STATE ROAD AND TOLLWAY AUTHORITY

Study of Potential Managed Lanes on I-75 South Corridor

STUDY OF POTENTIAL
MANAGED LANES ON
I-75 SOUTH CORRIDOR

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FINAL

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EXECUTIVE SUMMARY

Introduction

Managed Lanes and Value Pricing have become hot topics in the transportation arena to reduce congestion, increase safety, and improve reliability. The I-75 South Corridor is currently recognized as one of the most congested in Atlanta. Both residential and commercial activities have burgeoned in this area over the past decade. This growth, combined with activity at Hartsfield-Jackson Atlanta International Airport and an increasing number of warehouse and distribution facilities concentrated in the area, contributes to the need for improved mobility and congestion relief along the corridor.

Managed lanes refer to a combination of management tools and techniques used to improve efficiency and meet certain corridor and community objectives. The combination of management tools includes High Occupancy Vehicle (HOV) lanes, High Occupancy Toll (HOT) lanes, Truck Only Toll (TOT) lanes, and special use lanes such as express, bus-only, or truck-only.

The I-75 South Managed Lanes Study was intended to evaluate the proper combination and configuration of managed lanes along the I-75 South corridor from I-285 south to SR 16 in Butts County. Managed lanes are proposed to accommodate the expected increase in travel demand, provide a corridor with guaranteed mobility referred to also as "congestion insurance", and provide a guideway for the increasingly popular commuter express bus services operating in the corridor. The study goals are three fold:

- Evaluate the feasibility of value pricing techniques on the I-75 corridor to better manage travel and optimize the use of the corridor;
- Evaluate specific techniques to address the efficient movement of freight; and
- Identify the most efficient use of public funds in the corridor to optimize system benefits.

1.0 Existing Traffic Conditions

During the last several decades, the Atlanta Region has experienced enormous growth. Between 1980 and 2000, the population of the United States increased by 20 percent, while during the same period, the population of Georgia grew by 50 percent, and the population of the 20-County Atlanta region increased by a dramatic 84 percent. In particular, the counties surrounding the I-75 South Corridor, Clayton, Henry, and Spalding are some of the fastest growing counties in Georgia, the southeast, and the Nation. Henry County specifically has seen a dramatic increase in population between 1980 and 2000: an astounding increase of 229 percent. Clayton County saw an increase of 57 percent, and Spalding County experienced an increase of 22 percent, during that same time period.

Accompanying the recent population and employment growth of the 1990s and 2000s was a dramatic increase in traffic volumes and travel demand. One clear manifestation

of those increases was congestion levels that have worsened year by year, particularly on major roadways, in the peak commute periods.

Congestion is an increasing problem in the I-75 and I-675 corridors. With anticipated growth in population and employment along these corridors, coupled with increasing demand in freight traffic nation-wide, congestion is expected to increase dramatically over the next 25 years. As part of this study, contributing factors to existing travel conditions along these corridors were explored. Specific findings include:

- I-75 southbound (SB) typically experiences severe PM peak delays from I-285 to Forest Parkway and from SR 54 to Hudson Bridge Road/Eagles Landing Parkway.
- I-75 northbound (NB) typically experiences severe AM peak delays from Hampton-McDonough Road to I-675 and from Old Dixie Highway to I-285.
- I-675 SB typically experiences brief heavy congestion at the lane drop near Ellenwood Road and then severe congestion where it merges with I-75.
- I-675 NB typically experiences moderate congestion approaching SR 42 (Macon Highway) and then again as the highway merges with I-285.
- The primary reason for increasing congestion directly correlates to the projected increases in population and employment. Over the next 25 years, households and employment along the I-75 South study corridor are forecasted to increase by 77% and 47% respectively. In 2030, I-75 south corridor is anticipated to be the 3rd most populous corridor in the metro Atlanta area.
- I-75 south corridor carries significant heavy truck through traffic from the mid-west to Florida. The forecasted increase in truck traffic (annual growth rate of 3%) will further worsen traffic congestion along the I-75 south corridor.

2.0 Stated Preference Survey

Some key questions to consider when introducing managed lanes are:

- What is the public's willingness to pay tolls for improved transportation services?
- What is their value of time savings?

The assessment of potential managed lanes users' willingness to pay tolls in exchange for improved transportation services was accomplished through stated preference (SP) research. Telephone-based stated preference surveys were conducted to obtain feedback from the public. The SP analysis was designed to provide behavioral values for use in modeling traffic and revenue impacts of alternative strategies in the proposed managed lanes. SP surveying was conducted from April to June of 2007. The results of the SP analysis were applied within ARC's travel demand model calibrated along the I-75 South Corridor between I-285 and SR 16.

The primary outputs sought from the SP research were values of travel time savings and possibly 'alternative-specific constants,' which measures underlying bias towards an alternative. Values were required for each key market segment within the ARC model.

The travel demand model contains a detailed coded and validated network of the Atlanta regional highway system. The managed lanes have been coded into forecast year networks for which vehicle matrices have also been created. The impact of alternative roadway allocations resulting from allowing single occupant vehicles (SOVs) to buy into the managed lanes at various toll rates was then tested by modifying the networks and re-running the model.

3.0 Safety and Operations

Traffic volumes for I-75 South were obtained from a variety of sources including Georgia Department of Transportation's (GDOT's) State Traffic and Report Statistics (STARS) website and roadway crash data in the study area for years 2003, 2004, 2005 and 2006 collected from GDOT's Statewide Crash Database. The crash data collected for each of the study segments was reviewed and compared against statewide averages. Crash data analysis indicates that much of the study area experienced a higher than average crash frequency and severity over the evaluation period. Overall for the entire study area, the predominant crash type over all three years was rear-end crash.

