U.S. Department
of Transportation

**Federal Highway
Administration**

Commercial Driver Rest & Parking Requirements: Making Space for Safety

Final Report

Report No. FHWA-MC-96-0010 May 1996

Foreword

This report assesses the adequacy of truck parking at public and private rest areas along the Interstate Highway System. The goal of the research was to determine the supply, utilization, parking statutes and practice, and demand for truck parking at public rest area and private rest stops at the state and national levels. Based on the research findings, the study identifies policies and programs to meet truck drivers' rest needs and to improve the efficiency of rest area planning and development.

The study relied on three general methods of data collection, resulting in five sources: a national inventory of truck parking; direct observation of actual usage of truck parking; and a series of surveys including in-person truck driver surveys, a national survey of motor carriers, and a mail survey of truck stop operators. The surveys were designed to assess needs, perceptions, and preferences for truck parking.

The data were collected between October 1993 and December 1995

Notice

To the Reader

The enclosed report was produced by the Federal Highway Administrations's Office of Motor Carriers in 1966 in response to a Congressional directive. The principal contractor on the study was the American Trucking Associations' Trucking Research Institute. with significant assistance from subcontractors Apogee Incorporated and Wilbur Smith Associates.

This study assessed the adequacy of truck parking along Interstate highways at both public rest areas and privately owned truck stops. The goal was to generate an up-to-date, nationwide compilation of information about the supply, use, governing State and local statutes, and present and future demand for parking at these facilities. Drawing on study findings, the study also suggested policies and programs to meet parking and rest needs.

Data for this study were collected between October 1993 and December 1995 and were obtained through: (1) a national inventory of truck parking; (2) direct observation of actual parking space usage along a section of Interstate 81 in Virginia and Tennessee; (3) on-site surveys of truck drivers using I-81 parking spaces; (4) a national survey of interstate motor carriers; and (5) two separate mail surveys of privately owned truck stop operators. Based on these activities, both utilization and demand models of public rest area and privately owned truck stops' utilization and demand were generated.

This study documented a significant shortage, particularly at night, of parking spaces along Interstate highways for commercial drivers to use when seeking rest.

Additional information about this study may be obtained by contacting Bob Davis, Office of Research and Standards, Office of Motor Carriers, Federal Highway Administration, at
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Commercial Driver Rest Area Requirements: Making Space For Safety

Final Report

Report No. FHWA-MC-96-0010

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Preface

The Office of Motor Carriers, Federal Highway Administration, U. S. Department of Transportation, in accordance with Congressional direction, initiated a study of the "adequacy of places for truck drivers to stop and rest, both public and private." As directed, the Office of Motor Carriers contracted with the Trucking Research Institute (TRI) in 1992 to determine the adequacy of truck parking along the Interstate system. The Contracting Officer's Technical Representative for this project was Robert Davis.

TRI is the research arm of the ATA Foundation, an affiliate of the American Trucking Associations. The ATA Foundation is engaged in a wide variety of research and educational activities to enhance the safety and productivity of the for-hire motor carrier industry in the United States. Many of these efforts are being performed in cooperation with the Office of Motor Carriers. Dr. William Rogers was the Principal Investigator for the study, with assistance from Joy Miller and David Rogers.

TRI commissioned Apogee Research, Inc. and Wilbur Smith Associates to conduct the research. Apogee specializes in transportation economics, finance and policy research, and marketing communications at both local and national levels. Richard Mudge, Susan Jakubiak, Robert Hurd, Greta Jensen, Shaurav Sen, and Ward Kay conducted the research for Apogee.

Wilbur Smith Associates is a nationally recognized leader in traffic, parking, marketing, and related studies for the transportation industry worldwide. Gerald Cichy, Patricia Drake, and Naveen Lamba conducted the research for Wilbur Smith Associates.

EXECUTIVE SUMMARY

In 1992, the United States Senate, recommending further research on the causes of truck driver loss of alertness at the wheel, directed the Federal Highway Administration's Office of Motor Carriers (OMC) to undertake an ". . . evaluation of the adequacy of places for truck drivers to stop and rest, both public and private." (Senate Report 102-148, dated September 12, 1991; page 87). In accordance with House of Representatives Report language (House Report 102-156, dated July 18, 1991; page 103), the research was awarded to the American Trucking Associations Foundation's Trucking Research Institute (TRI), already actively supporting the OMC's Driver Fatigue and Alertness study. Apogee Research, Inc., and Wilbur Smith Associates served as subcontractors to TRI in evaluating truck driver rest and parking needs.

The steady growth in trucking nationwide appears to have increased the demand for rest areas along the Nation's highways. In part, this is reflected by evidence that, increasingly, truck drivers seeking rest are parking illegally along highway shoulders and entrance and exit ramps, rather than at either public rest areas or private truck stops. With a growing public and industry concern about commercial driver fatigue, and the need to assure public safety along the highways, this research has sought to address this perceived need for additional parking space through direct observation, interviews, statistical evaluations, and demographic data collection.

This research documented some important distinctions between public rest areas and private rest stops. Public rest areas on the Interstate highway system in the United States provide parking for automobile and truck drivers, as well as rest rooms. In most cases, vending machines are offered for food and beverages. Most private truck stops are located close to Interstate ramps and provide services such as fuel, showers, sleeping quarters, and restaurants, in addition to truck parking space. These differences in services provided apparently contribute significantly to truck drivers' decisions about where to stop and for how long.

The research team first assessed the current status of public rest area parking for trucks nationwide and developed analytical models to estimate the demand for truck parking spaces. The analysis resulted in considerable amounts of original data including: direct observation of truck parking activities at public rest areas, surveys of driver needs and attitudes, and, with the assistance of state Departments of Transportation (DOTs), a nationwide inventory of public rest areas. These data were then used to prepare the first comprehensive and systematic description of truck parking spaces at public rest areas across the United States, and to develop a detailed mathematical model of truck demand for public rest area parking spaces. This comprehensive assessment of public rest areas projected a current shortfall of 28,400 truck parking spaces in public rest areas nationwide.

An important component of the assessment was the information obtained from the driver survey. More than 90 percent of commercial drivers sampled perceived that there is a shortage of truck parking facilities, particularly for long-term or overnight parking. For short-term parking, a majority of the sampled drivers expressed a preference for public rest areas. Two-thirds of them indicated a preference for private truck stops for overnight or long-term rest needs.

Upon the completion of the public rest area study, a similar process was followed to assess the supply and demand for long-term truck parking at private truck stops. This assessment determined that about one-third of truck stop operators, based on a weighted sample, plan to expand their parking facilities over the next 3 years. This would increase total projected capacity from 185,000 truck parking spaces to more than 213,000. This suggests that some of the current shortfall at public rest areas might be satisfied in the future by private expansion efforts. However, this additional analysis found no conclusive evidence that private truck stops and public rest areas are direct substitutes for each other. Rather, they are complementary. The lack of evidence of direct substitutability between public rest areas and private truck stop parking, coupled with reports from surveyed truck stop owners that suggest their facilities are frequently full or overcrowded at night, suggests that the apparent shortfall of truck parking spaces nationwide continues to remain a problem for creative resolution by both the public and private sectors.

Projected costs to meet future truck parking demands total between $489 and $629 million. The problem of inadequate truck parking can only be met by creative strategies to help facilitate future rest area spending decisions over the next 10 years. Failure to solve the truck parking shortage could pose significant risks to the traveling public by forcing tired drivers to continue driving, or park on inherently dangerous locations such as ramps and shoulders.

PUBLIC REST AREA ANALYSIS

Methodology

Prior rest area research has typically concentrated on analyzing data at the individual Interstate corridor level. In order to undertake empirical research at the state and national level, it was necessary to develop an extensive database of truck parking activities at rest areas located along Interstates across the entire country. Therefore, this study relied on three general methods of data collection:

- An inventory of parking capacity and restrictions at public rest areas nationwide;
- Direct observation of the actual usage of truck parking at rest areas along a medium-density trucking corridor, and;
- A series of surveys:
  - An in-person survey of truck drivers along the same medium-density corridor to determine their needs, perceptions, and preferences for truck parking, as well as the reasons behind current practices;
  - A nationwide mail survey of motor carriers to identify perceived driver needs, preferences, and the availability of truck parking; and
  - A mail survey of truck stop operators to assess their perceptions of truck parking supply and demand, and the role of the public and private sectors in meeting that demand, as well as potential obstacles.

The data were collected between October 1993 and January 1994, and two quantitative models were developed to analyze the data collected. The first was an econometrically-derived Capacity Utilization Model, designed to identify those factors affecting rest area utilization by truck drivers, such as distance from the previous rest area and the amount of truck parking available at the rest area. The second, a Demand Model, was a mathematical construct designed to estimate the total demand for truck parking spaces at public rest areas nationwide.

The results of the quantitative analyses were then used to develop:

- Policy recommendations; and
- A Guidebook designed to inform state DOT executives of this research process and how it can be applied at the state level.

Products

Four new tools were developed and tested in this research:

• **National Database of Public Rest Areas.** This database, the most comprehensive and up-to-date available for public rest areas, contains detailed information on more than 1,350 rest areas nationwide. In addition to location, the database provides specific information on the facilities offered, utilization characteristics, and traffic data. The database is available through a geographic information system (GIS) that makes it accessible to federal and state planners.

• **Capacity Utilization Model.** An econometric model was developed to analyze the relationship between rest area characteristics and the utilization of the truck parking spaces. The model uses the data collected through three different surveys undertaken for this study as well as the new, national database. The model provides empirical estimates of the facilities and services that affect truck parking utilization of public rest areas.

• **Truck Parking Demand Model.** A demand model was also developed to estimate the current truck parking requirements at public rest areas on a nationwide basis. This model can be adapted to individual states to determine the truck parking requirements at the corridor or county level.

• **Rest Area Planning Guide.** A planning guiding was developed for state DOT officials for determining truck parking requirements at the state level. The guide provides a framework for collecting and analyzing rest area-related information for planning purposes.

Data Collection

Inventory of State Facilities and Policies

The primary new data requirements for this study were for nationwide information on truck parking capacity and usage at public rest areas and welcome centers, as well as parking restrictions and enforcement activities in each state. To acquire these data, the research team conducted a survey of the 48 contiguous states, as well as nine toll road/thruway agencies responsible for a combined total of 1,487 public rest areas with facilities on the Interstate highway system. This information forms the first national database on public rest areas on Interstate highways.

Key findings:

- Few states have parking regulations targeted specifically at trucks, but most have design standards for rest areas.

- Most facilities provide restrooms. Nine in ten rest areas offer picnic tables. The majority of rest area facilities provide drinking water and telephones, but only half of these facilities offer snack or beverage machines.

- Nearly eight in ten rest areas report truck parking utilization as either full or overflowing onto the ramps at night.

- During the day, nearly half of the rest areas are full or overflowing.

- Parking areas for cars are underutilized - six in ten rest areas have excess car parking capacity during the day, and eight in ten rest areas have excess capacity at night.

- At least 621 (42 percent) of the 1,487 rest areas have some type of limit on truck parking; e.g. 2 or 4 hours parking, or no overnight parking. At a majority of these facilities, however, they are "rarely" or "never" enforced. Only one in ten report that time limits are "always" enforced.

- Trucks often park on the shoulders and ramps to avoid parallel parking spaces because they are difficult to use.

- Many state DOTs are reluctant to enforce laws against parking on Interstate shoulders and ramps because they prefer that truck drivers rest when they are tired, rather than continue to drive.

Direct Observation of Rest Area Use

A direct observation survey was conducted to measure current capacity and demand for short- and long-term truck parking. In addition, the survey identified shortfalls in capacity and facility characteristics that determine utilization. Specifically, information on truck parking supply and demand was collected through peak-period surveillance of truck parking activities at four public rest areas and three privately-owned truck stops along a 200-mile segment of the I-81 corridor, southbound from Radford, Virginia to Knoxville, Tennessee. Observers counted the total number of truck parking spaces available at each site, monitored space utilization, recorded the number of trucks parked legally and illegally at each facility on an hourly basis, and recorded the amount of truck traffic passing each location hourly. Key findings from the observations are as follows:

- Of the approximately 576 spaces designated for truck parking at the seven sites along this corridor, only 20 percent were in public rest areas. The rest were at private truck stops.

- Few legal spaces were available at public rest areas between midnight and 5 a.m. on weekdays. Rest areas tended to fill up quickly and reach capacity before the larger private truck stops reached capacity.

- The number of available truck parking spaces at rest areas was reduced by about 10 percent by recreational vehicles and cars parked in truck-designated parking areas.

- Truck parking capacity was also reduced by poor designs that caused trucks to park across more than one space. It was evident throughout this study that pullthrough parking spaces are a more efficient type of truck parking space than either parallel or diagonal-not-pullthrough.

- Large numbers of trucks parked illegally on shoulders and ramps of rest areas. This often occurred before the corridor reached capacity and even when legal parking spaces were available at a rest area.

- Parking restrictions at many rest areas were not enforced or heeded.

- As expected, parking demand was strongly correlated with truck traffic on the highway. Facility features also contributed significantly to the demand for parking and the amount of overflow onto the ramps.

Target Group Surveys

Three other surveys conducted as part of this study, including interviews with truck drivers and surveys of motor carrier executives and truck stop operators, generated information about the needs, habits, attitudes, opinions and preferences of truck drivers.

Truck Driver Survey

The driver survey was administered to 500 truck drivers using public rest areas and privately-owned truck stops along the same corridor where the direct observation exercise was conducted. The results indicate that drivers perceive there is a shortage of adequate truck parking facilities, particularly for long-term or overnight parking.

- More than 90 percent of the truck drivers believe a shortage exists.

- Most truck drivers said the problem is worst in the Northeast (56 percent).

Truck drivers report that when overcrowding prohibits the use of rest areas or truck stops, they generally park on the entrance and exit ramps of highways, in shopping center parking lots, at shipper locations, and on the shoulders of the roadway.

- On average, truck drivers say this happens about four times per month.

- Truck drivers report that overcrowding at rest areas and truck stops peaks between 10 p.m. and midnight.

To relieve this perceived shortage, most truck drivers believe that the number of truck parking spaces should be increased at the Nation's public rest areas and privately-owned truck

stops. However, few are willing to pay for improvements in truck parking facilities through higher diesel fuel taxes or new highway user fees. Also, truck drivers did not express much desire to see public rest areas expand their services to include such features as fuel or food.

For short-term parking (less than 2 hours), truck drivers prefer public rest areas (49 percent) to private truck stops (43 percent). For those who prefer rest areas, accessibility is usually the most important factor in choosing a short-term parking space.

This pattern was dramatically reversed, however, when truck drivers were asked where they prefer to park for long-term or overnight parking to meet their rest needs. Nearly seven in ten truck drivers (68 percent) prefer private truck stops, and only 15 percent prefer to rest or sleep at public rest areas. Truck stops are preferred primarily for reasons of security and safety.

The majority of truck drivers rated private truck stops favorably. Two-thirds believe that private truck stops are either "excellent" or "good" for meeting drivers' needs, including more room to park, availability of food, cleanliness, a feeling of safety and security, and an overall feeling that truck drivers' needs can be met at truck stops.

A majority of truck drivers rate public rest areas as only "fair" or "poor" (54 percent) for meeting drivers' rest needs. The reasons given for this less than favorable rating include: overcrowding, safety concerns, campers and recreational vehicles parked in truck parking spaces, time restrictions, not enough public rest areas, dirty or poorly kept facilities, and poor parking area/space design. Only 5 percent rate public rest areas as "excellent".

Motor Carrier Survey

A mail survey of 330 motor carrier executives nationwide yielded responses that were strikingly similar to those expressed in the truck driver survey. Specifically, four out of five motor carriers believe there is a shortage of long-term or overnight parking facilities for truckers. Many say the problem is worst in the Northeast (41 percent).

Based on reports from their drivers, motor carriers perceive that truck drivers encounter a variety of difficulties or challenges when looking for a place to park and sleep for several hours while on the road, including overcrowded facilities, lack of facilities, security problems, prostitution in truck parking areas, unsanitary restrooms, and poorly designed truck parking spaces.

When truck drivers cannot find a place to park at a rest area or truck stop due to overcrowding, motor carriers say their drivers find other places to park and sleep such as shipper or consignee locations, shopping center parking lots, and the entrance and exit ramps of Interstates.

Many motor carrier executives believe that parking capacity should be increased at the Nation's public rest areas and/or privately-owned truck stops by building more parking spaces.

In addition, some also believe that more public rest areas and truck stops should be built. However, motor carrier executives say neither they nor their drivers are willing to pay for improvements in truck parking facilities, either through higher diesel fuel taxes or new highway user fees. In addition, about 65 percent said their drivers are "not very willing" or "not at all willing" to pay a fee to park at either a rest area or truck stop.

Motor carrier executives are evenly divided over whether or not public rest areas should provide a broader range of services, such as fuel or food.

Motor carriers believe that their drivers prefer privately-owned truck stops (60 percent) over public rest areas (13 percent) or motels (9 percent) for long-term parking. The reasons given for this perception include access to food, fuel, and truck services, and safety and security concerns.

Overall, seven out of ten motor carrier executives rated the Nation's public rest areas as only "fair" or "poor" for meeting drivers' rest and sleep needs. On the other hand, the majority of motor carriers surveyed rate private truck stops favorably--two-thirds say that private truck stops are either "excellent" or "good" for meeting drivers' rest and sleep needs.

Truck Stop Operator Survey

Few of the 170 truck stop operators who responded to the truck stop operator survey believe there is a shortage of long-term or overnight parking for truck drivers. In fact, nearly seven in ten truck stop operators say that a shortage of public rest area parking space for trucks does not exist. Only truck stop operators in the Northeast perceive there is a shortage, a position that supports the perceptions of a shortage in the Northeast by motor carriers and drivers.

Ninety-seven percent of truck stop operators recognize that truck stops are the preferred location of truck drivers to park and sleep while on the road. Most truck stop operators -- eight out of ten -- also believe that truck drivers prefer truck stops for short-term rest needs
(1 to 2 hours) as well.

In general, truck stop operators who recognize a shortage of adequate long-term parking believe that adding parking capacity at both public and private facilities is the best way to meet the demand. Truck stop operators report that the biggest obstacles to increasing the capacity at current facilities are cost and the availability of land. Nevertheless, more than four out of ten truck stop operators who responded to the survey report plan to increase truck parking capacity at their facility.

Few truck stop operators currently see public rest areas as a threat to their business. About half of the truck stop operators surveyed, however, believe that expanding long-term parking at public rest areas would have a negative impact on their business.

Quantitative Modeling and Analyses

Two models were tested to analyze public rest area usage by truck drivers and the need for additional truck parking spaces at rest areas along the Interstates. The first, referred to as the Capacity Utilization Model, identifies the factors influencing the use of public rest area parking spaces by truck drivers. This model was estimated using econometric techniques with a sample of 709 rest areas located across the country. The second, the Truck Parking Demand Model, was developed to estimate the need for additional truck parking spaces at public rest areas. This model was based on the modification of the recommendations of the 1981 Minnesota Department of Transportation (MnDOT) model for estimating truck parking spaces and the 1994 Virginia Department of Transportation (VDOT) study of the parameters used in truck parking estimation models. The findings of the Capacity Utilization Model were then incorporated into the modified Truck Parking Demand Model to generate the formula for predicting the need for truck parking spaces at public rest areas.

Capacity Utilization Model

The Capacity Utilization Model identifies the services and facilities that affect the utilization of truck parking spaces at rest areas. A review of past studies suggested that a number of factors, both demand- and supply-related, affect rest area parking usage by trucks. Table II-1 summarizes these factors, and example describing the application of this model is shown in Appendix C.

TABLE II-1. Factors Affecting Rest Area Usage by Trucks

DEMAND-RELATED FACTORS	SUPPLY-RELATED FACTORS
Average Daily Traffic Volume (ADT)	Total number of available truck parking spaces
Truck Traffic as a percentage of ADT	Type of parking space (parallel, diagonal)
Distance from previous rest area	Facilities (telephones, rest rooms, lighting)
Proximity of rest area to a major intersection	Special parking rules or requirements

Source: Apogee Research, Inc.

The econometric model was developed to estimate the individual impact of each of the factors on the utilization of parking spaces.

Summary of Key Findings

The estimation results indicate that the Capacity Utilization Model correctly predicts overutilization and underutilization of parking spaces at public rest areas 76 percent of the time. The results also indicate that one-way average daily traffic, distance from the previous rest area,

distance to the next interchange, adequate lighting, welcome centers, food facilities, and the presence of attendants have a positive impact on parking space utilization by trucks at rest areas. The availability of repair facilities and picnic tables at rest areas are also statistically significant in predicting a rest area's parking space utilization. In general, the conclusions from this model confirm the major findings of the surveys. Therefore, the factors identified by the Capacity Utilization Model, taken together with the survey findings, serve as a useful input to the Truck Parking Demand Model and to rest area design considerations.

Truck Parking Demand Model

To estimate the nationwide demand for truck parking spaces at public rest areas, a macro-level demand model was required. The approach to developing a demand model was based on the Truck Parking Estimation Model developed by the MnDOT in 1979, and included three steps:

(1) The team applied the analytical framework of the MnDOT model on a national level using the information available from the study's national inventory.

(2) The parameters of the MnDOT model were then modified using the guidelines presented in the 1994 VDOT study of rest area usage. The more recent VDOT model recommendations were based on data collected in summer 1994.

(3) The findings of the Capacity Utilization Model, combined with the results of the study surveys, were used to further modify the model using the descriptive characteristics of the pattern of rest area usage.

The original MnDOT Truck Parking Estimation Model was based on corridor-level data collected through extensive usage surveys at Minnesota Interstate rest areas. The model used a simple mathematical formula to estimate the required number of truck parking spaces in rest areas along the corridor. This study developed an improved model, the Apogee Model, which could be used to study, at individual, corridor, or state leve, demand for truck parking at rest areas.

The major findings of the Apogee Demand Model indicate a current total nationwide shortfall of approximately 28,400 parking spaces at public rest areas. The shortfall is projected to reach about 36,000 spaces over the next 5 years and almost 39,000 spaces over the next
10 years. The average current national truck parking space shortfall per rest area is 21. On a rest area basis, this shortage is highest in Connecticut, New Jersey, South Carolina, and Tennessee. The findings also indicate that FHWA Region 4, which consists of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee, has the greatest current shortfall in truck parking spaces. Other states where the current shortfall estimates are greatest include California, Pennsylvania, New York, Texas, and Virginia. Table II-3 shows the current statewide shortfall estimates of truck parking spaces.

Table II-3. Total Statewide Shortfall Estimates of Truck Parking Spaces (Apogee Model)

State	Total Number of Rest Areas in the State	Number of Rest Areas In Model	Current Truck Parking Space Requirements	Current Truck Parking Spaces Available	Current Truck Parking Space Shortfall
Alabama*	22	22	71	NA	NA
Arizona	40	40	1,371	762	609
Arkansas	19	19	920	64	856
California	53	53	2,084	966	1,118
Colorado	26	26	709	289	420
Connecticut	20	20	1,462	437	1,025
Delaware*	1	1	NA	39	NA
Florida	60	53	2,852	1,183	1,669
Georgia	29	29	1,763	794	969
Idaho	22	22	547	211	336
Illinois	54	52	2,155	1,310	845
Indiana*	46	10	501	NA	NA
Iowa	40	39	1,543	574	969
Kansas	34	34	797	400	397
Kentucky	28	28	1,484	751	733
Louisiana	40	34	1,474	457	1,017
Maine	11	11	297	116	181
Maryland	9	9	596	331	265
Massachusetts	31	31	1,572	1,180	392
Michigan	57	57	1,680	1,066	614
Minnesota	35	35	1,262	449	813
Mississippi*	20	20	NA	270	NA
Missouri	37	37	1,839	920	919
Montana	35	35	287	253	34
Nebraska	27	27	664	268	396
Nevada	10	10	213	159	54
New Hampshire	10	10	533	206	327
New Jersey	19	19	1,529	655	874
New Mexico*	27	27	NA	NA	NA
New York	58	54	2,399	1,218	1,181
North Carolina	39	39	2,037	685	1,352
North Dakota	30	30	390	275	115
Ohio	46	26	1,014	440	574
Oklahoma	14	12	427	207	220
Oregon	41	41	1,406	873	533
Pennsylvania	63	63	3,157	1,175	1,982
Rhode Island*	1	1	62	NA	NA
South Carolina	33	28	1,627	359	1,268
South Dakota	21	21	321	244	77
Tennessee	30	17	961	334	627
Texas	80	57	2,382	1,285	1,097
Utah	21	21	517	254	263
Vermont	19	19	250	192	58
Virginia	40	40	2,288	966	1,322
Washington	29	28	993	423	570
West Virginia	22	22	1,078	453	625
Wisconsin	26	26	1,215	500	715
Wyoming*	12	12	NA	131	NA
Total	**1,487**	**1,307**	**52,669**	**24,697**	**28,412**

NA - Insufficient data to determine shortfall estimates

* - Incomplete survey data

Interstate 95 heads the list of the top ten corridors in which the current shortfall estimates are the greatest. The other major Interstates in which there is a serious problem of insufficient truck parking spaces include I-80, I-10, I-5, I-40, I-81, I-90, I-35, I-70 and I-75. On average, the shortfall density estimates on these ten corridors range between 0.46 to 1.44 truck parking spaces per mile, and account for almost 63 percent of the total national shortfall in truck parking spaces at public rest areas.

PRIVATE TRUCK STOP ANALYSIS

Research Overview and Objectives

The initial phase of the research focused on public rest area supply and demand issues: the number of existing parking spaces, the extent and ways in which they are being used, and the extent to which adequate parking is available at these public facilities to meet the rest needs of long-haul truck drivers. The initial modeling which resulted, therefore, did not fully capture information about the spaces available at the large number of privately-owned truck stops operated across the country. The surveys and direct observation of truck drivers, motor carriers and private truck stop operators had indicated that the privately-owned facilities might offer a means to satisfy the apparent shortage of parking spaces at the public rest areas, especially at night. The driver survey had revealed that a majority of drivers prefer using privately-owned truck stops instead of public rest areas, for overnight parking due to a perception of greater safety and security at these locations.

In order to develop a broader understanding of the supply and demand for long-term truck parking, a follow-up mail survey was conducted with a cross section of truck stop operators nationwide. The goal was to obtain and analyze comparable data from these privately-owned facilities on truck parking capacity, usage and availability.

Research Methods

The sample for this survey was based on membership lists provided by the National Association of Truck Stop Operators (NATSO, Inc.), the same population surveyed in the public rest area study. These membership lists were used because complete mailing lists for all private truck stops were not available. Survey questionnaires were mailed to 987 NATSO members nationwide, and responses were received from operators representing 381 different truck stops, a response rate of 39 percent.

The publication *The Trucker's Friend*, the most comprehensive listing of truck stops nationwide, was used to establish the population parameters for evaluating and weighting the data. The target population was defined as privately-owned truck stops that provide truck parking along the Interstate highway system. Of the 4,265 different facilities listed in the publication, some 2,276 were identified as meeting that criteria. Prior to conducting the survey, a review determined that no information was available on the actual number of existing parking spaces (capacity) or the actual usage of truck parking, i.e., the extent to which these facilities were "uncrowded, full or overflowing."

The publication, however, did offer the best information available on the characteristics of these facilities in the target population, including regional distribution and relative size. The 2,276 truck stop facilities were also classified into one of three size categories used by

The Trucker's Friend -- ***small*** (26 percent offering parking for fewer than 25 trucks), ***medium*** (38 percent offering parking for 25-79 trucks), and ***large*** (35 percent offering parking for 80 or more trucks).

The survey sample included a broad cross section of truck stop facilities throughout the country, including truck stops from 44 different states -- with no responses from New Hampshire, Vermont, Rhode Island, and Delaware. A comparison of the unweighted survey sample with these population parameters indicated that the original sample list of NATSO members included a disproportionate number of large facilities and that many small facilities were not members. Therefore, statistical weighting procedures were used to adjust these deviations in both size and regional distribution to ensure that the final weighted survey results could be accurately projected to the total target population. Except where noted otherwise, the statistics reported in this document are based on the weighted survey results.

Private Truck Stop Research Findings

Truck Parking Capacity

Truck stop operators in the unweighted sample reported that they provide a total of 47,611 parking spaces at their 371 facilities. Weighted projections for the total target population suggest that the 2,276 truck stops nationwide provide a grand total of 185,000 parking spaces near the Interstate:

- 133,000 spaces provided by the 800 "large" facilities
- 42,000 spaces provided by the 854 "medium" facilities
- 10,000 spaces provided by the 601 "small" facilities.

Twenty-one of the 2,276 facilities (less than 1 percent) could not be classified because of incomplete surveys.

Perceptions of Overcrowding

- The vast majority of truck stop operators (84 percent) said their truck parking facilities were either "full" or "overflowing" at night. Only 15 percent described their parking as "uncrowded." Small facilities were much more likely to report nighttime "overflowing." Truck parking is also much more likely to be "overflowing" in the Northeast and Great Lakes regions.
- Truck parking is reported to be more crowded at night than during the day, for each of the three size categories.

Frequency of Overcrowding

- On average, truck stop operators report that their parking facilities are "filled to capacity" 16 nights each month. The average is greater than 15 nights per month in each of the three size categories. More than 50 percent say they are filled to capacity 20 nights per month or more.

- Overcrowding is also a more frequent problem among small facilities than among large facilities, and among those located in the South and Great Lakes -- both during the day and at night.

Reported Estimate Usage and Net Availability

- The 367 truck stop operators who answered this question in the unweighted sample reported that a total of 41,805 trucks parked at their facilities, on average, at night. This compares with a total estimated capacity of 47,611 spaces at the 371 truck stops in the unweighted sample.

- The survey results were statistically weighted to reflect the proper proportions of small, medium and large facilities nationwide. An average of 167,000 trucks are projected to be parked at the 2,276 privately-owned truck stops in the target population on any given night. This represents 90 percent of the total projected capacity (185,000) of the privately-owned truck stops that provide truck parking along the Interstate highway system nationwide.

- These results do not necessarily take into account "turnover" at night or other mitigating factors. However, of the 175 cases in which respondents reported that the number of trucks parking at night was greater than the reported capacity, 172 indicated in a separate question that they were usually "full" or "overflowing."

- An average of 145,000 trucks are projected to be parked at the 2,276 privately-owned truck stops in the target population during the day. However, turnover is much higher during the day than at night, making it more difficult to interpret the daytime results as indicative of "net availability."

Possible Expansion Plans

- About 32 percent of the truck stop operators in the weighted sample said they planned to expand truck parking at their facilities over the next 3 years. Another 31 percent said they "don't know."

- In the weighted sample of those planning to expand , the average number of new spaces to be created was 53, for a total of 4,722 new spaces among 89 facilities answering that question.

- These numbers can be projected to represent a total of 28,000 new parking spaces to be created at privately-owned truck stops nationwide -- increasing total projected capacity by 15 percent, from the current 185,000 spaces to more than 213,000.

Location, Services and Other Characteristics

- Most of the truck stops were located close to an Interstate ramp. The average in the weighted sample was one-quarter mile; and roughly half of the facilities were located within one-tenth of a mile from the ramp.

- Among truck stops in the target population, the average distance from the nearest public highway rest area was only 13.7 miles. This did not vary significantly by region.

