tatewide

★
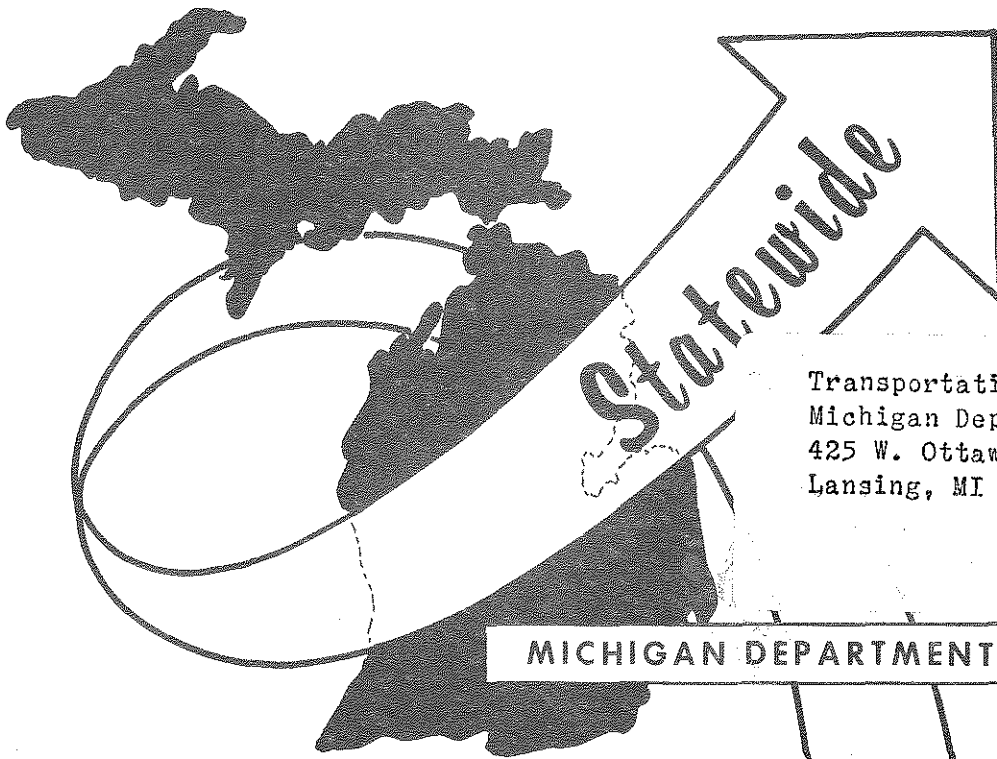
Transportation

Analysis &

Research

MICHIGAN'S
STATEWIDE TRAFFIC FORECASTING
MODEL

VOLUME III

"MULTI-LEVEL HIGHWAY NETWORK
GENERATOR"
("SEGMENTAL MODEL")

JUNE 1971

Statewide

MICHIGAN DEPARTMENT OF STATE HIGHWAYS

MICHIGAN DEPARTMENT OF STATE HIGHWAYS

IN COOPERATION WITH

THE U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

MICHIGAN'S
STATEWIDE TRAFFIC FORECASTING
MODEL

VOLUME III

"MULTI-LEVEL HIGHWAY NETWORK
GENERATOR"
("SEGMENTAL MODEL")

JUNE 1971

TRANSPORTATION PLANNING DIVISION
STATEWIDE STUDIES UNIT

Supervisor   _____
Richard E. Esch

Programmer   _____
Alan R. Friend

ACKNOWLEDGEMENT

We wish to thank the following people for their
valuable assistance in the production of this report:

Dale Stanaway: Graphics & Presentation

Evelyn Aldrich: Editing & Form

TABLE OF CONTENTS

PREFACE

PREFACE

This is the third report in a series of reports dealing
with the development of a statewide traffic forecasting
model for the State of Michigan. The previous reports are
as follows:

Vol. 1   Objectives and Work Program

Vol. 2   Development of Networks Models. This model
         probably should be referred to as a "Multi-
         level Network Generator" which more accurately
         defines the actual function of this process.

However, in this report and other discussions that have taken
place in the past this traffic forecasting tool has been
referred to as "Segmental Model".

INTRODUCTION
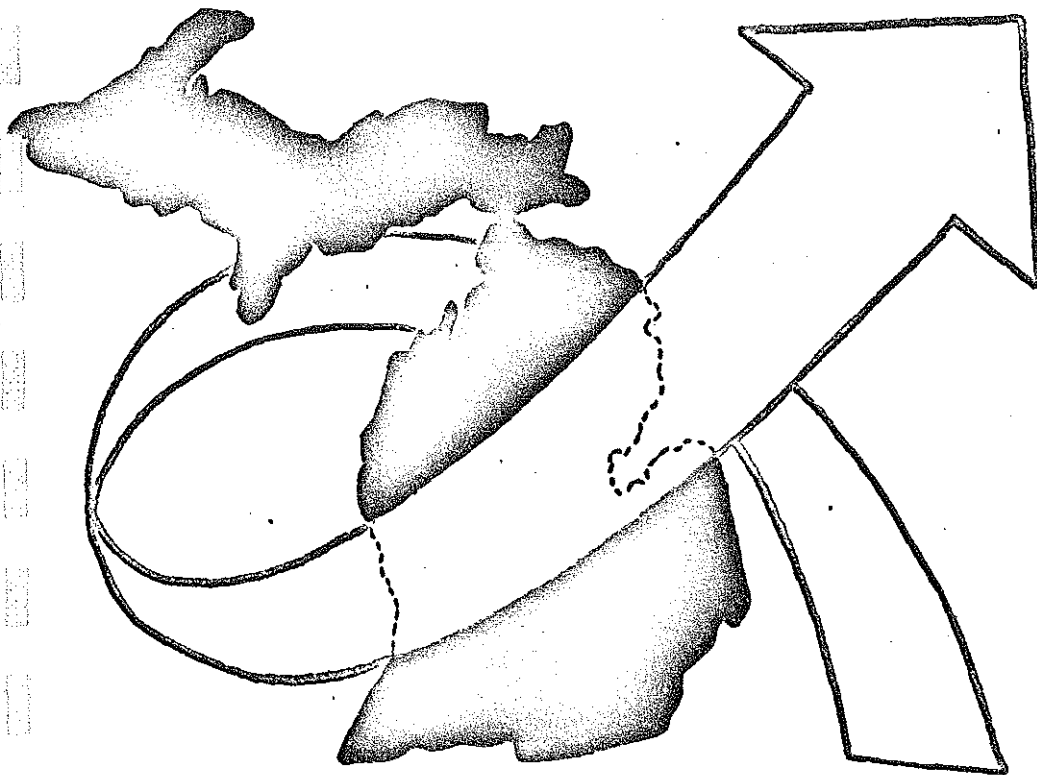
INTRODUCTION

During the past decade traffic forecasting techniques
have experienced extremely rapid change. Until the mid-
fifties only manual methods of traffic forecasting were in
use by analysts in the transportation field.

The Detroit Area Transportation Study (D.A.T.S.) was
initiated in 1953. As a result of this study several more
sophisticated techniques evolved which were to revolutionize
the traffic forecasting techniques then in use. Although
D.A.T.S. was not the first transportation study to apply
computerized traffic assignment techniques this study was
initiated at a time when rapid change in traffic forecasting
techniques began. In the early sixties the Michigan Depart-
ment of State Highways conducted origin-destination surveys
in most of Michigan's major cities. By the late sixties
this included survey data for approximately 35 urban areas.
The revolution that was occurring in the analysis of the
origin-destination survey data has been documented in several
reports by the Federal Highway Administration. A selected
list follows:

> Traffic Assignment Manual, B.P.R. 1964
>
> Traffic Assignment & Distribution for Small
> Urban Areas, B.P.R. 1965
>
> Calibration and Testing a Gravity Model for
> Any Size Urban Area, B.P.R. 1963

This computerized traffic analysis and forecasting
process can be divided into two primary operations.

1. Development and definition of a highway network model as suggested in the first report above for both present and future highway systems.

2. Creation of a travel matrix or trip table which is representative of the inter-zonal travel within each origin-destination study area for both present and future travel.

Many computer programs were developed to manipulate or complete analysis on these highways network and travel models. All of this development until the mid-sixties was directed at urban transportation studies.

During the late 1960's several states began to recognize the potential application of computerized urban traffic forecasting techniques at the statewide level. The potential was unlimited as most states were still using manual traffic forecasting techniques in the rural portions of each state.

Until this development most highway network models for these urban studies were composed of 100 to 300 sub-areas or zones within each survey area, except for the large metro-areas. With the advent of statewide traffic fore-casting model process many states found need to develop models involving 500 - 800 zones. This is what Michigan refers to as a first generation statewide model. The smaller urban studies included network models composed of 1000 - 2500 highway segments or links. Statewide models often included upwards of 3000 - 5000 highway segments or links such as the 540 zone highway network displayed in figure 1.

The urban study in most cases required small computer

3

FIGURE I

540 ZONE TRAFFIC FORECASTING SYSTEM

INSTATE NETWORK

Michigan Department of State Highways
Transportation Planning Division
Statewide Studies Unit

DETROIT
METROPOLITAN
AREA

4
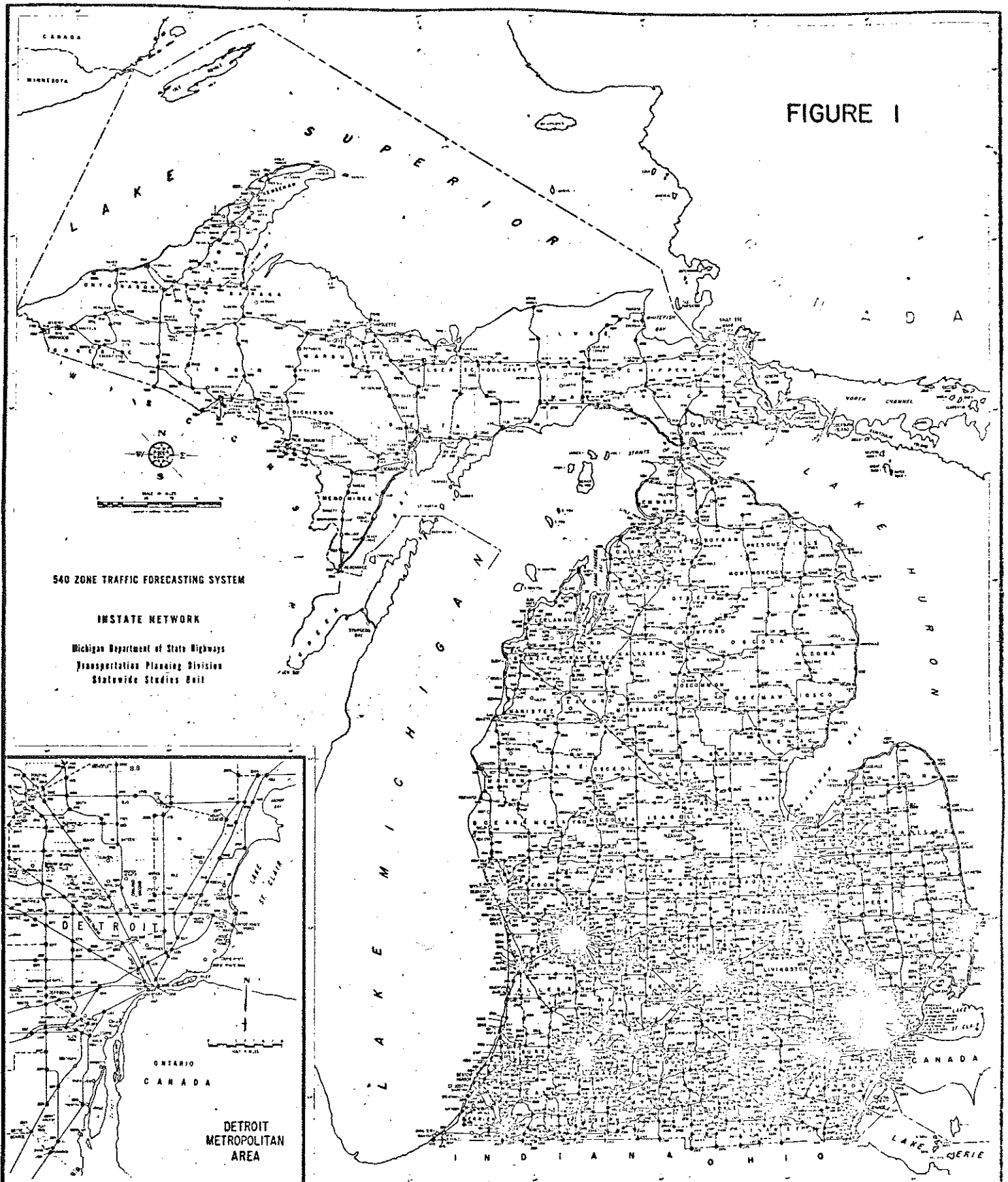
program run times of an hour or less. This was also true for many of the first generation statewide models. Most of the research that went into the calibration of a first generation statewide traffic forecasting model led Michigan to believe that a first generation statewide model would generally supply gross planning information and therefore only serve a single purpose. Michigan is in the process of developing a second generation statewide traffic forecasting model which hopefully will serve a dual purpose.

1. Supply general planning information.

2. Supply detailed design information.

With the advent of the second generation statewide model (1500-2500 zones) computer run time in some instances became prohibitive and at times bordered on the impossible. A 2300 highway network appears in figure 2 and this network contains approximately 12000 links. Many of the predicted twenty and thirty hour computer runs on this network are not practical with present computer techniques. In selected situations, depending on the type of computer used to complete the analysis, some of these run times could be reduced slightly.

The Michigan Department of State Highways since 1966 has been developing a statewide traffic forecasting model. Volume I entitled Statewide Model Objectives and Work Program, December, 1970, is a documentation of Michigans' proposed statewide model development process. The Michigan model as suggested in the work program will include four levels of zonal detail with a possible fifth being omitted presently.
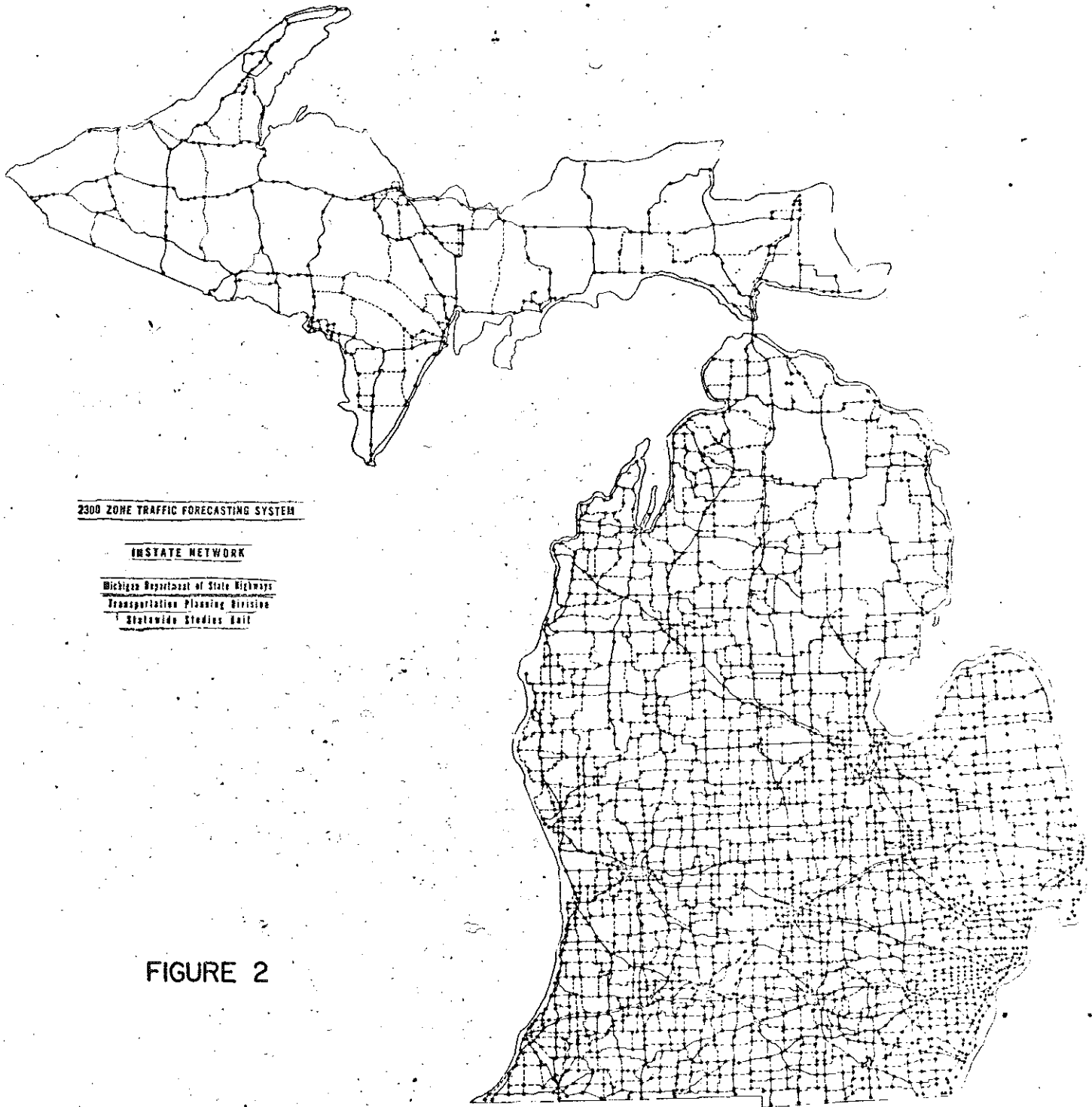
2300 ZONE TRAFFIC FORECASTING SYSTEM

INSTATE NETWORK

Michigan Department of State Highways
Transportation Planning Division
Statewide Studies Unit

FIGURE 2

1. A 83 County Zone System (Figure 3).

2. A 540 Zone System which contains zones that are a combination of townships (Figure 4).

3. A 2300 Zone Systems which contains zones which are single townships plus districts within urban areas

4. The fourth level of zonal detail will contain zones which are parts of townships plus all urban O-D zones. This will result in a 9000 zone system.

5. (Opt.) Micro Zone System, Blocks Urban – Square Mile Grids – Rural

The computer run times for the 540 zone system using Michigan Department of State Highways transportation planning package of computer program are displayed below.

TP Net	15 Minutes
TP Tree	1 Hour
TP Skim	1 Hour
TP G.M.	1 Hour
TP Load	1 3/4 Hours

This transportation planning package of computer programs is operational on a B-5500 and is similar to the Federal Highway Administration "360" package of transportation planning computer programs. With the advent of Michigan's 2300 zone system the following computer run times were estimated. These estimates were based on test runs for portions of the 2300 zone system using a B-5500. The B-6700 will greatly shorten these estimated run times because of the additonal internal core.

7

83 COUNTY ZONE SYSTEM

SEGMENTAL
MODEL
DETAIL
LEVEL
ONE

FIGURE 3

540 ZONE SYSTEM

SEGMENTAL
MODEL
DETAIL
LEVEL
TWO

FIGURE 4

2300 ZONE SYSTEM

SEGMENTAL
MODEL
DETAIL
LEVEL
THREE

2300 ZONE TRAFFIC FORECASTING SYSTEM

INSTATE ZONES

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRANSPORTATION PLANNING DIVISION
STATEWIDE STUDIES UNIT
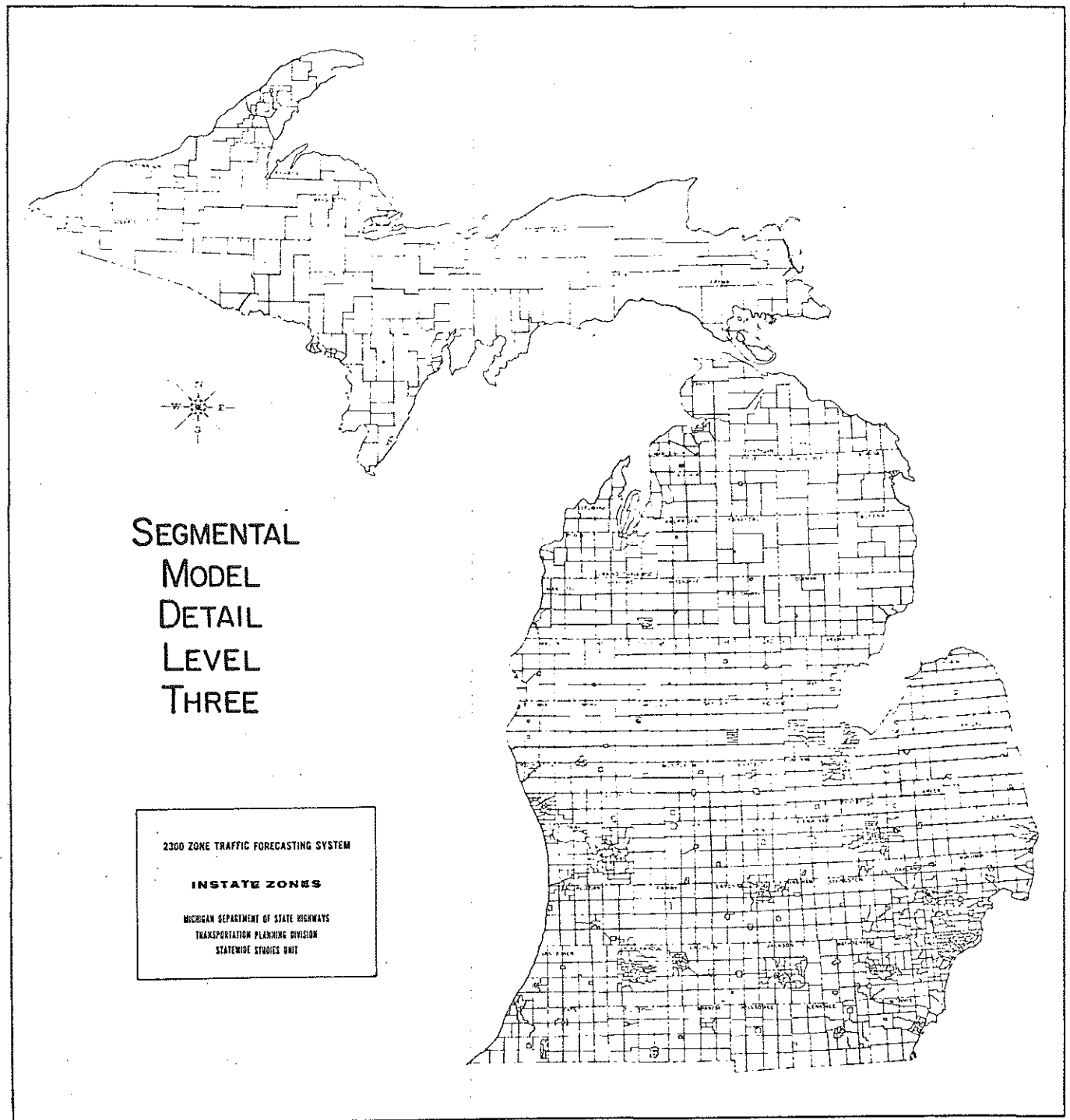
FIGURE 5

TP Net	1 Hour
TP Tree	22 Hours
TP Skim	No Test Data as of this Report
TP G.M.	No Test Data as of this Report
TP Load	18 Hours

The second generation statewide model when operational will often need to cycle through the transportation planning package upwards of 10-15 times per year. Assuming it was physically possible to run the programs based on the above computer run times, the scheduling of runs would still be extremely difficult. Any system significantly larger than a 2300 zone system would definitely be impossible with present technology. The department's computer package has been improved from time to time to shorten run times. Several programs such as TP TREE and TP LOAD still require large periods of time to complete. If the department obtains access to a B-6700 computer some of the above problems will be alleviated, but run times still will remain long. This problem still exists on 1000K IBM-360, as the department has investigated and found that run time, even with this machine, is as large as 10 hours with such programs or "build trees".

The second major problem facing the staff assigned the responsibilities for model development, was the fact that under normal operating situations the model would often be used to supply transportation information for small portions of the system, versus the total system runs.

Operation of a completed run for the whole state to obtain a solution for a single corridor would obviously be a grossly inefficient use of a statewide model and solutions to this problem had to be explored. TALUS is presently experiencing a similar situation where analysis is required for only a small portion of the system, but with present techniques the total system must be operated.

Some sub-area isolation technique might be a possible solution. Many of the present computerized traffic fore-casting techniques allow for sub-area assignment, just as Michigan's transportation planning package does, but most of these techniques supply analysis data only up to the cordon of the sub-area and not beyond. As an example refer to figure 6. The urban origin-destination cordon is the heavy dotted border and the sub-area selected for study is the fine solid line. With existing techniques a sub-area assignment could be completed but this would supply only traffic data for the sub-area. If any of the sub-area network changes effect the regional system it would be difficult to determine with the existing technology. This technique also requires that the large model be run initially before the sub-area program is run. Therefore, the computer run time is still extremely long on a statewide basis.

In many actual highway planning and design decisions the user is interested in the immediate study area in detail with the option of obtaining answers at a lesser level of detail in the outlying areas.

12

SUB AREA ISOLATION DIAGRAM

SUB-AREA

FIGURE 6

Attempts such as Texas' segmented traffic assignment,
and others, have been directed at a solution of some of the
above problems. After due consideration for existing
solutions and the scale of the problems discussed above
(The Statewide Studies Unit of the Michigan Department of
State Highways) has developed what is presently felt to be the
most comprehensive solution to the above problem of:

1. Long computer run times for second and third
   generation statewide models.

2. Transportation analysis needs on only parts of
   the total system.

3. Missing levels of detail as with sub-area isola-
   tion assignments.

4. Manually coding networks of various levels of
   detail.

The Statewide Studies Unit has referred to this
computerized traffic forecasting tool as the "segmental
model", or more specifically, "Multi-level Highway Network
Generator". This report will:

1. Document "segmental model" development techniques.

2. Define and explain "segmental model" computer
   programs.

3. Discuss use of program and run times on a B-5500.

4. Present test results on actual 2300 zone station
   model network.

5. Discuss future applications and program refinements.

DEVELOPMENT PROCESS & PROGRAM FUNCTIONS
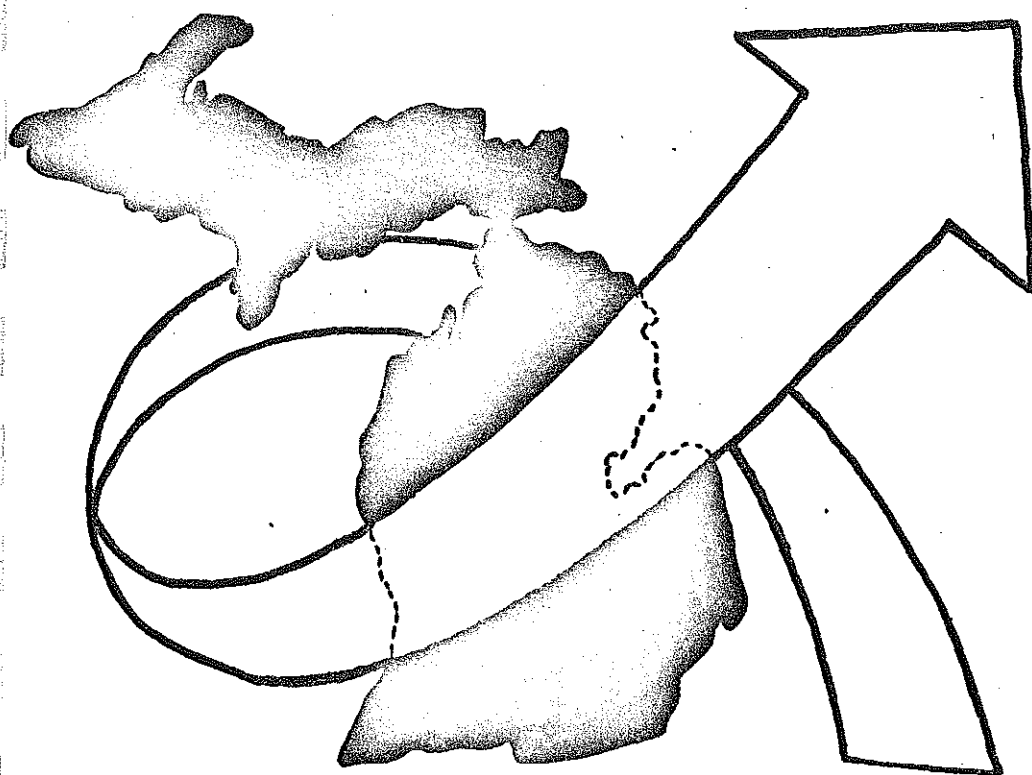
PROGRAM DEFINITION AND FUNCTIONS

The Michigan statewide traffic forecasting model development process was initiated in late 1965. From 1965 until January 1970, the staff of the Statewide Study Unit has been obtaining valuable experience related to the development of a statewide model for Michigan. As the report entitled Statewide Model Object Volume II indicates, development of a 2300 zone statewide model highway network was to be completed in early 1970. Initial computer run times with the department's transportation planning package indicated that the computer program run time for building all "trees" on this system would be practically impossible. Initial model research and development had indicated that there would be a necessity of developing a second generation model (2300 zone) which was a much finer system than the 540 zone system. The refined system would supply both general planning and detailed design data while maintaining only one mode. Incorporation of the urban studies within the statewide modeling process would involve upwards of 9000 zones requiring even more sophisticated technology.

In early 1970 definition and development of a "segmental model" was initiated. The "segmental model" discussions that followed resulted in the conclusion that this model should accomplish the following:

1. Maintain a single master detailed network file versus the present method of coding and maintaining several different network link files.

15

2. User specified level of network detail by area based on function classification and link type.

3. Elimination of unnecessary highway links as a result of deletion or compression of selected links by class therefore saving computer run times.

4. Automatic compression of trip table to match network detail by each area, so that traffic assignments could be completed after a "build all trees" run.

5. Multi-detail sub-areas with total network. For example generate a network with detail areas for Lansing and Kalamazoo and leave the rest of the state with a course network.

6. Conversion of master network coordinate files so new segmental network could be plotted automatically and used as a base map or work map.

Throughout this report two phrases will often appear. They are "preliminary segmental model" and "refined segmental model". The reason for this is the fact that the "segmental model" development process was two-phased. Phase I, which this report will cover in detail, deals with the development of an operational preliminary model. Hopefully, this preliminary model will establish the potential usefulness of this concept. Phase II is the planned refinement of the preliminary model. The refined model would be used as a daily forecasting tool within the Michigan Department of State Highway's transportation planning process. Steps 4 and 6 above are planned as part of the "refined segmental model" development process.

It is recommended that the ultimate "master network link file", which should be used with the "refined segmental model", would be a detailed link file for all roads in the state. In some states the state or federal needs study files might be

modified to fulfill this requirement if it was originally defined in such a manner as to be adaptable to the A-Node B-Node concept of most highway network models.

Any state which initiates and applies a concept such as "segmental model" will be required to maintain only one detailed highway network for the entire state, both urban or rural from that day forward. This is in direct contrast to many present studies which maintain two or three network files so that transportation analysis can be completed at varying levels of detail. Applying the "segmental model" concept Michigan will need to maintain only one detailed network file. It is also possible that in the future; "segmental model" would allow the Michigan Department of State Highways to automatically generate urban O-D study high-way network models with a single run of the "refined segmental model" program. This would simplify the present manual process of urban O-D network definition and development.

The "master network file" used presently as input to the "segmental model" program is the second generation 2300 zone statewide highway network model which was discussed in detail in a statewide traffic forecasting model report entitled, Development of Network Models, Volume II, March, 1971. This highway network model was defined using the conventional node-link concept of network definition which is commonly used in most urban traffic assignment processes. The network code form used for the 2300 zone system appears in figure 7. The format and actual codes follow.

FIGURE 7

18

B5500 Link Data Card:

Column	Contents
1	Card Type, A "2".
3-6	A-Node.
9-12	B-Node.
14-17	Distance.
18	A to B T or S.
19-21	A to B Time or Speed (AM).
22-24	A to B Time or Speed (PM).
25-27	A to B Time or Speed (OFF).
28-31	A to B Capacity (In Tens).
32-36	A to B Count.
40	Direction, 1-one way, 2-two way.
41	B to A T or S.
42-44	B to A Time or Speed (AM).
45-47	B to A Time or Speed (PM).
48-50	B to A Time or Speed (OFF).
51-54	B to A Capacity (In Tens).
55-59	B to A Count.
69-70	Link Type.
71-72	Link Jurisdiction.
73-74	Capacity Class.
80	Delete, A "D" If Link is to be Deleted.

Figure 8 is a copy of the 2300 zone Clinton County
Highway network model base map. This is one of Michigan's
83 county base maps, which will serve as a reference map
for the following discussion. As with all highway network
definition and coding operations a zonal system within the
study area was initially defined and numbered. The zone
numbers were four digit numbers. The first two digits were
the county numbers and the last two the statewide zone with
the county numbered sequentially. The central-most or
population center was selected as the first zone (01) in each
county. In figure 8 this would be zone 1901 where the first
two digits are the county number and last two (01) are the
zone number within the county.

