NCTR
NATIONAL CENTER for
TRANSIT RESEARCH

Impact of Transportation Demand Management (TDM) Elements on Managed Lanes Toll Prices

BDV26 977-02

March 2015

FINAL REPORT

PREPARED FOR
Florida Department of Transportation

National Center for Transit Research
Center for Urban Transportation Research
University of South Florida
www.nctr.usf.edu

Disclaimer

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the State of Florida Department of Transportation."

Metric Conversion

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		Note: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or metric ton)	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C

Technical Report Documentation

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
n/a		

4. Title and Subtitle	5. Report Date
Impact of Transportation Demand Management (TDM) Elements on Managed Lanes Toll Prices	March 2015
	6. Performing Organization Code
7. Author(s) Brian Pessaro, AICP, Patrick Buddenbrock, EI	8. Performing Organization Report No.
9. Performing Organization Name and Address National Center for Transit Research Center for Urban Transportation Research (CUTR) University of South Florida 4202 E. Fowler Ave., CUT 100 Tampa, FL 33620-5375	10. Work Unit No. (TRAIS) 11. Contract or Grant No. BDV26 977-02
12. Sponsoring Agency Name and Address Florida Department of Transportation Research Center 605 Suwannee Street, MS 30 Tallahassee, FL 32399-0450	13. Type of Report and Period Covered Final Report, March 2015 14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This research involved a simulation comparing three days of actual traffic data for the I-95 Express Lanes and General Purpose Lanes in Miami, Florida to a hypothetical scenario where all transportation demand management (TDM) activities and toll exemptions were eliminated. The purpose of the research was to quantify the extent to which carpooling, vanpooling, and transit usage contribute to better traffic flow in the I-95 corridor. The express lane analysis revealed a slight degradation in level of service (LOS) and a moderate increase in tolls in the southbound direction (+$0.41). It revealed a slight improvement in LOS and a slight decrease in tolls in the northbound direction (-$0.19). A phenomenon that occurred was that a large number of inherently low emission vehicles (ILEVs), which are toll exempt, opted out of the express lanes in the hypothetical scenario. The increase in express lane volume from former carpoolers, vanpoolers, and transit riders reverting to single occupant status was often offset by even larger volumes of ILEVs leaving the express lanes. Although the traffic impact to the express lanes was mild, the impact to the general purpose lanes was more severe. In the hypothetical scenario, the general purpose lanes operated at LOS F 22 percent more of time in the southbound direction and 8 percent more of the time in the northbound direction. Furthermore, the traffic densities in the general purpose lanes increased 100 percent of the time in the southbound direction and 94 percent of the time in the northbound direction.

17. Key Words: Managed Lanes, transit, carpooling, tolls	18. Distribution Statement

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified		

Executive Summary

This research involved a simulation comparing three days of observed traffic data for the I-95 Express Lanes and General Purpose Lanes in Miami, Florida to a hypothetical scenario where all transportation demand management (TDM) activities and toll exemptions were eliminated. The purpose of the research was to quantify the extent to which carpooling, vanpooling, and transit usage contribute to better traffic flow in the I-95 corridor. The express lane analysis revealed a slight degradation in level of service (LOS) and a moderate increase in tolls in the southbound direction (+$0.41). It revealed a slight improvement in LOS and a slight decrease in tolls in the northbound direction (-$0.19). A phenomenon that occurred was that a large number of inherently low emission vehicles (ILEVs), which are toll exempt, opted out of the express lanes in the hypothetical scenario. The increase in express lane volume from former carpoolers, vanpoolers, and transit riders reverting to single occupant status was often offset by even larger volumes of ILEVs leaving the express lanes. Although the traffic impact to the express lanes was mild, the impact to the general purpose lanes was more severe. In the hypothetical scenario, the general purpose lanes operated at LOS F 22 percent more of time in the southbound direction and 8 percent more of the time in the northbound direction. Furthermore, the traffic densities in the general purpose lanes increased 100 percent of the time in the southbound direction and 94 percent of the time in the northbound direction.

Table of Contents

List of Figures

List of Tables

Chapter 1 Introduction

The I-95 Express Lanes in Miami, Florida are dynamically tolled managed lanes. Single occupant vehicles (SOVs) must pay a toll to use the lanes. Registered 3+ carpools, vanpools, motorcycles, inherently low emission vehicles (ILEVs), and transit buses are exempt from the tolls. Transit and transportation demand management (TDM) activities play an important role in the operation of both the express and general purpose lanes by increasing person throughput and improving traffic flow.

Initial sketch planning done by the Florida Department of Transportation (FDOT) showed that roadway level of service (LOS) in the general purpose lanes would be degraded were it not for the transit and TDM components in the express lanes. The National Center for Transit Research (NCTR) took this sketch planning a step further. The research approach used was to compare three days of observed traffic and toll data (April 8-10, 2014) to simulated traffic and toll data under a hypothetical scenario where there were no toll exemptions or express bus service.

The research involved several tasks. The first task involved assembling all of the traffic and toll data into 15-minute increments by direction for both the express and general purpose lanes for the three days of analysis. This was relatively easy to do since the FDOT already collects a large amount of traffic and toll data in the I-95 corridor. Each 15-minute increment included data on the average speed, volume, and level of service (LOS), the average toll amount in the express lanes, the number of transit riders, the number of registered high occupancy vehicles (HOVs), and the number of registered ILEVs. The second task involved surveying riders of the I-95 Express Bus Service, registered carpoolers and vanpoolers, and registered ILEVs owners to ask them how they would travel if there was no express bus service or toll exemptions. The third step involved using the survey data to make adjustments to the actual traffic volumes in the express and general purpose lanes. The changes in volumes led to changes in speeds, traffic densities, and in the case of the express lanes, changes in toll amounts. The fourth and final step involves comparing the two datasets (the actual and the hypothetical) to see what impacts occurred.

Chapter 2 Literature Review

The Federal Highway Administration (FHWA) reports that there are a total of 345 HOV facilities in the United States (Federal Highway Administration, 2008). However, the carpool rate has been dropping for decades. Most recently, carpooling declined from 10.7 percent in 2003 to 9.7 percent in 2012 both in Florida and nationwide (Florida Department of Transportation, 2013). With carpool rates having dropped, HOT lanes have evolved as a way to make better use of unused capacity (Swisher, Eisele, Ungemah, & Goodin, 2003). In HOT lanes, carpools and transit use the facility for free while other vehicles pay a toll to take advantage of the excess capacity. The minimum occupancy requirement can vary. Some HOT facilities allow HOV-2's to use the facility for free while others only allow free access for HOV-3's. Some require HOVs to register, but most do not have this requirement. Table 2-1 shows the HOV policies for 11 HOT facilities in the U.S.

Table 2-1 HOV Toll Policies on HOT Lanes

	I-95	I-15	I-10	I-110	I-15	I-10	I-85	I-394	I-35W	I-25 CO	SR 167
	FL	CA	CA	CA	UT	TX	GA	MN	MN	CO	WA
HOV-2 toll	☑	☐	☑	☐	☐	☑	☑	☐	☐	☐	☐
HOV-2 free	☐	☑	☐	☑	☑	☑	☐	☑	☑	☑	☑
HOV-3+ toll	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
HOV-3+ free	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Registration requirement	☑	☐	☑	☑	☐	☐	☑	☐	☐	☐	☐

Sources: Agency websites

Note: HOVs on the I-10 Katy Managed Lanes in Houston are allowed to use the lanes for free between 5 and 11 am and 2 to 8 pm Monday through Friday. At all other times, they must pay the toll.

Almost all of the HOT facilities allow HOV-2's to use the lanes for free. Other than the I-95 Express Lanes in Miami, the only other HOT lanes that require HOV-2's to pay a toll are the I-10 Express Lanes in Los Angeles, the I-10 Katy Managed Lanes in Houston, and the I-85 Express Lanes in Atlanta. The HOV policy of the I-10 Katy Managed Lanes requires further explanation. All HOVs are allowed to use the HOT lanes for free during the peak hours. They only have to pay a toll during non-peak hours. The peak hours are 5 to 11 a.m. and 2 to 8 p.m. Monday through Friday. The only HOT facilities besides the I-95 Express Lanes that have registration requirements for HOVs are the I-110 and I-10 Express Lanes in Los Angeles and the I-85 Express Lanes in Atlanta. A brief history of a few of the HOT lanes in Table 2-1 follows.

In 1996, the San Diego Association of Governments (SANDAG) and Caltrans converted the HOV lanes on an 8-mile stretch of I-15 into HOT lanes. From 1996 to 1998, single occupant drivers were charged a monthly fee for unlimited usage of the I-15 Express Lanes. In 1998, the switch was made to variable dynamic pricing. The Inland Breeze was the name of the bus service initiated on the I-15 Express Lanes and was funded by the toll revenues. This congestion pricing project was formally evaluated by San Diego State University (SDSU). The evaluation reported that ridership on the Inland Breeze increased by 9 percent during the study period while ridership in the entire region increased 23 percent. Surveys showed that most of the Inland Breeze passengers were captive riders who had switched from other bus routes and were traveling in the reverse commute direction (Supernak, Brownstone, Golob, Kaschade, Kazimi, & Steffey, 2001).

Another early HOT project was the I-394 MnPass lanes in Minneapolis. They opened in 2005, and like the I-15 Express Lanes were an HOV to HOT conversion. Lee Munnich from the Hubert H. Humphrey Institute of Public Affairs at the University of Minnesota and Kenneth Buckeye from the Minnesota Department of Transportation reported on nine issues and outcomes of the I-394 MnPass project. Issue 8 was the concern that transit riders and carpoolers might suffer due to the adaption from HOV to HOT if there was a level of service (LOS) degradation. They reported that the I-394 MnPass project had no negative impacts on transit riders or carpoolers. The preliminary data indicated that transit usage in the I-394 corridor had improved more than that of the control corridor on I-35W. They reported also that transit users supported the idea of allowing solo drivers into the lane for a fee (Munnich & Buckeye, 1996).

