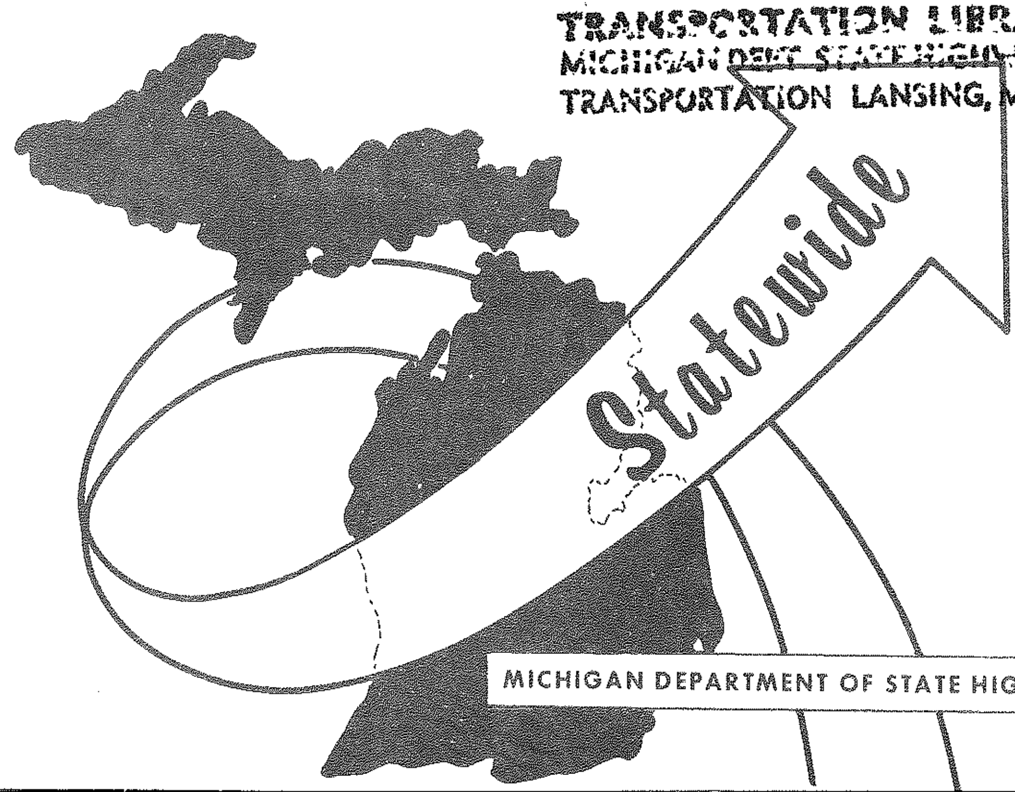
Statewide Transportation Analysis & Research

MICHIGAN'S
STATEWIDE TRANSPORTATION MODELING
SYSTEM

A METHOD FOR FUNCTIONALLY
LASSIFYING RURAL ARTERIAL HIGHWAYS

STATEWIDE STUDIES SECTION

September 1975



MICHIGAN DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

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OF

STATE HIGHWAYS AND TRANSPORTATION

BUREAU OF TRANSPORTATION PLANNING

MICHIGAN'S
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CLASSIFYING RURAL ARTERIAL HIGHWAYS

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September 1975

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, GOVERNOR

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JOHN P. WOODFORD, DIRECTOR

September 11, 1975

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 XII in a series of reports dealing with Michigan's Statewide Transportation Modeling System. The report, entitled "A Method for Functionally Classifying Rural Arterial Highways", documents the potential application of the Statewide model in the functional classification of rural highways using two basic elements.

1. Population Centers and Other Travel Generators
2. Highway Travel Characteristics

We have noted a recent concern in the Bureau of Transportation Planning pertaining to system level justification and also with the Federal Highway Administration in demonstrating the need for a project. It is felt that the elements contained within this report have the potential of supplying an answer to these questions and be of value in the state highway plan and regional planning process. It is also hoped that other states presently considering statewide transportation modeling have a chance to become familiar with potential multiple applications of a system such as this.

This report was prepared by Mr. James E. Carroll of 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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PREFACE

PREFACE

The following is the twelfth report in a series of reports dealing with the development of the Statewide Transportation Modeling System for the State of Michigan. The preceding reports are:

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Volume	I-B	Single and Multiple Corridor Analysis
Volume	I-C	Model Applications: Turnbacks
Volume	I-D	Proximity Analysis: Social Impacts of Alternate Plans on Public Facilities
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Volume	I-J	Service-Area Model
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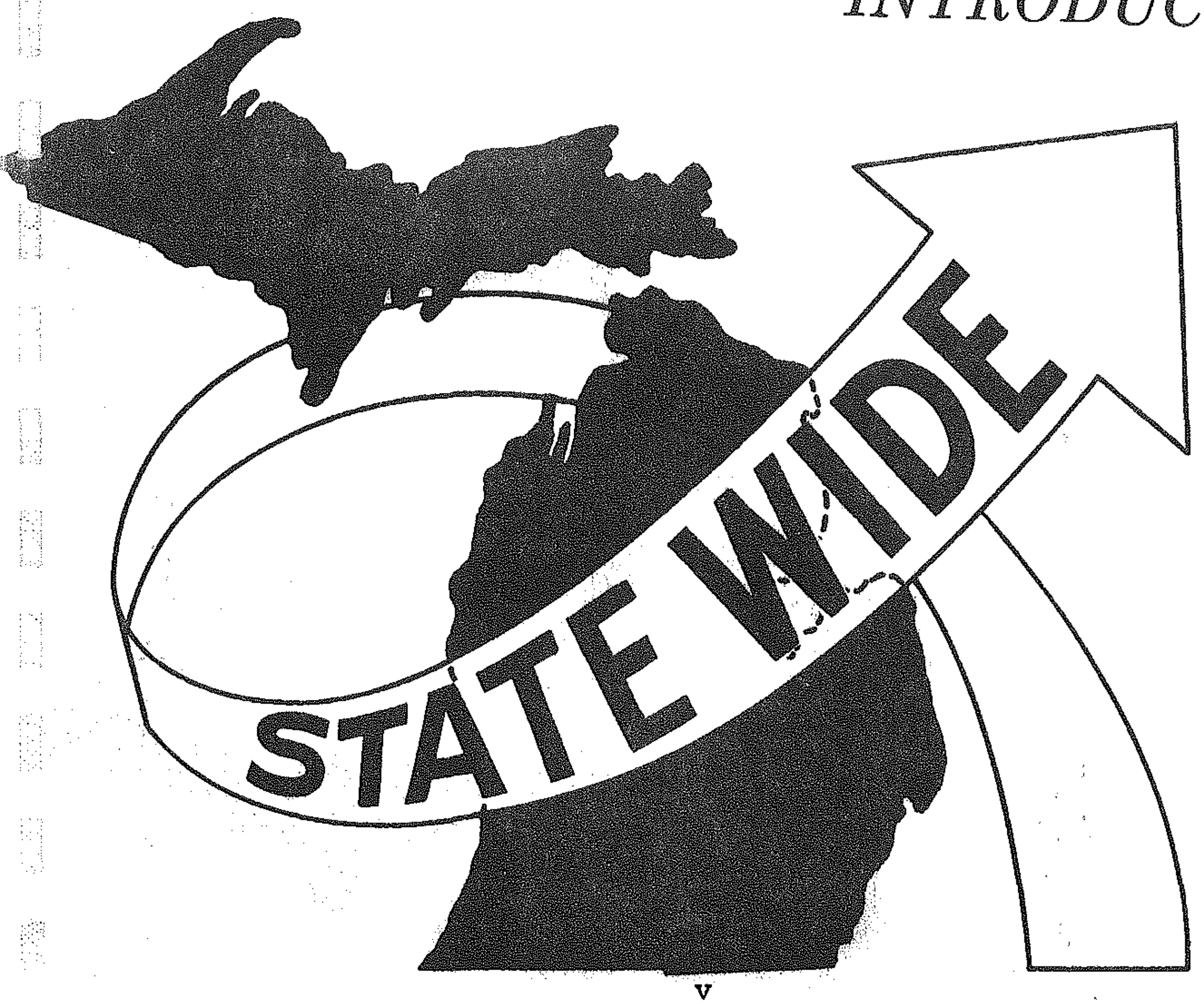
Volume	IX	Statewide Socio-Economic Data File
Volume	X-A	Statewide Travel Impact Analysis Procedures
Volume	X-B	Statewide Social Impact Analysis Procedures
Volume	X-C	Statewide Economic Impact Analysis Procedures
Volume	XI	Computer Run Times - An Aid in Selecting Statewide Travel Model System Size

This report deals with a systematic analysis routine which could assist in the systematic functional classification of a state trunkline highway network in rural areas.

Functional classification of the highway system is often difficult because the role a specific highway plays in society is continually changing. This change is due to the outside socio-economic change and also highway network changes. Many state transportation agencies find it necessary to rely on a vast array of manual techniques to complete the functional classification process. Monitoring the dynamic nature of this process often requires large amounts of time and staff. Therefore, because Michigan has developed a Statewide Transportation Modeling System that contains both the highway system and socio-economic data for the State, it was decided that a system such as this had the potential to systematically reduce the work load required to complete functional classification in future years. This report will deal with the initial phases in a long-range development project.

INTRODUCTION



INTRODUCTION

Functional classification is the process by which streets and highways are grouped into classes according to the function that they serve in a region or state. It is a basic fact that individual road segments do not serve travel independent of one another. Rather, most travel involves movement through a network of roads. Functional classification defines the part that any particular road segment plays in the flow of trips through a total highway network and the importance each of these segments plays in the connection of socio-economic centers.

Separate classifications are generally made in urban and rural areas. The reason for the distinction between the two is due to different characteristics each has in regard to density, type of land use, density of road networks, nature of travel patterns and the way all these elements are related.

The following categories are typical of a general functional classification system. Some states may vary the terminology used or divide certain classes.

RURAL AREAS	URBANIZED AREAS
Principal Arterials	Principal Arterials
Minor Arterial Roads	Minor Arterial Streets
Collector Roads	Collector Streets
Local Roads	Local Streets

Depending on whether a state is dealing with an urban or rural functional system, the following guidelines as to the percentage of total miles in each class generally apply.

RURAL FUNCTIONAL SYSTEMS

SYSTEMS	PERCENTAGE OF TOTAL RURAL MILES
Principal Arterial System	2 - 4
Principal Arterial Plus Minor Arterial Road System	6 - 12
Collector Road System	20 - 25
Local Road System	65 - 75

URBAN FUNCTIONAL SYSTEMS

SYSTEMS	PERCENTAGE OF TOTAL RURAL MILES
Principal Arterial System	5 - 10
Principal Arterial Plus Minor Arterial Street System	15 - 25
Collector Street System	5 - 10
Local Street System	65 - 80

The objective of this report is to show how Michigan's Statewide Transportation Modeling System could assist in classifying rural highways.

Michigan's Modeling System is a computerized process for simulating rural travel information using a typical gravity model distribution process. The statewide transportation modeling system process is based on three data files.

A. Statewide Network File - All highway link information is in this file, A-NODE, B-NODE, COORDINATES, and Link Data. (See Figure 1.)

FIGURE 1

STATEWIDE HIGHWAY NETWORK

LINK FILE

CONTENTS OF EACH HIGHWAY SEGMENT OR LINK

- AVERAGE SPEED
- DISTANCE
- URBAN-RURAL DESIGNATION
- TYPE OF ROUTE
- TRAFFIC VOLUME CAPACITY
- AVERAGE ANNUAL DAILY TRAFFIC VOLUME
- COMMERCIAL TRAFFIC VOLUME
- DESIGN HOUR VOLUME
- ACCIDENT FATAL RATE
- ACCIDENT INJURY RATE
- ACCIDENT RATE
- NUMBER OF LANES
- LANE WIDTH
- SURFACE CONDITION
- RIGHT OF WAY
- SIGHT RESTRICTION

B. Statewide Socio-Economic Data File - This contains information from the 1970 census of population and housing. (See Figure 2.)

C. Statewide Facility File - A collection of information about the physical environment. (See Figure 3.)

These three files were developed so that the Statewide Transportation Modeling System could be a dynamic process that will monitor impacts on major elements in society. The term dynamic is submitted in the sense that the user may modify any of the three basic data files and monitor the corresponding impact on society. The computer program components of the total modeling system have been divided into four groups. (See Figure 4.)

Group I - General Utility (This group contains information display programs.)

Group II - Basic Traffic Forecasting and Evaluation Tools (This group contains traffic information programs.)

Group III - Specific-Impact Modeling Process (This group contains specific-impact models developed from the traffic forecasting model.)

Group IV - Continuing Processes (This group contains the continuing analysis programs.)

The purpose of this report is not to add to the development of the modeling system; instead, it is directed at the application of the system in assisting the process of functional classification in any typical highway planning organization. (See Figure 5.) The following sections will show actual applications using the Michigan Statewide Transportation Model.

FIGURE 2

STATEWIDE SOCIO-ECONOMIC DATA FILE *

GENERAL CHARACTERISTICS OF POPULATION

SCHOOL ENROLLMENT BY TYPE OF SCHOOL
YEARS OF SCHOOL COMPLETED
CITIZENSHIP BY AGE

INCOME CHARACTERISTICS OF POPULATION

FAMILY INCOME
INCOME BY OCCUPATION AND SEX
RATIO OF FAMILY INCOME TO POVERTY LEVEL

LABOR FORCE CHARACTERISTICS OF POPULATION

EMPLOYMENT BY AGE
EMPLOYMENT BY OCCUPATION AND SEX
EMPLOYMENT BY INDUSTRY AND SEX

SOCIAL CHARACTERISTICS OF POPULATION

AGE BY SEX
TYPE OF FAMILY
MARITAL STATUS

AREA CHARACTERISTICS

LAKE FRONTAGE
ASSESSED VALUATION
WATER AREA

*THOSE ITEMS LISTED HERE ARE SAMPLES TAKEN FROM THE COMPLETE FILE WHICH CONTAINS OVER 700 ITEMS.

FIGURE 3

STATEWIDE FACILITY FILE

AIRPORTS
AMBULANCE SERVICE
BANKS
BUS TERMINALS
CAMP GROUNDS, PUBLIC AND PRIVATE
CERTIFIED INDUSTRIAL PARKS
CITIES OVER 5,000 POPULATION AND 30,000 POPULATION
CIVIL DEFENSE TERMINALS
COLLEGES, PUBLIC COMMUNITY
COLLEGES AND UNIVERSITIES, PUBLIC AND PRIVATE
COMMERCIAL CENTERS, MAJOR
CONVENTION CENTERS
DENTISTS
ELECTRICAL GENERATING PLANTS
GAME AREAS
GOLF COURSES
GRAIN ELEVATORS
HEALTH SCREENING CLINICS, EPSDT
HIGH SCHOOLS
HISTORIC SITES
HOMES FOR THE AGED
HORSEBACK ENTERPRISES
HOSPITALS
ICE ARENAS
MANUFACTURERS
MARINAS
MENTAL HEALTH CENTERS
NEWSPAPERS, DAILY
NEWSPAPERS, WEEKLY AND BIWEEKLY
NURSING HOMES
OIL PROCESSING AND STORAGE PLANTS
PHARMACIES
PHYSICIANS
POLICE DEPT'S, STATE AND LOCAL
PORTS
RAIL TERMINALS
SECRETARY OF THE STATE OFFICES
SEWAGE TREATMENT FACILITIES
SKI RESORTS
SNOWMOBILE TRAILS
SOCIAL SERVICES OFFICES
STATE PARKS
STATE POLICE POSTS
TOURIST ATTRACTIONS
TRAILER ON FLAT CAR TERMINALS
TRANSIT SYSTEMS, BUS
TREASURY OFFICES
TRUCK TERMINALS
UNEMPLOYMENT OFFICES
WEATHER SERVICE STATIONS–NATIONAL
WHOLESALE TRADE CENTERS