19
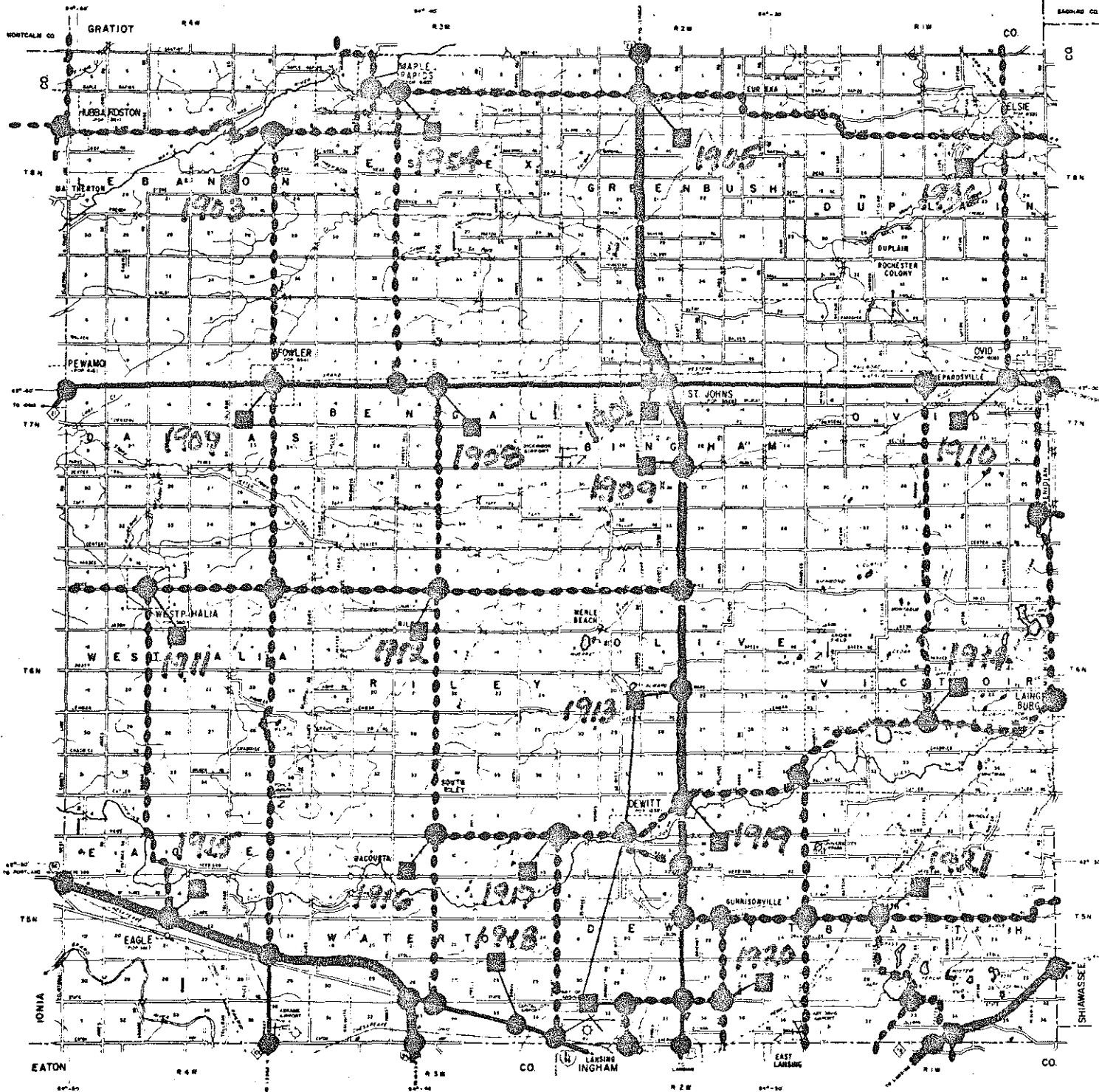
COUNTY RO.
STATE TRUNKLINE
CENTROID
NODE

FIGURE 8

CLINTON COUNTY
MICHIGAN
STATE HIGHWAY COMMISSION
DEPARTMENT OF STATE HIGHWAYS
DATA OBTAINED FROM
HIGHWAY PLANNING SURVEY
CONDUCTED IN COOPERATION WITH
U.S DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS

KEY TO COUNTIES

In this case a population center was selected as the first
zone in the county. The selection of the _first_ zone within
each county is critical to the operation of the "preliminary
segmental model". This is the zone which will represent
the county if the user specifies this county is to be used
as a non-detailed network area. The centroid link for this
first (01) zone must also connect directly to a state
trunkline.

The "preliminary segmental model" performs the following
five functions when creating a segmental network from a
detailed master network file. The computer program does
not perform these functions exactly in this order but for
discussion purposes this should suffice. Program details
will be documented in a later section of this report.

A. Centroid selection or deletion.

B. Selection of highway links in detailed network
   areas.

C. Highway network link deletion in non-detailed
   areas.

D. Elimination of unnecessary highway links thru
   link compression.

E. Renumbering of remaining centroid numbers for
   direct input into transportation planning package.

The user specifies which counties are to contain
detailed network link data and the program assumes the
remaining counties are to contain non-detailed network
data. The master network link file must be in sort by
A-Node, B-Node. Centroid links which are part of the

detail counties are selected and saved for the new network being created. In the non-detailed counties only the centroid links with A-nodes ending in 01 are selected and saved as these are the pre-specified zones which will represent that county.

All highway links with county codes matching those county codes specified by the users as being in the detailed area are selected and moved to a new network file.

In the third portion of this process the preliminary model deals with the selection of only specified highway link types in the non-detailed counties. The user is supposedly not interested in generating a detailed network in this area. The "preliminary segmental model" does not allow the user to specify which link types are to be included in the new network for this area. Presently only links which are specified as state highway links are selected and saved and all other road types are deleted. The program therefore saves only links which are presently coded 01 in the link type column for the 2300 zone system. Figure 8 is a sample of the 2300 zone network before a segmental model run. The newly created multi-level network would look like figure 9, if the preliminary segmental model process was halted in the third portion of the program just discussed and this county was specified as a non-detailed study area. Note that even though the network is sufficiently coarser than the original network in figure 8 there are many highway links, particularly in the urban area, which are not particularly
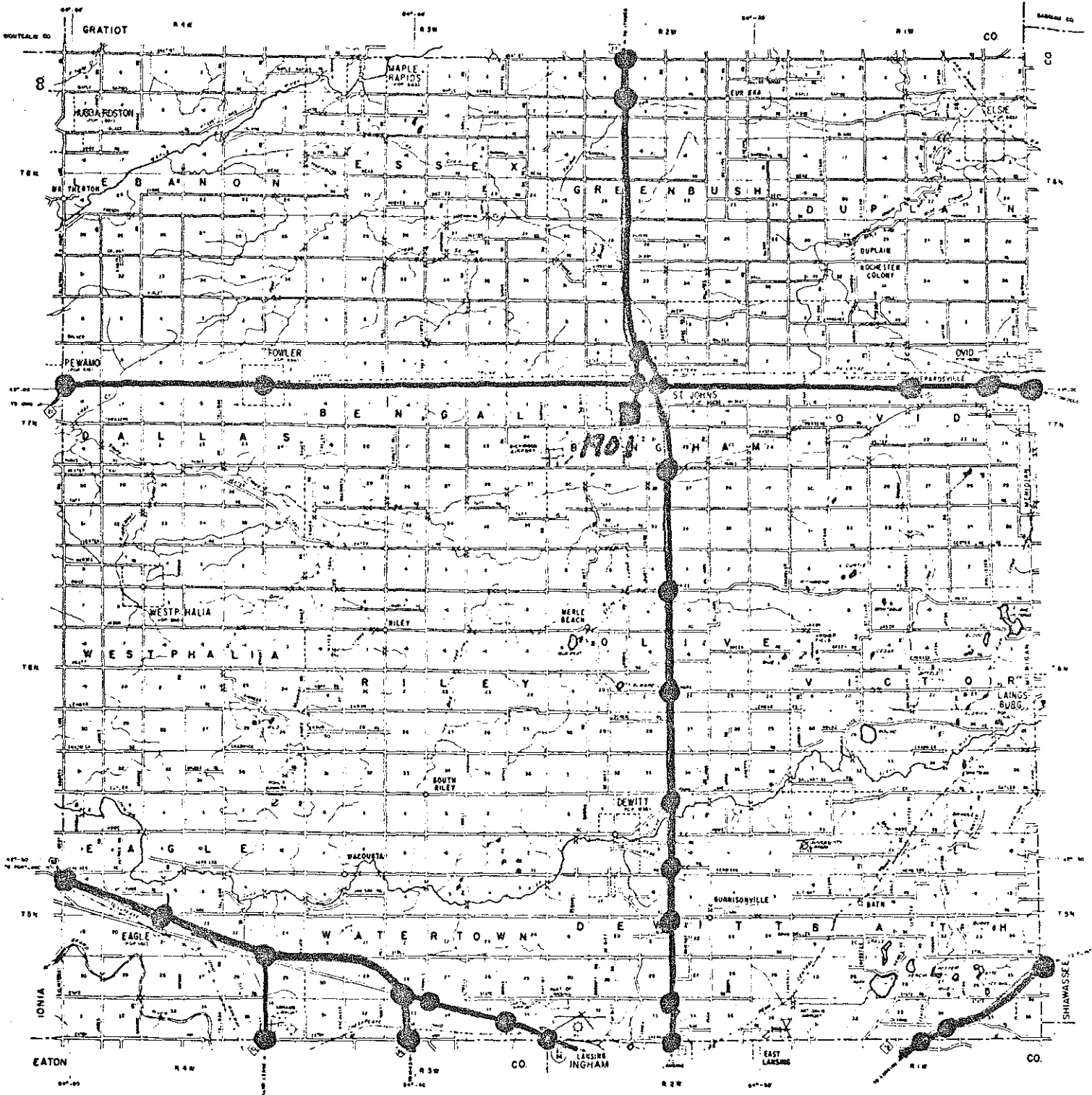
STATE TRUNKLINE ————

CENTROID ▣

NODE ●

CLINTON COUNTY
MICHIGAN
STATE HIGHWAY COMMISSION
DEPARTMENT OF STATE HIGHWAYS
DATA OBTAINED FROM
HIGHWAY PLANNING SURVEY
CONDUCTED IN COOPERATION WITH
U.S DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS

FIGURE 9

KEY TO COUNTIES

23

pertinent to operation of the forecasting model at this
level of network detail for this county.

The fourth task accomplished by the "preliminary
segmental model" is the elimination of these unnecessary
highway links in the non-detailed counties of the state.
These links affect computer run times in the "tree"
building and traffic assignment programs and elimination
of them does save significant computer run time. These
links are eliminated by a process explained in detail in the
programmer-operator section of this report. A single new
equivalent link is generated to replace any combination of
unnecessary links. After completion of the fourth function
in the "preliminary segmental model" process the newly created
multi-level network would be defined as shown in figure 10.

Up to this point the centroid links have the zone end
of the link identified by a zone number which relates this
link to a socio-economic data bank. As mentioned previously
this is a non-sequential zone numbering system. Most trans-
portation planning computer program packages require a
sequential zone number so the fifth portion of the preliminary
segmental model sequentially renumbers all of the centroid
link zone numbers which is the A-node of each centroid link.
A new centroid link is created using this sequential number
as input to the transportation planning computer program
package. The present program will also supply the user a
conversion list of original non-sequential zone numbers and
their sequential equivalence after passing through segmental
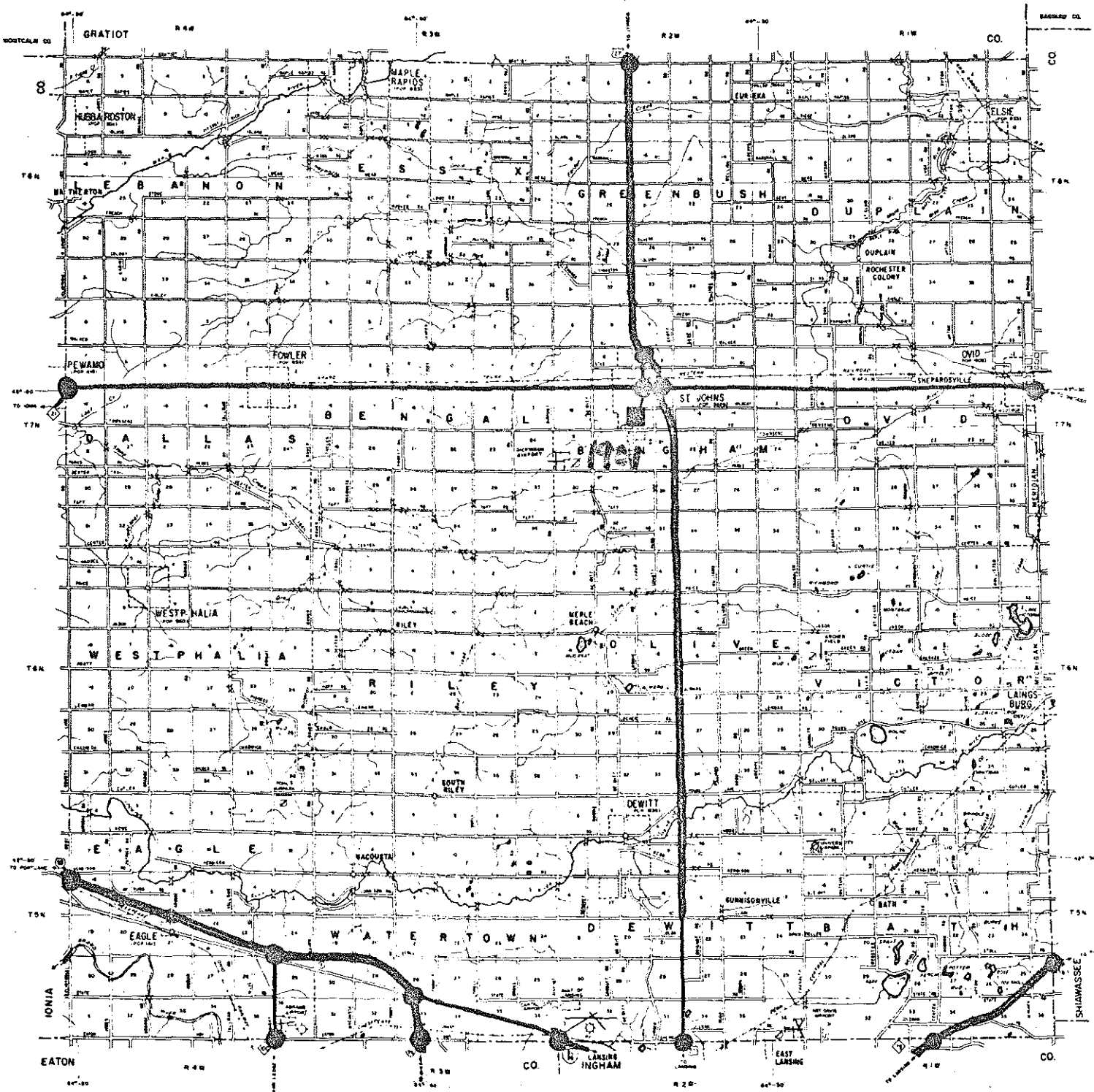
24

STATE TRUNKLINE ▬▬
CENTROID ▮
NODE ●

FIGURE 10

CLINTON COUNTY
MICHIGAN
STATE HIGHWAY COMMISSION
DEPARTMENT OF STATE HIGHWAYS

DATA OBTAINED FROM
HIGHWAY PLANNING SURVEY
CONDUCTED IN COOPERATION WITH
U.S DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS

1" = 2.75 MILES
POLYCONIC PROJECTION

KEY TO COUNTIES
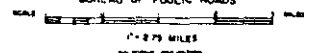
model. A sample of this equivalence list appears in figure 11. This listing is useful when completing analysis on a multi-level network where it is necessary to refer back to original master link file base maps.

The "preliminary segmental model" after completing the fifth stage calls the transportation planning computer program TPNET. The program submits the newly created network file just as if it were a newly coded network. The TPNET program completes the network edit and prepares a network file for use in the transportation planning computer program package as a base file for "tree" building and traffic assignment. This completes the full cycle for the "segmental model" process.

If the user wishes to complete a traffic assignment on the new network the trip table associated with the master file is not compatible with the new zone system, because of the deletion of zone centroids. In the "refined segmental model" this problem will be resolved by having the segmental model program generate trip table compression cards.

The last few pages should serve as a brief review of the procedual steps or stages carried out by the "preliminary segmental model" program. A copy of the actual computer program outputs is available in the section dealing with an actual test network. Information required to run this program on a B-5500 computer is discussed in the section following the "possible application" discussion. The programmer-operator portion of this report will discuss the actual inter-workings of the computer program.

CENTROID EQUIVALENCE LIST

0001 0101	0002 0201	0003 0301	0004 0302	0005 0303	0006 0304	0007 0305	0008 0306	0009 0307	0010 0308
0011 0309	0012 0310	0013 0311	0014 0312	0015 0313	0016 0314	0017 0315	0018 0316	0019 0317	0020 0318
0021 0319	0022 0320	0023 0321	0024 0322	0025 0323	0026 0324	0027 0325	0028 0326	0029 0327	0030 0328
0031 0329	0032 0330	0033 0331	0034 0332	0035 0333	0036 0334	0037 0401	0038 0501	0039 0601	0040 0701
0041 0801	0042 0802	0043 0803	0044 0804	0045 0805	0046 0806	0047 0807	0048 0808	0049 0809	0050 0810
0051 0811	0052 0812	0053 0813	0054 0814	0055 0815	0056 0816	0057 0817	0058 0818	0059 0901	0060 0902
0061 0903	0062 0904	0063 0905	0064 0906	0065 0907	0066 0908	0067 0909	0068 0910	0069 0911	0070 0912
0071 0913	0072 0914	0073 0915	0074 0916	0075 0917	0076 0918	0077 0919	0078 0920	0079 0921	0080 0922
0081 0923	0082 0924	0083 0925	0084 0926	0085 0927	0086 0928	0087 0929	0088 0930	0089 0931	0090 0932
0091 0933	0092 0934	0093 1001	0094 1101	0095 1102	0096 1103	0097 1104	0098 1105	0099 1106	0100 1107
0101 1108	0102 1109	0103 1110	0104 1111	0105 1112	0106 1113	0107 1114	0108 1115	0109 1116	0110 1117
0111 1118	0112 1119	0113 1120	0114 1121	0115 1122	0116 1123	0117 1124	0118 1125	0119 1126	0120 1127
0121 1128	0122 1129	0123 1130	0124 1131	0125 1132	0126 1133	0127 1134	0128 1135	0129 1136	0130 1137
0131 1138	0132 1139	0133 1140	0134 1141	0135 1142	0136 1143	0137 1144	0138 1145	0139 1146	0140 1147
0141 1148	0142 1149	0143 1150	0144 1151	0145 1152	0146 1153	0147 1154	0148 1155	0149 1156	0150 1157
0151 1158	0152 1159	0153 1160	0154 1161	0155 1162	0156 1163	0157 1164	0158 1201	0159 1202	0160 1203
0161 1204	0162 1205	0163 1206	0164 1207	0165 1208	0166 1209	0167 1210	0168 1211	0169 1212	0170 1213
0171 1214	0172 1215	0173 1216	0174 1217	0175 1218	0176 1219	0177 1220	0178 1221	0179 1301	0180 1302
0181 1303	0182 1304	0183 1305	0184 1306	0185 1307	0186 1308	0187 1309	0188 1310	0189 1311	0190 1312
0191 1313	0192 1314	0193 1315	0194 1316	0195 1317	0196 1318	0197 1319	0198 1320	0199 1321	0200 1322
0201 1323	0202 1324	0203 1325	0204 1326	0205 1327	0206 1328	0207 1329	0208 1330	0209 1331	0210 1332
0211 1333	0212 1334	0213 1335	0214 1336	0215 1337	0216 1338	0217 1339	0218 1340	0219 1341	0220 1342
0221 1343	0222 1344	0223 1345	0224 1346	0225 1401	0226 1402	0227 1403	0228 1404	0229 1405	0230 1406
0231 1407	0232 1408	0233 1409	0234 1410	0235 1411	0236 1412	0237 1413	0238 1414	0239 1415	0240 1416
0241 1417	0242 1418	0243 1419	0244 1420	0245 1501	0246 1601	0247 1701	0248 1801	0249 1901	0250 1902
0251 1903	0252 1904	0253 1905	0254 1906	0255 1907	0256 1908	0257 1909	0258 1910	0259 1911	0260 1912
0261 1913	0262 1914	0263 1915	0264 1916	0265 1917	0266 1918	0267 1919	0268 1920	0269 1921	0270 2001
0271 2101	0272 2201	0273 2301	0274 2302	0275 2303	0276 2304	0277 2305	0278 2306	0279 2307	0280 2308
0281 2309	0282 2310	0283 2311	0284 2312	0285 2313	0286 2314	0287 2315	0288 2316	0289 2317	0290 2318
0291 2319	0292 2320	0293 2321	0294 2322	0295 2323	0296 2324	0297 2325	0298 2326	0299 2327	0300 2328
0301 2329	0302 2330	0303 2401	0304 2501	0305 2502	0306 2503	0307 2504	0308 2505	0309 2506	0310 2507
0311 2508	0312 2509	0313 2510	0314 2511	0315 2512	0316 2513	0317 2514	0318 2515	0319 2516	0320 2517
0321 2518	0322 2519	0323 2520	0324 2521	0325 2522	0326 2523	0327 2524	0328 2525	0329 2526	0330 2527
0331 2528	0332 2529	0333 2530	0334 2531	0335 2532	0336 2533	0337 2534	0338 2535	0339 2536	0340 2537
0341 2538	0342 2539	0343 2540	0344 2541	0345 2542	0346 2543	0347 2544	0348 2545	0349 2546	0350 2547
0351 2548	0352 2549	0353 2550	0354 2551	0355 2552	0356 2553	0357 2554	0358 2555	0359 2556	0360 2557
0361 2558	0362 2559	0363 2560	0364 2561	0365 2562	0366 2563	0367 2564	0368 2565	0369 2566	0370 2567
0371 2568	0372 2569	0373 2570	0374 2571	0375 2572	0376 2573	0377 2574	0378 2575	0379 2576	0380 2577
0381 2578	0382 2579	0383 2580	0384 2581	0385 2582	0386 2583	0387 2584	0388 2585	0389 2586	0390 2587
0391 2588	0392 2589	0393 2590	0394 2591	0395 2592	0396 2593	0397 2594	0398 2601	0399 2701	0400 2801
0401 2901	0402 2902	0403 2903	0404 2904	0405 2905	0406 2906	0407 2907	0408 2908	0409 2909	0410 2910
0411 2911	0412 2912	0413 2913	0414 2914	0415 2915	0416 2916	0417 2917	0418 2918	0419 2919	0420 2920
0421 2921	0422 3001	0423 3002	0424 3003	0425 3004	0426 3005	0427 3006	0428 3007	0429 3008	0430 3009
0431 3010	0432 3011	0433 3012	0434 3013	0435 3014	0436 3015	0437 3016	0438 3017	0439 3018	0440 3101
0441 3201	0442 3202	0443 3203	0444 3204	0445 3205	0446 3206	0447 3207	0448 3208	0449 3209	0450 3210
0451 3211	0452 3212	0453 3213	0454 3214	0455 3215	0456 3216	0457 3217	0458 3218	0459 3219	0460 3220
0461 3221	0462 3222	0463 3223	0464 3224	0465 3225	0466 3226	0467 3227	0468 3228	0469 3229	0470 3301
0471 3302	0472 3303	0473 3304	0474 3305	0475 3306	0476 3307	0477 3308	0478 3309	0479 3310	0480 3311
0481 3312	0482 3313	0483 3314	0484 3315	0485 3316	0486 3317	0487 3318	0488 3319	0489 3320	0490 3321
0491 3322	0492 3323	0493 3324	0494 3325	0495 3326	0496 3327	0497 3328	0498 3329	0499 3330	0500 3331
0501 3332	0502 3333	0503 3334	0504 3335	0505 3336	0506 3337	0507 3338	0508 3339	0509 3340	0510 3341

27

FIGURE 11

POSSIBLE SEGMENTAL
MODEL APPLICATIONS
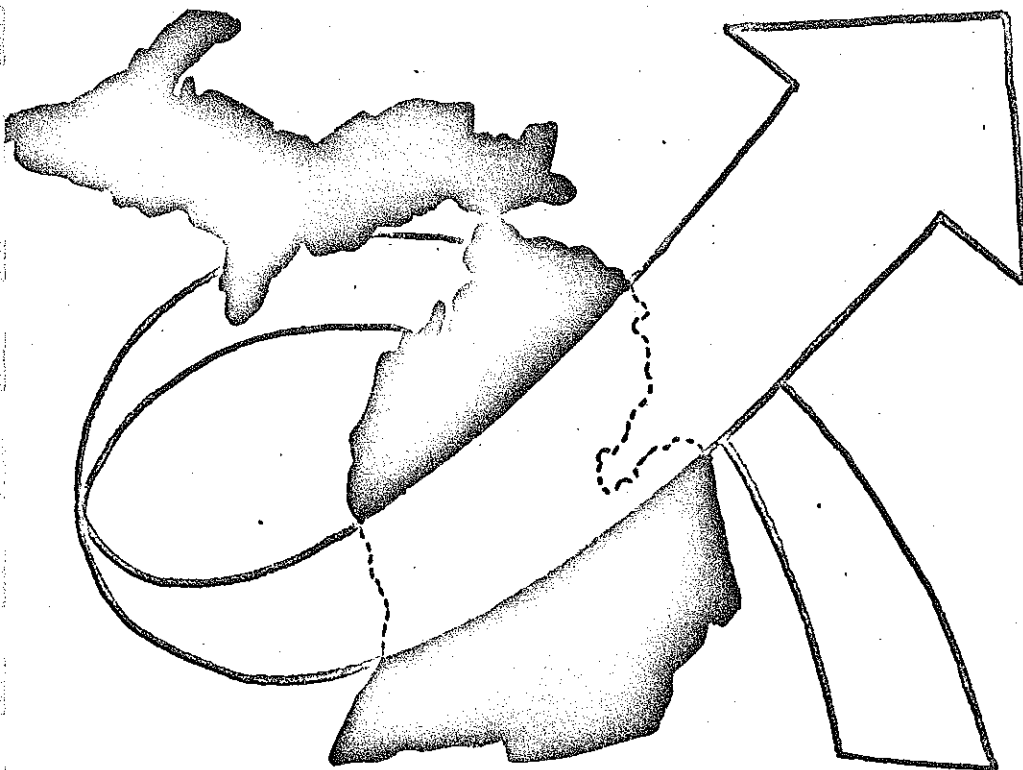
POSSIBLE SEGMENTAL MODEL APPLICATIONS

The Michigan Department of State Highways plans to use the "refined segmental model" to efficiently supply traffic forecasting information required by several divisions and sections within the department. The applications of this program should not be limited to just this department as the following discussion suggests.

Applications exist at the national level such as the national highway network model. The Federal Highway Administration would be able to generate various levels of network detail such as state, county, etc. yet maintain only one master network file. Detailed county network analysis could be completed in one region while leaving the rest of the network at the state level as suggested in figure 12. The effect of major changes in the study areas on thru traffic could easily be studied as a complete network in the non-detailed region is available with this technique.

One master national highway network file could be maintained by the Federal Highway Administration or others. This same network could be used by all states' statewide modeling units and segmental model could supply the outstate network for each individual state. For example, Michigan could run the model and obtain county level network details for Michigan's contiguous states one day, and California could use the segmental model plus the national network to generate their outstate network the next day. This would eliminate the task of all states defining and developing

REGIONAL ANALYSIS AT NATIONAL LEVEL
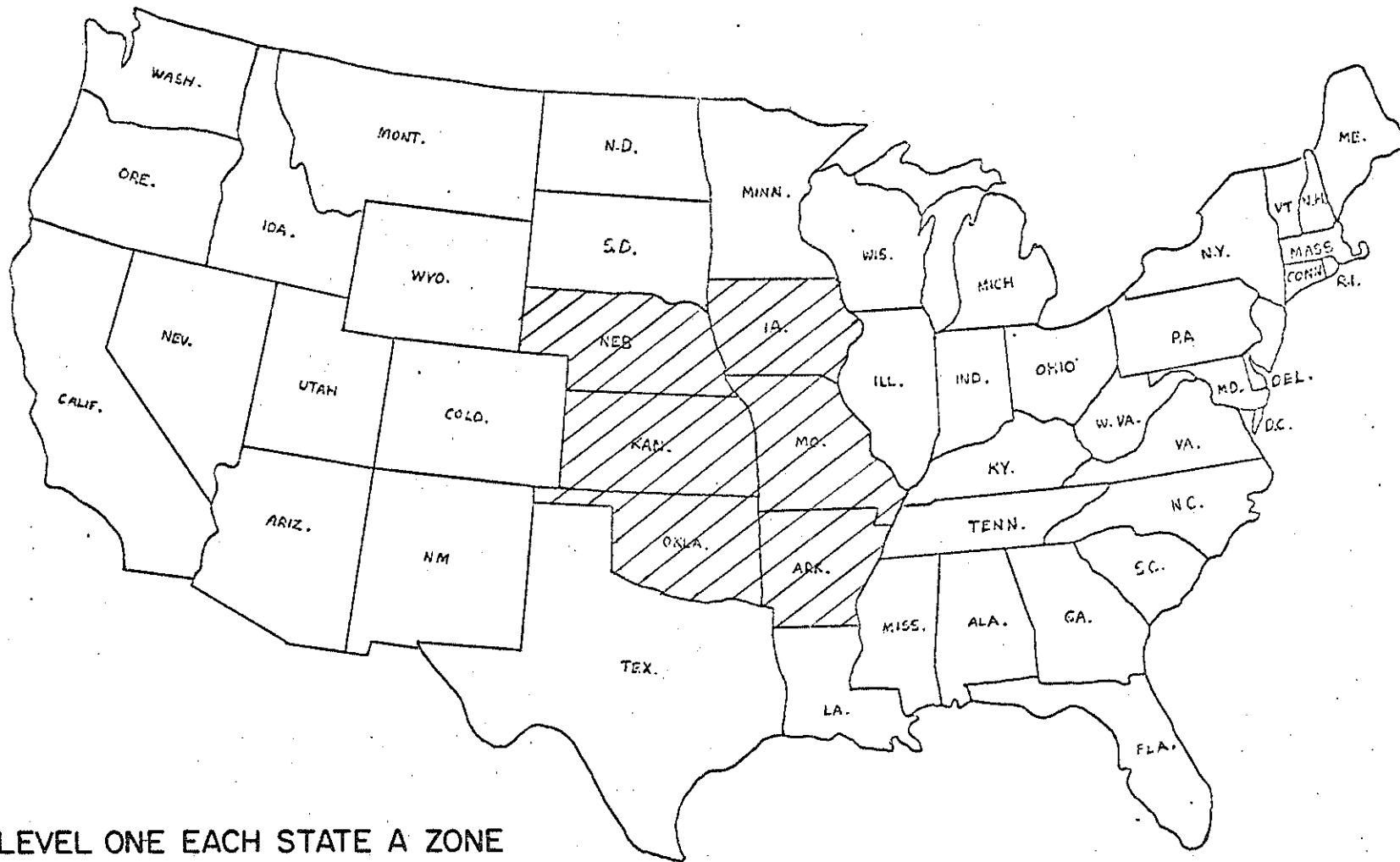
LEVEL ONE EACH STATE A ZONE
REPRESENTED BY BLANK AREAS
(NON-DETAILED STUDY AREAS)

LEVEL TWO COUNTIES IN EACH STATE
REPRESENTED BY SLASH MARKS
(DETAILED STUDY AREA)

FIGURE 12

29

highway networks outside their state independently.

States may use this model to save the large computer run times required by many of the "second generation" statewide models. Detailed network analysis could be completed on parts of a total system efficiency by generating the level of network detail required for just the study area. Figure 13 is an example where the route location engineering may wish to study alternate corridors in the region indicated as level four in this figure. This will save computer time by allowing the engineer to obtain answers with a much smaller zone and link system yet still study the effect on thru traffic in the state. Because of the advent of many of the statewide transportation system analysis approaches the states or consultants are finding it necessary to code two to four levels of network detail. The refined segmental model will save time by requiring the coding of only one network. The model will generate all of the network as the user so specifies, by area, by link type and jurisdiction.

With the advent of many systems analysis techniques at the stateside level there is a definite demand for maintaining two or three levels of zone and network detail. This is necessary because the study of goods movement, rail traffic and mass transit each require a specific level of zone and network detail.

A specific example of this systems analysis approach is the process previously defined in a report by Stanford

LEVEL 1 BLANK
LEVEL 2 ::::::
LEVEL 3 ooooo
         ooooo
LEVEL 4 /////

NOTE: These are the four levels of network detail discussed in the text just previous to figure 3.

FIGURE 13

31

Research Institute entitled <u>Systems Analysis Method for</u>
<u>Comprehensive Transportation Planning in the State of</u>
<u>Michigan</u>. Figure 14 is a copy of one of the zone systems
they wished to study. The related highway network is
displayed in figure 15. It should be noted that any state
which adapted a "segmental model" concept early in the
state planning process might be able to use this concept,
plus a total state network, to automatically generate any
necessary sub-sets of zone and links system required in the
system analysis process. This could have been done to
supply S.R.I. with the zone and link data they needed if the
"segmental model" process had been in existence at an early
date. This technique may have potential application in
any state which is just beginning to develop a statewide model.

Large urban studies after completing their initial
task of analysis on a total system find that much sub-
area analysis is required on a piece-meal basis before
the final construction is completed. Many of these studies
cannot afford to rerun the total system at the detailed
level for the whole study area. The refined segmental model
will allow them to complete analysis of these sub-areas at
a substantial saving in computer costs. It also eliminates
the task of manually coding the sub-area networks. Figure 16
is a map of the TALUS study area. The user in each city or
county in a regional study such as this could complete detailed
area analysis at a much smaller cost by using "segmental model".

