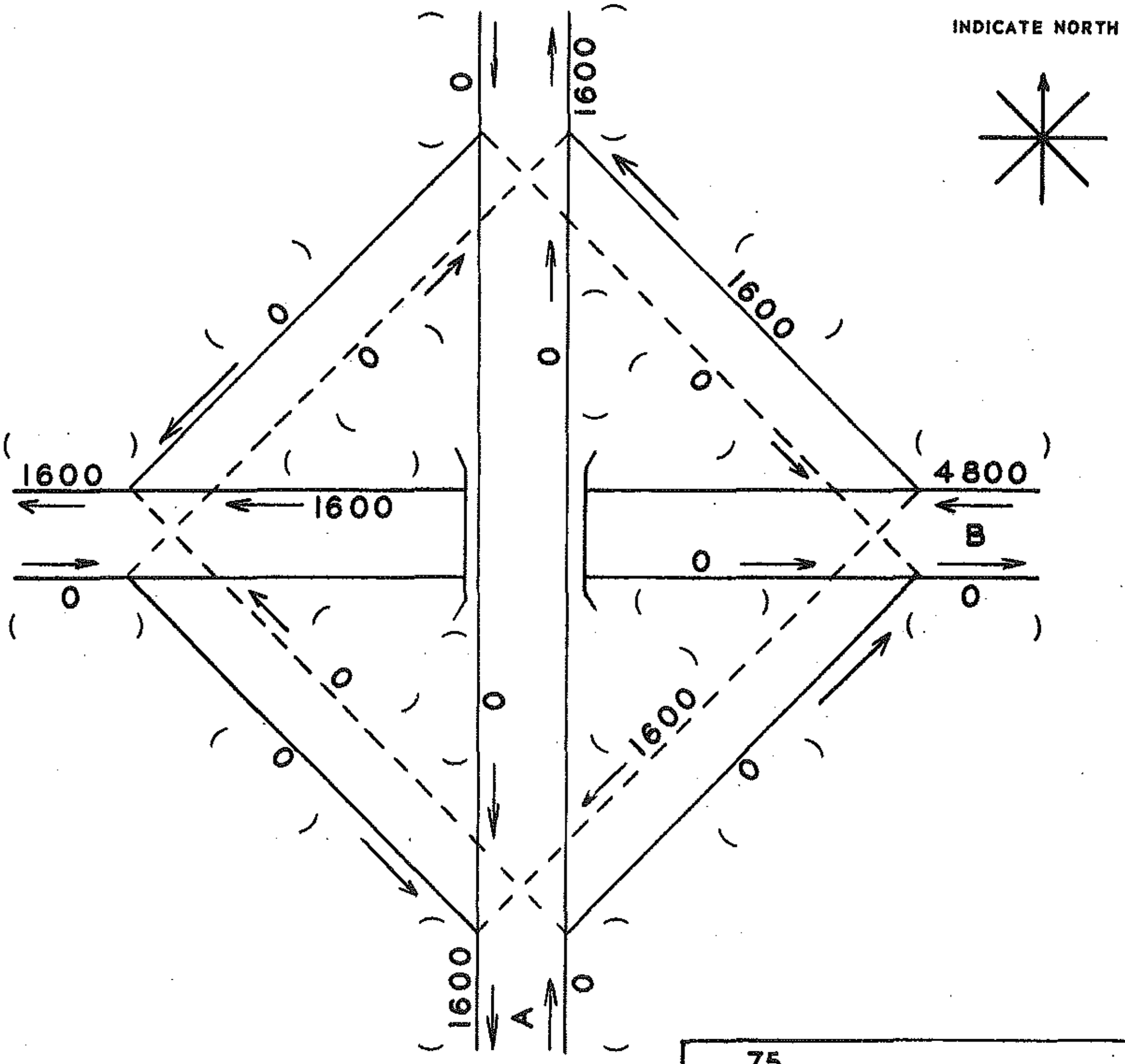
SHEET OF PLAN

DRAWN J. L. R.
DATE 7-29-59
SCALE



19 75 ESTIMATED TRAFFIC DISTRIBUTION

LEGEND

| | |
|---|---|
| 0000 | Average Daily Traffic |
| (000) | Design Hour Volume |
| 00.0% | Commercial |
| 000 | 19___ Average Daily Traffic |

Design hour volume of less than 100 is not shown.
AM & PM Design hour volume considered and only the highest one is shown

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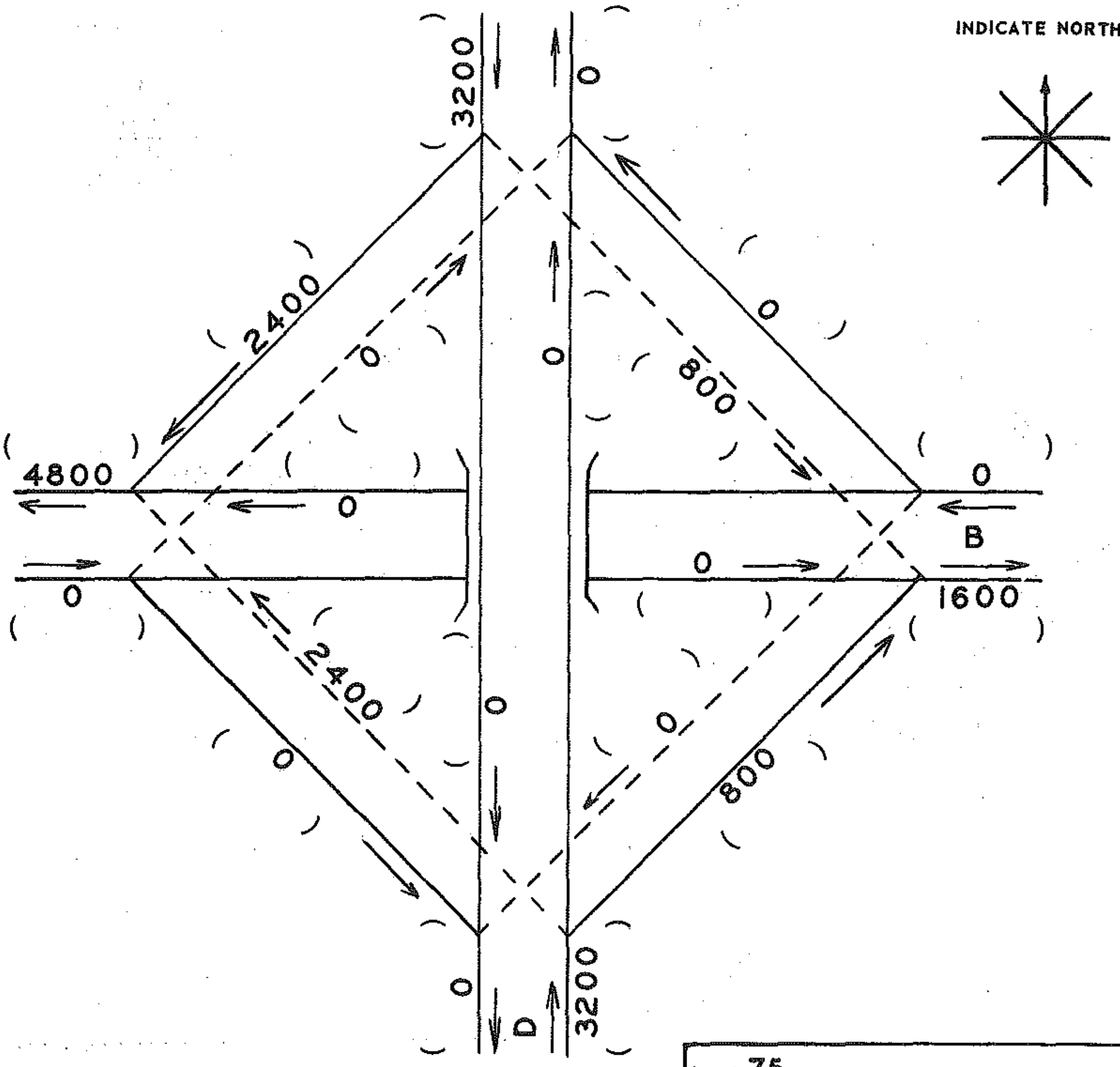
EXTERNAL OUTBOUND TRAFFIC USING MAIN INTERCHANGE A-B WITH INTERCHANGE AT B-D. GRADE SEPARATIONS AT A-E, A-F AND B-C.

**SCHEMATIC**
**VEHICLE VOLUME**

FIG 42

PROJECT ______________________________

INTERCHANGE OF HIGHWAY A WITH HIGHWAY B.



**19~~__~~75 ESTIMATED TRAFFIC DISTRIBUTION**

LEGEND

| | |
|---|---|
| 0000 | Average Daily Traffic |
| (000) | Design Hour Volume |
| 00.0% | Commercial |
| 000 | 19___ Average Daily Traffic |

Design hour volume of less than 100 is not shown.
AM & PM Design hour volume considered and only the highest one is shown

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EXTERNAL OUTBOUND TRAFFIC USING INTERCHANGE B-D. GRADE SEPARATIONS AT A-E, A-F AND B-C.

**SCHEMATIC**
**VEHICLE VOLUME**

FIG 43

PROJECT ____________________

INTERCHANGE OF HIGHWAY B WITH HIGHWAY D

The external outbound vehicle miles for one day were 44,800 from the accompanying tables. Multiplying this by two to include the return trips equals 89,600 vehicle miles.

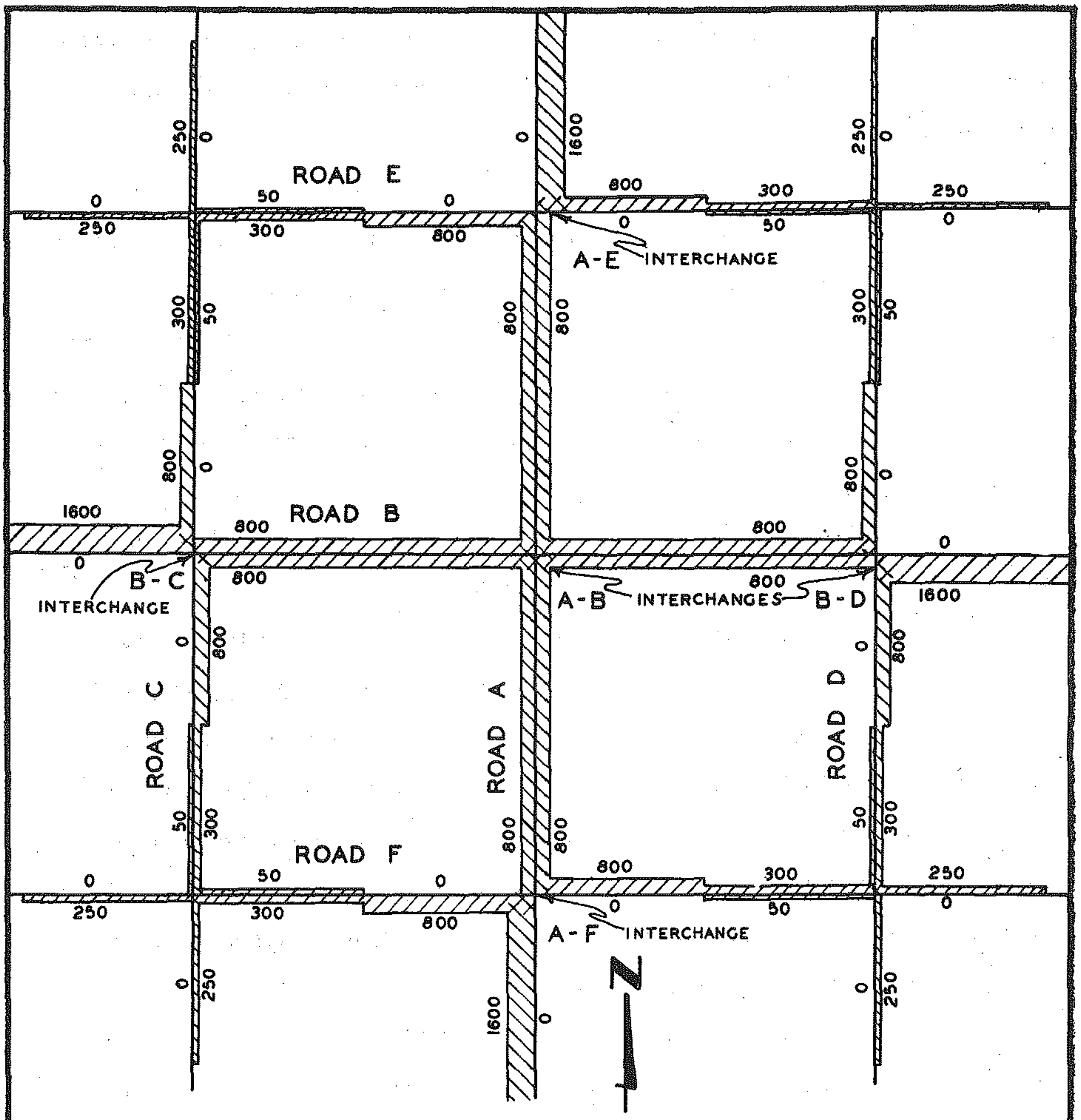
The next case studied includes all four external interchanges (A-E, A-F, B-C and B-D.) A similar table (not shown) was prepared tracing the trips through the road sections and interchange movements. Figure 44 shows a traffic flow map of the area for this case. Figure 45 shows the same movement at the main interchange. Figure 46 shows the movement at interchange B-C. (By rotating Figure 46 successively thru 90 degrees the movements at the other three interchanges can be determined.)

The outbound vehicle miles per day in this case were 24,000. Using both the outbound and return trips equals 48,000 vehicle miles.

If four interchanges were constructed (in addition to the main interchange) it would amount to a saving of 41,600 vehicle miles per day, 15,184,000 vehicle miles per year and 303,680,000 vehicle miles in 20 years over one interchange. These savings in vehicle miles and subsequent user benefits will be much larger if the traffic desires are increased. The Highway User Benefits for this case can be considered a minimum for the southern part of the State. By using a low figure of 5 cents per vehicle mile, over 15 million dollars would be saved by the highway users in twenty years.

