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Statewide Transportation Analysis & Research

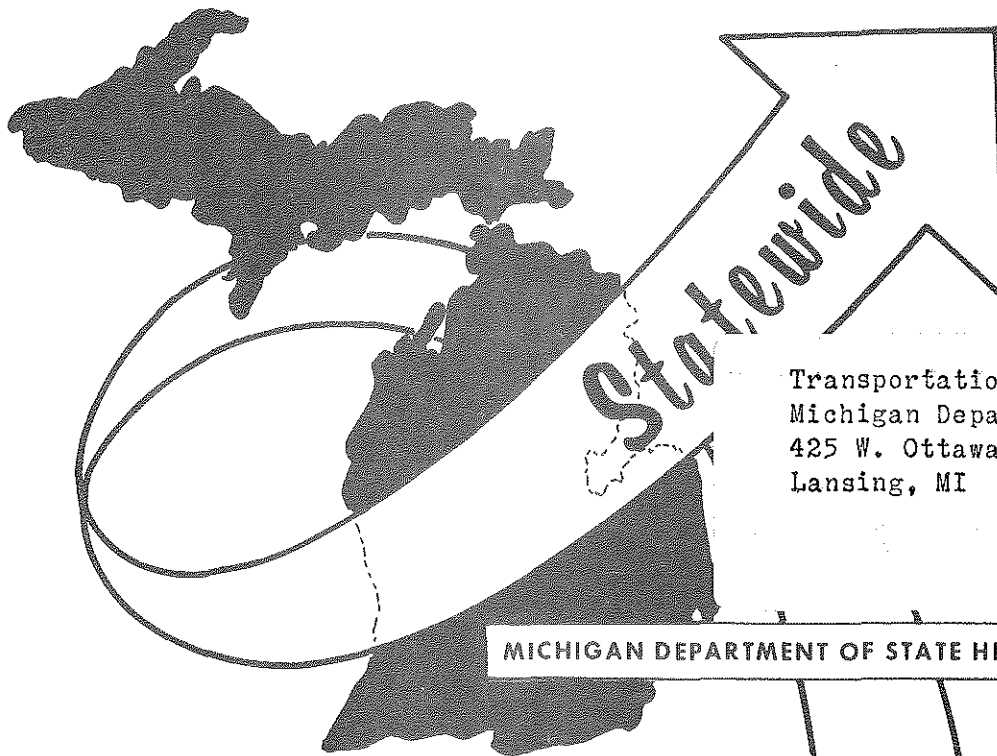
MICHIGAN'S STATEWIDE
TRANSPORTATION MODELING SYSTEM

VOLUME III-B

**AUTOMATIC NETWORK GENERATOR
USING INTERACTIVE GRAPHICS**

STATEWIDE TRANSPORTATION
PLANNING PROCEDURES

AUGUST, 1977



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MICHIGAN DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

**MICHIGAN DEPARTMENT OF STATE
HIGHWAYS AND TRANSPORTATION**

BUREAU OF TRANSPORTATION PLANNING

**MICHIGAN'S STATEWIDE
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JOHN P. WOODFORD, DIRECTOR

August 15, 1977

Mr. Sam F. Cryderman, Deputy Director
Michigan Department of State
Highways and Transportation
Bureau of Transportation Planning
P.O. Box 30050
Lansing, Michigan 48909

Dear Mr. Cryderman:

The Bureau of Transportation Planning has frequently been requested to address socio-economic issues at the local level. Growing public involvement has brought these local issues vividly to the foreground necessitating new analysis techniques which will enable the transportation planner to resolve such issues quickly, efficiently, and economically. This report, Volume III-B in the Statewide Transportation Modeling System Series, documents a newly developed process which has been designed to aid the transportation planner in this vital area.

Until recently, very few analysis tools were available to address local issues. The standard statewide analysis, although readily available, provided data which was much too coarse for use at a local level. Local problems can be solved only by concentrating upon the local socio-economic characteristics and the available local transportation facilities. This requires an ability to quickly create a detailed, local highway network. This report documents a method by which such networks may be created faster and more economically and accurately than in the past when the creation of such networks required much detailed manual coding. Since the process is fully compatible with the existing statewide analysis battery. Existing tools once used mainly for regional and statewide analysis may now be used at the local level as well.

This report was written by Joyce Newell who developed the process described therein. She is a member of the Statewide Procedures Section, under the supervision of Mr. Richard E. Esch.

Sincerely,

William M. Lepczyk, Acting Administrator
Highway Planning Division



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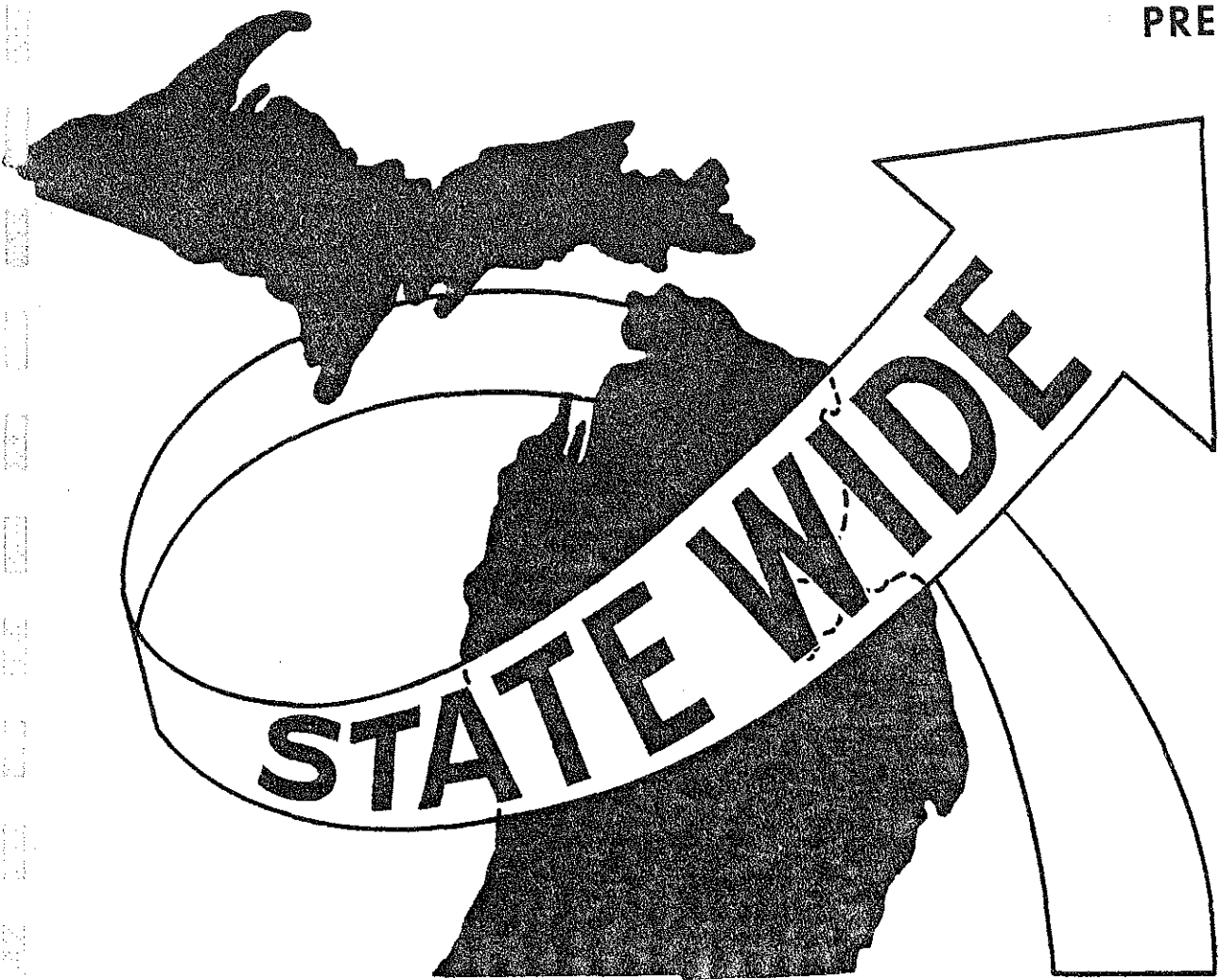
AUTOMATED NETWORK GENERATOR USING INTERACTIVE GRAPHICS

BY

JOYCE A. NEWELL

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PREFACE



PREFACE

Growing public and federal involvement in state transportation planning is rapidly generating new and complex demands to be met by state transportation departments.

Any major transportation project is likely to be seriously and perceptively challenged and transportation planners must be prepared to produce responsible, prompt answers. It has become imperative that each project be studied carefully and that all viable options be considered and compared. It must be shown that a thorough analysis of the "do nothing" alternative has been evaluated. Other modes and other alternatives must be examined. All travel, social, economic, and environmental impacts, both beneficial and adverse, must be carefully evaluated. These growing demands would be impossible to satisfy if new and more efficient transportation planning tools were not rapidly being developed.

In the past few years, when faced with a problem posed by an interested citizen, the transportation planner has been frequently forced to say, "We really cannot answer that question," or "we will try to address that problem after we have had a few weeks to determine the most reasonable solution." Such delay has often irritated and frustrated the concerned citizen, and he has begun to feel that his interests are of little or no consequence in the planning process. This report describes another tool which is now available to help obtain rapid, accurate solutions with a minimal amount of time and manpower when project level analysis is desired for small, local areas.

This is Volume III-B in the Statewide Series of reports. Previous reports in the series are listed on the following page.

SYSTEM DEVELOPMENT REPORTS

- Volume I - Objectives and Work Program
- Volume I-A - Region 4 Workshop Topic Summaries
- Volume I-B - Single and Multiple Corridor Analysis
- Volume I-C - Turnbacks
- Volume I-D - Proximity Analysis
- Volume I-E - Model Applications: Cost-Benefit Analysis
- Volume I-F - Air and Noise Pollution
- Volume I-G - Psychological Impact Model
- Volume I-H - Level of Service Model
- Volume I-I - Statewide Socio-Economic and Transportation Resources and Their Role in Intercity Transportation Decisions

- Volume I-J - Service Area Model
- Volume I-K - Effective Speed Model
- Volume I-L - System Impact Analysis Graphic Display
- Volume I-M - Modeling Gasoline Consumption
- Volume I-O - Accident Rates 547 Zone System
- Volume I-P - Population Projections 547 Zone System
- Volume II - Development of Network Models
- Volume II-A - Efficient Network Updating with Interactive Graphics
- Volume II-B - Tree Plotting with Interactive Graphics
- Volume III - Segmental Model
- Volume III-A - Semi-Automatic Network Generator Using a "Digitizer"
- Volume III-B - Automatic Network Generator Using Interactive Graphics
- Volume IV - AASHTO Report
- Volume IV-A - Michigan Statewide Modeling System - Synopsis
- Volume V - Part A - Reformation - Trip Data Bank Preparation
- Volume V - Part B - Development of Socio-Economic Data Bank for Trip Generation - Distribution

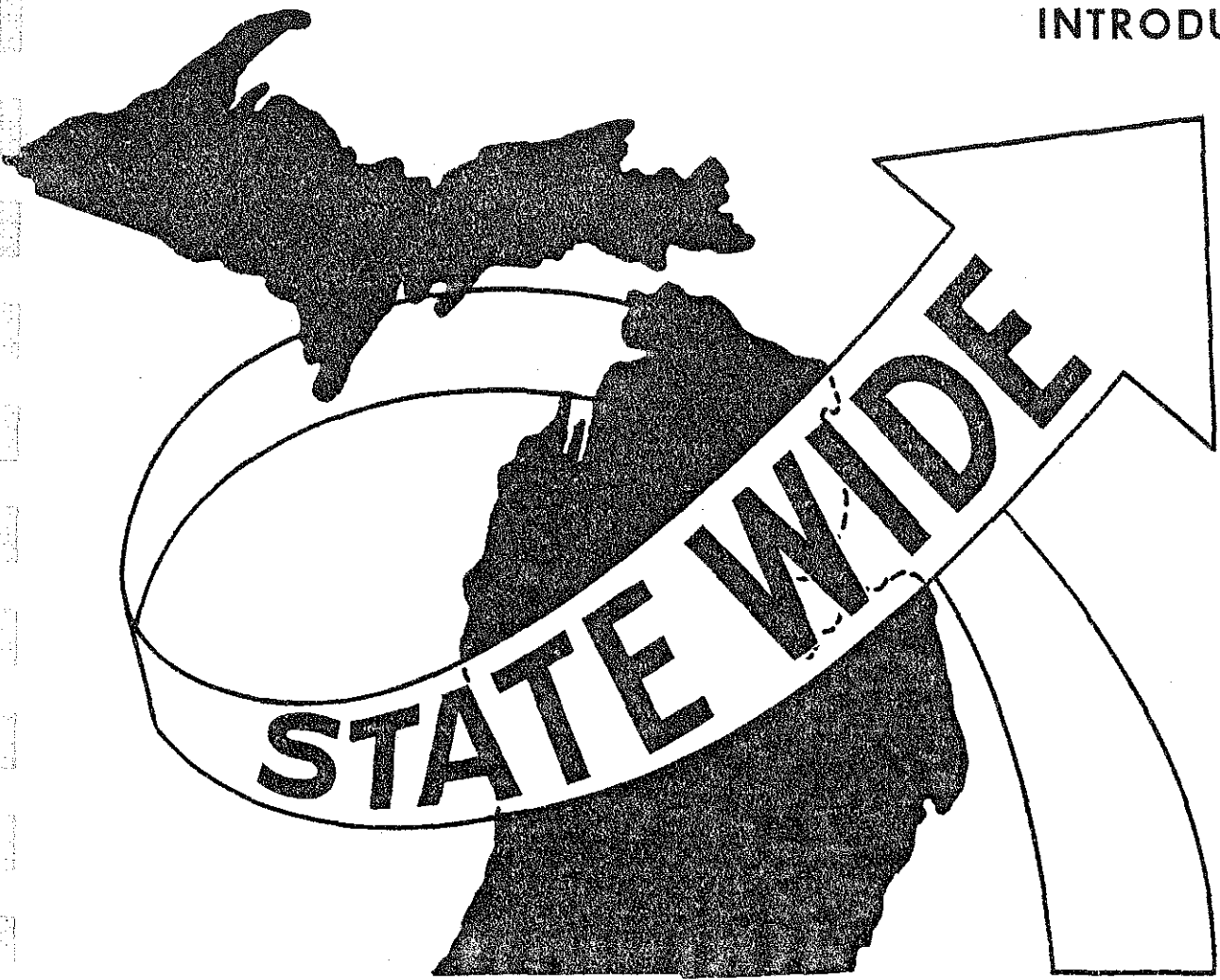
- Volume V-A - Single Station O & D Procedures Manual
- Volume V-B - External O & D Procedures Manual
- Volume VI - Corridor Location Dynamics
- Volume VI-A - Environmental Sensitivity Computer Mapping
- Volume VII - Design Hour Volume Model
- Volume VII-A - Capacity Adequacy Forecasting Model
- Volume VII-B - Modeling Major Facility Opening Impact on DHV
- Volume VIII - Public and Private Facility File
- Volume VIII-A - Conversion of Industrial Expansion File
- Volume IX - Socio-Economic Data File
- Volume IX-A - Mapping Socio-Economic Data with SYMAP
- Volume IX-B - Conversion of the Agricultural Census File
- Volume IX-C - Tax Rate and Assessed Valuation Information
- Volume IX-D - School District Data File
- Volume X-A - Travel Impact Analysis Procedures
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- Volume X-B - Social Impact Analysis Procedures
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- Volume XI - Computer Run Times
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- Volume XIII-B - 1972 Statewide Rail Network - Summary Tabulations
- Volume XIV-A - Commodity Flow Matrix - Ann Arbor Railroad
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- Volume XIV-C - Commodity Flow Matrix - Michigan Railroads 1% Sample
- Volume XV-A - Railroad Financial Impact Analysis
- Volume XV-B - Railroad Community Impact Analysis
- Volume XVI - Dial-A-Ride
- Volume XVII - Intermodal Impact Analysis - Truck and Railroad
- Volume XVIII - Outline Analysis Program

STATEWIDE SYSTEM APPLICATION REPORTS

- Report #1 - Community College Service - Area Analysis
- Report #2 - Proximity of People to General Purpose Hospitals
- Report #3 - Industrial Park Proximity Analysis
- Report #4 - Proximity of Automobile Injury Accidents to Hospitals
- Report #5 - Proximity of Airports with Scheduled Service to Population
- Report #6 - Regional Park Proximity Analysis
- Report #7 - Rifle Range Proximity Analysis
- Report #8 - Ambulance Service - Area Analysis
- Report #9 - Comprehensive Statewide Planning
- Report #10 - Graphic Display of Fixed-Object Accident Data
- Report #11 - Preliminary Investigation: A Technique for the Projection of Accident Rates
- Report #12 - Impact of 50, 55, or 60 M.P.H. Statewide Speed Limit
- Report #13 - A Method for Functionally Classifying Rural Arterial Highways
- Report #14 - Economic and Travel Impacts of Speed Limit Reduction Using a Statewide Transportation Modeling System
- Report #15 - I-69 Impact on the Accessibility of Health, Fire, and Ambulance Services to Residential Areas
- Report #16 - Crisis and Opportunity: Application of an Operational Statewide Transportation Modeling System
- Report #17 - US-23 Corridor Location Study - Preliminary Travel Impact Analysis
- Report #19 - Graphic Display of Accident Data
- Report #20 - Demographic Information for the Northwest Region
- Report #21 - AMTRAK Market Area Analysis - System Application

INTRODUCTION



INTRODUCTION

Public involvement is rapidly becoming a very important element in transportation planning. Federal legislation states that private citizens must be allowed to voice their opinions and concerns and that transportation planners must make every possible attempt to furnish any requested information.