A 2008 study by Katie Turnbull of the Texas Transportation Institute examined the impacts on transit that resulted from the conversion of HOV lanes into HOT lanes. The paper looked specifically at the experience with HOT lanes on I-15 in San Diego, I-394 in Minneapolis, and I-25 in Denver. Turnbull noted that transit was an important component in the I-394 and I-25 projects but was not as important a component in the I-15 project originally. On I-15 in San Diego, most of the bus ridership was initially in the reverse commute direction. To better serve peak direction commuter trips, the transit service plan was revised in 1999. There are now four express bus routes that operate in the I-15 Express Lanes, and bus riders account for 10 to 11 percent of the Express Lane users. On I-394 in Minneapolis, ridership levels remained relatively constant from 2005 until 2007. The report states that bus ridership growth on I-394 was limited due to constraints at the park and ride lots, most of which were at capacity. In Denver, approximately 10,400 bus passengers use the I-25 HOT lanes daily (at the time of the report). Buses on the I-25 HOT lanes account for only 2 percent of the vehicles but 25 percent of the people (Turnbull, 2008). This fact helps to illustrate why transit is an important component of HOT lane operations

The I-10 Katy Freeway in Houston is an interesting case study of changes in HOV requirements. The Katy Freeway HOV lane opened in 1984. At first, usage was restricted to buses and vanpools. Between 1984 and 1987, the restrictions were relaxed to include 4+ carpools, 3+ carpools, and finally 2+ carpools; however the HOV lanes were over capacity by 1988. Consequently, the Metropolitan Transit Authority of Harris County (METRO) raised the occupancy requirement to 3+ during the p.m. peak period. Then in 1998, METRO implemented the QuickRide Program that allowed 2+ carpools to access the Katy HOV lane for a flat $2 per trip fee. Studies of the new policy conducted by the Texas Transportation Institute showed that half of the 2+ carpools that enrolled in the QuickRide Program formed from SOVs in the general purpose lanes. In 2003, construction began on the Katy Managed Lanes (KML), which became fully operational in 2009. The KML is two lanes in each direction. They were originally planned as HOT-3+ meaning all vehicles with less than three passengers would have to pay the toll. Six months prior to opening, METRO decided to lower the occupancy requirement due to public pressure. The current policy is that all HOVs may use the KML for free during peak hours from 5 to 11 a.m. and 2 to 8 p.m. Monday through Friday. During non-peak hours, HOVs must pay the toll just like SOVs. There is no registration requirement for HOV vehicles. During the peak periods, the inside managed lane is designated as the HOV lane, and the outside managed lane is designate as the toll lane. Since the KML opened in 2009, traffic volumes have more than doubled in both the peak hour and peak period. Although HOV volumes have increased slightly, the majority of the growth has come from the toll lane (Goodin, Briefing Paper: Toward a Best Practice Model for Managed Lanes in Texas, 2013).

The formal evaluation of the Urban Partnership Agreements (UPAs) has provided the most up to date research on the impacts to public transit from priced managed lanes. In 2010, early results of transit user perceptions of the I-95 HOT lanes in Miami were reported in the Journal of the Transportation Research Board. Pre- and post-deployment surveys of the bus riders showed that the I-95 bus service was already highly rated when the Express Lanes were HOV and that the service ratings increased even further after the HOT conversion. Furthermore, the surveys showed that the ratings for travel time and service reliability improved by margins that were statistically significant at the 99 percent and 95 percent confidence levels, respectively (Cain, Van Nostrand, & Flynn, 2010). More recent transit results from the UPA evaluation will be reported in a forthcoming issue of the Journal of the Transportation Research Board. The article, Impacts to Transit from Variably Priced Tolls Lanes by Pessaro, Turnbull, and Zimmerman, reported several findings from the Miami, Minnesota, and Atlanta projects. In Miami and Minneapolis where speed data was available, buses speeds increased by 37 mph and 29 mph respectively. Ridership (a.m. peak period) increased in each of the corridors after tolling: 57 percent in Miami, 8 percent in Minneapolis, and 21 percent in Atlanta. The overall perception of the HOT lanes by bus riders has been positive. In Miami, 53 percent of new riders said they were influenced to take transit because of the HOT lanes. In Minneapolis, it was 23 percent. In Atlanta, it was 45 percent (Pessaro, Turnbull, & Zimmerman, 2013).

Next, the literature review looked at research that addressed defining the role of TDM in priced managed lanes. Both Ungemah and Goodin noted in two separate reports that as more HOV lanes are converted into HOT lanes, there is a need for research and guidance on defining the role of carpools in priced managed lanes and the tradeoffs between carpool exemptions and other project objectives (Ungemah, Goodin, Dusza, & Burris, 2007) (Goodin, 2009). The 2009 report by Goodin used HOV policy data collected from eight metropolitan areas with existing or planned HOT facilities to develop a matrix illustrating the tradeoffs between alternative HOV policies and a variety of managed lane performance objectives. The matrix is shown below in. Table 2-2. Determining the right HOV policy depends upon the project objectives. For example, if maximizing person throughput is the primary objective, the HOV policy should be more liberal. The opposite would apply if revenue generation were the primary objective. If enforcement and operations simplicity is the highest priority, the best HOV policy would be for all vehicles to pay the toll.

Table 2-2 HOV Policy Options for Various Managed Lane Performance Objectives

	Carpool Policy Scenarios					
Managed Lanes Performance Objectives	**All Vehicles Pay**	**HOV3+ 50% HOV2 Pay**	**All HOV 50% Toll**	**HOV3+ Free HOV2 Pay**	**HOV3+ Free HOV2 50%**	**All Carpools Free**
Person throughput	○	◒	◒	●	●	●
Revenue generation	●	●	●	◒	◒	○
Emissions reduction	◒	◒	◒	◒	◒	◒
Operational performance	◒	◒	◒	◒	◒	◒
Enforcement and operational simplicity	●	◒	◒	◒	○	◒
Public perception and support	○	◒	◒	◒	◒	◒

Relative success in achieving performance objective: High ● Medium/Neutral ◒ Low ○

Source: *The Role of Preferential Treatment for Carpools in Managed Lanes*, Texas Transportation Institute, 2009, p. 115.

Finally, the literature review looked for previous research that specifically tried to measure the impacts of TDM on priced managed lanes in a manner similar to what is being proposed for this NCTR project. Only two other pieces of similar research could be found. In 2009, Mark Burris from the Texas Transportation Institute conducted a stated preference survey of travelers in Houston and Dallas. The results were used to develop a mode choice model that would predict the impact of converting the Katy Freeway HOV lane into an electronic toll lane. Three scenarios were tested. In Scenario 1 where HOV-2's paid half the SOV toll, the results showed that there was very little change in HOV-2 volumes even as the toll increased. In Scenario 2 where HOV-2's paid the full toll, the percentage share of HOV-2 volume dropped from 8.9 percent to 7.6 percent as the toll increased. In Scenario 3 where all vehicles paid the toll, the percentage share of HOV-3's dropped from 6.9 percent to 5.3 percent. In terms of absolute numbers, the study concluded that the impacts of the changes in HOV policy were small compared to the entire traffic stream. However, the impact on the percentage of travelers using each mode was measurable (Burris, 2009).

A 2007 NCTR study by Phil Winters used CORSIM to measure the impacts of 189 employer-based TDM programs along an 8.6 mile segment of I-5 in Seattle. The research compared two scenarios. Scenario A: "With TDM" represented existing traffic conditions on the 8.6 mile segment. Scenario B: "Without TDM" represented traffic conditions with the vehicle trips reduced by the employer based programs added back onto the corridor. Most commuter assistance programs/rideshare agencies use measures of performance such as the number of commuters requesting assistance, the number of vanpools in service, and the number of vehicle trips and vehicle miles eliminated. By using CORSIM, the study sought to measure the impacts of TDM using performance measures more familiar to traffic operations professionals. Some of these performance measures included recurring delay in vehicle-minutes, average speed in miles per hour, spatial extent of congestion, temporal extent of congestion, and fuel consumption in gallons. The results of the CORSIM analysis showed for example that average speeds in the 8.6 mile corridor were up to 19 miles per hour faster in the a.m. peak period and up to 11 mile per hour faster in the p.m. peak period because of the vehicle trips reduced through the employer programs (Winters, Labib, Rai, & Zhou, 2007).

As stated at the beginning, this objective of this research is to calculate the difference in peak period traffic density, LOS, and toll rates on the I-95 Express Lanes under a hypothetical scenario where there is no transit or TDM component. The literature review revealed that no similar research has been attempted so far other than the research performed by Winters. Therefore, this NCTR research has the potential to add to the body of knowledge on priced managed lanes and TDM.

Chapter 3 Methodology

The *95 Express Toll Facilities Operations Manual* is the guidebook used by the Florida Department of Transportation (FDOT) to set the parameters for adjusting the tolls on the I-95 Express to maintain a minimum speed of 45 miles per hour. Therefore, the discussion of the proposed methodology for estimating TDM and ILEV impact on managed lane toll prices begins here. The operations manual states that the tolls are based on traffic density. The formula in the *Highway Capacity Manual* for calculating traffic density is as follows:

$$\text{Traffic Density (vehicles per mile per lane)} = \frac{\text{Volume (vehicles per hour per lane)}}{\text{Speed (miles per hour)}}$$

Table 3-1 shows the relationship between level of service (LOS) and traffic density. Every 15 minutes, the electronic toll calculation system collects real time speed and volume data from loop detectors in the Express Lanes and calculates the new traffic density.

Table 3-1 Level of Service (LOS) and Traffic Density

Level of Service	Traffic Density (vpmpl)	Expected Traffic Conditions
A	0 - 11	Free-Flow
B	> 11 – 18	Free-Flow
C	> 18 – 26	Free-Flow
D	> 26 – 35	Mild Congestion
E	> 35 – 45	Moderate Congestion
F	> 45	Severe Congestion

After the new traffic density is calculated, the electronic toll calculation system uses a look-up table called the Delta Settings Table to determine the change in toll based on the change in traffic density. The full Delta Table is shown in Appendix A. The toll collection system also incorporates minimum and maximum tolls, which are shown in Table 3-2. The new toll is compared to the minimum and maximum tolls. If the new toll falls within the range, the new toll is applied. If it falls outside the range, the minimum or maximum toll is applied instead.

Table 3-2 Level of Service Settings Table

Level of Service	Traffic Density (vpmpl)	Toll Amount	
		min	max
A	0 - 11	$0.50	$0.50
B	> 11 – 18	$0.50	$1.50
C	> 18 – 26	$1.50	$4.25
D	> 26 – 35	$4.00	$10.50
E	> 35 – 45	$8.50	$10.50
F	> 45	$9.50	$10.50

Source: FDOT District 6 SunGuide Center

The step-by-step process (algorithm) for calculating the toll is shown in **Error! Reference source not found.**. First, the change in traffic density (ΔTD) is calculated by subtracting the traffic density for the previous 15-minute interval (TD_{t-1}) from the traffic density for the current 15-minute interval (TD_t).

Figure 3-1 Toll Calculation Methodology

Step 1: Calculate ΔTD

$$\Delta TD = TD_t - TD_{t-1}$$

Step 2: Find ΔR based on ΔTD and TD_t

Refer to Delta Settings Table (see ***Table 3****)*

Step 3: Calculate R_t

$$R_t = R_{t-1} + \Delta R$$

Step 4: Decide Final R_t

$$R_t = \begin{cases} Max, \text{ if } R_t > Max \\ Min, \text{ if } R_t < Min \\ R_t, \text{ otherwise} \end{cases}$$

Where:

R_t – Current Toll	R_{t-1} – Previous Toll
TD_t – Current Traffic Density	TD_{t-1} – Previous Traffic Density
ΔTD – Change in Traffic Density	ΔR – Toll Adjustment
Max – Maximum Toll at a LOS	Min – Minimum Toll at a LOS

Source: 95 Express Toll Facility Operations Manual

Next, the toll adjustment (ΔR) is calculated using the Delta Settings Table (Appendix A). To do that, one locates the appropriate row on the left side of the table for current traffic density and then goes across to find the correct change in toll based on the change in density. The toll adjustment (ΔR) is added to the toll from the previous 15-minute interval (R_{t-1}) to get the current toll (R_t). In the final step, the current toll is compared to the minimum and maximum toll for the current traffic density. If the current toll falls within the minimum and maximum range, the current toll is applied. If the current toll falls outside the minimum or maximum, the minimum or maximum toll is applied. An example is provided below.

