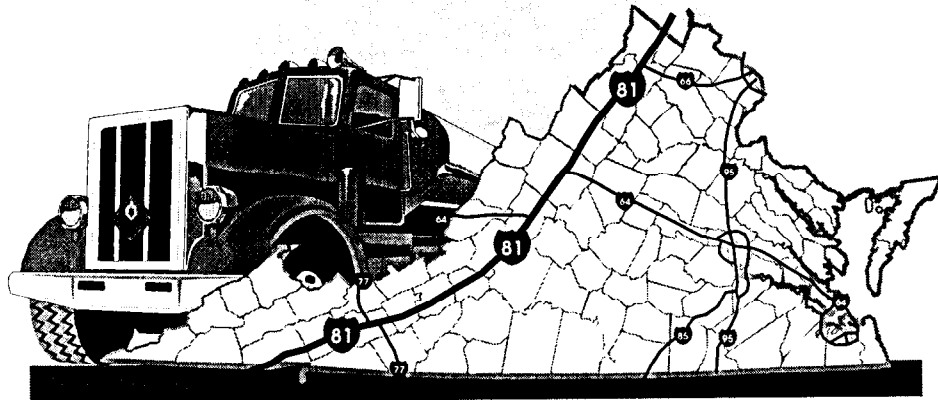


FINAL REPORT

PB2003-101583



ESTIMATING THE SUPPLY AND DEMAND FOR COMMERCIAL HEAVY TRUCK PARKING ON INTERSTATE HIGHWAYS: A CASE STUDY OF I-81 IN VIRGINIA



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<p>16. Abstract</p> <p>The increasing number of trucks traveling on Virginia highways has led to a growing demand for public rest areas and private truck stops. This study developed a methodology to determine the supply and demand for commercial heavy truck parking using I-81 in Virginia as a case study. In this study, <i>supply</i> was defined as the number of parking spaces available for large truck parking, and <i>demand</i> at a given time was defined as the sum of the parking accumulation and the illegal parking.</p> <p>Extensive data on the characteristics of large truck parking including parking duration and accumulation for different times of day were obtained. Data were obtained at 14 public rest areas and 29 private truck stops. Detailed information was also obtained on the characteristics of each truck stop and rest area, including the location; number and types of parking spaces; and availability of other facilities, such as restaurants and showers. Two types of questionnaire surveys were conducted. The first involved truck drivers, and the second involved truck stop managers/owners. The data collected were used to develop models to describe the relationship between parking accumulation and independent variables such as traffic volume on the highway, truck percentage, parking duration, and the distance of a truck stop from the interstate. The models developed were then used to estimate demand in 10 and 20 years. Any shortfall in supply with respect to the estimated demand was then determined for each truck stop and the entire highway.</p> <p>The results indicated that the existing maximum demand is 2,947 parking spaces, which exceeds the supply by 309 spaces. This deficiency will increase to 1,193 and 1,463 spaces in 2010 and 2020, respectively, if the number of parking spaces for large trucks does not increase.</p>			
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ABSTRACT

The increasing number of trucks traveling on Virginia highways has led to a growing demand for public rest areas and private truck stops. This study developed a methodology to determine the supply and demand for commercial heavy truck parking using I-81 in Virginia as a case study. In this study, *supply* was defined as the number of parking spaces available for large truck parking, and *demand* at a given time was defined as the sum of the parking accumulation and the illegal parking.

Extensive data on the characteristics of large truck parking including parking duration and accumulation for different times of day were obtained. Data were obtained at 14 public rest areas and 29 private truck stops. Detailed information was also obtained on the characteristics of each truck stop and rest area, including the location; number and types of parking spaces; and availability of other facilities, such as restaurants and showers. Two types of questionnaire surveys were conducted. The first involved truck drivers, and the second involved truck stop managers/owners. The data collected were used to develop models to describe the relationship between parking accumulation and independent variables such as traffic volume on the highway, truck percentage, parking duration, and the distance of a truck stop from the interstate. The models developed were then used to estimate demand in 10 and 20 years. Any shortfall in supply with respect to the estimated demand was then determined for each truck stop and the entire highway.

The results indicated that the existing maximum demand is 2,947 parking spaces, which exceeds the supply by 309 spaces. This deficiency will increase to 1,193 and 1,463 spaces in 2010 and 2020, respectively, if the number of parking spaces for large trucks does not increase.

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INTRODUCTION

The lack of adequate parking spaces for large trucks at rest areas and truck stops on parts of the interstate highway system is a serious concern for the driving public and the private industries that use the system. Several studies have indicated that fatigue-related crashes involving large trucks may be higher on routes with an insufficient number of truck parking facilities.¹⁻⁴ In addition, truck drivers who cannot find parking spaces at rest facilities often choose to park on interstate ramps and roadway shoulders, which may result in accelerated deterioration of the pavement.⁵⁻⁷ Studies have also shown that fatal crashes involving vehicles on shoulders are significant.^{8,9} An alternative to shoulder parking that has been used by some states is to allow large trucks to park at other lots that are accessible to them. For example, Maryland allows large trucks to park in a park-and-ride lot during nighttime hours.¹⁰

A study conducted by the Trucking Research Institute concluded that I-81 was one of the top 10 interstate highways that had serious truck parking shortfalls.¹¹ The current average annual daily traffic (AADT) on this route is 150,000, and up to 40 percent of the vehicles in the traffic stream are trucks.¹³ Crash data show that approximately 35 percent of fatal crashes on I-81 involve a truck.

Two studies have investigated the demand for and supply of truck parking facilities, but the results of these studies cannot be directly applied to Virginia highways without further evaluation.^{11,12} For example, a study conducted by Wilbur Smith and Associates for the Ohio Department of Transportation considered only traffic characteristics and did not consider factors such as parking duration and distances between parking facilities.¹² In addition, data were obtained only at rest areas. Because parking characteristics are different at rest areas and private truck stops in Virginia, it is important that both types of facilities be considered in investigating the supply and demand for large truck parking.

In addition, previous studies that investigated truck parking demand along interstate highways focused on public rest areas. This approach will not provide a comprehensive picture of the state of large truck parking on I-81 in Virginia for several reasons. First, only 267 of the 2,371 large truck parking spaces available are at public rest areas. Second, truck drivers are allowed a maximum stay of 2 hours at the rest areas, which is insufficient for truck drivers to take their required 8-hour break. An analysis of the demand for large truck parking on I-81 must therefore include a detailed review of the parking availability at the truck stops.

PURPOSE AND SCOPE

The purpose of this study was to develop a methodology for estimating the supply and demand for large truck parking on I-81 in Virginia. This methodology could be used to determine the shortfall, if any, of parking spaces on different highway segments. This study is the first phase of a larger study that will examine all interstate highways in Virginia.

I-81 was selected for the case study as it carries a relatively high percentage of trucks compared with other interstate highways in Virginia. This study was conducted at all 14 rest areas and at 29 truck stops along I-81 in Virginia. Only truck stops that have 15 or more large truck parking spaces and that are within 2 miles of I-81 were included. A preliminary survey found that nearly all truck drivers used truck stops within 2 miles of the interstate, so this was used as the limit for the study. Of the 29 truck stops, 16 are in the southbound direction and 13 are in the northbound direction.

In this study, *demand* for large truck parking at any given time is the sum of the parking accumulation and the illegal parking, and *supply* is the number of parking spaces available.

The objectives of the study were as follows:

1. Determine the supply characteristics of large truck parking facilities.
2. Determine the demand characteristics of large truck parking.
3. Determine current shortfalls in the supply of large truck parking spaces.
4. Estimate demand and shortfalls for large truck parking for the next 10 and 20 years.
5. Estimate the cost of meeting any current shortfall and for meeting long-term demand.

METHODOLOGY

In this study, extensive data on the truck stops and rest areas along I-81 were collected, and these data were used to develop demand models. The models were then used to estimate future demand at different sections of the highway.

In order to achieve the objectives of the project, a methodology was used that consisted of the following four major tasks:

1. data collection
2. model development
3. demand forecasting and parking shortfall determination
4. cost estimation.

Data Collection

This task consisted of five subtasks carried out between May 1999 and April 2000:

1. identification of rest areas and truck stops
2. inventory of rest areas and truck stops
3. survey of truck drivers and truck stop owners/managers
4. collection of traffic information
5. collection of truck parking accumulation and duration data.

Identification of Rest Areas and Truck Stops

Researchers identified rest area locations by consulting with personnel of the Virginia Department of Transportation (VDOT). Rest areas in Virginia are operated and maintained by VMS, Inc.; are open 24 hours; and are located adjacent to the interstate. Rest areas can be entered or exited directly from the highway. Most of the rest areas provide parking spaces for passenger cars and large trucks. All rest areas are operated free of charge to the public but have a 2-hour parking limit. Amenities at most rest areas include rest rooms, vending machines, telephones, picnic areas, and pet rest areas.

Truck stop locations were identified by two methods. First, a reference document that lists the locations and amenities of truck stops was consulted.¹⁴ Additional truck stops were identified by driving I-81 and determining if any other stops were visible from the highway. Truck stops are privately owned by both individuals and national or regional franchises. Most

truck stops that serve interstate highways are located within 2 miles of an interchange on the interstate, and most operate 24 hours a day. Service is usually provided for all vehicle types, although emphasis is placed on services for commercial vehicle drivers. In general, the range of services depends on the size of the truck stop. A small truck stop (30 parking spaces or less) generally provides facilities for the purchase of fuel and a convenience store (basic service). Large truck stops may offer additional services, such as restaurants, TV lounge areas, shower stalls, laundromats, game rooms, truck washes, truck repairs, and sleeping facilities (full service). However, not all large truck stops provide all of these facilities. Since truck stops are privately owned, there is no government subsidy. Many truck stops have business relationships with large trucking companies so that drivers of particular trucking companies can stop for fuel and other services at particular truck stops.

Each rest area and truck stop was identified and its location determined and recorded on a Geographic Information System (GIS) map of the Commonwealth of Virginia. The Trimble Navigation GeoExplorer GPS and ArcView GIS software were used to determine the coordinates of each site for subsequent mapping.

Inventory of Rest Areas and Truck Stops

Each rest area and truck stop was visited, and a detailed inventory taken. Information obtained included the layout and number of parking spaces for passenger cars and large trucks, hours of operation, parking restrictions, parking fees, and services provided (e.g., restaurants, shower stalls, TV lounge).

Questionnaire Surveys for Truck Drivers and Truck Stop Owners/Managers

Questionnaire surveys were administered to truck drivers at truck stops and at rest areas. An additional questionnaire survey was administered to truck stop owners or managers. It was necessary to use different survey forms at the rest areas and at the truck stops since the characteristics of these facilities were different. For example, it was necessary to obtain information on the influence of different types of services on the selection of a truck stop by a driver, but this information was not applicable to the rest areas since they all have identical services.

Two methods were used to distribute the survey forms to the truck drivers. In the first method, truck drivers were asked to complete the survey forms while they were at a truck stop or rest area. About 99 percent of the drivers completed and returned their forms before leaving the truck stop or rest area. The remainder opted to mail their completed forms. At truck stops, truck drivers were randomly selected for the survey as they arrived. At the rest areas, drivers of all trucks parked or arriving during the survey period were given the survey forms. At the truck stops, the survey forms were distributed from 1:30 P.M. to 1:30 A.M. while demand and accumulation data were being collected. This was done to ensure that the responses were from drivers who arrived during the data collection period. The survey was conducted at the time of the inventory at the rest areas. In the second method, blank copies of the survey forms were

mailed to trucking associations and individual trucking companies. The response rate of this group was about 51 percent. A letter (see Appendix A) stating the reason for the survey was also included in each package. Managers were asked to ensure that truck drivers who had previously completed a form for either a truck stop or rest area did not complete another form for that parking facility. Information obtained from the truck drivers included frequency of use, factors that influence their selection of a particular truck stop, adequacy of existing parking facilities, and where they would park if there were no parking spaces at the rest areas and truck stops of their choice. Space was also provided for the truck drivers to record any comments they wished to convey to the researchers.

On the day of the inventory of each truck stop, a survey form was given to the truck stop operator/manager and was returned to a member of the research team before the researchers left the site. Information obtained from the truck stop operators/managers included the day of the week and time of day that maximum accumulation occurred, the types of services provided, and the adequacy of the existing parking facilities for large trucks. The survey forms are shown in Appendix A.

Obtaining Traffic Information

The traffic information for this study was obtained from VDOT and through field studies conducted during the summer of 1999. Traffic volumes collected in either 1996 or 1997 were obtained from VDOT. These data included AADT; peak (AM, mid-day, and PM) traffic; total traffic for I-81 mainline and minor roads; on- and off-ramp traffic; and percentage of trucks on mainline, ramp, and minor road traffic. These data were obtained in electronic format for the entire length of I-81 within Virginia.

Since the traffic data obtained from VDOT were collected in 1996 and 1997 and the parking accumulation data were collected during the summer of 1999, adjustments were made to update the traffic data. Traffic growth rates were applied to VDOT traffic data to derive the 1999 traffic data. Growth rates were obtained from VDOT's Transportation & Mobility Planning Division for the widened condition of I-81 and varied by road segment.

Truck Parking Accumulation and Duration Data

This task involved collecting data on the number of trucks parked by time of day, the number of trucks parked in designated spaces, and the length of time each truck remained parked.

The number of trucks parked by time of day gave the parking accumulation, and the change in number of trucks parked in each space during a given time period and the length of time each truck remained parked gave the turnover rate and parking duration, respectively. The researchers obtained this information by recording the last three letters or numbers of the license plate of a truck parked in a legal parking space. This was used to determine the number of trucks parked in each space and the length of time each truck remained parked in a particular parking

bay. Data were collected at 30-minute intervals. Since this methodology is time-consuming and labor intensive, it was not feasible to collect the accumulation and duration data at all of the truck stops identified. The 29 truck stops were therefore first divided into three categories (small, medium, and large) based on the number of truck spaces at the truck stop. Small truck stops had 60 or fewer parking spaces, medium truck stops had between 60 and 100 parking spaces, and large truck stops had more than 100 parking spaces.

Seventeen candidate truck stop sites were selected for the accumulation and duration studies. These truck stops were selected to represent different sizes of truck stops, based on the number of truck stops in each category; the location of the truck stops; and site permission from truck stop owners/managers. Only one owner/manager declined the request for data to be collected at his truck stop, which did not affect the selection of representative truck stops for data collection in each category. The accumulation and duration data were collected between July 1999 and October 1999 on a Tuesday, Wednesday, or Thursday at each of the 17 truck stops as preliminary information received from truck stop owners/managers indicated that the maximum usage occurs on these days. In addition, information received from the truck stop owners/managers indicated that usage was low in the morning periods (6 A.M. to noon) and that most drivers arriving at 9:30 P.M. or later stayed for the night, with most of them leaving between 6 A.M. and 8 A.M. Thus, the required data were collected at all 17 representative truck stops between 1:30 P.M. and 1:30 A.M. This period of data collection allowed for the collection of data while the duration and accumulation varied; in most cases, the truck stops were full by 1 A.M., with very few trucks either arriving or departing. Thus the parking accumulation and duration remained constant until approximately 6 A.M.

