North Carolina Statewide Multimodal Freight Plan

Truck Parking Study

prepared for

North Carolina
Department of Transportation

prepared by

Cambridge Systematics, Inc.

with

American Transportation
Research Institute

CAMBRIDGE SYSTEMATICS

January 2017

report

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List of Acronyms

AASHTO	American Association of State Highway and Transportation Officials
AOBRD	Automatic onboard recording devices
ATRI	American Transportation Research Institute
CCTV	Closed circuit television
CMV	Commercial motor vehicle
CS	Cambridge Systematics
CVISN	Commercial Vehicle Information Systems and Networks
DE	North Carolina Division Engineer
DMS	Dynamic message sign
DOC	North Carolina Department of Commerce
DOT	Department of Transportation
ELD	Electronic logging device
FAST	Fixing America's Surface Transportation Act
FASTLANE	Fostering Advancements in Shipping and Transportation for the Long-term Achievement of National Efficiencies Grant Program
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
GPS	Global positioning systems
HOS	Hours of Service
HVAC	Heating, ventilation and air conditioning
IFTA	International Fuel Tax Agreement
IRP	International Registration Program
ITD	Innovative Technology Deployment
ITRE	North Carolina State University Institute for Transportation, Research and Education
ITS	Intelligent transportation systems
LPR	License plate readers
MAFC	Mid-America Freight Coalition
MAP-21	Moving Ahead for Progress in the 21st Century
MCSAP	Motor Carrier Safety Assistance Program
MPO	Metropolitan Planning Organization
MVFC	Mississippi Valley Freight Coalition

NCDOT	North Carolina Department of Transportation
NCHRP	National Cooperative Highway Research Program
NCTA	North Carolina Trucking Association
NHS	National Highway System
NJTPA	North Jersey Transportation Planning Authority
NYMTC	New York Metropolitan Transportation Council
O-O	Owner-operator
OOIDA	Owner Operator Independent Drivers Association
OS/OW	Oversize overweight
P3	Public-private partnership
REU	NCDOT Roadside Environmental Unit
ROW	Right of way
RPO	Rural Planning Organization
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SHP	North Carolina State Highway Patrol
STC	North Carolina Strategic Transportation Corridor
STI	Strategic Transportation Initiative
STIP	Statewide Transportation Improvement Program
TPIMS	Truck parking information management system
US DOT	United States Department of Transportation
VMS	Variable message sign
WIM	Weigh-in-motion

Executive Summary

Truck parking has become an increasingly serious concern for truck drivers, motor carriers, truck facility operators and public officials throughout the United States. According to a recent report, "Critical Issues in the Trucking Industry" (ATRI, 2016), truck parking is the third highest ranked issue in 2016 among truck driver respondents. Commercial drivers seeking to comply with the Federal Motor Carrier Safety Administration's Hours of Service (HOS) regulations may be forced to park illegally when legal parking is either not available, or the location of available parking is not known. Improving truck parking in strategic locations will help to make conditions safer for truck drivers and other travelers, reduce unnecessary fuel consumption, and improve the efficiency of commercial vehicle operations. In response to increasing concerns regarding unauthorized truck parking, the North Carolina Department of Transportation (NCDOT) undertook a statewide truck parking study.

The purpose of the study is to conduct an analysis of the adequacy of off-road truck parking in the State of North Carolina and provide truck parking solutions that better serve freight transportation providers and provide a safer environment for the traveling public in and through North Carolina. To accomplish this goal, the study's key tasks include the following activities:

- Inventory truck parking facilities along the state's key freight routes;
- Assess demand for truck parking;
- Analyze what actions will provide the greatest impact on traffic safety;
- Assess the best way to optimize public and private sector assets for truck parking;
- Identify public-private partnerships that may lead to increased truck parking;
- Identify technology enhancements and solutions to increase parking utilization; and
- Identify the costs and funding sources for increasing capacity of existing public truck parking facilities as well as converting existing rest areas, weigh stations and other assets to truck parking.

Major Trends Driving Truck Parking Demand

Regulatory changes. Strong support for highway construction and expansion across the country over the past 50 years coupled with deregulation of the trucking industry with the Federal Motor Carrier Act of 1980, has promoted the growth of trucking as the dominant mode of freight transport in the U.S. However, important safety regulations in effect today, including limitations on the number of daily and weekly hours that drivers can operate a truck, have had strong and widespread influences on when and where drivers choose to stop to rest.

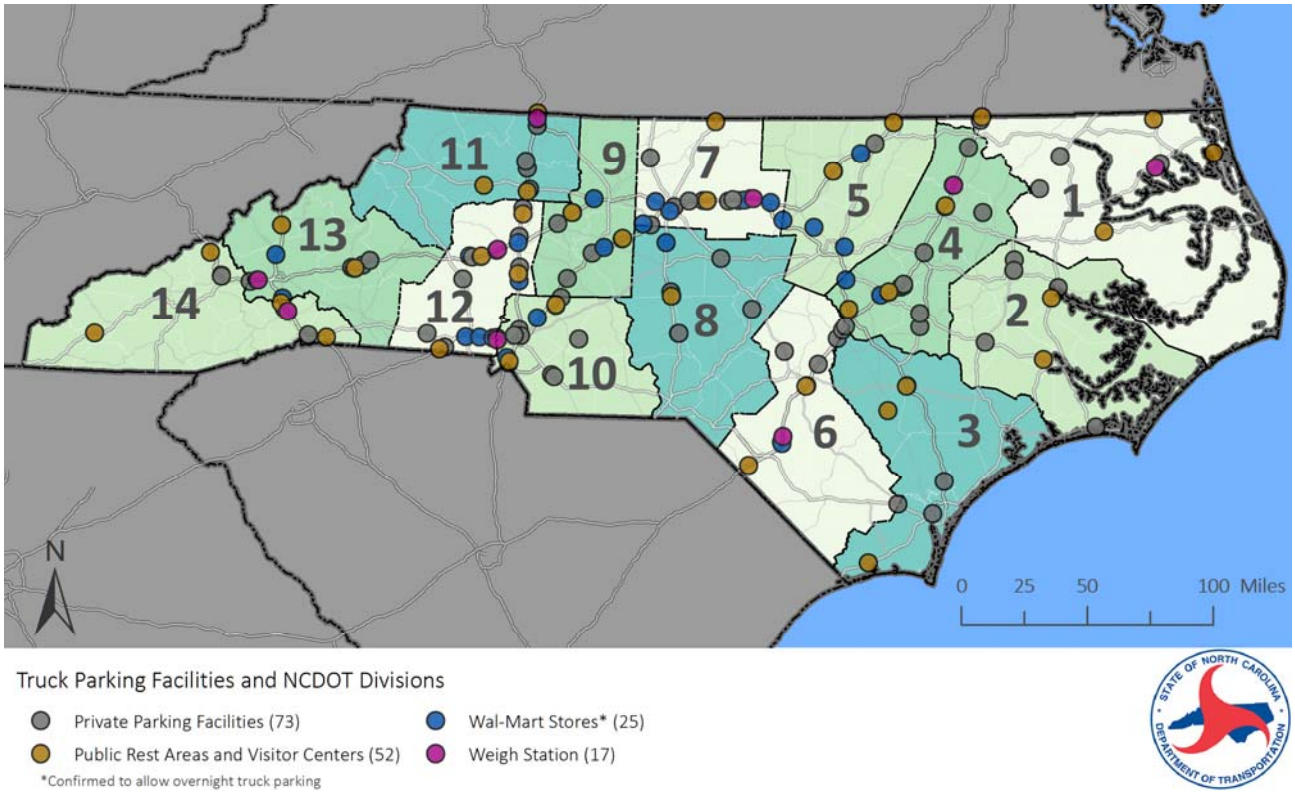
Population and economic growth. Population growth and the accompanying increase in demand for goods and services in North Carolina have contributed to the number of trucks driving to, from, and within the state.

Changes in the way goods move through the region. In response to structural changes in the North Carolina economy as well as that of the nation and the rest of the world, manufacturers and retailers today rely less on inventory and more on efficient supply chains to run lean, "just-in-time" production and distribution operations.

Existing and Future Capacity

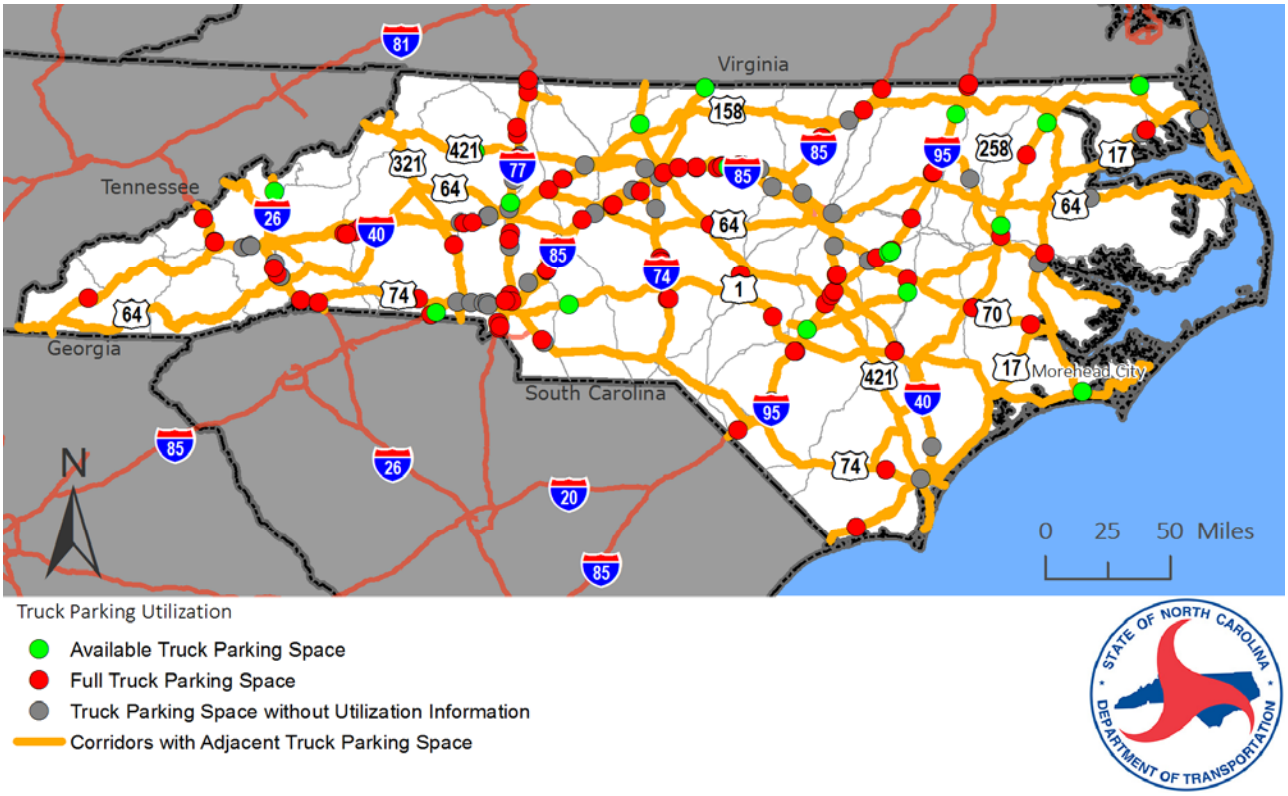
Today, the demand for truck parking in North Carolina exceeds capacity, which will likely persist for the next 5 to 10 years given future freight flows projected by the U.S. Department of Transportation (US DOT). The inventory of truck parking facilities in North Carolina, displayed in Figure E.1, consists of 167 parking facilities supplying nearly 4,800 parking spaces throughout the state. Approximately 59 percent of these facilities are private and 41 percent are public; however, about 85 percent of the truck parking spaces are private. The demand for truck parking was derived from three sources- stakeholder input, truck GPS data and utilization surveys. Figure E.2 displays truck parking utilization in North Carolina. The data indicate that parking facilities along I-26, I-77, I-85 and most of I-95 are at capacity for truck parking, and should be targeted for additional parking facilities or expansion of existing facilities. Additionally, truck driver survey respondents noted that parking demand is high statewide, not just in one geographical area or corridor.

Figure E.1 Public and Private Truck Parking Locations by NCDOT Division



Source: NCDOT and Consultant analysis

Figure E.2 Truck Parking Utilization in North Carolina



Source: NCDOT and CS analysis based on stakeholder interviews

Legislation Affecting Truck Parking

The Federal-Aid Highway Act of 1956, also known as the National Interstate and Defense Highways Act, established the interstate highway system and was the largest public works project in U.S. history. The Act also defined rest areas as places for driver safety and convenience, acknowledging that opportunities to exit the highway would be infrequent in rural parts of the country. A 1958 policy by the American Association of State Highway Officials (AASHTO) specified that drivers should encounter rest areas approximately every half hour while driving. This policy also outlined detailed standards for the design and placement of rest areas throughout the national interstate highway system. Since that time, private parking facilities, hotels, restaurants and other roadside amenities have been developed throughout the United States.[1]

Today, several major federal and state policies affect truck parking in North Carolina. At the federal level, the requirements of Jason's Law include an evaluation of each state's capability to provide adequate parking and rest facilities for commercial motor vehicles (CMVs), address the volume of CMV traffic in each state and develop a method to measure the adequacy of CMV parking in each state. This study address several components of Jason's Law by identifying truck routes and volumes in North Carolina.

[1] Lisa Wong Macabasco. "What's the Ideal Distance between Rest Stops?" *Slate*. Aug 3, 2015. Accessed Dec 27, 2016. http://www.slate.com/articles/life/travel_explainer/2015/08/rest_stop_distance_how_is_the_placement_of_rest_areas_on_highways_decided.html

Hours of service (HOS) regulations include strict provisions on driving limits, rest breaks, sleep berths and "restart" timing. A summary of key provisions is shown in Table E.1. HOS regulations are enforced by state highway patrols on interstate highways as well as local law enforcement in local jurisdictions, and penalties can be high for drivers and trucking companies. Finally, FMCSA introduced an electronic logging device (ELD) requirement to increase commercial truck and bus drivers' compliance with HOS regulations. Although FMCSA foresees an annual net benefit of over $1 billion because of paperwork reductions, it is currently the top issue for the trucking industry, as drivers have concerns with productivity impacts and additional regulatory burdens.

Table E.1 Summary of Federal HOS Regulations

HOS Provision	Description
11-Hour Driving Limit	Drivers may drive a maximum of 11 hours after 10 consecutive hours off duty. All time spent at the driving controls of a CMV in operation is considered driving time.
14-Hour Driving Limit	Property-carrying drivers may not drive beyond the 14th consecutive hour after coming on duty, following 10 consecutive hours off duty.
Rest breaks	Drivers may drive only if eight hours or less have passed since the end of the driver's last off-duty or sleeper berth period of at least 30 minutes.
60/70-Hour Limit	Drivers may not drive after 60/70 hours on duty in 7/8 consecutive dates. A driver may restate a 7/8 consecutive day period after taking 34 or more consecutive hours off duty.
Sleep Berth Provision	Drivers using the sleeper berth provision must take at least eight consecutive hours in the sleeper berth, plus a separate two consecutive hours either in the sleeper berth or off duty.
34-Hour Restart	A driver of a property-carrying vehicle may "restart" a 7/8-consecutive-day period after taking 34 or more consecutive hours off duty.

Source: Federal Motor Carrier Safety Administration.

There are also several state regulations in North Carolina that affect truck parking. For example, parking is prohibited on any interstate, controlled-access highway, or other controlled access facility. Parking on public road or highway shoulders is also prohibited, unless the vehicle is visible for 200 feet in either direction and does not obstruct traffic. Additionally, oversize and overweight (OS/OW) vehicles are required to obtain a permit prior to transport if the truck exceeds certain size or weight specifications. OS/OW vehicles are also not allowed to operate on Sundays or between sunset and sunrise in North Carolina. This affects capacity at parking facilities along North Carolina borders with neighboring states. When combined with HOS regulations, as well as with challenges that longer or heavier vehicles have in finding adequate parking spaces, scheduling parking as part of a longer OS/OW trip can prove challenging.

Primary Truck Parking Issues in North Carolina

There are seven primary truck parking issues in North Carolina:

- **Parking capacity limitations**. Truck parking shortfalls highlight the capacity constraints at most public facilities and many private facilities. While some existing parking facilities could be redesigned to increase truck parking capacity, other challenges include cost, local opposition and available real estate.

- **Safety**. Truck parking shortages present highway safety concerns when trucks are forced to park illegally on highway shoulders and ramps. Drivers reported parking on a road shoulder or ramp for 10 percent of stops in North Carolina. The lack of safe, convenient, and easy-to-find parking in the corridor

forces truck drivers to make difficult choices, with dangerous consequences. When truck drivers reach their HOS limits without having found an appropriate parking location, they must choose whether to park illegally or drive illegally. Truck drivers face these decisions on a regular basis.

- **Communicating parking information**. More truck drivers would use available parking facilities if they were better informed about parking availability. This lack of information results in some truckers driving longer than is safe while they search for a place to stop for the night. Some states are implementing electronic communication and detection systems, which provides better traveler information.

- **Lost productivity.** Almost 90 percent of drivers surveyed spent more than 30 minutes on average searching for truck parking in North Carolina, which is a potential drain on driver productivity.

- **Shipper/receiver practices**. Almost 75 percent of drivers surveyed experienced loading/unloading delays of over an hour. In addition, many distribution facilities only operate on weekdays, and do not allow for on-site parking before or after deliveries.

- **Public opposition.** There is a negative perception of trucks and truck stops among the general public, which limits the ability to expand existing facilities or build new facilities in some areas. As land is developed, it is increasingly difficult to find land available for additional truck parking. In addition, most parking demand occurs in metropolitan areas, where real estate prices are higher compared to areas that are more rural.

- **Maintaining parking facilities**. Most state DOTs in fast-growing locations like North Carolina cannot keep up with the growing backlog of maintenance needs. DOT leaders typically prioritize maintenance of deteriorating pavement and bridge structures ahead of constructing new or expanding existing rest areas with truck parking.

Opportunities and Recommendations for Mitigating Truck Parking Issues

Providing adequate, safe parking for trucks requires both public and private sector efforts and there is no single solution. Following is a summary of the opportunities and recommendations for ensuring adequate and safe truck parking in North Carolina.

- **Partner with Truck Travel Centers seeking to expand facilities**. Since the private sector controls 85 percent of the truck parking supply in the state, the private sector should be part of the truck parking solution. This is already occurring as private travel centers expand existing operations, build new facilities, and retrofit older facilities. It would be beneficial to establish a formal relationship between NCDOT and travel centers. For example, the facility operator Pilot has acquired WilcoHess and Speedy Stores in North Carolina, most of which have existing truck parking. They are retrofitting one facility on I-95 at exit 77 (Hodges Chapel Rd in Harnett County) and are considering several new locations along I-77 and I-85, both of which are high-volume truck corridors with parking limitations. NCDOT and the area MPOs/RPOs could coordinate with Pilot while it considers locations for new facilities to better understand the site plan considerations and possibly help mitigate any opposition to new truck parking facilities by communicating the benefits of increased economic development. The facility operator Loves is also retrofitting sites and several new facilities are under construction in the state. In addition to coordinating site plan considerations, there may be opportunities to coordinate truck parking signage and availability across public and private facilities, since improved parking information would benefit truck drivers.

- **Employ technology solutions**. Technology has the potential to significantly improve the truck parking situation in North Carolina. One of the biggest challenges is to ensure that truck drivers are aware of the location of truck facilities and parking availability, and can easily plan rest periods ahead of time and while in transit. Technology solutions to this issue come in two parts: communication and detection. Communication systems include signage (both fixed and variable), smartphones and web-based applications. This technology is advancing rapidly, and smart phones are now being used for crowd-sourcing information through social media. Detection systems improve the way in which parking spaces are monitored, tracked and counted.

- **Explore trial truck parking at selected weigh stations**. The Hillsborough Weigh Stations on I-40/I-85 and the new Gaston County Weigh Station on I-85 have room for overnight truck parking. These locations have back lots for queuing that could be striped for tractor-trailer truck parking. Funding would be required for striping, signage, new technology and expanded trash collection. Daytime restroom access is available at these sites. Technology options can be scaled proportionately to the amount of time the site is at capacity. The advantages to this option would be the relatively low cost of implementation to provide some additional truck parking. Disadvantages include disrupting weigh station activities with entering and exiting trucks, increased maintenance and potential confusion over where trucks should park.

- **Explore retrofitting selected abandoned rest areas.** Of the four abandoned rest areas evaluated in this study, one site measuring approximately 12 acres along I-85 in Cleveland County has the best potential for redevelopment.

- **Use weigh station technology to communicate truck parking**. Should weigh stations be established as acceptable for overnight truck parking, technology could play a role in communicating truck parking availability and in expanding weigh stations for truck parking. Technology retrofits could be cost-effective since weigh stations already have electronic communication capabilities. One example of a pilot program would be to consider installing dynamic message signs (DMS) displaying available spaces in advance of the Hillsborough Weigh Stations and/or the Gaston County Weigh Station to communicate and manage truck parking at those sites. These are the only sites identified where there is currently room for overnight truck parking. The utilization information could be collected using either in-pavement sensors or remote cameras. At these locations, the DMS signs could also serve the dual purpose of communicating whether or not the weigh station is open for commercial vehicle inspections.

- **Conduct truck parking notification system pilot.** Many states are exploring truck parking communication and detection systems, and some states have implemented pilot programs. The I-95 Corridor Coalition is testing an electronic truck parking detection system at the Ladysmith Rest Area in Caroline County, Virginia and the Welcome Center in Laurel, Maryland. Public and private facilities along I-95 in North Carolina could become engaged in an expansion of this program. Other states exploring this technology include Florida, Virginia, Wisconsin and Kansas. Private facilities are also participating in programs sponsored by the USDOT and other partners such as “Park My Truck,” which estimates truck parking availability based on a survey of demand at participating truck parking locations.

Many of these efforts have been funded via Federal grants. NCDOT should consider apply for a FASTLANE grant in cooperation with the private sector.

- **Coordinate with Metropolitan Planning Organizations (MPOs) and Rural Planning Organizations (RPOs) to develop guidelines and mitigation strategies aimed at easing public opposition to private truck parking facilities.** MPOs and RPOs can help to mitigate public opposition to truck parking. They can also assist with truck parking implementation because they are familiar with the impacts of truck parking on surrounding communities. As businesses locate new facilities, MPOs and RPOs can help to ensure that adequate truck parking is part of the development design process. MPOs and RPOs could convene truck parking subcommittees as part of the MPO and RPO Technical Committees, conduct local truck parking studies and add truck parking to the issues discussed with the private sector representatives of the MPO and RPO freight advisory committees.

- **Convene a Standing Truck Parking Committee**. A standing statewide Truck Parking Committee, similar to the steering committee for the current study effort, could help oversee the implementation of study recommendations and provide regular updates to the NCDOT Board of Transportation on progress. The committee could develop an implementation plan to detail the actions, resources, and roles and responsibilities for each of the recommendations.

1.0 Introduction

Truck parking has become an increasingly serious concern for truck drivers, motor carriers, truck facility operators and public officials throughout the United States. According to a recent report, "Critical Issues in the Trucking Industry" (ATRI, 2016), truck parking is the third highest ranked issue in 2016 among truck driver respondents. Adequate truck parking located in the right locations will help to make conditions safer for truck drivers and other travelers, reduce unnecessary fuel consumption, and improve the efficiency of commercial vehicle operations. In response to increasing concerns regarding unauthorized truck parking, the North Carolina Department of Transportation (NCDOT) contracted with Cambridge Systematics (CS) to conduct a Truck Parking Study.

1.1 Study Purpose

The purpose of the study is to conduct an analysis of the adequacy of off-road truck parking in the State of North Carolina. The study achieves the goal of identifying existing and future truck parking needs and provides truck parking solutions that better serve freight transportation providers and provide a safer environment for the traveling public in and through North Carolina. To accomplish this goal, the study's key tasks include the following activities:

- Inventory truck parking along the state's key freight routes;
- Assess truck parking demand;
- Investigate ways to provide additional off-highway public and private truck parking;
- Analyze what actions will provide the greatest impact on traffic safety;
- Assess the best way to optimize public and private sector assets for truck parking;
- Identify public-private partnerships that may lead to increased truck parking;
- Identify technology enhancements and solutions to increase parking utilization; and
- Identify the costs and funding sources for increasing capacity of existing public truck parking facilities as well as converting existing rest areas, weigh stations, and other assets to truck parking.

1.2 Truck Parking Overview

Trucks play the key role in these supply chains, often functioning as "warehouses on wheels" as they make their way to destinations across the country and within North Carolina. Long-haul truck drivers traveling from border crossings, seaports, and other points of entry make multi-day trips across the country and attempt to make their final overnight stop as close as possible to their final destinations in the region.

Truck parking is a multifaceted problem. It is first a safety concern, as trucks frequently park illegally on highway shoulders and ramps. Truck parking shortfalls also highlight the capacity constraints at existing facilities. Operationally, some existing truck parking facilities could benefit from being redesigned to increase efficiency of each facility, while on a corridor-scale, existing spaces in each segment of the corridor could be used more efficiently with better traveler information.

The lack of safe, convenient, and easy-to-find parking in the corridor forces truck drivers to make difficult choices, with dangerous consequences. When truck drivers reach their HOS limits without having found an appropriate parking location, they must choose whether to park illegally or drive illegally. Truck drivers face these decisions on a regular basis. A lack of information about available parking at public and private parking areas forces some truckers to drive longer than is safe while they search for a place to stop for the night. Truck parking is a problem that spans public-private and jurisdictional boundaries in state and it requires solutions that involve multiple partners. Several problems related to truck parking suggest public-private or multi-jurisdictional solutions including:

- The negative public perception of trucks and truck stops among the general public, which limits the ability to expand existing facilities or to build new facilities in many areas;
- Truck parking need is greatest in areas where land values dictate higher revenue than truck parking lots produce;
- The fact that those who are directly generating the demand for truck parking often are not able to address the problem due to liability concerns or legal constraints (e.g., municipalities that prohibit overnight truck parking at warehouses and distribution centers outside normal business hours or ports that do not have the authority or funding to address problems outside their gate)

Source: Truck n' Park Demonstration Project, 2015

- Most State DOTs in fast growing locations like North Carolina cannot keep up with a growing backlog of maintenance needs. DOT leaders typically prioritize maintenance of deteriorating pavement and bridge structures ahead of constructing new or expanding existing Rest Areas that offer truck parking. Additionally, they perceive the need for more truck parking and illegal parking as market driven problems requiring more private sector solutions and are reticent about spending their limited resources for what will likely result as an increased maintenance and enforcement/safety burden.

1.3 Organization of the Report

The remainder of the report is organized around the key tasks. Section 2 chronicles the outreach efforts including the truck parking survey and interviews with private facilities, enforcement officials and NCDOT District Engineers. Section 3 inventories the public and private truck parking facilities and describes characteristics, driving truck parking demand including truck volumes and freight generators. Section 4 summarizes the demand for truck parking in North Carolina and Section 5 evaluates truck parking options and costs based on reusing or expanding existing facilities. Section 6 explores truck parking technology solutions, which could help truck drivers obtain real time truck parking information and make better use of existing parking capacity. Finally, Section 6 presents opportunities and recommendations.

There are four appendices at the conclusion of this report. Appendix A presents the truck parking survey instrument that ATRI developed for truck drivers. Appendix B includes a complete inventory of truck parking facilities in North Carolina. Appendix C includes additional statistics on parking frequency at top

truck parking locations in North Carolina. Finally, Appendix D describes past federal and state truck parking studies as well as a review of legislation affecting truck parking.

2.0 Stakeholder Outreach

Stakeholder outreach played an integral part of the research effort. A multi-tiered approach was used to solicit input from key private and public sector stakeholders including:

- A project steering committee consisting of representatives from NCDOT, North Carolina Trucking Association (NCTA), North Carolina State Highway Patrol (SHP) and North Carolina Department of Commerce (DOC).
- A statewide truck parking survey targeting truck drivers who operate in North Carolina.
- In-person and telephone interviews with private parking facility managers, and SHP and NCDOT Division Engineers.

The project steering committee guided the development of the scope of work for the study and provided critical input and review of the study analysis and findings. The statewide truck parking study and interviews, both discussed in detail below, provided insights into the truck parking issues, concerns and opportunities in North Carolina.

2.1 Statewide Truck Parking Survey

An online truck driver survey targeting American Trucking Association (ATA) members throughout the country was conducted for this effort. The survey was developed, administered and analyzed by the American Transportation Research Institute (ATRI), which is a non-profit research group for the trucking industry. The process involved developing, vetting and pre-testing the survey instrument. Once approved by NCDOT and tested by a small group of carriers, the survey was distributed to carriers. The survey was distributed and marketed by various groups including the NCTA. The final survey instrument can be found in Appendix A.

Nationwide, ATRI has reported on truck parking issues, most recently in the report titled "Critical Issues in the Trucking Industry" (2016), which ranked truck parking as the third-highest issue in 2016 among truck drivers behind the electronic logging device (ELD) mandate and hours of service (HOS) regulations.[2] Table 2.1 presents the top five issues for commercial drivers and the trucking industry.

Table 2.1 Top Issues for Drivers and General Industry Response

Rank	Commercial Drivers	Trucking Industry
1	Electronic Logging Device Mandate	Electronic Logging Device Mandate
2	Hours-of-Service	Hours-of-Service
3	**Truck Parking**	Cumulative Economic Impact of Trucking Regulations
4	Cumulative Economic Impact of Trucking Regulations	**Truck Parking**
5	Economy	Economy

Source: ATRI

[2] American Transportation Research Institute. *Critical Issues in the Trucking Industry 2016.* Arlington, VA. October 2016.

Truck Parking Survey Background and Demographics

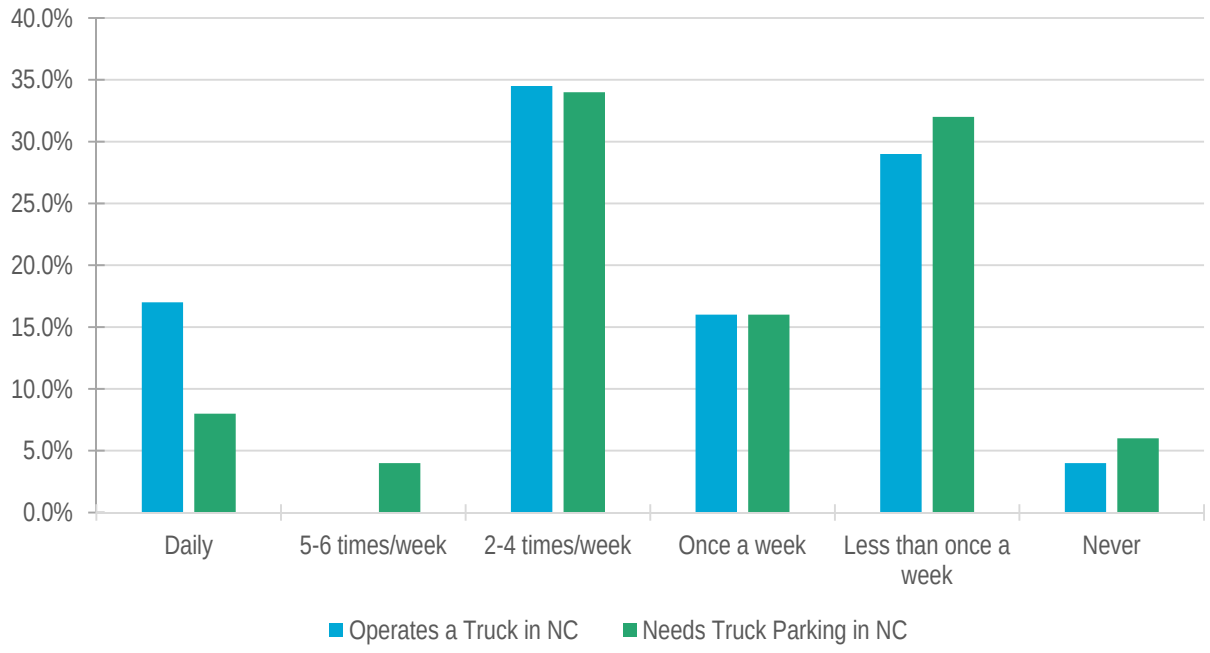
The trucking industry survey sought to expand existing knowledge of truck parking issues in North Carolina, understand where additional truck parking locations and services are needed, and gather truck driver perspectives on potential solutions for truck parking issues.

Using multiple industry databases, ATRI distributed the final survey online to carriers that operate in North Carolina and through the NCTA and trucking associations in surrounding states. In addition, the Owner Operator Independent Drivers Association (OOIDA) distributed the survey directly to drivers on behalf of ATRI. The survey was live from October 19 until November 21, 2016. This analysis reflects the responses received prior to November 10, which includes 761 drivers having completed the survey.[3]

Respondent Eligibility

The survey results revealed how many truck drivers operate or require truck parking in North Carolina. Figure 2.1 shows the frequency that respondents operate a truck in North Carolina and the frequency with which respondents need truck parking in North Carolina. Drivers who indicated that they never operate in (4 percent) or never require parking in (6 percent) North Carolina are excluded from the remainder of the survey results. Over half of respondents indicated that they require truck parking in North Carolina at least once a week (62 percent), suggesting that respondents are extremely familiar with North Carolina parking issues.

Figure 2.1 Frequency of Truck Operations in North Carolina



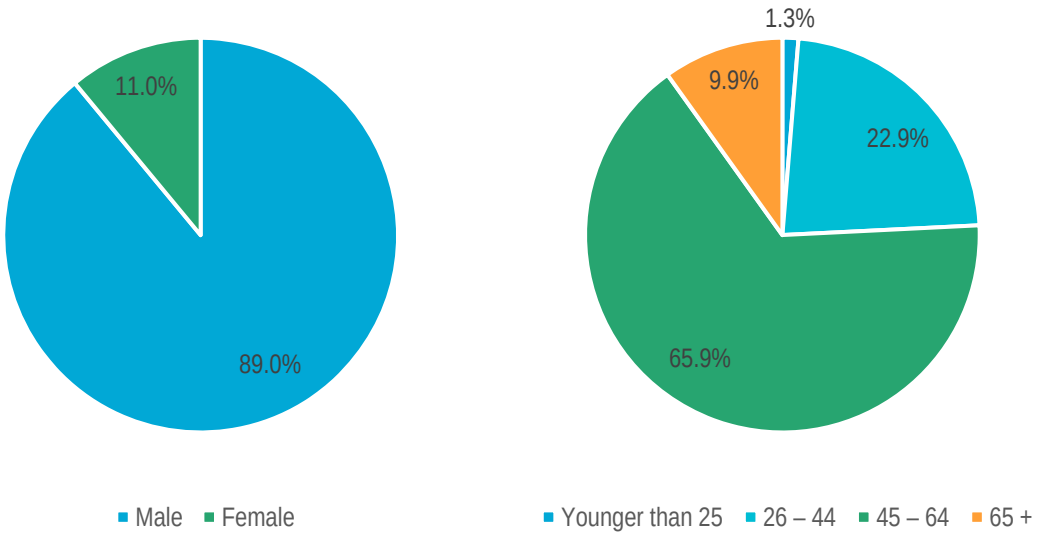
Source: ATRI

[3] ATRI staff completed evaluating the remaining surveys collected between Nov 10 and Nov 21, 2016 for a total of 777 survey responses and determined that responses were consistent with the first sample. Therefore, no further changes were made to this analysis.

Demographics

The North Carolina truck parking survey included a series of demographic questions. Figure 2.2 depicts the gender and age distribution of survey respondents. A greater proportion of female drivers (11 percent) are included in this sample compared to the industry as a whole, of which nearly 6 percent of drivers are women.[4] Additionally, this sample over-represents drivers aged 26 to 44 years and under-represents drivers aged 45 to 64 relative to the industry as a whole.[5]

Figure 2.2 Driver Gender and Age of Survey Respondents



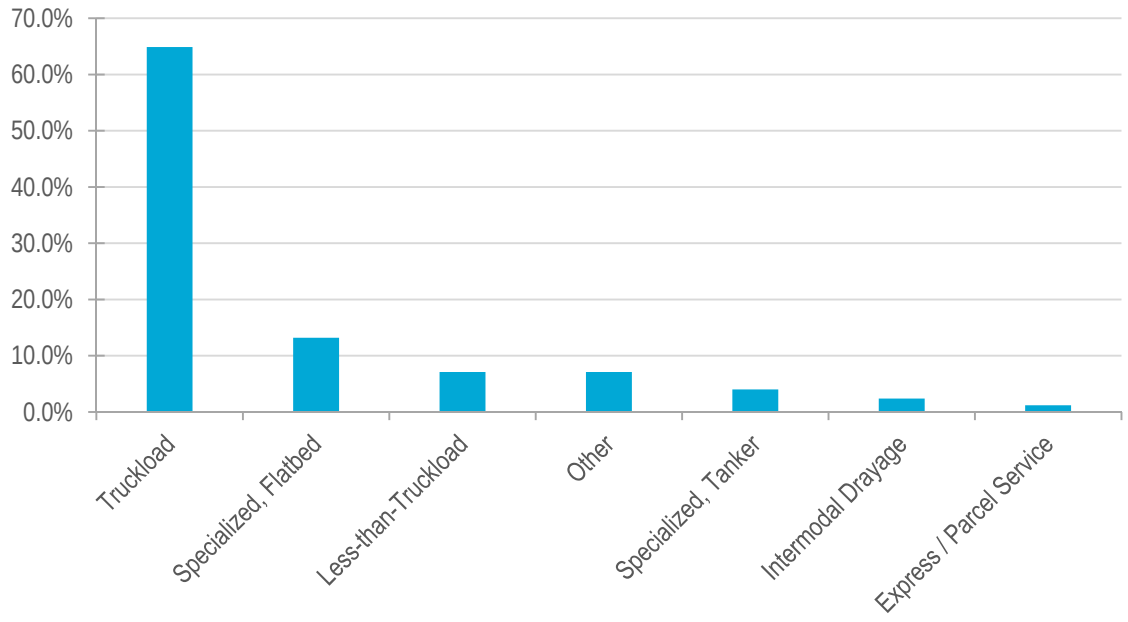
Source: ATRI.

Overall, 88 percent of survey respondents indicated they operated primarily in the for-hire sector of the trucking industry, while 12 percent of respondents were involved in private fleet operations. Of those who operated in the for-hire sector, Figure 2.3 shows the segment breakdowns of respondents in the for-hire sector. Nearly 65 percent of respondents operated in the truckload sector. Most responding drivers were owner-operators (O-O) with their own authority (39 percent) or leased to a motor carrier (25 percent), as shown in Figure 2.4.

[4] *American Trucking Trends* (2016). American Trucking Associations. Arlington, Virginia.

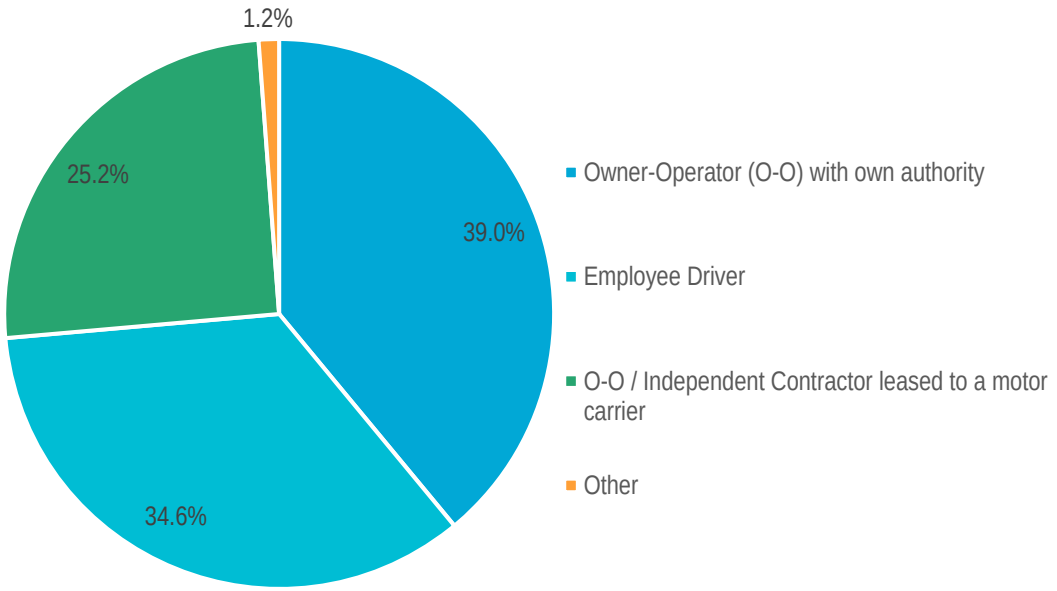
[5] Short, J. (2014). *WHITE PAPER: Analysis of Truck Driver Age Demographics across Two Decades.* American Transportation Research Institute. Arlington, Virginia. Available Online: http://atri-online.org/.

Figure 2.3 Industry Sector of Survey Respondents



Source: ATRI.

Figure 2.4 Employment Status of Survey Respondents



Source: ATRI.

To better understand truck parking needs, ATRI asked respondents to indicate their average length of haul. The results in Table 2.2 show that more than 71 percent of drivers completing more than 500 miles per haul, which is a well-represented group of drivers who would most likely need overnight parking.

Table 2.2 Average Length of Haul of Survey Respondents

Average Length of Haul	Response
Local (Less than 100 miles per trip)	1.8%
Regional (100-499 miles per trip	26.4%
Interregional (500-999 miles per trip)	44.3%
Long-haul (1,000 + miles per trip)	27.5%

Source: ATRI.

Table 2.3 displays the vehicle configuration of respondents. Half of drivers in the sample operate dry van vehicle configurations. Seven percent of individuals indicated an "other" vehicle configuration. Of the seven percent, many respondents indicated they regularly drive more than one type of vehicle configuration or they operated a truck with more than five axles.

Table 2.3 Vehicle Configuration of Survey Respondents

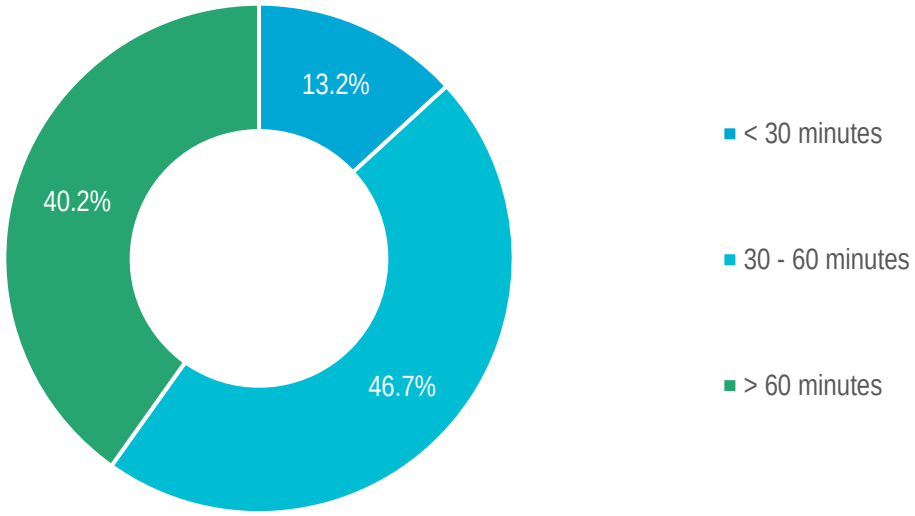
Vehicle Configuration	Response
5-axle Dry Van	50.7%
5-axle Refrigerated Trailer	17.1%
5-axle Flatbed	17.4%
5-axle Tanker	4.5%
Straight Truck	1.8%
Longer Combination Vehicles (I.e. doubles)	1.5%
Other (please specify)	7.0%

Source: ATRI.

2.1.1 *Truck Parking in North Carolina*

The next set of questions related to truck parking experience in North Carolina. To better understand the impact that searching for parking has on driver productivity, ATRI asked drivers to estimate the average length of time it takes to find truck parking in North Carolina, as shown in Figure 2.5.

Figure 2.5 Average Length of Time to Find Truck Parking in North Carolina



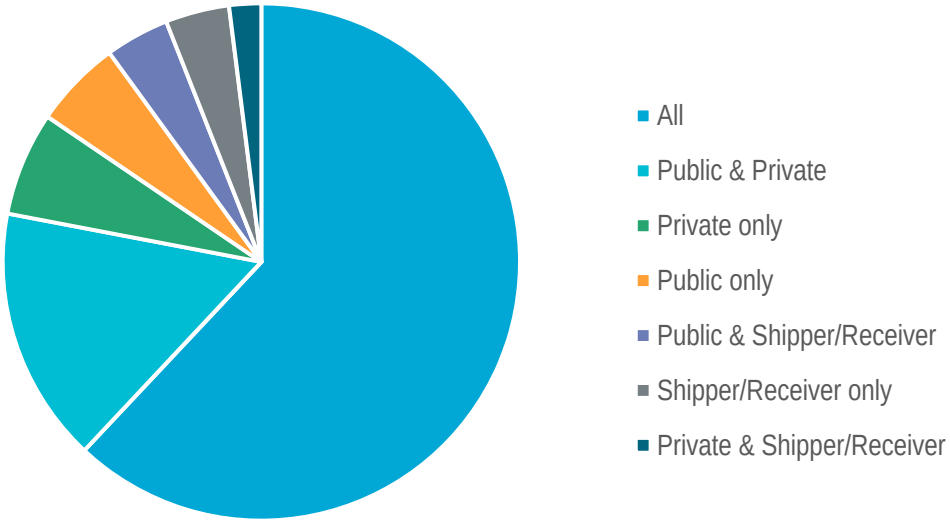
Source: ATRI

Almost 87 percent of respondents specified that it took over 30 minutes on average to find truck parking. These estimates are greater than the findings of a similar truck driver survey of a coalition of states in the Midwest, in which over 60 percent of respondents reported that finding parking, took at least 30 minutes.[6] Prevalent truck driver compensation models primarily pay drivers on a per-mile or per-load basis, neither of which reimburse drivers for non-revenue miles accrued while searching for parking. If the time required to secure truck parking reduces the revenue-earning miles for a driver, truck-parking issues have a tangible negative impact on truck drivers. In turn, this could affect the ability of shippers in the state to attract competitive service.

The difficulty in finding truck parking is not specific to public or private rest stops, as indicated in Figure 2.6. ATRI asked survey respondents to indicate all of the locations where it was most difficult to find truck parking. Survey respondents noted that the truck parking shortage extends across all facilities: public, private and shippers/receivers. More than 60 percent of truck operators specified that all three types of facilities were problematic. In the case of the latter facility, the "shortage" likely came from shipper/receiver unwillingness to provide truck parking.

[6] The Midwest states included: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Ohio, and Wisconsin.

Figure 2.6 Most Difficult Locations to Find Truck Parking



Source: ATRI.

Survey respondents were asked to estimate the frequency with which they park at certain locations in North Carolina. Table 2.4 shows the response average and median frequencies for each location. Survey results indicate that private facilities are most widely used for parking. The results also indicate moderate use of unauthorized parking. An average of 15.4 percent of drivers use ramps or road shoulders for parking when they cannot find a place to park.

Table 2.4 Average and Median Driver Rest Stop Location Type Frequency

Metric	Public Rest Area	Private Truck Stop	Shipper/ Receiver	Ramp/Road Shoulder	Other
Average	27.7%	46.0%	21.1%	15.4%	17.4%
Median	20.0%	40.0%	20.0%	10.0%	10.0%

Source: ATRI.

To further understand truck-parking shortages in North Carolina, ATRI provided drivers an opportunity to indicate specific roads and cities in which they had the most challenges in finding truck parking. Table 2.5 shows the top five cities mentioned most frequently, as well as the interstates associated with those cities. It is important to note that a majority of respondents indicated that it was not just one geographical area or roadway that needed more parking. In fact, respondents noted that capacity is low throughout the entire state. Many respondents stated that either a full stretch of an interstate or more than a 100-mile segment of an interstate needed truck parking.

Table 2.5 Top 5 Cities and Their Associated Interstates

Rank	City	Associated Interstate(s)
1	Charlotte	77 and 85
2	Raleigh	40
3	Greensboro	85 and 40
4	Asheville	26 and 40
5	Statesville	40 and 77

Source: ATRI.