Example

Given:

- Previous toll (R_{t-1}) is $0.25
- Previous traffic density (TD_{t-1}) is 12
- Current traffic density (TD_t) is 16

Using the process outlined in **Error! Reference source not found.**:

Step 1: $\Delta TD = TD_t - TD_{t-1}$ → 16 – 12 = 4

Step 2: Using the Delta Table, a TD_t of 16 yields a toll change (ΔR) of +$0.50.

Step 3: $R_t = R_{t-1} + \Delta R$ → $0.25 + $0.50 = $0.75

Step 4: The current traffic density, 16, falls within the range for LOS B (see Table 3-2). The minimum toll is $0.50, and the maximum toll is $1.50. Since $0.75 falls within the minimum and maximum, $0.75 is applied.

Data Sources

The analysis will use three days' worth of data from April 8 to 10, 2014. These days were selected because they were the days on which FDOT conducted its most recent vehicle occupancy surveys of the I-95 HOV lanes. The study will use five sources of data.

1. Traffic Data – Volume, speed, and toll data was provided by Florida's Turnpike Enterprise (FTE) and the FDOT SunGuide Center. The data was aggregated by direction and time of day in 15-minute increments. A sample of the data is shown in Appendix B Sample Traffic Data.

2. Toll Exempt Data – FTE tracks the number of toll exempt vehicles in the I-95 Express Lanes by video capturing license plate data and cross-checking it against a registry of toll exempt vehicles. The toll exempt data used in this report included registered 3+ carpools and Inherently Low Emission Vehicles (ILEVs). The data was aggregated by direction and time of day in 15-minute increments. A sample of the toll exempt data is shown in Appendix C Sample Toll Exempt Data.

3. Transit Data – Broward County Transit and Miami-Dade Transit provided passenger count data for the eight bus routes that operate on the I-95 Express Lanes. The data was aggregated by direction and by trip. The BCT data was collected manually each day from April 8 to 10. The MDT data was taken from the automated passenger counters (APCs) for the months of March and April. Samples of the transit data are shown in Appendix D Sample Transit Data.

4. Survey Data – Surveys were conducted of three groups of commuters: 3+ carpoolers, ILEV owners, and bus riders. The first two groups are required to register with South Florida Commuter Services (SFCS) in order to be exempt from the tolls. Because their e-mail addresses are in the SFCS database, they were contacted via e-mail to complete an online survey. For the bus riders, SFCS conducted intercept surveys at the park and ride lots served by the eight bus routes that operate in the I-95 Express Lanes. All of the surveys asked how they would make their trip if there were no toll exemptions and no transit service in the express lanes. The results were used to estimate the percentage of carpoolers and bus riders who would revert to single occupant vehicle (SOV) and pay the toll and the percentage of ILEV owners who would opt out of the I-95 Express Lanes if they were no longer toll exempt. The survey questions and results are shown in Appendix E Surveys.

Assignment of Transit Riders

The transit ridership was aggregated by trip, meaning the departure time from the first stop. However, we had to account for travel time from the first stop to when the bus was physically in the express lanes. Because the traffic data for the express lanes was provided in 15-minute increments, we have to assign the bus riders to the correct 15-minute time analysis period. For example, if the 6:00 a.m. departure had 20 passengers and it takes that bus 30 minutes to reach the start point of the express lanes, those 20 riders should be assigned to the 6:30 to 6:45 a.m. analysis period.

We consulted the route schedules of each bus route and Google Maps to estimate the travel time from the first stop to the entry point of the I-95 Express Lanes. Based on that analysis, the following guidelines were used when assigning the transit ridership figures to the appropriate 15-minute analysis period.

Morning

Route 106 (Miramar)	add 30 minutes to departure time
Route 107 (Hollywood)	add 30 minutes to departure time
Route 108 (Pembroke Pines)	add 30 minutes to departure time
Route 109 (Pembroke Pines/Miramar)	add 30 minutes to departure time
Route 110 (BB&T Center)	add 40 minutes to departure time
Route 114 (Westgate Square Mall)	add 40 minutes to departure time
Route 95X (Golden Glades)	add 0 minutes to departure time
Route 195X (Dade-Broward Express)	add 15 minutes to departure time

Afternoon	
Route 106 (Miramar)	add 15 minutes to departure time
Route 107 (Hollywood)	add 15 minutes to departure time
Route 108 (Pembroke Pines)	add 15 minutes to departure time
Route 109 (Pembroke Pines/Miramar)	add 15 minutes to departure time
Route 110 (BB&T Center)	add 15 minutes to departure time
Route 114 (Westgate Square Mall)	add 15 minutes to departure time
Route 95X (Golden Glades)	add 15 minutes to departure time
Route 195X (Dade-Broward Express)	add 15 minutes to departure time

Sample Calculation of Toll with TDM Activities Removed

To better illustrate the method that was used, we will provide a sample calculation for one of the 15-minute periods. Specifically, we will do a sample calculation for the 7:15 to 7:30 a.m. time period in the southbound direction for April 8, 2014. The following data is given:

Table 3-3 Given Data for Sample Calculation

Express Lane Volume	350 vehicles per lane*
Express Lane Speed	55 mph
Toll	$3.00
Traffic Density	26 pcphpl
No. of Carpools	2.5 per lane*
No. of ILEVs	8.5 per lane*

*Note: since the original figures were provided for both lanes, they had to be divided by two to get the necessary per lane data needed for the calculations.

Step 1: Calculate the change in Express Lane volume.

The first step is to calculate the change in express lane volume that would result from carpoolers, ILEV drivers, and bus riders changing their method of travel in the hypothetical scenario. First, we calculate for the carpoolers. There were 2.5 carpool vehicles per lane for the 7:15 to 7:30 a.m. analysis period. According to SFCS, the average vehicle occupancy (AVO) of the registered carpools on the I-95 Express Lanes is 3.1 passengers. An AVO of 3.1 applied to 2.5 carpools equates to 7.8 single occupant vehicles (SOVs). In the survey of registered carpoolers, 27.1 percent said they would drive alone in their own vehicle and pay the toll if they could no longer use the I-95 Express Lanes for free as a carpooler. Applying 27.1 percent to 7.8 SOVs equates to 2.1 SOVs from former carpoolers in the hypothetical scenario. Since there were 2.5 carpool vehicles under actual traffic conditions, there was no net increase in vehicles from former carpoolers (2.1 ≈ 2.5).

Next, we calculate for ILEVs. There were 8.5 ILEVs per lane in the express lanes from 7:15 to 7:30 a.m. According to the survey data, 78.4 percent of ILEV owners would opt out of the I-95 Express Lanes if they could not use it for free. Applying 78.4 percent to 8.5 ILEVs yields a reduction of 7 vehicles in the express lanes and an equivalent increase in the general purpose lanes

The calculation for bus riders is more complex. BCT and MDT provided the ridership numbers aggregated by trip. We surveyed the passengers on all eight bus routes to find out how they would make their trip if the I-95 express bus service was not available. The percentage of respondents who said they would opt to drive alone and pay the toll varied by bus route. For example, 22.7 percent of riders on the Route 106 (Miramar) said they would drive alone and pay the toll while on the Route 108 (Pembroke Pines) it was 14.2 percent. For this part of the calculation, we applied the route specific survey percentage to the ridership for that route for each 15-minute time period. For this sample calculation, there were 110 bus riders total (55 riders per lane) in the 7:15 to 7:30 a.m. analysis period who said they would opt to drive alone and pay the toll.

To get the adjusted volume for the hypothetical scenario where there are no TDM activities and no toll exemptions, the additional vehicles from former carpoolers and bus riders are added and the reduction in ILEV vehicles are subtracted. The calculation in this example would be: 350 + 0 + 55 - 7 = 398 vehicles.

Step 2: Calculate the new traffic density.

The tolls on the I-95 Express are based on traffic density. Traffic density = volume ÷ speed. To calculate the new density, we must first estimate the new speed with the adjusted volume. To do that, we will use the Highway Capacity Manual's Speed Flow Curves. The equations used for the HCM speed flow curves are shown in Figure 3-2.

FFS (mi/h)	Breakpoint (pc/h/ln)	Flow Rate Range: ≥0 ≤ Breakpoint	Flow Rate Range: >Breakpoint ≤ Capacity
75	1,000	75	$75 - 0.00001107\,(v_p - 1{,}000)^2$
70	1,200	70	$70 - 0.00001160\,(v_p - 1{,}200)^2$
65	1,400	65	$65 - 0.00001418\,(v_p - 1{,}400)^2$
60	1,600	60	$60 - 0.00001816\,(v_p - 1{,}600)^2$
55	1,800	55	$55 - 0.00002469\,(v_p - 1{,}800)^2$

Notes: FFS = free-flow speed, v_p = demand flow rate (pc/h/ln) under equivalent base conditions.
Maximum flow rate for the equations is capacity: 2,400 pc/h/ln for 70- and 75-mph FFS; 2,350 pc/h/ln for 65-mph FFS; 2,300 pc/h/ln for 60-mph FFS; and 2,250 pc/h/ln for 55-mph FFS.

Source: Highway Capacity Manual

Figure 3-2 Speed Flow Curve Equation

Based on conversations with staff from the FDOT SunGuide Center, the free-flow speeds for the I-95 Express Lanes and General Purpose Lanes are shown in Table 3-4.

Table 3-4 I-95 Free-Flow Speeds

	Southbound	Northbound
I-95 Express Lanes	65 mph	60 mph
I-95 General Purpose Lanes	55 mph	55 mph

In order to estimate traffic speed under the hypothetical scenario with the TDM activities and toll exemptions removed, we will use the HCM formulas in Figure 3-2. For example, when estimating the new speed for the I-95 Express Lanes in the southbound direction, we will use the formula $65 - 0.00001418\ (v_p - 1{,}400)^2$ where v_p equals the flow rate under the hypothetical scenario with the TDM activities and toll exemptions removed. For a road with a free-flow speed of 65 mph, the breakpoint volume is 1,400 vehicles per hour per lane. In theory, this means that speeds will only begin to deteriorate after the volume goes over 1,400.

If the hypothetical flow rate (v_p) is less than the breakpoint volume, it will be assumed that there is no change from the actual recorded speed that was reported because there is still available roadway capacity. The HCM speed will not be calculated, and the actual recorded speed will be retained to calculate the new density. If the hypothetical flow rate is greater than or equal to the breakpoint volume, the HCM speed will be calculated and compared to the actual recorded speed. The study will default to the lower of the two speeds when calculating the new density.

