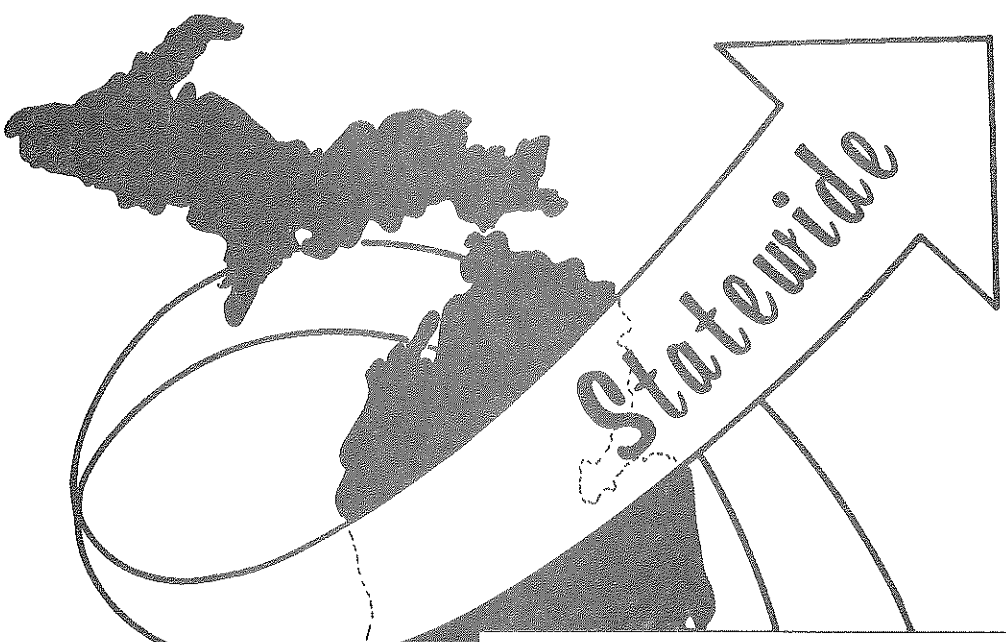
Statewide Transportation Analysis & Research

MICHIGAN'S STATEWIDE
TRANSPORTATION MODELING SYSTEM

VOLUME XVII

**STATEWIDE INTERMODAL
IMPACT ANALYSIS –
TRUCK AND RAIL**

STATEWIDE TRANSPORTATION
PLANNING PROCEDURES



MICHIGAN DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

MICHIGAN DEPARTMENT

OF

STATE HIGHWAYS AND TRANSPORTATION

BUREAU OF TRANSPORTATION PLANNING

MICHIGAN'S STATEWIDE
TRANSPORTATION MODELING SYSTEM

VOLUME XVII

STATEWIDE INTERMODAL IMPACT ANALYSIS – TRUCK AND RAIL

STATEWIDE TRANSPORTATION
PLANNING PROCEDURES

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, GOVERNOR

DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

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JOHN P. WOODFORD, DIRECTOR

February 3, 1976

Mr. Sam F. Cryderman, Deputy Director
Bureau of Transportation Planning
Michigan Department of State Highways
and Transportation
P.O. Drawer K
Lansing, Michigan 48904

Dear Mr. Cryderman:

The Highway Planning Division is pleased to present Volume XVII in the Statewide Transportation Modeling System Series entitled "Statewide Intermodal Impact Analysis - Truck and Railroad". This report documents a process for analyzing the impacts which railroads and highways may have upon each other. The procedure depends upon the existing Statewide Transportation Model and upon railroad traffic information recently obtained.

Because of recent Federal legislation and renewed public involvement, particularly concerning other transportation modes and environmental impacts, it has become imperative to develop efficient methods of providing answers to intermodal problems. Before any transportation decision can be finalized, it must be shown that the decision is the best solution, among all possible modes, to the problem being studied. The effects the decision may have upon every other mode must be determined and carefully considered. The process described in this report should aid transportation planners in analyzing the possible intermodal impacts of highway planning upon the railroad system. It will also help determine the possible effects rail planning may have upon highway sufficiencies.

The process described in this report by Miss Joyce Newell was developed by the Statewide Transportation Planning Procedures Section, managed by Mr. Richard E. Esch.

Sincerely,

R. J. Lilly

R. J. Lilly, Administrator
Highway Planning Division

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"STATEWIDE INTERMODAL IMPACT ANALYSIS – TRUCK AND RAIL"

by

Joyce A. Newell

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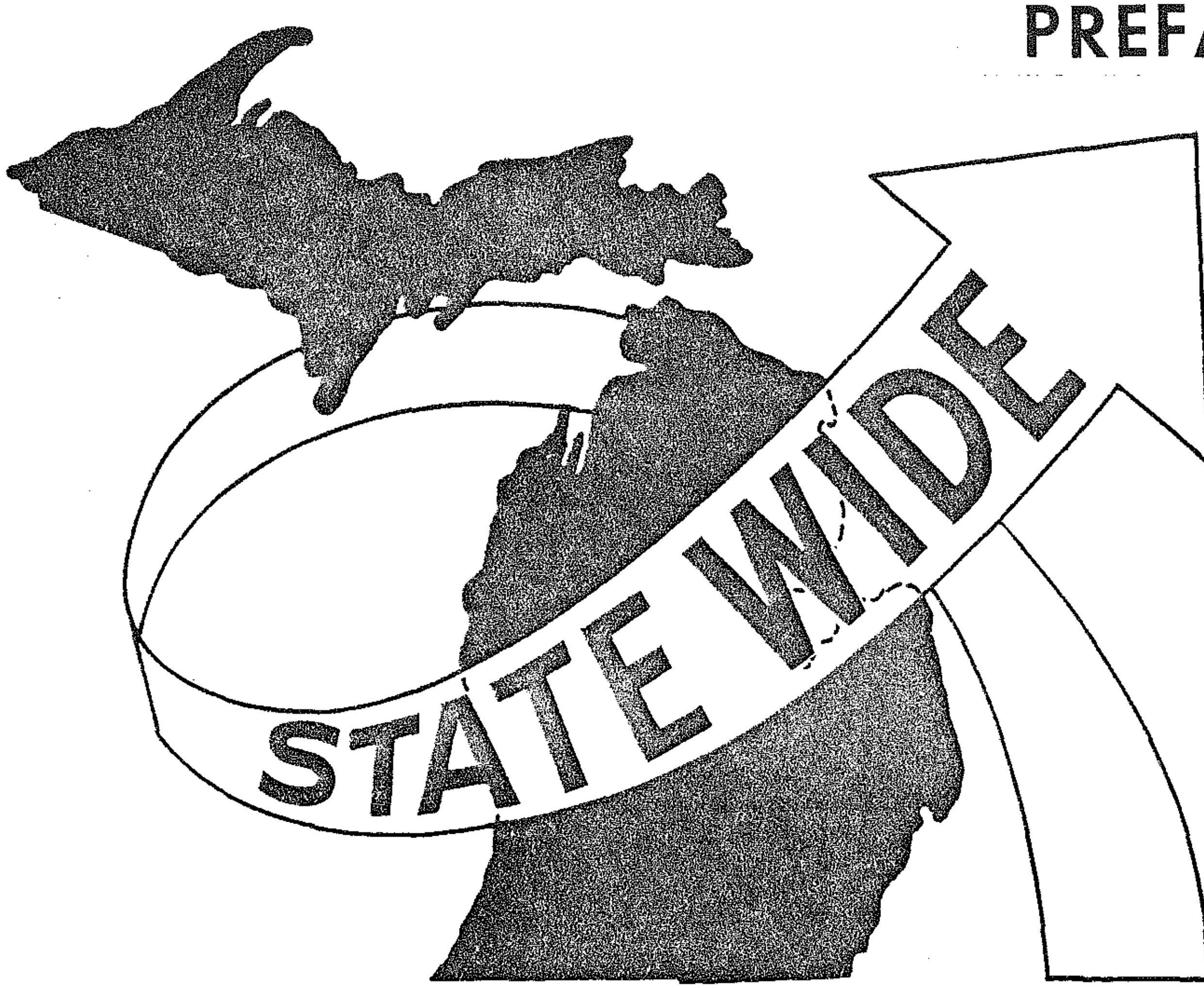

PREFACE

Recent emphasis in today's society has caused transportation planners to begin critically exploring the environmental, economic, and social impacts of highway development. The increased interest has made it necessary to devise methods for estimating such impacts. Once such impacts have been estimated, it is also important to show that all other alternatives, including the possible utilization of other modes, will not provide the same benefits with decreased adverse effects. This fact is especially evident when studying the Section 109(h) Guidelines of Title 23, United States Code, added to the code by Section 136(b) of the Federal-Aid Highway Act of 1970. These guidelines in part:

> ". . . call on Highway Agencies to adopt procedures and assign responsibilities to insure early identification of potential social, economic, and environmental effects, both beneficial and adverse. The Action Plan is to cover consideration of alternative courses of action, including the option of no highway improvement and, where appropriate, alternative scales of highway improvement and reliance upon other transportation modes."

It is in response to this growing concern that a method was devised to enable transportation planners to begin to estimate the intermodal impacts between railroad and truck travel. What would be the consequences of abandoning rail service in an area versus greatly improving the existing service? Would highway construction be necessary, given improved rail service? Would planned construction be sufficient if rail service were terminated? It is now possible to quickly, systematically make such comparisons using the existing statewide transportation modeling system analysis battery. This report will describe the intermodal analysis methods available and demonstrate their actual application in one of Michigan's Highway Planning Regions.

Reports describing the statewide transportation analysis battery are listed on the following page and are available from the Statewide Transportation Planning Procedures Section of the Michigan Department of State Highways and Transportation, Lansing, Michigan.

STATEWIDE TRAVEL MODELING SERIES

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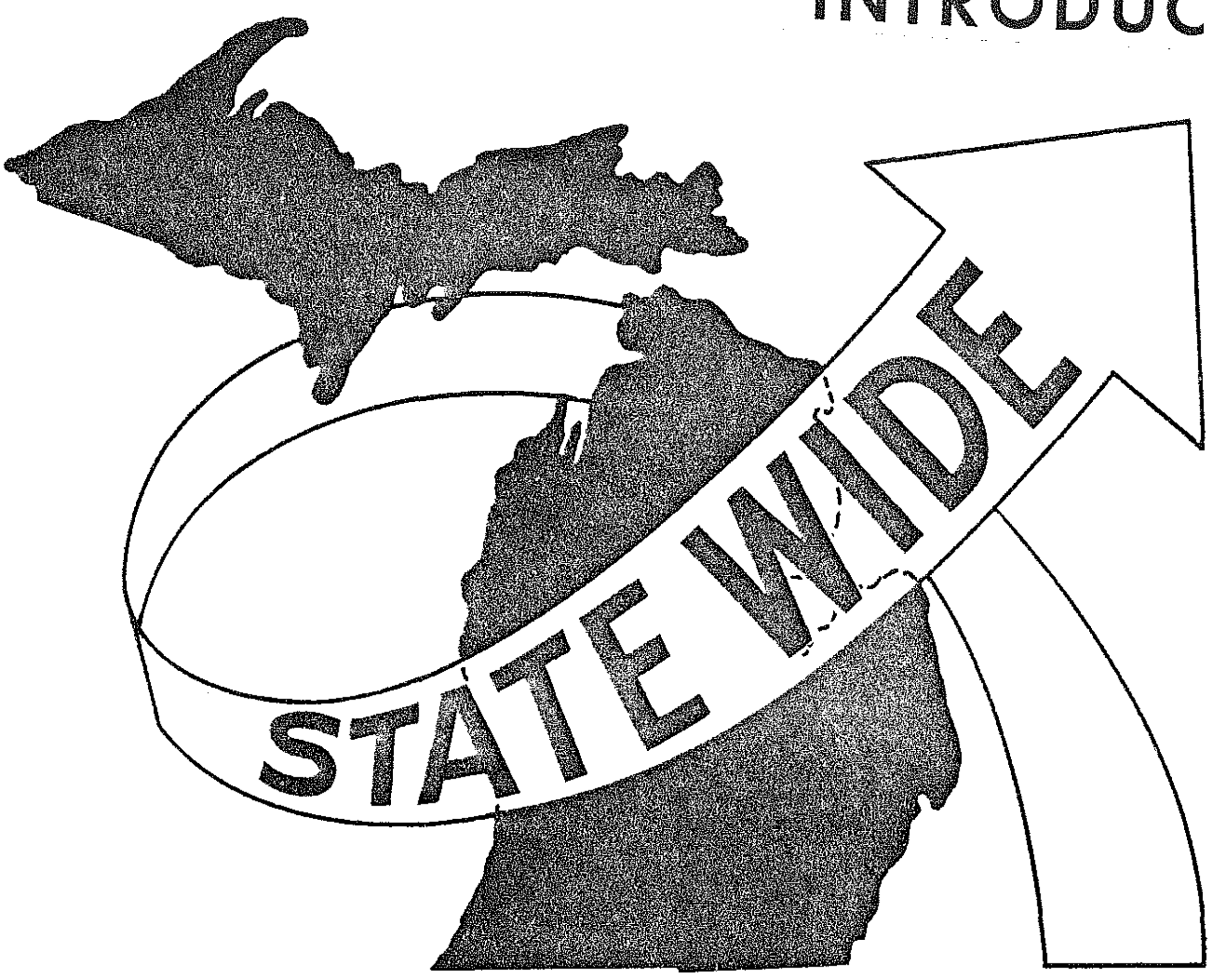
INTRODUCTION