The following conclusions are drawn from operational analysis of the AM and PM peak period under existing conditions.

- Along the study corridor, through volumes on I-75 generally increase from SR 16 on the south to I-285 on the north. At most interchanges, volume drops at off-ramps and increases often significantly at on-ramps.

- The AM freeway traffic displays an apparent directional distribution, with northbound volumes significantly higher than southbound volumes.

- The PM freeway traffic displays an apparent directional distribution, with southbound volumes significantly higher than northbound volumes especially in the area in or close to the City of Atlanta.

- Vehicular speed of both directions exhibits a general decreasing trend from SR 16 to I-285, i.e., the closer to the City of Atlanta, the lower the vehicular speed.

- Density of both directions exhibits a general increasing trend from SR 16 on the south, to I-285 on the north, i.e., the closer to the City of Atlanta, the higher the density.

- Significant congestions, reflected by high lost time, high density and low average speed, occur In the vicinity of the following interchanges along I-75: I-285, Old Dixie Highway, SR 54, Stockbridge Highway, I-675, Hudson Bridge Road, Jonesboro Road/CR 920, McDonough Road and Hampton-McDonough Road. Notable causes of congestions in these areas include high traffic volumes, insufficient capacity and merging/diverging.

4.0 Managed Lane Investment Alternatives

The combination and configuration of the managed lane system influences the traffic and toll revenue estimates. In order to assess the variations between different types of managed lane systems, eight investment alternatives were identified for evaluation along the I-75 South corridor.

Alternative A-1: This alternative assumed the construction of two managed lanes in each direction along the I-75 South corridor from I-285 to SR 16 with a HOT2+ occupancy policy. HOT2+ refers to a tolling alternative that would allow HOVs with two or more people to ride free along with transit vehicles, emergency/police vehicles, and motorcycles. Single Occupant Vehicles (SOV) and Commercial Vehicles (CV) including commercially registered autos, pickup trucks, and vans would pay a toll to use the HOT lanes. It was assumed that medium-duty and heavy-duty trucks would not be allowed to utilize the HOT lanes in this alternative.

Alternative A-2: This alternative assumed the construction of two managed lanes in each direction along the I-75 South corridor from I-285 to SR 16 with a HOT3+ occupancy policy. HOT3+ refers to a tolling alternative that would allow HOVs with three or more people to ride free along with transit vehicles, emergency/police vehicles, and motorcycles. Single Occupant Vehicles (SOV) and Commercial Vehicles (CV) including commercially registered autos, pickup trucks, and vans would pay a toll to use the HOT lanes. It was assumed that medium-duty and heavy-duty trucks would not be allowed to utilize the HOT lanes in this alternative.

Alternative A-3: This alternative assumed the construction of two Express Toll Lanes (ETL) for passenger cars in each direction along the I-75 South corridor from I-285 to SR 16. ETL refers to a tolling alternative that all passenger car traffic including SOVs, HOVs, and CVs would pay a toll to use the ETL. Transit vehicles, emergency/police vehicles, and motorcycles would be allowed to use the ETL for free. It was assumed that medium-duty and heavy-duty trucks would not be allowed to utilize the ETL in this alternative.

Alternative B: This alternative assumed the construction of two voluntary Truck Only Toll (TOT) lanes in each direction along the length of I-675 and I-75 South corridor from I-675 to SR 16. Voluntary TOT lane refers to a truck tolling alternative that would allow medium-duty trucks (FHWA classes 4-7) and heavy duty trucks (FHWA classes 8-13) to pay a toll to use the lanes. It was assumed that passenger cars and commercial vehicles would not be allowed to utilize the TOT lanes.

Alternative C-1: This alternative is the combination of Alternative A-1 and Alternative B. It assumed the construction of two managed lanes along the I-75 South corridor from I-285 to SR 16 with occupancy policy of HOT2+; and two voluntary TOT lanes in each direction along the length of I-675 and I-75 South corridor from I-675 to SR 16.

Alternative C-2: This alternative is the combination of Alternative A-2 and Alternative B. It assumed the construction of two managed lanes along the I-75 South corridor from I-285 to SR 16 with occupancy policy of HOT3+; and two voluntary TOT lanes in each direction along the length of I-675 and I-75 South corridor from I-675 to SR 16.

Alternative C-3: This alternative is the combination of Alternative A-3 and Alternative B. It assumed the construction of two ETL for passenger cars along the I-75 South corridor from I-285 to SR 16; and two voluntary TOT lanes in each direction along the length of I-675 and I-75 South corridor from I-675 to SR 16.

Alternative D: This alternative assumed the construction of two ETL for all vehicles in each direction along the I-75 South corridor from I-285 to SR 16. It was assumed that all vehicles including SOVs, HOVs, commercial vehicles, medium-duty trucks and heavy-duty trucks would pay a toll to use the ETL in this case.

