Methodological Framework Development for Evaluating Highway Truck Parking Location and Capacity Expansion

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16. Abstract

As the number of trucks on the road continues to increase, mandatory rest periods combined with a decreasing number of parking spaces and amenities geared towards truck drivers have created a paradoxical yet often overlooked issue of truck parking shortage. Especially within the urbanized landscape of New Jersey, truck stops are rarely considered a highest and best use form of development and those that exist are often expensive to operate. From the policy and public sector aspect, numerous regional-based studies have aimed to examine the magnitude of the truck parking issue, primarily in the most urbanized areas. Much of the additional existing research on this issue has focused on parking demand modeling and the use of intelligent transportation systems (ITS) technology to improve existing truck stops. Little research however has focused on identifying the precise steps and considerations involved with actually expanding parking capacity. This study is meant to serve as the next step in the process, through the development of a comprehensive cost-benefit analysis (CBA) based methodological framework aimed at developing or expanding truck stops. Addressing economic, fiscal, environmental and roadway safety factors, particularly through the scope of New Jersey, the ultimate goal is a framework that can be utilized by the private and public sectors statewide and elsewhere. The framework and its application to empirical case studies provide useful insights to both public and private agencies into addressing regional parking capacity shortfall and safety concerns.

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Executive Summary

This report was commissioned to examine methods of remediating the issue of truck parking shortage across the United States and particularly within urban metropolitan areas. Especially the case in recent years, truck vehicle miles travelled (VMT) continue to increase, while tightened department of transportation (DOT) budgets have slashed rest stop operations, leading to a continued decline in overnight truck parking. The report develops a semi-quantitative framework that can be used to identify costs and benefits associated with developing truck parking from a public and private sector point of view.

The first half of the report addresses economic, fiscal, environmental and safety factors associated with truck stop development, drawing research from New Jersey public tax records, Gaussian plume theory, sound measurement and the Rutgers University Plan4Safety crash database respectively. Analyzing development patterns and satellite imagery, the second half of the report is a county-by-county assessment of potential truck parking locations within New Jersey, which seeks to identify clusters of truck traffic-generating uses. Lastly, a hypothetical case study of a site in Newark, New Jersey is presented as an example of this methodology in use.

There are numerous findings from the report. Economic and fiscal figures provide rough financial figures for both the private and public sectors. Based on Gaussian plume and noise modeling, the negative effects of truck stops on nearby residential property values could be significant at over 10%, depending on distance. In terms of site selection particularly within New Jersey, undeveloped and underdeveloped land within Burlington, Gloucester, Middlesex and Monmouth Counties may be most conducive to truck stop construction given close proximity to large distribution centers and industrial parks along the Northeast Corridor. This report additionally aimed to quantify safety benefits associated with truck stop development. As a limitation of this methodology, the advanced modeling needed to quantify these benefits has yet to be conducted. Future studies should also aim to present such findings in an annualized basis for the purposes of constructing a true CBA format. This will allow for a clear and reliable process towards optimal truck parking development.

1 Description of the Problem

The United States is experiencing continued growth in commercial vehicle travel on national roadway systems, while also facing critical shortages in truck parking. Two major federal government-based ordinances have driven the demand to explore these particular issues in a more in-depth basis. The first of which is Jason's Law which was enacted in 2012. The law is named after Jason Rivenburg, a truck driver who was murdered in his fully loaded tractor trailer while he was napping. On the verge of experiencing fatigue and because there were no adjacent truck stops, Jason decided to pull into an abandoned gas station in South Carolina, where the murder would take place. Jason's Law set aside $6 million in federal funding for truck stop development and improvements including but not limited to the following:

- Construction of safety rest areas with truck parking
- Construction of truck parking areas adjacent to commercial truck stops and travel plazas
- Opening existing facilities to truck parking, including inspection and weigh stations and park-and-ride facilities
- Promoting availability of publicly or privately-provided truck parking on the National Highway System (NHS)
- Construction of turnouts along the NHS for commercial motor vehicles
- Making capital improvements to public truck parking facilities closed on a seasonal basis that will allow those facilities to remain open all year
- Improving the geometric design of interchanges on the NHS to improve access to truck parking facilities

As of 2015, although the Moving Ahead for Progress in the 21st Century Act (most commonly referred to as MAP-21) has yet to include a formal truck parking program funding source, under Jason's Law, truck parking is now eligible for funding under the National Highway Performance Program (NHPP), Surface Transportation Program (STP) and Highway Safety Improvement Program (HSIP) of the Federal Highway Administration (FHWA) *(1)*.

The second is new federal legislation on hours-of-service (HOS) for truck drivers. Such regulations are drafted and updated by the Federal Motor Carrier Safety Administration. Effective on July 1st, 2013, the new guidelines require a maximum of 70 hours of driving within 8 days, at least a 30-minute break during the first 8 hours of a shift, in addition to the existing 11-hour daily driving and 14-hour total work limits per day. The 70 hour driving limit represents a 12 hour decrease from the previous limits of 82. If a truck driver reaches this maximum threshold, a mandatory rest period of 34 consecutive hours is required which must include 2 periods between 1:00 AM and 5:00 AM, the time period when the human body requires the most sleep *(2)*. Although such guidelines have been implemented with the primary goal of safety in mind, the result has been a significant increase in demand for truck parking, particularly during the nighttime hours. In areas with congested freight operations and inadequate parking facilities, a fatigued driver may continue to drive long distances seeking parking on highway shoulders, thereby introducing safety and environmental hazards.

As one of the largest consumer markets and a national gateway for freight movements, the State of New Jersey is experiencing substantial increases in freight traffic and correspondingly, truck parking demand. The North Jersey Transportation Planning Authority (NJTPA) has laid the groundwork for identifying the need for additional truck parking in Northern New Jersey. According to their two-

phase studies, more than 80% of the 34 observed truck parking facilities in the region were over capacity, and almost 100% more parking spaces were needed to meet the demand in 2006 *(3-4)*. In view of growing freight traffic, the gap between parking space supply and demand is expected to widen in the years to come.

As such, there is a pressing need to strategically expand existing facilities and develop new truck parking facilities. Under limited public resources, data-driven investment decisions on freight infrastructure should be made not only to fulfill trucking demand and improve transportation safety, but also to support economic development on local, regional and national levels. In addition to alleviating parking congestion and complying with hour-of-service legislation, optimal expansion of public and commercial truck parking facilities also boosts employment and brings revenue opportunities.

To address the increasing safety concerns and parking congestion, there is an urgent need for relevant methodologies in support of the decisions on truck parking system improvement making best use of public resources. One key decision is selection of locations of existing and/or new facilities to expand. This depends on a host of socio-economic factors, including safety, environmental sustainability, mobility, economic competitiveness, policy, etc., and involving various public and private stakeholders. Spatial demand fulfillment and operation facilitation are important factors for freight industry. On the other hand, the safety hazards resulted from lack of parking spaces is the major concern for government agencies. Moreover, land use restriction, permitting cost and community resistance are the dominating costs and barriers in site selection. To provide a comprehensive evaluation of potential parking expansion projects, we aim to develop a semi-quantitative methodological framework that incorporates the important economic, fiscal, environmental and safety impacts. This framework is supplemented by a regional, local and site-level selection analysis that is applied for each county in New Jersey. Despite the specific focus on New Jersey however, this framework is applicable to other states and regions as well. In line with the strategic development of freight infrastructure, the proposed methodology framework can be a practical tool that provides decision makers with engineering guidelines and economic insights for alleviating congestion, facilitating compliance of the HOS requirement, and reducing the safety hazards.

2   Literature Review

Many studies conducted by metropolitan planning organizations (MPOs) and state departments of transportation (DOTs) have highlighted a deficit in truck parking that is expected to increase over the next decade.   Within New Jersey, the NJTPA and Delaware Valley Regional Planning Commission (DVRPC) have been at the forefront of highlighting this often overlooked issue.   In 2008, the NJTPA published the '*North Jersey Truck Rest Stop Study, an Assessment in Northern New Jersey and the Port District,'* the first study of its kind specifically looking at the truck parking issue within northern New Jersey.   The study found that despite northern New Jersey having 1400 available truck parking spaces, there was demand for an additional 1300 spaces on any given night and almost 82% of existing truck parking facilities were observed to be over capacity in 2006.   In addition to highlighting the need to make truck parking a priority at all levels of planning and policy, the study surveyed 20 sites based on criteria parcel size, ownership, proximity to interstate system, bi-directional accessibility, compatible land use, nearest alternate parking site, utilization of nearest alternate site, and anticipated level of demand satisfaction and identified 2 sites, the Molly Pitcher Service Area and Vince Lombardi Service Area as potential sites for truck parking expansion *(3).*   This site analysis framework and the selection of these two sites are the primary basis for the qualitative analysis presented in this report.

The NJTPA published an update to its previous study in 2009, known as the '*North Jersey Truck Rest Stop Study Refinement and Action Plan.'*   The updated study found that despite a small dip in demand in the peripheral areas of northern New Jersey (likely due to the economic recession), demand remained unchanged in the urban areas of the region and especially along the Interstate 95 corridor, further highlighting the need for additional truck parking *(4).*   Truck parking in portions of southern and central New Jersey was studied in 2011 by the DVRPC in '*Regional Truck Parking Study, a Comprehensive Analysis of the Supply and Demand of Truck Parking in the Philadelphia – Camden – Trenton Region.'*   Focusing on each truck stop in the Philadelphia-Camden-Trenton area, the study determined a truck parking utilization rate of 179% for the Pennsylvania study area, 107% for the New Jersey study area and a regional dearth of 466 parking spaces by 2035 assuming no additional parking capacity is added.   In terms of recommendations however, the DVRPC placed more of a focus on improving conditions and accessibility at existing rest areas rather than developing new ones.   Such recommendations include configuring ITS into all existing truck stops allowing for the transfer of data on parking availability to truck drivers while they are on the road and better maintenance of existing truck stop facilities *(5).*   No specific sites of interest were identified however.   Using New Jersey as a central scope, this research aims to directly build off and tie together the analyses performed by these two MPOs, while also aiming to incorporate some of the tactics introduced by additional MPO and DOT studies.

Outside of New Jersey, the truck parking shortage has been within in California, Connecticut, Maryland, Minnesota, New York, Pennsylvania and Massachusetts and Virginia as part of the Interstate 95 Northeast-Mid Atlantic Corridor *(6-10).*   There were both similarities and differences in the methodology of each study.   Connecticut's 2001 '*Truck Stop and Rest Area Parking Study'* primarily looked at previous failed attempts to reduce the 2020 projected deficit of 1200 parking spaces by repurposing commuter park & rides and reconfiguring existing truck stops *(6).* Minnesota's 2010 '*Minnesota/DOT Truck Parking Study: Phase 2,'* a follow-up to the DOT's previous study, analyzed the issue by identifying different locations, primarily around the Minneapolis area, that generated significant levels of freight traffic.   A spatial analysis overlaying these generators to congestion levels and existing truck stops was conducted to determine corridors where truck parking demand was the highest *(7).* Maryland's 2006 '*Truck Parking Partnership Study,'* performed by the Baltimore Metropolitan Council

also looked at parking from a corridor-level, additionally placing focus on recommendations for ITS development as well *(8)*. In 2009, the New York Metropolitan Council published '*Multi-State Truck Stop Inventory & Assessment Study'* which coordinated results of studies performed by the New York Metropolitan Council, NJTPA and Connecticut DOT. Most insightful and relevant to New Jersey however was a 272-participant origin-destination survey of truck drivers which showed that approximately 30% of trips either originate or terminate at a warehouse or distribution center, compared to just 10% and 21% respectively for the ports *(9)*.

The most detailed site selection methodology however was performed for the Oakland/Alameda County region of California in 2008 in the '*Truck Parking Facility Feasibility and Location Study,'* drafted together by The Tioga Group, Inc. & Dowling Associates Inc. of Philadelphia. Under the direction of Caltrans, researchers initially identified 33 potential sites throughout Alameda County for additional truck parking, with the top 10 ranked in terms of feasibility and opportunity. Of all the truck parking studies conducted for state DOTs and/or MPOs, the Oakland/Alameda County study appears to be the most effective in offering a constructive methodology that could be applied to any region to produce tangible results. While this report will not directly employ this methodology, the Caltrans study serves as a strong motivation for the location analysis conducted further on in the report. This location analysis will instead be done by analyzing existing uses and demographics around each county to determine where truck parking could feasibly be implemented.

At the national scale, truck parking was addressed by the Transportation Research Board (TRB) and USDOT. TRB's '*Dealing With Truck Parking Demands', 'A Synthesis of Highway Practice* and USDOT's '*Commercial Motor Vehicle Parking Shortage'* echo what been determined at the state and regional levels, advocating for increased truck parking and ITS development, especially in denser, urban areas that have many more freight generators *(11-12)*. The USDOT's report additionally explains legislation drafted in SAFETEA-LU which makes available a total of $30 million in funding for pilot truck parking. It also outlines some of the major funding challenges for such projects, since states are only allowed a maximum of $2.9 million in primary rounds of funding, despite some individual cost projections in the hundreds of millions of dollars *(12)*. Additionally, in their 2002 report, the Turner-Fairbank Highway Research Institute developed a truck parking demand model *(13)* that has been used in many of the previously mentioned studies, including those by conducted the NJTPA and DVRPC. To date, this has been the most quantitative and reliable study done on truck parking in the United States and continues to be applied in ongoing studies. The model details will be introduced in the Methodology Section to follow.

As a common recommendation throughout most of the previously outlined studies, existing literature has also focused on ITS development as a means of managing overnight truck parking demand. In recent times, the I-95 Corridor Coalition has drafted two reports focusing on the direct implementation of such technology. Published in 2009, '*Work Plan and Truck Parking Availability System Architecture*' outlines a year-by-year implementation of truck stop ITS, beginning with committee selection and development and followed by site selection (organized into multiple tiers of importance and urgency), system implementation, management and maintenance *(14)*. The actual technology is described further in their 2015 report entitled '*Truck Parking Initiative*' *(15)*.

Overall, the purpose of this study will be to bridge together the diverse material related to truck parking that has been provided by both the public sector and academia. As the next and long-missing step, those strategies that to date have been employed in a fragmented and separated fashion, will be employed to comprehensively evaluate the costs and benefits related to truck stops using New Jersey as

the primary study area. A major goal is to study the truck parking issue simply beyond MPO and other politically developed boundaries to provide more meaningful analysis. Lastly, the quantitative methods commonly used for other transportation applications will be applied to the analysis. While this is not intended to be a comprehensive guide to truck parking development, the methodology framework provides a strong foundation to begin to meaningfully tackle the problem within New Jersey and throughout the entire United States.

3 Methodology Development – Site Costs & Benefits Analysis

From the point of view of both the public and private sectors alike, it is important to identify the best locations for truck parking development. To date, there has yet to be any research that focuses on this by identifying and quantifying various costs and benefits, particularly within the unique scope of freight and logistics parking. This section of the report serves to build an introductory framework that attempts to quantify these figures with the goal that future studies will be able to apply this methodology to develop comprehensive cost-benefit analyses. Upon identification and description of the Turner-Fairbank Highway Research Institute Parking Model, which is used to estimate truck parking demand, the methodology is broken into four different parts. Economic, fiscal, environmental and safety methodologies are explained, along with individual analyses of how future studies and research into these topics should be conducted. Upon the site selection analysis to follow, each of these methodologies is employed in the Numerical Case Study.

3.1 Overview

In addition to fulfill the excessive parking demand, developing or expanding truck parking facilities generate long term economic benefits both directly and indirectly from value adding services, tax revenues and improved freight efficiency and safety. On the other hand, the potential social and environmental impacts could be significant enough to raise community resistance and impede such projects. To provide an approach of comprehensive and systematic evaluation of a candidate location, we propose a methodology framework that incorporates and quantifies major economic, fiscal, environmental and safety costs and benefits. The concepts in CBA are adopted with the purpose to facilitate decision making of optimal locations. Figure 1 illustrates an overview of the proposed framework which includes several major cost (minus sign) and benefit (plus sign) factors in these four categories. In the following subsections, we will develop individually the modeling and analytical approaches of these benefit/cost items, by economic and statistical analysis and integrating existing engineering models from literature. Some of the long term costs and benefits are not fully quantifiable due to lack of data and model limitation, for which we will discuss future research opportunities. The ultimate goal is to apply the proposed methodological framework to develop more comprehensive and advanced CBAs.

Figure 1: CBA based truck stop location methodology framework

3.2 Data Sources

Data related to the economic and fiscal factors was gathered from Reference USA, a database commonly used for business and consumer research *(16)*. Truck stops and related businesses are listed under the Standard Industrial Classification (SIC) code 554103. In order to determine economic indicators on per parking space and per acre bases, multiple datasets from TruckStopGuide.com *(17)* were downloaded and compiled. New Jersey Transparency Center *(18)* tax records were accessed to determine fiscal indicators for each parcel.

The air pollution and noise data and their effects on property values is based on hedonic regressions performed by researchers from Massachusetts Institute of Technology *(19)* and the Washington State Department of Transportation *(20)*. Especially useful in property value analyses, hedonic regressions assume that a product's full utility is the combination of the utility of its individual characteristics, where holding all other characteristics constant, the effects of an individual characteristics can be determined.

Safety data was obtained from the Plan4Safety New Jersey Crash Database, developed by the Rutgers University Center for Advanced Infrastructure and Transportation. This database records detailed highway crash accident information for all of New Jersey. For this report, the database was utilized to estimate greenhouse gas reductions and analyze safety statistics associated with shoulder-parked and fatigued-driver truck-related accidents. Still under construction, only a small portion of the Crash Database has been geocoded and so the spatial analysis of truck-related accidents was done at

the municipal and highway corridor level. When complete, the Crash Database will allow for more detailed spatial analysis in the form of detailed clustering. Lastly, air and noise pollution spatial modeling equations are generally accepted equations employed in both academic and professional case studies. Regulations for noise pollution emission and mitigation standards are in accordance with the FHWA *(21)* and New Jersey Department of Transportation (NJDOT) *(24)*, respectively.

3.3   Truck Parking Estimation Model

Before any analysis can be conducted, it will be important for any regional MPO or state DOT to determine truck parking demand. Truck parking inventory assessment model helps compare existing and projected supply and demand along the major truck corridors. In order to estimate truck parking demand at a specific location, this research employed the model developed by Turner-Fairbanks Highway Research Center in Federal Highway Administration (FHWA) *(13)* and added several parameters according to the results from DVRPC developed in 2002 *(5)*. This model includes multiple parameters, half of which were based on survey responses from over 2,000 truck drivers and the other half stemming from overnight field observations at truck stops in 8 states, ranging from driver characteristics to overall capacity figures at truck stops. Rather than basing the demand for parking on the characteristics of a parking facility, the model predicts truck parking demand for a highway segment based on total truck hours of travel and the time and duration of stops.

There are mainly three steps to implement the model. The first step is to identify major trucking corridors and select analysis segments. Second, the parking inventory of public rest area and private truck stop for each segment should be obtained. Finally, the truck parking demand estimation formulas are applied to estimate the parking demand for each analysis segment. Model parameter definition and values are presented in Table 11 in Appendix A. Essential formulas to calculate both short- and long-term parking demands are listed below which are extracted from report *(13)* where detailed explanations can be found.

Segment truck travel time (TT) per trip: $TT = L / S$

where   L = analysis segment length (km)

$\quad\quad$ S = speed limit or average truck speed (kph)

Truck-hours of Short-Haul (SH) and Long-Haul (LH) and LH travel:

$$THT_{SH} = P_{SH} \times V_t \times TT$$

$$THT_{LH} = P_{LH} \times V_t \times TT$$

where   PSH = proportion of total trucks that are short-haul

$\quad\quad$ PLH = proportion of total trucks that are long-haul

Truck-hours of SH parking demand: $\quad THP_{SH} = THT_{SH} / 12$

Truck-hours of LH parking demand: $\quad$ THP_{LH} $\quad$ = Parking time/driving time x THT_{LH} + THT_{LH} / 12

Peak-hour parking demand for SH: $\quad$ PHP_{SH} $\quad$ = PPF_{SH} x THP_{SH}

Peak-hour parking demand for LH: $\quad$ PHP_{LH} $\quad$ = PPF_{LH} x THP_{LH}

SH and LH peak-hour parking demand by facility type rest area (RA) and truck stop (TS):

$$PHP_{(SH,RA)} = P_{RA} \text{ x } PHP_{SH}$$

$$PHP_{(SH,TS)} = P_{TS} \text{ x } PHP_{SH}$$

$$PHP_{(LH,RA)} = P_{RA} \text{ x } PHP_{LH}$$

$$PHP_{(LH,TS)} = P_{TS} \text{ x } PHP_{LH}$$

where $\quad$ PRA = proportion of demand for rest area spaces

$\qquad$ PTS = proportion of demand for truck stop spaces

Although this research primarily employed the demand model by using default parameters from FHWA, we also collected different parameters from DVRPC. For example, the percent of daily traffic consisting of commercial trucks and speed limit of highway. Many of the parameter values depend on local highway and traffic characteristics, so should be carefully chosen or calibrated when applying to different locations.

3.4 Economic Analysis

The economic assessment analyzes total number of parking spaces, employment, and payroll for all privately managed truck stops in New Jersey. Figures for publically owned rest areas, notably those on the New Jersey Turnpike and Garden State Parkway were not available for analyses. Additionally, the costs of constructing a full-service truck stop are estimated. Ideally, such figures will be of value to municipal and state governments along with prospective private sector developers.

Employment and Economic Benefits

To estimate the average employment and economic benefits of truck stops, data for 86 existing locations containing long-term parking for trucks was utilized. Of those locations, however, 29 were privately owned gas stations and 26 were missing significant data on the TruckStopGuide.com datasets *(17)*. Those locations were omitted, leaving a total of 31 applicable private sector truck stops, which were broken down as 5 'single-service' and 26 'full-service' rest areas. Single-service rest areas solely provide fuel, restrooms and overnight parking, while full-service rest areas additionally include available services such as food and repair shops. Given this relatively low sample size of truck stops, comprised of different methods of truck parking provision, the figures below and for the fiscal analysis to follow are provided at the state level.

Table 1 below compiles economic averages for single-service and full-service truck stops in New Jersey. Of those full-service rest areas, 9 rest areas were identified as being larger than 15 acres,

significantly larger than the remaining rest areas which were are well under 10 acres in size. These larger rest areas are separately analyzed, as a larger truck stop would assist most in reducing truck parking shortages while also being most attractive to private investors.