INTERCITY HIGHWAY
NETWORK EXAMPLE

FIGURE 14

Traffic Analysis Zones

26

24

23

22

25

21

20

18

19

17

16

15

12

14

13

10

9

8

11

7 6 5 4 3 2

1
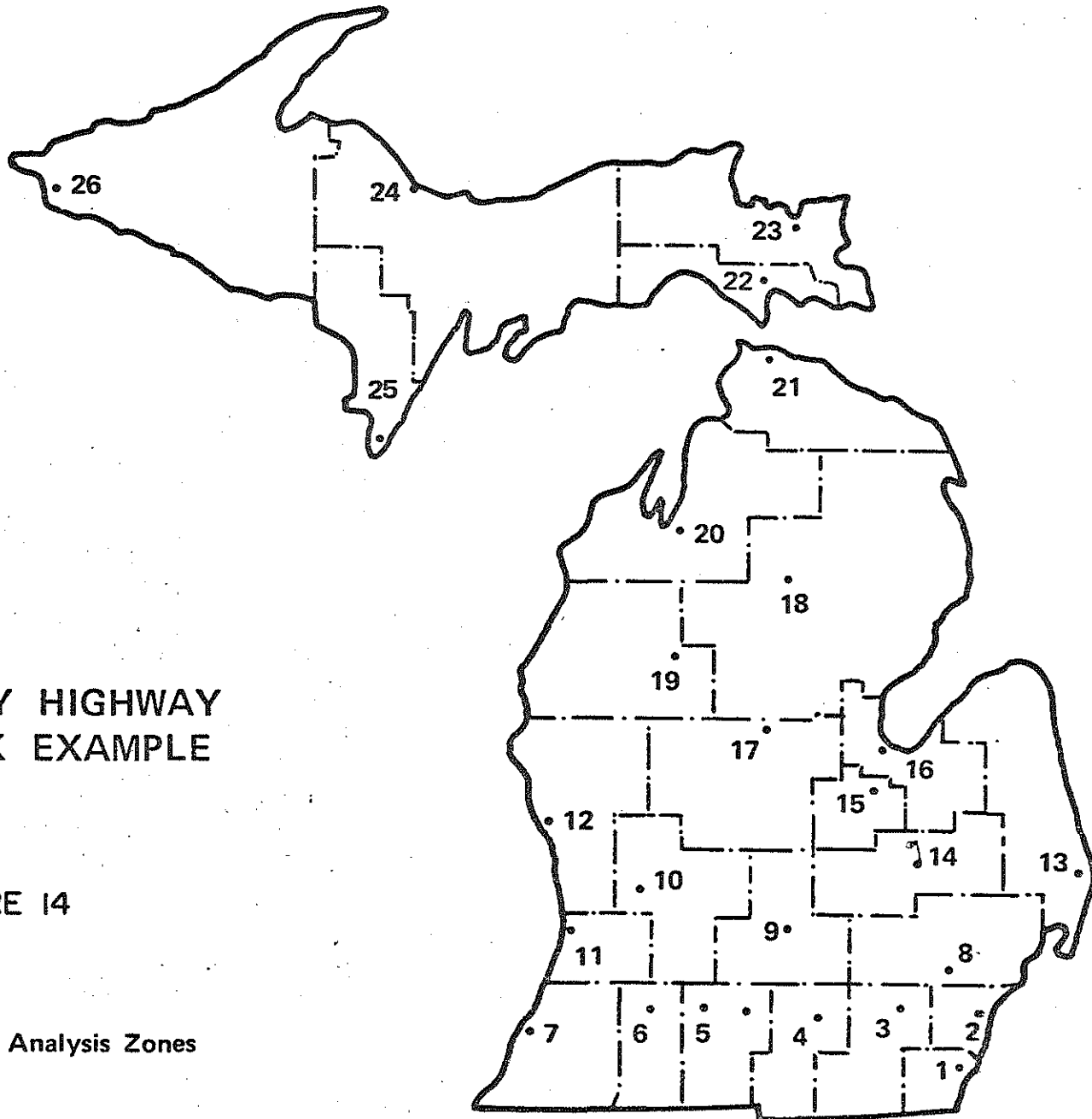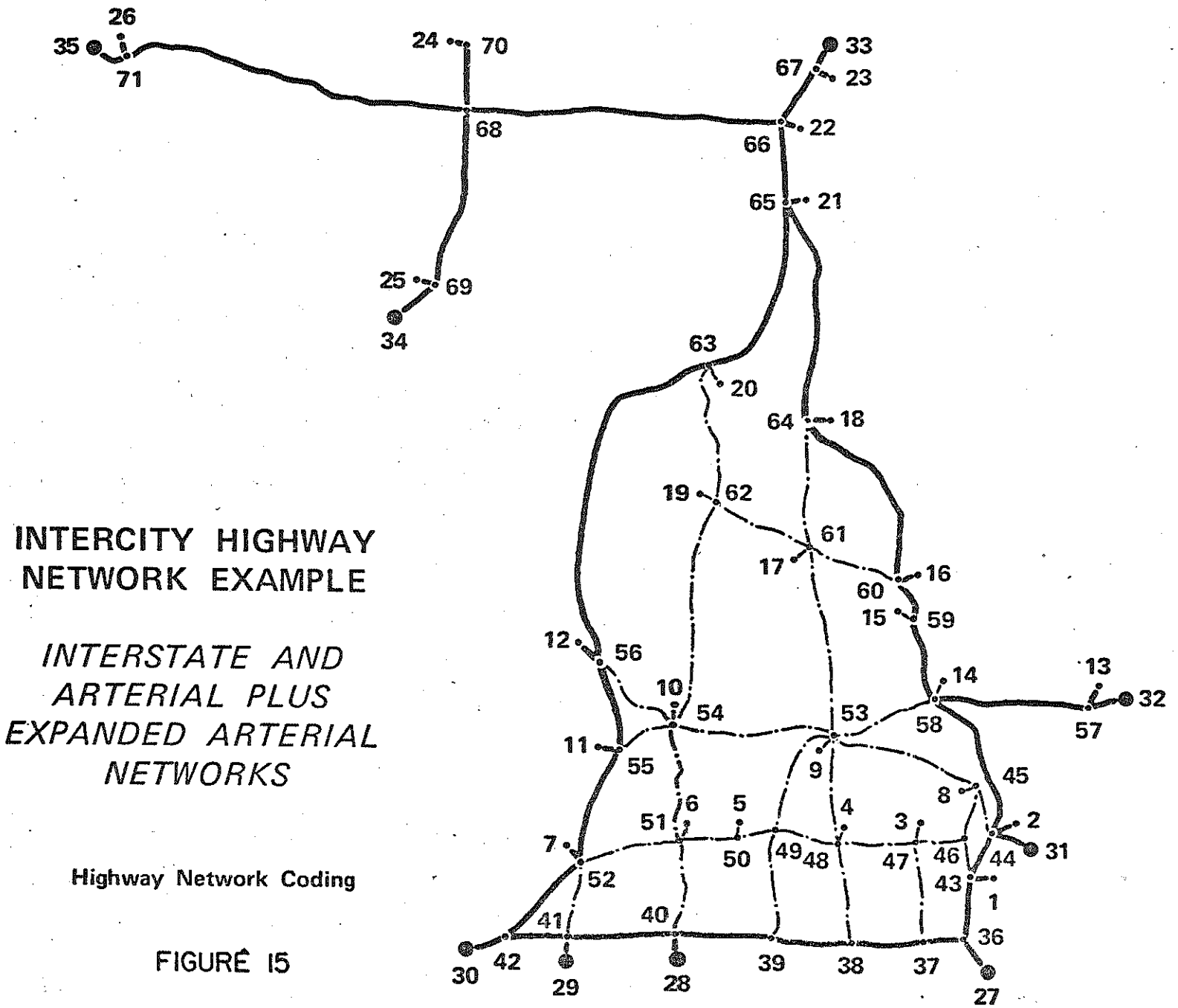
INTERCITY HIGHWAY
NETWORK EXAMPLE

INTERSTATE AND
ARTERIAL PLUS
EXPANDED ARTERIAL
NETWORKS

Highway Network Coding

FIGURE 15
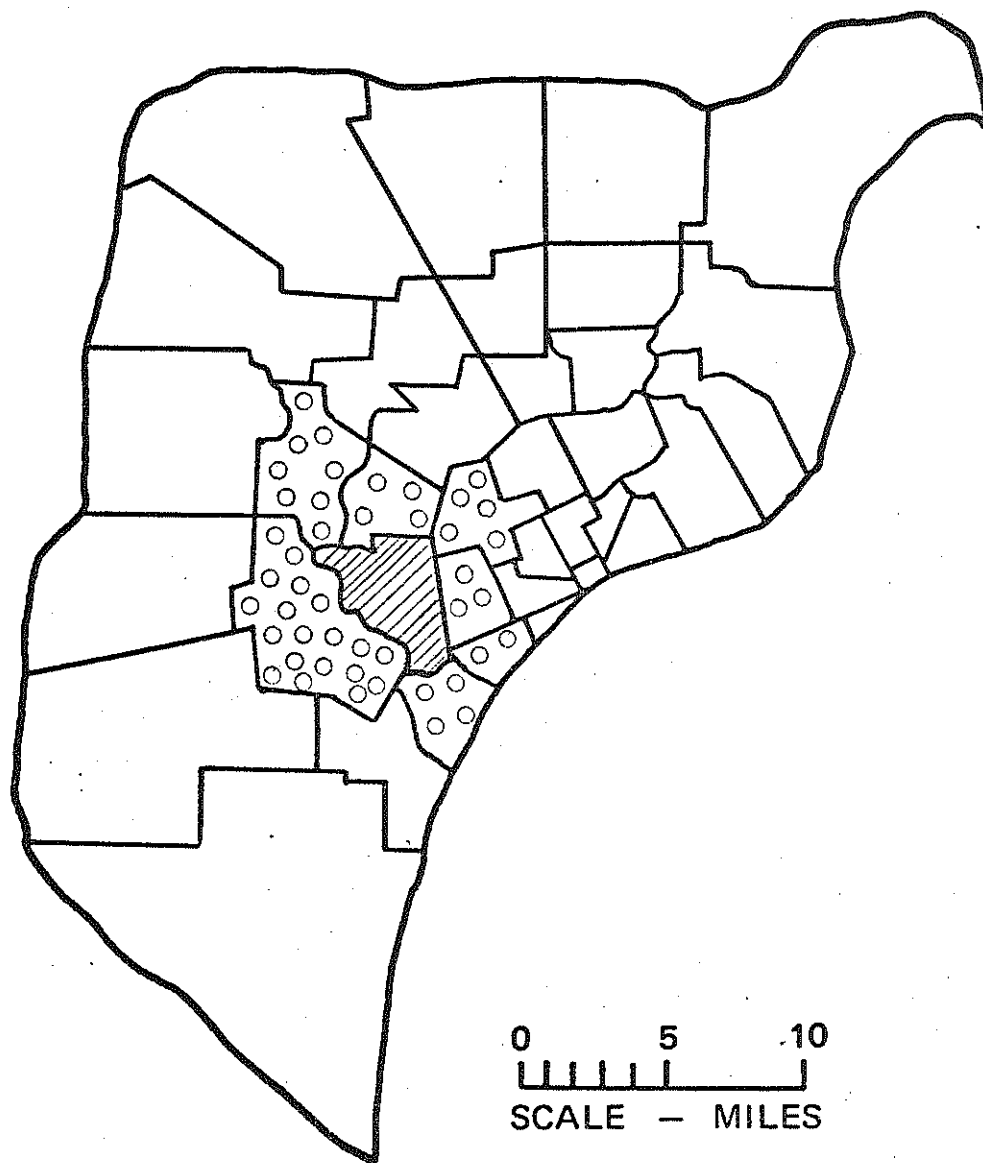
Figure 16

DETROIT ANALYSIS

Blank LEVEL ONE–PLANNING REGIONS

O O LEVEL TWO–DISTRICTS

///// LEVEL THREE–ZONE

	NUMBER OF ZONES
ZONE	1450
DISTRICTS	300
PLANNING REGIONS	60

0   5   .10

SCALE — MILES

Here again the user could study alternate corridor analysis in a detail study area such as the one in figure 16 and still determine the effect of the analysis on a total region.

The development effort up to the time this report was published involved approximately three-man months of analyst and programmers time plus four or five computer test runs. Obviously the potential for this type of traffic forecasting tool has only briefly been explored. The department would welcome any suggestion as to future applications of this type of technique. Comments for modification or improvement to the existing segmental model program would sincerely be appreciated.

Segmental Model
Operational
Procedures on a B-5500
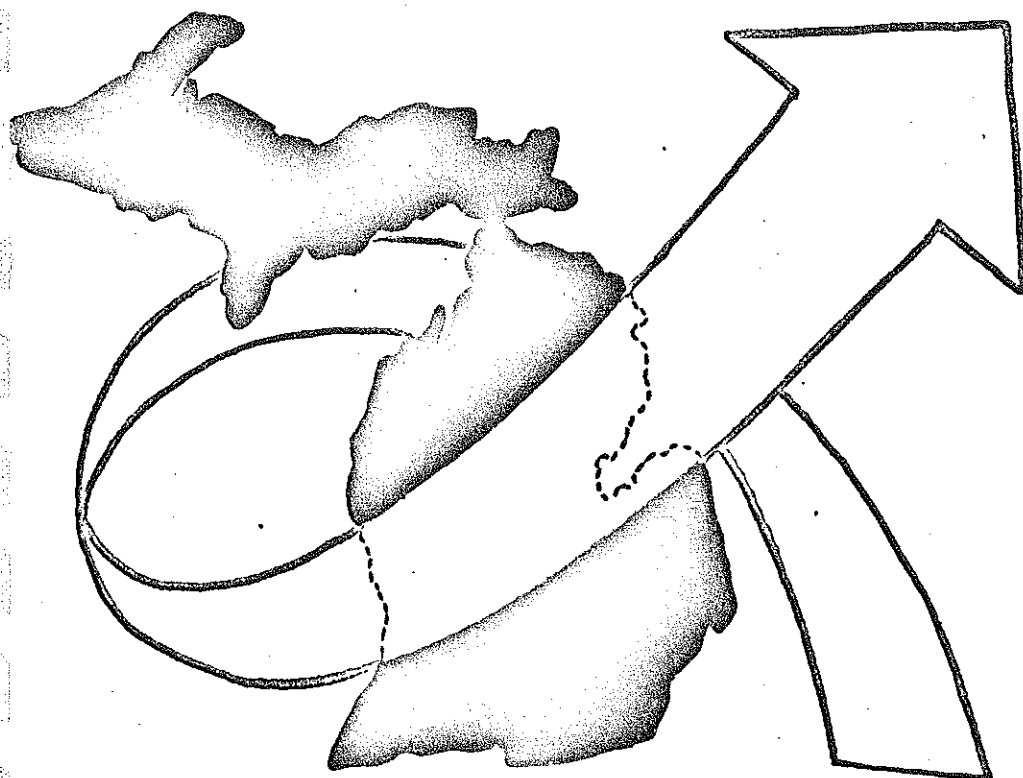
SEGMENTAL MODEL OPERATIONAL PROCEDURES ON A B-5500

This section describes the operational procedures required to operate the "preliminary segmental model" computer program on a B-5500.

It is assumed that the user has a master highway link deck in the format suggested in figure 7. If a network is available, but not in this format, the user may generate this format from his highway link deck through the use of a reproducing punch or other similar equipment.

The user should keep in mind the fact that if a district or state number was substituted where Michigan has its county number (column 75-76), this model could be operated on any existing highway link deck. This would also require the user to number the zone system accordingly, as explained in a previous section.

When using this program the system assumes the A-node is always greater than the B-node except for the non-sequential centroid link A-nodes. The master link file is presently on cards. This file is sorted by A-node and B-node and loaded on magnetic tape. Because of the fact that the "preliminary segmental model" automatically calls the network edit program from the Transportation Planning package, this model uses the same parameters and constraints as apply to the total Transportation Planning package. No distance should be greater than 25.5 miles and the maximum speed is 99.9 miles.

The user should note that with the "preliminary segmental model" program only a maximum of 40 master file highway

links can be compressed into a single new link. In the four test runs completed using Michigan's 2300 zone highway network model as the master file, this has not created any problems. It appears that in these test cases a maximum of 15-18 links were compressed and this occurred in only a relatively few situations.

The "preliminary segmental model" also assumes that only 83 counties exist. Therefore, only those users whose state or district totals remain 83 or less could immediately use this program as it presently exists. The out-of-state zones in Michigan's 2300 zone model have a range of 8400 to 9999 and are treated differently than instate zones. Both the zone and network remains the same as defined in the master link file regardless of which instate counties the user specifies as detailed. The present 2300 outstate zone and link system is displayed in figure 17 and 18.

A flow chart of the "preliminary segmental model" process appears in figure 19. Because of the fact that the segmental model program operates as part of a total package it has been defined as a series of four programs. This allows the user to enter the series of programs at more than one pre-selected point depending on the task to be accomplished.

The first program of the series is Q01436 which was designed to prepare link data for use in the network builder program. Q01436 will prepare link data for TPNET from three varying types of link data analysis as indicated on the flow chart. The outline of Q01436 follows the flow chart and briefly explains the options.

38

ONTARIO

MINNESOTA

WISCONSIN

MICHIGAN

NEW YORK

IOWA

PENNSYLVANIA

ILLINOIS

INDIANA

OHIO

WEST VIRGINIA

MISSOURI

KENTUCKY

FIGURE 17

2300 ZONE TRAFFIC FORECASTING SYSTEM

OUTSTATE ANALYSIS ZONES

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRANSPORTATION PLANNING DIVISION
STATEWIDE STUDIES UNIT
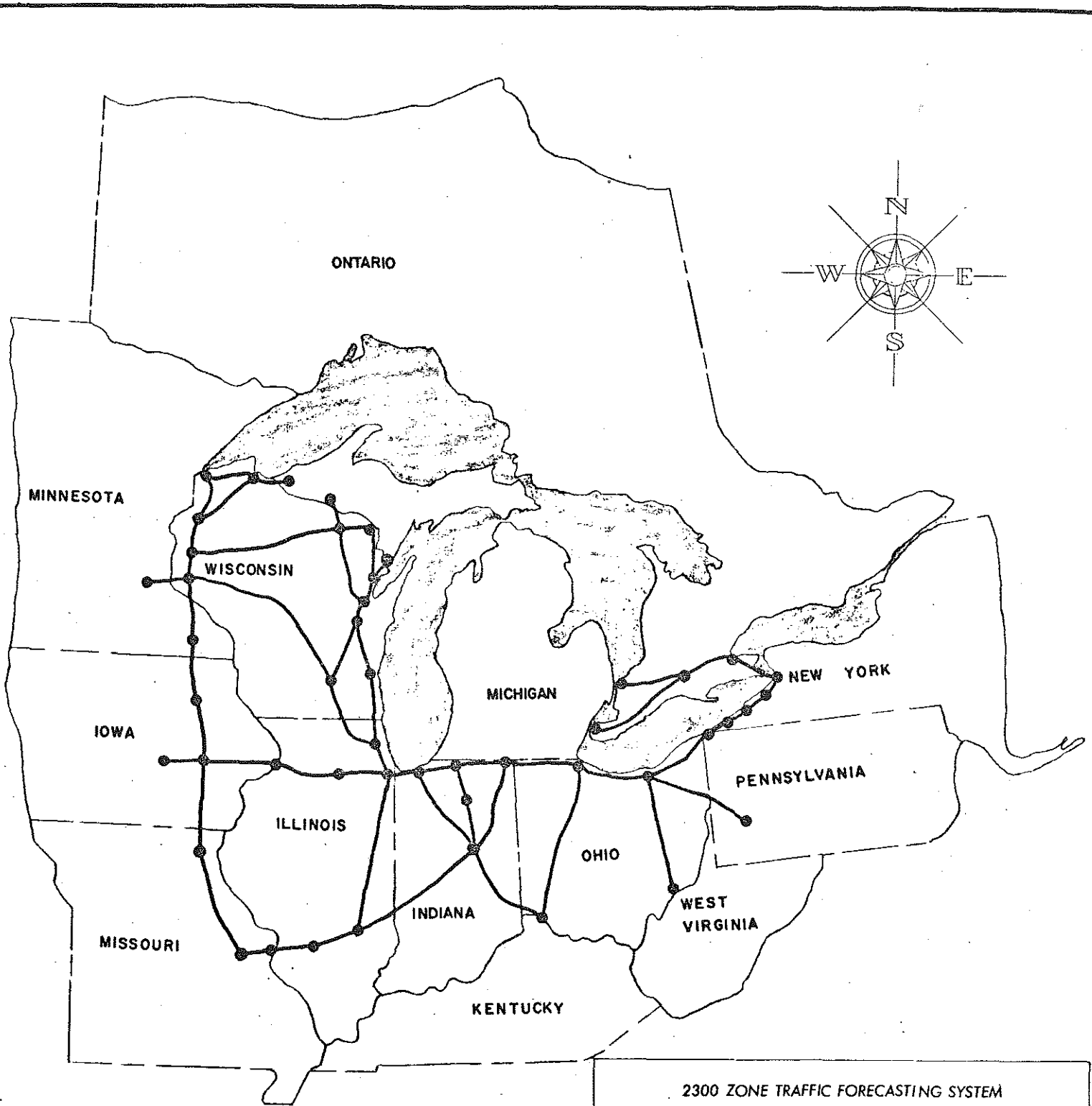
FIGURE 18

2300 ZONE TRAFFIC FORECASTING SYSTEM

OUTSTATE HIGHWAY NETWORK

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRANSPORTATION PLANNING DIVISION
STATEWIDE STUDIES UNIT

FIGURE 19
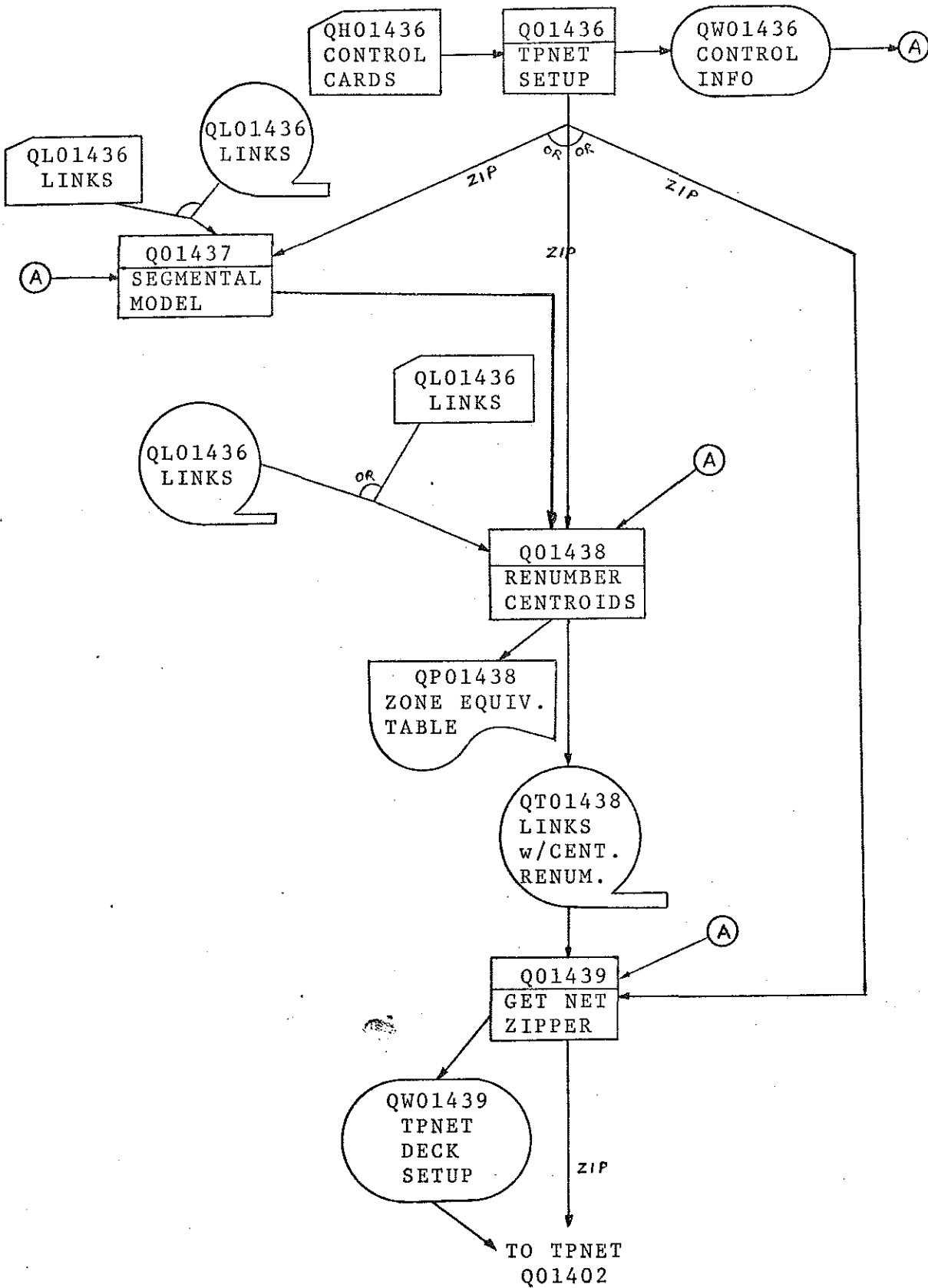
This program will prepare data for TPNET (Q01402) and then execute TPNET. Three basic run modes exist to prepare for the TPNET execution.

1. Run Code = "NOSQ"

    A. All input link cards supplied by user are saved.

    B. Centroids are renumbered--user specifies max. centroid.

    C. User supplies TPNET control cards.

    D. TPNET is executed.

2. Run Code = "ZNET"

    A. Link information is taken from QT01438 created by a previous run.

    B. User supplies TPNET control cards.

    C. TPNET is executed.

3. Run Code = "SQEZ"

    A. Only part of the link cards supplied by user are saved.

        (1) User specifies link type for county roads.

        (2) User specifies link type for centroids.

        (3) User specifies those county numbers for which all input link cards are saved.

        (4) County-road links which are not in the above list will be eliminated.

        (5) Centroid links not in the specified counties will be eliminated unless they are the first centroid link for that county.

    B. Centroids are renumbered--user specifies max. centroid.

    C. TPNET is executed.

The second program of the preliminary model series is
Q01437 which is the actual segmental model. This program
is zipped by the master control program (Q01436) if "SQEZ"
is coded in columns 8-11 in the run control card for that
master program. The detailed operations completed in this
program will be discussed in the next section of this report.
A brief summary of this program follows.

Q01437

Description

Program Q01437 is always zipped by Q01436. Input
(tape or card) QL01436 contains link information.
Input disk QW01436 contains control information.
The input links are for a detailed complete net-
work.

Program will delete some links and combine others
to form a network with two levels of detail. Output
tape QL01436 contains the new set of links for this
two-level network.

At completion of the program, program Q01438 is
executed to renumber the centroid links.

The third program is Q01438 which may follow the com-
pletion of Q01437. If the user wishes to apply only the
renumber portion of this series of programs, Q01438 may be
zipped directly by Q01436 if "NOSQ" is coded in the master
program control cards. The primary function of this program
is the renumbering of the non-sequential socio-economic
data bank zone numbers to sequential zone numbers. This
sequential zone numbering is a requirement of the Transportation
Planning analysis packages. A summary of this program follows.

Q01438

Description

Program Q01438 is always zipped by another program.
Input QL01436 (Tape or Disk) contains link informa-
tion. Link type for centroids and the maximum
centroid is passed to this program by disk QW01436.

This program then sorts incoming centroid links by
A-node, B-node, and then renumbers these centroids
serially beginning with 0001 until there are no more
centroids or the user-specified maximum has been
reached.

The output tape contains all input highway links
unchanged and the renumbered centroid links. This
output tape is input to the next program which is
zipped (Q01439).

Printer output gives an equivalence table for old
and new centroid numbers.

The final program in the preliminary segmental model

series is Q01439 which is a short program and its function

is to prepare two separate input files for use in the

Transportation Planning package network edit program. A

brief program summary follows.

Q01439

Description

Program Q01439 will be zipped by Q01436 or Q01438.
Input will be tape (link card images) QT01438
and disk QW01436 (TPNET control cards). Program
combines the two input files to form a TPNET
(Q01402) deck setup on disk QW01439. TPNET is
then zipped, lable equating the card reader to
disk QW01439.

At this point the network has entered the Transportation

Planning package and any changes or additions to this newly

created multi-level detail network may be handled just as it

would with any other highway network file. The user may
also use this network as input to any of the typical
transportation analysis programs such as tree builder or
traffic assignment. The user should note that this is
a totally automated process requiring no manual network
coding.

A copy of a "preliminary segmental model" run deck
is displayed in figure 20. This was a 3 county test run where
two counties out of three counties in the 2300 zone master
network file were run as non-detailed areas. The 47 coded
in the fifth card from the bottom in figure 20 indicates
which county is to contain detail link data. This run would
supply the user with multi-level network. The fourth control
card indicates that this was a "SQEZ" run.

The first five control cards pertain to the segmental
model run and the remaining control cards are required by
the TPNET program which is called by Q01439.

/END

2 598   6046 1105   6 518 4 15   25   US   01   4/264

UNTR CLOSE

STATE OF MICHIGAN
DEPARTMENT OF STATE HIGHWAYS
MANAGEMENT SERVICES – DATA CENTER

COMPUTER SERVICE REQUEST

Form 2350 F (Rev. 11/67)

Please run for production program(s)   *MAY NOT BE ON LIBRARY*   Date Submitted

QO1436 (WILL ZIP QO1437, 38, 39 ETC)   6/18/74

Distribution   ☒ Normal   ☐ Other   RICHARD ESCH 32663

Special Instructions (Use when deviating from abstract)

STATEWIDE STUDIES

IN = CARDS

OUT = QTO1438 = # (971)

OUT = QTO1400/SEGTEST = # (   )   5 min

Output Needed: (Check one)	☒ 24 Hrs.	☐ 3 Days	☐ 1 Week	☐ Other	CPU =

Oper. Inits.   2 | Run Date   6-18

FIGURE 20

46

SEGMENTAL MODEL
PROGRAM DETAILS
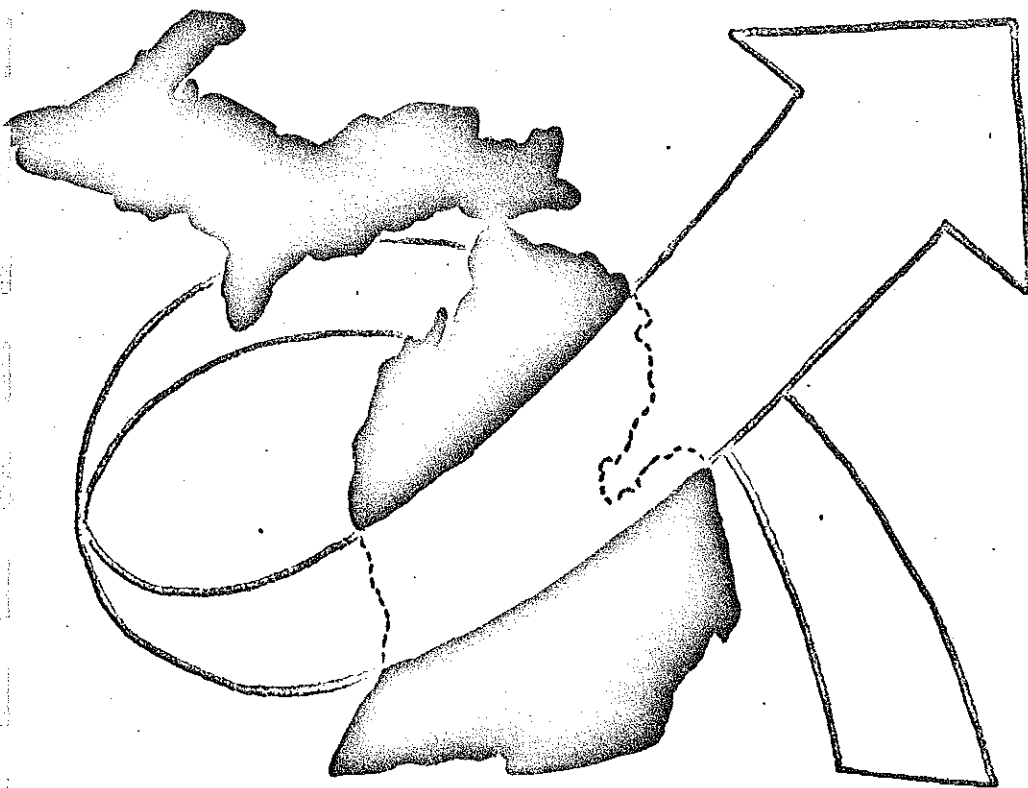
PRELIMINARY SEGMENTAL MODEL

Q01437

DETAILED DESCRIPTION

This section deals only with the detailed functions
of Q01437 which is the "preliminary segmental model"
program and how this program accomplishes these functions.
The other three programs in the "segmental model" process
are relatively insignificant and the explanation in the
previous section should suffice.

The basic function of this program is to eliminate
certain links so that a two-level network may be built.
A list of county numbers defines the area for which there
will be no changes in the master link file. In the case
of the national network state numbers might be substituted.
Urban or regional studies could replace the county number
in a master link file with sector or district codes. This
would allow an urban study to generate a network at both
the zone and district level or any combination of the two
yet maintaining only one network file. All out state links
are presently included with all "detail areas". The remain-
ing instate counties define a second level "gross area" from
which the program begins eliminating links. Link elimina-
tion or compression falls into two categories:

1. Elimination based on the given link type coded in
    column 69-70 on the master link file card.

2. Elimination of several links by combining links
    in the non-detailed area.

The program can be broken into three main sections.

SECTION I

Incoming link information is separated into three courses of action in the preliminary segments model program.

1. Certain master network links are written to the final tape with no change and those are as follows:

   a. Detail Area - all links both centroid and highway.

   b. Gross Area - only first centroid link is saved for each county.

2. Certain links are eliminated from the master network input file as follows:

   a. Detail Area - None

   b. Gross Area - (i) a specified link type (county roads). Presently all roads coded 02 in the link type column of the master link record.

   (ii) centroid links except the first one for each county.

3. Links which may be eligible for combining are written to disk. The number of times each node number occurs in the network file is then tallied.

   a. Detail Area - None

   b. Gross Area - all highway links except those with specified link type (county roads).

SECTION II

The disk containing all candidates for combining is rewound and read. Utilizing the node-count information we can determine which links are eligible for combining.

The eligibility for the compression routine is based on the following necessary and sufficient condition.

At least one node of a link must occur exactly twice in the network link file.