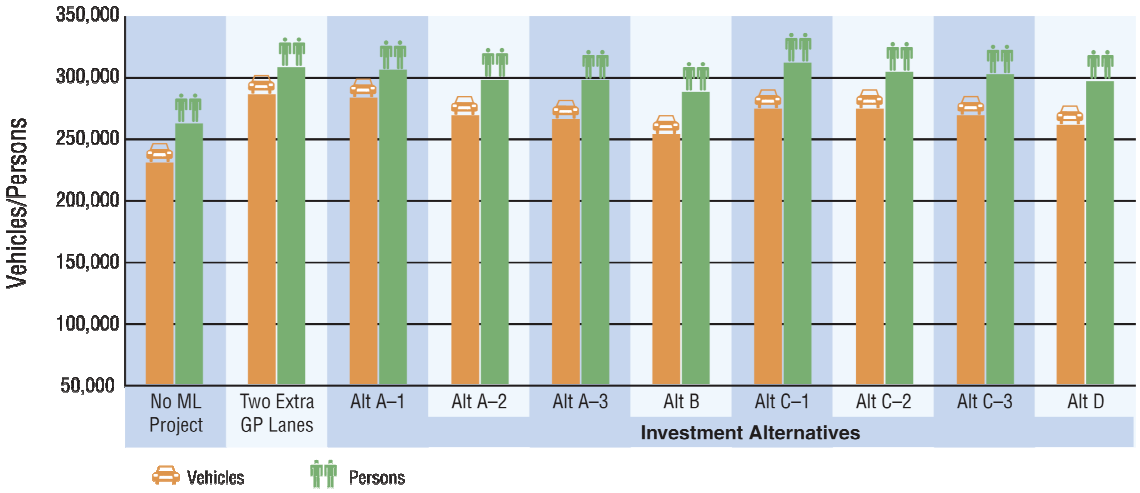
5.0 System Analysis

The following summary observations can be made based upon the modeling and traffic analyses conducted in this study:

- All eight managed lane investment alternatives have an overall impact on the travel demand, travel patterns, and traffic operations in the I-75 south corridor.

- The travel demand analyses show increases in person and vehicle volumes with all eight managed lane investment alternatives. Figure 1 shows the total daily vehicle and person demand on I-75 South in 2030 at the key location just north of Hudson Bridge Road. Compared to the baseline scenario (i.e. no managed lanes are constructed in the corridor), the total daily vehicle volume is forecasted to increase by a range of six percent to 20 percent in 2020 and seven percent to 16 percent in 2030; while the total daily person volume is forecasted to increase by a range of six percent to 22 percent in 2020 and eight percent to 20 percent in 2030. Investment Alternatives C1- C3, which include the construction of both managed lanes and voluntary TOT lanes, are forecasted to have the greatest increase in both person and vehicle volumes in the study corridor.

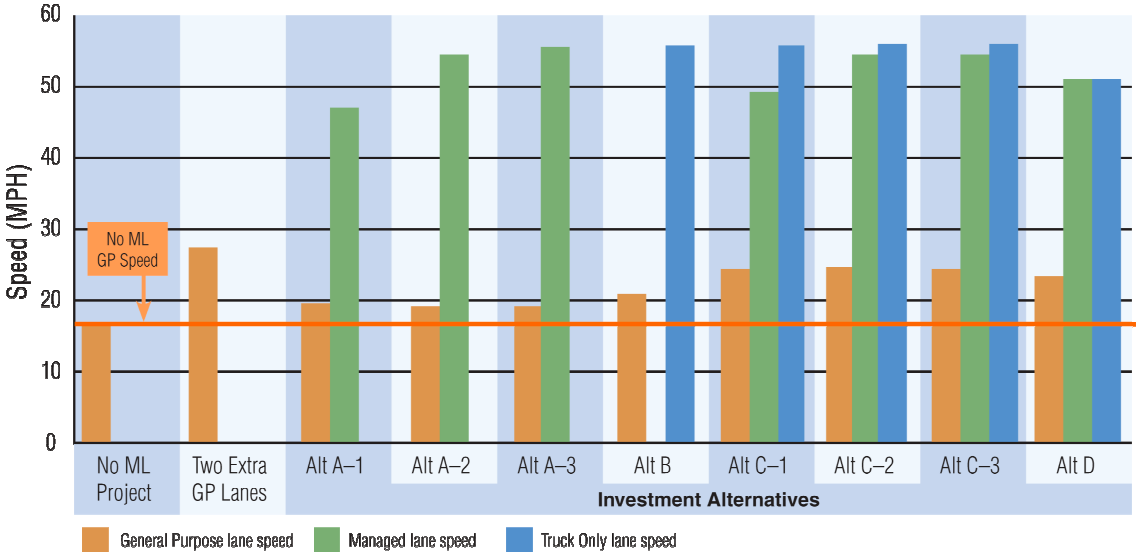
Figure 1: 2030 Corridor Daily Demand – Vehicles & Persons



- Constructing managed lanes and TOT lanes can provide reliable travel time and travel speed (at or above 45 mph) for people who choose to use managed lanes. Figure 2 shows the average travel speeds during the most congested travel periods,

AM peak period and PM peak period in 2030 on GP lanes, managed Lanes and TOT lanes. The analysis also shows improvements to operating conditions on the I-75 South GP lanes with managed lane/TOT lane investments. The weighted average speeds on the GP lanes along the corridor improve by the range of four to 13 mph in peak period in 2020 and six to 13 mph by 2030. However, congestion is not eliminated in the existing lanes, due to the attraction of additional vehicles from parallel facilities.

Figure 2: 2030 Corridor Travel Speeds
– General Purpose (GP) Lanes vs. Managed Lanes (ML)



- Building two-extra general purpose lanes each direction along the corridor will increase both total daily vehicle volumes and person volumes, but it can not provide guaranteed mobility in the long run. The operating travel speed in 2030 under two-extra GP lane scenario is below 30 mph.

- The additional capacity offered by Managed Lanes, results in the diversion of traffic from the two major parallel corridors in 2030:
    - US23/SR42
        - 14 percent to 41 percent decreases in total vehicle delay
        - two percent to 10 percent decreases in Vehicle Miles Traveled
        - seven percent to 22 percent decreases in Vehicle Hours Traveled
    - US19/US41
        - 13 percent to 30 percent decreases in total vehicle delay
        - two percent to six percent decreases in Vehicle Miles Traveled
        - four percent to 13 percent decreases in Vehicle Hours Traveled

- The analysis shows a significant reduction in total vehicle delay within the 5-mile transportation system. The total daily vehicle delay deceases by a range of 10 percent to 33 percent.

