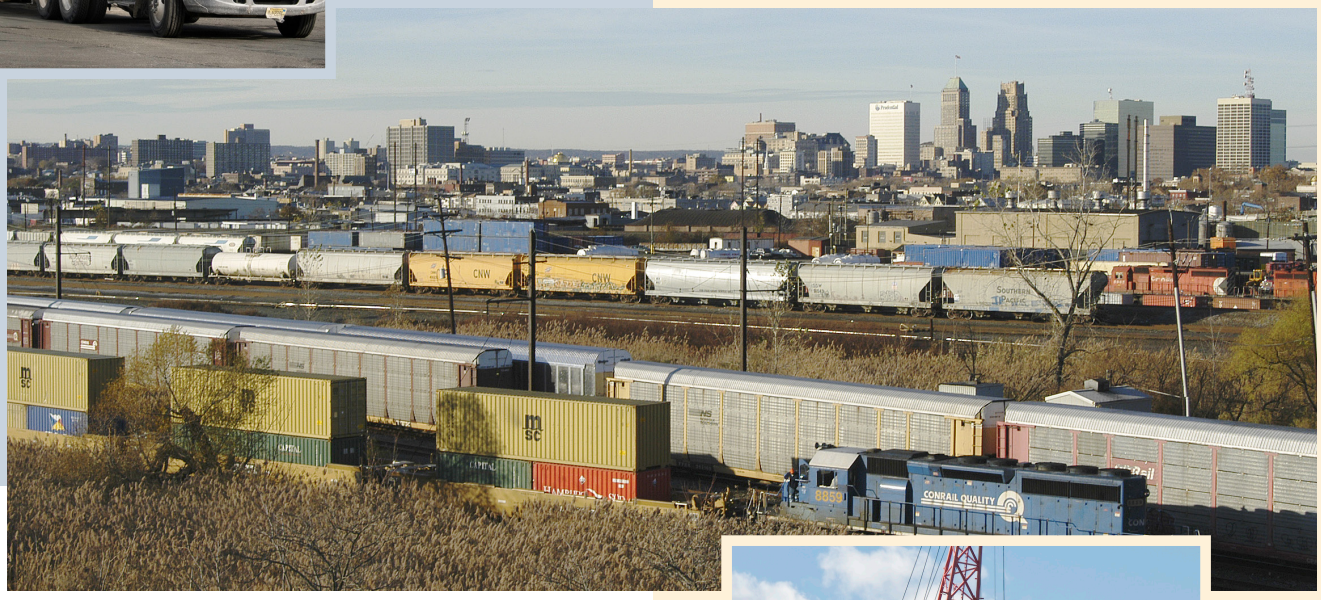
NJTPA

Final Report

2040 Freight Industry Level Forecasts



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Disclaimer

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Acronym Glossary

AADTT	Average Annual Daily Truck Traffic
CAGR	Compound Annual Growth Rate
CPI	Consumer Price Index
CS	Cambridge Systematics
FAF	Freight Analysis Framework developed by FHWA; There have been three releases of FAF: FAF1 with base year 1998 data; FAF2 with base year 2002 data; and FAF3 with base year 2007 data.
FHWA	Federal Highway Administration
FIC	Freight Initiatives Committee
FIPS	Federal Information Processing Standard
GDP	Gross Domestic Product
GIS	Geographic Information Systems
GSP	Gross State Product (used also for Garden State Parkway)
HPMS	Highway Performance Monitoring System
I-O	Input-Output
MSW	Municipal Solid Waste
NAICS	North American Industry Classification System
NEC	Not Elsewhere Classified
NJDEP	New Jersey Department of Environmental Protection
O/D	Origin/Destination
PANYNJ	Port Authority of New York and New Jersey
R/ECON	Rutgers Econometric Model
RRF	Resource Recovery Facility
RTAC	Regional Transportation Advisory Committee
RTM-E	Regional Transportation Model-Enhanced
SIC	Standard Industry Classification
TAZ	Traffic Analysis Zone
VIUS	Vehicle Inventory and Use Survey
WDC	Warehouse/Distribution Center

1.0 Introduction

1.1 IMPORTANCE OF FREIGHT MOVEMENT

Working with freight movement data can be a challenging experience, even for skilled planners. The data comes in many different forms, from many different sources. These sources are often inconsistent with each other, and frequently inconsistent with more traditional sources of transportation data such as highway vehicle counts.

Working with freight movement forecasts is even more challenging. Freight forecasts purchased as part of commercial datasets such as TRANSEARCH arrive as black boxes, and the purchaser has no idea what industry growth factors went into the forecasts, or how to adapt the results to different forecast assumptions. For planners who want to apply and test their own industry-level forecasts, there is no clearly established methodology or path to translate industry growth into changes in activity by commodity.

These two limitations – the problem of good baseline data, and the problem of how to forecast future activity in a clear, consistent, and transparent way – are less important in parts of the U.S. with limited freight movement. However, these issues are extremely important in the North Jersey Transportation Planning Authority (NJTPA) region, which is one of the largest freight-handling regions in the country. It hosts: the Port of New York and New Jersey, one of the nation's top three ports on the basis of tonnage and number of containers handled; heavily-used local, regional, and interstate truck corridors and crossings; heavy concentrations of intermodal and carload rail activity; significant national and international air cargo facilities; and hundreds of millions of square feet of warehouse/distribution space. These networks and facilities serve as gateways to not only the NJTPA region, but also the larger New York/New Jersey metropolitan region as a whole. They are essential to the economic and transportation well-being of 6.6 million residents in the NJTPA region and 20 million in the NY/NJ metropolitan statistical area, along with more than 300,000 regional businesses.

Understanding the effects and importance of freight is therefore critical – not only to ensure the accuracy of the regional transportation planning process, but also to effectively communicate the importance of freight to the region's freight stakeholders, businesses, communities, residents, and funding decision-makers. In other words, planning information and public information are both important.

It is therefore highly desirable to closely integrate freight planning within the larger NJTPA regional planning process. To accomplish this integration in an effective manner, one which can be sustained by NJTPA staff year over year, NJTPA would benefit from:

- A validated, accurate set of baseline freight metrics, defining freight movements by origin-destination pair, volume (tons and units), transportation mode, and commodity type.
- A clear understanding of the "key drivers" of the freight industry – the locations and types of business and consumer activities that generate demand for certain commodity volumes, by mode and by trade lane.
- An excellent understanding of freight trends and how they may act upon both industries and commodity movements. One of the key drawbacks of commercial freight datasets such as TRANSEARCH is that they assume the future will look a lot like the past – that is, if 10% of a given product moving from California to Newark today does so by truck, 10% will do so in the future. Clearly there are many cases in which this will not be true, and NJTPA has to know how to adapt such "straight line" projections to better fit known and emerging futures, or to test any number of potential alternative futures and scenarios. The world continues to change and planning tools must be adaptable.
- A state-of-the-art set of industry-level forecasts, completely transparent and tailored specifically for the NJTPA region, which can be closely integrated and married to other NJTPA planning and forecasting activities, including but not limited to the 2040 Regional Transportation Plan.
- A future freight demand database, depicting both "key drivers" and network flows over NJTPA's existing highway network model, generated directly from the NJTPA's industry-level forecasts, and providing the opportunity to test the effects of different types of freight trends on the database and network model.

To address these issues, the 2040 Freight Industry Level Forecasts study was prepared under contract to NJTPA and its participating subregions, gathering input and direction from the project Technical Advisory Committee (TAC) and other public involvement forums, including NJTPA's Regional Transportation Advisory Committee (RTAC) and NJTPA's Freight Initiatives Committee (FIC). Cambridge Systematics, Inc. was the lead consultant, in association with Parsons Brinckerhoff, A. Strauss-Wieder Inc., and the Rutgers University Center for Urban Policy Research.

1.2 GOAL AND ORGANIZATION OF THE PROJECT

The primary goal of the 2040 Freight Industry Level Forecasts project is to "develop a clear, accurate and comprehensive picture of regional freight activity, both current and future." The end product is to provide "an accurate picture of where concentrations of goods movement activity can be expected to occur in the region in the future, the types of commodities that will be moving, and where strategic investments should be made."

The work plan consisted of seven primary tasks:

1. Data Review and Validation
2. Freight Driver Summary
3. Review of Trends Impacting the Movement of Goods
4. Industry Level Forecasts
5. Sub-County Disaggregation of Origin-Destination Commodity Flows and Assignment Over the Highway Network
6. Final Report (and other deliverables)
7. Project Management (including outreach)

1.3 ORGANIZATION OF THIS REPORT

The most significant findings from each of the major steps in the work process have been documented and compiled into this report, which is organized as follows:

- Section 1 – Introduction
- Section 2 – Data Collection and Validation
- Section 3 – Freight Drivers
- Section 4 – Industry-Level Forecasts
- Section 5 – Freight Factors and Trends
- Section 6 – Freight Forecasting Tool
- Appendix A – Commodity Flow Data Analysis Approach
- Appendix B – Freight Facility Location Data Validation Approach
- Appendix C – NJTPA Freight Forecasting Tool Users Guide

Other deliverables under the contract have been provided to NJTPA and the subregions separately, including:

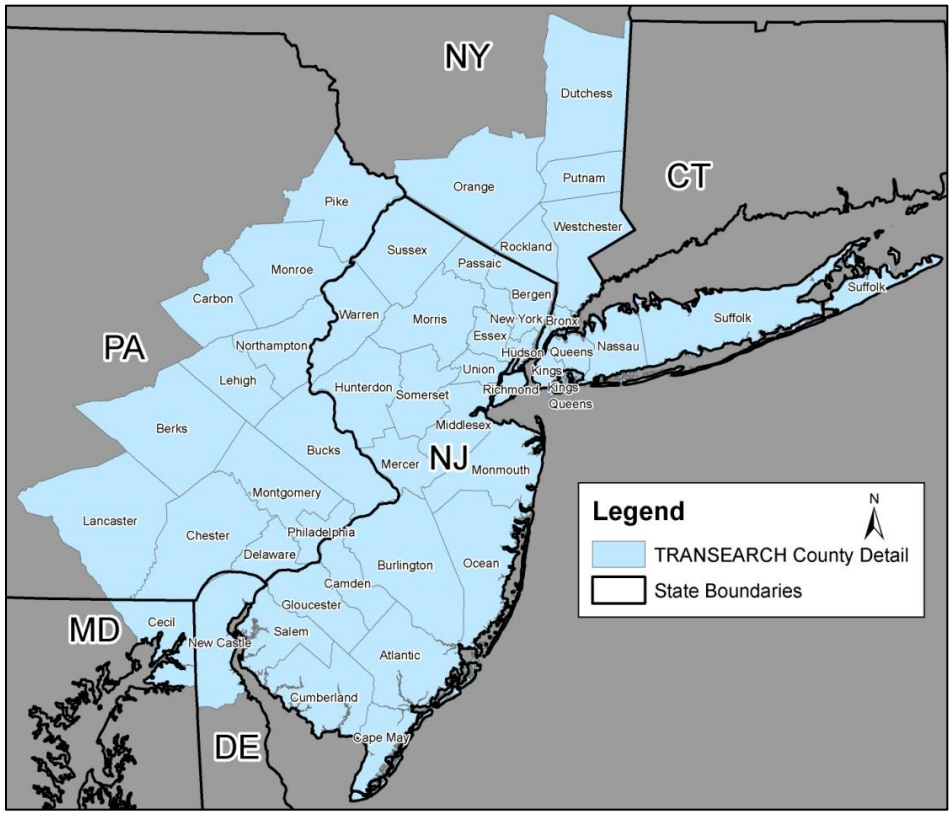
- Freight Facility Map Packages for NJTPA Subregions
- Industry Location Database with Validation Points
- Industry Location Maps
- Freight Profile Reports for NJTPA Subregions
- NJTPA Freight Forecasting Tool Spreadsheet Model

2.0 Data Collection and Validation

2.1 COMMODITY FLOW DATA

A TRANSEARCH domestic commodity flow database for New Jersey was obtained from IHS/Global Insight by North Jersey Transportation Planning Authority (NJTPA). That database is identical in structure and content to the database which was delivered to the New Jersey Department of Transportation. The database contains flows: by commodity at the four-digit Standard Transportation Commodity Code (STCC4) level, from zones which are counties in New Jersey; from portions of New York and Pennsylvania, as well as New Castle County, Delaware and Cecil County, Maryland, as shown in Figure 2.1; from the remainder of the United States as FAF2 zones, which correspond to Bureau of Economic Analysis areas; and from Canada and Mexico as single zones.

Figure 2.1 NJTPA County-Level TRANSEARCH Data Coverage Area

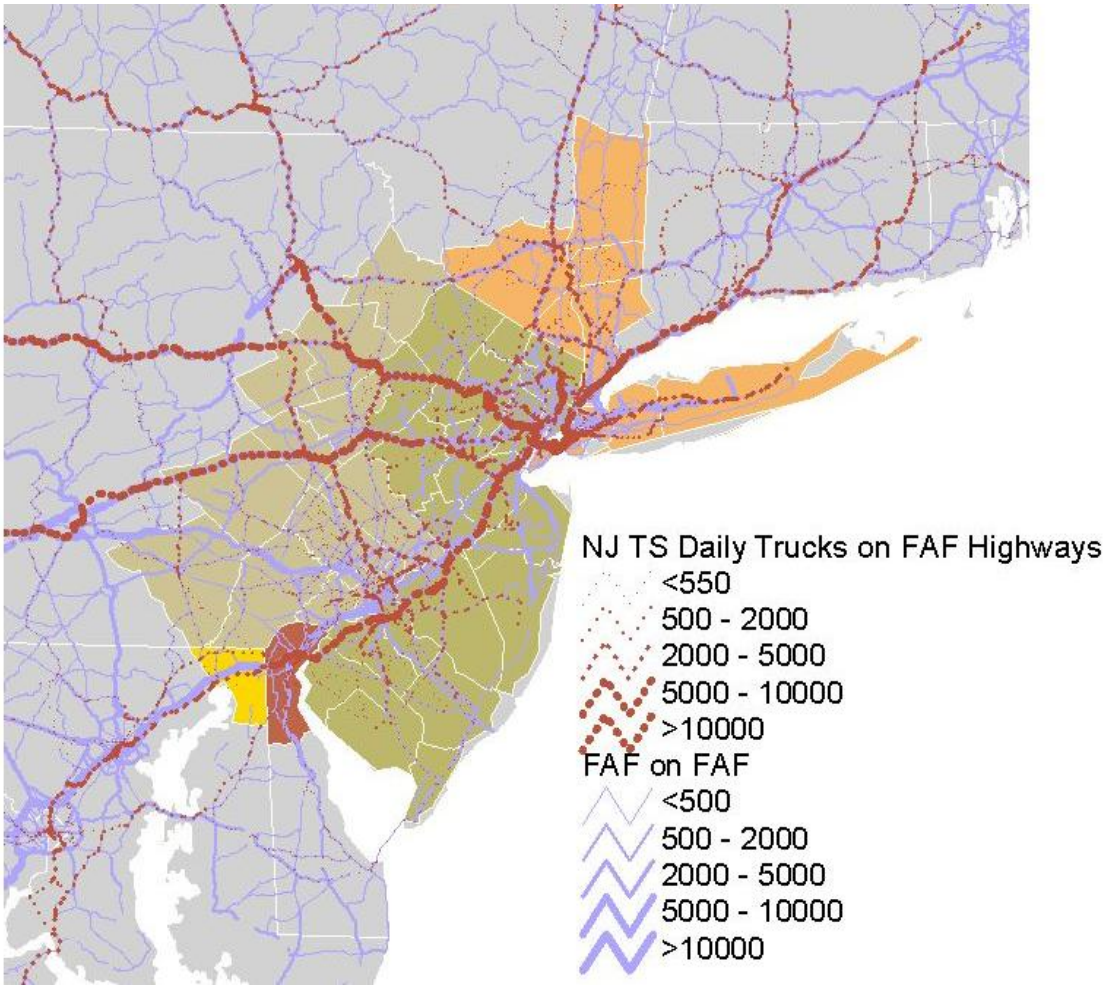


Source: Cambridge Systematics, using US Census Bureau.

TRANSEARCH contains freight flows (tonnage and value) by mode, commodity, origin and destination. As described in greater detail in Appendix A, the truck data were developed into a truck trip table, which was assigned to the FAF Highway network. The FAF Highway network consists of major highways throughout the country. The result of this assignment exercise was an illustration (shown as Figure 2.2) of the primary highway corridors and gateways that freight moving into, out of, and through the region use.

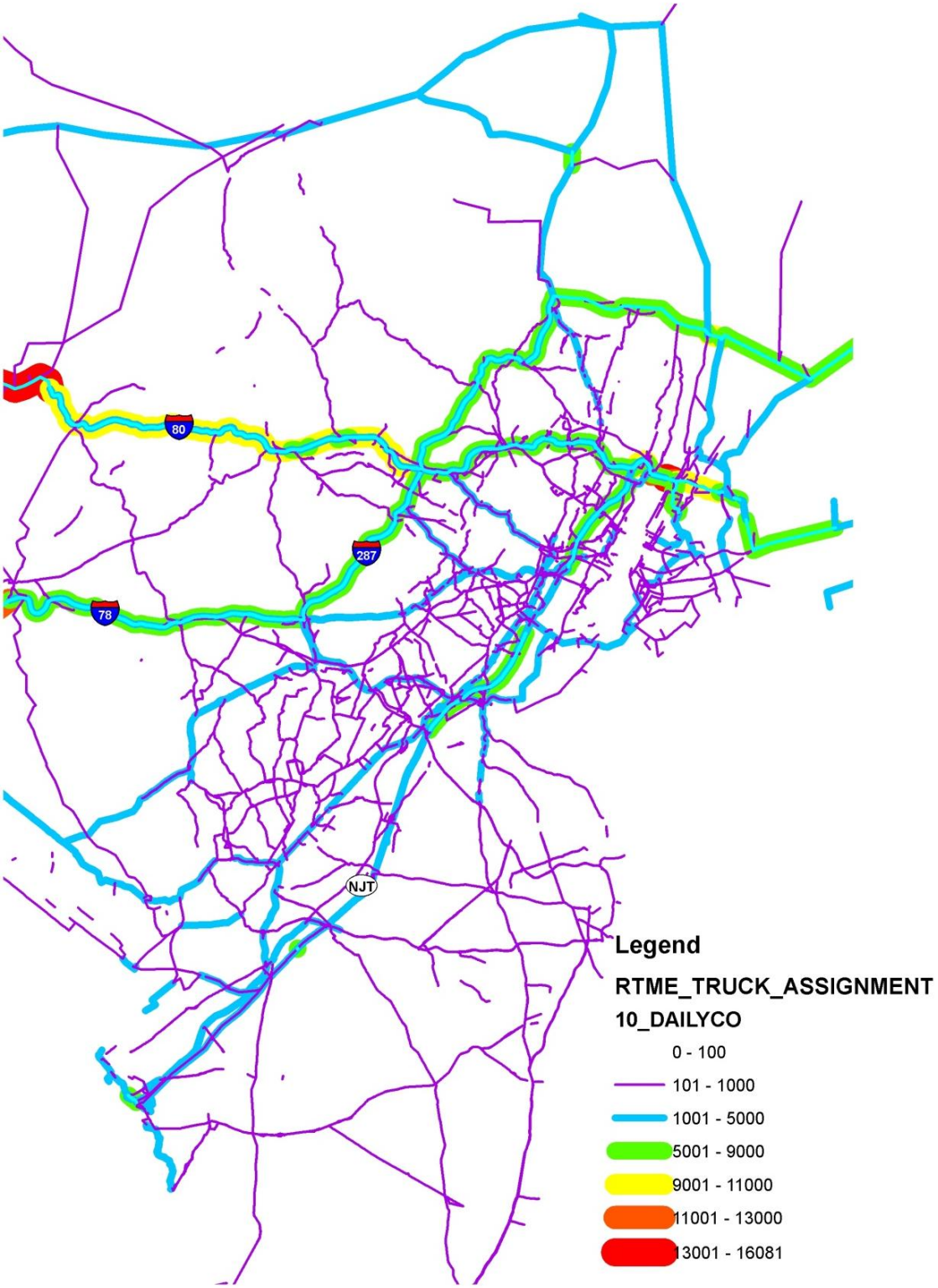
The FAF Highway network assignment was then used as a basis for an assignment of truck trips to the NJTPA's Regional Transportation Model-Enhanced (RTM-E) network, which consists of Interstate, state and county highways and many of the major local roads throughout the NJTPA Region. The RTM-E also disaggregates trips to Traffic Analysis Zones (TAZ), which are sub-county-level trip production and attraction zones. This provides the capability to perform sub-county level network analysis. The result of the RTM-E assignment is illustrated in Figure 2.3.

Figure 2.2 TRANSEARCH Assignment to FAF-3 Network



Source: Cambridge Systematics, using USDOT FAF 3.2.

Figure 2.3 TRANSEARCH Assignment to RTM-E Network



Source: Cambridge Systematics, using NJTPA's RTM-E Network.

2.2 FREIGHT FACILITY AND LAND USE DATA

Facility and Land Use Data Sources Acquired

The team acquired freight facility data from three separate sources: the Selectory database from Dun & Bradstreet, the Freight Locator database from IHS Global Insight, and the Torto Wheaton database from CB Richard Ellis. Each of these databases provide information on different types of facilities that are, or could potentially be, generating freight. An introduction to the contents of each database reveals the strengths and the value each brings to this project.

Dun and Bradstreet Selectory Database

The Dun and Bradstreet database provides information regarding business activity by location. It is produced and maintained through business surveys and interviews used to collect, verify, and update the information contained therein. The information procured and downloaded by NJTPA is from the 2010 edition of the database, and contains business attribute data for more than 360,000 businesses across the state of New Jersey, 336,000 of which are in the 13-county NJTPA region. The database's 137 fields are filled with business location address, management, industry classification, sales volume, size, and employment over time. For the purpose of understanding which businesses generate freight, how much freight (to the degree possible) and of what commodities, the fields of most value are listed in Table 2.1. The North American Industry Classification System (NAICS) codes for freight-intensive industries are described in Table 2.2.

Table 2.1 Selection of Selectory Database Fields

Field	*Description*
Company	Name of Company
Employment This Site	Number of Employees at this location
Primary NAICS	Primary North American Industry Classification System (NAICS) code
Plant/Facility Size	Size of facility in square feet
Latitude	Latitude in degrees, used for geocoding
Longitude	Longitude in degrees, used for geocoding

Source: Dun and Bradstreet, 2010.

Table 2.2 Definitions for Freight-Intensive NAICS Categories

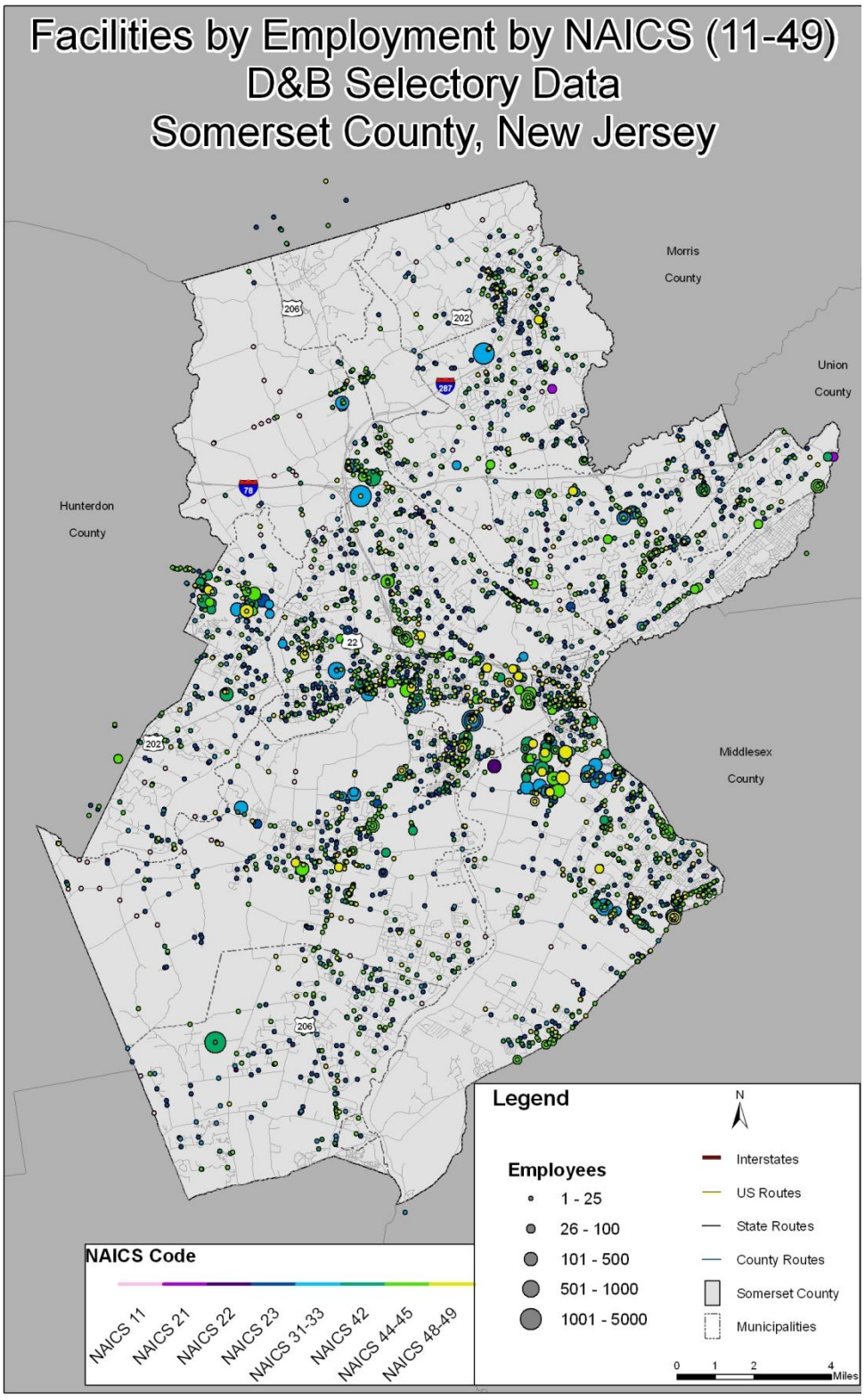
NAICS Code	Description
11	Agriculture, Forestry, Fishing and Hunting
21	Mining, Quarrying, and Oil and Gas Extraction
22	Utilities
23	Construction
31-33	Manufacturing
42	Wholesale Trade
44-45	Retail Trade
48-49	Transportation and Warehousing
51	Information
52	Finance and Insurance
53	Real Estate and Rental and Leasing
54	Professional, Scientific, and Technical Services
55	Management of Companies and Enterprises
56	Administrative and Support and Waste Management and Remediation Services
61	Educational Services
62	Health Care and Social Assistance
71	Arts, Entertainment, and Recreation
72	Accommodation and Food Services
81	Other Services (except Public Administration)
92	Public Administration

Source: US Census Bureau.

The value of the Selectory database is its comprehensive coverage of business locations in all industries throughout the region. The industry classification detail allows the team to gauge the number of businesses and number of employees engaged in freight-generating industries such as retail, manufacturing, construction, wholesale trade, and transportation. The team used this database to isolate businesses in freight-generating industries and to confirm or improve our understanding of the locations, and level of activity at those locations.

For analysis and display purposes, the Selectory data were mapped at the county level. A symbology that illustrates the number of employees by NAICS code was selected, as that would show the approximate size and level of activity by industry in each of the NJTPA subregions. Due to the large number of data points, mapping the Selectory database at the regional level was not performed. Figure 2.4 following shows the selected symbology applied to data points in Somerset County. The size of the circles corresponds to the number of employees at each business location, while the color corresponds to the industry classification. NAICS 11-49 are shown, as they represent freight-intensive industries.

Figure 2.4 Selectory Data for Somerset County, Geocoded



Source: Cambridge Systematics, using Dun and Bradstreet, 2010.

IHS Global Insight Freight Locator Database

Freight Locator, a database product from IHS Global Insight, contains information on known or potential freight-generating business locations, including industry type, sales, and estimated tonnage of freight by commodity type. Global Insight develops and maintains the database through interviews and surveys, and estimates inbound and outbound tonnage by commodity based upon the industry type and volume of sales. The Freight Locator database used for this study contains data collected in 2007 and includes more than 18,600 business locations in New Jersey, downstate New York, eastern Pennsylvania, northern Delaware, and northeastern Maryland. About 6,700 of the business locations are in New Jersey. The database contains 49 fields with information on business location and contact information, employment and sales, and inbound/outbound flows of freight by tonnage by commodity. The fields of greatest importance in this study are listed below in Table 2.3.

Table 2.3 Selection of Freight Locator Database Fields

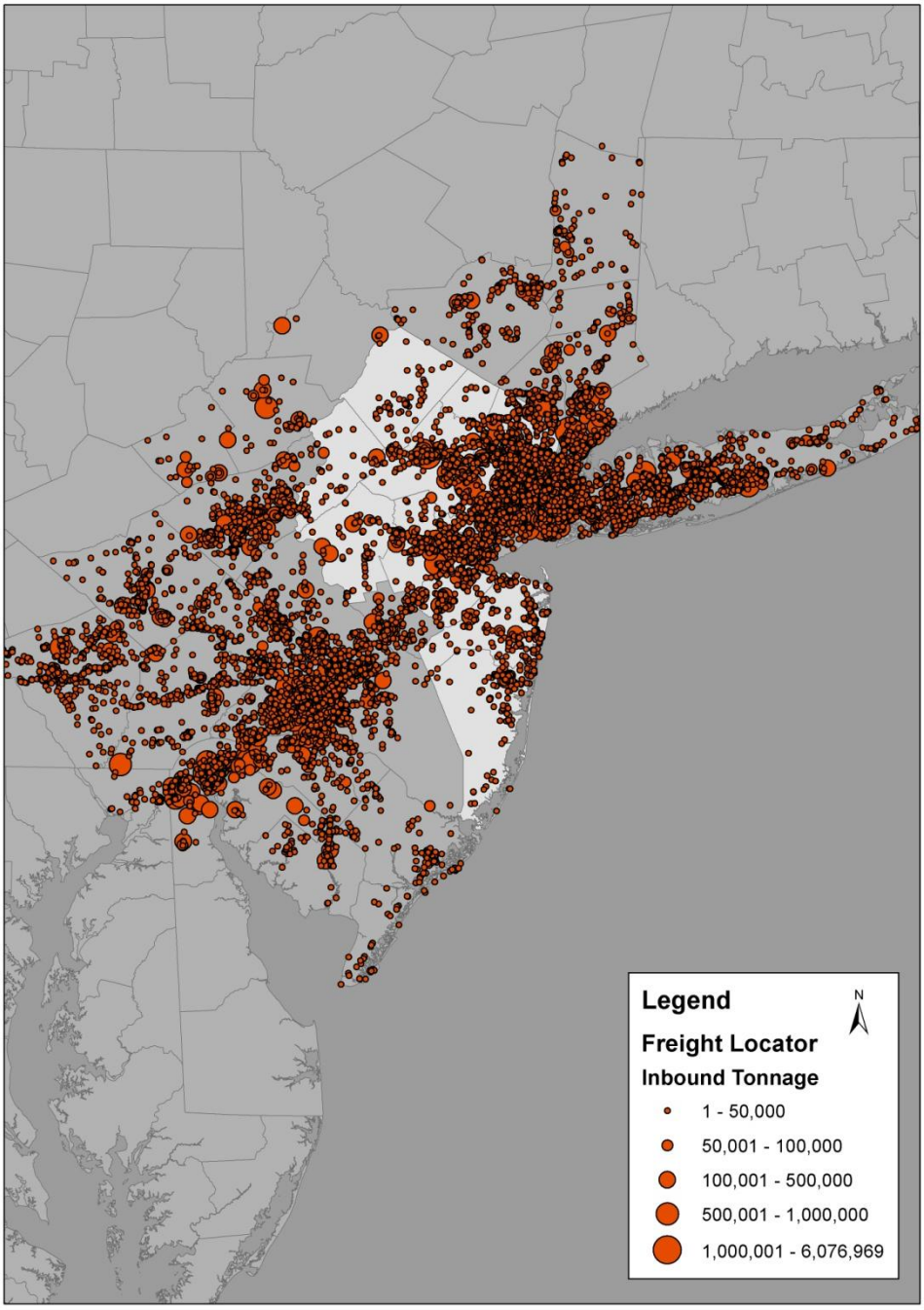
Field Name	*Description*
RECID	Unique identifier
COMPANY_NAME	Name of Company
LATITUDE	Latitude in degrees (used for geocoding)
LONGITUDE	Longitude in degrees (used for geocoding)
PRIMARY_SIC_CODE	Primary Standard Industry Classification (SIC) code
INBOUND_STCC_1	Standard Transportation Commodity Code (STCC) for primary inbound commodity
INBOUND_TONS_1	Number of tons (annual) for primary inbound commodity
OUTBOUND_STCC_1	Standard Transportation Commodity Code (STCC) for primary outbound commodity
OUTBOUND_TONS_1	Number of tons (annual) for primary outbound commodity
TOTAL_INBOUND_TONS	Total inbound tons among all commodities
TOTAL_OUTBOUND_TONS	Total outbound tons among all commodities

Source: IHS Global Insight, 2007.

While the Freight Locator database contains records on far fewer businesses than the Selectory database, the inclusion of estimated commodity flows associated with each business adds a valuable dimension to the team's understanding of freight-generating business locations.

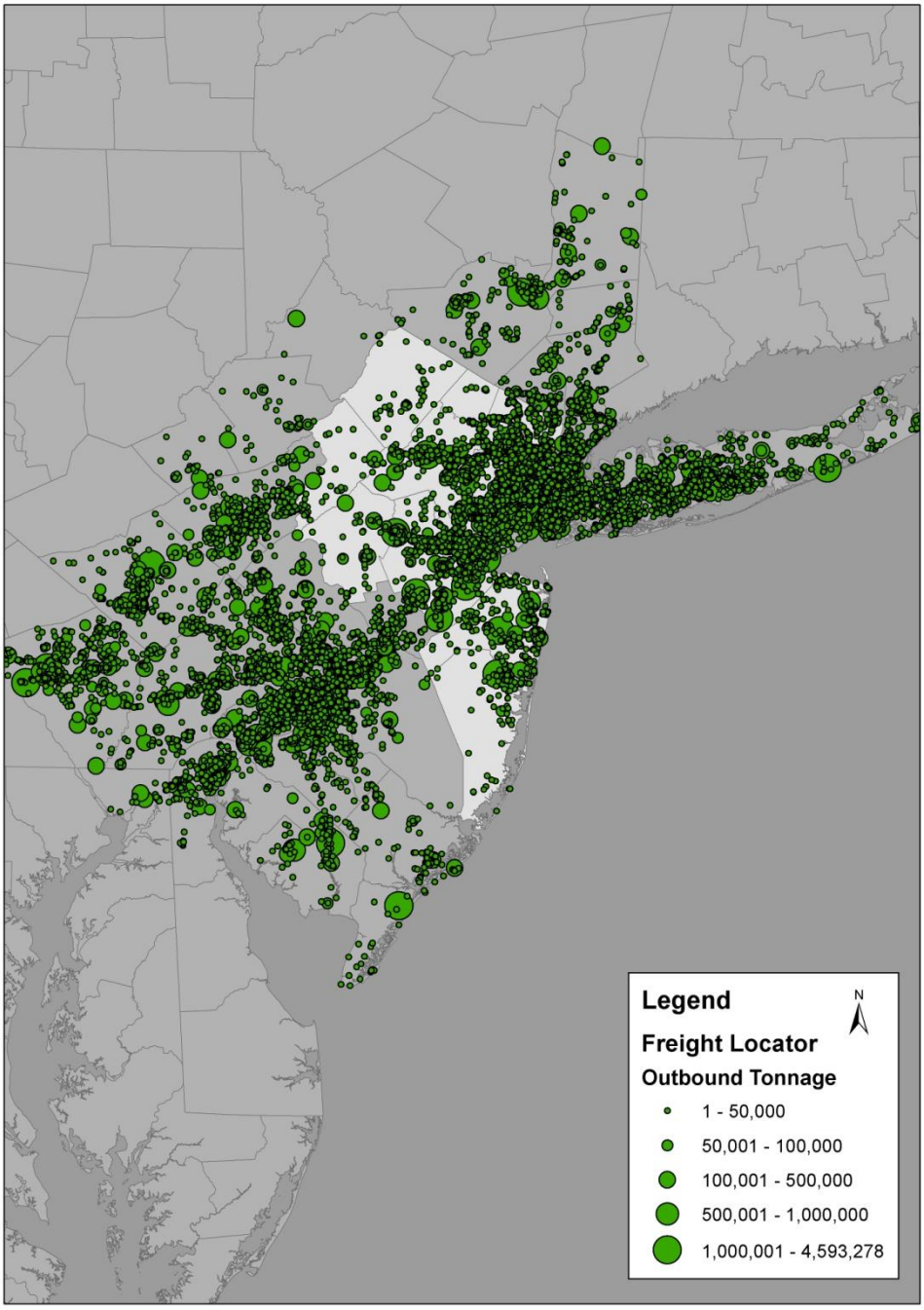
The Freight Locator database was geocoded and mapped, first at the regional level, then for each of the subregions individually. The symbology used for analysis illustrates business locations by inbound and outbound tonnage. In Figures 2.5 and 2.6 below, the size of each circle corresponds to the estimated number of tons that were moved inbound or outbound, respectively, in 2007.