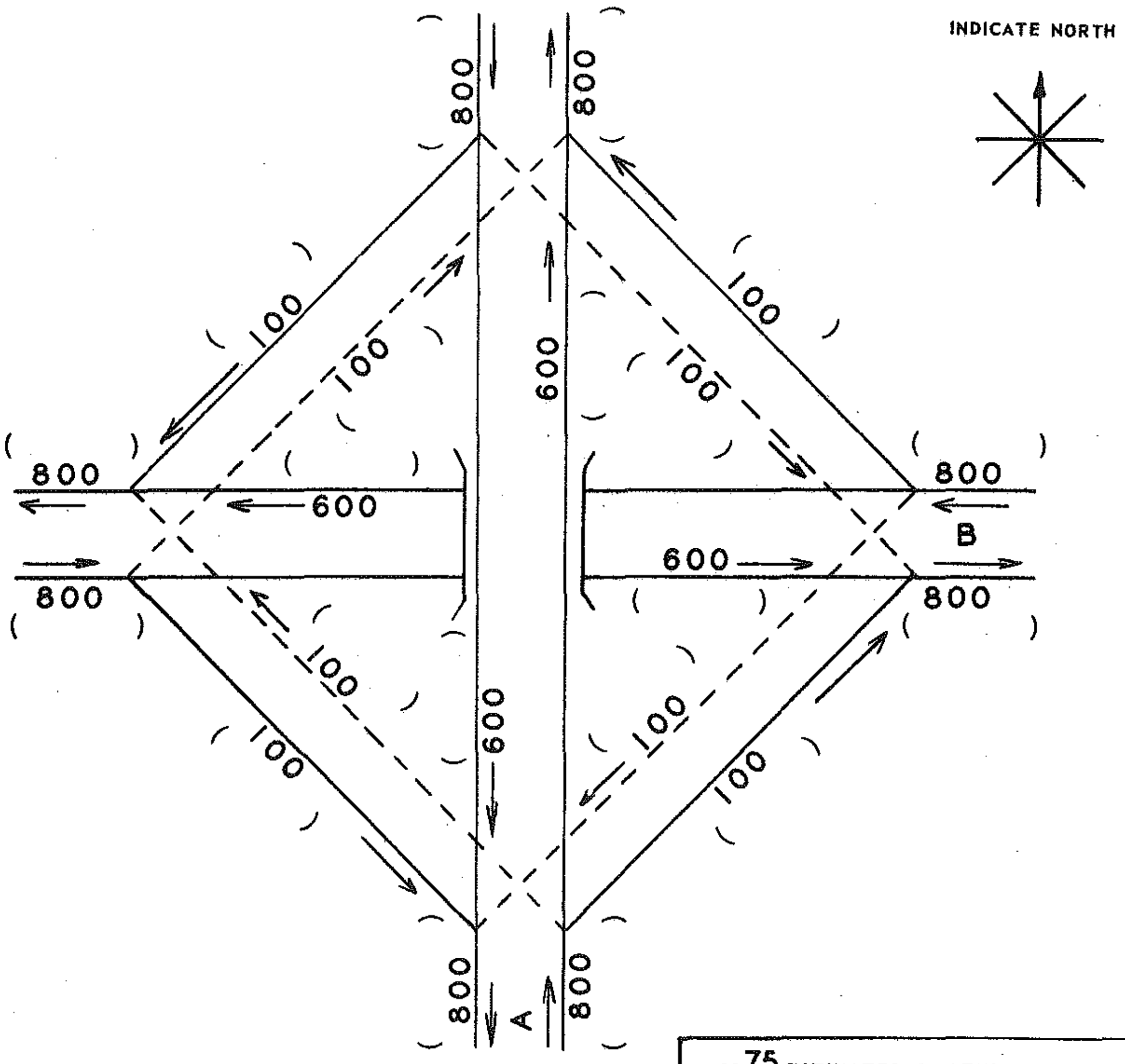
It has been determined by studying figures 41 and 44 that with one interchange, 9,600 outbound trips, 19,200 total trips or 38,400 vehicle miles per day are made on the 8 miles of limited access highway within the area. With four interchanges, 6,400 outbound trips, 12,800 total trips, or 25,600 vehicle miles per day are made on the same 8 miles of highway.

Therefore, with four interchanges, 12,800 vehicle miles per day, 4,672,000 vehicle miles per year or 93,440,000 vehicle miles in 20 years would



EXTERNAL OUTBOUND TRAFFIC FLOW USING LIMITED ACCESS HIGHWAY TO LEAVE THE AREA. WITH MAIN INTERCHANGE A-B AND INTERCHANGES AT B-C, B-D, A-E AND A-F.

| | | | |
|---|---|---|---|
| **MICHIGAN**<br>**STATE HIGHWAY DEPARTMENT**<br>**JOHN C. MACKIE, COMMISSIONER**<br>**TRAFFIC DIVISION** | FIG 44<br>YEAR 1975 | AUTH. NO.<br>CONT. SEC.<br>REF.<br>SHEET OF | DRAWN J.L.R.<br>DATE 7-29-59<br>SCALE<br>PLAN |



| | |
|---|---|
| 19 75 ESTIMATED TRAFFIC DISTRIBUTION | |

LEGEND

0000 Average Daily Traffic
(000) Design Hour Volume
00.0% Commercial
000 19___ Average Daily Traffic

Design hour volume of less than 100 is not shown.
AM & PM Design hour volume considered and only the highest one is shown

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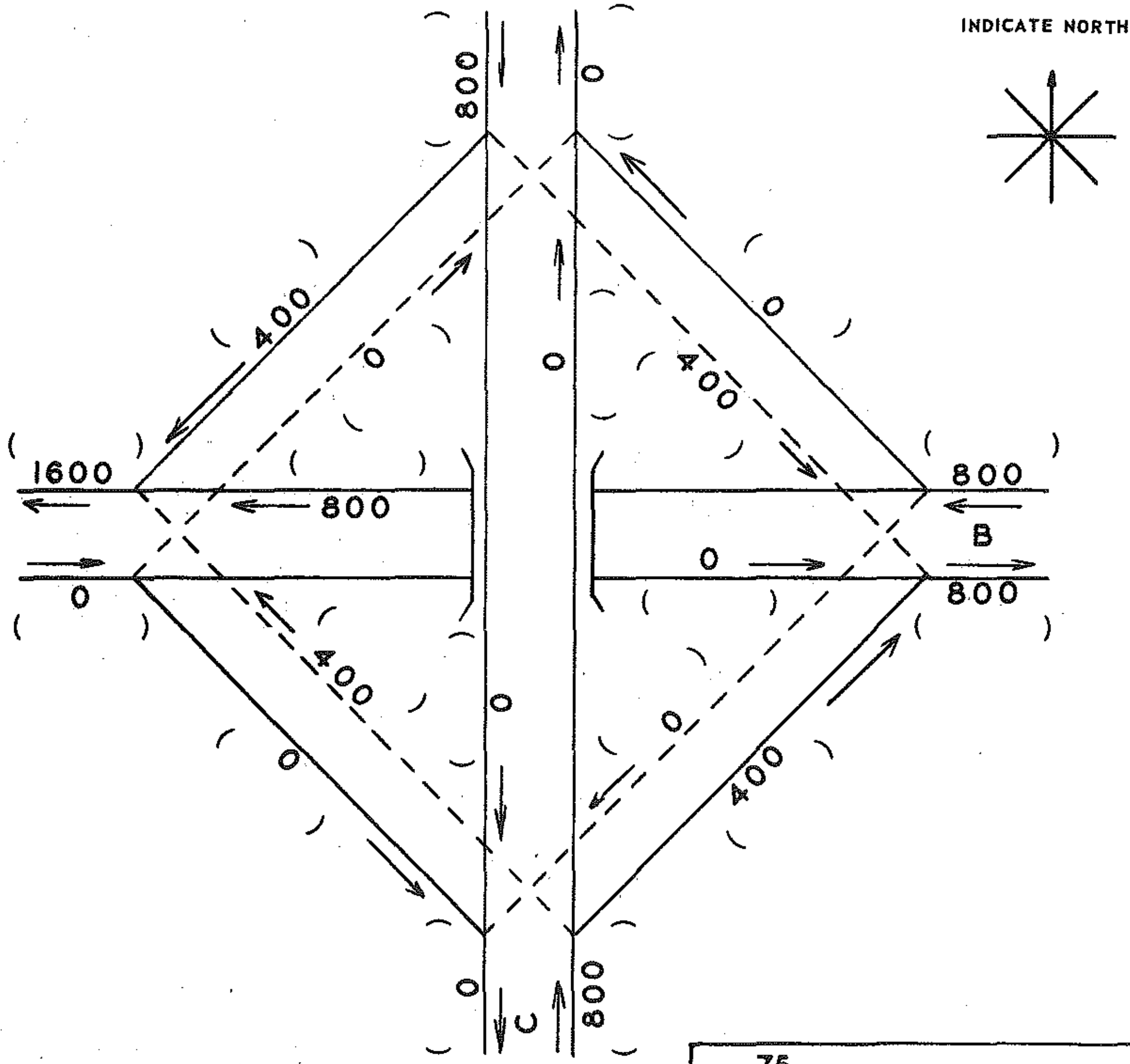
## EXTERNAL OUTBOUND TRAFFIC USING MAIN INTERCHANGE WITH INTERCHANGES AT B–C, B–D, A–E AND A–F.

SCHEMATIC
VEHICLE VOLUME

FIG 45

PROJECT ______________________________

INTERCHANGE OF HIGHWAY A WITH HIGHWAY B



19 75 ESTIMATED TRAFFIC DISTRIBUTION

LEGEND

| | |
|---|---|
| 0000 | Average Daily Traffic |
| (000) | Design Hour Volume |
| 00.0% | Commercial |
| 000 | 19___ Average Daily Traffic |

Design hour volume of less than 100 is not shown.

AM & PM Design hour volume considered and only the highest one is shown

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EXTERNAL OUTBOUND TRAFFIC USING INTERCHANGE B-C. INTERCHANGES AT B-D, A-E AND A-F.

SCHEMATIC
VEHICLE VOLUME

FIG 46

PROJECT ______________________________

INTERCHANGE OF HIGHWAY B WITH HIGHWAY C

be removed from these 8 miles of limited access highways. By proper placing of interchanges many vehicle miles of travel can be saved both on the local roads and limited access highways. Comparison of figures 42 (Page 97 and 45 (Page 101) show that the movements on certain ramps are much heavier with one interchange and more uniform with four.

Where limited access interchanges of this type are constructed, as discussed in Dr. Suggitt's report regarding the Brighton area (see quote pages 40 to 43), and even at minor interchanges as illustrated in Case C (F.A.I. 47 and M-654), traffic development will be much greater than in the case discussed above.

Inter-zone trips in the majority of cases would save no travel distance even with four interchanges. However, in a few cases, for example, trips from Zone 5 to Zone 12 would save two miles by using the interchanges and the limited access highway. Of the possible 120 different types of inter-zone trips, 86 would have to travel farther to use the Expressway, 30 would travel the same distance and 4 would save 2 miles per trip.

Similar studies may be requested for the cases of two and three interchanges, by the Office of Planning.

The size and trip density of the zones may be varied to fit any condition and the actual results can be obtained by following the illustrated procedures. To find the total volumes on the roads in the area, the same type of procedure should be used for all trips within and passing through the area.

# CONCLUSION

The statements, methods and conclusions made in this manual may appear startling and in some instances probably even controversial. It is our contention, however, that all the methods and analyses described here-in are necessary and extremely essential. Some of the points that need repeating are outlined as follows:

TRAFFIC CANNOT BE ESTIMATED FOR A SMALL SEGMENT OF ROAD OR ISOLATED INTERCHANGE without taking into consideration the influence of the surrounding area and even the entire State.

NOT ONE MILE of highway should be constructed which would be obsolete DUE TO AN INADEQUATE TRAFFIC ESTIMATE. Adequate Traffic Estimates MUST be recognized in the ULTIMATE PLANNING and DESIGN EVEN THOUGH HIGHER COSTS MAY REQUIRE FINANCING AND PROGRAMMING to be adjusted to Stage Construction.

In making a final traffic estimate A TRAFFIC PROJECTION FACTOR CANNOT BE USED PER SE.

Twelve traffic desires or movements at an intersection or interchange introduce new arithmetical applications. ADT must always equal the sum of the individual movements; DHV are seldom equal. PERCENTAGES must be used with caution at these locations.

In summation, traffic estimating, as a continuing function cannot remain STATIC in gleaning information regarding the constantly changing travel habits of man due to the changing economy. Predictions made must be substantiated as time goes on in order to be on firmer ground in SUCCEEDING forecasts. TRAFFIC, AS SUCH, IS INDELIBLY TIED TO MAN AND HIS ECONOMY AND MUST SO BE CONSIDERED.

# BIBLIOGRAPHY

1. A Policy on Geometric Design of Rural Highways, American Association of State Highway Officials, 1954 Edition.

2. A Policy on Arterial Highways in Urban Areas, American Association of State Highway Officials.

3. 1956 - 1957 Regional Planning, issued by Detroit Metropolitan Area Regional Planning Commission, March 9, 1958.

4. The Interstate and Defense Highway System as related to the Detroit Metropolitan Area; Michigan State Highway Department, March, 1958.

5. Interurbia, The Changing Face of America, J. Walter Thompson Company, 1958.

6. Detroit Metropolitan Area Traffic Study, Part 1 and 2, M.S.H.D.; Wayne County Road Commission, City of Detroit and B.P.R., 1955.

7. Highway Needs in Michigan, Michigan Good Roads Federation in cooperation with Bureau of Public Roads and Michigan State Highway Department, 1948.

8. Highway Capacity Manual, Bureau of Public Roads, 1950.

9. Highway Engineers' Handbook, Harger and Bonney, 4th Edition, 1927.

10. Expressways: Their Influence on Real Estate Values, Frank W. Suggitt, Head Resources Development Department, Michigan State University, March 25, 1959.

11. Coverdale and Colpitts: Report on Traffic and Revenues, Proposed Mackinac Straits Bridge, dated February 3, 1953.

12. Guide for Forecasting Traffic on Interstate System: E. H. Holmes, Deputy Commissioner, U.S. Department of Commerce, Bureau of Public Roads, dated October 15, 1956.

