1. INTRODUCTION

This Technical Memorandum summarizes the literature that is relevant to the Oregon Commercial Truck Parking Study. The review focuses on methods and approaches of previous studies, as well as on their findings and conclusions. Eleven statewide and local truck parking studies from around the country were summarized, noting the results of outreach efforts (if applicable) and how truck parking needs were evaluated. Emphasis was placed on more recent and comprehensive studies. Several federal studies were also reviewed, including the guidance coming from the National Coalition on Truck Parking. Finally, sixteen recent research studies were reviewed (mostly from the past 5 years), to better understand the cutting edge of truck parking demand modeling, needs evaluation, and technological solutions. A brief section is included at the end of this Memorandum that summarizes the lessons learned from the literature in relation to the Oregon Commercial Truck Parking Study.

The reviews for each study focus on three areas: outreach methodology (surveys and interviews), approach for supply-demand analysis, and key findings. However, the exact topics covered for each study vary depending on the emphasis placed in the study and usefulness to our project.

1.1 Hours of Service Regulations

The demand for truck parking is determined by the need of drivers to take the required rest breaks to ensure the safe operation of the trucks. Rest requirements are described by the Hours of Service regulations, which the Federal Motor Carrier Safety Administration summarizes as:

- 11-Hour Driving Limit: May drive a maximum of 11 hours after 10 consecutive hours off duty.

- 14-Hour Limit: May not drive beyond the 14th consecutive hour after coming on duty, following 10 consecutive hours off duty. Off-duty time does not extend the 14-hour period.
2. **FEDERAL AND NATIONAL STUDIES**

2.1 **USDOT Second Jason’s Law Survey**

In 2015 USDOT published the results of the first Jason’s Law truck parking survey. A second survey is currently underway, in order to update the inventory of truck parking and improvements to truck parking availability; evaluate truck travel by state to ascertain increases in truck parking demand; assess the types of technology being used to monitor availability and demand; and compile truck parking plans, studies and projects completed by states and metropolitan planning organizations. USDOT will also be conducting a field survey. This survey and studies will also include private truck stops.

2.2 **ATRI (2016) Managing Critical Truck Parking Case Study – Real World Insights from Truck Parking Diaries**

This report details the findings of the “Truck Parking Diaries” research conducted by ATRI, which collected and analyzed qualitative data on the daily issues truck drivers face related to truck parking. Drivers were provided with a postage-paid return envelope to ship the completed diary back to ATRI. In total, 148 completed diaries were returned between June and September 2016, representing a total of 2,035 days of truck parking activity and 4,763 unique stops.

2.2.1 **FINDINGS**

Some of the findings include:
- Drivers primarily select truck parking locations on their own (93.8 percent).
- Drivers predominantly use websites or smartphone applications (55.5 percent), GPS (53.4 percent) and books (37.7 percent) for selecting parking locations.
- A small percentage of drivers (4.1 percent) indicated that they do not do any advance planning for their parking locations.
- 61.6 percent of drivers report that time-of-day impacts truck parking availability. The diary data supports driver statements, showing that unauthorized/undesignated parking peaks between 7:00pm and 4:59am.

Issues related to public rest areas were cited by 24.4 percent of drivers. The closing of public rest areas and the distance between parking locations were identified as problematic by drivers. Another issue cited was parking time limits at public rest areas, as required 10-hour HOS breaks usually exceed these time limits, which range between two and ten hours.

The frequency of unauthorized/undesignated parking is shown in Figure 1. Over one-third of the drivers parked in undesignated locations three to four times per week (36.5 percent), followed by once or twice per week (25.7 percent). A small percentage of drivers (9.5 percent) in the sample rely heavily on shoulder and ramp parking to meet their parking needs, parking in an undesignated location at least once per day.

**Figure 1. Unauthorized/Undesignated Parking Frequency**

![Unauthorized/Undesignated Parking Frequency](source: ATRI)

Observations of non-trucks occupying truck parking spaces peak on Sundays (40.2 percent), followed by Saturdays and Mondays (37.3 percent). The weekend peaks of non-truck demand for parking spaces observed here are likely the result of weekend travel patterns for the general public.
population. Non-truck occupation of truck parking spaces is more likely to be observed in public rest areas (48.8 percent) than private truck stops (43.0% percent), in this sample.

Proximity to routes and destinations, restroom and shower facilities and expected parking availability were the top reasons for where drivers chose to stop for their required 10-hour breaks (see Table 1). The types of facilities that drivers use for their 10-hour break are shown in Table 2. Private truck stops were the most frequently used.

**Table 1. Factors Influencing Where Drivers Stop for Required 10-Hour HOS Breaks**

<table>
<thead>
<tr>
<th>Important Factor</th>
<th>Percent of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proximity to Route / Destination</td>
<td>96.5%</td>
</tr>
<tr>
<td>Restroom / Showers</td>
<td>79.8%</td>
</tr>
<tr>
<td>Expected Parking Availability</td>
<td>75.5%</td>
</tr>
<tr>
<td>Width of Parking Space / Ease of Access</td>
<td>31.9%</td>
</tr>
<tr>
<td>Restaurant</td>
<td>30.5%</td>
</tr>
<tr>
<td>Security</td>
<td>20.3%</td>
</tr>
<tr>
<td>Company Policy / Loyalty Program</td>
<td>18.1%</td>
</tr>
<tr>
<td>Internet</td>
<td>6.9%</td>
</tr>
<tr>
<td>Laundry</td>
<td>4.0%</td>
</tr>
<tr>
<td>Maintenance / Service Center</td>
<td>3.7%</td>
</tr>
<tr>
<td>Weather Conditions</td>
<td>3.6%</td>
</tr>
</tbody>
</table>

Source: ATRI

**Table 2. Stop Locations for Required 10-Hour Breaks**

<table>
<thead>
<tr>
<th>Location Type</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Truck Stop</td>
<td>71.4%</td>
</tr>
<tr>
<td>Public Rest Area</td>
<td>9.6%</td>
</tr>
<tr>
<td>Customer</td>
<td>8.9%</td>
</tr>
<tr>
<td>Business</td>
<td>4.3%</td>
</tr>
<tr>
<td>Terminal</td>
<td>4.1%</td>
</tr>
</tbody>
</table>

Source: ATRI

Respondents “gave up” an average of 56 minutes of available drive time per day by parking early rather than risking not being able to find parking later in the day. This unused drive time effectively reduces a driver’s productivity by 9,300 revenue-earning miles annually – which equates to lost wages of $4,600 annually. These productivity losses may reduce driver wages by up to 10 percent.

**2.3 National Coalition on Truck Parking**

The National Coalition on Truck Parking (NCTP) is an FHWA initiative that created four working groups to implement various truck parking opportunities identified in the 2016 National Coalition of Truck Parking Activity Report. These working groups focused on parking capacity, data and
technology, innovative funding options, and state and local government coordination. Below is a brief summary of the work that has been done in these areas.

2.3.1 **PARKING CAPACITY**
The Parking Capacity working group developed three work products to assist states in developing strategies to increase truck parking capacity:

- **Creative use of Right-of-Way (ROW):** This document provides examples of low-cost solutions for creating parking capacity using existing facilities in ROW or adjacent to the ROW. The examples focused on rest area and weigh station conversions to increase truck parking capacity, as well as on attempts to create parking at tourism centers. Other examples included truck parking inside an interchange (at Big Springs, Nebraska), and consolidation of public ROW at the Golden Glades Interchange in northern Miami-Dade County to accommodate truck parking.

- **Involving Shippers/Receivers to Address Truck Parking Capacity:** This document provided examples of methods that private companies have used to alleviate the shortage of truck parking. These strategies include:
  - providing designated “bullpen” areas outside distribution centers
  - using dispatchers to assign drivers parking spots at or near distribution centers for staging purposes.

- **Considerations for Low Cost Truck Parking:** This document describes some of the factors truck parking operators may consider to minimize maintenance and operation costs at their facilities. These factors include:
  - trash removal
  - using soil-cement as a low-cost paving material
  - vault toilets
  - safety measures such as emergency phones, fire extinguishers, and defibrillators

2.3.2 **DATA AND TECHNOLOGY**
The Data and Technology working group, chaired by ATRI, developed several products & recommendations:

- **Truck Parking App Survey:** This document provided a summary of a truck driver survey ATRI conducted at the Mid America Trucking Show in Louisville, KY to determine truck driver opinions on parking apps. The survey found that mapping features and driver-input on parking spot availability are the two most important features. Trucker Path and myPilot are the two most popular apps used by truckers to find available truck parking.

- **Best Practices for Truck Parking Availability Detection and Information Dissemination by States:** This document described the implementations of Truck Parking Information Management System (TPIMS) used by different states. Examples included:
- Entry/exit sensors used by Indiana DOT and Kentucky DOT that count the number of trucks using parking lots.
- In-pavement and entrance/exit ramp sensors used by Iowa DOT.
- “Computer vision” system used by Kansas DOT that employs cameras at 18 rest areas along I-70 to build a “3D image” of the parking area, and automatically identifies available spaces.
- The use of stereoscopic video analytics by Minnesota DOT.
- Other similar systems used by states such as California, Colorado, and Florida.