Figure 2.5 Facilities by Inbound Tonnage, 2007



Source: Cambridge Systematics, using IHS Global Insight, 2007.

Figure 2.6 Facilities by Outbound Tonnage, 2007



Source: Cambridge Systematics, using IHS Global Insight, 2007.

CB Richard Ellis Torto Wheaton Industrial Real Estate Database and Forecast

To acquire an understanding of where clusters of freight-generating manufacturing, warehousing and distribution activities are located and where clusters are likely to form, expand, or contract over the next three decades, the team purchased an industrial building stock database and industrial real estate forecast from industrial developer, CB Richard Ellis. The database is updated quarterly, and was purchased in November 2010, with Quarter 3, 2010 data being the most recent available. Forecasts through 2016 were extrapolated from that point. The Torto Wheaton database includes attribute data for manufacturing and warehouse/distribution center buildings, including name and address, building type (manufacturing or warehousing/distribution), and range of size in square feet.

Although Torto Wheaton offers square footage detail for each location, the cost was deemed prohibitive and unnecessary for the purpose of this project. Instead, the data were acquired in three aggregated size ranges—0-499,999 square feet, 500,000-999,999 square feet, and 1,000,000 square feet or more. These ranges provide enough detail to determine whether facilities are supporting local manufacturing and distribution or serving as regional, national or North American distribution centers.

The complete list of fields present in the Torto Wheaton database is provided in Table 2.4 below.

Table 2.4 Torto Wheaton Database Fields

Field	Description
id	Unique ID number
Name	Combination of all or any of the following: business name, building number, street address, street name
Market	Regional market (corresponds to metropolitan statistical areas)
lat	Latitude in degrees (used for geocoding)
long	Longitude in degrees (used for geocoding)
size_code	Code related to size of facility. 1MM Over = over 1,000,000 square feet, 500-1MM = 500,000-1,000,000 square feet, u500= under 500,000 square feet
type	Manufacturing ("manuf") or warehousing/distribution ("WDC")

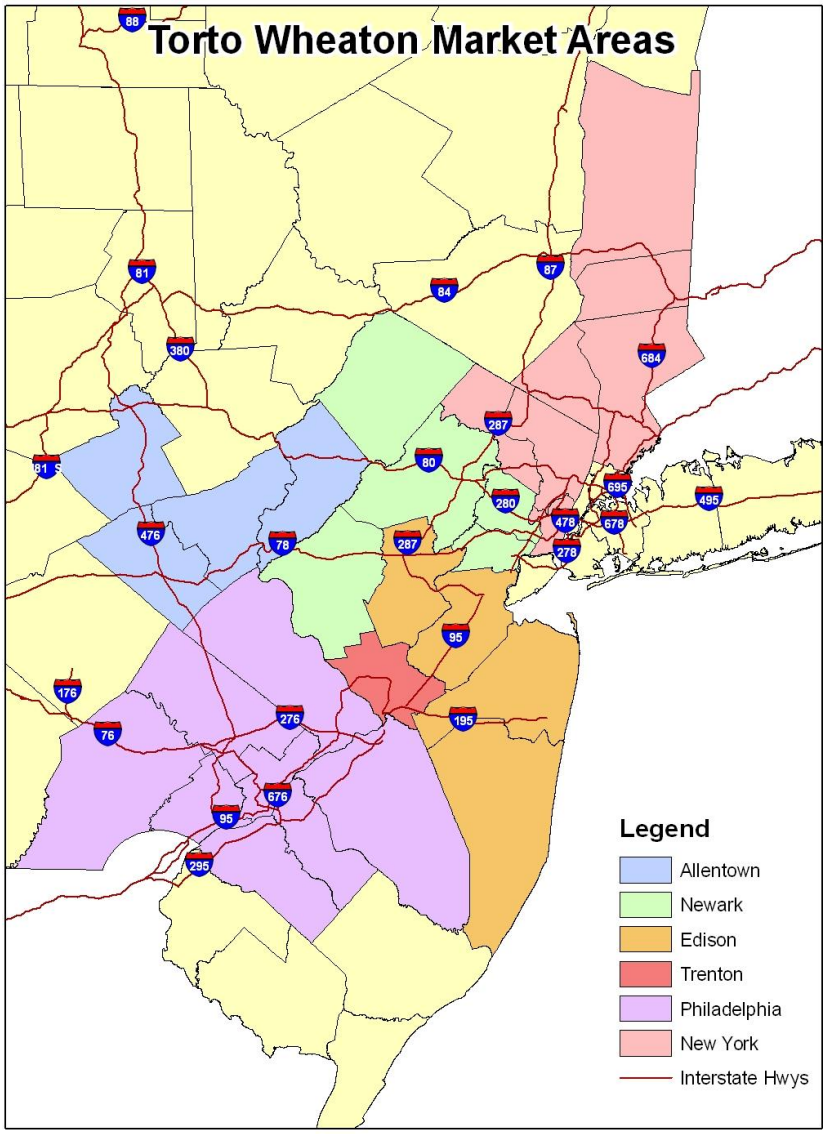
Source: CB Richard Ellis, Quarter 3, 2010.

The team acquired data for six regional market areas. These markets, illustrated in Figure 2.7 following, include:

- "Newark" (Essex, Union, Morris, Sussex, and Hunterdon counties);
- "New York" (Bergen and Passaic counties in New Jersey; Rockland, Westchester, Putnam, and Dutchess counties in New York);

- "Edison" (Middlesex, Somerset, Monmouth, and Ocean counties);
- "Trenton" (Mercer County);
- "Philadelphia" (Burlington, Camden, and Gloucester counties in New Jersey; Philadelphia, Chester, Delaware, Montgomery, and Bucks counties in Pennsylvania); and
- "Allentown" (Warren County in New Jersey and Lehigh, Northampton, and Carbon counties in Pennsylvania).

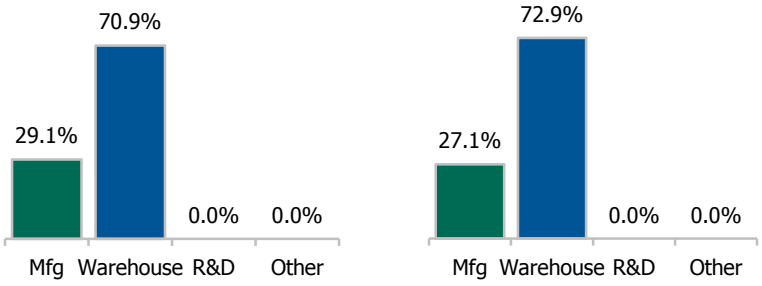
Figure 2.7 Torto Wheaton Market Areas of Interest in this Study



Source: Cambridge Systematics, using US Census Bureau.

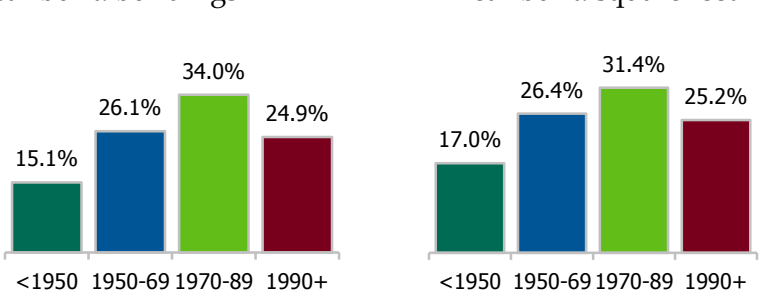
The data package acquired for this project includes more than 17,000 industrial buildings, with a total of 1.185 billion square feet of manufacturing and warehousing/distribution space across the six market areas. As shown in Figure 2.8, more than 70 percent of space in the six markets is used for warehousing and distribution, with the remainder used for manufacturing. About one-third of the spaces (buildings and square footage) were constructed between 1970 and 1989, while about a quarter of the buildings and square footage date from 1990-2010 and about another quarter from 1950-1969, as shown in Figure 2.9. These summary statistics were provided for the entire six-market region, but were not made available at a market or county-level disaggregation.

Figure 2.8 Distribution of Building Types and Square Footage by Type, 2010



Source: CB Richard Ellis, Quarter 3, 2010.

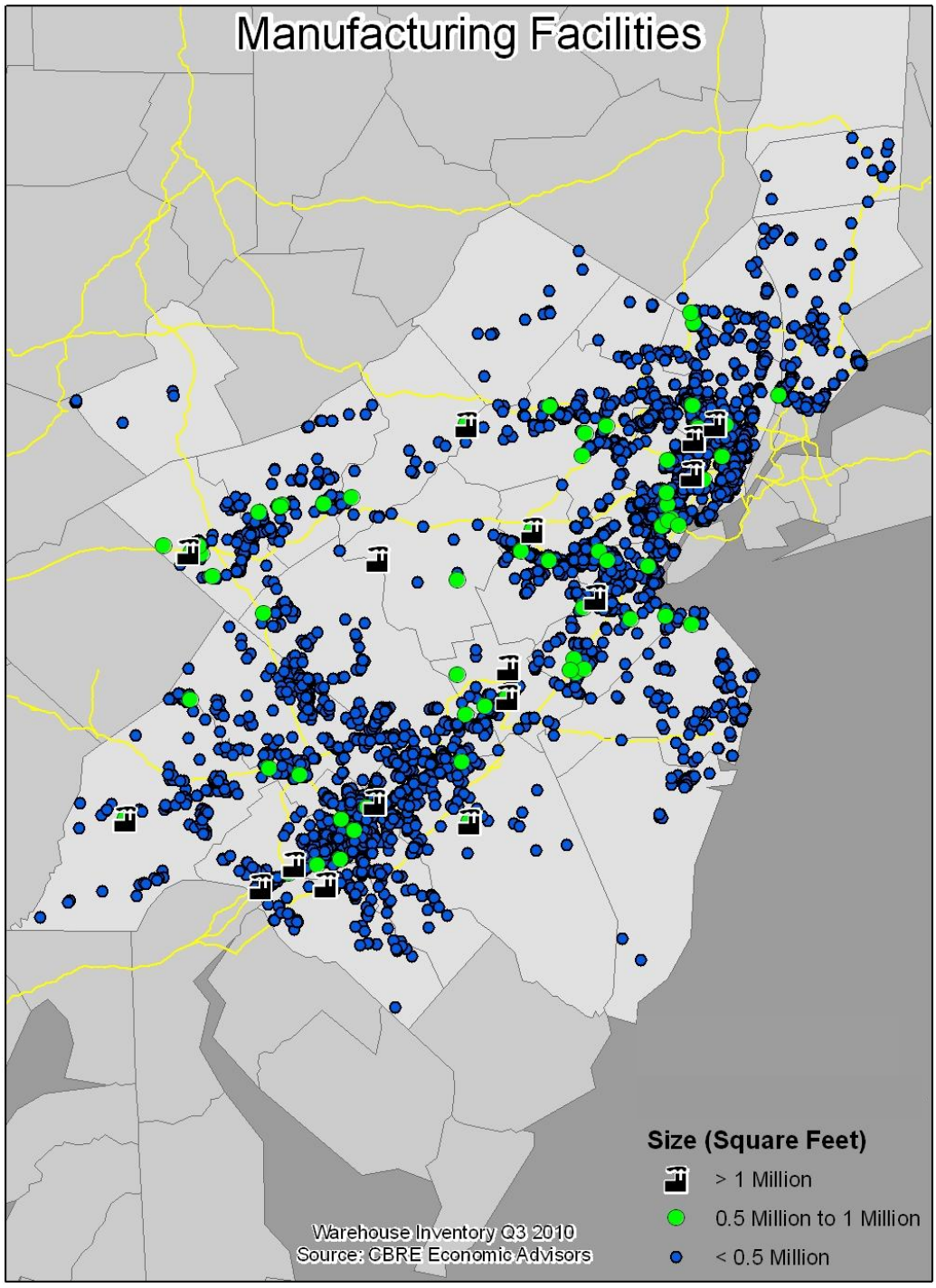
Figure 2.9 Vintage of Buildings and Square Footage by Year Built, 2010



Source: CB Richard Ellis, Quarter 3, 2010.

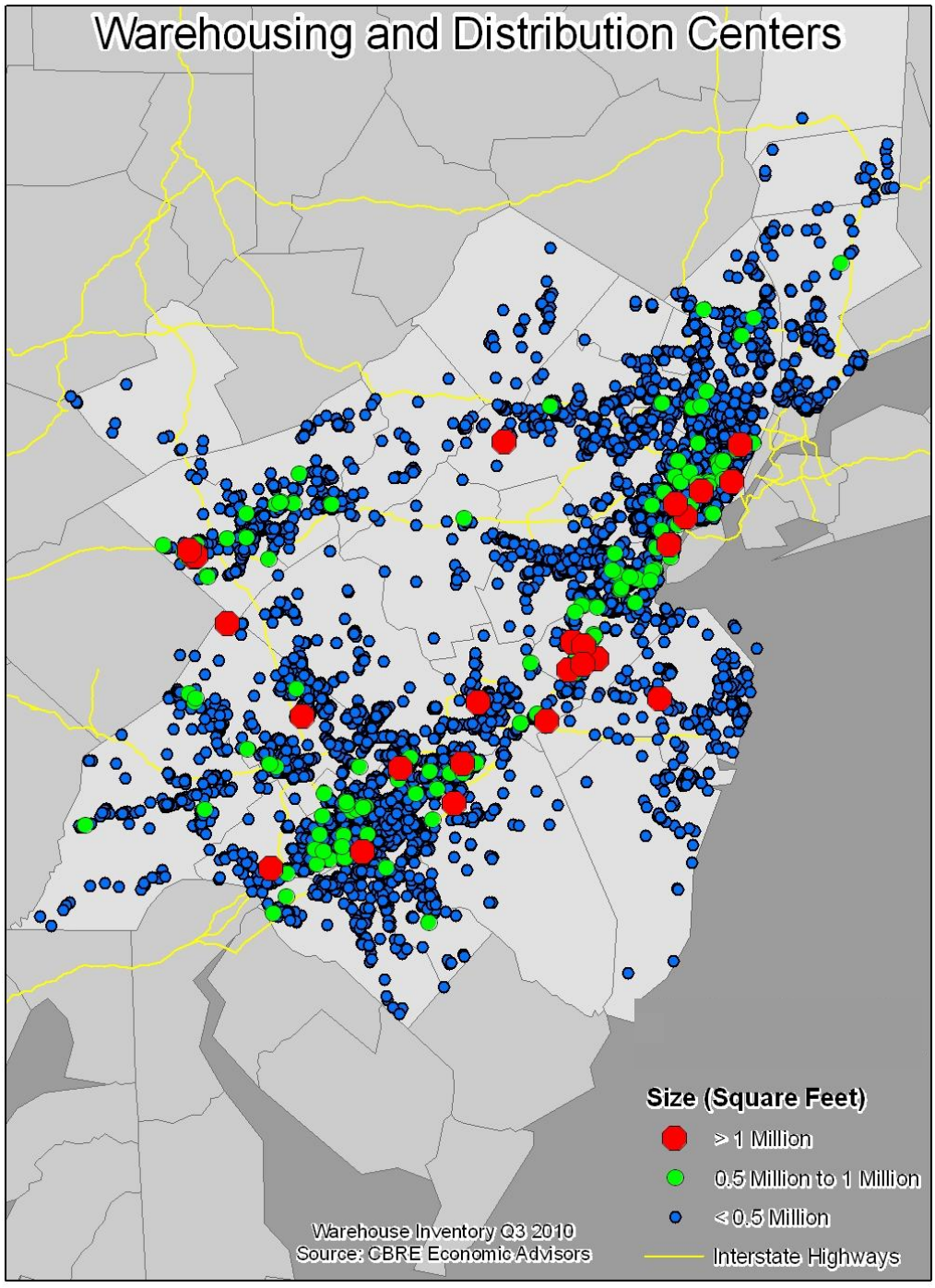
Figures 2.10 and 2.11 following show the distribution of manufacturing facilities and warehousing/distribution facilities, respectively, across the six market areas. The points are shown according to the corresponding size category. Not surprisingly, within the NJTPA counties, the largest facilities are clustered in the vicinity of Port Newark/Port Elizabeth (eastern Essex, eastern Union, western Hudson, and southern Bergen counties) and near Turnpike Interchange 8A in southern Middlesex County.

Figure 2.10 Manufacturing Facilities by Size Category, 2010



Source: Cambridge Systematics, using CB Richard Ellis, Quarter 3, 2010 and US Census Bureau.

Figure 2.11 Warehousing and Distribution Centers by Size Category, 2010

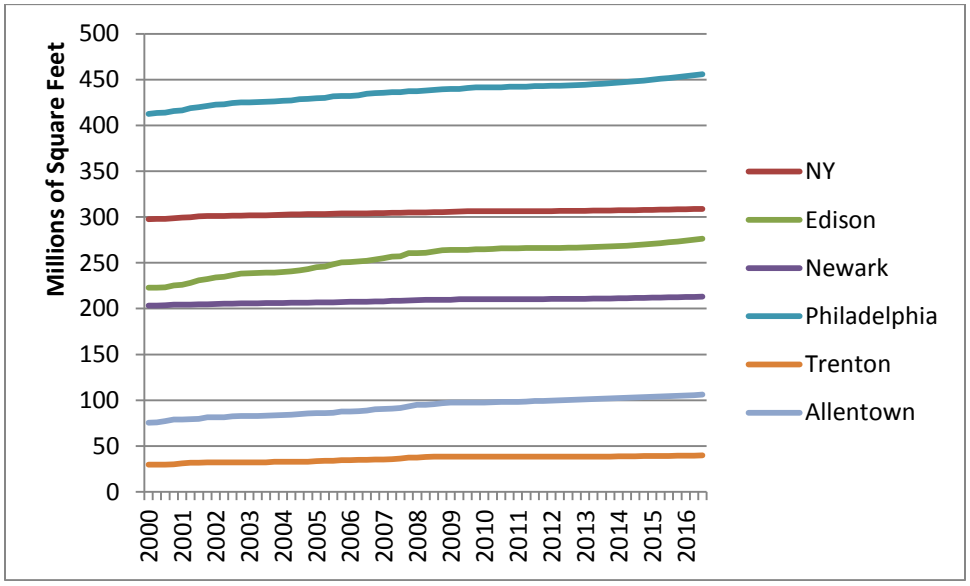


Source: Cambridge Systematics, using CB Richard Ellis, Quarter 3, 2010 and US Census Bureau.

In addition to the building stock database, Torto Wheaton supplied a historic database and forecast of warehouse / distribution space and vacancy rates by market area, covering the years 1980 to 2016. The forecasts are prepared in three scenarios—a baseline, which assumes a future economic climate in line with economy.com baseline forecasts, an "up" forecast which anticipates a quicker recovery from the 2008 economic recession and more rapid growth thereafter, and a "down" forecast which forecasts a "double-dip" recession through the second quarter of 2012 and slower growth thereafter.

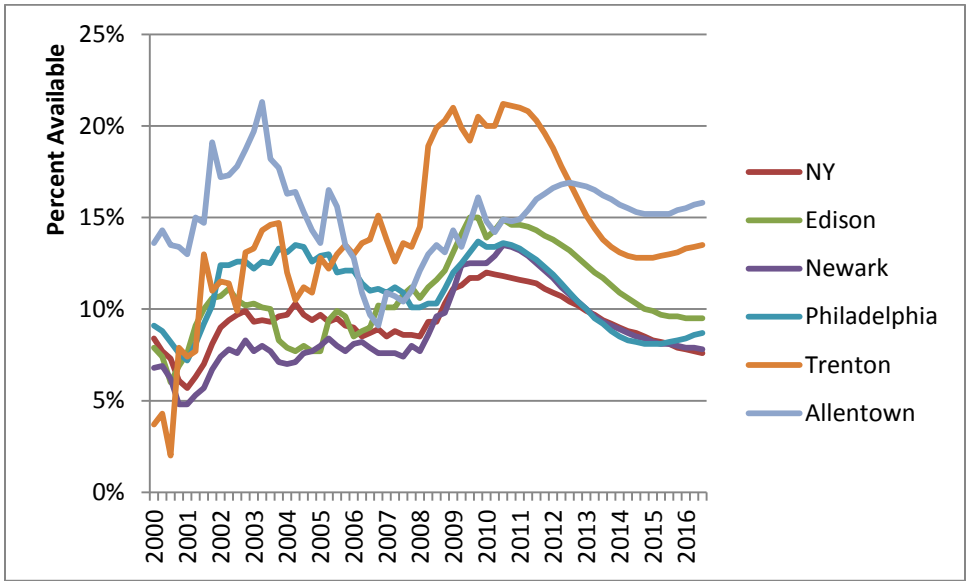
The outputs of the baseline forecast of inventory (by square feet) and vacancy rates in each market area are shown in Figures 2.12 and 2.13, respectively, with historic data from 2000 through the third quarter of 2010. The rates of growth in the Edison, Allentown, and Philadelphia markets are highest, while the New York, Newark, and Trenton markets are more mature and stable. Vacancy rates are more responsive to changes in economic conditions, as illustrated by the volatility of the lines in Figure 2.13. While the vacancy rate in the Trenton market was lowest among the six market areas in 2000 (just over 3 percent), it had the highest vacancy rate in 2010 (about 21 percent). The baseline forecast anticipates some of the younger, faster-growing industrial real estate markets to have higher vacancy rates than the mature markets by 2016.

Figure 2.12 Industrial Inventory History and Baseline Forecast by Market Area, 2000-2016



Source: CB Richard Ellis, Quarter 3, 2010.

Figure 2.13 Vacancy Rate History and Baseline Forecast, 2000-2016



Source: CB Richard Ellis, Quarter 3, 2010.

Freight Facility and Land Use Data Validation

The three databases have slightly different geographic coverage and their contents were developed for differing purposes (Selectory for business location, Freight Locator for freight transportation planning, and Torto Wheaton for industrial real estate). Further, the databases were developed at different times (Freight Locator in 2007, Torto Wheaton in 2010, and Selectory in 2010). For these reasons, facilities that exist in one database may not exist in one or both of the other two. Such inconsistencies are important to resolve, since major freight generators in the region may not be reflected in the data and therefore not considered in the forecasts and Freight Forecasting tool development tasks.

The team performed an analysis aimed at validating the contents of the databases to determine to what extent inconsistencies in the databases existed, and whether those inconsistencies were due to the differing purposes or data collection dates (i.e., businesses opened or closed between 2007 and 2010), accidental omission, or false or flawed information. This process is described in detail in Appendix B.

2.3 SUPPLEMENTAL DATA

To supplement the commodity flow, economic, and land use databases already acquired for the purpose of the project, the team acquired supplemental economic data from Moody's Economy.com, and acquired detailed data on

municipal solid waste and recycling for New Jersey counties from the New Jersey Department of Environmental Protection

Moody's Economy.com

The team procured economic data from Moody's Economy.com in order to supplement the variables in the R/ECON model. Working with Rutgers, CS negotiated for the procurement of national-level data for the series listed in Table 2.5, plus population and employment forecasts for the NJTPA counties.

Table 2.5 Purchased Moody's Economy.com Data Series

Field Name	Description	Source
FET.US	Employment: Total Nonagricultural, (Mil., SA)	Bureau of Labor Statistics: Form 790- Moody's Analytics
FGDP$.US	NIPA: Gross Domestic Product, (Bil. 05$, SAAR)	Bureau of Economic Analysis- Moody's Analytics
FAHETP.US	Avg. Hourly Earnings: Private - Total, ($ per Hour, SA)	Bureau of Labor Statistics: Form 790- Moody's Analytics
FRFED.US	Interest Rates: Federal Funds Rate, (% P.A., NSA)	Federal Reserve Board- Moody's Analytics
FCPIU.US	CPI: Urban Consumer - All Items, (Index, 1982-84=100, SA)	Bureau of Labor Statistics: Consumer Price Index- Moody's Analytics
FRT441.US	Retail Sales: Motor Vehicle and Parts Dealers, (Bil. $, SAAR)	Bureau of Census- Moody's Analytics
FRTFSX.US	Retail Sales: Retail Sales and Food Services excl. Motor Vehicle and Parts , (Bil. $, SAAR)	Bureau of Census- Moody's Analytics
FEIAMGTTQ.US	U.S. All Grades All Formulations Retail Gasoline Prices, (USD per Gallon)	EIA- Moody's Analytics
FCPWTI.US	Petroleum Crude Oil Price: West Texas Intermediate - Sweet Wellhead, ($ per bbl, NSA)	The Wall Street Journal- Moody's Analytics
FLBR.US	Household Survey: Unemployment Rate, (%, SA)	Bureau of Labor Statistics: Current Population Survey- Moody's Analytics
FPOPQ.US	Population: Total, (Mil., NSA)	Bureau of Census: Population Estimates- Moody's Analytics
FEXG$.US	NIPA: Exports of Goods, (Bil. 05$, SAAR)	Bureau of Economic Analysis- Moody's Analytics
FIMG$.US	NIPA: Imports of Goods, (Bil. 05$, SAAR)	Bureau of Economic Analysis- Moody's Analytics
FTWDBRD.US	Weighted Average Exchange Value of U.S. Dollar: Broad Index, (Index, Jan-1997=100, NSA)	Federal Reserve Board: Exchange Rates G.5 (405)- Moody's Analytics

Source: Moody's Economy.com, 2010.

Municipal Solid Waste and Recycling Data

A commodity that is not accounted for in TRANSEARCH and FAF is municipal solid waste (MSW), yet millions of tons of MSW in tens of thousands of trucks, trains, and barges are transported within, into, out of, and through the NJTPA region every year. The team reached out to the New Jersey Department of Environmental Protection (NJDEP) in an effort to procure historic and forecast data (if available) regarding MSW generation and movements through the region. NJDEP supplied four MS Excel spreadsheets:

- Wastedata2.xls, which summarizes intrastate flows of waste between transfer stations and disposal or resource recovery facilities within New Jersey (most easily read in the "PIVOT TOTALS" worksheet).

- 2009 Recycling Rates by County.xls, which provides the total tonnage of disposed and recycled waste by county in 2009. The worksheet titled "Rates" provides the summary of waste and recycling tonnage by county. NJDEP's data by county does not include data from 23 municipalities that report their waste movements directly to the state, nor does it include construction debris disposal that is contracted directly with the construction management, and not handled by local waste authorities. The field titled "with add-ins" includes real or estimated values for these flows, based upon the best information available to NJDEP.
- Transfer station to out of state facilities.xls, which summarizes, in the pivot table in Sheet 4, the flows of material that was transported from transfer stations in New Jersey to disposal locations outside the state. The data are from 2005.
- Direct Haul Out of State Waste.xls, which includes, in the pivot table in Sheet 4, a summary of waste flows directly from New Jersey counties to out-of-state transfer or disposal sites, without passing through a New Jersey transfer station.

To supplement the commodity flow database, the team used data from all four documents to develop an MSW truck trip table. This was prepared by using the 2009 waste generation numbers from the 2009 Recycling Rates by County.xls as control totals, and multiplying those totals times the distribution of flows to in-state and out-of-state facilities reported in the remaining worksheets. This provided the team with a summary worksheet showing estimated county-to-county flows of MSW tonnage for 2009. In addition, flows of waste through the state of New Jersey were added, based on a similar exercise that was completed for the Cross Harbor EIS, which estimated flows of waste from New York City and Long Island that travel to disposal sites in New Jersey, or which pass through New Jersey destined for disposal sites in other states. All of the MSW records were then appended to the TRANSEARCH database, with the MSW commodity identified as STCC 5100.

It is important to note that, while the counties of New Jersey generated under 10 million tons of MSW in 2009, there are more than 24 million tons accounted for in the commodity flow database. The difference is a result of the inclusion of 6 million tons of New York-generated waste and the "double-counting" of much of the New Jersey waste that is transported from each county to an in-state transfer station in a collection vehicle and then to a disposal facility in a waste hauler.

3.0 Freight Drivers

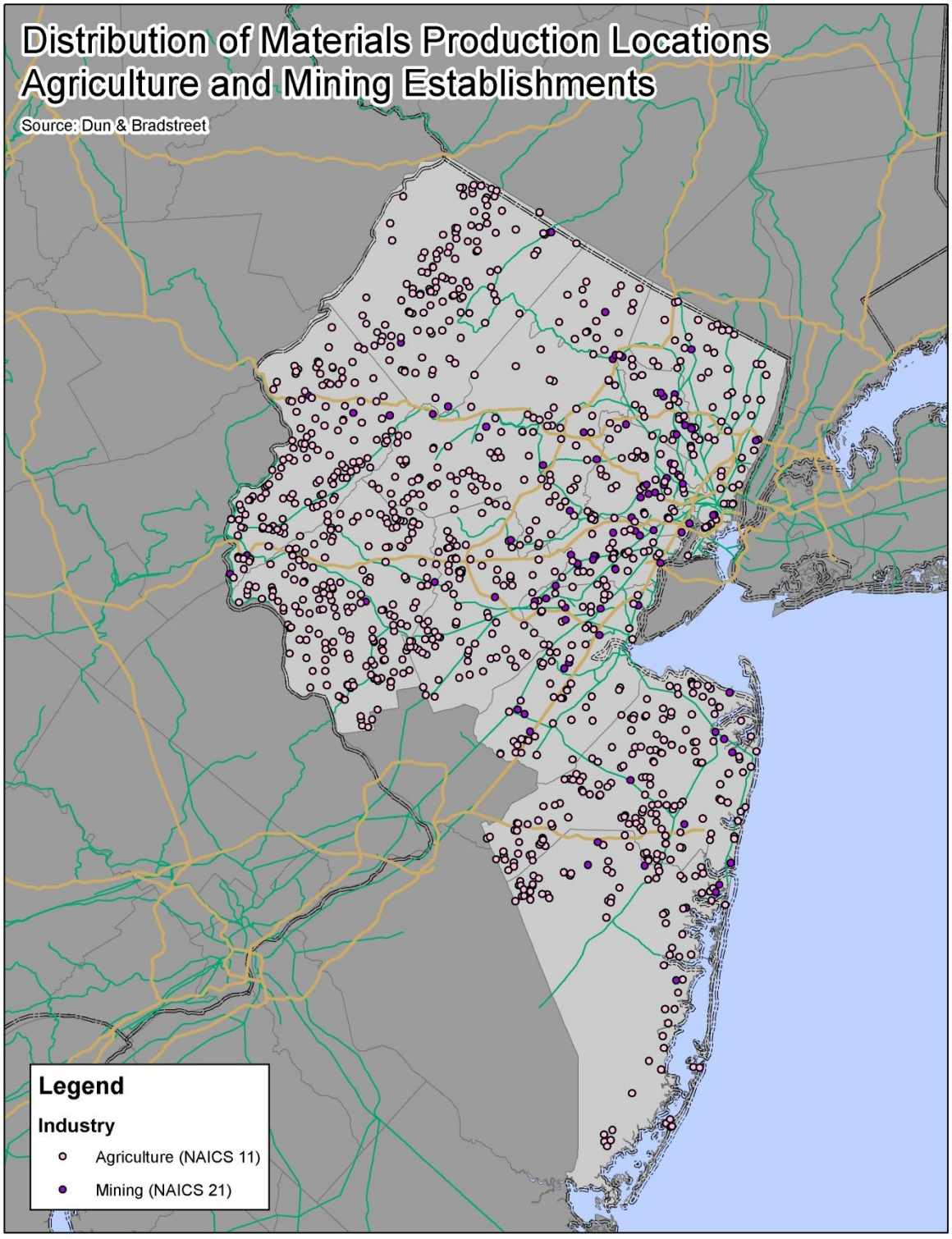
3.1 KEY BUSINESS ESTABLISHMENT DRIVERS

Freight is a derived demand based on the needs of consumers and businesses in an area, as well as other locations served by the infrastructure in a given region. For example, the Port of New York and New Jersey serves businesses and consumers in the NJTPA region and a much broader portion of North America. The key economic drivers, therefore, include a broad spectrum of the logistics chain—from producers through intermediaries to consumers, from point of origin to point of use, and ultimately to points of disposal or recycling—and result in physical activity over modal networks and through intermodal terminals and handling facilities. The following paragraphs identify, using data collected and validated in Task 1, the locations where key logistics functions—production, manufacturing, distribution, sale, and disposal—occur in the NJTPA region.

Production Locations

Production locations include agricultural businesses such as farms and nurseries, where food, animal, and botanical products are raised; and mining facilities where minerals and building materials are extracted from the earth. The activities taking place at these locations vary by geographic area within the region. For example, agriculture businesses in Sussex, Warren, Hunterdon, western Morris, Monmouth, and Ocean counties consist largely of farms, orchards, and ranches. In counties with higher population densities, such as Hudson, Essex, and Union, agriculture businesses tend to be nurseries, farmers markets, or distributors or wholesalers of agricultural products. Mining activities tend to vary north-to-south. In northern counties, mining businesses include quarries and mines that extract rock and other minerals. Mining operations in coastal areas of Monmouth and Ocean counties consist largely of sand mining operations. The locations of production businesses are mapped in Figure 3.1.