INTRODUCTION

The recent acquisition of several railroad waybill tapes has provided the key to many new transportation impact analysis procedures. The waybill tapes provide origin and destination commodity flow data by station for Michigan railroad companies. This data includes carloads, tons, revenue, short-line miles, and commodity types. The 1973 100% Penn Central and Ann Arbor waybill tapes, as well as the 1973 1% sample for Michigan railroads waybill tape, have thus far been processed and the commodity flow matrices are available in Reports XIV-A, B, and C - Commodity Flow Matrices. Others will soon be forthcoming. These matrices are based upon the 547 Michigan zone system, Figures 1 and 2. It is now also possible to build such matrices on a station-to-station level. These matrices, together with the rail network shown in Figure 3 can prove extremely useful when studying intermodal travel in Michigan.. For development of rail network, see XIII - Michigan Goes Multi-Modal. However, for the rail versus truck analysis process, only the highway network and the 547 zone commodity flow matrices are needed. The process simply consists of exploring the effects of two extremes:

a) Assume rail service to be so improved that all commodities now moved by truck will be moved by railroad, i.e., remove all truck traffic from the highway system.

b) Assume that rail service in a region is to be entirely abandoned and transfer the commodities presently moving by rail onto trucks traveling the highway system.

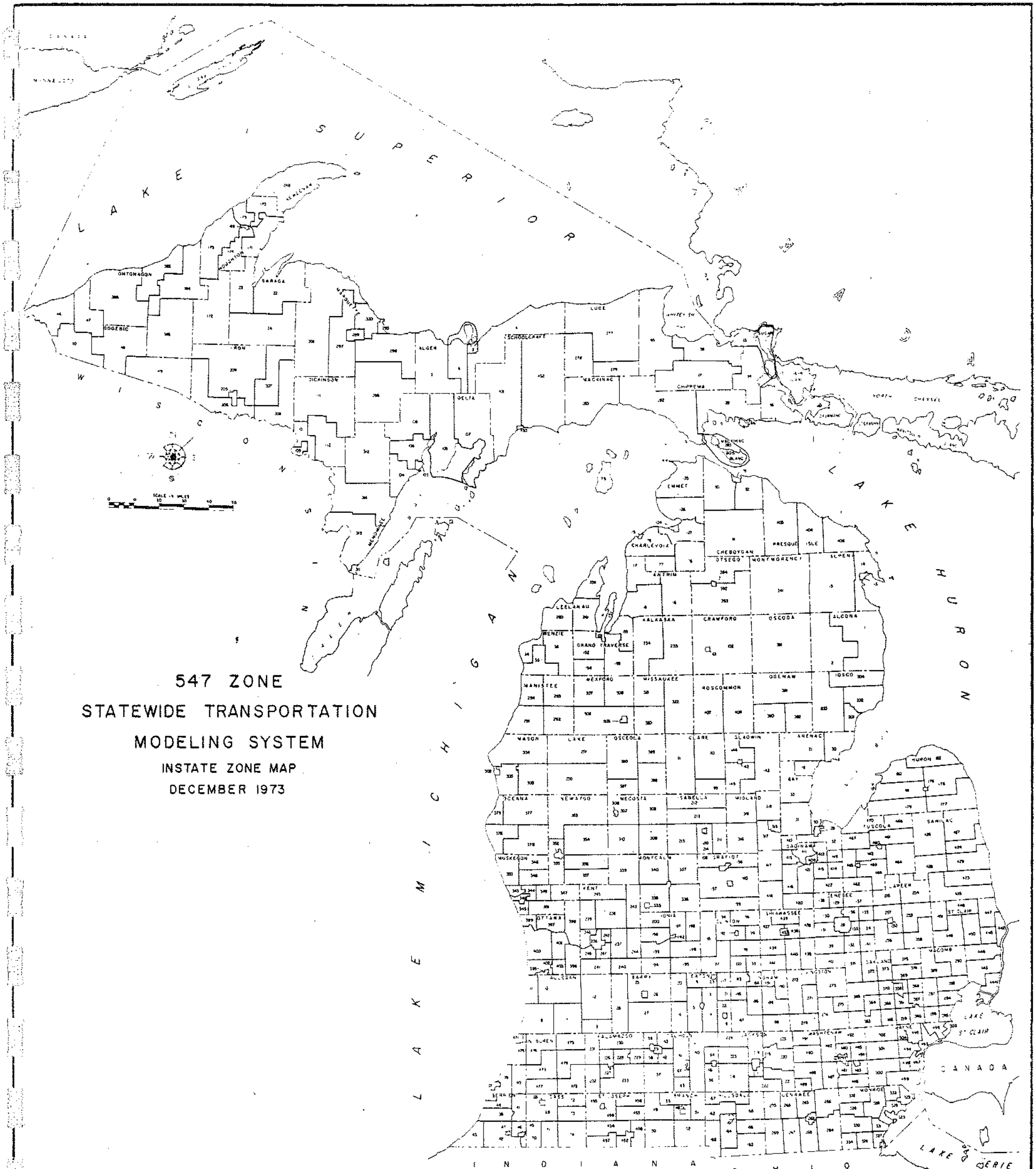
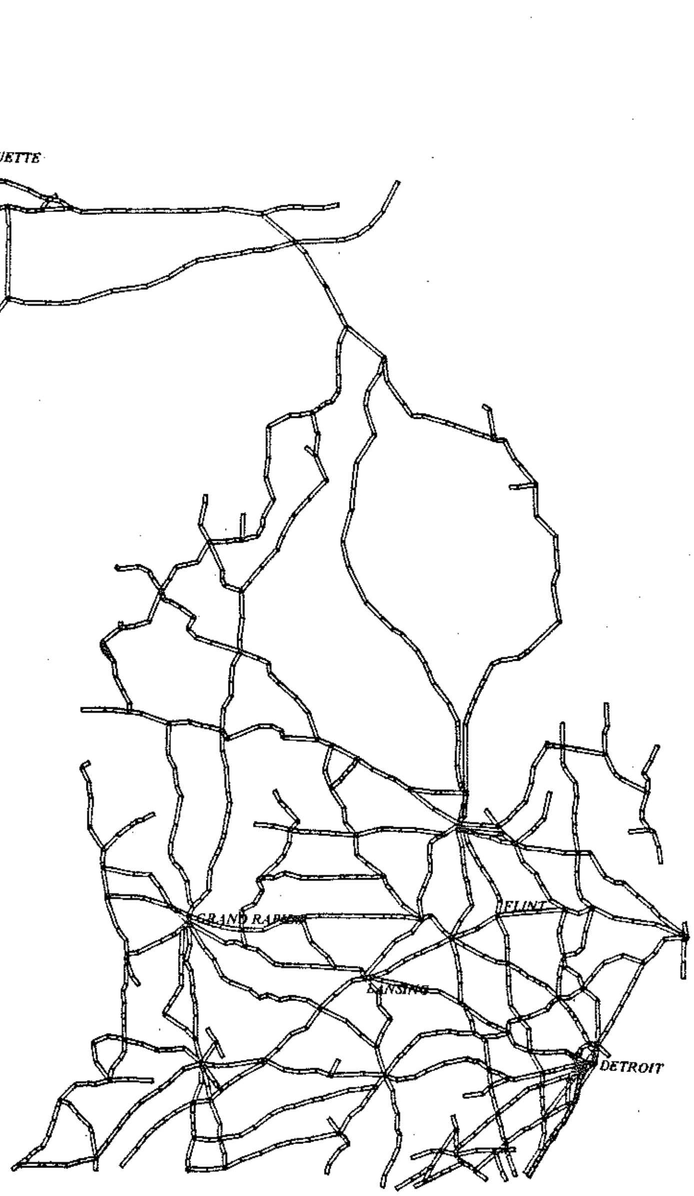

547 ZONE
STATEWIDE TRANSPORTATION
MODELING SYSTEM
INSTATE ZONE MAP
DECEMBER 1973
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
WISCONSIN
INDIANA
OHIO
CANADA
LAKE ERIE

FIGURE 1

MICHIGAN'S TRANSPORTATION MODELING SYSTEM

547 ZONE
OUTSTATE ANALYSIS ZONES

FIGURE 2

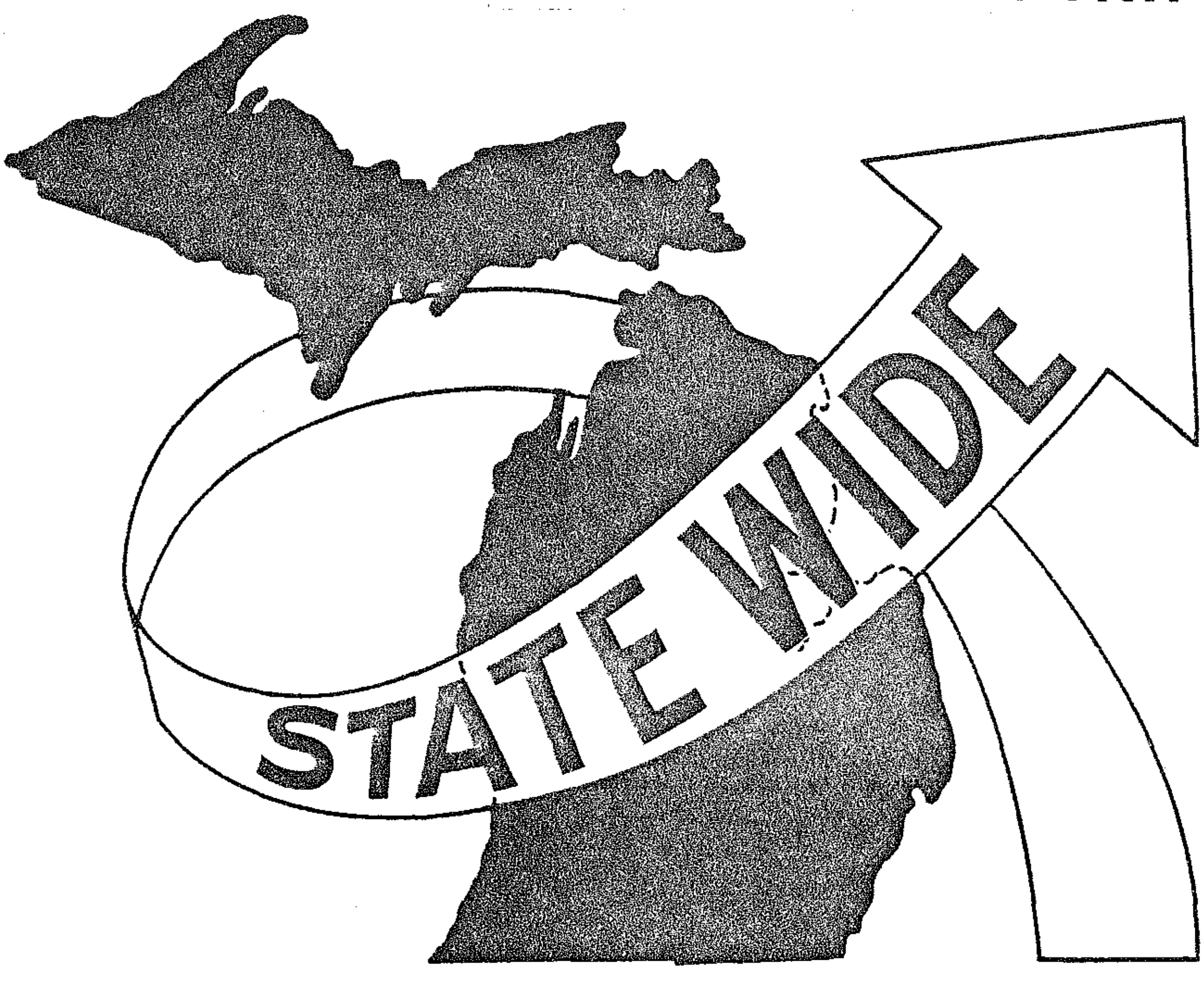


Rail Network

FIGURE 3

These two extremes can then be compared to the present traffic mix of cars and trucks and general conclusions reached. If significant changes occur, it may be difficult to justify planning highways independently from rail and other modes. If such a mass transfer of goods from rail to truck and vice-versa cause no significant changes in highway volumes, highway and railroad planning may safely proceed independently of each other, since both the "best" and "worst" possible extremes of rail service will not seriously affect the highway traffic.