FIGURE 4

COMPONENT DETAIL

1. GENERAL UTILITY

A. TP PACKAGE

B. STATISTICAL BATTERY

C. GRAPHIC DATA PRESENTATION BATTERY

2. BASIC TRAFFIC FORECASTING AND EVALUATION TOOLS

A. TRIP GENERATION-DISTRIBUTION MODEL

B. SEGMENTAL MODEL

C. DHV MODEL

D. MASS TRANSIT MODEL

3. SPECIFIC-IMPACT MODELING PROCESSES

A. COST-BENEFIT ANALYSIS

B. SOCIAL IMPACT ANALYSIS

C. PSYCHOLOGICAL IMPACT ANALYSIS

D. LEVEL OF SERVICE ANALYSIS

E. EFFECTIVE SPEED ANALYSIS

F. ENVIRONMENTAL IMPACT ANALYSIS

G. HIGHWAY BREAKDOWN PROBABILITY MODEL

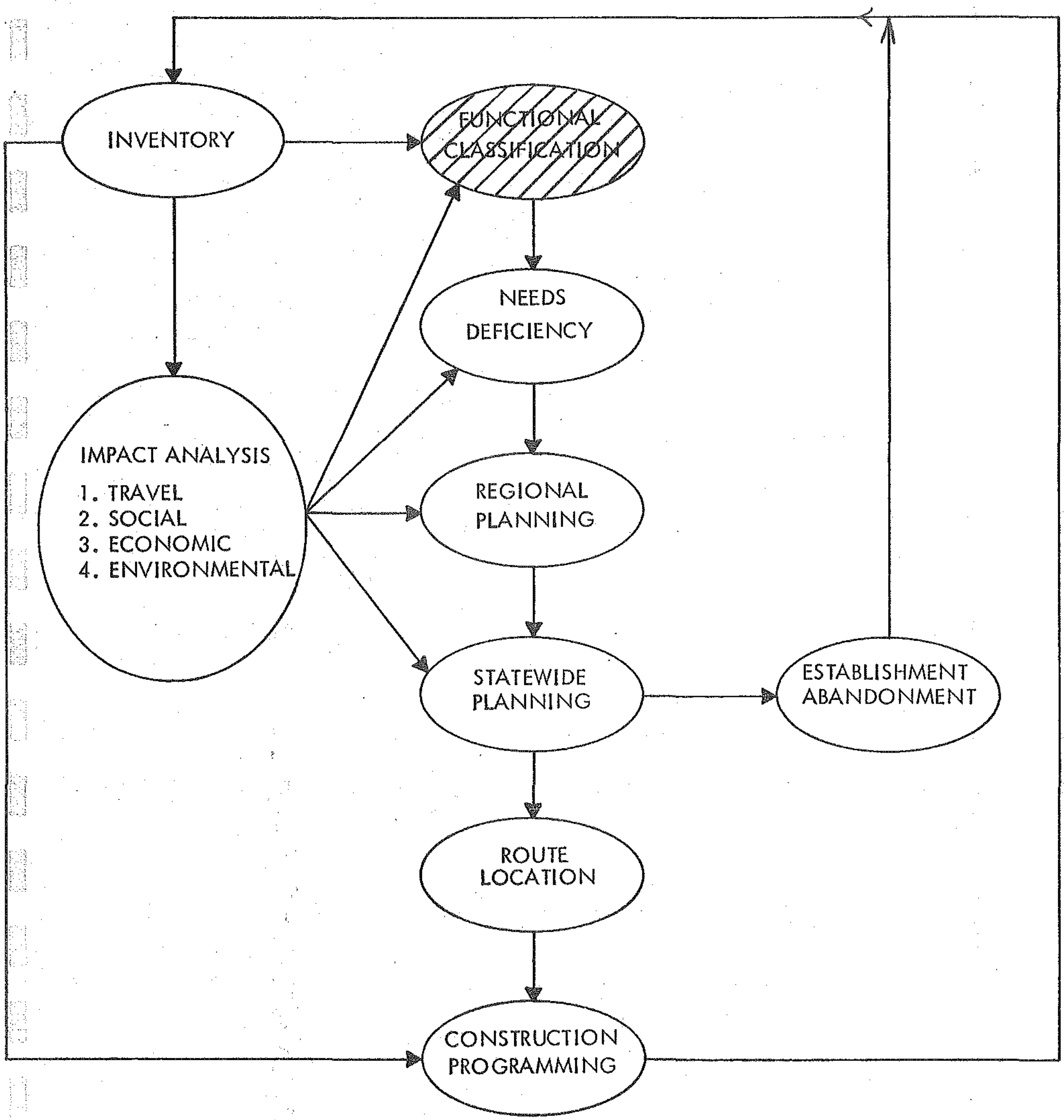
4. CONTINUING PROCESSES

A. SINGLE-STATION O & D ANALYSIS

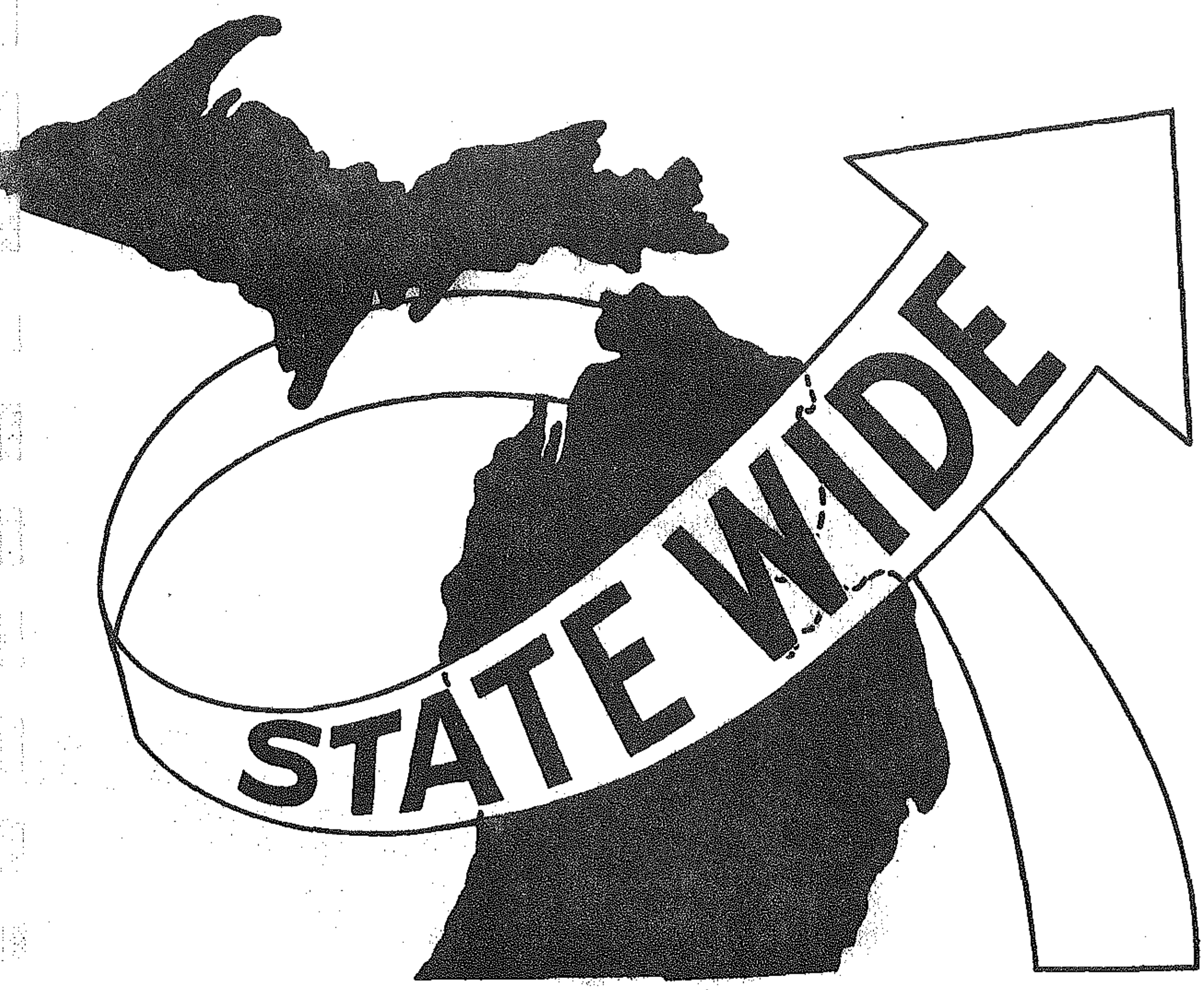
B. CORRIDOR LOCATION MODEL

FIGURE 5

TYPICAL PLANNING ACTIVITY RELATIONSHIPS



SUMMARY OF FHWA PROCESS



SUMMARY OF FHWA PROCESS

The following procedures for rural functional classification have been summarized from the "National Highway Functional Classification Study Manual", presented by the Federal Highway Administration (FHWA).

As a result of the major efforts on the part of the Federal Highway Administration and many states, the functional classification of any highway system involves identifying and ranking two basic elements.

1. Population Centers and Other Travel Generators
2. Highway Travel Characteristics

Since most trips begin or end in an urban area, population centers are considered the primary traffic generators. The size of the population in these areas generally reflects its capacity for generating and attracting travel. This is why population centers should be ranked in groups according to their estimated population as recommended by the FHWA example in Figure 6.

Major travel generators other than cities, such as recreation centers, should be treated separately during the ranking process. Usual trip generation rates do not apply since they contain little or no resident population, commercial activity, or industrial activity. The annual number of visitors to such a major travel generator can be equated to an urban area's population. The travel generator can then be grouped with population centers of similar trip generation potential. FHWA's recommended visitor/trip rate graph appears in Figure 7.

The procedure for functional classification of a rural system initially involves connecting travel generators in such a manner

FIGURE 6

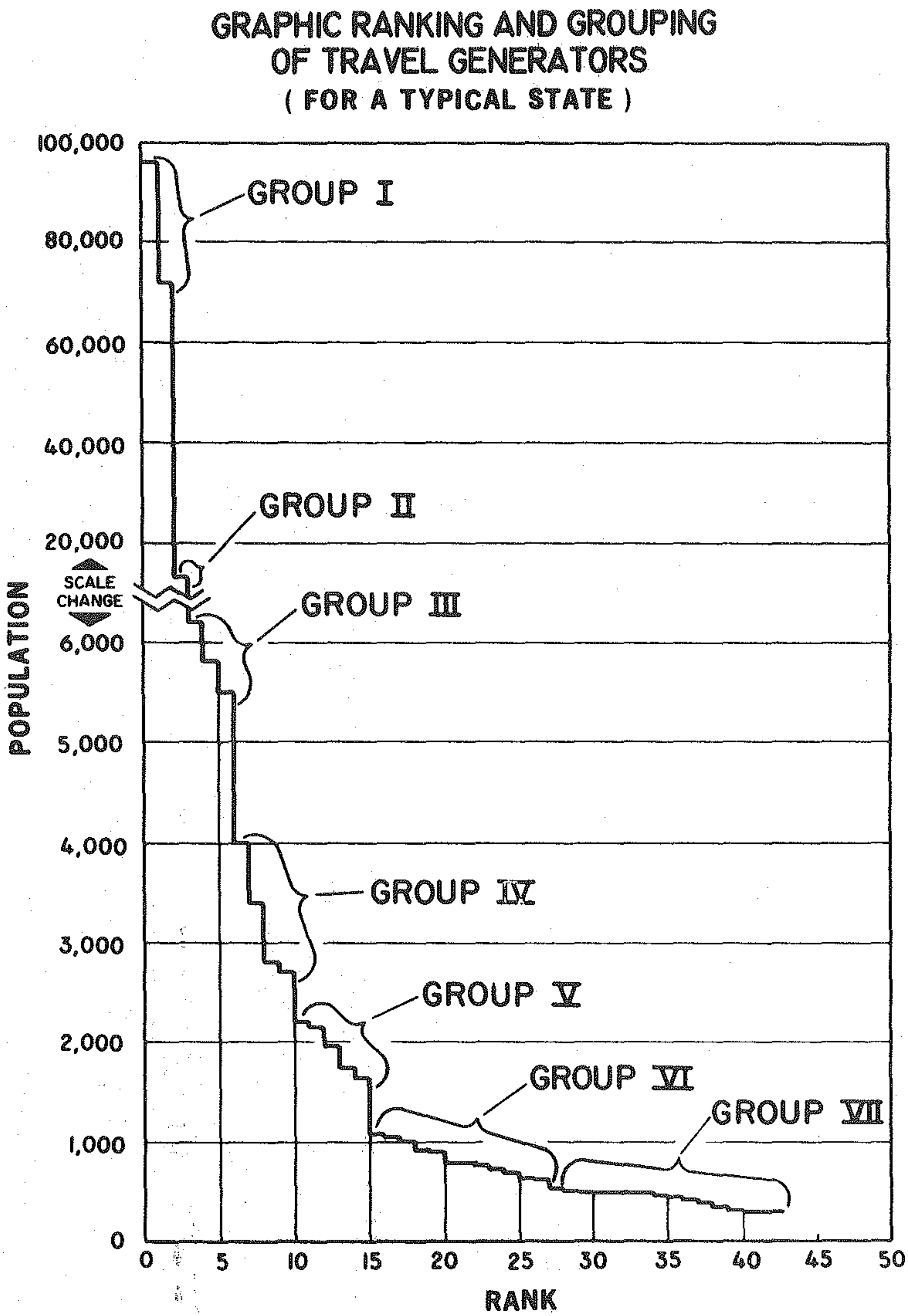
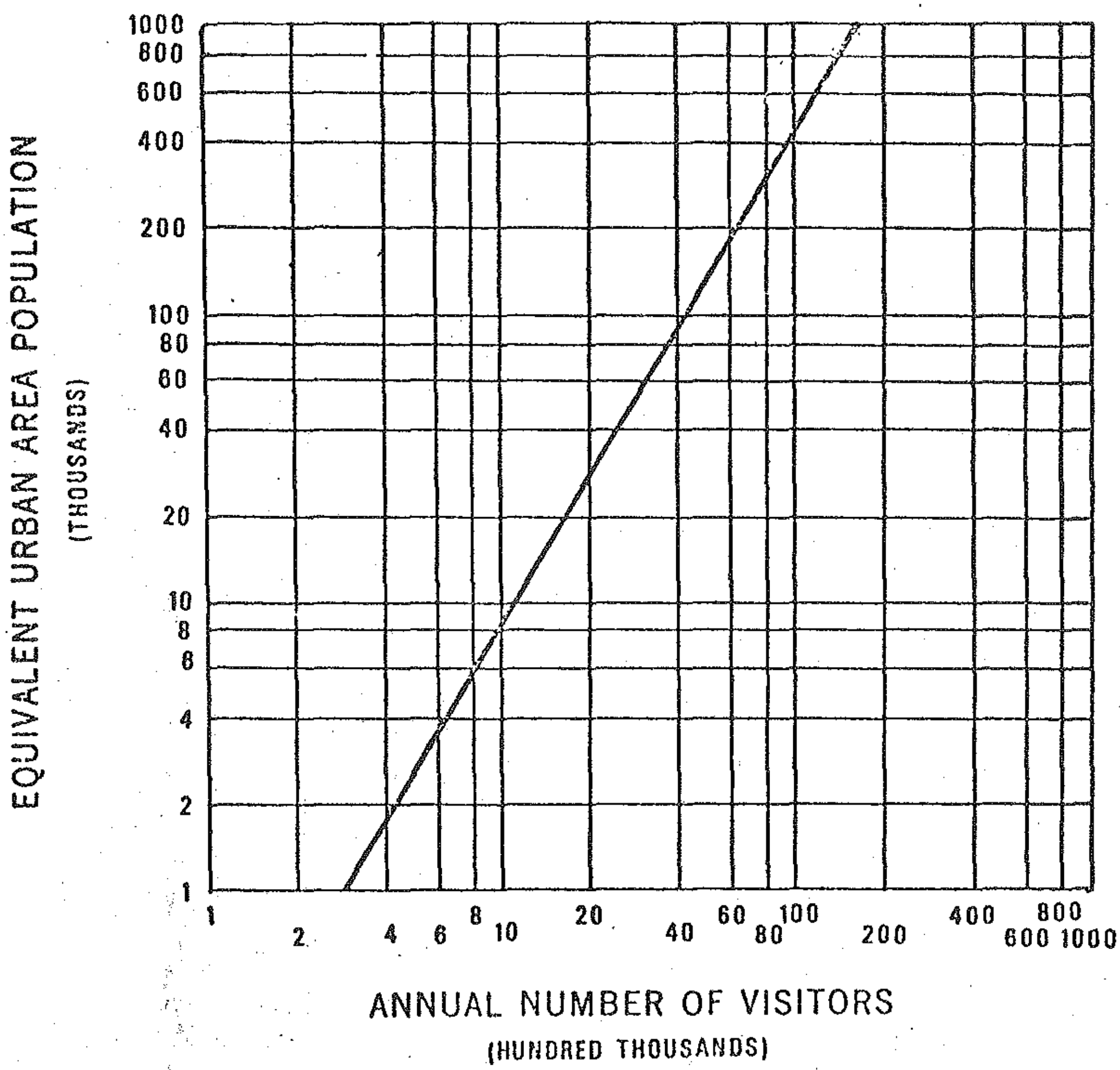

GRAPHIC RANKING AND GROUPING
OF TRAVEL GENERATORS
(FOR A TYPICAL STATE)
POPULATION
100,000
80,000
60,000
40,000
20,000
SCALE
CHANGE
6,000
5,000
4,000
3,000
2,000
1,000
0
RANK
0
5
10
15
20
25
30
35
40
45
50
GROUP I
GROUP II
GROUP III
GROUP IV
GROUP V
GROUP VI
GROUP VII

FIGURE 7

VISITATION VS. EQUIVALENT POPULATION FOR RANKING RECREATION GENERATORS



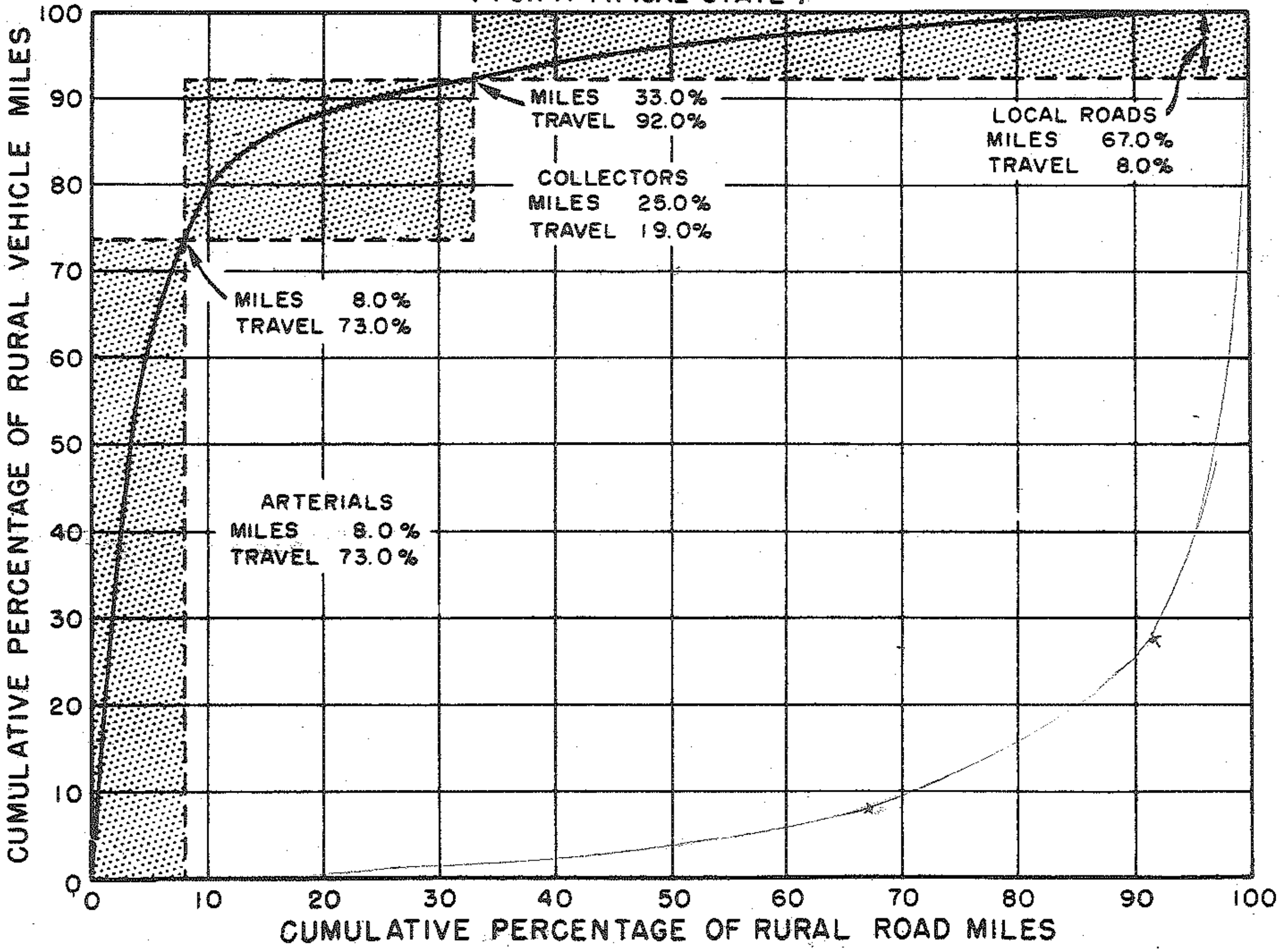
as to logically channelize the trips on the road network to represent the "real world". States having a Statewide Traffic Assignment Network and a travel model may use highway travel characteristics (average trip length, volume trip length index and vehicle miles) to evaluate the rural arterial systems. An example using vehicle miles as the travel characteristics being evaluated is shown in Figure 8 where the cumulative system mileage has been plotted against a cumulative travel characteristics which is vehicle miles of travel.

The following sections will demonstrate how the Statewide Transportation Modeling System can systematically identify and rank population centers, other travel generators, and highway travel characteristics.

