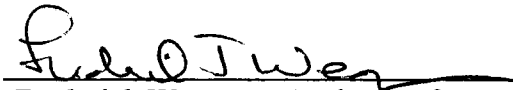
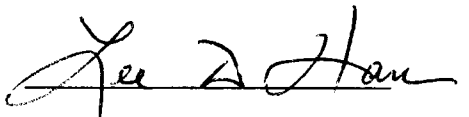
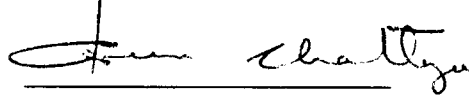


To the Graduate Council:

I am submitting herewith a thesis written by Jason Andrew Gregory entitled "Small Urban Area Transportation Planning-Athens, Tennessee Case Study." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Civil Engineering.


Frederick Wegmann, Major Professor

We have read this thesis
and recommend its acceptance:

Accepted for the Council:


Associate Vice Chancellor and
Dean of The Graduate School

**SMALL URBAN AREA TRANSPORTATION PLANNING-
ATHENS, TENNESSEE CASE STUDY**

A Thesis
Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Jason Andrew Gregory
May 1998

DEDICATION

“Whatever you do, work at it with all your heart, as working for the Lord, not for men, since you know that you will receive an inheritance from the Lord as a reward. It is the Lord Christ you are serving.” (NIV)

Colossians 3:23-24

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Also, I would like to thank the Southeastern Transportation Center for providing me with the financial support necessary to attend the University of Tennessee, Knoxville.

ABSTRACT

Federal regulations require long range transportation planning for large urban areas with a population of over 50,000. However, there are no federal requirements for small urban areas of 50,000 people or less. Currently the Tennessee Department of Transportation (TDOT) conducts a simplified planning procedure for small urban areas in Tennessee. The purpose of this study is to develop a mid-range procedure that lies between the current simplified TDOT procedure and the more complex procedure used in larger urban areas. For the purposes of demonstrating and testing the mid-range procedure, the city of Athens, Tennessee (population 12,700) was chosen as a case study. This report will discuss the steps necessary in developing the travel forecasting model for Athens and the resources involved in performing various tasks of the transportation planning process.

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I. Introduction

Urban Transportation Planning

Under the Hayden-Cartwright Act of 1934, up to 1.5 percent of federal aid funds to the states could be used “for making surveys, plans, and engineering investigations of projects for future construction” (Everett, 1992). While this act did allow for transportation planning, it was the Federal Aid Highway Act of 1962 that served as the major impetus for urban transportation planning. Under the 1962 act, urban areas with a population of 50,000 or more were required to develop a long range transportation plan in order to receive approval for any federal aid highway project. The planning process was to be comprehensive in scope, continuous in duration, and cooperatively implemented between state and local governments. This comprehensive, continuous, and cooperative planning process is commonly referred to as the 3-C planning process. The Bureau of Public Roads (BPR), predecessor of the Federal Highway Administration (FHWA), established 10 elements for the 3-C process in which detailed analysis was required. These 10 elements included:

1. Economic factors affecting development,
2. Population,
3. Land use,
4. Transportation facilities including those for mass transportation,
5. Travel patterns,
6. Terminal and transfer facilities,
7. Traffic control features,

8. Zoning ordinances, subdivision regulations, building codes, etc.,
9. Financial resources, and
10. Social and community value factors. (Welner, 1987)

A crucially important aspect of the 3-C urban transportation planning process is the advent of travel demand modeling using computers. The purpose of travel demand modeling is to forecast future traffic volumes on roadway segments. Since transportation plans are to be long range, the process must recognize that significant changes in land use development and on the road network are likely to occur. Therefore, most transportation planning models generally follow a four step process to best accommodate these changes. These steps are: trip generation, trip distribution, mode split, and traffic assignment. Using this stepwise procedure, major impacts on traffic due to large developments, such as a new shopping center, or changes to the roadway network, such as with the addition of a new bypass facility, are reflected.

State departments of transportation recognized the benefits of long range transportation planning and many established similar planning procedures for small urban areas with less than 50,000 people. However, the detailed level of analysis for large urban areas under the 3-C process was not appropriate for the limited resources available to small urban areas. Therefore, modifications were necessary to accommodate these limited resources. For instance, most small urban areas do not have public transportation. Hence, the mode split step is not necessary and the stepwise planning procedure would only contain three steps.

Since most small urban areas do not employ transportation planners who are primarily assigned to the task of travel demand modeling, many state departments of transportation assisted these smaller communities by performing the modeling using their own staff. However, due to funding and staff availability constraints, this modeling assistance was gradually reduced. The Tennessee Department of Transportation (TDOT) has now limited its assistance to a very simplified procedure which does not include travel demand modeling and forecasting.

Therefore, the purpose of this study is to identify and demonstrate a mid-range transportation planning procedure for small urban areas that lies between the current simplified procedure carried out by TDOT and the more complex procedure used in larger urban areas. The mid-range procedure should utilize simplified travel demand modeling techniques using a user-friendly software package. For the purpose of demonstrating and testing such a procedure, the city of Athens, Tennessee (population 12,700) was selected as a case study. This report will discuss the steps necessary in developing the travel forecasting model for Athens, Tennessee and the resources involved in performing various tasks of the transportation planning process.

Athens Transportation Planning Study Information

In 1996, TDOT's Bureau of Planning and Development conducted an existing conditions study for Athens, Tennessee. The study identified a number of transportation problems based upon accident records, traffic volume counts, volume-to-capacity ratios, and input from political representatives and citizens of Athens. Among the most pressing

concerns was the need for a bypass facility that would begin at Holiday Drive and Decatur Pike and encircle the southern and eastern portions of the city of Athens, terminating near I-75. The southern portion of the bypass is currently being studied by TDOT. It was felt that this bypass would eliminate the majority of transportation problems in Athens, including congestion in the central business district (CBD). Appendix A lists the transportation concerns in Athens as presented in the 1996 TDOT study. The general alignment for the bypass has been proposed and is shown in Plate 1 (in pocket).

A travel demand model can be used to demonstrate the effect on traffic volumes due to future land use patterns and the impact of a bypass on adjacent roads. TDOT is conducting a bypass feasibility study for the southern portion of the proposed bypass in which the future average daily traffic (ADT) estimates are based on an extrapolation of historical ADT growth trends. However, a prime application of a traffic forecasting model is to estimate traffic volumes on a proposed bypass based upon future population and land use patterns. Since Athens does not have an origin-destination (O-D) study available, transferable parameters presented in NCHRP Report 187 will be relied upon in this study. (An updated version of the NCHRP 187 manual, published in 1978, is not available at this time.) Since these transferable parameters are being used in this study, the software package known as Quick Response System II (QRS II) developed by AJH Associates was used. QRS II will make the maximum use of these transferable parameters while providing local planners with a fairly simple, user-friendly piece of software.

Background

The city of Athens, Tennessee is located in southeastern Tennessee in McMinn County and currently includes approximately 12,700 residents within its city limits. The population changes for both the city of Athens and McMinn County can be found in both Table 1 and Figure 1, which also shows population estimates since 1990. The planning area for this study coincides with the Athens planning region and includes all of the city of Athens as well as a portion of the planning region as defined by the Tennessee State Planning Office. The total population inside the planning area consists of approximately 16,000 people. Table 2 shows the socioeconomic values used in this study.

Although the vast majority of jobs in the planning area lie inside the Athens city limits, the pool of employees come from not only the city of Athens, but also from surrounding communities such as Englewood, Etowah, and Niota. The total number of employed persons in McMinn County in 1997 was 24,500 (Woods and Poole, 1997) of which 11,593 were employed in the Athens planning area during the same year. Retail employment consists of numerous restaurants and stores such as Wal-Mart. However, most of the jobs in the planning area are manufacturing oriented (see Table 3). As the McMinn county seat, Athens includes a number of other important non-retail employers such as the McMinn County courthouse, the McMinn County justice center, and McMinn high school. The Columbia Athens Regional Medical Center and the Tennessee Wesleyan College are also substantial employers in Athens.

Transportation plays a significant role in the Athens planning area. US-11 (Congress Pkwy) is a major thoroughfare along which lay a number of major retail centers

Table 1. Historical Changes in Population.

Source: Athens Area Chamber of Commerce, *Tennessee Community Data: Athens, Tennessee*, 1996.

Year	Athens	McMinn
1950	8618	32,024
1960	12,103	33,662
1970	11,881	35,462
1980	12,080	41,878
1990	12,052	42,383

Table 2. Athens Planning Region Socioeconomic Data.

	Retail Employment	Non-Retail Employment	Autos Per Household	Households	Population
Non-City	41	8	1.77	1768	4016
Athens	3598	7946	1.51	4969	12,052
Total	3639	7954	1.57	6737	16,068

Table 3. Key Manufacturing Industries.

Source: Athens Area Chamber of Commerce, *Tennessee Community Data: Athens, Tennessee*, 1996.

Industry	Number of Employees
Athens Furniture Industries	650
Athens Products Company	370
Damy Industries	235
The Heil Company	300
Johnson Controls	500
Mayfield Dairy Farms	500
Niota Textile Mills	275
Plastic Industries	325
Textron Automotive Interiors	917

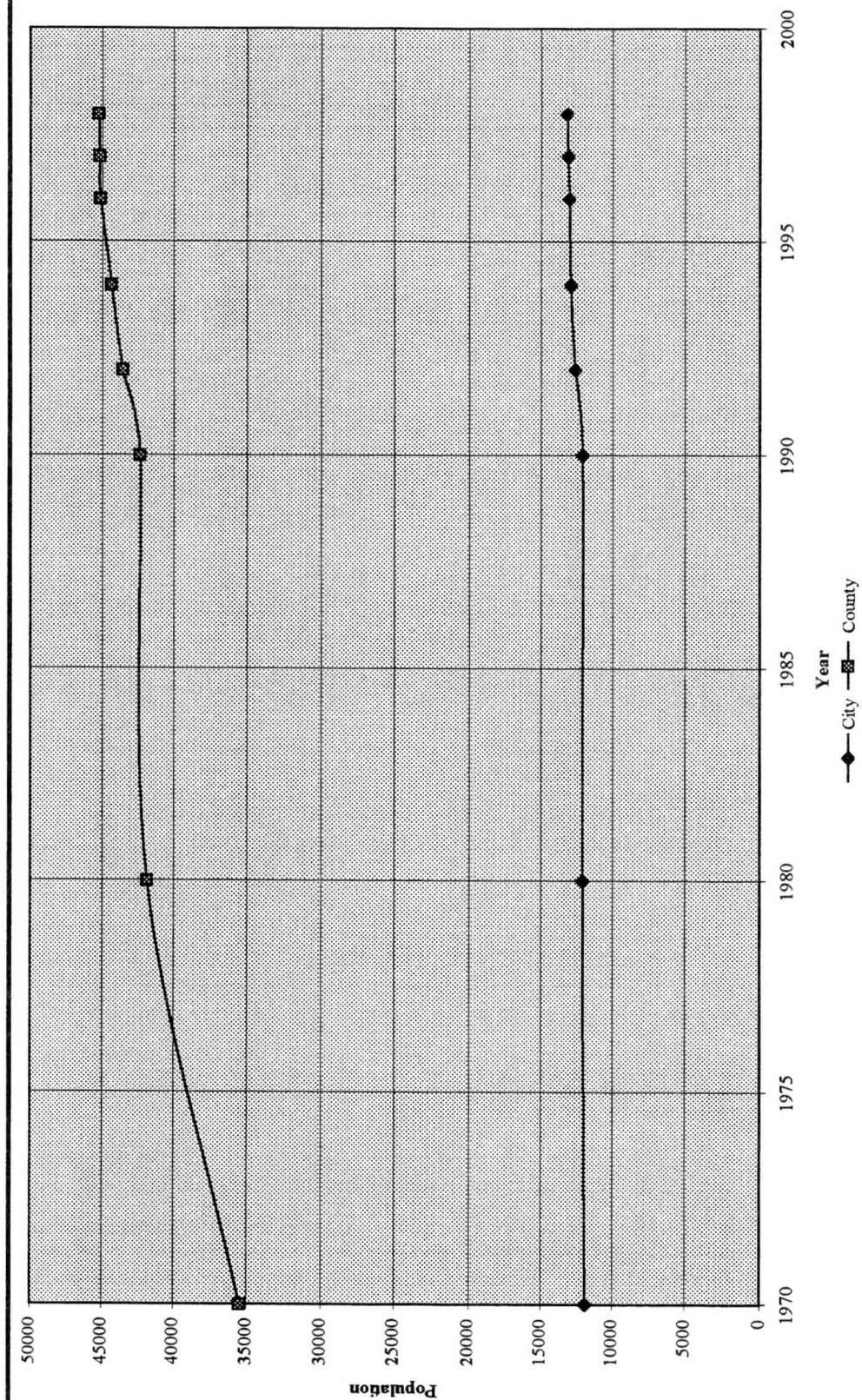


Figure 1. Population Changes in Athens and McMinn County.

(Sources: Athens Area Chamber of Commerce, *Tennessee Community Data: Athens, Tennessee, 1996 and Woods and Poole Economics, Inc., 1997 State Profile: Tennessee, January 1997.*)

and non-retail businesses. I-75 runs along the western perimeter of Athens where two exits provide access to the city. Both the CSX railroad and the Norfolk-Southern railroad provide rail entry into Athens.

II. Current Model Scenario Development

Network Development

Developing the network for Athens, Tennessee was one of the most time consuming portions of this project. Rather than plotting the roadway network manually, a GIS file, developed by the Chattanooga branch of the Tennessee State Planning Office, was used as the basic input. Before this GIS file was usable, a substantial amount of time was spent by Agatino LaRosa cleaning up the file so that it would be readable in QRS II's General Network Editor (GNE). Once the file was in GNE format, the network was then further pared down to include only the necessary links. Links are segments of a road which are connected to one another by nodes. An example of a node is at an intersection or when there is a change in roadway alignment or geometry (i.e. a curve in the road or a change in the number of lanes). Each individual node was then examined to ensure that all duplicate nodes were removed and that the roads actually intersected with one another at the proper locations.

The Athens planning area was divided into 104 traffic analysis zones (see Plate 1). The borders of these zones follow a number of items including major roadways, natural boundaries such as creeks, the Athens city limits, and census block boundaries. These items were chosen to account for the loading of trips from a zone onto the roadway network and to allow for the aggregating of census data.

The roads included in the network are generally those that are functionally classified as collectors or above, although a few local streets were also included when deemed necessary. There are 591 links and 415 nodes present in the network. Speeds

along the network were obtained by driving throughout the Athens planning area and directly viewing the posted speed limits. The number of lanes of each road and the layout at intersections (i.e. exclusive turn lanes) were also gathered from direct observation of the roads. Intersections with traffic control were also noted by direct observation. Seventeen of the intersections are signalized, with a 60 second cycle length assumed for all of these. QRS II determined the link distances from the network scale, based upon the original GIS network.

Trip Generation for Internal Trips

With the development of the network completed, the next step was to determine the number of trips within the planning area. This estimation of trip ends, known as trip generation, relies on socioeconomic data, including population, the number of dwelling units or households, the average automobile ownership per household, and employment figures. Trip ends occurring at the household end are called productions and those at the non-residential end are called attractions. Therefore productions and attractions are not true origins and destinations. For instance, traveling from home to work in the morning and then from work to home in the evening would result in two productions at the home end and two attractions at the work end, even though the second trip originated at the workplace. Productions and attractions are computed by zone and are represented on the network at a centroid. Centroids represent zones and are located at the center of zonal activity. They are attached to the network via centroid connectors, which basically represent local streets.

Input data for the generation of trip productions was obtained from the 1990 census. Table B-1 shows the input data by zone used for both the generation of trip productions and attractions. The Athens planning area consisted of 5 partial tracts, 16 block groups, and 650 blocks. Dwelling units were available on a block basis which were aggregated by traffic analysis zone. Auto ownership per household was available on a block group basis which was used to determine the average daily person trips per household and the percentage of daily person trips by purpose (see Table B-2). Trip purposes included home-based work (HBW), home-based non-work (HBNW), and non-home-based (NHB). With these figures, the number of productions were determined by trip purpose for each zone.

The data needed to calculate trip attractions on a zonal basis consists of the amount of retail and non-retail employment and the number of dwelling units. As previously mentioned, the number of dwelling units was obtained from 1990 census block data. Employment figures were collected through a "windshield survey" whereby two people simply drove and walked through Athens, stopping at each place of business to inquire about the number of workers there (very small businesses were estimated). Appendix B lists the equations from NCHRP Report 187 used to calculate attractions.

Because trip productions and attractions are estimated using different procedures, the sum of trip productions will not equal the sum of trip attractions. Therefore, productions and attractions must be balanced. Since trip productions are based on household data, they are felt to be more reliable and were held constant during the balancing procedure, while the attractions were adjusted. However, the production

formulas have no way of knowing where NHB trip ends are produced. Therefore, the NHB productions were set equal to NHB attractions. Appendix B shows the balancing procedures. The number of productions, excluding external stations, is 120,520. The total number of balanced productions and attractions can be found following the next section. The production and attraction output from trip generation, as computed by QRS II, can be found in Table C-1.

External-Internal and Through Trips

In addition to the trips made within the planning area, trips with at least one end outside of the area were also placed on the network. Through trips are trips in which both the origin and destination lie outside of the cordon line, and external-internal or internal-external trips are those where only one end lies outside of the study area. All of these trips were loaded onto the network at the 11 external stations.

The number of through trips were calculated using equations developed by Modlin for the North Carolina DOT, as shown in Appendix D. They were then adjusted using an average adjustment factor technique (see Appendix D) so that they would agree more closely with actual 1996 ADT coverage counts at each external station. Assuming a 50/50 split, the through trips were added to the network as one-way trips.

The remaining trips at the external stations are external-internal trips. These trips were separated by trip purpose for each external station, with 46 percent of the total number of external-internal trips as HBW trips, 32 percent as HBNW trips, and 22 percent as NHB trips (Sossiau, et. al., 1978). The external-internal trips by trip purpose were then

converted to person trips by multiplying the vehicle trips by the appropriate vehicle occupancy factors presented in Table 4. These person trips were then entered into the network as productions at the external stations. While these external-internal trips were included in the balancing procedure, through trips were added, after the balancing, as supplementary vehicle trips on the network by means of a trip table read into QRS II. The results of QRS II's trip generation and balancing procedure are shown in Table 5.

Excluding trips made at the external stations, the average number of trips per person in the Athens planning area is 7.5 and the average number of trips per household is 17.9. This number compares favorably with the 17.7 trips/household expected for an average auto ownership rate of 1.57 vehicles per household (see Table B-2).

Trip Distribution for Internal Trips

Once productions and attractions are determined, the next step is find out where these trips are going. Hence, the number of trips must be distributed between zones. In this study, the gravity model was used for trip distribution. The gravity model is based upon Newton's law of universal gravitation which states that the force of attraction between two bodies is directly proportional to their masses and inversely proportional to the square of the distance between them. Consequently, in the gravity model, the number of trips between zones is directly proportional to the number productions and attractions in each zone and inversely proportional to the travel time between two zones.

Table 4. Vehicle Occupancy Parameters.

Source: Sossiau, Arthur B., Amin B. Hassam, Maurice M. Carter, and George V. Wickstrom, *Quick-Response Urban Travel Estimation Techniques and Transferable Parameters: User's Guide*, National Cooperative Highway Research Program Report 187. Transportation Research Board, Washington DC, 1978.

Trip Purpose	Vehicle Occupancy
HBW	1.38
HBNW	1.82
NHB	1.43

Table 5. Summary of Productions and Attractions.

	HBW	HBNW	NHB	Total
Total Productions	35466.3	86253.3	36372.4	158,092
Total Attractions	35466.3	86253.3	36372.4	158,092
P's w/o External Stations	15871.3	68276.3	36372.4	120,520

Travel time is represented in the gravity model via a friction factor such that the greater the travel time between two zones, the more “friction” is present, thereby making travel between those zones less attractive to drivers. This friction factor can take different forms, such as a power model or an exponential model. Both of these forms were tried with various exponents and it was decided that the exponential form of the friction factor with an exponent of 0.1 yielded the most realistic results. This exponential friction factor was then applied in this study. QRS II performed thirty iterations of the gravity model. The gravity model equation with the associated exponential friction factor equation can be found in Appendix E.

