

## IV. DEMAND MODELING FOR THE PORTWAY EXTENSIONS ANALYSIS

A key component in the development and evaluation of the Portway Extensions improvement concepts was the creation of a modeling tool that is comprehensive yet flexible enough to allow quantified assessment of various physical and operational scenarios on a regional planning level. This section details the travel demand model development and application efforts that were performed to forecast and evaluate the transportation and mobility implications of the various Portway Extensions alternatives.

The basic starting point for the Portway Extensions modeling tool was the Portway Phase I Truck Model. This model was adapted from the NJDOT Statewide Truck Tool by URS Corporation to support the analyses performed for the Portway Phase I Feasibility Assessment. The Portway Phase I Model highway network and trip table files, along with the trip assignment control files for the Year 2000 Base and Year 2025 Build conditions were obtained from NJDOT for application to this study.

For the Portway Extensions analysis, the Portway Phase I Model was enhanced in the following manner:

- Additional zone and network details were added in areas adjacent to the Portway Phase I study area;
- Integrated the North Jersey Regional Transportation Model (NJRTM) with the Portway Model to allow for peak period and peak hour analyses;
- Integrated Reebie Associates TRANSEARCH base year commodity flow data with the Portway Phase I Model to allow for the separate analysis of commodity, and non-commodity truck trips;
- Integrated marine terminal and rail terminal container estimates and forecasts with the model to allow for the separate analysis of container and other commodity truck shipments;
- Integrated Port Authority studies of origin/destination patterns for international containers (PIDN);
- Recalibrated the base year estimates from the enhanced model system based on existing available and new traffic counts;
- Applied the enhanced model system to the 2025 forecast year; and
- Interpolated 2010 base trip tables from the enhanced model system's base year and 2025 forecast year trip tables.

These datasets are described in detail in Sections V, VI and VII of this report.

Section IV.1 describes the network and zone detailing that was performed for the Portway Extensions effort. Section IV.2 summarizes the integration of the different data sources into the original Portway Model. Section IV.3 summarizes the model recalibration effort.

## **IV.1 NETWORK AND ZONE ENHANCEMENT**

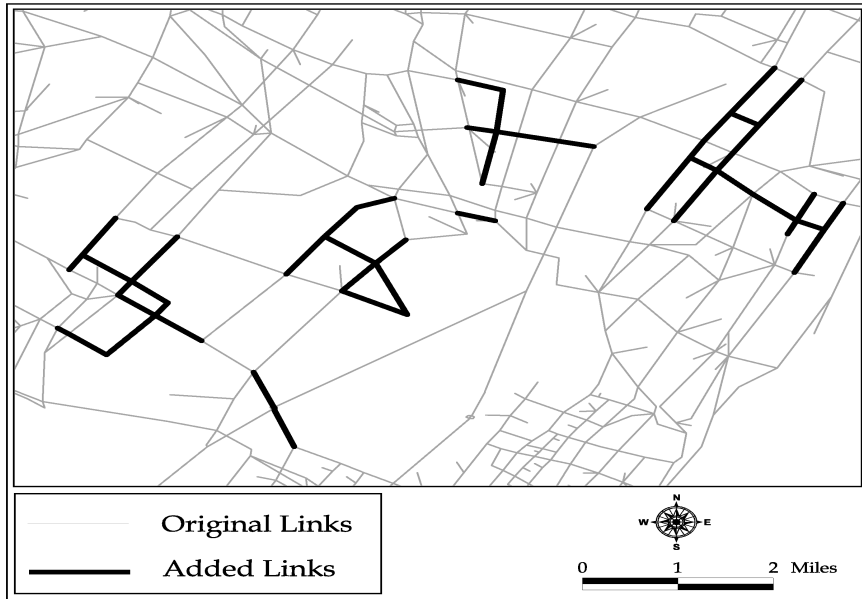
The Portway Phase I Model is basically a modified version of the NJDOT Statewide Truck Model. Compared to the Statewide Model, the Portway Model includes enhanced zone and network detail in the Portway Phase I study area. This additional detail was used to support more detailed analyses of the Phase I alternatives.