- Commercial truck stops provide the following types of parking:

  -- Free of charge (94 percent)
  -- Lighted parking (92 percent)
  -- Paved parking (86 percent)
  -- Marked parking spaces (55 percent)
  -- Secured at night (18 percent)

Private Truck Stop Models

A desired goal of the researchers was to merge the data collected on private truck stops with the existing database on public rest areas. In theory, as described in the public rest area analysis, the parking spaces provided at private truck stops represent a supply-side factor affecting truck parking utilization at public rest areas. In order to examine the impact of potentially available spaces at private truck stops on public rest area parking, it is desirable to try and create a reliable, unified database that could define both public and private space availability and needs.

A careful review of the data collected on private truck stops and public rest areas indicates a number of practical problems in merging the two databases together. These problems are based on the nature of the response rate to the survey which was difficult to predict in advance. Although adequate precaution was taken to ensure that the new survey would cover the geographical representation of the original database on public rest areas, it was difficult to predict which of the truck stop operators would respond. For example, the survey was mailed to 987 NATSO members nationwide of which approximately 39 percent responded. Although a nearly 40 percent response rate is high by mail survey standards, two major obstacles to combining the databases nevertheless emerged:

! *Geographical mis-match of databases*. The geographical distribution of the responses from the truck stops are different from the geographic distribution of public rest areas.

- ! *Differences in sample size.* The public rest area Capacity Utilization Model was based on a cross-sectional sample of 709 public rest areas nationwide. In contrast, the responses received from the private truck stops make up an effective sample of 381 truck stops nationwide.

A Capacity Utilization Model was developed to identify factors affecting truck parking at private truck stops. The estimation results indicate that the specified model correctly predicts the variables affecting overutilization and underutilization of parking spaces at private truck stops 55 percent of the time, and adds useful new information on the reasons truck drivers use private truck stops. The results also suggest that one-way average daily traffic, ease of entry and exit to and from the truck stop, the ability of truck stops to accommodate oversized or triples and security measures increase utilization at truck stops. The distance from the Interstate, presence of a public rest area, number of available parking spaces and the number of facilities offered at private truck stops decrease parking space utilization at private truck stops. The proximity of the truck stop to a major intersection and the ability to accommodate trucks carrying hazardous materials are found to have no effect on truck stop parking space utilization.

In general, the estimated coefficients and the direction of their impact on capacity utilization at truck stops are found to be in line with *a priori* assumptions. Some of the standard diagnostic tests conducted indicated that although the predictive capability of the models, measured in terms of the percentage of correct predictions, was not very high, the model estimates were relatively robust considering the sample size and the qualitative nature of the data.

Overall Model Comparisons

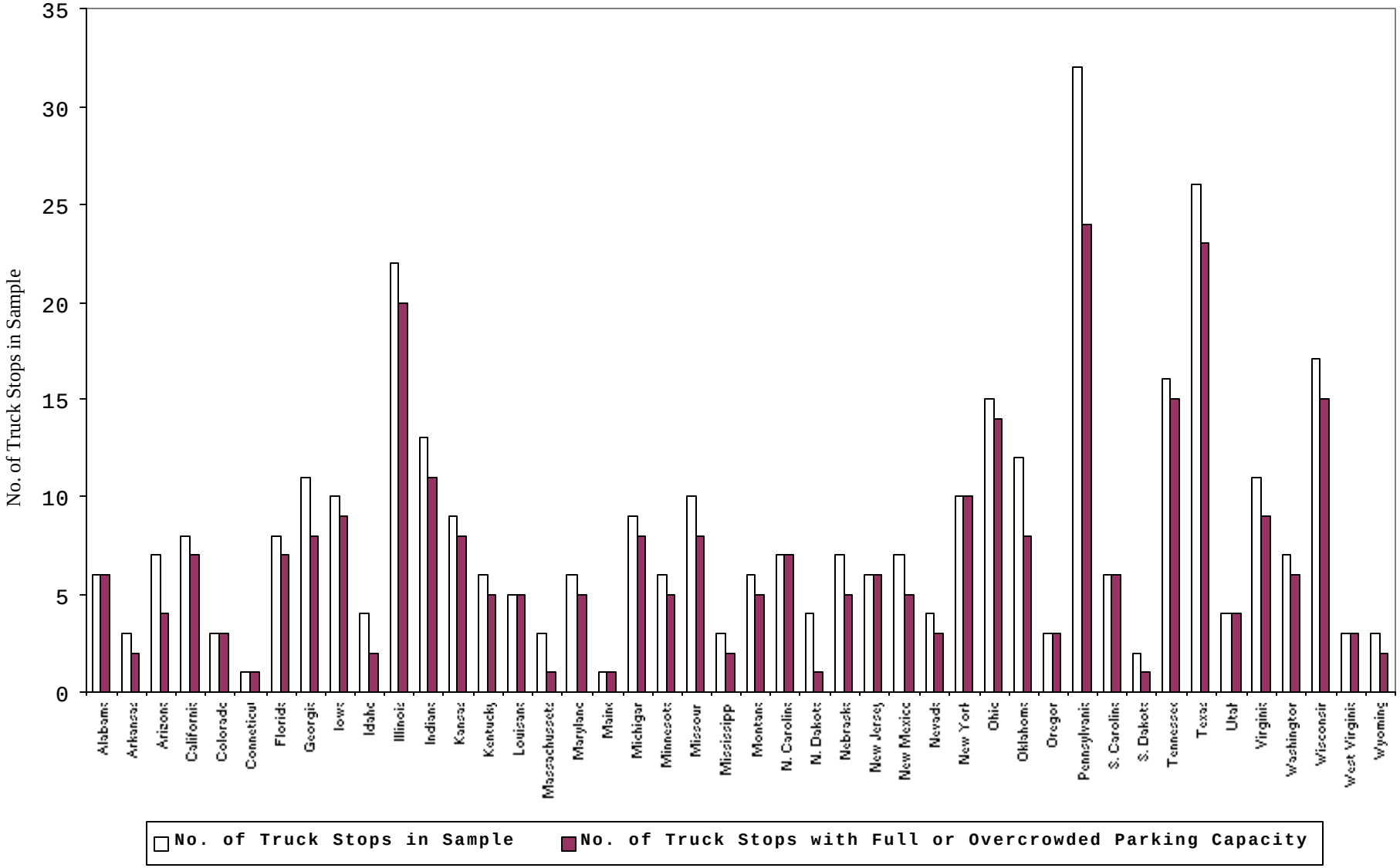
The predictive ability of the Capacity Utilization Model for private truck stops differs from that of the logit model developed in the analysis to examine truck parking at public rest areas -- 54.7 percent and 76.1 percent respectively. Although both models are statistically valid, some of the fundamental differences in the data used for the two models may explain the difference in the predictive power of each:

- The public rest area model was based on a sample that was almost twice as large as the one used in the Private Rest Stop Study;

- A considerable lack of variation in the values for the dependent variable (capacity utilization) was observed for the private truck stop model since approximately 84 percent of the sample represented truck stops that were reported to be either full or overcrowded during the night;

- Though the current database on private truck stops has a wider geographical coverage of the states compared to the Public Rest Area Capacity Utilization Model, the number of private truck stops within each state is considerably lower, thereby reducing the possibility of successfully controlling geographical variations in the coefficient estimates;

Figure 2. Number of Truck Stops With Full or OverCrowded Parking Capacity By State (Represents Sample Coverage Only)



- Unlike the original Capacity Utilization Model of public rest areas, the private truck stop Capacity Utilization Model was estimated using a simple proxy for Average Daily Traffic (ADT) values. Considering the importance of this demand-side variable, detailed ADT data could significantly improve the predictive power of the model.

Therefore, the Public Rest Area and Private Truck Stop Models are not interchangeable.

Substitutability Between Truck Stops and Rest Areas

From a policy viewpoint, an important question is whether or not truck drivers view public rest areas and private truck stops as direct substitutes for each other. This question is especially important in light of the findings of the Public Rest Area Study that indicated a shortfall in truck parking spaces at public rest areas nationwide. On the other hand, according to survey results, private truck stops provide a significant number of truck parking spaces at their facilities. This raises two important questions:

- Is there significant excess truck parking capacity in private truck stops to absorb the shortfall in parking spaces at public rest areas?

- Will the existence of excess parking capacity at private truck stops, if any, obviate the need for additional parking spaces at public rest areas?

The answer to the first question requires a detailed inventory of truck parking spaces and their utilization levels at all private truck stops nationwide which was beyond the scope of this study. However, the sample of truck stops in this study indicated that in a vast majority (approximately 84 percent), existing parking capacity is either full or overcrowded during nights (see Figure 1).

In order to answer the second question, it is important to first determine whether or not private truck stops and public rest areas are direct substitutes for each other. For example, if the two types of truck parking facilities are determined to be direct substitutes and excess parking capacity exists at private truck stops, the need for providing additional truck parking spaces at public rest areas is clearly reduced. However, if the two facilities are not direct substitutes for each other, then the existence of a shortfall in public rest area parking cannot be absorbed by the presence of excess parking spaces at private truck stops.

The findings and analyses of the studies on Private Truck Stop and Public Rest Areas offer certain insights to answering whether or not these two types of truck parking facilities along Interstates are direct substitutes. Some of these include:

- *Duration of Parking*: The findings from the direct observation of private truck stops and public rest areas in the Public Rest Area Study indicate that truck drivers tend to use public rest areas to meet their short-term parking needs, such as for short nap or telephone use, and private truck stops for their long-term parking needs, such as overnight rest, food requirements, showers, etc.

- *Differences in Range of Services/Facilities*: As indicated by the data collected for the two studies, a significant difference exists in the range of services and facilities offered at these two parking facilities. Private truck stops typically tend to offer a wider range of services compared to public rest areas. In addition, in both the models, the availability of facilities was found to have a statistically significant effect on capacity utilization of parking spaces.

- *Accessibility*: Based on only to driver survey findings, it appeared that accessibility to public and private facilities had some influence on driver choice of a place stop. Drivers who value accessibility or easy access from the Interstate tend to prefer public rest areas. More than 90 percent of the drivers who mentioned accessibility as an important factor in their choice of a short-term place to park prefer public rest areas. The extent to which this diminished their selection of private rest stops, however, was not determined.

- *Safety and Security Considerations*: The statistical findings in both studies, plus the direct observations, indicate that safety features are a positive feature in explaining capacity utilization of truck parking spaces, and a major reason why drivers prefer private truck stops.

- *Locational Differences*: The issue of substitutability becomes relevant when the truck driver has a simple choice between selecting a private truck stop or a public rest area. For example, if the distance between the private truck stop and the public rest area is great, a driver in need of immediate resting needs would park at the facility that is closer. The data collected in this study suggests that the average distance between truck stops and rest areas is approximately 13.7 miles and approximately 40 percent of the truck stops in the sample were located at least
10 miles from a public rest area.

In addition, it is important to note that although truck stops report providing a large number of truck parking spaces, most of these facilities report that they are full or overcrowded at night. In the sample used for this study, 84 percent of the truck stops indicated their parking capacity is full or overflowing at night.

Conclusion

The objective of the Private Truck Stop Study was to extend the Public Rest Area Study research effort by including data on private truck stops located across the nation. The major findings of the analysis are as follows:

- Significant differences in the two databases on truck stops and rest areas prevented the development of a single database to simultaneously model parking space utilization at these two types of truck parking facilities.

- A stand-alone statistical model of capacity utilization at private truck stops was developed that successfully predicted the impact of demand and supply factors on parking space utilization in 55 percent of the sample.

- One-way ADT, ease of accessibility to the truck stop, ability of the truck stop to accommodate oversized trucks or triples and security measures were found to increase truck parking space utilization.

- Distance of the truck stop from the Interstate, number of available truck parking spaces and the number of facilities offered at the truck stop were found to decrease on parking space utilization.

- The proximity of the truck stop to a major intersection and the truck stop*s ability to accommodate trucks carrying hazardous materials were found to have no effect on capacity utilization.

Based on the information collected and the analytical findings of the two studies, there is no conclusive evidence that private truck stops and public rest areas are direct substitutes for each other. This is important because the findings of the Public Rest Area Study estimated a shortfall of 28,400 parking spaces. Therefore, as determined by this research, the lack of evidence of direct substitutability between the two types of truck parking facilities suggests that the apparent shortfall of parking spaces nationwide continues to be a problem for creative resolution by both the public and private sectors. Included in that resolution may be non-regulatory approaches, such as education.

PUBLIC REST AREA POLICY RECOMMENDATIONS

Policy recommendations were developed in three stages. First, *policy evaluation criteria* were established based on background information collected on public rest areas nationwide from each state DOT, surveys of truck drivers, and the results of the modeling process. Second, a *range of policy options* was determined based on the analysis of this background data. These policy options were narrowed through an examination of the evaluation criteria. *Costs* were estimated for the suggested policy options and shown by state, FHWA region, and the top 10 Interstate corridors facing critical parking shortages nationwide. Finally, a *systematic planning strategy* on a state level was defined.

Strategic Goal and Evaluation Criteria

The primary goal was to screen and evaluate potential options to help develop an integrated strategy to improve the safety of truck drivers on the Interstate highway system by providing adequate truck parking spaces at public rest areas. The ideal policy option provides a substantial and cost-effective increase in parking for trucks, faces few roadblocks in implementation, has political support, and offers flexibility in meeting truck drivers' rest needs. Five summary criteria were used to judge the options.

1. Adequacy: *Is the truck parking generated under this option likely to be adequate to meet truck drivers' needs?*

2. Implementation Ease: *Are the administrative, legislative, and contractual actions and changes required to implement the options relatively easy?*

3. Impacts: *What are the impacts on the key parties involved? Are these impacts favorable or unfavorable from their point of view?*

4. Support: *Given the anticipated impacts, what is the expected level of support or potential for opposition from the parties involved?*

5. Flexibility: *Is the option sufficiently flexible to accommodate variations in project and regional characteristics?*

Options to Increase Truck Parking at Public Rest Areas

Options for expanding truck parking in rest areas nationwide vary substantially in cost, required engineering, administrative responsibilities, and number of additional parking spaces. The total federal funding committed to rest area modification, renovation, and new construction nationwide has averaged $42 million annually since 1991. The majority of the funding is dedicated to the maintenance of existing rest area facilities and services.

Options were classified in four categories:

- **Enforcement** - Increase enforcement of time limits or reduce time limits through regular patrolling of rest areas to encourage a greater turnover of spaces.

- **Modification** - Modify existing facilities to create additional truck parking spaces by using some of the car parking area for trucks at night or using existing park-and-ride facilities for night overflow parking or by modifying existing ramps at rest areas. This category provides an alternative use for existing parking areas that are underutilized at night, when truck parking demand is highest.

- **Renovation** - Redesign and reconfigure the parking area of existing facilities to allow for additional truck parking spaces and better use of the parking lot at existing rest areas. This involves upgrading rest areas to allow for maximum and efficient use of parking space, for example, designing diagonal pullthrough spaces instead of the parallel spaces commonly found today.

- **New Construction** - Build new rest areas to allow for additional truck parking spaces.

Each of the four categories includes a number of alternative rest area truck parking options, evaluated as follows:

- Overall prospects to increase truck parking at public rest areas in light of the defined evaluation criteria--additional parking adequacy, ease of implementation, expected impacts on parties involved, potential for cooperation from parties involved, and programmatic and financial flexibility; and

- Prospects for intended expenditures--administrative, design, modification, renovation, and new construction.

Enforcement

One third of the rest areas inventoried had no posted time limit on parking. Forty percent of the rest areas had time limits that ranged from 2 to 4 consecutive hours in states such as Georgia and Illinois, to 24 hours in Texas. Of those, only 10 percent indicated that the limits were always enforced; the remaining indicated that time limits were sometimes, rarely, or never enforced. The removal of vehicles through more strict enforcement of time restrictions might result in a greater number of commercial vehicle spaces being available at any one time. However, the benefits must be considered against the impact on tired drivers who would be forced to move on. Commercial drivers need a safe place to park, especially at night, in order to maintain their alertness. Strict enforcement may compel tired drivers who can find no other acceptable off-road parking to seek unacceptable options: namely, parking on the highway shoulder or at exit ramps, where their presence may constitute a safety hazard for the motoring public. Therefore, strict enforcement of parking time was discarded as an option.

Modification

Under this category, parking spaces for trucks could be enhanced using existing land with moderate capital expense and minimal disruption of services. Rest area parking regulations could be flexible enough to allow trucks to use the underutilized car parking spaces in the evening hours when the demand for car parking is minimal and truck parking along Interstates is at maximum capacity. These options would have low moderate capital costs because each rest area would be evaluated on an individual basis. But implementation of these modification options requires administrative and contractual actions.

The main advantage of modification is that it would be feasible in all areas of the country on all Interstates. It would also relieve the critical shortage of truck parking spaces around metropolitan areas where park-and-ride facilities are most likely to be located. Another key feature is that it provides alternative uses for parking areas that are underutilized at night, when truck drivers are seeking a short-term resting place. The disadvantage of the option is that it only add a minimal number of parking spaces nationally.

Although the impact on truck drivers would be positive, these modification options remain inadequate to solve the larger parking shortage. Political support from state DOTs for this method of increasing parking along Interstates would be strong, as it requires little disruption, minimal administrative and capital cost, and utilizes existing parking space. Truck drivers are in support of this remedy as it provides them with a safe, quiet, short-term place to rest.

Renovation

Many rest areas on Interstate highways were built early in the highway program from a design that typically provided about 35 diagonal parking spaces for cars and 12 parallel spaces for trucks. This parking configuration does not accommodate the volume of truck traffic on Interstate highways nor is it adequate for the type and size of truck using the Interstates today.

The two options involve renovation of existing rest areas and reconfiguring and/or redesigning the parking areas to allow for additional parking while using existing facilities and services. By renovating the space and using the same land area, while also converting from parallel parking spaces to diagonal pullthrough spaces, a rest area can increase the number of truck parking spaces by 70 percent (from 16 to 27 spaces). A major renovation can increase the number of truck parking spaces fivefold (from 8 to 40 truck parking spaces) and also can convert truck parking spaces from parallel to the preferred diagonal pullthrough type, without requiring land acquisition.

Based on objectives, truck driver expectation, highway safety and the cost of improvement, renovation is likely to allow the greatest number of increased truck parking spaces with minimal disruption. Renovation of all rest areas would not be possible because of space limitations, but truck drivers, state DOTs, and policy makers would benefit from this approach. Truck drivers would gain the parking necessary to rest and thereby increase safety on the Interstates. There would, however, be a temporary short-term setback from rest area closure for renovation. Local and state policy makers and state DOTs would be able to expand rest area parking to satisfy the safety issues resulting from inadequate rest area parking without acquiring additional land and with minimal disruption to surrounding neighborhoods.

New Construction

New construction can be construction of truck pulloff areas within the existing right-of-way with no additional facilities, or construction of entirely new rest areas. Financing options for a new rest area facility could include a variety of innovative financing possibilities to overcome the traditional barriers and help the public sector meet the growing demand for truck parking at public rest areas.

The first option, truck pulloff areas, offers the benefits of supplying additional parking for trucks without the cost of a full-service rest area and satisfies the needs of truck drivers to have quiet, accessible, and convenient stopping places for short-term rest along the Interstates. The Pennsylvania Turnpike makes the most successful use of truck pulloff areas which are adjacent

to and visible from the Interstate. Overall, this approach offers a moderate capital cost for the benefits derived from additional parking.

The second option, building a new rest area, supplies maximum truck parking and adds additional services and facilities, but requires a larger capital expenditure. These costs, however, could be shared through a low-cost loan program for private operators, tax incentives, public-private partnerships, or a shared facility approach. With a shared facility approach, the public rest area provides the land for additional parking, and a private operator maintains and operates the facility and services. In many cases, the states already have the necessary land because it was acquired when the original right-of-way was assembled.

The impact of funding options on the interested parties--truck drivers, state DOTs, and policy makers--depend on how the funds are structured. Truck pulloff areas require minimal funding, positively affect the tired truck driver, and could quickly increase the number of truck parking spaces on the Interstates. This option would be of no interest to a public/private partnership or the private sector as there are no services provided. The impact of the second option, a new rest area, depends on the financial structure established for construction.

Efforts to support new, additional resting space along the Interstates may encounter some practical political difficulties at the federal, state, and local levels because additional funding for rest areas will compete with other investment needs. In some cases, new construction may be more feasible if it is linked with the private sector.

Private truck stop operators reported that the biggest obstacles to increasing their capacity are cost and the availability of space or land. Through a partnership agreement, low-cost loans, or tax incentives, the public sector could share in the burden of these two obstacles and provide new spaces in a cost-effective way.

The flexibility of new construction accommodates variations in project and regional characteristics. New rest area planning should be part of a comprehensive approach to increasing Interstate parking, should be evaluated based on traffic characteristics, demand patterns, land availability, and topography.

Comparative Evaluation

All of the options considered may not be suited to all geographical areas with their utility depending on land costs and availability, population density, average daily traffic, and percentage of truck traffic. Truck pulloff areas, for example, may be appropriate for rural areas with great distances between rest areas and a need for a short-term rest solution. Facility modification is useful in an area where there is a need for an increase in a limited number of spaces or near an urban area where park-and-ride facilities are available. Rest area renovation, both minor and major, is appropriate for rest areas where the existing design can be reconfigured and for which the renovation can significantly expand both the number and type of truck parking spaces. New rest areas are appropriate where land is available and capital funds are made accessible either through public and/or private sources.

In general, modification and renovation encompass the most cost-effective options. A modification program would be relatively easy to implement and would have no impact on neighboring landowners. Modification is only possible, however, at a select group of existing public rest areas and will only expand parking modestly. The nighttime conversion of park-and-ride lots to truck parking is generally limited to urban areas across the country and will not serve as a solution for non-urban markets. A modification program would not substantially improve the rest area truck parking shortage nationwide.

Renovation offers the potential for the greatest number of additional parking spaces at a moderate capital cost. A renovation program would make the greatest use of existing land and would receive support from state DOTs, policy makers, and truck drivers. However, renovation would only be possible on a case-by-case basis, depending on the ability to reconfigure a rest area.

Although new construction incurs the greatest expense, it also offers the greatest opportunity to solve the rest area parking shortage. There is, however, some uncertainty as to whether it would receive political and local support without an associated financing initiative.

Cost Projections: A Public Rest Area Program

Based on the foregoing evaluation, this section presents a summary of the estimated costs of a program designed to cost-effectively meet the parking shortfall. To do this, a four-step methodology was adopted:

- *Four promising options*--truck pulloff areas, minor renovation of existing rest areas, major renovation of existing rest areas, and the construction of new rest areas--were differentiated based on the number of parking spaces that could be added.

- The approximate construction *cost per parking space* was estimated under each of the four options. These costs reflect only the costs for parking spaces and do not include costs for services or facilities.

- The total shortfall in truck parking spaces at *individual rest areas* was analyzed to determine the option category most appropriate to add parking spaces to meet current requirements.

- *A low-high cost sensitivity analysis* and aggregation was derived to estimate total cost projections to meet current requirements for truck parking spaces.

A detailed analysis of the individual case studies on renovation and new construction of rest areas provided valuable cost data for the four options considered. Table III-1 provides the estimated average cost implications for each option.

TABLE III-1. Summary of Rest Area Options			
Options	**Potential for Additional Spaces**	**Average Cost per Space***	
		Low	**High**
Truck Pulloff	0-10 Spaces	$ 5,000	$ 7,000
Minor Renovation	11-35 Spaces	$10,000	$15,000
Major Renovation	36-50 Spaces	$20,000	$25,000
New Construction	>50 spaces	$30,000	$35,000

* Based on information derived from truck stop operators and national rest area database (developed for this study). Figures represent only costs for parking spaces and do not include costs for services or facilities.

For establishing cost estimates, 1,035 rest areas were used. From the total effective sample of 1,307 rest areas available in the database, data on the current stock of truck parking spaces were not available for 117 rest areas. In addition, 155 rest areas were estimated to have a surplus of parking spaces and were excluded from the sample used for cost analysis (since a surplus of spaces in one rest area cannot be transferred to another to alleviate a shortfall). Therefore, the final sample size--the basis for national level cost projections--consists of a total of 1,035 public rest areas requiring 28,400 additional parking spaces.

Analysis of the Current Shortfall Per Rest Area

To apply the estimates outlined above, the total shortfall had to be analyzed on an individual rest area basis. The goal of this analysis was to group the additional space requirements for each rest area under the four options to facilitate the application of the cost assumptions.

A majority (about 95 percent) of the rest areas in the sample require 50 or fewer additional truck parking spaces. Approximately 65 percent of the rest areas inventoried require 35 or fewer additional truck parking spaces. Fifteen percent of the total require 10 or fewer parking spaces per rest area. The majority of rest areas inventoried require 20 to 40 additional truck parking spaces.

Approximately 43 percent of all the additional spaces may be added through minor renovation. Thirty-five percent of the parking space shortfall may be addressed under the option of major renovation. The construction of new rest areas may be required to provide about
20 percent of the total shortfall in parking spaces. The remaining spaces might be added under the truck pulloff option, which is the least costly alternative available.

The distribution of the number of additional parking spaces per rest area is used to categorize the potential option under each of the four options considered (See Table III-2). The total estimated cost of providing the additional 28,400 truck parking spaces ranges under all four options combined from $489 to $629 million.

TABLE III-2. Summary of Total Cost Estimates by Option Type				
Option	**Total Number of Additional Spaces**	**Average Cost Per Space***		**Total Estimated Cost (in $ millions)**
		Low	**High**	
Truck pulloff areas	874	$ 5,000	$ 7,000	$4-6
Minor renovation	12,172	$10,000	$15,000	$122-183
Major renovation	9,763	$20,000	$25,000	$195-244
New rest areas	5,604	$30,000	$35,000	$168-196
All Options	**28,412**			**$489-629**

* Based on information derived from truck stop operators and the national rest area database developed for this study. Figures represent only costs for parking spaces and do not include costs for services or facilities.

Cost Projections by state and FHWA Region

Table III-3 presents the estimated cost projections, by state, of adding truck parking spaces at rest areas for all four options considered. The table also shows the number of additional spaces required by all options based on the shortage defined at each rest area. For example, if a rest area required less than 10 spaces, a truck pulloff area was suggested. If a rest area was lacking over 50 spaces, a new rest area was proposed. The total estimated costs of adding the parking spaces based on the option defined was then calculated. The total estimated costs columns indicate both a low and a high range for cost estimates. Costs associated with the construction and renovation of parking spaces vary significantly among states. The states requiring the greatest expenditures are South Carolina, Florida, and Pennsylvania; the states requiring the least expenditures are Nevada, Montana, and Indiana.

Table III-3. Summary of Cost Estimates ($ millions) by State

State	Total - All Options		
	Additional Spaces Needed	Low	High
Pennsylvania	1982	35.4	45.3
Florida	1669	30.3	38.6
South Carolina	1268	28.7	35.1
Virginia	1322	24.9	31.5
Connecticut	1025	26.0	31.1
North Carolina	1352	23.4	30.1
New Jersey	874	21.5	25.6
Georgia	969	19.5	24.3
Texas	1097	18.6	24.1
New York	1181	18.0	23.7
California	1118	16.7	22.2
Louisiana	1017	16.6	21.6
Iowa	969	15.1	19.8
Minnesota	813	14.5	18.4
Kentucky	733	14.7	18.3
Missouri	919	12.9	17.5
Arizona	609	10.4	13.4
Tennessee	627	12.8	15.9
Wisconsin	715	11.5	15.1
Illinois	845	10.3	14.4
West Virginia	625	10.4	13.5
Arkansas	856	12.1	16.2
Washington	570	10.5	13.2
Michigan	614	7.9	10.9
Oregon	533	8.3	10.9
Ohio	574	7.8	10.5
New Hampshire	327	7.4	9.0
Maryland	265	7.7	9.0
Colorado	420	6.3	8.3
Massachusetts	392	6.2	8.2
Nebraska	396	3.8	5.7
Idaho	336	4.1	5.7
Kansas	397	3.6	5.4
Utah	263	3.3	4.6
Maine	181	2.8	3.7
Oklahoma	220	2.1	3.2
North Dakota	115	0.9	1.3
South Dakota	77	0.6	0.9
Vermont	58	0.6	0.9
Montana	34	0.2	0.2
Nevada	54	0.1	0.2
Indiana*	1	0.0	0.0
Alabama*	NA	NA	NA
Rhode Island*	NA	NA	NA
Wyoming*	NA	NA	NA
New Mexico*	NA	NA	NA
Mississippi*	NA	NA	NA
Delaware*	NA	NA	NA
Total	28,412	489.5	628.9

NA: Insufficient data to determine shortfall estimates

*: Incomplete data

Table III-4 presents the cost projections for the nine FHWA-classified regions. As the table indicates, the largest investment is required in Region 4, which consists of Florida, Georgia, Kentucky, North Carolina, South Carolina, and Tennessee. The total cost estimate for meeting the current demand in truck parking spaces for this region ranges from $129 million to $162 million. Region 1, which consists of Connecticut, Massachusetts, Maine, New Hampshire, New Jersey, New York, and Vermont, requires the second largest investment for providing additional parking spaces. The total projected costs for this region range from approximately $83 million to $103 million. In fact, Regions 1 and 4 together account for approximately 43 percent of the total projected costs. The problem, from a total investment standpoint, is least critical in Regions 8 and 10, which require an outlay of approximately $11 to $15 million and $23 to $30 million, respectively.

TABLE III-4. Summary of Total Regional Cost Estimates by Option Type

FHWA Region	Truck Pulloff (spaces)	Minor Renovation (spaces)	Major Renovation (spaces)	New Rest Areas (spaces)	Total Cost ($ millions)
1	106	1,356	812	1,763	$83-$103
3	22	1,544	1,608	1,022	$78-$99
4	28	1,677	3,496	1,417	$129-$162
5	161	2,022	1,030	348	$52-$69
6	22	1,666	1,165	337	$48-$62
7	144	1,711	719	108	$35-$48
8	174	473	212	51	$11-$15
9	126	1,030	298	327	$29-$39
10	92	693	423	231	$23-$30
All Regions	**874**	**12,172**	**9,763**	**5,604**	**$489-$629**

Cost Projections for Top 10 Critical Corridors

The 10 Interstate corridors in which the parking space shortfall is most critical are presented in Table III-5. The table indicates the total cost projections for all four of the options for the 10 critical corridors. The largest outlay, which ranges from $57 million to $71 million, is required in the I-95 corridor, where approximately 2,700 more spaces need to be added under the option of new rest areas (the most expensive option considered). Total potential outlays for the remaining corridors typically range between $20 million and $30 million. Approximately 80 percent of all additional spaces along these 10 corridors may be added under the options of minor and major renovation. The remaining spaces may be provided through truck pulloff areas and the construction of new rest areas.

TABLE III-5. Summary of Cost Estimates by Top 10 Critical Corridors			
Interstate	**Total Spaces Required**	**Total - All Options Estimated Cost ($ millions)**	
		Low	**High**
I-95	2,721	$57.1	$70.7
I-80	1,832	$25.5	$34.5
I-5	1,509	$23.0	$30.4
I-40	1,471	$27.3	$34.6
I-10	1,468	$23.0	$30.3
I-90	1,297	$18.7	$24.8
I-70	1,208	$18.0	$29.4
I-81	1,189	$23.5	$35.4
I-75	1,174	$19.7	$25.4
I-35	1,163	$20.0	$25.7
Total	**15,032**	**$255.8**	**$341.2**

Summary

Based on the statistical modeling of public rest area parking utilization and demand, the researchers identified a current shortfall of 28,400 truck parking spaces in public rest areas nationwide. The cost to meet this demand totals between $489 to $629 million. This serious problem can only be met by a strategy to help facilitate future rest area spending decisions over the next 10 years.