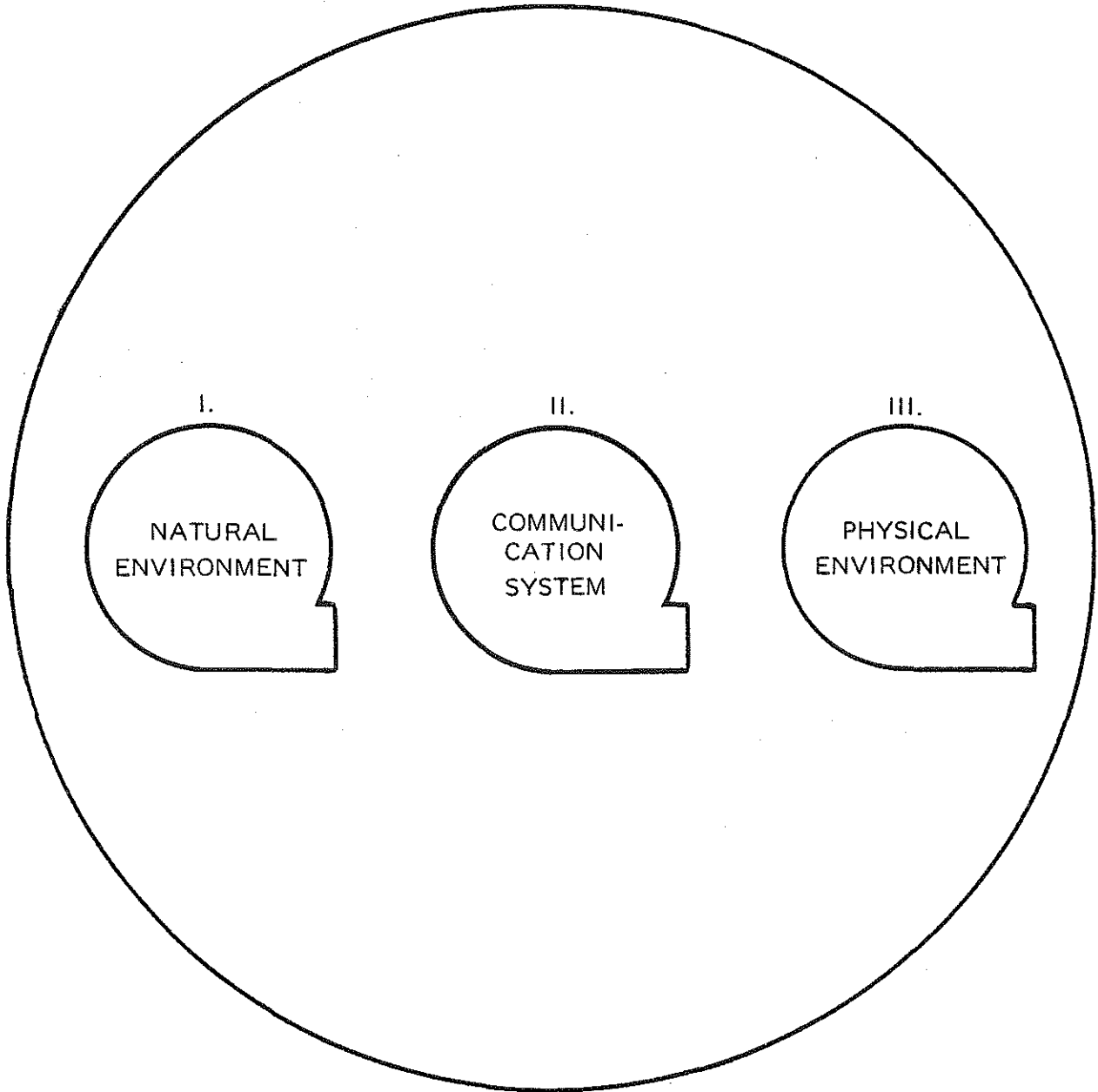
Environmental problems have generated much public concern. Social and economic disruptions, once insignificant, are now subjects of grave importance to every citizen. Finally, public involvement has been enhanced by the growing attentiveness of transportation planners to the needs and wishes expressed. However, any interested citizen who cannot obtain prompt, satisfactory answers to questions and problems which trouble him will likely become impatient and discouraged and thus abandon his attempts. Although this could temporarily eliminate many problems for the transportation planner, it is highly undesirable for it would also remove many necessary restraints and generate a great feeling of discontent which could erupt into bitter opposition to even the most reasonable projects. For these reasons, it is imperative that any transportation agency anticipate the sensitive issues and prepare methods of obtaining reliable answers in a short period of time.

The average citizen is generally most concerned about how a given transportation project will affect his daily life. Will he be more or less accessible to the places he works, shops, or visits? Will his community be seriously disrupted? Will traffic congestion become a major problem? Will new, major trunklines bring masses of unwanted traffic, noise, and pollution to his immediate neighborhood? Will his favorite scenic and recreational spots be destroyed? He generally is little impressed when told that the overall,

across the state benefits will greatly outnumber the problems. Knowing that people traveling through his community can reach their destination more quickly does not excite him much if they do so by traveling through his backyard. In most instances, the public citizen prefers to enhance his traveling capabilities within his community without encouraging massive through traffic. He objects strongly to projects which could cause him to become more isolated from services he considers vital. Only when he can be convinced that a transportation project will not seriously endanger his own lifestyle is he willing to begin considering the total, statewide impact of the project. Unfortunately, many transportation analysis techniques have been used only to estimate statewide and regional impacts while only a few successful analysis tools are focused upon evaluating the primary impacts on the local citizens. Recently, the Statewide Research and Development Section, of the Michigan Department of State Highways and Transportation, decided to modify some of the modeling concepts used to analyze statewide impacts so that they could also be used at the project level. An example of this concept is described in application Report #15 entitled, I-69 Impact on the Accessibility of Health, Fire, and Ambulance Services to Residential Areas. The major problem with the approach described in that report was the time and difficulty of preparing the necessary highway network data. This report describes a method of quickly generating the network data in a usable form with minimal error.

The Statewide Transportation Modeling System is dependent upon three major information files which represent society as defined in Figure 1. The first of these files contains data about the residents and properties within the state. A sample of this socio-economic data is shown in Figure 2. A complete

SOCIETY



I. STATEWIDE
SOCIO-ECONOMIC
DATA FILE

II. STATEWIDE
TRANSPORTATION
NETWORK

III. STATEWIDE
PUBLIC & PRIVATE
FACILITY FILE

STATEWIDE SOCIO-ECONOMIC DATA FILE

GENERAL CHARACTERISTICS OF POPULATION

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

INCOME CHARACTERISTICS OF POPULATION

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

LABOR FORCE CHARACTERISTICS OF POPULATION

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

SOCIAL CHARACTERISTICS OF POPULATION

AGE BY SEX
TYPE OF FAMILY
MARITAL STATUS

STRUCTURAL CHARACTERISTICS OF HOUSING

YEAR STRUCTURE BUILT
UNITS IN STRUCTURE
STORIES IN STRUCTURE

EQUIPMENT CHARACTERISTICS OF HOUSING

AIR CONDITIONING
TYPE OF HEATING FUEL
SOURCE OF WATER

OCCUPANCY CHARACTERISTICS OF HOUSING

OCCUPANCY / VACANCY STATUS
NUMBER OF PERSONS IN UNIT
NUMBER OF PERSONS PER ROOM

AREA CHARACTERISTICS

LAKE FRONTAGE
ASSESSED VALUATION
WATER AREA

*THOSE ITEMS LISTED HERE ARE SAMPLES TAKEN FROM THE COMPLETE
FILE WHICH CONTAINS 76 CATEGORIES WITH OVER 800 ITEMS

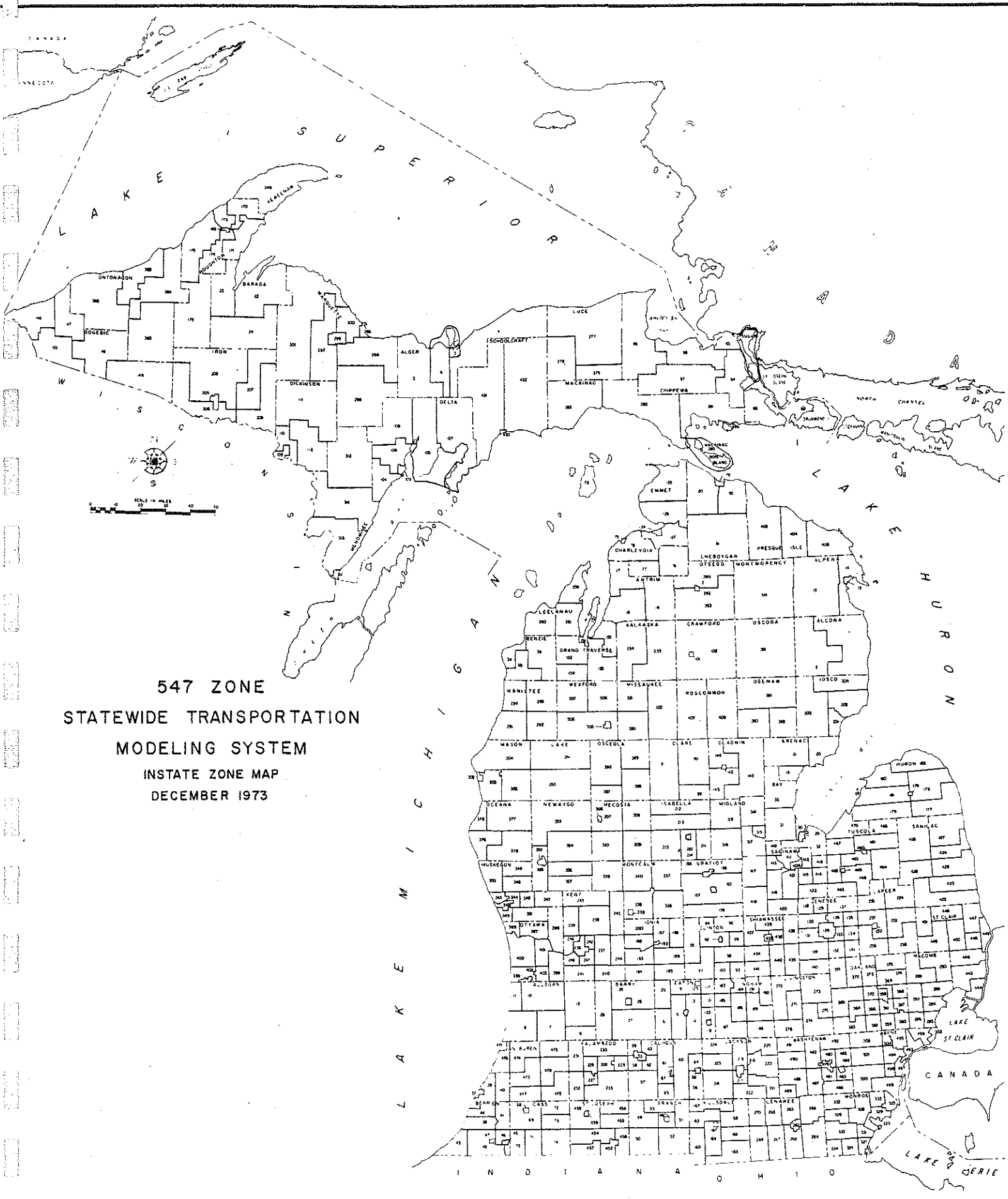
listing of the available data can be found in Statewide Volume IX entitled, Statewide Socio-Economic Data File. Information found on the Public and Private Facility File is listed in Figure 3. A more detailed description of this data is given in Statewide Volume VII: Statewide Public and Private Facility File. The second informational file known as the network file is especially vital in transportation planning since it describes the transportation facilities and "routes" which are available.

All information in each of these three files is related to geographical areas called zones. The State of Michigan and surrounding areas have been divided into 547 zones of which 508 are in Michigan. These zones are shown in Figures 4 and 5. Zone boundaries have been determined on the basis of population, land area, political boundaries, and other relevant factors. A "centroid", or center of population, has been chosen for each zone. This is a given point within the zone at which all travel is assumed to originate or terminate and at which all zone facilities and population are assumed to exist.

The network file consists of a set of links and nodes as shown in Figure 6. The basic element of the highway network file is a "link", a small segment of highway. Each link is uniquely identified by a pair of numbers called nodes designating its end points. This is referred to as an "A-node, B-node" format. A node is found at each intersection. Thus, a link is generally a segment of highway between two consecutive intersections. To complete the highway link file, other links, called "access" or "centroid" links, are included which are used to connect centroids or zones to the highway system. Distances and speeds, among other data (see Figure 7), may be assigned to each link and each node may be assigned X and Y coordinates. These coordinates are used to produce pictorial descriptions of the

STATEWIDE FACILITY FILE

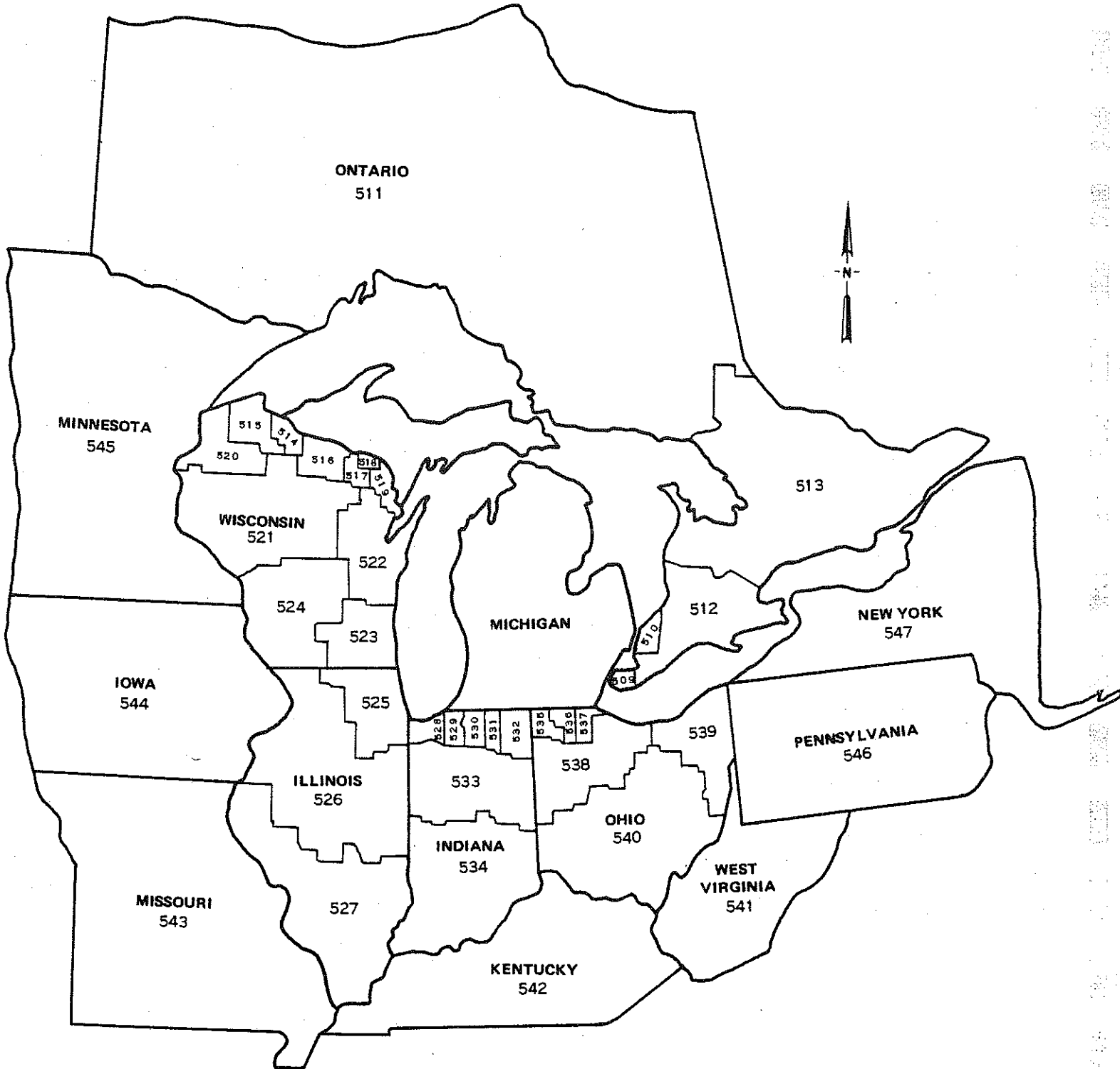
AIRPORTS - 110
AMBULANCE SERVICE - 120
BUS TERMINALS - 130
CAMPGROUNDS, PUBLIC - 140
CAMPGROUNDS, PRIVATE - 142
CERTIFIED INDUSTRIAL PARKS - 150
CITIES OVER 30,000 POPULATION - 160
CITIES OVER 5,000 POPULATION - 170
CIVIL DEFENSE TERMINALS - 180
COLLEGES, NONPUBLIC - 190
COLLEGES, PUBLIC COMMUNITY - 200
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POLICE DEPT'S, COUNTY - 347
POLICE DEPT'S, STATE - 348
POLICE DEPT'S, TOWNSHIP - 349
PORTS - 350
RAIL TERMINALS - 360
SECRETARY OF THE STATE OFFICES - 370
SEWAGE TREATMENT FACILITIES - 380
SKI RESORTS - 390
SNOWMOBILE TRAILS - 400
STATE PARKS - 410
TOURIST ATTRACTIONS - 430
TRAILER ON FLAT CAR TERMINALS - 433
TRANSIT SYSTEMS, BUS - 435
TREASURY OFFICES - 440
TRUCK TERMINALS - 450
UNEMPLOYMENT OFFICES - 460
VOCATIONAL REHABILITATION CENTERS - 465
WEATHER SERVICE STATIONS, NATIONAL - 470
WHOLESALE TRADE CENTERS - 480