The Portway Model covers the entire state of New Jersey, and includes 2,954 total zones. For the Portway Extensions modeling effort, the area of coverage was extended with enhanced network detail to areas adjacent to the Portway Phase I study area. As shown in Figures IV.1 through IV.3, the area of enhanced network detail was expanded to the east to cover the Bayonne Peninsula (Figure IV.1), to the north to the George Washington Bridge and west into East Rutherford (Figure IV.2), and to the south to the area around Exit 12 of the New Jersey Turnpike (Figure IV.3).

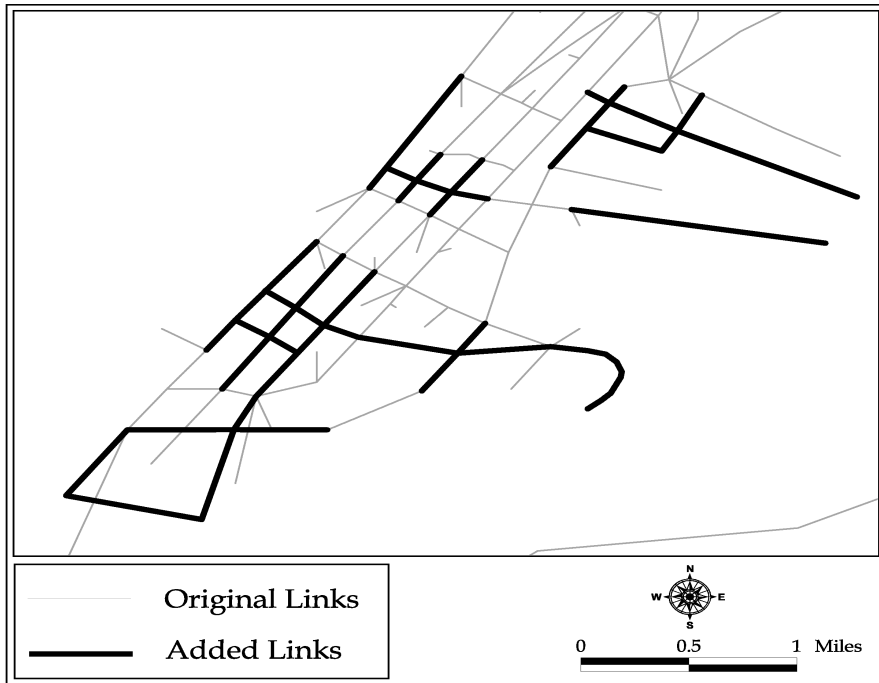
The highway network attributes for the new links, such as capacities and free flow speeds, were developed by referencing similar adjacent roadways that are represented in the Portway Model. Link distances were calculated from GIS coverage of the area.

In adding the network detail, it was necessary to split five Portway model zones into two smaller traffic analysis zones each. The zone splitting allowed for better loading of the highway network, particularly for the new links. Three of the five new zones are located in Hudson County. The other two are in Bergen County adjacent to the Portway Phase I study area. With the additional zones, the Portway Extensions Model has 2,959 zones.

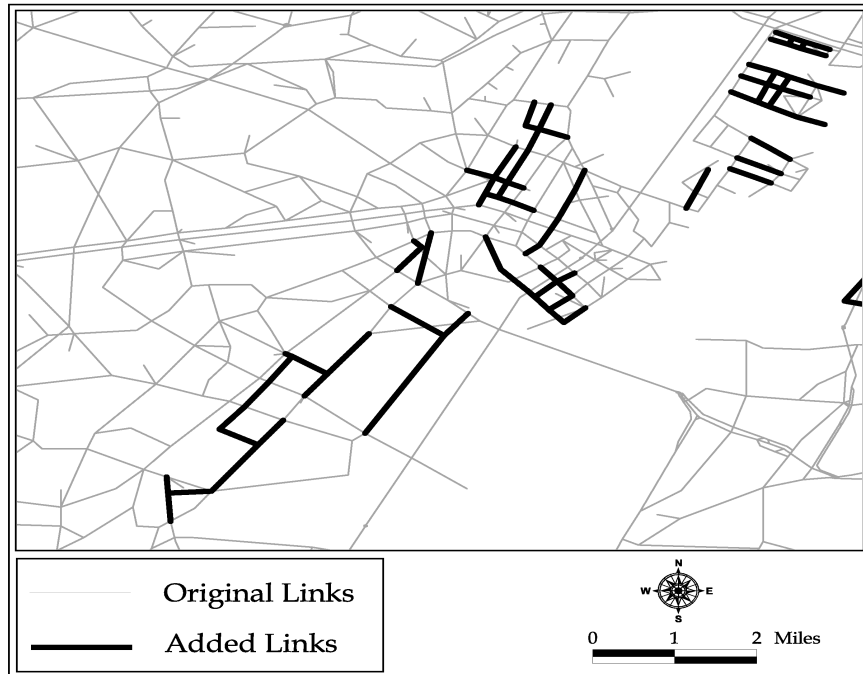
**Figure IV.1**  
**Network Enhancements North and West of Lincoln Tunnel**