- **A recommended guidebook on standards and Best Practices for national TPIMS program**

2.3.3 **FUNDING, FINANCING, AND REGULATIONS**

The Funding, Financing, and Regulations working group developed two work products:

- **Emissions Reduction Grant Programs Fact Sheet:** This document provides an overview of the various emission reductions grant programs available to states and local governments to fund transportation projects. The document discussed the Congestion Mitigation and Air Quality (CMAQ) program and the Diesel Emissions Reduction Act (DERA) program. It also provided examples of CMAQ and DERA-eligible Idle Reduction Technology (IRT) system implementations and truck stop electrification projects.

- **Public-Private Partnerships (P3) Examples and Considerations:** This document highlighted P3 initiatives and non-traditional funding sources to increase truck parking capacity. Examples included:
  - The use of a P3 to develop the Brainerd Lakes Area Welcome Center in Minnesota, which provides short-term truck parking, bathrooms, and vending machines.
  - An agreement between Virginia DOT and private sector sponsors through which the private sector may sponsor Virginia rest areas to assist funding of operation costs.
  - The leveraging of local fuel tax revenue by the City of Decatur to incentivize a private company to create a truck stop in the community.

2.3.4 **STATE, LOCAL, AND REGIONAL GOVERNMENT COORDINATION**

The State, Local, and Regional Government Coordination working group developed four products:

- **MPO-101 (How to improve truck parking in your region):** This guide provides background and a list of resources for engaging with MPO officials to improve truck parking.

- **Parking and Staging Requirements in Local Zoning:** This document provides examples of local governments efforts, including provision of truck parking and staging in local planning and zoning.
The Importance of Considering Truck Parking in Local Zoning: This document highlights the safety, commercial and congestion relief benefits that local communities may obtain from considering truck parking in plans for commercial development.

2.4 ATRI (2018) Critical Issues in the Trucking Industry

ATRI conducts an annual survey of industry stakeholders to identify and monitor the issues that are most likely to affect the trucking industry in the coming years. Since its inception in 2005, the “Top Industry Issues” survey has provided important insight into the most pressing issues facing truck drivers and executives alike.

The issue of truck parking has generally climbed higher in the top issues list for the last decade. While the “truck parking” issue ranked 5th in the overall list, among truck drivers it was the number 2 issue for the last two straight years.

Table 3. 2018 Top Industry Issues by Respondent Type

<table>
<thead>
<tr>
<th>Rank</th>
<th>Commercial Drivers</th>
<th>Motor Carriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hours-of-Service</td>
<td>Driver Shortage</td>
</tr>
<tr>
<td>2</td>
<td><strong>Truck Parking</strong></td>
<td>Hours-of-Service</td>
</tr>
<tr>
<td>3</td>
<td>Electronic Logging Device (ELD) Mandate</td>
<td>Driver Retention</td>
</tr>
<tr>
<td>4</td>
<td>Driver Distraction</td>
<td>Electronic Logging Device (ELD) Mandate</td>
</tr>
<tr>
<td>5</td>
<td>Driver Retention</td>
<td><strong>Truck Parking</strong></td>
</tr>
<tr>
<td>6</td>
<td>Compliance, Safety, Accountability (CSA)</td>
<td>Compliance, Safety, Accountability (CSA)</td>
</tr>
<tr>
<td>7</td>
<td>Driver Health and Wellness</td>
<td>Driver Distraction</td>
</tr>
<tr>
<td>8</td>
<td>Transportation Infrastructure/ Congestion/Funding</td>
<td>Transportation Infrastructure/ Congestion/Funding</td>
</tr>
<tr>
<td>9</td>
<td>Driver Shortage</td>
<td>Driver Health/Wellness</td>
</tr>
<tr>
<td>10</td>
<td>Automated Truck Technology</td>
<td>Economy</td>
</tr>
</tbody>
</table>

Source: ATRI

2.5 FHWA (2002) Study of Adequacy of Commercial Truck Parking Facilities

This study developed an analytical model to predict parking demand on a corridor segment as a function of the proportion of truck traffic, the annual total traffic, the length of the segment, the average speed of trucks, and the average parking time per travel time. The demand predictions can be adjusted by peak traffic, proportion of truck trip types (long-haul vs. short-haul), and loading and unloading times, using previously estimated factors.
3. **STATE, REGIONAL AND LOCAL STUDIES**

3.1 **MAASTO (Ongoing) Regional Truck Parking Information Management System**

In 2016, an 8-state coalition within the Midwest division of AASHTO received a $25 million Federal TIGER grant to develop a regional truck parking information system (TPIMS). The TPIMS program developed in response to the critical need for truck parking in the region. The lead state for the TPIMS project is Kansas DOT.

The primary objective of the TPIMS is to reduce time searching for parking and to provide safe truck parking alternatives in the states of Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Ohio and Wisconsin.

The state systems differ somewhat in design, technologies and management approaches, but will all monitor truck parking availability and provide real-time information to truck drivers via a combination of apps, websites and dynamic message signs. Five of the 8 state systems will be active by June, 2019.

Phase 1 of the TPIMS project is nearing completion, and includes the following tasks:

- Systems Engineering: Develop the TPIMS concept of operations, system and design requirements, design standards and 30-percent design plans.
- Stakeholder Engagement: Secure input regarding system concepts, and create project communications and branding.
- Performance Measures: Develop metrics for tracking TPIMS progress and effectiveness.
- Grant Oversight: Oversee federal TIGER grant compliance.
- Project Management: Coordinate project team tasks and quality control/quality assurance activities.
- Future Needs: Identify future needs for TPIMS final design, procurement and deployment.

3.2 **Hernandez and Anderson (2017) Truck Parking: An Emerging Safety Hazard to Highway Users**

This study, funded by the Oregon Department of Transportation, sought to better understand truck parking needs in Oregon by conducting a stated-preference survey of truck drivers that operate in the state and a survey of public agencies in other states. Then, the study conducted a demand analysis to model truck parking demand along a specific corridor in the state (US-97) and assess whether enough parking spaces are available to meet parking demand. Finally, the study conducted a safety hot-spots analysis along this corridor, finding that crashes tended to concentrate at the locations and during the time periods that trucks typically have difficulty finding parking. The approach and findings of this safety analysis are not covered in this section because they are not relevant.
3.2.1 SURVEY OF PUBLIC AGENCIES
A survey was administered using Qualtrics to: Oregon’s Area Commissions on Transportation (ACT), Oregon’s Metropolitan Planning Organizations (MPO), transportation engineers and planners in each Oregon county, the Commercial Vehicle Safety Alliance for states across the country, Departments of Transportation in several states, and FHWA administrators across the country. Out of the 120 surveys sent by email, 20 were completed. Of the responses, 74 percent came from State Departments of Transportation, 21 percent came from federal agencies, and 5 percent came from city level agencies. No responses were obtained from MPOs or county-level agencies in Oregon. The following were the main findings:

- 70 percent of respondents indicated that they have a problem with truck parking in their jurisdiction. Over half of respondents are extremely concerned about shoulder parking, and very or extremely concerned with parking on freeway on-ramps or conventional highway roadsides. One-third are very or extremely concerned about truck parking at public rest areas.
- The survey included an open-ended section that allowed respondents to detail the steps they are taking to address truck parking issues. The main responses were:
  - To increase truck parking availability in Montana, trucks are permitted to park at weigh stations if they do not impede normal operations.
  - Missouri has experimented with ways of cheaply increasing the number of spots available, including turning decommissioned rest areas into gravel “truck only” parking. As a result, the state has the most truck parking spaces per truck miles traveled.
  - Nevada seeks to have parking facilities at two-hour intervals, and is conducting research into systems that provide real-time parking information to drivers. Truck stop electrification is also being considered to reduce engine idling.
  - Idaho is working with law enforcement agencies to improve the truck parking situation; however, funding shortfalls make it difficult to construct new rest areas.
- The rest stops in southern Oregon tend to be older (40- to 50-year structures) and require significant renovations, including improving access to water and sewer.

3.2.2 SURVEY OF TRUCK DRIVERS
A stated-preference survey was administered by the researchers to truck drivers that operate in the Northwest, obtaining 201 usable responses. The main findings were:

- 85 percent of drivers decide where to park themselves, with the rest relying on plans provided by their companies.
- Drivers report most trouble finding parking in the evening, with the most difficult period to being 9:00pm - 11:59pm and the second most difficult period being 4:00pm - 8:59pm. Finding spots on Friday is considerably more difficult than any other day of the week. Because of the holiday rush, finding spots in December is considerably more difficult than other months of the year.
- The main reasons for parking on ramps and shoulders are: no nearby parking facilities, no available parking at nearby facilities, difficulty maneuvering around parking lots, and convenience of road access.

- The most important amenities at private truck stops/public rest areas are:
  - restrooms
  - convenience to highway
  - refueling services
  - security
  - restaurants (note that public rest stops typically can only provide vending machines and restrooms)

- 39 percent of respondents indicated that they would benefit from knowing in real-time the number of parking spaces available at upcoming facilities. The majority of these (56 percent) indicated that they would like to receive real-time parking information through smartphone applications.