Estimating Traffic on Michigan Highways

# Appendix A

## Vehicle Miles of Travel in Michigan by Systems Years 1956 to 1985

(Prepared for the Section 210 Study
in Cooperation with the
United States Department of Commerce
Bureau of Public Roads)

## Trip Trace Tables Development Traffic near the Interchange of Two Limited Access Highways

## Vehicle Miles of Travel in Michigan by Years, by Systems

### Interstate - Rural - 01

| YEAR | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 2.838 | 100.0 | 95.0 | 90.6 |
| 1957 | 2.986 | 105.2 | 100.0 | 95.3 |
| 1958 | 3.132 | 110.4 | 104.9 | 100.0 |
| 1959 | 3.277 | 115.5 | 109.7 | 104.6 |
| 1960 | 3.463 | 122.0 | 116.0 | 110.6 |
| 1961 | 3.662 | 129.0 | 122.6 | 116.9 |
| 1962 | 3.882 | 136.8 | 130.0 | 123.9 |
| 1963 | 4.115 | 145.0 | 137.8 | 131.4 |
| 1964 | 4.362 | 153.7 | 146.1 | 139.3 |
| 1965 | 4.659 | 164.2 | 156.0 | 148.8 |
| 1966 | 5.013 | 176.6 | 167.9 | 160.1 |
| 1967 | 5.434 | 191.5 | 182.0 | 173.5 |
| 1968 | 5.934 | 209.1 | 198.7 | 189.5 |
| 1969 | 6.527 | 230.0 | 218.6 | 208.4 |
| 1970 | 7.244 | 255.2 | 242.6 | 231.3 |
| 1971 | 8.182 | 288.3 | 274.0 | 261.2 |
| 1972 | 8.275 | 291.6 | 277.1 | 264.2 |
| 1973 | 8.368 | 294.9 | 280.2 | 267.2 |
| 1974 | 8.462 | 298.2 | 283.4 | 270.2 |
| 1975 | 8.555 | 301.4 | 286.5 | 273.1 |
| 1976 | 8.648 | 304.7 | 289.6 | 276.1 |
| 1977 | 8.741 | 308.0 | 292.7 | 279.1 |
| 1978 | 8.834 | 311.3 | 295.8 | 282.1 |
| 1979 | 8.928 | 314.6 | 299.6 | 285.1 |
| 1980 | 9.021 | 317.9 | 302.1 | 288.0 |
| 1981 | 9.114 | 321.1 | 305.2 | 291.0 |
| 1982 | 9.207 | 324.4 | 308.3 | 294.0 |
| 1983 | 9.300 | 327.7 | 311.4 | 296.9 |
| 1984 | 9.394 | 331.0 | 314.6 | 299.9 |
| 1985 | 9.487 | 334.3 | 317.7 | 302.9 |

## Vehicle Miles of Travel in Michigan by Years, by Systems

### Interstate - Urban - 02

| YEAR | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 2.447 | 100.0 | 97.2 | 94.5 |
| 1957 | 2.518 | 102.9 | 100.0 | 97.3 |
| 1958 | 2.589 | 105.8 | 102.8 | 100.0 |
| 1959 | 2.659 | 108.7 | 105.6 | 102.7 |
| 1960 | 2.730 | 111.6 | 108.4 | 105.4 |
| 1961 | 2.801 | 114.5 | 111.3 | 108.2 |
| 1962 | 2.872 | 117.4 | 114.1 | 110.9 |
| 1963 | 2.943 | 120.3 | 116.9 | 113.7 |
| 1964 | 3.013 | 123.1 | 119.7 | 116.4 |
| 1965 | 3.084 | 126.0 | 122.5 | 119.1 |
| 1966 | 3.155 | 128.9 | 125.3 | 121.9 |
| 1967 | 3.226 | 131.8 | 128.1 | 124.6 |
| 1968 | 3.297 | 134.7 | 130.9 | 127.3 |
| 1969 | 3.367 | 137.6 | 133.7 | 130.1 |
| 1970 | 3.438 | 140.5 | 136.5 | 132.8 |
| 1971 | 3.509 | 143.4 | 139.4 | 135.5 |
| 1972 | 3.557 | 145.4 | 141.3 | 137.4 |
| 1973 | 3.605 | 147.3 | 143.2 | 139.2 |
| 1974 | 3.652 | 149.2 | 145.0 | 141.1 |
| 1975 | 3.700 | 151.2 | 146.9 | 142.9 |
| 1976 | 3.748 | 153.2 | 148.8 | 144.8 |
| 1977 | 3.796 | 155.1 | 150.8 | 146.6 |
| 1978 | 3.843 | 157.0 | 152.6 | 148.4 |
| 1979 | 3.891 | 159.0 | 154.5 | 150.3 |
| 1980 | 3.939 | 161.0 | 156.4 | 152.1 |
| 1981 | 3.987 | 162.9 | 158.3 | 154.0 |
| 1982 | 4.034 | 164.9 | 160.2 | 155.8 |
| 1983 | 4.082 | 166.8 | 162.1 | 157.7 |
| 1984 | 4.130 | 168.8 | 164.0 | 159.5 |
| 1985 | 4.178 | 170.7 | 165.9 | 161.4 |

## Vehicle Miles of Travel in Michigan by Years, by Systems

### Federal Aid Primary - Rural - 03

| YEAR | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 5.941 | 100.0 | 95.5 | 91.3 |
| 1957 | 6.224 | 104.8 | 100.0 | 95.6 |
| 1958 | 6.508 | 109.5 | 104.6 | 100.0 |
| 1959 | 6.789 | 114.3 | 109.1 | 104.3 |
| 1960 | 7.143 | 120.2 | 114.8 | 109.8 |
| 1961 | 7.517 | 126.5 | 120.8 | 115.5 |
| 1962 | 7.923 | 133.4 | 127.3 | 121.7 |
| 1963 | 8.380 | 141.1 | 134.6 | 128.8 |
| 1964 | 8.895 | 149.7 | 142.9 | 136.7 |
| 1965 | 9.384 | 158.0 | 150.8 | 144.2 |
| 1966 | 9.941 | 167.3 | 159.7 | 152.8 |
| 1967 | 10.486 | 176.5 | 168.5 | 161.1 |
| 1968 | 10.990 | 185.0 | 176.6 | 168.9 |
| 1969 | 11.477 | 193.2 | 184.4 | 176.4 |
| 1970 | 11.999 | 202.0 | 192.8 | 184.4 |
| 1971 | 12.472 | 209.9 | 200.4 | 191.6 |
| 1972 | 12.641 | 212.8 | 203.1 | 194.2 |
| 1973 | 12.810 | 215.6 | 205.8 | 196.8 |
| 1974 | 12.979 | 218.5 | 208.5 | 199.4 |
| 1975 | 13.148 | 221.3 | 211.2 | 202.0 |
| 1976 | 13.317 | 224.2 | 214.0 | 204.6 |
| 1977 | 13.486 | 227.0 | 216.7 | 207.2 |
| 1978 | 13.655 | 229.8 | 219.4 | 209.8 |
| 1979 | 13.824 | 232.7 | 222.1 | 212.4 |
| 1980 | 13.993 | 235.5 | 224.8 | 215.0 |
| 1981 | 14.162 | 238.4 | 227.5 | 217.6 |
| 1982 | 14.331 | 241.2 | 230.3 | 220.2 |
| 1983 | 14.500 | 244.1 | 233.0 | 222.8 |
| 1984 | 14.669 | 246.9 | 235.7 | 225.4 |
| 1985 | 14.838 | 249.8 | 238.4 | 228.0 |

## Vehicle Miles of Travel in Michigan by Years, by Systems

### Federal Aid Primary - Urban - 04

| YEAR | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 2.139 | 100.0 | 95.3 | 90.9 |
| 1957 | 2.245 | 105.0 | 100.0 | 95.4 |
| 1958 | 2.353 | 110.0 | 104.8 | 100.0 |
| 1959 | 2.460 | 115.0 | 109.6 | 104.5 |
| 1960 | 2.584 | 120.8 | 115.1 | 109.8 |
| 1961 | 2.738 | 128.0 | 121.6 | 116.4 |
| 1962 | 2.896 | 135.4 | 129.0 | 123.1 |
| 1963 | 3.048 | 142.5 | 135.8 | 129.5 |
| 1964 | 3.200 | 149.6 | 142.5 | 136.0 |
| 1965 | 3.350 | 156.6 | 149.2 | 142.4 |
| 1966 | 3.500 | 163.6 | 155.9 | 148.7 |
| 1967 | 3.644 | 170.4 | 162.3 | 154.9 |
| 1968 | 3.781 | 176.8 | 168.4 | 160.7 |
| 1969 | 3.917 | 183.1 | 174.5 | 166.5 |
| 1970 | 4.054 | 189.5 | 180.6 | 172.3 |
| 1971 | 4.191 | 195.9 | 186.7 | 178.1 |
| 1972 | 4.270 | 199.6 | 190.2 | 181.5 |
| 1973 | 4.349 | 203.3 | 193.7 | 184.8 |
| 1974 | 4.428 | 207.0 | 197.2 | 188.2 |
| 1975 | 4.507 | 210.7 | 200.8 | 191.5 |
| 1976 | 4.586 | 214.4 | 204.3 | 194.9 |
| 1977 | 4.665 | 218.0 | 207.8 | 198.3 |
| 1978 | 4.744 | 221.8 | 211.3 | 201.6 |
| 1979 | 4.823 | 225.5 | 214.8 | 205.0 |
| 1980 | 4.902 | 229.2 | 218.3 | 208.3 |
| 1981 | 4.981 | 232.9 | 221.9 | 211.7 |
| 1982 | 5.060 | 236.6 | 225.4 | 215.0 |
| 1983 | 5.139 | 240.3 | 228.9 | 218.4 |
| 1984 | 5.218 | 243.9 | 232.4 | 221.8 |
| 1985 | 5.297 | 247.6 | 235.9 | 225.1 |

## Vehicle Miles of Travel in Michigan by Years, by Systems

### Federal Aid Secondary - State Jurisdiction - Rural - 05

| YEARS | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 0.689 | 100.0 | 95.3 | 90.9 |
| 1957 | 0.723 | 104.9 | 100.0 | 95.4 |
| 1958 | 0.758 | 110.0 | 104.8 | 100.0 |
| 1959 | 0.792 | 114.9 | 109.5 | 104.5 |
| 1960 | 0.832 | 120.8 | 115.1 | 109.8 |
| 1961 | 0.881 | 127.9 | 121.9 | 116.2 |
| 1962 | 0.933 | 135.4 | 129.0 | 123.1 |
| 1963 | 0.982 | 142.5 | 135.8 | 129.6 |
| 1964 | 1.040 | 150.9 | 143.8 | 137.2 |
| 1965 | 1.100 | 159.7 | 152.1 | 145.1 |
| 1966 | 1.158 | 168.1 | 160.2 | 152.8 |
| 1967 | 1.216 | 176.5 | 168.2 | 160.4 |
| 1968 | 1.275 | 185.0 | 176.3 | 168.2 |
| 1969 | 1.350 | 195.9 | 186.7 | 178.1 |
| 1970 | 1.411 | 204.8 | 195.2 | 186.1 |
| 1971 | 1.463 | 212.3 | 202.4 | 193.0 |
| 1972 | 1.476 | 214.2 | 204.1 | 194.7 |
| 1973 | 1.488 | 216.0 | 205.8 | 196.3 |
| 1974 | 1.501 | 217.9 | 207.6 | 198.0 |
| 1975 | 1.513 | 219.6 | 209.3 | 199.6 |
| 1976 | 1.526 | 221.5 | 211.1 | 201.3 |
| 1977 | 1.538 | 223.2 | 212.7 | 202.9 |
| 1978 | 1.551 | 225.1 | 214.5 | 204.6 |
| 1979 | 1.563 | 226.8 | 216.2 | 206.2 |
| 1980 | 1.576 | 228.7 | 218.0 | 207.9 |
| 1981 | 1.589 | 230.6 | 219.8 | 209.6 |
| 1982 | 1.601 | 232.4 | 221.4 | 211.2 |
| 1983 | 1.614 | 234.3 | 223.2 | 212.9 |
| 1984 | 1.626 | 236.0 | 224.9 | 214.5 |
| 1985 | 1.639 | 237.9 | 226.7 | 216.2 |

## Vehicle Miles of Travel in Michigan by Years, by Systems

## Federal Aid Secondary - State Jurisdiction - Urban - 06

| YEAR | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 0.143 | 100.0 | 92.3 | 85.1 |
| 1957 | 0.155 | 108.4 | 100.0 | 92.3 |
| 1958 | 0.168 | 117.5 | 108.4 | 100.0 |
| 1959 | 0.182 | 127.3 | 117.4 | 108.3 |
| 1960 | 0.197 | 137.8 | 127.1 | 117.3 |
| 1961 | 0.213 | 149.0 | 137.4 | 126.8 |
| 1962 | 0.233 | 162.9 | 150.3 | 138.7 |
| 1963 | 0.257 | 179.7 | 165.8 | 153.0 |
| 1964 | 0.286 | 200.0 | 184.5 | 170.2 |
| 1965 | 0.322 | 225.2 | 207.7 | 191.7 |
| 1966 | 0.365 | 255.2 | 235.5 | 217.3 |
| 1967 | 0.418 | 292.3 | 269.7 | 248.8 |
| 1968 | 0.482 | 337.0 | 311.0 | 286.9 |
| 1969 | 0.561 | 392.3 | 361.9 | 333.9 |
| 1970 | 0.659 | 460.8 | 425.2 | 392.3 |
| 1971 | 0.707 | 494.4 | 456.1 | 420.8 |
| 1972 | 0.720 | 503.5 | 464.5 | 428.6 |
| 1973 | 0.734 | 513.3 | 473.5 | 436.9 |
| 1974 | 0.747 | 522.4 | 481.9 | 444.6 |
| 1975 | 0.760 | 531.5 | 490.3 | 452.4 |
| 1976 | 0.774 | 541.3 | 499.4 | 460.7 |
| 1977 | 0.787 | 550.3 | 507.7 | 468.5 |
| 1978 | 0.800 | 559.4 | 516.1 | 476.2 |
| 1979 | 0.813 | 568.5 | 524.5 | 483.9 |
| 1980 | 0.827 | 578.3 | 533.5 | 492.3 |
| 1981 | 0.840 | 587.4 | 541.9 | 500.0 |
| 1982 | 0.853 | 596.5 | 550.3 | 507.7 |
| 1983 | 0.867 | 606.3 | 559.4 | 516.1 |
| 1984 | 0.880 | 615.4 | 567.7 | 523.8 |
| 1985 | 0.893 | 624.5 | 576.1 | 531.5 |