From Step 1, we know that the new 15-minute volume is 398 vehicles per lane. We have to convert this 15-minute figure into a 1-hour flow rate. The calculation is 398 x 4 = 1,592 vehicles per hour per lane. Since 1,592 vehicles are over the 1,400 breakpoint, we will calculate the HCM speed. The HCM speed is 64 mph. However, the actual recorded speed was 55 mph, and the methodology says we will defer to the lesser of the two speeds. Therefore, 55 mph will be used to calculate the new density. The new density is 29 vehicles per mile per lane (1,592 ÷ 55 = 29).

Step 3: Calculate the change in density.

The formula for calculating the change in density is $\Delta TD = TD_t - TD_{t-1}$ where TD_t equals the current traffic density and TD_{t-1} equals the previous traffic density. The current traffic density is the density under the hypothetical scenario (29 pcphpl). The previous traffic density is the traffic density under actual traffic conditions (26 pcphpl). In this sample calculation, $\Delta TD = 3$.

Step 4: Calculate the change in toll rate.

The change in toll rate (ΔR) is determined by using the change in traffic density (ΔTD), the current traffic density (TD_t), and the Delta Settings Table. In this case, $\Delta TD = +3$ and $TD_t = 29$. According to the Delta Settings Table, the change in toll is $1.00

Table 3-5 Sample Delta Settings Table

	Change in Traffic Density (ΔTD)																	
TD_t	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
29	.50	.75	**1.00**	1.25	1.50	2.00	2.25	2.50	2.75	2.75	3.00	3.50	4.00	4.50	5.00	5.50	5.50	5.50

Step 5: Calculate the new toll.

Recall that the toll was originally $3.00. Under the adjusted traffic volume, the new toll will be $4.00 ($3.00 + $1.00).

Step 6: Check the new toll against the min and max.

The current traffic density, 29, falls within the range for LOS D (see Table 3-2). The minimum toll under LOS D is $4.00, and the maximum toll is $10.50. Since the calculated toll of $4.00 falls within the minimum and maximum, $4.00 is applied.

Step 7: Summarize the results.

Table 3-6 Sample Results

Measure	With TDM	Without TDM
Volume	350	398
Traffic Density (vpmpl)	26	29
Level of Service	D	D
Toll	$3.00	$4.00

In this example, there was an increase in volume and density in the hypothetical scenario with the TDM activities and toll exemptions removed. This caused an increase in the toll amount. The LOS remained the same because the increase in volume was not large enough to degrade to the next LOS level. The sample data shown above is only for one, 15-minute segment in the morning peak period in the southbound direction. Furthermore it was only performed for the express lanes. These same steps will be repeated for each 15-minute segment of the morning and afternoon peak periods for both the express and general purpose lanes.

Chapter 4 Findings

The analysis compared three days of actual traffic and toll data from April 8-10, 2014 to simulated traffic and toll data under a hypothetical scenario where there were no express bus service or toll exemptions. The data was aggregated into 15-minute increments by peak period and peak direction. The analysis included data from 6:00 to 9:00 a.m. southbound and 4:00 to 7:00 p.m. northbound. The summary tables of the research findings are provided below while the full data tables are located in Appendix F.

Table 4-1 compares the percentage of time the express lanes were at a given LOS under the two scenarios. The columns marked “w/TDM” represent actual traffic conditions from April 8-10. The columns marked “w/o TDM” represent the hypothetical scenario. What Table 4-1 shows is that there was a mild degree of LOS degradation in the southbound direction. Under the hypothetical scenario with all TDM activities and toll exemptions removed, the express lanes operated at LOS B 5 percent less of the time and at LOS C 9 percent more of the time. The average toll was $0.41 higher. In the northbound direction, there was surprisingly a slight improvement in the LOS. Under the hypothetical scenario, the express lanes operated 3 percent more of the time at LOS C and 3 percent less of the time at LOS D. The average toll would have been $0.19 lower. The reason for this will be explained in a moment.

Table 4-1 Express Lane LOS with and without TDM

	Southbound Express (a.m.)		Northbound Express (p.m.)	
LOS	w/TDM	w/o TDM	w/TDM	w/o TDM
A	8%	8%	0%	0%
B	11%	6%	6%	6%
C	47%	56%	44%	47%
D	33%	31%	47%	44%
E	0%	0%	3%	3%
F	0%	0%	0%	0%
Avg Toll	$2.77	$3.18	$4.27	$4.08

Note: The percentages are the percentage of time the express lanes operated at that LOS during the 3-day analysis period from 6:00 to 9:00 a.m. (southbound) and 4:00 to 7:00 p.m. (northbound). See Appendix F

The analysis also looked at changes in traffic density and volumes. Because each LOS covers a range of traffic densities as shown in Table 4-2, it is possible for traffic densities to increase without crossing an LOS threshold. Such increases still represent a degradation of traffic flow because as traffic density increases, it becomes more difficult to change lanes.

Table 4-2 Level of Service (LOS) and Traffic Density

Level of Service	Traffic Density (vpmpl)	Expected Traffic Conditions
A	0 - 11	Free-Flow
B	> 11 – 18	Free-Flow
C	> 18 – 26	Free-Flow
D	> 26 – 35	Mild Congestion
E	> 35 – 45	Moderate Congestion
F	> 45	Severe Congestion

Table 4-3 shows how often the change in density and volume under the hypothetical scenario was the same, better, or worse compared to the actual traffic scenario. What it shows is that 47 percent of the time in the southbound direction and 36 percent of the time in the northbound direction, the traffic density under the hypothetical scenario got worse (i.e., it increased).

Table 4-3 Change in Density and Volume on I-95 Express Lanes

	Southbound Express (a.m.)		Northbound Express (p.m.)	
	Density	Volume	Density	Volume
Equal	31%	0%	42%	6%
Better	22%	42%	22%	44%
Worse	47%	58%	36%	50%
Total	100%	100%	100%	100%

Getting back to the question of why was there a slight improvement in the northbound direction, the reason has to do with inherently low emissions vehicles (ILEVs). As shown in Figure 4-1, ILEVs accounted for 64 percent of the toll exempt trips. In contrast, carpools, vanpools, and transit only accounted for 36 percent of the toll exempt trips. Furthermore, a large percentage of ILEV owners (77.3%) stated in the survey that they would opt out of the Express Lanes if there was no toll exemption for them. In contrast, the percentage of carpoolers/vanpoolers who said they would revert to SOV and pay the toll if there was no toll exemption for them was low (27.1%). For the bus riders, the percentages varied by route, but the highest was 26.3 percent. What often happened in the hypothetical scenario was that the increase in volume from carpoolers/vanpoolers and transit riders reverting to SOV was offset by even larger numbers of ILEV owners opting out of the express lanes.

The findings turn next to the general purpose lanes. Here the impacts were more severe.

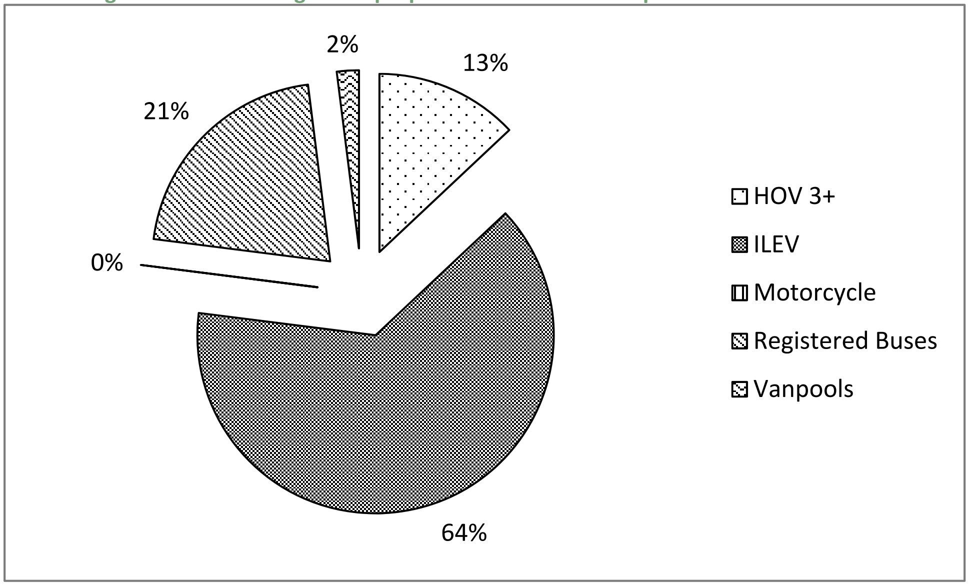

Figure 4-1 Breakdown of Toll Exempt Transactions

Source: 95 Express Monthly Operations Report – April 2014
www.sunguide.info/index.php

Table 4-4 compares the percentage of time the general purpose lanes were at a given LOS under the two scenarios. In the hypothetical scenario with all TDM activities and toll exemptions removed, the general purpose lanes operated at LOS F 22 percent more of time in the southbound direction and 8 percent more of the time in the northbound direction.

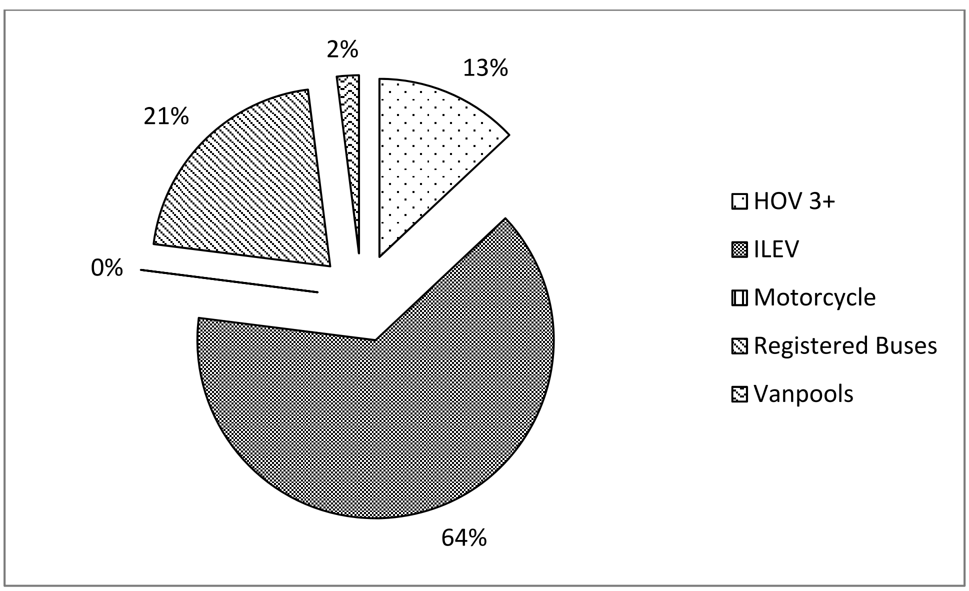

Figure 4-1 Breakdown of Toll Exempt Transactions

Source: 95 Express Monthly Operations Report – April 2014
www.sunguide.info/index.php

Table 4-4 General Purpose Lane LOS with and without TDM

	Southbound GP (a.m.)		Northbound GP (p.m.)	
LOS	w/TDM	w/o TDM	w/TDM	w/o TDM
A	0%	0%	0%	0%
B	0%	0%	0%	0%
C	8%	8%	3%	3%
D	28%	19%	17%	14%
E	47%	33%	39%	33%
F	17%	39%	42%	50%

As shown in Table 4-5, traffic densities in the general purpose lanes under the hypothetical scenario increased 100 percent of the time in the southbound direction and 94 percent of the time in the northbound direction. In the northbound direction, there were only two instances in all of the 15-minute periods that were analyzed where the traffic density remained the same. In all of the others, the traffic density increased.