**Figure IV.2**  
**Network Enhancements On the Bayonne Peninsula**



**Figure IV.3**  
**Network Enhancements South of the Portway Phase I Study Area**



## IV.2 INTEGRATION OF EXISTING MODELING TOOLS

The Portway Extensions Model was developed by integrating a number of data sources into the refined Portway Phase I modeling tool.

### *Portway Phase I Model<sup>1</sup>*

As described above, the Portway Phase I Model served as the base tool for development of the Portway Extensions Model. Once the network enhancements were implemented, improvements to the analytical capabilities of the model that were deemed to be important for the Portway Extensions analyses were implemented.

---

<sup>1</sup> The Portway Phase I Model development is described in the URS Corporation's "Technical Report - Portway Phase I Model Support Project," July 10, 2002, and in a letter from Tushar K. Patel, P.E., URS Senior Project Manager, to Scott Parker, August 16, 2002.

The Portway Phase I model includes daily trip tables for three vehicle classes, autos, medium trucks, and heavy trucks. To facilitate analysis of Portway Extensions alternatives, the model was enhanced to:

- Analyze peak period and peak hour travel; and
- Analyze different types of heavy truck traffic separately from each other.

### ***Development of Time-of-Day-Specific Analysis Capabilities***

To allow for the evaluation of alternatives based on peak hour travel conditions, we incorporated features of the North Jersey Regional Travel Model (NJRTM) into the Portway Model. Like the Portway Model, the NJRTM includes three vehicle classifications: auto, medium truck, and heavy truck. However, the NJRTM analyzes daily travel patterns by examining three travel periods, a two-hour a.m. peak period, a two-and-a-half-hour p.m. peak period, and an off-peak period.

To develop a similar time-of-day component for the Portway Model, we first developed the geographic zone correspondences between the Portway Model and the NJRTM. Since the Portway Model is a statewide model system, this correspondence was only partial. Next, time-of-day factors from the NJRTM were calculated. Where corresponding zone pairs existed, the NJRTM time-of-day factors by vehicle type were applied to the Portway daily trips. For origin-destination pairs in the Portway Model for which there was no corresponding NJRTM origin-destination pairs, representative time-of-day factors were applied. For trips with one end within the NJRTM region and one end outside, the time-of-day factors for trips between the corresponding NJRTM internal zone and the most relevant NJRTM external station were applied. For trip interchanges in the Portway Model that would not entail any travel in the NJRTM model area, the overall region wide average a.m. peak period and p.m. peak period time-of-day factors were applied.

The results of this model integration task were time period specific Portway Model trip tables by the three vehicle classes. These trip tables were used in subsequent initial analyses. During model calibration, some of the time-of-day factors were adjusted to better represent hourly vehicle class specific traffic counts.

