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## **ABSTRACT**

### **INTRODUCTION OF AN INFORMATION FEEDBACK LOOP TO ENHANCE THE URBAN TRANSPORTATION MODELING SYSTEM**

**by  
Kyle B. Winslow**

The Urban Transportation Modeling System (UTMS) is a methodology used to estimate urban travel demand. This demand is measured as the volume of traffic that flows through a system of streets and highways. Through the use of traffic assignment software, parts of UTMS have become automated. One of the newest automated processes is the extraction of a subarea from a larger model. This extraction process is important to the local planner because it maintains a linkage from the regional model to the local model and it allows the user to extract an already distributed trip table rather than building one from scratch. This subarea process as practiced, is a one way information flow. The larger model is calibrated and its information is then passed down to the subarea model.

The author proposes that an "information feedback loop" should be inserted into the process. This information channel is created by the subarea modeler using his calibration information and extra data collected specifically for the subarea model. This information is "looped" back to the regional model where it is used in recalibrating the larger model. The results of the test case in this thesis are used to develop general conclusions regarding the applicability of the feedback process, as well as areas of future improvement and research.

**INTRODUCTION OF AN INFORMATION FEEDBACK LOOP TO  
ENHANCE THE URBAN TRANSPORTATION MODELING SYSTEM**

by  
**Kyle B. Winslow**

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**APPROVAL PAGE**

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ENHANCE THE URBAN TRANSPORTATION MODELING SYSTEM**

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This thesis is dedicated to my parents,  
Rosa Bell and Theodore Winslow,  
and to three very caring and influential women in my life:  
Annie Fryar, Gladys Kearny, and Catherine Mack.  
Without you, I would be nothing.

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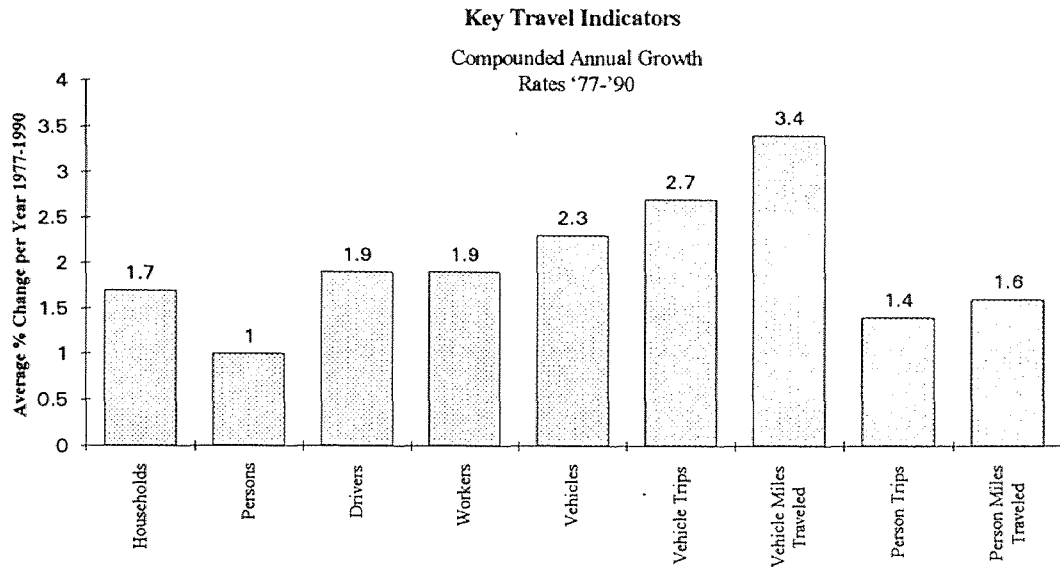
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# CHAPTER 1

## HISTORICAL PERSPECTIVE AND INTRODUCTION TO THE URBAN TRANSPORTATION MODELING SYSTEM AND RELATED SOFTWARE

### 1.1 Historical Background

Between 1977 and 1990 most major contributing factors to vehicle travel, on a national scale, have increased at a rate greater than one percent per year as shown in Figure 1.1.



**Figure 1.1** Key Travel Indicators Over Time (Source: *National Highway Statistics*, Federal Highway Administration, 1990)

Across the spectrum, from the number of households, to the number of licensed drivers, to the number of people in the work force, all variables that affect or are used to describe personal travel have shown marked increases as shown in Table 1.1.

During this thirteen year period, the number of person trips rose by 19% while the amount of vehicle miles traveled (VMT) showed a sharp increase of 55%.

**Table 1.1** National Highway Summary Statistics (Source: *National Highway Statistics*, Federal Highway Administration, 1990)

	1977	1990	% Change
Households (thousands)	75,412	93,347	24%
Persons (thousands)	213,141	243,209	14%
Licensed Drivers (thousands)	127,552	163,025	28%
Workers (thousands)	93,019	118,343	27%
Vehicles (thousands)	120,098	165,221	38%
Vehicle Trips (millions)	108,826	158,858	46%
Vehicle Miles of Travel (millions)	907,603	1,409,202	55%
Person Trips (millions)	211,778	252,697	19%
Person Miles of Travel (millions)	1,879,215	2,316,455	23%

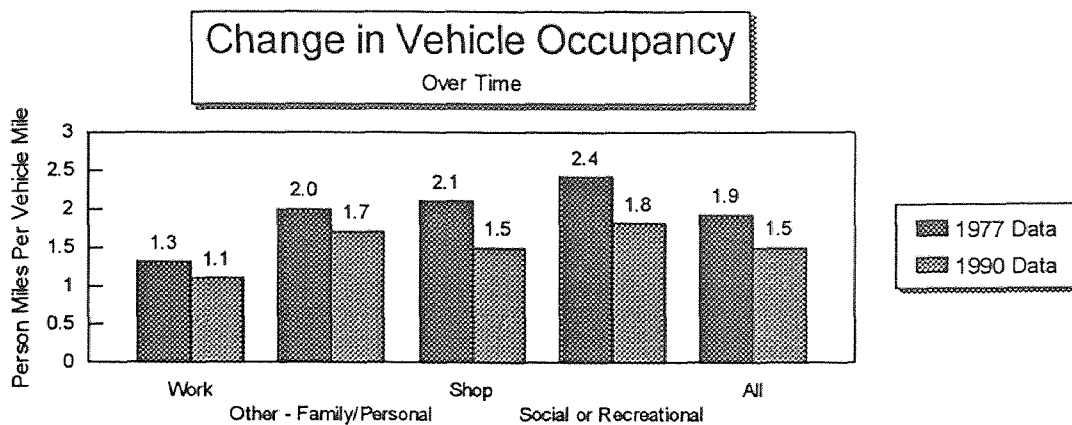
Not only has the volume of traffic increased, but the percentage mix of vehicle trips and VMT by trip purpose has also changed as shown in Table 1.2. Most notable, is the rise of “other personal business trips” from 12.0% to 20.1%.

**Table 1.2** Vehicle Miles of Travel by Trip Purpose (Source: *National Highway Statistics*, Federal Highway Administration, 1990)

Purposes	1977	1990
Work	31.7%	32.8%
Work related Business	7.6%	2.8%
Shopping	11.1%	11.9%
School/Church	5.2%	4.5%
Doctor/Dentist	1.8%	1.3%
Other Personal Business	12.0%	20.1%
Vacation	0.6%	0.8%
Visit Friends/Relatives	12.1%	11.4%
Pleasure Driving	0.9%	0.6%
Other Social/Recreational	13.7%	13.0%
Other	3.3%	0.8%
All Purposes	100.0%	100.0%

Over this same period of time, vehicle occupancy rates have decreased significantly for all trip purpose categories as shown in Figure 1.2.





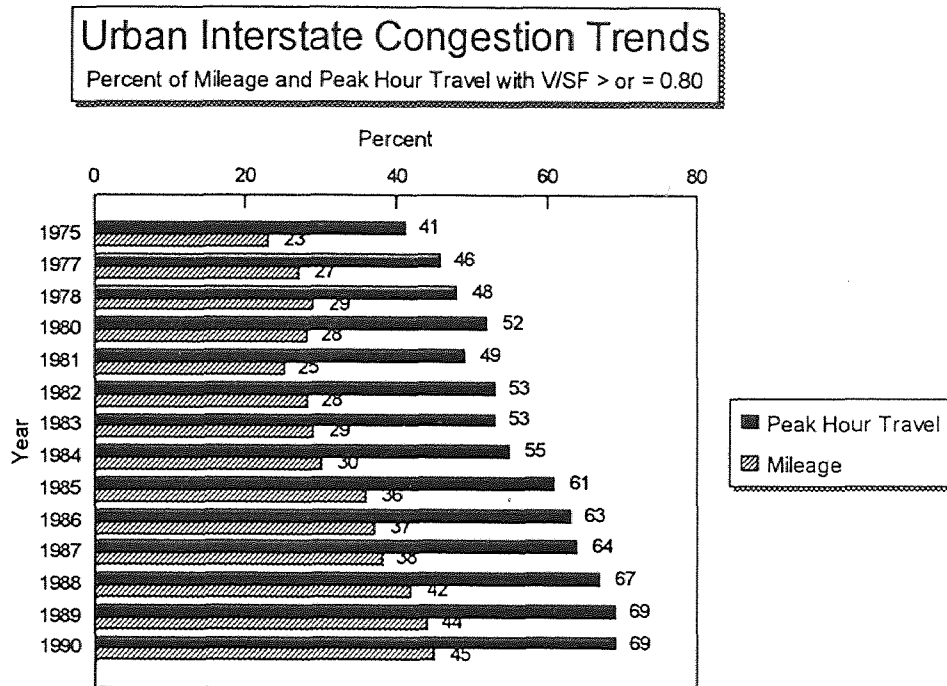
**Figure 1.2** Change in Vehicle Occupancy Over Time (Source: *National Highway Statistics*, Federal Highway Administration, 1990)

In summary, the above statistics indicate that as a country:

- 1) we are moving more people than ever before
- 2) we are moving more vehicles than ever before
- 3) more of our trips are of a personal nature
- 4) we are accomplishing these tasks in a less efficient manner than ever before

The increase in VMT and changes in travel patterns have put new strains on the nation's aging and finite transportation infrastructure. Increased travel has exacerbated the nation's air quality problems due to mobile source emissions and urban interstate congestion, as shown in Figure 1.3. The measure of congestion in Figure 1.3 is the ratio of volume to service flow. The Highway Capacity Manual (*Transportation Research Board, 1985, pg. 1-4*) defines service flow as "...the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform

section of a lane or roadway during a given time period under prevailing roadway , traffic, and control conditions...”



**Figure 1.3** Urban Interstate Congestion Trends (Source: *National Highway Statistics*, Federal Highway Administration, 1990)

Recent environmental concerns and other changes in the context of transportation planning have resulted in a higher reliance on regional transportation analysis methods and thus closer scrutiny of these methods.

These factors, combined with a finite resource pool, have created a new and unique spirit of cooperation among state, county, and local officials. No longer can local officials afford to have the traditional planning attitude of “planning in a box” (i.e., the

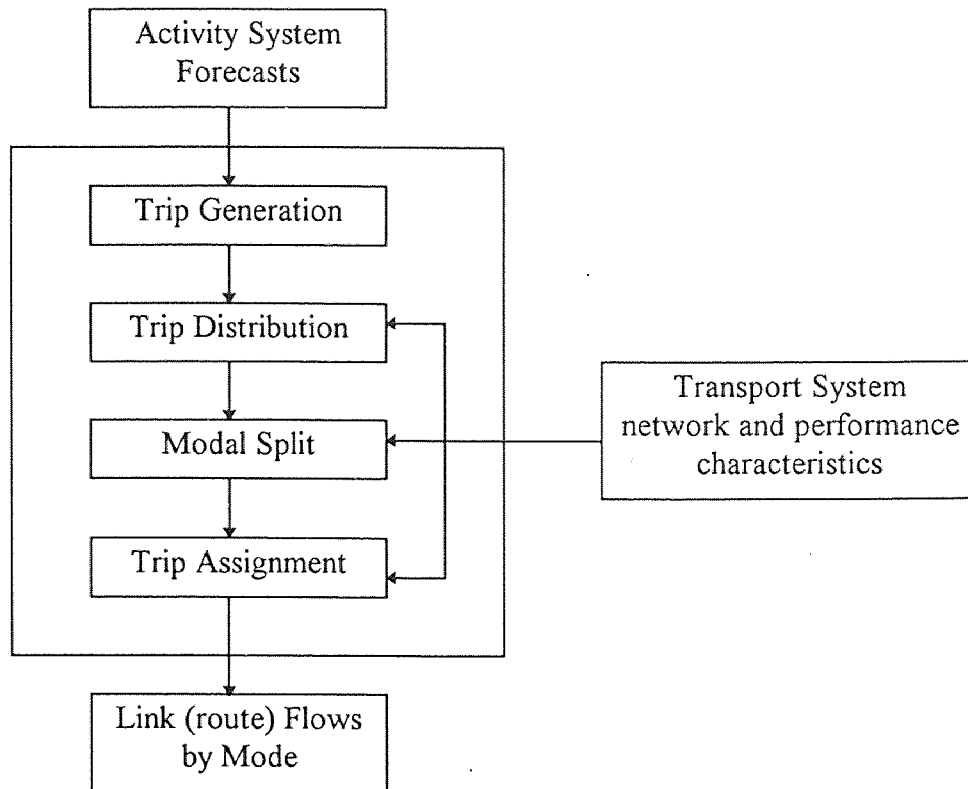
planning scope stops at the municipal boundaries). It has become evident that transportation planning on all levels is interconnected.

One way in which the transportation modeling/planning community has attempted to respond to this need, is by expanding the capabilities of its computerized models to form a new analysis tool called the “subarea focus model”. The subarea focus model is a technique of extracting a subset or section of a larger area, for use by the local planner in local study applications.

The subarea focus model has become a very useful and powerful tool because 1) it allows the local planner to redefine the limits of his study area within the context of the larger model, thus allowing him to concentrate only on those areas which affect local planning decisions; 2) it also allows the local planner to draw upon all of the previous data sets used in the larger model.

## **1.2 Review of the Urban Transportation Modeling System**

The Urban Transportation Modeling System (UTMS) is a set of procedures used by transportation planners to estimate urban travel demand in response to changes in land use, roadway characteristics and socioeconomic factors. UTMS is commonly referred to as the “Four Step Modeling Process”. and is presented in Figure 1.4. Steps one through four are Trip Generation, Trip Distribution, Modal Split, and Trip Assignment. The following sections contain brief descriptions of each step in UTMS and the type of data associated with that step. Since the subarea focus model plays an important role in this study, it has been added to the list as a fifth step.



**Figure 1.4 The Urban Transportation Modeling System** (Source: *Urban Transportation Planning A Decision-Oriented Approach*, Michael Myer and Eric J. Miller, 1984)

### 1.2.1 Trip Generation

Trip Generation analysis is concerned with the measure of zonal trip ends, that is, the estimated number of person trips produced by and attracted to each zone within the study area. To fulfill this objective, trip generation models (including both trip production and attraction models) are developed to establish a functional relationship between travel, land use, and socioeconomic characteristics of an area, so that the trip ends can be estimated by using developed models in conjunction with land use and socioeconomic information concerning the area under study. The types of land used and demographic data required to perform trip generation analysis depend upon the

variable specified in trip production and attraction models. In case of trip attraction models the required data were:

- Retail employment in zone - consumer retail employment
- Service employment in zone - government, school employees
- Basic employment in zone - all employment not covered by retail and service
- Total employment in zone
- Total number of households in zone

Trip Generation answers the question of: "Who is traveling?".