## Vehicle Miles of Travel in Michigan by Years, by Systems

## Federal Aid Secondary - Local Jurisdiction - Rural - 07

| YEAR | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 4.189 | 100.0 | 97.1 | 94.3 |
| 1957 | 4.315 | 103.0 | 100.0 | 97.2 |
| 1958 | 4.441 | 106.0 | 102.9 | 100.0 |
| 1959 | 4.566 | 109.0 | 105.8 | 102.8 |
| 1960 | 4.722 | 112.7 | 109.4 | 106.3 |
| 1961 | 4.878 | 116.4 | 113.0 | 109.8 |
| 1962 | 5.040 | 120.3 | 116.8 | 113.5 |
| 1963 | 5.230 | 124.9 | 121.2 | 117.8 |
| 1964 | 5.450 | 130.1 | 126.3 | 122.7 |
| 1965 | 5.700 | 136.1 | 132.1 | 128.4 |
| 1966 | 5.980 | 142.8 | 138.6 | 134.7 |
| 1967 | 6.210 | 148.2 | 143.9 | 139.8 |
| 1968 | 6.490 | 154.9 | 150.4 | 146.1 |
| 1969 | 6.734 | 160.8 | 156.1 | 151.6 |
| 1970 | 6.930 | 165.4 | 160.6 | 156.0 |
| 1971 | 7.126 | 170.1 | 165.1 | 160.5 |
| 1972 | 7.204 | 172.0 | 167.0 | 162.2 |
| 1973 | 7.281 | 173.8 | 168.7 | 164.0 |
| 1974 | 7.359 | 175.7 | 170.5 | 165.7 |
| 1975 | 7.437 | 177.5 | 172.4 | 167.5 |
| 1976 | 7.515 | 179.4 | 174.2 | 169.2 |
| 1977 | 7.592 | 181.2 | 175.9 | 171.0 |
| 1978 | 7.670 | 183.1 | 177.8 | 172.7 |
| 1979 | 7.748 | 185.0 | 179.6 | 174.5 |
| 1980 | 7.825 | 186.8 | 181.3 | 176.2 |
| 1981 | 7.903 | 188.7 | 183.2 | 178.0 |
| 1982 | 7.981 | 190.5 | 185.0 | 179.7 |
| 1983 | 8.058 | 192.4 | 186.7 | 181.5 |
| 1984 | 8.136 | 194.2 | 188.6 | 183.2 |
| 1985 | 8.214 | 196.1 | 190.4 | 185.0 |

## Vehicle Miles of Travel in Michigan by Years, by Systems

## Federal Aid Secondary - Local Jurisdiction - Urban - 08

| YEAR | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 0.282 | 100.0 | 95.3 | 91.0 |
| 1957 | 0.296 | 105.0 | 100.0 | 95.5 |
| 1958 | 0.310 | 110.0 | 104.7 | 100.0 |
| 1959 | 0.324 | 114.9 | 109.5 | 104.5 |
| 1960 | 0.340 | 120.6 | 114.9 | 109.7 |
| 1961 | 0.361 | 128.0 | 122.0 | 116.5 |
| 1962 | 0.378 | 134.0 | 127.7 | 121.9 |
| 1963 | 0.402 | 142.6 | 135.8 | 129.7 |
| 1964 | 0.426 | 151.1 | 143.9 | 137.4 |
| 1965 | 0.449 | 159.2 | 151.7 | 144.8 |
| 1966 | 0.483 | 171.3 | 163.2 | 155.8 |
| 1967 | 0.522 | 185.1 | 176.4 | 168.4 |
| 1968 | 0.572 | 202.8 | 193.2 | 184.5 |
| 1969 | 0.632 | 224.1 | 213.5 | 203.9 |
| 1970 | 0.689 | 244.3 | 232.8 | 222.3 |
| 1971 | 0.718 | 254.6 | 242.6 | 231.6 |
| 1972 | 0.732 | 259.6 | 247.3 | 236.1 |
| 1973 | 0.745 | 264.2 | 251.7 | 240.3 |
| 1974 | 0.759 | 269.1 | 256.4 | 244.8 |
| 1975 | 0.772 | 273.8 | 260.8 | 249.0 |
| 1976 | 0.786 | 278.7 | 265.5 | 253.5 |
| 1977 | 0.799 | 283.3 | 269.9 | 257.7 |
| 1978 | 0.813 | 288.3 | 274.7 | 262.3 |
| 1979 | 0.826 | 292.9 | 279.1 | 266.5 |
| 1980 | 0.840 | 297.9 | 283.8 | 271.0 |
| 1981 | 0.853 | 302.5 | 288.2 | 275.2 |
| 1982 | 0.867 | 307.4 | 292.9 | 279.7 |
| 1983 | 0.880 | 312.1 | 297.3 | 283.9 |
| 1984 | 0.894 | 317.0 | 302.0 | 288.4 |
| 1985 | 0.907 | 321.6 | 306.4 | 292.6 |

## Vehicle Miles of Travel in Michigan by Years, by Systems

### Other State Highways - Rural - 09

| YEAR | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 0.074 | 100.0 | 94.9 | 89.2 |
| 1957 | 0.078 | 105.4 | 100.0 | 94.0 |
| 1958 | 0.083 | 112.2 | 106.4 | 100.0 |
| 1959 | 0.087 | 117.6 | 111.5 | 104.8 |
| 1960 | 0.091 | 123.0 | 116.7 | 109.6 |
| 1961 | 0.096 | 129.7 | 123.1 | 115.7 |
| 1962 | 0.100 | 135.1 | 128.2 | 120.5 |
| 1963 | 0.104 | 140.5 | 133.3 | 125.3 |
| 1964 | 0.109 | 147.3 | 139.7 | 131.3 |
| 1965 | 0.113 | 152.7 | 144.9 | 136.1 |
| 1966 | 0.117 | 158.1 | 150.0 | 141.0 |
| 1967 | 0.122 | 164.9 | 156.4 | 147.0 |
| 1968 | 0.126 | 170.3 | 161.5 | 151.8 |
| 1969 | 0.130 | 175.7 | 166.7 | 156.6 |
| 1970 | 0.135 | 182.4 | 173.1 | 162.7 |
| 1971 | 0.139 | 187.8 | 178.2 | 167.5 |
| 1972 | 0.140 | 189.2 | 179.5 | 168.7 |
| 1973 | 0.141 | 190.5 | 180.8 | 169.9 |
| 1974 | 0.142 | 191.9 | 182.1 | 171.1 |
| 1975 | 0.143 | 193.2 | 183.3 | 172.3 |
| 1976 | 0.144 | 194.6 | 184.6 | 173.5 |
| 1977 | 0.145 | 195.9 | 185.9 | 174.7 |
| 1978 | 0.146 | 197.3 | 187.2 | 175.9 |
| 1979 | 0.147 | 198.6 | 188.5 | 177.1 |
| 1980 | 0.148 | 200.0 | 189.7 | 178.3 |
| 1981 | 0.149 | 201.4 | 191.0 | 179.5 |
| 1982 | 0.149 | 201.4 | 191.0 | 179.5 |
| 1983 | 0.150 | 202.7 | 192.3 | 180.7 |
| 1984 | 0.151 | 204.0 | 193.6 | 181.9 |
| 1985 | 0.152 | 205.4 | 194.9 | 183.1 |

## Vehicle Miles of Travel in Michigan by Years, by Systems

### Other State Highways - Urban - 10

| YEAR | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 0.085 | 100.0 | 92.4 | 85.0 |
| 1957 | 0.092 | 108.2 | 100.0 | 92.0 |
| 1958 | 0.100 | 117.6 | 108.7 | 100.0 |
| 1959 | 0.110 | 129.4 | 119.6 | 110.0 |
| 1960 | 0.122 | 143.5 | 132.6 | 122.0 |
| 1961 | 0.137 | 161.2 | 148.9 | 137.0 |
| 1962 | 0.156 | 183.5 | 169.6 | 156.0 |
| 1963 | 0.180 | 211.8 | 195.7 | 180.0 |
| 1964 | 0.211 | 248.2 | 229.3 | 211.0 |
| 1965 | 0.250 | 294.1 | 271.7 | 250.0 |
| 1966 | 0.300 | 352.9 | 326.1 | 300.0 |
| 1967 | 0.365 | 429.4 | 396.7 | 365.0 |
| 1968 | 0.449 | 528.2 | 488.0 | 449.0 |
| 1969 | 0.524 | 616.5 | 569.6 | 524.0 |
| 1970 | 0.558 | 656.5 | 606.5 | 558.0 |
| 1971 | 0.592 | 696.5 | 643.5 | 592.0 |
| 1972 | 0.599 | 704.7 | 651.1 | 599.0 |
| 1973 | 0.605 | 711.8 | 657.6 | 605.0 |
| 1974 | 0.612 | 720.0 | 665.2 | 612.0 |
| 1975 | 0.618 | 727.1 | 671.7 | 618.0 |
| 1976 | 0.625 | 735.3 | 679.3 | 625.0 |
| 1977 | 0.631 | 742.4 | 685.9 | 631.0 |
| 1978 | 0.638 | 750.6 | 693.5 | 638.0 |
| 1979 | 0.644 | 757.6 | 700.0 | 644.0 |
| 1980 | 0.651 | 765.9 | 707.6 | 651.0 |
| 1981 | 0.657 | 772.9 | 714.1 | 657.0 |
| 1982 | 0.664 | 781.2 | 721.7 | 664.0 |
| 1983 | 0.670 | 788.2 | 728.3 | 670.0 |
| 1984 | 0.677 | 796.5 | 735.9 | 677.0 |
| 1985 | 0.683 | 803.5 | 742.4 | 683.0 |

## Vehicle Miles of Travel in Michigan by Years, by Systems

### Other State Highways - Rural - 09

| YEAR | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 0.074 | 100.0 | 94.9 | 89.2 |
| 1957 | 0.078 | 105.4 | 100.0 | 94.0 |
| 1958 | 0.083 | 112.2 | 106.4 | 100.0 |
| 1959 | 0.087 | 117.6 | 111.5 | 104.8 |
| 1960 | 0.091 | 123.0 | 116.7 | 109.6 |
| 1961 | 0.096 | 129.7 | 123.1 | 115.7 |
| 1962 | 0.100 | 135.1 | 128.2 | 120.5 |
| 1963 | 0.104 | 140.5 | 133.3 | 125.3 |
| 1964 | 0.109 | 147.3 | 139.7 | 131.3 |
| 1965 | 0.113 | 152.7 | 144.9 | 136.1 |
| 1966 | 0.117 | 158.1 | 150.0 | 141.0 |
| 1967 | 0.122 | 164.9 | 156.4 | 147.0 |
| 1968 | 0.126 | 170.3 | 161.5 | 151.8 |
| 1969 | 0.130 | 175.7 | 166.7 | 156.6 |
| 1970 | 0.135 | 182.4 | 173.1 | 162.7 |
| 1971 | 0.139 | 187.8 | 178.2 | 167.5 |
| 1972 | 0.140 | 189.2 | 179.5 | 168.7 |
| 1973 | 0.141 | 190.5 | 180.8 | 169.9 |
| 1974 | 0.142 | 191.9 | 182.1 | 171.1 |
| 1975 | 0.143 | 193.2 | 183.3 | 172.3 |
| 1976 | 0.144 | 194.6 | 184.6 | 173.5 |
| 1977 | 0.145 | 195.9 | 185.9 | 174.7 |
| 1978 | 0.146 | 197.3 | 187.2 | 175.9 |
| 1979 | 0.147 | 198.6 | 188.5 | 177.1 |
| 1980 | 0.148 | 200.0 | 189.7 | 178.3 |
| 1981 | 0.149 | 201.4 | 191.0 | 179.5 |
| 1982 | 0.149 | 201.4 | 191.0 | 179.5 |
| 1983 | 0.150 | 202.7 | 192.3 | 180.7 |
| 1984 | 0.151 | 204.0 | 193.6 | 181.9 |
| 1985 | 0.152 | 205.4 | 194.9 | 183.1 |

## Vehicle Miles of Travel in Michigan by Years, by Systems

### Other State Highways - Urban - 10

| YEAR | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 0.085 | 100.0 | 92.4 | 85.0 |
| 1957 | 0.092 | 108.2 | 100.0 | 92.0 |
| 1958 | 0.100 | 117.6 | 108.7 | 100.0 |
| 1959 | 0.110 | 129.4 | 119.6 | 110.0 |
| 1960 | 0.122 | 143.5 | 132.6 | 122.0 |
| 1961 | 0.137 | 161.2 | 148.9 | 137.0 |
| 1962 | 0.156 | 183.5 | 169.6 | 156.0 |
| 1963 | 0.180 | 211.8 | 195.7 | 180.0 |
| 1964 | 0.211 | 248.2 | 229.3 | 211.0 |
| 1965 | 0.250 | 294.1 | 271.7 | 250.0 |
| 1966 | 0.300 | 352.9 | 326.1 | 300.0 |
| 1967 | 0.365 | 429.4 | 396.7 | 365.0 |
| 1968 | 0.449 | 528.2 | 488.0 | 449.0 |
| 1969 | 0.524 | 616.5 | 569.6 | 524.0 |
| 1970 | 0.558 | 656.5 | 606.5 | 558.0 |
| 1971 | 0.592 | 696.5 | 643.5 | 592.0 |
| 1972 | 0.599 | 704.7 | 651.1 | 599.0 |
| 1973 | 0.605 | 711.8 | 657.6 | 605.0 |
| 1974 | 0.612 | 720.0 | 665.2 | 612.0 |
| 1975 | 0.618 | 727.1 | 671.7 | 618.0 |
| 1976 | 0.625 | 735.3 | 679.3 | 625.0 |
| 1977 | 0.631 | 742.4 | 685.9 | 631.0 |
| 1978 | 0.638 | 750.6 | 693.5 | 638.0 |
| 1979 | 0.644 | 757.6 | 700.0 | 644.0 |
| 1980 | 0.651 | 765.9 | 707.6 | 651.0 |
| 1981 | 0.657 | 772.9 | 714.1 | 657.0 |
| 1982 | 0.664 | 781.2 | 721.7 | 664.0 |
| 1983 | 0.670 | 788.2 | 728.3 | 670.0 |
| 1984 | 0.677 | 796.5 | 735.9 | 677.0 |
| 1985 | 0.683 | 803.5 | 742.4 | 683.0 |

