APPENDIX A

TRAVEL DEMAND MODELING

OVERVIEW

The model set that the Central Transportation Planning Staff (CTPS), the Boston Region Metropolitan Planning Organization's (MPO) technical staff, uses for forecasting travel demand is based on procedures and data that have evolved over many years. The model set is of the same type as those used in most large urban areas in North America. It uses the best computer models, transportation networks, and input data available to CTPS at this time. The model set is used to simulate existing travel conditions and to forecast future year travel on the entire transportation system spanning most of Eastern Massachusetts, for the transit, auto, and walk/bike modes.

The model set simulates the modes and routes of trips from every zone to every other zone. Population, employment, number of households, auto ownership, highway and transit levels of service, downtown parking costs, auto operating costs and transit fares are some of the most important inputs that are used in applying the model to a real world situation. These inputs are constantly updated so that the model set simulates current travel patterns with as much accuracy as possible.

The MPO travel model set has been used in a number of recent studies such as the Urban Ring Phase Two Study, the Silver Line Phase III Study, the North Shore Transportation Study, and the South Weymouth Naval Air Station Development Study.

MAJOR FEATURES OF THE MODEL

Some important features of the model set are listed below.

- The model area encompasses 164 cities and towns in Eastern Massachusetts as shown in Figure A-1. The modeled area is divided into 2727 internal

FIGURE A-1

Boston Region Transportation Demand Model Area

Transportation Analysis Zones (TAZ's). There are 124 external stations around the periphery of the modeled area that allow for travel between the modeled area and adjacent areas of Massachusetts, New Hampshire and Rhode Island.

- The model set was estimated using data from a Household Travel Survey, External Cordon Survey, several Transit Passenger Surveys, the 2000 U.S. Census data, an employment database for the region, and a vast database of ground counts of transit ridership and traffic volume data collected over the last decade. CTPS will obtain the most current transit ridership data and highway volumes available.

- The transportation system is broken down into three primary modes. The transit mode contains all the MBTA rail and bus lines, commuter boat services, and private express bus carriers. The auto mode includes all of the express highways, principle arterials, many minor arterials and local roadways. Walk/bike trips are also examined and are represented in the non-motorized mode. The non-motorized mode is represented as a network of roadway, bike trails, and major walking paths.

- The model for this Needs Assessment is set up to examine travel on an average weekday in the spring over four time periods, for the year being examined. The base year is 2008. The forecast year is 2030.

FOUR STEP-MODEL

The model set is based on the traditional four-step urban transportation planning process of trip generation, trip distribution, mode choice, and trip assignment. This process is used to estimate the daily transit ridership and highway traffic volumes, based on changes to the transportation system. The model set takes into consideration data on service frequency (i.e. how often trains and buses arrive at any given transit stop), routing, travel time and fares for all transit services. The highway network includes all of the express highways and principle arterial roadways as well as many of the minor arterial and local roadways. Results from the computer model provide us with detailed information relating to transit ridership demand. Estimates of passenger boardings on all the existing and proposed transit lines can be obtained from the model output. A schematic representation of the modeling process is shown in Figure A-2.