PROCESS DESCRIPTION



PROCESS DESCRIPTION

Converting commodities from rail to truck and vice-versa may well affect highway deficiencies. Evaluating the possible effects requires studying three possible travel patterns:

1) the current highway and railroad travel patterns;

2) the pattern created by moving all truck travel to railroads; and

3) the pattern created by shifting all rail traffic to the highway system.

This process will allow transportation planners to determine if the demand for highway facilities is significantly increased or decreased by comparing the most extreme possibilities.

Two difficulties arise when attempting such an analysis. First, some measure should be derived to reflect the fact that trucks contribute more to highway congestion than automobiles. Secondly, railroad carloads must be converted to equivalent truckloads using a reasonable conversion factor. Following is a description of how these two factors were derived for the Northwest Regional Transportation Study.

<u>Trucks to Equivalent Passenger Cars</u>

The Ten County Region has a total of 785 trunkline miles. Of these, 97 are level, and 688 are rolling according to sufficiency ratings.

Using conversion factors from the Highway Capacity Manual, page 304, 1 truck = 2.5 cars on level terrain in areas of Level of Service B and C. Also, 1 truck = 5 cars on rolling terrain in areas of levels of service B and C as seen in Table 1.

Most of the level sections of trunkline were on US-131 as shown in Figure 4. According to Figure 5, where level of Service A is indicated by a single line, level of service B by two lines, etc., US-131 operated at level of service B on its level sections. Therefore, a factor of 2.5 was used for these sections. On all remaining sections, a factor of 5 was used, since the Capacity Manual calls for this factor for levels of service B, C, D, and E, at which all the rolling sections operated as seen in Figure 5.

Computations were then as follows:

97 (level miles) x 2.5 (truck factor) = 242.5

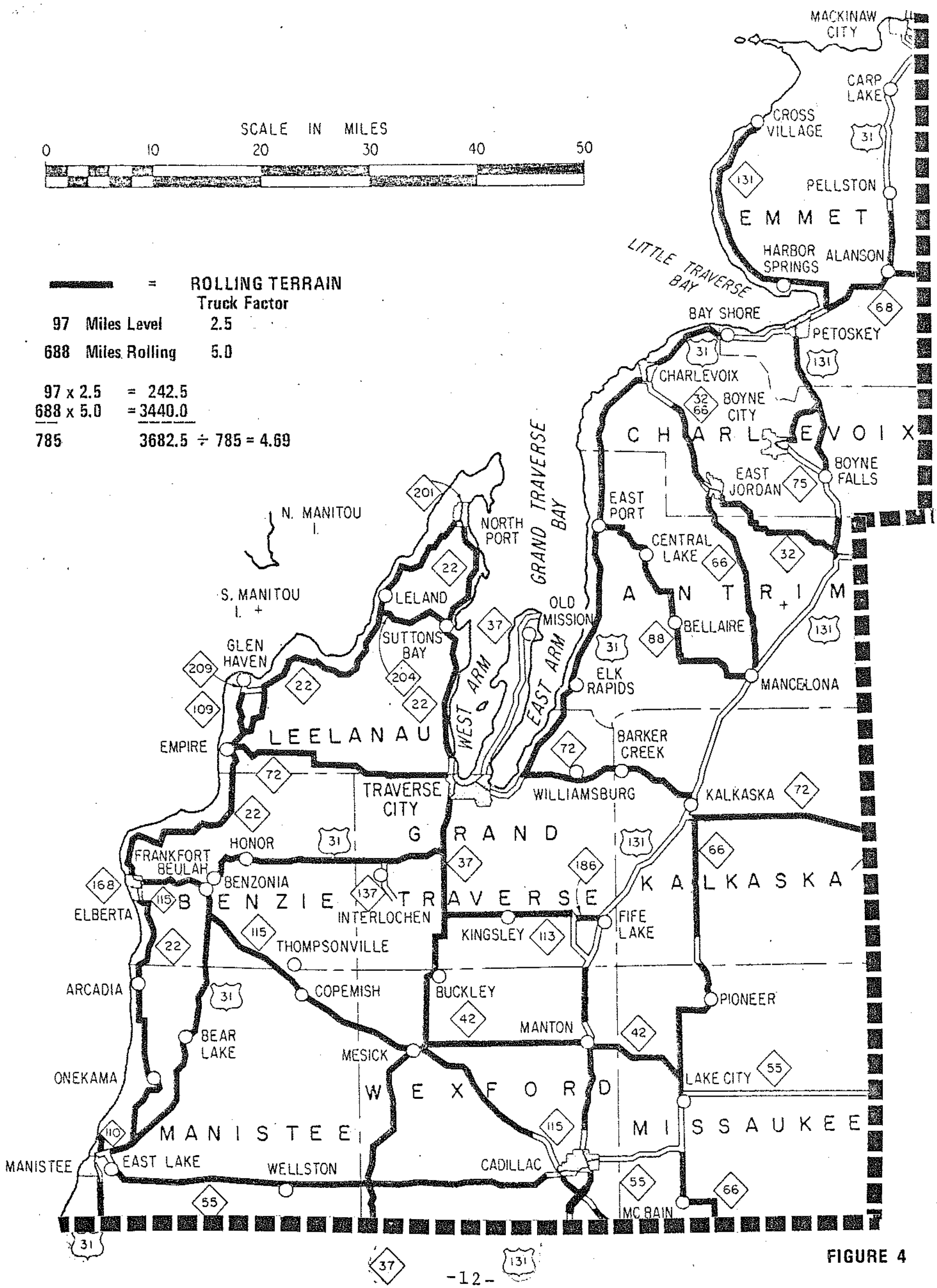
688 (rolling miles) x 5.0 (truck factor) = 3440.0

242.5 + 3440.0 = 3682.5 ÷ 785 (total miles) = 4.69 (truck factor

It should be noted that the levels of service derived from these factors will likely reflect somewhat more congestion than will actually occur. This is explained by the fact that levels of service are computed by using DHV in the V/C ratio. Design Hour Volumes (DHV) are the peak periods of traffic operation and trucks do not normally travel during these times but rather during the "off" periods. Therefore, a conversion factor of something less than 4.69 should probably be used to calculate the additional congestion caused by truck traffic. Unfortunately, such a figure is not available so it should be realized that a more realistic situation lies somewhere between the level of service with all vehicles considered as passenger cars and the level of service with truck volumes converted to cars.

TABLE 1 — AVERAGE GENERALIZED PASSENGER CAR EQUIVALENTS OF TRUCKS AND BUSES ON TWO-LANE HIGHWAYS, OVER EXTENDED SECTION LENGTHS (INCLUDING UPGRADES, DOWNGRADES, AND LEVEL SUBSECTIONS)

EQUIVALENT	LEVEL OF SERVICE	EQUIVALENT, FOR:		
		LEVEL TERRAIN	ROLLING TERRAIN	MOUNTAINOUS TERRAIN
Er, for trucks	A	3	4	7
	B and C	2.5	5	10
	D and E	2	5	12



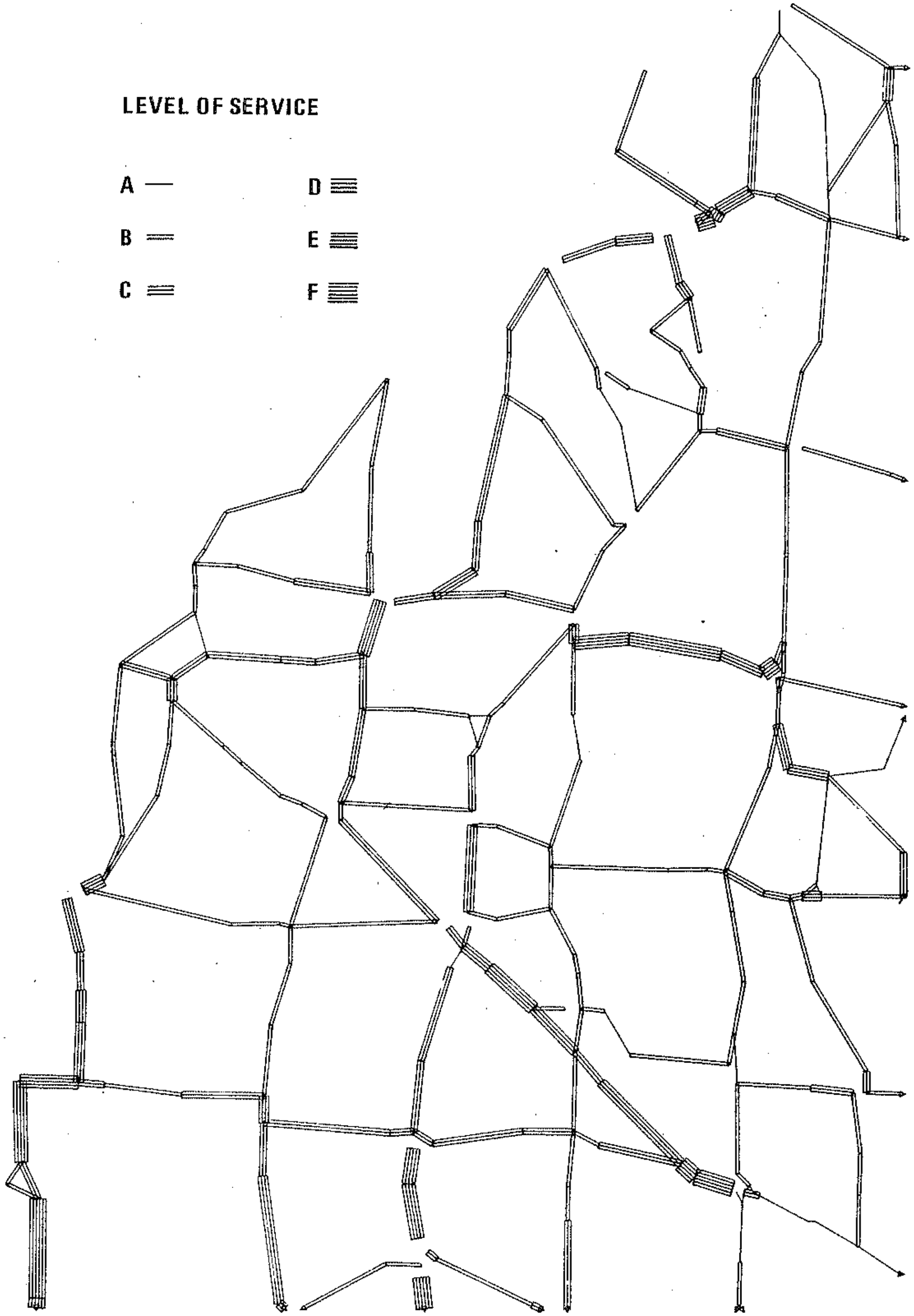
= **ROLLING TERRAIN**

		Truck Factor
97	Miles Level	2.5
688	Miles Rolling	5.0

97 x 2.5 = 242.5
688 x 5.0 = 3440.0

785 3682.5 ÷ 785 = 4.69

FIGURE 4



ALT 70 NORTHWEST REGION
ALTERNATE HWY PLAN
FUTURE DHV, AADT
LEVEL OF SERVICE
*
STATEWIDE TRANSPORTATION MODELING SYSTEM
*

NETWORK TAPE WAS CREATED OR UPDATED 10AU000
PREPLOT TAPE IS QT01P00/ALTPRE
DIR = 3.
SCA = 0.30
MINXP = 170.00
MAXXP = 210.00
MINYP = 150.00
MAXYP = 206.00
FIELD = 1.
MINV = 1.
MAXV = 999999
BAND1 = 1 TO 1
BAND2 = 2 TO 2
BAND3 = 3 TO 3
BAND4 = 4 TO 4
BAND5 = 5 TO 5
BAND6 = 6 TO 6
VOL(22) = TRUE

FIGURE 5

For future use, it should be possible to automate the process by developing a table based upon sight restrictions and level of service, both available from the statewide highway network, to produce an equivalence factor for each highway link. This would increase the accuracy of the process, particularly in non-homogeneous areas. At present, any regional factor produced will yield acceptable results only in that region and any other state planning region with the same terrain and level of service characteristics.

