Evaluating the Appropriate Level of Service for Michigan Rest Areas and Welcome Centers Considering Safety and Economic Factors

Executive Summary

ORBP Reference Number: OR10-045

Prepared For:

Michigan Department of Transportation
Office of Research and Best Practices
425 West Ottawa
Lansing, MI 48933

Prepared By:

Wayne State University
Transportation Research Group
5050 Anthony Wayne Drive
Detroit, MI 48202

Authors:

Timothy J. Gates, Ph.D., P.E.
Peter T. Savolainen, Ph. D., P.E.
Tapan K. Datta, Ph.D., P.E.
Ryan G. Todd, and
Stephanie Boileau

April 30, 2012

EXECUTIVE SUMMARY

The Michigan Department of Transportation (MDOT) currently operates and maintains 81 rest areas, including 14 welcome centers, along freeways and other major roadways. Public rest areas in Michigan serve a broad range of travelers, including vacation/recreational travelers, commercial vehicle operators, commuters, motorcyclists, bus tours, and others. A majority of travelers stopping at rest areas desire a restroom break or simply a stretch or short break. Other patrons utilize rest areas for picnicking, vending machines, relief for children or pets, vehicle maintenance, to change drivers, obtain travel information, or even sleep. Rest areas provide the distinct advantage of quick access and facilities that are open 24 hours per day.

Recent economic challenges have forced MDOT to reassess the functional value of rest areas, particularly those near commercial service facilities, such as gas stations, fast-food restaurants, or truck stops, as these locations typically provide services similar to or above those provided at rest areas. However, commercial service facilities do not provide the level of convenient access provided by most rest areas and do not possess many of the unique intrinsic benefits present at rest areas. Although MDOT has closed rest area facilities in the past due to various reasons, there were several issues related to rest area closure that required thorough investigation before such decisions could be made. As MDOT was scheduled to update the *Strategic Rest Area/Welcome Center Plan* in 2012, it was necessary to perform research to investigate these issues.

Although it is generally acknowledged that rest areas possess many intrinsic benefits to motorists, the safety and economic impacts associated with Michigan rest areas and welcome centers have remained largely unknown. As such, it was necessary to determine the value of rest areas to both users and MDOT. The overall goal of this research was to determine the value of rest areas and welcome centers, both individually and as a system, to determine the appropriate level of service for rest areas on MDOT roadways. Consideration was given to both the economic value of rest areas, in addition to the functional value provided by rest areas. Several tasks were performed as part of this research to help achieve this goal.

The research began with a comprehensive state-of-the-art review of rest area management and operations in the United States. From there, a comprehensive inventory of MDOT's existing rest areas and alternative commercial service facilities, including gas stations, fast food restaurants, and truck stops, was performed. Fatigue-related crash data were collected

and analyzed to determine potential safety impacts that are impacted by the presence or absence of rest areas. Face-to-face user surveys were performed at both rest areas and selected commercial service facilities to better understand why travelers select one type of facility over another and to provide insight as to how users value the services utilized during a rest area stop. Telephone surveys of truck stop operators were also performed along with nighttime truck parking utilization surveys to identify parking capacity issues along the major trucking routes. Data were collected regarding utilization characteristics of each rest area in order to determine usage trends and patterns for the rest area network. Economic data associated with rest areas, including benefits and costs, were also either obtained or estimated. These data were utilized to calculate the benefit/cost ratio for MDOT rest areas – both individually and as a system – according to the following equation:

$$\frac{B}{C} = \frac{\begin{array}{c}Vehicle\ Operating\ Benefits + Excess\ Travel\ Time\ Benefits + Comfort\ and\ Convenience\ Benefits \\ + Tourism\ Benefits + Safety\ Benefits\end{array}}{Amortized\ Construction\ Costs + Annual\ Operating\ Costs + Annual\ Maintenance\ Costs}$$

The results of the economic analysis showed that nearly all but three MDOT rest areas and welcome centers currently possess B/C ratios that exceed 1.0, with values for the 81 individual facilities ranging between 0.78 and 11.66. Thus, with few exceptions, each of the 81 facilities may be considered economically viable. The total systemwide benefits for 2011 totaled $88.65 million, compared to total costs of $19.43 million. The systemwide B/C ratio was found to be 4.56. This overall B/C value fell within the range of 3.2 to 7.4 reported in previous research. A majority of the benefits originated from a combination of comfort/convenience (i.e., the "value" to users), reduction of targeted fatigue-related crashes (estimated at 3.37 crashes per facility per year) and tourism benefits (welcome centers only).

Many of the monetary benefits associated with a facility were calculated based largely on traffic or visitor volumes and the subsequent B/C ratios were strongly correlated with facility utilization. Accordingly, the facilities with the highest economic value included the large, heavily utilized welcome centers in the Lower Peninsula (due to tourism, comfort/convenience, and fatigue crash reduction benefits) along with heavily utilized rest areas along major freeways in the southern Lower Peninsula (due to comfort/convenience and fatigue crash reduction benefits). The least economically viable facilities were those with the lowest utilization rates –

particularly facilities located in the North and Superior Regions and especially those that are closed during winter months.

In addition to assessment of the various economic related components that are associated with rest areas, it was also important to consider other factors that could not be monetarily quantified when determining the relative value of each rest area and welcome center facility. Such non-economic factors included those related to the availability of alternate facilities, including other rest areas, commercial truck stops, fast food restaurants, and gas stations, along with several facility-related features. An overall value index score was calculated with equal consideration given to economic and non-economic factors. The three top scoring facilities based on the value index were the Clare, New Buffalo, and Monroe Welcome Centers. These facilities were clearly separated from the others in terms of overall value scores and were followed by the Coldwater Welcome Center and the Portland, Belleville, Northfield Church, Potterville, Glenn, Turkeyville, and Battle Creek Rest Areas.

Although the economic and functional values were computed for each rest area and also systemwide, they only represent a "snapshot" based on current data and assumptions. To provide flexibility for future forecasting and planning, the economic, functional, and overall value assessment methodologies were embedded into an Excel spreadsheet, allowing the user to update any data, weights, and/or other assumptions, as necessary. This also makes it possible to experiment with the addition of a new rest area – or removal of an existing rest area – and receive an estimate of the resulting impacts, both on the nearby facilities and systemwide. This software tool has been provided to MDOT in Excel format as a companion to this report.

As all but three current facilities possess B/C ratios greater than 1.0, implementation of new rest area facilities would likely prove to be economically viable for MDOT. This is particularly true if the facility was to fill an existing gap on the limited access freeway system in southern Michigan, particularly within the Grand or Southwest Region along eastbound I-94 or northbound US-131 or along M-6. Consider also that the availability of commercial service facilities is especially sparse in northeast and northwest Lower Peninsula, and the northern Thumb area, suggesting the potential need for a facility along US-23, M-25, US-31, or M-115 in those areas. Other candidate roadways for additional rest areas or expansion of existing truck parking facilities include the section of I-94 from the Indiana border to Detroit and I-75 from the Ohio border to Saginaw as severe nighttime truck parking capacity issues were noted at both rest areas and commercial truck stops.

Evaluating the Appropriate Level of Service for Michigan Rest Areas and Welcome Centers Considering Safety and Economic Factors

Final Report

ORBP Reference Number: OR10-045

Prepared For:

Michigan Department of Transportation
Office of Research and Best Practices
425 West Ottawa
Lansing, MI 48933

Prepared By:

Wayne State University
Transportation Research Group
5050 Anthony Wayne Drive
Detroit, MI 48202

Authors:

Timothy J. Gates, Ph.D., P.E.
Peter T. Savolainen, Ph. D., P.E.
Tapan K. Datta, Ph.D., P.E.
Ryan G. Todd, and
Stephanie Boileau

April 30, 2012

Evaluating the Appropriate Level of Service for Michigan Rest Areas and Welcome Centers Considering Safety and Economic Factors

MDOT ORBP Project Number: OR10-045

FINAL REPORT

By Timothy J. Gates, Ph.D., P.E., Peter T. Savolainen, Ph.D., P.E., Tapan K. Datta, Ph.D., P.E., Ryan G. Todd, and Stephanie Boileau

Wayne State University - Transportation Research Group
April 30, 2012

1. Report No. RC-1570	**2. Government Accession No.** N/A	**3. MDOT Project Manager** Lynn Lynwood
4. Title and Subtitle Evaluating the Appropriate Level of Service for Michigan Rest Areas and Welcome Centers Considering Safety and Economic Factors		**5. Report Date** April 30, 2012 **6. Performing Organization Code** N/A
7. Author(s) Timothy J. Gates, Peter T. Savolainen, Tapan K. Datta, Ryan G. Todd, and Stephanie Boileau		**8. Performing Org. Report No.** N/A
9. Performing Organization Name and Address Wayne State University-Transportation Research Group Department of Civil and Environmental Engineering 5050 Anthony Wayne Drive, Room #0504 Detroit, MI 48202		**10. Work Unit No. (TRAIS)** N/A **11. Contract No.** 2010-0298 **11(a). Authorization No.** Z1
12. Sponsoring Agency Name and Address Michigan Department of Transportation Research Administration 425 West Ottawa Street Lansing MI 48933		**13. Type of Report & Period Covered** Final Report 5/2/2011 to 4/30/2012 **14. Sponsoring Agency Code** N/A

15. Supplementary Notes
None

16. Abstract
Research was performed to determine the value of public rest areas in Michigan, including welcome centers. A benefit/cost (B/C) economic analysis procedure was utilized to assess rest areas both individually and as a system. The benefits associated with rest areas included: travel diversion cost savings, comfort and convenience benefits, increased tourism spending (welcome centers only), and crash reductions. The costs associated with rest areas included amortized construction costs, operating costs, and routine maintenance costs. The results of the economic analysis showed that nearly all MDOT rest areas currently possess B/C ratios that exceed 1.0. The systemwide B/C ratio was estimated at 4.56 with individual values for the 81 facilities ranging between 0.78 and 11.66. A majority of the benefits originated from a combination of comfort/convenience (i.e., the "value" to users), reduction of targeted fatigue-related crashes (estimated at 3.37 crashes per facility per year) and tourism benefits (welcome centers only). The facilities with the highest B/C ratios included heavily utilized facilities located on major limited-access freeways in the lower peninsula of Michigan. The facilities with the lowest B/C ratios were underutilized facilities with high operation and maintenance costs – particularly facilities located in northern Michigan and especially those that are closed during winter months. A value index for overall prioritization of rest area facilities was computed for each facility considering the B/C ratio along with several non-economic functional factors. To provide flexibility for future forecasting and planning, a software tool was developed to allow for estimation of the impacts associated with the removal of an existing facility or addition of a new facility to the network.

17. Key Words Rest Areas, Welcome Centers, Economics, B/C Ratio, Functional Values	**18. Distribution Statement** No restrictions. This document is available to the public through the Michigan Department of Transportation

19. Security Classification - report Unclassified	**20. Security Classification - page** Unclassified	**21. No. of Pages** 132	**22. Price** N/A

TABLE OF CONTENTS

LIST OF TABLES

PAGE

LIST OF FIGURES

PAGE

EXECUTIVE SUMMARY

The Michigan Department of Transportation (MDOT) currently operates and maintains 81 rest areas, including 14 welcome centers, along freeways and other major roadways. Public rest areas in Michigan serve a broad range of travelers, including vacation/recreational travelers, commercial vehicle operators, commuters, motorcyclists, bus tours, and others. A majority of travelers stopping at rest areas desire a restroom break or simply a stretch or short break. Other patrons utilize rest areas for picnicking, vending machines, relief for children or pets, vehicle maintenance, to change drivers, obtain travel information, or even sleep. Rest areas provide the distinct advantage of quick access and facilities that are open 24 hours per day.

Recent economic challenges have forced MDOT to reassess the functional value of rest areas, particularly those near commercial service facilities, such as gas stations, fast-food restaurants, or truck stops, as these locations typically provide services similar to or above those provided at rest areas. However, commercial service facilities do not provide the level of convenient access provided by most rest areas and do not possess many of the unique intrinsic benefits present at rest areas. Although MDOT has closed rest area facilities in the past due to various reasons, there were several issues related to rest area closure that required thorough investigation before such decisions could be made. As MDOT was scheduled to update the *Strategic Rest Area/Welcome Center Plan* in 2012, it was necessary to perform research to investigate these issues.

Although it is generally acknowledged that rest areas possess many intrinsic benefits to motorists, the safety and economic impacts associated with Michigan rest areas and welcome centers have remained largely unknown. As such, it was necessary to determine the value of rest areas to both users and MDOT. The overall goal of this research was to determine the value of rest areas and welcome centers, both individually and as a system, to determine the appropriate level of service for rest areas on MDOT roadways. Consideration was given to both the economic value of rest areas, in addition to the functional value provided by rest areas. Several tasks were performed as part of this research to help achieve this goal.

The research began with a comprehensive state-of-the-art review of rest area management and operations in the United States. From there, a comprehensive inventory of MDOT's existing rest areas and alternative commercial service facilities, including gas stations, fast food restaurants, and truck stops, was performed. Fatigue-related crash data were collected

and analyzed to determine potential safety impacts that are impacted by the presence or absence of rest areas. Face-to-face user surveys were performed at both rest areas and selected commercial service facilities to better understand why travelers select one type of facility over another and to provide insight as to how users value the services utilized during a rest area stop. Telephone surveys of truck stop operators were also performed along with nighttime truck parking utilization surveys to identify parking capacity issues along the major trucking routes. Data were collected regarding utilization characteristics of each rest area in order to determine usage trends and patterns for the rest area network. Economic data associated with rest areas, including benefits and costs, were also either obtained or estimated. These data were utilized to calculate the benefit/cost ratio for MDOT rest areas – both individually and as a system – according to the following equation:

$$\frac{B}{C} = \frac{\begin{array}{c}Vehicle\ Operating\ Benefits + Excess\ Travel\ Time\ Benefits + Comfort\ and\ Convenience\ Benefits \\ + Tourism\ Benefits + Safety\ Benefits\end{array}}{Amortized\ Construction\ Costs + Annual\ Operating\ Costs + Annual\ Maintenance\ Costs}$$

The results of the economic analysis showed that nearly all but three MDOT rest areas and welcome centers currently possess B/C ratios that exceed 1.0, with values for the 81 individual facilities ranging between 0.78 and 11.66. Thus, with few exceptions, each of the 81 facilities may be considered economically viable. The total systemwide benefits for 2011 totaled $88.65 million, compared to total costs of $19.43 million. The systemwide B/C ratio was found to be 4.56. This overall B/C value fell within the range of 3.2 to 7.4 reported in previous research. A majority of the benefits originated from a combination of comfort/convenience (i.e., the "value" to users), reduction of targeted fatigue-related crashes (estimated at 3.37 crashes per facility per year) and tourism benefits (welcome centers only).

Many of the monetary benefits associated with a facility were calculated based largely on traffic or visitor volumes and the subsequent B/C ratios were strongly correlated with facility utilization. Accordingly, the facilities with the highest economic value included the large, heavily utilized welcome centers in the Lower Peninsula (due to tourism, comfort/convenience, and fatigue crash reduction benefits) along with heavily utilized rest areas along major freeways in the southern Lower Peninsula (due to comfort/convenience and fatigue crash reduction benefits). The least economically viable facilities were those with the lowest utilization rates –

particularly facilities located in the North and Superior Regions and especially those that are closed during winter months.

In addition to assessment of the various economic related components that are associated with rest areas, it was also important to consider other factors that could not be monetarily quantified when determining the relative value of each rest area and welcome center facility. Such non-economic factors included those related to the availability of alternate facilities, including other rest areas, commercial truck stops, fast food restaurants, and gas stations, along with several facility-related features. An overall value index score was calculated with equal consideration given to economic and non-economic factors. The three top scoring facilities based on the value index were the Clare, New Buffalo, and Monroe Welcome Centers. These facilities were clearly separated from the others in terms of overall value scores and were followed by the Coldwater Welcome Center and the Portland, Belleville, Northfield Church, Potterville, Glenn, Turkeyville, and Battle Creek Rest Areas.

Although the economic and functional values were computed for each rest area and also systemwide, they only represent a "snapshot" based on current data and assumptions. To provide flexibility for future forecasting and planning, the economic, functional, and overall value assessment methodologies were embedded into an Excel spreadsheet, allowing the user to update any data, weights, and/or other assumptions, as necessary. This also makes it possible to experiment with the addition of a new rest area – or removal of an existing rest area – and receive an estimate of the resulting impacts, both on the nearby facilities and systemwide. This software tool has been provided to MDOT in Excel format as a companion to this report.

As all but three current facilities possess B/C ratios greater than 1.0, implementation of new rest area facilities would likely prove to be economically viable for MDOT. This is particularly true if the facility was to fill an existing gap on the limited access freeway system in southern Michigan, particularly within the Grand or Southwest Region along eastbound I-94 or northbound US-131 or along M-6. Consider also that the availability of commercial service facilities is especially sparse in northeast and northwest Lower Peninsula, and the northern Thumb area, suggesting the potential need for a facility along US-23, M-25, US-31, or M-115 in those areas. Other candidate roadways for additional rest areas or expansion of existing truck parking facilities include the section of I-94 from the Indiana border to Detroit and I-75 from the Ohio border to Saginaw as severe nighttime truck parking capacity issues were noted at both rest areas and commercial truck stops.

CHAPTER 1:
INTRODUCTION

The Michigan Department of Transportation (MDOT) currently operates and maintains 81 public rest areas along freeways and other major roadways throughout Michigan. Michigan's public rest areas are generally spaced within one-hour of less of travel time from one another and provide the distinct advantage of quick access and free 24-hour availability of basic amenities, including parking, restrooms, vending machines, pay phones, picnic tables, a pet area, and traveler information. In 2004, MDOT's rest areas served an estimated 50 million visitors, with 37 facilities serving more than 500,000 visitors each (*1*). Table 1 displays basic inventory data for MDOT's rest areas by region and highway based on information obtained from the MDOT website (*2)*.

Table 1. Basic Inventory Data for MDOT Rest Areas and Welcome Centers (*2*)

			Number of Parking Spaces	
	Region or Highway	**Number of Rest Areas**	**Cars**	**Trucks/RV**
BY REGION	University	16	865	359
	North	14	770	176
	Grand	11	643	242
	Bay	10	742	254
	Southwest	10	642	266
	Superior	11	409	89
	Metro	9	531	202
	STATEWIDE TOTAL	**81**	**4,602**	**1,588**
BY HIGHWAY	I-75	22	1377	378
	I-94	12	821	341
	I-96	8	439	178
	I-69	7	380	162
	US-127	7	396	153
	US-131	6	357	102
	US-31	4	245	45
	I-196	3	167	80
	US-23	3	133	63
	US-2	4	103	23
	All Other Routes	5	184	63
	STATEWIDE TOTAL	**81**	**4,602**	**1,588**

MDOT rest areas serve a broad range of travelers, including vacation/recreational travelers, commercial vehicle operators, commuters, motorcyclists, bus tours, and others. Recreational travelers tend to use rest areas for purposes such as restroom use, short break/light exercise, vehicle check, pet relief, child relief, change drivers, and others. Many of these stops are unplanned and the quick access from the highway makes rest areas convenient to motorists. The ease of access and availability of truck parking make rest areas convenient for commercial vehicles operators, as they are required to follow federal regulations on driving time limits and must take breaks when these limits are met. Long-haul truckers will also often sleep at rest areas as most large rigs typically include a sleeping cabin.

Alternative commercial service facilities, including truck stops, gas stations, and fast-food restaurants, provide many of the basic services provided by public rest areas, in addition to other services, such as fuel or prepared meals. However, commercial facilities are not directly accessible from the limited access freeway system, and thus, do not provide the level of convenient access afforded by most rest areas. Furthermore, rest areas also provide several unique intrinsic features that are often not present at commercial service facilities, including:

- A relaxing natural environment with room to walk, stretch, and allow children to safely maneuver,
- Accommodation for pets,
- Accommodation for travelers with special needs, and
- Parking for large vehicles, including trucks, buses, and recreational vehicles (RVs).

STATEMENT OF PROBLEM

Recent economic challenges have forced MDOT to reassess the functional value of rest areas, particularly those near commercial service facilities, including gas stations, fast food restaurants, and privately-owned truck stops, as these facilities typically provide services similar to or exceeding those provided at MDOT rest areas. Although MDOT has closed rest area facilities in the past due to various reasons, there were several issues related to rest area closure that required thorough investigation before such decisions could be made. In particular, the safety and economic impacts associated with Michigan rest areas and welcome centers remained

largely unknown. As MDOT was scheduled to update the *Strategic Rest Area/Welcome Center Plan* in 2012, it was necessary to perform research to investigate these issues.

STUDY GOAL AND OBJECTIVES

The overall goal of this research was to determine the individual and collective value of rest areas and welcome centers in order to assess the appropriate level of service for rest areas on MDOT roadways. Consideration was given both to the economic value of rest areas, in addition to the functional value provided by rest areas. Further research objectives include the following:

- Quantify the functions and value of rest areas in Michigan.
- Identify correlation between driver fatigue-related crashes and availability of rest areas.
- Develop a benefit/cost analysis tool to evaluate economic impacts associated with rest areas, both individually and as a system.
- Develop criteria to evaluate the impacts of rest area closure on motorists.

It was particularly important to obtain data on the level of alternative commercial service facilities, including gas stations, fast food restaurants, and truck stops, along major MDOT roadways to determine service redundancies and gaps within the rest area system. Such data would be utilized to determine the ability for other rest areas and nearby commercial service facilities to absorb any residual user demand in the event that a particular rest area was closed, in addition to identification of areas that may be suitable candidates for expansion of the rest area network. It was also important to consider the convenient accessibility and other intrinsic benefits provided by rest areas that are not provided by most commercial service facilities. As such, it was necessary to gain a better understanding of the reasons why travelers select one type of facility over another, in addition to the value of services provided to users of rest areas.

SUMMARY OF TASKS

The following tasks were performed in order to accomplish the aforementioned research objectives:

- Perform a comprehensive state-of-the-art review of rest area management and operations in the United States.
- Collect relevant inventory data for DOT's existing rest areas and alternative commercial service facilities, including gas stations, fast food restaurants, and truck stops.
- Prepare GIS maps displaying the location of all commercial service facilities with respect to the MDOT rest area network.
- Collect and analyze fatigue-related crash data to determine potential safety impacts that are impacted by the presence or absence of rest areas.
- Survey users of rest areas and commercial service facilities to better understand why travelers select one type of facility over another and to provide insight as to how users value the services utilized during a rest area stop.
- Survey truck stop operators and collect nighttime truck parking utilization data to identify parking capacity issues along the major trucking routes.
- Collect and analyze utilization data for the rest area network to determine network usage trends and patterns.
- Model rest area demand as a function of the significant characteristics.
- Perform an economic analysis of MDOT rest areas.
- Define the functional values associated with rest areas and develop an assessment tool that considers both monetary and non-monetary benefits provided by rest areas.
- Develop conclusions pertaining to the economic and functional value of the MDOT rest area network.
- Provide recommendations pertaining to future modification of the rest area network.

A full description of all work performed as a part of this research is provided in the chapters that follow.

CHAPTER 2:
LITERATURE REVIEW

In order to establish the state-of-the-art and state-of-the-practice pertaining to public rest areas, a comprehensive review of all relevant research and current practices was performed in the early stages of this research project. Several subtopics pertaining to rest areas were reviewed, including:

- Nationwide status of public rest area closures or downgrading of services,
- Non-public funding strategies and public-private partnerships,
- Safety benefits provided by rest areas,
- Tourism support,
- Rest area utilization, and
- Support for commercial vehicle operators.

Relevant literature documents were identified from queries of the United States Department of Transportation's (USDOT) National Transportation Library Integrated Search (TRIS/TRID Online). These documents included peer-reviewed papers in transportation and safety journals, published reports, state and federal guideline documents, and relevant news articles. Each document or news article was summarized, evaluated, and critically reviewed. The following subsections present the salient findings from the literature review.

NATIONWIDE STATUS OF REST AREA CLOSURES

In an economic climate of declining revenue, it becomes increasingly challenging for states to maintain a network of rest areas that provide critical services for motorists. Economic issues have led to recent rest area closures in at least 14 states, including Arizona, Arkansas, California, Colorado, Georgia, Louisiana, Maine, Maryland, New Jersey, New York, South Carolina, Vermont, Virginia, and Wisconsin (*3,4,5,6,7,8*). Several other states that have been considering rest area closures, have significantly downgraded the services provided or have canceled plans to build new or rehabilitate existing facilities (*7*). Louisiana has closed the greatest number of rest areas, as 24 out of 34 facilities have been closed since 2000, resulting in an annual savings of $250,000 per rest area (*4*). The most recent closures occurred in late 2010

in New York as six highway rest areas were closed in order to save $1 million annually despite organized protests by motorists (*8*). Perhaps the most widely publicized wave of recent rest area closures occurred in Virginia in 2009. In response to a $2.6 billion revenue shortfall, the State of Virginia closed 19 of its 42 rest areas, several of which were near exits with commercially provided services (*9*). These rest area closures were expected to save the state $9 million annually, with an average of more than $473,000 per closed rest area per year. However, due to strong public opposition, all 19 rest areas were reopened by the newly elected governor in April 2010 (*10*). Rest area closure has also recently occurred in Michigan, as four public rest areas have been closed since the development of the Michigan Department of Transportation (MDOT)'s 2005-2030 long-range plan (*1*). However, these MDOT rest area closures were not necessarily performed in direct response to the recent economic downturn. In addition to these permanent closures, MDOT also performs regular four-month seasonal closures at five rest areas due to low utilization and winter weather-related safety concerns (*11*).

In an effort to compensate for the loss of services and parking capacity provided by rest areas, some states are utilizing a provision of the 2005 SAFTEA-LU legislation, referred to as the "Interstate Oasis" program. This program allows for the use of standard highway signs to designate alternate commercial service facilities located off the Interstate right-of way. In order to designate a facility as an "Interstate Oasis" the facility must offer products and services to the public, provide 24 hour restroom access and free drinking water, offer truck and automobile parking, and be located within three miles of the interstate (*12*). To be eligible for the program, it is also required that an engineering study be conducted to verify that the route to the site can "safely and conveniently accommodate vehicles of the types, sizes, and weights that would be traveling to the facility". Several states including Iowa, Idaho, Indiana, Oregon, Utah, and California are considering or have already implemented the Interstate Oasis program or a similar type of program (*13*).

NON-PUBLIC FUNDING STRATEGIES AND PUBLIC-PRIVATE PARTNERSHIPS

Various forms of rest area commercialization or privatization have been investigated by several states as a means to offset the costs associated with construction, maintenance, and operations of rest area facilities, as well as allowing for the expansion of services offered at these facilities. However, federal law prohibits the use of Interstate right-of-way for commercial purposes for highways that went into operation after the *1956 Interstate Highway Act* went into

effect (*14*). This Federal act prohibited the privatization or outsourcing of rest areas, although several affected states have recently begun lobbying for permission to commercialize their facilities (*3*). Commercialization programs were proposed in Texas, California, and Virginia in the early- to mid-1990's, with the hope that the federal commercialization prohibition would be eliminated or substantially modified (*15,16,17*).

There is no consensus between state agencies and industry groups with respect to commercialization of public rest areas. A recent AASHTO poll found that slightly less than half of the states support rest area commercialization (*18*). Many industry groups, including the National Association of Truck Stop Operators (NATSO), Petroleum Marketers Association of America (PMAA), and the National Federation of the Blind (NFB) are against commercialization. These groups believe that although motorists could benefit from commercialization, nearly 60,000 small businesses competing at exit based locations would be negatively affected (*18*). A recent survey in Virginia also found that industry groups were generally opposed to full rest area commercialization, although less opposition was provided to advertising and sponsorship of rest areas (*19*).

Surveys of rest area users have also found mixed opinions with respect to rest area commercialization. Surveys of rest area users in Texas showed a desire for expanded commercial services at rest areas (*15*). Surveys of rest area users in Virginia showed that motorists and truck drivers support rest area commercialization to generate revenue, particularly through selling fuel at rest areas (*19*). A Minnesota DOT focus groups survey found less positive responses from rest area users, as most were reluctant to support corporate sponsorship of rest areas and suggested it be used only as a last resort to avoid closures (*20*).

Public-private partnerships are one possibility for circumventing the anti-commercialization laws. Several states, particularly those along the eastern seaboard, are utilizing public-private partnerships to turn rest area facilities into revenue generators. The State of Delaware is projected to bring in $56 million over a 35-year contract while Connecticut is estimated to bring in $250 million over a similar period through its 23 service plazas (*3*). In lieu of replacing an aging rest area, the Idaho DOT recently entered into a public-private partnership to move the particular rest area's services to a nearby truck stop, saving the state $13.7 million in construction costs (*21*).

The Virginia Department of Transportation (VDOT) recently explored non-public funding options for the maintenance and operation of public rest areas to offset recent budget

constraints (*19*). Several options were considered, including the expansion of vending operations, indoor advertising, facility sponsorship, partnering with private facility at interchange outside of the interstate right-of-way, and connecting commercial facilities on private land adjacent to existing rest areas in the interstate right-of-way. A major component of this study was an investigation of the various public rest area funding options that state DOTs across the nation are utilizing. A survey was sent to 49 state DOTs (responses received from 16), which asked questions about public rest area closures, state actions to supplement rest area costs, charging of user fees at public rest areas, and states position regarding commercialization/privatization of rest areas (See Appendix Table A). Of the 16 state DOTs that responded, only two states reported rest area closures due to funding issues. In response to a question about supplementing revenues for rest area maintenance and operations, only 25% reported to taking action. None of the states currently charge user access fees at rest areas for services provided, which is not surprising as such fees in the right-of-way on the federal aid roadway system are currently prohibited by federal law (*22*). The majority of states (62.5%) responded to being interested in the commercialization of rest areas and are currently exploring or have already implemented programs to do such. The most common of these programs are public-private partnerships to offset state costs. The report also summarizes current funding initiatives that states are pursing in order to support public rest areas, which include (*19*):

- Arizona - Passed a bill that allows for agreements with counties, cities, towns, and private entities for maintenance/improvement of rest areas.
- California - Developing private facilities into "Traveler Service Rest Areas" and attempting to implement digital billboard advertising on highways based on the Interstate Oasis program.
- Florida - Considering piloting commercialized state-owned rest areas at an interchange (off interstate right-of-way).
- Georgia - Passed a bill in 2010 to urge the state DOT to press FHWA for permission to lease rest areas to retail market. Private partnerships for rest area/welcome center management. Commercially sponsored wireless Internet access.
- Iowa - Public/Private partnership with commercial store at interchange.
- Minnesota - Rest area partnership and sponsorship program.

- Missouri - Starting a pilot tolling program on I-70 under FHWA Interstate System Reconstruction and Rehabilitation Pilot Program (ISRRPP).
- North Carolina - 2 pilot programs for subcontracting of visitor centers to private and non-profit entities. 2 closed rest areas pending county take over.
- Ohio - Sales of interior advertising at rest areas. Investigated developing rest areas outside of the right-of-way.
- Oregon - Implemented solar power plant at a rest area under Oregon Solar Highway initiative.
- New Jersey - Concept of retailing turnpike rest area naming rights and public/private restaurants.
- South Carolina - Subcontracted welcome centers to non-profit concessionaries. Awarded 1 of 3 slots in Interstate System Construction Toll Pilot Program for I-73.
- Utah – Several rest areas are currently maintained through public-private partnerships. A program similar to the Interstate Oasis program has been implemented.
- Virginia - Awarded 1 of 3 slots in ISRRPP for tolling along I-95.

It is worth noting that the pilot interstate tolling programs awarded by the FHWA to Missouri, Virginia, and South Carolina represents a potential sign of progress towards allowing states to assess user fees at public rest areas to offset construction and maintenance costs.

The VDOT report also outlined both small-scale and large-scale options for increasing non-public revenue at interstate rest areas. The small-scale option calls for the leasing of rest areas to management enterprises that would generate revenue through expanded vending, advertising, and/or sponsorships. In March of 2011, VDOT began its Sponsorship, Advertising, and Vending Enhancement Program (SAVE) to try and offset a portion of the maintenance and operation costs for State rest areas and welcome centers (*23*). Recent news articles show that Virginia has followed through with some of the recommendations outlined in the report by announcing on August 30, 2011 that it had entered into a public-private partnership with a private vendor, which will provide ATM services and other traveler focused marketing options (*24,25*). The contract will pay VDOT an annual guaranteed rights fee of nearly $2 million and will also entitle them to revenue-sharing from a percentage of the sales. It is uncertain how this

partnership dealt with the Vending Facility Program included in the Randolph-Sheppard Act, which gives blind persons priority in the operation of vending facilities on federal property. The report also detailed two large scale options which draw upon the initiatives of other state DOTs. The first is the Traveler Service Rest Area (TSRA), where private property located directly adjacent to a rest area is linked via a pedestrian path. The private property would be commercially developed to offer a variety of services to the traveling public. The second option is to provide regionally or privately managed information centers located at an interchange near the interstate highway. If located near a scenic or historic attraction, Federal transportation enhancement funds may be available to help develop such a facility.

Dornbusch (*26*) developed a strategic recommendation for the planning, funding and implementation of rest area improvement for the California Department of Transportation. The recommendation included use of public/private partnerships to supplement or substitute for existing rest areas and developing new rest areas. The relative advantages of several public/private partnership models were evaluated. The Federal Interstate Oasis Program, alternative stopping opportunities (ASOs), and auxiliary parking facilities under public/private partnerships were considered the most feasible alternatives to expand rest area services at a reduced cost. The Federal Interstate Oasis Program was recommended as the best public/private partnership strategy for successful implementation in California.

In a previous study, Dornbusch (*27*) also evaluated the feasibility of financing public information in rest area interactive kiosks through private advertising. The potential user base for kiosks located at rest areas was examined along with the design and deployment of the kiosks and an estimate of the revenue that could be generated. It was concluded that advertising revenues associated with interactive kiosks are insufficient for the cost of kiosks design, implementation and operation. It was noted though that through sufficient advertising revenue or sponsorships, the kiosk systems operation and maintenance costs could be covered. The report concluded that interactive kiosks provide adequate social and economic benefits though they are not financially feasible based on their revenue generating potential.

In July 2011, a FHWA memorandum (*28*) provided interpretation of placement of acknowledgement signs for rest area sponsorship. It allows for the placement of signs on the mainline of the roadway acknowledging sponsorship of the rest area. The placement is limited to one sign upstream of each exit ramp to the facility. The interpretation also allows for additional

sponsorship signs to be placed within the rest area given that they are not visible to the highway traffic.

SAFETY IMPACTS

Public rest areas serve an important role in alleviating motorist fatigue and associated crashes. NHTSA estimates that 100,000 police-reported crashes resulting in 1,550 deaths and 71,000 injuries occur annually due to driver fatigue (*29*). Michigan crash data indicates that at least 1,262 crashes in 2009 involved asleep or fatigued drivers (*30*). However, both of these national and state figures are likely to underrepresent the true degree of this problem as such crashes are often not easily distinguishable by an investigating officer as drivers are unlikely to admit having been asleep at the wheel. In any case, rest areas help to reduce the risks of such crashes by providing safe parking areas for tired drivers. The most effective countermeasure to driver sleepiness is to stop driving and take a short nap (less than 15 min) or use caffeine (*31*).

In a 1999 study from Michigan State University (MSU), Taylor (*32*) analyzed the relationship between rest area spacing and the rate of single-vehicle truck crashes. The majority of the single vehicle truck collisions occurred between 12:00 AM and 8:00 AM. The researchers created a hazard model for freeway segments with rest areas spaced at least 50 miles apart. The study determined that there was a positive relationship between safety rest area spacing and fatigue-related single-vehicle truck crashes. The results of the study showed a significant increase in single vehicle truck crashes once the distance between rest areas was greater than 30 miles. A Minnesota study (*33*) showed similar results as single-vehicle truck crash densities were found to increase during all times of the day at distances greater than 30 miles beyond a rest area. They also found that during night time hours, there was a significant increase in single-vehicle crash densities beyond the rest areas related to increased truck parking demand and potential parking capacity issues at rest areas.

A 2009 study conducted at the University of California - Berkley (*34*), also obtained similar results to the MSU study. A spatial analysis of fatigue crashes was performed to determine the relationship between fatigue related crashes and rest area spacing. Crash data was extracted for an 11 year period (1995-2005) from Interstate highways in California. Fatigue related collisions were defined as those where driver was reported as “fell asleep” or fatigued (strict definition), at fault but not intoxicated or single vehicle crash (expanded definition). The study concluded that providing adequate rest area truck parking effectively reduces costs related

to highway crashes, with a cost savings ratio of 1.61. Analysis of both fatigue and non-fatigue collisions indicated that the number of collisions due to fatigue significantly increased as soon as the distance from the rest areas exceeded 30 miles. The findings of this study and the previously mentioned all yield distances shorter than the current FHWA recommendations of 50 miles or 1 hour drive time on major highways.