The survey asked respondents about the time of day in which it was most difficult to find truck parking. Table 2.6 presents the results, and shows that nearly 65 percent of respondents indicated that between 7:00 p.m. and midnight was the most difficult time of day to find parking. This response aligns with the national results of the 2015 Jason's Law Truck Parking Survey Results and Comparative Analysis driver survey results, which identifies 7:00 p.m. to midnight as the time when parking is the most difficult to find.[7]

Table 2.6 Time of Day When it is Most Difficult to Find Truck Parking

Time of Day	Response
5:00 a.m. – 9:00 a.m.	0.0%
9:00 a.m. – Noon	0.5%
Noon – 4:00 p.m.	0.5%
4:00 p.m. – 7:00 p.m.	15.5%
7:00 p.m. – Midnight	**64.8%**
Midnight – 5:00 a.m.	18.9%

Source: ATRI

The six charts in Figure 2.7 identify specific truck-parking challenges for drivers in North Carolina. Truck vandalism and theft were issues not frequently reported in this sample, as almost 80 percent of respondents reported they never/rarely experience these issues in North Carolina. Most respondents noted rest area time limitations at least occasionally (57 percent). The survey results also identified parking supply issues, with 44 percent of respondents reporting that they were only able to find parking in unsafe locations often or always. One parking location of particular attention was ramps or road shoulders, as 41 percent of respondents were only able to find parking on ramps or road shoulders often/always. Note that this is significantly higher than the 15.4 percent who reported using ramps and shoulders for parking in Table 2.4.

Drivers in this sample had significant concerns with issues related to shippers/receivers. Over 60 percent of drivers report that shippers/receivers never or rarely permit on-site parking outside of appointment hours. Almost 75 percent of drivers in this sample reported that loading/unloading delays often or always exceed

[7] Federal Highway Administration and Department of Transportation. *Jason's Law Truck Parking Survey Results and Comparative Analysis*. August 2015. Available Online: http://www.ops.fhwa.dot.gov/freight/infrastructure/truck_parking/jasons_law/truckparkingsurvey/jasons_law.pdf

one hour in North Carolina. The unpredictable nature of loading/unloading delays may affect drivers' ability to plan future parking spaces.

Figure 2.7 Frequency Drivers Experience Specific Conditions in North Carolina

Source: ATRI.

Ramp and Shoulder Parking

One out of every 10 times that a truck driver stops to park in North Carolina occurs on a ramp or shoulder. In North Carolina, ramp and shoulder parking is illegal. To assess truck drivers' experiences with law enforcement while parked on a ramp or shoulder, the survey asked a series of questions on this topic. One question inquired if drivers had been asked by a law enforcement officer to move their vehicle while parked on a ramp or shoulder. The second question asked drivers if they had ever been ticketed while parked on a

ramp or shoulder in North Carolina. Table 2.7 shows the survey responses to the two questions. A minority of drivers have been ticketed for parking on a ramp or shoulder (over 5 percent) and over 40 percent of drivers have been asked to move while parked on a ramp or shoulder.

Table 2.7 Law Enforcement and Truck Parking on a Ramp or Shoulder

	While parked on a ramp or shoulder, law enforcement has:	
Response	Asked me to move my truck	Ticketed me
Yes	41.2%	5.5%
No	58.8%	94.5%

Source: ATRI.

Reasons for Seeking Parking

Because of hours of service (HOS) regulations, truck drivers are required to take a 30-minute rest break within their first eight hours of driving. This break often presents an additional challenge to drivers in finding available parking. The HOS 10-hour rest break and 30-minute rest break ranked number one and two, respectively, as the top two reasons drivers require truck parking. Table 2.8 shows the top five reasons drivers look for parking in North Carolina. The reality is that drivers must stop for federally mandated HOS breaks, but can often only find parking in illegal locations like ramps or shoulders (41 percent). Inadequate levels of truck parking force drivers to choose either illegal parking or violation of federal HOS regulations.

Table 2.8 Top 5 Reasons for Seeking Truck Parking

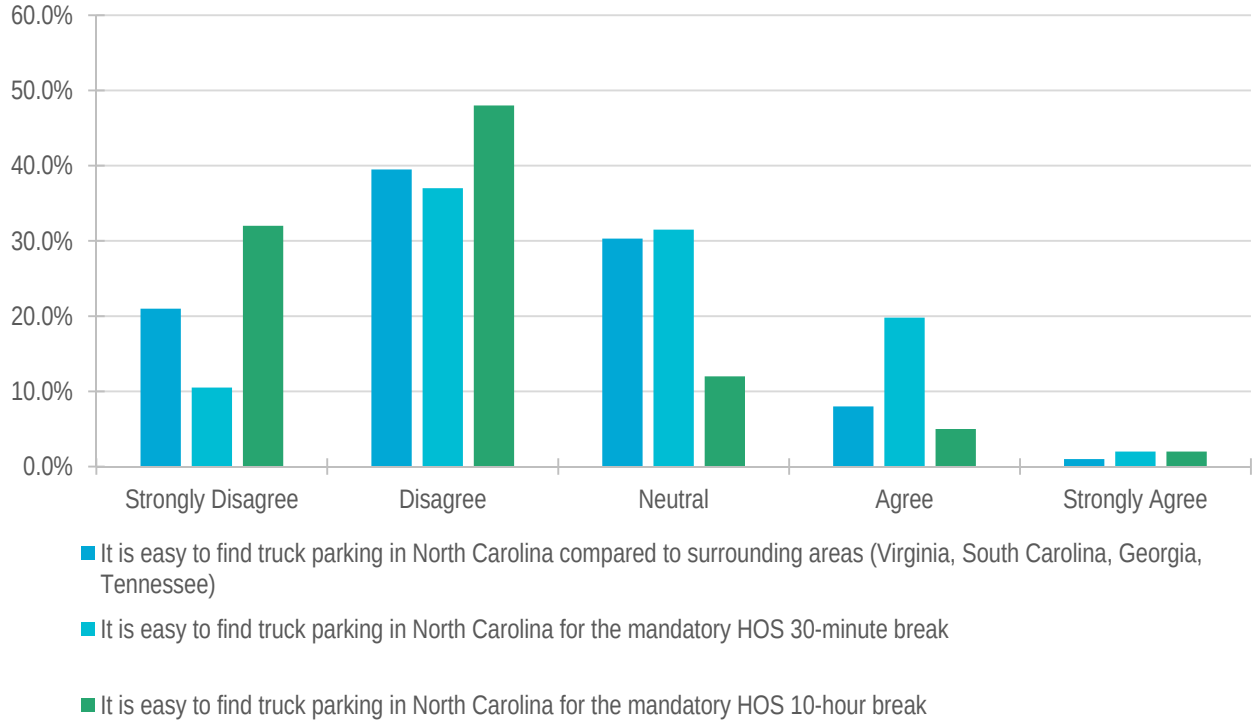
Rank	Parking Reason	Response	Overall Average Rank
1	HOS 10-Hour Rest Break	76.8%	2.5
2	HOS 30-Minute Rest Break	46.5%	3.9
3	Awaiting Dispatch	20.5%	2.7
4	Showering/Restroom	16.8%	5.6
5	Restaurant/Eating	15.0%	6.1

Source: ATRI.

Locating Truck Parking

ATRI asked survey participants three questions about the ease of finding parking in North Carolina relative to surrounding states and for required HOS breaks, as shown in Figure 2.8. Over 60 percent of respondents did not think that finding parking was easier in North Carolina compared to surrounding states. Additionally, over 80 percent of respondents did not agree with the sentiment that finding parking for 10-hour HOS breaks was easy, and nearly 50 percent of respondents did not agree that finding parking for the 30-minute HOS break was easy.

Figure 2.8 Ease in Which to Find Truck Parking

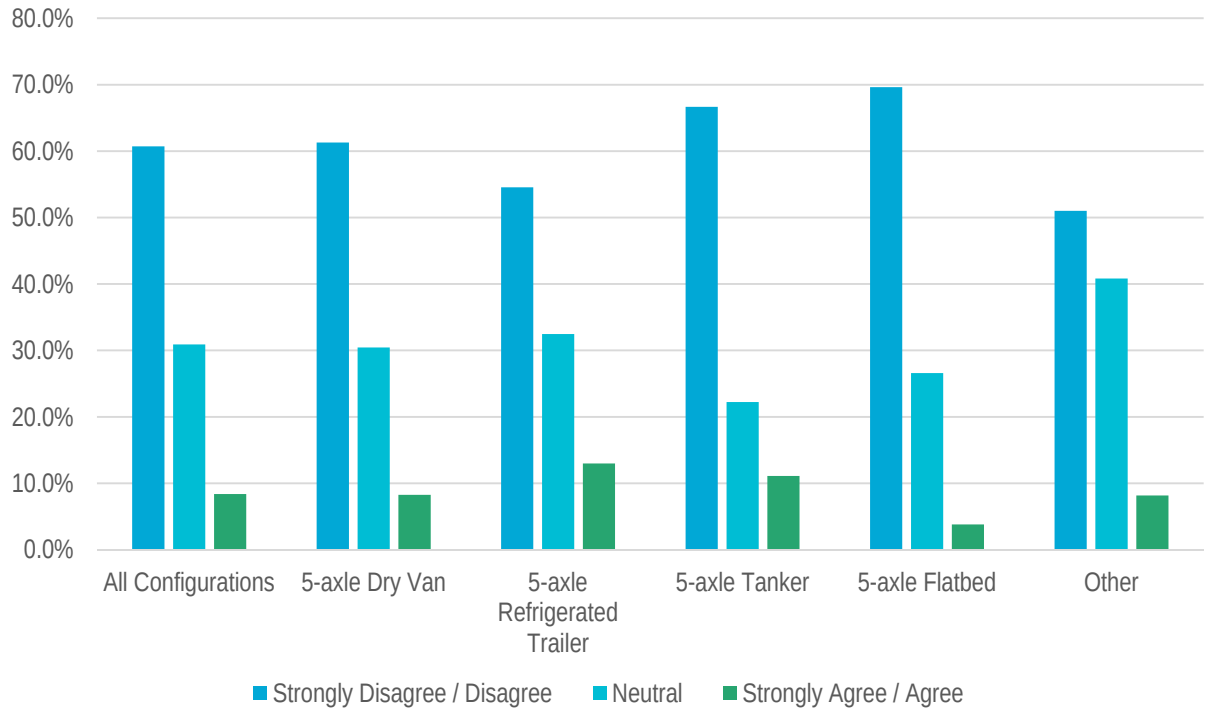


Source: ATRI.

The survey also asked participants about the ease of finding parking in North Carolina relative to surrounding states by vehicle configuration, as shown in Figure 2.9. The majority (over 60 percent) of respondents did not think finding parking was easier in North Carolina compared to surrounding states. Response distributions did not vary significantly among the 5-axle vehicle configurations. The difference observed between "other" configurations and 5-axle configurations is the result of the composition of the "other" vehicle configurations bin, which typically includes longer combination vehicles, straight trucks, intermodal chassis and vehicles with more than 5 axles. Longer combination vehicles and vehicles with more than 5 axles require a larger parking space than the typical 5-axle vehicle configurations. Additional obstacles for over-size/over-weight configurations are state-level laws that restrict the time-of-day that over-size/over-weight vehicles can operate. Also contained within the "other" category are configurations such as intermodal chassis and straight trucks, which have reduced parking needs relative other respondents as these configurations are often associated with local trip lengths.

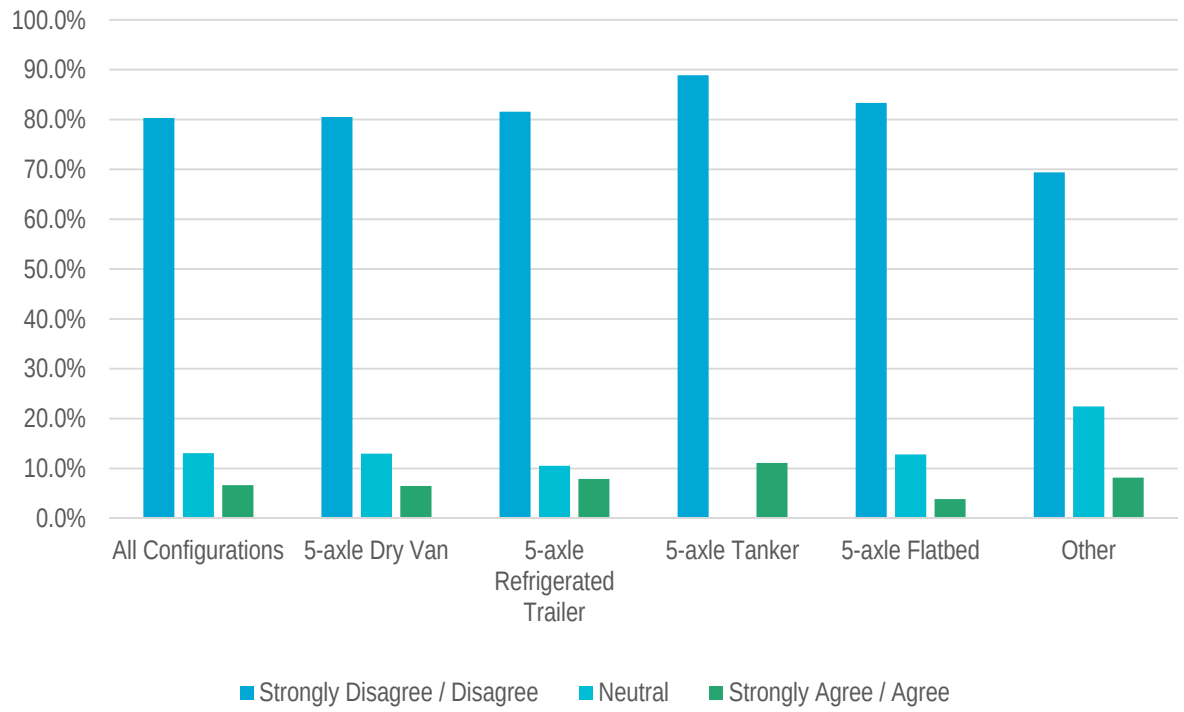
Respondents also reported the ease of finding parking for federally-mandated 10-hour HOS break in North Carolina, which is shown in Figure 2.10. Over 80 percent of respondents did not agree with the sentiment that finding parking for the 10-hour HOS rest break is easy.

Figure 2.9 Ease of Finding Parking Relative to Surrounding States



Source: ATRI

Figure 2.10 Ease of Finding Parking for the 10-Hour HOS Break in North Carolina

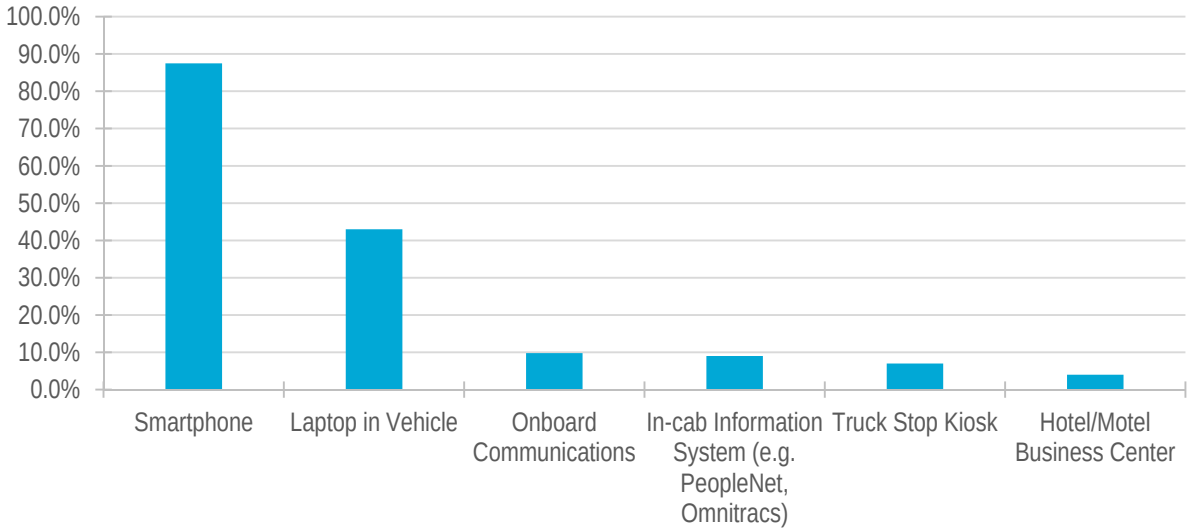


Source: ATRI.

Accessing Parking Information

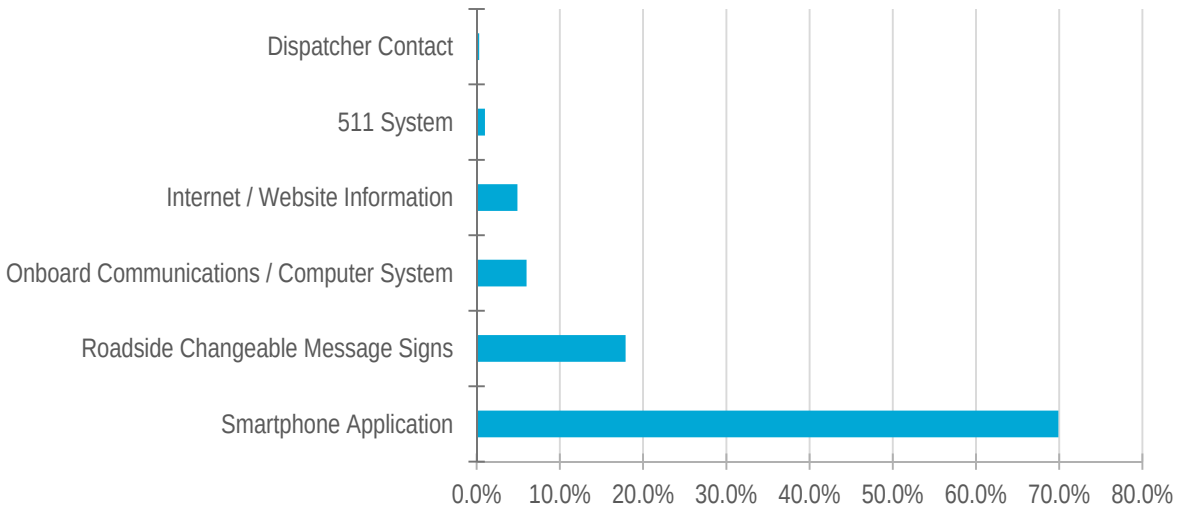
Figure 2.11 presents the types of technology that respondents generally use to access the internet while on the road, and Figure 2.12 indicates how drivers prefer to receive real-time parking information. Most drivers (87 percent) use smartphones, as well as laptops in the vehicle (43 percent). Not surprisingly, the majority of drivers (70 percent) prefer smartphones for receiving real-time truck parking information. Finally, ATRI asked respondents how far in advance of a parking location that they would like to receive real-time parking availability. Respondents preferred to have in information 20 miles from the facility (52 percent), followed by 10 miles from the facility (27 percent), and 5 miles from the facility (25 percent).

Figure 2.11 How Drivers Access Internet on the Road



Source: ATRI.

Figure 2.12 Preferred Method of Receiving Real-Time Parking Information



Source: ATRI

2.1.2 Motor Carrier Survey Conclusions

More than 700 truck driver respondents identified numerous opportunities for improving truck parking in North Carolina, and noted secondary safety and operational issues that are negatively impacted by inadequate parking, including:

- **Lost productivity.** Almost 90 percent of drivers surveyed spend more than 30 minutes on average locating truck parking in North Carolina, which is a potential drain on driver productivity.
- **Ramp or shoulder parking.** The relative difficulty of finding parking in North Carolina is also demonstrated by the frequency that drivers park on ramps or shoulders. Drivers reported parking on road shoulders or ramps for 10 percent of all stops in North Carolina. Law enforcement has made efforts to prevent drivers from parking in these dangerous locations, as over 40 percent of respondents have been asked to move from the shoulder or ramp. However, the risk of being ticketed for violating HOS regulations seems to supersede any fear of being ticketed for unauthorized parking, as more than 40 percent of respondents indicated that they often/always can only find parking on shoulders or ramps.
- **Areas with high truck parking demand.** Drivers identified 5 metropolitan areas that require additional parking. They include Asheboro, Charlotte, Greensboro, Raleigh, and Statesville.
- **Shipper/receiver practices.** Almost 75 percent of drivers in this sample experienced loading/unloading delays of over an hour. These delays compound existing parking issues as planning for future parking locations becomes more difficult.
- **Other parking issues.** Nearly 80 percent of drivers indicated that truck vandalism or theft is rarely or never an issue. Conversely, the ability to find safe parking was identified as an issue often/always by 43 percent of respondents. Time limits at public rest areas affected over half of respondents always/ often, which may introduce HOS compliance issues. Given that drivers ranked the 10-hour required HOS break as the top reason for seeking truck parking in North Carolina, these public sector time limits may make HOS compliance difficult.

2.2 North Carolina State Highway Patrol

The North Carolina State Highway Patrol (SHP) has a Motor Carrier Enforcement Section within the eight troops across the state identified as Troops A-H, as shown in Figure 2.13. The mission of the SHP Motor Carrier Enforcement Section is to promote highway safety, and to enforce all state and Federal laws regulating highway and commercial vehicle operations. The Motor Carrier Enforcement team consists of 290 full-time troopers operating in different troops across the state.

The CS Team interviewed three SHP Troopers in September 2016 to determine illegal truck parking activities in the state. The result of these interviews confirmed the increased demand for truck parking in North Carolina, and the 2015 Truck Parking Campaign resulted in more than 400 issued tickets. The campaign mostly targeted tractor-trailers parked along I-77. A growing number of drivers reaching the limit of the hours of operation have trouble finding parking spaces at truck stops and rest areas, and eventually park on highway shoulders and exit ramps, where they become hazards for other vehicles passing at high speeds.

Figure 2.13 North Carolina State Highway Patrol Troop and District Boundaries

Source: NCDOT.

Source: Don Strickland, Chattanooga Times Free Press.

According to the SHP interviewees, there is a growing truck parking capacity problem in North Carolina, and troopers have stepped up enforcement efforts in certain areas to address illegal parking issues. Most of the areas of concern are along high volume interstate corridors, including I-95, I-40, I-77, I-85, I-26, I-74, certain U.S. routes (U.S. 1, U.S. 421, U.S. 64), and around large freight generators. SHP does not have sufficient staff or resources to enforce illegal truck parking at all interstate locations. Therefore, troopers do not issue citations on a routine basis. This creates a burden on NCDOT to maintain a "safe harbor" for trucks to ensure they do not infringe on the travel lane regardless of where they park. In cases of illegal parking around freight generators, local law enforcement officers have the responsibility to enforce illegal parking.

Results from the ATRI truck parking demand analysis revealed some truck parking at weigh stations in North Carolina. Table 2.9 depicts the top three weigh stations with overnight truck parking, which are located along I-85 north, I-74 east, and I-85 south. When asked about weigh stations as truck parking locations, SHP Troopers reported that most of the permanent weigh stations in North Carolina lack space for overnight truck parking. However, the Hillsborough and (new) Gaston County sites have room for parking.

Table 2.9 Top Three Weigh Stations with Limited Overnight Truck Parking

Rank	Name/Location	Nearest Interstate	Average Time Stopped (hours)	Frequency (per 1,000 Trucks)
1	Weigh Station: Charlotte	I-85 North	11.63	1
2	Weigh Station: Mount Airy	I-74 East	9.78	1
3	Weigh Station: Charlotte	I-85 South	13.81	1

Source: ATRI.

2.3 NCDOT Division Engineers

The North Carolina Department of Transportation (NCDOT) maintains 14 Divisions in the state. These Divisions are responsible for the operations, maintenance, construction and oversight of transportation infrastructure. The CS Team interviewed all 14 NCDOT Division Engineers (DEs) using a combination of in-person meetings and phone calls. The interviews were held between September 19 and September 29, 2016. The CS Team sent questions in advance of interviews to solicit field observations, safety concerns, and other issues associated with truck parking on North Carolina highways. The findings from the interviews are summarized as follows:

- **For the most part, current public and private truck parking facilities appear to be adequate**. Illegal truck parking is occurring in specific locations but is not viewed to be a pervasive statewide safety or capacity problem.

- **Most illegal truck parking occurs in evenings and early mornings.** This is the time rest areas and private parking facilities tend to reach capacity. Over-capacity leads to illegal parking on ramps and shoulders leading in and out of interstate rest areas, and in some cases only a few miles from private truck stops. In the case of distribution centers, truck drivers use shoulders and ramps as a staging area until the center opens, depending on different distribution center policies.

- **Illegal truck parking is occurring along major freight corridors**, including I-95, I-85, I-40, I-26, and I-77, U.S. 1, U.S. 421, and U.S. 64.

  - Sections of I-40 in Division 13 – Trucks routinely park on interstate shoulders at the top or bottom of grades or in advance of an interchange, such as Old Fort / I-40. This is problematic and can be fatal, particularly for motorists at night who do not realize truck taillights are stationary and may subsequently crash into the back of the truck.

  - Sections of I-85 in Division 5 and I-95 in Division 6 – Private truck stops and rest areas are often full by late afternoon, forcing truck drivers to park on ramps and side roads in preparation for an early start. Trash is a constant maintenance issue.

  - Sections of I-77 and I-85/40 in Divisions 11 and 12 – Private truck stops and rest areas are nearing capacity at night, resulting in illegal parking and creating maintenance problems.

- **NCDOT Divisions take different approaches to illegal truck parking on interstate ramps**. Some divisions are installing "No Truck Parking" signs on interstate ramps. However, the majority of signs are knocked down, replaced and knocked down again. Other divisions are installing additional stone and gravel on interstate ramp shoulders to mitigate rutting and erosion. Some divisions reported the need to extend maintenance forces to pick up trash.

Source: I-40 Challenge, 2013.

- **Funding for new rest areas in North Carolina is limited**. The construction of new rest areas cannot compete with other proposed transportation capacity projects under the Strategic Transportation Investments (STI) law. Therefore, NCDOT focuses its resources on maintaining existing rest areas, with NCDOT's Roadside Environmental Unit (REU) and Division Engineers typically negotiating maintenance responsibilities. REU is responsible for the vertical infrastructure (buildings, restrooms, etc.), and does not have input on parking lot paving or access. New rest areas funded by public dollars would need to include restroom facilities, security cameras, trash pickup, new entry points to and from major highways and interstates, and increased SHP presence.

- **Additional capacity through new or expanded private truck stops**. Based on observations from field staff, the majority of statewide private truck stops have additional capacity, particularly along I-85 and I-95, especially during the day. Given these observations, there is less interest in constructing publicly owned truck parking sites. This is due mostly to concerns about the ongoing maintenance required at these locations.

- **Potential for public opposition**. New truck-only sites funded by public dollars may come under greater public scrutiny, and may not be welcomed by the surrounding community. Even if these sites were located where NCDOT owned the majority of right-of-way, the staff expressed concerns with ongoing oversight, community resistance, and siphoning away of resources to maintain such sites given the probability those sites may need to expand in the next 5 to 10 years.

- **NCDOT should assess and maximize the utilization of current assets.** Staff emphasized a need to better understand the utilization and dwell time of trucks at rest areas across the state. They noted several examples of older rest areas scheduled to close with new rest areas to open, which would provide service at typical driving distances between stops. For example, Divisions 11 and 12 are closing four rest areas and consolidating those spaces into one new rest area located in the median of I-77 in 2018.[8] They also recognized the sizeable nodal growth of restaurants and service industry at interchanges, which provide more options for motorists and truckers. Their observations point to the

[8] This rest area was exempted from STI due to its prior scheduling status

need for a more thorough review and utilization assessment of NCDOT's rest areas and weigh stations as part of the solution to future truck parking.

- **Technology advancements will help manage demand and communicate real time information.** The district engineers noted how technology could optimize how the location of available truck parking spaces is communicated. They cited future opportunities to use mobile apps; GPS based transponders in the cab or movable electronic message boards to display the number and location of open parking spaces at rest areas and private truck stops.

2.4 Private Truck Facility Operators

The CS Team conducted phone interviews with Real Estate personnel from Pilot and Loves Travel Centers to learn about truck parking trends, challenges, and new sites considered for construction. These interviews occurred between October 1 and October 15, 2016. The team also interviewed representatives from Wal-Mart, which provides truck parking at some store locations.

Pilot Travel Center is the largest of its kind, with over 550 facilities nationwide. Some of these facilities are identified as "Flying J" centers, now owned and operated by Pilot. Pilot constructs 15-25 new facilities and retrofits approximately 80 facilities every year. Loves Travel Centers owns approximately 330 facilities nationwide, and are building between 20 and 30 new facilities every year.

Source: Pilot Travel Center; Love's Travel Stops.

Loves Truck Centers are reported to be at capacity every night in most locations across the state. The Marion facility in McDowell County along I-40 has a small lot of fewer than 40 truck parking spaces, and is full every night. There is no room to expand at this site. The same is true for their Salisbury facility in Rowan County, which is also located along I-85. This is a new location and has been full every night since it was built and there is no room to expand further. The Dunn facility in Harnett County along I-95 is full most nights and Loves is getting ready to expand parking in the near future. Several Loves facilities are currently under construction and are expected to open over the next few years, including the Mebane facility in Alamance County along I-40/85 (2017) and the Statesville facility in Iredell County at the junction of I-40 and I-77, with construction slated to begin next year. Loves is considering new sites in Charlotte (Mecklenburg County), in Reidsville (Rockingham County) along US 29, and another site in Statesville (also in Iredell County along I-77).

Approximately 10 percent of Wal-Mart stores in North Carolina allow trucks to park overnight. This is largely at the discretion of the store manager and primarily includes those stores that are open 24 hours per day. The Wal-Mart website maintains a list of the stores that allow overnight truck parking, as well as those that do not allow truck parking. Wal-Mart also encourages recreational vehicles to use their parking sites during overnight hours.

2.4.1 Private Parking Facility Telephone Survey

To determine private facility truck parking demand in North Carolina, the CS Team conducted telephone surveys from November 2-8, 2016 and from December 27-30, 2016, targeting the 73 known private facilities with truck parking. This survey verified or corrected our parking estimates for the facility, determined whether the facility was at capacity every night, estimated how many spaces were available during the day, determined when spaces were available, and inquired whether the manager knew if the location had plans to expand truck parking.

Source: Raleigh News Observer.

Parking Space Count

The CS Team looked at aerial images of private facilities via Google Maps, and counted the number of available truck parking spaces. The team then compared these estimates with the responses from those facilities. 90 percent of survey respondents provided an estimate that generally aligned with the CS Team's count.

Although estimating via aerial imagery in Google Maps is less precise than visiting each site individually, the process of comparing our results to the respondents' estimates confirmed that our method was generally representative of the available parking at private facilities in North Carolina.

When Spaces are Not Available

Respondents reported that 72 percent of parking facilities were at capacity at night. Approximately 58 percent of those facilities reported to be full on the weekends, while only 19 percent were "at capacity only during the week." All spaces are on a first come, first served basis. The exception to this occurs at two facilities that will accept advance reservations, but this is more the exception than the rule.

When Spaces are Available

Our surveys revealed that facilities typically began to reach capacity from 4:00 p.m. to 9:00 p.m., though it varies by location. Locations along interstates and large facilities with higher capacity seemed to fill up more frequently during the week than facilities with fewer than 30 spaces.

Planned Parking Expansion

Parking expansion is not expected at 73 percent of facilities surveyed. Some of the facilities that are expected to expand include WilcoHess facilities, which are being bought out by Pilot. They reported expansion to begin at several sites in 2017. Of the remaining facilities, half planned to expand but had not begun the process, 25 percent could not expand due to existing access limitations and 25 percent reported expansion efforts already underway.

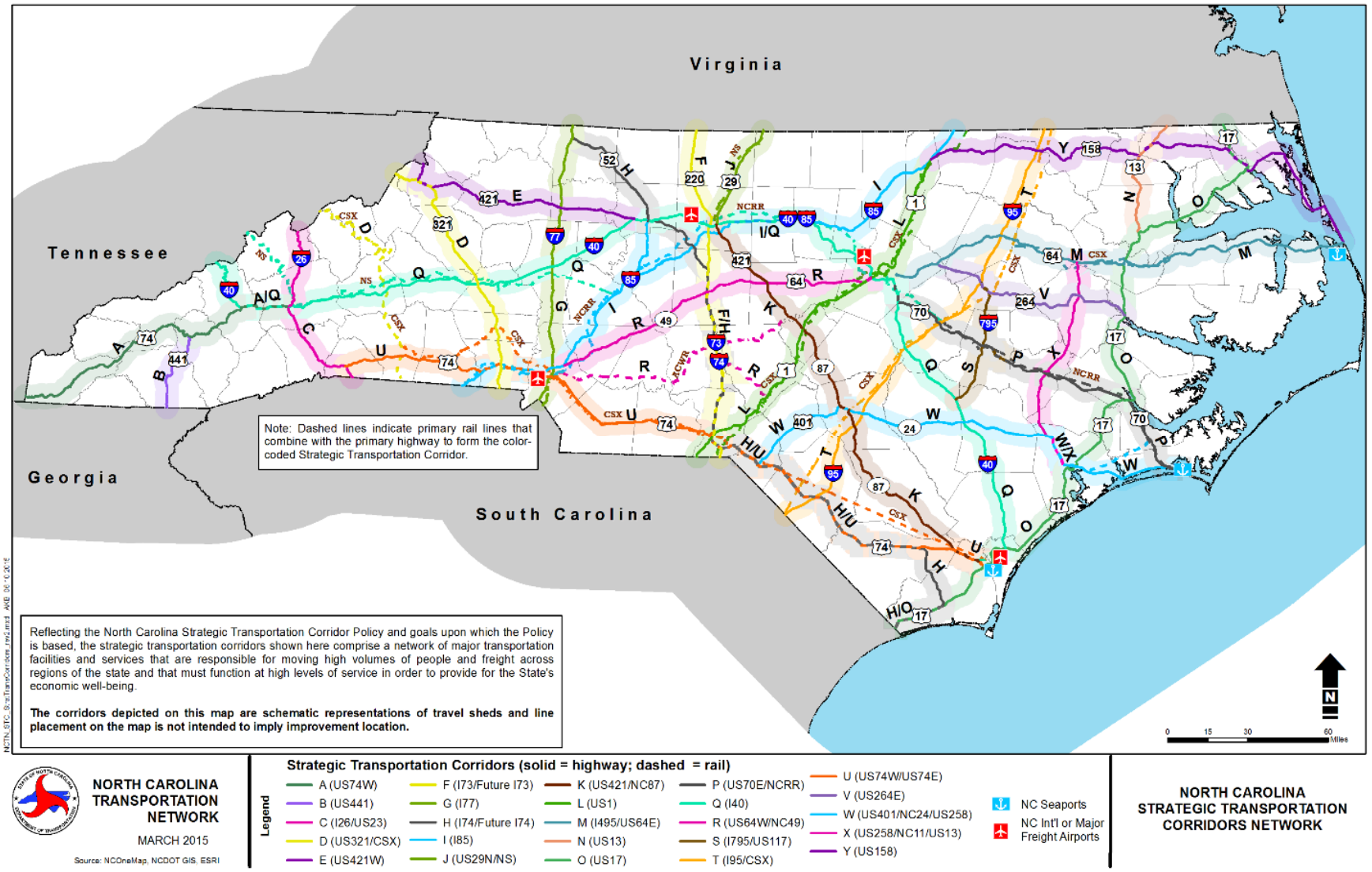
3.0 Truck Parking Supply in North Carolina

Truck parking supply refers to the number of authorized truck parking spaces capable of meeting truck parking requirements. To assess the truck parking supply, the study team collected data on existing public and private sector truck parking facilities, including location, number of parking spaces and available amenities.

3.1 Truck Parking Availability along Major Corridors

Truck parking in North Carolina primarily occurs primarily along the major truck corridors in the state. These corridors can be identified in the context of the North Carolina Strategic Transportation Corridors (STC) network, as shown in Figure 3.1. The STC represents a future network of 25 high-priority, integrated multimodal facilities (links) promoting efficient, reliable connectivity to critical transportation and economic activity centers (nodes) throughout the state. Links include Interstate and U.S. highways, Class I railroads, select short line railroads and nodes consist of connections to International airports, major seaports, and other transportation terminals. Freight activity was a primary element of the development of the STC network as high-truck volume corridors were identified as part of the analysis. Therefore, this section presents the driving factors impacting truck parking, such as truck volumes, freight generators, public and private parking facilities, and truck crash rates.

Figure 3.1 North Carolina Strategic Transportation Corridors



Source: NCDOT

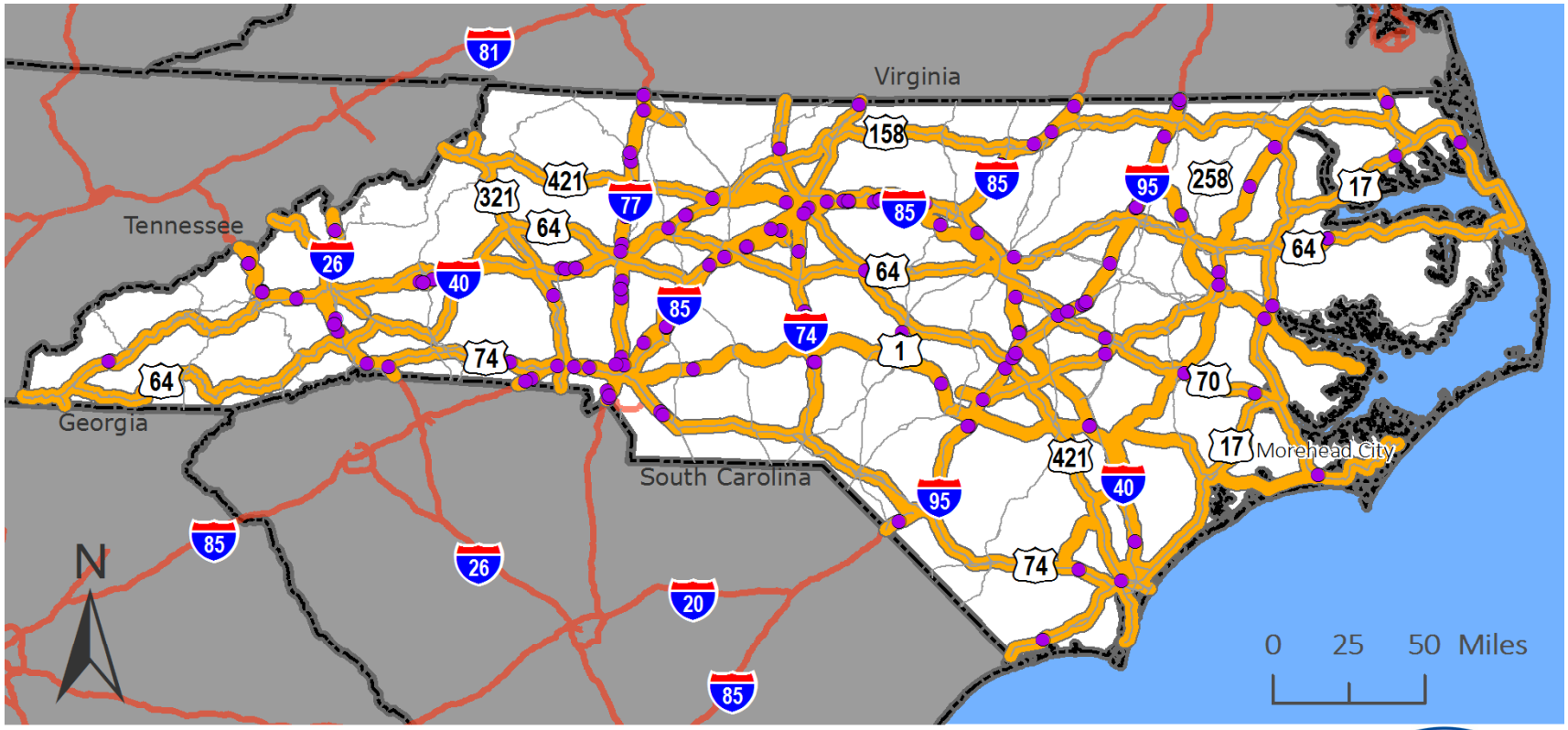
To better understand the truck parking situation in North Carolina, we identified all the STC corridors along which truck parking facilities are located. The CS Team also considered other highways not on a STC corridor where truck parking facilities were identified. These corridors are listed in Table 3.1 and displayed in Figure 4.2. Further analysis revealed that most of these corridors matched the STC system except for NC-11 and NC-13. Interstates are listed in descending order based on the number of truck parking facilities. Note that this does not always result in that corridor having a larger share of total truck parking spaces.

Table 3.1 List of North Carolina Corridors with Truck Parking within Two Miles

Corridor	No. Truck Parking Facilities	No. Truck Parking Spaces
I-40	35	852
I-85	26	523
I-95	24	1,216
I-77	17	405
I-26	10	154
I-40,85	8	852
US-70	6	44
US-17	5	47
US-13	4	135
I-73,74	3	76
I-74	3	10
NC-24	3	45
US-220	3	103
US-421	3	21
US-74	3	111
US-64	2	17
I-440	1	Variable
NC-11	1	10
NC-33	1	10
US-1	1	15
US-158	1	4
US-19	1	3
US-220,311	1	53
US-264	1	10
US-29	1	10
US-321	1	35
US-74,76	1	22
US-77	1	Variable
Total	**167**	**4,783**

Source: Cambridge Systematics.

Figure 3.2 North Carolina Strategic Corridors with Truck Parking Facility within Two Miles



Corridors with Truck Parking Spaces in North Carolina

- Truck Parking Space
- 2-mile Buffer Around Corridors with Truck Parking

Source: NCDOT

Table 3.2 lists the counties in North Carolina that have at least one truck parking facility. Of the 100 counties in the state, 64, or 64 percent of the counties have at least one authorized truck parking facility.

Table 3.2 Counties with Truck Parking

Alamance	Craven	Haywood	Orange	Vance
Beaufort	Cumberland	Henderson	Pasquotank	Wake
Bertie	Currituck	Hertford	Pender	Warren
Brunswick	Davidson	Iredell	Perquimans	Washington
Buncombe	Davie	Johnston	Pitt	Wayne
Cabarrus	Duplin	Lee	Polk	Wilkes
Camden	Durham	Lenoir	Randolph	Wilson
Carteret	Edgecombe	Madison	Robeson	Yadkin
Caswell	Forsyth	McDowell	Rockingham	
Catawba	Gaston	Mecklenburg	Rowan	
Chatham	Granville	Montgomery	Sampson	
Cherokee	Guilford	Nash	Stanly	
Cleveland	Halifax	New Hanover	Surry	
Columbus	Harnett	Northampton	Union	

3.2 Truck Parking Inventory

Truck parking facilities in North Carolina include public rest areas, privately owned and operated truck stops, and selected businesses that allow for truck parking. To obtain this information, the CS Team identified several data sources containing truck parking location information in North Carolina, including online websites and applications that report both available public and private truck parking stops, aerial photography of private facilities and NCDOT inventories that documented public truck parking facilities, including rest areas and weigh stations. All the data sources reviewed had either geographical information (i.e., latitude and longitude) or the address of truck parking locations in their database.

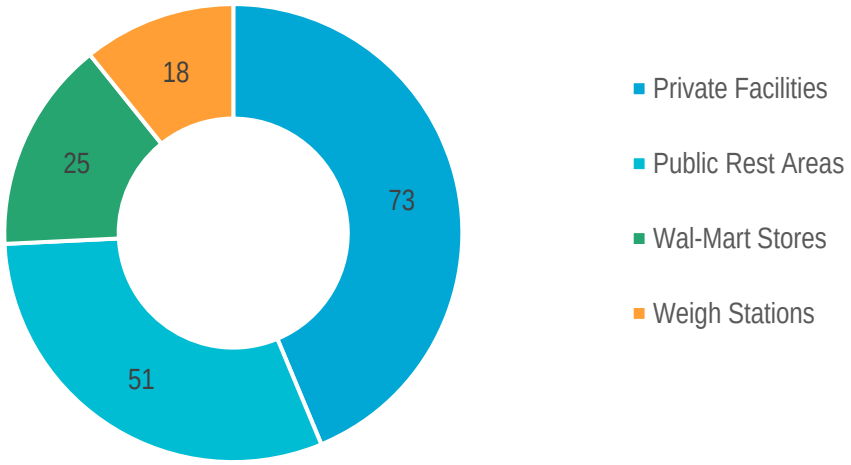
Source: Charlotte Observer.

Figure 3.3 presents the breakout of identified truck parking by type. The private sector controls most of the truck parking supply (85 percent) in the state. A detailed listing of truck parking facilities and their attributes is provided in Appendix B. Overall, the CS team identified 167 truck parking facilities, including 73 privately

owned and operated facilities with 4,064 spaces, 51 public rest areas with 719 spaces, 25 Wal-Mart Stores with 38 spaces and 18 weigh stations with 27 parking spaces.[9] The privately owned truck stops have many amenities to cater to truck drivers, including large truck parking lots designed for wide turning vehicles, restaurants, convenience stores, diesel fuel facilities, restrooms and showers. The public rest areas also have designated truck parking areas, restrooms and vending machines.

Approximately 10 percent of Wal-Mart stores in North Carolina allow trucks to park overnight. This is largely at the discretion of the store manager and primarily includes those stores that are open 24 hours per day. Parking availability at Wal-Mart stores also varies by site; as some stores have dedicated parking lots while other share parking with other stores. The Wal-Mart website maintains an inventory of those stores, which allow overnight truck parking, and those that do not allow it. Wal-Mart also encourages recreational vehicles to use their parking sites during overnight hours.

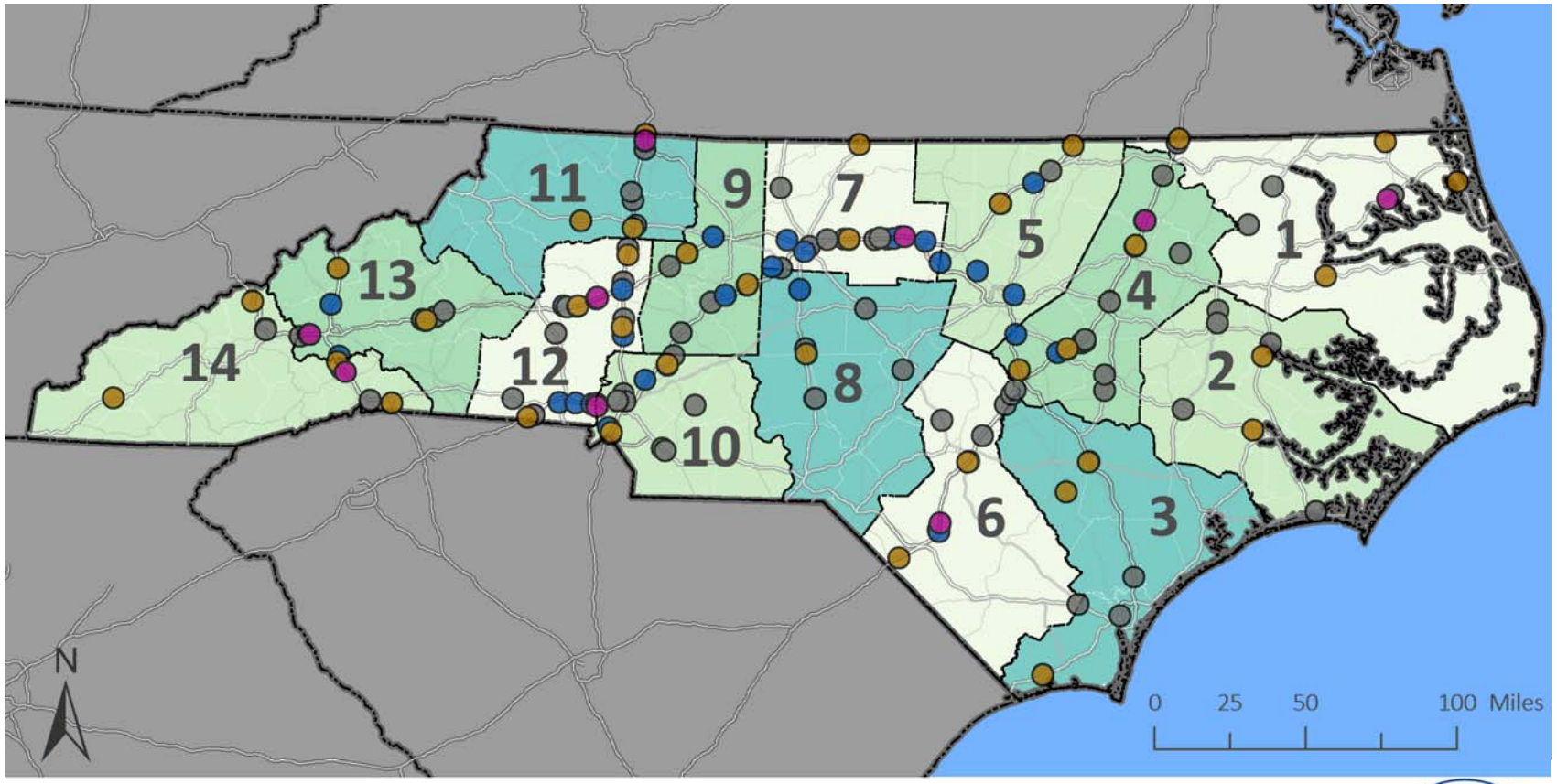
Figure 3.3 North Carolina Truck Parking Facilities by Type



The CS Team used the following criteria to identify truck parking: 1) sites with large trucks identified on Google Maps, (i.e., class 8 and above in FHWA vehicle classification) and 2) sites that allow overnight parking according to online truck parking sites. Figure 3.4 displays the location of public and private sector truck parking facilities. Table 3.3 illustrates the number of available truck parking by sector for each NCDOT division. For example, in Division 1, there are four private parking facilities, four public parking facilities, zero Wal-Marts, and one weigh station. It is important to note that "0" for Wal-Marts means that there were no Wal-Mart facilities that allowed truck parking, and "0" for weigh station means that there were no weigh stations in the division.