Figure 3.1 Agriculture and Mining Business Locations

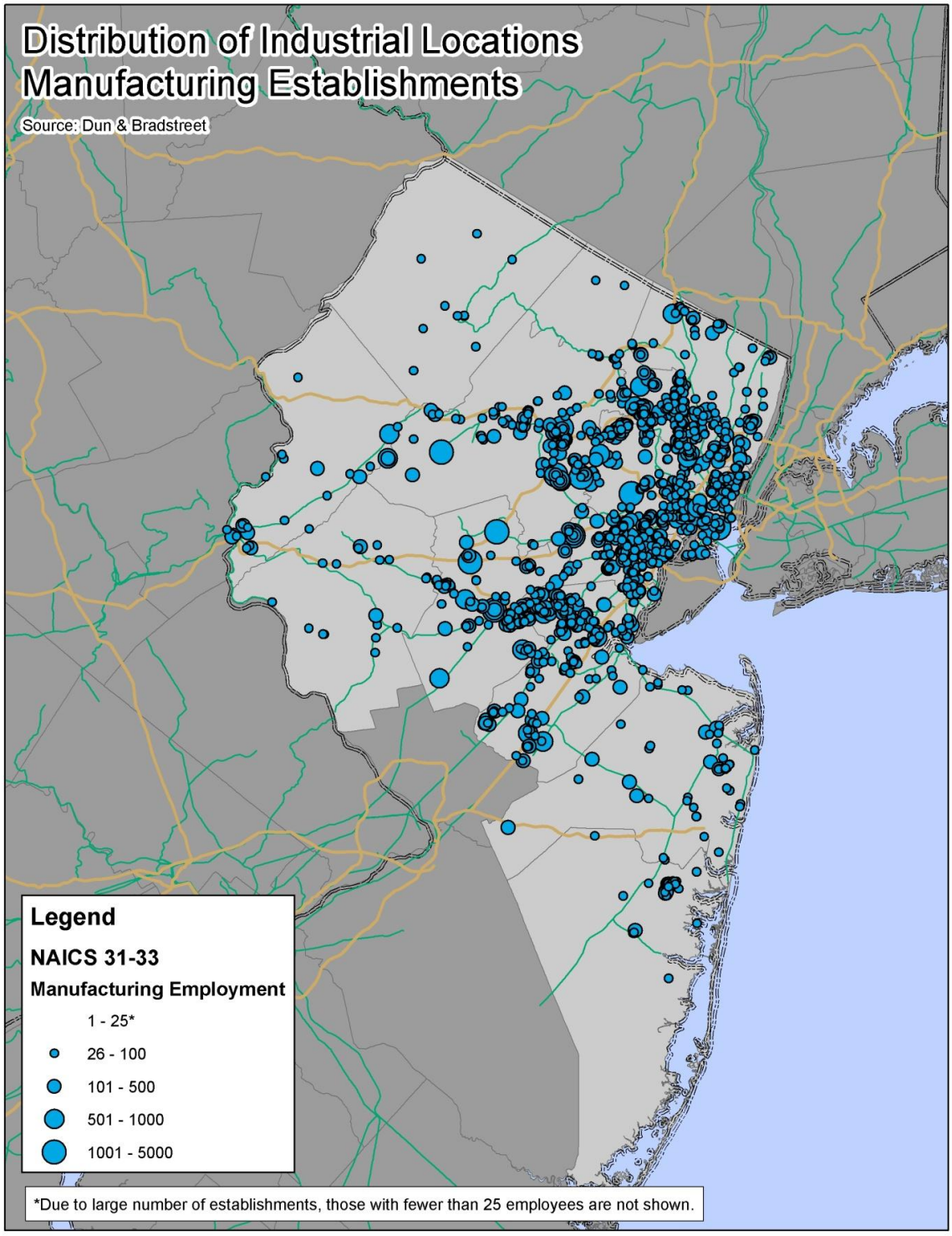


Source: Cambridge Systematics, using Dun and Bradstreet, 2010 and US Census Bureau.

Industrial Locations

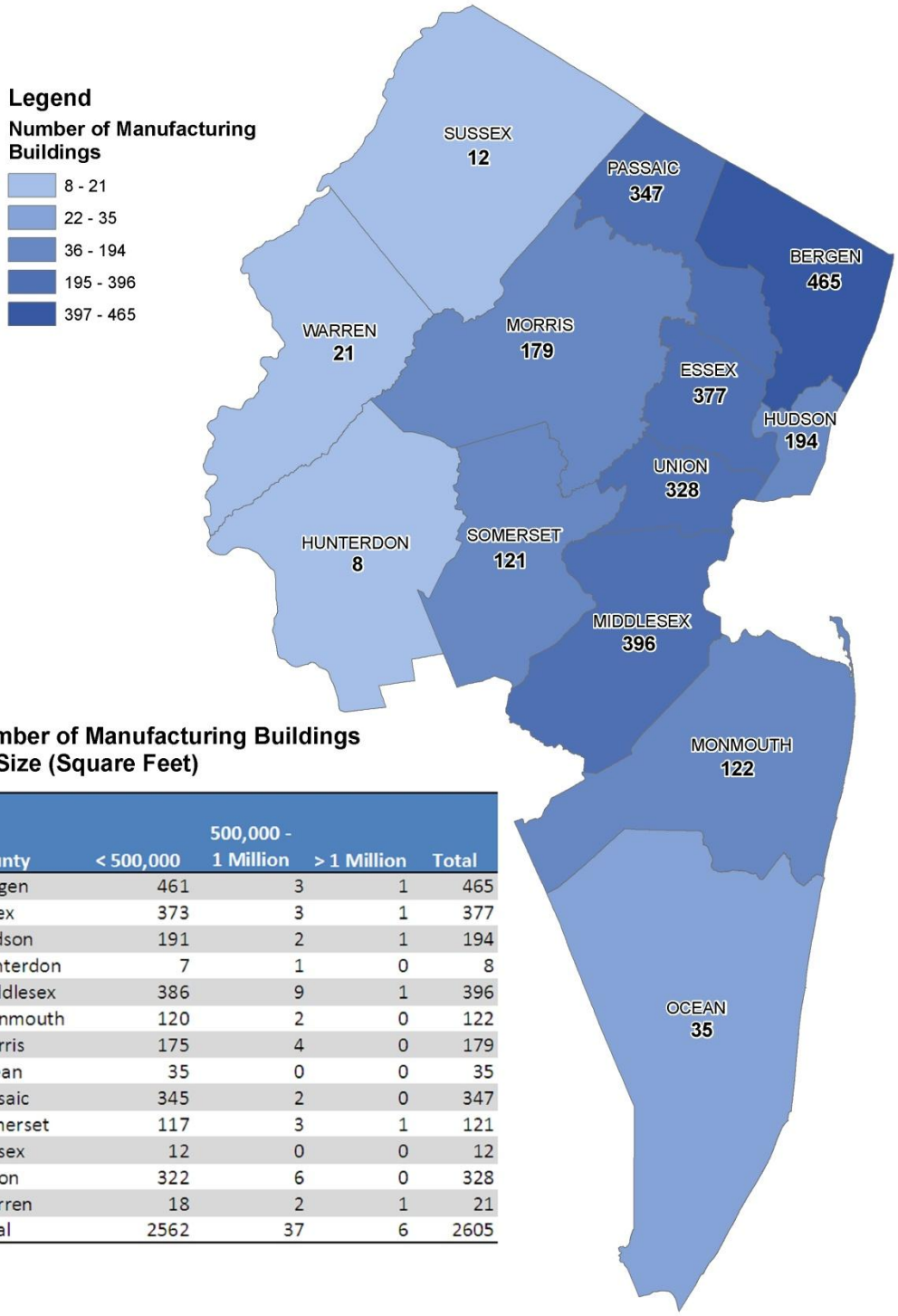
For the purpose of this analysis, "industrial locations" refers to locations of businesses that are engaged in manufacturing activities. Within the NJTPA region, manufacturing activities include "value-added" activities such as assembly; food and beverage processing; plastic, metal, or textile fabrication; and pharmaceutical manufacturing and research and development. Many of the largest manufacturing business locations (by employment) in the region are pharmaceutical or medical device manufacturing companies. Industrial locations are clustered in many of the region's urban centers, along freight-served rail lines, and in suburban industrial parks. The Lakewood Industrial Park and Lakewood Industrial Campus together compose the largest industrial complex in the region, covering more than 1,800 acres. Figure 3.2 illustrates the distribution of manufacturing businesses throughout the region. Figure 3.3 shows the number of manufacturing buildings located in each county according to the Torto Wheaton database.

Figure 3.2 Manufacturing Business Locations



Source: Cambridge Systematics, using Dun and Bradstreet, 2010 and US Census Bureau.

Figure 3.3 Manufacturing Buildings by County



Number of Manufacturing Buildings by Size (Square Feet)

County	< 500,000	500,000 - 1 Million	> 1 Million	Total
Bergen	461	3	1	465
Essex	373	3	1	377
Hudson	191	2	1	194
Hunterdon	7	1	0	8
Middlesex	386	9	1	396
Monmouth	120	2	0	122
Morris	175	4	0	179
Ocean	35	0	0	35
Passaic	345	2	0	347
Somerset	117	3	1	121
Sussex	12	0	0	12
Union	322	6	0	328
Warren	18	2	1	21
Total	2562	37	6	2605

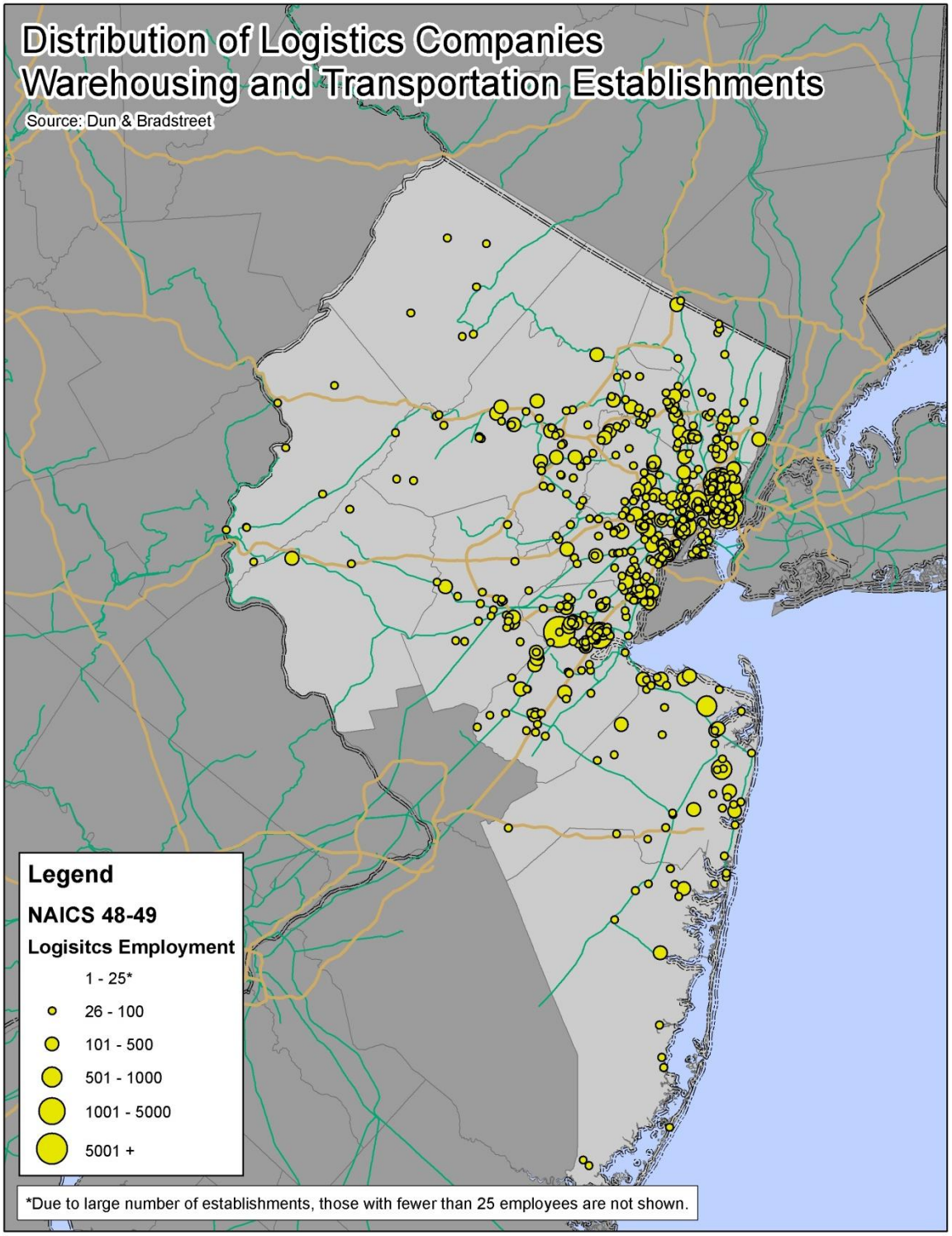
Source: CB Richard Ellis, Quarter 3, 2010; US Census Bureau.

Warehouses and Distribution Centers

Warehouses and distribution centers throughout the region support the distribution of international cargo that enters the region's port gateways throughout North America and the local distribution of inbound domestic cargo for wholesalers, retailers, and other shippers and receivers throughout the region and beyond. This study is informed by two sources of data that contain information on business locations in this category. In the Dun and Bradstreet database, businesses in NAICS 48 and 49 (Transportation and Warehousing) were queried. These businesses include trucking companies, railroads, warehouses, distribution centers, and third party logistics firms. Symbolized by employment in Figure 3.4, the largest clusters are located in northern Middlesex, eastern Union, eastern Essex, southern Bergen, and much of Hudson counties.

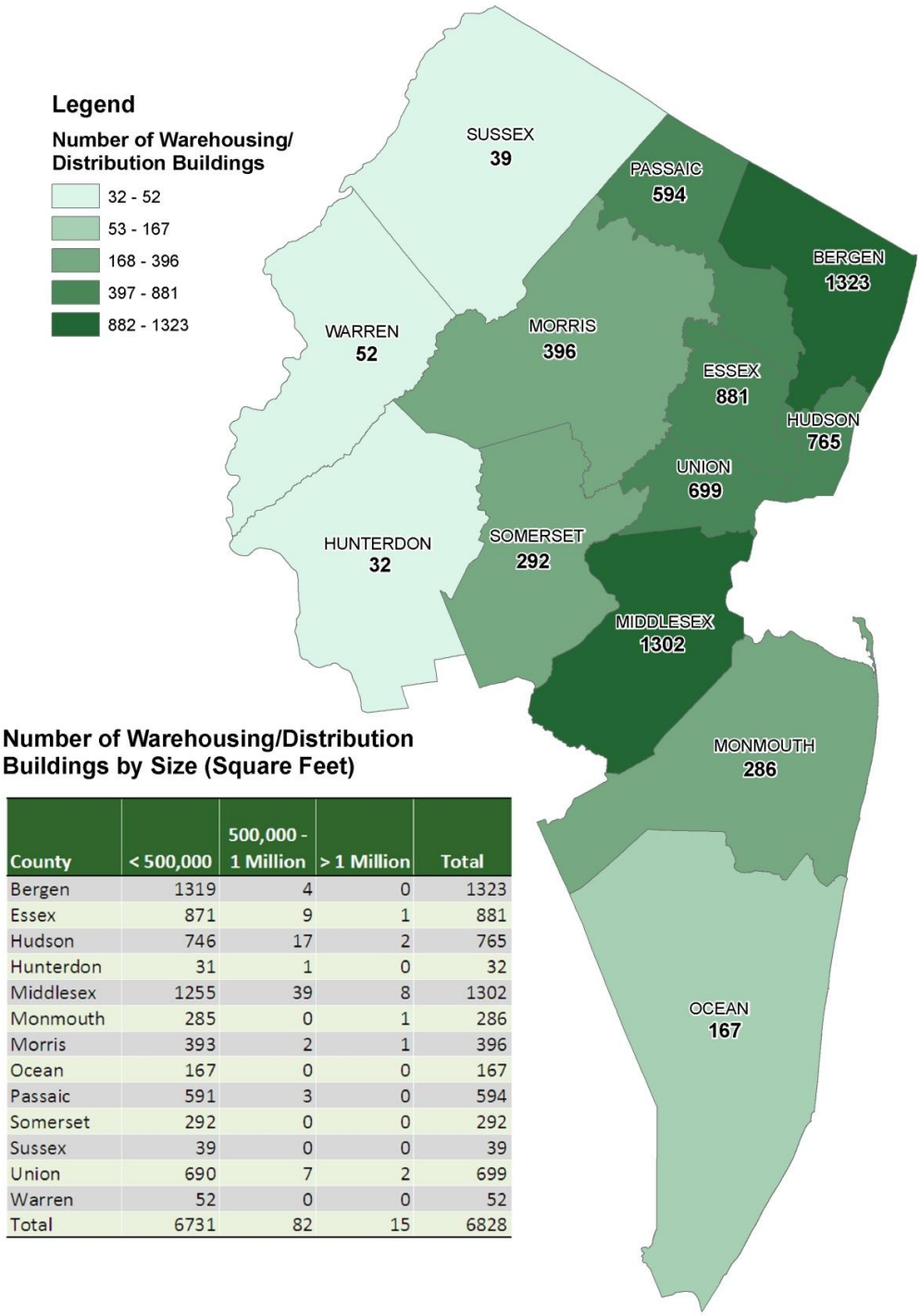
The distribution of warehousing and distribution buildings in the Torto Wheaton database also indicate that Middlesex, Bergen, Essex, Hudson, and Union counties contain large clusters of these buildings, as shown in Figure 3.5. As the data show, warehouse building size and employment are not necessarily covariant. In Middlesex County, for example, the "large dots" by employment are located in northern Middlesex County, while the largest buildings by square footage are located in southern Middlesex County. This observation is likely due to the fact that newer, larger warehousing and distribution center facilities which handle larger quantities of import/export goods and rely more heavily on automated equipment, require fewer employees per thousand square feet than older, smaller warehousing facilities where there is less automation and more value-added activities and local distribution.

Figure 3.4 Warehousing and Distribution Business Locations



Source: Cambridge Systematics, using Dun and Bradstreet, 2010 and US Census Bureau.

Figure 3.5 Warehousing/Distribution Buildings by County



Number of Warehousing/Distribution Buildings by Size (Square Feet)

County	< 500,000	500,000 - 1 Million	> 1 Million	Total
Bergen	1319	4	0	1323
Essex	871	9	1	881
Hudson	746	17	2	765
Hunterdon	31	1	0	32
Middlesex	1255	39	8	1302
Monmouth	285	0	1	286
Morris	393	2	1	396
Ocean	167	0	0	167
Passaic	591	3	0	594
Somerset	292	0	0	292
Sussex	39	0	0	39
Union	690	7	2	699
Warren	52	0	0	52
Total	6731	82	15	6828

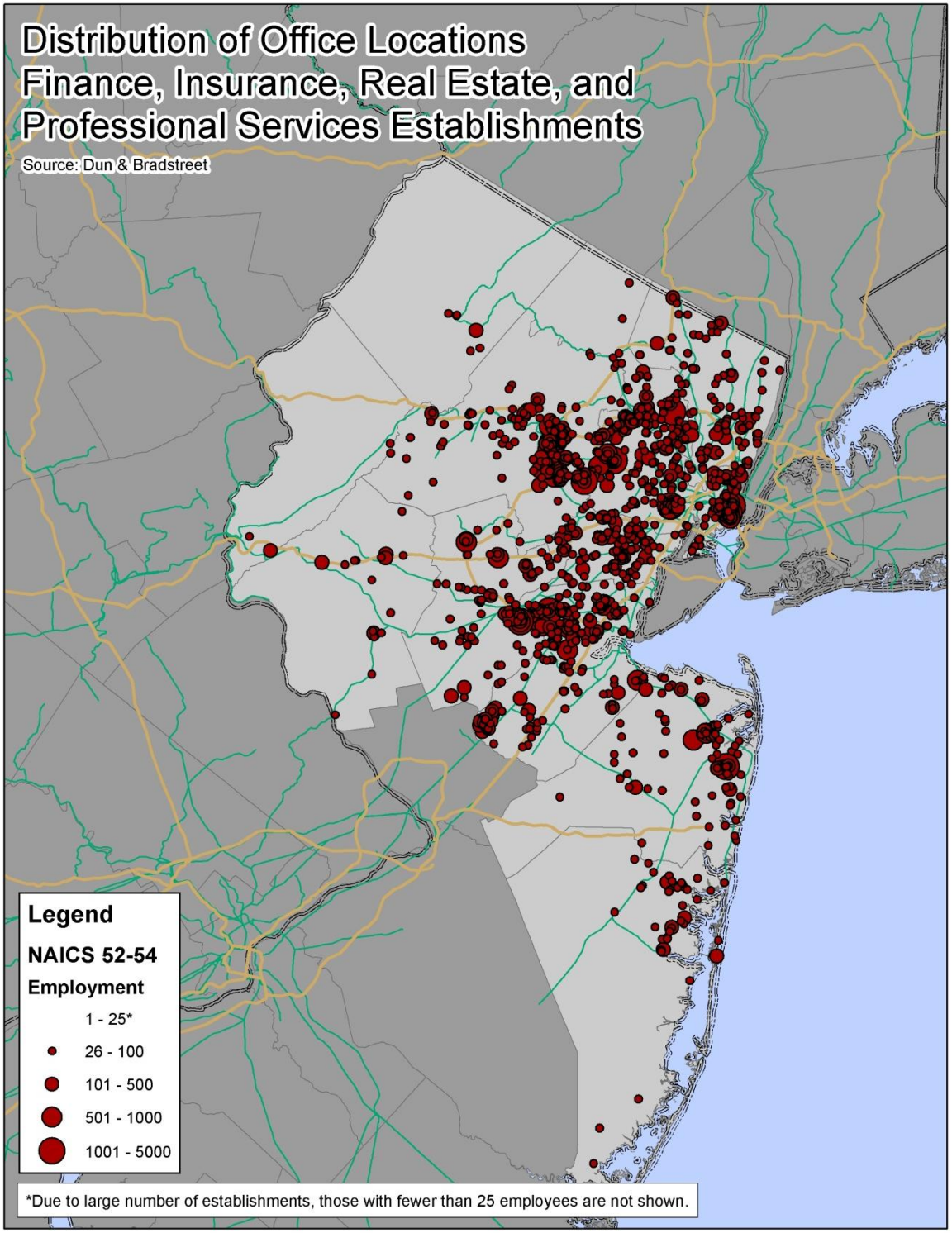
Source: CB Richard Ellis, Quarter 3, 2010; US Census Bureau.

Office Locations

Office locations receive shipments of office supplies, and, in the case of office buildings which contain cafeterias or dining halls, shipments of food products. Office locations are not, however, considered to be major freight generators on the scale of manufacturing, warehousing, and other heavy freight-generating facilities. To identify clusters of office locations in the NJTPA region, the Dun and Bradstreet database was queried to display points coded as NAICS 52 (Finance and Insurance), 53 (Real Estate and Rental and Leasing), and 54 (Professional, Scientific, and Technical Services).

As illustrated in Figure 3.6, the region's large clusters of office locations are found in urban cities such as Newark, Jersey City, Paterson, and New Brunswick, and in several prominent suburban clusters such as the western Essex County, Parsippany/Morristown, Piscataway/Somerset, Monmouth Junction/Plainsboro, and Eatontown areas.

Figure 3.6 Professional Services Business Locations

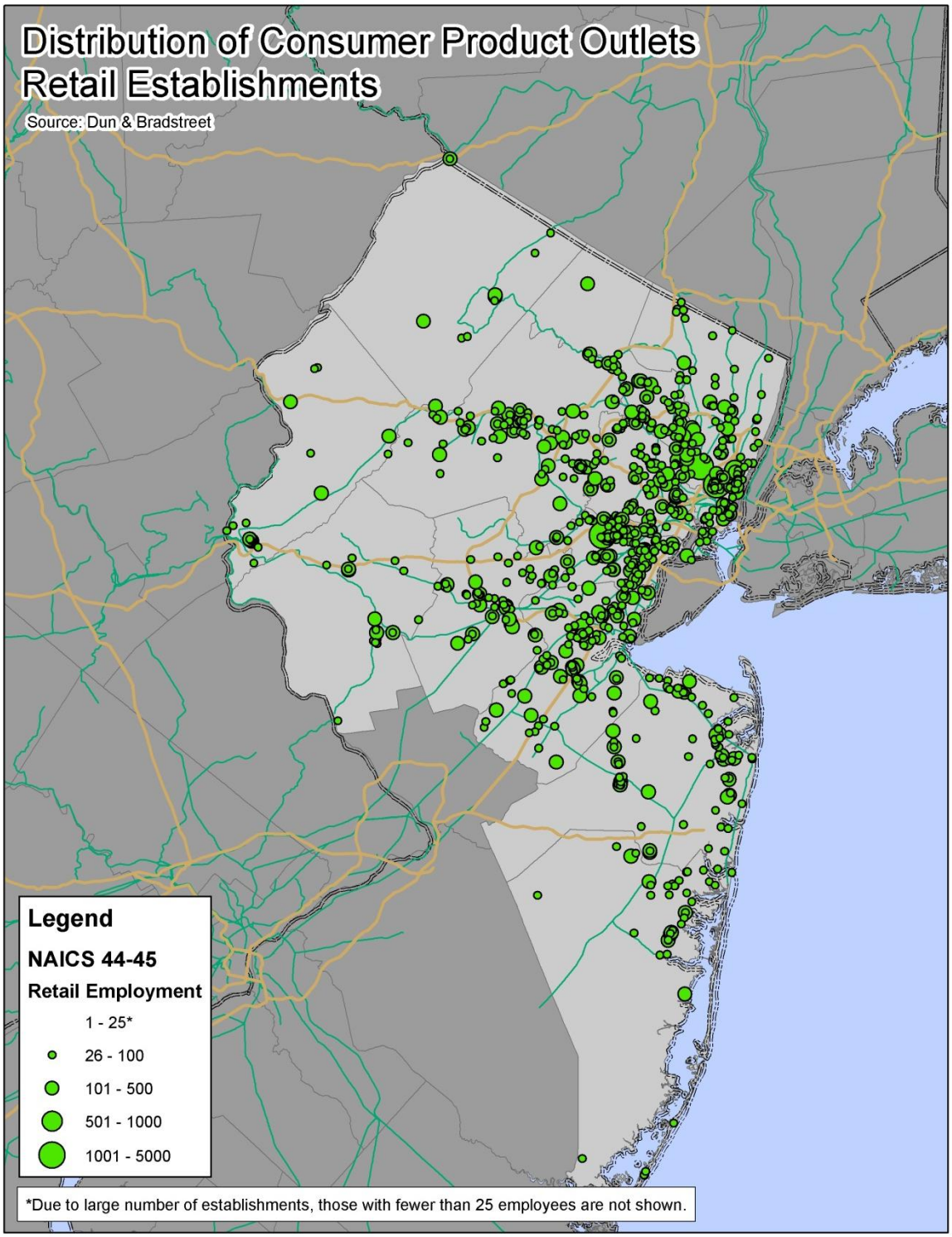


Source: Cambridge Systematics, using Dun and Bradstreet, 2010 and US Census Bureau.

Retail Locations

Retail locations receive inbound shipments of various "consumable" commodities that are picked up by consumers in-store. Big box retailers, supermarkets, and niche or boutique retailers are included in NAICS codes 44-45. Figure 3.7 illustrates the locations of businesses in the retail trade NAICS codes in the NJTPA region. While several points in the Dun and Bradstreet database are shown to have more than 1,000 employees, it is likely that these locations incorrectly contain company-wide employment or are headquarters or office locations. For example, the webinar held with Union County led our team to suspect and later verify that the employment figure for the Village Supermarket location in Springfield (4,299) represents company-wide employment.

Figure 3.7 Retail and Wholesale Business Locations

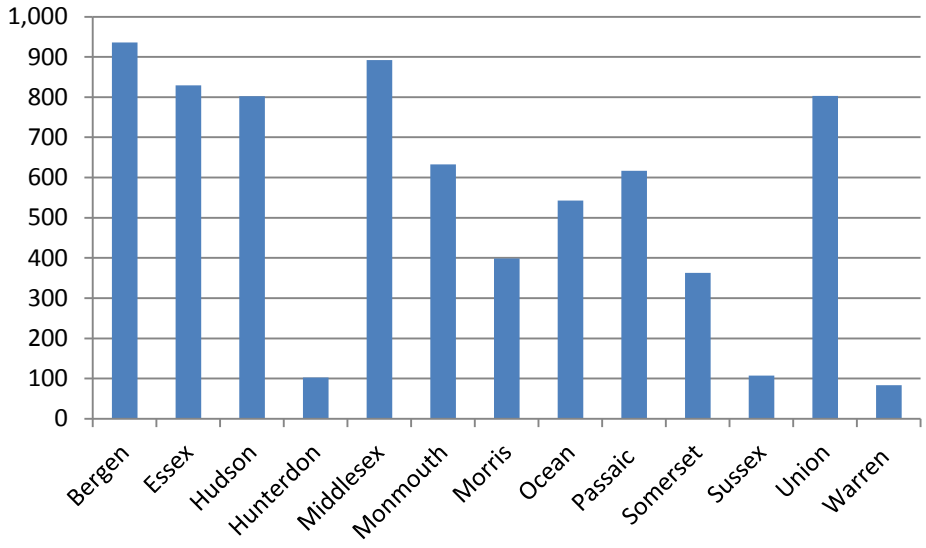


Source: Cambridge Systematics, using Dun and Bradstreet, 2010 and US Census Bureau.

Waste Collection and Transfer Locations

The MSW data received from NJDEP revealed some interesting characteristics of waste generation and disposal in the NJTPA region. With the exception of Hudson and Union counties, tons of waste generated nearly matches population on a 1-to-1 ratio. As illustrated in Figure 3.8, Bergen County, which has about 900,000 residents, generated just over 900,000 tons of waste. Essex County, which has just under 800,000 residents, generated just over 800,000 tons of waste. Hudson and Union counties each generated about 800,000 tons of waste, but their populations are just over 630,000 and just over 530,000 respectively.

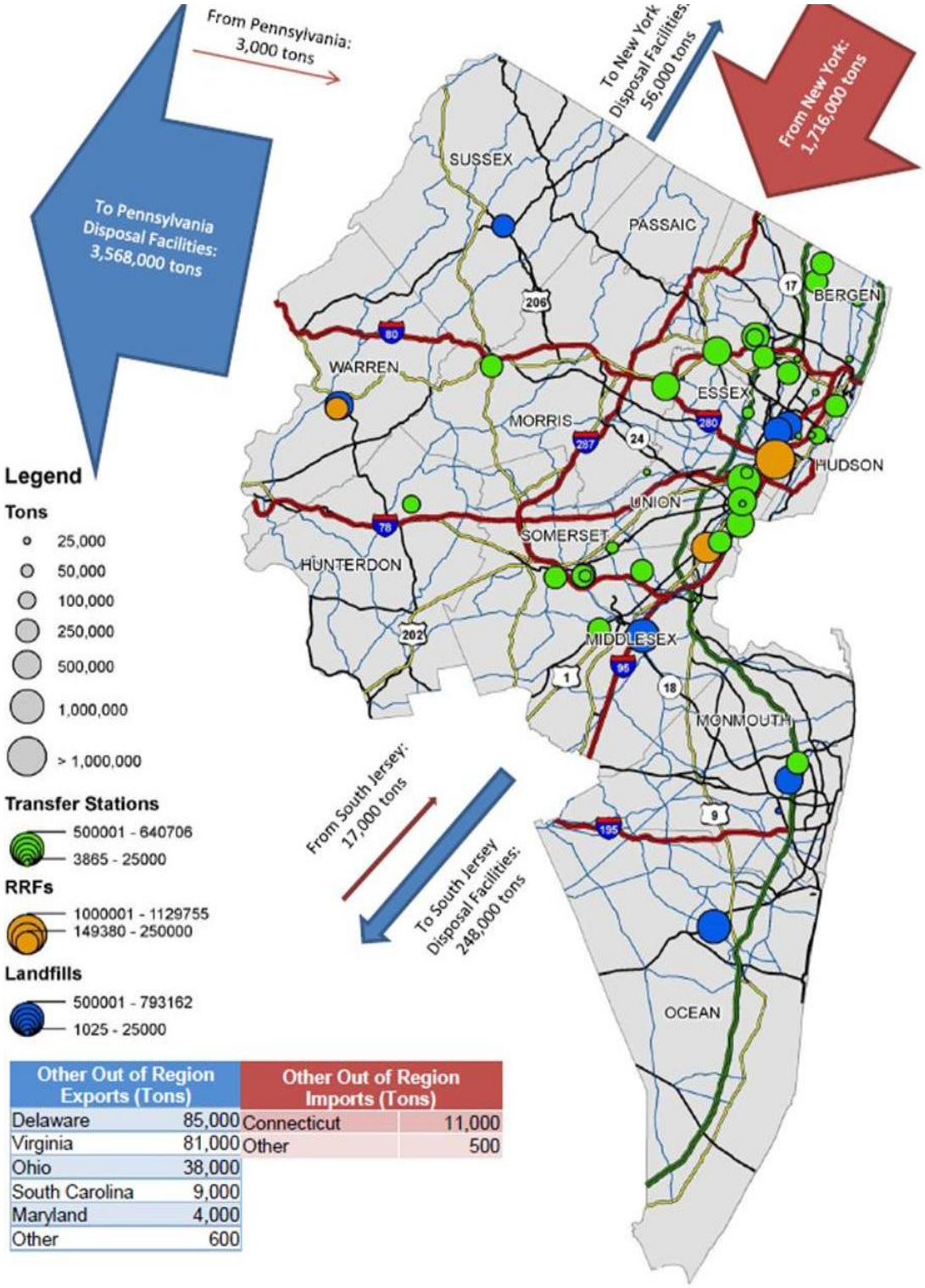
Figure 3.8 Waste Generation by County, 2009 (NJDEP Data)



Source: New Jersey Department of Environmental Protection (NJDEP).

The flows of waste through transfer stations and to landfills or resource recovery facilities (RRFs), as reported in the NJDEP data, were mapped to show the distribution of facilities and the inbound and outbound moves generated by each. Waste generated in each county are collected from residences, businesses, and construction sites, and transported to transfer stations, where loads are sorted and consolidated for shipment to recycling facilities, resource recovery facilities, or landfills. Some collection vehicles transport waste directly to landfills and RRFs. Of the 7.1 million tons of waste generated in the NJTPA region, about 42 percent was delivered to landfills and RRFs within the region. About 58 percent was transported to disposal facilities outside the region, about 87 percent of which was destined for facilities in Pennsylvania. Inbound flows of waste total 1.75 million tons, 98 percent of which originate in New York. Flows of MSW into, out of, and to disposal or recovery facilities within the NJTPA Region are illustrated in Figure 3.9.

Figure 3.9 Waste Flows To and From the NJTPA Region (NJDEP Data)



Other Out of Region Exports (Tons)	
Delaware	85,000
Virginia	81,000
Ohio	38,000
South Carolina	9,000
Maryland	4,000
Other	600

Other Out of Region Imports (Tons)	
Connecticut	11,000
Other	500

Source: *Cambridge Systematics, using NJDEP.*

3.2 SHIPMENTS BY COUNTY AND REGION

Commodity Flow Database MSW Enhancement

The TRANSEARCH commodity flow database was enhanced to include flows of municipal solid waste (MSW) that are otherwise not included. Using the waste generation, transfer station flows, landfill receipts, and out-of-state flows data provided by NJDEP, a county-level MSW trip table was developed and appended to the TRANSEARCH database. The MSW trip table distributes waste generated in each county to in-state processing and disposal facilities based upon NJDEP reportings. Out-of-state flows from each NJTPA county were distributed to out-of-state locations based upon the statewide proportions to those out-of-state locations reported by NJDEP.

Summary of Commodity Flow Analysis

In 2007, approximately 473 million tons of domestic freight moved into, out of, or within North Jersey, by all modes of transportation (truck, rail, water, and air). This figure includes commodities moving into or out of North Jersey, but excludes pass-through tonnage. For domestic origin-destination (O-D) tonnage, around 24 percent consisted of moves of consumer goods between warehouses or distribution centers, 55 percent of which moved in the outbound direction. Other leading commodities include nonmetallic minerals, which represents the Region's largest inbound commodity, petroleum or coal products, chemicals, clay/concrete/glass/stone, food, and municipal solid waste (MSW). The flows of the top ten commodities by direction are shown in Table 3.1.

As shown in Table 3.2, inbound and outbound flows at the regional level are nearly balanced. Internal moves account for about 4 percent of the region's total. At the county level, most counties have a considerable difference in inbound and outbound flows. These differences can be explained by the logistics patterns of local industries. For example, international shipments are not found in the domestic commodity flow database. Therefore, certain inbound and outbound moves of international cargo are not present to balance the inbound and outbound flows of the domestic portion of those logistics chains.