### **1.2.2 Trip Distribution**

"Trip Distribution is the process by which trips from one area are connected with trips from another area, thereby linking origins and destinations or productions and attractions."<sup>1</sup> Trip Distribution answers the question : "Where are people traveling".

### **1.2.3 Mode Choice Analysis**

Mode Choice Analysis is the process of "determining the magnitude of travel by mode"<sup>2</sup> (i.e., auto, bus, train, etc.); or in other words, the process of separating person-trips by mode of travel. The term "Mode Share" is the percentage of people in the various mode choice categories. Mode Choice answers the question: "What are people using to travel".

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<sup>1</sup> Transportation Research Board, *NCHRP 187*, 1978, pg. 22

<sup>2</sup> Transportation Research Board, *NCHRP 187*, 1978, pg. 63

#### **1.2.4 Trip Assignment**

Trip Assignment is the process of determining routes of travel and allocating the distributed trips to these routes. This is done by representing physical world street (link) data as parameters of travel. To accurately reflect roadway travel characteristics experienced by drivers on the network, several link characteristics must be obtained.

These data include:

- Roadway facility type
- Type of abutting land use
- Number of travel lanes
- Lane widths
- Intersection traffic control
- Link length
- Average speed
- Travel time
- Link capacities
- Traffic volumes

These parameters are used to calculate delay or the lack of it along the street network. Trip Assignment answers the question: "How (i.e., what route) do people use to travel from one point to another".

#### **1.2.5 Subarea Focus and Extraction**

The Subarea Focus and Extraction process involves a special type of trip assignment called a "select link" assignment. This assignment effectively cuts out a piece (subarea) of the larger network. This network carries along with it the attributes and

characteristics of the larger network. This process is used to develop focus area models on a local or sub-regional scale.

### **1.3 Review of Existing Travel Demand Software**

Most travel demand forecasting software packages used throughout New Jersey are based on the UTMS methodology. One such package will be reviewed in detail and its relationship shared with the UTMS process will be demonstrated. Two other travel demand forecasting software packages are listed with their UTMS equivalents. Table 1.3 shows the four stages of the UTMS process in the first column. The second column shows the equivalent stages of the QRS-II process. The third column shows the equivalent Tranplan process and the fourth column shows the equivalent MINUTP process or module(s).

**Table 1.3** The Urban Transportation Modeling System Steps and its Software Equivalents

UTPS	QRS-II	TRANPLAN	MINUTP
Trip Generation	Trip Generation Estimation	TRIPGEN.EXE	TRIPGEN.EXE
Trip Distribution	Trip Distribution	GMODEL.EXE FRATAR.EXE	PTHBLD.EXE TRPDST.EXE MATBAL.EXE FRATAR.EXE MATRIX.EXE
Modal Split	Mode Choice Analysis Automobile-Occupancy Time of Day	MSPLIT.EXE SPLTCAL.EXE	Not Applicable
Trip Assignment	Traffic Assignment	HWYLOD.EXE EQUILB.EXE	PTHBLD.EXE (in assignment mode)
Subarea Extraction	Not Applicable	SUBAREA.EXE EXNET.EXE	PTHBLD.EXE (in select link mode)

For this discussion only the first applicable module for MINUTP and Tranplan is used to describe its function in the UTMS process. Since QRS-II is not module based it will be referred to in a more general sense relating its options to the UTMS process. The reader is referred to the different packages user's guides for explanation of duplicate modules or the subtle differences between functions.



### **1.3.1 Quick Response System II**

The first package is the second phase of the "Quick Response System Urban Travel Estimation Techniques and Transferable Parameters". This system is more commonly known as QRS-II. As the name states QRS-II was developed as a planning system that would be able to respond to changes in urban policy issues and provide quick sets of solutions. The time savings would allow the planner to analyze several alternatives within a reasonable time. The procedures are structured to allow their utilization by transportation planners with various levels of experience.

QRS-II is primarily a menu driven system where the user calls upon and manipulates each of the modules in our interactive mode. It does have the capacity, albeit limited to run in batch mode after the user has programmed the initial iteration of defaults.

### **1.3.2 Tranplan**

The second travel demand forecasting system reviewed is the Tranplan software package distributed by the Urban Analysis Group of Danville California. Tranplan is a set of approximately 50 integrated executable programs whose basis is the Urban Transportation Modeling System (note: Several Tranplan modules are either report generators or similar to each other in execution). Like QRS-II, Tranplan modules can be run in batch mode and the user usually has primary control of the process. Tranplan has one important feature that MINUTP does not have and that is the ability to perform Mode Share analysis. Tranplan also possesses the ability to extract a subarea trip table and network, like MINUTP, while QRS-II does not.

### **1.3.3 MINUTP**

The third transportation planning package is the package on which my case study is based. It is the MINUTP software package distributed by The Comsis Corporation of

Silver Springs, Maryland. Like Tranplan, MINUTP is a set of software program modules that mimic the UTMS methodology. The MINUTP program library consists of 15 program modules that enable the user to perform three of four of the usual functions in the traditional transportation planning process: trip generation, trip distribution and network assignment. MINUTP does not contain a separate module for Mode Choice Analysis. Through some creative programming and with outside data inputs (i.e., Census Data or New Jersey Transit Ridership Survey Data) Mode Choice Analysis can be performed using a combination of MINUTP Modules.

#### **1.3.3.1 Trip Generation**

Trip Generation is performed using the TRIPGEN module, which is structured to take stratified zonal land use data, such as households by income, with up to 15 different categories (variables) for each zone. The output is a balanced trip end summary in P/A (production/attraction) format. The user specifies the total number of zones, the number of trip purposes (i.e., home-based work), and whether X-I (External Zone to Internal Zone) trips should be calculated. In addition the user sets up the method by which to calculate productions or attractions (i.e., category analysis, least squares regression).

#### **1.3.3.2 Trip Distribution**

The MINUTP trip distribution process, like QRS-II and Tranplan, is based on the classic gravity model illustrated in Equation 1-1<sup>3</sup>.

---

<sup>3</sup>Transportation Research Board, *Quick-Response Urban Travel Estimation Techniques and Transferable Parameters: User's Guide*.

$$T_{ij} = P_i \frac{A_j F_{ij} K_{ij}}{\sum_{j=1}^n A_j F_{ij} K_{ij}} \quad (1-1)$$

where

$$F_{ij} = f(t_{ij})$$

and

- $T_{ij}$  = trips produced in analysis area  $i$ , and attracted at analysis area  $j$ ;
- $P_i$  = total trip production at  $i$ ;
- $A_j$  = total trip attraction at  $j$ ;
- $F_{ij}$  = friction factor for trip interchange  $ij$ ;
- $K_{ij}$  = socioeconomic adjustment factor for interchange  $ij$  if necessary;
- $t_{ij}$  = travel time (or impedance) for interchange  $ij$ ;
- $i$  = origin analysis area number,  $i = 1, 2, 3 \dots n$ ;
- $j$  = destination analysis area number,  $j = 1, 2, 3 \dots n$ ;
- $n$  = number of analysis areas

This process is applied using three MINUTP modules: the PTHBLD (Path Building) module, the TRPDST (Trip Distribution) module, and the MATBAL module (Production/Attraction to and origin/destination conversion).

The PTHBLD module determines the minimum path between all zone pairs via a forward node seeking algorithm (The user is referred to the MINUTP manual , MINUTP Technical User Manual August 1993 for an in depth discussion of this algorithm). The user specifies the relative importance that time and distance have on the link impedance calculation. The output is a minimum path impedance matrix.

The TRPDST module calculates a trip distribution matrix using the trip generation summary, the impedance matrix, a user supplied friction factor file, and an optional user

supplied K-Factor file. The output of this module is a distributed trip matrix in production/attraction format.

The final step in the trip distribution process is a conversion from a production/attraction matrix to an origin/destination matrix. Up to this point all tables and matrices have been in daily (24 hour) format. The MATBAL module allows the user the option of converting these tables into daily, peak period or peak hour trip matrices. The output of this module is a study area origin/destination trip matrix that is ready to be assigned to a network.

### **1.3.3.3 Trip Assignment**

Trip assignment, in MINUTP, is accomplished using the PTHBLD module again. The inputs are: The output trip matrix from MATBAL (or any origin/destination matrix that could have been calculated externally) and a binary spatial network representation of the highway and street network of the study area. The PTHBLD module calculates minimum paths to all origin destination pairs and then routes trips from the trip matrix along the links of the selected paths. When all trips have been processed, the program adjusts link travel times based on congestion.

The trip assignment module is very flexible. It allows the user the options of:

- a) Number of trip matrices to be assigned (10 maximum)
- b) The path routing algorithm (i.e., all-or-nothing, equilibrium, stochastic)
- c) Modifying capacity restraint coefficients (travel time adjustment parameters) (i.e., delay curves)
- d) Format of final assigned link volumes (i.e., last iteration only)
- e) Number of iterations (10 Maximum)
- f) Select link matrix extraction

- g) Subarea trip matrix and network extraction
- h) Turn penalties and prohibitions
- i) Cold start tracing
- j) Separate high occupancy vehicle (HOV) trip table processing
- k) Link impedance selection

#### **1.3.3.4 Subarea Extraction**

The subarea extraction process is fairly straightforward. The user first defines the limits of the study area by drawing a cordon line around the area of interest. Second, the user specifies each and every link that crosses the cordon line. These cordon links become the new external stations for the subarea region. In other words they will represent all trips originating from or destined to the world external to the subarea. And third, the user must identify and renumber all of the zones contained within or internal to the study area.

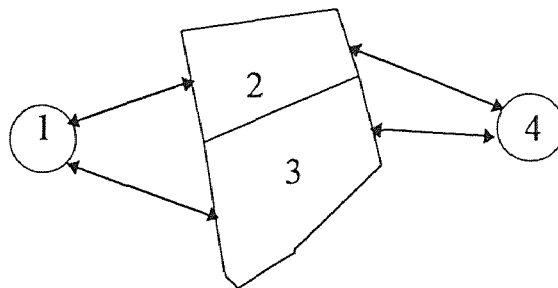
The user then runs the extraction which is a modified selected link assignment (PTHBLD). The assignment should be the same assignment used in the original network calibration. The only difference will be the trip table and network extraction parameters used to capture the subarea information. The result of the extraction assignment will be:

- 1) a network containing all of the information of the statewide model (roadway facility types, link capacities, etc.)
- 2) a trip table that corresponds only to trips on that subarea network

The user is cautioned at this point. Two of the travel demand modeling packages reviewed by the author, contain the capability of subarea extractions. Versions of

MINUTP and Tranplan before 1993 contain errors in their subarea extraction algorithms. Also the user must take care as to how he defines his cordon boundaries. Whenever possible the user should allow natural boundaries to become their cordon lines (i.e., rivers, mountains, etc. ). Natural boundaries usually negate the common pitfalls of subarea definition, which are “illegal” multiple cordon crossings.

“Illegal” multiple cordon crossings are defined as trips that pass through cordon links an unnecessary amount of times. Figure 1.5 is a small four zone subarea example that helps to illustrate this point. The circles 1 and 4 represent cordon points or external stations while the polygons 2 and 3 represent internal zones. If a trip is listed (in the trip table) as going from internal zone 2 to internal zone 3, it should be able to pass through 2 directly to 3 because the zones are adjacent to each other. It is unnecessary for that trip to pass through cordon station 1. A trip that goes from zone 2 to 1 to 3 is considered to be an “illegal” trip and is the product of poor cordon definition. This trip should not be included in the extracted trip table for the subarea. This type of error will cause the extraction process to produce an erroneous trip table. With proper care this type of problem can be avoided.



**Figure 1.5** Illustration of a Four Zone Subarea

Illegal multiple crossings can cause erroneous factoring errors or can cause trips to become lost during the extraction process. The user is charged with comparing and

checking the number of trips on the links of the subarea versus that of the regional model it was extracted from. If the number of trips differ between the two networks, the user must stop the process and investigate. The number of trips on the links must match exactly.

## CHAPTER 2

### REVIEW OF THE EXISTING METHODOLOGY

#### 2.1 Background

The emphasis of this thesis is on improving the results generated by UTMS to aid in better decision making for the transportation planner. The author's claim is that by modifying the way in which the subarea focus model is applied and by inserting an information feedback loop into the UTMS cycle, the modeler/planner at all levels will realize the benefits of improved model calibration.

Presently, the New Jersey State Department of Transportation (NJDOT) possesses two partial statewide highway transportation models. The North Jersey Model (Figure 2.1) and the South Jersey Model (Figure 2.2) cover most of the state's freeway, highway and major arterial system. The NJDOT has spent a number of years and millions of dollars on developing these models and millions more attempting to calibrate them. Sources of information to feed the modeling process range from The United States Bureau of the Census to the Department of Labor Statistics to telephone surveys. However, one important source of data and information has been overlooked, namely the regional/local planner (hereafter referred to as the local planner).





**Figure 2.1** North Jersey Model Network (Source: New Jersey Department of Transportation, 1993)



**Figure 2.2** South Jersey Model Network (Source: New Jersey Department of Transportation, 1991)

Over the last five to ten years, local planners have been utilizing a process that extracts subareas or portions of the North and South Jersey model for their specific region of the state. This saves the planner the time and expense of having to develop a trip table

from scratch. The task of developing a trip table is both expensive and time consuming and can cost up to 30-40% of a project's operating budget. Armed with an extracted trip table and local information the planner can develop a usable trip table in much less time than it would take to calculate trip generation and develop a reliable distribution and estimate mode choice percentages.

## **2.2 The Author's Test Case Network**

The North Jersey model, shown in Figure 2.1, covers an area of 13 counties containing over two hundred municipalities. The network consists of 1,377 internal traffic analysis zones and 9,970 network links, representing over 11,055 lane miles of roads. For this reason the Author's test case uses a more manageable subregion of the North Jersey Model. The author's primary focus area is the Northwest quadrant of Bergen County, New Jersey, as shown in Figure 2.3. This area covers one quarter of one county containing 16 municipalities. The network consists of 210 internal traffic analysis zones and 1629 network links, representing 454 lane miles of roads.



**Figure 2.3** Northwest Bergen County Model Network (Source: Garmen Associates, 1994)

The procedures outlined by the Author are applied on this smaller sub-region, but it is assumed that these same procedures can be applied at the North Jersey Model (NJM) scale and yield similar results. The Author's test case is set up to mimic the North

Jersey Model as supplied by the New Jersey Department of Transportation (NJDOT). The Northwest Bergen County Model (Northwest Model) comes complete with the following data:

1. Population and employment estimates
2. Trip production and attraction formulas and methodologies
3. An existing trip table
4. Highway and street inventory classifications
  - a) Facility type
  - b) Area type
5. A free flow speed and capacity table
6. Existing traffic or ground counts
7. A calibrated network

The Author lists all of the data that can be obtained from the Northwest Model, but will only detail those data sets that are used within the context of this test case.

### **2.3 The Traditional Method**

The traditional subarea extraction process, within the UTMS context is illustrated in Figure 2.4 (shown on next page). The process starts in the fourth UTMS step: *Trip Assignment*.

### 2.3.1 Download Statewide Model

The local planner uses the assigned and calibrated statewide model to download the calibrated model's attributes. This information usually includes an assigned and calibrated highway network and the trip table used for the assignment and calibration processes. Various other sets of important data can also be obtained; such as population and employment estimates, production and attraction equations, and existing traffic count data.

