Appendix C

Regional Travel Demand Model

The study team used a regional travel demand model to assist in the identification and evaluation of future traffic conditions. The model was used to estimate future roadway deficiencies in 2040 and evaluate the individual impacts of proposed capacity-increasing projects, providing an important performance measure for the project prioritization process.

The travel demand modeling process offers a planning level assessment. Although the model analyzes individual links of the highway network, it does not explicitly account for every intersection or specific details regarding intersection control, such as traffic signal timing. Trips, generated by traffic analysis zones (TAZs), are loaded onto the roadway network using generalized links that represent the local roadway system.

The GPATS travel demand model was originally developed in the mid-1990's using TRANPLAN software and has been subsequently updated approximately every five years. The model currently uses the TransCAD software platform.

The model encompasses portions of Greenville, Pickens, Anderson, Laurens and Spartanburg Counties and includes the primary roadways within the study area. The highway network database contains attributes for each individual highway segment including information on the roadway classification, number of lanes, and speed limits. The model incorporates trip generation, trip distribution, mode choice and traffic assignment.

Model output includes volume information along with VMT and VHT by link and by time period.

Summary of Model Components

Zone System – The zone system is comprised of 750 zones with 692 being internal TAZs and 58 being external TAZs.

County	Internal TAZs	External TAZs
Greenville	462	9
Spartanburg	47	14
Laurens	5	6
Anderson	38	13
Pickens	140	16

Time of Day – The model is divided into four periods consisting of AM, MD, PM and NT periods

Trip Generation – A cross-classification trip production process and a regression based trip attraction process is used. Total person trips are generated and divided into non-motorized and motorized. Only motorized person trips are loaded onto the network.

Trip Distribution – A gravity model is used.

Mode Split – There is a mode split process that accounts for non-auto trips, but it is not a logit choice model, and the non-auto trips do not carry forward to subsequent steps such as trip assignment.

Freight model – Freight (truck) trips are treated as separate trip purposes with truck-specific trip generation and distribution parameters.

Trip Assignment – Auto and truck vehicle trips are assigned using a combination of stochastic equilibrium and all-or-nothing assignments, depending on the trip purpose.

Travel Demand Model Input Data

The primary role of the travel demand model within the planning process is to assist in evaluating the transportation system and the impacts of transportation investments for the plan horizon year. Demographic and transportation network forecasts are needed to model future transportation improvement scenarios. The demographics represent the changes in land use in terms of population, households, and employment. The model's highway network also incorporates transportation investments (projects). The model results must be interpreted and applied to evaluate the impacts on key performance measures, including the impacts on vehicle miles traveled and congestion.

Demographic Forecasts

The demographic forecasts identify the future development patterns that will generate traffic within the region. Future year forecasts were developed based on forecasts from the previous model, the South Carolina Statewide Model, Upstate Forever Community Viz work, and stakeholder input. The table below summarizes the projections.

County	2015 Pop	2040 Pop	Pop Growth	2015 HH	2040 HH	HH Growth	2015 EMP	2040 EMP	EMP Growth
Greenville	467,334	548,062	17.3%	184,744	220,180	19.2%	276,413	375,447	35.8%
Spartanburg	27,701	37,510	35.4%	10,235	14,156	38.3%	22,717	29,549	30.1%
Laurens	6,181	7,374	19.3%	2,295	2,795	21.8%	2,573	3,180	23.6%
Anderson	64,933	80,495	24.0%	24,639	31,109	26.3%	21,928	29,128	32.8%
Pickens	100,589	137,698	36.9%	40,099	55,931	39.5%	44,573	61,796	38.6%

Highway Networks

The regional travel demand model assigns vehicle trips to a highway network for each scenario. The highway network has been developed to represent all regionally and locally significant roads in the Greenville study area. Significance is measured in terms of functional classification, average daily traffic, and connection within the transportation system. The model network is also influenced by the zone structure. In keeping with common practice, all roads classified as collectors or higher are included in the model network. Some local roads were also added to enhance network connectivity.

The highway network contains planned roads out to the 2040 design year, including projects in the Existing plus Committed network (E+C) and Long-Range Transportation Plan network (LRTP).

Trip Generation

The GPATS model employs a cross-classification-based trip production model and a regression-based trip attraction model to create daily person trips. There are four primary internal purposes: Home-Based Work, Home-Based School, Home-Based Other, and Non- Home-Based. Trip production and trip attraction rates were developed based on the 2003 BCDCOG Household Travel Survey (Charleston, SC). Freight (light, medium, and heavy trucks) is also accounted for in the model, using employment as the primary trip predictor. Special Generators were used for hospitals/medical centers, the airport, and major shopping attractions.

Trip Distribution

The trip distribution model, used to determine where the trips generated in the model come from and go to, is based on the traditional gravity model. The gravity model distributes trips according to the number of productions and attractions in each zone and the impedance between the zones. Travel time was the impedance variable utilized for the GPATS model. Friction factors, which represent the propensity for people to take trips of a certain length, were produced using the gamma function. Friction factors were based on information in the BCDCOG model and the 2003 BCDCOG Household Travel Survey and calibrated to observed trip lengths.

Mode Choice

Since the GPATS model is initially set up as a highway-only model, the mode choice model is used to convert the person trip tables created into vehicle trip tables. The mode choice model factors person trips by a mode split factor, which is determined by the length of the trip (since shorter trips have a higher propensity to take transit and nonmotorized trips), along with a vehicle occupancy factor, which varies by trip purpose. The mode split factors and the vehicle occupancy factors were based on the 2003 BCDCOG Household Travel Survey.

Trip Assignment

Trips were assigned to the highway network using a multi-class assignment, which uses several steps to incrementally assign traffic. All truck trips and external-external auto trips were first assigned using an all-or-nothing assignment where capacity was not considered. The rationales for this step are that these trips are the most indifferent to congestion, and are least likely to deviate from their typical path. The remaining internal-internal and external-internal automobiles were assigned using a stochastic assignment. The stochastic assignment is similar to an equilibrium assignment, except that it introduces a "randomness factor," meaning that the traveling public does not always know the best way to travel and sometimes takes more indirect routes. The stochastic assignment used for the GPATS model used a small randomness factor that accounts for these trips but stays within reason of an equilibrium assignment.

Scenario Management

Scenarios are managed for the GPATS model using a scenario file that points to all the needed files for the desired model run, including scenario name, model year, network, TAZ, and all necessary input and output files.

Each model year is treated as a scenario year, and each network scenario has unique network and zone attributes for model analysis. The TransCAD highway network has been developed so that both the base and forecast year network data are in one model file. This allows for network editing on the base year data to automatically apply to the future year network as well. For the highway network, each roadway segment is coded with a set of data fields with characteristics for each year. Unlike the highway network layer, socioeconomic data (housing and employment) for each traffic analysis zone are managed in a database layer for each forecast year.