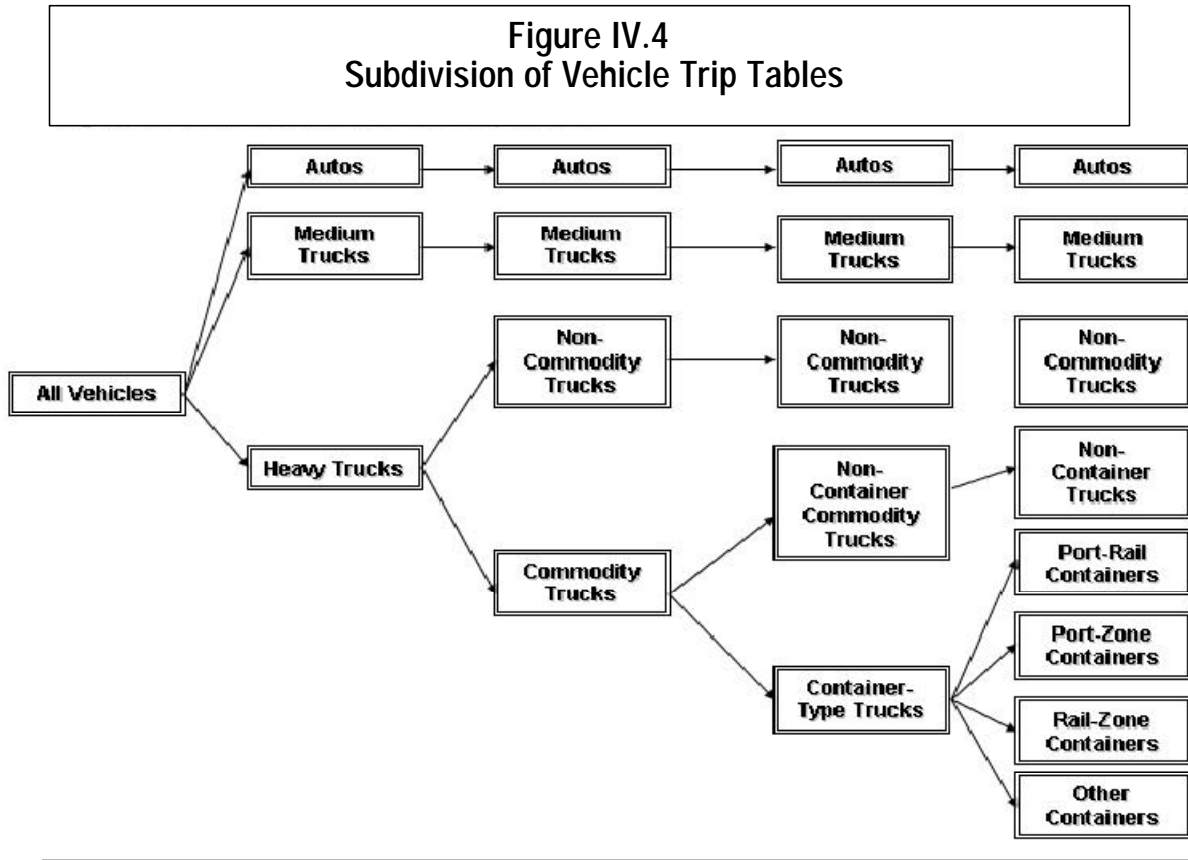
### ***Development of Detailed Truck Type Analysis Capabilities***

Since the Portway Extensions alternatives are aimed at specifically addressing issues related to the movement of containers, the Portway Model's use of a single vehicle class for heavy trucks makes it more difficult to make accurate conclusions about the efficacy

of some of the alternatives. The Portway Model was enhanced by integrating estimates of truck travel by more detailed classifications from other data sources.

Figure IV.4 shows the classification process used to obtain more detailed truck estimates. The Portway Model performs the initial division of total travel into autos, medium trucks, and heavy trucks. The process of further classifying the heavy trucks utilized the Reebie Commodity Flow database to divide truck trips into commodity truck trips and non-commodity truck trips. The Reebie data were further applied to classify commodity truck trips into container-type truck trips and non-container truck trips. Finally, available data received from the Port Authority was utilized to segment container-type truck trips into four categories:

- Container moves from New Jersey/New York ports to facilities in the region;
- Container moves from New Jersey/New York ports to intermodal rail facilities in the region;
- Container moves from intermodal rail facilities to facilities in the region;
- Other container-related movements.



***Integration of Commodity Flow Estimates***

The first step in segmenting the Portway truck trip estimates was to integrate data on commodity flows into the model. The primary source of commodity flow data was Reebie Associates’ 2002 TRANSEARCH domestic database. For most commodities, Reebie Associates provided estimates of commodity specific flows between the following geographic areas:

- Hudson County
- Bergen County
- Essex County
- Union County
- Remainder of NJTPA Region
- SJTPO Region
- DVRPC Region

- New York City
- Remainder of Long Island
- Westchester, Fairfield, and New Haven Counties
- Remainder of New England and New York State
- Pennsylvania Portion of BEA 12
- BEA 11
- Remainder of Pennsylvania
- Maryland portion of BEA 13
- Census Region 3 (East North Central)
- Census Region 4 (West North Central)
- Census Region 5 (South Atlantic)
- Census Region 6 (East South Central)
- Census Region 7 (West South Central)
- Census Region 8 (Mountain)
- Census Region 9 (Pacific)

For trips with both trip ends within the four county area of Hudson, Bergen, Essex, and Union counties, Reebie Associates provided additional geographic detail for shipments in the warehouse and distribution center commodity code and in the rail/truck intermodal drayage code. Data for these shipments were provided at the zip code level.