Traffic Assignment

After the number of person trips between zones are distributed, they must be converted to vehicle trips by dividing the person trips by the vehicle occupancy factors, presented previously in Table 4, and assigned to a path on the network. Since the external through trips were already vehicle trips, no conversion was necessary. The procedure used in this study to assign trips to links was all or nothing assignment. Using this technique, every vehicle trip is assigned to the minimum time path from origin to destination, irrespective of roadway capacity. The minimum time path is based on link distances and the free speed, as well as delay at traffic controlled intersections. Thus, the path chosen is the ideal route since speeds do not vary as the traffic volume approaches roadway capacity. Using all or nothing assignment, the average trip length is 8.84 minutes. Figure 2 shows the variation in trip lengths in the Athens planning area. Almost

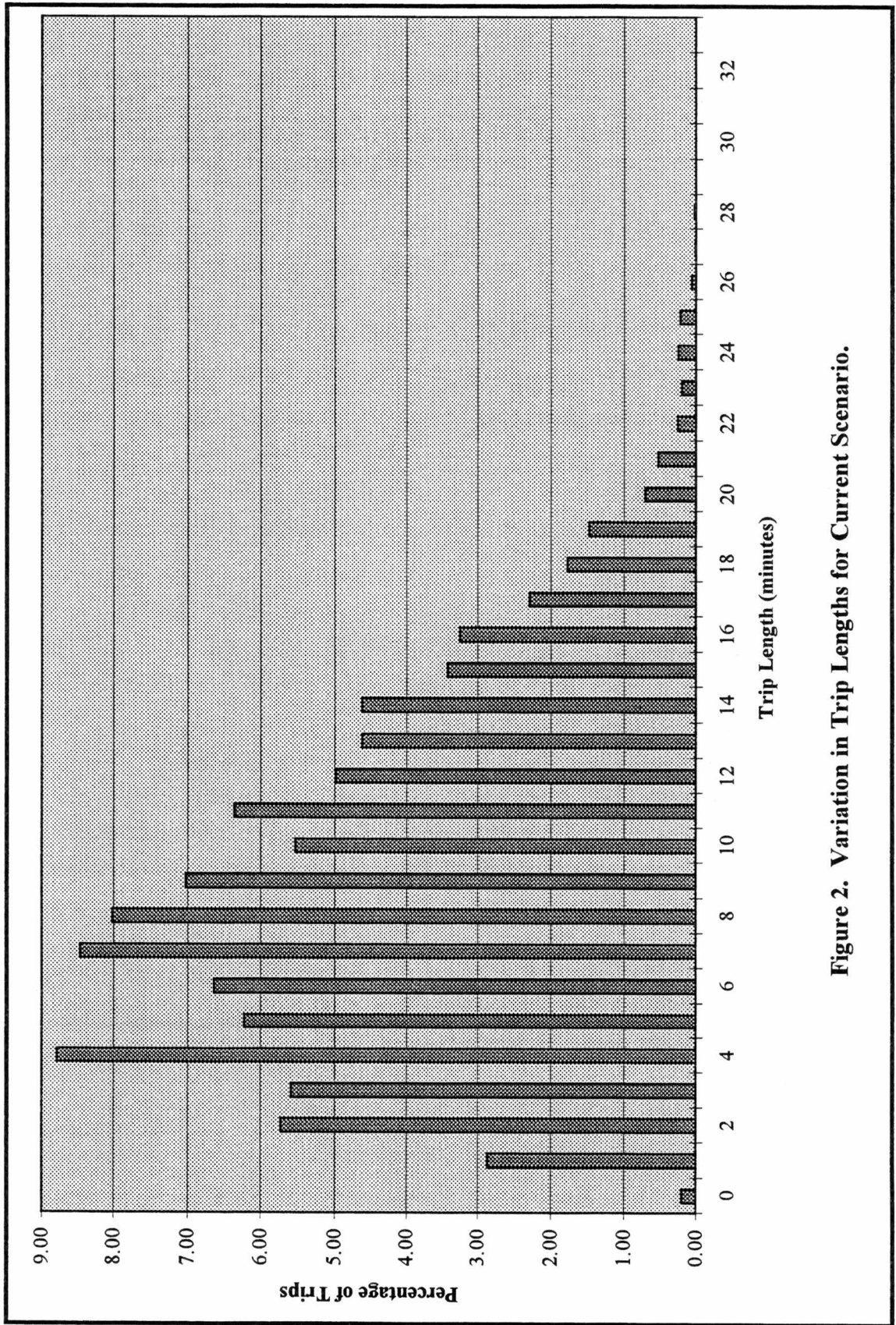


Figure 2. Variation in Trip Lengths for Current Scenario.

90 percent of the trip lengths are less than 15 minutes, which could be expected for a small community such as Athens. Table F-1 shows the number of vehicle trips moving in and between each zone and Table F-4 lists the variation in trip lengths in a tabular format for the current scenario.

Another assignment technique that was tried was capacity restraint. This method does take the roadway's capacity into account. Link speeds are reduced as the volumes near capacity which causes travel times to increase, thus diverting trips to alternate links. However, since Athens is a small community with limited congestion, all or nothing assignment is valid.

III. Model Validation and Calibration

Screenline Checks

In order to determine if the QRS II model accurately reflected what was happening in Athens, Tennessee, the model results were compared to actual traffic volume counts collected by TDOT and reported in the *Athens Urban Transportation Study: Existing Conditions*. After trying different distribution and assignment procedures, it was decided, as previously mentioned, that an exponential friction factor and all or nothing assignment compared favorably with the traffic counts. However, the model still differed too greatly and a number of changes were needed. These changes included adjusting the placement of several centroid connectors so that traffic was loaded onto the network realistically and the changing of various link speeds to make particular links either more or less attractive. With these adjustments made, the model was accepted. Two screenlines were used to determine how the model was performing. The results of the screenline checks are presented in Table 6.

Table 6. Model Screenline Results.

Screenline	Actual Traffic Counts	Model Results	Difference (%)
North-South	166,680	168,464	+1.1
East-West	48,350	54,028	+11.7
Combined	215,030	222,492	+3.5

Seed Tags

In order to determine if vehicles were traveling between centroids properly (i.e. not using centroid connectors to cut through zones, etc.), QRS II allows for the travel patterns of individual centroids to be examined using a "seed tag". Seed tags are attached to a particular centroid and after QRS II is run, an output file can be studied graphically to see the path taken from the centroid in question to all other destination zones. This method was used at all 11 external stations as well as at locations with a large number of productions or attractions, such as downtown, at the Wal-Mart, near the Columbia Athens Regional Medical Center, and so forth. Upon examination of the seed tag results, it was determined that trips appeared to move logically on the network.

Count Station Comparisons

The model was also examined at each count location and compared to the traffic count there (see Figure 3). It can be seen that the model compares favorably with most individual locations, with most locations falling within FHWA's acceptable error range. Two exceptions do exist and must be addressed here.

The first location is along Forrest St. between Madison and Ingleside where there is a 250 percent difference between the model result and the traffic volume count. The problem here may be that zone 55, which borders Forrest and Madison, is too large. Two large employers within zone 55, Johnson Controls and Athens Products, have access to Madison and not to Forrest. However, because several small business in zone 55 do have access to Forrest, centroid connectors were provided to both Madison and Forrest.

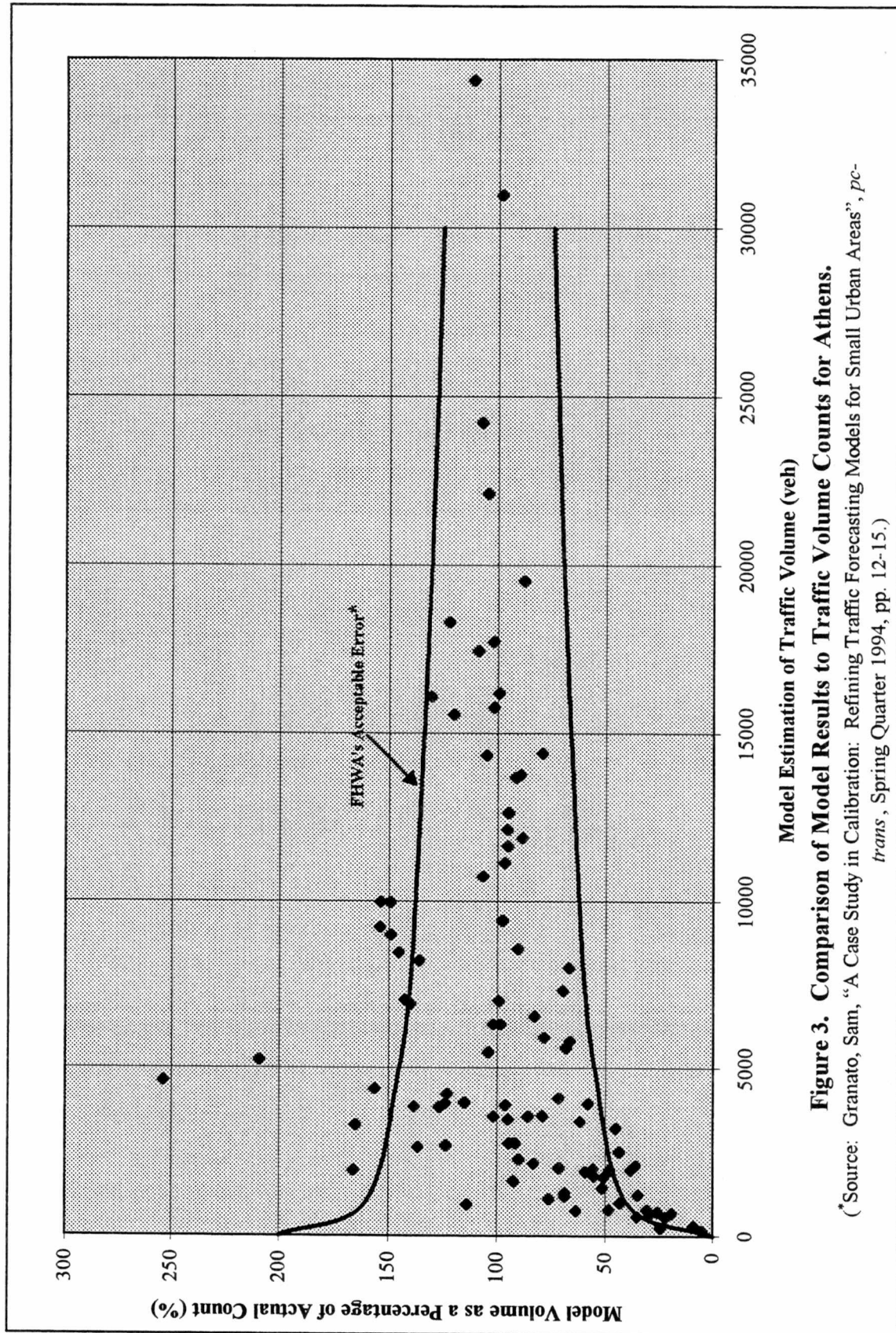


Figure 3. Comparison of Model Results to Traffic Volume Counts for Athens.

(*Source: Granato, Sam, "A Case Study in Calibration: Refining Traffic Forecasting Models for Small Urban Areas", *pc-trans*, Spring Quarter 1994, pp. 12-15.)

Therefore, trips generated by Johnson Controls and Athens Products now have access to Forrest by default and the centroid connector to Forrest is more attractive than traveling along Madison. This centroid connector to Forrest was made less attractive during one run by reducing the speed along it. However, more problems were created than were solved so it was felt that having this one anomaly was better than numerous ones. Perhaps, zone 55 should have been split in some manner so that the large employers were placed in a separate zone with access only to Madison.

The second problematic location is along Jackson, just south of Tellico where the difference between the model result and traffic volume counts is about 200 percent. This problem can most likely be associated with the difference between actual and predicted travel patterns due to the presence of the Norfolk-Southern rail line. These tracks run between the parallel streets of Jackson and Railroad Avenue, cutting off east-west traffic along Tellico and Decatur Pike/Green when a train is passing. Hence, the traffic volume counts show that drivers have a tendency to avoid Jackson and use Railroad Avenue as the more desirable north-south route to make their way to businesses along Decatur Pike, Congress Pkwy, and so forth. However, in the QRS II model, the railroad is not really represented and therefore Jackson appears to be more attractive than it really is.

IV. Forecast Year 2020 Scenarios

Description of Scenario Runs

As an example of an application of traffic forecasting in a small urban area, a proposed bypass around Athens was evaluated using the calibrated QRS II model. The year 2020 was chosen as the planning horizon to accommodate this bypass. The bypass has been under consideration since 1962, with several studies documenting its necessity in alleviating expected traffic congestion as well as the proposed alignment for the roadway (TDOT, 1963 and TDOT, 1989). However, before the bypass was added to the network, the model was run with updated socioeconomic and land use data that reflects changes expected for the year 2020. This run allowed for comparisons to be made regarding the effect of the bypass once it was placed on the network. Next, the bypass was added to the network with the updated socioeconomic data and the model was run again. Information regarding the alignment of the proposed bypass came from two TDOT studies: *Athens Urban Transportation Study: Existing Conditions* and *Feasibility Study: Proposed Connector Route from State Route 30 Northwest of Athens to State Route 39 East of Athens*. The bypass is four lanes with a design speed of 55 mph. Since no traffic signal warrant analysis was available for the bypass, none of the nine intersections associated with the bypass are signalized.

Updated Socioeconomic Data Methods and Information

Socioeconomic data was forecasted using two distinct methods. The first projection relies on local input from the city of Athens and the second comes from the

1997 State Profile for Tennessee, published by Woods and Poole (a brief discussion of the Woods and Poole forecasting methodology is presented at the end of this section). Both of the methods were tempered with local knowledge from planning and public works officials from the city of Athens to determine the amount and location of the growth in the county. Comparisons of the two methods are found in Tables 7 and 8. The population projection based upon local input exhibits a more optimistic outlook on growth in the city of Athens than the Woods and Poole forecast. This difference in population projections was applied to the employment figures obtained from Woods and Poole to arrive at the employment figures presented under the heading of "local input" in Table 7. The locations presented in that table are based upon input from the city of Athens as to where retail and non-retail businesses are most likely to emerge.

Residential growth was divided equally among ten areas in Athens that were deemed to be the most likely to increase, based upon local input and slated development. There are expected to be 2230 new households by the year 2020, so each of the ten areas of residential growth received 223 additional households. These areas are comprised of one or more zones (zone 80 actually contained two of the areas) and the households were partitioned accordingly (see Table 9).

This updated socioeconomic data does not reflect trips made at the external stations. Therefore, historical traffic volume data between the years 1985 and 1996 from TDOT for each external station was linearly extrapolated for the year 2020. Then, the same procedure previously used to compute and distribute through trips and external-internal trips was repeated for this extrapolated external trip data.

Table 7. Year 2020 Increases in Employment.

Location	Local Input		Woods and Poole	
	Retail Employment	Non-Retail Employment	Retail Employment	Non-Retail Employment
Holiday Drive	610	557	464	424
Mt. Verd Connector	305	140	232	106
To Etowah	305	0	232	0
I-75 Industrial Corridor	0	532	0	405
Near Hospital	0	279	0	212
Downtown	0	140	0	106

Table 8. Year 2020 Residential Related Forecast Totals.

	Local Input		Woods and Poole	
	Population	Households	Population	Households
City	16,042	6614	12,502	5183
Non-City	5345	2353	7616	3480
Total	21,387	8967	20,118	8663

Table 9. Additional Households by Zone for Year 2020.

Zone	Additional Households
1	56
3	56
6	55
7	56
61	111
63	112
64	112
65	111
70	223
72	223
77	111
78	112
80	446
83	223
93	56
94	56
96	56
104	55
Total	2230

Forecast Year 2020 Results

With the socioeconomic data updated, both of the year 2020 scenarios, with and without the bypass, were run. Table 10 shows the productions and attractions summary for both of the year 2020 scenarios. Excluding trips made at the external stations, the average number of trips per person in the Athens planning area increased from 7.5 to 7.7 and the average number of trips per household increased from 17.9 to 18.4 in comparison to the current model scenario. Although the total number of productions and attractions are identical for each of these scenarios, the distribution of trips between zones and the link volumes are different. Tables C-2 and C-3 shows the productions and attractions by zone for each scenario for the year 2020. Tables F-2 and F-3 show the number of vehicle trips moving in and between zones and Tables F-5 and F-6 list the variation of trip lengths in a tabular format for each scenario for the year 2020.

The results from the bypass scenario were compared with the simplified forecast presented in TDOT's *Feasibility Study* for the bypass, as shown in Table 11. Figure 4 shows that the difference in forecasts lies within FHWA's acceptable range of error. A comparison was also made between the no-bypass model results and historical ADT counts between 1985 and 1996. These historical counts, conducted by TDOT, were linearly extrapolated to the year 2020, which is similar to the current simplified forecasting procedure. The differences between the mid-range procedure used in this study and the linear extrapolation can be substantial in many cases. Although the differences between the two procedures is greater when the estimated volumes are low, discrepancies in the higher volumes should not be discounted. For instance, at count station 90 on I-75 the

Table 10. Summary of Productions and Attractions for Year 2020 Scenarios.

	HBW	HBNW	NHB	Total
Total Productions	52699.7	120776.4	51477.4	224,954
Total Attractions	52700.3	120776	51477.4	224,954
P's w/o External Stations	21201.7	91877.4	51477.4	164,557

Table 11. Comparison of QRS II Results on Bypass to TDOT Study Forecast.

Location	QRS II Results	TDOT Forecast	Difference (%)
Decatur Pike-Congress Pkwy	11,801	12,000	-1.7
Congress Pkwy-Madison	12945	11,600	+11.6
Madison-Cedar Springs	8124	11,400	-28.7
Cedar Sprigs-White	7589	11,200	-32.2
White-New Englewood	6458	4900	+31.8

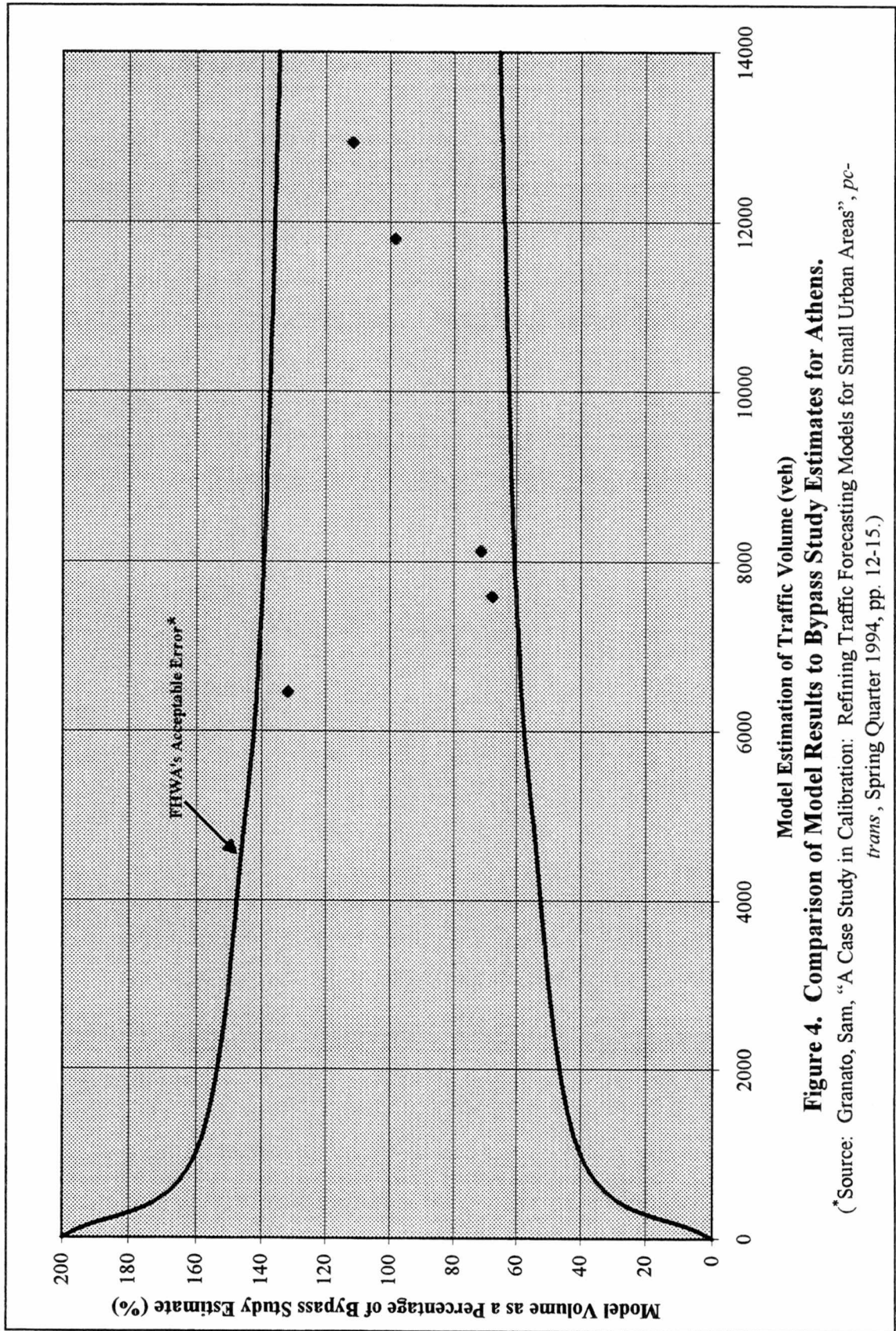


Figure 4. Comparison of Model Results to Bypass Study Estimates for Athens.

(*Source: Granato, Sam, "A Case Study in Calibration: Refining Traffic Forecasting Models for Small Urban Areas", *pc-trans*, Spring Quarter 1994, pp. 12-15.)

linearly extrapolated forecast estimates the ADT to be 77,216 whereas the QRS II model forecast shows the ADT to be 39,612. Although the percentage difference is not as great here as on the lower volume roads, the volume difference itself is obviously far more significant. The results of this comparison are shown in Figure 5.

As previously mentioned, the effect of the bypass on travel patterns was isolated by first running the year 2020 scenario without the bypass on the network and then rerunning it with the bypass in place as the only change to the model. Without the bypass, the average trip length is expected to be 9.49 minutes, up from the current trip length of 8.84 minutes. With the bypass, the average trip length would decrease, versus the no-bypass scenario, to 9.28 minutes. Overall, the changes in trip lengths are not very significant. The variation in average trip lengths for the year 2020 scenarios are shown in Figures 6 and 7.