[9] The CS Team estimated an average of 1-2 parking spaces available at selected Wal-Mart stores and weigh stations.

Figure 3.4 Public and Private Truck Parking Locations by NCDOT Division



Truck Parking Facilities and NCDOT Divisions

- Private Parking Facilities (73)
- Public Rest Areas and Visitor Centers (52)
- Wal-Mart Stores* (25)
- Weigh Station (17)

*Confirmed to allow overnight truck parking

Source: NCDOT and Consultant analysis.

Table 3.3 Truck Parking Facilities by NCDOT Division

NCDOT Division	Private Facilities	Public Facilities	Wal-Mart[10]	Weigh Station	Total
1	4	4	0	1	9
2	5	2	0	0	7
3	3	3	0	0	6
4	8	6	2	2	18
5	1	3	4	0	8
6	7	3	1	2	13
7	10	3	5	2	20
8	5	2	1	0	8
9	3	4	2	0	9
10	8	3	2	3	16
11	4	3	0	2	9
12	7	6	6	2	21
13	4	3	2	2	11
14	4	6	0	2	12
Total	**73**	**51**	**25**	**18**	**167**

Source: NCDOT.

3.2.1 Public Truck Parking Facilities

There are 51 public rest areas with 719 truck parking spaces in North Carolina. The NCDOT Road Environmental Unit maintains these public rest areas. These facilities are evenly spaced throughout the state and exist even in remote areas. Each site has restrooms, vending machines, and designated automobile and truck parking spaces.

In 2014, AASHTO conducted research for Jason's Law and requested truck parking utilization rates from multiple states. In response to this request, NCDOT conducted a survey of public parking facilities to determine utilization rates. Survey results confirmed nearly all the rest areas were full to capacity between 7:00 p.m. and 5:00 a.m., with the exception of rest areas in Randolph and Brunswick Counties, (50 to 100 percent full), and Camden, Caswell, Dare, Macon, Madison, Sampson and Wilkes Counties (0 to 50 percent full).[11]

A limited amount of truck parking occurs at weigh stations. This is likely due to the fact that amenities are typically not onsite (no restrooms or vending machines except for three sites), and SHP's focus on documenting truck permitting, taxes, and weights for regulatory purposes, not long term truck parking. The SHP opens and closes weigh stations depending on several factors. First, stations are opened at the discretion of the SHP. Second, weigh stations have limited capacity to inspect trucks, so the stations are

[10] Wal-Mart Stores that are open 24-7 provide limited overnight truck and RV parking at the discretion of the store manager.

[11] NCDOT Survey of Public Rest Areas, Road Environmental Unit, 2014.

often closed shortly after they open. Weigh station hours of service are determined by federal requirements and available staffing. Weigh stations are closed using signs, not barriers, so trucks can access weigh stations to park overnight if there is room. Overnight truck parking at weigh stations occurs in North Carolina on a very limited basis due to the limited parking capacity.

3.2.2 *Private Truck Parking Facilities*

Private sector facilities include Pilot/Flying J, Loves, Kangaroo Express and others. Private truck parking locations provide more information on available amenities at their sites, such as showers, food, shops and fuel. Our review of the private sector facilities revealed:

- 73 privately owned and operated facilities with over 4,700 spaces, with Kangaroo Express, Pilot/Flying J, Loves, and WilcoHess as the primary operators;
- 25 of the 210 Wal-Mart stores (12 percent) in North Carolina allow overnight parking; and
- Respondents to the survey indicated that most of the facilities are full most evenings.

3.3 Summary of Truck Parking Supply

Table 3.5 summarizes the truck parking inventory in North Carolina. In this study, Wal-Marts and weigh stations were considered as truck parking facilities since they allow truck parking on their premises. However, they do not have parking spaces specifically allocated for truck parking with pavement markings. Therefore, the CS Team estimated an average of 1-2 spaces at each Wal-Mart and weigh station in Table 3.4.

Table 3.4 Number of Truck Parking Spaces for Different Facility Types

Facility Type	Number of Truck Parking Facilities	Number of Truck Parking Spaces
Private	73	4,064
Public	51	719
Wal-Mart	25	38*
Weigh Station	18	27*
Total	**167**	**4,783**

Source: Aerial Photography.

* Note: It is estimated that there are between 1 and 2 truck parking spaces at each Wal-Mart and Weigh Station facility.

In total, there are nearly 4,800 authorized truck parking spaces throughout North Carolina. The supply of truck parking aligns with the heaviest traveled truck corridors and tend to cluster around key metropolitan regions. Public and private truck parking facilities vary by NCDOT Division. Most truck parking facilities are located in Division 4 (I-95), Division 12 (I-40 and I-77) and Division 7 (I-40 and I-85). The fewest number of truck parking facilities are located in Divisions 2, 3 and 8, where there are no interstate highways.

4.0 Truck Parking Demand

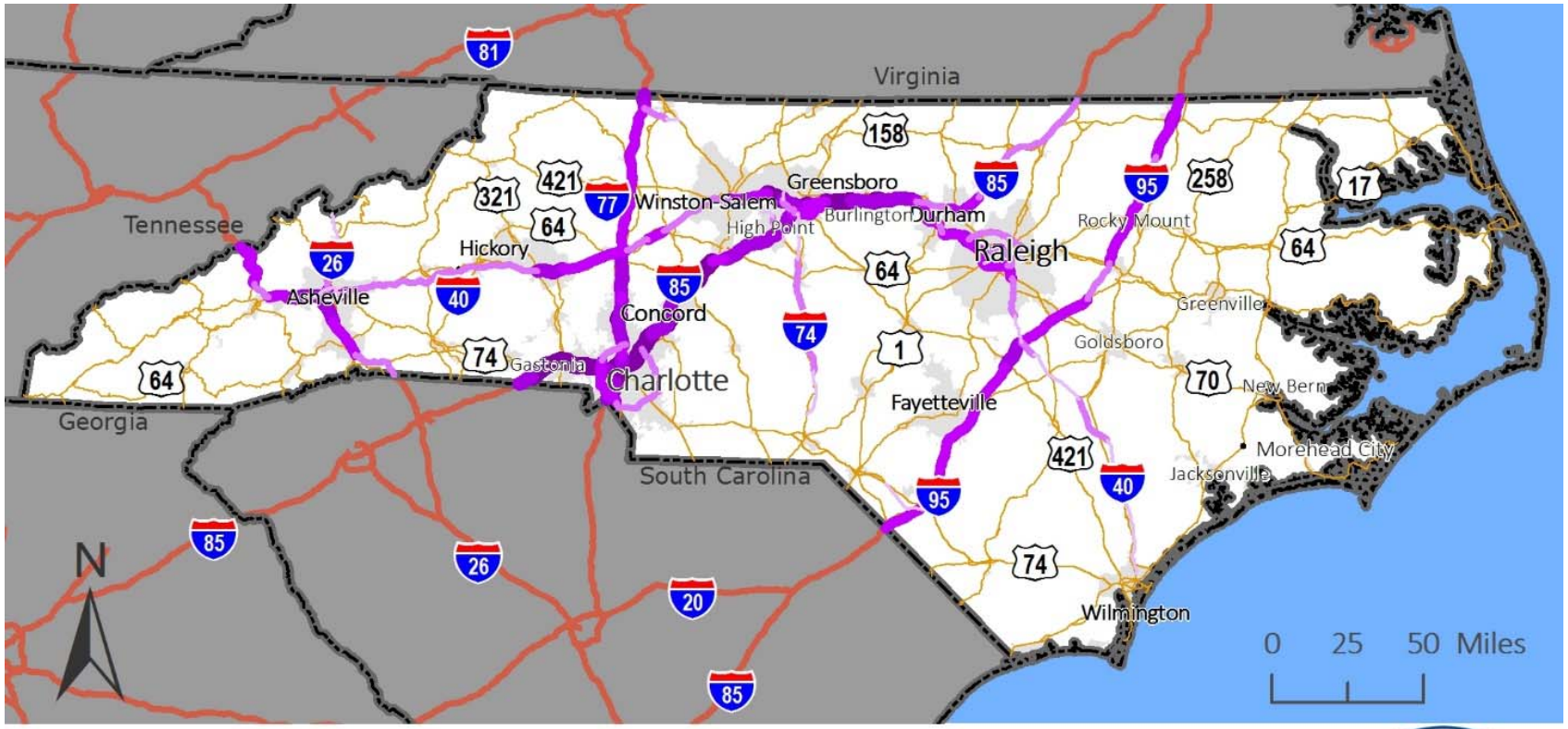
For the purpose of this study, truck parking demand is defined as parking for 45 minutes or longer. To understand demand for truck parking, it is important to understand the underlying number of trucks traveling on the state's roadways, the routes they are using and the reasons they are traveling those routes. To gain insight into these questions, this sections presents data on truck counts, truck routes and establishments that attract and generate truck traffic. This section then presents data on where trucks are parking and the potential safety implications of unauthorized parking.

4.1 Truck Volumes

Truck counts help to identify and corroborate the most significant truck corridors in the state. In Figure 4.1, roadways with higher truck volumes are displayed with heavier lines while those with lower truck volumes are displayed with thinner lines. Roadways with fewer than 500 trucks per day are not shown at all.

Most of North Carolina's truck flows occur on the interstate highway system. In particular, the highest truck volumes in the state are estimated to occur on I-85 between Greensboro and Durham, with over 16,000 trucks per day. Other interstate highways with particularly high truck volumes include I-77, I-40, I-26 and I-95. This matches the information collected by the truck driver survey, with survey respondents indicating the need for additional truck parking along each of these highways throughout North Carolina. I-77 between I-40 and SR 150 and between SR 73 and I-485 experience between 8,000 and 9,000 trucks per day. I-26 south of Asheville experiences similar volumes. I-40 between Winston Salem and Greensboro carries between 8,000 to 11,000 trucks daily. I-95 near its interchange with I-40 carriers nearly 8,500 trucks per day. Since North Carolina is situated in the middle of the Northeast Corridor, a significant portion of north-south truck traffic includes through traffic from the neighboring states of Virginia, South Carolina, Tennessee and Georgia.

Figure 4.1 Truck Volumes on the North Carolina Interstate Highway System



Freight Volumes on the Interstate Highway System

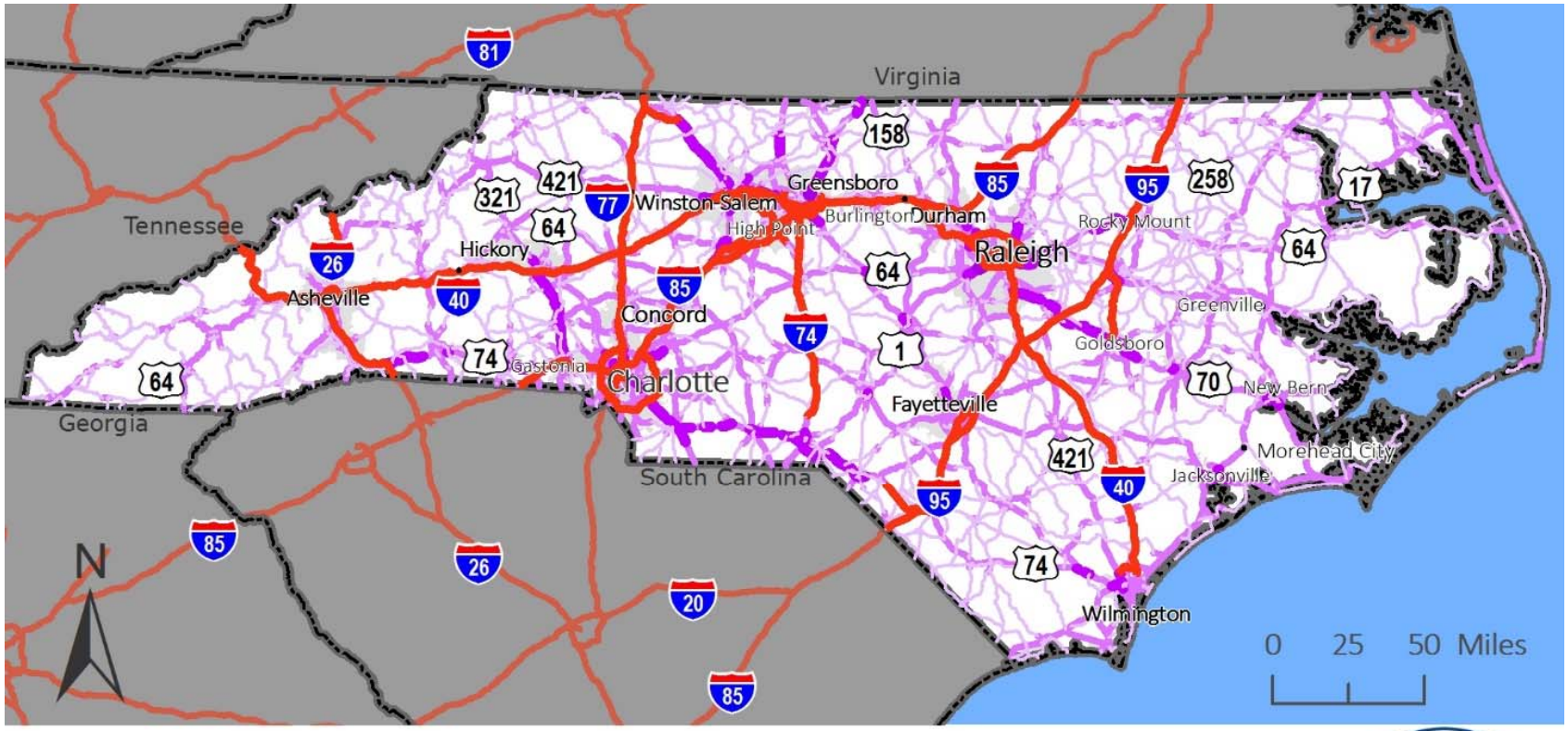
Average Annual Daily Truck Traffic

- <2,500
- 2,501 - 5,000
- 5,001 - 7,500
- 7,501 - 10,000
- 10,001 - 16,000

Source: NCDOT AADT.

Several non-interstate highways are important freight corridors as indicated by daily truck volumes displayed in Figure 4.2. Some of these highways achieve daily truck volumes that are comparable to those experienced by the interstate highway system. Among the largest non-interstate highway freight corridors are U.S. 74 and U.S. 70, which provide east-west connectivity over the southern portion of North Carolina and between Morehead City and Raleigh, respectively. These highways exhibit freight flows that approach those of interstate highways. At its busiest, portions of U.S. 74 transports nearly 5,000 trucks per day. U.S. 70 carries nearly 3,000 trucks daily along its busiest portions. This level of freight activity correlates to the fact that those highways connect major metro areas and distribution hubs and freight generators (in places like Charlotte and Raleigh/Durham) with the North Carolina Ports (such as in Wilmington and Morehead City).

Figure 4.2 Truck Volumes on Non-Interstate Highways



Freight Volumes on Non-Interstate Highways

Average Annual Daily Truck Traffic

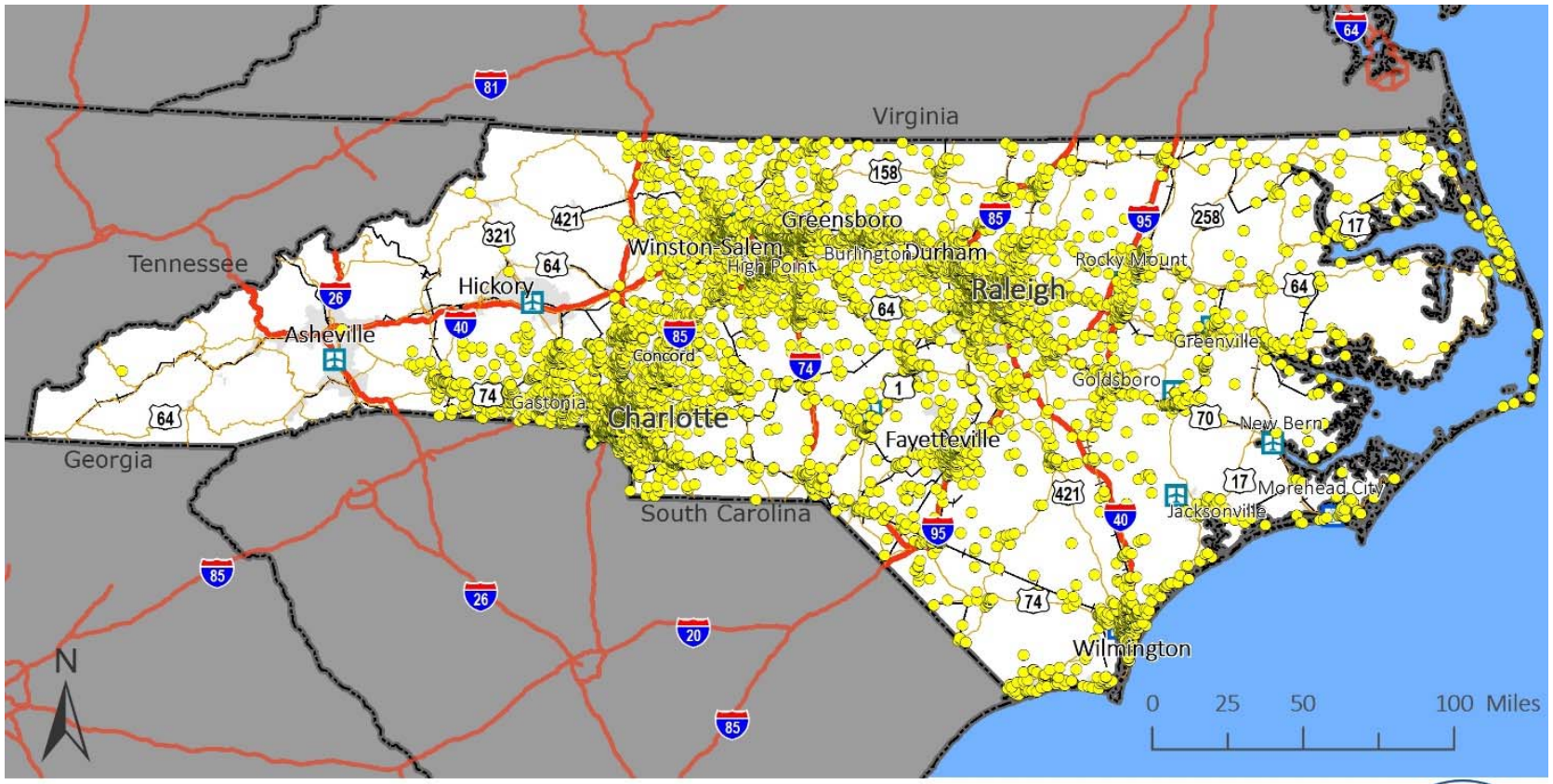
- <500
- 501 - 2,500
- 2,501 - 7,500
- 7,501 - 10,000
- 10,001 - 16,000

Source: NCDOT AADT

4.2 Freight Generators

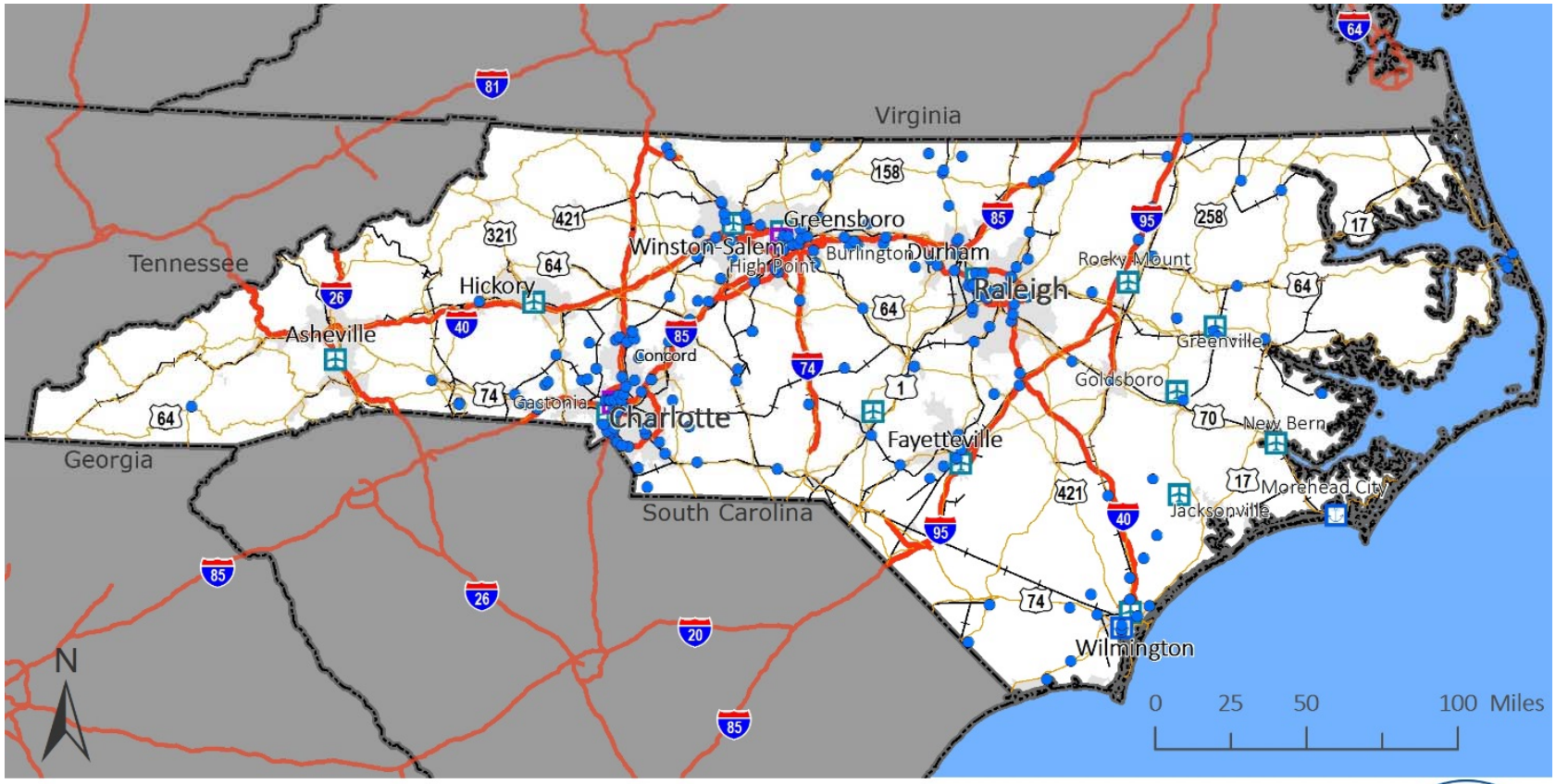
Another factor affecting truck parking facility locations includes freight generators, or freight intensive industries, in addition to mining/quarry facilities. Truck parking occurs near freight generators as drivers wait to either pick up or drop off deliveries. Some businesses allow truck drivers to park before or after they deliver their loads. Examples include Wal-Mart stores and food distribution centers. Other businesses do not allow for this type of parking, requiring drivers to seek alternative solutions for truck parking. The following four maps, Figure 4.3 through Figure 4.6, depict locations of freight-intensive industries in the state by economic sector. For purposes of this analysis, freight-intensive industries are defined as those with primary North American Industry Classification System (NAICS) codes corresponding to Manufacturing, Construction, Wholesale Trade, Transportation and Warehousing, Agriculture, and Mining. Largely, these facilities are clustered in the State's major metropolitan regions: Charlotte, the Triangle, Triad, Fayetteville and Wilmington regions.

Figure 4.3 Freight-Intensive Industries by Economic Sector – Manufacturing



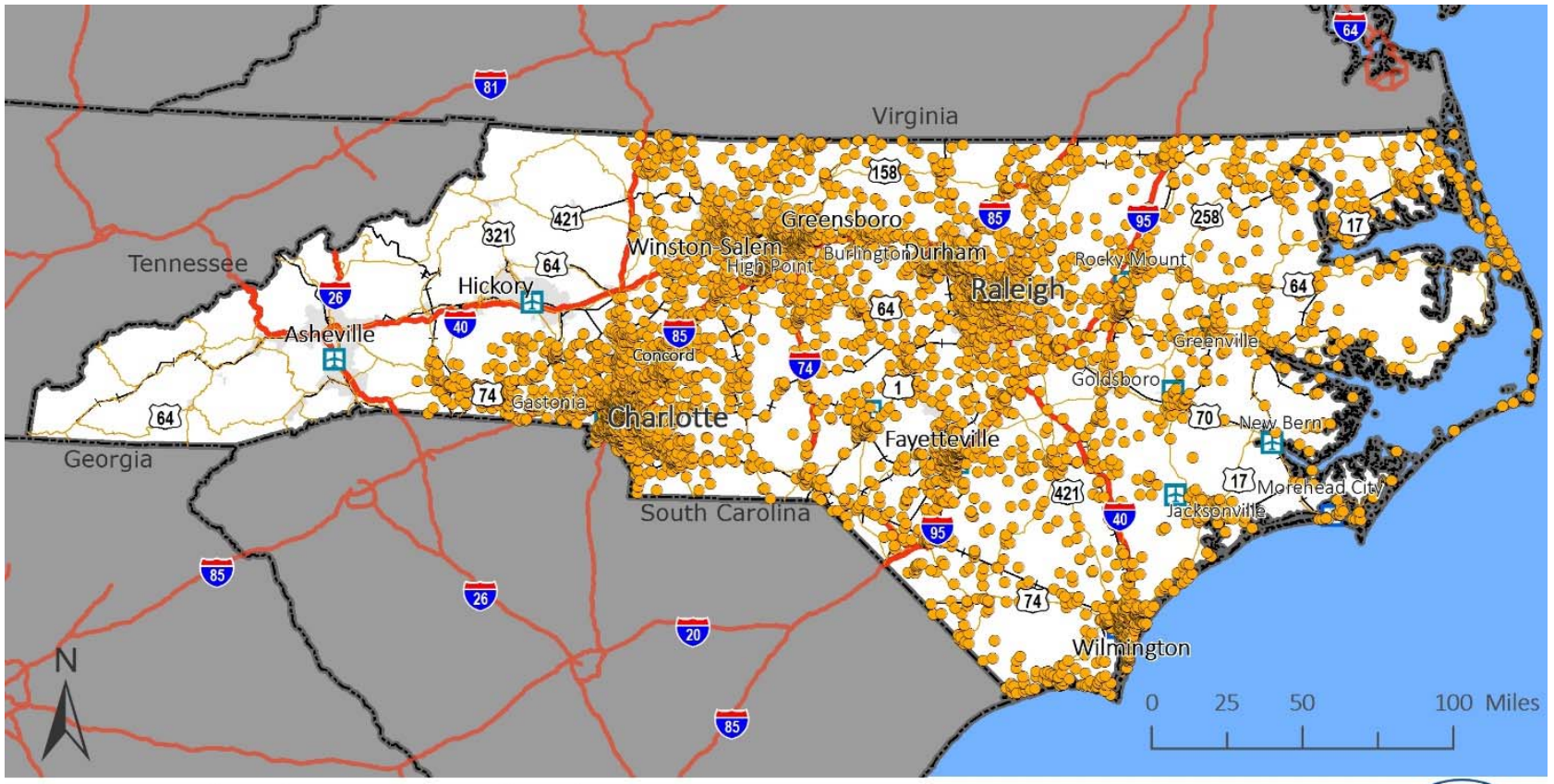
Source: Info USA.

Figure 4.4 Freight-Intensive Industries by Economic Sector – Mining/Quarries



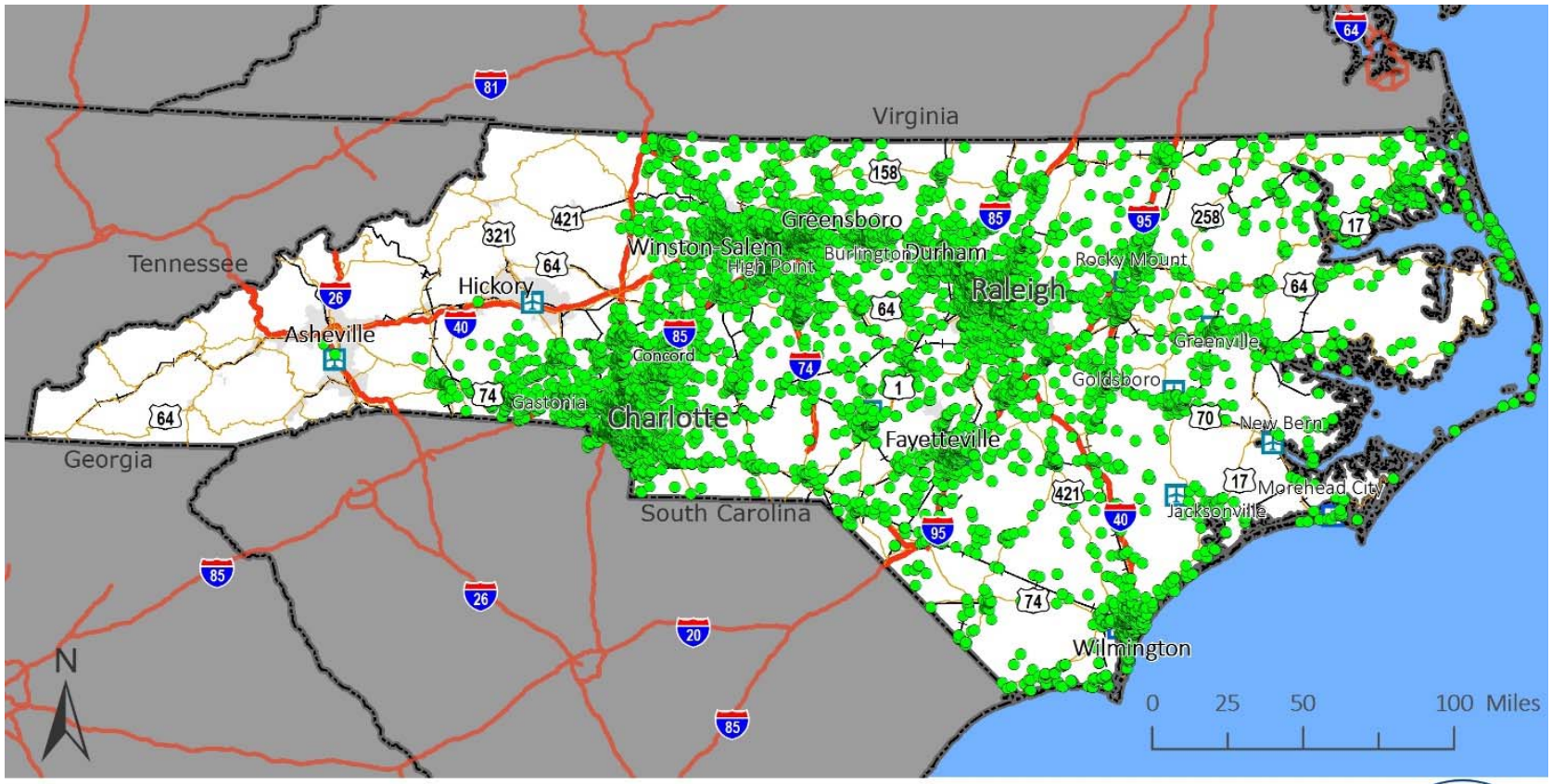
Source: Info USA

Figure 4.5 Freight-Intensive Industries by Economic Sector – Transportation/Warehousing



Source: Info USA.

Figure 4.6 Freight-Intensive Industries by Economic Sector – Wholesale Trade

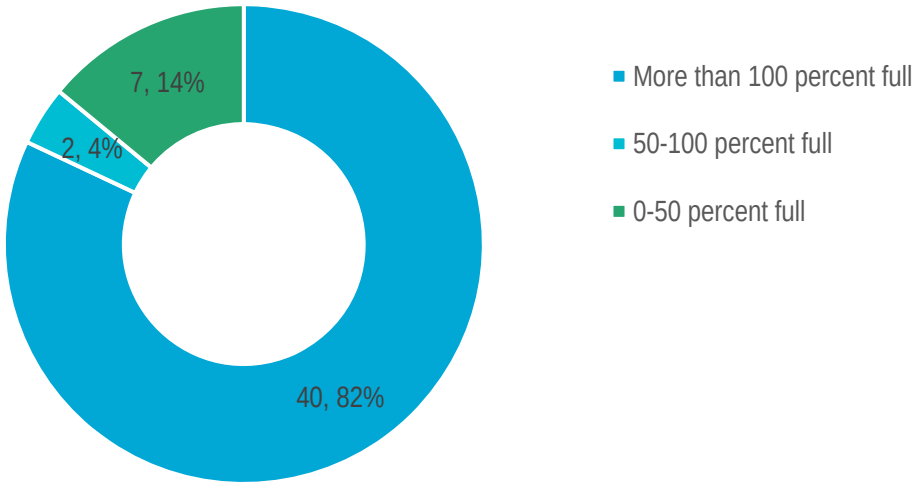


Source: Info USA.

4.3 Public Parking Facility Demand

In 2014, AASHTO was conducting research for Jason's Law and requested parking utilization rates from multiple states. In response to this request, NCDOT conducted a survey of 49 public parking facilities to determine utilization rates. A total of 47 out of 49 public parking facilities were included in the truck parking inventory developed by the CS Team. The two parking facilities that were not included were in remote locations and therefore had low utilization rates. Survey results, summarized in Figure 4.7, confirmed nearly all, or 86 percent of the rest areas were "more than 100 percent full" between 7:00 p.m. and 5:00 a.m., with the exception of rest areas in Randolph and Brunswick Counties, (50 to 100 percent full), and Camden, Caswell, Dare, Macon, Madison, Sampson and Wilkes Counties (0 to 50 percent full).[12] During the summer months of June, July and August and in December, public rest areas in six counties were more than 100 percent full. This included rest areas McDowell, Mecklenburg, Nash, Northampton, Polk and Randolph Counties.

Figure 4.7 Public Parking Facility Demand



Source: NCDOT REU.

4.4 Private Parking Facility Demand

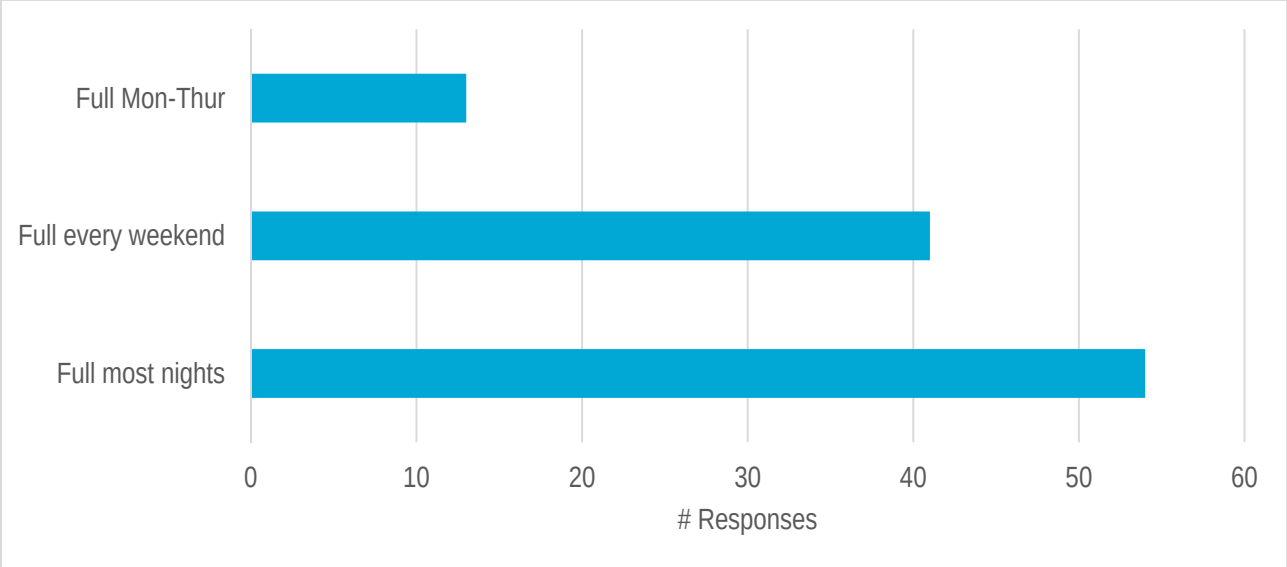
Between November 2 to 8, and between December 27-30, 2016, CS staff contacted representatives from 73 private truck parking facilities in the study area and obtained responses from 67 representatives, for a response rate of 92 percent. As shown in Figure 4.8, of those surveyed, 74 percent of respondents said they were "full most nights." 58 percent indicated they were "full every weekend," and 19 percent indicated they were "full only from Monday through Thursday" during the week.

These results indicated that private truck parking facilities are full most nights, and that there are different demands on parking capacity depending on the day of the week. This is largely due to the fact major

[12] NCDOT Survey of Public Rest Areas, Road Environmental Unit, 2014.

distribution centers often have weekday-only hours of operation. During the course of the survey, it was discovered that all North Carolina Pilot Travel Center stores were conducting a truck parking survey during the week of November 7, 2016 for the "Park My Truck" application currently under development by the Truck Parking Leadership Initiative. Store representatives counted available spaces three times daily for a period of one week to determine Pilot truck parking utilization rates.

Figure 4.8 Private Parking Facility Demand



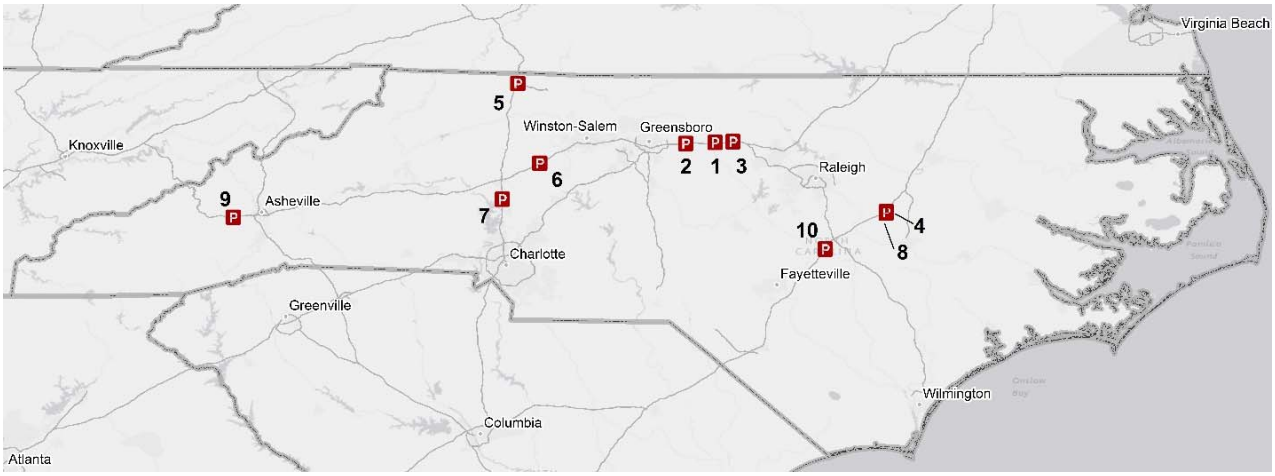
Source: CS.

4.5 GPS-Based Truck Parking Demand Analysis

ATRI truck GPS data and the parking location files for the 167 identified parking locations developed by the team were processed together in order to identify the top parking locations. For this analysis, an "official" stop at a parking location is classified to be between 8 and 38 hours. This stop time is partially based on historic experience, industry operational models and by the HOS regulations. The minimum of 8 hours is to account for the 8 to 10 hour rest break required of drivers after driving a full 11 hours. The maximum of 38 hours is to account for the 34 hour restart required of drivers after driving 60/70 hours for 7/8 consecutive days. A base line of 1,000 trucks across all locations was applied to determine the parking rate of the top ten parking locations. This base line is a way to normalize the number of trucks at each parking location in order for each facility to be directly comparable to one another. For example, the top ranked parking location, Pilot, has 58 trucks parking at this facility for every 1,000 trucks spread across all parking locations studied.

The remaining 942 trucks are considered parked at other parking facilities. The team also studied the average length of time that truck drivers remained at one parking location. Both results, relative volume and average length of time at the parking location, are presented in Figure 4.9 and the accompany Table 4.1.

Figure 4.9 Top 10 Parking Locations in North Carolina



Source: ATRI.

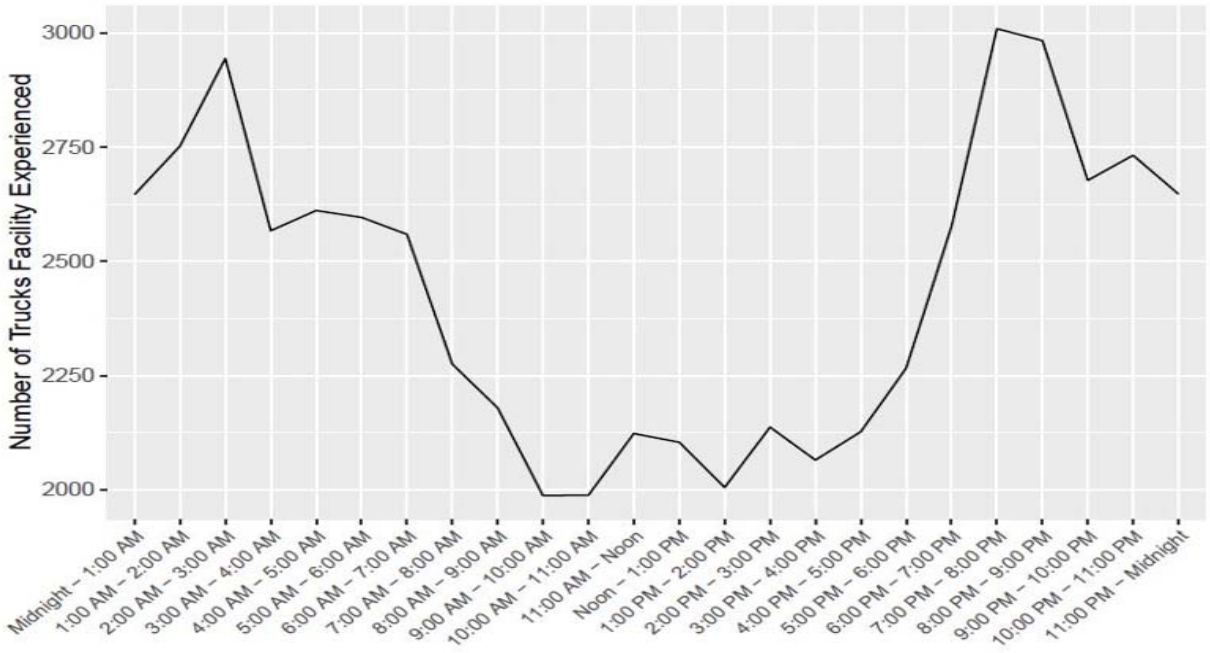
Table 4.1 Parking Location Average Stop Time and Relative Volume

Parking Rank	Parking Name	Average Time Stopped (Hours)	Relative Volume (Stopped trucks per 1,000 trucks)
1	Pilot	13.03	58
2	Travel Centers of America	13.43	55
3	Petro Mebane	13.13	55
4	Metro Kenly	13.03	53
5	Pilot	12.09	50
6	Travel Centers of America	13.49	44
7	WilcoHess	12.90	35
8	Flying J	12.99	34
9	Candler Travel Center	12.37	29
10	Pilot	12.93	28

Source: ATRI.

To better illustrate the challenges of finding parking at these top ten locations, Figure 4.10 shows the number of trucks per hour of the day for the top parking facility (Rank #1 – Pilot) as an example. As expected, parking frequency at each location dramatically increases in the late afternoon to early evening timeframe and reaches peak frequency around 8:00 PM. This graph demonstrates that a driver's schedule, break time and even compensation, are often dictated by the hour of the day in which they are able to find truck parking. The number of trucks per hour of the day graphs for the rest of top parking facilities are included in Appendix C.

Figure 4.10 Top Truck Parking Location (Rank #1- Pilot), Parking per Hour of Day



Source: ATRI.

Since the top ten parking locations were all associated with private parking facilities, the research team looked at the breakdown in other types of parking facilities. Table 4.2 shows the top three parking locations, average time stopped and relative volume for each of the following type of facilities: rest areas, Wal-Mart stores and weigh stations.

Table 4.2 Other Types of Parking Facilities and Rankings

Rank	Name/Location	Nearest Interstate	Average Time Stopped (hours)	Relative Volume (per 1,000 Trucks)
Public Parking				
1	Rest Area: Iredell / Yadkin Counties	I-77 North	10.90	5
2	Rest Area: Cumberland County	I-95 North	11.35	4
3	Rest Area: Cabarrus County	I-85 North	11.38	4
Wal-Mart				
1	Wal-Mart: Belmont	I-85	10.67	4
2	Wal-Mart: Charlotte	I-485	10.84	3
3	Wal-Mart: Mooresville	I-77	11.60	3
Weigh Station				
1	Weigh Station: Charlotte	I-85 North	11.63	1
2	Weigh Station: Mount Airy	I-74 East	9.78	1

Rank	Name/Location	Nearest Interstate	Average Time Stopped (hours)	Relative Volume (per 1,000 Trucks)
3	Weigh Station: Charlotte	I-85 South	13.81	1

Source: ATRI.