Data provided by the Federal Highway Administration indicates that a total of $48.1 million in Federal funds was obligated for rest area-related projects in 1994, resulting in $60 million of investment including the non-Federal match. (Data were not available on individual state spending.) Since 1991, a total of $168 million ($210 million with the non-federal match) has been spent to renovate or expand public rest areas. This spending rarely results in new rest areas or additional truck parking spaces at existing rest areas, but is typically used for resurfacing, additional lighting, and expansion of sanitary facilities.

The researchers estimated that, if the total investment required is spread over a period of 10 years, the average annual additional expenditures on both public rest areas and private trucks stops would be in the range of approximately $49 to $63 million before inflation -- a figure close to the current spending on public rest areas. The researchers also recommended that the most cost effective way to increase the number of parking spaces to meet the requirements is to renovate existing facilities and, where necessary, build new facilities.

The researchers also recommended that a public policy approach be developed by state and local officials to analyze current spending practices and integrate truck parking requirements into state DOT planning. After defining a need or demand, solutions must be developed through an orderly planning process and stated in terms of a program. To ensure commitments to such a rest area development program, objectives should be established, priorities set, and funding levels defined as part of an overall state program.

One suggested approach is to establish a systematic planning strategy on a state level based on a correlational analysis that identifies rest areas where immediate assistance is required in terms of providing additional truck parking spaces. This analysis could be used to:

- examine the relationship between accident rates and parking shortfall estimates--since other studies have suggested that a shortfall in truck parking spaces may contribute to accidents; and

- examine the relationship between maintenance expenditures on damaged shoulders and the shortfall in truck parking spaces -- since shoulder damage may be a consequence of increased illegal shoulder parking by trucks due to unavailability of parking spaces.

Essentially, this approach defines an orderly planning process and can serve as a foundation for initiating a comprehensive statewide rest area program.

SECTION I - PUBLIC REST AREAS

INTRODUCTION

A. Problem Statement

Over the last decade, the number of trucks on the road has increased 24 percent and the average annual mileage each truck travels has increased 37 percent. Yet over that same period of time, there has been little increase in the number of rest areas or the number of truck parking spaces at these facilities. In many areas of the country, the shortage of truck parking is apparently resulting in large numbers of trucks parked illegally on highway shoulders, causing damage to the shoulders and creating the potential for accidents.

One initial area researchers wanted to address was the perception that a number of states had enacted parking regulations that limit truck parking to 2 hours or less. When enforced such limitations make it difficult or impossible for drivers to comply with both the hours-of-service regulations and local parking regulations. Additionally, state bans on sleeping at rest areas prevent drivers from napping to meet their physiological sleep needs. Under such circumstances, drivers unable to find adequate rest areas have little choice but to continue driving and risk citations or fatigue-related accidents.

B. Research Goals and Methods

In accordance with Congressional direction, the Federal Highway Administration's (FHWA) Office of Motor Carriers (OMC) commissioned the Trucking Research Institute (TRI) and its subcontractors Apogee Research, Inc. and Wilbur Smith Associates to conduct a study of the availability and need for truck parking at public rest areas and private truck stops along the Interstate highway system. The goal of the study was to assess the supply, utilization, parking statutes and practices, and demand related to rest area parking at the state and national levels. Based on the findings of that analysis, the study was to identify policies and programs to meet commercial truck drivers' rest needs.

Realizing these goals requires data related to truck parking activities both at Interstate corridor and state levels. Prior research in this area has typically concentrated on analyzing data at the individual Interstate corridor level. In order to undertake empirical research at the state and national level, it was necessary to develop an extensive database of truck parking activities at rest areas located along Interstates across the entire country. This study relied on three general methods of data collection, resulting in five sources:

- An *inventory* of parking capacity and restrictions at public rest areas nationwide;[1]

- *Direct observation* of the actual usage of truck parking at rest areas along a medium-density trucking corridor;

- A series of *surveys* included:

  - An in-person *survey of truck drivers* along the corridor to determine their needs, perceptions, and preferences for truck parking as well as the reasons behind current practices;

  - A nationwide mail *survey of motor carriers* to identify perceived driver needs, preferences, and the availability of truck parking; and

  - A mail *survey of truck stop operators* to assess their perceptions of public rest area truck parking supply and demand, the role of the public and private sectors in meeting that demand, and potential obstacles.

The data were collected between October 1993 and January 1994.

Two quantitative models were developed to analyze the data collected. The first was an econometrically-derived *Capacity Utilization Model*, designed to identify those factors affecting rest area utilization by trucks. The second, a *Demand Model*, was a mathematical model designed to estimate the total demand for truck parking spaces at public rest areas nationwide.

The results of the quantitative analyses were then used to develop:

- *Policy recommendations* for FHWA;

- A *Guidebook*[2] designed to inform state DOT executives of this research process and how it can be applied at the state level.

[1] The national inventory is available as a separate Appendix B to this final report.
[2] The guidebook is available as a separate Appendix C to this final report.

I. DATA COLLECTION

This section provides an overview of the data collection methods used and a general description of the database.

A. Inventory of State Facilities and Policies

The primary new data requirements for this study were for nationwide information on truck parking capacity and usage at public rest areas and welcome centers, as well as parking restrictions and enforcement activities in each state. To do so, the research team conducted a survey with 44 of the 48 contiguous states as well as nine toll road/thruway agencies responsible for a combined total of 1,487 public rest areas with facilities on the Interstate highway system[3],[4]. This information forms the first national database on public rest areas on Interstate highways that serve both passenger and commercial vehicles. The database was used for a variety of purposes, including:

- The location and identification of public rest areas across the country
- Development of a Capacity Utilization Model to examine the utilization of public rest area truck parking spaces.
- Development of a nationwide Demand Model to determine truck driver parking requirements at public rest areas.

Data collection began with the establishment of a contact person within each state DOT and toll or thruway agency in the contiguous United states. This contact person was responsible for working with the study team to ensure that information on each Interstate rest area was gathered, assembled and forwarded for inclusion in the database. A list of the contact person from each agency furnishing data is included in this appendix.

Once the contact person was established, a questionnaire was sent to each state seeking details on each rest area on the Interstate system. A copy of the questionnaire is contained in Appendix B. Requested information included:

- ***Rest Area Identification***: Each state has a standard way of identifying a certain rest area. Rest areas and welcome centers generally are identified by either a name or a number. To identify a rest area for the Geographic Information System (GIS), each was designated with the abbreviation of the state plus a sequential number, as TX001 (Texas number 1). On each data sheet, the rest area is identified by both the local name and the GIS designation, which matches the location shown on the

[3] This study*s inventory of State facilities and policies is available as a separate Appendix B.

[4] Four states were not included in the database. While their DOTs did respond to questionnaires submitted by the contractors, they could not provide complete information on all the rest areas.

GIS system. Co-located rest areas on opposite sides of the highway had different numbers.

- ***Site Location***: The general description of the rest area includes county, DOT district, route number, travel direction, milepost number, and distance from an intersecting state road.

- ***Parking Characteristics***: Characteristics sought included the number of car spaces; the number and type of truck parking spaces, such as parallel (P), diagonal (D), diagonal pullthrough spaces (DPT) or diagonal-not-pullthrough spaces (DNPT); as well as the width and length of the truck space. When spaces were not marked (NM), the size of the total area was entered in the database where possible.

Additional information for selected rest areas included the number of spaces designated for buses, recreational vehicles, and for handicapped parking as well as information on whether or not the truck parking space size can accommodate triples and oversized vehicles.

- ***Facilities***: Facilities included whether or not the site was a welcome center, had an attendant, and had snack machines, drink machines, picnic tables, restrooms, gasoline, diesel fuel, water, repair facilities, and telephones.

- ***Use***: Information related to capacity utilization by time of day and complications of inadequate capacity caused by truck parking spaces filling up at night or in the early morning and overflowing onto entrance and exit ramps. A question was also included to determine if time limits existed in different states and if these time limits were enforced. An effort was also made to determine if rest areas in certain locations were being used to break down cargo loads and transfer to another commercial vehicle.

- ***Traffic***: Present and future average daily traffic volumes were requested, along with the year in which they were applicable.

Key findings of the database include:

- Few states have parking regulations targeted specifically for trucks, but most have design standards for rest areas.

- Most facilities provide restrooms. Nine in ten rest areas offer picnic tables. The majority of rest area facilities provide drinking water and telephones, but only half of these facilities offer snack or beverage machines.

- Nearly eight in ten of the rest areas report truck parking utilization as either full (35 percent of respondents) or overflowing (43 percent) onto the ramps at night.

- During the day, nearly half of the rest areas are full (36 percent) or overflowing (9 percent).

- Parking areas for cars are underutilized—six in ten rest areas have excess car parking capacity during the day and eight in ten rest areas have excess capacity at night.

- At least 621 (42 percent) of the 1,487 rest areas have some type of time limit on truck parking. At a majority of the facilities, however, they are "rarely" or "never" enforced. Only one in ten report that time limits are “always” enforced.

- Trucks often park on the shoulders and ramps to avoid parallel parking spaces.

- Many state departments of transportation (DOTs) are reluctant to enforce laws against parking on Interstate shoulders and ramps because they prefer that truck drivers rest rather than create a moving hazard for motorists.

B. Direct Observation of Rest Area Use

A direct observation survey was conducted to measure current capacity and demand for short- and long-term truck parking. In addition, the survey identified shortfalls in capacity and facility characteristics that determine utilization. Specifically, information on truck parking supply and demand was collected through peak-period surveillance of truck parking activities at four public rest areas and three privately-owned truck stops along a 200-mile segment of the I-81 corridor, southbound from Radford, Virginia to Knoxville, Tennessee. Observers counted the total number of truck parking spaces available at each site, observed space utilization, recorded the number of trucks parked legally and illegally at each facility on an hourly basis, and recorded the amount of truck traffic passing each location hourly. Key findings from the analysis include:

- Of the approximately 576 spaces designated for truck parking at the seven sites along this corridor, only 20 percent were in public rest areas. About eight in ten spaces were privately-owned truck stops.

- Truck parking along the corridor exceeded capacity during 9 of the 45 observation periods.

- Few legal spaces were available at rest areas between midnight and 5 a.m. on weekdays. Rest areas tended to fill up quickly and reach capacity before the larger truck stops reach capacity.

- The number of available truck parking spaces at rest areas was reduced by about 10 percent by RVs and cars parked in truck parking areas.

- Truck parking capacity was also reduced by design problems that lead to trucks parking across more than one space. It was evident throughout this study that a pullthrough parking space is a more efficient type of truck parking space than either a parallel or a diagonal-not-pullthrough space.

- Large numbers of trucks parked illegally on shoulders and ramps of rest areas. This often occurred before the corridor reached capacity and even when legal parking spaces were available at a rest area.

- Parking restrictions at rest areas do not appear to be enforced or heeded.

- As expected, parking demand was strongly correlated with truck traffic on the highway. Facility features also contribute significantly to the demand for parking and the amount of overflow onto the ramps.

C. Target Group Surveys

Three other surveys conducted for this study, including interviews with truck drivers and surveys of motor carrier executives and truck stop operators, generated information about the needs, habits, attitudes, opinions, and preferences of truck drivers. Each of the surveys and their major findings are described below.

C.1. Truck Driver Survey

The truck driver survey was administered to 500 truck drivers using public rest areas and privately-owned truck stops along the same corridor where the direct observation exercise was conducted.

The results indicate that drivers perceive there to be a shortage of adequate truck parking facilities, particularly for long-term or overnight parking.

- More than 90 percent of the truck drivers believe a shortage exists.

- Most truck drivers say the problem is the worst in the Northeast (56 percent).

Truck drivers report having to park and rest at places other than public rest areas or truck stops due to overcrowding. When overcrowding prohibits the use of rest areas or truck stops, they generally park on the entrance and exit ramps of highways, in shopping center parking lots, at shipper locations, and on the shoulders of the roadway.

- On average, truck drivers say this happens about four times per month.

- Truck drivers report that overcrowding at rest areas and truck stops peaks between 10 p.m. and midnight.

To relieve this perceived shortage, most truck drivers believe that the number of truck parking spaces should be increased at the Nation's public rest areas and privately-owned truck stops. According to some truck drivers, more rest areas and truck stops should be built as a desirable second step to adding more truck parking spaces.

Few truck drivers, however, are willing to pay for improvements in truck parking facilities through higher diesel fuel taxes or highway user fees.

- Only three in ten are "very" or "somewhat" willing to pay.

- More than six in ten are "not very" or "not at all" willing to pay.

Truck drivers did not express much desire to see public rest areas expand their services to include such features as fuel or food.

For *short-term* parking, truck drivers prefer public rest areas slightly (49 percent) to private truck stops (43 percent). For those who prefer rest areas, accessibility is usually the most important factor in choosing a short-term parking place.

This pattern was dramatically reversed, however, when truck drivers were asked where they prefer to park for *long-term* or overnight parking to meet their rest needs. Nearly seven in ten truck drivers (68 percent) prefer truck stops, and only 15 percent prefer to rest or sleep at public rest areas. Truck stops are preferred primarily for safety and security reasons.

The majority of truck drivers rate private truck stops favorably. Two-thirds say that private truck stops are either "excellent" or "good" for meeting drivers* rest and sleep needs, including more room to park, availability of food, cleanliness, a feeling of safety and security, and an overall feeling that truck drivers* needs can be met at truck stops.

A majority of the truck drivers rate public rest areas as "only fair" or "poor" (54 percent) for meeting drivers' rest needs. Only 5 percent rate public rest areas as "excellent." Reasons given for this less than favorable rating include: overcrowding, safety concerns, campers and RVs parked in truck parking spaces, time restrictions, not enough public rest areas, dirty or poorly kept facilities, and poor parking area/space design.

C.2. Motor Carrier Survey

A mail survey of 330 motor carrier executives nationwide yielded results that were strikingly similar to those expressed in the truck driver survey (Section C.1). Specifically, four out of five motor carriers believe there is a shortage of long term or overnight parking facilities for truckers. Many say the problem is the worst in the Northeast (41 percent). Motor carriers

often hear complaints from their drivers about a lack of available space or facilities for long-term/overnight truck parking:

Motor carriers perceive that truck drivers encounter a variety of difficulties or challenges when looking for a place to park and sleep for several hours while on the road, including overcrowded facilities, lack of facilities, security problems, prostitution in truck parking areas, unsanitary rest rooms, and poorly designed truck parking spaces.

When truck drivers cannot find a place to park at a rest area or truck stop due to overcrowding, motor carriers say their drivers find other places to park and sleep such as shipper or consignee locations, shopping center parking lots, and the entrance and exit ramps of Interstates.

Most motor carriers believe that something should be done to solve the long-term truck parking problem:

- Thirty-eight percent say it is "very" important to solve the problem;
- Forty-two percent say it is "somewhat" important; and
- Only 20 percent believe it is "not very" or "not at all" important.

Many motor carrier executives believe that parking capacity should be increased at the Nation's public rest areas and/or privately-owned truck stops by building more parking spaces. In addition, some also believe that more public rest areas and truck stops should be built.

Motor carrier executives say neither they nor their drivers are willing to pay for improvements in truck parking facilities through either higher diesel fuel taxes or highway user fees. Among motor carriers,

- Only two in ten are "very" or "somewhat" willing to pay; and
- More than seven in ten are "not very" or "not at all" willing to pay.

In addition, about 65 percent said their drivers are "not very willing" or "not at all willing" to pay a fee to park at either a rest area or truck stop.

Motor carrier executives are divided over whether or not public rest areas should be allowed to provide a broader range of services (such as fuel or food):

- Forty-six percent of the motor carriers say they would oppose such a proposal, and
- Forty-two percent say they would support it.

Motor carriers perceive that their drivers prefer privately-owned truck stops (60 percent) over public rest areas (13 percent) or motels (9 percent) for long-term parking. Reasons given for this perception include: access to food, fuel, and truck services; and safety and security concerns.

Overall, motor carrier executives tend to rate the Nation's public rest areas less than favorably for meeting drivers' rest and sleep needs.

- Most (70 percent) motor carriers rate public rest areas as "only fair" or "poor" for meeting the rest needs of their drivers.

- One in four motor carriers rate public rest areas as "good," and only 1 in 330 rate rest areas as "excellent."

On the other hand, the majority of motor carriers surveyed for this study rate private truck stops favorably—two-thirds say that private truck stops are either "excellent" or "good" for meeting drivers' rest and sleep needs.

C.3. Truck Stop Operator Survey

Few of the 170 truck stop operators who responded to the truck stop operator survey believe there to be a shortage of long-term or overnight parking at public rest areas for truck drivers. In fact, nearly seven in ten truck stop operators say that a shortage does not exist. Only truck stop operators in the Northeast perceive there to be a shortage, a position that supports the perceptions of the motor carriers and drivers that the parking shortage is more acute in the Northeast.

Truck stop operators recognize that truck stops are the preferred location of truck drivers to park and sleep while on the road—97 percent of the truck stop operators believe truck drivers prefer to park and sleep at truck stops.

Most truck stop operators also believe that truck drivers prefer truck stops for their short-term rest needs as well. More (80 percent) truck stop operators say that drivers prefer to park at truck stops for their short term rest needs (1 to 2 hours) while on the road.

In general, truck stop operators who see a shortage of adequate long-term truck parking believe that adding parking capacity at both public and private facilities is the best way to meet the demand. Truck stop operators report that the biggest obstacles to increasing the capacity at current facilities are cost and the availability of space or land. Nevertheless, more than
40 percent of truck stop operators report plans to increase truck parking capacity at their facility.

To assist private businesses in meeting this demand, one in five truck stop operators suggests that the government provide low interest loans or tax incentives to the private sector to help increase parking capacity. Few truck stop operators believe truck drivers are willing to pay either higher diesel fuel taxes or user fees to finance the expansion of truck parking facilities.

Few truck stop operators currently see public rest areas as a threat to their business. About half of the truck stop operators surveyed for this study, however, believe that expanding long-term parking at public rest areas would have a negative effect on their business. Most truck stop operators responded negatively to a suggestion that public rest areas be allowed to provide services such as fuel and food.

II. QUANTITATIVE MODELING AND ANALYSIS

The objective of the quantitative modeling and analysis was: (a) to analyze and understand the factors affecting the utilization of truck parking spaces at public rest areas, and (b) to develop a demand model to estimate the required number of truck parking spaces in rest areas nationwide. The database for this task includes data out of 1,487 rest areas located across the nation as well as direct observations from this study*s survey along I-81.

A literature survey revealed that individual states sometimes use detailed corridor level data on about 15 to 20 rest areas along a particular Interstate to assess the need for additional parking at rest areas. The advantage of such an approach is the ability to predict accurately both the design requirements and the number of additional parking spaces required in future rest areas along that specific corridor. Although the predictive ability of the approach is useful, cost considerations make it extremely difficult to apply on a nationwide basis.

Therefore, this study predicts the demand for truck parking spaces at individual rest areas based on national Interstate highway use and an extensive inventory of rest area facility characteristics. Aggregate data on the characteristics of rest areas located across the country are used to analyze some of the underlying factors related to truck parking activities in general. These factors are used to estimate the potential demand for truck parking spaces along the Interstate highway system.

A. Capacity Utilization Model

The Capacity Utilization Model identifies the services and facilities that affect the utilization of truck parking spaces at rest areas. A review of past studies suggested that a number of factors, both demand- and supply-related, affect rest area parking usage by trucks. Table II-1 summarizes these factors.

TABLE II-1. Factors Affecting Rest Area Usage by Trucks

DEMAND-RELATED FACTORS	SUPPLY-RELATED FACTORS
Average Daily Traffic Volume (ADT)	Total number of available truck parking spaces
Truck Traffic as a percentage of ADT	Type of parking space (parallel, diagonal)
Distance from previous rest area	Facilities (telephones, rest rooms, lighting)
Proximity of rest area to a major intersection	Special parking rules or requirements

Source: Apogee Research, Inc.

An econometric model was developed to estimate the individual impact of each of the above factors on the utilization of parking spaces:

$$\mathbf{CU = b_0 + b_1ADT + b_2TADT + b_3DPRV + b_4DINT + b_5SP + b_6TYPE + b_7Z + b_8REQ + e_i}$$

where,

CU represents utilization of rest area parking spaces (dependent variable)
ADT is one-way average daily traffic
TADT is trucks as a percentage of ADT
DPRV is the distance from the previous rest area
DINT is the distance from a major intersection
SP is the total number of available parking spaces
TYPE is the type of parking space available
Z is the matrix of all the facilities provided at the rest area (see Table II-2)
REQ represents any time limit rules related to parking
b_0 is the constant term that captures the average effect of all omitted variables $b_1 \ldots b_8$ are the individual coefficients on the independent variables
e_i is the error term

A.1. Data and Variables

The data for this model were derived from information provided by state DOTs nationwide. Table II-2 summarizes the list of independent or explanatory variables requested from each state for each rest area located in that state. The database contains information on approximately 1,487 rest areas located across the country covering 44 of the 48 contiguous states. This model used data from 709 of the 1,487 rest areas.[5]

The dependent variable in the model, capacity utilization (CU), is a dummy variable with a value of 1 if a rest area*s parking capacity is typically full or overflowing, or 0 if it is typically uncrowded.[6] A large number of independent variables depicting the characteristics of rest areas also had to be represented as dummy variables, as shown in Table II-2. The generation of dummy variables was required to quantify the impact of certain factors on rest area parking utilization, for which only qualitative information (such as "yes" or "no") was available. Some of the dummy variables generated include information on the type of truck parking space and whether or not there is a welcome center, snack machines, restricted parking time limits, lighting, and breakdown exchange space. All variables were included in the surveys of state DOTs. Variables such as repair facilities were included because of their presence on some toll roads.

[5] The selected rest areas had complete data on the variables required for estimating the model.

[6] The value of the dummy variable for capacity utilization is based on the subjective and observational response provided by the state DOT representatives.

TABLE II-2. Summary of Potential Independent Variables			
Variable Name	**Type (Demand-Side or Supply-Side)**	**Method of Measurement**	**Expected Sign of Coefficient**
Average Daily Traffic (ADT)	Demand	Number	Positive
Percentage of Trucks in ADT	Demand	Percentage	Positive
Number of Truck Parking Spaces	Supply	Number	Negative
Type of Truck Parking Space[a]	Supply	Dummy (DPT=1 or Otherwise=0)	Positive
Welcome Center Attendant	Supply	Dummy (Yes=1; No=0)	Positive
Distance from Previous Rest Area	Demand	Miles	Positive
Snack Machine	Supply	Dummy (Yes=1; No=0)	Positive
Drink Machine	Supply	Dummy (Yes=1; No=0)	Positive
Picnic Table	Supply	Dummy (Yes=1; No=0)	Positive
Repair Facility	Supply	Dummy (Yes=1; No=0)	Positive
Telephones	Supply	Dummy (Yes=1; No=0)	Positive
Distance to Next Intersection	Demand	Miles	Positive
Time Limits	Supply	Dummy (Yes=1; No=0)	Negative
Lighting	Supply	Dummy (Well-lit=1; Some or Poor=0)	Positive
Breakdown Exchange	Demand	Dummy (Yes=1; No=0)	Positive
Triples Space	Supply	Dummy (Yes=1; No=0)	Positive
Oversized Space	Supply	Dummy (Yes=1; No=0)	Positive

[a] DPT refers to diagonal-pullthrough parking as compared to parallel or diagonal-not-pullthrough parking

A.2. Estimation

A binomial logit regression procedure was used to estimate the Capacity Utilization Model,[7] where the individual coefficients measure the impact of the independent variables on the probability that a rest area*s parking capacity will be full or overflowing (since the CU dummy variable equals 1 only if the parking capacity is full or overflowing). Thus, a positive statistically significant coefficient implies that the characteristic increases the probability that the rest area*s parking capacity is full or overflowing. Similarly, a negative and statistically significant coefficient implies that the characteristic decreases the probability that the rest area*s parking capacity is full or overflowing.

The final sample used for estimation purposes contains data on 709 rest areas across the country with complete records on all the variables included in the model. The sample covers a reasonably good cross-section of nationwide rest areas, except for a large segment of California, Oregon, and Washington.[8]

The initial model included all the variables listed in Table II-2 (previous page). A number of statistical and data problems affected the results of this model. Multicollinearity between some of the independent variables resulted in the exclusion of certain variables.[9] In addition, there were some variables that exhibited little or no variation in the final sample selected and were also excluded from the model.[10] Therefore, the model was re-estimated after making these alterations and the results are presented in Table II-3.

A.3 Summary of Key Findings

The estimation results indicate that the Capacity Utilization Model correctly predicts overutilization and underutilization of parking spaces at public rest areas 76 percent of the time. The results also indicate that one-way average daily traffic, distance from the previous rest area, distance to the next interchange, adequate lighting, welcome centers, food facilities, and the presence of attendants have a positive impact on parking space utilization by trucks at rest areas. The availability of repair facilities and picnic tables at rest areas are statistically significant in predicting a rest area*s parking space utilization. In general, the conclusions from this model confirm the major findings of the surveys. Therefore, the factors identified by the Capacity Utilization Model taken together with the survey findings serve as useful input to the Truck Parking Demand Model and to design considerations.

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[7] This modeling procedure applies when the qualitative nature of the dependent variable does not permit the use of standard regression techniques, such as Ordinary Least Squares (OLS).

[8] DOTs of the states not included in the sample did respond to the questionnaires. However, complete information on all variables for rest areas in these states was not currently available.

[9] Multicollinearity refers to the degree of correlation between two or more independent variables in the model. In the presence of multicollinearity, therefore, it is difficult to isolate the impact of individual variables on the dependent variable. In this model, strong collinearity between FOOD and DRINK, OVERSIZED and TRIPLES, and REST ROOMS and PICNIC was observed. As a result, one of the two strongly correlated variables was dropped from the model (based on the individual t-statistics).

[10] For example, almost 99 percent of the rest areas in the final sample had rest room facilities and drinking fountains; subsequently, these variables were excluded from the final model.

TABLE II-3. Estimation Results of the Logit Model (n=709) (t-statistics in parenthesis)	
Variable	**Estimated Coefficient**
Average Daily Traffic	0.82 (5.46**)
Distance from Previous Rest Area	0.29 (3.18**)
Distance to Next Intersection	0.11 (1.66*)
Number of Truck Parking Spaces	-0.02 (-1.97**)
Type of Truck Parking Space	0.24 (1.68*)
Telephones	0.31 (0.97)
Food	0.83 (4.02**)
Repair Facility	0.07 (1.08)
Picnic Tables	-1.03 (-1.14)
Attendant	0.55 (2.16**)
Lighting	0.13 (1.96**)
Welcome Center	0.23 (2.00**)
Percentage of Correct Predictions	76.10%
Log of Likelihood Function	-340.4

** Indicates statistical significance at the 5 percent level.
* Indicates statistical significance at the 10 percent level.

Source: Apogee Research, Inc.

B. Truck Parking Demand Model

To estimate the nationwide demand for truck parking spaces at public rest areas, a macrolevel demand model was specified. The demand model was based on a modification of a mathematical model developed by the MnDOT. The modifications to the MnDOT model were based on the findings of the Capacity Utilization Model, recommendations from a study conducted by the VDOT, and the results of the surveys conducted for this study.

B.1. Methodology

The approach to developing the Demand Model was based on the truck parking estimation model developed by the MnDOT in 1979 and included three steps:

(1) The team applied the analytical framework of the MnDOT model on a national level using the information available from the study database.

(2) The parameters of the MnDOT model were then modified using the guidelines presented in the 1994 VDOT study of rest area usage. The VDOT model recommendations are more recent and the recommended parameters are based on data collected in summer 1994.

(3) The findings of the Capacity Utilization Model, combined with the results of the study surveys, were used to further modify the model using the descriptive characteristics of the pattern of rest area usage.

B.2. MnDOT and VDOT Models

The original MnDOT truck parking estimation model was based on corridor-level data collected through extensive usage surveys at Minnesota Interstate rest areas. The model used a simple mathematical formula to estimate the required number of truck parking spaces in rest areas along the corridor. The study also provided a broad set of guidelines for the model*s parameter values which may be used to study other rest areas. The estimation formula used in the MnDOT model is:[11]

$$NSPACES = \frac{ADT \times P \times DH \times D_t \times PF}{VHS}$$

where,

NSPACES	=	Truck parking spaces required
ADT	=	Average Daily Traffic with access to rest area
P	=	Total percentage of mainline traffic stopping at rest area
DH	=	Design hour usage[12]

[11] Source: Study of Rest Area Truck Parking, Wilbur Smith Associates (1990), pp. 34-36.

[12] Design Hour (DH) compares the design hourly volume (usually the 30th to 50th highest hourly volume) to the annual ADT and results in a factor that predicts a peak usage average hour situation.

D_t	=	Distribution of vehicles between car and truck parking spaces
PF	=	Peak factor, ratio of average day of five summer months to average day of year
VHS	=	Vehicles parked per hour per space

The general recommendations for the parameter values used in the model are summarized in Table II-4.

A 1994 survey by the Transport Planning Division of the VDOT reviewed existing rest area usage parameters in Virginia. The recommendations presented in this study are used to modify the original MnDOT parameter guidelines as shown in Table II-4. As the table indicates, there are two basic differences in the parameter recommendations of the VDOT model:

- If the rest area is classified as a welcome center, the VDOT study recommends increasing the percentage of mainline traffic entering the rest area to 14 percent.

- If the ADT exceeds 12,500 vehicles, the design hour (DH) usage ratio should be decreased to 0.10.

Traditionally, welcome centers offer a wider range of facilities to travelers and attract a larger percentage of traffic passing the rest area than standard rest areas. Accordingly, in the Capacity Utilization Model, the dummy variable representing welcome centers is statistically significant and positively associated with the utilization of the parking spaces in a rest area. As the model reveals, the ADT variable is a major driving force of the estimation model. The way the original model is designed, a high ADT volume is directly related to a higher number of truck parking spaces required. Although this direct proportionality between ADT and required parking spaces is intuitive, it is important to note that the relationship between ADT and truck parking spaces required only holds up to a certain level of ADT. Beyond that level of ADT, additional traffic volume does not necessarily relate to higher parking space requirements, under the assumption that the Design Hour ratio stabilizes to 0.10. The other recommendations of the VDOT model are similar to the assumptions used in the MnDOT model.

TABLE II-4. Parameter Recommendations for the MnDOT and VDOT Models			
Parameter	MnDOT Recommendations	VDOT Recommendations	APOGEE MODEL
Percent of mainline traffic entering rest area (P)	0.12	general=0.12; welcome centers=0.14	P = 0.12 P(WEL)=P + 0.01 P(ATT)= P + 0.01 P(Type of Space=1)= P + 0.01 P(Food)= P + 0.01 P(DPRV>50m)= P+ 0.01 P(DINT>10m)= P+ 0.01
Design hour usage (DH)	0.15	when ADT<12,500=0.15; when ADT>12,500=0.10	ADT <12,500= 0.15; ADT >12,500 and < 30,000=0.10; ADT > 30,000= 0.075;
Distribution between car and truck parking lots (D_t)	cars=0.75 trucks=0.25	cars=0.75 trucks=0.25	cars=0.75; trucks=0.25;
Peak factor ratio (PF)	1.80	1.80	1.80
Vehicles per hour per parking space (VHS)	3	3	2

Sources: Minnesota Department of Transportation, Virginia Department of Transportation, and Apogee Research, Inc.