The effect of the bypass was then examined in terms of reducing traffic congestion since this was a key concern of Athens citizens and local political representatives. Volume to capacity (v/c) ratios were calculated for every link both with and without the bypass in place. Since capacity is an hourly value, the peak hour volume was necessary for each link. The peak hour volume was computed by taking 30 percent of the ADT on each link. This percentage was chosen by looking at several published v/c ratios from *Athens Urban Transportation Study: Existing Conditions*. Knowing the capacity of the links in question, the published v/c ratios, and the volumes from the current QRS II scenario, the percentage of traffic during the peak hour was found to be approximately 30 percent. This

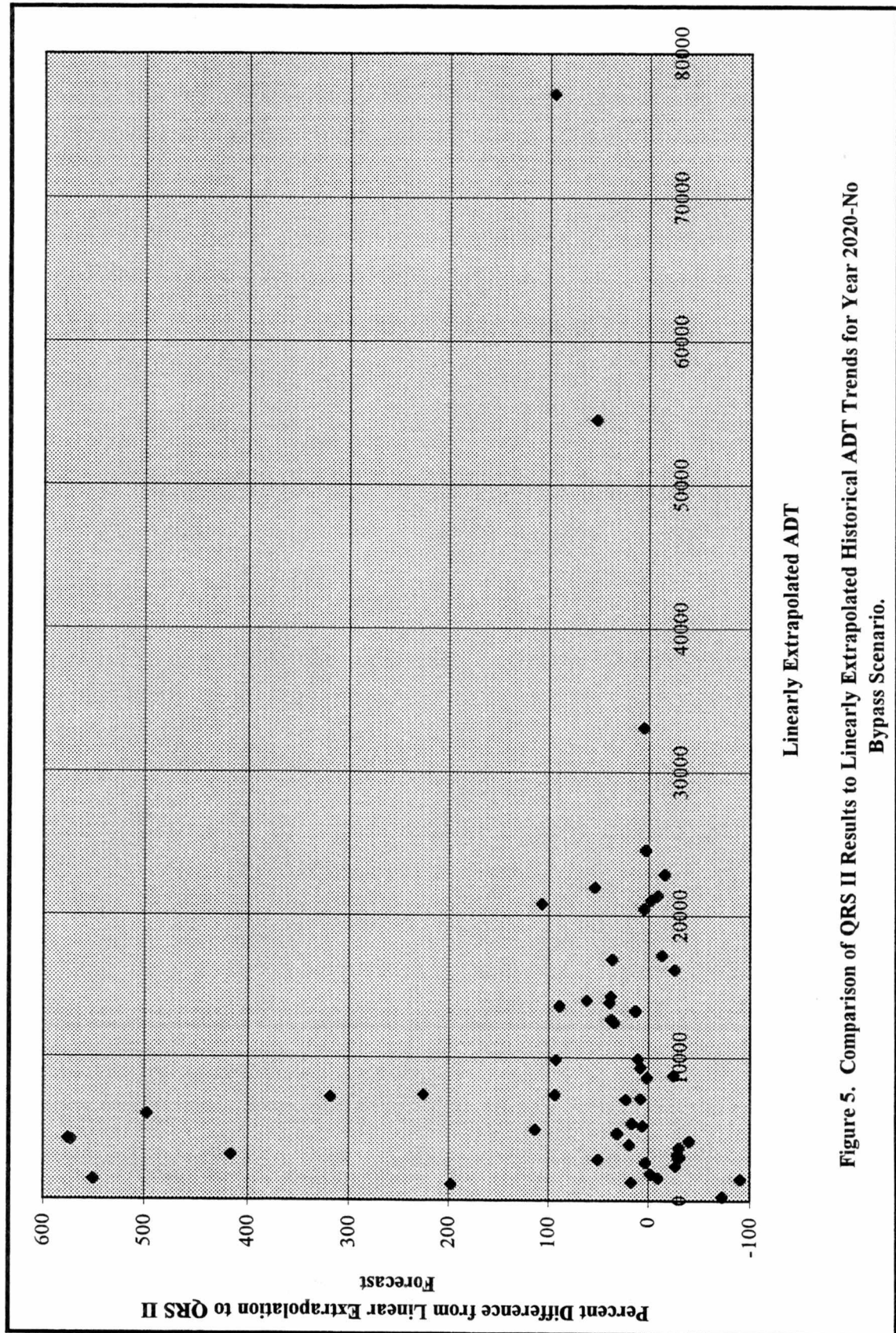


Figure 5. Comparison of QRS II Results to Linearly Extrapolated Historical ADT Trends for Year 2020-No Bypass Scenario.

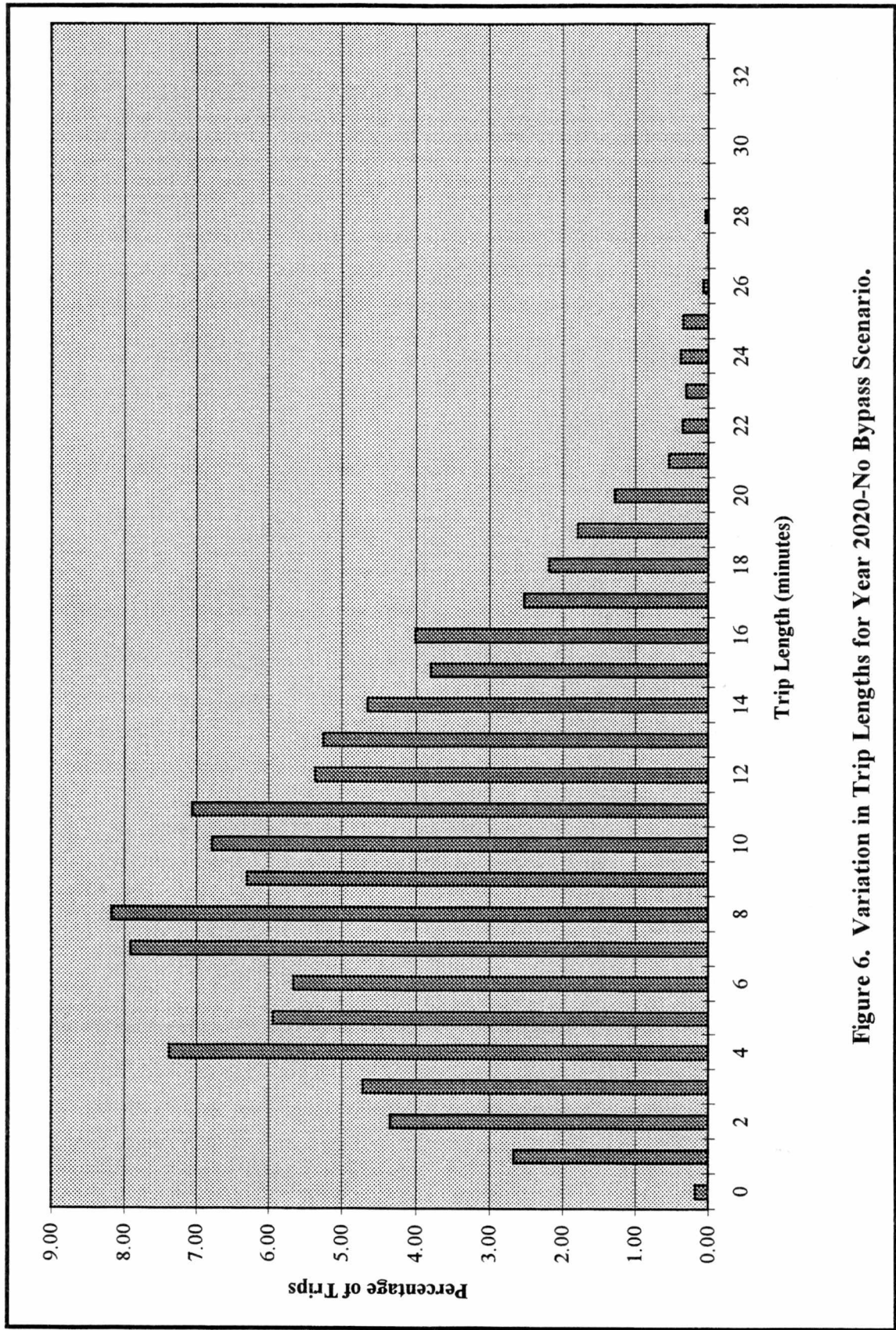


Figure 6. Variation in Trip Lengths for Year 2020-No Bypass Scenario.

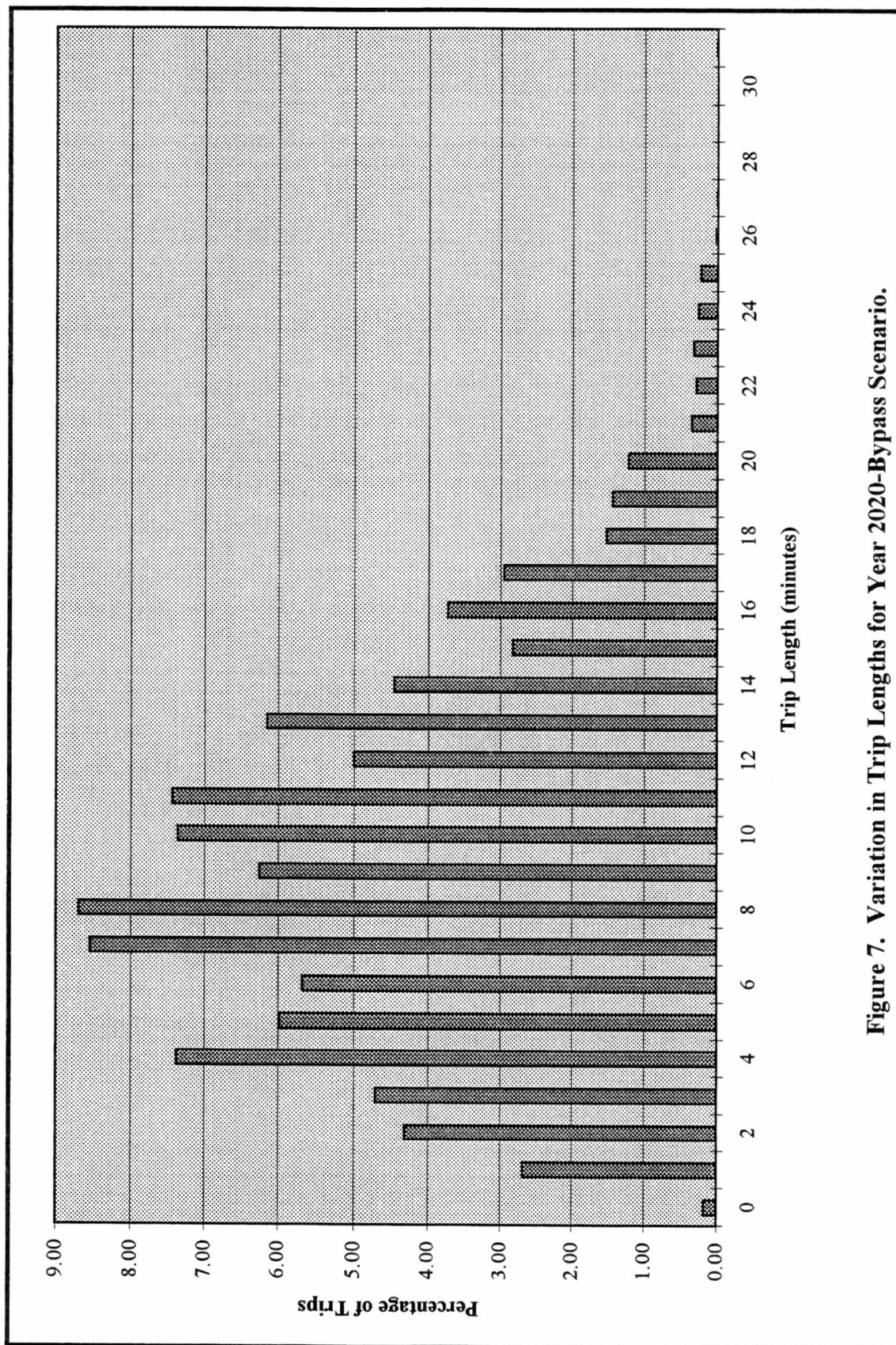


Figure 7. Variation in Trip Lengths for Year 2020-Bypass Scenario.

percentage was then applied to each link, except for I-75 where 10 percent was used since it would not generally be used for local travel.

The results of the capacity analysis can be seen in Plates 2 and 3 (both in pocket). Plates 2 and 3 graphically show stratified levels of congestion based upon v/c ratios. Table 12 shows a tabulation of the number of links that lie within each range. The bypass served to reduce or eliminate congestion at nearly every location examined in Athens. This was especially true in the downtown area. The only locations in which congestion increased are near a few of the exits/entrances on the bypass. These increases are due to the rerouting of traffic using the bypass instead of city streets to move from I-75 to Etowah, for instance. It should be noted that the volume associated with the v/c ratios is really demand volume. Therefore, v/c ratios much higher than 1.00 are possible given the fact that all or nothing assignment has been used which does not take into account a road's capacity.

Table 12. Levels of Congestion.

Level of Congestion	V/C Range	Number of Links	
		Without Bypass	With Bypass
Moderate	0.75-0.90	34	13
High	0.91-1.00	15	4
V/C > 1.00	> 1.00	29	25

Woods and Poole Projection Methodology

The forecasting procedure used in the Woods and Poole publication contains four basic stages (a full discussion of the procedure can be found in the *1997 State Profile* report). First, projections for the year 2020 are made for the entire United States in areas such as income, employment by industry, and population. These projections act as control totals for regional forecasts, thus linking the various regions of the country together since a change in one region will affect all of the other regions.

Second, the country is divided into 172 Economic Areas (EA's), which are aggregates of entire counties. Projections for employment are then made for these EA's. These employment projections are made using what Woods and Poole calls an "export-base" technique. The technique separates regional industries into "basic" and "non-basic" sectors. Basic sectors are those that produce goods and services that are not used locally, but rather on a national level. These may include agriculture or the Federal government. Non-basic sectors are then those that are used within the local region, such as retail trade or construction. Therefore, the basic sectors will control the development of the non-basic sectors. The employment projections are used to then predict earnings in the EA's. Both the employment and earnings projections will be used to determine population and number of households in the EA's.

The third stage is the forecast of each Economic Area's population. As mentioned, the population forecast is based upon employment opportunities since people are expected to move into or out of an area based upon the number of jobs available.

However, for the elderly and college or military aged population, historical migration data is used instead of economic elements. The second and third stages use the U.S. projections as the control total since these are estimates for EA's. The fourth stage is simply repeating stages two and three for the county level, with the EA's acting as the control totals.

V. Discussion and Conclusions

Summary of the Mid-Range Procedure Requirements

A total of four people contributed to this project during the GIS and windshield survey stages. Table 13 gives a breakdown of each task necessary in putting together the QRS II model for Athens, Tennessee. Included in the table are the required data and their sources, as well as the amount of time necessary to complete the tasks.

The total number of person hours required for the completion of this study was 261. 150 person hours were necessary for the network development, 80 person hours for trip generation, 13 person hours for the external-internal and through trips step, 5 person hours for model calibration, and 13 person hours for adjustments made for the year 2020 scenarios. Data sources included:

- 1990 US Census,
- Tennessee State Planning Office,
- *Athens Urban Transportation Study: Existing Conditions,*
- *Feasibility Study: Proposed Connector Route from State Route 30 Northwest of Athens to State Route 39 East of Athens,*
- NCHRP Report 187,
- 1997 Draft ADT Map for McMinn County,
- 1995 ADT Map for Athens and Niota,
- Woods and Poole's *1997 State Profile,*
- Local Knowledge and "Windshield Survey" from Athens, and
- Historical TDOT Traffic Volume Data.

Table 13. Task Breakdown for Athens Model.

Task	Data Required	Person-hours	Source
<i>I. Network Development</i>			
A. Cleaned up GIS Input File	GIS File	30	Tenn. State Planning Office
B. Developed Traffic Analysis Zones (aggregated census blocks)	Census Block Map	2	US Bureau of Census
C. Determined Area of TAZ's	1. Area in square miles 2. Census Block Map	8	1. Planimeter by Project Personnel 2. US Bureau of Census
D. Prepared Network in QRS II	QRS II Program and Info from Tasks I, A-C	80	Project Personnel
E. Collected and Input Road Characteristics into Model	1. Functional Class of Roads 2. Speeds (mph) 3. Roadway/Intersection Geometry 4. Signal Location and Timing	30	1. TDOT Athens Urban Transportation Study 2. Observed from posted speed limits 3. Observed while driving through Athens 4. By observation and assumption
<i>II. Trip Generation for Internal Trips</i>			
A. Collection of Socioeconomic Data	1. Retail and Non-Retail Employment Figures by block 2. Number of Households by census block 3. Total Population 4. Auto Ownership by Census Block	40	1. "Windshield Survey" 2. 1990 US Census 3. 1990 US Census 4. 1990 US Census
B. Input Socioeconomic Data into Model	Info from Task II, A	40	Project Personnel

Table 13 (continued).

Task	Data Required	Person-hours	Source
III. <i>External-Internal and Through Trips</i> A. Placed External Stations on Network and Collected Data Concerning These Stations	1. Average Daily Traffic 2. Percentage of Trucks 3. Functional Class of Roads	1	1. 1997 Draft ADT Map for McMinn County 2. 1995 ADT Map for Athens and Niota and when not available, assumed 10% 3. TDOT Athens Urban Transportation Study
B. Computed and Distributed Through Trips	Modlin Equations	8	NCHRP 187 Manual
C. Computed External-Internal Trips	1. Modlin Equations 2. Percentage of External-Internal Trips by Purpose 3. Vehicle Occupancy Parameters	2	All data from NCHRP 187 Manual
D. Input External Trip Data into QRS II	Info from Tasks III, B-C	2	Project Personnel
IV. <i>Model Calibration</i>	Average Daily Traffic Counts	5	Project Personnel TDOT Athens Urban Transportation Study
V. <i>Forecast Year 2020 Scenario</i> A. Placed Bypass onto Network	1. Alignment of Bypass 2. Speed and Geometry for Bypass	2	1. TDOT Athens Urban Transportation Study and TDOT Feasibility Study 2. TDOT Feasibility Study (assumed 55 mph and 4-lane for entire bypass)

Table 13 (continued).

Task	Data Required	Person-hours	Source
B. Modified Socioeconomic Data	1. Additional Retail and Non-Retail Employment 2. Additional Number of Households 3. Total Population	6	All data from Woods and Poole Publication and Local Input from Athens
C. Located and Changed Socioeconomic Data on Network	Info from Task IV. B.	2	Local Input from Athens and Project Personnel
D. Linear Extrapolation of 1997 ADT to 2020	1985-1996 Traffic Volumes	1	Historical TDOT Traffic Volume Data
E. Recomputed and Distributed Through Trips and Modified External-Internal Trips	Info from Tasks IV. D. and III. A-D	2	Previous Sources for Tasks III. A-D. and Project Personnel
Total		261	

Concluding Remarks

The mid-range transportation planning procedure presented in this study for small urban areas is felt to be effective, reliable, and fairly simple to use. Specifically, QRS II is a powerful tool in small urban area transportation planning. The graphical interface is quite user-friendly and the software does not require substantial amounts of time to learn and master. Although a local O-D study is more desirable than transferable parameters, this model is still felt to be reliable due to the consistency between the calibrated model results and real world data from TDOT count stations. In addition, forecasts obtained from the model can also be considered reliable because of the initial calibration and the use of local knowledge for future development.

The ability of traffic forecasting models in general, and QRS II specifically, to reflect changes in land use patterns, socioeconomic data, and network adjustments is one of their most important assets. This is further enhanced by the ease in which these changes can be made. Various scenarios can be examined expediently using QRS II and the output studied both graphically and in a tabular format.

The data necessary as input to the model is readily available and is not difficult to obtain. The manpower and time requirements necessary to gather this data are also not extravagant. Furthermore, if a GIS network is available, the time spent coding a network is drastically reduced. The entire process of gathering data, coding the network, and running the model for various scenarios can be completed in about 260 person-hours. Therefore, it is recommended that TDOT consider implementing traffic forecasting models for small urban areas in which major transportation projects are under consideration.

REFERENCES

REFERENCES

- Athens Area Chamber of Commerce, *Tennessee Community Data: Athens, Tennessee*, 1996.
- Everett, Jerry, *Air Quality Conformity, The California Experience: Past, Present, Future?*, June 2, 1992.
- Granato, Sam, "A Case Study in Calibration: Refining Traffic Forecasting Models for Small Urban Areas", *pc-trans*, Spring Quarter 1994, pp. 12-15.
- Horowitz, Alan J., *Reference Manual: Quick Response System II for Windows*, AJH Associates, Milwaukee, Wisconsin, 1997.
- North Bannock Metropolitan Planning Organization, Ada Planning Association, and Idaho Transportation Department, *Report on System Planning in a Small Urbanized Area*, November 1987.
- Sossau, Arthur B., Amin B. Hassam, Maurice M. Carter, and George V. Wickstrom, *Quick-Response Urban Travel Estimation Techniques and Transferable Parameters: User's Guide*, National Cooperative Highway Research Program Report 187, Transportation Research Board, Washington DC, 1978.
- Tennessee Department of Transportation, *Athens Urban Transportation Study: Future Conditions*, May 1989.
- Tennessee Department of Transportation, *Feasibility Study: Proposed Connector Route from State Route 30 Northwest of Athens to State Route 39 East of Athens*, October 1996.
- Tennessee Department of Transportation, *General Highway Map: McMinn County, Tennessee*, 1997.
- Tennessee Department of Transportation, *Statewide Planimetric Map: Athens and Niota, McMinn County, Tennessee*, 1995.
- Tennessee Department of Transportation, *Traffic Study: Athens, Tennessee*, October 1963.
- Transportation Planning Office, Tennessee Department of Transportation, *Athens Urban Transportation Study: Existing Conditions*, October 1996.
- Welner, Edward, "Urban Transportation Planning Since the Federal-Aid Highway Act of 1962", *Journal of Transportation Engineering*, Vol. 113, No. 6, November, 1987.

Woods and Poole Economics, Inc., *1997 State Profile: Tennessee*, January 1997.

APPENDICES

APPENDIX A
TRANSPORTATION CONCERNS IN ATHENS

Concerns of Local Officials

Source: Transportation Planning Office, Tennessee Department of Transportation, *Athens Urban Transportation Study: Existing Conditions*, October 1996.

1. Need for Bypass.
2. The Extension of Tellico Avenue.
3. Need for Extending Dennis Street.
4. Intersection of Madison Avenue (US-11 BUS) and Cook Drive.
5. Intersections of White Street (SR-30), New Englewood Road (SR-39), and S. Jackson Street.
6. Intersection of Railroad Avenue and Tellico Avenue.
7. Intersection of Congress Parkway (US-11) at Rocky Mount Road.
8. Intersection of Congress Parkway and Railroad Avenue/Clearwater Road.
9. Intersection of Green Street (SR-30) and White Street.
10. Intersection of Congress Parkway and Decatur Pike (SR-30)
11. Intersection of Green Street and Ingleside Avenue (US-11 BUS)/Washington Avenue (US-11 BUS).
12. Emergency Vehicle Crossover Needed on I-75.
13. Intersection of White Street (SR-30) and Elizabeth Street.

APPENDIX B
TRIP GENERATION INPUT

Table B-1. Zone Information.

Zone	Retail Employment[†]	Non-Retail Employment[†]	Avg. Autos/HH[‡]	Households[‡]
1	58	51	1.58	3
2	20	18	1.11	0
3	18	45	1.11	2
4	74	63	1.11	14
5	18	55	1.58	8
6	69	3	1.53	4
7	17	61	1.53	2
8	26	20	1.76	76
9	6	48	1.11	20
10	60	0	1.11	65
11	8	12	1.58	4
12	0	0	1.11	49
13	34	5	1.58	97
14	0	0	1.58	35
15	13	265	1.53	149
16	28	116	1.53	119
17	66	5	1.53	44
18	24	3	1.76	31
19	12	6	1.84	131
20	0	110	1.11	67
21	13	47	1.06	149
22	20	12	1.11	83
23	13	17	1.58	3
24	0	2	1.12	217
25	3	0	1.58	72
26	0	5	1.58	22
27	2	0	1.58	0
28	0	0	1.58	76
29	1	813	1.44	27
30	44	0	1.11	19
31	11	0	1.11	45
32	22	0	1.44	0
33	92	5	1.11	36
34	26	63	1.03	118
35	18	6	1	7
36	8	291	1.97	28
37	0	0	1.97	211
38	0	0	1.76	84
39	90	0	1.76	21
40	0	500	1.58	74

Table B-1 (continued).