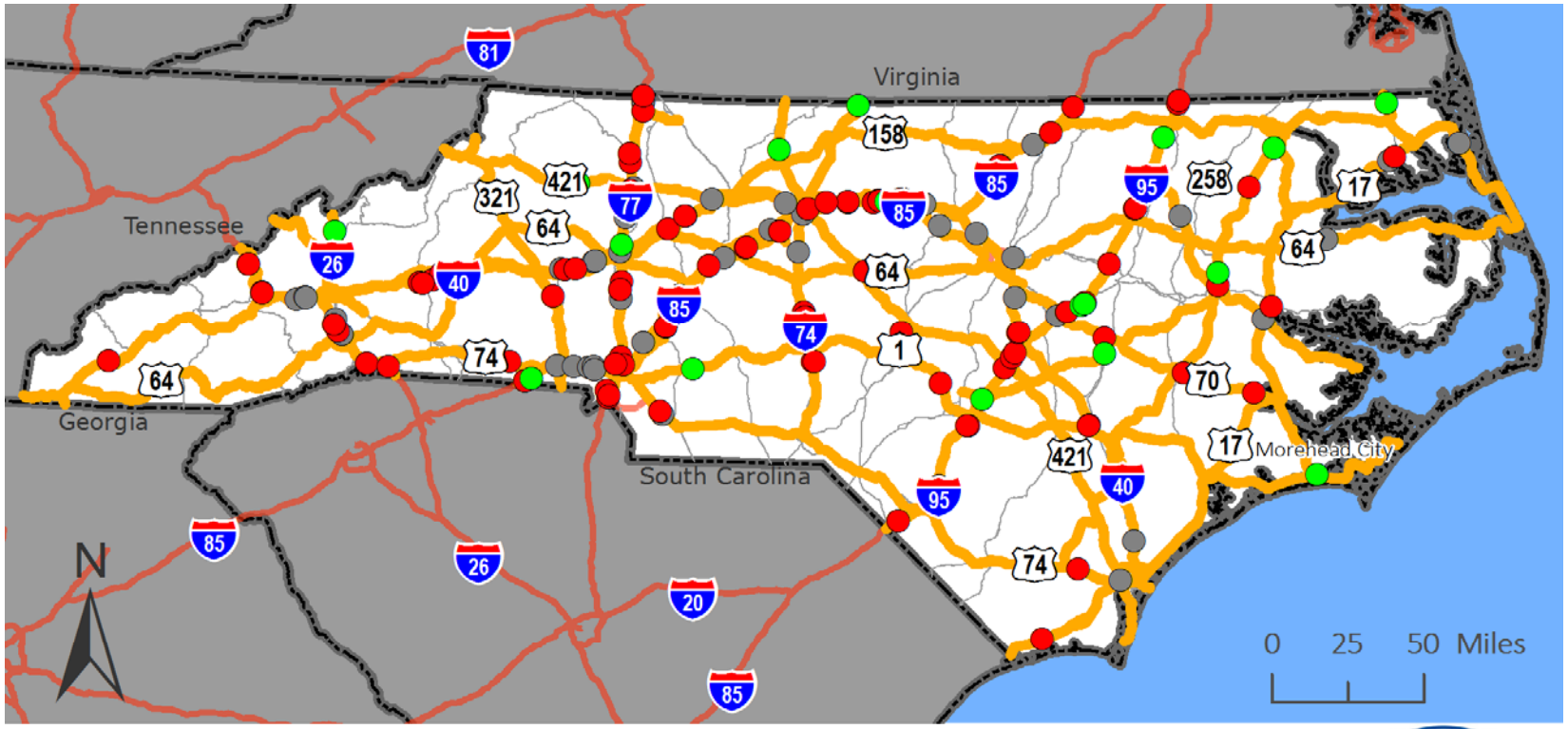
Results indicate the top truck parking locations are clustered in the central part of North Carolina. In addition, two of the ten parking locations are close to the Virginia and Tennessee state borders. These near-border locations may be highly frequented parking locations due to different freight regulations between each state. For example, over-sized/over-weight vehicles are not allowed to travel at night in North Carolina; however, this is not the case in Virginia. All parking locations are adjacent to the following four major interstates: I-77, I-85, I-40 and I-95. The parking frequency along these four interstates match the North Carolina Truck Parking survey results, with respondents indicating the need for additional truck parking along each of these highways throughout North Carolina. Truck GPS point data showed parking per hour of the day with a drastic increase in the number of trucks parking during the evening hours. This point data echoes survey respondents who indicated the most difficult time to find truck parking is during the evening hours.

4.6 Identifying Gaps on Study Corridors

The results of the truck parking demand analysis are displayed in Figure 4.11. The definition of “full parking facilities” on this map means that the facility is full at least Monday through Thursday. Full parking facilities are depicted in red, available spaces in green, and spaces without utilization information in gray. The CS Team contacted private parking facility managers to obtain utilization rates for private facilities. Corridors at capacity for truck parking include I-26, I-77, I-85 and most of I-95. Therefore, these corridors should be the focus of acquiring additional parking facilities or expanding existing facilities. This correlates with the high truck volumes on those corridors and the large concentrations of distribution facilities in Charlotte, Greensboro and Raleigh areas.

It is worth noting that although a facility may report that spaces are full, they may not actually be filled with a parked truck. The NCTA confirmed that some larger carriers have parking provisions in their fuel contracts with the larger private facility operators. Therefore, some spaces are reserved for these carriers and will not be available for use by others even if they are empty. The study team was not able to confirm the extent to which this actually results in unused spaces. However, it does open up the potential for a truck parking clearinghouse by which carriers could sell off their excess or unused parking on a nightly basis.

Figure 4.11 Truck Parking Utilization in North Carolina



Truck Parking Utilization

- Available Truck Parking Space
- Full Truck Parking Space
- Truck Parking Space without Utilization Information
- Corridors with Adjacent Truck Parking Space

Source: NCDOT and CS

Table 4.3 summarizes truck parking demand and capacity information for highly utilized facilities.

Table 4.3 Truck Parking Supply and Demand Summary Table

Rank	Name/Location	Nearest Interstate	Avg Time Stopped (hours)	Frequency (per 1,000 Trucks)	Capacity (# Truck Parking Spaces)
Private Parking					
1	Pilot	I-40,85	13.03	58	140
2	Travel Centers of America	I-40	13.43	55	186
3	Petro Mebane	I-40,85	13.13	55	285
4	Metro Kenly	I-95	13.03	53	250
5	Pilot	I-77	12.09	50	150
6	Travel Centers of America	I-40	13.49	44	134
7	WilcoHess	I-77	12.90	35	84
8	Flying J	I-95	12.99	34	145
9	Candler Travel Center	I-40	12.37	29	106
10	Pilot	I-95	12.93	28	300
Public Parking					
1	Rest Area: Iredell / Yadkin Counties	I-77 North	10.90	5	11
2	Rest Area: Cumberland County	I-95 North	11.35	4	18
3	Rest Area: Cabarrus County	I-85 North	11.38	4	21
Wal-Mart					
1	Wal-Mart: Belmont	I-85	10.67	4	Variable
2	Wal-Mart: Charlotte	I-485	10.84	3	Variable
3	Wal-Mart: Mooresville	I-77	11.60	3	Variable
Weigh Station					
1	Weigh Station: Charlotte	I-85 North	11.63	1	Limited
2	Weigh Station: Mount Airy	I-74 East	9.78	1	Limited
3	Weigh Station: Charlotte	I-85 South	13.81	1	Limited

4.7 Truck Safety

Truck crash data over the 2011 to 2015 time period was analyzed as part of the North Carolina Statewide Freight Plan and as part of the Truck Parking Study. Over this five-year period, a total of 48,878 truck-involved crashes occurred in the State. Figure 4.12 illustrates that the total number of crashes increased each year. As shown in Table 4.4, ten counties accounted for half of all truck crashes in the State over the five-year period. This is consistent with the same counties through which trucks travel in the highest volumes and in which the highest concentration of freight generators are located.

Figure 4.12 Truck Crashes by Year, 2011 - 2015

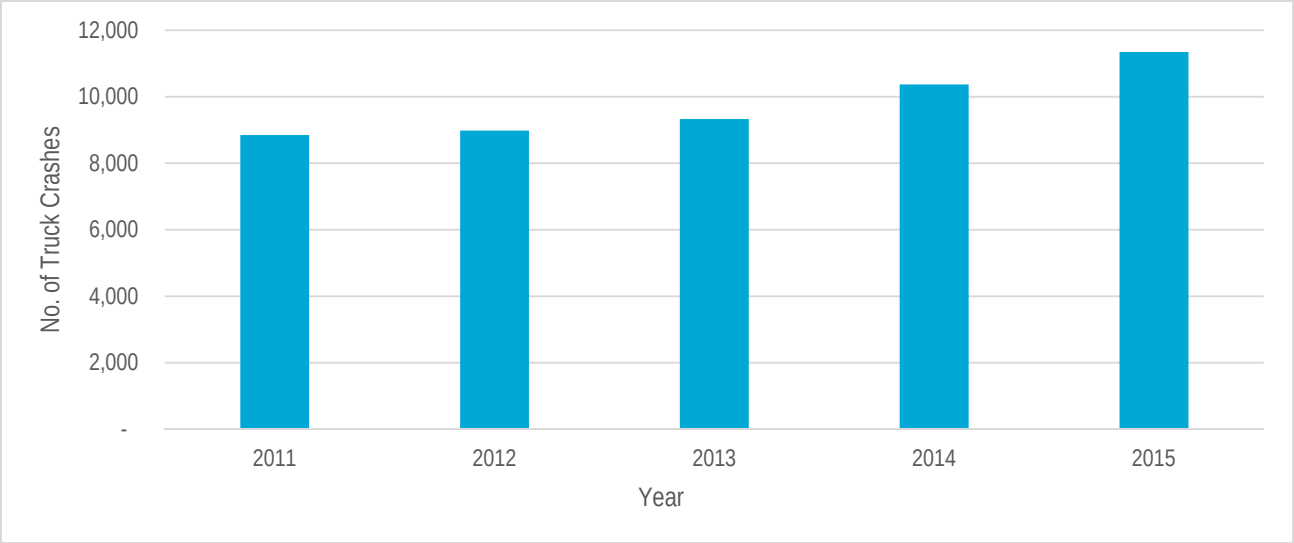


Table 4.4 Top Ten Counties by Truck Crashes, 2011 to 2015

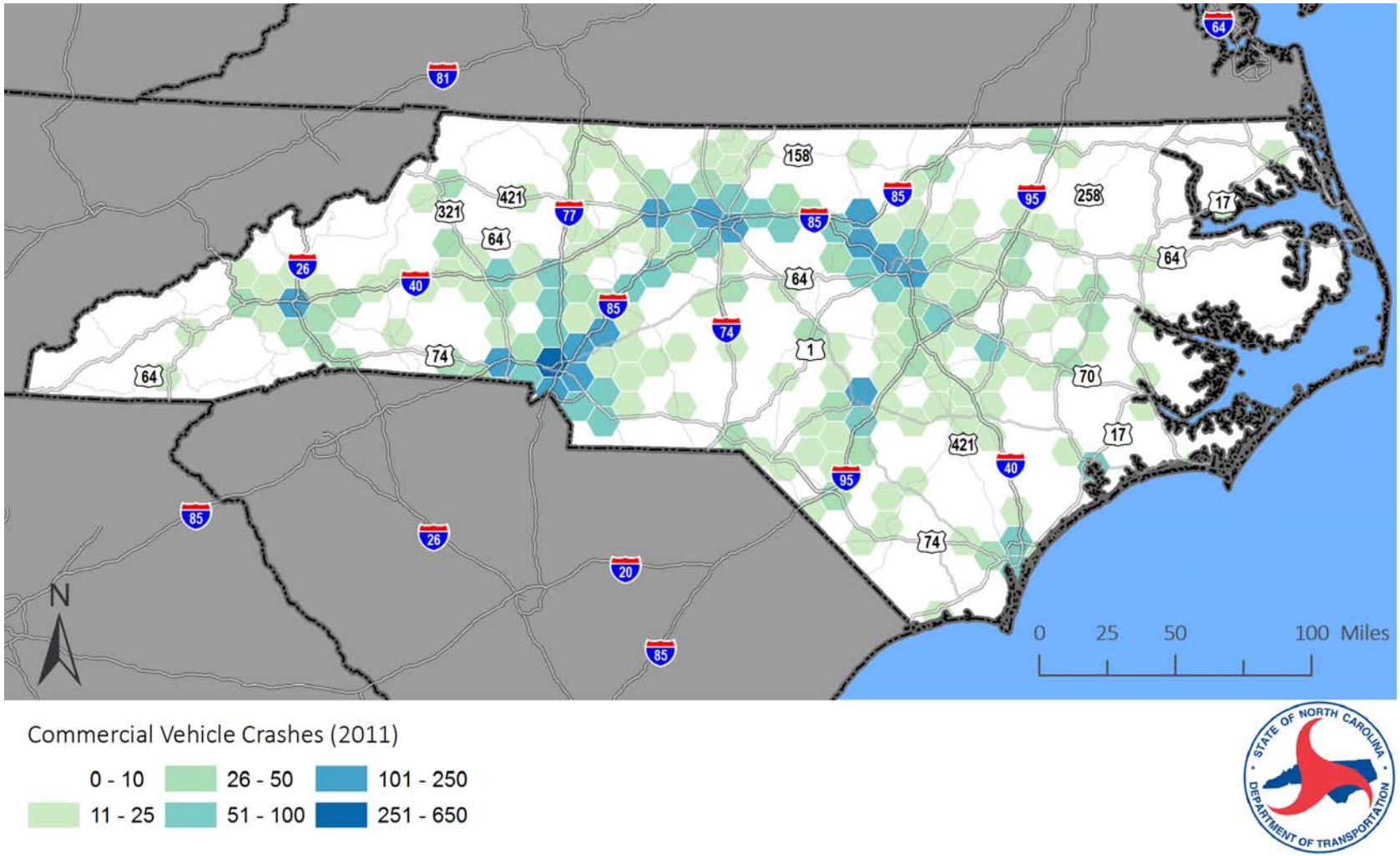
County	Number of Truck Crashes	Percentage of Total	Number of Truck Crashes on Ramps	Percentage of Truck Crashes on Ramps
Mecklenburg	6,940	14%	456	22%
Wake	4,503	9%	223	11%
Guilford	2,815	6%	175	8%
Forsyth	1,697	3%	96	5%
Durham	1,540	3%	54	3%
Buncombe	1,475	3%	93	4%
Cumberland	1,371	3%	30	1%
Iredell	1,279	3%	99	5%
Gaston	1,263	3%	68	3%
Cabarrus	1,186	2%	87	4%
Total 10 Counties	**24,069**	**49%**	**1,381**	**66%**
Statewide Total	**48,878**	**100%**	**2,094**	**100%**

Source: NCDOT.

Mecklenburg County accounted for the highest number of truck crashes, followed by Wake and Guilford Counties. This is consistent with the trend of high truck volumes on I-40 and I-85, along which most of the truck crashes occurred over the five-year period.

Figure 4.13 to Figure 4.17 display location of truck crashes for each year between 2011 and 2015. As it can be observed, the number of truck crashes consistently increase around high truck volume corridors including I-85, I-77 and I-40. Moreover, the number of truck crashes increase in vicinity of major urbanized areas such as Raleigh, Greensboro and Charlotte. This is consistent with the trend of freight generators, which have high concentration in the aforementioned urbanized areas.

Figure 4.13 Truck Crashes in North Carolina, 2011



Source: NCDOT Crash Data, 2011 to 2015.

Figure 4.14 Truck Crashes in North Carolina, 2012

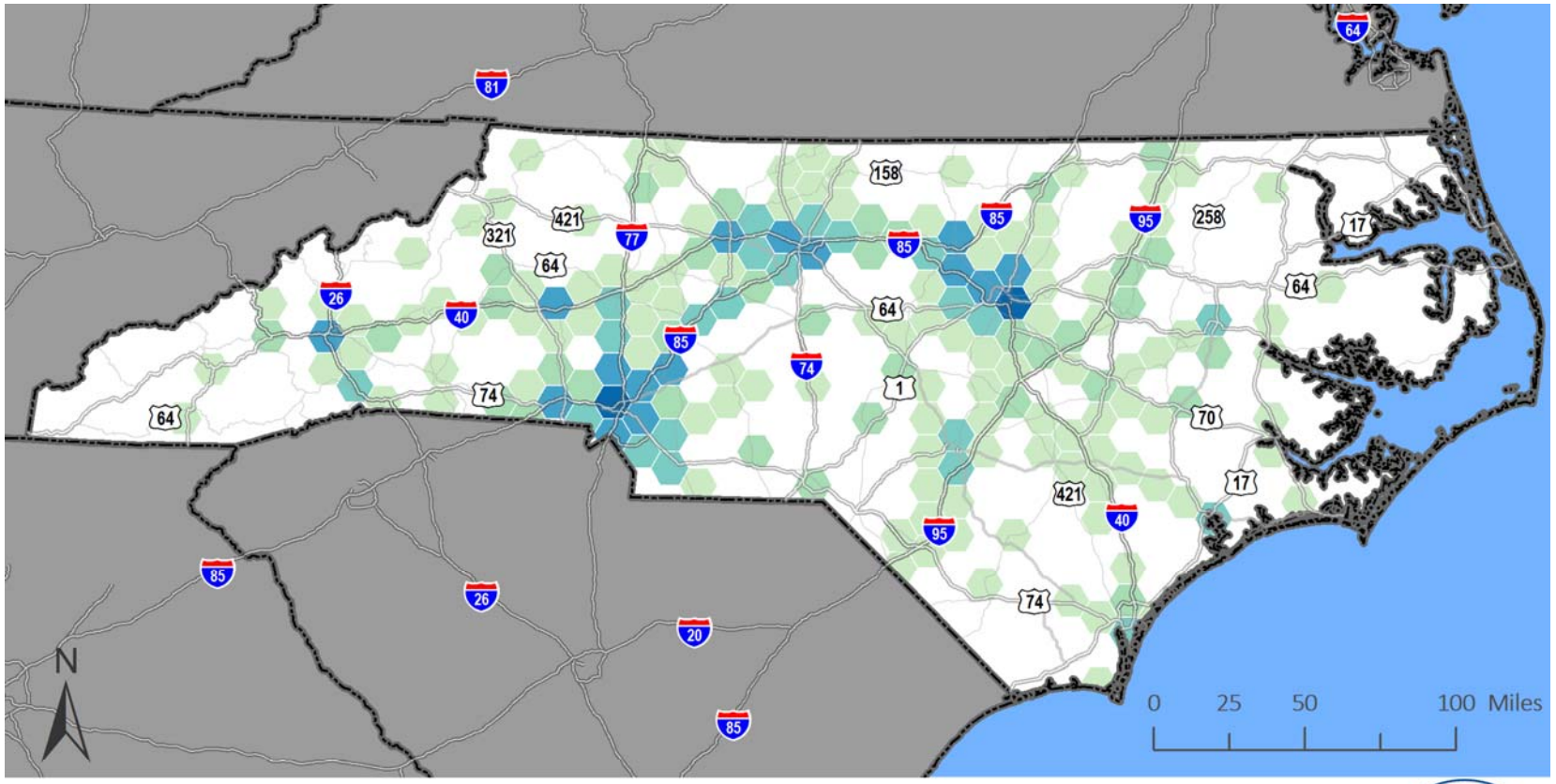


Figure 4.15 Truck Crashes in North Carolina, 2013

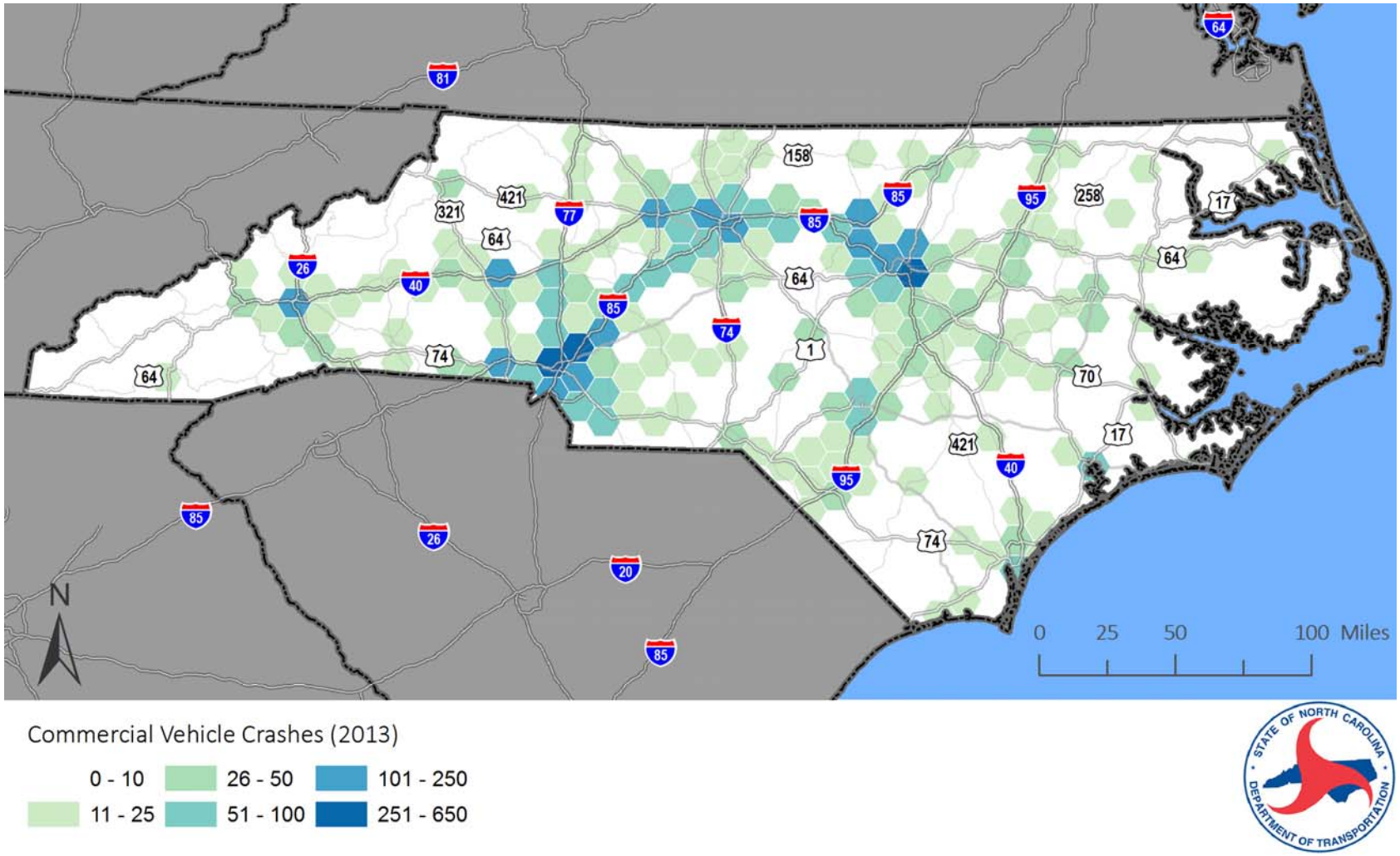


Figure 4.16 Truck Crashes in North Carolina, 2014

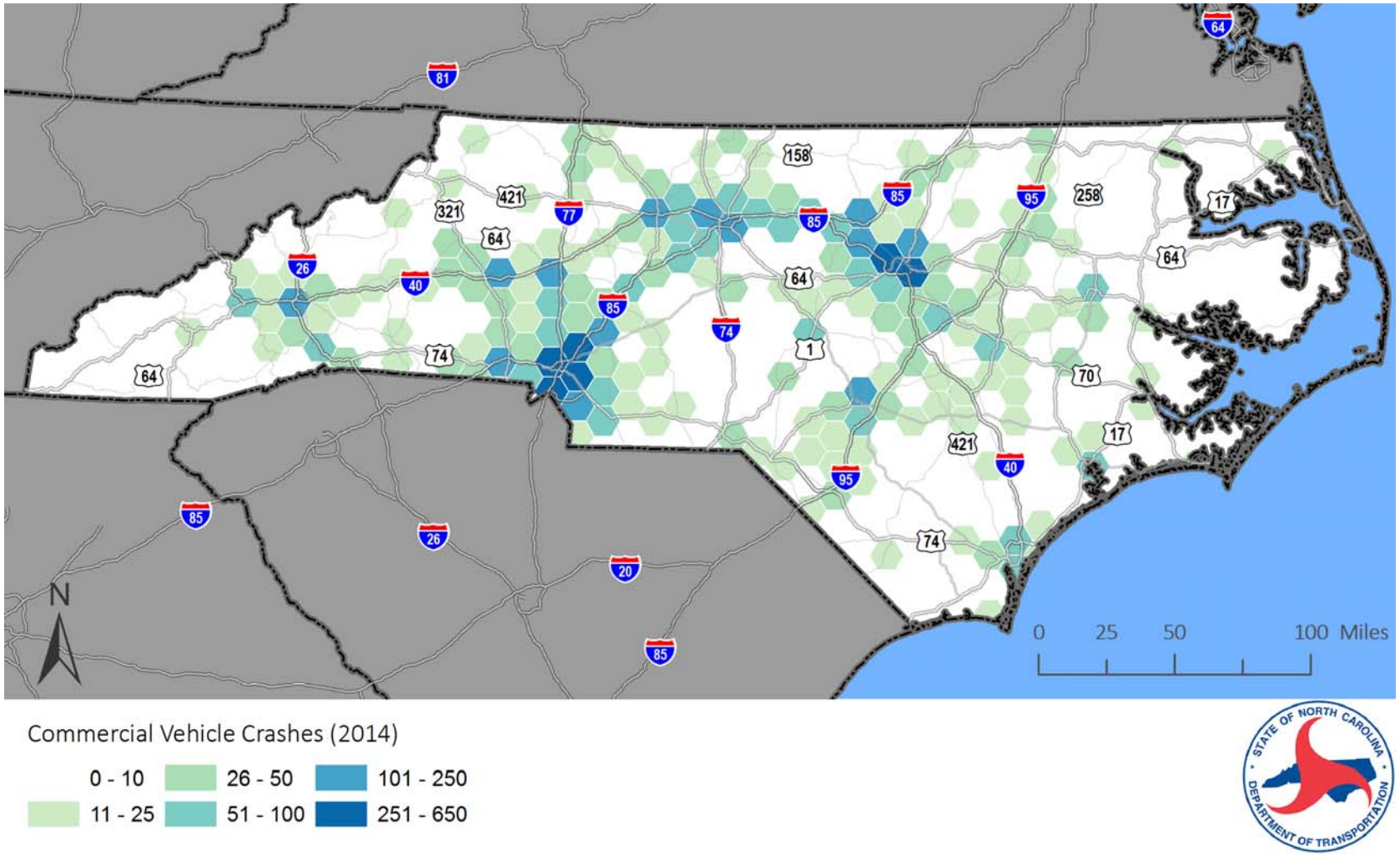


Figure 4.17 Truck Crashes in North Carolina, 2015

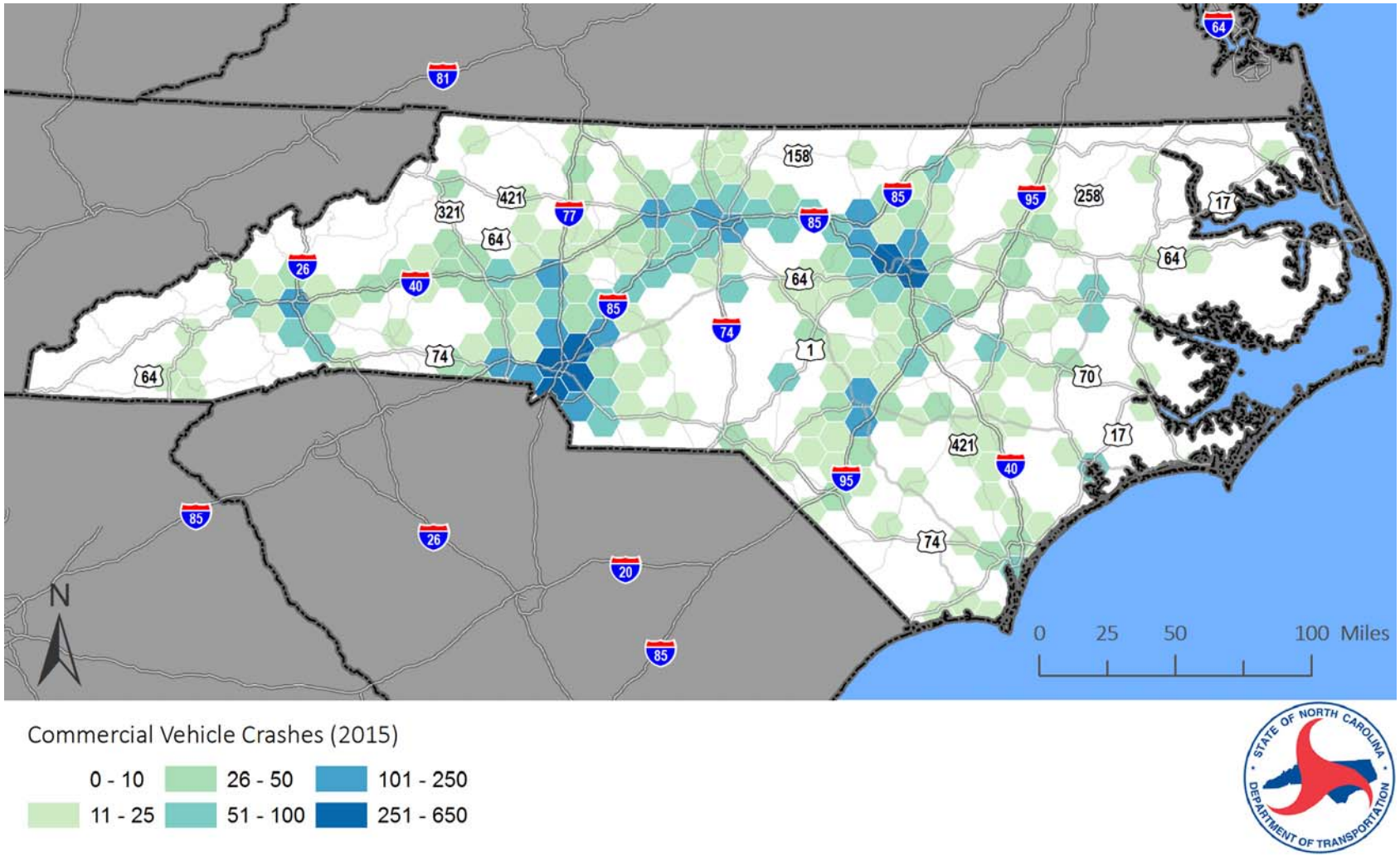
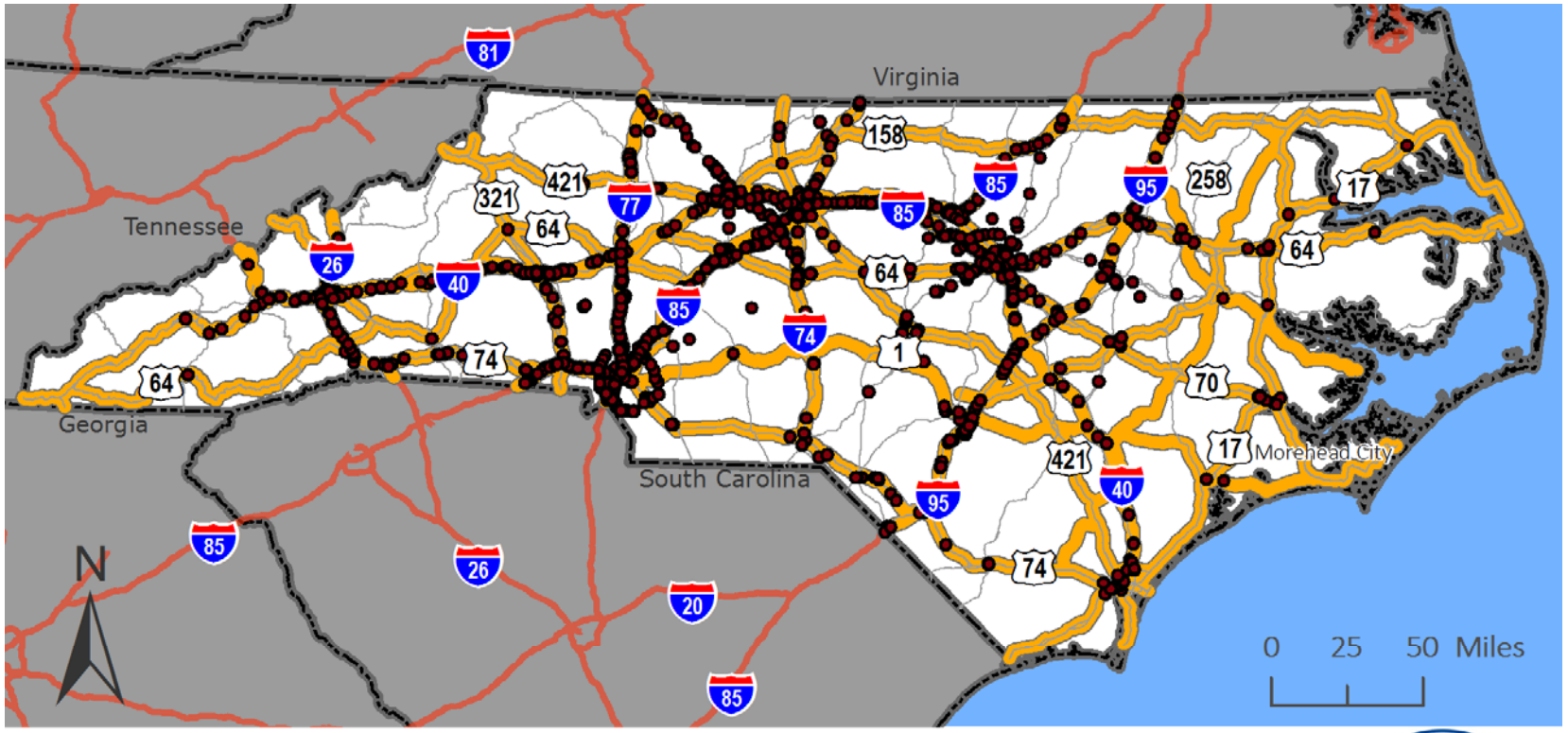


Figure 4.18 Truck Crashes on Ramps on STC Corridors



Source: NCDOT and CS.

A total of 44 percent of the total truck-related crashes occurring in North Carolina occurred on highway ramps within two miles of a truck parking facility, as shown in Figure 4.18. The lack of truck parking spaces coupled with the lack of information about available truck parking nearby forces truck drivers to park to illegally on ramps. It is important to recognize that truck crashes on ramps could be due to any number of factors besides parked trucks. Although these ramp crashes did not represent a majority of the total crashes, there is clearly a safety risk associated with trucks parking along ramps. In our interviews with private truck stop operators, they said that ramp parking is the first sign to passing trucks that parking facilities are at capacity. When trucks park on shoulders or ramps, they become a fixed object within the travel way endangering the traveling public. Off-ramps are more dangerous than on-ramps since vehicle exiting interstate highways are traveling at a higher rate of speed.

Truck ramp crashes along STC Corridors over the past five years occurred primarily within the urban areas around the cities of Charlotte, Greensboro and Raleigh and along I-85, I-40, I-77, I-26 and I-95. A significant number of on-ramp crashes involving trucks occur close to truck parking facilities. To determine how many of these crashes were due parked trucks would require examining the individual crash reports, which is recommended for future study. However, ramp crashes are just one safety concern regarding adequacy of truck parking. Of more concern is having truck drivers beyond their legal hours of service remain on the roadways.

Table 4.5 illustrates the percentage of on-ramp truck crashes occurring within a half-mile, 1-mile and 2 miles of a truck parking facility. Truck crashes on ramps could be reduced by expanding truck parking spaces near main truck corridors in the state, and by implementing technologies to allow truck drivers to find available truck parking. Adding more truck parking spaces at existing parking facilities would also help to meet truck parking demand.

Table 4.5 Truck Crashes on Highway Ramps, 2011 – 2015

Location	½-Mile Radius	1-Mile Radius	2-Mile Radius
Truck Crashes Near Truck Parking Facilities	282	457	673
Total Truck Crashes on Ramps	2,094	2,094	2,094
Percent of Truck Crashes on Ramps of All Truck Crashes	13%	22%	32%

Source: NCDOT Crash Data, 2011-2015.

North Carolina weigh stations experience ramp queues once stations are opened, and are at risk for interstate truck crashes. However, SHP routinely monitors ramp queue lengths during weigh station operations to ensure this does not happen. To evaluate at truck ramp crashes near weigh stations, we placed a half-mile buffer around each weigh station and counted the number of ramp crashes within the buffer. The crash data was from NCDOT from 2011 to 2015. The results, presented in Table 4.6, indicate that the percentage of truck crashes near weigh stations is not significant regardless of whether the crash was on ramp or at other locations.

Table 4.6 Proportion of Crashes Occurring near Weigh Stations

Location of Truck Crash	On-Ramp	Other Locations
Truck crashes within ½-mile of weigh stations	21	116
Total crashes	2,094	48,878
Percent of total crashes	**1%**	**0.2%**

Source: NCDOT Crash Data, 2011-2015.

The Study Team reviewed other studies to evaluate weigh station locations and truck crashes. In a Weigh Station Feasibility Study conducted for NCDOT in 2003 which included a review of accident reports, study authors could not establish a definitive link between the weigh stations and the crashes reported near them.[13]

[13] Weigh Station Feasibility Study, PBSJ, March, 2003, p. 12.

5.0 Truck Parking Facility Analysis

The cost of maintaining public rest areas is having an impact on how many rest areas states can afford to keep open. At a time when tired truck drivers are leading to increases in truck crashes, the decision to close public rest areas can be counter to safety recommendations to build more truck parking areas. Approximately 20 percent of crashes and 12 percent of all near-crashes are caused by tired drivers.

Source: Georgia DOT.[14]

Nevertheless, the national trend is toward reducing state-owned facilities. For example:

- In 2015, Georgia closed two rest areas on I-85 near Atlanta due to significant budget deficits. The state is considering whether to close rest areas, or cut back hours of operation. Georgia DOT estimated the annual savings will be $300,000 for each closed rest area;[14]
- Arizona Department of Transportation closed 13 rest areas, citing a $100 million budget shortfall in 2015;
- Vermont officials estimate that closing four interstate highway rest areas will save about $1 million;
- Virginia closed 19 of its 42 rest areas. State officials estimate that it costs about $500,000 to operate each site;[15]
- Texas DOT permanently reduced its inventory of rest areas by 10 over recent years in order to focus funds more effectively on remaining sites;[16] and
- New York is scheduled to close six interstate rest areas by the end of 2010.[17]

North Carolina has also closed two rest areas in the expectation that the counties in which they are located will assume their costs and eventually reopen them at no cost to the state.[18]

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[14] "No rest for the weary as rest areas close." NBC News. 11/15/2009. Available from: http://www.nbcnews.com/id/33917782/ns/travel-news/t/no-rest-weary-rest-areas-close/#.WCXkaE3rsdU.

[15] "Alternatives to the Public Funding and Operation of Virginia Safety Rest Areas and Welcome Centers." Virginia Department of Transportation. January 2011. Available from: http://www.virginiadot.org/projects/resources/POL_leg_studiesRest_Areas_Final_Report.pdf.

[16] "State DOT Leaders Review Options for Commercialization". AASHTO Journal. May 28, 2010. Accessed Dec 28, 2016. Available from: http://www.aashtojournal.org/Pages/052810restareas.aspx

[17] "New York Closing Rest Areas". Heavy Duty Trucking. Sep 26, 2010. Accessed Dec 28, 2016. Available from: http://www.truckinginfo.com/news/story/2010/09/new-york-closing-rest-areas.aspx

[18] North Carolina Board of Transportation, 2010

According to Federal policy, about every half-hour of driving or so there should be a place to take a break. This includes state-run rest stops, commercial rest stops and regular city exits. In other words, the placement of official rest stops is calculated against the existence of other, non-state-run opportunities to park a vehicle. States have the responsibility for creating and maintaining rest areas.

Some states have initiated or expanded private sector partnerships to provide rest area services to motorists. In Delaware, for example, DelDOT contracted with HMS Host to build a new 42,000-square foot welcome center on the busy I-95 corridor. Delaware did not spend any funds on the $35 million mini-mall in the highway median; in fact, the rest stop actually makes Delaware money. The state's contract with HMS Host, a company that runs retail operations at many airports, gives Delaware a percentage of revenues from sales of gas, food and other goods, totaling approximately $1.6 million per year for 35 years.

Like Delaware, Connecticut is not paying for the renovations. The state's private partner, Project Service, is paying the $178 million bill. Throughout the 35-year contract, Project Service will pay for the maintenance and operation of the service plazas and fork over a percentage of sales to the state, an estimated $250 million.[19]

5.1 Public Truck Parking Funding

Prior to the development of the Strategic Transportation Initiative (STI), NCDOT created a budget line item to construct new rest areas. Staff used a condition assessment survey to rate the quality, safety, cleanliness of vertical buildings and pavement needs. Historically, NCDOT has used the assessment data and expected budget financial support to plan for future facilities based on need. The NCDOT Roadside Environmental Unit also works with the 14 Division Engineers to determine which rest areas suffer from lack of utilization or age and recommend eroding facilities (such as pump stations and water/sewer lines) for closing or consolidation. NCDOT's cycle of proactive management and assessment has been successful in maintaining a high quality and standard of rest areas with limited resources.

STI legislation recognized that NCDOT needed a method to determine which projects in its delivery pipeline would be subject to the new data driven approach. Future planned rest areas cannot compete for capital funds and be included in the Statewide Transportation Improvement Program (STIP) since the Department's prioritization process does not include criteria to score and compare them to other infrastructure needs, such as highway capacity projects. Therefore, the Roadside Environmental Unit is now providing an "off the top" amount of state maintenance funds of around $3 million to address both routine maintenance items, such as fixtures, painting, and other needs, and to update older facilities, such as new electric wiring or replacement of HVAC systems. Division engineers have the budgetary discretion to determine at what investment level and by what funding source, such as Division resurfacing funds, to address these pavement needs. They must do this while also balancing investment in a growing backlog of priority pavement/bridge needs throughout their respective Divisions. Therefore, NCDOT's ability to plan for and construct new rest areas that address passenger demand and accommodate additional truck parking is extremely constrained.

Before the STI was implemented, NCDOT allocated funds to construct a new rest area on I-77 near Statesville. The $18 million dollar rest area in the median of I-77 (expected to open in 2018) is an example of a "transition" project already scheduled for construction prior to October 1, 2013 and therefore not subject to STI rules. This new rest area, depicted illustrates the prior point regarding NCDOT's cost resourceful

[19] http://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2010/07/28/as-some-states-close-highway-rest-stops-others-see-roadside-revenue.

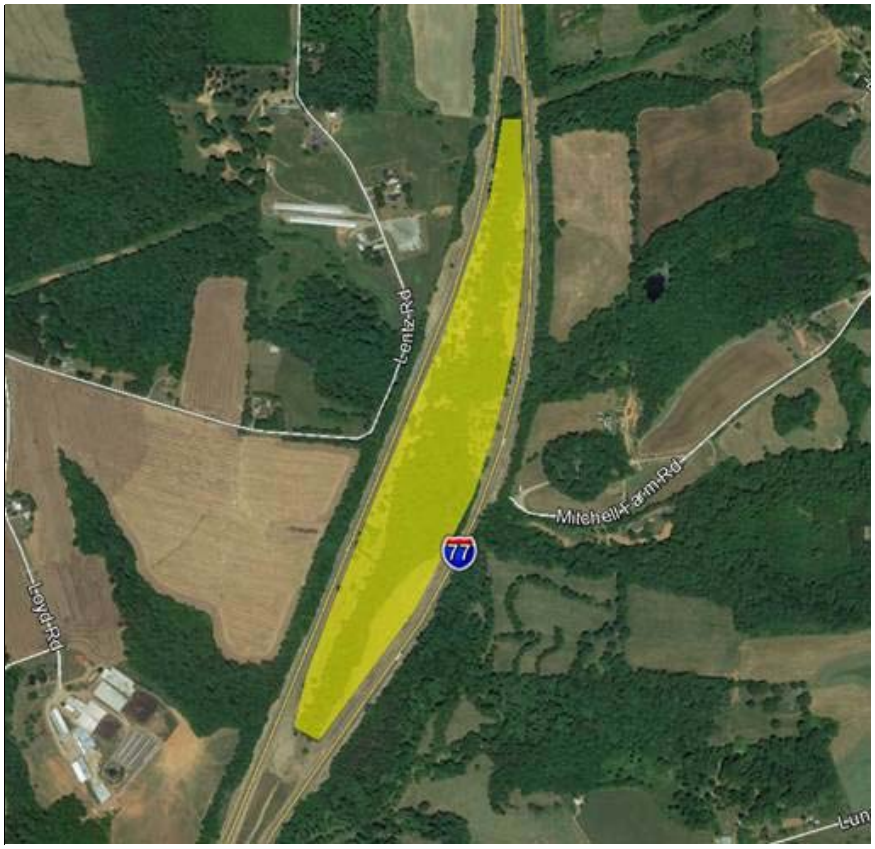
approach; this new facility allows four aging rest areas to retire in two adjacent Divisions (11 and 12) while maintaining an equitable number of truck parking spots (55 total).

Four rest areas on I-77 -two at the Iredell-Yadkin line and another two north of Mooresville- will be closed with the construction of the new complex. The new rest area will feature a 7,300 square foot facility, depicted in Figure 5.1, which will include two family restrooms, a women's room, and a men's room. The facility will also include picnic benches, maps, a walking trail and vending machines. The new 11-acre rest area site located in the I-77 median, depicted in Figure 5.2, will accommodate 55 truck parking spaces, and serve both north- and south-bound traffic. Traffic will enter and leave the rest stop from the left side of traffic. The construction budget is $18 million, approximately $5 million of which is for the building and utilities.

Figure 5.1 Rest Area Building on the New I-77 Rest Area

Source: NCDOT

Figure 5.2 NCDOT Rest Area Site in I-77 Median



Source: Google Maps

Maintenance Costs and Concerns

NCDOT staff routinely observes an increased level of trash associated with truck parking at existing rest areas, even during times when truck parking is plentiful and amenities are fully available. Staff expressed concerns about how new publicly-funded truck-only parking facilities would address these ongoing needs, which may exacerbate the already small Division maintenance budgets and service contracts. Staff noted such parking lots would need security safety equipment and bathroom facilities, which would add to NCDOT's maintenance budget.

5.2 Truck Parking Options

As mentioned previously, the private sector controls 85 percent of the truck parking supply in the state. Therefore, it would be appropriate to include the private sector as part of the solution. However, there are several options that NCDOT can explore to provide additional public parking spaces. Using data, interviews and best practices from 10 other related truck parking studies, CS explored several options to improve the state's truck parking situation, along with advantages and disadvantages to each option. The options discussed below are not listed in priority order.

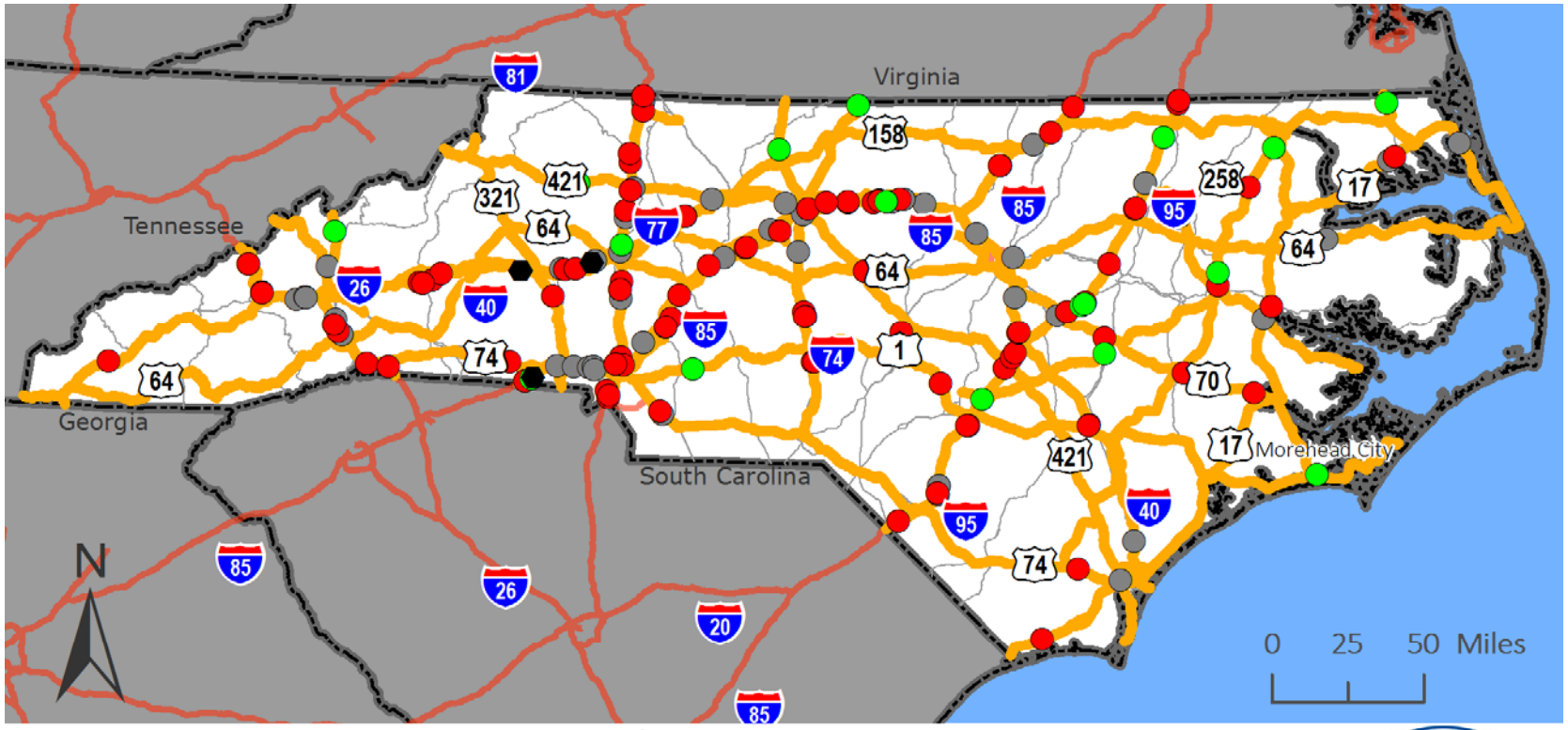
5.2.1 NCDOT Builds Truck Parking Lots at Abandoned Rest Areas

Advantages

NCDOT still owns the right-of-way for five abandoned rest area sites. Two are located on I-40 and three on I-85, as shown in Figure 5.3. For an abandoned rest area to be considered for reuse and renovation, it should meet two criteria: (1) there should not be available truck parking facilities with low utilization nearby, and (2) the site should be close to one of the main freight highway corridors. Several abandoned rest areas identified by NCDOT were evaluated to determine they met the above-mentioned criteria.