EXAMPLE:

Given the following links
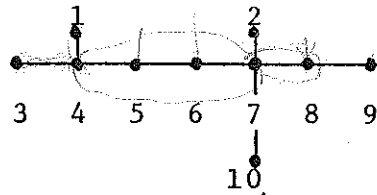
Node	Node-Count
1	1
2	1
3	1
4	3
5	2
6	2
7	4
8	2
9	1
10	1

Those links saved for compression will be:
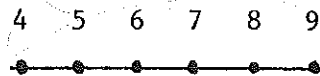
The resulting compression would give:
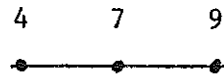
Assuming the same control section, link type, and link jurisdiction.

The final network would then be:
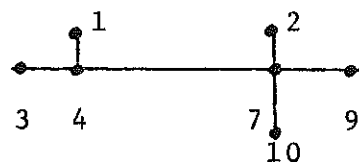
We then have the data divided into two categories.

1. Links which can be combined are stored on a random disk using the A-node as the relative address. For any given link if one of the A-nodes will be the beginning (or ending) of a chain, it will be put in the B-node field and the B-node placed in the A-node field. Because a number will occur twice as an A-node, there are two disk files.

2. Links which cannot be combined are written on the final tape without change.

SECTION III

When all selected links are stored on the two disk files, disk 1 is read sequential until the beginning of a chain of links in found. Both disks are then utilized to search out each of the chain. When all links in a chain are stored they are combined to create one link which now will represent the entire chain. If the control section, link type, and link jurisdiction are not the same, more than one final link will be created. The combined link(s) is (are) written on the final link tape and control returns to disk 1 to search for the beginning of a new chain. The new link distance presently is created by addition of the original master file link distance. The capacity for the new link in the lowest of the original capacities. The count and speed are a weighted average. Link type and jurisdiction and control section are the same as on the original link cards.

When all chains have been processed, the program terminates;
and control is passed to a new program where the centroid links
are sequentially renumbered.

Much of the initial programming work has been purposely
kept relatively simple until the department has had a better
opportunity to test this model on several realistic network
situations. It is hoped that after additional tests with the
"preliminary segmental model" the "refined segmental model"
will incorporate and require changes to efficiently and
realistically handle all of the network manipulations for
which it was originally designed.

PRELIMINARY SEGMENTAL MODEL PROGRAM
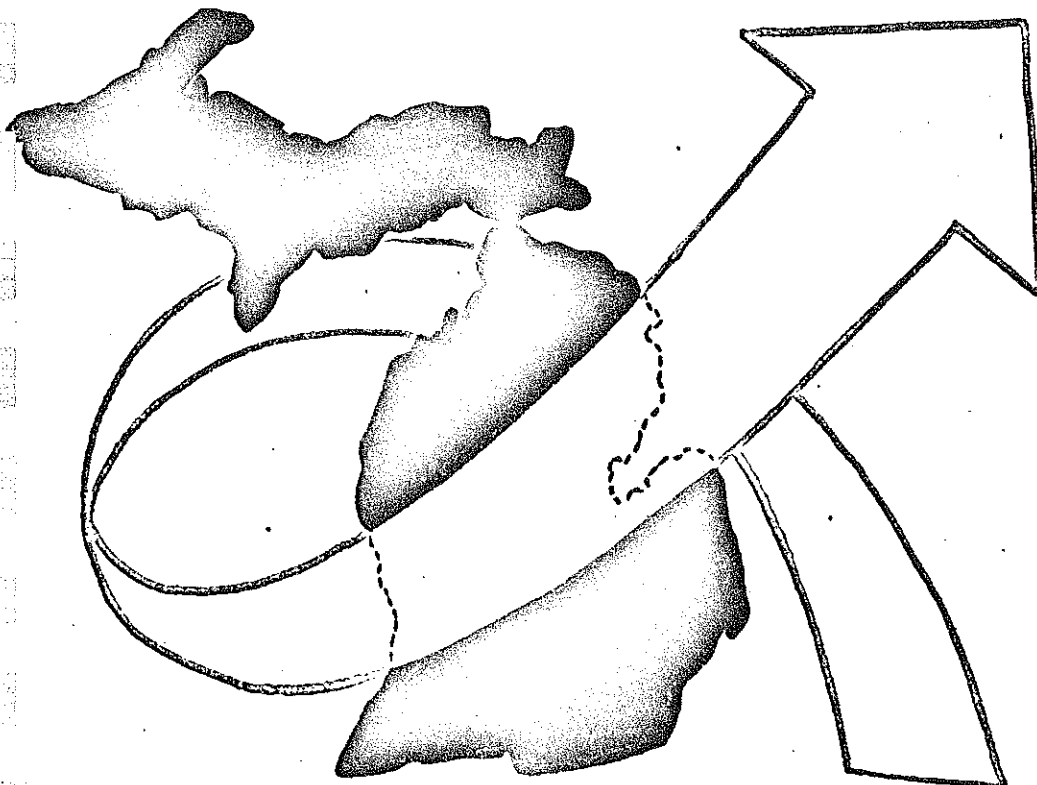
A copy of the actual preliminary segmental model computer program listing was not included in this report as it would be to voluminous. Those potential users who wish to obtain a copy of the preliminary segmental model program may address a letter requesting the program to the Michigan Department of State Highways, Post Office Drawer K.

SEGMENTAL MODEL
TEST RUN
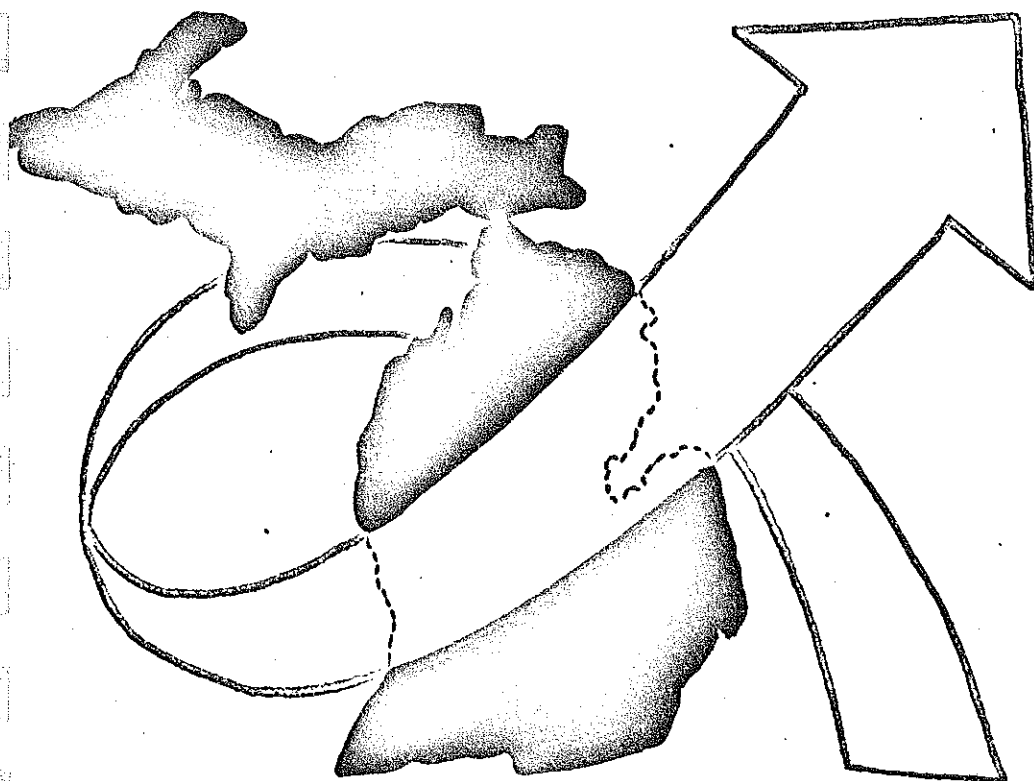
SEGMENTAL MODEL TEST RUN

(Actual Data)

In order to test the "preliminary segmental model" program with actual network data three counties from the 2300 statewide model highway network were selected as a test case. Figures 21, 23 and 25 are copies of the original 2300 highway network for Eaton, Ingham, and Livingston Counties which were used as test counties.

County 47 (Livingston County) was selected as the county which would contain detailed network information after the "preliminary segmental model" run. County 23 and 33 (Eaton and Ingham) were left as non-detailed study areas. Figure 20 was a copy of the actual control cards used to obtain the information for this test run.

Figures 22, 24 and 26 are copies of the county network maps after this run of the "preliminary segmental model". Note how much more simplified the network appears in counties 23 and 33, when compared to the original detailed network.
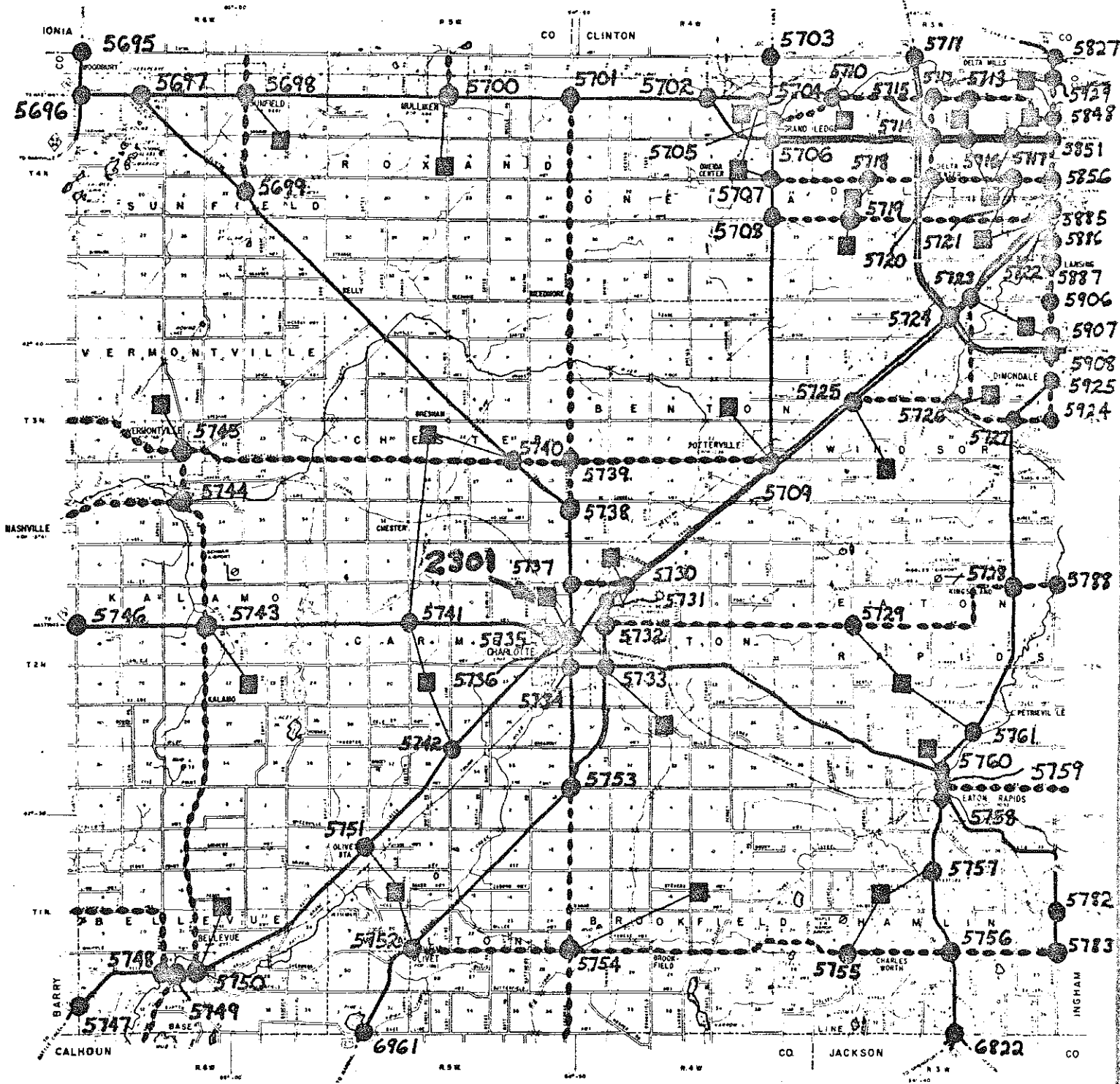
EATON COUNTY
MICHIGAN
STATE HIGHWAY COMMISSION
DEPARTMENT OF STATE HIGHWAYS

DATA OBTAINED FROM
HIGHWAY PLANNING SURVEY
CONDUCTED IN COOPERATION WITH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS
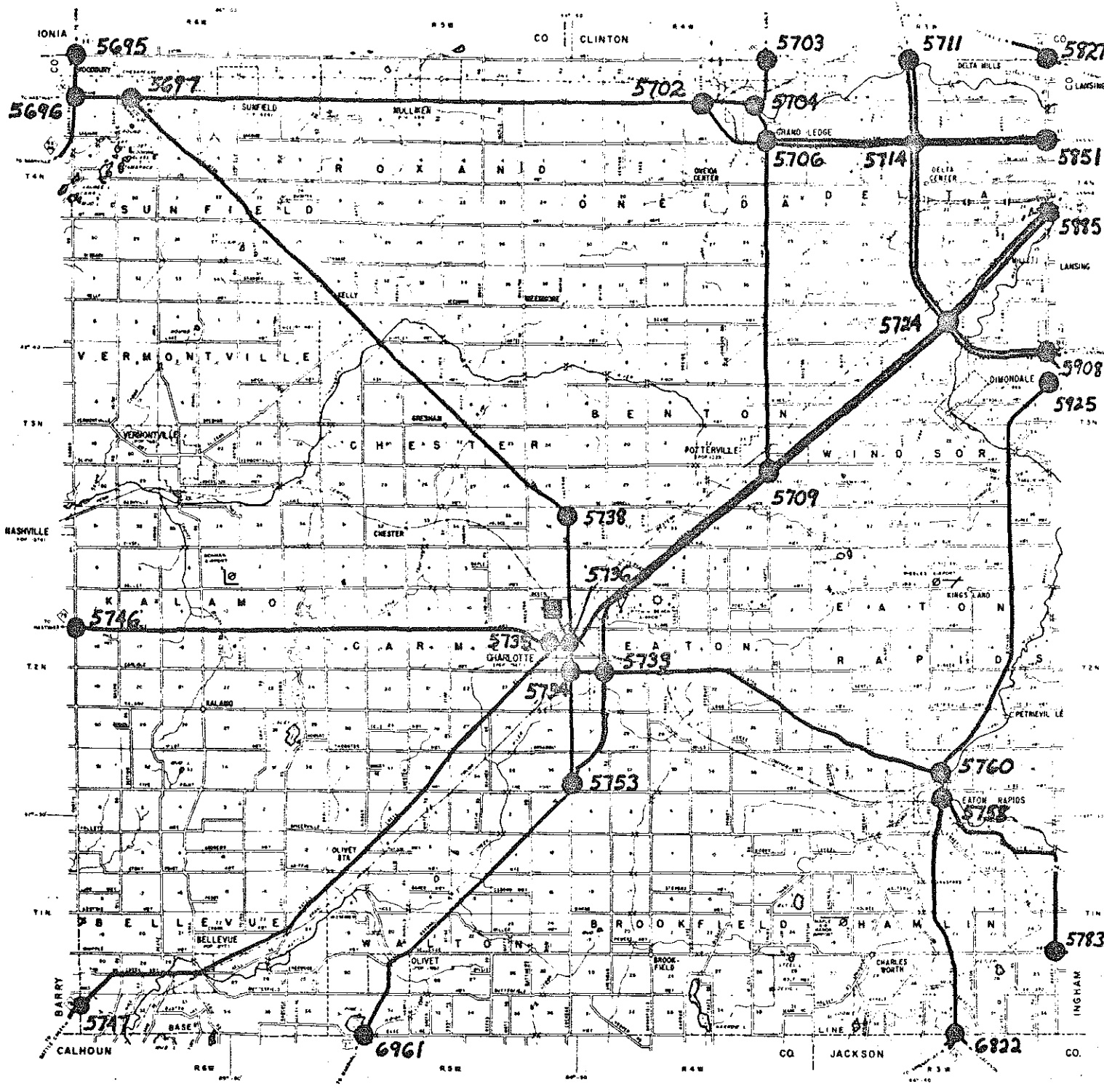
FIGURE 21

KEY TO COUNTIES

EATON COUNTY
MICHIGAN
STATE HIGHWAY COMMISSION
DEPARTMENT OF STATE HIGHWAYS

DATA OBTAINED FROM

HIGHWAY PLANNING SURVEY

CONDUCTED IN COOPERATION WITH
U.S DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS

FIGURE 22

KEY TO COUNTIES
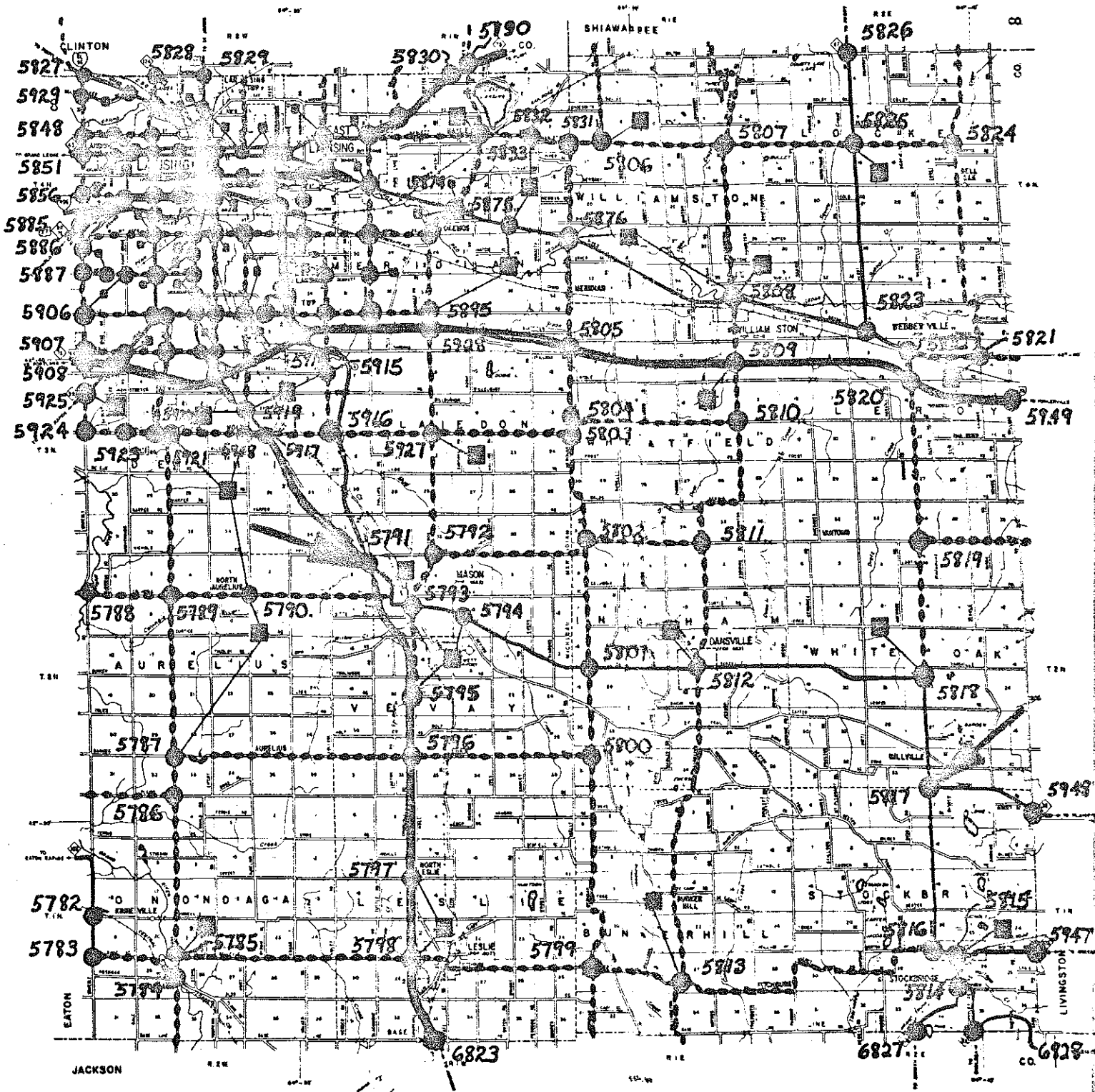
FIGURE 23

INGHAM COUNTY
MICHIGAN
STATE HIGHWAY COMMISSION
DEPARTMENT OF STATE HIGHWAYS
DATA OBTAINED FROM
HIGHWAY PLANNING SURVEY
CONDUCTED IN COOPERATION WITH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS

KEY TO COUNTIES

INGHAM COUNTY

MICHIGAN
STATE HIGHWAY COMMISSION
DEPARTMENT OF STATE HIGHWAYS

DATA OBTAINED FROM

HIGHWAY PLANNING SURVEY

CONDUCTED IN COOPERATION WITH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS

FIGURE 24

KEY TO COUNTIES

LIVINGSTON COUNTY
MICHIGAN
STATE HIGHWAY COMMISSION
DEPARTMENT OF STATE HIGHWAYS

DATA OBTAINED FROM

HIGHWAY PLANNING SURVEY

CONDUCTED IN COOPERATION WITH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS

FIGURE 25

KEY TO COUNTIES

This Is How Livingston County Would Have Looked If It Was A Non-Detailed County
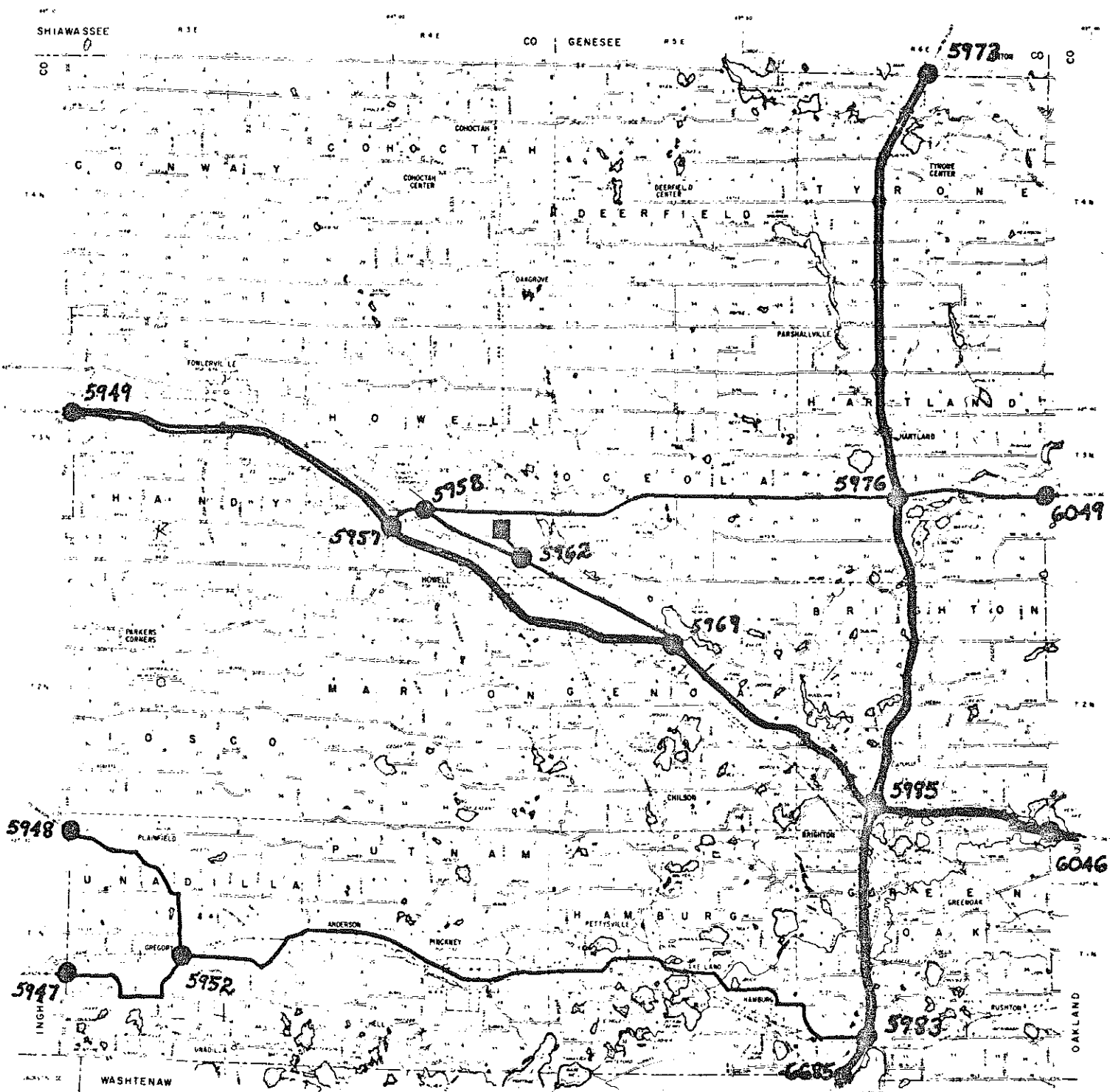
LIVINGSTON COUNTY
MICHIGAN
STATE HIGHWAY COMMISSION
DEPARTMENT OF STATE HIGHWAYS

FIGURE 26
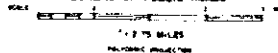
DATA OBTAINED FROM
HIGHWAY PLANNING SURVEY
CONDUCTED IN COOPERATION WITH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS

HIGHWAY NETWORK LINK DATA

BEFORE SEGMENTAL MODEL

The following nine pages are copies of the highway link

data from the original 2300 zone network before a segmental

model run has been completed. The first three pages are

the centroid links for each of the three test counties with the

A-node being the zone centroid. The first two digits of the

zone represent the county number and the last two digits represent

the zone within each county. There are approximately 160 cen-

troid links in this original network and 116 study zones. The

remaining six pages is a listing of all of the original 2300

zone highway links. There are approximately 380 highway links.

The format for this data is displayed in figure 7.

2	2301	5736	0100S	200	2S	0113	23000
	02	9	01	0	S	113	000
2	2303	5700	0200S	300	2S	0113	23000
2	2304	5704	0200S	300	2S	0113	23000
2	2304	5707	0115S	300	2S	0113	23000
2	2305	5704	0050S	200	2S	0113	23000
2	2306	5710	0040S	200	2S	0113	23000
2	2307	5718	0030S	200	2S	0113	23000
2	2307	5719	0075S	200	2S	0113	23000
2	2308	5719	0060S	200	2S	0113	23000
2	2309	5929	0080S	200	2S	0113	23000
2	2310	5713	0050S	200	2S	0113	23000
2	2310	5716	0050S	200	2S	0113	23000
2	2311	5713	0160S	200	2S	0113	23000
2	2311	5717	0050S	200	2S	0113	23000
2	2312	5716	0110S	200	2S	0113	23000
2	2312	5717	0110S	200	2S	0113	23000
2	2312	5721	0050S	200	2S	0113	23000
2	2313	5721	0160S	200	2S	0113	23000
2	2313	5722	0115S	200	2S	0113	23000
2	2314	5745	0100S	300	2S	0113	23000
2	2315	5740	0250S	300	2S	0113	23000
2	2315	5741	0500S	300	2S	0113	23000
2	2316	5709	0075S	300	2S	0113	23000
2	2317	5725	0160S	300	2S	0113	23000
2	2318	5723	0120S	200	2S	0113	23000
2	2318	5907	0100S	200	2S	0113	23000
2	2319	5726	0050S	200	2S	0113	23000
2	2320	5743	0110S	300	2S	0113	23000
2	2321	5741	0120S	300	2S	0113	23000
2	2321	5742	0200S	300	2S	0113	23000
2	2322	5730	0075S	300	2S	0113	23000
2	2323	5733	0176S	300	2S	0113	23000
2	2324	5729	0175S	300	2S	0113	23000
2	2324	5761	0175S	300	2S	0113	23000
2	2325	5760	0060S	200	2S	0113	23000
2	2326	5750	0120S	200	2S	0113	23000
2	2327	5751	0150S	300	2S	0113	23000
2	2327	5752	0150S	300	2S	0113	23000
2	2328	5754	0312S	300	2S	0113	23000
2	2329	5758	0050S	200	2S	0113	23000
2	2330	5755	0160S	300	2S	0113	23000
2	2330	5757	0130S	300	2S	0113	23000
2	3301	5855	0055S	200	2S	0113	33000
2	3301	5858	0075S	200	2S	0113	33000
2	3301	5860	0055S	200	2S	0113	33000
2	3301	5861	0045S	200	2S	0113	33000
2	3302	5806	0125S	300	2S	0113	33000
2	3303	5808	0305S	300	2S	0113	33000
2	3303	5876	0160S	200	2S	0113	33000
2	3304	5808	0050S	200	2S	0113	33000
2	3305	5825	0110S	300	2S	0113	33000
2	3306	5790	0260S	300	2S	0113	33000
2	3306	5918	0160S	300	2S	0113	33000
2	3306	5921	0200S	300	2S	0113	33000
2	3307	5827	0110S	300	2S	0113	33000
2	3308	5809	0100S	300	2S	0113	33000
2	3309	5821	0075S	300	2S	0113	33000
2	3310	5787	0015S	200	2S	0113	33000
2	3310	5790	0050S	300	2S	0113	33000
2	3311	5793	0050S	200	2S	0113	33000
2	3312	5794	0125S	300	2S	0113	33000
2	3312	5795	0120S	300	2S	0113	33000
2	3313	5812	0120S	300	2S	0113	33000
2	3314	5818	0150S	300	2S	0113	33000

INGHAM COUNTY CENTROID LINKS —

2	3317	5783	0100S	300	2S	0113	33000
	116	7	0	00	1S	0113	33000
2	3306	5798	0100S	300	2S	0113	33000
2	3307	5813	0200S	300	2S	0113	33000
2	3318	5815	0100S	300	2S	0113	33000
2	3319	5847	0045S	300	2S	0113	33000
2	3319	5929	0200S	200	2S	0113	33000
2	3320	5843	0049S	300	2S	0113	33000
2	3320	5844	0030S	300	2S	0113	33000
2	3321	5845	0046S	200	2S	0113	33000
2	3321	5850	0058S	200	2S	0113	33000
2	3322	5849	0030S	200	2S	0113	33000
2	3323	5854	0030S	200	2S	0113	33000
2	3324	5841	0080S	200	2S	0113	33000
2	3324	5850	0045S	200	2S	0113	33000
2	3324	5855	0046S	200	2S	0113	33000
2	3325	5843	0031S	300	2S	0113	33000
2	3326	5838	0052S	200	2S	0113	33000
2	3326	5839	0060S	200	2S	0113	33000
2	3326	5843	0090S	200	2S	0113	33000
2	3327	5837	0037S	200	2S	0113	33000
2	3327	5838	0060S	200	2S	0113	33000
2	3328	5835	0090S	200	2S	0113	33000
2	3329	5834	0045S	300	2S	0113	33000
2	3330	5833	0078S	300	2S	0113	33000
2	3331	5874	0045S	300	2S	0113	33000
2	3332	5832	0093S	300	2S	0113	33000
2	3332	5875	0140S	300	2S	0113	33000
2	3333	5852	0032S	200	2S	0113	33000
2	3334	5853	0035S	200	2S	0113	33000
2	3335	5856	0040S	200	2S	0113	33000
2	3336	5857	0055S	200	2S	0113	33000
2	3336	5858	0040S	200	2S	0113	33000
2	3337	5856	0025S	200	2S	0113	33000
2	3338	5883	0040S	200	2S	0113	33000
2	3338	5884	0040S	200	2S	0113	33000
2	3339	5860	0030S	200	2S	0113	33000
2	3340	5863	0062S	200	2S	0113	33000
2	3340	5882	0045S	200	2S	0113	33000
2	3341	5864	0030S	200	2S	0113	33000
2	3342	5838	0050S	200	2S	0113	33000
2	3342	5867	0035S	200	2S	0113	33000
2	3343	5866	0040S	200	2S	0113	33000
2	3344	5870	0040S	300	2S	0113	33000
2	3345	5873	0040S	300	2S	0113	33000
2	3346	5874	0079S	300	2S	0113	33000
2	3346	5877	0050S	300	2S	0113	33000
2	3347	5875	0080S	300	2S	0113	33000
2	3347	5895	0240S	300	2S	0113	33000
2	3348	5886	0050S	200	2S	0113	33000
2	3348	5888	0050S	200	2S	0113	33000
2	3349	5883	0040S	200	2S	0113	33000
2	3350	5882	0040S	200	2S	0113	33000
2	3351	5891	0030S	200	2S	0113	33000
2	3352	5881	0040S	200	2S	0113	33000
2	3353	5880	0085S	300	2S	0113	33000
2	3353	5900	0127S	300	2S	0113	33000
2	3354	5893	0050S	300	2S	0113	33000
2	3355	5894	0060S	300	2S	0113	33000
2	3356	5889	0071S	200	2S	0113	33000
2	3356	5906	0071S	200	2S	0113	33000
2	3357	5890	0050S	200	2S	0113	33000
2	3358	5892	0040S	200	2S	0113	33000
2	3358	5902	0040S	200	2S	0113	33000
2	3359	5901	0042S	200	2S	0113	33000