- Respondents rated the following as the most effective ways of improving truck parking:
  - build more parking spaces
  - improve parking layout/configuration
  - improve real-time information availability
  - improve public rest area amenities

### 3.2.3 SUPPLY AND DEMAND ANALYSIS

This study estimated demand for truck parking using the FHWA model published in 2002. Truck volumes were obtained from the Oregon Department of Transportation for 2014, and growth forecasts were obtained from the Oregon Statewide Integrated Model (SWIM). Following the FHWA model, the corridor was broken up into 2 segments on US-97 and 1 segment on I-84.

For each segment, the short-haul and long-haul travel hours were calculated using truck volumes, the proportion of short-haul travel (derived from a previous study\(^1\)), and the average speeds. Drawing from the literature, it was assumed that short-haul trucks on average stop for 5 minutes every 60 minutes of travel. For long-haul trucking, the ratio of stop time to hours of travel was obtained by comparing allowable travel times in HOS regulations with drive times from a survey conducted earlier in the literature. The actual ratio was not explicitly reported in the study.

The estimated hours of parking demand for short-haul and long-haul trucks were then converted to peak hour demand using specific factors from the literature. The proportion of demand at rest areas versus truck stops was also determined using factors from the literature.

\(^{1}\) Pecheux et al. (2002). The values of 0.36 and 0.64 are applied to analysis segments within 200 miles of a city with a population of at least 200,000.
These last two calculations represent a key weakness of this study because previous results were used instead of Oregon specific data. The demand for public rest areas will obviously depend on the availability of these facilities. It is likely that Oregon has a different prevalence of rest areas, and therefore the factors used in this study are likely not representative.

The Trucker Path application was used to describe the supply of parking spaces throughout US-97. Google Earth was used to verify the number of spaces at certain locations. This supply of truck parking spaces was compared to the demand estimated previously to assess shortfalls.

3.3 ADOT (2018) Arizona Truck Parking Supply, Demand, and Needs Analysis

This is an ongoing project conducted by the Arizona Department of Transportation (ADOT).

3.3.1 SURVEY AND OUTREACH

This study conducted an online survey of truck drivers with the help of the Arizona Trucking Association, and the Owner Operators Independent Driver Association (OOIDA). This survey achieved 164 responses from truck drivers that operate at least partially in the state. Various stakeholders were also consulted in developing their conclusions.

From the survey and consultations, this study found the following were the main reasons for truck parking: 1) legally-required 10+ hour rest breaks, 2) legally-required 30 min rest breaks, 3) short breaks for meals and restrooms, and 4) staging for pick-up or delivery at specific businesses. Different types of trucking were found to have different parking needs. Long-haul trucking required both legally mandated breaks and short rest breaks, while short-haul trucking only required short rest breaks.

The survey found that 93 percent of truck drivers had problems finding available spaces. Half of these problems finding parking occurred in urban areas. Also, 72 percent of truck drivers indicated that parking availability has gotten much worse or worse during the past year. The inability to find truck parking was found to generate the following problems:

- **Increased time searching for parking**: Half of all respondents indicated that they spend more than 16 minutes searching for parking. As parking availability decreases, drivers spend even more time searching, which has a large negative impact on productivity.

- **Stop early to secure available parking spot**: Since parking demand peaks in the evening, some drivers might give up searching and secure a spot earlier in the day than they would prefer. In Arizona, 63 percent of drivers give up 30 minutes or more of productive drive time to find a stop.

- **Parking in undesignedated locations**: In Arizona, 77 percent of drivers indicated that they park in undesignedated locations at least once per week, with 36 percent indicated that they park 1-3 times per week, 6 percent indicated they park 4-6 times per week, and 9 percent indicated that they use undesignedated spots daily. Drivers are forced to use undesignedated locations when they cannot find a spot that allows them to meet their delivery schedules and satisfy HOS regulations.
The survey found the following potential solutions:

- **Improved parking information:** The top 3 sources of information were smartphone applications, variable message signs, and in-cab messaging systems. About 41 percent of respondents preferred to receive parking information 20 miles or more ahead of the parking location.

- **Reservation of Parking Spaces:** Around 28 percent of respondents indicated that they are willing to pay to reserve a parking space. This finding falls in line with previous studies. While a small percent, this could represent a way of ensure parking availability. Around 13 percent indicated that they would be willing to pay $1 to $5 per reservation, which is less than the typical reservation fees at major truck stop chains.

The survey also asked about the factors that respondents perceived as limiting parking availability. Most respondents blamed the HOS regulations and lack of new construction to keep up with traffic increases. This report then described in detail the HOS regulations, how trucks manage these restrictions, the violations recorded throughout the state, and the effect of Electronic Logging Devices. The study further described economic factors that are leading truck traffic to increase (with corresponding increases of parking demand), including recent changes in the structure of supply-chains. The effect of recent innovations in truck technology were also discussed, albeit at a high-level.

### 3.3.2 SUPPLY AND DEMAND ANALYSIS

This study developed an inventory of truck parking locations in Arizona. This included public rest areas (owned and operated by the Arizona Department of Transportation) and private truck stop facilities. The inventory described overflow capacity (from satellite imagery) and amenities.

Informal/undesignated parking locations (inspection stations, closed rest areas, etc.) were identified manually by looking at clusters of parked trucks from ATRI’s GPS data, as shown in Figure 2. The study found that most truck parking was in private truck stops, including some at vacant warehouses.

**Figure 2. Identification of Informal Parking Stops**
Truck GPS data was used to provide insights into different aspects of truck parking, including how demand varied throughout the day, the length of stay, and types of trips involved. Several descriptive figures were included for statewide parking demand.

To assess the availability of truck parking information, this study analyzed crowdsourced data from Trucker Path, as shown in Figure 3. This data only covered locations being monitored by the Trucker Path application (designated only), excluding facilities with few records. This application asks truck drivers to rate whether there are “lots”, “some”, or “none” parking spaces available at specific facilities.

![Figure 3. Statewide Truck Parking Availability](image)

Gaps in the supply and demand of parking spaces were identified as shown in Figure 4 by overlaying two pieces of information on maps: the density of parking spaces per sq. mile (from the inventory), and the availability of those spaces as reported by Trucker Path. This analysis was conducted for 6 times of day to capture how availability changes throughout the day. This analysis identifies places that have open spaces during high demand periods, and vice versa. The analysis was then conducted in greater detail for specific corridors. A limitation of this analysis is that the Trucker Path application only considers designated parking facilities.

To quantify undesignated truck parking, the study conducted a cluster analysis of data from ATRI. This was a manual process that did not rely on algorithms. It is unclear the level of detail used in the manual identification, or the criteria used to filter truck stops for other reasons (such as making deliveries).
Figure 4. Locations of Truck Parking Demand

Source: CPCS
3.4 **VDOT (2015) Virginia Truck Parking Study**

The Virginia Department of Transportation (VDOT) published in 2015 the Virginia Truck Parking Study.

3.4.1 **SURVEY AND OUTREACH**

The study reached out to five separate stakeholder groups (state troopers, VDOT staff, VDOT rest area staff, truck drivers, and owners and operators of truck stops).

*Truck Drivers*

An online survey was administered to approximately 3,000 members of OOIDA in Virginia, 580 members of the Virginia Trucking Association (VTA), and 3,131 members of ATA, yielding 445 responses. The main findings were:

- Most respondents reported having parked in undesignated areas such as shoulders of ramps for both short-term and long-term parking needs.
- VDOT rest areas were preferred over private truck stops for short term parking (33 percent vs 26 percent), whereas for longer term parking, private truck stops were widely preferred over VDOT rest areas (49 percent vs 15 percent).
- 97 percent of respondents indicated the lack of sufficient parking spaces at rest areas, particularly overnight.

*State Troopers*

A survey of 1,000 state troopers indicated that more than half of the respondents had observed trucks parking in undesignated spots, such as highway ramps. Ninety percent of such undesignated parking was observed overnight. This is in part caused by designated parking being over capacity, with 66 percent of respondents confirming this finding. Of the state troopers observing undesignated parking, 70 percent indicate that they request the driver to move. Since HOS compliance is a primary reason for seeking parking, requesting drivers to find somewhere else to park may introduce issues with HOS compliance. It is worth noting that this survey was conducted before the ELD mandate took effect in 2018, which may affect enforcement attitudes.

*Rest Area Staff*

VDOT maintains 43 public rest areas, of which 36 include truck parking. A survey of VDOT rest area staff indicated that 97 percent of these rest areas are over capacity, with trucks regularly parking on exit ramps at over 80 percent of the facilities.

3.4.2 **SUPPLY AND DEMAND ANALYSIS**

The study also developed a demand profile for truck parking spaces in the various freight corridors. To this end, the authors used the demand equation from the FHWA *Study of Adequacy of Commercial Truck Parking Facilities – Technical Report* to calculate the demand for truck stops. The average parking duration per hour of travel came from "*Truck Parking in Pennsylvania – Final Report*", a 2007 report from the Pennsylvania State Transportation Advisory Committee. The parking demand calculated by this equation was then matched...
against existing truck parking supply in Virginia to identify gaps. The results of this analysis are presented in Figure 5 and Figure 6.