- While all of the eight managed lane investment alternatives have a slightly higher VMT compared to the baseline scenario, they all have greater positive impacts on

VHT. Alternatives C1- C3, which include the construction of both managed lanes and voluntary TOT lanes, have larger absolute and percentage changes on VHT within the 5-mile transportation system.

- Managed lanes provide an incentive to transit riders as transit vehicles achieve a travel time advantage as opposed to vehicles in the general-purpose lanes. By using the managed lanes, transit operators create a competitive option to the single occupant vehicle and help to reduce the number of cars in the general purpose lane that were driving alone.

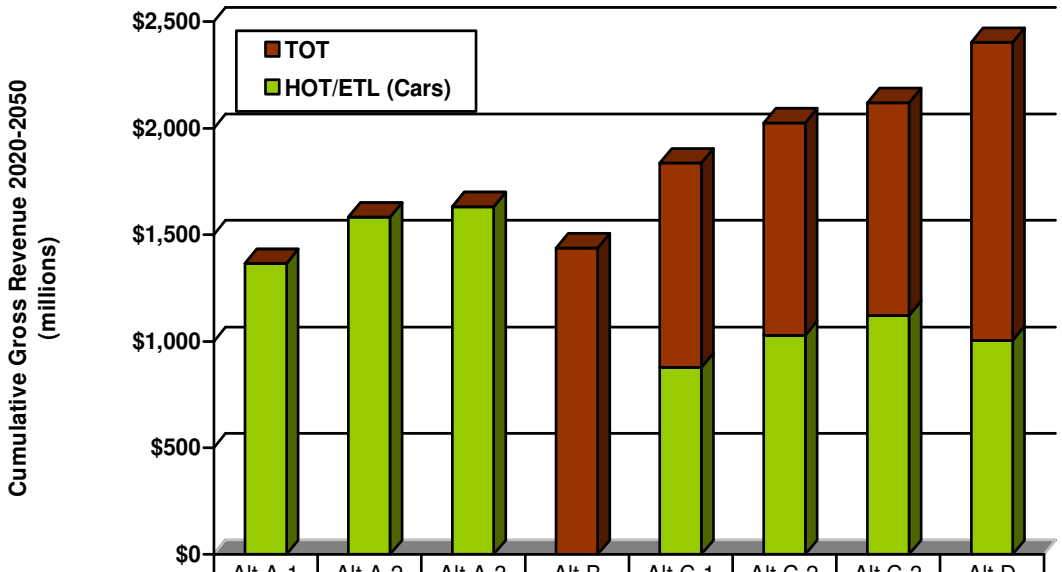
6.0 Revenue Estimates

Modeled Gross Revenue

Modeled Gross Revenue is the predicted toll collections in every year of the forecast horizon (year 2020 – year 2050), in which it is assumed that the modeled nominal toll rates will be adjusted annually for both inflation and growing demand so as to maintain optimality for the assumed tolling objectives.

Based upon the projected traffic volumes and toll rates recommended, the gross revenue was calculated for each model year (2020 and 2030); then the revenue streams were developed through 2050. A ramp-up period is assumed for the first four years of operation during which public acceptance is developing; Ramp Up schedule = 55% (Year 2020); 65% (Year 2021); 80% (Year 2022); and 97% (year 2023). Figure 3 and Figure 4 shows the accumulated gross revenue in 2007 dollars and in inflated dollars for each of the eight managed lane investment alternatives.

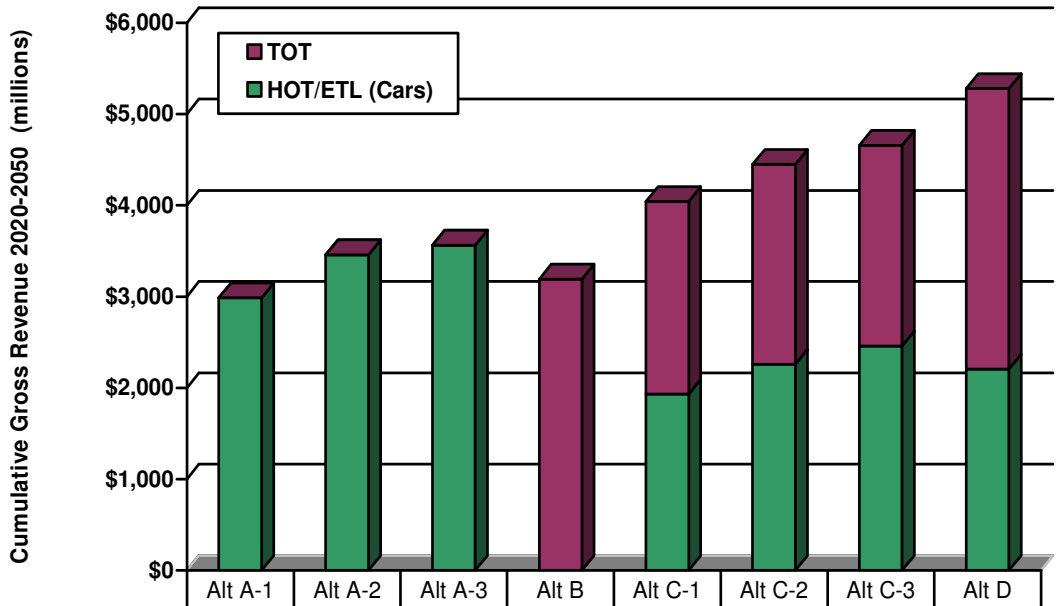
Figure 3: Cumulative Gross Revenue Summary 2020-2050 (in 2007 $)