TOURISM SUPPORT

Michigan's public rest areas also serve as an important marketing and advertising point of contact with the motoring public, helping to support travel and tourism. An even greater array of services and tourist information are provided at Michigan's 14 welcome centers, which are staffed daily during normal business hours.

In 2006, MDOT released its 2005-2030 Long-Range Strategic Plan Highway/Bridge Technical Report (*1*). Several rest area development goals were outlined in this report, including improving and modernizing infrastructure and expanding the rest area service in the Upper Peninsula, northern Lower Peninsula, and thumb area. Several issues/challenges with rest area development were also identified including rest area spacing, commercial truck parking, and exploring opportunities to reduce infrastructure while continuing to meet system needs. Funding for rest area improvement/development through the Roadside Development Program was reported as $9 million annually, not including rest area operational costs (*1*.

In an effort to quantify the presumed tourism benefit which safety rest areas provide, a 2010 Texas study (*35*) developed a benefit-cost model based upon the results of a rest area and travel information center (similar to welcome centers) public opinion survey. The self-reported survey data showed that 29.3 percent of visitors extended their stay by an average of 2.5 days as a result of information received at a travel center with a resulting average additional daily expenditure of $58.39 per visitor. The resulting model found an estimated $1.3 to $2 million in annual economic development and tourism benefits per travel information center. The overall rest area and travel information center benefits included increased comfort and convenience, decrease in excess travel and diversion, and an increase in economic development and tourism.

A 2010 study conducted by Michigan State University (*36*) evaluated the effectiveness of and satisfaction with traveler services provided at Michigan's 14 welcome centers. The survey respondents represented 44 different states, as well as Canada and other foreign countries. The average travel party size was 2.22 persons per party and spent on average 4.5 nights in Michigan.

Of those surveyed 87% stopped at the Welcome center to use the restroom, while 71% stopped to obtain travel information. Nearly two-thirds of the parties surveyed received and used travel information provided at the welcome centers, yielding approximately 725,000 parties annually that use traveler information provided at the facilities. The study also reported that, in general, visitors are receiving the services they deem necessary, noting that 90% responded that no new services were desired. The overall satisfaction ratings for individual Centers ranged from 4.4 to 4.7, on a 5 point scale (1 being the lowest, 5 being the highest). The study also evaluated economic measures associated with Michigan welcome centers, reporting the average cost per party served as $3.73. These measures ranged greatly from $2.05 at the New Buffalo Welcome Center to $74.56 at the Detroit Welcome center. The survey also revealed that 15.7 percent of welcome center users increased spending based on information obtained at the welcome center, with an average increase of $135 per party.

REST AREA DEMAND AND USAGE CHARACTERISTICS

Rest area usage and demand has been quantified in past research. The most comprehensive rest area evaluation to date was performed in the late 1980's as part of NCHRP Project 2-15 (*37*). Surveys performed as part of this research showed that more than 95 percent of all drivers had used a rest area and 60 percent preferred rest areas over other similar facilities if the stop did not require gas or food. Rest areas were found to be utilized more frequently by drivers taking longer trips and older drivers. Rest-area usage rates were found to vary widely as a proportion of total traffic on the adjacent roadway, ranging from less than 1% to more than 50% of vehicles with an average of 10%. Higher percentages were observed for trucks and recreational vehicles. Rest area users were willing to pay between $0.40 and $1.00 per stop to utilize the rest area, which represents $0.72 - $1.81 per stop when adjusted from 1989 to 2011 dollars. The benefit/cost ratio of rest areas based on user comfort/convenience, reduction in excess travel, and reduction in shoulder crashes ranged from 3.2 to 7.4.

A 2002 study sponsored by the New England Transportation Consortium investigated usage trends and motorists' preferences through a series of surveys conducted at 11 sites throughout the New England states (*38*). The surveys showed that motorists view rest areas as a necessity and favor keeping them, but also expressed issues with safety and cleanliness. The primary reason for using the rest area was to use the restroom facility, but information services

pertaining to road condition and tourism were also important reasons. Research performed in Vermont found that the highest levels of rest area usage are on holiday weekends during summer and fall (*39*). The highest rest area usage periods occur between 12:00 PM and 8:00 PM on Fridays and between 10:00 AM and 12:00 PM on Saturdays.

Blomquist and Carson (*40*) conducted a questionnaire survey at 16 rest areas to obtain information about the needs and expectations of Montana rest users. The overall satisfaction level was found to be favorable, although long distance travelers gave lower satisfaction scores. The most widely criticized aspect of the rest areas were the maintenance practices. The average acceptable fee rest area users were willing to pay was $0.25-$1.00. Survey respondents felt that there was an insufficient number of rest areas available in Montana, and felt rest area spacing should be somewhere between 40 to 100 miles apart. Most users felt more secure during daylight hours, in comparison to night-time hours. Those traveling longer distances and older travelers generally felt safer at night. As found in other rest area surveys, the majority of respondents indicated "restroom use" was their primary reason for stopping with stretching, walking, and using the drinking fountain as a secondary activity of choice.

A 2010 study in Montana (*41*) evaluated rest area usage at 44 rest areas. It was concluded that commercial vehicles have the greatest mean dwell time followed by RVs and cars. Dwell times were significantly higher during the night hours as the rest areas are used for sleep purposes by commercial vehicle drivers. The percentage of buses and commercial vehicles served by the rest areas during the daytime design peak and night time design peak are 70% and 200% of the mainline percentage respectively. The studied recommended, for planning and design purposes, a baseline traffic usage of 16% and 25% of peak traffic for rest areas on interstates and arterial highways respectively.

COMMERCIAL VEHICLE OPERATOR SUPPORT

Commercial motor vehicle (CMV) operators utilize rest areas differently than do recreational drivers as they must comply with federal hours-of-service regulations, as described in the Code of Federal Regulations, Title 49, Part 395 (*42*). These regulations establish the limits pertaining to the length of time that commercial motor vehicle drivers may drive both within a single day and over several days. The limits differ slightly depending on whether cargo or

passengers are being transported, but in both cases, a certain amount of off-duty time is required after driving for either 10 or 11 hours. As such, drivers of commercial vehicles are more likely to use rest areas for sleep purposes, often involving nighttime stays of several hours. The details of the federal hours-of-service regulation are presented as follows (*42*):

- Property-Carrying CMV Drivers
    - 11-Hour Driving Limit - May drive a max of 11 hours after 10 consecutive hours off duty.
    - 14-Hour Limit - May not drive beyond the 14th consecutive hour after coming on duty, following 10 hours of duty.
    - 60/70-Hour On-Duty Limit - May not drive after 60/70 hours on duty in 7/8 consecutive days. 7/8 day period may restart after 34 hours off duty.
    - Sleeper Berth Provision - Drivers using a sleeper berth must take at least 8 consecutive hours in the sleeper, plus 2 consecutive hours either in sleeper or off duty, or a combination of the two.
- Passenger-Carrying CMV Drivers
    - 10-Hour Driving Limit - May drive a max of 10 hours after 8 consecutive hours off duty.
    - 15-Hour On-Duty Limit - May not drive after having been on duty for 15 hours, following 8 consecutive hours off duty.
    - 60/70-Hour On-Duty Limit - May not drive 60/70 hours on duty in 7/8 consecutive days.
    - Sleeper Berth Provision - Drivers using a sleeper birth must take at least 8 hours in the sleeper, and may split the berth time into two periods provided neither is less than two hours.

The demand for overnight truck parking – often to meet federal off-duty-time requirements – has created truck parking availability issues in some areas of the United States. A nighttime truck parking usage survey at rest areas in Tennessee found that nighttime parking demand was the heaviest Monday through Thursday nights (*43*). Nearly 75 percent of trucks arriving at the rest area at night remained parked for more than four hours. A nationwide DOT survey performed in the mid-1990's found that nearly 80% of rest areas had truck parking areas that were either full or overflowing onto the ramps at night, while parking areas for cars were

typically underutilized during the day and especially at night (*44,45*). Truck parking demand remains high through early mornings as some locations are utilized as staging locations for on-time deliveries.

States often try to increase truck parking space turnover at state-owned rest areas by imposing overnight truck parking time limits. While nearly half of state-owned rest areas across the United States have truck parking time limits, these limits are typically not enforced. An FHWA-sponsored forum on rest areas found divided opinions pertaining to overnight parking time limits for truckers as some participants favored eliminating time limits, while others encouraged stricter enforcement of existing time limits as space turnover was necessary to satisfy demand (*46*).

A survey of truck drivers found that they slightly preferred rest areas over truck stops for stops of less than 2 hours, but a majority of drivers preferred privately-owned truck stops for long term parking (*44,45*). Only 15% of truck drivers preferred to sleep at rest areas – primarily for safety and security reasons.

A 2002 report for the FHWA (*47*) investigated the adequacy of commercial truck parking throughout the National Highway System. This study included a survey of commercial truck drivers, truck parking demand estimates, and truck parking supply estimates based upon a national inventory. Of the commercial vehicle drivers surveyed only 11 percent and 34 percent cited that they could almost always find parking at public rest areas and commercial truck stops, respectively. The surveys indicated that commercial trucks stops and travel plazas were preferred for long duration stops, while rest areas were preferred for quick naps. The overall nationwide demand for parking spaces at public rest areas exceeds the current supply, but the supply at commercial facilities is adequate. The study indicated that although truck parking is a national safety concern, the relative adequacy or inadequacy of available spaces is very much a local issue, which may require localized solutions. Some states may prefer to open more public facilities or expand existing facilities, while others may rely on private industry. Many states, including Michigan, have proposed or begun to implement programs to help inform commercial drivers of parking availability using changeable message signs and other ITS-linked communication media.

The recent VDOT rest area policy study also included a state agency survey of nationwide commercial truck parking policies (*19*). This survey asked the agencies questions about policies pertaining to overnight truck parking time restrictions, overnight parking fees, amenities, and law enforcement practices. Responses were received from 19 states (See Appendix Table B). Surprisingly, 15 of the 19 states do allow for overnight truck parking, although 6 and 8 hour time limits are imposed by West Virginia and Washington, respectively. Although states have been investigating the possibility of assessing user fees at rest areas, particularly for overnight truck parking, such fees constitute tolling, which is prohibited by federal law for roadways originally build using federal aid (*22*), although there has been recent relaxation of the anti-tolling regulations (*19*). As expected, none of the 19 agencies reported charging a fee for overnight truck parking. However, the VDOT user surveys showed that truckers are somewhat supportive of paying user fees, as approximately 40 percent of the truck drivers surveyed supported usage fees if these fees were utilized for expansion of truck facilities (*19*). A short lived federal law enacted in 2005 showed progress towards allowing user fees to support rest area truck facility operations. This law gave states the opportunity to provide fee-based electrification hook-ups at rest areas to reduce truck idling. However, this law was repealed in 2008 due to opposition from industry groups before any implementations had occurred (*19*).

LITERATURE SUMMARY

Public rest areas serve a variety of needs for both the traveling public and drivers of commercial motor vehicles. A comprehensive review of all relevant research and current practices was performed to establish the state-of-the-art and state-of-the-practice pertaining to public rest areas. The salient findings from this review are summarized as follows:

- **Nationwide Status of Public Rest Area Closures or Downgrading of Services**
    - Economic issues have led to recent rest area closures in at least 14 states, including Arizona, Arkansas, California, Colorado, Georgia, Louisiana, Maine, Maryland, New Jersey, New York, South Carolina, Vermont, Virginia, and Wisconsin (*3,4,5,6,7,8*).

- Large-scale closure of public rest areas by a particular state is typically met with considerable public opposition (*8*,*9*), in some cases prompting reopening of the closed facilities (*10*).
- The average annual savings associated with rest area closures varies by state and ranges between $166,666 (New York) to $473,000 (Virginia) per rest area per year (*4*,*8*,*9*).
- The federal "Interstate Oasis" program has been proposed as a means of offsetting the loss of services and parking capacity due to closure of public rest areas by providing official highway signage for nearby truck stops (*12*). Several States including Iowa, Idaho, Indiana, Oregon, Utah and California are considering or have already implemented the program (*13, 19, 26*).

- **Non-Public Funding Strategies and Public-Private Partnerships**
  - Federal law prohibits the use of Interstate right-of-way for commercial purposes (*14*), thereby limiting potential privatization opportunities. Additionally, user fees may not be assessed at rest areas within the right-of-way on roadways that were originally built using federal funds (*22*).
  - Several affected states have lobbied for permission to commercialize their facilities, although little progress has been achieved (*3*,*15*,*16*,*17*,*19*).
  - Various non-public funding strategies or partnerships have been pursued and, in some cases, implemented by state agencies as a means to offset the costs associated with expansion, maintenance, and operation of rest areas. These strategies include:
    - Privatization of operations, such as vending (Virginia [*23*,*24*]), internet (Georgia [*19*]), or welcome center staffing (Georgia, North Carolina, South Carolina [*19*]).
    - Indoor advertising or sponsorship (Virginia [*23*,*24*], Ohio, New Jersey, Minnesota [*19*]),
    - Partnering with private facility at interchange outside of the interstate right-of-way (Iowa, Florida, Ohio [*19*]),

        - Connecting commercial facilities on private land adjacent to existing rest areas or parking areas in the interstate right-of-way via pedestrian path (California [*19,26*]).
    - Pilot interstate tolling programs have been awarded by the FHWA to three states (Missouri, Virginia, and South Carolina), a potential sign of progress towards allowing states to assess user fees at public rest areas to offset construction and maintenance costs (*19*). Surveys have found that rest area users are willing to pay between $0.25 and $1.00 per stop to utilize the rest area (*37,40*).
    - There is no consensus between state agencies, industry groups, and rest area users with respect to commercialization/privatization of public rest areas.
        - Slightly less than half of the states support rest area commercialization (*18*).
        - Industry groups are typically strongly against commercialization as this poses additional competition to existing businesses at exit based locations (*18*).
        - Surveys of rest area users are also split. Rest area users in Texas and Virginia showed a desire for expanded commercial services at rest areas (*15,19*), while users in Minnesota were reluctant to support corporate sponsorship of rest areas (*20*).
        - Truck drivers are generally supportive of rest area commercialization (*19*).
- **Safety Benefits Provided by Rest Areas**
    - Michigan crash data indicates that at least 1,262 crashes in 2009 involved asleep or fatigued drivers (*30*), although the actual number of crashes due to driver fatigue is likely much higher.
    - The most effective countermeasure to driver sleepiness is to stop driving and take a short nap or use caffeine (*31*). Public rest areas help drivers fulfill this need by providing easy access to free, safe parking areas for tired drivers.
    - Several studies have found a positive relationship between rest area spacing and targeted crash types.

        - Single vehicle truck crashes in Michigan (*32*) and Minnesota (*33*) were found to increase significantly at distances greater than 30 miles beyond a rest area.
        - Fatigue-related crashes in California were also were found to increase significantly at distances greater than 30 miles beyond a rest area (*34*).
    - Overflowing truck parking areas also contribute to increases in nighttime single-vehicle crashes occurring beyond the rest areas (*33*).
    - Providing adequate rest area truck parking effectively reduces costs related to highway crashes, with a cost savings ratio of 1.61 (*34*).
    - These studies suggest a rest area spacing of 30 miles or less to prevent fatigue related crashes.
- **Tourism Support**
    - Michigan's public rest areas, and particularly the welcome centers, also serve as an important marketing and advertising point of contact with the motoring public, helping to support travel and tourism.
    - Nearly two-thirds of Michigan welcome center visitors received and used travel information during their stop, yielding approximately 725,000 parties annually that use traveler information provided at the facilities (*36*).
    - The average cost per party served at Michigan welcome centers was estimated at $3.73 (*36*).
    - A recent Texas study suggested that 29.3 percent of welcome center visitors extended their vacation stay in Texas by an average of 2.5 days as a result of information received at the welcome center (*35*).
    - The annual economic development generated per Texas welcome center was estimated at $1.3 to $2 million (*35*).
- **Rest Area Usage and Demand**
    - More than 95 percent of all drivers had used a rest area and 60 percent preferred rest areas over other similar facilities if the stop did not require gas or food (*37*).
    - Rest areas are utilized more frequently by drivers taking longer trips and older drivers (*37*).

- The highest levels of rest area usage are on holiday weekends during summer and fall, particularly on Friday afternoons/evenings and Saturday mornings (*39*).
- Nighttime parking demand for truckers is heaviest Monday through Thursday nights (*43*). Truck parking demand remains high through early mornings as some locations are utilized as staging locations for on-time deliveries.
- Overnight truck parking demand is very strong, as nearly 75 percent of trucks arriving at a rest area at night remain parked for more than four hours (*43*).
- The benefits provided to travelers at rest areas and welcome centers include: increased comfort and convenience, decrease in excess travel and diversion, an increase in economic development and tourism, and a reduction in shoulder crashes providing a benefit/cost ratio ranging from 3.2 to 7.4 (*37*).

- **Support for Commercial Vehicle Operators**
  - Commercial motor vehicle must comply with federal hours-of-service regulations, which leads to different rest area usage patterns compared to motorists (*42*).
  - Approximately one-half of states, including Michigan, do not have overnight truck parking time limits (*46*). However, many states with overnight parking time limits do not enforce such limits.
  - Many states, including Michigan, have proposed or begun to implement programs to help inform commercial drivers of parking availability using changeable message signs and other ITS-linked communication media (*47*).
  - Truckers slightly prefer rest areas over truck stops for short-term stops, but a majority of drivers preferred privately-owned truck stops for long term parking (*44*,*45*).
  - Only 15% of truck drivers prefer to sleep at rest areas – primarily for safety and security reasons (*44*,*45*).
  - Truckers are somewhat supportive of paying user fees if these fees were utilized for expansion of truck facilities (*19*).

CHAPTER 3:
INVENTORY DATA FOR REST AREAS AND COMMERCIAL SERVICE FACILITIES

A critical initial task in the early stages of this research included cataloging specific inventory data pertaining to Michigan's 81 rest areas. The FHWA guidelines for collecting rest area inventory characteristics provided the basis for the inventory data collection performed as part of this study (*45*). The inventory data for each rest area location that was obtained included:

- Spatial information
    - Specific location of rest area (roadway, milepost, and GPS coordinates) and
    - Distance from the nearest upstream and downstream rest areas along route
- Type of facility (welcome center or standard rest area)
- Number of parking spaces (passenger vehicle, truck/bus/RV)
- Roadway direction(s) that can access the rest area
- Traffic volume/classification data (including ADT and hourly counts) entering the rest area
- Traffic volume/classification data (including ADT and hourly counts) on the adjacent highway
- Building size
- Year of construction and reconstruction (where applicable)
- Design life of the facility
- Actual construction costs (where available)
- Annual operating costs for the facility (including: labor, utilities, travel, equipment, building lease)
- Annual routine maintenance costs for the facility (direct and contract)
- Seasonal closure period (if any)
- Any special amenities

These data were obtained from various sources, including MDOT Roadside Development, MDOT Office of Administrative Services, and MDOT Office of Fiscal Management. The data were compiled and saved in a single GIS database for use in several

subsequent tasks, including the economic analysis and assessment of the functional value of rest areas.

It was also necessary to determine the level of available alternate commercial services along each route to identify service gaps and redundancies with respect to the MDOT rest area system. As such, all alternate commercial service facilities located in Michigan were inventoried. Alternate commercial service facilities were defined as gas stations, fast food restaurants, and truck stop as these locations provide the basic services that are available at rest areas, including parking, public rest rooms, food, beverages, and relatively quick access from the parking lot to the building. Commercial service facilities were considered to be a potential stopping alternative to a rest area if they were within 20 miles upstream or downstream of the particular rest area and, for limited access freeways, within 1 mile of a service interchange. It was also required that the particular interchange allow for re-entry to the freeway in the original direction.

The commercial service facilities were identified using several sources, including franchised fast food restaurant websites, truck driver travel guides, and Google maps. GPS coordinates were obtained for all service facilities either directly from the reference source or using ArcGIS based on the provided address. Gas stations were identified using the GPS coordinates found in the 2011 database of Michigan fueling stations provided by the Michigan Department of Agriculture. Michigan truck stops were identified by merging and corroborating the information found in several online truck stop reference guides and large chain truck stop websites (i.e., Pilot, TA, etc.). The minimum service requirements for truck stops to be included were diesel fuel, public rest rooms, and truck parking. A total of 281 unique Michigan truck stop facilities were identified and included in the GIS database. Fast food restaurants were identified by searching the websites of the most common franchised fast food restaurants in Michigan, including: McDonalds, A & W, Arby's, Big John's, Blimpie's, Burger King, Church's Chicken, Culvers, Dairy Queen, Dunkin Donuts, Einstein Bagels, Hardees, Hot N' Now, Kentucky Fried Chicken, Long John Silvers, McDonalds, Mr. Pita, Panera Bread, Pizza Hut, Popeye's Chicken, Qdoba, Quiznos, Rally's, Sonic Drive In, Starbucks, Subway, Taco Bell, Tim Horton's, Tubby's Subs, Wendy's, and White Castle.

Populating the GIS database with the GPS coordinates for both the 81 MDOT rest areas/welcome centers and the alternate commercial service facilities allowed for the following data to be manually obtained using the distance measurement tool found in ArcGIS:

- Distance from the rest area to the nearest commercial facility,
- Distance from the rest area to the nearest truck stop,
- Quantity of all commercial service facilities within 20 miles upstream or downstream of an MDOT rest area/welcome center and, for limited access freeways, within 1 mile of the center of the interchange and
- Quantity of commercial truck stops within 20 miles upstream or downstream of an MDOT rest area/welcome center and, for limited access freeways, within 1 mile of the center of the interchange.

Upon collection of the aforementioned inventory data for all rest areas and alternate commercial service facilities, GIS maps were prepared depicting the locations of 1) MDOT rest areas/welcome centers, gas stations, fast food restaurants, and commercial truck stops (Figure 1) and 2) MDOT rest areas/welcome centers and commercial truck stops (Figure 2).

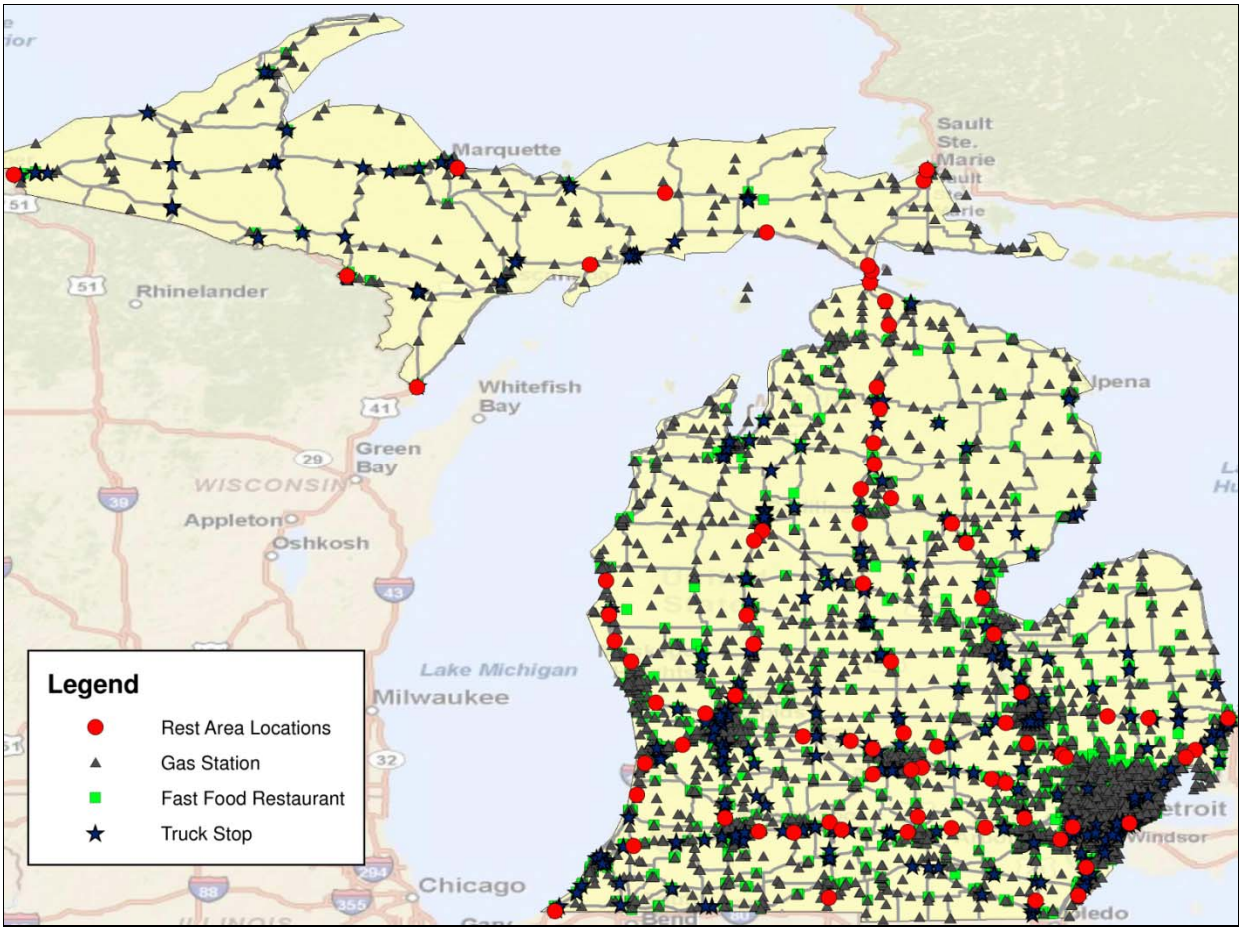

Figure 1. Map of MDOT Rest Areas and Alternate Commercial Service Facilities

Figure 2. Map of MDOT Rest Areas and Commercial Truck Stops

Close inspection of the maps show that the majority of alternate commercial service facilities are concentrated in the southern Lower Peninsula, particularly south of M-20. Commercial service facilities are especially sparse in the eastern Upper Peninsula, northeast Lower Peninsula, and the northern Thumb area. The concentration of commercial truck stops follows similar patterns, and are especially sparse in the eastern Upper Peninsula, northeast Lower Peninsula, and the northern Thumb area, and the northwest Lower Peninsula west of US-131. A table displaying the breakdown of commercial truck stops and rest areas by MDOT region and route is provided in Appendix Table C. A regional summary breakdown of the 281 commercial truck stops is provided as follows:

- Bay: 41
- Grand: 31
- Metro: 49
- North: 34
- Southwest: 48
- Superior: 40
- University: 38

CHAPTER 4:
SURVEYS OF REST AREA AND COMMERCIAL TRUCK STOP USERS

An interview-style questionnaire survey was implemented to travelers at a sample of rest areas throughout Michigan. A similar survey was also administered to travelers at a sample of commercial truck stops located near selected rest areas included in the survey. Sampling across these two types of facilities (rest areas and truck stops), allowed for a comparison to be made between the perceptions of these two user groups as they relate to how a facility is selected when a stop is necessary. The survey was targeted to three primary motorist groups:

- Drivers or passengers of passenger vehicles,
- Drivers of commercial trucks, and
- Drivers or passengers of recreational vehicles.

The survey data provided valuable information pertaining to the reasons why motorists use rest areas versus alternate commercial service facilities as a function of vehicle type, trip purpose, age, frequency of use, facility type, trip length, etc. These data were also important to help determine the "value" of rest areas and welcome centers to motorists, which was particularly important for use in the economic analysis.

REST AREA USER SURVEY METHODOLOGY

Public rest area users have been surveyed in past research in an effort to determine basic information, such as the purpose for stopping, opinion of services provided, desire for additional services, and overall satisfaction, among others. However, there had been limited research conducted on topics such as user preferences for rest areas versus private commercial facilities and the overall value of services provided by rest areas to users of the facilities. In an effort to better understand why travelers select rest areas versus commercial service facilities, a comprehensive survey was conducted at a sample of public rest areas across the State of Michigan. The primary objectives of this survey were to:

- Determine user preferences for rest areas vs. alternate commercial service facilities
- Determine the perceived value for services utilized at the rest area during the particular stop
- Determine the overall user satisfaction with public rest areas in Michigan

In order to collect an adequate representation of statewide users, the surveys were administered at 12 rest areas and 3 welcome centers located throughout the State of Michigan. The rest area locations were selected to include at least one rest area within each MDOT region and along each limited access freeway. At least one rest area in each direction were selected for each of the major truck-haul routes in Michigan, which included I-75, I-94, and I-69. The sample of rest areas also included several "isolated" rest areas where few commercial service facilities existed within reasonable proximity. Special emphasis was provided towards selection of locations from within the Grand Region as this region had been identified by MDOT as an area of potential unmet service needs, and along popular tourist routes. The survey locations are shown in Table 2 and Figure 3.

Table 2. Michigan Rest Area Survey Locations, by Type, Region, Route, and Direction

LOCATION	Facility Type	Region	Roadway and Direction	LOCATION	Facility Type	Region	Roadway and Direction
Swartz Creek	RA	Bay	EB I-69	Battle Creek	RA	Southwest	EB I-94
Clare	WC	Bay	NB/SB US-127	New Buffalo	WC	Southwest	EB I-94
Zeeland	RA	Grand	NB I-196	Watervliet	RA	Southwest	WB I-94
Morley	RA	Grand	NB US-131	Naubinway	RA	Superior	EB/WB US-2
Rothbury	RA	Grand	NB US-31	Chelsea	RA	University	EB I-94
Clarkston	RA	Metro	SB I-75	Dundee	WC	University	NB US-23
Capac	RA	Metro	WB I-69	Lake Chemung	RA	University	WB I-96
Grayling	RA	North	NB I-75				

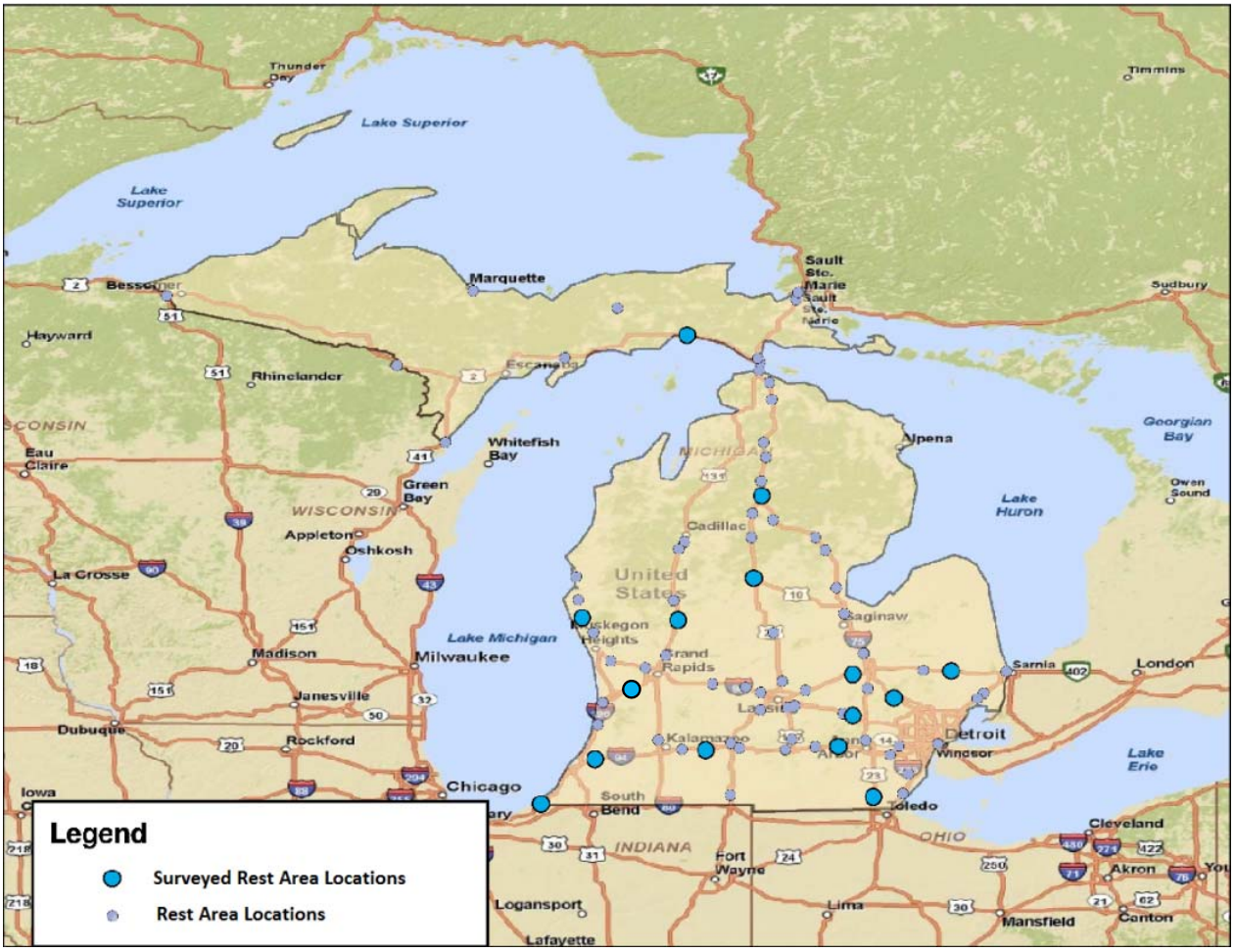

Figure 3. Map of Michigan Rest Area Survey Locations

The survey instrument consisted of a one-page questionnaire targeted at drivers and passengers of passenger vehicles, recreational vehicles, and commercial vehicles. Additional questions specific to commercial truck drivers were provided on the reverse side of the questionnaire form. The questionnaire was designed to be as concise as possible to encourage a high level of response. The survey questions were developed based on similar rest area surveys performed in Texas (*35*), Michigan (*36*), and Montana (*40*) along with the nationwide survey performed in NCHRP 324 (*37*). The survey questionnaire included the following topics (full questionnaire form is provided in the Appendix):

- Reason(s) for stopping at the particular facility, including why the facility was selected rather than an alternate commercial facility
- Contributing factors related to choosing a rest area versus a similar commercial facility
- Frequency of public rest-area use within Michigan

- Overall satisfaction with Michigan public rest areas
- Dollar value of the services utilized during the stop
- Trip information, including type of vehicle, purpose of trip (work, vacation/recreation, truck haul, personal business), number of persons in the vehicle, amount of time on the road since previous stop, amount of time remaining on the road
- Demographic information, including gender, age, trip origin, and trip destination
- Commercial driver information, including trucking company and information pertaining to experience with nighttime parking overflow at rest areas.

The surveys were conducted at the selected rest areas from July to September 2011. The surveys were performed during daylight hours on both weekdays and weekends. The surveys were performed at each location during periods when higher-than-normal traffic volumes were expected. For example, surveys were performed at northbound rest areas along major tourism routes on Fridays and Saturdays, while Sundays were selected for southbound routes. The surveys were not administered at night for safety reasons, although surveys were often performed into the early-evening hours to capture truck drivers preparing to rest for the night.

The surveys were conducted by a team of two to three individuals. Surveyors stationed themselves out in front of the rest area building entry point(s) with a portable canopy, small folding table, and sign. Patrons were asked participate in the survey as they approached the building and were given the option to take the survey either before or after entering the building. Whenever possible, the surveyors would also walk through the parking areas to interview persons that did not enter the building. However, it was not possible to engage all persons that did not approach the rest area building. Figure 4 shows sample photographs of surveys being conducted.

Figure 4. Examples of On-Site Rest Area User Survey Administration

Elevated high definition video cameras were placed at the rest area entry point to collect both rest area entry volumes and mainline volumes during the period of the survey. Each vehicle entering the rest area or passing by on the mainline was classified as a passenger vehicle, commercial truck, recreational vehicle, or bus. The general descriptive statistics for the survey are shown in Table 3.

Surveys were performed at the 15 survey sites for a total of 95 survey hours – an average of 6.33 hours per survey location. A total of 9,511 vehicles entered the rest areas during the survey data collection periods. The number of rest area users during the survey period was estimated by multiplying the average vehicle occupancy reported by the survey respondents by the number of vehicles entering the rest area during the survey period. The average occupancy was 2.76 persons per vehicle, which included several tour buses. The average survey response rate for was estimated at 10.8 percent of all persons using the rest areas during the survey periods.