Two sites on I-40 in Burke County, displayed in Figure 5.4, are near multiple private parking facilities along I-40 that are keeping up with truck parking demand along this corridor. A third site is located on I-85 just five miles north of North Carolina's southern border in Cleveland County. This site, shown in Figure 5.5, is near available parking locations including a North Carolina welcome center and King's Mountain Truck Plaza. However, I-85 is a high demand corridor with insufficient overall parking capacity. The size of this site is approximately twelve acres. Therefore, this site along I-85 is in a better location for re-use than the I-40 locations with regard to parking demand and parcel size. Two sites along I-40 in Iredell County (see Figure 5.6) are in a good location but lack the acreage required for any significant truck parking.

Figure 5.3 Location of Three Abandoned Rest Areas



Location of Abandoned Rest Areas with Respect to Full/Available Parking Locations

- Abandoned Rest Areas with Truck Parking Capacity
- Available Truck Parking Space
- Full Truck Parking Space
- Truck Parking Space without Utilization Information
- Corridors with Adjacent Truck Parking Space

Source: CS, NCDOT.

Figure 5.4 NCDOT Abandoned Rest Area on I-40 in Burke County

Source: NCDOT Roadside Envinronmental Unit, Oct 2016.

The concrete pavement is still intact at the I-40 site and the parcel length would allow NCDOT to construct long entrance and exit ramps for a future truck parking site. Along the eastbound lane, some concrete pavement is still in place. However, these sites would only provide limited truck parking and there is no room for any additional facilities.

Figure 5.5 NCDOT Abandoned Rest Area on I-85 in Cleveland County

Source: NCDOT Roadside Envinronmental Unit, Oct 2016.

The abandoned rest area on I-85 in Cleveland County, located five miles north of the South Carolina State Line, is a possible site for redevelopment due to the size of the land parcel, which is estimated to be approximately 12 acres. This is close to the same size as the current 11-acre rest area under construction on I-77 in Iredell County for $18 million, or approximately $1.63 million per acre. Using this same construction cost assumption, the Cleveland site constructed with the same level of parking and amenities would cost $19.6 million. Maintenance costs at approximately $10,000 per acre would amount to $120,000 per year if all 12 acres were utilized. The Cleveland County site is located between the North Carolina Welcome Center (which has 15 truck parking spaces) and the King's Mountain Truck Plaza (which has 88 truck parking spaces).

Figure 5.6 NCDOT Abandoned Rest Area on I-40 in Iredell County

Source: NCDOT Roadside Envinronmental Unit, Oct 2016.

The abandoned rest areas on I-40 in Iredell County have some pavement on the eastbound site, but no remaining pavement on the westbound site. These sites would provide limited truck parking capability due to size limitations.

Disadvantages

Ramps at each site are not up to current interstate standards and would need to be lengthened. The sites would also require upgrading water and sewer utilities to be considered in the construction cost to prepare this site for safe truck transport and parking. Residential development has expanded adjacent to the I-40 site, increasing the likelihood of community resistance to truck parking development. The community would experience higher decibel levels of noise and would be concerned about increased safety and security risks. Additional considerations include restrooms, installing adequate lighting and security cameras, providing vending machines and maintaining trash collection.

The sizes of these sites vary, from one half to twelve acres. This is an important consideration given the space needed for truck parking. Of the four proposed sites, the Cleveland County site on I-85 should be considered as a high-level planning candidate for parking new rest area since the site may have sufficient land for vehicle access, new facilities and parking.

5.2.2 NCDOT Uses Weigh Stations for Additional Truck Parking

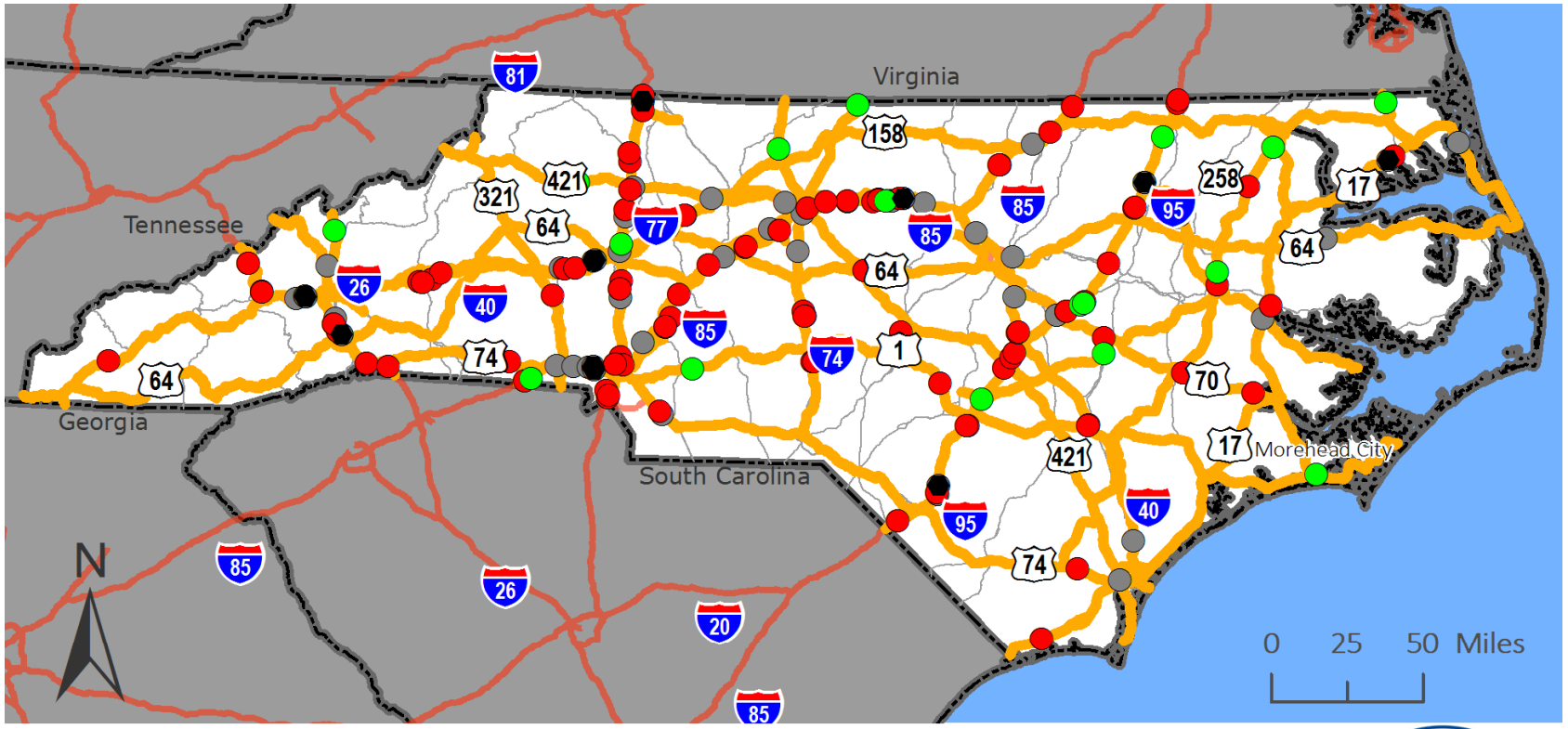
Advantages

For a weigh station to be considered for truck parking, staff concluded they have at least two of the following criteria: (1) there should not be available truck parking facilities nearby, and (2) the location should be close to one of the main freight corridors. The weigh stations we identified are located in areas, which *may* help mitigate the overcapacity problem at existing rest areas.

Engineering costs and construction expenses are not as problematic at weigh stations compared to rest areas, and some weigh stations could accommodate truck parking. Most weigh stations have adequate lighting and security camera installation would be more cost effective, depending on the condition of the utilities in place. Truck drivers may feel safer parking at a weigh station staffed by State Highway Patrol Officers, even if the facilities are not staffed overnight.

Figure 5.7 illustrates the location of weigh stations with respect to other truck parking locations. The weigh stations on I-26 and I-77 are good candidates for expansion to accommodate truck parking based on their locations. However, these sites are too small to accommodate more than two or three trucks for overnight parking due to size limitations. Out of the eight pairs of weigh stations, seven were constructed in the 1970s. Parking is adequate for patrol cars, but not adequate for truck inspections, impoundment and even short term parking at most locations. However, three sites have the potential to accommodate overnight truck parking. These include the two Hillsborough stations on I-40/I-85 in Orange County, and the new Charlotte NB Station that recently opened on I-85 in Gaston County.

Figure 5.7 North Carolina Weigh Stations



Location of Weigh Stations with Respect to Full/Available Parking Locations

- Weigh Station
- Available Truck Parking Space
- Full Truck Parking Space
- Truck Parking Space without Utilization Information
- Corridors with Adjacent Truck Parking Space

Source: CS, NCDOT.

Hillsborough Weigh Stations on I-40/I-85

The two Hillsborough weigh stations are located in Orange County along I-40/I-85 about 15 miles west of Hillsborough. One station handles eastbound traffic and the other handles westbound traffic. Unlike most North Carolina weigh stations, the Hillsborough Weigh Stations have secondary lots for additional queuing during daytime inspection operations, as shown in Figure 5.8. These secondary lots could be striped for approximately 15 overnight truck parking spaces on the westbound side and approximately 13 spaces on the eastbound side for a total of 28 additional truck parking spaces at both Hillsborough weigh stations. There are vending machines and restrooms for truck drivers. To notify truck drivers that parking is available, NCDOT could take a phased approach to installing signage and other technology.

The CS team developed planning level costs for installing static signage and pavement striping for the Hillsborough eastbound and westbound lots. In order to develop planning level costs for other technology, the CS Team used a recent 2015 bid to install similar technology signage for the I-485 Western Outer Loop Project in Mecklenburg County. The bid included the installation new fiber-optic communications cable, seven (7) new closed circuit television (CCTV) cameras, and two (2) new pedestal mount dynamic message signs (DMS). The bid included new or modified electrical service to be installed at each new designated CCTV and DMS and coordination with the appropriate electric utility company in the area to establish new service. This cost estimate could be reduced if fewer cameras are needed and if some fiber optic cable sections are already in place.

Table 5.1 Proposed Hillsborough Weigh Station Signage and Technology Costs

Item	Description	Proposed Cost
Phase 1: Install Static Signs and Pavement Striping	Two eastbound, ground-mounted “Truck Parking” signs (one on the main line, one for the internal lot), and pavement striping for 13 truck parking spaces Two westbound, ground-mounted “truck parking” static signs (one sign on the main line, one for the internal lot), pavement striping for 15 truck parking spaces	$40,000
Phase 2: Install DMS Signs and CCTV Cameras	One (1) DMS Sign and pedestal, eastbound side and three (3) CCTVs for the eastbound lot including fiber-optic cable One (1) DMS Sign and pedestal, westbound side and three (3) CCTVs for the westbound lot including fiber-optic cable	$800,000

Source: Volkert, Inc. (2017), NCDOT Bid for Mecklenburg I-485 Project from Charlotte Western Outer Loop West Of I-77 To I-85 North (2015) and CS analysis.

Figure 5.8 Hillsborough Weigh Stations along I-40/I-85

Source: Google Maps, CS.

New Gaston County Weigh Station on I-85

The recently-completed Gaston County Weigh Station, located on 13.8 acres about three miles east of King's Mountain on I-85, is similar in design to the Hillsborough Weigh Stations with a secondary back lot. The new $19.7 million weigh station replaced another weigh station along I-85 northbound at the Catawba River. Large volumes of trucks use the I-85 Charlotte Area weigh station and backups along I-85 have been common. This new weigh station in Gaston County was designed to fix this problem by providing more room for trucks exiting the interstate, and reduced the incline on the entry ramps so drivers do not have to accelerate when returning to I-85 after being weighed. The location of this weigh station is shown in Figure 5.9. Because of the expanded configuration for queuing, there is a back lot, which could accommodate overnight truck parking for approximately 28 trucks. Like the Hillsborough facilities, there are vending machines and restrooms for truck drivers.

Figure 5.9 Gaston County Weigh Station along I-85

Source: Google Maps, CS.

To be effective, information about these weigh station-parking options would need to be communicated to truck drivers on web sites and through additional electronic and/or static signage. NCDOT could take a phased approach to installing signage and other technology similar to that which was suggested for the Hillsborough Weigh Station sites. In order to determine the planning level costs for installing signage and other technology, the CS Team used a recent 2015 bid to install DMS signs and CCTVs in Mecklenburg County.

Table 5.2 Proposed Gaston County Weigh Station Signage and Technology Costs

Item	Description	Proposed Cost
Phase 1: Install Static Signs and Pavement Striping	One northbound "Truck Parking" sign (one on the mainline, one for the internal lot), pavement striping for 28 truck parking spaces	$20,000
Phase 2: Install DMS Signs and CCTV Cameras	One (1) DMS Sign and pedestal, northbound side and three (3) CCTVs for the northbound lot	$400,000

Source: Volkert, Inc. (2017), and NCDOT Bid for Mecklenburg I-485 Project from Charlotte Western Outer Loop West Of I-77 To I-85 North (2015).

Disadvantages

NCDOT is already facing challenges of replacing utility lines to these sites due to their remote locations. Weigh stations have been designed to accommodate truck queuing for weighing and inspection purposes, not for truck parking. Some additional site work may be required to accommodate truck parking, including

additional signage and striping to configure truck parking spaces. To be effective, implementing truck parking at weigh stations would need to be communicated broadly to truck drivers that weigh stations can be "safe havens" for truck drivers reaching the end of their hours of service.

5.2.3 NCDOT Pursues Public-Private Parking Arrangements

NCDOT can also work with the private sector to promote privately financed rest areas similar to the facility in Delaware along I-95. Since the private sector controls 85 percent of the truck parking supply in the state, the private sector can be part of the truck parking solution. Working with the private sector, NCDOT can establish public-private partnerships (P3) to design and construct additional truck parking facilities.

When Congress created the Interstate Highway System, community leaders were concerned that local businesses, would be jeopardized as truck drivers and motorists bypassed their towns. As a result, Congress prohibited states from offering commercial services, such as food and fuel, at commercial rest areas on the interstate right-of-way. Since that time, businesses such as restaurants, fuel stations and truck stops have clustered near the interstates at the interchanges along the interstates to provide traveler services. Due to their advantageous locations, state-owned commercial rest areas compete with businesses on the sale of services to highway travelers.[20]

Public-private partnerships (P3) are legal in North Carolina. Government entities may enter into a P3 for any public-private project for which the entity determines it has a critical need. The General P3 Statute defines P3 as "a capital improvement project undertaken for the benefit of a governmental entity and a private developer under a development contract that includes construction of a public facility or other improvements, including paving, grading, utilities, infrastructure, reconstruction, or repair, and may include both public and private facilities". There are two primary statutes that govern P3s in the state[21]:

- Section 143-128.1C of the North Carolina General Statutes (General P3 Statute), which authorizes governmental entities to enter into P3s to acquire, construct, own, lease as a lessor or lessee, and operate or participate in the acquisition, construction, ownership, leasing, and operation of a public-private project or of specific facilities within a public-private project. The General P3 Statute is primarily a procurement statute.

- Sections 136-18(39) and (39a) and 136-89.180 to 136-89.220 of the North Carolina General Statutes (DOT and TA P3 Statutes), which authorize the North Carolina Department of Transportation and the North Carolina Turnpike Authority to develop transportation infrastructure using P3s.

Advantages

These types of arrangements, found in other states, are receiving favorable results from private and public entities. In addition to the Delaware example, the reuse of brownfield sites that was recommended as a solution for additional truck parking in Illinois DOT's "Trucker's Parking/Rest Facility Study" (2008) and Virginia DOT's "Virginia Truck Parking Study" (2015), is one potential option for implementing a P3

[20] National Association of Truck Stop Operators (NATSO).

[21] "Public Private Partnership Legislation: North Carolina". Thompson Reuters. 2016. Available from: https://www.hunton.com/files/Publication/81d11105-d2b7-41e0-8389-7cec58cf5a1f/Presentation/PublicationAttachment/bce7a1c8-ca7a-4609-8e9c-ae2d8fed1134/Public_Private_Partnership_Legislation_North_Carolina.pdf

arrangement. Using underutilized retail, manufacturing, and seasonally affected sites could also be employed for additional truck parking.

Disadvantages

There may be limited locations where this arrangement is feasible. There are also limitations within the interstate ROW areas in North Carolina for such projects due to Federal regulations.

5.2.4 NCDOT Conducts Site Exploration at Major Interstate Crossings

Evaluate highly visible locations of abandoned facilities, distribution centers and warehouses at the intersection of major Interstates or at the state border where truckers can rely on availability and better time their stops based on delivery. These areas typically have more room due to the land required for ramps for both major interstates. Examples include the intersections of I-40 and I-95, I-40 and I-85 and I-26 and I-40.

Advantages

These types of arrangements, found in other states, are receiving favorable results from private and public entities. These locations would provide more land on which to construct such facilities.

Disadvantages

Access to such facilities may require the construction of long access roads due to access management requirements on interstate highways. Existing interchange intersections may be already at capacity for development, particularly in urban areas.

5.2.1 Utilizing Excess Passenger Car Parking at Existing Rest Areas

While the truck parking at public rest areas is at or near capacity, there is some underutilization of passenger spaces at existing rest areas. All rest areas on North Carolina Interstates have segregated parking for trucks and automobiles.

Advantages

NCDOT already owns and operates the facilities so the costs for restriping and designating the spots could be modest.

Disadvantages

According to NCDOT staff, underutilized peripheral passenger spots would require trucks to traverse through passenger parking lots, subsequently increasing safety risks to families and motorists. Additionally, the engineering constraints of this segregated parking configuration, including lack of turning radii through the passenger lot and the need to lengthen stalls, may prove cost prohibitive and may not generate enough new parking availability to address near term parking shortages. Finally, the net gain in truck parking spaces would be minimal.

6.0 Truck Parking Technology Solutions

Technology has the potential to significantly improve the truck parking situation in North Carolina. One of the biggest challenges is to ensure that truck drivers are aware of the location of truck facilities and parking availability, and can easily plan rest periods ahead of time and while in transit. Technology can assist ion this planning. However, if there is a shortage of truck parking, technology alone will not address the issue.

Technology solutions to this issue come in two parts: communication and detection. Communication systems include signage (both fixed and variable), smart phones and web-based applications. This technology is advancing rapidly, and smart phones are now being used for crowd-sourcing information through social media. Detection systems improve the way in which parking spaces are monitored, tracked and counted. There are a number of Intelligent Transportation System (ITS) opportunities for truck parking detection systems. ITS technology electronically estimates truck parking availability in a given area, and includes the following three categories:

- **In-Pavement Systems**, which includes induction sensors, magnetic sensors, and infrared sensors;
- **Video Systems**, which feature video cameras installed around a parking area; and
- **Light and Laser Detection Systems**, which include panels installed at entry/exit lanes.

With the current truck parking issues, despite available truck parking facilities, North Carolina would benefit from the of truck technology solutions to connect available truck parking with truck drivers on the road. Both improved communication systems and detection systems can help drivers plan and make informed decisions about safe, convenient and available parking spaces. This section will present truck technology investments as part of the Federal Innovative Technology Deployment (ITD) program in North Carolina, as well as a selection of the current technology solutions available to states, public/private truck stop operators and truck drivers.

6.1 Innovative Technology Deployment (ITD) Program

The Innovative Technology Deployment (ITD) Program (formerly known as the Commercial Vehicle Information System and Networks, or CVISN) is a key component of the Federal Motor Carrier Safety Administration's (FMCSA's) drive to improve commercial motor vehicle safety. This section describes the details of the national program and program activities in North Carolina.

6.1.1 ITD Program

The goal of FMCSA's ITD program is to improve commercial motor vehicle (CMV) safety, security, mobility and productivity. ITD is an information sharing initiative involving a partnership of government agencies, motor carriers, and other stakeholders and third parties. As a partnership formed around a common goal of sharing information, state enforcement agencies benefit from maximum nationwide participation from the public and private partners.

ITD consists of information systems and communications networks owned and operated by governments, motor carriers, and other stakeholders. These information systems support capabilities in three areas:

- **Safety Information Exchange –** designed to ensure the safety of motor carriers, commercial vehicles, commercial drivers, cargo and passengers through improved data collection and enhanced data sharing (inspection reports, credentials status, etc.). Projects within this area include electronic capture of roadside vehicle and driver inspection results and deployment of safety information systems that support the sharing of data across agencies and jurisdictions.

- **Electronic Screening** – designed to facilitate the verification of a commercial vehicle's size, weight, safety and credentials information by enforcement personnel while the vehicle remains in motion. Projects in this area include the use of transponder-based systems to identify commercial motor vehicles at highway speeds. Vehicles are allowed to bypass the inspection/weigh stations as long as they are within size and weight standards, have the necessary operating credentials, and are operated by a motor carrier with a history of good safety performance.

- **Electronic Credentials Administration –** designed to automate the application, processing and issuance of motor carrier operating credentials and permits. Projects in this area automate the issuance of International Registration Program (IRP) and International Fuel Tax Agreement (IFTA) credentials, as well as the processing of IFTA tax payments.

The Fixing America's Surface Transportation (FAST) Act signed in to law in December 2015 consolidated a number of FMCSA grant programs into the Motor Carrier Safety Assistance Program (MCSAP) and High Priority grant programs. CVISN was renamed to the Innovative Technology Deployment (ITD) program, though the majority of programmatic components remain the same.

6.1.2 Past CVISN Programming in North Carolina

In FY 2015, FMCSA distributed a total of nearly $12.4 million in Federal CVISN deployment funding to 21 states, which included North Carolina. The State is core compliant with the CVISN program, and received an expanded grant totaling $474,000 in FY 2015. The funding was awarded to supplement the following projects and activities:

- Upgrade existing weigh station facility (I-26 in Hendersonville) with Weigh in Motion (WIM), License Plate Readers (LPR), and variable message boards;

- Upgrade existing Hillsborough weigh station facility (I-40/85 north and southbound lanes) with infrared brake monitoring system;

- Provide funding for stakeholder travel to CVISN-related workshops and conferences; and

- CVISN program support with the engagement and participation of the North Carolina State University Institute for Transportation, Research and Education (ITRE).

Given these upgrades to weigh stations in North Carolina, integrating these facilities into the truck parking network by communicating available truck parking locations in the state may become a part of the solution to improve parking information.

6.2 Communication & Detection Systems

There are several types of communication systems for truck drivers in use throughout the United States, including different types of signage, smart phone applications and web-based materials to improve parking information and sharing. In many states, there are truck parking areas that are over capacity while at the same time many public and private parking facilities are underutilized. This was true in Kansas, which documented the issue in the "Kansas Statewide Freight Network Truck Parking Plan" (2016). The study found that this occurred due to a lack of information about the true availability of truck parking, particularly to drivers that are not familiar with the area. In addition, even drivers that were aware of these facilities often did not know whether any spaces were available prior to entering the lot.

6.2.1 Signage

Dynamic message signs (DMS) must be connected to a truck parking information management system (TPIMS) to provide real-time information about availability of parking spaces. This includes installing traffic sensors at ingress and egress points of truck parking sites, often with closed circuit television (CCTV) cameras or in-ground sensors installed to monitor and verify the number of available spaces.

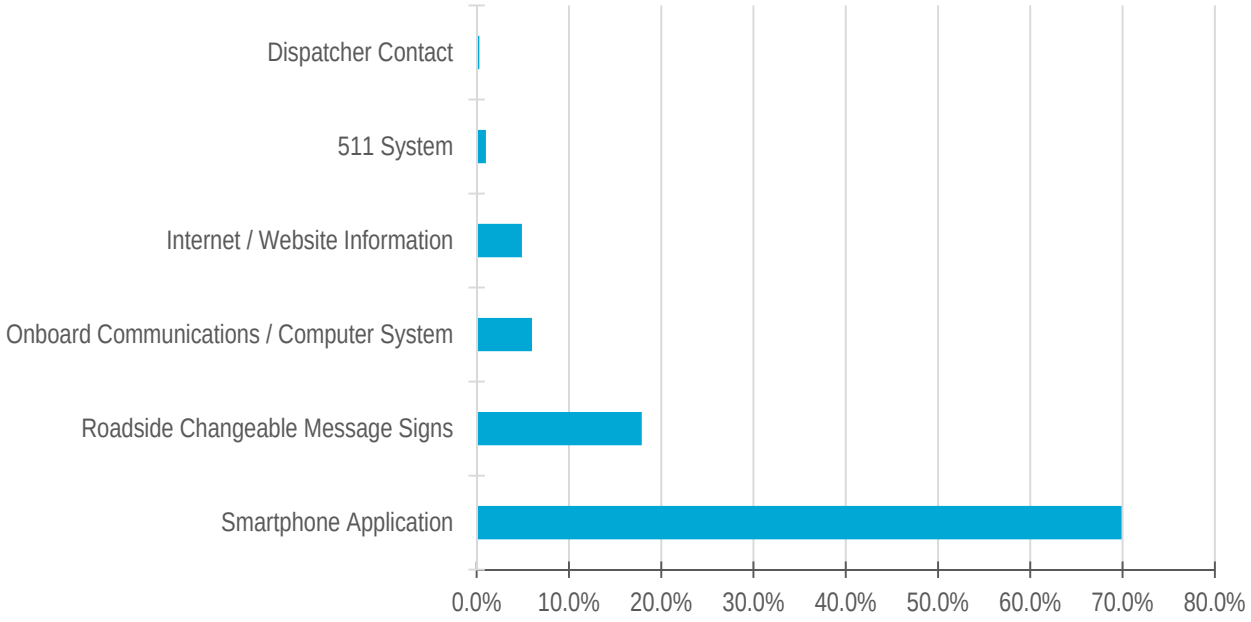
Figure 6.1 shows an example of TPIMS monitoring equipment and a DMS for truck parking facilities. The information collected through this technology can also be shared through smart phone applications and traveler information websites which helps to increase its distribution. TPIMS is best installed near interstate facilities and other major highways intersecting the Primary Freight Network to capture facilities within a 30-mile radius totaling at least 30 parking spaces. DMS tend to have a higher capital and operation cost compared to static signage; however, despite the added costs, the Kansas Plan found this strategy to be best for maximizing utilization.

Figure 6.1 TPIMS Monitoring Equipment (left) and Dynamic Real-Time Message Sign (right)

Source: Kansas Statewide Freight Network Truck Parking Plan; photo from Michigan DOT.

For both types of signage, truck parking information should be aggregated to exits or areas in order to avoid appearing to favor a specific facility or enterprise. They should also be placed between two and five miles in advance of a truck parking facility in order to allow the drive the make an informed decision prior to arriving at the facility. Additionally, the information on the sign should aggregate information for exits or areas without referencing specific facilities. As part of this study, the American Transportation Research Institute (ATRI) surveyed 761 truck drivers about their perspective on truck parking issues, trends, and capacity-related issues in North Carolina. One of the questions of this survey asked drivers to indicate their preferred method of receiving real-time parking information. While the majority preferred using smart phone applications (apps), 18 percent indicated a preference for roadside DMS, as shown in Figure 6.2.

Figure 6.2 Preferred Method of Receiving Real-Time Parking Information



Source: North Carolina Truck Parking Survey, NCDOT, and ATRI

6.2.2 Smartphone and Web-Based Technology

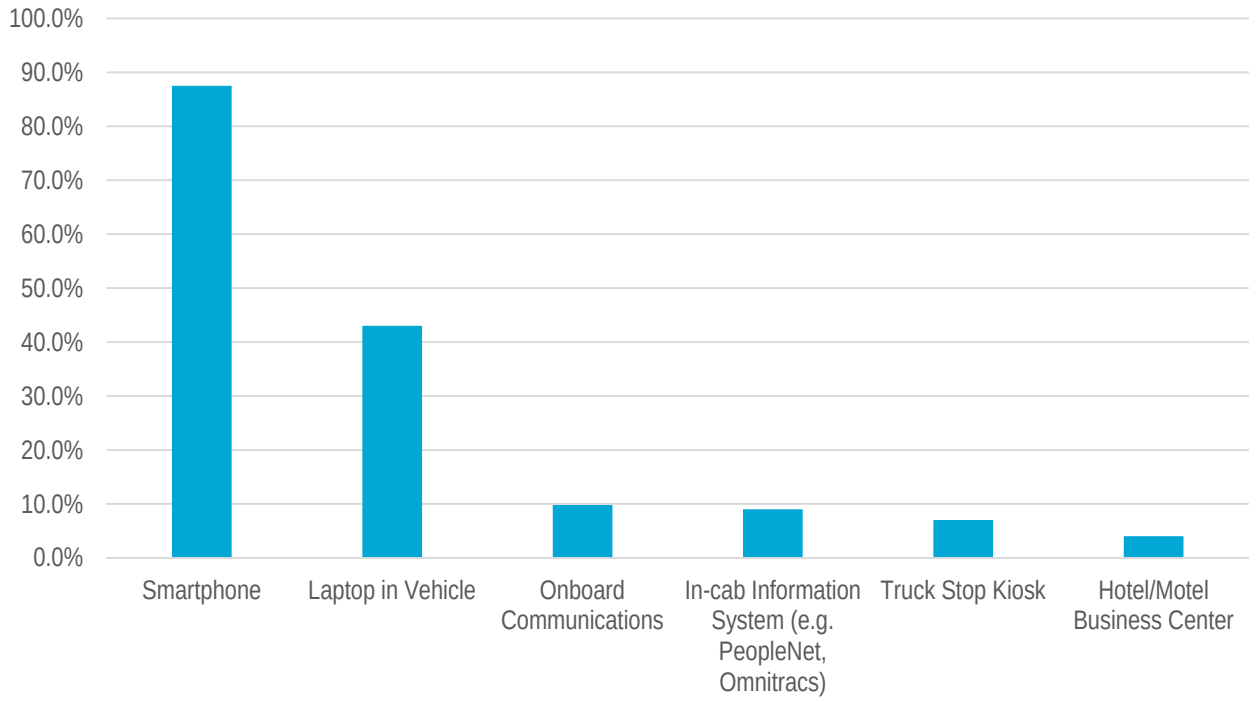
However, judging from the ATRI survey, smart phone apps appear to be highly popular among drivers. One example of a popular app is Trucker Path, which launched in 2013. Trucker Path offers crowd-sourced trip planning information for truck drivers. It is the most popular app in the U.S., with approximately 450,000 users (this approximately 1/3 of all U.S. Class 8 drivers). The app allows drivers to find and report truck parking availability; leave reviews on truck stops, report weigh station status, and identify truck wash facilities. According to Trucker Path, Mecklenburg County in North Carolina was the third busiest for truck parking in the country, which is defined as place where more than 60 percent of truck drivers report that truck stops are congested. This is mostly due to the resulting congestion from where I-85 and I-77 converge in Charlotte.[22] A similar app is Roadbreakers, which collects crowdsourced data identifying areas for overnight

[22] Aaron Marsh. "North America's top 10 counties with busiest, sleepiest truck stops." FleetOwner. August 29, 2016. Available from: http://fleetowner.com/technology/north-americas-top-10-counties-busiest-sleepiest-truck-stops.

truck parking locations. In addition to identifying locations, it allows users to comment on the quality of the parking location and report any problems with the area.

One of the advantages of developing smart phone apps is the low capital cost. Mid-America Freight Coalition's (MAFC) "Low Cost Strategies for Short Term Parking on Interstate Highways of the MVFC" (2015) study noted that a pilot project in Michigan found that the cost of developing a suitable smart phone app would cost roughly the same as two variable message signs. Once the app has been developed, the marginal cost of each additional user is significantly less than acquiring more signage. The ATRI survey from the Kansas Plan also found that the majority of the survey respondents preferred using a smart phone (43 percent) or laptop (31 percent) to access the Internet. The ATRI survey just completed in North Carolina found that the majority of survey respondents also preferred using and smart phone (87 percent), or laptop (43 percent) as shown in Figure 6.3, suggesting that phone and/or web-based programs may be a useful resource in improving the truck parking situation in North Carolina. However, smart phone apps have the potential for in-cab intrusion, and are only available to drivers with a smart phone, so they are best deployed as a complement to other truck parking communication technologies and resources.

Figure 6.3 How Drivers Access Internet While On the Road



Source: North Carolina Truck Parking Survey, NCDOT and ATRI

Websites that are accessible from a smart phone or laptop can also play a supporting role in planning for truck parking. MAFC's 2015 Study notes that while drivers do most of the planning for truck parking while on the road, well-designed websites can help drivers identify parking options ahead of time, particularly in new areas. Not only is it inexpensive to develop a website, but it is also accessible to anyone with an Internet connection, with or without a smart phone. Other inexpensive options to communicate with truck drivers include radio broadcasts and 511 services, though it is difficult to convey relevant information for truckers in all parts of the state at any given time.

6.2.3 Intelligent Transportation Systems (ITS) Technologies

In addition to technologies that communicate truck parking information to drivers, detection systems can help improve the means that truck parking availability is tracked and counted. Examples of this include in-pavement systems, video and light and laser detection, among others. MAFC's 2015 Study discussed these systems in detail, and will used as a reference throughout this section. ITS for truck parking includes the following three categories:

- **In-Pavement Systems**: i.e., induction sensors, magnetic sensors, and infrared sensors. In-pavement systems are generally preferred due to ease of installation and data processing. However, installation and maintenance require the closure of a truck parking location, and in-pavement systems are not as reliable when monitoring a wide range of vehicles, such as pickups and tractor-trailers.

- **Video Systems**: i.e., video cameras installed around a parking area. Video systems have several benefits, but have issues in rough weather and create privacy concerns.

- **Light and Laser Detection Systems**: i.e., panels installed at entry/exit lanes. Light/laser detection also has benefits, but is capital-intensive and vulnerable to vandalism.

In-pavement systems, depicted in Figure 6.4, which are widely tested and used in truck parking facilities across the nation, include a variety of technologies including induction sensors, magnetic sensors, and infrared sensors. Sensors are typically installed at the entry/exit points of parking facilities, and magnetic sensors are capable of counting and classifying vehicles. They are relatively easy to install and collect data that is easy to process. However, sensors must be installed in pavement, requiring parking areas to be closed during installation and maintenance, and the wire loops and hardware are subject to stresses related to temperature and traffic. Additionally, some types of sensors are not reliable at detecting certain types of vehicles, such as pickups and tractor-trailers, and often have difficulty handling irregular driving behavior, such as failing to park within stalls. Overall, in-pavement system technology is not strong enough to ensure complete accuracy.

Figure 6.4 In-Pavement Sensors (left) and Relay Nodes (right)

Source: FDOT Commercial Motor Vehicle Parking Trends at Rest Areas & Weigh Stations (2012).

One example of an in-pavement system was recently tested by Florida Department of Transportation (FDOT) in 2012. FDOT's "Commercial Motor Vehicle Parking Trends at Rest Areas & Weigh Stations" study implemented wireless ground sensors in select truck parking areas. The wireless ground sensors that they selected used differential magnetic induction measurement with a built-in infrared sensor, which were capable of determining whether the vehicle was a high-clearance truck chassis as opposed to a normal vehicle. It also included detection nodes and relay nodes to detect vehicle presence and relay the information to a data collector for processing. Both of these technologies are depicted in Figure 6.4. As part of this study, researchers placed sensors on the asphalt road surface and relay nodes 20 feet overhead on light poles. The installation process was somewhat lengthy and involved various equipment, including drills, vacuums, and other handheld tools. Limitations to this technology included the maximum communication of relay nodes (182 feet) and a reliable 110V power source for data collectors/cameras. The equipment was able to collect information to determine average occupancy, time/week variations, turnover, occupancy details and predications. Overall, the wireless vehicle detection system was deemed to have significantly lower capital and maintenance costs compared to other technologies, improved accuracy, and increased reliability.

In addition to in-pavement systems, video detection and light/laser detection are two viable alternatives. Video-based truck parking detection systems require truck parking facilities to mark each parking stall and install a series of video cameras around the parking area to monitor and detect when the stalls are empty or occupied. Video systems are flexible, easily reconfigured or reprogramed remotely, and are easier to install and maintain compared to in-pavement systems. However, video systems are more vulnerable to inclement weather and wind. In addition, they must be installed high up enough to detect activity, and some truckers have expressed concerns with ensuring privacy while parking facilities are under surveillance. Another option for parking detection is through light and laser systems. These systems are designed to count the

number of trucks entering and exiting parking facilities as opposed to individual stall occupancy. To increase accuracy, light and laser detection systems may also work alongside Doppler radar and video feeds. Although these systems are highly accurate at tracking vehicles, they are less capable of classifying vehicles. Light and laser detection systems are also capital intensive and vulnerable to vandalism, snow and ice, and only work at parking areas with controlled entry and exit points.

6.3 Conclusion

Technology solutions to North Carolina's truck parking problem have the ability make better use of available parking supply and communicate information about parking locations and availability. The Federal ITD program has spurred North Carolina's investment in weigh station signage, facility upgrades and truck technology research at ITRE. In particular, the weigh station upgrades have the potential to add a small amount to the supply of truck parking, and may be part of a broader solution involving weigh stations going forward.

Communication and detection technology systems are the two types of technology that are currently available to North Carolina. Improved communication systems involving signage, smart phones, and web-based applications can help drivers plan ahead of time where they will stop to rest, as well as learn of occupancy and availability prior to arriving at the parking facility. Additionally, there are several ITS technology solutions to improve the available data on truck parking in North Carolina. Each of the three types of ITS detection systems has benefits and drawbacks, but in-pavement detection and video feeds are generally preferred by truck parking operators. However, different combinations of detection systems will work for different types of facilities depending on volume, security, weather conditions and other factors.

7.0 Opportunities and Recommendations

The purpose of the study was to conduct an analysis of the adequacy of off-road truck parking in the State of North Carolina and provide truck parking solutions that better serve freight transportation providers and provide a safer environment for the traveling public in and through North Carolina. While the state is home to 167 facilities that provide about 4,800 spaces for authorized truck parking, research and analysis identifies a deficiency in safe, legal truck parking along some of the state's primary truck corridors. This shortage is most acute during nighttime hours. Additionally, truckers reported it taking significant time, often more than an hour, to locate legal parking. Inadequate truck parking leads to numerous concerns including concerns for the safety of the motoring public, truckers and their cargo; lost productivity and higher business costs associated with parking search times; and concerns over the growing costs of maintaining and adding additional public truck parking facilities.

Following are recommendations for addressing current and future truck parking needs in North Carolina that have been discussed throughout the report. Please note the recommendations are not listed in any particular order. Our analysis of the truck parking environment in North Carolina leads us to assert that there is no single solution to the identified truck parking needs and concerns. A combination of solutions should be implemented to drive meaningful change in parking availability and information.

Recommendation 1: Partner with Truck Travel Centers seeking to expand facilities.

Since the private sector controls 85 percent of the truck parking supply in the state, the private sector should be part of the truck parking solution. This is already occurring, as private travel centers expand existing operations; build new facilities, and retrofit older facilities. For example, the travel center Pilot has acquired WilcoHess and Speedy Stores in North Carolina, most of which have existing truck parking. They are retrofitting one facility on I-95 at exit 77 and are considering several new locations along I-77 and I-85, both of which are high-volume truck corridors with parking limitations. It would be beneficial for NCDOT to have formal communication channels with private facility operators. NCDOT and the area MPOs could coordinate with Pilot (and other operators) while it considers locations for new facilities to better understand the site plan considerations and possibly defray any opposition to new truck parking facilities by communicating the benefits of increased economic development. The travel center Loves is also retrofitting sites, and several new facilities are under construction in the state. In addition to coordinating site plan considerations, there may be opportunities to coordinate truck parking signage and availability across public and private facilities, since improved parking information would benefit truck drivers.

Recommendation 2: Explore trial truck parking at selected weigh stations.

Many truck drivers do not know whether they can park legally at weigh stations. This has become a national issue, as states have different policies on weigh station parking. However, some overnight parking at weigh stations is occurring in North Carolina. The GPS data collected by ATRI as part of this study revealed that one in every 1,000 trucks over the eight-week evaluation period parked overnight at the northbound and southbound Charlotte weigh stations and the eastbound Mount Airy Weigh Station. The CS Team also learned that according to the SHP, troopers do not enforce overnight weigh station parking but sometimes have to notify two to three drivers to “move along” in the mornings when weigh station operations begin.[23]

[23] Truck Parking at Weigh Stations: conversations with Jim Rigsbee and Eric Jackson, SHP, Jan 5, 2017

They believe that "a tired driver parked to rest is better than a tired driver on the road." NCDOT does not currently have a policy on overnight parking at weigh stations. However, the concept has some merit based on current rest area expansion limitations.[24] Formalizing such a policy at certain weigh stations with truck parking capacity could create "safe havens" for drivers seeking overnight parking options. This could result in additional use for fixed weigh stations since North Carolina and other states are supplementing fixed facilities with mobile "weigh-in-motion" (WIM) sites, primarily due to the high cost of maintaining the infrastructure and utilities.[25]

The Hillsborough Weigh Stations on I-40/I-85 in Orange County and the new Gaston County Weigh Station on I-85 have room for overnight truck parking. These locations have back lots for queuing that could be striped for tractor-trailer truck parking. Funding would be required for striping, signage and expanded trash collection. Restrooms are available to truck drivers at these sites. If demand is consistently high, lower investment technology such as CCTV cameras on an internet feed can be added to provide more information to drivers and dispatchers about current conditions. The advantages to this option would be the relatively low cost of implementation to provide some additional truck parking at these locations. Disadvantages include disrupting weigh station activities with entering and exiting trucks, increased maintenance and potential confusion over where trucks should park.

Recommendation 3: Explore retrofitting selected abandoned rest areas.

Of the four abandoned rest areas evaluated in this study, one site measuring approximately 12 acres along I-85 in Cleveland County has the best potential for redevelopment. This site is similar in size to the 11 acre rest area currently under construction on I-77 in Iredell County for $18 million, or approximately $1.63 million per acre. Using this same assumption, the Cleveland site constructed with the same level of parking and amenities would cost $19.6 million. Maintenance costs at approximately $10,000 per acre would be $120,000 per year if all 12 acres were utilized.

The next step for NCDOT would be to conduct a feasibility study that would examine the demand and the advantages and disadvantages in more detail.

Recommendation 4: Use weigh station technology to communicate truck parking.

Should weigh stations be established as acceptable for overnight truck parking, technology could play a role in communicating truck parking availability and in expanding, weigh stations for truck parking. However, static signs indicating parking is allowed is an important first step, since technology solutions should only be considered if there is sufficient parking supply. Since weigh stations already have electronic communication capabilities, improving the communication of truck parking availability would help drivers looking for available parking. One example of a pilot program would be to consider installing a dynamic message sign (DMS) displaying available spaces in advance of the Orange and/or Gaston County Weigh Stations to communicate and manage truck parking at those sites. These are the only sites identified where there is currently room for overnight truck parking. The utilization information could be collected using either in-pavement sensors or remote cameras. At these locations, the DMS signs could also serve the dual purpose of communicating

[24] Weigh Stations for Parking: conversation with Jennifer Pitts, Jan 3, 2017

[25] Fixed vs. Mobile Commercial Vehicle Enforcement: conversations with Greg Ferarra (ITRE) and Eric Jackson (SHP) Jan 5, 2017

whether or not the weigh station is open for commercial vehicle inspections. Below are some proposed phases to allow for truck parking at three weigh stations:

Phase 1: Install static "Truck Parking" signs at the two Hillsborough Weigh Stations in Orange County and the Gaston County Weigh Station. Add pavement striping to indicate truck parking spaces.

Phase 2: Install DMS signs and CCTV cameras to communicate truck parking utilization.

Recommendation 5: Conduct a truck parking notification system pilot

Many states are exploring truck parking communication and detection systems, and some states have implemented pilot programs. The I-95 Corridor Coalition is testing an electronic truck parking detection system at the Ladysmith Rest Area in Caroline County, Virginia and the Welcome Center in Laurel, Maryland. Other states exploring this technology include Florida, Virginia, Wisconsin and Kansas. Private facilities are also participating in programs sponsored by the USDOT and other partners such as "Park My Truck," which estimates truck parking availability based on a survey of demand at participating truck parking locations. Many of these efforts have been funded via federal grants. NCDOT should consider submitting a FASTLANE grant application in the next round as a potential method to secure funding for the pilot. This could be done in conjunction with a private sector partner. The weigh station expansion project could also serve as a truck parking communication system pilot. If a pilot is conducted, NCDOT should closely track and monitor the benefits and costs of the program.

Recommendation 6: Coordinate with Metropolitan Planning Organizations (MPOs) and Rural Planning Organizations (RPOs) to develop guidelines and mitigation strategies aimed at easing public opposition to private sector parking facilities.

MPOs and RPOs can help to develop guidelines and strategies to mitigate public opposition to truck parking. They can also assist with truck parking implementation because they are familiar with the impacts of truck parking on surrounding communities. As businesses locate new facilities, MPOs and RPOs can help to ensure that adequate truck parking is part of the development design process. MPOs could convene truck parking subcommittees as part of the MPO Technical Committees, conduct local truck parking studies and add truck parking to the issues discussed with the private sector representatives of the MPO freight advisory committees.

Recommendation 7: Convene a Standing Truck Parking Committee.

A standing statewide Truck Parking Committee, similar to the steering committee for the current study effort, could help oversee the implementation of study recommendations and provide regular updates to the NCDOT Board of Transportation on progress. The committee could develop an implementation plan to detail the actions, resources, and roles and responsibilities for each of the recommendations.

Recommendation 8: Conduct an in-depth analysis of individual crash reports at locations with the highest number of ramp crashes.

In order to determine the extent to which trucks parked on ramps are creating a safety hazard to the motoring public, there needs to be a more detailed examination of the causes of truck crashes. The current report demonstrates that ramp crashes happen frequently, but more detailed analysis is required to determine the causes of those crashes and thus, the extent to which adequate authorized truck parking could mitigate the issue.

Appendix A. ATRI Truck Parking Survey Instrument

The American Transportation Research Institute (ATRI), the not-for-profit research arm of the trucking industry, is assisting the North Carolina Department of Transportation in better understanding the truck parking issues that truck drivers face. ATRI is now seeking truck driver input on the attached survey.

The survey data will be used to help the NCDOT better understand truck parking issues such as supply and demand, and where additional truck parking locations and services are needed.

All responses to this survey will be kept strictly confidential and will only be reported in aggregate form. Due to the sensitivity of this research, under NO circumstances will we release any of your personal or organizational information.

1. Do you operate a truck in North Carolina?
    - o Less than once a week
    - o Once a week
    - o 2-4 times a week
    - o 5-6 times a week
    - o Everyday
    - o Never

    NOTE: If answer is “Never” survey is complete.

2. How often do you need truck parking in North Carolina?
    - o Less than once a week
    - o Once a week
    - o 2-4 times a week
    - o 5-6 times a week
    - o Everyday
    - o Never

    NOTE: If answer is “Never” survey is complete.