Table 1: New Jersey Truck Stop Economic Indicators

	Total Parking Spaces	Total Acreage	Spaces per Acre	Aggregate Number of Employees Needed	Jobs per Acre
Single-Service	89	19.48	4.57	37-85	1.90-4.36
All Full-Service Truck Stops	2208	364.75	6.05	564-1298	1.55-3.56
Large Full-Service Truck Stops (15 + Acres)	1682	280.95	5.99	315-740	1.12-2.63

As Table 1 shows, truck stops provide between approximately 4.5 and 6 parking spaces per acre, with full-service truck stops providing noticeably more parking spaces per acre. The ranges provided for total employees can be attributed to yearly fluctuations as a result of multiple business-related factors. Overall, the number of jobs per acre of truck stop varies noticeably from approximately 1 job to over 4. The decrease in job density for larger full-service truck stops can be attributed to most acreage being devoted to parking, where even as the number of parking space increases, the number of amenities and services provided will remain constant.

Rest Stop Design & Construction Costs

The construction process of a full-service rest area is divided into the parking and building areas. The cost of land, though an important factor, is not discussed in this analysis as such figures vary significantly based on numerous factors. Parking lot construction cost estimations are developed using the cost of automobile asphalt parking which is assumed to be approximately $671 per space in 2007 dollars. This figure factors in construction costs of $326 per space and annual maintenance costs of $345 per space and is adjusted for inflation to 2015 dollars hereafter to $788 *(23)*. Assuming a width of 10 feet and length of 18 feet of a single truck parking space and traffic lanes of 24 feet in length, approximately 150 automobile spaces can be added within 1 acre of land, representing a cost per acre of parking of $118,200. Each truck parking space will require approximately 6 inch-thick pavement, 1.33 times thicker than the 4.5 inch-thick threshold used for automobile parking, bringing the total cost per acre to $157,600 *(24)*.

Due to the lack of available data for rest area facility construction, figures for constructing small strip mall-style shopping centers are utilized for this methodology. On average, it costs about $72.61 per square foot to construct and develop such a building, including site work, hard construction and building design *(25)*. In the process of developing a truck stop, the total cost, including maintenance costs, may fluctuate significantly, especially considering the extent of amenities to be provided. Based on the synthesis from the literature, $72 per square feet appears to be an effective estimate. In the future, in-depth studies can further breakdown these cost figures based on specific building and layout designs.

3.5   Fiscal Analysis

Using the same datasets analyzed for the economic methodology *(17)* along with the New Jersey tax records *(18)*, the fiscal methodology presents the payroll, sales and property tax totals for the different breakdowns of the 31 rest areas. This information for 2014 is presented in Table 2 below:

Table 2: 2014 Fiscal Data for Existing New Jersey Truck Stops

	Single-Service	All Full-Service Truck Stops	Large Full-Service Truck Stops (15+ Acres)
Payroll Volume & Tax (1%)			
Total Payroll	$3,300,000 - $11,600,000	$23,250,000 - $61,250,010	$10,750,000 - $37,500,000
Total Payroll Tax	$33,000 - $116,000	$232,500 - $612,500	$107,500 - $375,000
Payroll per Acre	$169,405 - $595,483	$63,742 - $167,923	$38,263 - $133,475
Payroll Tax per Acre	$1,694 - $5,954	$637 - $1,679	$382 - $1,335
Sales Volume & Tax (7%)			
Total Sales	$30,000,000 - $70,000,000	$502,000,000 - $1,695,000,000	$213,000,000 - $745,000,000
Total Sales Tax	$2,070,000 - $4,900,000	$35,140,000 - $118,650,000	$14,880,000 - $5,215,000
Sales Volume per Acre	$1,510,000 -$3,590,000	$1,380,000 - $4,650,000	$760,000 -$2,650,000
Sales Tax per Acre	$110,000 - $250,000	$100,000 - $330,000	$50,000 - $190,000
Property Tax			
Total Net Property Value	$4,496,100	$91,494,700	$57,110,500
Total Prior Year Tax Amount (2014)	$111,104	$1,615,245	$836,793
Net Property Value per Acre	$230,806	$250,843	$203,276
Prior Year Net Tax Amount per Acre	$5,704	$4,428	$2,978

As the above figure shows, truck stops contribute a sizable amount to New Jersey's retail-based economy and revenue stream. The majority of the collected taxes stem from sales volume taxes, which may provide incentive to develop a full-service based truck stop, over other competing uses, at least for the public sector.

There were notable differences in the per acreage values of each tax. Single-service rest areas have the highest per acre efficiency for both payroll and property taxes, while per acre sales tax totals appeared to be relatively constant for both single and full service types of rest stops. The high payroll and property tax per acre efficiency for single-service rest areas is attributed to a larger portion of such properties being devoted to revenue generating usage. On the other hand, although full-service truck stops will support more revenue generating operations, larger proportions of such properties will

consist of actual non-revenue generating truck parking. The variations for payroll and sales volume taxes may be attributed to the fluctuations in the number of employees. Property tax on the other hand is solely based on the property specifics and is independent of total employees or sales volume, resulting in a specific figure for this category. Even in the "worst-case" scenario, the fiscal magnitude of a new truck stop is expected to be significant. While these figures are only averages, both these and the economic indicators represent reliable reference points for developing different types of analyses. In-depth and site-specific future analyses can focus on additional fiscal information, such as competitive uses of warehousing and distribution centers.

3.6 Environmental Factors & Analysis

Although the environmental methodology is developed using New Jersey as an example, the analytical framework is applicable to other regions. First, a proposed method is presented for estimating reductions in emissions as a result of reduced VMT from expanded parking options. The environmental methodology additionally analyzes spatial changes in air and noise pollution as a result of a proposed parking project and the resulting effects on nearby residential property values as a measure of environmental and societal impact. While excessive levels are undoubtedly harmful to society, there is insufficient evidence however to conclude that light emissions from individual highway facilities negatively affect the residential property values of nearby communities *(20)*.

Air Pollution Methodology

In developing a methodology that addresses spatial increases and decreases in air pollution, this study ignores exogenous factors such as the economy's effect on truck vehicle miles traveled (VMT). As such, the primary reductions in air pollution will come from decreased VMT occurring when truck drivers encounter a truck stop already at capacity. In the current situation, drivers are forced to continue driving a certain additional distance before likely pulling over onto the shoulder. This study uses existing parking studies and empirical New Jersey accident data and to approximate those distances.

This study uses spatial New Jersey accident data, collected between 2003 and early 2015 and assembled into the Plan4Safety New Jersey Crash Database to estimate how much further those truckers drive before pulling over. The data is assumed to follow a normal distribution that approximates the estimated reduced VMT *(26)*. The standard deviation thresholds are estimated based on the locations of accidents involving parked trucks in relation to the nearest truck stop. Table 3 breaks down accidents involving parked trucks by municipality for the Interstate 95 south of Interstate 287 corridor. Located in the center of the Northeast Corridor, Interstate 95 south of Interstate 287 carried approximately 11,000 trucks per day in 2007, a figure expected to grow to almost 20,000 trucks per day by 2040. As Table 3 shows, accidents significantly cluster in areas where rest stops are located, indicating that truck drivers won't driver much further beyond a rest area before pulling over onto the shoulder, thus explaining the lack of spillover of accidents into adjacent municipalities. The Molly Pitcher Service Area in Cranbury Township is located about 1.5 miles from the Monroe Township border and 2.5 miles from the East Windsor Township border. Neither bordering municipality however sees an elevated number of accidents.

Table 3: Accidents Involving Parked Trucks On I-95 South of I-287 (2003-2015)

I-95 South of I-287		
Municipality	**Accidents**	**Corridor Length (Miles)**
Edison Township	13	5.1
New Brunswick	1	0.6
East Brunswick Township*	81	7.8
Milltown	0	1
South Brunswick Township	4	3.5
Monroe Township	6	1.4
Cranbury Township*	86	4.1
East Windsor Township	2	3.9
Robbinsville Township	0	5.2
TOTAL	**192**	**32.6**

*Contains rest area

As a result, the standard deviation distance thresholds are estimated to be 0.5 miles, in which 68% of truck drivers will drive up to an additional 0.5 miles before pulling over, 27% who drive up to 1 mile and 5% who drive over 1 mile. Once the Plan4Safety New Jersey Crash Database is complete and fully geocoded, this analysis can be expanded and performed to develop more precise standard deviation distance thresholds.

Next, emission estimates per large truck are used to estimate the amount of reduced greenhouse gases that will be reduced with additional parking spaces. Taken directly from the United States Environmental Protection Agency, Table 4 estimates average emissions by particulate matter for long haul semi-tractor trailers (GVWR > 33,001 lbs), which comprise the majority of large trucks at rest areas. Currently, about 90% of all such trucks run on diesel fuel rather than gasoline, representing lower emissions for VOCs, THC, CO, PM 2.5 and PM 10, while higher emissions for NOx *(27)*. The numbers are average emissions that also take into account the acceleration and deceleration processes.

Table 4: Average Emissions for Long Haul Semi-Tractor Trailers (Grams / Mile)

	VOC	THC	CO	NOx	PM 2.5	PM 10
Gas	3.68	3.704	28.56	4.892	0.049	0.061
Diesel	0.455	0.461	2.395	9.191	0.215	0.233

As an example, to estimate the amount of reduced NOx that would be replaced from providing an additional parking space, Equation 1 would be utilized, using the standard deviation thresholds previously developed, information from Table 4 and the 9:1 ratio of diesel to gas vehicles *(27)*. As a conservative estimate of additional VMT, values of 0.25 miles, 0.5 miles and 1 mile are used for each of the standard deviation values. Such values can be calibrated accordingly based on regional or case-study specific parameters.

Equation 1: Reduced Emissions per Additional Parking Space

Emission Reductions = .9(.68 (diesel grams/quarter mile) + .27 (diesel grams/half mile) + .05 (diesel grams/mile)) + .1(.68 (gas grams/quarter mile) + .27 (gas grams/half mile) + .05 (gas grams/mile))

Using Equation 1 to estimate NOx reductions produces the following results:

NOx = .9 (.68 (2.3 grams) + .27 (4.6 grams) + .05 (9.191 grams)) + .1 (.68 (1.22 grams) + .27 (2.45 grams) + .05 (4.892 grams)) = **3.11 Grams of NOx Saved Per Each Additional Parking Space**

While an effective early estimator of emissions and VMT reduction, it is important to understand the limitations of this particular methodology. First, the standard deviation thresholds are rough estimations based on accident locations within municipalities, given a lack of geocoding of the Plan4Safety Crash Database. Additionally, to date, there has yet to be a usable longitudinal study of shoulder parked trucks conducted, meaning the Database is the most reliable source of data. Second, the accident data used is considered to be a small sample size that may not necessarily be representative of the entire population, especially given the complexities and differences that occur from highway to highway.   These limitations will be addressed further once larger and more geographically accurate samples can be utilized.

Although this study assumes no net increases in air pollution as a result of expanded truck parking, increased particulate concentrations in and around truck stops are expected to negatively affect nearby property values. It is estimated that every 1-μg/m3 increase in total suspended particulates results in a 0.05% decrease in property values and vice-versa *(19)*. Precise reductions in air quality to adjacent properties can be estimated using the Gaussian plume modeling equation shown below *(28)*. For this report, the Gaussian plume modeling equation assumes stable atmospheric conditions and that particulate emissions follow a normal distribution where concentrations are highest at the center of each truck's plume and then drop off in a standard bell curve pattern. Additionally, for the purposes of this report, given New Jersey's generally flat terrain, the z-coordinate is assigned a value of 0 since ground level is most relevant in the case of analyzing emission levels of nearby properties. This equation can however be further expanded to account for elevation changes which will be useful in regions with more mountainous terrains.

Equation 2: Modeling of Truck Plume Emissions by Distance *(28)*

$$C(X, Y, 0) = Q / (\Pi * u * \sigma_y * \sigma_z) \; EXP[(-H^2)/(2 * \sigma_z^2)] * EXP[(-Y^2)/(2 * \sigma_y^2)]$$

Where: **C** = Concentration at some specific point or receptor in g/m^3 (grams/meters cubed)
      Q = Source pollutant emission rate in g/s (grams/second)
      Π = Pi
      U = Horizontal wind velocity along plume centerline (meters/second)
      σ_y & σ_z = Horizontal & Vertical Dispersion Coefficients* (meters)
      H = Effective plume stack height* (meters)
      Y = Downwind perpendicular distance (meters)
      X = Downwind distance at which C is calculated (meters)

*Horizontal & vertical dispersion coefficients vary based on downwind distances and atmospheric conditions. Table 5 below is taken from the University of Washington Department of Civil and Environmental Engineering and provides coefficient values for multiple downwind distances *(29)*. For other distances, the dispersion coefficients can be determined using additional formulas, easily accessible online. For the purposes of this report however, the values and distances given below will suffice.

Table 5: Horizontal & Vertical Dispersion Coefficients for Stable Atmospheric Conditions (29)

Distance X (Km)	σ_y	σ_z
0.1	6	4
0.2	11	6
0.4	21	11
0.7	36	17
1.0	51	21
2.0	96	34
4.0	180	49
7.0	300	66
10.0	420	79
20.0	760	110

** The effective plume stack height **H** is composed of two factors:

H_s = Actual height of plume stack
*Δ H = Plume vertical rise (upon exit from plume stack, vertical rise of curve created by plume and due to plume's buoyancy). For the purposes of this study, given the small value of Δ H and the complex atmospheric factors that affect it, Δ H will already be factored into H_s, making **H_s = H.***

Taken from the United States Environmental Protection Agency, Table 6 shows large truck emissions at a time rather distance scale *(30)*. Using Equation 2, the concentrations of volatile organic compounds, carbon monoxide, nitrogen oxides and particulate matter of less than 10 microns at various distances where residences can be estimated. Such values can additionally be altered to factor in improvements in fuel standards or determine plume sizes by specific truck models.

Table 6: Idling Emissions for Large Trucks in Grams/Second (30)

	Gasoline	Diesel
VOC	0.00995	0.003467
CO	0.205	0.026167
NOx	0.002833	0.015283
PM $_{10}$	-	0.0007

Traditionally, Gaussian plume modeling is used to analyze emissions from single-standing, large point source plume generators such as factories and other industrial facilities. In order to fully utilize the Gaussian plume equation for the purposes of this report, a truck stop, which consists of numerous

individual point sources, should be considered as a single point source, with plumes being emitted from the center of the truck stop. Although this will slightly alter some of the spatial emission values, such amounts will likely be insignificant in property value analysis and are not worth the time-heavy process of calculating emission values based on the positioning of each individual truck. For example, a truck stop with a truck parking area with dimensions of 800 feet by 400 feet (length by width) would have a single, centralized point source at the 400 foot length mark and 200 foot width mark to which the aggregated emissions of all parked trucks would be released from. In real-world scenarios however, it is likely that truck parking will be laid out in a more irregular shape or pattern. In those cases, decisions on where to locate the centralized point source of the truck stop will be up to the discretion of the researcher and should be based on where truck parking is most concentrated.

Note that truckers tend to leave their trucks in idle when resting in their vehicles for security and comfort purposes. This being the case, idling emissions, which significantly contribute to air pollution will additionally need to be considered as truck VMT increase. In addition and due to data limits, this study only considers emissions directly from trucks and not emissions from vehicles that directly and indirectly interact with trucks through various forms of traffic flow and congestion. More in-depth CBAs should be conducted in the future to better assess the indirect forms of emissions through the use of location-specific simulation analyses.

Sound Pollution

Increases in sound pollution are inevitable in such a case where dispersed idling trucks are centralized into new or expanded truck stops. This methodology takes into account the projected increases in noise as well as commonly implemented noise abatement criteria using the following equation *(31)*:

Net Sound Pollution = Increase in Noise Level at Truck Stop – Noise Abatement Implementation

Changes in noise levels of new or expanded truck stops can be determined through the formula in Equation 3, while the distance factor of sound is presented in Equation 4 *(31)*.

Equation 3: Changes in Sound Level from Multiple, Equal Sound Sources

$$\Delta L = 10 * \log_{10} n$$

Where: **ΔL** is the decibel level increase
$\quad$ **n** is the number of equal sound sources

Equation 4: Changes in Sound Level Over Distance

$$2 * d = L - 6 \text{ dBA}$$

Where: **d** is the distance from the sound source
$\quad$ **L** is the decibel level in dBA

At the national level, sound emission regulations are governed by the Federal Highway Administration (FHWA) and state that maximum noise levels for large trucks are not to exceed a level of 85 dBA at 50 feet or more away from the vehicle. The FHWA however does not have the authority to govern dBA levels produced in a setting such as a truck stop where multiple trucks are simultaneously emitting noise

(21). Despite these relatively loose federal regulations, sound pollution has likely tangible effects on the residential property values of nearby communities. For every 2.5 dBA increase in noise levels above 55 dBA, residential property values are assumed to decrease by 0.2% to 1.2% with wealthier communities, likely consisting of residents willing to pay more for peace and quiet, being more sensitive to such increases in sound pollution *(20)*.

Under Federal Highway Administration guidelines, the development or expansion of a truck stop is considered a Type I project, meaning a noise impact study is required (22). Included in the noise impact study is the consideration and feasibility of installing noise barriers to remediate sound pollution. Besides these federal guidelines, specific noise remediation guidelines are determined by state and municipal factors. The quantitative-based noise abatement criteria used by the NJDOT and New Jersey Turnpike Authority (NJTA) to evaluate noise barrier project feasibility are listed below *(22)*:
   1. A primary goal of 7dBA in noise reduction to the closest row of residences or nearest noise-sensitive land.
   2. A mandatory minimum threshold of 5 dBA in noise reduction stemming from a noise barrier no more than 20 feet tall.
   3. A maximum cost of $50,000 per affected household or noise-sensitive land.
   4. A maximum cost of $55,000 per severely affected household or noise-sensitive land where dBA levels exceed 76 dBA or increase by 20 dBA over original totals.

Additional guidelines regarding NJDOT and NJTA land use-based criteria for noise abatement can be found in Appendix C. Although these above guidelines are exclusively used in New Jersey, each state will likely have its own noise abatement criteria, which all this methodology for sound pollution to be used for any similar scenario. It is important to recognize the noise-reduction capabilities of vegetation, which can range anywhere from around 3 dBA to over 10 dBA, depending on the type of vegetation and thickness of the buffer zone. Note also that the tendency of truck drivers to leave their vehicles in idle indicates that the increases in parking capacity could noticeably increase noise levels. Additionally, the noise mitigation standards used in New Jersey do not guarantee the construction of noise barriers for any affected properties. In order to minimize community opposition as well as the need for noise remediation, agricultural and industrial areas represent the best locations to construct or expand a truck stop, given the above noise pollution criteria and available data.

3.7   Safety Factors & Analysis

The safety methodology primarily analyzes indicators of roadway and truck safety. Specifically, accidents involving parked large trucks and fatigued truck drivers are examined for the purpose of determining the safety effectiveness of a new or expanded truck stop. The data used in the analysis was obtained from the Plan4Safety New Jersey Crash Database, hosted at Rutgers University. Future studies should be able to incorporate advanced modeling techniques to determine current and predicted accident rates for each corridor.

Shoulder & Fatigued Driving Methodology

The safety data analysis shows that between 2003 and early 2015, over 3.5 million vehicular accidents occurred in New Jersey. Of those accidents however, 10,044 involved parked trucks and 234 involved

fatigue driving, representing under 0.5% of all accidents. The breakdown of both types of accidents by full year is shown in Figure 2 below:

Figure 2: Breakdown of Accidents Involving Parked Trucks & Fatigued Drivers
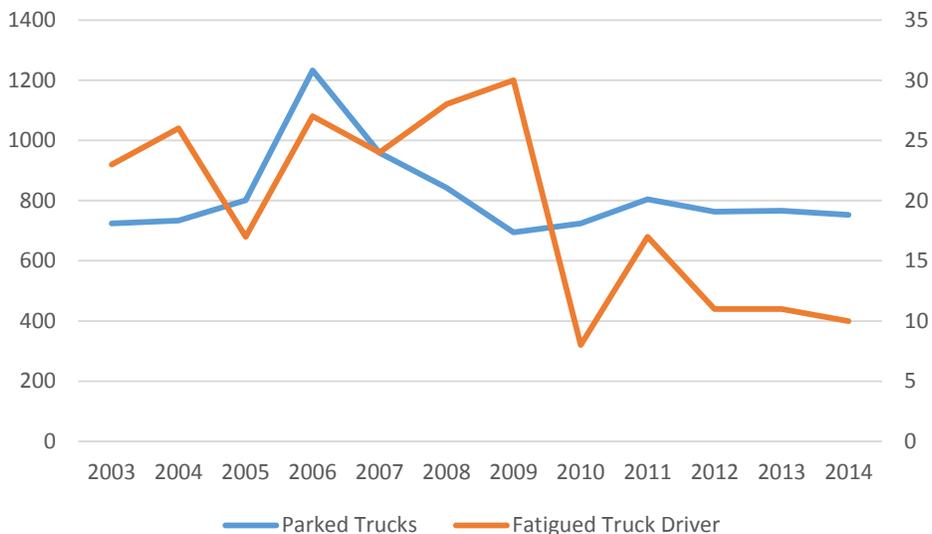
Despite a booming distribution and logistics industry given New Jersey's prominent location in the Northeast Corridor and a growing number of trucks on the road, the post-recession years have actually shown continued decreases in the numbers of both accidents. After peaking at over 1200 parked truck accidents in 2006, figures have leveled off to under 800 accidents in the following years. Given the small number of accidents involving fatigued truck drivers, greater variability in the annual totals was observed. The total number of such accidents peaked in 2009 at 30 but then dropped 73% to 8 accidents in 2010. Similar to the parked truck accidents trend, fatigue-related accidents were stable between 2012 and 2014.

Because a new truck stop would likely be placed on or close to an interstate highway, Figure 3 below can be used to measure the effectiveness of such project, based on the types of roads where such accidents occur.