**Figure 5. Truck Parking Demand Profile**

Source: Virginia Truck Parking Study
3.5 **UDOT (2012) Utah I-5 Truck Parking Study**

Using a Federal Highway Administration grant, the Utah Department of Transportation (UDOT) completed in 2012 a study on truck parking needs along 400 miles of I-15 in Utah. The primary objectives were to understand the adequacy of truck parking facilities along I-15, and hear from truck drivers about parking issues in general.

3.5.1 **SURVEY AND OUTREACH**

A survey was completed by 433 truck drivers at commercial truck stops. The survey sought to gain insights into truck drivers’ experience with long-term parking (defined as more than four hours) along the I-15 corridor. The main findings were:

- Commercial truck stops and public rest areas are the main parking options available to truck drivers. Drivers tend to prefer public rest areas for short-term parking, while they prefer commercial truck stops for long-term parking (more than four hours) and meals. Restrooms, convenient connection to the highway, showers, and refueling service are the features that are most important to drivers.

- Almost all drivers determine their own stopping locations, and the majority do so while driving. Road conditions and speed may affect compliance with HOS regulations, therefore rest locations often need to be evaluated mid-trip. Only 21 percent of drivers plan where to stop before they started driving for the day.

- Most drivers indicate they would plan long-term rest stops better if they were aware of the locations of parking facilities, which highlights the need for better signage and roadside
parking information. More than half of the drivers surveyed would prefer to know the number of spaces available and amenities at parking facilities along the direction of travel.

- More than 70 percent of respondents indicated that the primary reasons for parking on shoulders and on/off ramps were the lack of information about nearby parking facilities and the lack of available spaces. Blocked spaces and convenience of getting back on the highway were other reasons for undesignated parking.

- In addition to expanding truck parking facilities along the I-15 corridors, drivers would also like to see time limits on truck parking eliminated (used to ration available spaces at public parking facilities), and the layout and configuration of facilities improved (such as pull-through spaces and marked spaces).

UDOT also conducted interviews with long-haul truck drivers and commercial truck stop owners and operators. Both long-haul drivers and truck stop operators suggested increasing the amount of parking signage on the highway (such as “truck stop ahead” or “next rest area”), and identifying truck stops and parking facilities on maps distributed by UDOT. Participants suggested distributing such maps and other resources at state welcome centers, ports-of-entry, public rest areas, and commercial truck stops.

3.5.2 SUPPLY AND DEMAND ANALYSIS
An inventory of known commercial truck stops, public rest areas, and ports-of-entry along the I-15 corridor was completed by UDOT. The port-of-entry inventory was developed through calls to individual ports-of-entry, where the number of spaces available for long-term parking was confirmed. The commercial truck stop inventory was verified against commercial truck stop directories and guides, while the public rest areas inventory was compared to the Utah Statewide Rest Area Plan. An overview of these known parking facilities is presented in Figure 7.
Figure 7. Public Rest Areas and Commercial Truck Stops on I-15 in Utah

Figure 7 illustrates the locations of public rest areas and commercial truck stops along I-15 in Utah. The map shows various exits and locations named in different colors, indicating truck parking facilities.

Source: Utah I-15 Truck Parking Study

Truck parking demand was calculated using the Study of Adequacy of Commercial Truck Parking Facilities developed by FHWA in 2002. This method implicitly assumes that demand for parking can be explained better by truck-hours of driving than by the locations or attributes of parking facilities. This represents an assumption that could be relaxed in future studies with the appropriate data.
Demand was estimated by first determining the long-haul truck traffic over 5 segments of the I-15 corridor. This was done using a combination of Freight Analysis Framework 3 (FAF3) data, and origin-destination data from the Truck Parking Survey. Truck flows were routed on I-15 using the shortest path method between freight districts, and matched with the reported truck traffic at Utah’s borders to estimate long-haul traffic (presented in Figure 8). Short-haul truck traffic was calculated by subtracting the estimated long-haul truck traffic on each highway segment from the reported truck traffic.

The daily truck-hours of travel on each segment were calculated from traffic volumes, segment length, and average speed (75mph for rural areas and 65mph for urban areas). Then, the truck-hours of parking demand per day were calculated using the daily truck-hours of travel estimates and national ratios showing the average amount of time that trucks spend parked relative to moving. These ratios differ between the short-haul and long-haul traffic. For long-haul traffic, this ratio is 49 hours of parking time to 70 hours of driving. For short breaks, the assumption was a stop of five minutes per hour of driving. The demand for truck-hours of parking was calibrated using peak hour factors and seasonal factors. The net peak season, peak hour truck parking demand was then calculated (shown in Figure 9).
Figure 8. Long-haul truck traffic (2007 and 2040) on I-15

Source: Utah I-15 Truck Parking Study
Figure 9. Peak Season, Peak-hour Truck Parking Demand in 2007 and 2040

Source: Utah I-15 Truck Parking Study
3.5.3 FINDINGS
Based on the results of the survey and the demand analysis, the report makes the following recommendations that have already been implemented in Utah:

- Develop a visor card or truck parking map that indicates the locations of commercial truck stops and public rest stops along the National Highway System in Utah. This map, developed in 2012, also includes relevant information, such as telephone numbers, how many long-term parking spaces are available, and amenities offered.
- Enhance an existing smartphone application that informs motorists of road conditions to include the locations of commercial truck stops and public rest areas.
- Develop an interactive map and make available on the UDOT website that allows truck drivers to locate truck parking facilities in the state.
- Organize a Highway Rest Facility Committee (HRFC) to oversee the development and implementation of a formal Highway Rest Facility System Program (HRFP). This program would promote efforts to increase truck parking at public rest areas along the corridor, by identifying locations where parking is most needed as well as providing cost estimates and identifying potential funding sources.

3.6 ARC (2018) Atlanta Regional Truck Parking Assessment Study
The Atlanta Regional Commission (ARC) published in 2018 the “Atlanta Regional Truck Parking Assessment Study”. This study had the components described in Figure 10.

Figure 10. Atlanta Regional Truck Parking Assessment Study Tasks

Source: Atlanta Regional Truck Parking Assessment Study
3.6.1 **SURVEY AND OUTREACH**

This study included extensive outreach efforts to collect information from various sources. The study team participated in several local committee meetings, including the ARC Freight Advisory Task Force Meeting, the ARC Transportation Coordinating Committee Meeting, and the ARC Land Use Coordinating Committee Meeting. Preliminary results were presented at these meetings and feedback was sought on study findings.

- An online survey was administered to local jurisdictions/community improvement districts, law enforcement officers, truck stop/convenience store owners or operators, and trucking companies/shippers.

- Almost half of the responses came from local jurisdictions and community improvement districts (37 responses).
  - Of these, 22 percent indicated that they do take an active role in truck parking issues, mostly indicating that trucks cause substantial disruptions to regular traffic and sometimes even damage roadway infrastructure, like streetlights.
  - Other issues mentioned included: truck parking in large parking lots, residential parking, and road shoulders.
  - Zoning was the favored policy to address truck parking, and enforcement and communication were the preferred strategies to deal with specific parking issues.

- Law enforcement responses to the survey focused on the use of warnings, citations, and vehicle impounding.

- The sample received for truck stop owners or operators was too small to derive conclusive findings.

- Responses from trucking companies/shippers indicated that:
  - 73 percent thought that truck parking was a serious issue, with a majority explaining in detail how limitations in truck parking availability affect their operations.
  - Almost half also indicated that HOS regulations had a negative impact on their operations.
  - Ninety-five percent of respondents indicated that they expected truck parking demand to increase over the coming decade.
  - Thirty two percent of respondents indicated that dispatchers assist the truck to find parking.
  - Roughly half of the respondents indicated that truck drivers were the ones responsible for paying for parking, with 1/3 of these respondents indicating that they do not receive reimbursement from the trucking company.

The survey presented 10 interstate corridors in the metropolitan region, and asked respondents to indicate the level of parking availability on a six-point scale. About half of these corridors were perceived as having limited parking or rarely available parking, and three had 15 percent of respondents indicating that they did not have any parking available. The survey also
contained a “mapping exercise” using Wikimapping where respondents could annotate issues and comments on the map. This tool was used by local jurisdictions and law enforcement to identify illegal truck parking locations (shown in Figure 11).

**Figure 11. Illegal Truck Parking Locations Identified through Wikimapping Survey**

![Map showing illegal truck parking locations identified through Wikimapping survey.]

Source: Atlanta Regional Truck Parking Assessment Study

A survey was conducted of truck drivers with the assistance of ATRI, OOIDA, and the trucking associations of neighboring states. The survey contained questions about the background of the truck drivers and the parking challenges within the Atlanta region. This survey received 277 responses.

Respondents rated the most important amenities at truck stops to be:

- restrooms
- adequate security
- access to the interstate
- showers
- fueling services

Over half indicated that it takes them on average over 1 hour to find parking. The methods most commonly used to find parking were:
continue driving until a safe location is found (69 percent)
- smartphone applications (55 percent)
- being aware of destination in advance (47 percent)

Truck drivers were also asked to rate the availability of parking along certain highway segments in the Atlanta region.

The stakeholder outreach also included interviews of truck drivers, carriers, truck owners, and enforcement officers. The findings of these interviews are described in detail in the study but in general, they simply provide additional explanation for the issues raised.