## Vehicle Miles of Travel in Michigan by Years, by Systems

### Other Rural Roads - 11

| YEAR | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 3.564 | 100.0 | 99.0 | 98.0 |
| 1957 | 3.600 | 101.0 | 100.0 | 99.0 |
| 1958 | 3.636 | 102.0 | 101.0 | 100.0 |
| 1959 | 3.670 | 103.0 | 101.9 | 100.9 |
| 1960 | 3.707 | 104.0 | 103.0 | 102.0 |
| 1961 | 3.743 | 105.0 | 104.0 | 102.9 |
| 1962 | 3.786 | 106.2 | 105.2 | 104.1 |
| 1963 | 3.829 | 107.4 | 106.4 | 105.3 |
| 1964 | 3.880 | 108.9 | 107.8 | 106.7 |
| 1965 | 3.930 | 110.3 | 109.2 | 108.1 |
| 1966 | 3.975 | 111.5 | 110.4 | 109.3 |
| 1967 | 4.024 | 112.9 | 111.8 | 110.7 |
| 1968 | 4.066 | 114.1 | 112.9 | 111.8 |
| 1969 | 4.107 | 115.2 | 114.1 | 113.0 |
| 1970 | 4.149 | 116.4 | 115.2 | 114.1 |
| 1971 | 4.191 | 117.6 | 116.4 | 115.3 |
| 1972 | 4.226 | 118.6 | 117.4 | 116.2 |
| 1973 | 4.260 | 119.5 | 118.3 | 117.2 |
| 1974 | 4.295 | 120.5 | 119.3 | 118.1 |
| 1975 | 4.330 | 121.5 | 120.3 | 119.1 |
| 1976 | 4.364 | 122.4 | 121.2 | 120.0 |
| 1977 | 4.399 | 123.4 | 122.2 | 121.0 |
| 1978 | 4.434 | 124.4 | 123.2 | 121.9 |
| 1979 | 4.468 | 125.4 | 124.1 | 122.9 |
| 1980 | 4.503 | 126.3 | 125.1 | 123.8 |
| 1981 | 4.538 | 127.3 | 126.1 | 124.8 |
| 1982 | 4.572 | 128.3 | 127.0 | 125.7 |
| 1983 | 4.607 | 129.3 | 128.0 | 126.7 |
| 1984 | 4.641 | 130.2 | 128.9 | 127.6 |
| 1985 | 4.676 | 131.2 | 129.9 | 128.6 |

## Vehicle Miles of Travel in Michigan by Years, by Systems

### Other City Streets - 12

| YEAR | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 7.653 | 100.0 | 98.5 | 96.6 |
| 1957 | 7.768 | 101.5 | 100.0 | 98.1 |
| 1958 | 7.922 | 103.5 | 102.0 | 100.0 |
| 1959 | 8.084 | 105.6 | 104.1 | 102.0 |
| 1960 | 8.269 | 108.1 | 106.4 | 104.4 |
| 1961 | 8.473 | 110.7 | 109.1 | 107.0 |
| 1962 | 8.701 | 113.7 | 112.0 | 109.8 |
| 1963 | 8.930 | 116.7 | 115.0 | 112.7 |
| 1964 | 9.128 | 119.3 | 117.5 | 115.2 |
| 1965 | 9.359 | 122.3 | 120.5 | 118.1 |
| 1966 | 9.513 | 124.3 | 122.5 | 120.1 |
| 1967 | 9.733 | 127.2 | 125.3 | 122.9 |
| 1968 | 9.938 | 129.9 | 127.9 | 125.4 |
| 1969 | 10.174 | 132.9 | 131.0 | 128.4 |
| 1970 | 10.434 | 136.3 | 134.3 | 131.7 |
| 1971 | 10.710 | 140.0 | 137.9 | 135.2 |
| 1972 | 10.910 | 142.6 | 140.4 | 137.7 |
| 1973 | 11.114 | 145.2 | 143.1 | 140.3 |
| 1974 | 11.314 | 147.8 | 145.6 | 142.8 |
| 1975 | 11.517 | 150.5 | 148.3 | 145.4 |
| 1976 | 11.717 | 153.1 | 150.8 | 147.9 |
| 1977 | 11.921 | 155.8 | 153.5 | 150.5 |
| 1978 | 12.122 | 158.4 | 156.0 | 153.0 |
| 1979 | 12.325 | 161.1 | 158.7 | 155.6 |
| 1980 | 12.525 | 163.7 | 161.2 | 158.1 |
| 1981 | 12.729 | 166.3 | 163.9 | 160.7 |
| 1982 | 12.931 | 169.0 | 166.5 | 163.2 |
| 1983 | 13.133 | 171.6 | 169.1 | 165.8 |
| 1984 | 13.334 | 174.2 | 171.6 | 168.3 |
| 1985 | 13.536 | 176.9 | 174.2 | 170.9 |

## Vehicle Miles of Travel in Michigan by Years, by Systems

### Total All Systems

| YEAR | Vehicle Miles of Travel (Billions) | Percent (1956 = 100.0) | Percent (1957 = 100.0) | Percent (1958 = 100.0) |
|---|---|---|---|---|
| 1956 | 30.044 | 100.0 | 96.9 | 93.9 |
| 1957 | 31.000 | 103.2 | 100.0 | 96.9 |
| 1958 | 32.000 | 106.5 | 103.2 | 100.0 |
| 1959 | 33.000 | 109.8 | 106.5 | 103.1 |
| 1960 | 34.200 | 113.8 | 110.3 | 106.9 |
| 1961 | 35.500 | 118.1 | 114.5 | 110.9 |
| 1962 | 36.900 | 122.8 | 119.0 | 115.3 |
| 1963 | 38.400 | 127.8 | 123.9 | 120.0 |
| 1964 | 40.000 | 133.1 | 129.0 | 125.0 |
| 1965 | 41.700 | 138.8 | 134.5 | 130.3 |
| 1966 | 43.500 | 144.8 | 140.3 | 135.9 |
| 1967 | 45.400 | 151.1 | 146.5 | 141.9 |
| 1968 | 47.400 | 157.7 | 152.9 | 148.1 |
| 1969 | 49.500 | 164.7 | 159.7 | 154.7 |
| 1970 | 51.700 | 172.1 | 166.8 | 161.6 |
| 1971 | 54.000 | 179.7 | 174.2 | 168.8 |
| 1972 | 54.750 | 182.2 | 176.6 | 171.1 |
| 1973 | 55.500 | 184.7 | 179.0 | 173.4 |
| 1974 | 56.250 | 187.2 | 181.5 | 175.8 |
| 1975 | 57.000 | 189.7 | 183.9 | 178.1 |
| 1976 | 57.750 | 192.2 | 186.3 | 180.5 |
| 1977 | 58.500 | 194.7 | 188.7 | 182.8 |
| 1978 | 59.250 | 193.9 | 191.1 | 185.2 |
| 1979 | 60.000 | 199.7 | 193.6 | 187.5 |
| 1980 | 60.750 | 202.2 | 196.0 | 189.8 |
| 1981 | 61.500 | 204.7 | 198.4 | 192.2 |
| 1982 | 62.250 | 207.2 | 200.8 | 194.5 |
| 1983 | 63.000 | 209.7 | 203.2 | 196.9 |
| 1984 | 63.750 | 212.2 | 205.7 | 199.2 |
| 1985 | 64.500 | 214.7 | 208.1 | 201.6 |

## Daily External Outbound Trips from Zones 1-16
## Using Limited Access Highway A & B

| Road | Sec | Zone 1 to | | | | Zone 2 to | | | | Zone 3 to | | | | Zone 4 to | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | S | E | W | N | S | E | W | N | S | E | W | N | S | E | W |
| A | 1 | 100 | | | | 100 | | | | 100 | | | | 100 | | | |
| A | 2 | 100 | | | | 100 | | | | 100 | | | | 100 | | | |
| A | 3 | | 100 | | | | 100 | | | | 100 | | | | 100 | | |
| A | 4 | | 100 | | | | 100 | | | | 100 | | | | 100 | | |
| B | 1 | | | | 100 | | | | 100 | | | | 100 | | | | 100 |
| B | 2 | | | | 100 | | | | 100 | | | | 100 | | | | 100 |
| B | 3 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 |
| B | 4 | | | 100 | | | | 100 | | | | 100 | | | | 100 | |
| C | 1 | 50 | 50 | 50 | 50 | | | | | | | | | | | | |
| C | 2 | | | | | | | | | 50 | 50 | 50 | 50 | | | | |
| C | 3 | | | | | | | | | | | | | | | | |
| C | 4 | | | | | | | | | | | | | | | | |
| D | 1 | | | | | | | | | | | | | | | | |
| D | 2 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| D | 3 | | | | | | | | | | | | | | | | |
| D | 4 | | | | | | | | | | | | | | | | |
| E | 1 | 50 | 50 | 50 | 50 | | | | | 50 | 50 | 50 | 50 | | | | |
| E | 2 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| E | 3 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| E | 4 | | | | | | | | | | | | | | | | |
| F | 1 | | | | | | | | | | | | | | | | |
| F | 2 | | | | | | | | | | | | | | | | |
| F | 3 | | | | | | | | | | | | | | | | |
| F | 4 | | | | | | | | | | | | | | | | |
| Inter B-D | | | | | | | | | | | | | | | | | |
| | 2 | | | 100 | | | | 100 | | | | 100 | | | | 100 | |
| | 3 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 |
| | 6 | | | | | | | | | | | | | | | | |
| | 7 | | | | | | | | | | | | | | | | |
| Inter AB | | | | | | | | | | | | | | | | | |
| | 1 | 100 | | | | 100 | | | | 100 | | | | 100 | | | |
| | 9 | | | | 100 | | | | 100 | | | | 100 | | | | 100 |
| | 8 | | 100 | | | | 100 | | | | 100 | | | | 100 | | |

## Daily External Outbound Trips from Zones 1-16
## Using Limited Access Highway A & B

| Road Sec | | Zone 5 to | | | | Zone 6 to | | | | Zone 7 to | | | | Zone 8 to | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | S | E | W | N | S | E | W | N | S | E | W | N | S | E | W |
| A | 1 | 100 | | | | 100 | | | | 100 | | | | 100 | | | |
| A | 2 | 100 | | | | 100 | | | | 100 | | | | 100 | | | |
| A | 3 | | 100 | | | | 100 | | | | 100 | | | | 100 | | |
| A | 4 | | 100 | | | | 100 | | | | 100 | | | | 100 | | |
| B | 1 | | | | 100 | | | | 100 | | | | 100 | | | | 100 |
| B | 2 | | | | 100 | | | | 100 | | | | 100 | | | | 100 |
| B | 3 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 |
| B | 4 | | | 100 | | | | 100 | | | | 100 | | | | 100 | |
| C | 1 | | | | | | | | | | | | | | | | |
| C | 2 | | | | | | | | | | | | | | | | |
| C | 3 | 50 | 50 | 50 | 50 | | | | | | | | | | | | |
| C | 4 | | | | | | | | | 50 | 50 | 50 | 50 | | | | |
| D | 1 | | | | | | | | | | | | | | | | |
| D | 2 | | | | | | | | | | | | | | | | |
| D | 3 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| D | 4 | | | | | | | | | | | | | | | | |
| E | 1 | | | | | | | | | | | | | | | | |
| E | 2 | | | | | | | | | | | | | | | | |
| E | 3 | | | | | | | | | | | | | | | | |
| E | 4 | | | | | | | | | | | | | | | | |
| F | 1 | 50 | 50 | 50 | 50 | | | | | 50 | 50 | 50 | 50 | | | | |
| F | 2 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| F | 3 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| F | 4 | | | | | | | | | | | | | | | | |
| Inter B-D | | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | |
| | 6 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 |
| | 7 | | | 100 | | | | 100 | | | | 100 | | | | 100 | |
| Inter AB | | | | | | | | | | | | | | | | | |
| | 1 | 100 | | | | 100 | | | | 100 | | | | 100 | | | |
| | 9 | | | | 100 | | | | 100 | | | | 100 | | | | 100 |
| | 8 | | 100 | | | | 100 | | | | 100 | | | | 100 | | |

## Daily External Outbound Trips from Zones 1-16
## Using Limited Access Highway A & B

| Road | Sec | Zone 9 to | | | | Zone 10 to | | | | Zone 11 to | | | | Zone 12 to | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | S | E | W | N | S | E | W | N | S | E | W | N | S | E | W |
| A | 1 | 100 | | | | 100 | | | | 100 | | | | 100 | | | |
| A | 2 | 100 | | | | 100 | | | | 100 | | | | 100 | | | |
| A | 3 | | 100 | | | | 100 | | | | 100 | | | | 100 | | |
| A | 4 | | 100 | | | | 100 | | | | 100 | | | | 100 | | |
| B | 1 | | | | 100 | | | | 100 | | | | 100 | | | | 100 |
| B | 2 | | | | 100 | | | | 100 | | | | 100 | | | | 100 |
| B | 3 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 |
| B | 4 | | | 100 | | | | 100 | | | | 100 | | | | 100 | |
| C | 1 | | | | | | | | | | | | | | | | |
| C | 2 | | | | | | | | | | | | | | | | |
| C | 3 | | | | | | | | | | | | | | | | |
| C | 4 | | | | | | | | | | | | | | | | |
| D | 1 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | | | | | | | | |
| D | 2 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| D | 3 | | | | | | | | | | | | | | | | |
| D | 4 | | | | | | | | | | | | | | | | |
| E | 1 | | | | | | | | | | | | | | | | |
| E | 2 | | | | | | | | | | | | | | | | |
| E | 3 | 50 | 50 | 50 | 50 | | | | | | | | | | | | |
| E | 4 | | | | | 50 | 50 | 50 | 50 | | | | | | | | |
| F | 1 | | | | | | | | | | | | | | | | |
| F | 2 | | | | | | | | | | | | | | | | |
| F | 3 | | | | | | | | | | | | | | | | |
| F | 4 | | | | | | | | | | | | | | | | |
| Inter B-D | | | | | | | | | | | | | | | | | |
| | 2 | | | 100 | | | | 100 | | | | 100 | | | | 100 | |
| | 3 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 |
| | 6 | | | | | | | | | | | | | | | | |
| | 7 | | | | | | | | | | | | | | | | |
| Inter AB | | | | | | | | | | | | | | | | | |
| | 1 | 100 | | | | 100 | | | | 100 | | | | 100 | | | |
| | 9 | | | | 100 | | | | 100 | | | | 100 | | | | 100 |
| | 8 | | 100 | | | | 100 | | | | 100 | | | | 100 | | |