Figure 3: Crashes by Road Type
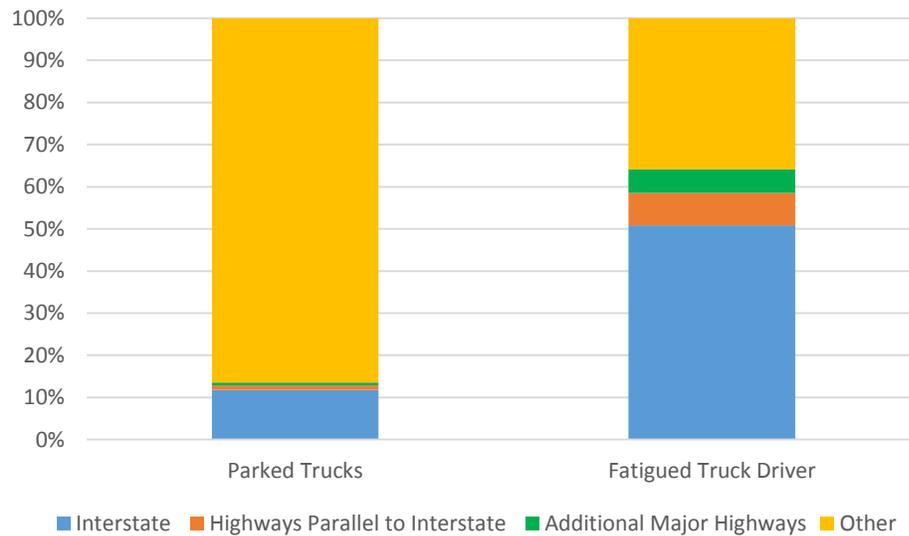
Overall, there were notable differences in the breakdowns of each type of accident. Figure 4 shows that only about 12% of the accidents involving parked trucks occurred on Interstate Highways between 2003 and 2015. Only an additional 1.5% occurred on other paralleling and other major highways throughout the state, while the overwhelming majority occurred on local roads throughout the state. Fatigue-involved accidents however occurred most frequently on the State's interstate highways, but paralleling and additional major highways accounted for a small number of such accidents.

Although only slightly, Figure 4 appears to show decreases in the proportion of accidents involving parked trucks taking place on Interstate highways, especially during the post-recession years. The numbers for paralleling highways and additional major highways did not show any emerging trends. The same can be said for accidents involving fatigued truck drivers, in which the range of accidents occurring on interstate highways ranged anywhere from almost 90% in 2005 to about 25% in 2010. This is shown in Figure 5. To further understand the spatial distribution of truck accidents, we tallied the total number of parking-related and fatigue-related truck accidents on major interstate highways (Figure 6).

Figure 4: Annual Breakdown of Parked Truck Accidents by Road Type
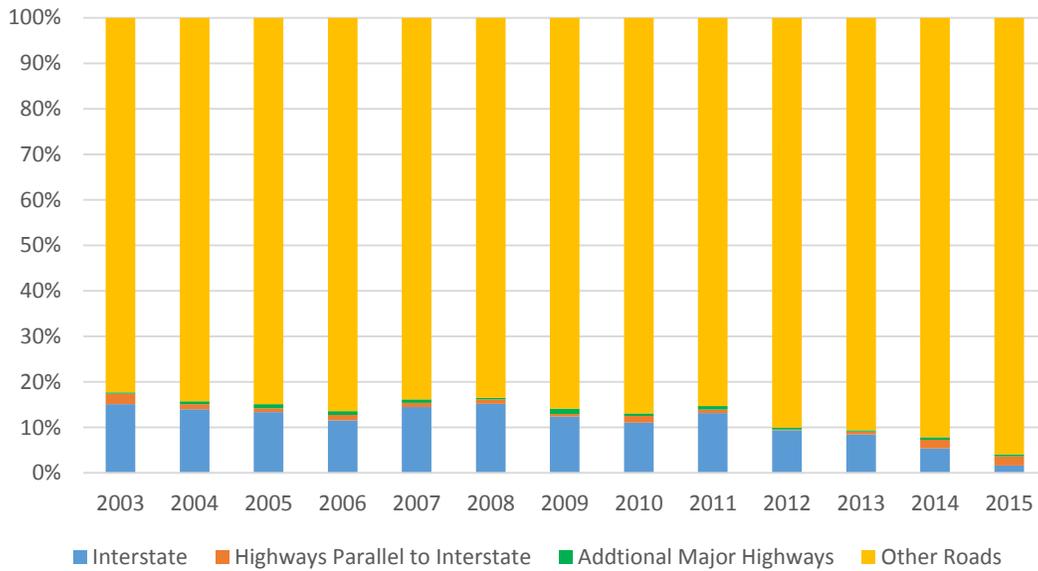
Figure 5: Annual Breakdown of Fatigued Truck Driver Accidents by Road Type*
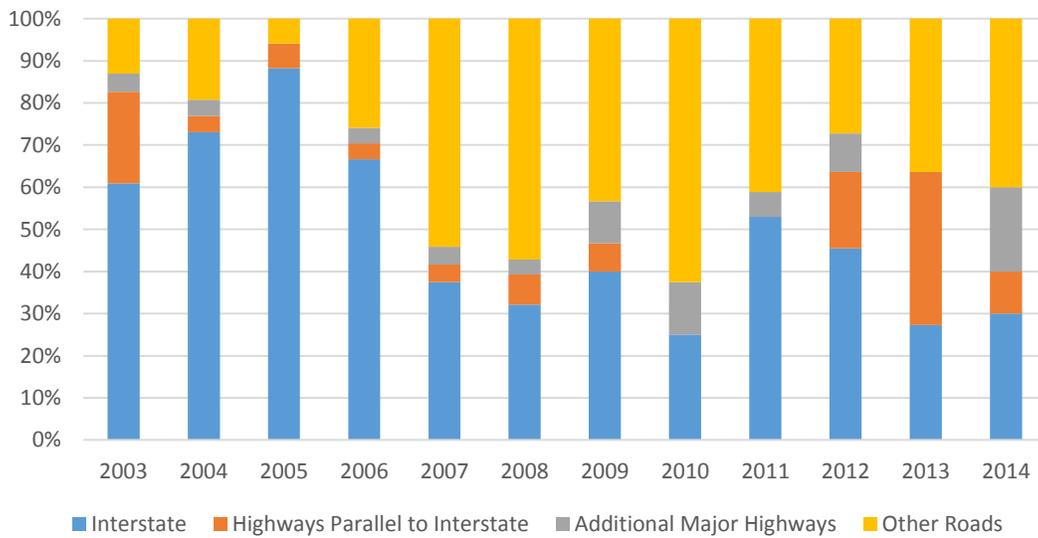
As it only contained 2 data points, early 2015 figures are omitted

Figure 6: Accidents by Interstate Highways (2003-2015)
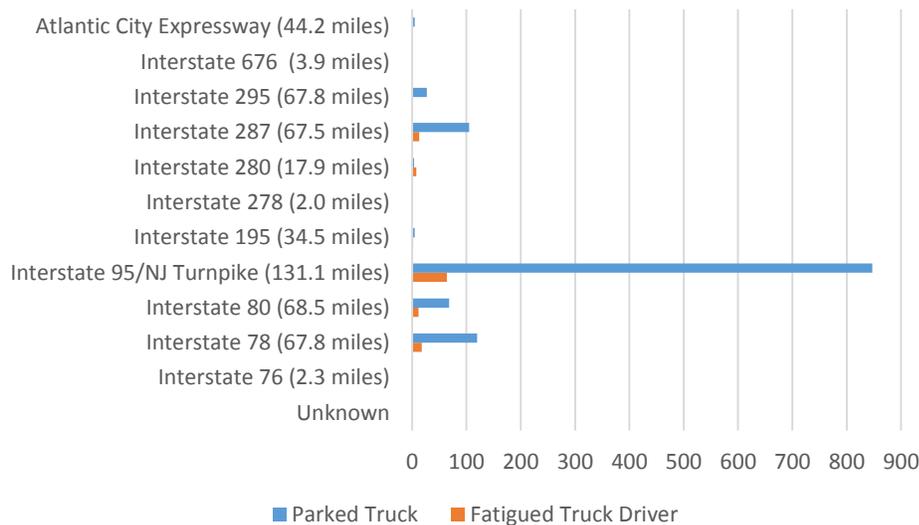
It is evident that the New Jersey Turnpike/Interstate 95 corridor experiences the largest number of truck-related accidents. This can be interpreted in a few ways. On the one hand, as described earlier in the report, the New Jersey Turnpike can expect to see upwards of 20,000 large trucks per day by 2040, making it the absolute most congested highway in New Jersey and one of the most congested in the entire Northeast region. In that case, it would pretty much be expected that the number of such accidents would be highest on the New Jersey Turnpike/Interstate 95. On the other hand however, as also studied by the NJTPA, other Interstates including 78 and 80 are expected to experience nearly similar totals. Yet, between 2003 and early 2015, both Interstates accounted for a small number of accidents experienced when compared to the New Jersey Turnpike/Interstate 95, even when accounting for differences in route mileage. This could be a strong indicator that despite what the parking demand figures estimated by the NJTPA show, the New Jersey Turnpike/Interstate 95 corridor may be in the most urgent for additional truck parking development, or at least some form of truck-oriented safety upgrades.

The last inferential analysis focused on the time breakdown of both types of accidents, as shown in Figure 7 and Figure 8. Even with noticeable differences in the aggregate number of parked truck accidents however, the time breakdown remained very consistent over the 12 years, with daylight hours accounting for about 75% of such accidents every year. In fact, the proportion of nighttime accidents appears to have declined over the past few years from over 20% to just under this benchmark, although these figures are likely to small to show the beginnings of any trend. Much more variability existed for the time breakdown of fatigue accidents. For some years, daylight accounted for well over 50% of all accidents, while in other years, nighttime reached or surpassed 50%, with no noticeable emerging trends or patterns. This somewhat random pattern is likely explained by the small sample size (234) of fatigue accidents, along with the fact that fatigue may hit drivers at different times and in different ways.

Figure 7: Annual Breakdown of Parked Truck Accidents by Time of Day

Breakdown of Parked Truck Accidents By Time of Day

Dark ■ Daylight ■ Dawn ■ Dusk ■ Unknown
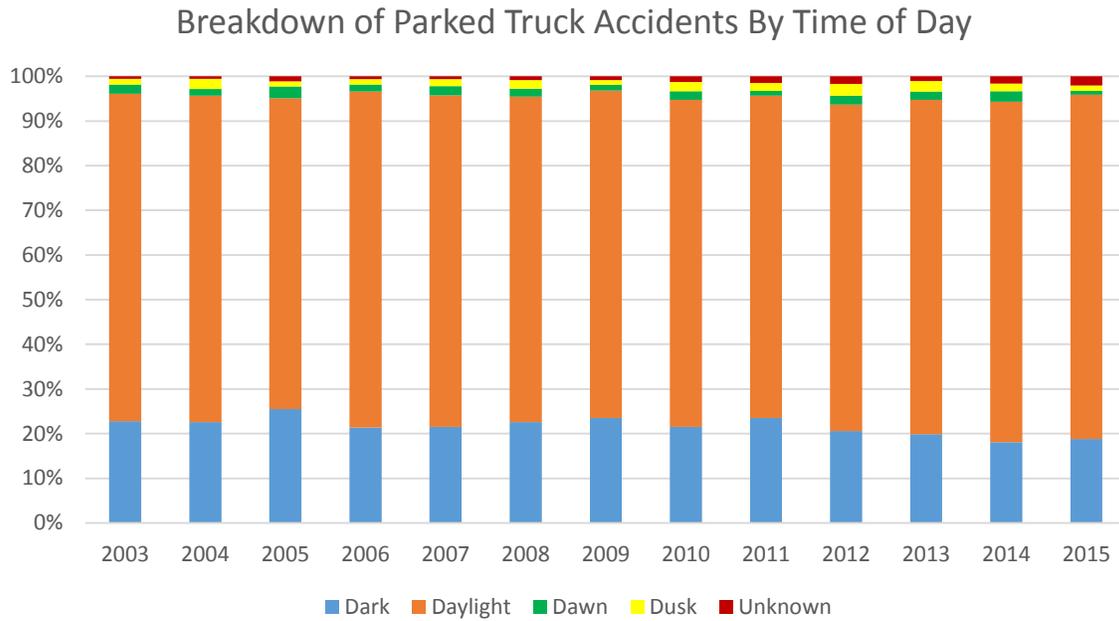
Figure 8: Annual Breakdown of Fatigue Accidents by Time of Day

Breakdown of Fatigue Accidents By Time of Day

Dark ■ Daylight ■ Dawn ■ Dusk
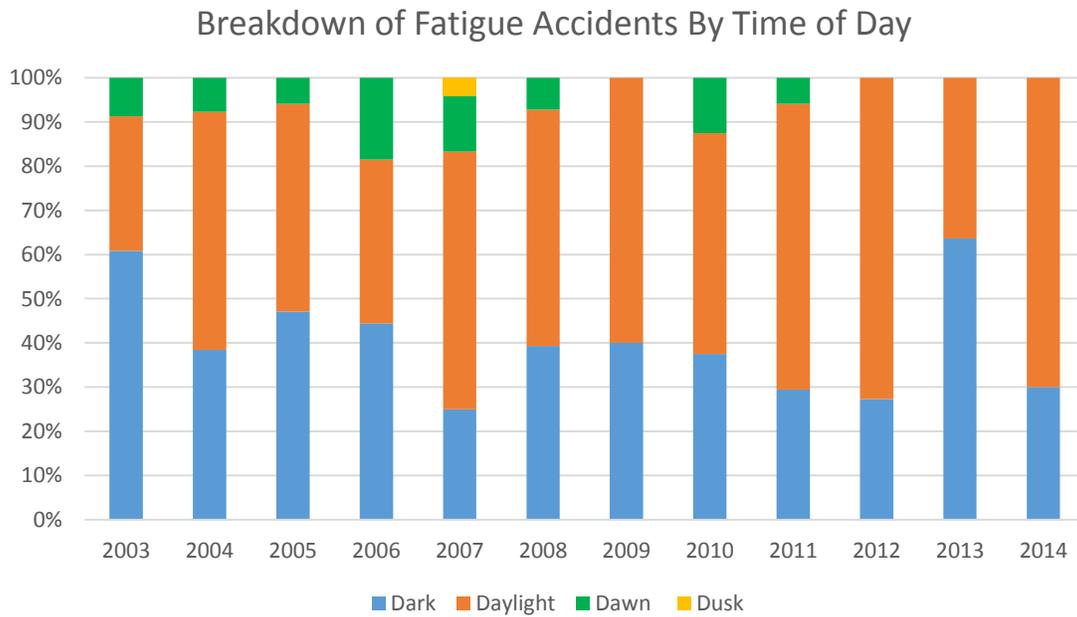
Further Analysis

Although determining the effects of added truck parking on the parked truck and fatigued truck driver accidents rates is beyond the scope of this report, the above inferential statistics provide useful insight into the matter. Surprisingly, a large number of both types of accidents occur on local roads not conducive to intra-regional travel and during daytime hours, when truck parking is assumed to be available.

It is however important to consider the number of "near" accidents that occur. Although very difficult to quantify, these incidents might be much more prevalent at night. As such, even though nighttime accidents accounted for less than half of the described accidents, the need for additional long-term truck parking spaces may actually prove more urgent than any statistics or modeling may indicate.

4 Location Analysis and Case Study in New Jersey

To apply the cost-benefit methodology introduced in the previous section, a set of candidate sites need to be identified first. To this end, this portion of the report re-examines the truck parking issues in the State of New Jersey. Population density, current freight trends, and truck traffic generation in New Jersey are analyzed using ArcGIS spatial tools. A significant portion of the analysis is also based on insightful information from meetings with representatives from, the National Association of Truck Stop Operators (NATSO), New Jersey Motor Truck Association (NJMTA), NJTPA, DVRPC, and NJTA. Next, a county-by-county analysis combining both qualitative and quantitative characteristics is provided. In addition to identifying key sites and criteria in New Jersey for truck parking, this section also aims to combine valuable information from truck parking studies performed separately by the NJTPA and DVRPC into a single, conforming analysis.

These analyses are important components of the overarching analytical framework to evaluate the solution of expanding truck parking capacities based on location characteristics so that it generates the most benefit to both industry and society in general. This section also serves as a working example of applying the integrated analytical framework to general study areas.

4.1 Industry Representatives Meetings: A Brief Takeaway

While there were notable differences in opinion on the subject of commercialization of truck stops, there were certain points which all contacted stakeholders agreed upon. Most significant of those was to potentially focus on existing brownfields, especially those near the ports or industrial areas, as possible locations for development. On the one hand, such sites may be highly suited to truck parking which may require less remediation than other uses. On the other hand however, given the challenges of making truck parking a truly profitable venture, developers and public sector entities may be reluctant to undertake such a project. An additional strategy put forward was to work with existing motels and hotels that cater to freight industry workers to allow for additional truck parking. While the strategies needed to develop such partnerships are not covered, the regional and location-based analysis to follow aims to identify corridors where such businesses locate.

A common topic all groups agreed upon was the need for more political support and action. In particular, it was recommended that more exemptions from existing laws and zoning codes are needed to allow commercial rest area operation on more types of land, especially since truckers do not always feel welcomed at many non-truck stop oriented facilities. It was expressed that despite truck stop investors often willing to pay a premium for valuable land, long waits for the granting of development permits of up to a few years may dissuade both existing and potential future investors.

A large portion of the analysis to follow is based on analyzing what the strongest drivers of freight traffic are. Multiple stakeholders stressed the significance of both warehousing and retail facilities as major freight drivers, especially given the State's high density and proximity to globally influential cities. Such claims are tested and also confirmed in the subsections to follow. Future studies should make strong attempts to gather further insight from such stakeholders and especially truck drivers who have the most stake in the decisions made out of these analyses.

4.2   Freight Trend Analysis

This subsection presents the approaches and analytical results of population density, current freight trends, and truck traffic generation in New Jersey using ArcGIS spatial tools. The purpose is draw insights of the best lands for truck parking development based on high level regional freight characteristics and trends.

Data Sources

Data used for freight analysis was retrieved from the North American Industry Classification System (NAICS) Association. Using data codes 31-33 (Manufacturing excluding companies with less than $1 million in sales volume), 44511 (Supermarket/Other Grocery Stores) and 49 (Warehousing and Storage) data points for the entire State of New Jersey were plotted and analyzed using ARCGIS hot-spot spatial analysis. At the qualitative level, the information is based upon phone meetings held with stakeholders from NJMTA, NATSO, DVRPC and NJTPA.

Location and capacity information of total 51 existing stops in New Jersey was obtained from multiple sources including the NJTPA reports and TruckStopGuide.com, and information of each individual truck stop was manually verified (Appendix B). For the regional and site selection, data was directly taken from truck parking studies conducted by the NJTPA and DVRPC. Additional data was also taken from the NJDOT based on a freight study focusing on southern New Jersey. Location-based data for site selection is based on satellite imagery and general transportation, land use and socioeconomic patterns conducive to each area's suitability.

Population Density

New Jersey is the densest state in the entire United States, given its location in the heart of the Northeast Corridor and directly in between New York and Philadelphia. As can be seen from the map below, densities are highest in locations closest to these two cities. In fact, densities remain relatively high along the entire Northeast Corridor within New Jersey, especially around cities such Newark, New Brunswick and Trenton. Overall however, densities are higher in northern New Jersey compared to the southern portion of the State where some of the more isolated areas are, including the Pine Barrens of Ocean and Burlington Counties as well as the Delaware Bay area comprised of Salem, Cumberland and Cape May Counties.

Given these high levels of density, New Jersey presents a rather unique and complex case study for the analysis of truck parking. Despite the presence of sparsely populated areas, no parts of New Jersey can truly be considered remote for any sort of development. Forms of development ranging from residential developments to agricultural processing facilities can be found practically in every portion of the State. As a result, unlike many other areas where truck parking has been studied, focusing the expansion of truck parking should not be limited only to the densest parts of New Jersey, but instead requires careful examination of each area of the State as well as the predicted commodity flows into and out of these areas. Such examinations begin with three commercial sectors described below and continue with the 'Regional Site Selection Criteria'.

Figure 9: Population Density Map of New Jersey
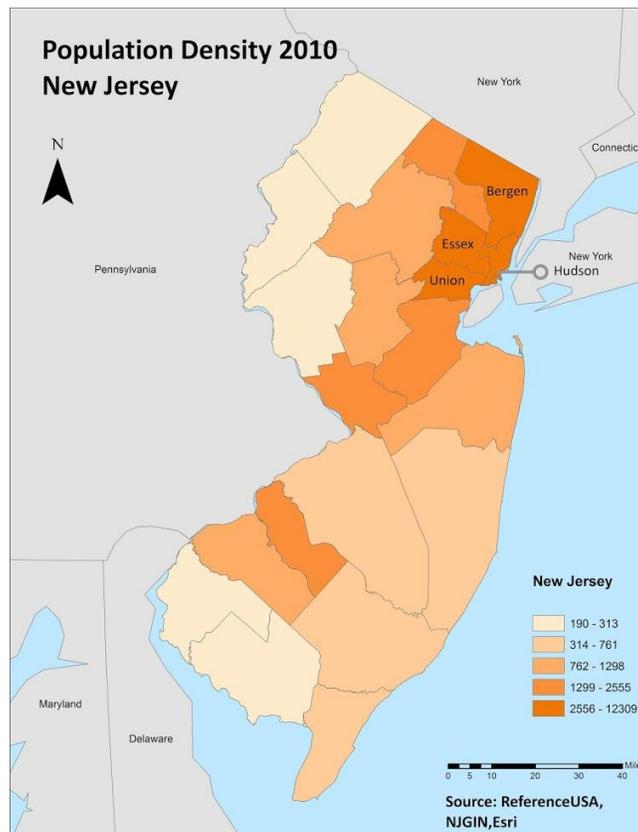
Retail Trade

A broad category comprising numerous types of businesses, retail trade is represented primarily by supermarket and grocery stores for the purposes of this analysis, given a large amount of data points. Overall, supermarkets and related uses appear to be a strong indicator of development patterns, while also supplying a diverse and expansive range of goods transported by the trucking logistics industry. Additionally, a common land use strategy is to locate supermarkets and related uses adjacent to or near other commercial uses. While future studies should be able to perform such analyses by further breaking down the retail trade sector, this simple hot-spot analysis of the entire sector, based on supermarkets, serves as an effective first-step analysis. The generated map *(16)* is shown below:

Figure 10: Retail Trade Hot-Spot Analysis of New Jersey
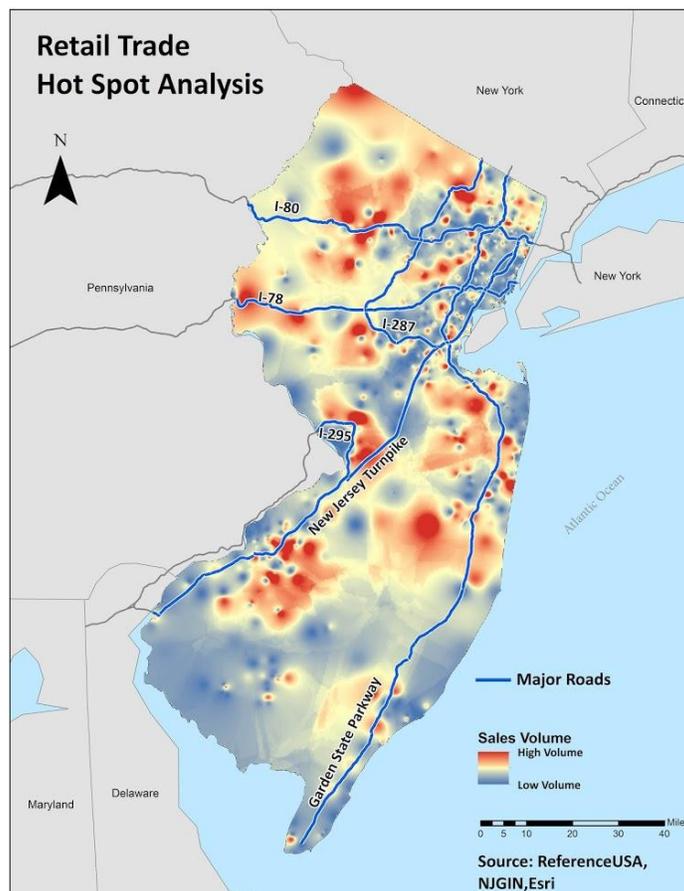
Multiple inferences can be made from the hot-spot analysis of supermarkets. At first glance, it may seem odd that many of the generated hot-spots happen to fall in some of the lesser populated portions of New Jersey. Such locations include the northern tip of the State, and areas about 30 miles southeast of Trenton. At the same time, the more populated portions of New Jersey, including the Newark, New Brunswick and Trenton areas generate a "cold" response. These disparities can be explained by the size of the supermarkets, especially in relation to other related uses. For example, the denser, urbanized portions of New Jersey are likely to contain numerous, smaller (in comparison) supermarkets. In light suburban and exurban locations, of which New Jersey is also largely comprised of, supermarkets tend to be more isolated, but also much more regionalized, thus occupying much more square footage than those in more urbanized locations. Overall, this analysis may prove to be the strongest at evaluating suburban and exurban population growth patterns as opposed to freight generation, given the presence of many strongly-defined hot-spots occurring at the fringes of high-density areas, including the outer southeastern suburbs of Philadelphia and along the Garden State Parkway and Interstate 287 in Monmouth and Middlesex Counties. On the other hand however, the presence of such uses may drive additional truck traffic and warehousing and distribution growth around these areas. As a result, the overall retail sector in general may be a strong indicator of growth for truck VMT.