Model Development

Stepwise regression analysis was used to develop models that would relate the truck stop parking accumulation at any given 30-minute period with specific independent variables. Based on the inventory and traffic data, 22 independent variables were initially considered for developing the models. Many of these variables were eliminated because they were found to have an insignificant effect on the model. A correlation analysis was also conducted to test whether there was any correlation between two or more independent variables that were to be considered in developing the models. Variables that did not correlate were used in the development of the models. This correlation analysis is shown in Appendix C. The independent variables used were:

- *TotalTruck*: Total number of trucks on I-81 near a truck stop in half-hour intervals.
- *PercentTruck*: Percentage of trucks in the traffic stream in half-hour intervals.
- *Duration*: Duration at a truck stop in half-hour intervals.
- *Dist_81*: Distance from a truck stop to I-81.
- *Dist_TS*: Distance from a truck stop to the nearest other truck stop.

- *Dist_RA*: Distance from a truck stop to nearest rest area.
- *SERVICE*: Dummy variable for measuring the difference of services between large and small truck stops. (Number of spaces > 60, SERVICE = 1.)

The values for these variables were obtained from a variety of sources. A previous consultant study of I-81 was used to generate the TotalTruck and PercentTruck variables.¹³ The data from this study were used to identify traffic variables near the truck stops at particular times of the year and on particular days of the week. The remaining variables were obtained during the data collection phase of this project. The distance to truck stops and rest areas in adjacent states was collected when necessary.

The models were developed using all of the data collected except those at two sites that were later used to test the accuracy of the models. The two truck stops used to validate the model were randomly selected, with the only criterion being that they were located in two different geographic areas. Two models were developed, with each based on one of two assumptions made on the duration after 9 P.M. Model 1 was based on the assumption that trucks arriving at a truck stop between 8 P.M. and 9 P.M. will stay for an average of 5 hours and that trucks arriving at a truck stop after 9 P.M. will stay for an average of 6 hours. Model 2 was based on the assumption that trucks arriving after 9 P.M. will stay until 5 A.M. the next day. These assumptions were based on the information obtained from the truck stop managers/operators.

Demand Forecasting

Future demand for large truck parking was estimated by examining (1) the predicted maximum parking accumulation at the truck stops based on the models, (2) parking at rest areas, and (3) parking on interstate ramps or shoulders, which is illegal. When the data were analyzed, the entire length of I-81 within Virginia was divided into six sections, with each approximately 55 miles long. Table 1 shows the begin-and-end mileposts, length, and total number of large truck parking spaces available in each section. It can be seen that sections 2 and 4 have more parking spaces than the others do. The reasons are that section 2 includes an overlap of I-81 and I-77, and section 4 includes an overlap of I-81 and I-64. Section 1 is unique as it has more parking spaces at rest areas than at truck stops; the largest rest area with 110 parking spaces is located in this section.

Table 1. Description of Sections Along I-81 Within Virginia

Section	Begin Milepost	End Milepost	Length	Parking Spaces in Rest Areas	Parking Spaces in Truck Stops	Illegal Parking (estimation)	Total
1	0	55	55	118	65	108	291
2	55	110	55	29	783	48	860
3	110	165	55	33	174	54	261
4	165	220	55	10	761	36	807
5	220	275	55	65	210	66	341
6	275	325	50	12	378	72	462

The demand for parking on I-81 was determined by separately estimating the demand for truck stops, rest areas, and illegal parking. The predicted truck stop maximum accumulations for the years 2010 and 2020 were determined by using the appropriate values for the variables in the regression models. Information obtained from VDOT's Transportation & Mobility Planning Division indicated that the traffic growth rate is predicted to increase at a rate of about 53 percent from the base year to 2010 and about 27 percent from 2010 to 2020 separately. These increases in volumes were used to predict future accumulations at truck stops on the I-81 corridor.

Next, the demand for rest areas was determined. The researchers determined that data were insufficient to generate separate regression models for rest area parking accumulation, so rest area demand was assumed to mirror truck stop demand. The researchers determined that the demand exceeded the capacity during the peak period for all rest areas on I-81. The data showed that the peak period parking demand was approximately double the available supply for all rest areas, with the exception of the truck-only rest area at exit 14. The capacity at this rest area was exceeded by only 20 percent. To simplify calculations, the researchers assumed that demand was 200 percent of supply for all rest areas except the one at exit 14. The researchers also assumed that demand for rest areas would increase at the same rate as truck stop demand.

The amount of illegal parking in the areas around truck stops and rest areas was determined by observing interchanges adjacent to truck stops. At the conclusion of data collection at a truck stop or rest area, researchers would examine the interchanges surrounding these locations to determine if any trucks were parking illegally on the interchange ramps. These field observations showed that a maximum of six trucks (three per side) were parked on I-81 interchange ramps downstream of interchanges that had a truck stop or rest area. To simplify the analysis, the researchers assumed that six vehicles would be parked illegally at any interchange that did not have a truck stop or was a freeway-to-freeway interchange. Further, the researchers also assumed that the amount of illegal parking would increase at the same rate as truck stop parking accumulation. The researchers observed that illegal parking occurred once trucks stops reached full capacity. It was believed reasonable to assume that the occurrence of illegal parking would mirror the demand for truck stop parking.

The model results were compared with the available parking supply. The predicted number of parking spaces was varied using several assumptions for the growth rate of truck parking spaces in the I-81 corridor. This allowed the researchers to compare the predicted demand with several supply scenarios.

RESULTS

Inventory of Rest Areas and Truck Stops (Parking Supply)

The number of commercial vehicle parking spaces available at the public rest areas and truck stops in each county along I-81 in Virginia are given in Table 2. Table 3 gives the name, location, and number of parking spaces for large trucks at each truck stop and rest area. Figure 1 shows the locations of the rest areas and truck stops in each county based on the GPS data, and Figure 2 shows the locations of the parking facilities and the number of parking spaces in each section.

Table 2. Number of Rest Areas and Truck Stops in Every County Along I-81 Within Virginia

County	Rest Areas		Truck Stops	
	No.	Large truck parking spaces	No.	Large truck parking spaces
Washington	2	110	1	35
Smyth	2	8	2	55
Wythe	0	0	6	628
Pulaski	0	0	2	115
Montgomery	3	52	2	55
Roanoke	0	0	0	0
Botetourt	1	10	2	134
Rockbridge	1	10	6	644
Augusta	2	28	2	117
Rockingham	2	37	1	69
Shenandoah	0	0	4	376
Clarke	1	12	1	143
Total	14	267	29	2371

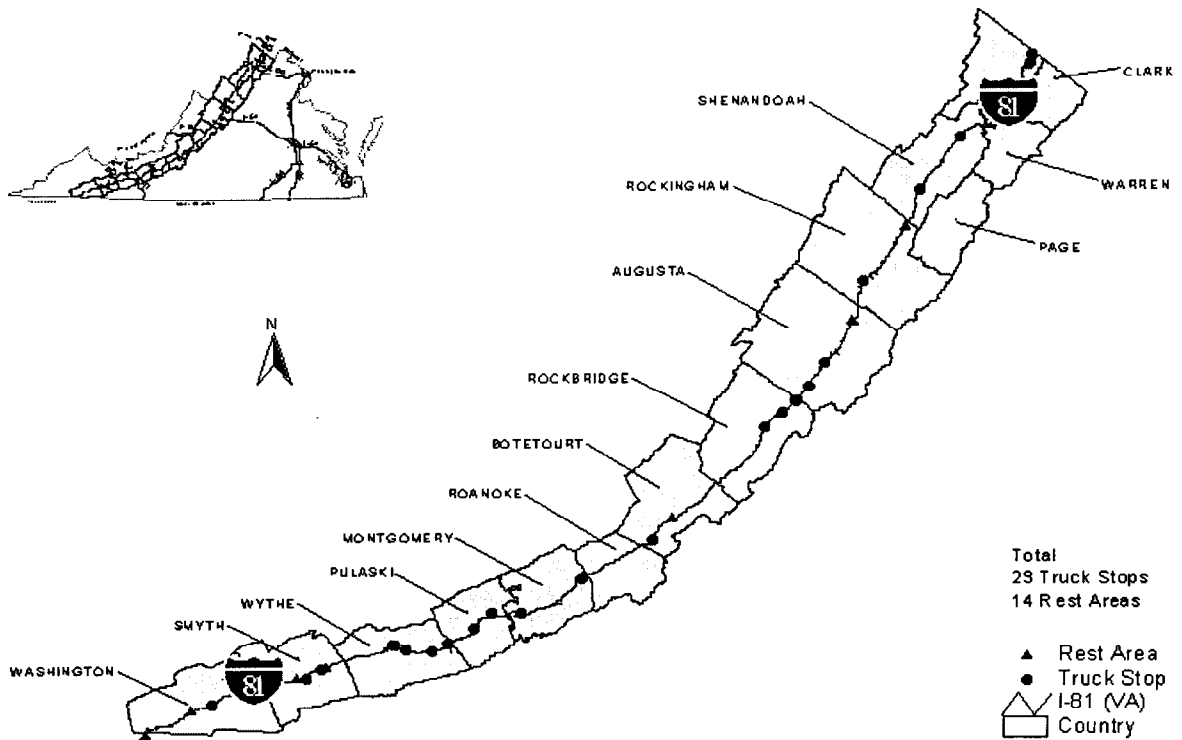


Figure 1. Layout of Commercial Vehicle Parking Facilities Along I-81 Within Virginia

Table 3. Truck Stops and Rest Areas Along I-81 Within Virginia

Type	Name	Exit/ Milepost	Direction	No. Parking Spaces For Trucks	Longitude	Latitude
RA	Bristol (no trucks allowed)	0.2	NB	0	W 82°14' 47.7"	N 39°14'34.40"
RA	Abingdon (trucks only)	13.9	NB	110	W 82°01'52.39"	N 36°41'00.73"
TS	Texaco	19	NB	35	W 81°55'54.18"	N 36°42'45.18"
TS	Village Truck Stop (Texaco)	54	NB	30	W 81°22'22.18"	N 36°53'09.25"
RA	Atkins	54	SB	8	W 81°23'09.65"	N 36°53'01.30"
TS	CITGO	60	NB	25	W 81°16'25.30"	N 36°54'37.26"
RA	Rural Retreat (closed)	61	NB	0	W 81°15'53.36"	N 36°54'58.94"
TS	Shell (Sentry Food & Travel)	72	SB	18	W 81°04'10.63"	N 36°57'58.70"
TS	TA Travel Plaza (BP)	72	SB	116	W 81°04'05.96"	N 36°57'54.46"
TS	Flying J	77	NB	161	W 80°59'34.60"	N 36°56'09.25"
TS	CITGO (Sentry Food & Travel)	77	NB	30	W 80°59'40.92"	N 36°56'07.47"
TS	Petro	80	NB	262	W 80°56'44.15"	N 36°56'42.20"
TS	Travel Plaza (Chevron)	86	SB	41	W 80°51'11.55"	N 36°57'57.15"
TS	Texaco	98	SB	30	W 80°41'29.19"	N 37°04'57.89"
TS	Lancer Travel Plaza (Chevron)	101	SB	85	W 80°38'59.80"	N 37°05'10.27"
RA	Radford	108.5	NB	15	W 80°31'27.73"	N 37°05'53.12"
RA	Radford	108.5	SB	14	W 80°31'16.31"	N 37°05'58.05"
TS	BP	109	SB	15	W 80°30'43.83"	N 37°05'58.04"
TS	CITGO	128	SB	40	W 80°14'23.24"	N 37°13'59.31"
RA	Ironto	129	NB	23	W 80°13'31.12"	N 37°14'21.15"
TS	Pilot	150	NB	15	W 79°54'03.63"	N 37°23'19.64"
TS	TA Travel Center (BP)	150	NB	119	W 79°54'09.82"	N 37°23'19.82"
RA	Botetourt	158.1	SB	10	W 79°48'43.79"	N 37°28'08.59"
TS	Lee Hi Truck Stop (Shell)	195	SB	167	W 79°22'38.70"	N 37°49'54.24"
RA	Fairfield	199.1	SB	10	W 79°18'33.29"	N 37°52'32.27"
TS	Sunshine Truck/Auto Plaza (CITGO)	200	SB	80	W 79°17'22.73"	N 37°53'06.82"
TS	White's Truck Stop (Exxon)	205	NB	185	W 79°13'47.42"	N 37°55'45.68"
TS	Fuel City	205	NB	29	W 79°13'31.23"	N 37°55'51.34"
TS	Texaco	205	SB	40	W 79°13'56.62"	N 37°55'50.84"
TS	Wilco Auto Truck	205	SB	143	W 79°13'53.72"	N 37°55'55.45"
TS	Pilot	213	NB	87	W 79°08'36.99"	N 38°01'07.71"
TS	CITGO	217	SB	30	W 79°05'20.31"	N 38°04'37.82"
RA	Mt. Sydney	232.2	NB	17	W 78°57'16.18"	N 38°15'00.94"
RA	Mt. Sydney	232.2	SB	11	W 78°57'20.96"	N 38°15'04.09"
TS	Travel Center	243	SB	69	W 78°54'38.90"	N 38°24'14.33"
RA	New Market	262.2	NB	19	W 78°42'21.85"	N 38°36'50.68"
RA	New Market	262.2	SB	18	W 78°42'21.90"	N 38°37'01.26"
TS	Sheetz 701	273	NB	72	W 78°37'55.52"	N 38°45'38.98"
TS	Shenandoah Truck Center	273	NB	69	W 78°37'55.52"	N 38°45'38.98"
TS	The Virginian	291	SB	77	W 78°26'22.11"	N 38°57'56.12"
TS	Wilco Travel Plaza 705 (CITGO)	291	SB	158	W 78°26'15.05"	N 38°57'59.68"
RA	Clearbrook	320	SB	12	W 78°06'55.09"	N 39°14'34.40"
TS	Olde Stone Auto/Truck Stop	323	SB	143	W 78°05'20.18"	N 39°16'52.69"

RA = rest area; TS = truck stop; NB = northbound; SB = southbound.