Demographics

3. Gender
    - o Female
    - o Male

4. What is your age?
    - o Younger than 25
    - o 26-44
    - o 45-64
    - o 65 +

5. In what segment of the trucking industry do you primarily operate? (check one)
    - o For-hire
    - o Private
    - o Don’t know

6. If for-hire, which sector best describes your operation? (check one)
    - o Truckload
    - o Less-than-truckload
    - o Specialized, flatbed
    - o Tanker
    - o Express / Parcel Service
    - o Intermodal Drayage
    - o Other (please specify): _____
    - o Don't know

7. Which of the following best describes your employment: (check one)
    - o Employee driver
    - o Owner-operator (O-O) with own authority
    - o O-O / Independent Contractor leased to a motor carrier
    - o Fleet executive / manager
    - o Other: _____

8. In general, what is your overall average length of haul? (check one)
    - o Local (less than 100 miles per trip)
    - o Regional (100-499 miles per trip)
    - o Interregional (500-999 miles per trip)
    - o Long-haul (1,000+ miles per trip)
    - o Don't know

9. What is the primary vehicle configuration that you typically operate? (check one)
    - o 5-axle Dry Van
    - o 5-axle Refrigerated Trailer
    - o 5-axle Flatbed
    - o 5-axle Tanker
    - o Straight Truck
    - o Longer Combination Vehicles (Doubles, Triples, etc.)
    - o Other (please specify): _____

North Carolina State Parking

10. On average, how long does it take for you to find truck parking in North Carolina?
    - o Less than 30 minutes
    - o 30 minutes – 1 hour
    - o More than 1 hour

11. When parking in North Carolina, where is it difficult to find available truck parking? (check all that apply)
    - o Public rest stops
    - o Private truck stops
    - o Shipper / Receiver

12. For every 10 parking stops you make in North Carolina, how many are at the following location types? (Sum total must equal 10)

Stop Location Type	Number of Stops
Public Rest Area	
Private Truck Stop	
Shipper / Receiver	
Ramp / Road Shoulder	
Other	
TOTAL	**10**

13. Please identify up to three locations in North Carolina where it is most difficult to find truck parking. Where possible, please provide the specific interstate and mile marker.

Location (drop box listing MPOs below)	**Interstate or Highway**	**Mile Marker**
Dropbox Location 1 selection		
Dropbox Location 2 selection		
Dropbox Location 3 selection		
Other Location: write in response		

14. During what time of day is it most difficult to find truck parking in North Carolina? (check one)
    - o Midnight – 5:00 AM
    - o 5:00 AM – 9:00 AM
    - o 9:00 AM – Noon
    - o Noon – 4:00 PM
    - o 4:00 PM – 7:00 PM
    - o 7:00 PM – Midnight

15. How often do you personally experience the following in North Carolina (check one response for each row)?

Condition	Never	Rarely	Occasionally	Often	Always
Public rest area time limit restrictions	❍	❍	❍	❍	❍
Can only find parking on ramps or shoulders	❍	❍	❍	❍	❍
Parking only available in unsafe locations	❍	❍	❍	❍	❍
Truck vandalism or theft	❍	❍	❍	❍	❍
Shipper/Receiver permits on-site parking outside of appointment hours	❍	❍	❍	❍	❍
Shipper/Receiver loading and unloading delays exceed one hour	❍	❍	❍	❍	❍

16. Have you been asked to move your vehicle by a law enforcement officer while parked on a ramp or shoulder in North Carolina?
    a. Yes
    b. No

17. Have you been ticketed while parked on a ramp or shoulder in North Carolina?
    a. Yes
    b. No

18. Please rank order (1-12) the reasons why you seek truck parking in North Carolina, with 1 being the MOST frequent reason. (If an answer is provided for "other," please include in ranking.)

Truck Parking Reasons	Rank (1-12)
Hours of Service 10 hour break	
Hours of Service 30 minute break	
Awaiting Dispatch	
Avoiding Congestion	
Mechanical Issues / Failures	
Restaurant / Eating	
Showering / Restroom	
Staging / Waiting for Loads	
Customer Delays / Detention	
Obtaining Directions	
Safety Checks / Load Securement	
Personal Communication (e.g., cell, Internet)	
Weather-related	
Other:	

19. Please indicate how easy it is to find truck parking in North Carolina with the following scenarios. (check one for each row)

Scenario	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
It is easy to find truck parking in North Carolina in comparison to the surrounding states (Virginia, South Carolina, Georgia, and Tennessee).	❍	❍	❍	❍	❍
It is easy to find truck parking in North Carolina for the mandatory Hours of Service 30 minute break	❍	❍	❍	❍	❍
It is easy to find truck parking in North Carolina for the mandatory Hours of Service 10 hour break	❍	❍	❍	❍	❍

20. How do you access the Internet while on the road? (check all that apply)
    a. Truck Stop Kiosk
    b. Hotel/Motel Business Center
    c. Onboard Communication
    d. In-cab Information system (e.g., PeopleNet, Omnitracs)
    e. Laptop in Vehicle
    f. Smartphone
    g. Other (please specify) _____

21. If available, what is your preferred method for receiving real-time truck parking availability information? (check one)
    o Onboard Communications/Computer System
    o Internet/Website Information
    o Roadside Changeable Message Signs
    o Dispatcher Contact
    o 511 System
    o Smartphone Application
    o Not applicable

22. Please indicate how far in advance you would like to receive information about the number of available truck parking spots. (check all that apply)
    a. At the exit
    b. ½ mile away
    c. 1 mile away
    d. 5 miles away
    e. 10 miles away
    f. 20 miles away
    g. Other: _____

23. Do you have any additional thoughts on finding convenient, safe, and legal truck parking in North Carolina?

Appendix B. Truck Parking Inventory

Table B.1 Truck Parking Facilities by County

Facility Name	Overnight Parking	Diesel	Food	Parking Spaces	Showers	Highway Corridor	County
4 Brothers	N/A	N/A	N/A	10	N/A	I-77	Yadkin
Big Boy's Truck Stop	N/A	N/A	N/A	100	9	I-95	Johnston
Big Jim's Express	N/A	N/A	yes	10	N/A	State Hwy 33	Edgecombe
Bill's truck stop	N/A	N/A	N/A	35	N/A	I-85	Davidson
Candler Travel Center	yes	yes	N/A	106	8	I-40	Buncombe
Charlotte travel plaza	N/A	N/A	N/A	35	N/A	I-77	Mecklenburg
Chex Truck World	N/A	N/A	N/A	55	N/A	I-85	Vance
Citgo	N/A	N/A	N/A	25	N/A	U.S. Hwy 220	Montgomery
Country Market	N/A	N/A	N/A	35	N/A	U.S. Hwy 321	Catawba
County Mart	yes	yes	yes	38	N/A	U.S. Hwy 13	Pitt
Downeast Truck Stop	N/A	N/A	N/A	31	N/A	U.S. Hwy 13	Wayne
Duck Thru Food Store	yes	yes	yes	34	N/A	State Hwy 11	Hertford
Duck Thru Food Store	N/A	N/A	N/A	10	N/A	State Hwy 11	Bertie
Eagle Xpress	yes	N/A	N/A	53	N/A	U.S. Hwy 220	Rockingham
Erps Truck Stop BP	N/A	N/A	N/A	9	N/A	U.S. Hwy 17	Pasquotank
Fast track	N/A	N/A	N/A	6	N/A	I-77	Surry
Fast track	N/A	N/A	N/A	8	N/A	I-77	Yadkin
Fast track	N/A	N/A	N/A	22	N/A	I-77	Iredell
Fast Track	N/A	N/A	N/A	30	N/A	I-77	Iredell
Flying J	yes	yes	yes	145	9	I-95	Johnston
Fort Bragg Travel Center	yes	yes	yes	100	3	I-95	Cumberland
Fuel Doc Travel Center	N/A	N/A	N/A	32	N/A	State Hwy 11	Pitt
Gasland USA	N/A	N/A	yes	9	N/A	U.S. Hwy 74	Cleveland
Happy Mart	N/A	N/A	N/A	11	N/A	I-95	Robeson
The Pantry	yes	yes	yes	42	3	I-95	Harnett
Kangaroo Express	N/A	N/A	N/A	8	N/A	U.S. Hwy 70	Wayne
Kangaroo Express	N/A	N/A	N/A	4	N/A	I-40,85	Alamance
Kangaroo Express	N/A	N/A	N/A	7	N/A	I-40	Guilford
Kangaroo Express	N/A	N/A	N/A	20	N/A	State Hwy 11	Lenoir
Pilot	yes	yes	yes	300	9	I-95	Harnett
Kangaroo Express	N/A	N/A	N/A	6	N/A	U.S. Hwy 70	Carteret
Kangaroo Express	yes	N/A	N/A	15	N/A	U.S. Hwy 421	Lee

Facility Name	Overnight Parking	Diesel	Food	Parking Spaces	Showers	Highway Corridor	County
Kangaroo Express	N/A	N/A	yes	13	N/A	U.S. Hwy 64	Chatham
Kangaroo Express	N/A	N/A	yes	12	N/A	State Hwy 24	Cumberland
Kangaroo Express	N/A	N/A	N/A	10	N/A	U.S. Hwy 17	Beaufort
Kangaroo Express	N/A	N/A	yes	10	N/A	I-95	Wilson
Kings Mountain Truck Plaza	N/A	N/A	N/A	88	N/A	I-85	Cleveland
Love's	yes	yes	yes	37	5	I-40	McDowell
Moose Tracks Citgo	yes	yes	yes	5	N/A	I-85	Guilford
Mountain Energy	N/A	N/A	N/A	81	N/A	I-26	Henderson
Nebo Truck Stop	N/A	N/A	yes	31	N/A	I-40	McDowell
Oasis Travel Center	N/A	N/A	N/A	36	N/A	I-95	Halifax
Petro Kenly	yes	yes	yes	250	15	I-95	Johnston
Pilot	yes	yes	yes	55	3	I-85	Cabarrus
Pilot	yes	yes	yes	140	8	I-40,85	Alamance
Pilot	yes	yes	yes	25	4	I-95	Northampton
Pilot	yes	yes	yes	60	4	I-40	Haywood
Pilot	yes	yes	yes	60	5	I-77	Mecklenburg
Pilot	yes	yes	yes	150	10	I-77	Surry
Pilot	yes	yes	yes	251	14	I-40,85	Alamance
Pilot	yes	yes	yes	32	4	I-40	McDowell
Quick Check	N/A	N/A	N/A	13	N/A	State Hwy 24	Stanly
Quick Check	N/A	N/A	yes	14	N/A	U.S. Hwy 220	Randolph
Saluda Truck Plaza	N/A	N/A	yes	18	N/A	I-26	Polk
Sam's Mart	N/A	N/A	N/A	15	N/A	I-40	Haywood
Sam's Mart	N/A	N/A	N/A	7	N/A	I-77	Mecklenburg
Sam's Pit Stop	yes	No	yes	22	N/A	U.S. Hwy 74	Columbus
seven eleven	N/A	N/A	N/A	3	N/A	I-85	Mecklenburg
Travel Centers of America	N/A	N/A	N/A	134	N/A	I-40	Davie
TravelCenters of America	yes	yes	yes	186	13	I-40,85	Guilford
Petro Mebane	yes	yes	yes	285	19	I-40,85	Orange
Wal-Mart	N/A	N/A	N/A	0	N/A	I-40	Forsyth
Wal-Mart	N/A	N/A	N/A	0	N/A	I-40	Johnston
Wal-Mart	N/A	N/A	N/A	0	N/A	I-77	Mecklenburg
Wal-Mart	N/A	N/A	N/A	0	N/A	I-26	Buncombe
Wal-Mart	N/A	N/A	N/A	0	N/A	U.S. Hwy 70	Wake

Facility Name	Overnight Parking	Diesel	Food	Parking Spaces	Showers	Highway Corridor	County
Wal-Mart	N/A	N/A	N/A	0	N/A	I-77	Iredell
Wal-Mart	N/A	N/A	N/A	0	N/A	I-40	Iredell
Wal-Mart	N/A	N/A	N/A	0	N/A	I-95	Johnston
Wal-Mart	N/A	N/A	N/A	0	N/A	I-85	Vance
Wal-Mart	N/A	N/A	N/A	0	N/A	U.S. Hwy 220	Randolph
Wal-Mart	N/A	N/A	N/A	0	N/A	U.S. Hwy 64	Wake
Wal-Mart	N/A	N/A	N/A	0	N/A	I-85	Gaston
Wal-Mart	N/A	N/A	N/A	0	N/A	I-85	Gaston
Wal-Mart	N/A	N/A	N/A	0	N/A	I-85	Cabarrus
Wal-Mart	N/A	N/A	N/A	0	N/A	I-85	Davidson
Wal-Mart	N/A	N/A	N/A	0	N/A	I-85	Guilford
Wal-Mart	N/A	N/A	N/A	0	N/A	U.S. Hwy 70	Guilford
Wal-Mart	N/A	N/A	N/A	N/A	N/A	I-26	Buncombe
Wal-Mart	N/A	N/A	N/A	0	N/A	I-95	Robeson
Wal-Mart	N/A	N/A	N/A	0	N/A	I-40	Orange
Wal-Mart	N/A	N/A	N/A	0	N/A	I-40	Catawba
Wal-Mart	N/A	N/A	N/A	0	N/A	I-40	Guilford
Wal-Mart	N/A	N/A	N/A	0	N/A	I-85	Gaston
Wal-Mart	N/A	N/A	N/A	0	N/A	I-40	Durham
Wal-Mart	N/A	N/A	N/A	0	N/A	I-40/I-85	Alamance
Welcome Center: Mecklenburg County I-77	N/A	N/A	N/A	17	N/A	I-77	Mecklenburg
Welcome Center: Surry County I-77	yes	N/A	N/A	10	N/A	I-77	Surry
Welcome Center: Polk County I-26	N/A	N/A	N/A	7	N/A	I-26	Polk
WilcoHess	yes	yes	yes	78	4	U.S. Hwy 220	Montgomery
WilcoHess	N/A	N/A	N/A	51	N/A	I-40	Catawba
WilcoHess	N/A	N/A	N/A	128	N/A	I-40,85	Alamance
WilcoHess	N/A	N/A	N/A	7	N/A	I-40	Guilford
WilcoHess	N/A	N/A	N/A	52	N/A	U.S. Hwy 74	Union
WilcoHess	N/A	N/A	yes	84	N/A	I-77	Iredell
WilcoHess	yes	yes	yes	20	3	I-40	Duplin
Wilmington Auto/Truck Stop	N/A	N/A	N/A	12	N/A	U.S. Hwy 421	New Hanover
Love's	N/A	yes	yes	75	3	I-95	Harnett
Monroe Oil	N/A	yes	yes	50	3	U.S. Hwy 74	Union

Facility Name	Overnight Parking	Diesel	Food	Parking Spaces	Showers	Highway Corridor	County
Phoenix Travel Plaza	yes	yes	yes	40	4	I-40	Pender
Love's	N/A	yes	yes	73	N/A	I-85	Rowan
Rest Area: Johnston County I-40, Westbound	N/A	N/A	N/A	15	N/A	I-40	Johnston
Rest Area: Davie County I-40, Eastbound	N/A	N/A	N/A	17	N/A	I-40	Davie
Rest Area: Catawba County I-40 Eastbound	N/A	N/A	N/A	15	N/A	I-40	Catawba
Rest Area: McDowell County I-40 Eastbound	N/A	N/A	N/A	12	N/A	I-40	McDowell
Rest Area: Henderson Buncombe County I-26, Eastbound	N/A	N/A	N/A	9	N/A	I-26	Henderson
Welcome Center: Madison County I-26	N/A	N/A	N/A	30	N/A	I-26	Madison
Welcome Center: Haywood County I-40, Eastbound	N/A	N/A	N/A	10	N/A	I-40	Haywood
Rest Area: Duplin County I-40	N/A	N/A	N/A	10	N/A	I-40	Duplin
Rest Area: Nash County I-95, Northbound	N/A	N/A	N/A	17	N/A	I-95	Nash
Rest Area: Johnston County I-95, Northbound	N/A	N/A	N/A	7	N/A	I-95	Johnston
Rest Area: Granville County I-85, Northbound	N/A	N/A	N/A	18	N/A	I-85	Granville
Rest Area: Cumberland County I-95, Northbound	N/A	N/A	N/A	18	N/A	I-95	Cumberland
Welcome Center: Robeson County I-95	N/A	N/A	N/A	18	N/A	I-95	Robeson
Rest Area: Alamance County I-85, Northbound	N/A	N/A	N/A	22	N/A	I-40,85	Alamance
Visitor Center: Randolph County I-73/74, Northbound	N/A	N/A	N/A	28	N/A	U.S. Hwy 220	Randolph
Rest Area: Davidson County I-85, Northbound	N/A	N/A	N/A	19	N/A	I-85	Davidson
Rest Area: Cabarrus County I-85, Northbound	N/A	N/A	N/A	21	N/A	I-85	Cabarrus

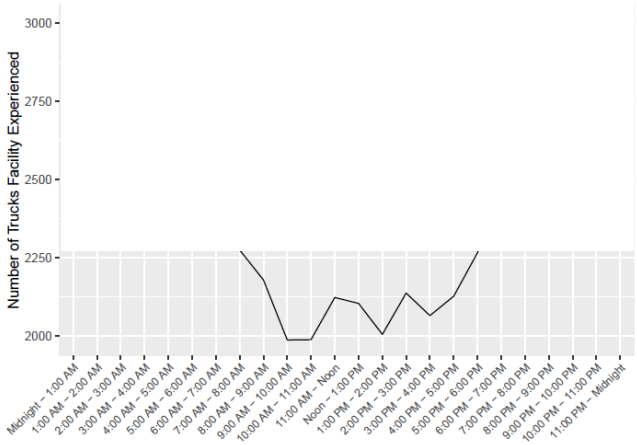
Facility Name	Overnight Parking	Diesel	Food	Parking Spaces	Showers	Highway Corridor	County
Rest Area: Iredell/Yadkin Counties I-77, Northbound	N/A	N/A	N/A	11	N/A	I-77	Yadkin
Welcome Center: Cleveland County I-85	N/A	N/A	N/A	18	N/A	I-85	Cleveland
Rest Area: Iredell County I-77, Northbound	N/A	N/A	N/A	11	N/A	I-77	Iredell
Visitor Center: Camden County U.S. 17	N/A	N/A	N/A	6	N/A	U.S. Hwy 17	Camden
Rest Area: Currituck County U.S. 158	N/A	N/A	N/A	4	N/A	U.S. Hwy 158	Currituck
Rest Area: Washington County U.S. 64	N/A	N/A	N/A	4	N/A	U.S. Hwy 64	Washington
Rest Area: Beaufort County U.S. 17	N/A	N/A	N/A	12	N/A	U.S. Hwy 17	Beaufort
Rest Area: Craven County U.S. 70	N/A	N/A	N/A	10	N/A	U.S. Hwy 70	Craven
Visitor Center: Brunswick County U.S. 17	N/A	N/A	N/A	8	N/A	U.S. Hwy 17	Brunswick
Rest Area: Nash County I-95, Southbound	N/A	N/A	N/A	17	N/A	I-95	Nash
Rest Area: Johnston County I-95, Southbound	N/A	N/A	N/A	7	N/A	I-95	Johnston
Welcome Center: Northampton County I-95	N/A	N/A	N/A	20	N/A	I-95	Northampton
Rest Area: Granville County I-85, Southbound	N/A	N/A	N/A	17	N/A	I-85	Granville
Welcome Center: Warren County I-85	N/A	N/A	N/A	16	N/A	I-85	Warren
Rest Area: Cumberland County I-95, Southbound	N/A	N/A	N/A	18	N/A	I-95	Cumberland
Rest Area: Alamance County I-85, Southbound	N/A	N/A	N/A	22	N/A	I-40,85	Alamance
Visitor Center: Randolph County I-73/74, Southbound	N/A	N/A	N/A	34	N/A	U.S. Hwy 220	Randolph

Facility Name	Overnight Parking	Diesel	Food	Parking Spaces	Showers	Highway Corridor	County
Rest Area: Davidson County I-85, Southbound	N/A	N/A	N/A	19	N/A	I-85	Davidson
Rest Area: Cabarrus County I-85, Southbound	N/A	N/A	N/A	21	N/A	I-85	Cabarrus
Rest Area: Iredell/Yadkin Counties I-77, Southbound	N/A	N/A	N/A	11	N/A	I-77	Iredell
Rest Area: Iredell County I-77, Southbound	N/A	N/A	N/A	11	N/A	I-77	Iredell
Rest Area: Johnston County I-40, Eastbound	N/A	N/A	N/A	15	N/A	I-40	Johnston
Rest Area: Davie County I-40, Westbound	N/A	N/A	N/A	17	N/A	I-40	Davie
Rest Area: Catawba County I-40 Westbound	N/A	N/A	N/A	14	N/A	I-40	Catawba
Rest Area: McDowell County I-40 Westbound	N/A	N/A	N/A	11	N/A	I-40	McDowell
Rest Area: Henderson Buncombe County I-26, Westbound	N/A	N/A	N/A	9	N/A	I-26	Henderson
Rest Area: Haywood County I-40, Westbound	N/A	N/A	N/A	10	N/A	I-40	Haywood
Rest Area: Sampson County U.S. 421	N/A	N/A	N/A	6	N/A	U.S. Hwy 421	Sampson
Visitor Center: Caswell County U.S. 29	N/A	N/A	N/A	10	N/A	U.S. Hwy 29	Caswell
Visitor Center: Wilkes County U.S. 421	N/A	N/A	N/A	7	N/A	U.S. Hwy 421	Wilkes
Rest Area: Cherokee County U.S. 19/129	N/A	N/A	N/A	3	N/A	U.S. Hwy 74	Cherokee

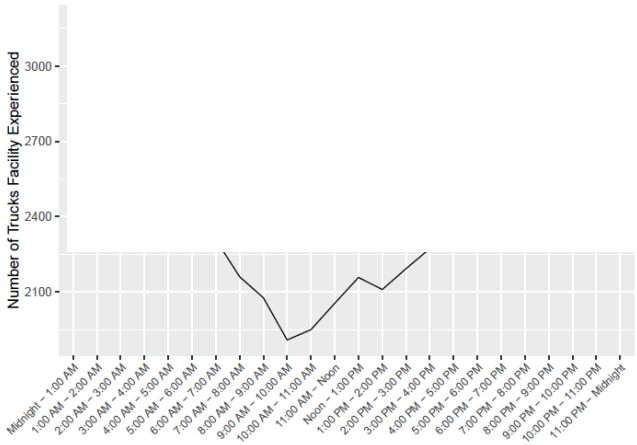
Appendix C. Supplemental Tables and Figures from ATRI Report

Figure C.1 Top Ten Truck Parking Locations – Parking per Hour of the Day

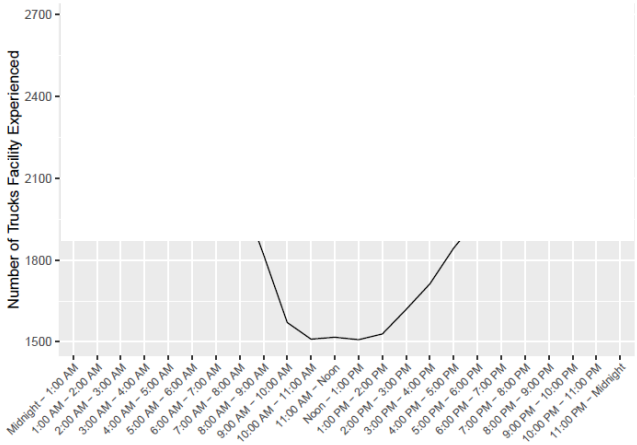
Rank 1: Pilot



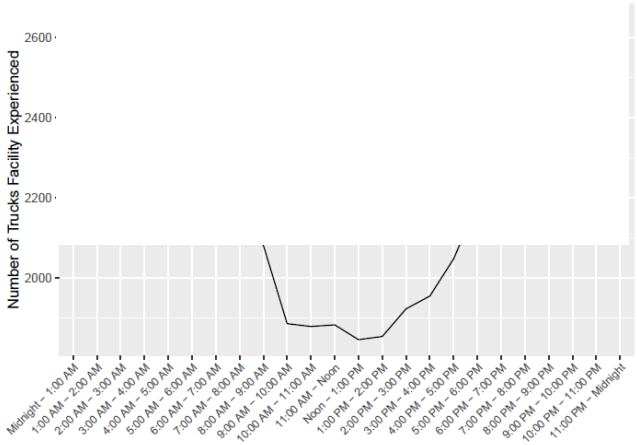
Rank 2: Travel Centers of America



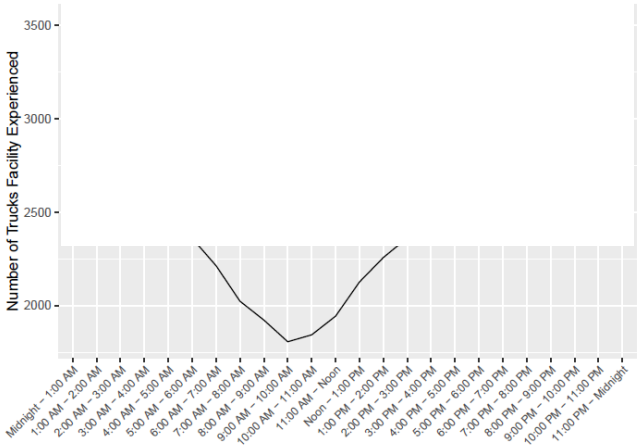
Rank 3: Petro Mebane



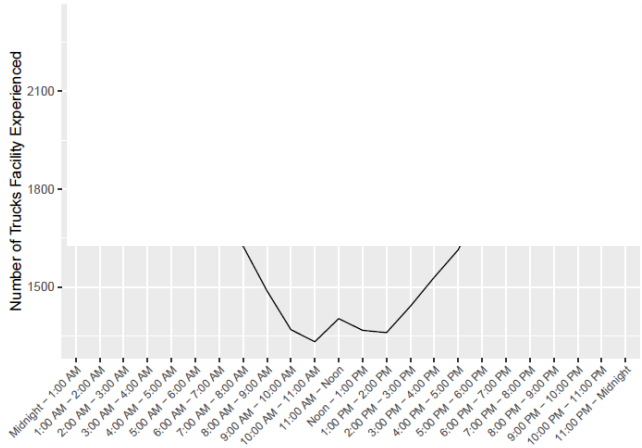
Rank 4: Metro Kenly



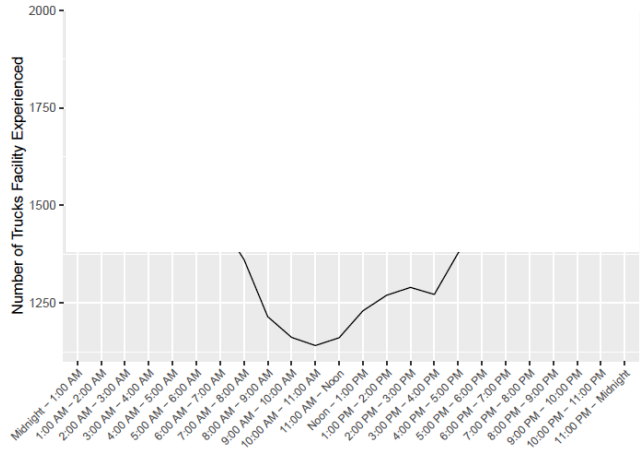
Rank 5: Pilot



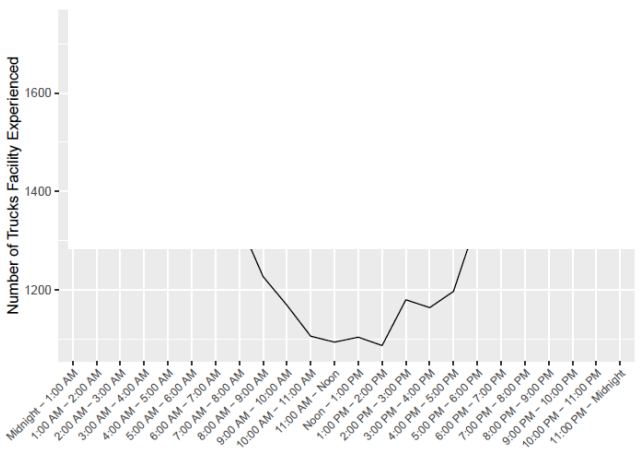
Rank 6: Travel Centers of America



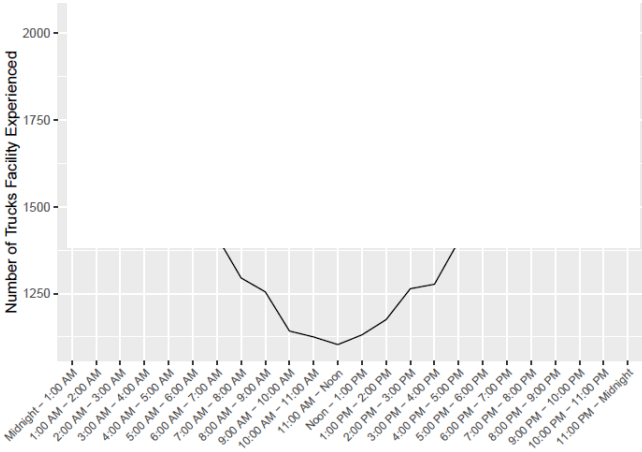
Rank 7: WilcoHess



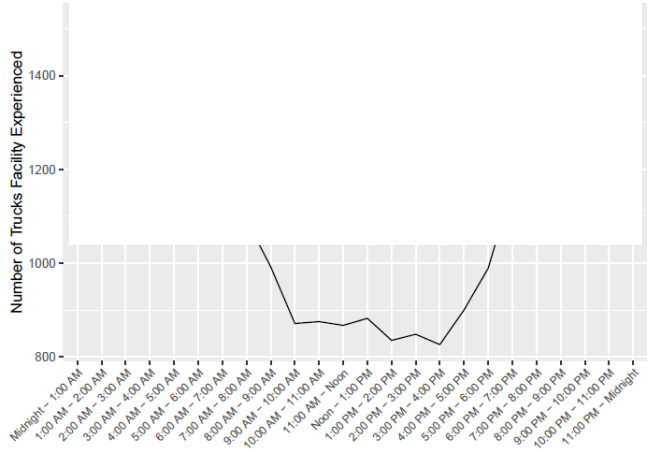
Rank 8: Flying J



Rank 9: Candler Travel Center



Rank 10: Pilot



Source: ATRI.

Table C.1 shows the results of incoming, outgoing and through trips for each exit station surrounding North Carolina.

Table C.1 March 2015 Exit Station Counts

	Road Identifier	March, 2015				
		Incoming Trips with Stop in NC	Incoming Through Trips	Outgoing Trips with Start in NC	Outgoing Through Trips	Total
North	I-95	3,770	4,707	3,854	4,688	17,019
	I-85	2,635	2,177	2,505	2,054	9,371
	I-77	7,500	5,539	7,876	5,431	26,346
West	I-26	696	1,027	732	1,021	3,476
	I-40	5,647	6,163	6,414	7,009	25,233
South	I-26	7,905	13,843	7,211	13,199	42,158
	I-85	2,510	4,767	2,623	4,790	14,690
	I-77	5,730	7,228	5,641	7,220	25,819
	I-95	4,115	3,806	4,122	3,845	15,888
Totals		40,508	49,257	40,978	49,257	
		89,765		**90,235**		

Source: ATRI.

May 2015 exit station counts are reported in Table C.2.

Table C.2 May 2015 Exit Station Counts

	Road Identifier	May, 2015				
		Incoming Trips with Stop in NC	Incoming Through Trips	Outgoing Trips with Start in NC	Outgoing Through Trips	Total
North	I-95	4,571	5,561	4,422	5,439	19,993
	I-85	2,999	2,195	2,658	2,064	9,916
	I-77	8,797	6,527	9,319	6,475	31,118
West	I-26	789	997	846	1,048	3,680
	I-40	6,332	7,427	7,143	8,173	29,075
South	I-26	8,374	14,783	7,598	14,402	45,157
	I-85	2,773	5,724	2,946	5,647	17,090
	I-77	6,129	8,562	6,235	8,492	29,418
	I-95	4,609	4,067	4,625	4,103	17,404
Totals		45,373	55,843	45,792	55,843	
		101,216		**101,635**		

Source: ATRI.

Incoming, outgoing and through truck trips during July 2015 are reported in Table C.3.

Table C.3 July 2015 Exit Station Counts

	Road Identifier	July, 2015				
		Incoming Trips with Stop in NC	Incoming Through Trips	Outgoing Trips with Start in NC	Outgoing Through Trips	Total
North	I-95	4,530	6,091	4,611	6,002	21,234
	I-85	3,207	2,438	2,899	2,405	10,949
	I-77	9,030	6,838	9,615	6,906	32,389
West	I-26	813	1,097	878	1,087	3,875
	I-40	6,594	7,295	7,398	8,208	29,495
South	I-26	9,082	16,487	8,301	15,715	49,585
	I-85	2,970	6,870	3,109	6,851	19,800
	I-77	6,230	8,838	6,365	8,739	30,172
	I-95	5,057	4,709	5,129	4,750	19,645
Totals		47,513	60,663	48,305	60,663	
		108,176		108,968		

Source: ATRI

Table C.4 shows exit station counts during October 2015.

Table C.4 October 2015 Exit Station Counts

	Road Identifier	October, 2015				
		Incoming Trips with Stop in NC	Incoming Through Trips	Outgoing Trips with Start in NC	Outgoing Through Trips	Total
North	I-95	3,279	3,769	3,251	3,548	13,847
	I-85	2,431	1,974	2,275	1,861	8,541
	I-77	7,016	5,681	7,454	5,402	25,553
West	I-26	654	791	669	848	2,962
	I-40	5,769	6,548	6,471	7,281	26,069
South	I-26	7,837	13,713	6,945	13,225	41,720
	I-85	3,025	5,023	2,993	5,104	16,145
	I-77	5,756	6,570	5,583	6,557	24,466
	I-95	3,586	2,843	3,728	3,086	13,243
Totals		39,353	46,912	39,369	46,912	
		86,265		86,281		

Source: ATRI

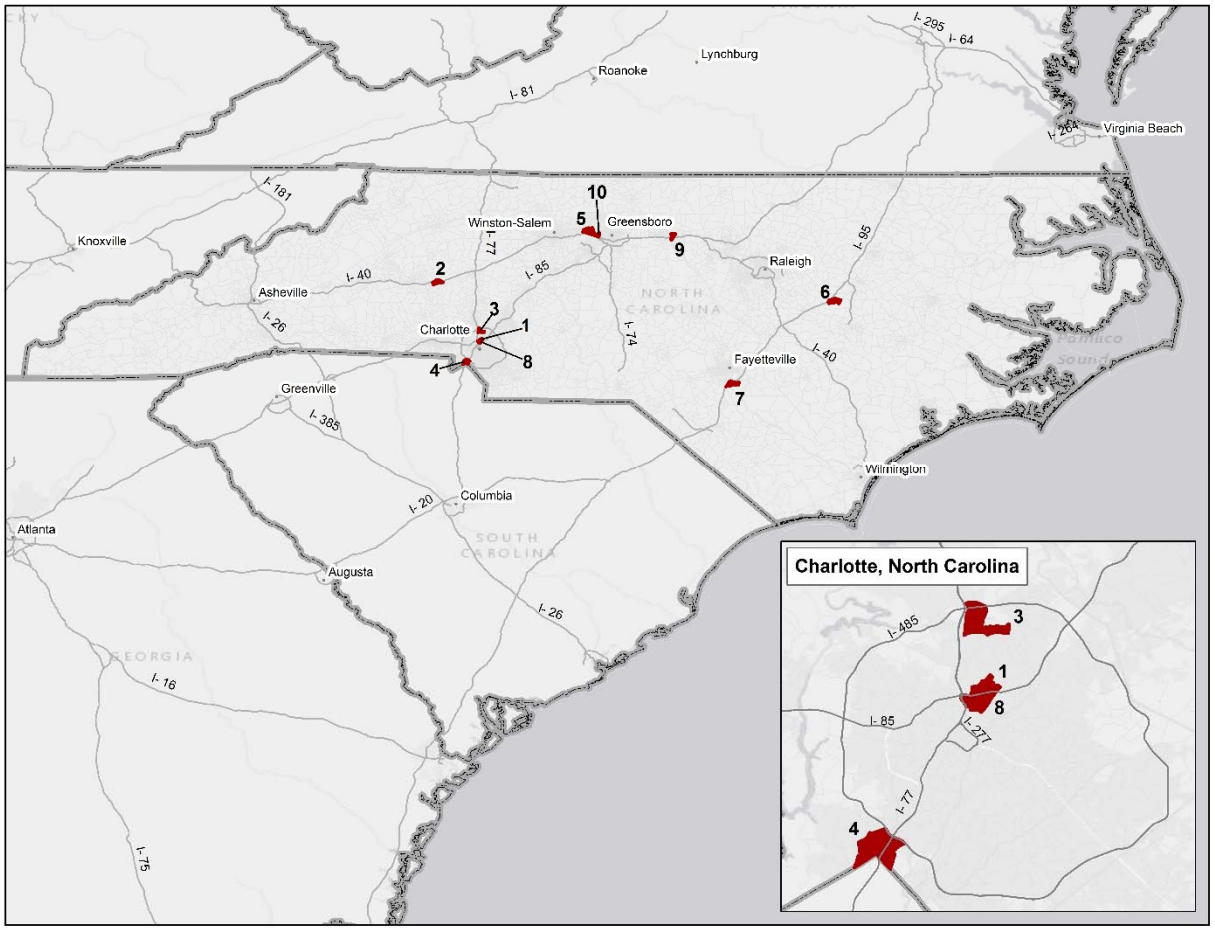
Table C.5 Top Ten Census Block Group Destinations, March 2015

Rank	Number of Stops
1	6,466
2	6,444
3	3,005
4	2,522
5	2,194
6	2,140
7	2,080
8	1,854
9	1,566
10	1,557

Source: ATRI

Figure C.2 displays the geographical location of each of the top ten census block groups, labeled by their corresponding rank number.

Figure C.2 Top Ten Census Block Destinations, March 2015



Source: ATRI

Table C.6 ranks the top ten census block group destinations during May 2015.

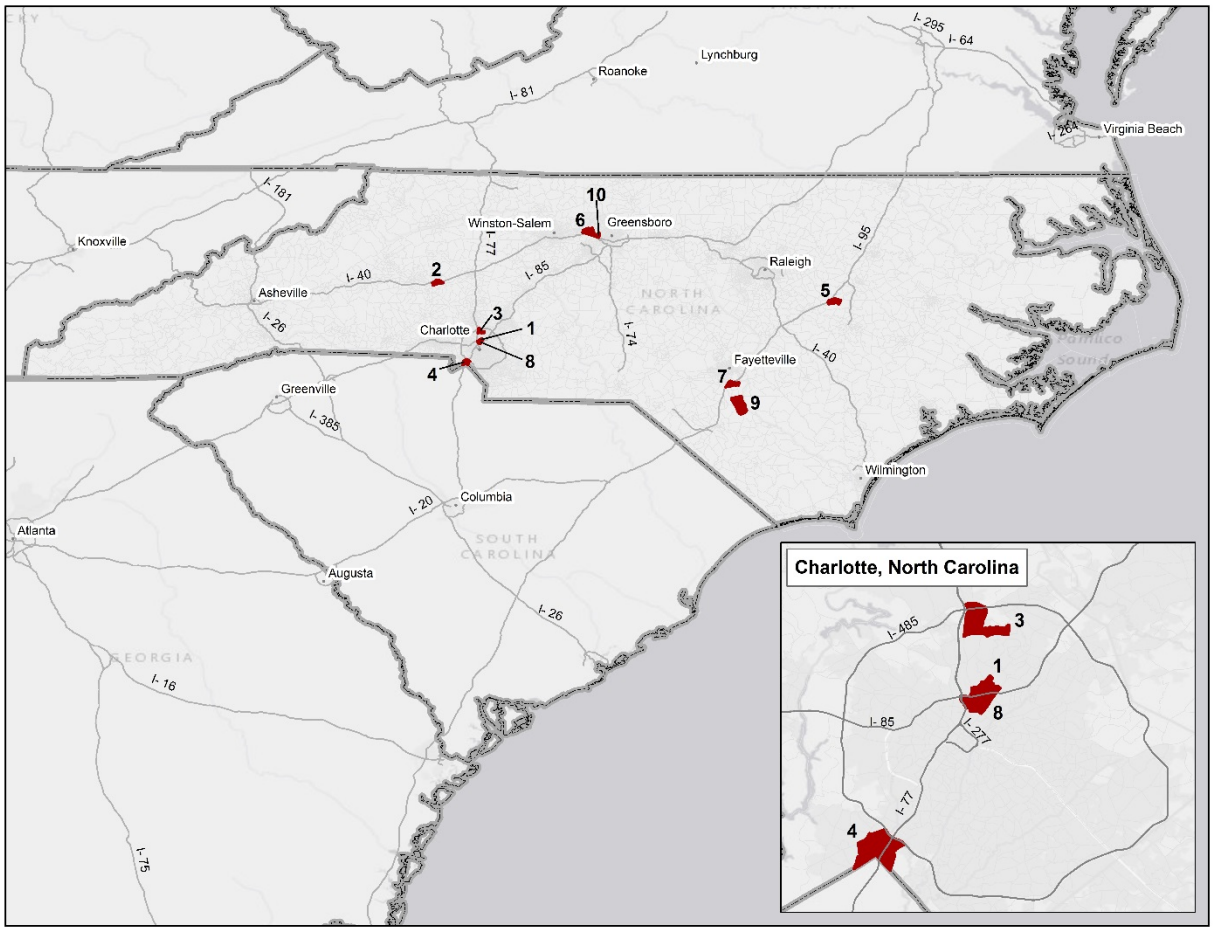
Table C.6 Top Ten Census Block Group Destinations, May 2015

Rank	Number of Stops
1	6,715
2	6,597
3	2,994
4	2,754
5	2,678
6	2,433
7	2,138
8	2,012
9	1,914
10	1,803

Source: ATRI

Figure C.3 displays the top ten census block group destinations for May 2015, with their corresponding rankings.

Figure C.3 Top Ten Census Block Destinations, May 2015



Source: ATRI.

The top ten census block group destinations for July are reported in Table C.7.

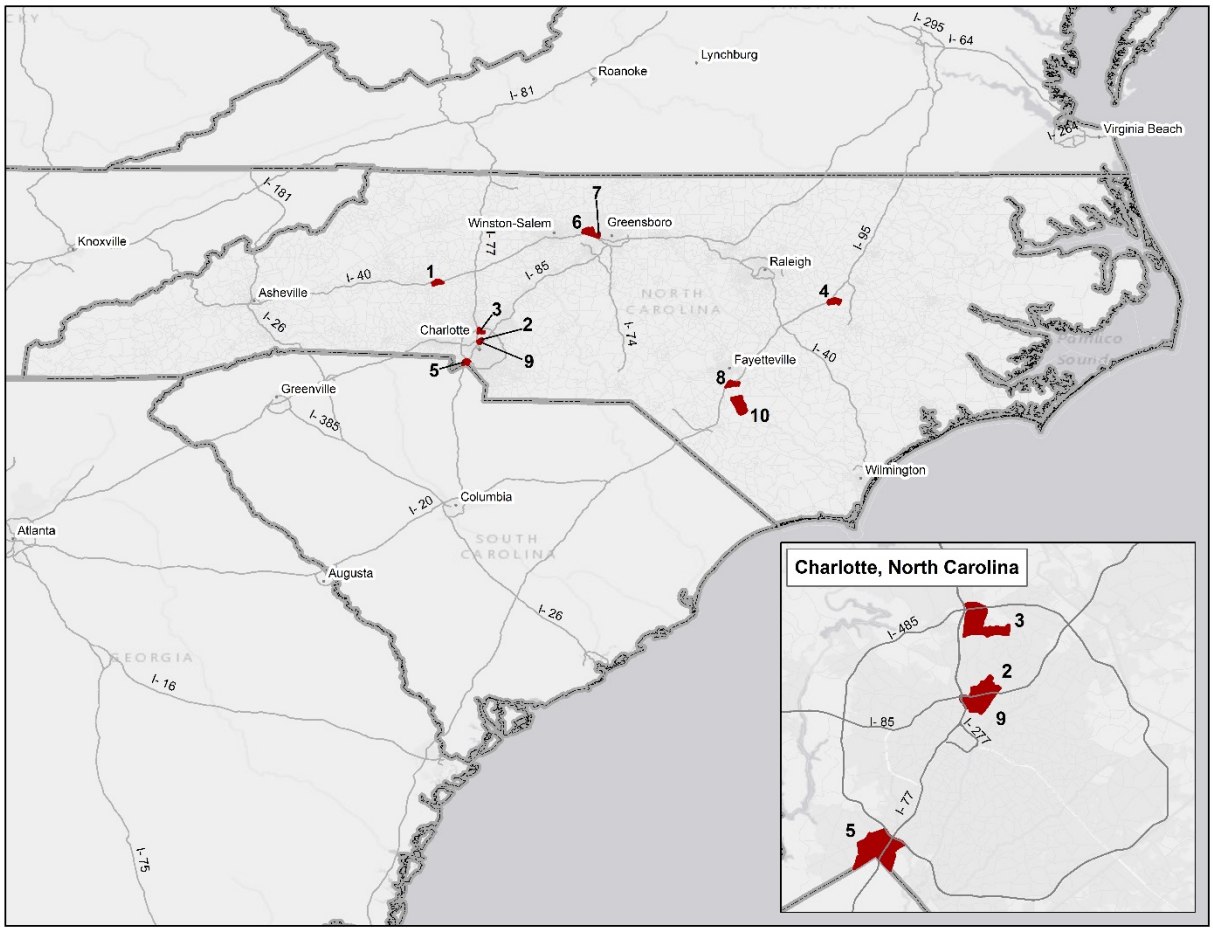
Table C.7 Top Ten Census Block Group Destinations, July 2015

Rank	Number of Stops
1	6,735
2	6,647
3	3,399
4	2,858
5	2,734
6	2,614
7	2,409
8	2,281
9	2,243
10	2,061

Source: ATRI

Figure C.4 indicates the location of the top ten census block group truck destinations during two weeks in July 2015.

Figure C.4 Top Ten Census Block Destinations, July 2015



Source: ATRI

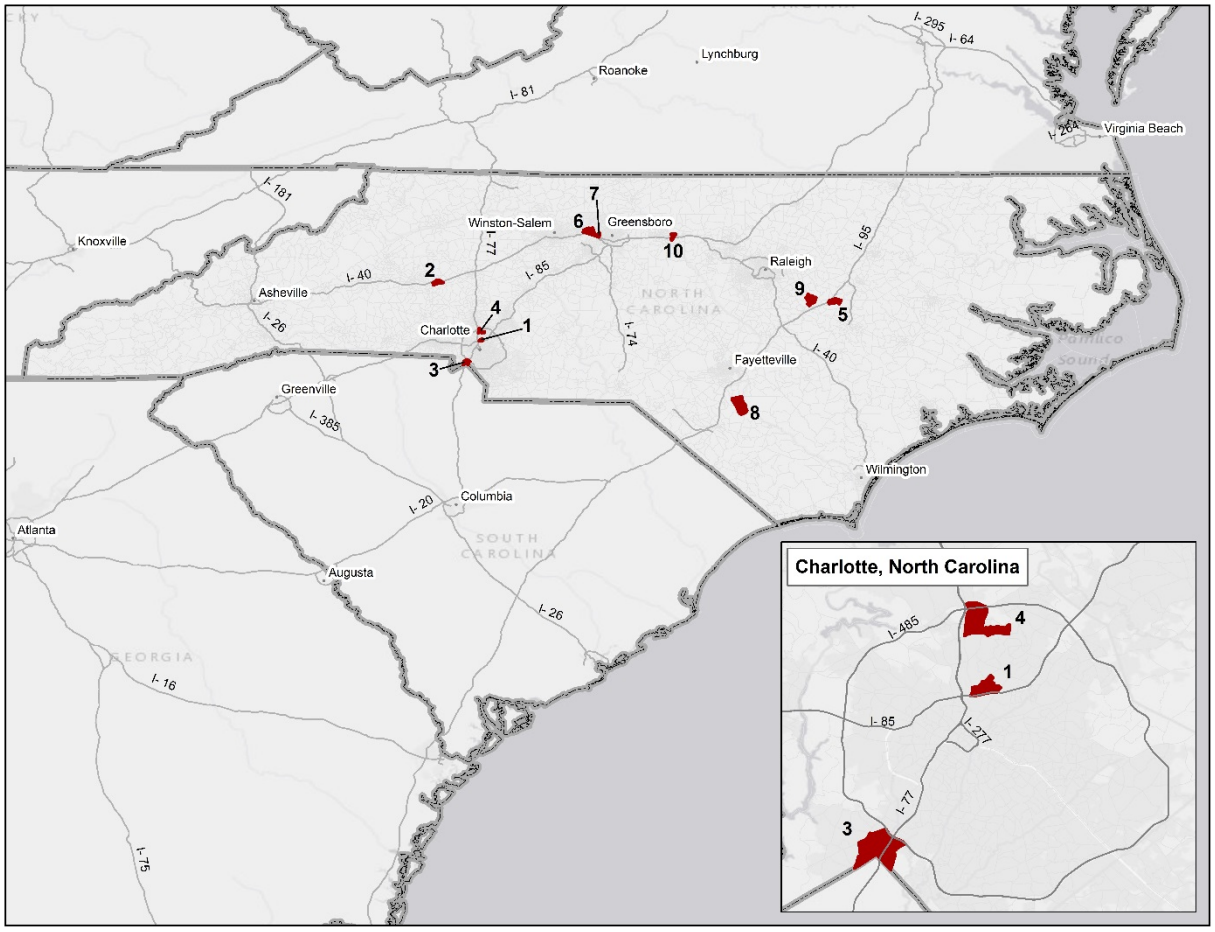
The top ten census block groups are listed in Table C.8, and geographically seen in Figure C.5 for October 2015.

