Assessing Truck Parking Capacity Usage to Inform Truck Parking Needs Assessments and Determine the Feasibility and Benefits of Truck Parking Capacity Management Platforms

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FOREWORD

Adequate parking remains a top concern for truck drivers, who need a safe place to stop for many reasons, including hours-of-service (HOS) requirements. For this study, the research team acquired and analyzed three data sets: (1) Truck Parking Information Management System (TPIMS) data to visualize the use and availability of truck parking capacity along the I-80 and I-94 corridors; (2) a sample of telematics data obtained from EROAD to identify when, where, and for how long trucks are stopping in authorized locations along the I-80 and I-94 corridors; and (3) the data collected during the truck parking technology pilot at nine rest areas along the I-80 and I-39/I-90/I-94 corridors.

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16. Abstract

Adequate parking remains a top concern for truck drivers, who need a safe place to stop for many reasons, including hours-of-service (HOS) requirements. The objectives of this research were to (a) gather and analyze data to understand the usage of truck parking capacity (both public and private) along selected National Highway System (NHS) corridors to facilitate a more comprehensive understanding of truck parking needs; (b) determine when, where, and for how long trucks are stopping in unauthorized locations along the selected corridors by analyzing telematics data; and (c) determine the feasibility and benefits of deploying truck parking capacity management platforms to optimize truck parking capacity usage from a geographical and temporal perspective by piloting the ParkUnload platform at selected rest areas. The results of this research can be used to inform truck parking needs assessment studies, inform policy, and prioritize investments in rest areas/facilities, which will ultimately alleviate the safety risks to truck drivers and the general public associated with truck drivers stopping at unauthorized locations due to a lack of adequate short- and long-term parking.

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

Acronym	Definition
ATRI	American Transportation Research Institute
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
GIS	geographic information system
GPS	global positioning system
HOS	hours-of-service
IoT	Internet of Things
MAASTO	Mid-America Association of Transportation Officials
MAFC	Mid-America Freight Coalition
MAP-21	Moving Ahead for Progress in the 21st Century
MoU	memorandum of understanding
MUTCD	Manual on Uniform Traffic Control Devices
NHS	National Highway System
OS/OW	oversize/overweight
ROW	right-of-way
TIGER	Transportation Investment Generating Economic Recovery
TPIMS	Truck Parking Information Management System
TTI	Texas A&M Transportation Institute
USDOT	U.S. Department of Transportation

EXECUTIVE SUMMARY

The American Transportation Research Institute (ATRI) reported in 2021 that available truck parking has consistently ranked as one of the top five industry concerns among stakeholders and the top concern among truck drivers.[1] Truck drivers need a safe place to stop for many reasons besides complying with hours-of-service (HOS) requirements. For example, truck drivers need a safe place to await a delivery offload or delivery dispatch, wait for the rush hour or congestion to clear, and wait for inclement weather to clear. A lack of adequate truck parking:

- Creates unsafe and hazardous conditions for both the drivers and other roadway users when truck drivers park on roadway shoulders, on ramps, and in the highway right-of-way (ROW).
- Limits a driver's ability to find safe parking in response to roadway incidents, congestion, or bad weather.
- Prevents a driver from resting during required stops when facilities are crowded, resulting in drivers parking at entrances and exits to resting facilities.
- Results in inefficiencies and increases the cost of trucking when drivers stop in advance of their HOS to secure a parking space in a truck parking facility.

Jason's Law was passed as part of the Moving Ahead for Progress in the 21st Century (MAP-21) legislation that became effective on October 1, 2012, to address the "shortage of long-term parking for commercial motor vehicles on the National Highway System (NHS)."[2] Since the passage of the legislation, the Federal Highway Administration (FHWA) conducted a survey and reported in the inaugural *Jason's Law Truck Parking Survey Results and Comparative Analysis* (2015) that many States have inadequate public and private truck parking facilities and most drivers (90 percent) reported having difficulty finding parking during the overnight hours (i.e., 7:00 p.m. to midnight).[3] The 2019 *Jason's Law Commercial Motor Vehicle Parking Survey and Comparative Assessment* found an increase in truck parking spaces of 6 percent at public rest areas and 11 percent at private truck stops.[4] However, truck parking shortages remained along the same major corridors as in 2014 and 98 percent of drivers reported problems finding safe parking. FHWA also found that truck parking information systems are emerging to inform drivers about parking availability. These truck parking information/availability systems generate data that can be analyzed and inform a discussion of truck parking needs and truck parking capacity usage, as well as prioritization of truck parking investments. At the same time, urban parking, and curb space management platforms—such as ParkUnload—present additional opportunities to optimize truck parking capacity usage and facilitate planning and management of rest area capacity.

PURPOSE

The objectives of this research were to:

4. Gather and analyze data to understand the usage of truck parking capacity (both public and private) along selected NHS corridors to facilitate a more comprehensive understanding of truck parking needs;
5. Determine when, where, and for how long trucks are stopping in unauthorized locations along the selected corridors by analyzing telematics data; and
6. Determine the feasibility and benefits of deploying truck parking capacity management platforms to optimize truck parking capacity usage from a geographical and temporal perspective by piloting the ParkUnload platform at selected rest areas.

PROCESS

The Mid-America Association of Transportation Officials (MAASTO) comprises the following 10 States: Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. In 2015, eight of the 10 MAASTO States (Illinois and Missouri did not participate) were awarded a $25 million Transportation Investment Generating Economic Recovery (TIGER) Grant for developing a regional Truck Parking Information Management System (TPIMS).[5] The first step in the research was for the team to identify and select, in consultation with FMCSA and FHWA, two NHS corridors that have truck parking facilities that partake in the MAASTO TPIMS project. The research team evaluated three metrics to inform the selection of the two corridors to be included in the research:

- Number of instrumented truck parking facilities and truck parking spaces included in the TPIMS.
- Major National Highway Freight Network corridors in terms of average annual daily long-distance truck traffic.
- MAASTO State Department of Transportation recommendations.

Based on these metrics, the research team recommended (and FMCSA and FHWA concurred) the analysis of truck parking capacity usage and the piloting of the truck parking capacity management platform at truck parking facilities along the I-94 and I-80 corridors.

The study team analyzed available TPIMS data for a 4-year period (from July 1, 2019, to June 30, 2023). The time frame was selected to account for data quality improvements and to temper the impacts of COVID-19 on the analysis.

STUDY FINDINGS

Truck Parking Capacity Usage Along the I-80 and I-94 Corridors

An analysis of TPIMS data revealed that the average daily utilization of the TPIMS instrumented truck parking facilities along both the I-80 and I-94 corridors was less than the available capacity

(i.e., ranging from 56 to 76 percent in the case of the I-80 corridor and from 30 to 70 percent in the case of the I-94 corridor) in the analysis period.

These averages, however, mask differences in truck parking capacity utilization related to (a) specific truck parking facilities; (b) different sizes of truck parking facilities (i.e., number of truck parking spaces); (c) facility ownership (i.e., public rest area or private truck stop); and (d) time of day (i.e., evening hours vs. daytime hours), day of week, and month.

The 24-hour average utilization of truck parking facilities for the I-80 and I-94 corridors had the following temporal patterns:

- For I-80, utilization ranged between a low of 57.8 percent in May to a high of 71.1 percent in August and September. For I-94, utilization ranged between a low of 43.3 percent and a high of 46.7 percent.
- For I-80, utilization was slightly higher on Tuesdays, Wednesdays, and Thursdays at 66.7 percent compared to 62–64 percent for the rest of the days of the week. For I-94, utilization ranged between 36 percent (Saturdays) and 50 percent (Tuesdays, Wednesdays, Thursdays).
- For both corridors, utilization was higher during the nighttime hours between 9:00 p.m. and 5:00 a.m., with the highest utilization between midnight and 3:00 a.m. at 75.6 percent.

At the facility level, the analysis showed a steady reduction in average truck parking availability at the Iowa 80 Truck Stop (Exit 284) on Wednesdays from 11:00 a.m. until 1:00 a.m. After 2:00 a.m., more trucks leave the facility than enter the facility and park, so there was a steady increase in average truck parking availability until 11:00 a.m.

Unauthorized Truck Parking Along the I-94 and I-80 Corridors

The research team obtained a sample of 360 truck parking clusters along the I-80 and I-94 corridors from EROAD with the following results:

- Of the 197 sample truck parking clusters along the I-80 corridor, 23 clusters (or about 12 percent) were categorized as trucks parking in unauthorized locations and 86.8 percent of the trucks stopping at these 23 unauthorized parking clusters stopped at the entrances or exits to the rest areas and truck stops along the I-80 corridor. Approximately 38.8 percent of the trucks stopped for 1 hour or less, and another 9 percent stopped for between 1.5 and 2 hours. Almost half (47.8 percent) of the trucks arriving in the unauthorized parking clusters along the I-80 corridor therefore stopped for an average of 2 hours or less.
- Of the 115 sample truck parking clusters obtained from EROAD along the I-94 corridor, nine (or about 8 percent) of the clusters were categorized as unauthorized truck parking locations. The largest unauthorized truck parking clusters in the EROAD sample—both in terms of number of clusters and number of trucks stopped—were at the entrances to and exits from rest areas along the I-94 corridor. About 56.6 percent of the trucks arriving at the nine unauthorized clusters stopped, on average, for 30 minutes or less. On the other hand, 14 percent of trucks stopped at the unauthorized parking locations for an average of 9.5 hours or more.

Truck Parking Capacity Management Platform Pilot

A key objective of this research was to pilot the use of a truck parking capacity management platform—developed by ParkUnload—to better understand how truck parking capacity is used and to determine the feasibility and benefits of deploying an app and Internet of Things (IoT) platform that provides real-time truck parking availability information to drivers at a more granular level.

The ParkUnload platform comprises four components:

- A **custom-designed Bluetooth-enabled sign** that is attached to a pole. A Bluetooth low energy device—attached to the sign—wirelessly emits the ID code of the parking zone without using a global positioning system (GPS).
- A **mobile phone app that drivers need** to download. When the driver is close to the parking sign (<40 m), the ParkUnload App detects the parking zone code in 3 seconds. For the platform to provide accurate information about parking space availability, a driver must click the "Start Parking" button on the app when arriving at the parking space and the "Stop Parking" button when vacating the parking space.
- A **mobile phone app for enforcement agencies.** For this pilot, it was decided early on that parking time limitations would not be enforced.
- A **web-based back office**. The web-based back office provides access to real-time and historical parking patterns for instrumented parking zones and real-time and historical occupancy levels of the parking zones.

The research team, in consultation with Iowa DOT and Wisconsin DOT (WisDOT), agreed to test the ParkUnload platform at four truck parking spaces at each of the nine rest areas included in the pilot. The specific four parking spaces at each of the rest areas were a function of the (a) availability of suitable poles on which to attach the Bluetooth-enabled sign; (b) range of the Bluetooth device, which was a function of the rest area design; and (c) convenient access to the rest area facilities.

The research team tested the truck parking management platform in two ways:

- At the six Iowa pilot sites, the research team tested the feasibility of using the ParkUnload platform to provide users with information about where and when truck parking is available and to gather data about the usage of the truck parking spaces included in the pilot.
- At the three Wisconsin pilot sites, the research team tested the feasibility of using the ParkUnload platform to designate the pilot parking spaces for short-duration parking. ParkUnload programmed the app to display a 2-hour limit for trucks parking in the pilot parking spaces at the Wisconsin sites. No enforcement of the parking time limit was conducted.

The FMCSA truck parking pilot started on August 1, 2022, and ended on July 31, 2023—lasting a total of 12 months. The ParkUnload App was used 418 times during the 12-month pilot by 338 truck drivers (ParkUnload App users) at the six pilot rest areas in Iowa and 147 times by 106 truck drivers at the three pilot rest areas in Wisconsin.

The data analysis revealed that one-third of the ParkUnload App users at the six Iowa rest areas parked between 9.5 and 13.5 hours in the pilot parking spaces, suggesting that these truck drivers slept at these rest areas. This observation was also supported by the time of day when drivers checked into the parking spaces. The number of parking sessions peaked between 7:00 p.m. and 9:30 p.m. After 9:30 p.m., there was a reduction in the number of parking sessions, and very few parking sessions started between 1:00 and 8:00 a.m. In addition, 18.7 percent (or 78) of the parking sessions lasted 30 minutes or less, and 18.2 percent (or 76) of the parking sessions were for 20 hours or more. Finally, 135 of the parking sessions (or almost one-third of the total parking sessions) were 9.5 to 13.5 hours.

The data analysis also revealed that ParkUnload App users were compliant with the 2-hour parking limit specified for the Wisconsin pilot rest areas. Although most parking sessions (56, or 38.1 percent of the total parking sessions) were between 130 and 140 minutes, these drivers overstayed the specified time limit of two hours by between 10 and 20 minutes. No parking session exceeded 140 minutes (or 20 minutes over the specified time limit). Almost half (69, or 46.9 percent) of the parking sessions at the Wisconsin pilot sites were less than 50 minutes, potentially indicating that these users of the ParkUnload App were using the rest areas to access the restroom facilities or to comply with break requirements. The analysis showed peaks in the number of parking sessions at 10:00 p.m., 11:00 p.m., 1:00 a.m., and noon. This finding indicates that drivers needing short-term parking at different hours than drivers using the rest areas to sleep (i.e., long break). These truck drivers may have been operating at night and needed to use the facilities or comply with HOS regulations that require drivers to take a 30-minute break when they have driven for a period of 8 cumulative hours without at least a 30-minute interruption.

Truck Parking Management Platform Benefits. Truck parking management platforms (such as ParkUnload demonstrated during the pilot) have the following benefits:

- They provide a low-cost technology option to inform drivers of not only the number of available truck parking spaces but also where the spaces are in a rest area or truck stop. (Current truck parking information systems, including TPIMS, communicate that parking spaces are low when a certain threshold is reached. According to stakeholders interviewed during this research, drivers will park on ramps or entrances/exits to rest areas rather than look for a parking space in an almost-full truck parking facility.)
- They provide comprehensive data on truck parking capacity usage that can help inform truck parking needs assessment studies, inform policy, and prioritize investments in truck parking facilities.
- They are extremely easy to deploy (a month from project acceptance) as opposed to the schedule for constructing rest areas and truck stops or implementing sophisticated truck parking availability systems.
- They are low cost with a high return on investment since they require no network infrastructure (only the driver's smartphone).
- They are proven to be technically feasible.
- They allow for diversifying and managing truck parking capacity (by designating truck parking spaces for certain load types or specifying the time available to park).

- They optimize the use of public rest areas and improve truck parking space utilization.
- They can be used to reserve a truck parking space (in a zone) in advance and thereby reduce the time drivers spend looking for a parking space.

Truck Parking Management Platform Challenges. The two biggest challenges associated with app-based truck parking management platforms are driver participation (i.e., reaching drivers and convincing drivers to download the app) and compliance (i.e., convincing drivers to use the app every time when parking to check in and check out).

Reaching out to drivers and getting information to drivers are both challenging. The research team implemented several initiatives to share information about the pilot with drivers and to recruit drivers to participate in the pilot. The research team engaged truck drivers when implementing the ParkUnload platform at the pilot rest areas (i.e., handed out the pilot brochures, explained the pilot objectives, and asked drivers to participate), shared information through social media, displayed information about the pilot on the rest area monitors at the Iowa sites, posted pilot posters at the Wisconsin sites, and participated in media events (i.e., trucking shows). A substantial effort was also conducted to share information about the pilot with trucking associations, trucking interest groups, trucking industry contacts, and Iowa and Wisconsin freight advisory committees. It is, however, not clear how many drivers received information about the pilot.

Driver participation in the pilot was also a major challenge. August 2022 was the month that saw the most use of the ParkUnload App. Even so, an analysis of WisDOT's rest area images database showed that 14.3 percent of the counted trucks that parked in the pilot parking spaces used the ParkUnload App at Poynette, 42.9 percent at Portage, and 5.3 percent at Janesville the first week of August 2022. After August, a decline in driver participation was seen every month until January 2023, when app use started increasing again after Iowa DOT started displaying information about the pilot on the rest area monitors along the I-80 corridor, pilot posters were installed in the Wisconsin pilot rest areas (in February), and the research team made an effort to engage the ParkUnload App users by thanking them for their participation in the pilot and requesting their feedback on parking challenges and the ParkUnload App (a survey link was texted to ParkUnload App users on March 15, April 19, and May 19, 2023). Driver participation, however, never returned to the August 2022 level. Note that driver participation in the pilot was voluntary. Several stakeholders as well as driver feedback pointed to the need to enforce the use of these app-based technologies for the platform to be feasible and provide reliable truck parking availability information to truck drivers.

Feasibility of Truck Parking Management Platforms (Driver Perspective). The assessment of the feasibility of truck parking management platforms—from a driver perspective—is complicated by the difficulty in identifying and reaching a representative sample of truck drivers that can be extrapolated to understand how the population of truck drivers will respond to these types of platforms. For example, the input received from truck drivers at the pilot rest areas during the implementation of the ParkUnload platform was *overwhelmingly positive*. Of the approximately 100 drivers approached, 90 took the time to listen to the pilot information shared, and most emphasized that truck parking is a major issue for the industry. The drivers were overwhelmingly open to the pilot idea, and most had experience using the Trucker Path app. Only six drivers were not interested in hearing about the pilot study. In addition, four drivers got

very agitated, noting that these kinds of projects are a waste of taxpayer money, and that the money can be better spent investing in additional truck parking facilities.

On the other hand, the input received in response to the social media outreach was *overwhelmingly negative*. The comments received from the trucking community were grouped and expressed the following sentiments:

- Stop research and invest in free truck parking.
- Need to involve truck drivers in truck parking design.
- Anti-app.
- Suspicion.

Finally, the feedback received from the ParkUnload App users was *predominantly constructive and positive*. For example, most of the ParkUnload App users that responded to the survey (71 percent) found the ParkUnload App extremely easy/easy to use, and almost 90 percent indicated that parking technology (such as the ParkUnload App) is useful in providing parking availability information to truck drivers.

CONCLUSIONS

Adequate, safe parking remains a top concern for the trucking industry and for truck drivers, but providing sufficient and free parking in a timely manner is becoming increasingly challenging for both the public and private sectors.

The data collected and analyzed during this research study demonstrated:

- There is demand (especially for overnight parking) that is not being met, resulting in truck drivers parking on the entrances and exits to rest areas along both the I-80 and the I-39/I-90/I-94 corridors.
- The demand for short duration parking during both daytime and nighttime hours.

The pilot illustrated the technical feasibility of using technology solutions, such as parking capacity management platforms, to provide drivers with "more granular" (digital) information about the availability and location of truck parking spaces. It also demonstrated that the technology can be used to specify a time limit for drivers to park in a parking space and thereby manage the time that drivers are allowed to park to meet the needs for both long-duration and short-duration truck parking. A major challenge, though, is to convince drivers to comply (in terms of both downloading and using the app) or to enforce the usage of the app. Overcoming this challenge seems daunting for the entire population of truck drivers, or even for most of the rest areas and truck stops, in the United States. Having said that, the research team has identified several cases where the technology can be feasible:

- **Truck Stops.** These technology platforms can be implemented by truck stop owners (a) interested in diversifying the parking services offered at truck stops, (b) interested in implementing a reservation system and payment for parking spaces, and (c) interested in

designating and reserving certain parking spaces as part of preferred parking programs for truck drivers. For example, Travel Centers of America offers truck drivers a free parking space at preferred parking locations when making fuel and non-fuel purchases (e.g., merchandise, food, or service and repairs). This technology can therefore be used to help implement these preferred parking programs.

- **Smaller Rest Areas.** These technology platforms can be implemented at smaller rest areas (10 to 15 spaces) or the safety and weight enforcement facilities in Wisconsin where sophisticated truck parking availability systems may be cost prohibitive.
- **Oversize/Overweight (OS/OW) Truck Parking Reservations.** OS/OW permitted loads are a specialized and niche segment of the trucking industry. OS/OW permitted loads face unique challenges given the size and weights of the loads. Furthermore, OS/OW trucks often park in multiple truck parking spaces, making TPIMS unreliable. Some State DOTs are starting to provide designated parking for OS/OW loads. Given the challenges associated with these loads, it is foreseen that this segment of the industry would see the benefits of using this technology and potentially the reservation functionality of the technology.
- **Electric Charging Infrastructure.** A significant benefit of the truck parking management platform is that the app provides information about the number and location of the parking spaces available, as well as when parking time limits will be reached. In the future, assuming higher adoption of electric trucks, information about where electric charging infrastructure is available would be of benefit to truck drivers. In addition, if charging time limits are specified, truck drivers will also be able to see when the charging infrastructure will become available.

1. INTRODUCTION

The American Transportation Research Institute (ATRI) reported in 2021 that available truck parking has consistently ranked as one of the top five industry concerns among stakeholders and the top concern among truck drivers.[6] Truck drivers need a safe place to stop to:

- use the restroom,
- await a delivery offload or delivery dispatch,
- wait for the rush hour or congestion to clear,
- wait for inclement weather to clear, and
- comply with hours-of-service (HOS) requirements—both in terms of break requirements and the need to overnight.

A lack of adequate truck parking:

- Creates unsafe and hazardous conditions for both the drivers and other roadway users when truck drivers park and rest in unauthorized areas, such as on roadway shoulders, on ramps, and in the highway right-of-way (ROW).
- Limits a driver's ability to find safe parking in response to unforeseen traffic conditions (due to roadway incidents, congestion, or bad weather).
- Potentially prevents a driver from resting during required stops when facilities are crowded or drivers are forced to park on entrances and exits to resting facilities.
- Potentially results in inefficiencies and increases the cost of trucking when drivers stop in advance of (and therefore do not fully capitalize on) their HOS to secure a parking space in a truck parking facility.

Jason's Law was passed as part of the Moving Ahead for Progress in the 21st Century (MAP-21) legislation that became effective on October 1, 2012, to address the "shortage of long-term parking for commercial motor vehicles on the National Highway System (NHS)."[7] Jason's Law required the U.S. Department of Transportation (USDOT) to conduct a survey and comparative assessment to:

7. "Evaluate the capability of [each] State to provide adequate parking and rest facilities for commercial motor vehicles engaged in interstate transportation;
8. Assess the volume of commercial motor vehicle traffic in [each] State; and
9. Develop a system of metrics to measure the adequacy of commercial motor vehicle parking facilities in [each] State."[8]

In response to Jason's Law, the Federal Highway Administration (FHWA) conducted a survey of State departments of transportation (DOTs), metropolitan planning organizations, and drivers to gauge their perceptions on truck parking. FHWA reported in the inaugural *Jason's Law Truck Parking Survey Results and Comparative Analysis* (2015)[9] that many States have inadequate public and private truck parking facilities. The parking problem was described as both (a) a

shortage in official parking locations and (b) drivers parking in unofficial locations. Some of the latter included drivers parking at entrances or exits to public rest areas, on freeway interchange ramps, on freeway shoulders, and on conventional highway roadsides. Most drivers (90 percent) reported having difficulty finding parking during the overnight hours (i.e., 7:00 p.m. to midnight). The 2019 *Jason's Law Commercial Motor Vehicle Parking Survey and Comparative Assessment*[10] found an increase in truck parking spaces of 6 percent at public rest areas and 11 percent at private truck stops. However, truck parking shortages remained along the same major corridors as in 2014, while several corridors, such as the entire I-95 corridor and Pacific corridors, emerged as experiencing truck parking shortages. The 2019 update found that 98 percent of drivers reported problems finding safe parking and that truck parking information systems are emerging to inform drivers about parking availability.

In response to Jason's Law and the FHWA survey, a number of State DOTs (e.g., Texas, Maryland, Oregon, Nevada, and Virginia) have funded truck parking needs assessment studies. The focus in current state-of-practice truck parking needs assessment studies is on long-term truck parking needs (e.g., 10 hours). These assessments typically involve interviewing drivers at truck stops, conducting supply and demand analyses, using truck volume and truck-stop location data, and, more recently, mapping global positioning system (GPS) data from commercial trucks to identify truck parking locations along corridors.

A recent research study by the Texas A&M Transportation Institute (TTI) that was funded by the Federal Motor Carrier Safety Administration (FMCSA), however, found that more than 50 percent of the trucks that parked in unauthorized locations (e.g., ramps and shoulders) along the I-35 corridor because of HOS requirements stopped on average for 1 hour. In the case of the I-90 corridor, this number was approximately 70 percent. The research pointed to a largely ignored need for short-term truck parking, as necessitated by the required 30-minute break after 8 hours of consecutive driving per the current HOS requirements.[11] Drivers must take a 30-minute break when they have driven for a period of 8 cumulative hours without at least a 30-minute interruption. The break may be satisfied by any non-driving period of 30 consecutive minutes (i.e., on-duty not driving, off-duty, sleeper berth, or any combination of these taken consecutively).

The research also reported that an analysis of the usage of truck parking capacity by time of day, day of week, or month has largely been ignored in truck parking needs assessments conducted by DOTs to date. Data collected by the Mid-America Association of Transportation Officials (MAASTO) Truck Parking Information Management System (TPIMS) project is one of a number of truck parking availability systems that generate data that can inform analysis and discussion of truck parking needs and truck parking capacity usage, as well as prioritization of truck parking investments. Urban parking and load space management platforms—such as ParkUnload—present additional opportunities to generate truck parking data and facilitate planning and management of rest area capacity.

The objectives of this research were to (a) gather and analyze data to understand the usage of truck parking capacity (both public and private) along selected NHS corridors to facilitate a more comprehensive understanding of truck parking needs; (b) determine when, where, and for how long trucks are stopping in unauthorized locations along the selected corridors by analyzing telematics data; and (c) determine the feasibility and benefits of deploying truck parking capacity

management platforms to optimize truck parking capacity usage from a geographical and temporal perspective by piloting the ParkUnload platform at selected rest areas. The results of this research can be used to inform truck parking needs assessment studies, inform policy, and prioritize investments in rest areas/facilities, which will ultimately alleviate the safety risks to truck drivers and the general public associated with truck drivers stopping at unauthorized locations due to a lack of adequate short- and long-term parking.

This report is a culmination of the research conducted and is structured as follows:

- Chapter 2 provides information on the selection of the two NHS corridors analyzed.
- Chapter 3 characterizes truck parking capacity usage along the I-80 and I-94 corridors using data gathered by the MAASTO TPIMS.
- Chapter 4 discusses the insights obtained as to where, when, and for how long truck drivers park in unauthorized locations along the I-94 and I-80 corridors using telematics data.
- Chapter 5 documents the design and implementation of the truck parking capacity management platform pilot.
- Chapter 6 discusses the data analysis conducted using the information collected during the pilot.
- Chapter 7 documents the truck driver input received during the research.
- Chapter 8 concludes with the findings and final remarks.

Additional information and details are provided in appendices to this report.

2. SELECTION OF THE NATIONAL HIGHWAY SYSTEM CORRIDORS FOR FURTHER ANALYSIS

MAASTO comprises the following 10 States: Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. The goal of MAASTO is to "foster the development, operation, and maintenance of an integrated and balanced transportation system that adequately serves the transportation needs of the ten member states."[(12)]

In 2015, eight of the 10 MAASTO States (Illinois and Missouri did not participate) were awarded a $25 million Transportation Investment Generating Economic Recovery (TIGER) Grant for developing a regional TPIMS.[(13)] Figure 1 shows the instrumented NHS corridors and the location of the truck parking facilities along the corridors that partake in the MAASTO TPIMS effort.

The first step in the current research was for the team to identify and select, in consultation with FMCSA and FHWA, two NHS corridors that have truck parking facilities that partake in the MAASTO TPIMS project. The capacity usage of the truck parking facilities along these corridors would be subsequently analyzed by time of day, day of week, and month. This chapter describes the research team's approach for identifying and selecting the two NHS corridors that were analyzed.

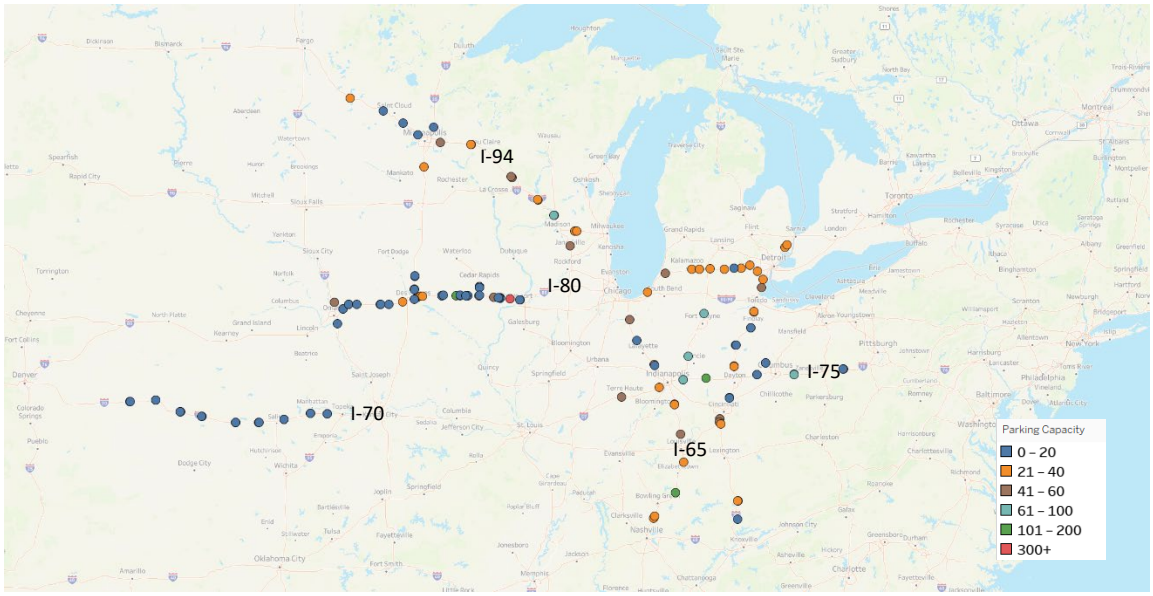


Figure 1. Map. MAASTO TPIMS instrumented sites: Locations along corridors.

2.1 CRITERIA FOR SELECTING MAASTO CORRIDORS

The research team evaluated a number of metrics to inform the selection of the two corridors to be included in the research. The following subsections summarize this process.

2.1.1 TPIMS Instrumented Truck Parking Facilities

The truck parking facilities included in the TPIMS were selected based on truck traffic volume, parking demand, and capacity for improvements.[14] Table 1 summarizes the corridors with instrumented TPIMS, the MAASTO States in which the instrumented truck parking facilities are located, the ownership of the truck parking facilities instrumented (i.e., public rest area or private truck stop), and the total number of truck parking spaces at all the instrumented truck parking facilities along the respective corridors.

Table 1. Summary of MAASTO TPIMS corridors and facilities.

Deployed Corridors	MAASTO States with Instrumented Sites	Instrumented Sites	Number of Truck Parking Spaces
I-80	Iowa	23 DOT, 12 Private	1,328
I-70	Indiana, Kansas, Ohio	37 DOT	950
I-65	Indiana, Kentucky	15 DOT, 1 Private	743
I-94	Michigan, Wisconsin, Minnesota	22 DOT	835
I-75	Kentucky, Michigan, Ohio	18 DOT	553
I-69	Indiana	3 DOT	243
I-90	Wisconsin	4 DOT	155
I-380	Iowa	2 DOT, 2 Private	154
I-35	Minnesota, Iowa	6 DOT	111
I-39	Wisconsin	1 DOT	68
I-29	Iowa	1 DOT, 1 Private	65
US 23	Michigan	1 DOT	30
I-275	Michigan	1 DOT	22
US 33	Ohio	2 DOT	16
I-235	Iowa	1 Private	11

The top five corridors in terms of the number of instrumented truck parking facilities and truck parking spaces included in the TPIMS are:

- I-80
- I-70

- I-65
- I-94
- I-75

2.1.2 Major National Highway Freight Network Corridors

The Mid-America Freight Coalition (MAFC), in its 2018 report entitled *Identification and Characterization of the MAASTO Region's Multimodal Freight Network*,[15] identified the following 10 major National Highway Freight Network corridors in terms of average annual daily long-distance truck traffic:

- I-94
- I-65
- I-70
- I-75
- I-90
- I-64
- I-35
- I-80
- I-44
- I-55

Of these corridors, I-64, I-44, and I-55 have no instrumented truck parking facilities.

2.1.3 MAASTO State Department of Transportation Input

The research team reached out to all 10 State DOTs to obtain their recommendations for which corridors should be included in the FMCSA pilot. Table 2 summarizes the input received from the State DOTs. The top three corridors in terms of the number of States that supported the corridor for inclusion in the FMCSA pilot were I-94, I-70, and I-35.

Table 2. MAASTO State DOT recommended corridors.

Deployed Corridors	MAASTO States with Instrumented Sites	State DOT Recommended
I-80	Iowa	Iowa
I-70	Indiana, Kansas, Ohio	Indiana, Kansas, Ohio, Missouri
I-65	Indiana, Kentucky	Indiana
I-94	Michigan, Minnesota, Wisconsin	Indiana, Michigan, Minnesota, Wisconsin
I-75	Kentucky, Michigan, Ohio	Michigan, Ohio
I-69	Indiana	—
I-90	Wisconsin	Wisconsin
I-380	Iowa	—
I-35	Iowa, Minnesota	Iowa, Kansas, Minnesota,

Deployed Corridors	MAASTO States with Instrumented Sites	State DOT Recommended
I-39	Wisconsin	—
I-29	Iowa	—

Note: A dash means "not recommended."

2.1.4 FMCSA and FHWA Input

Seven corridors were identified for presentation to FMCSA and FHWA based on the number of instrumented TPIMS truck parking facilities, the findings of MAFC's major freight corridors study, and the State DOT recommendations received. These seven corridors are all significant in terms of truck volumes, the length of the corridors (e.g., number of States the corridor traversed), and economic value.

The four major corridors that emerged were I-94, I-80, I-75, and I-70. Ultimately, the research team recommended the analysis of truck parking capacity usage and the piloting of the truck parking capacity management platform at truck parking facilities along the I-94 and I-80 corridors. Although I-75 is an important north-south corridor in the region, only 17 public rest areas (553 truck parking spaces) are instrumented. Similarly, I-70 is a major east-west corridor, but all 37 facilities (950 truck parking spaces) instrumented along the corridor are public rest areas. I-80 was therefore preferred because of the mix of public and private truck parking facilities that are instrumented along the corridor.

Table 3 summarizes the metrics that were considered in the research team's recommendation to analyze truck parking capacity usage and pilot the truck parking capacity management platform along I-94 and I-80.

Table 3. Characteristics of major MAASTO corridors.

Corridor	Length (Number of States)	Direction	Number of States (TPIMS)	Economic Value	Parking Ownership	Number of Parking Spaces	State DOT Supported
I-94	5	E/W	3	2	DOT	835	4
I-65	2	N/S	2	7	DOT/ Private	743	1
I-70	5	E/W	3	3	DOT	950	4
I-75	3	N/S	3	5	DOT	553	2
I-90	5	E/W	1	4	DOT	155	1
I-35	3	N/S	2	6	DOT	111	3
I-80	4	E/W	1	1	DOT/ Private	1,328	1

Note: E = east, W = west, N = north, S = south.

The research team presented the recommendation to study truck parking capacity along the I-94 and I-80 corridors to FMCSA and FHWA during a regularly scheduled project progress meeting on March 15, 2021. On April 1, 2021, the research team received concurrence to proceed with analyzing the capacity usage of the TPIMS instrumented truck parking facilities along the I-94 and I-80 corridors by time of day, day of week, and month.

3. TRUCK PARKING CAPACITY USAGE ALONG THE I-80 AND I-94 CORRIDORS

This chapter provides information about the TPIMS data collected and summarizes the research team's analysis of the available truck parking capacity usage data along the I-80 and I-94 corridors. In addition to the information summarized in this chapter, the research team developed two data analytics dashboards to visualize truck parking availability and usage by time of day, day of week, and month (https://parkingpilot.org/dashboard/).

3.1 MAASTO'S TPIMS DATA

The research team obtained access to truck parking capacity usage data gathered by the MAASTO TPIMS and managed by MAFC on selected NHS corridors in eight of the 10 States that comprise the MAASTO region. MAASTO's TPIMS aims to convey real-time information to truck drivers about available truck parking using occupancy-based solutions. Different kinds of technology are used, but in general, the system comprises technologies that:

- detect available truck parking,
- collect and store parking availability data, and
- communicate truck parking data to truck drivers.

Appendix A contains information about studies identified during the literature review.

3.1.1 Detect Available Truck Parking Data

The TPIMS facility owners use two main technology approaches to determine truck parking space availability:

- Counting vehicles as they come in and as they leave a facility (entry-exit counts, also referred to as screenline counts).
- Sensing a vehicle parked in an assigned location (space occupancy counts, also referred to as spot specific counts).

The technological approach used is a function of the needs, site characteristics, and available funding. Several TPIMS facility owners use an entry and exit technology—either magnetometer-based sensors or video detection—that is triggered when a truck enters and refreshed when a truck exits the truck parking facility. This technology is very cost-effective, works well with designated entrances and exits, and allows for the accommodation of trucks in unmarked truck parking spaces. The location and aiming of the sensors are critical for improved accuracy. Sensor failure may yield system failure. The technology is considered less accurate, and "truck counting errors can accrue until manually corrected, so the available space count must be verified and reset by operators regularly and periodically."[16] An analysis of the verification checks that are fed to MAFC showed that most of the instrumented truck parking facilities along I-80 in Iowa are manually verified only once a week (i.e., 22 out of 28 truck parking facilities), two (out of 28) are manually verified twice a week, and four (out of 28) are manually verified twice a day.

The second technology that is used by TPIMS facility owners senses vehicle occupancy in marked truck parking spaces using either video analytics or wireless magnetometer sensors in the pavement. Single sensor failures generally do not affect the entire system. These technologies are considered more accurate, but these systems typically:

- Require one or more sensors per parking space.
- Can be expensive to install, maintain, and may need additional communication networks.
- Cannot be adapted easily to unmarked truck parking spaces.[17]

Space occupancy counts are more expensive than entry-exit counts because more sensors need to be installed and maintained. These sensors are also driven over by large, heavy vehicles while turning and maneuvering into a space. This can lead to premature failure and thus higher long-term cost due to maintenance and less-reliable data.

3.1.2 Collect and Store Truck Parking Availability Data

Providing real-time truck parking information to truck drivers requires storing and processing the collected data and disseminating it to drivers. Different TPIMS facility owners have chosen different software platforms and vendors to process the raw data and to make the data accessible to drivers. One challenge with the data processing and storage is thus having a uniform standard across DOTs in a multi-state region or across districts in a multi-district DOT.

Some of the MAASTO States use their own systems (i.e., Indiana, Kentucky, Minnesota, and Kansas), while others use the contractor that provided the system to collect and process the data (i.e., Ohio, Wisconsin, Michigan, and Iowa). Figure 2 illustrates how TPIMS data are collected and stored by the MAASTO States that have implemented TPIMS.

Figure 2 shows that the truck parking availability data collected by each participating TPIMS facility owner is sent to a central data warehouse operated by MAFC. Different participating facility owners use different software platforms and vendors to send the information over to the central data warehouse and to disseminate the information to partner States and third-party vendors for use as illustrated.

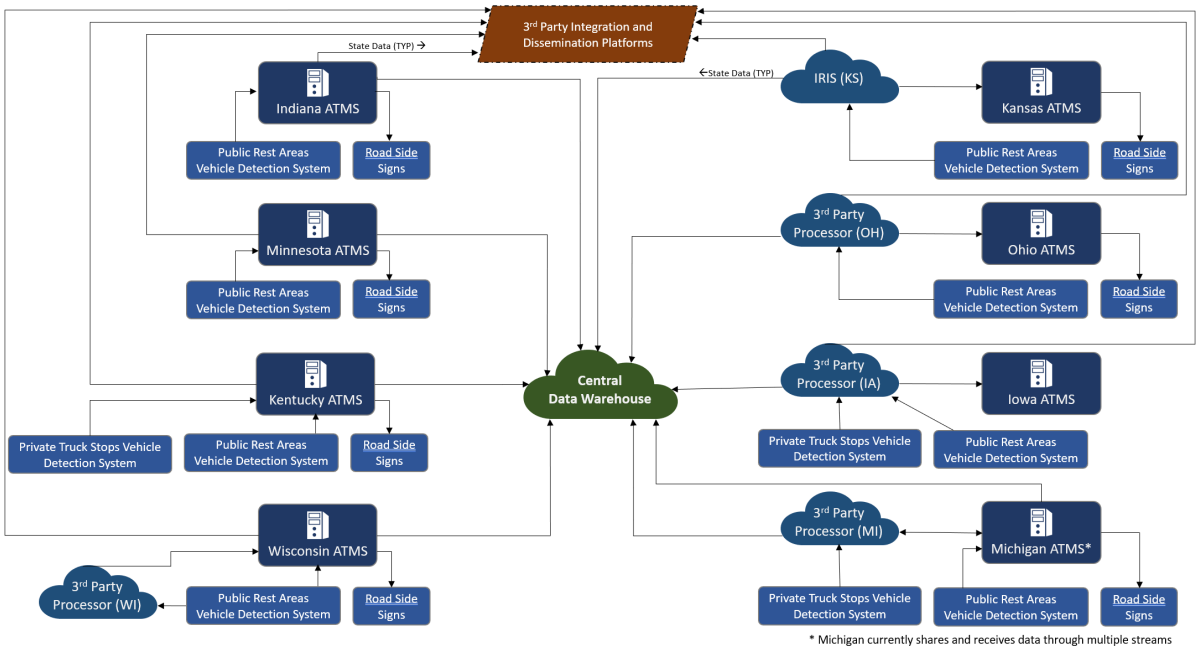


Figure 2. Diagram. MAASTO TPIMS data collection and storage.

3.1.3 Communicate Truck Parking Availability Data to Truck Drivers

Truck parking availability information is shared with truck drivers via different media, including dynamic message signs and State traveler information websites, such as 5-1-1. Dynamic/variable message signs (see Figure 3) display information on the number of available truck parking spaces at up to three of the nearest truck parking facilities. When the number of available truck parking spaces falls below a predetermined threshold, the word "LOW" is displayed instead of the number of available truck parking spaces. Each Agency determines the threshold for "LOW."[18]

Figure 3. Photograph. TPIMS dynamic message sign.

3.2 TPIMS PERFORMANCE MEASURES

The MAASTO TPIMS became fully operational in January 2019,[19] but it was observed that the data were less reliable during the months of January, February, and, to some extent, March 2019. From April 2019 onwards, the quality of the data recorded and transmitted improved considerably. The University of Wisconsin at Madison—a member of the research team—calculates three quarterly performance measures for the TPIMS:

- **Accuracy**—A measure of how close the system count number of available truck spaces and the manually verified number of available truck spaces are on average.
- **Downtime**—A measure of how often the system (instrumentation and data feed) is not functioning. This is measured against an expected frequency of an updated data feed every 5 minutes.
- **Utilization**—A measure of parking space utilization during the night hours on weekdays.

Figure 4, Figure 5, and Figure 6 provide the quarterly performance measures for 2019 and the first two quarters of 2020. Figure 4 shows that the TPIMS truck parking availability counts in Iowa, Minnesota, and Kansas were on average more than 90 percent accurate (as verified manually). Figure 4 also shows that the TPIMS truck parking availability counts became more accurate on average in the case of Wisconsin and Michigan.

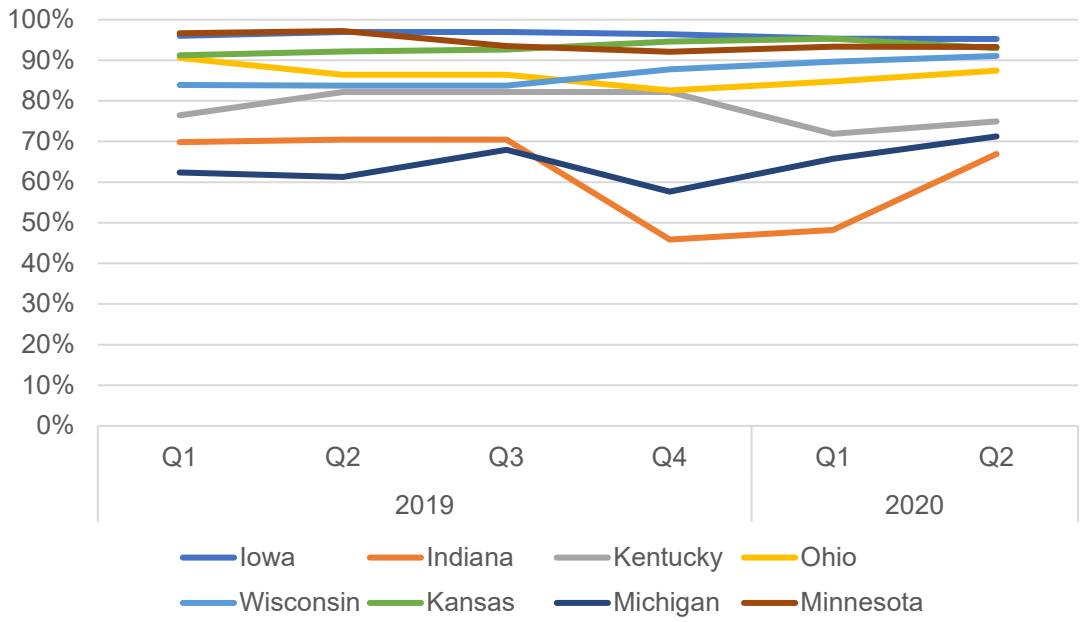


Figure 4. Graph. TPIMS accuracy (2019 and 2020).

Figure 5 shows the highest TPIMS truck parking space utilization during the night hours on weekdays in Wisconsin, Iowa, and Ohio. Figure 5 also shows that most States saw an increase in truck parking space utilization during the night hours on weekdays between the fourth quarter in 2019 and the second quarter in 2020.

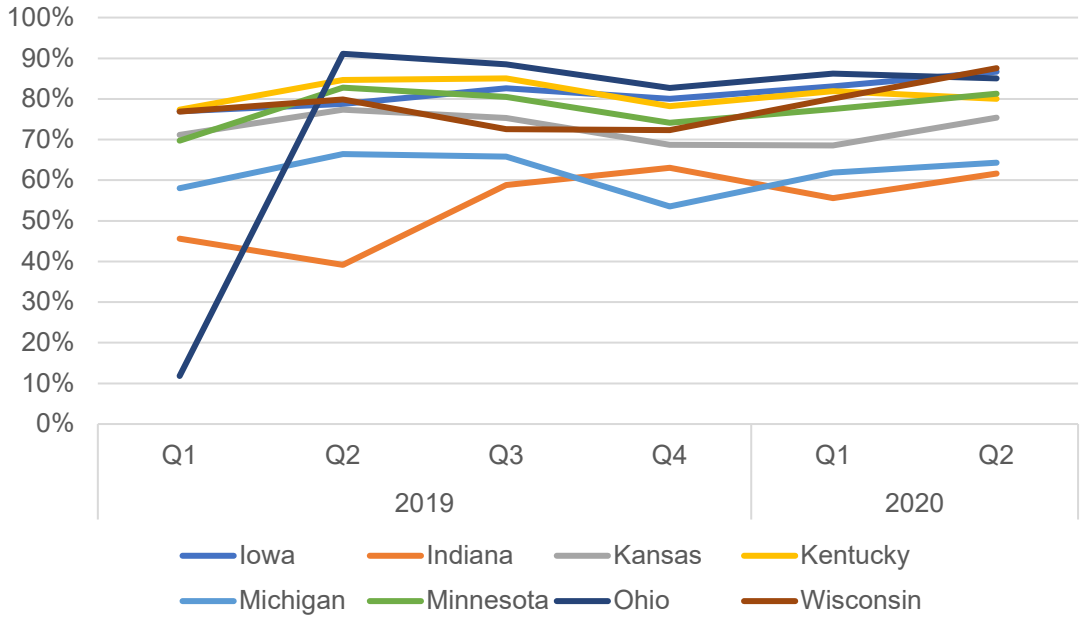


Figure 5. Graph. TPIMS utilization during nighttime hours on weekdays (2019 and 2020).

Figure 6 shows that the reliability (i.e., less downtime) of the TPIMS improved—in some cases substantially—between the fourth quarter in 2019 and the second quarter in 2020.

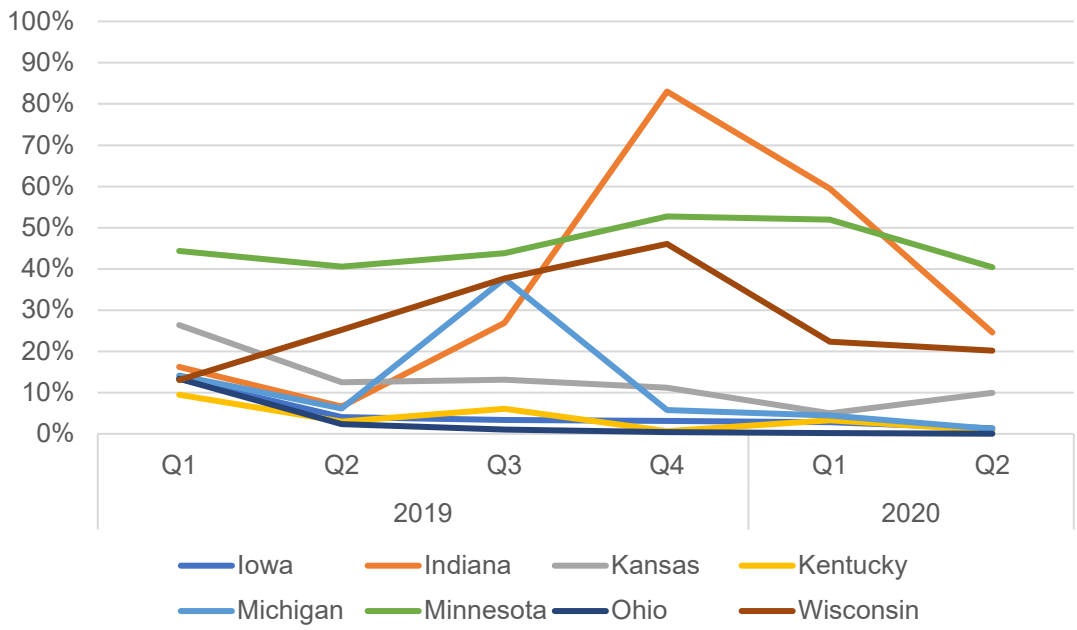


Figure 6. Graph. TPIMS downtime (2019 and 2020).

Considering these performance measures, the research team extracted and analyzed the TPIMS data for the I-80 and I-94 corridors between July 1, 2019, and June 30, 2023—a 4-year period. The time frame was selected to account for the data quality improvements and to temper the impacts of COVID-19 on the analysis.

3.3 CHARACTERISTICS OF TRUCK PARKING CAPACITY USAGE

The research team developed Tableau data analytics dashboards to visualize the truck parking data collected as part of the MAASTO TPIMS as follows:

The **Truck Parking Availability and Utilization Dashboard—Daily and Monthly Overview**. This dashboard allows the TPIMS data to be filtered by corridor (I-80 or I-94) or specific truck parking facility to visualize the temporal distribution (by day of week and month) of average truck parking space utilization and availability. Figure 7 provides a screenshot of the Truck Parking Availability and Utilization Dashboard—Daily and Monthly Overview.