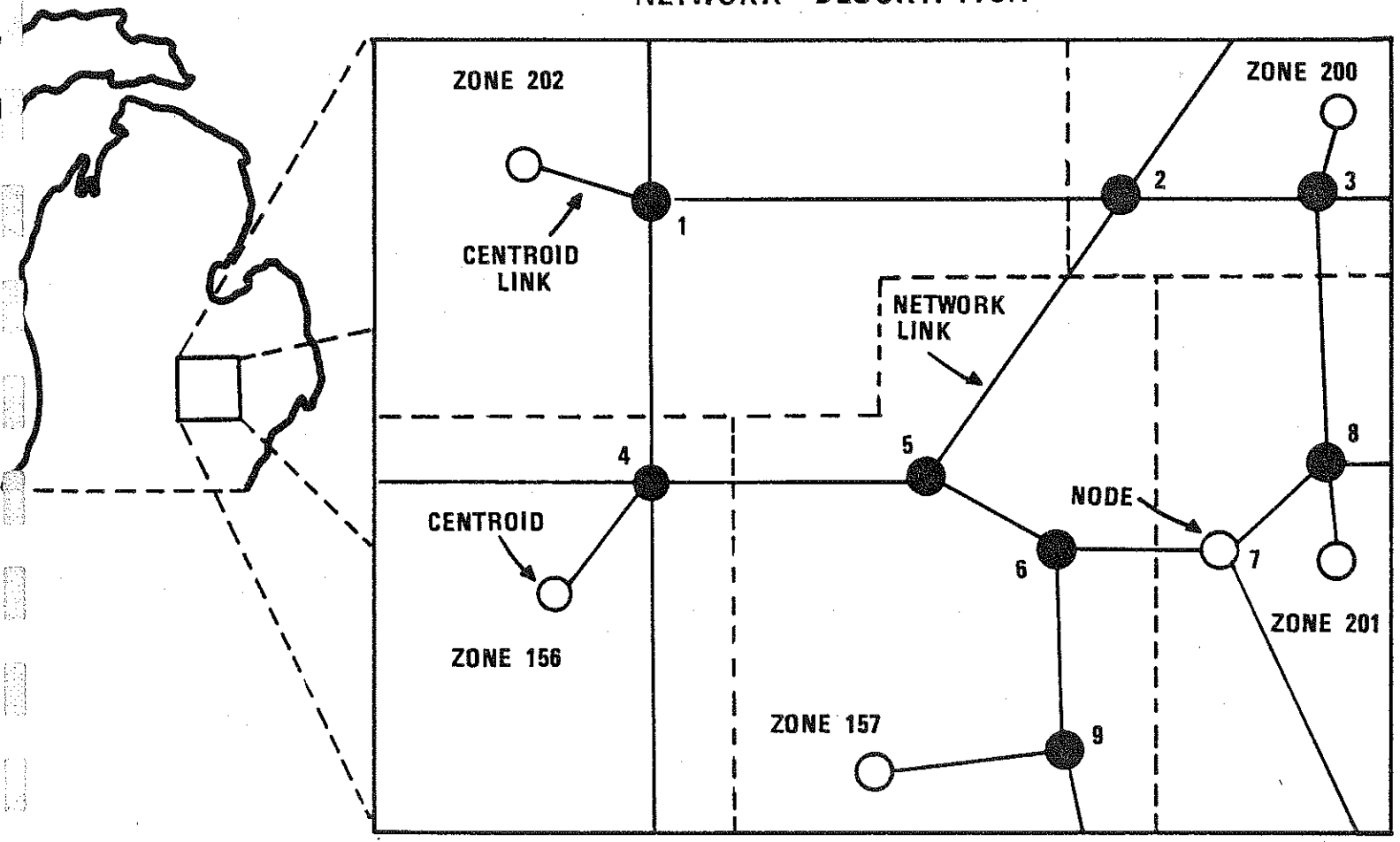
547 ZONE
 STATEWIDE TRANSPORTATION
 MODELING SYSTEM
 INSTATE ZONE MAP
 DECEMBER 1973

MICHIGAN'S TRANSPORTATION MODELING SYSTEM

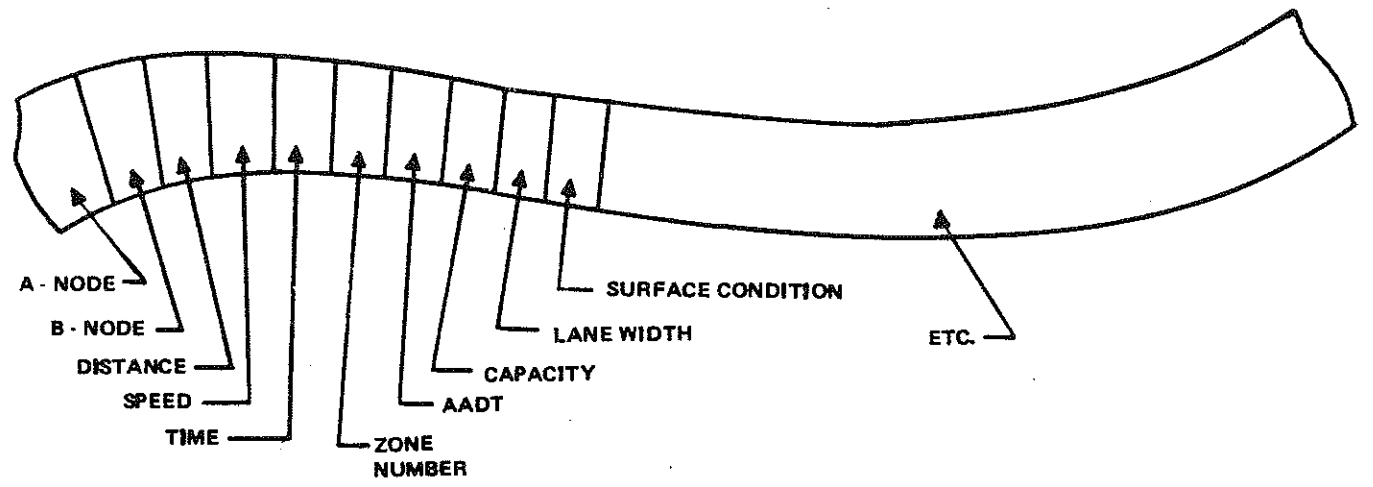
547 ZONE OUTSTATE ANALYSIS ZONES



NETWORK DESCRIPTION



LINK DESCRIPTION



STATEWIDE HIGHWAY NETWORK

LINK FILE

CONTENTS OF EACH HIGHWAY SEGMENT OR LINK

AVERAGE SPEED

DISTANCE

URBAN-RURAL DESIGNATION

TYPE OF ROUTE

TRAFFIC VOLUME CAPACITY

AVERAGE ANNUAL DAILY TRAFFIC VOLUME

COMMERCIAL TRAFFIC VOLUME

DESIGN HOUR VOLUME

ACCIDENT FATAL RATE

ACCIDENT INJURY RATE

ACCIDENT RATE

NUMBER OF LANES

LANE WIDTH

SURFACE CONDITION

RIGHT OF WAY

SIGHT RESTRICTION

highway network and display changes which may occur in travel times and patterns if proposed highway projects are completed.

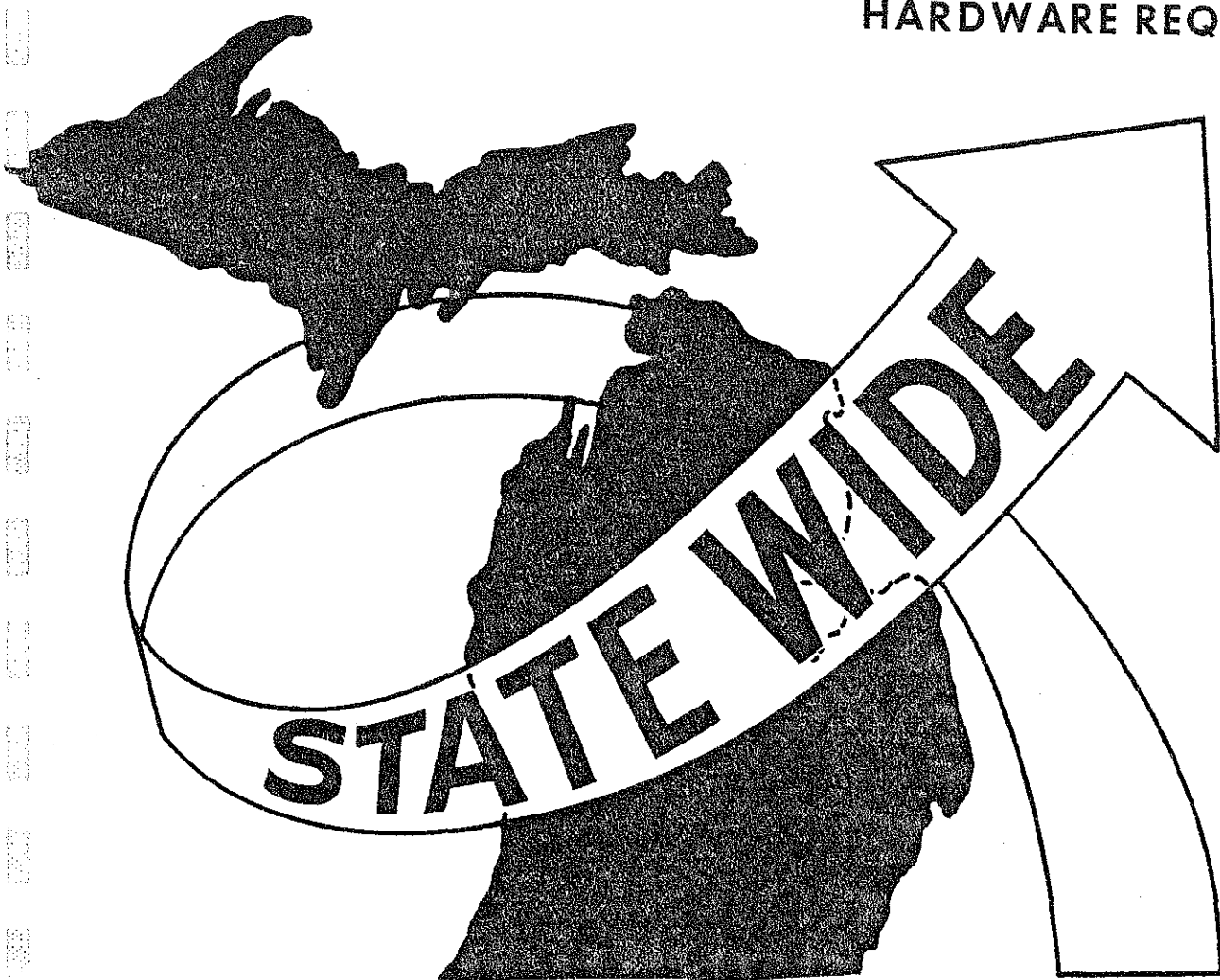
The above files and connected analysis system have been used extensively to analyze the impact of a given project on a statewide or regional basis. A program called TP TREE is used to determine "the path of least resistance" from each zone to every other zone. The TP SKIM program can then calculate the required travel times between any two zones by summarizing the driving times on all links along the minimum path. Then, using the socio-economic and facility data files, it is possible to determine the accessibility of any segment of population to the nearest "facility zone". For example, it is possible to find the average time it would take to reach the nearest zone containing a hospital. The analyst may then "build" the proposed new road into the network system and determine if the access time has increased or decreased.

Obviously, the above data system and statewide zone definitions are much too coarse to be used for any project level analysis which concentrates on local impacts. Therefore, the zone system should be redefined to include only the desired area with much smaller zones such as groups of homes or individual houses. For the I-69 impact report mentioned earlier, a new highway network file was prepared which included all local roads and which could, therefore, show more minute changes in travel times at the project level. County roads were actually closed by proposed highways and new travel paths and travel times found. This made it possible to then evaluate some of the local impacts of the project. At the time of that report, however, it was necessary to manually code all of the new highway system assigning nodes and links, measuring distances, and finding coordinates. Coordinates were assigned by using grid overlays. These overlays were not always easy to read and sometimes shifted on the map causing errors. Human

errors were also possible: errors such as transposing numbers or mistyping the coded data. Links were sometimes inadvertently left out. These errors were all difficult to detect until the network was built, a computer plot obtained, and the plot examined very carefully. Any mistake had to then be recoded, the network changed, replotted, and rechecked. When all errors had been corrected, one could finally run TP TREE and TP SKIM to evaluate the driving times. Often, these programs would make other errors apparent and more corrections became necessary. Meanwhile, of course, much valuable time was lost and the final results were frequently prepared long after the initial interest had begun to wane.

Many of the problems discussed above have now been solved by developing a method for updating network files using interactive graphics. This procedure is described in statewide studies report Volume II-A, Efficient Network Updating with Interactive Graphics. If a network file already exists which contains most of the highway network of interest, it can be quite effectively updated and added to using the procedure described in Volume II-A. If, however, one finds it necessary to build a new network almost entirely from "scratch", it is very helpful to be able to enter data with the direct help of a map. This is now possible with the use of a graphics tablet, a graphics computer terminal, and a process developed by the Statewide Research and Development Section. The remainder of this report will describe the hardware requirements of the process, explain what the software can accomplish, and give technical details for using the process. The report then concludes with a demonstrative application.

HARDWARE REQUIREMENTS



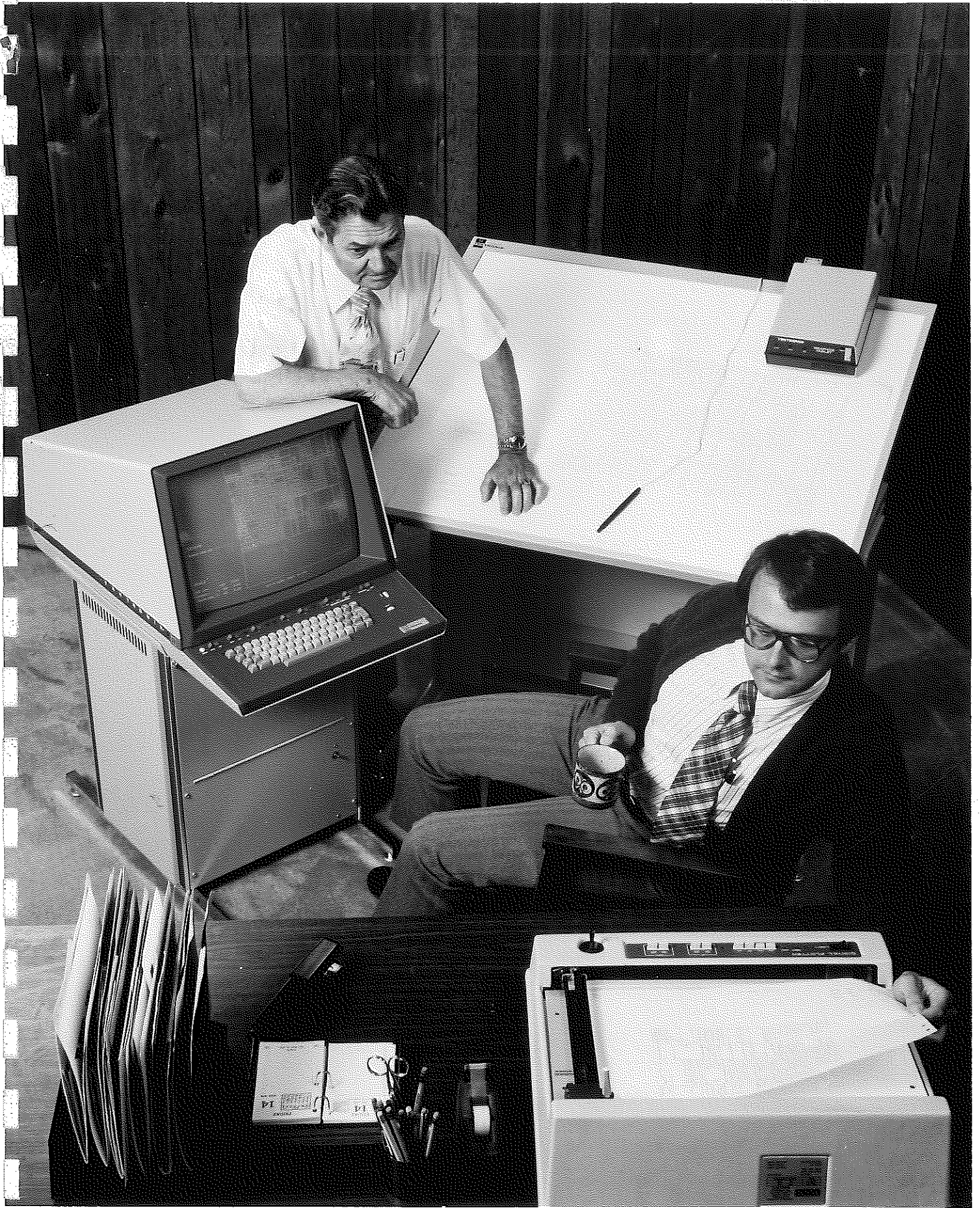
HARDWARE REQUIREMENTS

There are three basic "hardware" requirements for implementing a computerized system of network building. First, the user needs a cathode-ray-tube ("CRT") computer terminal - like the one in Figure 8, similar in appearance to a television screen - which is capable of drawing pictures as well as printing alpha-numeric characters. This type of terminal is sometimes referred to as a "full-graphics CRT". Second, there must be access to a computer which both supports a high-level FORTRAN (programming language) compiler and allows a computer program to be linked with routines which actually do the drawing on the screen. These routines are usually purchased from the manufacturer of the CRT at nominal cost. Finally, one needs a graphics tablet such as the one on which the map lies in Figure 8.

It is important that the screen of the CRT be large enough to display a natural unit of data - say, a county - without appearing overly cluttered. If it is difficult for the operator to figure out what he is looking at, the purposes of the interactive system - increasing efficiency and accuracy - will not be realized. Screen sizes range from about a ten-inch diagonal rectangle to about nineteen inches on the diagonal. The examples in this report were made on a Tektronix 4014-1, which has a nineteen-inch screen and carries a base price of about \$10,000 to buy or \$700 per month to lease. Smaller screens carry smaller price tags; screens larger than nineteen inches are generally too expensive to be cost-effective for the procedure described here.

Resolution is important if the program is to calculate the actual length of a link from the screen coordinates of its end points. The Tektronix 4014 series has 4096 x 4096 addressible points. By comparison, the small-screen

FIGURE 8



4010 has only 1024 x 1024, somewhat increasing the chance of approximation error. The Hughes C-9 has a screen as big as a 4014 but with the resolution of a 4010. The user should decide approximately how many square miles he wants to put on the screen, then compute possible errors for each model of CRT being considered. Pictorially, the situation looks like Figure 9.

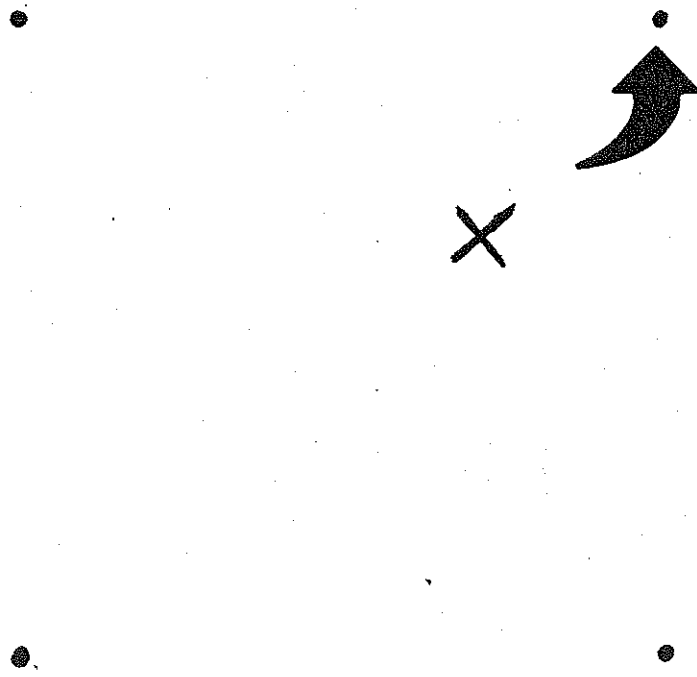
If the user wants to put a node at point "X" and "X" is not an addressible point, "X" will be assigned the coordinates of the nearest addressible point, shown by the arrow. How much resolution error is permissible can only be judged on the basis of each application. In the statewide network updating system, the coordinate approximation error for most counties can be shown to be on the order of magnitude of about ten feet.