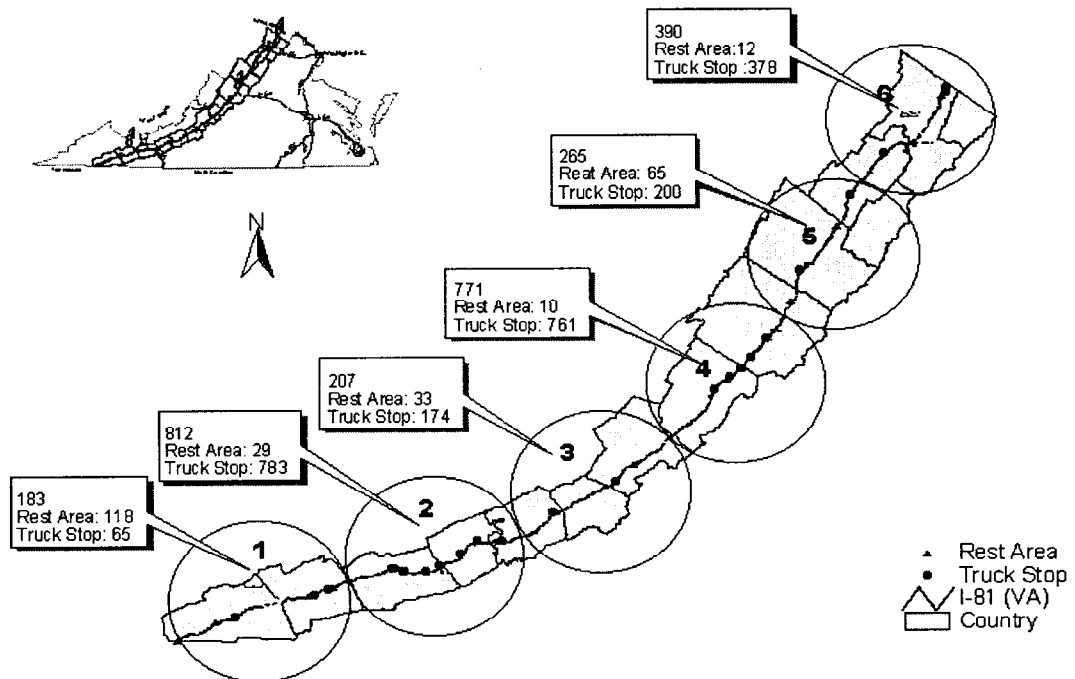


Figure 2. Distribution of Commercial Vehicle Parking Spaces Along I-81 Within Virginia

The results of the inventories showed that the number of truck parking spaces at a private truck stop varies between 15 and 262 spaces. Half of the private truck stops have fewer than 60 spaces. One third of the private truck stops have more than 100 parking spaces. Nearly all of these 28 truck stops had paved parking surfaces.

The layout of the parking bays at each parking facility was either one or a combination of two or more of the following layouts:

- diagonal pull-through
- diagonal pull-in back-out
- perpendicular pull-through
- perpendicular pull-in back-out.

Responses by Truck Drivers to Questionnaire Surveys

Truck drivers completed 296 rest area questionnaires of 350 distributed and 301 truck stop questionnaires of 400 distributed. Figure 3 shows the distribution of trucks by type for

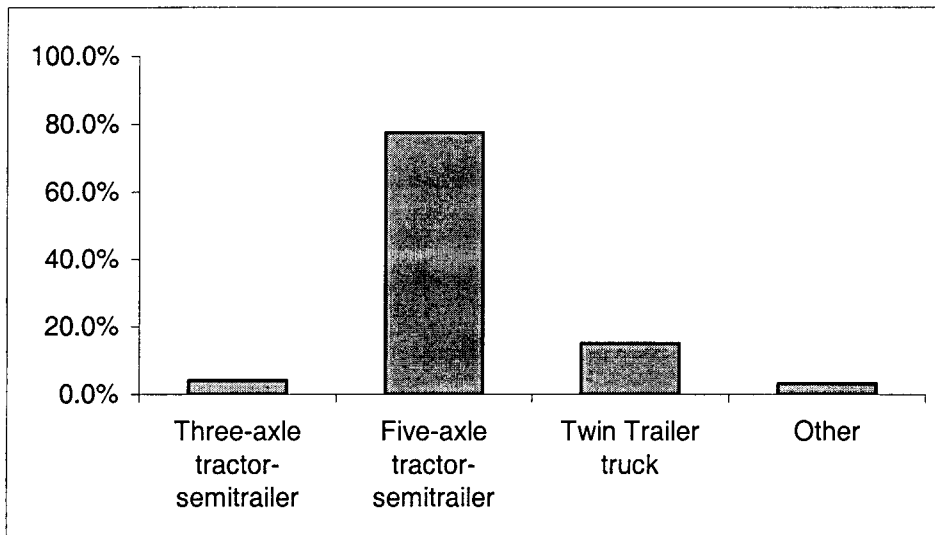


Figure 3. Truck Type at Rest Areas and Truck Stops Along I-81 in Virginia

trucks usually parked at the rest areas and truck stops. The vast majority of trucks using the rest areas and truck stops were five-axle tractor-semitrailers.

Figure 4 compares the parking facility used by truck drivers and their frequency of driving along I-81. Fifty-two percent of the drivers interviewed drove their trucks along I-81 within Virginia 3 or more times a week. Drivers who drove more frequently on this route tended to use the truck stops more than those who drove less frequently. This may be due to the knowledge frequent drivers have concerning the location and services provided at truck stops, which may not be readily available to less frequent drivers.

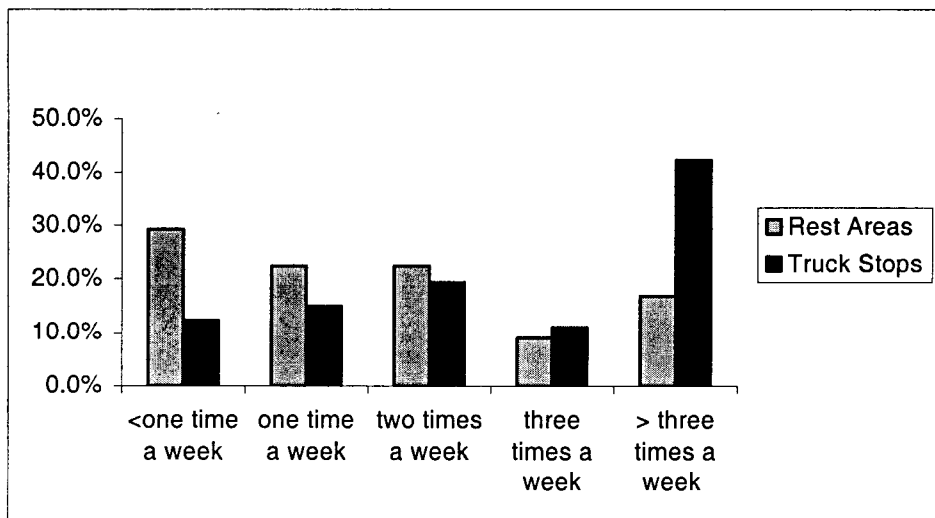


Figure 4. Comparison of Parking Facility Used With Frequency of Driving

About 80 percent of the truck drivers were driving for trucking companies, with most of them (88 percent) driving without a co-driver. A majority of truck drivers (51 percent) preferred to use the truck stops or motels for overnight stays or long breaks, but they preferred to use rest areas when they needed to take a break of less than 2 hours. This is mainly attributable to the 2-hour maximum stay restriction at Virginia rest areas.

Figures 5 and 6 show the duration distributions at rest areas and truck stops, respectively, as obtained from the drivers' responses to the question on the average length of time they stayed at each facility. Rest areas were used mainly for short durations, and the truck stops were used for longer durations. Although there is a parking limit of 2 hours at the rest areas, some drivers park for longer periods, including overnight.

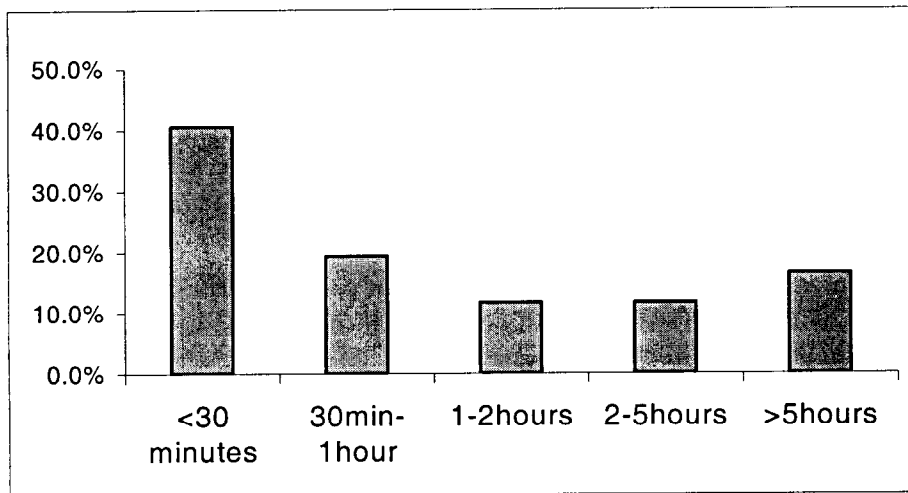


Figure 5. Duration Distributions at Rest Areas

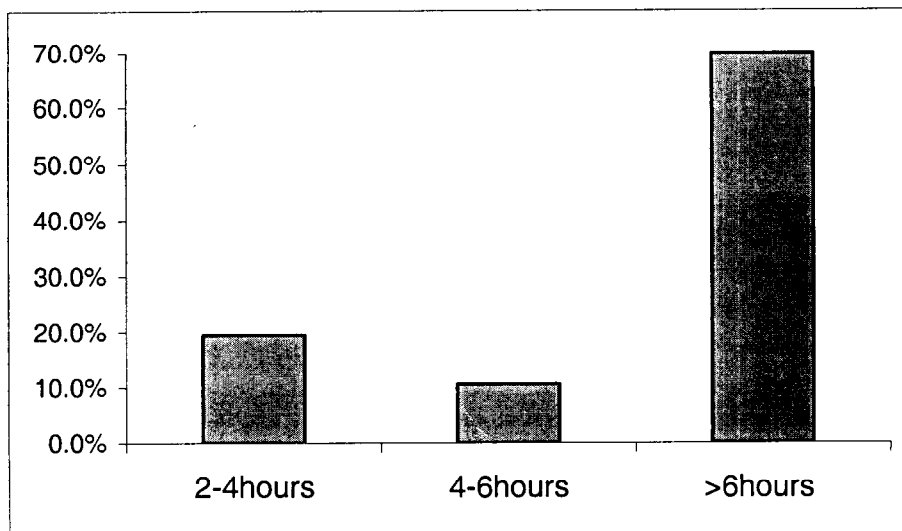


Figure 6. Duration Distributions at Truck Stops

Almost all truck drivers interviewed (95 percent) thought that the number of truck parking spaces along I-81 in Virginia was inadequate for long-term parking at night. About 59 percent indicated that the number was also inadequate during daytime. Truck drivers indicated that the availability of truck parking spaces depended on the time of the day. The truck parking space shortfall was thought to be the most severe between 9 P.M. and 6 A.M. Approximately 90 percent of the truck drivers surveyed would choose to stop at either the next closest rest area or truck stop if there were no parking spaces available at the rest area or truck stop when they arrived. Only 1 of 10 drivers indicated they would choose to stop along the roadway if there were no parking spaces available at their initial choice of rest area or truck stop.

The results of the surveys also showed that the majority of truck drivers were equipped with a communication system. For example, nearly all trucks (92 percent) were equipped with CB radios, about 50 percent of truck drivers possessed cellular phones, and one third of drivers owned onboard computers.

Almost two thirds of the drivers who worked for a trucking company stated that it was their company's policy to buy fuel at specific truck stops. However, only half of those responding said they would routinely take a rest at the truck stops where they purchased fuel. The location of a truck stop and the availability of a restaurant were the most significant factors that influenced truck drivers in selecting a truck stop for either a short or a long break. The number of parking spaces and the availability of free parking were also crucial factors that influenced their decision.

More than 90 percent of commercial vehicle drivers indicated that the maximum distance away from I-81 they would travel to a truck stop was 1.5 miles. Only 7 percent said they would be willing to travel for more than 1.5 mile.

More than 80 percent of the truck drivers responding to the questionnaire survey made personal comments on the space provided. A number of them also included their names and telephone numbers and indicated that they were willing to answer any follow-up questions on their comments although that was not requested, indicating a strong interest of the truck drivers in this study. The researchers also thought that these comments were of significant importance and presented some of them in Appendix B. The main issues commented on were:

- *The inadequacy of large truck parking facilities along I-81.* Most of the comments concerned the difficulty of finding parking spaces, particularly at night. There is strong support for building more rest areas similar to the one at exit 14, which is a truck-only rest area with a large number of parking spaces for trucks.
- *The 2-hour parking limit at rest areas.* The comments indicated that this is a very contentious issue for the truck drivers. They are of the opinion that drivers should not be awakened and told that they must leave the rest area because they have stayed longer than the 2-hour limit. Each comment on this issue noted that it is extremely dangerous for drivers to get back on the road when they are still fatigued. It was also noted that federal regulations require the truck drivers to rest for 8 hours but the rest areas allow a maximum stay of only 2 hours. This can serve to limit the usefulness of

Virginia rest areas for truck drivers. For example, a driver noted: “It’s a no win situation. I could get a ticket for staying in a rest area too long or I could get a ticket for driving too long.”

- *VSP officers checking drivers’ log books at rest areas.* There is a strong feeling that VSP personnel should not be allowed to use the rest areas for checking drivers’ logs. This action interferes with the required rest of the drivers and may lead to serious crashes. The researchers however obtained information that this is done only if a police officer has a valid reason, such as to check a driver’s statement that he or she has reached the maximum hours of driving.
- *Parking on interstate exit ramps.* There is a strong feeling among the drivers that they should be allowed to park on exit ramps when sufficient parking is unavailable. The point is often made that it is better for a fatigued driver to park on an exit ramp than to let the driver continue to drive on the highway.
- *Geometry of parking bays.* A few drivers noted that the lengths of most of the parking bays are inadequate for twin-trailers and that the angle of the bays makes properly parking longer trailers difficult.

Truck Stop Owners/Managers Responses to Questionnaire Survey

Twenty-one of 28 (75 percent) of the surveys distributed to truck stop owners and managers were completed and returned. The results indicated that more than two thirds of the truck stop owners/managers believed that the number of truck parking spaces along I-81 within Virginia was inadequate for the daytime and nighttime parking demand. More than 85 percent of the responding owners/managers perceived no variation in the demand of truck parking spaces among the seasons (winter, spring, summer and fall). However, they believed that there was fluctuation in the demand for truck parking spaces between daytime and nighttime. The results also showed that almost no truck stop included in this study charges a parking fee. A few truck stops charge a fee if drivers are not their patrons (i.e., not making use of any of the services) or if drivers dropped their trailers overnight. All but one truck stop allowed for overnight parking.

Almost all owners/managers responded that their truck stops tended to be busy between 8 P.M. and 6 A.M. Seventy-five percent agreed that the busiest days of the week were Tuesdays, Wednesdays, and Thursdays. Sixty-five percent also believed that the nearest rest areas had no effect on their business. Approximately 50 percent of owners/managers indicated they had no plan to expand their business within the next 5 years. Nine of 21 (43 percent) believed that truck parking spaces should be added at both public rest areas and private truck stops.