Manufacturing

As a major generator of freight traffic of all kinds, manufacturing is an important category to analyze. Whereas supermarkets and retail are strong indicators of population, manufacturing uses can be located in a wide range of areas, especially in a location such as New Jersey where proximity to locations of interest is rarely of issue. In order to remove excess noise, this analysis only takes into account manufacturing firms with over $1 million in annual sales, as such firms will be the primary drivers of freight traffic. The generated hot-spot map *(16)* is shown below:

Figure 11: Manufacturing Hot-Spot Analysis of New Jersey
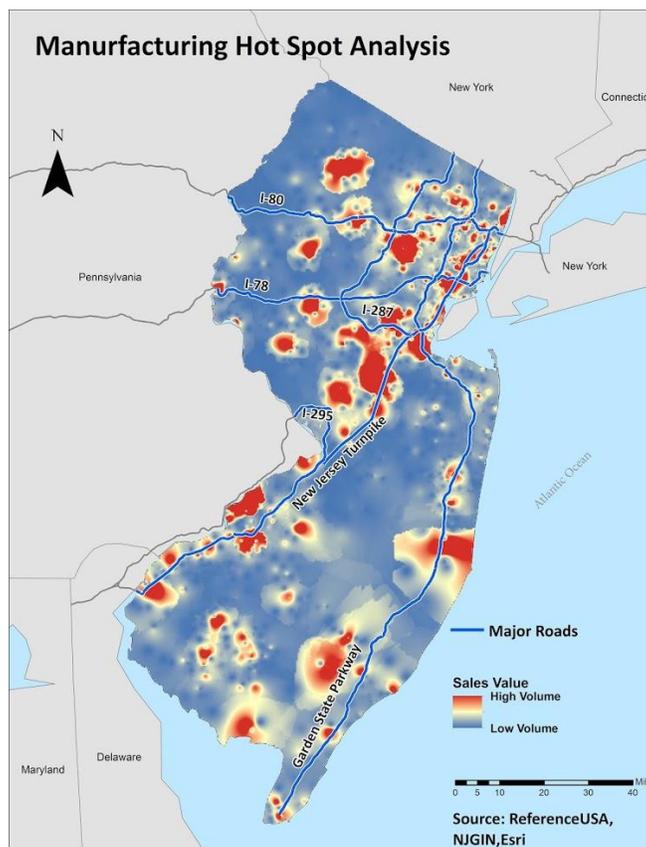
Again, multiple inferences can be made from the generated hot-spot analysis of manufacturing locations. First, there are multiple hot-spots distributed throughout the State. Some of the more pronounced include portions of Camden and Gloucester Counties outside of the City of Camden, Woodbridge Township in Middlesex County and surprisingly, the Newton area of predominantly rural Sussex County. An examination via satellite imagery of the Newton area shows a somewhat pronounced presence of manufacturing in what is otherwise a rural, which explains the strong return of a hot-spot for this area. Based on the overall results of this area, key nodes that are likely conducive to truck traffic generation and as a result, truck parking, are those hot-spots generated within or near denser areas. Such locations will likely generate the most congestion, especially given the probable presence of existing truck freight-generating uses. As a result, based on manufacturing uses alone, the Camden and Woodbridge areas may actually represent the most significant generators of manufacturing

traffic, given the density of such uses along with the likely presence of retail and similar freight-generating uses nearby.

Warehousing & Distribution

Warehousing and distribution may in fact be the most important driver of truck traffic in New Jersey. Despite a slow overall economic recovery, especially in comparison to neighboring states, New Jersey has experienced a booming industrial economy, driven by strong demand for distribution and warehousing space. As the demand for speedy and even same-day shipping of purchased goods and products expands, firms will continue to set up massive (over 500,000 square feet) warehouses and distribution centers where any product carried by the whole seller can be stored until purchased by a consumer.

Unlike manufacturing, warehousing and distribution centers generate almost exclusively truck traffic. Often times, goods require immediate transportation from one regional distribution to another, or to an intermediate processing center in a manner that makes trucks the most optimal mode choice. The locating of such facilities near port facilities also makes sense to accommodate goods reaching the area via maritime transportation. Given their massive size, such facilities tend to be clustered together in industrial parks or most recently, located in exurban areas, where a balance between expandable space and proximity to population centers can be achieved. The hot-spot analysis for distribution centers *(12)* is shown below:

Figure 12: Warehousing & Distribution Center Hot-Spot Analysis of New Jersey
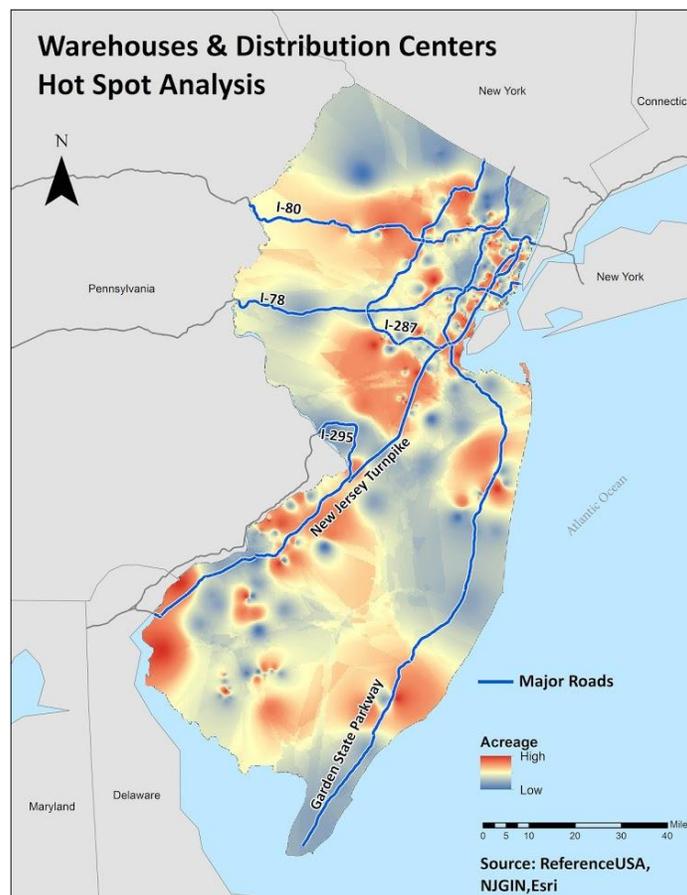
Especially for this analysis, it is important to distinguish between what might be excess noise and which locations are actually significant freight drivers. At first glance, the largest hot-spots seem to be in Salem County in the southwest portion of New Jersey, just outside of Atlantic City in Atlantic County and in northern Morris County in the northern portion of the State. Similar to the results of the manufacturing hot-spot analysis, these results indicate that while there may be a presence of some warehousing or distribution centers, the intensity of the hot-spots appears to primarily be an indicator of the lack of such land uses in surrounding areas. Most important for this analysis appears to be the smaller, more distinctive and defined hot-spots. Overlaid to the major highways map, these centralized generators of truck traffic closely follow the Northeast Corridor and specifically the New Jersey Turnpike/Interstate 95. The validity of these results is further strengthened by the naturally high volumes of freight traffic which already utilize this corridor and based on such findings, the Northeast Corridor comprised of Mercer, Middlesex, Union and Essex Counties appears to be worth further directly analyzing to develop or expand truck parking.

Truck Parking Inventory and Demand

Analyzing freight generation patterns boils down to estimating trucking parking demand. Truck parking facilities are location-sensitive in the sense that they are usually adjacent to major corridors. New Jersey Turnpike connects two primary markets (New York City and Philadelphia) making itself one of the busiest freight corridors in United States. Regional Travel Model-Enhanced (RTM-E) data is

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acquired from NJTPA to help select analysis segments with more than 1,000 trucks volume per day and also provide traffic volume for conducting the demand model calculation. Detailed calculation of truck parking demand estimation is illustrated in the numerical case study in subsection 3.4.

On the other hand, it is equally important to look at existing parking inventory supply. Figure 13 illustrates the existing truck parking facility distribution in New Jersey. Complete location and capacity data of the 51 existing truck stops in New Jersey is listed in Appendix B. According to NJTPA and DVRPC, the majority of these facilities are over saturated with demand. Utilizing advanced ITS technology to convey occupancy information to users is a promising approach to improve demand management in near future, which also helps collect real-time demand data.

Figure 13: Truck Parking Facility Distribution in New Jersey
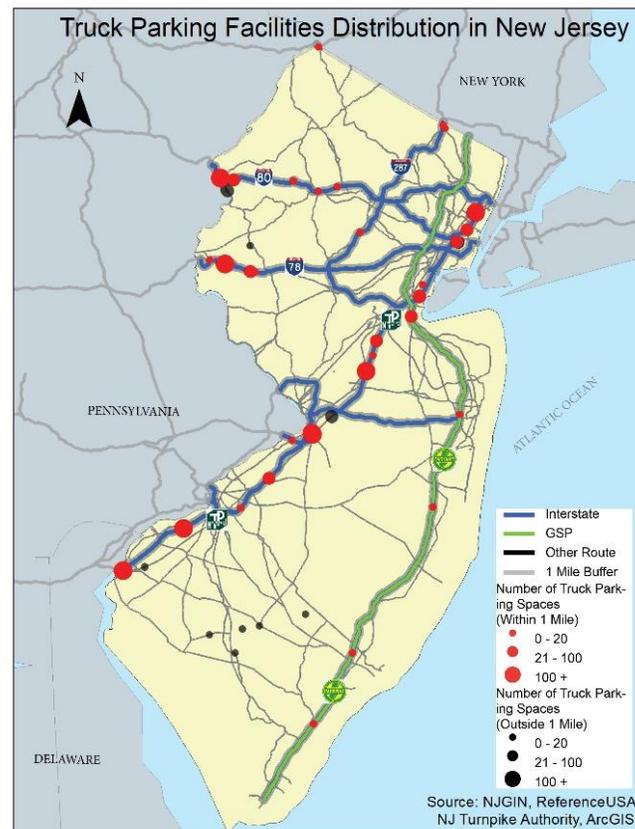
Further Analysis

Overall, the hot-spot analyses further add justification to what the basic State population density map describes. In particular, significant manufacturing usage appears to be located around the Camden and Woodbridge areas, while the analysis of warehousing and distribution centers shows major clustering along the New Jersey Turnpike/Interstate 95 corridor. From an industry analysis, this report now shifts to focus on identifying specific locations or areas where additional truck parking should locate.

4.3   Regional Site Selection Criteria

Whereas the statewide selection criteria sought to identify significant clusters of long-route truck generating traffic, this subsection seeks to identify, at the local and site levels, potential locations to develop or expand truck parking. As described in the literature review section, truck parking has directly been a topic study for the DVRPC and NJTPA. Additionally the NJDOT commissioned a freight study specifically focusing on South Jersey which also proves to be of value to the issue at hand. This subsection seeks to directly build off the recommendations and trends set forth by these studies in a single, coordinated document.

Figure 14: Metropolitan Planning Organizations of New Jersey
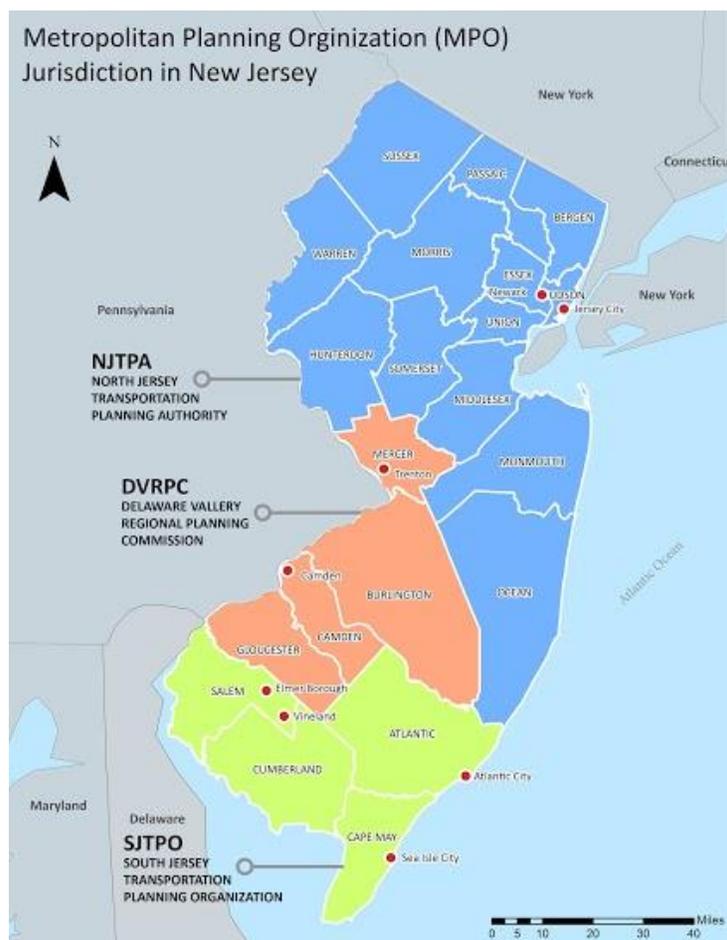
Multiple factors should be taken into consideration when making decisions on where to locate a truck stop. First and foremost for this analysis is to site truck stops where they will help most to alleviate demand in locations where parking is undersupplied. Assuming limited funding for such projects, this analysis also attempts to prioritize certain locations over others. At a more local scale, a truck stop should ideally be located away from residential and especially sensitive uses such as schools. Lastly, in situations where a potential truck stop would locate within closer proximity to residential communities, while special care should be taken to protect lower income and minority populations, it is also important to recognize, especially for private sector developers, that community resistance and

opposition will be most powerful in affluent communities. Rather than presenting a linear methodology for location identification, each of New Jersey's 21 counties was individually and qualitatively examined, taking into the account the factors described. At the MPO or DOT levels, this qualitative-based strategy can be employed at multiple levels, ranging from regional to even municipal boundaries. For the context of this main report, only a few selected counties with the most promising locations for truck parking are presented. The full 21-county analysis can be found in Appendix D.

Southern New Jersey

Atlantic, Cape May, Cumberland and Salem Counties fall under the jurisdiction of the SJTPO. As one of the least populated portions of New Jersey, the South Jersey Transportation Planning Organization (SJTPO) has not placed as much of an emphasis on freight and specifically truck travel planning. In 2010 however a study was commissioned by NJDOT which focuses on freight travel in southern New Jersey and provides the basis for the qualitative analysis of the four counties of the SJTPO *(35)*. The most insightful locations for truck parking within the SJTPO jurisdiction appear to be in Salem County and the corresponding analysis is provided below. Atlantic, Cape May and Cumberland County analyses can be found in the Appendix D.

Salem County

Salem County is located in the extreme southwestern section of New Jersey and serves as the terminus of the New Jersey Turnpike and the Delaware Memorial Bridge. Given the configuration of Interstate 95 in central New Jersey and north of Philadelphia, thru vehicular traffic heading from New Jersey, New York and points north towards Delaware, Baltimore, Washington DC and other points south and southwest will likely transverse Salem County, making it a potential hub for freight movement. Despite its location and somewhat close proximity to Philadelphia, Salem County has largely remained agricultural.

Salem County does however have some freight assets, most notably the Port of Salem, which handles a variety of cargo ranging from consumer goods and apparel to motor vehicles. Railroads leading to the port are in poor condition however and the Port's location in Salem, about 15 miles away from any highways makes truck accessibility another issue hindering future growth. Truck parking in the form of a Flying J Travel Center is located at the junction of Interstate 295 and the New Jersey Turnpike, approximately half a mile from the Delaware Memorial Bridge. Additional truck parking is located at the smaller Clara Barton Service Area, about 10 miles northeast on the New Jersey Turnpike.

Because SJTPO has not conducted any studies on truck parking so it is difficult to determine if the current supply of parking in Salem County adequately addresses demand. Within Salem County itself, infrastructure constraints appear to hinder freight movement growth in the southern portions of the County. Closer to Gloucester County and Philadelphia however, Salem County may see an increase in the presence of warehouses and distribution centers which would likely add to regional truck parking demand. In Oldmans Township, located along the Gloucester County border, the Gateway Business Park was recently opened, adding 3.6 million square feet of warehousing, manufacturing and distribution space. Although other portions of New Jersey are experiencing a greater demand for truck parking, an effective strategy may be to focus site planning on areas along the US Highway 130 and Interstate 295 north-south corridors of Salem County which have remained largely undeveloped, in anticipation that the industrial growth experienced in Gloucester County will further extend south.

Delaware Valley

Burlington, Camden, Gloucester and Mercer Counties fall under the jurisdiction of the DVRPC. In addition to these counties in New Jersey, the DVRPC also places focus on Bucks, Chester, Delaware, Montgomery and Philadelphia Counties in Pennsylvania. The DVRPC has put together an expansive freight planning data platform that provides significant value to this study. Table 7 below summarizes some of the basic statistics recorded by the DVRPC of significance to the trucking industry by DVRPC. Additionally, in 2011, the DVRPC published a regional truck parking study which includes occupancy statistics on all major truck stops in the Philadelphia-Delaware Valley Region. The 2011 study *(5)* is detailed further in the literature review section of this report but those occupancy statistics are detailed where appropriate for each county. Analyses for Gloucester and Burlington Counties are provided in this main section of the report, while analyses for Camden and Mercer Counties can be found in the Appendix D.

Table 7: DVRPC Counties Freight Statistics

County	Interstate Miles	US Highway Miles	Interstate Highway Interchanges	Daily Truck Miles (Thousands)	Number of Significant Regional Freight Center Facilities		
					Mega (1500+ Acres)	Major (700-1499 Acres)	Intermediate (250-699 Acres)
Gloucester	34	97	15	520	1	2	1
Camden	28	117	11	922	0	2	1
Burlington	58	128	12	851	1	0	3
Mercer	39	84	20	741	0	1	2

Gloucester County

      Located just south of Philadelphia and directly across the Delaware River from the City of Chester, Pennsylvania, Gloucester County is a lot more developed than neighboring southern and eastern counties. There are total of six major distribution center complexes within the County, primarily located along the Interstate 295 corridor. Gloucester County has encouraged industrial growth along the Interstate 295 corridor to further add to its strong logistics and chemical processing industries. The County is home to four significant freight center facilities, including the Pureland Industrial Complex, which at over 2600 acres, is the third largest freight center facility in the entire Delaware Valley and the largest in southern New Jersey. Additionally, Gloucester County is experiencing rapid population growth, recording a population increase of 13.2% between 2000 and 2010, compared with a statewide increase of just 4.5% over the same period.

      Despite a mature industrial presence and rapidly increasing population, the County still has significant undeveloped land within close proximity to these industrial centers and may contain some of the best sites in the entire State of New Jersey for increasing truck parking. As part of the 2011 truck parking study, the 185-space Travel Centers of America Truck Stop, located on Exit 18 of Interstate 295 in Paulsboro, was observed on a random night to have 194 parked trucks, with additional trucks parked on the shoulder of Interstate 295. As these observations show, Gloucester County is need of additional truck parking.

While the northwestern portion of Gloucester County has become more developed, population density and industrial development drops off noticeably southwest of Exit 17 on Interstate 295 in the Paulsboro-Mantua Township areas of the County. Because Gloucester County is encouraging development along the Interstate 295 exit nodes, vacant, undeveloped or underdeveloped lands adjacent to Exits 16-A-B, 15, 14 and 11 should be examined. An additional corridor of interest would be US Highway 322 between the Commodore Barry Bridge and Exit 3 on the New Jersey Turnpike. This corridor is located within one mile of the Pureland Industrial Complex, and within three miles of either Interstate 295 or Exit 3 on a portion of the New Jersey Turnpike conducive to longer-distance travel as interchanges are widely scattered.

Burlington County

Burlington County is the largest county in New Jersey in terms of area and while much of its southeastern and central areas are predominantly rural, the western (particularly northwestern) portion of the County might represent one of the best places in the entire State of New Jersey to develop additional truck parking. Four significant freight center facilities are located in Burlington County, including the 1500+ acre Haines Industrial Center in Burlington Township. Additionally, while areas between the New Jersey Turnpike and the Delaware River, bordering Camden County up to Burlington Township are more urbanized, there is still a large amount of undeveloped or underdeveloped land within close proximity to the Trenton area.