If points are to be referred to the screen by other than (X,Y) coordinates or tablet entry, some method of "pointing" to a particular place on the screen is necessary. This usually takes the form of a crosshair cursor or light pen. It is simply a way of telling the machine, "Put a node right here", and having the machine be able to understand. This is called Graphic Input Mode.

Variable alphanumeric character size is a very desirable feature. It can allow one type of labeling to be distinguished from another type. More important, the smaller character sizes give the screen a less cluttered appearance, and labels are less likely to be superimposed.

The graphics tablet should be large enough to contain most of the maps one might desire to use. For the examples in this report, a Tektronix 4954 tablet was used. The 4954 tablet has a flat writing surface with approximately 40 x 30 inches of usable area. It possesses a grid of 4096 by 3120 points.

POSSIBLE RESOLUTION ERROR



- ADDRESSABLE POINTS
- X POINT ASSIGNED BY USER

This grid corresponds exactly to the viewable, addressible screen coordinates on the 4014 terminal with enhanced graphics module. The 4954 tablet is also compatible with the viewable, addressible screen coordinates on the 4010, 4012, and 4014 terminals. It has been shown that, when using a grid of one coordinate/inch, coordinates are generally accurate within .04 inches if they are entered with only a minimal degree of caution. Either a stylus or a "bull's eye cursor" may be used to enter points from the tablet. The bull's eye cursor is preferable since it allows greater accuracy. The .04 inch maximum error mentioned above, however, was obtained using the stylus and having the coordinate grid "crooked", which necessitated programmatically "straightening" the grid before assigning the coordinates for each point. Under these conditions, 14 points were entered with an average error of .0137 inches.

A hard-copy unit, such as the one shown in Figure 8, is a great asset. It allows the user to take a "photograph" of what is on the screen for future reference. The remaining figures are hard-copies made on such a unit.

Selective erase - that is, the capability of erasing a part of the screen without redrawing the whole picture - is also desirable, but it becomes less important at higher transmission speeds. For instance, a picture which takes 30 seconds to draw at 300 baud (30 characters per second) on a dial-up line should theoretically take only a second or so if the terminal is hardwired to the computer and driven at 9600 baud.

The Hughes terminals have selective erase, Tektronix does not. But at this writing, the Hughes machine erases by redrawing or reprinting in "erase mode", which means the program has to remember what it has drawn or written.

A method of overcoming this limitation is supposed to be available in a few months.

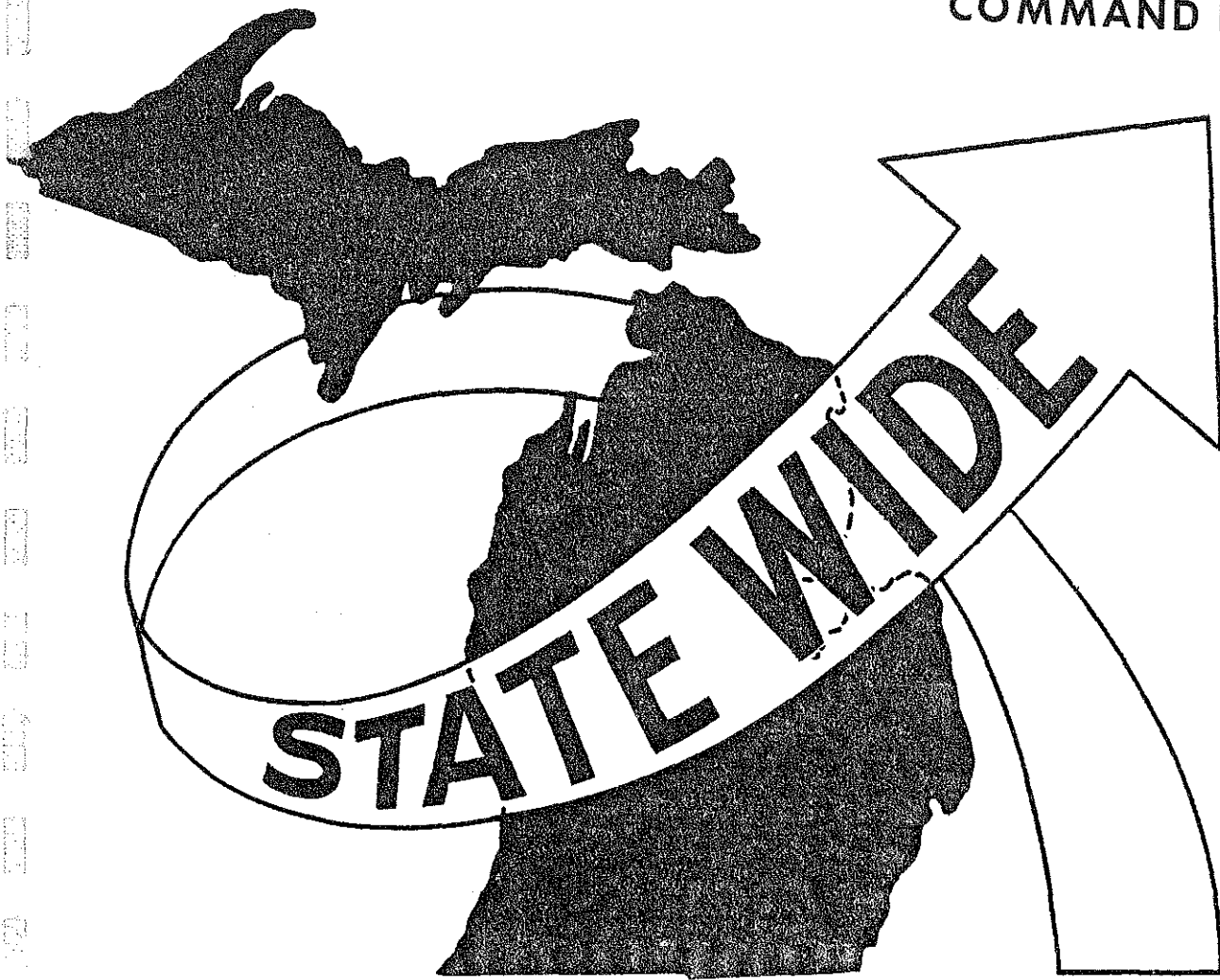
Refresh mode is a very nice, but relatively expensive feature. Basically, refresh mode works like a television screen, so that the position of each point on the screen is updated several times a second. Thus, if one wishes to move a line, only that line moves, without having to redraw the entire picture.

A few words are in order about computers. In order to allow several FORTRAN programs to make use of the same plotting software routines, the computer must be high-level enough to allow the linking of a user's compiled program with previously-compiled plot subroutines. This means that the programmer can move a screen cursor with a call to, say, subroutine MOVABS, although no subroutine of that name appears in his source code. The subroutine resides instead in the PLOT-10 subroutine package, which is "linked" or "bound" to the user's program before execution. Examples of such linking capabilities are the LINK-loader on CDC Cybernet's KRONOS time-sharing system or SYSTEM/BINDER on the Burroughs B-6700 or B-7700 systems.

A second consideration is computer speed. Most high-level machines are quite fast, but if a time-sharing system is overloaded, one should think very carefully about investing the time and money required to put up an interactive graphics system on it. Moreover, even a fast line will not help in such a situation: what good does it do to draw at 9600 baud if there is a thirty-second pause between bursts of drawing?

Finally, the reliability of the time-sharing system to be used must be looked at objectively. If the system is prone to frequent periods of down time, this will produce many false starts and restarts in a network update. In that case, it would probably be less frustrating and more productive to use manual coding techniques.

COMMAND DIRECTORY



COMMAND DIRECTORY

This section technically describes the software (i.e., a computer program) which makes network building possible using interactive graphics with a tablet. Several options are available to the user and are discussed here.

Once the highway network files have been created at the project level and saved, they may immediately become input for the standard "TP Battery" which builds networks, finds the "shortest" paths, etc. This preliminary analysis finally leads to the measurement of such social impacts as the change in accessibility of people to their basic daily requirements.

The user should be prepared to supply:

1. desired map, any size or scale;
2. coordinate scale (miles/coordinate - used only for link file); and
3. Two initial points and their X, Y coordinates - one near the bottom, the other near the top of the map.

The user may expect to produce:

1. a facility file - includes facility names and X, Y coordinates;
2. a coordinate node file - used to create highway network files such as described earlier;
3. a link file - used to create highway network files such as described earlier; and/or
4. a combined coordinate and link file - used to create highway network files such as described earlier.

Facility File - This file contains a zone number, a facility name, a node number, facility coordinates, up to three 8-digit integer data items, and the county number.

FORMAT: (I4, 4A6,A3, 2I6, I5, 3I8, I4)

Zone - I4

Facility Name - 4A6,A3

Coordinates - 2I6

Node - I5

Data - 3I8

County Number - I4

Coordinate Node File - This file contains the node number, the X, Y coordinates, up to four 8-digit integer data items, and possibly the county number. The format is compatible with the TP network update program.

FORMAT: ("1", T11,I5, T31,2I10, T72,"3", T2,I8, T16,I10,T51,2I10, T26,I4)

Node - T11,I5

Coordinates - T31,2I10

Data - T2,I8, T16,I10,T51,2I10

County Number - T26,I4

Link File - This file contains A-node, B-node, distance, speed, link type, jurisdiction, and five volume fields in the standard TP network link format.

Combined File - Combination of the coordinate and link files with the 999999 cards needed for the TP network update program.

The map should be fastened down securely. It should not be placed within two inches of any tablet edge. The program will correct for maps which are not "straight" based upon the two initial points and their coordinates. Since all subsequent data depends upon the two initial points, they should be as far apart and as accurate as possible.

"EXECUTION OF PROGRAM"

When the program begins, it will request information about the baud rate and terminal being used. The program will then request a coordinate scale.

Next, the program asks which county number is desired. Regardless of the map used (county or full state), the program will select the coordinates of the given county and display a window for that county with margins. Thus, the user need not determine the minimum or maximum desired coordinates. The user may

later enlarge any portion of that county or select any other county on the same, or a different, map. The county number entered here will appear on the node and facility files. If a county number other 1 - 83 is entered, the program will ask for the minimum and maximum coordinates desired.

The program will now request the user to enter a point (via the tablet) near the bottom of the map. The "ready" light on the digitizer should now be on. When the point is accepted, the program will ask for the user X,Y coordinates of that point. They should be entered in order as decimal numbers and separated by commas.

After the ready light comes on again and the program asks for a point near the top of the map, the above process should be repeated.

The screen should now erase and the user is ready to begin. The program will be waiting for a command. Valid commands are:

P, PO - point mode

FA - facility mode

L, LI - link mode

RE - reset all modes

T, TA - calls tablet subroutine to enter points

D, DE - delete links or modes

M, MO - move nodes

DR - draw or redraw latest net

S, SA - save disk file or list current data

QU - quit

F, FU - new county or region desired

ED - edit data, node numbers

AN - plot link data

AG - new map or correct initial points

E, EN - enlarge present drawing

O, OL - check for presence of recovery file or read last files created

Commands may be entered only when requested by the program. To obtain a program request for a command, the user must "exit" the command he is presently in.

All commands, except (T, TA), (M, MO), (D, DE), ED, (O, OL) and (S, SA) will return to the main program and request a new command automatically. The exit procedure for the exceptions mentioned above will be displayed on the screen and are described in the following documentation.

The first four commands will set the desired "MODE". These will only affect the amount and type of data expected by the tablet subroutine. The T, TA command cannot be executed until at least one mode has been selected. Any attempt to execute the T, TA command before selecting a mode will generate a request for a desired mode. After the mode has been selected, the user must again enter the tablet command. Any one, two, or three modes may be set.

P,PO - Sets point mode. Tablet subroutine will subsequently expect node numbers and four data items for each point (8-digit integers).

L,LI - Sets link mode. Tablet subroutine will expect a node number (unless user sets automatic sequencing - for details see T,TA command description) and then will draw a link from the preceding node if any. It will then request jurisdiction, speed (in tenths), and up to four data items to be given for the link.

FA - Sets facility modes. Tablet subroutine will expect a node number and then will ask for a facility name for each point.

RE - Resets all modes. To enter tablet subroutine after RE, the user must again set at least one mode.

T, TA

This subroutine cannot be entered until at least one mode has been selected. After entry, "BEGIN -" will be displayed. The ready light should be on and the user may begin. While in this subroutine, the ready light should be on whenever the program is looking for a tablet point. After each tablet point has been entered, the program will move to that point on the screen and wait for a node number (except when nodes are automatically numbered) and, if point mode is set, four data items, all free format, i.e. separated by commas. If a point was incorrectly entered, it may be discarded by entering 0 (zero) as the node number. If all four data items are not needed, the input may be ended with ",*". When in link mode, the program will request jurisdiction, speed, and four data items (volume fields) for each link after all node data has been entered. The program will move the pointer to the last point after all data has been entered.

If in doubt as to what is expected next, the user should first check the ready light. If it is on, enter the next point. Otherwise use the carriage return and check the ready light. If it is now on, enter the next point. If it is still off and the program does not appear to be waiting for link data, try sending a ",*". This could: a) cause the node number to be zero and thus remove it (with warning message); b) enter zero for link data if program was expecting link data (this may later be corrected by editing data "ED"); or c) accomplish nothing, implying a slow or nonoperative computer. If "a" or "b" occur, the ready light should again be on.

Whenever the ready light is on the user may:

1. enter a tablet point;
2. enter "A" for automatic sequencing;
3. enter "R" to return or break link sequence;
4. enter "N" to connect links to a previously entered node;
5. enter "D" to delete links or nodes;
6. enter "M" to move nodes;
7. enter "E" to enlarge a portion of the picture; or
8. enter "F" to obtain a full county or area picture.

For each of the above, except #1, the alpha character should be entered followed by a carriage return.

When "A" is entered, nodes will be numbered automatically. The program will ask for the lowest node number desired. This number will be used until the "NE" or "AG" command is used or until data in the core is removed (**possible only** after a save). The program will assign nodes beginning with the "lowest node number desired" checking to avoid duplicate node numbers. When entering points while in automatic sequencing, the assigned node will appear by the point and the program will expect only the four integer data items for that node (only if in point mode). "A" may be entered or reentered whenever the digitizer ready light is on.

When "R" is entered:

1. If in link mode, the link series will be broken.
2. The program will ask if the user desires any more points. If the user responds with a Y (yes), the ready light should again be lit. If the response is N (no), the program will leave the tablet subroutine and ask for a new command.

When in link (L) mode, links will be created between each successive node, unless the continuous "line" is broken by entering "R" followed by a Y (yes) response to "MORE POINTS?---". It will frequently be necessary to create a link which uses a node previously entered. This can be accomplished by entering "N" when the ready light is on and then entering the desired node number when requested.

When not automatically numbering nodes, two points could be assigned the same node number. To avoid mistakenly assigning the same node twice, a warning message will appear and the user will be given an opportunity to assign a different node number to that point. If the user responds with a "N" to the question, "DO YOU PREFER A NEW NODE NUMBER?", the duplicated node number will be accepted and the node data and coordinates of that node will be used as they were first entered.

When in facility (FA) mode after all integer node data has been entered, the user will be asked for the facility name corresponding to each point.

With one major exception, all data will be edited and user will be notified if invalid data was entered. If alpha characters are entered as node or link integer data, they will be translated as 0 (zero) and not be detected as invalid data.

D, DE

This subroutine may be used to delete unwanted links or nodes. The user will be asked if he wishes to delete links or nodes. If the user indicates a wish to delete links, he will be asked to enter node pairs. Deleted links will be marked by an X. If a link cannot be found, a message will inform the user. When the last link has been deleted, the user may return to the main program by entering an "*". If the user wishes to delete nodes, he will be asked to enter the node numbers. He should be cautious, however, for deleting a node will delete all links attached to that node.

M, MO

This subroutine will relocate nodes and corresponding links, readjusting link distances. The user will be asked to enter the desired node number after which the cursor will appear. The cursor should be correctly positioned and an \emptyset (oh) entered (no carriage return). Any affected links will be marked by an X and new locations drawn in dashed lines. When all nodes are in their desired locations, the user should enter "*" to return to the main program.

DR

This command will redraw the present picture after asking the user if he wants node numbers. The subroutine is also called by (T, TA), (F, FU), AN, AG, and (E, EN) commands and each time the user must specify whether or not he desires node numbers.

S, SA

This command enables the user to save any data he wishes (regardless of the mode he is presently in) or to list the data for checking and editing. The user will be asked to select the coordinate, link, combined coordinate and link or facility data files, and then specify whether he wishes to save or merely to list the selected file. If he wishes to list the data, the screen will erase, the data will be listed, and the program will exit the save subroutine and request another command. If the user desires to save the selected data, he will be asked to enter his initials and then to enter a 2-digit map number (this may be any two alpha - numeric characters). These will be used to create the disk file name. The program will then check to see if that file already exists. If it is present, the user will be notified and given a choice of changing the initials and/or map number or of adding to the existing file. The program will respond by informing the

user of the number of node and link records saved and the file name. The user will then be asked if he wishes to remove the data from core to avoid double copies on disk. The response should be N (no) unless the user plans to continue entering data which will later be added to the file he has just saved. When possible, it is desirable to save it again under a different name since once removed, it may not be displayed again. Removing the data from core will also allow the user to assign more than one point to each node number. In some cases, this is not desirable so the user will be required to know which nodes were previously assigned and subsequently removed from core. To exit this subroutine, the user must enter "Q" when asked for the type of file to be saved.

QU

The program will go to the STOP statement and a normal end of job. If some files are not saved, a warning message will appear allowing the user to save them before the job ends. Any desired files must be saved before QU is used since there are no files saved by QU.

F, FU

This command will generate a request for a new county number and will furnish the desired screen window, with proper user coordinates, for the desired county. A small margin is included within the given window to allow entry of county boundary points. If a county number other than 1-83 is given, the user will be asked to enter the minimum and maximum X, Y coordinates of the region he desires to obtain. A new screen drawing will then be made. This drawing will include all points and links which fall within the given county or coordinate range.

ED

This command will enable the user to edit node numbers, node data, link data, and facility names which may have been incorrectly entered. The user will be asked to specify the type of data he wishes to edit (N, L, F, or Q "QUIT").

For link editing, he will then be asked for a node pair separated by commas. For the other edits, he will be asked for a node number. If the node number is to be changed, respond to, "DO YOU WISH TO CHANGE THIS NODE NUMBER?", with a Y otherwise enter N. Caution should be used when changing node numbers since no checks are made to avoid use of a number previously assigned. If a node number is changed to one previously assigned, all node data will change as well. If a node number is changed, any links attached to that node will also be changed. After the user determines to change or not to change the node number, the present node or link data will be displayed, in order, and the user will be asked to enter the attribute number of the data item to be changed (zero if no change). Finally, he will be asked to enter the new desired value. To exit this subroutine, the user must enter Q when asked for the type of data to be edited.