Parking Accumulation and Duration

An analysis of the results of the accumulation and duration data indicated that the variation of these characteristics during the day were similar for all truck stops and they supported the views of the truck drivers and truck stop managers/owners. For example, both duration and accumulation tended to increase as the day went by, with the maximum values occurring sometime after 10 P.M. Figures 7 and 8 show the accumulation and average duration, respectively, for different times during the day for White's truck stop located at exit 205 northbound. Similar graphs are available for the other truck stops but were not included in this report in the interest of brevity.

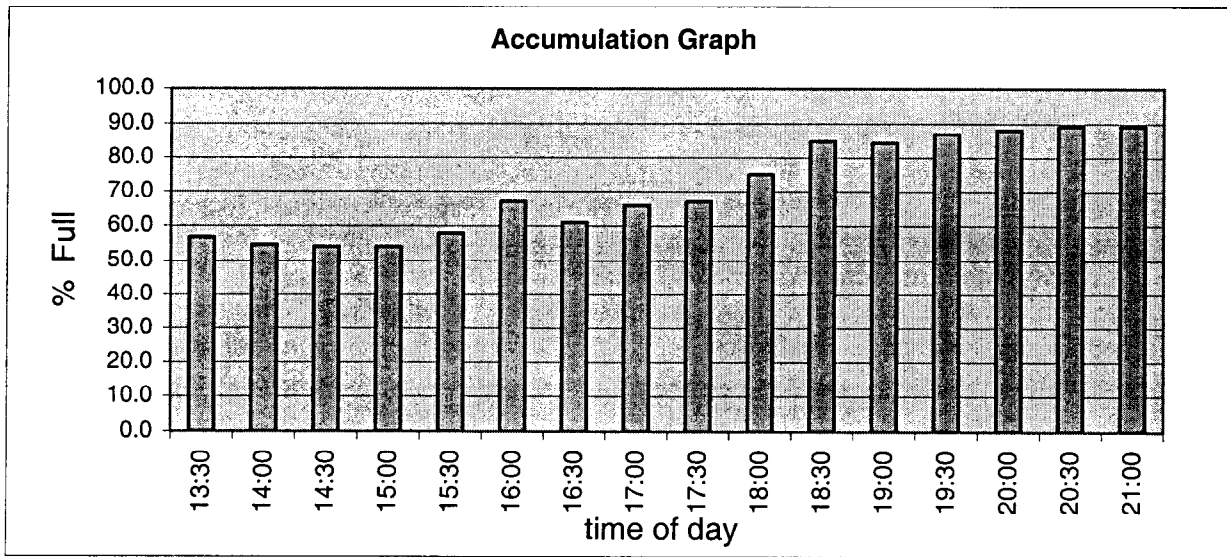


Figure 7. Accumulation vs. Time of Day at White's Truck Stop at Exit 205 Northbound

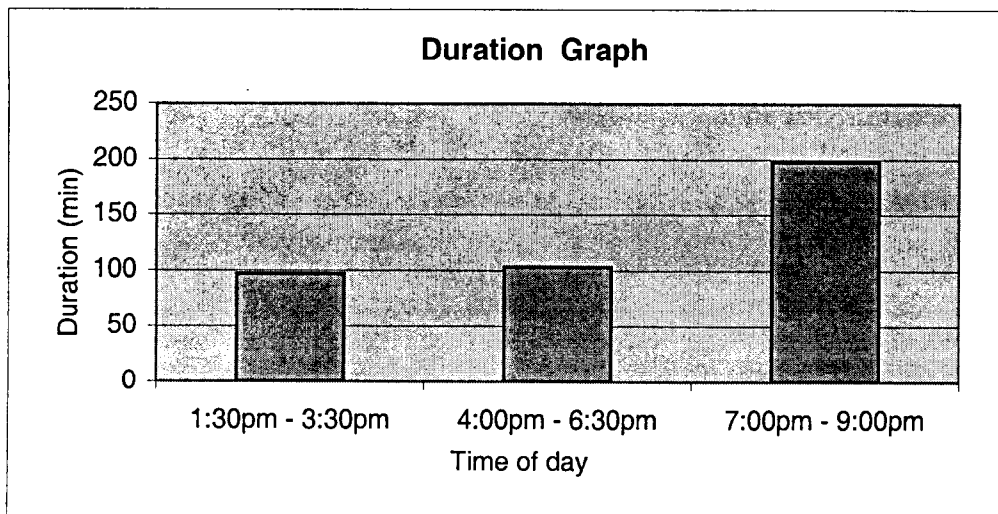


Figure 8. Average Duration vs. Time of Day at White's Truck Stop at Exit 205 Northbound

Truck Parking Accumulation Models for Truck Stops

The models obtained are shown here and in Table 4. Appendix C shows the standard coefficients, standard error, and confidence level for each coefficient. The correlation matrix for these variables is also included in Appendix C. Appendix C shows that the *TotalTruck* term is not significantly different from 0 for Model 2. Although the stepwise regression found that this term was not necessary, the researchers chose to force it into the model. The researchers thought that this was one term that would be sensitive to increases in traffic on I-81 and therefore included it. All remaining coefficients were significant.

Model 1

$$\begin{aligned} \text{Accumulation} = & -1586.89036 + 1.41039*\text{percentTRUCK} + 0.1556301*\text{Duration}_1 \\ & + 0.06955*\text{TotalTruck} - 123.29288*\text{DIST}_81 + 111.95632*\text{DIST}_\text{TS} + 14.22398*\text{DIST}_\text{RA} \\ & + 988.99725*\text{SERVICE} \\ (R^2 = & 0.9486) \end{aligned}$$

Model 2

$$\begin{aligned} \text{Accumulation} = & -1475.79228 + 1.54780*\text{percentTRUCK} + 0.13912*\text{Duration}_2 \\ & + 0.05898*\text{TotalTruck} - 114.32799*\text{DIST}_81 + 103.75365*\text{DIST}_\text{TS} + 13.80663*\text{DIST}_\text{RA} \\ & + 919.61570*\text{SERVICE} \\ (R^2 = & 0.9294) \end{aligned}$$

Table 4. Estimated Coefficients for Truck Parking Accumulation Model

Independent Variable	Model 1	Model 2	Sign
Intercept	-1586.89036	-1475.79228	-
Percent of trucks	1.41039	1.54780	+
Parking duration	0.1556301	0.13912	+
Total truck volume	0.06955	0.05898	+
Distance to I-81	-123.29288	-114.32799	-
Distance to nearest truck stop	111.95632	103.75365	+
Distance to nearest rest area	14.22398	13.80663	+
Service provided	988.99725	919.61570	+

The data obtained at the two truck stops (Wilco and Flying J) that were not used in the model development were then used to test the accuracy of the models as shown in Tables 5 and 6. Since the future demand was predicted based on the maximum accumulation during the peak period, the minimum errors occurred during the peak periods when the maximum accumulation occurred.

Figures 9 and 10 compare the model results with the actual data collected at Wilco and Flying J truck stops, respectively.

Table 5. Results of Models' Application at Wilco Truck Stop

Time of Day	Accumulation Field Data	Model 1	Model 2	Percentage of Error	
				Model 1	Model 2
1:30-2:00	47	45	46	-4	-2
2:00-2:30	44	45	46	+2	+5
2:30-3:00	55	43	44	-22	-20
3:00-3:30	48	43	44	-10	-8
3:30-4:00	59	47	48	-20	-19
4:00-4:30	59	40	44	-32	-25
4:30-5:00	55	38	42	-31	-24
5:00-5:30	55	38	42	-31	-24
5:30-6:00	62	50	55	-19	-11
6:00-6:30	62	50	55	-19	-11
6:30-7:00	62	51	57	-18	-8
7:00-7:30	62	64	68	+3	+10
7:30-8:00	58	71	76	+22	+31
8:00-8:30	61	71	76	+16	+25
8:30-9:00	84	79	84	+6	0
9:00-9:30	96	79	84	-18	-13
9:30-10:00	120	106	96	-12	-20
10:00-10:30	134	106	110	-21	-18
10:30-11:00	143	135	142	-6	-1
11:00-11:30	143	135	142	-6	-1
Average absolute error percentage				16	14

Table 6. Results of Models' Application at Flying J Truck Stop

Time of Day	Accumulation	Model 1	Model 2	Percentage of Error	
				Model 1	Model 2
4:30-5:00	152	125	134	-18	-12
5:00-5:30	144	131	140	-9	-3
5:30-6:00	123	137	147	+11	+20
6:00-6:30	145	138	148	-5	-2
6:30-7:00	145	142	152	-2	+5
7:00-7:30	151	150	161	-1	+7
7:30-8:00	164	170	179	+4	+9
8:00 – 8:30	183	171	181	-7	-1
8:30 – 9:00	160	176	187	+10	+17
9:00 – 9:30	176	167	177	-5	+1
9:30 – 10:00	178	185	196	+4	+10
Average absolute error percentage				9	7

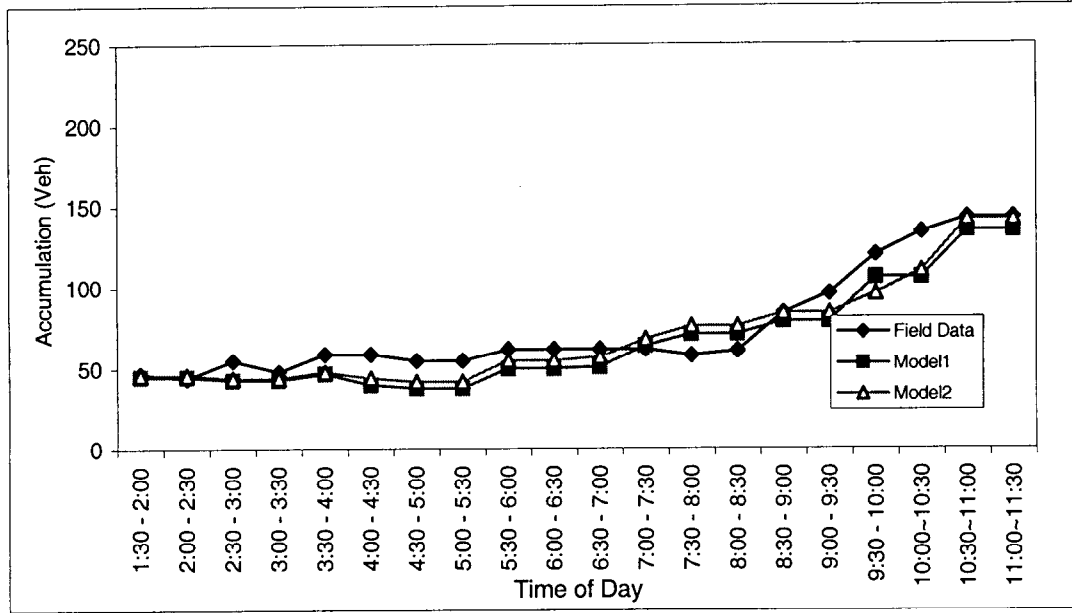


Figure 9. Comparison of Observed Accumulation and Model Values at Wilco Truck Stop at Exit 205 Southbound

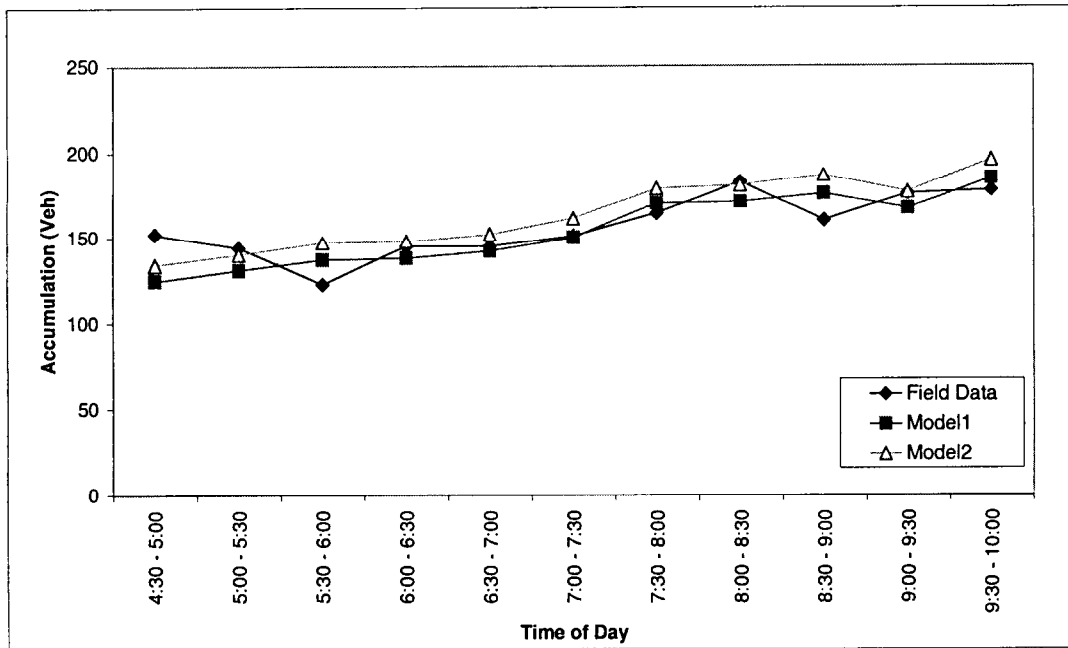


Figure 10. Comparison of Observed Accumulation and Model Values at Flying J Truck Stop at Exit 77 NB

Parking Demand Forecasting and Shortfall Determination

Parking demand was forecast in several steps. First, both regression equations for truck stop accumulations were evaluated under future traffic volumes, and the maximum accumulation (usually Model 2) was selected as the future year forecast. The percentage increase in accumulation between the base year and the predicted future year was then calculated. This percentage increase was then applied to the rest area accumulations and the estimated number of trucks illegally parked. It is possible that the estimated number of illegally parked trucks may not be accurate since personnel limitations made it impossible to conduct regular counts of the amount of illegal parking. This could bias the estimated parking shortfall calculations.

Table 7 shows the results obtained for maximum accumulation at each truck stop. Table 8 shows the current parking spaces and the current demand for each segment, and Tables 9 through 17 show the estimated demand for each segment in 2010 and 2020 for different parking space increase scenarios. Tables 18 through 26 show the associated deficiencies in parking spaces for each of the six segments. The results indicate that if there is an annual increase of 1 percent in large truck parking spaces in rest areas and an annual increase of 3 percent in truck stop parking spaces, the parking deficiency for large trucks will be eliminated by 2020.