	Alt A-1	Alt A-2	Alt A-3	Alt B	Alt C-1	Alt C-2	Alt C-3	Alt D
TOT	0	0	0	1,439	959	997	999	1,399
HOT/ETL (Cars)	1,366	1,583	1,632	0	878	1,029	1,121	1,004

Investment Alternatives

Figure 4: Cumulative Gross Revenue Summary 2020-2050 (in inflated $)



	Alt A-1	Alt A-2	Alt A-3	Alt B	Alt C-1	Alt C-2	Alt C-3	Alt D
TOT	0	0	0	3,193	2,110	2,189	2,194	3,073
HOT/ETL (Cars)	2,988	3,458	3,562	0	1,931	2,259	2,461	2,206

Investment Alternatives

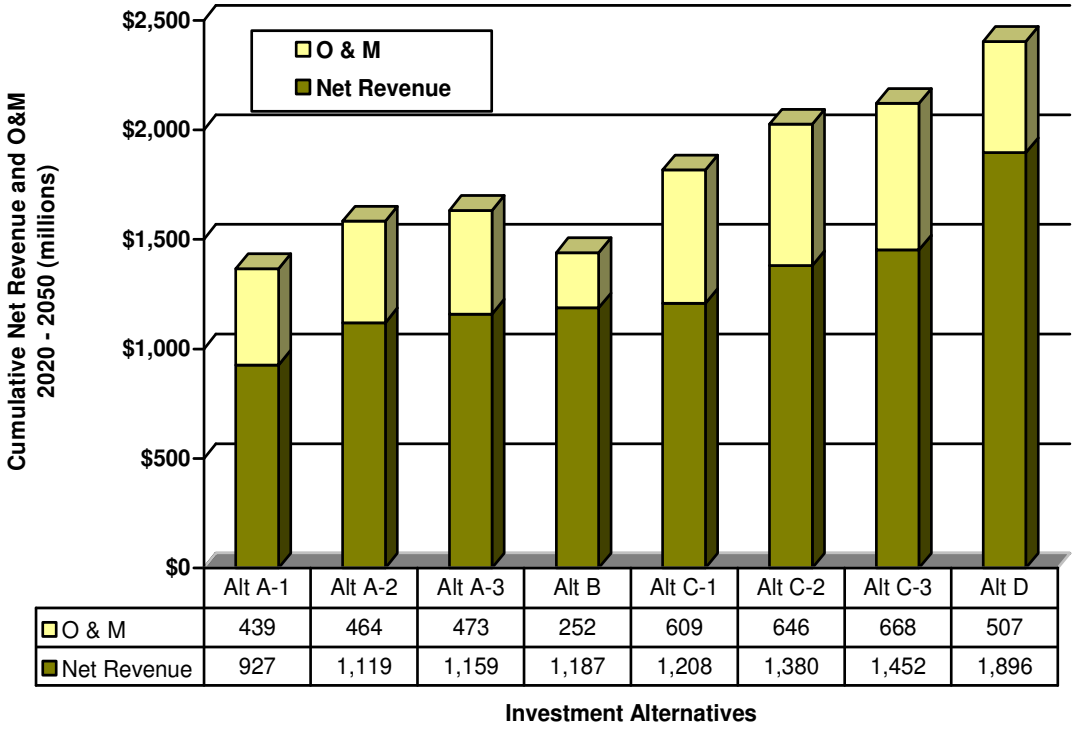
Net Revenue Estimates

Net Revenue is a measure of net financial revenue, which is based on the modeled adjusted gross revenue in the year of opening, less operating and maintenance costs and less enforcement cost. Net revenues are those available for debt service payments.

To compute the net revenue, tolling and infrastructure operating and maintenance costs are deducted from the gross annual gross revenue.

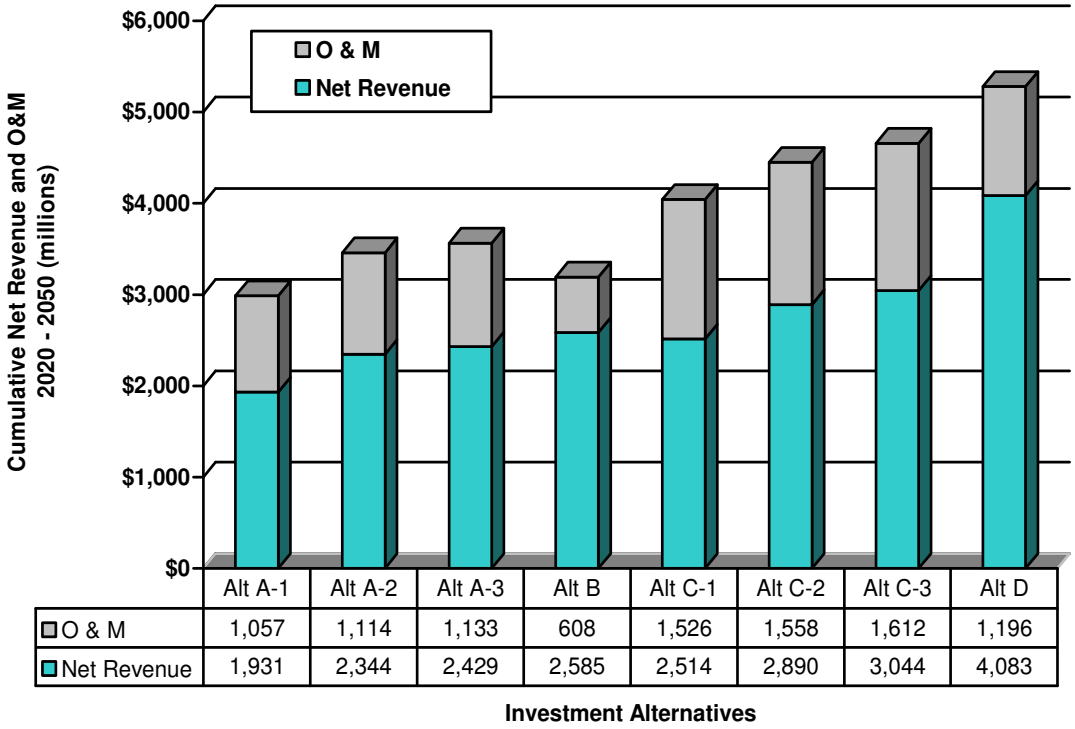
Figure 5 and Figure 6 shows the accumulated net revenue and operation and maintenance cost from 2020 to 2050 in 2007 dollars and in inflated dollars for each of the eight managed lane investment alternatives.