Railroad Carloads to Equivalent Truckloads

This conversion factor was derived through the cooperative efforts of personnel in the North Section, Multi-Regional Planning Division and the Rail Section, Multi-Modal Planning Division.

Step 1: Determination of the average number of tons that were carried by a freight car in 1972.

a) Source of data

Yearbook of Railroad Facts, 1975. Association of American Railroads, Economics and Finance Department, Washington, D. C. Table: Average Weight of a Carload of Freight.

b) Procedure

The needed information was provided directly in the Yearbook in the table "Average Weight of a Carload of Freight". According to the Yearbook the average number of tons carried by a freight car in the United States in 1972 was found to be 56.3.

Step 2: Determination of the average number of tons carried by an intercity truck in 1972.

a) Source of data

Freight Commodity Statistics of Class I Motor Carriers of Property Operating in Intercity Service - Common and Contract - in the United States, Calendar Year 1972. Interstate Commerce Commission, Bureau of Accounts, Washington, D. C. Table: United States Totals of Freight Traffic by Truckloads and Tons - less containers, trailers and semi-trailers returned empty.

b) Procedure

Two categories of information were used:

(1) Total number of truckloads carried in the United States in 1972.

(2) Total number of tons of freight carried in the United States in 1972.

An average was obtained by dividing the total number of tons carried by the total number of truckloads that were moved. The average number of tons carried by a truck in 1972 was found to be:

$$\frac{387,112,215}{21,100,501} = 18.34$$

Step 3: Determination of the rail - truck conversion factor

Having determined average tonnage for a rail freight car and average tonnage for an intercity truck, it was then possible to obtain a generalized conversion factor. This was done by dividing the average rail tonnage figure by the average truck tonnage figure:

$$\frac{56.3}{18.3} = 3.1$$

> This figure indicates that the average tonnnage carried by a rail freight car is 3.1 times that carried by truck, or that on the average it takes 3.1 trucks to carry the tonnage that can be carried by one rail freight car.

Before analyzing the two extreme cases of a) no rail service or b) such improved service that trucks are virtually eliminated, one should analyze the present traffic conditions. Such an analysis can serve as a comparison base. The statewide transportation modeling system is used to analyze present traffic patterns. The commercial percent, included in the highway network by link, was used to help calculate the number of trucks on each section of highway. The trucks were then converted to equivalent cars using the truck to car factor described earlier. Thus, the present highway volumes in "passenger car units" is obtained.

The effect of removing all trucks from the highways is now easily determined by subtracting the number of trucks per link, calculated in the preceding paragraph, from the total traffic on the links.

Diverting all rail traffic onto the highway system can be accomplished by:

1) loading the 547 zone rail commodity flow matrix onto the highway network;

2) multiplying the number of rail cars per link by the rail carload to truckload factor of 3.1 to obtain the number of additional trucks per link;

3) multiplying the number of additional trucks per link by the truck to car conversion factor of 4.69 for the Northwest Region; and

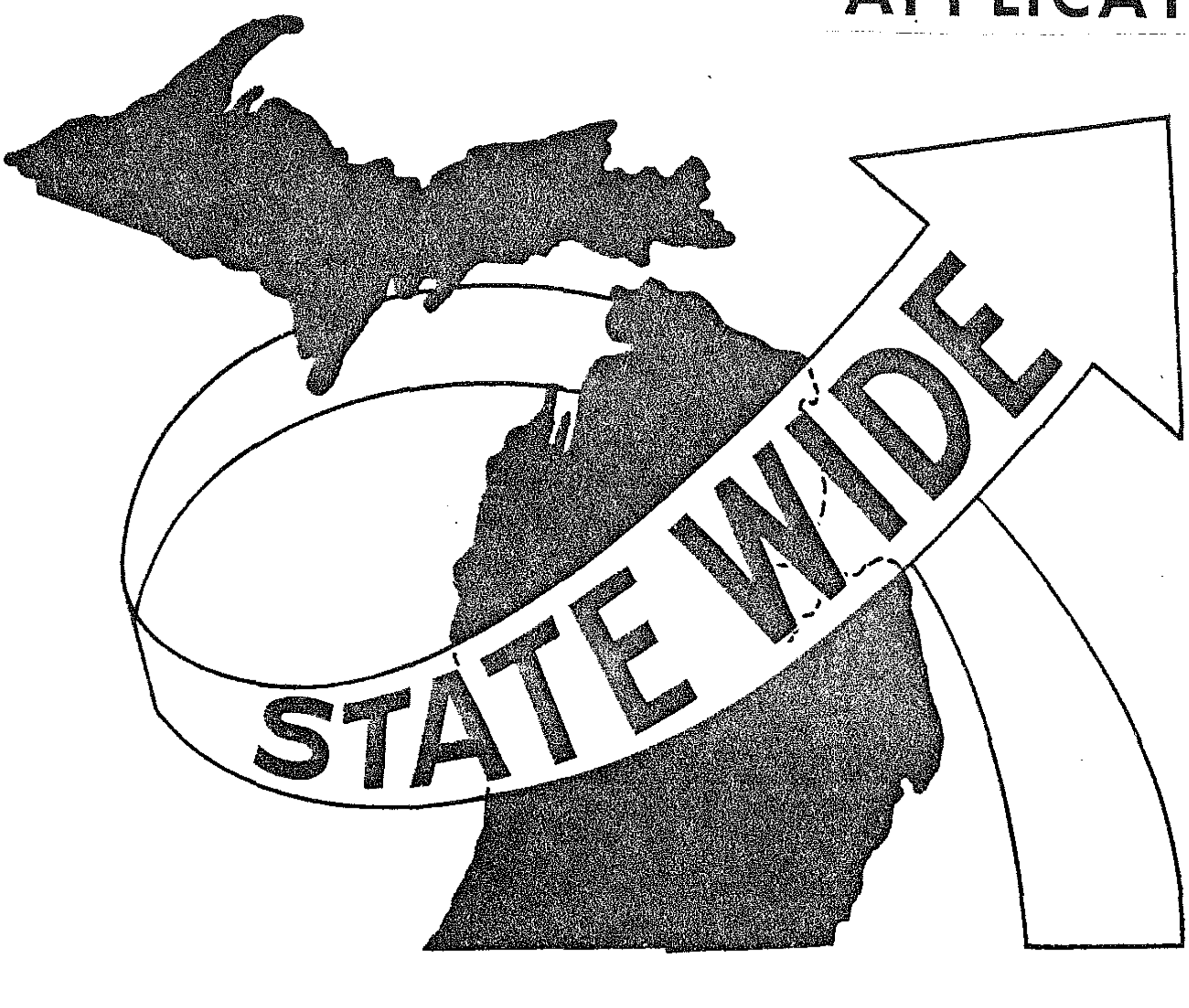
4) adding this final additional volume to the present highway volumes.

After the new volumes have been calculated, a new ADT (average daily traffic) and DHV (design hour volume) may be computed for each highway link, and the resultant level of service for each of the three cases can be derived. These may then be compared to determine if railroad planning is likely to have any effect upon the highway system and future highway planning.

At this point, some words of caution are needed. One must recognize that converting all truck traffic to the railroad system is an exaggeration since: 1) some of the truck traffic is light-duty, local vehicles; 2) some trips are too short to make conversion to rail economically feasible; 3) not all freight lends itself to rail carloads; and, 4) not all shippers have access to rail service. These may also apply to the converse situation: not all rail traffic could or should be moved by trucks. However, since rail commodities and mileages are recorded on the waybill tapes, some correction is possible here. Finally, as mentioned earlier, each of the three hypothesis compute level of service figures assuming a design hour volume, although trucks do not normally travel during such peak periods. Since only the extreme cases are examined, however, and most of these problems tend to increase the differences in extremes, one may be quite certain that the most realistic possibilities fall somewhere between the two extreme cases.

One more difficulty should be mentioned before proceeding. Because of the lack of past rail traffic data and the probable effect pending abandonments would have had upon any such data, it is not possible to accurately predict future rail service demands based upon recent rail traffic trends. However, estimates of expected future demands for rail service may be obtained by using "estimated growth factors". CONSAD Research Corporation, under contract to the Railroad Planning Section, Michigan Department of State Highways and Transportation, has developed county growth factors for Michigan. Eighteen social and economic indicators were examined; the counties were grouped into homogeneous categories and regression analysis was performed to produce these county factors. They have been listed in the appendix of this report. These growth factors may be used to estimate the future increase in rail service demands. They were not used for the application discussed in this report, but they are readily available if future applications should require them.

APPLICATION



APPLICATION

This method of estimating the possible impacts of rail service has been used in the recent Northwest Regional Transportation Study. The truck to passenger car conversion factor was calculated at 4.69 cars/truck as previously explained, and the rail carload to truckload factor of 3.1 trucks/carload described earlier was used. New average daily traffic figures for each highway link were computed for: a) present traffic - in passenger car units, i.e., all trucks were converted to passenger cars; b) passenger cars only, assuming all trucks were transferred to railroad cars; and 3) passenger cars plus trucks and rail carloads, both converted to passenger car units, thus assuming no rail service. Trucks were converted to passenger car units to avoid making the overly optimistic assumption that adding one truck to the highway traffic would have the same impact as adding one passenger car. Figure 6 shows a computer plot of the resultant ADT for each of the three cases. The first number on each link is the ADT for cars only, assuming exceptionally good rail service; the second number is the ADT for the present traffic of cars and trucks converted to cars implying no change in rail service, and the last number on each of the links is the ADT for cars, trucks, and train carloads, all in passenger car units, thus assuming no rail service. The DHV was also computed, by highway link, and the resultant computer plot is shown in Figure 7. The numbers on each link correspond to the numbers in the ADT plot, Figure 6.