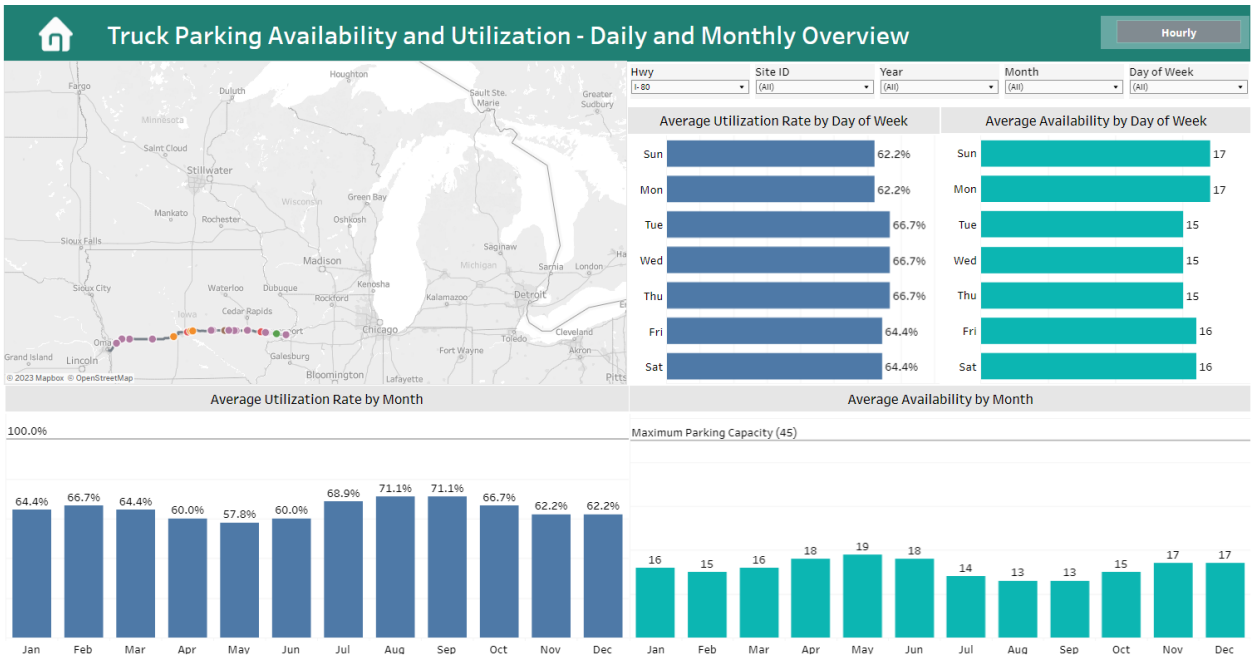


Figure 7. Screenshot. Truck Parking Availability and Utilization Dashboard—Daily and Monthly Overview.

The **Truck Parking Availability and Utilization Dashboard—Hourly Overview**. This dashboard allows the TPIMS data to be filtered by corridor (I-80 or I-94) or specific truck parking facility to visualize the average hourly truck parking space utilization, availability, and utilization rate. The dashboard also shows the average utilization rate by the size of the truck parking facility. Figure 8 provides a screenshot of the Truck Parking Availability and Utilization Dashboard—Hourly Overview.

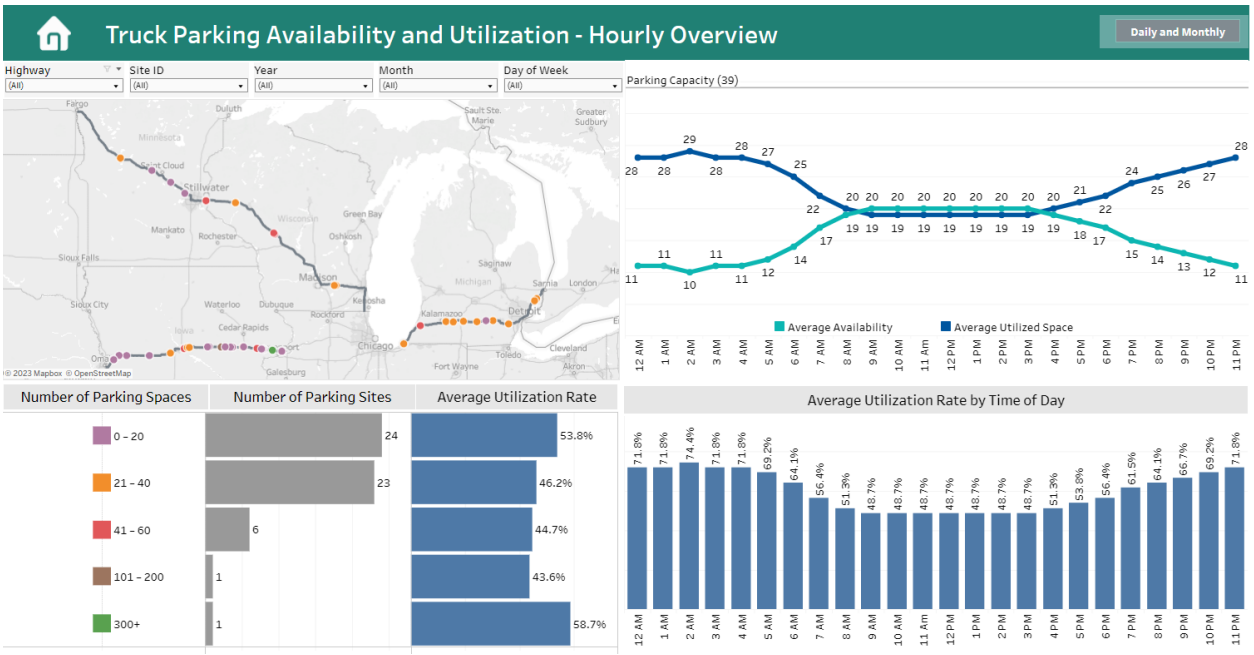


Figure 8. Screenshot. Truck Parking Availability and Utilization Dashboard—Hourly Overview.

3.3.1 Characteristics of Truck Parking Capacity Usage along I-80

This section highlights interesting insights obtained from visualizing the utilization of truck parking capacity along the I-80 corridor. For additional insights, see the data analytics dashboards at https://parkingpilot.org/dashboard/.

Figure 9 shows the temporal distribution (by day of week and month) of the 24-hour average utilization of truck parking facilities for the I-80 corridor during the analysis period. Figure 9 shows that the 24-hour average utilization ranged between a low of 57.8 percent in the May months to a high of 71.1 percent in the August and September months. Figure 9 also shows slightly higher 24-hour average utilization of truck parking capacity along the I-80 corridor on Tuesdays, Wednesdays, and Thursdays, at 66.7 percent.

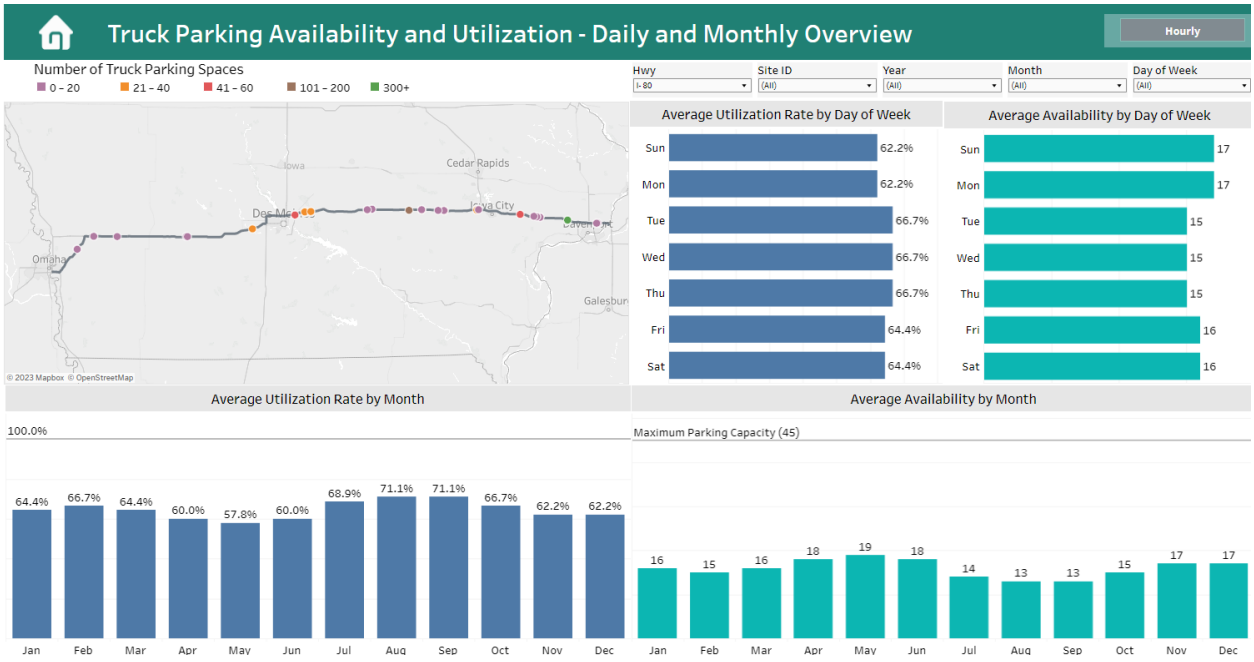


Figure 9. Screenshot. Average truck parking capacity utilization along I-80 corridor by day of week and month.

Figure 10 shows higher truck parking capacity utilization during the nighttime hours between 9:00 p.m. and 5:00 a.m., with the highest utilization between midnight and 3:00 a.m. at 75.6 percent.

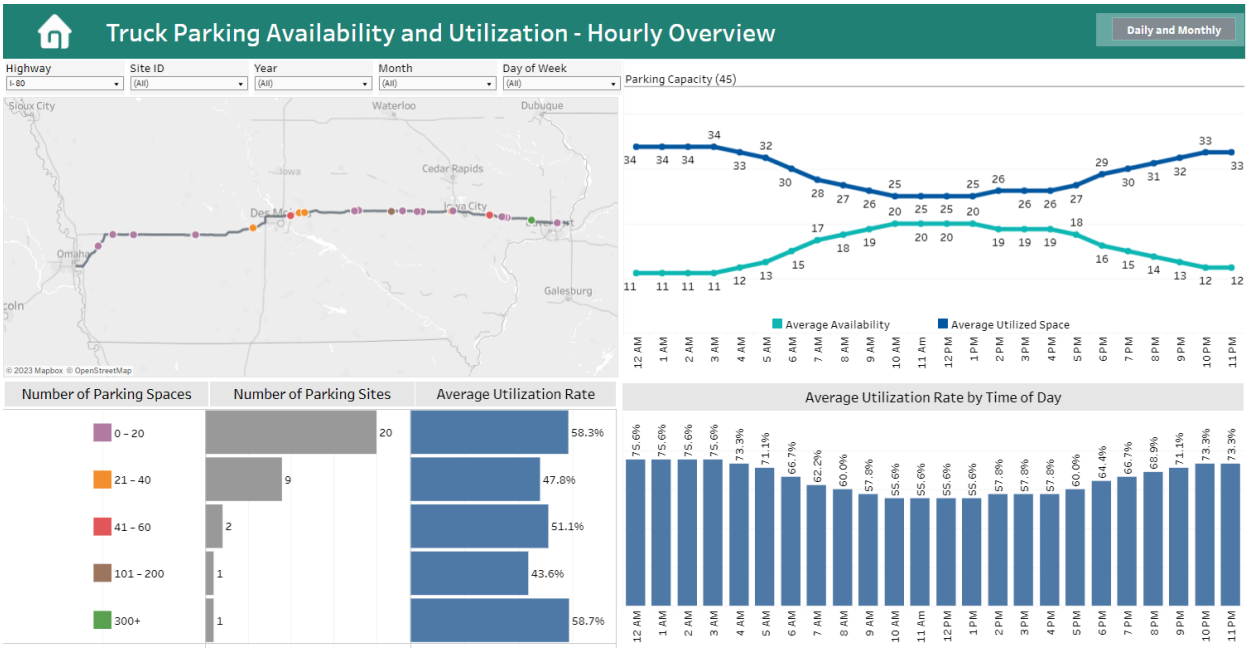


Figure 10. Screenshot. Average truck parking capacity utilization along I-80 corridor by time of day.

The research team also analyzed the average truck parking capacity utilization for TPIMS instrumented truck parking facilities of different sizes (in terms of number of truck parking spaces) along the I-80 corridor. There is only one truck parking facility in the 101–200 truck parking space facility range, with 110 truck parking spaces, and only one truck parking facility in the 300+ truck parking space facility range, with 850 truck parking spaces. Both of these truck parking facilities are private facilities. Table 4 shows that the truck parking facility with 110 truck parking spaces had the lowest 24-hour average utilization in the analysis period, at 43.6 percent.

Table 4. Average truck parking capacity utilization by truck parking facility size (I-80 corridor).

Number of Truck Parking Spaces	Average Truck Parking Capacity Utilization (%)
0–20	58.3
21–40	47.8
41–60	51.1
101–200	43.6
300+	58.7

These average values mask the variation in truck parking capacity utilization of specific truck parking facilities during certain hours or days during a specified year. Traveling westbound (WB) along I-80 in Iowa, the Iowa 80 Truck Stop (Exit 284) is approximately 92 mi from Kwik Star (Exit 201), which is approximately 50 mi from the Colfax (WB) Weigh Station, which is approximately 11 mi west of the Prairie Meadows Casino (Exit 142).

Figure 11 shows the average truck parking capacity utilization at these four rest areas at 1:00 a.m. during the analysis period. Figure 11 shows that the Iowa 80 Truck Stop—a private truck parking facility with 850 truck parking spaces—was on average 79.1 percent utilized at 1:00 a.m. during the analysis period. Kwik Star (Exit 201)—a private truck parking facility with

110 truck parking spaces—was on average 54.1 percent utilized at 1:00 a.m. during the analysis period. The Colfax (WB) Weigh Station—a public facility with 24 truck parking spaces—was on average 45.8 percent utilized at 1:00 a.m. during the analysis period. Finally, the private truck parking facility at Prairie View Meadows Casino (Exit 142)—a facility with 48 truck spaces—was on average 75 percent utilized at 1:00 a.m. during the analysis period.

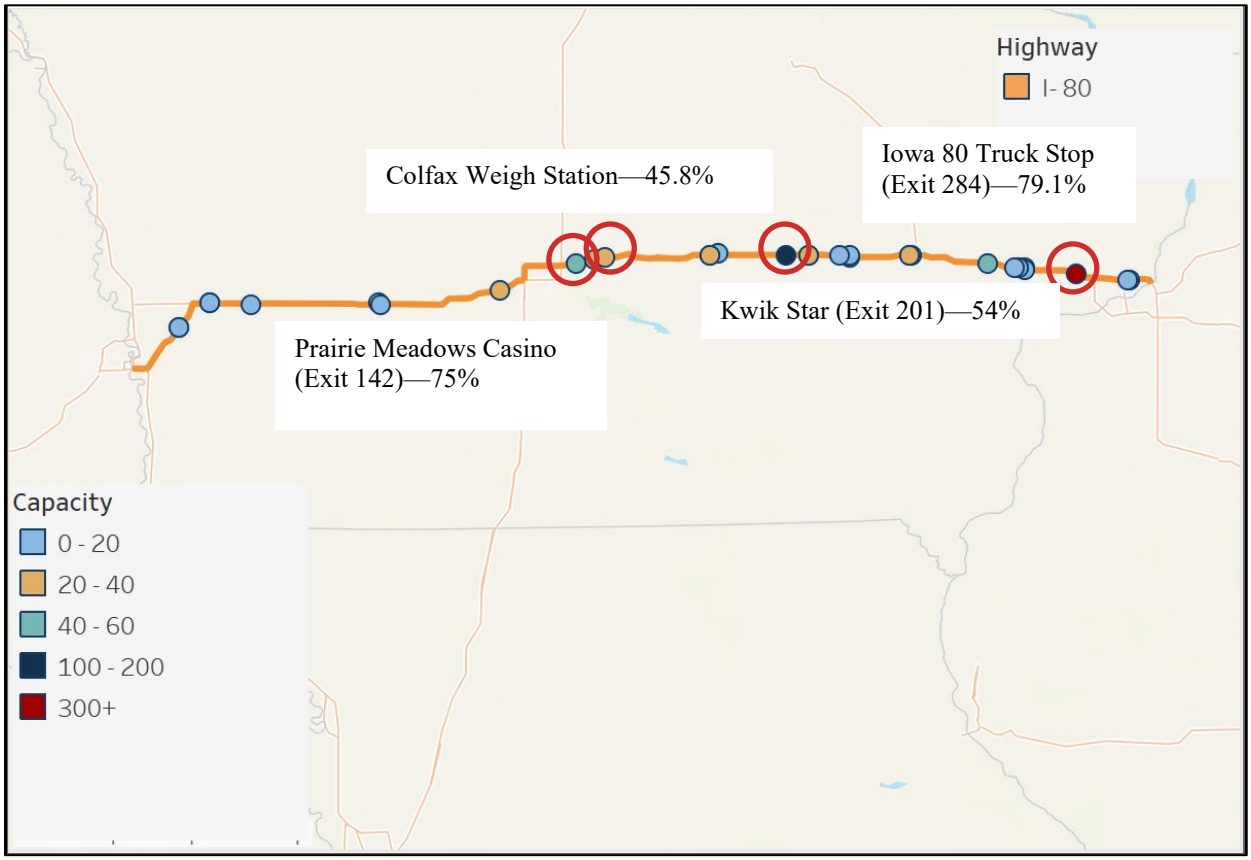


Figure 11. Map. Truck parking utilization at selected truck parking facilities along I-80 corridor in Iowa (1:00 a.m.).

The variation in truck parking capacity utilization is even more pronounced when looking at 1:00 a.m. on Wednesdays in August 2019 compared to August 2022. Figure 12 shows the average truck parking capacity utilization at five rest areas along the I-80 corridor at 1:00 a.m. on Wednesdays in August 2019 and August 2022. The Victor WB and Victor eastbound (EB) rest areas are public facilities with 19 truck parking spaces and 22 truck parking spaces, respectively. Kum and Go, Casey's General Store, and McDonald's are private truck stops. Kum and Go has nine truck parking spaces, Casey's General Store has 20 truck parking spaces, and McDonald's has 28 truck parking spaces. Figure 12 shows that Victor WB, Victor EB, and Kum and Go were at or near capacity at 1:00 a.m. on Wednesdays in August 2019, but the truck parking capacities at Casey's General Store and McDonald's were underutilized at 1:00 a.m. on Wednesdays in August 2019. At 1:00 a.m. on Wednesdays in August 2022, all five truck parking facilities had truck parking spaces available.

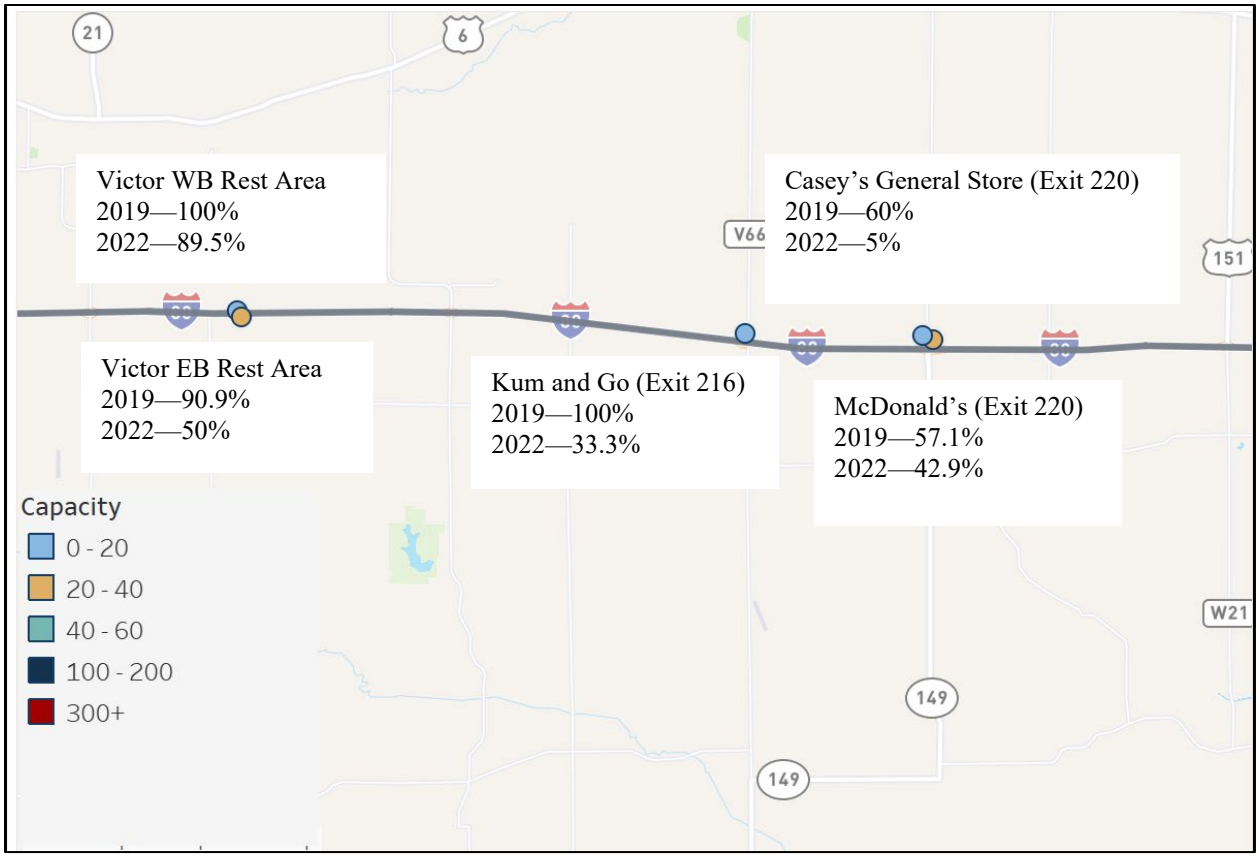


Figure 12. Map. Truck parking utilization at selected rest areas along I-80 in Iowa (1:00 a.m. on Wednesdays in August).

Figure 13 shows the steady reduction in average truck parking availability along the I-80 corridor from 4:00 p.m. until midnight as more trucks arrived and parked at the TPIMS instrumented truck parking facilities than exited. After 3:00 a.m., there was a steady increase in average truck parking availability up until 10:00 a.m. as more trucks left the truck parking facilities than entered.

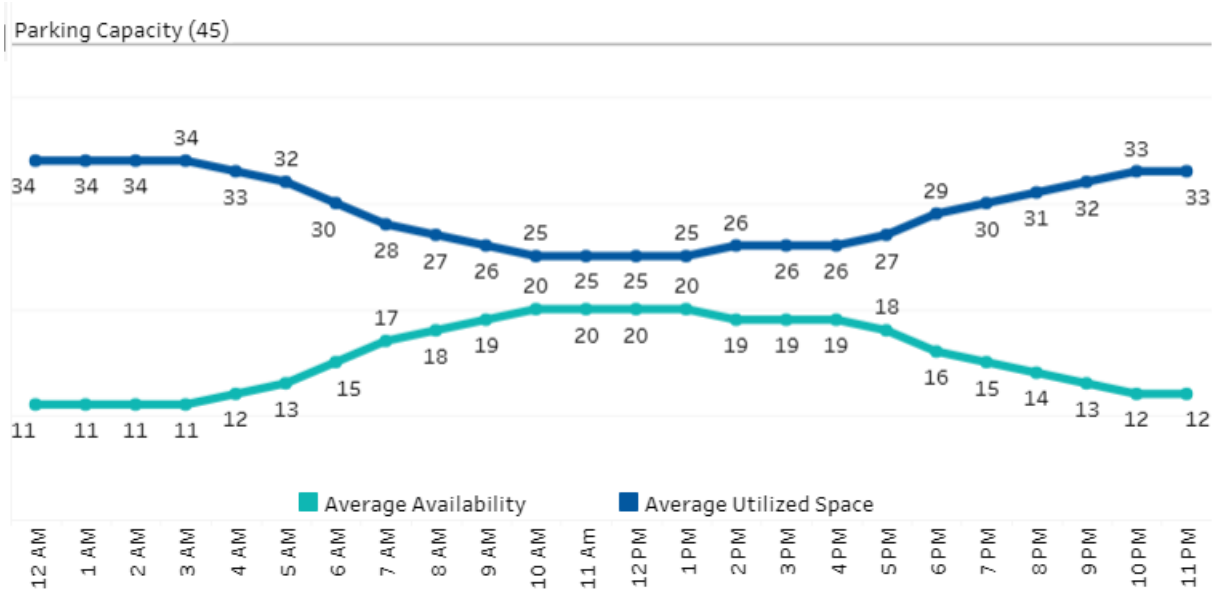


Figure 13. Graph. Average truck parking utilization along I-80 corridor (over 24-hour period).

At the truck parking facility level, Figure 14 shows a steady reduction in average truck parking availability at the Iowa 80 Truck Stop (Exit 284) on Wednesdays from 11:00 a.m. until 1:00 a.m. After 2:00 a.m., more trucks started to leave the facility than enter the facility and park, so there was a steady increase in average truck parking availability until 11:00 a.m. Figure 14 also shows the major exodus of trucks between 5:00 a.m. and 7:00 a.m.

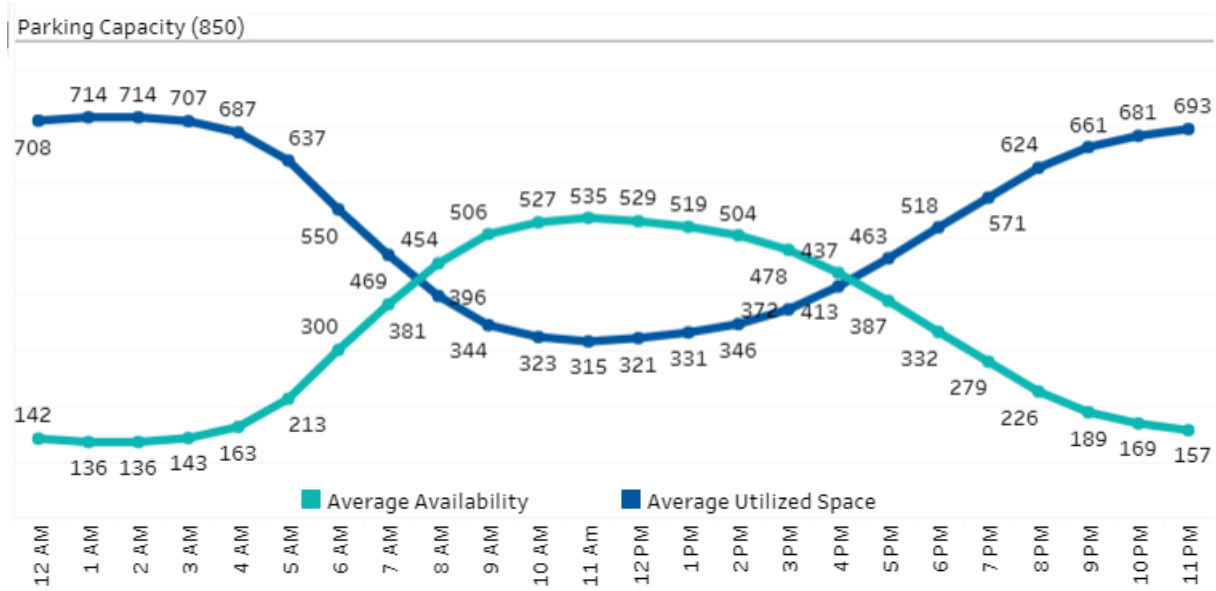


Figure 14. Graph. Average truck parking utilization of Iowa 80 truck stop (Wednesdays).

3.3.2 Characteristics of Truck Parking Capacity Usage along I-94

This section highlights interesting insights obtained from visualizing the utilization of truck parking capacity along the I-94 corridor. For additional insights, see the data analytics dashboards at https://parkingpilot.org/dashboard/.

Figure 15 shows the temporal distribution (by day of week and month) of the 24-hour average utilization of truck parking facilities for the I-94 corridor during the analysis period. Figure 15 shows that the 24-hour average utilization of the truck parking capacity is relatively constant by month: 43.3 percent in the months of January, February, July, August, and December and 46.7 percent in the remaining months. Figure 15 also shows slightly higher 24-hour average utilization of truck parking capacity along the I-94 corridor on Tuesdays, Wednesdays, and Thursdays, at 50 percent.

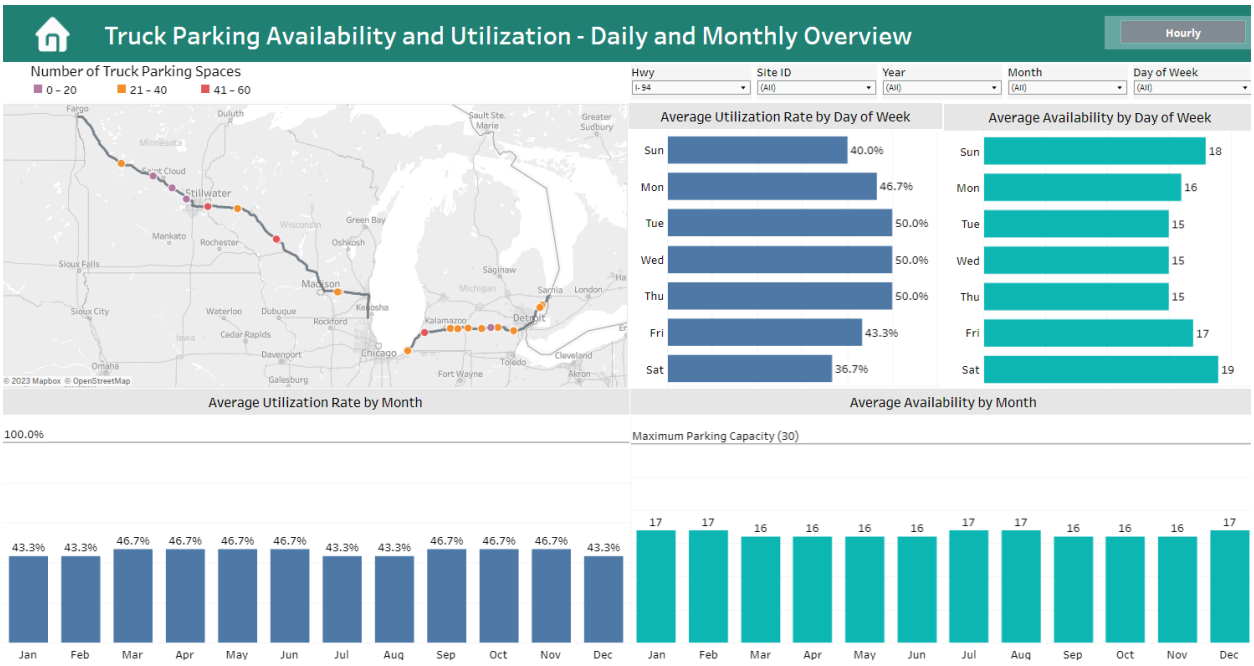


Figure 15. Screenshot. Average truck parking capacity utilization along I-94 corridor (by day of week and month).

Figure 16 shows higher truck parking capacity utilization during the nighttime hours between 10:00 p.m. and 5:00 a.m., with the highest utilization between 1:00 a.m. and 4:00 a.m. During the peak evening hours, the average utilization of the truck parking capacity along the I-94 corridor was 70 percent during the analysis period.

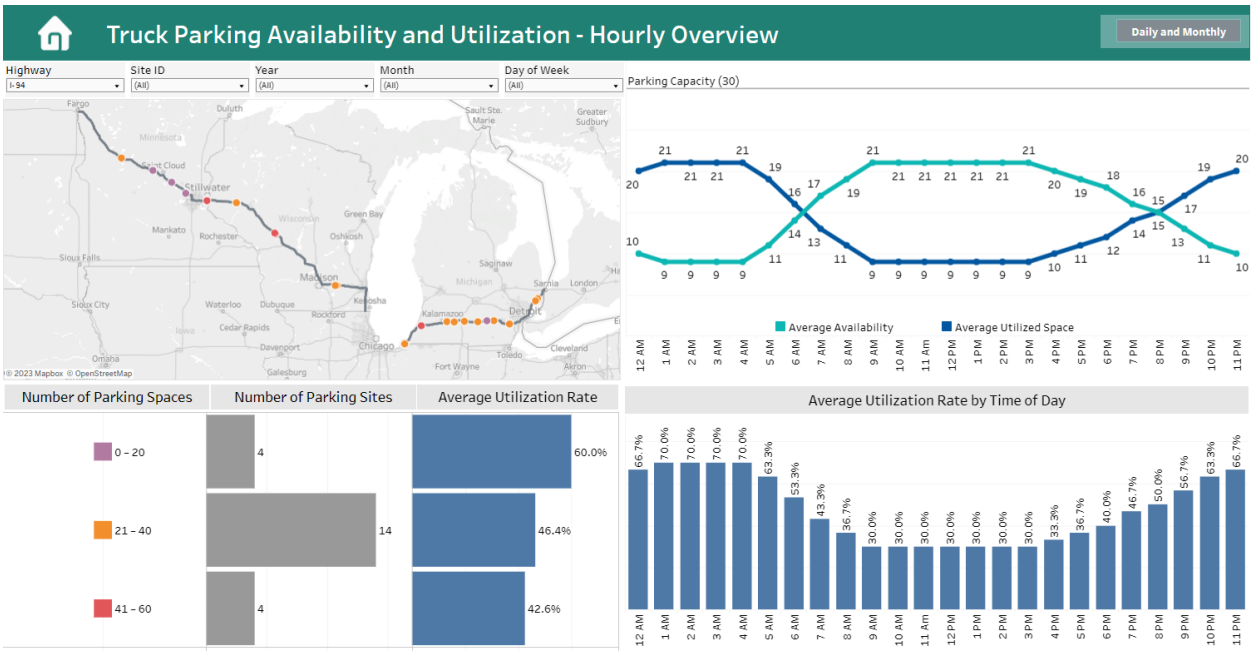


Figure 16. Screenshot. Average truck parking capacity utilization along I-94 corridor by time of day.

Similar to the I-80 corridor, further analysis by the research team showed higher average utilization of the smaller TPIMS instrumented truck parking facilities than the larger TPIMS instrumented truck parking facilities along the I-94 corridor. Specifically, truck parking facilities with 20 or fewer truck parking spaces had a 24-hour average utilization of 60 percent in the analysis period, compared to 46.4 percent for truck parking facilities with 21 to 40 truck parking spaces and 42.6 percent for truck parking facilities with 41 to 60 truck parking spaces (see Table 5).

Table 5. Average truck parking capacity utilization by truck parking facility size (I-94 corridor).

Number of Truck Parking Spaces	Average Truck Parking Capacity Utilization (%)
0–20	60.0
21–40	46.4
41–60	42.6

The average values, however, mask the variation in truck parking capacity utilization of specific truck parking facilities during certain hours or days of a specified year. Traveling west along I-94 in Wisconsin, Johnson Creek (Rest Area 14) is 141 mi from Black River Falls (Rest Area 54), which is 79 mi west from Wisconsin DOT (WisDOT) Rest Area 62. Figure 17 shows the average truck parking capacity utilization at these three rest areas at 1:00 a.m. during the analysis period. Figure 17 shows that Johnson Creek—a public rest area facility with 30 truck parking spaces—was on average 43.3 percent utilized at 1:00 a.m. during the analysis period. Black Rivers Falls—a public rest area facility with 43 truck parking spaces—was on average 95.3 percent utilized at 1:00 a.m. during the analysis period. Finally, Rest Area 62—a public rest area facility with 25 truck parking spaces—was on average 104 percent utilized at 1:00 a.m. during the analysis period.

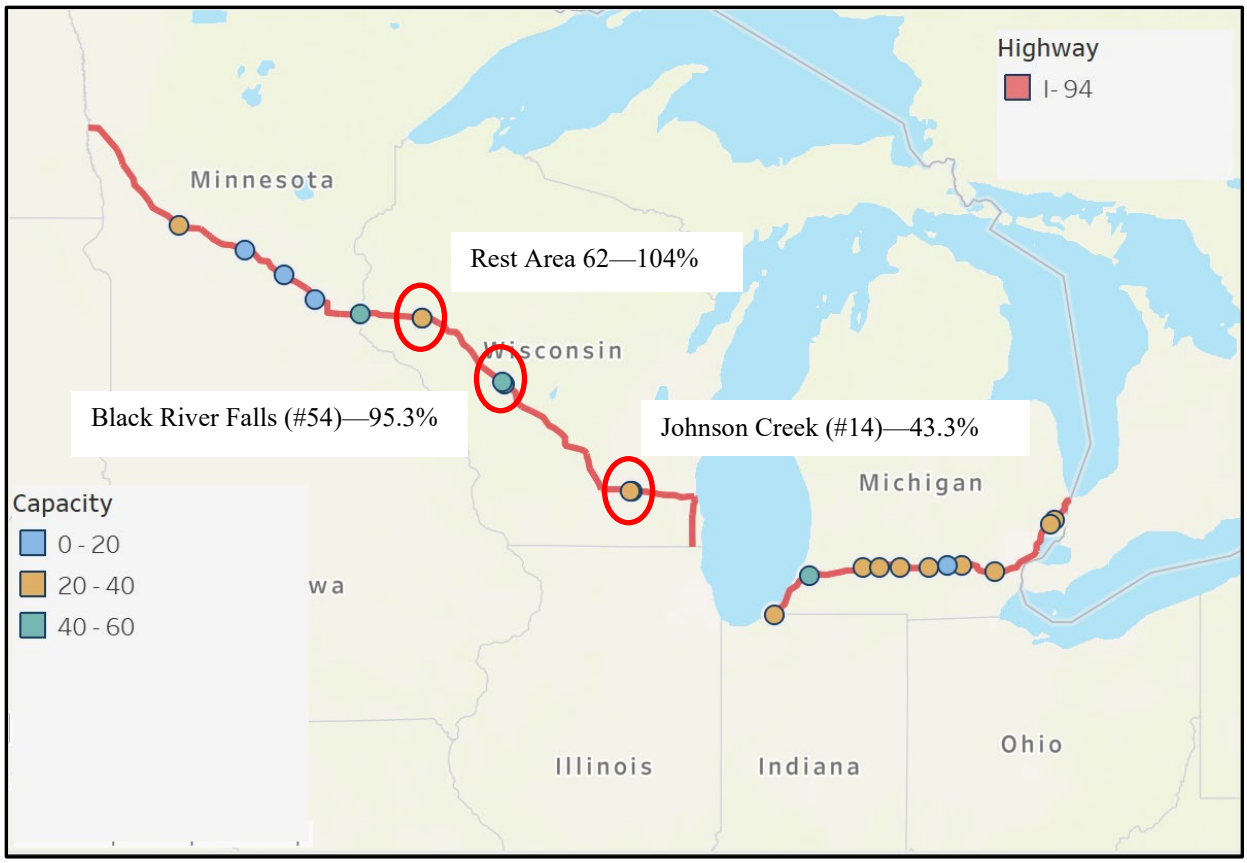


Figure 17. Map. Truck parking utilization at Johnson Creek, Black River Falls, and Rest Area 62 in Wisconsin (1:00 a.m.).

Traveling east along I-94 in Wisconsin, the nearest rest area to Johnson Creek is Lake Mills (Rest Area 13), to Black River Falls is Milston (Rest Area 53), and to Rest Area 62 is Menomonie Travel Center. Lake Mills is 136 mi from Milston, which is 81 mi from Menomonie Travel Center. Figure 18 shows the average truck parking capacity utilization at these three rest areas at 1:00 a.m. during the analysis period. Figure 18 shows that Menomonie Travel Center—a public rest area facility with 24 truck parking spaces—was on average 70.8 percent utilized at 1:00 a.m. during the analysis period. Milston—a public rest area facility with 41 truck parking spaces—was on average 92.7 percent utilized at 1:00 a.m. during the analysis period. Finally, Lake Mills—a public rest area facility with 28 truck parking spaces—was on average 60.7 percent utilized at 1:00 a.m. during the analysis period.

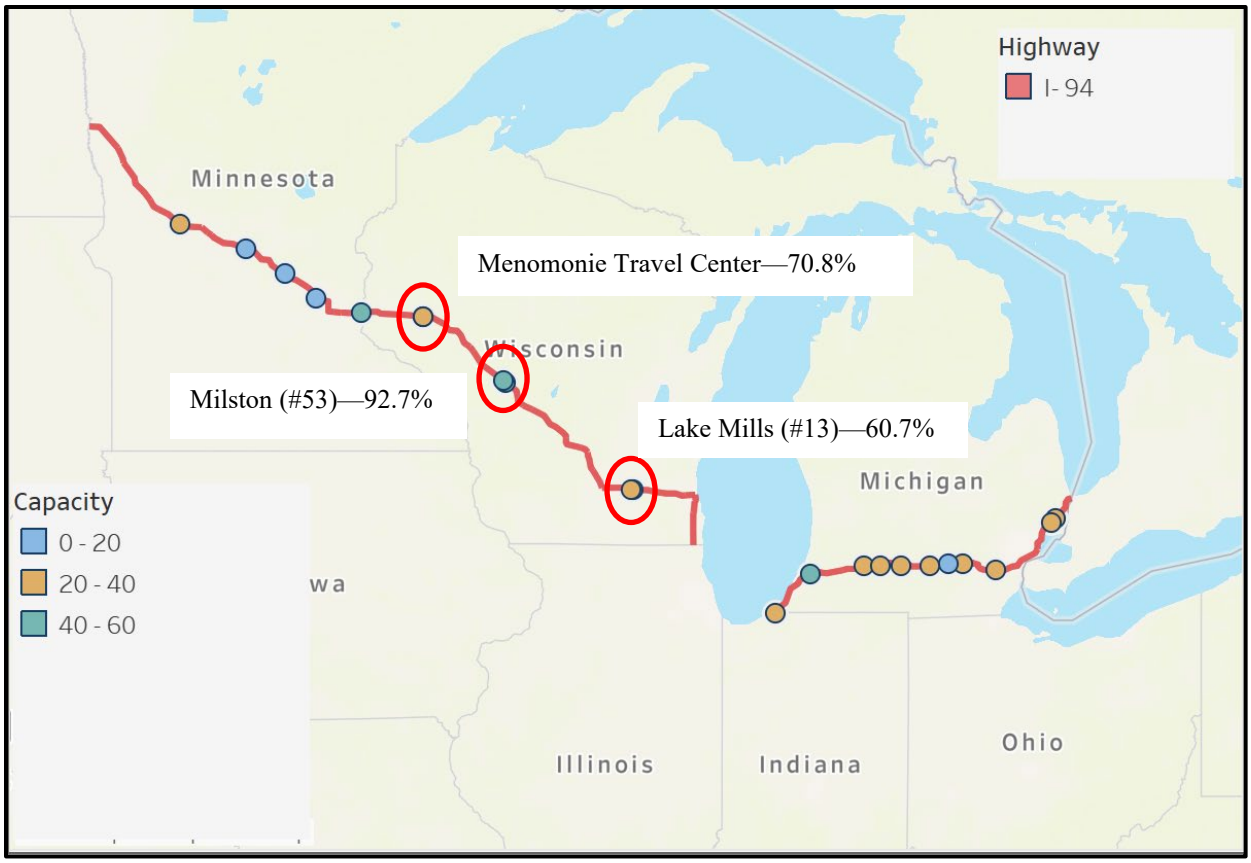


Figure 18. Map. Truck parking utilization at Menomonie Travel Center, Milston, and Lake Mills in Wisconsin (1:00 a.m.).

The variation in truck parking capacity utilization is even more pronounced when looking at 1:00 a.m. on Wednesdays in August 2019 compared to August 2022. Figure 19 shows the average truck parking capacity utilization at the five rest areas included in Figure 17 and Figure 18 at 1:00 a.m. on Wednesdays in August 2019 and August 2022. Information was not available for Milston (Rest Area 53) for August 2019 or August 2022. Figure 19 shows that all five rest area facilities had truck parking spaces available at 1:00 a.m. on Wednesdays in August 2019. In 2022, Rest Area 62 (WB) and Black River Falls (Rest Area 54) were over capacity at 1:00 a.m. on Wednesdays in August, while Menomonie Travel Center (EB), Johnson Creek (WB), and Lake Mills (EB) were underutilized at 1:00 on Wednesdays in August 2022.

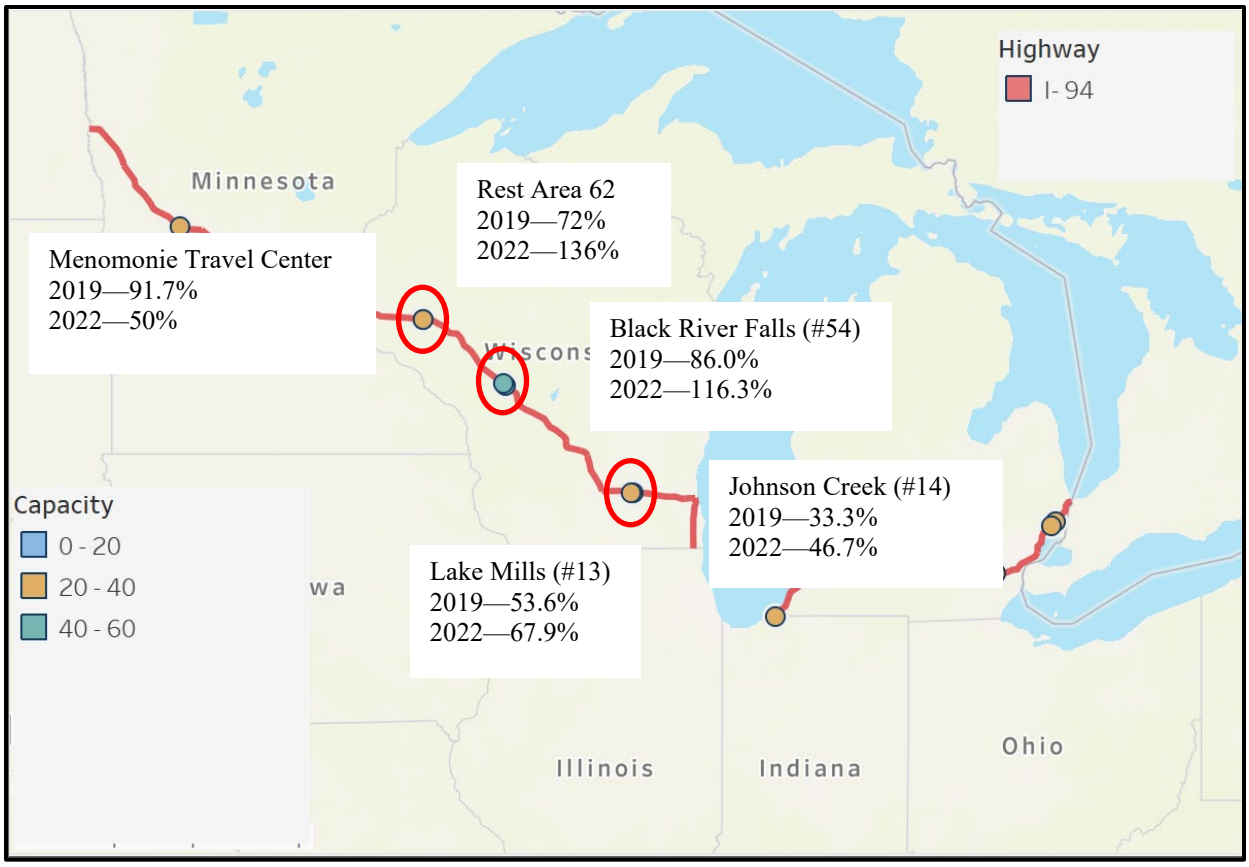


Figure 19. Map. Truck parking utilization at selected rest areas along I-94 in Wisconsin (1:00 a.m. on Wednesdays in August).

The temporal distribution of the usage of truck parking capacity is even more evident when visualizing the average hourly utilization of the truck parking capacity along the I-94 corridor. Figure 20 shows the steady reduction in average truck parking availability from 3:00 p.m. until 1:00 a.m. (i.e., more trucks arrived and parked at the truck parking facilities than exited). After 4:00 a.m., there was a steady increase in average truck parking availability until 9:00 a.m. as more trucks left the truck parking facilities than entered the facilities.

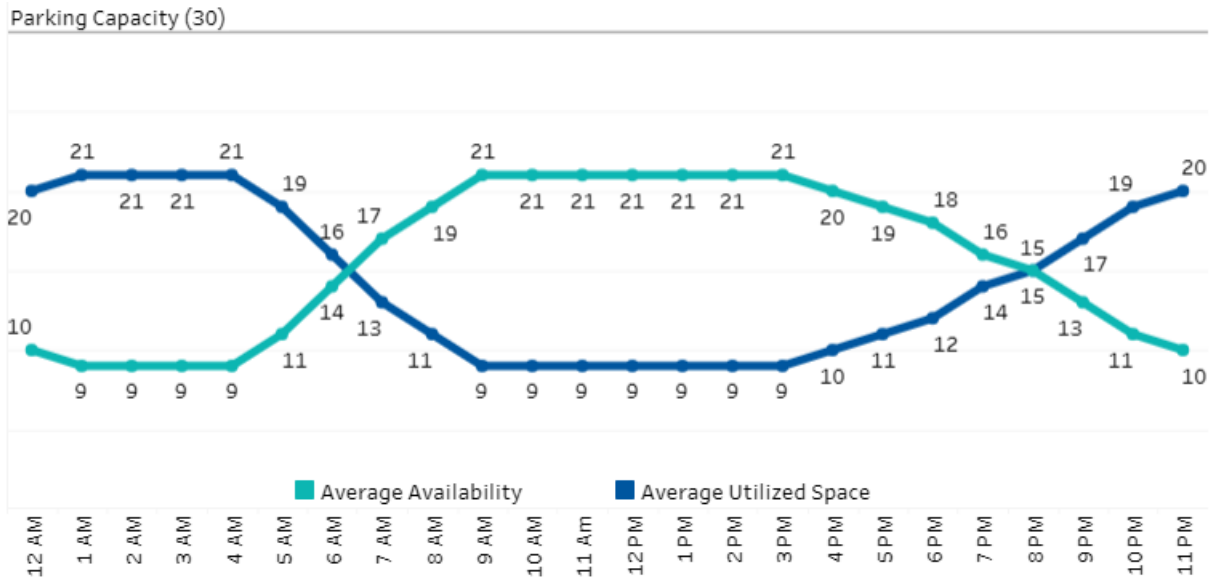


Figure 20. Graph. Average truck parking utilization along I-94 corridor (over 24-hour period).

Figure 21 shows a steady reduction in average truck parking availability at Rest Area 62 on Wednesdays from 2:00 p.m. until 10:00 p.m. The figure also shows that by 8:00 p.m., Rest Area 62 had reached capacity when more trucks arrived and parked than the number of truck parking spaces available. After 2:00 a.m., more trucks started to leave the facility than what arrived, and there was a steady increase in average truck parking availability until 9:00 a.m.