LIVINGSTON COUNTY CENTROID LINKS

2 3359	5902	0038S	200	25	0113	33000
50	0	00	0	5	113	000
2 3361	5908	0080S	300	25	0113	33000
2 3361	5913	0092S	300	25	0113	33000
2 3362	5900	0060S	300	25	0113	33000
2 3363	5923	0071S	300	25	0113	33000
2 3363	5925	0100S	300	25	0113	33000
2 3364	5919	0440S	300	25	0113	33000
2 3364	5921	0081S	300	25	0113	33000
2 3365	5915	0130S	300	25	0113	33000
2 3365	5919	010002	300	25	0113	33000
2 4701	5962	0025S	200	25	0113	47000
2 4702	5824	0400S	300	25	0113	47000
2 4702	5956	0115S	300	25	0113	47000
2 4703	5956	0520S	300	25	0113	47000
2 4703	5959	0200S	300	25	0113	47000
2 4704	5971	0150S	300	25	0113	47000
2 4705	5971	0600S	300	25	0113	47000
2 4705	5972	0200S	300	25	0113	47000
2 4705	5974	0150S	300	25	0113	47000
2 4706	5975	0200S	300	25	0113	47000
2 4706	5977	0100S	300	25	0113	47000
2 4707	5970	0100S	300	25	0113	47000
2 4708	5958	0175S	300	25	0113	47000
2 4708	5961	0200S	300	25	0113	47000
2 4709	5955	0110S	300	25	0113	47000
2 4710	5950	0105S	300	25	0113	47000
2 4711	5965	0110S	300	25	0113	47000
2 4712	5968	0110S	300	25	0113	47000
2 4713	5980	0025S	200	25	0113	47000
2 4713	5981	0200S	200	25	0113	47000
2 4714	5976	0525S	300	25	0113	47000
2 4714	5986	0175S	200	25	0113	47000
2 4715	5987	0105S	300	25	0113	47000
2 4715	5989	0200S	300	25	0113	47000
2 4716	6047	0200S	300	25	0113	47000
2 4716	6048	0170S	300	25	0113	47000
2 4717	5983	0300S	300	25	0113	47000
2 4717	5984	0100S	300	25	0113	47000
2 4717	6686	0200S	300	25	0113	47000
2 4718	5982	0120S	300	25	0113	47000
2 4718	5984	0210S	300	25	0113	47000
2 4718	5988	0260S	300	25	0113	47000
2 4719	5967	0080S	300	25	0113	47000
2 4720	5966	0110S	300	25	0113	47000
2 4721	5952	0100S	300	25	0113	47000
2 5069	5971	0580S	350	25	0207	47000
2 5077	5974	0350S	350	25	0207	25000
2 5106	5956	0950S	350	25	010207	76000
2 5107	5959	0334S	350	25	010207	76000
2 5173	5835	0410S	350	25	010207	19000
2 5188	5838	0300S	350	25	010207	19000
2 5189	5930	0230S	350	25	0207	33000
2 5190	5830	0030S	4500713	25	010103	19041
2 5190	5833	0200S	350	25	0207	33000
2 5207	5698	0300S	350	25	010207	34000
2 5208	5700	0450S	350	25	010207	34000
2 5660	5745	0350S	350	25	010207	23000
2 5661	5744	0325S	350	25	010207	23000
2 5666	5748	0650S	350	25	010207	08000
2 5696	5697	0108S	450037301300	25	010103	23052
2 5697	5698	0292S	450037701300	25	010103	23041
2 5697	5699	0375S	450036800350	25	020103	23052
2 5698	5699	0250S	350	25	010207	23000
2 5698	5700	0400S	450038100050	25		

2	5699	5740	0916S	450036800500	2S		03 03	23052
2	5700	5701	02..	..0036..150	.S		03 03	23041
2	5701	5702	0331S	450038101550	2S		04 03	23041
2	5701	5739	0900S	350	2S		010207	23000
2	5702	5704	0144S	350034801700	2S		01 07	23043
2	5702	5706	0204S	350041001350	2S		05 03	23041
2	5703	5704	0125S	300015001500	2S		01 05	23072
2	5704	5705	0045S	300013301500	2S		02 05	23072
2	5705	5706	0055S	350034801500	2S		03 05	23072
2	5705	5710	0150S	250	2S		010212	23000
2	5706	5707	0100S	450010501400	2S		03 05	23071
2	5706	5714	0361S	500069703850	2S		01 03	23042
2	5707	5708	0100S	450010500750	2S		02 05	23071
2	5707	5718	0250S	250	2S		010208	23000
2	5708	5709	0606S	400010500725	2S		01 05	23071
2	5708	5719	0200S	250	2S		010208	23000
2	5709	5725	0257S	450071304950	2S		04 03	23012
2	5709	5730	0446S	450071305200	2S		03 03	23012
2	5709	5739	0500S	350	2S		010207	23000
2	5710	5712	0250S	250	2S		010212	23000
2	5711	5714	0212S	600089003900	2S		02 02	23152
2	5712	5713	0100S	250	2S		010212	23000
2	5712	5715	0100S	350	2S		0211	23000
2	5713	5848	0220S	250	2S		010208	23000
2	5714	5715	0068S	500069703700	2S		02 03	23042
2	5714	5724	0463S	600090103400	2S		01 01	23152
2	5715	5716	0090S	550069703400	2S		03 03	23042
2	5715	5720	0100S	350	2S		0211	23000
2	5716	5717	0090S	550069705800	2S		04 03	23042
2	5717	5851	0090S	550069705700	2S		05 03	23042
2	5718	5720	0250S	250	2S		010208	23000
2	5719	5722	0475S	250	2S		010208	23000
2	5720	5721	0200S	250	2S		010208	23000
2	5721	5856	0100S	250	2S		010208	23000
2	5722	5723	0247S	450071304700	2S		07 03	23012
2	5722	5885	0038S	450071305700	2S		08 03	23012
2	5723	5724	0079S	450071305950	2S		06 03	23012
2	5723	5726	0270S	350	2S		010207	23000
2	5724	5725	0328S	450087104700	2S		05 03	23012
2	5724	5908	0285S	600090101200	2S		01 01	23151
2	5725	5726	0230S	350	2S		010207	23000
2	5726	5727	0120S	350	2S		010207	23000
2	5727	5728	0400S	450033001900	2S		04 05	23092
2	5727	5924	0100S	350	2S		010207	23000
2	5727	5925	0130S	450033002150	2S		05 05	23092
2	5728	5729	0500S	350	2S		010207	23000
2	5728	5761	0375S	450009301850	2S		03 05	23092
2	5728	5788	0100S	350	2S		010207	23000
2	5729	5732	0600S	350	2S		010207	23000
2	5730	5731	0068S	400071306000	2S		02 03	23012
2	5730	5737	0150S	350	2S		010207	23000
2	5731	5732	0281S	300038703700	2S		03 04	23061
2	5731	5736	0139S	300072602400	2S		01 03	23012
2	5732	5733	0090S	350038703700	2S		02 03	23061
2	5733	5734	0100S	350054405750	2S		01 03	23051
2	5733	5753	0073S	450038703700	2S		01 03	23061
2	5733	5760	0887S	450033305750	2S		02 03	23051
2	5734	5736	0077S	300130701700	2S		04 03	23031
2	5734	5753	0245S	450130703050	2S		03 03	23031
2	5735	5736	0048S	300130701550	2S		07 05	23011
2	5735	5741	0375S	350037701000	2S		03 05	23021
2	5735	5742	0367S	400032701500	2S		06 05	23011
2	5736	5737	0146S	300058700800	2S		06 03	23052
2	5737	5738	0165S	400040501450	2S		05 03	23052

2	5738	5740	0212S	450040500750	2S	04	03	23052
	39	0	0	0	S	207	000	
2	5740	5745	0800S	350	2S	010207		23000
2	5741	5743	0500S	45003680 550	2S	02	05	23021
2	5742	5751	0331S	450032701450	2S	05	05	23011
2	5743	5744	0300S	350	2S	010207		23000
2	5743	5746	0300S	450036800450	2S	01	05	23021
2	5743	5750	0850S	350	2S	010207		23000
2	5744	5745	0100S	350	2S	010207		23000
2	5747	5748	0227S	450032001950	2S	01	03	23011
2	5748	5749	0048S	450032001950	2S	02	03	23011
2	5749	5750	0048S	300081701900	2S	03	03	23011
2	5749	6966	0380S	350	2S	0207		23000
2	5750	5751	0521S	450037701250	2S	04	05	23011
2	5752	5753	0624S	300033703000	2S	02	03	23031
2	5752	5754	0400S	350	2S	010207		23000
2	5752	6961	0239S	450033703000	2S	01	03	23031
2	5753	5754	0400S	350	2S	010207		23000
2	5754	5755	0675S	350	2S	010207		23000
2	5754	6963	0550S	350	2S	010207		23000
2	5755	5756	0210S	350	2S	010207		23000
2	5756	5757	0225S	450032601400	2S	02	03	23091
2	5756	5783	0250S	350	2S	010207		23000
2	5756	6822	0198S	450032601400	2S	01	03	23091
2	5757	5758	0183S	450032601450	2S	03	03	23091
2	5758	5759	0025S	350032601600	2S	04	03	23091
2	5758	5782	0499S	350009300250	2S	01	05	23111
2	5759	5760	0025S	350032601600	2S	05	03	23091
2	5759	5786	0500S	350	2S	010207		23000
2	5760	5761	0127S	450009301800	2S	02	05	23092
2	5782	5783	0100S	350	2S	0207		33000
2	5783	5784	0200S	350	2S	010207		33000
2	5784	5785	0050S	350	2S	010207		33000
2	5784	6838	0450S	350	2S	0207		33000
2	5785	5786	0400S	350	2S	010207		33000
2	5785	5798	0600S	350	2S	010207		33000
2	5786	5787	0100S	350	2S	010207		33000
2	5787	5789	0400S	350	2S	010207		33000
2	5787	5796	0600S	350	2S	010207		33000
2	5788	5789	0200S	350	2S	010207		33000
2	5789	5790	0200S	350	2S	010207		33000
2	5789	5921	0400S	350	2S	010207		33000
2	5790	5793	0400S	350	2S	010207		33000
2	5791	5793	0149S	350010901200	2S	01	03	33021
2	5791	5795	0278S	450079805600	2S	01	03	33032
2	5791	5917	0385S	550068505650	2S	02	03	33032
2	5792	5793	0100S	350	2S	010207		33000
2	5792	5802	0350S	350	2S	010207		33000
2	5792	5927	0300S	350	2S	010207		33000
2	5793	5794	0146S	350010900600	2S	02	03	33021
2	5793	5795	0190S	350	2S	010207		33000
2	5794	5801	0334S	450010900500	2S	03	03	33021
2	5795	5796	0200S	550065502875	2S	04	03	33031
2	5796	5797	0310S	550065503650	2S	03	03	33031
2	5796	5800	0450S	350	2S	010207		33000
2	5797	5798	0210S	550065502850	2S	02	03	33031
2	5798	5799	0425S	350	2S	010207		33000
2	5798	6823	0249S	550065503250	2S	01	03	33031
2	5799	5800	0500S	350	2S	010207		33000
2	5799	5813	0200S	350	2S	010207		33000
2	5799	6834	0480S	350	2S	0207		38000
2	5800	5801	0200S	350	2S	010207		33000
2	5801	5802	0300S	350	2S	010207		33000
2	5801	5812	0285S	450010900550	2S	04	03	33021
2	5802	5803	0200S	350	2S	010207		33000

2	5802	5811	0300S	350	25		010207	33000
	03		OC	0	S		207	000
2	5803	5927	0350S	350	25		010207	33000
2	5804	5805	0200S	350	25		010207	33000
2	5804	5810	0400S	350	25		010207	33000
2	5805	5809	0403S	600090105950	25		04 01	33084
2	5805	5876	0250S	350	25		010207	33000
2	5805	5928	0351S	600090105750	25		03 01	33084
2	5806	5807	0300S	350	25		010207	33000
2	5806	5831	0100S	350	25		010207	33000
2	5807	5808	0400S	350	25		010207	33000
2	5807	5825	0350S	350	25		010207	33000
2	5808	5809	0150S	350	25		010207	33000
2	5808	5823	0335S	300054502750	25		07 05	33082
2	5808	5876	0411S	450053302650	25		06 05	33082
2	5809	5810	0150S	350	25		010207	33000
2	5809	5820	0434S	600090105950	25		05 01	33084
2	5810	5811	0400S	350	25		010207	33000
2	5811	5812	0300S	350	25		010207	33000
2	5812	5813	0850S	350	25		010207	33000
2	5812	5818	0573S	450010900300	25		05 03	33021
2	5813	5816	0600S	350	25		010207	33000
2	5813	6832	0348S	350	25		0208	38000
2	5614	5815	0076S	400036900750	25		02 05	33091
2	5814	6827	0162S	450034800650	25		01 05	33071
2	5814	6828	0103S	450041400650	25		01 05	33091
2	5815	5816	0065S	450010900650	25		03 05	33091
2	5615	5947	0205S	400009800200	25		01 03	33072
2	5816	5817	0420S	450033700650	25		04 05	33091
2	5817	5818	0274S	450034000250	25		06 03	33021
2	5817	5948	0285S	450026900200	25		07 03	33021
2	5818	5819	0325S	350	25		010207	33000
2	5819	5820	0400S	350	25		010207	33000
2	5819	5953	0600S	350	25		010207	33000
2	5820	5822	0068S	400038100650	25		01 05	33051
2	5820	5949	0268S	600090105950	25		01 01	33085
2	5821	5822	0150S	350	25		010207	33000
2	5821	5824	0600S	350	25		010207	33000
2	5821	5955	0500S	350	25		010207	33000
2	5822	5823	0112S	450056801850	25		08 05	33082
2	5823	5825	0486S	450038100650	25		02 05	33051
2	5824	5825	0250S	350	25		010207	33000
2	5825	5826	0225S	450038100650	25		03 05	33051
2	5827	5847	0130S	350089104950	25		01 03	33081
2	5827	5929	0050S	250	25		0208	33000
2	5828	5846	0067S	300008902300	25		01 04	33131
2	5829	5843	0036S	400093511350	25		04 04	33034
2	5830	5930	0200S	400072011250	25		04 04	33043
2	5831	5832	0100S	250	25		010208	33000
2	5831	5876	0250S	350	25		010207	33000
2	5832	5833	0120S	250	25		010208	33000
2	5833	5834	0275S	250	25		010208	33000
2	5833	5874	0200S	250	25		010208	33000
2	5834	5835	0107S	350072011250	25		02 04	33043
2	5834	5873	0170S	250	25		010208	33000
2	5834	5930	0100S	450072011250	25		05 04	33043
2	5835	5836	0115S	350079212300	25		01 04	33043
2	5835	5872	0075S	250	25		010208	33000
2	5836	5837	0030S	400130623400	25		04 04	33042
2	5836	5872	0106S	400093508750	25		01 05	33082
2	5837	5838	0080S	400130623400	25		03 04	33042
2	5837	5868	0063S	400106904250	25		03 04	33171
2	5838	5839	0060S	400130623500	25		02 04	33042
2	5839	5840	0035S	400178123500	25		01 04	33042
2	5839	5840	0050S	250	45			

2 5840	5841	0090S	400106916000	2S		03	04	33034
2 5840	5859	0050S	400130616000	2S		05	04	33061
2 5840	5861	0061S	400112811500	2S		03	03	33033
2 5841	5842	0041S	400093510500	2S		02	04	33034
2 5842	5843	0033S	400093511000	2S		03	04	33034
2 5842	5844	0031S	400089105650	2S		05	03	33081
2 5844	5845	0036S	350089108250	2S		04	03	33081
2 5845	5846	0070S	350089108500	2S		03	03	33081
2 5846	5847	0071S	350071208500	2S		02	03	33081
2 5846	5850	0100S	250	2S		010208		33000
2 5848	5849	0075S	350	2S		0207		33000
2 5848	5851	0050S	250	2S		010208		33000
2 5848	5929	0100S	250	2S		0208		33000
2 5849	5850	0110S	250	2S		010208		33000
2 5850	5854	0050S	250	2S		010208		33000
2 5851	5852	0079S	500098010200	2S		01	04	33061
2 5851	5856	0100S	250	2S		010208		33000
2 5852	5853	0050S	500098011000	2S		02	04	33061
2 5853	5854	0049S	350130616000	2S		03	04	33061
2 5854	5855	0069S	350106916000	2S		04	04	33061
2 5854	5858	0050S	250	2S		010208		33000
2 5856	5857	0110S	250	2S		010208		33000
2 5856	5885	0075S	250	2S		010208		33000
2 5857	5859	0069S	400083106000	2S		02	04	33041
2 5857	5885	0138S	550071304500	2S		01	04	33041
2 5858	5859	0050S	250	2S		010208		33000
2 5859	5860	0068S	400083106000	2S		03	04	33041
2 5859	5884	0055S	350089113000	2S		07	06	33011
2 5860	5863	0043S	400103906000	2S		04	04	33041
2 5861	5862	0023S	400109810500	2S		02	03	33033
2 5861	5864	0026S	350115311350	2S		01	04	33062
2 5862	5863	0023S	400142511000	2S		01	03	33033
2 5862	5865	0025S	250	2S		010208		33000
2 5863	5866	0025S	250	2S		010208		33000
2 5863	5882	0090S	400077215000	2S		11	08	33032
2 5864	5865	0025S	250	2S		010208		33000
2 5864	5867	0060S	350115312500	2S		02	04	33062
2 5865	5866	0025S	250	2S		010208		33000
2 5865	5869	0150S	250	2S		010208		33000
2 5866	5881	0100S	250	2S		010208		33000
2 5867	5868	0080S	400115313000	2S		03	04	33062
2 5868	5869	0032S	550141104250	2S		02	04	33171
2 5868	5871	0085S	400099013250	2S		04	04	33062
2 5869	5926	0053S	400141106500	2S		01	04	33171
2 5870	5871	0050S	250	2S		010208		33000
2 5870	5879	0075S	250	2S		010208		33000
2 5871	5872	0055S	400092411600	2S		05	04	33062
2 5872	5873	0120S	400092407750	2S		02	05	33082
2 5873	5874	0223S	400092813750	2S		03	05	33082
2 5873	5878	0130S	250	2S		010208		33000
2 5874	5875	0142S	400053310000	2S		04	05	33082
2 5874	5877	0075S	250	2S		010208		33000
2 5875	5876	0148S	450053304100	2S		05	05	33082
2 5877	5878	0170S	250	2S		010208		33000
2 5877	5895	0200S	250	2S		010208		33000
2 5878	5879	0175S	250	2S		010208		33000
2 5878	5894	0100S	250	2S		010208		33000
2 5879	5880	0150S	250	2S		010208		33000
2 5879	5893	0150S	250	2S		010208		33000
2 5880	5881	0100S	250	2S		010208		33000
2 5880	5900	0200S	250	2S		010208		33000
2 5881	5901	0200S	250	2S		0212		33000
2 5882	5883	0140S	250	2S		010208		33000
2 5883	5903	0095S	350093814500	2S				

2 5883	5884	0043S	350089112000	2S	06 06	33011	
83	5	02	0	S	208	3000	
2 5883	5890	0102S	350133609500	2S	05 06	33011	
2 5885	5886	0050S	250	2S	010208	33000	
2 5886	5887	0075S	250	2S	010208	33000	
2 5887	5888	0050S	250	2S	010208	33000	
2 5887	5906	0100S	250	2S	010208	33000	
2 5888	5889	0050S	250	2S	010208	33000	
2 5889	5890	0075S	250	2S	010208	33000	
2 5890	5892	0110S	250	2S	010208	33000	
2 5890	5905	0102S	350133609500	2S	04 06	33011	
2 5891	5892	0050S	350093514500	2S	09 08	33032	
2 5892	5902	0050S	350093514250	2S	08 08	33032	
2 5893	5897	0100S	250	2S	010208	33000	
2 5894	5896	0100S	250	2S	010208	33000	
2 5895	5896	0150S	250	2S	010208	33000	
2 5895	5928	0025S	350	2S	0207	33000	
2 5896	5897	0100S	250	2S	010208	33000	
2 5897	5899	0150S	250	2S	010208	33000	
2 5897	5915	0150S	350	2S	010207	33000	
2 5898	5899	0100S	250	2S	010208	33000	
2 5898	5914	0110S	600 93008500	2S	01 02	33045	
2 5898	5926	0230S	500141114000	2S	02 02	33045	
2 5899	5900	0050S	250	2S	010208	33000	
2 5900	5901	0080S	250	2S	010208	33000	
2 5900	5919	0250S	250	2S	010208	33000	
2 5901	5903	0050S	250	2S	010208	33000	
2 5901	5913	0100S	250	2S	010208	33000	
2 5902	5903	0050S	350093512150	2S	07 08	33032	
2 5903	5904	0070S	250	2S	010208	33000	
2 5903	5912	0100S	350093509650	2S	06 08	33032	
2 5904	5905	0030S	250	2S	010208	33000	
2 5904	5911	0100S	250	2S	010208	33000	
2 5905	5906	0175S	250	2S	010208	33000	
2 5905	5909	0124S	350133605050	2S	03 06	33011	
2 5906	5907	0100S	250	2S	010208	33000	
2 5907	5908	0020S	250	2S	010208	33000	
2 5907	5909	0100S	250	2S	010208	33000	
2 5908	5910	0070S	600090104800	2S	01 02	33083	
2 5908	5925	0080S	250	2S	010208	33000	
2 5909	5910	0043S	350133603500	2S	02 06	33011	
2 5909	5911	0100S	250	2S	010208	33000	
2 5910	5920	0299S	550135104800	2S	02 02	33083	
2 5910	5925	0102S	350111602250	2S	01 06	33011	
2 5911	5912	0090S	250	2S	010208	33000	
2 5911	5922	0200S	250	2S	010208	33000	
2 5912	5913	0020S	250	2S	010208	33000	
2 5912	5920	0075S	350093507850	2S	05 08	33032	
2 5913	5920	0075S	250	2S	010208	33000	
2 5914	5920	0240S	500090106000	2S	01 01	33084	
2 5914	5928	0329S	600090105850	2S	02 01	33084	
2 5915	5916	0150S	350	2S	010207	33000	
2 5916	5917	0160S	350	2S	010207	33000	
2 5916	5927	0250S	350	2S	010207	33000	
2 5917	5918	0040S	350	2S	010207	33000	
2 5917	5919	0070S	450041407750	2S	03 07	33032	
2 5918	5919	0050S	250	2S	010208	33000	
2 5918	5921	0200S	350	2S	010207	33000	
2 5919	5920	0110S	450103809500	2S	04 07	33032	
2 5921	5922	0025S	350	2S	010207	33000	
2 5922	5923	0075S	350	2S	010207	33000	
2 5923	5924	0100S	350	2S	010207	33000	
2 5924	5925	0100S	250	2S	010208	33000	
2 5927	5928	0270S	450	2S	010207	33000	

2 5948	5951 0190S	450010800150	2S	01 05	47041
49	4 0	0018 950	S	01	066
2 5950	5951 0500S	350	2S	0207	47000
2 5950	5953 0410S	350	2S	0207	47000
2 5951	5952 0301S	450010800150	2S	02 05	47041
2 5952	5966 0831S	400010800300	2S	03 05	47041
2 5953	5954 0330S	350	2S	0207	47000
2 5953	5963 0690S	350	2S	0207	47000
2 5954	5955 0090S	350	2S	0207	47000
2 5954	5957 0510S	600180205950	2S	02 01	47066
2 5955	5956 0530S	350	2S	0207	47000
2 5955	5958 0570S	350	2S	0207	47000
2 5957	5958 0100S	450040000950	2S	01 03	47082
2 5957	5964 0340S	600180205200	2S	01 01	47065
2 5958	5961 0262S	350040001000	2S	02 04	47082
2 5958	5962 0263S	500098003900	2S	01 04	47061
2 5959	5960 0480S	350	2S	0207	47000
2 5960	5961 0500S	350	2S	0207	47000
2 5960	5971 0500S	350	2S	0207	47000
2 5961	5962 0120S	350	2S	0207	47000
2 5961	5970 0460S	450040001415	2S	03 03	47082
2 5962	5963 0050S	350	2S	0207	47000
2 5962	5969 0456S	600073702900	2S	01 01	47062
2 5963	5964 0060S	350	2S	0207	47000
2 5964	5965 0350S	350	2S	0207	47000
2 5964	5969 0433S	600180205700	2S	02 01	47065
2 5965	5966 0570S	350	2S	0207	47000
2 5965	5968 0350S	350	2S	0207	47000
2 5966	5967 0590S	450010800850	2S	04 05	47041
2 5967	5968 0500S	350	2S	0207	47000
2 5967	5983 0460S	450010801000	2S	05 05	47041
2 5968	5980 0400S	350	2S	0207	47000
2 5969	5979 0420S	600180206250	2S	03 01	47065
2 5970	5971 0500S	350	2S	0207	47000
2 5970	5976 0450S	450040001300	2S	04 03	47082
2 5972	5973 0120S	500180206500	2S	03 03	47014
2 5972	5976 0930S	500180206500	2S	02 03	47014
2 5974	5975 0470S	350	2S	0207	47000
2 5975	5978 0300S	350	2S	0207	47000
2 5976	5977 0062S	450040002050	2S	05 03	47082
2 5976	5985 0783S	500144108000	2S	01 03	47014
2 5977	5978 0192S	450040001850	2S	06 03	47082
2 5978	6049 0110S	450040001800	2S	07 03	47082
2 5979	5980 0125S	300	2S	0208	47000
2 5979	5986 0150S	600180206400	2S	04 01	47065
2 5980	5986 0080S	350	2S	0207	47000
2 5981	5982 0283S	500180206500	2S	03 03	47013
2 5981	5985 0110S	500180205750	2S	04 03	47013
2 5982	5983 0171S	500180207750	2S	02 03	47013
2 5982	5984 0310S	350	2S	0207	47000
2 5983	6685 0132S	500180208000	2S	01 03	47013
2 5984	6048 0230S	350	2S	0207	47000
2 5985	5986 0090S	600180207450	2S	05 01	47065
2 5985	5988 0190S	600180208150	2S	01 01	47064
2 5986	5987 0250S	350	2S	0207	47000
2 5987	6056 0650S	300	2S	0207	63000
2 5988	5989 0171S	600180208150	2S	02 01	47064

ZONE CENTROID EQUIVALENT LIST

This is the first listing out of the "preliminary segmental model" series of computer programs. The program that produces this is the renumber program Q01438. The user will remember that most transportation planning packages require that zone centroids be numbered sequentially. The original zone centroids as displayed in the previous listing were non-sequential; therefore program Q01438 sequentially renumbers all centroids after the segmental model program has generated a new link file. Before segmental model there were approximately 160 centroid links for 116 zones plus 380 highway links.

The information supplied on the following page as the result of program Q01438 indicates that the original network has been compressed to 40 centroid links, 23 zones and 137 highway links and at the same time left the network in the detail study area complete so as to be useful in transportation analysis.

This equivalence list is useful when using the original base maps as reference material.

```
0001 2301    0002 3301    0003 4701    0004 4702    0005 4703    0006 4704    0007 4705    0008 4706    0009 4707    0010 4708
0011 4709    0012 4710    0013 4711    0014 4712    0015 4713    0016 4714    0017 4715    0018 4716    0019 4717    0020 4718
0021 4719    0022 4720    0023 4721
```

NO. OF HWY LINKS =   137   NO. OF CENTROID LINKS =   40   TOTAL LINKS =   177

"SEGMENTAL MODEL" NETWORK LISTING

The following pages are a copy of the compressed
network as it appears after segmental model. This is an
actual copy of the network listing out of the network builder
program TP 1402. Most of this listing is self explanatory.

As a specific example of what the segmental model process
has accomplished a selected section of highway in Ingham
County will be discussed. This segment of highway is identified
by the arrows in figure 23 and 24. Note that this segment of
highway is composed of six highway links in the original network.
Each of these is identified by a check mark on the original
listing. As a result of segmental model this whole section
of road is represented by a single link in the new network.
This link is underlined in the following sample network
listing. Note the new link is representative of the six old
links in that the distance is a sum of the six old distances,
the speed and counts are weighted averages and the capacity is
the lowest of the original six links.

The user should also note that there is only one centroid
link for each of the non-detailed counties with the zone
centroid (A-node) renumbered. Each of these new centroid links
is underlined in the following listing. All of the original
zones and centroid links for Livingston County remain unchanged
as this was specified as a detailed area for the test run.

TPREPO 103 (INFURMATION) NETWORK BUILT ON 17JUN71

```
SPARAM
      ZONES   =    23
      FRWY    =     0        0
      NODES   =     1     8191
      MPH0    =   0.0     80.0
      MPH1    =   0.0     80.0
      MPH2    =   0.0     80.0
      MPH3    =   0.0     80.0
      MPH4    =   0.0     80.0
      MPH5    =   0.0     80.0
      MPH6    =   0.0     80.0
      MPH7    =   0.0     80.0
      MPH8    =   0.0     80.0
      MPH9    =   0.0     80.0
      MPH10   =   0.0     80.0
      MPH11   =   0.0     80.0
      MPH12   =   0.0     80.0
      MPH13   =   0.0     80.0
      MPH14   =   0.0     80.0
      MPH15   =   0.0     80.0
      DMAX    =  25.5
      TMAX    =  25.5
      THRU    =    24
      CLASS   =     0       15
      JURIS   =     0       15
      CAPAC   =     0       15
      DSCALE  =  1.00
      CSCALE  =  1.00
      LOCAL   =     1        2
      TURN0   =   0.2
      TURN1   =   0.5
      TURN2   =   1.0
      NVOL    =     2
      NOIN    =     8
      DELETE  =
SEND
```

74

```
$OPTION   S (INFORMATION) NETWORK BUILT IN 17JUN71
     AM      =      F
     PM      =      F
     OFF     =      T
     BUILD   =      T
     UPDATE  =      F
     REPORT  =      T
     PRINT   =      T
     PCR     =      F
     XY      =      F
     VOLUME  =      T   T
SEND
```

NETWORK   DESCRIPTION

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
1	5736	13	1	0	0	1.00	3.00	20.1	0 0
2	5855	13	1	0	0	0.55	1.65	20.1	0 0
	5858	13	1	0	0	0.75	2.25	20.1	0 0
	5860	13	1	0	0	0.55	1.65	20.1	0 0
	5861	13	1	0	0	0.45	1.35	20.1	0 0
3	5962	13	1	0	0	0.25	0.75	20.1	0 0
4	5824	13	1	0	0	4.00	8.00	30.1	0 0
	5956	13	1	0	0	1.15	2.30	30.1	0 0
5	5956	13	1	0	0	5.20	10.40	30.1	0 0
	5959	13	1	0	0	2.00	4.00	30.1	0 0
6	5971	13	1	0	0	1.50	3.00	30.1	0 0
7	5971	13	1	0	0	6.00	12.00	30.1	0 0
	5972	13	1	0	0	2.00	4.00	30.1	0 0
	5974	13	1	0	0	1.50	3.00	30.1	0 0
8	5975	13	1	0	0	2.00	4.00	30.1	0 0
	5977	13	1	0	0	1.00	2.00	30.1	0 0

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
9	5970	13	1	0	0	1.00	2.00	30.1	0 0
10	5958	13	1	0	0	1.75	3.50	30.1	0 0
	5961	13	1	0	0	2.00	4.00	30.1	0 0
11	5955	13	1	0	0	1.10	2.20	30.1	0 0
12	5950	13	1	0	0	1.05	2.10	30.1	0 0
13	5965	13	1	0	0	1.10	2.20	30.1	0 0
14	5968	13	1	0	0	1.10	2.20	30.1	0 0
15	5980	13	1	0	0	0.25	0.75	20.1	0 0
	5981	13	1	0	0	2.00	6.00	20.1	0 0
16	5976	13	1	0	0	5.25	10.50	30.1	0 0
	5986	13	1	0	0	1.75	5.25	20.1	0 0
17	5987	13	1	0	0	1.05	2.10	30.1	0 0
	5989	13	1	0	0	2.00	4.00	30.1	0 0
18	6047	13	1	0	0	2.00	4.00	30.1	0 0
	6048	13	1	0	0	1.70	3.40	30.1	0 0

Handwritten annotations: CENT. LINKS (bracketing nodes 5855–5861); EATON / INGHAM; page number 76.