Figure 5: Cumulative Net Revenue Summary 2020-2050 (in 2007 $)



	Alt A-1	Alt A-2	Alt A-3	Alt B	Alt C-1	Alt C-2	Alt C-3	Alt D
O & M	439	464	473	252	609	646	668	507
Net Revenue	927	1,119	1,159	1,187	1,208	1,380	1,452	1,896

Figure 6: Cumulative Net Revenue Summary 2020-2050 (in inflated $)



	Alt A-1	Alt A-2	Alt A-3	Alt B	Alt C-1	Alt C-2	Alt C-3	Alt D
O & M	1,057	1,114	1,133	608	1,526	1,558	1,612	1,196
Net Revenue	1,931	2,344	2,429	2,585	2,514	2,890	3,044	4,083

7.0 Toll Technology

As priced facilities, managed lanes entail operational needs above and beyond those of traditional facilities – such as toll collection and enforcement. The I-75 South corridor will be comprised of two separate managed lane systems: one will facilitate passenger car movement and the other will be dedicated to trucks. Based on a toll, both systems enable each vehicle type to traverse through the I-75 South corridor with more reliable travel times. Toll collection technology has evolved in response to the introduction of managed lane systems that require complex transactions and have multiple occupancy and eligibility requirements.

Generally, two main system concepts can be applied while tolling a corridor: Open-Barrier and Closed-Barrier Toll Collection Systems. Open-Barrier Toll Collection System design consists of multiple toll stations along a facility. A single trip on the facility may require payments at all the toll stations that are traversed. Closed-Barrier Toll Collection System design has toll collection points at all entrances and exits. Since tolls are distance based, the system records the vehicle's point of entry and based on the miles traveled, charges it a toll rate at the point of exit.

Irrespective of which system is used, the toll collection system design should be able to record the following significant parameters of a vehicle's travel through the managed lane or truck only toll lane system:

- Time and place of vehicle's entry in the tolled lane;
- Number of tolling zones passed through; and
- Time and place of vehicle's exit from the tolled lane.

8.0 Total Capital Costs (Roadway + Tolling)

Preliminary cost estimates were developed for both roadway and tolling systems. The cost estimates are in present dollars and are not adjusted for possible year of expenditure, since the schedule for the project can not yet been determined. It is important to note that decisions still outstanding i.e. engineering and policy issues may significantly increase the capital cost estimates. As further detail is developed for the engineering concepts, project cost estimates will be refined and updated.

Capital costs were developed to provide a conceptual level estimate for three (3) major configurations of managed lanes and/or TOT lanes along the study corridor. They are:

- Managed Lanes or ETL Only – two (2) lanes per direction;
- TOT Lanes Only – two (2) lanes per direction; and
- Combined Managed Lanes and TOT Lanes
    - Four (4) lanes per direction on I-75 South from I-675 to SR16
    - Two (2) TOT lanes per direction on I-675
    - Two (2) managed lanes per direction on I-75 South from I-285 to I-675.

The following six major elements were included in the capital cost estimation:

- Right of Way Cost ;

- Construction Cost (including Utility Cost);
- Contingency;
- Preliminary Engineering Cost;
- Mobilization Cost; and
- Cost Escalation over the construction length;

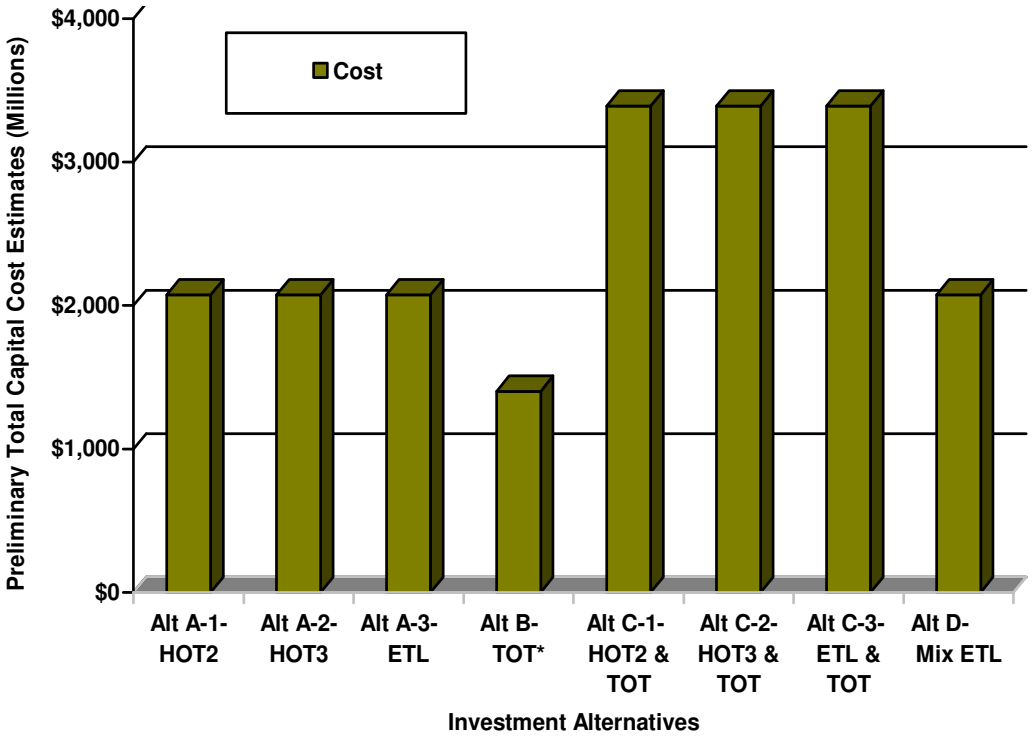
A preliminary estimate of system tolling costs was prepared based on each tolling concept plan for the managed lanes components. Concept T-B-2, a Closed Toll Collection System with enforcement through random checks of eligibility along the corridor, is considered the most favorable option based on a qualitative assessment. Therefore, the tolling capital cost of Concept T-B-2 is used for the managed lane and ETL alternatives (A1-A3 and D). The tolling capital cost of Concept T-B-2 and Truck Only Toll Lanes are summed up to illustrate the total tolling equipment cost for managed lane alternatives C1-C3 (the combination of Alternative A1-A3 and TOT lanes).