Zone	Retail Employment[†]	Non-Retail Employment[†]	Avg. Autos/HH[‡]	Households[‡]
41	0	0	1.58	0
42	0	0	1.12	79
43	10	75	1.44	32
44	76	0	1.76	111
45	0	15	1.76	8
46	131	7	1.76	168
47	204	14	1	0
48	160	677	1	223
49	226	701	1.76	49
50	5	7	1.76	23
51	51	46	1.76	201
52	181	1213	1.45	248
53	4	17	1.38	138
54	0	0	1.12	51
55	70	1245	1.55	112
56	0	0	2.18	9
57	7	14	1.86	157
58	42	0	2.02	65
59	50	19	1.77	46
60	0	0	1.83	28
61	0	0	1.85	84
62	0	0	1.76	11
63	0	0	1.92	68
64	0	0	1.97	213
65	0	0	1.97	174
66	0	0	1.97	35
67	0	2	1	0
68	5	19	1	6
69	0	102	1	1
70	262	345	1.47	1
71	0	0	1.47	1
72	63	45	1.47	129
73	188	0	1.47	22
74	370	20	1.47	104
75	289	0	1.47	7
76	35	22	1.47	227
77	0	0	1.47	76
78	0	0	1.47	140
79	119	18	1.82	79
80	0	0	1.82	68

Table B-1 (continued).

Zone	Retail Employment[†]	Non-Retail Employment[†]	Avg. Autos/HH[‡]	Households[‡]
81	61	676	1.69	0
82	17	2	1.82	35
83	0	0	1.82	14
84	0	0	1.82	48
85	0	0	1.82	0
86	0	0	2.18	72
87	0	0	1.79	77
88	0	0	2.18	90
89	0	2	1.95	45
90	0	0	1.87	23
91	0	0	1.83	66
92	0	0	2.08	116
93	12	0	1	42
94	0	0	2.08	16
95	0	0	1.14	100
96	6	4	1.14	24
97	6	0	1.14	26
98	0	0	2	115
99	42	0	2	5
100	33	0	1.95	8
101	0	0	1.95	29
102	0	0	1.96	62
103	0	0	1.95	132
104	0	0	2.08	186
Totals	3639	7954		6737

Notes: [†] 1997 Values [‡] 1990 Census Values

Table B-2. Trip Production Characteristics.

Source: Sossau, Arthur B., Amin B. Hassam, Maurice M. Carter, and George V. Wickstrom, *Quick-Response Urban Travel Estimation Techniques and Transferable Parameters: User's Guide*, National Cooperative Highway Research Program Report 187. Transportation Research Board, Washington DC, 1978.

Avg. Autos/HH	Avg. Daily Person Trips/HH	% Avg. Daily Person Trips		
		HBW	HBNW	NHB
0.56	4.5	21	57	22
0.81	6.8	21	57	22
0.88	8.4	21	57	22
0.99	10.2	18	59	23
1.07	11.9	18	59	23
1.17	13.2	16	61	23
1.25	14.4	16	61	23
1.31	15.1	16	61	23
1.47	16.4	15	62	23
1.69	17.7	14	62	24
1.85	18.0	13	62	25
2.03	19.0	13	62	25
2.07	19.2	13	62	25

Trip Attraction Equations

$$\text{HBW Attractions}^* = 1.7(\text{Total Employment})$$

$$\text{HBNW Attractions}^* = 10.0(\text{Retail Employment}) + 0.5(\text{Non-retail Employment}) + 1.0(\text{Dwelling Units})$$

$$\text{NHB Attractions}^* = 2.0(\text{Retail Employment}) + 2.5(\text{Non-retail Employment}) + 0.5(\text{Dwelling Units})$$

Note: * Units of Person Trips

Balancing Technique

1. Calculate unadjusted productions (P's) by trip purpose using Table B-2.
2. Calculate unadjusted attractions (A's) by trip purpose using trip attractions equations.
3. Compute adjustment factor for A's by trip purpose where:

$$\text{Adjustment Factor} = \frac{\text{Sum of Unadjusted P's by Trip Purpose}}{\text{Sum of Unadjusted A's by Trip Purpose}}$$

4. Apply adjustment factors to the A's by trip purpose.
5. Set NHB P's equal to adjusted NHB A's.
6. The sum of P's by trip purpose should be reasonably close to the sum of A's by trip purpose. P's and A's by zone will not necessarily match.

APPENDIX C
TRIP GENERATION OUTPUT

Table C-1. Productions and Attractions by Zone for Current Scenario.

Zone		HBW	HBNW	NHB
1	Ps:	7.4	31.7	291.8
	As:	333.5	1117.6	291.8
2	Ps:	0	0	101.2
	As:	116.3	383.9	101.2
3	Ps:	4.3	14.9	178.1
	As:	192.7	375.6	178.1
4	Ps:	29.9	104	372.2
	As:	419.1	1442.7	372.2
5	Ps:	19.8	84.6	211.4
	As:	223.3	395.8	211.4
6	Ps:	9.9	41.6	175.7
	As:	220.3	1277.4	175.7
7	Ps:	4.9	20.8	223.3
	As:	238.6	371.9	223.3
8	Ps:	183.8	840.2	166.7
	As:	140.7	635.5	166.7
9	Ps:	42.7	148.5	169.1
	As:	165.2	191	169.1
10	Ps:	138.9	482.8	181.6
	As:	183.6	1221.4	181.6
11	Ps:	9.9	42.3	57.2
	As:	61.2	165.3	57.2
12	Ps:	104.7	363.9	29.2
	As:	0	90	29.2
13	Ps:	239.8	1025.4	153.6
	As:	119.3	807.2	153.6
14	Ps:	86.5	370	65.5
	As:	45.9	78.1	65.5
15	Ps:	367.7	1547.8	908.7
	As:	850.5	755.8	908.7
16	Ps:	293.6	1236.2	482.9
	As:	440.5	839.4	482.9
17	Ps:	108.6	457.1	198.3
	As:	217.2	1297.6	198.3
18	Ps:	75	342.7	84.6
	As:	82.6	500.5	84.6
19	Ps:	307.7	1460.4	124.5
	As:	55.1	466.5	124.5
20	Ps:	143.1	497.6	1186.2
	As:	1177.8	476.6	1186.2

Table C-1 (continued).

Zone		HBW	HBNW	NHB
21	Ps:	313.5	1027.4	259.6
	As:	183.6	555.6	259.6
22	Ps:	177.3	616.5	132.8
	As:	97.9	530.8	132.8
23	Ps:	7.4	31.7	83.4
	As:	91.8	259.9	83.4
24	Ps:	463	1634	135.2
	As:	6.1	400.4	135.2
25	Ps:	178	761.1	50
	As:	9.2	187.3	50
26	Ps:	54.4	232.6	28
	As:	15.3	45	28
27	Ps:	0	0	4.8
	As:	6.1	36.7	4.8
28	Ps:	187.9	803.4	45.3
	As:	0	139.6	45.3
29	Ps:	66.3	269.6	2439.2
	As:	2490.3	814.6	2439.2
30	Ps:	40.6	141.1	116.1
	As:	134.6	843	116.1
31	Ps:	96.1	334.2	53
	As:	33.7	284.7	53
32	Ps:	0	0	52.4
	As:	67.3	404.1	52.4
33	Ps:	76.9	267.4	255.5
	As:	296.8	1760.5	255.5
34	Ps:	234.7	769.3	319.8
	As:	272.3	752.1	319.8
35	Ps:	13.1	43	64.9
	As:	73.4	349	64.9
36	Ps:	67.9	324.1	83.4
	As:	73.4	213.1	83.4
37	Ps:	512	2442	125.7
	As:	0	387.5	125.7
38	Ps:	203.1	928.7	50
	As:	0	154.3	50
39	Ps:	50.8	232.2	226.9
	As:	275.3	1691.6	226.9
40	Ps:	182.9	782.3	1532.8
	As:	1529.7	595.1	1532.8

Table C-1 (continued).

Zone		HBW	HBNW	NHB
41	Ps:	0	0	0
	As:	0	0	0
42	Ps:	168.5	594.9	47
	As:	0	145.1	47
43	Ps:	78.5	319.6	266.2
	As:	260	311.3	266.2
44	Ps:	268.4	1227.1	211.4
	As:	186.6	1324.2	211.4
45	Ps:	19.3	88.4	49.4
	As:	45.9	28.5	49.4
46	Ps:	406.3	1857.3	432.9
	As:	422.2	2721	432.9
47	Ps:	0	0	591.9
	As:	749.5	4255.6	591.9
48	Ps:	418	1370	2529.7
	As:	2560.6	3970	2529.7
49	Ps:	118.5	541.7	2590.4
	As:	2753.4	4388.7	2590.4
50	Ps:	55.6	254.3	19.7
	As:	6.1	44.1	19.7
51	Ps:	486.1	2222.1	404.9
	As:	327.3	1444.5	404.9
52	Ps:	609.1	2491.6	4190.5
	As:	4264.7	4893.8	4190.5
53	Ps:	336.5	1328.5	142.3
	As:	64.2	342.5	142.3
54	Ps:	108.8	384	30.4
	As:	0	93.7	30.4
55	Ps:	276.6	1171.6	3940.4
	As:	4023	2634.7	3940.4
56	Ps:	22.5	107.1	5.4
	As:	0	16.5	5.4
57	Ps:	368.5	1757.5	151.9
	As:	64.2	429.8	151.9
58	Ps:	160.1	763.5	138.8
	As:	128.5	890.8	138.8
59	Ps:	110.8	509.1	203.1
	As:	211.1	1020.3	203.1
60	Ps:	66	311.8	16.7
	As:	0	51.4	16.7

Table C-1 (continued).

Zone		HBW	HBNW	NHB
61	Ps:	196.6	937.4	50
	As:	0	154.3	50
62	Ps:	26.6	121.6	6.6
	As:	0	20.2	6.6
63	Ps:	162.6	775.3	40.5
	As:	0	124.9	40.5
64	Ps:	516.9	2465.1	126.8
	As:	0	391.2	126.8
65	Ps:	422.2	2013.8	103.6
	As:	0	319.6	103.6
66	Ps:	84.9	405.1	20.8
	As:	0	64.3	20.8
67	Ps:	0	0	6
	As:	6.1	1.8	6
68	Ps:	11.2	36.9	72.1
	As:	73.4	120.3	72.1
69	Ps:	1.9	6.1	304.3
	As:	312	95.5	304.3
70	Ps:	2.5	10.2	1099.3
	As:	1147.2	869.7	1099.3
71	Ps:	2.5	10.2	553.2
	As:	709.8	4262.9	553.2
72	Ps:	317.3	1311.7	360.9
	As:	330.4	1435.4	360.9
73	Ps:	54.1	223.7	460.9
	As:	575.1	3493.4	460.9
74	Ps:	255.8	1057.5	1002.8
	As:	1193.1	7005.1	1002.8
75	Ps:	17.2	71.2	692.6
	As:	884.1	5320.8	692.6
76	Ps:	558.4	2308.1	284.1
	As:	174.4	1080	284.1
77	Ps:	187	772.8	45.3
	As:	0	139.6	45.3
78	Ps:	344.4	1423.5	83.4
	As:	0	257.1	83.4
79	Ps:	186.9	878.9	384.1
	As:	419.1	2347.3	384.1
80	Ps:	160.9	756.5	40.5
	As:	0	124.9	40.5

Table C-1 (continued).

Zone		HBW	HBNW	NHB
81	Ps:	0	0	2158.1
	As:	2254.7	1741.2	2158.1
82	Ps:	82.8	389.4	67.3
	As:	58.1	378.4	67.3
83	Ps:	33.1	155.8	8.3
	As:	0	25.7	8.3
84	Ps:	113.6	534	28.6
	As:	0	88.2	28.6
85	Ps:	0	0	0
	As:	0	0	0
86	Ps:	179.7	857.1	42.9
	As:	0	132.2	42.9
87	Ps:	184.2	853.9	45.9
	As:	0	141.4	45.9
88	Ps:	224.6	1071.4	53.6
	As:	0	165.3	53.6
89	Ps:	108.6	517.7	32.8
	As:	6.1	84.5	32.8
90	Ps:	54.2	258.3	13.7
	As:	0	42.2	13.7
91	Ps:	155.6	735	39.3
	As:	0	121.2	39.3
92	Ps:	289.5	1380.9	69.1
	As:	0	213.1	69.1
93	Ps:	78.7	258	53.6
	As:	36.7	297.5	53.6
94	Ps:	39.9	190.5	9.5
	As:	0	29.4	9.5
95	Ps:	212.6	773.7	59.5
	As:	0	183.7	59.5
96	Ps:	51	185.7	40.5
	As:	30.6	158	40.5
97	Ps:	55.3	201.2	29.8
	As:	18.4	158	29.8
98	Ps:	281.6	1342.8	68.5
	As:	0	211.2	68.5
99	Ps:	12.2	58.4	103
	As:	128.5	780.6	103
100	Ps:	19.3	92	83.4
	As:	101	620.8	83.4

Table C-1 (continued).

Zone		HBW	HBNW	NHB
101	Ps:	70	333.6	17.3
	As:	0	53.3	17.3
102	Ps:	150	715.4	36.9
	As:	0	113.9	36.9
103	Ps:	318.4	1518.6	78.6
	As:	0	242.4	78.6
104	Ps:	464.3	2214.1	110.8
	As:	0	341.6	110.8
105	Ps:	2395	2197	0
	As:	0	0	0
106	Ps:	2417	2218	0
	As:	0	0	0
107	Ps:	898	824	0
	As:	0	0	0
108	Ps:	416	381	0
	As:	0	0	0
109	Ps:	3209	2944	0
	As:	0	0	0
110	Ps:	3978	3650	0
	As:	0	0	0
111	Ps:	423	388	0
	As:	0	0	0
112	Ps:	854	783	0
	As:	0	0	0
113	Ps:	2536	2327	0
	As:	0	0	0
114	Ps:	2112	1938	0
	As:	0	0	0
115	Ps:	357	327	0
	As:	0	0	0

Table C-2. Productions and Attractions by Zone for Year 2020-No Bypass Scenario.

Zone		HBW	HBNW	NHB
1	Ps:	145.9	623.7	451.9
	As:	488.3	1314.2	451.9
2	Ps:	0	0	181.9
	As:	211.4	425.1	181.9
3	Ps:	123.9	430.8	323.3
	As:	320.7	530	323.3
4	Ps:	29.9	104	421
	As:	499.3	1524.9	421
5	Ps:	19.8	84.6	239.1
	As:	266	418.3	239.1
6	Ps:	145.6	612.9	235.7
	As:	262.4	1456.9	235.7
7	Ps:	143.1	602.5	526
	As:	539.4	569.8	526
8	Ps:	183.8	840.2	188.6
	As:	167.6	671.7	188.6
9	Ps:	42.7	148.5	191.3
	As:	196.8	201.9	191.3
10	Ps:	138.9	482.8	205.4
	As:	218.7	1290.9	205.4
11	Ps:	9.9	42.3	64.7
	As:	72.9	174.7	64.7
12	Ps:	104.7	363.9	33
	As:	0	95.1	33
13	Ps:	239.8	1025.4	173.8
	As:	142.1	853.2	173.8
14	Ps:	86.5	370	74.1
	As:	54.7	82.5	74.1
15	Ps:	367.7	1547.8	1027.8
	As:	1013.1	798.8	1027.8
16	Ps:	293.6	1236.2	546.2
	As:	524.8	887.2	546.2
17	Ps:	108.6	457.1	224.3
	As:	258.7	1371.5	224.3
18	Ps:	75	342.7	95.6
	As:	98.4	529	95.6
19	Ps:	307.7	1460.4	140.8
	As:	65.6	493.1	140.8
20	Ps:	143.1	497.6	1809.8
	As:	1909.6	638.7	1809.8

Table C-2 (continued).

Zone		HBW	HBNW	NHB
21	Ps:	313.5	1027.4	293.7
	As:	218.7	587.2	293.7
22	Ps:	177.3	616.5	150.2
	As:	116.6	561	150.2
23	Ps:	7.4	31.7	94.3
	As:	109.3	274.7	94.3
24	Ps:	463	1634	152.9
	As:	7.3	423.2	152.9
25	Ps:	178	761.1	56.6
	As:	10.9	198	56.6
26	Ps:	54.4	232.6	31.7
	As:	18.2	47.6	31.7
27	Ps:	0	0	5.4
	As:	7.3	38.8	5.4
28	Ps:	187.9	803.4	51.2
	As:	0	147.5	51.2
29	Ps:	66.3	269.6	2758.8
	As:	2966.5	860.9	2758.8
30	Ps:	40.6	141.1	131.3
	As:	160.3	891	131.3
31	Ps:	96.1	334.2	59.9
	As:	40.1	300.9	59.9
32	Ps:	0	0	59.3
	As:	80.2	427.1	59.3
33	Ps:	76.9	267.4	288.9
	As:	353.5	1860.7	288.9
34	Ps:	234.7	769.3	361.7
	As:	324.3	794.9	361.7
35	Ps:	13.1	43	73.4
	As:	87.5	368.8	73.4
36	Ps:	67.9	324.1	565.8
	As:	597.7	361.1	565.8
37	Ps:	512	2442	142.1
	As:	0	409.6	142.1
38	Ps:	203.1	928.7	56.6
	As:	0	163.1	56.6
39	Ps:	50.8	232.2	256.6
	As:	328	1787.9	256.6
40	Ps:	182.9	782.3	1733.7
	As:	1822.1	629	1733.7

Table C-2 (continued).

Zone		HBW	HBNW	NHB
41	Ps:	0	0	0
	As:	0	0	0
42	Ps:	168.5	594.9	53.2
	As:	0	153.4	53.2
43	Ps:	78.5	319.6	301.1
	As:	309.8	329	301.1
44	Ps:	268.4	1227.1	239.1
	As:	222.3	1399.6	239.1
45	Ps:	19.3	88.4	55.9
	As:	54.7	30.1	55.9
46	Ps:	406.3	1857.3	489.7
	As:	502.9	2876	489.7
47	Ps:	0	0	669.5
	As:	892.9	4497.9	669.5
48	Ps:	418	1370	2861.2
	As:	3050.3	4196	2861.2
49	Ps:	118.5	541.7	2929.9
	As:	3279.9	4638.6	2929.9
50	Ps:	55.6	254.3	22.2
	As:	7.3	46.6	22.2
51	Ps:	486.1	2222.1	458
	As:	389.9	1526.8	458
52	Ps:	609.1	2491.6	4739.7
	As:	5080.1	5172.5	4739.7
53	Ps:	336.5	1328.5	161
	As:	76.5	362	161
54	Ps:	108.8	384	34.4
	As:	0	99	34.4
55	Ps:	276.6	1171.6	4456.8
	As:	4792.2	2784.7	4456.8
56	Ps:	22.5	107.1	6.1
	As:	0	17.5	6.1
57	Ps:	368.5	1757.5	171.8
	As:	76.5	454.3	171.8
58	Ps:	160.1	763.5	156.9
	As:	153.1	941.5	156.9
59	Ps:	110.8	509.1	229.7
	As:	251.5	1078.4	229.7
60	Ps:	66	311.8	18.9
	As:	0	54.4	18.9

Table C-2 (continued).

Zone		HBW	HBW	NHB
61	Ps:	456.3	2176.2	131.3
	As:	0	378.5	131.3
62	Ps:	26.6	121.6	7.4
	As:	0	21.4	7.4
63	Ps:	430.3	2052.2	121.2
	As:	0	349.4	121.2
64	Ps:	788.7	3761.3	218.9
	As:	0	630.9	218.9
65	Ps:	691.6	3298.4	192
	As:	0	553.3	192
66	Ps:	84.9	405.1	23.6
	As:	0	67.9	23.6
67	Ps:	0	0	6.7
	As:	7.3	1.9	6.7
68	Ps:	11.2	36.9	81.5
	As:	87.5	127.2	81.5
69	Ps:	1.9	6.1	344.2
	As:	371.7	100.9	344.2
70	Ps:	551	2277.6	1393.5
	As:	1366.6	1352.1	1393.5
71	Ps:	2.5	10.2	625.7
	As:	845.5	4505.7	625.7
72	Ps:	865.9	3579.1	558.4
	As:	393.6	1950	558.4
73	Ps:	54.1	223.7	521.3
	As:	685.1	3692.3	521.3
74	Ps:	255.8	1057.5	1134.2
	As:	1421.3	7403.9	1134.2
75	Ps:	17.2	71.2	4302.6
	As:	5306.1	18006.1	4302.6
76	Ps:	558.4	2308.1	321.3
	As:	207.7	1141.5	321.3
77	Ps:	460	1901.4	126
	As:	0	363	126
78	Ps:	619.9	2562.3	169.7
	As:	0	489.2	169.7
79	Ps:	186.9	878.9	434.4
	As:	499.3	2480.9	434.4
80	Ps:	1216.3	5718.3	1639.4
	As:	1621.7	7054.5	1639.4

Table C-2 (continued).

Zone		HBW	HBNW	NHB
81	Ps:	0	0	2440.9
	As:	2685.8	1840.3	2440.9
82	Ps:	82.8	389.4	76.1
	As:	69.2	399.9	76.1
83	Ps:	560.8	2636.7	159.6
	As:	0	460.1	159.6
84	Ps:	113.6	534	32.3
	As:	0	93.2	32.3
85	Ps:	0	0	0
	As:	0	0	0
86	Ps:	179.7	857.1	48.5
	As:	0	139.8	48.5
87	Ps:	184.2	853.9	51.9
	As:	0	149.5	51.9
88	Ps:	224.6	1071.4	60.6
	As:	0	174.7	60.6
89	Ps:	108.6	517.7	446.6
	As:	561.2	3040	446.6
90	Ps:	54.2	258.3	15.5
	As:	0	44.6	15.5
91	Ps:	155.6	735	456.7
	As:	557.6	3098.2	456.7
92	Ps:	289.5	1380.9	78.1
	As:	0	225.2	78.1
93	Ps:	183.7	602.1	98.3
	As:	43.7	423.2	98.3
94	Ps:	179.7	857.1	48.5
	As:	0	139.8	48.5
95	Ps:	212.6	773.7	67.4
	As:	0	194.1	67.4
96	Ps:	170.1	619	83.5
	As:	36.4	275.7	83.5
97	Ps:	55.3	201.2	33.7
	As:	21.9	166.9	33.7
98	Ps:	281.6	1342.8	77.5
	As:	0	223.2	77.5
99	Ps:	12.2	58.4	116.5
	As:	153.1	825	116.5
100	Ps:	19.3	92	94.3
	As:	120.3	656.1	94.3

Table C-2 (continued).