AVERAGE DAILY TRAFFIC

1) Cars Only

2) Cars and trucks converted to cars

3) Cars and trucks and trains both converted to cars

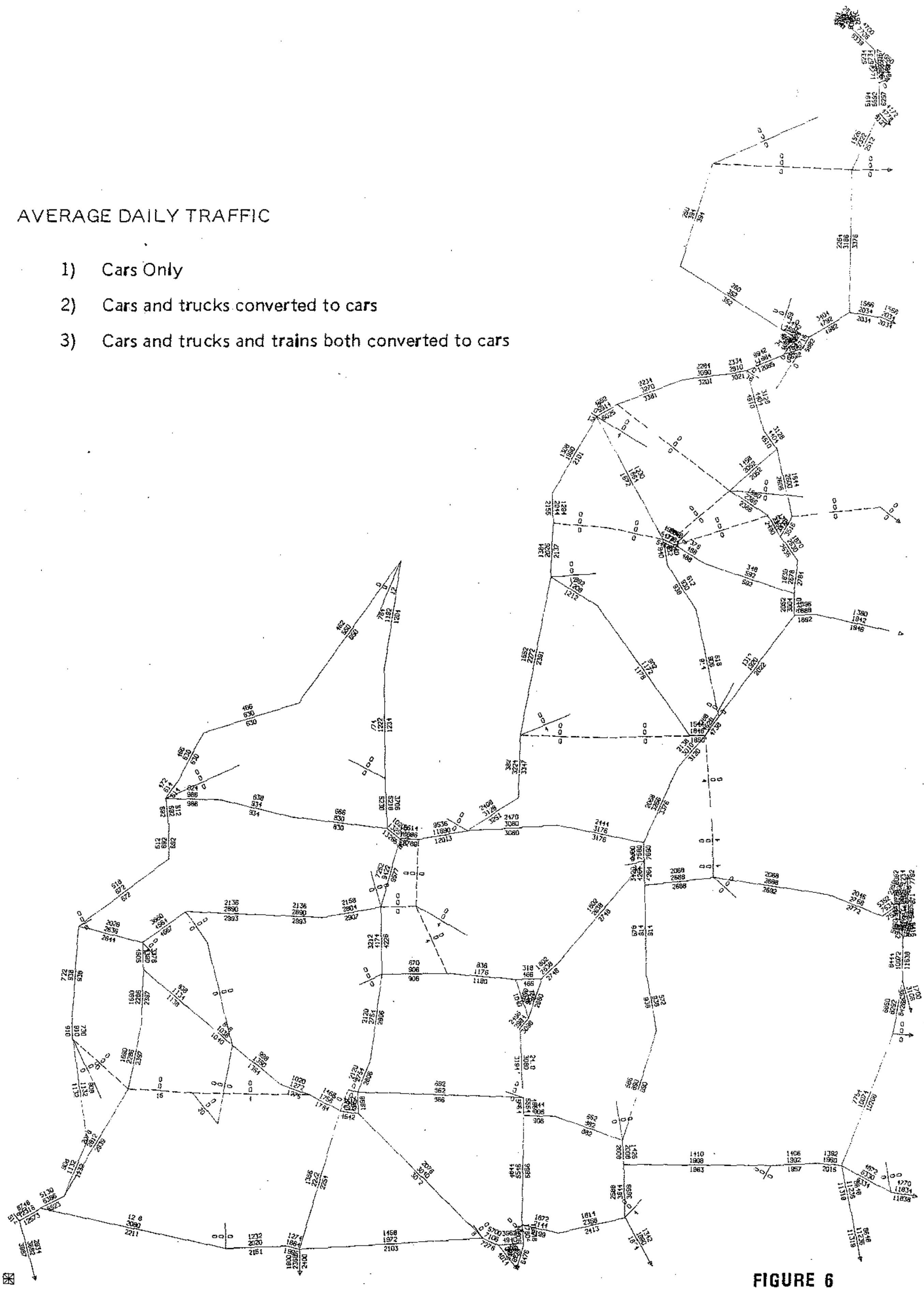


FIGURE 6

DESIGN HOUR VOLUMES

1) Cars Only

2) Cars and trucks converted to cars

3) Cars and trucks and trains ~~both~~ converted to cars

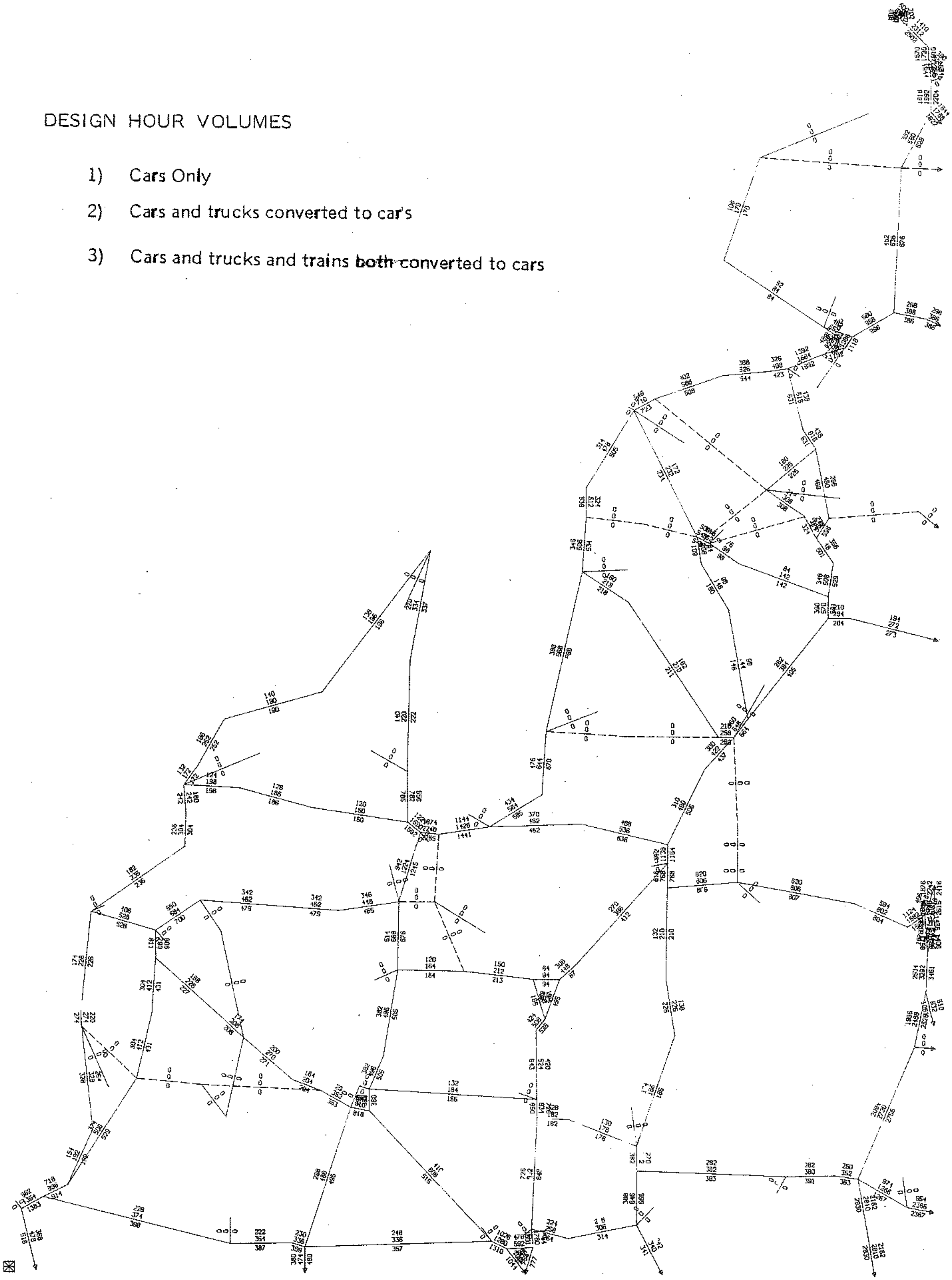
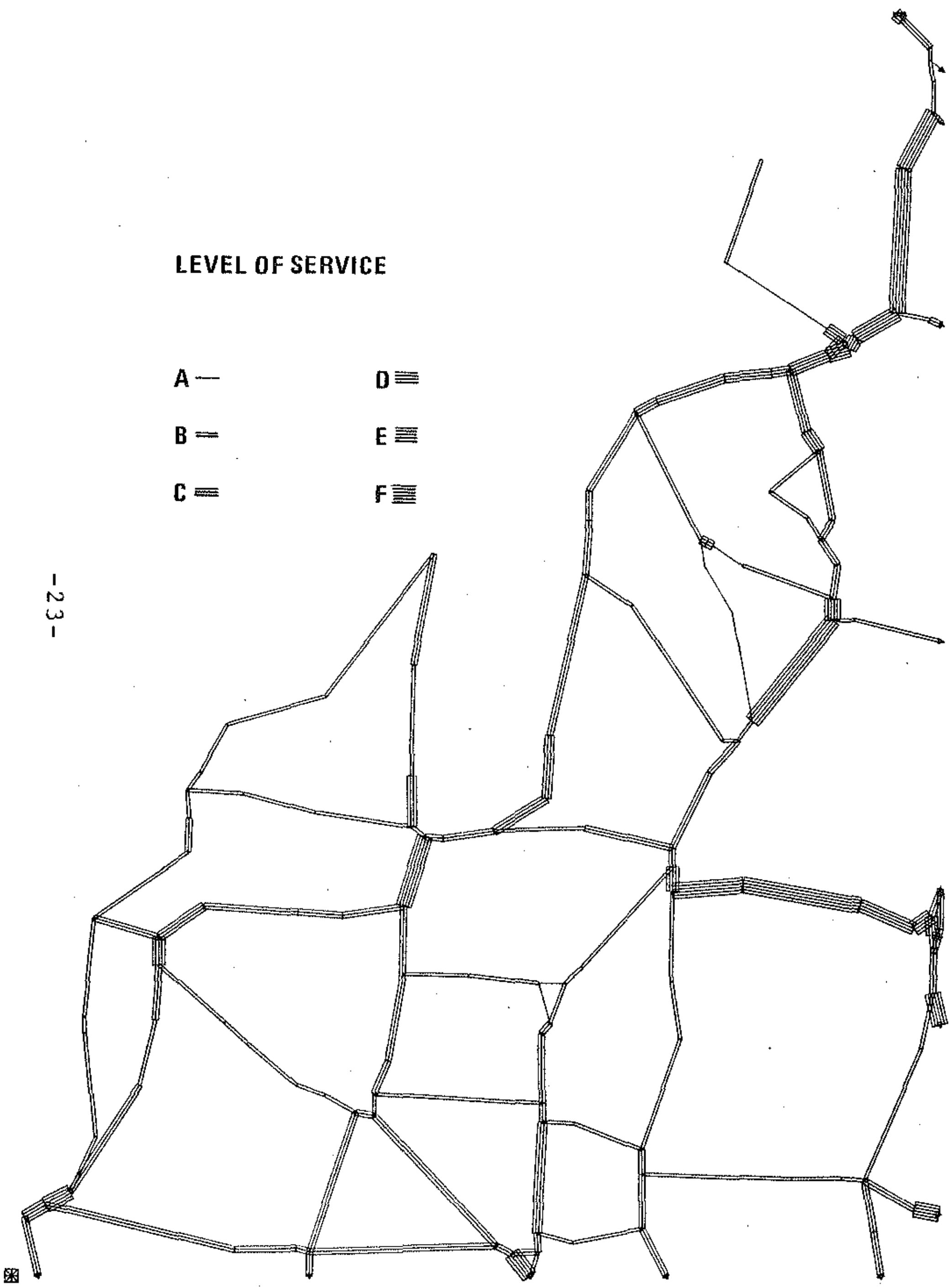


FIGURE 7

Finally, the level of service of each link was derived based upon the DHV, number of lanes, and the capacity of each link. The level of service was then plotted, using bandwidth plotting, for each of the three cases. The results are shown in Figures 8, 9, and 10. A road plotted as a single line has a level of service A; two lines indicate level of service B; etc. Levels of service D and E are below the desired level. It should be noted that the computed levels of service are based upon 1970 highway traffic data and 1973 railroad waybill tapes, the closest complementary statistics available. It should also be noted that even though no level of service changes are shown for a given highway, the ADT and DHV for that highway may have changed considerably, but not quite enough to cause a change in the level of service class.

The ADT, DHV, and level of service plots were examined closely by the Northwest Regional Team to discover any changes among the three cases studied. These changes were then noted in their recent report, Northwest Regional Transportation Study, Michigan Department of State Highways and Transportation, November 1975, which was made available to the public in January, 1975.