Table 3. General Descriptive Statistics for Survey Data Collection at Rest Areas									
REST AREA	**Dates Surveys Conducted (2011)**	**No. of Surveys**	**Total No. of Survey Hours**	**Ave Veh Occ.**	**Total Mainline Traffic Volume**	**Rest Area Traffic Volume**	**Vehicular Turn-in rate**	**Estimated Rest Area Visitors**	**Survey Response Rate**
Swartz Creek	8-3, 8-4	226	8	4.14*****	9,628	481	5.0%	1,989	11.4%
Dundee WC	8-5, 8-6	271	9	2.50	12,766	687	5.4%	1,718	15.8%
Clarkston	8-7	240	6	2.59	17,724	791	4.5%	2,052	11.7%
Battle Creek	8-10, 8-18	158	7	2.11	13,698	825	6.0%	1,737	9.1%
Watervliet	8-10	101	4	2.11	5,481	337	6.1%	710	14.2%
Capac	7-28, 8-11	133	7	1.91	5,764	332	5.8%	633	21.0%
New Buffalo WC	8-11	242	6	3.11*****	15,578	1,313	8.4%	4,086	5.9%
Lake Chemung	7-29, 8-12	214	10	3.57*****	29,221	770	2.6%	2,750	7.8%
Zeeland	8-12	110	5	2.03	14,109	328	2.3%	665	16.5%
Morley	7-15, 8-19	113	6	2.67	13,673	659	4.8%	1,757	6.4%
Rothbury	7-15, 8-19	239	9	2.49	8,055	494	6.1%	1,229	19.5%
Grayling	8-18	156	4	3.00*****	6,066	383	6.3%	1,149	13.6%
Naubinway	8-21	245	5	2.58	4,761	518	10.9%	1,337	18.3%
Clare WC	8-19	283	5	2.79*****	13,628	1,295	9.5%	3,619	7.8%
Chelsea	9-16	100	4	2.49*****	7,587	298	3.9%	742	13.5%
Total		**2,831**	**95**	**2.76***	**177,739**	**9,511**	**5.4%**	**26,174**	**10.8%**

***** Average vehicular occupancy includes one or more tour buses

RESULTS

Demographic and Trip Information for Rest Area Users

A total of 2,831 rest area users were surveyed at the 15 rest areas and welcome centers. A majority of travelers were on a vacation or recreational trip (65%), the typical mode of travel was a passenger vehicle (81%), and 22 percent were traveling with children. The median age of the survey respondents was 52 years old. Males were slightly more represented than females, representing 57 percent of those surveyed. Eighty-seven (87) percent of participants had

previously used a Michigan rest area in the past 12 months, with the median falling in the range of 6 – 10 stops at Michigan rest areas in the past 12 months. The median time on the road since the previous stop for motorists fell in the range of 2 – 3 hours, while the median time remaining for travel on that particular day fell between 1 – 2 hours. Details of the survey demographic and trip related responses are presented in Table 4.

Table 4. Demographic and Trip Related Responses to Michigan Rest Area Survey

Primary purpose of this trip					
Work	Vacation/Recreation	Personal Business	Bus Tour	Truck Haul Route	Other
13.1%	65.3%	12.9%	1.5%	3.2%	3.6%

Type of vehicle				
Passenger Vehicle	Motorcycle	RV or Pass Veh towing trailer	Commercial Truck	Tour Bus
81.0%	1.5%	7.8%	8.0%	1.8%

Demographic and Occupancy Information							
Gender		Age		# People in Vehicle		Traveling w/children	
Male	Female	16-29	9.5%	1	26.5%	Yes	No
56.7%	43.3%	30-44	16.9%	2	41.5%	22.1%	77.9%
		45-54	20.5%	3	11.9%		
		55-64	27.4%	4	11.7%		
		65+	18.6%	5	4.0%		
				5+	4.4%		

Trip Origin		
In-State	Border State/Province	Non-Border State
62.5%	27.5%	10.0%

Trip Destination		
In-State	Border State/Province	Non-Border State
86.0%	10.0%	4.0%

Frequency of Stops at <u>Any</u> Michigan Rest Area in Past 12 Months					
First time	2-5 times	6-10 times	11-25 times	26-50 times	50+ times
12.9%	31.1%	22.1%	15.7%	8.9%	9.3%

Time on the Road Since Previous Stop				
Under 1 hr	1-2 hrs	2-3 hrs	3-4 hrs	4 + hrs
9.6%	33.3%	27.4%	12.6%	17.2%

Travel Time Remaining for the Day				
Under 1 hr	1-2 hrs	2-3 hrs	3-4 hrs	4 + hrs
21%	35.2%	20%	10%	13.9%

Note: Represent 2,831 survey responses.

Vehicle Occupancy Characteristics

Vehicular occupancy rates were determined from the self-reported survey data. Occupancy rates are useful for estimating the number of visitors utilizing a rest area based on rest area entry volumes. The vehicular occupancy data reported by survey respondents and stratified by vehicle type is shown in the table that follows.

Table 5. Self-Reported Vehicular Occupancy by Vehicle Type and Trip Purpose

	Survey Responses		Occupancy Characteristics	
Vehicle Type	**Number**	**Pct. of Total**	**Mean Occupancy (persons per veh)**	**Pct. of Vehicles Including Children**
Passenger Vehicle	1,900	81.4%	2.42	22.9%
-Vacation/Personal	1,706	89.8% (sub)	2.54	25.2%
-Work Related	194	10.2% (sub)	1.42	2.7%
Motorcycle	35	1.5%	1.57	0%
RV	186	8.0%	2.86	35.2%
Commercial Truck	181	7.8%	1.25	2.9%
Tour Bus	32	1.4%	27.06	N/A
TOTAL	2,721	100.0%	2.76	22.1%

The average self-reported vehicular occupancy was 2.76 persons per vehicle. As expected, commercial trucks had the lowest occupancies at 1.25 persons per vehicle, while tour buses had the highest occupancies at 27.06 persons per vehicle. The average occupancy for the 1,900 surveyed travelers in passenger vehicles was 2.42 persons per vehicle. Further analysis of the passenger vehicle travelers by trip purpose found that the occupancies differed based on the purpose of the trip. Passenger vehicle occupancies for vacation/personal trips had occupancies of 2.54 persons per vehicle, while work related trips had occupancies of 1.42 persons per vehicle.

Overall, 22.1 percent of the vehicles included children aged 17 and under. Not surprisingly, RVs included the highest percentage of children per vehicle, as 35.2 percent of those surveyed indicated that children were present in the vehicle. Nearly 23 percent of passenger vehicles included children, although there was a large discrepancy between vacation/personal trips (25.2%) and work trips (2.7%), providing a likely explanation for the differences between the occupancy rates between the passenger vehicle trip purposes. Data collected during pilot versions of the survey showed that 18.3 percent of passenger vehicle occupants were children aged 17 and under.

Trip Origins and Destinations

Displayed in Figures 5 and 6 are the concentrations of trip origins and destinations, as reported by the rest area survey respondents. Nearly 63 percent of the trips originated from within Michigan, while an additional 27 percent originated from a border state or province (Ohio, Indiana, Illinois, Wisconsin, or Ontario). Eighty-six (86) percent of the trip destinations were within Michigan, with an additional 10 percent of the destinations falling within a border state or province. The imbalance between in-state origins and destinations is likely due to the survey sampling strategy, which favored in-bound rest areas (i.e., northbound, eastbound, most welcome centers) over outbound rest areas (i.e., southbound, westbound). Over 44 states and provinces were represented in both the reported trip origins and destinations.

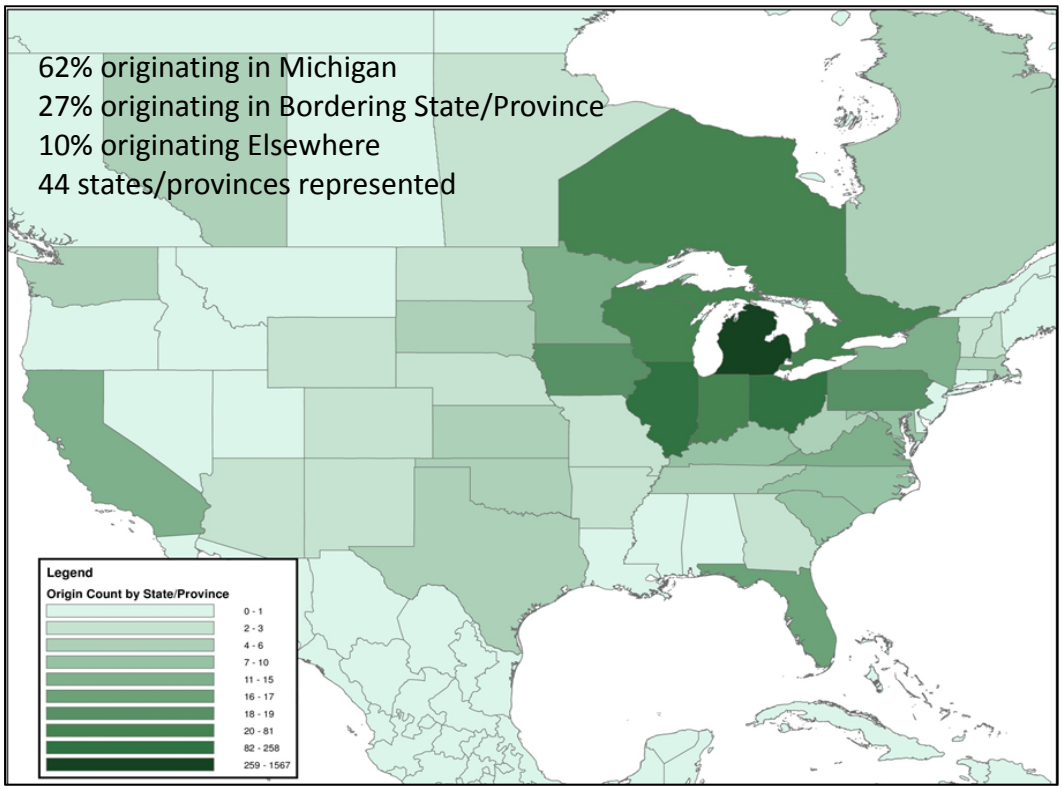

Figure 5. Concentration of Origin Zip Codes by State/Province

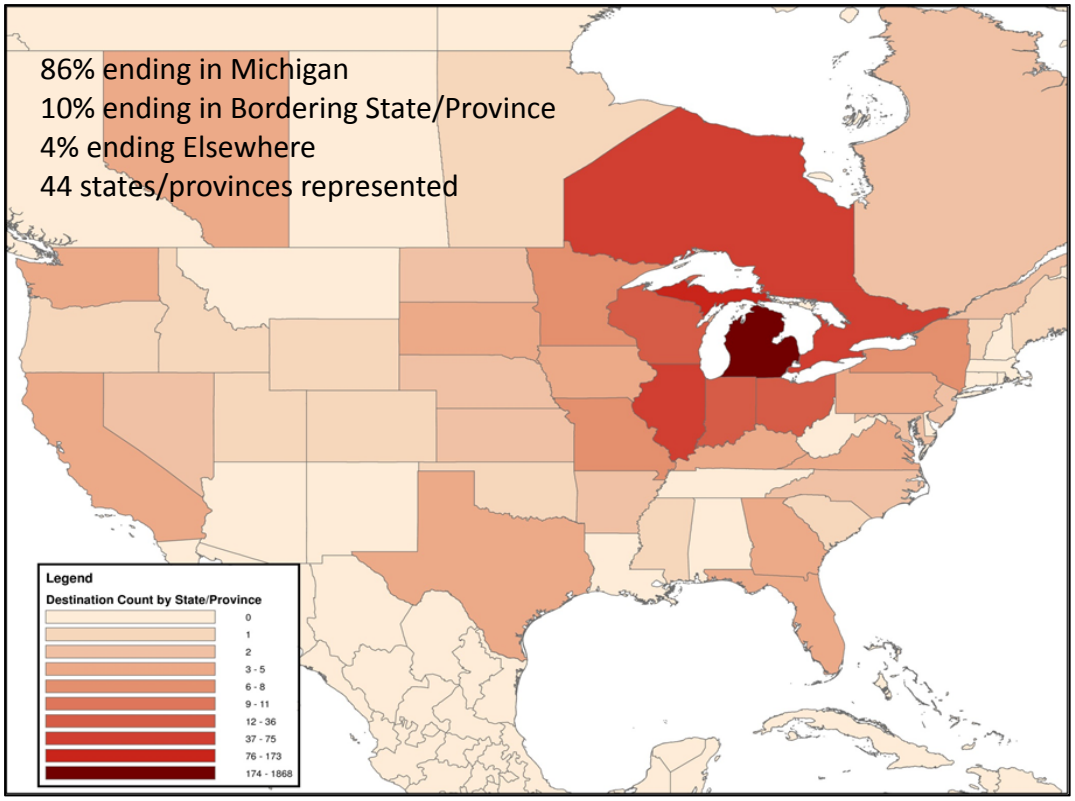

Figure 6. Concentration of Destination Zip Codes by State/Province

Reasons for Stopping at Rest Areas

The questionnaire also solicited the reason(s) for stopping at the facility, and in particular, why the particular rest area was chosen over a private facility. The survey provided 12 possible responses (multiple responses were allowed), including use restroom, stretch/walk/break, sleep, picnic, travel info, etc. (see Appendix for full list). The first and second most common reasons selected were "use restroom" at nearly 95% and "stretch/walk/take break" at 54.8 percent. No other responses exceeded 10 percent of all respondents. Respondents were then questioned why they chose a rest area over a nearby private facility. "Quick access from highway" was selected most frequently (88.3%), followed by "no need for additional services" (36.8%), "cleanliness of facilities" (35.6%), and "parking availability" (31.0%). Table 6 details the responses for each selection.

Table 6. Reason for Stopping at the Particular Rest Area

Reason for stopping at rest area (Q7)	Percent Responding	Why did you choose a rest area over a private facility? (Q8)	Percent Responding
Use Restroom	94.4%	Quick Access from Highway	88.3%
Stretch, Walk, Break	54.8%	No Need for Additional Services	36.8%
Break for Children	8.8%	Cleanliness of Facility	35.6%
Use Vending Machine	7.1%	Parking Availability	31.0%
Tourist/Travel info	6.4%	Nearest Available Option	19.6%
Pet Relief	5.5%	Safety/Security	11.3%
Check Vehicle	5.3%	Need to Rest	9.0%
Change Drivers	4.8%	Tourist/Travel info	6.1%
Picnic	3.0%	Traveling with Children	5.2%
Sleep	1.5%	Unsure of private facilities in area	4.9%
Other	1.5%	Traveling with Pets	4.9%
Out of Hours (Commercial)	0.2%	Other	1.9%

Preference for Rest Areas vs. Commercial Service Facilities

Users were also asked to indicate whether they preferred a rest area versus an alternate commercial service facility for each of eight common reasons for travelers to stop. For a specific service, respondents were asked to indicate whether they preferred a rest area, a private facility, or no preference. The results showed that rest area users preferred rest areas 81% of the time when it was necessary to use the restroom. Similarly, respondents indicated that rest areas were the preferred choices when needing a short break (80%). Preferences for having a snack and checking vehicle were neutral, with the majority of respondents indicating no preference for either service. Private facilities were desired for eating a meal and for long rest, as 58.5 and 40.5 percent preferred private facilities, respectively.

A statistical analysis of the data was performed using ordered logit modeling for each preference question. The analysis found that the user's type of vehicle, age, frequency of rest area use, and travel time were significant in determining preference towards selection of a rest area or private facility. Figure 7 provides a summary of the preference percentages for each desired service.

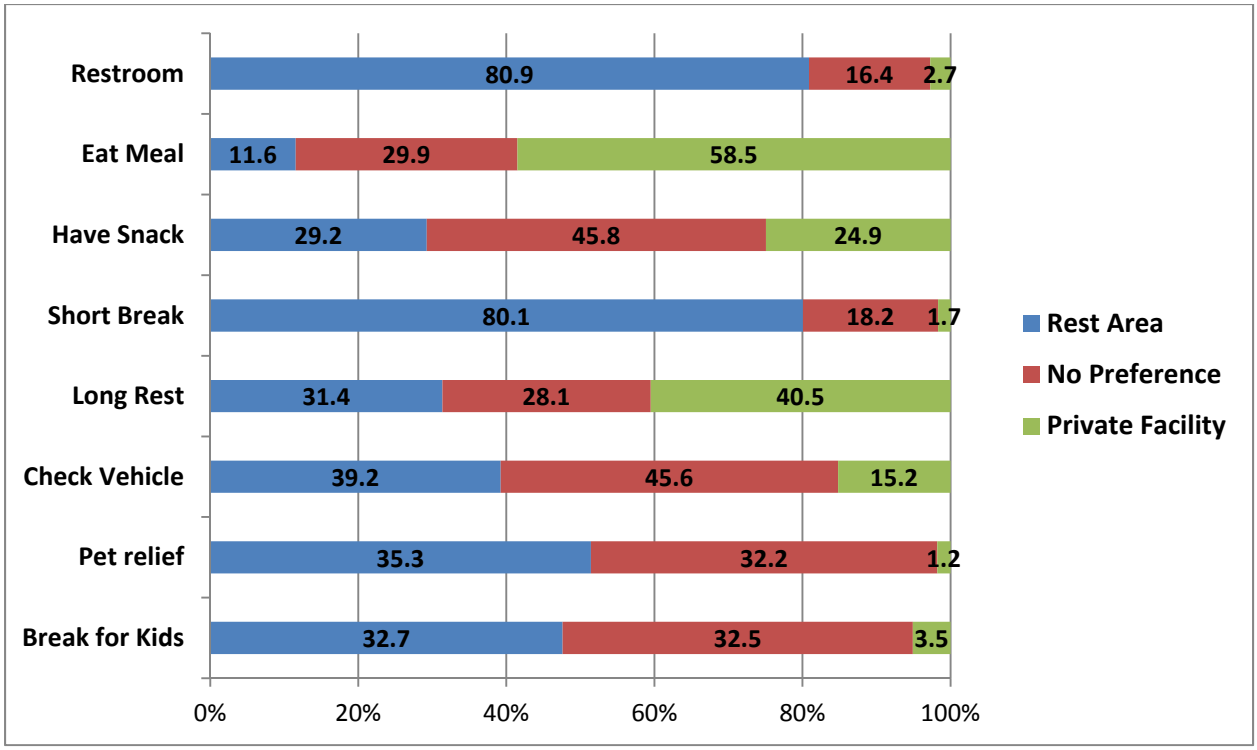

Figure 7. Rest Area User Preferences by Desired Service

Overall Satisfaction with Michigan Rest Areas

The questionnaire asked users to provide a score indicating their satisfaction level with Michigan rest areas. Respondents were asked to make selection on a scale of 1 (very unsatisfied) to 5 (very satisfied). Of those responding, 84.7 percent chose either a 4 or 5 satisfaction level with a mean satisfaction level of 4.26. Fewer than 8 percent of respondents indicated low satisfaction with the facilities (i.e., satisfaction of either 1 or 2). These overall satisfaction results are displayed in Figure 8.

A statistical analysis of the satisfaction data was performed using ordered logit modeling. The analysis showed that multiple factors were found to influence the level of satisfaction indicated by rest area users. Motorcyclists, RV'ers, frequent rest area users, vacation travelers, and persons traveling with children had the highest satisfaction levels, while commercial truck drivers, younger travelers, and first time rest area users had lower levels of satisfaction.

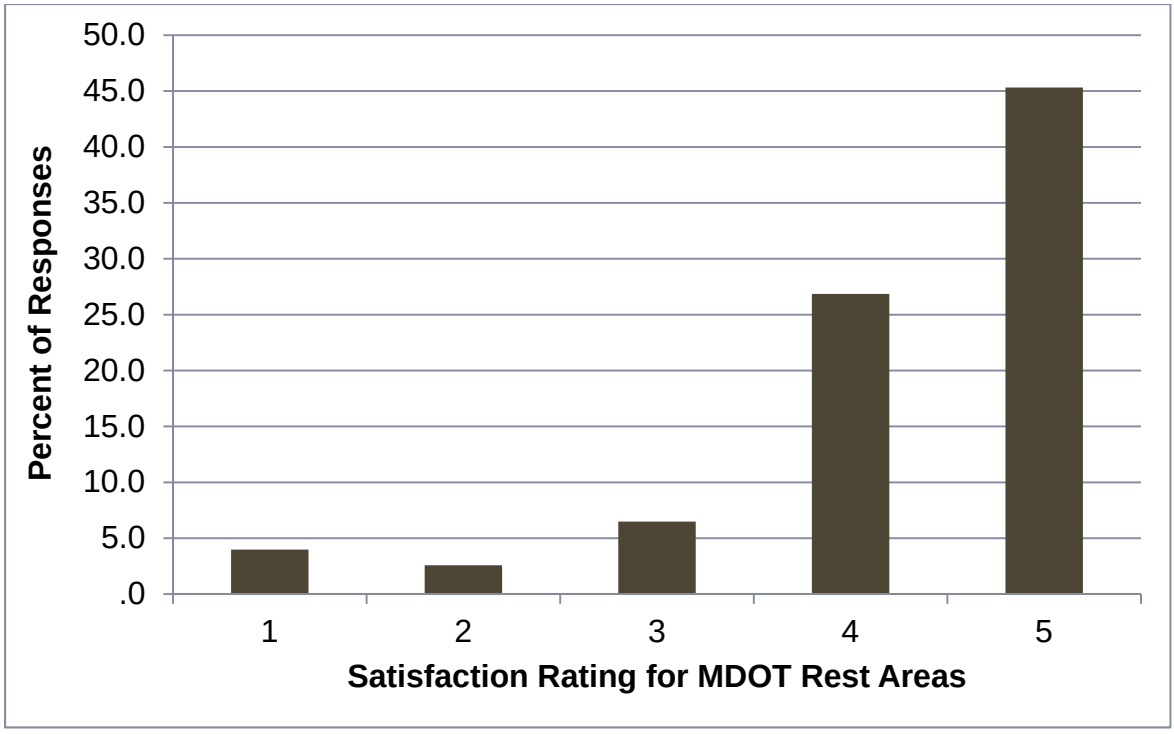

Figure 8. Michigan Rest Area Survey User Satisfaction Level

Value of Services Provided to Rest Area Users

To assess the perceived value the traveling public has with services provided at rest areas and welcome centers, surveyed patrons were asked to indicate the perceived value of the services utilized during the particular stop at the rest area. Seven categorical choices were provided based on results of a pilot survey and previous surveys found in the literature and included a range from $0 to $5 or more. A total of 2,556 responses were received.

Only 15.5 percent of respondents indicated a value of $0 for the services utilized. The remaining 84.5 percent of respondents indicated some value to the services utilized, with the most common response falling in the $1.00 - $2.00 category. The median overall value was estimated at $1.81.

A statistical analysis of the value to user data was performed using ordered logit modeling. The analysis found that the rest area services are valued highest by welcome center visitors, older motorists, frequent rest area users, those relieving pets, vending machine users, picnickers, persons obtaining tourist or travel info, and motorists who had been on the road for more than 2 hours. Rest area survey respondents who indicated the lowest value were truck drivers, young motorists, first time users, and those on the road less than 2 hours. The most

substantial differences in the median value to users were found between rest area users and welcome center users, as the median value of the stop for rest area users was $1.68 compared to $2.21 for welcome center users. This finding is consistent with previous research and is indicative of the additional level of traveler services provided by welcome centers. Table 7 shows the relative percentages for each of the value categories, for rest areas, welcome centers, and overall.

Table 7. Perceived Value of Services Utilized During Rest Area Stop

Value of Services Utilized During Stop at Rest Area	Percent of Respondents		
	All Facilities	Rest Areas	Welcome Centers
$0	15.5%	16.4%	13.3%
$0.01 - $1.00	14.6%	16.4%	10.5%
$1.00 - $2.00	24.6%	25.6%	22.3%
$2.00 - $3.00	14.9%	13.2%	18.8%
$3.00 - $5.00	14.6%	13.9%	16.6%
$5.00 +	15.8%	14.6%	18.5%
Median Value	**$1.81**	**$1.68**	**$2.21**

COMPARISON OF PREFERENCES BETWEEN REST AREA AND COMMERCIAL TRUCK STOP PATRONS

In an effort to better understand the differences in traveler opinions between rest area users and commercial truck stop users, a companion survey was performed at two large Pilot Travel Centers along the I-94 corridor was conducted in Fall of 2011. These travel centers were selected due to their size, services provided, and locations with respect to rest areas included in the survey. The Battle Creek Pilot includes a McDonald's restaurant and is located at Exit 104, which is 8 miles from the Battle Creek Rest Area. The Dexter Pilot includes an Arby's restaurant and is located at Exit 167 and is 6 miles from the Chelsea Rest Area. The responses of the surveyed truck stop users were then compared to survey respondents from Michigan rest areas located along I-94, including Battle Creek, Watervliet, New Buffalo, and Chelsea. The objective of this analysis was to gain insight into the variation of road user's purpose and choice for stopping, facility preferences, and satisfaction with Michigan rest areas based upon the type of facility where the survey was conducted.

A one page questionnaire was provided to patrons of Pilot Travel Centers in Battle Creek and Dexter, Michigan located along I-94. The questions detailed in the survey were identical to the MDOT Rest Area User survey with a few exceptions. The questions pertaining to reason for stopping and why the facility was chosen over a rest area were modified to include the options "buy food or beverage" and "get fuel". Another notable difference between the questionnaires was that the question regarding perceived value of services received at Michigan rest areas was omitted. WSU-TRG staff were stationed outside of the travel centers and provided surveys to all patrons that were willing to participate. Surveys were performed for two weekend days at each location in attempt to capture vacation/recreation travelers. A total of 656 survey responses were obtained at the two survey locations.

To provide a representative comparison between the rest area and truck stop users, the survey data were post-stratified such that the proportions of vehicle types, trip purposes, and trip origins were approximately equal between the truck stop and rest area surveys. The resulting rest area and truck stop survey samples each included 28 percent commercial vehicles and 60 to 65 percent passenger vehicles. Sixty-eight (68) percent of the trips originated from within Michigan for the rest area and truck stop survey samples. The two samples also included approximately 50 percent vacation/personal trips and 28 percent work trips. Certain demographic characteristics were found to differ between the two survey samples. Most notably, the truck stop survey respondents were far more likely to have been on the road for less than one hour – likely due to the fuel and food services provided. The truck stop respondents were also more likely to be traveling alone compared to the rest area users and also had greater representation among younger persons. As expected, rest area survey respondents were more likely to be frequent users of Michigan rest areas. Table 8 details the survey demographic and travel characteristics for the two types of sites.

Table 8. Demographic and Trip Information for I-94 Rest Area and Truck Stop Surveys

Category	Subcategory	Percent of I-94 Rest Area Respondents	Percent of I-94 Truck Stop Respondents
Trip Purpose	Work	27.5%	28.9%
	Vacation/Recreation	37.7%	25.5%
	Personal Business	13.9%	24.7%
	Bus Tour	2.8%	4.3%
	Truck Haul Route	14.5%	8.9%
	Other	3.7%	7.7%
Type of Vehicle	Passenger Vehicle (PV)	60.8%	65.0%
	Motorcycle	1.9%	0.8%
	RV or PV towing trailer	5.6%	3.2%
	Commercial Truck	28.4%	28.4%
	Tour Bus	3.4%	2.5%
Gender	Male	68.3%	71.3%
	Female	31.7%	28.7%
Age Category	16-29	12.3%	17.6%
	30-44	23.1%	26.6%
	45-54	22.4%	27.9%
	55-64	25.0%	18.3%
	65+	17.2%	9.5%
Number of People in Vehicle	1	43.9%	54.9%
	2	33.6%	29.5%
	3	7.0%	6.1%
	4	8.3%	6.1%
	5	1.0%	2.0%
	5+	6.2%	1.4%
Traveling with Children	Yes	13.6%	14.5%
	No	86.4%	85.5%
State of Trip Origin	In-State	68.2%	68.4%
	Border State	21.3%	18.9%
	Non-Border State	10.5%	12.7%
Number of Stops at ANY Michigan Rest Area in the past 12 months	1st time (RA) or Never (TS)	7.6%	17.1%
	1-5 times	28.6%	35.8%
	6-10 times	19.7%	18.5%
	11-25 times	15.5%	13.0%
	26-50 times	11.5%	8.9%
	50+ times	17.1%	6.6%
Time on road since most recent stop	Under 1 hour	10.9%	51.6%
	1-2 hours	28.3%	16.3%
	2-3 hours	26.4%	12.4%
	3-4 hours	9.9%	7.5%
	4+ hours	24.5%	12.2%
No. of Survey Responses		**324**	**472**

The questionnaire also inquired on users reason(s) for stopping at the facility. Nearly 94% of rest area users indicated restroom use as the reason for stopping compared to only 30% of private truck stops users. As in the previous survey data the other primary reason for rest area users to stop is to stretch or take a short break. Only a limited number of truck stop users indicated stretch/walk/break as their reason for stopping. The primary reason for stopping indicated by truck stop users was to get fuel, followed by buying food or beverages. The remaining reasons are relatively equal at the two types of facilities. The breakdown of percentages for each response provided is detailed in Table 9.

Table 9. Reason for Stopping at Facility – Rest Area vs. Commercial Truck Stop Users

	Percent of I-94 Rest Area Respondents	Percent of I-94 Truck Stop Respondents
Use Restroom	93.8%	29.2%
Stretch, Walk, Break	52.2%	12.5%
Check Vehicle	10.5%	8.3%
Use Vending Machine (RA)/Buy Food or Beverage (TS)	10.2%	34.3%
Get Fuel	N/A	76.9%
Break for Children	5.9%	1.9%
Picnic	4.0%	N/A
Sleep	3.7%	5.7%
Tourist/Travel info	3.7%	0.4%
Pet Relief	2.8%	2.5%
Change Drivers	2.5%	1.9%
Other	1.2%	3.2%
Out of Hours (Commercial Truckers)	0.6%	1.9%

A comparison of facility user preference was also conducted. The survey respondents from the I-94 truck stops indicated a different distribution of facility preferences for the same purposes compared to the rest area survey respondents. Comparison of the facility preferences between the two survey groups is shown in Figures 9 and 10. There was evidence of a general shift in preference towards truck stops for all stopping purposes. However, among truck stop survey respondents, rest areas were still preferred over private truck stops for several common uses, including: restroom use, short break, pet relief, and break for kids. Surprisingly, the preference for using rest areas for pet relief was actually *higher* for truck stop patrons compared to rest areas. The greatest preference for rest area use among truck stop patrons was for taking a short break, as 55.9 percent preferred rest areas.

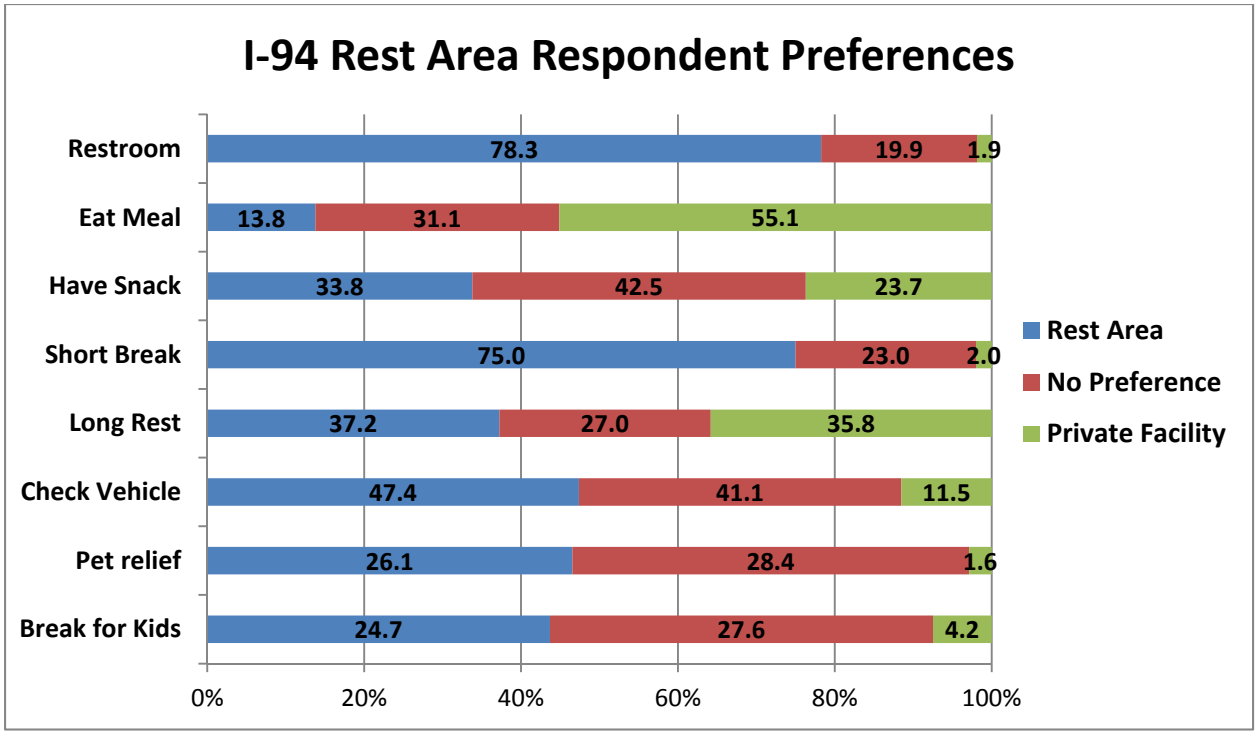

Figure 9. I-94 Rest Area User Preferences

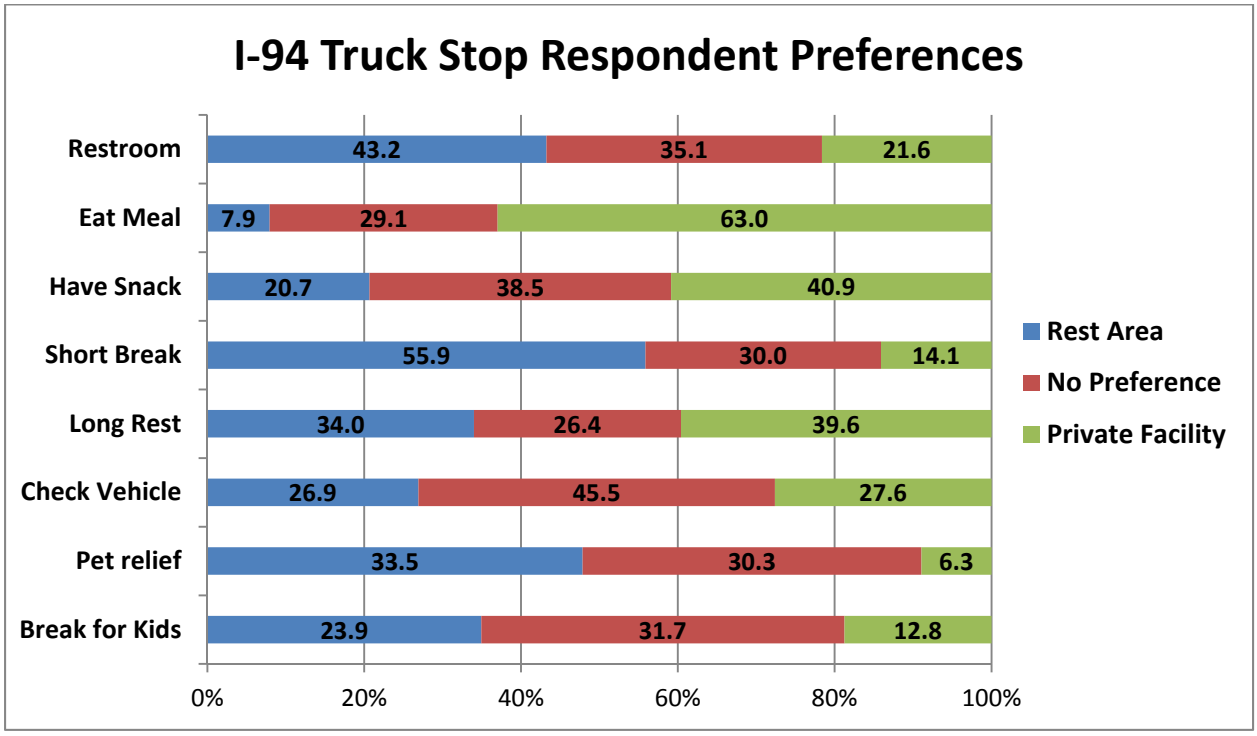

Figure 10. I-94 Private Truck Stop User Preferences

Respondents were also asked to indicate a level of overall satisfaction with Michigan rest areas. This question was presented to both rest area users and truck stop users. A comparison of satisfaction levels for each type of facility user is presented in Figure 11. As indicated in the figure, rest area users have a higher overall satisfaction level with over 82% selecting a 4 or 5. In comparison only 69% of truck stop respondents indicated a 4 or 5 satisfaction level with Michigan rest areas. The overall mean satisfaction level for rest area users vs. truck stop users is 4.18 and 3.88, respectively.