Table 4-5 Change in Density and Volume on I-95 General Purpose Lanes

	Southbound General Purpose (a.m.)		Northbound General Purpose (p.m.)	
	Density	Volume	Density	Volume
Equal	0%	0%	6%	0%
Better	0%	0%	0%	0%
Worse	100%	100%	94%	100%
Total	100%	100%	100%	100%

Chapter 5 Conclusions

The conclusion of this research is that TDM activities do in fact provide a benefit, albeit a minor one, to other commuters in the I-95 Express Lanes in the form of better LOS and lower tolls. They provide a greater benefit to commuters in the general purpose lanes, who would otherwise suffer from even worse traffic congestion. An unanticipated finding from the research was the important role that ILEV vehicles in the express lanes play in the reducing traffic congestion in the general purpose lanes. This leads to a policy dilemma. As pointed out by Robert Poole from the Reason Foundation, toll exemptions of any kind (1) reduce the power of variable pricing to eliminate congestion in the HOT lane, and (2) reduce the revenue needed to expand from just individual priced lanes to whole networks of lanes (Poole, 2014). On the one hand, the toll exemption for ILEVs is keeping these cars out of the general purpose lanes. On the other hand, as ILEVs grow in popularity and number on the roadways, they will undermine the power of variable pricing in the express lanes. The Florida Legislature has decided to sunset the toll exemption for ILEVs. So this may not be an issue for Florida. However, this research finding is worth pointing out to other states that have toll exemptions for ILEVs on their HOT lanes.

Appendix A Full Delta Settings Table

	Change in TD																	
TD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
2	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
3	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
4	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
5	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
6	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
7	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
8	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
9	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
10	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
11	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
12	0.25	0.25	0.25	0.50	0.50	0.50	0.75	0.75	0.75	1.00	1.00	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13	0.25	0.25	0.25	0.50	0.50	0.50	0.75	0.75	0.75	1.00	1.00	1.25	1.25	1.25	1.25	1.25	1.25	1.25
14	0.25	0.25	0.25	0.50	0.50	0.50	0.75	0.75	0.75	1.00	1.00	1.25	1.25	1.25	1.25	1.25	1.25	1.25
15	0.25	0.25	0.50	0.50	0.50	0.50	0.75	0.75	0.75	1.00	1.00	1.25	1.25	1.25	1.25	1.25	1.25	1.25
16	0.25	0.25	0.50	0.50	0.50	0.50	0.75	0.75	0.75	1.00	1.00	1.25	1.25	1.25	1.25	1.25	1.25	1.25
17	0.25	0.25	0.50	0.75	1.00	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
18	0.25	0.25	0.50	0.75	1.00	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
19	0.25	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.25	3.75	3.75	3.75	3.75	3.75
20	0.25	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.25	3.75	3.75	3.75	3.75	3.75
21	0.25	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.25	3.75	3.75	3.75	3.75	3.75
22	0.25	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.25	3.75	3.75	3.75	3.75	3.75
23	0.25	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.25	3.75	3.75	3.75	3.75	3.75
24	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	2.75	3.25	3.75	3.75	3.75	3.75	3.75
25	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.75	3.75	3.75	3.75	3.75
26	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.50	3.75	3.75	3.75	3.75	3.75
27	0.25	0.75	1.00	1.25	1.50	2.00	2.25	2.25	2.50	2.75	3.00	3.50	4.00	4.50	5.00	5.50	5.50	5.50
28	0.50	0.75	1.00	1.25	1.50	2.00	2.25	2.50	2.50	2.75	3.00	3.50	4.00	4.50	5.00	5.50	5.50	5.50
29	0.50	0.75	1.00	1.25	1.50	2.00	2.25	2.50	2.75	2.75	3.00	3.50	4.00	4.50	5.00	5.50	5.50	5.50
30	0.50	0.75	1.00	1.25	1.50	2.00	2.25	2.50	2.75	3.00	3.00	3.50	4.00	4.50	5.00	5.50	5.50	5.50
31	0.50	0.75	1.00	1.25	1.50	2.00	2.25	2.50	2.75	3.00	3.25	3.50	4.00	4.50	5.00	5.50	5.50	5.50
32	0.50	0.75	1.00	1.25	1.50	2.00	2.25	2.50	2.75	3.00	3.25	3.50	4.00	4.50	5.00	5.50	5.50	5.50

	Change in TD																	
TD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
33	0.50	0.75	1.00	1.25	1.50	2.00	2.25	2.50	2.75	3.00	3.25	3.50	4.00	4.50	5.00	5.50	5.50	5.50
34	0.50	0.75	1.00	1.25	1.50	2.00	2.25	2.50	2.75	3.00	3.25	3.50	4.00	4.50	5.00	5.50	5.50	5.50
35	0.50	0.75	1.00	1.25	1.50	2.00	2.25	2.50	2.75	3.00	3.25	3.50	4.00	4.50	5.00	5.50	5.50	5.50
36	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
37	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.50	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
38	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.25	3.50	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
39	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.25	3.50	3.75	4.00	4.00	4.00	4.00	4.00	4.00	4.00
40	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.25	3.50	3.50	3.75	4.00	4.00	4.00	4.00	4.00	4.00
41	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.25	3.50	3.50	3.50	3.75	4.00	4.00	4.00	4.00	4.00
42	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.25	3.50	3.50	3.50	3.50	3.75	4.00	4.00	4.00	4.00
43	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.25	3.50	3.50	3.50	3.50	3.50	3.75	4.00	4.00	4.00
44	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.25	3.50	3.50	3.50	3.50	3.50	3.50	3.75	4.00	4.00
45	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.25	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.75	4.00
46	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
47	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
48	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
49	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
50	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
51	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
52	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
53	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
54	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
55	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
56	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
57	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
58	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
59	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
60	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Appendix B Sample Traffic Data

Toll Data

SOUTHBOUND

	4/8/2014	4/9/2014	4/10/2014
Time	**Toll**	**Toll**	**Toll**
06:00:00 - 06:14:59	$0.50	$0.50	$0.50
06:15:00 - 06:29:59	$0.50	$1.00	$0.50
06:30:00 - 06:44:59	$2.25	$2.50	$1.50
06:45:00 - 06:59:59	$0.00	$3.25	$3.00
07:00:00 - 07:14:59	$0.00	$3.00	$0.00
07:15:00 - 07:29:59	$3.00	$3.75	$0.00
07:30:00 - 07:44:59	$5.00	$4.25	$3.00
07:45:00 - 07:59:59	$5.50	$5.00	$4.25
08:00:00 - 08:14:59	$5.50	$5.50	$4.25
08:15:00 - 08:29:59	$5.00	$5.00	$4.00
08:30:00 - 08:44:59	$4.75	$0.00	$3.75
08:45:00 - 08:59:59	$5.50	$0.00	$3.75
09:00:00 - 09:14:59	$4.75	$5.00	$3.75
09:15:00 - 09:29:59	$3.25	$3.75	$3.25
09:30:00 - 09:44:59	$3.25	$2.75	$3.00
09:45:00 - 09:59:59	$3.25	$2.75	$3.00

Source: FDOT SunGuide Center

Traffic Count Data

Florida's Turnpike Enterprise
Daily Traffic Counts Report
(109620) I-95 NW 144th St
For 15 Minute Intervals

Facility ID	Plaza Traffic Group Name	Period From	Period To	Traffic Count
109620	95 Express South (NW 144th St)	Apr 8, 2014 6:00:00 AM	Apr 8, 2014 6:14:59 AM	362
109620	95 Express South (NW 144th St)	Apr 8, 2014 6:15:00 AM	Apr 8, 2014 6:29:59 AM	628
109620	95 Express South (NW 144th St)	Apr 8, 2014 6:30:00 AM	Apr 8, 2014 6:44:59 AM	775
109620	95 Express South (NW 144th St)	Apr 8, 2014 6:45:00 AM	Apr 8, 2014 6:59:59 AM	805
109620	95 Express South (NW 144th St)	Apr 8, 2014 7:00:00 AM	Apr 8, 2014 7:14:59 AM	534
109620	95 Express South (NW 144th St)	Apr 8, 2014 7:15:00 AM	Apr 8, 2014 7:29:59 AM	700
109620	95 Express South (NW 144th St)	Apr 8, 2014 7:30:00 AM	Apr 8, 2014 7:44:59 AM	891
109620	95 Express South (NW 144th St)	Apr 8, 2014 7:45:00 AM	Apr 8, 2014 7:59:59 AM	933
109620	95 Express South (NW 144th St)	Apr 8, 2014 8:00:00 AM	Apr 8, 2014 8:14:59 AM	985
109620	95 Express South (NW 144th St)	Apr 8, 2014 8:15:00 AM	Apr 8, 2014 8:29:59 AM	926
109620	95 Express South (NW 144th St)	Apr 8, 2014 8:30:00 AM	Apr 8, 2014 8:44:59 AM	988
109620	95 Express South (NW 144th St)	Apr 8, 2014 8:45:00 AM	Apr 8, 2014 8:59:59 AM	877
109620	95 Express South (NW 144th St)	Apr 8, 2014 9:00:00 AM	Apr 8, 2014 9:14:59 AM	664
109620	95 Express South (NW 144th St)	Apr 8, 2014 9:15:00 AM	Apr 8, 2014 9:29:59 AM	702
109620	95 Express South (NW 144th St)	Apr 8, 2014 9:30:00 AM	Apr 8, 2014 9:44:59 AM	693
109620	95 Express South (NW 144th St)	Apr 8, 2014 9:45:00 AM	Apr 8, 2014 9:59:59 AM	592