Table 3.1 Top Ten Commodities by Tonnage (in Millions) by Direction

Commodity	Outbound	Inbound	Internal	TOTAL
Warehouse and Distribution Center	62.52	47.14	4.97	114.63
Nonmetallic Minerals, Except Fuels	36.58	50.56	3.26	90.40
Petroleum or Coal Products	33.57	30.14	0.85	64.56
Chemicals or Allied Products	26.00	15.31	0.25	41.55
Clay, Concrete, Glass, or Stone Products	14.35	19.08	0.63	34.06
Food or Kindred Products	12.08	16.23	0.68	28.99
Municipal Solid Waste (MSW)	6.78	4.43	5.22	16.43
Waste or Scrap Materials	4.73	4.52	0.00	9.25
Freight All Kinds	4.40	4.79	0.00	9.19
Crude Petroleum, Natural Gas, or Gasoline	0.03	8.69	0.00	8.72
TOTAL (TOP TEN COMMODITIES)	201.03	200.89	15.87	417.78

Source: NJTPA Freight Forecasting Tool.

Table 3.2 Tonnage (in Millions) by Direction by County

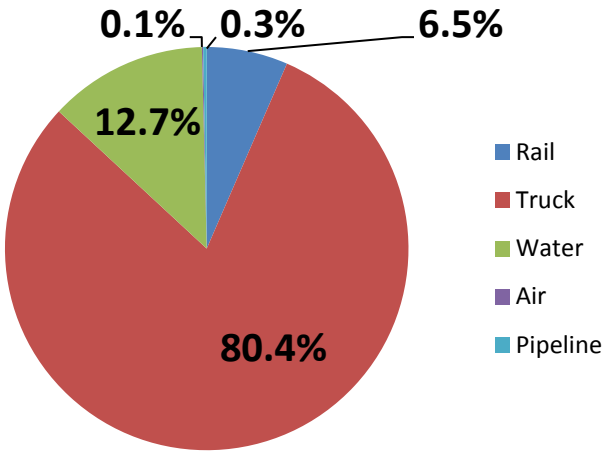
County	Outbound	Inbound	Internal	TOTAL
Bergen	20.34	31.15	2.48	**53.97**
Essex	28.20	47.35	1.70	**77.25**
Hudson	47.37	24.33	0.96	**72.66**
Hunterdon	2.39	4.82	0.07	**7.28**
Middlesex	34.04	34.23	3.29	**71.57**
Monmouth	5.50	15.19	0.92	**21.61**
Morris	12.89	20.21	1.29	**34.38**
Ocean	5.58	7.40	1.51	**14.49**
Passaic	7.82	8.55	0.65	**17.02**
Somerset	21.35	10.44	1.12	**32.90**
Sussex	4.70	2.03	0.59	**7.32**
Union	28.49	22.29	1.71	**52.48**
Warren	5.32	4.71	0.24	**10.28**
TOTAL	**223.98**	**232.70**	**16.53**	**473.21**

Source: NJTPA Freight Forecasting Tool.

For domestic freight traveling to, from or within North Jersey, more than 80 percent travels by truck. Nearly 13 percent travels by water, and 7 percent by rail. Less than 1 percent of freight in the Region travels by air, pipeline, or other modes. The mode split for the NJTPA Region is illustrated in Figure 3.10. Mode splits by county are summarized in Table 3.3. Four counties (Hunterdon, Monmouth, Morris, and Ocean) have truck mode shares at or above 99 percent. Essex and Hudson counties have the lowest share of freight moved by truck (55 percent each), and the highest mode shares for water (over 30 percent each).

Essex County is the only county with a measurable value for air, as Newark Liberty International Airport is the Region's air cargo gateway. Warren County is the only county with tonnage reported moving by "other," in this case, by pipeline.

Figure 3.10 Mode Split for the North Jersey Region, 2007



Source: NJTPA Freight Forecasting Tool.

Table 3.3 Mode Splits by County[1]

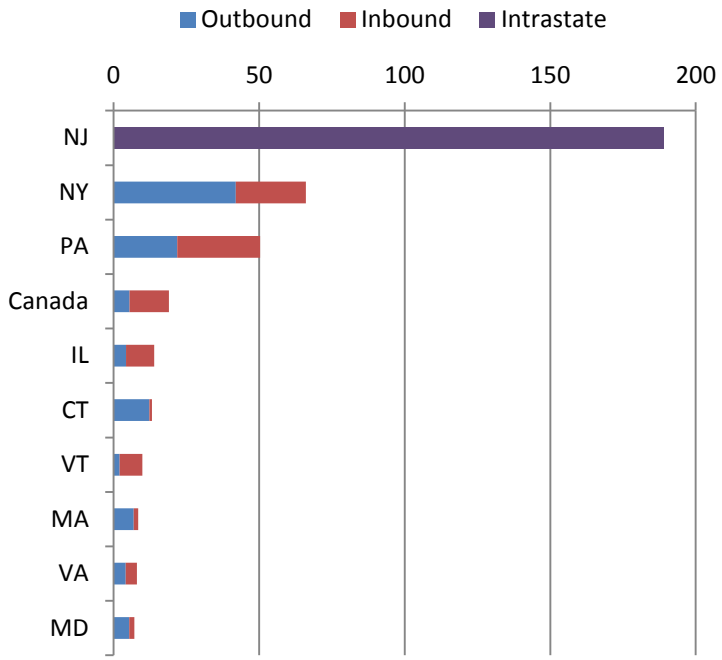
County	Truck	Rail	Water	Air	Other	Total
Bergen	96.0%	4.0%	0.0%	0.0%	0.0%	100.0%
Essex	55.0%	5.0%	39.0%	1.0%	0.0%	100.0%
Hudson	55.0%	14.0%	31.0%	0.0%	0.0%	100.0%
Hunterdon	99.0%	1.0%	0.0%	0.0%	0.0%	100.0%
Middlesex	81.0%	9.0%	10.0%	0.0%	0.0%	100.0%
Monmouth	99.5%	0.5%	0.0%	0.0%	0.0%	100.0%
Morris	99.5%	0.5%	0.0%	0.0%	0.0%	100.0%
Ocean	99.6%	0.4%	0.0%	0.0%	0.0%	100.0%
Passaic	97.0%	3.0%	0.0%	0.0%	0.0%	100.0%
Somerset	98.0%	2.0%	0.0%	0.0%	0.0%	100.0%
Sussex	98.0%	2.0%	0.0%	0.0%	0.0%	100.0%
Union	87.0%	13.0%	0.0%	0.0%	0.0%	100.0%
Warren	86.0%	2.0%	0.0%	0.0%	12.0%	100.0%
Region	**80.4%**	**6.5%**	**12.7%**	**0.1%**	**0.3%**	**100.0%**

Source: NJTPA Freight Forecasting Tool.

As shown in Figure 3.11, North Jersey's major trading partners are its neighbors. About 40 percent (189 million tons) of all tonnage is transported between origins and destinations within the State of New Jersey. New York and Pennsylvania are the largest out-of-state trading partners. Most New York trade is in the outbound direction, while most trade with Pennsylvania is inbound. Canada, Illinois, New England, Virginia, and Maryland are also among the Region's top trading partners.

[1] *Note that the TRANSEARCH database doesn't report international movements and instead captures the tonnage as domestic moves to/from ports and airports. As such, the mode splits in Table 3.3 count the international airport tonnage not as air tonnage but as truck tonnage to/from the airport. Similarly, the international port tonnage is not seen as water but as a combination of truck and rail tonnage moving to/from the port. Also, the domestic air tonnage (about 700,000 annual tons) traveling to/from Newark Liberty International Airport, which is located on the border of Essex and Union counties, is assigned to Essex County. Therefore, the mode splits for air and water in Union County are shown as 0%.*

Figure 3.11 North Jersey Trading Partners by Tonnage (in Millions) by Direction



Source: NJTPA Freight Forecasting Tool.

The county-level commodity flow data analysis results are best summarized in the Subregional Freight Profiles, available as separate stand-alone documents.

3.3 NETWORK ANALYSIS

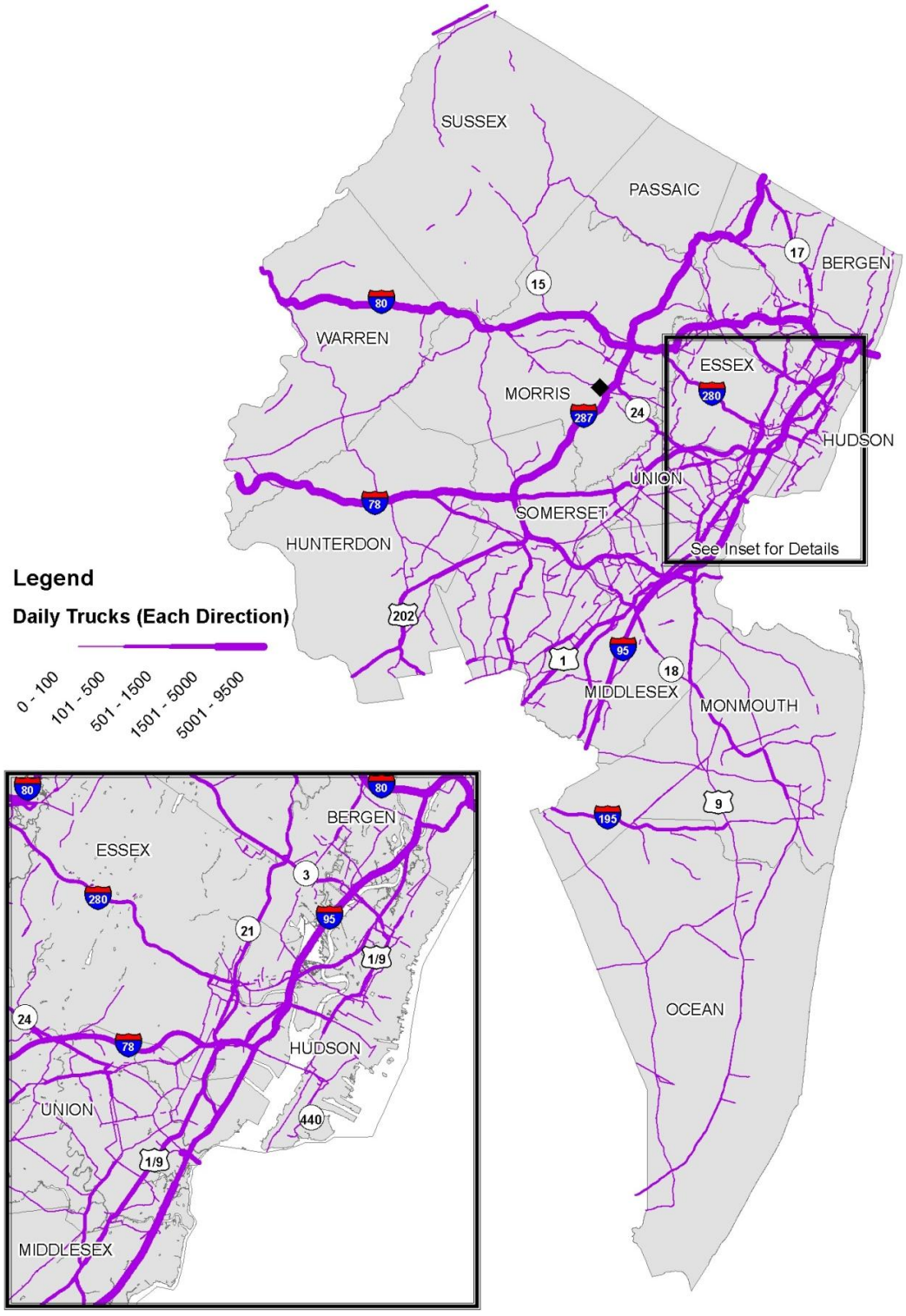
To prepare a truck trip table using the enhanced TRANSEARCH commodity flow database, annual tons were converted to weekday trucks using national average payload factors by commodity. The truckloads were then disaggregated to the RTM-E Network TAZs based upon the distribution of total truck trip ends by TAZ in the RTM-E Network. It is important to note that the truck trip table prepared for this analysis contains only commodity trucks, based upon the enhanced TRANSEARCH, and does not provide any representation of non-commodity truck tonnage, utility trucks, municipal service trucks, etc.

The truck trip table was assigned to the RTM-E model network along with the network's automobile trip table. The inclusion of automobile traffic allows for the inclusion of reasonably accurate congestion resulting from automobile traffic, which impacts the route choices in the assignment.

The result of the assignment is illustrated in Figure 3.12. The line weights are associated with the number of commodity trucks assigned to each network link. Segments of the New Jersey Turnpike and Interstate 80 accommodate more than 18,000 commodity trucks per day. These routes carry large volumes because

North Jersey's largest trading partners are South Jersey, Pennsylvania, and the Midwestern and Mid-Atlantic states. Portions of the Turnpike south of Interstate 287, Interstates 78 and 287, and parts of Routes 1 and 9 in Hudson County carry more than 10,000 commodity trucks per day.

Figure 3.12 Commodity Truck Flows in North Jersey



Source: Cambridge Systematics, using NJTPA's RTM-E.

4.0 Industry-Level Freight Forecasts

4.1 ABOUT THE R/ECON MODEL

The CS consultant team utilized the Rutgers Economic Advisory Service (R/ECON™) econometric model of the State of New Jersey to produce economic forecasts of the State of New Jersey for the period from 2010 to 2040, in 10-year increments.

The R/ECON™ Econometric Forecasting Model is a highly detailed model of the New Jersey economy. The model is specific to New Jersey, and consists of nearly 300 equations covering all major sectors of the State's economy. The equations are based on historical time series data for New Jersey and the nation. The model forecasts the full range of macroeconomic variables, including gross domestic product (GDP), prices, personal income, population and labor force, and state tax revenue. It also has energy, real estate, and motor vehicles sectors. The model is used for both forecasting and for impact analysis.

The R/ECON™ model has six key sectors: 1) the industry sector, including employment, GDP of New Jersey, wage rates, and price deflators for major industries; 2) the personal income sector; 3) the population and labor force sector; 4) the state tax revenue and expenditure sector; 5) an energy sector for electric and gas utilities and for fuel oil; and 6) an "other" sector which includes equations for real estate, construction and motor vehicles.

The individual industry sector elements drive the model. About 30 industries are included in the model (the total is higher for employment than for GDP). The industries included are listed in Table 4.1 following.

Table 4.1 Industries Included in the R/ECON™ Model

Natural Resources	Finance
Manufacturing	Depository Credit Intermediation
Fabricated Metals	Securities and Commodities
Machinery	Insurance
Computer and Electronics	Real Estate and Rental and Leasing
Other Durables	Services
Food	Professional and Business
Paper	Professional, Scientific, and Technical
Printing	Management of Businesses
Chemicals	Administration, Support, and Waste Management
Pharmaceuticals	Educational and Health
Other Chemicals	Education
Plastics	Health Care
Other Nondurables	Social Services
Construction	Leisure and Hospitality
Transportation, Trade, and Utilities	Arts and Entertainment
Transportation	Accommodations
Trade	Food Services and Drinking Places
Wholesale Trade	Other Services
Retail Trade	Public Administration
Utilities	Federal
Information	State
	Local

Source: R/ECON.

In general, employment in a sector depends on demand for the output of the sector and on wages and prices relative to national wages and prices. Output in a sector depends on state demand and national output in the sector as well as on relative prices. Wages in a sector depend on national wages in the sector, state prices relative to national prices, and a measure of labor market conditions. Each component of personal income, other than wages and salaries, depends on that national component of personal income and on the relative size of New Jersey to the United States in terms of population or employment. Total wages and salaries is the sum of wages and salaries over all industries. Population growth is driven by total employment and by state wages and prices relative to their national counterparts. Revenues for each of the major state taxes are driven by the tax base, the tax rate, and prevailing tax codes.

Most of the equations in the energy and "other" sectors have been added for use in specific projects, and have been retained in the model because they are useful in examining specific components of the State's economy. For instance, for a project dealing with the impact of the real estate transfer tax, equations were added to the model to explain the demand for new home sales and existing home

sales. New and existing home sales are part of an equation for gross domestic product in the real estate sector, which in turn helps determine employment in real estate, GSP for financial services, and real estate transfer tax revenues. This new sector of the model was further expanded for a project examining the energy efficiency of the housing stock over time. Equations for single and multi-unit housing stock were added to the model. Like the new home sales equation, they depend on residential building permits.

Similarly, equations have been added to the R/ECON™ model to describe prices and usage of energy in New Jersey. The energy sector includes prices and usage of electric power, natural gas, fuel oil, and motor fuel. Electric power is divided into equations for the residential, commercial, industrial, and other sectors; fuel oil is divided into the residential, commercial, industrial, transportation (diesel), residual, and other sectors; and natural gas is divided into equations for the residential, commercial, industrial, and electric power sectors. R/ECON™ already includes a transportation sector which is separated into two parts: trucking and warehousing and "other" transportation.

R/ECON™ yields a matrix-based accounting of the value of the shipments from each industry to each other industry. Thus, such tables show the value of each good and service any particular industry buys and the shares of its revenues that are consumed by other industries in the economy. One aspect of the I-O (input-output) system is a set of satellite accounts, which yield wholesale and retail trade margins on sold commodities as well as typical margins for their transportation shipment costs. A main advantage of I-O models, compared to other economic models, is their extreme industry detail—more than 400 sectors versus about 60 in models like the R/ECON™ econometric model for New Jersey. This relative detail enables I-O models to articulate the very different production functions (think of these as production "recipes") among an economy's industries. These inputs and outputs served as the basis for the "make and use" tables that are discussed in Section 4.2.

The New Jersey forecasts used as their U.S. drivers the most recent U.S. long-term economic forecast of IHS Global Insight, which extends from 2010 to 2040. The historical data for both the United States and New Jersey is updated, depending on the series, to 2007, 2008, or 2009. All the employment and income data is updated through 2009. The forecasts take into account the economic activity of the recent past, including the recession that began in 2007. They take into account current and projected exchange rates, fuel prices, and monetary and fiscal policy—the latter both Federal and state. They produce forecasts for population, employment, and GDP by industry for the State.

4.2 EMPLOYMENT FORECAST METHODOLOGY

A baseline R/ECON forecast through 2040 was developed at the state-level, disaggregated to subareas consistent with the NJTPA planning region, and then further disaggregated to the level of individual counties, using factors provided by Rutgers. County-level estimates, above and beyond what is normally available from R/ECON, are a key value-added product of this task.

Additionally, four forecast variations were provided by Rutgers, based on the manipulation of certain model input assumptions. These included:

- Higher Population
- Lower Population
- Higher CPI
- Lower CPI

The variations were identified and agreed on through discussions between the consultant team and NJTPA. Within the R/ECON model, changes in one of these factors influences other factors – for example, higher population leads to higher employment, leading to greater industry output and more freight movement. Section 4.4 summarizes the primary effects and attributes of the base forecast and each variation.

The CS team also obtained 30-year county level forecasts from Moody's Economy.Com and compared them to the R/ECON results. Generally, there was a strong degree of correspondence between Moody's and R/ECON results, providing increased confidence in the R/ECON findings.

The CS team explored methods to integrate the industry forecasts with the IHS Global Insight Freight Locator data. The intended method was to identify each Freight Locator-identified industry, determine which R/ECON industry cluster it was associated with, and increase its freight volume according to the R/ECON growth rate for that industry. However, as a result of extensive land use and industry mapping analysis, it was determined that a significant number of key NJTPA industries are not represented in the Freight Locator database, and that growing the industries that were represented would not yield any useful or instructive results.

For purposes of freight forecasting, the most important output of R/ECON is the employment forecasts. However, there also needs to be a "bridge" between employment and freight movement. Certain industries require commodities as inputs to their activity – for example, construction industries need lumber, cement, copper, etc. – and these are known as "Use" commodities. Conversely, other industries create outputs from their activity – for example, manufacturers of pharmaceuticals or energy products – and these are known as "Make" commodities. For any given industry, "Use" commodities are inbound moves to

a facility, and "Make" commodities are outbound moves. For this project, Rutgers generated a "Make/Use" table which relates major industry groups to the major types of commodities they make or use. For example, from the Make/Use table, we might know that a 10% increase in employment in a certain industry generates a 5% increase in the use of one commodity and a 3% increase in the use of another. This enables us to "grow" current freight tonnages, by commodity and direction, based on employment forecasts.

Finally, as supplemental data to R/ECON and to TRANSEARCH, the consultant team developed estimates of local package delivery traffic and municipal solid waste (MSW) truck traffic which were not included in TRANSEARCH or forecast in R/ECON. Current estimates of package delivery traffic were derived by identifying "mismatches" in the TRANSEARCH dataset, where warehouse/distribution traffic entered a known transfer facility (UPS, FedEx, etc.) but did not exit, or vice versa; CS manually added the "missing leg" of these trips as new data records in the NJTPA TRANSEARCH database. Once in the database, they can be forecast at the R/ECON rate for other warehouse/distribution traffic. Current estimates of MSW truck traffic were developed through interviews with waste handling agencies in New Jersey and New York, and similarly appended as new records to the NJTPA TRANSEARCH dataset; future volumes were forecast at the R/ECON rate associated with end-user consumer products.

4.3 NATIONAL ECONOMIC INPUTS

As previously noted, the R/ECON Model includes national forecast data provided by IHS Global Insight, Inc. Growth in these factors between the years 2010 and 2040 is summarized in Table 2 below, along with comparable factors utilized in the Moody's Economy.com forecast. The primary factors listed in Table 2 are: gross domestic product (GDP); population (Pop); consumer price index (CPI); non-farm employment (NF Emp); retail sales (Ret Sales); value of imported goods (Imp Val); and value of exported goods (Exp Val). The figures shown represent the ratio of 2040 values to 2010 values for each forecast and factor. Overall, the two national forecasts are comparable on most dimensions, although Moody's sees somewhat lower growth in GDP, CPI, and retail sales, and somewhat higher growth in import value.

Table 4.2 Growth in National Economic Factors, R/ECON and Moodys

Indexed US Factors 2010-2040	GDP	Pop	CPI	NF Emp	Ret Sales	Imp Val	Exp Val
Factors from RECON	2.21	1.31	2.01	1.36	4.04	4.93	6.91
Factors from Moodys	1.96	1.31	1.91	1.32	2.48	5.47	6.73

Source: R/ECON; Moody's Economy.com, 2010.

4.4 STATE AND REGIONAL ECONOMIC INPUTS

Table 4.3 following shows the ratios of 2040 to 2010 values for key economic growth factors associated with the base R/ECON forecast and the four alternative R/ECON forecasts. The factors are: New Jersey gross state product (NJ GSP); New Jersey population (NJ Pop); New Jersey consumer price index (NJ CPI); New Jersey non-farm employment (NJ NF Emp); New Jersey retail sales (NJ Ret Sales); NJTPA population (NJTPA Pop); and NJTPA non-farm employment (NJTPA NF Emp). From Table 4.3, the differences in the primary forecast variables are easily observed. For example, population in the base forecast is 1.23 times higher in 2040 than in 2010, while in the alternative high population forecast it is 1.36 times higher and in the alternative low population forecast it is 1.17 times higher; and these differences result in different changes in GSP, retail sales, and (most importantly for our purposes) employment. Changes in CPI assumptions have similar effects; a higher CPI means less employment, a lower CPI more employment.

Table 4.3 Growth in New Jersey and NJTPA Economic Factors, R/ECON

Indexed NJ Factors 2010-2040	*NJ GSP*	*NJ Pop*	*NJ CPI*	*NJ NF Emp*	*NJ Ret Sales*	*NJTPA Pop*	*NJTPA NF Emp*
Base RECON Forecast	**1.81**	**1.23**	**1.80**	**1.34**	**3.34**	**1.22**	**1.32**
Alt (Higher Pop) Forecast	1.90	1.36	1.79	1.41	3.72	1.34	1.40
Alt (Lower Pop) Forecast	1.73	1.17	1.80	1.29	3.23	1.16	1.27
Alt (Higher CPI) Forecast	1.77	1.22	1.89	1.31	3.31	1.21	1.28
Alt (Lower CPI) Forecast	1.87	1.24	1.69	1.37	3.37	1.23	1.37

Source: R/ECON.

Table 4.4 following shows the values for these factors in year 2010. Note that the base forecast and the four alternatives start with the same values.

Table 4.4 Value of New Jersey and NJTPA Economic Factors, 2010

R/ECON Forecast Values, 2010	*NJ GSP ($2000 bil)*	*NJ Pop (000)*	*NJ CPI (1982= 100)*	*NJ NF Emp (000)*	*NJ Ret Sales ($ bil)*	*NJTPA Pop (000)*	*NJTPA NF Emp (000)*
Base RECON Forecast	434	8,792	234	3,854	121	6,580	2,847
Alt (Higher Pop) Forecast	434	8,792	234	3,854	121	6,580	2,847
Alt (Lower Pop) Forecast	434	8,792	234	3,854	121	6,580	2,847
Alt (Higher CPI) Forecast	434	8,792	234	3,854	121	6,580	2,847
Alt (Lower CPI) Forecast	434	8,792	234	3,854	121	6,580	2,847

Source: R/ECON.

Table 4.5 following shows the values for these factors in year 2040. Note that the base forecast and the four alternatives now diverge with respect to GSP, population, CPI, employment, and retail sales. (For users of the NJTPA Freight

Forecasting Tool, these values are re-calculated and displayed for any forecast year chosen, and serve as a guide – the user can select the forecast that most closely approximates the preferred values for GSP, population, and other factors.)

Table 4.5 Value of New Jersey and NJTPA Economic Factors, 2040

R/ECON Forecast Values, 2040	NJ GSP ($2000 bil)	NJ Pop (000)	NJ CPI (1982= 100)	NJ NF Emp (000)	NJ Ret Sales ($ bil)	NJTPA Pop (000)	NJTPA NF Emp (000)
Base RECON Forecast	786	10,805	421	5,151	403	8,003	3,768
Alt (Higher Pop) Forecast	825	11,972	420	5,441	449	8,848	3,975
Alt (Lower Pop) Forecast	749	10,323	421	4,962	389	7,655	3,631
Alt (Higher CPI) Forecast	769	10,729	442	5,066	400	7,947	3,654
Alt (Lower CPI) Forecast	812	10,909	396	5,275	407	8,081	3,917

Source: R/ECON.

4.5 EMPLOYMENT FORECAST RESULTS

Tables 4.6 through 4.10 on the following pages present summaries of the employment forecast results for the period 2010-2040 for the base R/ECON forecast and alternatives.

Table 4.6 Base R/ECON Forecast, 2010-2040

NON-FARM EMPLOYMENT (in thousands)	2010	2040	Change	Percent	CAGR
Agriculture and Mining	52.0	56.2	4.1	108%	0.3%
Chemical	47.4	50.3	2.9	106%	0.2%
Computers & Electronics	14.7	16.2	1.5	110%	0.3%
Construction	42.6	46.0	3.4	108%	0.3%
Fabricated Metal	18.4	19.1	0.7	104%	0.1%
Federal and State Government	437.0	526.8	89.8	121%	0.6%
Finance, Insurance, real estate, rental, and leasing	239.0	331.3	92.3	139%	1.1%
Food (Food & Drink)	16.0	16.4	0.4	102%	0.1%
Information	76.8	106.2	29.4	138%	1.1%
Machinery	20.7	21.6	0.8	104%	0.1%
Other Durables	2.3	2.9	0.6	125%	0.8%
Other Nondurable and Unspecified	49.3	51.4	2.1	104%	0.1%
Other Services	1,174.8	1,625.9	451.1	138%	1.1%
Paper	7.1	7.9	0.8	111%	0.3%
Plastics	9.6	11.1	1.5	115%	0.5%
Printing	12.0	11.7	(0.4)	97%	-0.1%
Retail trade	319.6	442.1	122.5	138%	1.1%
Transportation, Warehousing, Utilities	134.6	186.5	51.9	139%	1.1%
Wholesale trade	172.5	238.9	66.3	138%	1.1%
Grand Total	**2,846.6**	**3,768.2**	**921.6**	**132%**	**0.9%**
Bergen	453.4	601.7	148.3	133%	0.9%
Essex	361.2	458.8	97.6	127%	0.8%
Hudson	232.3	314.1	81.8	135%	1.0%
Hunterdon	54.9	69.8	14.9	127%	0.8%
Middlesex	391.6	541.0	149.4	138%	1.1%
Monmouth	262.4	355.8	93.5	136%	1.0%
Morris	281.2	362.6	81.4	129%	0.9%
Ocean	160.9	218.1	57.2	136%	1.0%
Passaic	172.7	230.1	57.4	133%	1.0%
Somerset	169.6	230.8	61.1	136%	1.0%
Union	224.2	281.6	57.4	126%	0.8%
Warren	37.3	46.6	9.2	125%	0.7%
Sussex	45.0	57.3	12.3	127%	0.8%
Grand Total	**2,846.6**	**3,768.2**	**921.6**	**132%**	**0.9%**

Source: R/ECON.

Table 4.7 Alternative R/ECON Forecast High Population, 2010-2040

NON-FARM EMPLOYMENT (in thousands)	2010	2040	Change	Percent	CAGR
Agriculture and Mining	52.0	61.7	9.6	118%	0.6%
Chemical	47.4	55.2	7.8	116%	0.5%
Computers & Electronics	14.7	17.8	3.1	121%	0.6%
Construction	42.6	50.5	7.9	118%	0.6%
Fabricated Metal	18.4	20.9	2.5	114%	0.4%
Federal and State Government	437.0	597.7	160.7	137%	1.0%
Finance, Insurance, real estate, rental, and leasing	239.0	343.2	104.2	144%	1.2%
Food (Food & Drink)	16.0	18.0	2.0	112%	0.4%
Information	76.8	110.0	33.2	143%	1.2%
Machinery	20.7	23.7	2.9	114%	0.4%
Other Durables	2.3	3.2	0.9	137%	1.1%
Other Nondurable and Unspecified	49.3	56.4	7.1	114%	0.4%
Other Services	1,174.8	1,684.2	509.4	143%	1.2%
Paper	7.1	8.7	1.6	122%	0.7%
Plastics	9.6	12.2	2.5	126%	0.8%
Printing	12.0	12.8	0.8	107%	0.2%
Retail trade	319.6	458.0	138.4	143%	1.2%
Transportation, Warehousing, Utilities	134.6	193.2	58.6	144%	1.2%
Wholesale trade	172.5	247.4	74.9	143%	1.2%
Grand Total	**2,846.6**	**3,974.6**	**1,128.0**	**140%**	**1.1%**
Bergen	453.4	632.3	178.9	139%	1.1%
Essex	361.2	485.1	124.0	134%	1.0%
Hudson	232.3	331.8	99.6	143%	1.2%
Hunterdon	54.9	73.5	18.7	134%	1.0%
Middlesex	391.6	571.8	180.2	146%	1.3%
Monmouth	262.4	375.8	113.4	143%	1.2%
Morris	281.2	380.5	99.3	135%	1.0%
Ocean	160.9	230.6	69.7	143%	1.2%
Passaic	172.7	243.6	70.9	141%	1.2%
Somerset	169.6	243.0	73.4	143%	1.2%
Union	224.2	296.8	72.7	132%	0.9%
Warren	37.3	49.3	11.9	132%	0.9%
Sussex	45.0	60.4	15.4	134%	1.0%
Grand Total	**2,846.6**	**3,974.6**	**1,128.0**	**140%**	**1.1%**

Source: R/ECON.

Table 4.8 Alternative R/ECON Forecast Low Population, 2010-2040

NON-FARM EMPLOYMENT (in thousands)	2010	2040	Change	Percent	CAGR
Agriculture and Mining	52.0	53.8	1.8	103%	0.1%
Chemical	47.4	48.2	0.8	102%	0.1%
Computers & Electronics	14.7	15.5	0.9	106%	0.2%
Construction	42.6	44.1	1.5	103%	0.1%
Fabricated Metal	18.4	18.3	(0.1)	99%	0.0%
Federal and State Government	437.0	495.2	58.2	113%	0.4%
Finance, Insurance, real estate, rental, and leasing	239.0	320.7	81.8	134%	1.0%
Food (Food & Drink)	16.0	15.7	(0.3)	98%	-0.1%
Information	76.8	102.8	26.0	134%	1.0%
Machinery	20.7	20.7	(0.1)	100%	0.0%
Other Durables	2.3	2.8	0.5	120%	0.6%
Other Nondurable and Unspecified	49.3	49.3	(0.0)	100%	0.0%
Other Services	1,174.8	1,574.2	399.4	134%	1.0%
Paper	7.1	7.6	0.5	106%	0.2%
Plastics	9.6	10.6	1.0	110%	0.3%
Printing	12.0	11.2	(0.8)	93%	-0.2%
Retail trade	319.6	428.1	108.4	134%	1.0%
Transportation, Warehousing, Utilities	134.6	180.6	46.0	134%	1.0%
Wholesale trade	172.5	231.3	58.7	134%	1.0%
Grand Total	**2,846.6**	**3,630.6**	**784.1**	**128%**	**0.8%**
Bergen	453.4	580.4	127.0	128%	0.8%
Essex	361.2	441.6	80.4	122%	0.7%
Hudson	232.3	302.4	70.1	130%	0.9%
Hunterdon	54.9	67.2	12.4	123%	0.7%
Middlesex	391.6	521.0	129.4	133%	1.0%
Monmouth	262.4	342.7	80.3	131%	0.9%
Morris	281.2	349.9	68.7	124%	0.7%
Ocean	160.9	209.9	49.1	131%	0.9%
Passaic	172.7	221.5	48.8	128%	0.8%
Somerset	169.6	222.5	52.9	131%	0.9%
Union	224.2	271.4	47.2	121%	0.6%
Warren	37.3	44.8	7.5	120%	0.6%
Sussex	45.0	55.2	10.2	123%	0.7%
Grand Total	**2,846.6**	**3,630.6**	**784.1**	**128%**	**0.8%**

Source: R/ECON.

Table 4.9 Alternative R/ECON Forecast High CPI, 2010-2040

NON-FARM EMPLOYMENT (in thousands)	2010	2040	Change	Percent	CAGR
Agriculture and Mining	52.0	56.5	4.5	109%	0.3%
Chemical	47.4	50.6	3.2	107%	0.2%
Computers & Electronics	14.7	16.3	1.6	111%	0.4%
Construction	42.6	46.3	3.7	109%	0.3%
Fabricated Metal	18.4	19.2	0.8	104%	0.1%
Federal and State Government	437.0	481.7	44.7	110%	0.3%
Finance, Insurance, real estate, rental, and leasing	239.0	323.2	84.3	135%	1.0%
Food (Food & Drink)	16.0	16.5	0.5	103%	0.1%
Information	76.8	103.6	26.8	135%	1.0%
Machinery	20.7	21.7	1.0	105%	0.2%
Other Durables	2.3	2.9	0.6	126%	0.8%
Other Nondurable and Unspecified	49.3	51.8	2.4	105%	0.2%
Other Services	1,174.8	1,586.5	411.6	135%	1.0%
Paper	7.1	8.0	0.8	112%	0.4%
Plastics	9.6	11.1	1.5	116%	0.5%
Printing	12.0	11.7	(0.3)	98%	-0.1%
Retail trade	319.6	431.4	111.8	135%	1.0%
Transportation, Warehousing, Utilities	134.6	182.0	47.4	135%	1.0%
Wholesale trade	172.5	233.1	60.5	135%	1.0%
Grand Total	**2,846.6**	**3,654.2**	**807.6**	**128%**	**0.8%**
Bergen	453.4	584.9	131.5	129%	0.9%
Essex	361.2	443.2	82.0	123%	0.7%
Hudson	232.3	303.6	71.3	131%	0.9%
Hunterdon	54.9	67.6	12.8	123%	0.7%
Middlesex	391.6	525.0	133.4	134%	1.0%
Monmouth	262.4	344.6	82.2	131%	0.9%
Morris	281.2	352.5	71.3	125%	0.8%
Ocean	160.9	211.1	50.2	131%	0.9%
Passaic	172.7	223.0	50.2	129%	0.9%
Somerset	169.6	224.6	54.9	132%	0.9%
Union	224.2	273.4	49.2	122%	0.7%
Warren	37.3	45.2	7.9	121%	0.6%
Sussex	45.0	55.5	10.5	123%	0.7%
Grand Total	**2,846.6**	**3,654.2**	**807.6**	**128%**	**0.8%**

Source: R/ECON.