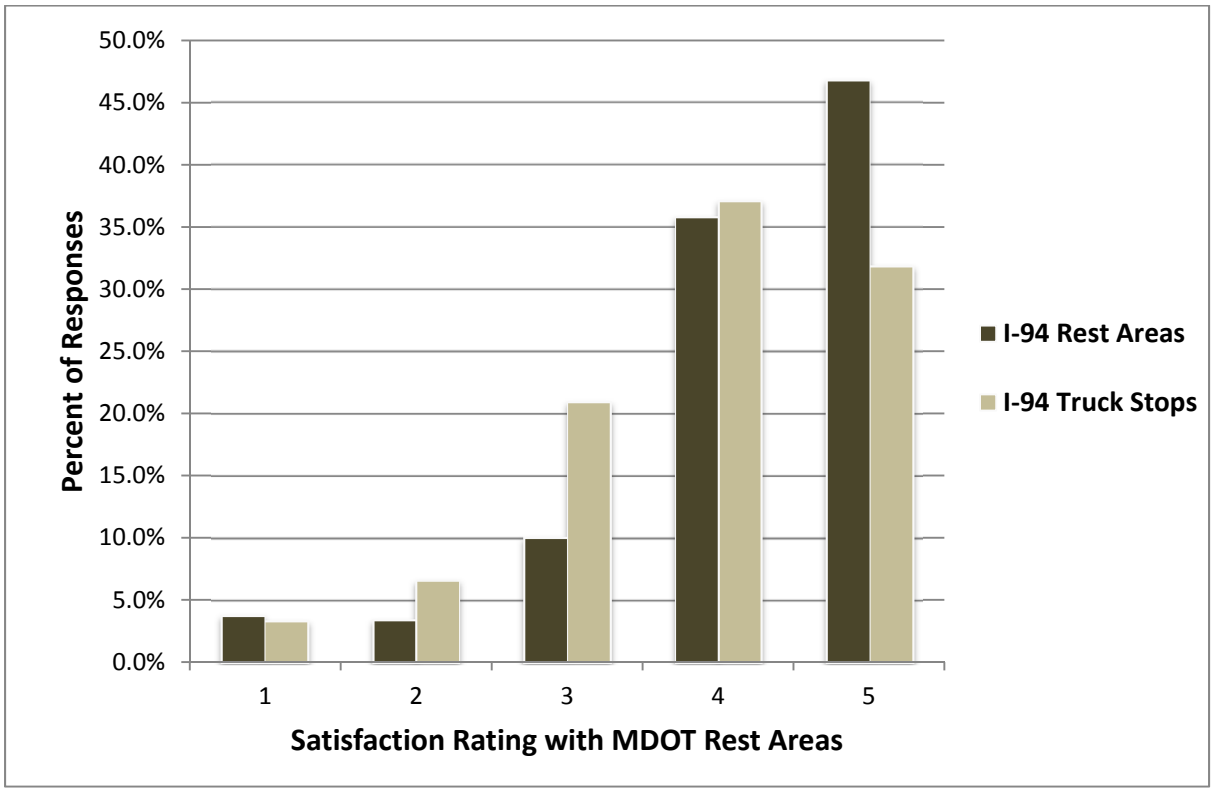

Figure 11. Comparison of I-94 Travelers Satisfaction Level with MDOT Rest Areas

CHAPTER 5:
NIGHTTIME TRUCK PARKING UTILIZATION AND CAPACITY ASSESSMENT

This chapter provides a detailed assessment of truck parking capacity and the level of nighttime utilization at both rest areas and commercial truck stops along the major trucking routes in Michigan, which include I-69, I-75, I-94, and I-96. This information is critical to not only assess the current level of truck parking capacity and utilization, but to also determine the ability for the current system to absorb any residual parking demand caused by potential rest area closures. Two methods were used to collect the necessary data:

- Telephone interview survey of commercial truck stop operators
- Nighttime parking utilization assessment at selected rest areas along major routes

SURVEY OF TRUCK STOP OPERATORS

An interview survey with commercial truck stop operators along the major trucking routes in Michigan was performed in order to obtain relevant information pertaining to truck parking capacity, nighttime occupancy and overflow issues, as well as opinion-based queries about parking and public rest areas along the route. This survey was administered via telephone to management staff at 71 truck stops with overnight truck parking areas along major trucking routes in Michigan, including I-69, I-75, I-94, and I-96. Both major national chains (Pilot, TA, etc.) and locally owned facilities were contacted, which were identified during the inventory data collection task. After requesting to speak with the manager of the facility, the following questions were asked during the telephone survey:

1. How many truck parking spaces exist at your facility?
2. During a typical weeknight, what is the approximate percentage of truck parking spaces that are occupied during peak nighttime hours?
3. How many times per week does the truck parking area overflow at night?
4. Do you believe that there is a truck parking shortage along this highway?
5. Do you believe that the State of Michigan should open more public rest areas along this highway?
6. Do you believe that the State of Michigan should close selected public rest areas along this highway?

Of the 71 truck stops that were contacted, 33 (46.5%) provided responses. Each response was recorded into a table for the particular roadway. The itemized response tables are provided in Appendix Tables D through G. In addition, summaries of the responses to each question were aggregated by roadway type and are shown in the following table.

Table 10. Summary of Commercial Truck Stop Operator Surveys

Route	No. of Survey Responses	Average Percentage of Truck Parking Spaces Occupied at Peak Nighttime Hours	Average Number of Times Per Week Truck Parking Area Overflows at Night	Percent of Locations With Nighttime Parking Overflows at Least Once per Week	Percent of Respondents Believing a Truck Parking Shortage Exists Along the Highway	Percent of Respondents Believing the State of Michigan Should Open More Public Rest Areas Along the Highway	Percent of Respondents Believing the State of Michigan Should Close Selected Public Rest Areas Along the Highway
I-69	4	70%	0.5	25%	100%	75%	0%
I-75 (north of Flint)	11	39%	0.4	18%	20%	33%	11%
I-75 (Detroit and Monroe)	2	75%	5.0	100%	100%	100%	0%
I-94	11	88%	2.4	80%	40%	64%	9%
I-96	5	77%	1.6	40%	67%	75%	25%
TOTAL	33	66%	1.5	47%	46%	60%	10%

Table 10 shows evidence of commercial truck parking shortages along the major interstate corridors in Michigan. Of the 33 truck stops participating in the survey, the average peak nighttime truck parking capacity was reported at 66 percent. Forty-seven (47) percent of the locations reported the occurrence of nighttime overflows of the truck parking areas at least once per week. Truck parking overflows were reported to occur on average 1.5 nights per week. Nearly half (46%) of those surveyed believed that a truck parking shortage exists along their highway. The survey participants also greatly favored the opening of more public rest areas (60%) compared to closing public rest areas (10%) along the particular highway.

The most severe truck parking issues were reported along the entire I-94 corridor and I-75 in Detroit and Monroe. Commercial truck stops along I-94 experience the highest nighttime truck parking occupancy (88%) and also frequently exceed nighttime parking capacity with 80% of the surveyed locations experiencing weekly overflows at an average overflow frequency of 2.4 nights per week. A review of the individual responses (see Appendix Tables D-G) showed consistent truck parking capacity issues along the entire length of the I-94 corridor. The

two surveyed truck stops along I-75 in southeastern Michigan reported the most severe truck parking issues with an average of five overflow nights per week.

Information pertaining to the number of truck parking spots was obtained through corroboration of various truck parking reference guides that are freely available online. The number of truck parking spaces for the 71 truck stops along the four major interstate trucking corridors is shown in Table 11 along with the parking information for MDOT rest areas.

Table 11. Truck Parking Capacity at Commercial Truck Stops and MDOT Rest Areas

	COMMERCIAL TRUCK STOPS WITH OVERNIGHT TRUCK PARKING			MDOT REST AREAS			Ratio: Truck Stop Parking/ MDOT Rest Area Parking
Route	No. of Facilities	Average No. of Truck Parking Spaces per Facility	Total No. of Truck Parking Spaces at All Facilities	No. of Facilities	Average No. of Truck Parking Spaces per Facility	Total No. of Truck Parking Spaces at All Facilities	
I-69	8	62	495	7	23	162	3.1
I-75	27	48	1,296	22	17	378	3.4
I-94	28	72	2,010	12	28	341	5.9
I-96	8	76	607	8	22	178	3.4
TOTAL	**71**	**62**	**4,408**	**49**	**22**	**1,059**	**4.2**

Note: The commercial truck stop parking data presented here represents information for commercial truck stops with overnight truck parking as reported in available online truck parking reference guides. MDOT rest area parking capacity information was obtained from the MDOT public website.

As expected, the greatest commercial truck parking capacity is found along I-94 with 28 commercial truck stops and more than 2,000 commercial truck parking spaces. Commercial truck parking capacity clearly outweighs the capacity provided by MDOT rest areas. The ratio of commercial truck stop parking ranges from 3.1 along I-69 to 5.9 along I-94, with an overall ratio of 4.2 between the four primary interstate trucking routes in Michigan.

NIGHTTIME UTILIZATION OF REST AREA TRUCK PARKING

An overnight truck parking study was performed at a sample of rest areas along the major interstate trucking routes in Michigan. The objective of the overnight rest area truck parking study was two-fold: 1.) determine the level of nighttime truck parking utilization by hour and 2.) assess any overflow issues.

Only rest areas with truck parking areas that were known by MDOT to regularly operate at or above capacity were utilized. Seven Michigan Rest Areas were chosen as a representative sample of these overflow locations: Battle Creek (WB I-94), Clio (SB I-75), Dodge Road (NB I-75), Galesburg (EB I-94), Grass Lake (WB I-94), Howell (EB I-96), and Swartz Creek (EB I-69).

Data Collection

Data collection at each rest area occurred on a normal weeknight during September or October. At each rest area, two pole mounted video cameras were mounted on stationary objects (sign posts, light poles, etc.) at opposite ends of the truck parking area and were aimed towards the truck parking lot. The cameras were positioned to achieve a maximum view of the lot, as well as the entrance and exit ramps to capture any overflow (Figure 12). Video were recorded from late evening until morning at each location.

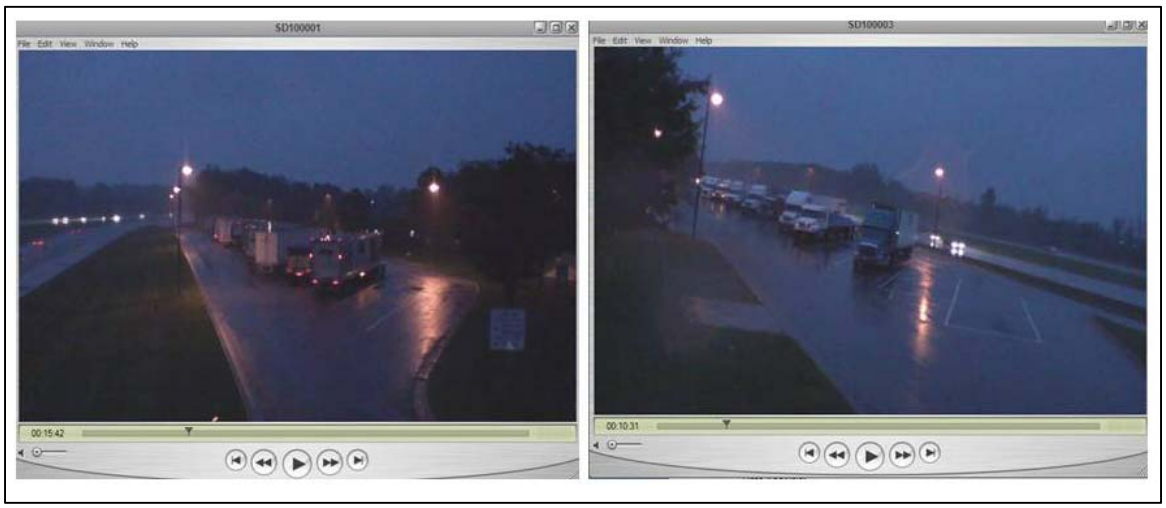

Figure 12. Opposing Camera Views from Howell Truck Parking Lot

Evaluating the nighttime truck parking videos required the analyst to initially view both camera angles during daylight hours to determine the total number of truck parking spaces that were visible in the field of view. From there, both videos were simultaneously reviewed at 15 minute intervals and the number of trucks in the lot at that time was recorded (Figure 13). Care was taken to not double count spaces between the two camera views. Cases where the truck parking lot was at or above capacity were denoted along with the number of excess trucks parked

in the lot. It was also noted where these extra trucks were parked when the lot was overflowed, especially if parking was occurring on the entrance or exit ramps.

Figure 13. Assessment of Truck Parking Space Utilization.

The data were consolidated into a single spreadsheet and sorted by time and location. The time range between 10:00 PM and 8:00 AM was selected to provide a uniform overnight parking analysis period between the various locations. The average hourly parking space occupancy was determined by averaging the number of trucks parked for each of the fifteen minute intervals. Additionally, the total percent of time spent in overflow was calculated using each fifteen minute time interval for each rest area:

$$Total\ \%\ Time\ in\ Overflow\ = \left[\frac{Number\ of\ 15\ minute\ periods\ spent\ at\ or\ above\ capacity}{Total\ Number\ of\ 15\ minute\ periods\ analyzed}\right] \times 100\%$$

Results

As shown in Table 12, only the Battle Creek (EB I-94), Swartz Creek (EB I-69), and Grass Lake (WB I-94) Rest Areas had truck parking overflow issues during peak nighttime hours. Swartz Creek and Grass Lake displayed the greatest levels of truck parking overflows, which were present for the majority of the overnight period at each rest area. Although the truck parking area rarely overflowed, Battle Creek was at or above 80 percent capacity for nearly the entire night. The other four rest areas never reached maximum truck parking capacity during the particular night for which data were collected. The Dodge Rd and Clio Rest Areas were

approximately 15% to 30% full for much of the night, the Galesburg Rest Area remained about 35% to 50% full, and the Howell Rest Area never exceeded 75% of capacity.

Table 12. Hourly Nighttime Truck Parking Space Occupancy and Capacity Assessment

		I-94			I-75		I-96	I-69
	Time Period	**Battle Creek**	**Grass Lake**	**Galesburg**	**Clio**	**Dodge Rd**	**Howell**	**Swartz Creek**
Percent of Truck Parking Spaces Occupied	10:00 -11:00 PM	93%	37%	36%	17%	13%	29%	67%
	11:00 PM - 12:00 AM	95%	62%	46%	16%	13%	43%	72%
	12:00-1:00 AM	88%	108%	52%	25%	16%	60%	96%
	1:00-2:00 AM	85%	112%	42%	18%	21%	54%	120%
	2:00-3:00 AM	96%	113%	42%	13%	27%	64%	124%
	3:00-4:00 AM	83%	110%	38%	16%	30%	55%	138%
	4:00-5:00 AM	83%	112%	37%	21%	31%	58%	151%
	5:00-6:00 AM	100%	114%	N/A	32%	51%	73%	146%
	6:00-7:00 AM	84%	117%	N/A	27%	30%	74%	128%
	7:00-8:00 AM	56%	104%	N/A	26%	16%	54%	87%
	10:00 PM – 8:00 AM	**86%**	**99%**	**42%**	**21%**	**25%**	**56%**	**113%**
Percent of Time At or Above Truck Parking Space Capacity	10:00 -11:00 PM	50%	0%	0%	0%	0%	0%	0%
	11:00 PM - 12:00 AM	0%	0%	0%	0%	0%	0%	0%
	12:00-1:00 AM	0%	75%	0%	0%	0%	0%	50%
	1:00-2:00 AM	0%	75%	0%	0%	0%	0%	100%
	2:00-3:00 AM	25%	100%	0%	0%	0%	0%	100%
	3:00-4:00 AM	0%	75%	0%	0%	0%	0%	100%
	4:00-5:00 AM	0%	100%	0%	0%	0%	0%	100%
	5:00-6:00 AM	50%	100%	N/A	0%	0%	0%	100%
	6:00-7:00 AM	0%	100%	N/A	0%	0%	0%	100%
	7:00-8:00 AM	0%	75%	N/A	0%	0%	0%	25%
	10:00 PM – 8:00 AM	**13%**	**70%**	**0%**	**0%**	**0%**	**0%**	**68%**

Note: Equipment failure was experienced at Galesburg after 5:00 AM.

CHAPTER 6:
REST AREA UTILIZATION

In order to provide an adequate assessment of the level of demand for passenger vehicles and commercial vehicles at MDOT rest areas, rest area usage data were collected and analyzed. Four different types of demand data were collected from various sources:

- Hourly rest area entry traffic volumes by vehicle type, time of day, day of week, and month of year
- Hourly mainline traffic volume by vehicle type, for the same time of day, day of week, and month of year
- Overnight utilization of truck parking spaces by time of day
- Duration of stay for trucks during overnight periods

DATA COLLECTION

MDOT's rest area hourly entering traffic count data were obtained by querying the Traffic Monitoring Information System (TMIS) online database. As MDOT collects rest area traffic counts for one week at a time on a triennial cycle, it was not possible to obtain data for all rest areas for the same year. As a result, only the most recent year of available hourly traffic count data were obtained for each rest area. For all but a few exceptions, all rest area traffic counts were taken between 2007 and 2009. All welcome center counts were provided by MDOT's planning division from counts taken in 2011 as this was the only year for which hourly classification data were available from MDOT. MDOT does not collect traffic volume data for the following welcome centers: Menominee, Iron Mountain, and Detroit. Data from the Saint Ignace Welcome Center was obtained, but not utilized due to errors reported by MDOT. The Port Huron Welcome Center was also excluded as it was temporarily moved in 2011 in preparation for a new facility. Thus, hourly volume data were obtained for a total of 76 facilities. For a majority of the facilities, at least an entire week's worth of hourly volumes was available.

Total rest area hourly volumes were available for 74 facilities. Passenger vehicle hourly volumes (including motorcycles, cars, pickups, SUVs, minivans, vans) were available for 70 facilities, while commercial vehicle hourly volumes (including single-unit trucks, multi-unit trucks, recreational vehicles, and buses) were available for 68 facilities. Additional information that was included for each hourly volume count included: month, day, time of day, day of week,

route, and MDOT region. It should be noted that only spring, summer, and fall counts were included as MDOT does not collect rest area volumes during winter periods. A summary of the hourly rest area volume counts is displayed in Table 13. The following subsections present the rest area usage trends based on analyses of the hourly rest area volume data.

Table 13. Descriptive Statistics for Rest Area Vehicular Traffic Volumes

Vehicle Classification	No. of Facilities	No. of Hourly Traffic Volume Counts	Mean Vehicles per Hour (vph)	Std. Deviation Vehicles per Hour (vph)
Passenger Vehicles	70	19,263	24.0	26.0
Commercial Vehicles	68	18,272	7.5	7.6
Total Vehicles	74	19,869	28.6	26.8

RESULTS

Day-of-Week Trends

The usage of Michigan rest areas varies depending on the day of the week. The day-of-week usage trends by vehicle type are shown in Figure 14. In general, an inverse relationship exists between passenger vehicles entering the rest area and commercial vehicles. Passenger vehicle utilization follows a pattern of increased use on Friday, Saturday, and Sunday, with lower utilization during weekdays. The opposite pattern exists for commercial vehicles. The commercial vehicle demand for rest areas is greatest during Monday through Thursday, with considerable drop-offs on Saturday and Sunday. The peak overall rest area utilization occurred on Fridays. These trends were expected given that commercial vehicles are more likely traveling during the work week and passenger vehicles are utilizing the facilities during recreational trips taken on the weekends.

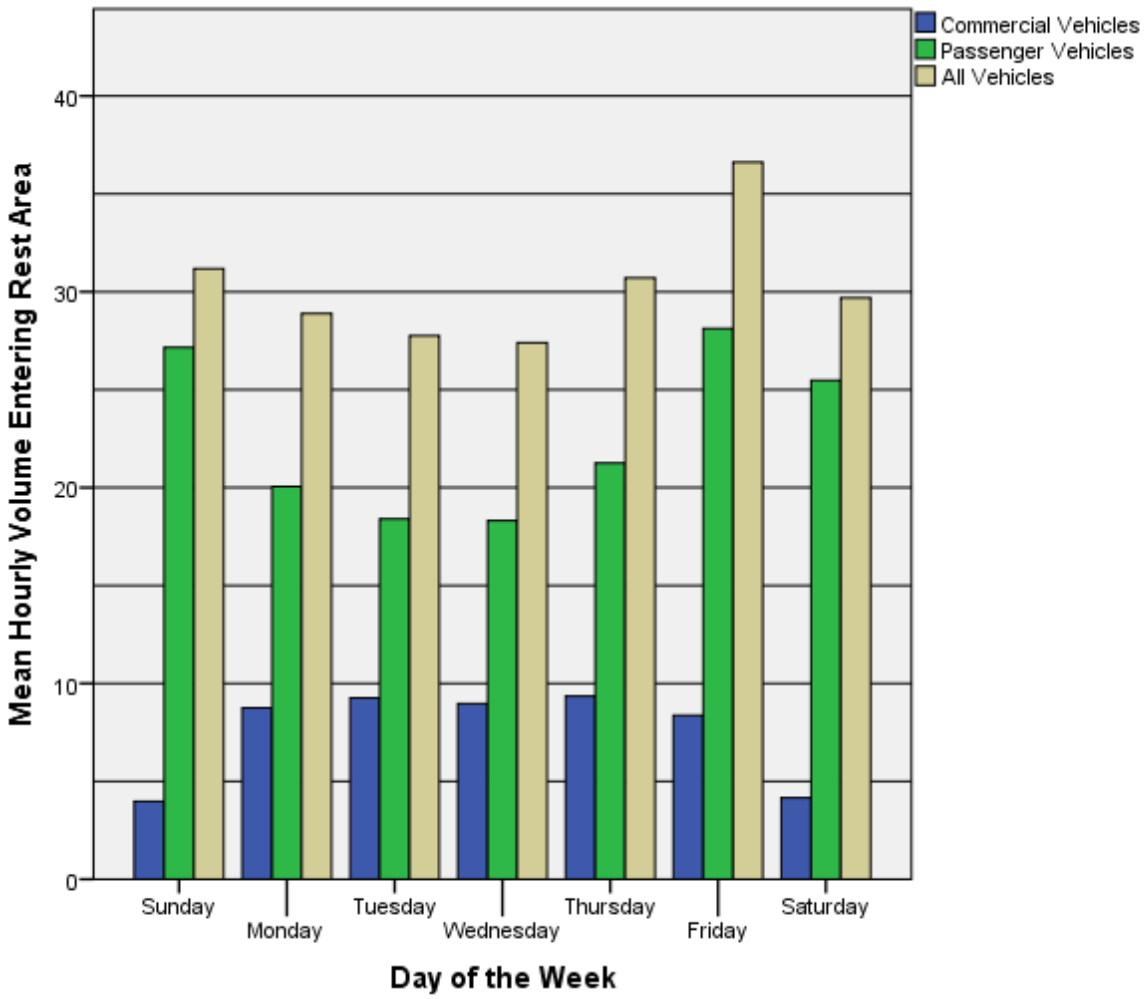

Figure 14. Rest Area Utilization by Day of the Week

Time of Day Trends

The time-of-day also has a significant impact on rest area utilization. The time-of-day usage trends by vehicle type are shown in Figure 15. Passenger vehicle travelers are far more likely to use the rest area during the afternoon hours compared to other times of the day. Nearly 60 vehicles per hour enter the rest area between 12 PM and 6 PM. Passenger vehicle volumes during the morning hours (6 AM – 12 PM) and evening hours (6 PM – 10 PM) are nearly the same. Commercial vehicle utilization is highest during the morning and afternoon periods. As expected, commercial vehicles represent a much greater proportion of the nighttime rest area volumes.

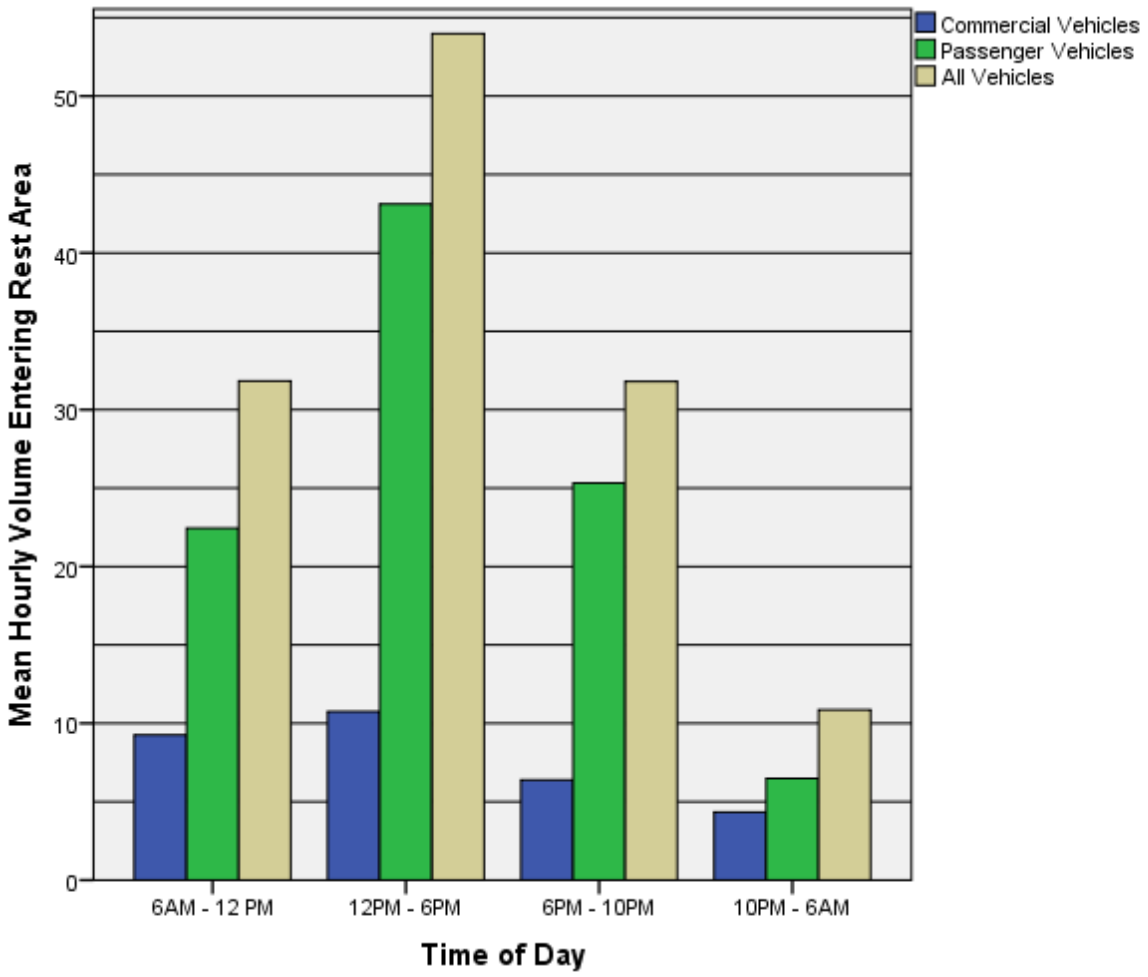

Figure 15. Rest Area Utilization by Time of Day

Seasonal Trends

The seasonal usage trends by vehicle type are shown in Figure 16. MDOT collects rest area volume data from March through November. Winter counts are not performed by MDOT. As expected the most frequent rest area use occurs during the summer months. Spring and fall volumes are relatively similar. Commercial vehicles tend to utilize rest areas more frequently during the summer and fall months.

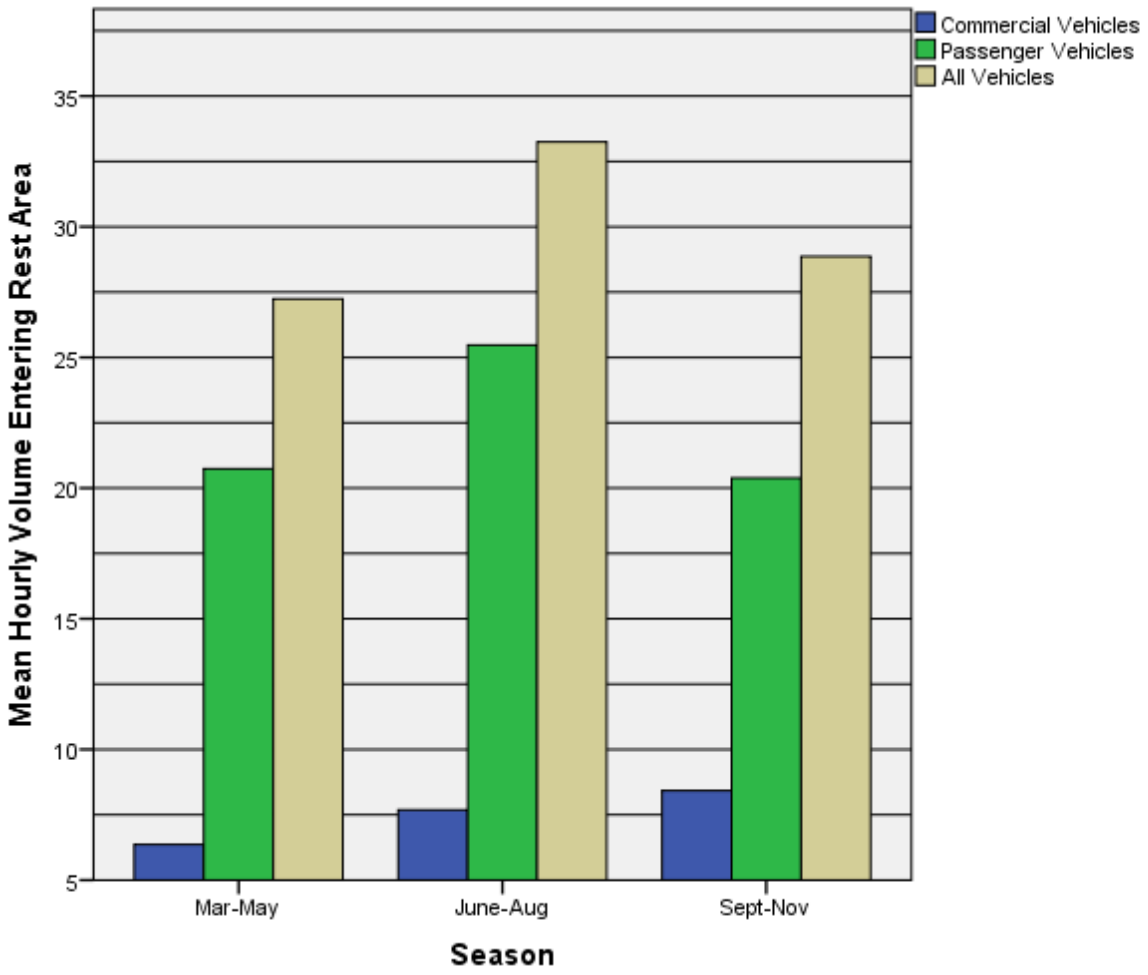

Figure 16. Rest Area Utilization by Season

Usage by Region and Route

The hourly volumes were also stratified by region and route, as shown in Figures 17 and 18. The regions with the highest average hourly use include the Southwest Region, Bay Region, and University Region. Commercial vehicle usage was particularly high in the Southwest Region. As expected, the Superior and North Regions had the lowest average hourly use. The busiest rest areas, on average, were those located along I-94, US-23, I-96, and I-69. Commercial truck utilization was also highest on these routes, along with I-196. The least utilized facilities were on non-limited access roadways in the Upper Peninsula.

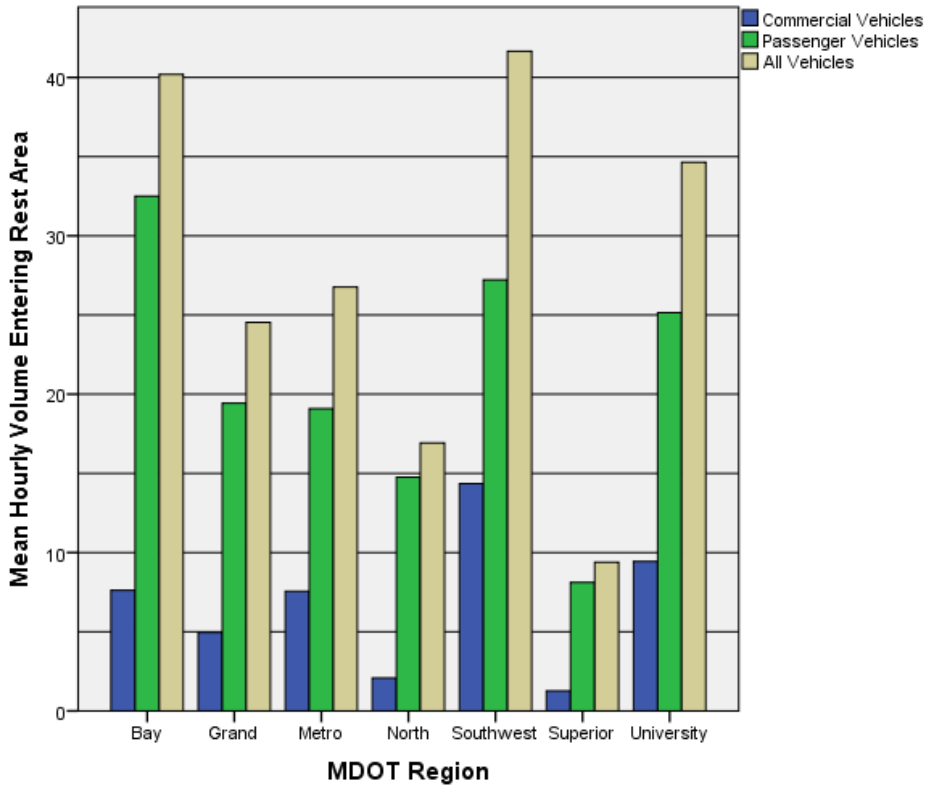

Figure 17. Rest Area Utilization by MDOT Region

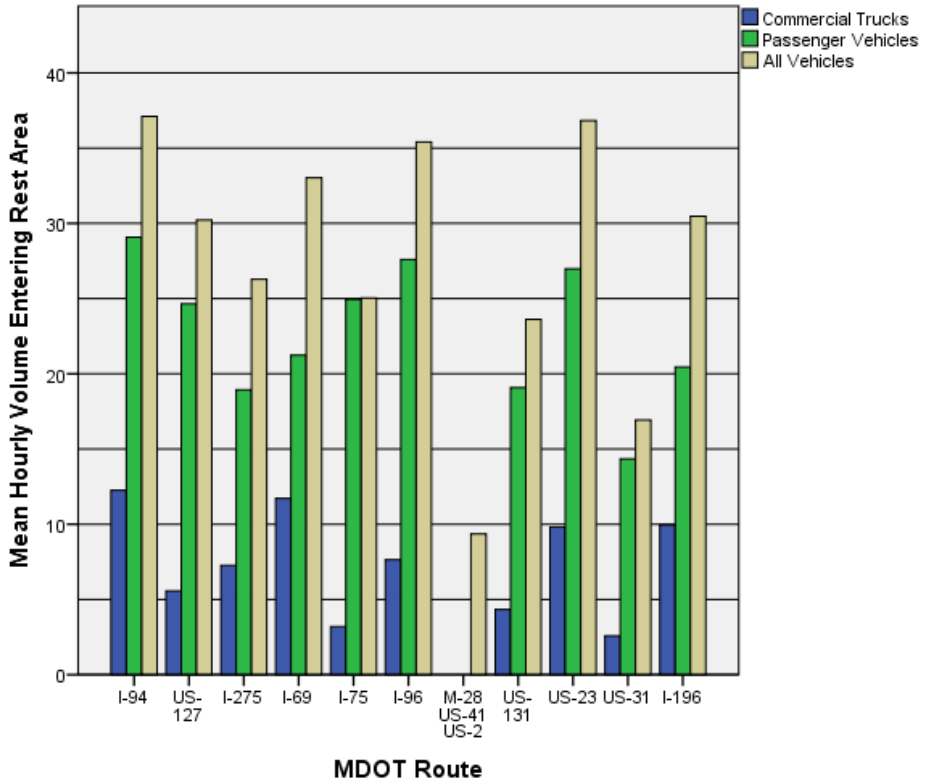

Figure 18. Rest Area Utilization by Route

Facility Traffic and Visitor Volume Estimates and Turn-in Rates

It was necessary to calculate estimated average annual daily traffic (AADT) volumes for each facility for use in the subsequent economic analysis and functional assessment. The hourly volumes obtained from MDOT TMIS for the most recent year available were sum totaled for each 24-hour period and were utilized to compute AADT volumes for all 76 facilities for which data were available. With few exceptions, these traffic counts were taken during the most recent triennial rest area data collection cycle between 2007 and 2009. Recent monthly traffic volume data for the remaining five welcome centers were also obtained and utilized to calculate the AADTs. All daily count volumes were seasonally adjusted based on the route type, year, month, and day of week using seasonal adjustment factors provided by MDOT. The adjusted daily volume counts were then averaged over the entire data collection period – typically one week. This value represents the estimated average annual daily traffic volume (AADT) for the year in which the traffic volume data were collected. Data for facilities that experience winter closures were adjusted accordingly to reflect the impacts of such closures on the average annual daily traffic. Daily visitor counts were then estimated for each facility assuming 2.4 persons per passenger vehicle and 1.6 persons per commercial vehicle, based upon self-reported vehicle occupancies collected during the rest area user survey. The commercial vehicle occupancy rate reflects a weighted average of trucks, RVs and buses, based on 95 percent trucks, 4 percent RVs, and 1 percent buses. Annual visitor counts were calculated by multiplying the average daily visitor estimates by 365.