FIGURE 8

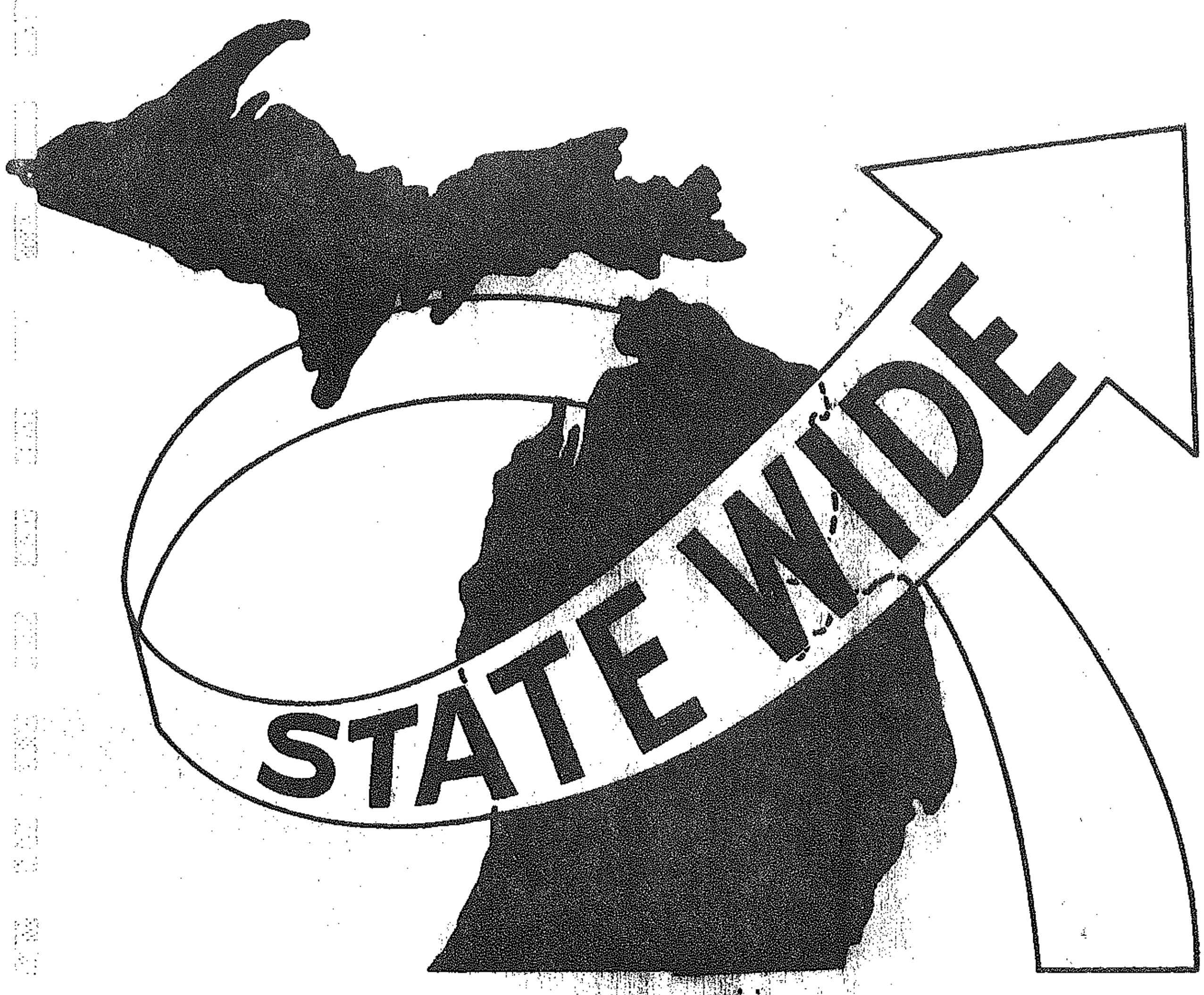
PLOT OF CUMULATIVE ROAD MILEAGE VERSUS CUMULATIVE VEHICLE MILES SERVED

(FOR A TYPICAL STATE)



IDENTIFYING AND RANKING

POPULATION CENTERS



IDENTIFYING AND RANKING POPULATION CENTERS

The previous section stated that the Federal Highway Administration found the evaluation of two elements necessary for the functional classification of any highway system. The two elements are:

1. Population Centers and Other Travel Generator Analysis
2. Highway Travel Characteristic Analysis

This section will examine the ranking of population centers and other travel generators using a statewide model.

In order to evaluate population centers and the role each plays in functional classification for a state, the population for these areas must be readily available. The statewide transportation modeling system uses the census of housing and population information as the system data base. One of the variables applied in the trip generation equations is population. This makes population for the entire state accessible by the model on a zonal basis. States without a statewide transportation modeling system are forced to use the number of inhabitants as the only element when ranking population centers. This is where a system such as Michigan's can play an effective role, since the trip generation characteristics of each area more realistically portray the area's socio-economic importance. Figure 9 shows Michigan's statewide model's 547 zone system. One page of an actual output of population and trips generated by these zones is shown in Figure 10. This type of travel data is typically used in the travel forecasting process, but may now serve a dual role in the identification and ranking of trip generators required for functional classification.

FIGURE 9

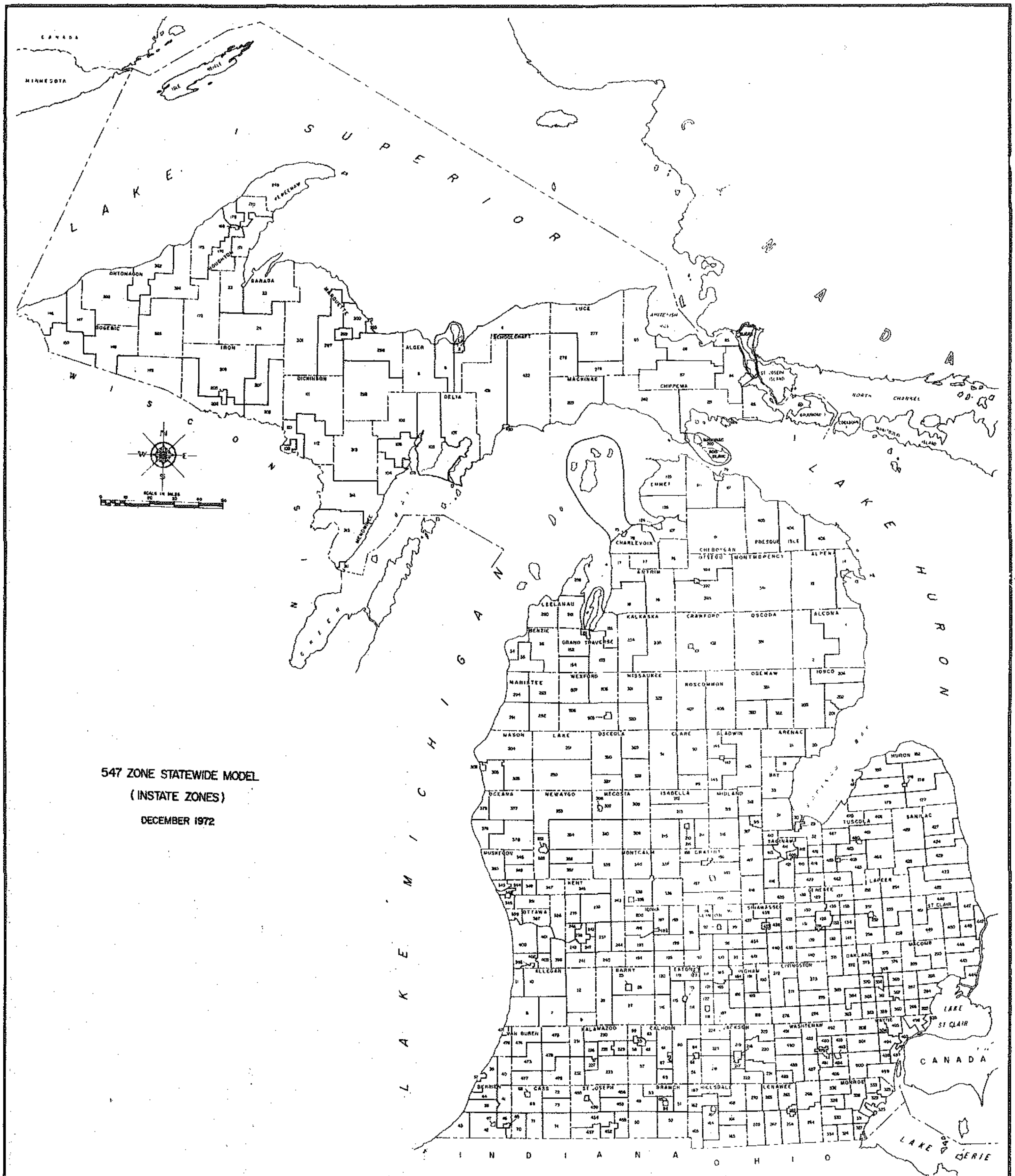

547 ZONE STATEWIDE MODEL
(INSTATE ZONES)
DECEMBER 1972
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
CANADA
WISCONSIN
INDIANA
OHIO
MINNESOTA
LAKE ERIE
LAKE ST CLAIR
NORTH CHANNEL

FIGURE 10

ZONAL TRIP GENERATION OUTPUT

ZONE		POPULATION	TRIPS GENERATED
1	101.	5466.000	7453.500
2	102.	1188.000	4139.250
3	201.	547.000	5806.000
4	202.	1842.000	1842.000
5	203.	2518.000	3791.500
6	204.	4000.000	5176.500
7	301.	10499.000	82285.000
8	302.	7225.000	20199.500
9	303.	13112.000	98584.750
10	304.	12241.000	60667.500
11	305.	4960.000	52135.750
12	306.	15273.000	87214.750
13	401.	6077.000	17798.500
14	402.	8768.000	27630.000
15	403.	14675.000	27630.000
16	501.	3295.000	7252.500
17	502.	4360.000	8216.000
18	503.	3415.000	10483.750
19	601.	4195.000	12850.000
20	602.	2842.000	11084.250
21	603.	3152.000	28222.750
22	701.	2345.000	6842.500
23	702.	4005.000	6596.250
24	703.	985.000	3158.750
25	801.	9995.000	62909.750
26	802.	10770.000	26669.250
27	803.	6450.000	50229.750
28	804.	7670.000	18275.000

Analysis of trips is the key to functional classification of a specific highway. A significant part of this analysis is where the trips on each individual highway originate. Typically, the more inhabitants a population center has, the more trips generated by that population center. There are exceptions, such as a state park which has little opulation but generates many trips. This is the reason a study was made on the population centers which generated the larger number of trips. The file partially displayed in Figure 11 contains the generated trips per population center, or zone, sorted from high to low using the statewide model trip generation data. The grouping displayed on Figure 11 is for this test only and could have been changed according to individual trip generation characteristics in each state.

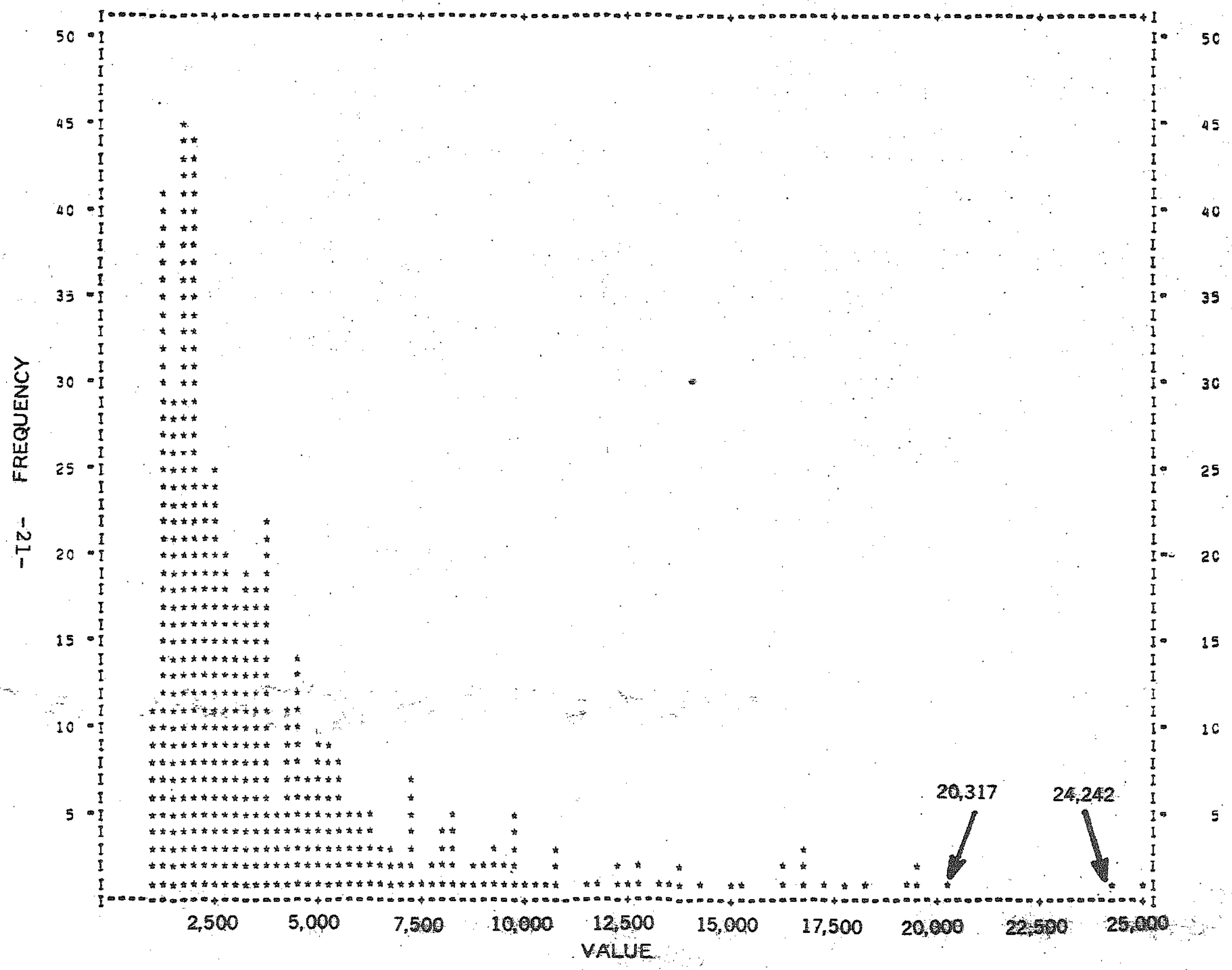
Further analysis can be made on the generated trips of each zone using histograms. (See Figures 12 and 13.) The histograms show the majority of the zones generateng between 1,000 and 5,000 trips. Note the large gap in stratification in Figures 11 and 12 between the zone generating 20,317 trips and the zone generating 24,242 trips as indicated by the arrows. For test purposes, Michigan used this gap to define the large trip generators, i.e., any zone which generated more than 20,317 trips was considered as being a large trip generator. The resulting group will be titled Group A. In Michigan, Group A would include the following:

ZONE NUMBER	LOCATION
128	Flint
183	Lansing
236	Grand Rapids
248	Grand Rapids Area
285	St. Clair Shores, Roseville
286	Warren
358-362	Pontiac and Area
370	Pontiac Area
409	Saginaw
493-498	Detroit and Area
501-504	Detroit Area

FIGURE 11
GROUPING OF ZONAL TRIP GENERATION

ZONE NUMBER	TRIPS GENERATED		GROUP	
495	174243	1	GRØUP I	GRØUP A
496	144815	2	GRØUP I	GRØUP A
493	112129	3	GRØUP I	GRØUP A
494	100204	4	GRØUP I	GRØUP A
360	56409	5	GRØUP II	GRØUP A
504	55625	6	GRØUP II	GRØUP A
497	53491	7	GRØUP II	GRØUP A
286	50764	8	GRØUP II	GRØUP A
285	46419	9	GRØUP II	GRØUP A
501	39336	10	GRØUP III	GRØUP A
502	38764	11	GRØUP III	GRØUP A
128	37563	12	GRØUP III	GRØUP A
503	35719	13	GRØUP III	GRØUP A
236	34560	14	GRØUP III	GRØUP A
358	33527	15	GRØUP III	GRØUP A
183	33369	16	GRØUP III	GRØUP A
362	30300	17	GRØUP III	GRØUP A
359	29446	18	GRØUP III	GRØUP A
361	26895	19	GRØUP III	GRØUP A
498	26692	20	GRØUP III	GRØUP A
409	25686	21	GRØUP III	GRØUP A
248	25099	22	GRØUP III	GRØUP A
370	24242	23	GRØUP III	GRØUP A
499	20317	24	GRØUP IV	
226	19594	25	GRØUP IV	
29	19465	26	GRØUP IV	
284	19350	27	GRØUP IV	
479	18197	28	GRØUP IV	
500	17831	29	GRØUP IV	
287	17329	30	GRØUP IV	
133	16827	31	GRØUP IV	

HISTOGRAM OF VARIABLE TTG



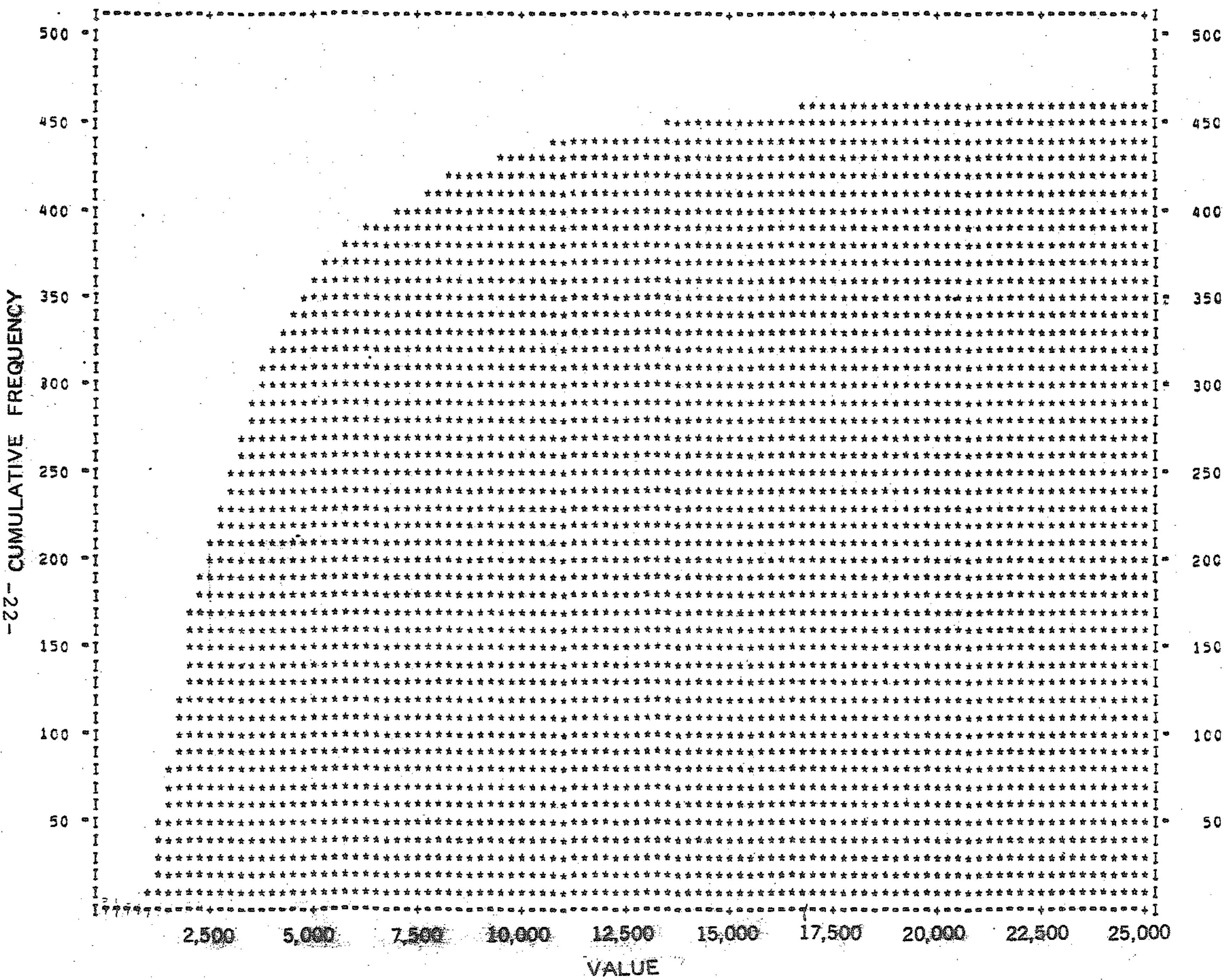
OBSERVED FREQUENCY PLOTTED AGAINST VALUE OF VARIABLE

FIGURE 12

HISTOGRAM OUTPUT

DATA DEF= TRIPSG   TOTAL TRIPS GENERATED E+7   BASIS

CUMULATIVE HISTOGRAM   TTG



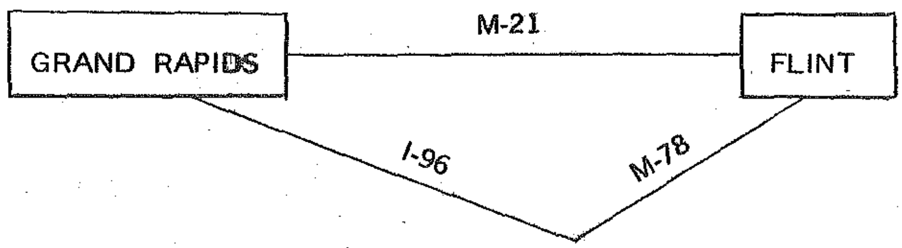
OBSERVED FREQUENCY PLOTTED AGAINST VALUE OF VARIABLE

FIGURE 13

HISTOGRAM OUTPUT

Once the major trip generators have been identified and ranked, the next step is to connect the routes on the highway network that serve them. This task is simple, provided that the connecting routes between major generators are obvious. But what if the connecting route is not obvious as shown in Figure 14.