Table 4.10 Alternative R/ECON Forecast Low CPI, 2010-2040

NON-FARM EMPLOYMENT (in thousands)	2010	2040	Change	Percent	CAGR
Agriculture and Mining	52.0	55.7	3.7	107%	0.2%
Chemical	47.4	49.9	2.5	105%	0.2%
Computers & Electronics	14.7	16.1	1.4	109%	0.3%
Construction	42.6	45.6	3.0	107%	0.2%
Fabricated Metal	18.4	18.9	0.5	103%	0.1%
Federal and State Government	437.0	588.3	151.3	135%	1.0%
Finance, Insurance, real estate, rental, and leasing	239.0	341.4	102.5	143%	1.2%
Food (Food & Drink)	16.0	16.2	0.3	102%	0.1%
Information	76.8	109.4	32.6	143%	1.2%
Machinery	20.7	21.4	0.7	103%	0.1%
Other Durables	2.3	2.9	0.6	124%	0.7%
Other Nondurable and Unspecified	49.3	51.0	1.7	103%	0.1%
Other Services	1,174.8	1,675.7	500.9	143%	1.2%
Paper	7.1	7.9	0.7	110%	0.3%
Plastics	9.6	11.0	1.4	114%	0.4%
Printing	12.0	11.6	(0.4)	96%	-0.1%
Retail trade	319.6	455.7	136.0	143%	1.2%
Transportation, Warehousing, Utilities	134.6	192.3	57.6	143%	1.2%
Wholesale trade	172.5	246.2	73.6	143%	1.2%
Grand Total	**2,846.6**	**3,917.0**	**1,070.5**	**138%**	**1.1%**
Bergen	453.4	623.4	170.0	137%	1.1%
Essex	361.2	479.3	118.2	133%	0.9%
Hudson	232.3	327.9	95.6	141%	1.2%
Hunterdon	54.9	72.6	17.7	132%	0.9%
Middlesex	391.6	561.8	170.2	143%	1.2%
Monmouth	262.4	370.5	108.2	141%	1.2%
Morris	281.2	375.7	94.5	134%	1.0%
Ocean	160.9	227.2	66.3	141%	1.2%
Passaic	172.7	239.5	66.8	139%	1.1%
Somerset	169.6	238.8	69.2	141%	1.1%
Union	224.2	292.4	68.2	130%	0.9%
Warren	37.3	48.3	11.0	129%	0.9%
Sussex	45.0	59.6	14.7	133%	0.9%
Grand Total	**2,846.6**	**3,917.0**	**1,070.5**	**138%**	**1.1%**

Source: R/ECON.

4.6 INTEGRATION WITH THE NJTPA FREIGHT FORECASTING TOOL

The five R/ECON forecasts are contained in, and integrated with, the NJTPA Freight Forecasting Tool. Using the Tool, additional detail and capabilities can be accessed. Section 6 of this Report and Appendix C provide more detail on the Tool. With respect to handling of the R/ECON data, the key features of the Tool are as follows.

- **Disaggregation of inputs**. The Freight Forecasting Tool includes disaggregation factors to step down from NJTPA region industry employment data to county-level data.
- **Substitution of user-defined forecasts**. As future forecasts become available, the Freight Forecasting Tool can read an alternative user-entered forecast. So long as the user enters NJTPA region employment by year by industry group, the model will disaggregate it to counties, perform calculations, and generate reports, in the same way it does for the R/ECON forecasts.
- **"What if" analysis**. The Freight Forecasting Tool allows the user to selectively change the employment forecast in one or more county/industry pairs, to test the effect of alternative assumptions. This allows the examination of much finer-grained changes than would be possible simply by changing the input regional employment forecast.
- **Integration of Make-Use tables**. The Freight Forecasting Tool determines the employment growth associated with each county-industry pair based on the selected R/ECON forecast. Then it examines the TRANSEARCH freight flow dataset, where each individual record has an origin, destination, commodity type, direction, and mode. For each TRANSEARCH record, the Freight Forecasting Tool determines which NJTPA counties and industries are linked to that commodity move, identifies the associated county-industry growth factors from R/ECON and calculates the applicable commodity tonnage growth factors from the Make-Use tables.
- **Detailed reporting of employment forecasts**. Tables 4.6 through 4.10 above summarize employment by industry group and employment by county. More detailed data on county employment by industry, and employment for interim forecast years, is reported within the Freight Forecasting Tool.

5.0 Freight Factors and Trends

5.1 INITIAL SCAN OF KEY FACTORS

Within the overall study work plan, it was important to identify and document the key factors and trends impacting the movement of goods, so they could be addressed as variables within the NJTPA Freight Forecasting Tool. Work focused on the following questions: What are the most critical factors NJTPA should consider in freight forecasting? What types of changes and trends are affecting these factors? And what is the best method for incorporating these factors as "what-if" conditions within the NJTPA Freight Forecasting Tool?

As a starting point for the analysis, NJTPA and the consultant team identified the following factors and trends impacting goods movement that might need to be addressed:

- The global economy;
- The U.S. economy and economic geography;
- Global and domestic supply chains;
- Regional economic development;
- Regional infrastructure development;
- Environmental policies;
- Transportation carrier strategies;
- Competing region strategies;
- Workforce productivity changes;
- Fuel and energy factors; and
- Risk and uncertainty.

5.2 APPROACH

The factors listed in Section 5.1 encompass public policy, private enterprise, economic activity, and transportation infrastructure at a broad range of geographies from local to global. To effectively address these factors within the freight forecasting process, it is essential to reduce them to the minimum number of independent factors, and to treat them in an organized manner.

To begin, it is useful to divide the various factors according to how they are treated, or not treated, within the R/ECON forecasting process:

- Local and regional economy factors that are accessible variables within the R/ECON model alternative employment forecasts. The most appropriate values can be selected and utilized in freight forecasts by choosing a corresponding R/ECON forecast.
- National economy and trade factors that are input variables to the R/ECON model. These are national values, sourced from a forecast produced by IHS Global Insight, and do not vary among the five alternative R/ECON forecasts. Manipulation of these factors requires post-processing adjustments to the R/ECON employment forecasts and the freight flow forecasts they generate.
- Global economy and trade factors that are underlying variables for the national forecast, but not explicitly defined or accessible. Manipulation of these factors also requires post-processing adjustments.
- Transportation and logistics factors that are not considered in the R/ECON model. Manipulation of these factors also requires post-processing adjustments.

5.3 LOCAL AND REGIONAL ECONOMY AND TRADE

The key output of the R/ECON model is an employment forecast for the State of New Jersey, disaggregated to the NJTPA region by county and industry sector. Growth in freight tonnage is proportional to growth in employment, all other factors being equal. (There are many reasons why other factors might not be equal – increases in workforce productivity so that each employee generates more freight, changes in import/export balance, economic policy, modal preferences, transportation infrastructure constraints, etc. – and these are all addressed through post-processing steps in the Freight Forecasting Tool.) But as a starting point, all freight forecasts begin with underlying NJTPA region employment forecasts.

As described in Section 4.2, five alternative R/ECON forecasts were developed for this study:

- A "base" forecast representing most likely conditions
- "High population" and "Low population" forecasts representing different levels of New Jersey and NJTPA population growth
- "High CPI" and "Low CPI" forecasts representing different levels of New Jersey and NJTPA consumer prices

These two variables – population and CPI – can be directly manipulated by the forecaster, through the choice of an appropriate R/ECON forecast.

Among all economic drivers of freight movement, there is significant correlation across many different factors. The R/ECON model itself includes more than 100 regression equations. Changes in assumptions about population and CPI tend to produce corresponding changes in other NJ and NJTPA regional factors, including:

- Personal Income
- Retail Sales
- New Vehicle Registrations
- Residential Building Permits
- Gross State Product

These values are all reported out by R/ECON. Changes in any of these factors can therefore be accessed indirectly, by selecting the alternative R/ECON forecast that produces values most closely approximating the desired targets.

These factors, the ways they impact the movement of goods and their associated trends and forecasted changes, are summarized in Table 5.1 following. Table 5.2 following shows the differences in trends (in terms of compound annual growth rate, or CAGR) between the base forecast and the four alternative forecasts.

Table 5.1 Local and Regional Economy Factors, Base R/ECON Forecast

NJ and NJTPA Regional Factors	Impact on Goods Movement	Trend/Forecast 2010-2040 CAGR
Employment	Employment is the most important number calculated by R/ECON, and is the key metric for generating freight tonnage forecasts. Higher employment means more consumption and production, hence more goods movement. Lower employment means less goods movement. Employment forecasts are generated by R/ECON as a function of other variables and inputs.	1.0% NJ 0.9% NJTPA
Population	Faster population growth means faster growth in employment and more consumption and production, hence more goods movement, other factors being constant. Slower population growth means less goods movement.	0.7%
Consumer Price Index	Higher CPI means higher prices and less consumption and production, hence less goods movement, other factors being constant; lower CPI means lower process and more consumption and production, hence more goods movement.	2.0%
Personal Income	Higher personal income means more spending, more production and consumption, and more goods movement. Lower personal income means less goods movement.	4.4%NJ 4.5% NJTPA
Retail Sales	Higher retail sales generates more production and consumption, and more goods movement. Lower retail sales generates less goods movement.	4.1%
Vehicle Registrations	Higher vehicle registrations mean more production of automobiles and related parts, more retail sales of autos, and more spending on auto-related expenses, generating more goods movement. Lower registrations mean less freight.	1.9%
Building Permits	More building permits reflect increased construction activity, along with increased demand for raw materials and employment, generating more goods movement. Fewer building permits generate less goods movement.	5.7%
Gross State Product	Gross State Product (the value of business output less business costs, or "value-added") measures the extent of production activities. The higher the GSP, the greater the demand for inbound materials and outbound finished products, and the greater the freight movement. Generally this is a 1:1 correlation, controlled for other variables, according to MARAD analyses.	2.0%

Source: R/ECON.

Table 5.2 Local and Regional Economy Factors, Comparison of R/ECON Forecasts

NJ and NJTPA Regional Factors	Forecast Scenario	Trend/Forecast 2010-2040 CAGR
Employment	Base	1.0% NJ, 0.9% NJTPA
	High Population	1.2% NJ, 1.1% NJTPA
	Low Population	0.8% NJ, 0.8% NJTPA
	High CPI	0.9% NJ, 0.9% NJTPA
	Low CPI	1.1% NJ, 1.1% NJTPA
Population	Base	0.7%
	High Population	1.0%
	Low Population	0.5%
	High CPI	0.7%
	Low CPI	0.7%
Consumer Price Index	Base	2.0%
	High Population	2.0%
	Low Population	2.0%
	High CPI	2.1%
	Low CPI	1.8%
Personal Income	Base	4.4%NJ, 4.5% NJTPA
	High Population	4.8% NJ, 4.9% NJTPA
	Low Population	4.3% NJ, 4.4% NJTPA
	High CPI	4.4% NJ, 4.4% NJTPA
	Low CPI	4.4% NJ, 4.5% NJTPA
Retail Sales	Base	4.1%
	High Population	4.5%
	Low Population	4.0%
	High CPI	4.1%
	Low CPI	4.1%
Vehicle Registrations	Base	1.9%
	High Population	2.1%
	Low Population	1.7%
	High CPI	1.8%
	Low CPI	1.9%
Building Permits	Base	5.7%
	High Population	6.6%
	Low Population	5.2%
	High CPI	5.4%
	Low CPI	6.1%
Gross State Product	Base	2.0%
	High Population	2.2%
	Low Population	1.8%
	High CPI	1.9%
	Low CPI	2.1%

5.4 NATIONAL ECONOMY AND TRADE

R/ECON includes a variety of other national economic factors which are sourced from IHS Global Insight, Inc. As previously mentioned, these factors do not change across the various R/ECON forecasts, so they cannot be "selected" based on the choice of one R/ECON forecast over another. They can, however, be addressed through "post-processing," as discussed in Section 5.7.

Table 5.3 below summarizes the key national economy and trade factors and the trends and forecasts assumed by R/ECON.

Table 5.3 National Economy and Trade Factors

National Factors	Impact on Goods Movement	Trend/Forecast 2010-2040 CAGR
Employment	Same as Table 5.1	1.0%
Population	Same as Table 5.1	0.9%
Consumer Price Index	Same as Table 5.1	2.0%
Consumption	More consumption in durable and non-durable products means more freight moving from producers to consumers, and more materials moving to producers.	
Durables		3.5%
Non-Durables		4.4%
Services		4.5%
Retail and Vehicle Sales	Same as Table 5.1	
Retail Sales		4.8%
Auto Sales		2.2%
Light Truck Sales		1.5%
Retail Prices	Lower prices means a higher propensity to consume, resulting in more freight movement associated with construction, vehicle purchases, and vehicle operations. Higher fuel prices also advantage more fuel efficient modes, such as rail and water, over truck. However, given that many rail and water services are intermodal and involve trucking at the origin or destination points of the trip, these modes are still impacted by higher fuel costs.	
Median Home Price		3.0%
Light Vehicle Price		2.3%
Fuel Price		2.0%
Wholesale Prices		
Processed Foods		0.9%
Electric Power		2.8%
Utility Natural Gas		1.4%
Refined Petroleum		1.9%
Chemicals		1.4%
Metal Products		1.4%
Wages and Benefits	Higher wages mean an increased ability to consume, resulting in more freight movement.	
Personal Income		4.8%
Minimum Wage		1.9%

Cost of Funds	Lower costs of funds mean an increased ability to	
Mortgage Rate	invest in construction, business expansion, and other	1.4%
Long-Term Bond Rate	activities that stimulate the economy and generate	1.2%
3-Month T-Bill Rate	freight movement.	12.3%
Business Indices	Higher profits, stock values, and GDP generally	
Before-Tax Profits	reflect higher levels of economic activity in both goods	3.5%
S&P 500 Index	and service producing industries, and are correlated	4.6%
Gross Domestic Product	with increased freight movement.	2.7%
Trade Factors	A key factor in overall freight movement is the	
Value of Imports	balance between international and domestic	5.5%
Value of Exports	movement. Some share of domestic production is exported to global markets; some share of domestic consumption is imported from global markets	6.7%

Source: R/ECON.

One of NJTPA's goals for this project is to create a Freight Forecasting Tool that allows for the analyst to test a wide range of "what if" scenarios, without actually running the economic models again. However, the relationships among the factors listed in Table 5.3 are complex. One of the most important jobs of national economic models (like the IHS Global Insight Model) and regional economic models (like R/ECON) is to address the interrelationships and interdependencies of critical input factors, and to address them within a framework of regression equations. Respecting this complexity, the analyst should be cautious in attempting to manipulate any single factor outside of the model environment.

Even so, it is reasonable for the Freight Forecasting Tool to test the potential effects of different assumptions regarding: US GDP; US Fuel Price; and US Import and Export Values. This is a short list of factors which are linked, but to a reasonable degree independent, with a high degree of explanatory power.

- US GDP is probably the highest level basic economic driver. It will be highly (but not entirely) determinative of all other economic variables, including personal income and consumption rates, and will also be a key explanatory variable for housing and auto sales, other investments in plant and equipment, etc. US GDP provides an additional dimension compared to NJ GSP, because it reflects the propensity for "pass through" freight movement traversing New Jersey between domestic origins and destinations, for "gateway" freight movement between international air and seaports and other states, and for trade with other states. Relating major components of GDP to freight volumes is, of course, a complex task. The question is how to simplify it so that it provides reasonable and useful results. For consumer spending and a few other GDP components the relationships are relatively straightforward. For example, increasing

consumption of food can generally be translated into increased volumes of food products. (Agricultural products such as grain are, however, a significant part of US exports). Consumer spending is also a primary driver of volumes for many goods such as apparel, furniture, appliances, etc. Likewise, increased consumer spending on automobiles (primarily purchases of new vehicles) translates to increased volumes of vehicles being moved, whether domestic or imported. But for this large category, vehicle volumes are also dependent on business investment in vehicles. Investment in residential and non-residential construction are major drivers of many industrial goods volumes ranging from wood and metal products to bulk materials such as cement and gravel. Other investment categories such as business investment in equipment are directly related to increased volumes of industrial equipment and other capital goods such as computers and telecommunications equipment. The greatest difficulty is in relating GDP components to goods volumes in industrial materials and intermediate goods such as oil and related products, chemicals, plastics, metals and metal products and so on. For these products that are indirectly used by all components of the economy an aggregate measure of the economy such as GDP may be the only simple way to relate economic growth to freight volumes. Finally, there is also a directional component to GDP growth: a stronger domestic economy means more of the nation's needs are met through domestic production, there are more goods available to export, and fewer goods need to be imported.

- US Fuel Price is one component of US CPI, but is subject to significant swings based on global conditions and US policy. Fuel price has important and direct effects on the volume of freight movement (higher fuel prices mean higher transportation costs and a lessening of freight movement activity), the modes by which freight moves (higher fuel prices tend to shift freight from fuel intensive modes to fuel efficient modes), and the length of supply chains (higher fuel prices favor shorter domestic moves over longer international moves). So it is important to identify and test the effects of alternative assumptions.
- US Import Value and Export Values are a function of US GDP, fuel prices (affecting inland cost to gateways), and many other factors. Growth in the value of US imports and exports could vary significantly depending on the structure of the US economy and world economies, trading patterns, US trade policy and infrastructure investments, and a host of other factors. In recent years, the US has been an exporter of agricultural products, forest products, mined products, and advanced high-value machinery. It has been an importer of consumer goods, and has developed a significant and growing trade value imbalance. Future forecasts generally anticipate more of a balance, with export values growing faster than import values. Improving trade balance and growing US exports has been a policy goal of the Federal government and many

states. However, given the wide range of uncertainty it is useful to be able to test different scenarios. Growth in export value requires growth in domestic production capacity, which means not only are more goods produced for export, but also fewer goods need to be imported. There has been much discussion lately of the possibility of "reshoring," or bringing manufacturing growth back to the US, to achieve this. This is the same effect mentioned in the GDP discussion above: a stronger domestic economy tends to grow exports faster than imports. It is difficult, and in the end probably pointless, to quantify all the different inputs that determine import and export value. What is possible, and of considerable value, is the analyst's ability to test scenarios: e.g., if the sum total of all factors is an X% increase in imports and a Y% increase in exports, what is the effect on freight movement for the NJTPA region?

5.5 GLOBAL ECONOMY AND TRADE

Beyond the factors listed above, there is another set of freight movement drivers that could have profound effects on the amount of freight that is moved to, from and within the NJTPA region.

- **Global Economic Changes**. The recent world recession and economic slowdown has affected goods movement in New Jersey as well as other regions. Understanding the magnitude of the impact on recent movements is essential to determining future freight flows. Of particular interest are the foreign economies that are significant trade partners with North Jersey and other regions in the United States relying on North Jersey's ports. It is possible that global economic growth may be faster or slower than current projections that support the IHS Global Insight and R/ECON forecasts; so it will be useful to have the capability to enter alternative global activity forecasts into the Freight Forecasting Tool. World GDP is the recommended measure. It is also important to consider regional economic development, which adjusts for varying growth in demand by world regions. For example, if growth is higher in regions such as Europe, the Mideast, India or Southeast Asia that are generally served by New York/New Jersey ports, export volumes from the NJTPA regions and from the US as a whole will be greater than the baseline forecast. Regional effects can be addressed by using a World GDP applicable to key trading regions, rather than the full world economy.
- **Country Sourcing** reflects potential shifts in sourcing of US imports. If imports from Northeast Asian sources shift to Europe, the Middle East, India or Southeast Asia, then imports to and through the NJTPA region will be larger than the baseline forecast. Such sourcing shifts could occur due to currency revaluations or changes in exchange rates (e.g. shifting

sourcing from China to Vietnam). A significant increase in global fuel costs, which could cause shifts from China to Mexico ("near sourcing"), would result in imports lower than the baseline forecast. Exchange rates and world fuel costs are both suggested as measures within the Freight Forecasting Tool. A strong dollar tends to favor imports, while a weak dollar tends to favor exports; high fuel prices tend to suppress trade and favor "nearshoring."

5.6 TRANSPORTATION AND LOGISTICS FACTORS

The R/ECON and Global Insight models live in a mathematical world. Freight movement occurs in the real world, over real physical infrastructure. These models do not take into account the amount of capacity in a given mode or route, or the propensity to use the Panama Canal vs. the Suez Canal, or factors that would favor one transportation mode over another. These types of factors become critically important when developing freight forecasts, so it is necessary to build a bridge between the mathematical world and the real world. Again, the goal is to identify a minimum number of key drivers that provide a maximum of explanatory and analytical power.

- **Mode Shift Between Truck and Rail.** The NJTPA region is served by truck, rail, air, and water, but some of the most important policy decisions facing the region have to do with the modal balance between truck and rail. To a large extent the market has, and will continue to, establish this balance based on the "customer service trinity" of reliability, cost, and speed. As fuel prices rise, trucking costs will rise faster than rail costs, favoring a shift to rail; so US Fuel Price is an important factor to consider. But there are other factors as well – congestion on the highways vs. congestion on the rail system, truck driver availability vs. railroad service strategies and pricing, planned improvements for highways vs. planned improvements for rail networks and terminals, environmental policies providing mandates and/or incentives for clean trucks vs. cleaner rail engines, public acceptance of more trucks vs. more rail traffic, and public policies to help tilt the balance. All of these factors are difficult to quantify, but they can be tested in a simple way: the user identifies a Target Mode Share based on the combined effect of these variables, and the Freight Forecasting Tool calculates the corresponding effect on NJTPA freight movement.
- **Global Supply Chain Changes –** Global changes in freight operations, infrastructure, and policy could impact the demand for goods movement in the region. Major infrastructure projects abroad will influence future goods movements. Expansion of the Panama Canal and integration of European maritime operations could each significantly affect the region's ports. Ports along the U.S. East and Gulf coasts are investing in

additional infrastructure in anticipation of greater container volumes as well as calls by larger vessels soon to be able to pass through the Panama Canal. Utilization of the Suez Canal and rail "landbridge" services from US West Coast ports will continue to remain important, and will compete with the Panama Canal for business. Freight forecasting needs to consider three aspects of this factor:

- Panama Canal Impacts. There is no consensus on the most likely effects of Panama Canal expansion on any given port. This consultant team believes that the total cost of transporting international containerized goods to the region – whether by Panama Canal, Suez Canal, or rail landbridge from west coast ports – is likely to be relatively unchanged in aggregate, due to competitive pricing among these three routings for contestable traffic. The result is that containers imported to the region (the key directional driver for container trade) will likely be the same, with or without Panama Canal expansion. The Suez routings will always have a geographic advantage for Southeast Asia, India, and Europe trades. The trade more in question is China and Northeast Asia, which is likely to arrive either by rail landbridge or all-water via the Panama Canal. If by landbridge, the trade will generate more rail moves to the region and more truck moves from railyards to regional destinations; this means less all-water moves to the region and fewer truck and inland rail trips generated from marine terminals. If by all-water, the trade will generate more vessel moves to the region and more truck and inland rail moves from marine terminals; this means less rail landbridge traffic and fewer truck trips serving the railyards. Essentially, we view the Panama Canal as having no effect on the total amount of freight produced or consumed in the region, but as having a significant effect on how that freight moves to and from the region, on what types of secondary trips are generated, and on the locations where freight traffic is generated.
- Bayonne Bridge Impacts. The bridge currently presents an "air draft" (vessel height above water) restriction, preventing the world's largest container ships from transiting the Kill van Kull to reach marine container terminals in Newark Bay (the Port Newark/Elizabeth complex). According to PANYNJ, ongoing environmental studies have not yet determined how much marine traffic might be lost if the bridge height is not improved. Clearly, there would be a potential loss of future growth in container volumes for PANYNJ marine terminals in Newark Bay. However, following the same logic as our Panama Canal argument, we believe such losses would be offset by increases in rail landbridge traffic arriving in the region, so the region would see the same amount of import tonnage, but via a different arriving mode. (We

do not believe that trucking from other east coast ports will be a factor, since the only nearby port with sufficient water depth and air draft for very large ships is Baltimore, which is around one-tenth the size of PANYNJ in terms of containers handled.) Failure to improve the Bayonne Bridge has significant economic impacts, since the region would lose benefits associated with handling marine cargo bound for the NY/NJ metropolitan region as well as for inland "hinterland" destinations.

- Competition and Capacity Impacts. If the region fails to modernize its marine terminals to provide sufficient capacity for future demand, and falls behind competing ports that are aggressively modernizing, it will lose the ability to meet its international trade needs through its own facilities, and will become more dependent on other ports. Again, we see this as a zero-sum situation, where the import tonnage to the region is not changed, but swings between over-the-wharf volume and rail landbridge volume. Since this issue is not limited to very large vessels, other east coast ports could serve the region by truck as well as landbridge. However, we would note that much of the region's non-containerized "breakbulk" – fruit and agricultural products, building materials, machinery, and vehicles – has already moved to other ports (Davisville RI, Philadelphia PA, Wilmington DE, and Baltimore MD) and already enters the region by truck. The region's liquid and dry bulk commodities are largely handled through private terminals and these moves will continue. The main issue will be where containers come from, and the question is not limited to China trade or very large vessels, but also includes Europe trade and smaller vessels. Alternative ports include the US West Coast as well as the Ports of Virginia, Charleston, and Savannah, all of which could serve the NY/NJ region effectively by rail due to ongoing improvements in the national rail network.

- **Rail System Improvements.** One of the most critical projects being planned in the region is an intermodal rail terminal at Greenville Yard, adjacent to the Global/MOTBY marine terminal complex in Bayonne. With this improvement, Global/MOTBY will generate a significant amount of rail traffic for inland markets, without generating local truck trips between the marine terminal and railyards. If the Greenville intermodal rail terminal is not constructed, this traffic would have to move over local streets between the marine terminal and suitable off-terminal railyards.

- **Warehouse Logistics.** There are two important trends that should be reflected in freight forecasting:

- The first is "freight sprawl," the tendency for new and very large warehouse/distribution centers to locate some distance from population centers; for these facilities, developers increasingly seek significant, affordable acreage with good access to interstate grade highways, and are willing to sacrifice proximity to customers to get it. As a result we have seen significant development along the New Jersey Turnpike as far south as Exit 6, and into Eastern Pennsylvania along I-80 and I-78 through Allentown and as far as Harrisburg, where a number of important national rail lines intersect with I-81 and I-78. The tendency for Port-related warehouse and distribution facilities to prefer Pennsylvania locations means less local truck traffic to and from marine terminals, but more longer-haul truck traffic to these locations.
- A more overarching trend is for Overseas Warehousing. The traditional logistics approach is for shippers to import containers of different products, move them to warehouse/distribution centers, and then build shipments of mixed products for their retail outlets. Increasingly, this "mixing" process is occurring overseas, where full containerloads are being made for direct delivery to retail outlets, bypassing US warehouse/distribution facilities. This trend may reduce the overall amount of freight moving to and from regional warehouse/distribution centers.

5.7 INTEGRATION WITH FREIGHT FORECASTING TOOL

As previously mentioned, a major goal of the study is to develop a Freight Forecasting Tool that is responsive to key freight drivers and trends, and allows NJTPA to test the effects of alternative future scenarios affecting these drivers.

The preferred response developed over the course of the study through intensive and iterative discussions between NJTPA, its subregions, and the consultant team. The initial consultant recommendation was to create an "adjustment matrix" illustrating how changes in different freight drivers would affect different types of freight movements. Ultimately, three separate adjustment matrices were developed, and these were included in the Freight Forecasting Tool to allow for "what if" adjustments by the user. (For more detail on the "what if" capabilities of the Freight Forecasting Tool, please refer to Section 6 and Appendix C). The three adjustment matrices are:

- County and Industry Employment. NJTPA employment is the single most important driver for freight movement. This matrix reads input values from the selected R/ECON forecast and allows the user to make selected changes in employment by county and industry type, if desired.

These changes, in turn, will affect the amount of freight movement generated by a county and industry.

- Economy and Trade Factors. These include: World GDP; World fuel price; US GDP; US fuel price; exchange rate; US import value; and US export value. They capture the critical effects discussed in Sections 5.4 and 5.5 above.
- Transportation and Logistics Factors. These include: fuel price effects on truck/rail mode shares; truck/rail modal balance; Panama Canal effects; Bayonne Bridge effects; other port competitiveness and capacity effects; Greenville Yard effects; Pennsylvania DC development; and overseas warehousing effects. They address the issues and trends discussed in Section 5.6 above.

Additionally, a separate pre-processing step was created to address workforce productivity. The workforce productivity adjustment is essentially a scalar factor relating growth in employment to growth in freight tonnage. Set at 1, the factor means that growth in freight tonnage will be directly proportional to growth in employment. Set at higher values, it means that each employee is more productive, and is generating more freight.

This structure ensures that the key drivers of freight movement, and their associated trends and forecasts, are reflected in the freight forecasting process. It also provides NJTPA with the ability to respond to changes in trends and forecasts, and to assess risk and uncertainty by testing a broad range of potential "what-if" scenarios.

6.0 Freight Forecasting Tool

6.1 DEVELOPMENT STEPS

Development of the Freight Forecasting Tool focused on the following tasks:

- Developing translation routines to convert industry forecasts to changes in freight tonnage flows, and codifying these routines in the form of an interactive NJTPA Freight Forecasting Tool.
- Using the Freight Forecasting Tool to automatically create RTM-E (Regional Transportation Model – Enhanced) truck trip tables from generated freight forecasts.
- Preparing a base case year 2040 freight forecast and associated RTM-E truck trip table, running RTM-E with the new trip table, and incorporating the 2040 freight forecast and RTM-E network flows into the Subregional Freight Profiles initially developed under Task 2 of this project.

6.2 THE NJTPA FREIGHT FORECASTING TOOL

The NJTPA Freight Forecasting Tool is a large Microsoft Excel spreadsheet model consisting of multiple worksheets:

- A User Input screen where the user specifies the years to be forecast, the employment forecast to be used (one of the five R/ECON forecasts or the user-defined values), and two optional adjustments (employee productivity and allocation of regional warehouse growth). The User Input screen contains instructions on the use of Macro commands to run the model.
- A set of "What If" tables where the user can enter different values for employment growth, global and national trade and economic factors, and transportation logistics factors.
- A set of worksheets where the results (employment forecasts and freight forecasts) are reported and stored. High-level summary results are also reported to the User Input worksheet for quick review.
- The five alternative R/ECON forecasts for NJTPA regional employment, as discussed in Section 4.2, plus a "blank" forecast in the correct format, where user-entered values can be accepted.
- A series of processing worksheets to disaggregate NJTPA regional employment to the level of counties and industry types.

- A set of "Make/Use" tables to relate changes in county/industry employment to changes in freight tonnage demand by county/commodity/direction, plus calculations to generate the specific growth rates to be applied to each record in the TRANSEARCH database, according to origin-destination, commodity, and mode.
- The TRANSEARCH freight flow database for year 2007. TRANSEARCH is a commercial product of IHS Global Insight, purchased by NJTPA, containing confidential information subject to a restricted use license. TRANSEARCH, and by extension the Freight Forecasting Tool itself, cannot be shared or used in a manner not consistent with the license. Each record in TRANSEARCH provides an origin, destination, mode, commodity, and volume. Freight flows between the years 2007 and 2010 were relatively flat, due to the recession, and the 2007 data is considered applicable to the current year. Columns appended to the TRANSEARCH freight flow database will look up growth factors from other worksheets depending on the particular attributes of the individual record (county, type of flow, mode, commodity, and international vs. domestic). All records look up an employment-related growth factor based on the Make/Use tables. Some records, but not others, look up other growth factors from the "What If" tables. For each record, the growth factors are summed and applied to the current year volumes, to produce a future year forecast.
- A worksheet for generating RTM-E heavy truck trip tables.
- Additional worksheets containing background information on R/ECON drivers and an alternative national forecast sourced from Moody's Economy.com.

Appendix C is a User Guide for the Freight Forecasting Tool, and provides detailed documentation of each of these features, as well as the procedures and suggested use of the Tool.

6.3 RTM-E TRUCK TRIP TABLES

Once the Freight Forecasting Tool generates a future year forecast, it is a relatively straightforward process to create an RTM-E trip table for heavy trucks based on the truck tonnage in the forecast. (Note: all of the truck tonnage in the forecast is assumed to be heavy trucks. TRANSEARCH does not capture, or at best poorly captures, local and lower-weight truck trips.)

In developing the methodology, CS built on past experience on the PANYNJ Cross Harbor Freight Movement Program EIS.

- CS is a member of a joint venture preparing the PANYNJ Cross Harbor Freight Movement Program. CS is leading the effort to develop transportation models and forecasts of freight demand. As part of that effort, CS assigned the truck flows in the PANYNJ's TRANSEARCH database to the

Federal Highway Administration's (FHWA) FAF2 highway network. This was done using assignment routines in TransCAD, consistent with the software platform of the FAF2 network, as discussed in the technical documentation for FAF2 available from FHWA. The process includes converting the annual truck unit flows to average weekday flows using an equivalency of 295 equivalent days per year. The consultant team used the TransCAD procedures for creating a subarea O/D matrix, with the model boundary of the NJRTM-E as the subarea applied to the national network.

- These procedures were used to create a weekday freight truck O/D matrix consistent with the NJRTM-E network. This process associates flows, to and from TRANSEARCH regional zones beyond the NJRTM-E model region, with external stations created on the links where the national highway network crosses the NJRTM-E model boundary.
- External stations are not utilized in the NJRTM-E. The consultant team, therefore, followed the *"Specific exceptions to this process were made for long-haul truck trips assumed to access the region at specific interstate roadways along the extended boundary"* guidance as described in the NJRTM-E documentation[2] to associate truck traffic from external highways with the correct traffic analysis zone (TAZ) in the NJRTM-E for loading purposes.
- The disaggregation from internal counties to TAZs was done by creating disaggregation factors from the share that a TAZ was of the county's total employment and population. The resulting disaggregated TRANSEARCH truck O/D matrix was assigned to the NJRTM-E highway network using the procedures described in the model documentation.

For this project, the consultant team used a modified version of this process. National freight flows were assigned to the FAF network. A weekday freight truck O/D matrix for the NJRTM-E region was created using a subarea extraction process. The flows internal to the NJRTM-E model were disaggregated to TAZs using the share of employment by industry.[3] This process was initially done "manually" (e.g., outside of the Freight Forecasting Tool) to ensure that RTM-E trip tables were prepared in sufficient time for integration into the Subregional Freight Profiles; it was subsequently automated within the Freight Forecasting Tool as the Tool was completed.

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[2] URS et al., *North Jersey Regional Transportation Model Enhanced: Model Development Report,* NJTPA, November 2008.