AN

This command enables the user to select up to three link data items (distance, speed, link type, or jurisdiction) to be plotted on each link. He will be asked to enter the number of the link attribute desired. If less than three items are desired, a ",*" must be entered. Any zero data will not be plotted.

AG

If the two initial points were incorrectly entered or interpreted, this command will enable the user to reenter the desired point. The user may also change maps with this request.

E, EN

This command will call the cursor to help the user enlarge a desired portion of the presently displayed region. Any two points may be entered. After cursor is positioned, enter \emptyset (oh). No carriage return.

O, OL

This command will enable the user to read files previously created by this program. It will first check for any recovery files which the user might have. Such recovery files are always created and contain all data entered. They are removed by the program only if the user saves the data and exits the program after all additions or changes to the data. If recovery files are found, the user will be asked if he wishes to use these. If none are found, the user will be requested to enter the file type (coordinate, facility, or link) and the file name.

The link file may be entered only after a coordinate or facility file. The user may enter as many files as he wishes, provided link files are last. Since coordinate and facility files contain all of the same data except the facility names, only one of these need be entered for each point set.

ERASE MESSAGE

If at any time the bottom of the screen window is approached, the user will receive a message warning him that the screen is about to erase. He will be asked to enter 0 (zero) to redraw the window or 1 if he wishes to erase. The user should respond as desired but he should remember what his next response is to be, if any. If the user is asked for data and then warned about a coming erasure, he must first obtain a hard copy, if desired, then respond to the erase message, then enter the next data required.

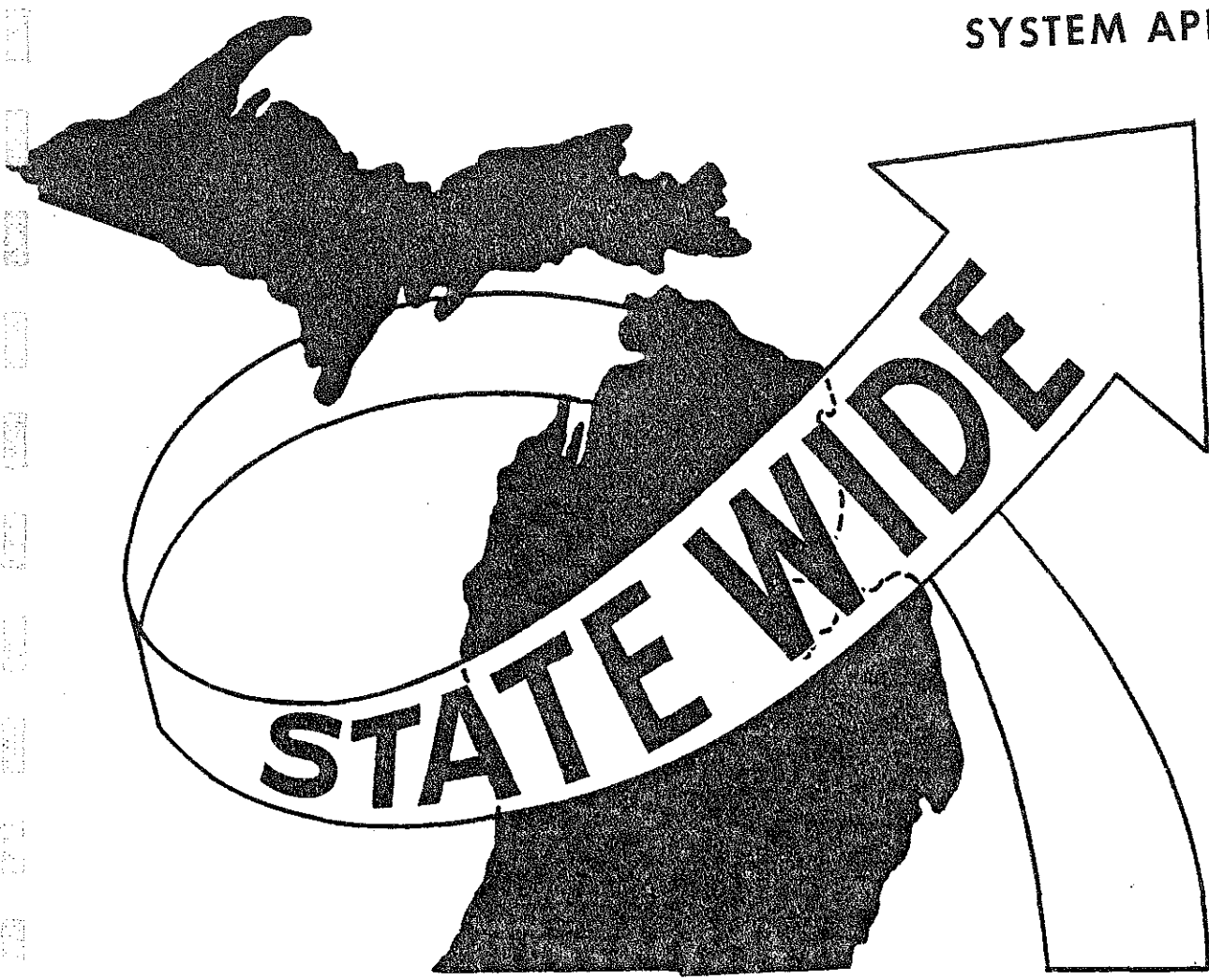
SPECIAL POINT SYMBOLS

Whenever a picture is drawn with node numbers, a small circle will be drawn at each node. However, special symbols may be obtained as desired. If a user is digitizing two or more types of facilities, for example, different symbols for each type of facility might be desired. To obtain the special symbols, the user

must be in point (P, PO) mode. If the user enters a number between -1 and -11 for the first data item following the node number, the symbols listed below will be used at that point:

- 1 ○ circle
- 2 X drawn X
- 3 ▲ triangle
- 4 ■ square
- 5 ★ star
- 6 ◆ diamond
- 7 | vertical bar
- 8 + cross
- 9 ↑ up arrow below point
- 10 ↓ down arrow above point
- 11 ▼ reverse triangle

SYSTEM APPLICATION



SYSTEM APPLICATION

The following section is an actual application of the process described in the previous sections. Concern had been expressed by the residents of Commerce Township, Oakland County, that the proposed I-275 extension would adversely effect them. Since the 547 zone model is too coarse to allow adequate analysis for such a small region as a township, a new network and zone system for that locality was needed. Therefore, all the major roads of several counties in southeast Michigan were digitized using the process described, resulting in the network shown in Figure 10.

The procedures used to create this network are demonstrated in the remaining figures. Figure 11 shows the small region created for this demonstration. The initial steps required to begin are shown in Figure 12. Next, the county number and first two points must be entered, with user coordinates as in Figure 13. Figure 14 shows the user entering the "tablet" subroutine which will accept points as entered from the tablet (see Figure 15). The arrow in Figure 16 points to an "E" entered to enlarge the area being worked on. The resulting enlarged view is shown in the next figure. Figure 18 is a further enlargement. Here one sees letters (N and R) scattered among the node numbers. The arrow pointing up is indicating an "R" which was entered because the user wished to break the sequence of links after reaching this point. The question "MORE POINTS" then asks the user if he wishes to continue, beginning another series of links. The user answered with a "Y" (for yes), then entered an "N" followed by node number 1025 indicating he wished to begin the next series of links at 1025. The arrow pointing down shows that he then entered another "N" to indicate he wished to build a link

FIGURE 10

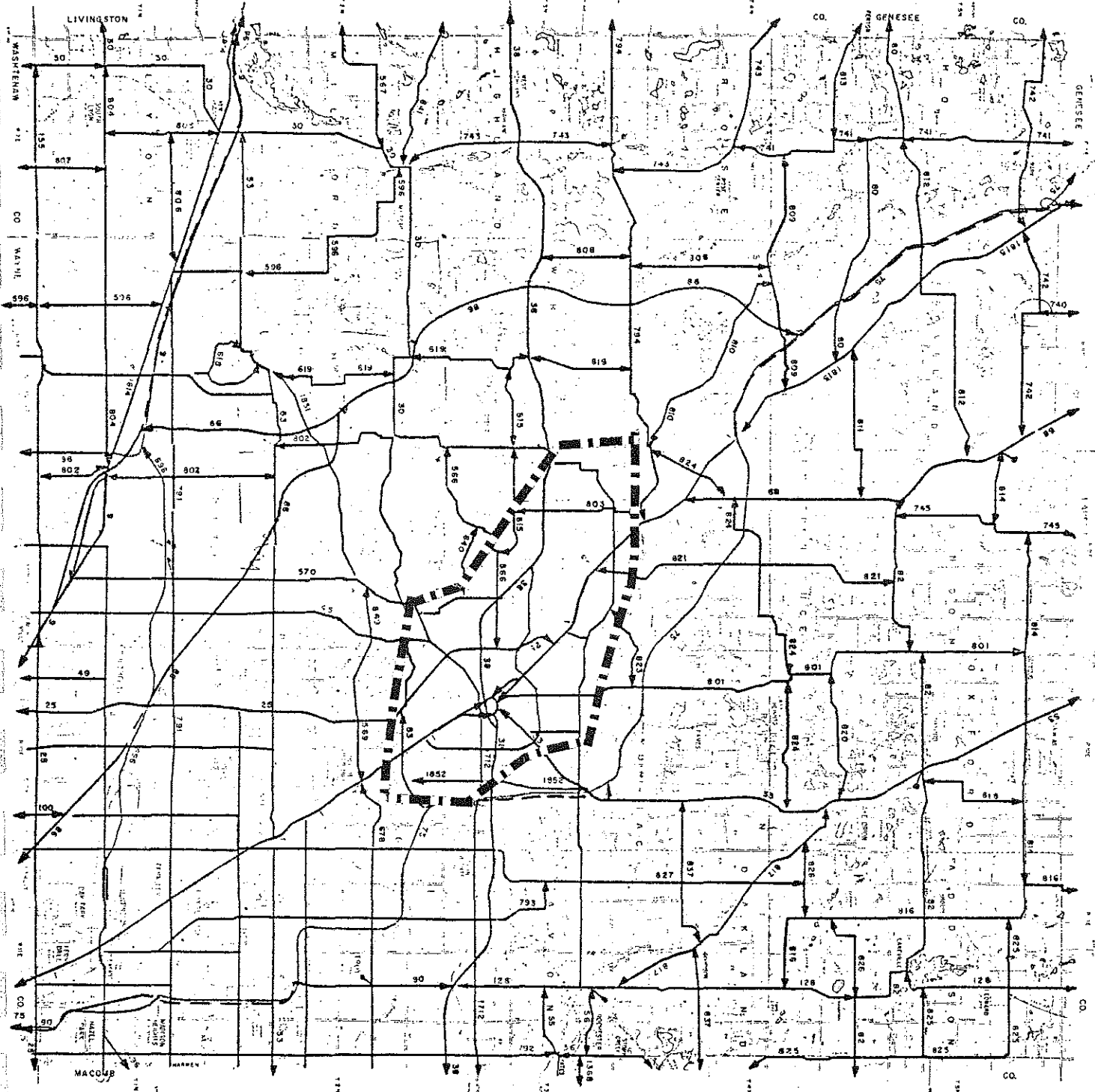


LEGEND

APPROVED FEDERAL AID SYSTEM	PROPOSED REVISIONS
INTERSTATE	ADDITION TO _____ SYSTEM
INTERSTATE AND PRIMARY	DELETION FROM _____ SYSTEM
PRIMARY	
SECONDARY (STATE)	FEDERAL-AID URBAN BOUNDARY
SECONDARY (COUNTY)	REVISED TO JANUARY 1, 1975
URBAN	

FIGURE 11

FOR FEDERAL-AID SYSTEM DETAILS
SEE FEDERAL-AID SYSTEM AND
URBAN AREA BOUNDARY MAP.



OAKLAND COUNTY

MICHIGAN
STATE HIGHWAY COMMISSION
DEPARTMENT OF STATE HIGHWAYS
HIGHWAY PLANNING SURVEY



R 6P/GRAPHICS/TABLET/BOUND,PT-68
BRUNING 0081
87

*****TEKTRONIX TABLET DIGITIZER*****

PROGRAM ASSUMES YOU HAVE A 880-CPS LINE AND A
4014-TYPE TERMINAL WITH EXTENDED GRAPHICS. IF THIS IS
TRUE, ANSWER YES, OTHERWISE NO.---

Y

ENTER YOUR INITIALS, PLEASE---

JAM

ENTER COORDINATE SCALE (MILES/COORDINATE) ---
2.75

ENTER COUNTY NUMBER 0-83
(0 (ZERO) IF WISH REGION OTHER THAN COUNTY)---
63

DIGITIZE POINT NEAR BOTTOM OF MAP.

DO YOU WANT NODE NUMBERS PLOTTED?(Y,N)---
N

USER (X,Y)-COORDINATES---
833.49,131.67

USER (X,Y)-COORDINATES---
822.96,120.23

DIGITIZE POINT NEAR TOP OF MAP.

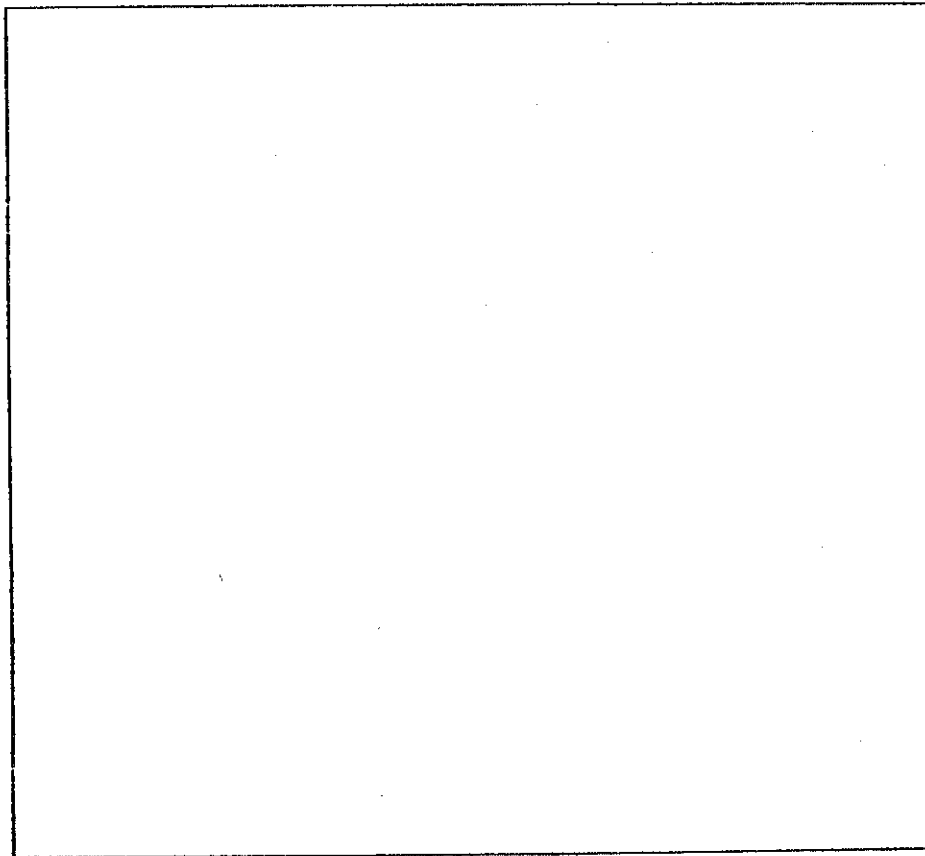
X-COORDS, Y-COORDS 221.70, 234.78, 119.04, 132.50,

COMMAND----

LINK MODE SET.