Factors to convert annual tonnage into annual trucks were developed from the Vehicle Inventory and Usage Survey (VIUS) conducted by the U.S. Bureau of the Census. This database provides detailed information on the physical and operational characteristics of the U.S. truck population, based on a mail survey of approximately 154,000 private and commercial truck companies. Individual state and national estimates are produced.

The VIUS microdata include the empty weight of the vehicle; the average loaded weight of the vehicle; expansion factors based on the miles traveled; the percentage of the miles that the vehicle's trip falls in one of five different distance-classes; the percentage of the miles the vehicle is empty; and, when full, the percentage of the miles that the vehicle is used to carry 31 distinct product classes that are closely related to the two-digit STCC commodity classes established for TRANSEARCH.



Average payloads were calculated for New Jersey based trucks by the five distance-classes established in VIUS: 1) local (less than 50-mile trips); 2) short (50 to 100-mile trips); 3) medium-short (100 to 200-mile trips); 4) medium-long (200 to 500-mile trips), and 5) long (over 500-mile trips). The payloads are calculated by distance-class, because the average payloads and truck size varied by distance-class. Shorter-distance trips tend to be dominated by single unit trucks, which carry smaller average payloads. Longer-distance trips are dominated by combination tractor-trailer trucks, which carry larger average payloads.

The weighted annual mileage for each VIUS product carried by distance-class was calculated for each record in the New Jersey VIUS database. That mileage was multiplied by the average payload for that record to obtain the weighted, annual ton-miles by product class, and by distance-class for each record. The weighted, annual ton-miles, and the weighted annual miles were summed over all records. The average payload for each commodity by distance-class was obtained by dividing average annual ton-miles by average annual miles.

After the conversion of annual tons to annual trucks, the resulting annual truck trip table is converted into a daily truck trip table. The Highway Capacity Manual<sup>2</sup> suggests that an average truck working week consists of five weekdays at full capacity and two weekend days at 44 percent of capacity. This equates to 306 truck working days per year. In addition, there are six federal holidays that are excluded from working calculations, so the annual truck trips were divided by 300 average weighted truck working days to calculate daily truck trips.

The geographic areas outside the Portway model area that are included in the Reebie Associates database were assigned to external stations in the model area, and the revised Portway Model zones were aggregated to the County and zip code levels. The estimated commodity truck trips from the Reebie data were then subtracted from the Portway heavy truck estimates, so that the heavy truck trips were classified into commodity truck trips and non-commodity truck trips. For origin-destination pairs where the commodity truck estimates were higher than the total number of truck trips, we increased the total number of heavy trucks. These incidences occurred primarily with trips that have an external trip end.

The resulting trip tables were disaggregated to the Portway Model level of detail by maintaining the distribution of heavy truck trips for both commodity and non-commodity trips.

---

<sup>2</sup> Highway Capacity Manual, Transportation Research Board, 2000.

The Reebie estimates were then used to divide the commodity trips into container-type and non-container trips. The same general process was used as for dividing the heavy truck trips into commodity and non-commodity trips, but the zip code level of detail allowed us to perform this allocation at a finer geography for trips within northern New Jersey.

The output of the integration with the Reebie commodity flow data was a set of heavy truck tables that differentiates between non-commodity truck trips, commodity non-container truck trips, and container-type truck trips.

### ***Port Truck Trips***

To allow for the analysis of specific policy alternatives that are aimed at truck trips to and from the ports and other intermodal facilities only, PIDN data provided by the Port Authority were used to further subdivide the container estimates into:

- Container moves from New Jersey/New York ports to facilities in the region;
- Container moves from New Jersey/New York ports to intermodal rail facilities in the region;
- Container moves from intermodal rail facilities to facilities in the region;
- Other container-type movements.