3.6.2 SUPPLY AND DEMAND ANALYSIS

An inventory of truck parking facilities in the region was obtained by mining data from various sources, including:

- Federal Highway Administration
- the Georgia Department of Transportation
- the Georgia Environmental Protection Division
- website and smartphone applications (Trucker’s Friend, National Truck Stop Directory, and NATSO’s Park My Truck)

The inventory included information on facility name, location (geocoded), number of spaces, amenities, and data source.

To identify private or undesignated parking, the study relied on GPS data from ATRI to manually identify locations where truck stops cluster.

The demand for truck parking along interstates was calculated using a model published by the FHWA in 2002. A key input of this model is freight volume information, which this study obtained from the Freight Analysis Framework database, for current and future conditions. This might represent a limitation of this study as the volumes in this database are sometimes substantially different than the volumes observed on the ground, because the database values result from several national modeling efforts that cannot replicate conditions precisely throughout the country, particularly in complex urban areas such as Atlanta. Parking demand estimates were compared to the supply of public and private spaces found in the inventory to estimate the deficit or surplus of truck parking spaces. The results were mapped as shown in Figure 12.

Parking utilization was also quantified using truck GPS data from ATRI. This analysis compared the number of truck stopping locations longer than 2 hours on the corridor between 12am and 4am, to the availability of parking spaces. The GPS routes from ATRI were then used to show how trucks that pass through a specific polygon, for example at a milepost in I-74, are routed through the regional network.
3.7 **WSDOT (2016) Washington State Truck Parking Study**

In 2016, the Washington State Department of Transportation (WSDOT) published the Washington State Truck Parking Study.

3.7.1 **INVENTORY**

*Findings for Private Parking*

WSDOT identified 49 private truck stops in Washington with a combined 2,442 parking spaces for trucks. Most of these truck stops are located along major truck routes, such as I-5, I-90 and I-82, although there are no truck stops around the Seattle metro region. Truck stops range in size from just a couple of spaces to over 200 spaces.

The study noted the presence of private retail locations, such as Wal-Mart or Home Depot, that allow truck parking in their parking lots, especially after hours. Many truck drivers park in these locations as they are well-lit, easy to find, and are close to food outlets and restrooms.

The study also considered truck parking facilities in vacant or abandoned lots on privately owned land, which arise in response to the deficit of truck parking spaces. However, it is difficult to gauge the exact supply and demand for these spaces as most are not documented. Further, these stops typically lack the basic amenities desired by truckers.

*Findings for Public Parking Spots*

WSDOT owns and operates 47 rest areas in Washington, with over 500 truck parking stalls. These rest areas are located 35 to 40 miles apart in accordance with FHWA recommendations. Weigh station locations owned by WSDOT are also commonly used for undesignated truck parking and consequently WSDOT regional offices have reported littering at some of these sites.
WSDOT owned right of way (ROW), including highway shoulders, exit ramps, mountain chain-up areas, and passing zones, are also unofficial truck parking locations, as it is easy for trucks to identify vacancies. Land owned by cities, counties, and ports may also be designated for truck parking facilities. Some municipalities, however, severely restrict truck parking. Seattle limits commercial vehicles to a loading time of 30 minutes and bans vehicles over 80 inches in width from parking on city streets between midnight and 6am.

Ports also experience truck parking issues in surrounding areas from short-term and longer-term parking or truck storage. Truck drivers may require temporary staging locations while waiting for port gates to open. Longer-term parking is required to satisfy HOS requirements or for truck storage. Truck parking options are often limited near port facilities, forcing truck drivers to park on the streets in industrial areas or even in residential neighborhoods.

**Figure 13. Truck Parking Locations in Washington**

![Truck Parking Locations in Washington](source)

3.7.2 **SURVEY AND OUTREACH**

WSDOT engaged truck drivers in an online survey, as well as other industry stakeholders in roundtable discussions. The survey received 1,118 responses, 84 percent of which were from truck drivers. The main findings of the survey were:

- Private truck stops are the number one preference for both short-term and overnight parking (32 and 36 percent of respondents, respectively).
- Short-term and overnight parking is generally difficult to find, with 60 percent of respondents taking one-hour or longer to find overnight parking.
- Truck parking shortages increase safety and legal risks, such as driving while fatigued or outside allowed HOS.
- The interstate highways (I-5, I-405, I-82, and I-90) have the greatest truck parking shortage.

Among others, the main issues identified in the survey were:

- **Driver safety**, with 59 percent of respondents expressing concern over finding safe parking at night.
- **Highway safety**, with trucks parked in unofficial locations such as exit and entrance ramps, chain up/down areas on mountain passes, and on roadway shoulders, posing a safety hazard to the public.
- **Mismatch between parking preference and use**. Truck drivers prefer to park in private truck stops, followed by public rest areas. However, many drivers find these parking spots unavailable, leading to parking in undesignated locations. As can be seen in Figure 14, there is a mismatch between the preferences of drivers and the availability of different facilities.

![Mismatch between Parking Availability and Preference](image)

**Figure 14. Mismatch between Parking Availability and Preference**

<table>
<thead>
<tr>
<th>Parking Type</th>
<th>Preference</th>
<th>Actual Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private truck stop</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Public rest area</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Shipper/reciever location</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Abandoned lot</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Weigh station</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Roadside</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Temporary parking lot (e.g., Walmart, casino)</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Highway on-ramp/off-ramp</td>
<td>9</td>
<td>3</td>
</tr>
</tbody>
</table>

Source: WSDOT survey

### 3.7.3 RELEVANT FINDINGS

Based on the outreach and engagement efforts highlighted above, WSDOT identified locations of high truck parking interest, as well as technologies to meet the demand for truck parking. These could include using intelligent transportation systems (ITS) solutions such as real-time parking availability information to better match supply and demand of parking spots, using FHWA’s Freight Advanced Traveler Information System (FRATIS) and private mobile device apps that provide parking information to truckers.

In particular, the Freight-Specific Dynamic Travel Planning and Performance application of FRATIS includes travel information, dynamic routing and performance monitoring elements that would be useful in reducing street wait times, travel times, and turn-around times at terminals. The wait time data provided to drivers may assist them to better plan their parking locations in advance of the trip. These features are available in commercial software used by truck lines; FRATIS offers a public-source alternative for operators who have not acquired other systems.
3.8 **WisDOT (2009) Low Cost Strategies to Increase Truck Parking in Wisconsin**

A report titled “Low Cost Strategies to Increase Truck Parking in Wisconsin” was published by Wisconsin DOT (WisDOT) in 2009. The study aimed to identify truck parking problems and solutions from stakeholders through surveys and in-person interviews.

3.8.1 **SURVEY AND OUTREACH**

The study team developed a GIS-based online tool that allowed the collection of data from participants throughout the study period. This GIS tool was distributed to truckers, highway patrol officers, and public freight planners.

The survey primarily inquired about freight corridor locations with truck parking issues, and the frequency with which these issues were observed. In total, over 50 locations with truck parking issues were identified. Around 300 offline surveys were also completed at truck shows to supplement the online survey.

3.8.2 **RELEVANT FINDINGS**

The major findings of this study were:

- In order of importance, truckers were mainly concerned with:
  - location of parking areas,
  - available amenities,
  - space availability, and
  - time limits.
- Truck parking problems primarily occur at the outskirts of large metro areas, where truckers park for staging before customer appointment times.
- When there is a lack of sufficient parking spaces during peak demand hours, overflow trucks often park on the ramps.
- Parking capacity shortages occur in the early evening or late at night.
- Truckers not familiar with the location and conditions of truck parking spots are less likely to find a parking spot when needed, thereby highlighting the need for advance information about available spaces.
- Poor geometrics and design at some locations make entry and exit movements difficult, and some trucks take up more than one spot due to poor lane markings, wasting parking capacity.

In December 2016, WisDOT joined seven other Midwestern states by installing a Truck Parking Information Management System (TPIMS) that uses sensors and cameras to create real-time information about the availability of truck parking. Truck drivers can monitor parking availability using tools such as dynamic roadside signs.
3.9 **NCTCOG (2018) Truck Parking Study: A Freight North Texas Study**

This study was conducted to determine the locations and capacity of truck parking (short term and long term) in the Dallas-FortWorth region of Texas by the North Central Texas Council of Governments (NCTCOG). As with the other studies, this study attempted to identify corridors where truck parking demand exceeds the supply. The study also developed possible solutions to address truck parking concerns at the regional level.

3.9.1 **SUPPLY AND DEMAND ANALYSIS**

*Inventory*

In addition to reviewing data from prior truck parking studies in Texas and elsewhere, this study gathered information on all truck stop facilities and Texas Department of Transportation (TxDOT) sponsored rest areas, including their location, total truck-parking lanes available, amenities offered, overnight parking availability, and any relevant technology installed. An illustration of the location of existing parking facilities is presented in Figure 15.

*Demand*

On the demand side, the study reviewed the most heavily traveled freight corridors to identify the average truck volume on these highways, as well as travel time data from across the region. This was done to determine how long it takes to travel across a given corridor, the effect of a drivers’ HOS, and the travel time to and from Freight Oriented Developments (FODs), and major freight facilities. Local truck parking ordinances were also reviewed to identify corridors that lack adequate parking due to restrictions on commercial vehicles. This analysis was performed corridor by corridor; however, because of the availability of data on parking demand, it is difficult to ascertain the accuracy of the results.