B.3. Model Output (MnDOT and VDOT Recommendations)

A three-step process was designed for the model output. First, the MnDOT and VDOT recommendations were tested. This study*s database provided one-way ADT data for 1,307 rest areas in 44 contiguous states around the country. Four states, Wyoming, New Mexico, Mississippi, and Delaware, were not included as there were no ADT figures available. The second step required a separate model to estimate the total number of required truck parking spaces based on the ADT figures in the current database and the recommended parameter guidelines from the MnDOT and VDOT studies. The third step used the method described below to evaluate the predictive power of the models to determine their general validity:

- A prediction is treated as "correct" if the estimated number of truck parking spaces at a rest area exceeds the number of available spaces at the rest area AND the coding scheme used for the dummy dependent variable for the capacity utilization shows the value "1" for that rest area. "1" represents full or overflowing parking capacity.

- A prediction is also treated as "correct" if the estimated number of parking spaces at a rest area is lower than the number of available spaces at the rest area AND the coding scheme used for the dummy dependent variable for the capacity utilization shows the value "0" for that rest area. "0" represents uncrowded parking capacity.

- A prediction is treated as "wrong" if the estimated number of parking spaces at the rest area exceeds the number of available spaces at the rest area AND the coding scheme used for the dummy dependent variable for the capacity utilization shows the value "0" for that rest area. "0" represents uncrowded parking capacity.

- A prediction is also treated as "wrong" if the estimated number of parking spaces at a rest area is lower than the number of available spaces at the rest area AND the coding scheme used for the dummy dependent variable for the capacity utilization shows the value "1" for that rest area. "1" represents full or overflowing parking capacity.

Although estimates for parking spaces are available for the 1,307 rest areas included in the model, the percentage of correct predictions is based on a total of 1,098 rest areas; these were the records that also included data on the coded dummy variable representing capacity utilization.[13] The results indicate that the MnDOT model*s recommended parameters predict 61.7 percent of the rest areas correctly, while the VDOT model*s recommendations predict 65.3 percent of the rest areas correctly. The slight improvement in predictions of the VDOT model may be attributable to the recommendations that are different with respect to the percentage of mainline traffic entering a welcome center and the design hour ratio.

B.4. Modified Apogee Model

The Apogee model estimation results are based on a modification of the original MnDOT model and the suggested VDOT recommendations. In general, there were three basic modifications made to the original MnDOT model:

(a) Additional controls for the design hour ratio assumption for ADT figures exceeding 30,000 vehicles.

(b) An upward adjustment to the percentage of trucks (D_t) of mainline traffic entering a rest area. This adjustment was based on the findings of the Capacity Utilization Model, which indicated that certain characteristics (such as welcome center,[14] proper lighting, food facility, diagonal pullthrough parking, distance from the previous rest area, and the distance to the next interchange) of a rest area increased the truck utilization level.

(c) A decrease in the vehicles per hour per space assumption to reflect the longer truck parking time per space on the average. This is suggested by survey findings described above.

The specific modifications made to the MnDOT model are:

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[13] These 1,098 rest areas were selected based on the availability of information on the capacity utilization variable (i.e., "fully utilized" or "underutilized").

[14] This is similar to the recommended parameter value in the VDOT rest area study.

- Increase D_t (0.25), the percentage of mainline traffic entering the rest area, by 0.01 for each of the following attributes: welcome center, proper lighting, food facility, diagonal-pullthrough parking spaces, and an attendant on the premises.

- Increase D_t (0.25), the percentage of mainline traffic entering the rest area, by 0.01 if (i) the distance between the rest area and the previous rest area was greater than 50 miles and (ii) the distance to the next interchange was greater than 10 miles.

- Use the following design hour usage values: 0.15 for ADT figures below 12,500; 0.10 for ADT figures between 12,500 and 30,000; and 0.50 for ADT figures above 30,000.

- Change the vehicles per hour per space (VHS) assumption from 3.0 to 2.0, indicating an average parking time per space of 30 minutes instead of 20 minutes.[15]

It is important to note the differences in the time frame associated with the Capacity Utilization Model and the truck parking spaces estimation model. In the Capacity Utilization Model, the dependent variable (the dummy variable representing parking space utilization) is based on observations of nighttime parking at rest areas by trucks. In contrast, the parking space estimation model is not based on data from a particular time of the day or night. The ADT figure used as an input to the model is the average of ADT along a particular Interstate as reported in this study*s database.[16] Therefore, the estimates for total truck parking requirements at public rest areas are not confined to night parking requirements only.

B.5. Current Truck Parking Space Estimates

In total, approximately 52,700 truck parking spaces are necessary in public rest areas to satisfy demand along Interstates. Figure II-1 provides an overview of the statewide truck parking space requirements across the nation. Table II-5 provides a detailed breakdown of the total statewide truck parking space requirements and the current shortfall estimated.

The total current shortfall in truck parking spaces nationwide is estimated to total approximately 28,400 spaces (Table II-5). Figure II-2 provides an overview of the total current shortfall in truck parking spaces nationwide. As shown in Table II-5 and Figure II-2, Pennsylvania, Florida, North Carolina, and South Carolina, and Virginia alone account for almost 23 percent of the total shortfall. Figure II-3 and Table A1 of Appendix A summarize the shortfall estimates per rest area, which is also demonstrated. On average, the current shortfall in truck parking spaces on a per rest area basis is approximately 21 spaces on a nationwide level.

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[15] Based on the survey findings from the Apogee surveys of commercial drivers, motor carriers and private truck stop operators.

[16] It should also be noted that the ADT figures used in the model do not represent a single year. The individual ADT numbers reported in the database are based on 1991, 1992, and 1993 figures, depending on their availability.

The statewide estimation of total requirements and shortfall in truck parking spaces has also been aggregated over the nine FHWA-classified regions.[17] The results are summarized in Tables A2 and A3 in Appendix A. Region 4, which comprises Florida, Georgia, Alabama, Kentucky, Mississippi, Tennessee, South Carolina, and North Carolina, accounts for almost 24 percent of the overall shortfall, with a total estimated need for approximately 6,600 additional parking spaces.

[17] Statewide and regional estimates only include rest areas for which ADT data were available; the reported statewide and regional estimates do not control for rest areas that were not included in the sample.

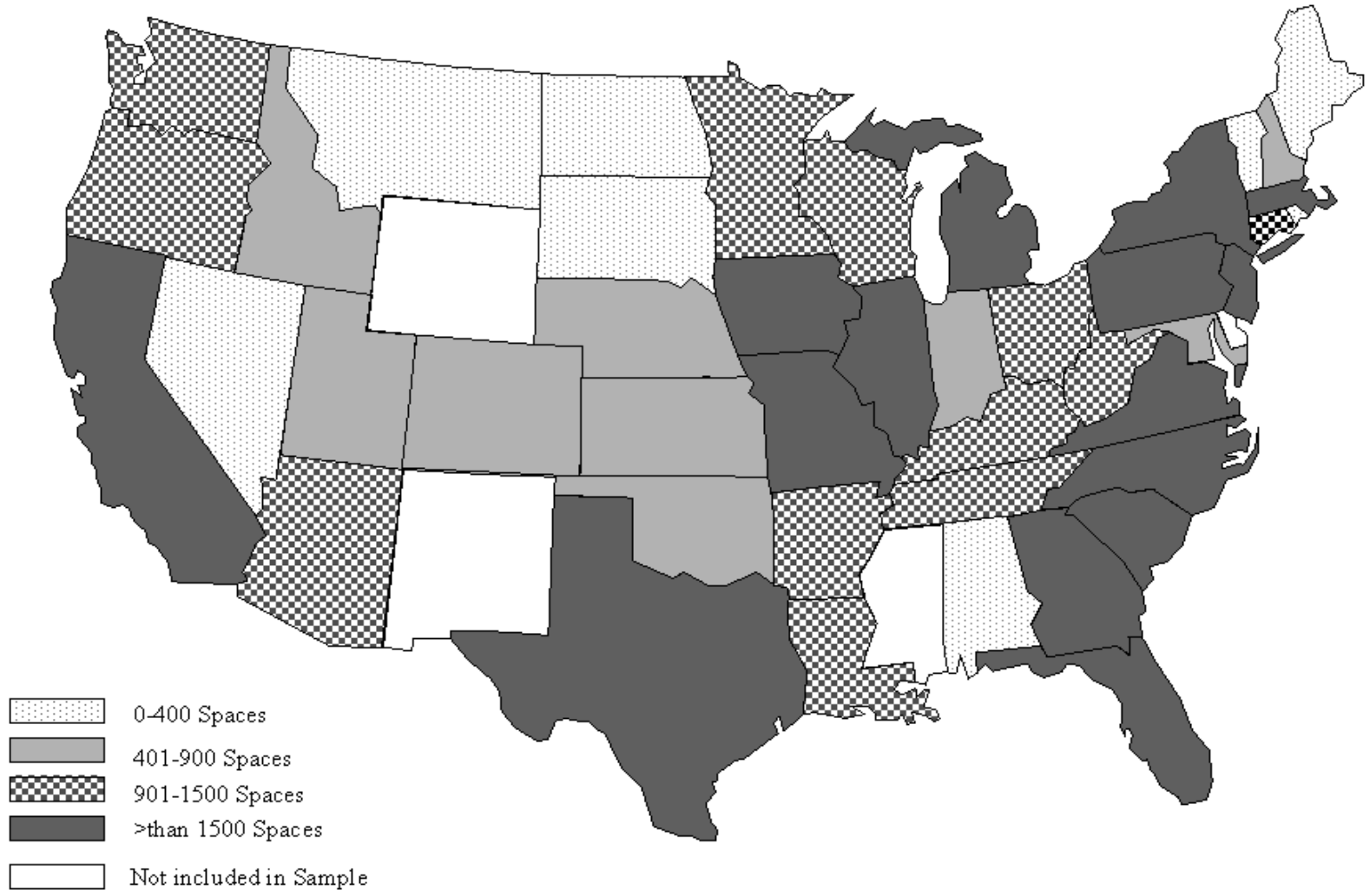

FIGURE II-1. Statewide Truck Parking Space Requirements

Table II-5. Total statewide Shortfall Estimates of Truck Parking Spaces

state	Total Number of Rest Areas in the state	Number of Rest Areas In Model	Current Truck Parking Space Requirements	Current Truck Parking Spaces Available	Current Truck Parking Space Shortfall
Alabama*	22	22	71	NA	NA
Arizona	40	40	1,371	762	609
Arkansas	19	19	920	64	856
California	53	53	2,084	966	1,118
Colorado	26	26	709	289	420
Connecticut	20	20	1,462	437	1,025
Delaware*	1	1	NA	39	NA
Florida	60	53	2,852	1,183	1,669
Georgia	29	29	1,763	794	969
Idaho	22	22	547	211	336
Illinois	54	52	2,155	1,310	845
Indiana*	46	10	501	NA	NA
Iowa	40	39	1,543	574	969
Kansas	34	34	797	400	397
Kentucky	28	28	1,484	751	733
Louisiana	40	34	1,474	457	1,017
Maine	11	11	297	116	181
Maryland	9	9	596	331	265
Massachusetts	31	31	1,572	1,180	392
Michigan	57	57	1,680	1,066	614
Minnesota	35	35	1,262	449	813
Mississippi*	20	20	NA	270	NA
Missouri	37	37	1,839	920	919
Montana	35	35	287	253	34
Nebraska	27	27	664	268	396
Nevada	10	10	213	159	54
New Hampshire	10	10	533	206	327
New Jersey	19	19	1,529	655	874
New Mexico*	27	27	NA	NA	NA
New York	58	54	2,399	1,218	1,181
North Carolina	39	39	2,037	685	1,352
North Dakota	30	30	390	275	115
Ohio	46	26	1,014	440	574
Oklahoma	14	12	427	207	220
Oregon	41	41	1,406	873	533
Pennsylvania	63	63	3,157	1,175	1,982
Rhode Island*	1	1	62	NA	NA
South Carolina	33	28	1,627	359	1,268
South Dakota	21	21	321	244	77
Tennessee	30	17	961	334	627
Texas	80	57	2,382	1,285	1,097
Utah	21	21	517	254	263
Vermont	19	19	250	192	58
Virginia	40	40	2,288	966	1,322
Washington	29	28	993	423	570
West Virginia	22	22	1,078	453	625
Wisconsin	26	26	1,215	500	715
Wyoming*	12	12	NA	131	NA
Total	**1,487**	**1,307**	**52,669**	**24,697**	**28,412**

NA: Insufficient data to determine shortfall estimates * : Incomplete survey data

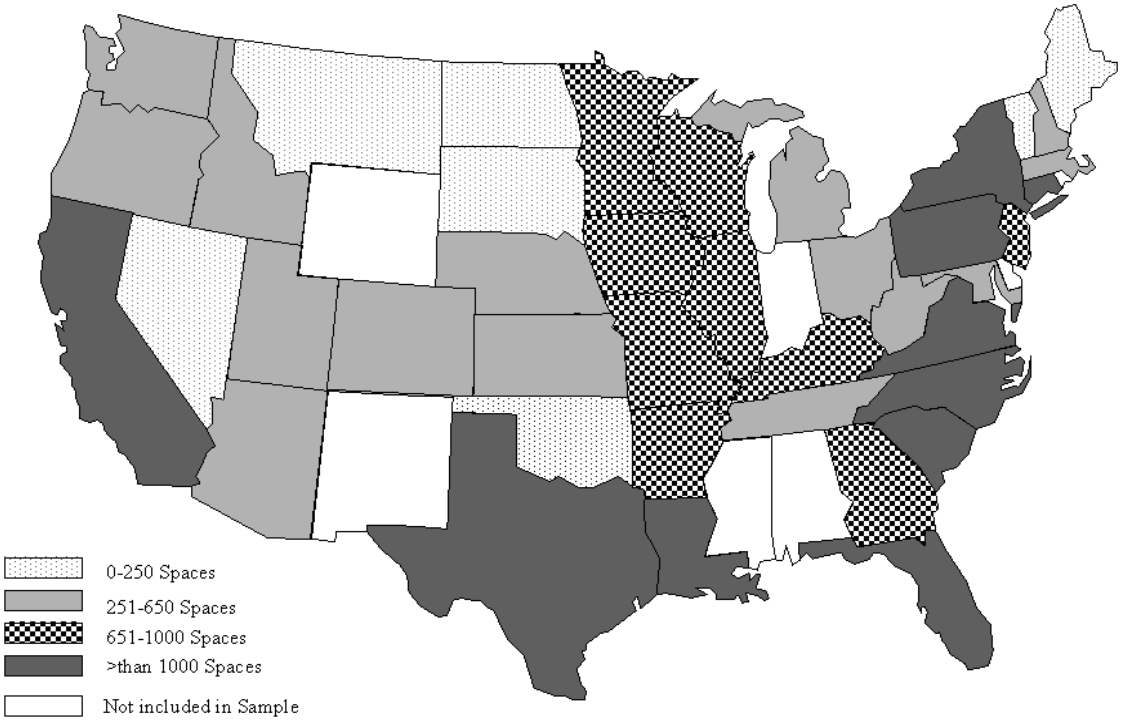

FIGURE II-2. Total Shortfall in Statewide Truck Parking Spaces

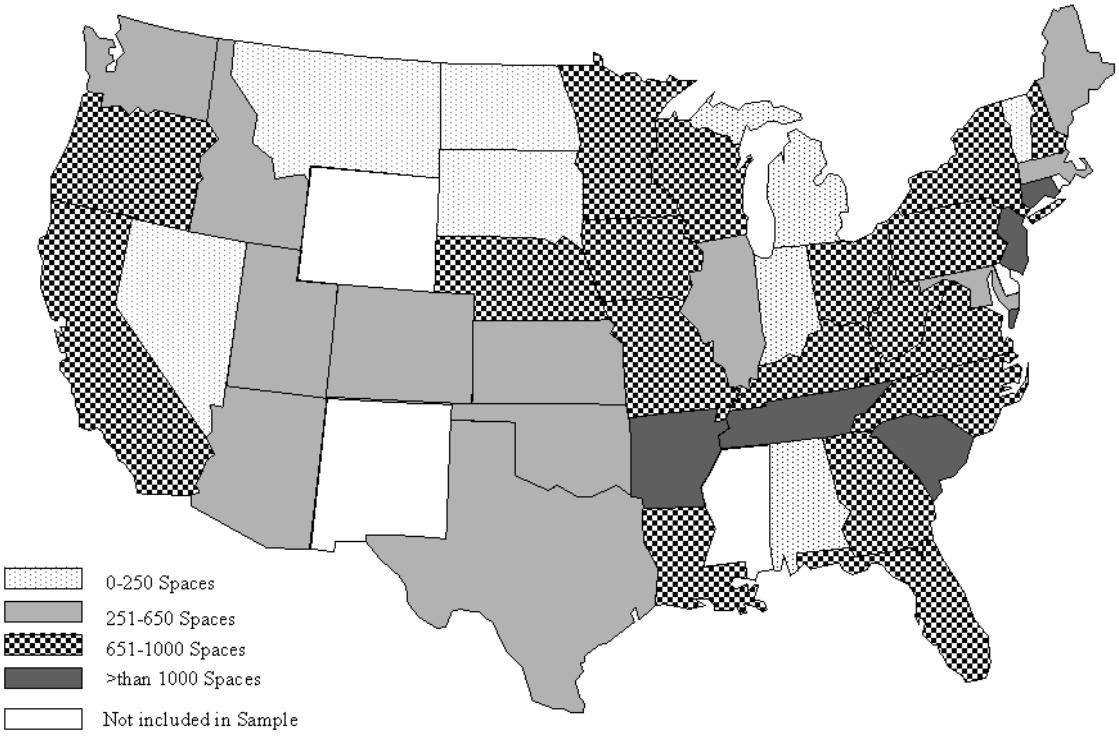

FIGURE II-3. Average Shortfall Per Rest Area in Statewide Truck Parking Spaces

B.6. Truck Parking Space Estimates by Interstate Corridors

The demand model identified the total current requirements in truck parking spaces at public rest areas nationwide by FHWA region. The findings of the demand model are analyzed in further detail to understand requirements for truck parking spaces along the major Interstates in the country. The top 10 corridors with the most critical shortfall in public rest area truck parking spaces were selected for additional analysis. These Interstate routes are described in Table A4 in Appendix A and include:

- I-95
- I-80
- I-10
- I-40
- I-5
- I-90
- I-35
- I-81
- I-70
- I-75

Table A4 also shows the shortfall in truck parking spaces per mile of Interstate. The shortfall per mile is greatest along the I-95 corridor with an average of 1.4 additional truck parking spaces required per mile. Within I-95, the problem is most critical when the Interstate passes through Maryland, Pennsylvania, and Virginia, where the shortfall per mile increases to 1.5.[18] The other major corridors where the shortfall density exceeds 1.0 per mile include I-5 and I-81. The corridor-level analysis indicates that the top 10 critical corridors, identified in Table A4, account for almost 63 percent of the total national shortfall in truck parking spaces at public rest areas.

B.7. 5- and 10-Year Projection Estimates

As shown in Tables A5 through A8 in Appendix A, the 5-year projected shortfall (based on truck ADT growth at 2.5 percent[19]) is estimated to be 36,000 truck parking spaces. The shortfall represents an increase of approximately 30 percent over current shortfall estimates. The 10-year projection shows a total estimated shortfall of 39,000 truck parking spaces, an increase of approximately 40 percent over current shortfall estimates.

C. Summary

The major findings of the demand model indicate a current total nationwide shortfall of approximately 28,400 truck parking spaces at public rest areas. The shortfall is projected to reach about 36,000 spaces over the next 5 years and almost 39,000 spaces over the next 10 years. The average current national truck parking space shortfall per rest area is 21. On a rest area basis, this shortage is critical in Connecticut, New Jersey, South Carolina, and Tennessee. The findings also indicate that FHWA Region 4, which consists of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee, has the greatest current shortfall in

[18] These States and the District of Columbia make up FHWA Region 3.

[19] Estimate provided by the American Trucking Associations.

truck parking spaces. Other states where the current shortfall estimates are critical include California, Pennsylvania, New York, Texas, and Virginia.

Interstate 95 heads the list of the top 10 corridors in which the current shortfall estimates are most critical. The other major Interstates in which there is a serious problem of insufficient truck parking spaces include I-80, I-10, I-5, I-40, I-81, I-90, I-35, I-70, and I-75. On average, the shortfall density estimates on these 10 corridors range between 0.46 to 1.44 truck parking spaces per mile.

SECTION II - PRIVATE REST STOPS

SECTION II-1: NATSO SURVEY RESULTS

INTRODUCTION

A. The Current Task -- Problem statement

In previous tasks, the data collection and analysis focused on the supply and demand for truck parking at public highway rest areas -- the number of existing parking spaces, the extent and ways in which they are being used, and the extent to which adequate parking is available at these public facilities to meet the rest needs of long-haul truck drivers.

However, the national inventory of truck parking included only public facilities, and did not include parking provided by the large number privately-owned truck stops operated across the country. Obtaining comparable data from these privately-owned facilities would clearly be useful and advantageous in developing a fuller understanding of the supply and demand for long-term truck parking, particularly since many truck drivers in the survey indicated they preferred using privately-owned truck stops instead of public rest areas for overnight parking, and the direct observation exercise suggested that these privately-owned facilities might account for a large proportion of the total supply and usage of truck parking nationwide.

TRI and Apogee reviewed possible sources of information on the supply and demand for truck parking at privately-owned truck stops. This search revealed several useful publications and databases that provided information on truck stops, truck services and truck parking. This included a publication called ***"The Trucker's Friend."*** However, the review also indicated that although detailed information was available on the location of these facilities, the services they provided and the general size of their truck parking areas, ***no information was available from these sources on the actual number of existing parking spaces or the actual usage of truck parking***, i.e. the capacity for truck parking or the extent to which these facilities were "uncrowded, full or overflowing," as it was measured for public highway rest areas in previous tasks.

B. Survey Goals and Methods

To meet this need for information, the FHWA directed TRI and Apogee to conduct a follow-up survey with truck stop operators nationwide and obtain comparable data on truck parking capacity, usage and availability with the goal of adding this data to the capacity utilization and demand models that were used to assess the supply and demand for parking at public highway rest areas nationwide and to identify the characteristics that influence demand.

B.1 Survey Design and Methodology

It was determined that the survey would be administered by mail for two important reasons. First, responding to the questions might be easier for respondents if they were given some extra time to think about their answers, particularly some of the more detailed and quantitative questions concerning truck parking usage. Second, the mail survey method would likely be more cost-effective than other methods for sampling and interviewing because lists of truck stops were readily available.

A suitable mail questionnaire was then developed in consultation with TRI, FHWA and the NATSO, Inc. The survey was designed to collect information on:

- The location of the truck stop, by city, state, Interstate highway and exit number;
- The perceived ease of using the facility;
- The distance of the facility from:
  - -- the Interstate highway ramp, and
  - -- the nearest public highway rest area (in each direction).
- The number of parking spaces available for trucks, and for automobiles;
- The types of parking and services offered;
- The extent to which the parking facility is "uncrowded, full or overflowing" both at night and during the day;
- The average number of trucks parked at the facility at night (and during the day);
- The number of nights (and days) each month the facility is filled to capacity;
- Whether they have plans to increase parking capacity over the next 3 years;
- The number of spaces they plan to add; and
- Whether there is undeveloped land adjacent to their facility that could be used for that purpose.

The survey was then formatted on a single, two-sided 8.5 x 14 inch sheet of paper to minimize respondent burden. A copy of the mail questionnaire is appended.

B.2 Sample Design and Administration

The sample for this survey was based on membership lists provided by the NATSO, Inc. While the NATSO membership list was not a universal or exhaustive list from which to develop a survey sample, it was extensive and represented a diverse range of truck stop operators nationwide for whom names and addresses were readily available -- a necessity for mail surveys. For these reasons, the list was determined to be adequate for the purposes of this study.

The NATSO membership list was organized by persons, and not by companies or facilities. As a result, there was the potential for duplication in those cases in which more than one individual working at a truck stop was listed as a NATSO member. A total of 1,146 separate mail questionnaires were sent to a total of 987 different truck stops nationwide. Because the unit of analysis in this study was the truck stop or facility and not the person, only one completed questionnaire was accepted for each facility. Nevertheless, each member was sent a survey in order to help increase the probability that someone at the facility would complete the survey and return it.

The survey of truck stop operators was implemented between July, 1995 and August, 1995. Each questionnaire was accompanied by a cover letter on NATSO letterhead from the President of the organization discussing the importance of the project and encouraging their members to participate. Members were also assured that the necessary steps would be taken to maintain confidentiality of their responses. Completed survey questionnaires were returned to Apogee, where they were entered into a computer database and compiled for analysis.

As of September 14, 1995, questionnaires had been completed and received from persons representing a total of 381 different truck stops from the sample of 987 facilities nationwide, for a response rate of 39 percent. This was determined to be a good response rate, particularly because the budget did not allow for follow-up mailings or participant incentives.

C. Survey Response and Sample Quality

C.1 Response Rates

The response rate of a survey is an important concern for three reasons. First, higher response rates mean lower data collection costs -- more data can be collected with the same amount of resources and effort. Mailing a survey to 1,000 or so potential respondents requires the same cost and effort whether 100 people or 400 people answer back. A low response rate can mean having less data to analyze, or require spending more time, money and effort to persuade more people to respond through additional mailings and incentives.

Second, higher response rates mean larger samples of completed questionnaires, and potentially more accurate results. If the sample is truly random, it will be representative of the total population on all characteristics. And the accuracy of a random sample increases with sample size -- although there is a point of diminishing returns where additional interviews yield such marginal increases in accuracy that the extra cost cannot be justified.

All of this assumes that the sample is truly random, and this raises the third and perhaps most important concern. To maintain the integrity of a random sample, it is essential that each member of the population have an equal (or known) chance of being included in the sample. In a mail or telephone survey, this requires not only that potential respondents be selected at random -- but that there is also no systematic bias affecting who responds and who doesn't. A high response rate is the best assurance against this potential self-selection bias. A low response rate means a larger proportion of people have decided not to participate and this increases the chance that there is some systematic difference between those who answered and those who did not, and that this difference could affect the outcome of the survey and the interpretation of the results.

Finally, there is no reason that the standards for evaluating survey response and the quality of sampling should vary from one method of data collection to another. Declining response rates are a growing concern, particularly for telephone surveys today. Response rates for professional telephone surveys generally range from 60 to 80 percent. Historically, the survey industry has found that response rates to mail surveys have been lower than telephone surveys, except in cases in which exceptional efforts have been taken to follow-up with non-respondents. The cost of such extra efforts often cannot be justified, particularly when other more cost-effective methods of data collection might be available. The response rates to mail surveys often range from 10 percent to 50 percent, depending on the target group, the topic and the level of effort. Of course, higher response rates have been reported for mail (and telephone) surveys, but these appear to be exceptions.

In this case, a single mailing was sent to 1,146 members of NATSO working at 987 different truck stops nationwide. After duplicate entries were eliminated, a total of 381 questionnaires had been returned and tabulated, yielding a response rate of 39 percent. The next step was to assess the quality or representativeness of the sample and ensure that the results from this survey could be projected accurately to the entire population of truck stop operators nationwide.

C.2 Procedures for Assessing Sample Quality

As noted earlier, lower response rates create the potential for self-selection bias in the sample that could affect the interpretation of the survey results. For that reason, considerable efforts were taken to compare the characteristics of the resulting sample with known population parameters and thereby assess the quality and representativeness of the sample.

First, it is important to note that the 381 facilities in the sample were taken from a list of 987 facilities representing only those truck stops nationwide that are operated by NATSO members. Of course, not all truck stop operators are members of NATSO, although they may provide parking for long-haul truck drivers along the Interstate. There is reason to believe NATSO membership may be more prevalent among larger truck stop operators and that many operators of smaller facilities may not be members. However, complete and accurate mailing lists of NATSO members were readily available, and similar lists for non-members and other smaller operators were not. For example, although the "***The Trucker's Friend***" provides information on both NATSO members and non-members, it does not provide the telephone number or complete address for truck stops listed in the publication. Although the NATSO membership list was not a universal or exhaustive list of their entire target population for the survey, it was extensive and represented a diverse range of truck stop operators nationwide. For this reason, it was selected as the source for generating the survey sample.

"*The Trucker's Friend*" did, however, provide sufficient information on truck stops nationwide to make it a useful source for evaluating the quality and representativeness of the resulting sample. The publication appears to be the most comprehensive listing of truck stops nationwide that is available today. For each truck stop listed in the publication, information is provided about its location and the types of services offered. It also indicates:

- Whether or not the facility is ***located on the Interstate*** highway system; and
- Whether or not ***truck parking is provided***;
- Whether the size of the truck parking lot is "***small***" (1-24 parking spaces); "***medium***" (25-79 parking spaces), or "***large***" (80 or more parking spaces).

As noted before, however, the publication did not provide information on the exact number of parking spaces or capacity at each facility (only the rough size category), or information on the actual usage of those parking spaces. A review of these listings in the publication determined that it included a total of 4,265 different facilities, of which 1,598 were not located on the Interstate highway system and were therefore not relevant for the purposes of this study.

Of the remaining 2,667 facilities located on the Interstate, 391 indicated that they did not provide truck parking and were therefore not relevant to this study. ***This process provided the basis for estimating the number of facilities nationwide that offer truck parking along the Interstate highway system -- 2,276.***

C.3 Population Parameters

For the purpose of assessing sample quality, each of these 2,276 facilities in the total target population were classified into one of five regions and one of the three size categories. The results of this classification are presented below and provided the basis for assessing the representativeness of the sample. These numbers were taken to represent the best available information on the parameters or characteristics of the target population against which the survey sample could be compared.

The 2,276 truck stops that provide truck parking along the Interstate highway system were classified into the following five regions:

- **Northeast (10 percent)**: Connecticut, Delaware, Massachusetts, Maryland, Maine, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont;
- **South (31 percent)**: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, West Virginia;
- **Great Lakes (19 percent)**: Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin;
- **Central (22 percent)**: Iowa, Kansas, Missouri, North Dakota, Nebraska, Oklahoma, South Dakota, Texas;
- **West (18 percent)**: Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington, Wyoming.

Listings for truck stops in Hawaii and Alaska were not included. The 2,276 truck stop facilities were also classified into one of three size categories used by "*The Trucker's Friend*":

- **Small (26 percent)**: offering parking for fewer than 25 trucks;
- **Medium (38 percent)**: offering parking for 25-79 trucks; and
- **Large (35 percent)**: offering parking for 80 or more trucks.

Twenty-one of the 2,276 facilities (less than 1 percent) could not be classified due to missing data.

C.4 Sample Quality and Representativeness

The survey sample included a broad cross section of truck stop facilities from across the nation, including truck stops from 44 of the 48 contiguous states. Not included in the final sample were the two unlisted states (Alaska and Hawaii) and four others -- New Hampshire, Vermont, Rhode Island, and Delaware. It may be worth noting that no questionnaires were mailed to Alaska, Hawaii or Delaware because these three states have no NATSO members. The remaining three states include a total of 12 truck stops with parking along the Interstate out of the total target population of 2,276 facilities.