Table 1 and Figure 7 show the roadway construction cost, tolling capital cost and total capital cost for each of the eight managed lane investment alternatives.

Table 1: Roadway Capital Construction and Tolling Capital Cost (in 2007 $)

Managed Lanes Alternatives	Roadway Construction Cost (,000)	Tolling Capital Cost (,000)	Total Capital Cost (,000)
A1	$2,053,272	$21,031	$2,074,303
A2	$2,053,272	$21,031	$2,074,303
A3	$2,053,272	$21,031	$2,074,303
B	$1,389,638	$11,500	$1,401,138
C1	$3,358,155	$32,531	$3,390,686
C2	$3,358,155	$32,531	$3,390,686
C3	$3,358,155	$32,531	$3,390,686
D	$2,053,272	$21,031	$2,074,303

Figure 7: Preliminary Total Capital Cost Estimates (in 2007 $)



9.0 Preferred Alternative

Based on the combined assessment of traffic and toll revenue, system analysis, toll technology, and capital costs, Alternative A-3 Express Toll Lanes (Cars Only) was considered to be the alternative that provides the most efficient use of public funds. Alternative A-3 has good revenue potential vs. its estimated costs and also operational advantages by limiting to autos only without the need for occupancy enforcement.

Alternative D (mixed ETL) is another alternative to keep in close consideration for further evaluation. Operationally, Alternative D (mixed ETL) needs further analysis of larger vehicles mixing with smaller vehicles when planning roadway characteristics of the managed lane facility. Extra planning is required to guarantee that cars and trucks, with different operational characteristics, can share the facility safely and efficiently.

Alternatives A-1 (HOT2+) and A-2 (HOT3+) were eliminated based on service provided, financial viability (cost vs. benefits), and vehicle occupancy enforcement limitations. Alternative B (TOT) does not maximize benefits during the peak periods since passenger cars cannot take advantage of the lane. Alternatives C-1 (HOT2+/TOT), C-2 (HOT3+/TOT), and C-3 (ETL/TOT) have a very large footprint due to the number of lanes (4 additional lanes each direction) and therefore have a very high cost for the amount of traffic that will benefit.

As the preferred alternative, Alternative A-3 was further explored utilizing three sensitivity tests to explore future scenarios in the corridor including an increase in willingness to pay (resulting in higher potential revenue), incorporation of additional land use and transportation improvements resulting from the Atlanta Regional Commission

(ARC) Southern Regional Accessibility Study (resulting in lower potential revenue). Another sensitivity test was performed to assess the impacts to traffic and toll revenue of three-lane mixed ETL configuration in each direction on I-75 South corridor from SR 16 to I-285.

10.0 Recommendations and Next Steps

The intent of this study is to determine the financial and operational feasibility of the managed lanes (HOT, ETL, TOT) on the I-75 South corridor, through a planning-level analysis, and to initiate a process that may ultimately lead to future project implementation and operations.

Preliminary traffic/revenue estimates and cost estimates were analyzed for eight managed lane investment alternatives in the study. The assumptions regarding the revenue and cost at this preliminary assessment of the project's feasibility were used to determine whether the project shows promise. It was found in the study that the potential to implement managed lanes in the I-75 South corridor is promising and managed lanes could provide benefits to both I-75 South corridor and the surrounding transportation system.

In the next step, leadership briefings of the study's key findings and a public education campaign should be implemented to gain political acceptance, public understanding and support. The managed lanes offer a variety of benefits and opportunities, but the concept has challenging issues related to social equity. Community outreach strategies should be employed to educate and explain managed lanes and solicit feedback and active participation from the public to develop a system that meets their needs.

If a decision is made to proceed with the future implementation of managed lanes on the I-75 South corridor, further detailed studies and analyses will need to be conducted, including a more detailed financial feasibility study, investment-grade traffic and revenue analyses, comprehensive engineering design and operational analysis, NEPA process, etc. Investment grade traffic and revenue analysis will refine traffic forecasts and revenue estimates for higher accuracy to support and secure financing. A financial feasibility study would evaluate cost of finance, period of finance and interests rates, debt service coverage ratio and reserve account, etc to determine the financial feasibility and finalize the funding arrangements and financing options available to proceed with project implementation. The engineering and traffic analyses will develop the final typical cross sections for the managed lanes, identify and finalize the ingress and egress locations, determine the specific tolling zone locations and overall tolling scheme, and refine the project cost estimates and schedule.