Burlington County's high conduciveness to additional truck parking stems from two major infrastructure projects affecting New Jersey and Pennsylvania. The New Jersey Turnpike Authority recently completed its widening project, widening the total lanes from 6 to 12, up to the Exit 6-Interstate 276 (Pennsylvania Turnpike) interchange in Mansfield Township, eliminating a notorious bottleneck in Middlesex County and greatly easing truck travel into the area. Most significant might be the planned Interstate 276 – Interstate 95 interchange in Bristol, Bucks County, Pennsylvania and under five miles from the New Jersey border. Under current conditions, there is no direct route for thru traffic between central New Jersey, New York City and north heading to Philadelphia and vice-versa. When completed, the interchange will be the most direct route into the Philadelphia area via Northeast Philadelphia and Bensalem, Pennsylvania, while eliminating the need to use Routes 38 and 73 via Exit 4 of the New Jersey Turnpike in Camden County or Interstate 195 to US Highway 1 to Interstate 95 via Trenton, both of which contain numerous signal-controlled intersections, or add extraneous miles using Interstates 195, 295 and 76/676. Construction of the interchange is expected to begin in 2017, once design specifications are complete *(36)*.

Analysis of the effects of the new interchange on industrial leasing rates has not yet been completed, but demand along the Interstate 276 corridor will likely further increase, in addition to any increases that may be occurring with the elimination of the New Jersey Turnpike/Interstate 95 bottleneck in Middlesex County. Once completed, Burlington County has the potential to be an even stronger industrial center and will likely be absorbed into the central New Jersey industrial economy, providing direct access to the New York and Philadelphia markets and short proximity to Harrisburg, Pennsylvania and other points south and west.

According to the DVRPC regional truck parking study, Burlington County has a total of 615 truck parking spaces, most of which (490 spaces) are provided by Petro in Bordentown Township. The remaining two are provided by Love's in Bordentown Township (79 spaces) and the James Fenimore Cooper Service Area (46 spaces) of the New Jersey Turnpike in Mount Laurel Township *(5)*. The parking

study observed that the Petro stop was at full capacity, and the two remaining truck stops were at 111% and 117% capacity respectively on a random night, indicating an already existing need for truck parking. Additionally, it was revealed that two adjacent rest areas, collectively known as the Howard Stern Rest Stop, serving Interstate 295 north and south between Exits 47-A-B and Exits 52-A-B in Springfield Township were closed in 2008, eliminating possibly up to 50 spaces from the Region *(5)*. This was the only rest area to close in recent times in southern New Jersey, although many states have shuttered rest areas for cost-saving measures.

Moving forward, a public-private partnership used to reopen and possibly expand the Howard Stern Rest Area may represent the best course of action on expanding parking in the area. Infrastructures in the form of entrance and exit ramps and basic facilities have already been established and the site is far enough from any concentrations of residential development that any negative effects would be minimized. The site is also close to the northern Burlington County industrial submarket which includes the Haines Industrial Center. Sites directly next to or near the Haines Industrial Complex and along US Highway 130 may be hard to come by, given existing development throughout most of the area and sensitive uses, including the Florence Township Memorial High School within close proximity to undeveloped sites. Additional sites of interest that should be explored however include the stretch of land between Interstate 295 and the New Jersey Turnpike along Interstate 295 Exits 45-A-B in Westampton Township, County Route 656 between Interstate 276 and the New Jersey Turnpike along Exits 52-A-B of Interstate 295 in Florence Township and lands near US Highway 206 specifically near the Manheim car auction site in Bordentown Township near Exit 7 of the New Jersey Turnpike.

Northern New Jersey

Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Passaic, Somerset, Sussex and Warren Counties fall under the jurisdiction of the NJTPA. As a separate MPO, the NJTPA conducted a separate freight analysis from the one completed by the DVRPC. Whereas the DVRPC implemented a user-friendly qualitative interface of regional freight assets in the Delaware Valley, the NJTPA's analysis is a more quantitative-based analysis, particularly looking forward to 2040. While the spatial data of distribution & warehousing facilities is not directly available for export, the statistics provided in NJTPA's 2040 Freight Industry Level Forecasts *(37)* are of significant benefit to this report.

As an important indicator of freight activity for each northern New Jersey county, Table 8 *(4)* below estimates the location of the largest expected truck flow of each jurisdictional county.

Table 8: 2040 Largest Expected Truck Flow for Each NJTPA County

	2040 Expected Maximum Daily Bi-Directional Truck Flow	Location of Expected Maximum Daily Truck Flow
Ocean	4,000	Interstate 195
Monmouth	3,000	Interstate 195
Middlesex	19,600	New Jersey Turnpike/Interstate 95
Somerset	16,000	Interstate 78
Hunterdon	9,600	Interstate 78
Union	16,000	New Jersey Turnpike/Interstate 95
Essex	15,000	New Jersey Turnpike/Interstate 95 & Interstate 80
Morris	17,000	Interstate 80
Warren	19,000	Interstate 78
Hudson	15,000	New Jersey Turnpike/Interstate 95
Bergen	19,000	New Jersey Turnpike/Interstate 95 & Interstate 80
Passaic	14,200	Interstate 80
Sussex	9,000	Interstate 80

As Table 8 shows, the highest traffic flow is expected to occur primarily on New Jersey's interstate highways. Most telling however are the expected maximum flow values for each county. Ocean and Monmouth Counties both have the lowest values of 4,000 and 3,000 trucks per day, compared to Middlesex and Bergen Counties where flow values are expected to reach almost 20,000 trucks per day *(37)*. This information can be compared with the corridor summaries put together by the NJTPA in the 2008 North Jersey Truck Rest Stop Study. Those summaries are provided in Table 9 below.

Table 9: 2007 Estimated Truck Parking Demand by Corridor

Rank	Roadway	Limits	Capacity	Demand	Parking Deficit	Thru Counties
1	Interstate 78	East of I-287	0	520	(520)	Somerset, Union, Essex, Hudson
2	New Jersey Turnpike	Between I-287 & I-80	103	326	(223)	Middlesex, Union, Hudson, Bergen
3	Interstate 287	North of I-80	153	333	(180)	Morris, Passaic, Bergen
4	New Jersey Turnpike	South of I-287	138	310	(172)	Middlesex
5	Interstate 80	East of I-287	122	218	(96)	Morris, Essex, Passaic, Bergen
6	Interstate 287	Between I-78 and I-80	23	98	(75)	Somerset, Morris
7	NJ Route 18/ US Highway 9	East of I-95	0	17	(17)	Middlesex, Monmouth
8	New Jersey Turnpike	North of I-80	236	122	+ 114	Bergen
9	Interstate 78	West of I-287	312	140	+ 172	Somerset, Hunterdon, Warren
10	Interstate 80	West of I-287	290	103	+ 187	Morris, Sussex, Warren

 As Table 9 shows, many of the corridors with the highest demand for truck parking are also the ones with the highest expected truck flows. Interstate 78 to the east of Interstate 287 had the highest parking deficit at 520 spaces *(4)*.   Through Somerset County, particularly within Bedminster, Bridgewater, Bernards, Warren and Watchung Townships, Interstate 78 is projected to carry upwards of 16,000 trucks per day. This figure is likely to increase as Interstate 78 nears Newark Airport and Port Newark, although the New Jersey Turnpike will still continue to carry the most trucks as the center of the Northeast Corridor. At the same time, such figures should be taken with some caution. Although 3 of the 10 corridors appear to have large surpluses of parking, these figures represent totals using the FHWA's parking demand model for each unique corridor. In reality, such surpluses can easily be diminished by the lack of parking on adjacent corridors where deficits exist. An example would be the supposed parking surplus for the Interstate 78 west of Interstate 287 corridor being diminished as a result of non-existent truck parking on Interstate 78 east of Interstate 287.

Second, the NJTPA has taken steps to identify all distribution and warehousing facilities in the northern New Jersey counties. Although spatial data is not available for export for further analysis, the numerical totals for each county are summarized in Table 10 below:

Table 10: Warehousing and Distribution Facilities by County (37)

	< 500,000 Square Feet	500,000 - 1,000,000 Square Feet	1,000,000 + Square Feet
Ocean	167	0	0
Monmouth	285	0	1
Middlesex	1255	39	8
Somerset	292	0	0
Hunterdon	31	1	0
Union	690	7	2
Essex	871	9	1
Morris	393	2	1
Warren	52	0	0
Hudson	746	17	2
Bergen	1319	4	0
Passaic	591	3	0
Sussex	39	0	0

This analysis is most concerned with those facilities larger than 500,000 square feet as these will generate the most truck traffic. As Table 10 shows, Middlesex County by far has the number of large distribution and warehousing facilities. Not counting Bergen County, which primarily consists of smaller warehouses, Hudson, Union and Essex Counties had considerable numbers of such facilities. This presents a unique set of challenges for the Region as Hudson, Essex and Union Counties are some of the most built-out counties in the entire United States, given their immediate proximity to New York City.

Of additional importance is the destination location of freight generated and/or passing through New Jersey counties. Broken down by northern New Jersey County, Figure 15 estimates the breakdown of freight generated and or passing through for 2040 *(37)*.

Figure 15: 2040 Freight Travel Characteristics by County
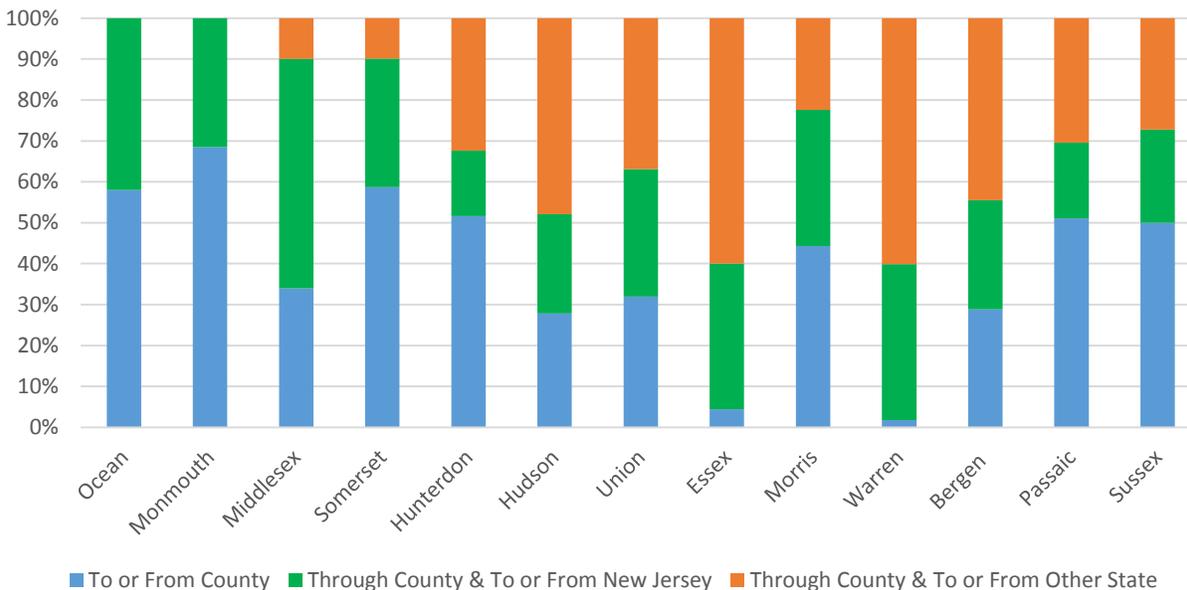
Given New Jersey's small size, it would be safe to assume that counties where freight stays exclusively within New Jersey have little if any demand for truck parking, such as Ocean and Monmouth Counties. Once the presence of intra-state freight is introduced however, the graph is less intuitive. Essex and Warren Counties had the highest rates of intra-state freight travel at over 50%, despite each possessing very different economic and population characteristics. Middlesex County, which appears to be one of the largest generators of truck traffic and truck parking demand only generates about 10% of intra-state freight travel. It should also be noted that truck travel will continue to comprise approximate 80% of all freight travel in New Jersey up to and likely beyond 2040 *(37)*. The analyses for Middlesex, Bergen, Hudson and Essex Counties are to follow, while the remaining analyses for the NJTPA counties can be found in the Appendix D.

Middlesex County

Middlesex County contains one of the strongest industrial and warehousing economies in the entire United States, given its close proximity to New York City and Port Newark, Philadelphia and its location in the heart of the Northeast Corridor transportation network. As Table 10 shows, Middlesex County has by far the most large warehousing and distribution centers (500,000 square feet +) of any county in New Jersey. The rise of Middlesex County's industrial economy can be seen along the major corridors of New Jersey Turnpike/Interstate 95 and Interstate 287 and the junction between the two highways in Edison Township is the site of one of the state's largest cluster of such uses.

In addition to Edison Township, large clusters of warehousing and distribution facilities can be found just off of Exit 8 on the New Jersey Turnpike/Interstate 95 in Cranbury and South Brunswick Townships. The area is also home to the Molly Pitcher Service Area of the New Jersey Turnpike/Interstate 95 in Cranbury Township which has been identified by the NJTPA as a specific site of interest for expanding truck parking. Immediately adjacent to the rest area is a large swath of land that

as of 2008 was currently being used as agricultural lands but had recently been rezoned as industrial land and still remains undeveloped as of 2015. According to the NJTPA, a public-private partnership could be used to allow for additional truck parking on the site, more than doubling the amount of available to anywhere from 300 to 450 spaces. Given a current deficit of approximately 172 spaces on the New Jersey Turnpike/Interstate 95 south of Interstate 287 corridor, such a project would go an extremely long way to adequately addressing truck parking needs on what is likely the busiest freight corridor in the entire United States.

Although there may be additional sites within close proximity to both industrial uses and thru corridors that would be suitable to truck parking in Middlesex County, no other sites provide direct access to existing truck parking infrastructure and amenities. Although the Thomas Edison Service Area of the New Jersey Turnpike/Interstate 95 is located in Woodbridge Township, approximately 22 miles north of the Molly Pitcher Service Area, there is little developable space adjacent to the facility. For these reasons, the NJTPA's public-private partnership strategy on the lands adjacent to the Molly Pitcher Service Area represents the best strategy for truck parking development in the vital Middlesex County industrial submarket.

Bergen County

Bergen County is located in the northeastern portion of New Jersey and is home to the western terminus of the George Washington Bridge, a major thoroughfare of the Northeast Corridor that carries a wide range of traffic. As with other counties in metropolitan northeastern New Jersey, Bergen County is very dense, with the majority of lands within the county already built out. Furthermore, Bergen County's wealth and developed office use economy present hurdles to developing truck parking at existing businesses on or near the County's major highways.

Located in Ridgefield, in the southern portion of Bergen County however is the Vince Lombardi Service Area of the New Jersey Turnpike/Interstate 95, which was the second of two locations (the first being the Molly Pitcher Service Area in Cranbury Township, Middlesex County) recommended by the NJTPA in their 2008 Truck Rest Stop Study for truck parking development and expansion, based on a number of criteria. Such truck parking expansion would involve converting an existing portion of the rest area from automobile to truck-specific parking, increasing such parking by between 100 and 200 spaces. For the purposes of expanding truck parking in the Region, the recommended site proves to be very effective in relieving parking deficits on the Interstate 95 between Interstate 80 and 78, along with the Interstate 80 east of Interstate 287 corridor. Both corridors have some of the highest parking deficits in New Jersey, with adjacent land uses often not conducive to any new sort of development. Additionally, since it is highly unlikely that any additional wetlands in this area of the Meadowlands will be developed, and because the rest area is owned by the New Jersey Turnpike Authority as opposed to a private developer, the reconfiguration of the Vince Lombardi Service Area proves to be an effective strategy for truck parking expansion.

Hudson County

The western terminus of the Lincoln and Holland Tunnels, Hudson County is the smallest county in New Jersey in terms of area, but also the densest. Additionally, Hudson County is home to the second highest number of warehousing and distribution center facilities greater than 500,000 square feet (19 compared to 47 for Middlesex County). The strong industrial economy, combined with the presence of the Port Jersey Multimodal Terminal located in Bayonne, make Hudson County a major driver of freight

traffic and also the reason each interstate corridor that passes through Hudson County has a significant shortage of truck parking.

There are significant obstacles that make developing or expanding truck parking in Hudson County a challenging uptake. First, Hudson County's density rivals that of New York City in many locations. Even areas near the Port Jersey Marine Terminal have already been fully urbanized, with very little tracts of developable land remaining. Second and equally as significant, are the obstacles that come with developing on brownfield sites. Geographically, the South Kearny Industrial Area, already home to a number of truck stops, serves as an effective place for truck parking given its close proximity to the New Jersey Turnpike/Interstate 95, Port Newark and large distance to any existing residential uses.

Unique to Hudson County and a few other areas of New Jersey however is the presence of businesses aimed at providing service directly to truckers. This can be seen along much of the length of US Highway 1-9 in North Bergen Township, Jersey City and Kearny and takes the form of motels, auto-mechanics and eateries aimed at such drivers. Although most of these are small businesses that only provide parking to a few trucks each, an effective regional approach to determining how much additional truck parking is needed to further assemble these locations into an accessible database recognizing both large and small truck stops provided by both the private and public sectors.

Essex County

Essex County is home to Port Newark, the third largest port by tonnage in the entire United States and the largest on the east coast. Numerous industrial facilities ranging from manufacturing to distribution centers are located in and around Port Newark and the adjacent Newark Liberty International Airport. Overall Essex County is an extremely large generator of truck traffic likely for the entire Northeast and Mid-Atlantic Regions of the United States and also the reason for the high demand for truck parking on most of northern New Jersey's interstate corridors.

Like most other counties in northeastern New Jersey, there are numerous obstacles that make developing additional truck parking a difficult task in Essex County. With the exception of Fairfield Township in the northwestern portion of the County, most of central and western Essex County, has already been completely built out and is comprised of generally wealthy suburbs and the urban areas of Orange, East Orange, Bloomfield, and Irvington. While there is undeveloped land around Interstate 80 in Fairfield Township, the area consists of wetlands that often flood, most likely preventing any sort of development, not limited to truck parking.

Areas closer to the industrial uses of Newark and eastern Essex County are even denser in terms of both industrial and residential developments. All 10 of the warehousing and distribution facilities larger than 500,000 square feet are located east of the Garden State Parkway in either dense, urban residential areas, or closer to Port Newark and Newark Airport where numerous other industrial facilities are located. Although developable space is very limited however, the NJTPA has identified in their 2009 Phase II Truck Stop Study, a potentially suitable site for truck parking in Newark. The site, located on Hyatt Avenue and about a mile from Port Newark Airport would provide between 200 and 300 truck parking spaces if developed and may be the only feasible location to develop truck parking on the entire Interstate 78 east of Interstate 287 corridor which does not currently contain any truck parking despite having extremely high demand for such amenities. The site is described in the next

subsection of this report. It may be possible to examine other sites in this area, although factors such as brownfield mitigation may be of significant issues.

Further Analysis

Each county within New Jersey presents its unique challenges and opportunities towards relieving state and region-wide parking deficits.   Overall, the most feasible opportunities for parking appear development appear to be in the southern portion of the state where there is still relatively large swaths of land available for development. Additionally, expanding existing truck stops, detailed by the NJTPA is also recommended given existing related infrastructure already in place. The northern portion of New Jersey presents more pronounced challenges. Although there is more demand for parking, many of these areas have already been completely built up. Other areas, particularly in Morris and Somerset Counties where wealth is more significantly concentrated, present challenges in the form of probable and powerful community opposition. In northwestern New Jersey, there may be more developable space is less populated areas, but such locations are far from ideal for truckers who wish to park overnight closer to origins and destinations such as the area ports and distribution centers. Such issues however create opportunities for public-private partnerships, which may present some of the most feasible solutions for expanding truck parking. The details and workings of such partnerships however are beyond the scope of this report, but should be explored by MPOs and DOTs.

4.4   Numerical Case Study

In this subsection, the developed methodology is used to evaluate a 200-space, 44.9-acre parcel in Newark, New Jersey, identified by the NJTPA as a site of interest for a new truck stop. A 30,000 square foot facility is also proposed, which would include a convenience store, multiple meal options, and maintenance facility, in addition to a fueling station. Since the focus of this study is the methodology integration and development, the case study serves as an application example for illustration purpose. The methodology framework is more useful in comparing different potential sites where the relative magnitudes of the cost and benefits become more important than the accuracy of absolute values due to data limit.

Site Information

Located on Hyatt Avenue in the Ironbound District of Newark and consisting of 5 separate parcels, the currently vacant site is just down the road from Port Newark and Port Elizabeth Marine Terminal and other related industrial sites. The site is situated between Interstate 95 and US 1-9, which also acts to separate it from any residential or noise-sensitive sites, which is especially useful in noise pollution evaluations. Additional nearby points of interest include the Interstate 95 and Interstate 78 junction and Newark Liberty International Airport. The site and surrounding areas are visualized in Figure 16 below.

Figure 16: Candidate Truck Parking Site in Newark
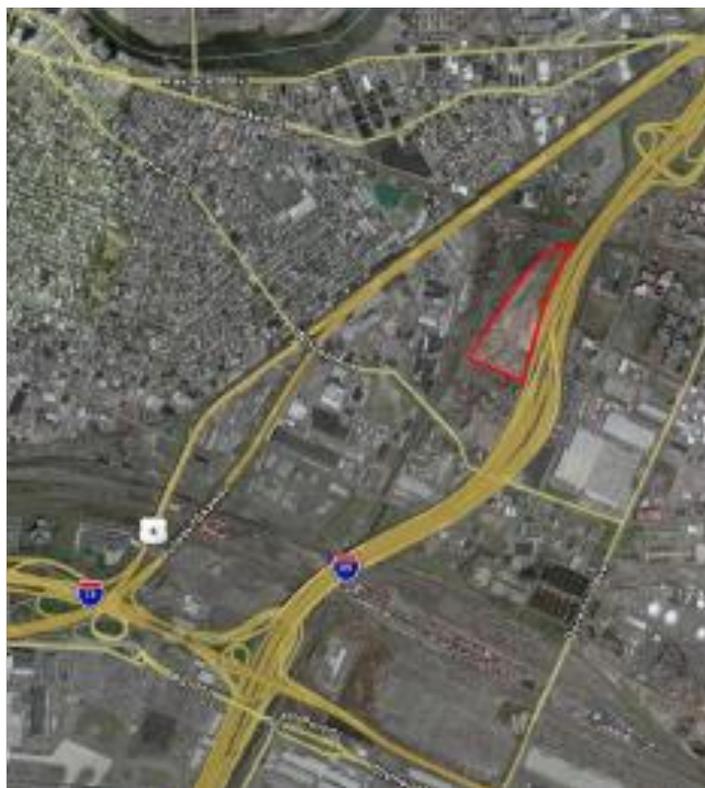
Demand Analysis

New Jersey turnpike is apparently the major route that the candidate site is adjacent to and the most important highway corridor in New Jersey both for automobiles and commercial trucks. New Jersey Turnpike connects two primary markets (New York City and Philadelphia) making itself one of the busiest freight corridors in United States. In addition, corridors that carry current truck traffic exceeding 1,000 trucks per day are considered to be major trucking corridors *(13)*. Regional Travel Model-Enhanced (RTM-E) data is acquired from NJTPA to help select analysis segments with more than 1,000 trucks volume per day and also provide traffic volume for conducting the demand model calculation.