The Port Authority database provided base year estimates of intermodal container movements between Port Authority facilities and U.S. zip codes and between other international ports and U.S. zip codes.

The shipments from non-Port Authority facilities to New Jersey zip codes were assumed to arrive in the region at intermodal rail yards, and then to be shipped by truck to the final zip code. Thus, for these shipments, we developed a trip table of truck trips from the zones with the intermodal rail facilities to the zones corresponding to the zip codes. For zip codes with more than one zone, the trips were allocated to the zones based on the distribution of total container trips among those zones.

The shipments from Port Authority facilities were divided into truck trips and rail trips using estimates of the base year modal split for the Port Authority facilities. The numbers of containers from each Port Authority facility assigned to rail in this process were split among existing or proposed on-dock rail yards (Express Rail, Bayonne Peninsula, Howland Hook) and did not generate truck trips outside the marine terminals. The remaining Port Authority container shipments were assigned to the truck mode, and these truck trips between the port facilities and zip codes were assigned to a new trip

table. As before, for zip codes with more than one zone, trips were allocated to the zones based on the distribution of container trip ends in those zones.

The three new container truck trip tables were subtracted from the total container truck trip table, and the remaining trips were assigned to the “other container” trip table. For zone pairs where the total number of container trips from the three port-related trip tables exceeded the preliminary estimate of container trips, the total container trip estimates were increased.

The final set of four container trip tables allow for the analysis of potential policy changes at the ports and intermodal facilities, but the actual assignment of trips in the revised model is done at the five trip table level (autos, medium trucks, non-commodity heavy trucks, non-container commodity heavy trucks, and container heavy trucks) because of the multi-class assignment limitations of the demand modeling software.

### **IV.3 BASE YEAR MODEL RE-CALIBRATION**

The model enhancements affected both the Portway Model’s highway network and daily truck trip tables, and also introduced a previously unused time-of-day component to the model system. Therefore, it was necessary to calibrate the model to ensure that the base year estimates tracked well against known ground counts. Available time-of-day specific traffic count data were assembled, and an additional traffic data collection effort was performed to allow the modified model system to be calibrated. Initially, four screenlines were constructed:

- Bayonne Park (east-west screenline in Bayonne);
- Hudson River;
- North of Lincoln Tunnel (east-west screenline north of the tunnel); and
- Hackensack River.

The base year estimated travel by time-of-day crossing these screenlines was compared to the corresponding total counts for the screenlines. Adjustments to highway network parameters and time-of-day factors were then made, and the model re-run.

Once the main screenlines were within an acceptable margin of the counts, data from other specific key count locations throughout Northern New Jersey were used to further improve the model calibration. Additional counts were conducted at along a variety of key container flow corridors, with vehicle observations aggregated into light, medium, heavy non-container truck and container truck categories. The calibration process

continued until a reasonable correspondence between the observed volumes and model volumes was attained by vehicle type.

#### **IV.4 APPLICATION OF THE MODEL TO FUTURE CONDITIONS**

The enhanced Portway Model system was applied for several forecast year “no-build” scenarios, including:

- Year 2025; High Port Growth Scenario; No Port-Inland Distribution Network (PIDN) implementation;
- Year 2025; High Port Growth Scenario; With Port-Inland Distribution Network (PIDN) implementation;
- Year 2025; Low Port Growth Scenario; No Port-Inland Distribution Network (PIDN) implementation;
- Year 2025; Low Port Growth Scenario; With Port-Inland Distribution Network (PIDN) implementation;
- Year 2010; High Port Growth Scenario; No Port-Inland Distribution Network (PIDN) implementation;
- Year 2010; High Port Growth Scenario; With Port-Inland Distribution Network (PIDN) implementation;
- Year 2010; Low Port Growth Scenario; No Port-Inland Distribution Network (PIDN) implementation; and
- Year 2010; Low Port Growth Scenario; With Port-Inland Distribution Network (PIDN) implementation.

While each of these future scenarios was evaluated, key scenarios were identified for use in the development of improvement concepts. These “no-build” scenarios were used to define the range of Portway Extensions improvements to be evaluated, and served as the bases for comparison of the Portway Extensions alternatives. The development of container flow and warehouse/distribution projections for use in the modeling of future scenarios is detailed in subsequent sections of this report.