[3] Cambridge Systematics, Inc., *Development of A Computerized Method to Subdivide the FAF2 Regional Commodity OD Data to County Level OD Data,* FHWA, January 2009

7.0 2040 Freight Forecast Findings

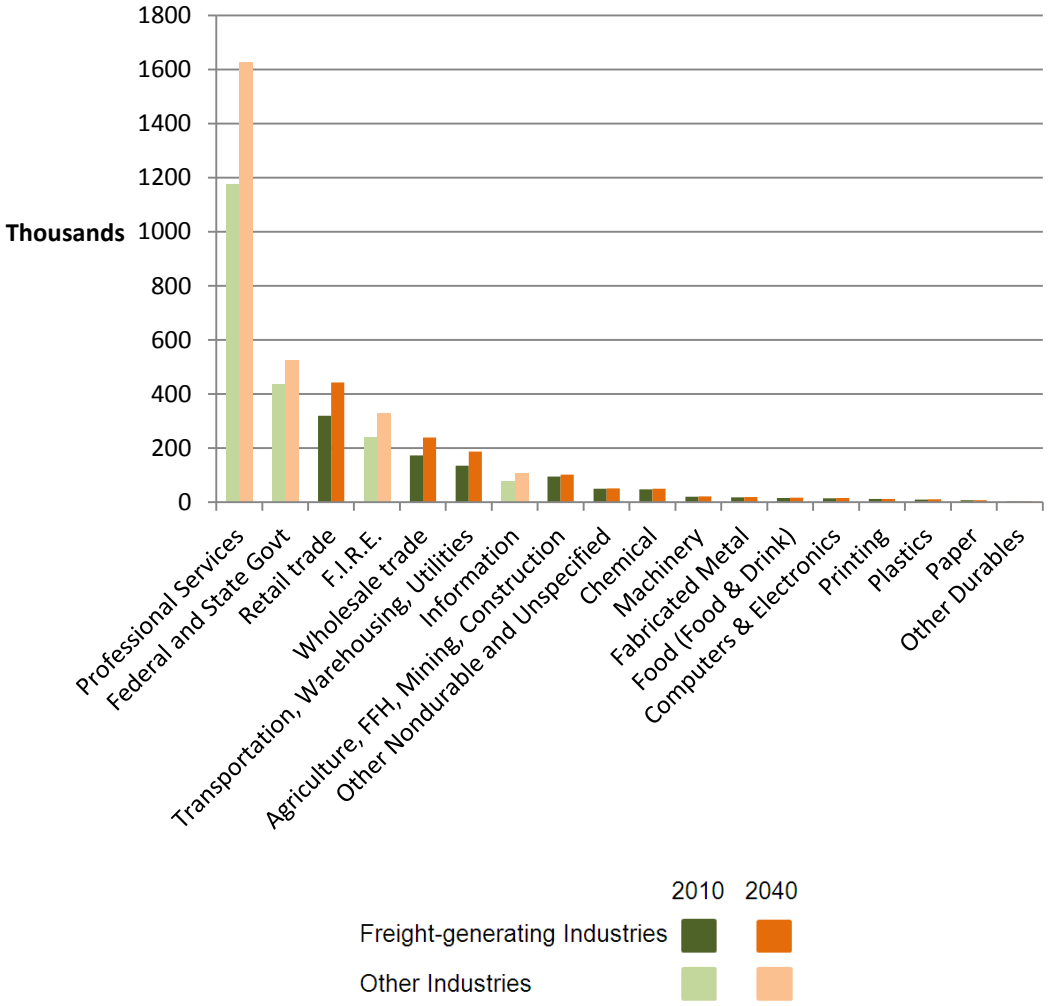
Using the "baseline" R/ECON 2040 employment forecast (as described in Section 4.1), a "baseline" 2040 freight forecast was developed using the NJTPA Freight Forecasting Tool. Analysis of this baseline 2040 freight forecast served as a validation exercise for the Freight Forecasting Tool, and as the 2040 freight forecast for the NJTPA Freight Profiles. The Freight Profiles are stand-alone products, one for each of the 13 NJTPA counties, Newark, Jersey City, and the entire NJTPA region. This section describes the findings of the baseline 2040 R/ECON employment forecast and the NJTPA Freight Forecasting Tool baseline 2040 freight forecast relative to the 2007 enhanced TRANSEARCH commodity flow database described in Section 3.2 of this report.

7.1 EMPLOYMENT

In 2010, the North Jersey region's economy employed 2.85 million people in more than 312,000 business establishments. About 32 percent were employed in "freight intensive" industries such as construction, manufacturing, mining and extraction, retail trade, wholesale trade, and logistics (trucking and warehousing/distribution). About 68 percent were employed in industries that may generate freight but are less dependent upon freight movement. These industries include professional services, federal and state government, finance, insurance and real estate, and information.

Between 2010 and 2040, non-farm employment in the 13-county North Jersey region is expected to grow by 32 percent, from 2.85 million to 3.77 million jobs. Employment in freight-intensive industries is expected to grow by 28 percent, or about 259,000 jobs, over the forecast period, compared to 34 percent, or about 663,000 jobs, in other industries. Figure 7.1 illustrates the anticipated growth in employment by industry between 2010 and 2040.

Figure 7.1 R/ECON Baseline Industry Employment Forecast, 2010 to 2040



Source: Cambridge Systematics, using R/ECON.

7.2 COMMODITY FLOWS

In 2007, approximately 473 million tons of domestic freight moved into, out of, or within North Jersey, by all modes of transportation (truck, rail, water, and air). This figure includes commodities moving into or out of North Jersey but excludes pass-through tonnage. The local movement of international cargo to and from seaports, airports and border crossings is captured in the database and counted as domestic cargo.

According to the base forecast, freight flows into, out of, and within North Jersey are expected to have increased by 43 percent, from 473 million tons to 675 million tons, or a difference of 202 million tons, between 2007 and 2040. Warehouse and distribution center traffic is expected to remain the number one commodity in North Jersey by tonnage, accounting for about 24 percent of total tonnage. As

shown in Table 7.1, growth rates among the region's top ten commodities by tonnage are expected to range from 29 percent (nonmetallic minerals) to 63 percent (waste or scrap materials).

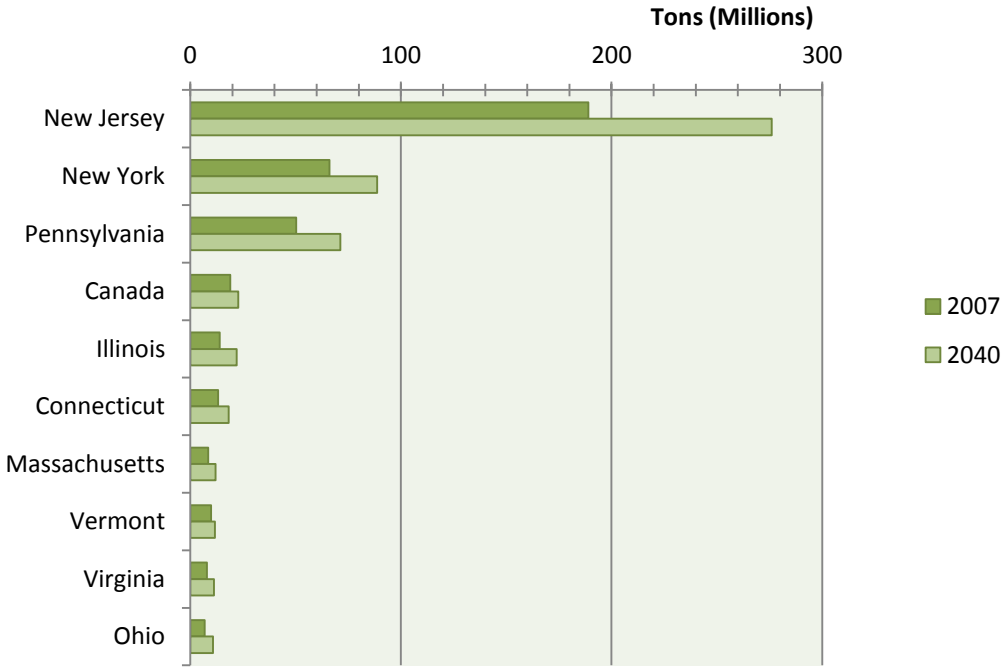
Table 7.1 Top 10 Commodities by Tonnage, 2007 to 2040

Commodity	2007 Tons (millions)	2040 Tons (millions)	Difference (millions)	Growth Rate
Warehouse and Distribution Center	114.6	173.1	58.5	51%
Nonmetallic Minerals, Except Fuels	90.4	116.6	26.2	29%
Petroleum or Coal Products	64.6	92.1	27.5	43%
Chemicals or Allied Products	41.5	58.2	16.6	40%
Clay, Concrete, Glass, or Stone Products	34.1	50.8	16.8	49%
Food or Kindred Products	29.0	41.1	12.1	42%
Municipal Solid Waste (MSW)	16.4	24.8	8.4	51%
Waste or Scrap Materials	9.3	15.1	5.8	63%
Freight All Kinds	9.2	14.8	5.6	61%
Pulp, Paper, or Allied Products	8.7	10.6	2.9	38%
TOTAL (TOP TEN COMMODITIES)	417.8	597.2	179.4	43%

Source: NJTPA Freight Forecasting Tool.

North Jersey's major trading partners are its neighbors. In 2007, about 40 percent (189 million tons) of all tonnage was transported between origins and destinations within the State of New Jersey. New York and Pennsylvania were the largest out-of-state trading partners. Most New York trade was in the outbound direction, while most trade with Pennsylvania was inbound. Canada, Illinois, the New England states, Virginia, and Maryland were also among the region's top trading partners. By 2040, the same states and regions are expected to remain North Jersey's top trading partners. About 41 percent of trade will be intrastate. Growth in trade with Midwestern states is expected to exceed growth in trade with Northeastern states, thereby allowing Illinois and Ohio to gain slightly larger shares of the region's trade in 2040 compared to 2007. Figure 7.2 illustrates North Jersey's top ten trading partners by tonnage in 2007, 2040, and rate of growth.

Figure 7.2 Top 10 Trading Partners by Tonnage, 2007 and 2040

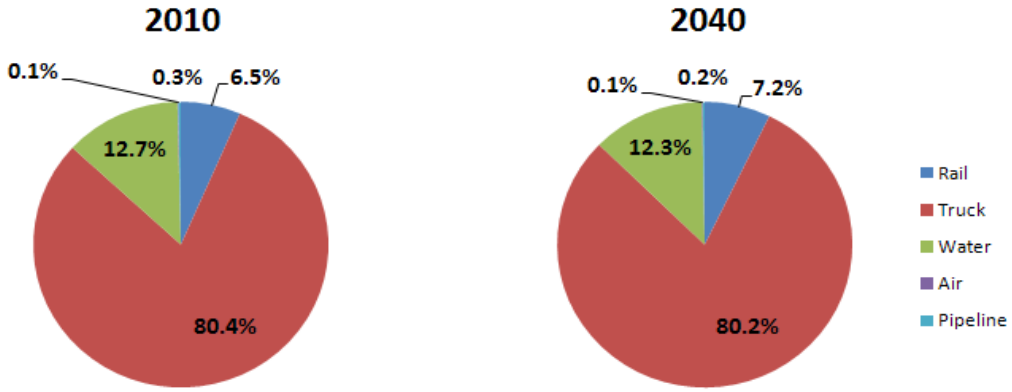


Source: NJTPA Freight Forecasting Tool.

Freight can be handled by truck, rail, air or water. The choice of mode depends on a variety of factors, including: length of trip (rail and air are more competitive at longer distances), commodity types (rail and water are more competitive for heavy materials), time sensitivity (truck and air are most competitive), need for door-to-door service (trucking is needed unless the customer has a dock or rail connection).

Figure 7.3 illustrates the mode splits for 2010 and 2040. On a tonnage basis, for domestic freight traveling to, from, or within New Jersey, more than 80 percent traveled by truck in 2010. About 12.7 percent traveled by water and 6.5 percent by rail. Less than 1 percent traveled by air, pipeline, or other modes. The forecast anticipates that by 2040, rail will gain a slightly larger share of the market (7.2 percent) and water will carry a slightly lower share (12.3 percent). This small shift corresponds to the anticipated growth in warehouse and distribution center trade, particularly with distant states in the Midwest, South, and West. The mode shares for truck and air are expected to remain about the same, at 80 percent and less than 1 percent, respectively.

Figure 7.3 Mode Splits, 2007 and 2040

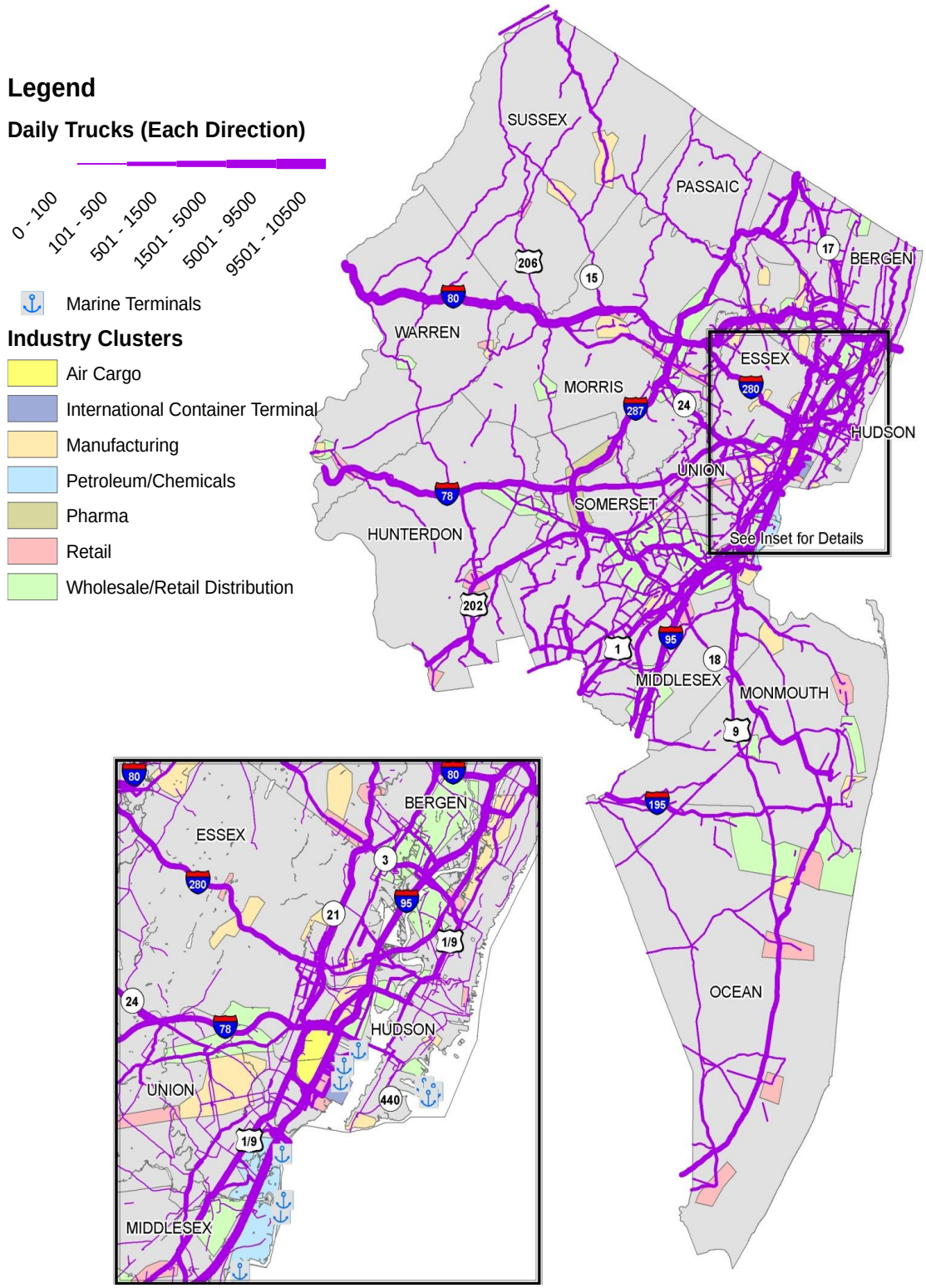


Source: NJTPA Freight Forecasting Tool.

7.3 HIGHWAY NETWORK ASSIGNMENT

North Jersey's highway network serves to connect its major freight activity centers with key trading partners elsewhere in the State of New Jersey, in other parts of North America, and – via international seaports and airports – the world. According to the assignment of the TRANSEARCH database to the NJTPA Regional Transportation Model-Enhanced (RTM-E) network, a procedure described in Appendix A, and the results of which are illustrated in Figure 3.12, segments of the New Jersey Turnpike and Interstate 80 accommodated more than 18,000 trucks per day in 2010. Parts of the Turnpike south of Interstate 287, Interstates 78 and 287, and parts of Routes 1 and 9 in Hudson County carried more than 10,000 trucks per day in 2010. According to the NJTPA Freight Forecasting Tool output using the base R/ECON econometric forecast, an assignment of the resulting 2040 truck trip table to the RTM-E network shows that portions of the New Jersey Turnpike and Interstate 80 will likely carry 30 percent (6,000) more trucks in 2040 than they carried in 2010. Segments of Interstates 78 and 287 and US Routes 1 and 9 could carry 2,500-3,000 more trucks per day in 2040 than in 2010. Figure 7.4 illustrates the projected truck volumes in 2040 on highways in North Jersey, according to the base R/ECON forecast.

Figure 7.4 Commodity Truck Flows in North Jersey, 2040

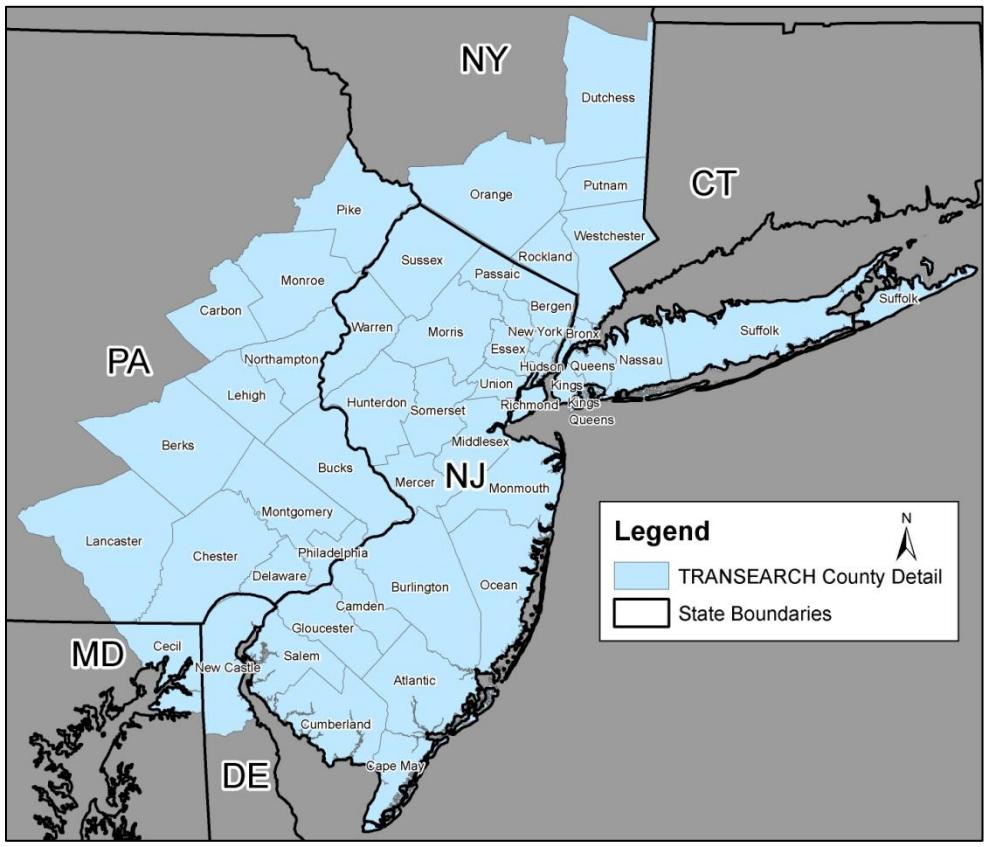


Source: Cambridge Systematics, using NJTPA's RTM-E.

A. Appendix A – Commodity Flow Data Analysis Approach

A TRANSEARCH database for New Jersey was obtained from IHS/Global Insight by North Jersey Transportation Planning Authority (NJTPA). That database is identical in structure and content to the database which was delivered to the New Jersey Department of Transportation. The database has flows by commodity at the four-digit Standard Transportation Commodity Code (STCC4) level, from zones which are counties in New Jersey; certain counties in nearby New York and Pennsylvania, as well as New Castle County, Delaware and Cecil County, Maryland, as shown in Figure A.1; the remainder of the United States as FAF2 zones, which correspond to Bureau of Economic Analysis areas; and the Canada and Mexico as single zones. The database includes modal flows by subcategory as shown in Table A.1 following.

Figure A.1 NJTPA County-Level TRANSEARCH Data Coverage Area



Source: Cambridge Systematics, using US Census Bureau.

Table A.1 NJ TRANSEARCH Modal Codes

Mode Code	Mode Name	Mode_Group
0	None	None
1	Rail Carload	Rail
2	Rail Intermodal	Rail
3	Rail NEC	Rail
4	Truck Truckload	Truck
5	Truck Less-than-Truck Load	Truck
6	Truck Private	Truck
7	Truck NEC	Truck
8	Air	Air
9	Water	Water
10	Other	Other
11	Pipeline	Pipeline

Source: IHS Global Insight, 2007.

Both the Rail NEC and Truck NEC (Not Elsewhere Classified) sub-modes consist of flows to and from the NAFTA countries of Canada and Mexico, for which less detailed information is available. For purposes of assigning to the FAF Highway network, all of the Truck sub-modes were combined to the Truck Mode_Group as suggested by IHS/GI.

The TRANSEARCH database also includes information on truck configuration based on the VIUS and HPMS truck categories as shown in Table A.2 following. These categories provide more detail than is necessary in the FAF assignment, but it does confirm that no TS flows were assigned to Single Unit trucks. The FAF network flows by contrast will include the sum of Single Unit and Tractor and Trailer Combination Units.

Table A.2 NJ TRANSEARCH Truck Configurations

Configuration Code	Configuration Name
CS4	Tractor-Semitrailer Combinations with 4-Axle
CS5	Tractor-Semitrailer Combinations with 5-Axles
CS6	Tractor-Semitrailer Combinations with 6-Axles
CS7	Tractor-Semitrailer Combinations with 7- or more Axles
DS5	Tractor-Double Semitrailer Combinations with 5-Axles
DS6	Tractor-Double Semitrailer Combinations with 6-Axles
DS7	Tractor-Double Semitrailer Combinations with 7-Axles
DS8	Tractor-Double Semitrailer Combinations with 8-Axles
DS9+	Tractor-Double Semitrailer Combinations with 9- or more Axles
TS7+	Tractor-Triple Semitrailer Combinations with 7- or more Axles

Source: IHS Global Insight, 2007.

The TRANSEARCH database records include information which would allow the routing of trucks on the TRANSEARCH Highway network. Those fields include *first_segment; last_segment; From_FIPS; To_FIPS; Entry_Road;* and *Exit_Road*. Since the purpose of this analysis is to assign the TRANSEARCH truck flows to the FAF3 highway network in place of using the TRANSEARCH routings, the routing fields were not retained when the data was aggregated into truck trip tables.

The TRANSEARCH database reports truck flows as *tons07* ;*units07*;*value07*; *tons35*; *units35;* and *value35* flows; which are flows in annual tons, annual trucks, and annual dollar values for 2007 and 2035. Since the purpose of the FAF assignment is to compare the assignment of the TRANSEARCH truck trip table with observed counts and assignments by FAF and others, the flow unit which was used in aggregation is the annual units (trucks). To convert to the weekday trucks required by the FAF highway network assignment scripts, the annual flows were divided by a factor of 295 (i.e. the flow of 295 average weekdays equals the annual flow)

For purpose of assigning the daily truck table to the FAF network, the New Jersey TRANSEARCH Regions have to be loaded at FAF highway network county centroids and network loading nodes. For New Jersey and the surrounding regions, where the TRANSEARCH regions are counties, that association is obvious. For the other TRANSEARCH regions, a disaggregation of the FAF flows to counties[4] was used to identify the county within each Region which has the largest number of inbound and outbound flows. These counties

[4] Cambridge Systematics, *Development of A Computerized Method to Subdivide the FAF2 Regional Commodity OD Data to County Level OD Data, FHWA Draft Report,* January 2009

were designated as the FAF highway network loading nodes for these regions. The FAF network covers only the Continental United States. For flows to and from Canada and Mexico, which are only a single region in TRANSEARCH, the flows are loaded at a highway border crossing.

The 2007 TRANSEARCH database that NJTPA procured was used to prepare a daily truck table, using the methods as described above. That table was assigned to the FAF highway network using the assignment scripts to the FAF technical documentation.[5][6] The loaded network assignment of the FAF highway network also includes the FAF-3 recorded volumes for 2007 AADTT (Average Annual Daily Truck Traffic) and the FAF assignment of daily tucks. These fields were compared to the TRANSEARCH volumes.

In the FAF highway network, total truck flows were added using HPMS data, and where those were not available, using default look up tables. Total truck volumes are deducted from the total volumes and are used mostly as an accounting procedure to show autos and non-FAF trucks, and are not actually used to assign FAF trucks. However in New Jersey for the Garden State Parkway (GSP), apparently truck flows were not reported in HPMS because it is a nonfederal aid toll road. It is also a road which prohibits trucks. When the default process was used by FHWA to populate AADTT truck flows on the GSP links, it did not recognize this truck prohibition. The truck prohibition was recognized by the FAF assignment process and very few FAF trucks are assigned to the GSP links. But the FAF network shows it to have the highest volumes of total in NJ, which has been raising concerns about the FAF assignment. This has been brought to the attention of FHWA and the comparison of the TRANSEARCH assignment on the GSP links were not made to the FAF 2007 AADTTs. Figures A.2 and A.3 illustrate the results of the assignment to the FAF network and the RTM-E network, respectively.

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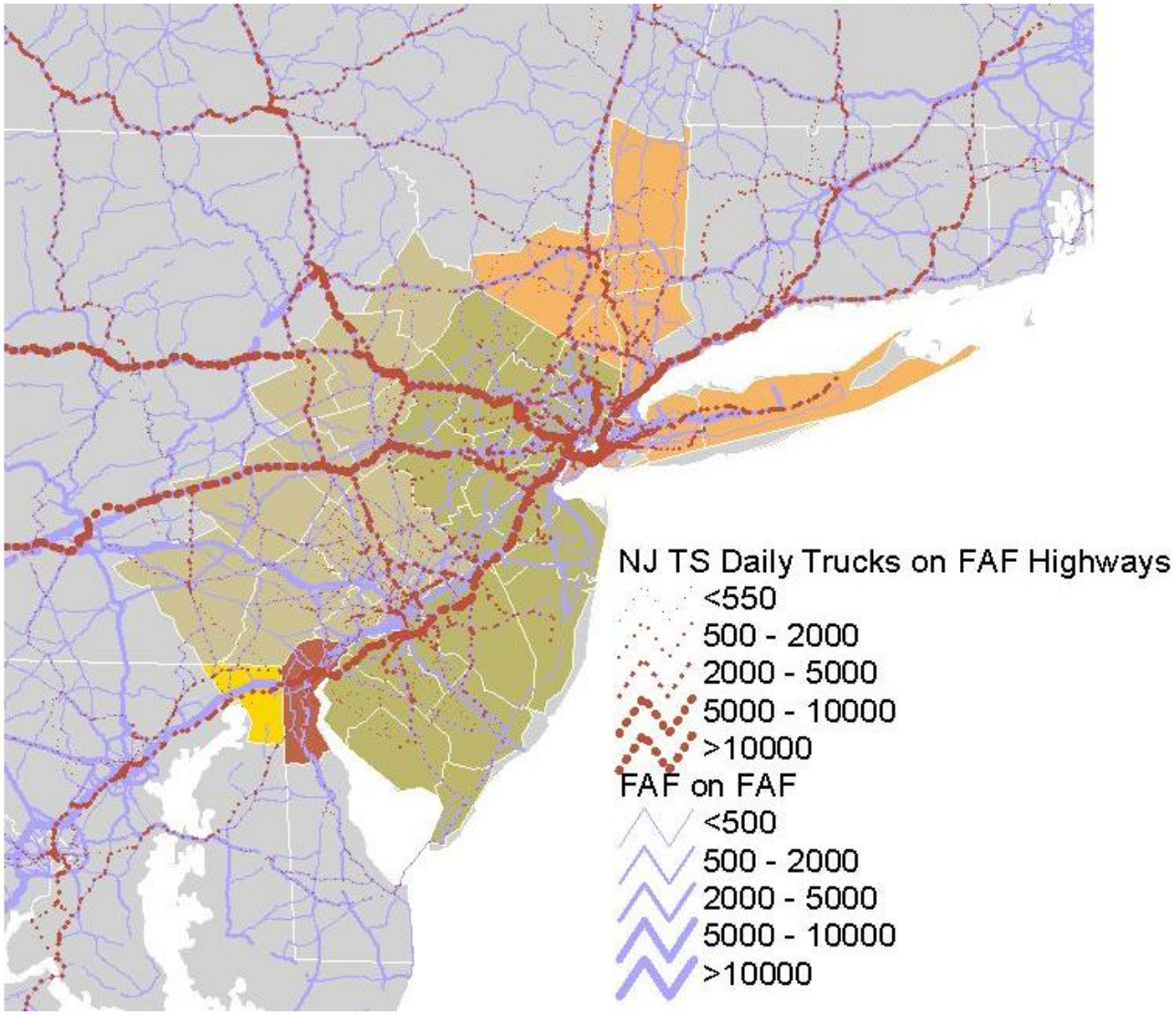
[5] Alam, M., *Network Assignment of Highway Truck Traffic in FAF3*, Oak Ridge National Laboratory, October, 26 2010 http://cta-is.ornl.gov/faf/Data/FAF_3_network_assignment_executive_summary.pdf, accessed on March 16, 2011

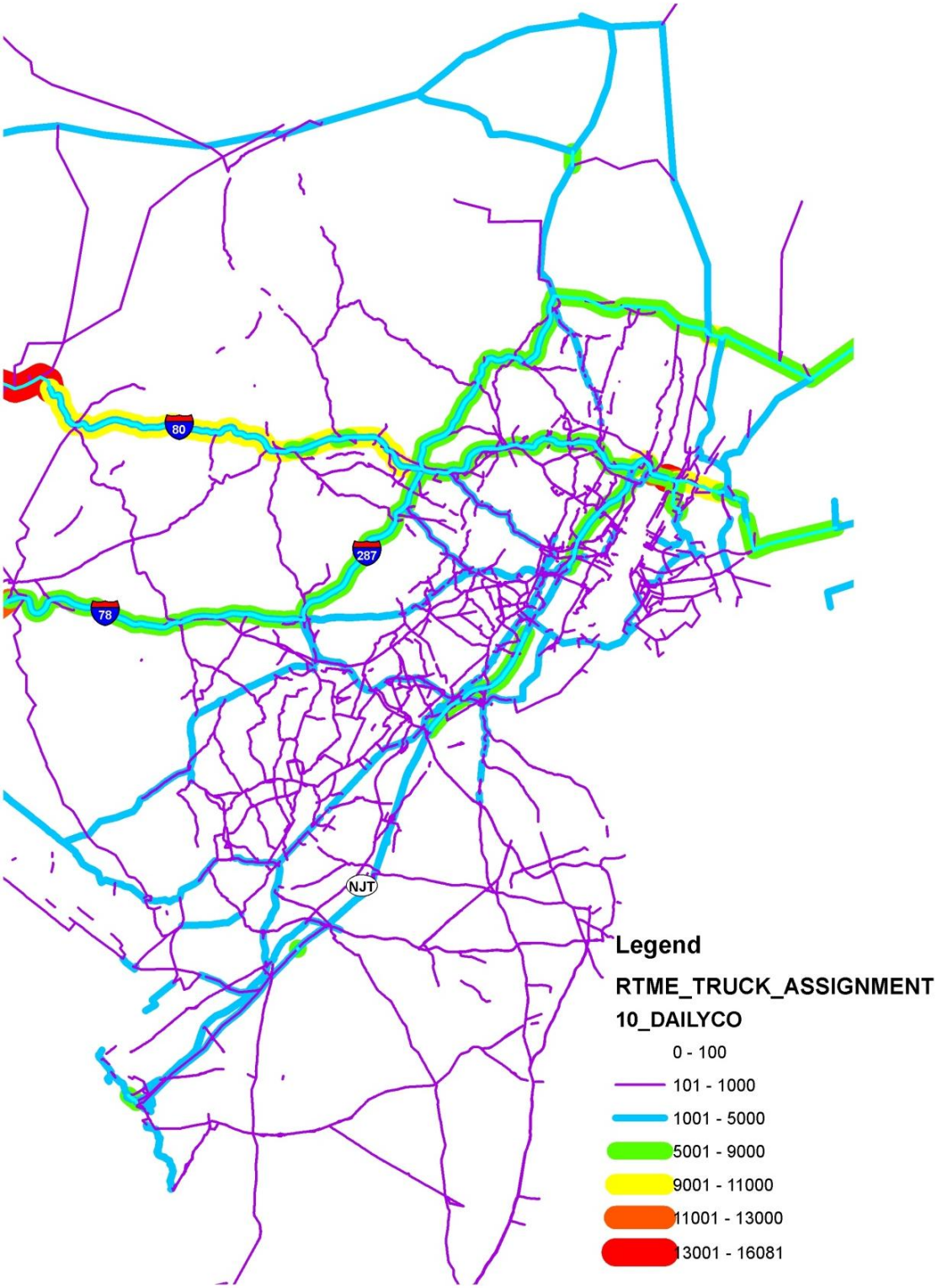
[6] Alam, M., Fekpe, E., and Majed, M., Battelle Memorial Institute, *FAF2 FREIGHT TRAFFIC ANALYSIS: Chapter 5: Freight Truck Assignment And Calibration*, Office of Freight Management and Operations (HOFM), Federal Highway Administration Washington, D.C., June 27, 2007 http://ops.fhwa.dot.gov/freight/freight_analysis/faf/faf2_reports/reports7/c5_assign.htm, accessed on March 16, 2011

Figure A.2 TRANSEARCH Assignment to FAF-3 Network



Source: Cambridge Systematics, using USDOT FAF 3.2.

Figure A.3 TRANSEARCH Assignment to RTM-E Network



Source: Cambridge Systematics, using NJTPA's RTM-E Network.

B. Appendix B – Freight Facility Location Data Validation Approach

FREIGHT FACILITY AND LAND USE DATA VALIDATION

The three databases have slightly different geographic coverage and their contents were developed for differing purposes (Selectory for business location, Freight Locator for freight transportation planning, and Torto Wheaton for industrial real estate). Further, the databases were developed at different times (Freight Locator in 2007, Torto Wheaton in 2010, and Selectory in 2010). For these reasons, facilities that exist in one database may not exist in one or both of the other two. Such inconsistencies are important to resolve, since major freight generators in the region may not be reflected in the data and therefore not considered in the forecasts and Freight Forecasting tool development tasks.

The team performed an analysis aimed at validating the contents of the databases to determine to what extent inconsistencies in the databases existed, and whether those inconsistencies were due to the differing purposes or data collection dates (i.e., businesses opened or closed between 2007 and 2010), accidental omission, or false or flawed information. This process was completed in four steps:

1. Mapping all of the data at the subregional level for all 15 subregions;
2. Matching duplicate records in each database, with the assumption that if a facility exists in two or more databases, it is legitimate;
3. Conducting internet research on facilities which are not confirmed by more than one database to validate; and
4. Reaching out to planners in the subregions through a series of web-meeting GIS workshops to review and validate the data.

Mapping

The first validation step required the mapping of all three databases at the county level. The Dun & Bradstreet data were already separated by county, but "select by location" queries of the Freight Locator and Torto Wheaton data were made to create separate shapefiles/databases for each subregion. These county-level shapefiles were mapped using the symbology schemes illustrated in Figures B.1, B.2, B.3, and B.4. The consultant team and NJTPA reviewed these

maps to make sure the locations of clusters of points align with known clusters of industrial and commercial land uses in the region.

Matching Process

Next, records from each database were "matched" by business name and address in order to use the databases to validate points among each other. Because the Torto Wheaton database's "Name" field contains any combination of business name, address, building number, industrial park or development name, etc., and in no consistent order or convention, the first step in this process was to separate the field to create "Company Name" and "Address" fields with consistent conventions for street names and for handling of abbreviations in company names ("Co." for company, "Corp." for corporation, "Inc." for incorporated, etc.).

For each county, an Excel workbook was created, containing records from each database on separate worksheets. In a fourth worksheet, a series of VLOOKUP queries were created to find ID numbers from each database that matched by address or company name. Because the Freight Locator and Torto Wheaton databases include only freight facilities, while Dun and Bradstreet contains all business types, the former two were used as the "base" for the queries to "match to." The first match attempt resulted in a match of about 33 percent of the records in Freight Locator and Torto Wheaton. The map of Somerset County, shown as Figure B.1 provides an illustrative example of the results of the first match attempt.