Comparing the Sample vs. the Population

Table 1 presents the known distribution of truck stop facilities in the total target population across the five regions and compares these percentages with those obtained from the survey sample. There appeared to be some minor differences between the sample distribution and the distribution of qualified truck stops listed in "The Trucker's Friend." For example, 16 percent of the responses in the sample came from truck stop operators in the Northeast, but that region represents only 10 percent of the truck stops in the target population. Thus, it appeared that the sample "over-represented" the Northeast. Similarly, the sample appeared to "under-represent truck stops in the Southern region because 24 percent of the responses in the survey sample were from operators in that region and the South appears to represent nearly 31 percent of all facilities in the target population, as defined by the scope of this study.

These minor discrepancies indicate differences in either: (a) the response rates by region (i.e. less cooperation and participation in the South relative to the Northeast, for example), or (b) the composition of the NATSO membership by region (i.e. greater membership in the Northeast than in the South). In either case, these differences were minor and could be corrected through the use of statistical weighting procedures. These are described later in this section.

Table 1
A Comparison of Population Parameters and Sample Characteristics
Before and After Statistical Weighting of the Survey Sample

	Estimated Population Parameter*		Sample Percentage Before Weighting		Sample Percentage After Weighting	
BY REGION	**(N)**	**%**	**(N)**	**%**	**(N)**	**%**
Northeast	(229)	10%	(59)	16%	(39)	10%
South	(706)	31%	(91)	24%	(114)	30%
Great Lakes	(412)	18%	(87)	23%	(75)	20%
Central	(491)	22%	(87)	23%	(83)	22%
West	(417)	18%	(57)	15%	(70)	18%
(Not Classified)	(21)	1%	(0)	0%	(0)	0%
TOTAL	(2,276)	100%	(381)	100%	(381)	100%
BY SIZE	**(N)**	**%**	**(N)**	**%**	**(N)**	**%**
Small	(601)	26%	(19)	5%	(96)	26%
Medium	(854)	38%	(97)	26%	(144)	38%
Large	(800)	35%	(255)	67%	(132)	35%
(Not Classified)	(21)	1%	(10)	3%	(9)	2%
TOTAL	(2,276)	100%	(381)	100%	(381)	100%

* Based on data from "*The Truckers Friend*."
** Percentages may not total 100 percent due to rounding.

Of greater potential concern is the discrepancy between the sample and population distributions for size categories. Table 1 shows that only 5 percent of the sample was classified as "small" truck stops although they appear to comprise 26 percent of the facilities in the target population. The sample also appears to "under-represent" medium-sized facilities somewhat (26 percent in the sample and 38 percent of the total target population). Conversely, large truck stop facilities are represented in the survey sample in much greater proportion (67 percent) than they are believed to exist in the target population (35 percent) of all 2,276 truck stops that provide truck parking along the Interstate highway system.

Again, this discrepancy between the sample percentages and the estimated population parameters could be the result of either a tendency for operators of larger truck stops to:

- Be included in the original sample list of NATSO members in greater numbers than in the total population relative to smaller truck stops; and/or

- Respond disproportionately more often than operators of smaller truck stops.

Both of these explanations are plausible, although there is reason to believe, as noted earlier, that NATSO membership is more prevalent among larger truck stop operators and that many operators of smaller facilities may not be members and thus were not included in the original mailing. ***In either case, the survey results were statistically weighted using standard industry techniques to ensure the sample reflected the proper proportion of truck stop facilities based on both size and region.***

C.5 Statistical Weighting

Statistical "weighting" procedures were used in an effort to correct for any bias that might be introduced into the survey results due to the "oversampling" of large facilities and the observed differences between the initial sample percentages and the known parameters of the target population. These population parameters were derived from "The Trucker's Friend" and included both geographic distribution of facilities by region and the distribution of facilities by size categories.

Standard industry procedures were used to assign a special "weight" to the results for each respondent in the survey sample, depending on their region and size, to ensure that respondents in their group are represented adequately in the population. This required the development of 15 different weights -- one unique weight for each of the 15 different possible combinations of the three sizes of facilities across five regions. For example, one weight was generated to ensure that small truck stops in the South were included proportionally to their occurrence in the total target population, and a separate weight was developed for medium-sized facilities in the Great Lakes region.

This procedure had the effect of correcting the regional distribution of the sample results while also increasing the weight given to smaller truck stops that appeared to be underrepresented in the original sample list of NATSO members and/or among those who actually responded to the survey, and decreasing the relative weight given to large truck stops that appeared to be overrepresented in the initial, unweighted sample.

These procedures help ensure that the results from this survey can be projected accurately to the entire population of truck stop operators nationwide.

The results of the statistical weighting can be seen in Table 1. A comparison of the "population parameters" in the first column and the "sample percentages after weighting" in the third column show little, if any, difference. Except where otherwise noted, ***the percentages presented in this report are based on the weighted survey sample results and have already corrected any bias due to the underrepresentation of truck stops based on small size or region.***

C.6 NATSO Cover Letter, Questionnaire, Truck Stop Respondents

(See following pages)

Dear NATSO Member:

We have provided information to NATSO members regularly regarding the ATA Foundation's study of truck parking facilities for the Federal Highway Administration. As part of that study1 the ATA Foundation has asked to survey NATSO members to determine the degree of utilization of your parking facilities. I urge you to complete the enclosed survey and return it in the enclosed envelope to Apogee Research, Inc. The survey should only take a few minutes to complete.

Apogee Research will tabulate the results and include them in their report to the Federal Highway Administration. The individual responses will remain strictly confidential and a copy of the results will be made available to NATSO.

If you have any question about this project please call Scot Imus or me here at NATSO or you may wish to speak to Mr. Ward Kay of Apogee Research at (301) 652-8444.

Your cooperation in this request is greatly appreciated.

Sincerely,

Original signed by

W. Dewey Clower
President

NATSO. Inc. c 1199 North Fairfax Street Suite 801
PO Box 1285 c Alexandria, VA 22313-1285 c(703)549-2100 c FAX (703) 684-4525

Truck Parking Inventory

Please complete the survey as instructed below by placing a check mark or circling the number next to your answer for each question. Your answers will remain anonyimous and confidential. The results will be reported in aggregated form only. If you have any questions about the survey, please call Mr. Ward Key of Apogee Research at (301) 662-

Location

Truck Stop Name: _____

City _____ **State** _____

Interstate Route _____ **Exit No.** _____

If near intersection of two interstate -- Second Interstate Route _____

Distance of facility from ramp in miles (ex. I mi. or 0.2 mi.) _____

ml.

Please estimate the miles to nearest public highway rest areas in both (or all) directions from your facility

1. Northbound: Prior to your exit: _____ **After your exit:** _____

2. Southbound: Prior to your exit: _____ **After your exit:** _____

3. Eastbound: Prior to your exit: _____ **After your exit:** _____

4 Westbound Prior to your exit: _____ **After your exit:** _____

5. How easy or hard is it for trucks to enter and exit your facllity from the Interstate? Consider how many turns are necessary, the degree of difficulty of turns for trucks, the windingness of the road and the amount of car traffic Is It:

very easy	Somewhat easy	Somewhat difficult	Very difficult
I	2	3	4

Parking

6. How many parking spaces do you have for automobile? _____

7. How many parking spaces do you have for trucks? _____

8. Is the truck parking:

____ **Paved**

_____ **Spaces marked**

_____ **Lighted at night**

_____ **Secured at night**

____ **Free**

_____ **Able to accommodate:**

_____ **Triples**

_____ **Oversized**

_____ **Hazmat**

9. What type of parking spaces do you have at your facility. If more than one kind, please Indicate the approximate number of places for each type of parking listed below:

_____ Parallel
_____ Straight parking
_____ Diagonal pull through
_____ Diagonal, not pull though
_____ Not specified -- trucks park as can
_____ Other type of parking spaces (specify) _____

Parking Utilization

10. During the night, would describe your parking facility as:

Uncrowded	Full	Overflowing
1	2	3

11. What is the average number of trucks in your facility at night? _____

12. How many nights a month does your facility fill to capacity? _____

13. During the day, would describe your parking facility as:

Uncrowded	Full	Overflowing
1	2	3

14. What is the average number of trucks in your facility during the day? _____

15. How many days a month does your facility fill to capacity? _____

16. Is there any undeveloped land adjacent to your facility that could be used to expand the parking capacity at your facility?

1 Yes 2 No

Services

17 what services are provided on your premises? (CHECK ALL THAT APPLY)

_____ Arcade games
_____ Buses welcome
_____ Check cashing
_____ Emergency road service
_____ Hotel/motel
_____ Information kiosk
_____ Laundry
_____ Loadlboard
_____ Open 24 hours
_____ Public Fax
_____ Public Telephones
_____ Restaurant/Deli
_____ Retail/Convenience store
_____ RV facilities
_____ Scales
_____ Security patrol
_____ Showers
_____ Telecommunications services
_____ Truck repair
_____ Truck wash
_____ TV room

Truck Stops Returning Surveys

#116 Burwell Fuel Stop
11-87 Truck Plaza Inc.
115 Truck Stop
222 Travel Plaza
231 Ambest Plaza
35/55 Truck Plaza
Akron All American 76 Plaza
Akron/Canton Truck Plaza
Alawk I T/S
All American Plaza
Alpine Auto Truck Plaza
Anglers Auto/Truck Plaza
B&D Auto / Truck Plaza
Baggett's Gallup 76
Baggett's Music City A/TS
Bair's Truck Stop
Bairs Truck Stop
Baker Truck Corral
Baldwins Auto Truck Plaza
Bandit Truck Stop #1
Bar-B AMBEST Travel Plaza
Bar-B Travel Plaza
Barney's Auto Truck Plaza
Bartones State Line
Bearcreek Crossing
Bells Silvercreek Junction
Beto Junction Travel Plaza
Big Chief ATS
Big Steer Truckstop
Big Vic Truckstop
Bloomington Auto Truck Plaza
Bluegrass A/TP
Blytheville Truck Plaza
Bob's Truck Stop Inn
Bobber Auto Truck Plaza
Bobber Auto Truck Plaza
Bobber Auto/Truck Plaza
Bosselman Travel Center
Brazil 70 Truck Plaza
Broadway Flying I.
Broadway Flying J
Bruces Truck Plaza
Burns Bros. Travel Stop #11
Burns Brothers Travel Plaza
Busler Truck and Car Plaza
Buzz's Auto Truck Plaza
Calumet Auto/Truck Plaza
Carlisle Texaco Travel Plaza
Charlestown West 76 Auto/Truckstop
Cherokee Texaco Inc.
Chevron Truck Stop
Choo Choo Truck Wash Plaza
Circle Bar 76
Circle C
Cisco Travel Plaza Inc.
Citgo Corner Fuel Center
Citgo Superstop #3
Cloverdale Travel Plaza, Inc.
Coffee Cup Fuel Stop
Colt Service Center
Columbia 20 Auto/Truckstop
Columbus 70 West
Commercial Truck Terminal
Country Express Auto/Truck Stop
Country Style Plaza
Crossroads 66
Crossroads Truck Center
Dade Corners
Daleville Travel Plaza
Davenport Travel Plaza
Davis Bros. Travel Plaza
Davy Crockett Auto/Travel Center
Day Break
Dayton South Travel Center
Dayton Truck Stop
Deano's Truck Stop
Delta Fuel Stop
Detco Travel Center
Detroiter Truckstop
Diamond J's Truck & Auto Stop Inc.
Diamonds Truck Stop
Dixie Boy Travel Center #7
Doc's One Stop
Donna's Travel Plazas Inc.
Doswell All American Travel Plaza
Double Mickle Fuel Center
Driver's Travelmart #411
Drivers Travelmart
Drivers Travelmart #408
Ed's Truck Stop Inc.
Edinburg A/TS
Effingham Truck Plaza
El Cheapo's #50
El Paso Travel Center
Elgin West Truckstop
Elk Run Truck Plaza

Truck Stops Returning Surveys

Emlenton Truck Plaza
Exit 35 Truckstop
Exit 45 Auto/Truck Plaza
Flying J
Frank's Trucking Center
Frederick I70 Truck City
Freedom Junction Auto Truck Plaza
Frystown All American
Fuel CITY #56
Fuel City 68
Gables of Frystown (All American Plaza)
Gallahan Travel Plaza
Gate Travel Store 1142
Gateway Midstate Truck Plaza
Gateway Midstate Truck Plaza, Inc
Gateway Travel Plaza DBA Truckstops of America
Gearjammer Truck Plaza
Giant Travel Center
Git-n-go 43
Golden Rule Travel Plaza
Goldmine Truck Plaza
Grandma's Kitchen/Pumper Truck Stop
Green Shingle Service
Gromann's I39 Auto/Truck Plaza
Hampshire Fuel Stop Inc.
Highlands Mobil Travel Plaza
Hitchin Post
Holts Texaco Truckstop
Hood Service Center Inc.
Horns 76 Auto/Truck Plaza
Horse Heaven Hills Travel Plaza
How-Dea Service Center Inc.
Howes 84 A/T Plaza
Huck's Travel Center
Hy Mark Inc.
I-35 Truckstop
l-84 Lakewood Truckstop
I55 Motor Plaza
Indianapolis West 70 Truck Plaza
Inland Travel Center
Interstate Motor Plaza
Iowa 80 T/A
Jack's Truck Stop
Jacksonville South Travel Center. Inc
Jersey Truck Center, Inc.
Jiffy Truck/Auto Plaza #8
Jim’s Auto Truck Stop Inc.
JJ's Truck Stop Inc.
Johnny's Truck Stop
Joker Joe's/El Cheapo #44
Joliet I55 AW
Joplin Petro
K&H Truck Plaza
Kearney Truck Plaza
Keysers Ridge Truck Stop, Inc.
Keystone Shortway 76 Inc.
Kings Mountain Truck Plaza
Knox
Knoxville Travel Center
Kwik Fill Auto/Truck Plaza
Kwik Trip 796
LA I20 East Travel Center
Lake Oasis Truck Stop
Lakewood Travel Center
Lee Hi
Little America
Longhorn Truck and Car Plaza, Inc.
Lounsberry
Love's
Love's Country Stores #205
Love's Travel Stop
Love's Travel Stop #211
Loves #213
Loves Country Store
Loves Country Store
Loves Country Store #201
Loves Country Store #202
M&M Truckstop
Madison 20 Truck Plaza
Madisonville Auto Truck Stop
Magic Wand
Mapco Express
Mapco Express (3238)
Mardi Gras Truck Stop
Marianna 76 Truck/Auto Stop
Maryland's Liberty Bell ATP
Mid Cal Auto/Truck Plaza, Inc.
MID Kansas Travel Center
Mid-Tenn Auto Truck Plaza
Midway Truck Stop
Milton All American Travel Plaza
Mitten Truck Stop
Moasis Truck and Auto Center
Mobile 76 Auto Truck Plaza
Montgomery 76 Auto/Truck Plaza Inc.
Mr. Fuel
Mr. Fuel #2

Truck Stop Returning Surveys

Muralt's Truck Plaza
N. Lewiston Dynamart
Nashville East 40
Nashville South 76 Auto Truck Plaza
Newell Truck Plaza
Nichols Travel Plaza
Oasis
Ogallala 76 Auto/Truck Plaza
Ontario Auto/Truck Plaza
Outpost Station
Panhandle 76
Park City Truck Stop
Patty's Truck Stop
Pendleton 76
Penn-Can Restaurant/Truckstop
Petro
Petro
Petro
Petro #58
Petro 60
Petro Inc.
Petro of Richmond Inc.
Petro Stopping Center
Petro Stopping Center #13
Petro Stopping Center #18
Petro Stopping Center #4
Petro Stopping Center #51
Petro Stopping Center L.P. #10
Petro: 2
Pilat Travel Center
Pilot
Pilot #273
Pilot #280
Pilot #283
Pilot 268
pilot 365
Pilot Corp. #258
Pilot Oil #265
Pilot Oil #354
Pilot Oil Corp. #245
Pilot Oil Corp. 253
Pilot Travel Center
Pilot Travel Center
Pine Grove All American
Pioneer Fuel Town
Pioneer Plaza Truck stop
Pioneer Travel Center
Planeview Travel Plaza
Po-Jo's Gas N Go
Pride Travel Center
Qulk Trip
Red Barrel Food Stores Inc.
Rhodes Travel Center
Rib Mountain Travel Center
Rice Hill Truck Plaza
Rip Griffin Truck Travel Center
Rip Griffin's Truck/Travel Center
Rip Griffin's Truck/Travel Center
Riverside Travel Plaza
Rochelle Travel Plaza/Petro
Romines Standard Plaza
Rosselman Plaza
Sac Forty Niner Truck Stop
Sadler Travel Plaza
Salt Lake Auto Truck Plaza
San Paso Truck and Auto
Sapp Bros.
Sapp Bros.
Sapp Bros.
Sapp Bros. Omaha
Sav-a-Trip, Phillips 66
Savannah Travel Center
Schatz Crossroads Truck Stop
Scott 80 Truck and car Plaza (Texaco)
Seattle East Auto Truck Plaza
Secondi Bros. Truck Stop
Senate Crossroads Econostop
Servicetown
Shoemaker's Truck Station, Inc.
Sierra 76 Inc.
Simmons Auto Truck Terminal
Skyliner Truck Plaza
Skyway Truck Stop
SOS Truck Stop
Speed and Briscoe
Spring Creek Ravel Plaza
Steele City Truck Stop
Stimker Truck Stop #74
Stony Ridge T/P
Stony Ridge Travel Center
Sturbridge Isle Truck Stop
Sugar Creek Travel Plaza #90
Sweetwater 76 ATS
TA Baltimore South
TA Janesville
Texaco
Texaco Travel Center
The Tennesean Truck Stop

Truck Stops Returning Surveys

Tifton Travel Center
Tiger Discount Truck Stop
Tomahawk Auto/Truck Plaza
Tomahawk Truck Stoo
Topeka Travel Plaza
Total 1899
Trails Truck's Travel Plaza
Travel Port
Travel Port 76 #131
Travel Port of America
Travel Ports of America
Travel Ports of America, Inc.
Traveler's Oasis
Travelports of America
Travelports of America
Trexler Plaza Inc.
Truck 'n' Travel (TA Eugene)
Truck and Travel
Truck and Travel - Van Horn
Truck Haven, Inc.
Truck World
Truckers Inn
Truckomat
Truckomat
Truckomat of Council Bluffs
Trucks International
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America
Truckstops of America - Kenly
Truckstops of America, Inc.
Tucson Truck Terminal, Inc.
Twin City West
United Truck Stop
Vija Truck Stop
Voss Truck Port
Waddy Travel Center
Wakeeney Travel Plaza
Walt Whitman Truck Stop, Inc.
Warfleld Truck Terminal
Wes-T-Go Truck Stop
West Winds
Whites Truckstop
Wilderness Road Truckstop
Wildwood Travel Center
Wilhite's Travel Center
Wilton Servicenter
Windmill Truck Stop
Windsor Marathon Truck Stop
Windy City So. Auto/Truck Plaza
Wolffs Travel Stop
Wolverine Truck Plaza.
Woodhall Plaza
Youngstown 76

A Comparison of Weighted and Unweighted Responses on Key Survey Questions

	Unweighted Sample	Weighted Sample	Population Projection*
Number of Facilities	381	381	2,276
Average Capacity -- Number of Truck Parking Spaces	128	82	82
Total Estimated Capacity	47,611 spaces	30,520 spaces	185,000 spaces
Perceptions of Parking At Night:			
"Uncrowded"	17%	15%	15%
"Full"	62%	62%	62%
"Overflowing"	20%	22%	22%
Average Number of Nights Per Month "Filled to Capacity"	15 nights	16 nights	16 nights
Average Number of Trucks Parked at Night	114 trucks	78 trucks	78 trucks
Total Estimated Number of Trucks Parked at Night	41,805 trucks	28,049 trucks	167,453 trucks
Percent Planning to Expand Truck Parking	31%	32%	32%
Average Number of Spaces to be Added	61 new spaces	53 new spaces	53 new spaces
Total Estimated Number of New Spaces to be Added	6,218 spaces	4,722 spaces	28,190 spaces

* Projections are based on sample survey data that were statistically weighted to reflect the distribution by region and facility size category of privately-owned truck stops nationwide providing truck parking along the Interstate highway system, according to "*The Truckers Friend*."

I. TRUCK STOP SURVEY RESULTS

A. Parking Characteristics and Services

Truck stop operators in the survey provided detailed information about their location, facilities and the types of services they offer. These questions included their location on the Interstate system, the distance from the ramp and the distance to the nearest public highway rest area on both east-west and north-south routes.

A.1 Distance from the Interstate

Most of the truck stops were located close to the Interstate ramp. The average reported distance from the Interstate ramp was 0.24 miles. The median distance was of .01 miles, meaning that half of the respondents were located less than one-tenth of a mile from the Interstate ramp. These distances can be broken down as follows:

- 0.1 miles or less (50 percent);
- Between 0.1 and 0.4 miles (28 percent);
- Between 0.5 and 1.0 miles (10 percent);
- Between 1 and 2 miles (<1 percent);
- Between 2 and 8 miles (1 percent).

About 10 percent did not answer. There were no significant differences based on size or region.

A.2 Perceived Ease of Use

Truck stop operators were also asked to indicate how easy or difficult it is for trucks to enter and exit their facility from the Interstate, taking into consideration the amount of car traffic, the number of curves and difficulty of turns. Most truck stop operators perceived this was not a problem:

- 71 percent said it is "very easy;"
- 21 percent said it is "somewhat easy;"
- Only 7 percent said it was "somewhat difficult;"
- Less than 1 percent said it "very difficult."

Only 2 of the 381 truck stops in the sample did not answer (less than 1 percent).
Table 2 below shows that operators of small truck stops are less likely than other operators to perceive that their facilities are "very easy" to use.

Table 2
Perceived Ease of Use by Size of Truck Stop

		Size of Truck Stop		
(Weighted Base)	**All Respondents (381)**	**Small (96)**	**Medium (144)**	**Large (132)**
Very Easy	71%	52%	82%	74%
Somewhat Easy	21%	30%	16%	20%
Somewhat Difficult	7%	17%	2%	5%
Very Difficult	--	1%	--	1%

Table 3 shows that truck stop operators in the Great Lakes region are also less likely than other operators to perceive that their facilities are "very easy" to use.

Table 3
Perceived Ease of Use by Region

	Region				
(Weighted Base)	**Northeast (39)**	**South (114)**	**Great Lakes (75)**	**Central (83)**	**West (70)**
Very Easy	77%	74%	54%	71%	84%
Somewhat Easy	22%	17%	27%	27%	16%
Somewhat Difficult	1%	9%	19%	2%	--
Very Difficult	--	--	--	--	--

A.3 Distance from Public Rest Areas

Truck stop operators also provided information on the distance of their facility from the nearest public highway rest area. These distances ranged from less than one mile (for 16 percent of the facilities) to a high of 204 miles (for one facility). The average distance was 13.7 miles. The median distance was 8.0 miles, meaning that half of the respondents were located within 8 miles of a public highway rest area. These distances can be broken down as follows:

- Less than 1 mile (16 percent);
- 1 to 9 miles (32 percent);
- 10 to 24 miles (22 percent);
- 25 to 50 miles (15 percent);
- More than 50 miles (3 percent)

About 13 percent did not provide an answer to this question. There were only minor variations based on region and no significant differences based on size of the facility. These distances were also recorded and calculated separately for eastbound, westbound, southbound and northbound traffic at each facility. These facilities reported they were located, on average, between 22 and 28 miles of a public highway rest area in any one of these directions.

A.4 Services Provided by Truck Stop Operators

Truck stop operators in the national survey were also asked to indicate the services that they currently offer to truck drivers. These responses are summarized in Table 4 below.

Table 4
Truck Stop Services By Size

		Size of Truck Stop		
(Weighted Base)	**All Respondents (381)**	**Small (96)**	**Medium (144)**	**Large (132)**
Public Telephones	99%	100%	100%	100%
Open 24 hours	99%	100%	100%	100%
Restaurant/Deli	97%	97%	96%	100%
Retail/ Convenience Store	96%	100%	94%	99%
Public Fax	93%	94%	93%	97%
Showers	92%	80%	94%	99%
Buses Welcome	90%	80%	91%	98%
Check Cashing	84%	72%	83%	96%
Scales	68%	44%	64%	93%
Arcade Games	64%	31%	61%	93%
TV Room	58%	10%	56%	95%
Laundry	58%	20%	52%	93%
Loadboard	50%	30%	39%	80%
Truck Repair	49%	11%	43%	84%
Telecommunications Services	48%	28%	43%	72%
Emergency Road Service	47%	6%	43%	82%
Hotel/Motel	32%	14%	33%	45%
Truck Wash	30%	16%	25%	47%
RV Facilities	21%	8%	22%	30%
Security Patrol	17%	0%	11%	36%
Information Kiosk	17%	10%	15%	26%

B. Current Parking Capacity

Truck stop operators in the survey also provided detailed information on the types of parking and the number of spaces at their facilities.

B.1 Number of Truck Parking Spaces

The size of the truck parking facilities varied significantly across the sample, from one facility that reported providing 4 parking spaces to another that provides 600 spaces for trucks. ***Altogether, the 371 truck stop operators who answered this question in the initial unweighted sample reported that they provide a total of 47,611 truck parking spaces at their 371 facilities.*** Ten truck stop operators (3 percent of the sample) did not answer this question.

The average number of truck parking spaces per facility in the initial unweighted sample was 128 spaces. The median number of parking spaces was 102, meaning that half of the facilities provided 102 parking spaces or more. There were no significant differences in the size of facility across the five regions.

Separate averages were also calculated, however, for each of the three size categories based on the survey results. The average number of existing parking spaces for truck stops in each of the three size categories was:

- ***Small*** -- **16.4** spaces;
- ***Medium*** -- **49.0** spaces; and
- ***Large*** -- **166.2** spaces.

B.2 Projections to the Total Target Population

This information was then used to generate more precise and reliable quantitative estimates of the total number of truck parking spaces provided by all 2,276 facilities in the target population. This was necessary because, as noted before, "*The Trucker's Friend*" only indicates the general size category for each truck stop and does not provide information on the exact number of existing parking spaces. The averages calculated for each size category on the previous page were then multiplied by the number of truck stops in each category, using the total target population figures from "*The Trucker's Friend*." These procedures have the same effect as making projections from the weighted survey data to the total target population.

The resulting estimates are:

- 9,856 spaces provided by 601 "small" facilities;
- 41,846 spaces provided by 854 "medium" facilities; and
- 132,960 spaces provided by 800 "large" facilities;

- **For a grand total of approximately 185,000 spaces provided by 2,276 truck stops along the Interstate nationwide.**

This would suggest that the information that this survey collected on 381 facilities and a total of 47,611 parking spaces, represents roughly 17 percent of all the facilities and 26 percent of all the parking spaces at privately-owned truck stops along the Interstate highway system.

It is worth noting that although there is little difference between the weighted and unweighted averages for each of the size categories (due to small, non-significant differences between the regions), the overall average and median for the entire weighted sample are much lower -- 82 and 50 parking spaces, respectively. This is a reflection of the increased weight or emphasis given in the weighted sample to the smaller truck stops that were under-represented in the initial sample of NATSO members, and the decreased weight given to the larger truck stops that were over-represented initially.

When the sample is weighted to reflect the proper proportion of small, medium and large truck stops in the total target population, the estimated number of spaces provided by any random sample of 381 facilities is also lower -- 30,520. ***But projections from the weighted sample to the target population yield the same results as indicated above -- roughly 185,000 parking spaces provided by all 2,276 facilities.***

B.3 Types of Truck Parking

Truck stop operators were also asked to describe the types of parking they provided:

- 94 percent said that truck parking is ***free of charge*** at their facility;
- 92 percent said their truck parking was ***lighted*** at night;
- 86 percent said they provided ***paved*** parking for trucks;
- 55 percent said their truck parking spaces were ***marked***;
- 18 percent said their truck parking was ***secured at night***;

In addition, 73 percent said they are able to accommodate at least one of several non-standard types of trucks:

- Oversized trucks (71 percent);
- Triples (51 percent); and
- Hazmat trucks (30 percent).

The percentages reported here are based on the weighted survey results. This corrects for the over-sampling of large truck stops and the under-sampling of smaller facilities in the initial sample. In this way, statistical weighting ensures that the sample reflects the proper proportion of truck stop facilities based on size and region.

The differences among the three size categories can be seen below in Table 5.

Table 5
Types of Truck Parking Services by Size

		Size of Truck Stop		
(Weighted Base)	**All Respondents (381)**	**Small (96)**	**Medium (144)**	**Large (132)**
Free Truck Parking	94%	94%	96%	93%
Lighted Parking	92%	91%	77%	95%
Paved Parking	86%	91%	77%	95%
Marked Parking	55%	68%	35%	70%
Secured at Night	18%	3%	17%	32%
Accommodate Non-Standard Trucks	73%	35%	82%	90%
• Oversized Trucks	71%	32%	80%	88%
• Triples	51%	23%	53%	67%
• Hazmat Trucks	30%	0%	37%	43%

B.4 Types of Parking Spaces

Truck stop operators were also asked to indicate ***what types of parking spaces*** they provided for trucks -- and the number of spaces devoted to each type of parking. This information is summarized in Table 6 on the next page.

Table 6
Types of Parking Spaces Provided by Truck Stops

		Percent of All Respondents Who Answer: (Weighted Base: 381)	
Type of Parking Space	**Total Number of Spaces and Respondents***	**"YES"**	**"NO"**
Parallel Parking Spaces	28 provide 1,929 spaces	21%	79%
Straight Parking Spaces	105 provide 7,793 spaces	57%	44%
Diagonal Pull-Through	65 provide 3,721 spaces	38%	62%
Diagonal (Not Pull-Through)	42 provide 1,868 spaces	21%	79%
Not Specified -- Park as Available	56 provide 3,449 spaces	28%	72%
"Other" Types of Parking Spaces	8 provide 288 spaces	6%	94%
Total Spaces Accounted For	19,048 spaces in the weighted sample (out of a total weighted sample capacity of 30,520 spaces, or 62 percent) **A projected 113,717 spaces of the total projected capacity of 185,000 spaces (62 percent)**		

* Many respondents simply indicated the type of space provided and not the number of spaces provided in each category.

B.5 Automobile Parking

Truck stop operators were also asked how many spaces were available for automobile parking. The 362 facilities answering this question in the unweighted sample provided a total of 22,129 parking spaces for cars. In other words, about one-third of their parking spaces are reserved for automobiles and two-thirds for trucks. This, of course, does not take into account the differences in the size of the spaces for the two types of vehicles.

The responses ranged from 4 parking spaces to 225 parking spaces. The unweighted average (mean) number of auto parking spaces for these facilities was 61, although this average is based on the unweighted sample and reflects a disproportionate number of large facilities offering more parking.

When the sample is weighted to reflect the proper proportion of small, medium and large truck stops in the total target population, the average and total estimated number of spaces is reduced. As noted before, the weighted sample provided the most appropriate base for making

projections to the total target population. The weighted average for the number of auto parking spaces for these facilities is approximately 46. ***Altogether, the 2,276 privately-owned truck stops in the target population provide a projected total of 97,000 parking spaces for automobiles.***

C. Parking Utilization

Truck stop operators in the survey were asked a series of questions to measure the actual usage of the parking spaces available at their facilities for truck parking. More specifically, they were asked to indicate:

- Whether their truck parking facility is "uncrowded" "full" or "overflowing" at night (and during the day);
- The number of nights (and days) each month that their truck parking facility is filled to capacity; and
- The average number of trucks parked at their facility at night (and during the day).