Table C.8 Top Ten Census Block Group Destinations, October 2015

Rank	Number of Stops
1	3,349
2	2,731
3	2,629
4	2,608
5	2,005
6	1,996
7	1,915
8	1,804
9	1,630
10	1,569

Source: ATRI

Figure C.5 Top Ten Census Block Destinations, October 2015



Source: ATRI

Table C.9 shows the top ten parking location rankings and the average time stopped at each location during the first two weeks of March 2015.

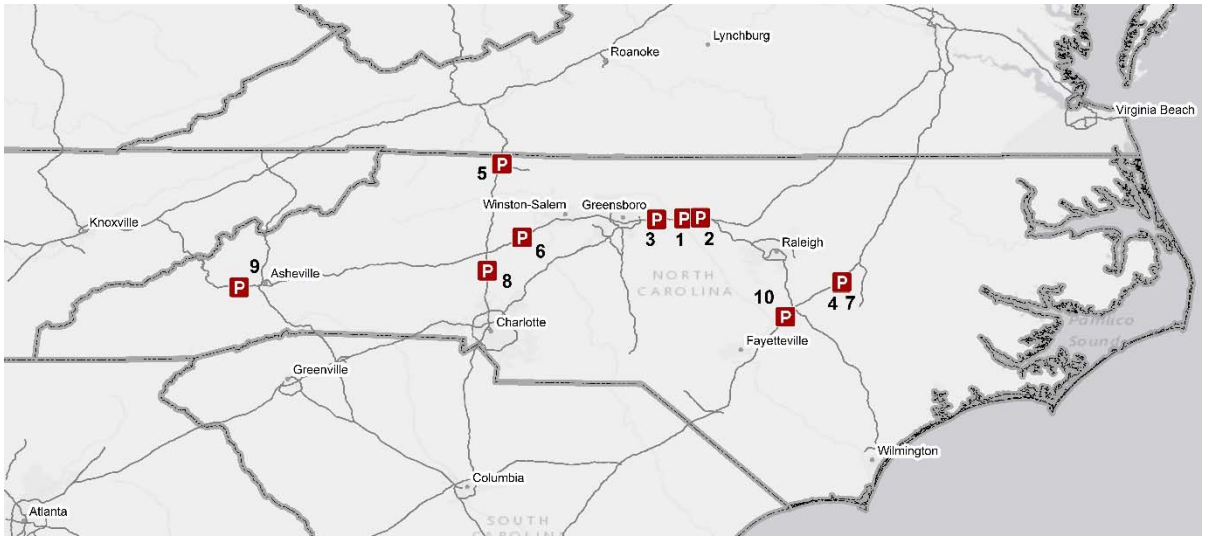
Table C.9 Parking Location Average Stop Time and Relative Volume, March 2015

Parking Rank	Average Time Stopped (hours)	Frequency (per 1,000 trucks)	Location Name
1	13.2	61	Pilot
2	13.1	56	Petro Mebane
3	13.1	55	Travel Centers of America
4	12.7	53	Petro Kenly
5	11.9	52	Pilot
6	13.3	50	Travel Centers of America
7	11.9	36	Flying J
8	12.7	32	WilcoHess
9	12.4	29	Candler Travel Center
10	12.7	27	Pilot

Source: ATRI

Figure C.6 displays the geographical location of each of the top ten parking areas labeled by their corresponding rank in relative volume.

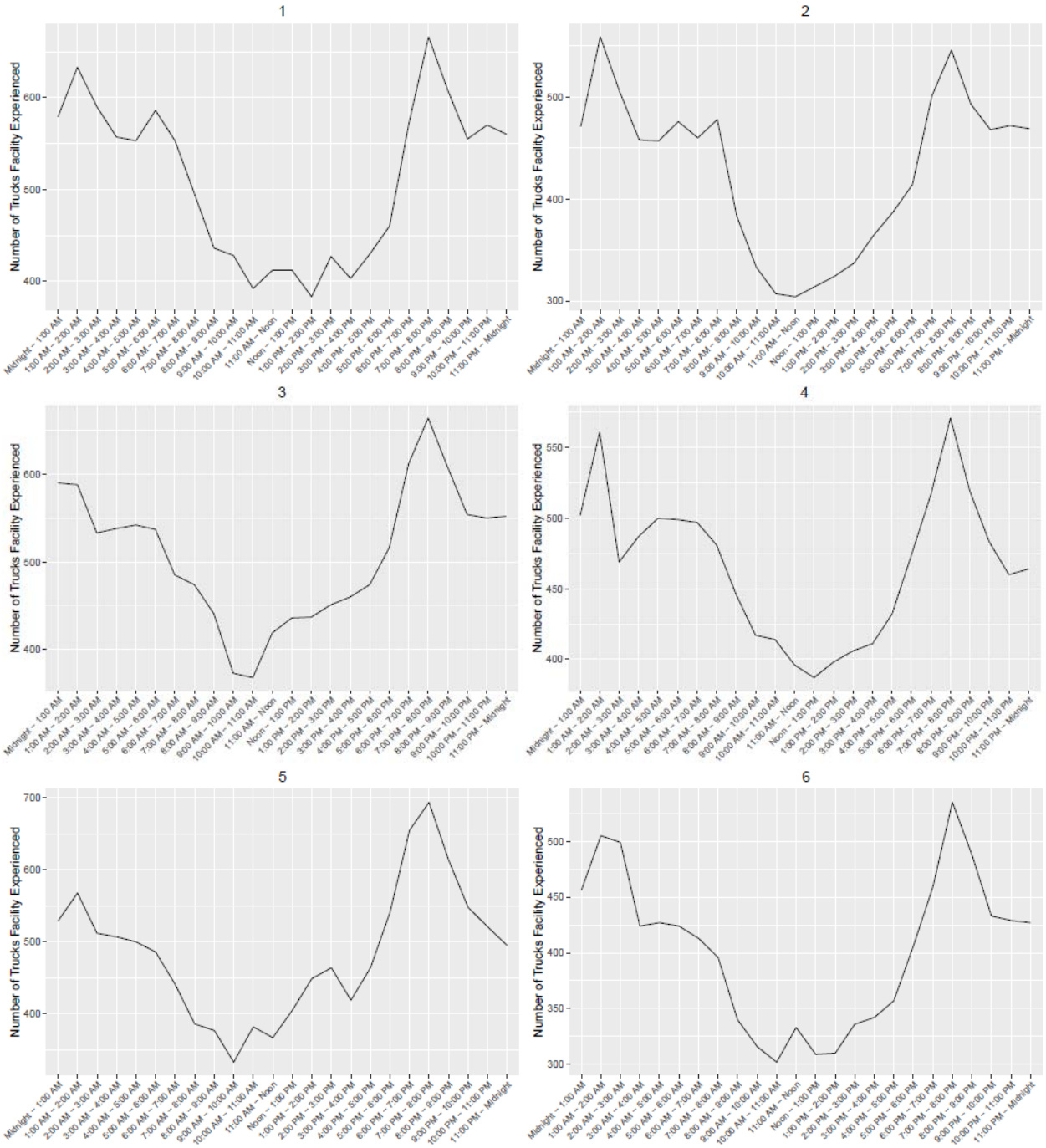
Figure C.6 Top 10 Parking Locations March 2015

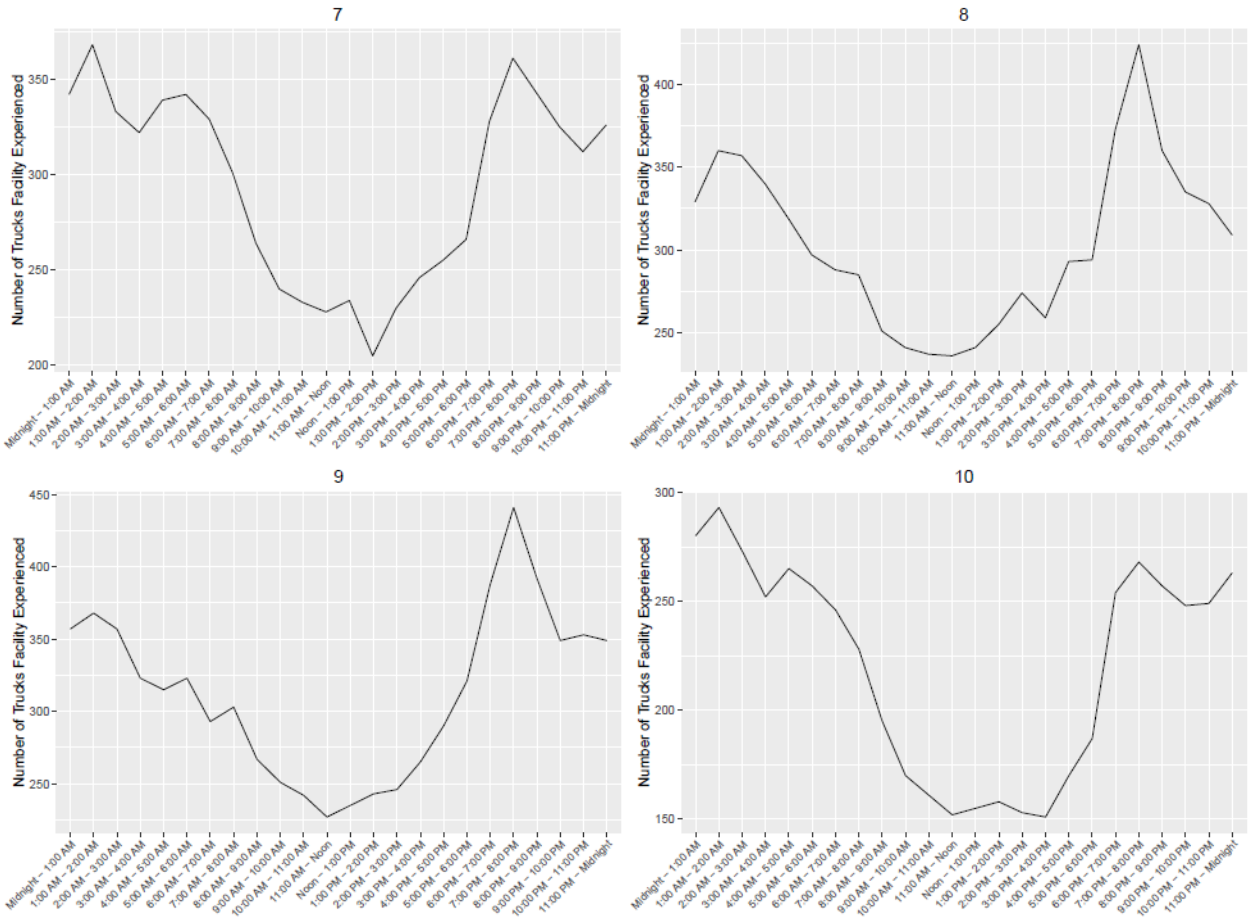


Source: ATRI.

Figure C.7 shows the number of trucks per hour of the day at the top ten parking facilities during the month of March 2015.

Figure C.7 Top Ten Truck Parking Locations – Parking per Hour, March 2015





Source: ATRI

Table C.10 shows the top ten parking location rankings and the average time stopped at each location during two weeks in May 2015.

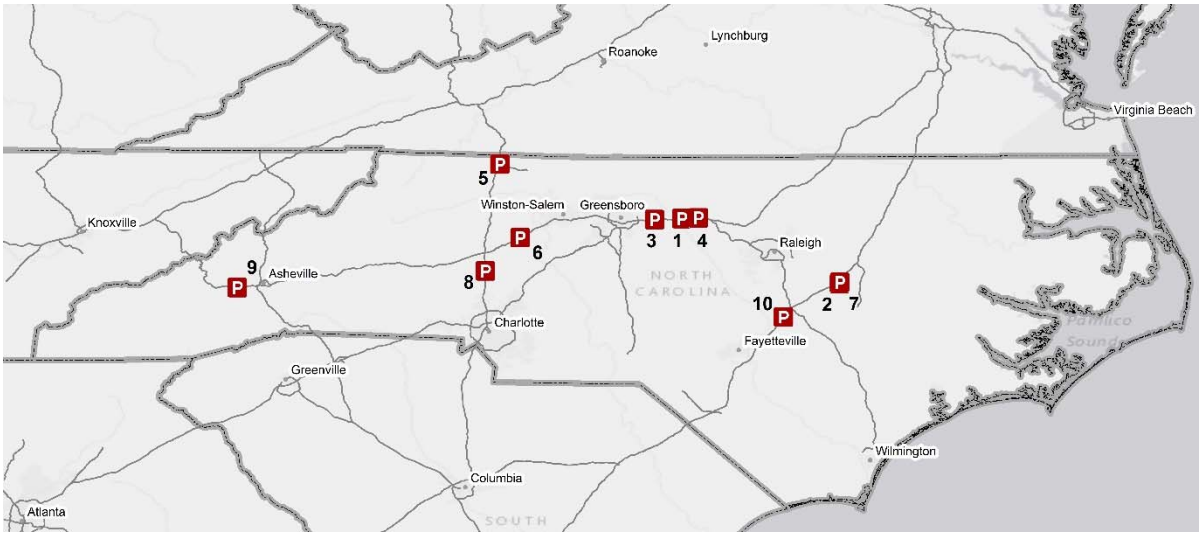
Table C.10 Parking Location Average Stop Time and Relative Volume, May 2015

Parking Rank	Average Time Stopped (hours)	Frequency (per 1,000 trucks)	Location Name
1	12.8	59	Pilot
2	12.6	56	Petro Kenly
3	12.6	56	Travel Centers of America
4	12.9	56	Petro Mebane
5	12.0	52	Pilot
6	13.5	43	Travel Centers of America
7	12.3	34	Flying J
8	12.0	34	WilcoHess
9	11.9	28	Candler Travel Center
10	12.4	27	Pilot

Source: ATRI

The geographical location of each of the top ten parking areas labeled by their corresponding rank in relative volume are displayed Figure C.8.

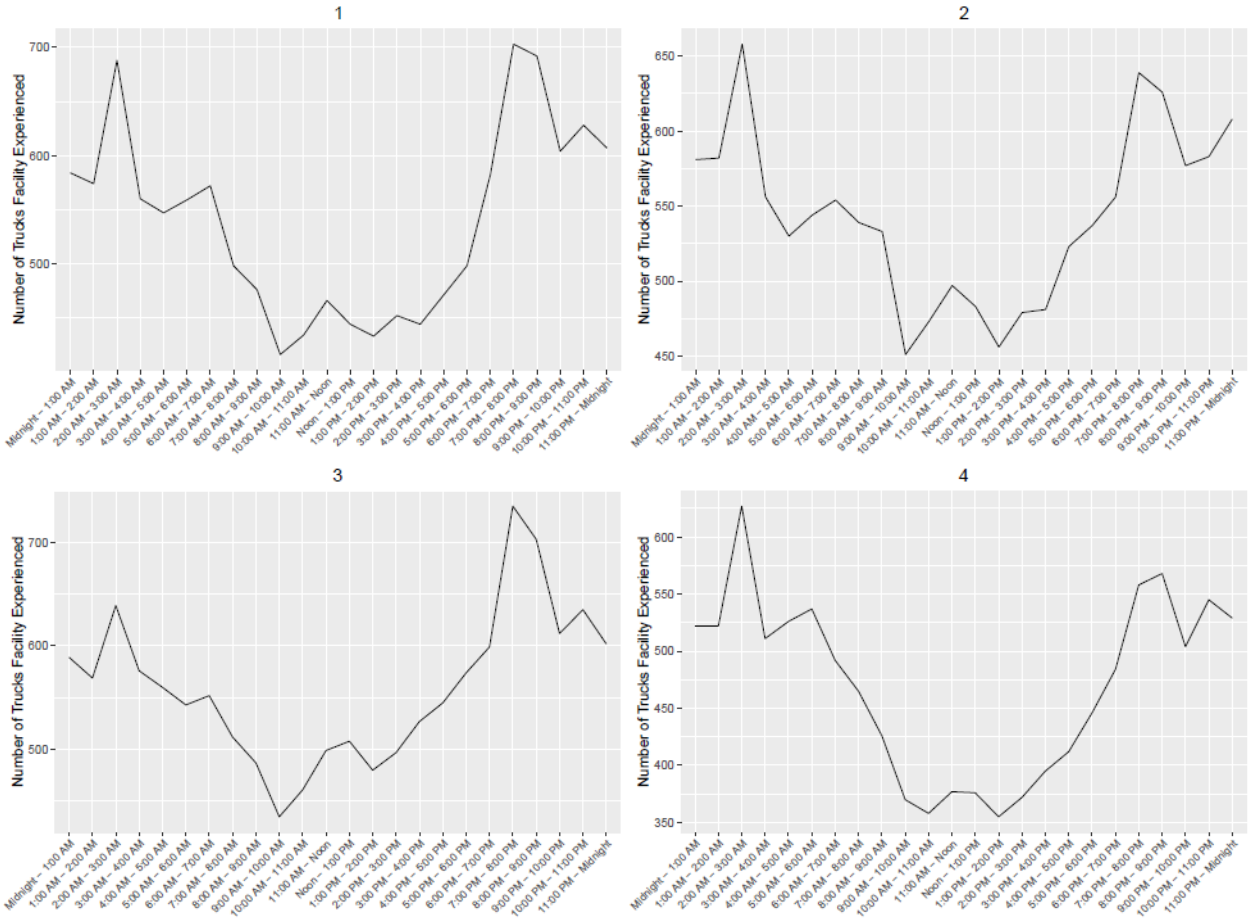
Figure C.8 Top 10 Parking Locations May 2015

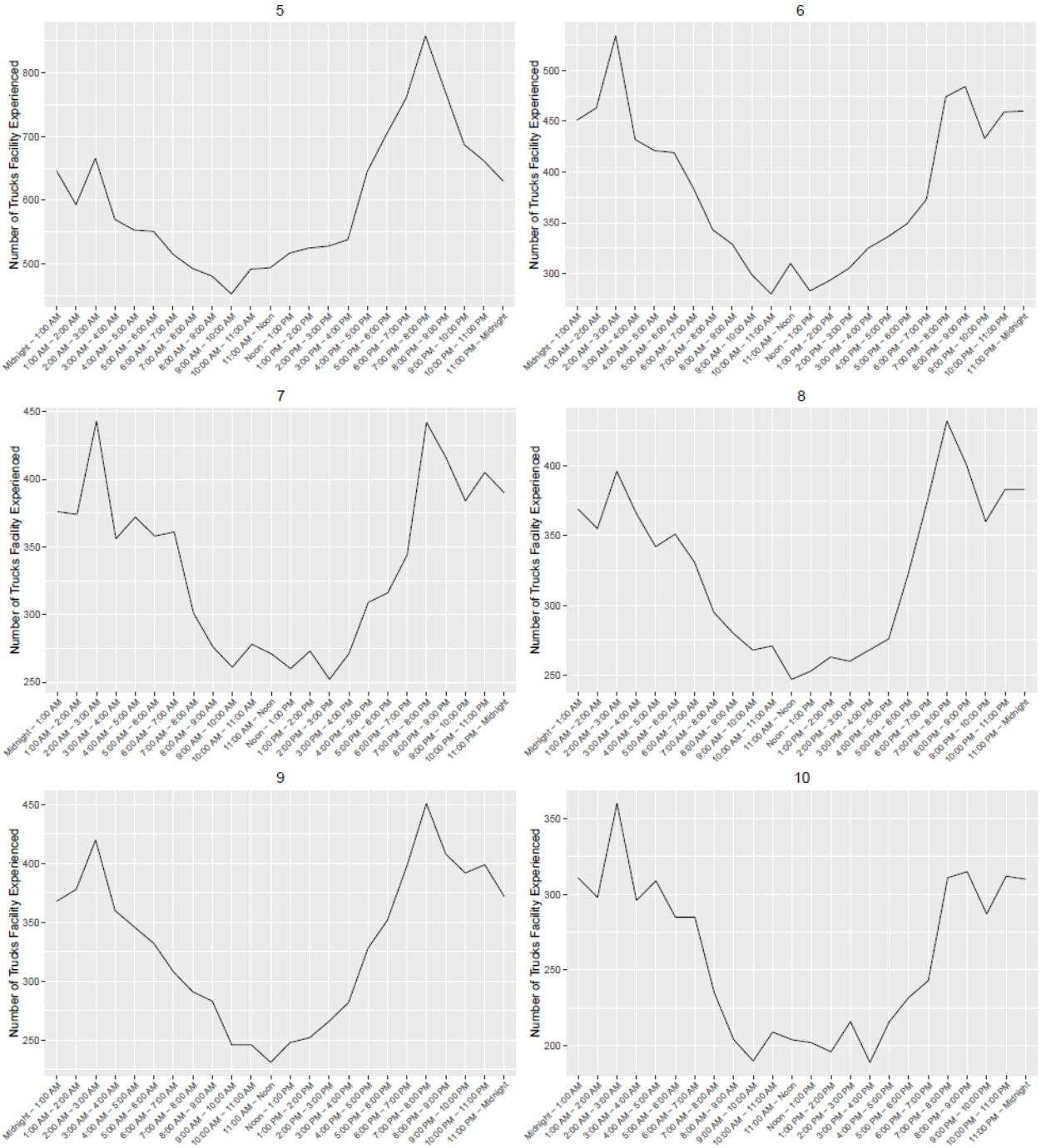


Source: ATRI

Figure C.9 shows the top ten parking locations during May 2015 and the number of trucks per hour of the day.

Figure C.9 Top Ten Truck Parking Locations – Parking per Hour, May 2015





Source: ATRI

Table C.11 indicates July 2015 top ten rankings, average length of time trucks remain at each parking location and frequency per 1,000 trucks.

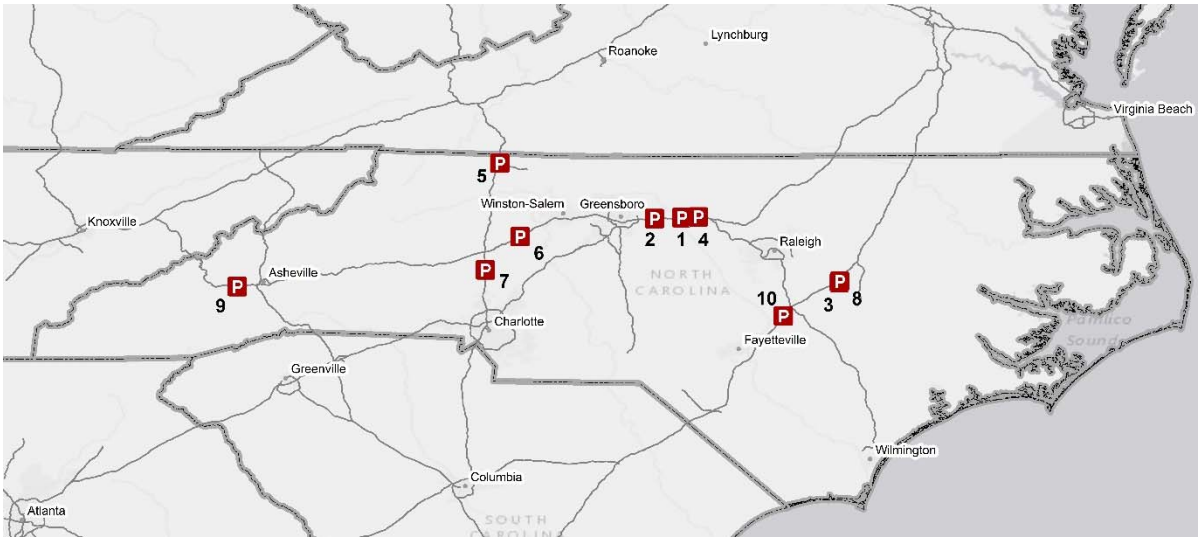
Table C.11 Parking Location Average Stop Time and Relative Volume, July 2015

Parking Rank	Average Time Stopped (hours)	Frequency (per 1,000 trucks)	Location Name
1	12.7	57	Pilot
2	13.0	54	Travel Centers of America
3	12.7	50	Petro Kenly
4	12.5	50	Petro Mebane
5	11.8	47	Pilot
6	12.7	41	Travel Centers of America
7	12.5	34	WilcoHess
8	12.7	31	Flying J
9	12.5	30	Candler Travel Center
10	12.5	29	Pilot

Source: ATRI

Figure C.10 shows the geographical locations of the results from Table C3, during July 2015.

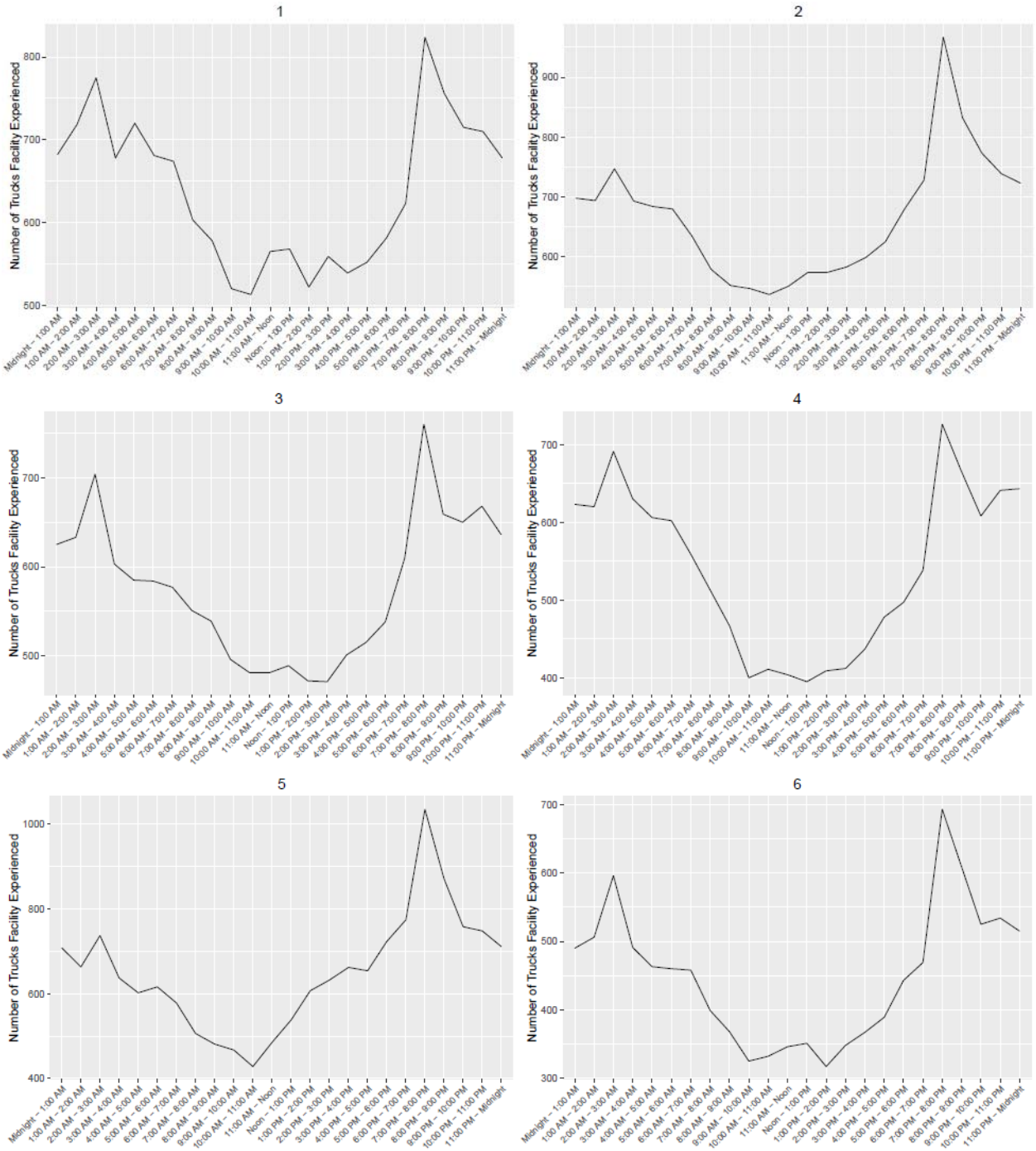
Figure C.10 Top 10 Parking Locations July 2015

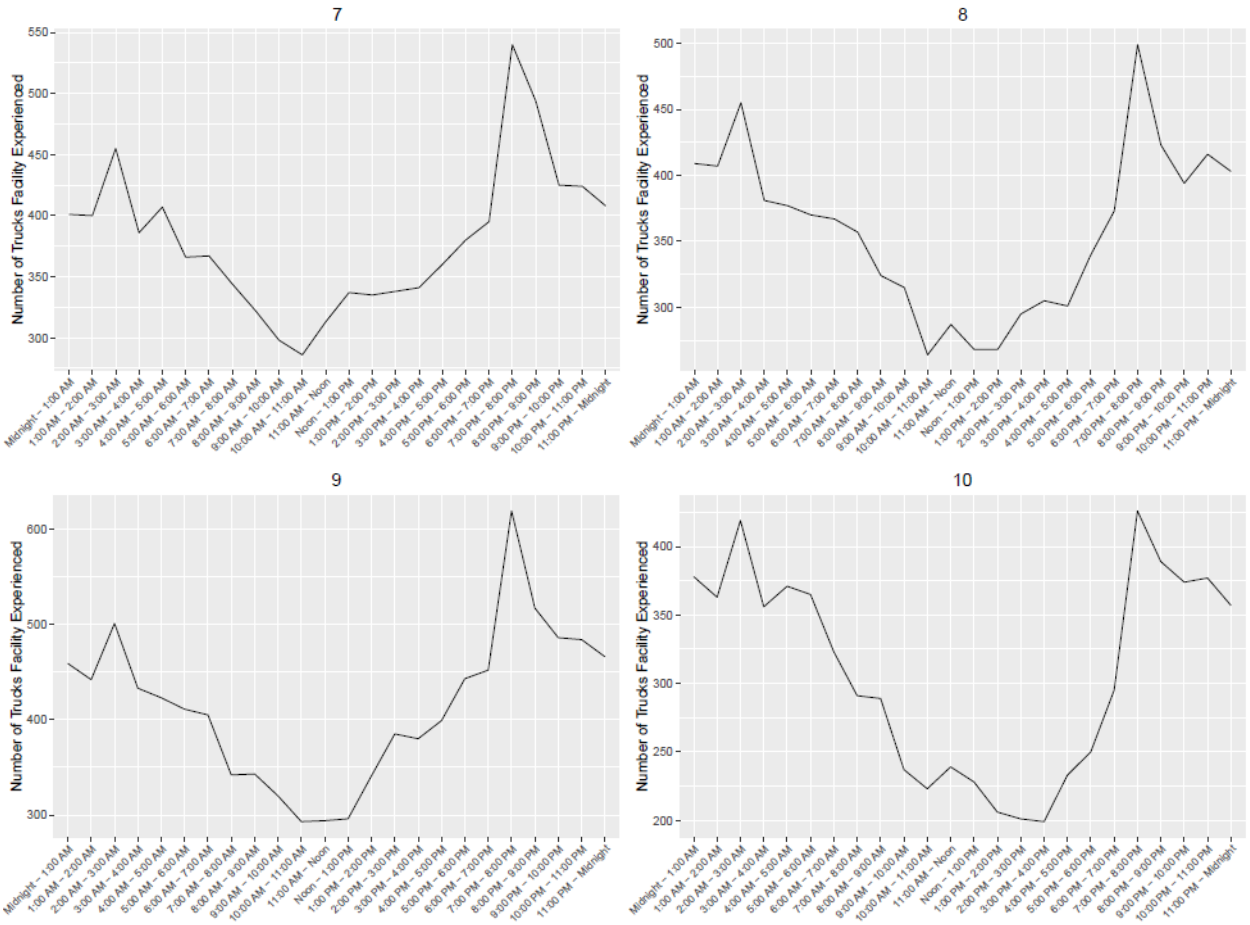


Source: ATRI

The top ten parking locations are portrayed in Figure C.11 showing the parking volumes per hour of the day during July 2015.

Figure C.11 Top Ten Truck Parking Locations – Parking per Hour, July 2015





Source: ATRI

Table C.12 indicates the top ranked parking locations in North Carolina during October 2015.

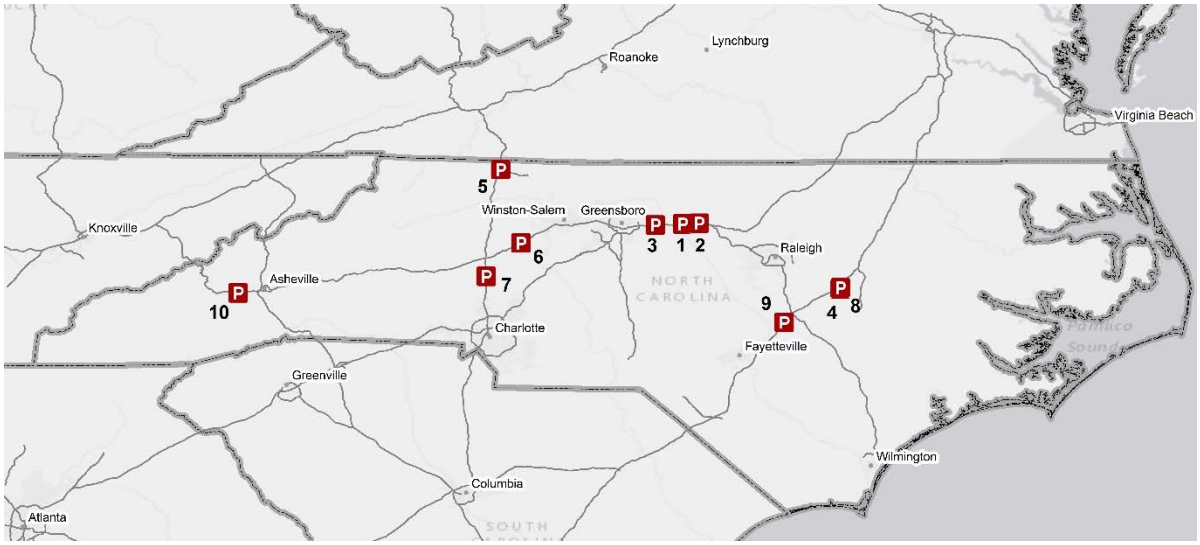
Table C.12 Parking Location Average Stop Time and Relative Volume, October 2015

Parking Rank	Average Time Stopped (hours)	Frequency (per 1,000 trucks)	Location Name
1	13.3	57	Pilot
2	13.7	57	Petro Mebane
3	14.6	55	Travel Centers of America
4	13.9	51	Petro Kenly
5	12.4	50	Pilot
6	14.1	44	Travel Centers of America
7	13.9	37	WilcoHess
8	14.4	34	Flying J
9	13.7	30	Pilot
10	12.6	29	Candler Travel Center

Source: ATRI

The geographical locations of the top ten parking locations in North Carolina are shown in Figure C.12.

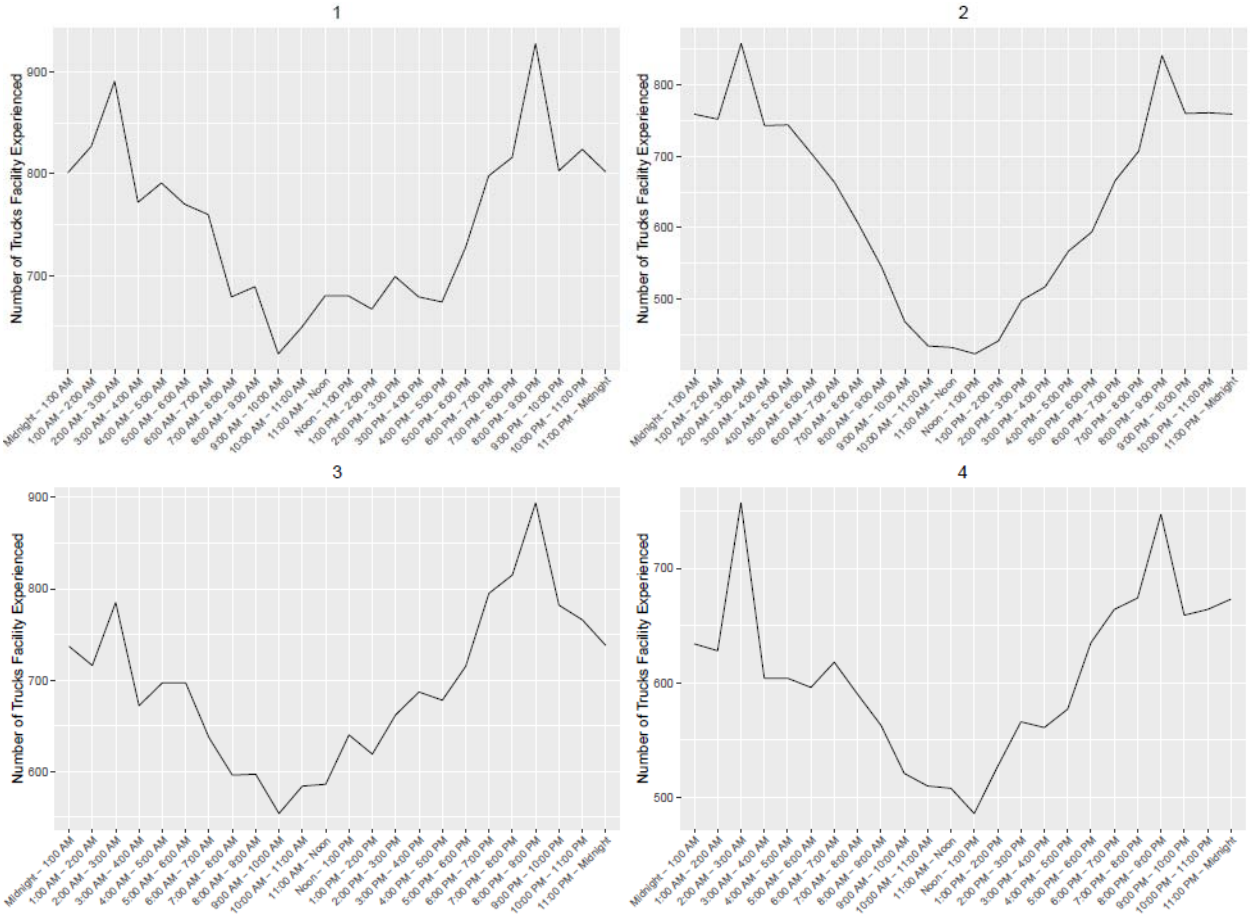
Figure C.12 Top 10 Parking Locations October 2015

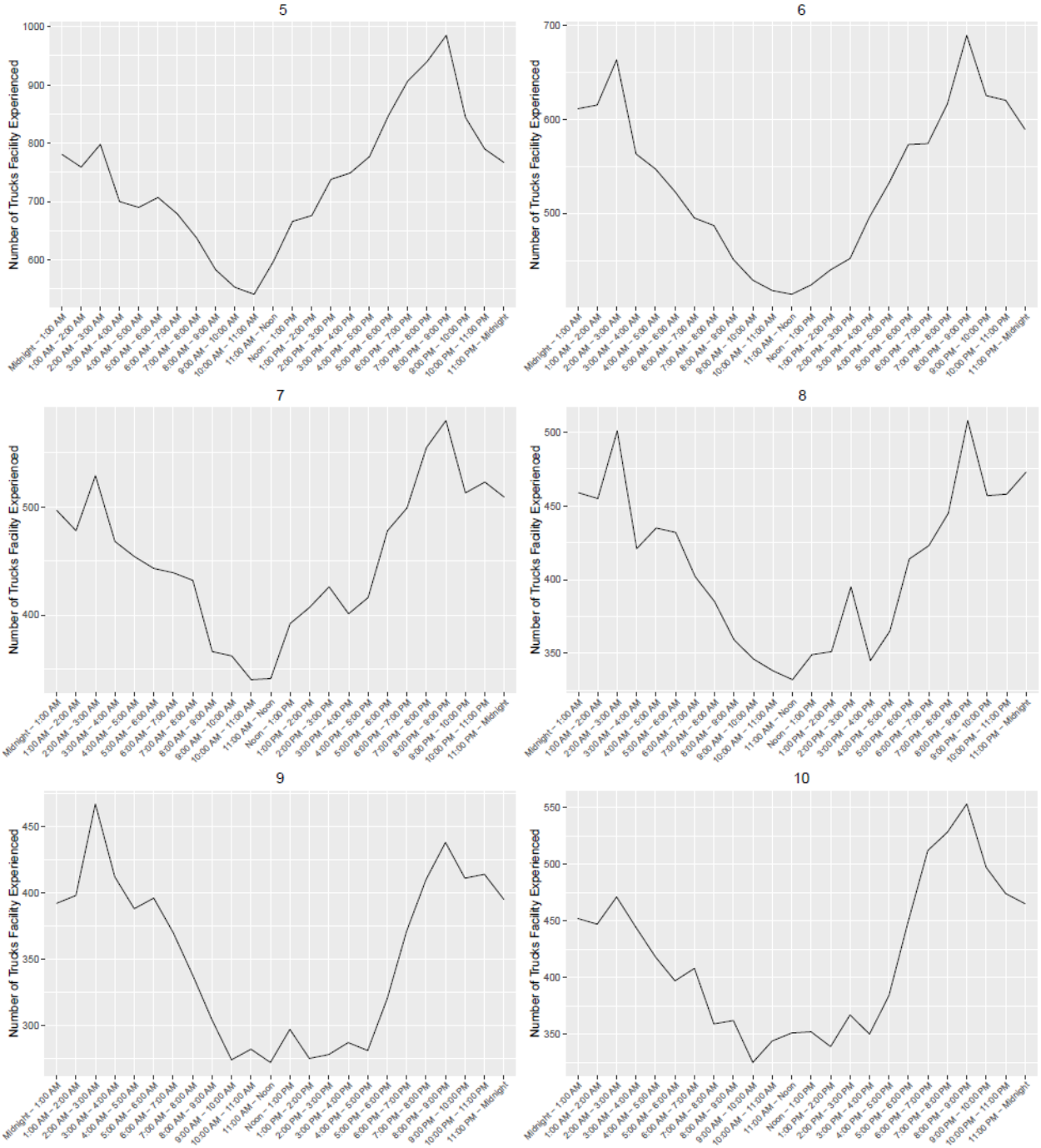


Source: ATRI

Parking by hour of the day for the top ten parking locations during October 2015 is shown in Figure C.13.

Figure C.13 Top Ten Truck Parking Locations – Parking per Hour, October 2015




5
6
7
8
9
10
Number of Trucks Facility Experienced
Midnight – 1:00 AM
1:00 AM – 2:00 AM
2:00 AM – 3:00 AM
3:00 AM – 4:00 AM
4:00 AM – 5:00 AM
5:00 AM – 6:00 AM
6:00 AM – 7:00 AM
7:00 AM – 8:00 AM
8:00 AM – 9:00 AM
9:00 AM – 10:00 AM
10:00 AM – 11:00 AM
11:00 AM – Noon
Noon – 1:00 PM
1:00 PM – 2:00 PM
2:00 PM – 3:00 PM
3:00 PM – 4:00 PM
4:00 PM – 5:00 PM
5:00 PM – 6:00 PM
6:00 PM – 7:00 PM
7:00 PM – 8:00 PM
8:00 PM – 9:00 PM
9:00 PM – 10:00 PM
10:00 PM – 11:00 PM
11:00 PM – Midnight

Source: ATRI

Appendix D. Literature Review

This section contains a review of the laws, policies, and constraints related to truck parking North Carolina at both the state and Federal level. The analysis is not limited to specific law or regulation targeting truck parking and includes other types of laws and ordinances (such as local noise ordinances) that may have an impact on locating truck parking facilities.

Federal Laws and Policies Affecting Truck Parking

This section describes the major Federal policies that affect truck parking in North Carolina. This includes recent legislation from Jason's Law, Hours of Service (HOS) requirements, parking of vehicles with hazardous materials, statewide rest area regulations, and noise emission standards.

Jason's Law

After a truck driver, Jason Rivenburg, was killed at an abandoned gas station while waiting to show up at a delivery site earlier than the site allowed, Jason's widow Hope Rivenburg fought to have "Jason's Law" included in the Moving Ahead for Progress in the 21st Century Act (MAP-21) highway bill. Though Rivenburg was only 12 miles away from the delivery site in South Carolina, he was forced to stay in an unsafe location because he was ahead of schedule and could not find another place to park. Jason's Law addresses the shortage of long-term parking for commercial vehicles on the National Highway System (NHS), and seeks to improve safety for truck drivers nationwide. The requirements of Jason's Law include an evaluation of each state's capability to provide adequate parking and rest facilities for commercial motor vehicles (CMVs), address the volume of CMV traffic in each state, and develop a method to measure the adequacy of CMV parking in each state.[26]

This study helps to address the requirements in Jason's Law by identifying truck routes and volumes in the state, areas which are over capacity based on survey results, and by evaluating where additional parking facilities are needed.

Hours of Service

Hours of service for CMV drivers are regulated by the U.S. Department of Transportation's Federal Motor Carrier Safety Administration (FMCSA) in an effort to increase safety on the road. These regulations are known as the mandatory hours of service (HOS) regulations for drivers of commercial motor vehicles (CMV), which also referred to as property-carrying drivers. CMVs are broadly defined as a vehicle that is used as part of a business, involved in interstate commerce, weighs 10,001 pounds of more, or transports certain commodities or passengers. The HOS regulations are outlined below[27]:

[26] "Jason's Law Truck Parking Survey Results and Comparative Analysis." U.S. Department of Transportation, Federal Highway Administration. Accessed October 6, 2016. Available from: http://www.ops.fhwa.dot.gov/freight/infrastructure/truck_parking/jasons_law/truckparkingsurvey/ch1.htm.

[27] Summary of Hours of Service Regulations. Federal Motor Carrier Safety Administration. Available from: https://www.fmcsa.dot.gov/regulations/hours-service/summary-hours-service-regulations.

- **11-Hour Driving Limit.** Drivers may drive a maximum of 11 hours after 10 consecutive hours off duty. All time spent at the driving controls of a CMV in operation is considered driving time.
- **14-Hour Driving Limit.** Property-carrying drivers may not drive beyond the 14th consecutive hour after coming on duty, following 10 consecutive hours off duty.
- **Rest breaks.** Drivers may drive only if eight hours or less have passed since the end of the driver's last off-duty or sleeper berth period of at least 30 minutes.
- **60/70-Hour Limit.** Drivers may not drive after 60/70 hours on duty in 7/8 consecutive dates. A driver may restate a 7/8 consecutive day period after taking 34 or more consecutive hours off duty.
- **Sleep Berth Provision.** Drivers using the sleeper berth provision must take at least eight consecutive hours in the sleeper berth, plus a separate two consecutive hours either in the sleeper berth or off duty.
- **34-Hour Restart.** A driver of a property-carrying vehicle may "restart" a 7/8-consecutive-day period after taking 34 or more consecutive hours off duty.