## Daily External Outbound Trips from Zones 1-16
## Using Limited Access Highway A & B

| Road Sec | Zone 13 to | | | | Zone 14 to | | | | Zone 15 to | | | | Zone 16 to | | | | Total Outbound Vehicles | Total Outbound Vehicle Miles |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | S | E | W | N | S | E | W | N | S | E | W | N | S | E | W | | |
| A 1 | 100 | | | | 100 | | | | 100 | | | | 100 | | | | 1,600 | 0 |
| A 2 | 100 | | | | 100 | | | | 100 | | | | 100 | | | | 1,600 | 3,200 |
| A 3 | | 100 | | | | 100 | | | | 100 | | | | 100 | | | 1,600 | 3,200 |
| A 4 | | 100 | | | | 100 | | | | 100 | | | | 100 | | | 1,600 | 0 |
| B 1 | | | | 100 | | | | 100 | | | | 100 | | | | 100 | 1,600 | 0 |
| B 2 | | | | 100 | | | | 100 | | | | 100 | | | | 100 | 1,600 | 3,200 |
| B 3 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 | 4,800 | 9,600 |
| B 4 | | | 100 | | | | 100 | | | | 100 | | | | 100 | | 1,600 | 0 |
| C 1 | | | | | | | | | | | | | | | | | 200 | 200 |
| C 2 | | | | | | | | | | | | | | | | | 200 | 200 |
| C 3 | | | | | | | | | | | | | | | | | 200 | 200 |
| C 4 | | | | | | | | | | | | | | | | | 200 | 200 |
| D 1 | | | | | | | | | | | | | | | | | 400 | 400 |
| D 2 | | | | | | | | | | | | | | | | | 3,200 | 5,600 |
| D 3 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 3,200 | 5,600 |
| D 4 | | | | | | | | | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 400 | 400 |
| E 1 | | | | | | | | | | | | | | | | | 400 | 400 |
| E 2 | | | | | | | | | | | | | | | | | 1,600 | 2,400 |
| E 3 | | | | | | | | | | | | | | | | | 1,800 | 3,400 |
| E 4 | | | | | | | | | | | | | | | | | 200 | 200 |
| F 1 | | | | | | | | | | | | | | | | | 400 | 400 |
| F 2 | | | | | | | | | | | | | | | | | 1,600 | 2,400 |
| F 3 | | | | | | | | | 50 | 50 | 50 | 50 | | | | | 1,800 | 3,400 |
| F 4 | | | | | | | | | | | | | 50 | 50 | 50 | 50 | 200 | 200 |
| | | | | | | | | | | | | | | | | TOTAL | 32,000 | 44,800 |
| Inter B-D | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | 800 | |
| 3 | | | | | | | | | | | | | | | | | 2,400 | |
| 6 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 | 100 | 100 | | 100 | 2,400 | |
| 7 | | | 100 | | | | 100 | | | | 100 | | | | 100 | | 800 | |
| Inter AB | | | | | | | | | | | | | | | | | | |
| 1 | 100 | | | | 100 | | | | 100 | | | | 100 | | | | 1,600 | |
| 9 | | | | 100 | | | | 100 | | | | 100 | | | | 100 | 1,600 | |
| 8 | | 100 | | | | 100 | | | | 100 | | | | 100 | | | 1,600 | |

# Appendix B

## Method of Determination of Current Traffic on and in the Vicinity of Limited Access Highway LA

## METHOD OF DETERMINATION OF CURRENT TRAFFIC ON AND IN THE VICINITY OF LIMITED ACCESS HIGHWAY LA

Estimating current traffic is found on page 32 of this manual. For the location and data in the area of limited access highway LA see figure 17 on page 33.

Traffic will be rerouted and diverted from the roads in the following order:

a. Closed Roads
b. Roads with Grade Separations
c. Road W
d. Road LA
e. Road R

Each traffic movement has been assigned an item number. These item numbers have been used to refer to traffic movements that appear on other sections of roads instead of repeating the description of the movement. The first time an item number occurs it will not be preceded by the word item.

### Assignment of Current Traffic to Closed Roads

Road B - 1959 ADT = 120

Present Routing

| | | | |
|---|---|---|---|
| 1. | South on N, West on B, South on R | = | 10 |
| 2. | South on N, West on B | = | 30 |
| 3. | North on N, West on B, North on R | = | 10 |
| 4. | North on N, West on B | = | 30 |
| 5. | West on B, North on R | = | 10 |
| 6. | West on B, South on R | = | 10 |
| 7. | West on B | = | 20 |
| | Total | = | 120 |

New Routing - B

| | | | |
|---|---|---|---|
| 1a. | West on A, South on R | = | 4 |
| 1b. | South on N, West on W, South on LA | = | 6 |
| 2. | West on A, South on R, West on B | = | 30 |
| 3. | North on N, West on A, North on R | = | 10 |
| 4. | West on D, North on R, West on B | = | 30 |
| 5. | North on N, West on A, North on R | = | 10 |
| 6a. | South on N, West on D, South on R | = | 6 |
| 6b. | South on N, West on W, South on LA | = | 4 |
| 7. | North on N, West on A, South on R, West on B | = | 20 |
| | Total | = | 120 |

Road E - 1959 ADT = 140

Present Routing

8. South on N, West on E, South on R . . . . . . . . . = 10
9. South on N, West on E . . . . . . . . . . . . = 10
10. North on N, West on E, North on R . . . . . . . . . = 10
11. North on N, West on E . . . . . . . . . . . . = 10
12. West on E, North on R . . . . . . . . . . . . = 30
13. West on E, South on R . . . . . . . . . . . . = 30
14. West on E . . . . . . . . . . . . . . . = 40

Total . . . . = 140

New Routing - E

8a. West on D, South on R . . . . . . . . . . . . = 4
8b. South on N, West on W, South on LA . . . . . . . . . = 6
9. West on D, South on R, West on E . . . . . . . . . = 10
10. North on N, West on D, North on R . . . . . . . . . = 10
11. West on W, North on R, West on E . . . . . . . . . = 10
12. North on N, West on D, North on R . . . . . . . . . = 30
13a. South on N, West on W, South on R . . . . . . . . . = 16
13b. South on N, West on W, South on LA . . . . . . . . . = 14
14. North on N, West on D, South on R, West on E . . . . . . = 40

Total . . . . = 140

Road F - 1959 ADT = 180

Present Routing

15. South on N, West on F, South on R . . . . . . . . . = 10
16. South on N, West on F . . . . . . . . . . . . = 10
17. North on N, West on F, North on R . . . . . . . . . = 10
18. North on N, West on F . . . . . . . . . . . . = 50
19. West on F, North on R . . . . . . . . . . . . = 10
20. West on F, South on R . . . . . . . . . . . . = 50
21. West on F . . . . . . . . . . . . . . . = 40

Total . . . . = 180

New Routing - F

15a. South on N, West on W, South on R . . . . . . . . . = 4
15b. South on N, West on W, South on LA . . . . . . . . . = 6
16. West on D, South on R, West on F . . . . . . . . . = 10
17. North on N, West on D, North on R . . . . . . . . . = 10
18. West on W, North on R, West on F . . . . . . . . . = 50

New Routing - F (Cont.)

19. North on N, West on D, North on R . . . . . . . . = 10
20a. South on N, West on W, South on R . . . . . . . . = 26
20b. South on N, West on W, South on LA . . . . . . . . = 24
21. South on N, West on W, North on R, West on F . . . . . = 40

Total . . . . = 180

Road G - 1959 ADT = 160

Present Routing

22. South on N, West on G, South on R . . . . . . . . = 20
23. South on N, West on G . . . . . . . . . . . = 20
24. North on N, West on G, North on R . . . . . . . . = 20
25. North on N, West on G . . . . . . . . . . . = 20
26. West on G, North on R . . . . . . . . . . . = 20
27. West on G, South on R . . . . . . . . . . . = 20
28. West on G . . . . . . . . . . . . . . = 40

Total . . . . = 160

New Routing - G

22. South on N, West on K, South on R . . . . . . . . = 20
23. West on W, South on R, West on G . . . . . . . . = 20
24a. North on N, West on W, North on R . . . . . . . . = 10
24b. North on N, West on W, North on LA . . . . . . . . = 10
25. North on N, West on W, South on R, West on G . . . . . = 20
26a. North on N, West on W, North on R . . . . . . . . = 10
26b. North on N, West on W, North on LA . . . . . . . . = 10
27. South on N, West on K, South on R . . . . . . . . = 20
28. North on N, West on W, South on R, West on G . . . . . = 40

Total . . . . = 160

Road H - 1959 ADT = 100

Present Routing

29. South on N, West on H, South on R . . . . . . . . = 20
30. North on N, West on H, North on R . . . . . . . . = 20
31. West on H, North on R . . . . . . . . . . . = 40
32. West on H, South on R . . . . . . . . . . . = 20

Total . . . . = 100

New Routing - H

29. South on N, West on K, South on R . . . . . . . . = 20
30a. North on N, West on W, North on R . . . . . . . . = 10
30b. North on N, West on W, North on LA . . . . . . . . = 10
31a. North on N, West on W, North on R . . . . . . . . = 20
31b. North on N, West on W, North on LA . . . . . . . . = 20
32. South on N, West on K, South on R . . . . . . . . = 20

Total . . . . = 100

## Assignment of Current Traffic to Grade Separated Roads

Road A - 1959 ADT = 1200

Present Routing

33. North on N, West on A, North on R . . . . . . . . = 130
34. North on N, West on A . . . . . . . . . . . = 410
35. West on A, North on R . . . . . . . . . . . = 130
36. West on A, South on R . . . . . . . . . . . = 300
37. West on A . . . . . . . . . . . . . . = 230

Total . . . . = 1200

New Routing - A

33. North on N, West on A, North on R . . . . . . . . = 130
34. North on N, West on A . . . . . . . . . . . = 410
35. West on A, North on R . . . . . . . . . . . = 130
36a. West on A, South on R . . . . . . . . . . . = 150
36b. South on N, West on W, South on LA . . . . . . . . = 150
37. West on A . . . . . . . . . . . . . . = 230

Total . . . . = 1200

Additional Traffic on Road A Diverted to Road R
from Roads N, M and Roads East of M

38. West on A, North on R . . . . . . . . . . . = 210
39. West on A, South on R . . . . . . . . . . . = 240

40. Total . . . . = 450

Current Traffic - Road A

From Road A (Total minus Item 36b) = 1050  
From Road B (Items 1a, 2, 3, 5 and 7) = 74  
Item 40 = 450  
Total = 1574

Road D - 1959 ADT = 800

Present Routing

41. South on N, West on D, South on R = 20  
42. South on N, West on D = 20  
43. North on N, West on D, North on R = 40  
44. North on N, West on D = 40  
45. West on D, North on R = 40  
46. West on D, South on R = 100  
47. West on D = 540  
Total = 800

New Routing - D

41a. South on N, West on D, South on R = 10  
41b. South on N, West on W, South on LA = 10  
42. South on N, West on D = 20  
43. North on N, West on D, North on R = 40  
44. North on N, West on D = 40  
45. West on D, North on R = 40  
46a. West on D, South on R = 50  
46b. South on N, West on W, South on LA = 50  
47. West on D = 540  
Total = 800

Additional Traffic on Road D Diverted to Road R from Roads N, M and Roads East of M

48. West on D, North on R = 240  
49. West on D, South on R = 280  
50. Total = 520

Current Traffic - Road D

| | |
|---|---|
| From Road D (Total minus Items 41b and 46b) | = 740 |
| From Road B (Items 4 and 6a) | = 36 |
| From Road E (Items 8a, 9, 10, 12 and 14) | = 94 |
| From Road F (Items 16, 17 and 19) | = 30 |
| Item 50 | = 520 |
| Total | = 1420 |

Road K - 1959 ADT = 1800

Present Routing

| | | |
|---|---|---|
| 51. | South on N, West on K, South on R | = 60 |
| 52. | South on N, West on K | = 60 |
| 53. | North on N, West on K, North on R | = 90 |
| 54. | North on N, West on K | = 90 |
| 55. | West on K, North on R | = 50 |
| 56. | West on K, South on R | = 60 |
| 57. | West on K | = 1390 |
| | Total | = 1800 |

New Routing - K

| | | |
|---|---|---|
| 51. | South on N, West on K, South on R | = 60 |
| 52. | South on N, West on K | = 60 |
| 53a. | North on N, West on K, North on R | = 40 |
| 53b. | North on N, West on W, North on LA | = 50 |
| 54. | North on N, West on K | = 90 |
| 55a. | West on K, North on R | = 20 |
| 55b. | North on N, West on W, North on LA | = 30 |
| 56. | West on K, South on R | = 60 |
| 57. | West on K | = 1390 |
| | Total | = 1800 |

Additional Traffic on Road K Diverted to Road R from Roads N, M and Roads East of M.

| | | |
|---|---|---|
| 58. | West on K, North on R | = 180 |
| 59. | West on K, South on R | = 220 |
| 60. | Total | = 400 |

Current Traffic - Road K

| | |
|---|---|
| From K (Total minus Items 53b and 55b) | = 1720 |
| From G (Items 22 and 27) | = 40 |
| From H (Items 29 and 32) | = 40 |
| Item 60 | = 400 |
| Total | = 2200 |

Road W - 1959 ADT = 5600

Present Routing

| | | |
|---|---|---|
| 61. | South on N, West on W, South on R | = 260 |
| 62. | South on N, West on W | = 200 |
| 63. | North on N, West on W, North on R | = 180 |
| 64. | North on N, West on W | = 160 |
| 65. | West on W, North on R | = 420 |
| 66. | West on W, South on R | = 1540 |
| 67. | West on W | = 2840 |
| | Total | = 5600 |

New Routing - W

| | | |
|---|---|---|
| 61a. | South on N, West on W, South on R | = 100 |
| 61b. | South on N, West on W, South on LA | = 160 |
| 62. | South on N, West on W | = 200 |
| 63a. | North on N, West on W, North on R | = 80 |
| 63b. | North on N, West on W, North on LA | = 100 |
| 64. | North on N, West on W | = 160 |
| 65a. | West on W, North on R | = 180 |
| 65b. | West on W, North on LA | = 240 |
| 66a. | West on W, South on R | = 600 |
| 66b. | West on W, South on LA | = 940 |
| 67. | West on W | = 2840 |
| | Total | = 5600 |