Speed Data

Date	Time	NB				SB			
		EL		GPL		EL		GPL	
		Average Speed	Average Volume	Average Speed	Average Volume	Average Speed	Average Volume	Average Speed	Average Volume
4/8/2014	6:00:00 AM	67	103	60	716	67	327	58	1234
4/8/2014	6:15:00 AM	67	181	59	889	65	581	56	1594
4/8/2014	6:30:00 AM	68	236	59	1024	64	703	50	1740
4/8/2014	6:45:00 AM	67	269	59	1148	61	647	45	1708
4/8/2014	7:00:00 AM	68	310	60	1215	52	479	39	1588
4/8/2014	7:15:00 AM	68	394	59	1362	55	691	31	1323
4/8/2014	7:30:00 AM	69	435	59	1431	56	837	26	1252
4/8/2014	7:45:00 AM	69	411	58	1583	60	863	29	1373
4/8/2014	8:00:00 AM	70	455	59	1539	61	873	29	1371
4/8/2014	8:15:00 AM	68	519	58	1489	61	834	28	1291
4/8/2014	8:30:00 AM	68	490	59	1392	62	871	31	1321
4/8/2014	8:45:00 AM	69	411	59	1369	60	829	33	1391
4/8/2014	9:00:00 AM	68	381	60	1181	63	653	33	1348
4/8/2014	9:15:00 AM	67	333	59	1216	65	656	38	1423
4/8/2014	9:30:00 AM	67	255	60	1371	65	661	40	1454
4/8/2014	9:45:00 AM	67	341	59	1219	65	602	42	1473
4/8/2014	10:00:00 AM	67	335	59	1191	67	498	44	1489

Source: FDOT SunGuide Center

Appendix C Sample Toll Exempt Data

ILEVs

	Hour		NORTHBOUND			SOUTHBOUND		
			4/8/2014	4/9/2014	4/10/2014	4/8/2014	4/9/2014	4/10/2014
ILEVs	**6**	00 - 15		1		10	9	6
		15 - 30	7	4	4	11	6	7
		31 - 45	4	1	3	18	18	18
		46 - 59		1	1	1	23	20
	7	00 - 15	8	3	1		25	16
		15 - 30	4	4	5	17	25	
		31 - 45		5	8	50	60	26
		46 - 59		4	3	58	52	67
	8	00 - 15	2	4		54	73	60
		15 - 30	2	7		73	62	62
		31 - 45	9	4	5	60	28	50
		46 - 59	4	4		33		49
	9	00 - 15	1	3		26	25	23
		15 - 30		3	1	28	31	30
		31 - 45		3	6	20	23	26
		46 - 59	1	2		16	10	14
	10	00 - 15	5	1	3	8	9	7
		15 - 30	3	4	2	7	9	7
		31 - 45	3	3	4	2	5	4
		46 - 59	2	2	3	5	5	6

Source: Florida’s Turnpike Enterprise

Registered 3+ Carpools

	Hour		NORTHBOUND 4/8/2014	NORTHBOUND 4/9/2014	NORTHBOUND 4/10/2014	SOUTHBOUND 4/8/2014	SOUTHBOUND 4/9/2014	SOUTHBOUND 4/10/2014
3+ Carpools	**6**	00 - 15				3	3	2
		15 - 30				2	2	3
		31 - 45		1		4	4	3
		46 - 59					4	6
	7	00 - 15					13	4
		15 - 30	1	1	1	5	9	
		31 - 45			1	15	22	12
		46 - 59		1	1	10	14	14
	8	00 - 15				20	18	21
		15 - 30		1		19	12	12
		31 - 45				13	6	9
		46 - 59				6		10
	9	00 - 15				8	8	5
		15 - 30				2	5	3
		31 - 45				2	2	7
		46 - 59				3	2	7
	10	00 - 15				2	1	
		15 - 30	1			2	3	1
		31 - 45					3	1
		46 - 59					1	

Source: Florida’s Turnpike Enterprise

Appendix D Sample Transit Data

Broward County Transit Sample Data

95 EXPRESS SERVICE PASSENGER BOARDINGS

Route 106 - Miramar Regional Park to Civic Center

SOUTHBOUND				
Trip	Tue	Wed	Thu	Avg
	4/8	4/9	4/10	
5:40	59	54	42	52
6:05	52	53	38	48
6:30	52	50	70	57
6:55	44	47	48	46
7:20	30	24	23	26
7:45	16	27	19	21
8:10	13	11	18	14
8:40	3	8	11	7
TOTAL	269	274	269	271

NORTHBOUND				
Trip	Tue	Wed	Thu	Avg
	4/8	4/9	4/10	
3:07	12	17	13	14
3:37	25	34	23	27
4:07	45	46	50	47
4:37	50	39	43	44
5:07	43	41	33	39
5:37	23	23	25	24
6:07	18	24	22	21
6:37	15	11	13	13
7:07	4	10	11	8
7:37	30	23	9	21
8:07	8	1	4	4
TOTAL	273	269	246	263

Note: The BCT data also included the Routes 107, 108, 109, 110, and 114.

Miami Dade Transit Sample Data

ROUTE 95X TRIP SUMMARY
APRIL 1 - 11, 2014

TRIP DEPART TIME	BLOCK	PATTERN	RIDERS	NUMBER OF SAMPLES
08:03	950064	SB08	31	8
08:13	950003	SB16	17	8
08:13	950066	SB04	23	6
08:28	950057	SB04	26	5
08:38	950051	SB04	24	8
08:58	950060	SB04	27	6
09:28	950052	SB04	29	5
16:03	950070	NB04	20	2
16:10	950075	NB14	23	1
16:13	950076	NB04	20	5
16:15	950011	NB08	24	5
16:23	950073	NB02	56	7
16:27	950074	NB08	37	3
16:30	2071004	NB14	40	1

Note: The data shown above is only a partial sample. The full dataset included more departure times as well as data from the Route 195X (Dade-Broward Express).

Appendix E Surveys

ILEV/Hybrid Survey

If you did not own a hybrid vehicle which gave you free access to the I-95 Express Lanes, how would you travel to work/school? (select one)

	Response Count	Response Percent
I would drive in the Express Lanes and pay the toll.	188	21.5%
I would drive on I-95 in the General Lanes.	478	54.7%
I would form a 3+ carpool to continue using the Express Lanes.	10	1.1%
I would take a different route to work/school.	146	16.7%
I would switch to Tri-Rail.	15	1.7%
I would not make the trip.	37	4.2%
Total	874	100.0%

874 out of 2,391 registered ILEV/Hybrid owners responded to the online survey (37%).

3+Carpool Survey

If carpoolers and vanpoolers were charged the same toll as everyone else to use the 95 Express Lanes how would you travel to work/school? Please select one.

	Response Count	Response Percent
I would continue to carpool or vanpool in the Express Lanes and pay the toll.	199	23.2%
I would drive alone in my own car in the Express Lanes and pay the toll.	232	27.1%
I would drive on I-95 in the General Lanes.	266	31.0%
I would switch to Tri-Rail.	33	3.9%
I would take a different route to work/school.	86	10.0%
I would not make the trip.	41	4.8%
Total	857	100.0%

857 out of 1,764 registered carpoolers (49%) registered carpoolers responded to the online survey.

Transit Survey

From the end of March to the end of April 2014, staff from South Florida Commuter Services (SFCS) conducted intercept surveys of I-95 Express bus passengers at the park and ride lots. The purpose of the survey was to ask bus riders how they would make their trip if they did not take the I-95 Express bus. The responses will be used to estimate the percentage of bus riders who would switch to driving their own vehicle either in the express lanes or the general purpose lanes if there were no TDM activities in the I-95 Express Lanes. A copy of the survey questionnaire is shown at the end of this summary. Surveys were conducted at the park and ride lots of each bus route that uses the I-95 Express Lanes. The routes and their associated park and ride lots routes are shown in **Error! Reference source not found.**table below.

Survey Location	Route Number- Name	Operating Agency
Miramar Regional	106 - 95 Express Miramar	BCT
Pembroke Commons Hollywood Hills	107 - 95 Express Hollywood	BCT
Perry Airport	108 - 95 Express Pembroke Pines	BCT
CB Smith Ansin Sports Complex	109 - 95 Express Pembroke Pines/Miramar	BCT
BB&T Center FLL Airport Tri-Rail Station	110 - 595 Express BB&T Center	BCT
Westgate Square FLL Airport Tri-Rail Station	114 - 595 Express Westgate Square	BCT
Golden Glades	95X - Route 95 Golden Glades	MDT
Sheridan Street Broward Boulevard	195X - Route 95 Dade-Broward Express	MDT

Note: BCT = Broward County Transit; MDT = Miami-Dade Transit

The table below shows the number of completed surveys that were collected by individual route and the margin of error. The morning ridership of each route was used as the population size for calculating the margin of error. The confidence level is 95 percent. This means that one can be 95 percent certain that the true population would pick the same response as the survey participants did within the margin of error.

Route No.	Surveys Collected	Average A.M. Ridership	Margin of Error
106	161	271	± 4.9%
107	88	122	± 5.5%
108	162	199	± 3.3%
109	305	376	± 2.4%
110	137	157	± 3.0%
114	148	173	± 3.1%
95X	817	1,041	± 1.6%
195X	561	691	± 1.8%

Note: Average a.m. ridership for BCT routes based on data collected by BCT April 8-10, 2014.
Average a.m. ridership for MDT routes based on data collected by MDT in March 2014.

The following question was posed to the bus riders.

If you did not take the I-95 Express Bus today, how would you have gotten to your destination? (please check one)

- I would drive in the Express Lanes.
- I would drive in the I-95 General Lanes.
- I would drive some other route.
- I would take a local bus route.
- I would switch to Tri-Rail.
- I would not make the trip.
- Other

They were also provided with the following sample toll data to help them answer the survey question.