Zone		HBW	HBNW	NHB
101	Ps:	70	333.6	915.3
	As:	969.4	314.5	915.3
102	Ps:	150	715.4	41.8
	As:	0	120.4	41.8
103	Ps:	318.4	1518.6	984.7
	As:	969.4	514.4	984.7
104	Ps:	601.5	2868.9	162.3
	As:	0	467.8	162.3
105	Ps:	4309	3953	0
	As:	0	0	0
106	Ps:	4055	3720	0
	As:	0	0	0
107	Ps:	1747	1603	0
	As:	0	0	0
108	Ps:	416	381	0
	As:	0	0	0
109	Ps:	6036	5538	0
	As:	0	0	0
110	Ps:	5509	5055	0
	As:	0	0	0
111	Ps:	719	660	0
	As:	0	0	0
112	Ps:	1186	1088	0
	As:	0	0	0
113	Ps:	3975	3647	0
	As:	0	0	0
114	Ps:	3427	3144	0
	As:	0	0	0
115	Ps:	119	110	0
	As:	0	0	0

Table C-3. Productions and Attractions by Zone for Year 2020-Bypass Scenario.

Zone		HBW	HBNW	NHB
1	Ps:	145.9	623.7	451.9
	As:	488.3	1314.2	451.9
2	Ps:	0	0	181.9
	As:	211.4	425.1	181.9
3	Ps:	123.9	430.8	323.3
	As:	320.7	530	323.3
4	Ps:	29.9	104	421
	As:	499.3	1524.9	421
5	Ps:	19.8	84.6	239.1
	As:	266	418.3	239.1
6	Ps:	145.6	612.9	235.7
	As:	262.4	1456.9	235.7
7	Ps:	143.1	602.5	526
	As:	539.4	569.8	526
8	Ps:	183.8	840.2	188.6
	As:	167.6	671.7	188.6
9	Ps:	42.7	148.5	191.3
	As:	196.8	201.9	191.3
10	Ps:	138.9	482.8	205.4
	As:	218.7	1290.9	205.4
11	Ps:	9.9	42.3	64.7
	As:	72.9	174.7	64.7
12	Ps:	104.7	363.9	33
	As:	0	95.1	33
13	Ps:	239.8	1025.4	173.8
	As:	142.1	853.2	173.8
14	Ps:	86.5	370	74.1
	As:	54.7	82.5	74.1
15	Ps:	367.7	1547.8	1027.8
	As:	1013.1	798.8	1027.8
16	Ps:	293.6	1236.2	546.2
	As:	524.8	887.2	546.2
17	Ps:	108.6	457.1	224.3
	As:	258.7	1371.5	224.3
18	Ps:	75	342.7	95.6
	As:	98.4	529	95.6
19	Ps:	307.7	1460.4	140.8
	As:	65.6	493.1	140.8
20	Ps:	143.1	497.6	1809.8
	As:	1909.6	638.7	1809.8

Table C-3 (continued).

Zone		HBW	HBNW	NHB
21	Ps:	313.5	1027.4	293.7
	As:	218.7	587.2	293.7
22	Ps:	177.3	616.5	150.2
	As:	116.6	561	150.2
23	Ps:	7.4	31.7	94.3
	As:	109.3	274.7	94.3
24	Ps:	463	1634	152.9
	As:	7.3	423.2	152.9
25	Ps:	178	761.1	56.6
	As:	10.9	198	56.6
26	Ps:	54.4	232.6	31.7
	As:	18.2	47.6	31.7
27	Ps:	0	0	5.4
	As:	7.3	38.8	5.4
28	Ps:	187.9	803.4	51.2
	As:	0	147.5	51.2
29	Ps:	66.3	269.6	2758.8
	As:	2966.5	860.9	2758.8
30	Ps:	40.6	141.1	131.3
	As:	160.3	891	131.3
31	Ps:	96.1	334.2	59.9
	As:	40.1	300.9	59.9
32	Ps:	0	0	59.3
	As:	80.2	427.1	59.3
33	Ps:	76.9	267.4	288.9
	As:	353.5	1860.7	288.9
34	Ps:	234.7	769.3	361.7
	As:	324.3	794.9	361.7
35	Ps:	13.1	43	73.4
	As:	87.5	368.8	73.4
36	Ps:	67.9	324.1	565.8
	As:	597.7	361.1	565.8
37	Ps:	512	2442	142.1
	As:	0	409.6	142.1
38	Ps:	203.1	928.7	56.6
	As:	0	163.1	56.6
39	Ps:	50.8	232.2	256.6
	As:	328	1787.9	256.6
40	Ps:	182.9	782.3	1733.7
	As:	1822.1	629	1733.7

Table C-3 (continued).

Zone		HBW	HBW	NHB
41	Ps:	0	0	0
	As:	0	0	0
42	Ps:	168.5	594.9	53.2
	As:	0	153.4	53.2
43	Ps:	78.5	319.6	301.1
	As:	309.8	329	301.1
44	Ps:	268.4	1227.1	239.1
	As:	222.3	1399.6	239.1
45	Ps:	19.3	88.4	55.9
	As:	54.7	30.1	55.9
46	Ps:	406.3	1857.3	489.7
	As:	502.9	2876	489.7
47	Ps:	0	0	669.5
	As:	892.9	4497.9	669.5
48	Ps:	418	1370	2861.2
	As:	3050.3	4196	2861.2
49	Ps:	118.5	541.7	2929.9
	As:	3279.9	4638.6	2929.9
50	Ps:	55.6	254.3	22.2
	As:	7.3	46.6	22.2
51	Ps:	486.1	2222.1	458
	As:	389.9	1526.8	458
52	Ps:	609.1	2491.6	4739.7
	As:	5080.1	5172.5	4739.7
53	Ps:	336.5	1328.5	161
	As:	76.5	362	161
54	Ps:	108.8	384	34.4
	As:	0	99	34.4
55	Ps:	276.6	1171.6	4456.8
	As:	4792.2	2784.7	4456.8
56	Ps:	22.5	107.1	6.1
	As:	0	17.5	6.1
57	Ps:	368.5	1757.5	171.8
	As:	76.5	454.3	171.8
58	Ps:	160.1	763.5	156.9
	As:	153.1	941.5	156.9
59	Ps:	110.8	509.1	229.7
	As:	251.5	1078.4	229.7
60	Ps:	66	311.8	18.9
	As:	0	54.4	18.9

Table C-3 (continued).

Zone		HBW	HBNW	NHB
61	Ps:	456.3	2176.2	131.3
	As:	0	378.5	131.3
62	Ps:	26.6	121.6	7.4
	As:	0	21.4	7.4
63	Ps:	430.3	2052.2	121.2
	As:	0	349.4	121.2
64	Ps:	788.7	3761.3	218.9
	As:	0	630.9	218.9
65	Ps:	691.6	3298.4	192
	As:	0	553.3	192
66	Ps:	84.9	405.1	23.6
	As:	0	67.9	23.6
67	Ps:	0	0	6.7
	As:	7.3	1.9	6.7
68	Ps:	11.2	36.9	81.5
	As:	87.5	127.2	81.5
69	Ps:	1.9	6.1	344.2
	As:	371.7	100.9	344.2
70	Ps:	551	2277.6	1393.5
	As:	1366.6	1352.1	1393.5
71	Ps:	2.5	10.2	625.7
	As:	845.5	4505.7	625.7
72	Ps:	865.9	3579.1	558.4
	As:	393.6	1950	558.4
73	Ps:	54.1	223.7	521.3
	As:	685.1	3692.3	521.3
74	Ps:	255.8	1057.5	1134.2
	As:	1421.3	7403.9	1134.2
75	Ps:	17.2	71.2	4302.6
	As:	5306.1	18006.1	4302.6
76	Ps:	558.4	2308.1	321.3
	As:	207.7	1141.5	321.3
77	Ps:	460	1901.4	126
	As:	0	363	126
78	Ps:	619.9	2562.3	169.7
	As:	0	489.2	169.7
79	Ps:	186.9	878.9	434.4
	As:	499.3	2480.9	434.4
80	Ps:	1216.3	5718.3	1639.4
	As:	1621.7	7054.5	1639.4

Table C-3 (continued).

Zone		HBW	HBNW	NHB
81	Ps:	0	0	2440.9
	As:	2685.8	1840.3	2440.9
82	Ps:	82.8	389.4	76.1
	As:	69.2	399.9	76.1
83	Ps:	560.8	2636.7	159.6
	As:	0	460.1	159.6
84	Ps:	113.6	534	32.3
	As:	0	93.2	32.3
85	Ps:	0	0	0
	As:	0	0	0
86	Ps:	179.7	857.1	48.5
	As:	0	139.8	48.5
87	Ps:	184.2	853.9	51.9
	As:	0	149.5	51.9
88	Ps:	224.6	1071.4	60.6
	As:	0	174.7	60.6
89	Ps:	108.6	517.7	446.6
	As:	561.2	3040	446.6
90	Ps:	54.2	258.3	15.5
	As:	0	44.6	15.5
91	Ps:	155.6	735	456.7
	As:	557.6	3098.2	456.7
92	Ps:	289.5	1380.9	78.1
	As:	0	225.2	78.1
93	Ps:	183.7	602.1	98.3
	As:	43.7	423.2	98.3
94	Ps:	179.7	857.1	48.5
	As:	0	139.8	48.5
95	Ps:	212.6	773.7	67.4
	As:	0	194.1	67.4
96	Ps:	170.1	619	83.5
	As:	36.4	275.7	83.5
97	Ps:	55.3	201.2	33.7
	As:	21.9	166.9	33.7
98	Ps:	281.6	1342.8	77.5
	As:	0	223.2	77.5
99	Ps:	12.2	58.4	116.5
	As:	153.1	825	116.5
100	Ps:	19.3	92	94.3
	As:	120.3	656.1	94.3

Table C-3 (continued).

Zone		HBW	HBNW	NHB
101	Ps:	70	333.6	915.3
	As:	969.4	314.5	915.3
102	Ps:	150	715.4	41.8
	As:	0	120.4	41.8
103	Ps:	318.4	1518.6	984.7
	As:	969.4	514.4	984.7
104	Ps:	601.5	2868.9	162.3
	As:	0	467.8	162.3
105	Ps:	4309	3953	0
	As:	0	0	0
106	Ps:	4055	3720	0
	As:	0	0	0
107	Ps:	1747	1603	0
	As:	0	0	0
108	Ps:	416	381	0
	As:	0	0	0
109	Ps:	6036	5538	0
	As:	0	0	0
110	Ps:	5509	5055	0
	As:	0	0	0
111	Ps:	719	660	0
	As:	0	0	0
112	Ps:	1186	1088	0
	As:	0	0	0
113	Ps:	3975	3647	0
	As:	0	0	0
114	Ps:	3427	3144	0
	As:	0	0	0
115	Ps:	119	110	0
	As:	0	0	0

APPENDIX D
EXTERNAL TRIPS

Modlin's Equations

$$Y(I) = 76.76 + 11.22(INT) - 25.74(OPA) - 42.18(MINA) - 51.22(MAJC) - 53.40(MINC) \\ + 0.00012(ADT) + 0.59(PTKS) - 0.48(PPS) - 0.000417(POP)$$

where: $Y(I)$ = percentage of through trips of the ADT,

INT = interstate,

OPA = other principal arterial,

MINA = minor arterial,

MAJC = major collector,

MINC = minor collector,

ADT = average daily traffic,

PTKS = percentage of trucks excluding vans and pick-ups (%),

PPS = percentage of vans and pick-ups (%), and

POP = population inside the study area.

1 or 0 depending on the functional
classification at the external station

Modlin developed five other equations based upon the functional classification at the external station to distribute through trips from an origin external station (I) to each of the remaining external stations (J).

Interstate

$$Y(I,J) = -2.70 + 0.21(PTTDES) + 67.86 (RTECON)$$

Principal Arterial

$$Y(I,J) = -7.40 + 0.55(PTTDES) + 24.68(RTECON) + 45.62 \left(\frac{ADT}{CD} \right)$$

Minor Arterial

$$Y(I,J) = -0.63 + 86.68 \left(\frac{ADT}{CD} \right) + 30.04(RTECON)$$

Major Collector

$$Y(I,J) = -1.08 + 0.00079(DESADT) + 0.47(PTKDES) + 31.78 \left(\frac{ADT}{CD} \right)$$

Minor Collector/Local

$$Y(I,J) = -0.40 + 109.42 \left(\frac{ADT}{CD} \right)$$

where: $Y(I,J)$ = percentage of through trips from origin station, I, to destination station, J
PTTDES = percentage of through trips at destination station (from previous eqn.)

RTECON = route continuity (1 = Yes, 0 = No)

ADT = average daily traffic at the destination station

CD = sum of average daily traffic at all external stations

DESADT = average daily traffic at the destination station

PTKDES = percentage of trucks at the destination station.

Average Adjustment Factor Technique Example

Origin Zone	Destination Zone			Sum	Actual Count
	East	West	North		
East	0	300	100	400	500
West	300	0	150	450	250
North	100	150	0	250	300
			Total	1100	1050

$$\text{East Zone Adjustment Factor} = \frac{500}{400} = 1.25$$

$$\text{West Zone Adjustment Factor} = \frac{250}{450} = 0.56$$

$$\text{North Zone Adjustment Factor} = \frac{300}{250} = 1.20$$

Adjustment of Trips

$$\text{East} \leftrightarrow \text{West} = (300 + 300) \left(\frac{1.25 + 0.56}{2} \right) = 543$$

$$\text{East} \leftrightarrow \text{North} = (100 + 100) \left(\frac{1.25 + 1.20}{2} \right) = 245$$

$$\text{West} \leftrightarrow \text{North} = (150 + 150) \left(\frac{0.56 + 1.20}{2} \right) = 264$$

Origin Zone	Destination Zone			Sum	Actual Count
	East	West	North		
East	0	272	123	395	500
West	272	0	132	395	250
North	123	132	0	255	300
			Total	1045	1050

APPENDIX E
TRIP DISTRIBUTION

Gravity Model Equation

$$T_{ij} = P_i \left(\frac{A_j F_{ij}}{\sum_{j=1}^n (A_j F_{ij})} \right)$$

where: T_{ij} = Total trips from zone i to zone j,
 P_i = Total trips (productions) from zone i,
 A_j = Total trips (attractions) received by zone j, and

$$F_{ij} = e^{-\beta(tt_{ij})}$$

where: F_{ij} = Friction factor from zone i to zone j,
 β = exponential parameter, and
 tt_{ij} = travel time between zone i and zone j.

APPENDIX F
TRAFFIC ASSIGNMENT

Table F-1. Vehicle Trips by Zone for Current Scenario.

Zone	Leaving	Entering	IntraZonal
1	654	656	3
2	223	223	0
3	310	311	1
4	859	861	7
5	375	376	2
6	577	578	2
7	360	361	2
8	644	644	7
9	293	293	2
10	716	717	8
11	125	126	0
12	186	185	0
13	745	744	9
14	221	220	1
15	1706	1709	45
16	1172	1173	27
17	743	744	9
18	352	352	2
19	751	750	8
20	1569	1574	54
21	804	803	9
22	512	512	5
23	178	178	0
24	830	828	7
25	367	367	2
26	123	123	0
27	16	16	0
28	363	362	1
29	2838	2850	183
30	421	421	2
31	257	257	1
32	175	175	0
33	880	881	7
34	831	831	12
35	188	188	0
36	261	261	1
37	1052	1049	15
38	410	409	2
39	813	814	7
40	2024	2030	107
41	0	0	0

Table F-1 (continued).

Zone	Leaving	Entering	IntraZonal
42	301	300	1
43	491	491	4
44	1013	1012	18
45	92	93	0
46	1840	1840	53
47	1878	1881	11
48	4122	4132	303
49	4105	4117	211
50	120	120	0
51	1574	1573	40
52	6225	6243	677
53	708	706	8
54	195	194	1
55	4719	4736	795
56	47	46	0
57	866	865	12
58	657	657	10
59	681	681	11
60	137	137	1
61	409	408	4
62	54	54	0
63	337	337	2
64	1055	1053	22
65	872	870	8
66	177	176	0
67	7	7	0
68	127	127	0
69	362	364	3
70	1431	1436	39
71	1842	1845	10
72	1235	1235	30
73	1579	1581	21
74	3399	3403	105
75	2301	2305	32
76	1387	1385	31
77	354	353	1
78	649	648	6
79	1370	1372	29
80	332	332	1
81	2695	2705	193
82	312	312	2

Table F-1 (continued).

Zone	Leaving	Entering	IntraZonal
83	69	69	0
84	235	234	1
85	0	0	0
86	370	369	3
87	375	374	3
88	461	460	4
89	233	232	1
90	113	113	1
91	323	322	2
92	591	589	9
93	234	234	2
94	83	82	0
95	384	383	4
96	155	154	1
97	148	148	1
98	574	573	12
99	358	359	2
100	301	302	2
101	146	145	0
102	309	308	4
103	647	646	17
104	939	936	24
<i>105</i>	<i>18624</i>	<i>18612</i>	<i>0</i>
<i>106</i>	<i>3662</i>	<i>3650</i>	<i>0</i>
<i>107</i>	<i>1129</i>	<i>1125</i>	<i>0</i>
<i>108</i>	<i>466</i>	<i>464</i>	<i>0</i>
<i>109</i>	<i>3294</i>	<i>3279</i>	<i>0</i>
<i>110</i>	<i>5306</i>	<i>5287</i>	<i>0</i>
<i>111</i>	<i>710</i>	<i>708</i>	<i>0</i>
<i>112</i>	<i>1090</i>	<i>1086</i>	<i>0</i>
<i>113</i>	<i>3803</i>	<i>3791</i>	<i>0</i>
<i>114</i>	<i>17192</i>	<i>17182</i>	<i>0</i>
<i>115</i>	<i>649</i>	<i>648</i>	<i>0</i>

Note: *Italics denotes external stations.*

Table F-2. Vehicle Trips by Zone for Year 2020-No Bypass Scenario.

Zone	Leaving	Entering	IntraZonal
1	1088	1090	13
2	328	329	1
3	661	662	5
4	948	950	6
5	417	419	2
6	888	888	9
7	949	951	11
8	681	681	6
9	324	324	1
10	767	768	7
11	138	138	0
12	190	190	0
13	782	782	7
14	231	231	1
15	1870	1873	40
16	1266	1268	23
17	800	800	7
18	374	374	2
19	776	775	7
20	2306	2314	85
21	852	851	7
22	541	541	4
23	197	197	0
24	851	849	5
25	376	375	1
26	128	127	0
27	17	17	0
28	370	369	1
29	3270	3284	172
30	455	456	1
31	270	269	1
32	191	192	0
33	954	956	6
34	895	895	10
35	205	205	0
36	838	840	10
37	1073	1070	12
38	418	417	2
39	882	883	6
40	2293	2300	102
41	0	0	0

Table F-2 (continued).

Zone	Leaving	Entering	IntraZonal
42	308	307	1
43	540	541	3
44	1071	1070	14
45	101	101	0
46	1965	1965	42
47	2055	2059	10
48	4649	4661	261
49	4642	4657	184
50	123	123	0
51	1668	1667	31
52	7096	7118	583
53	733	732	7
54	199	199	0
55	5439	5461	776
56	47	47	0
57	894	893	10
58	695	695	8
59	733	734	9
60	140	139	0
61	959	957	15
62	55	55	0
63	902	900	12
64	1632	1628	39
65	1449	1446	16
66	180	179	0
67	8	8	0
68	141	141	0
69	415	417	3
70	2651	2655	80
71	2013	2017	9
72	2336	2334	71
73	1724	1727	16
74	3712	3717	82
75	9517	9542	598
76	1451	1450	24
77	885	883	6
78	1188	1185	13
79	1480	1482	22
80	5271	5273	517
81	3100	3113	180
82	329	329	2

Table F-2 (continued).

Zone	Leaving	Entering	IntraZonal
83	1172	1169	12
84	239	239	1
85	0	0	0
86	377	376	2
87	382	381	2
88	470	469	3
89	1527	1529	33
90	115	115	1
91	1623	1625	36
92	603	602	7
93	437	436	4
94	377	376	2
95	394	393	3
96	384	383	2
97	155	154	1
98	587	586	8
99	390	391	1
100	327	327	1
101	1190	1194	40
102	316	315	3
103	1622	1625	135
104	1238	1235	29
<i>105</i>	<i>19816</i>	<i>19796</i>	<i>0</i>
<i>106</i>	<i>4682</i>	<i>4663</i>	<i>0</i>
<i>107</i>	<i>1658</i>	<i>1650</i>	<i>0</i>
<i>108</i>	<i>466</i>	<i>464</i>	<i>0</i>
<i>109</i>	<i>5055</i>	<i>5026</i>	<i>0</i>
<i>110</i>	<i>6260</i>	<i>6234</i>	<i>0</i>
<i>111</i>	<i>894</i>	<i>891</i>	<i>0</i>
<i>112</i>	<i>1297</i>	<i>1291</i>	<i>0</i>
<i>113</i>	<i>4699</i>	<i>4680</i>	<i>0</i>
<i>114</i>	<i>18011</i>	<i>17994</i>	<i>0</i>
<i>115</i>	<i>501</i>	<i>501</i>	<i>0</i>

Note: *Italics denotes external stations*

Table F-3. Vehicle Trips by Zone for Year 2020-Bypass Scenario.

Zone	Leaving	Entering	IntraZonal
1	1088	1090	13
2	328	329	1
3	661	662	6
4	948	950	6
5	417	419	2
6	888	888	9
7	949	951	12
8	681	681	6
9	324	324	1
10	767	768	7
11	138	138	0
12	190	190	0
13	782	781	7
14	231	231	1
15	1869	1872	41
16	1266	1267	24
17	800	800	7
18	374	374	2
19	776	775	7
20	2305	2314	86
21	851	851	8
22	541	541	4
23	197	197	0
24	851	849	5
25	376	375	1
26	128	127	0
27	17	17	0
28	370	369	1
29	3269	3283	173
30	455	456	1
31	270	269	1
32	191	192	0
33	954	956	6
34	895	895	10
35	205	205	0
36	838	840	10
37	1073	1070	12
38	418	417	2
39	881	883	6
40	2292	2300	103
41	0	0	0

Table F-3 (continued).