FIGURE 14



Is the connecting route between Grand Rapids and Flint M-21, which is a shorter but slower route or I-96 to M-78, which is a longer but faster route? The decision cannot be an arbitrary one and must be based on facts. Other questions that arise include the following. What percent of the total traffic of each trunkline do the trips from these zones represent? How do these percents compare with other trunklines? The purpose of this test is to answer these and other questions about population centers and the routes connecting them. The test was conducted in the following manner.

Since only the trips from the Group A zones are going to be used for this analysis, the 547 zone trip table was modified so that the trips from the selected zones remained. All other trips were zeroed out as shown in Figure 15. Trips generated by the selected zones were loaded to a statewide network tape which has total trips for each trunkline on it. (Keep in mind that the selected zones are the zones which represent the major trip generators.) A comparison was made to

FIGURE 15

PROCESS OF ZEROING–OUT TRIPS FROM INSIGNICANT ZONES

USING THE 547 ZONE TRIP TABLE

	001–127	129–182	184–235	237–247	249–284	287–357	363–369	371–408	410–492	499–500	505–547
001–127	●										
129–182	●	●									
184–235	●	●	●								
237–247	●	●	●	●							
249–284	●	●	●	●	●						
287–357	●	●	●	●	●	●					
363–369	●	●	●	●	●	●	●				
371–408	●	●	●	●	●	●	●	●			
410–492	●	●	●	●	●	●	●	●	●		
499–500	●	●	●	●	●	●	●	●	●	●	
505–547	●	●	●	●	●	●	●	●	●	●	●

Remaining Significant Zones WITH TRIPS

- 128
- 183
- 236
- 248
- 285–286
- 358–362
- 370
- 409
- 493–498
- 501–504

Follow each ROW across to each column. If a (●) appears in that column the zones for that respective ROW and column are multiplied by zero.

determine the percentage of trips that the select zones contribute to the total trips on each trunkline. This percentage was plotted for the entire state and is shown in Figure 16. If the rural trunklines were functionally classified based only on this percentage, this figure could represent a classifiadtion of state trunklines based on the percent of travel on a route originating from major trip generators.

The percentage in Figure 16 has one assumed decimal point. The higher the percent on a trunkline, the more important is the trunkline to the population centers. In this test, that would be population centers in Group A. Compare the percent on two trunklines, I-75 and I-96 (see Figure 17). Approximately fifty percent (50%) of the travel on I-96 is from Group A. I-75 has approximately twenty percent (20%). Both are interstate routes but I-96 has a more important function in regard to the selected population centers. If desired, another group of population centers could be selected. The process would then be repeated and could be applied to all the generated trips from each of the ppopulation groups.

This type of analysis is useful in determining how important each section of road is to a state and what its function might be in regard to major trip generators. This is obviously not enough by itself so the next section will deal with functional classification from the standpoint of travel characteristics.

FIGURE 16

THE PERCENTAGE OF TRIPS GENERATED BY GROUP A

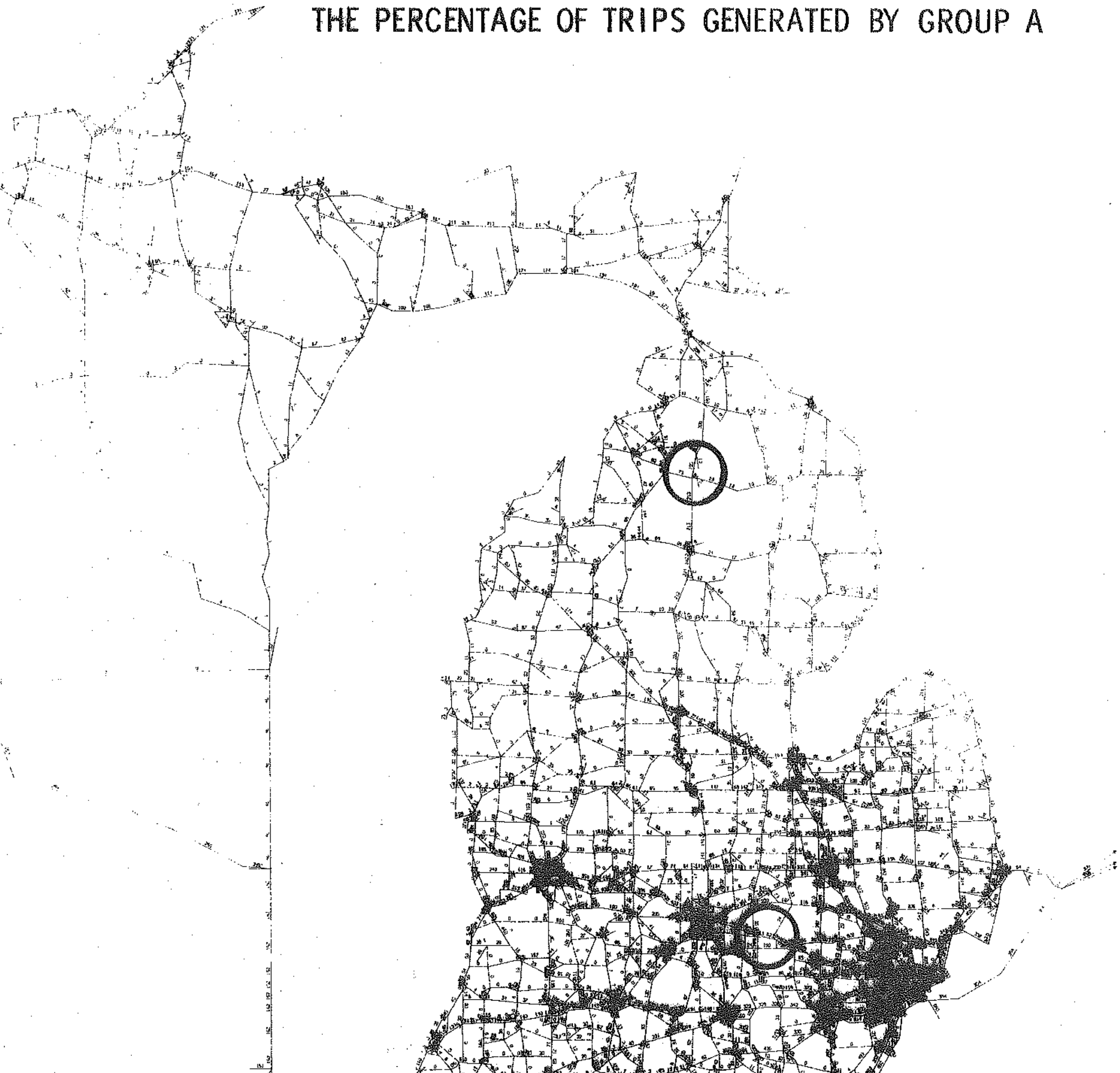
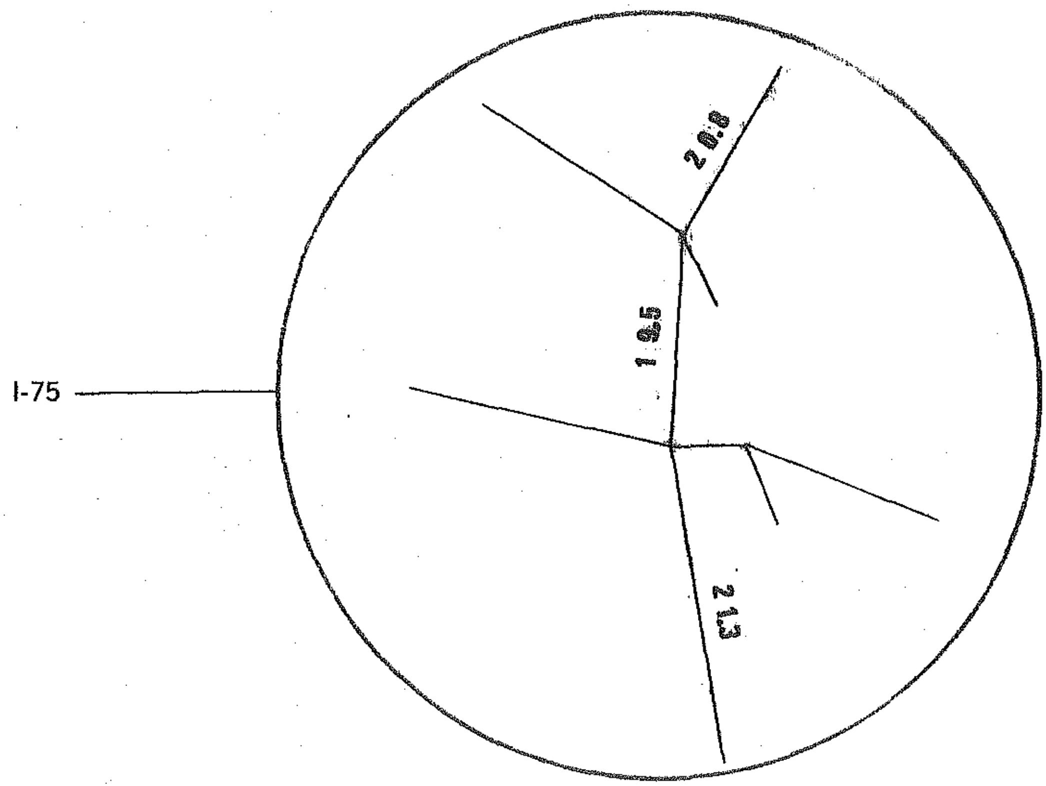
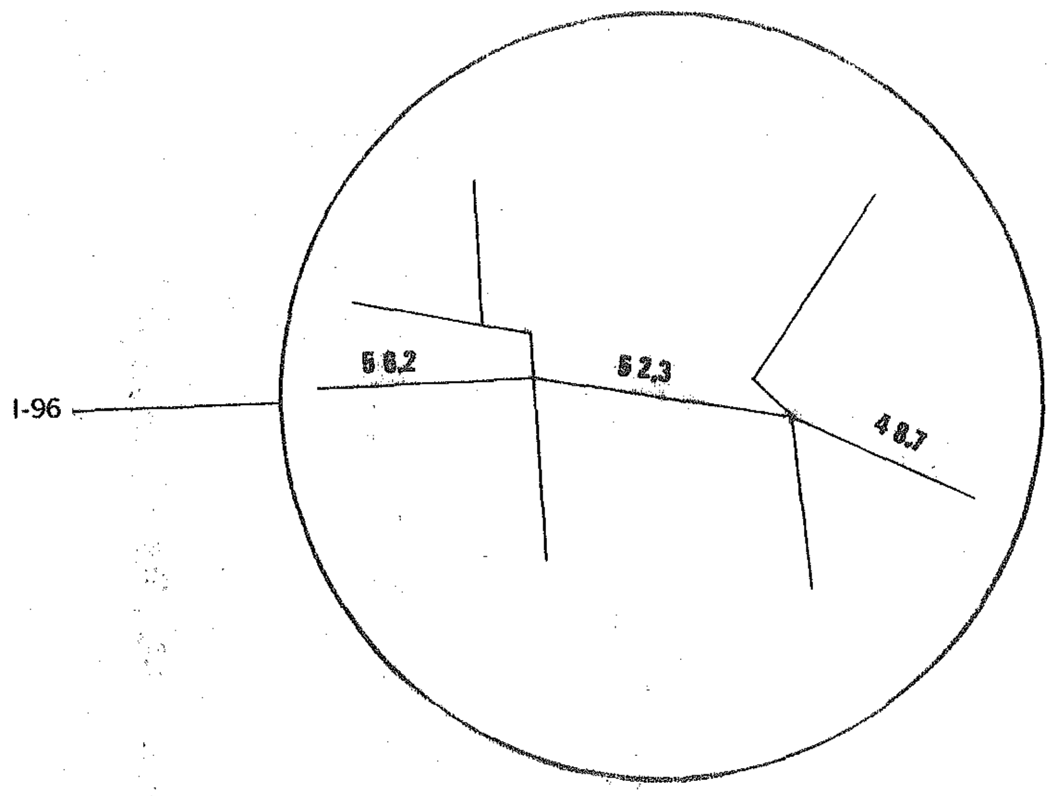


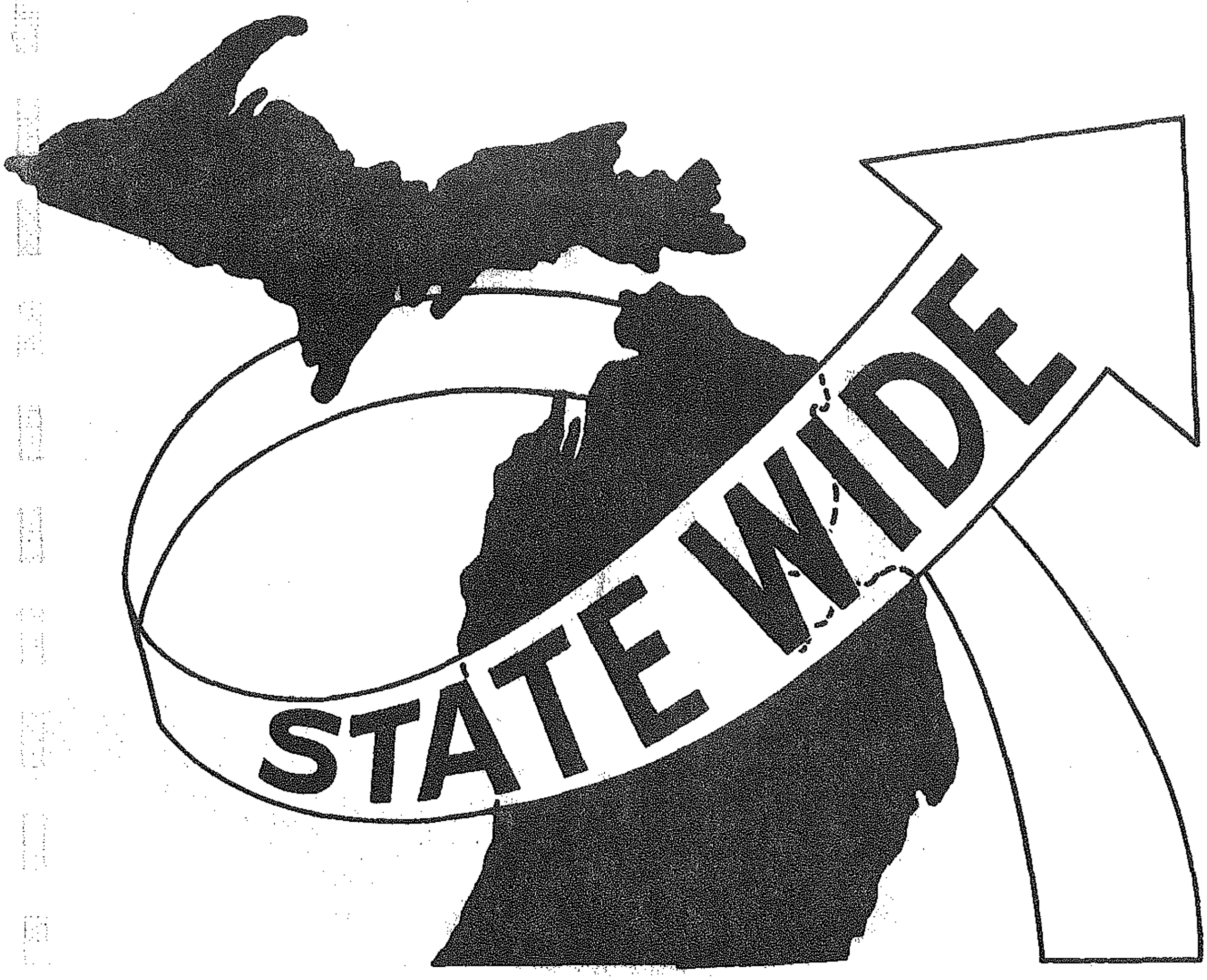
FIGURE 17

BLOW-UP OF THE PERCENTAGE OF TRIPS GENERATED BY GROUP A ON I-75 AND I-96





IDENTIFYING AND RANKING HIGHWAY TRAVEL CHARACTERISTICS



IDENTIFYING AND RANKING

HIGHWAY TRAVEL CHARACTERISTICS

The type of travel a trunkline serves varies from recreational trips, to commercial trips, to work trips. The kind of travel on a trunkline identifies the trunkline characteristics. Trunklines with similar travel characteristics often carry the same functional classification. Some examples of travel characteristic data which are useful in functional classification are average trip length, vehicle miles, and volume data. This type of data is readily available from any statewide transportation modeling system as independent variables in the analysis of functional classification.

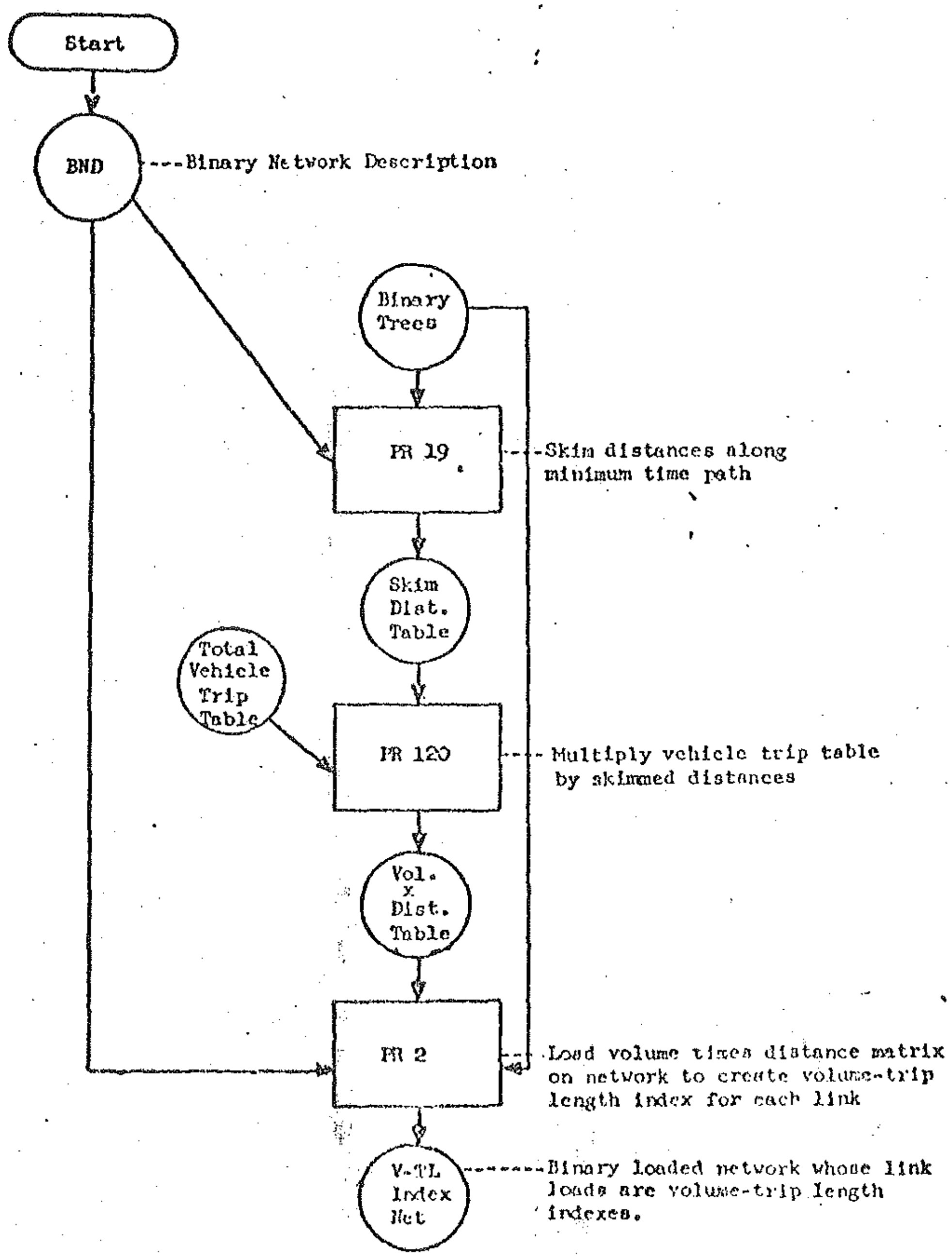
The Federal Highway Administration has developed a procedure using a combination of these variables for determining a volume - trip index measurement using a computerized highway network and a combination of these values. (See Figure 18.) This procedure was followed using Michigan's Statewide Transportation Modeling System as described in the following paragraphs.