Second, the parking inventory of public rest areas and private truck stops for this segment were obtained. Figure 13 illustrates the truck parking facility distribution in New Jersey. Truck parking facilities are location-sensitive in the sense that they are usually adjacent to major corridors. Since New Jersey Turnpike is identified as the major corridor in this research, all truck parking facilities located within 1 mile to New Jersey Turnpike are selected as truck parking supply (See Figure 13).

Finally, the truck parking demand estimation formulas are applied to estimate the parking demand for each analysis segment. Model parameter definition and values are presented in Table 11 in Appendix A. We apply the parameters and formulas from Section 3 to calculate both short- and long-term parking demands as follows:

<u>Site Factor – Truck Traffic along I-95 (New Jersey Turnpike)</u>

Length (Bi-directed, from New York City to Philadelphia)   = **343 km** (213 mi)

Daily Total Truck Volume   = **17,500 Truck per day (tpd)**

S (Speed Limit)   = **105 kph** (65 mph)

<u>Supply – Truck Parking Facilities along I-95 (New Jersey Turnpike)</u>

Parking$_{RA}$ = **855 spaces**

Parking$_{TS}$ = **1,489 spaces**

<u>Demand – Truck Parking Demand along I-95 (New Jersey Turnpike)</u>

Segment truck travel time per trip: TT   = $L / S = 343/105 =$ **3.27 hrs**

Truck-hrs of SH and LH travel: THT_{SH} $= P_{SH} \times V_t \times TT = (.36)(17,500)(3.27) =$ **20,601 veh-hrs**

                                          THT_{LH} $= P_{LH} \times V_t \times TT = (.64)(17,500)(3.27) =$ **36,624 veh-hrs**

Truck-hrs of SH parking demand: THP_{SH} $= THT_{SH} / 12 = (20,601)/12 =$ **1,716 veh-hrs**

Truck-hrs of LH parking demand: THP_{LH} $=$ Parking time/driving time $\times THT_{LH} + THT_{LH} / 12$

                                           $= 0.70 \times (36,624) + 36,624/12 =$ **28,689 veh-hrs**

Peak-hour parking demand for SH: PHP_{SH} $= PPF_{SH} \times THP_{SH} = 0.02(1,716) =$ **34 veh**

Peak-hour parking demand for LH: PHP_{LH} $= PPF_{LH} \times THP_{LH} = 0.09(28,689) =$ **2,582 veh**

SH and LH peak-hour parking

Hourly demand by facility type: $PHP_{(SH,RA)} = P_{RA} \times PHP_{SH} = 0.23 (34) =$ **8 veh**

                                           $PHP_{(SH,TS)} = P_{TS} \times PHP_{SH} = 0.77 (34) =$ **26 veh**

                                           $PHP_{(LH,RA)} = P_{RA} \times PHP_{LH} = 0.23 (2,582) =$ **594 veh**

                                           $PHP_{(LH,TS)} = P_{TS} \times PHP_{LH} = 0.77(2,582) =$ **1,988 veh**

The total peak-hour parking demand for public rest areas is 8 + 594 = 602 trucks, and the total peak hour parking demand for private truck stops is 26 + 1,988 = 2,014 trucks. Considering the supply of parking spaces on this segment, there is a **surplus of public rest area parking of 855 - 602 = 253(+) spaces**, while there is a **shortage of private truck stop parking of 1,489 - 1,988 = 499(-) spaces**. Hence, based on the predicted truck traffic volume and current truck parking spaces, we can forecast there is a shortage of

truck parking spaces in 2020 along New Jersey Turnpike, which is the major freight route in New Jersey. Given the assumption in this demand analysis that only considered limited length of the segment along NJ Turnpike, the numbers obtained above is considered an underestimation of the actual demand forecast.

Economic Analysis

As described earlier, the economic analysis takes into account the amount of parking spaces and jobs expected to be created as a function of acreage. Additionally, rough cost estimates are presented, based on acreage. It's important to note that the construction costs are preliminary figures which will fluctuate throughout the building process, making it difficult to establish an annualized format for this particular aspect of the project. Once funding sources and financing strategies are identified, an annualized format can be implemented.

A. Employment and Economic Benefits

Step 1: Assumptions

        Each of the calculations begins with stated assumptions that will have influence on the final figures. For employment and economic benefits, the following assumption is made:

1. The mean of the 'Average Number of Employees Needed' figure for large full-service truck stops of 1.875 jobs per acre from Table 1 is used.

Step 2: Determine Total Created Jobs

        Calculating jobs per acre simply involves multiplying the jobs per acre figure assumed above by the size of the site of 44.9 acres:

Jobs Created = 1.875 jobs per acre * 44.9 acres **~ 88 Jobs**

B. Rest Stop Design & Construction Costs

Step 1: Approximate construction costs for parking lot & truck stop facility:

        Calculating construction costs for the parking lot simply involves multiplying the approximate costs per acre by the total number of acres:

Parking Lot Costs = $118,200 per acre * 46.76 acres = **$5,527,032**

        Calculating construction costs for the truck stop facility simply involves multiplying the cost per square foot by the total number of square feet:

Building Construction & Design Costs = $72.61 * 30,000 square feet = **$2,178,300**

Fiscal Analysis

The fiscal analysis is simply an extension of the economic analysis. For this section however payroll, sales and property taxes are estimated based on the proposed site specifications. Such information will be of benefit primarily to the public sector, especially if alternative projects are considered for a certain site.

Step 1: Assumptions

Means for all figures containing ranges from Table 2 are used. To recall from the methodology section, ranges are given to account for commonly seen fluctuations in the total number of employees. The analysis uses annual figures for large full-service truck stops.

Step 2: Calculate payroll, taxes and revenue

Again, such calculations are straightforward, taking into account the per acre figures above and the total number of acres:

Total Payroll = $85,869 * 46.76 acres = **$4,015,234**

Sales Revenue = $1,705,000 * 46.76 acres = **$79,725,800**

Annual Payroll Tax: $859 * 46.76 = **$40,167**

Annual Sales Tax: $120,000 * 46.76 acres = **$5,611,200**

Annual Property Tax: $2,978 * 46.76 acres = **$139,251**

Environmental Impacts Analysis

Recalling from the methodology, air and noise impacts from the truck stops are monetized on the basis of their effects on residential property values. To show display the functionality of the methodology, only NOx emissions are analyzed, though the same processes can be repeated for all emissions of interest. For this precise case study, in which the truck stop is separated from residential areas by US Highway 1-9, a major truck route, much of the noise pollution can actually be disregarded since the highway itself will produce much louder decibels of noise. To demonstrate the methodology however, these calculations will assume that the proposed truck stop has a direct effect on property values in the neighboring Ironbound neighborhood of Newark.

A. Reduction in VMT from Added Parking

Step 1: Assumptions

1. Values of 0.25 miles, 0.5 miles and 1 mile for each of the normal bell curve standard deviation levels of extra truck VMT under the current scenario.
2. NOx emission rates of 4.892 grams/mile for gasoline and 9.191 grams/mile for diesel and a gas to diesel ratio of 1:9.

Step 2: Calculation of VMT reduction

To determine the VMT reductions, Equation 1, taken from the methodology section, is employed. Lastly, the combined diesel and gasoline emission reductions are multiplied by the proposed number of spaces and normalized to annual figures.

Equation 1: Reduced Emissions per Additional Parking Space

Emission Reductions = .9(.68 (diesel grams/quarter mile) + .27 (diesel grams/half mile) + .05 (diesel grams/mile)) + .1(.68 (gas grams/quarter mile) + .27 (gas grams/half mile) + .05 (gas grams/mile))

Using Equation 1 yields the following results, taking into account a breakdown of 90% diesel-powered large trucks and 10% gasoline-powered large trucks:

Diesel Reductions: 0.9*(0.68 (0.25 miles * 9.191 grams/mile) + 0.27 (0.5 miles * 9.191 grams/mile) + 0.05 (1 mile * 9.191 grams/mile))= **2.94 Grams**

Gasoline Reductions: 0.1*(0.68 (0.25 miles * 4.892 grams/mile) + 0.27 (0.5 miles * 4.892 grams/mile) + 0.05 (1 mile * 4.892 grams/mile))= **0.17 Grams**

2.94 Grams + 0.17 Grams = 3.11 Grams of NOx per space * 250 spaces = **722.5 Gram reduction in NOx per Night of Parking ~ 263.71 kg per Year**

B. Gaussian Plume Dispersion Modeling to Determine Impact on Property Values

Step 1: Assumptions

1. NOx emission rates of 0.002833 grams/sec for gasoline and 0.015283 grams/sec for diesel and a gas to diesel ratio of 1:9, producing a weighted value of .014 grams/sec.
2. A single emissions source consisting of 200 trucks 0.7 km (2300 feet) from residential neighborhood.
3. Plume stack height of 4.2 meters, approximately the average height of a large truck tractor trailer.
4. Downwind (u) of 4.7 mph (2.1 m/s) at transverse distance (y) of 100m *(30)*.
5. σ_y and σ_z values of 48 m and 29 m based on neutral atmospheric conditions *(29)*.

Step 2: Utilization of Gaussian Equation

Equation 2 is applied with the following values for each variable:

C = Value to be determined as a result of modeling
Q (measured in micrograms) = 0.014 * 10^6 μg/s
U = 2.1 m/s downwind
σ_y & σ_z = 48 m & 29 m respectively
H = 4.2 m

Equation 2 can be broken up & calculated in three parts:

Q/(Π * u * σ_y * σ_z) = (0.014 * 10 ^ 6 μg/s)/(Π * 3.1415 * 2.1 m/s *48 m *24 m) = 5.7895

EXP[(-H^2) / (2 * σ_z^2) = Exp[-(4.2^2 m)/(2 * 24^2 m)] = -0.0153

EXP[-(Y^2) / (2 * σ_y^2)] = Exp [-(100^{2}m)/(2 *48^2 m)] = -2.1701

5.7895 ^ (-0.0153 * -2.1701) = **1.02 μg/m^3 per parking space**

Next, the above figure is multiplied by 200 to get the total emissions experienced .7 km (2300 feet):

1.02 μg/m^3 per parking space * 200 spaces = 20.4 μg/m^3

Lastly, this figure is multiplied by 0.05%, representing the decrease in property values per μg/m^3 of pollution. The final result is the approximate reduction in residential property values closest to the truck stop, based on NOx emissions coming from parked trucks at the proposed site.

20.4 μg/m^3 * 0.05% = **10.2% reduction in property values**

There is a still a significant amount of refinement that could be done to improve the versatility of using Gaussian plume modeling to impacts on property values. For example, it will be important to determine whether or not aggregated totals of all particulate pollutants should be factored into property reductions, or as in the example provided above, simply the values based on a single significant pollutant.

C. Estimated Noise Pollution Impact on Nearby Property Values

Step 1: Assumptions
1. Noise levels adhering to the maximum allowable federal guidelines.
2. A single sound source consisting of 200 trucks 0.7 km (2300 feet) from residential neighborhood.
3. To show the entire methodology, disregard adjacent highways between truck stop and residential areas, which would produce higher dBA levels than truck stop.

Step 2: Estimation of Impacts on Property Values

For the sake of simplicity, Equation 4 can be displayed graphically in order to estimate dBA values by distance. The graphical form of Equation 4 is displayed below in Figure 17:

Figure 17: dBA Values over Distance
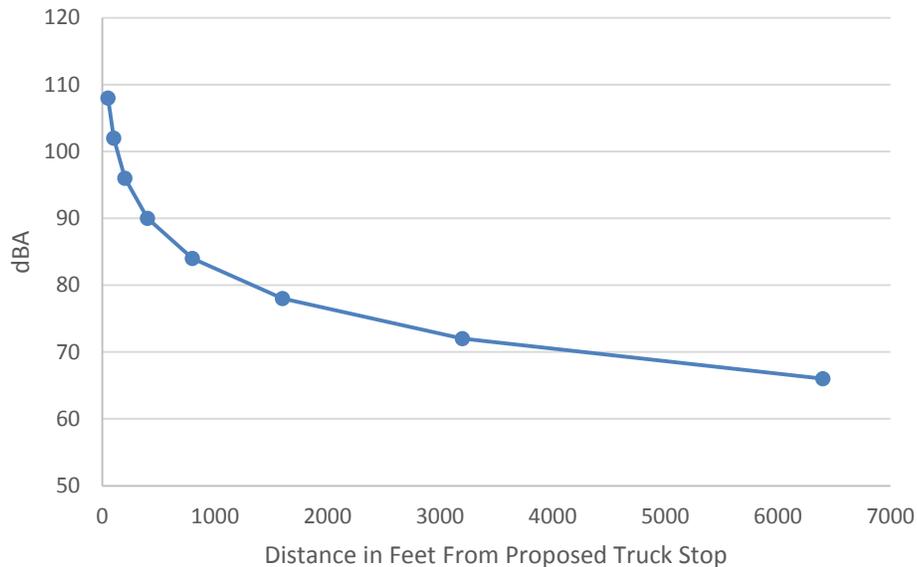
Using Equation 3, at approximately 50 feet from the center of the truck stop, an approximate dBA value of 108 is experienced given the following equation, taking into account a total of 200 trucks:

$$\Delta L = 10 * \log_{10} n \text{ where } n = 200$$

$$\Delta L = 23$$

The ΔL value of 23 is added to 85 dBA, which represents the maximum allowable noise level 50 feet from any truck, yielding a total of about 108 dBA 50 feet from the approximate center of the truck stop. From here, because an official equation has yet to be established for the exponential decay equation produced by Equation 4, the dBA level at 2300 feet can be visually estimated at about 75 dBA.

Step 3: Assessment of Noise Abatement Strategies

As identified in the methodology, every 2.5 dBA increase in noise levels above 55 dBA results in anywhere from 0.2% to 1.2% reduction in property values. Given the characteristics of the Ironbound neighborhood of Newark, a value of 0.5% is appropriate. The % reduction in property values is calculated below:

75 dBA -55 dBA = 20 dBA / 2.5 dBA threshold = 8 increases of 2.5 dBA

8 * 0.5% = **4% reduction in property values without application of noise abatement criteria**

Assuming, the truck stop wasn't separated from the nearby residential neighborhood by a more significant sound source, because the value of 75 dBA experienced is over the 67 dBA NJDOT threshold (See Appendix C), the project is eligible (not guaranteed) for the implementation of sound barriers. If noise abatement criteria were applied resulting in a reduction of 7 dBA, the following would hold true:

68 dBA – 55 dBA = 13 dBA / 2.5 dBA threshold = 5.2 ~ 6 increases of 2.5 dBA

6 * 0.5% = **3% reduction in property values with application of noise abatement criteria**

Safety Impacts

Although a thorough safety methodology has yet to be developed or monetized, preliminary evaluations indicate that the site would be highly effective in reducing accidents and improving trucker safety on the North Jersey region's highways. Located adjacent to the Interstate 95 junction with Interstate 78, the site would add significant parking capacity to the two New Jersey corridors facing the highest parking deficits of 260 spaces (Interstate 78 east of Interstate 287) and 223 spaces (Interstate 95 between Interstate 287 and Interstate 80). While monetization of this analysis has not yet been conducted, this site would likely provide a high value of safety.

Summary

The analyses above detail some of the expected benefits and costs if the Hyatt Avenue truck stop site in Newark is developed. The results are summarized as follows:
- Besides construction and annual maintenance costs, a proposed truck stop at this location is expected to generate $5,546,838 in total taxes annually and reduce greenhouse gases.
- On the other hand, concentrating so many trucks in any one location increases noise and sound pollution in and around the area, potentially resulting in a more than 13% reduction in nearby residential property values.
- While not yet monetized however, the potential safety benefits associated with the site are significant and can be monetized in future studies in order to fully outline both the costs and benefits of this or any site.

5 Research Implementation

One key element in the implementation of the methodology above is the location and characteristics of each parking facility. In order to provide decision makers with a visual, interactive tool to screen existing and emerging truck parking facilities, the Center for Advanced Infrastructure and Transportation (CAIT) at Rutgers University has developed a preliminary web-based mapping system (Figure 18) that contains information on the name, type, address and parking spaces for each truck stop. In the future, the cost-benefit methodology can be implemented on this platform to assess and compare the cost-effectiveness of alternative parking locations under future traffic demands. Ultimately, the further development of this tool will assist transportation agencies in the optimal allocation of resources for improving truck parking facility capacity locally, regionally and nationally.

Figure 18: Snapshot of web-based mapping tool for truck parking facility
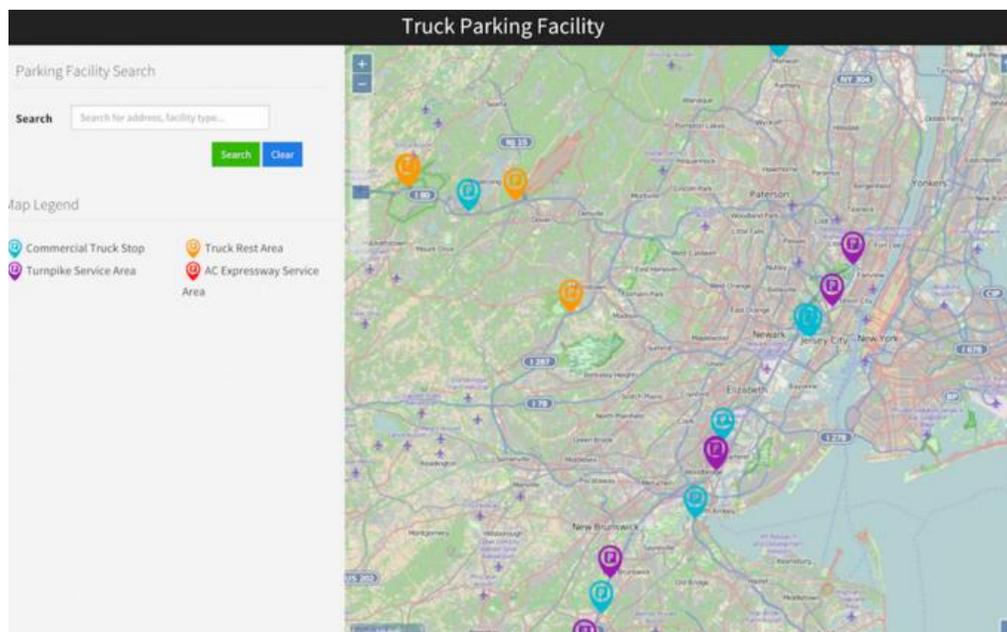
6 Conclusions & Future Research

As part of freight system development, strategic expansion of truck stops can likely not only improve mobility of the freight industry and reduce freight cost, but also boost local and regional employment and revenue opportunities, thereby increasing a region's long-term economic competitiveness. This research presented guidelines for truck parking site selection and outlined some of the major economic, fiscal, environmental and safety factors associated with developing or expanding a truck stop. The result is a new and significant next step beyond what existing literature has focused on. The framework and its application to empirical case studies provide insights to both public (e.g., MPOs) and private agencies into addressing regional parking capacity shortfall and safety concerns. It can potentially aid the sustainable planning and system design of an integrated intermodal freight system, and provide information support in development of future policies.

As the case study finds, certain factors of a truck stop development or expansion are more impactful to society than others. For example, sales tax may be the most lucrative source of revenue to the state government. On the other hand, society appears to directly be affected by noise pollution to a much greater extent than air pollution by means of significantly larger reductions in residential property values. Moving forward, future studies may choose to assign greater weight to one or more of these consequences over others.

There are a number of directions that this research can be improved and extended, most of which have been discussed throughout this report. In terms of methodology, this study made an initial exploration of quantifying the various impacts in a CBA framework, while some cost and benefit factors need to be further studied or incorporated in future research. For example, land permitting cost and economic opportunity cost are important factors in location choice but not elaborated in this study. Also, the safety benefits and costs have to some degree a diversion effect between the highway network and the proximity of a truck stop. Future research should look in depth into this using more advanced statistical models. More importantly, these cannot be done without relevant, sufficient and high quality data. Data collection in all aspects of freight and truck parking operations should be a primary focus for future truck parking research.

The limitations of this methodology however reflect the need for additional research into the truck parking deficit faced by New Jersey and many other states. What this study does not do is provide a strategy or method for increasing the profitability of truck stops as ventures for the private and public sectors. As New Jersey's commercial industrial economy continues to thrive, distribution centers and other similar uses will continue to remain the highest and best uses for the dwindling available industrial space, with truck stops receiving little consideration. Sustainable methods of providing truck parking are possible however and may be achieved by focusing on ways to provide long-term parking at highest and best use sites such as distribution centers and warehouses. Such a strategy will require careful policy development along with strong and sustained cooperation between states and multiple private sector companies.