Zone	Leaving	Entering	IntraZonal
42	308	307	1
43	540	541	3
44	1070	1070	14
45	101	101	0
46	1964	1965	42
47	2055	2059	10
48	4649	4661	260
49	4641	4656	184
50	123	123	0
51	1667	1667	31
52	7093	7114	586
53	733	732	7
54	199	199	0
55	5452	5473	763
56	47	47	0
57	895	893	9
58	695	695	8
59	733	734	8
60	140	139	0
61	963	961	11
62	55	55	0
63	905	903	9
64	1635	1631	36
65	1449	1445	17
66	180	179	0
67	8	8	0
68	141	141	0
69	415	417	3
70	2651	2655	80
71	2013	2017	9
72	2338	2335	70
73	1724	1727	16
74	3711	3717	83
75	9519	9544	595
76	1451	1449	24
77	885	883	6
78	1187	1185	13
79	1480	1482	22
80	5274	5276	514
81	3100	3112	180
82	329	329	2

Table F-3 (continued).

Zone	Leaving	Entering	IntraZonal
83	1171	1169	12
84	239	239	1
85	0	0	0
86	377	376	2
87	382	382	2
88	471	469	3
89	1531	1533	29
90	115	115	1
91	1628	1630	32
92	604	603	6
93	438	437	3
94	377	376	2
95	394	393	2
96	384	383	2
97	155	154	1
98	588	586	8
99	390	391	1
100	327	327	1
101	1190	1195	40
102	316	315	2
103	1621	1624	136
104	1241	1239	26
<i>105</i>	<i>19816</i>	<i>19796</i>	<i>0</i>
<i>106</i>	<i>4682</i>	<i>4663</i>	<i>0</i>
<i>107</i>	<i>1658</i>	<i>1650</i>	<i>0</i>
<i>108</i>	<i>466</i>	<i>464</i>	<i>0</i>
<i>109</i>	<i>5055</i>	<i>5026</i>	<i>0</i>
<i>110</i>	<i>6260</i>	<i>6234</i>	<i>0</i>
<i>111</i>	<i>894</i>	<i>891</i>	<i>0</i>
<i>112</i>	<i>1297</i>	<i>1291</i>	<i>0</i>
<i>113</i>	<i>4699</i>	<i>4680</i>	<i>0</i>
<i>114</i>	<i>18011</i>	<i>17994</i>	<i>0</i>
<i>115</i>	<i>501</i>	<i>501</i>	<i>0</i>

Note: *Italics denotes external stations*

Table F-4. Trip Lengths by Purpose for Current Scenario.

Trip Length (minutes)	Percentage of Trips by Purpose		
	HBW	HBNW	NHB
0	0.050	0.034	0.510
1	1.067	2.343	5.176
2	3.340	4.078	9.748
3	3.109	5.812	7.829
4	5.409	7.218	13.733
5	4.022	6.720	7.923
6	4.443	6.916	8.554
7	5.852	8.531	11.000
8	6.406	7.939	9.695
9	5.869	6.903	8.285
10	5.391	6.747	4.440
11	6.491	6.432	6.127
12	7.290	5.590	2.049
13	6.768	5.098	1.968
14	7.803	5.030	1.001
15	5.487	4.070	0.712
16	6.137	3.136	0.494
17	4.079	2.435	0.337
18	3.565	1.647	0.104
19	3.159	1.168	0.086
20	1.235	0.777	0.099
21	0.957	0.560	0.041
22	0.444	0.248	0.057
23	0.347	0.203	0.028
24	0.578	0.153	0.002
25	0.530	0.121	0.001
26	0.123	0.050	0.001
27	0.001	0.022	0.000
28	0.047	0.011	0.000
29	0.000	0.002	0.000
30	0.000	0.001	0.000
31	0.000	0.001	0.000
32	0.000	0.001	0.000
33	0.000	0.001	0.000
Totals	100.0	100.0	100.0

Table F-5. Trip Lengths by Purpose for Year 2020-No Bypass Scenario.

Trip Length (minutes)	Percentage of Trips by Purpose		
	HBW	HBNW	NHB
0	0.053	0.074	0.388
1	0.871	1.799	5.345
2	2.733	3.166	7.152
3	2.725	5.170	6.266
4	4.676	6.232	11.216
5	3.407	6.047	8.369
6	3.559	6.174	7.233
7	5.145	7.951	10.644
8	6.321	8.215	10.001
9	5.350	6.363	7.182
10	6.757	7.598	6.003
11	6.606	7.511	7.050
12	6.916	6.084	3.083
13	7.491	5.259	2.997
14	6.774	4.941	2.251
15	5.843	4.277	1.258
16	6.622	3.631	1.761
17	4.152	2.822	0.619
18	4.177	2.102	0.288
19	3.528	1.524	0.335
20	2.123	1.370	0.358
21	1.006	0.528	0.062
22	0.651	0.303	0.090
23	0.554	0.311	0.034
24	0.867	0.234	0.014
25	0.828	0.194	0.001
26	0.150	0.054	0.001
27	0.003	0.025	0.001
28	0.094	0.035	0.000
29	0.000	0.002	0.000
30	0.000	0.000	0.000
31	0.000	0.001	0.000
32	0.000	0.001	0.000
33	0.019	0.002	0.000
Totals	100.0	100.0	100.0

Table F-6. Trip Lengths by Purpose for Year 2020-Bypass Scenario.

Trip Length (minutes)	Percentage of Trips by Purpose		
	HBW	HBNW	NHB
0	0.055	0.076	0.389
1	0.890	1.817	5.346
2	2.643	3.161	7.138
3	2.714	5.148	6.262
4	4.636	6.273	11.229
5	3.447	6.125	8.371
6	3.560	6.231	7.241
7	6.483	8.442	10.708
8	6.942	9.063	10.090
9	5.073	6.375	7.309
10	8.244	7.747	6.116
11	7.550	7.745	7.002
12	5.991	5.920	3.085
13	8.217	6.764	3.472
14	6.743	4.865	1.789
15	4.051	3.264	1.163
16	6.352	3.114	1.714
17	5.296	3.019	0.541
18	2.970	1.337	0.261
19	2.768	1.289	0.263
20	2.252	1.078	0.339
21	0.552	0.440	0.058
22	0.548	0.237	0.078
23	0.694	0.235	0.036
24	0.673	0.114	0.001
25	0.588	0.092	0.001
26	0.046	0.012	0.000
27	0.003	0.012	0.001
28	0.000	0.001	0.000
29	0.000	0.001	0.000
30	0.000	0.000	0.000
31	0.020	0.002	0.000
Totals	100.0	100.0	100.0

APPENDIX G
LINK VOLUMES

Table G-1. Link Volumes by Direction of Travel for Current Scenario.

Link Label*	A→B	B→A
Cate Quarry:Coile-Node	7.1	7.1
Cate Quarry:Node-Rocky Mount	359.2	358.2
Cedar Springs:705-Node	147.2	166.7
Cedar Springs:Elizabeth-Node	742.8	33.2
Cedar Springs:Keith-Node	995.2	963.1
Cedar Springs:Long Mill-Elizab	1110	1087.6
Cedar Springs:Matlock-Node	530.4	560.7
Cedar Springs:Node-705	709.5	707.5
Cedar Springs:Node-Church	709.5	0
Cedar Springs:Node-Keith	566.3	596.4
Cedar Springs:Node-Long Mill	810.2	785.6
Cedar Springs:Node-Matlock	261.3	294.8
Cedar Springs:Node-Node	742.8	33.2
Cedar Springs:Node-Node	742.8	33.2
Cedar Springs:Node-Node	156.3	175.8
Church:Cedar Springs-Park	709.5	0
Clearwater:Congress-Node	3222	3226.7
Clearwater:Node-Node	649.2	647.5
Clearwater:Node-Node	649.2	647.5
Clearwater:Node-Node	1293	1289.8
Clearwater:Node-Node	1293	1289.8
Clearwater:Node-Node	1293	1289.8
Clearwater:Node-Node	1292.4	1289.3
Clearwater:Node-Old Mt. Verd	1920.3	1915.5
Clearwater:Node-Old Mt. Verd	2196.4	2201.9
Co. Rd. 168:Decatur-Node	0	0
Co. Rd. 705:Madison-Node	773.1	803.9
Co. Rd. 705:Node-Cedar Springs	578.3	599.8
Co. Rd. 705:Node-Node	567.5	583.5
Co. Rd. 718:Congress-Node	1808.1	1832.2
Co. Rd. 718:Node-Madison	1808.1	1832.2
Co. Rd. 718:Node-Node	16	16
Co. Rd. 718:Node-Sterling	9.6	9.6
Co. Rd. 718:Sterling-Congress	9.6	9.6
Coile:Congress-Sterling	7.1	7.1
Coile:Sterling-Node	7.1	7.1
Congress Pkwy:255-Node	2795.7	2802.8
Congress Pkwy:718-No Name	4968.8	4930.4
Congress Pkwy:Clearwater-Node	2789.2	2796.6
Congress Pkwy:Decatur-Node	7009.3	7002.2
Congress Pkwy:Dennis-Node	6869.8	6831.5

Table G-1 (continued).

Link Label*	A→B	B→A
Congress Pkwy:Ingleside-Node	4290	4290.7
Congress Pkwy:Layman-Node	8121	8086.8
Congress Pkwy:Lee Hwy-Node	3650.3	3661.7
Congress Pkwy:No Name-Node	4975.9	4937.5
Congress Pkwy:Node-255	2795.7	2802.8
Congress Pkwy:Node-718	4761.8	4747.5
Congress Pkwy:Node-Clearwater	6634.3	6621.9
Congress Pkwy:Node-Decatur	9169	9137.6
Congress Pkwy:Node-Ingleside	3663.6	3674.6
Congress Pkwy:Node-Layman	8121	8086.8
Congress Pkwy:Node-Lee Hwy	2795.7	2802.8
Congress Pkwy:Node-Node	5804.1	5800.5
Congress Pkwy:Node-Node	4711.6	4697.5
Congress Pkwy:Node-Node	3802.7	3790.8
Congress Pkwy:Node-Piper	7091.8	7052.1
Congress Pkwy:Node-Sterling	5240.7	5202.1
Congress Pkwy:Node-Tellico	6815.5	6815.1
Congress Pkwy:Node-Velma	7155.7	7145.2
Congress Pkwy:Piper-Dennis	6937.6	6899.2
Congress Pkwy:Rocky Mount-Node	6096.6	6043
Congress Pkwy:Sterling-Rocky M	5223.2	5182.3
Congress Pkwy:Tellico-Node	7177.3	7167
Congress Pkwy:Velma-Node	7179.1	7168.7
Cook:Madison-Node	2115.2	1758.9
Cook:Node-Jackson	1503	1253.8
Cook:Node-Node	1503	1253.8
Cook:Node-Node	1109.7	845.4
Cook:Node-Westside	2671.8	2302.8
Cook:Westside-Node	1109.7	845.4
Crestway:Madison-Node	505.8	506.8
Crestway:Matlock-Node	8	8
Crestway:Node-Keith	0	0
Crestway:Node-Matlock	216.3	218.2
Crestway:Node-Node	507.7	508.7
Crestway:Node-Node	507.7	508.7
Decatur Pike:168-Node	873.2	871.2
Decatur Pike:Congress-Node	9776.7	9747.6
Decatur Pike:Dupit-Node	10008.5	10004.2
Decatur Pike:I-75 to Node	6858.1	6844.4
Decatur Pike:Maple-Node	7231	7171.7
Decatur Pike:Node to I-75	1605.1	1603.7

Table G-1 (continued).

Link Label*	A→B	B→A
Decatur Pike:Node-Congress	9148.7	9144
Decatur Pike:Node-Dupit	9331.6	9314.3
Decatur Pike:Node-Maple	10369.8	10365.7
Decatur Pike:Node-Node	873.2	871.2
Decatur Pike:Node-Node	1014.5	1012.1
Decatur Pike:Node-Node	6537.7	6525.2
Decatur Pike:Node-Node	6326.7	6314.8
Decatur Pike:Node-Node	8522.9	8395.7
Decatur Pike:Node-Node	8909.3	8775.5
Decatur Pike:Node-Old Ricevill	7231	7171.7
Decatur Pike:Node-Railroad	8788.4	8658
Decatur Pike:Node-Spring Creek	309.1	308.4
Decatur Pike:Node-Velma	9633.1	9625.9
Decatur Pike:Node-Westside	8362.9	8289.1
Decatur Pike:Old Riceville-Nod	8689.6	8605
Decatur Pike:Railroad-Jackson	8939.4	8805.9
Decatur Pike:Spring Creek-168	873.2	871.2
Decatur Pike:Velma-Node	9731.9	9725.6
Decatur Pike:Westside-Node	8148.4	8030.9
Dennis:Madison-Node	871.5	868.8
Dennis:Node-Congress	67.7	67.8
Dennis:Node-Rocky Mount	881.3	878.6
Dennis:Rocky Mount-Node	0	0
Dupit:Decatur-Node	905.8	892.9
Dupit:Node-Tellico	1348.3	1335.7
Elizabeth:Cedar Springs-Node	367.3	1054.4
Elizabeth:Node-White	270.5	937.6
External Conector 111	709.5	707.5
External Connector 105	18623.7	18612.4
External Connector 106	3661.7	3650.3
External Connector 107	1129.4	1125.2
External Connector 108	465.9	464
External Connector 109	3293.8	3278.7
External Connector 110	5306	5287.2
External Connector 112	1089.8	1085.8
External Connector 113	3802.7	3790.8
External Connector 114	17191.6	17181.7
External Connector 115	649.2	647.5
Forrest:Green-Node	2079.7	2220.1
Forrest:Guille-Node	1929	2073.6
Forrest:Node-Guille	1929	2073.6

Table G-1 (continued).

Link Label*	A→B	B→A
Forrest:Node-Madison	2212.6	2404.5
Forrest:Node-Node	2399	2577.2
Forrest:Node-Tellico	1692.3	1836.7
Forrest:Tellico-Node	2399	2577.2
Frye:Node-Westside	1291.1	1352.2
Frye:Old Riceville-Node	1621.4	1676.1
Green:Forrest-Node	2364.1	9638.8
Green:Ingleside-Madison	4742.1	14130.3
Green:Jackson-Node	4363.2	11738.2
Green:Jackson-White	4654.4	13070.7
Green:Madison-Node	5612.5	11480.3
Green:Node-Forrest	4228.8	11643.9
Green:Node-Ingleside	2231	9676.6
Green:Node-Jackson	4891.7	10885.9
Green:Node-Node	4849.5	10719.7
Guille:Forrest-Node	0	0
Guille:Node-Woodward	70.3	70.1
Hammar:Node-Ingleside	972.4	1023.1
Hammar:Tellico-Node	581	631.2
I-75:Decatur-Mt. Verd Connecto	15488	15490.4
I-75:Mt. Verd Connector-Node	18612.4	18623.7
I-75:Node-Decatur	17191.6	17181.7
Ingleside:Congress-Node	3430.7	3431.9
Ingleside:Forrest-Node	3134.5	3189.7
Ingleside:Hammar-Node	5219.8	5271.3
Ingleside:Lee Hwy-Node	5469.1	5470.1
Ingleside:Node-Congress	4992.3	4983.2
Ingleside:Node-Forrest	3740.9	3829.9
Ingleside:Node-Green	3151.4	3180.7
Ingleside:Node-Hammar	5472.1	5472.9
Ingleside:Node-Lee Hwy	4610.6	4615.9
Ingleside:Node-Node	5219.8	5271.3
Ingleside:Node-Node	3477.1	3535.9
Ingleside:Node-Node	3477.1	3535.9
Ingleside:Node-Node	3137	3192
Ingleside:Node-Node	3137	3192
Ingleside:Node-Node	3253.1	3282.6
Ingleside:Node-Node	3151.4	3180.7
Ingleside:Node-Tellico	4968.3	5019.5
Ingleside:Node-Woodward	3484.6	3543.3
Ingleside:Tellico-Node	3443.7	3502.3

Table G-1 (continued).

Link Label*	A→B	B→A
Ingleside:Woodward-Node	3701.3	3790.4
Jackson:Cook-Node	1500.2	9143.4
Jackson:Decatur-Knoxville	5535.5	5629.4
Jackson:Green-Node	2422.1	0
Jackson:Knoxville-Y Intersecti	3697.2	3732.2
Jackson:Madison-Washington	2331.1	0
Jackson:New Englewood-Node	188	187.2
Jackson:Node-Cook	318.8	8211.3
Jackson:Node-Decatur	1573.6	9176
Jackson:Node-Green	888.8	888.8
Jackson:Node-Madison	2496.2	0
Jackson:Node-New Englewood	151.7	151.5
Jackson:Node-Node	119	118.7
Jackson:Node-Node	119	118.7
Jackson:Node-Node	119	118.7
Jackson:Node-Node	119	118.7
Jackson:Node-Tellico	2607.7	2625.5
Jackson:Node-White(split)	291.4	0
Jackson:Old Etowah-Node	112.1	111.9
Jackson:Washington-Node	153.8	0
Jackson:White(Split)-Node	288.1	8229.2
Jackson:Woodward-Node	2898.9	2916.1
Jackson:Y Intersection-Woodwar	1956	1970.3
Keith:Cedar Springs-Node	665.2	727.4
Keith:Crestway-Node	1349	1408.9
Keith:Node-Crestway	1349	1408.9
Keith:Node-Madison	1318	1380.6
Knoxville:Jackson-Node	1862.3	1921.2
Knoxville:Node-Node	627.8	682.7
Knoxville:Node-Node	1862.3	1921.2
Knoxville:Node-Tellico	969.2	1004.7
Knoxville:Node-Woodward	627.8	682.7
Knoxville:Woodward-Node	841.1	876.9
Layman:Node-Congress	0	0
Layman:Piper-Node	0	0
Lee Hwy:Ingleside-Node	854.2	858.5
Lee Hwy:Node-Congress	854.6	858.9
Lee Hwy:Node-Node	854.6	858.9
Lee Hwy:Node-Node	854.6	858.9
Lions Park:Sterling-Madison	105.8	108.2
Long Mill:Node-Cedar Springs	723.8	726

Table G-1 (continued).

Link Label*	A→B	B→A
Long Mill:Node-Node	518.5	517.2
Long Mill:Node-Node	518.5	517.2
Madison:705-Lions Park	2122.5	2104.9
Madison:718-705	1395.5	1408.6
Madison:Cook-Node	3323.2	3698.3
Madison:Crestway-Old Riceville	1974.2	1960.3
Madison:Dennis-Node	1586.3	1573.8
Madison:Green-Node	3493	3442.8
Madison:Jackson-Node	3551.3	0
Madison:Keith-Node	3236.7	3689.1
Madison:Lions Park-Dennis	2217.9	2202.6
Madison:Matlock-Cook	2893.2	2911.9
Madison:Node-718	1684.5	1673.4
Madison:Node-Crestway	1706.8	1693.9
Madison:Node-Green	3570.5	0
Madison:Node-Jackson	3386.2	0
Madison:Node-Keith	3809.9	4199.7
Madison:Node-Matlock	2681.4	2698.3
Madison:Node-Node	298.8	300.1
Madison:Node-Node	3532.3	3501.8
Madison:Node-Node	3532.3	3501.8
Madison:Node-Node	3558.2	3507.7
Madison:Node-Node	3558.2	3507.7
Madison:Node-Node	3920.8	0
Madison:Node-Node	3515.9	0
Madison:Node-Node	1421.8	1428.3
Madison:Node-Node	1089.8	1085.8
Madison:Node-Node	1089.8	1085.8
Madison:Node-Slack	2065.5	2040.3
Madison:Node-Tellico	1435.5	1441.5
Madison:Node-Washington	3392.1	3419.1
Madison:Node-White	4103.7	0
Madison:Old Riceville-Node	2943.9	2962.8
Madison:Slack-Node	334.3	335.7
Madison:Tellico-Node	1125.2	1129.4
Madison:Washington-Node	3392.1	0
Madison:White-Node	3378.3	0
Maple:Node-Decatur	3193.9	3138.8
Maple:Old Riceville-Node	2652.2	2595.1
Matlock:Cedar Springs-Node	303.1	306.4
Matlock:Crestway-Node	227.2	229

Table G-1 (continued).

Link Label*	A→B	B→A
Matlock:Node-Crestway	2.8	2.8
Matlock:Node-Madison	211.8	213.7
Mt. Verd Cnct:I-75 to Old Mt.	4971.4	4962.4
Mt. Verd Cnct:Old Mt. Verd-Nod	4968.4	4959.5
Mt. Verd Connector:Node-Node	4992.3	4983.2
Mt. Verd Connector:Node-Node	4992.3	4983.2
Mt. Verd Connector:Node-Node	4992.3	4983.2
New Englewood:Jackson-Node	4787.4	4643.1
New Englewood:Node-Node	3982.4	3836.7
New Englewood:Node-Node	3278.7	3293.8
New Englewood:Node-Node	3278.7	3293.8
New Englewood:White-Jackson	4890.4	4745.5
Old Mt. Verd:Bruce Henry-Node	3	3
Old Mt. Verd:Clearwater-Node	287.3	287.9
Old Mt. Verd:Node-Bruce Henry	3	3
Old Mt. Verd:Node-Mt. Verd Cnc	3	3
Old Mt. Verd:Node-Node	5.8	5.8
Old Mt. Verd:Node-Node	0	0
Old Riceville:Frye-Node	569.9	543.1
Old Riceville:Madison-Rocky Mo	2405.1	2372.3
Old Riceville:Node-Decatur	1458.5	1433.3
Old Riceville:Node-Frye	1746	1716.9
Old Riceville:Rocky Mount-Node	1154.4	1148.5
Park:Church-White	709.5	0
Piper:Congress-Node	154.2	153
Piper:Node-Layman	0	0
Railroad Ave:Decatur-Node	322.4	325.5
Railroad Ave:Node-Congress	3970.4	3994.9
Railroad Ave:Node-Node	1517.5	1535.1
Railroad Ave:Node-Node	1517.5	1535.1
Railroad Ave:Node-Node	1956.4	1977
Railroad Ave:Node-Sharp	1983.9	2003.5
Railroad Ave:Node-Tellico	1519.6	1540.2
Railroad Ave:Node-Y Intersecti	152.4	152.5
Railroad Ave:Sharp-Node	1932.8	1950.9
Railroad Ave:Tellico-Node	1983.9	2003.5
Railroad Ave:Y Intersection-No	1912.9	1933.6
Rocky Mount:Cate Quarry-Congre	504.9	503.8
Rocky Mount:Congress-Node	1043.5	1055
Rocky Mount:Dennis-Node	710.3	706.8
Rocky Mount:Node-Dennis	1068.8	1068

Table G-1 (continued).