NETWORK DESCRIPTION

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME	A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
										5702	5697	3	0	0	0	14.09	20.03	42.3	3770
19	5983	13	1	0	0	3.00	6.00	30.1	0										1205
									0		5704	7	0	0	0	1.44	2.47	35.0	3480
	5984	13	1	0	0	1.00	2.00	30.1	0										1700
									0		5706	3	0	0	0	2.04	3.50	35.0	4100
	6686	13	1	0	0	2.00	4.00	30.1	0										1350
									0										
										5703	5704	5	0	0	0	1.25	2.50	30.1	1500
20	5982	13	1	0	0	1.20	2.40	30.1	0										1500
									0										
	5984	13	1	0	0	2.10	4.20	30.1	0	5704	5702	7	0	0	0	1.44	2.47	35.0	3480
									0										1700
	5988	13	1	0	0	2.60	5.20	30.1	0		5703	5	0	0	0	1.25	2.50	30.1	1500
									0										1500
21	5967	13	1	0	0	0.80	1.60	30.1	0		5706	5	0	0	0	1.00	1.83	32.8	1330
									0										1500
22	5966	13	1	0	0	1.10	2.20	30.1	0	5706	5702	3	0	0	0	2.04	3.50	35.0	4100
									0										1350
											5704	5	0	0	0	1.00	1.83	32.8	1330
23	5952	13	1	0	0	1.00	2.00	30.1	0										1500
									0		5709	5	0	0	0	8.06	11.74	41.2	1050
																			812
5069	5971	7	2	0	0	5.80	9.94	35.1	0		5714	3	0	0	0	3.61	4.33	50.1	6970
									0										3850
5190	5830	3	0	0	0	0.30	0.40	45.1	7130	5709	5706	5	0	0	0	8.06	11.74	41.2	1050
									0										812
											5724	3	0	0	0	5.85	7.80	45.1	7130
5696	5697	3	0	0	0	1.08	1.44	45.0	3730										4810
									1300		5731	3	0	0	0	5.14	6.96	44.4	7130
																			5306
5697	5696	3	0	0	0	1.08	1.44	45.0	3730	5711	5714	2	0	0	0	2.12	2.12	60.1	8900
									1300										3900
	5702	3	0	0	0	14.09	20.03	42.3	3770	5714	5706	3	0	0	0	3.61	4.33	50.1	6970
									1205										3850
	5736	3	0	0	0	18.14	25.14	43.3	3680		5711	2	0	0	0	2.12	2.12	60.1	8900
									609										3900

77

NETWORK   DESCRIPTION

Left panel:

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
	5724	1	0	0	0	4.63	4.63	60.1	9010 / 3400
	5851	3	0	0	0	3.38	3.76	54.0	6970 / 4712
5724	5709	3	0	0	0	5.85	7.80	45.1	7130 / 4810
	5714	1	0	0	0	4.63	4.63	60.1	9010 / 3400
	5885	3	0	0	0	3.64	4.85	45.1	7130 / 5076
	5908	1	0	0	0	2.85	2.85	60.1	9010 / 1200
5731	5709	3	0	0	0	5.14	6.96	44.4	7130 / 5306
	5732	4	0	0	0	2.81	5.62	30.1	3870 / 3700
	5736	3	0	0	0	1.39	2.78	30.1	7260 / 2400
5732	5731	4	0	0	0	2.81	5.62	30.1	3870 / 3700
	5733	3	0	0	0	0.90	1.54	35.1	3870 / 3700
5733	5732	3	0	0	0	0.90	1.54	35.1	3870 / 3700
	5734	3	0	0	0	1.00	1.71	35.1	5440 / 5750
	5753	3	0	0	0	0.73	0.97	45.2	3870 / 3700
	5760	3	0	0	0	8.87	11.83	45.0	3330 / 5750
5734	5733	3	0	0	0	1.00	1.71	35.1	5440 / 5750
	5736	3	0	0	0	0.77	1.54	30.1	13070 / 1700
	5753	3	0	0	0	2.45	3.27	45.0	13070

Right panel:

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
									3050
5735	5736	5	0	0	0	0.48	0.96	30.1	13070 / 1550
	5746	5	0	0	0	11.75	16.87	41.8	3680 / 668
	5750	5	0	0	0	12.19	16.81	43.6	3270 / 1379
5736	1	13	1	0	0	1.00	3.00	20.1	0 / 0
	5697	3	0	0	0	18.14	25.14	43.3	3680 / 609
	5731	3	0	0	0	1.39	2.78	30.1	7260 / 2400
	5734	3	0	0	0	0.77	1.54	30.1	13070 / 1700
	5735	5	0	0	0	0.48	0.96	30.1	13070 / 1550
5746	5735	5	0	0	0	11.75	16.87	41.8	3680 / 668
5747	5750	3	0	0	0	3.23	4.53	42.8	3200 / 1942
5750	5735	5	0	0	0	12.19	16.81	43.6	3270 / 1379
	5747	3	0	0	0	3.23	4.53	42.8	3200 / 1942
5753	5733	3	0	0	0	0.73	0.97	45.2	3870 / 3700
	5734	3	0	0	0	2.45	3.27	45.0	13070 / 3050
	6961	3	0	0	0	8.63	15.14	34.3	3370 / 3000
5758	5760	3	0	0	0	0.50	0.86	34.9	3260 / 1600

78

NETWORK DESCRIPTION

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
	5782	5	0	0	0	4.99	8.55	35.1	930 / 250
	6822	3	0	0	0	6.06	8.08	45.1	3260 / 1415
5760	5733	3	0	0	0	8.87	11.83	45.0	3330 / 5750
	5758	3	0	0	0	0.50	0.86	34.9	3260 / 1600
	5925	5	0	0	0	10.32	13.76	45.0	930 / 1901
5782	5758	5	0	0	0	4.99	8.55	35.1	930 / 250
5791	5795	3	0	0	0	2.78	3.71	45.0	7980 / 5600
	5817	3	0	0	0	17.61	24.40	43.4	1090 / 472
	5917	3	0	0	0	3.85	4.20	55.1	6850 / 5650
5795	5791	3	0	0	0	2.78	3.71	45.0	7980 / 5600
	6823	3	0	0	0	9.69	10.57	55.1	6550 / 3214
5814	5815	5	0	0	0	0.76	1.14	40.1	3690 / 750
	6827	5	0	0	0	1.62	2.16	45.1	3480 / 650
	6828	5	0	0	0	1.03	1.37	45.2	4140 / 650
5815	5814	5	0	0	0	0.76	1.14	40.1	3690 / 750
	5817	5	0	0	0	4.85	6.47	45.0	1090 / 650
	5947	3	0	0	0	2.05	3.08	40.0	980 / 200

(handwritten margin notes: "HWY", "LINK" pointing to node 5791 / 5817 row)

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
5817	5791	3	0	0	0	17.61	24.40	43.4	1090 / 472
	5815	5	0	0	0	4.85	6.47	45.0	1090 / 650
	5948	3	0	0	0	2.85	3.80	45.1	2690 / 200
5820	5822	5	0	0	0	0.68	1.02	40.1	3810 / 650
	5914	1	0	0	0	15.17	15.17	60.1	9010 / 5882
	5949	1	0	0	0	2.68	2.68	60.1	9010 / 5950
5822	5820	5	0	0	0	0.68	1.02	40.1	3810 / 650
	5823	5	0	0	0	1.12	1.49	45.2	5680 / 1850
5823	5822	5	0	0	0	1.12	1.49	45.2	5680 / 1850
	5826	5	0	0	0	7.11	9.48	45.1	3810 / 650
	5872	5	0	0	0	13.79	20.89	39.7	5330 / 5825
5824	4	13	1	0	0	4.00	8.00	30.1	0 / 0
5826	5823	5	0	0	0	7.11	9.48	45.1	3810 / 650
5827	5846	3	0	0	0	2.01	3.45	35.0	7120 / 6204
5828	5846	4	0	0	0	0.67	1.34	30.1	890 / 2300
5829	5842	4	0	0	0	0.69	1.04	39.9	9350

NETWORK DESCRIPTION

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME	A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
									11183										2300
											5842	3	0	0	0	1.37	2.28	36.1	8910
5830	5190	3	0	0	0	0.30	0.40	45.1	7130										7789
									0										
	5836	4	0	0	0	5.22	8.07	38.9	7200	5851	5714	3	0	0	0	3.38	3.76	54.0	6970
									11481										4712
5836	5830	4	0	0	0	5.22	8.07	38.9	7200		5855	4	0	0	0	2.47	3.46	42.9	9800
									11481										13133
	5837	4	0	0	0	0.30	0.45	40.1	13060										
									23400	5855	2	13	1	0	0	0.55	1.65	20.1	0
	5872	5	0	0	0	1.06	1.59	40.1	9350										0
									8750		5840	4	0	0	0	0.50	0.75	40.1	13060
5837	5836	4	0	0	0	0.30	0.45	40.1	13060										16000
									23400		5851	4	0	0	0	2.47	3.46	42.9	9800
	5840	4	0	0	0	1.75	2.63	40.0	13060										13133
									23454	5858	2	13	1	0	0	0.75	2.25	20.1	0
	5868	4	0	0	0	0.63	0.95	39.8	10690										0
									4250	5859	5860	4	0	0	0	0.68	1.02	40.1	8310
5840	5837	4	0	0	0	1.75	2.63	40.0	13060										6000
									23454		5885	4	0	0	0	2.07	2.48	50.1	7130
	5842	4	0	0	0	1.31	1.97	39.9	9350										5000
									14279		5910	6	0	0	0	4.69	6.04	35.1	8910
	5855	4	0	0	0	0.50	0.75	40.1	13060										8413
									16000	5860	2	13	1	0	0	0.55	1.65	20.1	0
	5861	3	0	0	0	0.61	0.92	39.8	11280										0
									11500		5859	4	0	0	0	0.68	1.02	40.1	8310
5842	5829	4	0	0	0	0.69	1.04	39.9	9350										6000
									11183		5863	4	0	0	0	0.43	0.65	39.7	10390
	5840	4	0	0	0	1.31	1.97	39.9	9350										6000
									14279	5861	2	13	1	0	0	0.45	1.35	20.1	0
	5846	3	0	0	0	1.37	2.28	36.1	8910										0
									7789		5840	3	0	0	0	0.61	0.92	39.8	11280
5846	5827	3	0	0	0	2.01	3.45	35.0	7120										11500
									6204		5863	3	0	0	0	0.46	0.69	40.1	10980
	5828	4	0	0	0	0.67	1.34	30.1	890										10750
											5868	4	0	0	0	1.66	2.66	37.5	11530

N E T W O R K   D E S C R I P T I O N

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
									12561
5863	5860	4	0	0	0	0.43	0.65	39.7	10390
									6000
	5861	3	0	0	0	0.46	0.69	40.1	10980
									10750
	5920	8	0	0	0	4.70	7.83	36.1	7720
									12226
5868	5837	4	0	0	0	0.63	0.95	39.8	10690
									4250
	5861	4	0	0	0	1.66	2.66	37.5	11530
									12561
	5872	4	0	0	0	1.40	2.10	40.1	9240
									12601
	5926	4	0	0	0	0.85	1.12	45.6	14110
									5653
5872	5823	5	0	0	0	13.79	20.89	39.7	5330
									5825
	5836	5	0	0	0	1.06	1.59	40.1	9350
									8750
	5868	4	0	0	0	1.40	2.10	40.1	9240
									12601
5885	5724	3	0	0	0	3.64	4.85	45.1	7130
									5076
	5859	4	0	0	0	2.07	2.48	50.1	7130
									5000
5908	5724	1	0	0	0	2.85	2.85	60.1	9010
									1200
	5910	2	0	0	0	0.70	0.70	60.1	9010
									4800
5910	5859	6	0	0	0	4.69	8.04	35.1	8910
									8413
	5908	2	0	0	0	0.70	0.70	60.1	9010
									4800
	5920	2	0	0	0	2.99	3.26	55.1	13510

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
									4800
	5925	6	0	0	0	1.02	1.75	35.0	11160
									2250
5914	5820	1	0	0	0	15.17	15.17	60.1	9010
									5882
	5920	1	0	0	0	2.40	2.88	50.1	9010
									6000
	5926	2	0	0	0	3.40	3.83	53.3	9300
									12221
5917	5791	3	0	0	0	3.85	4.20	55.1	6850
									5650
	5920	7	0	0	0	1.80	2.40	45.1	4140
									8819
5920	5863	8	0	0	0	4.70	7.83	36.1	7720
									12226
	5910	2	0	0	0	2.99	3.26	55.1	13510
									4800
	5914	1	0	0	0	2.40	2.88	50.1	9010
									6000
	5917	7	0	0	0	1.80	2.40	45.1	4140
									8819
5925	5760	5	0	0	0	10.32	13.76	45.0	930
									1901
	5910	6	0	0	0	1.02	1.75	35.0	11160
									2250
5926	5868	4	0	0	0	0.85	1.12	45.6	14110
									5653
	5914	2	0	0	0	3.40	3.83	53.3	9300
									12221
5947	5815	3	0	0	0	2.05	3.08	40.0	980
									200
	5952	5	0	0	0	3.89	5.19	45.0	1000
									4500

N E T W O R K   D E S C R I P T I O N

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME	A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
5948	5817	3	0	0	0	2.85	3.80	45.1	2690	5954	5949	1	0	0	0	3.66	3.66	60.1	18020
									200										5950
	5951	5	0	0	0	1.90	2.53	45.1	1080		5953	7	2	0	0	3.30	5.66	35.0	0
									150										0
5949	5820	1	0	0	0	2.68	2.68	60.1	9010		5955	7	2	0	0	0.90	1.54	35.1	0
									5950										0
	5954	1	0	0	0	3.66	3.66	60.1	18020		5957	1	0	0	0	5.10	5.10	60.1	18020
									5950										5950
5950	12	13	1	0	0	1.05	2.10	30.1	0	5955	11	13	1	0	0	1.10	2.20	30.1	0
									0										0
	5951	7	2	0	0	5.00	8.57	35.1	0		5954	7	2	0	0	0.90	1.54	35.1	0
									0										0
	5953	7	2	0	0	4.10	7.03	35.0	0		5956	7	2	0	0	5.30	9.09	35.0	0
									0										0
5951	5948	5	0	0	0	1.90	2.53	45.1	1080		5958	7	2	0	0	5.70	9.77	35.1	0
									150										0
	5950	7	2	0	0	5.00	8.57	35.1	0	5956	4	13	1	0	0	1.15	2.30	30.1	0
									0										0
	5952	5	0	0	0	3.01	4.01	45.1	1080		5	13	1	0	0	5.20	10.40	30.1	0
									150										0
5952	23	13	1	0	0	1.00	2.00	30.1	0		5955	7	2	0	0	5.30	9.09	35.0	0
									0										0
	5947	5	0	0	0	3.89	5.19	45.0	1000	5957	5954	1	0	0	0	5.10	5.10	60.1	18020
									4500										5950
	5951	5	0	0	0	3.01	4.01	45.1	1080		5958	3	0	0	0	1.00	1.33	45.2	4000
									150										950
	5966	5	0	0	0	8.31	12.47	40.0	1080		5964	1	0	0	0	3.40	3.40	60.1	18020
									300										5200
5953	5950	7	2	0	0	4.10	7.03	35.0	0	5958	10	13	1	0	0	1.75	3.50	30.1	0
									0										0
	5954	7	2	0	0	3.30	5.66	35.0	0		5955	7	2	0	0	5.70	9.77	35.1	0
									0										0
	5963	7	2	0	0	6.90	11.83	35.0	0		5957	3	0	0	0	1.00	1.33	45.2	4000
									0										950
											5961	4	0	0	0	2.62	4.49	35.1	4000
																			1000

82

N E T W O R K   D E S C R I P T I O N

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME	A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
	5962	4	0	0	0	2.63	3.16	50.0	9800 3900		5964	7	2	0	0	0.60	1.03	35.0	0 0 0
5959	5	13	1	0	0	2.00	4.00	30.1	0 0	5964	5957	1	0	0	0	3.40	3.40	60.1	18020 5200
	5960	7	2	0	0	4.80	8.23	35.0	0 0		5963	7	2	0	0	0.60	1.03	35.0	0 0
5960	5959	7	2	0	0	4.80	8.23	35.0	0 0		5965	7	2	0	0	3.50	6.00	35.1	0 0
	5961	7	2	0	0	5.00	8.57	35.1	0 0		5969	1	0	0	0	4.33	4.33	60.1	18020 5700
	5971	7	2	0	0	5.00	8.57	35.1	0 0	5965	13	13	1	0	0	1.10	2.20	30.1	0 0
5961	10	13	1	0	0	2.00	4.00	30.1	0 0		5964	7	2	0	0	3.50	6.00	35.1	0 0
	5958	4	0	0	0	2.62	4.49	35.1	4000 1000		5966	7	2	0	0	5.70	9.77	35.1	0 0
	5960	7	2	0	0	5.00	8.57	35.1	0 0		5968	7	2	0	0	3.50	6.00	35.1	0 0
	5962	7	2	0	0	1.20	2.06	35.0	0 0	5966	22	13	1	0	0	1.10	2.20	30.1	0 0
	5970	3	0	0	0	4.60	6.13	45.1	4000 1415		5952	5	0	0	0	8.31	12.47	40.0	1080 300
5962	3	13	1	0	0	0.25	0.75	20.1	0 0		5965	7	2	0	0	5.70	9.77	35.1	0 0
	5958	4	0	0	0	2.63	3.16	50.0	9800 3900		5967	5	0	0	0	5.90	7.87	45.0	1080 850
	5961	7	2	0	0	1.20	2.06	35.0	0 0	5967	21	13	1	0	0	0.80	1.60	30.1	0 0
	5963	7	2	0	0	0.50	0.86	34.9	0 0		5966	5	0	0	0	5.90	7.87	45.0	1080 850
	5969	1	0	0	0	4.56	4.56	60.1	7370 2900		5968	7	2	0	0	5.00	8.57	35.1	0 0
5963	5953	7	2	0	0	6.90	11.83	35.0	0 0		5983	5	0	0	0	4.60	6.13	45.1	1080 1000
	5962	7	2	0	0	0.50	0.86	34.9	0										

NETWORK DESCRIPTION

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
5968	14	13	1	0	0	1.10	2.20	30.1	0 / 0
	5965	7	2	0	0	3.50	6.00	35.1	0 / 0
	5967	7	2	0	0	5.00	8.57	35.1	0 / 0
	5980	7	2	0	0	4.00	6.86	35.0	0 / 0
5969	5962	1	0	0	0	4.56	4.56	60.1	7370 / 2900
	5964	1	0	0	0	4.33	4.33	60.1	18020 / 5700
	5979	1	0	0	0	4.20	4.20	60.1	18020 / 6250
5970	9	13	1	0	0	1.00	2.00	30.1	0 / 0
	5961	3	0	0	0	4.60	6.13	45.1	4000 / 1415
	5971	7	2	0	0	5.00	8.57	35.1	0 / 0
	5976	3	0	0	0	4.50	6.00	45.1	4000 / 1300
5971	6	13	1	0	0	1.50	3.00	30.1	0 / 0
	7	13	1	0	0	6.00	12.00	30.1	0 / 0
	5069	7	2	0	0	5.80	9.94	35.1	0 / 0
	5960	7	2	0	0	5.00	8.57	35.1	0 / 0
	5970	7	2	0	0	5.00	8.57	35.1	0 / 0
5972	7	13	1	0	0	2.00	4.00	30.1	0 / 0
	5973	3	0	0	0	1.20	1.44	50.1	18020 / 6500
	5976	3	0	0	0	9.30	11.16	50.1	18020 / 6500
5973	5972	3	0	0	0	1.20	1.44	50.1	18020 / 6500
5974	7	13	1	0	0	1.50	3.00	30.1	0 / 0
	5975	7	2	0	0	4.70	8.06	35.0	0 / 0
5975	8	13	1	0	0	2.00	4.00	30.1	0 / 0
	5974	7	2	0	0	4.70	8.06	35.0	0 / 0
	5978	7	2	0	0	3.00	5.14	35.1	0 / 0
5976	16	13	1	0	0	5.25	10.50	30.1	0 / 0
	5970	3	0	0	0	4.50	6.00	45.1	4000 / 1300
	5972	3	0	0	0	9.30	11.16	50.1	18020 / 6500
	5977	3	0	0	0	0.62	0.83	44.9	4000 / 2050
	5985	3	0	0	0	7.83	9.40	50.0	14410 / 8000
5977	8	13	1	0	0	1.00	2.00	30.1	0 / 0
	5976	3	0	0	0	0.62	0.83	44.9	4000 / 2050
	5978	3	0	0	0	1.92	2.56	45.1	4000 / 1850
5978	5975	7	2	0	0	3.00	5.14	35.1	0 / 0
	5977	3	0	0	0	1.92	2.56	45.1	4000 / 1850

NETWORK   DESCRIPTION

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME	A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
	6049	3	0	0	0	1.10	1.47	44.9	4000 / 1800		6685	3	0	0	0	1.32	1.58	50.2	7750 / 18020 / 8000
5979	5969	1	0	0	0	4.20	4.20	60.1	18020 / 6250	5984	19	13	1	0	0	1.00	2.00	30.1	0
	5980	8	2	0	0	1.25	2.50	30.1	0 / 0		20	13	1	0	0	2.10	4.20	30.1	0 / 0
	5986	1	0	0	0	1.50	1.50	60.1	18020 / 6400		5982	7	2	0	0	3.10	5.31	35.1	0 / 0
5980	15	13	1	0	0	0.25	0.75	20.1	0 / 0		6048	7	2	0	0	2.30	3.94	35.1	0 / 0
	5968	7	2	0	0	4.00	6.86	35.0	0 / 0	5985	5976	3	0	0	0	7.83	9.40	50.0	14410 / 8000
	5979	8	2	0	0	1.25	2.50	30.1	0 / 0		5981	3	0	0	0	1.10	1.32	50.0	18020 / 5750
	5986	7	2	0	0	0.80	1.37	35.1	0 / 0		5986	1	0	0	0	0.90	0.90	60.1	18020 / 7450
5981	15	13	1	0	0	2.00	6.00	20.1	0 / 0		5988	1	0	0	0	1.90	1.90	60.1	18020 / 8150
	5982	3	0	0	0	2.83	3.40	50.0	18020 / 6500	5986	16	13	1	0	0	1.75	5.25	20.1	0 / 0
	5985	3	0	0	0	1.10	1.32	50.0	18020 / 5750		5979	1	0	0	0	1.50	1.50	60.1	18020 / 6400
5982	20	13	1	0	0	1.20	2.40	30.1	0 / 0		5980	7	2	0	0	0.80	1.37	35.1	0 / 0
	5981	3	0	0	0	2.83	3.40	50.0	18020 / 6500		5985	1	0	0	0	0.90	0.90	60.1	18020 / 7450
	5983	3	0	0	0	1.71	2.05	50.1	18020 / 7750		5987	7	2	0	0	2.50	4.29	35.0	0 / 0
	5984	7	2	0	0	3.10	5.31	35.1	0 / 0	5987	17	13	1	0	0	1.05	2.10	30.1	0 / 0
5983	19	13	1	0	0	3.00	6.00	30.1	0 / 0		5986	7	2	0	0	2.50	4.29	35.0	0 / 0
	5967	5	0	0	0	4.60	6.13	45.1	1080 / 1000	5988	20	13	1	0	0	2.60	5.20	30.1	0 / 0
	5982	3	0	0	0	1.71	2.05	50.1	18020										

85

N E T W O R K   D E S C R I P T I O N

A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME	A-NODE	B-NODE	JU	LC	CI	SF	DIST	TIME	SPEED	VOLUME
	5985	1	0	0	0	1.90	1.90	60.1	18020										
									8150	6828	5814	5	0	0	0	1.03	1.37	45.2	4140
	5989	1	0	0	0	1.71	1.71	60.1	18020										650
									8150										
										6961	5753	3	0	-0	0	8.63	15.14	34.3	3370
5989	17	13	1	0	0	2.00	4.00	30.1	0										3000
									0										
	5988	1	0	0	0	1.71	1.71	60.1	18020										
									8150										
	6046	1	0	0	0	1.10	1.10	60.1	18020										
									8150										
6046	5989	1	0	0	0	1.10	1.10	60.1	18020										
									8150										
6047	18	13	1	0	0	2.00	4.00	30.1	0										
									0										
6048	18	13	1	0	0	1.70	3.40	30.1	0										
									0										
	5984	7	2	0	0	2.30	3.94	35.1	0										
									0										
6049	5978	3	0	0	0	1.10	1.47	44.9	4000										
									1800										
6685	5983	3	0	0	0	1.32	1.58	50.2	18020										
									8000										
6686	19	13	1	0	0	2.00	4.00	30.1	0										
									0										
6822	5758	3	0	0	0	6.06	8.08	45.1	3260										
									1415										
6823	5795	3	0	0	0	9.69	10.57	55.1	6550										
									3214										
6827	5814	5	0	0	0	1.62	2.16	45.1	3480										
									650										

L I N K   S U M M A R I E S   B Y   C L A S S   A N D   J U R I S D I C T I O N

			CLASS															
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
0	AVG. SPEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOT. MILES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NO. LINKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	AVG. SPEED	59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59
	TOT. MILES	119	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	119
	NO. LINKS	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
2	AVG. SPEED	57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57
	TOT. MILES	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
	NO. LINKS	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
3	AVG. SPEED	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44
	TOT. MILES	345	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	345
	NO. LINKS	88	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	88
4	AVG. SPEED	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40
	TOT. MILES	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56
	NO. LINKS	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36
5	AVG. SPEED	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41
	TOT. MILES	217	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	217
	NO. LINKS	46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46
6	AVG. SPEED	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35
	TOT. MILES	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
	NO. LINKS	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
7	AVG. SPEED	40	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	35
	TOT. MILES	6	0	194	0	0	0	0	0	0	0	0	0	0	0	0	0	201
	NO. LINKS	4	0	52	0	0	0	0	0	0	0	0	0	0	0	0	0	56

J U R I S D I C T I O N

87

LINK SUMMARIES BY CLASS AND JURISDICTION

			0	1	2	3	4	5	6	CLASS 7	8	9	10	11	12	13	14	15	TOTAL
	8	AVG. SPEED	36	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	33
		TOT. MILES	9	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	12
		NO. LINKS	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	4
	9	AVG. SPEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TOT. MILES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		NO. LINKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J	10	AVG. SPEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U		TOT. MILES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R		NO. LINKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I	11	AVG. SPEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S		TOT. MILES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D		NO. LINKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I	12	AVG. SPEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C		TOT. MILES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T		NO. LINKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I	13	AVG. SPEED	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
O		TOT. MILES	0	138	0	0	0	0	0	0	0	0	0	0	0	0	0	0	138
N		NO. LINKS	0	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80
	14	AVG. SPEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TOT. MILES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		NO. LINKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	15	AVG. SPEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TOT. MILES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		NO. LINKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	AVG. SPEED	45	28	35	0	0	0	0	0	0	0	0	0	0	0	0	0	108
		TOT. MILES	783	138	197	0	0	0	0	0	0	0	0	0	0	0	0	0	1118
		NO. LINKS	220	80	54	0	0	0	0	0	0	0	0	0	0	0	0	0	354

NO OF LINKS IN AND OUT OF EACH NODE

IN	NODE	OUT	IN	NODE	OUT	IN	NODE	OUT	IN	NODE	OUT
1	1	1	5	5736	5	2	5917	2	4	5983	4
4	2	4	1	5746	1	4	5920	4	4	5984	4
1	3	1	1	5747	1	2	5925	2	4	5985	4
2	4	2	2	5750	2	2	5926	2	5	5986	5
2	5	2	3	5753	3	2	5947	2	2	5987	2
1	6	1	3	5758	3	2	5948	2	3	5988	3
3	7	3	3	5760	3	2	5949	2	3	5989	3
2	8	2	1	5782	1	3	5950	3	1	6046	1
1	9	1	3	5791	3	3	5951	3	1	6047	1
2	10	2	2	5795	2	4	5952	4	2	6048	2
1	11	1	3	5814	3	3	5953	3	1	6049	1
1	12	1	3	5815	3	4	5954	4	1	6685	1
1	13	1	3	5817	3	4	5955	4	1	6686	1
1	14	1	3	5820	3	3	5956	3	1	6822	1
2	15	2	2	5822	2	3	5957	3	1	6823	1
2	16	2	3	5823	3	5	5958	5	1	6827	1
2	17	2	1	5824	1	2	5959	2	1	6828	1
2	18	2	1	5826	1	3	5960	3	1	6961	1
3	19	3	1	5827	1	5	5961	5			
3	20	3	1	5828	1	5	5962	5			
1	21	1	1	5829	1	3	5963	3			
1	22	1	2	5830	2	4	5964	4			
1	23	1	3	5836	3	4	5965	4			
1	5069	1	3	5837	3	4	5966	4			
1	5190	1	4	5840	4	4	5967	4			
1	5696	1	3	5842	3	4	5968	4			
3	5697	3	3	5846	3	3	5969	3			
3	5702	3	2	5851	2	4	5970	4			
1	5703	1	3	5855	3	5	5971	5			
3	5704	3	1	5858	1	3	5972	3			
4	5706	4	3	5859	3	1	5973	1			
3	5709	3	3	5860	3	2	5974	2			
1	5711	1	4	5861	4	3	5975	3			
4	5714	4	3	5863	3	5	5976	5			
4	5724	4	4	5868	4	3	5977	3			
3	5731	3	3	5872	3	3	5978	3			
2	5732	2	2	5885	2	3	5979	3			
4	5733	4	2	5908	2	4	5980	4			
3	5734	3	4	5910	4	3	5981	3			
3	5735	3	3	5914	3	4	5982	4			