Table 7. Maximum Parking Accumulation at Truck Stops Along I-81 Within Virginia

Truck Stop/Exit No.	Existing Number of Spaces	Maximum Parking Accumulation	
		2010	2020
19	35	45	48
54	30	39	41
60	25	32	34
72	134	172	184
77	191	250	271
80	262	283	302
86	41	45	48
98	30	39	41
101	85	84	89
109	15	19	21
128	40	51	55
150	134	172	184
195	167	137	146
205NB	214	270	289
205SB	183	184	197
200	80	95	101
213	87	112	120
217	30	39	41
243	69	87	94
273	141	210	224
291	235	222	238
323	143	176	189

Table 8. Estimation of Total Commercial Vehicle Parking Demand

Section No.	Begin Milepost	End Milepost	Existing Parking Spaces			Current Parking Demand			
			Rest Areas	Truck Stops	Total	Rest Areas	Truck Stops	Illegal Parking	Total
1	0	55	118	65	183	148	65	108	321
2	55	110	29	783	812	58	680	48	786
3	110	165	33	174	207	66	174	54	294
4	165	220	10	761	771	20	657	36	713
5	220	275	65	210	275	130	231	66	427
6	275	325	12	378	390	24	310	72	406
Total			267	2371	2638	446	2117	384	2947

Table 9. Estimation of Total Commercial Vehicle Parking Demand

Section No.	Parking Demand in 2010				Parking Demand in 2020			
	Rest Areas	Truck Stops	Illegal Parking	Total	Rest Areas	Truck Stops	Illegal Parking	Total
1	191	84	139	414	204	89	149	442
2	75	924	61	1060	80	992	66	1138
3	85	224	69	378	91	240	74	405
4	26	836	46	908	28	894	49	971
5	167	297	85	549	179	318	91	588
6	31	399	92	522	31	427	99	557
Total	575	2764	492	3831	613	2960	528	4101

**Table 10. Estimation of Total Commercial Vehicle Parking Supply
(1% annual increase in rest areas and 1% annual increase in truck stops)**

Section No.	Parking Supply in 2010			Parking Supply in 2020		
	Rest Areas	Truck Stops	Total	Rest Areas	Truck Stops	Total
1	130	71	201	142	78	220
2	32	861	893	35	940	975
3	36	191	227	40	209	249
4	11	837	848	12	913	925
5	71	231	302	78	252	330
6	13	416	429	14	454	468
Total	293	2607	2900	321	2846	3167

**Table 11. Estimation of Total Commercial Vehicle Parking Supply
(1% annual increase in rest areas and 2% annual increase in truck stops)**

Section No.	Parking Supply in 2010			Parking Supply in 2020		
	Rest Areas	Truck Stops	Total	Rest Areas	Truck Stops	Total
1	130	78	208	142	91	233
2	32	940	972	35	1096	1131
3	36	209	245	40	244	284
4	11	913	924	12	1065	1077
5	71	252	323	78	294	372
6	13	454	467	14	529	543
Total	293	2846	3139	321	3319	3640

**Table 12. Estimation of Total Commercial Vehicle Parking Supply
(1% annual increase in rest areas and 3% annual increase in truck stops)**

Section No.	Parking Supply in 2010			Parking Supply in 2020		
	Rest Areas	Truck Stops	Total	Rest Areas	Truck Stops	Total
1	130	84	214	142	104	246
2	32	1018	1050	35	1253	1288
3	36	226	262	40	278	318
4	11	989	1000	12	1217	1229
5	71	273	344	78	336	414
6	13	491	504	14	605	619
Total	293	3081	3374	321	3793	4114

**Table 13. Estimation of Total Commercial Vehicle Parking Supply
(1% annual increase in rest areas and 4% annual increase in truck stops)**

Section No.	Parking Supply in 2010			Parking Supply in 2020		
	Rest Areas	Truck Stops	Total	Rest Areas	Truck Stops	Total
1	130	91	221	142	117	259
2	32	1096	1128	35	1409	1444
3	36	244	280	40	313	353
4	11	1065	1076	12	1370	1382
5	71	294	365	78	378	456
6	13	529	542	14	680	694
Total	293	3319	3612	321	4267	4588

**Table 14. Estimation of Total Commercial Vehicle Parking Supply
(2% annual increase in rest areas and 1% annual increase in truck stops)**

Section No.	Parking Supply in 2010			Parking Supply in 2020		
	Rest Areas	Truck Stops	Total	Rest Areas	Truck Stops	Total
1	142	71	213	165	78	243
2	35	861	896	41	940	981
3	40	191	231	46	209	255
4	12	837	849	14	913	927
5	78	231	309	91	252	343
6	14	416	430	17	454	471
Total	321	2607	2928	374	2846	3220

**Table 15. Estimation of Total Commercial Vehicle Parking Supply
(2% annual increase in rest areas and 2% annual increase in truck stops)**

Section No.	Parking Supply in 2010			Parking Supply in 2020		
	Rest Areas	Truck Stops	Total	Rest Areas	Truck Stops	Total
1	142	78	220	165	91	256
2	35	940	975	41	1096	1137
3	40	209	249	46	244	290
4	12	913	925	14	1065	1079
5	78	252	330	91	294	385
6	14	454	468	17	529	546
Total	321	2846	3167	374	3319	3693

**Table 16. Estimation of Total Commercial Vehicle Parking Supply
(2% annual increase in rest areas and 3% annual increase in truck stops)**

Section No.	Parking Supply in 2010			Parking Supply in 2020		
	Rest Areas	Truck Stops	Total	Rest Areas	Truck Stops	Total
1	142	84	226	165	104	269
2	35	1018	1053	41	1253	1294
3	40	226	266	46	278	324
4	12	989	1001	14	1218	1232
5	78	273	351	91	336	427
6	14	491	505	17	605	622
Total	321	3081	3402	374	3794	4168

**Table 17. Estimation of Total Commercial Vehicle Parking Supply
(2% annual increase in rest areas and 4% annual increase in truck stops)**

Section No.	Parking Supply in 2010			Parking Supply in 2020		
	Rest Areas	Truck Stops	Total	Rest Areas	Truck Stops	Total
1	142	91	233	165	117	282
2	35	1096	1131	41	1409	1450
3	40	244	284	46	313	359
4	12	1065	1077	14	1370	1384
5	78	294	372	91	378	469
6	14	529	543	17	680	697
Total	321	3319	3640	374	4267	4641

Table 18. Deficiency of Large Truck Parking Spaces (0 increase)

Segment	Current Parking Spaces	Current Demand	Current Deficiency	Deficiency in 2010	Deficiency in 2020
1	183	321	138	231	259
2	812	786	-26	248	326
3	207	294	87	171	198
4	771	713	-58	137	200
5	275	427	152	274	313
6	390	406	16	132	167
Total	2638	2947	309	1193	1463

**Table 19. Deficiency of Large Truck Parking Space
(1% annual increase in rest areas and 1% annual increase in truck stops)**

Segment	Current Parking Spaces	Parking supply in 2010	Parking supply in 2020	Deficiency in 2010	Deficiency in 2020
1	183	201	220	213	222
2	812	893	975	167	163
3	207	227	249	151	156
4	771	848	925	60	46
5	275	302	330	247	258
6	390	429	468	93	89
Total	2638	2900	3167	931	934

Table 20. Deficiency of Large Truck Parking Spaces
(1% annual increase in rest areas and 2% annual increase in truck stops)

Segment	Current Parking Spaces	Parking supply in 2010	Parking supply in 2020	Deficiency in 2010	Deficiency in 2020
1	183	208	233	206	209
2	812	972	1131	88	7
3	207	245	284	133	121
4	771	924	1077	-16	-106
5	275	323	372	226	216
6	390	467	543	55	14
Total	2638	3139	3640	692	461

Table 21. Deficiency of Large Truck Parking Spaces
(1% annual increase in rest areas and 3% annual increase in truck stops)

Segment	Current Parking Spaces	Parking supply in 2010	Parking supply in 2020	Deficiency in 2010	Deficiency in 2020
1	183	214	246	200	196
2	812	1050	1288	10	-150
3	207	262	318	116	87
4	771	1000	1229	-92	-258
5	275	344	414	205	174
6	390	504	619	18	-62
Total	2638	3374	4114	457	-13

Table 22. Deficiency of Large Truck Parking Spaces
(1% annual increase in rest areas and 4% annual increase in truck stops)

Segment	Current Parking Spaces	Parking supply in 2010	Parking supply in 2020	Deficiency in 2010	Deficiency in 2020
1	183	221	259	193	183
2	812	1128	1444	-68	-306
3	207	280	353	98	52
4	771	1076	1382	-168	-411
5	275	365	456	184	132
6	390	542	694	-20	-137
Total	2638	3612	4588	219	-487

Table 23. Deficiency of Large Truck Parking Space
(2% annual increase in rest areas and 1% annual increase in truck stops)

Segment	Current Parking Spaces	Parking supply in 2010	Parking supply in 2020	Deficiency in 2010	Deficiency in 2020
1	183	213	243	201	199
2	812	896	981	164	157
3	207	231	255	147	150
4	771	849	927	59	44
5	275	309	343	240	245
6	390	430	471	92	86
Total	2638	2928	3220	903	881

Table 24. Deficiency of Large Truck Parking Space
(2% annual increase in rest areas and 2% annual increase in truck stops)

Segment	Current Parking Spaces	Parking supply in 2010	Parking supply in 2020	Deficiency in 2010	Deficiency in 2020
1	183	220	256	194	186
2	812	975	1137	85	1
3	207	249	290	129	115
4	771	925	1079	-17	-108
5	275	330	385	219	203
6	390	468	546	54	11
Total	2638	3167	3693	664	408

Table 25. Deficiency of Large Truck Parking Space
(2% annual increase in rest areas and 3% annual increase in truck stops)

Segment	Current Parking Spaces	Parking supply in 2010	Parking supply in 2020	Deficiency in 2010	Deficiency in 2020
1	183	226	269	188	173
2	812	1053	1294	7	-156
3	207	266	324	112	81
4	771	1001	1232	-93	-261
5	275	351	427	198	161
6	390	505	622	17	-65
Total	2638	3402	4168	429	-67

Table 26. Deficiency of Large Truck Parking Space
(2% annual increase in rest areas and 4% annual increase in truck stops)

Segment	Current Parking Spaces	Parking Supply in 2010	Parking Supply in 2020	Deficiency in 2010	Deficiency in 2020
1	183	233	282	181	160
2	812	1131	1450	-71	-312
3	207	284	359	94	46
4	771	1077	1384	-169	-413
5	275	372	469	177	119
6	390	543	697	-21	-140
Total	2638	3640	4641	191	-540

Cost Estimation

The researchers found it extremely difficult to obtain cost estimates for building truck stops in Virginia as very few were recently built. The researchers found only one recent example of construction costs for truck stop parking spaces. The unit costs in 2001 dollars for building truck stop parking spaces were obtained for a real project built by Vesuvius, Inc.¹⁵ Table 27 shows the unit costs, and Table 28 shows the estimated cost by section. The costs in Table 27 and Table 28 are in 2001 dollars.

The construction costs for building spaces at a truck stop will be highly variable depending on site characteristics. Possible factors that could influence the cost of building spaces include right-of-way cost, amount of grading and excavation at the site, and cost to provide access to the spaces. In addition, costs will differ between spaces that are being added to an existing truck stop versus construction of a new stop. The costs in Tables 27 and 28 should be used only to provide a potential indication of the amount of money that may be required to meet the truck parking needs of I-81. It is possible that the actual costs may differ significantly from these numbers.

Table 27. Unit Costs for Constructing Truck Stops

Item	Unit Cost per Space
Purchase price of land	\$2,0000
Excavation cost	\$2,1250
Gravel base and paving	\$3,5000
Lights and curbing	\$1,0000
Total	\$8,625

Source: Vesuvius, Inc.

Table 28. Summary of Total Cost (\$ Year 2001) Estimation by Sections

2010						
Section No.	Deficiency (Spaces)	Purchasing Land Cost	Excavation Cost	Cost of Gravel Base and Paving	Cost of Lights and Curbing	Total
1	231	462,000	490,875	808,500	231,000	1,992,375
2	248	496,000	527,000	868,000	248,000	2,139,000
3	171	342,000	363,375	598,500	171,000	1,474,875
4	137	274,000	291,125	479,500	137,000	1,181,625
5	274	548,000	582,250	959,000	274,000	2,363,250
6	132	264,000	280,500	462,000	132,000	1,138,500
Total	1193	2,386,000	2,535,125	4,175,500	1,193,000	10,289,625
2020						
Section No.	Deficiency (Spaces)	Purchasing Land Cost	Excavation Cost	Cost of Gravel Base and Paving	Cost of Lights and Curbing	Total
1	259	518,000	550,375	906,500	259,000	2,233,875
2	326	652,000	692,750	1,141,000	326,000	2,811,750
3	198	396,000	420,750	693,000	198,000	1,707,750
4	200	400,000	425,000	700,000	200,000	1,725,000
5	313	626,000	665,125	1,095,500	313,000	2,699,625
6	167	334,000	354,875	584,500	167,000	1,440,375
Total	1463	2,926,000	3,108,875	5,120,500	1,463,000	12,618,375

DISCUSSION

Although the scope of the project originally included only truck stops with 15 or more parking spaces, this limitation had no effect on the results, as there were no truck stops with fewer than 15 parking spaces within the 2-mile limit from I-81. Similarly, the restriction of considering only truck stops that were within 2 miles from I-81 should have no impact on the results of the study as large truck drivers indicated that they would seldom exceed that distance when looking for a parking facility. Although the data collection procedure was very time-consuming, the procedure gave the opportunity for detailed information to be obtained on large truck parking characteristics adjacent to I-81 within Virginia.

A major problem associated with this procedure, however, was the need to obtain data on the variation in large truck parking (accumulation) as traffic and other independent variables vary. In this study, for example, the models were developed based on large truck parking

accumulation in half-hour intervals, which required traffic volumes also in half hour-intervals. The researchers were fortunate to obtain the necessary traffic data because of a recent traffic study conducted on I-81 within Virginia. Similar data may not be available for other highways should the study be extended.

The R-squared values obtained for the models indicate that the models are good prediction tools for large truck parking along I-81 within Virginia. This was also confirmed by the very good fit of the data at truck stops that were not used to develop the models. However, although the model closely fits the data that were not used in developing the model, there is no guarantee that the models will be suitable for parking demand forecasting at other interstate highways in Virginia. The reason for this is that parking characteristics such as parking duration and locations of the truck stops may be different. It is therefore necessary to collect additional data at parking facilities along other interstate highways within Virginia to validate the models developed.

The significant difference in the increase in large truck parking demand between 2000 and 2010 and 2010 and 2020 may be due to two factors. First, the rate of increase of large truck parking demand is not necessarily the same as that for traffic volume, as there are other factors that influence the large truck parking demand. Second, traffic volume is predicted to increase at a rate of about 53 percent from the base year to 2010 and about 27 percent from 2010 to 2020.