Survey item #1 collected information from truck stop operators about the actual usage of truck parking at privately-owned facilities nationwide using the same format that was used earlier to obtain comparable data from state DOT authorities about the usage of truck parking at public rest areas nationwide. Survey item #2 measured how often, if ever, the facilities are filled to capacity during a typical month. And survey item #3 allowed for a direct and more quantitative comparison between self-reported capacity and usage at their facilities.

By asking the question in several different ways from a national sample, it was possible to collect information and perform analyses that take into consideration location, time of day, peak periods and frequency. Again, the results presented below are based on the weighted sample, unless noted otherwise, to ensure that the sample reflects the actual distribution of truck stops geographically and the proper proportion of small, medium and large facilities in the total target population.

C.1 Item #1 -- Perceived Crowding (At Night)

The vast majority of privately-owned truck stop operators nationwide described their truck parking facilities as full or overflowing at night. This was true for both the weighted and the unweighted samples. In the raw, unweighted sample, 82 percent of the respondents reported that their facilities were "full" or "overflowing." And there was little change in these numbers when the survey results were statistically weighted to ensure that they reflected the proper proportion of small, medium and large truck stops in the target sample. The weighted survey results indicated that:

- 62 percent said their facilities were ***"full"*** at night;
- 22 percent said their facilities were ***"overflowing;"*** and
- Only 15 percent said their facilities were "uncrowded."

The remaining 1 percent (4 respondents) did not answer this question.

Table 7 shows that truck stops in each size category were equally likely to report they are full at night, but that the ***small facilities were much more likely*** than larger facilities (providing 25 or more truck parking spaces) ***to report they are overflowing at night***.

Table 9 on the following page shows that ***truck parking is much more likely to be "overflowing" in the Northeast and the Great Lakes*** than in the other regions. This problem appears to be less critical in the Central states.

C.2 Item #2 -- Perceived Crowding (During the Day)

In contrast to the nighttime results, most of the truck stop operators said their truck parking facilities are not crowded during the day. Again this was true for both the weighted and the unweighted survey samples. In the raw unweighted sample, only 18 percent report that their facilities are full or overflowing during the day. When these results were statistically weighted to ensure they reflected the proper proportion of small, medium and large facilities, that percentage increased from 18 percent to 25 percent because small facilities tend to be more crowded and were underrepresented in the original sample of NATSO members. These results are displayed in Table 8 on the following page.

Table 7
Perceived Nighttime Crowding by Size of Truck Stop

		Size of Truck Stop		
(Weighted Base)	**All Respondents (381)**	**Small (96)**	**Medium (144)**	**Large (132)**
Uncrowded	15%	9%	16%	15%
Full	62%	57%	66%	64%
Overflowing	23%	34%	18%	22%

Table 8
Perceived Daytime Crowding by Size of Truck Stop

		Size of Truck Stop		
(Weighted Base)	**All Respondents (381)**	**Small (96)**	**Medium (144)**	**Large (132)**
Uncrowded	74%	50%	79%	85%
Full	23%	38%	21%	15%
Overflowing	3%	12%	0%	0%

Table 9
Perceived Nighttime Crowding by Region

	Region				
(Weighted Base)	**Northeast (39)**	**South (114)**	**Great Lakes (75)**	**Central (83)**	**West (70)**
Uncrowded	15%	10%	6%	33%	14%
Full	48%	67%	61%	59%	68%
Overflowing	38%	23%	33%	9%	18%

The weighted survey results indicate that:

- 73 percent said their facilities were ***"uncrowded"*** during the day;
- 22 percent said their facilities were "full" during the day;
- Only 3 percent said their facilities were "overflowing."

The remaining 2 percent (6 respondents) did not answer this question.

When Table 7 (nighttime crowding) and Table 8 (daytime crowding) are compared on the preceding page, it is clear that truck parking is more crowded at night than during the day for facilities in each of the size categories. Table 8 also shows, however, that 50 percent of all small facilities reported that they are full or overflowing during the day. This suggests that for many small facilities, crowded parking is a problem both at night and during the day.

Table 10 below shows that privately-owned truck stops in the Great Lakes are more likely than other regions to report they are full or overflowing during the day.

Table 10
Perceived Daytime Crowding by Region

	Region				
(Weighted Base)	**Northeast (39)**	**South (114)**	**Great Lakes (75)**	**Central (83)**	**West (70)**
Uncrowded	72%	75%	54%	86%	82%
Full	18%	19%	46%	14%	18%
Overflowing	10%	7%	0%	0%	0%

C.3 Item #3 -- Frequency of Overcrowding (At Night)

The truck stop operators were then asked how many nights each month their facilities were "filled to capacity." The results from the weighted survey sample indicate:

- 9 percent said "never" or "zero" nights per month;
- 20 percent said they are filled between 1 and 9 nights per month;
- 12 percent said they are filled between 10 and 19 nights per month; and
- 54 percent said they are filled ***20 nights per month or more***.

About 5 percent (17 respondents) did not answer this question. The truck stop operators indicated that their facilities are full 16 nights per month, on average.

Table 11 on the next page shows that overcrowding is a somewhat more frequent problem at small facilities than among medium and large facilities (providing 25 or more parking spaces). Although these differences were statistically significant, they were not large enough to affect the overall average when the survey results were statistically weighted -- increasing the average from 15 nights per month in the unweighted sample to 16 nights per month in the weighted sample.

In addition, Table 12 on the following page shows that overcrowding is also a more frequent problem at night than during the day, and a more frequent problem either time in the South and the Great Lakes than in the other regions.

When all of the weighted responses were aggregated together, the 364 truck stop operators who answered this question indicated that their facilities are full a total of 5,816 nights out of a possible 10,920 nights (30 possible nights per month x 364 locations), or 53 percent.

In other words, a truck driver has about a 50/50 chance of finding a truck parking space at any particular privately-owned truck stop on any given night nationwide. This assumes that the capacity, usage and availability of truck parking is distributed evenly across the nation. However,

these and other data from this study suggest that any possible truck parking shortages are clustered in specific locations at specific peak times of day and days of the week (or month).

Table 11
Frequency of Overcrowding (Night and Day) by Size of Truck Stop

	Size of Truck Stop		
(Weighted Base)	**Small (96)**	**Medium (144)**	**Large (132)**
Average Number of Nights Per Month Filled to Capacity	18.8 nights	15.4 nights	15.0 nights
Average Number of Days Per Month Filled to Capacity	16.2 days	10.6 days	7.3 days

Table 12
Frequency of Overcrowding (Night and Day) by Region

	Region				
(Weighted Base)	**Northeast (39)**	**South (114)**	**Great Lakes (75)**	**Central (83)**	**West (70)**
Average Number of Nights Per Month Filled to Capacity	15.6	18.0	18.2	14.0	12.7
Average Number of Days Per Month Filled to Capacity	10.7	13.3	12.9	7.7	8.2

C.4 Item #4 -- Frequency of Overcrowding (During the Day)

Again, the truck stop operators in the weighted survey sample reported their facilities are much less likely to be "filled to capacity" during the day:

- About 35 percent said they are ***"never" filled during the day;***
- 14 percent said they are filled between 1 and 9 days per month;
- 11 percent said they are filled between 10 and 19 days per month; and
- 34 percent said they are filled 20 or more days per month.

About 7 percent (27 respondents) did not answer this question.

The truck stop operators in the weighted sample indicated that their facilities are filled an average of 11 days per month. This was higher than the average obtained from the raw, unweighted sample (only 8 days per month) because the daytime overcrowding is a more frequent problem at the smaller facilities and the weighting corrected for the underrepresentation of these facilities in the original sample of NATSO members.

The weighted results, however, were used as the basis for making projections to the total target population because they reflect the proper proportion of small, medium and large facilities nationwide and in each of the five regions. Tables 11 and 12 on the preceding page show that daytime overcrowding was reported to be a more frequent problem at small facilities, and at privately-owned truck stops in the South and Great Lakes.

When all of the responses were aggregated together, the 354 truck stop operators who answered this question indicated that their facilities were full a total of 3,825 days out of a possible 10,620 nights (30 possible days per month x 354 locations), or 36 percent.

In other words, a truck driver has a much better chance (about 2 in 3) of finding a truck parking space during the day at any particular privately-owned truck stop on any given day nationwide. Again, other data from this study suggest that the availability of truck parking varies greatly, depending on the location, the time of day, and the day of the week or month.

C.5 Item #5 -- Actual Truck Parking Usage (At Night)

Finally, truck stop operators in the national survey were asked to estimate the average number of trucks parked at their facility at night. Of the 381 truck stop operators in the unweighted sample, 367 answered this question. Another 14 respondents (or 4 percent of the total sample) did not. The responses ranged from 8 to 500, and were obviously tied to the total number of existing spaces at each particular facility.

The average number of trucks that were reported parking at their facilities was 114. The median response was lower, with half of the truck stop operators indicating that 100 or more trucks are parked at their facility at night. Altogether, the 367 truck stop operators who answered this question in the unweighted sample reported that a total of 41,805 trucks parked at their facilities at night. This compares with a total estimated capacity of 47,611 parking spaces among the 371 truck stop operators who answered that particular question. In other words, a slightly smaller number of operators report serving 88 percent of the total capacity reported in the unweighted sample.

These figures are based on the unweighted, initial sample and are inflated by the disproportionate number of large truck stops in the original sample of NATSO members. When the results are statistically weighted to reflect the proper proportion of small, medium and large truck stops nationwide and in each of the five regions, the average number of trucks reported parking at the facilities drops to 78 and the median drops to 50, based on a weighted sample of 358 respondents and a weighted total of 28,049 trucks.

As a result, an average of 167,000 trucks are projected to be parked at the 2,276 privately-owned truck stops in the target population on any given night. This represents about 90 percent of the projected total capacity of the privately-owned truck stops the provide truck parking along the Interstate nationwide.

Table 13 shows the average capacity and the average nighttime usage of truck parking for facilities in each of the three size categories. Although the average usage appears to increase as the size of facility increases, it is also clear that small facilities serve more trucks relative to their truck parking capacity. This also appears to be true for daytime usage.

Table 13
Average Parking Capacity and Usage by Size of Truck Stop

	Size of Truck Stop		
(Weighted Base)	**Small (96)**	**Medium (144)**	**Large (132)**
Average Capacity -- Total Number of Existing Truck Parking Spaces	16.4 spaces	49.0 spaces	166.2 spaces
Estimated Average Nighttime Usage -- Average Number of Trucks Parked	32 trucks	43 trucks	148 trucks
Estimated Average Daytime Usage -- Average Number of Trucks Parked	45 trucks	48 trucks	107 trucks

C.6 Item #6 -- Actual Truck Parking Usage (During the Day)

Truck stop operators nationwide were also asked to estimate the average number of trucks parked at their facility ***during the day***. Of the 381 truck stop operators in the unweighted sample, 364 answered this question. Another 17 respondents (or 4 percent of the total unweighted sample) did not. The responses ranged from 3 to 2,000 and again were tied to the number of existing spaces at each particular facility.

The average number of trucks that were reported parking at their facilities during the day was 89. The median response was lower, with half of the truck stop operators indicating that 50 or more trucks parked at their facility during the day. Altogether, the 364 truck stop operators answering this question in the initial, unweighted sample reported that a total of 32,231 trucks parked at their facilities during the day. This compares with an estimated capacity of 47,611 parking spaces among 371 truck stop operators who answered that particular question in the unweighted sample.

Again, it was necessary to weight the sample to correct for the apparent oversampling of large truck stops and ensure that the results reflect the proper proportion of small, medium and large truck stops in the total target population. When the survey sample results are properly weighted, 352 respondents report some 24,227 trucks parked at their facilities on average during the day, for a weighted average of 69 trucks and a median of 30.

The weighted survey results provided the basis for making projections to the total target population. ***These calculations indicate that an average of 145,000 trucks are projected to be parked at the 2,276 privately-owned truck stops that provide truck parking along the Interstate on any given day. This represents about 78 percent of the total projected capacity.***

Again, Table 13 shows that smaller facilities on average serve more trucks relative to their average capacity, both during the day and at night.

D. Actual Parking Availability

Several factors must be taken into consideration in assessing the actual availability or possible shortage of truck parking:

- First, it is necessary to measure existing truck parking ***capacity***, that is, the actual number of truck parking spaces nationwide (see Section B).

- Second, it is necessary to measure ***actual utilization*** or usage, that is, the number of truck parking spaces that are being used or occupied (see Section C).

- The ***actual availability*** then is the difference between the total number of truck parking spaces and the number of spaces being used -- because a space cannot be "available" or used by a truck driver if it is occupied by another truck.

The latter can be accomplished at the individual or the aggregate level. An effort was made to perform such an analysis based on the survey data. Considerable care must be taken in interpreting the results of this analysis, however, because the assumptions and intended meanings of the respondents are less clear. Although the majority of truck stop operators clearly indicated that their truck parking facilities were often full or overflowing at night, it was more difficult to ascertain quantitatively the precise shortfall or excess of parking spaces from the raw survey results alone -- partly because the usage of truck parking changes continuously and varies so much by time of day, day of week or month and location. The limitations of this analysis are discussed in more detail below.

D.1 Actual Truck Parking Availability at Night

Of the 381 truck stop operators in the weighted survey sample, some 351 provided information on both their truck parking capacity ***and*** their estimates of actual truck parking usage at their facilities. For each of these 351 respondents, the number of trucks parking at their facility

during the night was subtracted from their total capacity. The resulting differences can be interpreted to indicate the extent to which parking spaces are actually available, or whether the existing capacity is already being used. The responses ranged from one facility that reported 300 trucks parked in excess of total capacity to another facility that reported parking by 250 trucks less than their total capacity.

When all of these individual differences were properly weighted and aggregated, the results showed a net excess of 1,744 more spaces than trucks parked. This can be projected to represent an excess of 10,000 truck parking spaces at privately-owned truck stop facilities nationwide. On average, the typical facility in the weighted sample reported 5 more parking spaces than trucks served.

Behind this weighted average, however, lies a large number of facilities on both sides of the equation:

- 27 percent who report the number of trucks parking is greater than their capacity;
- 20 percent who report the number of trucks parking equals their capacity;
- 47 percent who report the number of trucks parking is less than their capacity;
- 8 percent who did not provide all of the information necessary to make this calculation.

This analysis is also consistent with other results from the survey indicating that the problem of overcrowded truck parking is more serious at small facilities (those with fewer than 25 parking spaces). On average, small facilities reported that the number of trucks parking was 15 greater than their capacity. In contrast, medium size facilities on average reported that the number of trucks parking was 5 less than their capacity. And large facilities on average reported that the number of trucks was about 18 less than their capacity. These differences are also apparent in Table 13.

D.2 Possible Limitations of this Analysis

As noted earlier, caution must be taken in interpreting these results, however, because they do not necessarily take into account "turnover" during the night and/or the length of stay for all of the trucks parking at their facilities. It is possible, for example, that a truck might not be parked at a facility for the entire evening, or that a single truck might even park at more than one facility during the night, creating the potential for "double-counting." On the other hand, the results from other tasks in this project suggest that many truck drivers do park all night and that the lack of "turnover" at night creates problems for drivers looking for a place to park, at least at public highway rest areas. But it is also possible for a truck stop operator to provide parking spaces for 100 trucks, serve 120 trucks per night and never be full or overcrowded.

However, it does not appear that respondents interpreted the question in this manner, or that "turnover" for nighttime parking was a significant problem. As part of the quality assurance process, the survey data were closely examined for possible inconsistencies. In this case, the responses were compared for each truck stop operator who reported the number of trucks parking was greater than or equal to their total truck parking capacity. In 172 of 175 relevant cases (98 percent), the truck stop operators also reported on a separate question that their facilities were "full" or "overflowing" at night. In addition, of the 174 who reported that the number of trucks parking was less than their capacity, only 3 said in a separate question that their parking was "overflowing." ***This suggests that the calculations reported here can be interpreted as actual parking availability -- indicative of excess or insufficient parking capacity to meet demand.***

D.3 Actual Truck Parking Availability During the Day

Because data were collected for both daytime and nighttime usage, it was possible to perform a separate assessment of daytime parking availability using the same procedures as outlined above for nighttime parking. Of the 381 truck stop operators in the weighted survey sample, some 345 provided the necessary information on both their truck parking capacity ***and*** their estimates of actual truck parking usage at their facility during the day. When the number of trucks parking at their facility during the night was subtracted from their total capacity, the results ranged from one facility that reported 440 trucks parked in excess of total capacity to another facility that reported parking by 400 trucks less than their total capacity.

When all of these individual differences were properly weighted and aggregated, the results suggested a net excess of 5,518 more spaces than trucks parked. This can be projected as representing an excess of 33,000 spaces during the day. On average, the typical facility in the weighted sample reported 16 more parking spaces than trucks served.

Once again, this weighted average conceals a large number of facilities on both sides of the equation:

- 21 percent who report the number of trucks parking is greater than their capacity;
- 2 percent who report the number of trucks parking equals their capacity;
- 69 percent who report the number of trucks parking is less than their capacity;
- 9 percent who did not provide all of the information necessary to make this calculation.

However, an analysis of respondents who reported that the number of trucks parking during the day exceeded their capacity raises questions about the applicability of this analytic approach for the daytime data. A majority of these respondents often indicated in other survey questions that they were not crowded during the day. This indicates that turnover during the day is much higher than at night, making it difficult to interpret these daytime results.

E. Possible Expansion Plans

Truck stop operators in the national survey were also asked if:

- They had any plans to increase capacity for truck parking during the next 3 years;
- How many spaces, if any, they planned to add; and
- Whether undeveloped land was available adjacent to their facility so they could expand.

The percentages reported here are based on the weighted survey sample to ensure that the results reflect the proper proportion of small, medium and large truck stops in the target population nationwide and in each of the five regions.

E.1 Plans to Expand Truck Parking

About 32 percent of the truck stop operators in the weighted sample said they planned to expand truck parking at their facilities over the next 3 years. About 36 percent said they did not plan to expand truck parking. And 31 percent said they did not know whether they might expand or not. The remaining 2 percent (7 respondents) did not answer the question.

Of the 120 truck stop operators in the weighted sample who said they planned to expand truck parking, 89 provided an estimate of the number of parking spaces they expected to add. These estimates ranged from 1 parking space to 300 additional parking spaces. The initial, unweighted results indicated a total of 6,218 spaces might be built at some 102 facilities, with an average of 61 spaces per truck stop. However, these unweighted results are inflated by the disproportionate number of large facilities in the initial sample of NATSO members. When the sample was statistically weighted to ensure that the results reflected the proper proportion of small, medium and large truck stops in the target population, the weighted average and sample estimate is somewhat lower, as expected -- ***a total of 4,722 new parking spaces to be created at some 89 facilities in the weighted sample during the next three years, for an average of 53 new spaces per facility planning to expand.***

This would have the effect of increasing the estimated total number of existing truck parking spaces at the 381 facilities in the weighted sample from the current 30,520 spaces to 35,242 spaces -- or an estimated 15 percent increase in capacity over the next 3 years.

These numbers can also be projected to represent a total of 28,000 new parking spaces at privately-owned truck stops nationwide, increasing the total projected capacity from the current 185,000 to more than 213,000. The extent to which this projected increase could be used to offset the current projected shortage at public rest areas is dependent, apparently, upon the commercial driver's decision to used a public rest area or private truck stop when needing to safely leave the road. As noted elsewhere in the report, drivers have different objectives in

choosing where they stop. Thus, the researchers were reluctant to state that this projected increase in private parking spaces could solve the current parking shortage at public rest areas identified above.

This projection of new truck stop spaces does not include those respondents who said they planned to add spaces, but did not provide an estimate of the actual number of spaces they planned to add. These respondents represent about one-quarter of those truck stop operators in the survey sample who plan to expand.

There were no significant differences detected in the expansion plans of facilities across the five regions. Small, medium and large facilities were also equally likely to be planning to expand their truck parking. However, there were some differences in the average number of new spaces that small (50), medium (39) and large (68) facilities planned to create. Compared to the medium and large facilities, small truck stops who plan to expand reported they are planning to add more spaces on average relative to their capacity. This may be another indication that the overcrowding problem is more serious among smaller facilities.

Table 14 on the following page also shows there is a clear relationship between perceived overcrowding and plans to expand truck parking. Among those facilities who reported their truck parking is "overflowing" at night, 50 percent said they plan to expand compared to only 26 percent of those who said they were "uncrowded" at night. This difference was statistically significant. It is worth noting, however, that no significant effect of perceived overcrowding was detected during the day.

Table 14
The Impact of Perceived Overcrowding on Plans to Expand Truck Parking

	Level of Perceived Overcrowding		
(Weighted Base)	**"Uncrowded" at Night (55)**	**"Full" at Night (233)**	**"Overcrowded" at Night (85)**
YES -- Plans to Expand Truck Parking in the Next 3 Years	28%	26%	50%
NO -- Does Not Plan to Expand Truck Parking	41%	43%	17%
NOT SURE whether they might expand or not	31%	31%	33%

E.2 Availability of Land for Expansion

Most of the 381 truck stop operators in the weighted survey sample indicated that undeveloped land is available adjacent to their facility if they wanted to expand their truck parking:

- 73 percent said land is available;
- 24 percent said land is not available; and
- 3 percent (13 respondents) did not answer the question.

The availability of land also appeared to be a significant obstacle to expansion plans. Among those who said that land was available, 39 percent said they planned to expand their truck parking. But among those who said that suitable land was not available, only 10 percent said they planned to expand their truck parking. Presumably, these facilities would be forced to simply reconfigure their parking on existing land in an effort to increase the number of truck parking spaces.

SECTION II-2: NATSO MODELING RESULTS

A. Research Objective

The objective of this report is to extend the analysis of the original project by including new data on private truck stops across the country. Specifically, the present study has a three-fold objective:

- Evaluate the feasibility of combing the original database on public rest areas with the new data on private truck stops to improve the statistical models developed in the original project;

- Develop a stand-alone Capacity Utilization Model using statistical techniques to analyze the factors affecting truck parking at private truck stops; and

- Use the results of Capacity Utilization Model to evaluate the differences in parking characteristics at private truck stops and public rest areas.

The next section describes the new database on private truck stops and evaluates the potential for merging the truck stop information with the existing database on public rest areas. Section II of this report summarizes the findings of the Capacity Utilization Model. Summary and conclusions are presented in Section III of the report.

B. Database On Private Truck Stops

This section provides an overview of the data collected on private truck stops during a recent survey of the members of NATSO, Inc. between July, 1995 and August, 1995. A mail questionnaire was sent to 987 truck stops nationwide requesting information related to the location and facilities offered at each truck stop. Responses were received from 381 different truck stops. Key information collected include:

- The location of the truck stop, by city, state, Interstate highway and exit number;

- The perceived ease of use of the facility;

- The distance of the facility from:
  - the Interstate highway ramp, and
  - the nearest public rest area in each direction.

- The number of truck parking spaces available for trucks and automobiles;

- The types of parking and services offered;

- The extent to which the parking capacity is "uncrowded, full or overflowing" both at night and during the day;

- The average number of trucks parked at the facility at night and during the day;

- The number of nights and days each month the facility is filled to capacity;

- Any plans to increase parking capacity over the next three years; and

- Availability of undeveloped land adjacent to the facility that could be used for expansion.

One of the goals of this part of the study was to merge the data collected on private truck stops with the existing database on public rest areas. In theory, as described in the original analysis, the parking spaces provided at private truck stops represent a supply-side factor affecting truck parking utilization at public rest areas.

A careful review of the data collected on private truck stops and public rest areas indicates a number of practical problems in merging the two databases together. These problems are based on the nature of the response rate to the survey and are difficult to predict in advance. Although adequate precaution was taken to ensure that the new survey would cover the geographical representation of the original database on public rest areas, it was difficult to predict which of the truck stop operators would respond. For example, the survey was mailed to 987 NATSO members nationwide of which approximately 39 percent responded, thereby creating two major obstacles in merging the databases:

- *Geographical mis-match of databases:* The geographical distribution of the responses from the truck stops are different from the geographic distribution of public rest areas included in the original analysis. Although, the truck stops included in the sample represent most of the states in which the public rest areas included in the original database were located, differences in location at the Interstate level make it difficult to reliably merge the two databases.[20] For example, although data were collected on private truck stops located in Illinois, it is difficult to match the private truck stops to specific public rest areas in Illinois in a manner that would allow the estimation of the impact of the presence of private truck stops on the capacity utilization at public rest areas.

[20] In some cases, the sample of private truck stops represent certain states that were not represented in the capacity utilization model developed in the original analysis.

- *Differences in sample size:* The Capacity Utilization Model that was developed in the original study was based on a cross-sectional sample of 709 public rest areas nationwide. In contrast, the responses received from the private truck stops make up an effective sample of 381 truck stops nationwide. Merging the two databases with unequal sample sizes creates a potential for bias and mis-representation that may seriously undermine the reliability of developing a single Capacity Utilization Model based on the combined data sets.

These fundamental differences in the two databases make it difficult to merge the new data collected with the existing database on public rest areas. However, adequate new data is available on private truck stops to develop a Capacity Utilization Model to examine the factors affecting truck parking at private truck stops. The development of a stand-alone Capacity Utilization Model for private truck stops, similar to the model developed for public rest areas in the original analysis, will aid the evaluation of the potential differences between the characteristics of truck parking at private truck stops with that of public rest areas. The following section provides a detailed analysis of the Capacity Utilization Model and discusses some of the major statistical findings.

II. CAPACITY UTILIZATION MODEL

This section describes the development of a Capacity Utilization Model to analyze the factors affecting truck parking at private truck stops. The purpose of this analysis is to compare potential differences in truck parking characteristics at private truck stops and public rest areas. The underlying structure of model developed here is similar to the one developed for the Public Rest Area Study.

The objective of this model is to identify the major factors affecting utilization of truck parking spaces at private truck stops. In general, a number of factors, both demand-related and supply-related, have an effect on private truck stop parking usage by trucks.[21] These factors are summarized in Table 1 below.

Table 1: Factors Affecting Truck Parking at Private Truck Stops

Demand-Related Factors	Supply-Related Factors
Average Daily Traffic volume (ADT)	Total number of available truck parking spaces at the truck stops
Truck traffic as a percentage of ADT	Type of parking space (parallel, diagonal, etc.)
Proximity of truck stop to a major intersection	Facilities (telephones, rest rooms, lighting, etc.)
Proximity of public rest area to the truck stop location	Distance of truck stop from the Interstate
	Ease of entry and exit to and from the truck stop

Source: Apogee Research, Inc.

In order to estimate the individual impact of each of the above factors on the utilization of parking spaces, Apogee specified an econometric model as follows:

$$CU = b_0 + b_1 ADT + b_2 EASE + b_3 LRAMP + b_4 DINT + b_5 PRA + b_6 SP + b_7 TYPE + b_8 Z + e_i$$

[21] There is currently no literature on the specific factors that affect truck parking at private truck stops. The factors reported here are based on the literature on public rest area parking usage and are adapted to meet the requirements of the private truck stop model.

where,

CU represents utilization of private truck stop parking spaces (dependent variable)

ADT is one-way average daily traffic[22]

EASE represents the ease of entry and exit to and from the truck stop

LRAMP is the length of the ramp leading to the truck stop (distance from Interstate)

DINT is the distance to a major intersection

PRA represents the presence of a public rest area

SP is the total number of available parking spaces

TYPE is the type of parking space available

Z is the matrix of all the facilities provided at the rest area

b_0 is the constant term that captures the average effect of all omitted variables

$b_1 ... b_8$ are the individual coefficients on the independent variables

e_i is the error term

A. Data and Variables

The data for this model is based on information collected through a mail survey of NATSO-affiliated private truck stops.[23] Table 2 summarizes the list of independent or explanatory variables that were requested from each private truck stop operator for each truck stop included in the sample. The database contains information on approximately 381 truck stops located across the country covering a total of 44 contiguous states. Unfortunately, a number of observations for certain variables included in the model are not available in the current database for each truck stop in the sample. Of the 381 total, 362 truck stops had complete data on the variables required for

[22] Data on one-way ADT was not available through the survey of private truck stop operators. Since ADT represents an important demand-side variable (as reported in the findings of the original study), a proxy variable was used to measure the impact of ADT on private truck stop parking. This proxy was based on the average state-wide ADT data collected in the original study. Based on the average state-wide ADT three levels of ADT were defined: Low, Medium and High. All states with ADT levels less than 8,000 were classified as "low ADT"; states with an ADT levels between 8,000 and 12,000 were classified as "medium ADT" and states with ADT levels greater than or equal to 12,000 were classified as "high ADT." A dummy variable "ADT" was then generated taking on a value of 0 for all states with low ADT and a value of 1 with all states with medium ADT, and value of 2 for states with a high ADT. This coding scheme was then applied to the data records of the individual truck stops depending on the state in which they were located. Although this is a crude method of controlling for the effect of ADT, it nevertheless is an important proxy variable for the general validity of the reported results.

[23] It should be noted that all data used in the statistical model developed for private truck stops represent unweighted raw data. This is different from the descriptive analysis of the survey data presented in "Truck Parking Capacity and Usage at Privately-Owned Truck Stops: National Survey Results," Trucking Research Institute and Apogee Research, September, 1995, in which some of the data were weighted based on population parameters.

estimating the model.[24] Figure 1 compares the statewide sample coverage of the current model with that of the rest area model developed in the original analysis.

The original database was recoded to make the data usable in the econometric model. The dependent variable in the model, capacity utilization (CU), is a dummy variable taking the value 1, if parking spaces at a truck stop are typically full or overflowing; or 0, if typically uncrowded. This qualitative information was gathered from the private truck stop operators who responded to the survey question. A large number of independent variables depicting the characteristics of truck stops were also represented as dummy variables, as shown on Table 2. The generation of dummy variables was required to quantify the impact of certain factors on truck stop parking utilization, for which only qualitative information (such as "yes", "no", etc.) was available. Some of the dummy variables generated include information on the type of truck parking space and the presence of various facilities such as telephones, lodging, food, etc. at the individual truck stops. Specific data such as the exact number of rest rooms, telephones and vending machines in each truck stop were not included in the database.

B. Estimation Procedure

A binomial logit regression procedure is applied to estimate the Capacity Utilization Model.[25] Logit models are typically used in analyzing data of a qualitative nature. The procedure measures the impact of an independent variable on the *probability* that the dummy variable representing the dependent variable in the model, takes on the value of 1.[26] It should also be noted that the estimated coefficient of an independent variable measures the impact on the dependent variable while holding all the other variables, included in the model, constant. The modeling procedure measures the individual contribution of a particular variable in explaining the variation in the dependent variable.

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[24] An analysis of the survey results revealed that some of the respondents did not indicate the specific number of parking spaces that were available at the truck stop. In such instances, to avoid losing additional sample units, an average number of parking spaces at other private truck stops in the represented state was used as proxy for filling the missing values.

[25] This modeling procedure is adopted when the qualitative nature of the dependent variable does not permit the use of standard regression techniques, such Ordinary Least Squares (OLS).

[26] Technically, the estimated coefficients of the independent variables in a logit model measure the impact of the variable on the log of the odds that the dependent variable will equal 1. However, since the log of the odds is directly proportional to the probability that the dependent variable equals 1, the use of the term 'probability* in interpretation is valid.