TPREPO 404 (INFORMATION) NUMBER OF UNUSED NODES = 8053

TPREPO 403 (INFORMATION) LIST OF UNUSED NODE NOS. FOLLOWS.

```
  24   25   26   27   28   29   30   31   32   33   34   35   36   37   38   39   40   41   42   43   44   45   46   47   48
  49   50   51   52   53   54   55   56   57   58   59   60   61   62   63   64   65   66   67   68   69   70   71   72   73
  74   75   76   77   78   79   80   81   82   83   84   85   86   87   88   89   90   91   92   93   94   95   96   97   98
  99  100  101  102  103  104  105  106  107  108  109  110  111  112  113  114  115  116  117  118  119  120  121  122  123
 124  125  126  127  128  129  130  131  132  133  134  135  136  137  138  139  140  141  142  143  144  145  146  147  148
 149  150  151  152  153  154  155  156  157  158  159  160  161  162  163  164  165  166  167  168  169  170  171  172  173
 174  175  176  177  178  179  180  181  182  183  184  185  186  187  188  189  190  191  192  193  194  195  196  197  198
 199  200  201  202  203  204  205  206  207  208  209  210  211  212  213  214  215  216  217  218  219  220  221  222  223
 224  225  226  227  228  229  230  231  232  233  234  235  236  237  238  239  240  241  242  243  244  245  246  247  248
 249  250  251  252  253  254  255  256  257  258  259  260  261  262  263  264  265  266  267  268  269  270  271  272  273
 274  275  276  277  278  279  280  281  282  283  284  285  286  287  288  289  290  291  292  293  294  295  296  297  298
 299  300  301  302  303  304  305  306  307  308  309  310  311  312  313  314  315  316  317  318  319  320  321  322  323
 324  325  326  327  328  329  330  331  332  333  334  335  336  337  338  339  340  341  342  343  344  345  346  347  348
 349  350  351  352  353  354  355  356  357  358  359  360  361  362  363  364  365  366  367  368  369  370  371  372  373
 374  375  376  377  378  379  380  381  382  383  384  385  386  387  388  389  390  391  392  393  394  395  396  397  398
 399  400  401  402  403  404  405  406  407  408  409  410  411  412  413  414  415  416  417  418  419  420  421  422  423
 424  425  426  427  428  429  430  431  432  433  434  435  436  437  438  439  440  441  442  443  444  445  446  447  448
 449  450  451  452  453  454  455  456  457  458  459  460  461  462  463  464  465  466  467  468  469  470  471  472  473
 474  475  476  477  478  479  480  481  482  483  484  485  486  487  488  489  490  491  492  493  494  495  496  497  498
 499  500  501  502  503  504  505  506  507  508  509  510  511  512  513  514  515  516  517  518  519  520  521  522  523
 524  525  526  527  528  529  530  531  532  533  534  535  536  537  538  539  540  541  542  543  544  545  546  547  548
 549  550  551  552  553  554  555  556  557  558  559  560  561  562  563  564  565  566  567  568  569  570  571  572  573
 574  575  576  577  578  579  580  581  582  583  584  585  586  587  588  589  590  591  592  593  594  595  596  597  598
 599  600  601  602  603  604  605  606  607  608  609  610  611  612  613  614  615  616  617  618  619  620  621  622  623
 624  625  626  627  628  629  630  631  632  633  634  635  636  637  638  639  640  641  642  643  644  645  646  647  648
 649  650  651  652  653  654  655  656  657  658  659  660  661  662  663  664  665  666  667  668  669  670  671  672  673
 674  675  676  677  678  679  680  681  682  683  684  685  686  687  688  689  690  691  692  693  694  695  696  697  698
 699  700  701  702  703  704  705  706  707  708  709  710  711  712  713  714  715  716  717  718  719  720  721  722  723
 724  725  726  727  728  729  730  731  732  733  734  735  736  737  738  739  740  741  742  743  744  745  746  747  748
 749  750  751  752  753  754  755  756  757  758  759  760  761  762  763  764  765  766  767  768  769  770  771  772  773
 774  775  776  777  778  779  780  781  782  783  784  785  786  787  788  789  790  791  792  793  794  795  796  797  798
 799  800  801  802  803  804  805  806  807  808  809  810  811  812  813  814  815  816  817  818  819  820  821  822  823
 824  825  826  827  828  829  830  831  832  833  834  835  836  837  838  839  840  841  842  843  844  845  846  847  848
 849  850  851  852  853  854  855  856  857  858  859  860  861  862  863  864  865  866  867  868  869  870  871  872  873
 874  875  876  877  878  879  880  881  882  883  884  885  886  887  888  889  890  891  892  893  894  895  896  897  898
 899  900  901  902  903  904  905  906  907  908  909  910  911  912  913  914  915  916  917  918  919  920  921  922  923
 924  925  926  927  928  929  930  931  932  933  934  935  936  937  938  939  940  941  942  943  944  945  946  947  948
 949  950  951  952  953  954  955  956  957  958  959  960  961  962  963  964  965  966  967  968  969  970  971  972  973
 974  975  976  977  978  979  980  981  982  983  984  985  986  987  988  989  990  991  992  993  994  995  996  997  998
 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023
1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1041 1042 1043 1044 1045 1046 1047 1048
1049 1050 1051 1052 1053 1054 1055 1056 1057 1058 1059 1060 1061 1062 1063 1064 1065 1066 1067 1068 1069 1070 1071 1072 1073
1074 1075 1076 1077 1078 1079 1080 1081 1082 1083 1084 1085 1086 1087 1088 1089 1090 1091 1092 1093 1094 1095 1096 1097 1098
1099 1100 1101 1102 1103 1104 1105 1106 1107 1108 1109 1110 1111 1112 1113 1114 1115 1116 1117 1118 1119 1120 1121 1122 1123
1124 1125 1126 1127 1128 1129 1130 1131 1132 1133 1134 1135 1136 1137 1138 1139 1140 1141 1142 1143 1144 1145 1146 1147 1148
1149 1150 1151 1152 1153 1154 1155 1156 1157 1158 1159 1160 1161 1162 1163 1164 1165 1166 1167 1168 1169 1170 1171 1172 1173
1174 1175 1176 1177 1178 1179 1180 1181 1182 1183 1184 1185 1186 1187 1188 1189 1190 1191 1192 1193 1194 1195 1196 1197 1198
1199 1200 1201 1202 1203 1204 1205 1206 1207 1208 1209 1210 1211 1212 1213 1214 1215 1216 1217 1218 1219 1220 1221 1222 1223
1224 1225 1226 1227 1228 1229 1230 1231 1232 1233 1234 1235 1236 1237 1238 1239 1240 1241 1242 1243 1244 1245 1246 1247 1248
1249 1250 1251 1252 1253 1254 1255 1256 1257 1258 1259 1260 1261 1262 1263 1264 1265 1266 1267 1268 1269 1270 1271 1272 1273
1274 1275 1276 1277 1278 1279 1280 1281 1282 1283 1284 1285 1286 1287 1288 1289 1290 1291 1292 1293 1294 1295 1296 1297 1298
1299 1300 1301 1302 1303 1304 1305 1306 1307 1308 1309 1310 1311 1312 1313 1314 1315 1316 1317 1318 1319 1320 1321 1322 1323
1324 1325 1326 1327 1328 1329 1330 1331 1332 1333 1334 1335 1336 1337 1338 1339 1340 1341 1342 1343 1344 1345 1346 1347 1348
1349 1350 1351 1352 1353 1354 1355 1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372 1373
1374 1375 1376 1377 1378 1379 1380 1381 1382 1383 1384 1385 1386 1387 1388 1389 1390 1391 1392 1393 1394 1395 1396 1397 1398
1399 1400 1401 1402 1403 1404 1405 1406 1407 1408 1409 1410 1411 1412 1413 1414 1415 1416 1417 1418 1419 1420 1421 1422 1423
1424 1425 1426 1427 1428 1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 1440 1441 1442 1443 1444 1445 1446 1447 1448
1449 1450 1451 1452 1453 1454 1455 1456 1457 1458 1459 1460 1461 1462 1463 1464 1465 1466 1467 1468 1469 1470 1471 1472 1473
1474 1475 1476 1477 1478 1479 1480 1481 1482 1483 1484 1485 1486 1487 1488 1489 1490 1491 1492 1493 1494 1495 1496 1497 1498
```

```
1524 1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535 1536 1537 1538 1539 1540 1541 1542 1543 1544 1545 1546 1547 1548
1549 1550 1551 1552 1553 1554 1555 1556 1557 1558 1559 1560 1561 1562 1563 1564 1565 1566 1567 1568 1569 1570 1571 1572 1573
1574 1575 1576 1577 1578 1579 1580 1581 1582 1583 1584 1585 1586 1587 1588 1589 1590 1591 1592 1593 1594 1595 1596 1597 1598
1599 1600 1601 1602 1603 1604 1605 1606 1607 1608 1609 1610 1611 1612 1613 1614 1615 1616 1617 1618 1619 1620 1621 1622 1623
1624 1625 1626 1627 1628 1629 1630 1631 1632 1633 1634 1635 1636 1637 1638 1639 1640 1641 1642 1643 1644 1645 1646 1647 1648
1649 1650 1651 1652 1653 1654 1655 1656 1657 1658 1659 1660 1661 1662 1663 1664 1665 1666 1667 1668 1669 1670 1671 1672 1673
1674 1675 1676 1677 1678 1679 1680 1681 1682 1683 1684 1685 1686 1687 1688 1689 1690 1691 1692 1693 1694 1695 1696 1697 1698
1699 1700 1701 1702 1703 1704 1705 1706 1707 1708 1709 1710 1711 1712 1713 1714 1715 1716 1717 1718 1719 1720 1721 1722 1723
1724 1725 1726 1727 1728 1729 1730 1731 1732 1733 1734 1735 1736 1737 1738 1739 1740 1741 1742 1743 1744 1745 1746 1747 1748
1749 1750 1751 1752 1753 1754 1755 1756 1757 1758 1759 1760 1761 1762 1763 1764 1765 1766 1767 1768 1769 1770 1771 1772 1773
1774 1775 1776 1777 1778 1779 1780 1781 1782 1783 1784 1785 1786 1787 1788 1789 1790 1791 1792 1793 1794 1795 1796 1797 1798
1799 1800 1801 1802 1803 1804 1805 1806 1807 1808 1809 1810 1811 1812 1813 1814 1815 1816 1817 1818 1819 1820 1821 1822 1823
1824 1825 1826 1827 1828 1829 1830 1831 1832 1833 1834 1835 1836 1837 1838 1839 1840 1841 1842 1843 1844 1845 1846 1847 1848
1849 1850 1851 1852 1853 1854 1855 1856 1857 1858 1859 1860 1861 1862 1863 1864 1865 1866 1867 1868 1869 1870 1871 1872 1873
1874 1875 1876 1877 1878 1879 1880 1881 1882 1883 1884 1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1895 1896 1897 1898
1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923
1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948
1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973
1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048
2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073
2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093 2094 2095 2096 2097 2098
2099 2100 2101 2102 2103 2104 2105 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120 2121 2122 2123
2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135 2136 2137 2138 2139 2140 2141 2142 2143 2144 2145 2146 2147 2148
2149 2150 2151 2152 2153 2154 2155 2156 2157 2158 2159 2160 2161 2162 2163 2164 2165 2166 2167 2168 2169 2170 2171 2172 2173
2174 2175 2176 2177 2178 2179 2180 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192 2193 2194 2195 2196 2197 2198
2199 2200 2201 2202 2203 2204 2205 2206 2207 2208 2209 2210 2211 2212 2213 2214 2215 2216 2217 2218 2219 2220 2221 2222 2223
2224 2225 2226 2227 2228 2229 2230 2231 2232 2233 2234 2235 2236 2237 2238 2239 2240 2241 2242 2243 2244 2245 2246 2247 2248
2249 2250 2251 2252 2253 2254 2255 2256 2257 2258 2259 2260 2261 2262 2263 2264 2265 2266 2267 2268 2269 2270 2271 2272 2273
2274 2275 2276 2277 2278 2279 2280 2281 2282 2283 2284 2285 2286 2287 2288 2289 2290 2291 2292 2293 2294 2295 2296 2297 2298
2299 2300 2301 2302 2303 2304 2305 2306 2307 2308 2309 2310 2311 2312 2313 2314 2315 2316 2317 2318 2319 2320 2321 2322 2323
2324 2325 2326 2327 2328 2329 2330 2331 2332 2333 2334 2335 2336 2337 2338 2339 2340 2341 2342 2343 2344 2345 2346 2347 2348
2349 2350 2351 2352 2353 2354 2355 2356 2357 2358 2359 2360 2361 2362 2363 2364 2365 2366 2367 2368 2369 2370 2371 2372 2373
2374 2375 2376 2377 2378 2379 2380 2381 2382 2383 2384 2385 2386 2387 2388 2389 2390 2391 2392 2393 2394 2395 2396 2397 2398
2399 2400 2401 2402 2403 2404 2405 2406 2407 2408 2409 2410 2411 2412 2413 2414 2415 2416 2417 2418 2419 2420 2421 2422 2423
2424 2425 2426 2427 2428 2429 2430 2431 2432 2433 2434 2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446 2447 2448
2449 2450 2451 2452 2453 2454 2455 2456 2457 2458 2459 2460 2461 2462 2463 2464 2465 2466 2467 2468 2469 2470 2471 2472 2473
2474 2475 2476 2477 2478 2479 2480 2481 2482 2483 2484 2485 2486 2487 2488 2489 2490 2491 2492 2493 2494 2495 2496 2497 2498
2499 2500 2501 2502 2503 2504 2505 2506 2507 2508 2509 2510 2511 2512 2513 2514 2515 2516 2517 2518 2519 2520 2521 2522 2523
2524 2525 2526 2527 2528 2529 2530 2531 2532 2533 2534 2535 2536 2537 2538 2539 2540 2541 2542 2543 2544 2545 2546 2547 2548
2549 2550 2551 2552 2553 2554 2555 2556 2557 2558 2559 2560 2561 2562 2563 2564 2565 2566 2567 2568 2569 2570 2571 2572 2573
2574 2575 2576 2577 2578 2579 2580 2581 2582 2583 2584 2585 2586 2587 2588 2589 2590 2591 2592 2593 2594 2595 2596 2597 2598
2599 2600 2601 2602 2603 2604 2605 2606 2607 2608 2609 2610 2611 2612 2613 2614 2615 2616 2617 2618 2619 2620 2621 2622 2623
2624 2625 2626 2627 2628 2629 2630 2631 2632 2633 2634 2635 2636 2637 2638 2639 2640 2641 2642 2643 2644 2645 2646 2647 2648
2649 2650 2651 2652 2653 2654 2655 2656 2657 2658 2659 2660 2661 2662 2663 2664 2665 2666 2667 2668 2669 2670 2671 2672 2673
2674 2675 2676 2677 2678 2679 2680 2681 2682 2683 2684 2685 2686 2687 2688 2689 2690 2691 2692 2693 2694 2695 2696 2697 2698
2699 2700 2701 2702 2703 2704 2705 2706 2707 2708 2709 2710 2711 2712 2713 2714 2715 2716 2717 2718 2719 2720 2721 2722 2723
2724 2725 2726 2727 2728 2729 2730 2731 2732 2733 2734 2735 2736 2737 2738 2739 2740 2741 2742 2743 2744 2745 2746 2747 2748
2749 2750 2751 2752 2753 2754 2755 2756 2757 2758 2759 2760 2761 2762 2763 2764 2765 2766 2767 2768 2769 2770 2771 2772 2773
2774 2775 2776 2777 2778 2779 2780 2781 2782 2783 2784 2785 2786 2787 2788 2789 2790 2791 2792 2793 2794 2795 2796 2797 2798
2799 2800 2801 2802 2803 2804 2805 2806 2807 2808 2809 2810 2811 2812 2813 2814 2815 2816 2817 2818 2819 2820 2821 2822 2823
2824 2825 2826 2827 2828 2829 2830 2831 2832 2833 2834 2835 2836 2837 2838 2839 2840 2841 2842 2843 2844 2845 2846 2847 2848
2849 2850 2851 2852 2853 2854 2855 2856 2857 2858 2859 2860 2861 2862 2863 2864 2865 2866 2867 2868 2869 2870 2871 2872 2873
2874 2875 2876 2877 2878 2879 2880 2881 2882 2883 2884 2885 2886 2887 2888 2889 2890 2891 2892 2893 2894 2895 2896 2897 2898
2899 2900 2901 2902 2903 2904 2905 2906 2907 2908 2909 2910 2911 2912 2913 2914 2915 2916 2917 2918 2919 2920 2921 2922 2923
2924 2925 2926 2927 2928 2929 2930 2931 2932 2933 2934 2935 2936 2937 2938 2939 2940 2941 2942 2943 2944 2945 2946 2947 2948
2949 2950 2951 2952 2953 2954 2955 2956 2957 2958 2959 2960 2961 2962 2963 2964 2965 2966 2967 2968 2969 2970 2971 2972 2973
2974 2975 2976 2977 2978 2979 2980 2981 2982 2983 2984 2985 2986 2987 2988 2989 2990 2991 2992 2993 2994 2995 2996 2997 2998
2999 3000 3001 3002 3003 3004 3005 3006 3007 3008 3009 3010 3011 3012 3013 3014 3015 3016 3017 3018 3019 3020 3021 3022 3023
3024 3025 3026 3027 3028 3029 3030 3031 3032 3033 3034 3035 3036 3037 3038 3039 3040 3041 3042 3043 3044 3045 3046 3047 3048
3049 3050 3051 3052 3053 3054 3055 3056 3057 3058 3059 3060 3061 3062 3063 3064 3065 3066 3067 3068 3069 3070 3071 3072 3073
3074 3075 3076 3077 3078 3079 3080 3081 3082 3083 3084 3085 3086 3087 3088 3089 3090 3091 3092 3093 3094 3095 3096 3097 3098
3099 3100 3101 3102 3103 3104 3105 3106 3107 3108 3109 3110 3111 3112 3113 3114 3115 3116 3117 3118 3119 3120 3121 3122 3123
```

```
3124 3125 3126 3127 3128 3129 3130 3131 3132 3133 3134 3135 3136 3137 3138 3139 3140 3141 3142 3143 3144 3145 3146 3147 3148
3149 3150 3151 3152 3153 3154 3155 3156 3157 3158 3159 3160 3161 3162 3163 3164 3165 3166 3167 3168 3169 3170 3171 3172 3173
3174 3175 3176 3177 3178 3179 3180 3181 3182 3183 3184 3185 3186 3187 3188 3189 3190 3191 3192 3193 3194 3195 3196 3197 3198
3199 3200 3201 3202 3203 3204 3205 3206 3207 3208 3209 3210 3211 3212 3213 3214 3215 3216 3217 3218 3219 3220 3221 3222 3223
3224 3225 3226 3227 3228 3229 3230 3231 3232 3233 3234 3235 3236 3237 3238 3239 3240 3241 3242 3243 3244 3245 3246 3247 3248
3249 3250 3251 3252 3253 3254 3255 3256 3257 3258 3259 3260 3261 3262 3263 3264 3265 3266 3267 3268 3269 3270 3271 3272 3273
3274 3275 3276 3277 3278 3279 3280 3281 3282 3283 3284 3285 3286 3287 3288 3289 3290 3291 3292 3293 3294 3295 3296 3297 3298
3299 3300 3301 3302 3303 3304 3305 3306 3307 3308 3309 3310 3311 3312 3313 3314 3315 3316 3317 3318 3319 3320 3321 3322 3323
3324 3325 3326 3327 3328 3329 3330 3331 3332 3333 3334 3335 3336 3337 3338 3339 3340 3341 3342 3343 3344 3345 3346 3347 3348
3349 3350 3351 3352 3353 3354 3355 3356 3357 3358 3359 3360 3361 3362 3363 3364 3365 3366 3367 3368 3369 3370 3371 3372 3373
3374 3375 3376 3377 3378 3379 3380 3381 3382 3383 3384 3385 3386 3387 3388 3389 3390 3391 3392 3393 3394 3395 3396 3397 3398
3399 3400 3401 3402 3403 3404 3405 3406 3407 3408 3409 3410 3411 3412 3413 3414 3415 3416 3417 3418 3419 3420 3421 3422 3423
3424 3425 3426 3427 3428 3429 3430 3431 3432 3433 3434 3435 3436 3437 3438 3439 3440 3441 3442 3443 3444 3445 3446 3447 3448
3449 3450 3451 3452 3453 3454 3455 3456 3457 3458 3459 3460 3461 3462 3463 3464 3465 3466 3467 3468 3469 3470 3471 3472 3473
3474 3475 3476 3477 3478 3479 3480 3481 3482 3483 3484 3485 3486 3487 3488 3489 3490 3491 3492 3493 3494 3495 3496 3497 3498
3499 3500 3501 3502 3503 3504 3505 3506 3507 3508 3509 3510 3511 3512 3513 3514 3515 3516 3517 3518 3519 3520 3521 3522 3523
3524 3525 3526 3527 3528 3529 3530 3531 3532 3533 3534 3535 3536 3537 3538 3539 3540 3541 3542 3543 3544 3545 3546 3547 3548
3549 3550 3551 3552 3553 3554 3555 3556 3557 3558 3559 3560 3561 3562 3563 3564 3565 3566 3567 3568 3569 3570 3571 3572 3573
3574 3575 3576 3577 3578 3579 3580 3581 3582 3583 3584 3585 3586 3587 3588 3589 3590 3591 3592 3593 3594 3595 3596 3597 3598
3599 3600 3601 3602 3603 3604 3605 3606 3607 3608 3609 3610 3611 3612 3613 3614 3615 3616 3617 3618 3619 3620 3621 3622 3623
3624 3625 3626 3627 3628 3629 3630 3631 3632 3633 3634 3635 3636 3637 3638 3639 3640 3641 3642 3643 3644 3645 3646 3647 3648
3649 3650 3651 3652 3653 3654 3655 3656 3657 3658 3659 3660 3661 3662 3663 3664 3665 3666 3667 3668 3669 3670 3671 3672 3673
3674 3675 3676 3677 3678 3679 3680 3681 3682 3683 3684 3685 3686 3687 3688 3689 3690 3691 3692 3693 3694 3695 3696 3697 3698
3699 3700 3701 3702 3703 3704 3705 3706 3707 3708 3709 3710 3711 3712 3713 3714 3715 3716 3717 3718 3719 3720 3721 3722 3723
3724 3725 3726 3727 3728 3729 3730 3731 3732 3733 3734 3735 3736 3737 3738 3739 3740 3741 3742 3743 3744 3745 3746 3747 3748
3749 3750 3751 3752 3753 3754 3755 3756 3757 3758 3759 3760 3761 3762 3763 3764 3765 3766 3767 3768 3769 3770 3771 3772 3773
3774 3775 3776 3777 3778 3779 3780 3781 3782 3783 3784 3785 3786 3787 3788 3789 3790 3791 3792 3793 3794 3795 3796 3797 3798
3799 3800 3801 3802 3803 3804 3805 3806 3807 3808 3809 3810 3811 3812 3813 3814 3815 3816 3817 3818 3819 3820 3821 3822 3823
3824 3825 3826 3827 3828 3829 3830 3831 3832 3833 3834 3835 3836 3837 3838 3839 3840 3841 3842 3843 3844 3845 3846 3847 3848
3849 3850 3851 3852 3853 3854 3855 3856 3857 3858 3859 3860 3861 3862 3863 3864 3865 3866 3867 3868 3869 3870 3871 3872 3873
3874 3875 3876 3877 3878 3879 3880 3881 3882 3883 3884 3885 3886 3887 3888 3889 3890 3891 3892 3893 3894 3895 3896 3897 3898
3899 3900 3901 3902 3903 3904 3905 3906 3907 3908 3909 3910 3911 3912 3913 3914 3915 3916 3917 3918 3919 3920 3921 3922 3923
3924 3925 3926 3927 3928 3929 3930 3931 3932 3933 3934 3935 3936 3937 3938 3939 3940 3941 3942 3943 3944 3945 3946 3947 3948
3949 3950 3951 3952 3953 3954 3955 3956 3957 3958 3959 3960 3961 3962 3963 3964 3965 3966 3967 3968 3969 3970 3971 3972 3973
3974 3975 3976 3977 3978 3979 3980 3981 3982 3983 3984 3985 3986 3987 3988 3989 3990 3991 3992 3993 3994 3995 3996 3997 3998
3999 4000 4001 4002 4003 4004 4005 4006 4007 4008 4009 4010 4011 4012 4013 4014 4015 4016 4017 4018 4019 4020 4021 4022 4023
4024 4025 4026 4027 4028 4029 4030 4031 4032 4033 4034 4035 4036 4037 4038 4039 4040 4041 4042 4043 4044 4045 4046 4047 4048
4049 4050 4051 4052 4053 4054 4055 4056 4057 4058 4059 4060 4061 4062 4063 4064 4065 4066 4067 4068 4069 4070 4071 4072 4073
4074 4075 4076 4077 4078 4079 4080 4081 4082 4083 4084 4085 4086 4087 4088 4089 4090 4091 4092 4093 4094 4095 4096 4097 4098
4099 4100 4101 4102 4103 4104 4105 4106 4107 4108 4109 4110 4111 4112 4113 4114 4115 4116 4117 4118 4119 4120 4121 4122 4123
4124 4125 4126 4127 4128 4129 4130 4131 4132 4133 4134 4135 4136 4137 4138 4139 4140 4141 4142 4143 4144 4145 4146 4147 4148
4149 4150 4151 4152 4153 4154 4155 4156 4157 4158 4159 4160 4161 4162 4163 4164 4165 4166 4167 4168 4169 4170 4171 4172 4173
4174 4175 4176 4177 4178 4179 4180 4181 4182 4183 4184 4185 4186 4187 4188 4189 4190 4191 4192 4193 4194 4195 4196 4197 4198
4199 4200 4201 4202 4203 4204 4205 4206 4207 4208 4209 4210 4211 4212 4213 4214 4215 4216 4217 4218 4219 4220 4221 4222 4223
4224 4225 4226 4227 4228 4229 4230 4231 4232 4233 4234 4235 4236 4237 4238 4239 4240 4241 4242 4243 4244 4245 4246 4247 4248
4249 4250 4251 4252 4253 4254 4255 4256 4257 4258 4259 4260 4261 4262 4263 4264 4265 4266 4267 4268 4269 4270 4271 4272 4273
4274 4275 4276 4277 4278 4279 4280 4281 4282 4283 4284 4285 4286 4287 4288 4289 4290 4291 4292 4293 4294 4295 4296 4297 4298
4299 4300 4301 4302 4303 4304 4305 4306 4307 4308 4309 4310 4311 4312 4313 4314 4315 4316 4317 4318 4319 4320 4321 4322 4323
4324 4325 4326 4327 4328 4329 4330 4331 4332 4333 4334 4335 4336 4337 4338 4339 4340 4341 4342 4343 4344 4345 4346 4347 4348
4349 4350 4351 4352 4353 4354 4355 4356 4357 4358 4359 4360 4361 4362 4363 4364 4365 4366 4367 4368 4369 4370 4371 4372 4373
4374 4375 4376 4377 4378 4379 4380 4381 4382 4383 4384 4385 4386 4387 4388 4389 4390 4391 4392 4393 4394 4395 4396 4397 4398
4399 4400 4401 4402 4403 4404 4405 4406 4407 4408 4409 4410 4411 4412 4413 4414 4415 4416 4417 4418 4419 4420 4421 4422 4423
4424 4425 4426 4427 4428 4429 4430 4431 4432 4433 4434 4435 4436 4437 4438 4439 4440 4441 4442 4443 4444 4445 4446 4447 4448
4449 4450 4451 4452 4453 4454 4455 4456 4457 4458 4459 4460 4461 4462 4463 4464 4465 4466 4467 4468 4469 4470 4471 4472 4473
4474 4475 4476 4477 4478 4479 4480 4481 4482 4483 4484 4485 4486 4487 4488 4489 4490 4491 4492 4493 4494 4495 4496 4497 4498
4499 4500 4501 4502 4503 4504 4505 4506 4507 4508 4509 4510 4511 4512 4513 4514 4515 4516 4517 4518 4519 4520 4521 4522 4523
4524 4525 4526 4527 4528 4529 4530 4531 4532 4533 4534 4535 4536 4537 4538 4539 4540 4541 4542 4543 4544 4545 4546 4547 4548
4549 4550 4551 4552 4553 4554 4555 4556 4557 4558 4559 4560 4561 4562 4563 4564 4565 4566 4567 4568 4569 4570 4571 4572 4573
4574 4575 4576 4577 4578 4579 4580 4581 4582 4583 4584 4585 4586 4587 4588 4589 4590 4591 4592 4593 4594 4595 4596 4597 4598
4599 4600 4601 4602 4603 4604 4605 4606 4607 4608 4609 4610 4611 4612 4613 4614 4615 4616 4617 4618 4619 4620 4621 4622 4623
4624 4625 4626 4627 4628 4629 4630 4631 4632 4633 4634 4635 4636 4637 4638 4639 4640 4641 4642 4643 4644 4645 4646 4647 4648
4649 4650 4651 4652 4653 4654 4655 4656 4657 4658 4659 4660 4661 4662 4663 4664 4665 4666 4667 4668 4669 4670 4671 4672 4673
4674 4675 4676 4677 4678 4679 4680 4681 4682 4683 4684 4685 4686 4687 4688 4689 4690 4691 4692 4693 4694 4695 4696 4697 4698
4699 4700 4701 4702 4703 4704 4705 4706 4707 4708 4709 4710 4711 4712 4713 4714 4715 4716 4717 4718 4719 4720 4721 4722 4723
4724 4725 4726 4727 4728 4729 4730 4731 4732 4733 4734 4735 4736 4737 4738 4739 4740 4741 4742 4743 4744 4745 4746 4747 4748
```

```
4799 4800 4801 4802 4803 4804 4805 4806 4807 4808 4809 4810 4811 4812 4813 4814 4815 4816 4817 4818 4819 4820 4821 4822 4823
4824 4825 4826 4827 4828 4829 4830 4831 4832 4833 4834 4835 4836 4837 4838 4839 4840 4841 4842 4843 4844 4845 4846 4847 4848
4849 4850 4851 4852 4853 4854 4855 4856 4857 4858 4859 4860 4861 4862 4863 4864 4865 4866 4867 4868 4869 4870 4871 4872 4873
4874 4875 4876 4877 4878 4879 4880 4881 4882 4883 4884 4885 4886 4887 4888 4889 4890 4891 4892 4893 4894 4895 4896 4897 4898
4899 4900 4901 4902 4903 4904 4905 4906 4907 4908 4909 4910 4911 4912 4913 4914 4915 4916 4917 4918 4919 4920 4921 4922 4923
4924 4925 4926 4927 4928 4929 4930 4931 4932 4933 4934 4935 4936 4937 4938 4939 4940 4941 4942 4943 4944 4945 4946 4947 4948
4949 4950 4951 4952 4953 4954 4955 4956 4957 4958 4959 4960 4961 4962 4963 4964 4965 4966 4967 4968 4969 4970 4971 4972 4973
4974 4975 4976 4977 4978 4979 4980 4981 4982 4983 4984 4985 4986 4987 4988 4989 4990 4991 4992 4993 4994 4995 4996 4997 4998
4999 5000 5001 5002 5003 5004 5005 5006 5007 5008 5009 5010 5011 5012 5013 5014 5015 5016 5017 5018 5019 5020 5021 5022 5023
5024 5025 5026 5027 5028 5029 5030 5031 5032 5033 5034 5035 5036 5037 5038 5039 5040 5041 5042 5043 5044 5045 5046 5047 5048
5049 5050 5051 5052 5053 5054 5055 5056 5057 5058 5059 5060 5061 5062 5063 5064 5065 5066 5067 5068 5070 5071 5072 5073 5074
5075 5076 5077 5078 5079 5080 5081 5082 5083 5084 5085 5086 5087 5088 5089 5090 5091 5092 5093 5094 5095 5096 5097 5098 5099
5100 5101 5102 5103 5104 5105 5106 5107 5108 5109 5110 5111 5112 5113 5114 5115 5116 5117 5118 5119 5120 5121 5122 5123 5124
5125 5126 5127 5128 5129 5130 5131 5132 5133 5134 5135 5136 5137 5138 5139 5140 5141 5142 5143 5144 5145 5146 5147 5148 5149
5150 5151 5152 5153 5154 5155 5156 5157 5158 5159 5160 5161 5162 5163 5164 5165 5166 5167 5168 5169 5170 5171 5172 5173 5174
5175 5176 5177 5178 5179 5180 5181 5182 5183 5184 5185 5186 5187 5188 5189 5191 5192 5193 5194 5195 5196 5197 5198 5199 5200
5201 5202 5203 5204 5205 5206 5207 5208 5209 5210 5211 5212 5213 5214 5215 5216 5217 5218 5219 5220 5221 5222 5223 5224 5225
5226 5227 5228 5229 5230 5231 5232 5233 5234 5235 5236 5237 5238 5239 5240 5241 5242 5243 5244 5245 5246 5247 5248 5249 5250
5251 5252 5253 5254 5255 5256 5257 5258 5259 5260 5261 5262 5263 5264 5265 5266 5267 5268 5269 5270 5271 5272 5273 5274 5275
5276 5277 5278 5279 5280 5281 5282 5283 5284 5285 5286 5287 5288 5289 5290 5291 5292 5293 5294 5295 5296 5297 5298 5299 5300
5301 5302 5303 5304 5305 5306 5307 5308 5309 5310 5311 5312 5313 5314 5315 5316 5317 5318 5319 5320 5321 5322 5323 5324 5325
5326 5327 5328 5329 5330 5331 5332 5333 5334 5335 5336 5337 5338 5339 5340 5341 5342 5343 5344 5345 5346 5347 5348 5349 5350
5351 5352 5353 5354 5355 5356 5357 5358 5359 5360 5361 5362 5363 5364 5365 5366 5367 5368 5369 5370 5371 5372 5373 5374 5375
5376 5377 5378 5379 5380 5381 5382 5383 5384 5385 5386 5387 5388 5389 5390 5391 5392 5393 5394 5395 5396 5397 5398 5399 5400
5401 5402 5403 5404 5405 5406 5407 5408 5409 5410 5411 5412 5413 5414 5415 5416 5417 5418 5419 5420 5421 5422 5423 5424 5425
5426 5427 5428 5429 5430 5431 5432 5433 5434 5435 5436 5437 5438 5439 5440 5441 5442 5443 5444 5445 5446 5447 5448 5449 5450
5451 5452 5453 5454 5455 5456 5457 5458 5459 5460 5461 5462 5463 5464 5465 5466 5467 5468 5469 5470 5471 5472 5473 5474 5475
5476 5477 5478 5479 5480 5481 5482 5483 5484 5485 5486 5487 5488 5489 5490 5491 5492 5493 5494 5495 5496 5497 5498 5499 5500
5501 5502 5503 5504 5505 5506 5507 5508 5509 5510 5511 5512 5513 5514 5515 5516 5517 5518 5519 5520 5521 5522 5523 5524 5525
5526 5527 5528 5529 5530 5531 5532 5533 5534 5535 5536 5537 5538 5539 5540 5541 5542 5543 5544 5545 5546 5547 5548 5549 5550
5551 5552 5553 5554 5555 5556 5557 5558 5559 5560 5561 5562 5563 5564 5565 5566 5567 5568 5569 5570 5571 5572 5573 5574 5575
5576 5577 5578 5579 5580 5581 5582 5583 5584 5585 5586 5587 5588 5589 5590 5591 5592 5593 5594 5595 5596 5597 5598 5599 5600
5601 5602 5603 5604 5605 5606 5607 5608 5609 5610 5611 5612 5613 5614 5615 5616 5617 5618 5619 5620 5621 5622 5623 5624 5625
5626 5627 5628 5629 5630 5631 5632 5633 5634 5635 5636 5637 5638 5639 5640 5641 5642 5643 5644 5645 5646 5647 5648 5649 5650
5651 5652 5653 5654 5655 5656 5657 5658 5659 5660 5661 5662 5663 5664 5665 5666 5667 5668 5669 5670 5671 5672 5673 5674 5675
5676 5677 5678 5679 5680 5681 5682 5683 5684 5685 5686 5687 5688 5689 5690 5691 5692 5693 5694 5695 5698 5699 5700 5701 5705
5707 5708 5710 5712 5713 5715 5716 5717 5718 5719 5720 5721 5722 5723 5725 5726 5727 5728 5729 5730 5737 5738 5739 5740 5741
5742 5743 5744 5745 5748 5749 5751 5752 5754 5755 5756 5757 5759 5761 5762 5763 5764 5765 5766 5767 5768 5769 5770 5771 5772
5773 5774 5775 5776 5777 5778 5779 5780 5781 5783 5784 5785 5786 5787 5788 5789 5790 5792 5793 5794 5796 5797 5798 5799 5800
5801 5802 5803 5804 5805 5806 5807 5808 5809 5810 5811 5812 5813 5816 5818 5819 5821 5825 5831 5832 5833 5834 5835 5838 5839
5841 5843 5844 5845 5847 5848 5849 5850 5852 5853 5854 5856 5857 5862 5864 5865 5866 5867 5869 5870 5871 5873 5874 5875 5876
5877 5878 5879 5880 5881 5882 5883 5884 5886 5887 5888 5889 5890 5891 5892 5893 5894 5895 5896 5897 5898 5899 5900 5901 5902
5903 5904 5905 5906 5907 5909 5911 5912 5913 5915 5916 5918 5919 5921 5922 5923 5924 5927 5928 5929 5930 5931 5932 5933 5934
5935 5936 5937 5938 5939 5940 5941 5942 5943 5944 5945 5946 5990 5991 5992 5993 5994 5995 5996 5997 5998 5999 6000 6001 6002
6003 6004 6005 6006 6007 6008 6009 6010 6011 6012 6013 6014 6015 6016 6017 6018 6019 6020 6021 6022 6023 6024 6025 6026 6027
6028 6029 6030 6031 6032 6033 6034 6035 6036 6037 6038 6039 6040 6041 6042 6043 6044 6045 6050 6051 6052 6053 6054 6055 6056
6057 6058 6059 6060 6061 6062 6063 6064 6065 6066 6067 6068 6069 6070 6071 6072 6073 6074 6075 6076 6077 6078 6079 6080 6081
6082 6083 6084 6085 6086 6087 6088 6089 6090 6091 6092 6093 6094 6095 6096 6097 6098 6099 6100 6101 6102 6103 6104 6105 6106
6107 6108 6109 6110 6111 6112 6113 6114 6115 6116 6117 6118 6119 6120 6121 6122 6123 6124 6125 6126 6127 6128 6129 6130 6131
6132 6133 6134 6135 6136 6137 6138 6139 6140 6141 6142 6143 6144 6145 6146 6147 6148 6149 6150 6151 6152 6153 6154 6155 6156
6157 6158 6159 6160 6161 6162 6163 6164 6165 6166 6167 6168 6169 6170 6171 6172 6173 6174 6175 6176 6177 6178 6179 6180 6181
6182 6183 6184 6185 6186 6187 6188 6189 6190 6191 6192 6193 6194 6195 6196 6197 6198 6199 6200 6201 6202 6203 6204 6205 6206
6207 6208 6209 6210 6211 6212 6213 6214 6215 6216 6217 6218 6219 6220 6221 6222 6223 6224 6225 6226 6227 6228 6229 6230 6231
6232 6233 6234 6235 6236 6237 6238 6239 6240 6241 6242 6243 6244 6245 6246 6247 6248 6249 6250 6251 6252 6253 6254 6255 6256
6257 6258 6259 6260 6261 6262 6263 6264 6265 6266 6267 6268 6269 6270 6271 6272 6273 6274 6275 6276 6277 6278 6279 6280 6281
6282 6283 6284 6285 6286 6287 6288 6289 6290 6291 6292 6293 6294 6295 6296 6297 6298 6299 6300 6301 6302 6303 6304 6305 6306
6307 6308 6309 6310 6311 6312 6313 6314 6315 6316 6317 6318 6319 6320 6321 6322 6323 6324 6325 6326 6327 6328 6329 6330 6331
6332 6333 6334 6335 6336 6337 6338 6339 6340 6341 6342 6343 6344 6345 6346 6347 6348 6349 6350 6351 6352 6353 6354 6355 6356
6357 6358 6359 6360 6361 6362 6363 6364 6365 6366 6367 6368 6369 6370 6371 6372 6373 6374 6375 6376 6377 6378 6379 6380 6381
6382 6383 6384 6385 6386 6387 6388 6389 6390 6391 6392 6393 6394 6395 6396 6397 6398 6399 6400 6401 6402 6403 6404 6405 6406
6407 6408 6409 6410 6411 6412 6413 6414 6415 6416 6417 6418 6419 6420 6421 6422 6423 6424 6425 6426 6427 6428 6429 6430 6431
6432 6433 6434 6435 6436 6437 6438 6439 6440 6441 6442 6443 6444 6445 6446 6447 6448 6449 6450 6451 6452 6453 6454 6455 6456
6457 6458 6459 6460 6461 6462 6463 6464 6465 6466 6467 6468 6469 6470 6471 6472 6473 6474 6475 6476 6477 6478 6479 6480 6481
```

```
6507 6508 6509 6510 6511 6512 6513 6514 6515 6516 6517 6518 6519 6520 6521 6522 6523 6524 6525 6526 6527 6528 6529 6530 6531
6532 6533 6534 6535 6536 6537 6538 6539 6540 6541 6542 6543 6544 6545 6546 6547 6548 6549 6550 6551 6552 6553 6554 6555 6556
6557 6558 6559 6560 6561 6562 6563 6564 6565 6566 6567 6568 6569 6570 6571 6572 6573 6574 6575 6576 6577 6578 6579 6580 6581
6582 6583 6584 6585 6586 6587 6588 6589 6590 6591 6592 6593 6594 6595 6596 6597 6598 6599 6600 6601 6602 6603 6604 6605 6606
6607 6608 6609 6610 6611 6612 6613 6614 6615 6616 6617 6618 6619 6620 6621 6622 6623 6624 6625 6626 6627 6628 6629 6630 6631
6632 6633 6634 6635 6636 6637 6638 6639 6640 6641 6642 6643 6644 6645 6646 6647 6648 6649 6650 6651 6652 6653 6654 6655 6656
6657 6658 6659 6660 6661 6662 6663 6664 6665 6666 6667 6668 6669 6670 6671 6672 6673 6674 6675 6676 6677 6678 6679 6680 6681
6682 6683 6684 6687 6688 6689 6690 6691 6692 6693 6694 6695 6696 6697 6698 6699 6700 6701 6702 6703 6704 6705 6706 6707 6708
6709 6710 6711 6712 6713 6714 6715 6716 6717 6718 6719 6720 6721 6722 6723 6724 6725 6726 6727 6728 6729 6730 6731 6732 6733
6734 6735 6736 6737 6738 6739 6740 6741 6742 6743 6744 6745 6746 6747 6748 6749 6750 6751 6752 6753 6754 6755 6756 6757 6758
6759 6760 6761 6762 6763 6764 6765 6766 6767 6768 6769 6770 6771 6772 6773 6774 6775 6776 6777 6778 6779 6780 6781 6782 6783
6784 6785 6786 6787 6788 6789 6790 6791 6792 6793 6794 6795 6796 6797 6798 6799 6800 6801 6802 6803 6804 6805 6806 6807 6808
6809 6810 6811 6812 6813 6814 6815 6816 6817 6818 6819 6820 6821 6824 6825 6826 6829 6830 6831 6832 6833 6834 6835 6836 6837
6838 6839 6840 6841 6842 6843 6844 6845 6846 6847 6848 6849 6850 6851 6852 6853 6854 6855 6856 6857 6858 6859 6860 6861 6862
6863 6864 6865 6866 6867 6868 6869 6870 6871 6872 6873 6874 6875 6876 6877 6878 6879 6880 6881 6882 6883 6884 6885 6886 6887
6888 6889 6890 6891 6892 6893 6894 6895 6896 6897 6898 6899 6900 6901 6902 6903 6904 6905 6906 6907 6908 6909 6910 6911 6912
6913 6914 6915 6916 6917 6918 6919 6920 6921 6922 6923 6924 6925 6926 6927 6928 6929 6930 6931 6932 6933 6934 6935 6936 6937
6938 6939 6940 6941 6942 6943 6944 6945 6946 6947 6948 6949 6950 6951 6952 6953 6954 6955 6956 6957 6958 6959 6960 6962 6963
6964 6965 6966 6967 6968 6969 6970 6971 6972 6973 6974 6975 6976 6977 6978 6979 6980 6981 6982 6983 6984 6985 6986 6987 6988
6989 6990 6991 6992 6993 6994 6995 6996 6997 6998 6999 7000 7001 7002 7003 7004 7005 7006 7007 7008 7009 7010 7011 7012 7013
7014 7015 7016 7017 7018 7019 7020 7021 7022 7023 7024 7025 7026 7027 7028 7029 7030 7031 7032 7033 7034 7035 7036 7037 7038
7039 7040 7041 7042 7043 7044 7045 7046 7047 7048 7049 7050 7051 7052 7053 7054 7055 7056 7057 7058 7059 7060 7061 7062 7063
7064 7065 7066 7067 7068 7069 7070 7071 7072 7073 7074 7075 7076 7077 7078 7079 7080 7081 7082 7083 7084 7085 7086 7087 7088
7089 7090 7091 7092 7093 7094 7095 7096 7097 7098 7099 7100 7101 7102 7103 7104 7105 7106 7107 7108 7109 7110 7111 7112 7113
7114 7115 7116 7117 7118 7119 7120 7121 7122 7123 7124 7125 7126 7127 7128 7129 7130 7131 7132 7133 7134 7135 7136 7137 7138
7139 7140 7141 7142 7143 7144 7145 7146 7147 7148 7149 7150 7151 7152 7153 7154 7155 7156 7157 7158 7159 7160 7161 7162 7163
7164 7165 7166 7167 7168 7169 7170 7171 7172 7173 7174 7175 7176 7177 7178 7179 7180 7181 7182 7183 7184 7185 7186 7187 7188
7189 7190 7191 7192 7193 7194 7195 7196 7197 7198 7199 7200 7201 7202 7203 7204 7205 7206 7207 7208 7209 7210 7211 7212 7213
7214 7215 7216 7217 7218 7219 7220 7221 7222 7223 7224 7225 7226 7227 7228 7229 7230 7231 7232 7233 7234 7235 7236 7237 7238
7239 7240 7241 7242 7243 7244 7245 7246 7247 7248 7249 7250 7251 7252 7253 7254 7255 7256 7257 7258 7259 7260 7261 7262 7263
7264 7265 7266 7267 7268 7269 7270 7271 7272 7273 7274 7275 7276 7277 7278 7279 7280 7281 7282 7283 7284 7285 7286 7287 7288
7289 7290 7291 7292 7293 7294 7295 7296 7297 7298 7299 7300 7301 7302 7303 7304 7305 7306 7307 7308 7309 7310 7311 7312 7313
7314 7315 7316 7317 7318 7319 7320 7321 7322 7323 7324 7325 7326 7327 7328 7329 7330 7331 7332 7333 7334 7335 7336 7337 7338
7339 7340 7341 7342 7343 7344 7345 7346 7347 7348 7349 7350 7351 7352 7353 7354 7355 7356 7357 7358 7359 7360 7361 7362 7363
7364 7365 7366 7367 7368 7369 7370 7371 7372 7373 7374 7375 7376 7377 7378 7379 7380 7381 7382 7383 7384 7385 7386 7387 7388
7389 7390 7391 7392 7393 7394 7395 7396 7397 7398 7399 7400 7401 7402 7403 7404 7405 7406 7407 7408 7409 7410 7411 7412 7413
7414 7415 7416 7417 7418 7419 7420 7421 7422 7423 7424 7425 7426 7427 7428 7429 7430 7431 7432 7433 7434 7435 7436 7437 7438
7439 7440 7441 7442 7443 7444 7445 7446 7447 7448 7449 7450 7451 7452 7453 7454 7455 7456 7457 7458 7459 7460 7461 7462 7463
7464 7465 7466 7467 7468 7469 7470 7471 7472 7473 7474 7475 7476 7477 7478 7479 7480 7481 7482 7483 7484 7485 7486 7487 7488
7489 7490 7491 7492 7493 7494 7495 7496 7497 7498 7499 7500 7501 7502 7503 7504 7505 7506 7507 7508 7509 7510 7511 7512 7513
7514 7515 7516 7517 7518 7519 7520 7521 7522 7523 7524 7525 7526 7527 7528 7529 7530 7531 7532 7533 7534 7535 7536 7537 7538
7539 7540 7541 7542 7543 7544 7545 7546 7547 7548 7549 7550 7551 7552 7553 7554 7555 7556 7557 7558 7559 7560 7561 7562 7563
7564 7565 7566 7567 7568 7569 7570 7571 7572 7573 7574 7575 7576 7577 7578 7579 7580 7581 7582 7583 7584 7585 7586 7587 7588
7589 7590 7591 7592 7593 7594 7595 7596 7597 7598 7599 7600 7601 7602 7603 7604 7605 7606 7607 7608 7609 7610 7611 7612 7613
7614 7615 7616 7617 7618 7619 7620 7621 7622 7623 7624 7625 7626 7627 7628 7629 7630 7631 7632 7633 7634 7635 7636 7637 7638
7639 7640 7641 7642 7643 7644 7645 7646 7647 7648 7649 7650 7651 7652 7653 7654 7655 7656 7657 7658 7659 7660 7661 7662 7663
7664 7665 7666 7667 7668 7669 7670 7671 7672 7673 7674 7675 7676 7677 7678 7679 7680 7681 7682 7683 7684 7685 7686 7687 7688
7689 7690 7691 7692 7693 7694 7695 7696 7697 7698 7699 7700 7701 7702 7703 7704 7705 7706 7707 7708 7709 7710 7711 7712 7713
7714 7715 7716 7717 7718 7719 7720 7721 7722 7723 7724 7725 7726 7727 7728 7729 7730 7731 7732 7733 7734 7735 7736 7737 7738
7739 7740 7741 7742 7743 7744 7745 7746 7747 7748 7749 7750 7751 7752 7753 7754 7755 7756 7757 7758 7759 7760 7761 7762 7763
7764 7765 7766 7767 7768 7769 7770 7771 7772 7773 7774 7775 7776 7777 7778 7779 7780 7781 7782 7783 7784 7785 7786 7787 7788
7789 7790 7791 7792 7793 7794 7795 7796 7797 7798 7799 7800 7801 7802 7803 7804 7805 7806 7807 7808 7809 7810 7811 7812 7813
7814 7815 7816 7817 7818 7819 7820 7821 7822 7823 7824 7825 7826 7827 7828 7829 7830 7831 7832 7833 7834 7835 7836 7837 7838
7839 7840 7841 7842 7843 7844 7845 7846 7847 7848 7849 7850 7851 7852 7853 7854 7855 7856 7857 7858 7859 7860 7861 7862 7863
7864 7865 7866 7867 7868 7869 7870 7871 7872 7873 7874 7875 7876 7877 7878 7879 7880 7881 7882 7883 7884 7885 7886 7887 7888
7889 7890 7891 7892 7893 7894 7895 7896 7897 7898 7899 7900 7901 7902 7903 7904 7905 7906 7907 7908 7909 7910 7911 7912 7913
7914 7915 7916 7917 7918 7919 7920 7921 7922 7923 7924 7925 7926 7927 7928 7929 7930 7931 7932 7933 7934 7935 7936 7937 7938
7939 7940 7941 7942 7943 7944 7945 7946 7947 7948 7949 7950 7951 7952 7953 7954 7955 7956 7957 7958 7959 7960 7961 7962 7963
7964 7965 7966 7967 7968 7969 7970 7971 7972 7973 7974 7975 7976 7977 7978 7979 7980 7981 7982 7983 7984 7985 7986 7987 7988
7989 7990 7991 7992 7993 7994 7995 7996 7997 7998 7999 8000 8001 8002 8003 8004 8005 8006 8007 8008 8009 8010 8011 8012 8013
8014 8015 8016 8017 8018 8019 8020 8021 8022 8023 8024 8025 8026 8027 8028 8029 8030 8031 8032 8033 8034 8035 8036 8037 8038
8039 8040 8041 8042 8043 8044 8045 8046 8047 8048 8049 8050 8051 8052 8053 8054 8055 8056 8057 8058 8059 8060 8061 8062 8063
8064 8065 8066 8067 8068 8069 8070 8071 8072 8073 8074 8075 8076 8077 8078 8079 8080 8081 8082 8083 8084 8085 8086 8087 8088
8089 8090 8091 8092 8093 8094 8095 8096 8097 8098 8099 8100 8101 8102 8103 8104 8105 8106 8107 8108 8109 8110 8111 8112 8113
```