CONCLUSIONS

- I-81 within Virginia will have a significant shortfall of commercial vehicle parking spaces. Currently, the deficiency is about 309 spaces. If no new parking spaces are provided in the future, the number will increase to about 1,193 in 2010 and to 1,463 in 2020.
- The private truck stops play a major role in providing parking facilities for commercial vehicles along I-81 within Virginia. Almost 90 percent of parking spaces are provided at private truck stops.
- Developing a short-term or long-term parking improvement plan requires the cooperation of the public and private sectors.
- The models developed for estimating large truck parking demand at truck stops along I-81 give reasonable results.
- The factors that affect the demand for large truck parking include the number and percentage of trucks in the traffic stream, the distance the truck stop is from I-81, the distance the truck stop is from the nearest truck stop or rest area, and the facilities provided at the truck stop.
- Truck stop drivers must use the private truck stops for long stops because of the 2-hour parking limit at the rest areas.

- It will be extremely difficult to eliminate illegal parking by large trucks unless the number of parking spaces is significantly increased.

RECOMMENDATIONS

1. *Conduct a study to investigate the feasibility and/or necessity of establishing a public/private partnership for the construction of new large truck parking facilities adjacent to interstate highways within Virginia.* The results of the study indicate the significant contribution of the private sector in providing large truck parking facilities in Virginia. It is therefore apparent that the construction of new large truck parking facilities cannot solely be undertaken by the public sector.
2. *Since many truck drivers made negative comments regarding the 2-hour parking limit at rest areas, conduct a detailed study to determine the feasibility of maintaining or increasing the limit at the rest areas.* It is possible that extension of the parking limit might exacerbate the existing parking shortage on I-81, however.
3. *Investigate the feasibility of allowing large truck parking at some interstate exit ramps.* Allowing some large truck parking at exit ramps may provide some temporary relief until more parking facilities are provided, but this may have safety implications. Factors that should be considered include the geometry (curvature, length, width of shoulders) of the ramp, the time of day parking should be allowed, and the maximum parking duration that should be allowed.
4. *Conduct a study to determine the advantages and disadvantages of the practice of waking up drivers at rest areas to check their log books.*
5. *Extend this study to all interstate highways within Virginia.*
6. *Conduct a detailed study to select appropriate technology to provide real-time information on the availability of parking spaces for large trucks.*

ACKNOWLEDGMENTS

The authors acknowledge the support given by the Virginia Transportation Research Council and offer special thanks to Mr. Lewis Woodson who played a very important role during the field data collection phase of the project. In addition, the authors thank all the undergraduate and graduate students from the University of Virginia who worked hard during the data collection phase.

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APPENDIX A
Questionnaire Survey Forms

Virginia Department of Transportation



COMMONWEALTH of VIRGINIA

VIRGINIA DEPARTMENT OF TRANSPORTATION
DAVID R. GLENN, COMMISSIONER
RESEARCH COUNCIL
GEORGE ALLEN, M.D., RESEARCH DIRECTOR

VIRGINIA TRANSPORTATION RESEARCH COUNCIL
530 EDMONT ROAD
CHARLOTTESVILLE, VA 22903

UNIVERSITY OF VIRGINIA
JOYCE CALLETT, PRESIDENT
DEPARTMENT OF CIVIL ENGINEERING
NICHOLAS J. GAMBER, CHAIRMAN

July 12, 1999

Dear Professional Drivers:

The Virginia Transportation Research Council (VTRC), the research branch of the Virginia Department of Transportation (VDOT), is conducting a study to evaluate the adequacy of truck parking facilities along Interstate 81 in Virginia.

The purpose of this study is to achieve a greater understanding of truck parking needs and problems, and ultimately to provide better services for professional drivers and improved road safety for interstate travelers. We hope that the results of this study can be used to develop viable options to improve the current situation.

Your cooperation will help us to accurately assess the current situation and identify the parking needs of commercial vehicle drivers. Please fill out the attached questionnaire and additional comments. Your answers will be kept completely confidential and will be combined with the answers of many other professional drivers to help us better understand your parking needs and preferences.

If you have any questions or comments regarding this study, please do not hesitate to contact me at (804) 293-1917. We truly appreciate your time and cooperation.

Sincerely,

Wayne S. Ferguson
Research Manager

We promote excellence in transportation through objective research and superior technical service.

TELEPHONE (804) 293-1900 — FAX (804) 293-1990

Form A-1
Rest Area Inventory Worksheet

Location: _____	Day & Date: _____
Direction: _____	Time : _____
	Prepared by: _____

Does this rest area have access from the other side of the highway? <input type="checkbox"/> Yes <input type="checkbox"/> No	Space Provided for : <input type="checkbox"/> All types of vehicles <input type="checkbox"/> Only Trucks <input type="checkbox"/> Other _____
Parking Surface are : <input type="checkbox"/> Paved <input type="checkbox"/> Unpaved <input type="checkbox"/> Paved and Unpaved in some areas	Service Provided : <input type="checkbox"/> Restroom <input type="checkbox"/> Information center <input type="checkbox"/> Cold drink and soda vending machine <input type="checkbox"/> Hot drink and coffee vending machine <input type="checkbox"/> Snack vending machine <input type="checkbox"/> Public telephone <input type="checkbox"/> Picnic area <input type="checkbox"/> Pet rest area <input type="checkbox"/> Other _____
Parking spaces are : <input type="checkbox"/> Marked <input type="checkbox"/> Unmarked <input type="checkbox"/> Marked and Unmarked in some areas	

No. of Parking Spaces for <u>Automobiles</u> :	No. of Parking Spaces for <u>Trucks</u> :
Paved Surface: <input type="checkbox"/> Parallel () _____ <input type="checkbox"/> Diagonal (//) _____ <input type="checkbox"/> Perpendicular (⊥) _____	Paved Surface: <input type="checkbox"/> Parallel () _____ <input type="checkbox"/> Diagonal (//) _____ • Drive through slot _____ • Pull in – back out slot _____ <input type="checkbox"/> Perpendicular (⊥) _____ • Drive through slot _____ • Pull in – back out slot _____
Unpaved Surface: Approximately _____	Unpaved Surface: Approximately _____

At time of survey Situation at the facility <input type="checkbox"/> Empty <input type="checkbox"/> Almost empty <input type="checkbox"/> ¼ full <input type="checkbox"/> 1/3 full <input type="checkbox"/> ½ full <input type="checkbox"/> 2/3 full <input type="checkbox"/> full <input type="checkbox"/> overfull	Situation near by, trucks are parked at: <input type="checkbox"/> Rest area entrance _____ <input type="checkbox"/> Rest area exit _____ <input type="checkbox"/> Along the highway _____ <input type="checkbox"/> Highway ramp _____ <input type="checkbox"/> Near the intersection _____
Please sketch the facility layout and parking space characteristics on the back of this worksheet	

Form A-2
Truck Stop Inventory Worksheet

Location: _____	Day & Date: _____
Direction: _____	Time : _____
	Prepared by: _____

Does this truck stop have access from the other side of the highway? <input type="checkbox"/> Yes <input type="checkbox"/> No	Space provided for : <input type="checkbox"/> All types of vehicles <input type="checkbox"/> Only large size vehicles
Parking surface are : <input type="checkbox"/> Paved <input type="checkbox"/> Unpaved <input type="checkbox"/> Paved and Unpaved in some areas	Service provided : <input type="checkbox"/> Fuel <input type="checkbox"/> Platform scale <input type="checkbox"/> Convenience store <input type="checkbox"/> Restaurant <input type="checkbox"/> Truck repair <input type="checkbox"/> Truck wash <input type="checkbox"/> Hotel / Motel <input type="checkbox"/> Other _____
Parking spaces are : <input type="checkbox"/> Marked <input type="checkbox"/> Unmarked <input type="checkbox"/> Marked and Unmarked in some areas	

<p>No. of Parking Spaces for <i>Large size vehicles</i> :</p> <p>Paved Surface:</p> <p><input type="checkbox"/> Diagonal (//) • Drive through slot _____ • Pull in – back out slot _____</p> <p><input type="checkbox"/> Perpendicular (⊥) • Drive through slot _____ • Pull in – back out slot _____</p> <p><input type="checkbox"/> Parallel () _____</p> <p>Unpaved Surface: Approximately _____</p>
--

At time of survey Situation at the facility <input type="checkbox"/> Empty <input type="checkbox"/> Almost empty <input type="checkbox"/> ¼ full <input type="checkbox"/> 1/3 full <input type="checkbox"/> ½ full <input type="checkbox"/> 2/3 full <input type="checkbox"/> full <input type="checkbox"/> overfull	Situation near by, trucks are parked at: <input type="checkbox"/> Rest area entrance _____ <input type="checkbox"/> Rest area exit _____ <input type="checkbox"/> Along the highway _____ <input type="checkbox"/> Highway ramp _____ <input type="checkbox"/> Near the intersection _____
<p>Please sketch the facility layout and parking space characteristics on the back of this worksheet</p>	

QUESTIONNAIRE

Location : _____	Date & Day : _____
Direction (northbound or southbound): _____	Time : _____
	Interviewer : _____

PLEASE CHECK ONE CORRECT ANSWER (UNLESS OTHERWISE STATED)

1. What type of truck do you usually drive?

- Three-axle tractor-semitrailer (14-wheeler)
- Five-axle tractor-semitrailer (18-wheeler)
- Twin trailer truck
- Other _____

2. Type of truck ownership

- Drive for a company
- Independent driver

3. Do you usually have a co-driver?

- Yes
- No

4. How often do you drive your truck along Interstate-81 within Virginia?

- Less than one time a week
- One time a week
- Two times a week
- Three times a week
- More than three times a week

5. How long do you expect to stay here?

- Less than 30 minutes
- 30 minutes to 1 hour
- 1-2 hours
- 2-5 hours
- overnight

6. Was there any designated truck parking space available for you when you arrived at this rest area?

- Yes
- No

7. Where do you park your truck at this moment?

- At the designated truck space
- Space provided for automobile
- On the entrance ramp
- On the exit ramp
- Other _____

8. Do you usually plan in advance to stop at a specific rest area?

- Yes
- No

If yes, when you arrive there, is there usually space available for you?

- Yes, all the time
- Yes, but depend on the time of the day
- No

If the availability of spaces depend on the time of the day, what is the time of the day that is difficult for you to find parking spaces at the rest area.

9. When you want to stop *overnight or have a long break*, which place do you prefer?

- A specific rest area
- Any rest area
- A specific truck stop
- Any truck stop
- Hotel / Motel
- No preference

If you choose "a specific rest area" or "any rest area," what reasons make you choose to stop for a long break at that location?

(check all that apply)

- Location on your route
- Timing on your route
- Location close to the highway (easy to access)
- Number of parking spaces
- Free parking
- Size of truck space (width and length)
- Welcome / Information center
- Restrooms
- Attendant / rest area patrol
- Newspaper stand
- Drinking fountain
- Snack machines
- Cold drink / Soda machines
- Hot drink / Coffee machines
- Public telephone
- Picnic area
- Pet rest area
- Other _____

10. When you want to take a *rest for less than 2 hours*, which place do you prefer?

- A specific rest area
- Any rest area
- A specific truck stop
- Any truck stop
- Hotel / Motel
- No preference

If you choose "a specific rest area" or "any rest area," what reasons make you choose to stop for a short break at that location? **(check all that apply)**

- Location on your route
- Timing on your route
- Location close to the highway (easy to access)
- Number of parking spaces
- Free parking
- Size of truck space (width and length)
- Welcome / Information center
- Restrooms
- Attendant / rest area patrol
- Newspaper stand
- Drinking fountain
- Snack machines
- Cold drink / Soda machines
- Hot drink / Coffee machines
- Public telephone
- Picnic area
- Pet rest area
- Other _____

11. Do you think there is a fluctuation in the need for truck parking spaces at a rest area between the seasons.
- Yes
 - No
- If yes, which season is the busiest?
- Winter (15 Dec. – 15 Mar.)
 - Spring (15 Mar. – 15 Jun.)
 - Summer (15 Jun. – 15 Sept.)
 - Fall (15 Sept. – 15 Dec.)
12. Which rest area do you usually stop at when using Interstate-81 within Virginia?
(check all that apply)
- Welcome Center at milepost 1 – Northbound
(no truck allowed)
 - Truck rest area at milepost 14 – Northbound
 - Rest area at milepost 54 – Southbound
 - Rest area at milepost 61 – Northbound
(currently closed)
 - Rest area at milepost 108 – Northbound
 - Rest area at milepost 108 – Southbound
 - Rest area at milepost 129 – Northbound
 - Rest area at milepost 158 – Southbound
 - Rest area at milepost 199 – Southbound
 - Rest area at milepost 232 – Northbound
 - Rest area at milepost 232 – Southbound
 - Rest area at milepost 262 – Northbound
 - Rest area at milepost 262 – Southbound
 - Rest area at milepost 320 – Southbound
13. How long do you usually rest for a *short period of time* (less than 2 hours) at the rest area?
- Less than 15 minutes
 - 15 minutes to 30 minutes
 - 30 minutes to 1 hour
 - 1-2 hours
14. How long do you usually rest for a *long period of time* (more than 2 hours) at the rest area?
- 2-4 hours
 - 4-6 hours
 - 6 hours to overnight
15. If there are no parking spaces available at the rest area, where would you choose to stop?
- The closest rest area
 - The closest private truck stop
 - Either the closest rest area or private truck stop
 - Along the roadway
 - Hotel / Motel
16. In your opinion, is the number of truck parking spaces at the rest area during the *daytime* on Interstate-81:
- Too few spaces
 - About the right number of spaces
 - Too many spaces
17. In your opinion, is the number of truck parking spaces at the rest area during the *nighttime* on Interstate-81:
- Too few spaces
 - About the right number of spaces
 - Too many spaces

18. Do you think there are sufficient truck parking spaces at this rest area?
- Yes
 - No
19. If truck parking spaces are not adequate at the rest area along Interstate-81 within Virginia, how should more additional truck parking spaces be added?
- Expand and add more truck parking spaces at the existing rest areas
 - Add new rest areas at different locations
 - Both expanding the existing rest areas and adding new rest areas at different locations
 - Other (please specify) _____
- If new rest areas should be added, what type of facilities do you expect at the new locations?
- Truck rest area (like the one at milepost 14)
 - Truck parking area (without rest room and other services)
 - Regular rest area that provides parking spaces for all types of vehicle and regular services.
 - Other (please specify) _____
20. Do you think the type of parking space, for example parallel parking, has an effect on ramp parking?
- Yes
 - No
21. What kind of services else are you looking for at a rest area?
- Fuel
 - Shower
 - Fast food and restaurant
 - Convenient / retail store
 - ATM machine
 - Other (please specify) _____
22. Are you willing to contribute for the improvement and increase in the number of parking spaces at the rest area?
- Yes
 - No
- If yes, should it be direct or indirect fee?
(A direct fee is to pay only for the service you receive. An indirect fee is, for example, toll fee and fuel tax.)
- Direct fee
 - Indirect fee
23. Should the state of Virginia privatize the rest area?
- Yes
 - No

QUESTIONNAIRE
(TO BE COMPLETED BY TRUCK DRIVER)
PLEASE CHECK ONE CORRECT ANSWER (UNLESS OTHERWISE STATED)

1. What type of truck do you usually drive?
 Three-axle tractor-semitrailer (14-wheeler)
 Five-axle tractor-semitrailer (18-wheeler)
 Twin trailer truck
 Other _____

2. Type of truck ownership
 Drive for a company
 Independent driver

3. Do you usually have a co-driver?
 Yes
 No

4. How often do you drive your truck along Interstate-81 within Virginia?
 Less than one time a week
 Once a week
 Two times a week
 Three times a week
 More than three times a week

5. What type of cargo do you usually carry?

6. Which type of place you would prefer the most when you stop to rest?
 Rest area only
 Private truck stop only
 Either rest area or private truck stop
 Hotel / Motel
 Roadside
 No preference
 Other (please specify) _____

7. Do you usually plan in advance to stop at a specific rest area or truck stop?
 Yes
 No

If yes, when you arrive there, is there usually space available for you?
 Yes, all the time
 Yes, but depend on the time of the day
 No

If the availability of spaces depend on the time of the day, what is the time of the day that is difficult for you to find parking spaces.