A skim tree was built from an existing loaded network. The skim trees were determined by the shortest distance. The output consists of a zone to zone distance matrix over the minimum time path for each zone. Figure 19 is an example of the skim tree output for zone number 1. The circled area in Figure 19 shows that the shortest distance from Zone 1 to Zone 102 is 91 miles.

The total trip table matrix from the loaded network is shown in Figure 20. The circled area in Figure 20 shows that the total trips from Zone 1 to Zone 102 is 1,380. This matrix is multiplied by the

FIGURE 18

FLOW OF OPERATIONS FOR COMPUTING VOLUME-TRIP LENGTH INDEX



INTE NGE UES ZO 1 ALL R Z TABL UMB 01

	0	1	2	3	4	5	6	7	8	9
0		0	30	279	274	297	285	291	305	271
1	286	289.	284	35	38	50	118	153	143	73
2	61	77	390	394	379	236	241	232	250	101
3	98	102	105	83	175	169	164	317	331	315
4	305	320	334	341	319	324	326	330	260	274
5	273	266	268	263	261	241	242	258	244	243
6	238	238	243	238	232	249	232	236	309	312
7	324	322	296	308	310	153	134	133	157	115
8	139	111	121	211	213	234	224	193	212	127
9	119	123	172	184	179	184	158	204	177	167
10	201	86	91	301	304	294	296	281	296	353
11	353	382	347	214	214	217	228	196	211	204
12	222	201	210	201	137	153	135	132	147	134
13	147	148	153	151	152	151	147	141	138	154
14	161	162	98	96	101	107	481	471	458	429
15	476	139	147	143	145	130	149	160	141	164
16	156	265	261	269	266	279	262	262	251	419
17	434	436	398	421	421	432	154	178	166	137
18	153	142	171	191	188	201	204	210	201	198
19	184	187	199	226	223	218	204	201	189	213
20	202	39	35	54	28	398	408	386	382	407
21	142	141	131	138	143	152	231	234	242	231
22	223	241	240	240	219	213	269	271	263	253
23	255	276	276	269	112	106	255	223	217	228
24	247	260	222	203	215	211	230	251	255	460
25	185	171	161	171	157	151	171	163	182	166
26	161	146	236	234	238	237	228	262	243	259
27	245	180	188	174	186	179	197	237	233	232
28	165	198	181	211	201	211	201	194	206	196
29	210	186	168	170	180	322	318	341	330	333
30	332	353	210	200	203	209	179	169	150	161
31	184	354	328	350	328	117	131	119	121	123
32	130	128	111	236	240	230	221	246	228	237
33	229	238	216	233	235	195	177	173	198	188
34	181	78	244	249	243	250	232	225	241	236
35	243	240	221	197	204	223	213	211	178	196
36	198	190	198	191	185	181	184	194	188	179
37	174	162	164	172	184	185	236	214	226	223
38	76	67	64	443	428	416	463	168	158	139
39	159	50	104	107	118	278	232	243	264	253
40	285	271	279	274	75	94	54	100	86	112
41	115	112	110	116	127	118	133	130	148	115
42	142	128	128	191	179	171	153	158	163	167
43	249	256	248	165	173	160	163	159	143	147
44	165	173	208	232	226	205	205	203	185	195
45	197	183	287	270	287	291	276	302	290	285
46	132	139	134	134	142	119	137	124	135	125
47	125	305	292	297	299	292	309	303	287	195
48	196	199	194	204	206	198	208	210	223	222
49	211	202	192	217	210	206	208	216	217	222
50	219	210	207	213	203	138	143	151	137	231
51	241	233	355	355	485	508	437	425	360	375
52	541	622	479	532	647	446	408	457	393	378
53	340	321	305	337	350	284	287	249	293	283
54	293	542	515	859	768	705	532	544		

TOTAL = 124074. MEAN = 226.826

MICHIGAN STATEWIDE 1965 540 ZONE SKIM TREE MATRIX

FIGURE 19

SKIM TREE OUTPUT

MICHIGAN STATEWIDE 1965 540 ZONE MINIP MATRIX E-7

INTERCHANGE VALUES FROM ZONE 1 TO ALL OTHER ZONES TABLES NUMBER 101

	0	1	2	3	4	5	6	7	8	9
0		0	263395	111	127	91	20	229	235	240
1	204	77	288	279230	97239	36154	537	718	710	3286
2	12075	3977	32	67	35	177	291	198	309	3690
3	1432	2247	1189	4838	244	308	266	234	203	190
4	211	87	134	257	172	156	158	85	130	62
5	131	92	143	133	92	428	89	129	222	202
6	125	96	124	142	71	29	179	91	85	137
7	109	97	60	67	132	523	787	812	480	3367
8	1555	1972	1904	692	130	272	210	270	117	530
9	900	726	272	148	127	175	239	165	213	170
10	317	1184	1380	130	32	39	127	38	57	87
11	29	53	56	133	109	113	126	261	71	111
12	104	78	98	119	1774	2414	953	809	4367	532
13	1294	827	655	1012	489	188	934	383	400	402
14	970	203	755	1889	735	876	83	47	25	16
15	51	1445	688	648	119	429	761	478	675	362
16	157	129	107	127	92	109	98	89	117	48
17	110	48	48	16	28	52	377	859	463	726
18	607	901	830	2308	451	309	255	218	143	150
19	128	208	167	57	146	62	137	121	189	137
20	178	45398	136360	12377	662423	61	36	47	19	59
21	689	345	324	435	247	439	575	317	230	271
22	324	176	87	69	113	170	850	269	124	59
23	248	61	33	263	594	450	1249	137	375	172
24	144	215	125	141	176	301	148	295	528	279
25	332	119	152	356	239	336	257	168	210	764
26	523	728	382	150	199	85	356	201	182	159
27	126	330	239	229	330	254	182	191	76	144
28	345	192	153	109	870	1616	1358	853	289	313
29	374	780	150	340	364	192	101	57	127	109
30	38	74	341	221	252	175	357	177	332	346
31	155	191	79	169	83	2206	1347	820	693	597
32	1092	316	505	360	155	88	91	133	210	299
33	122	44	86	170	52	207	472	475	195	224
34	322	13316	471	369	149	238	88	106	181	115
35	253	176	113	228	224	102	183	216	1351	772
36	2503	771	738	468	529	501	424	323	434	248
37	1099	273	159	486	488	231	208	326	205	103
38	5147	3877	6302	92	52	128	172	343	452	397
39	241	13378	724	833	897	173	145	68	152	226
40	146	107	146	98	19956	3046	17340	2785	3476	4193
41	314	1940	779	519	375	568	440	808	380	204
42	458	564	385	444	351	436	581	413	527	611
43	130	37	171	558	126	278	267	220	117	104
44	82	138	1153	438	541	165	95	304	255	197
45	109	214	191	97	146	87	118	113	66	94
46	349	433	477	430	291	457	768	523	413	638
47	381	101	173	160	164	90	94	71	192	1170
48	97	179	197	401	363	103	223	167	109	85
49	157	120	181	4233	1829	5123	4149	1731	584	622
50	574	1442	1337	724	874	910	310	165	431	1352
51	1053	898	2880	4537	170	381	540	171	110	342
52	1705	2887	1460	2477	1043	5456	2773	2316	1461	636
53	1550	487	1186	1346	2689	496	892	1671	2029	5757
54	591	139	266	183	134	241	654	521		

TOTAL = 1908650 MEAN = 3489.305

FIGURE 20

TOTAL TRIP TABLE MATRIX

skim tree matrix, which will result in a new matrix of zone-to-zone trips times zone-to-zone distance. (See Figure 21.) The circled area shows that the value from Zone 1 to Zone 102 is 125,580. The resulting matrix is loaded to the network. The value assigned to each link is that links "volume - trip length index". A plot of the assigned value was prepared for the entire state. A portion of that plot appears in Figure 22.

The "average trip length" per link was computed by dividing the volume trip length index per link by the total traffic assigned per link. This value was plotted for the entire state. (See Figure 23.)

The average trip length for each link is also shown in a bandwidth plot for the entire state. (See Figure 24.) Bandwidth is a plotting technique used as a visual aid. The width of the band for each link is determined by the value or range of values being plotted as specified. For our plots, the value or range of values for each band will be listed in the title block.

The average trip length is in miles and is in a network file which is sorted from largest to smallest average trip length. If classification were to be made based on average trip length, the higher values would indicate the more important roads in a state trunkline system.

The term "vehicle miles" refers to the amount of travel by one motor vehicle traveling one mile and includes all highways and streets. As it was stated earlier, the guidelines for cumulative vehicle miles and cumulative road mileage in classification studies remain consistent for a typical state. They are as follows:

INTERCHANGE VALUES FROM ZONE 1 TO ALL OTHER ZONES TABLES NUMBER 101

	0	1	2	3	4	5	6	7	8	9
0		0	7901850	30969	34798	27027	5700	66639	71675	65040
1	58344	22253	81792	9773050	3695082	1807700	63366	109854	101530	239878
2	736575	306229	12480	26398	13265	41772	70131	45936	77250	372690
3	140336	229194	124845	401554	42700	52052	43624	74178	67193	59850
4	64355	27840	44756	87637	54868	50544	51508	28050	33800	16988
5	35763	24472	38324	34979	24012	103148	21538	33282	54168	49086
6	29750	22848	30132	33796	16472	7221	41528	21476	26265	42744
7	35316	31234	17760	20636	40920	80019	105458	107996	75360	387205
8	216145	218892	230384	146012	27690	63648	47040	52110	24804	67310
9	107100	89298	46784	27232	22733	32200	37762	33660	37701	28390
10	63717	101824	125580	39130	9728	11466	37592	10678	16872	30711
11	10237	20246	19432	28462	23326	24521	28728	51156	14981	22644
12	23088	15678	20580	23919	243038	369342	128655	106788	641949	71288
13	190218	122396	100215	152812	74328	23388	137298	54003	55200	61908
14	156170	32886	73990	181344	74235	93732	39923	22137	11450	6864
15	24276	200855	101136	92664	17255	55770	113389	76480	95175	59368
16	24492	34185	27927	34163	24472	30411	25676	23318	29367	20112
17	47740	20928	19104	6736	11788	22464	58058	152902	76858	99462
18	92871	127942	141930	440828	84788	62109	52020	45780	28743	29700
19	23552	38896	33233	12882	32558	13516	27948	24321	35721	29181
20	35956	1770522	4772600	668358	18547844	24278	14688	18142	7258	24013
21	97838	48645	42444	60030	35321	65728	132825	74178	55660	62601
22	72252	42416	20880	16560	24747	36210	228650	72899	32612	14927
23	63240	16836	9108	70747	66528	47700	313495	30551	81375	39216
24	35568	55900	27750	28623	37840	63511	34040	74045	134640	128340
25	61420	20349	24472	60876	37523	50736	43947	27384	38220	126824
26	84203	106288	90152	35100	47362	20145	81168	52662	44226	41181
27	30870	59400	44932	39846	61380	45466	32854	45267	17708	33408
28	56925	38016	27693	22999	174870	340976	272958	165482	59534	61348
29	78540	145080	25200	57800	65520	61824	32118	19437	41910	36297
30	12616	26122	71610	44200	51156	36575	63903	29913	49800	55706
31	28520	67614	25912	59150	27224	258102	170457	97580	83853	73431
32	141960	40448	56055	84960	37200	20240	20111	32718	47880	70863
33	27938	10472	18576	39610	12220	40365	83544	82175	38610	42112
34	58282	1038648	114924	91881	36207	59500	20416	23850	31571	27140
35	61479	42240	24973	44916	45696	22746	38979	45576	240478	151312
36	495594	146490	146124	89388	97865	90681	78016	62662	81592	44392
37	171226	44226	26076	83592	89792	42735	49088	69764	46330	22969
38	391172	259759	403328	40756	22256	53248	79636	57624	71416	55183
39	38319	668900	75296	89131	105846	48094	33640	16524	40128	57178
40	41610	28997	40734	26852	1496700	286324	936360	278500	298936	469616
41	36110	217280	85690	60204	47625	67024	58520	105040	56240	23460
42	65036	72192	49280	84804	62829	74556	88893	65254	85901	102037
43	32370	9472	42408	92070	21798	44480	43521	34980	16731	15288
44	13530	23874	239824	101616	122266	33825	19475	61712	47175	38415
45	21473	39162	54817	26190	41902	25317	32568	34126	19140	26790
46	46068	60187	63918	57620	41322	54383	105216	64852	55755	79750
47	47625	30805	50516	47520	49036	26280	29046	21513	55104	228150
48	19012	35621	38218	81804	74778	20394	46384	35070	24307	18870
49	33127	24240	34752	918561	384090	1055338	862992	373896	126728	138084
50	125706	302820	276759	154212	177422	125580	44330	24915	59047	312312
51	253773	209234	1022400	1610635	82450	193548	235980	72675	39600	128250
52	922405	1795714	699340	1317764	674821	2433376	1131384	1058412	574173	240408
53	527000	156327	361730	453602	941150	140364	256004	416079	594497	1629231
54	1731923	75338	136990	157197	102912	169905	347928	283424		

TOTAL = 115739630 MEAN = 211589.817

FIGURE 21

VOLUME - TRIP LENGTH INDEX ZONE TO ZONE

FIGURE 22

VOLUME - TRIP LENGTH INDEX PLOT

FIGURE 23

AVERAGE TRIP LENGTH VOLUME FOR EACH LINK

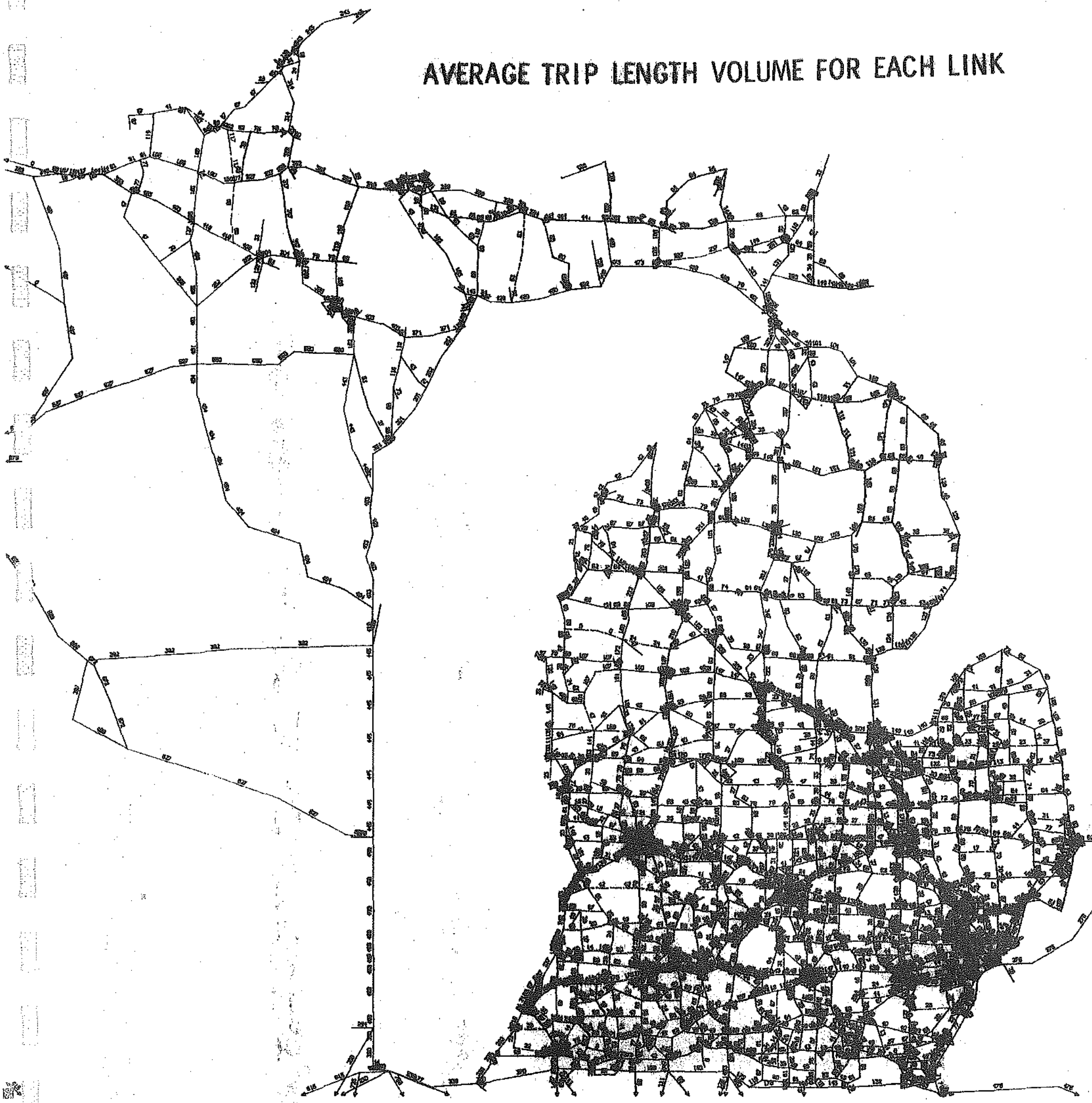
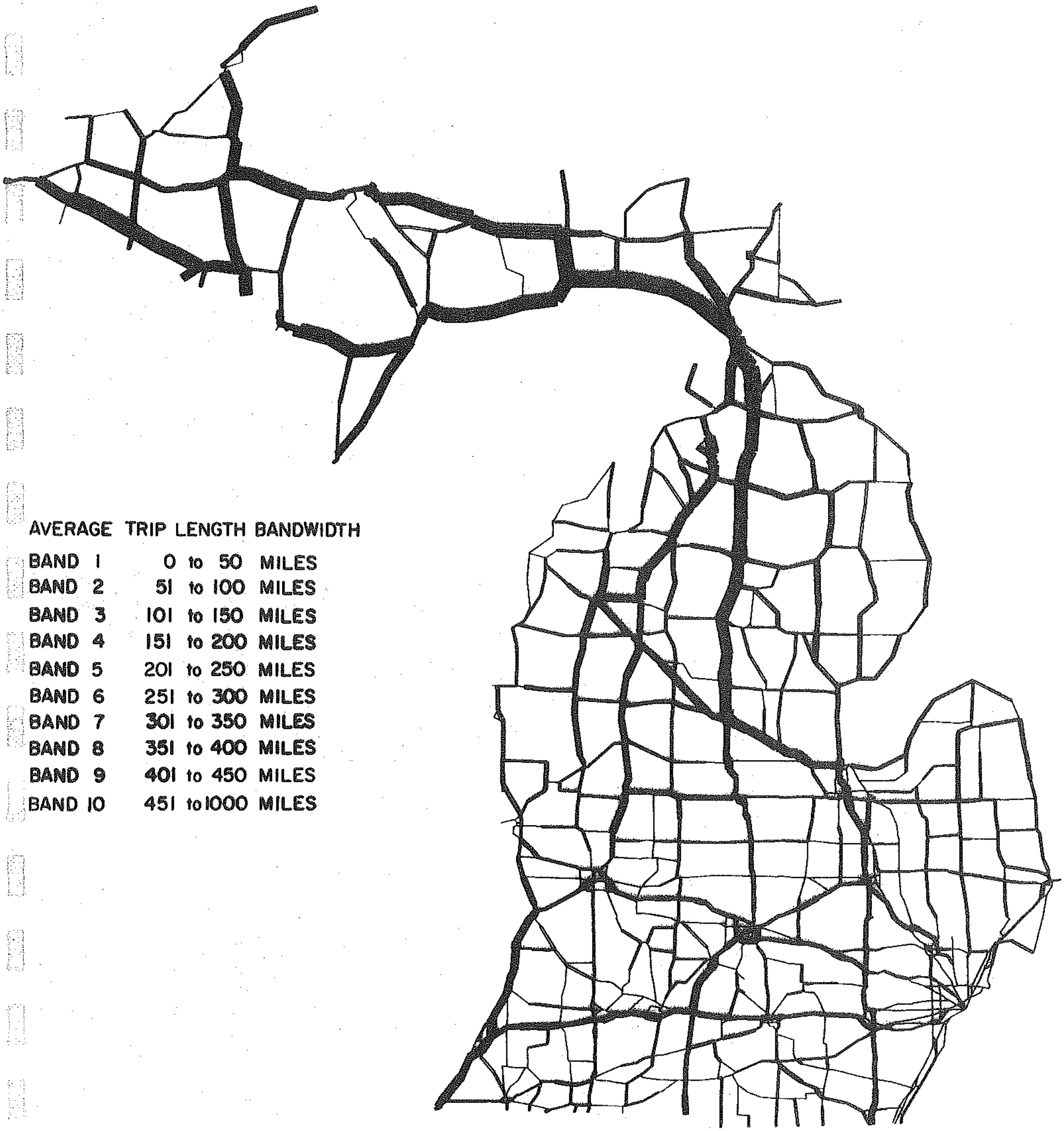


FIGURE 24


AVERAGE TRIP LENGTH BANDWIDTH
BAND 1 0 to 50 MILES
BAND 2 51 to 100 MILES
BAND 3 101 to 150 MILES
BAND 4 151 to 200 MILES
BAND 5 201 to 250 MILES
BAND 6 251 to 300 MILES
BAND 7 301 to 350 MILES
BAND 8 351 to 400 MILES
BAND 9 401 to 450 MILES
BAND 10 451 to 1000 MILES

Arterials - Represent 8% of the total rural road miles and 73% of the vehicle miles

Collectors - Represent 25% of the total rural road miles and 19% of the vehicle miles

Local Roads - Represent 67% of the total rural road miles and 8% of the vehicle miles

The application of these guidelines using the Statewide Transportation Modeling System was made in the following manner.