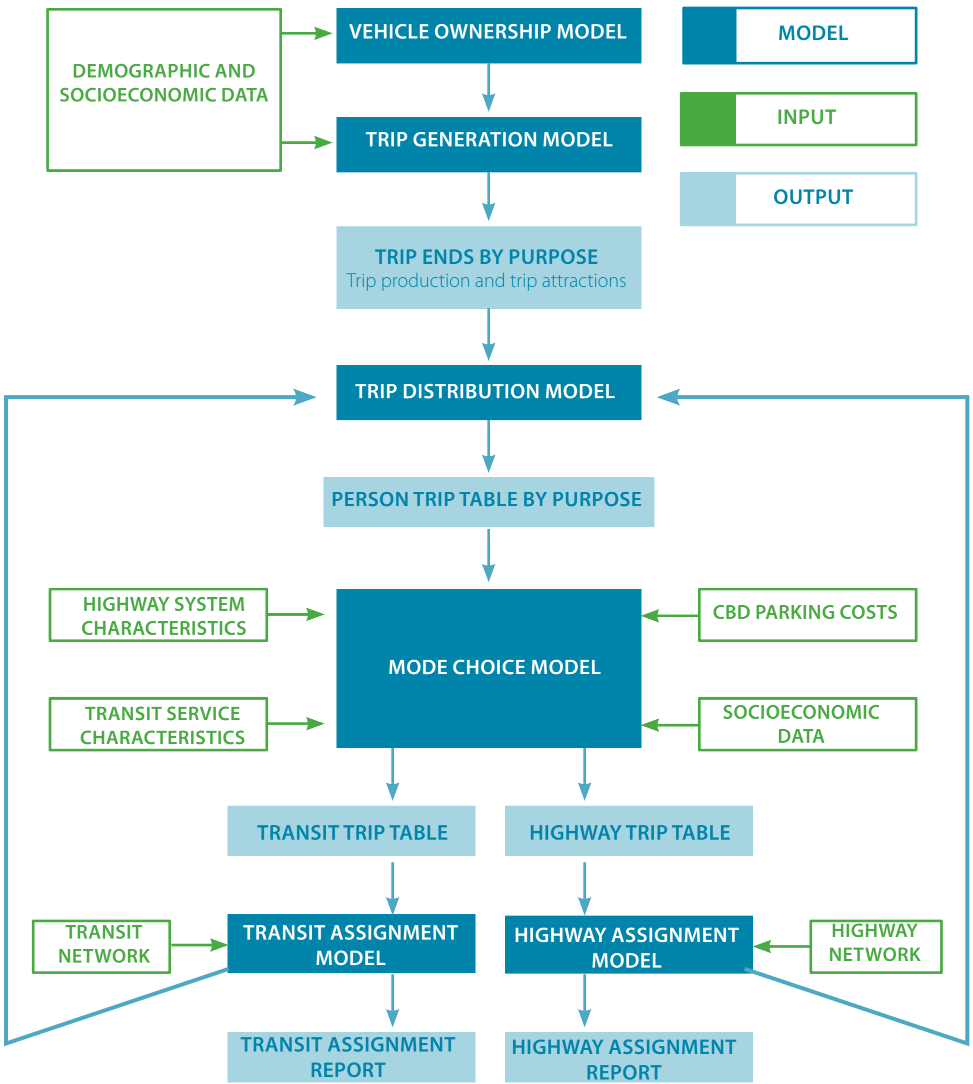
The Four-Step Model

1. Trip Generation: In the first step, the total number of trips produced by the residents in the model area is calculated using demographic and socio-economic data. Similarly, the numbers of trips attracted by different types of land use such as employment centers, schools, hospitals, shopping centers etc., are estimated using land use data and trip generation rates obtained from travel surveys. All of these calculations are performed at the TAZ level.

2. Trip Distribution: In the second step, the model determines how the trips produced and attracted would be matched throughout the region. Trips are

FIGURE A-2

Model Set Flowchart



distributed based on transit and highway travel times between TAZ and the relative attractiveness of each TAZ. The attractiveness of a TAZ is influenced by the number and type of jobs available, the size of schools, hospitals, shopping centers etc.

3. Mode choice: Once the total number of trips between all combinations of TAZ's is determined, the mode choice step of the model splits the total trips among the available modes of travel. The modes of travel are walk, auto and transit. To determine what proportions of trips each mode receives, the model takes into account the travel times, number of transfers required, and costs associated with these options. Some of the other variables used in the mode choice are auto ownership rates, household size, and income.

4. Assignment: After estimating the number of trips by mode for all possible TAZ combinations, the model assigns them to their respective transportation networks. Reports showing the transit and highway usage can be produced as well as the impact of these modes on regional air quality.

MODEL APPLICATION

Once the calibration is complete, the model for the final Paths to a Sustainable Region will be run for the forecast year, 2035, using future year inputs such as projected population and employment by TAZ, in addition to transportation system characteristics.

Ridership forecasts are first developed for a no-build forecast year that assumes no improvements in the corridor. Then the transportation network is updated to reflect the project improvements and the model is re-run for the various build options. The outputs of these model runs can then be compared to the no-build to see what changes in travel patterns occur to the transportation system.

MODEL OUTPUTS

The travel model can produce several important statistics related to the region's transportation system. Some of these are listed below.

- Average daily transit ridership by transit sub modes
- Average weekday station boardings by mode of access
- Average mode split by geographic region
- Average trip length for transit and auto trips
- User benefits (travel time savings) associated with different market segments
- Total vehicle miles and vehicle hours of travel, made by all vehicles on a typical weekday in the model area and by subregion.
- Average speed of traffic in the region
- Daily traffic volumes on major freeways, expressways and arterials

- Volume to capacity ratios on major freeways, expressways and arterials
- Amount of air pollution produced by the automobile traffic, locomotives and buses

As noted in Step 1 of the Four-Step Modeling process, existing and proposed socioeconomic information (population and employment data) and the existing and proposed transportation network are important factors in developing this needs assessment. When completed, the adopted LRTP – Paths to a Sustainable Region will include a base year of 2009 using 2009 socioeconomic data and the 2009 transportation network. The future horizon year of the LRTP will be 2035. Both the socioeconomic projections and the future transportation network will be for the year 2035.

However, when this needs assessment was started, the 2009 base travel-demand model network was not completed, therefore the existing 2008 travel-demand model network was used. The 2008 network was used in the development of the JOURNEY TO 2030 Amendment adopted in September 2009. In addition, the transportation network uses information on conditions prior to the spike in gas prices. On the other hand, 2009 socioeconomic data was available. Therefore, throughout the Needs Assessment corridor chapters, information for existing conditions in the land use section will include 2009 socioeconomic data, while existing conditions for travel will be for 2008.

Again, for future No-Build conditions in this needs assessment, 2035 socioeconomic projections were not available at the onset of this analysis. The MPO allowed the assessment to go forward using the 2030 No-Build population and employment projections and transportation network. Again, the 2030 network was used in the development of the JOURNEY TO 2030 Amendment adopted in September 2009. The 2035 population and employment projections were available near the completion of the needs assessment so this information has been included in the Land Use section. Once the 2009 and 2035 networks are completed and results are available from the travel-demand model, information in this needs assessment will be reviewed to determine if any outcomes have changed.