Additional Traffic on Road W, East of LA

| | | |
|---|---|---|
| 68. | South on N, West on W, South on LA | = 120 |
| 69. | North on N, West on W, North on LA | = 140 |
| 70. | South on M, West on W, South on LA | = 130 |
| 71. | North on M, West on W, North on LA | = 160 |
| 72. | South on Roads East of M, West on W, South on LA | = 200 |
| 73. | North on Roads East of M, West on W, North on LA | = 240 |
| 74. | Total | = 990 |

Additional Traffic on Road W, West of LA

75. South on R, East on W, South on LA . . . . . . . . = 300
76. North on R, East on W, North on LA . . . . . . . . = 260
77. South on X, East on W, South on LA . . . . . . . . = 260
78. North on X, East on W, North on LA . . . . . . . . = 310
79. South on Y, East on W, South on LA . . . . . . . . = 240
80. North on Y, East on W, North on LA . . . . . . . . = 200
81. South on Roads West of Y, East on W, South on LA . . . . . . = 200
82. North on Roads West of Y, East on W, North on LA . . . . . . = 160

83. Total . . . . = 1930

Current Traffic - Road W

| | | West of LA | East of LA |
|---|---|---|---|
| Item 74 | = | | 990 |
| Item 83 | = | 1930 | |
| From Road W | | | |
| Total | = | | 5600 |
| Total Minus Items 61b, 63b, 65b and 66b | = | 4160 | |
| From Road A (Item 36b) | = | | 150 |
| From Road B (Items 1b and 6b) | = | | 10 |
| From Road D (Items 41b and 46b) | = | | 60 |
| From Road E | | | |
| Items 11 and 13a | = | 26 | |
| Items 8b, 11, 13a and 13b | = | | 46 |
| From Road F | | | |
| Items 15a, 18, 20a and 21 | = | 120 | |
| Items 15a, 15b, 18, 20a, 20b and 21 | = | | 150 |
| From Road G | | | |
| Items 23, 24a, 25, 26a and 28 | = | 100 | |
| Items 23, 24a, 24b, 25, 26a, 26b and 28 | = | | 120 |
| From Road H | | | |
| Items 30a and 31a | = | 30 | |
| Items 30a, 30b, 31a and 31b | = | | 60 |
| From Road K (Items 53b and 55b) | = | | 80 |
| Total | = | 6366 | 7266 |

Current Traffic Road LA (Entering at Road W)

| | | South of W | North of W |
|---|---|---|---|
| Items 68, 70 and 72 | = | 450 | |
| Items 69, 71 and 73 | = | | 540 |
| Items 75, 77, 79 and 81 | = | 1000 | |
| Items 76, 78, 80 and 82 | = | | 930 |
| From Road A (Item 36b) | = | 150 | |

Current Traffic Road LA (Cont.)

| | | South of W | North of W |
|---|---|---|---|
| From Road B (Items 1b and 6b) | = | 10 | |
| From Road D (Items 41b and 46b) | = | 60 | |
| From Road E (Items 8b and 13b) | = | 20 | |
| From Road F (Items 15b and 20b) | = | 30 | |
| From Road W | | | |
| Items 61b and 66b | = | 1100 | |
| Items 63b and 65b | = | | 340 |
| From Road G (Items 24b and 26b) | = | | 20 |
| From Road H (Items 30b and 31b) | = | | 30 |
| From Road K (Items 53b and 55b) | = | | 80 |
| Total | = | 2820 | 1940 |

Current Traffic Road LA (Entering North or South of Road W)
(Determined from O-D Data)

| | | | |
|---|---|---|---|
| 84. | From Road R | = | 8000 |
| 85. | From Road Y | = | 600 |
| 86. | From Roads West of Y | = | 600 |
| 87. | From Road S | = | 1200 |
| 88. | From Road T | = | 900 |
| 89. | From Road M | = | 800 |
| 90. | From Roads East of M | = | 600 |
| 91. | From Road P | = | 1200 |
| 92. | Total | = | 13,900 |

| Total South of W | Total North of W |
|---|---|
| 16,720 | 15,840 |

Assignment of Current Traffic to Road R by Road Sections. (Determination made by adding and subtracting traffic diverted from and diverted to Road R).

North of A - 1959 ADT = 12,120

| | | | |
|---|---|---|---|
| 93. | Diverted from Y and West of Y, East on A, North on R | | + 120 |
| | Item 38 | | + 210 |
| 94. | Diverted from Y and West of Y, East on B, North on R | | + 10 |
| 95. | Diverted from Y and West of Y, East on C, North on R | | + 20 |
| | Item 48 | | + 240 |
| 96. | Diverted from Y and West of Y, East on D, North on R | | + 160 |
| 97. | Diverted from Y and West of Y, East on E, North on R | | + 10 |
| 98. | Diverted from Y and West of Y, East on F, North on R | | + 20 |
| | Items 63b and 65b | - 340 | |
| | Item 76 | - 260 | |

North of A (Cont.)

| | | | |
|---|---|---|---|
| 99. | Diverted from Y and West of Y, East on W, North on R | | + 100 |
| | Items 24b and 26b | - 20 | |
| 100. | Diverted from Y and West of Y, East on G, North on R | | + 16 |
| | Items 30b and 31b | - 30 | |
| 101. | Diverted from Y and West of Y, East on J, North on R | | + 40 |
| | Items 53b and 55b | - 80 | |
| | Item 58 | | + 180 |
| 102. | Diverted from Y and West of Y, East on K, North on R | | + 160 |
| 103. | Diverted to R from Roads North of A | | + 400 |
| 104. | Diverted to R from Roads South of K | | + 300 |
| | Item 84 | - 8000 | |
| | Total | - 8730 | + 1986 |

Current Traffic - North of A . . . . . . . . . . 5376

A-B - 1959 ADT = 12,000

| | | | |
|---|---|---|---|
| | Item 36b | - 150 | |
| | Item 39 | | + 240 |
| 105. | Diverted from Y and West of Y, East on A, South on R | | + 180 |
| | Items 1a, 2 and 7 | | + 54 |
| | Items 3 and 5 | - 20 | |
| | Item 94 | | + 10 |
| | Item 95 | | + 20 |
| | Item 48 | | + 240 |
| | Item 96 | | + 160 |
| | Item 97 | | + 10 |
| | Item 98 | | + 20 |
| | Items 63b and 65b | - 340 | |
| | Item 76 | - 260 | |
| | Item 99 | | + 100 |
| | Items 24b and 26b | - 20 | |
| | Item 100 | | + 16 |
| | Items 30b and 31b | - 30 | |
| | Item 101 | | + 40 |
| | Items 53b and 55b | - 80 | |
| | Item 58 | | + 180 |
| | Item 102 | | + 160 |
| | Item 103 | | + 400 |
| | Item 104 | | + 300 |
| | Item 84 | - 8000 | |
| | Total | - 8900 | + 2130 |

Current Traffic - A-B . . . . . . . . . . . 5230

Current Traffic Road LA (Cont.)

| | | South of W | North of W |
|---|---|---|---|
| From Road B (Items 1b and 6b) | = | 10 | |
| From Road D (Items 41b and 46b) | = | 60 | |
| From Road E (Items 8b and 13b) | = | 20 | |
| From Road F (Items 15b and 20b) | = | 30 | |
| From Road W | | | |
| Items 61b and 66b | = | 1100 | |
| Items 63b and 65b | = | | 340 |
| From Road G (Items 24b and 26b) | = | | 20 |
| From Road H (Items 30b and 31b) | = | | 30 |
| From Road K (Items 53b and 55b) | = | | 80 |
| Total | = | 2820 | 1940 |

Current Traffic Road LA (Entering North or South of Road W)
(Determined from O-D Data)

| | | | |
|---|---|---|---|
| 84. | From Road R | = | 8000 |
| 85. | From Road Y | = | 600 |
| 86. | From Roads West of Y | = | 600 |
| 87. | From Road S | = | 1200 |
| 88. | From Road T | = | 900 |
| 89. | From Road M | = | 800 |
| 90. | From Roads East of M | = | 600 |
| 91. | From Road P | = | 1200 |
| 92. | Total | = | 13,900 |

| Total South of W | Total North of W |
|---|---|
| 16,720 | 15,840 |

Assignment of Current Traffic to Road R by Road Sections. (Determination made by adding and subtracting traffic diverted from and diverted to Road R).

North of A - 1959 ADT = 12,120

| | | | |
|---|---|---|---|
| 93. | Diverted from Y and West of Y, East on A, North on R | | + 120 |
| | Item 38 | | + 210 |
| 94. | Diverted from Y and West of Y, East on B, North on R | | + 10 |
| 95. | Diverted from Y and West of Y, East on C, North on R | | + 20 |
| | Item 48 | | + 240 |
| 96. | Diverted from Y and West of Y, East on D, North on R | | + 160 |
| 97. | Diverted from Y and West of Y, East on E, North on R | | + 10 |
| 98. | Diverted from Y and West of Y, East on F, North on R | | + 20 |
| | Items 63b and 65b | - 340 | |
| | Item 76 | - 260 | |

North of A (Cont.)

| | | | |
|---|---|---|---|
| 99. | Diverted from Y and West of Y, East on W, North on R | | + 100 |
| | Items 24b and 26b | - 20 | |
| 100. | Diverted from Y and West of Y, East on G, North on R | | + 16 |
| | Items 30b and 31b | - 30 | |
| 101. | Diverted from Y and West of Y, East on J, North on R | | + 40 |
| | Items 53b and 55b | - 80 | |
| | Item 58 | | + 180 |
| 102. | Diverted from Y and West of Y, East on K, North on R | | + 160 |
| 103. | Diverted to R from Roads North of A | | + 400 |
| 104. | Diverted to R from Roads South of K | | + 300 |
| | Item 84 | - 8000 | |
| | Total | - 8730 | + 1986 |

Current Traffic - North of A . . . . . . . . . . 5376

A-B - 1959 ADT = 12,000

| | | | |
|---|---|---|---|
| | Item 36b | - 150 | |
| | Item 39 | | + 240 |
| 105. | Diverted from Y and West of Y, East on A, South on R | | + 180 |
| | Items 1a, 2 and 7 | | + 54 |
| | Items 3 and 5 | - 20 | |
| | Item 94 | | + 10 |
| | Item 95 | | + 20 |
| | Item 48 | | + 240 |
| | Item 96 | | + 160 |
| | Item 97 | | + 10 |
| | Item 98 | | + 20 |
| | Items 63b and 65b | - 340 | |
| | Item 76 | - 260 | |
| | Item 99 | | + 100 |
| | Items 24b and 26b | - 20 | |
| | Item 100 | | + 16 |
| | Items 30b and 31b | - 30 | |
| | Item 101 | | + 40 |
| | Items 53b and 55b | - 80 | |
| | Item 58 | | + 180 |
| | Item 102 | | + 160 |
| | Item 103 | | + 400 |
| | Item 104 | | + 300 |
| | Item 84 | - 8000 | |
| | Total | - 8900 | + 2130 |

Current Traffic - A-B . . . . . . . . . . . 5230

B-C - 1959 ADT = 11,960

| | | | |
|---|---|---|---|
| | Item 36b | - 150 | |
| | Item 39 | | + 240 |
| | Item 105 | | + 180 |
| | Item 4 | | + 30 |
| | Items 1b, 6a, and 6b | - 16 | |
| 106. | Diverted from Y and West of Y, East on B, South on R | | + 14 |
| | Item 95 | | + 20 |
| | Item 48 | | + 240 |
| | Item 96 | | + 160 |
| | Item 97 | | + 10 |
| | Item 98 | | + 20 |
| | Items 63b and 65b | - 340 | |
| | Item 76 | - 260 | |
| | Item 99 | | + 100 |
| | Items 24b and 26b | - 20 | |
| | Item 100 | | + 16 |
| | Items 30b and 31b | - 30 | |
| | Item 101 | | + 40 |
| | Items 53b and 55b | - 80 | |
| | Item 58 | | + 180 |
| | Item 102 | | + 160 |
| | Item 103 | | + 400 |
| | Item 104 | | + 300 |
| | Item 84 | - 8000 | |
| | Total | - 8896 | + 2110 |

Current Traffic - B-C . . . . . . . . . . 5174

C-D - 1959 ADT = 11,920

| | | | |
|---|---|---|---|
| | Item 36b | - 150 | |
| | Item 39 | | + 240 |
| | Item 105 | | + 180 |
| | Item 4 | | + 30 |
| | Items 1b, 6a, and 6b | - 16 | |
| | Item 106 | | + 14 |
| 107. | Diverted from Y and West of Y, East on C, South on R | | + 24 |
| | Item 48 | | + 240 |
| | Item 96 | | + 160 |
| | Item 97 | | + 10 |
| | Item 98 | | + 20 |
| | Items 63b and 65b | - 340 | |
| | Item 76 | - 260 | |
| | Item 99 | | + 100 |
| | Items 24b and 26b | - 20 | |
| | Item 100 | | + 16 |
| | Items 30b and 31b | - 30 | |
| | Item 101 | | + 40 |

| | | |
|---|---|---|
| Items 53b and 55b | - 80 | |
| Item 58 | | + 180 |
| Item 102 | | + 160 |
| Item 103 | | + 400 |
| Item 104 | | + 300 |
| Item 84 | - 8000 | |
| Total | - 8896 | + 2114 |

Current Traffic C-D . . . . . . . . . . . 5138

D-E - 1959 ADT = 11,960

| | | |
|---|---|---|
| Item 36b | - 150 | |
| Item 39 | | + 240 |
| Item 105 | | + 180 |
| Items 1b and 6b | - 10 | |
| Item 106 | | + 14 |
| Item 107 | | + 24 |
| Items 41b and 46b | - 60 | |
| Item 49 | | + 280 |
| 108. Diverted from Y and West of Y, East on D, South on R | | + 140 |
| Items 8a, 9 and 14 | | + 54 |
| Items 10 and 12 | - 40 | |
| Item 97 | | + 10 |
| Item 16 | | + 10 |
| Items 17 and 19 | - 20 | |
| Item 98 | | + 20 |
| Items 63b and 65b | - 340 | |
| Item 76 | - 260 | |
| Item 99 | | + 100 |
| Items 24b and 26b | - 20 | |
| Item 100 | | + 16 |
| Items 30b and 31b | - 30 | |
| Item 101 | | + 40 |
| Items 53b and 55b | - 80 | |
| Item 58 | | + 180 |
| Item 102 | | + 160 |
| Item 103 | | + 400 |
| Item 104 | | + 300 |
| Item 84 | - 8000 | |
| Total | - 9010 | + 2168 |