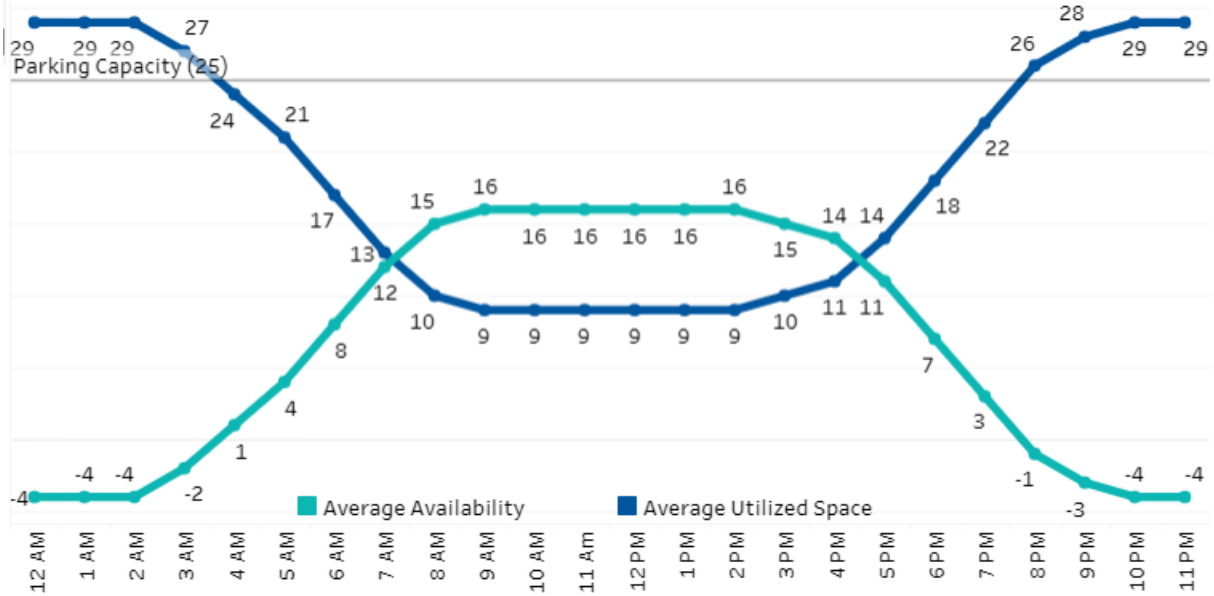


Figure 21. Graph. Average truck parking utilization of Rest Area 62 (Wednesdays).

4. ANALYSIS OF ELECTRONIC TELEMATICS DATA

EROAD is a regulatory telematics company that, through its product offering, has amassed a large data source relating to the movement of vehicles in North America. EROAD allows the use of the data for transportation research and operation, but only after the data have been sufficiently anonymized and aggregated.

The research team obtained a sample of anonymized, aggregated telematics data from EROAD to identify where, when (by time of day, day of week, and month), and for how long truck drivers were stopping in unauthorized locations along the I-80 and I-94 corridors. The research team obtained data for the period July 1, 2019, to June 30, 2020, to limit the impact of COVID.

4.1 TELEMATICS DATA

The first data extraction received from EROAD identified the parking clusters using an automated clustering method. (Clusters were created from events where trucks were stopped for more than 5 minutes to exclude situations where trucks were stopped at traffic lights.) The challenges associated with the method were that multiple clusters represented a single facility (i.e., rest area, truck stop) or location (see Figure 22). In addition, some clusters spanned both sides of the highway, and some clusters combined parking in both authorized and unauthorized locations. To conduct the analysis, the research team needed one cluster per facility with the attributes assigned to the cluster.

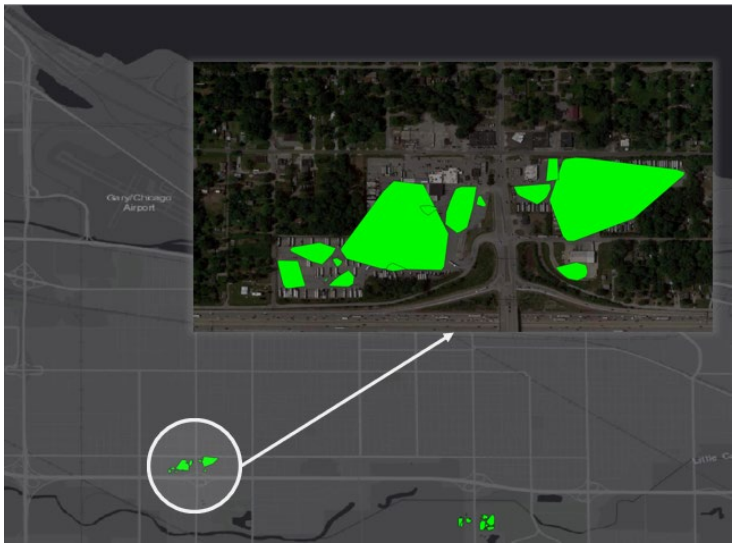


Figure 22. Illustration. Multiple clusters representing a single location.

The research team worked with EROAD and developed and implemented a three-step process to extract representative data to allow the team to identify where, when (by time of day, day of week, and month), and for how long truck drivers were stopping in unauthorized locations along the I-80 and I-94 corridors:

- Step 1: Texas A&M Transportation Institute (TTI) identified and geofenced the authorized parking locations (in shapefile format) along the I-80 and I-94 corridors.
- Step 2: EROAD extracted and processed truck activity data for the authorized locations and derived the statistics needed for the parking events specific to the authorized truck parking locations.
- Step 3: EROAD identified unauthorized locations using a clustering algorithm with the remaining data, ran the analysis, and derived the necessary statistics for the unauthorized truck parking locations.

Figure 23 provides a visual of how authorized and unauthorized parking were determined.

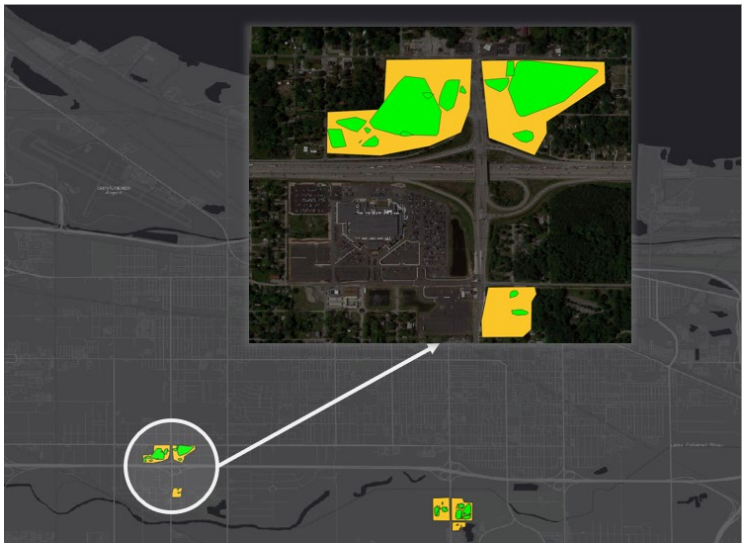


Figure 23. Illustration. Clusters showing authorized parking (green) and unauthorized parking (yellow).

Table 6, Table 7, and Table 8 provide the data fields and a description of the data fields that were used in the research study. Specifically, the final data tables obtained from EROAD provided:

- Statistics for the truck arrivals at the identified parking clusters (see Table 6).
- Cluster locations (see Table 7).
- Stopped time at the cluster (see Table 8).

Table 6. Statistics of truck arrivals at parking clusters.

Data Field	Data Field Description
cluster_id	Unique ID of the cluster.
arrival_month	Arrival calendar month number (01 to 12).
arrival_dow	Arrival day of week number (1 = Sunday, 7 = Saturday).
arrival_hod	Arrival hour of day (00 to 23).
num_vehicles	Number of distinct vehicles given above aggregations.
Is_holiday	Boolean indicating if hod/dow combination represents a holiday.
mean_time_to_arrive	Mean drive time to reach cluster.
stdev_time_to_arrive	Standard deviation of drive time to reach cluster.

Data Field	Data Field Description
arrival_time_percentiles	5th, 25th, 50th, 75th, 95th of time to arrive.
mean_distance_to_arrive	Mean drive time to reach cluster.
stdev_ distance _to_arrive	Standard deviation of drive time to reach cluster.
arrival_ distance _percentiles	5th, 25th, 50th, 75th, 95th of time to arrive.

Table 7. Cluster locations.

Data Field	Data Field Description
cluster_id	ID for each cluster identified.
cluster geometry	Geometry of cluster's concave.

Table 8. Stopped time at cluster.

Data Field	Data Field Description
cluster_id	Unique ID for each cluster.
arrival_month	Arrival calendar month number (01 to 12).
arrival_dow	Arrival day of week number (1 = Sunday, 7 = Saturday).
arrival_hod	Arrival hour of day (00 to 23).
num_vehicles	Number of distinct vehicles given above aggregations.
Is_holiday	Boolean indicating if hod/dow combination represents a holiday.
Statistic	Percentiles of stopped time in seconds at cluster given at 5% increments from 0% (min) to 100% (max). Mean and standard deviation of stopped time.
Value	Value of above statistic for each cluster.

The research team developed geographic information system (GIS) layers for linking the telematics data and road geometry data geographically and temporally. The research team incorporated the GIS layers into the data visualization software (Tableau), then used Tableau to process and analyze the data.

4.2 DATA ANALYSIS AND VISUALIZATION

The research team obtained a sample of 360 parking clusters in a 1,000-m buffer along the I-80 and I-94 corridors (i.e., 197 parking clusters in a 1,000-m buffer along the I-80 corridor and 163 parking clusters in a 1,000-m buffer along the I-94 corridor). The analysis documented in this section pertains to a sample of trucks that are equipped with EROAD's telematics devices and cannot necessarily be extrapolated to the entire population of trucks traversing the corridors.

The research team developed data analytics dashboards that characterize authorized and unauthorized truck parking clusters in terms of size, location, geographical, and temporal distribution. The data analytics dashboards focused on answering the following questions:

- When and where do truck drivers stop in authorized (see Figure 24) and unauthorized (see Figure 25) locations along the I-80 and I-94 corridors traversing the MAASTO States?

- How long are truck drivers stopping in authorized and unauthorized locations along the I-80 and I-94 corridors in the MAASTO States?

Although the data analytics dashboards contain the analysis for both the authorized and unauthorized truck parking clusters, this section of the report focuses on the characteristics of the unauthorized parking clusters along the I-80 and I-94 corridors in the MAASTO States.

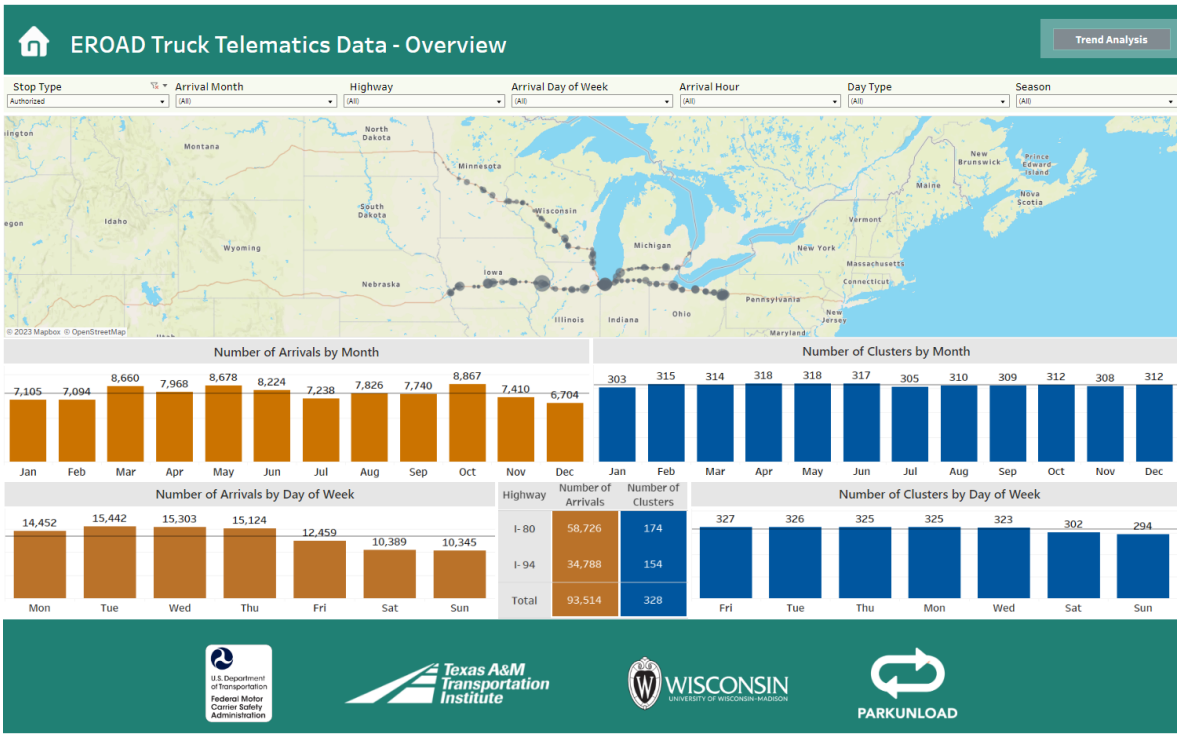


Figure 24. Screenshot. Geographical and temporal distribution of authorized truck parking clusters along I-80 and I-94 corridors.

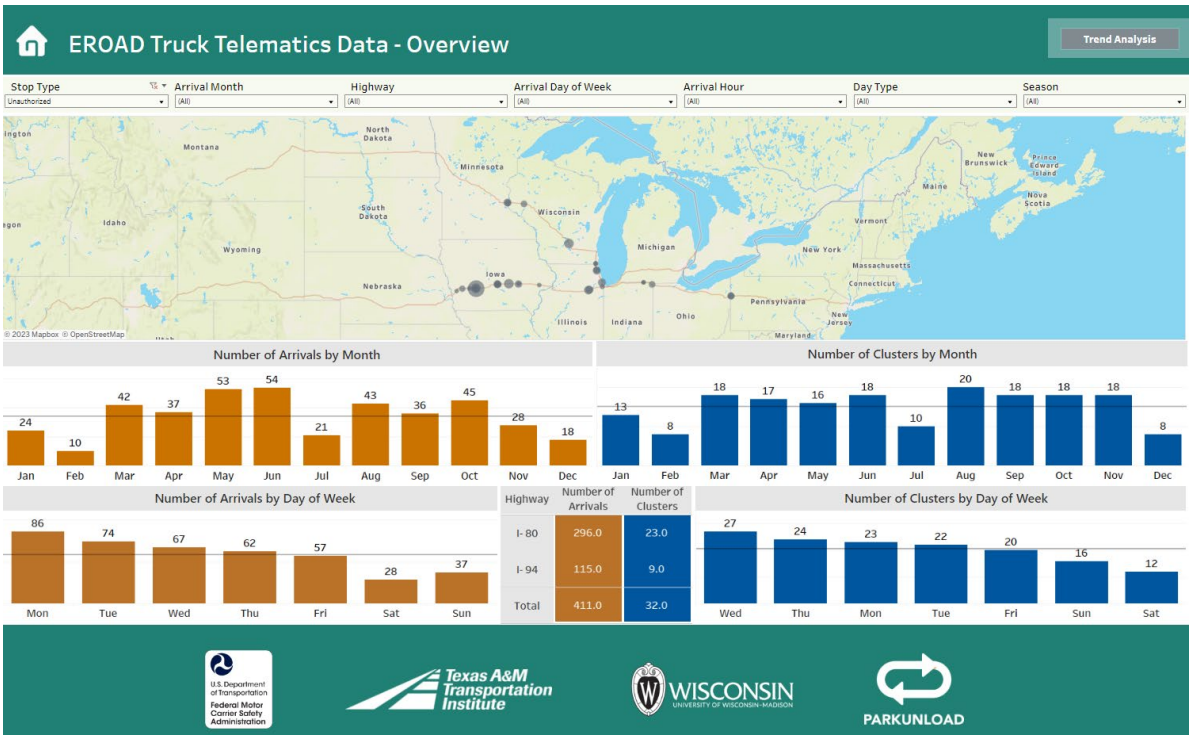


Figure 25. Screenshot. Geographical and temporal distribution of unauthorized truck parking clusters along I-80 and I-94 corridors.

4.2.1 I-80 Corridor

Of the 197 sample truck parking clusters obtained from EROAD along the I-80 corridor, only 23 clusters (or about 12 percent) were categorized as trucks parking in unauthorized locations (i.e., unauthorized truck parking clusters). Figure 26 illustrates the location of the unauthorized parking clusters along the I-80 corridor. It also provides a visual of the highlighted cluster.

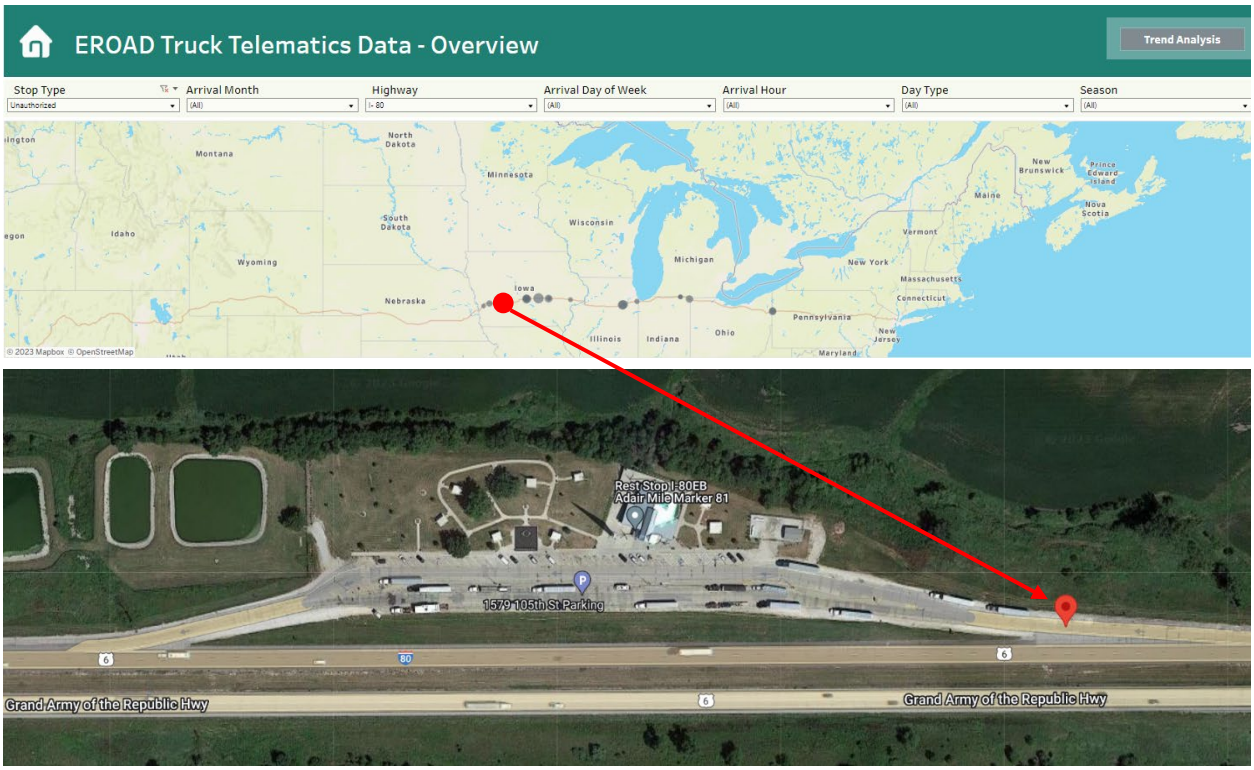


Figure 26. Screenshot and map. Unauthorized truck parking clusters along I-80 (top) and highlighted truck parking cluster (bottom).

Table 9 shows that the largest unauthorized truck parking clusters in the EROAD sample—both in terms of number of clusters and number of trucks parked—were at the entrances to and exits from rest areas along the I-80 corridor analyzed. The large number of trucks parked at the entrances to and exits from rest areas and truck stops suggests insufficient truck parking capacity at these facilities or truck drivers being unwilling to look for a parking space in an almost-full facility.

Table 9. Unauthorized truck parking cluster categories along the I-80 corridor.

Unauthorized Parking Cluster Category*	Number of Clusters	Number of Trucks
Empty Lot	1	9
Ramps to/from I-80	2	10
Entrance/Exit to/from Rest Area	13	220
Entrance/Exit to/from Truck Stop	5	37
Entrance/Exit to/from Iowa Weight Station	1	8
Shoulder Main Highway Lanes	1	12

* **Empty Lot** refers to empty lots (e.g., often dirt or gravel lots) beyond the highway shoulder that are not a designated truck parking facility. **Ramps to/from I-80** refers to parking clusters on the shoulders of the ramps. **Entrance/Exit to/from Rest Area, Truck Stop, and Iowa Weight Station** refers to parking clusters along the shoulders of the entrances and exits of the rest areas, truck stops, and Iowa weight stations, respectively. **Shoulder Main Highway Lanes** refers to parking clusters on the shoulders of the main highway lanes.

The research team also analyzed the sample data to determine when drivers were stopping at the unauthorized locations and identify differences by month, day of week, and time of day. Figure 27 illustrates the number of unauthorized truck parking clusters and the number of truck arrivals at the unauthorized truck parking clusters by month. Figure 27 shows both a higher number of unauthorized parking clusters and a higher number of trucks arriving at these unauthorized parking clusters in the spring (i.e., March, April, and May) and fall (i.e., September, October, November) months. June and August also show a high number of unauthorized truck parking clusters and truck arrivals. The winter months (i.e., December, January, and February) saw comparatively fewer unauthorized truck parking clusters and number of truck arrivals.

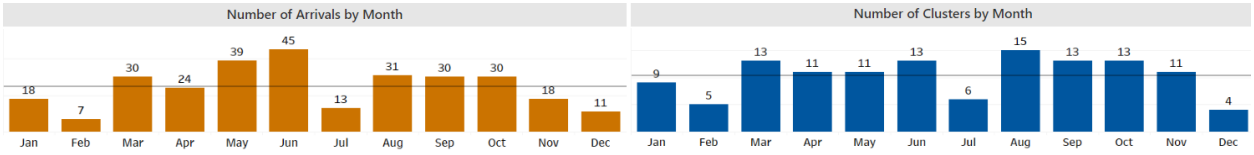


Figure 27. Graph. Number of truck arrivals (left) and number of unauthorized parking clusters (right) along I-80 by month.

Figure 28 illustrates the number of unauthorized truck parking clusters by day of week. The figure shows more unauthorized truck parking clusters on Wednesdays compared to the rest of the weekdays. Weekend days showed substantially fewer clusters than weekdays.

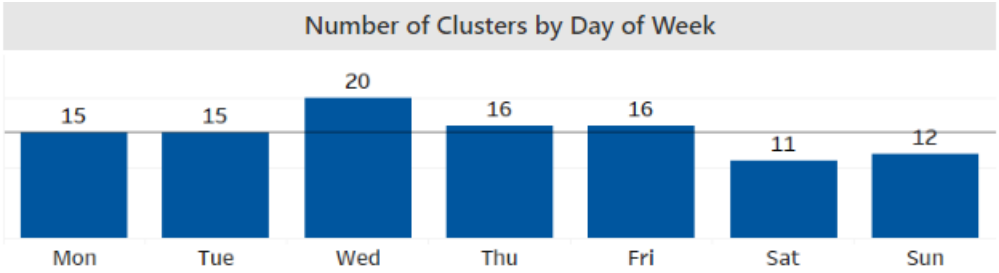


Figure 28. Graph. Number of unauthorized parking clusters along I-80 by day of week.

Figure 29 illustrates the number of trucks arriving at the unauthorized truck parking clusters by day of week. The figure shows more trucks arriving at the unauthorized locations on Mondays and Tuesdays. Although Mondays and Tuesdays therefore had fewer unauthorized parking locations, the number of trucks arriving at these locations was higher at the beginning of the week. Similar to the number of unauthorized truck parking clusters, weekend days showed substantially fewer trucks arriving at the unauthorized parking locations.

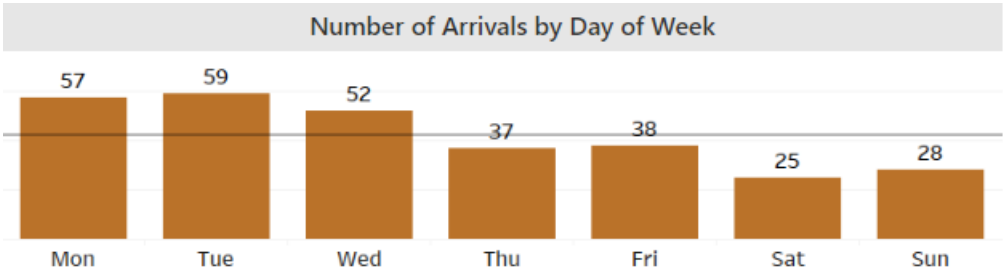


Figure 29. Graph. Number of trucks arriving at unauthorized parking clusters along I-80 by day of week.

Figure 30 illustrates the average number of truck arrivals per unauthorized truck parking cluster and the number of unauthorized truck parking clusters by time of day. Figure 30 shows a peak in the average number of truck arrivals per unauthorized truck parking cluster at 3:00 a.m., although the number of unauthorized truck parking clusters at 3:00 a.m. was relatively low. The figure also shows an increase in the average number of truck arrivals per unauthorized truck parking cluster and the number of unauthorized truck parking clusters between 4:00 p.m. and 9:00 p.m.

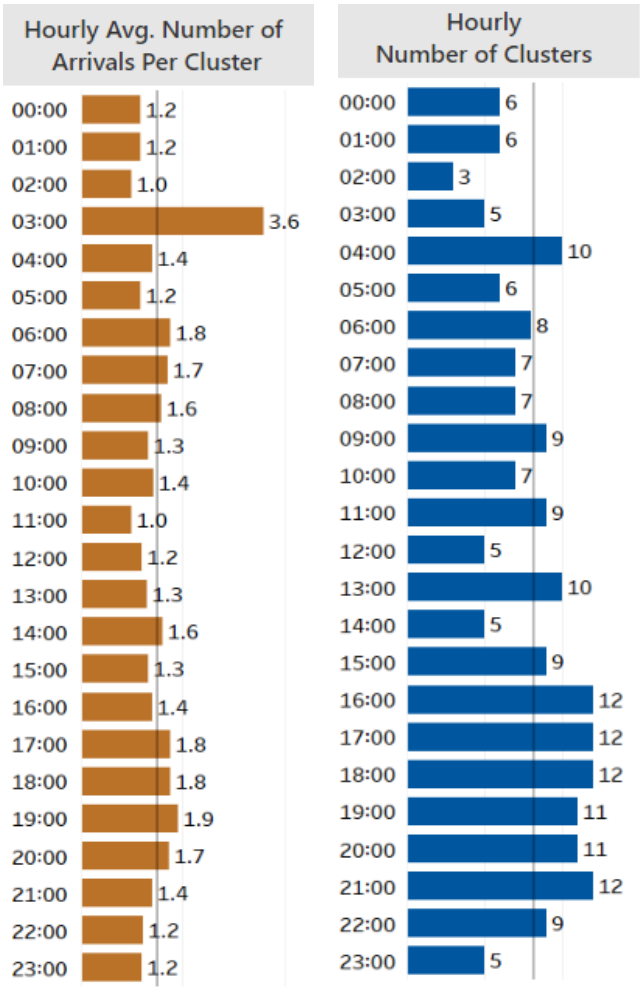


Figure 30. Graph. Hourly average number of truck arrivals per unauthorized truck parking cluster (left) and number of unauthorized parking clusters (right) along I-80 by time of day.

Figure 31 shows a higher percentage of truck arrivals at the unauthorized parking clusters along I-80 between 4:00 p.m. and 9:00 p.m. Figure 31 also shows that 6.1 percent of the trucks included in the data sample arrived at 3:00 a.m. at the authorized parking clusters along the I-80 corridor.

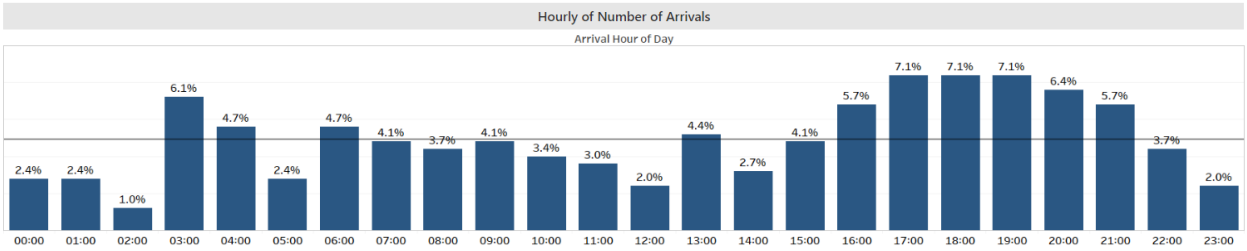


Figure 31. Graph. Percentage of truck arrivals at unauthorized parking clusters along I-80 by time of day.

Table 10 shows, on average, how long trucks stopped at the unauthorized parking clusters along I-80. About 38.8 percent of the trucks stopped for an hour or less on average, and another 9 percent stopped between 1.5 and 2 hours on average. Almost half (47.8 percent) of the trucks arriving in unauthorized parking clusters stopped for 2 hours or less on average. On the other hand, 10.5 percent of trucks stopped at the unauthorized parking clusters for an average of more than 9.5 hours.

Table 10. Average stop duration at unauthorized truck parking clusters along I-80.

Average Stop Duration (Hours)	Percentage of Trucks
<0.5	10.7
0.5	21.6
1	6.5
1.5	3.8
2	5.2
2.5	2.4
3	2.1
3.5	3.1
4	3.4
4.5	1.0
5	1.7
5.5	2.1
6	3.1
6.5	1.4
7	1.4
7.5	3.1
8	3.1
8.5	3.8
9	4.8
9.5	5.2
>9.5	10.5

Figure 32 illustrates the average distance (in miles) and the average drive time (in hours) of trucks arriving at unauthorized truck parking clusters along the I-80 corridor by time of day. Figure 32 shows that trucks arriving at the unauthorized truck parking clusters between 6:00 a.m. and 5:00 p.m. had traveled longer (time) and farther (distance) than trucks arriving at these

unauthorized truck parking clusters after 5:00 p.m. and before 6:00 a.m. The figure also shows the peak in trucks arriving at the unauthorized locations at noon. These trucks, on average, had driven 555 mi and 10.86 hours.

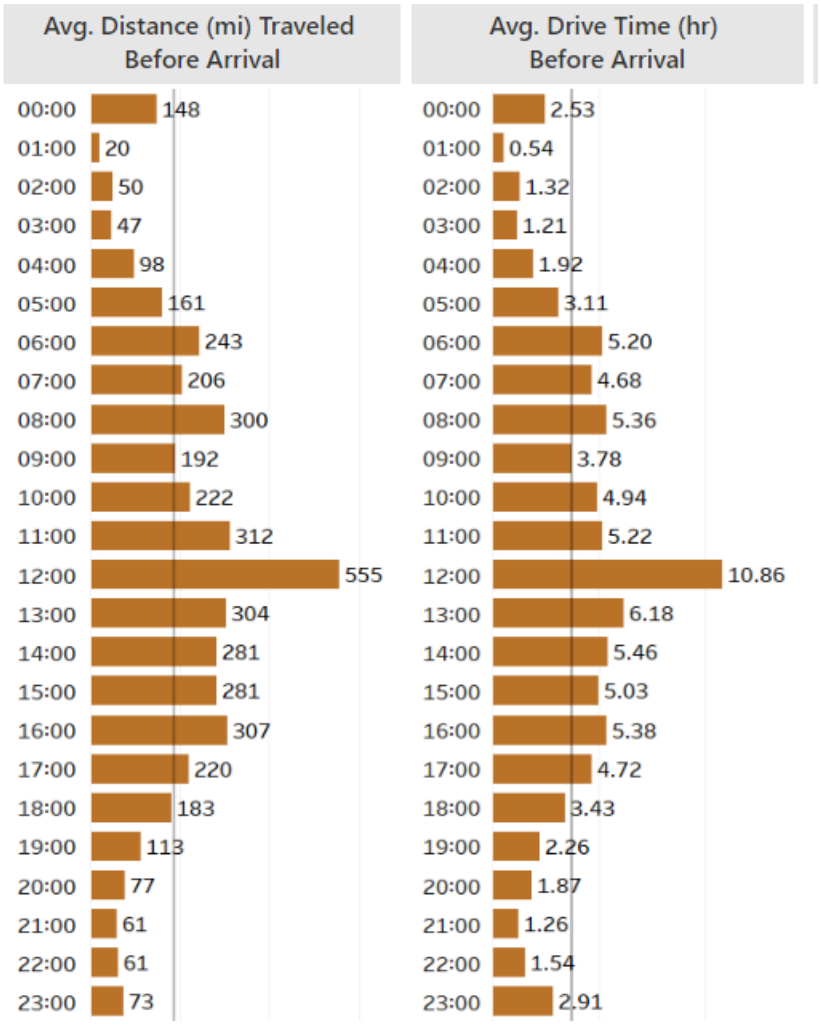


Figure 32. Graph. Average distance (miles) traveled (left) and average drive time before arrival at unauthorized parking clusters (right) along I-80 by time of day.

4.2.2 I-94 Corridor

Of the 115 sample truck parking clusters obtained from EROAD along the I-94 corridor, nine (or about 8 percent) of the clusters were categorized as unauthorized truck parking clusters. Figure 33 illustrates the location of the unauthorized parking clusters along the I-94 corridor. It also provides a visual of the highlighted cluster.

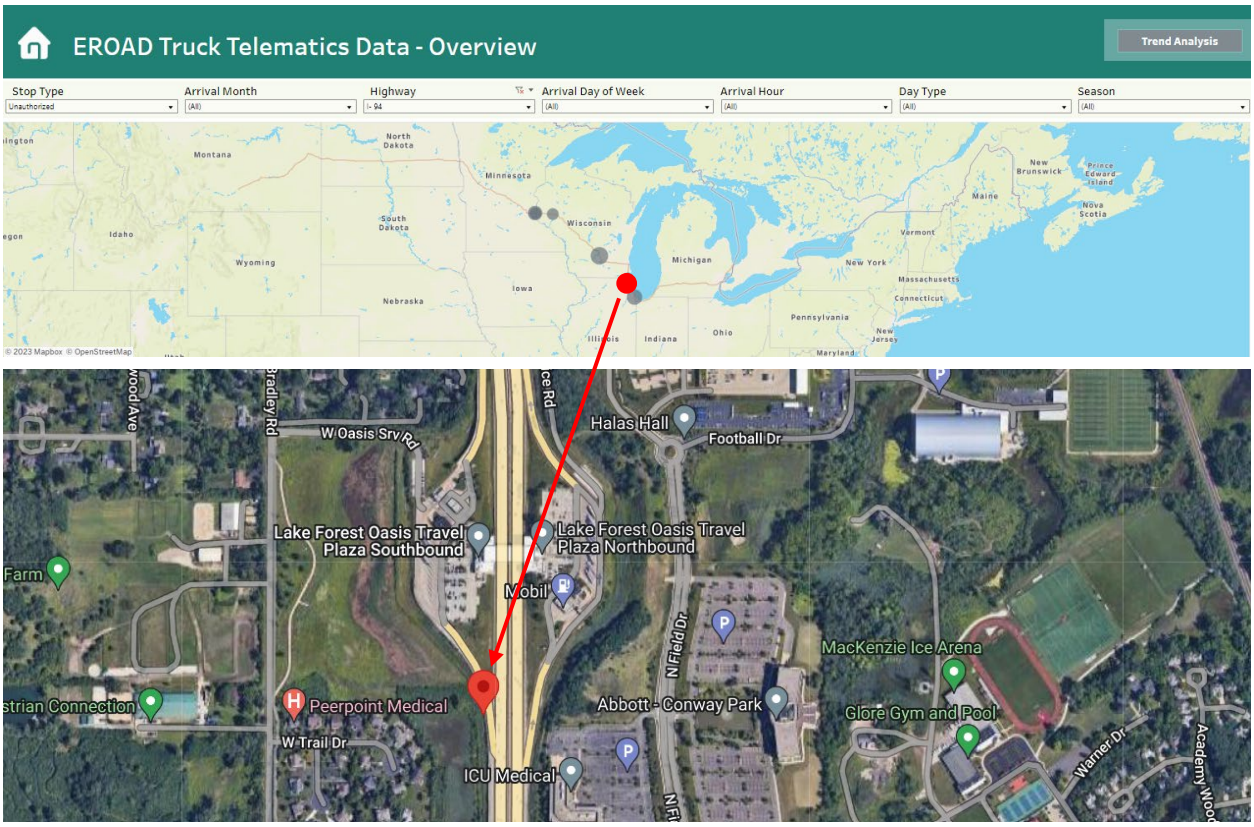


Figure 33. Screenshot and map. Unauthorized truck parking clusters along I-94 (top) and highlighted truck parking cluster (bottom).

The EROAD data set included only nine unauthorized clusters along the I-94 corridor in the MAASTO States. This is a very small sample, so care should be taken in extrapolating the analysis to the entire population of trucks traversing the I-94 corridor. Table 11 shows that the largest unauthorized truck parking clusters in the EROAD sample—both in terms of number of clusters and number of trucks stopped—were at the entrances to and exits from rest areas along the I-94 corridor. The large number of trucks parked at the entrances to and exits from rest areas and truck stops suggests insufficient truck parking capacity at these facilities.

Table 11. Unauthorized truck parking cluster categories along the I-94 corridor.

Unauthorized Parking Cluster Category*	Number of Clusters	Number of Trucks
Ramps to/from I-94	2	12
Entrance/Exit to/from Rest Area	5	64
Shoulder of Road	2	39

*** Ramps to/from I-94** refers to parking clusters on the shoulders of the ramps. **Entrance/Exit to/from Rest Area** refers to parking clusters along the shoulders of the entrances and exits of the rest areas. **Shoulder of Road** refers to parking clusters on the shoulders of the roads or side streets.

The research team also analyzed the sample data to determine when drivers were stopping at the unauthorized locations and identify differences by month, day of week, and time of day. Figure 34 illustrates the number of unauthorized truck parking clusters and the number of truck arrivals

at the unauthorized truck parking clusters by month. Figure 34 shows a similar number of unauthorized parking clusters from March to November, with a small increase in the number of clusters in April and November. The number of trucks arriving at these unauthorized parking clusters was, however, higher in the spring months (i.e., March, April, and May), in August, and in the fall months (specifically, October and November). The winter months (i.e., December, January, and February) saw comparatively fewer unauthorized truck parking clusters and number of truck arrivals.

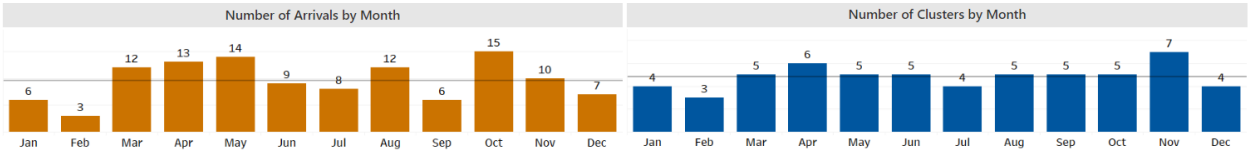


Figure 34. Graph. Number of truck arrivals (left) and number of unauthorized parking clusters (right) along I-94 by month.

Figure 35 illustrates the number of unauthorized truck parking clusters by day of week. The figure shows more unauthorized truck parking clusters on the weekdays (specifically, Mondays to Thursdays) compared to Fridays and the weekend days.

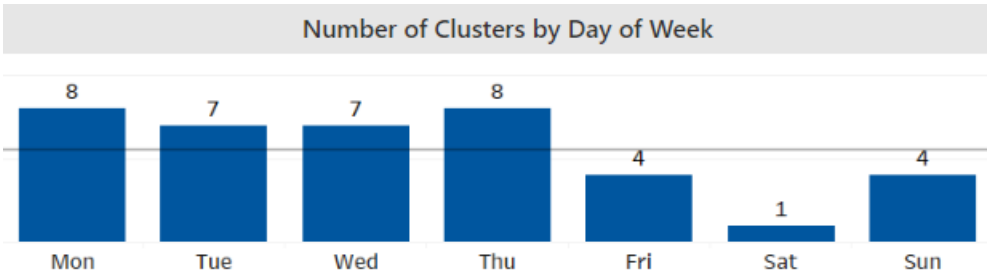


Figure 35. Graph. Number of unauthorized parking clusters along I-94 by day of week.

Figure 36 illustrates the number of trucks arriving at the unauthorized truck parking clusters by day of week. The figure shows more trucks arriving at the unauthorized locations on Mondays and Thursdays. Mondays and Thursdays also had more unauthorized parking locations (see Figure 35). Similar to the number of unauthorized truck parking clusters, weekend days (i.e., Saturdays and Sundays) showed substantially fewer trucks parking at the unauthorized parking locations. The exception was Fridays, which showed a comparatively high number of arrivals at comparatively fewer unauthorized parking locations.

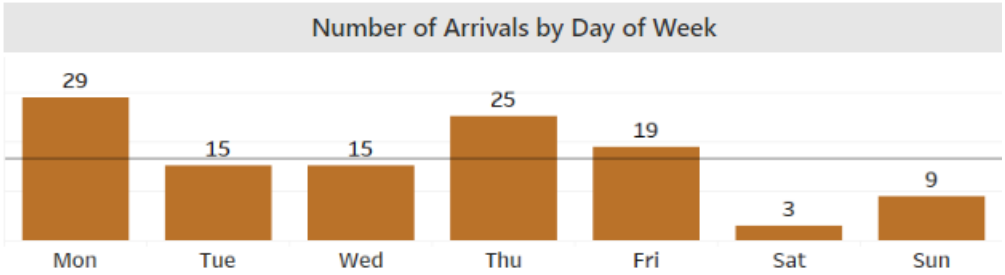


Figure 36. Graph. Number of trucks arriving at unauthorized parking clusters along I-94 by day of week.

Figure 37 illustrates the average number of truck arrivals per unauthorized truck parking cluster and the number of unauthorized truck parking clusters by time of day along the I-94 corridor. Figure 37 shows a higher number of unauthorized truck parking clusters between 9:00 a.m. and 10:00 p.m. compared to between 11:00 p.m. and 8:00 a.m. The figure also shows a higher average number of truck arrivals per unauthorized truck parking cluster at 2:00 a.m., at 7:00 a.m., between 9:00 a.m. and 11:00 a.m., at 3:00 p.m., and between 6:00 p.m. and 7:00 p.m.

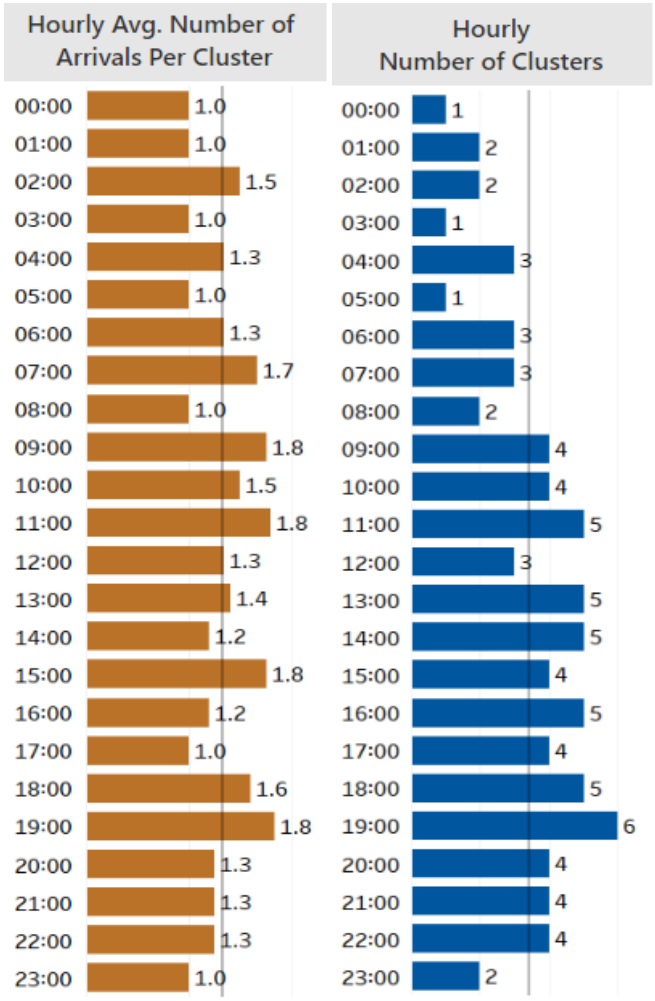


Figure 37. Graph. Hourly average number of truck arrivals per unauthorized truck parking cluster (left) and number of unauthorized parking clusters (right) along I-94 by time of day.

Figure 38 shows a higher percentage of truck arrivals at the unauthorized parking clusters along I-94 between 9:00 a.m. and 11:00 a.m., between 1:00 p.m. and 4:00 p.m., and between 6:00 p.m. and 7:00 p.m.

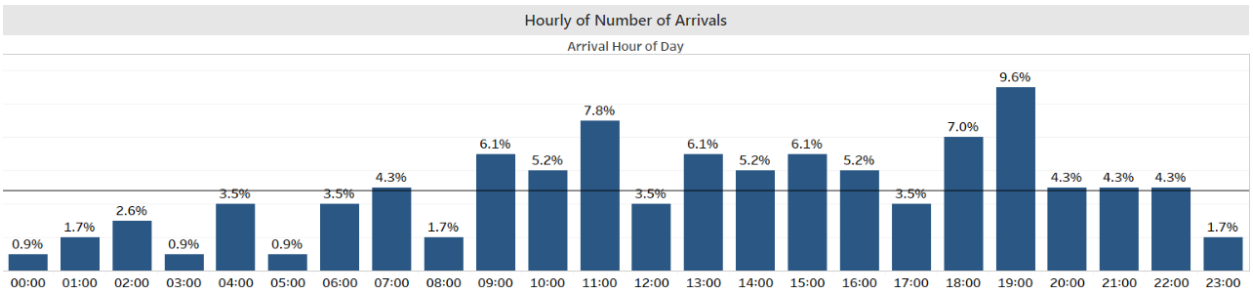


Figure 38. Graph. Percentage of truck arrivals at unauthorized parking clusters along I-94 by time of day.

Table 12 shows, on average, how long trucks stopped at the unauthorized parking clusters along the I-94 corridor. About 56.6 percent of the trucks stopped for 30 minutes or less, on average, at an unauthorized truck parking location along the I-94 corridor. On the other hand, 14 percent of trucks stopped at the unauthorized parking locations for an average of 9.5 hours or more.

Table 12. Average stop duration at unauthorized truck parking clusters along I-94.

Average Stop Duration (Hours)	Percentage of Trucks
<0.5	38.3
0.5	18.3
1	1.7
1.5	3.5
2	1.7
2.5	0
3	0.9
3.5	2.6
4	2.6
4.5	0
5	1.7
5.5	0.9
6	1.7
6.5	0
7	1.7
7.5	1.7
8	3.5
8.5	4.3
9	0.9
9.5	6.1
>9.5	7.9

Figure 39 illustrates the average distance (in miles) and the average drive time (in hours) of trucks arriving at unauthorized truck parking clusters along the I-94 corridor by time of day. Figure 39 shows that trucks arriving at the unauthorized truck parking clusters at 4:00 a.m., at 8:00 a.m., between noon and 3:00 p.m., at 8:00 p.m., and at 10:00 p.m. had traveled longer (time) and farther (distance) than trucks arriving at the unauthorized truck parking clusters during the

remaining hours of the day. Similar to the I-80 corridor, the figure also shows a peak in trucks arriving at the unauthorized locations at noon. These trucks, on average, had driven 322 mi and 6.8 hours.

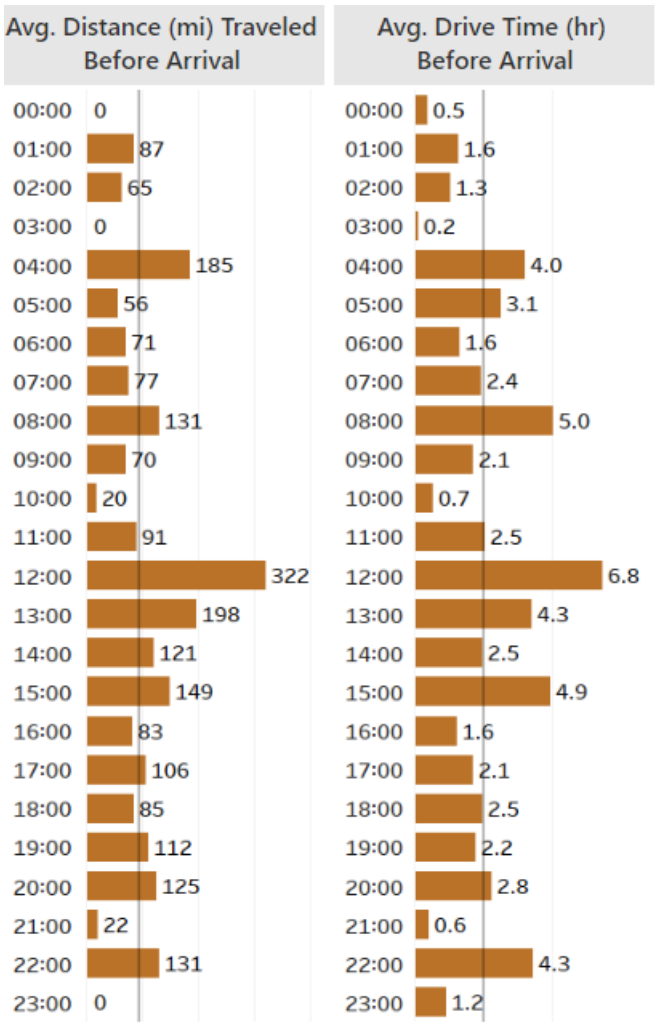


Figure 39. Graph. Average distance (miles) traveled (left) and average drive time before arrival at unauthorized parking clusters (right) along I-94 by time of day.

5. PILOTING THE TRUCK PARKING MANAGEMENT PLATFORM

A key objective of this research project was to pilot the use of a truck parking capacity management platform—developed by ParkUnload—to better understand how truck parking capacity is used and to determine the feasibility and benefits of deploying a truck parking capacity management app and Internet of Things (IoT) platform that provides real-time truck parking availability information to drivers at a more granular level. The ParkUnload platform was developed for managing curb space in urban areas (i.e., loading and unloading operations). The FMCSA pilot was the first time this platform was used at Interstate rest areas.

The research team reached out to the MAASTO States and the private sector with parking facilities along the I-80 and I-94 corridors to request permission for the research team to pilot the truck parking capacity management platform at their rest areas/truck stops. Appendix B provides a brief summary of the main insights obtained during this outreach. Ultimately, Iowa DOT and WisDOT were the only entities willing to participate in the pilot.

Once the pilot partners were identified, the following steps were followed in designing and implementing the pilot:

- Step 1: Sign Memorandum of Understanding with Iowa DOT and WisDOT.
- Step 2: Identify Pilot Rest Areas.
- Step 3: Prepare for, Configure, and Install ParkUnload Platform.
- Step 4: Develop and Implement Communications Strategy.
- Step 5: Assess Truck Parking Usage (see Chapter 6).
- Step 6: Assess Driver Satisfaction (see Chapter 7).

This chapter provides information about the ParkUnload platform, preparation for the implementation of the truck parking pilot, and installation of the ParkUnload platform at six rest areas along the I-80 corridor in Iowa and the three rest areas along the I-39/I-90/I-94 corridor in Wisconsin.