The vehicle miles per link were added to the network by multiplying the link mileage times the link assignment. The results were totaled by a summary program and that total was also added to each link of the network. Each link's vehicle miles were divided by the total vehicle miles for the entire state starting with the link with the highest average trip length and proceeding to the smallest. The percentage that each link was of the total was cumulated after each division. The network's links remain sorted by average trip length so the links with higher average trip length are cumulated first. (See Figure 25.)

Using the vehicle mile guidelines, the cumulative percentage was separated at eight percent (8%) and thirty-three percent (33%). A number was assigned each percentage group as follows:

Number 1 - Assigned to all links with a cumulative vehicle mile percentage between 0% and 8%

Number 2 - Assigned to all links with a cumulative vehicle mile percentage greater than 8% but less than 33%

Number 3 - Assigned to all links with a cumulative vehicle mile percentage greater than 33%.

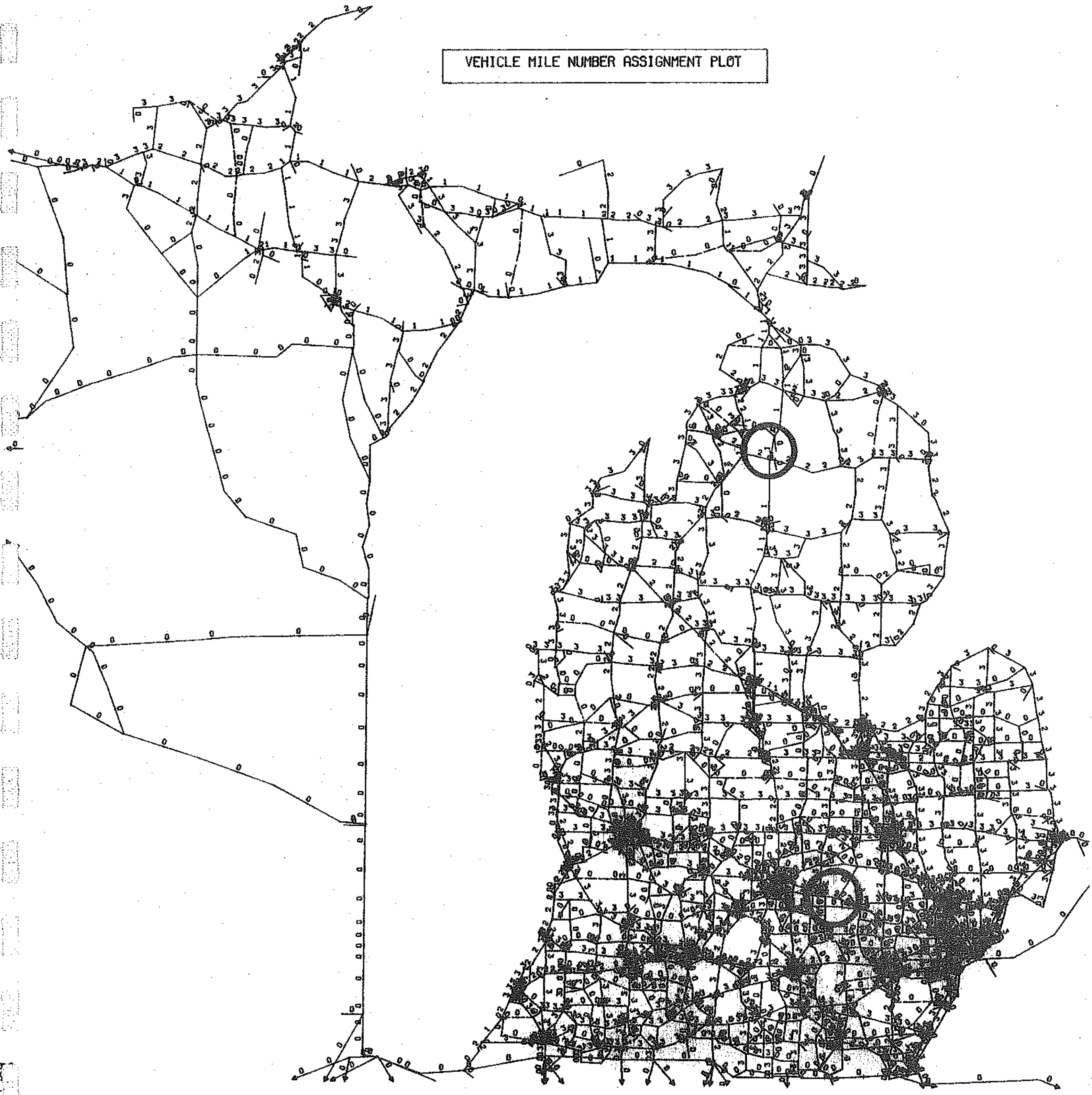
The number assignment for each link was loaded to the network and plotted. (See Figure 26.) Compare the circled areas of two roads,

FIGURE 25

AVERAGE TRIP LENGTH FILE SORTED HIGH TO LOW

LINK V.M.T.	A.T.L.	TOTAL V.M.	% TOTAL	CUM TOTAL
1520670	00000490	2382679192	0.06	0.06
3886480	00000489	2382679192	0.16	0.23
2586610	00000489	2382679192	0.11	0.34
1574400	00000489	2382679192	0.07	0.40
3904600	00000473	2382679192	0.16	0.57
836100	00000473	2382679192	0.04	0.60
1134236	00000465	2382679192	0.05	0.65
2496971	00000465	2382679192	0.10	0.75
2477700	00000465	2382679192	0.10	0.86
1238680	00000463	2382679192	0.05	0.91
592620	00000462	2382679192	0.02	0.93
243390	00000457	2382679192	0.01	0.94
4750350	00000451	2382679192	0.20	1.14
2228700	00000450	2382679192	0.09	1.24
2639250	00000450	2382679192	0.11	1.35
1839600	00000449	2382679192	0.08	1.42
529000	00000441	2382679192	0.02	1.45
486680	00000441	2382679192	0.02	1.47
1597580	00000441	2382679192	0.07	1.53
5313000	00000440	2382679192	0.22	1.76
6337650	00000440	2382679192	0.27	2.02
160020	00000438	2382679192	0.01	2.03
1606020	00000428	2382679192	0.07	2.10
1276580	00000428	2382679192	0.05	2.15
152829	00000423	2382679192	0.01	2.16
2998230	00000422	2382679192	0.13	2.28
455060	00000416	2382679192	0.02	2.30
837900	00000415	2382679192	0.04	2.34
782250	00000415	2382679192	0.03	2.37
883920	00000408	2382679192	0.04	2.41
1572089	00000406	2382679192	0.07	2.47

FIGURE 26

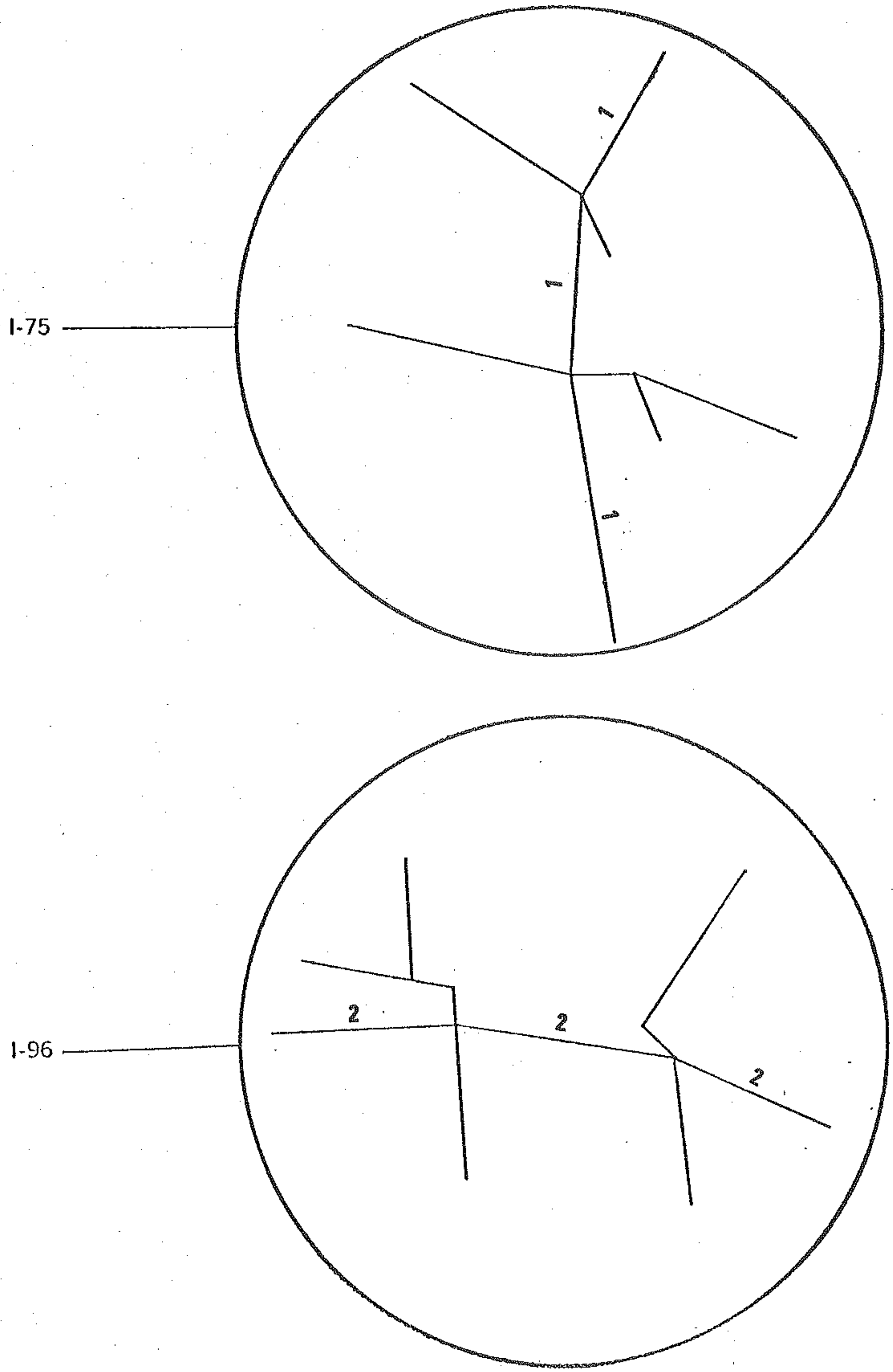


I-96 and I-75 in Figure 27. It is known that both roads are interstate routes, and it is expected that they would be functionally classified the same, but, the plot shows that if a classification were to be made based on travel characteristics alone, the two roads would differ.

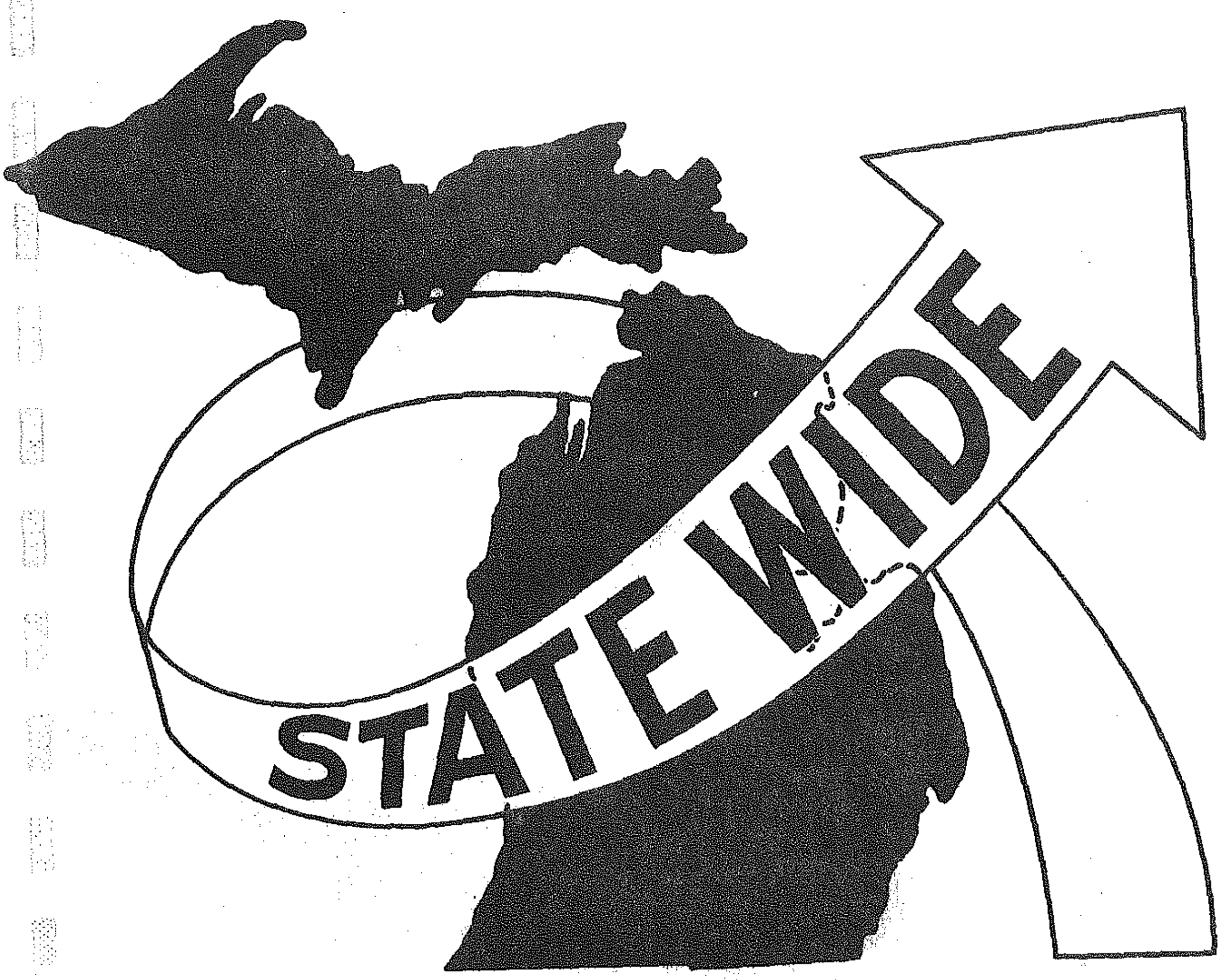
The exercise above has shown, however, that data such as the volume - trip length index, average trip length, and vehicle miles of a road, can be measured on a link by link basis using Michigan's Statewide Transportation Modeling System. The next portion of the report is a preliminary attempt at combining the analysis completed in the previous section with the travel characteristic analysis in this section to obtain a total data base for functional classification.

FIGURE 27

BLOW-UP OF VEHICLE MILE NUMBER ASSIGNMENT FOR I-75 AND I-96



COMBINING THE ANALYSIS OF POPULATION CENTERS AND HIGHWAY TRAVEL CHARACTERISTICS



COMBINING THE ANALYSIS OF POPULATION CENTERS AND HIGHWAY TRAVEL CHARACTERISTICS

Functional classification of a road according to its character of service requires looking at more than one variable. This section will deal with the combining of both zonal ranking data and individual route travel characteristics. The combination could be used to assist in functional classification of rural state trunkline networks on a system level.

In the travel characteristic section, a number assignment was given to the cumulative vehicle mile percentage on each link. The number assignment was as follows:

Number 1 - Assigned to all links with a cumulative vehicle mile percentage between 0% and 8%

Number 2 - Assigned to all links with a cumulative vehicle mile percentage greater than 8% but less than 33%

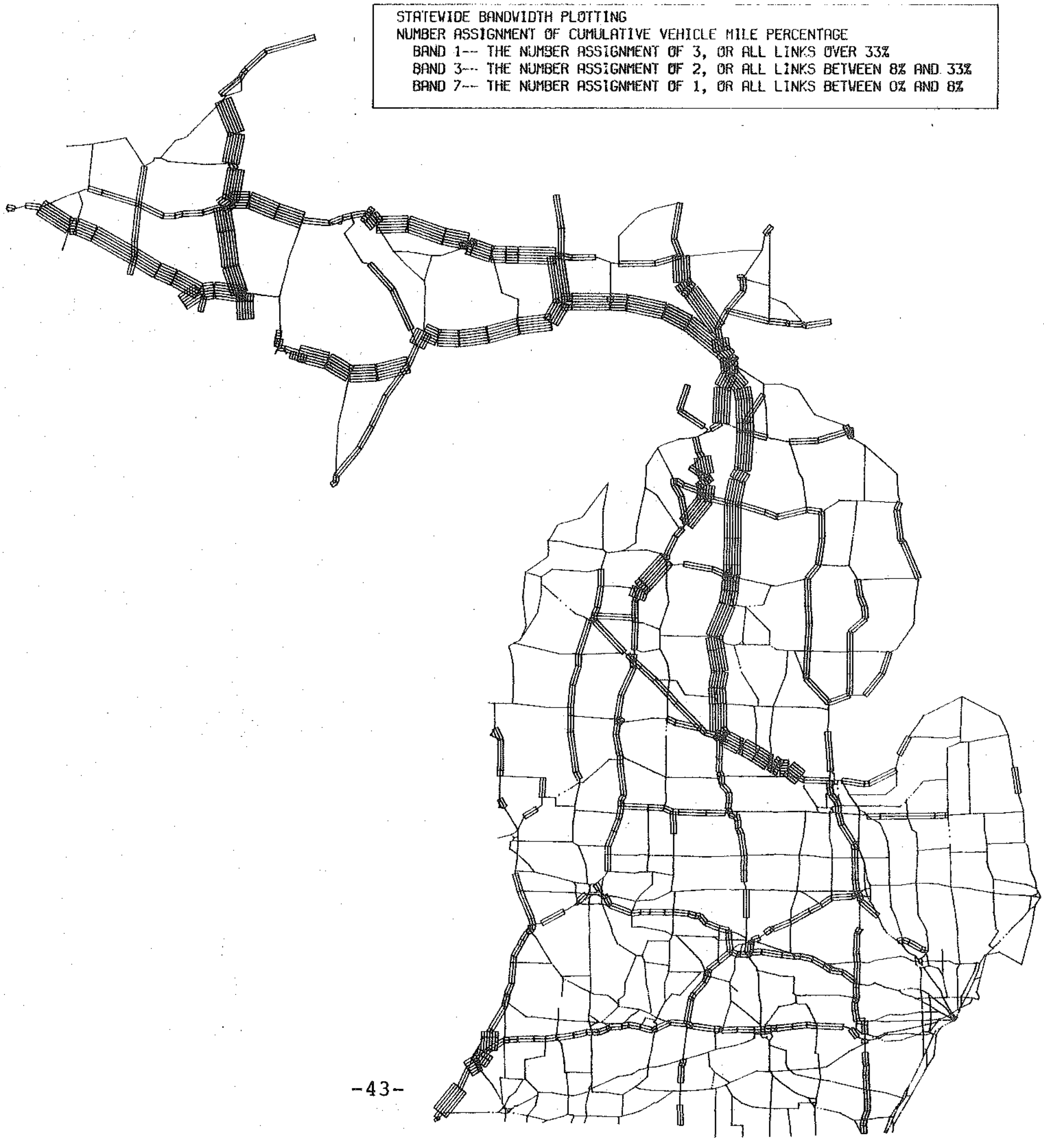
Number 3 - Assigned to all links with a cumulative vehicle mile percentage greater than 33%.