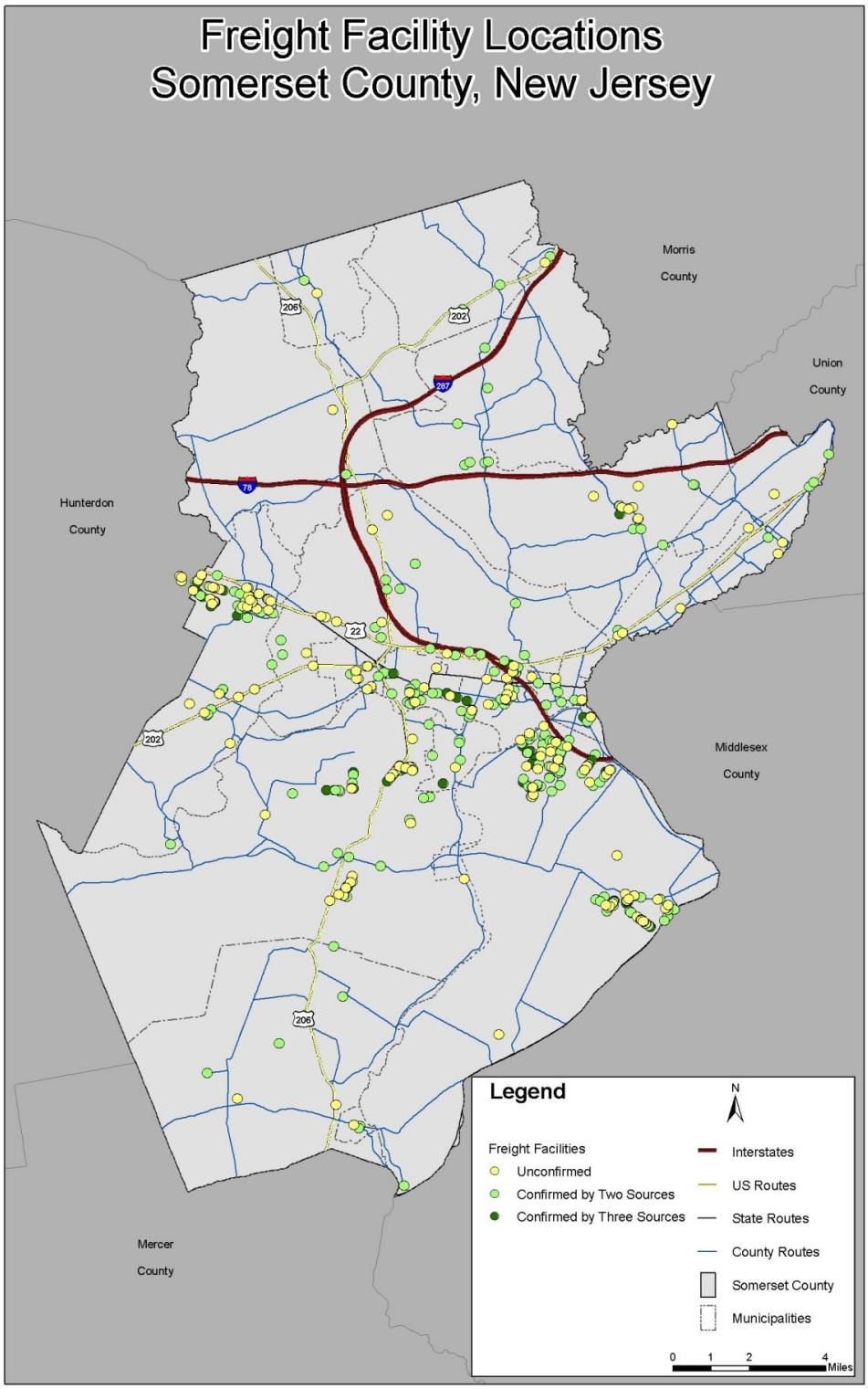
A second attempt at matching the records sought a higher match rate by performing a record-by-record "scrubbing" of the business name and address fields in all three databases to ensure that the conventions, abbreviations, and spellings are consistent (for example there was inconsistency among the databases regarding whether Tonnelle Avenue is spelled with one "L" or two). The scrubbing resulted in a higher match rate, with about 45 percent of records in the Torto Wheaton and Freight Locator databases having a match in at least one of the other databases. Figure B.2 shows the result of the second matching attempt for data points in Somerset County.

Many of the "unmatched" records were found to be in the Dun & Bradstreet Selectory database. This is understandable, given the Selectory database contains information on businesses in all industry types, not just freight-generating businesses or businesses that occupy industrial buildings. Further, Selectory contains data on many small businesses which may have one or two employees and may not be generating much freight at all, even if they are classified in a freight-generating industry. Therefore there are many thousands more records in the Selectory database than in the other two. To reduce the number of Selectory records that were likely to remain "unmatched" for those reasons, the team decided to query the Selectory database in order to isolate businesses in freight-generating industries that are large enough to generate regular or sizeable commodity flows. The team therefore selected records in NAICS codes 11-49, which have facilities of at least 60,000 square feet in size, and used this selection

as the basis for the next round of record matching. To illustrate an example of the results of this matching effort, the matched and unmatched points in Somerset County are shown in Figure B.3.

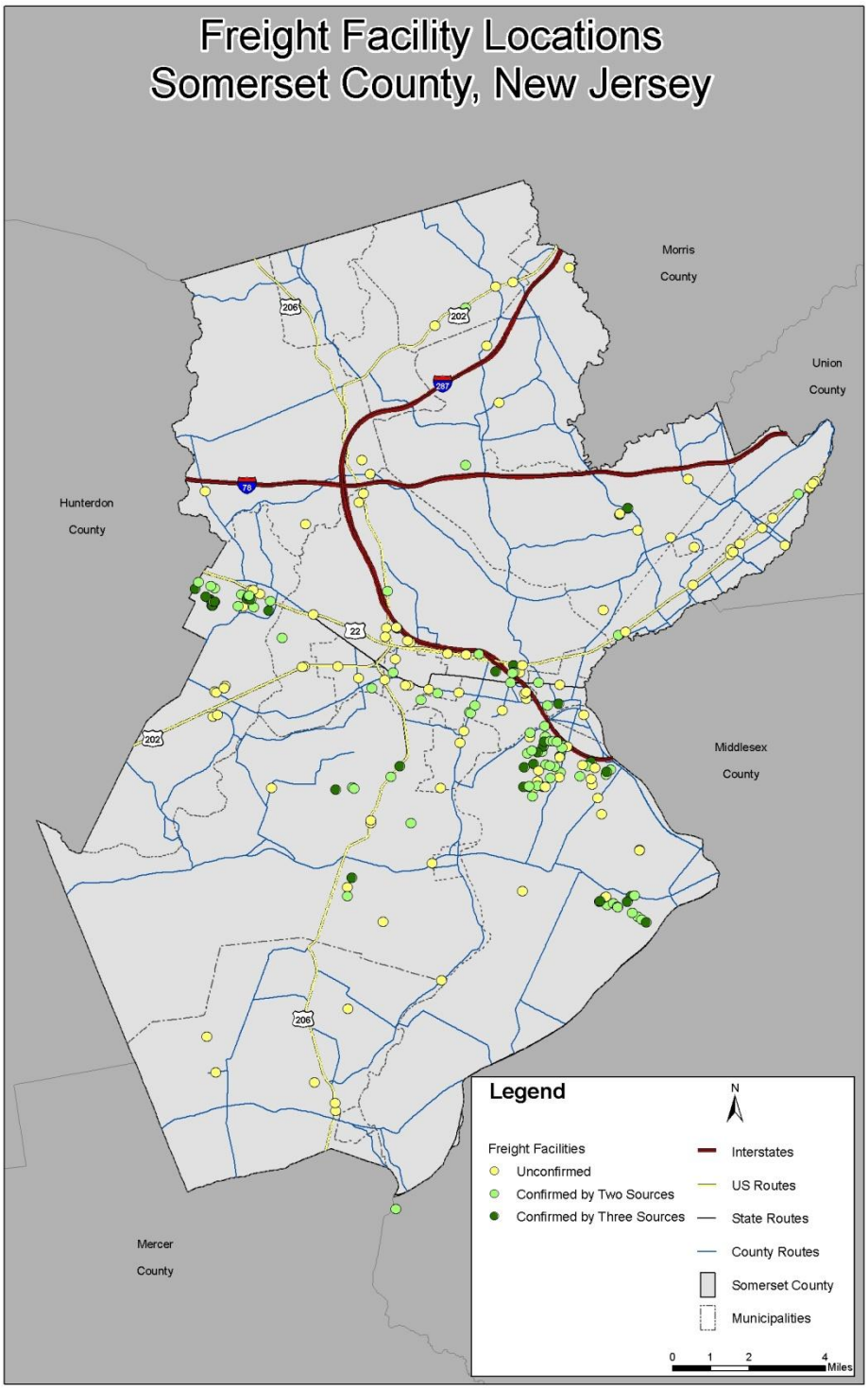
After the third attempt, about one-third of the records did not return a match in other databases. Generally speaking, the largest facilities (by size or freight tonnage generated) were, more often than not, confirmed in other databases. Of the unmatched records, the team decided to identify the largest (by size or freight tonnage generated) on which to perform internet research to validate. In the query worksheets, thresholds were established to select facilities from the Torto Wheaton database that were in the 500,000-1 million and 1 million-plus square feet ranges and from the Freight Locator database that generated more than 30,000 total annual tons (inbound and outbound combined). These facilities were mapped and referred to as "Validation Points." Figure B.4 shows the validation points in Somerset County.

Figure B.1 Result of First Data Match Attempt, Somerset County Example



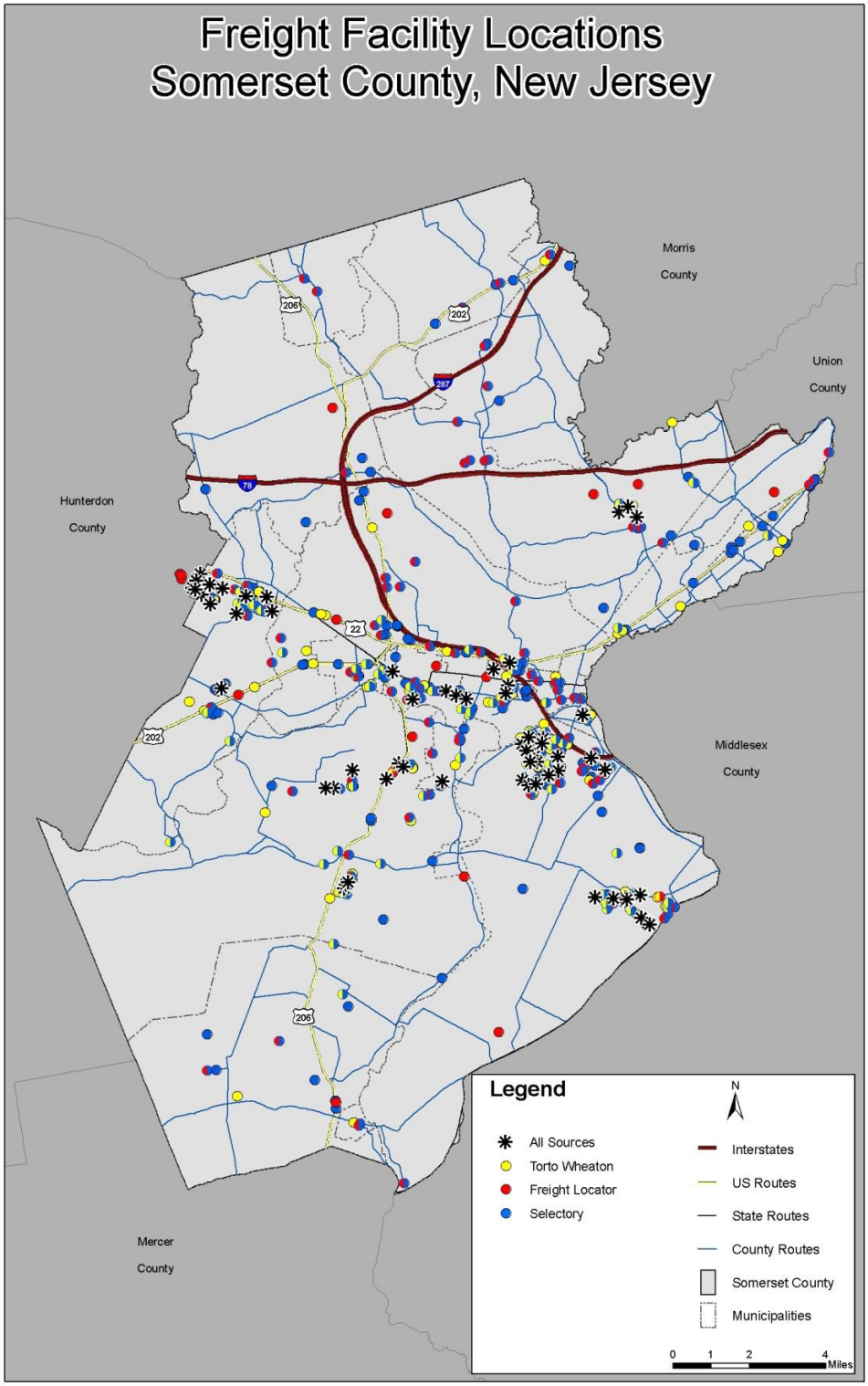
Source: Cambridge Systematics, using: CB Richard Ellis, Quarter 3, 2010; IHS Global Insight, 2007; and Dun and Bradstreet, 2010.

Figure B.2 Result of Second Data Match Attempt, Somerset County Example



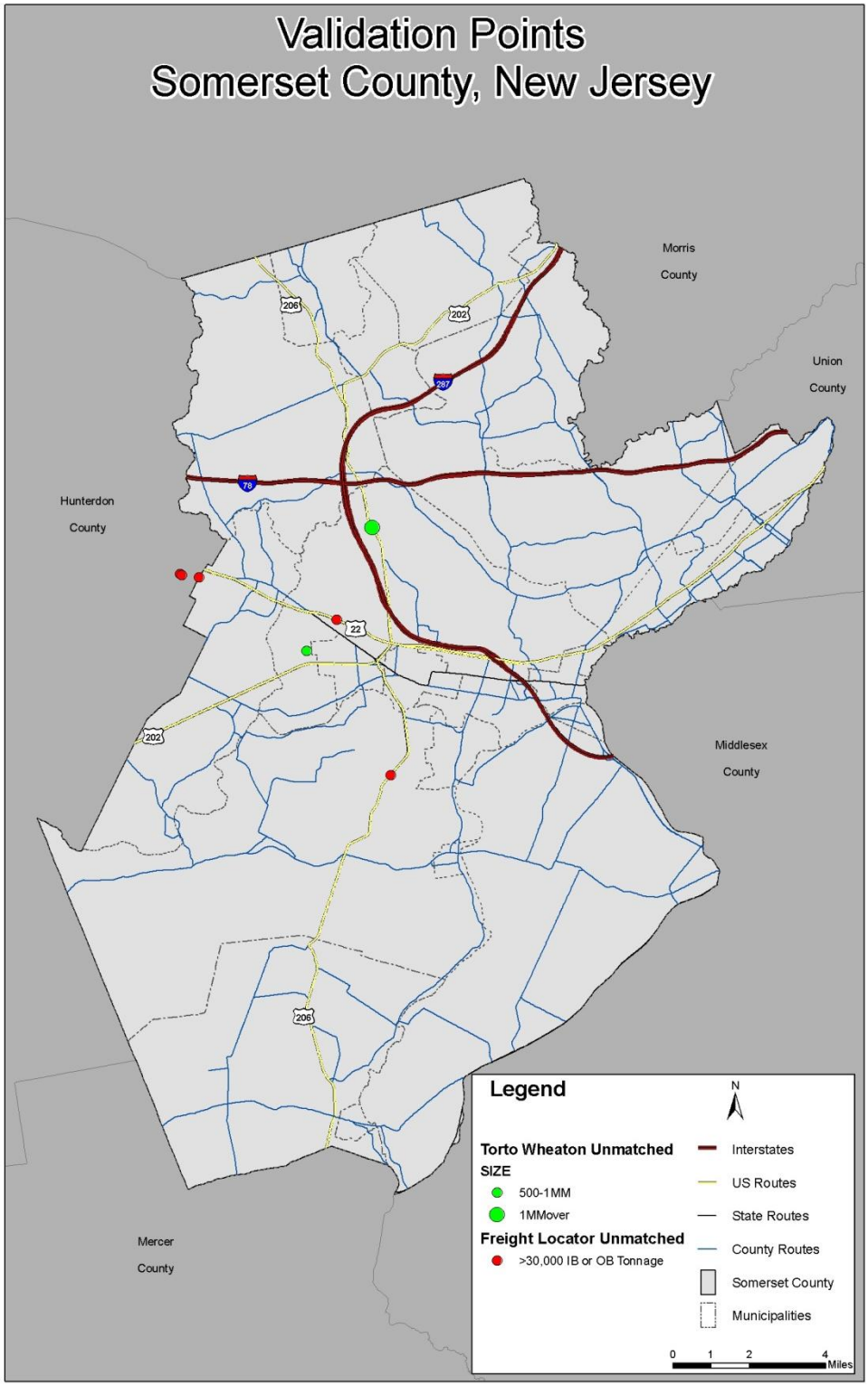
Source: Cambridge Systematics, using: CB Richard Ellis, Quarter 3, 2010; IHS Global Insight, 2007; and Dun and Bradstreet, 2010.

Figure B.3 Result of Third Data Match Attempt, Somerset County Example



Source: Cambridge Systematics, using: CB Richard Ellis, Quarter 3, 2010; IHS Global Insight, 2007; and Dun and Bradstreet, 2010.

Figure B.4 Validation Points, Somerset County Example



Source: Cambridge Systematics, using: CB Richard Ellis, Quarter 3, 2010; IHS Global Insight, 2007; and Dun and Bradstreet, 2010.

Internet Validation

A. Strauss-Wieder, Inc. (ASW) conducted internet research to validate the "Validation Points." ASW used the Google search engine to verify business name and address information and used the satellite feature in Google Maps to verify the presence of industrial or commercial buildings at the listed address locations. The conclusions of ASW's internet validation effort are summarized in the "Validation Points" worksheet.

Subregional Webmeetings

In March through May of 2011, the team conducted a series of webmeetings with planning and economic development staff from each of the subregions. Staff from all but four of NJTPA's 15 subregions participated. The webmeetings lasted approximately 90 minutes each, consisting of a 20-minute PowerPoint presentation that provided an overview of the project scope and a 70-minute live GIS question and answer session. The session served as an opportunity for the subregions to get a first look at the land use databases that were subsequently made available to them for their planning activities. The session also allowed the project team to review the contents of the land use databases to confirm their accuracy, and to ask specific questions regarding some of the Validation Points that were not confirmed through internet research alone. Comments from subregional staff regarding the Validation Points are included in the "Validation Points" Microsoft Excel worksheet.

C. Appendix C – NJTPA Freight Forecasting Tool User Guide

ABOUT THE NJTPA FREIGHT FORECASTING TOOL

The NJTPA Freight Forecasting Tool is a large Microsoft Excel spreadsheet model. It was developed to the specifications of the North Jersey Transportation Planning Authority, Inc. (the Metropolitan Planning Organization for thirteen counties in North Jersey), its subregional clients (counties and cities), and other Technical Advisory Committee (TAC) representatives (including the New Jersey Department of Transportation and the Port Authority of New York and New Jersey).

The Freight Forecasting Tool was prepared as part of the NJTPA's *Freight Industry-Level Forecasts to the Year 2040* project. The Freight Forecasting Tool was created by Cambridge Systematics, Inc., in association with Parsons Brinckerhoff, the Rutgers University Center for Urban Policy Research, and A. Strauss-Weider Inc.

The Freight Forecasting Tool contains a TRANSEARCH freight flow database for year 2007. TRANSEARCH is a commercial product of IHS Global Insight, purchased by NJTPA, containing confidential information subject to a restricted use license. TRANSEARCH, and by extension the Freight Forecasting Tool itself, cannot be shared or used in a manner not consistent with the license.

The Freight Forecasting Tool also includes a set of New Jersey economic and employment forecasts produced by Rutgers using its R/ECON model. The R/ECON forecasts are the most widely-accepted economic forecasts in the state.

Both TRANSEARCH and R/ECON forecasts are available independently. What is unique about the NJTPA Freight Forecasting Tool is:

- How it integrates these two primary inputs, using the employment forecasts to grow current freight tonnages to projected future levels
- How it applies a set of highly customized "what if" analysis factors to further modify the freight tonnage forecast
- How it automatically generates detailed summary reports
- How it automatically generates heavy truck trip tables for the NJTPA Regional Transportation Model – Enhanced (RTM-E)

Finally, it should be noted that the Tool is targeted at users who have a basic knowledge of economic forecasting and freight movement. With a suitable degree of user experience being assumed, development efforts were focused on the functionality and economy of the Tool.

COMPONENTS AND PROCESSING

The Freight Forecasting Tool consists of 25 worksheets within a single spreadsheet file. Most user interaction with the Tool will be on the first seven worksheets, with inputs on the first two worksheets and outputs on the next five worksheets; the use of these sheets is described in detail in the following section on "Running the Tool." Below is a list of the worksheets by name, and a brief description of their contents and functions.

- **USER INPUTS MODEL**. This is the first worksheet, and the primary user interface area. On this worksheet, the user specifies the years to be forecast, the employment forecast to be used (one of the five R/ECON forecasts or a set of user-defined values), and two optional adjustments (employee productivity and allocation of regional warehouse growth). The User Input screen also contains instructions on the use of Macro commands to run the model.
- **WHAT IF.** This sheet contains a set of "What If" tables where the user can enter different values for employment growth, global and national trade and economic factors, and transportation logistics factors. Freight forecasts are driven primarily by the employment forecasts (from R/ECON or user-entered values), but can be significantly modified based on values entered in these tables.
- **COUNTY TABLES Employment** and **COUNTY TABLES Freight**. A set of worksheets where detailed results (employment forecasts and freight forecasts) are reported and stored. High-level summary results are also reported to the USER INPUTS MODEL worksheet for quick review.
- **EMPLOYMENT No What-If** and **FREIGHT No What-If.** After creating a forecast based on employment, prior to the application of any What-If adjustments, the user has the option to save the results to these two worksheets, for comparison with the results following the application of What-If adjustments.
- **RTME Adjusted.** This worksheet generates a heavy truck trip table for the NJTPA Regional Transportation Model-Enhanced, based on the freight forecast results.
- **SELECTED FORECAST**. Based on the user's choice of employment forecasts, this worksheet populates with the correct employment information.
- **CHANGE BY CNTY-IND.** This worksheet disaggregates the NJTPA regional employment estimates by county and industry, based on factors provided by Rutgers along with the R/ECON forecasts.
- **WAREHOUSE ADJ.** This worksheet applies an optional calculation, recommended by ASW Inc., to reallocate warehouse and distribution center related employment from one NJTPA county to another, based on the most recent available information from the real estate development community.

- **ADJ CHANGE BY CNTY-IND.** This worksheet updates the disaggregated NJTPA regional employment to reflect the warehouse/distribution center adjustment, if applied.
- **EMPLOYMENT DRIVERS.** This worksheet extracts the employment growth rates by county and industry for the selected forecast years, and also provides a location for these growth rates to be modified based on information entered on the "What-If" worksheet.
- **MAKE-USE TABLES.** This worksheet contains tables that relate changes in industry employment to changes in the demand for certain types of commodities as inputs (USE) or outputs (MAKE).
- **FORECAST BASED ADJ MATRIX**. This worksheet takes the county-industry growth rates from the Employment Drivers worksheet and applies factors from the Make-Use tables to generate commodity class growth rates, differentiated by county, direction of move (inbound, outbound, internal or through), and mode of transportation. The base case assumption is that each TRANSEARCH record is grown without changing the mode associated with that record; however, there may be changes in modal shares because truck-oriented commodities may grow at a different rate than rail-oriented commodities. Mode share is a factor that can be manipulated by the user as a What-If adjustment.
- **SECTION II PIVOTS.** The "What-If" adjustment process actually takes place in two stages. The first stage affects the volume of freight moved and its origins and destinations. The second stage affects primarily how it is moved – shifting it from one mode to another, or one county to another. To properly calculate the adjustments, the second stage has to know the results of any changes made in the first stage. This worksheet creates a pivot table of results following the first stage of adjustments, from which the second stage of adjustments can look up the appropriate values.
- **PROCESSED TS 2007**. This worksheet contains a processed version of the NJTPA TRANSEARCH dataset. Compared to the original data, it contains additional lookup and sort fields, but less commodity specificity (2-digit code as opposed to the original 4-digit code). Each record in TRANSEARCH provides an origin, destination, mode, commodity, and volume. Freight flows between the years 2007 and 2010 were relatively flat, due to the recession, and the 2007 data is considered applicable to the current year. Columns appended to the TRANSEARCH freight flow database look up growth factors from other worksheets depending on the particular attributes of the individual record (county, type of flow, mode, commodity, and international vs. domestic). All records look up an employment-related growth factor from the FORECAST BASED ADJ MATRIX. Some records, but not others, look up other growth factors from the "What If" tables. For each record, the growth factors are summed and applied to the current year volumes, to produce a future year forecast.

- **recon base, recon hi pop, recon low pop, recon high CPI, recon low CPI**. These are five alternative R/ECON forecasts for NJTPA regional employment. The differences between them are summarized on the USER INPUTS MODEL worksheet to assist the user in selecting the most appropriate forecast; these sheets provide details for the interested user.
- **user defined.** This worksheet allows the user to input their own employment growth forecasts for the NJTPA region. The User forecast can be selected and applied from the USER INPUTS MODEL worksheet.
- **recon drivers.** This worksheet describes national forecast drivers that are part of R/ECON, presented for the interested user.
- **moodys.** At the request of NJTPA, as a backcheck on R/ECON, a Moody's Economy.com forecast was acquired and is presented for the interested user.
- **notes.** This worksheet presents the User Guide, for ready reference.

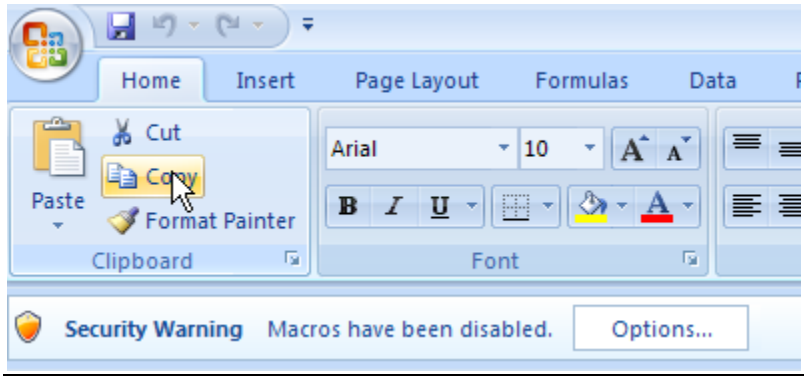
RUNNING THE TOOL – FOUR STEPS

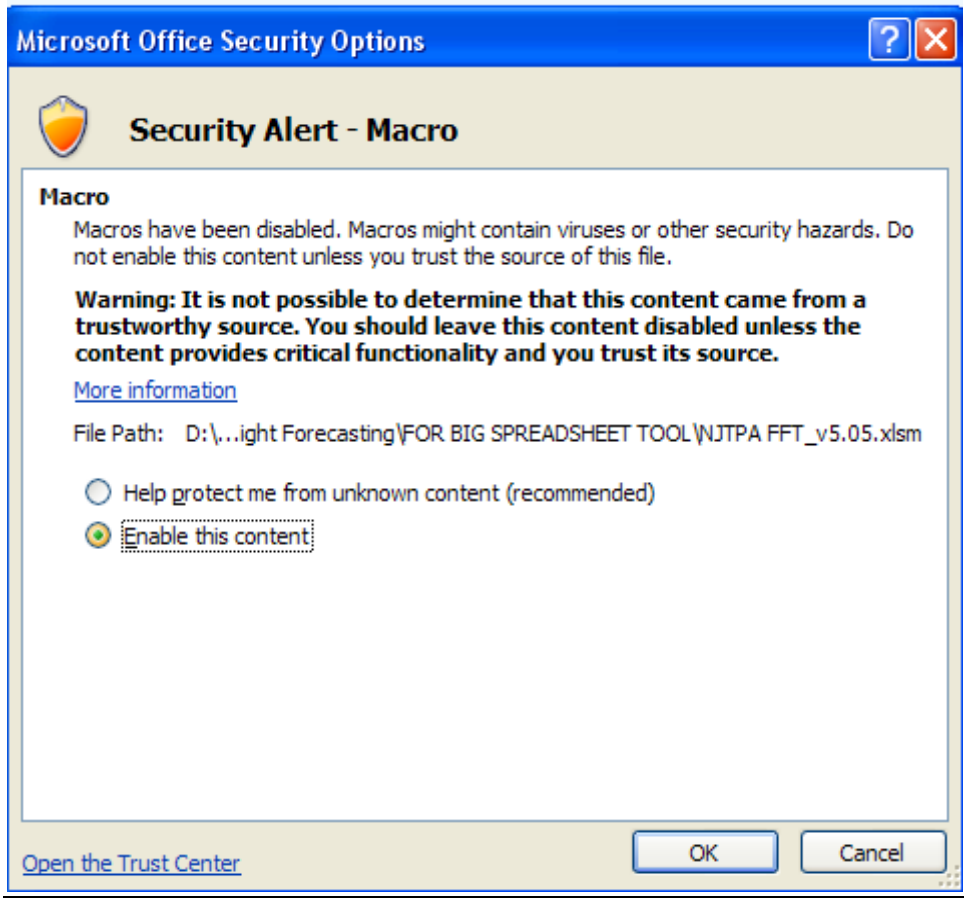
Open the Tool

Open Excel.

Then open the NJTPA Freight Forecasting Tool file. This may take up to five minutes, depending on your machine, so please be patient.

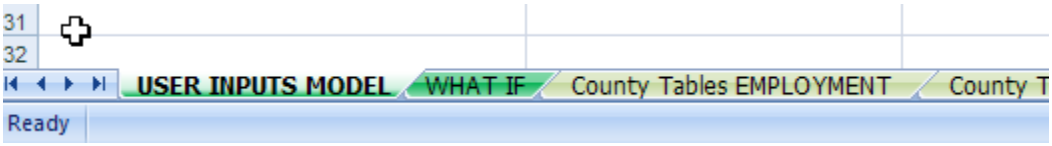
When you see the Security Warning, click Options, then "Enable this content" so the macro scripts in the Tool will run properly.



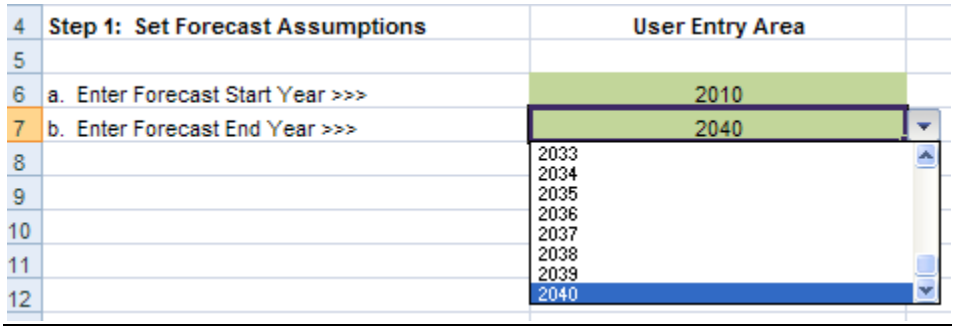


Step 1 – Set Forecast Assumptions

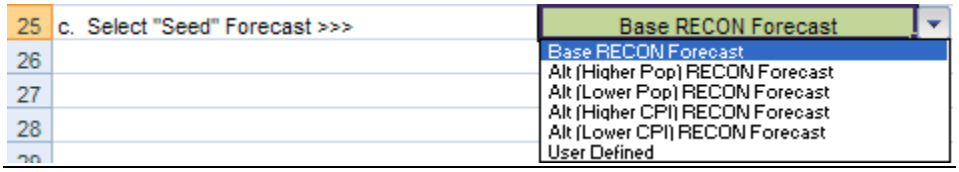
Make sure you are on the USER INPUTS MODEL worksheet. It is the first tab in the list of worksheets.



From the pull-down menus, select a forecast start year and a forecast end year.



Next, from the pull-down menu, select one of the six options for a "seed" forecast.



To assist in selecting the most appropriate seed forecast, the USER INPUTS MODEL provides summaries of the key values and differences associated with these forecast variations.

Indexed US Factors 2010-2040	*US GDP*	*US Pop*	*US CPI*	*NF Emp*	*Ret Sales*	*Imp Val*	*Exp Val*
Factors from RECON	2.21	1.31	2.01	1.36	4.04	4.93	6.91
Factors from Moodys	1.96	1.31	1.91	1.32	2.48	5.47	6.73

Indexed NJ Factors 2010-2040	*NJ GSP*	*NJ Pop*	*NJ CPI*	*NJ NF Emp*	*NJ Ret Sales*	*NJTPA Pop*	*NJTPA NF Emp*
Base RECON Forecast	**1.81**	**1.23**	**1.80**	**1.34**	**3.34**	**1.22**	**1.32**
Alt (Higher Pop) RECON Forecast	1.90	**1.36**	1.79	1.41	3.72	1.34	1.40
Alt (Lower Pop) RECON Forecast	1.73	**1.17**	1.80	1.29	3.23	1.16	1.28
Alt (Higher CPI) RECON Forecast	1.77	1.22	**1.89**	1.31	3.31	1.21	1.28
Alt (Lower CPI) RECON Forecast	1.87	1.24	**1.69**	1.37	3.37	1.23	1.38

Selected Start Year Values	*NJ GSP ($2000 bil)*	*NJ Pop (000)*	*NJ CPI (1982=100)*	*NJ NF Emp (000)*	*NJ Ret Sales ($bil)*	*NJTPA Pop (000)*	*NJTPA NF Emp (000)*
Base RECON Forecast	434	8,792	234	3,854	121	6,580	2,847
Alt (Higher Pop) RECON Forecast	434	8,792	234	3,854	121	6,580	2,847
Alt (Lower Pop) RECON Forecast	434	8,792	234	3,854	121	6,580	2,847
Alt (Higher CPI) RECON Forecast	434	8,792	234	3,854	121	6,580	2,847
Alt (Lower CPI) RECON Forecast	434	8,792	234	3,854	121	6,580	2,847

Selected End Year Values	*NJ GSP ($2000 bil)*	*NJ Pop (000)*	*NJ CPI (1982=100)*	*NJ NF Emp (000)*	*NJ Ret Sales ($bil)*	*NJTPA Pop (000)*	*NJTPA NF Emp (000)*
Base RECON Forecast	786	10,805	421	5,151	403	8,003	3,768
Alt (Higher Pop) RECON Forecast	825	11,972	420	5,441	449	8,848	3,975
Alt (Lower Pop) RECON Forecast	749	10,323	421	4,962	389	7,655	3,631
Alt (Higher CPI) RECON Forecast	769	10,729	442	5,066	400	7,947	3,654
Alt (Lower CPI) RECON Forecast	812	10,909	396	5,275	407	8,081	3,917

HINT: SELECT FORECAST THAT MOST CLOSELY REFLECTS YOUR TARGET FOR END YEAR VOLUMES.

If you have selected the User Defined forecast, please make sure you have entered forecast values in the USER DEFINED worksheet. The values must be entered in this format, for as many years as your forecast needs to cover, or the Tool will not process the data correctly.