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Appendix A: Glossary and Default Value of Truck Parking Demand Estimation Model

Table 11: Glossary and Default Value of Truck Parking Estimation Model *(13)*

Model Variable	Description	Default Value
L	Length of Highway segment (km)	(Variable)
AADT	Annual Average Daily Traffic (AADT)	(Variable)
P_t	Percent of daily traffic consisting of commercial trucks	18%
F_s	Seasonal peaking factor	1.15
S	Speed limit of highway or average truck speed (kph)	105 kph (65 mph)
D_{ST}	Short-term parking duration per hour traveled (hour/hour)	0.083*
D_{LT}	Long-term parking duration per hour traveled (hour/hour)	1.725*
P_{RA}	Proportion of demand for rest area spaces	0.23**
P_{TS}	Proportion of demand for truck stop spaces	0.77**
P_{SH}	Proportion of total trucks that are short-haul	0.85 or 0.65
P_{LH}	Proportion of total trucks that are long-haul	0.15 or 0.35***
PPF_{SH}	Percentage of truck that are parked during peak hours	0.01898****
PPF_{LH}	Percentage of truck that are parked during peak hours	0.4****
D_{ST}/stop	Short-term parking average duration per stop (hours/stop)	0.6667 Hour*****
D_{LT}/stop	Long-term parking average duration per stop (hours/stop)	7 Hours*****
V_t	Peak daily truck volume (trucks/day)	AADT x P_t x FS
TT	Average truck travel time (hours/truck)	L / S
THT_{SH}	Daily short-haul truck-hours of travel (hours/day)	PSH x Vt x TT
THT_{LH}	Daily long-haul truck-hours of travel (hours/day)	PLH x Vt x TT
THP_{SH}	Truck-hours of short-haul parking demand	THTSH / 12
THP_{LH}	Truck-hours of long-haul parking demand	Parking time/driving time x THTLH + THTLH / 12
$PHP_{SH, RA}$	Peak-hour short-haul parking demand at rest areas (trucks or spaces/hour)	PRA x PHPSH
$PHP_{SH, TS}$	Peak-hour short-haul parking demand at truck stops (trucks or spaces/hour)	PTS x PHPSH
$PHP_{LH, RA}$	Peak-hour long-haul parking demand at rest areas (trucks or spaces/hour)	PRA x PHPLH
$PHP_{LH, TS}$	Peak-hour long-haul parking demand at truck stops (trucks or spaces/hour)	PTS x PHPLH

Appendix B: Truck Parking Inventory in New Jersey

Table 12: Truck Parking Inventory in New Jersey

Name	Type of Facility	Address	County	Spaces Available
Frank S. Farley Service Plaza	AC Expressway Service Area	AC Expressway MM 21.3 Bi-Directional	Atlantic	15
ACI Truck Stop	Commercial Truck Stop	55 US-46	Hunterdon	25
Clinton Truck Stop	Commercial Truck Stop	16 Route 173 W	Hunterdon	20
Deep Water Truck Stop	Commercial Truck Stop	455 Shell Road (U.S. 130)	Salem	30
Delaware Truck Stop	Commercial Truck Stop	71 US-46	Hunterdon	24
Gas & Diesel	Commercial Truck Stop	54 US-46	Hunterdon	10
Love's Travel Stop	Commercial Truck Stop	2008 Hwy 206 S	Burlington	100
Luke Oil Truck Stop	Commercial Truck Stop	362 Hwy 40	Salem	20
Mahwah Fuel Stop	Commercial Truck Stop	131 Hwy 17 N	Bergen	15
Major Auto Truck Plaza	Commercial Truck Stop	New Jersey 56	Cumberland	10
Major Truck Stop	Commercial Truck Stop	1197 N Main Rd	Cumberland	10
Metro 111	Commercial Truck Stop	2540 Randolph Ave	Middlesex	20
New Jersey Truck Stop	Commercial Truck Stop	1 Hackensack Ave	Hudson	75
Penn/Jersey Truck Stop	Commercial Truck Stop	1400 Hwy 22 E	Warren	15
Petro Plaza	Commercial Truck Stop	472 Hwy 31 N	Hunterdon	7
Pilot Flying J	Commercial Truck Stop	979 State Route 173	Hunterdon	30
Pilot Flying J	Commercial Truck Stop	326 Slapes Corner	Salem	360
Pilot Flying J	Commercial Truck Stop	600 Pennsville-Auburn Road	Salem	25
Pilot Flying J	Commercial Truck Stop	66 State Route 173	Hunterdon	50
Pilot Flying J	Commercial Truck Stop	230 Route 17 South	Bergen	8
Pilot Flying J	Commercial Truck Stop	15 Route 23	Sussex	4
Pilot Flying J	Commercial Truck Stop	1470 US-46	Morris	15

Riggins Truck Stop	Commercial Truck Stop	4133 S Main Rd	Cumberland	15
Sunoco	Commercial Truck Stop	939 Cranbury S River Road	Middlesex	8
Sunoco (Sahib LLC)	Commercial Truck Stop	327 Hawks Bridge Rd	Salem	70
Travel Centers of America	Commercial Truck Stop	975 Route 173	Hunterdon	122
Travel Centers of America	Commercial Truck Stop	402 Rising Sun Square Road	Burlington	490
Travel Centers of America	Commercial Truck Stop	2 Simpson Road	Warren	172
Travel Centers of America	Commercial Truck Stop	171 Berkley Road	Gloucester	175
Tullo Brothers Truck Stop	Commercial Truck Stop	61 Lincoln Highway	Hudson	35
Victory Truck Stop	Commercial Truck Stop	15 Victory Plaza	Middlesex	75
Vineland Truck Stop	Commercial Truck Stop	760 S Harding Hwy	Atlantic	11
Wawa	Commercial Truck Stop	2051 U.S 130	Burlington	6
Truck Rest Area	Truck Rest Area	Interstate 80 MM 21 Westbound	Warren	12
Truck Rest Area	Truck Rest Area	Interstate 80 MM 21 Westbound	Warren	12
Truck Rest Area	Truck Rest Area	Interstate 295 MM 3 Northbound	Salem	35
Truck Rest Area	Truck Rest Area	Interstate 287 MM 32 Northbound	Morris	20
Truck Rest Area	Truck Rest Area	Interstate 80 MM 7 Eastbound	Warren	25
Truck Rest Area	Truck Rest Area	Interstate 80 MM 32 Westbound	Morris	12
Alexander Hamilton	Turnpike Service Area	NJ Turnpike MM 111.6 Southbound	Hudson	30
Clara Barton	Turnpike Service Area	NJ Turnpike MM 5.4 Southbound	Salem	15
Grover Cleveland	Turnpike Service Area	NJ Turnpike MM 92.9 Northbound	Middlesex	75
James Fenimore Cooper	Turnpike Service Area	NJ Turnpike MM 39.4 Northbound	Burlington	50
John Fenwick	Turnpike Service Area	NJ Turnpike MM 5.4 Northbound	Salem	15
Joyce Kilmer	Turnpike Service Area	NJ Turnpike MM 78.7 Northbound	Middlesex	75
Molly Pitcher	Turnpike Service Area	NJ Turnpike MM 71.7 Southbound	Middlesex	100
Richard Stockton	Turnpike Service Area	NJ Turnpike MM 58.7 Southbound	Mercer	50
Thomas Edison	Turnpike Service Area	NJ Turnpike MM 92.9 Southbound	Middlesex	75

Vince Lombardi	Turnpike Service Area	NJ Turnpike MM 116 Bi-directional	Bergen	285
Walt Whitman	Turnpike Service Area	NJ Turnpike MM 30.2 Southbound	Camden	20
Woodrow Wilson	Turnpike Service Area	NJ Turnpike MM 58.7 Northbound	Mercer	30

Appendix C: New Jersey Department of Transportation and New Jersey Turnpike Authority Noise Abatement Criteria

Table 13: Noise Abatement Criteria *(22)*

Activity Category	Leq(h) Activity Criteria*	L10(h) Activity Criteria*	Evaluation Location	Activity Description/Land Use
A	57	60	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67	70	Exterior	Residential
C	67	70	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52	55	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E	72	75	Exterior	Hotels, motels, offices,

				restaurants/bars, and other developed lands, properties or activities not included B-3 in A-D or F.
F	-	-	-	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G	-	-	-	Undeveloped lands that are not permitted

Appendix D: New Jersey County-Level Truck Parking Suitability Analyses

Atlantic County

Although Atlantic County is home to the Atlantic City-Hammonton Metropolitan Statistical area of over 250,000 residents, freight traffic is still limited by the County's location relatively far away from the major thoroughfares of the Northeast Corridor. The area ranks fourth, behind Cape May, for seafood exports in the Northeast at 40.7 million pounds of seafood in 2008. From a trucking perspective however, seafood represents a small portion of goods shipped by truck. In 2007, food commodities represented just 10% of goods shipped by truck, of which, seafood likely comprises a small portion *(35)*. Additionally, as Atlantic City's casino and hospitality industry has greatly been hampered by out-of-state competition, growth in the region is expected to be limited in the next few decades, likely affecting the flow of additional commodities into and out of the area. Like Cape May County, Atlantic County has not historically been considered as in need of additional truck parking and as a result, is not further considered.

Bergen County

Bergen County is located in the northeastern portion of New Jersey and is home to the western terminus of the George Washington Bridge, a major thoroughfare of the Northeast Corridor that carries a wide range of traffic. As with other counties in metropolitan northeastern New Jersey, Bergen County is very dense, with the majority of lands within the County already built out. Furthermore, Bergen County's wealth and developed office use economy present hurdles to developing truck parking at existing businesses on or near the County's major highways.

Located in Ridgefield, in the southern portion of Bergen County however is the Vince Lombardi Service Area of the New Jersey Turnpike/Interstate 95, which was the second of two locations (the first being the Molly Pitcher Service Area in Cranbury Township, Middlesex County) recommended by the NJTPA in their 2008 Truck Rest Stop Study for truck parking development and expansion, based on a number of criteria. Such truck parking expansion would involve converting an existing portion of the existing rest area from automobile to truck-specific parking, increasing such parking by between 100 and 200 spaces. For the purposes of expanding truck parking in the Region, the recommended site proves to be very effective in relieving parking deficits on the Interstate 95 between Interstate 80 and 78, along with the Interstate 80 east of Interstate 287 corridor. Both corridors have some of the highest parking deficits in New Jersey, with adjacent land uses often not conducive to any new sort of development. Additionally, since it is highly unlikely that any additional wetlands in this area of the Meadowlands will be developed, and because the rest area is owned by the New Jersey Turnpike Authority as opposed to a private developer, the reconfiguration of the Vince Lombardi Service Area proves to be an effective strategy for truck parking expansion.

Burlington County

Burlington County is the largest county in New Jersey in terms of area and while much of its southeastern and central areas are predominantly rural, the western (particularly northwestern) portion of the County might represent one of the best places in the entire State of New Jersey to develop additional truck parking. Four significant freight center facilities are located in Burlington County,

including the 1500+ acre Haines Industrial Center in Burlington Township. Additionally, while areas between the New Jersey Turnpike and the Delaware River, bordering Camden County up to Burlington Township are more urbanized there is still a large amount of undeveloped or underdeveloped land within close proximity to the Trenton area.

Burlington County's high conduciveness to additional truck parking stems from two major infrastructure projects affecting New Jersey and Pennsylvania. The New Jersey Turnpike Authority recently completed its widening project, widening the total lanes from 6 to 12, up to the Exit 6-Interstate 276 (Pennsylvania Turnpike) interchange in Mansfield Township, eliminating a notorious bottleneck in Middlesex County and greatly easing truck travel into the area. Most significant might be the planned Interstate 276 – Interstate 95 interchange in Bristol, Bucks County, Pennsylvania and under five miles from the New Jersey border. Under current conditions, there is no direct route for thru traffic between central New Jersey, New York City and points north heading to Philadelphia and vice-versa. When completed, the interchange will be the most direct route into the Philadelphia area via Northeast Philadelphia and Bensalem, Pennsylvania, while eliminating the need to use Routes 38 and 73 via Exit 4 of the New Jersey Turnpike in Camden County or Interstate 195 to US Highway 1 to Interstate 95 via Trenton, both of which contain numerous signal-controlled intersections, or add extraneous miles using Interstates 195, 295 and 76/676. Construction of the interchange is expected to begin in 2017, once design specifications are complete *(36)*.

Analysis of the effects of the new interchange on industrial leasing rates has not yet been completed, but demand along the Interstate 276 corridor will likely further increase, in addition to any increases that may be occurring with the elimination of the New Jersey Turnpike/Interstate 95 bottleneck in Middlesex County. Once completed, Burlington County has the potential to be an even stronger industrial center and will likely be absorbed into the central New Jersey industrial economy, providing direct access to the New York and Philadelphia markets and short proximity to Harrisburg, Pennsylvania and other points south and west.

According to the DVRPC regional truck parking study, Burlington County has a total of 615 truck parking spaces, most of which (490 spaces) are provided by Petro in Bordentown Township. The remaining two are provided by Love's in Bordentown Township (79 spaces) and the James Fenimore Cooper Service Area (46 spaces) of the New Jersey Turnpike in Mount Laurel Township *(5)*. The parking study observed that the Petro stop was at full capacity, and the two remaining truck stops were at 111% and 117% capacity respectively on a random night, indicating an already existing need for truck parking. Additionally, it was revealed that two adjacent rest areas, collectively known as the Howard Stern Rest Stop, serving Interstate 295 north and south between Exits 47-A-B and Exits 52-A-B in Springfield Township was closed in 2008, eliminating possibly up to 50 spaces from the Region *(5)*. This was the only rest area to close in recent times in southern New Jersey, although many states have shuttered rest areas for cost-saving measures.

Moving forward, a public-private partnership used to reopen and possibly expand the Howard Stern Rest Area may represent the best course of action on expanding parking in the area. Infrastructure in the form of entrance and exit ramps and basic facilities have already been established and the site is far enough from any concentrations of residential development that any negative effects (discussed later in the report) would be minimized. The site is also close to the northern Burlington County industrial submarket which includes the Haines Industrial Center. Sites directly next to or near the Haines Industrial Complex and along US Highway 130 may be hard to come by, given existing development throughout most of the area and sensitive uses, including the Florence Township

Memorial High School within close proximity to undeveloped sites. Additional sites of interest that should be explored however include the stretch of land between Interstate 295 and the New Jersey Turnpike along Interstate 295 Exits 45-A-B in Westampton Township, County Route 656 between Interstate 276 and the New Jersey Turnpike along Exits 52-A-B of Interstate 295 in Florence Township and lands near US Highway 206 specifically near the Manheim car auction site in Bordentown Township near Exit 7 of the New Jersey Turnpike.

Camden County

Located just across the Delaware River from Philadelphia, Camden County is a lot more developed than Gloucester County and is considered the economic hub of southern New Jersey. The City of Camden itself is home to the Port of Camden & Gloucester City and 3 significant freight center complexes. Further inland from the Delaware River, Camden County is mostly suburban in character, while extreme southeastern areas of the County that are away from major highways are exurban and rural in character.

Despite a large population and mature economy, Camden County may present limited opportunities for developing effective additional truck parking. The Port of Camden & Gloucester City handles under 10 million tons of cargo annually compared to almost 40 million tons at the Paulsboro Marine Terminal in neighboring Gloucester County. Under the 2011 regional truck parking study, the Walt Whitman Service Area which has a capacity of 31 parking spaces was found to have 28 parked trucks on a random night without any presence of shoulder parking. Although close to capacity, such figures are quite low, both in terms of sheer capacity and capacity utilization, when compared with neighboring portions of New Jersey and Pennsylvania. These figures may be attributed to a freight and industrial economy of Camden County that primarily services Philadelphia and points west and northwest. Such claims are strengthened by access to Pennsylvania via three different bridges and the presence of overcrowding in truck stops in Gloucester and Burlington Counties in New Jersey, as well as in the Linwood, Valley Forge and Yardley areas of Pennsylvania which surround Philadelphia.

Should Camden County be considered as a site of interest to develop truck parking, a feasible site may be directly south of the US Highway 130 and State Highway 73 junction, located in Pennsauken Township, in the extreme northwestern portion of the County. The tract of cleared, paved land is located directly next to the Pennsauken Industrial Park, although it is currently unclear why the land has not been developed as part of the industrial park or for other use. Expansion of parking of the Walt Whitman Service Area on the New Jersey Turnpike in Cherry Hill may be limited as the rest area sits on a narrow strip of land between the New Jersey Turnpike and Interstate 295. The wooded area on the other side of the New Jersey Turnpike is adjacent to numerous residential neighborhoods and a middle school, which could present numerous obstacles preventing development. Although Camden County is a likely driver of regional truck volumes, other locations both in southern New Jersey and southeastern Pennsylvania should be considered for truck parking development.

Cape May County

As the southern tip of New Jersey, thru traffic into Cape May County is limited. On the other hand, Cape May is the third largest fishing port in the entire Northeast, exporting 68.4 million pounds of seafood and is the most sophisticated and diversified fishery in New Jersey. Seafood is primarily processed at a location on Ocean Drive in Cape May before being transported by truck or vessel. Freight traffic is however limited by capacity restraints on the Middle Thorofare Bridge and Channel *(35)*.

Restrictions on trucks throughout most of the Garden State Parkway and lack of access to other key highways and interstates in New Jersey further increases travel costs for shipping goods to the more populated portions of the State and the entire Northeast. Given these capacity and accessibility issues, freight traffic is not expected to increase significantly in Cape May County over the next few decades and because the area has not historically been considered as in need of additional truck parking, especially when compared to other portions of New Jersey, it is not further considered.

Cumberland County

Similar to other adjacent counties in extreme southern New Jersey, infrastructure restraints and lack of access to other major routes limits freight movement demand in Cumberland County. Vineland, a relatively large but spread-out city of just over 60,000 residents in Cumberland County however continues to be a hub for glass production and related products. The County is also home to a large agricultural sector of which production of more perishable commodities is largely dependent on the trucking industry. Perdue, a major producer of poultry products has two grain facilities in Bridgeton, located just south of Vineland and Bordentown, located in Burlington County and comprises almost 40% of grain and feed-related agricultural production, though a lot of which is transported by rail however *(35)*. Given the short distances to the grain and other facilities located within New Jersey, those commodities which are transported by truck do not increase demand for overnight truck parking.

Cumberland County has a few distribution centers in Vineland, Millville and Bridgeton, the three cities in the County and there are plans to construct a new business park just north of Bridgeton. Despite this development, there is only one major highway through Cumberland County (Route 55) which narrows into an undivided roadway just south of the City of Millville as it heads towards Cape May County. Additionally, the Port of Bridgeton, located along the Maurice River which empties into the Delaware Bay, is not in operation and multiple obstacles make it difficult to upgrade the port facility to more modern standards *(35)*. Even with the presence of distribution centers and a sizable agricultural industry, freight movement is not expected to increase substantially in the next few decades. As with other counties in the deep southern portion of New Jersey, Cumberland County has not historically been considered an area in need of additional truck parking and is not further considered.

Essex County

Essex County is home to Port Newark, the third largest port by tonnage in the entire United States and the largest on the east coast. Numerous industrial facilities ranging from manufacturing to distribution centers are located in and around Port Newark and the adjacent Newark Liberty International Airport. Overall Essex County is an extremely large generator of truck traffic likely for the entire Northeast and Mid-Atlantic Regions of the United States and also the reason for the high demand for truck parking on most of northern New Jersey's interstate corridors.

Like most other counties in northeastern New Jersey, there are numerous obstacles that make developing additional truck parking a difficult task in Essex County. With the exception of Fairfield Township in the northwestern portion of the County, most of central and western Essex County, has already been completely built out and is comprised of generally wealthy suburbs and the urban areas of Orange, East Orange, Bloomfield, and Irvington. While there is undeveloped land around Interstate 80 in Fairfield Township, the area consists of wetlands that often flood, most likely preventing any sort of development, not limited to truck parking.

Areas closer to the industrial uses of Newark and eastern Essex County are even denser in terms of both industrial and residential developments. All 10 of the warehousing and distribution facilities larger than 500,000 square feet are located east of the Garden State Parkway in either dense, urban residential areas, or closer to Port Newark and Newark Airport where numerous other industrial facilities are located. Although developable space is very limited however, the NJTPA has identified in their 2009 Phase II Truck Stop Study, a potentially suitable site for truck parking in Newark. The site, located on Hyatt Avenue and about a mile from Port Newark Airport would provide between 200 and 300 truck parking spaces if developed and may be the only feasible location to develop truck parking on the entire Interstate 78 east of Interstate 287 corridor which does not currently contain any truck parking despite having extremely high demand for such amenities. The site is described in more detail later on in this report. It may be possible to examine other sites in this area, although factors such as brownfield mitigation may be of significant issues.

Gloucester County

Located just south of Philadelphia and directly across the Delaware River from the City of Chester, Pennsylvania, Gloucester County is a lot more developed than neighboring southern and eastern counties. There are total of six major distribution center complexes within the County, primarily located along the Interstate 295 corridor. Gloucester County has encouraged industrial growth along the Interstate 295 corridor to further add to its strong logistics and chemical processing industries. The County is home to 4 significant freight center facilities, including the Pureland Industrial Complex, which at over 2600 acres, is the third largest freight center facility in the entire Delaware Valley and the largest in southern New Jersey. Additionally, Gloucester County is experiencing rapid population growth, recording a population increase of 13.2% between 2000 and 2010, compared with a statewide increase of just 4.5% over the same period.

Despite a mature industrial presence and rapidly increasing population, the County still has significant undeveloped land within close proximity to these industrial centers and may contain some of the best sites in the entire State of New Jersey for increasing truck parking. As part of a 2011 regional truck parking study, the 185-space Travel Centers of America Truck Stop, located on Exit 18 of Interstate 295 in Paulsboro, was observed on a random night to have 194 parked trucks, with additional trucks parked on the shoulder of Interstate 295. As these observations show, Gloucester County is need of additional truck parking.

While the northwestern portion of Gloucester County has become more developed, population density and industrial development drops off noticeably southwest of Exit 17 on Interstate 295 in the Paulsboro-Mantua Township areas of the County.   Because Gloucester County is encouraging development along the Interstate 295 exit nodes, vacant, undeveloped or underdeveloped lands adjacent to Exits 16-A-B, 15, 14 and 11 should be examined. An additional corridor of interest would be US Highway 322 between the Commodore Barry Bridge and Exit 3 on the New Jersey Turnpike. This corridor is located within one mile of the Pureland Industrial Complex, and within three miles of either Interstate 295 or Exit 3 on a portion of the New Jersey Turnpike conducive to longer-distance travel as interchanges are widely scattered.

Hudson County

The western terminus of the Lincoln and Holland Tunnels, Hudson County is the smallest county in New Jersey in terms of area, but also the densest. Additionally, Hudson County is home to the second

highest number of warehousing and distribution center facilities greater than 500,000 square feet (19 compared to 47 for Middlesex County). The strong industrial economy, combined with the presence of the Port Jersey Multimodal Terminal located in Bayonne, make Hudson County a major driver of freight traffic and also the reason each interstate corridor that passes through Hudson County has a significant shortage of truck parking.

There are significant obstacles that make developing or expanding truck parking in Hudson County a challenging uptake. First, Hudson County's density rivals that of New York City in many locations. Even areas near the Port Jersey Marine Terminal have already been fully urbanized, with very little tracts of developable land remaining. Second and equally as significant, are the obstacles that come with developing on brownfield sites. Geographically, the South Kearny Industrial Area, already home to a number of truck stops, serves as an effective place for truck parking given its close proximity to the New Jersey Turnpike/Interstate 95, Port Newark and large distance to any existing residential uses.

Unique to Hudson County and a few other areas of New Jersey however is the presence of businesses aimed at providing service directly to truckers. This can be seen along much of the length of US Highway 1-9 in North Bergen Township, Jersey City and Kearny and takes the form of motels, auto-mechanics and eateries aimed at such drivers. Although most of these are small businesses that only provide parking to a few trucks each, an effective regional approach to determining how much additional truck parking is needed to further assemble these locations into an accessible database recognizing both large and small truck parking provided by both the private and public sectors.