These HOS regulations are strongly enforced by state highway patrols on interstate highways and to some extent by local law enforcement in local jurisdictions, and penalties can be high. Trucking companies that exceed driving limits by more than three hours could be fined up to $11,000 per offense, and the driver could be responsible for additional penalties of up to $2,750 for each offense.[28] To avoid these steep fines, drivers need to efficiently find parking near the end of their HOS time limit to avoid violating HOS regulations while trying to make pick-ups/deliveries as efficiently as possible.

Although the intention of the HOS rules are to increase safety, drivers noted two particular changes in the rules in 2013 that have contributed the most to truck parking challenges across the industry. This includes 1) the requirement for a continuous off-duty window as part of the "34-hour restart" to include two consecutive late-night periods of 1:00 AM to 5:00 AM, and 2) the requirement for drivers to take a 30-minute rest break during the first 8 hours of a shift. As a result of the strict requirements surrounding rest periods, drivers must carefully time deliveries and schedule adequate rest, making sufficient parking critical on their routes and deliveries.[29]

Electronic Logging Devices (ELD) Requirement

In December 2015, the Federal Motor Carrier Safety Administration (FMCSA) announced rulemaking to require the use of electronic logging devices (ELD) to increase commercial truck and bus drivers' compliance with HOS regulations. ELDs automatically record driving time, and monitors engine hours, vehicle movement, miles driven, and location information. Prior to the existence of ELDs, truck drivers recorded on-

[28] "New Hours-of-Service Safety Regulations to Reduce Truck Driver Fatigue Begin Today." Federal Motor Carrier Safety Administration. July 1, 2013. Accessed October 6, 2016. Available from: https://www.fmcsa.dot.gov/newsroom/new-hours-service-safety-regulations-reduce-truck-driver-fatigue-begin-today.

[29] "Jason's Law Truck Parking Survey Results and Comparative Analysis." U.S. Department of Transportation, Federal Highway Administration. Accessed October 6, 2016. Available from: http://www.ops.fhwa.dot.gov/freight/infrastructure/truck_parking/jasons_law/truckparkingsurvey/ch1.htm.

duty/off-duty logs by hand, which are virtually impossible to verify and easily "adjusted" by drivers. There are four main elements of the ELD Final Rule[30]:

- Commercial truck drivers must adopt ELDs within two years;
- Commercial driver harassment is strictly prohibited. The Final Rule provides both procedural and technical provisions intended to protect drivers from harassment resulting from information collected by ELDs;
- FMCSA set specific technology standards detailing performance and design requirements for ELDs, and permits smart phones and other wireless devices as ELDs as long as they satisfy technical specifications; and
- Paperwork will be reduced for HOS compliance as part of the Final Rule.

FMCSA estimates that ELDs will result in an annual net benefit of over $1 billion as a result of reducing the amount of required industry paperwork. However, the American Transportation Research Institute's (ATRI) most recent annual trucking industry survey found that the Federal mandate on ELDs is the number one issue for the trucking industry. Over 65 percent of the 3,200 respondents indicated their concerns with productivity impacts and additional regulatory burdens.[31] Carriers and drivers who are currently using paper logs or logging software must transition to ELDs on or before December 18, 2017. However, carriers and drivers who are using automatic onboard recording devices (AOBRD) must transition to ELDs on or before December 16, 2019.[32]

North Carolina Regulations and Policies Affecting Truck Parking

The following sections highlight North Carolina legislation that pertains to truck parking throughout the State.

State Parking Regulations

There are several North Carolina State laws that affect the truck parking situation for interstate and intrastate commercial vehicle drivers. Most truck-specific laws pertain to commercial vehicle size and weight, but there are two parking restrictions that apply to all motor vehicles and contributes to the truck parking situation in North Carolina. These restrictions are described below[33]:

---

30 "Electronic Logging Devices to be required across Commercial Truck and Bus Industries." FMCSA. December 10, 2015. Accessed October 6, 2016. Available from: https://www.fmcsa.dot.gov/newsroom/electronic-logging-devices-be-required-across-commercial-truck-and-bus-industries

31 "Mandated Use of Electronic Logging Devices Tops the List of Concerns in Annual Trucking Industry Survey." October 3, 2016. American Transportation Research Institute. Accessed October 6, 2016. Available from: http://atri-online.org/2016/10/03/mandated-use-of-electronic-logging-devices-tops-the-list-of-concerns-in-annual-trucking-industry-survey/.

32 Electronic Logging Devices. FMCSA. December 21, 2015. Accessed October 6, 2016. Available from: https://www.fmcsa.dot.gov/hours-service/elds/electronic-logging-devices.

33 North Carolina Traffic Ordinance Manual. NCDOT Mobility and Safety Information Section. November 2015. Accessed October 6, 2016. Available from: https://connect.ncdot.gov/resources/safety/Documents/Chapter%2002%20-%20Parking%20Restrictions.pdf

- Parking any vehicle on any interstate, controlled-access highway, or other controlled access facility is prohibited by general statute and does not need to be ordinanced (§ 20-140.3 and § 136-89.58).

- Parking any vehicle on the shoulder of any public road or highway is prohibited by general statute, unless the vehicle is visible for 200 feet in either direction and does not obstruct traffic. In this case the ordinance would be required to prohibit parking regardless of the 200-foot or obstruction exceptions (§ 20-161).

Heavy-Duty Vehicle Idling Restrictions

North Carolina passed legislation in 2010 (15A NCAC 25.1010) to limit idling of heavy-duty vehicles, which are defined as motor vehicles, excluding trailers, with a gross vehicle weight rating of 10,0001 pounds of greater. The rule was aimed at reducing excessive idling by heavy-duty vehicles in all parts of North Carolina. The requirements stated that operators of heavy-duty vehicles are prohibited from idling for longer than five consecutive minutes in any 60-minute period.[34] There were some exceptions to this rule pertaining to trucks and commercial vehicles. For example, heavy-duty trucks could idle to refrigerate cargo, process cargo, and perform any dumping, lifting, hoisting, mixing, loading, unloading, or other operations requiring the use of power take offs. However, these exemptions did not apply when idling for driver comfort only, meaning that drivers idling to stay warm or cool while resting in their vehicle would be violating North Carolina's rules.

However, this rule was repealed in April 2016, and the Department of Environmental and Natural Resources was ordered to discontinue enforcement of these rules by September 1, 2016.[35] Proponents of repealing this rule argued that five minutes was too short to be enforceable, and that trucking companies already limit idling in their operations to avoid wasting money on fuel.[36]

North Carolina Oversize/Overweight Vehicle Movements

Truck companies transporting oversize and overweight (OS/OW) vehicles in North Carolina are required to obtain a permit from the NCDOT Oversize/Overweight Permit Unit. Examples of such loads include military convoys and the transportation of large equipment, houses, boats, or specialty trailers. Permits are required if trucks meet any of the following size/weight specifications:

- Total width is over 8 feet 6 inches;

- Overall height is greater than 13 feet 6 inches;

- A single vehicle is over 40 feet or vehicle combination is over 60 feet in length. Exceptions include: 1) truck tractor/48-foot semi-trailer combination with no overall length limitation is allowed on all roads,

[34] 15A NCAC 02D.1010 Heavy-Duty Vehicle Idling Restrictions. Available from: http://ncrules.state.nc.us/ncac/title%2015a%20-%20environmental%20quality/chapter%2002%20-%20environmental%20management/subchapter%20d/15a%20ncac%2002d%20.1010.pdf.

[35] Session Law 2015-286 House Bill 765. General Assembly of North Carolina, Session 2015. Available from: http://www.ncga.state.nc.us/Sessions/2015/Bills/House/PDF/H765v6.pdf.

[36] "Bill Would Allow Trucks to Idle Engines Indefinitely, DENR Offers Support." NC Health News. July 15, 2015. Accessed October 6, 2016. Available from: http://www.northcarolinahealthnews.org/2015/07/15/bill-would-allow-trucks-to-idle-engines-indefinitely-denr-offers-support/.

and 2) truck tractor/53-foot semi-trailer combination with no overall length limitation is allowed on all North Carolina primary (North Carolina, U.S., Interstate) routes unless restricted; or

- Weight exceeds legal weight by North Carolina law.[37]

From a parking perspective, the biggest challenge is that permitted OS/OW vehicles have reduced hours of operation. Permitted vehicles are not allowed to operate on Sundays or between sunset and sunrise in North Carolina, which has an impact on parking for OS/OW trucks.[38] There are also travel time restrictions around many of Federal holidays. When combined with HOS regulations and the challenges which longer or heavier vehicles have in finding adequate parking spaces, scheduling parking as part of a longer OS/OW trip can prove to be a challenge.

One example of such a challenge is when carriers enter or leave the state with permitted loads. For example, the Commonwealth of Virginia does not have similar timing restrictions. Therefore, parking at or near state borders becomes a challenge, especially when loads have police escorts in one or both states.

The other example is the seasonal nature of sunrise and sunset. In the period from November through February, there is a dramatic reduction in the number of available hours in which a permit vehicle may be driven. For longer trips in North Carolina, that restriction may cause what used to be a one-day trip to become a two-day trip, with parking needs for the permit load plus any other CMV supporting the trip.

Local Laws Affecting Truck Parking

Most municipalities in North Carolina do not have additional parking restrictions that would affect truck parking at desired locations along the interstate system. However, some major cities have parking regulations that may affect truck parking in certain areas:

- **Charlotte**: medium- and large-sized commercial vehicle parking are prohibited in all residential districts.
- **Durham**: truck parking on any public street in the city is prohibited, day or night, unless in a designated space designated by painted lines. Additionally, it is illegal for any motor vehicle more than 6 ½ feet in width on any public streets between the hours of 6 p.m. and 7 a.m. the following day, except when loading and unloading.
- **Greensboro**: the parking of any motor vehicle in excess of 80 inches in width or 30 feet in length (or any trailer) on public streets at any time, except when loading and unloading.
- **Raleigh**: motor truck carriers are prohibited from using public streets except for the purpose of travel and transporting, loading and unloading.
- **Wilmington**: trucks are prohibited from parking on city streets if the vehicle is wider than 7 feet, longer than 25 feet, or heavier than 2 ½ tons, except in designated areas.

[37] "Oversize/Overweight Trucking Permits." Connect NCDOT Business Partner Resources. Accessed October 6, 2016. Available from: https://connect.ncdot.gov/business/trucking/Pages/overpermits.aspx.

[38] North Carolina Department of Transportation Oversize/Overweight Permit Handbook. Available from: https://connect.ncdot.gov/business/trucking/Documents/Oversize%20Overweight%20Permit%20Handbook.pdf

Federal Truck Parking Studies

Since the early 2000s, there have been a number of truck parking studies conducted at the Federal level. The following sections will summarize each of these studies and initiatives.

I-95 Corridor Coalition Truck Parking Initiative

The I-95 Corridor Coalition is a partnership of transportation agencies, toll authorities, and related organizations, including public safety, port, transit and rail organizations – from the State of Maine to the State of Florida – working together to improve long distance travel for passengers and freight. Originally created to harmonize tolling along the I-95 Corridor, the coalition today comprises 17 Departments of Transportation, 17 transportation agencies, and six Federal agencies. After recently receiving a grant from the Federal Highway Administration (FHWA), the Coalition has launched a Truck Parking Availability System to provide over-the-road truck drivers with real-time truck parking information. The study was able to analyze the severity of the truck parking issue along the I-95 corridor by depicting the capacity and utilization of truck parking locations between North Carolina and Massachusetts.

The pilot uses a space-by-space monitoring approach to track truck parking spaces using in-ground sensors. Parking data will be made available via three resources: a truck parking website, an automated telephone system, and a continuously generated external data feed. The technology was tested at two truck parking locations – the Ladysmith Rest Area in Caroline County, Virginia, and the Welcome Center in Laurel, Maryland – and will be tested at more rest areas with more trucker participation in the next phases of the project. At the conclusion of the 4-year project timeline, the entire program will be assessed, and a sustainability and marketing plan will be developed to help replicate the truck parking program in other areas.

Study of Adequacy of Commercial Truck Parking Facilities –FHWA

The Federal Highway Administration (FHWA) conducted the "Study of Adequacy of Commercial Truck Parking Facilities" in 2002 in response to the Transportation Equity Act for the 21st Century (TEA-21), Section 4027. This legislation required an investigation into the location and quantity of commercial truck stop parking facilities, travel plazas, and public rest areas. It also required an analysis of shortages, as well as a plan to address the parking shortages. FHWA engaged a number of state-level private- and public-sector stakeholders throughout the study, and provided technical guidance throughout the research and documentation process. The Rest Area Forum, which was hosted in Atlanta, Georgia in June 1999, was the major stakeholder outreach event hosted by FHWA for the purpose of this study. At the Forum, more than 70 State Department of Transportation (DOT) and enforcement officials, industry representatives, truck stop operators, and other interested parties attended and participated.

The full report involved four major sections: 1) estimation of parking demand using a modeling approach, 2) inventory of public and commercial truck spaces, 3) identification of deficiencies, supply, and demand, and 4) recommendations. The major recommendations to address any current or future problems were identified in six major categories:

- **Expand or improve public rest areas.** 15 states had firm plans to provide additional spaces, and 11 of these states provided a specific number (1,600 over the next five years). Improving the geometric design of public rest areas would increase driver convenience.

- **Expand or improve commercial truck stops and travel plazas.** Increase yearly truck registration fees to help states pursue initiatives related to truck parking issues. Implement a program to allow states to close rest areas in locations that are already well served by private rest areas. Eliminate cost-prohibitive road improvement requirements imposed by state DOTs upon developers attempting to open new facilities.

- **Encourage the formation of public-private partnerships.** Provide low-interest loans or grants to commercial truck stops to help increase capacity. Construct state-owned lots adjacent to commercial truck stops and plazas, and enter into agreements for owners to lease or maintain lots. Work with owners of commercial truck stops to help promote availability of parking.

- **Educate or inform drivers about available spaces.** Development intelligent transportation system (ITS) deployments to provide drivers with real-time information on location and availability of truck parking spaces. Publish and distribute a "trucker's map" with relevant information for drivers.

- **Change parking enforcement rules.** Implement stricter enforcement of parking rules to remove vehicles from dangerous locations, such as interchange ramps. Change parking limits to permit trucks more time to park at public rest areas. Encourage local government and business support for truck stop and travel plaza facilities near industrial and business parks via zoning.

- **Conduct additional studies.** Refine study results to develop a more detailed assessment of strategies of specific highway locations. Establish a multi-state committee to evaluate alternatives and recommend solution to addressing truck staging and just-in-time deliveries.

Truck Parking Management Systems, Mid-America Freight Coalition

The Mid-America Freight Coalition produced the "Truck Parking Management Systems: A Synthesis of Projects, Research, and Resources" in 2015 along with the National Center for Freight & Infrastructure Research & Education (CFIRE). The report summarizes recent research on truck parking and pilot programs developed and implemented to address truck parking systems.

This report featured a summary of truck parking detection systems and data management opportunities that are relevant to states seeking the better manage truck parking practices. There are a number of intelligent transportation systems (ITS) opportunities for truck parking, which refers to systems to estimate the occupancy of a truck parking site in a given area. ITS for truck parking includes the following three categories: in-pavement systems (includes induction sensors, magnetic sensors, and infrared sensors), video (features video cameras installed around a parking area), and light and laser detection (panels installed at entry/exit lanes). In-pavement systems are generally preferred due to ease of installation and data processing. However, installation and maintenance require the closure of a truck parking location, and in-pavement systems are not as reliable when monitoring a wide range of vehicles, such as pickups and tractor-trailers. Video systems have several benefits, but have issues in rough weather and create privacy concerns. Light/laser detection also has benefits, but is capital-intensive and vulnerable to vandalism.

Additionally, the report included a summary of communication technologies as well as data management, modeling, and spot management techniques to help convey information and predict future truck parking demands on key corridors. The five opportunities include: modeling with floating vehicle data (FVD), telematics controlled parking, variable message signs (VMS), smartphone applications, and websites. Websites, smartphone applications, and VMS are generally preferred for the low cost and ease of

implementation, while FVD and telematics controlled parking are relatively new technology solutions with practical and cost limitations.

Dealing with Truck Parking Demands, NCHRP Synthesis 317

"Dealing with Truck Parking Demands" was a result of National Cooperative Highway Research Program (NCHRP) Synthesis 317, which provided funding to assist transportation agency administrators in identifying solutions to manage increasing demand for commercial vehicle parking. The research plan involved distributing a comprehensive survey to highway maintenance engineers in all fifty states, District of Columbia, and Puerto Rico, and synthesizing the results. The outreach determined that legislative authority plays a significant role in managing commercial vehicle parking, and the development of parking spaces in the United States paralleled the development of the Interstate Highway System. However, as the motor vehicle carrier industry grew, the parking capacity at public rest areas has not been able to accommodate increase demand. At the time of the survey, a number of states of varying sizes and populations were experiencing extreme shortages of roadside commercial vehicle parking.

Although states have implemented a number of alternative approaches to manage the demand for commercial vehicle parking, there is no single entity is responsible for providing parking facilities. Nationwide, the study found a shortage of more than 100 percent in public parking places, though the private parking supply showed a surplus. In North Carolina, the pattern was similar, and overall there was a surplus of parking spaces in the public and private markets, as shown in Table D.1.

Table D.1 Demand/Supply Ratio along Interstate and NHS Routes* in North Carolina

Facility	Demand/Supply Ratio[39]	Category	No. Parking Facilities	No. Parking Spaces
Public	1.98	Shortage	37	645
Private	0.58	Surplus	105	7,325
Total	**0.69**	**Surplus**	**142**	**7,970**

* NHS route carrying more than 1,000 trucks per day.

Commercial Motor Vehicle Parking Shortage, FHWA

FHWA authored "Commercial Motor Vehicle Parking Shortage" after the Consolidated and Further Continuing Appropriations Act of 2012, which requested that FHWA study commercial motor vehicle parking shortages as it related to compliance with Federal safety requirements. This report, which was produced after "Study of Adequacy of Commercial Truck Parking Facilities," continued on these findings and provided updates on estimates and forecasts of long-distance trucking activity, information from the Truck Parking Pilot Grant Program, as well as observations from safety enforcement officers.

[39] Note: A demand/supply ratio of less than 0.9 indicates a surplus of spaces (available parking spaces is likely to exceed peak demand), a ratio between 0.9 and 1.1 indicates sufficient parking space utilization (peak demand and supply of parking spaces is nearly the same), and a ratio more than 1.1 indicates a shortage of spaces (overcrowding is likely).

The data collected was largely anecdotal, but the study concluded that truck parking shortages remain widespread, particularly in certain geographic areas. Unless utilization of and investment in parking capacity is improved, shortages were expected to increase with growth in demand for the trucking industry. FHWA recommended that strategies from its prior report, such as creating public-private partnerships, are still relevant and necessary to provide additional parking capacity where needed.

SAFETEA-LU Section 1305

Section 1305 of Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) was established as a pilot program to help address shortages in long-term parking for commercial motor vehicles on the National Highway System. $25 million in total funding was authorized through this program, distributed annually between 2005 and 2012. Fund was distributed to states with the greatest needed, prioritized by the following attributes: demonstration of a severe shortage of commercial vehicle parking in the corridor, consultation with affected state and local governments and other stakeholders, and demonstration that their proposed projects are likely to have positive effects on safety, congestion, and air quality. Once funds were made available, states could put funding towards the following activities:

- Construction safety rest areas that include commercial vehicle parking;
- Constructing commercial vehicle parking facilities adjacent to commercial truck stops and travel plazas;
- Opening existing facilities to commercial vehicles;
- Promoting the availability of publicly or privately provided commercial vehicle parking on the NHS using ITS systems and other means;
- Constructing turnouts for commercial vehicles;
- Making capital improvements to public commercial vehicle parking facilities to allow year-round use; and
- Improve the geometric design of interchanges to improve access to parking facilities.

Truck Parking Studies Completed by Other States

Within the past decade, there have been a number of state-sponsored truck parking studies. This report will evaluate 10 recent studies in order from newest to oldest, as shown in Table D.2. The table also identifies whether the study featured a survey, supply/demand analysis, identified specific corridors, or provided recommendations. Each of the ten studies will be reviewed and summarized in the following sections.

Table D.2 State Truck Parking Studies Reviewed

Study Title	Sponsor/Author	Date	Survey	Supply/ Demand Analysis	Corridor Identification	Recommendations
WSDOT Truck Parking Survey (Summary)	Washington State Department of Transportation (WSDOT)	Aug 2016	✓			
Kansas Statewide Freight Network Truck Parking Plan	Kansas Department of Transportation (KDOT) and Kansas Turnpike Authority (KTA)	Feb 2016	✓	✓	✓	✓
Virginia Truck Parking Study	Virginia Department of Transportation (VDOT)	Jul 2015	✓			✓
Commercial Motor Vehicle Parking Trends at Rest Areas and Weigh Stations	Florida Department of Transportation (FDOT)	Dec 2012	✓	✓	✓	
Mn/DOT Truck Parking Study: Phase 2	Minnesota Department of Transportation (MnDOT)	Nov 2010			✓	✓
Low Cost Strategies to Increase Truck Parking in Wisconsin	Wisconsin Department of Transportation (WisDOT)	Sep 2009	✓	✓	✓	✓
Low Cost Strategies for Short Term Parking on Interstate Highways of the MVFC	Mississippi Valley Freight Coalition (MVFC)	May 2009	✓	✓	✓	✓
Truckers' Park/Rest Facility Study	Illinois Center for Transportation	Jul 2008		✓	✓	✓
The Minnesota Interstate Truck Parking Study	Minnesota Department of Transportation (MnDOT)	Jan 2008	✓	✓	✓	
North Jersey Truck Rest Stop Study	The North Jersey Transportation Planning Authority (NJTPA)	Jan 2008	✓	✓	✓	✓

WSDOT Truck Parking Survey Summary, Washington State DOT

The Washington State Department of Transportation (WSDOT) conducted an 18-question survey in 2016 to better understand the truck parking attitude and concerns of truck drivers and other stakeholders in Washington State. WSDOT developed the survey with help from the Federal Highway Administration (FHWA), Washington

Trucking Association partners, and other trucking industry participants to ensure clarity and completeness. The survey results and summary of findings is currently available, with a full report forthcoming.

The survey received over 1,110 responses, and 84 percent of the responses came from truck drivers. Generally, drivers prefer private truck stops (which typically have amenities such as food, showers, and laundry) for short-term and overnight breaks, as shown in Table D.3, but finding parking can take a significant amount of time: 36 percent of drivers noted it takes over 30 minutes to find short-term parking, and for overnight parking, 66 percent of respondents required an hour or more. The Seattle-Tacoma region in particular does not have adequate parking. Overnight safety was frequently a concern for nearly 60 percent of drivers, and over half of drivers frequently or regularly drive while fatigued as a result of inadequate parking options. Drivers noted that the most difficult corridors to find parking are I-5, I-405, and I-90, suggesting that interstate highway routes have the greatest parking shortage. Finally, the majority of respondents (58 percent) do not support any kind of trucking fee to ensure safe and consistent parking availability.

Table D.3 Ranked Preferences vs. Use, Short-Term and Overnight Parking

Parking Type	Short-Term		Overnight	
	Preference	Actual Usage	Preference	Actual Usage
Private truck stop	1	1	1	1
Public rest area	2	2	2	2
Abandoned lot	3	5	4	5
Weigh station	4	8	5	8
Roadside	5	7	6	4
Shipper/receiver location	6	4	3	7
Highway on-ramp/off-ramp	7	3	8	3
Temporary parking lot (i.e., Walmart)	8	6	7	6

Source: WSDOT Truck Parking Survey Summary (2016).

Kansas Statewide Freight Network Truck Parking Plan

The Kansas Department of Transportation (KDOT) and the Kansas Turnpike Authority (KTA) sponsored the Kansas Statewide Freight Network Truck Parking Plan in 2015 to develop strategies for improving the network's safety, efficiency, and competitiveness along primary and secondary freight corridors. The study focused most heavily on I-70, I-35, and the Kansas Turnpike. KDOT and KTA completed three primary tasks as part of this study, including developing an inventory of public/private truck parking locations and current capacity, assessing any physical barriers, regulations, and policies affecting truck parking, and identifying opportunities for improving parking capacity. Data collection method included an inventory assessment, literature review, stakeholder interviews, surveys, and trend analysis.

The project team gathered a vast amount of information from stakeholders about the current conditions. Key insights from the study include:

- Peak truck parking times are between 12 a.m. and 4 a.m. Drivers average 30 minutes of search time to locate available parking. A significant number of drivers report parking in illegal locations that can be

unsafe, particularly outside urban areas. Most large legal parking facilities are at or over capacity regularly, especially near urban areas or the intersections of major highway-to-highway connections.

- Affordable truck parking strategies exist, and include expanding or improving parking at public rest areas, commercial truck stops and travel plazas; encouraging creation of public-private partnership (P3) solutions to share costs and information for parking; informing drivers about available spaces through technology and other means; and changing parking enforcement rules.

- Kansas has the opportunity to gain a "first mover" advantage by undertaking its truck parking decision-making in a regional context wherever possible. Drivers are more likely to make routing decisions favorable to Kansas in terms of efficient use of its parking assets and economic impact if they can take better advantage of regional consistency in travel costs, business process, trip-time predictability, and driver services availability.

The project team used the information acquired to come up with four major recommendations and corresponding implementation strategies, which are detailed in Figure D.1.

Figure D.1 Study Recommendations and Implementation Strategies, Kansas Statewide Freight Network Truck Parking Plan

Improve parking information and sharing	Add or improve parking assets	Explore creating parking improvement partnerships	Examine pro-parking policies for freight trucks
• Post parking information via static signage • Deploy a dynamic truck parking information management system (TPIMS)	• Expand parking lot numbers and capacity • Use excess right of way for parking • Improve geometrics for better parking	• Identify intra-agency opportunities to work with agencies to expand parking • Investigate benefits of creating multistate, regional truck parking policies • Secure marketplace guidance as to the viability of expanding parking via P3s	• Develop pro-freight truck tax policies • Develop integrated local parking policies • Explore opportunities for coordinating delivery policies to expand parking

The last phase of the study recommendations included a robust benefit cost analysis (BCA), which helps prioritize each strategy based on how well they are expected to improve Kansas freight truck parking and provide other benefits versus the cost of implementation. Tier 1 included the most highly recommended infrastructure investments, and included projects such as static and dynamic parking information and adding parking capacity where demand is greatest. Tier 2 included strategies that have a good benefit-cost ratio but are not critical, and Tier 3 included investments with the lowest benefit-cost ratio that is still desirable, but not critical.

Virginia Truck Parking Study, Virginia DOT

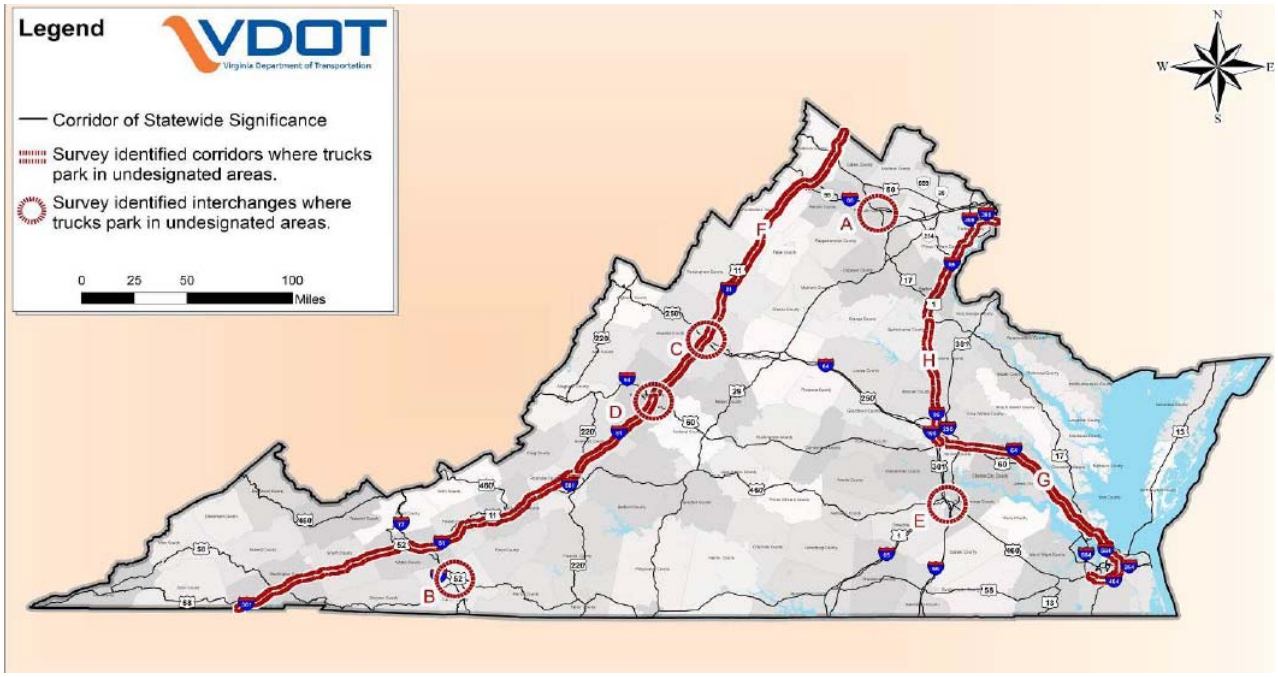
The Virginia Department of Transportation (VDOT) released the Virginia Truck Parking Study in July 2015 after conducting the work between September 2013 and June 2014. The purpose of this study was twofold: 1) identify the frequency of truck parking along ramps near interchanges and rest areas along key freight

corridors, and 2) determine where additional truck parking is needed. Prior to this study, the latest research on truck parking in Virginia was conducted in 2004 by the Virginia Center for Transportation and Innovation Research (VCTIR), titled "Estimation of the Demand for Commercial Truck Parking on Interstate Highways in Virginia." The 2015 Study acknowledges the persistent problem of truck parking, and collaborated with stakeholders from the public sector, private sector, advocacy groups, truck stop owners/operators, state police, and other key players in the industry during the study.

The study determined several regional truck parking challenges as identified by stakeholders in Virginia. These challenges included:

- Vehicles parked on mainline and ramp shoulders pose a significant safety risk to the public, and create maintenance challenges for VDOT and truck stop operators. There were eight corridors identified as having a higher incidence of trucks parking in undesignated areas, as shown in Figure D.2. They include seven interstate highways and four U.S. highways in North Carolina.

Figure D.2 Truck Parking in Undesignated Areas, Virginia



Source: Virginia Truck Parking Study, VDOT (2015).

- There is a shortage of truck parking supply in Virginia, particularly in northern Virginia, Hampton Roads, and Southwest Virginia areas. Truckers do not know where available truck parking spaces are located, and if they exist, they are typically already at/over capacity when truckers arrive. Many shippers and receives also have scheduled delivery and pick-up times that inflexible and do not allow on-site parking.

- Over 70 percent of drivers surveyed reported that overnight parking is a personal safety concern. Truckers also noted that the hours of service (HOS) regulation changes require an increase in the frequency of their rest stops, which is difficult to plan. Accessibility of truck parking spaces is also an issue; 85 percent of truck drivers felt that there are areas at public and private facilities that are not accessible to them.

- There are also several regional challenges contributing to the problem, including geographic characteristics, regional freight characteristics, shortage of truck parking spaces, transportation congestion, high land acquisition costs, and diverse truck parking needs.

In light of the Federal HOS requirements and existing truck parking inventory, the study produced three recommendations for VDOT to better address issues surrounding truck parking in Virginia. The first is to partner with private industry and local governments to increase capacity and related improvements, allowing VDOT to act as an agent to connect stakeholders, encourage local action, and identify funding sources to assist with the effort. Next, provide accurate and real-time information about truck parking supply and availability in Virginia. VDOT can increase the amount of truck parking by collecting facility information for rest areas, weigh stations, port facilities, and other truck and enforcement locations. The final recommendation is to improve the safety, effectiveness, and supply of truck parking spaces at State-owned facilities.

Commercial Motor Vehicle Parking Trends at Rest Areas and Weigh Stations, Florida DOT

The Florida Department of Transportation (FDOT) sponsored the development of the report "Commercial Motor Vehicle Parking Trends at Rest Areas and Weigh Stations" in 2012, which documented the demand for truck parking at public rest areas on interstate highways in Florida. The primary objectives of this research were to be addressed in phases: Phase 1 would determine trends, and Phase 2 would develop a suitable smart parking management system for commercial motor vehicles and conduct a pilot project to test the system.

In Phase 1, the research team collected field data at public rest areas along I-10, I-75, and I-95 corridors to determine the number of truck parking spaces and record total truck parking utilization. They also interviewed a number of on-site personnel, including county sheriffs, state troopers, security officers, and other staff. These data collection efforts led the team to determine levels of truck parking capacity problems at each rest area on a low-to-high scale. In Phase 2, the research team conducted an assessment of the available technology that could be used to improve truck parking management at rest areas in Florida, and ultimately test implementation. Ultimately, wireless ground sensors, which detect the presence of a vehicle above the device, was selected to install and test at several rest areas. Various software tools were developed to complement other wireless vehicle detection systems. The team also developed an occupancy prediction model to predict available parking spaces at a date and time specified by the user.

The study concluded with three recommendations for future research, including better utilization of weigh stations for nighttime truck parking, a pilot study to develop a comprehensive truck stop database in Florida, and an evaluation of public-private partnership opportunities for Florida's rest areas and truck stops.

Truck Parking Study, Minnesota DOT

The Minnesota Department of Transportation (MnDOT) completed the "Minnesota Interstate Truck Parking Study" in 2008 to help develop the information necessary to support decisions regarding future approaches to truck parking issues in Minnesota. The study specifically examined public and private commercial vehicle parking demand along three major interstate corridors: I-90, I-35, and I-94. To achieve this, the project team developed of an inventory of the state's interstate truck parking supply using aerial photographs, Google Earth, national truck stop directories, and through discussions with truck stop operators. Next, they conducted an analysis of truck parking demand through field observation and data collection for both private and public facilities. With this information, the team was able to identify facilities that were overcapacity 15,

25, and 50 percent of the time. 20 facilities were identified as having significant capacity issues during peak hours. Finally, the team conducted a survey of trucking company practices and attitudes regarding truck parking. They conducted interviews to get a sense of truck parking availability, and distributed surveys to carriers by telephone, fax, U.S. mail, or email to determine the reasons for parking selection.

This initial study led to the development of a framework for future discussions regarding the impacts of various options to address truck parking in Florida, including financial, safety, and industry impacts. The results of this study established the foundation for future research on implementing solutions, and identified four key areas for next steps, including public private partnerships, parking capacity additions, parking policy revisions, and information technology systems (ITS). In 2010, MNDOT conducted a study focused on determining opportunities for expanding truck parking in critical areas throughout Minnesota. Although it was clear that interstate and intercity truck parking may be limited, the areas with the biggest need were in urban code areas, specifically the Twin Cities and outstate Minnesota.

This phase of the truck parking study involved five key tasks: investigate lower cost marginal improvements to truck parking capacity along Minnesota's interstate highway system; investigate the development of urban truck parking in other metropolitan areas around the U.S.; investigate truck parking demand derived from major truck traffic generators in the Twin Cities metropolitan area to better understand spatial relationships between locations generating truck traffic and truck parking needs; and coordinate with internal MnDOT stakeholders to review the research results and potential solutions to Minnesota's truck parking shortage; communicate with external stakeholders.

The research team used a combination of interviews and spatial analysis to better understand which of the State's corridors needed improvements. The corridors selected as part of the analysis were I-94, I-90, and I-35. After conducting both the quantitative and qualitative aspects of the analysis, a series of short- and long-term recommendations were suggested for each corridor, as shown in Table D.4. These recommendations were developed to help address concerns with safety, HOS requirements, and staging area needs in Minnesota's urban areas.

Table D.4 Recommendations by Corridor, MnDOT Truck Parking Study Phase 2

Corridor	Recommendations
I-94 East	**Short-Term:** Capacity enhancement of St. Croix rest area facility by 5-10 spaces, improved information regarding truck parking availability, coordination with WisDOT in providing parking information and spaces
I-94 West	**Short-Term:** Capacity enhancement of Elm Creek and Burgen Lake rest area facilities by 15-23 spaces, **Long-Term:** Improved information regarding parking availability, capacity enhancement of Fuller Lake rest area facility by 5-10 spaces
I-90 East	**Short-Term:** Improved information regarding parking availability **Long-Term:** Capacity enhancement of High Forest and Oakland Woods facilities by 10-20 spaces
I-90 West	**Long Term:** Improved information regarding parking availability, capacity enhancement of Clear Lake facility by 5-7 spaces
I-35 South	**Short-Term:** Utilization of abandoned weigh station(s) south of Straight River facilities, possible truck-only designation of Straight River northbound facility, capacity enhancement of Albert Lea and Health Creek facilities by 9-25 spaces **Long-Term:** Improved information regarding parking availability, private truck stop facility south of the Twin Cities near New Market facility, possibly utilize wide median south of Heath Creek
I-35 North	**Long-Term:** Improved information regarding truck parking availability

Source: MnDOT Truck Parking Study: Phase 2.

Low-Cost Strategies to Increase Truck Parking in Wisconsin (Wisconsin DOT)

The Wisconsin Department of Transportation (WisDOT) sponsored the study titled "Low Cost Strategies to Increase Truck Parking in Wisconsin" in 2009 to document the truck parking issues along major state highways in the State. The report acknowledged that HOS regulations have increased the need for truck parking facilities, as drivers are sometimes unable to find parking and are forced between driving illegally or parking illegally on ramps and shoulders. Adding to that, much of the truck parking that is available is poorly designed and challenging to navigate. The study focused on parking needs along I-43, U.S. Highways 8, 10, 41, 51, 53, and 151, and State Trunk Highway 29.

The research objective of this study was to better understand truck parking issues associated with stops for meals, bathroom breaks, and other driver needs, as well as operational issues causing the need for parking, locations where truck parking problems exist along the study corridors, and available low-cost solutions for these areas. The project team used a GIS-supported survey instrument and in-person interviews to gather data. The survey was designed to extract information from truckers/carriers, highway patrol officers, and public freight planners. The team also went to four truck shows in Iowa, Wisconsin, and Illinois to speak with truckers and conduct surveys/interviews.

The results of the study determined that the most common parking-related problems were with insufficient parking capacity during peak demand hours, which often resulted in overflow parking along ramps and exists. Parking problems typically occurred in the early evening and late at night, and took place outside of larger metropolitan areas such as Milwaukee, where truckers tend to conduct staging for customer appointment times. Additionally, design issues in public parking areas make entry and exit movements more challenging, particularly when lane markings were not properly sized for larger vehicles.

The study concluded with three main recommendations. First, the study corridors with the most serious parking shortages are grouped into three categories: top priority, high priority, and medium priority. Next, real-time parking information in advance of each parking area would help truckers find available parking spots more efficiently. In particular, variable road signs are recommended most. Finally, it is critical to improve communication with truckers so they understand policies regarding allowable parking in public rest areas and other locations.

Low Cost Strategies for Short-Term Parking on Interstate Highways of the MVFC

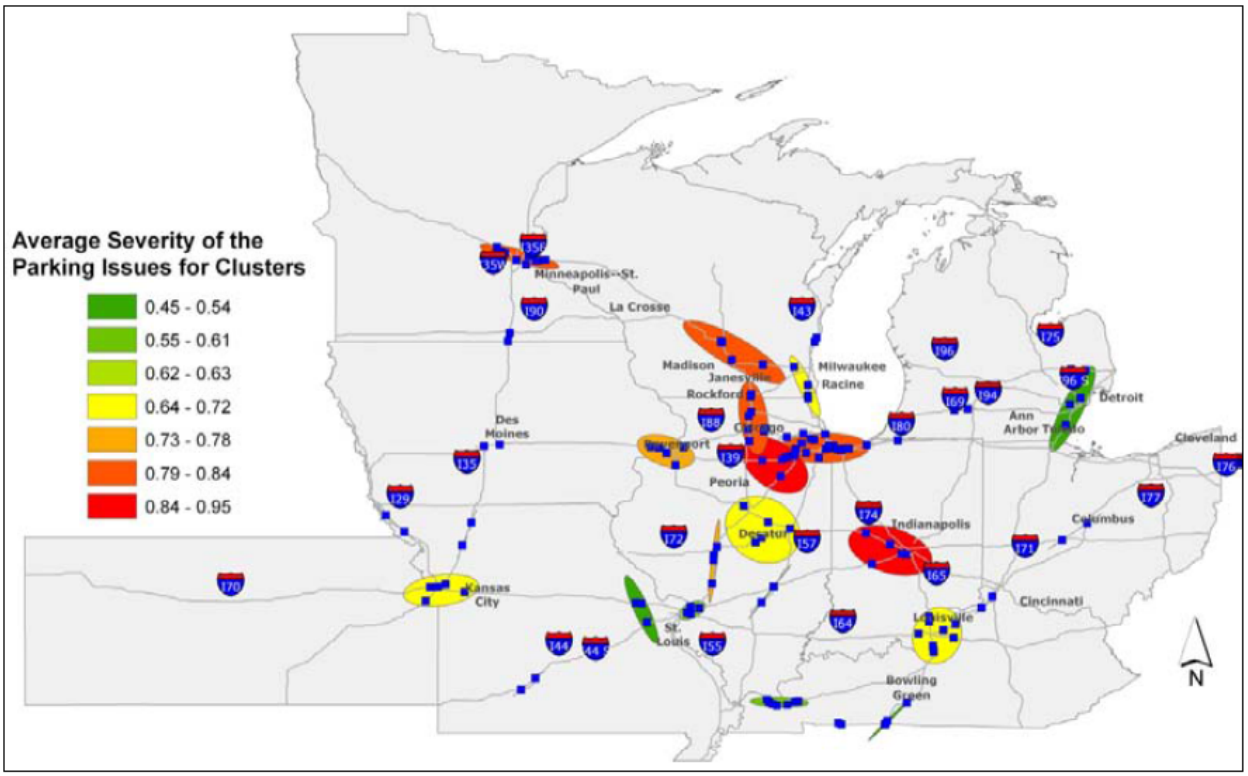
The Mississippi Valley Freight Coalition (MVFC, now known as the Mid-America Freight Coalition) which includes the 10 States of Illinois, Iowa, Indiana, Kansas, Kentucky, Michigan, Minnesota, Missouri, Ohio and Wisconsin, sponsored "Low Cost Strategies for Short Term Parking on Interstate Highways of the MVFC" through pooled funds of the 10-state Midwest region of the American Association of State Highway and Transportation Officials (AASHTO). The study focused on identifying problems and solutions with stakeholders through surveys and in-person interviews, specifically during four truck shows in Iowa, Wisconsin, and Illinois. Many of the truck show participants were long-haul drivers from states across the MVFC region.

To further the analysis, the project team developed a GIS-supported online survey for gathering information from truckers/carriers, highway patrol, and public freight planners. The survey also included questions about commodities, origin/destinations, perceptions about mandatory breaks, reasons for parking, availability of nearby parking capacity, and recommendations for solutions. Additionally, the study reviewed several low cost strategies available at that time that could be used to assist truckers. These technologies included in-

vehicle radio (VB, low power FM radio, etc.), electronical visual displays in vehicles, and the Internet. Most survey participants preferred the in-vehicle ratio option. Ultimately, truckers who have experienced problems in finding suitable parking have the most valuable intelligence pertaining to truck parking issues and are critical in developing new parking solutions and increasing capacity. Oftentimes public freight planners are not able to identify all of the issues since they are not seeing them on a daily basis.

The study also found that truck parking problems tend to take place on the periphery of large metro areas such as Chicago, which is where truckers park primarily for staging for customer appointment times. A map of the most severe clusters is featured in Figure D.3. In addition, parking capacity shortages often occur in the early evening or late at night. Truckers that have trouble finding available parking tend to know little about parking availability in the nearby area. Finally, truckers also identified design problems in public truck parking areas, such as poor lane marking and inadequate space for entry and exit movements.

Figure D.3 Clusters of Incommensurate Truck Parking Facilities in MVFC Region



Source: Low Cost Strategies for Short Term Parking on Interstate Highways of the MVFC.

The study concluded with a series of recommendations:

- Areas with most serious shortages of parking capacity include: Joliet, Illinois; Bolingbrook, Illinois; Elmhurst, Illinois; Chicago, Illinois; Indianapolis, Indiana; Gary, Indiana; Minneapolis/St. Paul, Minnesota; Davenport, Iowa; Janesville, Wisconsin; Rockford, Illinois; Milwaukee, Wisconsin; Kansas City, Missouri/ Kansas; Louisville, Kentucky; Detroit, Michigan; Toledo and St. Louis, Missouri.

- There are several advancements that would be useful to truckers searching for parking, including advance parking information posted in real-time and upstream of each parking area. Variable road signs are also recommended.

- Public-private partnership investments, developing and using ITS and web-based solutions, converting weigh stations near parking facilities into additional parking, allowing overnight parking at malls or large retail chains, and improving communication regarding state truck parking policies are all additional strategies that could be implemented to alleviate the current parking shortage in the MVFC region.

Truckers' Park/Rest Facility Study, Illinois DOT

The "Truckers' Parking/Rest Facility Study" was sponsored by the Illinois Department of Transportation (IDOT) in 2008 to examine the current state of truck parking and rest area facilities in the northeast Illinois region (primarily Chicago and its environs). The study area included the counties of Boone, Cook, DuPage, Grundy, Kane, Kankakee, Kendall, Lake, McHenry, and Will, also known as Chicagoland. To complete the study, the research team interviewed truck drivers and state, county, and municipal authorities, as well as completed a study a truck traffic volume and parking availability at public and private parking facilities.

After completing both tasks, the research team was able to identify truck parking problems throughout the region. However, the biggest issue involved local company drivers and independent over-the-road drivers making picks ups and deliveries around Chicagoland. Local company drivers had been routinely parking in rest areas designed for over-the-road truckers as well as on highway access ramps, which created safety hazards, generated emissions, and reduced the efficiency of the freight transportation system. Interviews with stakeholders determined that drivers chose their parking and rest facilities based off of delivery pick-up and drop-off times, traffic locations, and log book requirements.

Overall, the study found that truck parking in Chicagoland works well, but a small portion of trucks generate the majority of issues. As a result of these findings, the team recommends expanding parking capacity at existing parking sites, reusing brownfield sites, and using underutilized retail, manufacturing, and seasonally affected sites for additional truck parking. It would also be beneficial for truck drivers to have access to a radio or other wireless technology to find out where truck parking is available in the area.

North Jersey Truck Rest Stop Study, North Jersey Transportation Planning Authority

Northern New Jersey's Metropolitan Planning Organization (MPO), North Jersey Transportation Planning Authority (NJTPA), conducted the "North Jersey Truck Rest Stop Study" in 2008 to outline the requirements, issues, and inventory of truck parking in the region. The study included the cooperation of other MPOs, including the New York Metropolitan Transportation Council (NYMTC) and several MPOs in southern Connecticut. It also included data collection and compilation, public outreach, survey of drivers and the trucking industry, identification of issues, and recommendations for future action. The general findings from the research and outreach concluded that most of the public rest areas and private truck stops are significantly overcapacity most nights, while truck traffic continues to increase annually. Commercial vehicles parked on highway shoulders are common, particularly near the port and other warehouse/distribution access points, which pose a serious safety hazard for drivers. It was found that a 10 percent increase in peak parking demand could result in twice the amount of illegally parked vehicles on highway shoulders.

The report determined three areas of recommended action to address the region's truck parking needs, which are summarized below:

- **Policy/Institutional:** Secure truck parking sites as a necessary land use, advance favorable Federal legislation that promotes innovation and public-private partnerships, pursue alternative fuels, energy, and environmental opportunities, and advance complementary land use approaches.

- **Planning and Finance:** Provide incentives for the private sector to develop more truck parking, incorporate truck parking into the planning and design of facility improvements, and integrate truck parking as a key element of port and intermodal facility development.

- **Partnering:** Promote public-private partnerships and collaborate with neighboring agencies (DOTs, MPOs, and local planning officials).

The study also evaluated 20 sites in the North Jersey Transportation Planning Authority (NJTPA) region to identify which had the greatest potential for expansion or further development, looking at measures such as parcel size, ownership, proximity to Interstate System, compatible land use, and other measures. Two sites were recommended as potential locations: New Jersey Turnpike Vince Lombardi Service Area (Ridgefield Borough, Bergen Count), and New Jersey Turnpike Molly Pitcher Service Area (Cranbury Township, Middlesex County). A third site, the I-78/I-95 port area, was also recommended for further investigation and analysis.