5.1 PARKUNLOAD PLATFORM

The research team partnered with ParkUnload and piloted the ParkUnload App and IoT platform in this research project. The ParkUnload platform comprises four components (see Figure 40):

- A **custom-designed Bluetooth-enabled sign** that is attached to a pole. The sign has an IP67 plastic enclosure attached with a Bluetooth low energy device that wirelessly emits the ID code of the parking zone without using GPS. The operating temperature of this device with lithium batteries ranges from −76ºF to +185ºF, with a range of up to 40 m and lasting for 5 years.

- A **mobile phone app that drivers need** to download. When the driver is close to the parking sign (<40 m), the ParkUnload App detects the parking zone code in 3 seconds. In the European cities where ParkUnload has been implemented, the app displays the vehicle's maximum parking time based on several criteria, such as location, time of day, vehicle emissions, driver's profile, and vehicle type. For the purposes of this pilot, the app was programmed to state that drivers could park 20 hours at the rest areas along the I-80 corridor and 2 hours at the rest areas along the I-39/I-90/I-94 corridor. For the platform to provide accurate information about parking space availability, a driver has to register their use/occupancy of the parking space. The driver does this by clicking the "Start Parking" button on the app when arriving at the parking space and the "Stop Parking" button when vacating the parking space. This simple action provides accurate real-time information about truck parking space availability to all drivers that have downloaded the app. When a maximum parking time is specified, the app also provides drivers with real-time information about the time remaining for vehicles that are occupying the spaces in the parking zones of interest.

  Mobile apps offer access to truck parking availability information at any time and any location. Note, however, that FMCSA's recent rule restricts the use of all mobile devices by commercial vehicle operators while in the act of operating a vehicle. Drivers are not allowed to make a call or dial by pressing more than a single button. This generally means a driver must already be parked somewhere to utilize a truck parking availability app.
- A **mobile phone app for enforcement agencies.** Parking enforcement officers are registered to obtain access to the enforcement functionality of the platform. In European cities where the ParkUnload platform has been implemented, parking officers enforce the parking rules (e.g., stated time limits) to ensure rotation and access to available parking for vehicle delivery drivers. For this pilot, it was decided early on that parking time limitations would not be enforced. Concern was expressed by FHWA in March 2021 about forcing a driver to leave a parking space if the driver parked there for the required 10-hour HOS break and all other spaces were filled. In addition, both Iowa DOT and WisDOT did not anticipate that law enforcement agencies would be willing to enforce set parking time limits.
- A **web-based back office**. The web-based back office provides access to real-time and historical parking patterns for instrumented parking zones and real-time and historical occupancy levels of the parking zones. Daily, weekly, and monthly reports are displayed in dashboards and data graphs in real time. ParkUnload's back office is hosted in the Cloud (Microsoft Azure) and includes Azure SQL, Azure Redis Cache, Azure App Services, Azure Storage, and Azure WebJobs, among others. Back-office analytics are developed using C# language in a .NET framework. ParkUnload's platform uses Google Map's web-based services in both the mobile applications and web-based back office. By default, parking zone pictures are taken from Google Street View. ParkUnload's platform uses Google Firebase tools for tracking analytics, reporting and fixing app crashes, and conducting product experiments. Both the SMS mobile phone validation process and push notification services are based on Google Firebase. ParkUnload's platform uses Google Analytics tools for tracking analytics and reporting user interaction with the web-based applications. Finally, ParkUnload's communication between the back office and

the app is based on secure protocols with TSL 1.2. Data communication protocols are based on standard REST and JSON API services.

Figure 40. Diagram. ParkUnload platform components.

Since 2018, the ParkUnload platform has been implemented successfully in a number of European cities, including Vic (Barcelona), Dublin and Belfast (Ireland), Madrid (Spain), and Paris and Argenteuil (France). In these applications, the ParkUnload platform is used to share information with delivery drivers about the availability of loading zone spaces and to ensure high space utilization and rotation by specifying and enforcing the time that delivery drivers can park in the loading zones. The research pilot therefore aimed to test a proven technology in a different context—in other words, test the feasibility of these types of platforms in providing truck drivers with information about truck parking availability at rest areas and truck stops, as well as the feasibility of designating a number of truck parking spaces for short-duration parking to provide drivers with a safe space to park to comply with the 30-minute HOS break requirement.

5.2 DESIGNING AND IMPLEMENTING THE PILOT

5.2.1 Sign Memorandum of Understanding

A memorandum of understanding (MoU) was developed to establish and provide the framework for the DOTs' cooperation and collaboration with the research team in the deployment of the FMCSA pilot. The MoU was developed in consultation with the DOTs. Several drafts were developed and revised until both parties (i.e., the research team and the DOTs) were comfortable with the framework outlined in the MoU. The final MoU stated that the DOT would:

- Assist in the identification of specific rest area facilities for inclusion in the FMCSA pilot.
- Approve the instrumentation of an agreed-upon number of parking spaces at identified rest area facilities.

- Share insights and provide guidance on the approach adopted for instrumenting the parking spaces (e.g., install 10 percent of the parking capacity at a specific rest area, parking spaces closest to bathrooms, etc.).
- Share relevant stakeholder contacts and facilitate conversations with stakeholders critical to the success of the research.
- Meet monthly to discuss parking data reports and any challenges/concerns.

The MoU also included the expectations for the research team. The research team was responsible for:

- Analyzing identified rest areas to identify poles for sign installations.
- Coordinating with the appropriate DOT bureaus with respect to site signage.
- Overseeing the planning and logistics of the parking sign installations.
- Coordinating the manufacturing of the parking signs that would be installed at the identified and agreed-upon rest area facilities.
- Establishing the ParkUnload platform for drivers, DOTs, and researchers.
- Obtaining permits to perform any required work on State highway ROWs.
- Facilitating the installation and testing of the parking signs in the identified truck parking locations.
- Replacing damaged signs, which included all materials, labor, etc.
- Developing the communications strategy for sharing the pilot information with trucking associations, trucking companies, and users (e.g., brochures, social media, press releases, etc.).
- Providing support to users of the ParkUnload platform by providing a hotline number to call.
- Providing operational support and maintenance for all software, hardware components, and system integrations.
- Providing periodic parking data reports and analytical services.
- Conducting any driver surveys on the use of the ParkUnload App.
- Ensuring all applicable Federal and State regulations and standards were followed.
- Removing all hardware and physical infrastructure and ensuring that the sites were restored to their original or better condition (normal wear and tear and casualty loss excluded).
- Supplying a report and recommendations to Iowa DOT and WisDOT related to project results within 1 month after study completion.

The MoU with WisDOT was signed on January 4, 2022, and the MoU with Iowa DOT became effective January 18, 2022. Appendix C provides a copy of the MoU that was entered into with Iowa DOT, and Appendix D provides a copy of the MoU with WisDOT.

WisDOT required the research team to apply for two permits to install the ParkUnload platform at the three rest areas in Wisconsin. One permit allowed for the installation of the ParkUnload platform at the Portage (Rest Area 11) and Poynette (Rest Area 12) rest areas, and the second permit allowed for the installation of the ParkUnload platform at Janesville (Rest Area 17). Appendix E provides a copy of the Wisconsin permit that allowed for the installation of the ParkUnload platform at the Portage and Poynette rest areas.

5.2.2 Prepare for, Configure, and Install ParkUnload Platform

5.2.2.1 Identify the Truck Parking Pilot Sites

The research team met several times with Iowa DOT and WisDOT in 2021 to discuss the identification of the truck parking pilot rest areas and the approach for deciding on the parking spaces that would be instrumented (e.g., install 10 percent of the parking capacity at a specific rest area, parking spaces closest to bathrooms, a specific number of parking spaces at each pilot site, etc.). Ultimately, two options were considered for implementing the truck parking management platform:

- Instrument fewer facilities along the I-80 and I-39/I-90/I-94 corridors but include all the truck parking spaces at the facility in the pilot.
- Instrument multiple rest areas along the I-80 and I-39/I-90/I-94 corridors but include only a few truck parking spaces at each rest area in the pilot.

Both Iowa DOT and WisDOT preferred the second option.

In May 2021, the research team proposed the following rest areas/truck stops after an analysis of the TPIMS data, the spacing of the rest areas/truck stops along the I-80 and I-39/I-90/I-94 corridors, the capacity of the rest areas/truck stops, and an initial identification of potential available poles (using Google maps) to attach the signs to:

- I-80 Corridor:
  - Exit 284 Iowa Truck Stop, Wallcot (private).
  - Exit 201 Kwik Star (private).
  - Wilton WB Welcome Center (public).
  - Exit 142 Prairie Meadows Casino (private).
- I-94 Corridor:
  - Menomonie and Rest Area 62.
  - Black River Falls Rest Area 54.
  - Milston Rest Area 53.
  - Johnson Creek Rest Area 14.
  - Lake Mills Rest Area 13.

Considering the data available from the TPIMS project along with a project meeting held on August 26, 2021, the following sites were proposed by Iowa DOT for instrumentation as part of the FMCSA truck parking pilot:

- I-80 Rest Area near Wilton (EB and WB),
- I-80 Rest Area near Mitchellville (EB and WB),
- I-80 Rest Area near Underwood (EB and WB), and
- I-380 Truck Stop (either Kwik Star or Casey's) at the I-380/Wright Bros Interchange.

WisDOT recommended the following rest areas for further consideration:

- Janesville (Rest Area 17) with 78 truck parking spaces,
- Portage (Rest Area 11) with 68 truck parking spaces,
- Poynette (Rest Area 12) with 63 truck parking spaces, and
- Beloit (Rest Area 22) with 52 truck parking spaces.

During the week of February 7, 2022 (February 7 to 11), the research team visited each of the identified potential sites to determine their suitability (e.g., available poles) and tested the range of the Bluetooth device to confirm the number of parking spaces that were within the range of the Bluetooth device. The latter determined the parking spaces that would be recommended for inclusion in the parking pilot.

The following observations were recorded for each of the potential rest areas in Iowa.

- **Mitchellville (EB and WB).** The research team identified at least three robust light poles to which the pilot sign could be attached at each of the two rest areas near Mitchellville (see Figure 41). The layout of the rest areas and the location of the light poles allowed for a single sign to be detected in four truck parking spaces. The research team therefore recommended that the four truck parking spaces closest to the facilities be included in the pilot.

Figure 41. Photographs. I-80 rest area near Mitchellville WB.

- **Wilton (EB and WB).** The design of the Wilton rest areas (both EB and WB) is similar to the design of the rest areas near Mitchellville. The research team identified at least three good poles to which the truck parking pilot sign could be attached (see Figure 42). One sign could be detected from six spaces with the ParkUnload App.

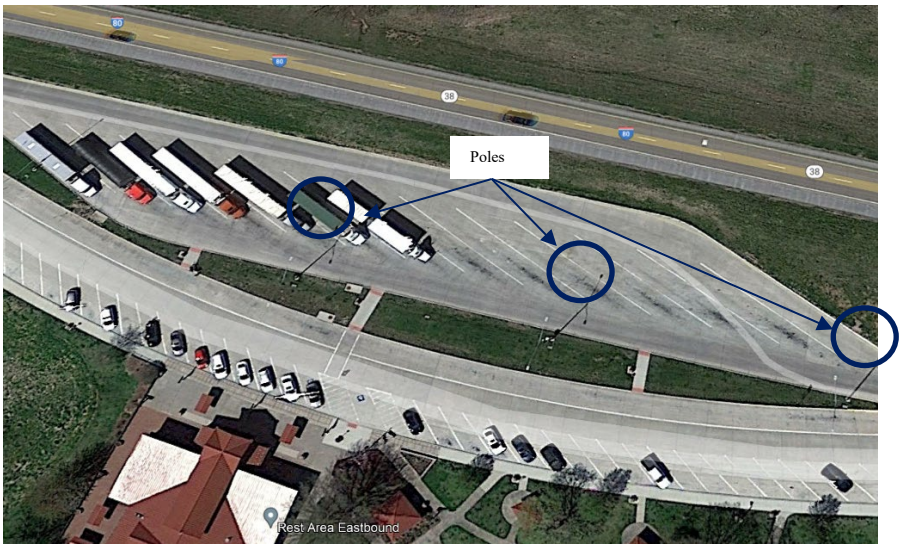


Figure 42. Photograph. I-80 rest area near Wilton EB.

- **Underwood (EB and WB).** The design of the rest areas near Underwood is such that the truck driver would face away from the signs when the truck was parked. When the research team tested the Bluetooth range, a single sign covered approximately five truck parking spaces, but only if the driver had clear sight of the parking sign. When obstructed by another truck, the app did not detect the signal. Also, even though the research team identified several robust metal poles (light poles) to which the parking sign could be attached, there were already several attachments to the poles (see Figure 43), which potentially would detract from the pilot sign. Finally, Figure 43 shows the layout of the rest area and a wood pole that provided information for pet owners. This sign could not support the parking sign. The research team therefore requested subsequent to the site visit that Iowa DOT allow the instrumentation of the rest areas near Adaire (Mile Marker 81). These two rest areas were, however, scheduled for maintenance during the pilot time frame. Ultimately, the decision was made to pilot the truck parking management platform at the two rest areas (EB and WB) near Ladora.

Figure 43. Photograph. I-80 rest area near Underwood WB.

- **I-380 Truck Stop (Kwik Star) at the I-380/Wright Bros Interchange.** Kwik Star is along I-380 north of I-80. The truck stop is a smaller facility with parking for approximately 15 trucks. The research team identified two potential poles to which the pilot sign could be attached, but the layout of the truck stop—similar to the rest areas near Underwood—resulted in the poles being at the back of the trucks when parked (see Figure 44). When the signal was obstructed by another truck, the app did not pick up the signal. This Kwik Start Truck Stop was therefore not further considered for inclusion in the pilot.

Figure 44. Photograph. Kwik Star truck stop at I-380/Wright Bros interchange.

- **I-380 Truck Stop (Casey's) at the I-380/Wright Bros Interchange.** Casey's Truck Stop is along I-380 north of I-80. The truck stop has parking for approximately 50 trucks. The research team identified a number of poles that could be instrumented next to (on the side of) the parking spaces (see Figure 45). The layout of the truck stop resulted in only the two truck parking spaces on either side of the median with the pole being within

Bluetooth range. The research team was, however, unsuccessful in recruiting Casey's to participate in the pilot.

Figure 45. Photographs. Casey's Truck Stop at I-380/Wright Bros interchange.

The following observations were recorded for each of the potential rest areas in Wisconsin.

- **Beloit (Rest Area 22).** The research team identified six good poles in the back of the rest area to which the pilot sign could be attached (see Figure 46). However, each of the six poles had a sign attached to it—similar in size to the parking pilot sign—that said, "NO PARKING ANY TIME." These signs warn against trucks parking parallel to the curb and thereby preventing trucks from parking safely. The research team concluded that the truck parking pilot signs and these signs would provide drivers with contradictory information. It was therefore decided not to include the Beloit rest area in the truck parking pilot.

Figure 46. Photograph. Beloit (Rest Area 22).

- **Janesville (Rest Area 17).** The research team identified many good poles at the Janesville rest area to which the truck parking pilot sign could be attached (see Figure 47). All these poles allowed for the sign to be detected from approximately five spaces with the ParkUnload App. The research team attached the sign to a pole near the entrance of the rest area.

Figure 47. Photograph. Janesville (Rest Area 17).

- **Poynette (Rest Area 12).** The research team identified only one good pole at the Poynette rest area to which the truck parking pilot sign could be attached with a very large bracket (see Figure 48). The rest of the light poles at the rest area were in medians between truck parking spaces. When trucks were parked in the spaces, the sign could only be detected by the ParkUnload App at the two parking spaces nearest to the sign.

Figure 48. Photograph. Poynette (Rest Area 12).

- **Portage (Rest Area 11).** Similar to the Poynette rest area, the research team identified only one good pole at the Portage rest area to which the truck parking pilot sign could be attached with a very large bracket (see Figure 49). The sign could be detected with the ParkUnload App from about five parking spaces. The rest of the light poles at the rest area were also in medians between truck parking spaces. When trucks were parked in these spaces, the sign could only be detected by the ParkUnload App at the two parking spaces nearest to the sign.

Figure 49. Photograph. Portage (Rest Area 11).

5.2.2.2 Pilot Parking Time Limits by Corridor

After several meetings with Iowa DOT and WisDOT staff, it was agreed that:

- At the six Iowa sites, the research team would test the feasibility of using the ParkUnload platform to provide users with information about where and when truck parking was

available and to gather data about the usage of the truck parking spaces included in the pilot.

- At the three Wisconsin sites, the research team would test the feasibility of using the ParkUnload platform to designate the pilot parking spaces for short-duration parking. ParkUnload programmed the app to display a 2-hour limit for trucks parking in the pilot parking spaces at the Wisconsin sites.

At the Wisconsin sites, a big question was therefore if drivers would comply with the 2-hour parking limit. At the outset, it was clear that the parking time limits would not be enforced. Neither the DOT nor State troopers would be expected to enforce the parking time limits. The ParkUnload App interface was programmed to provide drivers with the parking time limit when the drivers parked and checked in/claimed the parking space. When the 2-hour limit was approaching, the app interface screen would turn from green to yellow to let drivers know that the parking time was reaching the 2-hour limit. Once the 2-hour limit was reached, the app interface turned red and notified drivers that they had exceeded the 2-hour limit. Figure 50 illustrates how the ParkUnload App provides drivers with visual cues that parking time limits are being reached (yellow screen) or exceeded (red screen).

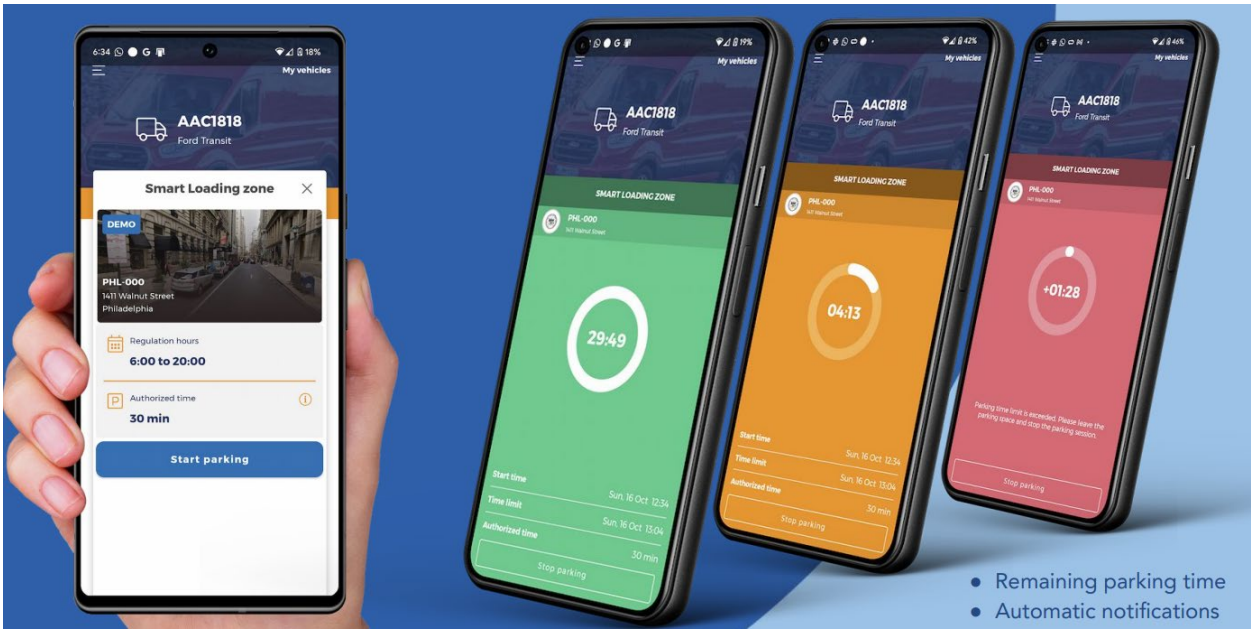


Figure 50. Image. ParkUnload app visual cues that parking time is approaching or exceeding time allowed.

5.2.2.3 Prepare to Install ParkUnload Platform

Design Pilot Parking Sign. Research that included a review of the *Manual on Uniform Traffic Control Devices* (MUTCD) and consultation with sign and pavement marking subject matter experts at TTI and FHWA revealed that parking signs used in rest areas are exempt from the signing requirements per the MUTCD. Although the signs were exempt from MUTCD requirements, they still had to be approved by FMCSA (because approval was required for using the FMCSA logo), Iowa DOT, and WisDOT. The signs also had to be legible, and care had to be exercised to design a parking sign that conveyed the intent of the truck parking pilot, as well as

provide sufficient information to guide a driver on how to participate in the truck parking pilot and what was expected of them. Finally, the signs needed to be attached to existing poles at the rest areas, which impacted the size of the signs.

Although not a requirement, the research team did design a parking sign considering the MUTCD requirements. For example, the research team used green for the sign to differentiate it from brown (already used on information signs), red (used for warnings), and blue (used for handicap signs). Figure 51 shows the first prototype sign that was developed by the research team and that was reviewed and approved by FMCSA. The overall dimensions of the sign were 24 inches by 30 inches. The "Parking Pilot" text was 3 inches, the "Parking Time Digitally . . ." text was 2.25 inches, and the "Zone Code" was 2 inches. The FMCSA logo was located at the top left corner of the sign, and the logos of the research team were located at the bottom of the sign.

Figure 51. Image. First prototype sign.

The research team manufactured two prototype signs and met with Iowa DOT (April 15, 2022) and WisDOT (April 14, 2022) to demonstrate the prototype signs and the capabilities of the ParkUnload platform (e.g., driver app, monitoring app, and back-office data collected). During this visit, the research team also identified the parking spaces that would be included in the pilot and discussed the implementation steps and logistics for installing the ParkUnload platform at the pilot rest areas.

The research team also met with Trucker Path and Truck Specialized Parking Services (TSPS) to review the prototype sign. These entities felt that the information on the sign was not descriptive enough for a truck driver not familiar with the research. Specifically, the DOTs and TSPS recommended that the research team revise the sign and include:

- a more descriptive title,
- specific directions to advise truck drivers what was expected of them when they parked in a space (e.g., download the ParkUnload App, enter the zone code, etc.),
- the name of the app, and
- the following statements: “No Cost to Driver,” No Time Limit on Parking,” and “Anonymous.” ((To allow the research team to use the same sign design at the pilot rest areas along the I-80 corridor and the I-39/I-90/I-94 corridors, these statements were not included in the final pilot sign design.)

Finally, it was recommended that the size of the FMCSA logo be reduced to allow for the more descriptive title. Figure 52 shows the final pilot sign that was approved and installed at the pilot rest areas. The overall dimensions of the final version of the sign were 24 inches by 30 inches.

Figure 52. Image. Final pilot sign.

Identify and Mark Parking Spaces. The research team, in consultation with Iowa DOT and WisDOT, agreed to test the ParkUnload platform at four truck parking spaces at each of the nine rest areas included in the pilot. The specific four parking spaces at each of the rest areas were a function of the (a) availability of suitable poles on which to attach the Bluetooth-enabled sign; (b) range of the Bluetooth device, which was a function of the rest area design; and (c) convenient access to the rest area facilities. Appendix F provides the layout of each of the rest areas and the locations of the four parking spaces in each of the rest areas that were included in the truck parking pilot.

To clearly designate the four parking spaces included in the truck parking pilot, the research team painted the four truck parking spaces bright green and stenciled the words “Technology

Test" in three places on each of the pilot truck parking spaces (see Figure 53 for a schematic and Figure 54 for a photo of the four pilot spaces painted at the Janesville rest area in Wisconsin). (The research team attempted to contract the painting of the parking spaces out to a DOT-preferred contractor, but all the contractors contacted either could not accommodate the work in the spring/summertime frame or were not interested in the work. After several attempts, the research team worked with TTI's Signs and Markings program manager to train Technicians Cody Kaecker and Lee Mutz to paint the parking spaces.)

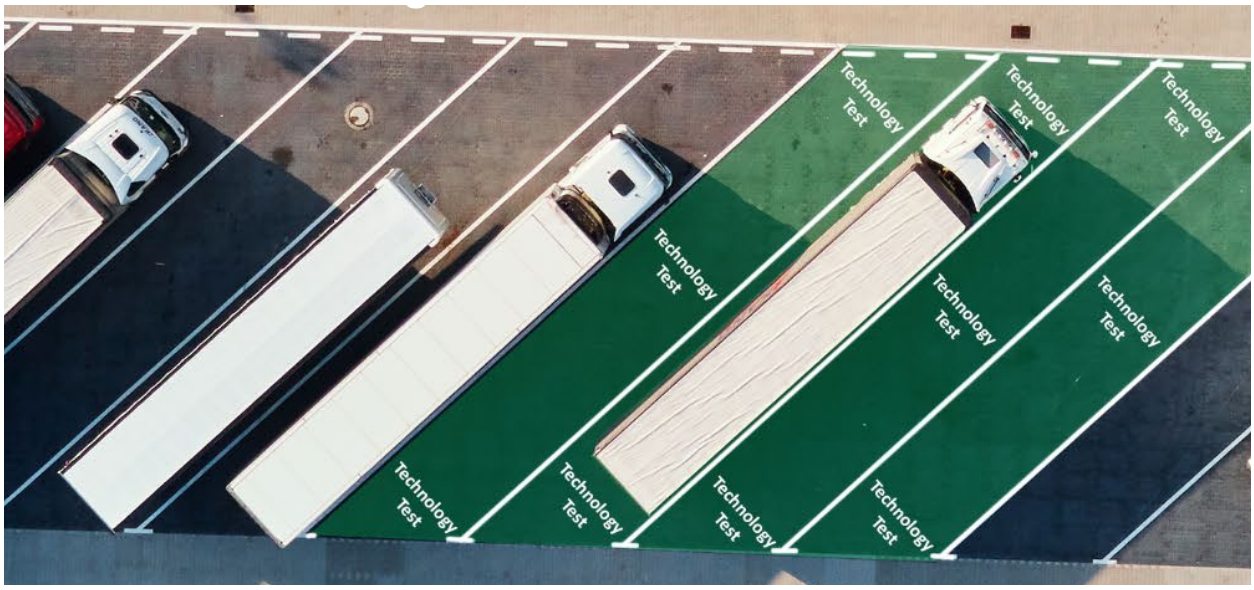


Figure 53. Schematic. Pavement markings.

Figure 54. Photograph. Painted parking spaces (Janesville Rest Area).

Install ParkUnload Platform. The research team painted the parking spaces and installed the Bluetooth-enabled signs the week of July 17, 2022 (see Figure 55). The research team tested all

the Bluetooth signs and the platform the week of July 25, 2022. The 1-year truck parking pilot officially started August 1, 2022, and ended July 31, 2023.

Figure 55. Photographs. Installation of ParkUnload platform and painting of parking spaces (week of July 17, 2022).

The research team experienced several challenges prior to and during the week of the installation of the ParkUnload platform, including:

- The supplier of the green paint invoked force majeure on the delivery date for the green paint. The latter complicated the logistics of the installation of the ParkUnload platform.
- The original sign manufacturer experienced supply chain issues and needed to be replaced by another U.S. sign manufacturer.

- Flight cancellations, lost luggage, equipment failures, and weather concerns compressed the research team's timeline for installing the ParkUnload platform and painting the parking spaces at the nine pilot rest areas.

5.2.2.4 Develop and Implement Communications Strategy

Pilot Brochure. The research team developed a brochure that was shared with stakeholders and distributed to drivers at the pilot rest areas. Similar to the pilot sign, the brochure underwent several changes before being approved by FMCSA, Iowa DOT, and WisDOT. The information in the final brochure was organized to answer the following questions about the truck parking pilot:

- What are the goals?
- How do truck drivers benefit?
- How does it work?
- What do we need from you?
- What do we want to measure?
- What do I need to know? Specifically, the brochure provided links to explain the use of personal data.
- Who to contact for information? The brochure provided the names of the U.S. project leads, a study email address, and a toll-free number that drivers could use if they had any questions, comments, or suggestions about the pilot.

Figure 56 and Figure 57 provide images of the front and back page of the final brochure. The brochure was folded as a trifold and handed to drivers during the week of July 17, 2022. Brochures were also left at the pilot rest areas to provide drivers with information about the pilot.

Figure 56. Image. Pilot brochure (page 1).

Figure 57. Image. Pilot brochure (page 2).

Website. The research team developed a pilot website (see www.parkingpilot.org) to disseminate information about the FMCSA pilot to DOT partners, stakeholders, and drivers. The website's landing page included information about the pilot and answered questions that drivers might have about the pilot and participating in the pilot as follows:

- How to identify the parking spaces that are part of the pilot.
- How to download the app.
- How truck drivers could find the parking spaces used for this pilot and their availability.
- How to claim the parking space after parking the truck.
- What to do when leaving.
- What to do if the parking space is shown available on the app but someone else is already parked there (i.e., why the app is not showing the correct parking availability information).
- What the research team is doing with the vehicle information.
- What the benefits are to the truck drivers participating in the pilot.

From the landing page, website visitors could view the diagrams of the pilot rest areas (see Appendix F) that clearly showed the parking spaces included in the pilot. The website also included information about how to download and use the ParkUnload App. Finally, the website allowed visitors to submit comments or reach the research team through the pilot email address or the toll-free number provided.

Communications Strategy. The research team communicated information about the pilot and solicited participation of truck drivers in the pilot by:

- reaching out to trucking associations and trucking interest groups,
- issuing press releases and reaching out to drivers through social media,
- distributing the pilot brochures to and talking with drivers at the pilot rest areas during the week that the ParkUnload platform was installed, and
- participating in a number of media events.

Three weeks prior to the launch of the pilot, the research team reached out to the State trucking associations along the I-80 and I-94 corridors, trucking interest groups, State DOTs, Trucker Path, and the Iowa and Wisconsin divisions of FMCSA (see Table 13 for a list of the stakeholder entities contacted). The research team shared information about the FMCSA pilot via email with these stakeholders and requested that the stakeholders share information about the FMCSA pilot with the industry. In the case of the trucking associations, the research team specifically asked that they share the information with their members and ultimately the truck drivers. The research team also offered to set up Microsoft Teams meetings with the stakeholders to answer questions and address any concerns.

Table 13. Stakeholder outreach.

State Trucking Associations	
• Illinois • Indiana • Iowa • Kansas • Kentucky	• Michigan • Minnesota • Missouri • Ohio • Wisconsin
Other Trucking Associations/Interest Groups	
• Owner-Operator Independent Drivers Association (OOIDA) • National Association of Small Trucking Companies (NASTC) • Trucker Path • National Association of Independent Truckers • Agricultural and Food Transporters Conference	• Women in Trucking • Automobile Carriers Conference/ Distribution & LTL Carriers Association • National Tank Truck Carriers Association • Truckload Carriers Association • Intermodal Motor Carriers Conference
State Departments of Transportation	
• Illinois • Indiana • Kansas • Michigan	• Minnesota • Missouri • Ohio

The research team developed a press release that was approved by FMCSA for distribution and shared it with Iowa DOT and WisDOT. Appendix G contains a copy of the press release. The press release was distributed via Meltwater on July 21, 2022—1 week prior to the launch of the pilot. Both Iowa DOT and WisDOT shared information about the pilot with freight stakeholders participating in their freight advisory committees. Iowa DOT also shared information about the pilot with the Iowa DOT director of the Office of Public Affairs, who included the information on the Iowa DOT website; motor vehicle enforcement; and State law enforcement. WisDOT shared information about the pilot with Wisconsin's Motor Carrier Advisory Committee and emailed information about the pilot to its trucking industry contacts (a database that contains approximately 10,000 trucking industry emails).

During the week of July 17, 2022, when the ParkUnload platform was installed and TTI technicians painted the truck parking spaces, members of the research team handed out the approved brochure to truck drivers and asked drivers to participate in the truck parking pilot by downloading the ParkUnload App and using it when parking in the green parking spaces. Members of the research team handed out these brochures for about 4 hours per rest area on average.

The research team also participated in a number of media events. The principal investigator was a guest on the:

- Women In Trucking Show (SiriusXM) on July 23, 2022.
- Dave Nemo Show on August 1, 2022.
- Road Dog Trucking (Sirius XM) on August 10, 2022.

These media events provided the research team with an opportunity to provide information on the truck parking pilot, answer questions, and request that drivers participate in the pilot by downloading the ParkUnload App and using it when parking in the green parking spaces.

Finally, the research team and FMCSA met with representatives from the American Trucking Association and ATRI on August 12, 2022, to request support in distributing information about the pilot to drivers and recruiting drivers to participate in the pilot.

The research monitored the use of the ParkUnload App (i.e., both in terms of the number of downloads and the usage of the app) over the course of the 1-year pilot. The research team reported to Iowa DOT and WisDOT the number of times the app was used during scheduled monthly progress meetings.

The research team saw a significant decline (see Chapter 6) in the usage of the app after August. To increase the usage of the app, the research team, in collaboration with Iowa DOT and WisDOT:

- Used targeted outreach to trucking interest groups through social media.
- Displayed information about the truck parking pilot on the monitors in the rest areas along the I-80 corridor in Iowa.

- Developed a poster with information about the truck parking pilot that was displayed in the rest areas along the I-39/I-90/I-94 corridor.

Social Media Outreach. Several attempts were made to connect and share information about the truck parking pilot with truck drivers. Iowa DOT, in coordination with the research team, developed a blog post about the truck parking pilot (see New App Tests Process of Identifying Available Truck Parking) that was posted on the Iowa DOT website on August 19, 2022.

On September 22, 2022, in an attempt to increase driver participation in the pilot, the research team paid to post the following message on social media (Facebook and Instagram):

> *Congratulations to the first monthly winner of a $150 Amazon gift card, Jeff Serafin of Freemont Contract Carriers (FCC). Jeff downloaded and used the ParkUnload app that is being tested to share information about available truck parking along the I-80 and I-39/I-90/I-94 corridors and found it very easy to use. Are you a truck driver interested in giving it a try? Visit https://parkingpilot.org/features-and-services/ to get started!*
> #Trucking #Parking #Technology

Facebook rejected the posting, stating that "Ads must not promote products, services, schemes or offers using deceptive or misleading practices, including those meant to mislead or scam people out of money or personal information." Upon reviewing Facebook's Business Practices Policy, the research team found that the posting was rejected because the research team mentioned the Amazon gift card and used a person's real name and a real organization in a paid post.

The research team therefore generalized the post to:

> *Are you a truck driver who travels along the I-80 and I-39/I-90/I-94 corridors? The Texas A&M Transportation Institute, the University of Wisconsin at Madison and ParkUnload are conducting a study to understand how truck drivers use existing truck parking spaces and to test the benefits of using technology (i.e., a parking app) to provide drivers with truck parking availability and location information. Interested in giving it a try? Visit* https://parkingpilot.org/features-and-services/ *to get started!*
> *#Trucking #Parking #Technology*

The revised post was re-posted on October 4, 2022. The post reached 16,356 people, of which 205 people clicked on the link provided. The gender, age, and location profiles of the people that received the post and clicked on the link are shown in Table 14, Table 15, and Table 16, respectively. In addition, Iowa DOT posted the TTI

Facebook post on the Iowa DOT main Facebook account as well as Iowa's Motor Vehicle Enforcement Facebook page.

Table 14. Gender profile of audience reached and number of clicks on link.

Gender	Audience Reached	Number of Clicks
Women	2,788	27
Men	13,440	178

Table 15. Age profile of audience reached and number of clicks on link.

Age	Audience Reached	Number of Clicks
18–24	440	2
25–34	1,512	13
35–44	1,992	14
45–54	2,508	26
55–64	3,988	44
65+	5,904	106

Table 16. State of audience reached and number of clicks on link.

State	Audience Reached	Number of Clicks
Iowa	7,044	108
Wisconsin	9,312	97

Rest Area Monitor Displays (I-80). Iowa DOT, in coordination with the research team, developed content to display on the pilot rest area monitors along the I-80 corridor in December 2022. The information started to be displayed (see Figure 58) on the rest area monitors in mid-January 2023.

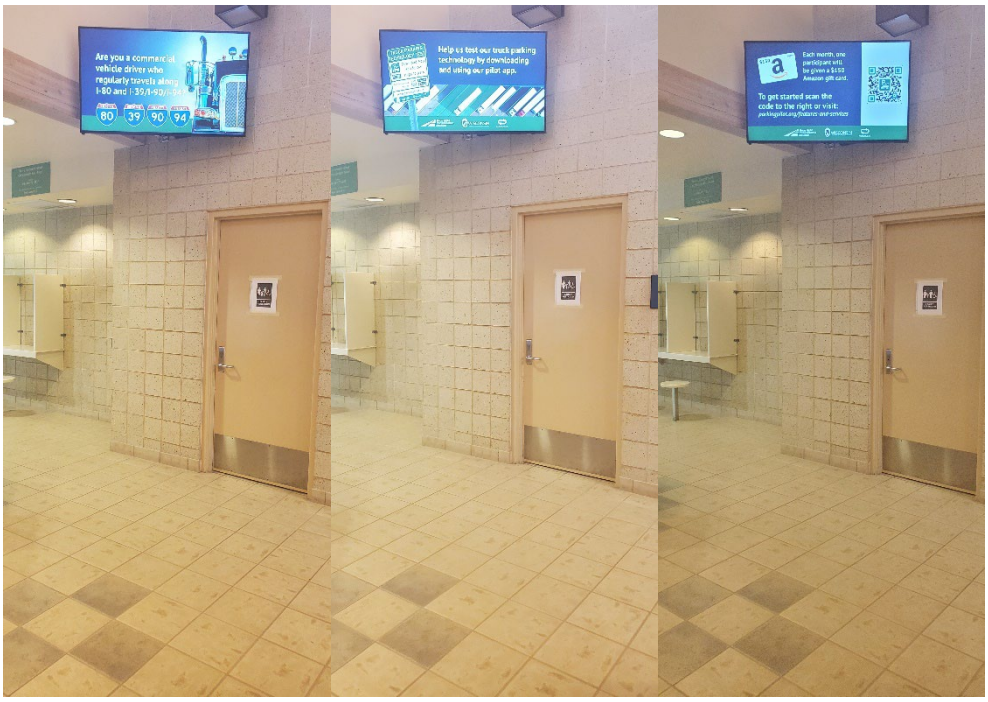


Figure 58. Photograph. Rest area monitor content.

Rest Area Posters (I-39/I-90/I-94). The Wisconsin rest areas did not have monitors to display information about the truck parking pilot. The research team therefore developed posters that were displayed in the rest areas (see Figure 59). Figure 60 shows a photo of the posters displayed in the Janesville rest area. The posters were attached to the walls at the entrances to the toilet facilities. The posters were adhered in the rest areas along the I-39/I-90/I-94 corridor the week of February 20, 2023.

Figure 59. Image. Rest area poster.

Figure 60. Photographs. Posters displayed at entrances to toilet facilities (Janesville Rest Area).

6. PILOT DATA COLLECTION AND ANALYSIS

The FMCSA truck parking pilot started on August 1, 2022, and ended on July 31, 2023—lasting a total of 12 months. In that year, 496 truck drivers downloaded the ParkUnload App and used the app 694 times (i.e., checked in/claimed a pilot parking space when parking at one of the pilot spaces and checked out/released the parking space when leaving). Of these 694 uses, in 129 cases, the parking sessions lasted less than 5 minutes. The research team excluded these parking sessions from further analysis because it was assumed that in these cases, the drivers were only testing the app. This chapter summarizes the analyses that were conducted on the use of the app by 395 truck drivers. These 395 truck drivers used the app 564 times (i.e., checked in/claimed a pilot parking space when parked at one of the pilot spaces for 5 or more minutes before checking out/releasing the parking space). Overall, the truck driver that used the app the most used it 29 times during the year. Most drivers (348 out of the 395 drivers, or 88 percent) used the app only once (see Figure 61).

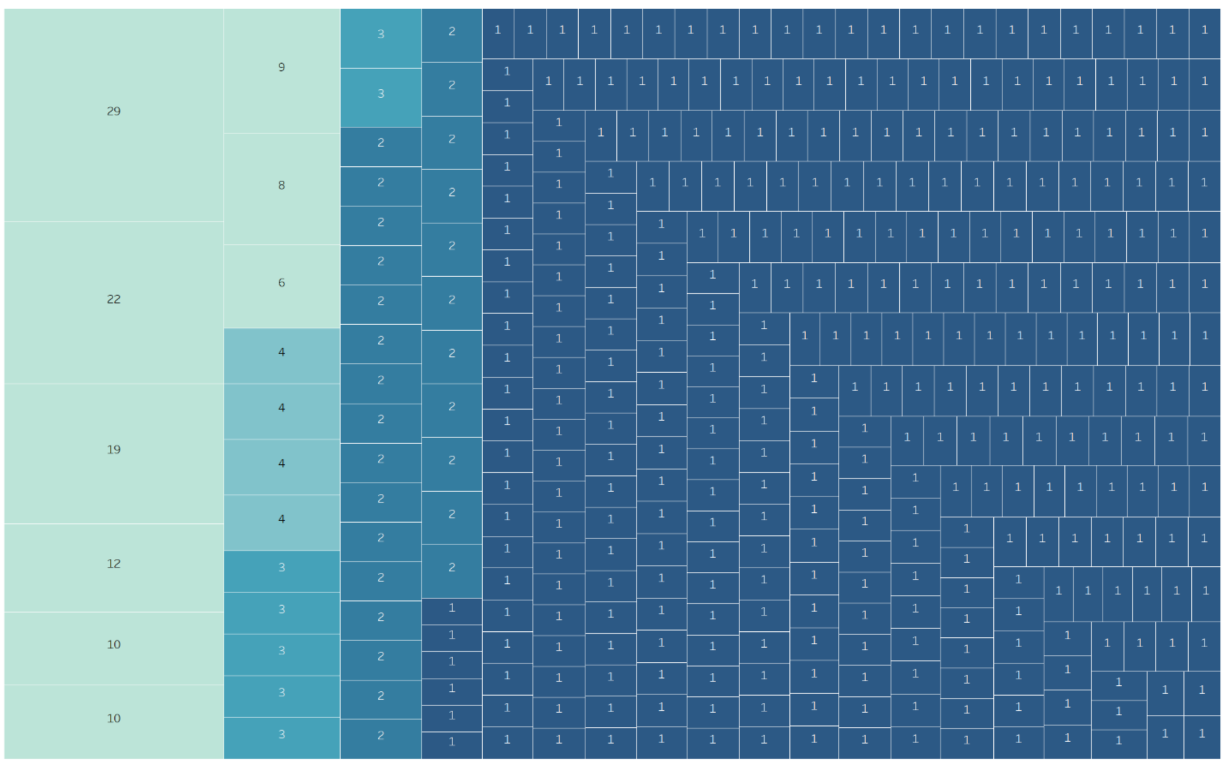


Figure 61. Graphic. Number of ParkUnload app uses per user.

Figure 62 shows the number of ParkUnload App uses (i.e., parking sessions), number of ParkUnload users, parking time limit, and average parking time by pilot rest area. Figure 62 shows that the app was used most at the Mitchellville rest areas (along I-80), with 108 parking sessions at Mitchellville WB registered by 72 ParkUnload App users, and 93 parking sessions at Mitchellville EB registered by 76 ParkUnload App users. The two pilot rest areas that saw the lowest participation were Portage (Rest Area 11) along the I-39/I-90/I-94 corridor at only 19 parking sessions and Ladora EB along the I-80 corridor at 35 parking sessions. Figure 62 also shows that on average, truck drivers parked for long periods at the I-80 pilot rest area spaces. Trucks parked the longest at Mitchellville WB, where they parked on average 11.8 hours. The

parking sessions registered at the I-39/I-90/I-94 rest areas were used for shorter-duration parking. The average time parked at all three pilot rest areas was less than 1.5 hours (see Figure 62). This high level of compliance with the parking time limit specified by the ParkUnload App users was achieved without any enforcement of the time limit specified.

At the six Iowa I-80 pilot rest areas, the research team tested the feasibility of using the ParkUnload platform to provide users with information about where and when truck parking was available and to gather data about the usage of the truck parking spaces included in the pilot. No time limit on the parking duration was specified.

At the three Wisconsin I-39/I-90/I-94 pilot rest areas, the research team tested the feasibility of using the ParkUnload platform to designate the pilot parking spaces for short-duration parking. The app was programmed to display a 2-hour limit for trucks parking in the pilot parking spaces at the Wisconsin rest areas.

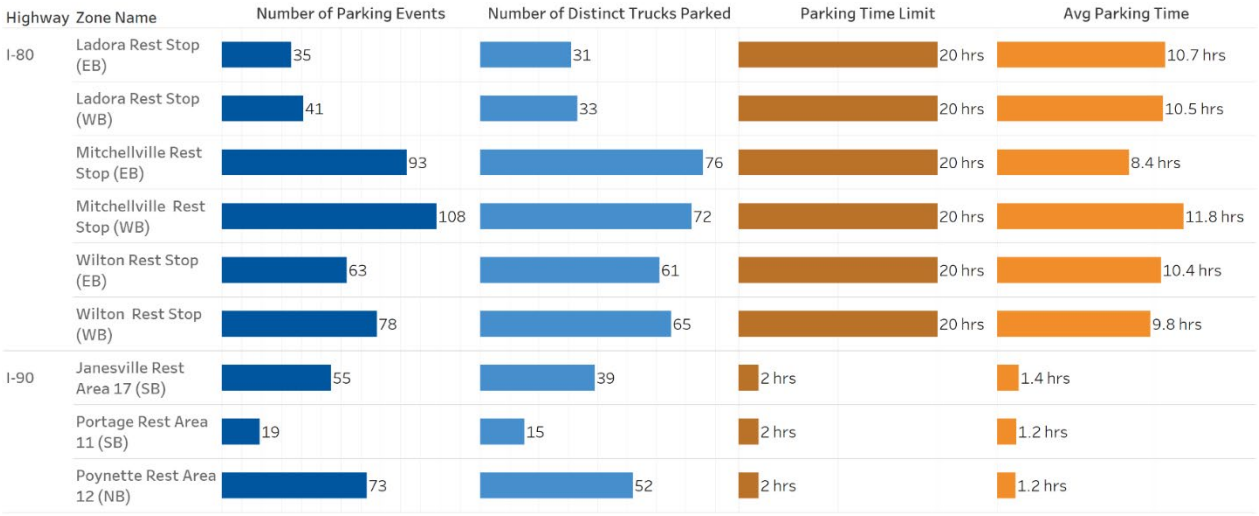


Figure 62. Graph. Number of ParkUnload app uses (parking sessions), number of ParkUnload users, parking time limit, and average parking time by rest area.

Figure 63 shows the total number of ParkUnload App uses (i.e., parking sessions) by month. Figure 63 shows the highest number of app uses in the first month of the pilot project. After August, the number of app uses decreased every month in the fall before stabilizing in the winter months. Although spring and summer saw an increase in the number of app uses, the number of app uses did not increase to the level seen in the first month of the pilot.

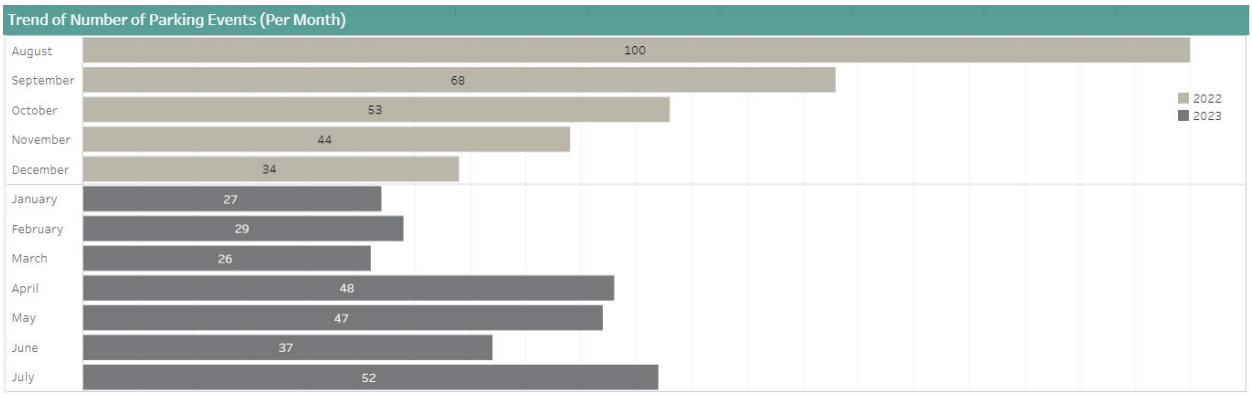


Figure 63. Graph. Number of ParkUnload app uses (parking sessions) by month.

Figure 64 shows the number of ParkUnload App uses (i.e., parking sessions) by week and the initiatives that the research team and DOT partners conducted in an attempt to increase the number of truck drivers participating in the pilot. Figure 64 shows that the social media outreach (the week of October 4, 2022), the pilot information displayed on the monitors in the Iowa rest areas (starting mid-January 2023), and the posters displayed in the Wisconsin rest areas (starting the week of February 20, 2023) did not result in a significant increase in the use of the ParkUnload App. On the other hand, reaching out to those that had downloaded the ParkUnload App in mid-April and mid-May seemed to result in an increase in app use. Overall, driver participation in the truck parking pilot remained a challenge throughout the duration of the pilot.

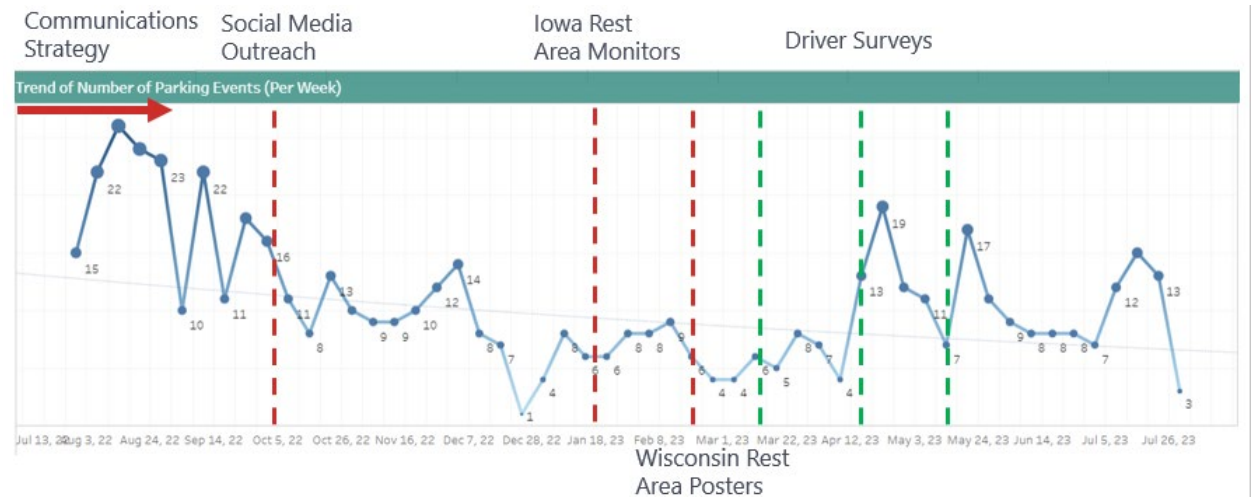


Figure 64. Graph. Number of ParkUnload app uses (parking sessions) by week.

Figure 65 shows the number of ParkUnload App uses (i.e., parking sessions) by the day of the week. Figure 65 shows a higher number of parking sessions on weekdays (specifically, Mondays and Wednesdays) compared to weekend days. This pattern in truck parking capacity usage was consistent with the TPIMS data collected.