3.9.2 **SURVEY AND OUTREACH**

A driver survey was conducted where different groups of motor carriers were surveyed to obtain their observations regarding truck parking availability and the amenities and characteristics that are valuable to drivers. NCTCOG staff distributed the survey at The Great American Truck Show to drivers that frequent the North Central Texas region and are familiar with truck parking facilities in the region. The survey was also available online (the number of responses was not shown).

For both short-term and long-term truck parking stops, drivers graded safety and security as the highest priority factors. For short-term stops, highly valued amenities included food choices, restrooms and shopping choices.
Figure 15. Location of Parking Facilities

Other Outreach
In addition to the survey, other forms of stakeholder outreach were conducted. Fleet managers were engaged to determine specific areas of concern for short- and long-term parking. Site visits to truck stops were conducted to identify availability of parking and amenities at specific locations. The study was also discussed at the Regional Freight Advisory Committee public meetings to gather stakeholder input and to help determine specific corridors of concern.

3.9.3 FINDINGS
In addition to corridor-specific solutions and recommendations, this study also leaned on similar truck parking studies around the country to provide solutions for truck parking concerns. The study recommended strategies such as:

- Unused right-of-way owned by TxDOT, including weigh stations and closed rest areas, may be a short-term option for truck parking capacity.
- Requiring on-site parking at FODs and freight facilities such as distribution centers and warehouses would reduce the need for short-term truck parking. This would include parking facilities specifically set aside for drivers who arrive too early or who are mandated to take a break due to their hours of service.
The study identified the need for a review of land use and zoning study around FODs and freight-focused areas. Residential lots that are often near or mixed with these freight facilities are not compatible with providing adequate truck parking spaces at these terminals.

- Funding agreements between the state and local/regional public agencies could be arranged for facility construction, maintenance, and operation of public rest areas.

- The public and private sectors could collaborate to develop more truck parking along with the development of incentives that mutually benefit the two parties. This could include roadway improvements, entrance/exit upgrades, competitive leasing, special zoning districts, intelligent parking availability notification (advanced signage), electrified parking, security measures, and other driver amenities.

- Technologies may be implemented to promote a more cohesive relationship between actual truck parking availability or projected availability, notification of availability, and amenities specific to individual facilities.

3.10 **NCDOT (2017) North Carolina Statewide Multimodal Freight Plan: Truck Parking Study**

This study analyzes the adequacy of truck parking resources in North Carolina.

3.10.1 **SURVEY AND OUTREACH**

Overall, the outreach efforts of this study were similar to the efforts of parking studies in Virginia and other states. Multiple private and public sector stakeholders were contacted or surveyed as part of the data collection process. A project steering committee consisting of representatives from the NCDOT, North Carolina Trucking Association (NCTA), North Carolina State Highway Patrol, and North Carolina Department of Commerce were surveyed. In-person and telephone interviews were conducted with private parking facility managers, State Highway Patrol officers, and North Carolina DOT Division Engineers.

An online truck driver survey was also conducted. The survey was developed and administered by ATRI, who distributed the final survey online to carriers operating in North Carolina through the NCTA and trucking associations in surrounding states. In addition, OOIDA distributed the survey directly to drivers on behalf of ATRI.

Almost 87 percent of respondents indicated that it took over 30 minutes on average to find truck parking, for both public and private parking facilities. Shipper unwillingness to provide truck parking also increased demand for off-site parking. The study notes that truck driver compensation models often do not 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, drivers will be impacted negatively.
The HOS 10-hour rest break and 30-minute rest break ranked number one and two, respectively, as the top reasons drivers require truck parking. Other reasons included parking while awaiting dispatch, and parking to access restrooms or food establishments. Private truck stops were the most-utilized facility type by drivers, followed by public rest areas and shipper/receiver locations (see Figure 16).

### 3.10.2 ADDITIONAL FINDINGS

Besides corridor-specific solutions, this study recommended the following strategies to ensure adequate and safe truck parking spaces:

- Partner with private truck travel centers to expand parking facilities and coordinate signage, since improved parking information was found to be important to drivers.

- Develop and employ communication and signage systems to provide information on truck facility locations and parking availability to drivers so that they can plan rest periods ahead of time or while in-transit. Detection systems to monitor the safety of truck parking spaces were also recommended.

- Explore the possibility of piloting truck parking at weigh stations. The advantages of this option would be the relatively low cost of implementation to provide some additional truck parking spaces. Disadvantages include disrupting weigh station activities with entering and exiting trucks, increased maintenance, and potential confusion over where trucks should park.

- Referencing efforts in Virginia, Kansas, Wisconsin and Florida, the study recommends developing a truck parking notifications pilot system that estimates truck parking availability based on demand at participating truck parking facilities.

- Coordinate with Metropolitan Planning Organizations and Rural Planning Organizations to develop guidelines and mitigation strategies aimed at easing public opposition to private truck parking facilities.

- Create a Truck Parking standing subcommittee within the DOT to assist the implementation of the corridor-specific and regional study recommendations.
3.11 ATRI (2017) Managing Critical Truck Parking Tech Memo #2: Minnesota Case Study

ATRI was contracted by the Minnesota Department of Transportation (MNDOT) to conduct an analysis using truck GPS data for several rest stop locations, based on a customized methodology that utilizes ATRI’s large database of truck GPS points. This first-of-its-kind research assessed truck parking supply and demand by cross-referencing GPS data (i.e. truck activity) at several Minnesota rest stops. The findings were used to justify investments in expanded truck parking spaces.

3.11.1 METHODOLOGY

ATRI selected October 2015 as the observation period for the Goose Creek Rest Area, which lies along the I-35 northbound corridor north of the Twin Cities. ATRI used rest area truck counts derived from its GPS database and expanded these counts, using an extrapolation factor associated with MNDOT truck count data, to estimate the total number of trucks at the stop for each hour of the observation month.

To prepare the October 2015 data, first a geographic bounding box was created around truck parking in the rest area, and the needed data was extracted based on if a point’s latitude and longitude fell inside this bounding box. Next, the point data were joined with spatial polygons resulting in the points receiving a text identifier of the study area. The number of trucks parked by hour of day and day of week were then found by:

- Removing trucks with a speed greater than zero miles per hour (MPH) to establish that a truck is parked;
- Converting the date/time stamp on a truck’s GPS ping from Greenwich Mean Time (GMT) to Central Standard Time (CST);
- Extracting hour of day and day of week information from the converted date/time stamp;
- Creating a unique identifier (UID) for each point using the truck identification number, hour of day, and day of week indicator;
- Removing duplicate UIDs to account for a truck pinging a location more than once in any given hour on any given day; and
- Aggregating the number of UIDs by the hour of the day and day of the week.

Truck Count Expansion

ATRI developed an expansion factor for every hour in the observation period. This factor was used to expand GPS rest area counts in order to estimate the total number of trucks occupying the location. ATRI used truck count data at a MNDOT weigh-in-motion (WIM) traffic counting station 17 miles upstream of the Goose Creek rest area, and ATRI GPS data at the same geographical location to develop the expansion factor.

First, the MNDOT WIM data was analyzed to determine the number of trucks observed by day and hour of day on I-35. Next, ATRI GPS data was cross-referenced with the truck count data.
to determine the proportion of the sample to the WIM data, for each hour for each day. This expansion factor was then applied to the ATRI GPS data found at the Goose Creek rest stop, providing a reasonable estimation of the number of trucks parked in the rest stop. For example, if the MNDOT WIM data showed 18 trucks on the road at a particular time on a particular day, and the ATRI GPS data showed nine trucks, it can reasonably be assumed that ATRI GPS data is capturing 50 percent of the trucks for that time period, and applying a factor of two to the GPS counts at Goose Creek estimates truck parking usage.

When the expansion factors were applied for all hours of the selected dates at Goose Creek, a truck parking usage matrix was able to be developed, including occurrences where capacity was exceeded during certain hours of certain days.

3.11.2 RESULTS
The Goose Creek Rest Area experienced 55 hours at overcapacity in October of 2015. This equates to being overcapacity 7.4 percent of the month. The latter part of the week experienced more crowding, with Wednesday, Thursday, and Friday seeing the bulk of the issue (see Figure 17). Additionally, the issue was concentrated during the daylight hours between 5:00 AM and 6:00 PM, with the other hours of the day seeing no overcapacity issue, suggesting that overcapacity is caused by drivers stopping for their hours-of-service (HOS) rest break (Figure 18).

Figure 17. Goose Creek Rest Area - Overcapacity by Day of Week

Source: ATRI
This quantitative analysis, using real world truck GPS data, corroborates that truck parking capacity assessments can be developed for planning and management purposes. The analysis showed that while overcapacity occurs at some locations more frequently than others, all of the locations examined experienced overcapacity at some point during October 2015. Additionally, this analysis uncovered a trend whereby truck drivers had the greatest difficulty finding available parking in the second half of the week.

3.12  **KDOT (2016) Kansas Statewide Freight Network Truck Parking Plan**

The objective of this study was to improve the freight network’s safety, efficiency, and competitiveness, especially along main freight corridors in the state, such as I-70 and the Kansas Turnpike.