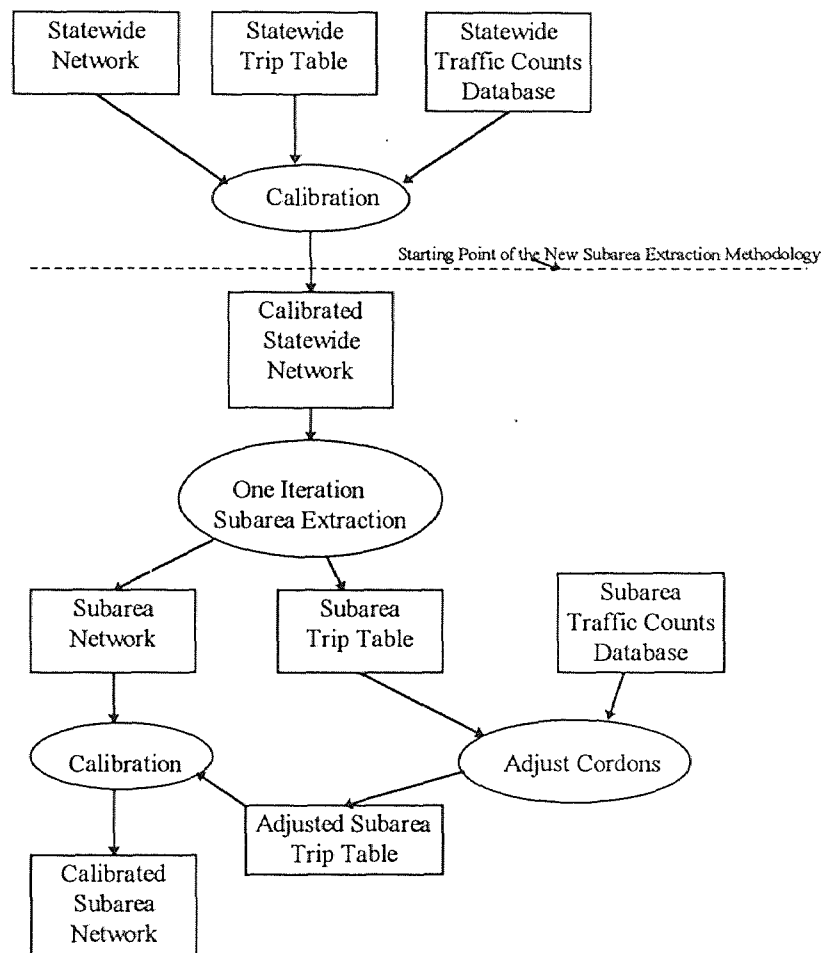
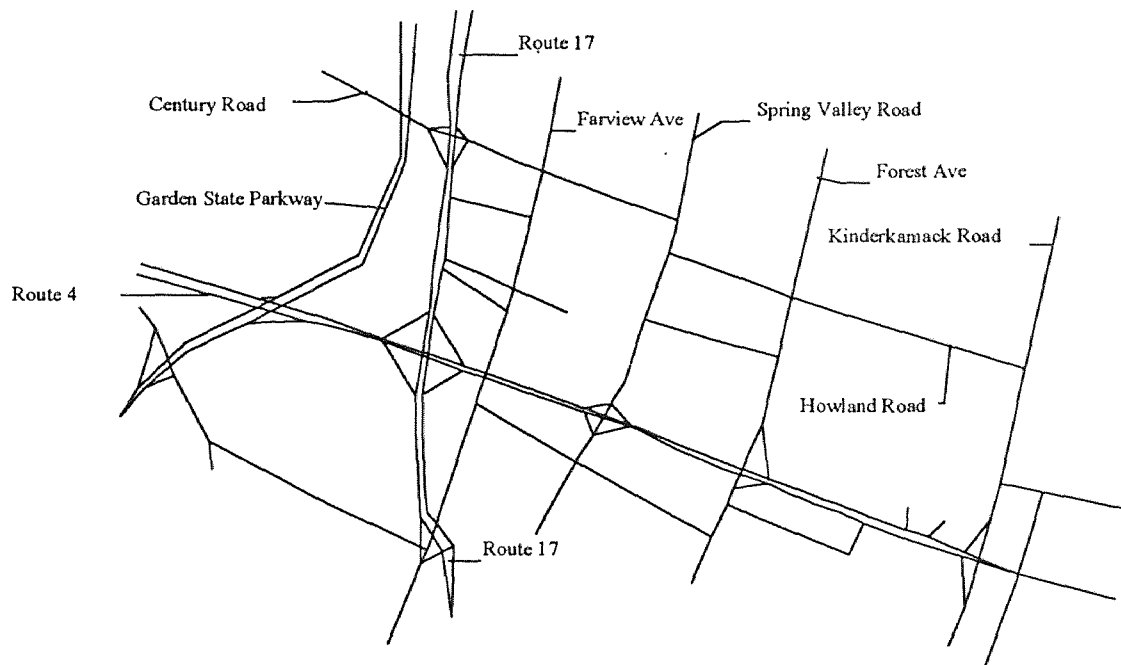


Figure 2.4 Traditional Subarea Extraction Process

### 2.3.2 Subarea Extraction

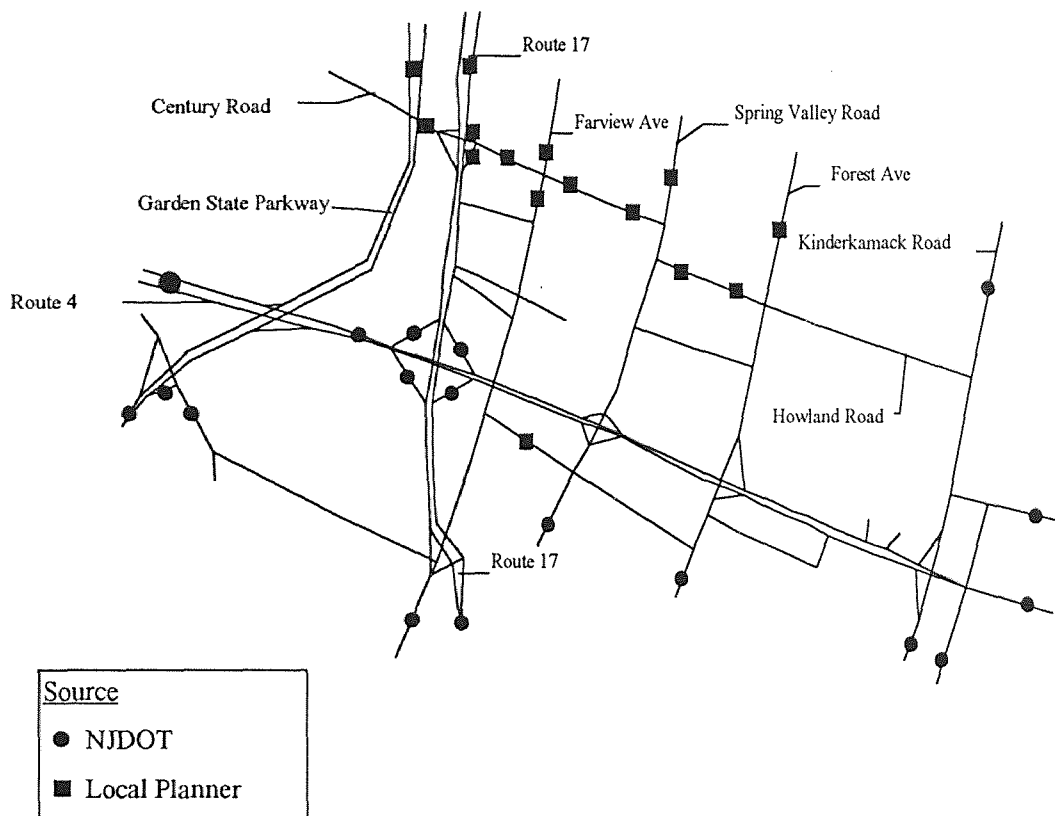
The information downloaded from the statewide model is then used to extract a subarea of the statewide model for local planning use. This is done through an all-or-nothing assignment using the select link option. The outputs of this process are: 1) a subarea trip table and 2) a subarea network which is shown in Figure 2.5. This is the process where the author believes the greatest error occurs. Extracting a subarea without verifying that calibration errors in the subarea focus region can be reduced



**Figure 2.5** Route 4 and 17 Subarea Network

### 2.3.3 Obtain Local Traffic Count Information

In order for the local planner to realize good calibration on his subarea network, he must make sure that he has adequate local coverage for traffic count information. The state model comes downloaded with traffic counts, whose locations are represented by circles in Figure 2.6.



**Figure 2.6** Route 4 and 17 Subarea Network Traffic Count Locations (Source: Garmen Associates, 1994)

These Counts alone are not enough to ensure good calibration for two reasons. First, the supplied counts do not cover all of the cordon points. As a self-contained area, the subarea focus region is required to model the behavior of the outside world through the



cordon points. This requires accurate traffic counts on all cordon points, especially in this test case subarea because of its large “through traffic” component. Through traffic is defined as traffic that neither begins or ends within the subarea (e.g., a vehicle entering the subarea at the western end on Route 4 and exiting from its eastern end).

Second, the traffic counts provided by the state do not provide any information on the local road system such as Howland Road in Figure 2.6. Therefore the local planner must enhance his traffic count database by performing extra traffic counts or collecting this information from local sources (i.e., municipal police department or local traffic impact studies). The squares in Figure 2.6 represent traffic count locations for which data was obtained through local sources.

#### **2.3.4 Adjust Cords**

The extracted trip table is then adjusted, via some matrix factoring process to match local ground count totals at the cordon points. This correction process is usually done using a program called FRATAR. FRATAR is a matrix factoring methodology used to obtain row and column totals. The problem with the FRATAR methodology is that it is purely mathematical in nature, and thus does not have a mechanism that allows it to account for network topology. In other words, FRATAR factors trip matrices disregarding the distribution of the factored trips. Herein lies the problem of the traditional methodology.

## CHAPTER 3

### NEW METHODOLOGY AND CASE STUDY

#### 3.1 New Methodology

As stated in Chapter two, the traditional methodology of the subarea extraction process is to extract the trip table and network using a one iteration, all-or-nothing assignment, with loaded impedances as base link impedances.

The author's methodology presented in Figure 3.1 starts by taking one step backward in the subarea extraction process to the level of model calibration on the statewide model. The first step involves the planner attempting to gain better calibration in the subarea region, at the statewide (regional) scale, before extracting the subarea.

The local planner does this in two steps: 1) by running the same equilibrium assignment setup that the NJDOT has run and 2) by enhancing the state's database with locally collected data (see the feedback loop in Figure 3.1). What the local planner does differently is that he draws upon his locally enhanced data sets to aid him in making intelligent decisions about changing local network attributes to affect the distribution and assignment in his subarea region. For this test case, the author has chosen to change attributes that affect link speed and capacity.

Once the local planner has run the new calibration assignment, he must check statistics on two levels. If he is satisfied that he has improved calibration in the region of his

subarea, then he must compare the new regional calibration statistics versus the original regional calibration statistics. If changing local attributes has adversely affected the overall regional calibration then the planner must try again, by changing the attributes in a different manner.

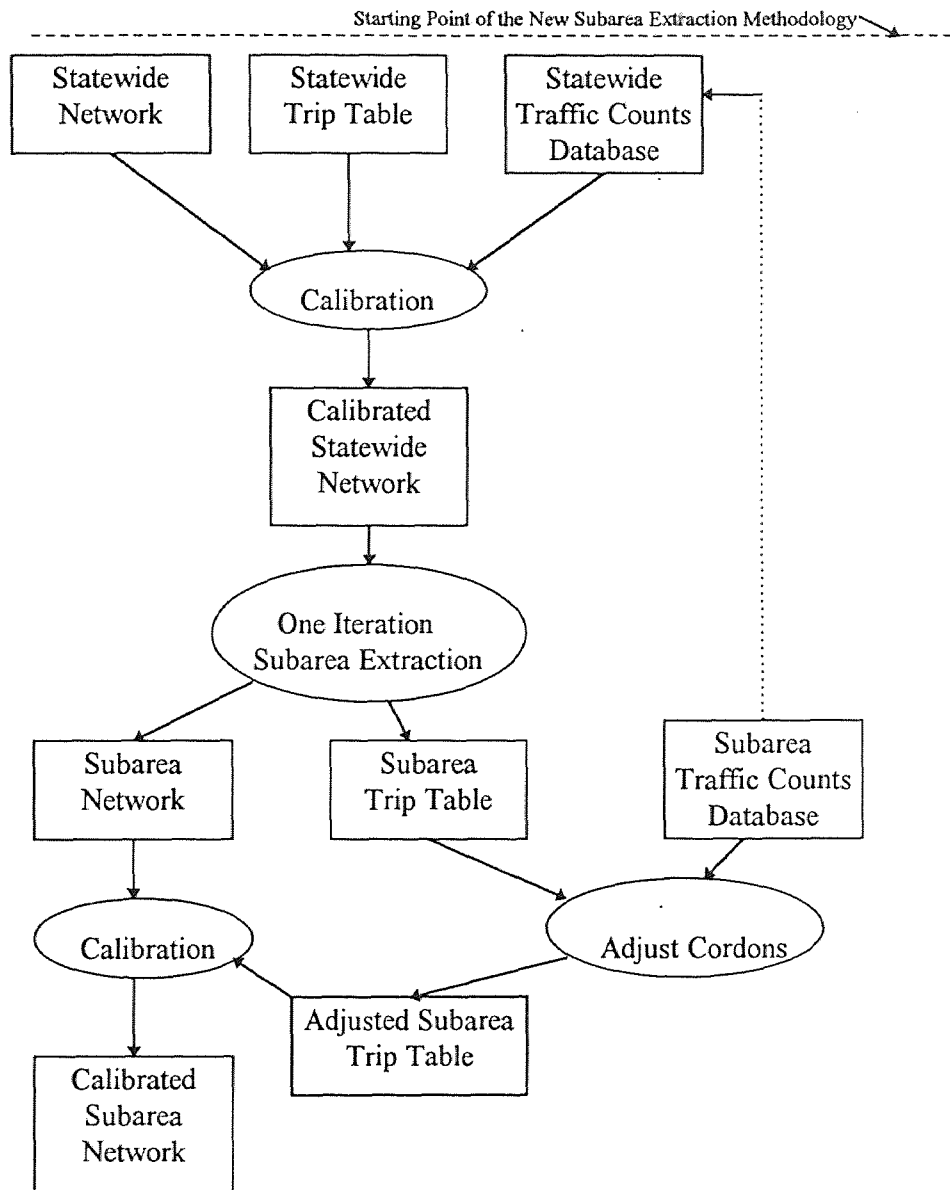


Figure 3.1 New Subarea Extraction Methodology

If the planner is satisfied with the calibration statistics at both levels, then he should proceed with the subarea extraction process.

Once the local planner has recalibrated the regional model, he should package his local traffic counts along with his link attribute changes, and funnel (loop) this information back to the NJDOT. Periodically the NJDOT should update its statewide models with all of the new information received from local planners. In theory, this would facilitate better statewide assignments in areas of previously fair to poor calibration.

## **3.2 Case Study**

### **3.2.1 Define Subarea Boundaries**

The author's methodology starts much like the traditional methodology. The user defines the boundaries of the subarea to be extracted by listing the cordon links inside the regional model. In Figure 2.3 the box around the proposed subarea effectively does this.