Vehicular turn-in rates were also computed and expressed as a percentage of the directional mainline traffic volumes. Total AADT volumes and commercial AADT volumes from 2009 (most recent year available) were obtained directly from MDOT's public website for the mainline segment immediately adjacent to each rest area facility. Directional mainline volumes were computed by dividing the total mainline volumes by 2. The turn-in rate (percent) was calculated for each hourly rest area/mainline volume pair by dividing the rest area AADT by the mainline AADT in the direction(s) of travel with access to the facility. Table 14 displays the facility AADT volumes, adjacent mainline AADT, turn-in rates, estimated visitor counts, and utilization ranks for all 81 rest areas and welcome centers, alphabetized by facility name.

Table 14. Rest Area and Welcome Center Average Annual Daily Traffic Volumes (AADT), Mainline AADT, Vehicular Turn-in Rates, and Visitor Estimates

Facility	Facility Pass. Veh AADT	Facility Comm. Veh AADT	Facility Total AADT	Mainline AADT	Vehicular Turn-in Rate	Daily Visitors	Annual Visitors	Annual Visitors Systemwide Rank
Adair	346	126	472	14,450	3.3%	1,033	376,890	49
Alamo	352	152	504	17,600	2.9%	1,087	396,933	45
Alger	540	75	615	8,450	7.3%	1,416	516,840	36
Battle Creek	886	515	1,401	24,000	5.8%	2,950	1,076,896	4
Bay City	969	107	1076	25,000	4.3%	2,497	911,310	6
Belleville	492	270	762	41,500	1.8%	1,612	588,302	28
Big Rapids	413	73	486	9,450	5.1%	1,109	404,622	44
Cadillac	395	72	467	5,700	8.2%	1,063	388,113	48
Capac	264	270	534	6,425	8.3%	1,065	388,604	47
Carleton	290	145	435	11,950	3.6%	927	338,396	53
Chelsea	611	353	964	22,450	4.3%	2,032	741,526	14
Clare WC	1,288	504	1,792	21,400	8.4%	3,898	1,422,844	1
Clarkston	787	114	901	26,300	3.4%	2,072	756,163	12
Clio	658	165	823	34,400	2.4%	1,844	673,138	20
Coldwater WC	599	239	838	9,600	8.7%	1,821	664,569	22
Davisburg	696	98	794	26,300	3.0%	1,828	667,142	21
Detroit WC	67	55	122	42,400	0.3%	250	91,174	80
DeWitt	522	89	611	12,250	5.0%	1,395	509,355	37
Dodge Rd.	825	169	995	34,400	2.9%	2,252	821,878	9
Dundee WC	504	236	740	15,350	4.8%	1,587	579,281	31
Fenton	763	188	951	25,600	3.7%	2,132	778,180	10
Five Lakes	362	301	663	10,150	6.5%	1,350	492,612	38
Fruitport	301	62	363	10,600	3.4%	821	299,652	59
Galesburg	555	375	930	25,350	3.7%	1,932	705,255	17
Garden Corners	191	58	249	4,200	5.9%	551	201,188	68
Gaylord	379	40	419	7,150	5.9%	973	355,165	50
Glenn	604	324	929	9,350	9.9%	1,969	718,729	15
Grand Ledge	580	105	685	20,350	3.4%	1,560	569,330	32
Grass Lake	548	292	840	23,400	3.6%	1,783	650,673	23
Grayling	475	86	560	9,250	6.1%	1,276	465,782	42
Hart*	140	25	165	3,900	4.2%	376	137,240	75
Hartwick Pines	269	42	311	7,100	4.4%	713	260,307	63
Hebron*	236	9	245	3,550	6.9%	581	211,992	67
Higgins Lake	194	31	224	3,500	6.4%	514	187,610	69
Houghton Lake	290	38	329	4,200	7.8%	758	276,796	62
Howell	830	209	1,039	23,100	4.5%	2,326	848,849	8
Iron Mountain WC	110	47	157	19,000	0.8%	340	124,112	78
Ironwood WC	123	53	176	5,300	3.3%	380	138,688	74
Ithaca	408	63	471	9,700	4.9%	1,080	394,310	46
Jackson	294	61	355	8,800	4.0%	803	292,914	60
Lake Chemung	576	237	813	25,350	3.2%	1,761	642,594	25
Lansing	348	67	415	16,000	2.6%	943	344,023	52
Linwood	796	87	884	11,300	7.8%	2,051	748,474	13
Ludington*	196	25	221	3,850	5.7%	510	186,296	70
Mackinaw City WC	242	117	359	8,800	4.1%	768	280,250	61

Table 14. Rest Area and Welcome Center Average Annual Daily Traffic Volumes (AADT), Mainline AADT, Vehicular Turn-in Rates, and Visitor Estimates (Continued)

Facility	Facility Pass. Veh AADT	Facility Comm. Veh AADT	Facility Total AADT	Mainline AADT	Vehicular Turn-in Rate	Daily Visitors	Annual Visitors	Annual Visitors Systemwide Rank
Marquette WC	156	67	223	18,000	1.2%	483	176,181	72
Marshall	537	192	729	15,150	4.8%	1,596	582,610	30
Menominee WC	111	48	159	15,400	1.0%	343	125,233	77
Monroe WC	799	677	1,475	27,700	5.3%	2,999	1,094,790	3
Morley	564	111	675	9,400	7.2%	1,532	559,168	34
Muskegon	305	61	366	9,250	4.0%	830	302,804	58
Naubinway	336	42	378	3,600	10.5%	874	318,864	57
New Buffalo WC	1,031	485	1,515	17,550	8.6%	3,249	1,185,964	2
Nine Mile Hill	337	45	383	5,600	6.8%	882	322,048	56
Northfield Church	898	182	1,080	31,050	3.5%	2,447	893,069	7
Okemos	749	176	925	22,050	4.2%	2,079	758,908	11
Port Huron WC**	202	87	289	10,950	2.6%	624	227,620	66
Portland	923	291	1,215	16,850	7.2%	2,682	978,887	5
Potterville	476	290	765	15,050	5.1%	1,605	585,775	29
Richmond	327	85	412	14,450	2.8%	920	335,833	54
Rockford	457	132	589	15,700	3.8%	1,308	477,535	40
Rothbury	324	113	437	5,100	8.6%	959	350,108	51
Saint Ignace RA*	88	9	97	3,900	2.5%	226	82,344	81
Saint Ignace WC	295	126	422	5,300	8.0%	911	332,460	55
Sandstone	635	270	905	15,700	5.8%	1,956	713,940	16
Saranac	650	130	780	15,250	5.1%	1,768	645,384	24
Saugatuck	406	195	601	13,450	4.5%	1,286	469,436	41
Sault Ste. Marie RA	132	44	177	3,450	5.1%	388	141,692	73
Sault Ste. Marie WC	108	42	151	2,300	6.6%	328	119,697	79
Seney	276	29	305	2,400	12.7%	709	258,712	64
Swartz Creek	521	264	785	17,050	4.6%	1,672	610,277	27
Topinabee*	194	20	214	3,850	5.6%	498	181,624	71
Turkeyville	545	365	910	10,850	8.4%	1,892	690,508	18
Tustin	120	37	157	5,950	2.6%	347	126,685	76
Vanderbilt	230	58	288	6,450	4.5%	645	235,359	65
Walker	419	87	507	18,850	2.7%	1,147	418,528	43
Watervliet	509	409	919	14,400	6.4%	1,877	685,116	19
West Branch	580	62	642	6,950	9.2%	1,491	544,288	35
Westland	532	165	697	47,400	1.5%	1,542	562,662	33
Woodbury	545	244	789	14,900	5.3%	1,698	619,747	26
Zeeland	414	202	616	18,650	3.3%	1,318	480,989	39
STATEWIDE AVG.	**457**	**156**	**613**	**14,668**	**5.0%**	**1,347**	**491,603**	
STATEWIDE TOT.	**37,047**	**12,614**	**49,661**	**1,188,125**	**4.2%**	**109,095**	**39,819,844**	

* Facility is closed seasonally from December through March. Traffic volume and visitor counts have been adjusted accordingly to reflect such closures.

** Facility is currently closed and scheduled to be moved to a nearby location in the future.

Note: The data in the table represent seasonally adjusted volumes for the most recently available rest area traffic counts. Visitor counts were calculated assuming 2.4 persons/passenger vehicle and 1.6 persons/commercial vehicle. The commercial vehicle occupancy rate reflects a weighted average of trucks, RVs and buses, based on the following assumed commercial vehicle proportions: 95 percent trucks, 4 percent RVs, 1 percent buses.

.

Systemwide, the average annual daily traffic volume for a facility was 613 vehicles per day, including 457 passenger vehicles (74.6 percent) and 156 commercial vehicles (25.4 percent). The systemwide vehicular turn-in rate was 4.2 percent, while the average of the 81 individual turn-in rates was 5.0 percent. On average, 1,347 visitors utilized each facility per day, representing systemwide totals of 109,095 visitors per day and 39,819,844 visitors per year at the 81 facilities.

The most highly utilized facilities were typically located along major freeways in the southern Lower Peninsula. The most underutilized facilities were typically located in the northern Lower Peninsula and Upper Peninsula, including some facilities that experience winter closures. The facilities with the highest turn-in rates were located on non-freeways in the Upper Peninsula. Several welcome centers in the Lower Peninsula also experience high turn-in rates. The top 10 and bottom 10 facilities ranked by both visitors and turn-in rates are provided in Table 15.

Table 15. Highest and Lowest Ranked Facilities based on Annual Visitors and Vehicular Turn-in Rates

ANNUAL VISITORS		VEHICULAR TURN-IN RATES	
Highest 10 Facilities	**Lowest 10 Facilities**	**Highest 10 Facilities**	**Lowest 10 Facilities**
Clare WC	Saint Ignace RA*	Seney RA	Detroit WC
New Buffalo WC	Detroit WC	Naubinway RA	Iron Mountain WC
Monroe WC	Sault Ste. Marie WC	Glenn RA	Menominee WC
Battle Creek RA	Iron Mountain WC	West Branch RA	Marquette WC
Portland RA	Menominee WC	Coldwater WC	Westland RA
Bay City RA	Tustin RA	New Buffalo WC	Belleville RA
Northfield Church RA	Hart RA*	Rothbury RA	Clio RA
Howell RA	Ironwood WC	Turkeyville RA	Saint Ignace RA*
Dodge Road RA	Sault Ste. Marie RA	Clare WC	Lansing RA
Fenton RA	Marquette WC	Capac RA	Port Huron WC**

* Facility is closed seasonally from December through March.
** Facility is currently closed and scheduled to be moved to a new location in the future.

CHAPTER 7:
SAFETY BENEFITS PROVIDED BY REST AREAS

The National Highway Traffic Safety Administration (NHTSA) estimates that fatigue and drowsy driving account for 2.2 to 2.6 percent of total fatal crashes annually, with the proportion of fatigue related crashes remaining relatively consistent over the five year study period from 2005 to 2009 (*48*). One of the principal justifications for rest areas is that such facilities provide an opportunity for motorists to pull over and rest rather than continue driving and risk involvement in a crash due to fatigue. Banerjee et al. conducted the most recent study of the relationship between fatigue-related crashes and rest area locations (*34*). The study results showed that fatigue-related collisions decreased downstream of rest areas, increasing approximately 30 miles after rest areas. Other studies focused on truck-involved crashes have also found rest area spacing to influence safety on interstate highways (*33*,*32*).

METHODOLOGY

As a part of this study, a similar crash analysis was conducted in order to assess the influence of rest areas on the frequency of fatigue-related crashes occurring both upstream and downstream of rest areas. The direct coding of fatigue-related crashes, such as on the Michigan UD-10 crash report form, has been shown to be largely underreported (*49*,*50*). To address this issue, the California study (*34*) utilized 'expanded' definitions of fatigue-related collisions. This study uses a lane departure crash definition logic that was developed by the Michigan Traffic Safety Engineering Action Team that is quite similar to that used in the California study (*34*). Three logic criteria were used to identify all lane departure crashes occurring between 10 PM and 6 AM within 20 miles of a rest area. Crashes within a 20-mile radius were examined as Michigan rest areas are generally spaced at distances of approximately 40 miles apart. The criteria definitions are as follows:

1. All crashes that were coded as "fatigue-related" by the investigating officer
2. Single-vehicle crashes where:
    a. Exactly one motor vehicle was involved;
    b. The crash did not occur within an intersection or driveway;
    c. The at-fault driver was not under the influence of drugs or alcohol; and

d. The crash did not occur on the roadway or occurred on the roadway and involved striking a roadside object, such as a pole or guardrail.

3. Parked vehicle crashes where:
    a. More than one motor vehicle was involved;
    b. The prior action for at least one involved vehicle was "parked";
    c. The crash did not occur within an intersection or driveway;
    d. The crash did not occur on the roadway; and
    e. The at-fault driver was not under the influence of drugs or alcohol.

Relevant data were extracted for all rest areas that were located on a limited access freeway in the Lower Peninsula or a non-limited access rural highway in the Upper Peninsula and where the respective freeway or highway extended at least 20 miles in each direction of the rest area. Only crashes occurring in the same direction of travel as the rest area were included in the model. Thus, locations on non-limited access roadways included crashes for both directions of travel as these facilities are accessible from both directions. The roadway near each rest area was then disaggregated into one-mile segments so that each rest area included 40 associated segments. In addition to crash data, average annual mainline daily traffic (AADT) for each segment were also collected and averaged over the period of 2006 to 2010. Initial investigation of the crashes by segment for each route showed a substantially large increase in crashes in the metro-Detroit area along I-75 and I-94, as displayed in Figures 19 and 20. As a result, rest areas in Wayne and Oakland Counties were excluded from the model development.

Figure 21 and Figure 22 present averages of the annual target crash frequency from 2006 to 2010 for rest areas on freeways in the in the Lower Peninsula and rural non-freeways in the Upper Peninsula, respectively. From a visual inspection of these data, it is shown that crashes tend to decrease as segments become nearer to the rest area from both the upstream (indicated by negative distances) and downstream (indicated by positive distances) directions of the rest area. Comparison of the best fit regression lines indicates that the magnitude of the reductions are more pronounced along non-limited access roadways, likely due to the lack of alternative commercial facilities.

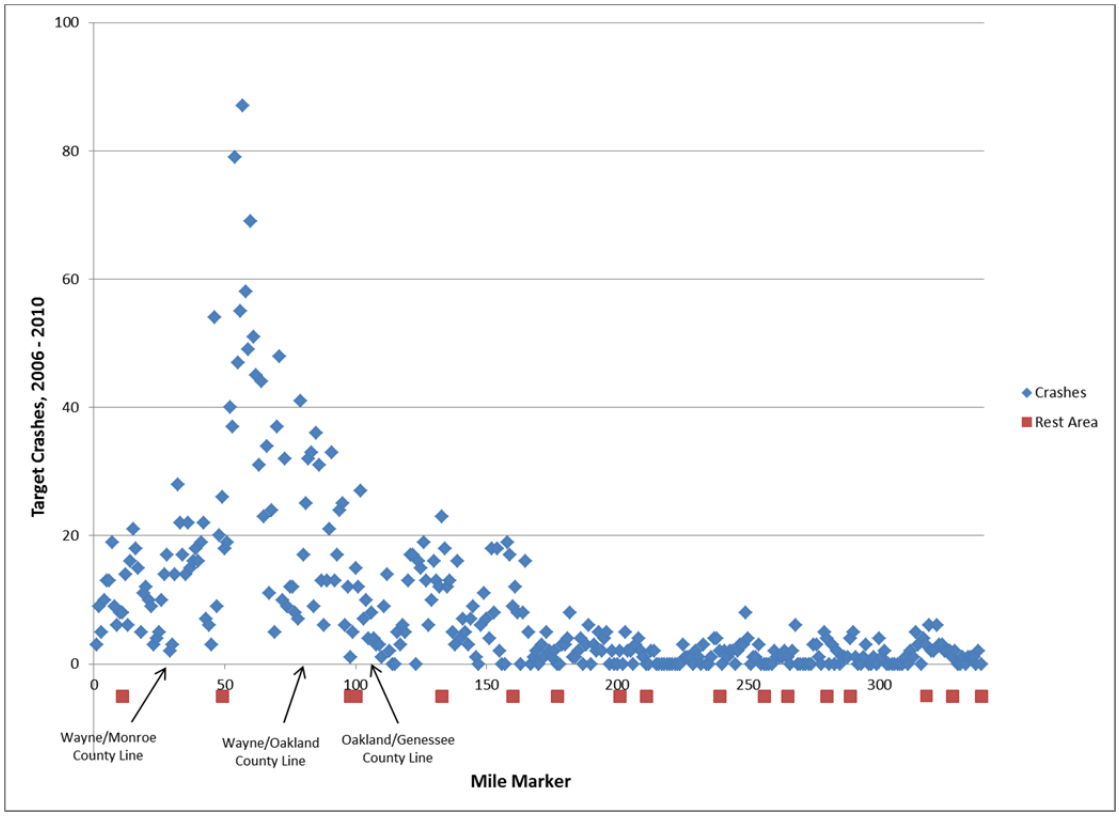

Figure 19. Target Crashes on I-75 (Border to Mackinaw), 2006 – 2010

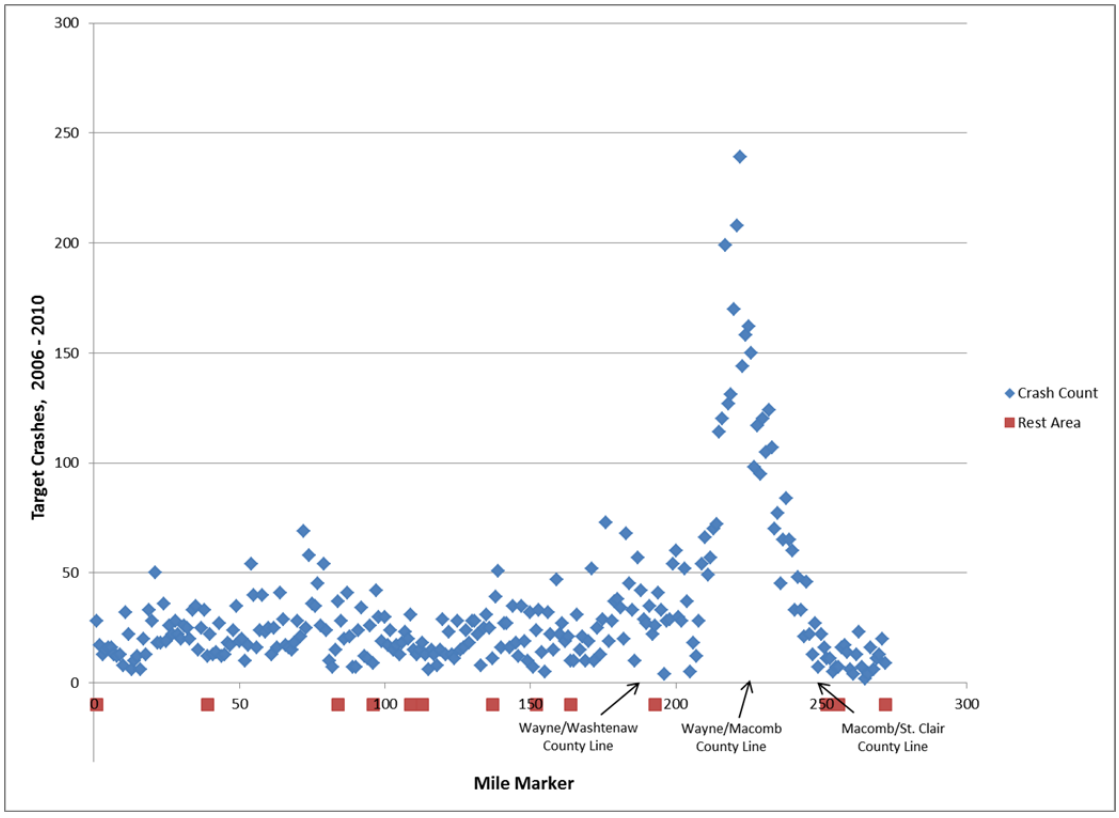

Figure 20. Target Crashes on I-94 (Border to Border), 2006 – 2010

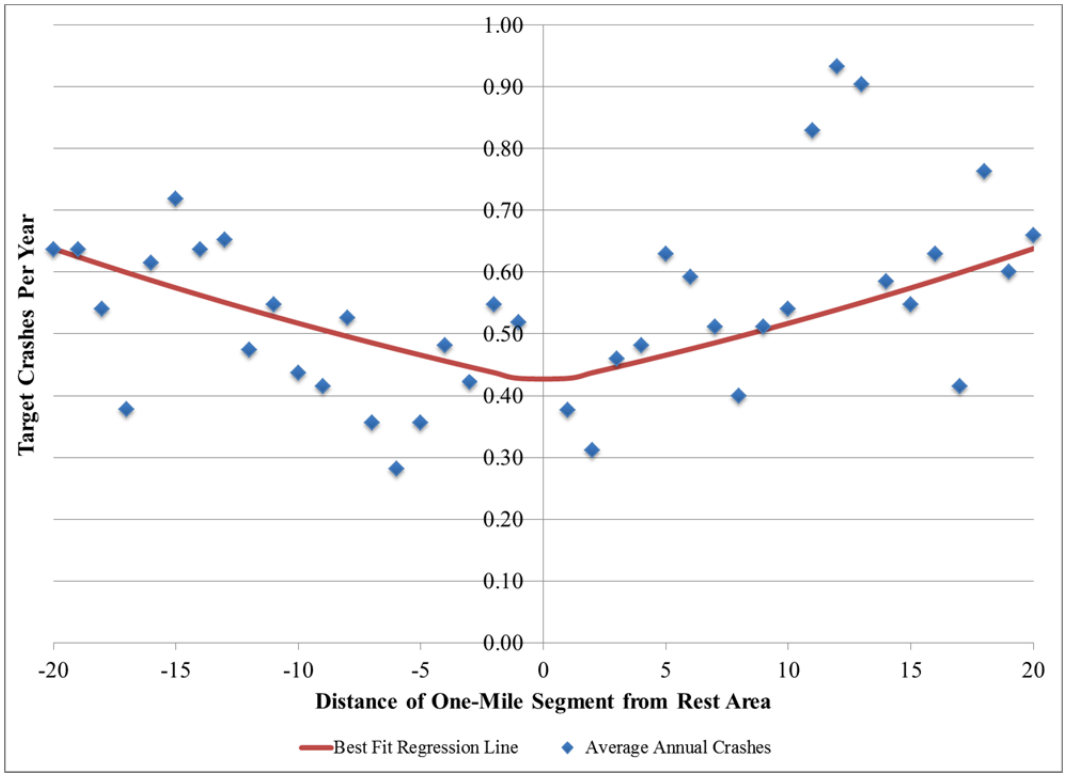

Figure 21. Average Annual Target Crash Frequencies for 1-Mile Road Segments Based on Distance from Rest Area – Limited Access Freeways in Lower Peninsula

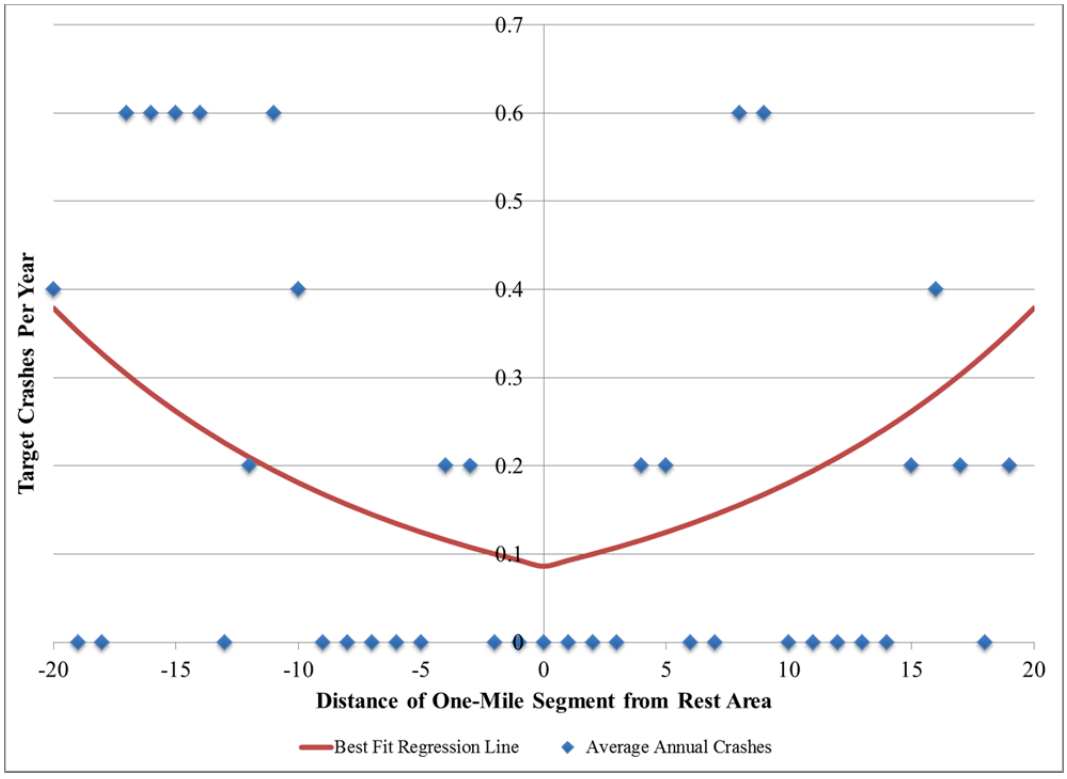

Figure 22. Average Annual Target Crash Frequencies for 1-Mile Road Segments Based on Distance from Rest Area – Non-Limited Access Rural Highways in Upper Peninsula

PREDICTION MODELING OF FATIGUE-RELATED CRASHES

In order to estimate the precise impacts of the rest areas on target (i.e., fatigue-related) crashes, separate negative binomial regression models were developed for those road segments near rest areas located on the limited access freeway system and non-limited access rural highways. Negative binomial models allow for an assessment of the effects of covariates (e.g., mainline AADT, distance from rest area) on the frequency of crashes occurring on each one-mile segment. These regression models assume that the log of μ_j is a linear function of these covariates. Maximum likelihood estimation techniques are used to arrive at the final models, which are of the following form:

Rest Areas on Limited Access Freeways:

$$E(Y) = AADT^{1.251} \times exp(-11.473 + 0.021 \times DIST)$$

Rest Areas on Non-Limited Access Rural Highways:

$$E(Y) = AADT^{0.719} \times exp(-8.394 + 0.074 \times DIST)$$

Where:

E(Y) = predicted mean number of target crashes over 5 years on a specific one-mile segment
AADT = average annual daily mainline directional traffic on a specific one-mile segment
DIST = distance (miles) of a specific one-mile segment from the nearest rest area

In comparing the models, it is interesting to note that traffic volumes tended to have a stronger effect on crashes near rest areas on the limited access freeway system whereas the distance of each segment to the nearest rest area was a more critical predictive factor on road segments along non-limited access rural highways. This fact is illustrated by the crash trends presented in Figure 21 and Figure 22.

Reductions in fatigue-related crashes near rest areas can be estimated as follows:

(1) It is assumed that rest areas reduce fatigue-related crashes up to a 20-mile radius in each direction.
(2) This safety effect is gradually reduced on each successive road segment up to the 20-mile boundary in each direction.

(3) If the rest area were not in use, it is assumed that the safety performance for each one-mile segment would deteriorate such that it was equal to the safety performance of a segment located 20 miles upstream/downstream of a rest area. It is further assumed that this "baseline" relationship would hold across the entire 40-mile stretch from the upstream boundary to the downstream boundary.

(4) The safety benefit created by the rest area can be quantified by comparing the difference in safety performance within a 20-mile radius of each rest area using the appropriate negative binomial model. The predicted number of crashes on each one-mile segment is calculated based upon mainline AADT. The arithmetic difference between this value and the "baseline" predicted crash frequency at the 20-mile boundary is then computed.

(5) These estimated crash savings are further adjusted based on the ratio of the facility turn-in percentage to the median systemwide turn-in percentage. The sum total of these differences over the entire 40-mile influence area represents the estimated crash reduction due to the presence of the rest area.

RESULTS

Based on this methodology, it was predicted that on average, each rest area reduces fatigue-related crashes within a 20 mile radius along the route by 3.37 crashes per year. Systemwide, it was estimated that Michigan rest areas and welcome centers contribute to the annual reduction of 273 fatigue related crashes. The estimated annual crash reductions associated with each facility are displayed in Table 16 along with the statewide rank.

Comparison of Table 16 with Table 14 shows that, as expected, the facilities with the greatest estimated annual crash reductions were those located on roadways with the highest mainline traffic volumes and possessing the highest turn-in rates. A total of nine facilities were predicted to contribute to the reduction of six or more fatigue-related crashes annually, including the Monroe, Clare, and New Buffalo Welcome Centers along with the Battle Creek, Northfield Church, Portland, Dodge Road, Bay City, and Howell Rest Areas.

Table 16. Estimated Annual Fatigue Related Crash Reductions, by Facility

Facility	Hwy	Estimated Annual Crash Reduction	Crash Reduction Rank	Facility	Hwy	Estimated Annual Crash Reduction	Crash Reduction Rank
Adair	I-94	2.52	47	Lake Chemung	I-96	4.99	19
Alamo	US-131	2.82	45	Lansing	US-127	2.27	52
Alger	I-75	2.86	43	Linwood	I-75	4.43	25
Battle Creek	I-94	8.48	3	Ludington	US-31	0.85	70
Bay City	I-75	6.58	8	Mackinaw City WC	I-75	1.42	64
Belleville	I-94	5.29	16	Marquette WC	US-41	1.06	68
Big Rapids	US-131	2.33	48	Marshall	I-94	3.93	33
Cadillac	US-131	1.97	55	Menominee WC	US-41	0.72	74
Capac	I-69	2.32	49	Monroe WC	I-75	9.26	1
Carleton	I-275	2.21	53	Morley	US-131	3.23	38
Chelsea	I-94	5.74	11	Muskegon	US-31	1.74	60
Clare WC	US-127	8.86	2	Naubinway	US-2	3.64	34
Clarkston	I-75	5.58	13	New Buffalo WC	I-94	8.48	4
Clio	I-75	5.46	15	Nine Mile Hill	I-75	1.61	62
Coldwater WC	I-69	4.03	30	Northfield Church	US-23	6.98	5
Davisburg	I-75	4.92	21	Okemos	I-96	5.48	14
Detroit WC	I-75	0.72	75	Port Huron WC	I-94	1.44	63
DeWitt	US-127	3.12	41	Portland	I-96	6.73	6
Dodge Rd.	I-75	6.59	7	Potterville	I-69	4.12	29
Dundee WC	US-23	4.00	31	Richmond	I-94	2.19	54
Fenton	US-23	5.85	10	Rockford	US-131	3.21	39
Five Lakes	I-69	3.23	37	Rothbury	US-31	1.80	57
Fruitport	I-96	1.79	58	Saint Ignace RA	I-75	0.37	81
Galesburg	I-94	5.71	12	Saint Ignace WC	I-75	1.75	59
Garden Corners	US-2	2.30	50	Sandstone	I-94	4.92	20
Gaylord	I-75	1.87	56	Saranac	I-96	4.21	28
Glenn	I-196	4.44	24	Saugatuck	I-196	3.15	40
Grand Ledge	I-96	3.98	32	Sault Ste. Marie RA	I-75	0.66	77
Grass Lake	I-94	5.05	17	Sault Ste. Marie WC	I-75	0.51	80
Grayling	I-75	2.67	46	Seney	M-28	3.30	36
Hart	US-31	0.63	78	Swartz Creek	I-69	4.36	26
Hartwick Pines	I-75	1.39	65	Topinabee	I-75	0.82	72
Hebron	I-75	0.92	69	Turkeyville	I-69	4.51	23
Higgins Lake	US-127	0.84	71	Tustin	US-131	0.67	76
Houghton Lake	US-127	1.28	66	Vanderbilt	I-75	1.25	67
Howell	I-96	6.23	9	Walker	I-96	2.89	42
Iron Mountain WC	US-2	0.76	73	Watervliet	I-94	4.89	22
Ironwood WC	US-2	0.61	79	West Branch	I-75	2.85	44
Ithaca	US-127	2.27	51	Westland	I-275	5.01	18
Jackson	US-127	1.67	61	Woodbury	I-69	4.24	27
				Zeeland	I-196	3.50	35
SYSTEMWIDE AVG.		**3.37**		**SYSTEMWIDE TOTAL**		**273.28**	

CHAPTER 8:
ECONOMIC ANALYSIS OF REST AREAS

In order to understand the economic impacts provided by MDOT rest areas and welcome centers, it was necessary to perform a comprehensive economic analysis. Several arithmetical methods for economic assessment of MDOT rest areas were evaluated for use in this research, including equivalent uniform annual cost, present worth, equivalent uniform annual net return, net present value, rate of return, and benefit/cost ratio. Of these, the most applicable to assessment of rest areas is the benefit/cost ratio method. Benefit/cost (or B/C) methodologies for economic analysis of rest areas have been utilized in previous rest area research, most notably NCHRP 324 (*37*) and a 2011 study of Texas rest areas and welcome centers (*35*). These studies provided the basis for the methodology described herein, in addition to Winfrey' fundamental 1969 text entitled *Economic Analysis for Highways* (*54*) and a recent economic evaluation of Michigan welcome centers by Vogt (*36*).

GENERAL BENEFIT/COST METHODOLOGY

The benefit/cost ratio is simply an expression of the ratio of total net benefits to total net costs and is most useful for comparing the relative economic viability of several highway infrastructure alternatives (*54*). The benefits and costs may be expressed either as equivalent annualized values or net present values. Alternatives with B/C greater than 1.0 are considered economically beneficial and the alternative with the greatest B/C is considered the most desirable alternative. The procedure may also be utilized to determine the system-wide B/C.

The first step to development of the benefit/cost tool was to determine the quantifiable benefits and costs associated with MDOT rest areas. Benefits are entered into the numerator and are typically derived as incremental changes from a prior or existing condition. For example, benefits may be measured by reductions in annual expenses for a particular alternative over the baseline or "do nothing" condition. Cost components are entered into the denominator and include all capital investments (annualized) in addition to annual maintenance/upkeep and operating costs. The basic form of the equation as it relates to highway projects is provided as follows:

$$\frac{B}{C} = \frac{\text{Annual Benefits}}{\text{Capital Investments (Annualized)} + \text{Annual Operating and Maintenance Costs} - \text{Salvage Value}}$$

NCHRP 324 estimated that the benefit/cost ratio of rest areas based on comfort/convenience of motorists, reduction in excess travel, and reduction in shoulder crashes was found to fall between 3.2 and 7.4 (*37*). The 2011 Texas study by Carson et al suggested that B/C for rest areas along several Texas corridors ranged from 8.7 to 29.5, with a majority of the benefits associated with either safety or tourism benefits (*35*). Using a slightly different approach, Vogt estimated the average return-on-investment for Michigan welcome centers to be at $0.49 in tax revenue back to the State per dollar spent in annual operating costs (*36*).

BENEFITS PROVIDED BY MDOT REST AREAS AND WELCOME CENTERS

The most challenging aspect of the B/C methodology is determination of the benefits associated with the particular entity. It is important to consider that for any benefit to be included in the analysis, it must be associated with a monetary value. Additionally, benefits may only be attributed to the entity if and only if that entity directly and solely contributed to the benefit. While it is acknowledged that additional intangible benefits exist that are unique to MDOT rest areas, these factors cannot be utilized in an economic analysis as they cannot be monetarily quantified. King et al. (*37*) and Carson et al (*35*) suggested that monetarily quantifiable benefits related to rest areas typically include:

- Comfort/convenience to motorists,
- Reduction in excess travel (including vehicle operating costs and travel time),
- Prevention of target crash types, and
- Increased tourism spending (welcome centers only).

Carson et al. further suggested that tangible rest area-related benefits may be quantified in the following manner (*35*):

- Direct measurement,
- Estimated based on local data, or
- Estimated based on data obtained from other states or literature sources.

Many of the benefits provided by rest areas to motorists in terms of convenience or comfort are difficult to quantify, but may be quantified on a proxy basis using a "willingness to pay" estimate for users. Reduction in excess travel may be quantified based on the reductions in

vehicle operating costs and excess travel time required to search for services off of the limited access freeway system if rest areas were not available. Evidence that rest areas contribute to the prevention of fatigue related crashes also serves as a benefit and the appropriate monetary value is assigned accordingly based on the expected reduction in crashes in each severity category. Rest areas also serve as a marketing/advertising outlet for MDOT to promote tourism and provide public service information, although in Michigan, these benefits are only quantifiable as they relate to welcome centers due to the limited information provided at standard rest areas (*35*,*36*,*37*).

Table 17 displays the tangible and intangible benefits associated with rest areas that have been identified in the literature, in addition to the method that has been utilized to quantify the monetary value of the benefits for use in the economic analysis performed in this study. The remainder of the discussion will focus on quantification of the monetary benefits associated with public rest areas.