Table 2. Summary of Potential Independent Variables

Variable Name	Type	Method of Measurement	Expected Sign of Coefficient
One-way Average Daily Traffic	Demand	<8000 = 0 (Low) 8000-12000=1 (Medium) >12000=2 (High)	Positive
Ease of entry and exit	Supply	0-3 with 0=very easy and 3=very difficult	Negative
Distance from Interstate	Supply	miles	Negative
Number of Truck Parking Spaces	Supply	Number	Negative
Type of Truck Parking Space[a]	Supply	Dummy (DPT=1; Parallel or DNPT=0)	Positive
Nearest Rest Area	Supply	If within 60 miles =1; Otherwise =0	Unknown
Proximity to Intersection	Supply	If close to intersection=1; Otherwise=0	Positive
Facilities Offered: Arcade Games Check Cashing Emergency Road Services Hotel/Motel Information Kiosk Laundry Loadboard Open 24 hours Buses Welcome Telecommunication Services Restaurant/Deli Retail/Convenience Store RV Facilities Scales Showers Truck Repair Truck Wash TV Room	Supply	Sum of no. of facilities offered	Positive

a. DPT refers to diagonal-pull through parking as compared to parallel or diagonal-not-pull-through parking (DNPT).

Source: Apogee Research, Inc.

In the Capacity Utilization Model, therefore, the individual coefficients measure the impact of the independent variables on the probability that a private truck stop*s parking capacity will be full or overflowing (since the CU dummy variable equals 1, only if the parking capacity is full or overflowing). This implies that a positive and statistically significant coefficient on an independent variable increases the probability that a truck stop*s parking capacity will be full or overflowing. Similarly, a negative and statistically significant coefficient, implies that the variable decreases the probability that the truck stop*s parking capacity is full or overflowing. The following section discusses the estimation results for the Capacity Utilization Model.

C. Estimation Results and Interpretation

The final sample used for estimation purposes contained data on 362 truck stops across the country with complete records on all the variables included in the model. The sample had a reasonably good cross-sectional coverage of nationwide truck stops (see Figure 1 next page).

The initial model included all the variables that are listed in Table 2.[27] A number of statistical and data problems affected the results of this model. Not surprisingly, multicollinearity between some of the independent variables was found which resulted in the exclusion of certain variables.[28] In addition, there were some variables that exhibited little or no variation in the final sample selected, and thus, were also excluded from the model.[29] The model was re-estimated after making these alterations and the results are presented in Table 3. The interpretation of the estimated coefficients of the explanatory variables are presented below:

- *Average Daily Traffic:* The positive coefficient on this variable implies that, holding all the other factors constant, the probability that the parking capacity at a given truck stop is either full or overflowing increases when the ADT in the state in which the truck stop is located is classified as medium or high. In other words, the probability that a truck stop*s capacity is full or overflowing is directly proportionate to the level of ADT in the state in which it is located. This, of course, is not surprising as similar results were

[27] Logit regression results from this model are not presented here. The results can be made available upon request.

[28] Multicollinearity refers to the degree of correlation between two or more independent variables in the model. In the presence of multicollinearity, therefore, it is difficult to isolate the impact of individual variables on the dependent variable. In particular, the problem of multicollinearity was severe between the dummy variables representing the facilities offered at the truck stops. For example, the Hotel/Motel variable was strongly correlated with the Restaurant/Deli and the Showers dummy variables and the TV Room variable, Truck Repair and Truck Wash were also strongly correlated. In general, degree of correlation between the dummy variables representing various facilities ranged from a low of 0.39 to a high of 0.99. In order to alleviate the problem of multicollinearity the facilities* variables were combined into groups as discussed later in the report.

[29] For example, almost 99 percent of the rest areas in the final sample had public telephones, were open 24 Hours, had a Restaurant/Deli and a Convenience/Retail Store; these variables were, therefore, excluded from the initial model.

reported in the original analysis of public rest area parking, indicating a direct correlation of ADT with demand for parking.

- *Ease of Entry and Exit:* This variable was coded based on a scale of 0 through 3 with 0 representing "very easy" access to and from the truck stop and 3 representing "very difficult" access to and from the truck stop. The negative coefficient on this variable implies that the probability of a truck stop*s parking capacity being full or overflowing is inversely related to the ease of entry and exit to and from the truck stop. For example, those truck stops that have "somewhat difficult" or "very difficult" accessibility are less likely to be full or overflowing in terms of their parking capacity. However, although the sign on this coefficient is negative, the statistical significance of this coefficient, as represented by a t-statistic of 1.09, is low indicating that this result may not be valid over other samples. This is not surprising since only 8 percent of the sample reported accessibility to the parking facility as either "somewhat difficult" or "very difficult".

- *Distance from the Interstate:* The negative coefficient on this variable indicates that the greater the distance between the Interstate and the truck stop, the lower is the probability that the facility will be full or overcrowded. Again, the statistical significance of this finding is weak (t-statistic of 0.67), mainly due to the fact only about 1.5 percent of the sample reported being more than 1 mile from the Interstate. In general, there is very little variation in the distance from the Interstate. Almost 78 percent of all truck stops reported being located within 0.4 miles of the Interstate.

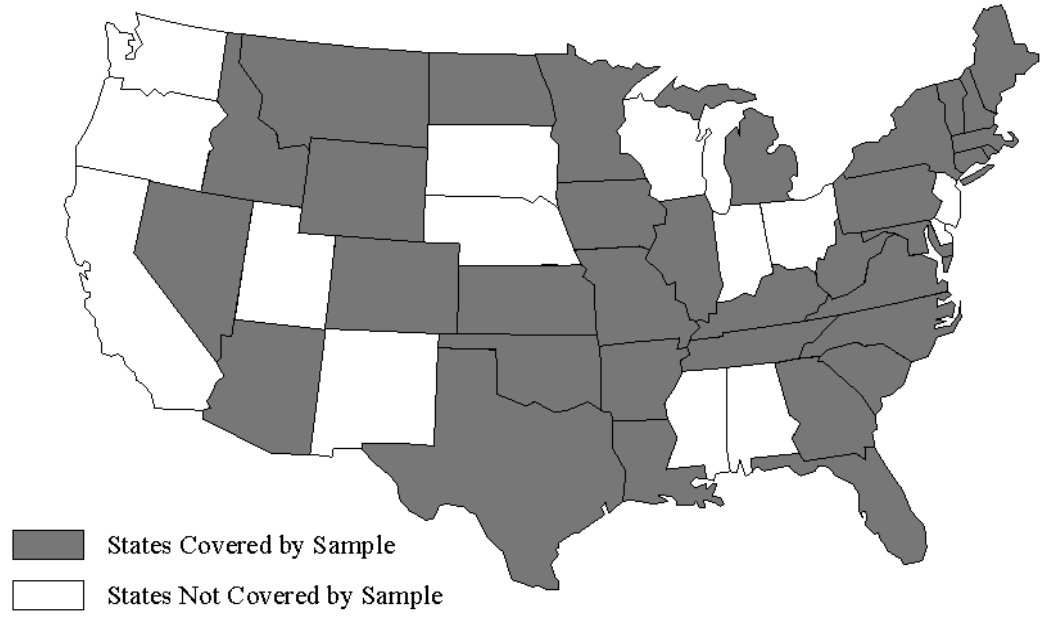
- *Proximity to intersection:* This variable is a dummy variable taking on a value of 1 if the respondent indicated that the truck stop was located close to the intersection of two Interstates and a value of 0 if not. The estimated coefficient of this variable (with a t-statistic of 0.01) is found to be statistically insignificant in explaining the variation in capacity utilization.

- *Presence of Public Rest Area:* The negative coefficient on this variable indicates that the probability of a truck stop*s parking capacity being full or overflowing decreases if a public rest area is located within 60 miles of the truck stop.[30] This interpretation is purely from a statistical viewpoint based on the estimated negative coefficient for the variable. In reality, the information obtained here is insufficient to determine the reasons for this inverse relationship. For example, on one hand it may imply that the truckers prefer stopping at public rest areas rather than at private truck stops; while on the other, it is also possible that once a trucker notices that the parking capacity at the

[30] Note that this dummy variable was coded with a value of 1 if a public rest area was located within 60 miles (in all directions) of the facility and a value of 0 if no public rest area was located within that radius.

FIGURE 1. Sample Area Coverage Under Capacity Utilization Models

A. Private Truck Stops Model



B. Public Rest Areas Model

Variable	Estimated Coefficient
Average Daily Traffic	0.015
	(3.07**)
Ease of Entry and Exit	-0.002
	(-1.09)
Distance from Interstate	-0.01
	(-0.67)
Proximity to Intersection	-0.0003
	(-0.01)
Presence of Public Rest Area	-0.037
	(2.18*)
Number of Available Parking Spaces	-0.47
	(-2.79**)
Type of Parking Space	0.09
	(1.73*)
Accommodate Triples/Oversized	0.24
	(1.98*)
Accommodate Hazmat Trucks	0.008
	(0.04)
Security Measures	0.0003
	(1.89*)
Facilities and Services	-0.042
	(-1.96*)
Constant	0.02
	(3.87**)
Sample Size	362
Percentage of Correct Predictions	54.70%
Log of Likelihood Function	-189.01

* indicates statistical significance at the 10 percent level

**indicates statistical significance at the 5 percent level

Source: Apogee Research, Inc.

private truck stop is full or close to being full, he continues to drive if he is aware that a public rest area is located within close proximity. In the latter situation, the private truck stop will be less likely to experience full or overflowing parking capacity conditions.

- *Number of available truck parking spaces:* The interpretation of this variable is straightforward. The higher the number of parking spaces available at a given truck stop, the lower the probability of the parking capacity being full or overflowing.

- *Type of parking spaces:* This dummy variable was coded as 1 if the truck stop reported a majority of their parking spaces as diagonal-pull-through, and 0 if the truck stop reported a majority of their parking spaces being diagonal-not-pull-through or parallel. The positive coefficient implies that truck stops with diagonal-pull-through spaces have a greater probability of having their parking capacity full or overflowing. The statistical significance of this variable is relatively high with a t-statistic of 1.73.

- *Parking space features:* Two separate dummy variables were created to measure the impact of parking space features on capacity utilization:

  a) TRIPLES: This variable assumed a value of 1 if the truck stop had parking spaces that could accommodate oversized trucks or triples, and 0 otherwise. As can be seen in Table 3, this variable has a positive coefficient indicating that truck stops that are able to accommodate triples or oversized trucks, have a higher probability of having their parking capacity being full or overcrowded.

  b) HAZMAT: This variable assumed a value of 1 if the truck stop had parking spaces that could accommodate trucks carrying hazardous materials, and 0 otherwise. The estimated coefficient on this variable is not statistically significant in explaining the variation in capacity utilization of parking spaces at truck stops.

- *Facilities offered:* Due to severe multicollinearity between the dummy variables representing the different facilities offered at the truck stops, it was necessary to combine the different facilities into a single group. This group represents a simple summation of the all the facilities offered at the truck stop. For example the total number of facilities offered at each truck stop ranges between 4 and 11. The negative coefficient on this variable is a surprising result. Literally interpreted, the negative coefficient indicates that truck stops with more facilities have a lower probability of their parking spaces being full or overcrowded. However, there may be a potential explanation for this unexpected result. In general, larger truck stops

provide more services than the smaller ones.[31] Thus, since the number of parking spaces at truck stops offering a greater number of facilities tend to be larger, it is possible that these truck stops typically report their parking capacity to be uncrowded.

- *Security at truck stops:* This dummy variable measures the impact on parking space utilization of having proper lighting or security patrol at the truck stop. The positive coefficient on this variable implies that truck stops that provide proper lighting or security patrol have a higher probability of having their parking capacity full or flowing. This finding corroborates the findings from the direct observation survey of truck drivers in the original study, where some of the drivers who were interviewed indicated that safety and security measures at truck stops played an important role in their decision to choose to stop at rest areas or truck stops.

- *The constant term:* The high statistical significance of the constant term indicates that the current model has not been able to capture all the systematic influences of factors affecting capacity utilization at private truck stops. The findings suggest that it is possible that a single or more explanatory variables exist for which no data is currently available that may explain the variation in the dependent variable. This often occurs in statistical models, where it is difficult to either identify all the factors that may be related to the dependent variable or obtain the data on all the identified variables. Examples of missing data for this model may include a specific dummy variable capturing geographical or regional factors, detailed data on percentage of trucks in ADT, average duration of truck parking at the facility and others.

It should be noted that unlike standard regression models, the R-square in the logit model is not a valid measure for evaluating the performance of the model. Instead, the "percentage of correct predictions" is typically used. The results indicate that the percentage of correct predictions for this model is 54.7 percent. This implies that in 55 out of 100 cases, the independent variables used in the model predicts the capacity utilization dummy variable value (full/overflowing or uncrowded) correctly. The reported log-likelihood function statistic is used to measure the overall significance of all the variables in the model. The test statistic indicates that the variables included in the model are jointly significant in explaining the variation in capacity utilization at truck stops. As a standard procedure in statistical modeling, some minor alterations were made to the sample size to examine the robustness of the estimated coefficients.

[31] The correlation between the number of truck parking spaces available and the number of services offered was found to be 0.86.

The overall signs and significance of the model coefficients remained unchanged under the different sample sizes.[32]

D. Summary of Key Findings

The Capacity Utilization Model described above was developed primarily to identify factors affecting truck parking at private truck stops. The estimation results indicate that the specified model correctly predicts the variables affecting overutilization and underutilization of parking spaces at private truck stops 55 percent of the time, and adds useful new information on the reasons truck drivers use private truck stops. The results also suggest that one-way average daily traffic, ease of entry and exit to and from the truck stop, the ability of truck stops to accommodate oversized or triples and security measures have a positive impact on truck parking space utilization at truck stops. The distance from the interstate, presence of a public rest area, number of available parking spaces and the number of facilities offered at private truck stops have a negative influence on parking space utilization at private truck stops. The proximity of the truck stop to a major intersection and the ability to accommodate trucks carrying hazardous materials are found to have no effect on truck stop parking space utilization.

In general, the estimated coefficients and the direction of their impact on capacity utilization at truck stops are found to be in line with *a priori* assumptions. Some of the standard diagonostical tests conducted indicated that although the predictive capability of the models, measured in terms of the percentage of correct predictions, was not very high, the model estimates were relatively robust considering the sample size and the qualitative nature of the data. Some of the general differences between the Capacity Utilization Models developed for private truck stops and public rest areas are discussed in the next section of the report.

[32] Continuous data were also available to measure capacity utilization at truck stops (i.e. the truck stop operators were also asked to indicate approximately the number of nights their facility was filled to capacity, in addition to indicating whether the parking capacity was uncrowded, full or overflowing which represented the non-continuous data used for the dependent variable in this study). The continuous data for the dependent variable was used to develop standard regression models as a basis for comparison. In general, the signs on the coefficients from the linear regression models were similar to those of the logit model. The R-square in the regression models estimated ranged from 0.41 to 0.52.

III. SUMMARY AND CONCLUSIONS

This section evaluates the differences in the Capacity Utilization Models developed for private truck stops in this study, and for public rest areas in the original study. It also identifies some of the broad similarities and differences in truck parking characteristics at private truck stops and public rest areas, and evaluates the significance of the findings from this study in light of the conclusions drawn from the previous study on public rest areas.

A. Overall Model Comparisons

The predictive ability of the Capacity Utilization Model for private truck stops as measured by the percentage of correct predictions in the logit analysis is lower than the results of the logit model developed in the original analysis to examine truck parking at public rest areas.[33] Some of the fundamental differences in the data used for the two models may explain the difference in the predictive power of the two models:

- The public rest area model was based on a sample that was almost twice as large as the one used in this study;

- A considerable lack of variation in the values for the dependent variable (capacity utilization) was observed since approximately 84 percent of the sample represented truck stops that were reported to be either full or overcrowded during the night (see Figure 2);

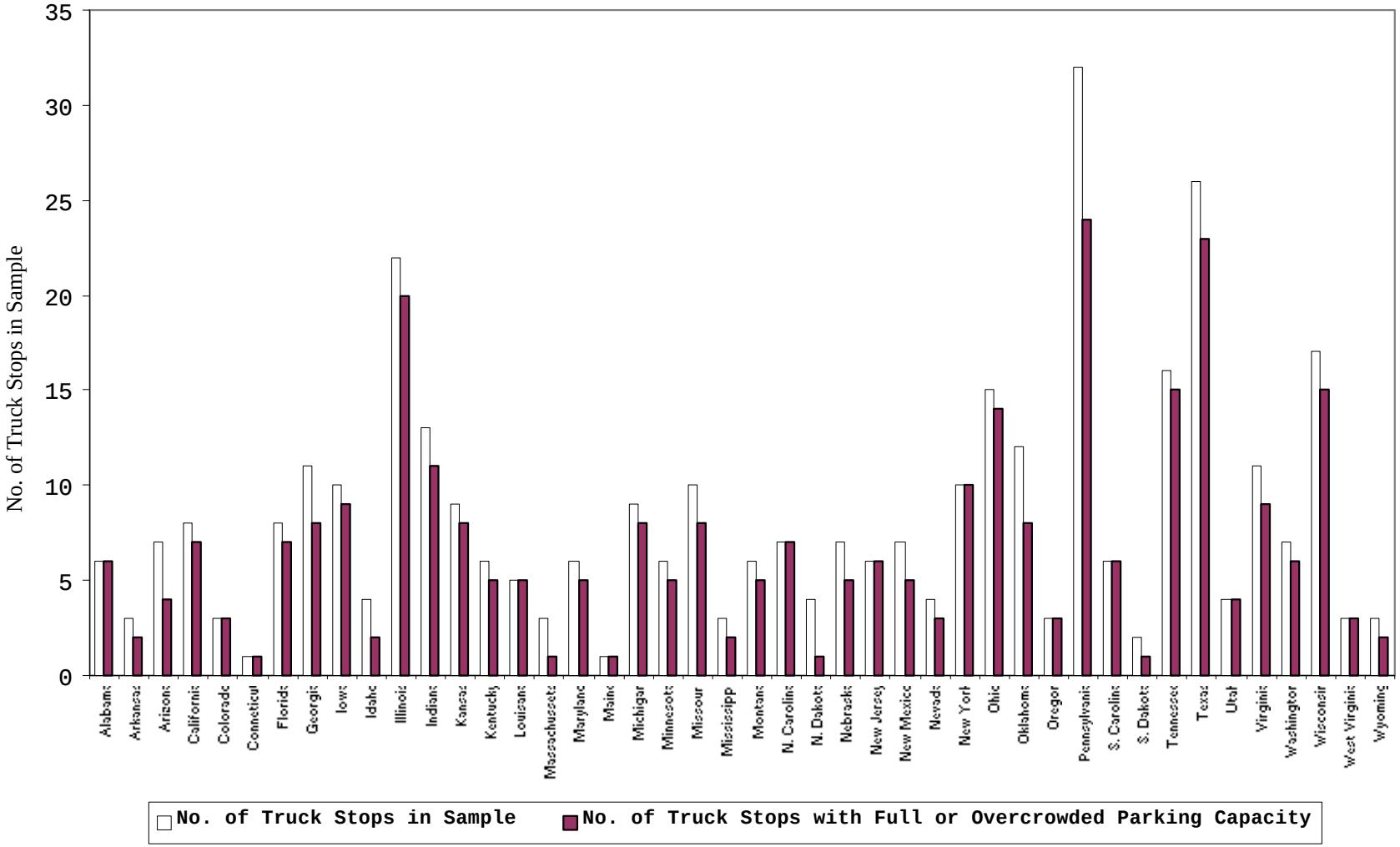
- Although the current database on private truck stops has a wider geographical coverage of the states compared to the public rest area model, the sample of private truck stops that responded within each state was considerably lower than the number of public rest areas, thereby, reducing the possibility of successfully controlling geographical variations in the coefficient estimates;

- Unlike the Capacity Utilization Model of public rest areas, the Private Truck Stop Model was estimated using a simple proxy for ADT values. Considering the importance of this demand-side variable, detailed ADT data may significantly improve the predictive power of the model; and

[33] While the percentage of correct predictions for the private truck stops model was 54.7, the percentage of correct predictions for the public rest area model was 76.1.

- The presence of a large number of dummy variables necessitated by the nature of the information collected led to some serious multicollinearity problems compared to the model developed for public rest areas.

Figure 2. Number of Truck Stops With Full or OverCrowded Parking Capacity By State (Represents Sample Coverage Only)



In terms of the general findings of the two models, certain similarities and differences can also be observed. For example, some of the common variables included in both the models such as ADT, number of truck parking spaces and type of truck parking spaces were found to have similar impacts on capacity utilization at public rest areas and private truck stops. The impact of parking spaces that can accommodate triples or oversized trucks was found to be greater in truck stops as compared to public rest areas. Also, the proximity of a public rest area to a major intersection had a greater impact on capacity utilization as compared to truck stops. In general, however, it is inappropriate to directly compare the results from the two models. As mentioned earlier, significant data differences exist between the two models which have to be reviewed cautiously prior to drawing comparisons between the model results.

B. Substitutability Between Truck Stops and Rest Areas

From a policy standpoint, an important question is whether or not truck drivers view public rest areas and private truck stops as direct substitutes. This question is especially important in light of the findings of the original study that indicated a shortfall in truck parking spaces at public rest areas nationwide. The data collection effort in this study suggests that private truck stops located across the country provide a significant number of truck parking spaces at their facilities. This raises two important questions:

- Is there significant excess truck parking capacity in private truck stops to absorb the shortfall in parking spaces at public rest areas? and
- Will the existence of excess parking capacity at private truck stops, if any, obviate the need for additional parking spaces at public rest areas?

The answer to the first question requires a detailed inventory of truck parking spaces and their utilization levels at all private truck stops nationwide which was beyond the scope of this study. However, as shown in Figure 2, the sample of truck stops in this study indicate that in a vast majority of the truck stops (approximately 84 percent) existing parking capacity is either full or overcrowded during nights.

In order to answer the second question, it is important to first determine whether or not private truck stops and public rest areas are direct substitutes for each other. For example, if the two types of truck parking facilities are determined to be direct substitutes and excess parking capacity exists at private truck stops, the need for providing additional truck parking spaces at public rest areas is reduced. However, if the two facilities are not direct substitutes for each other, then the existence of a shortfall in public rest area parking cannot be absorbed by the presence of excess parking spaces at private truck stops.

The findings and analyses of the study on Private Truck stops and the earlier study on Public Rest Areas offer certain insights to answering whether or not these two types of truck parking facilities along Interstates are direct substitutes. Some of these include:

- *Duration of Parking*: The findings from the direct observation of private truck stops and public rest areas in the earlier study indicate that truck drivers tend to use public rest areas to meet their short-term parking needs such as for short nap or telephone use, and private truck stops for their long-term parking needs such as overnight rest, food requirements, showers, etc.

- *Differences in Range of Services/Facilities*: As indicated by the data collected for the two studies, a significant difference exists in the range of services and facilities offered at these two parking facilities. Private truck stops typically tend to offer a wider range of services compared to public rest areas. In addition, in both the models estimated, the availability of facilities is found to have a statistically significant effect on capacity utilization of parking spaces.

- *Accessibility*: Based on driver survey findings, it appeared that accessability to public and private facilities had some influence on driver choice of a place to stop. Drivers who value accessibility or easy access from the Interstate tend to prefer public rest areas. More than 90 percent of the drivers who mentioned accessibility as an important factor in their choice of a short-term parking place prefer public rest areas. The extent to which this diminished their selection of private rest stops, however, was not determined.

- *Safety and Security Considerations*: The statistical findings in both the studies, and the direct observation, indicate that safety features are significant in explaining capacity utilization of truck parking spaces, and a major reason why drivers prefer private truck stops.

- *Locational Differences*: The issue of substitutability becomes relevant when the truck driver has a simple choice between selecting a private truck stop over a public rest area or vice-versa. For example, if the distance between the private truck stop and the public rest area is great, a driver in need of immediate resting would park at the facility that is closer. The data collected in this study suggest that the average distance between truck stops and rest areas is approximately

  13.7 miles and approximately 40 percent of the truck stops included in the sample were located at least 10 miles from a public rest area.

Some of these general findings from the two studies indicate that private truck stops and public rest areas may not be direct substitutes for each other, but in fact, may serve to complement each other. Although additional empirical evidence is required to arrive at a more definitive

conclusion on this issue, assuming that these truck parking facilities are not direct substitutes, the shortfall in parking spaces at public rest areas continues to remain a real problem which must be addressed in the future. In addition, it is important to note that although truck stops report providing a large number of truck parking spaces, most of these facilities continue to be full or overcrowded. In the sample used for this study, 84 percent of the truck stops indicated their parking capacity is full or overflowing at night (see Figure 2 above).

C. Conclusion

The objective of this analysis was to extend the previous research effort analyzing truck parking at public rest areas by including data on private truck stops located across the nation. The major findings of the analysis are as follows:

- Significant differences in the two databases on truck stops and rest areas prevented the development of a single database to simultaneously model parking space utilization at these two truck parking facilities;

- A stand-alone statistical model of capacity utilization at private truck stops was developed that could successfully predict the impact of demand and supply factors on parking space utilization in 55 percent of the sample.

- One-way average daily traffic (ADT), ease of accessibility to the truck stop, ability of the truck stop to accommodate oversized trucks or triples and security measures were found to have a positive influence on truck parking space utilization;

- Distance of the truck stop from the Interstate, number of available truck parking spaces and the number of facilities offered at the truck stop were found to have a negative impact on parking space utilization; and

- The proximity of the truck stop to a major intersection and the truck stop*s ability to accommodate trucks carrying hazardous materials were found to have no effect on capacity utilization.

Based on the information collected and the analytical findings of the current and previous study, this study finds no conclusive evidence that private truck stops and public rest areas are direct substitutes of each other. This is important because the findings for the Public Rest Area Study estimated a shortfall of 28,400 parking spaces. The lack of evidence of direct substitutability between public rest areas and private truck stops, coupled with reports from surveyed truck stop owners that suggest their facilities are frequently full or overcrowded at night,

suggests that the shortfall of truck parking spaces nationwide continues to remain a problem for creative resolution by both the public and private sector.

SECTION III - POLICY RECOMMENDATIONS

This chapter describes policies and programs that could be used to address the shortage of truck parking nationwide along the Interstate highway system.[34] Both public and private investments should be applied. These would include such actions as those described by private truck stop owners (e.g., privately financed expansion of spaces), as well as public sector initiatives to increase and/or improve the utility of existing spaces at public rest areas. The following pages describe actions that states and localities may undertake to improve parking at public rest areas.

These policy recommendations were developed in three stages. First, policy *evaluation criteria* were established based on background information collected on public rest areas nationwide from each state DOT, surveys of truck drivers, and the results of the modeling process. Second, a *range of policy options* was determined based on the analysis of this background data. These policy options were narrowed through an examination of the evaluation criteria. Costs were estimated for the suggested policy options and shown by state, FHWA region, and the top 10 Interstate corridors facing critical parking shortages nationwide. Finally, a *systematic planning strategy* on a state level was defined.

A. Strategic Goal and Evaluation Criteria

In accordance with Congressional recommendations, the study was undertaken to "evaluate the adequacy of places for truck drivers to stop and rest, both public and private," and to identify potentially effective strategies to ensure that all truckers needing safe parking spaces can access them. In terms of public policy, there could be several options to consider. The ideal policy option provides a substantial increase in parking for trucks, is cost-effective, faces few roadblocks in implementation, has support, and offers flexibility in meeting truck drivers* rest needs. Five summary criteria were used to judge the options.

1. Adequacy: *Is the truck parking generated under this option likely to be adequate to meet truck drivers* needs?*

Not all options are likely to generate sufficient parking to alleviate the parking problem associated with trucking safety and efficiency. Options that fall short, however, should not be dismissed without further consideration; they could possibly fill a gap not met by other options or could be easier or less costly to implement. In judging truck parking adequacy, emphasis should be placed

[34] Data for the analysis were derived from State DOTs, direct observation of demand and capacity truck parking, surveys of truck drivers, and the rest area capacity utilization model and the national truck parking demand model (both described in Section I).

on the ability to add a sufficient number of parking spaces to a corridor so that truck drivers can stop, park safely, and rest. Importance should be placed on areas of high demand and where there is a defined critical truck parking shortage.

2. Implementation Ease: *Are the administrative, legislative, and contractual actions and changes required to implement the options relatively easy?*

This criterion takes into account the administrative, legislative, and contractual actions and changes that are necessary to implement and administer an expanded rest area program. In some cases, minor changes to current legislation are necessary; in other cases, significant changes are required that may carry implications for other Federal programs. Changes in design criteria may also have to be considered.

3. Impacts: *What are the impacts on the key parties actively involved? Are these impacts favorable or unfavorable from their point of view?*

This evaluation focuses on parties that are actively involved or affected in the day-to-day operations: enforcement officials, state DOTs, policy makers at the state and local levels, motor carriers and truck drivers, and other Interstate rest area users. Impacts are divided into two categories:

- Financial impacts, i.e., the effects of an increase in funding for rest areas; and
- Effects on control and decision-making authority for safety issues on Interstates.

The financial impact is straightforward—an increase in funds available for rest area enhancement. The financial impact depends on what proportion (if any) of the financial burden is borne by general taxpayers through other funding arrangements and the impact of the diversion of funds from other activities. From each participant*s point of view (including truck drivers and state DOTs), any change in control, decision-making authority, or engineering and design standards can have a safety impact.

4. Support: *Given the anticipated impacts, what is the expected level of support or potential for opposition from the parties involved?*

This evaluation factor relates to the expected level of support or potential opposition from landowners, truck stop operators, state DOTs, policy makers, and rest area users including trucks, RVs, and cars. The level of expected cooperation is presumed to flow directly from the impacts they anticipate; their expected support or opposition, therefore, can be derived from the preceding evaluation factor.

The level of support or expected opposition depends on several factors:

- Allocation of financial burden;
- Perceived nuisance and devaluation of property values;
- Difficulty in implementing legislative and administrative changes;
- Safety and design concerns, and
- Loss of business at private truck stops.

State DOTs and policy makers may have a different set of motivations than the truck drivers or neighboring landowners. For example, if FHWA funds are diverted to a rest area from other programs, a truck driver may view it positively. It could, however, negatively affect other state and local programs for which the funds were initially targeted.

5. Flexibility: *Is the option sufficiently flexible to accommodate variations in project and regional characteristics?*

Rest area projects vary in engineering, economic, and administrative characteristics. For example, some projects entail a pulloff area without services, others entail minor renovation to create an increase in truck parking capacity with limited services, and others require new construction of a full-service rest area where a rest area did not exist before. These variations depend on the proximity of consecutive rest areas in the region, average daily traffic (ADT), population density, land availability, and a variety of other characteristics.

B. Overview of Options to Increase Truck Parking at Rest Areas

Options for expanding truck parking in rest areas nationwide vary substantially in cost, required engineering, administrative responsibilities, and number of additional parking spaces. The total Federal funding committed to rest area modification, renovation, and new construction nationwide has averaged $42 million annually since 1991. The majority of the funding is dedicated to the maintenance of existing rest area facilities and services.

Options were classified in four categories:

- **Enforcement:** Improve enforcement policies by increasing enforcement of time limits or reducing time limits through regular posting of rest areas to encourage a greater turnover of spaces.