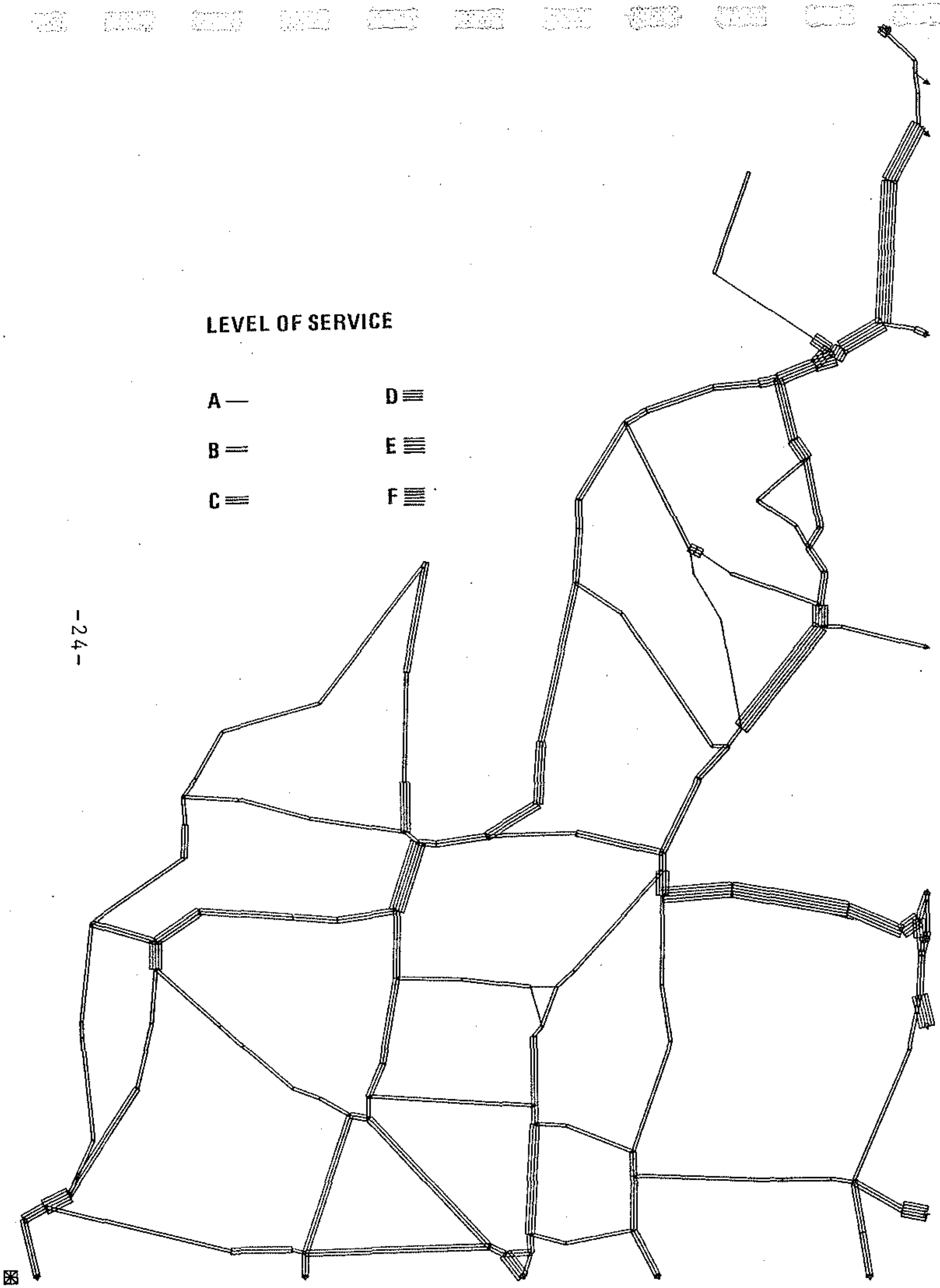
This type of intermodal analysis is supplying information necessary to help determine whether a regional highway planning process can proceed as an independent study or if other modes must be considered throughout the entire planning process. Figures 11, 12, and 13 are examples of how this information was actually used by Northwest Regional Team in their recent report mentioned above.



LEVEL OF SERVICE---CARS AND TRUCKS AND TRAINS BOTH CONVERTED TO CARS

```
NETWORK TAPE WAS CREATED OR UPDATED 28AUG75
PREPLOT TAPE IS QT01P00/TRUCKBL
     DIR =       2.
     SCA =        0.40
   MINXP =     175.00
   MAXXP =     205.00
   MINYP =     165.00
   MAXYP =     206.00
   FIELD =       2.
    MINV =       1.
    MAXV = 999999
   BAND1 =  1  TO   2
   BAND2 =  3  TO   4
   BAND3 =  5  TO   6
   BAND4 =  7  TO   8
   BAND5 =  9  TO  10
   BAND6 = 11  TO  12
 VOL(16) = TRUE
```

FIGURE 8



LEVEL OF SERVICE---CARS AND TRUCKS CONVERTED TO CARS

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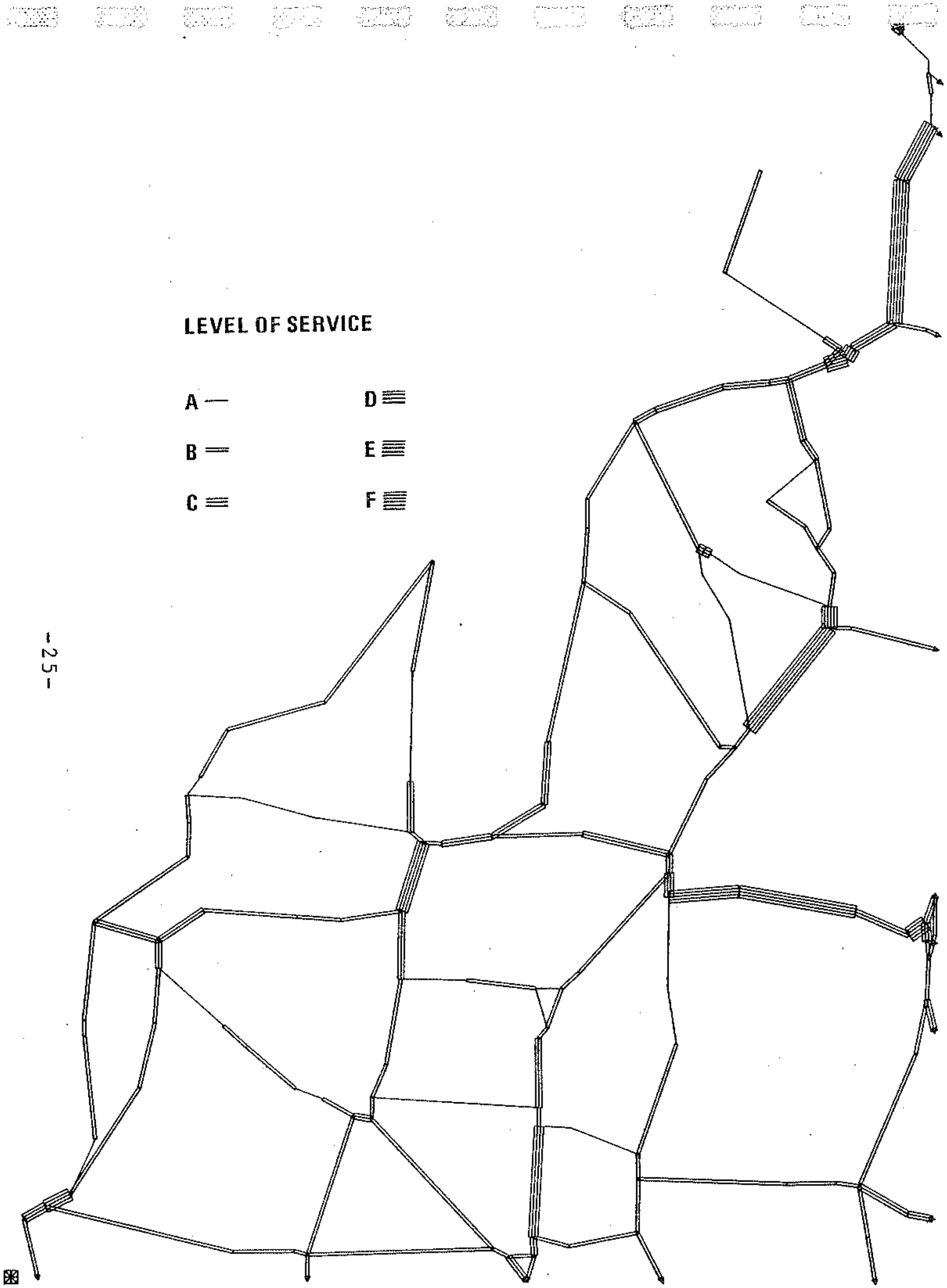
     SCA =       0.40
   MINXP =    175.00
   MAXXP =    205.00
   MINYP =    165.00
   MAXYP =    206.00
   FIELD =      2.
    MINV =      1.
    MAXV = 999999
   BAND1 =  1  TO   2
   BAND2 =  3  TO   4
   BAND3 =  5  TO   6
   BAND4 =  7  TO   8
   BAND5 =  9  TO  10
   BAND6 = 11  TO  12
 VOL(13) = TRUE
```

FIGURE 9



LEVEL OF SERVICE---CARS ONLY

NETWORK TAPE WAS CREATED OR UPDATED 28AUG75
PREPLOT TAPE IS QT01P00/TRUCKBL