COMMAND----

DO YOU WANT NODE NUMBERS PLOTTED?(Y,N)---
N



COUNTY-- 03 X-COORDS-- 221.70, 234.78, Y-COORDS-- 119.04, 132.50,

FIGURE 14

AT EACH POINT, ENTER NODE NUMBER

ENTER JUR,LEGAL SYSTEM,CS,TUN,CITY FOR EACH LINK

ALL ABOVE DATA IS FREE FORMAT--IF NOT DESIRED ENTER BLANKS OR X
TO RETURN, ENTER 'R' INSTEAD OF A TABLET POINT

BEGIN-

A
NODES WILL BE AUTOMATICALLY NUMBERED
PLZ ENTER LOWEST DESIRED NODE NUMBER---
1000

BEGIN-

ENTER LINK DATA---
7,8

ENTER LINK DATA---
7,8

ENTER LINK DATA---
7,8

ENTER LINK DATA---
7,8

ENTER LINK DATA---
7,8

ENTER LINK DATA---
7,8

ENTER LINK DATA---
7,8

ENTER LINK DATA---
7,8

ENTER LINK DATA---
7,8

ENTER LINK DATA---
7,8

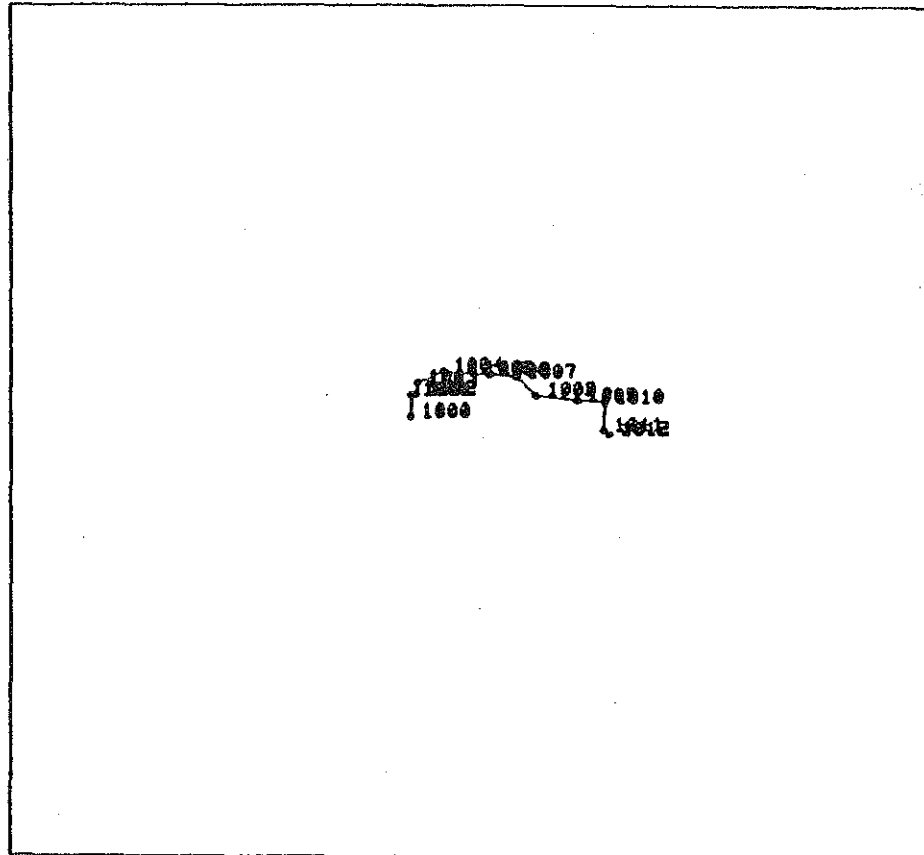
ENTER LINK DATA---
7,8

ENTER LINK DATA---

ABOUT TO ERASE--TO REDRAW NET, ENTER 0, ELSE 1---NO RECALL OF LAST LINE...PLZ REMEMBER DESIRED RESPONSE

DO YOU WANT NODE NUMBERS PLOTTED?(Y,N)---

VCOUNTY-- 83 X-COORDS-- 221.78, 234.78, Y-COORDS-- 119.84, 132.50,



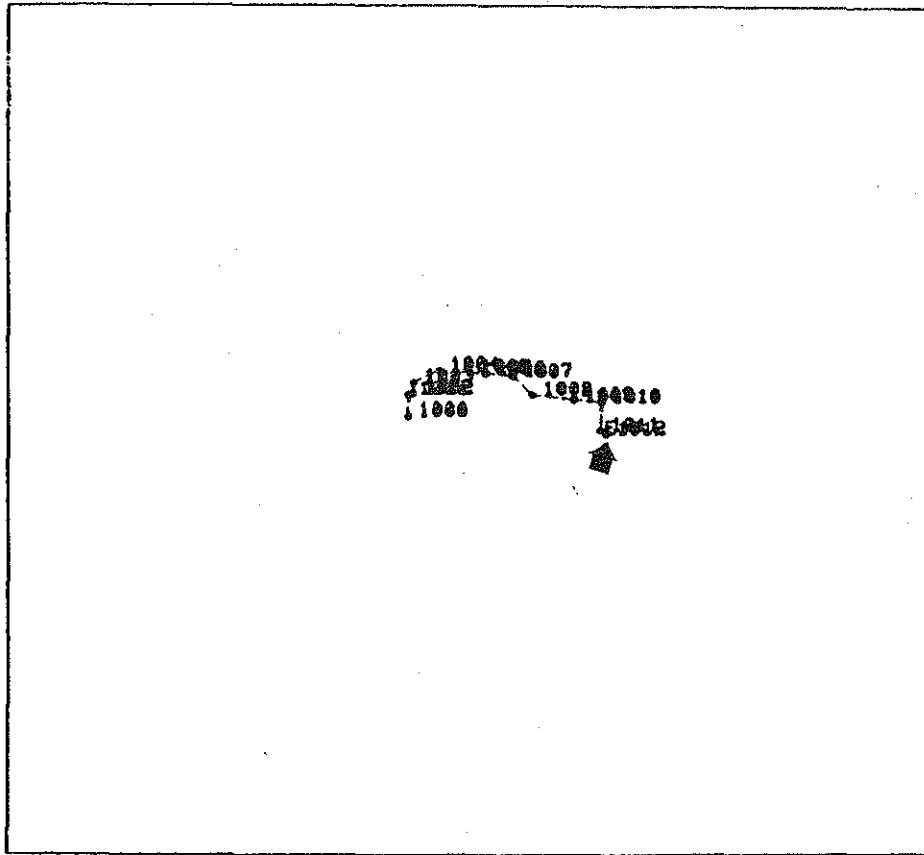
7.2

POSITION CURSOR-

DO YOU WANT NODE NUMBERS PLOTTED?(Y,N)--
Y

X= 231.19, Y= 127.16

X= 226.63, Y= 123.84



COUNTY-- 03 X-COORDS-- 221.70, 234.70, Y-COORDS-- 119.04, 132.50,

FIGURE 16

-77-

X-COORDS, Y-COORDS 226.68, 231.19, 123.84, 127.16,

ENTER LINK DATA---
7,8

ENTER LINK DATA---
7,8

ENTER LINK DATA---
7,8

ENTER LINK DATA---
7,8

ENTER LINK DATA---
4,8

ENTER LINK DATA---
4,8

ENTER LINK DATA---
4,8

ENTER LINK DATA---
4,8

ENTER LINK DATA---
4,8

ENTER LINK DATA---
4,8

ENTER LINK DATA---
4,8

ENTER LINK DATA---
4,8

ENTER NODE NUMBER---

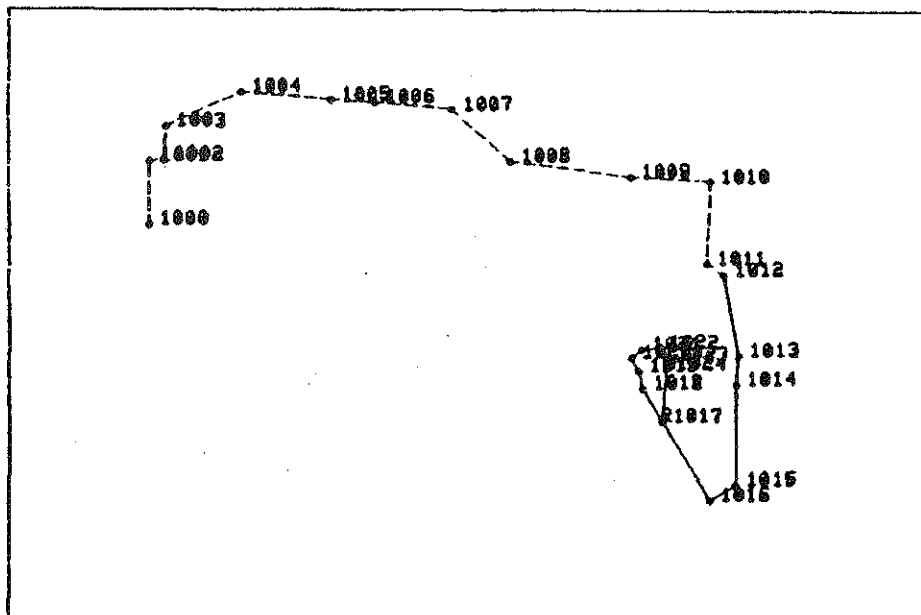
1017
ENTER LINK DATA---
4,8

MORE POINTS?---

E

ABOUT TO ERASE--TO REDRAW NET, ENTER 0, ELSE 1---NO RECALL OF LAST LINE...PLZ REMEMBER DESIRED RESPONSE

DO YOU WANT NODE NUMBERS PLOTTED?(Y,N)---
Y-COORDS--- 83 X-COORDS--- 226.68, 231.19, Y-COORDS--- 123.84, 127.16.



-45-

FIGURE 17

X-COORDS, Y-COORDS 229.25, 230.43, 124.58, 125.84,

BEGIN-

N
ENTER NODE NUMBER---
1019
ENTER NODE NUMBER---
1024
ENTER LINK DATA---

ENTER LINK DATA---
4, 2

ENTER NODE NUMBER---
1023
ENTER LINK DATA---

MORE POINTS?---

N

ENTER NODE NUMBER---
1025
ENTER NODE NUMBER---
1013
ENTER LINK DATA---

MORE POINTS?---

N

ENTER NODE NUMBER---
1018
ENTER NODE NUMBER---
1022
ENTER LINK DATA---

MORE POINTS?---

N

ENTER NODE NUMBER---
1021
ENTER LINK DATA---

ABOUT TO ERASE--TO REDRAW NET, ENTER 0, ELSE 1---NO RECALL OF LAST LINE...PLZ REMEMBER DESIRED RESPONSE
DO YOU WANT NODE NUMBERS PLOTTED(Y,N)---
YCOORDY-- 83 X-COORDS-- 229.25, 230.43, Y-COORDS-- 124.58, 125.84,

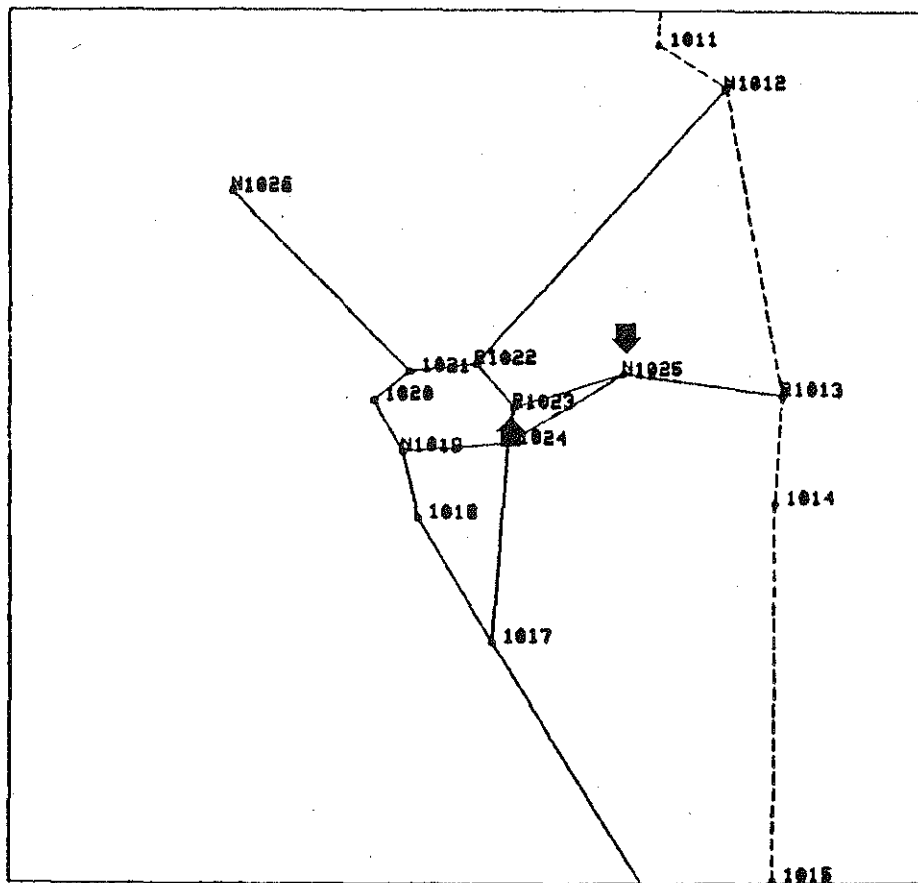


FIGURE 18

from 1025 to another already existing point. When the program again asked for a node number, he entered 1013, thus building the link between 1025 and 1013.

Whenever a point is given from the map which cannot be pictured within the displayed window., the user is informed, as shown in Figure 19. At this point, the user chose to enlarge so as to be able to enter the desired point. The arrow indicates the "E" entered to get a large window.

While producing this portion of the network, the program was accidentally and prematurely terminated before any of the created data had been saved as seen in Figure 20. However, this did not result in a major loss since backup files are automatically created and saved. These backup files were recovered (Figure 21) and the process continued in Figure 22. Files were saved in Figure 23 and Figures 24-27 show partial listings of the coordinate and link files created.

When building such a network, the user will probably make a few errors. Therefore, some editing commands are also available. Figures 28 and 29 show how one may display link information on the links. Figures 30 and 31 show the network when a node is moved and the resulting changes in distances. (Compare distances in Figure 29 with those in Figure 31, one of which is indicated by arrows.) Finally, Figures 32 and 33 show the deletion of a link.

This example was part of an actual application job. The entire network shown in Figure 10 was accurately created and quickly edited, thus enabling the user to do the necessary analysis to answer the questions raised by persons in Commerce Township within a very reasonable length of time.

ENTER NODE NUMBER---
4,8

X= 230.67, Y= 124.36

MORE POINTS?---

Y
N

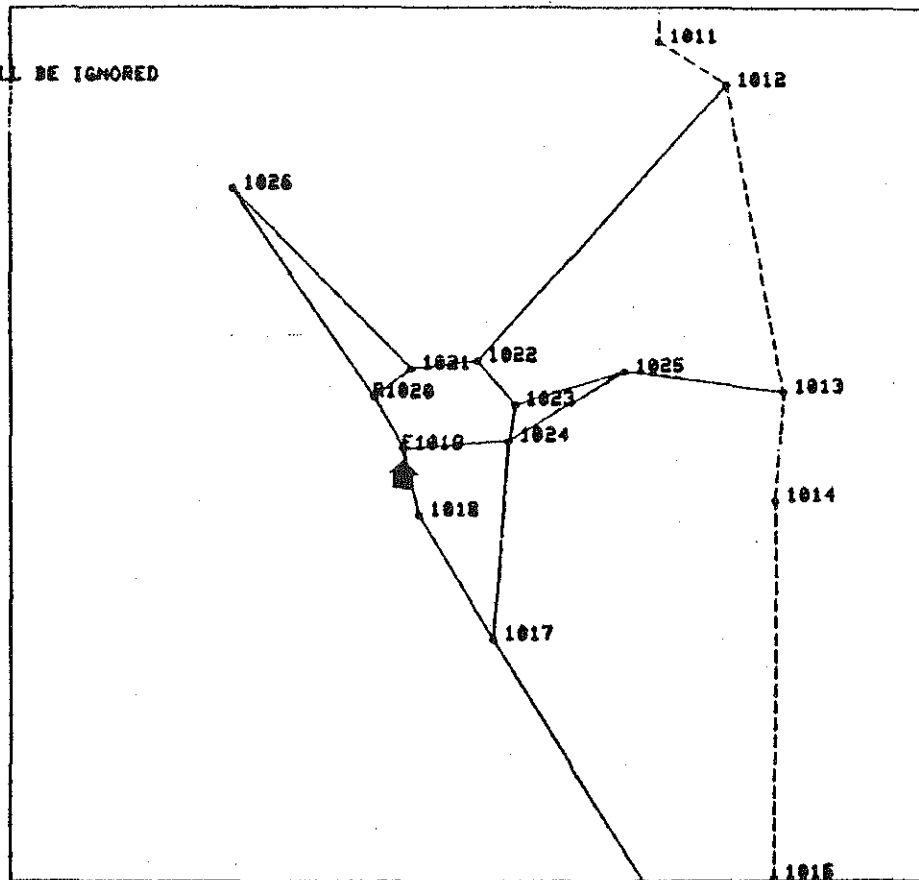
ENTER NODE NUMBER---

1010
THAT POINT WAS OUTSIDE THE WINDOW...IT WILL BE IGNORED

POSITION CURSOR-

DO YOU WANT NODE NUMBERS PLOTTED?(Y,N)---

Y



COUNTY-- 83 | X-COORDS-- 229.85, 230.43, Y-COORDS-- 124.58, 125.84,

FIGURE 19

7,X

ENTER LINK DATA---
4,X

MORE POINTS?---

Y

N

ENTER NODE NUMBER---

1026

ENTER NODE NUMBER---

1046

ENTER LINK DATA---

4,X

ENTER LINK DATA---

4,X

ENTER NODE NUMBER---

1044

ENTER LINK DATA---

4,X

ENTER NODE NUMBER---

1030

ENTER LINK DATA---

4,X

MORE POINTS?---

Y

0021

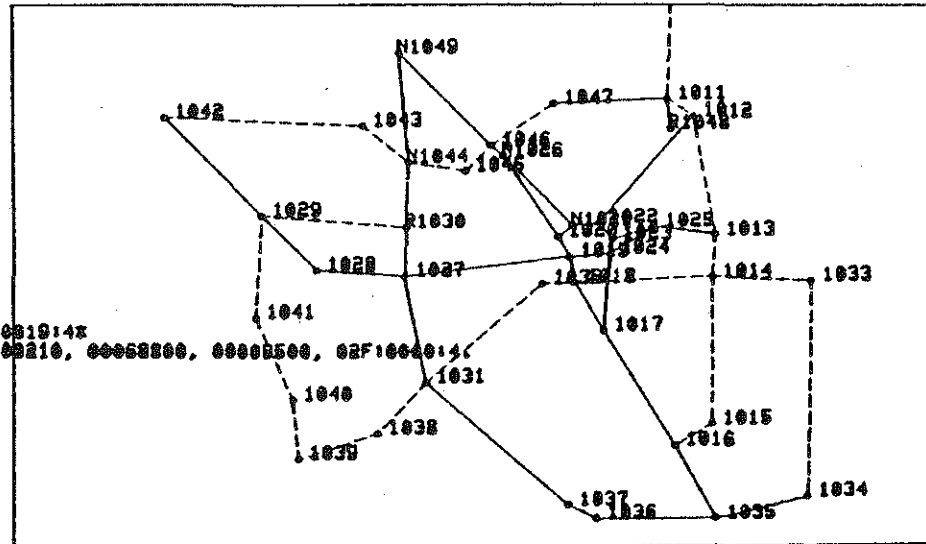
ENTER NODE NUMBER---

1021

ENTER NODE NUMBER---

1047

00061 BREAK ON OUTPUT:NETBUILD/IO @ 077:0819:4X
\$1-DS @ 00003800, 00025040, 00023870, 00000210, 00000000, 00000500, 02F10040:4,
SET-31:40.5 PT-15.7 IO-1.8



COUNTY-- 03 X-COORDS-- 227.91, 230.97, Y-COORDS-- 124.12, 125.14,

FIGURE 20

X-COORDS, Y-COORDS 221.70, 234.78, 119.04, 132.50.