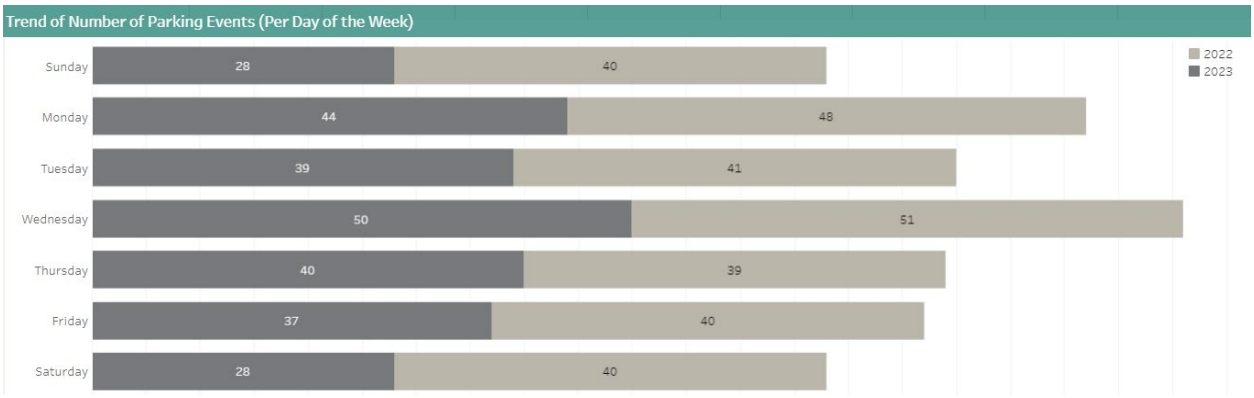


Figure 65. Graph. Number of ParkUnload app uses (parking sessions) by day of week.

Figure 66 shows the number of ParkUnload App uses (i.e., parking sessions) started by hour of the day. Figure 66 shows that the highest number of parking sessions were started between 7:00 p.m. and 10:00 p.m. The lowest number of parking sessions were started between 2:00 a.m. and 6:00 a.m.

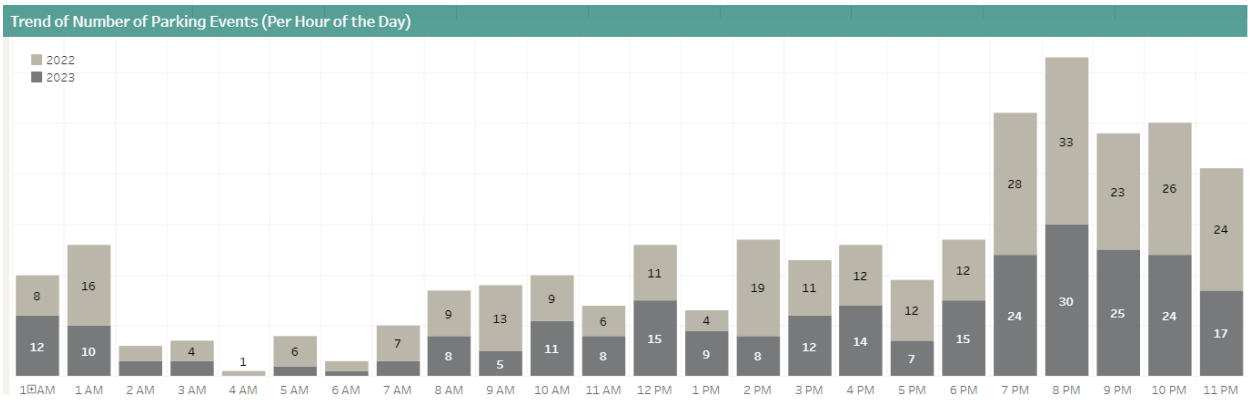


Figure 66. Graph. Number of ParkUnload app uses (parking sessions) by hour.

For additional information and analysis, see the data analytics dashboards that the research team developed at https://parkingpilot.org/dashboard/.

6.1 I-80 CORRIDOR

As mentioned before, the ParkUnload platform was used at the rest areas along the I-80 corridor to collect data on the usage of the app and how long drivers were parked in the pilot parking spaces. For this corridor, no parking time limit was programmed in the app. The ParkUnload platform in this scenario worked similar to the truck parking availability systems (such as TPIMS), with the exception that the drivers also knew where the available spaces were located in the rest area. Drivers were therefore not only provided with information via the app on how many parking spaces were available but also where the parking spaces were in the rest areas. The parking space reservation functionality of the ParkUnload platform was not tested at any rest areas along the I-80 corridor. All the rest areas included in the pilot were also included in the TPIMS project.

The ParkUnload App was used 418 times during the 12-month pilot by 338 truck drivers (ParkUnload App users) at the six pilot rest areas in Iowa. This section highlights insights obtained from the analysis of the data for these 418 parking sessions.

Figure 67 shows that August saw the highest number of app uses at the six pilot rest areas along the I-80 corridor, at 76 parking sessions. This is potentially the result of the communication strategy implemented in July and August 2022 that involved the research team reaching out to trucking associations and trucking groups, issuing a press release, conducting social media outreach, distributing pilot brochures and talking with drivers at the pilot rest areas during the week that the ParkUnload platform was installed, and participating in a number of media events. Figure 67 shows that after August, there was a decline every month in driver participation until January 2023, when there was a slight increase in the use of the app in January and February. The slight increase in January and February is potentially attributable to Iowa DOT displaying information about the pilot on the rest area monitors along the I-80 corridor starting mid-January 2023. The increase in app use in April is potentially attributable to the survey that was sent via text to ParkUnload App users on March 15, April 19, and May 19, 2023, to thank drivers for their participation and to solicit feedback on parking challenges and the ParkUnload App.

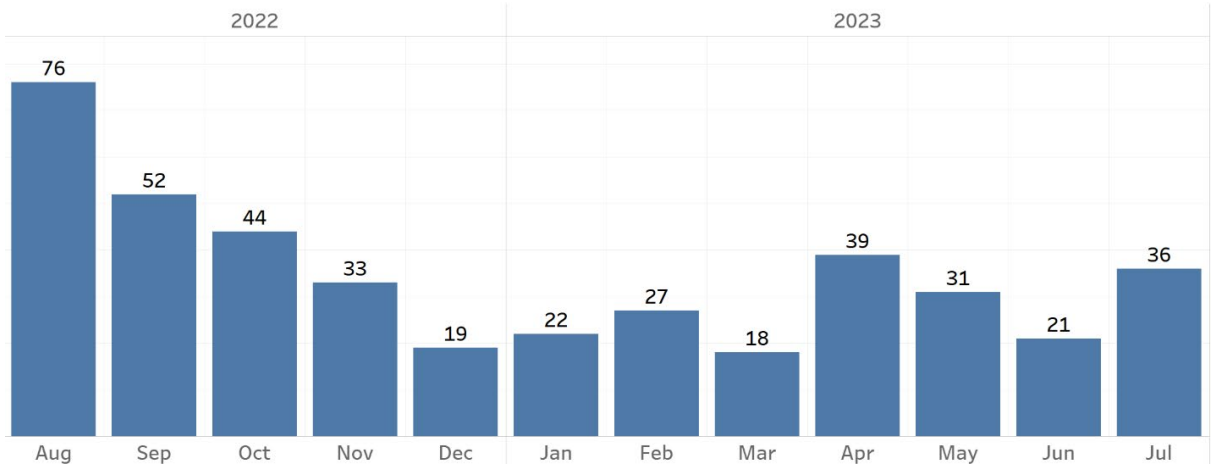


Figure 67. Graph. Number of parking sessions by month (I-80 corridor).

The research team included 24 parking spaces along the I-80 corridor in the pilot. Figure 68 shows that most days, the number of app uses varied between zero and two. In other words, of the 24 parking spaces included in the pilot, drivers checked into/claimed between zero and two parking spaces in a day on most days. The highest number of parking spaces checked into/claimed in a day was six.

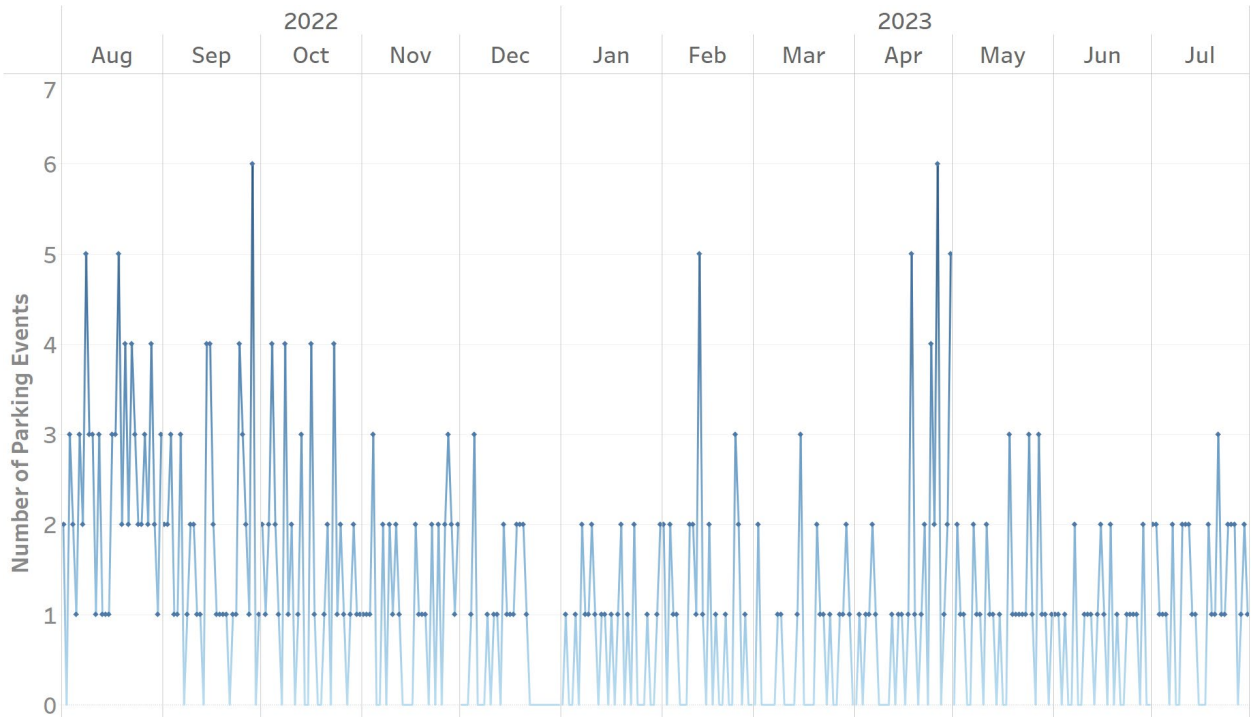


Figure 68. Graph. Number of parking sessions per day (I-80 corridor).

Figure 69 shows that most parking sessions (78, or 18.7 percent of the total parking sessions) were 30 minutes or less. On the other extreme, 76 (or 18.2 percent) of the parking sessions were 20 hours or more. Finally, 135 of the parking sessions (or almost one-third of the total parking sessions) were 9.5 to 13.5 hours, indicating that these users of the ParkUnload App were sleeping at these rest areas.

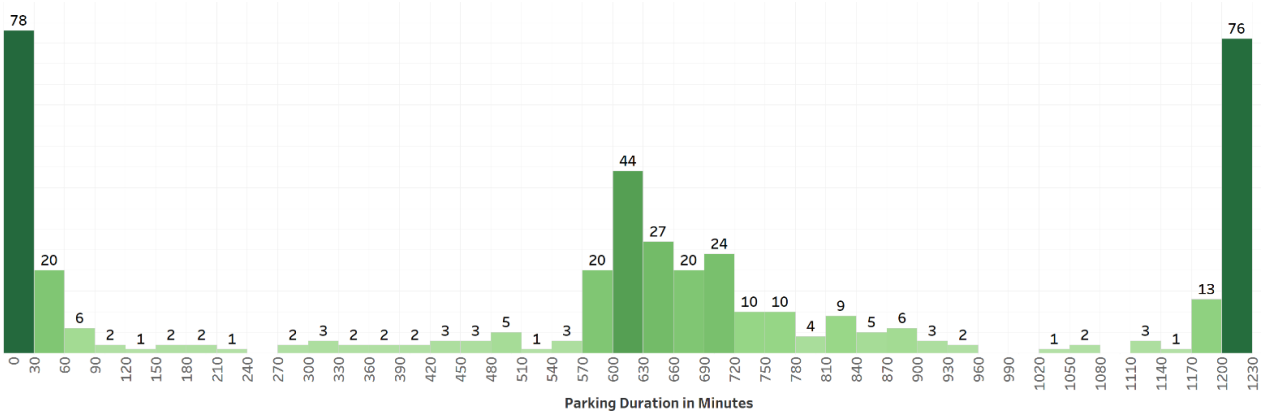


Figure 69. Graph. Time parked per parking session (I-80 corridor).

Figure 70 shows a peak in the number of parking sessions that were registered with the ParkUnload App between 7:00 p.m. and 9:30 p.m. After 9:30 p.m., there was a reduction in the number of parking sessions, and very few parking sessions started between 1:00 and 8:00 a.m.

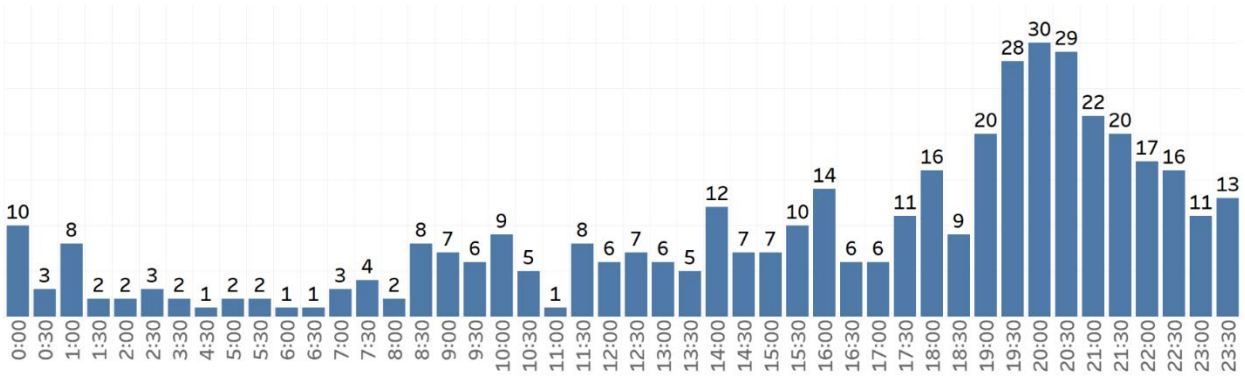


Figure 70. Graph. Number of parking sessions every 30 minutes of a day (I-80 corridor).

Appendix H contains the number of parking sessions by month, number of parking sessions per day, time parked per parking session, and number of parking sessions every 30 minutes of a day for each of the pilot rest areas along the I-80 corridor.

6.2 I-39/I-90/I-94 CORRIDOR

Similar to the application of the ParkUnload platform at the rest areas along the I-80 corridor, the ParkUnload platform was used at the three pilot rest areas along the I-39/I-90/I-94 corridor to collect data on the usage of the app and how long drivers were parked in the pilot parking spaces. At the rest areas along the I-39/I-90/I-94 corridor, however, a parking time limit of 2 hours was specified. In addition to providing drivers with information about the availability of parking and the location of the parking spaces, the research team attempted to explore the need for short-term parking. The 2-hour limit was programmed into the app. Drivers received a visual cue from the app that they had exceeded the time limit (i.e., the screen turned red), but no enforcement of the time limit was conducted.

The ParkUnload App was used 147 times during the 12-month pilot by 106 truck drivers (ParkUnload App users). This section highlights insights obtained from the analysis of the data for these 147 parking sessions.

Similar to the pilot rest areas along the I-80 corridor, Figure 71 shows that August saw the highest number of app uses at the three pilot rest areas that were included in the parking pilot at 24 recorded parking sessions. As stated before, this is potentially the result of the communication strategy implemented in July and August 2022. Figure 71 shows a decline in driver participation in September and October, but unlike the rest areas along the I-80 corridor, driver participation increased in November and December. January and February 2023 saw the lowest number of parking sessions. Similar to the I-80 corridor, the increase in app use in March, April, and May is potentially attributable to the survey that was texted to ParkUnload App users on March 15, April 19, and May 19, 2023, to thank drivers for their participation and to solicit feedback on parking challenges and the ParkUnload App.

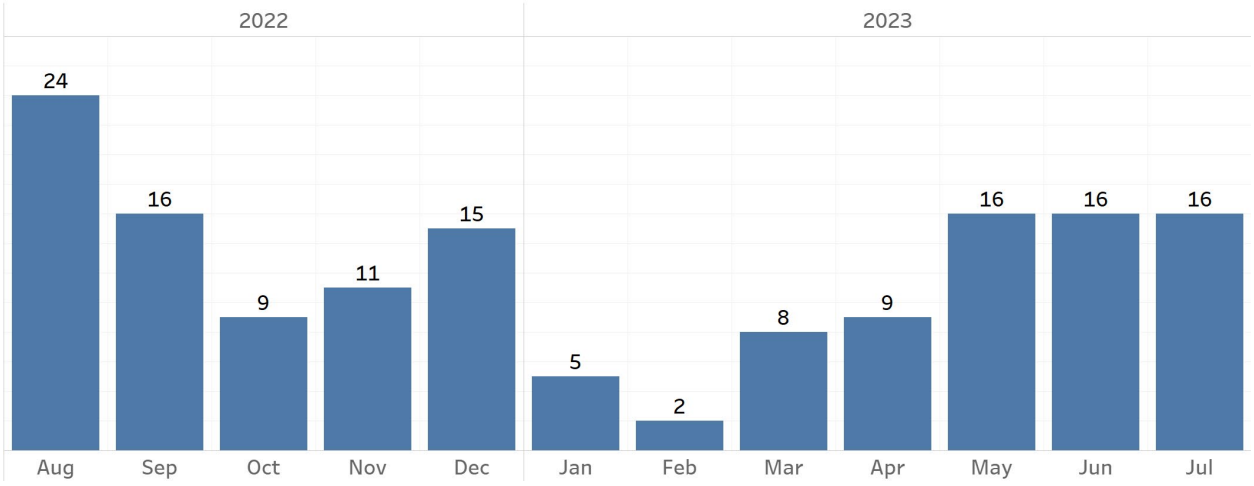


Figure 71. Graph. Number of parking sessions by month (I-39/I-90/I-94 corridor).

The research team included 12 parking spaces at three rest areas along the I-39/I-90/I-94 corridor in the pilot. Figure 72 shows that most days, the number of app uses varied between zero and one. In other words, of the 12 parking spaces included in the pilot, drivers checked into/claimed between zero and one parking spaces in a day on most days. The highest number of parking spaces checked into/claimed in a day was four.

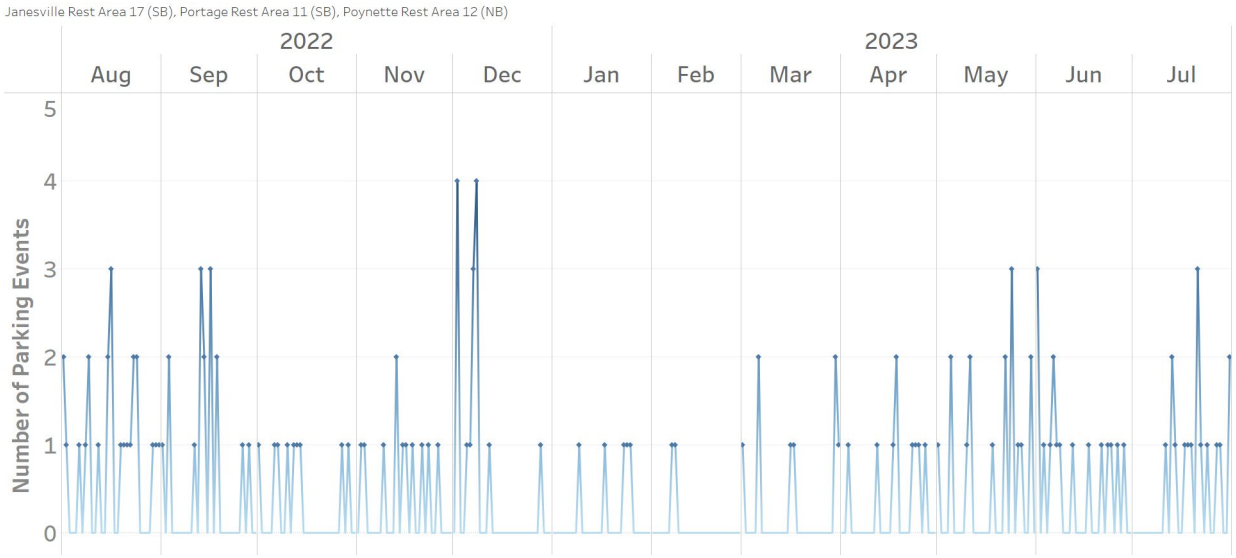


Figure 72. Graph. Number of parking sessions per day (I-39/I-90/I-94 corridor).

Figure 73 shows that most parking sessions (56, or 38.1 percent of the total parking sessions) were between 130 and 140 minutes. In other words, 38.1 percent of the parking sessions were over the time limit of 2 hours specified by between 10 and 20 minutes. No parking session, however, exceeded 140 minutes. Sixty-nine (or 46.9 percent) of the parking sessions were less than 50 minutes, potentially indicating that these users of the ParkUnload App were using the rest areas to access the restroom facilities or to comply with break requirements.

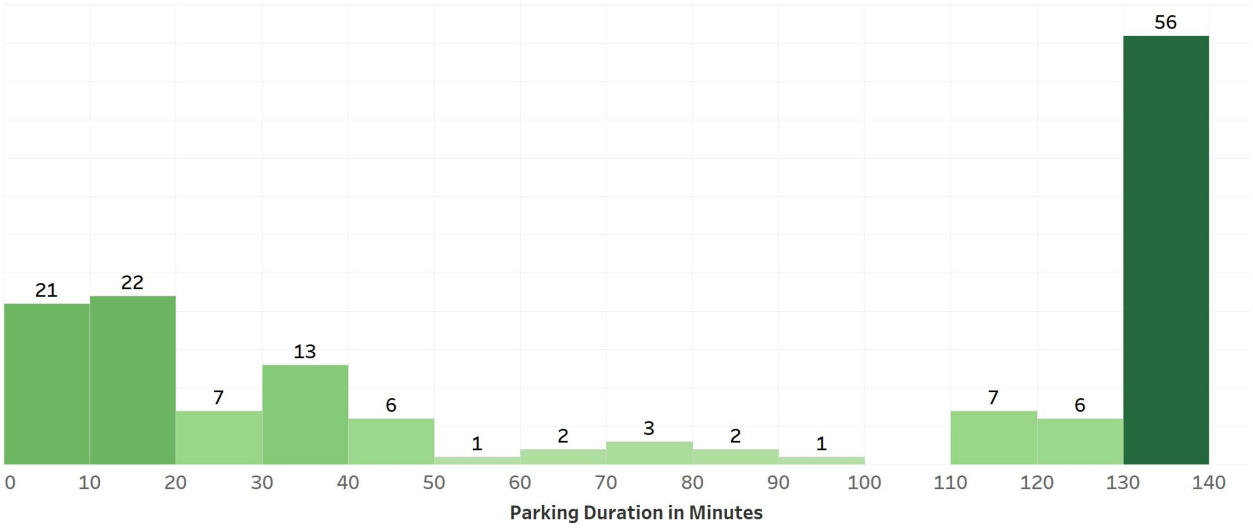


Figure 73. Graph. Time parked per parking session (I-39/I-90/I-94 corridor).

Figure 74 shows peaks in the number of parking sessions at 10:00 p.m., 11:00 p.m., 1:00 a.m., and noon. This finding seems to indicate drivers needing short-term parking at different hours than drivers using the rest areas to sleep (i.e., long breaks). These app users may have been truck drivers that operated at night and needed to use the restroom facilities or to comply with HOS regulations that require drivers to take a 30-minute break when they have driven for a period of eight cumulative hours without at least a 30-minute interruption.

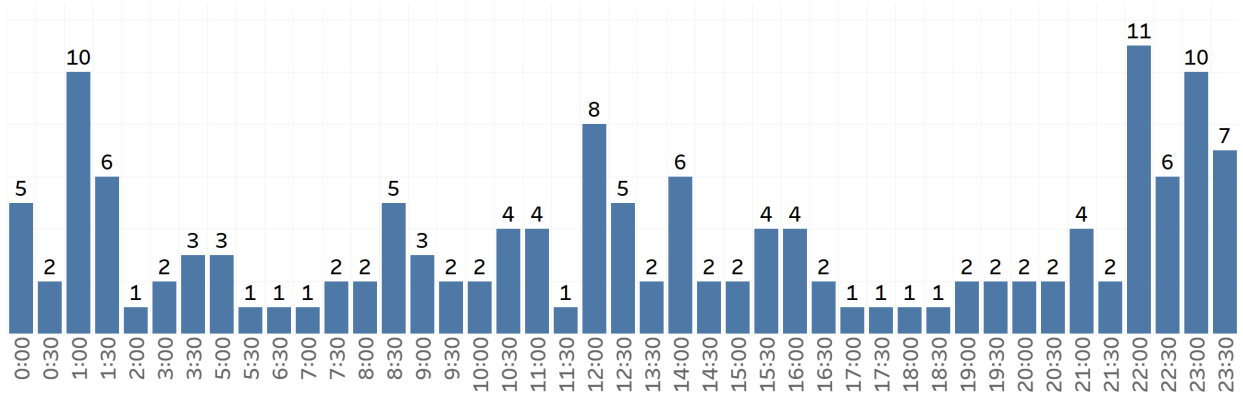


Figure 74. Graph. Number of parking sessions every 30 minutes of a day (I-39/I-90/I-94 corridor).

Appendix H contains the number of parking sessions by month, number of parking sessions per day, time parked per parking session, and number of parking sessions every 30 minutes of a day for each of the pilot rest areas along the I-39/I-90/I-94 corridor.

6.3 COMPLIANCE

WisDOT monitors its rest areas 24 hours a day and provided the research team with access to its rest area images database. In an effort to gauge compliance, the research team accessed the rest area images to determine how many trucks parked in the pilot parking spaces the first week of

August 2022 at each of the pilot rest areas and how many truck drivers checked in/claimed a parking space during the same week. This information reflects the best-case scenario because August was the month that saw the highest usage of the ParkUnload App.

The research team identified the number of trucks parked in the pilot parking spaces by reviewing all the rest area images captured in WisDOT's rest area images database and counting the number of trucks that parked in the pilot parking spaces. Note that these images were captured intermittently during the day and not necessarily at specific time intervals. It is therefore possible that some trucks that arrived after an image was recorded and left before the next image was recorded were not counted by the research team (see 08/6/2022 in Table 18).

Table 17, Table 18, and Table 19 show the counted number of trucks parked in the pilot parking spaces the first week of August 2022, the number of recreational vehicles parked in the pilot parking spaces, and the number of ParkUnload App uses at each of the three pilot rest areas in Wisconsin: Poynette, Portage, and Janesville, respectively.

Table 17 shows that the research team counted 35 trucks that parked in the pilot truck parking spaces at the Poynette rest area and that only five truck drivers used the ParkUnload App to claim/check into the pilot parking spaces, which resulted in a low compliance rate of only 14.3 percent. Table 17 also provides evidence of truck drivers' concern about the increased usage of truck parking spaces by recreational vehicles.

Table 17. Number of parked trucks, parked recreational vehicles, and ParkUnload app uses at Poynette.

Date	Trucks	Recreational Vehicles	ParkUnload App Uses	Compliance
8/1/2022	6	0	2	33.3%
8/2/2022	6	0	2	33.3%
8/3/2022	5	2	0	0.0%
8/4/2022	8	1	0	0.0%
8/5/2022	5	1	1	20.0%
8/6/2022	4	1	0	0.0%
8/7/2022	1	1	0	0.0%
Total	**35**	**6**	**5**	**14.3%**

Table 18 shows that the research team counted seven trucks that parked in the pilot truck parking spaces at the Portage rest area and that three truck drivers used the ParkUnload App to claim/check into the pilot parking spaces, which resulted in a low compliance rate of only 42.9 percent. No recreational vehicles parked in the pilot truck parking spaces the first week of August 2022.

Table 18. Number of parked trucks, parked recreational vehicles, and ParkUnload app uses at Portage.

Date	Trucks	Recreational Vehicles	ParkUnload App Uses	Compliance
8/1/2022	3	0	0	0.0%
8/2/2022	1	0	1	100.0%
8/3/2022	1	0	1	100.0%

Date	Trucks	Recreational Vehicles	ParkUnload App Uses	Compliance
8/4/2022	1	0	0	0.0%
8/5/2022	1	0	0	0.0%
8/6/2022	0	0	1	NA
8/7/2022	0	0	0	NA
Total	**7**	**0**	**3**	**42.9%**

Note: NA = not applicable.

Table 19 shows that the research team counted 19 trucks that parked in the pilot truck parking spaces at the Janesville rest area and that only one truck driver used the ParkUnload App to claim/check into the pilot parking spaces, which resulted in a low compliance rate of only 5.3 percent. Only one recreational vehicle parked in the pilot truck parking spaces the first week of August 2022.

Table 19. Number of parked trucks, parked recreational vehicles, and ParkUnload app uses at Janesville.

Date	Trucks	Recreational Vehicles	ParkUnload App Uses	Compliance
8/1/2022	4	0	1	25.0%
8/2/2022	5	0	0	0.0%
8/3/2022	6	0	0	0.0%
8/4/2022	1	0	0	0.0%
8/5/2022	2	1	0	0.0%
8/6/2022	1	0	0	0.0%
8/7/2022	0	0	0	NA
Total	**19**	**1**	**1**	**5.3%**

Note: NA = not applicable.

These observations, made over the first week of the pilot, indicate a significant number of truck drivers did not use the app. In an urban deployment, app use is enforced, and drivers are fined for not using the app when parked in the managed parking spaces.

7. DRIVER OUTREACH

The research team engaged truck drivers by handing out the pilot project brochures at the pilot rest areas, obtaining driver feedback in response to the social media outreach, and conducting a survey of the ParkUnload App users. This chapter summarizes the observations and feedback received from the truck driver community.

7.1 DISTRIBUTING BROCHURES AT PILOT REST AREAS

While implementing the truck parking management platform pilot (i.e., painting the parking spaces green and attaching the parking pilot signs to existing poles at the pilot rest areas), the research team used the opportunity to engage and explain to drivers the purpose of the pilot, how to participate in the pilot, and how to obtain additional information on the pilot. During the week of July 17, 2023, the research team handed out the project fliers and talked to about 100 drivers as they entered or exited the pilot rest areas.

Most of the drivers took the time to listen to the explanation, and most agreed that truck parking is a major issue for the industry. The drivers were overwhelming open to the pilot idea, and most had experience using the Trucker Path app. The Trucker Path App provides drivers with information about truck stop locations, available parking, fuel prices, and weigh station status, as well as a navigation tool to help them plan their route. Truck parking availability is estimated and uploaded by truck drivers using the app (https://truckerpath.com/trucker-path-app/). Initially, there was some concern that relying on drivers to download and use an app could be a challenge because the average age of a truck driver in the United States exceeds 50 years. However, in the conversations with the drivers, it became clear that it was not the app that provided pause but rather the need to download and use yet another app. Drivers already have numerous apps on their phones.

A few drivers elaborated on the challenges of being a truck driver (e.g., changes in tax regulations that do not allow drivers to deduct showers as business expenses in the case of owner-operators), but most drivers discussed the challenges associated with finding safe truck parking (i.e., overcrowded truck stops and rest areas, inadequate truck parking, parking on shoulders to comply with HOS requirements, and being bothered by unscrupulous individuals when parked at certain rest areas/truck stops). One driver was very excited about the pilot study and the potential benefits of using these types of applications to take advantage of Safe Haven rules. The driver mentioned that he needs permission to use Safe Haven, but it is usually denied. (Safe Haven rules apply only to certain hazmat drivers and parking locations for hazmat drivers. There is no Safe Haven rule that allows non-hazmat drivers to exceed their HOS.) Since the ParkUnload App provides information on the location and the number of parking spaces that are available along a corridor, he felt that it could be beneficial in helping him get approval for Safe Haven requests.

Of the approximately 100 drivers approached, six were not interested in hearing about the pilot study. In addition, four drivers got very agitated, stating that these kinds of projects are a waste of taxpayer money, and that the money can be better spent investing in additional truck parking facilities. One driver got very aggressive and stated that it was against the law for the research

team to paint the parking spaces green and to install the truck parking management platform at the public rest areas. He also indicated that he would not participate in the pilot. Finally, he stated that the funding could have been better used to create dedicated truck parking spaces for handicapped truck drivers or trucks drivers who are veterans.

7.2 ENGAGING DRIVERS THROUGH SOCIAL MEDIA

In October 2022—2 months after the pilot started—the research team conducted paid and targeted social media outreach to 16,356 Facebook and Instagram users belonging to various trucking groups in Iowa and Wisconsin. The truck parking pilot website link embedded in the message was opened by 205 users and was shared 222 times. The comments received from the trucking community were grouped and expressed the following sentiments:

- Stop research and invest in free truck parking.
- Need to involve truck drivers in truck parking design.
- Anti-app.
- Suspicion.

Specific comments received relating to each of these sentiments are copied below:

- Stop research and invest in free truck parking:
  - *"If the state governments stopped spending money on technology and actually added physical parking spaces, and exert the importance of them and new truck stops to the NIMBY people, we'd be better off."*
  - *"I love what you folks do, but this is probably expensive, time-consuming and unnecessary. Put the researchers in a truck for a week or two and they'll figure it out in short order. Then we can move to the next step much faster, which is actually solving the problem."*
  - *"I'll save you the time and money. Make more truck parking available especially near big cities."*
  - *"IACMV only cares about profits. If they cared about driver safety, there would be parking for a handful of trucks at every exit."*
  - *"They always want us to do the work in helping them map this situation out, but after everything is said and done very little to nothing changes. Why? Because we wasted 5 million doing a study and there wasn't enough funds left to make the changes. Government policies in action."*
  - *"Spaces have to physically be there. They are not. Quit wasting time with technology & get out there & make more spots. There are NONE in Va on 81 at night. And cops will wake you up on the ramp if youre desperately needing a nap on the ramp …"*
- Need to involve truck drivers in truck parking design:
  - *"Either way NO dummy with a degree should be allowed to be a 100% say so in the design. Mainly when it comes to parking. They dont comprehend the swing of a*

tractor and trailer type plays a factor in the swing. Some of these places it's actually a pain to get in and out of and the design is terrible. So when it comes to parking as yall study in so many areas. Include some drivers in the design before building, not everyone drives a 72' long fleet truck and trailer combo."

- Anti-app:
  - *"Another App, just what this country needs!!"*
  - *"I tried but the officer told me it was pointless to use the app and then proceeded to put me on the portables."*
  - *"Until they pay me for my time I'm not downloading anything."*
- Suspicion:
  - *" . . . they studying how to charge you via app."*
  - *"Just want you to log in so they can cross your logs to it . . . no thanks."*
  - *"They already know how many spaces are needed and they already know what areas of the country need them. This is just them trying to figure out how to charge for parking."*
  - *"A private company, located in a foreign country, is partnered in this study. That private company has a service to sell, should not be involved with the research. Not participating in it."*
  - *"Just another way to get your info . . ."*

7.3 SURVEYING PARKUNLOAD APP USERS

Drivers had the opportunity to comment on their experiences using the ParkUnload App and on the pilot project by (a) leaving a review of the ParkUnload App at the Apple Store/Google Play; (b) submitting comments to the pilot website (at Contact Us—Parking Pilot); and (c) calling the project hotline number, 833-256-0550 (toll free), provided on the pilot website. The research team received no driver comments on the pilot project website, no truck driver called the pilot project's toll-free number, and no comments were left at the Apple Store/Google Play.

The research team also texted a link to a six-question survey to the users of the ParkUnload App on March 15, April 19, and May 19, 2023. The six questions that comprised the online survey were:

- At which rest area have you used the ParkUnload App (if more than one, please mark the rest area you have used most often)?
- How difficult is it to find available long-term parking (more than 7 hours) at the rest area you most frequently use?
- How often do you need to park for a short duration (less than 2 hours) in a day?
- How difficult is it to find available parking for a short duration (less than 2 hours) between 8:00 p.m. and 6:00 a.m.?

- Please rate how easy it is to use the ParkUnload App to check in (and out) of the spaces included in the Truck Parking Pilot (i.e., the green-painted parking spots).
- Do you have additional feedback to provide?

Although 51 ParkUnload App users clicked on the survey link, only 37 completed the survey. Given that by the end of April 2023, 282 truck drivers have downloaded and used the app, then 37 participants represent a sample size of 13 percent of the ParkUnload App users. Figure 75 shows the responses to the following question: At which rest area have you used the ParkUnload App (if more than one, please mark the rest area you have used most often)? Figure 75 shows that eight of the nine pilot rest areas were mentioned by the survey respondents. The only pilot rest area that was not mentioned was Mitchellville EB.

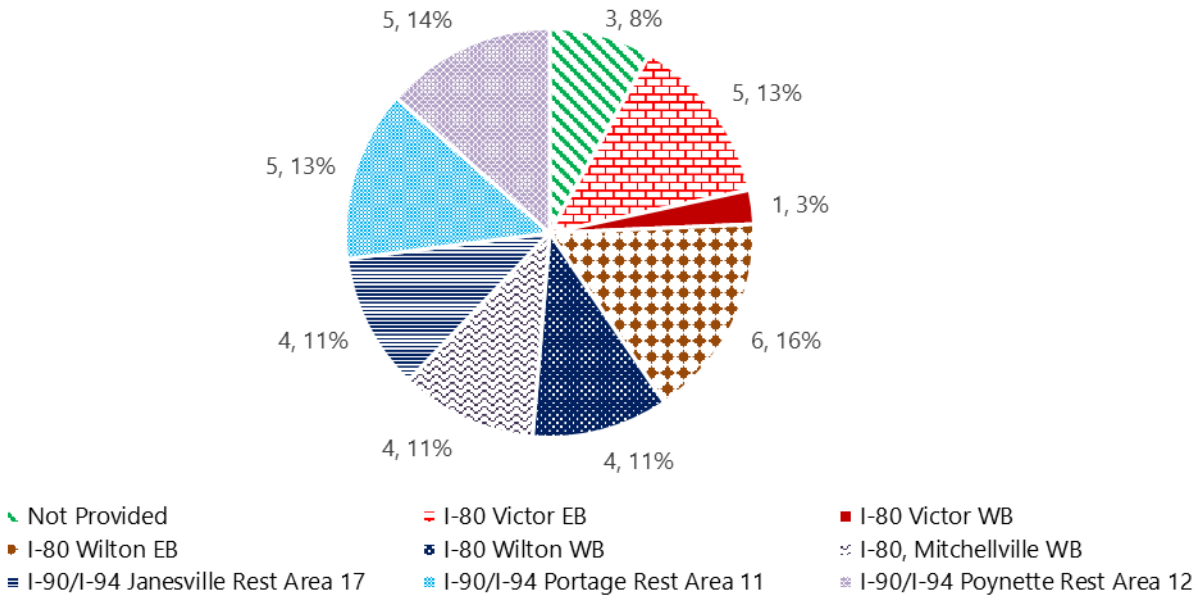


Figure 75. Graph. Rest areas where drivers used ParkUnload app.

Figure 76 shows the responses to the following question: How difficult is it to find available long-term parking (more than 7 hours) at the rest area you most frequently use? Figure 76 shows that almost half of the respondents reported that it was always a problem/usually a problem to find long-term parking (more than 7 hours) at the rest area they most frequently used. In some cases—for example, the Poynette rest area—it was reported that parking was always a problem, usually a problem, and never a problem. This discrepancy can potentially be attributable to time-of-day variations when a driver arrived at the rest area.

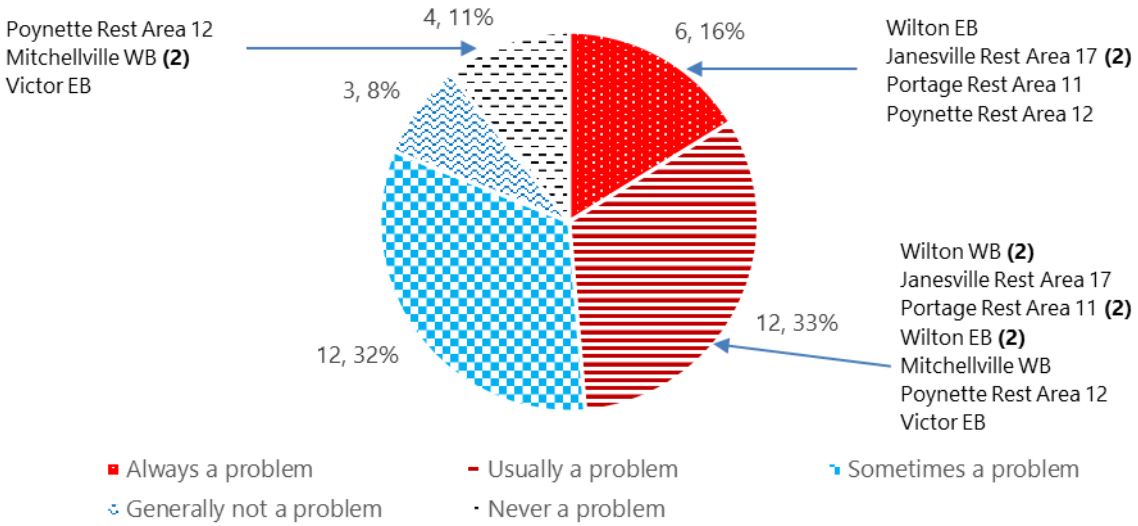


Figure 76. Graph. Difficulty finding long-term parking (more than 7 hours).

Figure 77 shows the responses to the following question: How often do you need to park for a short duration (less than 2 hours) in a day? Figure 77 shows that almost half of the respondents indicated that they needed to park once per day for a short duration (less than 2 hours). About 15 percent of the respondents indicated that they needed to park three times per day or more for a short duration. A similar percentage of respondents (14 percent) indicated that they did not need to park for a short duration in a day.

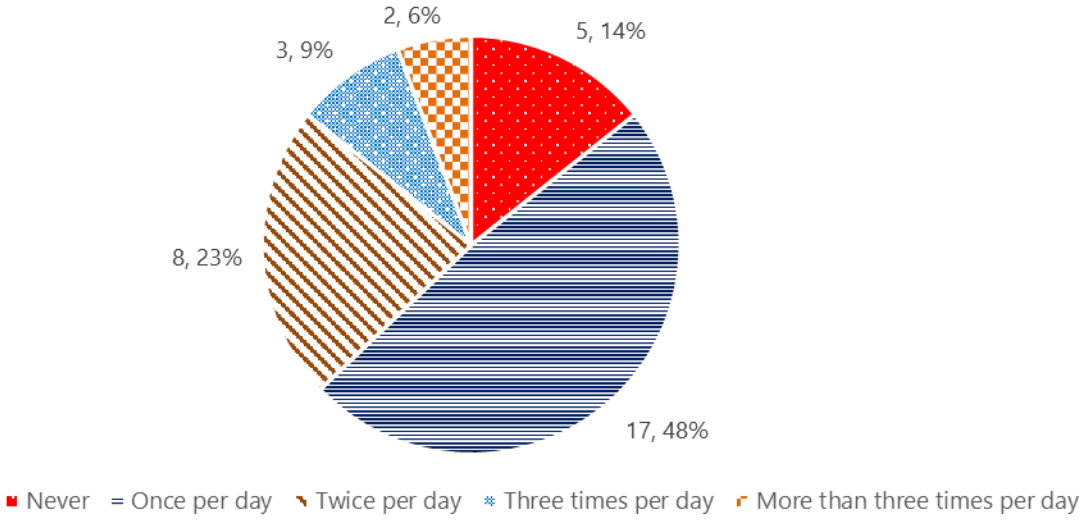


Figure 77. Graph. Need for short-duration parking (less than 2 hours).

Figure 78 shows the responses to the following question: How difficult is it to find available parking for a short duration (less than 2 hours) between 8:00 p.m. and 6:00 a.m.? Figure 78 shows the majority of the respondents (72 percent) reported that short-duration parking is always or usually a problem.

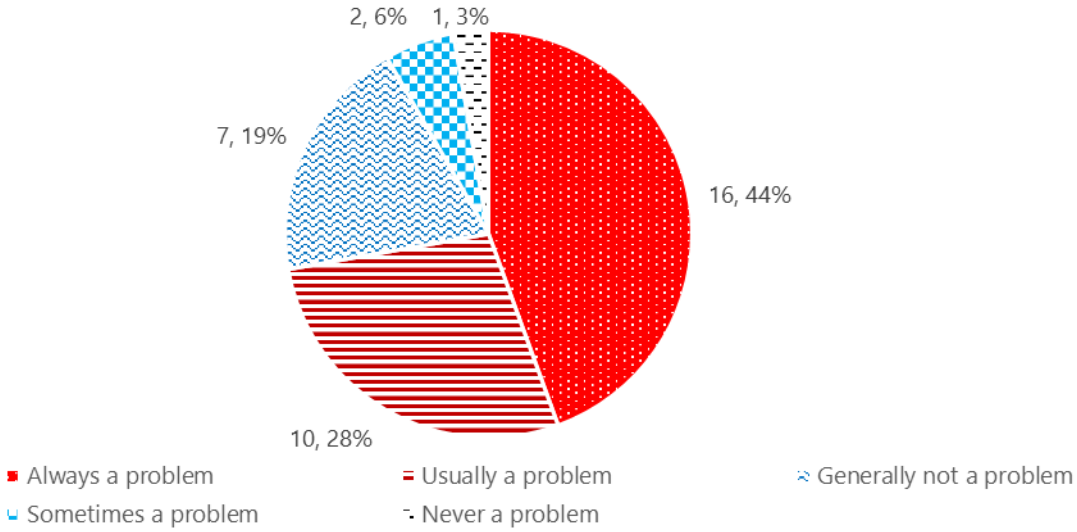


Figure 78. Graph. Difficulty finding short-duration parking (less than 2 hours)

Figure 79 shows the responses to the following request: Please rate how easy it is to use the ParkUnload App to check in (and out) of the spaces included in the Truck Parking Pilot (i.e., the green-painted parking spots). Figure 79 shows that the majority of the respondents (71 percent) found it extremely easy/easy to use the ParkUnload App.

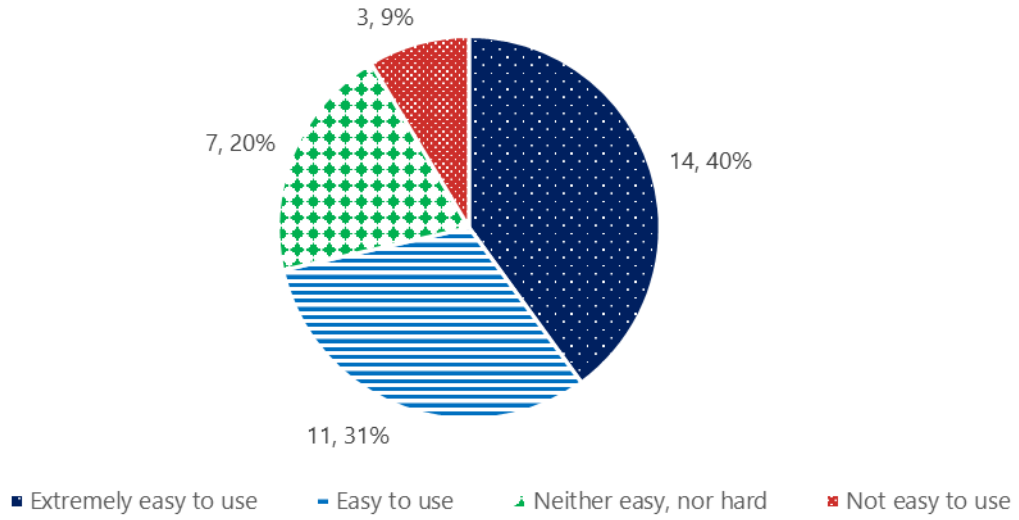


Figure 79. Graph. ParkUnload app ease of use.

Finally, drivers provided the following additional feedback to the open-ended question:

- *"I would like to see more inventive to use the parking program. Like perhaps free high speed wifi."*

- *"Honestly we need more parking spaces at places for overnight parking and not restricting drivers to less. It's more necessary to have more spaces for overnight than just a quick in and out which we can do at truck stops very easily."*
- *"It would be nice if there was more than 2 hours available."*
- *"Connectivity to the sensors /Wi-Fi at locations had to walk around the lot to connect."*
- *"I don't understand the purpose. Is it going to become paid or reserved parking? If so i am not for it."*
- *"We drivers need much more parking all around the USA. Its a shame the government doesn't take this lack of safe parking more seriously!!"*

The research team developed a second survey at the conclusion of the pilot to thank drivers for participating in the truck parking technology pilot and to gather input on the usefulness of app-based technologies in providing truck drivers with truck parking availability information and the need for dedicated short-duration parking. The research team developed a three-question survey (using Qualtrics) that was sent as a text message to the users of the ParkUnload App on August 2, 2023—one day after the end of the pilot period. The three questions that comprised the online survey were:

- In your opinion, is Parking Technology (such as the ParkUnload App) useful in finding where and when parking is available at rest areas?
- Do you think that dedicated short-duration parking spaces (i.e., 2 hours or less) at rest areas would be beneficial to you?
- Any other comments?

The research team analyzed the responses from 36 ParkUnload App users that completed the survey. Figure 80 shows the responses to the following question: In your opinion, is Parking Technology (such as the ParkUnload App) useful in finding where and when parking is available at rest areas? Figure 80 shows that 32 of the 36 respondents (almost 90 percent) indicated that parking technology (such as the ParkUnload App) is useful in providing parking availability information to truck drivers.

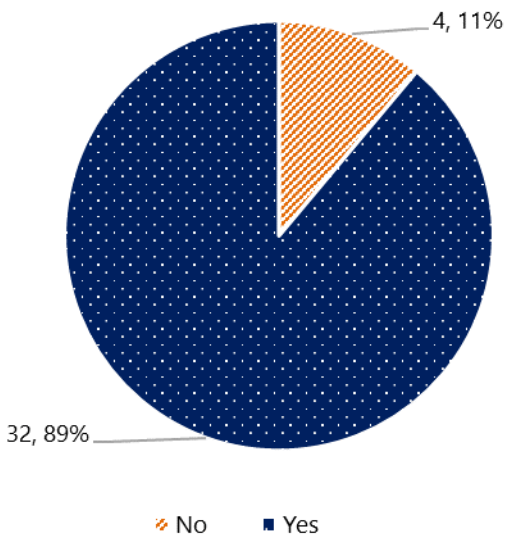


Figure 80. Graph. Feedback on whether parking technology is useful in providing available parking information.

Figure 81 shows the responses to the following question: Do you think that dedicated short-duration parking spaces (i.e., 2 hours or less) at rest areas would be beneficial to you? Figure 81 shows the respondents divided, with 47 percent indicating that dedicated short-duration parking spaces at rest areas would be beneficial and 53 percent indicating that short-duration parking spaces at rest areas would not be beneficial.