Table 17. Potential Rest Area and Welcome Center Benefits (*35,36,37,54*)

Category	Subcategory	Benefit	Is the Benefit Quantifiable?	Valuation Method
ROAD USER	Comfort/ Convenience	Restroom Access	Yes	Aggregate estimation based on the median self-reported value of services utilized during the rest area stop from surveys of rest area users performed in this research
		Rest/Stretch/Exercise	Yes	
		Pet Exercise	Yes	
		Break for Children	Yes	
		Picnic	Yes	
		Trip Planning/Navigation	Yes	
		Refuge During Poor Weather	Yes	
		Commercial Vehicle Parking/Staging	Yes	
		Check Vehicle/ Perform Light Maintenance	Yes	
	Reduction in Excess Travel	Travel Time Savings	Yes[1]	Estimated based on reduction in excess travel time and distance to/from off-freeway services
		Vehicle Operating Cost Savings	Yes[1]	
	Safety	Reduction in Targeted Crash Types	Yes	Estimated based on crash analysis performed as part of this research.
AGENCY	Operations and Maintenance	Reduction in Cross Street and Ramp Volume and Deterioration	No	N/A
		Reduced Shoulder Deterioration	No	N/A
		Reduced Litter on ROW	No	N/A
	Income	Tax Revenue from Tourism	Yes[2]	Estimated based on user reported data collected by Vogt (*36*)
	Public Relations	Information Exchange with Road Users	No	N/A
PRIVATE BUSINESS	Income	Increased Tourism Business	Yes[2]	Estimated based on user reported data collected by Vogt (*36*)

[1] Only applies to facilities on limited access freeway system.
[2] Only applies to welcome centers.

Reduction in Excess Travel

Public rest areas on the limited access freeway system impact the driving characteristics of motorists in need of services or rest. Due to their existence within the MDOT right of way, public rest areas are inherently more directly accessible compared to alternative private facilities

located off of the limited-access freeway system. If rest areas are not available to the motorists, there are four reasonable alternative courses of action that drivers may take:

- Navigate to an alternate commercial service facility (gas station, fast food restaurant, truck stop),
- Travel to the next public rest area,
- Stop on the shoulder, or
- Continue on to the destination without stopping.

Public rest area facilities located on limited access freeways provide benefits to travelers by reducing the excess travel costs that would otherwise be required if alternate services were sought off of the freeway. It is important to note that the excess travel benefits only apply to rest areas located on the limited access freeway system and do not apply to rest areas located on non-access controlled roadways. Two primary monetary road user benefits are typically associated with reductions in excess travel, which are:

- Vehicle operating cost savings and
- Travel time savings.

In the context of MDOT rest areas on the limited access freeway system, excess travel is defined for a particular rest area as the arithmetic difference between the net distance (or time) traveled to access the next closest alternate commercial service facility (defined as fast food restaurant, gas station, or truck stop) and the net distance (or time) traveled to access the particular rest area. Such values are conservative as they only consider travel to the nearest commercial facility, although additional facilities may be available for motorists to utilize. For both rest areas and alternate service facilities, the gross travel distance was measured from the beginning of the exit ramp taper to the parking lot of the facility and from the parking lot to the end of the freeway entrance ramp taper. The net travel distance is then computed as the difference between the gross travel distance to the facility and the travel distance along the freeway mainline from the start of the exit ramp taper to the end of the entrance ramp taper. The excess travel distance is simply the difference between the net travel distances for the alternate commercial facility and the rest area. A small number of rest area facilities actually resulted in greater travel distances compared to the alternate commercial facility, in which case a negative

net excess travel benefit resulted. All distances were scaled with ArcGIS using the geocoded database of all rest areas and alternate service facilities in Michigan.

It is important to consider that only a certain percentage of rest area users will divert to an alternate private facility off of the limited access freeway system if the particular rest area were not available, while other users will stop on the shoulder, continue to the next rest area, or continue non-stop to the destination. NCHRP 324 estimated the percentage of persons diverting off of the limited access freeway system at 40 percent. However, this study was performed in the late 1980's prior to the extensive use of logo signs on freeways (*37*). In order to determine an estimated diversion percentage for motorists, follow-up surveys were performed in December 2011 at 13 rest areas and 3 welcome centers located on limited access freeways throughout the Lower Peninsula. In addition to the same demographic and trip related questions in previous versions of the rest area survey, the following question was posed to patrons:

If this Rest Area was closed, where would you have stopped instead? (check one):

☐ Nearest exit with a similar service facility (gas station, fast food, truck stop)

☐ Next rest area along route

☐ Side of the road (shoulder)

☐ Continue to destination without stopping

The results showed that 61.7 percent of the 764 surveyed rest area users would divert to a similar service facility if the rest area was closed. The diversion percentages varied by facility from 52.7 to 75.7 percent. Linear regression analysis found that the site-by-site diversion percentages were not correlated with the availability of similar services in the area, the distance to the next rest area, or type of facility (rest area or welcome center). The diversion percentage was, however, correlated with vehicle type. The diversion percentages were 65.9 percent and 38.3 percent for passenger vehicles and commercial trucks, respectively. The various responses to this particular question are shown in Table 18 separated by vehicle type and overall.

Table 18. Action Taken by Motorist if Rest Area Were Closed, as Reported During Rest Area User Surveys

	PASSENGER VEHICLE		COMMERCIAL TRUCK		ALL	
	Number of Responses	**Percent of Total**	**Number of Responses**	**Percent of Total**	**Number of Responses**	**Percent of Total**
Stopped at Nearest Exit with Similar Service Facility	418	65.9%	44	38.3%	470	61.7%
Stopped at Next Rest Area Along Route	160	25.2%	45	39.1%	208	27.3%
Stopped on Side of the Road (Shoulder)	17	2.7%	16	13.9%	34	4.5%
Continue to Destination Non-Stop	39	6.2%	10	8.7%	50	6.6%
TOTAL	**634**	**100.0%**	**115**	**100.0%**	**782**	**100.0%**

The methods, supporting data, and assumptions used to estimate excess travel benefits attributable to MDOT rest areas and welcome centers are described in the following sub sections.

Vehicle Operating Cost Benefits

As the overall travel distance during entry and exit to a typical rest area is typically less than that of an alternate off-freeway private facility, most rest areas result in a reduced net travel distance and subsequent reduction in vehicular operating costs. Barnes and Langworthy (*55*) suggest that vehicular operating benefits associated with roadway improvements should consider the marginal cost of driving a vehicle one additional mile, which includes the following cost components:

- Fuel consumption,
- Routine maintenance,
- Non-scheduled repairs,
- Tires, and
- Depreciation.

Other fixed costs incurred by motorists, including insurance and financing, do not vary based on mileage and should not be considered in a per mile operating cost rate. It is for this reason that the vehicular operating costs developed by Barnes and Langworthy are lower than the personal vehicle mileage reimbursement rate utilized by the IRS.

The vehicle operating cost rate is largely dependent on the type of vehicle. As such, separate operating cost rates were developed for passenger vehicles and commercial trucks. The rate is also dependent on driving situation, such as speed, number of stops, temperature, grade, and pavement condition. The operating costs for commercial trucks do not include driver wages or other delay related expenses not directly related to the vehicle itself.

The rates utilized herein were developed assuming normal city driving situations. City driving conditions were assumed rather than freeway driving conditions, as at multiple stops and starts are necessary for vehicles utilizing an alternate private facility located off of a limited access freeway. As the Barnes and Langworthy study utilized 2003 costs, it was necessary to make appropriate modifications to these values to account for rising fuel costs, in addition to inflation and changes in vehicular fuel economy. The fuel cost was revised based on the average cost for a gallon of gasoline in Michigan in January 2012, which was listed on Gasbuddy.com at $3.55 per gallon (*56*). This value represents a conservative estimate as fuel costs are typically higher during the peak summer travel seasons than during winter. The average gasoline cost in Michigan peaked during early May of 2011 at $4.26 per gallon. The average diesel cost in Michigan in January 2012 was $3.81 per gallon (*57*). Maintenance, repair, and depreciation costs were indexed using the Consumer Price Index (CPI) published by the United States Bureau of Labor Statistics, which represents monthly changes in prices of all goods and services purchased for consumption by urban households (*58*). According to CPI data, the costs of goods and services rose by 22.62 percent between October 2003 and October 2011. Finally, the assumed fuel economy was revised using data from the Bureau of Transportation Statistics (BTS) to represent the 2011 vehicle fleet based on the average fuel efficiency of light duty (i.e., passenger) vehicles operating in the United States (*59*). The BTS data suggest that the average light duty vehicle, which includes cars, pickups, SUVs, and minivans, was 7.2 percent more fuel efficient in 2009 (most recent year available) compared to 2003. No changes in fuel economy were observed for commercial vehicles between 2003 and 2009. The revised itemized vehicle operating costs for city driving conditions representing 2011 dollars are shown in Table 19 along with the 2003 values developed by Barnes and Langworthy (*55*).

Table 19. Vehicle Operating Cost Rates per Mile of City Driving (*55*)

	2003*		2011**	
Component	**Automobile**	**Commercial Truck**	**Passenger Vehicles**	**Commercial Truck**
Fuel	$0.070	$0.280	$0.155	$0.711
Maintenance/Repair	$0.038	$0.121	$0.047	$0.148
Tires	$0.009	$0.035	$0.011	$0.043
Depreciation	$0.074	$0.092	$0.091	$0.113
TOTAL	**$0.191**	**$0.529**	**$0.304**	**$1.015**

* Values represent 2003 dollars, as reported directly by Barnes and Langworthy (*55*). Fuel costs were calculated assuming $1.50 per gallon of fuel.

** Values represent 2011 dollars, modified from values reported by Barnes and Langworthy (*55*). Fuel costs assume $3.55 per gallon of gasoline (*56*) and $3.81 per gallon of diesel (*57*) and 7.2 percent increased fuel efficiency (passenger vehicles only) from 2003 to 2011 (*59*).

Travel Time Cost Benefits

The net reduction in excess travel distance provided by a typical rest area will also result in an overall travel time cost savings to motorists. It was first necessary to determine average hourly value-of-time estimates for typical rest area users that would otherwise be required to search for similar services off of the limited access freeway system. The USDOT's *Departmental Guidance for the Valuation of Travel Time in Economic Analysis* recommends computing separate values-of-time for truck drivers, other business travelers, and personal (i.e., non-work) travelers (*60*). The document recommends estimating values-of-time for truck drivers and other business travelers based on nationwide average total compensation rates for each traveler, including both wages and fringe benefits. Personal travel time is to be valued based on the equivalent median household wage, excluding fringe benefits, applied to the entire vehicle rather than per traveler. Furthermore, personal travel time values should be reduced by 30 percent to represent the devaluation of time spent towards personal purposes (*60*).

Average hourly wage and benefit information were obtained from the United States Bureau of Labor Statistics website (*61*). The average national total hourly compensation for the civilian work force in September 2011 (most recent data available for total compensation) was reported as $30.11 (*61*), which was utilized to represent an estimated value-of-time for each business traveler. Wages accounted for $20.91 (69.4 percent) of the total, while benefits accounted for the remaining $9.21 (30.6 percent). The average national hourly wage for heavy and tractor-trailer truck drivers in May 2010 (most recent data available) was reported as $18.97

(*62*), which using CPI data was indexed to a September 2011 value of $19.73 (*58*). As no fringe benefit information was provided for truck drivers, the total compensation was estimated based on the wage information assuming the aforementioned wage/benefit proportions for civilian workers. Thus, assuming that wages represent 69.4 percent of a truck driver's total compensation, the national average hourly compensation for truck drivers was estimated at $28.43 per hour, which was utilized to represent an estimated value-of-time for each truck driver. The nationwide median household income was obtained from the United States Census Bureau website (*63*), which was reported as $49,445 in 2010 (most recent data available) and indexed to a September 2011 value of $51,342 (*58*). The equivalent household hourly wage was estimated by dividing the annual income by the number of full-time work hours per year, typically estimated at 2,000 (*60*). Thus, the equivalent nationwide hourly household wage was estimated as $25.67, which was further devalued by 30 percent to $17.97, in order to account for the devaluation of personal time compared to work time. This value was utilized to represent an estimated value-of-time for each travel party that was engaged in personal/vacation travel.

It was also necessary to determine the relative proportion of work related trips versus personal/vacation trips for passenger vehicles so that the wage rates are appropriately applied to the rest area traffic volumes. These values were estimated based on data collected during the rest area user surveys. As shown in Table 5, personal/vacation related travel accounted for approximately 90 percent of passenger vehicle travelers surveyed, while work related travel accounted for the remaining 10 percent. As it is not possible to determine the relative proportions of commercial trucks versus recreational vehicles from the MDOT-collected commercial vehicle volume data, it was assumed that all commercial vehicles were heavy trucks.

As business travelers and truck driver wages were to be applied on a per-person basis, it was necessary to determine estimated vehicular occupancies for each vehicle type and trip purpose. As shown in Table 5, the average self-reported passenger vehicle occupancy rate for business travel obtained during the rest area user surveys was equal to 1.42 persons/vehicle. It was also assumed that all occupants were traveling for work purposes. It was not necessary to utilize passenger vehicle occupancies for personal/vacation travel as the wages for such trips were estimated at the household level and were thus applied on a per vehicle basis. The average self-reported truck occupancy was 1.25 persons/vehicle. Although it was assumed that the driver was traveling for work purposes, it was assumed that any passenger accompanying the truck driver was traveling for personal purposes. Thus, separate wage rates were applied to drivers

versus passengers of commercial vehicles. The value-of-time estimates by trip purpose and vehicle type are provided in Table 20.

Table 20. Value-of-Time Estimates by Trip Purpose and Vehicle Type

	Passenger Vehicle		Commercial Vehicle	
	Work Travel	**Personal/ Vacation Travel**	**Driver**	**Passenger**
Wage per Person per Hour	$30.11	N/A	$28.43	$19.73
Persons per Vehicle	1.42	N/A	1.00	0.25
Wage per Vehicle per Hour	$42.76	$25.67	$28.43	$4.93
Devaluation for Personal Time	0%	30%	0%	30%
Value-of-Time per Vehicle per Hour	$42.76	$17.97	$28.43	$3.45
Proportion of Trips	0.1	0.9	N/A	N/A
Weighted Value-of-Time per Vehicle per Hour	**$20.45**		**$31.88**	

Note: Values represent September 2011 dollars obtained from references *61,62,63.*

It was also necessary to determine the net increase (or decrease) in excess travel time that would be accumulated while seeking alternate services off of the limited access freeway system. As it was not possible to take actual measurements for the excess travel time for each rest area, such values were estimated based on the excess travel distance calculated for each rest area/nearest alternate service facility pair on the limited access freeway system. It was assumed that any excess travel distance would be encountered on surface roadways (opposed to exit/entry ramps). It was subsequently assumed that the additional travel distance would occur at an average speed of 30 mph, as recommended by Carson et al. (*35*). Thus, the excess travel time savings was computed for each rest area based on the excess travel distance divided by 30 mph. It should be noted that all rest areas not located directly on the limited access freeway system were not considered for travel time diversion benefits.

Safety Benefits

Using the results of the negative binomial model presented earlier, the economic benefits due to reductions in fatigue-related crashes near rest areas can be assessed as follows:

(1) It is assumed that rest areas reduce fatigue-related crashes up to a 20-mile radius in each direction.

(2) This safety effect is gradually reduced on each successive road segment up to the 20-mile boundary in each direction.

(3) If the rest area were not in use, it is assumed that the safety performance for each one-mile segment would deteriorate such that it was equal to the safety performance of a segment located 20 miles upstream/downstream of a rest area. It is further assumed that this "baseline" relationship would hold across the entire 40-mile stretch from the upstream boundary to the downstream boundary.

(4) The safety benefit created by the rest area can be quantified by comparing the difference in safety performance within a 20-mile radius of each rest area using the appropriate negative binomial model. The predicted number of crashes on each one-mile segment is calculated based upon mainline AADT. The arithmetic difference between this value and the "baseline" predicted crash frequency at the 20-mile boundary is then computed.

(5) These estimated crash savings are further adjusted based on the ratio of the facility turn-in percentage to the median systemwide turn-in percentage. The sum total of these differences over the entire 40-mile influence area represents the estimated crash reduction due to the presence of the rest area.

(6) This estimated crash reduction over the 40-mile analysis segment for each rest area is then multiplied by the corresponding comprehensive crash cost for a lane departure crash. The FHWA provides an estimate in 2001 dollars (*52*) that was calculated based on the costs of lane departure-related crashes and the percentage of such crashes as determined in a previous study (*53*). A weighted average of $87,143 was computed per lane departure crash (*52*). This value was indexed to represent 2011 dollars using a multiplier of 1.270 based on Consumer Price Index data obtained from the U.S. Bureau of Labor Statistics website (*58*). The weighted average lane departure crash was equal to $110,672 in 2011 dollars.

Comfort and Convenience Benefits

Although the "value" of a rest area to a motorist depends on several factors, it may be proxied by obtaining data on the dollar value that travelers place on services utilized while stopped at a rest area. This value is often obtained by surveying users as to their "willingness to pay" to utilize a rest area, although it is noted that such questions are typically undervalued by respondents (*37*). The inflation adjusted range of "willingness to pay" values reported in

NCHRP 324 ranged from $0.72 - $1.81 per vehicle (*37*). In order to obtain an accurate estimate of the value of services provided by a rest area, an alternative question asking "What value do you place on the service utilized during your stop today" was included during the rest area user survey performed as part of this research. Analysis of the survey data showed that users' valuation of the services utilized varied significantly between welcome centers and standard rest areas, with median values of $2.21 and $1.68, respectively, the latter of which fell within the range of inflation adjusted "willingness to pay" values for rest areas reported in NCHRP 324.

Tourism Benefits

Rest areas that provide tourism information (i.e., welcome centers) are often associated with positive impacts to tourism as a result of travelers using such information to make subsequent decisions to either extend their stay, make future trips, or visit additional attractions (*35,36,37,40*). Although it was acknowledged that standard rest areas serve to promote tourism, quantification of tourism related economic benefits were limited to welcome centers, as suggested by Carson et al (*35*). This is due to the level of tourism information provided at welcome centers through staff and printed materials that are not available at standard rest areas.

Vogt (*36*) suggested that tourism-related benefits may be derived based on estimation of the number of welcome center patrons who increased their spending as a result of information received at the welcome center and along with the average additional spending per party. Survey data collected at all 14 Michigan welcome centers in 2008 and 2009 suggested that out of 7,864 persons surveyed, 15.7 percent indicated a change in spending based on information obtained at the welcome center by an average increase of $135 per party (*36*). These values were found to vary between facilities located in the Upper Peninsula versus the Lower Peninsula. Upper Peninsula welcome centers (including Mackinaw) were found to have a higher percentage of patrons who increased spending (19.0 percent versus 12.5 percent), although the average increase in spending per party was slightly lower than that reported at Lower Peninsula welcome centers ($131 versus $140). These benefits were assumed to be inclusive of tax revenue, which was estimated at 7 percent of the net additional spending (*36*). As the average spending values were reported in 2008-2009 values, it was necessary to index them to 2011 dollars using a multiplier of 1.048 based on Consumer Price Index data obtained from the U.S. Bureau of Labor Statistics website (*58*). Thus, the assumed average increase in spending per party was $137 for Upper Peninsula welcome centers and $147 for Lower Peninsula welcome centers.

As tourism-related benefits are computed based on a per party (vehicle) basis using counts of vehicles entering the parking lot, it was also necessary to account for the fact that not all entering vehicles will utilize the information service area of the welcome center. Data collected by Vogt at a limited number of Lower Peninsula welcome centers indicated that approximately 60 percent of entering vehicles had one or more occupants enter the information service area (*37*). Furthermore, it was also assumed that only patrons arriving in passenger vehicles would utilize the traveler service area as patrons arriving in commercial vehicles are most likely on work-related trips and are therefore excluded from calculation of tourism benefits.

FACILITY COSTS

The life-cycle costs associated with the MDOT rest area system are primarily associated with the costs incurred by MDOT, which include:

- Construction of the facility,
- Major rehabilitation,
- Routine maintenance/upkeep, and
- Regular operation.

Construction and Rehabilitation Costs

Construction related costs were generally available from MDOT for facilities built within the past decade. However, only limited construction cost data existed for older facilities. Thus, various assumptions based on the type and size of the building and period of construction were necessary to determine an estimated construction cost for each facility. All actual costs were converted to 2011 dollars based on Consumer Price Index data obtained from the U.S. Bureau of Labor Statistics website (*58*).

MDOT currently constructs two primary types of standard rest area facilities: the "quad" style (3,276 sft) and the slightly smaller "three-room" style (2,288 sft). The current cost to build a quad style MDOT rest area facility on an existing site, including the building, parking lot, ramps, sewer facilities, and landscaping is approximately 3 million dollars. The smaller three-room facility provides only slightly lower total construction cost, as the cost of the building only comprises approximately 20 to 35 percent of the current total construction cost. These construction costs do not include initial or additional property acquisition, site design, or site

development/remediation costs, each of which varies widely based on the location, although estimates were made for each facility and were included in the overall construction cost estimate. Welcome center construction costs were considered on a case-by-case basis based on the size of the building and additional property features. Minor rehabilitation costs are typically included in the routine maintenance costs, which were provided by MDOT for each facility. Major rehabilitation costs were generally not available, although most facility components are currently typically designed for a uniform service life (i.e., 40 years) and are thus included in the facility reconstruction costs. As such, it was assumed that all cost components included in the initial construction cost provided an adequate estimation of the total construction/rehabilitation costs over the entire design life of the facility. Furthermore, assuming no residual salvage value, a majority of the facility components and subsequent construction costs would be repeated upon reconstruction of the facility at the end of service life.

It was necessary to convert all construction costs to an equivalent uniform annual cost. MDOT does not maintain a serviceability or sufficiency rating for rest areas and welcome centers. The MDOT Office of Administrative Services calculates straight-line depreciation for rest area facilities based on a 40 years design service life for all facilities built since 1990. Facilities built prior to 1990 (M-series, etc), which are of styles that differ from current designs, have averaged 30 year service lives prior to reconstruction. These costs were then amortized over the estimated design life of the particular facility (30 or 40 years) and averaged over all facilities within the particular class.

Operations and Maintenance Costs

The MDOT Office of Administrative Services provided the actual annual operational and routine maintenance (O&M) costs for each rest area and welcome center for the years 2008, 2009, and 2010. O&M costs for 2011 were also provided for a limited number of facilities that had experienced substantially different costs compared to previous years due to contract modifications or opening of new facilities. Operational and maintenance costs included the following:

- Operational costs
    - Wages and benefits
    - Travel

    - Equipment
    - Utilities
    - Building Leases
- Maintenance costs
    - Routine maintenance by MDOT crews
    - Contract routine maintenance

As expected, operational costs were higher for welcome centers than standard rest areas, while maintenance costs were typically higher for older facilities. An average value for the three year period was computed for each facility and utilized in the B/C calculation. Any year of closure or reconstruction for a particular rest area was excluded from this calculation. As the average operation and maintenance costs were reported in 2008-2010 values, it was necessary to index them to 2011 dollars using a multiplier of 1.048 based on Consumer Price Index data obtained from the U.S. Bureau of Labor Statistics website for conversion of 2009 dollars to 2011 dollars (*58*).

COMPUTATIONAL METHODS

The following subsections present the computational methods for determining the monetary value of the benefits and costs associated with MDOT rest areas and welcome centers. Included in each description are the mathematical formulae utilized for the calculations, as well as the basis for all coefficients, input values, and assumptions. **All monetary values used in the B/C analysis were computed as equivalent annualized values, indexed to 2011 dollars.**

Vehicle Operating Benefits

The annual vehicle operating cost savings for each rest area along the limited access freeway system were computed according to the procedure that follows. This benefit was not applied to facilities that were not directly accessible from the limited access freeway system.

Annual Vehicle Operating Cost Savings = Passenger Vehicle Operating Cost Savings + Commercial Vehicle Operating Cost Savings

Passenger Vehicle Operating Cost Savings = Average Annual Daily Rest Area Passenger Vehicle Traffic × Passenger Vehicle Diversion % × Excess Travel Mileage × Passenger Vehicle Operating Unit Costs × 365

Commercial Vehicle Operating Cost Savings = Average Annual Daily Rest Area Commercial Vehicle Traffic × Commercial Vehicle Diversion % × Excess Travel Mileage × Commercial Vehicle Operating Unit Costs × 365

Where:

- Annual Vehicle Operating Cost Savings = estimated additional vehicle operating costs incurred while accessing the nearest alternate private facility (fast food, gas station, truck stop) if the rest area were unavailable. Passenger and commercial vehicle cost savings were computed separately.
- Average Annual Daily Rest Area Vehicle Traffic = estimated average annual daily count of passenger vehicles or commercial vehicles entering the rest area facility, based on the most recently available vehicle classification counts for the rest area obtained via MDOT TMIS website and utilizing appropriate seasonal adjustment factors provided by MDOT. These values are shown for each rest area and welcome center in Table 14.
- Vehicle Diversion % = percent of rest area users that would travel to the nearest alternate private facility services if a rest area facility was unavailable. This value is assumed to be 65.9 percent for passenger vehicles and 38.3 percent of commercial vehicles based on the rest area user surveys.
- Excess Travel Mileage = the arithmetic difference between the net distance traveled from the mainline to access the nearest alternate private service facility and the net distance traveled from the mainline to access the rest area.

- Vehicle Operating Unit Costs = $0.304/mile for passenger vehicles, $1.015/mile for commercial vehicles, estimated in 2011 dollars based on the methodology developed by Barnes and Langworthy in 2003 (*55*).

Excess Travel Time Benefits

The annual excess travel time savings for each rest area along the limited access freeway system were computed according to the procedure that follows. This benefit was not applied to facilities that were not directly accessible from the limited access freeway system.

Annual Excess Travel Time Cost Savings = Passenger Vehicle Travel Time Cost Savings + Commercial Vehicle Travel Time Cost Savings

Passenger Vehicle Travel Time Costs Savings = Average Annual Daily Rest Area Passenger Vehicle Traffic × Passenger Vehicle Diversion % × Excess Travel Mileage × Passenger Vehicle Travel Time Unit Cost (per vehicle per hour) ÷ Assumed Average Operating Speed (mph) × 365

Commercial Vehicle Travel Time Costs Savings = Average Annual Daily Rest Area Commercial Vehicle Traffic × Commercial Vehicle Diversion % × Excess Travel Mileage × Commercial Vehicle Travel Time Unit Cost (per vehicle per hour) ÷ Assumed Average Operating Speed (mph) × 365

Where:

- Average Annual Daily Rest Area Vehicle Traffic = estimated average annual daily count of passenger vehicles or commercial vehicles entering the rest area facility, based on the most recently available vehicle classification counts for the rest area obtained via MDOT

TMIS website and utilizing appropriate seasonal adjustment factors provided by MDOT. These values are shown for each rest area and welcome center in Table 14.

- Vehicle Diversion % = percent of rest area users that would travel to the nearest alternate private facility services if a rest area facility was unavailable. This value is assumed to be 65.9 percent for passenger vehicles and 38.3 percent of commercial vehicles based on the rest area user surveys.
- Excess Travel Mileage = the arithmetic difference between the net distance traveled from the mainline to access the nearest alternate private service facility and the net distance traveled from the mainline to access the rest area.
- Assumed Average Operating Speed = 30 mph, as recommended by Carson et al. (*35*) based on the assumption that any excess travel for an alternate off-freeway service facility would be encountered on surface roadways and not on exit/entry ramps.
- Travel Time Unit Costs per vehicle per hour were estimated as follows:
    - Passenger Vehicle: 0.90 × $17.97 (Personal/vacation travel unit cost) + 0.10 × $42.76 (Business travel unit cost) = $20.45 per vehicle per hour
        - Personal/vacation travel unit cost: $25.67 per vehicle per hour × 0.7 personal travel time value reduction = $17.97 per vehicle per hour
        - Business travel unit cost: $30.11 per person per hour × 1.42 persons per vehicle = $42.76 per vehicle per hour
    - Commercial Vehicle: $28.43 per driver per hour × 1 driver per vehicle + $19.73 per passenger per hour × 0.7 personal travel time value reduction × 0.25 passenger per vehicle = $31.88 per vehicle per hour

  Where:
        - $25.67 represents the national median household hourly wage in September 2011 based on data obtained from the U.S. Census Bureau (*63*).
        - $30.11 represents the average national total hourly compensation for the civilian work force in September 2011 as reported by the Bureau of Labor Statistics (*61*).

- $28.43 represents the average national total hourly compensation for heavy and tractor-trailer truck drivers in September 2011 based on data obtained from the Bureau of Labor Statistics (*62*). $19.73 is the wage-only portion of this value.
- 0.90 is the fraction of surveyed rest area users traveling in a passenger vehicle that indicated a non-work related trip purpose
- 0.10 is the fraction of surveyed rest area users traveling in a passenger vehicle that indicated a work related trip purpose
- 0.7 is a reduction factor that reflects a reduced value of time for personal travel compared to work-related travel, as recommended by the USDOT for valuation of intercity personal travel time (*60*). This value was only applied to non-work related passenger vehicle travel and passengers of commercial vehicles.
- Vehicle occupancies represent the average of the self-reported values obtained during the rest area user survey for the specific vehicle type and trip purpose.

Comfort/Convenience Benefits

All comfort/convenience benefits were aggregated into a single "value to user" monetary benefit, based on the results of the surveys of rest area users performed as a part of this research. Analysis of the survey data showed that users' valuation of the services utilized varied significantly between welcome centers and standard rest areas, with median values of $2.21 and $1.68, respectively, which is reflective of the additional informational services and materials provided at welcome centers. The standard rest area median value of $1.68 was within the range of inflation-adjusted "willingness to pay" values reported in previous research for services provided at standard rest area (*37*). These values were applied to the respective facilities on a per vehicle basis rather than per person, as it was conservatively assumed that convenience benefits apply uniformly to entering vehicles.

Annual Value of Services Utilized by Rest Area Patrons = Average Value of Services Utilized at Rest Areas × Average Annual Daily Rest Area Vehicle Traffic × 365

Annual Value of Services Utilized by Welcome Center Patrons = Average Value of Services Utilized at Welcome Centers × Average Annual Daily Welcome Center Vehicle Traffic × 365

Where:

- Average Value of Services Utilized at Rest Areas = $1.68 for a standard Michigan rest area, per party, based on self-reported survey data collected in this study.
- Average Value of Services Utilized at Welcome Centers = $2.21 for a Michigan welcome center, per party, based on self-reported survey data collected in this study.

Tourism-Related Benefits

Total annual tourism-related benefits associated with welcome centers were computed based on the procedures and data recommended by Vogt in a 2008-2009 study of Michigan welcome centers (*36*). It was conservatively assumed that standard Michigan rest areas did not generate any additional tourism related revenue.

Annual Tourism-Related Benefits Generated by Welcome Center Patrons = Average Annual Daily Welcome Center Passenger Vehicle Traffic × % of Parties Who Increased Spending × Net Additional Spending per Party × 0.6 × 365

Where:

- % of Parties Who Increased Spending = 12.5 percent for Lower Peninsula welcome centers and 19.0 percent for Upper Peninsula welcome centers (including Mackinaw)

- Net Additional Spending per Party = $147 for Lower Peninsula welcome centers and $137 for Upper Peninsula welcome centers (2011 dollars)
- 0.6 = the fraction of vehicles entering the welcome center that had one or more occupants entering the information service area

Safety Benefits

The economic benefits due to reductions in fatigue-related crashes near each rest area can be calculated according to the following procedure.

$$\textit{Annual Crash Cost Savings Due to Rest Area} = [E(Y)_{\textit{Rest Area}} - E(Y)_{\textit{No Rest Area}}] \times \$110{,}672$$

Where:

- $E(Y)_{Rest\ Area}$ = predicted mean number of target crashes per year, sum totaled for 40 one-mile segments from 20 miles upstream to 20 miles downstream of the rest area
- $E(Y)_{No\ Rest\ Area}$ = predicted mean number of target crashes per year, sum totaled for the entire 40 mile distance assuming that the rest area did not exist at the location. Without the rest area, it is assumed that the safety performance would deteriorate such that it was equal to the "baseline" 20-mile limit across the entire 40-mile stretch from the upstream boundary to the downstream boundary.
- The prediction of E(Y) varies based on whether the rest area is located on a limited access freeway or non-limited access highway:
    - Limited access freeways: $E(Y) = AADT^{1.251} \times exp(-11.473 + 0.021 \times DIST)$ × (*Facility turn-in % ÷ Median turn-in %*)
    - Non-limited access highways: $E(Y) = AADT^{0.719} \times exp(-8.394 + 0.074 \times DIST)$ × (*Facility turn-in % ÷ Median turn-in %*)
    - *AADT* = average annual daily mainline directional traffic on a specific one-mile segment; typically assumed as the average over the entire segment.
    - *DIST* = distance (mi) of a specific one-mile segment from the particular rest area.
    - *Facility turn in %* = percentage of mainline vehicles entering the rest area for the facility

- *Median facility turn in %* = percentage of mainline vehicles entering rest area; median of all facilities statewide
- $110,672 = assumed weighted average cost per lane departure crash in 2011 dollars (*52*)

Costs

The total annualized cost associated with each rest area was computed according to the following procedure.

Total Annualized Cost = Amortized Construction Costs + Annual Operating Costs + Annual Maintenance Costs

Where:

- Amortized Construction Costs = construction costs for a rest area facility, converted to 2011 dollars and amortized (straight-line) over a 30-year or 40-year facility design life, depending on the year of construction. These data represented either the actual construction costs where available or were estimated based on costs to build a similar facility of the same size and type during the same time period.
- Annual Operations Costs = average annual operating costs (actual) for a rest area facility for 2008-2010, converted to 2011 dollars. Operating costs include: labor, utilities, travel, equipment, and building leases.
- Annual Maintenance Costs = average annual routine maintenance costs (actual) for a rest area facility for 2008-2010, converted to 2011 dollars. Routine maintenance costs include those incurred by agency labor and/or contracted labor.

RESULTS

Utilizing the aforementioned computational procedures for the itemized benefits and costs, the B/C ratio as it applies to Michigan rest areas and welcome centers was computed for each facility and overall for the network of 81 facilities as follows:

$$\frac{B}{C} = \frac{\begin{array}{c}Vehicle\ Operating\ Benefits + Excess\ Travel\ Time\ Benefits + Comfort\ and\ Convenience\ Benefits \\ + Tourism\ Benefits + Safety\ Benefits\end{array}}{Amortized\ Construction\ Costs + Annual\ Operating\ Costs + Annual\ Maintenance\ Costs}$$

Table 21 displays the itemized benefits and costs in 2011 dollars, in addition to the benefit/cost ratio for all 81 rest areas and welcome centers. Several interesting conclusions may be drawn from inspection of Table 21. First, the 2011 B/C for Michigan rest areas and welcome centers ranged from between 0.78 (St. Ignace Rest Area) to 11.66 (Clare Welcome Center). The total systemwide benefits for 2011 were estimated at $88,653,339, compared to total costs of $19,428,095. The overall systemwide B/C ratio was found to be 4.56. This value was within the range of expected rest area B/C ratios of 3.2 to 7.4 reported in NCHRP 324, which considered user comfort/convenience, reduction in excess travel, and reduction in shoulder crashes. The proportional breakdown of the systemwide benefits were as follows:

- Vehicle Operating Benefits = 1.5%
- Excess Travel Time Benefits = 2.7%
- Comfort/ Convenience Benefits = 36.1%
- Tourism Benefits = 25.6%
- Crash Reduction Benefits = 34.1%

Assuming an overall sales tax recovery rate of 7 percent (*36*) on the increased tourism spending of $22,684,613, the 2011 tax revenue generated by the 14 welcome centers was estimated at $1.59 million, representing a direct return on investment of $0.26 per dollar for the $5.79 million in total construction (annualized), operation, and maintenance costs for the welcome centers.