Typical Toll Amounts	
Southbound 95 Express	
Week of March 17 to 23, 2014	
6:00 to 9:00 a.m. Peak Period	
Lowest Toll	$0.50
Highest Toll	$9.00
Express Lane Speed Benefit	19 mph faster
6:00 – 7:00	$0.50 on average
7:00 – 8:00	$3.25 on average
8:00 – 9:00	$4.00 on average

The results of the bus rider survey were as follows:

	Response					
Route	I would drive in the Express Lanes	I would drive in the I-95 General Lanes	I would drive some other route	I would take a local bus route	I would switch to Tri-Rail	I would not make the trip
106	8.7%	39.1%	50.9%	0.6%	0.0%	0.6%
107	22.7%	48.9%	9.1%	6.8%	9.1%	3.4%
108	14.2%	51.2%	29.0%	3.7%	0.6%	1.2%
109	17.7%	54.8%	21.0%	2.3%	0.0%	4.3%
110	26.3%	51.1%	8.8%	0.0%	10.9%	2.9%
114	18.9%	43.2%	14.9%	0.7%	18.9%	3.4%
95X	13.7%	42.4%	9.2%	30.0%	4.7%	0.1%
195X	20.5%	36.7%	4.8%	1.8%	32.4%	3.7%

Appendix F Analysis Data

Southbound Express

		With TDM					Without TDM					Difference		
Date	Time Period	Speed	Volume (per Lane)	Traffic Density	LOS	Toll	Speed	Volume (per Lane)	Traffic Density	LOS	Toll	LOS Change	Traffic Density Change	Volume Change
8-Apr	6:00 - 6:15 am	67	164	9	A	$0.50	67	185	11	A	$0.75	Equal	Worse	Worse
8-Apr	6:16 - 6:30 am	65	290	17	B	$0.50	65	313	19	C	$1.50	Worse	Worse	Worse
8-Apr	6:31 - 6:45 am	64	352	22	C	$2.25	64	358	22	C	$2.25	Equal	Equal	Worse
8-Apr	6:46 - 7:00 am	61	323	21	C	-	61	354	23	C	$1.50	Equal	Worse	Worse
8-Apr	7:01 - 7:15 am	52	239	18	B	-	52	267	20	C	$1.50	Worse	Worse	Worse
8-Apr	7:16 - 7:30 am	55	346	25	C	$3.00	55	394	28	D	$4.00	Worse	Worse	Worse
8-Apr	7:31 - 7:45 am	56	419	29	D	$5.00	56	415	29	D	$5.00	Equal	Equal	Better
8-Apr	7:46 - 8:00 am	60	432	28	D	$5.50	60	423	28	D	$5.50	Equal	Equal	Better
8-Apr	8:01 - 8:15 am	61	437	28	D	$5.50	61	431	28	D	$5.50	Equal	Equal	Better
8-Apr	8:16 - 8:30 am	61	417	27	D	$5.00	61	394	25	C	$4.25	Better	Better	Better
8-Apr	8:31 - 8:45 am	62	435	28	D	$4.75	62	417	26	C	$4.25	Better	Better	Better
8-Apr	8:46 - 9:00 am	60	415	27	D	$5.50	60	417	27	D	$5.50	Equal	Equal	Worse
9-Apr	6:00 - 6:15 am	67	174	10	A	$0.50	67	195	11	A	$0.75	Equal	Worse	Worse
9-Apr	6:16 - 6:30 am	67	285	17	B	$1.00	67	309	18	B	$1.25	Equal	Worse	Worse
9-Apr	6:31 - 6:45 am	65	362	22	C	$2.50	65	368	22	C	$2.50	Equal	Equal	Worse
9-Apr	6:46 - 7:00 am	63	341	21	C	$3.25	63	366	23	C	$3.50	Equal	Worse	Worse
9-Apr	7:01 - 7:15 am	63	356	22	C	$3.00	63	371	23	C	$3.25	Equal	Worse	Worse
9-Apr	7:16 - 7:30 am	64	403	25	C	$3.75	63	443	28	D	$4.75	Worse	Worse	Worse
9-Apr	7:31 - 7:45 am	63	441	28	D	$4.25	63	431	27	D	$4.00	Equal	Better	Better
9-Apr	7:46 - 8:00 am	61	444	28	D	$5.00	61	438	28	D	$5.00	Equal	Equal	Better
9-Apr	8:01 - 8:15 am	62	437	28	D	$5.50	62	424	27	D	$5.25	Equal	Better	Better
9-Apr	8:16 - 8:30 am	60	417	27	D	$5.00	60	400	26	C	$4.25	Better	Better	Better
9-Apr	8:31 - 8:45 am	62	417	26	C	-	62	415	26	C	$1.50	Equal	Equal	Better

Southbound Express

		With TDM					Without TDM					Difference		
9-Apr	8:46 - 9:00 am	54	352	26	C	-	54	368	27	D	$4.00	Worse	Worse	Worse
10-Apr	6:00 - 6:15 am	61	153	10	A	$0.50	61	175	11	A	$0.75	Equal	Worse	Worse
10-Apr	6:16 - 6:30 am	60	252	16	B	$0.50	60	277	18	B	$0.75	Equal	Worse	Worse
10-Apr	6:31 - 6:45 am	59	349	23	C	$1.50	59	355	24	C	$1.75	Equal	Worse	Worse
10-Apr	6:46 - 7:00 am	59	336	22	C	$3.00	59	361	24	C	$3.50	Equal	Worse	Worse
10-Apr	7:01 - 7:15 am	58	348	23	C	$0.00	58	367	25	C	$1.50	Equal	Worse	Worse
10-Apr	7:16 - 7:30 am	50	275	21	C	$0.00	50	328	26	C	$1.50	Equal	Worse	Worse
10-Apr	7:31 - 7:45 am	52	377	29	D	$3.00	52	381	29	D	$4.00	Equal	Equal	Worse
10-Apr	7:46 - 8:00 am	57	392	27	D	$4.25	57	380	26	C	$4.00	Better	Better	Better
10-Apr	8:01 - 8:15 am	63	408	25	C	$4.25	63	398	25	C	$4.25	Equal	Equal	Better
10-Apr	8:16 - 8:30 am	64	418	26	C	$4.00	64	401	25	C	$3.75	Equal	Better	Better
10-Apr	8:31 - 8:45 am	64	391	24	C	$3.75	64	379	23	C	$3.50	Equal	Better	Better
10-Apr	8:46 - 9:00 am	57	378	26	C	$3.75	57	373	26	C	$3.75	Equal	Equal	Better

Average Toll w/ TDM $2.77

Average Toll w/o TDM $3.18

Northbound Express

		With TDM					Without TDM					Difference		
Date	Time Period	Speed	Volume (per Lane)	Traffic Density	LOS	Toll	Speed	Volume (per Lane)	Traffic Density	LOS	Toll	LOS Change	Traffic Density Change	Volume Change
8-Apr	4:01 - 4:15 pm	60	367	24	C	$2.50	60	365	24	C	$2.50	Equal	Equal	Better
8-Apr	4:16 - 4:30 pm	63	370	23	C	$2.50	63	378	24	C	$2.75	Equal	Worse	Worse
8-Apr	4:31 - 4:45 pm	61	361	23	C	$2.75	61	369	24	C	$3.00	Equal	Worse	Worse
8-Apr	4:46 - 5:00 pm	59	368	24	C	$2.50	59	376	25	C	$2.75	Equal	Worse	Worse
8-Apr	5:01 - 5:15 pm	51	367	28	D	$2.75	51	362	28	D	$4.00	Equal	Equal	Better
8-Apr	5:16 - 5:30 pm	39	318	32	D	$4.00	39	323	33	D	$4.50	Equal	Worse	Worse
8-Apr	5:31 - 5:45 pm	30	279	37	E	$8.50	30	275	36	E	$8.50	Equal	Better	Better
8-Apr	5:46 - 6:00 pm	37	301	32	D	$10.50	37	299	32	D	$10.50	Equal	Equal	Better
8-Apr	6:01 - 6:15 pm	48	301	25	C	$9.50	48	289	24	C	$4.25	Equal	Better	Better
8-Apr	6:16 - 6:30 pm	49	276	22	C	$4.00	49	276	22	C	$4.00	Equal	Equal	Equal
8-Apr	6:31 - 6:45 pm	55	324	23	C	$3.00	55	313	22	C	$2.75	Equal	Better	Better
8-Apr	6:46 - 7:00 pm	62	327	21	C	$2.50	62	322	20	C	$2.25	Equal	Better	Better
9-Apr	4:01 - 4:15 pm	60	423	28	D	$3.00	60	422	28	D	$4.00	Equal	Equal	Better
9-Apr	4:16 - 4:30 pm	61	418	27	D	$4.00	60	426	28	D	$4.50	Equal	Worse	Worse
9-Apr	4:31 - 4:45 pm	60	394	26	C	$3.75	60	404	26	C	$3.75	Equal	Equal	Worse
9-Apr	4:46 - 5:00 pm	57	433	30	D	$3.75	57	443	31	D	$4.25	Equal	Worse	Worse
9-Apr	5:01 - 5:15 pm	52	394	30	D	$4.50	52	396	30	D	$4.50	Equal	Equal	Worse
9-Apr	5:16 - 5:30 pm	47	385	32	D	$5.50	47	393	33	D	$6.00	Equal	Worse	Worse
9-Apr	5:31 - 5:45 pm	50	334	26	C	$8.50	50	335	26	C	$4.25	Equal	Equal	Worse
9-Apr	5:46 - 6:00 pm	56	317	22	C	$0.00	56	327	23	C	$1.50	Equal	Worse	Worse
9-Apr	6:01 - 6:15 pm	51	244	19	C	$0.00	51	247	19	C	$1.50	Equal	Equal	Worse
9-Apr	6:16 - 6:30 pm	47	227	19	C	$0.00	47	240	20	C	$1.50	Equal	Worse	Worse
9-Apr	6:31 - 6:45 pm	56	377	27	D	$4.25	56	372	26	C	$4.00	Better	Better	Better
9-Apr	6:46 - 7:00 pm	65	277	17	B	$5.50	65	272	16	B	$1.50	Equal	Better	Better
10-Apr	4:01 - 4:15 pm	54	375	27	D	$2.75	54	372	27	D	$4.00	Equal	Equal	Better

Northbound Express

		With TDM					Without TDM					Difference		
10-Apr	4:16 - 4:30 pm	49	383	31	D	$3.25	49	395	32	D	$4.00	Equal	Worse	Worse
10-Apr	4:31 - 4:45 pm	47	361	30	D	$4.75	47	368	31	D	$5.25	Equal	Worse	Worse
10-Apr	4:46 - 5:00 pm	51	360	28	D	$5.50	51	369	28	D	$5.50	Equal	Equal	Worse
10-Apr	5:01 - 5:15 pm	48	377	31	D	$4.75	48	376	31	D	$4.75	Equal	Equal	Better
10-Apr	5:16 - 5:30 pm	44	359	32	D	$5.75	44	363	33	D	$6.25	Equal	Worse	Worse
10-Apr	5:31 - 5:45 pm	40	349	35	D	$5.75	40	347	34	D	$5.25	Equal	Better	Better
10-Apr	5:46 - 6:00 pm	49	352	28	D	$8.50	49	347	28	D	$8.50	Equal	Equal	Better
10-Apr	6:01 - 6:15 pm	56	311	22	C	$9.00	56	299	21	C	$4.25	Equal	Better	Better
10-Apr	6:16 - 6:30 pm	64	304	19	C	$6.00	64	304	19	C	$4.25	Equal	Equal	Equal
10-Apr	6:31 - 6:45 pm	60	317	21	C	$0.00	60	315	21	C	$1.50	Equal	Equal	Better
10-Apr	6:46 - 7:00 pm	63	246	15	B	$0.00	63	252	16	B	$0.50	Equal	Worse	Worse