Employment in Goods Producing Industries by Labor	**2007**	**2008**	**2009**	**2010**
NJTPA	500	1,000	1,500	2,000
Employment in Private Service Producing Industries by Labor	**2007**	**2008**	**2009**	**2010**
NJTPA	500	750	1,000	1,250
Employment in Government by Labor Area, in Thousands	**2007**	**2008**	**2009**	**2010**
NJTPA	100	100	100	100

Next, decide whether to accept the optional Warehouse Employment adjustment, which shifts some of the forecast growth in warehouse/distribution industries from Bergen to Middlesex. We recommend accepting this adjustment by selecting "Yes" from the pull down menu.

28			
29	d. Adjust Warehouse Employment? >>>	Yes	APPLIED

Next, decide whether to apply labor productivity changes. With no changes, these values are set at 1.0, and freight tonnage increases at the same rate as employment in the industries that generate particular types of freight. With higher values, future employees are assumed to produce more freight than current employees, and freight tonnage will grow faster than employment. We recommend a value of 1.20 for the year 2040, which represents productivity gains of 0.0067 per year between 2010 and 2040. To adjust labor productivity, select "Yes" from the pull down menu and enter scalar values for each type of industry. Changes of .01 or more per year are not recommended.

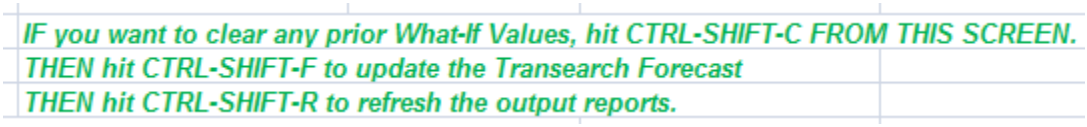
32			
33	e. Adjust Labor Productivity? >>>	Yes	APPLIED
34			

Indexed Output per Employee	*Ag Mining*	*Construction*	*Manufacturing*
Default Factors	1.00	1.00	1.00
User Adjustment (per year)	0.0067	0.0067	0.0067
Alternate Factor	1.20	1.20	1.20

Step 2 – Process the Forecast

Once Step 1 is completed, go to the Step 2 area and select "Yes" from the pull down menu.

You will then see the following instructions. It is critical to follow these instructions, and to perform them in the correct order.



- CTRL-SHIFT-C clears any data that may be in the What-If area from previous sessions. If you leave that data there, the Tool will use it in processing the forecast, and you will not get the expected results. This macro may take 2-3 minutes to run.
- CTRL-SHIFT-F refreshes the TRANSEARCH forecast. It updates pivot tables and performs copy/paste values calculations within the Tool to "lock in" the changes. This macro typically runs in about a minute.
- CTRL-SHIFT-R creates detailed output reports. This macro may take 1-2 minutes to run.

Once each of these macros has been run, detailed results will be stored in the COUNTY TABLES Employment and COUNTY TABLES Freight worksheets. Summary results will be reported and displayed on the USER INPUTS MODEL worksheet (shown on the following page).

With respect to the reported tonnage, it is very important to remember that TRANSEARCH does not include international air and water tonnage. It includes only domestic and cross-border surface trade tonnage. Therefore, international air and water tonnage is not forecast within TRANSEARCH. However, the landside traffic (by truck, rail, and water) moving to and from international gateways is part of TRANSEARCH. Several of the "What If" adjustments specifically target international trade volumes, and directly impact these landside connecting moves.

NON-FARM EMPLOYMENT (in thousands)	2010	2040	Change	Percent	CAGR
Agriculture and Mining	52.0	56.2	4.1	108%	0.3%
Chemical	47.4	50.3	2.9	106%	0.2%
Computers & Electronics	14.7	16.2	1.5	110%	0.3%
Construction	42.6	46.0	3.4	108%	0.3%
Fabricated Metal	18.4	19.1	0.7	104%	0.1%
Federal and State Government	437.0	526.8	89.8	121%	0.6%
Finance, Insurance, real estate, rental, and leasing	239.0	331.3	92.3	139%	1.1%
Food (Food & Drink)	16.0	16.4	0.4	102%	0.1%
Information	76.8	106.2	29.4	138%	1.1%
Machinery	20.7	21.6	0.8	104%	0.1%
Other Durables	2.3	2.9	0.6	125%	0.8%
Other Nondurable and Unspecified	49.3	51.4	2.1	104%	0.1%
Other Services	1,174.8	1,625.9	451.1	138%	1.1%
Paper	7.1	7.9	0.8	111%	0.3%
Plastics	9.6	11.1	1.5	115%	0.5%
Printing	12.0	11.7	(0.4)	97%	-0.1%
Retail trade	319.6	442.1	122.5	138%	1.1%
Transportation, Warehousing, Utilities	134.6	186.5	51.9	139%	1.1%
Wholesale trade	172.5	238.9	66.3	138%	1.1%
Grand Total	**2,846.6**	**3,768.2**	**921.6**	**132%**	**0.9%**
Bergen	453.4	601.7	148.3	133%	0.9%
Essex	361.2	458.8	97.6	127%	0.8%
Hudson	232.3	314.1	81.8	135%	1.0%
Hunterdon	54.9	69.8	14.9	127%	0.8%
Middlesex	391.6	541.0	149.4	138%	1.1%
Monmouth	262.4	355.8	93.5	136%	1.0%
Morris	281.2	362.6	81.4	129%	0.9%
Ocean	160.9	218.1	57.2	136%	1.0%
Passaic	172.7	230.1	57.4	133%	1.0%
Somerset	169.6	230.8	61.1	136%	1.0%
Union	224.2	281.6	57.4	126%	0.8%
Warren	37.3	46.6	9.2	125%	0.7%
Sussex	45.0	57.3	12.3	127%	0.8%
Grand Total	**2,846.6**	**3,768.2**	**921.6**	**132%**	**0.9%**

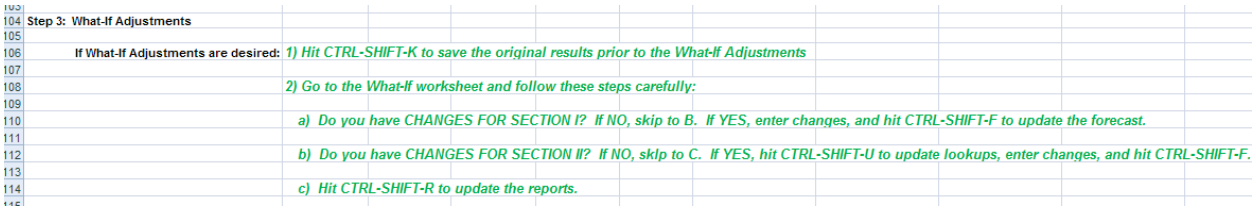
FREIGHT TONS, NJTPA REGION	2010	2040	Change	Percent	CAGR
Outbound	147,888,783	201,825,582	53,936,799	136%	1.0%
Inbound	156,607,268	229,835,937	73,228,669	147%	1.3%
Internal	92,622,431	136,829,665	44,207,234	148%	1.3%
Through	265,617,202	374,881,559	109,264,357	141%	1.2%
Total	**662,735,684**	**943,372,743**	**280,637,059**	**142%**	**1.2%**
Air	479,810	637,364	157,554	133%	1.0%
Rail Carload	31,173,074	46,487,229	15,314,155	149%	1.3%
Rail Intermodal	12,295,420	19,804,304	7,508,884	161%	1.6%
Rail NEC	2,154,368	3,064,383	910,015	142%	1.2%
Truck	537,611,540	763,602,437	225,990,898	142%	1.2%
Water	76,352,515	106,629,199	30,276,684	140%	1.1%
Pipeline/Other	2,668,956	3,147,827	478,870	118%	0.6%
Total	**662,735,684**	**943,372,743**	**280,637,059**	**142%**	**1.2%**

Step 3 – What-If Adjustments

If the user simply wants to generate a freight forecast directly from the employment forecasts, this step can be skipped. However, if the user wants to make "surgical" changes to the employment and freight forecasts, Step 3 is the opportunity to do so.

Through Steps 1 and 2, all user inputs to the Tool have been in the USER INPUT MODEL worksheet. In Step 3, the user will work with the WHAT IF worksheet.

On the USER INPUT MODEL worksheet, there is a short list of instructions for how to perform and apply the "What If" changes. As in Step 2, it is critically important to perform each of these steps, and to perform them in the correct order, or the Tool may produce unexpected results.



- First, hit CTRL-SHIFT-K. This saves the results from Step 2 to the EMPLOYMENT No What-If and FREIGHT No What-If worksheets, so they can be compared to the results after applying the What-If adjustments. Also, the No What-If results are reported in summary form on the USER INPUTS MODEL worksheet.
- Next, go to the WHAT IF worksheet. Data entry on this worksheet is divided into two Sections. Any data entered in Section I must be fed back into the Tool, processed, and read by Section II before data is entered in Section II.
- If you have any changes to the items listed in Section I, enter them and hit CTRL-SHIFT-F to refresh the TRANSEARCH forecast.
- If you have any changes to the items listed in Section II, hit CTRL-SHIFT-U to update the lookup tables that are required by the variables in Section II. Then enter data and hit CTRL-SHIFT-F to refresh the TRANSEARCH forecast. If you have no changes to Section II, skip this step.
- Finally, hit CTRL-SHIFT-R to update the reports. The forecasts with the What-If adjustments applied will be stored in the COUNTY TABLES Employment and COUNTY TABLES Freight worksheets. Summary results will be reported and displayed on the USER INPUTS MODEL worksheet, side by side with the No What-If results; the gray shaded column between them shows the difference between the end year values for the two forecasts, so the user can see at a glance the effect of the "What If" changes.

Detailed explanations of the various What-If adjustments available to the user are presented at the end of this User Guide, following the discussion of Step 4.

Step 4 – RTM-E Trip Table Generation

Once the desired freight forecast has been generated, the user can hit CTRL-SHIFT-T to generate a corresponding heavy truck trip table for the NJTPA Regional Transportation Model – Enhanced (NJRTM-E). The table is created and stored in the RTME ADJUSTED worksheet. The user can then use copy/paste values to move the information to an external location.

Additional Detail on the What-If Adjustments

The discussion above provides a basic overview of the structure and functionality of the NJTPA Freight Forecasting Tool. Most of the functions are straightforward and relatively easy to explain and understand. However, some of the "What If" adjustments are not intuitive, and all of them warrant further discussion.

So: let's walk through each of the "What If" adjustment steps in more detail.

First, remember to hit CTRL-SHIFT-K to save the No What-If forecast results.

Next, go to the WHAT IF worksheet. As mentioned earlier, the WHAT IF worksheet is divided into two Sections which are processed separately. Section I contains adjustments to Employment Drivers and Import/Export/Domestic Balance. Section II contains adjustments to Mode Choice and Logistics Factors.

Starting with Section I: to adjust Employment Drivers, look for Section 1A and the long list of industry classes and counties, starting in row 14. In this area, the current and future employment from the selected seed forecast is displayed. For any given line, the user can override these values, by entering either a Compound Annual Growth Rate or an Alternative Future Employment. Any number other than zero is read as a change to the seed forecast, and processed accordingly.

	I	J	K	L	M	N	O	P	Q
14	1A. ADJUSTMENTS TO THE EMPLOYMENT DRIVERS TABLE								
15		2010	2040	Change (000)	CAGR		Enter Alternative	Enter Alternative	Adjusted 2040
16		Employment (000)	Employment (000)				CAGR (<>0)	Future Employment (<>0)	Employment (000)
17	Agriculture and Mining								
18	Bergen	7.5	7.9	0.5	0.2%		1.0%		10.1
19	Hudson	2.4	2.6	0.1	0.2%			4.0	4.0
20	Passaic	3.9	4.1	0.2	0.2%				0.0
21	Essex	4.8	3.8	(1.0)	-0.8%				0.0
22	Hunterdon	1.8	1.4	(0.4)	-0.8%				0.0
23	Morris	5.4	4.2	(1.1)	-0.8%				0.0
24	Sussex	1.5	1.2	(0.3)	-0.8%				0.0
25	Union	4.4	3.5	(0.9)	-0.8%				0.0
26	Warren	0.9	0.8	(0.1)	-0.3%				0.0
27	Middlesex	5.8	7.9	2.1	1.0%				0.0
28	Monmouth	6.2	8.5	2.3	1.0%				0.0
29	Ocean	4.7	6.4	1.7	1.0%				0.0
30	Somerset	2.9	4.0	1.1	1.0%				0.0

In the example above, we increased the CAGR for Agriculture and Mining employment in Bergen County from 0.2% to 1.0%, for a forecast through 2040. We specified a value of 4,000 employees for Hudson County. The resulting adjustments are shown in Column G, Adjusted Employment. Similar adjustments can be made in every other industry class in the same way – with two exceptions.

The exceptions are the Manufacturing and the Other Services (Including Information) industry groups, where it is necessary to first calculate the change in employment, and then allocate it across specific industries. In the example below, we increased the CAGR for Manufacturing employment in Bergen County from 0.2% to 1.0%, for a forecast through 2040. We specified a value of 15,000 employees for Hudson County. The resulting adjustments are shown in Column G, Adjusted Employment.

	I	J	K	L	M	N	O	P	Q
14	1A. ADJUSTMENTS TO THE EMPLOYMENT DRIVERS TABLE								
15		2010	2040	Change (000)	CAGR		Enter Alternative	Enter Alternative	Adjusted 2040
16		Employment (000)	Employment (000)				CAGR (<>0)	Future Employment (<>0)	Employment (000)
47	Manufacturing								
48	Bergen	33.4	35.5	2.0	0.2%		1.0%		45.1
49	Hudson	10.7	11.3	0.6	0.2%			15.0	15.0
50	Passaic	15.2	16.1	0.9	0.2%				0.0
51	Essex	21.0	16.6	(4.4)	-0.8%				0.0
52	Hunterdon	2.7	2.1	(0.6)	-0.8%				0.0
53	Morris	20.9	16.5	(4.4)	-0.8%				0.0
54	Sussex	1.8	1.4	(0.4)	-0.8%				0.0
55	Union	24.2	19.1	(5.1)	-0.8%				0.0
56	Warren	5.4	4.9	(0.5)	-0.3%				0.0
57	Middlesex	34.7	47.4	12.7	1.0%				0.0
58	Monmouth	8.4	11.4	3.0	1.0%				0.0
59	Ocean	4.7	6.4	1.7	1.0%				0.0
60	Somerset	14.4	19.7	5.3	1.0%				0.0

Looking to the right of the Manufacturing employment data entry area, there is a column reporting the changed employment to the user, and a set of industries where values may be entered. The user has to assign all of the employment in the "ALLOCATE THIS CHANGE" column to the industries listed in the columns

to the right. In the example below, we created 13,300 new employees but did not allocate them to industries, and the Tool provided a friendly reminder to do so. When the employment is correctly assigned, the reminder disappears.

Q	R	S	T	U	V
Adjusted 2040 Employment (000)					
	ALLOCATE THIS CHANGE	Chemical	Computers and Electronics	Fabricated Metal	Food
45.1	9.6				
15.0	3.7				
0.0	0.0				
0.0	0.0				
0.0	0.0				
0.0	0.0				
0.0	0.0				
0.0	0.0				
0.0	0.0				
0.0	0.0				
0.0	0.0				
0.0	0.0				
	13.3	0.0			
	WARNING, CHANGE NOT ALLOCATED, PLEASE ASSIGN TO INDUSTRIES				

Q	R	S	T	U	V
Adjusted 2040 Employment (000)					
	ALLOCATE THIS CHANGE	Chemical	Computers and Electronics	Fabricated Metal	Food
45.1	9.6	9.6			
15.0	3.7		3.7		
0.0	0.0				
0.0	0.0				
0.0	0.0				
0.0	0.0				
0.0	0.0				
0.0	0.0				
0.0	0.0				
0.0	0.0				
0.0	0.0				
0.0	0.0				
	13.3	13.3			

For Other Services (Including Information) the same allocation step is required.

The Tool will calculate whatever changes the user specifies, but unless extreme effects are the user's goal, it is suggested that changes to the seed forecast values not be less than 1/3 or more than 3 times the original values. Where possible, changes should relate to known industrial development projects, or to employment forecasts developed by or for each county.

Still in Section I, and moving on to Import/Export/Domestic Balance: look for Section 1B, starting in row 188. You will see a list of factors: World GDP; US GDP; World Fuel Price; US Fuel Price; Exchange Rates; Other Adjustments to Imports; and Other Adjustments to Exports and Domestic Production.

	I	J	K	L	M	N	O
188	**1B. Adjustments to Import/Export/Domestic Balance**						
189		**DEFAULT EST**	**NEW**	**RESULT**	**ADJUSTMENT**	**SENSITIVITY**	**SCALAR**
190		**for analysis year**	**(one cell only)**		**RATIO**		
191	GDP, World						
192	CAGR (must be <> 0)	4.40%		0.00%			
193	End/Begin	3.64		-	1.00	100.0%	1.00
194	Start Value ($2005 bil)	63,123					
195	End Value ($2005 bil)	229,980		-			
196	Added Value ($2005 bil)	166,857		-			
197							
198	GDP, US						
199	CAGR (must be <> 0)	2.68%		0.00%			
200	End/Begin	2.21		-			
201	Start Value ($2005 bil)	13,249					
202	End Value ($2005 bil)	29,271		-	1.00	100.0%	1.00
203	Added Value ($2005 bil)	16,022		-			
204							
205							
206	Fuel Price, World (assumes same avg as US)						
207	CAGR (must be <> 0)	2.54%		0.00%			
208	End/Begin	2.13		-	1.00	33.0%	1.00
209	Start Value ($2005 barrel)	85.03					
210	End Value ($2005 barrel)	181.22		-			
211	Added Value ($2005 barrel)	96.19		-			
212							
213							
214	Fuel Price, US						
215	CAGR (must be <> 0)	2.54%		0.00%			
216	End/Begin	2.13		-	1.00	33.0%	1.00
217	Start Value ($2005 barrel)	85.03					
218	End Value ($2005 barrel)	181.22		-			
219	Added Value ($2005 barrel)	96.19		-			

	I	J	K	L	M	N	O
188	**1B. Adjustments to Import/Export/Domestic Balance**						
189		**DEFAULT EST**	**NEW**	**RESULT**	**ADJUSTMENT**	**SENSITIVITY**	**SCALAR**
222	Exchange Rate						
223	CAGR (must be <> 0)	-0.30%		0.00%			
224	End/Begin	0.93		-	1.00	100.0%	1.00
225	Start Value (indexed)	99.46					
226	End Value (indexed)	92.01		-			
227	Added Value (indexed)	(7.45)		-			
228							
229							
230	Other Adjustments to Imports						
231	CAGR	5.46%		0.00%			
232	End/Begin	4.93		-	1.00	100.0%	1.00
233	Start Value ($2005 bil)	1,757					
234	End Value ($2005 bil)	8,662		-			
235	Added Value ($2005 bil)	6,904		-			
236							
237							
238	Other Adjustments to Exports and Domestic Production						
239	CAGR	6.66%		0.00%			
240	End/Begin	6.91		-	1.00	100.0%	1.00
241	Start Value ($2005 bil)	1,207					
242	End Value ($2005 bil)	8,341		-			
243	Added Value ($2005 bil)	7,134		-			

For each factor, the Tool reports "default values" from the R/ECON forecast and its underlying IHS Global Insight national forecast: the CAGR for that factor for the forecast period; the ratio of end value to start value; the start value; the end value; and the added value. In Column K, the user can enter a new value for any of these except the start value, and the Tool will use it to override the default values.

In the example below, we specify that US GDP will grow at 3.00% per year through the forecast period, up from the 2.68% assumption built into the seed forecast. This creates a higher end year value, more added value, and a higher ratio of end year to start year value – all of which is calculated for the user.

I	J	K	L	M	N	O
1B. Adjustments to Import/Export/Domestic Balance						
	DEFAULT EST	**NEW**	**RESULT**	**ADJUSTMENT**	**SENSITIVITY**	**SCALAR**
GDP, US						
CAGR (must be <> 0)	2.68%	3.00%	3.00%			
End/Begin	2.21		2.43			
Start Value ($2005 bil)	13,249					
End Value ($2005 bil)	29,271		32,159	1.10	100.0%	1.10
Added Value ($2005 bil)	16,022		18,910			

Note that the "Scalar" column is no longer 1.00; it is now 1.10. This is the ratio by which freight movements which are advantaged by higher GDP should be increased, and freight movements which are disadvantaged should be decreased. The Scalar value is based on the Adjustment, times the Sensitivity. Changes in GDP and freight tonnage are closely correlated, so we assume a Sensitivity of 100%. (For other factors which are less closely correlated with freight tonnage, such as the effect of fuel price changes, we use a reduced Sensitivity to dampen down the effects of the Scalar.)

In this example, we see that a higher US GDP produces increased domestic freight tonnage in all directions (outbound, inbound, internal, and through), as well as increased exports and export-related landside tonnage (due to stronger domestic production), but decreases imports and import-related landside tonnage (due to reduced reliance on imported goods). The PROCESSED TS 2007 worksheet "knows" to look for scalar factors in this table and apply them when it calculates future growth; which cell it looks in depends on whether the record represents domestic or international traffic, and in what direction.

	I	Q	R	S	T	U	V	W	X	Y
188	**1B. Adjustments to Import/Ex**									
189		**INTERNATIONAL EFFECTS IN REGION**					**DOMESTIC EFFECTS IN REGION**			
190		Import	Export	Import Related	Export Related		Outbound	Inbound	Internal	Through
198	GDP, US									
199	CAGR (must be <> 0)									
200	End/Begin									
201	Start Value ($2005 bil)									
202	End Value ($2005 bil)	0.91	1.10	0.91	1.10		1.10	1.10	1.10	1.10
203	Added Value ($2005 bil)									

The effects of higher/stronger values for each of these factors are as follows, with lower/weaker values producing the opposite effects:

- World GDP – higher import and import-related landside tonnage; higher export and export-related landside tonnage
- US GDP – higher domestic tonnage; higher export and export-related tonnage; lower import and import-related tonnage
- World Fuel Price – lower import and import-related landside tonnage; lower export and export-related landside tonnage
- US Fuel Price – lower domestic tonnage
- Exchange Rates – higher import and import-related landside tonnage; lower export and export-related landside tonnage
- Other Adjustments to Imports – higher import and import-related landside tonnage
- Other Adjustments to Exports and Domestic Production – lower import and import-related landside tonnage; higher export and export-related landside tonnage; higher domestic tonnage

Our general recommendation is to not make any significant adjustments to these factors unless the changes are supported by reliable sources. However, it is not unreasonable for analysts to test risk and uncertainty by asking "what if" the default forecasts are not realized, by varying the end year values upward or downward by not more than 10%.

After your Section I changes are complete, you must hit CTRL-SHIFT-F to update the TRANSEARCH forecast. If you have changes for Section II, proceed as described below. Otherwise, just hit CTRL-SHIFT-R to generate reports, and you are finished.

Assuming you have changes to Section II, here is how to make them.

Before doing anything else, make sure you hit CTRL-SHIFT-U. Anything you entered in Section I had the effect of altering the freight forecast you generated way back in Step 2. In Section II, the adjustments focus on shifting freight tonnage between modes and origins and destinations, so Section II has to know about any changes you made in Section I in order to reallocate the tonnage accurately. CTRL-SHIFT-F updates the TRANSEARCH forecast, and CTRL-SHIFT-U generates lookup tables from that forecast.

Section II addresses two primary types of factors: truck/rail balance and mode choice; and port/distribution center utilization. In practice these are complex issues but with some reasonable simplifying assumptions they can be addressed.

Starting in row 258, there are two truck/rail balance adjustments. The user is presented with starting and ending Long Haul Truck and Rail tons, and the truck share of the combined Long Haul Truck-Rail market.

	I	J	K	L	M	N	O
256	2. Adjustments to Mode Choice and Logistics Factors						
257		VALUES FOR	NEW	RESULT	ADJUSTMENT	SENSITIVITY	SCALAR
258		ANALYSIS YEAR			RATIO		
259							
260	TR1. Fuel Costs (ENTER "YES" TO APPLY ADJUSTMENT)				1.14	33.0%	1.05
261	Start LH Truck Tons	284,622,625		284,622,625			
262	End LH Truck Tons	402,285,924		384,660,816			
263	Change in LH Truck Tons	117,663,298		100,038,190			
264	LH Truck CAGR	1.2%		1.0%			
265	Start LH Rail Tons	44,774,570	yes	44,774,570			
266	End LH Rail Tons	68,123,022		85,748,130			
267	Change in LH Rail Tons	23,348,452		40,973,560			
268	LH Rail CAGR	1.4%		2.2%			
269	Start Truck Share of LH Truck-Rail Market	86.4%		86.4%			
270	End Truck Share of LH Truck-Rail Market	85.5%		81.8%			
271							
272							
273	TR2. Other Trucking Costs (Tolls, Drivers, Congestion, Compliance, Capacity, etc.) or Policy Changes Affecting Truck/Rail Mode Share						
274	Start LH Truck Tons	284,622,625		284,622,625			
275	End LH Truck Tons	384,660,816		384,660,816			
276	Change in LH Truck Tons	100,038,190		100,038,190			
277	LH Truck CAGR	1.0%		1.0%			
278	Start LH Rail Tons	44,774,570		44,774,570			
279	End LH Rail Tons	85,748,130		85,748,130			
280	Change in LH Rail Tons	40,973,560		40,973,560			
281	LH Rail CAGR	2.2%		2.2%			
282	Start Truck Share of LH Truck-Rail Market	86.4%		86.4%			
283	End Truck Share of LH Truck-Rail Market	81.8%		81.8%			

In the example above, we entered "yes" to apply a fuel price adjustment. The assumption is that higher US fuel prices will tend to shift freight from truck to rail. In this example, we assumed that fuel prices would grow at 3% per year, rather than 2.5% per year as assumed by the forecast. The Adjustment Factor is actually carried down from the US Fuel Price line in Section I. The higher growth produces a higher adjustment factor, which means a greater reduction in truck volumes. In this case, applying the adjustment reduced the end year long haul truck tonnage from 402 million tons to 385 million tons, increased the end year rail tonnage by an equal amount, and reduced the future truck mode share from 85.5% to 81.8%.

The Tool also allows for a second adjustment. Truck and rail are competing modes; trucking costs can vary depending on driver availability, highway congestion, regulation, industry and infrastructure capacity, and other factors; rail costs can vary depending on business factors and infrastructure conditions; and public policy decisions on how to regulate, where to invest, etc. can influence modal shares as well. The default mode share estimate, carried down from the fuel price adjustment, is 81.8% for trucks; if the user enters a different value, the Tool reduces the amount of truck tonnage and increases the amount of rail tonnage by a corresponding amount.

After these two adjustments are calculated, they are combined as scalar factors affecting long haul truck records and rail records, and the PROCESSED TS 2007 worksheet "knows" to look for and apply them.

Next, starting in row 288, there are two port-related adjustments – one for Panama Canal effects, and the other for effects related to not improving the Bayonne Bridge height clearance. These are the most complicated adjustments to implement in the model, but they are not too difficult to explain.

The consultant team believes that the Panama Canal, Suez Canal, and rail "landbridge" services from other ports into the region will all continue to carry traffic, and will compete with each other. With widening of the Panama Canal, it will gain some cost advantage over the other two routes. Those routes may in turn reduce their prices, or the Panama Canal might raise its prices (to better pay off its debts). In any case, the net cost effect for the region's shippers and receivers is likely to be small, compared to the total end-to-end cost of the international freight move – so the total amount of import and export traffic is not changed. What the Panama Canal will do is: a) reduce rail landbridge arrivals into the region, along with truck deliveries from the region's railyards to end users; and b) increase marine cargo arrivals at the region's container terminals, along with rail traffic to inland destinations and truck traffic to local destinations. For the Tool, the complication is that the landbridge railyards are located in two different counties; the marine terminals are located in three different counties; and the effects are different depending on the direction of traffic (inbound, outbound, or internal) and the import/export trade balance.

Interestingly, the same argument applies to any Port competitiveness argument. For example, if we assume that the region does not modernize and expand its container handling capacity, it will likely be served by other ports through a combination of truck and rail; however, the nearest "truck" ports provide far less capacity than would be required, and replacement service from "rail" ports is far more likely. Therefore, the "Panama Canal" adjustment also serves as a "Port Competitiveness" adjustment.

To apply the adjustment, the user must enter values for each cell highlighted in green below. Values suggested by the consultant team are presented for illustrative purposes, but the user may substitute other values as established by market studies, or according to preference. In the example below, the default values were accepted. The net effect is 1,000,000 TEU increase in waterborne container traffic compared to base case PANYNJ forecasts; the import share is 60%; the inland rail market share is 30%; and traffic is allocated between Hudson, Essex and Union counties. In columns M and N, the increases and decreases in rail and truck traffic by county by direction are calculated; in other columns, not shown below, these are translated into adjustment factors which are read by the PROCESSED TS 2007 worksheet and applied to the appropriate records.

	H	I	J	K	L	M	N
287			**SUGGESTED TEST VALUES**		**TEUs**	**Inbound to Port/Region**	**Outbound from Port/Region**
288	**Port and DC Factors**	PDC1. Change from Current Baseline Forecast Due to Panama Canal, Port Competitiveness, or Other Port-Wide Factors					
289		Effect on Waterborne TEUs	1,000,000	1,000,000	1,000,000		
290		Import Share of Affected TEUs	60%	60%		2,800,000	4,200,000
291		Inland Market (Rail IMX) Share of Affected TEUs	30%	30%			
292		Rail IMX Tons Generated				840,000	1,260,000
293		Truck Tons Generated				1,960,000	2,940,000
294	Rail IMX Share Assigned to Hudson; other end follows TS distribution		25%	25%		210,000	315,000
295	Rail IMX Share Assigned to Essex; other end follows TS distribution		25%	25%		210,000	315,000
296	Rail IMX Share Assigned to Union; other end follows TS distribution		50%	50%		420,000	630,000
297	Truck STCC 5010 Share Assigned to Hudson; other end follows TS distribution		25%	25%		490,000	735,000
298	Truck STCC 5010 Share Assigned to Essex; other end follows TS distribution		25%	25%		490,000	735,000
299	Truck STCC 5010 Share Assigned to Union; other end follows TS distribution		50%	50%		980,000	1,470,000
300	Rail IMX Landbridge Imports Impacted, Hudson from all		50%	50%		(2,100,000)	-
301	Rail IMX Landbridge Imports Impacted, Union from all		50%	50%		(2,100,000)	-
302	Rail Drayage STCC 5021 5022 Impacted, Hudson to all					-	(2,100,000)
303	Rail Drayage STCC 5021 5022 Impacted, Union to all					-	(2,100,000)
304	Net Effects (for Backcheck)					**(1,400,000)**	-

The project to raise the Bayonne Bridge, which imposes a height restriction on marine cargo vessels transiting the Kill van Kull to access container terminals in Newark Bay, will likely prevent the region from losing marine cargo. As with the Panama Canal, we would argue that cargo not arriving by water will instead arrive by rail. So the calculation of effects is similar to the Panama Canal case, except here we are avoiding the loss of marine cargo, rather than capturing additional cargo. As with the Panama Canal adjustment, the Tool includes illustrative values suggested by the consultant team, but the user may enter any values, based on market studies or preference. In the illustration following, we assume that failure to improve the Bayonne Bridge would result in the loss of 750,000 TEUs of marine container traffic in Essex and Union counties (Hudson is not affected), a corresponding increase in rail landbridge arrivals, and secondary changes in truck and rail trip generation.

306							
307		PDC2. Effects if Bayonne Bridge Clearance is Not Improved			**TEUs**	**Inbound to Port/Region**	**Outbound from Port/Region**
308		Effect on Waterborne TEUs	(750,000)	(750,000)	(750,000)		
309		Import Share of Affected TEUs	60%	60%		(2,100,000)	(3,150,000)
310		Inland Market (Rail IMX) Share of Affected TEUs	30%	30%			
311		Rail IMX Tons Generated				(630,000)	(945,000)
312		Truck Tons Generated				(1,470,000)	(2,205,000)
313	Rail IMX Share Assigned to Hudson; other end follows TS distribution		0%			-	-
314	Rail IMX Share Assigned to Essex; other end follows TS distribution		33%	33%		(210,000)	(315,000)
315	Rail IMX Share Assigned to Union; other end follows TS distribution		67%	67%		(420,000)	(630,000)
316	Truck STCC 5010 Share Assigned to Hudson; other end follows TS distribution		0%			-	-
317	Truck STCC 5010 Share Assigned to Essex; other end follows TS distribution		33%	33%		(490,000)	(735,000)
318	Truck STCC 5010 Share Assigned to Union; other end follows TS distribution		67%	67%		(980,000)	(1,470,000)
319	Rail IMX Landbridge Imports Impacted, Hudson from all		50%	50%		1,575,000	-
320	Rail IMX Landbridge Imports Impacted, Union from all		50%	50%		1,575,000	-
321	Rail Drayage STCC 5021 5022 Impacted, Hudson to all					-	1,575,000
322	Rail Drayage STCC 5021 5022 Impacted, Union to all					-	1,575,000
323	Net Effects (for Backcheck)					**1,050,000**	-
324							

The project to construct an intermodal rail terminal at Greenville Yard, adjacent to the Global/MOTBY container terminal complex, has simpler effects. If the project is not built, local trucks would have to dray containers between the marine terminal and off-site railyards, creating truck trips that would not otherwise exist. The user needs to enter the total TEUs handled at the terminal and the anticipated rail share, and the Tool calculates truck tons created without the project and applies the corresponding adjustments to TRANSEARCH records.

325	PDC3. Effects if Greenville Intermodal Yard is Not Constructed			TEUs
326	Total Waterborne TEUs at Global/MOTBY	2,000,000	2,000,000	2,000,000
327	Inland Market (Rail IMX) Share of Affected TEUs	30%	30%	600,000
328	Yard Constructed?	NO	NO	
329	Rail Drayage 5021 5022 Tons Created, Internal, Hudson County			

Finally, there are two What-If adjustments relating to warehouse and distribution center development.

- The first adjustment examines a scenario where port-related warehouse and distribution traffic is developed in Pennsylvania, rather than in the NJTPA region. The user specifies the square footage involved, the typical freight tonnage moved per square foot per year, and the share of port traffic associated with Hudson, Essex, and Union counties. The Tool calculates adjustments for added truck trips between these counties and Pennsylvania, reduced truck trips between these counties and other locations, and increased truck trips from Pennsylvania back into the NJTPA region.
- The second adjustment examines a scenario in which future demand for Warehouse/Distribution activity is reduced due to these functions being performed overseas. The user specifies the amount of the reduction, and the Tool calculates the corresponding reduction in warehouse/distribution related traffic in the NJTPA region.

334	PDC4. Effects if NJTPA Port-Related Warehousing is Shifted to PA		
335	SF of Port-Related Warehouse SF Shifted to PA	50,000,000	50,000,000
336	Tons per SF per Year	0.16	0.16
337	Truck STCC 5010 Share Assigned to Hudson	25%	25%
338	Truck STCC 5010 Share Assigned to Essex	25%	25%
339	Truck STCC 5010 Share Assigned to Union	50%	50%
340	Truck STCC 5010 Tons, Hudson-PA		
341	Truck STCC 5010 Tons, Essex-PA		
342	Truck STCC 5010 Tons, Union-PA		
343	Truck STCC 5010 Tons, Hudson-Other		
344	Truck STCC 5010 Tons, Essex-Other		
345	Truck STCC 5010 Tons, Union-Other		
346	Truck STCC 5010 Drayage Effects, PA to NJTPA		
347	Net Effects (for Backcheck)		
348			
349			
350			
351	PDC5. Effects of Changes in NJTPA-Related Warehouse-Distribution Activity		
352	Change in Warehouse-Distribution Related Tonnage	-25%	-25%
353	Truck STCC 5010 Drayage Effects, NJTPA		
354	Net Effects (for Backcheck)		

Once all the Section II What-If adjustments are completed, the user must hit CTRL-SHIFT-F (to update the TRANSEARCH forecast for the last time) and CTRL-SHIFT-R (to generate output reports.) You are finished. Congratulations!