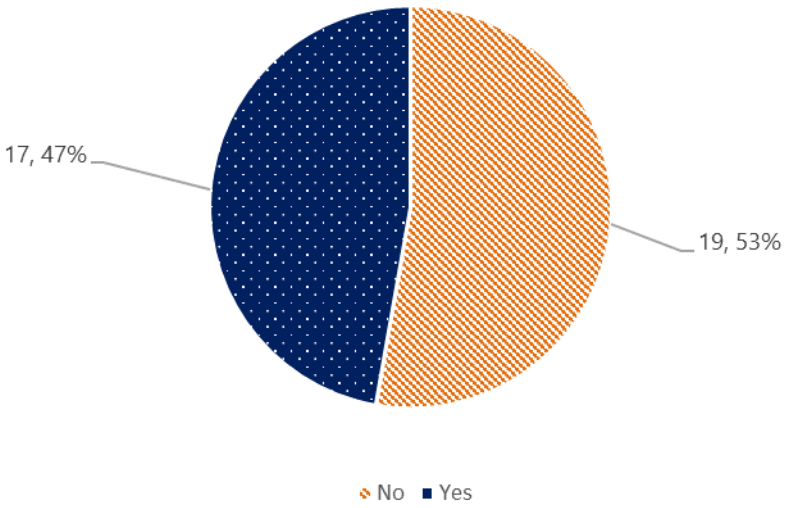


Figure 81. Graph. Feedback on whether short-duration parking spaces would be beneficial.

Finally, drivers provided the following additional comments to the open-ended question:

- *"Truckers don't need 2 hours we need 10. Doing this makes less space for truckers."*

- *"Every state, every highway needs more safe free parking."*
- *"I generally use Trucker Path app to find parking because of its extensive net work that is built-in."*
- *"Keep RV's and cars w/ trailers out of truck parking there are many other places they can park. This would help the truck parking shortage immensely."*
- *"The main problem for truckers, of course, is places to sleep at night. However, the idea of leaving space open so that trucks can get in and out to use the restroom is a great idea. I think it would be very difficult to enforce."*
- *"I would like to see the program expanded to all parking spaces. I believe it would be more useful then."*
- *"You would need a way to enforce the parking; otherwise, anyone can take the parking spot."*
- *"We need spaces for 10 hr parking i personally have no other needs for anything else."*
- *"Parking is a big problem, whether it's for a 30 minute break or 10 hours. I feel like if it isn't enforced, it doesn't matter how many green spots there are, if someone needs a spot, they park wherever they want."*
- *"What we really need is CAPACITY. More parking at more rest areas, more parking at shippers and receivers, and more strategically located sites. States like Indiana are closing rest areas, but not replacing them. Interstate 69 begins at Fulton, Kentucky. The first rest area is at the 250 mile marker in INDIANA! Kansas and Nebraska rest areas are very small."*
- *"Pretty useful while i[u]sing."*
- *"I wasn't in the trial area often and usually forgot to use the app."*
- *"Once i got to the parking area the app thought i was 6 mile away from the parking spot, i tried to restart the app and my phone several times but it still wouldn't get my current location. It worked great when i first started to use the app."*

8. STUDY FINDINGS AND CONCLUDING REMARKS

Adequate, safe parking remains a top concern for the trucking industry and for truck drivers, but providing sufficient and free parking in a timely manner is becoming increasingly challenging for both the public and private sectors. The objectives of this research were to (a) analyze the usage of truck parking capacity along the I-80 and I-94 corridors in the MAASTO States; (b) identify when, where, and for how long trucks are stopping in unauthorized locations along these two corridors; and (c) determine the feasibility and benefits of deploying truck parking capacity management platforms to optimize truck parking capacity usage from a geographical and temporal perspective.

8.1 DATA ANALYSIS

The research team acquired and analyzed three data sets while conducting the study:

10. The TPIMS data collected by MAFC to visualize the use and availability of truck parking capacity along the I-80 and I-94 corridors.
11. A sample of telematics data obtained from EROAD to identify when, where, and for how long trucks are stopping in authorized locations along the I-80 and I-94 corridors.
12. The data collected during the truck parking technology (app with Bluetooth) pilot at nine rest areas along the I-80 and I-39/I-90/I-94 corridors.

8.1.1 TPIMS Data

The analysis of the TPIMS data revealed that the average daily utilization of the TPIMS instrumented truck parking facilities along both the I-80 and I-94 corridors was less than the available capacity (i.e., ranging from 56 to 76 percent in the case of the I-80 corridor and from 30 to 70 percent in the case of the I-94 corridor) in the analysis period. These averages, however, mask differences in truck parking capacity utilization related to (a) specific truck parking facilities; (b) different sizes of truck parking facilities (i.e., number of truck parking spaces); (c) facility ownership (i.e., public rest area or private truck stop); and (d) time of day (i.e., evening hours vs. daytime hours), day of week, and month. For example, the research team found that there was a steady reduction in average truck parking availability at Rest Area 62 along the I-94 corridor on Wednesdays from 2:00 p.m. until 10:00 p.m. By 8:00 p.m., Rest Area 62 had reached capacity when more trucks had arrived and parked than the number of truck parking spaces available. After 2:00 a.m., more trucks started to leave the facility than arrived, and there was a steady increase in average truck parking availability until 9:00 a.m.

The study team analyzed available TPIMS data for a 4-year period (from July 1, 2019, to June 30, 2023). The time frame was selected to account for data quality improvements and to temper the impacts of COVID-19 on the analysis.

The analysis results are also impacted by the technology used to determine truck parking space availability. For example, entry-exit counts or screenline counts are very cost-effective, work well with designated entrances and exits, and allow for the accommodation of trucks in unmarked truck parking spaces. In general, the technology is considered less accurate though.

Space occupancy counts are more expensive than entry-exit counts because more sensors need to be installed and maintained. Space occupancy counts are considered more accurate, but these systems typically cannot be adapted easily to unmarked truck parking spaces.

8.1.2 Telematics Data

The research team obtained a sample of 360 truck parking clusters along the I-80 and I-94 corridors (i.e., 197 truck parking clusters along the I-80 corridor and 163 truck parking clusters along the I-94 corridor). Of the 197 sample truck parking clusters obtained from EROAD along the I-80 corridor, 23 clusters (or about 12 percent) were categorized as trucks parking in unauthorized locations. Analysis of the data revealed that 86.8 percent of the trucks stopping at these 23 unauthorized parking clusters stopped at the entrances or exits to the rest areas and truck stops along the I-80 corridor. The analysis also revealed that about 38.8 percent of the trucks stopped for an hour or less on average, and another 9 percent stopped for between 1.5 and 2 hours on average. Almost half (47.8 percent) of the trucks arriving in the unauthorized parking clusters along the I-80 corridor therefore stopped for an average of 2 hours or less.

Of the 115 sample truck parking clusters obtained from EROAD along the I-94 corridor, nine (or about 8 percent) of the clusters were categorized as unauthorized truck parking clusters. This sample is very small, so care should be taken in extrapolating the analysis to the entire population of trucks traversing the I-94 corridor. However, similar to the results for the I-80 corridor, the analysis also showed that the largest unauthorized truck parking clusters in the EROAD sample—both in terms of number of clusters and number of trucks stopped—were at the entrances to and exits from rest areas along the I-94 corridor. About 56.6 percent of the trucks arriving at the nine unauthorized clusters stopped, on average, for 30 minutes or less. On the other hand, 14 percent of trucks stopped at the unauthorized parking locations for an average of 9.5 hours or more.

8.1.3 Truck Parking Pilot Data Collected

A key objective of this research was to pilot the use of a truck parking capacity management platform—developed by ParkUnload—to better understand how truck parking capacity is used and to determine the feasibility and benefits of deploying an app and IoT platform that provides real-time truck parking availability information to drivers at a more granular level.

The research team tested the truck parking management platform in two ways:

- At the six Iowa pilot sites, the research team tested the feasibility of using the ParkUnload platform to provide users with information about where and when truck parking is available and to gather data about the usage of the truck parking spaces included in the pilot.
- At the three Wisconsin pilot sites, the research team tested the feasibility of using the ParkUnload platform to designate the pilot parking spaces for short-duration parking. ParkUnload programmed the app to display a 2-hour limit for trucks parking in the pilot parking spaces at the Wisconsin sites. No enforcement of the parking time limit was conducted.

The FMCSA truck parking pilot started on August 1, 2022, and ended on July 31, 2023—lasting a total of 12 months. The ParkUnload App was used 418 times during the 12-month pilot by 338 truck drivers (ParkUnload App users) at the six pilot rest areas in Iowa and 147 times by 106 truck drivers at the three pilot rest areas in Wisconsin.

The data analysis revealed that one-third of the ParkUnload App users at the six Iowa rest areas parked between 9.5 and 13.5 hours in the pilot parking spaces, suggesting that these truck drivers slept at these rest areas. This observation was also supported by the time of day when drivers checked into the parking spaces. The number of parking sessions peaked between 7:00 p.m. and 9:30 p.m. After 9:30 p.m., there was a reduction in the number of parking sessions, and very few parking sessions started between 1:00 and 8:00 a.m. In addition, 18.7 percent (or 78) of the parking sessions lasted 30 minutes or less, and 18.2 percent (or 76) of the parking sessions were for 20 hours or more.

The data analysis also revealed that ParkUnload App users were compliant with the 2-hour parking limit specified for the Wisconsin pilot rest areas. Although most parking sessions (56, or 38.1 percent of the total parking sessions) were between 130 and 140 minutes, these drivers overstayed the specified time limit of 2 hours by between 10 and 20 minutes. No parking session exceeded 140 minutes (or 20 minutes over the specified time limit). Almost half (69, or 46.9 percent) of the parking sessions at the Wisconsin pilot sites were less than 50 minutes. The analysis showed peaks in the number of parking sessions at 10:00 p.m., 11:00 p.m., 1:00 a.m., and noon. This finding seems to indicate drivers needing short-term parking at different hours than drivers using the rest areas to sleep (i.e., long break). These truck drivers may have been operating at night and needed to use the facilities or comply with HOS regulations that require drivers to take a 30-minute break when they have driven for a period of 8 cumulative hours without at least a 30-minute interruption.

8.2 TRUCK PARKING MANAGEMENT PLATFORM BENEFITS

Both Iowa DOT and WisDOT pointed to the fact that there is not enough funding to expand truck parking to meet current demand—let alone future demand. Truck parking management platforms—such as ParkUnload—as demonstrated during the pilot:

- Provide a low-cost technology option to inform drivers of not only the number of available truck parking spaces but also where the spaces are in a rest area or truck stop. (Current truck parking information systems, including TPIMS, communicate that parking spaces are low when a certain threshold is reached. According to stakeholders interviewed during this research, drivers will park on ramps or entrances/exits to rest areas rather than look for a parking space in an almost-full truck parking facility.)
- Provide comprehensive data on truck parking capacity usage that can help inform truck parking needs assessment studies, inform policy, and prioritize investments in truck parking facilities.
- Are extremely easy to deploy (a month from project acceptance) as opposed to the schedule for constructing rest areas and truck stops or implementing sophisticated truck parking availability systems.

- Are low cost with a high return on investment since they require no network infrastructure (only the driver's smartphone).
- Are proven to be technically feasible.
- Allow for diversifying and managing truck parking capacity (by designating truck parking spaces for certain load types or specifying the time available to park).
- Optimize the use of public rest areas and improve truck parking space utilization.
- Can be used to reserve a truck parking space (in a zone) in advance and thereby reduce the time drivers spend looking for a parking space. This capability of the technology was proposed for deployment at truck stops (private facilities), but none of the private stakeholders approached were interested in participating in the pilot.

8.3 TRUCK PARKING MANAGEMENT PLATFORM CHALLENGES

The two biggest challenges associated with app-based truck parking management platforms are driver participation (i.e., reaching drivers and convincing drivers to download the app) and compliance (i.e., convincing drivers to use the app every time when parking to check in and check out).

Reaching out to drivers and getting information to drivers are both challenging. The research team implemented a number of initiatives in an effort to share information about the pilot with drivers and to recruit drivers to participate in the pilot. The research team engaged truck drivers when implementing the ParkUnload platform at the pilot rest areas (i.e., handed out the pilot brochures, explained the pilot objectives, and asked drivers to participate), shared information through social media, displayed information about the pilot on the rest area monitors at the Iowa sites, posted pilot posters at the Wisconsin sites, and participated in media events (i.e., trucking shows). A substantial effort was also conducted to share information about the pilot with trucking associations, trucking interest groups, trucking industry contacts, and Iowa and Wisconsin freight advisory committees. It is, however, not clear how many drivers received information about the pilot. For example, the research team asked the trucking associations to share the pilot information with their members. It is not clear whether the associations shared the information with their members, and even if they did, it is unclear whether the member companies shared the information with truck drivers and asked them to participate in the pilot.

Driver participation in the pilot was also a major challenge. The research team, Iowa DOT, and WisDOT made a significant effort to provide information about the pilot and ask drivers to participate. August 2022 was the month that saw the most use of the ParkUnload App. Even so, an analysis of WisDOT's rest area images database showed that 14.3 percent of the counted trucks that parked in the pilot parking spaces used the ParkUnload App at Poynette, 42.9 percent at Portage, and 5.3 percent at Janesville the first week of August 2022. After August, a decline in driver participation was seen every month until January 2023, when app use started increasing again after Iowa DOT started displaying information about the pilot on the rest area monitors along the I-80 corridor, pilot posters were installed in the Wisconsin pilot rest areas (in February), and the research team made an effort to engage the ParkUnload App users by thanking them for their participation in the pilot and requesting their feedback on parking

challenges and the ParkUnload App (a survey link was texted to ParkUnload App users on March 15, April 19, and May 19, 2023.) Driver participation, however, never returned to the August 2022 level. Note that driver participation in the pilot was voluntary. A number of stakeholders as well as driver feedback pointed to the need to enforce the use of these app-based technologies for the platform to be feasible and provide reliable truck parking availability information to truck drivers.

Finally, the use of truck parking by pick-up trucks towing trailers and recreational vehicles (RVs) also impacts the accuracy and reliability of truck parking availability information shared with truck drivers. These vehicles parked in the pilot parking spaces but did not use the app. RVs accounted for six of the 41 vehicles (or 14.6 percent) that parked in the pilot parking spaces at Poynette the first week of August 2022.

8.4 DETERMINING THE FEASIBILITY OF TRUCK PARKING MANAGEMENT PLATFORMS (DRIVER PERSPECTIVE)

The assessment of the feasibility of truck parking management platforms—from a driver perspective—is complicated by the difficulty in identifying and reaching a representative sample of truck drivers that can be extrapolated to understand how the population of truck drivers will respond to these types of platforms. For example, the input received from truck drivers at the pilot rest areas during the implementation of the ParkUnload platform was *overwhelmingly positive*. Of the approximately 100 drivers approached, 90 took the time to listen to the pilot information shared, and most emphasized that truck parking is a major issue for the industry. The drivers were overwhelmingly open to the pilot idea, and most had experience using the Trucker Path app. Only six drivers were not interested in hearing about the pilot study. In addition, four drivers got very agitated, noting that these kinds of projects are a waste of taxpayer money, and that the money can be better spent investing in additional truck parking facilities.

On the other hand, the input received in response to the social media outreach was *overwhelmingly negative*. The sentiments expressed and example comments to illustrate each sentiment are provided below:

- Stop research and invest in free truck parking.
  - *"Spaces have to physically be there. They are not. Quit wasting time with technology & get out there & make more spots. There are NONE in Va on 81 at night. And cops will wake you up on the ramp if youre desperately needing a nap on the ramp . . ."*
- Need to involve truck drivers in truck parking design.
  - *"Either way NO dummy with a degree should be allowed to be a 100% say so in the design. Mainly when it comes to parking. They dont comprehend the swing of a tractor and trailer type plays a factor in the swing. Some of these places it's actually a pain to get in and out of and the design is terrible. So when it comes to parking as yall study in so many areas. Include some drivers in the design before building, not everyone drives a 72' long fleet truck and trailer combo."*
- Anti-app.

  - *"Another App, just what this country needs!!"*
- Suspicion.
  - *" . . . they studying how to charge you via app."*
  - *"Just want you to log in so they can cross your logs to it . . . no thanks."*

Finally, the feedback received from the ParkUnload App users was *predominantly constructive and positive*. For example, the majority of the ParkUnload App users that responded to the survey (71 percent) found the ParkUnload App extremely easy/easy to use, and almost 90 percent indicated that parking technology (such as the ParkUnload App) is useful in providing parking availability information to truck drivers.

8.5 RECOMMENDATIONS

The data collected and analyzed during this research study demonstrate:

- There is demand (especially for overnight parking) that is not being met, resulting in truck drivers, for example, parking on the entrances and exits to rest areas along both the I-80 and the I-39/I-90/I-94 corridors.
- The demand for short duration parking during both daytime and nighttime hours.

The pilot illustrated the technical feasibility of using technology solutions, such as parking capacity management platforms, to provide drivers with "more granular" (digital) information about the availability and location of truck parking spaces. It also demonstrated that the technology can be used to specify a time limit for drivers to park in a parking space and thereby manage the time that drivers are allowed to park to meet the needs for both long-duration and short-duration truck parking. A major challenge, though, is to convince drivers to comply (in terms of both downloading and using the app) or to enforce the usage of the app. Overcoming this challenge seems daunting for the entire population of truck drivers, or even for most of the rest areas and truck stops, in the United States. Having said that, the research team has identified a number of cases where the technology can be feasible:

- **Truck Stops.** These technology platforms can be implemented by truck stop owners interested in diversifying the parking services offered at truck stops. For example, truck stop owners can designate certain parking spaces close to the facilities for short-duration parking, providing truck drivers with a safe space to stop to use the facilities, purchase merchandise or food, or take a short break. These technology platforms also allow for the reservation and payment of parking spaces and can be used to designate and reserve certain parking spaces as part of preferred parking programs for truck drivers. For example, Travel Centers of America offers truck drivers a free parking space at preferred parking locations when making fuel and non-fuel purchases (e.g., merchandise, food, or service and repairs). This technology can therefore be used to help implement these preferred parking programs. Finally, truck stops have personnel on site 24/7 that can enforce the use of the app.

- **Smaller Rest Areas.** These technology platforms can be implemented at smaller rest areas (10 to 15 spaces) or the safety and weight enforcement facilities in Wisconsin where sophisticated truck parking availability systems may be cost prohibitive.
- **Oversize/Overweight (OS/OW) Truck Parking Reservations.** OS/OW permitted loads are a specialized and niche segment of the trucking industry. OS/OW permitted loads face unique challenges given the size and weights of the loads. In addition to the availability of truck parking spaces (which the general trucking sector is also challenged with), truck parking for OS/OW loads is further complicated by access constraints due to the design or location of rest areas/truck stops, the geometry of access roads to rest areas or parking facilities, and the difficulty of maneuvering OS/OW loads in half-full parking facilities. Furthermore, OS/OW trucks often just park in multiple truck parking spaces, making TPIMS unreliable. Some State DOTs are starting to provide designated parking for OS/OW loads. Given the challenges associated with these loads, it is foreseen that this segment of the industry would see the benefits of using this technology and potentially the reservation functionality of the technology.
- **Electric Charging Infrastructure.** As documented, a significant benefit of the truck parking management platform is that the app provides information about the number and location of the parking spaces available, as well as when parking time limits will be reached. In the future, assuming higher adoption of electric trucks, information about where electric charging infrastructure is available would be of benefit to truck drivers. In addition, if charging time limits are specified, truck drivers will also be able to see when the charging infrastructure will become available.

APPENDIX A. STATE DEPARTMENTS OF TRANSPORTATION INVESTED IN TRUCK PARKING AVAILABILITY SYSTEMS

In response to Jason's Law and the FHWA survey, several State DOTs (e.g., most MAASTO States along with Texas, Florida, Virginia, etc.) have implemented TPIMS. These systems are intended to convey real-time information to truck drivers about available parking. Figure 82 illustrates available truck parking data collection and dissemination technologies and their linkages.

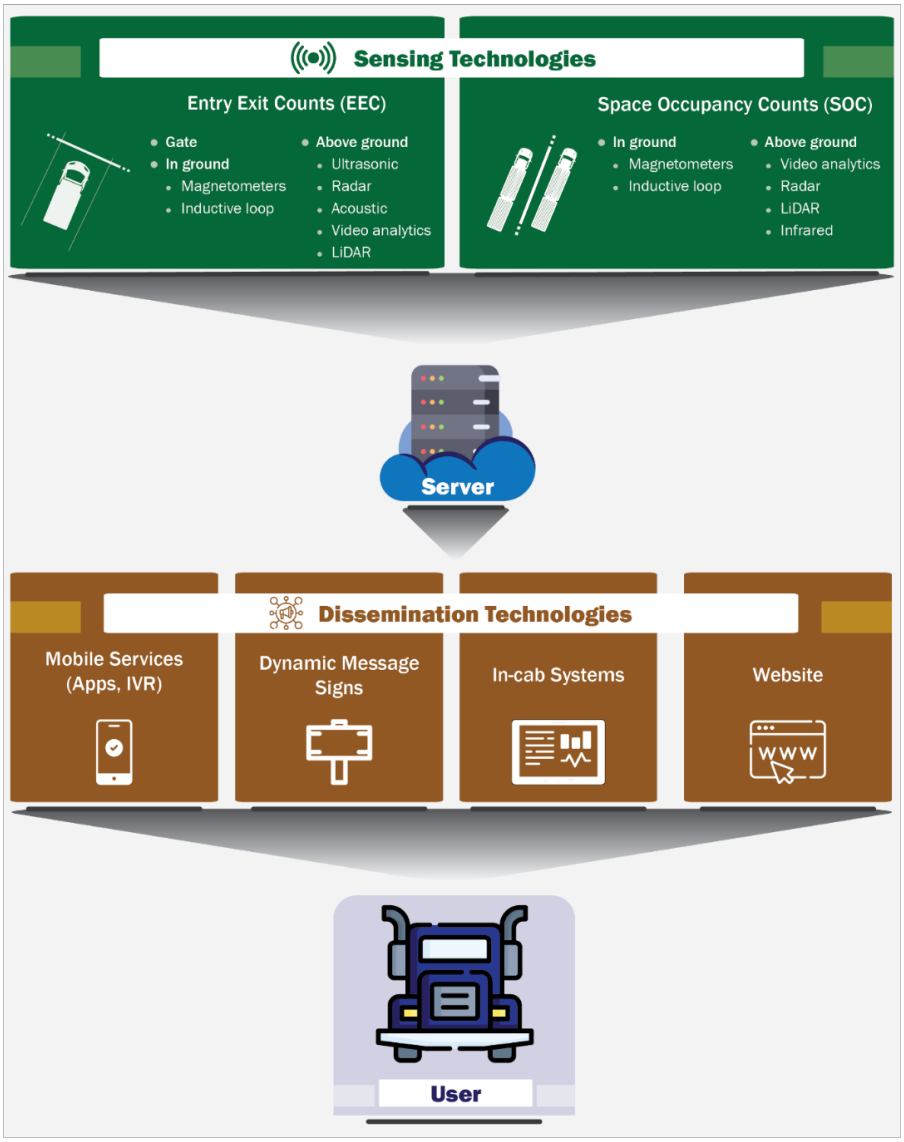


Figure 82. Diagram. Truck parking data collection and dissemination.

Different TPIMSs use different kinds of technology, and even combinations of technologies, to determine the number of parked vehicles and empty truck parking spaces. The methods for counting vehicles include camera vision systems that use software to identify and analyze objects in a video image at high speeds, in-ground sensors, infrared sensors, above-ground radar, and

side laser scanners, among others. Emerging technologies include sensor fusion, which combines radar with video analytics.

Table 20 summarizes previous truck parking studies that have deployed different sensing approaches and technologies for sensing and information dissemination.

Table 20. Examples of truck parking availability system studies.

Name of the Study	Location (States)	Sensing Approach	Sensing Technology	Dissemination Technology
SmartPark Technology Demonstration Project[20]	I-75 (TN)	EEC	Laser scanners/doppler radars	Mobile/DMS/ Website
Accelerating SmartPark Deployment Strategic Plan[21]	Not specified	EEC-SOC	Magnetometer, video analytics	Mobile/DMS/ Website
A Comprehensive System for Assessing Truck Parking Availability[22]	I-94 (MN)	EEC-SOC	Video analytics	Mobile/DMS/ Website
Truck Parking Information Systems: Truck Driver Use and Perceptions[23]	Not specified	EEC-SOC	Magnetometer, video analytics, in-ground sensors	Mobile/DMS/ Website
ATCMTD Grant Application: I-10 Corridor Coalition Truck Parking Availability System[24]	I-10 (CA, AZ, NM, TX)	EEC-SOC	In-ground sensors, video analytics	Mobile/DMS/ Website
Smart Parking-Management System for Commercial Vehicle Parking at Public Rest Areas[25]	I-10 (FL)	SOC	In-ground sensors	Website
Evaluation of Commercial Truck Parking Detection for Rest Areas[26]	I-75 (FL)	SOC	In-ground sensors/video analytics	DMS

Name of the Study	Location (States)	Sensing Approach	Sensing Technology	Dissemination Technology
SmartPark Truck Parking Availability System: Magnetometer Technology Field Operational Test Results[27]	I-95 (MA)	EEC-SOC	Magnetometer	Website
SmartPark Truck Parking Availability System: Video Technology Field Operational Test Results[28]	I-90 (MA)	EEC	Video analytics	Website
Evaluation of Michigan DOT Truck Parking Information and Management System[29]	I-94 (MI)	EEC	Magnetometer, video analytics	Website
Automated Low-Cost and Real-Time Truck Parking Information System[30]	I-95 (MD)	SOC	In-ground sensors	Website

EEC = Entry-Exit Counts
SOC = Space Occupancy Counts
DMS = Dynamic Message Sign

APPENDIX B. STAKEHOLDER OUTREACH

In spring and summer 2021, the research team presented the research objectives to stakeholders to obtain input and to identify and solicit potential rest area/truck stop owners to allow the research team to pilot the truck parking capacity management platform at their rest areas/truck stops. The research team developed PowerPoint presentations (PPPs) and scheduled Microsoft Teams meetings with FHWA, selected State DOTs, and private truck stop owners. Table 21 lists the stakeholder agencies/companies with which the research team met. The rest of this section highlights some of the feedback received.

Table 21. Stakeholder agencies/companies.

Agency/Company
State Departments of Transportation: • Minnesota • Wisconsin • Indiana • Ohio • Iowa
Turnpikes: • Indiana Toll Road Authority • Ohio Turnpike and Infrastructure Commission
Private Truck Stops: • KwikTrip • Iowa 80 Truck Stop • Pilot Travel Centers
Other: • Trucker Path

MINNESOTA

The research team met with a representative from the Minnesota DOT. The Minnesota DOT representative remarked that the TPIMS data collected are not 100 percent accurate. He also observed that truck drivers are reluctant to go look for a truck parking space in an almost-full facility. There is therefore a behavior component to the truck parking problem. Also, truck drivers are a diverse population, with many truck drivers not speaking English.

The DOT representative said that truck parking was a challenge in Minnesota. The situation was at the time made worse by the City of Minneapolis banning tractor-trailers from parking on city streets in both residential and industrial areas. The action by the city reduced regional truck parking capacity even further. He mentioned that there was insufficient truck parking in both Minneapolis and Lauderdale.

The challenge in Minnesota was not spreading the peak but rather addressing the truck parking needs. The DOT representative offered that truck parking facilities will have to be developed in collaboration with nonprofit organizations since neither the private nor the public sector is in a position to solve the truck parking problem.

The DOT representative said that KwikTrip was not interested in participating in TPIMS. He said that the institutional support for Minnesota DOT's participation in TPIMS after the grant period was also uncertain. Minnesota DOT was ultimately not interested in participating in the FMCSA pilot study.

INDIANA

The research team met with two representatives from the Indiana DOT and a representative from the Indiana Toll Road Authority.

The representatives from Indiana DOT said that the DOT had no instrumented TPIMS rest area facilities along I-94. The rest area facilities on I-94 were leased to a consortium. Indiana DOT was therefore not in a position to participate in the pilot project but recommended that the research team reach out to the Indiana Toll Road Authority.

The Indiana Toll Road Authority representative was initially very interested in participating in the FMCSA pilot. The Indiana Toll Road Authority at the time was investing in a smart truck parking system that recorded the trucks entering and leaving a travel plaza. The system was going to be calibrated every 24 hours, and truck parking availability information (i.e., number of available truck parking spaces) was going to be made available to truck drivers via dynamic message signs. The system was set to be implemented at four pairs of travel plazas (eight facilities in total). The system was not going to be implemented in two pairs of travel plazas (four facilities). These travel plazas were seen as potential locations for being included in the pilot. The representative mentioned that trucks represented 75 percent of the authority's toll revenue. Ultimately, the Indiana Toll Road Authority decided not to participate in the pilot because there was concern that drivers would get confused if the two systems were implemented during a similar time frame.

OHIO

The representative that met with the research team were very interested in the research but mentioned that I-80 through Ohio is a toll road managed by the Ohio Turnpike and Infrastructure Commission. (The Ohio Turnpike and Infrastructure Commission is a separate entity from ODOT but is connected with ODOT in that the ODOT director serves on the board of the Ohio Turnpike and Infrastructure Commission.) At the time, Ohio DOT (ODOT) had recently completed its freight plan. One of the components of the freight plan focused on truck parking. Specifically, the freight plan identified opportunities for investing in truck parking and providing safe havens for trucks to park. ODOT also applied for a Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grant to plan the truck parking facilities of the future because the ODOT representative foresaw that different amenities, for example, electric charging stations, would be needed in the future. The ODOT representative cautioned that the TPIMS information is not particularly accurate. Many rest areas are instrumented with in-ground sensors (i.e., puck systems) that are older technology and provide less robust data.

The Ohio Turnpike and Infrastructure Commission manages 14 service plazas with truck parking along I-80 in Ohio. The research team met with several representatives from the commission, but

ultimately the commission was concerned that participating in the FMCSA pilot would be viewed as the turnpike receiving Federal funds. The turnpike is not under FHWA jurisdiction, and the commission was concerned that participating in the Federally funded research could jeopardize its agreement.

IOWA

The research team met several times with representatives from Iowa DOT. Iowa DOT participated in TPIMS, but unlike most DOTs that made truck parking availability information available through variable message signs, Iowa DOT decided to provide truck drivers with information about parking availability through the agency's 5-1-1 site (see Iowa 511 Travel Information [511ia.org]).

Iowa DOT was specifically interested in the more granular data that were to be collected with the ParkUnload platform. The final meeting that the research team had with Iowa DOT involved 13 employees that represented field operations, systems operations, systems planning, project management, traffic and safety, and maintenance.

WISCONSIN

The research team had several meetings with WisDOT. WisDOT agreed to participate in the FMCSA pilot early on. However, WisDOT requested that an MoU be developed that outlined the expectations of the DOT and the research team clearly. WisDOT recommended a consistent approach for instrumenting the parking spaces (e.g., X percent of the parking capacity at a specific rest area, a specific number of parking spaces closest to bathrooms, etc.). WisDOT also shared relevant stakeholder contacts and facilitated conversations with stakeholders critical to the success of the study (e.g., WisDOT region maintenance staff, rest area facility site supervisors, State troopers, Office of Public Affairs).

PRIVATE SECTOR

The private sector was more difficult to connect with. The research team did manage to communicate with representatives from KwikTrip, the Iowa 80 Truck Stop, and Pilot Travel Centers, but follow-up emails and telephone attempts were left unanswered after the research team requested participation in the FMCSA pilot.

The research team also met with representatives from Trucker Path. The representatives saw many benefits in the ParkUnload platform and thought that the app could reduce the time drivers spent looking for a parking space. A significant benefit of the platform was that the app provided not only the number of spaces available but also the location of the spaces. Trucker Path pointed out that compliance was the biggest challenge foreseen with the use of the parking app since there were no consequences for a driver not complying. Trucker Path therefore recommended that the research team offer an incentive for drivers to participate in the pilot.

APPENDIX C. MEMORANDUM OF UNDERSTANDING WITH THE IOWA DEPARTMENT OF TRANSPORTATION

FINAL DRAFT

MEMORANDUM OF UNDERSTANDING

between the

Texas A&M Transportation Institute

and the

Iowa Department of Transportation

November 1, 2021

BACKGROUND

In October 2021, the Texas A&M Transportation Institute (TTI) and the Iowa Department of Transportation (Iowa DOT) (collectively: "Parties") recognized the mutual benefits of collaborating and cooperating on the Federal Motor Carrier Safety Administration (FMCSA) study entitled, "**Assessing Truck Parking Capacity Usage to Inform Truck Parking Needs Assessments and Determine the Feasibility and Benefits of Truck Parking Capacity Management Platforms**," which is being conducted by the TTI, the University of Wisconsin-Madison, and ParkUnload (collectively: "Study Team"). The period of performance for the research study ends September 30, 2023.

The objectives of the research are to collect truck parking capacity usage data at public and private rest areas along the I-80 corridor and to determine the feasibility and benefits of deploying a truck parking capacity management app and Internet of Things (IoT) platform to understand and optimize truck parking capacity usage. Funding for this study is provided by FMCSA under the agency's FY20 High Priority Cooperative Agreement program. To facilitate coordination, Iowa DOT and TTI have developed this Memorandum of Understanding (MOU) to establish a framework for cooperation and collaboration to support and advance the research.

THE PARTIES AGREE AS FOLLOWS:

A) Iowa DOT will collaborate with the Study Team by:

1. Identifying specific rest area facilities in Iowa for inclusion in the study.
2. Approving the instrumentation of an agreed number of parking spaces at identified rest area facilities.
3. Sharing insight and providing guidance on the approach for instrumenting parking spaces (e.g., install 10 percent of the parking capacity at a specific rest area, parking spaces closest to bathrooms, etc.).
4. Sharing relevant stakeholder contacts and facilitating conversations with stakeholders critical to the success of the study.
5. Meeting monthly to discuss parking data reports and any challenges/concerns.

B) The Study Team will be responsible for:

1. Analyzing the truck parking locations identified by Iowa DOT's Project Management Bureau to identify poles for sign installations.
2. Coordinating with the Traffic and Safety Bureau and the Maintenance Bureau with respect to site signage.
3. Planning and logistics of the installation of the Smart Road Signs.
4. Manufacturing of the Smart Road Signs that will be installed at the identified and agreed upon rest area facilities.
5. Establishing the ParkUnload platform for drivers, Iowa DOT, and the researchers.
6. Obtaining permits to perform any required work on state highway ROW as detailed in this MOU.
7. Facilitating installation and testing of Smart Road Signs in the identified truck parking locations.
8. Replacing damaged signs, which includes all materials, labor, etc.
9. Developing a communications strategy for sharing the pilot project information with trucking associations, trucking companies, and users (e.g., brochures, twitter, press releases, etc.).
10. Providing support to users of the ParkUnload platform by providing a hotline number to call.
11. Providing operational support and maintenance for all software, hardware components, and system integrations.
12. Providing periodic parking data reports and analytical services.
13. Conducting any driver surveys on the use of the ParkUnload app.
14. Ensuring all applicable federal and state regulations and standards are followed.
15. Removing all hardware and physical infrastructure and ensuring that the sites are restored to their original or better condition (normal wear and tear and casualty loss excluded).
16. Supplying a report and recommendations to Iowa DOT related to project results within one month after study completion to Mr. Phil Mescher (Phil.Mescher@iowadot.us) and Mr. Sam Hiscocks (Samuel.Hiscocks@iowadot.us).

ATTEST

Texas A&M Transportation Institute:	**Iowa Department of Transportation:**
DocuSigned by: Rodney Horrell	
Signature	Signature
Rodney Horrell, Chief Financial Officer	CRAIG MARKLEY, SYSTEMS PLANNING BUREAU DIRECTOR
	Printed Name, Title
1/18/2022	1-14-2022
Date	Date

APPENDIX D. MEMORANDUM OF UNDERSTANDING WITH THE WISCONSIN DEPARTMENT OF TRANSPORTATION

MEMORANDUM OF UNDERSTANDING

between the

Texas A&M Transportation Institute

and the

Wisconsin Department of Transportation

November 29, 2021

BACKGROUND

In July 2021, the Texas A&M Transportation Institute (TTI) and Wisconsin Department of Transportation (WisDOT) (collectively: "Parties") recognized the mutual benefits of collaborating and cooperating on the Federal Motor Carrier Safety Administration (FMCSA) study entitled, "**Assessing Truck Parking Capacity Usage to Inform Truck Parking Needs Assessments and Determine the Feasibility and Benefits of Truck Parking Capacity Management Platforms**," which is being conducted by the TTI, the University of Wisconsin-Madison, and ParkUnload (collectively: "Study Team"). The period of performance for the research study ends September 30, 2023.

The objectives of the research are to collect truck parking capacity usage data at public rest areas along the I-94 corridor and to determine the feasibility and benefits of deploying a truck parking capacity management app and Internet of Things (IoT) platform (collectively: "ParkUnload Platform") to understand and optimize truck parking capacity usage. Funding for this study is provided by FMCSA under the agency's FY20 High Priority Cooperative Agreement program. To facilitate coordination, WisDOT and TTI have developed this Memorandum of Understanding (MOU) to establish a framework for cooperation and collaboration to support and advance the research.

THE PARTIES AGREE TO PERFORM DURING THE STUDY PERIOD AS FOLLOWS:

A) WisDOT will collaborate with the Study Team by:

1. Identifying specific rest area facilities or Safety Weight Enforcement Facilities (SWEFs) in Wisconsin for inclusion in the study.
2. Approving the instrumentation of an agreed number of parking spaces at WisDOT identified rest area facilities or SWEFs in Wisconsin.
3. Sharing relevant data (Drivewyze) as permitted by applicable use agreements or subscriptions to compare with the data collected by ParkUnload (e.g., how long drivers stop at the rest area facilities and SWEFs).
4. Sharing insight and providing guidance on the approach for instrumenting parking spaces (e.g., install 10 percent of the parking capacity at a specific rest area, parking spaces closest to bathrooms, etc.).
5. Sharing relevant stakeholder contacts and facilitating conversations with stakeholders critical to the success of the study (e.g., WisDOT Region Maintenance staff, rest area facility site supervisors, state troopers, Office of Public Affairs)
6. Exploring the adaptation and use of the Traveler Satisfaction survey used by the Bureau of Highway Maintenance to include questions that address the use of the ParkUnload Platform.
7. Meeting monthly to discuss parking data reports and any challenges/concerns.

B) The Study Team will:

1. Analyze the truck parking locations identified by WisDOT to identify poles for sign installations.
2. Coordinate with the Bureau of Traffic Operations and the Bureau of Highway Maintenance Roadside Facilities with respect to site signage.
3. Consult with WisDOT's Division of State Patrol (DSP) on the allocated spaces at the Safety Weigh Enforcement Facilities (SWEFs), if used during this study, and coordinate on the site staging needs and designated locations for out of service vehicles at the SWEFs as well as enforcement needs.
4. Manufacture, test, and install the Smart Road Signs on existing poles (at the expense of the Study Team) at the identified and agreed upon rest area facilities or SWEFs in Wisconsin.
5. Implement the ParkUnload Platform for drivers, WisDOT, and the researchers.
6. Obtain a WisDOT Work on Highway Right-of-Way Permit to perform any required work on state highway ROW as detailed in this MOU.
7. Replace any damaged signs.
8. Develop a communications strategy for sharing the pilot project information with trucking associations, trucking companies, and users (e.g., brochures, twitter, press releases, etc.).
9. Provide operational support to users of the ParkUnload Platform by providing a hotline number to call.
10. Maintain all software, hardware components, and system integrations to ensure continued operability of the ParkUnload Platform during the study period.
11. Provide periodic parking data reports to WisDOT at regular intervals.
12. Conduct driver surveys on the use of the ParkUnload Platform.
13. Ensure all applicable federal and state regulations and standards are followed.
14. Remove all signs and ensure that the sites are restored to their original or better condition (normal wear and tear and casualty loss excluded).
15. Complete all activities and supply a report and recommendations to WisDOT related to project results no later than November 1, 2023 to Chris Ohm (chris.ohm@dot.wi.gov) and Tom DeWinter (thomas.dewinter@dot.wi.gov).

ATTEST

Texas Transportation Institute:	**Wisconsin Department of Transportation:**
DocuSigned by: Rodney Horrell 599EA8D7F3C948C...	Christopher A Ohm
Signature	Signature
Rodney Horrell	CHRISTOPHER A. OHM SECTION CHIEF
Assistant Agency Director and CFO	Printed Name, Title
12/10/2021	4 JAN 22
Date	Date

APPENDIX E. WISCONSIN DEPARTMENT OF TRANSPORTATION PERMIT TO WORK ON HIGHWAY RIGHT-OF-WAY

APPLICATION/PERMIT TO WORK ON HIGHWAY RIGHT-OF-WAY

Wisconsin Department of Transportation (WisDOT)
DT1812 1/2016 s. 86.07(2), 86.16 and other applicable Wis. Stats.

1. Applicant's Name, Address, City, State and ZIP Code	2. Work Start Date / 3. Work Finish Date*	4. Location Description (¼ section, section, town, range; provide plat and location maps)
Texas A&M Transportation Institute (TTI) 505 E. Huntland Drive Austin, TX 78752	Upon approval 11/30/2023	RA11: SE¼ S13, T11N, R8E RA12: SW¼ S18 & NW¼ S19, T11N, R9E

5. Is the work area near a survey monument? (If yes, call 866-568-2852 or email geodetic@dot.wi.gov.)	☐ Yes ☒ No
8. Trans 401 project designation? (Provide a formal erosion control plan for all Major projects. See provision #13.)	☐ Major ☒ Minor
9. Are any environmental approvals, certifications or permits required from other regulatory agencies? (If yes, provide a copy of each item. If no, provide proof of other agency coordination as needed. For additional information, go to environmental coordination.)	☐ Yes ☒ No

6. Work Location (List all that apply)	7. Highway (List all that apply)
Town: Dekorra	WIS
Village:	US
City:	Interstate 39/90/94
County: Columbia	

10. Work Type (Check all that apply)

- ☐ Access management
- ☐ Crash investigation/cleanup
- ☐ Drainage: Culverts/tiles
- ☐ Drainage: Grading/riprap
- ☐ Drainage: Storm Sewer
- ☐ Environmental assessment
- ☐ Harvesting nature products
- ☐ Hazmat: Cleanup/remediation
- ☐ Hazmat: Monitoring wells
- ☐ Invasive species assessment
- ☐ Landscaping
- ☐ Soil borings
- ☐ Surveying
- ☒ Truck Parking Technology Test

11. Vegetation Management (Check all that apply)

- ☐ Mow ☐ Remove
- ☐ Prune ☐ Cut and/or trim
- ☐ Plant ☐ Chemically treat[13]

12. Work Zone Description (Check all that apply)

- ☐ Not applicable
- ☐ Full road closure: detour**
- ☐ Full road closure: temporary
- ☐ Lane closure: without flagging
- ☐ Lane closure: with flagging
- ☐ Lane encroachment (2 feet or less)
- ☐ Intersection/roundabout
- ☒ Parking lane closure

Freeway/expressway location
- ☐ Off shoulder: < 30' off white line
- ☐ Off shoulder: ≥ 30' off white line
- ☒ Rest area

Non–Freeway/expressway location
- ☐ Off shoulder: < 15' off white line
- ☐ Off shoulder: ≥ 15' off white line
- ☐ Back of curb: < 2' behind
- ☐ Back of curb: ≥ 2' behind

13. Provide detailed description of how work will be accomplished. Use page 2 or additional pages if needed. Provide work plans, drawings and specifications as needed. For chemical treatment, answer questions on page 2.

Paint four rest area parking spaces and install Bluetooth enabled truck parking signs on existing poles at Rest Areas 11 & 12 in conjunction with a FMCSA-funded study to pilot the use of a truck parking capacity management platform. The objectives of the pilot are to (a) gather and analyze data to understand the usage of truck parking capacity at three public rest areas in Wisconsin and (b) determine the feasibility and benefits of deploying a truck parking capacity management app and Internet of Things (IoT) platform that provides real-time truck parking availability information to drivers. The study team identified four truck parking spaces at each of the rest areas to paint green to make it clear to truck drivers that the technology is being tested at these spaces. See attached diagrams. The study is sponsored by TTI, UW-Madison and ParkUnload. See page two for more details.

It is understood and agreed that approval is subject to the applicant's full compliance with the pertinent Statutes, as well as any codes, rules, regulations, and other jurisdictional agencies' permit requirements. Applicant shall comply with all permit provisions, superimposed notes, and detail drawings that WisDOT may add. Any alteration of this form by the applicant is prohibited and may be cause to revoke this permit. When approved, the permit does not transfer any land; nor give, grant or convey any land right, right in land, nor easement in WisDOT right-of-way. It is not assignable or transferrable. All costs associated with this permit are the permittee's responsibility unless otherwise noted.

Texas A&M Transportation Institute (Main Contractor Company Name, If applicable)	X *jprozzi* 06/23/2022 (Applicant or Authorized Representative Signature) (If Computer-filled, Brush Script Font) (Date)
(Contractor Representative/Title) (Area Code/Phone No.)	Jolanda Prozzi Division Head: Multimodal Planning and Environment (Printed Name) (Title)
512-584-9143 (Area Code/Phone No. – Cell) (Email Address)	512-584-9143 j-prozzi@tti.tamu.edu (Area Code/Phone No.) (Email Address)

* **Includes permanent restoration. If the permitted work has not started by the "Work Finish Date", this permit is null and void. If the permitted work has started, but has not been completed by the "Work Finish Date", the work shall not be completed unless authorized through an approved written time extension or a subsequent permit.** ***ANY PERMIT ISSUED IS REVOCABLE.***

For Official Wisconsin DOT Use Only – Do Not Write Below

☒ *PERMITTEE SHALL NOTIFY THE WISDOT REPRESENTATIVE LISTED BELOW 3 BUSINESS DAYS BEFORE STARTING ANY WORK:* Region contact, title, office address, area code/phone no., and email address Peter Kaiser, Roadway Maintenance Engineer Wisconsin DOT Southwest Region - Madison Office 2101 Wright Street Madison, WI 53704 608-228-4161 peter.kaiser@dot.wi.gov	☒ **See Supplemental Permit Provisions (Page 4)** ☐ **Special Permit Provisions Also Included** ☐ Lane Closure System notification required ☐ Insurance or performance bond required ☐ Other regulatory agency permits not required ☐ **State highway traffic detour permit required ☐ Permit issued in conjunction with: _____ ☐ Permit voids and supersedes permit(s): #_____, Issued _____	Date Application Received 6/23/2022 Date Application Complete 7/14/2022 Permit Issuance Date 7/15/2022 Permit Expiration Date 11/30/2023 Permit Extension Date
Robert C. Fasick (WisDOT Authorized Representative Signature – If Computer-filled, Brush Script Font)	Bureau of Highway Maintenance 4822 Madison Yards Way, 5th Floor South Madison, WI 53705 robert.fasick@dot.wi.gov 608-266-3438	Permit Number 001355

Use this section to provide information on chemical treatment (question #11):	Use this section to provide information that does not fit on front page or #11(a)-(f) on left:
(a) Chemical(s) to be used and EPA Registration Number(s)? (Example: Garlon 4 Ultra, EPA REG. NO. 62719-527) (b) Type of application(s)? (Example: Stump treatment, broadcast, etc.) (c) Applicator name(s) and Wisconsin certification number(s)? (Example: Bill Smith, 146886-CA. Personnel must be licensed as commercial applicators in category 6.0, Right-of-Way, to legally apply herbicides on roadsides.) (d) How will property owners bordering the affected highway ROW be notified prior to spraying? (Examples: in-person, doorknob cards, letters, phone calls, etc.) (e) Will spraying occur near wetlands? (If yes, see question #9) (f) Provide name(s) and cell number(s) for the supervisor or lead worker of each crew:	Paint four truck parking spaces green and install Bluetooth enabled truck parking signs. The work will be conducted by TTI technicians during daylight hours only using the following steps: 1. Set safety cones next to the work buffer spaces and four truck parking spaces and at the ends of these spaces to make it clear that truck drivers cannot use the spaces. 2. Tape any existing pavement markings to cover and prevent paint loss. 3. Broom/air-blow the spaces to remove loose debris. 4. Paint the four parking spaces green using a sprayer. 5. Paint "Technology Test" (using white paint) in three places on each parking space (using a specially ordered stencil) per the attached diagram. 6. While paint dries, attach a single Bluetooth enabled sign to an existing light pole at the rest area. See diagrams for a schematic. *Steps 1-6 typically take ~4 hours to complete.* 7. During the study period, the green paint or white stencil may be touched-up with additional paint as needed. 8. After the study is concluded (9/30/2023), remove the signs and water-blast the green paint. Touch-up or repaint WisDOT's existing parking lane lines as needed.

INDEMNIFICATION

The Applicant shall save and hold the State, its officers, employees, agents, and all private and governmental contractors and subcontractors with the State under Chapter 84 Wisconsin Statutes, harmless from actions of any nature whatsoever (including any by Applicant itself) which arise out of, or are connected with, or are claimed to arise out of or be connected with any of the work done by the Applicant, or the construction or maintenance of facilities by the Applicant, pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, (1) while the Applicant is performing its work, or (2) while any of the Applicant's property, equipment, or personnel, are in or about such place or the vicinity thereof, or (3) while any property constructed, placed or operated by or on behalf of Applicant remains on the State's property or right-of-way pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way; including without limiting the generality of the foregoing, all liability, damages, loss, expense, claims, demands and actions on account of personal injury, death or property loss to the State, its officers, employees, agents, contractors, subcontractors or frequenters; to the Applicant, its employees, agents, contractors, subcontractors, or frequenters; or to any other persons, whether based upon, or claimed to be based upon, statutory (including, without limiting the generality of the foregoing, worker's compensation), contractual, tort, or whether or not caused or claimed to have been caused by active or inactive negligence or other breach of duty by the State, its officers, employees, agents, contractors, subcontractors or frequenters; Applicant, its employees, agents, contractors, subcontractors or frequenters; or any other person. Without limiting the generality of the foregoing, the liability, damage, loss, expense, claims, demands and actions indemnified against shall include all liability, damage, loss, expense, claims, demands and actions for damage to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way in the past or present, or that are located on any highway or State property or right-of-way with or without a permit issued by the State, for any loss of data, information, or material; for trademark, copyright or patent infringement; for unfair competition or infringement of personal or property rights of any kind whatever. The Applicant shall at its own expense investigate all such claims and demands, attend to their settlement or other disposition, defend all actions based thereon and pay all charges of attorneys and all other costs and expenses of any kind arising from any such liability, damage, loss, claims, demands and actions.

Any transfer, whether voluntary or involuntary, of ownership or control of any property constructed, placed or operated by or on behalf of the Applicant that remains on the State's property or right-of-way pursuant to this permit shall not release Applicant from any of the indemnification requirements of this permit, unless the State is notified of such transfer in writing. Any acceptance by any other person or entity, whether voluntary or involuntary, of ownership or control of any property constructed, placed or operated by or on behalf of the Applicant that remains on the State's property or right-of-way pursuant to this permit, shall include acceptance of all of the indemnification requirements of this permit by the other person or entity receiving ownership or control.

Notwithstanding the foregoing, a private contractor or subcontractor with the State under Chapter 84 Wisconsin Statutes, that fails to comply with sections 66.0831 and 182.0175 Wisconsin Statutes (2013-2014), remains subject to the payment to the Applicant of the actual cost of repair of intentional or negligent damage by the contractor or subcontractor to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, and remains subject to payment to the Applicant for losses due to personal injury or death resulting from negligence by the contractor or subcontractor.