81 140 1 81 142 4 8 814 47 814 150 81 153 4 8 815 57 815 60 81 163

8164 8165 8166 8167 8168 8169 8170 8171 8172 8173 8174 8175 8176 8177 8178 8179 8180 8181 8182 8183 8184 8185 8186 8187 8188
8189 8190 8191

                              DATE   21.53.45
ELAPSED PROCESSOR TIME   00.01.35

PLANNED MODEL REFINEMENT
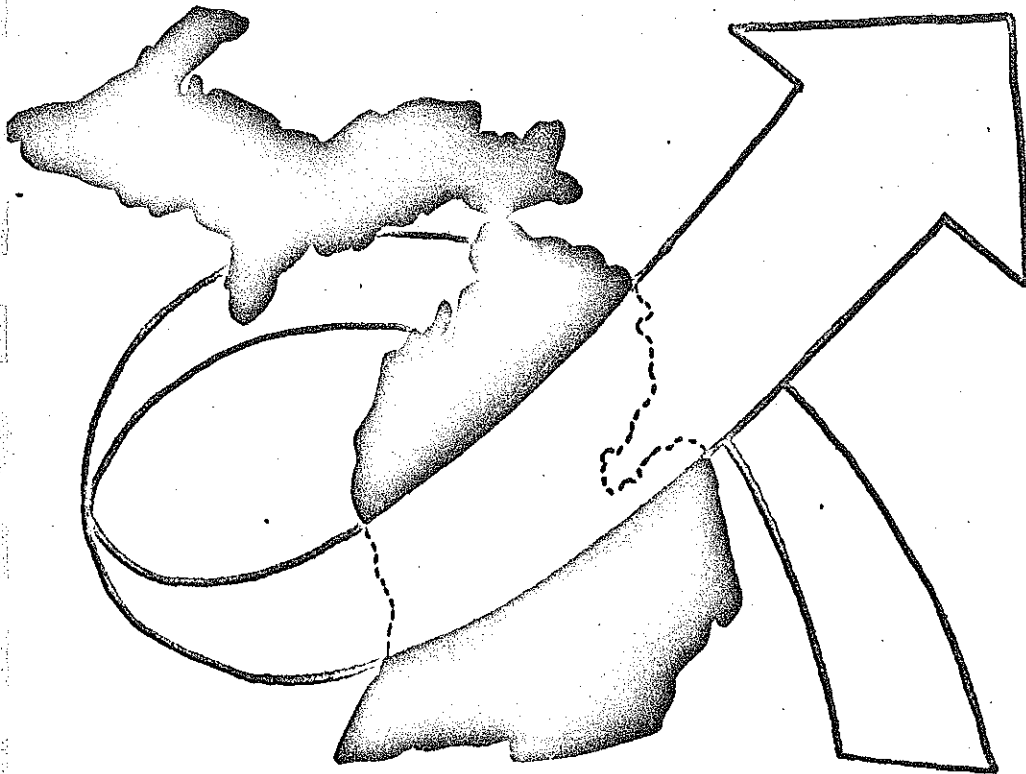
PLANNED MODEL REFINEMENT

As indicated in the first portion of this report the "preliminary segmental model" program is fully operational on the department's B-5500. This initial effort was greatly simplified in order to quickly test the potential applications of a concept such as this.

Preliminary test runs have been completed on a more sophisticated segmental model concept. In the discussion to follow the more sophisticated version of the model will be referred to as "refined segmental model." A brief resume of the differences between the "preliminary segmental model" and the "refined segmental model" follow. Any potential user interested in this concept should keep in mind the fact that only initial testing has been completed on the "refined segmental model." A total operational model is expected to be available in July or August of 1971.

The "refined segmental model" as presently planned will accomplish the following tasks related to network and trip table development.

1. Maintain a single "master detailed network file versus the present method of coding several different network link files.

2. User specified level of network detail by area based on function classification and link type.

3. Elimination of unnecessary highway links as a result of deletion or compression of selected

links by class, therefore saving computer run times.

4. Automatic compression of trip table to match
    network detail by each area so that traffic
    assignments could be completed after a "build
    all trees" run.

5. Multi-detail sub-areas with total network. For
    example, generate a network with detail areas for
    Lansing and Kalamazoo and leave the rest of the
    state with a coarse network.

6. Conversion of master network coordinate files
    so new segmental network could be plotted auto-
    matically and used as a base map or work map.

A flow chart of the "refined segmental model process"
appears in figure 27. With the "refined segmental model"
the user will be able to maintain a master network file
with six digit A-node B-nodes. After selecting the links
necessary to obtain the level of network detail required the
"refined segmental model" will sequentially renumber all nodes
so that no node number is larger than four digits. The four
digit node number is generally the maximum size allowed with
most network analysis programs. The "preliminary segmental
model" would only allow four-digit node numbers and no renum-
bering was completed. This six-digit capability will allow
many states to define a total road system or needs study
network in a manner similar to the concept used in network

definition. The "refined segmental model" would then allow the user to complete analysis on a needs study link file, or total road system file, using Transportation Planning programs presently in existence.

The second task of specifying level of network detail was very limited in the "preliminary segmental model" as there was only a detailed and non-detailed area allowed. The user had no choice as to the type of link that was to be included in each study area. With the "refined segmental model" the user will be able to specify four levels of network detail. In addition to this feature the user will also be able to specify which link type and/or jurisdiction is to be present at each level. Figure 28 is an example of a network composed of four levels of details. Level four or the actual study area is the most detailed in this example and it is surnamed by concentric rings in which the level of network detail becomes coarser farther from the study area. The user specifies what link type and jurisdiction are to be included in each level. Even though the "refined segmental model" will allow up to four levels only two or three need be used if that is all that is required.

Elimination of unnecessary links, as a result of user specified link selection based on link type and link jurisdiction, is the same process as defined in the "preliminary segmental model." The savings in computer run times using this link elimination technique is definitely significant with the large networks that might be in use in the next few years.

The fourth task, which was not operational in the "prelim-
inary segmental model", is the ability to generate trip table
compression cards that could be used to compress a detailed
trip table to the zone level specified by the user in seg-
mental model. The total process diagramed in Figure 27 is
completely automated and allows the user to plot and do
analysis of segmental network without the need for any
manual operation.

The fifth task which is performed by the refined seg-
mental model is the operation of generating a network with
multi-centered study areas. Preliminary segmental model also
had the capability of accomplishing this but was limited to
only two levels of detail. Figure 29 is a diagram of the
multi-centered study area concept. This could allow the user
to study urban centers in detail while maintaining a coarser
level of detail in the rural areas.

The "refined segmental model" has been defined in a
manner such that networks generated as a result of segmental
model may also be plotted using a Cal-comp plotter. A
sub-routine within the program generates a list of new
coordinates for the sequentially renumbered nodes. The
ability to plot segmental networks allows the user to present
traffic analysis data almost instantly. It also is beneficial
when editing a network. As a final note the refined seg-
mental model program has been modified so the user instructions
are similar to Michigan's transportation planning computer
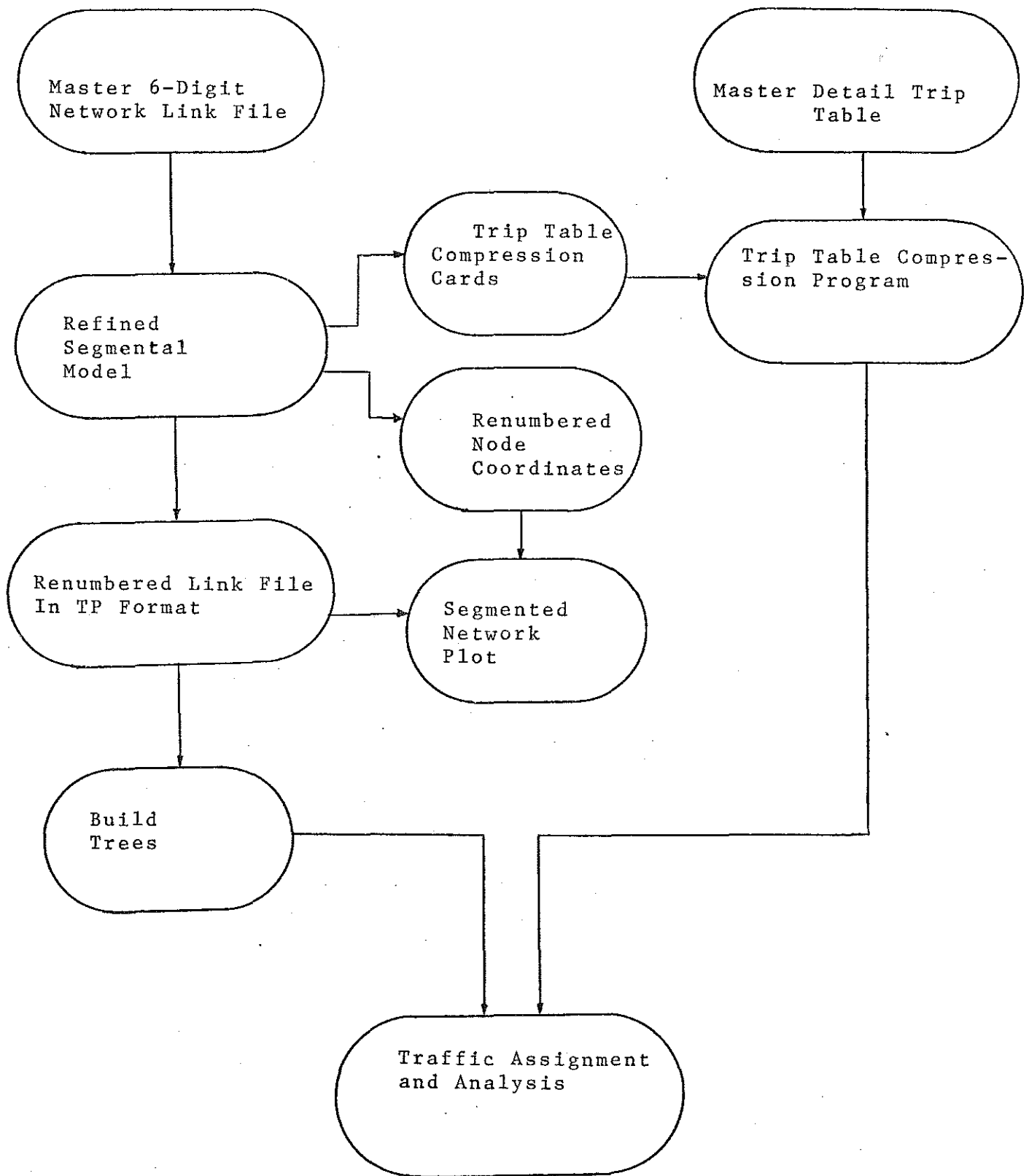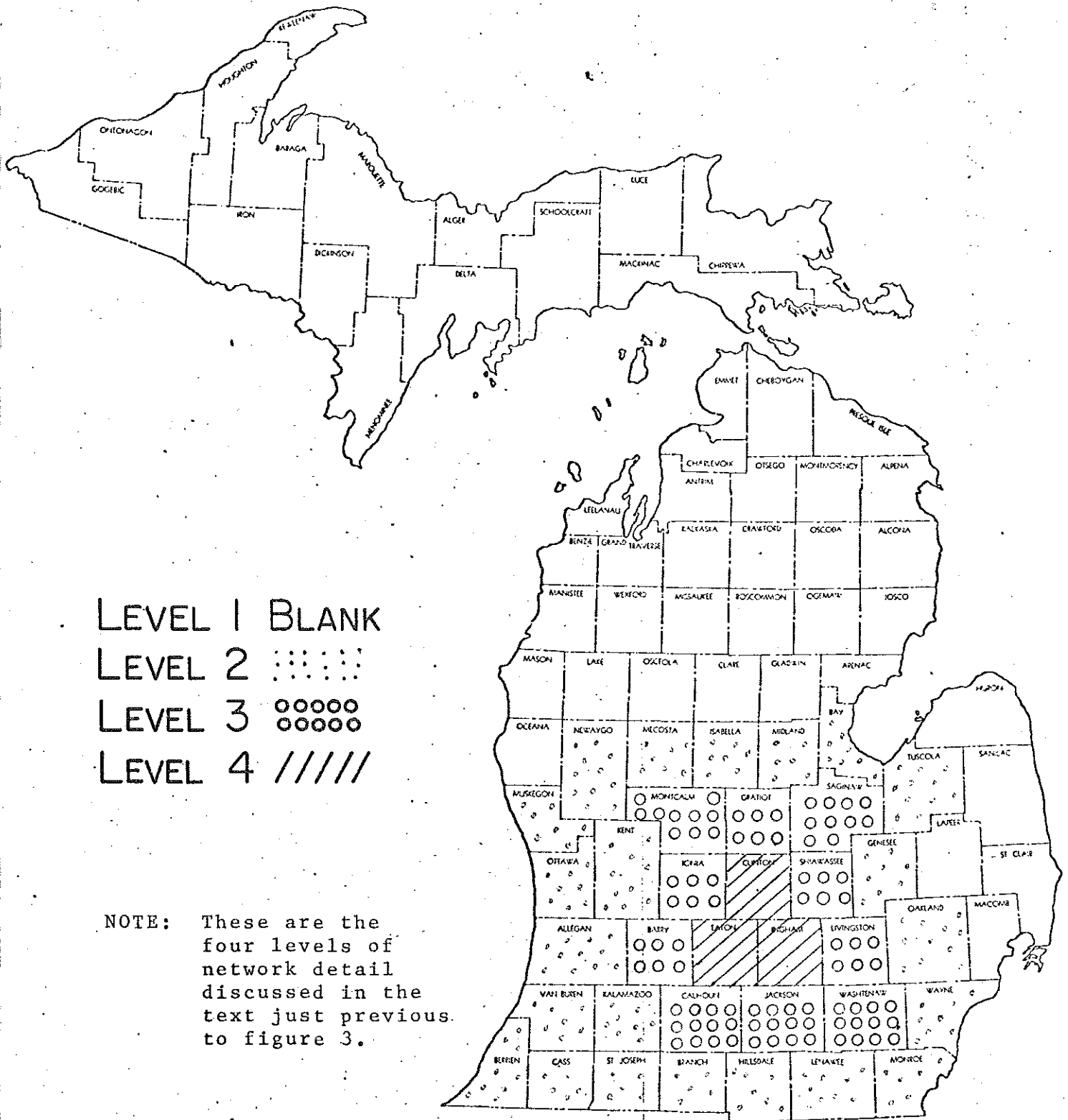package. The transportation planning package uses a para-

```
┌─────────────────┐                              ┌─────────────────┐
│ Master 6-Digit  │                              │Master Detail Trip│
│ Network Link File│                             │     Table       │
└─────────────────┘                              └─────────────────┘
         │                                                 │
         ▼                                                 │
┌─────────────────┐        ┌──────────────┐               ▼
│   Refined       │───────▶│ Trip Table   │      ┌──────────────────┐
│   Segmental     │        │ Compression  │─────▶│ Trip Table Compres-│
│   Model         │        │ Cards        │      │ sion Program     │
└─────────────────┘        └──────────────┘      └──────────────────┘
         │         │                                       │
         │         │        ┌──────────────┐               │
         │         └───────▶│ Renumbered   │               │
         │                  │ Node         │               │
         │                  │ Coordinates  │               │
         ▼                  └──────────────┘               │
┌─────────────────┐                │                       │
│Renumbered Link File│             ▼                       │
│ In TP Format    │──────▶┌──────────────┐                 │
└─────────────────┘       │ Segmented    │                 │
         │                │ Network      │                 │
         │                │ Plot         │                 │
         ▼                └──────────────┘                 │
┌─────────────────┐                                        │
│   Build         │──────────────┐          ┌──────────────┘
│   Trees         │              │          │
└─────────────────┘              ▼          ▼
                       ┌──────────────────────┐
                       │ Traffic Assignment   │
                       │ and Analysis         │
                       └──────────────────────┘
```

FIGURE 27

102

LEVEL 1 BLANK
LEVEL 2 :::::::
LEVEL 3 ooooo
       ooooo
LEVEL 4 //////

NOTE: These are the
four levels of
network detail
discussed in the
text just previous
to figure 3.

FIGURE 28

LEVEL 1 BLANK
LEVEL 2 :::::
LEVEL 3 ooooo
         ooooo
LEVEL 4 /////

NOTE: These are the
four levels of
network detail
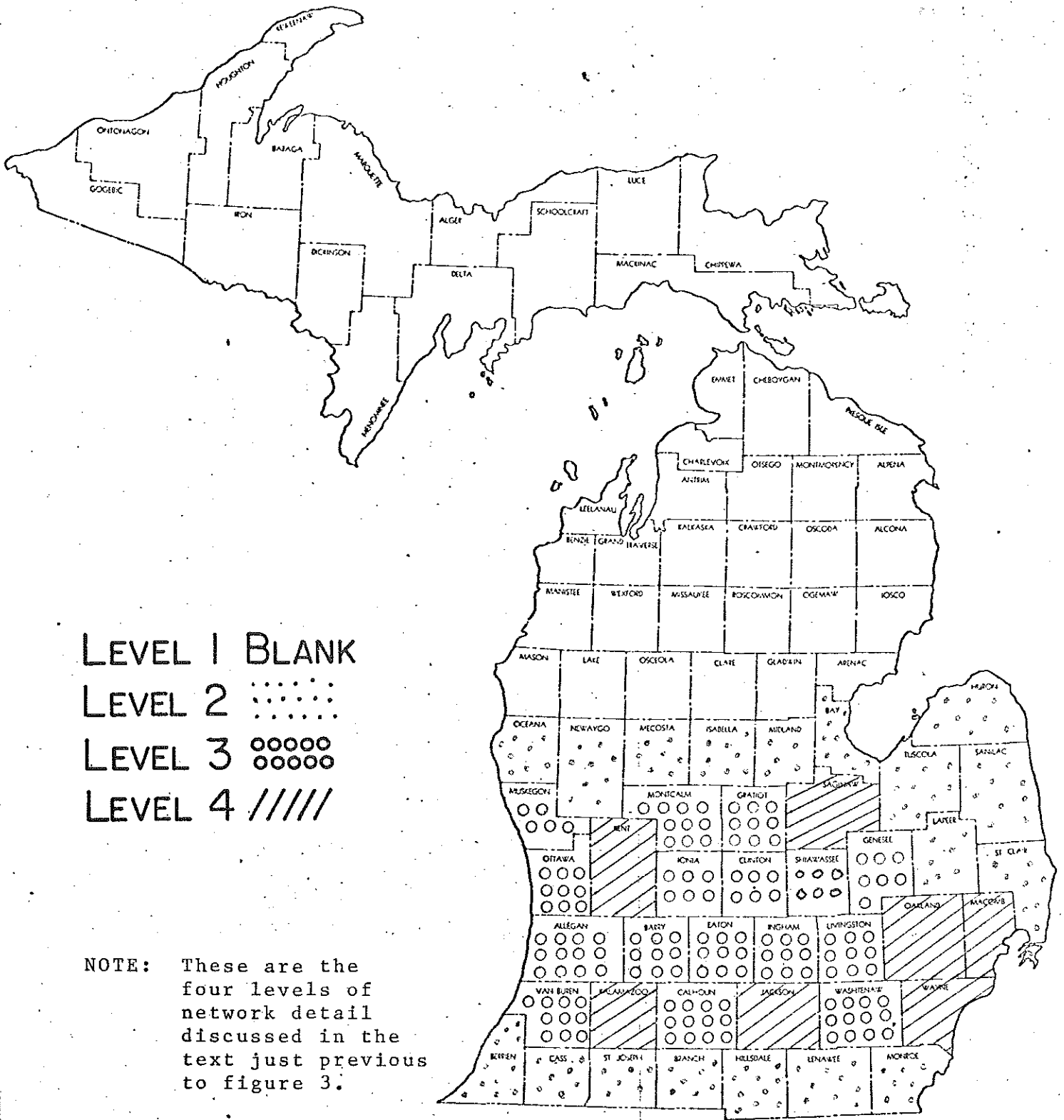discussed in the
text just previous
to figure 3.

FIGURE 29

meter-options format which is tied in with a key word table. A sample of the keyword table for "refined segmental model" appears below.

KEYWORD	TYPE	DEFAULT	MAX	VALUE OR PURPOSE
NZON	I	2300	2500	Number of Zones
NCNTY	I	99	99	Highest County Number
NAREAS	I	4	4	No. of Different Areas of Detail
NVOLSQ	I	4	25	Vol. Word of Sequence No.
NVOLCS	I	3	25	Vol. Word of Control Section
NVOLCT	I	2	25	Vol. Word of Count
NVOLCP	I	1	25	Vol. Word of Capacity
CJS(I,J)	I	99	99	List of Jurisdiction Codes (J Long, J Not to exceed 16) To be Included in Area I for Centroid Links
CLT(I,J)	I	99	99	List of Link Types (As Above for CJS(I,J)

Special Code -- To Indicate That All Links In An Area are to be Kept Code: CLT(I,1) = 16, CJS(I,1) = 16

HLT,(I,J)	I	99	99	As Above for CLT and CJS
HJS(I,J)	I	99	99	Except these will be for Highway Links
HCON(I)	I	0	1	Jursidiction and Linktype Connector for Highway Links 0 = AND (Both LT AND JS NEEDED) 1 = OR (Either LT OR JS NEEDED) in area I.
CCON(I)	I	0	1	Same as above but for Centroids
CENTLT(I)	I	99	99	Used for Nonsequential Zones List of Link Types for all Centroids
*CMPRES	L	T		T If Segmental Model to be Run

```
*NETAPE          L          T               T If Network Tape is Input

*TPSQEZ          L          T               T If TPSQEZ Setup Cards are to
                                            Be Assembled and Written to Tape
```

The keyword table supplies the user with a standard list of
parameter and option abbreviations as indicated by this table
under the heading keyword. The user must specify values for
the parameters or they will default to the value specified
in the default column. The last three entrees in this chart
are the program options. The user should note that the para-
meter-option type of computer program operation allows the
user to efficiently adapt to many varying situations easily.
A typical program run set up for the "refined segmental
model" appears below.

<u>INPUT</u>

1. Title Cards
2. Params
3. Options
4. Labels for Label Equating
5. CNTY--Area Equivalence Cards in TPSQEZ Zone-Dist.
    Card Format
6. TPSQEZ Deck Setup Cards
7. TPNET Deck Setup Cards

No full scale tests have been completed with the "refined
segmental model." A preliminary test has been completed but
this program is not fully operational on a B-5500. A potential
user interested in a specific application is encouraged to
contact the Michigan Department of State Highways.