Table 21. Michigan Rest Area and Welcome Center Itemized Benefits, Costs, and B/C Ratios, 2011

	BENEFITS					COSTS		
Location	Vehicle Operating Benefits	Excess Travel Time Benefits	Comfort/ Convenience Benefits	Tourism Benefits (Welcome Centers)	Crash Reduction Benefits	Estimated Annualized Construction Costs	Annual O&M Costs	B/C
Adair	$25,138	$43,827	$289,585	$0	$278,532	$96,857	$107,019	**3.12**
Alamo	$24,171	$40,951	$308,843	$0	$312,128	$92,232	$88,001	**3.81**
Alger	$6,436	$12,769	$377,118	$0	$317,023	$96,857	$123,736	**3.23**
Battle Creek	$2,757	$4,425	$859,093	$0	$938,524	$96,857	$127,143	**8.06**
Bay City	$22,915	$46,435	$659,817	$0	$728,247	$96,857	$155,843	**5.77**
Belleville	$75,485	$122,423	$467,006	$0	$585,362	$96,857	$91,877	**6.62**
Big Rapids	$23,283	$44,996	$298,162	$0	$257,785	$92,232	$85,497	**3.51**
Cadillac	$18,280	$35,194	$286,410	$0	$218,115	$92,232	$91,207	**3.04**
Capac	$20,206	$29,169	$327,239	$0	$256,811	$92,232	$140,493	**2.72**
Carleton	$55,485	$91,518	$266,521	$0	$244,412	$92,232	$128,875	**2.98**
Chelsea	-$43,960	-$70,626	$591,279	$0	$635,214	$96,857	$32,121	**8.62**
Clare WC	$45,577	$78,498	$1,445,775	$5,183,533	$980,314	$108,896	$554,407	**11.66**
Clarkston	$20,291	$40,099	$552,542	$0	$617,656	$96,857	$90,846	**6.56**
Clio	$9,746	$18,000	$504,912	$0	$603,760	$96,857	$114,546	**5.38**
Coldwater WC	$13,130	$22,542	$676,231	$2,411,578	$446,205	$108,896	$456,758	**6.31**
Davisburg	$843	$1,670	$487,084	$0	$544,484	$96,857	$96,538	**5.35**
Detroit WC***	-$1,813	-$2,731	$98,734	$271,387	$79,481	$0	$350,685	**1.27**
DeWitt	-$1,570	-$3,047	$374,778	$0	$345,835	$96,857	$111,014	**3.44**
Dodge Rd.	-$17,312	-$32,853	$609,906	$0	$729,309	$96,857	$151,824	**5.18**
Dundee WC	$3,446	$5,753	$596,856	$2,028,159	$443,070	$103,107	$428,974	**5.78**
Fenton	$3,134	$5,802	$583,153	$0	$647,475	$96,857	$122,992	**5.64**
Five Lakes	$46,204	$69,359	$406,289	$0	$357,627	$92,232	$101,823	**4.53**
Fruitport	$18,357	$34,800	$222,455	$0	$197,955	$96,857	$99,579	**2.41**
Galesburg	$47,113	$73,519	$570,360	$0	$631,713	$96,857	$104,343	**6.57**
Garden Corners**	$0	$0	$152,687	$0	$254,421	$88,177	$62,341	**2.70**
Gaylord	$15,491	$31,514	$256,787	$0	$207,003	$92,232	$99,709	**2.66**
Glenn	$13,402	$21,831	$569,368	$0	$490,952	$96,857	$71,004	**6.53**
Grand Ledge	$16,855	$32,469	$420,047	$0	$440,271	$96,857	$95,842	**4.72**
Grass Lake	$32,208	$52,517	$515,214	$0	$559,285	$96,857	$100,836	**5.86**
Grayling	$11,248	$21,681	$343,574	$0	$295,457	$96,857	$89,733	**3.60**
Hart*	$28	$53	$101,178	$0	$70,051	$92,232	$80,995	**0.99**
Hartwick Pines	$4,045	$7,937	$190,709	$0	$153,465	$96,857	$94,583	**1.86**
Hebron*	-$645	-$1,390	$150,234	$0	$101,589	$92,232	$146,409	**1.05**
Higgins Lake	$16,433	$32,172	$137,571	$0	$92,696	$92,232	$146,321	**1.17**
Houghton Lake	$6,401	$12,765	$201,578	$0	$142,184	$92,232	$158,191	**1.45**
Howell	$43,985	$81,181	$636,901	$0	$689,145	$96,857	$115,837	**6.82**
Iron Mountain WC**,***	$0	$0	$126,999	$443,298	$83,579	$0	$158,018	**4.14**
Ironwood WC**	$0	$0	$141,906	$495,450	$67,784	$103,107	$266,042	**1.91**
Ithaca	$19,502	$38,276	$288,870	$0	$251,393	$96,857	$106,765	**2.94**
Jackson	$11,820	$22,382	$217,556	$0	$184,760	$92,232	$85,566	**2.46**
Lake Chemung	$17,714	$30,250	$498,227	$0	$551,820	$92,232	$87,568	**6.11**
Lansing	$19,524	$37,319	$254,580	$0	$251,206	$92,232	$76,363	**3.34**
Linwood	$13,652	$27,679	$541,810	$0	$489,938	$96,857	$146,771	**4.40**
Ludington*	$7,009	$14,021	$135,517	$0	$93,523	$92,232	$74,338	**1.50**

Table 21. Michigan Rest Area and Welcome Center Itemized Benefits, Costs, and B/C Ratios, 2011 (Continued)

	BENEFITS					COSTS		
Location	Vehicle Operating Benefits	Excess Travel Time Benefits	Comfort/ Convenience Benefits	Tourism Benefits (Welcome Centers)	Crash Reduction Benefits	Estimated Annualized Construction Costs	Annual O&M Costs	B/C
Mackinaw City WC	-$25,984	-$43,260	$289,426	$974,482	$157,012	$103,107	$390,881	**2.74**
Marquette WC**	$0	$0	$180,238	$629,695	$117,017	$23,557	$279,204	**3.06**
Marshall	$65,096	$113,775	$447,170	$0	$435,240	$96,857	$101,656	**5.35**
Menominee WC**	$0	$0	$128,161	$447,161	$80,012	$23,557	$175,770	**3.29**
Monroe WC	$154,928	$231,727	$1,190,035	$3,214,149	$1,024,498	$108,896	$449,403	**10.42**
Morley	-$6,046	-$11,530	$414,152	$0	$357,591	$92,232	$94,302	**4.04**
Muskegon	$20,432	$38,896	$224,431	$0	$193,000	$92,232	$91,250	**2.60**
Naubinway**	$0	$0	$231,790	$0	$403,327	$88,177	$65,489	**4.13**
New Buffalo WC	-$33,294	-$55,543	$1,222,365	$4,148,068	$938,434	$124,706	$627,689	**8.27**
Nine Mile Hill	$7,825	$15,577	$234,691	$0	$177,936	$92,232	$203,069	**1.48**
Northfield Church	$25,629	$48,695	$662,424	$0	$771,997	$96,857	$102,362	**7.57**
Okemos	$16,634	$31,000	$567,210	$0	$606,613	$96,857	$113,805	**5.80**
Port Huron WC	$2,193	$3,718	$232,896	$813,195	$158,834	$103,107	$228,487	**3.65**
Portland	$8,271	$14,759	$744,733	$0	$744,474	$96,857	$123,141	**6.87**
Potterville	$14,494	$23,061	$469,270	$0	$455,991	$96,857	$102,117	**4.84**
Richmond	$6,555	$12,040	$252,477	$0	$242,841	$92,232	$173,927	**1.93**
Rockford	$24,656	$44,619	$361,192	$0	$354,717	$96,857	$103,623	**3.92**
Rothbury	$22,649	$39,743	$268,263	$0	$198,670	$92,232	$138,655	**2.29**
Saint Ignace RA*	$2,687	$5,480	$59,480	$0	$41,182	$92,232	$48,187	**0.78**
Saint Ignace WC	$46,490	$78,836	$340,148	$1,187,922	$193,353	$103,107	$307,665	**4.50**
Sandstone	$3,576	$6,072	$554,946	$0	$544,996	$96,857	$110,440	**5.35**
Saranac	$47,372	$90,186	$478,333	$0	$466,340	$92,232	$116,126	**5.19**
Saugatuck	$19,671	$32,688	$368,467	$0	$348,080	$92,232	$87,912	**4.27**
Sault Ste Marie RA	$3,639	$6,429	$108,253	$0	$72,678	$92,232	$79,242	**1.11**
Sault Ste Marie WC	$10,472	$18,053	$121,578	$436,537	$56,045	$103,107	$306,175	**1.57**
Seney**	$0	$0	$187,026	$0	$364,709	$88,177	$74,299	**3.40**
Swartz Creek	$24,998	$41,143	$481,134	$0	$482,393	$96,857	$103,638	**5.14**
Topinabee*	$4,869	$9,924	$131,225	$0	$90,560	$92,232	$144,764	**1.00**
Turkeyville	$13,696	$21,413	$557,914	$0	$499,381	$96,857	$59,634	**6.98**
Tustin	$1,688	$3,021	$57,303	$0	$74,107	$44,088	$16,329	**2.25**
Vanderbilt	$7,135	$13,172	$176,581	$0	$138,712	$92,232	$85,786	**1.89**
Walker	$41,701	$78,969	$310,840	$0	$319,604	$92,232	$115,907	**3.61**
Watervliet	$3,812	$5,759	$563,241	$0	$541,272	$96,857	$106,586	**5.48**
West Branch	$12,346	$25,090	$393,674	$0	$315,099	$92,232	$188,617	**2.66**
Westland	$55,877	$99,944	$427,649	$0	$554,217	$92,232	$104,771	**5.77**
Woodbury	$42,522	$71,542	$483,720	$0	$468,852	$96,857	$103,813	**5.32**
Zeeland	$29,779	$49,355	$377,990	$0	$387,609	$96,857	$90,374	**4.51**
TOTAL SYSTEM	$1,342,380	$2,339,503	$32,041,888	$22,684,613	$30,244,955	$7,393,628	$12,034,467	**4.56**

* Facility is closed seasonally from December through March.
** Facility is located on a non-limited access highway. Vehicle operating benefits and excess travel time benefits do not apply.
*** Leased facility; construction cost = $0. Annual lease cost included in operational costs.

Close comparison of Table 21 with Table 14 reveals that the facility B/C is strongly correlated with the utilization of the facility, which was expected due to the fact that most of the benefits are calculated based on traffic or visitor volumes. This finding also suggests that facility costs are not well correlated with utilization. Similarly, facilities with low traffic volumes and/or relatively high O&M costs generally had the lowest overall B/C ratios. The B/C ratio versus annual visitors for each facility is displayed in Figure 23 along with a linear trendline.

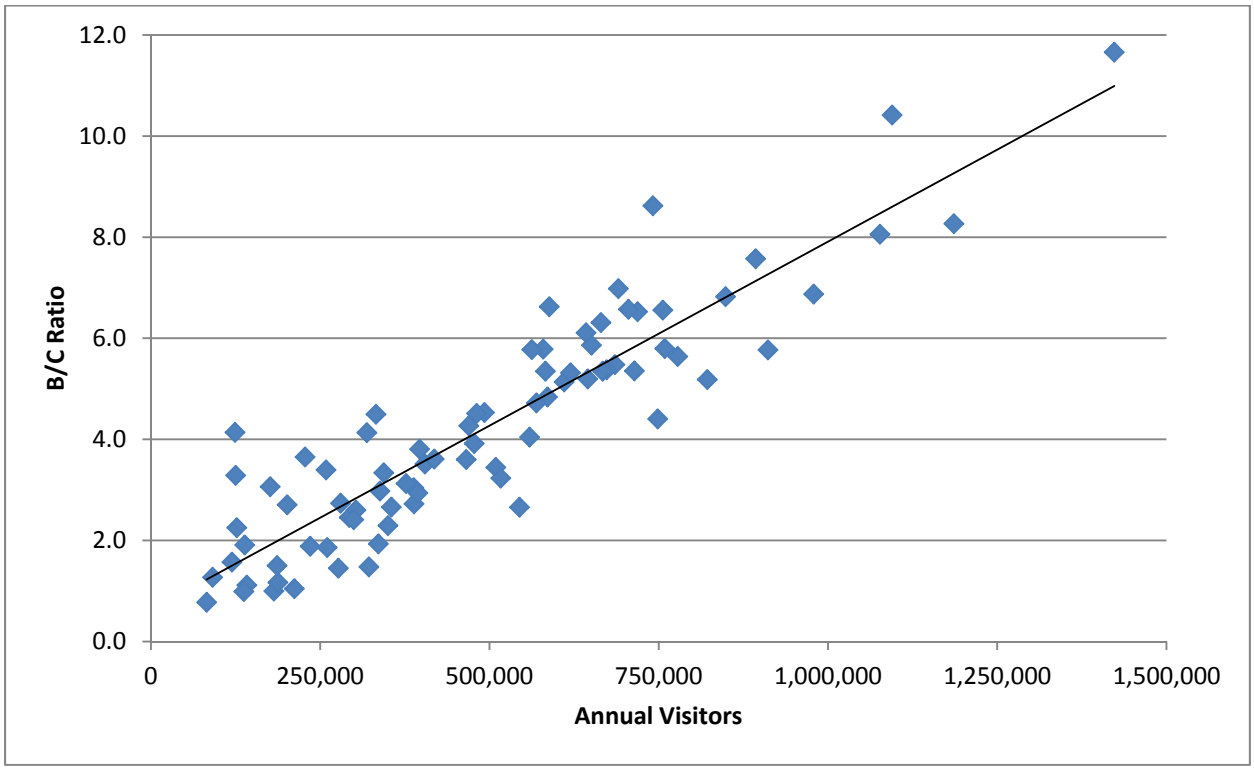

Figure 23. Facility B/C Ratio versus Annual Visitors

Facilities with the highest B/C ratios included those located on major freeways in the southern and central Lower Peninsula. A total of five facilities were found to have B/C greater than 8.0, which included the Clare, Monroe, and New Buffalo Welcome Centers along with the Chelsea and Battle Creek Rest Areas. Facilities in the North and Superior Regions – particularly those with seasonal closures – had the lowest B/C ratios. The five seasonally closed facilities, including the Sault Saint Marie, Hebron, Topinabee, Hart, and Saint Ignace Rest Areas possessed the lowest B/C ratios, clearly attributable to the lack of utilization during the four month closure period. Three of these facilities had B/C ratios that were less than or equal to 1.0, including the Saint Ignace, Hart, and Topinabee Rest Areas.

CHAPTER 9:
REST AREA VALUE ASSESSMENT

In addition to assessment of the various economic related components that are associated with rest areas, it was also important to consider other factors that could not be monetarily quantified in determining the relative value of each rest area and welcome center facility. These non-economic functional characteristics were utilized in conjunction with the B/C ratios to provide assessment of the relative "value" for each facility within the MDOT network of rest areas and welcome centers.

METHODOLOGY

A utility function was developed for facility prioritization considering both non-monetary and monetary factors. Utility functions have been utilized in past rest area research to assess the relative functionality of each facility (*37*). The relative priority (or "rank") of each individual rest area may then be quantified based on the output of such a utility function. The basic form as it applies to rest area functional assessment is given as follows (*37*):

$$U_i = \sum_j W_j S_{ij}$$

Where: U_i = relative value (utility) of rest area "i" compared to all other rest areas

S_{ij} = value for rest area "i" for the "jth" factor

W_j = weight assigned to the utility of the "jth" factor based on relative importance compared to all other factors

It was first necessary to determine the relevant characteristics related to the functional value of a rest area to both motorists and MDOT. A potential list of relevant characteristics was initially identified through the literature. A characteristic was considered only if each of the following criteria were met:

- The factor is not directly utilized in the B/C calculation.
- The factor may be quantified for each facility, either directly or through expert scoring.
- Data for each facility are available from MDOT or other sources or were directly obtained as part of the research performed here.

The researchers developed a list of proposed non-economic characteristics for rest area functional assessment in Michigan based on findings from the literature (*37,44,45*). Factors related to traffic or visitor volumes were specifically excluded from this list due to the use within calculation of several of the benefits. The list of characteristics included many of the facility inventory factors obtained during this study (e.g., type of sewer system, facility age, truck parking spaces, and parking expansion capabilities) in addition to factors related to gaps and redundancies in the rest area system, such as the availability of alternate commercial service facilities and proximity to other rest areas along the route. Because rest area sites with scenic, natural, historical, or cultural qualities attract recreational travelers and indirectly support tourism, a factor was included that specifically addressed these features. Several rest areas are also utilized to support mobile commercial vehicle enforcement and a corresponding factor was subsequently included in the list. A seasonal (i.e., winter) closure factor was also included to help offset low utilization values due to the facilities being closed for four months annually.

It was also necessary to determine the relative importance for each of the potential functional factors. To assist in this process, a survey was administered by invitation to 19 representatives of various MDOT divisions and regions, including all members of the MDOT Research Advisory Panel and Project Manager. The participants were asked to individually weight each of the characteristics on a scale of 1 to 10 (1 being not important; 10 being critically important) considering the relative importance towards assessing the functional value of a public rest area in Michigan. The results were tallied and the median relative weights were calculated for each characteristic, as shown in Table 22.

Table 22. Non-Economic (Functional) Factors and Relative Weights

Non-Economic Factor	Relative Weight*
Distance to Nearest Rest Area	10.9%
Number of Truck Parking Spaces	9.5%
Unique Site Characteristics (scenic, natural, historical, cultural)	9.5%
Facility Age	8.9%
Turn-in Rate	8.9%
Number of Truck Stops within 20 miles	8.9%
Number of Fast Food/Gas Stations within 20 miles	8.8%
Ability for Expansion of Truck Parking within the Existing Property	8.8%
Type of Sanitary Sewer System	8.8%
Used for Mobile Commercial Vehicle Enforcement	8.8%
Seasonal Closure	8.2%

*Median weight from expert panel scores

The relevant data for each factor, including both the functional factors and the B/C ratios were obtained for each facility and compiled into a single spreadsheet for computational purposes, as shown in Table H of the Appendix. These data were then appropriately scaled for each factor on a 0 to 1 scale using straight line proportionality between the lowest and highest observed values for each factor. Factors were either directly scaled (0 = lowest value, 1 = highest value) or inversely scaled (0 = highest value, 1 = lowest value). For example, a higher supply of commercial service facilities within 20 miles is assigned a lower scaled value, representing a factor that is inversely scaled. Table 23 displays each factor utilized in the value index calculation along with the method for converting the raw data to a scaled value.

Table 23. Rest Area Value Assessment Factors and Associated Data Scaling Method

Category	Factor	Relative Weight	Raw Data Value	Data Scaling Method*
ECONOMIC	B/C Ratio	50.0%	Actual Value	Scaled proportionally 0 = lowest actual value; 1 = highest actual value
NON-ECONOMIC	Facility Age	4.4%	Actual Value	Scaled proportionally 0 = highest actual value; 1 = lowest actual value
	Turn-in Rate	4.4%	Actual Value	Scaled proportionally 0 = lowest actual value; 1 = highest actual value
	Number of Truck Parking Spaces	4.8%	Actual Value	Scaled proportionally 0 = lowest actual value; 1 = highest actual value
	Seasonal Closure	4.1%	0 = No Closure; 1 = Seasonal Closure	0 = No Closure; 1 = Seasonal Closure
	Distance to Nearest Rest Area	5.5%	Actual Value	Scaled proportionally 0 = lowest actual value; 1 = highest actual value
	Number of Truck Stops within 20 miles	4.4%	Actual Value	Scaled proportionally 0 = highest actual value; 1 = lowest actual value
	Number of Fast Food/Gas Stations within 20 miles	4.4%	Actual Value	Scaled proportionally 0 = highest actual value; 1 = lowest actual value
	Ability for Expansion of Truck Parking within the Existing Property	4.4%	0 = < 5 spaces; 0.5 = 5-10 spaces; 1 = 11+ spaces	0 = < 5 spaces; 0.5 = 5-10 spaces; 1 = 11+ spaces
	Type of Sanitary Sewer System	4.4%	0 = lagoon; 0.5 = septic; 1 = municipal	0 = lagoon; 0.5 = septic; 1 = municipal
	Unique Site Characteristics (scenic, natural, historical, cultural)	4.8%	0 = none; 0.5 = moderately unique; 1 = highly unique	0 = none; 0.5 = moderately unique; 1 = highly unique
	Used for Mobile Commercial Vehicle Enforcement	4.4%	0 = No; 1 = Yes	0 = No; 1 = Yes

*For each factor, a scaled value of "1" represents the highest ranked facility, while a scaled value of "0" represents the lowest ranked facility.

FACILITY SCORES AND ASSOCIATED RANKS

The functional score for each facility was computed by multiplying the scaled value for each functional factor by the respective factor weight and computing the sum total over all factors. The overall value index score was calculated with equal consideration given to economic and non-economic factors and was computed accordingly based on an average of the total functional score and the scaled B/C score. Facilities with higher overall value index scores were considered to have higher relative value compared to facilities with lower scores and were accordingly assigned higher rankings. For example, a ranking of "1" represents the facility with the highest relative value. Table 24 provides the results for a.) the scaled functional score, b.) the scaled B/C ratio score, c.) the average of the scaled functional score and the scaled B/C ratio score (i.e., overall value index score), and d.) the overall ranking for each facility based on the overall value index.

Figure 24 displays a scatterplot of the scaled B/C scores versus the scaled functional scores for each facility. The figure shows no evidence of correlation between the scaled B/C scores and the scaled functional scores, suggesting a desirable level of independence between the two scoring methods. The three top scoring facilities based on the value index were the Clare, New Buffalo, and Monroe Welcome Centers, each of which had an overall value index score greater than or equal to 0.80 (out of 1.0). These facilities were clearly separated from the others in terms of overall value scores and were followed by the Coldwater Welcome Center and the Portland, Belleville, Northfield Church, Potterville, Glenn, Turkeyville, and Battle Creek Rest Areas, each of which had an overall value index between 0.60 and 0.72. The facilities with the lowest overall value included the Detroit Welcome Center along with the Hartwick Pines, Houghton Lake, Adair, Fruitport, Hart, Tustin, Higgins Lake, and Richmond Rest Areas, each of which had an overall value index less than 0.30.

Table 24. Facility Functional, B/C, and Overall Value Index Scores and Corresponding Ranks

Location	Scaled Functional (Non-Economic) SCORE	Functional (Non-Economic) RANK	Scaled B/C SCORE	B/C RANK	Overall Value Index SCORE*	Overall Value Index RANK
Clare Welcome Center	0.88	4	1.00	1	**0.94**	**1**
New Buffalo Welcome Center	1.00	1	0.69	4	**0.84**	**2**
Monroe Welcome Center	0.71	15	0.89	2	**0.80**	**3**
Coldwater Welcome Center	0.94	2	0.51	14	**0.72**	**4**
Portland Rest Area	0.80	7	0.56	8	**0.68**	**5**
Belleville Rest Area	0.78	8	0.54	10	**0.66**	**6**
Northfield Church Rest Area	0.67	24	0.62	6	**0.65**	**7**
Potterville Rest Area	0.89	3	0.37	31	**0.63**	**8**
Glenn Rest Area	0.69	20	0.53	13	**0.61**	**9**
Turkeyville Rest Area	0.63	32	0.57	7	**0.60**	**10**
Battle Creek Rest Area	0.53	50	0.67	5	**0.60**	**11**
Watervliet Rest Area	0.76	11	0.43	22	**0.59**	**12**
Dodge Road Rest Area	0.76	10	0.41	29	**0.58**	**13**
Morley Rest Area	0.85	6	0.30	40	**0.58**	**14**
Galesburg Rest Area	0.60	38	0.53	11	**0.57**	**15**
Five Lakes Rest Area	0.78	9	0.35	33	**0.56**	**16**
Seney Rest Area	0.87	5	0.24	48	**0.56**	**17**
Chelsea Rest Area	0.39	72	0.72	3	**0.55**	**18**
Swartz Creek Rest Area	0.70	18	0.40	30	**0.55**	**19**
Saranac Rest Area	0.68	22	0.41	28	**0.54**	**20**
Dundee Welcome Center	0.62	35	0.46	18	**0.54**	**21**
Linwood Rest Area	0.74	12	0.33	36	**0.54**	**22**
Woodbury Rest Area	0.64	29	0.42	27	**0.53**	**23**
Saugatuck Rest Area	0.72	14	0.32	37	**0.52**	**24**
Saint Ignace Welcome Center	0.69	19	0.34	35	**0.52**	**25**
Marshall Rest Area	0.60	39	0.42	26	**0.51**	**26**
Fenton Rest Area	0.57	43	0.45	21	**0.51**	**27**
Naubinway Rest Area	0.66	26	0.31	39	**0.48**	**28**
Big Rapids Rest Area	0.71	16	0.25	46	**0.48**	**29**
Howell Rest Area	0.40	68	0.56	9	**0.48**	**30**
Grass Lake Rest Area	0.48	60	0.47	16	**0.47**	**31**
Iron Mountain Welcome Center	0.63	34	0.31	38	**0.47**	**32**
DeWitt Rest Area	0.68	21	0.25	47	**0.46**	**33**
Okemos Rest Area	0.46	64	0.46	17	**0.46**	**34**
Grayling Rest Area	0.65	27	0.26	45	**0.46**	**35**
Lake Chemung Rest Area	0.42	67	0.49	15	**0.45**	**36**
Alamo Rest Area	0.63	33	0.28	42	**0.45**	**37**
Clarkston Rest Area	0.36	73	0.53	12	**0.45**	**38**
Sandstone Rest Area	0.46	63	0.42	24	**0.44**	**39**
Menominee Welcome Center	0.64	31	0.23	50	**0.43**	**40**
Clio Rest Area	0.44	66	0.42	23	**0.43**	**41**
Cadillac Rest Area	0.65	28	0.21	54	**0.43**	**42**
Bay City Rest Area	0.39	71	0.46	20	**0.43**	**43**
Zeeland Rest Area	0.50	55	0.34	34	**0.42**	**44**
Alger Rest Area	0.61	37	0.23	51	**0.42**	**45**
Marquette Welcome Center	0.61	36	0.21	53	**0.41**	**46**

Table 24. Facility Functional, B/C, and Overall Value Index Scores and Corresponding Ranks (Continued)

Location	Scaled Functional (Non-Economic) SCORE	Functional (Non-Economic) RANK	Scaled B/C SCORE	B/C RANK	Overall Value Index SCORE*	Overall Value Index RANK
Lansing Rest Area	0.55	46	0.24	49	**0.39**	**47**
Ludington Rest Area	0.70	17	0.07	72	**0.38**	**48**
Rockford Rest Area	0.48	62	0.29	41	**0.38**	**49**
Capac Rest Area	0.58	42	0.18	58	**0.38**	**50**
Walker Rest Area	0.49	58	0.26	44	**0.37**	**51**
Topinabee Rest Area	0.72	13	0.02	79	**0.37**	**52**
Sault Saint Marie Welcome Center	0.67	23	0.07	71	**0.37**	**53**
Westland Rest Area	0.28	79	0.46	19	**0.37**	**54**
Jackson Rest Area	0.56	44	0.15	63	**0.36**	**55**
Davisburg Rest Area	0.30	78	0.42	25	**0.36**	**56**
West Branch Rest Area	0.54	47	0.17	61	**0.36**	**57**
Mackinaw City Welcome Center	0.52	51	0.18	57	**0.35**	**58**
Muskegon Rest Area	0.53	48	0.17	62	**0.35**	**59**
Garden Corners Rest Area	0.52	52	0.18	59	**0.35**	**60**
Rothbury Rest Area	0.56	45	0.14	65	**0.35**	**61**
Carleton Rest Area	0.49	57	0.20	55	**0.34**	**62**
Ironwood Welcome Center	0.58	41	0.10	68	**0.34**	**63**
Grand Ledge Rest Area	0.32	77	0.36	32	**0.34**	**64**
Ithaca Rest Area	0.48	61	0.20	56	**0.34**	**65**
Sault Saint Marie Rest Area	0.64	30	0.03	77	**0.34**	**66**
Saint Ignace Rest Area	0.66	25	0.00	81	**0.33**	**67**
Vanderbilt Rest Area	0.52	53	0.10	69	**0.31**	**68**
Gaylord Rest Area	0.44	65	0.17	60	**0.31**	**69**
Hebron Rest Area	0.59	40	0.02	78	**0.31**	**70**
Port Huron Welcome Center	0.34	74	0.26	43	**0.30**	**71**
Nine Mile Hill Rest Area	0.53	49	0.06	73	**0.30**	**72**
Hartwick Pines Rest Area	0.48	59	0.10	70	**0.29**	**73**
Houghton Lake Rest Area	0.50	56	0.06	74	**0.28**	**74**
Adair Rest Area	0.33	76	0.22	52	**0.27**	**75**
Fruitport Rest Area	0.40	69	0.15	64	**0.27**	**76**
Hart Rest Area	0.51	54	0.02	80	**0.26**	**77**
Detroit Welcome Center	0.40	70	0.05	75	**0.22**	**78**
Tustin Rest Area	0.26	80	0.14	66	**0.20**	**79**
Higgins Lake Rest Area	0.34	75	0.04	76	**0.19**	**80**
Richmond Rest Area	0.00	81	0.11	67	**0.05**	**81**

*Represents the average of the Scaled Functional Score and the Scaled B/C Score.

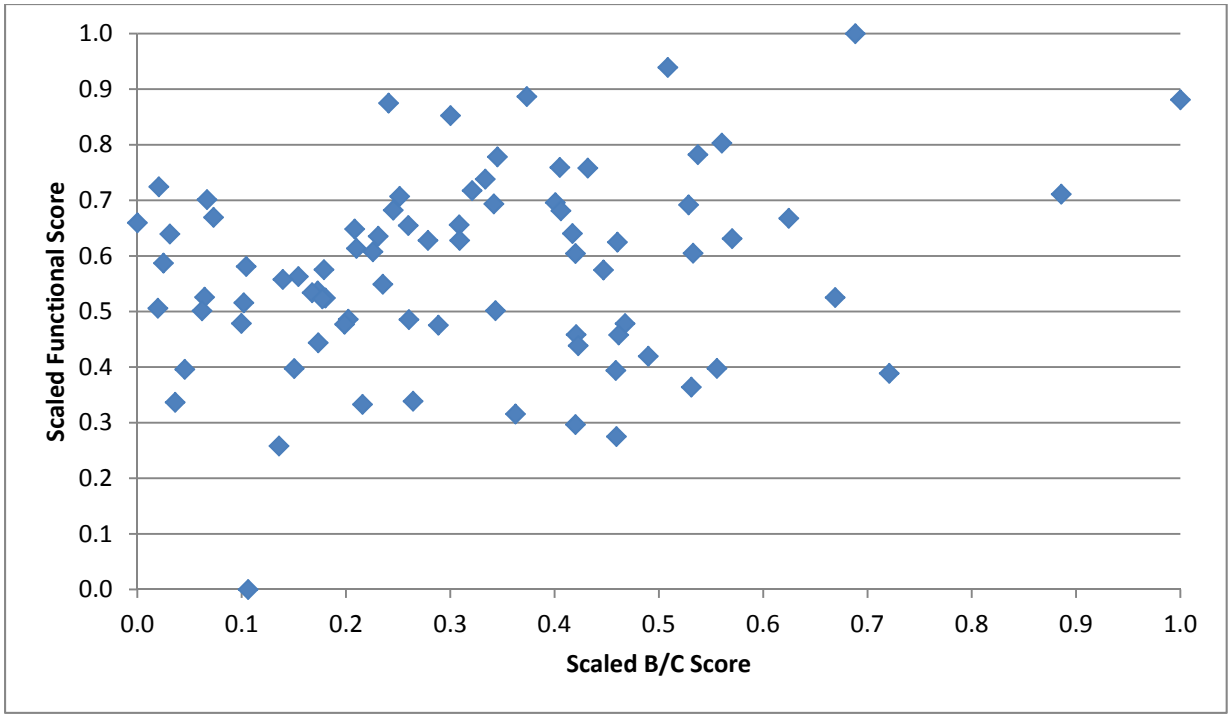

Figure 24. Scatterplot of Scaled Functional Score vs. Scaled B/C Score for Each Facility

SOFTWARE TOOL FOR FACILITY ASSESSMENT

Although the economic and functional values were computed for each rest area and also systemwide (See Tables 21 and 24), they only represent a "snapshot" based on current data and assumptions. To provide flexibility for future forecasting and planning, the economic, functional, and overall value assessment methodologies were embedded into an Excel spreadsheet, allowing the user to update any data, weights, and/or other assumptions, as necessary. This also makes it possible to experiment with the addition of a new rest area – or removal of an existing rest area – and receive an estimate of the resulting impacts, both on the nearby facilities and systemwide. The electronic version of this tool has been provided to MDOT in Excel format as a companion to this report.

CHAPTER 10:
CONCLUSIONS AND RECOMMENDATIONS

Public rest areas in Michigan serve a variety of needs for all travelers, including vacation/recreational travelers, commercial vehicle drivers, commuters, motorcyclists, and others. A majority of travelers stopping at rest areas desire a restroom break or simply a stretch or short break. Other patrons utilize rest areas for picnicking, vending machines, relief for children or pets, vehicle maintenance, to change drivers, obtain travel information, or to even sleep. Rest areas provide the distinct advantage of quick access and facilities that are open 24 hours per day. Although it is generally acknowledged that rest areas possess many intrinsic benefits to motorists, the safety and economic impacts associated with Michigan rest areas and welcome centers had previously remained largely unknown. As such, it was necessary to determine the economic value of rest areas to both users and MDOT, both individually and as a system. The overall goal of this research was to determine the value of rest areas and welcome centers, both individually and as a system, to determine the appropriate level of service for rest areas on MDOT roadways. Consideration was given to both the economic value of rest areas, in addition to the non-economic functional value provided by rest areas. Several tasks were performed as part of this research to help achieve this goal. The conclusions drawn from each of the tasks are provided in the paragraphs that follow.

CONCLUSIONS

Rest Area Utilization Trends

Analysis of nearly 20,000 recent hourly rest area traffic volume counts from 76 rest areas was performed in order to assess general rest area usage trends. The peak overall rest area utilization occurred on Fridays. Passenger vehicle utilization follows a pattern of increased use on Friday, Saturday, and Sunday, with lower utilization during weekdays. Commercial vehicle demand for rest areas was greatest during Monday through Thursday, with considerable drop-offs on Saturday and Sunday. Passenger vehicle travelers are far more likely to use the rest area during the afternoon hours compared to other times of the day. Commercial vehicle utilization was highest during the morning and afternoon periods. As expected, commercial vehicles represented a much greater proportion of the nighttime rest area volumes compared to daytime periods.

The regions with the highest rest area use include the Southwest Region, Bay Region, and University Region. Commercial vehicle usage was particularly high in the Southwest Region. As expected, the Superior and North Regions had the lowest average hourly use. The busiest rest areas, on average, were those located along I-94, US-23, I-96, and I-69. Commercial truck utilization was also highest on these routes, along with I-196. The least utilized facilities were on non-limited access roadways in the Upper Peninsula. The overall systemwide turn-in rate for rest area entry traffic as a percent of traffic on the adjacent mainline was estimated at 4.2 percent.

The average self-reported vehicular occupancy was 2.76 persons per vehicle. As expected, commercial trucks had the lowest occupancies at 1.25 persons per vehicle, while passenger vehicle occupancy was 2.42 persons per vehicle. Further analysis of the passenger vehicle travelers by trip purpose found that the occupancies differed based on the purpose of the trip. Passenger vehicle occupancies for vacation/personal trips had occupancies of 2.54 persons per vehicle, while work related trips had occupancies of 1.42 persons per vehicle. Overall, 22.1 percent of the vehicles included children aged 17 and under. Data collected during pilot versions of the survey showed that 18.3 percent of passenger vehicle occupants were children aged 17 and under.

Truck Parking Capacity Assessment

Corroboration of the results from the survey of truck stop operators along with the nighttime rest area truck parking data collection found evidence of major nighttime truck capacity issues at both rest areas and commercial truck stops along the entire length of I-94, I-69 near Flint, and I-75 between Monroe and Detroit. Commercial truck stops along I-94 experience the highest nighttime truck parking occupancy (88%) and also frequently exceed nighttime parking capacity with 80% of the surveyed locations experiencing weekly overflows at an average overflow frequency of 2.4 nights per week. Truck stops along I-75 between Monroe and Detroit also reported severe truck parking issues with an average of 5 overflow nights per week.

User Satisfaction and Valuation of Rest Areas

The rest area user survey yielded a total of 2,831 responses obtained from a representative sample of 12 rest areas and three welcome centers selected from throughout Michigan. The overwhelmingly common reasons for stopping at a rest area were to use the

restroom (95%) and to stretch/walk/take break (55%). The primary reason for selecting the rest area rather than a nearby commercial facility was due to the quick access from the highway (88.3%). When asked to rate their overall satisfaction with Michigan rest areas on a scale of 1 (very unsatisfied) to 5 (very satisfied), 84.7 percent of rest area users chose either a 4 or 5 satisfaction level with a mean satisfaction of 4.26. Motorcyclists, RV'ers, frequent rest area users, vacation travelers, and persons traveling with children had the highest satisfaction levels, while commercial truck drivers, younger travelers, and first time rest area users had lower levels of satisfaction.

In order to estimate an aggregate value of comfort and convenience to motorists, respondents were also asked to assess the value of the services utilized during the stop. The median value was $1.68 for standard rest areas compared to $2.21 for welcome center users. These values were consistent with previous research (*37*), and the incremental increase for welcome centers is indicative of the additional level of traveler services provided.

Rest area preference was compared between users at selected rest area versus commercial truck stop facilities along I-94. Among truck stop survey respondents, it was important to note that rest areas were preferred over private truck stops for several common uses, including: restroom use, short break, pet relief, and break for kids. The greatest preference for rest area use among truck stop patrons was for taking a short break, as 55.9 percent preferred rest areas.

Crash Reductions

Analysis of fatigue-related crash data within a 20 mile radius of each rest area along the particular route were collected and analyzed. It was concluded that fatigue-related crashes are impacted by the presence or absence of rest areas and the estimated magnitude of the crash reductions due to rest area presence are well correlated with mainline traffic volumes. Modeling of the rest area related crash reductions estimated the greatest safety impacts to be associated with facilities on roadways with the highest mainline traffic volumes and possessing the highest turn-in rates. Considering the entire system of MDOT rest areas and welcome centers, it was estimated that Michigan rest areas and welcome centers contribute to the reduction of 273 fatigue-related crashes systemwide per year within 20 miles upstream and downstream of the facilities – an average of 3.37 crashes per facility per year.