Average Toll w/ TDM $4.27

Average Toll w/o TDM $4.08

Southbound General Purpose

		With TDM				Without TDM				Difference		
Date	Time Period	Speed	Volume (per lane)	Traffic Density	LOS	Speed	Volume (per lane)	Traffic Density	LOS	LOS Change	Traffic Density Change	Volume Change
8-Apr	6:00 - 6:15 am	58	308	21	C	58	339	23	C	Equal	Worse	Worse
8-Apr	6:16 - 6:30 am	56	398	28	D	56	432	31	D	Equal	Worse	Worse
8-Apr	6:31 - 6:45 am	50	435	34	D	50	459	36	E	Worse	Worse	Worse
8-Apr	6:46 - 7:00 am	45	427	37	E	45	462	41	E	Equal	Worse	Worse
8-Apr	7:01 - 7:15 am	39	397	40	E	39	434	44	E	Equal	Worse	Worse
8-Apr	7:16 - 7:30 am	31	331	42	E	31	393	50	F	Worse	Worse	Worse
8-Apr	7:31 - 7:45 am	26	313	47	F	26	349	53	F	Equal	Worse	Worse
8-Apr	7:46 - 8:00 am	29	343	47	F	29	372	51	F	Equal	Worse	Worse
8-Apr	8:01 - 8:15 am	29	343	47	F	29	373	52	F	Equal	Worse	Worse
8-Apr	8:16 - 8:30 am	28	323	45	E	28	348	49	F	Worse	Worse	Worse
8-Apr	8:31 - 8:45 am	31	330	42	E	31	349	45	E	Equal	Worse	Worse
8-Apr	8:46 - 9:00 am	33	348	42	E	33	369	45	E	Equal	Worse	Worse
9-Apr	6:00 - 6:15 am	59	306	20	C	59	336	22	C	Equal	Worse	Worse
9-Apr	6:16 - 6:30 am	57	415	29	D	57	446	31	D	Equal	Worse	Worse
9-Apr	6:31 - 6:45 am	52	435	33	D	52	460	35	D	Equal	Worse	Worse
9-Apr	6:46 - 7:00 am	35	343	39	E	35	386	44	E	Equal	Worse	Worse
9-Apr	7:01 - 7:15 am	30	316	42	E	30	357	48	F	Worse	Worse	Worse
9-Apr	7:16 - 7:30 am	31	345	44	E	31	407	52	F	Worse	Worse	Worse
9-Apr	7:31 - 7:45 am	32	379	47	F	32	415	51	F	Equal	Worse	Worse
9-Apr	7:46 - 8:00 am	30	346	45	E	30	374	49	F	Worse	Worse	Worse
9-Apr	8:01 - 8:15 am	28	323	45	E	28	356	50	F	Worse	Worse	Worse
9-Apr	8:16 - 8:30 am	28	335	48	F	28	356	51	F	Equal	Worse	Worse
9-Apr	8:31 - 8:45 am	30	352	47	F	30	365	48	F	Equal	Worse	Worse
9-Apr	8:46 - 9:00 am	32	353	44	E	32	368	46	F	Worse	Worse	Worse

Southbound General Purpose

		With TDM				Without TDM				Difference		
10-Apr	6:00 - 6:15 am	54	281	20	C	54	309	23	C	Equal	Worse	Worse
10-Apr	6:16 - 6:30 am	51	377	29	D	51	409	31	D	Equal	Worse	Worse
10-Apr	6:31 - 6:45 am	46	402	34	D	46	426	36	E	Worse	Worse	Worse
10-Apr	6:46 - 7:00 am	44	394	36	E	44	437	40	E	Equal	Worse	Worse
10-Apr	7:01 - 7:15 am	40	374	37	E	40	410	41	E	Equal	Worse	Worse
10-Apr	7:16 - 7:30 am	36	362	39	E	36	419	46	F	Worse	Worse	Worse
10-Apr	7:31 - 7:45 am	35	351	40	E	35	379	43	E	Equal	Worse	Worse
10-Apr	7:46 - 8:00 am	36	337	37	E	36	368	40	E	Equal	Worse	Worse
10-Apr	8:01 - 8:15 am	42	338	32	D	42	370	35	D	Equal	Worse	Worse
10-Apr	8:16 - 8:30 am	40	352	35	D	40	373	37	E	Worse	Worse	Worse
10-Apr	8:31 - 8:45 am	40	334	33	D	40	352	35	D	Equal	Worse	Worse
10-Apr	8:46 - 9:00 am	44	331	30	D	44	355	32	D	Equal	Worse	Worse

Northbound General Purpose

		With TDM				Without TDM				Difference		
Date	Time Period	Speed	Volume	Traffic Density	LOS	Speed	Volume	Traffic Density	LOS	LOS Change	Traffic Density Change	Volume Change
8-Apr	4:01 - 4:15 pm	40	379	38	E	40	389	39	E	Equal	Worse	Worse
8-Apr	4:16 - 4:30 pm	40	392	39	E	40	429	42	E	Equal	Worse	Worse
8-Apr	4:31 - 4:45 pm	41	382	37	E	41	413	40	E	Equal	Worse	Worse
8-Apr	4:46 - 5:00 pm	42	384	36	E	42	427	40	E	Equal	Worse	Worse
8-Apr	5:01 - 5:15 pm	40	373	37	E	40	408	40	E	Equal	Worse	Worse
8-Apr	5:16 - 5:30 pm	33	352	43	E	33	398	48	F	Worse	Worse	Worse
8-Apr	5:31 - 5:45 pm	25	305	48	F	25	324	51	F	Equal	Worse	Worse
8-Apr	5:46 - 6:00 pm	24	314	52	F	24	338	56	F	Equal	Worse	Worse
8-Apr	6:01 - 6:15 pm	24	335	55	F	24	347	57	F	Equal	Worse	Worse
8-Apr	6:16 - 6:30 pm	20	273	55	F	20	295	60	F	Equal	Worse	Worse
8-Apr	6:31 - 6:45 pm	22	295	53	F	22	300	54	F	Equal	Worse	Worse
8-Apr	6:46 - 7:00 pm	32	377	47	F	32	391	48	F	Equal	Worse	Worse
9-Apr	4:01 - 4:15 pm	49	278	22	C	45	288	25	C	Equal	Worse	Worse
9-Apr	4:16 - 4:30 pm	46	349	30	D	46	390	33	D	Equal	Worse	Worse
9-Apr	4:31 - 4:45 pm	39	402	41	E	39	430	44	E	Equal	Worse	Worse
9-Apr	4:46 - 5:00 pm	38	355	36	E	38	396	41	E	Equal	Worse	Worse
9-Apr	5:01 - 5:15 pm	44	339	31	D	44	370	33	D	Equal	Worse	Worse
9-Apr	5:16 - 5:30 pm	42	369	35	D	42	411	39	E	Worse	Worse	Worse
9-Apr	5:31 - 5:45 pm	35	396	44	E	35	415	47	F	Worse	Worse	Worse
9-Apr	5:46 - 6:00 pm	32	389	48	F	32	403	50	F	Equal	Worse	Worse
9-Apr	6:01 - 6:15 pm	33	380	46	F	33	383	46	F	Equal	Equal	Worse
9-Apr	6:16 - 6:30 pm	39	393	40	E	39	412	42	E	Equal	Worse	Worse
9-Apr	6:31 - 6:45 pm	49	401	32	D	49	405	33	D	Equal	Worse	Worse
9-Apr	6:46 - 7:00 pm	54	369	27	D	53	383	28	D	Equal	Worse	Worse
10-Apr	4:01 - 4:15 pm	32	370	45	E	32	380	47	F	Worse	Worse	Worse

Northbound General Purpose

		With TDM				Without TDM				Difference		
10-Apr	4:16 - 4:30 pm	31	370	48	F	31	411	53	F	Equal	Worse	Worse
10-Apr	4:31 - 4:45 pm	31	371	48	F	31	403	52	F	Equal	Worse	Worse
10-Apr	4:46 - 5:00 pm	31	373	47	F	31	411	52	F	Equal	Worse	Worse
10-Apr	5:01 - 5:15 pm	31	374	48	F	31	406	53	F	Equal	Worse	Worse
10-Apr	5:16 - 5:30 pm	29	369	50	F	29	408	55	F	Equal	Worse	Worse
10-Apr	5:31 - 5:45 pm	29	363	50	F	29	384	53	F	Equal	Worse	Worse
10-Apr	5:46 - 6:00 pm	31	371	48	F	31	393	51	F	Equal	Worse	Worse
10-Apr	6:01 - 6:15 pm	35	383	43	E	35	395	44	E	Equal	Worse	Worse
10-Apr	6:16 - 6:30 pm	38	380	40	E	38	407	43	E	Equal	Worse	Worse
10-Apr	6:31 - 6:45 pm	39	385	39	E	39	387	39	E	Equal	Equal	Worse
10-Apr	6:46 - 7:00 pm	48	389	32	D	48	398	33	D	Equal	Worse	Worse

References

Burris, M. (2009). Investigating the Impact of Tolls on High Occupancy Vehicle Lanes Using Managed Lanes. *Transportation Research Record: Journal of the Transportation Research Board, No. 2099*, 113-122.

Cain, A., Van Nostrand, C., & Flynn, J. (2010). Impact of Miami, Florida, Urban Partnership Agreement Phase 1A on Transit User Perceptions of I-95 Express Bus Service. *Transportation Research Record: Journal of the Transportation Research Board, No. 2144*, 44-51.

Federal Highway Administration. (2008). *A Compendium of Existing HOV Lane Facilities in the United States.* Washington, D.C.: U.S. Department of Transportation Federal Highway Administration.

Florida Department of Transportation. (2013). *Commuting Trends in Florida.* Tallahassee: Florida Department of Transportation.

Goodin, G. (2009). *The Role of Preferential Treatment for Carpools in Managed Lanes.* Austin: Texas Transportation Institute.

Goodin, G. (2013). *Briefing Paper: Toward a Best Practice Model for Managed Lanes in Texas.* College Station: Texas Transportation Institute.

Munnich, L., & Buckeye, K. (1996). I-394 MnPass High Occupancy Toll Lanes: Planning and Operational Issues and Outcomes (Lessons Learned in Year 1). *Transportation Research Record: Journal of the Transportation Research Board, No. 1996*, 49-57.

Pessaro, B., Turnbull, K., & Zimmerman, C. (2013). Impacts to Transit from Variably Priced Toll Lanes. *Transportation Research Record: Journal of the Transportation Research Board*, not yet published.

Supernak, J., Brownstone, D., Golob, J., Kaschade, C., Kazimi, C., & Steffey, D. (2001). *I-15 Congestion Pricing Project Monitoring and Evaluation Services: Task 13 Phase II Year Three Overall Report.* San Diego: San Diego State University Foundation.

Swisher, M., Eisele, W., Ungemah, D., & Goodin, G. (2003). Life-Cycle Graphical Representation of Managed High-Occupancy Vehicle Lane Evolution. *Transportation Research Record: Journal of the Transportation Research Board, No. 1856*, 161-167.

Turnbull, K. (2008). High Occupancy Toll Lanes and Public Transportation. *Transportation Research Record: Journal of the Transportation Research Board, No. 2065*, 36-40.

Ungemah, D., Goodin, G., Dusza, C., & Burris, M. (2007). Examining Incentives and Preferential Treatment of Carpools on Managed Lane Facilities. *Journal of Public Transportation, Vol. 10, No. 4*, 151-169.

Winters, P., Labib, N., Rai, S., & Zhou, L. (2007). *Impact of Employer-based Programs on Transit System Ridership and Transportation System Performance.* Tampa: National Center for Transit Research.