8. Are there specific truck stops where you purchase fuel along Interstate-81 within Virginia?
 Yes
 No
 If answer is yes, please list those truck stops.

9. Is it your company's policy to buy fuel at this specific truck stop?
 Yes
 No

10. Do you usually rest or take a break at the truck stop where you purchase fuel?
 Yes
 No

11. When you want to stop *overnight or have a long break*, which place do you prefer?
 A specific rest area
 Any rest area
 A specific truck stop
 Any truck stop
 Hotel / Motel
 No preference

If you choose "a specific truck stop" or "any truck stop", what types of facility and service would make you choose to stop for a long break at that location?
(check all that apply)
 Location on your route
 Timing on your route
 Number of parking spaces
 Building and area facilities (eg. security patrol, lighting)
 Fuel
 Free parking
 Retail store
 Deli
 Fast food
 Restaurant
 Check cashing
 ATM machine
 Fax machine
 TV and Video Lounge
 Shower
 Laundry
 Platform scale
 Truck repairs and services
 Truck wash
 Other _____

12. When you want to take a rest for less than 2 hours, which place do you prefer?

- A specific rest area
- Any rest area
- A specific truck stop
- Any truck stop
- Hotel / Motel
- No preference

If you choose "a specific truck stop" or "any truck stop", what types of facility and service would make you choose to stop for a short break at that location?

(check all that apply)

- Location on your route
- Timing on your route
- Number of parking spaces
- Building and area facilities (eg. security patrol, lighting)
- Fuel
- Free parking
- Retail store
- Deli
- Fast food
- Restaurant
- Check cashing
- ATM machine
- Fax machine
- TV and Video Lounge
- Shower
- Laundry
- Platform scale
- Truck repairs and services
- Truck wash
- Other _____

13. What is the maximum distance away from a highway that you will travel for a truck stop?

- Less than 0.5 mile
- 0.5 mile – 1.0 mile
- 1.0 mile – 1.5 mile
- more than 1.5 mile

14. Which truck stops do you usually choose to stop at when using interstate-81 within Virginia?

(check all that apply)

- Texaco -- exit 19
- Village Truck Stop (Texaco) -- exit 54
- CITGO -- exit 60
- Shell (Sentry Food & Travel) -- exit 72
- TA Travel Plaza (BP) (Travel Centers of America -- Wytheville) -- exit 72
- Flying J -- exit 77
- CITGO (Sentry Food & Travel) -- exit 77
- Petro -- exit 80
- I-81 Travel Plaza (Chevron) -- exit 86
- Texaco -- exit 98
- Lancer Travel Plaza (Chevron) -- exit 101
- BP -- exit 109
- CITGO -- exit 128
- Pilot -- exit 150
- TA Travel Center (BP) -- exit 150
- Lee Hi Truck Stop (Shell) -- exit 195
- Sunshine Truck / Auto Plaza (CITGO) -- exit 200
- White's Truck Stop (Exxon) -- exit 205
- Fuel City -- exit 205
- Texaco -- exit 205
- Wilco Auto Truck -- exit 205
- CITGO -- exit 217
- Travel Center -- exit 243
- Sheetz -- exit 273
- Shenandoah Truck Center (Chevron) -- exit 273
- The Virginian -- exit 291
- Wilco Travel Plaza (CITGO) -- exit 291
- Olde Stone Auto / Truck Stop (Flying J) -- exit 323

15. How long do you usually rest for a *short period of time* (less than 2 hours) at the truck stop?

- Less than 15 minutes
- 15 minutes to 30 minutes
- 30 minutes to 1 hour
- 1-2 hours

16. How long do you usually rest for a *long period of time* (more than 2 hours) at the truck stop?

- 2-4 hours
- 4-6 hours
- 6 hours to overnight

17. If there are no parking spaces available at the truck stop, where would you choose to stop?

- The closest rest area
- The closest private truck stop
- Either the closest rest area or private truck stop
- Along the roadway
- Hotel / Motel

18. In your opinion, is the number of truck parking spaces (including both rest areas and truck stops) during the *daytime* on Interstate-81:

- Too few spaces
- About the right number of spaces
- Too many spaces

19. In your opinion, is the number of truck parking spaces (including both rest areas and truck stops) during the *nighttime* on Interstate-81:

- Too few spaces
- About the right number of spaces
- Too many spaces

20. If truck parking space are not adequate along Interstate-81 within Virginia, where should more additional truck parking spaces be added?

- at the public rest areas
- at the private truck stops
- both at the public rest areas and private truck stops
- Other (please specify) _____

21. What kind of communication devices do you have available while you are on the trip?.

(check all that apply)

- CB radio
- Cellular phone
- Onboard computer
- Other _____

22. Which devices in your cab do you usually use to get the information about the route?

(check all that apply)

- CB radio
- Cellular phone
- Onboard computer
- Other _____

QUESTIONNAIRE
(TO BE COMPLETED BY TRUCK STOP OPERATOR / MANAGER)

PLEASE CHECK ONE CORRECT ANSWER (UNLESS OTHERWISE STATED)

1. Name of truck stop:

2. Name of owner / manager / contact person:

Address:

Phone no. _____

Fax no. _____

Email address: _____

3. What type of services do you provide here at your truck stop? (*choose all that apply*)

- Fuel
- Retail store
- Deli
- Fast food
- Restaurant
- Check cashing
- ATM machine
- Fax machine
- Postal service
- TV and Video Lounge
- Shower
- Laundry
- Church
- Platform scale
- Truck repair
- Emergency road service
- Truck wash
- Hotel / Motel
- Load boards
- Other _____

4. The parking surface for trucks at your truck stop is:

- Paved
- Unpaved
- Paved in some areas, unpaved in others

5. The parking surface for the truck parking area at your truck stop is:

- Marked
- Unmarked
- Marked in some areas and unmarked in others

6. How many parking spaces for trucks?

Paved Surface:

Diagonal (//)

- Drive through slot _____ spaces
- Pull in – back out slot _____ spaces

Perpendicular (⊥)

- Drive through slot _____ spaces
- Pull in – back out slot _____ spaces

Parallel (|) _____ spaces

Unpaved Surface:

Approximately _____ spaces

7. Is there any parking fee?

- Yes
- No

If yes, is it for :

- The parking space itself
- Other special services
- Both of the above options
- Other (please specify) _____

8. If your answer to question 7 is "yes", does the parking fee depend on the *time of day*.

- Yes
- No

9. If your answer to question 7 is "yes", does the parking fee depend on *frequency of use*.

- Yes
- No

10. Is overnight parking available?

- Yes
- No

11. Do you think a need for truck parking spaces vary between the daytime and the nighttime?

- Yes
- No

If yes, when is your truck stop usually full?
(check all that apply)

- very early morning (1 am - 4 am)
- early morning (4 am - 7 am)
- late morning to midday (7am - 12 noon)
- midday to evening (12 noon - 8 pm)
- late evening (8 pm - midnight)
- Other _____

12. Do you think there is a fluctuation in the need for truck parking spaces between the seasons?

- Yes
- No

If yes, which season is the busiest?

- Winter (15 Dec. - 15 Mar.)
- Spring (15 Mar. - 15 Jun.)
- Summer (15 Jun. - 15 Sept.)
- Fall (15 Sept. - 15 Dec.)

13. During the busiest season, which day(s) in the week does your truck stop tend to be full?

(check all that apply)

- Monday
- Tuesday
- Wednesday
- Thursday
- Friday
- Saturday
- Sunday

For each day that your truck stop tends to be full, please specify those hours.

14. During the busiest time, is there any truck parking along a roadway?

- Yes
- No

15. In your opinion, is the number of truck parking spaces (including both rest areas and truck stops) during the *daytime* on Interstate-81:

- Too few spaces
- About the right number of spaces
- Too many spaces

16. In your opinion, is the number of truck parking spaces (including both rest areas and truck stops) during the *nighttime* on Interstate-81:

- Too few spaces
- About the right number of spaces
- Too many spaces

17. If truck parking spaces are not adequate along Interstate-81 within Virginia, where should more additional truck parking spaces be added?

- at the public rest areas
- at the private truck stops
- both at the public rest areas and private truck stops
- Other (please specify) _____

18. Where is the nearest rest area to your truck stop on Interstate-81?

19. Do you think that the nearest rest area has a *positive* effect on your business?

- Yes
- No

20. Do you think that the nearest rest area has a *negative* effect on your business?

- Yes
- No

21. Do you have a plan to expand your business within next 5 years?

- Yes
- No

APPENDIX B
Some Comments from Truck Drivers

- I don't stop at rest areas because D.O.T only allows only two hours parking and at some times 8 hour break is up. I don't need anyone setting me up. Make room to sleep are deal with it.
- The truck rest area at mm14 North is an excellent idea. You should add one South and at the north end of I-81 before West Virginia.
Adding additional lanes to I-81 will be a great help also. Traffic is much too heavy for this highway as it is now!
- If you stop at a rest area at night for any period of time. The VA. Troopers will wake you up and tell you to move on.
- I can say is it's too dangerous to stop in rest areas, and I'd rather sleep on an on ramp any day or at a truck stop.
- Rest areas definitely need more spaces. Any night if you drive by, there are trucks on the on and off ramp. If you get tired best thing is to stop.
- We as professional drivers along this route do need more spaces to be able to safely deliver our commodities.
- Not enough parking spaces in rest areas along I-81.
Not enough rest areas.
State police giving out tickets to tired truckers who stay longer than 2 hrs at rest areas is awful.
- Needs to be more truck areas only, no 4 wheelers allowed. At ex. 14 is a good stop.
- We need more spaces in the rest areas and less hassle from the DOT if there is no room in the rest areas. We are out here to provide a service and we can't do that without sleep or places to rest. Thanks.
- VA state police ticket us for trying to operate safely by resting when we get tired and park on an exit ramp.
- I feel that more rest areas should be added with more truck spaces (slated more for easier entry and exit from spaces) and special spaces for oversize loads! Drivers will not rest as much in truck stops due to watching TV, sitting in restaurant (talking to other drivers and hassling waitresses) when they could be in their sleepers resting. Also the safety factor would be greater in getting the trucks (with tired drivers) off the shoulders and ramps, due to other drivers going to sleep behind the wheel and running into parked trucks.
- Stop waking drivers up that are resting along the way.

- Just like last night I couldn't find a place to park my truck and I was close to running out of hrs, and was also fatigued, I hate to run at night but sometimes you have to, to be on unloading schedule!
- Make it easier for truck stops to be built. Keep cost down for truckers. Not to be bothered when resting or taking a breaks.
- There should be designated parking spaces for twin trailers due to the fact that they cannot be backed. This should be enforced.
- The rest areas are not big enough.
- Truck parking is a national problem. If hours of service are changed it is going to be a bigger problem. Shippers and receivers should also provide parking.
- As a linehaul driver pulling two trailers I find it very difficult to find adequate parking at a truck stop or rest area at any time of day or night. Most truck stops have no provision for "doubles".
- Need to be able to stay at rest areas longer than just two hours. Needs to be at least eight hours so the driver can be legal to drive again.
- The all-truck rest area on I-81 is a good start on some of these problems. I don't think the state police writing parking tickets for sleeping on off ramps serves any good purpose. I think it's better to have a sleepy driver on the off-ramp than on the highway.
- I travel all over the U.S.A. and truck parking at night is a major problem everywhere.
- Lets make rest areas "rest areas" and not convenient places for anybody with a "badge" to wake up drivers to check their logbooks or pester them in other ways
- There is a desperate need for more truck parking on I-81. The new rest stop for trucks only at the 13 mile mark is excellent, but there is a need for many more.
- Too many companies have extra trucks and drivers on the systems to stay competitive with others, so they make the drivers suffer the consequences of finding parking.
- Need more parking at rest areas. The truck parking going north on I-81 first one is a very nice one, exit 14. Need more like that.
- Some rest areas need to be enlarged if possible. The rest areas around mile marker (m.m). 10 and m.m.108 are good rest areas. Rest stops need to accommodate more trucks. Along with trucks you have the tourists with motor homes that need to park too. Need more rest stops along rt. 81. Not so far apart.

- When in rest area or safely off the road on ramps police or DOT should not make you move if you are sleeping. Could be dangerous to driver and others on road for driver to be driving while tired.
- Police is problem; afraid of tickets from them; even in the truck stops they are rude
- A need for limited time parking spaces for drivers to use rest rooms. Overnight truck parking should be stopped. Drivers are forced to use access ramps to relieve themselves because rest areas are blocked up by long time parkers
- There is way too little truck parking in rest areas and too many R.V.'s parked in the few that do exist. Pull off areas like Pennsylvania has would help greatly at less expense, and probably fewer R.V.'s parked where trucks should be.
- More truck stops.
- Cops give tickets for sleeping on ramps, but with double trailers there is no parking and if you drive tired and have a wreck you get a ticket for that also!
- Need more parking.
- Stop writing tickets and get off ramps and rest areas!! When you're tired and need to rest you just need to get somewhere to pull off and rest so you do not jeopardize the safety and well being of myself and the general public.
- Rest area parking spaces should have longer and wider spaces because the trucks are longer and the trailers are also longer creating situations where a space may be available but the longer equipment cannot make the turn into the space. In addition some spaces are so tight at the exit points as to create a situation where you cannot get out of the parking space.
- The fines imposed for parking rest areas are unfair. Norfolk to Staunton, VA only one truck stop. After 10 no parking most anywhere.
- Everyone who has a decision making position or is affected by the 18 wheelers and the trucking industry should get with some long haul, truck food carrier and see for themselves what is the case. Don't believe the hype, experience is the best teacher.
- Rest areas are too small. Too many trucks for too little parking in VA as well as all over the country. Especially around big cities. They want the trucks to deliver their freight but there isn't any place for them to park to get another load or to take a break.
- If any improvements are made, which they need to be for the safety of all people concerned, don't forget that most trailers are 244" wheelbase with 53' trailers so please make parking lots big enough.