Figure 28 is a Statewide bandwidth plot of this number assignment. If a similar number assignment were given to the link percentage of trips generated by zones of Group A in the zonal importance section, a combination of the two number assignments could be made.

For test purposes, the following number assignment was made for the percentage of trips generated from zones in Group A. (The higher the percentage, the more important a link is to the zones in Group A.) This number assignment was loaded to the network and plotted

FIGURE 28

THE NUMBER ASSIGNMENT OF THE CUMULATIVE VEHICLE MILE PERCENTAGE



using bandwidth for the entire state. (See Figure 29.)

Number 1 - Assigned to all links 30% and over

Number 2 - Assigned to all links between 20% and 30%

Number 3 - Assigned to all links between 0% and 20%.

Each link on the network has a number assigned to it for zonal importance and one for travel characteristics. The two were utilized in combination by averaging. This average was plotted in bandwidth for the state. (See Figure 30.)

Figure 30 shows the results of the preceding two sections on one plot. The user now has the ability to look at as many variables, for assisting him in functional classification of rural trunklines, as are available to the Statewide Transportation Modeling System. Variables such as zonal importance and route characteristics can be monitored separately or in combination. Figure 30 demonstrates that the Statewide Transportation Modeling System can greatly assist in functional classification of areas where the generated trips from population centers follow typical trip generation patterns. The areas which do not follow these patterns have a relatively small population but generate a large number of trips. They are known as special interest areas. So far, they have not been examined for functional classification purposes using a Statewide Model.

FIGURE 29

THE NUMBER ASSIGNMENT OF THE PERCENTAGE OF TRIPS GENERATED BY GROUP A

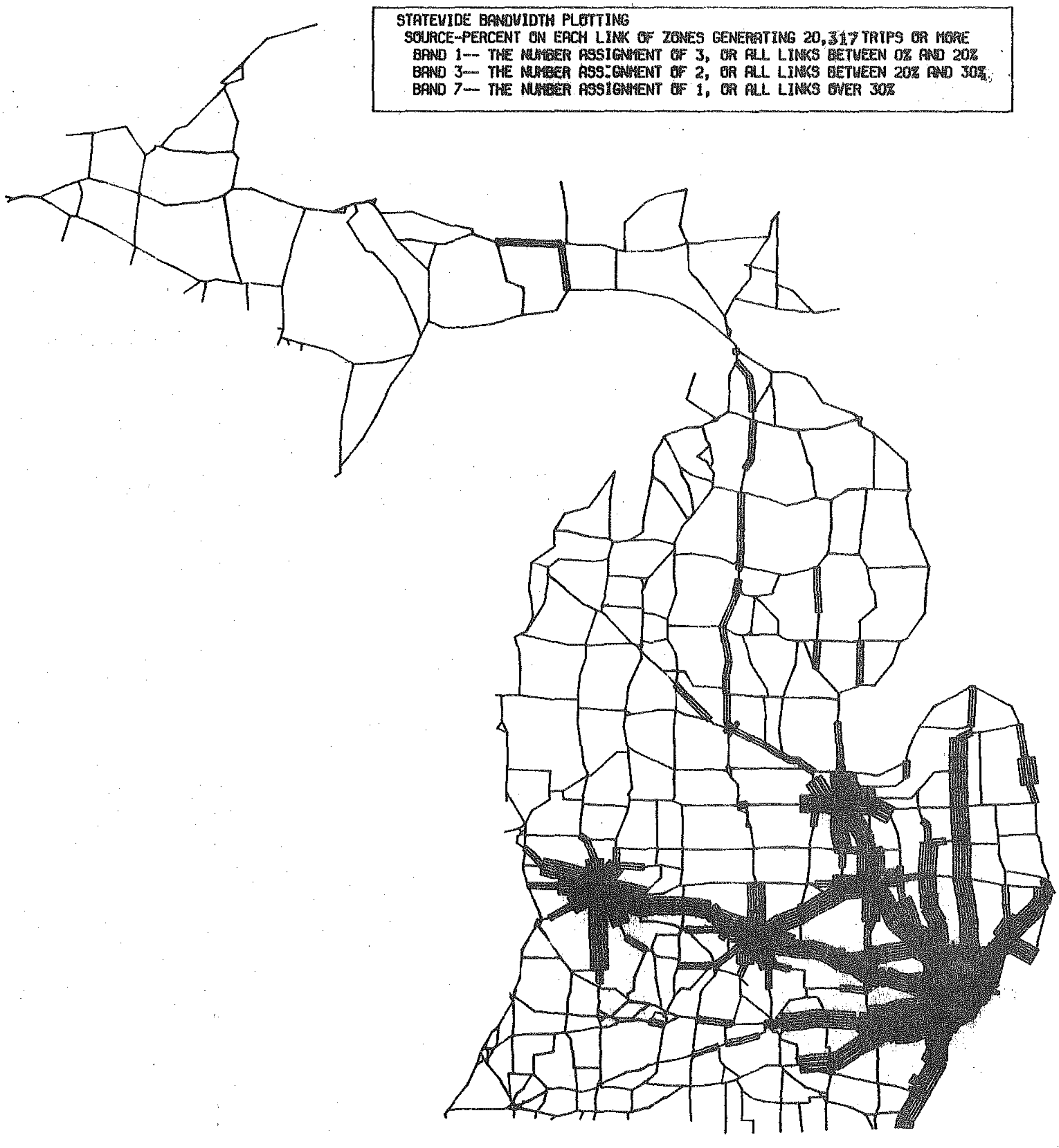
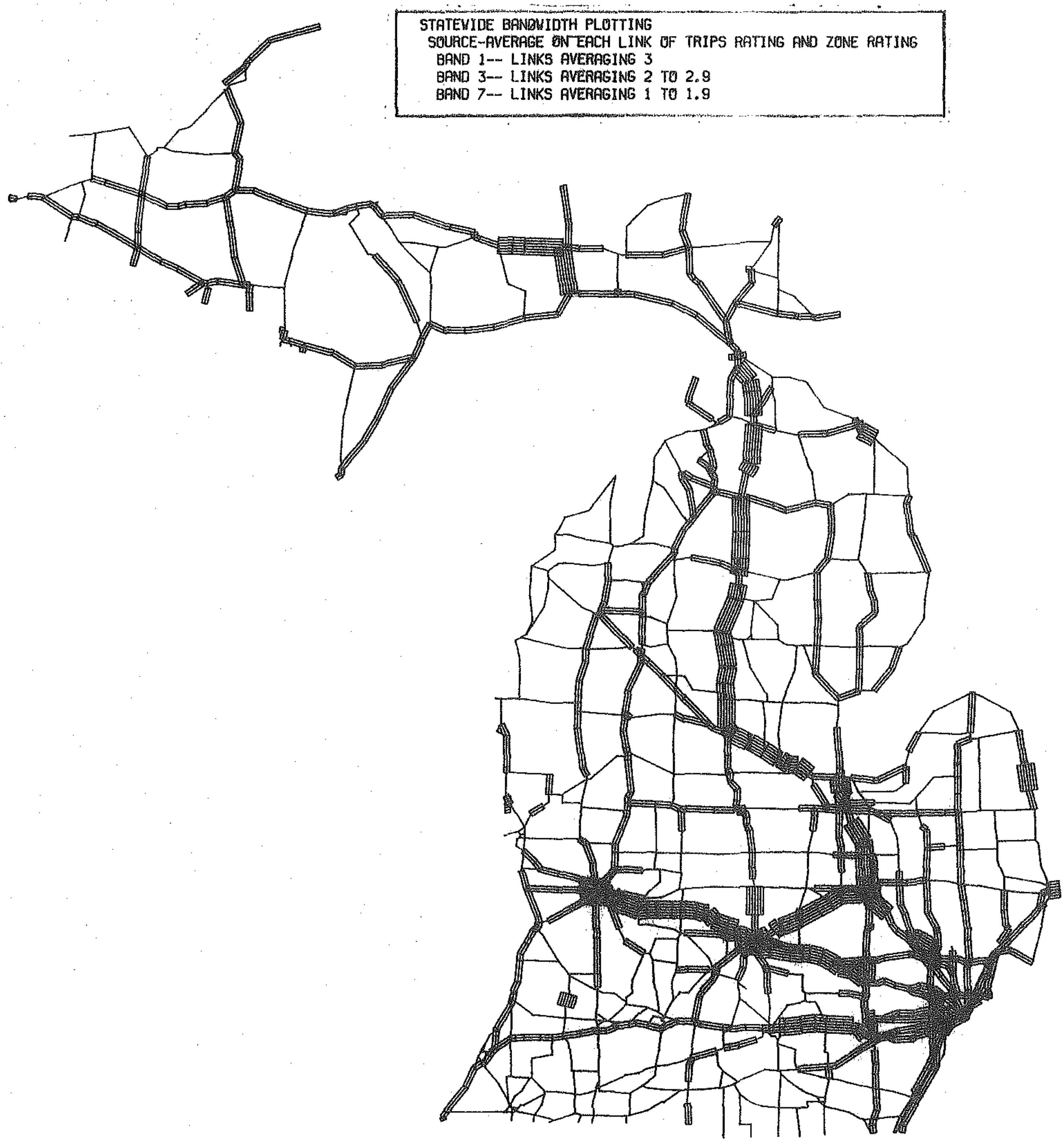


FIGURE 30

NUMBER ASSIGNMENT AFTER AVERAGING



PLACE CLASSIFICATION

PLACE CLASSIFICATION

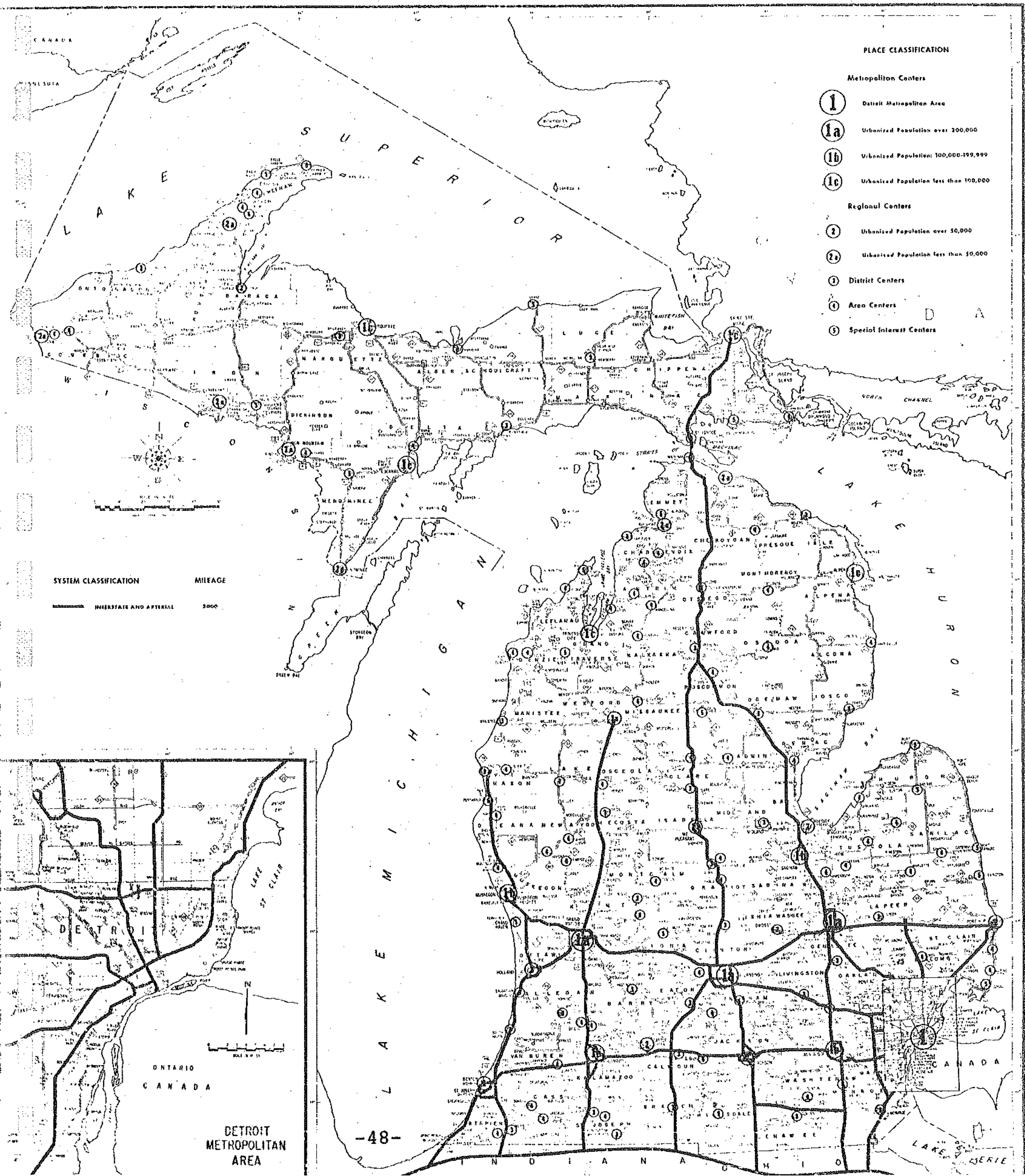
Place classification is a means of ranking cities or special interest areas in the state according to its importance as a traffic attractor. In the report, Highway Classification in Michigan, the Michigan Department of State Highways and Transportation considered 147 places as warranting state trunkline service. The places were ranked and separated into classes by differences in socio-economic characteristics. (See Figure 31.) Since this requires a tedious, time consuming process, it was felt that the Statewide Transportation Modeling System would be of value in this area as it relates directly to functional classification. This section is a brief demonstration of some of the model's potential application using its own socio-economic data files. These files are the same ones used in ranking zones by generated trips and also in the travel characteristic analysis.

The two major factors typically used in ranking a place are its population and the relationship to surrounding population. With the Statewide Transportation Modeling System, each can be examined quickly and efficiently because they are the same elements used in the statewide trip generation-distribution analysis.

The statewide 547 zone network system is used in the place classification development process discussed in the next few pages. The 147 places classified by the Michigan Department of State Highways and Transportation in the previously mentioned report were used for this test. The original place classification and population of the initial 147 areas were given to the zone in the transportation modeling system which represented that area.

FIGURE 31

PLACE CLASSIFICATION FROM THE REPORT HIGHWAY CLASSIFICATION IN MICHIGAN



The place classification assigned each area was sorted from most important place classification to least important. (See Figure 32.) This file is used as a comparison with the order of importance given by the model analysis process.

The first attempt at place classification by the model was done by ranking the population of each area. Only the statewide model zones containing the study areas were sorted by population size. The zones were sorted from highest population to lowest. (See Figure 33.)

It should be mentioned at this time that only the first page of the output will be shown in these figures. They contain enough information to demonstrate the point we are making and save printing the extra pages.

Compare Figure 32 with Figure 33. Note that the seven highest population areas match the seven highest place classifications. Also, note that when the population is below 50,000, that the match ceases. Why is the city of Bay City with a population of 49,449 less important in place classification than the city of Alpena which has a population of 13,805? The reason is the surrounding population.

Typically, the importance or role an area has in the hierarchy of a state is directly related to the function it plays to the surrounding population. An area like the city of Alpena is a perfect example of this. It is rated high in place classification because of the type of service provided to the surrounding population. Therefore, if the statewide modeling system is going to assist in place classification, it must be capable of analyzing the type, as well as the magnitude, of services provided to the surrounding population.

FIGURE 32

PLACE CLASSIFICATION FILE

SORTED BY THE CLASSIFICATION IN THE REPORT

HIGHWAY CLASSIFICATION IN MICHIGAN

* — CLASSIFICATION

DETROIT	1	493	2849269	1513601	53	1
LANSING	1A	183	550998	131546	24	2
FLINT	1A	128	651974	193317	30	3
GRAND RAPIDS	1A	236	495690	197649	40	4
KALAMAZOO	1B	226	438893	85555	19	5
ANN ARBOR	1B	479	2639101	99797	4	6
MUSKEGON	1B	342	329295	44631	14	7
SAGINAW	1B	409	317778	91849	29	8
ALPENA	1C	13	13805	13805	1	9
TRAVERSE CITY	1C	151	20690	18048	87	10
SAULT STE MARIE	1C	83	17148	15136	88	11
MARQUETTE	1C	295	21967	21967	100	12
ESCANABA	1C	103	15368	15368	100	13
BATTLE CREEK	2	055	473505	38931	8	14
JACKSON	2	216	473621	45484	10	15
HOLLAND	2	395	332301	26479	8	16
BENTON HARBOR-ST JOSEPH	2	037	87155	27523	32	17
PORT HURON	2	442	830001	35794	4	18
BAY CITY	2	029	286708	49449	17	19
MOUNT PLEASANT	2A	210	92014	20504	22	20
CADILLAC	2A	505	21985	9990	45	21
PETOSKEY	2A	124	11895	6342	53	22
CHEBOYGAN	2A	79	11895	5553	47	23
MENOMINEE	2A	311	10748	10748	100	24
IRON MOUNTAIN	2A	109	13978	8702	62	25
IRON RIVER,	2A	205	13978	2684	19	26
HOUGHTON-HANCOCK	2A	169	10887	10887	100	27
IRONWOOD	2A	146	0	8711	0	28
ALLEGAN	3	007	424610	4516	1	29
HASTINGS	3	025	616030	6501	1	30
THREE RIVERS	3	459	225682	7355	3	31

FIGURE 33

PLACE CLASSIFICATION FILE SORTED BY POPULATION

				*		
DETROIT	1	493	2849269	1513601	53	1
GRAND RAPIDS	1A	236	495690	197649	40	2
FLINT	1A	128	651974	193317	30	3
LANSING	1A	183	550998	131546	24	4
ANN ARBOR	1B	479	2639101	90797	4	5
SAGINAW	1B	409	317778	91849	29	6
KALAMAZOO	1B	226	438893	85555	19	7
BAY CITY	2	029	286708	49449	17	8
JACKSON	2	216	473621	45484	10	9
MUSKEGON	1B	342	329295	44631	14	10
BATTLE CREEK	2	055	473505	38931	8	11
PORT HURON	2	442	830001	35794	4	12
MIDLAND	3	315	127786	35176	28	13
BENTON HARBOR-ST JOSEPH	2	037	87155	27523	32	14
HOLLAND	2	395	332301	26479	8	15
MONROE	3	323	2388188	23894	1	16
MARQUETTE	1C	295	21967	21967	100	17
MOUNT PLEASANT	2A	210	92014	20504	22	18
ADRIAN	3	262	226823	20382	9	19
TRAVERSE CITY	1C	151	20690	18048	87	20
OWOSSO	3	433	436504	17179	4	21
ESCANABA	1C	103	15368	15368	100	22
SAULT STE MARIE	1C	83	17148	15136	88	23
ALPENA	1C	13	13805	13805	100	24
NILES	3	045	60920	12988	21	25
ALBION	4	170	10887	12112	100	26
BIG RAPIDS	3	306	53447	11995	22	27
GRAND HAVEN	3	399	335766	11844	4	28
HOUGHTON-HANCOCK	2A	169	10887	10887	100	29
MENOMINEE	2A	311	10748	10748	100	30
CADILLAC	2A	505	21985	9990	45	31

* — POPULATION

Surrounding population can be examined with a process called proximity analysis. Proximity analysis documents the potential of the modeling technqiue in describing the degree to which any socio-economic characteristic - for example, population - is concentrated around a zone of interest. This is accomplished by using the average driving time between zones based on an actual road network. Any individual wishing further information on proximity analysis may review the publication entitled: Volume 1-D Proximity Analysis: Social Impacts of Alternate Highway Plans on Public Facilities, May 1974. In the Alpena-Bay City situation, this process would evaluate the relationship of each of these cities and their surrounding areas.