Economic Assessment

An economic analysis was performed for rest areas using the following benefit/cost procedure:

$$\frac{B}{C} = \frac{\begin{array}{c}Vehicle\ Operating\ Benefits + Excess\ Travel\ Time\ Benefits + Comfort\ and\ Convenience\ Benefits \\ + Tourism\ Benefits + Safety\ Benefits\end{array}}{Amortized\ Construction\ Costs + Annual\ Operating\ Costs + Annual\ Maintenance\ Costs}$$

The results of the economic analysis showed that nearly all but three MDOT rest areas and welcome centers currently possess B/C ratios that exceed 1.0, with values for the 81 individual facilities ranging between 0.78 and 11.66. Thus, with few exceptions, each of the 81 facilities may be considered economically viable. The total systemwide benefits for 2011 totaled $88.65 million, compared to total costs of $19.43 million. The systemwide B/C ratio was found to be 4.56. This overall B/C value fell within the range of 3.2 to 7.4 reported in NCHRP 324 using similar assumptions. A majority of the benefits originated from a combination of comfort/convenience (i.e., the "value" to users), reduction of targeted fatigue-related crashes, and tourism benefits (welcome centers only). Reductions in excess travel diversion costs associated with rest areas were estimated to account for fewer than 5 percent of the overall benefits. The annual direct tax revenue associated with increased tourism spending at welcome centers was estimated at $1.58 million. This represents an annual agency return on investment of $0.26 for each dollar spent on construction, operation, and maintenance of the welcome centers.

Many of the monetary benefits associated with a facility were calculated based largely on traffic or visitor volumes and the subsequent B/C ratios were strongly correlated with facility utilization. Accordingly, the facilities with the highest economic value included the large, heavily utilized welcome centers in the Lower Peninsula (due to tourism benefits) along with heavily utilized rest areas along major freeways in the southern Lower Peninsula (due to comfort/convenience benefits). The least economically viable facilities were those with the lowest utilization rates – particularly facilities located in the North and Superior Regions and especially those that are closed during winter months.

Overall Value Assessment and Facility Ranking

In addition to assessment of the various economic related components that are associated with rest areas, it was also important to consider other factors that could not be monetarily quantified when determining the relative value of each rest area and welcome center facility. An assessment of the relative non-economic functional values of each rest area was performed considering a weighted combination of several characteristics related to the utility of a facility that could not be monetarily quantified. These characteristics were related to the availability of alternate facilities, including other rest areas, commercial truck stops, fast food restaurants, and gas stations, along with several facility-related features.

An overall value index score was calculated with equal consideration given to economic and non-economic factors. Thus, the value index scores were computed based on an average of the total scaled functional score and the scaled B/C score. The three top scoring facilities based on the value index were the Clare, New Buffalo, and Monroe Welcome Centers, each of which had an overall value index score greater than or equal to 0.80 (out of 1.0). These facilities were clearly separated from the others in terms of overall value scores and were followed by the Coldwater Welcome Center and the Portland, Belleville, Northfield Church, Potterville, Glenn, Turkeyville, and Battle Creek Rest Areas, each of which had an overall value index between 0.60 and 0.72. The facilities with the lowest overall value included the Detroit Welcome Center along with the Hartwick Pines, Houghton Lake, Adair, Fruitport, Hart, Tustin, Higgins Lake, and Richmond Rest Areas, each of which had an overall value index less than 0.30.

RECOMMENDATIONS

As all but three current facilities possess B/C ratios greater than 1.0, implementation of new rest area facilities would likely prove to be economically viable for MDOT. This is particularly true if the facility was to fill an existing gap on the limited access freeway system in southern Michigan, particularly within the Grand or Southwest Region along eastbound I-94 or northbound US-131 or along M-6. Consider also that the availability of commercial service facilities is especially sparse in northeast and northwest Lower Peninsula, and the northern Thumb area, suggesting the potential need for a facility along US-23, M-25, US-31, or M-115 in those areas. Other candidate roadways for additional rest areas or expansion of existing truck parking facilities include the section of I-94 from the Indiana border to Detroit and I-75 from the Ohio border to Saginaw as severe nighttime truck parking capacity issues were noted at both rest

areas and commercial truck stops. Although closure of rest areas is not necessarily recommended due to the positive B/C for nearly all 81 facilities, it appears that the facilities of least value are clustered in the northern and western Lower Peninsula and the Port Huron area, in addition to the Detroit Welcome Center. The rest area value assessment tool software is recommended for use towards assessment of the impacts of adding a new facility or closure of an existing facility.

REFERENCES

1. *MDOT State Long Range Transportation Plan 2005 – 2030 Highway/Bridge Technical Report.* Michigan Department of Transportation, Lansing, MI, November 2006.
2. Michigan Department of Transportation Website, http://www.michigan.gov/mdot/0,1607,7-151-9615-60528--,00.html, Accessed January 2011.
3. Eaves, A., As Some States Close Highway Rest Stops, Others See Roadside Revenue, Stateline: State Policy & Politics, http://www.stateline.org/live/details/story?contentId=501568, Accessed January 2011.
4. Bello, M., States Close Rest Areas to Save Money, *USA Today*, http://www.usatoday.com/travel/2009-07-16-reststop_N.htm, Accessed January 2011.
5. Family Motor Coach Association for Motorhome Owners Website, http://fmca.com/motorhome/motorhome-news/2933-rest-areas-falling-to-budget-cuts, Accessed January, 2011.
6. South Carolina Department of Transportation Website, http://www.scdot.org/artman/publish/article_954.shtml, Accessed January, 2011.
7. Restareahistory.org, http://www.restareahistory.org/Current.html, Accessed January, 2011
8. Times Union NY http://www.timesunion.com/local/article/State-closes-rest-stops-despite-protest-778836.php
9. Virginia Department of Transportation Website, http://www.virginiadot.org/newsroom/statewide/2009/vdot_finalizes_service_area40566.asp, Accessed December, 2010.
10. Virginia Department of Transportation Website, http://www.virginiadot.org/newsroom/statewide/2010/vdot_reopens_first_four45199.asp Accessed December, 2010.
11. Michigan Department of Transportation Website, http://www.michigan.gov/printerFriendly/0,1687,7-151--247561--,00.html, Accessed January, 2011.
12. Federal Highway Administration, "Interstate Oasis Program", FHWA Docket No. FHWA-2006-23550, Federal Register: October 18, 2006 (Volume 71, Number 201), wais.access.gpo.gov, Accessed August 2011.
13. Dornbush, D., and J. Ramey. *Partnership Strategies for Safety Roadside Rest Areas.* Research performed by Dornbush and Associates for the California Department of Transportation, January 2009.
14. United States Code, Title 23, Section 111, United States Congress, 1956.
15. Euritt, M.A., R. Harrison, and S. Grant. *Feasibility of Safety Rest Area Commercialization in Texas: Final Report*. University of Texas – Austin, Center for Transportation Research, Texas DOT, FHWA, Austin, TX, 1992.
16. Kress, E.N. and D.M. Dombusch. Commercialization of Rest Areas in California. In *Transportation Research Record 1326.* Transportation Research Board, Washington D.C., 1991.
17. Phillips, A.W.M. and M.A. Perfater. *Opportunities for the Privatization of Virginia's Rest Areas and Welcome Centers: Final Report.* Virginia Transportation Research Council, Charlottesville, VA, 1991.
18. Petroleum Marketers Association of America. "Interstate Rest Area Commercialization". April 2011.
19. Fitch, G.M., A. Moruza and M. Perfater. *Review of Nonpublic Funding Options to the Virginia Department of Transportation for the Operation and Maintenance of Its Safety Rest*

Areas and Welcome Centers. VCTIR 11-R22. Virginia Transportation Research Council, April 2011.
20. *Rest Area Sponsorship Focus Group.* Cook Research and Consulting, Inc., Minnesota Department of Transportation, St. Paul, MN, 2003.
21. Spokesman Review Website, http://www.spokesmanreview.com/breaking/story.asp?ID=13645. Accessed January, 2011.
22. United States Code, Title 23, Section 301, United States Congress, 1958.
23. Virginia Department of Transportation. "VDOT Safety Rest Area & Welcome Center Sponsorship, Advertising and Vending Enhancement Program". Request for Proposal, RFP #123-ABJ (Revised), VDOT March 21, 2011.
24. VDOT announces public-private partnership to maintain rest areas", Landlinemag.com, http://www.landlinemag.com/todays_news/Daily/2011/Aug11/082911/083111-06.shtml. Accessed September, 2011.
25. Heffernan, J., "Local Firm to Partner on Rest Areas". NVDAILY.com, http://www.nvdaily.com/news/2011/08/local_firm_to_partner_on_rest_areas-print.html. Accessed September, 2011.
26. Dornbusch Associates. *Final Task 5 Report: Strategic Recommendation-Safety Roadside Rest Area Master Plan.* California Department of Transportation, April 2011.
27. Dornbush, D.M., and Company. *Feasibility of Financing Public Information in Rest Area Interactive Kiosks through Private Advertising.* Federal Highway Administration DTFH61-94-00220, June, 1996.
28. Federal Highway Administration, "ACTION: Rest Area Sponsorship Policy Interpretation", FHWA Memorandum, July 8, 2011.
29. Knipling, R.R. and J.-S. Wang, *Crashes and Fatalities Related to Driver Drowsiness/Fatigue*, Washington, DC: National Highway Traffic Safety Administration, 1994.
30. Michigan Office of Highway Safety Planning, Michigan Traffic Crash Facts Data Query Tool, http://www.michigantrafficcrashfacts.org/datatool/build, Accessed January 2011.
31. De Valck, E., and R. Cluydts. *Slow-release caffeine as a countermeasure to driver sleepiness induced by partial sleep deprivation.* Journal of Sleep Research, September, 2001.
32. Taylor, W.C., N. Sung, K. Kolody, and A. Jawad. *A Study of Highway Rest Area Characteristics and Fatigue Related Truck Crashes.* Michigan State University, July 1999.
33. SRF Consulting Group, Inc. "Interstate Highway Safety Study: Analysis of Vehicle Crashes Related to Safety Rest Area Spacing". Minnesota Department of Transportation, July 2007.
34. Banerjee, I., J. Lee, K. Jang, S. Pande, and D. Ragland. *Rest Areas: Reducing Accidents Involving Driver Fatigue.* UC Berkeley Traffic Safety Center, California Department of Transportation, May 2009.
35. Carson, J., V. Pezoldt, N. Koncz, and K. Obeng-Boampong. *Benefits of Public Roadside Safety Rest Areas in Texas: Technical Report.* Texas Transportation Institute, Texas Department of Transportation, May 2011.
36. Vogt C., and D. Holecek. *A Survey of Travel Michigan Welcome Center Visitors*, Michigan Economic Development Corporation, 2010.
37. King, G.F. *Evaluation of Safety Roadside Rest Areas.* NCHRP Report 324. Transportation Research Board, National Research Council, Washington, D.C., 1989.
38. Gardner, P.E. and N. Bosonetto. *Quantifying Roadside Rest Area Usage*. University of Maine, New England Transportation Consortium, University of Connecticut, Storrs, CT, 2002.

39. Byrne, B. *Usage of Three Rest Areas in Vermont (Abridgement)*. In *Transportation Research Record 1326.* Transportation Research Board, National Research Council, Washington, D.C., 1991.
40. Blomquist, D., J. Carson. "Rest Area User Survey". Western Transportation Institute, Montana Department of Transportation, December 1998.
41. Al-Kaisy, A., D. Veneziano, and Z. Kirkemo. *Montana Rest Area Usage: Data Acquisition and Usage Estimation. Final Report.* Western Transportation Institute, Montana Department of Transportation, February 2011.
42. Electronic Code of Federal Regulations Website, http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=/ecfrbrowse/Title49/49cfr395_main_02.tpl, Accessed January, 2011.
43. Chatterjee, A. and F.J. Wegmann. Overnight Truck Parking Along Tennessee's Interstate Highways and Rest Areas. In *Transportation Research Record 1734.* Transportation Research Board, National Research Council, Washington, D.C., 2000.
44. Davis, R. Commercial Driver Rest and Parking Requirements: Making Space for Safety. In *Transportation Research Record 1595.* Transportation Research Board, National Research Council, 1997.
45. *Commercial Driver Rest Area Requirements: Making Space for Safety*. Federal Highway Administration United States Department of Transportation, Washington, D.C., 1996.
46. *Rest Area Forum: Summary of Proceedings*. Federal Highway Administration. United States Department of Transportation, Washington, D.C., 1999.
47. Fleger, S., et al. *Study of Adequacy of Commercial Truck Parking Facilities-Technical Report.* Science Applications International Corporation, Federal Highway Administration, March 2002.
48. National Highway Traffic Safety Administration. *Traffic Safety Facts: Crash Stats – Drowsy Driving* (DOT HS 811 449), United States Department of Transportation, http://www-nrd.nhtsa.dot.gov/Pubs/811449.pdf, 2011, Accessed January 2012.
49. Knipling, R. R., & Wang, J. S. Revised Estimates of the U.S. Drowsy Driver Crash Problem Size Based on General Estimates System Case Reviews, *Proceedings of the 39th Annual Meeting of the Association for the Advancement of Automotive Medicine*, p.451-466, 1995
50. Smith, M., Oppenhuis, M., and G. Koorey. Crash Data Collection: Is it Time for a Rethink of the Process?, *International Transport Forum*, 2006.
51. Washington, S. P., Karlaftis, M. G., and F.L. Mannering. *Statistical and Econometric Methods for Transportation Data Analysis*, 2nd edition. Boca Raton, FL: Chapman & Hall/CRC, 2011.
52. Federal Highway Administration. *TechBrief: Safety Evaluation of Improved Curve Delineation*, FHWA-HRT-09-046, 2009.
53. Council, F., Zaloshnja, E., Miller, T., and B. Persaud. *Crash Cost Estimates by Maximum Police-Reported Injury Severity within Selected Crash Geometries,* FHWA-HRT-05-051, Federal Highway Administration, McLean, VA, 2005.
54. Winfrey, R. *Economic Analysis for Highway.* International Textbook Company, Scranton, PA, 1969.
55. Barnes, G. and P. Langworthy, *The Per-Mile Costs of Operating Automobiles and Trucks,* Final Report, University of Minnesota, Minnesota Department of Transportation, June 2003.
56. Average cost for a gallon of gasoline in Michigan in January 2012, www.gasbuddy.com, accessed January 2012.
57. Average cost for a gallon of diesel in Michigan in January 2012, http://www.truckmiles.com/FuelPrices.asp, accessed January 2012.

58. United States Bureau of Labor Statistics (BLS), *Consumer Price Index for All Urban Consumers (CPI-U) - U.S. City Average by Month and Year*, ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt, accessed January 2012.
59. United States Bureau of Transportation Statistics (BTS), *Average Fuel Efficiency of U.S. Light Duty Vehicles*, accessed January 2012. http://www.bts.gov/publications/national_transportation_statistics/html/table_04_23.html
60. United States Department of Transportation, *Revised Departmental Guidance for the Valuation of Travel Time in Economic Analysis,* Washington D.C., 2003.
61. United States Bureau of Labor Statistics (BLS), *Employer Costs for Employee Compensation – September 2011.* http://www.bls.gov/news.release/ecec.nr0.htm, accessed January 2012.
62. United States Bureau of Labor Statistics (BLS), *May 2010 National Occupational Employment and Wage Estimates.* http://www.bls.gov/oes/current/oes_nat.htm#00-0000, accessed January 2012.
63. United States Census, *Table H-6. Regions-by Median and Mean Income.* http://www.census.gov/hhes/www/income/data/historical/household/, accessed February 2012.

APPENDIX

Table A. Responses to Virginia DOT's Survey of Public Rest Area Funding (*19*)

State	Does your DOT currently have closed rest areas as a result of funding shortages?	What actions has your state taken to supplement revenues supporting maintenance and operations at rest areas?	Have you considered charging user fees for the use of rest areas?	Although currently prohibited, is your state interested in commercializing interstate rest areas?	What other actions considered by your DOT to financially support rest areas have been prevented by state or federal code and/or organized opposition?
Arkansas	No	None	No	None	None
California	No	None	No	Yes. Modeling a new commercialized rest area after the Oasis program. Piloting 6 locations for partnered facilities.	Attempted a private partnership to provide digital advertising with rest areas, unsuccessful.
Florida	No	Began using asset management contracts	No	Considering piloting RA sites off-interstate at an interchange	None
Idaho	No	None	No	None	None
Illinois	No	None	No	Yes	Privatization, Advertising, expanded vending
Iowa	No	None	No	None	None
Kentucky	No	None	No	None	None
Louisiana	Yes, 23 of 34 RA's	None	No	Yes	None
Mississippi	No	Included in Budget		None	None
Missouri	No	None	No	Yes	Privatization
Montana	No	Developing an asset management approach to allocate "set-aside" funding. Experimented with contracted maintenance services	No	None	None
New Mexico	No	None	No	Attempted partnership with Native American tribe, but federal regulations prohibited the project	None
Ohio	No	Investigated on site advertising	No	Possibly. Have investigated developments outside ROW	None
Washington	No	No	No	Potentially. Have explored commercialization for electric vehicle charging and alternative fueling, but determined a fee system would not work	None
Utah	No	None	No	Several Rest stops are maintained through public-private partnerships. Implemented a program similar to Interstate Oasis Program. Also supports commercialization/privatization	None
West Virginia	No	None	No	Interested, but have not explored.	None
Wisconsin	Yes (one RA along I-94)	Implemented cost cutting by reducing services, staffing, and deferring larger scale maintenance and repairs.	No	Interested, but not explored. Pursuing rest area travel literature distribution contracts with private vendors.	Public/Private partnerships, commercial products/services and commercial advertising.

Table B. Responses to Virginia DOT's Survey of Commercial Truck Parking Policies (*19*)

State	Does your state allow overnight truck parking at public rest areas	Is there a charge for overnight parking?	What driver amenities are available?	Is electrification available for truck idling reduction?	Are vehicles documented to help compliance with hours of service regulation?	Is law enforcement provided?
Florida	Yes	No	Restroom, vending	No	No	Nighttime security
Iowa	Yes	No	Restroom, vending, kiosks, free wireless internet, maps	No	NR	No
Indiana	Yes	No	Restrooms, vending, water fountain	No	No	No
Kansas	Yes	No	Restrooms	No	No	Drive-by
Louisiana	No	No	Restroom, vending	No	No	Yes
Maryland	Yes	No	Restroom, vending	No	No	Drive-by
Minnesota	Yes	No	Restroom, vending	No	No	No
Missouri	Yes	No	Restroom, vending	No	No	Drive-by
Mississippi	No	No	Restroom, dump station	No	No	Yes
Montana	Yes	No	Restroom, weather info	No	Yes	No
North Dakota	Yes	No	Restroom	No	No	No
Nebraska	Yes (10 hr limit)	No	Restroom	No	No	No
New Jersey	Yes	No	Restroom	No	No	No
Ohio	No (3 hr limit)	No	NR	NR	NR	NR
Pennsylvania	No (2 hr limit)	NR	NR	NR	NR	NR
Texas	Yes	NR	None	No	No	No
Washington	Yes (8 hr limit)	No	Restroom, vending	No	No	Yes
West Virginia	Yes (6 hr limit)	No	Restroom, vending	No	No	No
Wisconsin	Yes	No	Restroom, vending	No	No	Drive-by

NR = No Response

Table C. Commercial Truck Stops and Rest Areas by MDOT Region and Route

Region	Route	Number of Commercial Truck Stops*	Number of Rest Areas
Bay	I-75	11	5
	US-127	9	2
	I-69	3	2
	US-23	0	1
	Other	18	0
Grand	US-131	11	3
	I-96	7	4
	US-31	2	3
	I-196	1	1
	Other	10	0
Metro	I-94	16	4
	I-75	10	3
	I-275	6	1
	I-69	3	1
	Other	14	0
North	I-75	9	9
	US-131	7	2
	US-31	5	1
	US-127	1	2
	Other	12	0
Southwest	I-94	24	5
	US-131	7	1
	I-69	3	2
	I-196	3	2
	Other	11	0
Superior	US-2	18	5
	US-41	8	2
	M-28	6	1
	I-75	3	3
	Other	5	0
University	US-23	9	2
	I-96	8	4
	I-94	6	3
	I-75	5	1
	I-69	3	2
	US-127	2	3
	I-275	1	1
	Other	4	0
STATEWIDE	ALL	281	81

*Each facility includes diesel fuel, food, and truck parking at a minimum

SURVEY OF MICHIGAN REST AREA USERS

1. What is the primary purpose of this trip? (check one)

☐ work ☐ vacation/recreation ☐ personal business ☐ bus tour ☐ truck haul route ☐ other_____

2. Type of vehicle (check one)

☐ passenger vehicle ☐ motorcycle ☐ RV or passenger vehicle towing trailer ☐ commercial truck ☐ tour bus

3. Trip start point: City_____ State_____ **Trip end point:** City_____ State_____

4. Please indicate: Gender: ☐M ☐F Age: _____ **#** People in Vehicle:_____ Traveling w/Children? ☐Y ☐N

5. Over the past 12 months, how many times have you:

Stopped at This Rest Area: ☐ first time ☐ 2 – 5 ☐ 6 – 10 ☐ 11 – 25 ☐ 26 - 50 ☐ more than 50

Stopped at Any Michigan Rest Area: ☐ first time ☐ 2 – 5 ☐ 6 – 10 ☐ 11 – 25 ☐ 26 - 50 ☐ more than 50

6. Since your most recent stop today:

How long have you been on the road? ☐ under 1 hr ☐ 1 – 2 hrs ☐ 2 – 3 hrs ☐ 3 – 4 hrs ☐ over 4 hrs

How much longer will you be on the road? ☐ under 1 hr ☐ 1 – 2 hrs ☐ 2 – 3 hrs ☐ 3 – 4 hrs ☐ over 4 hrs

7. Please indicate your reason(s) for stopping at this Rest Area today (check all that apply)

☐ use restroom ☐ stretch, walk, take break ☐ sleep ☐ picnic ☐ pet relief ☐ use vending machine

☐ break for children ☐ check vehicle ☐ out of hours ☐ change drivers ☐ tourist/travel info ☐ other:_____

8. Why did you choose to stop at this Rest Area today rather than a nearby private facility, such as a gas station, fast food restaurant, or truck stop? (check all that apply)

☐ quick access from highway ☐ parking availability ☐ cleanliness of facilities ☐ nearest available option

☐ no need for additional services (fuel, meal, etc.) ☐ safety/security ☐ unsure of private facilities in the area

☐ need to rest ☐ traveling with pets ☐ traveling with children ☐ tourist/travel information ☐ other_____

9. When traveling, do you prefer stopping at a Rest Area or comparable private facility for the following purposes:

Use restroom:	☐ Prefer Rest Area	☐ No Preference	☐ Prefer Private Facility	
Eat meal:	☐ Prefer Rest Area	☐ No Preference	☐ Prefer Private Facility	
Have snack/refreshments:	☐ Prefer Rest Area	☐ No Preference	☐ Prefer Private Facility	
Short break/stretch/walk:	☐ Prefer Rest Area	☐ No Preference	☐ Prefer Private Facility	
Long rest/sleep:	☐ Prefer Rest Area	☐ No Preference	☐ Prefer Private Facility	
Check vehicle:	☐ Prefer Rest Area	☐ No Preference	☐ Prefer Private Facility	
Pet relief:	☐ Prefer Rest Area	☐ No Preference	☐ Prefer Private Facility	☐ Not Applicable
Break for children:	☐ Prefer Rest Area	☐ No Preference	☐ Prefer Private Facility	☐ Not Applicable

10. On a scale of 1 (very unsatisfied) to 5 (very satisfied), how satisfied are you with Michigan Rest Areas (circle one)?

1 2 3 4 5

11. What value (in dollars) would you place on the services utilized during this stop:

☐ $0 ☐ $0.01 - $0.25 ☐ $0.25 - $1 ☐ $1 - $2 ☐ $2 - $3 ☐ $3 - $5 ☐ more than $5

TRUCKERS SEE REVERSE

COMMERCIAL TRUCK/BUS DRIVERS ONLY

Please provide the following information:

Have you experienced a lack of available parking at a rest area and were unable to use the facilities? ☐ Y ☐ N

Have you parked on the ramps due to a lack of adequate truck/bus parking? ☐ Y ☐ N

Truck/Bus company_____

Shipper/Origin Info: Name_____City/town_____State_____

Receiver/Destination Info: Name_____City/town_____State_____

Please provide any additional comments in the space below:

Office Use Only:

Survey No:	Rest Area:	Date:	Time:	Surveyor Initials:

Telephone Interview Question for Commercial Truck Stops

Survey Questions for Truck Stop Manager On-Duty:

1. How many truck parking spaces exist at your facility?
2. During a typical weeknight, what is the approximate percentage of truck parking spaces that are occupied during peak nighttime hours?
3. How many times per week does the truck parking area overflow at night?
4. Do you believe that there is a truck parking shortage along this highway?
5. Do you believe that the State of Michigan should open more public rest areas along this highway?
6. Do you believe that the State of Michigan should close selected public rest areas along this highway?

Table D. I-69 Responses

CITY	NAME	Q. 1	Q. 2	Q. 3	Q. 4	Q. 5	Q. 6	Comments
EMMETT	SUNRISE C-STORE	40		0		yes	no	Overflows w/ bad weather
EMMETT	BISCO'S TS	50	75	0	yes	yes	no	
PERRY	GILIZY RITX TRUCK PLAZA	75	80	0	yes	No	no	Expand exist lots
CAPAC	EXPRESS FOOD DEPOT BP	10	50-60	2	yes	yes	no	

Table E. I-75 Responses

CITY	NAME	Q. 1	Q. 2	Q. 3	Q. 4	Q. 5	Q. 6	Comments
GRAYLING	CHARLIE'S COUNTRY CORNER	75	33	2	no	no	no	
SAGINAW	M-81 EXPRESS	75	80	0		yes	no	
SAGINAW	FLYING J	50	35	0	no	no	no	
DETROIT	US FUEL MART	10-15	50	3	yes	yes	no	
ST. IGNACE	ST. IGNACE TRUCK STOP	80	25-30	0	no	yes	no	overflows when bridge closes
BIRCH RUN	BIRCH RUN EXPRESS STOP	20	50	0	no	yes	no	
BIRCH RUN	FAST PAX	20	10	0	no	no	no	
MONROE	PILOT	20	100	7	yes	yes	no	
GAYLORD	SOUTH END MARATHON	8	50	0	no	no	yes	
WEST BRANCH	7-11 MARATHON	4	0	0	yes	yes/ no	yes/no	
SAULT SAINT MARIE	HOLIDAY TRAVELCENTERS	6	50	0	no	no	no	
WEST BRANCH	JAXX SNAXX WEST BRANCH	12-15	40	2	yes	no	no	Easy on/Easy off
SAULT SAINT MARIE	ADMIRAL SHIP STORE		50	0	no			

Table F. I-96 Responses

CITY	NAME	Q. 1	Q. 2	Q. 3	Q. 4	Q. 5	Q. 6	Comments
GRAND LEDGE	FLYING J	150	100	0	No	no	yes	I-96 R.A are almost empty
WEBBERVILLE	NADAS MOBIL	30	50	0	Yes	yes	no	
GRAND LEDGE	POHL OIL	25-30	100	3	Yes	yes	no	
PORTLAND	SPEEDWAY	15	40	0	no	yes	no	
IONIA	PILOT	15	95	5				

Table G. I-94 Responses

CITY	NAME	Q. 1	Q. 2	Q. 3	Q. 4	Q. 5	Q. 6	Comments
NEW BUFFALO	PLAZA 1 TRUCK STOP	30	75	0	yes	yes	no	
BENTON HARBOR	FLYING J	300	variable	4	no	yes	no	
DEXTER	PILOT	80	100	5	no	no	no	
MARSHALL	LOVES	110	100	4	no	no	yes	
JACKSON	I-45 AUTO/TRUCK PLAZA	55	100	4	no	no	no	Never overflowing (trucks will pass by)
MATTAWAN	SPEEDWAY	40	70	1-2	yes	yes	no	
PAW PAW	ROAD HAWK TRAVEL CENTER	50	75		yes	yes	no	
SAWYER	DUNE'S A/T PLAZA	30	75	2	yes	yes	no	
BATTLE CREEK	PILOT	30	90-100	2-3	no	yes	no	
BENTON HARBOR	PRI MAR FUEL CENTER	20	100	1	no	no	no	Truckers prefer to park here, More signage too
ADAIR	257 BP	5	100	0	no	yes	no	

Table H. Facility Raw Data Values for Value Assessment Factors

FACILITY NAME	Truck/ RV Parking Spaces	Ability to Expand Truck Parking	Unique Site Character-istics	Winter Closure	Truck Enforce-ment	Build-ing Age (yrs)	Sanitary Sewer Type	Number of Truck Stops within 20 mi	Number of Fast Food/Gas Stations within 20 mi	Dist to Nearest RA (mi)	Turn-in Rate	B/C Ratio
Adair	28	0	0	0	0	4	0	9	74	94	3.27%	3.12
Alamo	21	0	0.5	0	1	14	0.5	4	42	56	2.86%	3.81
Alger	14	0	0	0	1	3	0.5	4	16	33	7.28%	3.23
Battle Creek	24	0	0.5	0	1	30	1	13	64	39	5.84%	8.06
Bay City	30	0	0	0	0	32	1	5	34	28	4.30%	5.77
Belleville	43	0	0	0	1	4	1	2	170	39	1.84%	6.62
Big Rapids	24	1	0	0	1	22	0.5	5	12	33	5.15%	3.51
Cadillac	9	0.5	0.5	0	0	7	0.5	4	8	52	8.19%	3.04
Capac	25	0.5	0	0	1	22	0	6	12	31	8.31%	2.72
Carleton	22	0	0.5	0	0	33	1	9	26	65	3.64%	2.98
Chelsea	39	0	0	0	0	5	0.5	3	73	26	4.30%	8.62
Clare WC	48	0	1	0	1	18	1	6	33	27	8.38%	11.66
Clarkston	21	0	0	0	0	8	0.5	1	63	36	3.43%	6.56
Clio	25	0	0	0	1	18	1	9	77	28	2.39%	5.38
Coldwater WC	26	0	1	0	1	8	1	6	19	62	8.73%	6.31
Davisburg	23	0	0	0	0	21	0.5	2	67	33	3.02%	5.35
Detroit WC	6	0	1	0	0	3	1	9	220	37	0.29%	1.27
DeWitt	16	0.5	0.5	0	1	11	0	1	20	38	4.99%	3.44
Dodge Rd.	41	1	0.5	0	1	16	1	10	75	33	2.89%	5.18
Dundee WC	22	0	1	0	1	44	0	6	14	74	4.82%	5.78
Fenton	20	0	0	0	1	6	1	4	50	24	3.71%	5.64
Five Lakes	21	1	0.5	0	1	24	0.5	4	30	35	6.53%	4.53
Fruitport	18	0	0	0	0	7	0.5	1	36	33	3.42%	2.41
Galesburg	38	0.5	0.5	0	1	25	1	14	67	28	3.67%	6.57
Garden Corners	5	0	0.5	0	0	11	0.5	5	9	64	5.93%	2.70
Gaylord	14	0	0	0	1	35	0.5	4	27	25	5.86%	2.66
Glenn	17	0	0.5	0	1	1	0	1	17	30	9.93%	6.53
Grand Ledge	25	0	0.5	0	0	0	0	10	44	24	3.37%	4.72
Grass Lake	21	0	0.5	0	0	3	0.5	3	45	36	3.59%	5.86
Grayling	23	1	0.5	0	0	18	0.5	4	9	25	6.06%	3.60
Hart	0	0	0.5	1	0	32	0.5	1	16	23	4.23%	0.99
Hartwick Pines	20	0	0.5	0	0	1	0.5	5	26	25	4.38%	1.86
Hebron	0	0	1	1	0	32	0.5	1	23	10	6.90%	1.05
Higgins Lake	16	0	0	0	0	36	0.5	2	12	22	6.41%	1.17
Houghton Lake	17	0	0	0	1	36	0.5	4	14	26	7.83%	1.45
Howell	21	0	0	0	0	6	0.5	3	57	48	4.50%	6.82
Iron Mountain WC	5	0	1	0	0	27	1	2	23	87	0.83%	4.14
Ironwood WC	7	0	1	0	0	47	1	7	15	99	3.32%	1.91
Ithaca	15	0	0	0	0	18	1	2	20	39	4.86%	2.94
Jackson	21	0	0	0	1	9	0.5	1	46	38	4.03%	2.46
Lake Chemung	21	0	0	0	1	44	1	4	70	30	3.21%	6.11
Lansing	20	0	0.5	0	1	44	0.5	0	41	48	2.59%	3.34
Linwood	21	0	0	0	1	10	1	1	14	35	7.82%	4.40
Ludington	11	1	0	1	0	20	0.5	1	10	28	5.74%	1.50
Mackinaw City WC	11	0	1	0	0	33	1	1	15	6	4.08%	2.74
Marquette WC	6	0	1	0	0	23	1	3	23	75	1.24%	3.06

Table H. Facility Raw Data Values for Value Assessment Factors (Continued)

FACILITY NAME	Truck/ RV Parking Spaces	Ability to Expand Truck Parking	Unique Site Character-istics	Winter Closure	Truck Enforce-ment	Build-ing Age (yrs)	Sanitary Sewer Type	Number of Truck Stops within 20 mi	Number of Fast Food/Gas Stations within 20 mi	Dist to Nearest RA (mi)	Turn-in Rate	B/C Ratio
Marshall	25	0	0.5	0	1	4	1	14	44	28	4.81%	5.35
Menominee WC	0	0	1	0	0	29	1	2	12	92	1.03%	3.29
Monroe WC	46	0	1	0	0	6	1	8	34	37	5.33%	10.42
Morley	20	1	0.5	0	1	24	0.5	4	11	52	7.19%	4.04
Muskegon	14	0	0	0	1	7	0.5	0	40	23	3.96%	2.60
Naubinway	6	0	1	0	0	20	0.5	0	3	39	10.50%	4.13
New Buffalo WC	35	1	1	0	0	21	1	6	18	96	8.63%	8.27
Nine Mile Hill	14	0.5	0	0	0	6	0.5	3	7	27	6.83%	1.48
Northfield Church	21	0	0	0	1	1	1	4	47	57	3.48%	7.57
Okemos	45	0	0	0	0	0	0.5	6	40	30	4.20%	5.80
Port Huron WC	7	0	1	0	0	44	0.5	6	24	24	2.64%	3.65
Portland	40	0.5	1	0	0	8	1	8	19	32	7.21%	6.87
Potterville	25	0.5	0.5	0	1	10	1	2	34	58	5.08%	4.84
Richmond	20	0	0	0	0	41	0	8	94	24	2.85%	1.93
Rockford	23	0	0	0	1	5	0.5	6	72	37	3.75%	3.92
Rothbury	20	0.5	0.5	0	0	33	0.5	1	25	28	8.58%	2.29
Saint Ignace RA	12	0.5	1	1	0	32	0.5	2	13	10	2.49%	0.78
Saint Ignace WC	15	0.5	1	0	0	23	1	2	14	6	7.96%	4.50
Sandstone	22	0	0	0	0	3	1	6	39	26	5.76%	5.35
Saranac	24	0	0.5	0	1	26	1	4	18	24	5.12%	5.19
Saugatuck	19	0.5	0.5	0	1	32	0.5	1	18	47	4.47%	4.27
Sault Ste Marie RA	16	0.5	1	0	0	33	0.5	2	8	45	5.12%	1.11
Sault Ste Marie WC	11	0	1	0	0	24	1	2	10	46	6.55%	1.57
Seney	6	0.5	0.5	0	0	12	1	0	2	80	12.71%	3.40
Swartz Creek	19	0	0.5	0	1	2	1	2	69	35	4.60%	5.14
Topinabee	9	0.5	1	1	0	35	0.5	0	13	21	5.56%	1.00
Turkeyville	22	0	0	0	1	5	0	3	18	61	8.39%	6.98
Tustin	5	0	0	0	1	None	0	6	18	33	2.64%	2.25
Vanderbilt	16	0	0.5	0	1	35	0.5	4	29	25	4.46%	1.89
Walker	15	0	0.5	0	0	10	1	2	63	38	2.69%	3.61
Watervliet	39	0.5	0	0	1	17	1	5	45	43	6.38%	5.48
West Branch	11	0.5	0	0	0	10	0.5	3	14	35	9.24%	2.66
Westland	29	0	0	0	0	34	1	7	68	33	1.47%	5.77
Woodbury	24	0.5	0.5	0	0	16	0.5	3	22	61	5.29%	5.32
Zeeland	44	0	0	0	1	2	0	3	68	30	3.31%	4.51