### **3.2.2 Obtain Local Traffic Count Information**

This process is the same as described in Section 2.3.3. The planner checks the subarea for available traffic count data. He identifies locations where additional coverage is needed. Cordon station counts are prerequisites for good local subarea calibration. Other internal links may also be important for establishing both through traffic and internal circulation.

### **3.2.3 Check Calibration of Regional Model**

The local planner then checks the link calibration of the regional model within the subarea region, paying particular attention to the links defined as subarea cordons. The

user makes the determination of whether the calibration falls within acceptable margins of error (see Chapter 4). If the answer is "yes", then the user can proceed with the traditional subarea extraction process. If the answer is "no", then the author suggests the following steps, which will lead to a recalibration of the regional model, in an attempt to gain a better calibration in the subarea region.

### **3.2.4 Create New Network Variables**

In order to use the author's methodology, some slight enhancements must be made to the regional model. Addition of four fields should become new standard fields within the state modeling context. Thus these fields would become new defaults for anyone basing their work upon the statewide model:

- 1) CAPADD - link capacity to be added in vehicles per hour per lane (vphpl)
- 2) CAPSUB- link capacity to be subtracted in vehicles per hour per lane (vphpl)
- 1) SPDADD - link free speed to be added in tenths of a mile (i.e., 100 = 10.0 miles per hour)
- 2) SPDSUB - link free speed to be subtracted in tenths of a mile

These variables give the planner a very powerful tool by which to fine tune an individual link's capacity and free speed. This is important because it allows the planner to make minute adjustments to link impedances that were previously not available to the NJDOT model. Certain link attributes can be altered based on observations or sound engineering judgment. This allows the user to utilize the whole range of the

speed and capacity table. In effect, the user has the ability to differentiate between the same facility and area type combination for different geographic locations and features.

An example of this might be the Interstate 80 mainline along a long straight stretch versus Interstate 80 in the vicinity of a heavy weave section like the interchange at Interstate 287. The facility/area class for both sections would be a freeway (facility type = 1) with vacant adjacent land use (area = 6). This would give both links an effective free speed of 65 miles per hour and an effective capacity of 1900 vehicles per hour per lane. In reality the weave section at I-287 may have an effective capacity of only 1750 vphpl and a free speed of 53 miles per hour.

Previously, the user would have to alter the speed and capacity of the link by changing the facility type and/or area type to fit the desired class. This would cause erroneous results in assignments and network statistical reporting.

With the new variables in place, the user can code a CAPSUB value of 150 and a SPDSUB value of 70 (7.0 miles per hour) to obtain the desired reduction in free speed and capacity.

The actual calculation is performed in a "NETMRG" step, before the assignment is done (Appendix A) This technique is preferable to the traditional technique because it maintains the link's original facility/area attributes while keeping a logical, duplicable, and traceable list of link characteristic changes.

### **3.2.5 Adjust Link Attributes**

After creating these new attributes, the user proceeds to adjust local attributes on those links in the areas where calibration is fair to poor. The author suggests that the planner starts with low volume roads first (since they are generally the poorest calibrated set of links) and work his way up to the higher volumes links.

The planner may choose to enter these attributes directly onto the link via NETVUE (the on-screen network editor). The author suggests that these changes be programmed as part of the pre-assignment NETMRG setup as listed in Appendix A.

### **3.2.6 Recalibrate Network**

Once the initial adjustment process is complete the planner runs the statewide model assignment process. The user then checks the calibration on two levels:

- 1) at the Northwest model level
- 2) in the area of the subarea focus

If he is not satisfied, the user may iterate as many times as needed by readjusting local attributes and rerunning the calibration process on the regional network.

### **3.2.7 Extract Subarea and Check Distribution**

Once the planner is satisfied with the regional and subarea region's calibration, then he is free to extract his subarea network (Figure 2.5). At this point the planner should make a comparison of the extracted trip tables' distributions using the two extraction methods. As in the traditional methodology, the planner will probably still use a matrix factoring process (i.e., FRATAR) to adjust his cordon trip totals. However having corrected the extracted trip table's distribution, and having improved the calibration at these cordon points, the FRATAR process will have a lessening effect on the skewing of the trip table's distribution.

## CHAPTER 4

### PRESENTATION OF RESULTS

#### 4.1 Calibration Methods

In order to assess the success of the author's methodology, first, calibration results of the case study are presented for comparison to the traditional method of subarea extraction. This is done for the network as a whole and secondly on the region of subarea focus. The Author evaluates calibration on both levels to check that better calibration in the subarea is not gained at the expense of less calibration accuracy at the regional network level. The following are five ways which the United States Department of Transportation (USDOT) uses to compare traffic assignment accuracies (i.e., model calibration)<sup>3</sup>:

- 1) a comparison of total counted volume versus assigned volume across some aggregation such as total study area or screenlines
- 2) a comparison of total vehicle miles of travel (VMT) from ground counts to vehicle miles of travel from the assignment results.
- 3) developing a total weighted error between ground counts and assigned volumes

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<sup>3</sup> Federal Highway Administration, *Traffic Assignment*, 1973, pg 164



4) the calculation of the root-mean square (RMS) errors comparing ground counts to assigned volumes by link within volume range stratification

$$RMS = \sqrt{\frac{\sum_i (X_{gc} - X_{ta})^2}{N-1}} \quad (4-1)$$

where

$X_{gc}$	=	Ground count on link $L_i$
$X_{ta}$	=	Volume assigned on link $L_i$
$N$	=	Total number of links in observations group
$i$	=	1 through $N$

The root-mean square error measures the deviation between two distributions, in this case counted and assigned link volumes. The percent RMS error is derived by dividing the RMS error by the average group count for a particular group.

5) a graphic comparison of ground counts versus assigned volumes

For this discussion methods 1) and 4) were used as assignment calibration measures.

#### 4.2 Calibration Comparisons on the Northwest Model

Table 4.1 depicts the calibration statistics for the Northwest Model regional network as received from the NJDOT. The absolute difference of total counted volume to total assigned volume is 224,555 vehicles or 3.38%. The root-mean square error for the entire network is 4,124 vehicles while the RMS percentage is 28.28%. Table 4.2 depicts calibration statistics of the same network using the author's test case. The absolute difference of total counted volume to total assigned volume is 221,234 vehicles or 3.33%. The root-mean square error for the entire network is 4,111 vehicles while the RMS percentage is 28.19%.

**Table 4.1** Performance Measures for the Northwest Model Network using the Traditional Methodology

Volume Range		Number of	Total Counted	Total Assigned	Difference	Percent	Root-Mean	% Root-Mean
Lower Limit	Upper Limit	Records	Volume	Volume	Assigned - Counted	Difference	Square Error	Square Error
0	5,000	169	468,208	435,668	-32,540	-6.95%	1,814	65.48%
5,001	10,000	116	856,311	820,067	-36,244	-4.23%	3,440	46.60%
10,001	20,000	72	970,971	1,003,120	32,149	3.31%	5,357	39.72%
20,001	30,000	22	530,291	461,634	-68,657	-12.95%	4,627	19.20%
30,001	40,000	25	827,775	786,336	-41,439	-5.01%	6,979	21.08%
40,001	50,000	13	606,324	575,333	-30,991	-5.11%	5,831	12.50%
50,001	60,000	15	859,090	852,343	-6,747	-0.79%	7,418	12.95%
60,001	70,000	23	1,516,252	1,476,166	-40,086	-2.64%	6,654	10.09%
All Links		455	6,635,222	6,410,667	-224,555	-3.38%	4,124	28.28%

**Table 4.2** Performance Measures for the Northwest Model Network using the Author's Methodology

Volume Range		Number of	Total Counted	Total Assigned	Difference	Percent	Root-Mean	% Root-Mean
Lower Limit	Upper Limit	Records	Volume	Volume	ASS-CNT	Difference	Square Error	Square Error
0	5,000	169	468,208	421,289	-46,919	-10.02%	1,767	63.78%
5,001	10,000	116	856,311	789,960	-66,351	-7.75%	3,312	44.87%
10,001	20,000	72	970,971	1,005,785	34,814	3.59%	5,439	40.33%
20,001	30,000	22	530,291	464,993	-65,298	-12.31%	4,650	19.29%
30,001	40,000	25	827,775	786,526	-41,249	-4.98%	6,974	21.06%
40,001	50,000	13	606,324	582,577	-23,747	-3.92%	4,502	9.65%
50,001	60,000	15	859,090	880,321	21,231	2.47%	8,889	15.52%
60,001	70,000	23	1,516,252	1,482,537	-33,715	-2.22%	6,088	9.23%
All Links		455	6,635,222	6,413,988	-221,234	-3.33%	4,111	28.19%

Using the author's methodology the user has realized an improvement of 0.05% or 3,321 vehicles in total counted versus total assigned volume. The RMS error has improved by 13 vehicles (from 4,124 to 4,111), while the RMS percentage has improved by eight hundredths of a percent.

The network statistics in Tables 4.1 - 4.2 show only moderate changes. Because of the minor nature of the author's network edits (20 out of 1629 links) in the subarea region, one would not expect the calibration results to improve by much. But the fact that they do improve is enough to go on to the next step which is comparison of the calibration results on the subarea focus region.

#### **4.3 Calibration Comparisons on the Subarea Region**

Table 4.3 depicts the calibration statistics for the Northwest Model in the region of the subarea focus as received from the NJDOT. The absolute difference of total counted volume to total assigned volume is 86,117 vehicles or 3.66%. The root-mean square error for the subarea focus region is 4,262 vehicles while the RMS percentage is 15.93 %. Table 4.4 depicts calibration statistics of the same network using the author's test case. The absolute difference of total counted volume to total assigned volume is 73,185 vehicles or 3.11%. The root-mean square error for the entire network is 4,144 vehicles while the RMS percentage is 15.49%. Using the author's methodology the user has realized an improvement of 0.34% or 12,932 vehicles in total counted versus total assigned volume. The RMS error has improved by 118 vehicles (from 4,262 to 4,144), while the RMS percentage has improved by 0.44% (from 15.93% to 15.49%).

**Table 4.3** Performance Measures for the Route 4 and 17 Focus Area using the Traditional Methodology

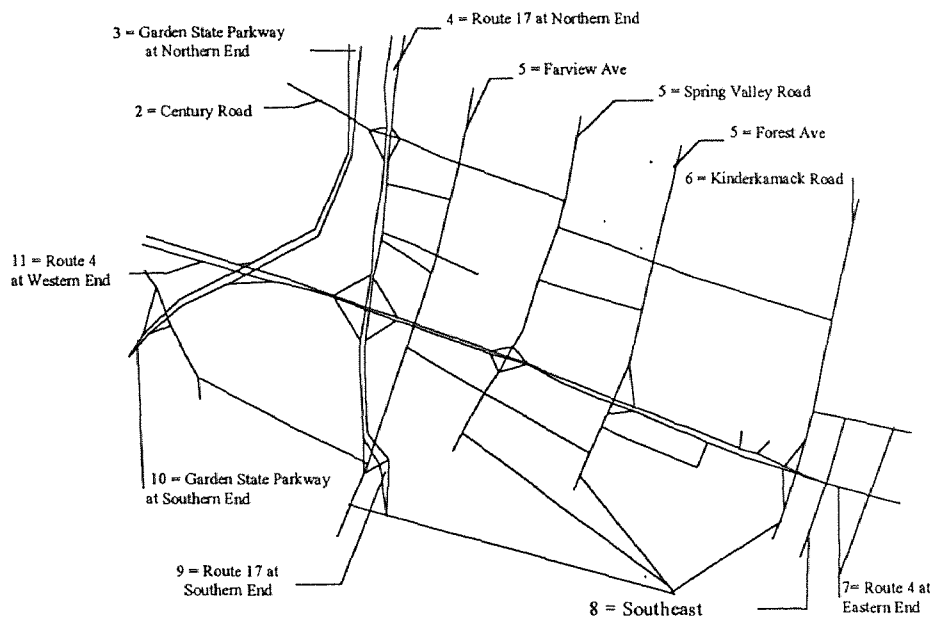
Volume Range		Number of	Total Counted	Total Assigned	Difference	Percent	Root-Mean	% Root-Mean
Lower Limit	Upper Limit	Records	Volume	Volume	Assigned - Counted	Difference	Square Error	Square Error
0	5,000	9	27,864	41,075	13,211	47.41%	2,421	78.19%
5,001	10,000	32	238,105	263,352	25,247	10.60%	3,644	48.98%
10,001	30,000	15	188,026	201,260	13,234	7.04%	4,755	37.93%
30,001	50,000	9	417,948	409,157	-8,791	-2.10%	3,790	8.16%
50,001	60,000	8	478,220	513,846	35,626	7.45%	6,672	11.16%
60,001	70,000	15	1,003,512	1,011,102	7,590	0.76%	5,200	7.77%
All Links		88	2,353,675	2,439,792	86,117	3.66%	4,262	15.93%

**Table 4.4** Performance Measures for the Route 4 and 17 Focus Area using the Author's Methodology

Volume Range		Number of	Total Counted	Total Assigned	Difference	Percent	Root-Mean	% Root-Mean
Lower Limit	Upper Limit	Records	Volume	Volume	Assigned - Counted	Difference	Square Error	Square Error
0	5,000	9	27,864	25,824	-2,040	-7.32%	1,447	46.75%
5,001	10,000	32	238,105	231,941	-6,164	-2.59%	3,092	41.56%
10,001	30,000	15	188,026	206,182	18,156	9.66%	4,897	39.06%
30,001	50,000	9	417,948	411,087	-6,861	-1.64%	2,843	6.12%
50,001	60,000	8	478,220	536,782	58,562	12.25%	7,574	12.67%
60,001	70,000	15	1,003,512	1,015,044	11,532	1.15%	5,201	7.77%
All Links		88	2,353,675	2,426,860	73,185	3.11%	4,144	15.49%

### 4.3 Subarea Trip Table Distributions

The third and most conclusive measure of validation of the author's methodology, is a comparison of the extracted subarea trip tables, from both methodologies. Table 4.5 (shown on next page) is a compressed district trip table for the traditional methodology. The 11 districts are represented in Figure 4.1. For this discussion all internal zones are compressed into the first district, since the subarea process does not affect them. This fact will be borne out in comparison of the extracted trip tables.



**Figure 4.1** Trip Table Reporting Districts for Subarea Focus Region

Table 4.5 indicates the total trips extracted for the subarea are 473,133. Table 4.6 is a compressed district trip table for the author's methodology. It indicates the total trips extracted for the subarea are 482,437. The trip table totals are presented for the user as a guideline as to the magnitude of trips one should expect to have extracted.