- **Modification:** Modify existing facilities to create additional truck parking spaces by using some of the car parking area for trucks at night or using existing park-and-ride facilities for night overflow parking or by modifying existing ramps at rest

areas. This category provides an alternative use for existing parking areas that are underutilized at night, during the hours of peak truck parking demand.

- **Renovation:** Redesign and reconfigure the parking area of existing facilities to allow for additional truck parking spaces and better use of the parking lot at existing rest areas. This involves upgrading rest areas to allow for maximum and efficient use of parking space, for example, designing diagonal pullthrough spaces instead of the parallel spaces commonly found today.

- **New Construction:** Build new rest areas to allow for additional truck parking spaces.

Each of the four categories includes a number of alternative rest area truck parking options. Evaluation covers two dimensions:

- Overall suitability to increase truck parking at public rest areas in light of the defined evaluation criteria—additional parking adequacy, ease of implementation, expected impacts on parties involved, potential for cooperation from players involved, and programmatic and financial flexibility; and

- Suitability for intended expenditures—administrative, design, modification, renovation, and new construction.

Table III-1 presents the options (for each of the four categories), their advantages, and their disadvantages.

TABLE III-1. Options for Increased Truck Parking at Rest Areas

Options	Advantages	Disadvantages
CATEGORY 1—MODIFICATION		
Option 1a: Use some car parking area for trucks at night	• Low cost • Increases truck parking during peak usage time	• Provides only a few parallel spaces for trucks during nighttime hours • Trucks may still tend to park on shoulders and ramps
Option 1b: Use existing park-and-ride facilities for night overflow parking	• Low costs for signing and publicity to drivers only • Provides parking for periods of high parking volumes • Space for pullthrough-type parking	• Does not provide normal rest area facilities • May require some enforcement to ensure that trucks leave before normal daytime use of lot begins • May only be feasible in select urban areas
CATEGORY 2—RENOVATION		
Option 2a: Minor renovation of rest area parking lot with pull-through type spaces	Maximum use of existing land Provides parking for an additional number of trucks Truck parking is pullthrough-type, allowing better utilization	Moderate capital expense Requires rest area (or sections of the rest area) to be temporarily closed May not provide adequate additional parking for all trucks
Option 2b: Major renovation, convert/redesign existing parking lot to add additional truck parking spaces that are pull-through type.	Maximum use of existing land Provides potentially substantial additional parking for trucks Truck parking is pullthrough-type, which has higher parking utilization than parallel	May require extensive capital expense Requires rest area (or sections of the rest area) to be temporarily closed Extra land may be required May not be feasible at all rest areas
CATEGORY 3—NEW CONSTRUCTION		
Option 3a: Build pulloff areas within the existing right-of-way with no additional facilities	• Supplies additional parking for trucks without cost of a complete rest area • Can provide day time picnic area for cars	• Moderate capital cost • If not visible from the Interstate, drivers may perceive that it is not safe for parking • May be rejected as a safety hazard • May lack public support
Option 3b: Build new rest areas	• Supplies maximum truck parking • Supplies security and service	• May require large capital expense • May require new land • Requires acceleration lane for re-entry. • May lack public support

B.1. Strict Enforcement of Parking Time (Discarded as an Option)

More strenuous state enforcement of time restrictions on commercial motor vehicle parking spaces was initially considered and then eliminated as a viable option for improving accessibility to such spaces. The removal of vehicles through more strict enforcement of time restrictions, in fact, might result in a greater number of commercial vehicle spaces being available at any one time. However, the benefit has to be considered against the impact of tired drivers who would be forced to move on. Commercial drivers need a safe place to park, especially in hours of darkness, in order to regain their alertness by using their sleeper berths or otherwise relaxing in their cab. Strict enforcement may compel tired drivers who can find no other acceptable off-road parking (e.g., private rest stop) to seek unacceptable options: namely, parking on the highway shoulder or at exit ramps, where their presence may constitute a safety hazard for the motoring public.

B.2. Modification

Under this category, parking spaces for trucks could be enhanced using existing land with moderate capital expense and minimal disruption of services. Rest areas could be flexible enough to allow trucks to use the underutilized car parking spaces in the evening hours when the demand for car parking is minimal and truck parking along Interstates is at maximum capacity.

Research findings through state DOTs and other surveys for this project identify a number of key features or characteristics that are important to truck drivers when they look for a place to park and rest short-term, including easy access on and off the Interstate and available parking. At night, the use of car parking at rest areas and existing park-and-ride facilities at rest areas help satisfy the parking characteristics truck drivers seek when they need a space to rest.

Implementation of these modification options require administrative and contractual actions. These options would have low to moderate capital costs because each rest area would be evaluated on an individual basis. The main advantage of modification is that it would be feasible in all areas of the country on all Interstates. It would also relieve the critical shortage of truck parking spaces around metropolitan areas where park-and-ride facilities are most likely to be located.[35]

The flexibility of this category is one of the attractive features. The advantage of modification is that it provides alternative uses for parking areas that are underutilized at night when truck drivers are seeking a short-term resting place. The disadvantage of the option is that it only allows for a minimal number of parking spaces to be added nationally.

[35] For example, Maryland uses some of the park-and-ride facilities for rest area parking in the evening hours. Also, modification of certain rest areas are currently underway in South Carolina.

Although the impacts on truck drivers would be positive, these modification options remain inadequate to solve the magnitude of the parking shortage. The options meet their demands for a safe, short-term place to park and rest, including easy access on and off the Interstate and available parking. They are of moderate expense, do not require additional land, and do not require a large capital expense. Modification alone, however, cannot provide enough parking to meet the nationwide shortfall, and it must be properly designed to minimize accident risk.

Political support and support from state DOTs for this method of increasing parking along Interstates would be strong as it requires little disruption, minimal administrative cost, minimal capital cost, and utilizes existing parking space. Truck drivers are in support of this category as it provides them with a safe, quiet, short-term place to rest.

B.3. Renovation

Many rest areas on Interstate highways were built early in the Interstate program from a design that typically provided about 35 diagonal parking spaces for cars and 12 parallel spaces for trucks. This parking configuration does not accommodate the volume of truck traffic on Interstate highways nor is it is adequate for the type and size of truck using the Interstates today.

The two options involve renovation of existing rest areas and reconfiguring and redesigning the parking areas to allow for additional parking while using existing facilities and services. By renovating the space and using the same land area, a minor renovation of a rest area can increase the number of truck parking spaces by 70 percent (from 16 to 27 spaces) while also converting from parallel parking spaces to diagonal pullthrough spaces. A major renovation can increase the number of truck parking spaces fivefold (from 8 to 40 truck parking spaces) and also can convert truck parking spaces from parallel to the preferred diagonal pullthrough type.[36]

Based on the desires expressed by truck drivers, the concerns of highway safety, and the cost to improve the problem, this category is likely to allow the greatest number of increased truck parking spaces with minimal disruption. Renovation of a rest area requires redesigning the parking area to allow for pullthrough-type truck parking spaces and to reconfigure the car parking to allow for truck parking in the evening hours.

The implementation of these options would require the rest area, or a portion of the rest area, to be closed for a period of time, and it requires a capital expense. Renovation of all rest areas would not be possible due to space limitations or feasible due to cost considerations. Selection of rest areas to be renovated should be based on an evaluation of need and engineering design issues. A rest area renovation program should be implemented only after determining which rest areas within a specific corridor would allow for the number of truck parking spaces to be maximized based on the topography and the existing land at a given rest area.

[36] See Appendix A for rest area renovation examples.

The renovation process should be completed in tiers based on existing and projected traffic volumes, annual usage surveys, and a recommended spacing interval between rest areas. The most critical corridors should be given priority and the program should be structured based on an evaluation of rest areas that are amenable to reconfiguration.

Truck drivers, state DOTs, and policy makers would benefit from this category. Truck drivers would gain the parking necessary to rest and thereby increase safety on the Interstates. There would, however, be a temporary short-term setback from rest area closure for renovation. Local and state policy makers and state DOTs would be able to expand rest area parking without acquiring additional land and with minimal disruption to surrounding neighborhoods to satisfy the safety issues resulting from inadequate rest area parking.

B.4. New Construction

The new construction category consists of two levels of construction: construction of truck pulloff areas within the existing right-of-way with no additional facilities and construction of new rest areas. Financing options for a new rest area facility could include a variety of innovative financing options to overcome the traditional barriers and help the public sector meet the growing demand for truck parking at public rest areas.

The first option, truck pulloff areas, has the benefits of supplying additional parking for trucks without the cost of a full-service rest area and satisfies the needs of truck drivers to have quiet, accessible, and convenient stopping places for short-term rest along the Interstates. The Pennsylvania Turnpike makes the most successful use of these truck pulloff areas where the truck pulloff is adjacent to and visible from the Interstate. Overall, this option offers a moderate capital cost for the benefits derived from additional parking. The second option, building a new rest area, supplies maximum truck parking and adds additional services and facilities, but it requires a large capital expense. These costs, however, could be shared through a low-cost loan program for private operators, tax incentives, public-private partnerships, or a shared facility approach. With a shared facility approach, the public rest area provides the land for additional parking, and a private operator maintains and operates the facility and services.

The impacts of funding options on the active parties—truck drivers, state DOTs, and policy makers—depend on how the funds are structured. Truck pulloff areas require minimal funding, positively affect the tired truck driver, and could quickly increase the number of truck parking spaces on the Interstates. This option would not be of interest to a public/private partnership or the private sector as there are no services provided. The impact of the second option, a new rest area, depends on the financial structure established for construction.

Efforts to support new additional resting space along the Interstates may encounter some practical political difficulties. Difficulties face policy makers at the Federal, state, and local levels because additional funding for rest areas will compete with other investment needs. Also, adjacent landowners may perceive a possible devaluation as a result of noise, trash, and congestion. In some cases, new construction may be more feasible if it is linked with the private sector. Many of the private truck stop operators (44 percent) who participated in this study reported plans to expand truck parking at their facilities. Truck stop operators reported that the biggest obstacles to increasing capacity are cost and the availability of space or land. With a partnership arrangement, low-cost loans, or tax incentives, the public sector could share in the burden of these two obstacles and provide new spaces in a cost-effective way.

The flexibility of this category accommodates variations in project and regional characteristics. New rest area planning should be part of a comprehensive method of increasing Interstate parking. The process should be evaluated based on traffic characteristics, demand patterns, land availability, and topography.

B.5. Comparative Evaluation

Figure III-1 summarizes the evaluation of each of the options relative to the five criteria. These assessments represent a characterization of the conclusions of this work from a national perspective. Clearly, a combination of options will ultimately be necessary to meet additional truck parking needs.

Figure III-1. Summary of Categories by Evaluation Factors

No.	Criteria / Options	ADEQUACY	IMPLEMENTATION EASE	IMPACTS	SUPPORT	FLEXIBILITY
1	**MODIFICATION**					
1a	Use some car parking area for trucks at night	**3**	**M**	**M**	**M**	**3**
1b	Use existing park-and-ride facilities for night overflow parking	**3**	**M**	**M**	**M**	**3**
2	**RENOVATION**					
2a	Minor renovation of rest area parking lot with pullthrough type spaces	**M**	**3**	**3**	**3**	**M**
2b	Major renovation by redesigning parking lot to add additional truck parking spaces	**M**	**F**	**3**	**3**	**3**
3	**NEW CONSTRUCTION**					
3a	Build pulloff areas	**M**	**M**	**M**	**3**	**M**
3b	Build new rest areas	**M**	**F**	**M**	**3**	**3**

M Yes **3** Maybe **F** No

All of the options considered may not be suited to all geographical areas with their utility depending on land costs and availability, population density, average daily traffic, and percentage of truck traffic. Truck pulloff areas, for example, may be appropriate for rural areas with great distances between rest areas and a need for a short-term rest solution. Modification is useful in an area where there is a need for an increase in a limited number of spaces or near an urban area where park-and ride facilities are available. Rest area renovation, both minor and major, is appropriate for rest areas where the existing design can be reconfigured and for which the renovation can expand both the number and type of truck parking spaces significantly. New rest areas are appropriate where land is available and capital funds are made accessible either through public and/or private sources.

In general, modification and renovation encompass the most cost-effective options, as shown in Figure III-1. A modification program would be relatively easy to implement and would have no impact on neighboring landowners. Modification is only possible, however, at a select group of public rest areas and will only expand parking modestly at existing rest areas. The nighttime conversion of park-and-ride lots to truck parking is generally limited to urban areas across the country and will not serve as a solution for non-urban markets; this program, however, could help truck parking issues in select urban areas. A modification program would not substantially improve the rest area truck parking shortage nationwide.

Renovation offers the potential for the greatest number of additional parking spaces at a moderate capital cost. A renovation program would make the greatest use of existing land and would receive support from state DOTs, policy makers, and truck drivers. Renovation would only be possible on a case-by-case basis if a rest area could be reconfigured to allow for increased parking.

Enforcement would not greatly improve the parking requirements nationwide and may compromise highway safety if, for example, resting hours are limited or enforced at public rest areas and an alternative resting solution is not offered. This category has high administrative costs and low probability of support or implementation. There is little support from the perspective of enforcement or safety officials.

Although new construction incurs the greatest expense, it also offers the greatest advantage to solving the rest area parking shortage. There is, however, some uncertainty as to whether it would receive political and local support without a new financing initiative.

C. Cost Projections: A Public Rest Area Program

Based on the evaluation described above, this section presents a summary of the estimated costs of a program designed to cost-effectively meet the public rest area parking shortfall. To do so, a four-step methodology was adopted:

(i) *Four promising options*—truck pulloff areas, minor renovation of existing rest areas, major renovation of existing rest areas, and new rest areas—were differentiated based on the number of parking spaces that could be added.

(ii) The approximate construction *cost per parking space* was estimated under each of the four options. These costs reflect only the costs for parking spaces and do not include costs for services or facilities. Likewise, the estimates are for paving only and do not reflect other associated construction costs.

(iii) The total shortfall in truck parking spaces at *individual rest areas* was analyzed to determine the program category most appropriate to add parking spaces to meet current requirements.

(iv) A *low-high cost sensitivity analysis* and aggregation was derived to estimate total cost projections to meet current requirements for truck parking spaces.

A detailed analysis of the individual case studies on renovation and new construction of rest areas provided valuable cost data for the four options considered to add new truck parking spaces along Interstates. Table III-2 summarizes the options and provides the estimated average cost implications.

TABLE III-2. Summary of Rest Area Options Considered

Options	Potential for Additional Spaces	Average Cost for Space*	
		Low	High
Truck Pulloff	0-10 Spaces	$ 5,000	$ 7,000
Minor Renovation	11-35 Spaces	$10,000	$15,000
Major Renovation	36-50 Spaces	$20,000	$25,000
New Rest Area	>50 spaces	$30,000	$35,000

* Based on information derived from truck stop operators and national rest area database (developed for this study).

For projecting cost estimates, 1,035 rest areas were used. From the total effective sample of 1,307 rest areas available in the database, data on the current stock of truck parking spaces were not available for 117 rest areas.[37] In addition, 155 rest areas in the total sample were estimated to have a surplus number of parking spaces and were excluded from the sample used for cost analysis (since a surplus of spaces in one rest area cannot be transferred to another to alleviate a shortfall). Therefore, the final sample size—the basis for national level cost projections—consists of a total of 1,035 public rest areas requiring 28,400 additional parking spaces (see Table III-3 next page).

[37] Although the Wilbur Smith database contained data on a total of 1,487 rest areas nationwide, only 1,307 of those could actually be used in the analysis. Data on a number of different variables were missing from the database on the 180 records that were left out of the final sample.

TABLE III-3. Summary of Rest Areas Considered for Cost Analysis	
Rest Areas with Excess Capacity	155
Rest Areas with Actual Truck Parking Spaces Data Missing	117
Sample Used for Cost Analysis	1,035
TOTAL Rest Areas	**1,307**

C.1 Analysis of the Current Shortfall Per Rest Area

To apply the average cost estimates outlined above, the total shortfall had to be analyzed on an individual rest area basis. The goal of this analysis was to group the additional space requirements for each rest area under the four renovation/new construction options to facilitate the application of the cost assumptions.

Figure III-2 presents a cumulative frequency distribution histogram of the total shortfall on a per rest area basis. The figure should be interpreted in this manner: the curved cumulative frequency line is read off the axis on the right which ranges from 0 to 100 percent. For example, approximately 9 percent of all the rest areas included in the sample require five or fewer additional parking spaces per rest area.

Therefore, a majority (about 95 percent) of the rest areas in the sample require 50 or fewer additional truck parking spaces per rest area. Approximately 65 percent of the rest areas inventoried require 35 or fewer additional truck parking spaces. Fifteen percent of the total rest areas require 10 or fewer parking spaces per rest area. The majority of rest areas inventoried require 20 to 40 additional truck parking spaces. The distribution of the number of additional parking spaces per rest area is used to categorize the potential option under each of the four options considered.

Approximately 43 percent of all the additional spaces may be added under minor renovation. Thirty-five percent of the shortfall in truck parking spaces may be added under the option of major renovation. The construction of new rest areas may be required to provide about 20 percent of the total shortfall in parking spaces. The remaining spaces may be added under the truck pulloff option, which is the least costly alternative available. The distribution of the number of additional parking spaces per rest area is used to categorize the potential option under each of the four options considered (see Table III-4). The total cost of providing the additional estimated 28,400 truck parking spaces ranges from $489 to $629 million.

Similarly, approximately 78 percent of all the rest areas in the sample require 40 or fewer additional parking spaces per rest area. The frequency bars should be read off the left axis, which ranges from 0 to 250. For example, approximately 87 of the rest areas included in the sample require 10 additional parking spaces each. Similarly, approximately 220 rest areas included in the sample require 40 additional parking spaces each.

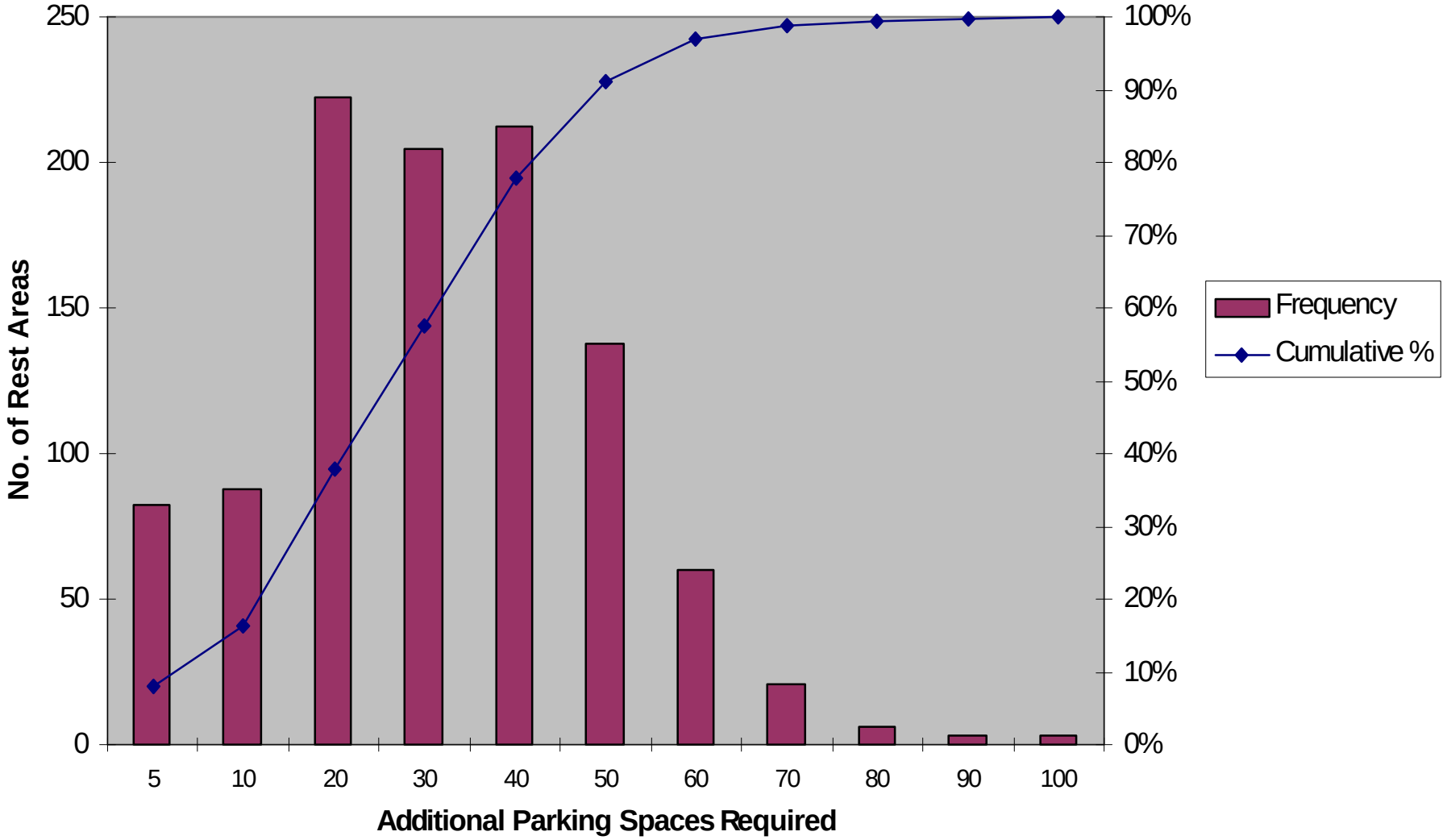


FIGURE III-2. Frequency Distribution of Additional Parking Spaces required

TABLE III-4. Summary of Total Cost Estimates by Option Type				
Option	**Total Number of Additional Spaces**	**Average Cost Per Space***		**Total Estimated Costs (in $millions)**
		Low	**High**	
Truck pulloff areas	874	$ 5,000	$ 7,000	$4-6
Minor renovation	12,172	$10,000	$15,000	$122-183
Major renovation	9,763	$20,000	$25,000	$195-244
New rest areas	5,604	$30,000	$35,000	$168-196
All Options	**28,412**			**$489-629**

* Based on information derived from truck stop operators and national rest area database (developed for this study).

C.2 Cost Projections by State and FHWA Region

Table III-5 presents the estimated cost projections, by state, of adding truck parking spaces at rest areas under each of the four options considered. The summary table shows the number of additional spaces required under all options based on the shortage defined at each rest area. For example, if a rest area had less than 10 spaces required, a truck pulloff area was suggested. If a rest area was lacking in over 50 spaces, a new rest area was proposed. The total estimated costs of adding the parking spaces based on the option defined was then calculated. The total estimated cost columns indicate both a low and a high range for cost estimates. (Costs associated with the construction and renovation of parking spaces vary significantly among states.) The total estimated costs for adding the 28,400 parking spaces under all the four options combined ranges from approximately $489 million to $629 million. The states requiring the greatest expenditures are South Carolina, Florida, and Pennsylvania. The states requiring the least expenditures are Nevada, Montana, and Indiana.

Table III-5. Summary of Cost Estimates by State

State	Total - All Options		
	Total Spaces^	Low	High
Pennsylvania	1982	35.4	45.3
Florida	1669	30.3	38.6
South Carolina	1268	28.7	35.1
Virginia	1322	24.9	31.5
Connecticut	1025	26.0	31.1
North Carolina	1352	23.4	30.1
New Jersey	874	21.5	25.6
Georgia	969	19.5	24.3
Texas	1097	18.6	24.1
New York	1181	18.0	23.7
California	1118	16.7	22.2
Louisiana	1017	16.6	21.6
Iowa	969	15.1	19.8
Minnesota	813	14.5	18.4
Kentucky	733	14.7	18.3
Missouri	919	12.9	17.5
Arizona	609	10.4	13.4
Tennessee	627	12.8	15.9
Wisconsin	715	11.5	15.1
Illinois	845	10.3	14.4
West Virginia	625	10.4	13.5
Arkansas	856	12.1	16.2
Washington	570	10.5	13.2
Michigan	614	7.9	10.9
Oregon	533	8.3	10.9
Ohio	574	7.8	10.5
New Hampshire	327	7.4	9.0
Maryland	265	7.7	9.0
Colorado	420	6.3	8.3
Massachusetts	392	6.2	8.2
Nebraska	396	3.8	5.7
Idaho	336	4.1	5.7
Kansas	397	3.6	5.4
Utah	263	3.3	4.6
Maine	181	2.8	3.7
Oklahoma	220	2.1	3.2
North Dakota	115	0.9	1.3
South Dakota	77	0.6	0.9
Vermont	58	0.6	0.9
Montana	34	0.2	0.2
Nevada	54	0.1	0.2
Indiana*	1	0.0	0.0
Alabama*	NA	NA	NA
Rhode Island*	NA	NA	NA
Wyoming*	NA	NA	NA
New Mexico*	NA	NA	NA
Mississippi*	NA	NA	NA
Delaware*	NA	NA	NA
Total	28,412	489.5	628.9

^:Additional spaces needed, by state. *: Incomplete data

NA: Insufficient data to determine shortfall estimates Source: Apogee Research

Table III-6 presents the cost projections for the nine FHWA-classified regions. As the table indicates, the largest investment is required in Region 4, which consists of Florida, Georgia, Kentucky, North Carolina, South Carolina, and Tennessee. The total cost estimate for meeting the current demand in truck parking spaces for this region ranges from

$129 million to $162 million. Region 1, which consists of Connecticut, Massachusetts, Maine, New Hampshire, New Jersey, New York, and Vermont, requires the second largest investment for providing additional parking spaces. The total projected costs for this region range from approximately $83 million to $103 million. In fact, Regions 1 and 4 together account for approximately 43 percent of the total projected costs. The problem, from a total investment standpoint, is least critical in Regions 8 and 10, which require an outlay of approximately $11 to $15 million and $23 to $30 million, respectively.

TABLE III-6. Summary of Total Regional Cost Estimates by Option Type

FHWA Region	Truck Pulloff (spaces)	Minor Renovation (spaces)	Major Renovation (spaces)	New Rest Areas (spaces)	Total Cost ($ millions)
1	106	1,356	812	1,763	$83-$103
3	22	1,544	1,608	1,022	$78-$99
4	28	1,677	3,496	1,417	$129-$162
5	161	2,022	1,030	348	$52-$69
6	22	1,666	1,165	337	$48-$62
7	144	1,711	719	108	$35-$48
8	174	473	212	51	$11-$15
9	126	1,030	298	327	$29-$39
10	92	693	423	231	$23-$30
All Regions	**874**	**12,172**	**9,763**	**5,604**	**$489-$629**

C.3. Cost Projections for Top 10 Critical Corridors

The 10 Interstate corridors in which the shortfall in parking spaces is most critical are presented in Table III-7. The table indicates the total cost projections for all of the four options for the 10 critical corridors. The largest outlay, which ranges from $57 million to

$71 million, is required in the I-95 corridor, where approximately 2,700 more spaces need to be added under the option of new rest areas (the most expensive option considered). Total potential outlays for the remaining corridors typically range between $20 million and

$30 million. Approximately 80 percent of all additional spaces along these 10 corridors may be added under the options of minor and major renovation. The remaining spaces may be provided through truck pulloff areas and the construction of new rest areas.

TABLE III-7. Summary of Cost Estimates by Top 10 Critical Corridors			
Interstate	**Total Spaces**	**Total - All Options Estimate Cost ($ millions)**	
		Low	**High**
I-95	2,721	57.1	70.7
I-80	1,832	25.5	34.5
I-5	1,509	23.0	30.4
I-40	1,471	27.3	34.6
I-10	1,468	23.0	30.3
I-90	1,297	18.7	24.8
I-70	1,208	18.0	29.4
I-81	1,189	23.5	35.4
I-75	1,174	19.7	25.4
I-35	1,163	20.0	25.7
Total	**15,032**	**255.8**	**341.2**

D. Summary

The study finds a current shortfall of 28,400 truck parking spaces in rest areas nationwide. The cost to meet this demand totals approximately $489 million to $629 million. This summary section outlines a strategy to help facilitate future rest area spending decisions over the next 10 years.

Data provided by the Federal Highway Administration indicates that a total of $48.1 million in Federal funds was obligated for rest area-related projects in 1994, resulting in $60 million of investment including the non-federal match. (Data were not available on state only spending.) Since 1991, a total of $168 million ($210 million with the non-federal match) has been spent to renovate or expand public rest areas. This spending rarely results in new rest areas or additional truck parking spaces at existing rest areas and are typically used for resurfacing, additional lighting, and expansion of sanitary facilities.

If the total investment required is spread over a period of 10 years, the average annual expenditures on rest areas will be in the range of approximately $49 to $63 million before inflation, a figure close to the current spending on public rest areas. The study also indicates that the most cost-effective way to increase the number of parking spaces to meet the requirements is to renovate existing rest areas and, where necessary, build new facilities.

A clear public policy approach should be developed to analyze current spending practices and integrate truck parking requirements into state DOT planning. After defining a need or demand, solutions must be developed through an orderly planning process and stated in terms of a program. To ensure commitments to a rest area development program, objectives should be established, priorities set, and funding levels defined as part of an overall state development objective.

One suggested approach is to establish a systematic planning strategy on a state level base on a correlational analysis that identifies rest areas where immediate assistance is required in terms of providing additional truck parking spaces. This analysis could also be used to:

- examine the relationship between accident rates and parking shortfall estimates—earlier studies have suggested that a shortfall in truck parking spaces may contribute to accidents, and

- examine the relationship between maintenance expenditures on damaged shoulders and the shortfall in truck parking spaces—shoulder damage may be a consequence of increased illegal shoulder parking by trucks as a result of their inability to park at rest areas due to the unavailability of parking spaces.

Essentially, this approach defines an orderly planning process and is a foundation for initiating a comprehensive statewide rest area program.

The results of this research suggest that there is a significant, national shortage of truck parking spaces at night along the Interstate system. Failure to solve the truck parking shortage could pose significant risks to the traveling public by forcing tired drivers to continue driving or park on inherently dangerous locations such as ramps and shoulders.

E. Future Research

E.1 Capacity Utilization Model

- Increase the sample size to include additional rest areas from states excluded from the model due to the unavailability of complete data.

- Develop a similar econometric model on a regionwide basis to control for potential differences across regions on truck parking usage at rest areas.

- Incorporate additional and more specific data on the independent variables that were represented using dummy variables in the model. This will enhance the variance in the independent variables and may add to the overall predictive power of the model.

- Apply the model to data collected at different times of the year to shed light on seasonal differences in rest area usage by trucks.

E.2 Truck Parking Demand Model

The possible extensions to the Truck Parking Demand Model include:

- Increasing the sample size to include additional data on rest areas that were excluded from the original model because the data was unavailable.

- Applying the methodology to a corridor-specific database to provide actual data on the parameters of the model and to substitute the use of recommended parameters.

- Incorporating similar data on currently available truck parking spaces at private truck stops to increase the efficiency of the model to predict the current shortfall in truck parking spaces at public rest areas.

The framework and findings of the study provide useful information regarding the application of the models on a statewide or regionwide level. The findings suggest important policy implications regarding the need for additional truck parking spaces across the nation. The usable products of this study include the Capacity Utilization Model and the Apogee Demand Model. Both models can be applied on a statewide, regionwide, and corridor level to assess the need for and to estimate additional truck parking spaces at public rest areas. Researchers have recommended that future research should concentrate on enhancing the currently available database to include data on all rest areas across the nation. Regular updating of the database and the models will provide input to policy initiatives regarding trucking safety along Interstates.