Current Traffic D-E . . . . . . . . . . . 5118

E-F - 1959 ADT = 11,960

| | | |
|---|---|---|
| Item 36b | - 150 | |
| Item 39 | | + 240 |
| Item 105 | | + 180 |
| Items 1b and 6b | - 10 | |

E-F (Cont.)

| | | | |
|---|---|---|---|
| | Item 106 | | + 14 |
| | Item 107 | | + 24 |
| | Items 41b and 46b | - 60 | |
| | Item 49 | | + 280 |
| | Item 108 | | + 140 |
| | Items 8b, 13a, and 13b | - 36 | |
| | Item 11 | | + 10 |
| 109. | Diverted from Y and West of Y East on E, South on R | | + 14 |
| | Item 16 | | + 10 |
| | Items 17 and 19 | - 20 | |
| | Item 98 | | + 20 |
| | Items 63b and 65b | - 340 | |
| | Item 76 | - 260 | |
| | Item 99 | | + 100 |
| | Items 24b and 26b | - 20 | |
| | Item 100 | | + 16 |
| | Items 30b and 31b | - 30 | |
| | Item 101 | | + 40 |
| | Items 53b and 55b | - 80 | |
| | Item 58 | | + 180 |
| | Item 102 | | + 160 |
| | Item 103 | | + 400 |
| | Item 104 | | + 300 |
| | Item 84 | - 8000 | |
| | Total | - 9006 | + 2128 |

Current Traffic E-F . . . . . . . . . . . 5082

F-W - 1959 ADT = 12,000

| | | | |
|---|---|---|---|
| | Item 36b | - 150 | |
| | Item 39 | | + 240 |
| | Item 105 | | + 180 |
| | Items 1b and 6b | - 10 | |
| | Item 106 | | + 14 |
| | Item 107 | | + 24 |
| | Item 41b and 46b | - 60 | |
| | Item 49 | | + 280 |
| | Item 108 | | + 140 |
| | Items 8b, 13a, and 13b | - 36 | |
| | Item 11 | | + 10 |
| | Item 109 | | + 14 |
| | Items 15a, 15b, 20a, and 20b | - 60 | |
| | Items 18 and 21 | | + 90 |
| 110. | Diverted from Y and West of Y, East on F, South on R | | + 24 |
| | Items 63b and 65b | - 340 | |
| | Item 76 | - 260 | |
| | Item 99 | | + 100 |
| | Items 24b and 26b | - 20 | |

F-W (Cont.)

| | | |
|---|---|---|
| Item 100 | | + 16 |
| Items 30b and 31b | - 30 | |
| Item 101 | | + 40 |
| Items 53b and 55b | - 80 | |
| Item 58 | | + 180 |
| Item 102 | | + 160 |
| Item 103 | | + 400 |
| Item 104 | | + 300 |
| Item 84 | - 8000 | |
| Total | - 9046 | + 2212 |

Current Traffic F-W . . . . . . . . . . . 5166

W-G - 1959 ADT = 14,000

| | | |
|---|---|---|
| Item 36b | - 150 | |
| Item 39 | | + 240 |
| Item 105 | | + 180 |
| Items 1b and 6b | - 10 | |
| Item 106 | | + 14 |
| Item 107 | | + 24 |
| Items 41b and 46b | - 60 | |
| Item 49 | | + 280 |
| Item 108 | | + 140 |
| Items 8b and 13b | - 20 | |
| Item 109 | | + 14 |
| Items 15b and 20b | - 30 | |
| Item 110 | | + 24 |
| Items 61b and 66b | - 1100 | |
| Item 75 | - 300 | |
| 111. Diverted from Y and West of Y, East on W, South on R | | + 120 |
| Items 24a, 24b, 26a and 26b | - 40 | |
| Items 23, 25 and 28 | | + 80 |
| Item 100 | | + 16 |
| Items 30a, 30b, 31a and 31b | - 60 | |
| Item 101 | | + 40 |
| Items 53b and 55b | - 80 | |
| Item 58 | | + 180 |
| Item 102 | | + 160 |
| Item 103 | | + 400 |
| Item 104 | | + 300 |
| Item 84 | - 8000 | |
| Total | - 9850 | + 2212 |

Current Traffic W-G . . . . . . . . . . . 6362

G-H - 1959 ADT = 14,000

| | | |
|---|---|---|
| Item 36b | - 150 | |
| Item 39 | | + 240 |
| Item 105 | | + 180 |
| Items 1b and 6b | - 10 | |
| Item 106 | | + 14 |
| Item 107 | | + 24 |
| Items 41b and 46b | - 60 | |
| Item 49 | | + 280 |
| Item 108 | | + 140 |
| Items 8b and 13b | - 20 | |
| Item 109 | | + 14 |
| Items 15b and 20b | - 30 | |
| Item 110 | | + 24 |
| Items 61b and 66b | - 1100 | |
| Item 75 | - 300 | |
| Item 111 | | + 120 |
| Items 22 and 27 | - 40 | |
| 112. Diverted from Y and West of Y, East on G, South on R | | + 18 |
| Items 30a, 30b, 31a, and 31b | - 60 | |
| Item 101 | | + 40 |
| Items 53b and 55b | - 80 | |
| Item 58 | | + 180 |
| Item 102 | | + 160 |
| Item 103 | | + 400 |
| Item 104 | | + 300 |
| Item 84 | - 8000 | |
| Total | - 9850 | + 2134 |

Current Traffic G-H . . . . . . . . . . . 6284

H-J - 1959 ADT = 14,100

| | | |
|---|---|---|
| Item 36b | - 150 | |
| Item 39 | | + 240 |
| Item 105 | | + 180 |
| Items 1b and 6b | - 10 | |
| Item 106 | | + 14 |
| Item 107 | | + 24 |
| Items 41b and 46b | - 60 | |
| Item 49 | | + 280 |
| Item 108 | | + 140 |
| Items 8b and 13b | - 20 | |
| Item 109 | | + 14 |
| Items 15b and 20b | - 30 | |
| Item 110 | | + 24 |
| Items 61b and 66b | - 1100 | |
| Item 75 | - 300 | |
| Item 111 | | + 120 |
| Items 22 and 27 | - 40 | |

H-J (Cont.)

| | | |
|---|---|---|
| Item 112 | | + 18 |
| Items 29 and 32 | - 40 | |
| Item 101 | | + 40 |
| Items 53b and 55b | - 80 | |
| Item 58 | | + 180 |
| Item 102 | | + 160 |
| Item 103 | | + 400 |
| Item 104 | | + 300 |
| Item 84 | - 8000 | |
| Total | - 9830 | + 2134 |

Current Traffic H-J . . . . . . . . . . . 6404

J-K - 1959 ADT = 14,060

| | | | |
|---|---|---|---|
| | Item 36b | - 150 | |
| | Item 39 | | + 240 |
| | Item 105 | | + 180 |
| | Items 1b and 6b | - 10 | |
| | Item 106 | | + 14 |
| | Item 107 | | + 24 |
| | Items 41b and 46b | - 60 | |
| | Item 49 | | + 280 |
| | Item 108 | | + 140 |
| | Items 8b and 13b | - 20 | |
| | Item 109 | | + 14 |
| | Items 15b and 20b | - 30 | |
| | Item 110 | | + 24 |
| | Items 61b and 66b | - 1100 | |
| | Item 75 | - 300 | |
| | Item 111 | | + 120 |
| | Items 22 and 27 | - 40 | |
| | Item 112 | | + 18 |
| | Items 29 and 32 | - 40 | |
| 113. | Diverted from Y and West of Y, East on J, South on R | | + 50 |
| | Items 53b and 55b | - 80 | |
| | Item 58 | | + 180 |
| | Item 102 | | + 160 |
| | Item 103 | | + 400 |
| | Item 104 | | + 300 |
| | Item 84 | - 8000 | |
| | Total | - 9830 | + 2144 |

Current Traffic J-K . . . . . . . . . . . 6374

South of K - 1959 ADT = 14,000

| | | |
|---|---|---|
| Item 36b | - 150 | |
| Item 39 | | + 240 |
| Item 105 | | + 180 |
| Items 1b and 6b | - 10 | |
| Item 106 | | + 14 |
| Item 107 | | + 24 |
| Items 41b and 46b | - 60 | |
| Item 49 | | + 280 |
| Item 108 | | + 140 |
| Items 8b and 13b | - 20 | |
| Item 109 | | + 14 |
| Items 15b and 20b | - 30 | |
| Item 110 | | + 24 |
| Items 61b and 66b | - 1100 | |
| Item 75 | - 300 | |
| Item 111 | | + 120 |
| Item 112 | | + 18 |
| Item 113 | | + 50 |
| Item 59 | | + 220 |
| 114. Diverted from Y and West of Y, East on K, South on R | | + 200 |
| Item 103 | | + 400 |
| Item 104 | | + 300 |
| Item 84 | - 8000 | |
| Total | - 9670 | + 2224 |

Current Traffic South of K . . . . . . . . . 6554

# Appendix C

## Definition of Terms and Abbreviations

# DEFINITIONS OF TERMS AND ABBREVIATIONS

These definitions have in the most part been taken from AASHO, "A POLICY ON GEOMETRIC DESIGN OF RURAL HIGHWAYS". The definitions (from the above report) have been added to and slightly reworded for clarity as used in this manual.

AVERAGE DAILY TRAFFIC = ADT,--The average 24-hour volume, being the total volume during a stated period divided by the number of days in that period. Unless otherwise stated, the period is a year.

ADJUSTED AVERAGE DAILY TRAFFIC,--Five times the Average Weekday plus the average Saturday plus the average Sunday, divided by seven.

COMMERCIAL TRAFFIC,--Composed of all single unit trucks with dual rear tires, tractor-semitrailer combinations, combinations involving full trailers and busses. (Does not include pickups and light panel trucks.)

CORRIDOR,--The general strip of terrain through which a new or improved highway is to pass. (May vary in width from several hundred feet to several miles.)

CURRENT TRAFFIC,--The volume of existing or diverted traffic that would use a new or improved traffic facility if it were open to traffic at this time.

DESIGN HOUR VOLUME = DHV,--An hourly volume determined for use in design, representing the traffic expected to use the highway. Usually 30th high hour for a period 20 years in the future.

DEVELOPMENT TRAFFIC,--Traffic that is due to improvements on adjacent land over and above the development which would have taken place had not the new or improved highway been constructed.

DIVERTED TRAFFIC,--Traffic that will be diverted from parallel routes to the new facility due to its design. Where road closures are involved at a limited access facility, traffic will be diverted to the cross roads that remain open.

EXISTING OR PRESENT TRAFFIC,--Traffic on the roads and streets as of the year the traffic estimate is made.

FUTURE TRAFFIC,--Estimated traffic that will be using a highway during the design year. Usually 20 years in the future.

GENERATED TRAFFIC,--Generated traffic consists of motor vehicle trips (other than by public transit) that would not have been made if the new facility had not been provided.

GRADE SEPARATION,--A crossing of two highways at different levels, with no provision for turning movements.

INTERCHANGE,--A crossing of two highways at different levels, with turning roadways between all intersection legs. (See Partial Interchange).

LIMITED ACCESS HIGHWAY,--A highway on which all ingress and egress takes place on legally specified free flowing ramps. (Ramps are not necessarily free flowing on the cross road.)

MERGING TRAFFIC,--The converging of separate streams of traffic into a single stream without compulsary stops.

NORMAL TRAFFIC GROWTH,--The increase in traffic volumes due to general increase in number and usage of motor vehicles.

PARTIAL INTERCHANGE,--An interchange with turning roadways not provided between some intersection legs.

POSSIBLE CAPACITY,--The maximum number of vehicles that can pass a given point on a lane or roadway during one hour. (As traffic density increases above that at possible capacity, a sharp reduction in traffic volume results.)

RAMP,--A roadway for traffic to enter or leave a highway either at an interchange or at some point where no crossing of the highway is allowed.

ROAD SYSTEMS,--As used for the United States, Department of Commerce, Bureau of Public Roads.

Interstate - Rural - 01 = F.A.I.
Interstate - Urban - 02 = F.A.I.
Federal Aid Primary - Rural - 03 = F.A.P.
Federal Aid Primary - Urban - 04 = F.A.P.
Federal Aid Secondary (State jurisdiction) - Rural - 05 = F.A.S
Federal Aid Secondary (State jurisdiction) - Urban - 06 = F.A.S.
Federal Aid Secondary (County jurisdiction) - Rural - 07 = F.A.S.
Federal Aid Secondary (County jurisdiction) - Urban - 08 = F.A.S.
Other State Highways - Rural - 09
Other State Highways - Urban - 10
Other Local Roads - Rural - 11
Other City Streets - Urban - 12

THIRTIETH HIGHEST HOURLY = 30th high hour = 30HV,--The hourly volume that is exceeded by 29 hourly volumes during a designated year. (Corresponding definitions apply to any other ordinal highest hourly volume, as fiftieth, eightieth etc.)

TRAFFIC DENSITY,--The number of vehicles per mile on the traveled way at a given instant.

TRAFFIC ESTIMATE,--The present and expected future traffic on a new or improved highway and on all roads crossing the main highway. The future traffic to consist of DHV, commercial traffic and average daily traffic for a year usually 20 years hence.

TRAFFIC PATTERN,--The relationship of daily and monthly traffic volume distribution to Average Daily Traffic on a road or group of roads.

TRAFFIC PROJECTION FACTOR,--The relationship of estimated future traffic to the present traffic on and in the vicinity of a new or improved highway. (Not used as such for a final traffic estimate.)

TRUNKLINE SYSTEM,--All Interstate, US and M numbered highways in the State.

TURNING MOVEMENT,--The volume of traffic making each movement at an intersection or interchange during a designated period of time.

VEHICLES PER DAY = VPD,--Actual vehicles counted or a component part of either vehicles counted or ADT.

VOLUME,--The number of vehicles passing a given point during a specified period of time.

WEAVING TRAFFIC,--The crossing of traffic streams moving in the same general direction accomplished by merging and diverging.