**Table 4.5** Extracted Subarea Trip Table Using Traditional Methodology

		Route 4/17 Subarea Trip Table Extracted Using Traditional Methodology											
		Destination District											
		1	2	3	4	5	6	7	8	9	10	11	Total
O	1 Internal	10950	1818	442	10777	4204	2890	8540	7178	5729	7285	14371	74184
r	2 Century	1074	0	0	3134	575	299	319	483	956	833	0	7673
i	3 GSPNorth	1577	0	0	0	0	0	0	0	0	42592	863	45032
g	4 Rt17Nrth	7421	2827	0	209	1647	473	17521	5245	26848	72	5116	67379
i	5 ParamusW	4607	604	0	1750	172	156	1970	1378	1179	2196	1826	15838
n	6 ParamusE	3365	37	0	296	398	0	1494	2292	626	1007	1517	11032
	7 Rt4East+	7975	327	0	18320	1007	1172	2594	8703	807	3513	10873	55291
D	8 SthEast	6623	480	0	5300	863	1875	9147	1553	2368	3267	5150	36626
i	9 Rt17Sth	5975	1545	0	24520	1097	526	891	2467	0	638	7810	45469
s	10 GSPSth	7638	0	40050	0	1520	941	4112	3626	676	0	7255	65818
t	11 Rt4West+	11004	0	9816	0	2343	987	9762	4524	6282	4073	0	48791
Total		68209	7638	50308	64306	13826	9319	56350	37449	45471	65476	54781	473133



Table 4.6 Extracted Subarea Trip Table Using The Author's Methodology

		Route 4/17 Subarea Trip Table Extracted Using Author's Test Case											
		Destination District											
		1	2	3	4	5	6	7	8	9	10	11	Total
O	1 Internal	9895	1707	442	10740	4473	2521	8242	6928	5529	7285	16422	74184
r	2 Century	1012	0	0	3134	572	21	319	483	956	833	0	7330
i	3 GSPNorth	1483	0	0	0	0	0	0	0	0	43242	844	45569
g	4 Rt17Nrth	7556	2827	0	209	1626	2	18206	5455	27070	72	5106	68129
i	5 ParamusW	5622	579	0	1568	202	896	2103	1535	1179	1546	1879	17109
n	6 ParamusE	1565	26	0	0	1549	0	1494	2292	626	1007	2473	11032
	7 Rt4East+	4451	327	0	18012	1128	1172	2594	8703	807	3513	14584	55291
D	8 SthEast	4679	480	0	5168	958	1875	9147	1553	2368	3267	7131	36626
i	9 Rt17Sth	5975	1545	0	24595	1097	526	891	2467	0	638	7735	45469
s	10 GSPStH	7638	0	40050	0	1520	941	4112	3626	676	0	7255	65818
t	11 Rt4West+	18333	0	9796	0	2404	1365	9242	4407	6260	4073	0	55880
Total		68209	7491	50288	63426	15529	9319	56350	37449	45471	65476	63429	482437

The importance of the Author's methodology is seen in Tables 4.7 and 4.8. Table 4.7 represents the differences between the two extracted trip tables, while Table 4.8 represents the percentage differences of these same tables. While Table 4.8 indicates that there is only a difference of 2% total trips between the trip tables, Table 4.7 indicates that the distributions of each table are vastly different.

As an example, if the reader looks at the total number of trips destined to District 6 in Tables 4.5 and 4.6, it is indicated that the total number of trips, 9,316 has not changed from the traditional methodology and the author's test case. However, examining Table 4.7 indicates the origins of these trips are quite different. In the author's test case (740) vehicles have shifted to the local roads. A large percentage of these trips (471) shifted from Route 17.

If we assume that the regional trip table has good trip distribution, and we know from the calibration statistics, that we have improved our calibration in this area, then it is safe to conclude that the distribution of the author's extracted trip table is better than the distribution in the trip table extracted using the traditional methodology. These comparisons help to support the claims that the authors 's methodology is a more sound one.

**Table 4.7** Trip Differences Between the Extracted Subarea Trip Tables

		Route 4/17 Subarea Trip Table Absolute Differences Traditional Methodology versus Author's Test Case											
		Destination District											
		1	2	3	4	5	6	7	8	9	10	11	Total
O	1 Internal	-1055	-111	0	-37	269	-369	-298	-250	-200	0	2051	0
r	2 Century	-62	0	0	0	-3	-278	0	0	0	0	0	-343
i	3 GSPNorth	-94	0	0	0	0	0	0	0	0	650	-19	537
g	4 Rt17Nrth	135	0	0	0	-21	-471	685	210	222	0	-10	750
i	5 ParamusW	1015	-25	0	-182	30	740	133	157	0	-650	53	1271
n	6 ParamusE	-1800	-11	0	-296	1151	0	0	0	0	0	956	0
	7 Rt4East+	-3524	0	0	-308	121	0	0	0	0	0	3711	0
D	8 SthEast	-1944	0	0	-132	95	0	0	0	0	0	1981	0
i	9 Rt17Sth	0	0	0	75	0	0	0	0	0	0	-75	0
s	10 GSPSth	0	0	0	0	0	0	0	0	0	0	0	0
t	11 Rt4West+	7329	0	-20	0	61	378	-520	-117	-22	0	0	7089
Total		0	-147	-20	-880	1703	0	0	0	0	0	8648	9304

**Table 4.8** Trip Percentage Differences Between the Extracted Subarea Trip Tables

Route 4/17 Subarea Trip Table Percent Differences  
Traditional Methodology versus  
Author's Test Case

		Destination District											
		1	2	3	4	5	6	7	8	9	10	11	Total
Origin District	1 Internal	.90	.94	1.00	1.00	1.06	.87	.97	.97	.97	1.00	1.14	1.00
	2 Century	.94	.00	.00	1.00	.99	.07	1.00	1.00	1.00	1.00	.00	.96
	3 GSPNorth	.94	.00	.00	.00	.00	.00	.00	.00	.00	1.02	.98	1.01
	4 Rt17Nnth	1.02	1.00	.00	1.00	.99	.00	1.04	1.04	1.01	1.00	1.00	1.01
	5 ParamusW	1.22	.96	.00	.90	1.17	5.74	1.07	1.11	1.00	.70	1.03	1.08
	6 ParamusE	.47	.70	.00	.00	3.89	.00	1.00	1.00	1.00	1.00	1.63	1.00
	7 Rt4East+	.56	1.00	.00	.98	1.12	1.00	1.00	1.00	1.00	1.00	1.34	1.00
	8 SthEast	.71	1.00	.00	.98	1.11	1.00	1.00	1.00	1.00	1.00	1.38	1.00
	9 Rt17Sth	1.00	1.00	.00	1.00	1.00	1.00	1.00	1.00	.00	1.00	.99	1.00
	10 GSPsth	1.00	.00	1.00	.00	1.00	1.00	1.00	1.00	1.00	.00	1.00	1.00
	11 Rt4West+	1.67	.00	1.00	.00	1.03	1.38	.95	.97	1.00	1.00	.00	1.15
Total		1.00	.98	1.00	.99	1.12	1.00	1.00	1.00	1.00	1.00	1.16	1.02

## CHAPTER 5

### CONCLUSIONS

The case study that the author has used in demonstrating his methodology, is one that involves a regional model and a subarea of the regional model. It has been shown that by using the author's looping methodology, improvement was realized in the calibration of the regional model, particularly in the region of the subarea focus model. This improved calibration process is the key to developing subarea focus models with properly distributed trip tables.

The author believes that this looping methodology will work at all levels of the modeling process. He believes that it could be instituted at the state-wide modeling level. The New Jersey Department of Transportation (NJDOT) could require that any transportation model that is funded or reviewed by the NJDOT, must have its basis on the DOT's state-wide model. Planners would set up and collect data specific to their area and insert these new attributes back into the regional model, attempting to gain better calibration for their specific area. After running the statewide model, the local planner would then be in a better position to extract the trip table for their particular project, along with population and employment data or other pertinent data. They would then calibrate their own model using the extracted data plus their own enhanced data set (i.e., traffic counts, ITE data, etc.).

Once this information has been processed by the local planner, the data can be channeled back to the state NJDOT. Modifications can be made to the statewide modeling process which would translate into new link attributes or new coefficients for production and attraction equations.

This new set of data, which is now tailored to the subarea region, would be incorporated into the modeling process. At designated intervals, all of the subarea models' (being used inside the state) data would be collected and integrated and the statewide model would be recalibrated.

As the process continues some of the realized benefits would be:

- A statewide traffic count database
- Updates for the production and attraction equation coefficients
- Standardized data collection techniques
- New and better trip distributions
- Standard statewide screenlines
- Reduction in duplication of data collection
- Significant improvements of calibration results all levels
- More efficient use of planning budgets
- Better dialogue between federal, state and local officials

The author believes that more regularity and consistency between calibration updates would draw the modeling community closer to responding to changing issues in a reasonable span of time. This would eliminate the excuse of the model

being "out of date". Better calibration logically yields better forecasts, and better forecasts aid the planner with the needed insight of the land use and infrastructure planning process.

## APPENDIX

### MINUTP INPUT SETUP FILES FOR NETWORK ASSIGNMENTS AND SUBAREA EXTRACTIONS.

```
$ This Setup Assigns the Northwest Model Using the Traditional
$ Methodology.
$
$
$>erase KYLE*.prn
*pgm netmrg NWII20A.Y90,NWII20F.Y90
$      #####
$      #####
$-----
$
$ Update network speeds and capacities
COMP SPDSUB=0
COMP CAPSUB=0$ This setup Assigns the Northwest Network using the
Author's
$ Methodology. Comments have been added to assist the reader
$ in identifying link attributes that have been altered for this
$ process.
$
$
$>erase KYLE*.prn
*pgm netmrg NWII20A.Y90,NWII20F.Y90.
$      #####
$      #####
$-----
$ THIS IS THE "CHANGE LINK ATTRIBUTE" SECTION
$-----
IF A=6067          HOWLAND AVE WB W. OF KINDERKAMACK
  IF B=2055
    COMP SPDSUB=15
    COMP CAPSUB=600
  ENDIF
ENDIF
IF A=2055          HOWLAND AVE WB W. OF FOREST
  IF B=4124
    COMP SPDSUB=15
    COMP CAPSUB=600
  ENDIF
ENDIF
IF A=2045          FOREST SB N. OF HOWLAND
  IF B=2055
    COMP SPDADD=5
    COMP CAPADD=300
  ENDIF
ENDIF
IF A=2043          FOREST SB N. OF HOWLAND
  IF B=2045
    COMP SPDADD=5
    COMP CAPADD=300
  ENDIF
ENDIF
IF A=2043          SPRING VALLEY RD SB N. OF HOWLAND
  IF B=2797
    COMP SPDADD=10
    COMP CAPADD=300
  ENDIF
ENDIF
ENDIF
```



```

IF A=2797                                SPRING VALLEY RD SB N. OF HOWLAND
  IF B=2051
    COMP SPDADD=10
    COMP CAPADD=300
  ENDIF
ENDIF

$IF A=1953                                RTE 4 EB TO RTE 17 NB
$  IF B=1955
$    COMP SPDSUB=15
$    COMP CAPSUB=300
$  ENDIF
$ENDIF

IF A=1955                                RTE 17 NB TO RTE 4 EB
  IF B=1953
    COMP SPDSUB=20
    COMP CAPSUB=1200
  ENDIF
ENDIF

$IF A=1949                                RTE 17 NB TO RTE 4 WB
$  IF B=1951
$    COMP SPDSUB=15
$    COMP CAPSUB=900
$  ENDIF
$ENDIF

IF A=1961                                RTE 4 WB TO RTE 17 SB
  IF B=1963
    COMP SPDSUB=20
    COMP CAPSUB=1200
  ENDIF
ENDIF

IF A=1967                                CENTURY RD TO RTE 17 NB
  IF B=1965
    COMP SPDSUB=10
    COMP CAPSUB=300
  ENDIF
ENDIF

IF A=2525                                CENTURY RD WB
  IF B=1967
    COMP SPDSUB=10
    COMP CAPSUB=300
  ENDIF
ENDIF

IF A=2049                                CENTURY RD WB
  IF B=2525
    COMP SPDSUB=10
    COMP CAPSUB=300
  ENDIF
ENDIF

IF A=4125                                HOWLAND AVE WB
  IF B=2049
    COMP SPDSUB=10
    COMP CAPSUB=300
  ENDIF
ENDIF

IF A=2051                                HOWLAND AVE WB
  IF B=4125
    COMP SPDSUB=10
    COMP CAPSUB=300
  ENDIF
ENDIF

IF A=4125                                CENTURY RD EB W. OF SPRING VALLEY
  IF B=2051

```

```

        COMP SPDSUB=10
        COMP CAPSUB=300
    ENDIF
ENDIF
IF A=4124                HOWLAND EB W. OF FOREST
    IF B=2055
        COMP SPDSUB=10
        COMP CAPSUB=300
    ENDIF
ENDIF
IF A=2055                HOWLAND EB W. OF KINDERKAMACK
    IF B=6067
        COMP SPDSUB=10
        COMP CAPSUB=300
    ENDIF
ENDIF
IF A=2527                HOWLAND EB W. OF FOREST
    IF B=2049
        COMP SPDADD=5
        COMP CAPADD=500
    ENDIF
ENDIF

```

```
ENDIF
```

```

$-----
$ END THE "CHANGE LINK ATTRIBUTE" SECTION
$-----

```

```
*PAR PAGE=1
```

```
*ID WWGM: Update Network Speeds & Caps
```

```
$=====
```

```

$ Part 1: Replace Default MinUTP speed/capacity lookup table
$ with a revised Garmen lookup table
$ Note that this setup eliminates the "high/low" speed sections
$ of the SPED table that are a relic of the earliest NETMOD days

```

```
SPED 1,10,20,30,40,50,60,70,80,90,100
```

```
SPED 11,110,120,130,140,150,160,170,180,190,200
```

```
SPED 21,210,220,230,240,250,260,270,280,290,300
```

```
SPED 31,310,320,330,340,350,360,370,380,390,400
```

```
SPED 41,410,420,430,440,450,460,470,480,490,500
```

```
SPED 51,510,520,530,540,550,560,570,580,590,600
```

```
SPED 61,610,620,630
```

```
CAPA 1,0375,0400,0425,0450,0475,0500,0525,0550,0575,0600
```

```
CAPA 11,0625,0650,0675,0700,0725,0750,0775,0800,0825,0850
```

```
CAPA 21,0875,0900,0925,0950,0975,1000,1025,1050,1075,1100
```

```
CAPA 31,1125,1150,1175,1200,1225,1250,1275,1300,1325,1350
```

```
CAPA 41,1375,1400,1425,1450,1475,1500,1525,1550,1575,1600
```

```
CAPA 51,1625,1650,1675,1700,1725,1750,1775,1800,1825,1850
```

```
CAPA 61,1875,2000,9999
```

```

$ Note that for this setup the max realistic per-lane capacity
$ (CAPC=62) is 2000 vphpl. This value is used below for
$ FACTYPE=1 and 9

```

```
$=====
```

```
$ Route 208 / Northwest Bergen FACTYPES and AREATYPES:
```

```
$
```

```
$ FACTYPE: 1 = Freeway
```

```
$ 2 = Major Divided Arterial With Shoulder
```

```
$ 3 = Major Divided Arterial Without Shoulder
```

```
$ 4 = Major Undivided Arterial
```

```
$ 5 = Undivided Arterial with Shoulder
```

```
$ 6 = Undivided Arterial Without Shoulder
```

```
$ 7 = Collector / Local (2 lanes)
```

```
$ 8 = Highway Ramp / Jughandle
```

```
$ 9 = Centroid Connector
```

```
$
```

```

$
$ AREA:      1 = Central Business District
$           2 = Urban Residential / Commercial / Industrial
$           3 = Suburban Residential
$           4 = Suburban Commercial
$           5 = Suburban Residential / Mixed Usage
$           6 = Vacant / Rural / Agriculture

```

```

$=====

```

```

comp capc=1.
comp spdc=1.
comp tsva=0.
comp cdev=cnt(1)
comp arrtype=0
comp nsigs=0
comp tsin=0
$ ---- this section determines capacity & speed from factype ----
$   values CAPA is vphpl, SPDC is 0.1 mph
$
$   These capacities and speeds are rederived from the NW Bergen