Notwithstanding the foregoing, if the State, or its officers, employees and agents, fail to comply with sections 66.0831 and 182.0175 Wisconsin Statutes (2013-2014), the State or its officers, employees and agents, remain subject to the payment to the Applicant of the actual cost of repair of willful and intentional damage by the State, or its officers, employees and agents, to any property, lines or facilities placed by or on behalf of the Applicant pursuant to this permit or any other permit issued by the State for location of property, lines or facilities on highway right-of-way, and remain subject to payment to the Applicant for losses due to personal injury or death resulting from negligence by the State, its officers, employees and agents.

No indemnification of private contractors or subcontractors with the State under Chapter 84 Wisconsin Statutes, shall apply in the event of willful and intentional damage by such private contractors or subcontractors to the property, lines and facilities of the Applicant located on the highway right-of-way pursuant to this permit or any other permit issued by the State for the location of property, lines or facilities on highway right-of-way.

GENERAL PERMIT PROVISIONS AND CONDITIONS OF APPROVAL (#1-22)

Pursuant to Wisconsin Statutes and once approved by WisDOT, this permit allows performance of the specific work described over which WisDOT has permit authority. ***The permittee shall abide by these general provisions, and any supplemental and/or special provisions.*** (ROW = right-of-way)

1. Warning signs, devices and methods shall be in place and fully functional prior to the start of any permitted work within highway ROW and shall protect the public until all permitted work is complete. Warning signs and devices shall conform to the appropriate sizes, designs and configurations specified within the Wisconsin Manual of Uniform Traffic Control Devices, current edition. Provide and maintain the quantity of signs and devices therein described, and supplement those with additional signs, devices, and flaggers as necessary to functionally protect people and property from injury or damage at all times and under all conditions, including changed or changing conditions. **All personnel shall wear retro-reflective safety vests while working within the highway ROW.**
2. Secure the work site with appropriate work zone traffic control against any hazard to the public when the work is ongoing. This includes vehicles, equipment, and materials. **Ring the buffer areas and truck stalls to be painted with 28" (minimum), 36" or 42" cones or barrels.** Any violation of this permit, particularly any failure to maintain safe work site and traffic control zone, will require immediately cure by the permittee, and may result in WisDOT stopping further work, removal of permittee from the highway ROW, and/or permit revocation.
3. Coordinate the permitted work and in no case interfere with any ongoing highway improvement project.
4. Keep a complete copy of the permit, which may be electronic, at the job site at all times the permitted work is ongoing along with a project manager or supervisor familiar with the permit and all of its details and requirements. Failure to comply with any part of this permit is the permittee's responsibility.
5. Determine the location of, and protect or cause to protect from any damage, any existing facilities in the area affected by the permitted work. All notifications to other facility owners are the permittee's responsibility.
6. Perform all permitted work without obstructing or closing any part of any traffic lane or fully closing any road unless specifically authorized by WisDOT.
7. Alter the permitted facilities as may be ordered by WisDOT to facilitate highway improvement, alteration, safety control, or maintenance. Accept all costs of constructing, maintaining, altering, temporarily moving or relocating the permitted facilities.
8. The permit authorizes only the described work of and for the permittee indicated on this permit. It does not grant authority for the work of any other, either by present or future installation.
9. Any disturbance to, operation within, or use of a highway median is expressly prohibited, unless specifically authorized by WisDOT. **The use of interstate or freeway median crossovers for any reason is prohibited and subject to law enforcement citation.**
10. Construction methods and restorations shall be in accordance with applicable parts of WisDOT's Standard Specifications for Highway and Structure Construction, current edition.
11. Comply with all applicable regulations and codes, including, but not limited to, the U.S. Department of Labor, Occupational Safety and Health Administration, 29 CFR Part 1926 for construction safety precautions and operations.
12. Install the facility in the specified permit location. Move any part of the facility found to be otherwise located to the correct location upon WisDOT order. Any facility part located other than as specified in this permit is at permittee's sole risk. Accordingly, if the same is undetected or is suffered to remain in variance to the permit, the permittee shall hold the State, its employees, agents, and officers harmless and free of any cost, claim or liability associated with any accidental damage to such facility that may result from a highway construction, maintenance, traffic control, or ROW management project or function.
13. Collect any brush, trash or waste materials resulting from the permitted work, and dispose of said materials off the ROW in accordance with applicable solid waste disposal regulations.
14. Send notice **within 10 calendar days** via regular mail or email to the authorized WisDOT representative who approved the permit upon completion of the work and restoration.
15. Promptly restore all highway facilities disturbed by the permitted work or associated operation. This includes natural highway facilities, including but not limited to living snow fence, headlamp screens, and other such highway safety features. WisDOT may issue a notice setting a specific time by which the restoration must be complete if restoration is not done voluntarily without delay. If the permittee fails to satisfactorily complete the restoration within the time established, WisDOT shall arrange for the restoration to be completed and bill the permittee accordingly. The permittee shall pay for all restoration costs.
16. Restore in-kind any curb, gutter, sidewalk, driveway, gravel base, ballast, shoulder material, or other highway ROW element/facility disturbed under this permit to the qualities, grades, compactions and conditions specified in WisDOT's Standard Specifications for Highway and Structure Construction, current edition.
17. Restore any turfed ROW area disturbed under this permit with fine-graded topsoil having a depth of not less than 4" and reseeded to perennial grass or sodded to WisDOT's satisfaction.
18. Adjust manhole covers, shut-off and regulator valves, and like facilities to the level of the immediately adjacent grades.
19. Cure faults related to work or facilities under this permit that, in WisDOT's opinion, obstruct highway drainage or in any other manner adversely affect highway maintenance or operation, and restore the ROW as directed by and to WisDOT's satisfaction.
20. Do not keep vehicles/equipment/materials related to this permit within the non-freeway ROW limits except as are actively engaged in the work operation.
21. Be aware that future highway improvements may require the adjustment of part or all of the permitted facility, at permittee's cost, to conform to WisDOT's *Utility Accommodation Policy*.
22. Comply with appropriate laws, rules, policies, etc. when within tribal or federal lands. Provide documentation as needed when on WisDOT ROW to prove compliance or coordination with the following agencies:
    - Wisconsin Historical Society to avoid/mitigate any potential cultural resource (archeological, historical, burial site, etc.) impacts per Wis. Stat. s. 44.40.
    - Department of Natural Resources to avoid/mitigate any potential storm water runoff, site erosion, wetland, waterway and endangered/threatened species impacts.

SUPPLEMENTAL PERMIT PROVISIONS (#23-42)

The permittee shall abide by the following checked provisions:

TREE & VEGETATION MANAGEMENT

☐ 23. Plant trees/vegetation only in such locations and in such species as indicated on the plans included and approved with this permit, or as WisDOT specifies in the field.

☐ 24. Maintain all plantings according to the attached special permit provisions.

☐ 25. Do not place any sign or marker identifying the plantings within the highway ROW limits.

☐ 26. WisDOT accepts no responsibility for loss that may occur to the plantings. Be fully aware that the plantings are subject to:
- Thinning and/or mortality
- Normal hazards due to maintenance operations, snow control, and public utility installation or alteration
- Trimming or removal, if or when the plantings cause restrictions to sight distance or hazardous snow/ice conditions on the highway
- Destruction, if highway reconstruction is done
- Partial or complete abandonment or obliteration, or return to private ownership, if future changes in

☒ 27. Do not cut, trim, or damage trees/vegetation to facilitate the installation or maintenance of the permitted facility except as authorized by the owner of such tree/vegetation. See Wis. Stat. ss. 86.03(2), (4), 86.16(3), and 182.017(5).

☒ 28. Do not cut or prune oak trees between April 15 and October 15 to prevent Oak Wilt Disease from spreading unless a thick coat of asphalt base tree paint is applied immediately after **any** cut, pruning wound, or abrasion made between those dates. Cleanly cut the exposed ends of any roots encountered during grading or trenching with suitable pruning tools immediately after exposure. Adhere to any applicable laws, including local ordinances if they are stricter than WisDOT specifications.

☒ 29. Remove all stumps, branches, logs, and other debris resulting from the cutting and trimming operations and dispose of such materials off the ROW. Tree disposal may also occur by giving them to the adjacent property owner(s) at a storage location approved by the owner(s). Comply with applicable laws that regulate the sale, transport, or pruning/cutting of trees.

☐ 30. Cut trees flush with the ground. Any remaining stumps shall not interfere with mowing operations.

☐ 31. Cut trees may be chipped and used for mulch on the ROW in a layer not exceeding three inches.

☐ 32. Trim only the trees/vegetation necessary to provide safe clearances or by special provisions. Do not damage non-target trees/vegetation. Do not clear-cut trees/vegetation.

☐ 33. Survey the trees/vegetation to be removed and inspect jointly with a WisDOT representative prior to starting any work on the highway ROW.

☐ 34. Treat all deciduous tree stumps with a herbicide approved for this use. Do not treat evergreen tree stumps.

☐ 35. Follow the conditions specified in WisDOT's "Vegetation Alteration Decision" for vegetation removed or trimmed pursuant to Wis. Stat. s. 84.305.

WORK RESTRICTIONS

☐ 36. Daily, holiday and/or seasonal work restrictions apply to the permitted work as detailed on page ___. Review the restrictions with the WisDOT Region Office(s) identified on this permit.

MISCELLANEOUS

☒ 37. **Contact the Rest Area supervisor** identified below three business days prior to the work to inform them of the upcoming activity:
• RA 11 (Portage) & RA 12 (Poynette)
Terry Mohr, 608-745-8377 or tmohr@nwdswi.org

☒ 38. **Contact the WisDOT Region Office** representative identified on this permit prior to completing the final restoration for the permitted work to arrange for an inspection of the work area before the permittee's employees or crews leave.

☒ 39. **Contact Randy Hoyt** 414-227-4671 or randall.hoyt@dot.wi.gov at the State Traffic Management Center (TMC) three business days prior to the work to inform the TMC that six truck parking spaces will be unavailable during the work activity. The TMC may place restriction on work times based upon various special events, oversize freight movements, or daily peak travel times.

☒ 40. **Contact David Hunt** 608-261-6121 or david.hunt@dot.wi.gov in WisDOT's Office of Public Affairs three business days prior to the work.

☒ 41. Painting the parking spaces may only take place between 8:30AM and 4:30PM. Crews may arrive prior to 8:30AM and may start earlier if all six stalls are unoccupied.

☒ 42. The November 29, 2021, MOU (attached) between TTI and WisDOT is incorporated as a condition of this permit.

MEMORANDUM OF UNDERSTANDING

between the

Texas A&M Transportation Institute

and the

Wisconsin Department of Transportation

November 29, 2021

BACKGROUND

In July 2021, the Texas A&M Transportation Institute (TTI) and Wisconsin Department of Transportation (WisDOT) (collectively: "Parties") recognized the mutual benefits of collaborating and cooperating on the Federal Motor Carrier Safety Administration (FMCSA) study entitled, "**Assessing Truck Parking Capacity Usage to Inform Truck Parking Needs Assessments and Determine the Feasibility and Benefits of Truck Parking Capacity Management Platforms**," which is being conducted by the TTI, the University of Wisconsin-Madison, and ParkUnload (collectively: "Study Team"). The period of performance for the research study ends September 30, 2023.

The objectives of the research are to collect truck parking capacity usage data at public rest areas along the I-94 corridor and to determine the feasibility and benefits of deploying a truck parking capacity management app and Internet of Things (IoT) platform (collectively: "ParkUnload Platform") to understand and optimize truck parking capacity usage. Funding for this study is provided by FMCSA under the agency's FY20 High Priority Cooperative Agreement program. To facilitate coordination, WisDOT and TTI have developed this Memorandum of Understanding (MOU) to establish a framework for cooperation and collaboration to support and advance the research.

THE PARTIES AGREE TO PERFORM DURING THE STUDY PERIOD AS FOLLOWS:

A) WisDOT will collaborate with the Study Team by:

1. Identifying specific rest area facilities or Safety Weight Enforcement Facilities (SWEFs) in Wisconsin for inclusion in the study.
2. Approving the instrumentation of an agreed number of parking spaces at WisDOT identified rest area facilities or SWEFs in Wisconsin.
3. Sharing relevant data (Drivewyze) as permitted by applicable use agreements or subscriptions to compare with the data collected by ParkUnload (e.g., how long drivers stop at the rest area facilities and SWEFs).
4. Sharing insight and providing guidance on the approach for instrumenting parking spaces (e.g., install 10 percent of the parking capacity at a specific rest area, parking spaces closest to bathrooms, etc.).
5. Sharing relevant stakeholder contacts and facilitating conversations with stakeholders critical to the success of the study (e.g., WisDOT Region Maintenance staff, rest area facility site supervisors, state troopers, Office of Public Affairs)
6. Exploring the adaptation and use of the Traveler Satisfaction survey used by the Bureau of Highway Maintenance to include questions that address the use of the ParkUnload Platform.
7. Meeting monthly to discuss parking data reports and any challenges/concerns.

B) The Study Team will:

1. Analyze the truck parking locations identified by WisDOT to identify poles for sign installations.
2. Coordinate with the Bureau of Traffic Operations and the Bureau of Highway Maintenance Roadside Facilities with respect to site signage.
3. Consult with WisDOT's Division of State Patrol (DSP) on the allocated spaces at the Safety Weigh Enforcement Facilities (SWEFs), if used during this study, and coordinate on the site staging needs and designated locations for out of service vehicles at the SWEFs as well as enforcement needs.
4. Manufacture, test, and install the Smart Road Signs on existing poles (at the expense of the Study Team) at the identified and agreed upon rest area facilities or SWEFs in Wisconsin.
5. Implement the ParkUnload Platform for drivers, WisDOT, and the researchers.
6. Obtain a WisDOT Work on Highway Right-of-Way Permit to perform any required work on state highway ROW as detailed in this MOU.
7. Replace any damaged signs.
8. Develop a communications strategy for sharing the pilot project information with trucking associations, trucking companies, and users (e.g., brochures, twitter, press releases, etc.).
9. Provide operational support to users of the ParkUnload Platform by providing a hotline number to call.
10. Maintain all software, hardware components, and system integrations to ensure continued operability of the ParkUnload Platform during the study period.
11. Provide periodic parking data reports to WisDOT at regular intervals.
12. Conduct driver surveys on the use of the ParkUnload Platform.
13. Ensure all applicable federal and state regulations and standards are followed.
14. Remove all signs and ensure that the sites are restored to their original or better condition (normal wear and tear and casualty loss excluded).
15. Complete all activities and supply a report and recommendations to WisDOT related to project results no later than November 1, 2023 to Chris Ohm (chris.ohm@dot.wi.gov) and Tom DeWinter (thomas.dewinter@dot.wi.gov).

ATTEST

Texas Transportation Institute:	**Wisconsin Department of Transportation:**
DocuSigned by: Rodney Horrell 59BEA8D7F9CB4BC...	Christopher A Ohm
Signature	Signature
Rodney Horrell	CHRISTOPHER A. OHM SECTION CHIEF
Assistant Agency Director and CFO	Printed Name, Title
12/10/2021	4 JAN 22
Date	Date


Zone Code: IUS-003
Portage Rest Area 11 (SB)
Poynette, WI 53955
PARKING TECHNOLOGY TEST
ROAD WORK AHEAD
250'
Technology Test Parking Spaces Painted Green
Light Pole with the Technology Test Sign
www.parkingpilot.org


Zone Code: IUS-002
Poynette Rest Area 12 (NB)
Poynette, WI 53955
PARKING TECHNOLOGY TEST
P 24/7
Technology Test Parking Spaces Painted Green
Light Pole with the Technology Test Sign
250'
ROAD WORK AHEAD
www.parkingpilot.org


TRUCK PARKING
TECHNOLOGY TEST
P 24/7
Download App
and follow
steps to park
Zone Code:
WIS-001
Get Parkunload
App at:
Google Play
App Store
www.parkingpilot.org
WISCONSIN

RA-11 Portage
Zone Code: IUS-003

24" x 30" - 1.875" radius w/ .375" border + .625" offset

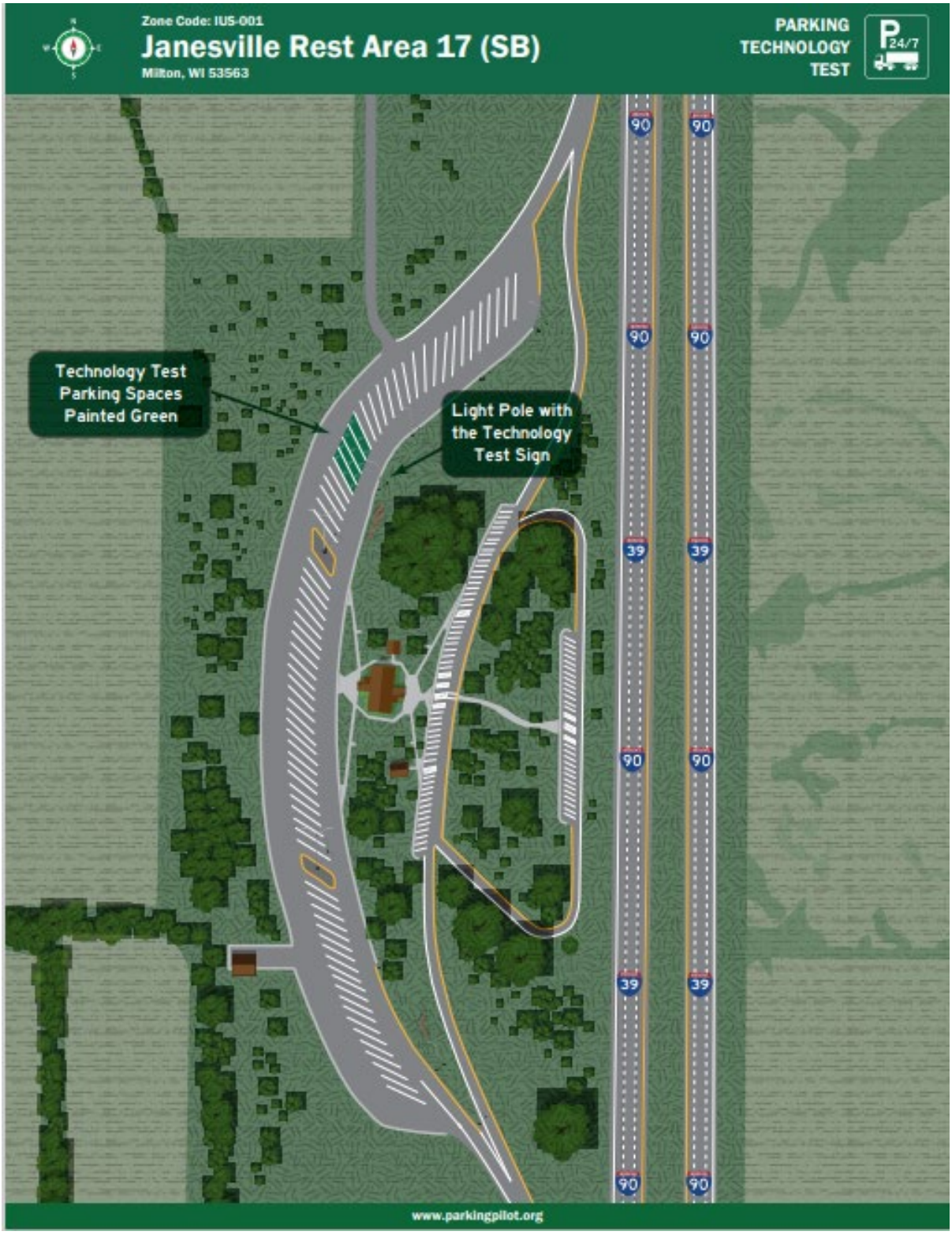
White Legend on Green Background
Truck Parking Technology Test: 2" Highway Gothic
Black Legend on White Background
Download app and follow steps to park: 1.675" Highway Gothic
White Text on Blue Background
Zone Code: IUS-003: .651" Highway Gothic
Black Legend on White Background
Get Parkunload App at:: 1" Highway Gothic
Black Legend on White Background
www.parkingpilot.org: 1.375" Highway Gothic

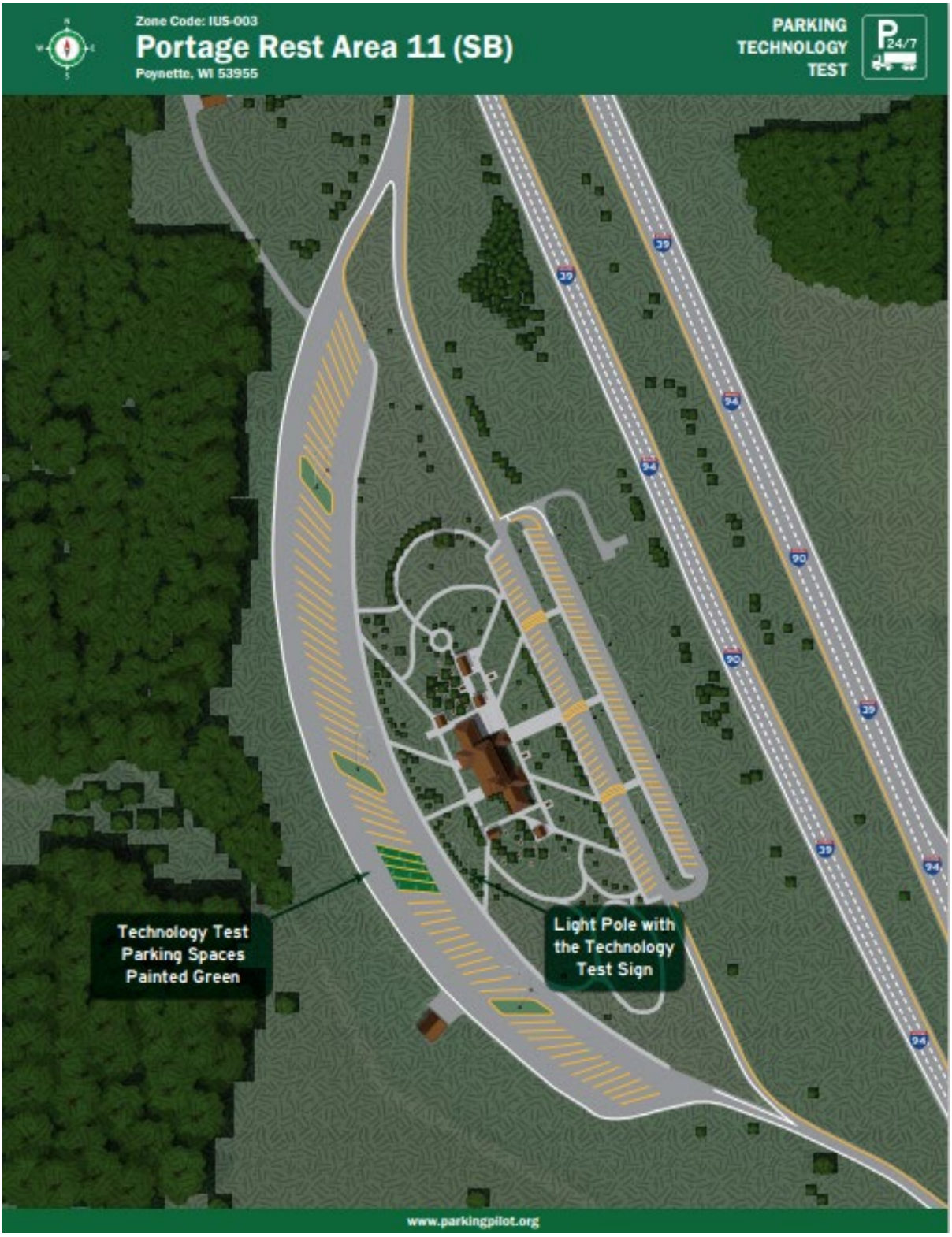
RA-12 Poynette
Zone Code: IUS-002

24" x 30" - 1.875" radius w/ .375" border + .625" offset

White Legend on Green Background
Truck Parking Technology Test: 2" Highway Gothic
Black Legend on White Background
Download app and follow steps to park: 1.675" Highway Gothic
White Text on Blue Background
Zone Code: IUS-002: .651" Highway Gothic
Black Legend on White Background
Get Parkunload App at:: 1" Highway Gothic
Black Legend on White Background
www.parkingpilot.org: 1.375" Highway Gothic

APPENDIX F. PILOT REST AREA LAYOUTS AND PARKING SPACES INCLUDED IN PILOT

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Portage Rest Area 11 (SB)
Poynette, WI 53955
PARKING
TECHNOLOGY
TEST
P 24/7
Technology Test
Parking Spaces
Painted Green
Light Pole with
the Technology
Test Sign
www.parkingpilot.org


Zone Code: IUS-002
Poynette Rest Area 12 (NB)
Poynette, WI 53955
PARKING
TECHNOLOGY
TEST
P 24/7
Technology Test
Parking Spaces
Painted Green
Light Pole with
the Technology
Test Sign
www.parkingpilot.org

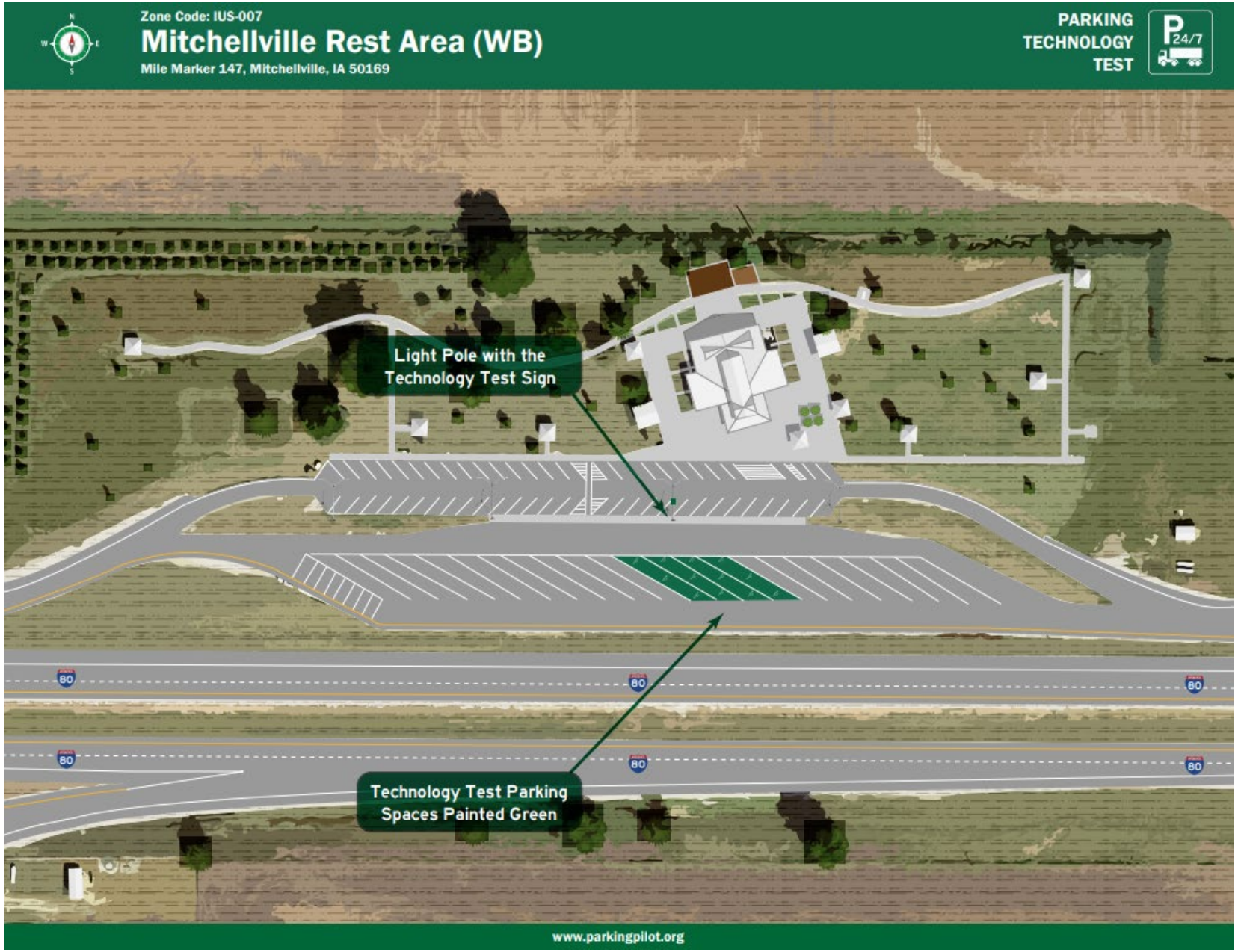
Zone Code: IUS-006

Mitchellville Rest Area (EB)

Mile Marker 147, Mitchellville, IA 50169

PARKING TECHNOLOGY TEST

www.parkingpilot.org


Zone Code: IUS-007
Mitchellville Rest Area (WB)
Mile Marker 147, Mitchellville, IA 50169
PARKING
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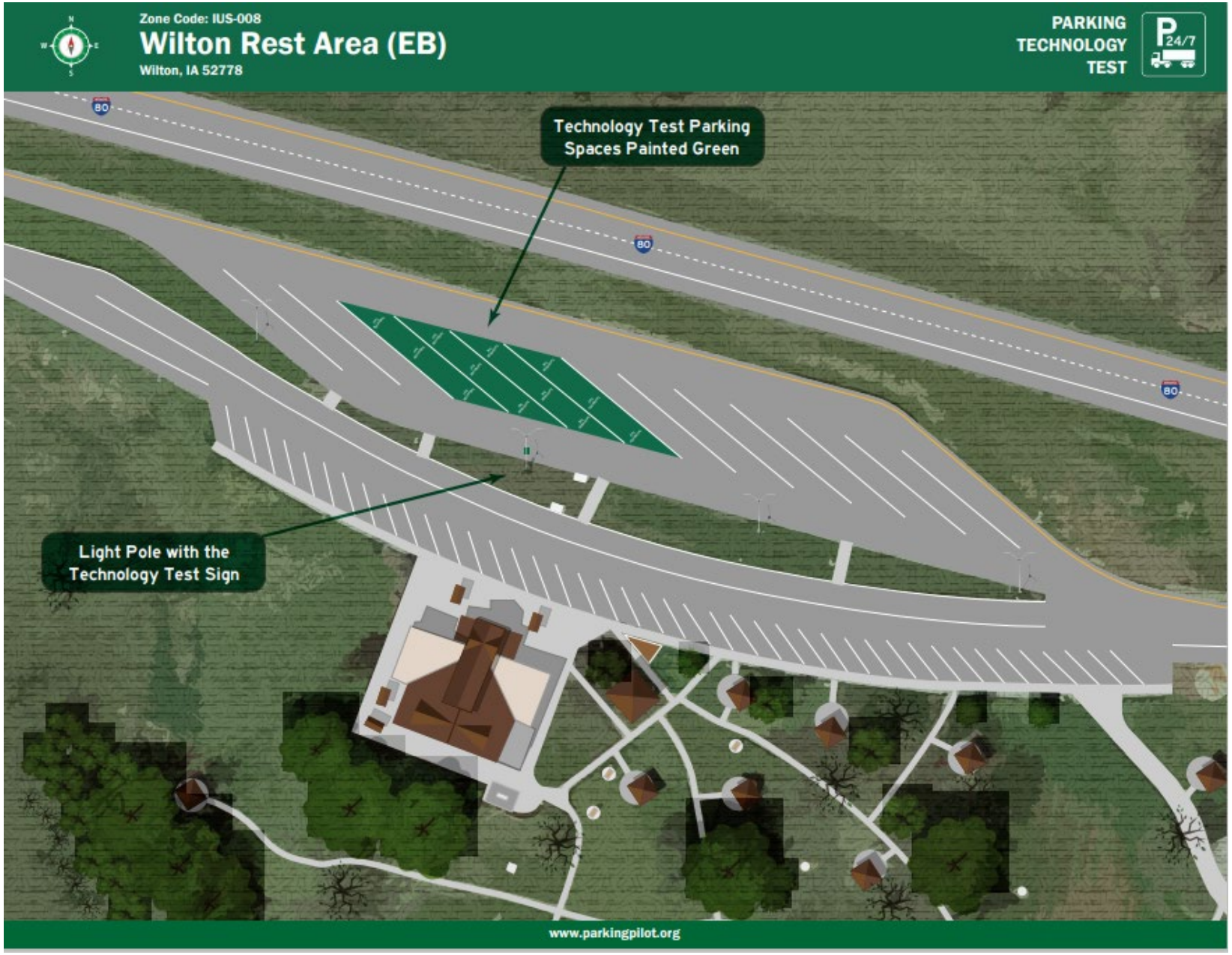
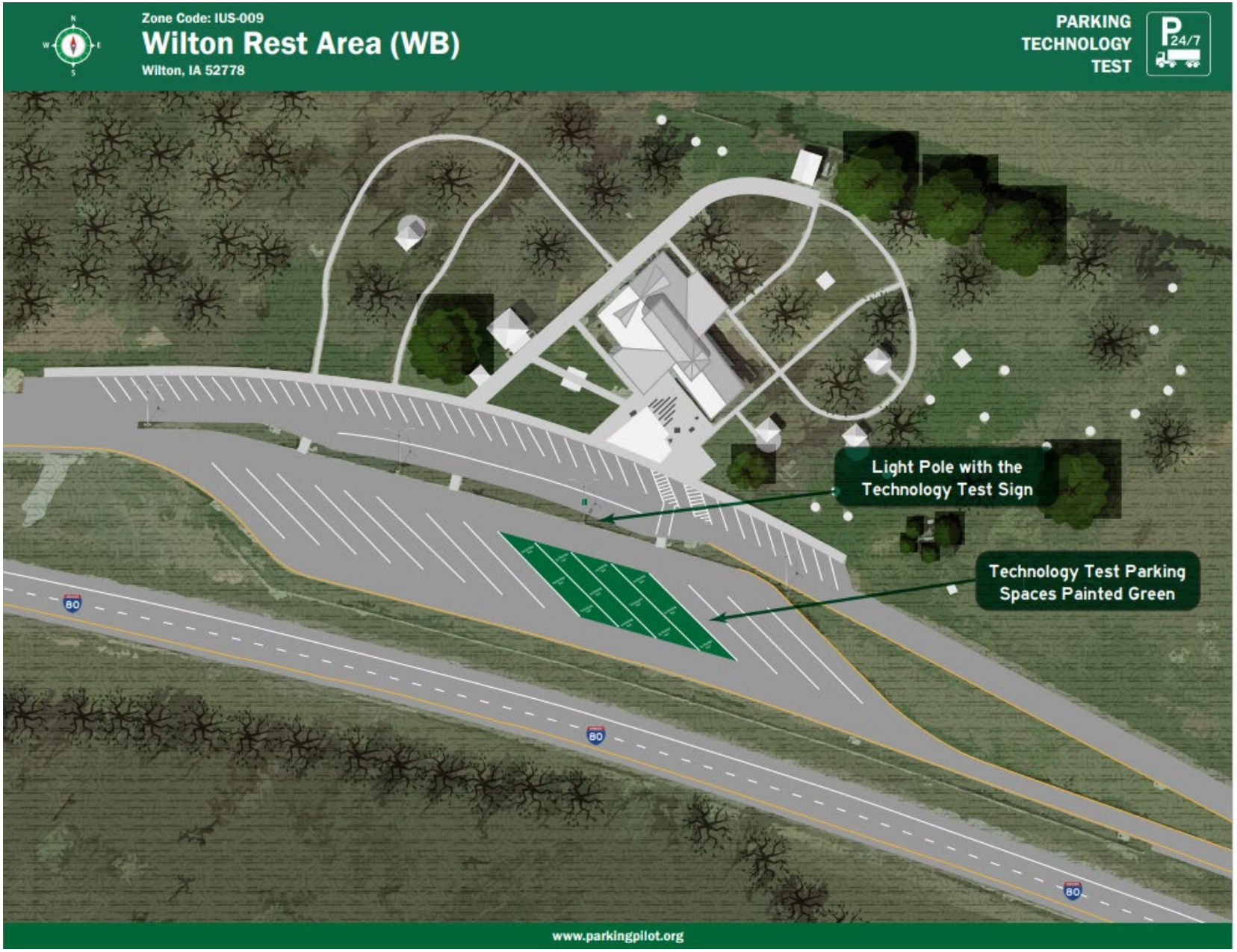
TEST
P 24/7
Light Pole with the
Technology Test Sign
Technology Test Parking
Spaces Painted Green
80
www.parkingpilot.org


Zone Code: IUS-008
Wilton Rest Area (EB)
Wilton, IA 52778
PARKING
TECHNOLOGY
TEST
P 24/7
Technology Test Parking
Spaces Painted Green
Light Pole with the
Technology Test Sign
80
www.parkingpilot.org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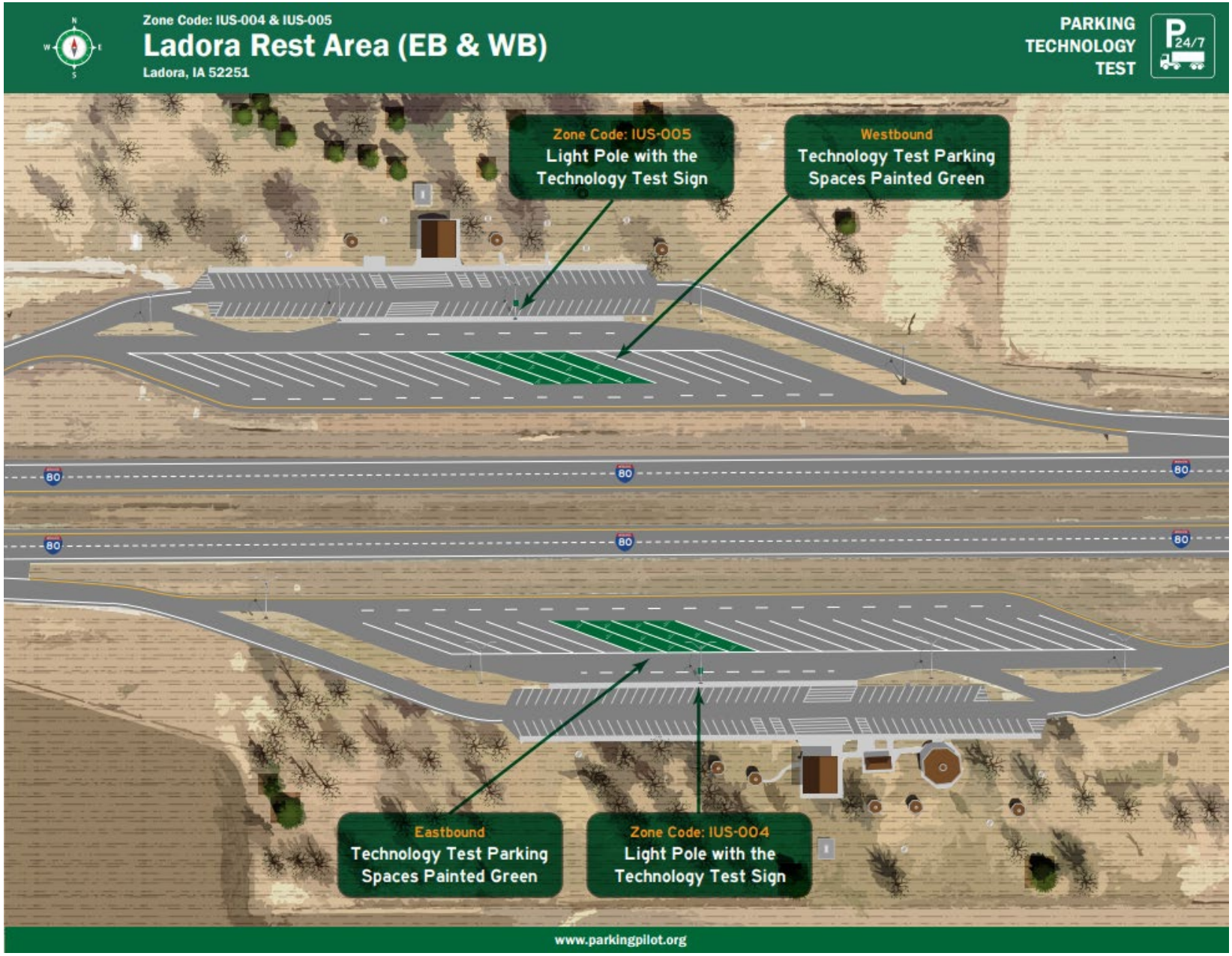
Wilton Rest Area (WB)
Wilton, IA 52778
PARKING
TECHNOLOGY
TEST
P 24/7
Light Pole with the
Technology Test Sign
Technology Test Parking
Spaces Painted Green
80
80
80
www.parkingpilot.org


Zone Code: IUS-004 & IUS-005
Ladora Rest Area (EB & WB)
Ladora, IA 52251
PARKING TECHNOLOGY TEST
P 24/7
Zone Code: IUS-005
Light Pole with the Technology Test Sign
Westbound
Technology Test Parking Spaces Painted Green
80
Eastbound
Technology Test Parking Spaces Painted Green
Zone Code: IUS-004
Light Pole with the Technology Test Sign
www.parkingpilot.org

APPENDIX G. PILOT PRESS RELEASE

Texas A&M Transportation Institute
3135 TAMU
College Station, TX 77843-3135
http://tti.tamu.edu

FOR IMMEDIATE RELEASE

CONTACT: Jolanda Prozzi, (512) 407-1104, j-prozzi@tti.tamu.edu

Truck Study Focusing on Parking Technology Coming to I-80 and I-94 Corridors

Mobile parking app will provide drivers with truck parking availability and location information.

BRYAN, TEXAS — Researchers from the Texas A&M Transportation Institute (TTI) are teaming up with the University of Wisconsin at Madison and ParkUnload to conduct a truck parking pilot study to better understand how truck drivers use existing parking spaces and to test the benefits of using a mobile parking app. Funding for this study is provided by the Federal Motor Carrier Safety Administration (FMCSA) under a cooperative agreement through the Agency's FY20 High Priority grant program.

This week, select truck parking spaces along Interstate 80 (I-80) and 94 (I-94) will be painted green and signs instrumented with truck parking technology (i.e., Bluetooth devices) will be installed. These devices will communicate with the ParkUnload app when a driver's phone is in close proximity to the parking zone. Once the app detects the marked zone, the truck driver can park and check-in to the parking space on the app to let other drivers see information on remaining spaces. Signs will also provide drivers with additional information.

"Insufficient truck parking presents a safety hazard for all highway users when drivers park in unauthorized locations, drive when fatigued, or drive past their hours of service to find safe parking," says Transportation Specialist Brian Routhier, from the FMCSA Technology Division. "We're hoping this study will provide a better understanding of the truck parking needs along these corridors and whether a truck parking app is beneficial to drivers."

Drivers who travel along the I-80 and I-94 corridors can get started and participate in just three steps:

1. Download the ParkUnload app;
2. Park and check-in to the parking space in the app; and
3. When leaving, check-out in the app.

"For the pilot to work, we need drivers to download the app and check-in when they park in a designated parking space," says TTI Senior Research Scientist Jolanda Prozzi, lead researcher on the study. "If we can collect actual, on-the-ground information, then we can better understand, plan for and prioritize truck parking investments."

To learn more about the study, visit https://parkingpilot.org/.

# # #

About the Texas A&M Transportation Institute:
Recognized as one of the premier higher education-affiliated transportation research agencies in the world, TTI's research and development program has made significant breakthroughs across all facets of the transportation system. TTI research is widely known as an excellent value with a proven impact of saving lives, time and resources. In the laboratory and the classroom, TTI researchers help prepare students for transportation careers. | https://tti.tamu.edu/

APPENDIX H. PILOT REST AREA DATA COLLECTION AND ANALYSIS

This appendix summarizes the number of parking sessions by month, number of parking sessions per day, time parked per parking session, and number of parking sessions every 30 minutes of a day for each of the pilot rest areas along the I-80 and I-39/I-90/I-94 corridors. Additional information and graphics are available at https://parkingpilot.org/dashboard/.

PILOT REST AREAS ALONG THE I-80 CORRIDOR

Mitchellville EB

The ParkUnload App was used 93 times during the 12-month pilot by 76 truck drivers (ParkUnload App users) at the Mitchellville EB rest area. Figure 83 shows that August and April saw the highest number of app uses at the Mitchellville EB rest area, at 14 recorded parking sessions. Figure 83 shows a decline in driver participation from September to December 2022. December 2022 and January and July 2023 saw the lowest number of parking sessions. The increase in app use in February, March, and April 2023 is potentially attributable to the pilot information being displayed at the rest area monitors along the I-80 corridor and the survey that was texted to ParkUnload App users on March 15, April 19, and May 19, 2023.

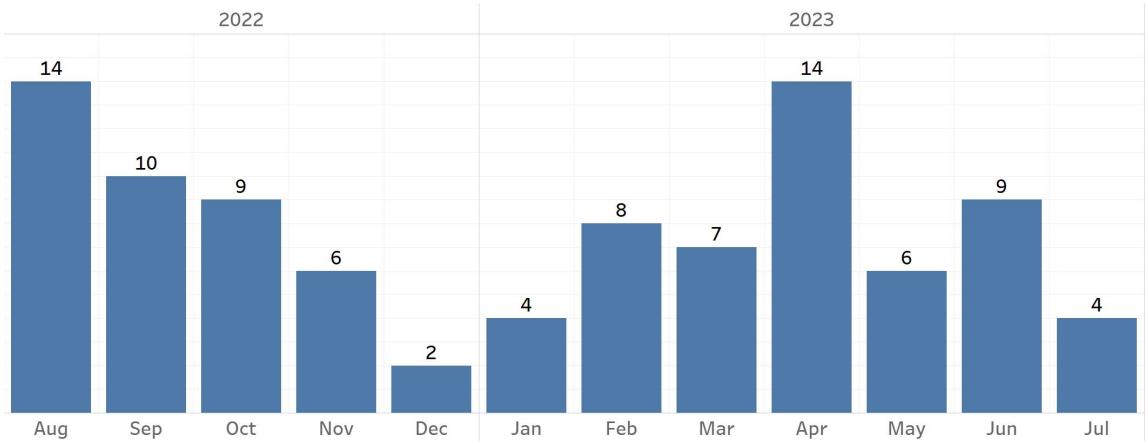


Figure 83. Graph. Number of parking sessions by month (Mitchellville EB).

The research team included four parking spaces at the Mitchellville EB rest area in the pilot. Figure 84 shows that most days, the number of app uses varied between zero and one. In other words, of the four parking spaces included in the pilot, drivers checked into/claimed between zero and one parking spaces in a day on most days. The highest number of parking spaces checked into/claimed in a day was three.

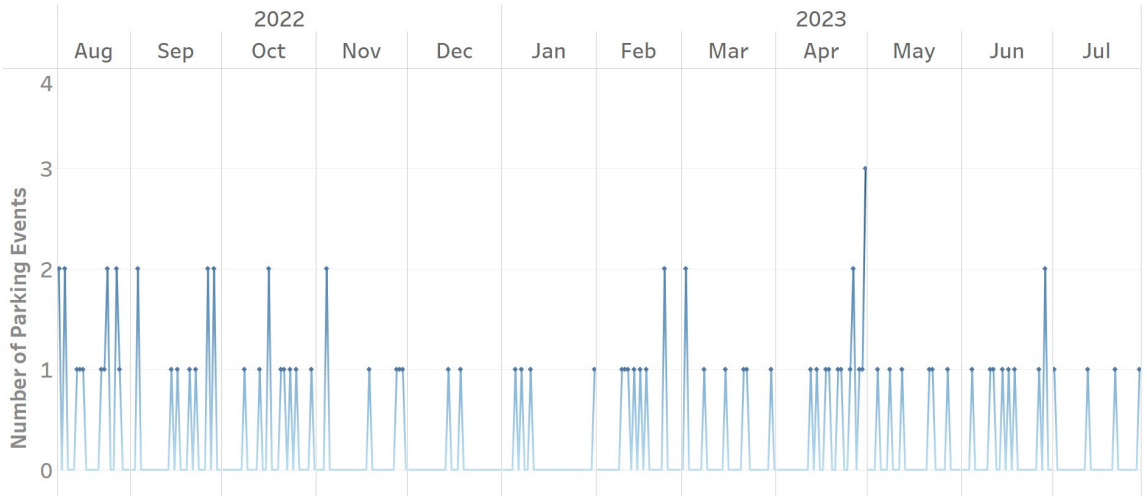


Figure 84. Graph. Number of parking sessions per day (Mitchellville EB).

Figure 85 shows that most parking sessions (22, or 23.7 percent of the total parking sessions) were less than 30 minutes. On the other extreme, 15 (or 16.1 percent) of the parking sessions were 20 hours or more. Finally, 30 of the parking sessions (or almost one-third of the total parking sessions) were 9.5 to 13.5 hours, potentially indicating that these users of the ParkUnload App were sleeping at these rest areas.

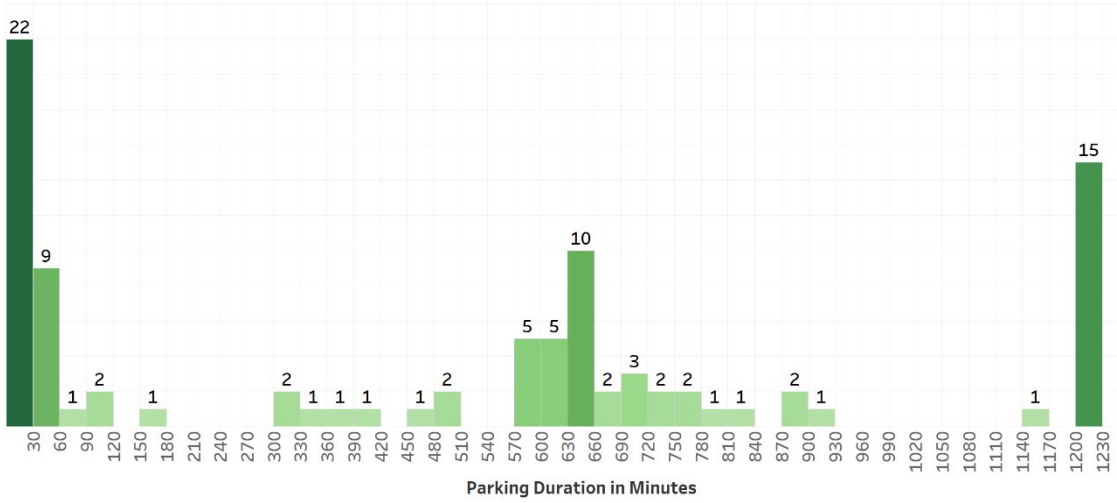


Figure 85. Graph. Time parked per parking session (Mitchellville EB).

Mitchellville WB

The ParkUnload App was used 108 times during the 12-month pilot by 72 truck drivers (ParkUnload App users) at the Mitchellville WB rest area. Figure 86 shows that August saw the highest number of app uses at the Mitchellville WB rest area, at 21 recorded parking sessions. Figure 86 shows a decline in driver participation in September but an increase in driver participation in October. December 2022 and June 2023 saw the lowest number of parking sessions.