In the tests, the populations for all urban zones within sixty (60) minutes of each study area were totaled. (This sixty minute time band was considered the "surrounding population" but could have been set to any other user time specification.) The surrounding population totals were listed by study area and the population of the urban zones within the sixty minute time band of the study area. A ratio was calculated to determine what percent the population of the study was of the urban population within the surrounding population for each study area. This ratio was sorted from high to low. (See Figure 34.)

The higher the ratio, the more important this area is to the surrounding population. In other words, the higher ratio has a smaller total of urban population within the 60 minute time band. The converse is also true.

When comparing Figure 32 with Figure 34, the match is very poor. However, note that the first ten cities listed in Figure 34 are important in place classification.

FIGURE 34

PLACE CLASSIFICATION FILE SORTED BY SURROUNDING POPULATION RATIO

					*
MARQUETTE	1C	295	21967	21967	100
ESCANABA	1C	103	15368	15368	100
MENOMINEE	2A	311	10748	10748	100
ALPENA	1C	13	13805	13805	100
HOUGHTON-HANCOCK	2A	169	10887	10887	100
SAULT STE MARIE	1C	83	17148	15136	88
TRAVERSE CITY	1C	151	20690	18048	87
MANISTEE	3	291	9021	7723	86
IRON MOUNTAIN	2A	109	13978	8702	62
CHARLEVOIX	3	75	6342	3519	55
DETROIT	1	493	2849269	1513601	53
PETOSKEY	2A	124	11895	6342	53
BOYNE CITY	4	78	6342	2969	47
CHEBOYGAN	2A	79	11895	5553	47
CADILLAC	2A	505	21985	9990	45
GRAND RAPIDS	1A	236	495690	197649	40
CALUMET-LAURIUM	4	170	10887	3875	36
GLADSTONE	4	106	15368	5237	34
BENTON HARBOR-ST JOSEPH	2	037	87155	27523	32
EAST JORDAN	4	77	6342	2041	32
FLINT	1A	128	651974	193317	30
SAGINAW	1B	409	317778	91849	29
MIDLAND	3	315	127786	35176	28
MARLETTE	4	428	6270	1706	27
GAYLORD	4	392	11895	3012	25
LANSING	1A	183	550998	131546	24
NEGAUNEE	3	299	21967	5248	24
LANSE	3	22	10887	2538	23
MOUNT PLEASANT	2A	210	92014	20504	22

* — SURROUNDING POPULATION RATIO

Now look at Figure 33 and Figure 34. Figure 33 lacks the areas important to surrounding population in its place classification order. Figure 34 lacks the areas of population importance in its order. A combination of the two is needed to get a variable which will include both.

The variable was attained by multiplying the ratio times the population. The new variable was sorted from high to low and listed. (See Figure 35.)

Compare Figure 32 with Figure 35. Note that this match is much closer than the previous two. Most differences now are due to a socio-economic characteristic of that area. Measuring these additional socio-economic characteristics is not beyond the statewide model's capabilities as the socio-economic data file contains over 1,000 pieces of information about each of the 508 instate zones.

Proximity analysis also allows the use of any facility available in the facility file on a zonal basis. Examples of facility file data are newspaper circulation, number of hospitals, airports, etc., per zone. (See Figures 36 and 37.) Both the facility file data and the socio-economic data may also be graphically displayed as Figures 36 and 37 indicate. The facility file contains many variables which could be measured and used for place classification by the user.

Place classification is important in the functional classification of a road because it indicates the road service needed for that area. The purpose of this section is to show the model's potential as a tool of assistance in making a decision on place classification. Although it is realized that the Statewide Transportation Modeling System is

FIGURE 35

PLACE CLASSIFICATION FILE SORTED BY POPULATION AND SURROUNDING POPULATION VARIABLE

DETROIT	1	493	2849269	1513601	53	80220853	1
GRAND RAPIDS	1A	236	495690	197649	40	7905960	2
FLINT	1A	128	651974	193317	30	5799510	3
LANSING	1A	183	550998	131546	24	3157104	4
SAGINAW	1B	409	317778	91849	29	2663621	5
MARQUETTE	1C	295	21967	21967	100	2196700	6
KALAMAZOO	1B	226	438893	85555	19	1625545	7
TRAVERSE CITY	1C	151	20690	18048	87	1570176	8
ESCANABA	1C	103	15368	15368	100	1536800	9
ALPENA	1C	13	13805	13805	100	1380500	10
SAULT STE MARIE	1C	83	17148	15136	88	1331968	11
HOUGHTON-HANCOCK	2A	169	10887	10887	100	1088700	12
MENOMINEE	2A	311	10748	10748	100	1074800	13
MIDLAND	3	315	127786	35176	28	984928	14
BENTON HARBOR-ST JOSEPH	2	037	87155	27523	32	880736	15
BAY CITY	2	029	286708	49449	17	840633	16
MANISTEE	3	291	9021	7723	86	664178	17
MUSKEGON	1B	342	329295	44631	14	624834	18
IRON MOUNTAIN	2A	109	13978	8702	62	539524	19
JACKSON	2	216	473621	45484	10	454840	20
MOUNT PLEASANT	2A	210	92014	20504	22	451088	21
CADILLAC	2A	505	21985	9990	45	449550	22
ANN ARBOR	1B	479	2639101	99797	4	399188	23
PETOSKEY	2A	124	11895	6342	53	336126	24
BATTLE CREEK	2	055	473505	38931	8	311448	25
NILES	3	045	60920	12988	21	272748	26
BIG RAPIDS	3	306	53447	11995	22	263890	27
CHEBOYGAN	2A	79	11895	5553	47	260991	28
HOLLAND	2	395	332301	26479	8	211832	29
CHARLEVOIX	3	75	6342	3519	55	193545	30
ADRIAN	3	262	226823	20382	9	183438	31

* — POPULATION AND SURROUNDING POPULATION VARIABLE

FIGURE 36

FREQUENCY DISTRIBUTION OF DAILY NEWSPAPER CIRCULATION ON A ZONAL BASIS

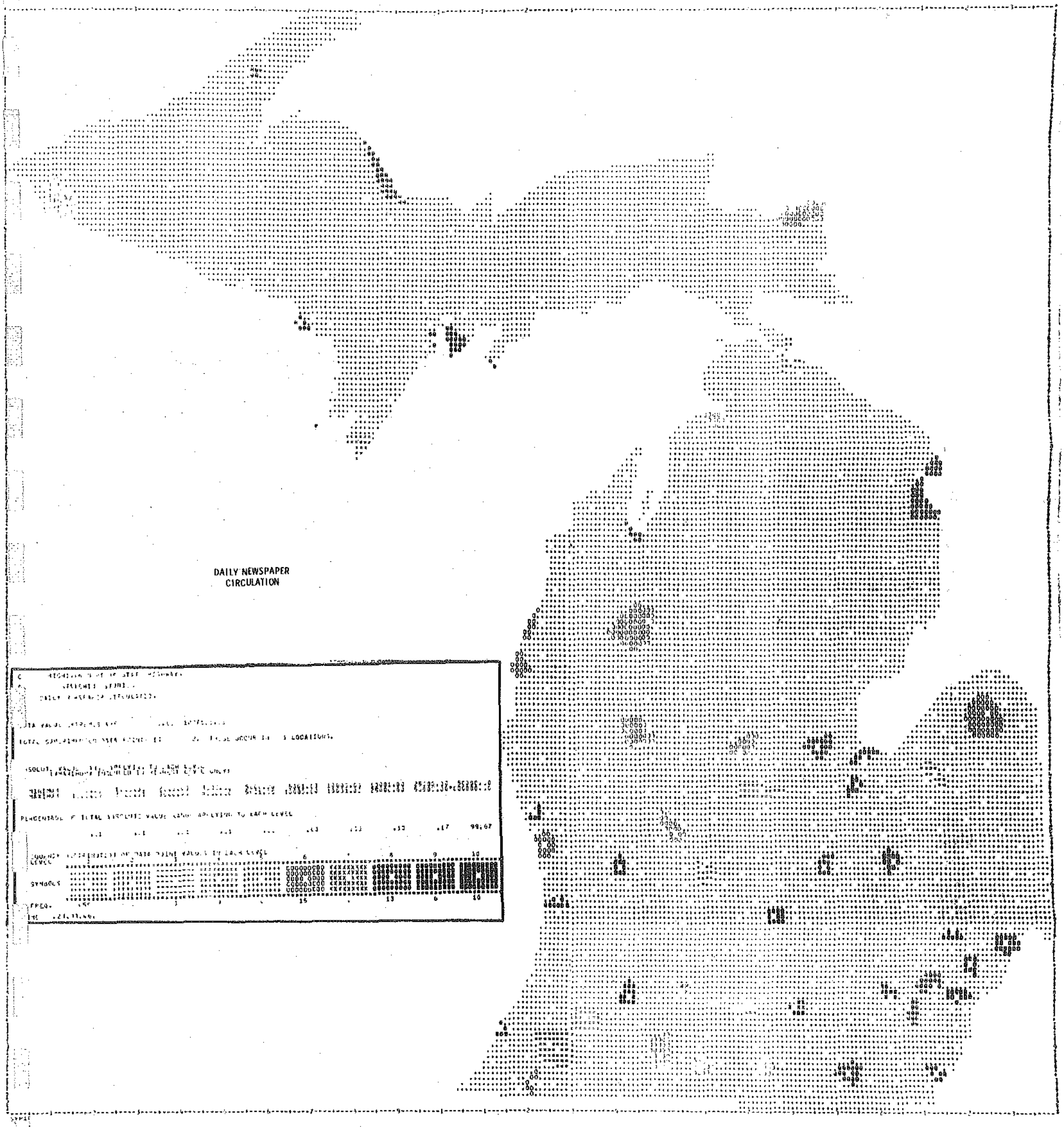
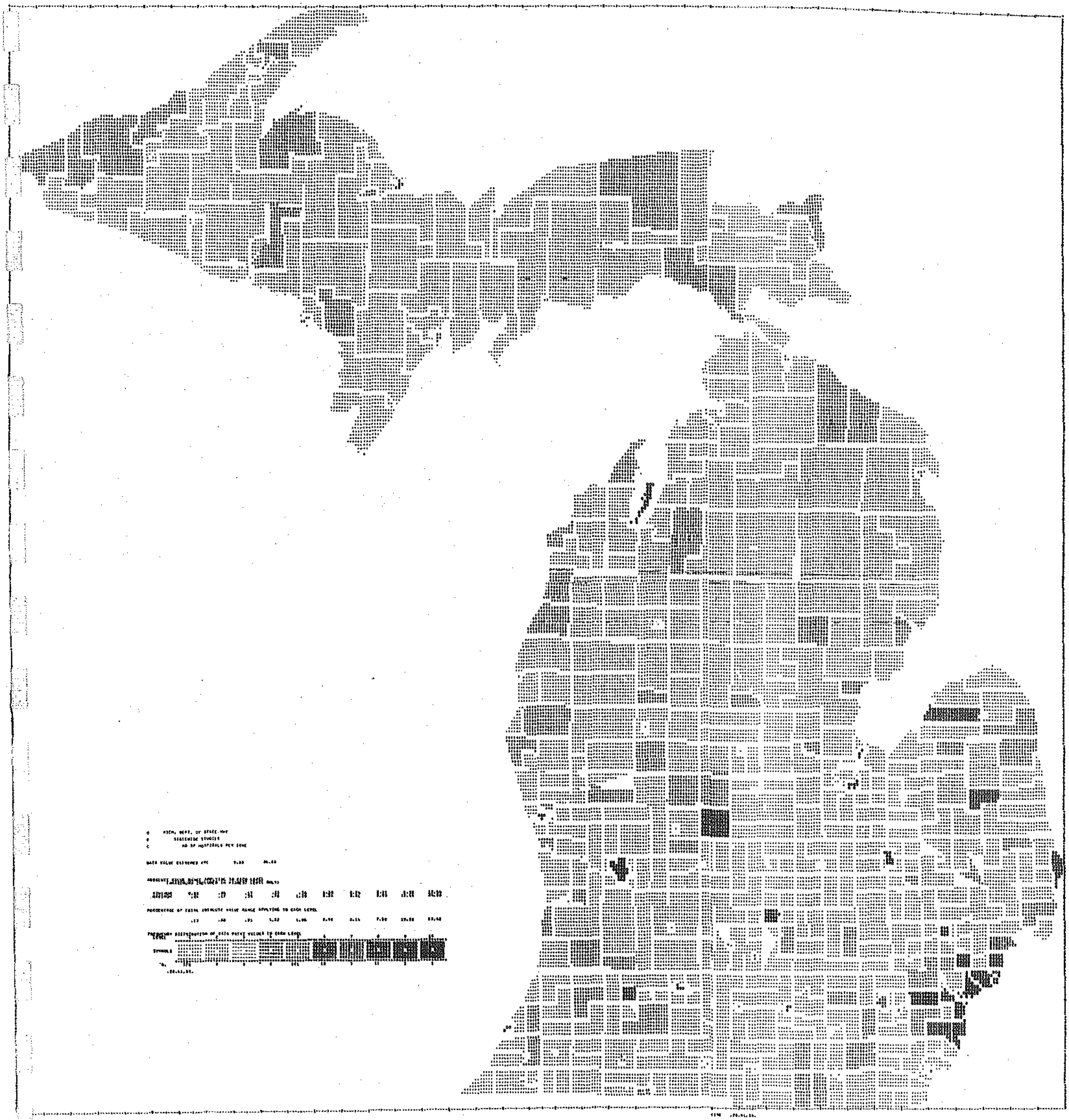


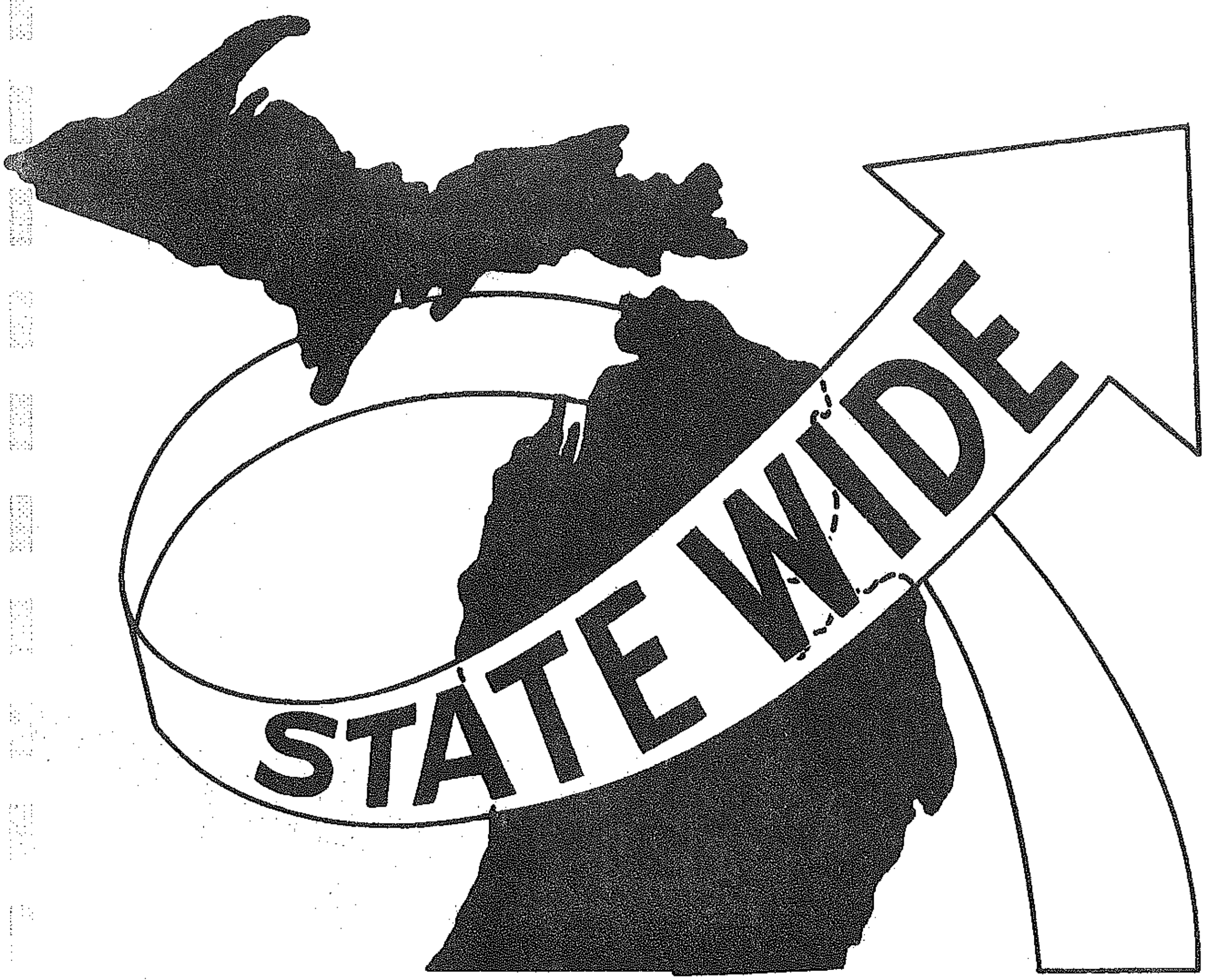
FIGURE 37

FREQUENCY DISTRIBUTION OF HOSPITALS ON A ZONAL BASIS



limited in doing the entire job of place classification, it is felt that it can contribute a large part to it.

CONCLUSION



CONCLUSION

The process of functional classification using present techniques places extreme pressures upon the staff of every state. Every year, a more detailed project arises with the additions of future roads throughout the state. Now, more than ever before, a highway department must provide system level justification or need for a project. The present process for functional classification remains mostly manual. All of this requires time and time is expensive. This is why a system application of the statewide transportation modeling system can be beneficial to the functional classification process, state highway plan, and regional planning process.

Certain limitations do exist using Michigan's statewide model. The analysis is limited to state trunklines in rural areas. Another limitation is that certain zones are not fine enough, i.e., the zone's total area is too large for the detail needed. But, these limitations are offset by the advantage of having an added tool to assist in the functional classification process.

All information is on a link by link basis for the entire state. It can be displayed in listing or plot form. The biggest advantage to using an automated system to get trip characteristics versus manual methods is the time savings. Additionally, the entire process is "dynamic" in that as new highways are constructed, the functional classification of the total Statewide Transportation Modeling System can automatically be updated. The tests presented in this report were made on the 1965 highway network. But, if it were necessary to get trip characteristics on the 1975 highway network, all that is required is that the old network be updated and the process rerun with the new network and new population data.

A 2300 zone statewide modeling system is in the preliminary stages. When that model becomes operational, the same process described above can be applied to provide more refined data eliminating the present limitations of the 547 zone system. It is felt that Michigan's statewide model has the potential of being most helpful in the process of functional classification in the future.