```

```

use FACTYPE=1-9
$ factype=1   FREEWAY
IF FACTYPE=1
  IF LANE=1
    $   Cap=1500, Spd=60
    COMP CAPC=46
    COMP SPDC=60
  ENDIF
  IF LANE=2-999
    IF AREA=1
      $   Cap=1800, Spd=55
      COMP CAPC=58
      COMP SPDC=55
    ENDIF
    IF AREA=2-3
      $   Cap=1800 but use 2000, Spd=65 Use 63
      COMP CAPC=58
      COMP SPDC=63
    ENDIF
    IF AREA=4-6
      $   Cap=1800 but use 2000, Spd=65 Use 63
      COMP CAPC=58
      COMP SPDC=63
    ENDIF
  ENDIF
ENDIF

```

```

$ factype=2 Major Divided Arterial with Shoulder (i.e. Rte 17)
IF FACTYPE=2
  IF LANE=1
    $   Cap=1500, Spd=40
    COMP CAPC=46
    COMP SPDC=40
  ENDIF
  IF LANE=2-999
    IF AREA=1
      $   Cap=1800, Spd=60
      COMP CAPC=58
      COMP SPDC=60
    ENDIF
    IF AREA=2-6
      $   Cap=1800, Spd=62 & 65, use 63

```

```

        COMP CAPC=58
        COMP SPDC=63
    ENDIF
ENDIF
ENDIF

$ factype=3 Major Divided Arterial, No Shoulder
IF FACTYPE=3
    IF LANE=1
        IF AREA=1
            $ Cap=1500, Spd=35
              COMP CAPC=46
              COMP SPDC=35
        ENDIF
        IF AREA=2-3
            $ Cap=1600, Spd=40
              COMP CAPC=50
              COMP SPDC=40
        ENDIF
        IF AREA=4-5
            $ Cap=1600, Spd=45
              COMP CAPC=50
              COMP SPDC=45
        ENDIF
        IF AREA=6
            $ Cap=1600, Spd=50
              COMP CAPC=50
              SPDC=50
        ENDIF
    ENDIF
    IF LANE=2
        IF AREA=1
            $ Cap=1500, Spd=40
              COMP CAPC=46
              COMP SPDC=40
        ENDIF
        IF AREA=2-3
            $ Cap=1600, Spd=42
              COMP CAPC=50
              COMP SPDC=42
        ENDIF
        IF AREA=4-5
            $ Cap=1700, Spd=45
              COMP CAPC=54
              COMP SPDC=45
        ENDIF
        IF AREA=6
            $ Cap=1700, Spd=47
              COMP CAPC=54
              COMP SPDC=47
        ENDIF
    ENDIF
    IF LANE=3-999
        IF AREA=1
            $ Cap=1600, Spd=40
              COMP CAPC=50
              COMP SPDC=40
        ENDIF
        IF AREA=2-3
            $ Cap=1600, Spd=42
              COMP CAPC=50
              COMP SPDC=42
        ENDIF
    ENDIF

```

```

    IF AREA=4-5
$     Cap=1700, Spd=45
        COMP CAPC=54
        COMP SPDC=45
    ENDIF
    IF AREA=6
$     Cap=1700, Spd=47
        COMP CAPC=54
        COMP SPDC=47
    ENDIF
  ENDIF
ENDIF

```

```

$ factype=4   Major Undivided Arterial
IF FACTYPE=4

```

```

  IF LANE=1
    IF AREA=1
$     Cap=1500, Spd=30
        COMP CAPC=46
        COMP SPDC=30
    ENDIF
    IF AREA=2-3
$     Cap=1500, Spd=37
        COMP CAPC=46
        COMP SPDC=37
    ENDIF
    IF AREA=4-5
$     Cap=1700, Spd=37
        COMP CAPC=54
        COMP SPDC=37
    ENDIF
    IF AREA=6
$     Cap=1700, Spd=40
        COMP CAPC=54
        SPDC=40
    ENDIF
  ENDIF
  IF LANE=2-999
    IF AREA=1
$     Cap=1600, Spd=26
        COMP CAPC=50
        COMP SPDC=26
    ENDIF
    IF AREA=2-3
$     Cap=1600, Spd=31
        COMP CAPC=50
        COMP SPDC=31
    ENDIF
    IF AREA=4-5
$     Cap=1700, Spd=35
        COMP CAPC=54
        COMP SPDC=35
    ENDIF
    IF AREA=6
$     Cap=1700, Spd=38
        COMP CAPC=54
        COMP SPDC=38
    ENDIF
  ENDIF
ENDIF

```

```

$ factype=5   Undivided Arterial, With Shoulder
IF FACTYPE=5

```

```

IF LANE=1
  IF AREA=1
$    Cap=1500, Spd=25
      COMP CAPC=46
      COMP SPDC=25
  ENDIF
  IF AREA=2-3
$    Cap=1500, Spd=30
      COMP CAPC=46
      COMP SPDC=30
  ENDIF
  IF AREA=4-5
$    Cap=1700, Spd=33
      COMP CAPC=54
      COMP SPDC=33
  ENDIF
  IF AREA=6
$    Cap=1700, Spd=37
      COMP CAPC=54
      SPDC=37
  ENDIF
ENDIF
IF LANE=2-999
  IF AREA=1
$    Cap=1600, Spd=25
      COMP CAPC=50
      COMP SPDC=25
  ENDIF
  IF AREA=2-3
$    Cap=1600, Spd=33
      COMP CAPC=50
      COMP SPDC=33
  ENDIF
  IF AREA=4-5
$    Cap=1700, Spd=35
      COMP CAPC=54
      COMP SPDC=35
  ENDIF
  IF AREA=6
$    Cap=1700, Spd=37
      COMP CAPC=54
      COMP SPDC=40
  ENDIF
ENDIF
ENDIF

$ factype=6  Undivided Arterial Without Shoulder
IF FACTYPE=6
  IF LANE=1
    IF AREA=1
$      Cap=1500, Spd=25
          COMP CAPC=46
          COMP SPDC=25
    ENDIF
    IF AREA=2-3
$      Cap=1500, Spd=30
          COMP CAPC=46
          COMP SPDC=30
    ENDIF
    IF AREA=4-5
$      Cap=1700, Spd=33
          COMP CAPC=54
          COMP SPDC=35
    ENDIF
  ENDIF

```

```

ENDIF
IF AREA=6
$   Cap=1700, Spd=37
    COMP CAPC=54
    SPDC=37
ENDIF
ENDIF
IF LANE=2-999
IF AREA=1
$   Cap=1600, Spd=25
    COMP CAPC=50
    COMP SPDC=25
ENDIF
IF AREA=2-3
$   Cap=1600, Spd=33
    COMP CAPC=50
    COMP SPDC=33
ENDIF
IF AREA=4-5
$   Cap=1700, Spd=35
    COMP CAPC=54
    COMP SPDC=35
ENDIF
IF AREA=6
$   Cap=1700, Spd=37
    COMP CAPC=54
    COMP SPDC=37
ENDIF
ENDIF
ENDIF

```

```

$ factype=7   Collector / Local (2-lanes)
IF FACTYPE=7
  IF LANE=1
    IF AREA=1
$     Cap=900, Spd=14
        COMP CAPC=22
        COMP SPDC=14
    ENDIF
    IF AREA=2-3
$     Cap=1100, Spd=18
        COMP CAPC=30
        COMP SPDC=18
    ENDIF
    IF AREA=4-5
$     Cap=1300, Spd=21
        COMP CAPC=38
        COMP SPDC=21
    ENDIF
    IF AREA=6
$     Cap=1350, Spd=25
        COMP CAPC=40
        SPDC=25
    ENDIF
  ENDIF
  IF LANE=2-999
    IF AREA=1
$     Cap=900, Spd=18
        COMP CAPC=22
        COMP SPDC=18
    ENDIF
    IF AREA=2-3
$     Cap=1100, Spd=20

```

```

        COMP CAPC=30
        COMP SPDC=20
    ENDIF
    IF AREA=4-5
$       Cap=1300, Spd=24
        COMP CAPC=38
        COMP SPDC=24
    ENDIF
    IF AREA=6
$       Cap=1350, Spd=25
        COMP CAPC=40
        COMP SPDC=25
    ENDIF
    ENDIF
ENDIF
ENDIF

$ factype=8 Ramps & jughandles
IF FACTYPE=8
    IF LANE=1
        IF AREA=1
$       Cap=1500, Spd=33
            COMP CAPC=46
            COMP SPDC=33
        ENDIF
        IF AREA=2-3
$       Cap=1500, Spd=35
            COMP CAPC=46
            COMP SPDC=35
        ENDIF
        IF AREA=4-5
$       Cap=1700, Spd=35
            COMP CAPC=54
            COMP SPDC=35
        ENDIF
        IF AREA=6
$       Cap=1700, Spd=37
            COMP CAPC=54
            SPDC=37
        ENDIF
    ENDIF
    IF LANE=2-999
        IF AREA=1
$       Cap=1600, Spd=25
            COMP CAPC=50
            COMP SPDC=25
        ENDIF
        IF AREA=2-3
$       Cap=1600, Spd=33
            COMP CAPC=50
            COMP SPDC=33
        ENDIF
        IF AREA=4-5
$       Cap=1700, Spd=35
            COMP CAPC=54
            COMP SPDC=35
        ENDIF
        IF AREA=6
$       Cap=1700, Spd=37
            COMP CAPC=54
            COMP SPDC=37
        ENDIF
    ENDIF
ENDIF
ENDIF

```



```

$ factype=9   Centroid Connector
IF FACTYPE=9
  COMP CAPC=63
  COMP SPDC=25
ENDIF

```

```

$
$ Check to make sure we got 'em all.  List those that are missing.
if capc=1
  if spdc=1
    titl 1
    A      B      CAPC      SPDC      FACTYPE      area      LANE
    list a,b,capc,spdc,factype,area,lane
  endif
endif

```

```

$=====
$=====

```

```

$ Part 2: Apply user-coded speed and capacity adjustments.
$ Note that the resulting capacity value is rounded to the
$ nearest 25 vphpl increment.  Note also that entries
$ in the SPDADD and SPDSUB fields must be in whole mph, while
$ CAPADD and CAPSUB values must be in whole vphpl.  Finally,
$ note that coding a non-zero value for SPDADD or SPDSUB moves
$ the SPDC value into the "upper" part of the look-up table
$ (i.e., index values of 11-63).

```

```

if spdadd=1-99999
  comp spdc=spdc+spdadd
endif
if spdsup=1-99999
  comp spdc=spdc+spdsup
endif
if capadd=1-99999
  comp capc=capc+int((capadd/25.)+0.5)
endif
if capsub=1-99999
  comp capc=capc-int((capsub/25.)+0.5)
endif
$ Check bounds.
if spdc=-9999-10
  comp spdc=1
endif
if spdc=64-9999
  comp spdc=63
endif
if capc=-9999-1
  comp capc=1
endif
if capc=64-9999
  comp capc=62
endif
comp capacity=capa*lane

```

```

$=====

```

```

$ Step 3: check
$ List the links for which a user-coded speed or capacity override

```

```

$ value was coded.
$titl 1
$a      b      dist tsva tsin spdc sped capc capa cdev ft at
$if CAPADD=1-9999
$ list a,b,dist,tsva,tsin,spdc,sped,capc,capa,cdev,factype,area
$endif
$if SPDADD=1-9999
$ list a,b,dist,tsva,tsin,spdc,sped,capc,capa,cdev,factype,area
$endif
$if CAPSUB=1-9999
$ list a,b,dist,tsva,tsin,spdc,sped,capc,capa,cdev,factype,area
$endif
$if SPDSUB=1-9999
$ list a,b,dist,tsva,tsin,spdc,sped,capc,capa,cdev,factype,area
$endif
$titl 2
$
$                                old
new
$ dist          spdc   sped      t.d1      t.d2          t.zvd t.nsig t.sp
spdc
$if ARRTYPE=40-40
$ list a,b,dist,t.spdc,sped,t.d1,t.d2,t.zvd,t.sp
$endif

$===== Section to Calculate Capacity at LOS of "C"=====
COMP CAPCLOSF=CAPC

comp t.cap=0.85*((capc*25.)+350)
if capc=1-62
  comp capc=int((t.cap-350.)/25.+0.5)
endif
if capc=0
  comp capc=1
endif
if capc=64-9999
  comp capc=62
endif
$-----
*
$-----BEGIN ASSIGN-----

$
$ Assign Northwest Network from 1990 North Jersey net
$
$>ERASE KYLE*.PRN
$-----
$ Network modified for Bergen County
*pgm assign NWII20A.Y90
*par page=1,msglev=5
*unit 14=NWEST15.Y90,21=NWII21F.Y92
mati 401
*id MASTER'S THESIS: NEW METHODOLOGY
$ setup is ASS2492.SET
pctadt=10
$ do 5 ITERATION EQUILIBRIUM ASSIGNMENT
EQUI
thet 0,0,0,0,0
speed=0
repo -3,6
*
$-----
$ Calculate Calibration Statistics
*PGM NETMRG NWII21F.Y92,NWII21F.Y92,NWII21F.Y90
SKIP A=1-220

```

```

SKIP B=1-220
SKIP VOL24=0
if VOL24=1-99999
  comp SQUARE=(vol24-vol)**2
  comp T.LINK=1.0
sum SQUARE
tab SQUARE,vol24=1-99999-5000
tab T.LINK,vol24=1-99999-5000
tab vol24,vol24=1-99999-5000
endif
$ #####
lsto 2,SCENE2.DAT
list A=1-5,B=6-10,VOL24=11-17,VOL=18-24,FACTYPE=25-26,AREA=27-28
list SPDC=29-31,CAPC=32-34,SPED=35-38,CAPA=39-44

IF VOL24=0
  IF VOL24FAC=0
    COMP COLOR=10
  ENDIF
ENDIF
IF VOL24=1-5000
  IF VOL=1-999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-48
      COMP COLOR=30
    ELSE
      IF ASSOBSA=49-53
        COMP COLOR=50
      ELSE
        IF ASSOBSA=54-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 5,000 - 10,000
$-----
IF VOL24=1-10000
  IF VOL=1-999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-40
      COMP COLOR=30
    ELSE
      IF ASSOBSA=41-45
        COMP COLOR=50
      ELSE
        IF ASSOBSA=46-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 10,000 - 20,000
$-----
IF VOL24=10001-20000
  IF VOL=1-9999999

```

```

COMP ASSOBS=(1-(VOL/VOL24))*100
COMP ASSOBS2=ASSOBS*ASSOBS
COMP ASSOBSA=INT(SQRT(ASSOBS2))
IF ASSOBSA=0-30
  COMP COLOR=30
ELSE
  IF ASSOBSA=31-35
    COMP COLOR=50
  ELSE
    IF ASSOBSA=36-999999
      COMP COLOR=40
    ENDIF
  ENDIF
ENDIF
ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 20,000 - 30,000
$-----
IF VOL24=20001-30000
  IF VOL=1-99999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-26
      COMP COLOR=30
    ELSE
      IF ASSOBSA=27-31
        COMP COLOR=50
      ELSE
        IF ASSOBSA=32-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 30,000 - 40,000
$-----
IF VOL24=30001-40000
  IF VOL=1-99999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-24
      COMP COLOR=30
    ELSE
      IF ASSOBSA=25-29
        COMP COLOR=50
      ELSE
        IF ASSOBSA=30-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 40,000 - 50,000
$-----
IF VOL24=40001-50000
  IF VOL=1-99999999
    COMP ASSOBS=(1-(VOL/VOL24))*100