Link Label*	A→B	B→A
Rocky Mount:Node-No Name	145.7	145.6
Rocky Mount:Node-Node	1.9	1.9
Rocky Mount:Node-Node	972.9	984.6
Rocky Mount:Node-Old Riceville	1237.3	1264.2
Sharp:Node-Railroad	87.5	86
Sharp:Velma-Node	97.1	95.2
Showbarn:Node-Old Etowah	112.1	111.9
Slack:Madison-Node	887.1	1052.4
Slack:Node-Node	812.2	977.4
Slack:Node-Node	464	465.9
Spring Creek:Node-Decatur	574	572.6
Sterling:718-Coile	0	0
Sterling:Coile-Node	0	0
Sterling:Congress-Lions Park	17.5	19.8
Sterling:Node-Congress	0	0
Tellico:Congress-Node	1911.8	1921.8
Tellico:Dupit-Node	994.9	992.2
Tellico:Hammar-Node	368.9	376.5
Tellico:Ingleside-Node	1946.3	1945
Tellico:Jackson-Node	2385	2400.5
Tellico:Knoxville-Hammar	949.9	1007.7
Tellico:Node-Dupit	1911.8	1921.8
Tellico:Node-Ingleside	296.4	302.6
Tellico:Node-Jackson	1082.3	1080
Tellico:Node-Knoxville	477.4	499.7
Tellico:Node-Madison	1751.9	1750.1
Tellico:Node-Node	368.9	376.5
Tellico:Node-Node	1078.9	1076.1
Tellico:Node-Railroad	1070	1066.6
Tellico:Railroad-Node	1139.1	1136.6
Union Hill:Node-Node	3.7	3.7
Union Hill:Node-White	55.4	55.7
Velma:Decatur-Node	199.7	198.8
Velma:Node-Congress	143.5	141.7
Velma:Node-Node	148.9	147.2
Velma:Node-Node	95.3	93.4
Velma:Node-Sharp	97.8	95.9
Washington:Green-Node	1913.1	0
Washington:Jackson-Node	4192.8	0
Washington:Node-Jackson	2015.5	0
Washington:Node-Madison	3419.1	0

Table G-1 (continued).

Link Label*	A→B	B→A
Washington:Node-Node	3956	0
Washington:Node-Node	3956	0
Washington:Node-White	4184.3	0
Washington:White-Node	4377.5	0
Westside:Cook-Frye	1671.5	1566.8
Westside:Frye-Node	329.9	286.4
Westside:Node-Decatur	831.4	787.7
White:Elizabeth-Node	11915	11768.2
White:Jackson-Node	8232.5	0
White:Madison-Node	9000.6	0
White:New Englewood-Node	6874.4	6894.2
White:Node-Elizabeth	12311.8	11497.9
White:Node-New Englewood	11123.3	10998.2
White:Node-Node	5287.2	5306
White:Node-Node	5287.2	5306
White:Node-Node	5287.2	5306
White:Node-Park/Green	8520.7	0
White:Node-Union Hill	5768.4	5788.1
White:Node-Washington	8468.4	0
White:Park/Green-Node	12513.9	11700.1
White:Union Hill-Node	5823.8	5843.8
White:Washington-Madison	8275.2	0
Woodward:Guille-Node	240.1	270.6
Woodward:Jackson-Node	962.2	959.4
Woodward:Knoxville-Node	428.3	459.4
Woodward:Node-Guille	307.3	338.1
Woodward:Node-Ingleside	260.7	291.2
Woodward:Node-Knoxville	633.9	645.9
Y Intersection:Jackson-RR Ave.	1766	1786.6

Note: *The term "Node" denotes a location without an intersection.

Table G-2. Link Volumes by Direction of Travel for Year 2020-No Bypass Scenario.

Link Label*	A→B	B→A
Cate Quarry:Coile-Node	8.3	8.3
Cate Quarry:Node-Rocky Mount	365.8	364.8
Cedar Springs:705-Node	212.2	235.7
Cedar Springs:Elizabeth-Node	1069.4	39.3
Cedar Springs:Keith-Node	1526.9	1477.9
Cedar Springs:Long Mill-Elizab	1739.1	1696.4
Cedar Springs:Matlock-Node	908.5	957.9
Cedar Springs:Node-705	894	890.6
Cedar Springs:Node-Church	1030.1	0
Cedar Springs:Node-Keith	936.5	985.8
Cedar Springs:Node-Long Mill	1342.1	1299.3
Cedar Springs:Node-Matlock	517.6	571.2
Cedar Springs:Node-Node	1069.4	39.3
Cedar Springs:Node-Node	1069.4	39.3
Cedar Springs:Node-Node	239.7	263.2
Church:Cedar Springs-Park	1030.1	0
Clearwater:Congress-Node	7858.3	7858.1
Clearwater:Node-Node	501.4	500.8
Clearwater:Node-Node	501.4	500.8
Clearwater:Node-Node	2111	2113.5
Clearwater:Node-Node	2111	2113.5
Clearwater:Node-Node	2111	2113.5
Clearwater:Node-Node	2147.7	2150
Clearwater:Node-Old Mt. Verd	3151.6	3151.2
Clearwater:Node-Old Mt. Verd	6926.4	6927.2
Co. Rd. 168:Decatur-Node	0	0
Co. Rd. 705:Madison-Node	1251.3	1305.8
Co. Rd. 705:Node-Cedar Springs	704.4	731.3
Co. Rd. 705:Node-Node	695.3	717.8
Co. Rd. 718:Congress-Node	2211.9	2239.8
Co. Rd. 718:Node-Madison	2211.9	2239.8
Co. Rd. 718:Node-Node	18.2	18.2
Co. Rd. 718:Node-Sterling	11.9	11.9
Co. Rd. 718:Sterling-Congress	11.9	11.9
Coile:Congress-Sterling	8.3	8.3
Coile:Sterling-Node	8.3	8.3
Congress Pkwy:255-Node	3523.4	3535.9
Congress Pkwy:718-Coile	6305.8	6255.8
Congress Pkwy:Clearwater-Node	4039.7	4053.7
Congress Pkwy:Coile-Node	6314.1	6264
Congress Pkwy:Decatur-Node	10378.3	10370.4

Table G-2 (continued).

Link Label*	A→B	B→A
Congress Pkwy:Dennis-Node	9649	9589
Congress Pkwy:Ingleside-Node	5255.4	5260.1
Congress Pkwy:Layman-Node	12010.3	11952.7
Congress Pkwy:Lee Hwy-Node	4662.6	4681.7
Congress Pkwy:Node-255	3523.4	3535.9
Congress Pkwy:Node-718	6134.7	6112.5
Congress Pkwy:Node-Clearwater	10416.7	10408.6
Congress Pkwy:Node-Decatur	12961.9	12907.5
Congress Pkwy:Node-Ingleside	5021.6	5040.6
Congress Pkwy:Node-Layman	12010.3	11952.7
Congress Pkwy:Node-Lee Hwy	3523.4	3535.9
Congress Pkwy:Node-Node	9201.9	9198.5
Congress Pkwy:Node-Node	5896.1	5874.4
Congress Pkwy:Node-Node	4699	4680.3
Congress Pkwy:Node-Piper	9979.3	9917.6
Congress Pkwy:Node-Sterling	6926	6875.1
Congress Pkwy:Node-Tellico	10409.3	10410.1
Congress Pkwy:Node-Velma	10812	10805.6
Congress Pkwy:Piper-Dennis	9756.9	9696.6
Congress Pkwy:Rocky Mount-Node	8105	8032.2
Congress Pkwy:Sterling-Rocky M	6892	6834.1
Congress Pkwy:Tellico-Node	10834.2	10827.9
Congress Pkwy:Velma-Node	10875.2	10868.9
Cook:Madison-Node	2770.6	2348.3
Cook:Node-Jackson	1942.9	1650.3
Cook:Node-Node	1942.9	1650.3
Cook:Node-Node	1523.1	1218
Cook:Node-Westside	3592.8	3158
Cook:Westside-Node	1523.1	1218
Crestway:Madison-Node	823.1	824.8
Crestway:Matlock-Node	10.4	10.4
Crestway:Node-Keith	0	0
Crestway:Node-Matlock	290.4	292.5
Crestway:Node-Node	825.4	827.1
Crestway:Node-Node	825.4	827.1
Decatur Pike:168-Node	895.7	893.7
Decatur Pike:Congress-Node	13828.3	13794.6
Decatur Pike:Dupit-Node	13608.2	13599
Decatur Pike:I-75 to Node	8852.1	8832.7
Decatur Pike:Maple-Node	9409.3	9336.4
Decatur Pike:Node to I-75	2704.2	2707.6

Table G-2 (continued).

Link Label*	A→B	B→A
Decatur Pike:Node-Congress	15946.1	15958.9
Decatur Pike:Node-Dupit	12664.9	12645.4
Decatur Pike:Node-Maple	13863.7	13854.9
Decatur Pike:Node-Node	895.7	893.7
Decatur Pike:Node-Node	2051.3	2053.5
Decatur Pike:Node-Node	7477.4	7465.2
Decatur Pike:Node-Node	7198.4	7187
Decatur Pike:Node-Node	10593.2	10438
Decatur Pike:Node-Node	10993.1	10829.6
Decatur Pike:Node-Old Ricevill	9409.3	9336.4
Decatur Pike:Node-Railroad	10859.8	10702.5
Decatur Pike:Node-Spring Creek	315.5	314.8
Decatur Pike:Node-Velma	16643.9	16652.5
Decatur Pike:Node-Westside	10423.3	10340.7
Decatur Pike:Old Riceville-Nod	10818.8	10721.1
Decatur Pike:Railroad-Jackson	11009.8	10846.9
Decatur Pike:Spring Creek-168	895.7	893.7
Decatur Pike:Velma-Node	16742.6	16753.7
Decatur Pike:Westside-Node	10206.6	10065.3
Dennis:Madison-Node	1278.2	1273.7
Dennis:Node-Congress	107.6	107.9
Dennis:Node-Rocky Mount	1286.6	1282.1
Dennis:Rocky Mount-Node	0	0
Dupit:Decatur-Node	1131.2	1120.9
Dupit:Node-Tellico	1632.9	1622.9
Elizabeth:Cedar Springs-Node	669.6	1657.1
Elizabeth:Node-White	554.9	1523.8
External Conector 111	894	890.6
External Connector 105	19816	19795.6
External Connector 106	4681.7	4662.6
External Connector 107	1658.2	1650
External Connector 108	465.9	464
External Connector 109	5054.8	5026.3
External Connector 110	6259.7	6233.7
External Connector 112	1296.7	1291.1
External Connector 113	4699	4680.3
External Connector 114	18010.6	17994.4
External Connector 115	501.4	500.8
Forrest:Green-Node	2282.5	2420.5
Forrest:Guille-Node	2116	2258.9
Forrest:Node-Guille	2116	2258.9

Table G-2 (continued).

Link Label*	A→B	B→A
Forrest:Node-Madison	2558.9	2746.1
Forrest:Node-Node	2589.5	2761
Forrest:Node-Tellico	1870.1	2012.8
Forrest:Tellico-Node	2589.5	2761
Frye:Node-Westside	1774.8	1845.6
Frye:Old Riceville-Node	2175.2	2237.7
Green:Forrest-Node	2610.8	12907.3
Green:Ingleside-Madison	5365	18129.3
Green:Jackson-Node	4785.2	15173.7
Green:Jackson-White	5563.9	17099.7
Green:Madison-Node	6616.8	14564.4
Green:Node-Forrest	4651.8	15086.2
Green:Node-Ingleside	2480.3	12968
Green:Node-Jackson	5910.6	14020.8
Green:Node-Node	5847.4	13797.9
Guille:Forrest-Node	0	0
Guille:Node-Woodward	74.9	74.7
Hammar:Node-Ingleside	1329.4	1401.6
Hammar:Tellico-Node	864.4	935.5
I-75:Decatur-Mt. Verd Connecto	16322	16328.6
I-75:Mt. Verd Connector-Node	19795.6	19816
I-75:Node-Decatur	18010.6	17994.4
Ingleside:Congress-Node	4663	4665.6
Ingleside:Forrest-Node	3593.8	3664.4
Ingleside:Hammar-Node	6347.6	6417.9
Ingleside:Lee Hwy-Node	7069.6	7070.4
Ingleside:Node-Congress	6117.1	6105.5
Ingleside:Node-Forrest	4246	4345.5
Ingleside:Node-Green	3626.5	3671.8
Ingleside:Node-Hammar	6985	6983.2
Ingleside:Node-Lee Hwy	5931.9	5939.4
Ingleside:Node-Node	6347.6	6417.9
Ingleside:Node-Node	4005.4	4080.4
Ingleside:Node-Node	4005.4	4080.4
Ingleside:Node-Node	3596.4	3666.8
Ingleside:Node-Node	3596.4	3666.8
Ingleside:Node-Node	3728.4	3773.6
Ingleside:Node-Node	3626.5	3671.8
Ingleside:Node-Tellico	6030.1	6100
Ingleside:Node-Woodward	4008.9	4083.7
Ingleside:Tellico-Node	3983.4	4058.5

Table G-2 (continued).

Link Label*	A→B	B→A
Ingleside:Woodward-Node	4212	4311.6
Jackson:Cook-Node	1942.7	12643.5
Jackson:Decatur-Knoxville	7362.8	7465.4
Jackson:Green-Node	3425.4	0
Jackson:Knoxville-Y Intersecti	5220.8	5248.9
Jackson:Madison-Washington	3090.1	0
Jackson:New Englewood-Node	235.1	234.2
Jackson:Node-Cook	359.8	11353.2
Jackson:Node-Decatur	2025.7	12679.8
Jackson:Node-Green	941.8	942
Jackson:Node-Madison	3701.6	0
Jackson:Node-New Englewood	156	155.9
Jackson:Node-Node	112.2	112
Jackson:Node-Node	112.2	112
Jackson:Node-Node	112.2	112
Jackson:Node-Node	112.2	112
Jackson:Node-Tellico	3044	3057.2
Jackson:Node-White(split)	326.1	0
Jackson:Old Etowah-Node	106.8	106.6
Jackson:Washington-Node	172.8	0
Jackson:White(Split)-Node	323.2	11366.8
Jackson:Woodward-Node	3339.6	3352
Jackson:Y Intersection-Woodwar	2103.3	2112.4
Keith:Cedar Springs-Node	966.9	1065.2
Keith:Crestway-Node	1602.5	1698.4
Keith:Node-Crestway	1602.5	1698.4
Keith:Node-Madison	1546.6	1647.4
Knoxville:Jackson-Node	2161.1	2235.6
Knoxville:Node-Node	821.5	894.2
Knoxville:Node-Node	2161.1	2235.6
Knoxville:Node-Tellico	1212.1	1270.5
Knoxville:Node-Woodward	821.5	894.2
Knoxville:Woodward-Node	1068.6	1127.4
Layman:Node-Congress	0	0
Layman:Piper-Node	0	0
Lee Hwy:Ingleside-Node	1131	1137.7
Lee Hwy:Node-Congress	1139.2	1145.9
Lee Hwy:Node-Node	1139.2	1145.9
Lee Hwy:Node-Node	1139.2	1145.9
Lions Park:Sterling-Madison	157.8	164.5
Long Mill:Node-Cedar Springs	1235.6	1235.7

Table G-2 (continued).

Link Label [*]	A→B	B→A
Long Mill:Node-Node	1026.9	1024.5
Long Mill:Node-Node	1026.9	1024.5
Madison:705-Lions Park	2915.1	2876.7
Madison:718-705	1741.2	1757.4
Madison:Cook-Node	4246.4	4675.5
Madison:Crestway-Old Riceville	2700.4	2671.2
Madison:Dennis-Node	2072.7	2045.5
Madison:Green-Node	4230.7	4180.4
Madison:Jackson-Node	4895.4	0
Madison:Keith-Node	4104.6	4652.8
Madison:Lions Park-Dennis	3060.2	3028.6
Madison:Matlock-Cook	3612.5	3619.3
Madison:Node-718	1982.4	1970.7
Madison:Node-Crestway	2199.7	2172.1
Madison:Node-Green	4867	0
Madison:Node-Jackson	4283.9	0
Madison:Node-Keith	4867.9	5315.3
Madison:Node-Matlock	3337.9	3342.5
Madison:Node-Node	478	480.5
Madison:Node-Node	4237	4205.6
Madison:Node-Node	4237	4205.6
Madison:Node-Node	4268.1	4217.7
Madison:Node-Node	4268.1	4217.7
Madison:Node-Node	4819.2	0
Madison:Node-Node	4399.8	0
Madison:Node-Node	1911.5	1921.1
Madison:Node-Node	1296.7	1291.1
Madison:Node-Node	1296.7	1291.1
Madison:Node-Slack	2543.7	2518.6
Madison:Node-Tellico	1943.6	1952.9
Madison:Node-Washington	4265.3	4367.5
Madison:Node-White	5238.3	0
Madison:Old Riceville-Node	3811.8	3819.6
Madison:Slack-Node	515.8	518.5
Madison:Tellico-Node	1650	1658.2
Madison:Washington-Node	4265.3	0
Madison:White-Node	4271.7	0
Maple:Node-Decatur	4518.4	4454.3
Maple:Old Riceville-Node	3849.1	3782.6
Matlock:Cedar Springs-Node	477.2	481.4
Matlock:Crestway-Node	308.7	310.8

Table G-2 (continued).

Link Label*	A→B	B→A
Matlock:Node-Crestway	7.9	7.9
Matlock:Node-Madison	274.6	276.8
Mt. Verd Cnct:I-75 to Old Mt.	5844.3	5830.5
Mt. Verd Cnct:Old Mt. Verd-Nod	5838.1	5824.3
Mt. Verd Connector:Node-Node	6117.1	6105.5
Mt. Verd Connector:Node-Node	6117.1	6105.5
Mt. Verd Connector:Node-Node	6117.1	6105.5
New Englewood:Jackson-Node	6570.1	6444.9
New Englewood:Node-Node	5741.6	5615.1
New Englewood:Node-Node	5026.3	5054.8
New Englewood:Node-Node	5026.3	5054.8
New Englewood:White-Jackson	6679.6	6553.5
Old Mt. Verd:Bruce Henry-Node	6.2	6.2
Old Mt. Verd:Clearwater-Node	4087.9	4088.3
Old Mt. Verd:Node-Bruce Henry	6.2	6.2
Old Mt. Verd:Node-Mt. Verd Cnc	6.2	6.2
Old Mt. Verd:Node-Node	126.8	126.6
Old Mt. Verd:Node-Node	0	0
Old Riceville:Frye-Node	518.3	491.7
Old Riceville:Madison-Rocky Mo	3249	3212
Old Riceville:Node-Decatur	1409.5	1384.7
Old Riceville:Node-Frye	2337.4	2306.8
Old Riceville:Rocky Mount-Node	1831.7	1821.4
Park:Church-White	1030.1	0
Piper:Congress-Node	222.4	221
Piper:Node-Layman	0	0
Railroad Ave:Decatur-Node	351.8	357.5
Railroad Ave:Node-Congress	6285.5	6307.3
Railroad Ave:Node-Node	3077.4	3091.2
Railroad Ave:Node-Node	3077.4	3091.2
Railroad Ave:Node-Node	3363.7	3382.7
Railroad Ave:Node-Sharp	3626.8	3645
Railroad Ave:Node-Tellico	2931.6	2950.7
Railroad Ave:Node-Y Intersecti	177.8	177.9
Railroad Ave:Sharp-Node	3495.7	3509.8
Railroad Ave:Tellico-Node	3626.8	3645
Railroad Ave:Y Intersection-No	3311.7	3330.7
Rocky Mount:Cate Quarry-Congre	518.9	517.7
Rocky Mount:Congress-Node	1471.3	1485
Rocky Mount:Dennis-Node	861.9	859.9
Rocky Mount:Node-Dennis	1499.8	1502.3

Table G-2 (continued).

Link Label*	A→B	B→A
Rocky Mount:Node-No Name	153.1	152.9
Rocky Mount:Node-Node	1.4	1.4
Rocky Mount:Node-Node	1388.4	1402.3
Rocky Mount:Node-Old Riceville	1403	1429.7
Sharp:Node-Railroad	178.1	174
Sharp:Velma-Node	188.2	183.4
Showbarn:Node-Old Etowah	106.8	106.6
Slack:Madison-Node	889	1048.4
Slack:Node-Node	816	975.4
Slack:Node-Node	464	465.9
Spring Creek:Node-Decatur	587.2	585.9
Sterling:718-Coile	0	0
Sterling:Coile-Node	0	0
Sterling:Congress-Lions Park	34	41
Sterling:Node-Congress	0	0
Tellico:Congress-Node	2499.6	2506.7
Tellico:Dupit-Node	1223.5	1220.6
Tellico:Hammar-Node	355.3	360.8
Tellico:Ingleside-Node	2486.2	2485.7
Tellico:Jackson-Node	2564.2	2574.6
Tellico:Knoxville-Hammar	1219.7	1296.3
Tellico:Node-Dupit	2499.6	2506.7
Tellico:Node-Ingleside	311.6	316.2
Tellico:Node-Jackson	1468.7	1466
Tellico:Node-Knoxville	490.2	508.4
Tellico:Node-Madison	2281.7	2280.6
Tellico:Node-Node	355.3	360.8
Tellico:Node-Node	1293.4	1290.5
Tellico:Node-Railroad	1294	1290.2
Tellico:Railroad-Node	1536.7	1533.8
Union Hill:Node-Node	11.2	11.2
Union Hill:Node-White	87.7	87.9
Velma:Decatur-Node	505.7	503.1
Velma:Node-Congress	298.4	293.9
Velma:Node-Node	308.4	303.8
Velma:Node-Node	186.7	182
Velma:Node-Sharp	188.6	183.9
Washington:Green-Node	2231.3	0
Washington:Jackson-Node	5334.5	0
Washington:Node-Jackson	2417.2	0
Washington:Node-Madison	4367.5	0

Table G-2 (continued).