3.12.1  **DEMAND AND SUPPLY ANALYSIS**

After conducting a review of previous national studies, KDOT performed a statewide inventory of truck parking facilities and characterized their usage patterns. This was completed in two steps:

- Aerial imagery from Google Earth was used to identify truck parking facilities on major freight corridors, from which a count of parking spaces was established. A geographic database of designated parking spaces was created during this review to guide the field teams in the following step.

- Field review teams drove to the truck parking facilities in the database to collect data on parking utilization, type of facility (rest area, service area, commuter lot, truck stop, etc.), condition of the facility, amenities offered, and whether it was public or private. The field teams found that in many cases truck parking facilities were fully utilized, with undesignated truck parking occurring nearby.
The parking database was enhanced with the data collected from the field review and then mapped to illustrate locations with high utilization rates (shown in Figure 19).

**Figure 19. Parking Facility Utilization and Geographic Concentration**

This truck parking inventory was supplemented with a study of GPS data from trucks to determine when and where drivers are parking overnight and for their mandated 30-minute breaks. This GPS data was collected by ATRI for four two-week periods over the course of a year. The data collected was mapped (shown in Figure 20) to analyze geographic trends and corroborate other findings (such as the ease in finding parking in rural areas relative to urban areas).
3.12.2 **SURVEY AND OUTREACH**

An electronic survey was prepared and distributed by ATRI to truckers operating in and through Kansas. About 750 surveys were completed. The key findings were:

- 83 percent of respondents cited HOS as the main factor in their decision to park.
- 78 percent required up to one hour or more to find adequate parking
- 52 percent found it equally difficult to find parking in public or private rest stops
- 48 percent were most likely to find parking in rural areas versus only 25 percent in metropolitan areas.

Further, interviews were conducted with MAASTO and the Mid-America Freight Coalition (MAFC), as well as peer organizations such as DOTs in Iowa, Minnesota, Missouri, Colorado and Wisconsin, to gain insights on best practices for evaluating the benefits of truck parking improvements, and factors affecting parking decisions.
According to the study, peer DOTs also experienced difficulties from truck parking demand exceeding supply at some locations that are near urban areas. The interview with the MAFC further stressed the need for truckers to have real-time information on truck parking availability and amenities offered to allow them to plan their trips. Many of the interviews mentioned the need to leverage public-private partnerships to enhance truck parking supply in major freight corridors. To address these problems, DOTs have added parking capacity and have started using technology to provide parking availability information to truckers.

3.12.3 **FINDINGS**

Based on the field work and outreach efforts, KDOT developed a map of potential opportunity locations for truck parking improvements (shown in Figure 21)

**Figure 21. Opportunity Zones for Truck Parking Improvements**

![Figure 21. Opportunity Zones for Truck Parking Improvements](image)

Source: Kansas Statewide Freight Network Parking Plan

The general recommendations of this study were:

- Developing new (or improving existing) public and private truck parking facilities where the need is greatest.
- Overcoming barriers to using existing designated parking facilities in urban and rural areas.
- Identifying information and technology services to help truckers make better parking decisions.
Creating partnerships with public- and private-sector entities to improve parking facilities and amenities.

The study also mentioned specific implementation strategies to fulfill the above recommendations:

- Deploy a dynamic truck parking information management system (TPIMS).
- Use excess right of way for parking and improve geometrics where applicable for better parking.
- Investigate benefits of creating multistate, regional truck parking policies, as well as integrated local parking policies and pro-freight truck tax policies.

3.13 **Woodroffe J. et al. (2016) Evaluation of MDOT Truck Parking Information and Management System**

Michigan sought to evaluate the impact on the truck drivers exposed to their original real-time truck parking system on I-94. Sixty truck drivers were surveyed during four site visits, at both private truck stops and public rest areas, in 2015. Drivers overwhelmingly reported that they found TPIMS personally valuable, and that TPIMS saves them time. Dynamic roadside message signs were considered the best method to disseminate information on truck parking availability.

4. **RECENT RESEARCH**

4.1 **Diaz-Corro, K. et al. (2018) Comparison of overnight truck parking counts on GPS derived counts for truck parking facility utilization analysis**

This study estimated expansion factors for calculating truck parking demand from GPS data. This study is particularly important for the proposed work in Oregon because one of the approaches that will be explored involves using expansion factors to estimate parking demand at locations that were not monitored through video.

The expansion factors in this study were calculated by comparing observations on the ground in Arkansas of overnight parking and truck volumes with GPS data. Expansion factors were calculated for different types of facilities: public, private commercial (e.g. restaurants, stores, etc.), and private truck stops. Ground observations were obtained from an Overnight Truck Parking Study that is conducted each year by the Arkansas Department of Transportation. During the first week of September, teams of observers counted the number of trucks parked at 102 facilities around the state, between 10pm and 6am (at the time the observers reached the facilities).

The results of this data collection effort were compared to GPS data from ATRI for the same time period. Stops in the GPS data were identified through two sequential filters. First, trucks with few GPS pings (less than 20) or unrealistic speeds were removed from the sample. Then,
trucks that have pings that do not move in space (within a certain tolerance) for 30 minutes were identified as being stopped.

The expansion factors were calculated through the following steps:

1. defining geographic bounding boxes or polygons for truck parking facilities from satellite imagery;
2. identifying parked trucks from the GPS sample;
3. estimating parking facility capacity, and
4. matching observed and GPS-derived counts to estimate expansion factors.

Parking capacity was determined from satellite imagery by counting available spaces. Where spaces were not visible, or shared with passenger vehicles (such as in commercial establishments), the capacity was determined using a linear regression with the surface area of the facility as the independent variable.

A perfect match between GPS data and observed counts could not be made because the date and time of the observation was not recorded in the yearly surveys. Therefore, the GPS parking data for 10pm to 6am during the first week of November was averaged and compared to the ground observation. This represents a significant limitation of the study because the GPS data showed large variability in demand throughout these hours of the day, and even from day to day, particularly for public parking facilities. Therefore, the exact time that ground observations were made is likely to have a large impact on the expansion factors calculated through this method. For the Oregon study, we will have video data that precisely indicates the demand at certain times of the day, which should produce more reliable estimates.

The study calculated an overnight truck parking expansion factor of 6.4 for public rest stops, 4.2 for private commercial property, and 5.4 for private truck stops. These represent the average number of real-life trucks parking at these facilities per GPS records parked. As can be seen in Figure 22, the relationship appears to be roughly linear—a greater number of observed parked trucks corresponds to a proportionally greater number of GPS records. The study then used the expansion factors to calculate demand at truck stops throughout the state, and compared these figures with estimated capacity to identify locations where there is a scarcity of designated truck parking spaces.
4.2 **Morris, T. et al. (2017) A Comprehensive System for Assessing Truck Parking Availability**

This project developed a system that uses video cameras to continuously monitor the availability of truck parking spaces at specific facilities, and then provides real-time occupancy information through roadside signs, a web portal, and an onboard geolocation application.

A survey was also collected as part of this project; however, the questions focused on how drivers would prefer to receive parking occupancy information, and how they would use this information in their day-to-day operations.

4.3 **Ioannou, P. et al. (2018) Intelligent Parking Assist for Trucks with Prediction**

This project developed a parking assist algorithm that could help truck drivers better plan their trips by providing information about parking availability. Several methods for predicting truck parking were explored, although the study concludes that no single method is clearly better than all others in all situations, and therefore recommends that different prediction models be used in different cases. The approach taken in this paper is not directly useful in the Oregon project because the paper focused on modeling demand in real time.

This study used a stated-preference survey to understand the factors causing truck drivers to park on ramps, shoulders, interchanges, and other facilities. Through statistical modeling, the study found the following factors were important:

- driver characteristics (particularly years of experience)
- trip characteristics
- parking difficulty
- real-time information availability
- parking features

These factors could be included in the specification of a parking demand model in the Oregon project.


This study developed a statistical model to predict the occupancy of truck parking locations in California at a specific time of the day, based only on historical data and real-time parking occupancy information. The model is intended to help truck drivers better plan trips by predicting parking availability later in the day. The model was estimated on 1 year of data from I-5 in California, and provided reasonable approximations of parking availability. It is unclear where the historical data came from.

4.6 **Cherry, C. et al. (2016) Truck Parking Facilities and Ramp Parking: Role of Supply, Demand, and Ramp Characteristics.**

This study analyzed the use of shoulders on ramps for overnight parking in Tennessee. An inventory of truck parking locations in the state was created. Utilization rates at illegal ramp shoulders were monitored through field observation. A survey was also conducted at privately owned truck parking facilities to ascertain the perceptions of truck drivers regarding parking availability. This study found that the following factors increased the likelihood of ramp shoulder parking:

- wider shoulders
- absence of no parking signs
- diamond interchanges
- longer ramps
- smaller width with fewer lanes near intersection
These factors could be considered for inclusion in the model that estimates undesignated truck parking demand.


This study used PTV Vissim microsimulation software to study truck parking demand along a corridor. It routed origin-destination data along the corridor, and then simulated how trucks would travel, stopping at the designated and undesignated truck stops to meet HOS regulations. The parking demand at different stops was then observed through multiple simulation iterations.

A significant limitation of this study is that little effort was placed on calibrating the simulation using observed data to increase its realism and ability to predict existing demand. The author asserts that this was the first instance in the literature of using Vissim to simulate truck parking behavior.