Hunterdon County

Hunterdon County is a sparsely developed, exurban county located about 15 miles north of Trenton and about 45 miles from New York City. Likely the case of strong zoning guidelines at the municipal level, Hunterdon County is one of the most affluent counties in the entire United States, with a median income around $100,000. The County is home to 1 distribution center larger than 500,000 square feet located in Lebanon Township, just off Exit 20 on Interstate 78. Beyond that however, Hunterdon County generates very little freight traffic when compared to other parts of northern New Jersey.

Looking forward to 2040, Hunterdon County is expected to carry a maximum total of about 9,600 trucks per day, specifically on Interstate 78, although this figure is much smaller than for Interstate 78 in Warren and Somerset Counties where peak daily truck traffic is expected to reach 19,000 and 16,000 vehicles respectively. Additionally, the County falls entirely within the Interstate 78 west of Interstate 287 corridor which supposedly has a surplus of truck parking. On the other hand however, Hunterdon County is within close proximity (within 5 five miles at its closest) to Interstate 287 which is experiencing a deficit parking throughout its entire length within New Jersey. Assuming some of the deficits are brought about by truck travel that occurs on Interstate 78 through Hunterdon County, it may be wise to consider options for truck parking development in the area, possibly through another expansion of the Pilot Travel Center in Union Township, located just off Exit 12 on Interstate 78. Because a recent (scaled-back from 200 spaces to 54) expansion just occurred at this site, with noted backlash from Union Township residents however, any additional expansions will be difficult and it may make sense to instead examine other areas along Interstate 78, or US Highway 22 and State Highway 173 which parallel the Interstate, or other areas in counties with overall higher truck parking demands all together.

Mercer County

Home to the City of Trenton, New Jersey's state capital, Mercer County is also located approximately halfway between New York City and Philadelphia. The northern portion of the County, specifically north and west of Princeton is exurban and rural in character while the central and southern portions of the County, specifically closer to Trenton are much more urbanized. Mercer County presents a rather complex scenario for the truck parking situation. On the one hand, Mercer County is situated next to major industrial markets in Middlesex and Burlington Counties. The County however does not appear to have as strong of industrial centers as these two counties but rather contains more clusters of residential and office uses.

Mercer County is home to one major freight center just off Exit 7 on Interstate 195 and adjacent to Exit 7A of Interstate 95/New Jersey Turnpike in Robbinsville Township. The two remaining intermediate freight centers are located on the Trenton/Lawrenceville Township border and on-site of the Trenton-Mercer Airport along Interstate 295 in Ewing Township. The two intermediate sites are primarily surrounded by denser residential and other uses not necessarily suitable to a new truck stop. At the same time, the Robbinsville Township major freight center's location presents its own challenges. The area is home to numerous residential sub developments on former farmland, while other tracts of land have either been preserved, still exist as fully functional farms, or consist heavily forested areas.

Despite these challenges, there does appear to be strong demand for additional overnight truck parking. The DVRPC's 2011 regional truck parking study found that the Woodrow Wilson and Richard Stockton Service Areas on the New Jersey Turnpike, south of Interstate 195 in Hamilton Township, which each serve one direction of thru traffic had 128 total overnight parked trucks despite a capacity of 84. This capacity utilization rate of 152% was the highest observed in the New Jersey portion of the Delaware Valley and the third highest in the entire Delaware Valley behind the Yardley Welcome Center in Yardley, Pennsylvania (200%) and Valley Forge Service Area in Wayne, Pennsylvania (667%) *(5)*. It should be noted however that both are quite small in size (under 10 spaces) and the Valley Forge Service Area has since closed.

Although Mercer County's high demand might be indicative of a dearth of truck parking in nearby counties, there would be strong incentive to locate parking within the County to help alleviate demand in both the Delaware Valley and the New York City area. Both New Jersey Turnpike service areas are located in low density or under/undeveloped areas that could be acquired through a public-private partnership to expand truck parking. Additional lands on the northern fringe of the Robbinsville Township major freight center may be considered, although such land is both further from New Jersey Turnpike access and appears to consist of fully-functioning farms. Lands to the east of the major freight center and along Interstate 195 are focused on in the analysis of Monmouth County.

Land along US Highways 1 and 130 and State Highway 33 (adjacent to Exit 8 of the New Jersey Turnpike/Interstate 95) may not provide as much opportunity to develop a truck stop however. US Highway 130 and State Route 33 consist primarily of retail and residential uses, where a truck stop would not necessarily be suited. Although more commercialized, US Highway 1 is home to the Princeton and West Windsor area office submarket, which is one of the strongest within the State of New Jersey. Currently, there is no truck parking along Interstate 295 through Mercer County, which forms the outer belt of Trenton while providing access to the Trenton-Mercer Airport. The DVRPC has not placed focus on analyzing truck parking demand on the corridor, although truck stop development potential may

already be limited by a large presence of office and residential uses not necessarily conducive to the trucking industry.

Middlesex County

Middlesex County contains one of the strongest industrial and warehousing economies in the entire United States, given its close proximity to New York City and Port Newark, Philadelphia and its location in the heart of the Northeast Corridor transportation network. As Figure 11 shows, Middlesex County has by far the most large warehousing and distribution centers (500,000 square feet +) of any county in New Jersey. The rise in Middlesex County's industrial economy can be seen along the major corridors of the New Jersey Turnpike/Interstate 95 and Interstate 287 and the junction between the two highways in Edison Township is the site of one of the state's largest cluster of such uses.

In addition to Edison Township, large clusters of warehousing and distribution facilities can be found just off of Exit 8 on the New Jersey Turnpike/Interstate 95 in Cranbury and South Brunswick Township.   The area is also home to the Molly Pitcher Service Area of the New Jersey Turnpike/Interstate 95 in Cranbury Township which has been identified by the NJTPA as a specific site of interest for expanding truck parking. Immediately adjacent to the rest area is a large swath of land that as of 2008 was currently being used as agricultural lands but had recently been rezoned as industrial land and still remains undeveloped as of 2015. According to the NJTPA, a public-private partnership could be used to allow for additional truck parking on the site, more than doubling the amount of available to anywhere from 300 to 450 spaces. Given a current deficit of approximately 172 spaces on the New Jersey Turnpike/Interstate 95 south of Interstate 287 corridor, such a project would go an extremely long way to adequately addressing truck parking needs on what is likely the busiest freight corridor in the entire United States.

Although there may be additional sites within close proximity to both industrial uses and thru corridors that would be suitable to truck parking in Middlesex County, no other sites provide direct access to existing truck parking infrastructure and amenities. Although the Thomas Edison Service Area of the New Jersey Turnpike/Interstate 95 is located in Woodbridge Township, approximately 22 miles north of the Molly Pitcher Service Area, there is little developable space adjacent to the facility. For these reasons, the NJTPA's public-private partnership strategy on the lands adjacent to the Molly Pitcher Service Area represents the best strategy for truck parking development in the vital Middlesex County industrial submarket.

Monmouth County

Located north of Ocean County and closer to New York City, Monmouth County is more urbanized than its neighbor to the south. Likely due to the presence of manufacturing along the Route 35 corridor in Aberdeen Township, Matawan and Keyport, the Route 18/US Highway 9 corridor between Monmouth County and Middlesex County has been identified by the NJTPA as a corridor in need of truck parking. This portion of northern Monmouth County presents certain obstacles to developing truck parking, including the presence of sensitive wetlands and a large presence of developed suburban areas. Given that the corridor has an estimated demand of only 17 spaces, such parking deficits may be filled effectively by expanding parking options in nearby locations. Like Ocean County, none of the warehousing or distribution centers located in Monmouth County fulfill out-of-state demand, meaning the need for overnight truck parking is likely limited.

On the other hand, the western portion of Monmouth County, along Interstate 195 in Upper Freehold Township may present one of the best locations in the entire state for placing truck parking. While this area of Monmouth County is sparsely populated and does not have much of an industrial economy, Upper Freehold Township borders Robbinsville Township of Mercer County which is home to a major freight center. In fact, Upper Freehold Township can be accessed on Interstate 195 one mile east of the New Jersey Turnpike via Exit 8, which also provides access to the freight center. Unlike to the west of the New Jersey Turnpike, there still appear to be tracts of undeveloped or underdeveloped cleared land which could be used to develop additional truck parking for the Middlesex and Mercer County warehousing and distribution centers. Should this be the case, western Monmouth County could see a major increase in truck traffic, particularly along Interstate 195, which has not yet been considered by the NJTPA. At the same time however, such attempts to expand the industrial economy of Upper Freehold Township could of course be limited by municipal level zoning efforts maintained by the western Monmouth County municipality.

Morris County

Morris County is one of the larger counties in northern New Jersey in terms of area. Located in the center of northern New Jersey, areas in and around the major corridor highways of the County tend to be significantly more developed while areas further away tend to be rural or exurban in character. Approximately 22 miles of Interstate 287, the major outer-belt of New York City passes through Morris County. The truck parking demand in Morris County can be interpreted in multiple ways. On the one hand, Interstate 287 both north and south of the junction with Interstate 80 in Parsippany-Troy Hills Township has a significant demand for truck parking. The same can be said for Interstate 80 east of Interstate 287. West of Interstate 287 however, demand drops off considerably and there appears to be actually be surplus of parking, as described in the *Warren County* section.

Despite the range of demands experienced in Morris County, there may be notable challenges faced in developing truck parking in the area. Although it would be possible to mitigate demand on the Interstate 287 and Interstate 80 east of Interstate 287 by placing additional parking within a few miles west of the junction, Morris County's urbanized development patterns around such corridors, even further west where overall residential densities drop off, make this a challenging feat. Similar issues exist on US Highway 46 and State Highway 10, both of which parallel Interstate 80 throughout much of the County.

While relatively little opportunity exists to expand truck parking in Morris County, an important action that could be taken by the New Jersey Department of Transportation is to revitalize and reopen the facilities in the Harding Rest area on Interstate 287 in Harding Township. Although the rest area is still open for parking, conditions in the rest area have deteriorated since the 2006 closure, with graffiti-ridden portable toilets and overflowing trash cans a common site. Given the challenges associated with upgrading the existing facilities alone, along with the wealthy neighborhood that the rest area is located within (Harding Township's median income is approximately $170,000 *(34)*), efforts to expand parking at the Harding Rest Area would likely fail. According to the NJTPA's 2008 Truck Stop Study however, in addition to parking capacity constraints, safety was the second most pressing factor in relation to existing truck parking locations *(4)*. Given the conditions at the Harding Rest Area, this is likely to be of significant issue here and revitalizing the rest area could go a long way at easing New Jersey's truck parking issues.

Ocean County

Although Ocean County is primarily located in the southern portion of New Jersey, the presence of the Garden State Parkway, extreme southern suburbs of New York City (Lakewood, Toms River etc.) and weak connections to southwestern New Jersey and the Philadelphia area are likely reasons that the County falls under the jurisdiction of the North Jersey Transportation Planning Authority rather than the Delaware Valley Regional Planning Commission or South Jersey Transportation Planning Organization. With the exception of the coastline and areas bordering Monmouth County, Ocean County is quite rural and isolated in character. As the NJTPA's 2040 Freight Forecast for Ocean County depicts, freight activity in the County is limited, especially when compared with other counties in New Jersey. The maximum projected highway truck traffic is expected to be about 4000 vehicles, specifically through Jackson Township, and there are currently no warehouses or distribution centers larger than 500,000 square feet. Additionally, location-wise, Ocean County is located at least 10 miles from the New Jersey Turnpike/Interstate 95 corridor and even further from most centers of population, making it an unlikely location for warehousing and distribution growth. Perhaps most important however is that all freight that passes through Ocean County remains within New Jersey, meaning there is little, if any presence of intra-state truck travel that would require parking accommodations. As a result, Ocean County is not further considered.

Passaic County

Passaic County is a uniquely shaped county in northern New Jersey that can be divided into different sections. The northwestern portion of Passaic County, north and west of Interstate 287 is actually quite rural in character, primarily due to a steeper topography as well as a longer distance to New York City. Although still a divided highway through West Milford Township in northwestern Passaic County, State Highway 23 narrows into a two-lane, undivided roadway further northwest in Sussex County and does not carry very many intrastate truck traffic. Additionally, being the site of the Newark Watershed, most of the area is actually not available for any sort of development.

Southeastern Passaic County presents a major contrast however. Home to Paterson, New Jersey's third largest city, the area south and east of Interstate 287 is a lot more built up. Interstate 80 east of Interstate 287, which is expected to carry over 14,000 trucks per day by 2040 through the County passes through southeastern Passaic County, along with State Highway 3 and US Highway 46 which carry additional significant numbers of traffic directly to and from the Lincoln Tunnel and George Washington Bridge. Although there is an approximate deficit of 95 parking spaces on this corridor of Interstate 80, southeastern Passaic County's high population density greatly reduces the feasibility of developing any additional truck parking in the area. Almost all lands adjacent or within close proximity to the area's major highways have already been completely built out, whether through residential, commercial or industrial uses. If truck parking is to be expanded within Passaic County, the likely only feasible course of action would be to develop a partnership with an existing business that is in ownership of a large swath parking that may not always be fully utilized. Such efforts however will however have to be done in conjunction with the individual municipality as well given the introduction of additional trucks to the area.

Salem County

Salem County is located in the extreme southwestern section of New Jersey and serves as the terminus of the New Jersey Turnpike and the Delaware Memorial Bridge. Given the configuration of Interstate 95 in central New Jersey and north of Philadelphia, thru vehicular traffic heading from New

Jersey, New York and points north towards Delaware, Baltimore, Washington DC and other points south and southwest will likely transverse through Salem County, making it a potential hub for freight movement. Despite its location and somewhat close proximity to Philadelphia, Salem County has largely remained agricultural.

Salem County does however have some freight assets, most notably the Port of Salem, which handles a variety of cargo ranging from consumer goods and apparel to motor vehicles. Railroads leading to the port are in poor condition however and the Port's location in Salem, about 15 miles away from any highways makes truck accessibility another issue hindering future growth. Truck parking in the form of a Flying J Travel Center is located at the junction of Interstate 295 and the New Jersey Turnpike, approximately half a mile from the Delaware Memorial Bridge. Additional truck parking is located at the smaller Clara Barton Service Area, about 10 miles northeast on the New Jersey Turnpike.

Because SJTPO has not conducted any studies on truck parking so it is difficult to determine if the current supply of parking in Salem County adequately addresses demand. Within Salem County itself, infrastructure constraints appear to hinder freight movement growth in the southern portions of the County. Closer to Gloucester County and Philadelphia however, Salem County may see an increase in the presence of warehouses and distribution centers which would likely add to regional truck parking demand. In Oldmans Township, located along the Gloucester County border, the Gateway Business Park was recently opened, adding 3.6 million square feet of warehousing, manufacturing and distribution space. Although other portions of New Jersey are experiencing a greater demand for truck parking, an effective strategy may be to focus site planning on areas along the US Highway 130 and Interstate 295 north-south corridors of Salem County which have remained largely undeveloped, in anticipation that the industrial growth experienced in Gloucester County will further extend south.

Somerset County

In terms of geographic location and development patterns, Somerset County is relatively similar to Morris County in that areas closer to the major thoroughfares (Interstates 78 and 287 and US Highways 22 and 202 and 206) tend to be more developed. More of a constraint in Somerset County however is an increased presence of protected lands, especially around Interstate 78. As described in the *Union County* section, Interstate 78 east of Interstate 287 does not contain a single rest area or truck parking amenity. Although the corridor transverses Somerset County for approximately 12 miles, many adjacent tracts of open space in Warren, Bernards and Bridgewater Townships have been converted into municipal and county conservation areas, thus further reducing the feasibility of developing around such locations.

There may however be opportunities for truck parking along a seemingly vacant tract of land on Meister Avenue, parallel to US Highway 22 in Branchburg Township. The area, just south of US Highway 22 and near the border with Hunterdon County is primarily industrial in character, containing facilities such as a FedEx Ship Center. Although a few miles southwest of the junction of the Interstate 78 and Interstate 287 junction, the site is one of the few open tracts of land in wealthy Somerset County and north-central New Jersey that is both far away from residential areas and adjacent to truck traffic generating facilities. Given the strong dearth of available land further east along US Highway 22 (and Interstate 287) this site should further be investigated as a potential source of parking.

Sussex County

Sussex County is the northernmost county in New Jersey, bordering Pike County, Pennsylvania to the northwest and Orange County, New York to the northeast. Given its relatively far distance to New York City and a rougher terrain within the Appalachian Mountains, Sussex County for the most part has remained fairly undeveloped, especially in relation to most other northern New Jersey counties. Of all NJTPA counties, Sussex County had the least amount of warehousing and distribution centers and was one of only three counties (Ocean & Warren Counties being the other) to not contain any such facilities larger than 500,000 square feet.

Interstate 80 briefly transverses one mile through Sussex County in its southern tip through Byram Township and is projected to carry approximately 9,000 trucks per day by 2040. This particular section of Interstate 80 however is heavily wooded and presents a topography not conducive to any sort of truck parking. Additional limited access thru highways are greatly limited with the exceptions of portions of State Routes 15 and 23, although these particular routes carry more local than thru traffic. Before crossing the Delaware River into Pennsylvania, Interstate 84 briefly comes within a few feet of Sussex County's (and New Jersey's) northern tip of Montague Township and is slated to also carry approximately 9,000 trucks per day by 2040. Again however, a challenging topography in the area greatly limits the feasibility of placing any truck parking in the area and better opportunities (if needed) may exist across the Delaware River along US Highway 209 in Matamoras, Pennsylvania.

Besides these factors, Sussex County's distance to other metropolitan areas makes it an unlike location to see any significant increases in freight traffic. At its closest point, Sussex County is still over 50 miles from the Scranton and Wilkes-Barre areas, and although Orange County, New York is seeing significant increases in population, this is concentrated closer to Middletown, Newburgh and Harriman which are all at the very least, 20 miles away from Sussex County. Additionally, Orange County is currently seeing a rise in the amount of warehousing and distribution space, particularly in the "Golden Triangle" of highways formed by Interstates 84 and 87, along with NY State Highway 17 (Future Interstate 86). Such distribution centers will likely handle freight from regions such as Scranton, Albany and Binghamton, thus satisfying most freight and warehousing demands in the northwest portion of the New York City Metropolitan Areas. For these reasons, Sussex County is not considered.

Union County

Union County is very similar to Essex County in terms of development patterns, where the western portion of the County is comprised of wealthy suburbs while the eastern portion of the County is more urban and lower income in character. The extreme northeastern portion of Union County, within Elizabeth, is comprised of the southern half of both Newark Airport and Port Newark, making this area a strong driver of truck traffic into and out of the area. As the western terminus of the Goethals Bridge, Union County also serves as a major thru point for vehicular traffic bound for Brooklyn, Queens and other points east.

Like Essex County, there are significant obstacles that exist in terms of truck parking development in Union County. Almost half of the length of the Interstate 78 east of Interstate 287 corridor, which has the highest demand for truck parking, (an estimated 520 spaces, with 0 spaces currently being provided) passes through Union County *(4)*. Despite this being the case, there is little opportunity for truck parking along the corridor. East of the State Highway 24 split in Springfield Township and through Union and Hillside Townships, Intestate 78 cuts through extremely denser inner-ring suburban and urban neighborhoods with very little in the ways of developable space. West of the

split and through Summit and Berkeley Heights Township, although densities taper off, Interstate 78 winds through the foothills of the Watchung Mountains which are not at all conducive to truck parking development. Paralleling Interstate 78 is US Highway 22, a semi-limited access highway, which follows a similar route to the controlled access interstate, carries much of the same issues, passing through Hillside Township, Union Township, Mountainside and Scotch Plains Township.

Similar to Hudson County however, numerous businesses along US Highway 1-9 through Elizabeth, Linden and Rahway provide amenities specifically geared towards truckers. Despite being small businesses which each provide only small amounts of overnight parking, such businesses, including mechanics, fuel stations and motels should be identified and assembled into the same databases that have assembled parking provided by official truck stops in one location. Doing so will present opportunities for both the public sector and these very businesses themselves.

An additional strategy for developing truck parking in Union County may also be to examine the former site of General Motor's facility, located on US Highway 1-9 and across from Linden Airport in Linden. The site which has already been cleared of debris, is to be developed into industrial warehousing and distribution space by Duke Realty, a large commercial real estate developer. In marketing this location on their website, Duke Realty boasts that the site (to be called the Legacy Commerce Center) will have abundant trailer parking *(39)*. Given that construction has not yet begun as of 2015, this site may be an excellent opportunity to develop a public-private partnership in which a portion of this site could be dedicated to overnight truck parking. Located within five miles of Port Newark and Newark Airport, this site would be of extreme value to mitigating parking demand along the State's interstate corridors. Given the pace of industrial construction in New Jersey however, such a decision to form a public-private partnership should be made sooner rather than later.

Warren County

Located in northwestern New Jersey, Warren County is located about 50 miles west of New York City. Given its location within the Appalachian Mounty, most of Warren County has remained fairly undeveloped, with the exception of the Hackettstown area in the north and the Phillipsburg area of the Lehigh Valley in the south. Warren County generates very little freight traffic and according to the NJTPA's 2008 Truck Rest Stop Study, Interstates 78 and 80 to the west of Interstate 287 which both transverse the County, appear to actually have a large surplus of truck parking. Truck parking along the Interstate 80 west of Interstate 287 corridor is provided primarily by the Travel Centers of America truck stop in Columbia (Knowltown Township) which contains approximately 190 available spaces. The Interstate 78 west of Interstate 287 corridor is served primarily by the Travel Centers of America truck stop in Bloomsbury which provides approximately 122 of such spaces *(18)*.

Despite these factors, it may still be important to consider Warren County as a location for additional truck parking. Although Interstate 80 beyond Warren County and New Jersey remains fairly rural, Interstate 78 beyond Warren County and New Jersey enters the Lehigh Valley urbanized areas of Easton, Bethlehem and Allentown. According to the Lehigh Valley Planning Commission, the area (Lehigh and Northampton Counties in Pennsylvania, but not including Warren County) is expected to grow by a significant 32% between 2000 and 2030 *(38)*. Furthermore, although the Lehigh Valley has experienced recent growth in warehousing and distribution centers primarily in the less populated western portion of the area (to the west of Allentown and at least 20 miles from Phillipsburg and Warren County), the significance of the New York-Allentown-Harrisburg corridor and the lack of available space closer to Newark and New York City make it wise to consider additional parking in

Warren County. This may be factored in to the NJTPA's County Freight Profiles which estimate daily truck traffic levels to reach 19,000 on Interstate 78 through the County. Locations along Exits 3, 4 and 6 of Interstate 78 in Greenwich and Pohatcong Townships may be considered, but such decisions should be done in conjunction with the Lehigh Valley Planning Commission.