```
     DIR =      2.
     SCA =        0.40
   MINXP =    175.00
   MAXXP =    205.00
   MINYP =    165.00
   MAXYP =    206.00
   FIELD =      2.
    MINV =      1.
    MAXV = 999999
   BAND1 =  1  TO   2
   BAND2 =  3  TO   4
   BAND3 =  5  TO   6
   BAND4 =  7  TO   8
   BAND5 =  9  TO  10
   BAND6 = 11  TO  12
 VOL(10) = TRUE
```

FIGURE 10

SHORT RANGE APPROACH

As stated previously, questions have arisen relative to the need for new highways if rail service is improved sufficiently so that a considerable amount of highway traffic shifts onto the rail network. Conversely, if all the railroad service in the Northwest Region were to be abandoned it has been suggested that the resulting truck movements would seriously overload the highway facilities——present or planned.

These two hypotheses have been tested in their most extreme cases. First, railroad service was assumed to be so improved in the Region that all highway traffic that had any potential of being moved by railroads was removed from the highway network. Of interest was whether the removal of this portion of highway traffic would sufficiently decrease the demand for new highway facilities. And second, railroad service was assumed to be completely abandoned in the whole Region and the carloads of railroad traffic were converted to highway truckloads and added to the existing highway loads. Of interest was whether this incremental traffic was significant regarding decisions for new facilities. What actually happens in the future will be somewhere in between these two extreme cases. A realistic situation would not require capacity increasing improvements given that neither of these polar cases revealed the need for such improvements.

The existing Levels of Service on the highway network were calculated to be used as a basis of comparison for the two cases. Level of Service was defined on page 17 as "the condition under which a highway functions given a certain capacity and traffic volume". There are six commonly recognized classes——A, B, C, D, E, and F——ranging from unrestricted traffic movement to frequent stops.

The analysis being discussed sought to determine the change in Level of Service for each case when compared to the existing conditions.

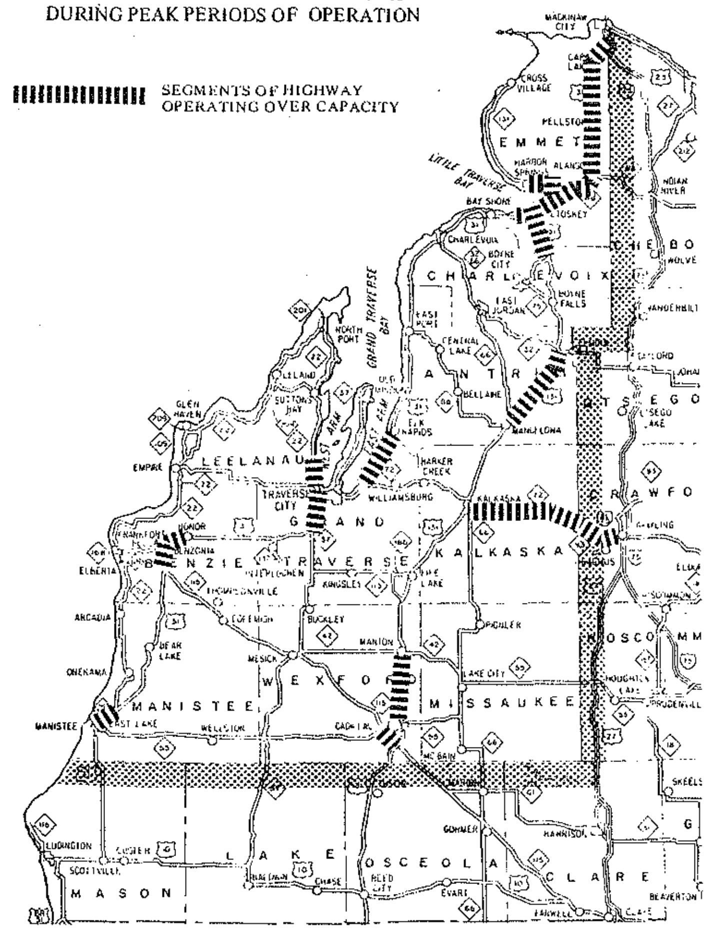
In this analysis, trucks were factored by 4.69 to yield passenger car equivalents for the calculations. The Highway Capacity Manual[1] prescribes conversion factors of 2.5 and 5.0 for trucks to passenger car equivalents on level and rolling terrain, respectively. Prorating each factor for the applicable miles of trunk line with such characteristics yielded the 4.69 composite factor. Factoring the truck component of the traffic volume into passenger car equivalents provided a more representative assessment of current levels of service as shown on the following map.

[1] *Highway Capacity Manual; Highway Research Board, Special Report No. 87; 1965.*

Northwest Regional Transportation Study,
Michigan Department of State Highways and Transportation, 1975.

EXISTING LEVELS OF SERVICE
(CARS AND TRUCKS)

THE CURRENT HIGHWAY TRAFFIC SITUATION
DURING PEAK PERIODS OF OPERATION



NOTE: Levels of Service calculations are based upon 1970 highway traffic data. The inconsistencies with the map on page 4 are the result of car/truck conversions as explained in the "note" in the left-hand column on page 17.

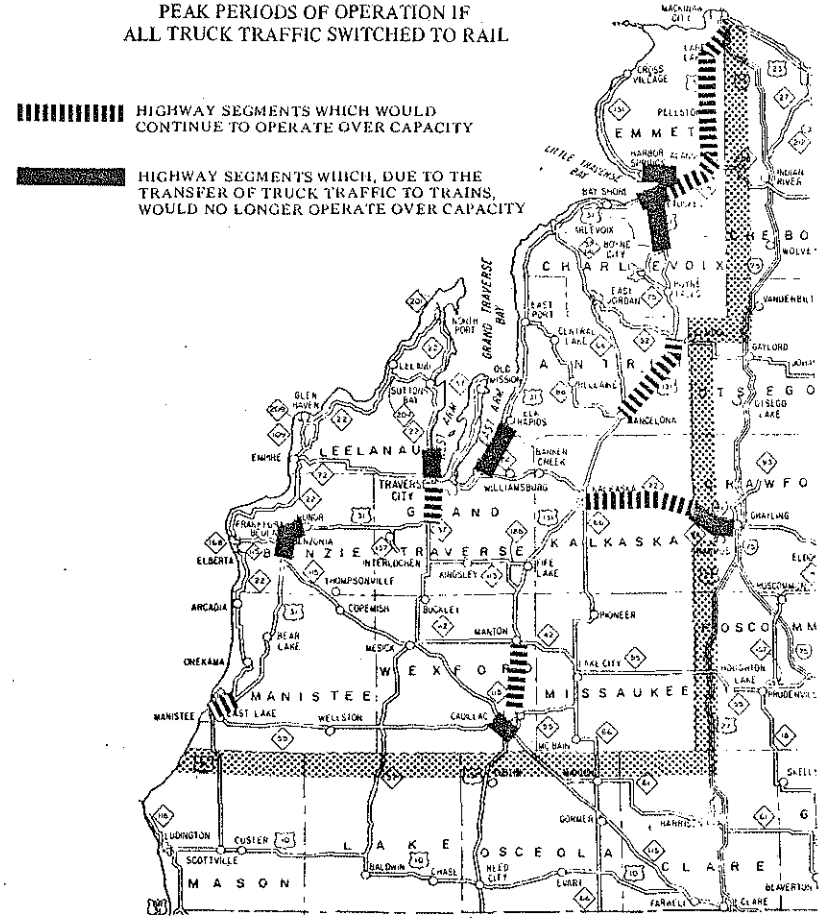
FIGURE 11

LEVELS OF SERVICE
(CARS ONLY)

THE HIGHWAY TRAFFIC SITUATION DURING PEAK PERIODS OF OPERATION IF ALL TRUCK TRAFFIC SWITCHED TO RAIL

Next, the truck component of the traffic volumes was completely deleted and the Levels of Service were calculated again. The assumption that all of this service could be provided by the railroad mode is an exaggeration in that some of the truck traffic is light-duty, local service vehicles and would not transfer to rail. Using this "total transfer" theory, approximately 47 miles of highway that were operating at "unacceptable" levels of service in the existing situation attained "acceptable" levels of service as shown on the accompanying map. Actual differences were in the 100 vehicles per day range.

When assessing the significance of the amount of highway improved by this theoretical transfer (about 1/3 of that rated over capacity) the exaggeration of the underlying assumptions cannot be overstated. Clearly, not all truck traffic could be removed from the highway network and transferred to rail. For instance, not all freight lends itself to train carloads, not all trips are of a length to make the transfer economical, and not all shippers and receivers are conveniently located near a rail facility. Furthermore, areas of noticeable improvement occur around urban areas where short-haul, local service truck travel would continue to operate regardless of the availability of rail service. These realistic situations tend to de-emphasize the significance of the amount of highway which appears to be improved by the transfer as shown on the map.



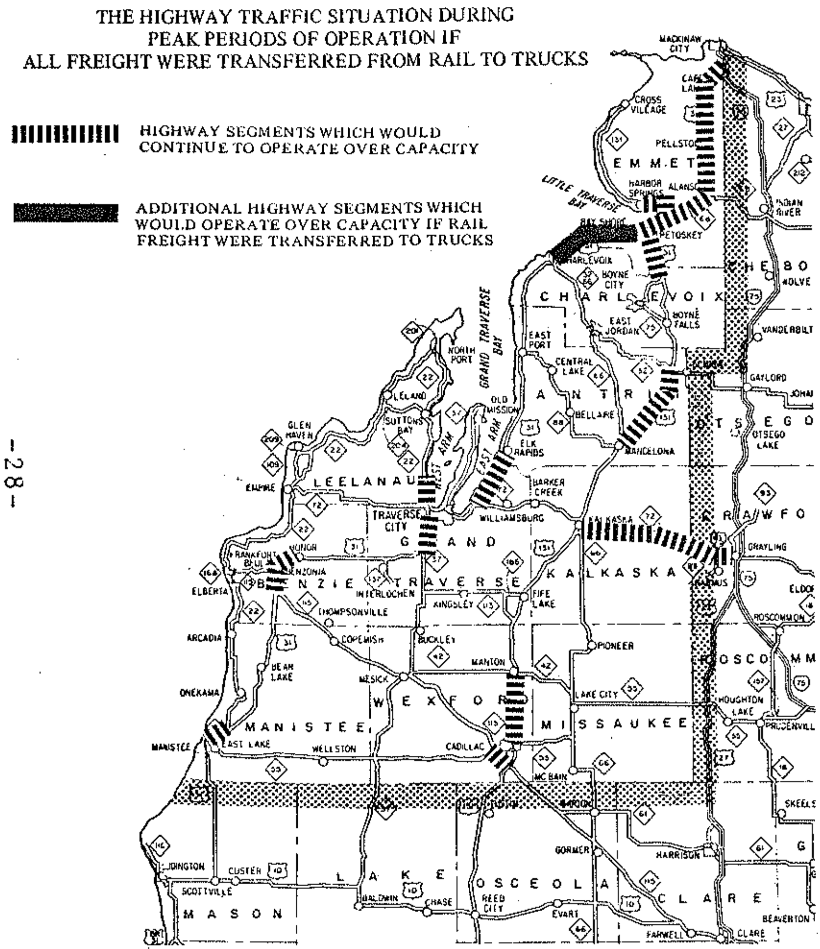
NOTE: Levels of Service calculations are based upon 1970 highway traffic data.

Northwest Regional Transportation Study,
Michigan Department of State Highways and Transportation, 1975.

FIGURE 12

-27-

LEVELS OF SERVICE
(CARS, TRUCKS AND RAIL FREIGHT CONVERTED TO HIGHWAYS)



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NOTE: Levels of service calculations are based upon 1970 highway traffic data and 1972 railroad data, the closest complementary statistics available.

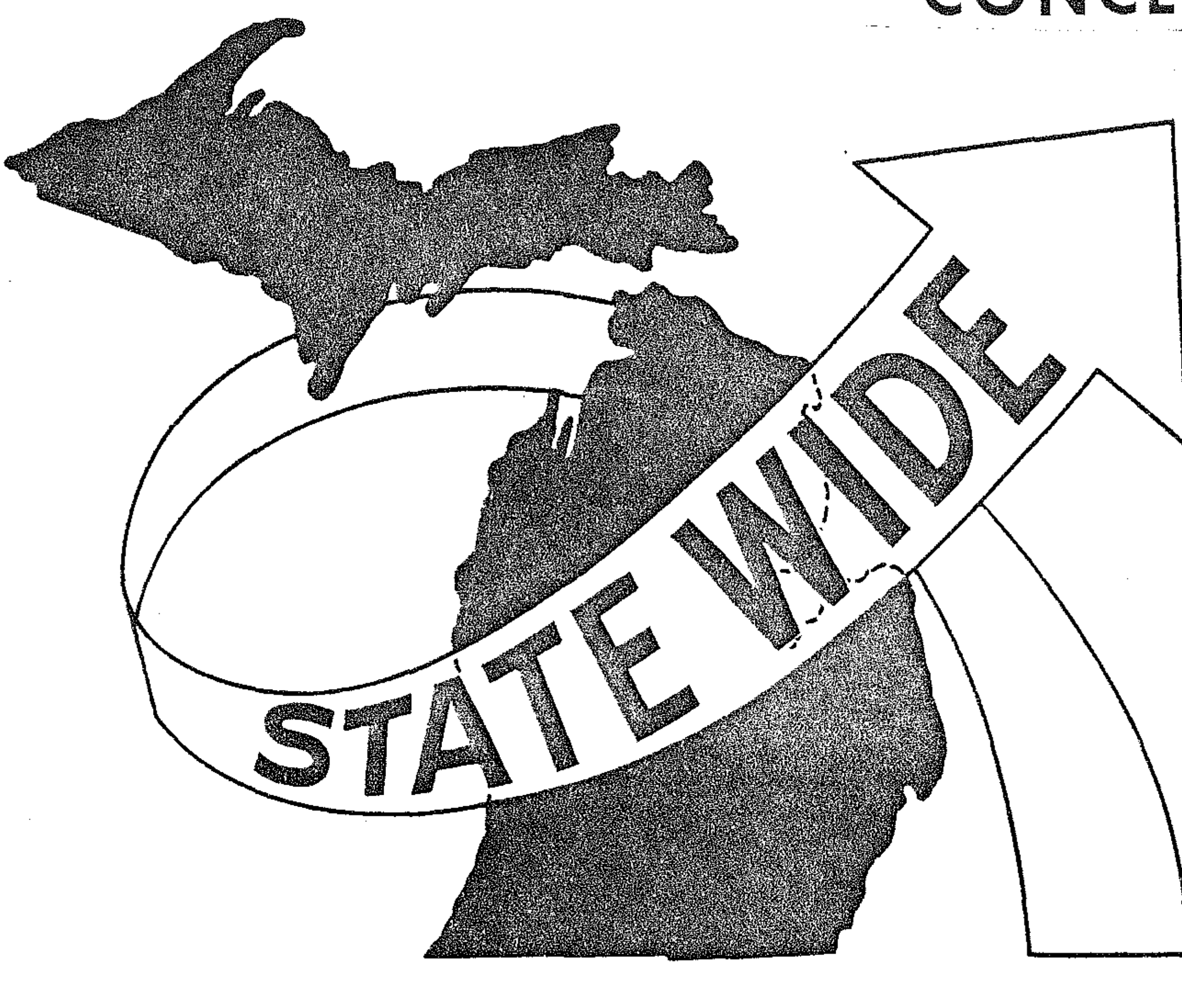
The third and final step in this analysis was to take all the railroad traffic off the railroad network, convert the rail carloads to truckloads, factor the truckloads for passenger car equivalents and calculate the third set of levels of service. Conversion of rail carloads to truckloads was accomplished by using a factor of 3.1 which suggests that 3.1 trucks would be necessary to haul the contents of one railroad car. This factor was derived by dividing tons of freight carried by trucks in the United States in 1972 by the number of truckloads hauled in the United States in 1972 and by dividing the answer into the average weight of a carload of freight in the United States in 1972. The major variable in such a factor is the commodity being moved but such precision was considered inappropriate for the purposes of this analysis. Comparing these levels of service to the existing situation showed few highway segments altered from one level to a worse level. Only one additional segment dropped to an "unacceptable" level. This is shown on the adjacent map.