COMMAND----

OL
LINK AND COORD BACKUP FILES EXIST

DO YOU WISH TO USE THE BACKUP FILES?(Y,N)
IF NOT USED NOW, THEY WILL BE LOST

Y

50 RECORDS READ FROM BACKUP COORDINATE FILE

115 RECORDS READ FROM BACKUP LINK FILE

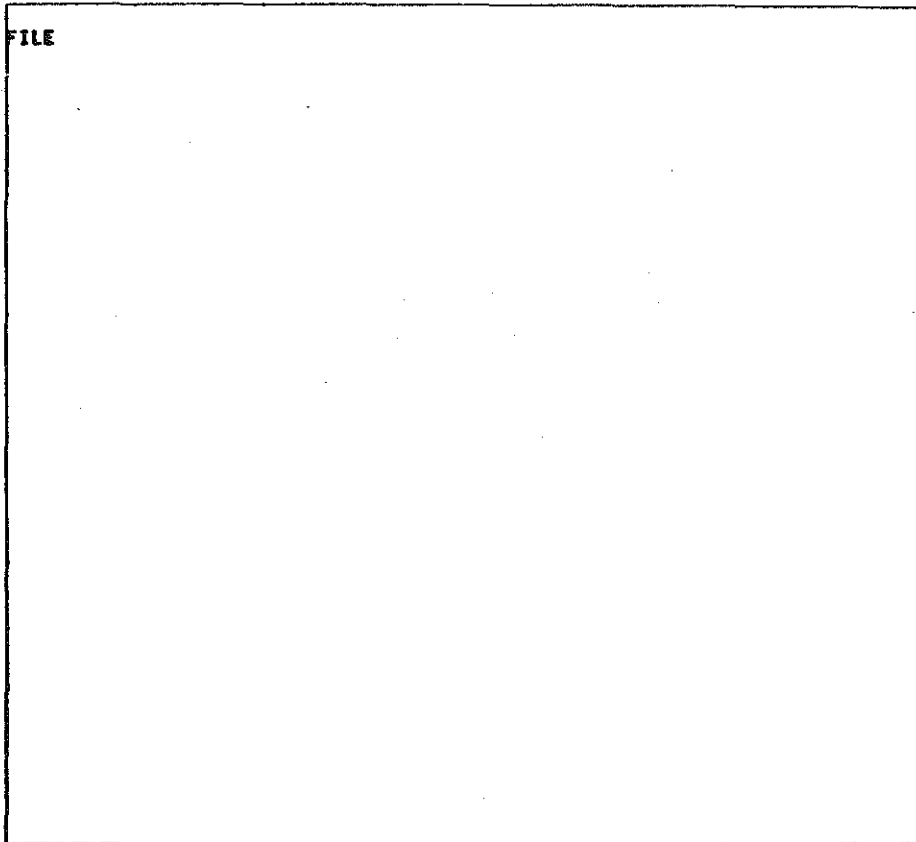
COMMAND----

LI
LINK MODE SET.

COMMAND----

TA
DO YOU WANT NODE NUMBERS PLOTTED?(Y,N)---

Y



COUNTY-- 63 X-COORDS-- 221.70, 234.78, Y-COORDS-- 119.04, 132.50,

FIGURE 21

X-COORDS, Y-COORDS 227.27, 231.78, 124.06, 127.13.

BEGIN-

U
ENTER NODE NUMBER---
1049
ENTER LINK DATA---
4,2

ENTER LINK DATA---
4,2

ENTER NODE NUMBER---
1005
ENTER LINK DATA---
4,2

MORE POINTS?---

N

ENTER NODE NUMBER---
1008
ENTER NODE NUMBER---
1051
ENTER LINK DATA---

MORE POINTS?---

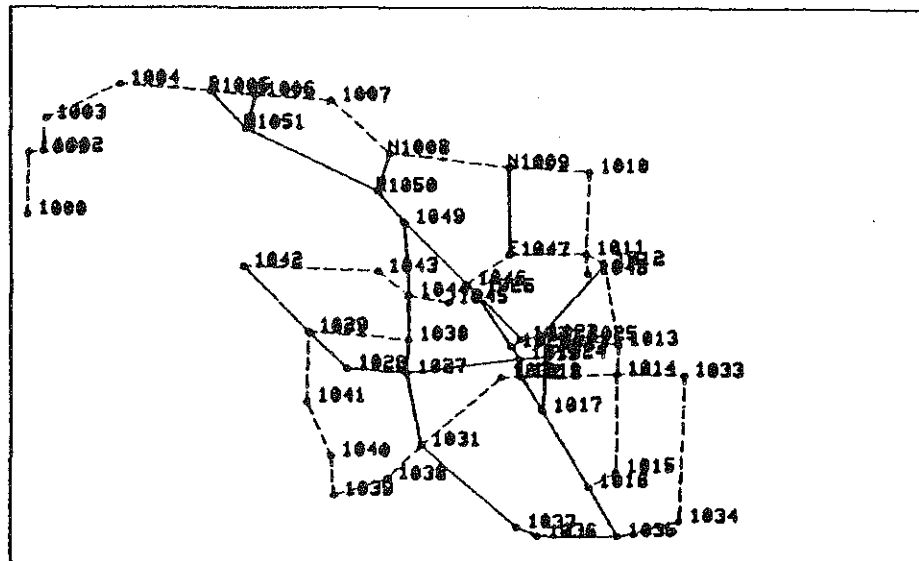
N

ENTER NODE NUMBER---
1008
ENTER NODE NUMBER---
1050
ENTER LINK DATA---
7,2

MORE POINTS?---

N

ENTER NODE NUMBER---
1008
ENTER NODE NUMBER---
1047
ENTER LINK DATA---
7,2



ABOUT TO ERASE--TO REDRAW NET, ENTER 0, ELSE 1---NO RECALL OF LAST LINE...PLZ REMEMBER DESIRED RESPONSE

0
DO YOU WANT NODE NUMBERS PLOTTED?(Y,N)---
NCOUNTY-- 83 X-COORDS-- 227.27, 231.78, Y-COORDS-- 124.06, 127.13.

COMMAND----
COORDS, LINKS, BOTH, FACIL,QUIT? (C,L,B,F,Q)---

DO YOU WISH TO LIST OR SAVE? (L,S)---

ENTER YOUR INITIALS, PLEASE---

ENTER A MAP NUMBER---

NODES WRITTEN = 58
LINKS WRITTEN = 8
FILE SAUED AS JAN/NETBLD/C98.

NOW THAT DATA IS SAUED, DO YOU WISH TO REMOVE IT FROM CORE TO AVOID DOUBLE COPIES ON DISK?

COORDS, LINKS, BOTH, FACIL,QUIT? (C,L,B,F,Q)---

DO YOU WISH TO LIST OR SAVE? (L,S)---

ENTER YOUR INITIALS, PLEASE---

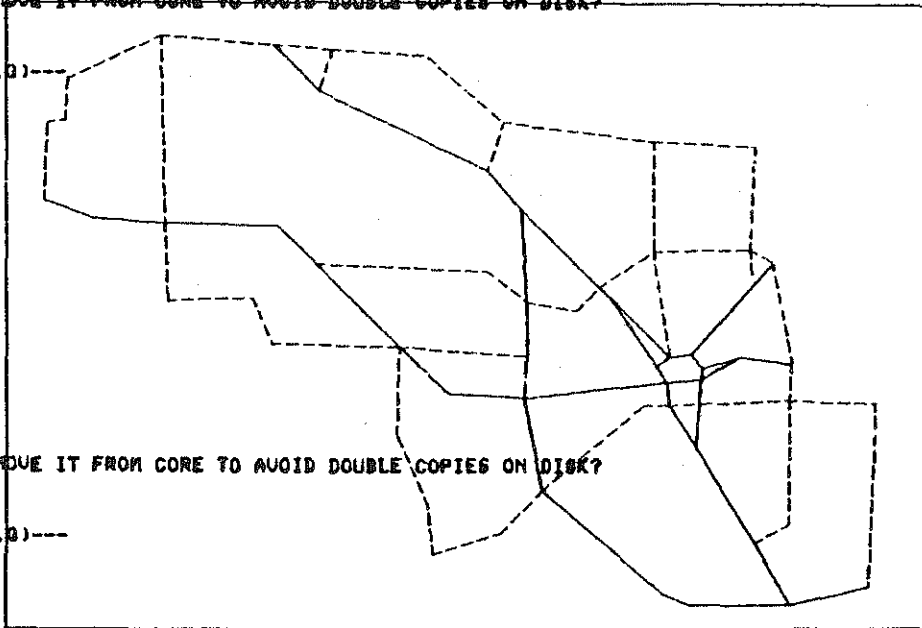
ENTER A MAP NUMBER---

NODES WRITTEN = 58
LINKS WRITTEN = 81
FILE SAUED AS JAN/NETBLD/L98.

NOW THAT DATA IS SAUED, DO YOU WISH TO REMOVE IT FROM CORE TO AVOID DOUBLE COPIES ON DISK?

COORDS, LINKS, BOTH, FACIL,QUIT? (C,L,B,F,Q)---

COMMAND----
DO YOU WANT NODE NUMBERS PLOTTED?(Y,N)---



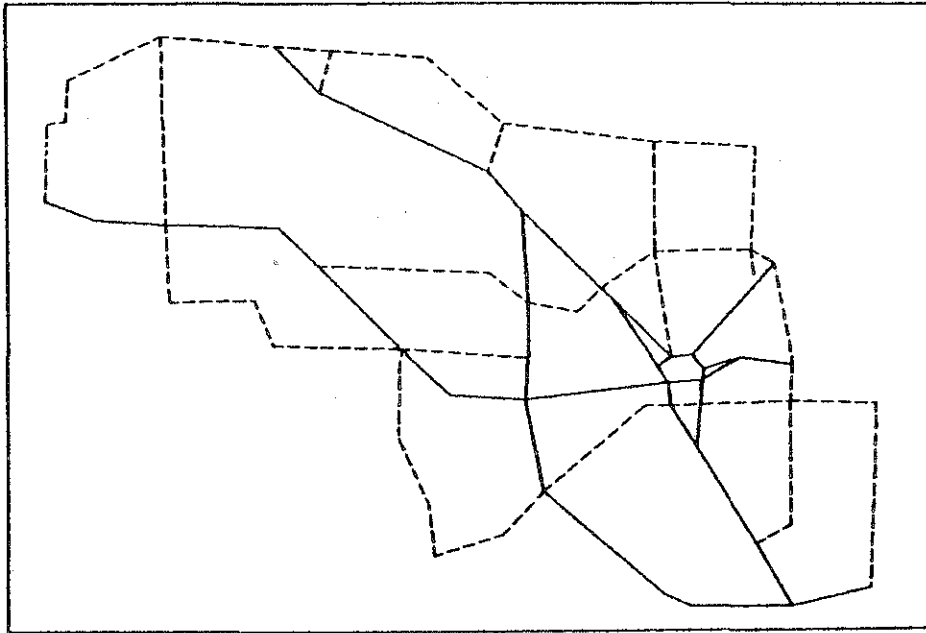
COUNTY-- 63 X-COORDS-- 227.20, 230.77, Y-COORDS-- 124.11, 126.85.

FIGURE 23

COMMAND----

COORDS, LINKS, BOTH, FACIL, QUIT? (C,L,B,F,Q)---

DO YOU WISH TO LIST OR SAVE? (L,S)---



COUNTY-- 63 X-COORDS-- 227.20, 230.77, Y-COORDS-- 124.11, 126.85.

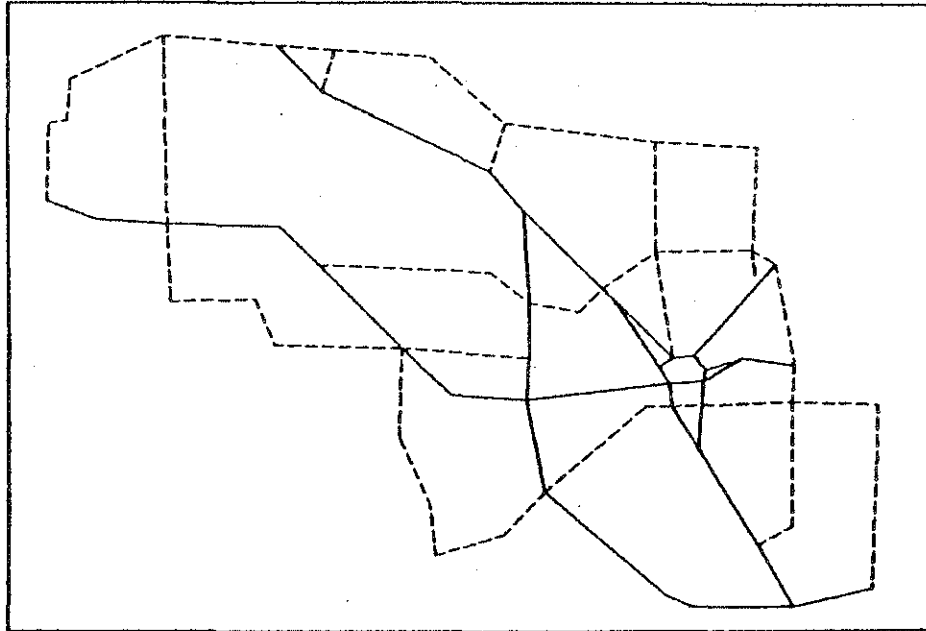
FIGURE 24

0	1000	0	63	22734	12599	0	0	3
0	1001	0	63	22736	12633	0	0	3
0	1002	0	63	22743	12634	0	0	3
0	1003	0	63	22744	12651	0	0	3
0	1004	0	63	22780	12671	0	0	3
0	1005	0	63	22824	12687	0	0	3
0	1006	0	63	22846	12685	0	0	3
0	1007	0	63	22883	12662	0	0	3
0	1008	0	63	22912	12633	0	0	3
0	1009	0	63	22970	12625	0	0	3
0	1010	0	63	23009	12623	0	0	3
0	1011	0	63	23007	12578	0	0	3
0	1012	0	63	23016	12572	0	0	3
0	1013	0	63	23023	12528	0	0	3
0	1014	0	63	23022	12512	0	0	3
0	1015	0	63	23022	12458	0	0	3
0	1016	0	63	23009	12450	0	0	3
0	1017	0	63	22986	12402	0	0	3
0	1018	0	63	22976	12509	0	0	3
0	1019	0	63	22975	12520	0	0	3
0	1020	0	63	22971	12528	0	0	3
0	1021	0	63	22976	12530	0	0	3
0	1022	0	63	22984	12532	0	0	3
0	1023	0	63	22988	12526	0	0	3
0	1024	0	63	22988	12521	0	0	3
0	1025	0	63	23003	12530	0	0	3
0	1026	0	63	22953	12557	0	0	3
0	1027	0	63	22926	12513	0	0	3
0	1028	0	63	22891	12515	0	0	3
0	1029	0	63	22872	12534	0	0	3
0	1030	0	63	22921	12530	0	0	3

ABOUT TO ERASE--TO REDRAW NET, ENTER 0, ELSE 1---NO RECALL OF LAST LINE...PLZ REMEMBER DESIRED RESPONSE

COMMAND----
SA
COORDS, LINKS, BOTH, FACIL,QUIT? (C,L,B,F,Q)---

DO YOU WISH TO LIST OR SAVE? (L,S)---



COUNTY-- 63 X-COORDS-- 227.20, 230.77, Y-COORDS-- 124.11, 126.85,

1000	1001	953	350	0	0	2	0	010	7	63000
1001	1002	103	350	0	0	2	0	010	7	63000
1002	1003	503	350	0	0	2	0	010	7	63000
1003	1004	1123	350	0	0	2	0	010	7	63000
1004	1005	1213	350	0	0	2	0	010	7	63000
1005	1006	593	350	0	0	2	0	010	7	63000
1006	1007	1036	350	0	0	2	0	010	7	63000
1007	1008	1105	350	0	0	2	0	010	7	63000
1008	1009	1623	350	0	0	2	0	010	7	63000
1009	1010	1065	350	0	0	2	0	010	7	63000
1010	1011	1223	350	0	0	2	0	010	7	63000
1011	1012	293	350	0	0	2	0	010	7	63000
1012	1013	1223	350	0	0	2	0	010	7	63000
1013	1014	423	350	0	0	2	0	010	7	63000
1014	1016	1493	350	0	0	2	0	010	7	63000
1015	1016	403	350	0	0	2	0	010	7	63000
1016	1017	1333	400	0	0	2	0	010	4	63000
1017	1018	553	400	0	0	2	0	010	4	63000
1018	1019	263	400	0	0	2	0	010	4	63000
1019	1020	223	400	0	0	2	0	010	4	63000
1020	1021	173	400	0	0	2	0	010	4	63000
1021	1022	233	400	0	0	2	0	010	4	63000
1022	1023	213	400	0	0	2	0	010	4	63000
1023	1024	143	400	0	0	2	0	010	4	63000
1024	1017	783	400	0	0	2	0	010	4	63000
1019	1024	363	400	0	0	2	0	010	4	63000
1024	1025	493	400	0	0	2	0	010	4	63000
1025	1023	403	400	0	0	2	0	010	4	63000
1025	1013	553	400	0	0	2	0	010	4	63000
1012	1022	1393	400	0	0	2	0	010	4	63000
1021	1026	943	400	0	0	2	0	010	4	63000

ABOUT TO ERASE--TO REDRAW NET, ENTER 0, ELSE 1---NO RECALL OF LAST LINE...PLZ REMEMBER DESIRED RESPONSE

1

FIGURE 27

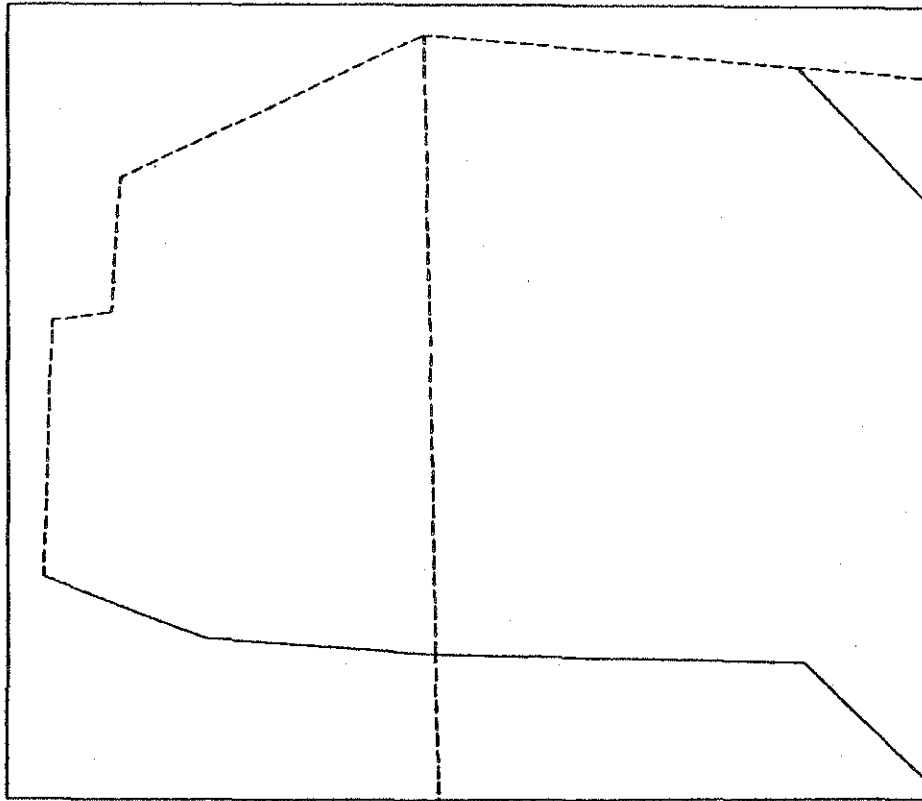
-56-

X-COORDS, Y-COORDS 227.31, 228.40, 125.69, 126.75,

COMMAND----

AN
PLOT DIST, SPD, LT, JUR, CS, TUN, ID, CITY, LS? (CHOOSE UP TO 3) (1,2,3,4,5,6,7,8,9)---

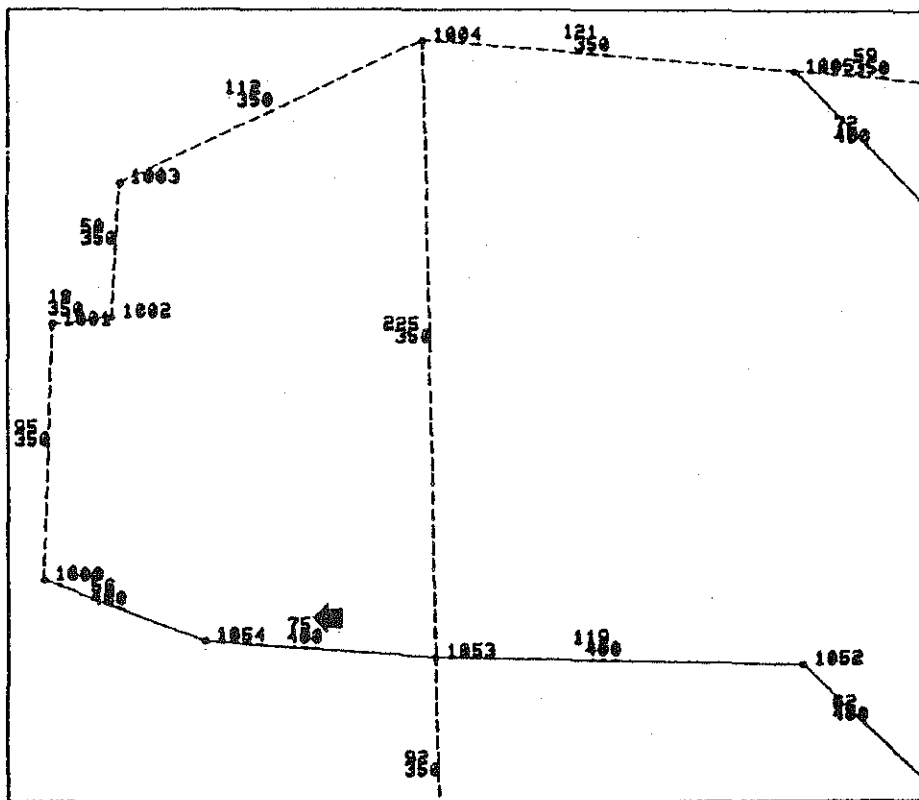
1, 2, X
DO YOU WANT NODE NUMBERS PLOTTED? (Y,N)--
Y