4.8 Dulebenets, M.A. et al. (2017) Development of Tolls for Processing Truck GPS Data and Analysis of Freight Transportation Facilities

A tool was developed that processes and extracts GPS data for use in planning analyses. The tool has several scripts that provide: truck trip tables, truck performance estimates between TAZ, and truck parking demand estimates. In this latter script, the user inputs two GIS files, one with the GPS trips, and another with the truck parking locations identified by polygons. The script then processes the GPS data and extracts truck tour information, including demand for truck parking at specific facilities, as well as on the approaches nearby. The main value of this tool is the algorithm used to define truck tours, which itself can be used to estimate parking demand.


This study used a simulation model to replicate current parking demand at spaces along a highway in Germany. This simulation considered local HOS regulations. While interesting, it is unlikely that simulation would be able to replicate truck parking behavior in Oregon corridors, because of the range of factors involved.


This study developed an autoregressive model that considers temporal and spatial correlations in modeling parking availability in cities. The model is intended to be used in near-real time conditions to identify the parking location that is most likely to have a spot available at the
anticipated arrival time. While this paper does not focus on trucks, the model could be applied to study truck parking availability as well.


This study collected data on truck rest areas in Florida, and then evaluated parking availability along several key interstate corridors. The study evaluated various truck parking detection technologies, and made recommendations for how to improve information on parking availability in the state.


This study compared the supply and demand for truck parking in Virginia to identify gaps. Demand was modeled as a function of traffic volumes, truck percentage, parking duration, and distance from another highway rest stop. Once calibrated, the model was used to forecast parking demand to 2020. An inventory of rest stops was developed to identify parking capacity shortfalls. The study found that some of the key interstates had a parking shortfall as high as 40 percent. There are more recent studies available that have implemented comparable approaches to identify parking shortfalls.


This study notes that interstate ramps are the locations in the roadway system with the highest crash rates, yet trucks often chose these locations to park overnight, potentially exacerbating safety issues. This study analyzed police reported truck crashes where the truck was parked illegally on the side of the road, finding that one-third of these crashes occurred adjacent to parking facilities with 90 percent or higher utilization. The study then estimated statistical models to investigate the causes of accidents, finding that these crashes tended to concentrate on ramps with wide shoulders, diamond-shaped ramp configurations, and the presence of adjacent public parking facilities that are at capacity. This could provide important information about where to look for undesignated truck parking.


This study investigated the frequency of illegal truck parking in urban Chicago by analyzing citation data. The study found that illegal parking issues are more frequent in downtown urban areas with a high density of establishments, particularly food-related businesses. It also found that illegal parking was common in newly developed neighborhoods because they have not allocated enough curbside space for freight uses.
4.15 **Nevland, E.A. et al. (2019) Development of a Classification Scheme and Supply-model for Inter-regional Truck Parking Facilities**

This study developed an inventory of truck parking facilities using establishment data and truck GPS data. It classified truck parking facilities into the following categories:

- public rest areas and gas stations
- weigh stations
- publicly accessible truck parking
- privately accessible truck parking
- legal roadside parking
- illegal roadside parking
- illegal highway ramp parking
- illegal parking on public property
- illegal parking on private property

A statistical model was then estimated on the availability of parking spaces at these facilities, however, the results were not presented in this report. It is likely that these results will be presented in an up-coming paper.

4.16 **Gaddy, A. et al. (2018) Incorporating Truck Parking and Hours of Service into a Truck Routing Heuristic**

This study developed a truck routing model that considers the HOS regulations. It improved on the literature by considering all of the details in the HOS regulations, including the 60/70 rule, and not assuming that truck parking is always available, as had been done before. This resulted in a model that is more realistic than previous models, and better able to simulate the effect of different parking policies.


Trucker Path is one of the most frequently used smartphone applications by truck drivers to identify available parking. In 2018, Trucker Path surveyed drivers and analyzed how the implementation of the Electronic Logging Device (ELD) mandate impacted truck parking issues. Major findings from the driver survey included:

- 85 percent of drivers cite truck parking as the biggest source of stress at work
- 70 percent of drivers have violated HOS as a result of not being able to locate available truck parking
- 96 percent of drivers have parked in unauthorized areas as a result of not being able to locate available truck parking
Drivers have increased the average number of times they look up information on parking availability in the Trucker Path application from April 2017 (pre-ELD mandate) to April 2018 (post-ELD mandate).

5. LESSONS LEARNED FOR PROJECT

The literature review is intended to inform the conduct of this study. This section describes the key lessons learned from the literature review. The lessons learned are organized according to the relevant task of this project so that they can easily be cross referenced while conducting that task.

5.1 Truck Parking Inventory (Task 6)

Previous studies have used a wide range of information to identify the locations and amenities of designated and undesignated truck parking facilities, including:

- Designated: Jasons’s Law Inventory, State DOT District staff, Trucker Path, Truckers Friend, National Truck Stop Directory, Park my Truck, driver interviews and surveys, Google Earth, etc.
- Undesignated: State DOT District Staff, ATRI GPS records (manual or automated cluster analysis), law enforcement officers, parking citations, driver interviews and surveys, Google Earth, etc.

- Undesignated roadside locations could include: shoulders, ramps, weigh stations, and mountain chain-up areas.
- Many commercial establishments permit overnight truck parking on their private parking lots (e.g. Wal-Mart, Home Depot, vacant lots)
- The most important amenities for truck drivers that should be considered in the inventory are: proximity to route, showers/restroom, parking spaces, refueling services, width of parking spaces/ease of access, restaurant, internet, laundry, and service center.
- If possible, it could be beneficial to indicate in the boundary of the facility the on/off-ramps that provide access to the facility, because overnight parking on these areas is common in many places.

5.2 Current and Future Parking Demand (Task 7)

The following are the key lessons learned regarding the supply-demand analysis of parking needs:

- Many studies used the FHWA model published in 2002 to estimate truck parking demand. While not a bad tool for providing high-level estimates, this approach relies on factors for
average parking time per drive time and other factors that come from older, national research or from other states.

- Use video evidence to calculate GPS parking demand expansion factors, building on Diaz-Corro et al. (2018).
- Consider parking demand variability throughout the day and throughout the year. Estimate peak demand by considering how demand varies throughout the day, week, month and year. The influence of weather was not explored in studies reviewed here, and could be revealing.
- Think of parking demand as a stochastic process that varies randomly from time to time.
- The Oregon Statewide Integrated Model (SWIM) can provide truck volume forecasts.
- Truck volumes are better obtained from traffic counts than from models (such as state transportation demand models or the Freight Analysis Framework). TRANSEARCH routed data could be used to estimate the proportion of short-haul vs long-haul truck volumes, and the incidence of traffic types where drivers may rely on terminals (such as LTL carriage).

5.3 **Stakeholder Survey (Task 8)**

Many of the studies conducted surveys that shed light on the parking needs of the trucking industry. The results of these surveys agreed that many truck drivers often have difficulty finding parking, leading to a variety of responses and behaviors that pose safety risks (such as undesignated parking) and compliance issues (HOS). It also decreases the productivity of the sector with most drivers stopping 30 to 60 minutes before HOS time expires to secure an overnight parking spot.

The surveys described how it is already difficult for truck drivers to plan where to stop for the day. Most drivers have to make this decision themselves using limited information (considering the amount of driving they have done in the day, the HOS regulations, and the location of parking facilities) and are not reimbursed for parking reservation fees, time or mileage driven searching for a space. These problems are expected to worsen over the coming years as freight volumes outstrip new parking construction and HOS regulations are enforced through electronic logs. Currently truck driver’s most important tool is the availability of information about the location, services, and availability of parking facilities. Having more, and more accurate information will benefit truck drivers make better use of existing parking facilities.

Having said this, the degree of parking shortage varies dramatically between different regions and different corridors. There typically tends to be a deficit of parking spaces around metropolitan areas and on high volume corridors. This deficit also varies by time of day, day of the week, and time of the year.

The surveys also demonstrated the need to differentiate between short-haul and long-haul trucking, and recognize that there are large differences between the amenities and types of facilities that are preferred by different drivers and for different types of stops.
The following are the main lessons learned from the literature regarding the development and implementation of surveys:

- The following can be surveyed: truck drivers, truck owners, State DOT staff (for study state and other states), FHWA staff, law enforcement officers, rest area staff, MPOs, county government, city government, community improvement districts, etc.

- There have already been many surveys about general attitudes regarding truck parking. Greater value can be obtained from a survey that focuses on specific problems and locations in Oregon.

- It is challenging to obtain a large sample from MPOs and local/county government agencies in Oregon (Hernandez et al. 2017).

- It is valuable to obtain specific location information. Several studies have had success with use of a map-based online component to the survey. This allows respondents to pinpoint undesigned truck parking locations and identify other problems geographically. This approach was implemented successfully in the Atlanta Regional Truck Parking study using Wikimapping and in Wisconsin using a GIS-based online tool.

- Support from local trucking associations increases the reach of the survey and response rates (e.g. Owner Operators Independent Driver Association, American Trucking Associations).

- An open ended question in surveys allows respondents to detail their specific issues and to describe solutions being implemented.