- I will NOT drive more than 10 hrs. But I do not want to have to park along the road or ramps to get my sleep. More breaks would be nice if we had more space to park. Both rest areas and truck stops.
- Good job on raising the speed for trip in VA. Less fatigue, better for safety.
- To evaluate nighttime parking on I-81: 1. Observe vehicles parked at get-on ramps. 2. Observe available parking in rest areas and truck stops.
- Need to change 2 hr. parking rule at rest areas to 8 hours. DOT and state police should not be allowed to wake you up to move on or give you a ticket for taking longer than 2 hours or parked on the on and off ramps of rest areas or exits and entrances to I-81 or I-95, or I-66, or I-64, or I-85 when it might be the only place you can park since everything else is full.
- On several occasions in the past 12 years, while traveling on I-81 in Virginia, while in accordance with the Federal Hours of Service regulations for truck drivers, taking an 8 hour break, I've been woken from a sound sleep and informed by Virginia Highway Patrol officers that there was a 2 hour limit on rest area stops. This practice needs to be stopped.
- I-81 between Carlisle and state line in the state of PA. Need much improvement.
- There are extremely few legal places in Virginia to pull over for the DOT-required tire and equipment checks, or to relieve fatigue. This should be of serious concern for safety reasons.
- Rest area does not need to have a two-hour limit. Lot of the time you need more than two hours of rest.
- The state of Virginia needs (badly!) more truck stops and rest areas to accommodate the truck driver. without trucks, merchandise would not get anywhere.
- Make more spaces available and stop VDOT from waking trucker two hours when they are on their 8 hr. break.
- Virginia law on 2 hr. parking limit in rest areas is the stupidest law I've seen. If a driver pulls in because he's tired why chase him out to run over and kill someone. Especially when he's out of hours and federal law requires him to be off the road for 8 hours. State should be held responsible for any accidents in this situation.
- I feel it is a crime for the state police to stop and give a driver a ticket for taking a nap on an off ramp or an on ramp. I don't do it if I don't need to but I do stop on them if I get sleepy. I consider myself an endangerment to myself and all who are around me when I get sleepy. To force me out or someone else out is really stupid because of the ramifications of a sleepy driver on the road.
- This is in regards to the parking availability and safety of truck traffic on I-81 in Virginia. PARKING: The new hours of service regulations for OTR drivers will have a big effect on

truck parking. Most drivers will try to do their driving during the daylight if it's feasible to do so. This will cause all entrance ramps, truck stops, rest areas, & shopping centers to be blocked along I-81 from Bristol to the W. Va. Line. There will not be enough rotation of trucks coming in and leaving. The company that I work for, which is ABF Freight runs mostly during the dark hours. At the end of our tour of duty they put us to bed in company bunkhouses or motels because of the hours in which we work. Sometimes we have to take a short nap in route. Because of the double trailers in which we pull we cannot back into a parking space. So therefore it's more difficult to find a place to park. So maybe a tax break to the truck stops to enlarge parking areas. SAFETY: For the number of trucks and cars on I-81 especially on holidays, Sunday afternoon and night and Wednesday afternoon and night there is not near enough state police. The state police do a good job for the number of officers that they have available. The number of trucks and fatal accidents on I-81 since August 1, 1999 is unreal. I believe that speed is a major cause and that following too close by truck drivers should have the same penalty as reckless driving because of stopping distance. I take my job very seriously because of the families and other people on the road. I try to take care of those families. It's too bad that other drivers don't do the same. If there is anything that I or other drivers at ABF in Wytheville can do to help please let us know.

- 2 hr. time limit in rest areas is inadequate and unfair. If we are forced to move and are on an 8 hr. break we are being told to do something illegal by law enforcement and then get a ticket. If we are doing the safe thing by parking and getting off the road because we are too tired we still can get a ticket if there for more than 2 hrs. It's basically discrimination and just another way to make money for the commonwealth of VA.
- Truckers should not be waken-up in rest areas and told to move. A lot of times 2 hrs. isn't enough. We need more trucks only rest areas. A small booklet needs to be put out by the DMV to NOK-CDL (?) people to READ and learn and take a test on the Do's and Don'ts concerning what to do in traveling the highway with trucks.
- As a driver for ABF out of Wytheville, VA, I appreciate your concern about rest stops for truckers. There is a need for larger rest areas and truck stop parking lots with spaces to accommodate the larger and longer trucks of today. Finding a space to park a set of twin trailers is a real headache at best of times, because you cannot back a set of doubles hardly at all. We drivers have to get away from home much of the time and one can get very hungry before he finds a parking space. Sometimes it helps to stop and rest the eyes even for 30 minutes if one has been driving in pouring rain late at night or rain or fog or both. I hope by filling out the questionnaire that it will give some helpful insight to the problem of too few parking spaces along the I-81 corridor.
- As a professional driver and due to the shortage of parking along the interstate of Virginia, I feel it's safer for me and the general public to have the right to stop and take a nap for on the on and off ramps. It's better for me to stop and take a nap for an hour or two than to push it and to fall asleep at the wheel and hit another truck, car, highway patrolman or you, who's also taking this survey. (signed name) P.S. I answered your questionnaire but can't understand why you didn't focus on parking on parking on ramps.

- Parking is not available after sundown on I-81. I have heard stories about drivers receiving tickets for parking too long at rest areas. Federal law requires an 8-hour break after working 10 hours and I have been forced to drive over 8 hours to find parking. It's a no win situation, I could get a ticket for staying in a rest area too long or I could get a ticket for driving too long. Everything in trucking revolves around safety and I feel that limited time parking areas forces drivers to drive over their scheduled breaks and forces them to drive when fatigue could cause an accident just to find a place to park. I-81 is just about the worst place to overnight park because of limited spaces.
- The truck driver has the most important job in the United States, without us for just one week I believe the country would be in serious trouble. Why are we so underpaid? But yet we are so strictly enforced by the law. How would you like to say goodbye to your family on Sunday and only talk to them on the phone for the next week or two? Think about that, then ask yourself how you would feel in our shoes, we get respect only 'cause what we drive is larger than most things on the road. Not why we're on the road. And when we get tired and can't find a place to park it's "dangerous" to us our family and the people on the road with us I could go on , but we do need more space and more places to park.
- Limited parking spaces in VA and other states force drivers to continue on driving, when they aren't able to drive. I'm a linehaul driver that pulls doubles 95 percent of the time with no place to park them when I need a short nap. If I park on an entrance ramp I receive a ticket. If a driver is driving sleepy he is as bad as a drunk driver, either of which we don't need on our highways. I don't know what the real answer is, but we don't need anyone parked on the side of interstates. On the ramp, ok. It would help if drivers had to take a 10-hour rest break instead of 8. On an 8 hour break a driver receives only about six hours rest. If that.
- My biggest complaint is pulling into a rest area to get some sleep and rest, especially in Virginia, is the DOT waking you up and asking for you logbooks and paperwork. You pull into a rest area to rest and sleep and relax, not to be hassled by the DOT. Waking you up from a break, where the law, federal DOT says you will get an 8 hr. connective break with no interruption. This needs to stop, it is uncalled for. Lots of drivers crossing VA will not stop for this reason and will usually drive tired to clear Virginia.
- I am a TRL driver. I travel Interstate 81 a lot and have noticed especially at NIOMT (?) there is no parking at any rest areas. Too many cars towing RV campers and boats. Trucks have to resort to parking on shoulders and off-ramps. They should have more rest areas for common-carrier trucks, not campers and SUV towing things. It would make it a lot easier for trucks. Have it patrolled by state police more than once a night. Example: I was parked in one rest area for trucks only there were motor homes side-by-side. When police came in they just passed by and did nothing. So it would be a plus for trucks to have more parking in rest areas as well as more truck stops to park at. Thank you for your time.
- The time limit in VA rest areas should be abolished. It interferes with a driver being able to rest the 8 hours required by federal law. Forcing a driver out early harms safety. If a person drives to see whether there are adequate spaces available for the number of trucks on the

interstate just take a look late at night at the trucks parked on on-ramps. Listen to the C.B. around the truck stops and drive through several truck stops and see the mess caused by full truck stops and rest areas. Separate parking areas for R. U.S. would be helpful. Many nights I will pull into the rest areas and 25-50% of the slots are filled by R.V.'s camping there. I even had one that had his slide out section pulled out and was taking up 2 parking slots. R.V.'s are a hazard much of the time out here. If a person chooses to pull a 30' camper or a 40' bus motor home, or pull a trailer and a boat (doubles) then they should have to have a special license. Probably a CDL type license.

- With the longer trailers some of the parking spaces in the rest areas are difficult to get into. I suggest parking spaces at a lesser degree. Example 30 degree instead of 45 degree. It would be a help if there were more truck-only rest areas and enforced as such. R.V.'s can go to K.O.A.'s, we can't. I realize that with the terrain in VA, that in some areas large rest areas are not feasible and cost prohibitive. Roadside pull-offs, like PA has on the turnpike, would be a help and would not take up much area. There should not be a time limit for parking in rest areas and D.O.T. inspectors should not be allowed to wake up a driver and check his logbook or truck. This action breaks up the required 8 hrs. off-duty time and puts the driver in violation. I thank you for your interest in assisting the truck driver in getting a safer place to park and get his rest. If you need clarification on any of my suggestions feel free to drop me a note (address given).
- I try to stop in truck stops that are clean and have nice facilities. I see nothing wrong with sleeping 5-6 hours in a rest area. If I was not sleepy, I would not be sleeping. If I sleep on the roadside, it will be an entrance ramp only, using the entrance ramp is much safer than the exit ramp. I have been driving a truck for 22 years and never before have I seen so much carnage as happens in a month of travel. There are so many places now that tie you up all day doing a 1 hr. job. That is one of the reasons there are very few parking places around the country. Everyone sits around waiting to do something. I enjoy traveling through Virginia, it's very clean – good roads, friendly people.
- 1. Would like to see a nationwide speed limit of 65 m.p.h. 2. Would like to see more tickets written for tailgating; no use of turn signal, and speeding. I thought VA had a minimum following distance of 200 ft. I never see this enforced. Trucks and tractor-trailers run North and South entirely too fast (most times in excess of 70 m.p.h.) and just inches off each others bumper. Something has to be done about this. Entirely too much speed and unqualified drivers make for a bad mix. Would like to see more DOT inspections. Need more driver education for the public and private sector to kind of let them know what large trucks can and can't do. Particularly older and younger drivers.
- I personally pull double trailers almost all the time from terminal to terminal where we are always either put up in a motel or a bunkhouse at the terminal for our sleep breaks. For this reason the parking problem doesn't affect me probably as much as the drivers who depend on these type places for their rest breaks. However, I've noticed in recent years that the problem is getting bigger; obviously the number of trucks on the roads are constantly on the increase; therefore I don't think the number of truck stops and rest areas have increased nowhere at this rate helping to create the problem we are now facing. I know the state is putting up no-

parking signs on a lot of exit ramps where drivers pull over for naps. I also know the reason for the signs is because of so much litter being thrown out which I think is a shame on the drivers part that they have no respect than to do this; so what is the answer? There is no black and white answer in my opinion. Getting back to the available parking in rest stops and truck stops; yes, in my opinion, it's a large problem. I know a lot of places you may as well forget it after dark. This is causing drivers to push themselves in some cases to try to make it somewhere else causing a dangerous situation for themselves and other people on the highway.

- Virginia needs to remove the 2-hour limit at rest areas because of safety for the truck drivers and the general public. A driver comes in for an 8-hour break, goes to sleep, 2 hours later a state trooper knocks on his door. Hands him a ticket and tells him to leave or else he'll get another ticket. What's wrong with this picture??? The truck driver, not wanting another ticket, leaves. Before he can find another place to park he falls asleep behind the wheel at the very least runs off the road and does damage to his truck. AT THE WORST runs into a car and kills a family. Who's fault is it? He stopped to take his break, but is told to move on. The same state trooper that wrote the ticket will say that the truck driver is at fault for driving when he was supposed to be sleeping. But if the state trooper hadn't waken him up, he would have still been asleep when the family turned into their driveway, parked their car, and went inside, and went to bed. Now tell me who's fault it is?? The parking problem isn't just on I-81 it's just more obvious on that road. All interstates in Virginia need more parking.
- I have a problem with parking because I haul cars and I'm usually longer than usual. I also have to slide the 5th wheel back to make sharp turns when off hwy. So my cars don't bump together. One of my peeves is pulling in a rest area and there's a car parked in the only truck spot left. But if I park on the car side I'll get a ticket. That happens nationwide! The general public is totally unaware of the trucking industry – it's a sad lack of education. I could go on but that's another story and I gotta go. I've only got 6.5 hours I can log today and then I'll have to find a place to park and something to do for about 24 hours while my logbook catches up.
- With the shortage of truck parking spaces and because a driver gets sleepy, he should be allowed to park along the exit and entrance ramps rather than be forced to drive sleepy, as police will arrest him if caught weaving, or if he gets involved in an accident. So you do the safe thing when you get sleepy, but you will still get a ticket for parking on ramps, which is forcing drivers into unsafe driving.
- Keep on ticketing trucks for parking on exit and entrance ramps. This practice is, in my opinion, very dangerous.
- I would like to park on get-on ramp without getting a ticket. There should be no parking along the side of the road for safety.
- Make exit ramps' shoulders wider so we can sleep there.

- Make parking for double trailers at rest areas. You cannot back them up. Need parking that can be pulled straight through.

APPENDIX C
Regression Coefficient Section

Model 1

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	-1586.89	156.2236	-1898.63	-1275.151	0.0000
percentTRUCK	1.410393	0.3022867	0.8071893	2.013597	0.3313
Duration_1	0.1556301	0.0521857	5.149518E-02	0.2597651	0.1488
TotalTruck	6.955238E-02	3.405918E-02	1.588351E-03	0.1375164	0.0708
DIST_81	-123.2929	16.57129	-156.3604	-90.22539	-0.5989
DIST_TS	111.9563	12.50094	87.01109	136.9016	4.3087
DIST_RA	14.22398	0.8934022	12.44122	16.00673	1.9340
Service	988.9973	104.4803	780.5101	1197.484	5.0266
T-Critical	1.995469				

Model 2

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	-1475.792	140.3553	-1755.867	-1195.718	0.0000
percentTRUCK	1.547801	0.2736363	1.001769	2.093834	0.3636
Duration_2	0.1391216	4.833565E-02	0.0426693	0.2355739	0.1393
TotalTruck	5.897636E-02	3.362821E-02	-8.127686E-03	0.1260804	0.0600
DIST_81	-114.328	15.11122	-144.482	-84.17402	-0.5553
DIST_TS	103.7537	11.40081	81.00369	126.5036	3.9930
DIST_RA	13.80663	0.8376812	12.13506	15.47819	1.8772
Service	919.6157	95.03294	729.9804	1109.251	4.6740
T-Critical	1.995469				