Link Label [*]	A→B	B→A
Washington:Node-Node	4938.3	0
Washington:Node-Node	4938.3	0
Washington:Node-White	5321.3	0
Washington:White-Node	5611.4	0
Westside:Cook-Frye	2176.8	2047.1
Westside:Frye-Node	339.9	281
Westside:Node-Decatur	857.9	799.2
White:Elizabeth-Node	15831.9	15706.7
White:Jackson-Node	11369.8	0
White:Madison-Node	12297.1	0
White:New Englewood-Node	9742.2	9763.8
White:Node-Elizabeth	16246.4	15152.4
White:Node-New Englewood	15000.3	14895.8
White:Node-Node	6233.7	6259.7
White:Node-Node	6233.7	6259.7
White:Node-Node	6233.7	6259.7
White:Node-Park/Green	11599.8	0
White:Node-Union Hill	8625.2	8646.9
White:Node-Washington	11620.6	0
White:Park/Green-Node	16448.3	15354.2
White:Union Hill-Node	8712.9	8734.9
White:Washington-Madison	11330.5	0
Woodward:Guille-Node	225.4	250.3
Woodward:Jackson-Node	1253.7	1250.4
Woodward:Knoxville-Node	415.4	440.9
Woodward:Node-Guille	297.8	323
Woodward:Node-Ingleside	245.5	270.4
Woodward:Node-Knoxville	739.4	750.9
Y Intersection:Jackson-RR Ave.	3138.4	3157.4

Note: ^{*}The term "Node" denotes a location without an intersection.

Table G-3. Link Volumes by Direction of Travel for Year 2020-Bypass Scenario.

Link Label*	A→B	B→A
Bypass:Cedar Springs-White	3408.6	4180.3
Bypass:Congress Pkwy-Madison	6215	6730.2
Bypass:Congress Pkwy-Mt. Verd	4696.2	4564.2
Bypass:Decatur Pike-Node	5658.5	6141.6
Bypass:Madison-Node	3802	3675.1
Bypass:Madison-Node	3700	4423.9
Bypass:New Englewood-Node	3652.4	3560.6
Bypass:Node-Cedar Springs	3700	4423.9
Bypass:Node-Congress Pkwy	3802	3675.1
Bypass:Node-Congress Pkwy	5658.5	6141.6
Bypass:Node-Madison	3652.4	3560.6
Bypass:Node-Node	5658.5	6141.6
Bypass:White-New Englewood	2894.5	3563.1
Cate Quarry:Coile-Node	165.2	162.7
Cate Quarry:Node-Rocky Mount	217.2	213.7
Cedar Springs:705-Node	204.3	218.5
Cedar Springs:Bypass-Node	871.3	838
Cedar Springs:Elizabeth-Node	812.9	37
Cedar Springs:Keith-Node	769.1	723.9
Cedar Springs:Long Mill-Elizab	1049.2	1010.2
Cedar Springs:Matlock-Node	622.6	648.9
Cedar Springs:Node-705	894	890.6
Cedar Springs:Node-Bypass	798.8	813.3
Cedar Springs:Node-Church	775.9	0
Cedar Springs:Node-Keith	514.4	540.5
Cedar Springs:Node-Long Mill	581.8	543
Cedar Springs:Node-Matlock	887.2	870.9
Cedar Springs:Node-Node	812.9	37
Cedar Springs:Node-Node	812.9	37
Church:Cedar Springs-Park	775.9	0
Clearwater:Congress-Node	7702.4	7832.7
Clearwater:Node-Node	501.4	500.8
Clearwater:Node-Node	501.4	500.8
Clearwater:Node-Node	2109.8	2112.3
Clearwater:Node-Node	2109.8	2112.3
Clearwater:Node-Node	2109.8	2112.3
Clearwater:Node-Node	2146.2	2148.5
Clearwater:Node-Old Mt. Verd	3149.4	3149
Clearwater:Node-Old Mt. Verd	6770.4	6901.7
Co. Rd. 168:Decatur-Node	0	0
Co. Rd. 705:Madison-Node	1270.4	1307

Table G-3 (continued).

Link Label*	A→B	B→A
Co. Rd. 705:Node-Cedar Springs	672.1	689.6
Co. Rd. 705:Node-Node	676.4	693.9
Co. Rd. 718:Congress-Node	79.7	79.7
Co. Rd. 718:Node-Madison	79.7	79.7
Co. Rd. 718:Node-Node	12.9	12.9
Co. Rd. 718:Node-Sterling	7.4	7.4
Co. Rd. 718:Sterling-Congress	7.4	7.4
Coile:Congress-Sterling	165.2	162.7
Coile:Sterling-Node	165.2	162.7
Congress Pkwy:255-Node	1731.5	1742.5
Congress Pkwy:718-Coile	6059	6036.9
Congress Pkwy:Bypass-Node	4662.6	4681.7
Congress Pkwy:Bypass-Node	4307.6	4255.8
Congress Pkwy:Clearwater-Node	3591.5	3603.1
Congress Pkwy:Coile-Bypass	6221.8	6202.1
Congress Pkwy:Decatur-Node	9995.2	9983.3
Congress Pkwy:Dennis-Node	5853.5	5804.1
Congress Pkwy:Ingleside-Node	3253.8	3255.4
Congress Pkwy:Layman-Node	8088.4	8040.6
Congress Pkwy:Lee Hwy-Bypass	2113.6	2127.7
Congress Pkwy:Node-255	1731.5	1742.5
Congress Pkwy:Node-718	6140.4	6118.3
Congress Pkwy:Node-Clearwater	10012.7	10002
Congress Pkwy:Node-Decatur	8990.3	8945.7
Congress Pkwy:Node-Ingleside	4559.7	4576.3
Congress Pkwy:Node-Layman	8088.4	8040.6
Congress Pkwy:Node-Lee Hwy	1731.5	1742.5
Congress Pkwy:Node-Node	8824.5	8817
Congress Pkwy:Node-Node	5904.6	5882.9
Congress Pkwy:Node-Node	4699	4680.3
Congress Pkwy:Node-Piper	6310.5	6258.7
Congress Pkwy:Node-Sterling	4333.2	4280.1
Congress Pkwy:Node-Tellico	10031.5	10028.2
Congress Pkwy:Node-Velma	10427.5	10419
Congress Pkwy:Piper-Dennis	5961.1	5911.4
Congress Pkwy:Rocky Mount-Node	4688.8	4626.5
Congress Pkwy:Sterling-Rocky M	4333.2	4280.1
Congress Pkwy:Tellico-Node	10449.6	10441.3
Congress Pkwy:Velma-Node	10491.2	10482.3
Cook:Madison-Node	2497.6	2106.4
Cook:Node-Jackson	1955.5	1663.5

Table G-3 (continued).

Link Label*	A→B	B→A
Cook:Node-Node	1955.5	1663.5
Cook:Node-Node	1533.6	1229.5
Cook:Node-Westside	3328.1	2924.2
Cook:Westside-Node	1533.6	1229.5
Crestway:Madison-Node	487.7	488.8
Crestway:Matlock-Node	10.5	10.5
Crestway:Node-Keith	0	0
Crestway:Node-Matlock	283.7	285.7
Crestway:Node-Node	489.9	491
Crestway:Node-Node	489.9	491
Decatur Pike:168-Node	896.4	894.3
Decatur Pike:Bypass-Node	4102.3	3614.7
Decatur Pike:Congress-Node	11659	11169.6
Decatur Pike:Dupit-Node	11263.4	10798.6
Decatur Pike:I-75 to Node	9217.8	9196.4
Decatur Pike:Maple-Node	7593.4	7068.1
Decatur Pike:Node to I-75	2708.4	2711.7
Decatur Pike:Node-Bypass	9022.7	9018.1
Decatur Pike:Node-Congress	10009.5	9552.8
Decatur Pike:Node-Dupit	10317.1	9841.8
Decatur Pike:Node-Maple	11400.4	10936.1
Decatur Pike:Node-Node	896.4	894.3
Decatur Pike:Node-Node	2053.5	2055.7
Decatur Pike:Node-Node	9297.1	9291.8
Decatur Pike:Node-Node	8747.2	8167.5
Decatur Pike:Node-Node	9146	8558.6
Decatur Pike:Node-Old Ricevill	7593.4	7068.1
Decatur Pike:Node-Railroad	9013.5	8431.4
Decatur Pike:Node-Spring Creek	315.6	314.9
Decatur Pike:Node-Velma	10770.8	10294.3
Decatur Pike:Node-Westside	8583.2	8047.3
Decatur Pike:Old Riceville-Nod	8978.7	8429.4
Decatur Pike:Railroad-Jackson	9160.6	8573.8
Decatur Pike:Spring Creek-168	896.4	894.3
Decatur Pike:Velma-Node	10810.3	10351.8
Decatur Pike:Westside-Node	8362.4	7794.8
Dennis:Madison-Node	1023.4	850.6
Dennis:Node-Congress	107.3	107.6
Dennis:Node-Rocky Mount	1031.7	858.9
Dennis:Rocky Mount-Node	0	0
Dupit:Decatur-Node	1135.3	1124.8

Table G-3 (continued).

Link Label*	A→B	B→A
Dupit:Node-Tellico	1641	1630.9
Elizabeth:Cedar Springs-Node	236.3	973.3
Elizabeth:Node-White	133.1	842.5
External Conector 111	894	890.6
External Connector 105	19816	19795.6
External Connector 106	4681.7	4662.6
External Connector 107	1658.2	1650
External Connector 108	465.9	464
External Connector 109	5054.8	5026.3
External Connector 110	6259.7	6233.7
External Connector 112	1296.7	1291.1
External Connector 113	4699	4680.3
External Connector 114	18010.6	17994.4
External Connector 115	501.4	500.8
Forrest:Green-Node	2223.7	2347.3
Forrest:Guille-Node	2052.4	2181
Forrest:Node-Guille	2052.4	2181
Forrest:Node-Madison	1672.2	1882.4
Forrest:Node-Node	2454.8	2612.5
Forrest:Node-Tellico	1806.4	1934.8
Forrest:Tellico-Node	2454.8	2612.5
Frye:Node-Westside	1527.5	1596.4
Frye:Old Riceville-Node	1930	1990.4
Green:Forrest-Node	2604.2	10440.7
Green:Ingleside-Madison	2983.6	13216.3
Green:Jackson-Node	4723.3	12638.5
Green:Jackson-White	2219	10076.4
Green:Madison-Node	3272.6	8722.2
Green:Node-Forrest	4587.7	12547.7
Green:Node-Ingleside	2464.9	10492.9
Green:Node-Jackson	2565.8	8177.9
Green:Node-Node	2509.1	7961.5
Guille:Forrest-Node	0	0
Guille:Node-Woodward	76.1	75.9
Hammar:Node-Ingleside	1321.4	1393.3
Hammar:Tellico-Node	857.1	927.8
I-75:Decatur-Mt. Verd Connecto	16676.1	16684.7
I-75:Mt. Verd Connector-Node	19795.6	19816
I-75:Node-Decatur	18010.6	17994.4
Ingleside:Congress-Node	1985.8	1989.7
Ingleside:Forrest-Node	1219.1	1289.2

Table G-3 (continued).

Link Label*	A→B	B→A
Ingleside:Hammar-Node	2744.4	2817.5
Ingleside:Lee Hwy-Node	3467.2	3471.2
Ingleside:Node-Congress	1968.6	1957.4
Ingleside:Node-Forrest	1806.2	1905.6
Ingleside:Node-Green	1254.5	1298.4
Ingleside:Node-Hammar	3377.7	3379
Ingleside:Node-Lee Hwy	3089.6	3096.6
Ingleside:Node-Node	2744.4	2817.5
Ingleside:Node-Node	1567.6	1642.6
Ingleside:Node-Node	1567.6	1642.6
Ingleside:Node-Node	1221.7	1291.6
Ingleside:Node-Node	1221.7	1291.6
Ingleside:Node-Node	1355	1398.9
Ingleside:Node-Node	1254.5	1298.4
Ingleside:Node-Tellico	2427.7	2500.4
Ingleside:Node-Woodward	1570.1	1644.8
Ingleside:Tellico-Node	1550.1	1625.3
Ingleside:Woodward-Node	1773.6	1873.2
Jackson:Cook-Node	1914.4	10712.1
Jackson:Decatur-Knoxville	7082.2	7332.2
Jackson:Green-Node	2245.6	0
Jackson:Knoxville-Y Intersecti	4952.3	5128.1
Jackson:Madison-Washington	1926.8	0
Jackson:New Englewood-Node	277.9	276.7
Jackson:Node-Cook	360.9	9450.6
Jackson:Node-Decatur	1998	10750.1
Jackson:Node-Green	885.7	885.5
Jackson:Node-Madison	2531.9	0
Jackson:Node-New Englewood	171.3	171.2
Jackson:Node-Node	112.6	112.3
Jackson:Node-Node	112.6	112.3
Jackson:Node-Node	112.6	112.3
Jackson:Node-Node	112.6	112.3
Jackson:Node-Tellico	3034.7	3047.9
Jackson:Node-White(split)	326.2	0
Jackson:Old Etowah-Node	107.5	107.3
Jackson:Washington-Node	172	0
Jackson:White(Split)-Node	323.2	9462.1
Jackson:Woodward-Node	3323	3337.6
Jackson:Y Intersection-Woodwar	2079.1	2090.4
Keith:Cedar Springs-Node	555.7	627

Table G-3 (continued).

Link Label*	A→B	B→A
Keith:Crestway-Node	1201.9	1270.9
Keith:Node-Crestway	1201.9	1270.9
Keith:Node-Madison	1149.6	1223.6
Knoxville:Jackson-Node	2149.4	2223.7
Knoxville:Node-Node	819.9	892.3
Knoxville:Node-Node	2149.4	2223.7
Knoxville:Node-Tellico	1210.3	1268.6
Knoxville:Node-Woodward	819.9	892.3
Knoxville:Woodward-Node	1066.4	1125
Layman:Node-Congress	0	0
Layman:Piper-Node	0	0
Lee Hwy:Ingleside-Node	374.5	377.6
Lee Hwy:Node-Congress	382.1	385.2
Lee Hwy:Node-Node	382.1	385.2
Lee Hwy:Node-Node	382.1	385.2
Lions Park:Sterling-Madison	50.6	50.8
Long Mill:Node-Cedar Springs	699.7	699.5
Long Mill:Node-Node	491.6	488.8
Long Mill:Node-Node	491.6	488.8
Madison:705-Bypass	3224.7	3180.8
Madison:718-705	1997.4	1990.1
Madison:Bypass-Lions Park	2039.1	1786.4
Madison:Bypass-Node	1650	1658.2
Madison:Cook-Node	2979.5	3100.6
Madison:Crestway-Old Riceville	1604.7	1523.6
Madison:Dennis-Node	1245.4	1165.7
Madison:Green-Node	3201.2	3111.1
Madison:Jackson-Node	4894.7	0
Madison:Keith-Node	3174.1	3387.7
Madison:Lions Park-Dennis	2044.6	1792.1
Madison:Matlock-Cook	2595.1	2325.1
Madison:Node-718	2006.1	1998.9
Madison:Node-Crestway	1306.4	1226.4
Madison:Node-Green	4873.1	0
Madison:Node-Jackson	4289.6	0
Madison:Node-Keith	3587.2	3726.8
Madison:Node-Matlock	2327	2054.9
Madison:Node-Node	415.2	418.5
Madison:Node-Node	3230.5	3160.4
Madison:Node-Node	3230.5	3160.4
Madison:Node-Node	3262.1	3172.3

Table G-3 (continued).

Link Label*	A→B	B→A
Madison:Node-Node	3262.1	3172.3
Madison:Node-Node	3893.2	0
Madison:Node-Node	3470.9	0
Madison:Node-Node	2793.2	2766.3
Madison:Node-Node	1296.7	1291.1
Madison:Node-Node	1296.7	1291.1
Madison:Node-Slack	1597.5	1534.3
Madison:Node-Tellico	2876.4	2847.7
Madison:Node-Washington	3335.9	3101.6
Madison:Node-White	4314.7	0
Madison:Old Riceville-Node	2804.3	2582.6
Madison:Slack-Node	452.3	455.8
Madison:Tellico-Bypass	2459.1	2432.3
Madison:Washington-Node	3335.9	0
Madison:White-Node	4276.3	0
Maple:Node-Decatur	3868	3807.1
Maple:Old Riceville-Node	3209.4	3146.1
Matlock:Cedar Springs-Node	869.9	827.2
Matlock:Crestway-Node	348.3	303
Matlock:Node-Crestway	54.1	6.8
Matlock:Node-Madison	268.1	270.2
Mt. Verd Cnct:I-75 to Old Mt.	6222.8	6211
Mt. Verd Cnct:Old Mt. Verd-Nod	6216.5	6204.8
Mt. Verd Connector:Bypass-Node	1968.6	1957.4
Mt. Verd Connector:Node-Bypass	6532.8	6653.6
Mt. Verd Connector:Node-Node	1968.6	1957.4
New Englewood:Bypass-Node	5752.5	5640.5
New Englewood:Jackson-Node	4615.7	3744.6
New Englewood:Node-Bypass	3891.3	3018.8
New Englewood:Node-Node	5026.3	5054.8
New Englewood:Node-Node	5026.3	5054.8
New Englewood:White-Jackson	4759.1	3886.9
Old Mt. Verd:Bruce Henry-Node	6.3	6.3
Old Mt. Verd:Clearwater-Node	3933.5	4064.4
Old Mt. Verd:Node-Bruce Henry	6.3	6.3
Old Mt. Verd:Node-Mt. Verd Cnc	6.3	6.3
Old Mt. Verd:Node-Node	126.6	126.4
Old Mt. Verd:Node-Node	0	0
Old Riceville:Frye-Node	513.8	488
Old Riceville:Madison-Rocky Mo	2393.6	2534.1
Old Riceville:Node-Decatur	1385.3	1361.3

Table G-3 (continued).

Link Label*	A→B	B→A
Old Riceville:Node-Frye	1955.6	1926.8
Old Riceville:Rocky Mount-Node	1449.4	1441
Park:Church-White	775.9	0
Piper:Congress-Node	349.4	347.3
Piper:Node-Layman	0	0
Railroad Ave:Decatur-Node	352.8	357.5
Railroad Ave:Node-Congress	6107.3	6260
Railroad Ave:Node-Node	2885.4	3029.8
Railroad Ave:Node-Node	2885.4	3029.8
Railroad Ave:Node-Node	3122.9	3287.3
Railroad Ave:Node-Sharp	3403.9	3568.1
Railroad Ave:Node-Tellico	2701.2	2865.7
Railroad Ave:Node-Y Intersecti	180.6	180.6
Railroad Ave:Sharp-Node	3292	3436.7
Railroad Ave:Tellico-Node	3403.9	3568.1
Railroad Ave:Y Intersection-No	3070.4	3235
Rocky Mount:Cate Quarry-Congre	370.4	366.7
Rocky Mount:Congress-Node	222.2	227.8
Rocky Mount:Dennis-Node	1161.5	983.6
Rocky Mount:Node-Dennis	256.1	251
Rocky Mount:Node-No Name	153.2	153.1
Rocky Mount:Node-Node	1.3	1.3
Rocky Mount:Node-Node	141.4	147.1
Rocky Mount:Node-Old Riceville	1102	953.1
Sharp:Node-Railroad	174.3	154.8
Sharp:Velma-Node	184.4	164.8
Showbarn:Node-Old Etowah	107.5	107.3
Slack:Madison-Node	853.6	997.1
Slack:Node-Node	767.4	911
Slack:Node-Node	464	465.9
Spring Creek:Node-Decatur	587.5	586.2
Sterling:718-Coile	0	0
Sterling:Coile-Node	0	0
Sterling:Congress-Lions Park	0	0
Sterling:Node-Congress	0	0
Tellico:Congress-Node	2519.7	2524.8
Tellico:Dupit-Node	1238.7	1233.5
Tellico:Hammar-Node	359.9	365.5
Tellico:Ingleside-Node	1298	1300.3
Tellico:Jackson-Node	2554.7	2563.7
Tellico:Knoxville-Hammar	1217	1293.3

Table G-3 (continued).

Link Label*	A→B	B→A
Tellico:Node-Dupit	2519.7	2524.8
Tellico:Node-Ingleside	310.1	314.9
Tellico:Node-Jackson	1480.6	1476.4
Tellico:Node-Knoxville	493.8	511.8
Tellico:Node-Madison	1112.9	1114.7
Tellico:Node-Node	359.9	365.5
Tellico:Node-Node	1309	1303.8
Tellico:Node-Railroad	1303.1	1297.7
Tellico:Railroad-Node	1551.4	1546.3
Union Hill:Node-Node	10.4	10.4
Union Hill:Node-White	241.7	232.5
Velma:Decatur-Node	523.5	505.5
Velma:Node-Congress	295.9	276
Velma:Node-Node	306	286
Velma:Node-Node	182.9	163.3
Velma:Node-Sharp	184.8	165.2
Washington:Green-Node	2160.9	0
Washington:Jackson-Node	4094.9	0
Washington:Node-Jackson	2340.1	0
Washington:Node-Madison	3101.6	0
Washington:Node-Node	3674.5	0
Washington:Node-Node	3674.5	0
Washington:Node-White	4080.6	0
Washington:White-Node	4348.1	0
Westside:Cook-Frye	1902	1802.2
Westside:Frye-Node	314.4	283.5
Westside:Node-Decatur	832.6	800.9
White:Bypass-Node	8811.8	8833.8
White:Elizabeth-Node	9524.5	8554.1
White:Jackson-Node	9465	0
White:Madison-Node	9484.8	0
White:New Englewood-Node	4758.9	4677.3
White:Node-Elizabeth	10101	8421.2
White:Node-New Englewood	8956.2	8002.4
White:Node-Node	6233.7	6259.7
White:Node-Node	6233.7	6259.7
White:Node-Node	6233.7	6259.7
White:Node-Park/Green	8774.5	0
White:Node-Union Hill	3918.4	3846.5
White:Node-Washington	9714	0
White:Park/Green-Node	10307.1	8614.2

Table G-3 (continued).

Link Label*	A→B	B→A
White: Washington-Madison	9446.5	0
Woodward: Guille-Node	226.1	250.9
Woodward: Jackson-Node	1261.6	1258.3
Woodward: Knoxville-Node	417.8	443.1
Woodward: Node-Guille	299.7	324.8
Woodward: Node-Ingleside	246.4	271.2
Woodward: Node-Knoxville	741.1	752.7
Y Intersection: Jackson-RR Ave.	2894.5	3059

Note: *The term "Node" denotes a location without an intersection.

VITA

Jason Gregory was born in Cincinnati, Ohio on July 15, 1974. He grew up in Germantown, Tennessee where he graduated from Germantown High School. He received his Bachelor of Science in Civil Engineering from The University of Memphis in May of 1996. He graduated from the University of Tennessee, Knoxville in May of 1998 with his Master of Science in Civil Engineering. He has worked at the Southeastern Transportation Center where he studied transportation problems in and around the Great Smoky Mountains National Park. Currently he is working at Science Applications International Corporation in Oak Ridge, Tennessee.