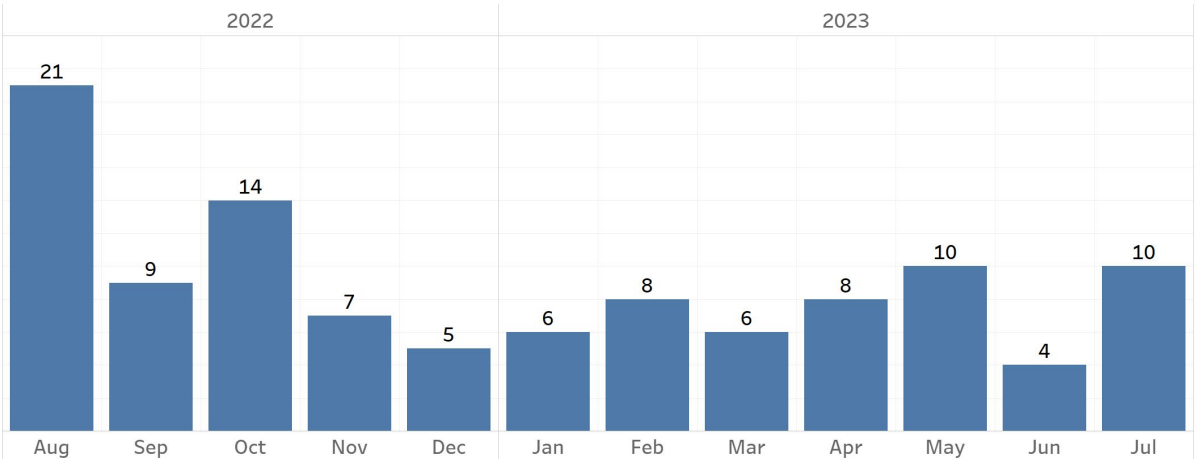


Figure 86. Graph. Number of parking sessions by month (Mitchellville WB).

The research team included four parking spaces at the Mitchellville WB rest area in the pilot. Figure 87 shows that most days, the number of app uses varied between zero and one. In other words, of the four parking spaces included in the pilot, drivers checked into/claimed between zero and one parking spaces in a day on most days. The highest number of parking spaces checked into/claimed in a day was five.

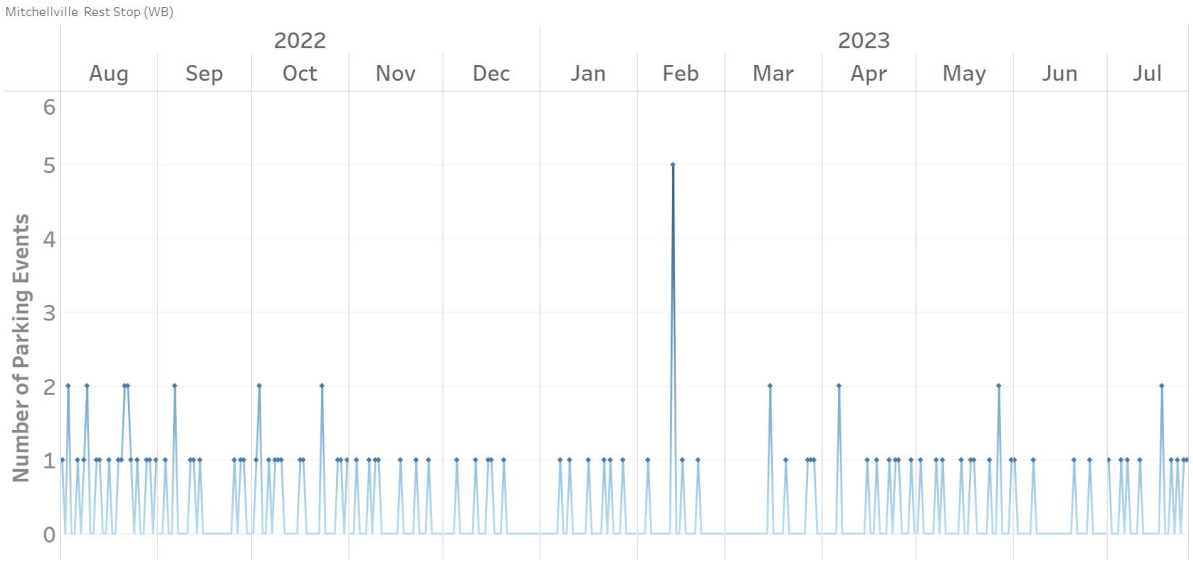


Figure 87. Graph. Number of parking sessions per day (Mitchellville WB).

Figure 88 shows that most parking sessions (20, or 18.5 percent of the total parking sessions) were 20 hours or more. On the other extreme, 14 (or almost 13.0 percent) of the parking sessions were less than 30 minutes. Finally, 40 of the parking sessions (or 45.4 percent of the total parking sessions) were 9.5 to 13.5 hours, potentially indicating that these users of the ParkUnload App were sleeping at this rest area.

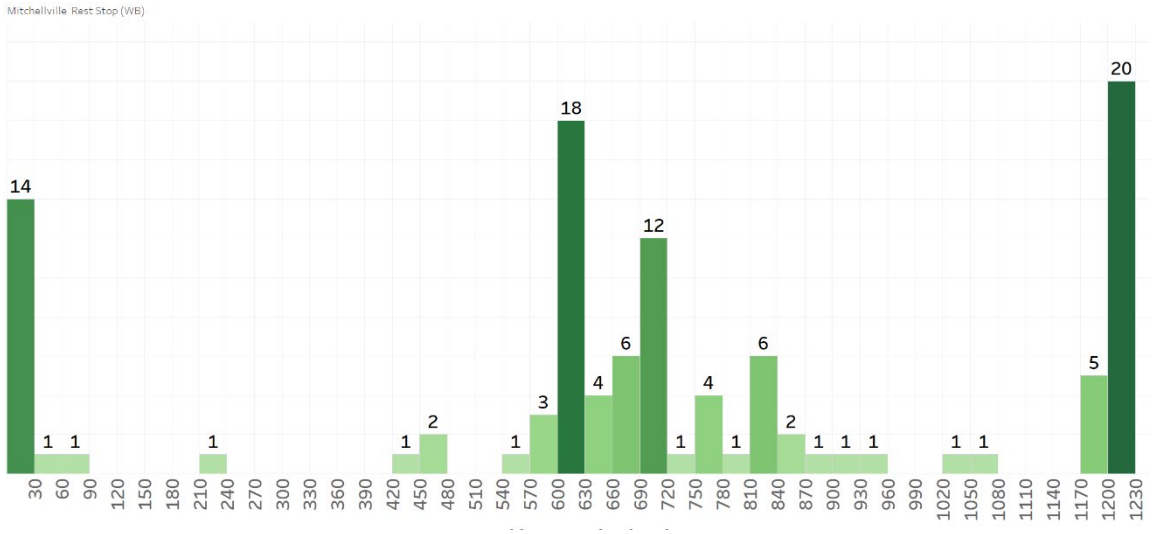


Figure 88. Graph. Time parked per parking session (Mitchellville WB).

Ladora EB

The ParkUnload App was used only 35 times during the 12-month pilot by 31 truck drivers (ParkUnload App users) at the Ladora EB rest area. Similar to the other rest areas along the I-80 corridor, Figure 89 shows that August saw the highest number of app uses at the Ladora EB rest area, at 10 recorded parking sessions. Overall, it does not appear that the outreach to drivers (e.g., display of pilot information on the rest area monitors or the ParkUnload App user survey) resulted in a significant increase in driver participation in the pilot.

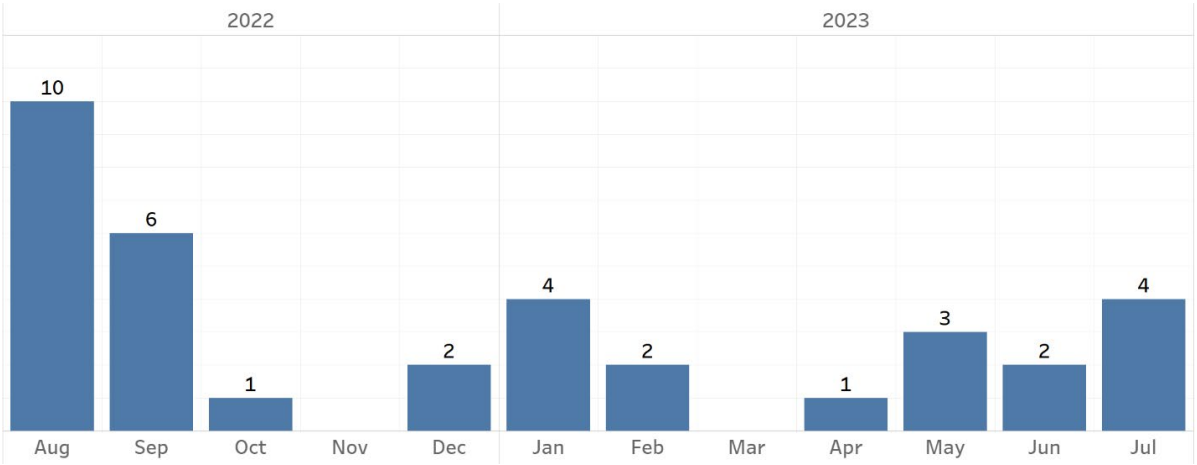


Figure 89. Graph. Number of parking sessions by month (Ladora EB).

Figure 90 shows that most days, drivers did not check into/claim one of the pilot parking spaces. The highest number of parking spaces checked into/claimed in a day was two.

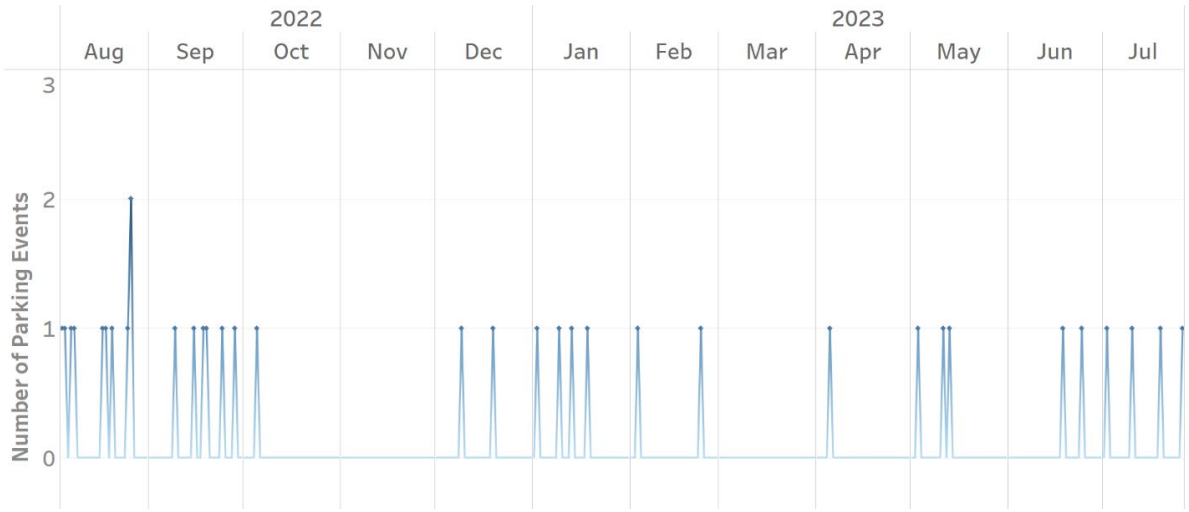


Figure 90. Graph. Number of parking sessions per day (Ladora EB).

Figure 91 shows that most parking sessions (eight, or 22.9 percent of the total parking sessions) were 20 or more hours. On the other extreme, 10 (or 28.6 percent) of the parking sessions were an hour or less.

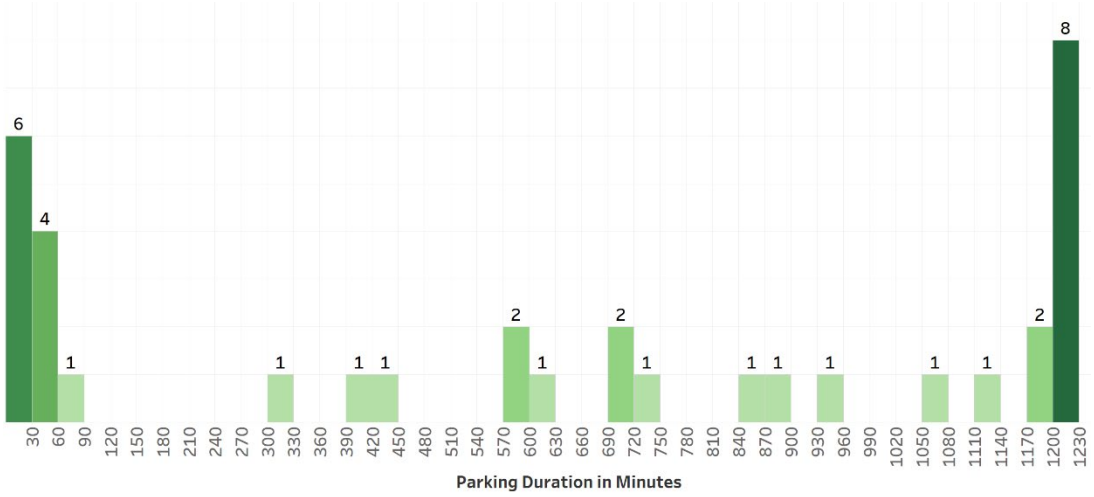


Figure 91. Graph. Time parked per parking session (Ladora EB).

Ladora WB

The ParkUnload App was used only 41 times during the 12-month pilot by 33 truck drivers (ParkUnload App users) at the Ladora WB rest area. Figure 92 shows that August 2022 and April 2023 saw the highest number of app uses, but at only seven recorded parking sessions each month. Most months saw four or fewer parking sessions being recorded.

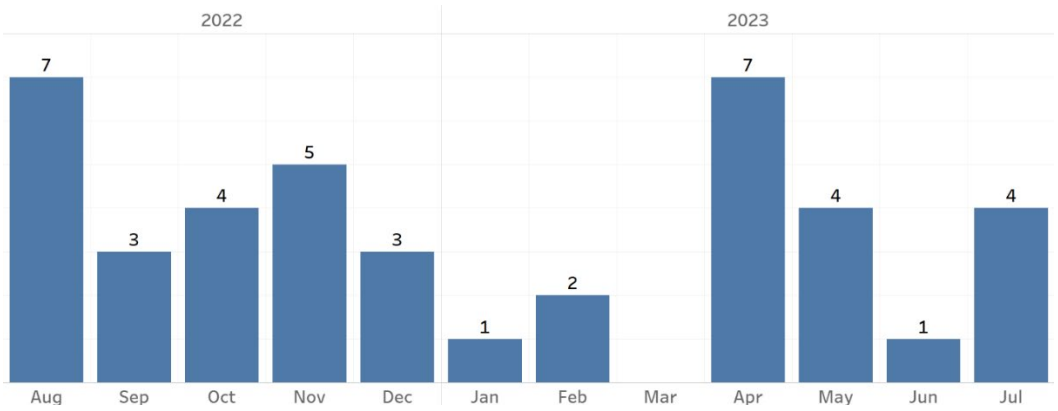


Figure 92. Graph. Number of parking sessions by month (Ladora WB).

Similar to the Ladora EB rest area, Figure 93 shows that most days, drivers did not check into/claim one of the pilot parking spaces at the Ladora WB rest area. The highest number of parking spaces checked into/claimed in a day was two.

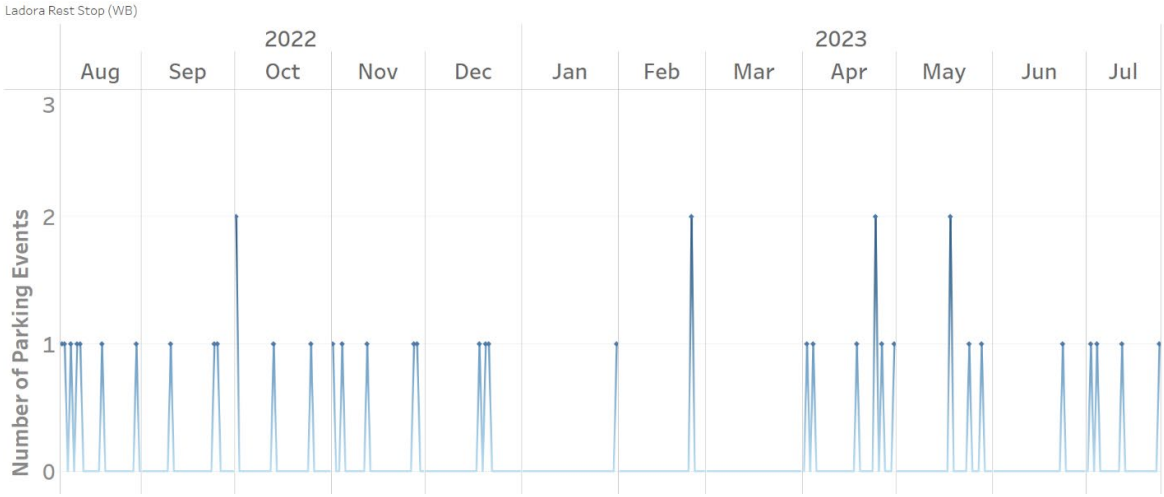


Figure 93. Graph. Number of parking sessions per day (Ladora WB).

Figure 94 shows that most parking sessions (nine, or 22.0 percent of the total parking sessions) were 20 hours or more. Similarly, nine parking sessions were 60 minutes or less. Finally, 18 of the parking sessions (or 43.9 percent of the total parking sessions) were 9.5 to 13.5 hours, potentially indicating that these users of the ParkUnload App were sleeping at the rest area.

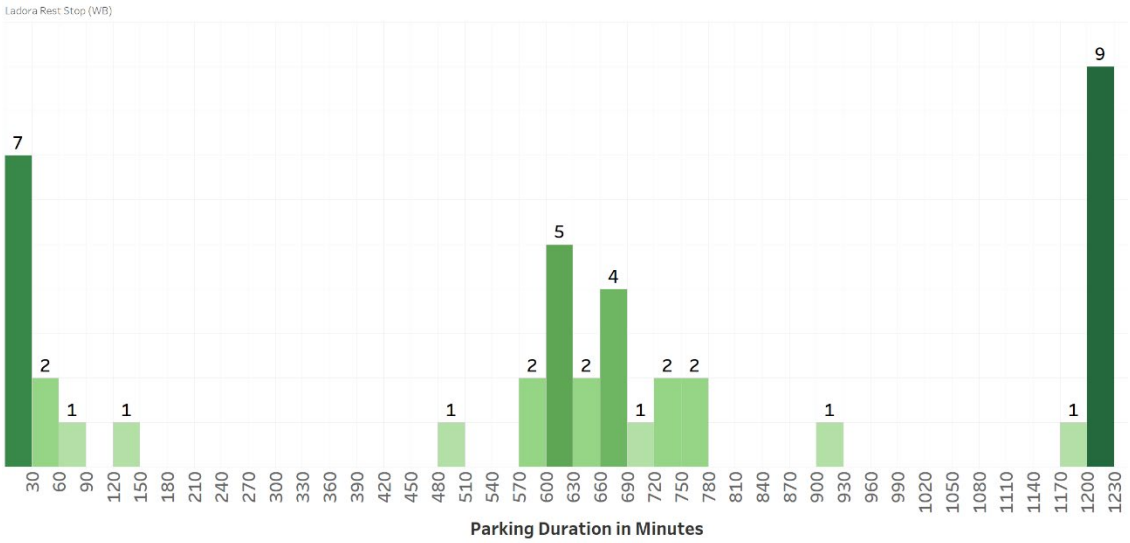


Figure 94. Graph. Time parked per parking session (Ladora WB).

Wilton EB

The ParkUnload App was used 63 times during the 12-month pilot by 61 truck drivers (ParkUnload App users) at the Wilton EB rest area. The Wilton EB rest area was the only pilot rest area that saw an increase in the number of app uses in September. After that, as Figure 95 shows, there was a decline in driver participation in October and November, and relatively lower participation in the winter months (i.e., December, January, and February) and most of the spring months (i.e., March and April). May and July saw relatively higher participation in the pilot again.

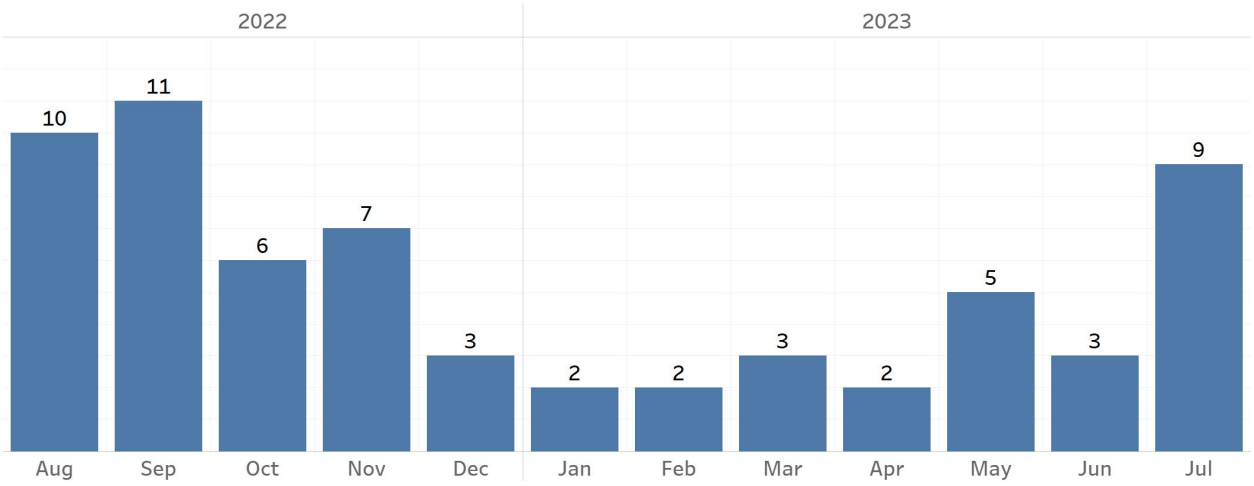


Figure 95. Graph. Number of parking sessions by month (Wilton EB).

Figure 96 shows that most days, the number of app uses varied between zero and one. The highest number of parking spaces checked into/claimed in a day was two.

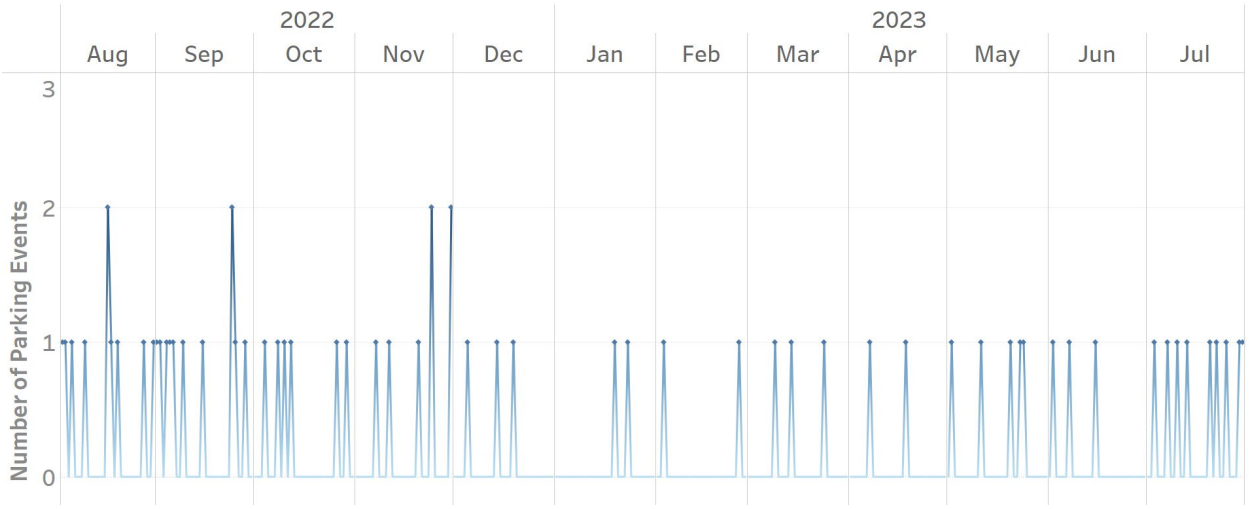


Figure 96. Graph. Number of parking sessions per day (Wilton EB).

Figure 97 shows that most parking sessions (10, or 15.9 percent of the total parking sessions) were 20 hours or more. On the other extreme, eight (or 13.1 percent) of the parking sessions were 30 minutes or less. Finally, 31 of the parking sessions (or almost half of the total parking sessions) were 9.5 to 12.5 hours, potentially indicating that these users of the ParkUnload App were sleeping at the rest area.

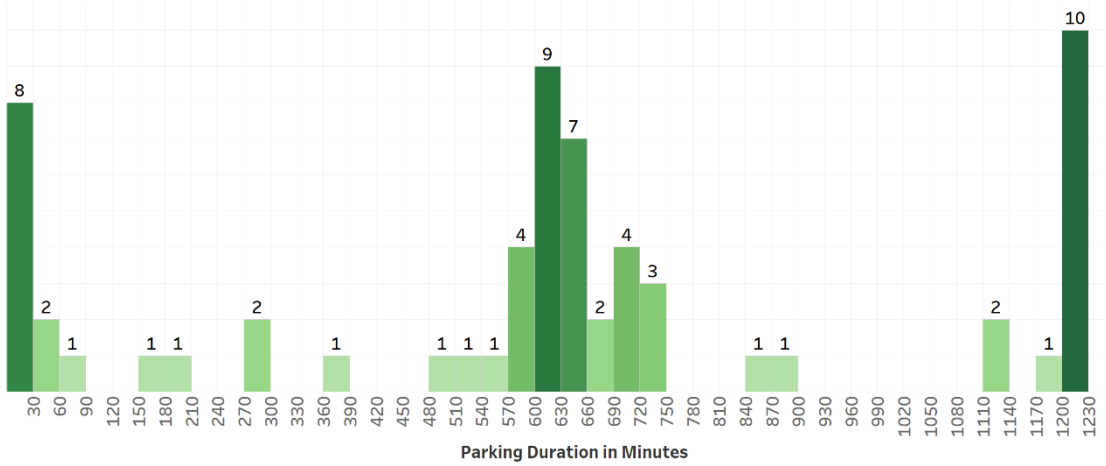


Figure 97. Graph. Time parked per parking session (Wilton EB).

Wilton WB

The ParkUnload App was used 78 times during the 12-month pilot by 65 truck drivers (ParkUnload App users) at the Wilton WB rest area. Figure 98 shows that August saw the highest number of app uses, at 14 recorded parking sessions. After August, Figure 98 shows a decline in driver participation until December. January, February, April, and July 2023 saw a modest increase in the number of parking sessions, but overall, the number of parking sessions in winter, spring, and summer were comparatively low.

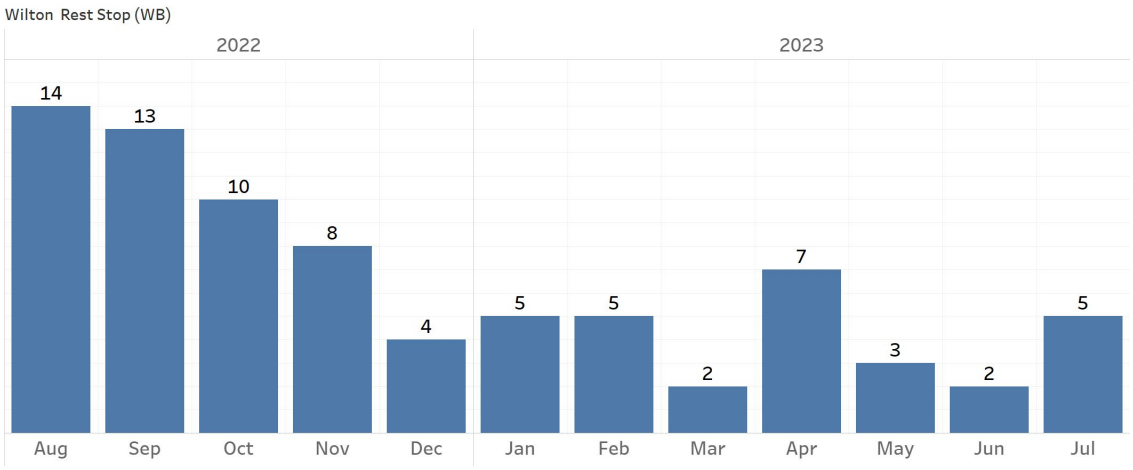


Figure 98. Graph. Number of parking sessions by month (Wilton WB).

Figure 99 shows that most days, the number of app uses varied between zero and one. The highest number of parking spaces checked into/claimed in a day was three.

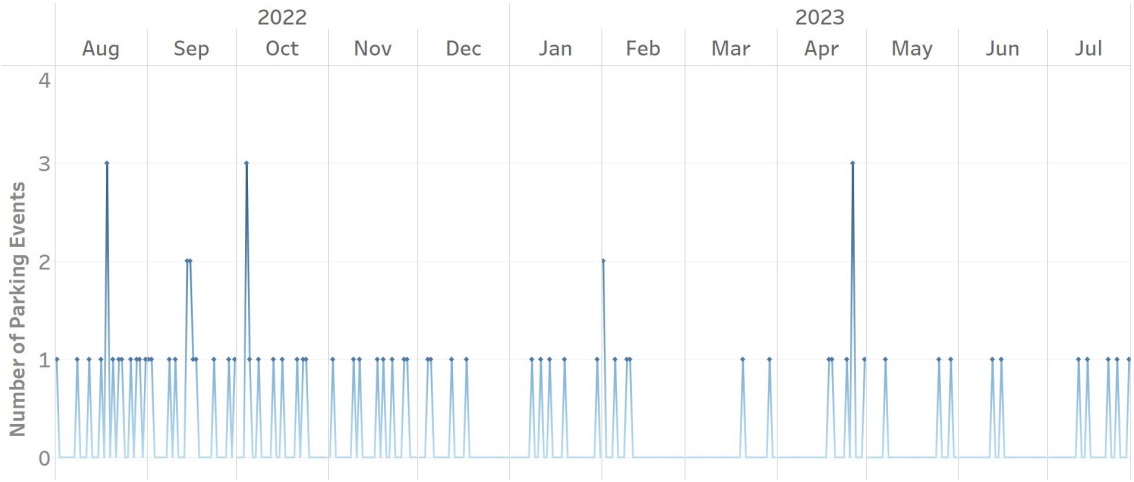


Figure 99. Graph. Number of parking sessions per day (Wilton WB).

Figure 100 shows that most parking sessions (21, or 26.9 percent of the total parking sessions) were 30 minutes or less. On the other extreme, 14 (or 17.9 percent) of the parking sessions were 20 hours or more. Finally, 28 of the parking sessions (or more than one-third of the total parking sessions) were 9.5 to 13.5 hours, potentially indicating that these users of the ParkUnload App were sleeping at the rest area.

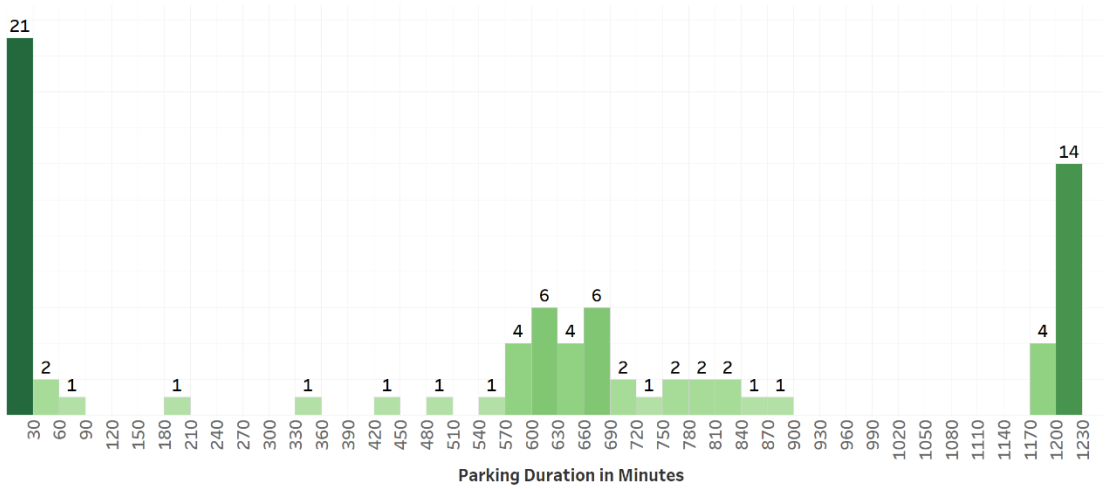


Figure 100. Graph. Time parked per parking session (Wilton WB).

PILOT REST AREAS ALONG THE I-39/I-90/I-94 CORRIDOR

Janesville SB

The ParkUnload App was used 55 times during the 12-month pilot by 39 truck drivers (ParkUnload App users) at the Janesville SB rest area. Figure 101 shows that August and December saw the highest number of app uses, at nine and 10 recorded parking sessions, respectively. Figure 101 also shows that fall, most of winter, and most of spring saw comparatively fewer parking sessions. May, June, and July saw a modest increase in the number of parking sessions.

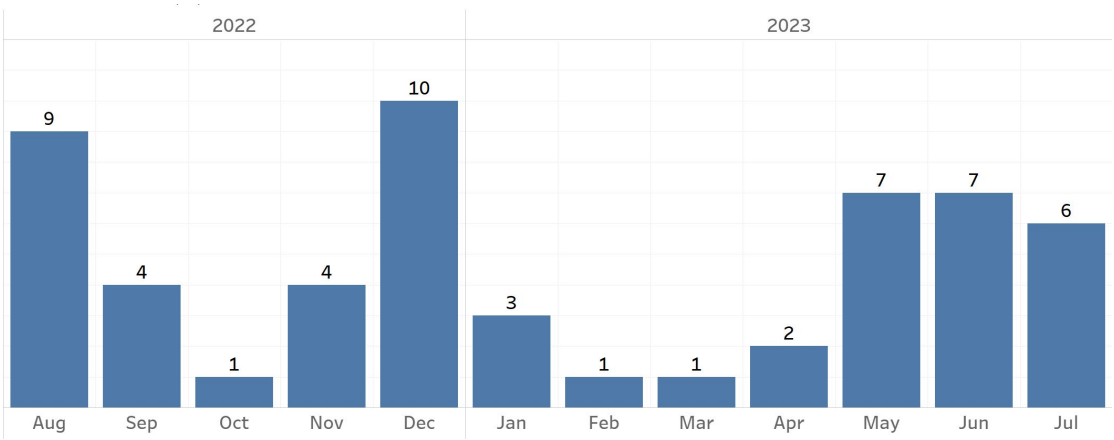


Figure 101. Graph. Number of parking sessions by month (Janesville SB).

Figure 102 shows that most days, the number of app uses varied between zero and one. The highest number of parking spaces checked into/claimed in a day was four.

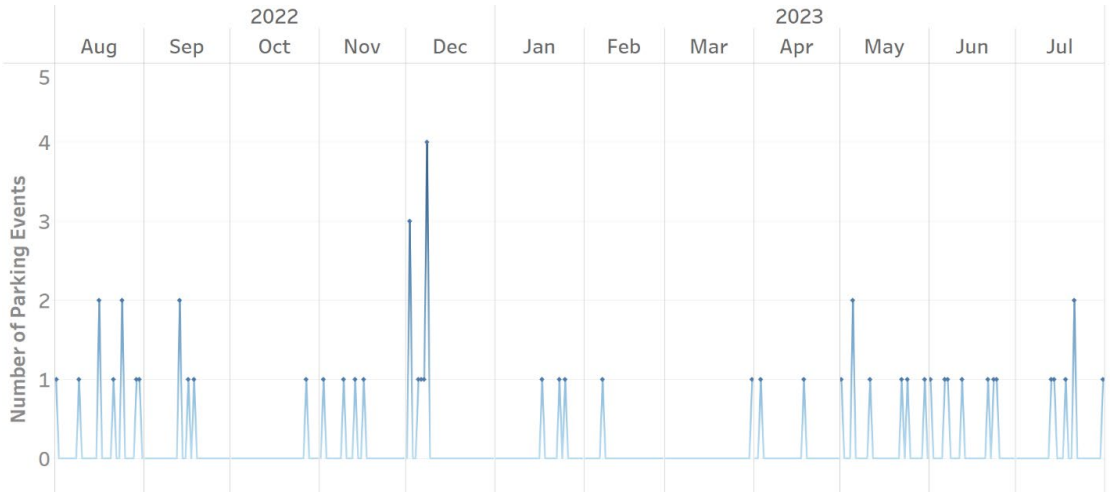


Figure 102. Graph. Number of parking sessions per day (Janesville SB).

Figure 103 shows 26 parking sessions (or 47.3 percent of the total parking sessions) were between 130 and 140 minutes—in other words, 10 to 20 minutes longer than the 2-hour parking limit specified. None of the app users registered a parking time of more than 140 minutes. Figure 103 also shows that 20 of the parking sessions (or more than one-third of the total parking sessions) were 30 minutes or less.

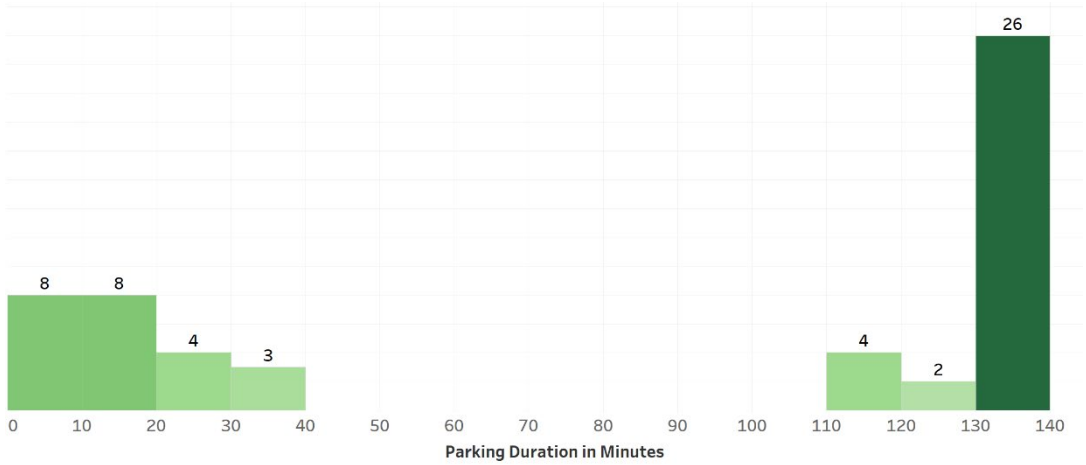


Figure 103. Graph. Time parked per parking session (Janesville SB).

Portage SB

The ParkUnload App was used only 19 times during the 12-month pilot by 15 truck drivers (ParkUnload App users) at the Portage SB rest area. This rest area saw the lowest number of app uses in the pilot. Figure 104 shows that August 2022 saw the highest number of app uses, but at only four recorded parking sessions. Most months saw fewer than three parking sessions being recorded.

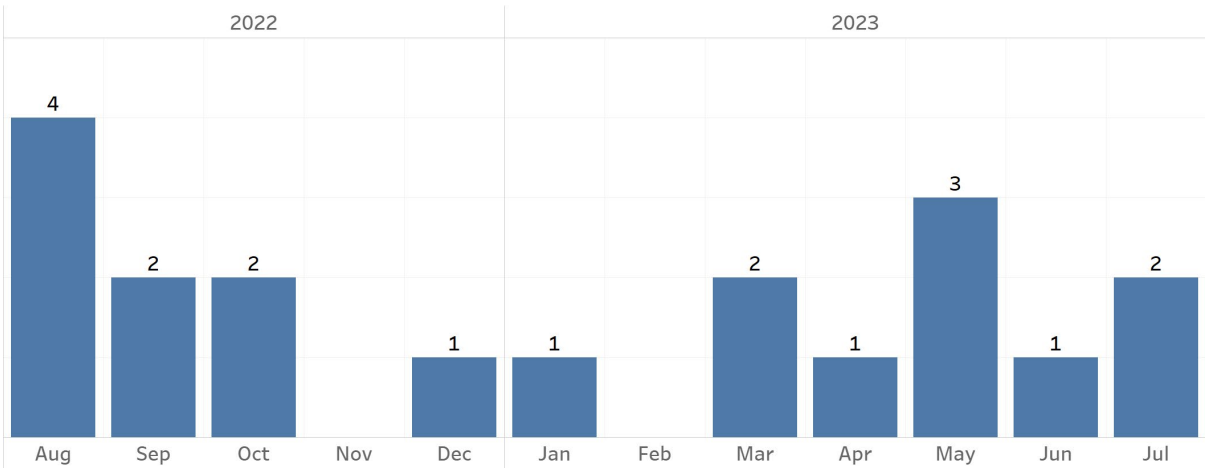


Figure 104. Graph. Number of parking sessions by month (Portage SB).

Figure 105 shows that most days, the number of app uses was zero. The highest number of parking spaces checked into/claimed in a day was one.

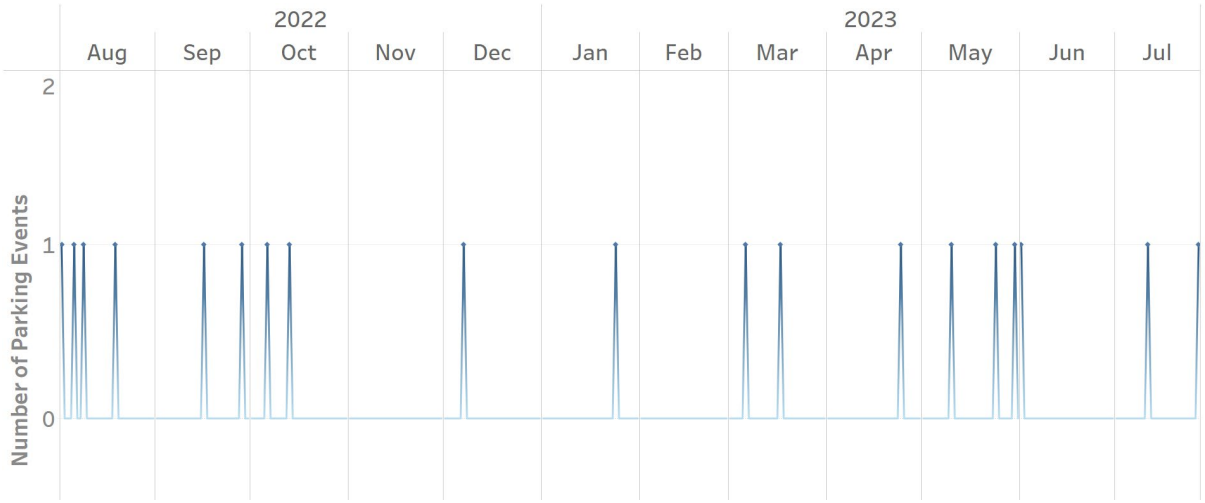


Figure 105. Graph. Number of parking sessions per day (Portage SB).

Figure 106 shows that six parking sessions were between 130 and 140 minutes—in other words, 10 to 20 minutes longer than the 2-hour parking limit specified. None of the app users registered a parking time of more than 140 minutes. Figure 106 also shows that seven of the parking sessions were 30 minutes or less.

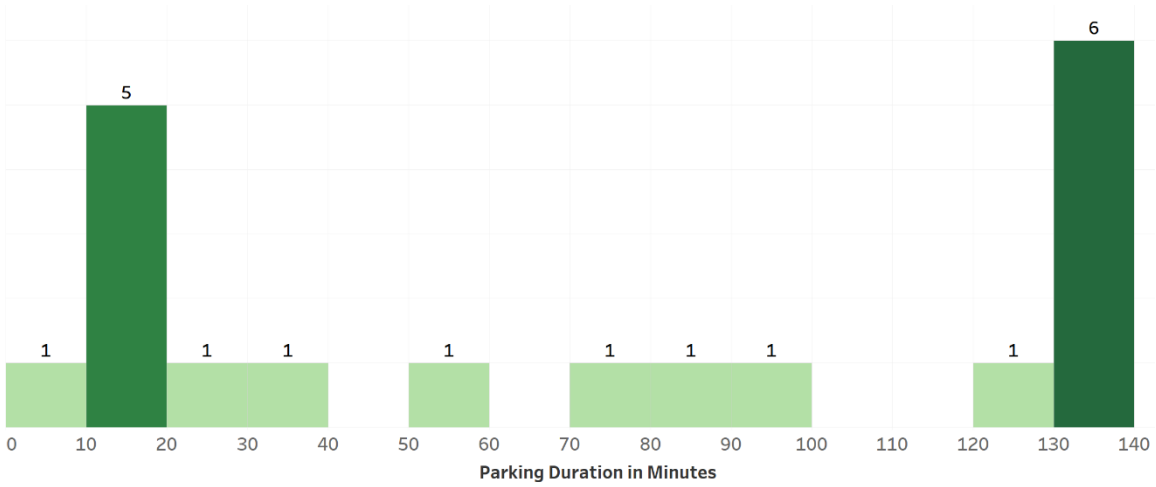


Figure 106. Graph. Time parked per parking session (Portage SB).

Poynette NB

The ParkUnload App was used 73 times during the 12-month pilot by 52 truck drivers (ParkUnload App users) at the Poynette NB rest area. Similar to the rest areas along the I-80 corridor, Figure 107 shows that August saw the highest number of app uses, at 11 recorded parking sessions. Figure 107. shows a decline in driver participation in September and October. The winter months (i.e., December, January, and February) saw the lowest number of parking sessions. Similar to the I-80 corridor, the increase in app use in March, April, and May is potentially attributable to the survey that was texted to ParkUnload App users on March 15, April 19, and May 19, 2023, to thank drivers for their participation and to solicit feedback on parking challenges and the ParkUnload App.

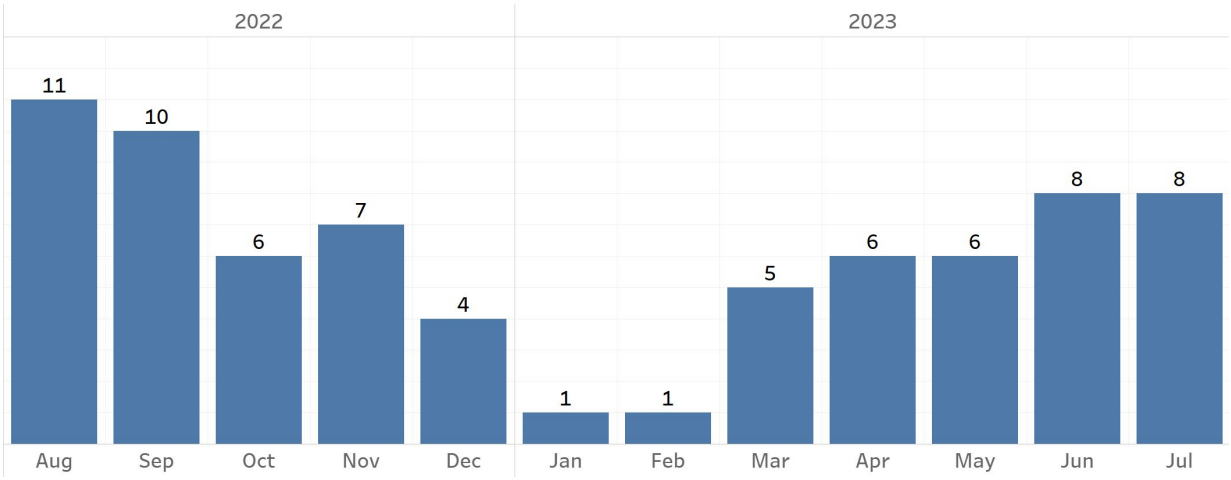


Figure 107. Graph. Number of parking sessions by month (Poynette NB).

Figure 108 shows that most days, the number of app uses varied between zero and one. The highest number of parking spaces checked into/claimed in a day was two.

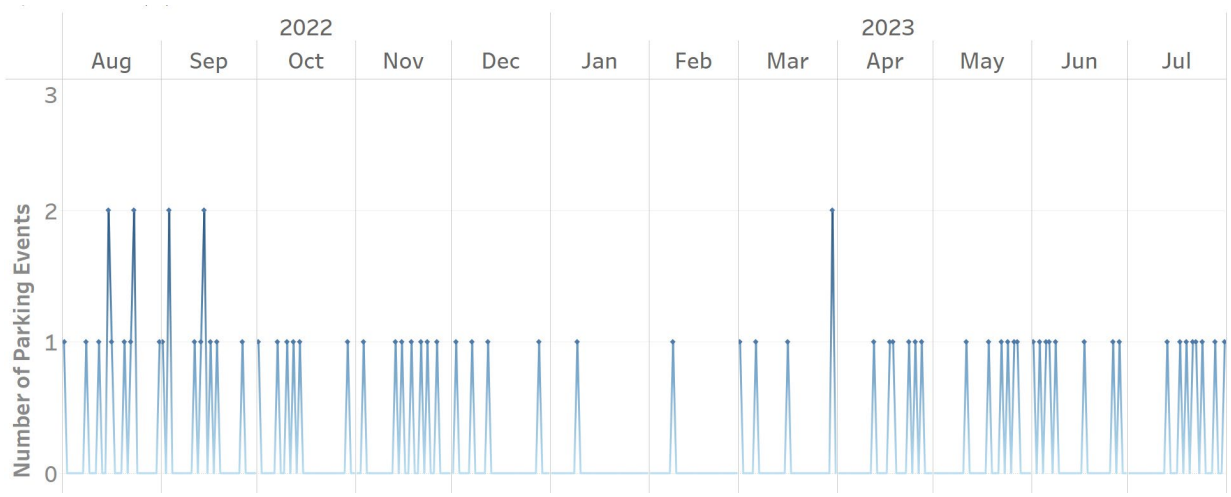


Figure 108. Graph. Number of parking sessions per day (Poynette NB).

Figure 109 shows 24 parking sessions (or 32.8 percent of the total parking sessions) were between 130 and 140 minutes—in other words, 10 to 20 minutes longer than the 2-hour parking limit specified. None of the app users registered a parking time of more than 140 minutes. Figure 109 also shows that 23 of the parking sessions (or almost one-third of the total parking sessions) were 30 minutes or less.

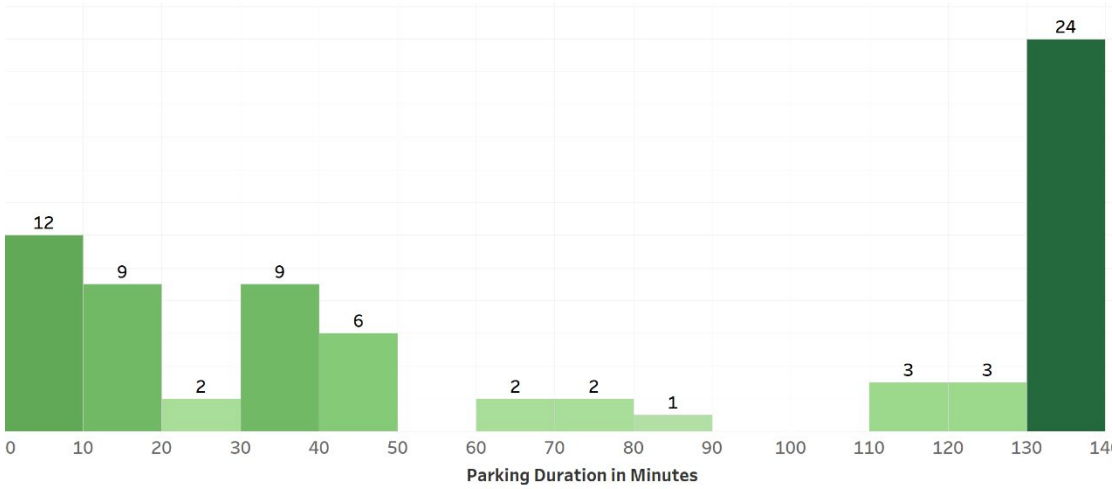


Figure 109. Graph. Time parked per parking session (Poynette NB).

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