COUNTY-- 63 X-COORDS-- 227.31, 228.40, Y-COORDS-- 125.69, 126.75,

FIGURE 28

COMMAND----



COUNTY-- 03 X-COORDS-- 227.31, 228.40, Y-COORDS-- 125.69, 126.75,

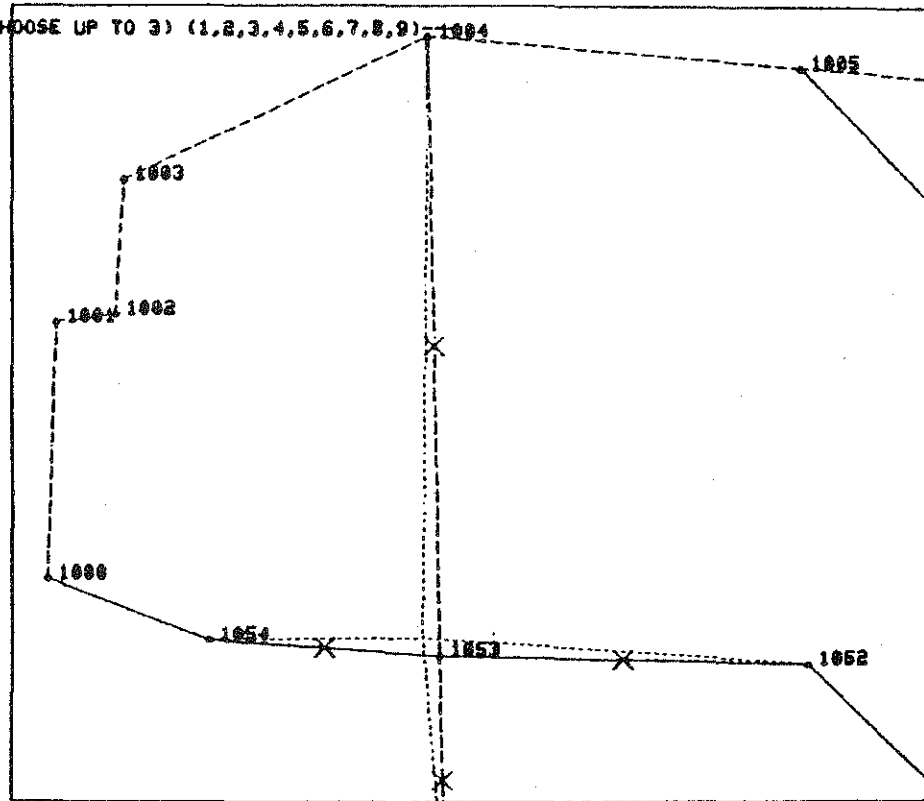
FIGURE 29

COMMAND----
NO
(TYPE 'X' TO STOP.)

NODE---
1053

NODE---
X

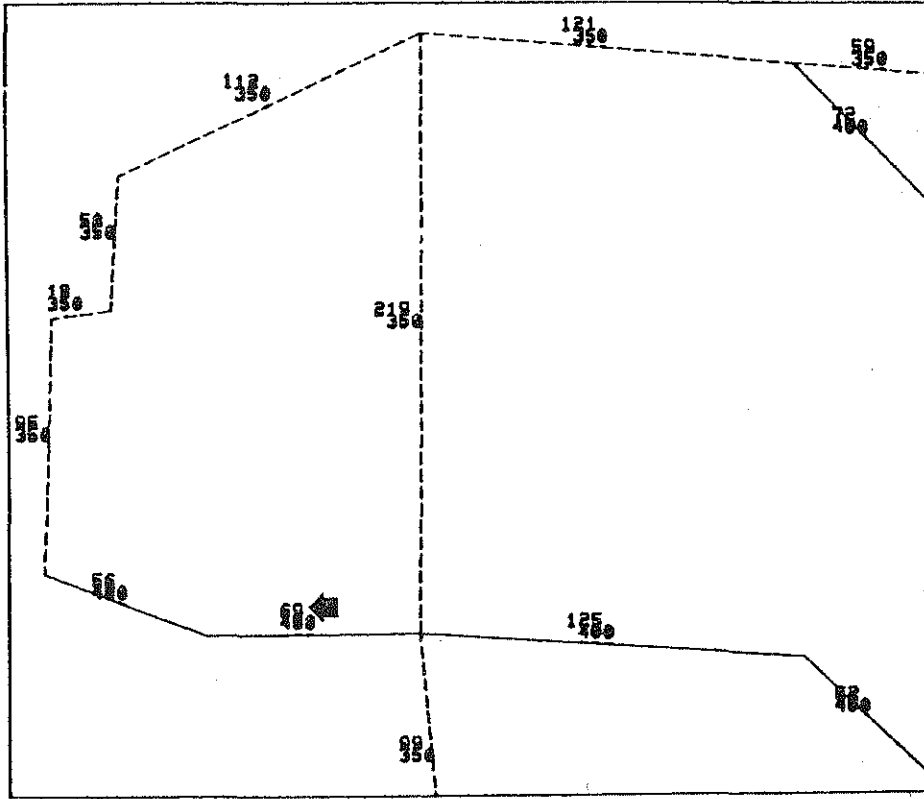
COMMAND----
AN
PLOT DIST, SPD, LT, JUR, CS, TUN, ID, CITY, LS? (CHOOSE UP TO 3) (1,2,3,4,5,6,7,8,9)---1004
1 2, X
DO YOU WANT NODE NUMBERS PLOTTED?(Y,N)---
N



COUNTY-- 83 X-COORDS-- 227.31, 228.40, Y-COORDS-- 125.69, 126.75.

COMMAND----

-69-



COUNTY-- 63 X-COORDS-- 827.31, 828.40, Y-COORDS-- 125.69, 126.75,

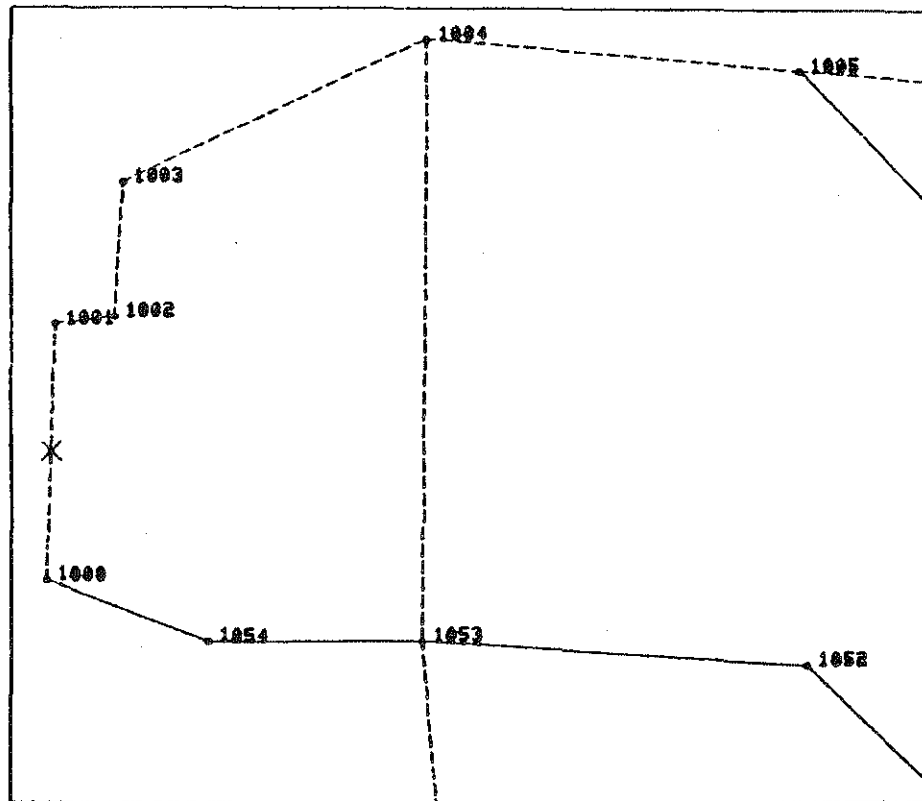
FIGURE 31

COMMAND----
DE
DO YOU WISH TO DELETE LINKS,NODES,QUIT? (L,N,Q)---

ENTER *X* TO STOP DELETIONS.

ENTER NODE PAIR---
1001,1000

ENTER NODE PAIR---
*
COMMAND----
DE
DO YOU WANT NODE NUMBERS PLOTTED?(Y,N)--
Y



COUNTY-- 63 X-COORDS-- 227.31, 228.40, Y-COORDS-- 125.69, 126.75.

COMMAND----

COORDINATE FILE HAS NOT BEEN SAUED SINCE LAST CHANGES

FACILITY FILE HAS NOT BEEN SAUED SINCE LAST CHANGES

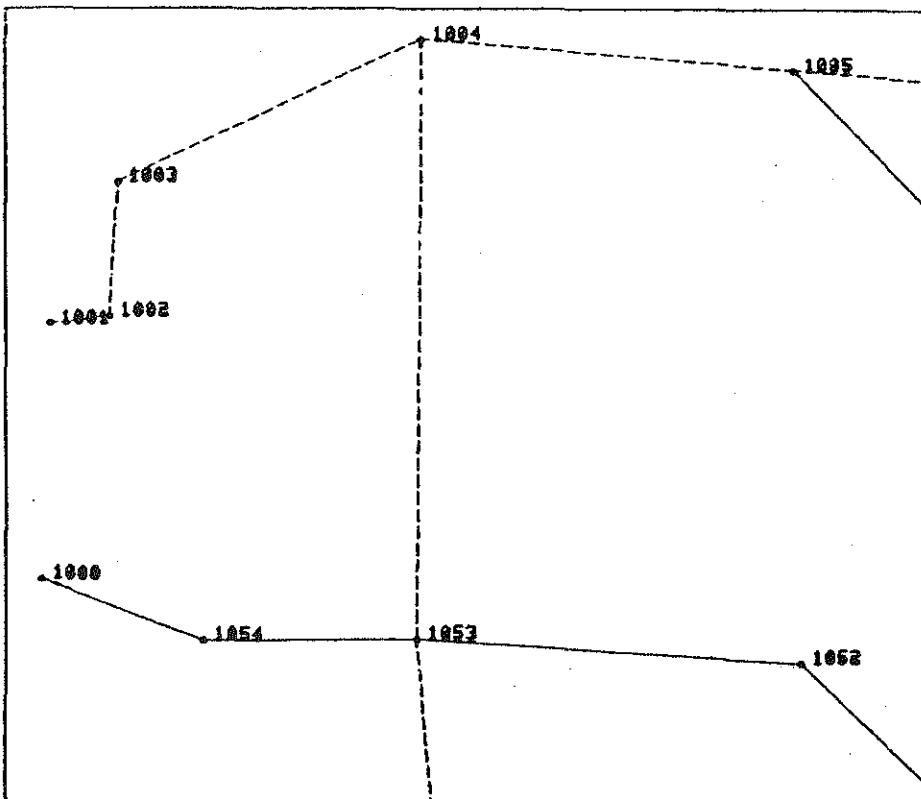
LINK FILE HAS NOT BEEN SAUED SINCE LAST CHANGES

DO YOU REALLY WISH TO QUIT(Y,N)?----

(FILES NOT SAUED NOW WILL BE LOST...NO BACKUP..)

Y

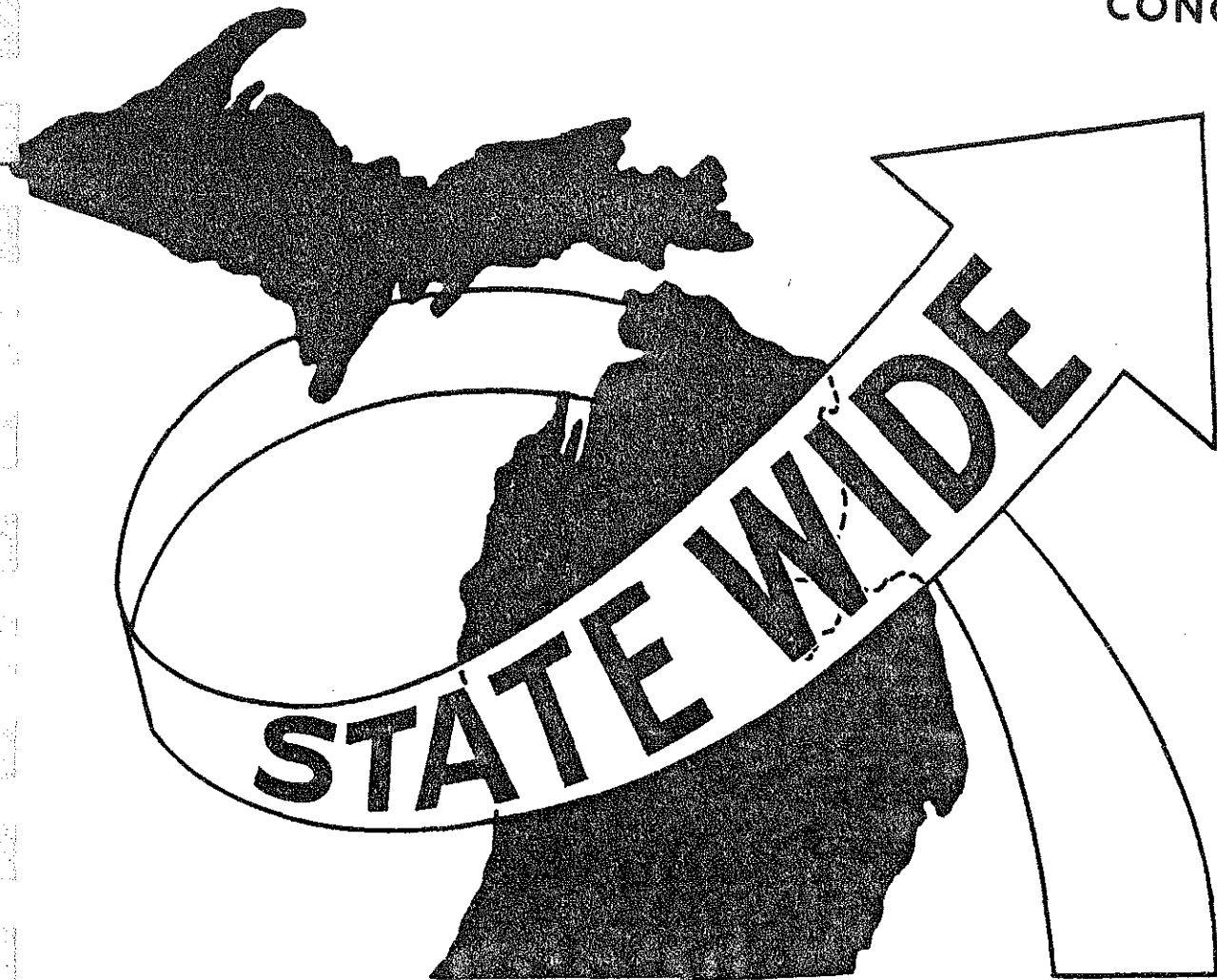
SET=22:38.0 PT=25.1 IO=3.7



COUNTY-- 63 X-COORDS-- 227.31, 228.40, Y-COORDS-- 125.89, 126.76.

FIGURE 33

CONCLUSION



CONCLUSION

Due to recent federal legislation, highway planners are now confronted with many new demands which emphasize the necessity of greater public involvement. Since the average citizen is concerned first of all with local impacts, new methods of analyzing such impacts should be developed. The automatic network generator described in this report has been used effectively to help evaluate local impacts as well as to enhance the more highly developed statewide analysis battery. This process has not only helped reduce the required time and manpower required to complete jobs which could have been quite massive, but it has also greatly improved the accuracy with which selected social impact analysis tasks can be completed. No longer will it be necessary to estimate or measure distances or locations. The planner may now concentrate on fewer aspects of network creation, generating results more quickly and accurately, thus allowing more time to carefully study each question as the the public becomes more and more involved.

Another major benefit of this system is that it was designed to fit in with the Statewide Transportation Modeling System. The data base and analysis tools already available for statewide analysis may now also be used at the local level. This growing integrated system should be able to help answer many troublesome social-economic problems which were previously very difficult and time consuming.