In conclusion, it is apparent that whether the railroads in the Northwest cease operation altogether or provide all the service currently provided by both modes of transportation, very little difference would occur with regard to the planning of new or upgraded highway trunk line facilities. This is not to say that major and minor county arterials with seasonal weight restrictions or bridge restrictions would not be impacted by abandonment of railroads. Nor does this analysis purport to account for the community impacts of loss of railroad service such as loss of income, unemployment, tax losses, business closings, reduced accessibility, etc. The Railroad Planning Section, in developing the State railroad plan, is independently assessing the community impacts associated with loss of rail service on a segment by segment basis. What this analysis does indicate is that planning can progress in the Northwest Regional Transportation Study even in the uncertain environment surrounding the status of railroad operations in the Region.

Northwest Regional Transportation Study,
Michigan Department of State Highways and Transportation, 1975.

FIGURE 13

CONCLUSION



CONCLUSION

It is now possible to quickly and systematically evalute the potential effects of railroad planning upon the state highway system. The method described in this report should provide an effective tool for transportation planners, particularly at a time when major decisions are being made in both highway and railroad planning. Some modifications are possible which may further enhance the effectiveness of this method. One such improvement would be to automate the calculation of truck to car conversion factors for each highway link based upon sight restrictions and the level of service instead of calculating a regional average. This change would make the results of any given example valid for the entire state rather than just for a single region. A second possible improvement would be to eliminate all non-truckable commodities such as iron ore when transferring rail traffic to trucks, since the loss of rail service would probably cause these shipments to cease. This can easily be accomplished, since commodity types for each shipment are recorded on the railroad waybill tapes. It would be difficult, however, to limit truck to train transfers to only those commodities which are conducive to rail travel since truck commodity information is not readily available. It might, however, be feasible to limit the transfer of trucks to railroad cars to those trips of a sufficiently long distance or to those trips originating in and destined for areas with available rail service.

The intermodal analysis method described here should provide useful and necessary information for transportation planners. The process will help determine whether or not other modes could have a significant impact upon the highway system. If it can be shown that another mode, such as rail, will have no appreciable effect upon the highway system, highway planning may proceed independently of that mode. If, however, this process should show that improving or abandoning other modes significantly changes highway deficiency ratings, those modes must be considered throughout the entire highway planning process. Similarly, if it is shown that planned or proposed highway improvements may significantly increase or decrease the demand for rail service in a particular area, any decision involving such rail service should be made only after careful evaluation of those changes.

In case of questions, or for additional information, please contact:

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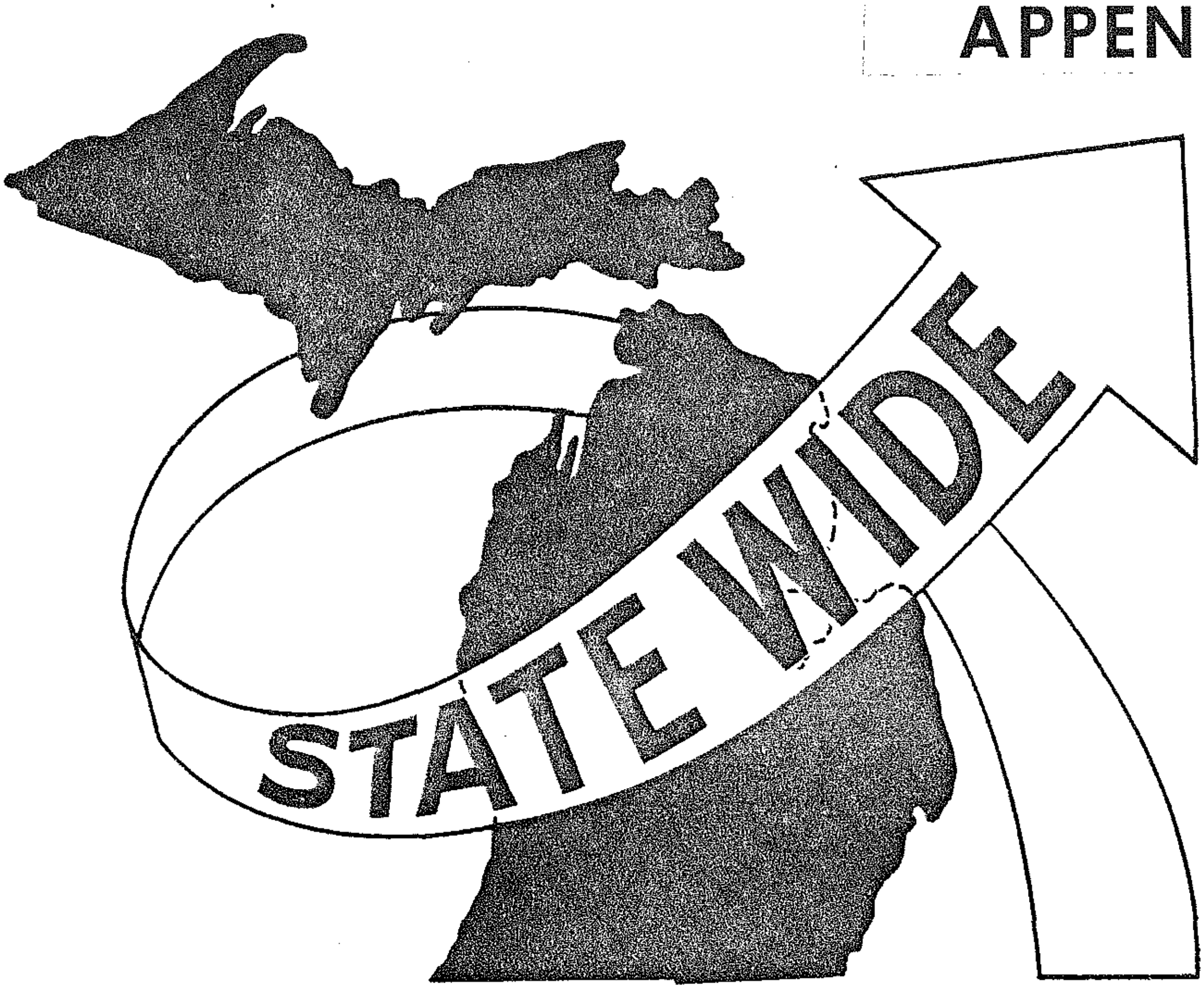
APPENDIX



SMSA COUNTIES

PERCENT GROWTH METHOD

R (CARS/WHL EMP) = .990 R^2 (CARS/WHL EMP) = .981

R (TONS/WHL EMP) = .984 R^2 (TONS/WHL EMP) = .969

COUNTY	1971 WHL EMP	1980 WHL EMP	Δ WHL EMP	% GROWTH CARS, TONS
BAY	1528	2092	564	36.9
CLINTON	202	222	20	9.9
EATON	189	282	93	49.2
GENESEE	10102	17876	7774	77.0
INGHAM	3184	6046	2862	89.9
JACKSON	1662	2463	801	48.2
KALAMAZOO	2370	2948	578	24.4
KENT	9029	12934	3905	43.2
LAPEER	147	217	70	47.6
MACOMB	4625	7178	2553	55.2
MUSKEGON	2316	2762	446	19.3
OAKLAND	10964	19300	8752	80.1
OTTAWA	1158	1455	297	25.6
SAGINAW	2955	4619	1664	56.3
WASHTENAW	1191	2615	1424	119.6
WAYNE	60028	84307	24279	40.4

WHL EMP = WHOLESALE TRADE EMPLOYMENT

TABLE -2-

NON–SMSA, HIGH AGRICULTURE COUNTIES IN LOWER PENINSULA

PERCENT GROWTH METHOD

R (CARS/POP) = .823 R^2 (CARS/POP) = .677

R (TONS/POP) = .702 R^2 (TONS/POP) = .493

COUNTY	1971 WHL EMP	1980 WHL EMP	△ WHL EMP	% GROWTH CARS, TONS
ALLEGAN	66575	75050	8475	12.7
BARRY	38166	44063	5897	15.5
BERRIEN	163875	174404	10529	6.4
BRANCH	37906	40342	2436	6.4
CALHOUN	141963	140597	- 1366	- 1.0
CASS	43312	50146	6834	15.8
GRATIOT	39246	40491	1245	3.2
HILLSDALE	37171	38767	1596	4.3
HURON	34083	31765	- 2318	- 6.8
IONIA	44800	48068	3268	7.3
ISABELLA	44594	57094	12500	28.0
LENAWEE	81609	85638	4029	4.9
LIVINGSTON	58967	79925	20938	35.5
MECOSTA	27992	30122	2130	7.6
MONROE	118479	132953	14474	12.2
MONTCALM	39660	42813	3153	8.0
NEWAYGO	27992	30976	2984	10.7
OCEANA	17984	18891	907	5.0
ST. CLAIR	120175	130862	10687	8.9
ST. JOSEPH	43792	52064	4672	9.9
SANILAC	34889	36554	1665	4.8
SHIAWASSEE	63075	72366	9291	14.7
TUSCOLA	48603	53831	5228	10.8
VAN BUREN	56173	63316	7143	12.7

POP = POPULATION

TABLE -3-

NON–SMSA, LOW AGRICULTURE COUNTIES IN LOWER PENINSULA

PERCENT GROWTH METHOD

R (CARS/POP) = .769 R^2 (CARS/POP) = .591

R (TONS/POP) = .761 R^2 (TONS/POP) = .579

COUNTY	1970 POP	1980 POP	Δ POP	% GROWTH CARS, TONS
ALCONA	7113	7208	95	1.3
ALPENA	20708	31210	502	1.6
ANTRIM	12612	14423	1811	14.4
ARENAC	11149	12358	1209	10.8
BENZIE	8593	9095	502	5.8
CHARLEVOIX	16541	19359	2818	17.0
CHEBOYGAN	16573	18224	1651	10.0
CLARE	16695	20842	4147	24.8
CRAWFORD	6482	7967	1485	22.9
EMMET	18331	20283	1952	10.6
GRAND TRAVERSE	39175	45618	6443	16.4
IOSCO	24905	32282	7377	29.6
KALKASKA	5272	5905	633	12.0
LAKE	5661	5680	19	0.3
LEELANAU	10872	12246	1374	12.6
MANISTEE	20094	20084	- 10	0.0
MASON	22612	21878	- 734	- 3.2
MIDLAND	63769	74387	10618	16.7
MISSAUKEE	7126	7062	- 64	- 0.9
OGEMAW	11903	13776	1873	15.7
OSCEOLA	14838	16009	1171	7.9
OTSEGO	10422	13392	2920	28.0
PRESQUE ISLE	12836	11451	- 1385	- 10.8
ROSCOMMON	9892	11759	1867	18.9
WEXFORD	19717	20466	749	3.8

POP = POPULATION

TABLE -4-

UPPER PENINSULA COUNTIES

PERCENT GROWTH METHOD

R (CARS/RET EMP) = .791 $\qquad R^2$ (CARS/RET EMP) = .626

R (TONS/RET EMP) = .830 $\qquad R^2$ (TONS/RET EMP) = .689

COUNTY	1971 RET EMP	1980 RET EMP	Δ RET EMP	% GROWTH • CARS, TONS
ALGER	238	260	22	9.2
BARAGA	287	260	- 27	- 9.4
CHIPPEWA	1225	1908	683	55.8
DELTA	1969	2133	164	8.3
DICKINSON	1153	1203	50	4.3
HOUGHTON	1532	1693	161	10.5
IRON	550	741	191	34.7
LUCE	230	248	18	7.8
MACKINAC	379	527	148	39.1
MARQUETTE	2715	3697	982	36.2
MENOMINEE	728	804	76	10.4
ONTONAGON	299	308	9	3.0
SCHOOLCRAFT	332	376	44	13.3

RET EMP = RETAIL TRADE EMPLOYMENT

TABLE -5-