```

```

COMP ASSOBS2=ASSOBS*ASSOBS
COMP ASSOBSA=INT(SQRT(ASSOBS2))
IF ASSOBSA=0-22
  COMP COLOR=30
ELSE
  IF ASSOBSA=23-27
    COMP COLOR=50
  ELSE
    IF ASSOBSA=28-999999
      COMP COLOR=40
    ENDIF
  ENDIF
ENDIF
ENDIF
ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 50,000 - 60,000
$-----
IF VOL24=50001-60000
  IF VOL=1-99999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-19
      COMP COLOR=30
    ELSE
      IF ASSOBSA=20-23
        COMP COLOR=50
      ELSE
        IF ASSOBSA=24-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 60,000 - 70,000
$-----
IF VOL24=60001-70000
  IF VOL=1-99999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-18
      COMP COLOR=30
    ELSE
      IF ASSOBSA=19-21
        COMP COLOR=50
      ELSE
        IF ASSOBSA=22-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 70,000 - 80,000
$-----
IF VOL24=70001-80000
  IF VOL=1-99999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS

```

```

COMP ASSOBSA=INT(SQRT(ASSOBS2))
IF ASSOBSA=0-16
  COMP COLOR=30
ELSE
  IF ASSOBSA=17-20
    COMP COLOR=50
  ELSE
    IF ASSOBSA=21-999999
      COMP COLOR=40
    ENDIF
  ENDIF
ENDIF
ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 80,000 and ABOVE
$-----
IF VOL24=80001-9999999
  IF VOL=1-9999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-15
      COMP COLOR=30
    ELSE
      IF ASSOBSA=16-18
        COMP COLOR=50
      ELSE
        IF ASSOBSA=19-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
ENDIF
COMP VOLCAL=VOL(2)
COMP VOLNOW=VOL(1)
COMP VOLDIF=ABS(VOLCAL-VOLNOW)
$-----
*
$-----
$ #####
*PGM NETMRG NUL,NWIICAL.Y92
SKIP A=1-220
SKIP B=1-220
SKIP VOL24=0
SKIP STUDY=0
$ #####
lsto 2,STDY2.DAT
list A=1-5,B=6-10,VOL24=11-17,VOL=18-24,FACTYPE=25-26,AREA=27-28
list SPDC=29-31,CAPC=32-34,SPED=35-38,CAPA=39-44
*
$>erase assam92.prn
$>copy KYLE*.prn assam92.prn
$>erase KYLE*.prn
$pause
$list assam92.prn
$>ERASE KYLE*.PRN
$>NETVUE NWIICAL.Y92

```

COMP SPDADD=0  
COMP CAPADD=0  
COMP ADDLNS=0

```

COMP SUBLNS=0
if VOL24=0
  if VOL24FAC=1-99999
    COMP VOL24=VOL24FAC
  endif
endif

```

```

$-----
*PAR PAGE=1
*ID WWGM: Update Network Speeds & Caps
$=====
$ Part 1: Replace Default MinUTP speed/capacity lookup table
$ with a revised Garmen lookup table
$ Note that this setup eliminates the "high/low" speed sections
$ of the SPED table that are a relic of the earliest NETMOD days
SPED 1,10,20,30,40,50,60,70,80,90,100
SPED 11,110,120,130,140,150,160,170,180,190,200
SPED 21,210,220,230,240,250,260,270,280,290,300
SPED 31,310,320,330,340,350,360,370,380,390,400
SPED 41,410,420,430,440,450,460,470,480,490,500
SPED 51,510,520,530,540,550,560,570,580,590,600
SPED 61,610,620,630
CAPA 1,0375,0400,0425,0450,0475,0500,0525,0550,0575,0600
CAPA 11,0625,0650,0675,0700,0725,0750,0775,0800,0825,0850
CAPA 21,0875,0900,0925,0950,0975,1000,1025,1050,1075,1100
CAPA 31,1125,1150,1175,1200,1225,1250,1275,1300,1325,1350
CAPA 41,1375,1400,1425,1450,1475,1500,1525,1550,1575,1600
CAPA 51,1625,1650,1675,1700,1725,1750,1775,1800,1825,1850
CAPA 61,1875,2000,9999

$ Note that for this setup the max realistic per-lane capacity
$ (CAPC=62) is 2000 vphpl. This value is used below for
$ FACTYPE=1 and 9

```

```

$=====
$ Route 208 / Northwest Bergen FACTYPES and AREATYPES:
$
$ FACTYPE:      1 = Freeway
$               2 = Major Divided Arterial With Shoulder
$               3 = Major Divided Arterial Without Shoulder
$               4 = Major Undivided Arterial
$               5 = Undivided Arterial with Shoulder
$               6 = Undivided Arterial Without Shoulder
$               7 = Collector / Local (2 lanes)
$               8 = Highway Ramp / Jughandle
$               9 = Centroid Connector
$
$ AREA:         1 = Central Business District
$               2 = Urban Residential / Commercial / Industrial
$               3 = Suburban Residential
$               4 = Suburban Commercial
$               5 = Suburban Residential / Mixed Usage
$               6 = Vacant / Rural / Agriculture

```

```

$=====
comp capc=1.
comp spdc=1.
comp tsva=0.
comp cdev=cnt(1)
comp arrtype=0
comp nsigs=0
comp tsin=0
$ ---- this section determines capacity & speed from factype ----
$ values CAPA is vphpl, SPDC is 0.1 mph

```

```
$
$   These capacities and speeds are rederived from the NW Bergen
```

```
use FACTYPE=1-9
$ factype=1   FREEWAY
IF FACTYPE=1
  IF LANE=1
    $   Cap=1500, Spd=60
      COMP CAPC=46
      COMP SPDC=60
    ENDIF
  IF LANE=2-999
    IF AREA=1
      $   Cap=1800, Spd=55
        COMP CAPC=58
        COMP SPDC=55
      ENDIF
    IF AREA=2-3
      $   Cap=1800 but use 2000, Spd=65   Use 63
        COMP CAPC=58
        COMP SPDC=63
      ENDIF
    IF AREA=4-6
      $   Cap=1800 but use 2000, Spd=65   Use 63
        COMP CAPC=58
        COMP SPDC=63
      ENDIF
    ENDIF
  ENDIF
ENDIF
```

```
$ factype=2 Major Divided Arterial with Shoulder (i.e. Rte 17)
IF FACTYPE=2
  IF LANE=1
    $   Cap=1500, Spd=40
      COMP CAPC=46
      COMP SPDC=40
    ENDIF
  IF LANE=2-999
    IF AREA=1
      $   Cap=1800, Spd=60
        COMP CAPC=58
        COMP SPDC=60
      ENDIF
    IF AREA=2-6
      $   Cap=1800, Spd=62 & 65, use 63
        COMP CAPC=58
        COMP SPDC=63
      ENDIF
    ENDIF
  ENDIF
ENDIF
```

```
$ factype=3 Major Divided Arterial, No Shoulder
IF FACTYPE=3
  IF LANE=1
    IF AREA=1
      $   Cap=1500, Spd=35
        COMP CAPC=46
        COMP SPDC=35
      ENDIF
    IF AREA=2-3
      $   Cap=1600, Spd=40
        COMP CAPC=50
      ENDIF
    ENDIF
  ENDIF
ENDIF
```



```

        COMP SPDC=40
    ENDIF
    IF AREA=4-5
$   Cap=1600, Spd=45
        COMP CAPC=50
        COMP SPDC=45
    ENDIF
    IF AREA=6
$   Cap=1600, Spd=50
        COMP CAPC=50
        SPDC=50
    ENDIF
ENDIF
IF LANE=2
    IF AREA=1
$   Cap=1500, Spd=40
        COMP CAPC=46
        COMP SPDC=40
    ENDIF
    IF AREA=2-3
$   Cap=1600, Spd=42
        COMP CAPC=50
        COMP SPDC=42
    ENDIF
    IF AREA=4-5
$   Cap=1700, Spd=45
        COMP CAPC=54
        COMP SPDC=45
    ENDIF
    IF AREA=6
$   Cap=1700, Spd=47
        COMP CAPC=54
        COMP SPDC=47
    ENDIF
ENDIF
IF LANE=3-999
    IF AREA=1
$   Cap=1600, Spd=40
        COMP CAPC=50
        COMP SPDC=40
    ENDIF
    IF AREA=2-3
$   Cap=1600, Spd=42
        COMP CAPC=50
        COMP SPDC=42
    ENDIF
    IF AREA=4-5
$   Cap=1700, Spd=45
        COMP CAPC=54
        COMP SPDC=45
    ENDIF
    IF AREA=6
$   Cap=1700, Spd=47
        COMP CAPC=54
        COMP SPDC=47
    ENDIF
ENDIF
ENDIF
ENDIF
$ factype=4 Major Undivided Arterial
IF FACTYPE=4
    IF LANE=1
        IF AREA=1

```

```

$      Cap=1500, Spd=30
        COMP CAPC=46
        COMP SPDC=30
    ENDIF
    IF AREA=2-3
$      Cap=1500, Spd=37
        COMP CAPC=46
        COMP SPDC=37
    ENDIF
    IF AREA=4-5
$      Cap=1700, Spd=37
        COMP CAPC=54
        COMP SPDC=37
    ENDIF
    IF AREA=6
$      Cap=1700, Spd=40
        COMP CAPC=54
        SPDC=40
    ENDIF
ENDIF
IF LANE=2-999
    IF AREA=1
$      Cap=1600, Spd=26
        COMP CAPC=50
        COMP SPDC=26
    ENDIF
    IF AREA=2-3
$      Cap=1600, Spd=31
        COMP CAPC=50
        COMP SPDC=31
    ENDIF
    IF AREA=4-5
$      Cap=1700, Spd=35
        COMP CAPC=54
        COMP SPDC=35
    ENDIF
    IF AREA=6
$      Cap=1700, Spd=38
        COMP CAPC=54
        COMP SPDC=38
    ENDIF
ENDIF
ENDIF
ENDIF
$ factype=5      Undivided Arterial, With Shoulder
IF FACTYPE=5
    IF LANE=1
        IF AREA=1
$      Cap=1500, Spd=25
            COMP CAPC=46
            COMP SPDC=25
        ENDIF
        IF AREA=2-3
$      Cap=1500, Spd=30
            COMP CAPC=46
            COMP SPDC=30
        ENDIF
        IF AREA=4-5
$      Cap=1700, Spd=33
            COMP CAPC=54
            COMP SPDC=33
        ENDIF
        IF AREA=6
$      Cap=1700, Spd=37

```

```

        COMP CAPC=54
        SPDC=37
    ENDIF
ENDIF
IF LANE=2-999
    IF AREA=1
$       Cap=1600, Spd=25
        COMP CAPC=50
        COMP SPDC=25
    ENDIF
    IF AREA=2-3
$       Cap=1600, Spd=33
        COMP CAPC=50
        COMP SPDC=33
    ENDIF
    IF AREA=4-5
$       Cap=1700, Spd=35
        COMP CAPC=54
        COMP SPDC=35
    ENDIF
    IF AREA=6
$       Cap=1700, Spd=37
        COMP CAPC=54
        COMP SPDC=40
    ENDIF
ENDIF
ENDIF

$ factype=6   Undivided Arterial Without Shoulder
IF FACTYPE=6
    IF LANE=1
$       IF AREA=1
        Cap=1500, Spd=25
        COMP CAPC=46
        COMP SPDC=25
    ENDIF
    IF AREA=2-3
$       Cap=1500, Spd=30
        COMP CAPC=46
        COMP SPDC=30
    ENDIF
    IF AREA=4-5
$       Cap=1700, Spd=33
        COMP CAPC=54
        COMP SPDC=35
    ENDIF
    IF AREA=6
$       Cap=1700, Spd=37
        COMP CAPC=54
        SPDC=37
    ENDIF
ENDIF
IF LANE=2-999
    IF AREA=1
$       Cap=1600, Spd=25
        COMP CAPC=50
        COMP SPDC=25
    ENDIF
    IF AREA=2-3
$       Cap=1600, Spd=33
        COMP CAPC=50
        COMP SPDC=33
    ENDIF

```

```

    IF AREA=4-5
$     Cap=1700, Spd=35
        COMP CAPC=54
        COMP SPDC=35
    ENDIF
    IF AREA=6
$     Cap=1700, Spd=37
        COMP CAPC=54
        COMP SPDC=37
    ENDIF
    ENDIF
ENDIF

```

```

$ factype=7 Collector / Local (2-lanes)

```

```

IF FACTYPE=7
    IF LANE=1
        IF AREA=1
$     Cap=900, Spd=14
            COMP CAPC=22
            COMP SPDC=14
        ENDIF
        IF AREA=2-3
$     Cap=1100, Spd=18
            COMP CAPC=30
            COMP SPDC=18
        ENDIF
        IF AREA=4-5
$     Cap=1300, Spd=21
            COMP CAPC=38
            COMP SPDC=21
        ENDIF
        IF AREA=6
$     Cap=1350, Spd=25
            COMP CAPC=40
            SPDC=25
        ENDIF
    ENDIF
    IF LANE=2-999
        IF AREA=1
$     Cap=900, Spd=18
            COMP CAPC=22
            COMP SPDC=18
        ENDIF
        IF AREA=2-3
$     Cap=1100, Spd=20
            COMP CAPC=30
            COMP SPDC=20
        ENDIF
        IF AREA=4-5
$     Cap=1300, Spd=24
            COMP CAPC=38
            COMP SPDC=24
        ENDIF
        IF AREA=6
$     Cap=1350, Spd=25
            COMP CAPC=40
            COMP SPDC=25
        ENDIF
    ENDIF
ENDIF

```

```

$ factype=8 Ramps & jughandles

```

```

IF FACTYPE=8
  IF LANE=1
    IF AREA=1
$     Cap=1500, Spd=33
      COMP CAPC=46
      COMP SPDC=33
    ENDIF
    IF AREA=2-3
$     Cap=1500, Spd=35
      COMP CAPC=46
      COMP SPDC=35
    ENDIF
    IF AREA=4-5
$     Cap=1700, Spd=35
      COMP CAPC=54
      COMP SPDC=35
    ENDIF
    IF AREA=6
$     Cap=1700, Spd=37
      COMP CAPC=54
      SPDC=37
    ENDIF
  ENDIF
  IF LANE=2-999
$     IF AREA=1
      Cap=1600, Spd=25
      COMP CAPC=50
      COMP SPDC=25
    ENDIF
$     IF AREA=2-3
      Cap=1600, Spd=33
      COMP CAPC=50
      COMP SPDC=33
    ENDIF
$     IF AREA=4-5
      Cap=1700, Spd=35
      COMP CAPC=54
      COMP SPDC=35
    ENDIF
$     IF AREA=6
      Cap=1700, Spd=37
      COMP CAPC=54
      COMP SPDC=37
    ENDIF
  ENDIF
ENDIF

$ factype=9   Centroid Connector
IF FACTYPE=9
  COMP CAPC=63
  COMP SPDC=25
ENDIF

$
$ Check to make sure we got 'em all.  List those that are missing.
if capc=1
  if spdc=1
    titl 1
A   B   CAPC   SPDC   FACTYPE   area   LANE
    list a,b,capc,spdc,factype,area,lane
  endif

```

```

endif
$=====
$=====
$ Part 2: Apply user-coded speed and capacity adjustments.
$ Note that the resulting capacity value is rounded to the
$ nearest 25 vphpl increment. Note also that entries
$ in the SPDADD and SPDSUB fields must be in whole mph, while
$ CAPADD and CAPSUB values must be in whole vphpl. Finally,
$ note that coding a non-zero value for SPDADD or SPDSUB moves
$ the SPDC value into the "upper" part of the look-up table
$ (i.e., index values of 11-63).

if spdadd=1-99999
  comp spdc=spdc+spdadd
endif
if spdsub=1-99999
  comp spdc=spdc-spdsub
endif
if capadd=1-99999
  comp capc=capc+int((capadd/25.)+0.5)
endif
if capsu=1-99999
  comp capc=capc-int((capsu/25.)+0.5)
endif
$ Check bounds.
if spdc=-9999-10
  comp spdc=1
endif
if spdc=64-9999
  comp spdc=63
endif
if capc=-9999-1
  comp capc=1
endif
if capc=64-9999
  comp capc=62
endif
comp capacity=capa*lane

$=====
$ Step 3: check
$ List the links for which a user-coded speed or capacity override
$ value was coded.
$titl 1
$a      b      dist tsva tsin spdc sped capc  capa  cdev  ft  at
$if CAPADD=1-9999
$ list a,b,dist,tsva,tsin,spdc,sped,capc,capa,cdev,factype,area
$endif
$if SPDADD=1-9999
$ list a,b,dist,tsva,tsin,spdc,sped,capc,capa,cdev,factype,area
$endif
$if CAPSUB=1-9999
$ list a,b,dist,tsva,tsin,spdc,sped,capc,capa,cdev,factype,area
$endif
$if SPDSUB=1-9999
$ list a,b,dist,tsva,tsin,spdc,sped,capc,capa,cdev,factype,area
$endif
$titl 2
$
$          old
new

```

```

$ dist      spdc  sped      t.d1      t.d2      t.zvd  t.nsig  t.sp
spdc
$if ARRTYPE=40-40
$ list a,b,dist,t.spdc,sped,t.d1,t.d2,t.zvd,t.sp
$endif

$==== Section to Calculate Capacity at LOS of "C"====
COMP CAPCLOSF=CAPC

comp t.cap=0.85*((capc*25.)+350)
if capc=1-62
  comp capc=int((t.cap-350.)/25.+0.5)
endif
if capc=0
  comp capc=1
endif
if capc=64-9999
  comp capc=62
endif
$-----
*
$-----BEGIN ASSIGN-----

$
$ Assign Northwest Network from 1990 North Jersey net
$
$>ERASE KYLE*.PRN
$-----
$ Network modified for Bergen County
*pgm assign NWII20A.Y90
*par page=1,msglev=5
*unit 14=NWEST15.Y90,21=NWII21F.Y90
mati 401
*id MASTER'S THESIS: TRADITIONAL METHODOLOGY
$ setup is ASS2490.SET
pctadt=10
$ do 5 ITERATION EQUILIBRIUM ASSIGNMENT
EQUI
thet 0,0,0,0,0
speed=0
repo -3,6
*
$-----
$ Calculate Calibration Statistics

*PGM NETMRG NWIICAL.Y90,NWII21F.Y90
SKIP A=1-220
SKIP B=1-220
SKIP VOL24=0
if VOL24=1-99999
  comp SQUARE=(vol24-vol)**2
  comp T.LINK=1.0
sum SQUARE
tab SQUARE,vol24=1-99999-5000
tab T.LINK,vol24=1-99999-5000
tab vol24,vol24=1-99999-5000
endif
lsto 2,EXISTING.DAT
list A=1-5,B=6-10,VOL24=11-17,VOL=18-24,FACTYPE=25-26,AREA=27-28
list SPDC=29-31,CAPC=32-34,SPED=35-38,CAPA=39-44

IF VOL24=0
  IF VOL24FAC=0
    COMP COLOR=10

```

```

ENDIF
ENDIF
IF VOL24=1-5000
  IF VOL=1-999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-48
      COMP COLOR=30
    ELSE
      IF ASSOBSA=49-53
        COMP COLOR=50
      ELSE
        IF ASSOBSA=54-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 5,000 - 10,000
$-----
IF VOL24=1-10000
  IF VOL=1-999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-40
      COMP COLOR=30
    ELSE
      IF ASSOBSA=41-45
        COMP COLOR=50
      ELSE
        IF ASSOBSA=46-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 10,000 - 20,000
$-----
IF VOL24=10001-20000
  IF VOL=1-9999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-30
      COMP COLOR=30
    ELSE
      IF ASSOBSA=31-35
        COMP COLOR=50
      ELSE
        IF ASSOBSA=36-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 20,000 - 30,000

```



```

$-----
IF VOL24=20001-30000
  IF VOL=1-9999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-26
      COMP COLOR=30
    ELSE
      IF ASSOBSA=27-31
        COMP COLOR=50
      ELSE
        IF ASSOBSA=32-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 30,000 - 40,000
$-----
IF VOL24=30001-40000
  IF VOL=1-9999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-24
      COMP COLOR=30
    ELSE
      IF ASSOBSA=25-29
        COMP COLOR=50
      ELSE
        IF ASSOBSA=30-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 40,000 - 50,000
$-----
IF VOL24=40001-50000
  IF VOL=1-9999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-22
      COMP COLOR=30
    ELSE
      IF ASSOBSA=23-27
        COMP COLOR=50
      ELSE
        IF ASSOBSA=28-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 50,000 - 60,000
$-----

```

```

IF VOL24=50001-60000
  IF VOL=1-9999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-19
      COMP COLOR=30
    ELSE
      IF ASSOBSA=20-23
        COMP COLOR=50
      ELSE
        IF ASSOBSA=24-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 60,000 - 70,000
$-----
IF VOL24=60001-70000
  IF VOL=1-9999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-18
      COMP COLOR=30
    ELSE
      IF ASSOBSA=19-21
        COMP COLOR=50
      ELSE
        IF ASSOBSA=22-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 70,000 - 80,000
$-----
IF VOL24=70001-80000
  IF VOL=1-9999999
    COMP ASSOBS=(1-(VOL/VOL24))*100
    COMP ASSOBS2=ASSOBS*ASSOBS
    COMP ASSOBSA=INT(SQRT(ASSOBS2))
    IF ASSOBSA=0-16
      COMP COLOR=30
    ELSE
      IF ASSOBSA=17-20
        COMP COLOR=50
      ELSE
        IF ASSOBSA=21-999999
          COMP COLOR=40
        ENDIF
      ENDIF
    ENDIF
  ENDIF
ENDIF
$-----
$ Post Observed ADT Volumes of 80,000 and ABOVE
$-----
IF VOL24=80001-9999999

```

```
IF VOL=1-9999999
  COMP ASSOBS=(1-(VOL/VOL24))*100
  COMP ASSOBS2=ASSOBS*ASSOBS
  COMP ASSOBSA=INT(SQRT(ASSOBS2))
  IF ASSOBSA=0-15
    COMP COLOR=30
  ELSE
    IF ASSOBSA=16-18
      COMP COLOR=50
    ELSE
      IF ASSOBSA=19-9999999
        COMP COLOR=40
      ENDIF
    ENDIF
  ENDIF
ENDIF
ENDIF
ENDIF
$-----
*
$-----
-----
*PGM NETMRG NUL,NWIICAL.Y90
SKIP A=1-220
SKIP B=1-220
SKIP VOL24=0
SKIP STUDY=0
lsto 2,STDYAREA.DAT
list A=1-5,B=6-10,VOL24=11-17,VOL=18-24,FACTYPE=25-26,AREA=27-28
list SPDC=29-31,CAPC=32-34,SPED=35-38,CAPA=39-44
*
$>erase assam90.prn
$>copy KYLE*.prn assam90.prn
$>erase KYLE*.prn
$pause
$list assam90.prn
$>ERASE KYLE*.PRN

```

```
$ This setup extracts the Route 4 and 17 subarea trip table and network
using the traditional
$ methodology. This extraction uses a one iteration all-or-nothing
assignment with utilizing
$ the last iteration loaded impedance (from the Northwest Model
assignment) as the impedance
$ variable.
```

```
$
$
$ Extract Route 4 / Route 17 Subarea Network
$ from 1990 Northwest Bergen County net
$
$ Oct 13, 1993 KBW
```

```
*
$>erase KYLE*.prn
*pgm netmrg TEMPIN.NET,NWII21F.Y90
dele ctime,nimp-iimp
```

```
*
$-----
*pgm assign TEMPIN.NET
*par page=1,msglev=5,ZONES=276
*unit 14=nwest15.y90,15=4&1715.Y90,21=TEMPOUT.NET
*id Bergen: Extract Northwest Net, 1986
$ setup is EXTOAK.SET
par slerr=M,slnk=1,impvar=ctim
MATI 401
$seL T=6059,1347,1341,2557,2103
$sel I=1,J=1
$ do 1 pass AON assignment
thet 0
```

```
$-----
----
$ use turn penalties
$penf c:\bergen\92012\assign\penalty.dat
$ extract link & coord files
subn 0,4&170790.asc,4&1790xy.asc
```

```
$-----
----
$ Specify subarea zones.
newz 1=133
newz 2=134
newz 3=135
newz 4=136
newz 5=137
newz 6=139
newz 7=140
newz 8=141
newz 9=142
newz 10=143
```

```
$
$ NEXT SECTION SPECIFIES THE CORDON LINKS
```

```
$-----
alnk 1,n=11,1927-2523*          Century Road
alnk 2,n=12,2469-2471*          Garden State Parkway SB @ North
Cordon
alnk 3,n=12,2135-2137*          Garden State Parkway NB @ North
Cordon
alnk 4,n=13,2239-2243*          Route 17 SB @ North Cordon
alnk 5,n=13,2241-2245*          Route 17 NB @ North Cordon
alnk 6,n=14,2047-2049*          Farview Avenue @ North Cordon
```

alnk 7,n=15,2797-2051*	Spring Valley Road @ North Cordon
alnk 8,n=16,2045-2055*	Forest Avenue @ North Cordon
alnk 9,n=17,243-6067*	Kinderkamack Road @ North Cordon
alnk 10,n=18,244-6063*	Main Street
alnk 11,n=19,245-2399*	Route 4 @ East Cordon
alnk 12,n=20,246-2399*	Hackensack Avenue
alnk 13,n=21,247-2511*	Kinderkamack Road @ South Cordon
alnk 14,n=22,248-6033*	Forest Avenue @ South Cordon
alnk 15,n=23,249-2065*	Spring Valley Road @ South Cordon
alnk 16,n=24,250-6050*	Farview Avenue @ South Cordon
alnk 17,n=25,251-2617*	Route 17 @ South Cordon
alnk 18,n=26,253-2073*	Paramus Road/Passaic Street @ South
Cordon	
alnk 19,n=27,252-6052*	Garden State Parkway @ South Cordon
alnk 20,n=28,6035-2535*	Paramus Road @ North Cordon
alnk 21,n=29,1939-1943*	Route 4 East @ West Cordon
alnk 22,n=29,2289-1947*	Route 4 West @ West Cordon
repo -3,4,6	

-----

\*

```

$erase nwii22F.y90
$>copy KYLE*.prn ext4&170.prn
$>erase KYLE*.prn
$pause
$list ext4&17.prn
$list 4&170790.asc
$>COPY KYLES LNK.M00 4&1715.Y90

```

\$ This setup extracts the Route 4 and 17 subarea trip table and network using the Author's methodology. This extraction uses a five iteration equilibrium assignment.

\$  
\$  
\$  
\$ Extract Route 4 / Route 17 Subarea Network  
\$ from 1990 Northwest Bergen County net  
\$

\*  
\$>erase KYLE\*.prn  
\*pgm netmrg TEMPIN.NET,NWII21F.Y92  
dele ctime,nimp-iimp  
\*

\$-----  
\*pgm assign TEMPIN.NET  
\*par page=1,msglev=5,ZONES=276  
\*unit 14=nwest15.y90,15=4&1715.Y92,21=TEMPOUT.NET  
\*id Bergen: Extract Northwest Net, 1986  
\$ setup is EXTOAK.SET  
par slerr=M,slnk=2  
\$sel T=6059,1347,1341,2557,2103  
\$sel I=1,J=1  
\$Five iteration equilibrium assignment  
EQUI  
thet 0,0,0,0,0  
\$-----

----  
\$ use turn penalties  
\$penf c:\bergen\92012\assign\penalty.dat  
\$ extract link & coord files  
subn 0,4&170790.asc,4&1790xy.asc  
\$-----

----  
\$ Specify subarea zones.  
newz 1=133  
newz 2=134  
newz 3=135  
newz 4=136  
newz 5=137  
newz 6=139  
newz 7=140  
newz 8=141  
newz 9=142  
newz 10=143

\$  
\$ NEXT SECTION SPECIFIES THE CORDON LINKS  
\$-----

aln	1,n=11,1927-2523*	Century Road
aln	2,n=12,2469-2471*	Garden State Parkway SB @ North
	Cordon	
aln	3,n=12,2135-2137*	Garden State Parkway NB @ North
	Cordon	
aln	4,n=13,2239-2243*	Route 17 SB @ North Cordon
aln	5,n=13,2241-2245*	Route 17 NB @ North Cordon
aln	6,n=14,2047-2049*	Farview Avenue @ North Cordon
aln	7,n=15,2797-2051*	Spring Valley Road @ North Cordon
aln	8,n=16,2045-2055*	Forest Avenue @ North Cordon
aln	9,n=17,243-6067*	Kinderkamack Road @ North Cordon
aln	10,n=18,244-6063*	Main Street

alnk 11,n=19,245-2399*	Route 4 @ East Cordon
alnk 12,n=20,246-2399*	Hackensack Avenue
alnk 13,n=21,247-2511*	Kinderkamack Road @ South Cordon
alnk 14,n=22,248-6033*	Forest Avenue @ South Cordon
alnk 15,n=23,249-2065*	Spring Valley Road @ South Cordon
alnk 16,n=24,250-6050*	Farview Avenue @ South Cordon
alnk 17,n=25,251-2617*	Route 17 @ South Cordon
alnk 18,n=26,253-2073*	Paramus Road/Passaic Street @ South
Cordon	
alnk 19,n=27,252-6052*	Garden State Parkway @ South Cordon
alnk 20,n=28,6035-2535*	Paramus Road @ North Cordon
alnk 21,n=29,1939-1943*	Route 4 East @ West Cordon
alnk 22,n=29,2289-1947*	Route 4 West @ West Cordon
repo -3,4,6	

\$-----

\*

```

$erase nwii22F.y92
$>copy KYLE*.prn ext4&172.prn
$>erase KYLE*.prn
$pause
$list ext4&17.prn
$list 4&170790.asc
$>COPY KYLES LNK.M00 4&1715.Y92

```

## REFERENCES

- 1 Comsis. *MINUTP Technical User Manual, 93-B Version*. August 1993.
- 2 The Urban Analysis Group. *TRANPLAN: User Manual, Version 7.1*. 1992.
- 3 Transportation Research Board. *Quick-Response Urban Travel Estimation Techniques and Transferable Parameters: User's Guide*. 1978, pp. 22, 63.
- 4 Federal Highway Administration. *Traffic Assignment*. 1973, pp. 164-166.
- 5 Federal Highway Administration. *National Highway Statistics*. 1991, pp. 111-115.
- 6 Transportation Research Board. *Highway Capacity Manual Special Report 209*. 1985, pg. 1-4.
- 7 Meyer, M., and E. Miller. *Urban Transportation Planning: A Design-Oriented Approach*. 1984.