To ensure the success and the ultimate long-term implementation of the managed lane project, a close and early coordination with the FHWA, connections with the Atlanta Metro and local transit and transportation system will be also required. Coordination with transit agencies will be important as managed lanes will provide benefits to transit operators. The implications of reliable travel time provide by managed lanes may result in expanded or new transit options in the corridor.

11.0 Public Involvement Summary

The study team utilized several methods to inform the public of study activities and to solicit public input. An educational fact sheets was developed and used to convey study information at speaker's bureau events and steering committee meetings. The fact sheet was also made available for download from the project website and was provided upon request to interested parties. Additionally, a brochure highlighting the study's findings was produced for distribution.

The study website provided background information on the I-75 South Managed Lane Study and provided a repository for all study related documentation as well as educational materials on managed lanes. The site also included a feature where steering committee members could log-in to access meeting-related materials: http://srta- valuepricing.net/.

The Project Team attended the ARC's Public Involvement Advisory Group (PIAG) meeting on May 17, 2007 and provided a presentation about the I-75 South study and hosted a roundtable meeting with the trucking industry on September 12, 2007.

Four project steering committee meetings were held throughout the course of the study.

Date	Location
March 19, 2007	Project Steering Committee Kickoff Meeting Clayton State University
July 17, 2007	Henry County Government Administration Building, 140 Henry Parkway, McDonough
November 15, 2007	Henry County Government Administration Building, 140 Henry Parkway, McDonough
June 12, 2008	Henry County Government Administration Building, 140 Henry Parkway, McDonough

In coordination with SRTA, Project Team representatives scheduled meetings with key community groups at their standing meetings to provide an overview of the study and to educate them on study related issues. Six presentations were given to the following groups:

Date	Group / Location
July 13, 2007	Henry County Chamber of Commerce - Transportation Committee 1709 Highway 20 West, McDonough
July 18, 2007	Griffin Spalding Area Transportation Committee Spalding County Courthouse Annex, 119 E. Solomon Street, Griffin
August 9, 2007	Henry County Development Authority 124 Westridge Industrial Blvd, McDonough
August 14, 2007	Airport Area Chamber of Commerce Georgia International Convention Center
August 14, 2007	Clayton County Board of Commissioners 112 Smith Street, Jonesboro
August 27, 2007	Hartsfield Area Transportation Management Association Board Meeting

CHAPTER 1

Baseline Traffic and Operating Conditions

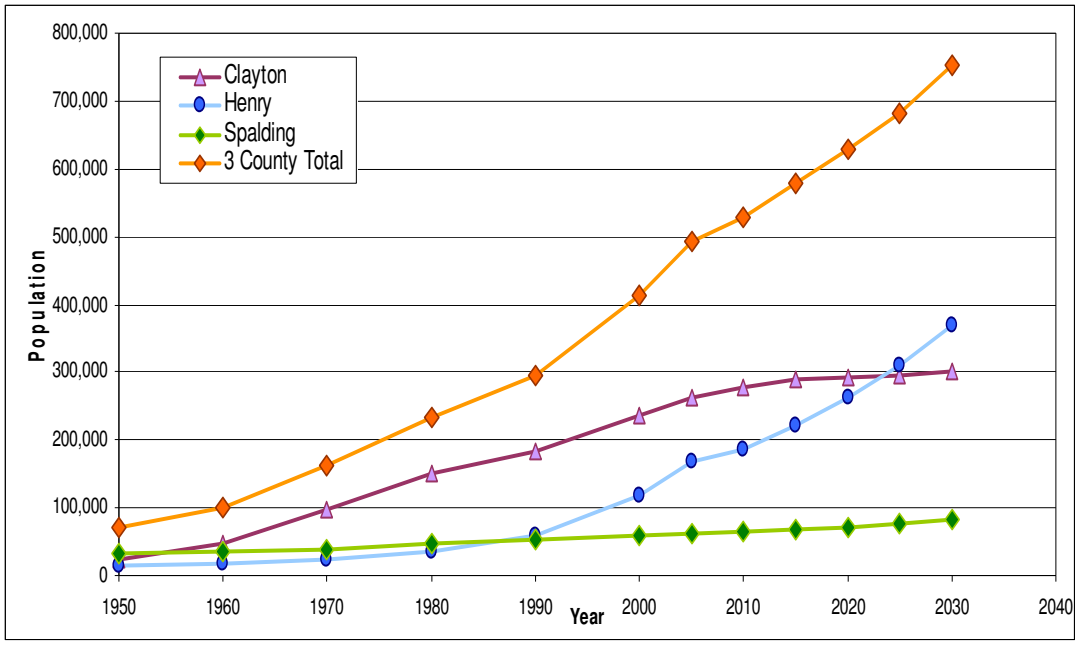
1.1 Regional Growth and Congestion

1.1.1 Growth in the Atlanta Region

During the last several decades, the Atlanta Region has experienced enormous growth. Between 1980 and 2000, the population of the United States increased by 20 percent, while during the same period, the population of Georgia grew by 50 percent, and the population of the 20-County Atlanta region increased by a dramatic 84 percent. In particular, the counties surrounding the I-75 South Corridor, Clayton, Henry, and Spalding are some of the fastest growing counties in Georgia, the southeast, and even the nation. Henry County specifically has seen a dramatic increase in population between 1980 and 2000: an astounding increase of 229 percent. Clayton County saw an increase of 57 percent and Spalding County with an increase of 22 percent, during that same time period.

Economic forecasts for the region project the boom to continue for at least the next two decades. The population of the Atlanta Region is expected to surpass six million by 2030. As shown in Figure 1-1, projections indicate that by 2030 the combined population of these 3 counties will exceed 750,000 people.

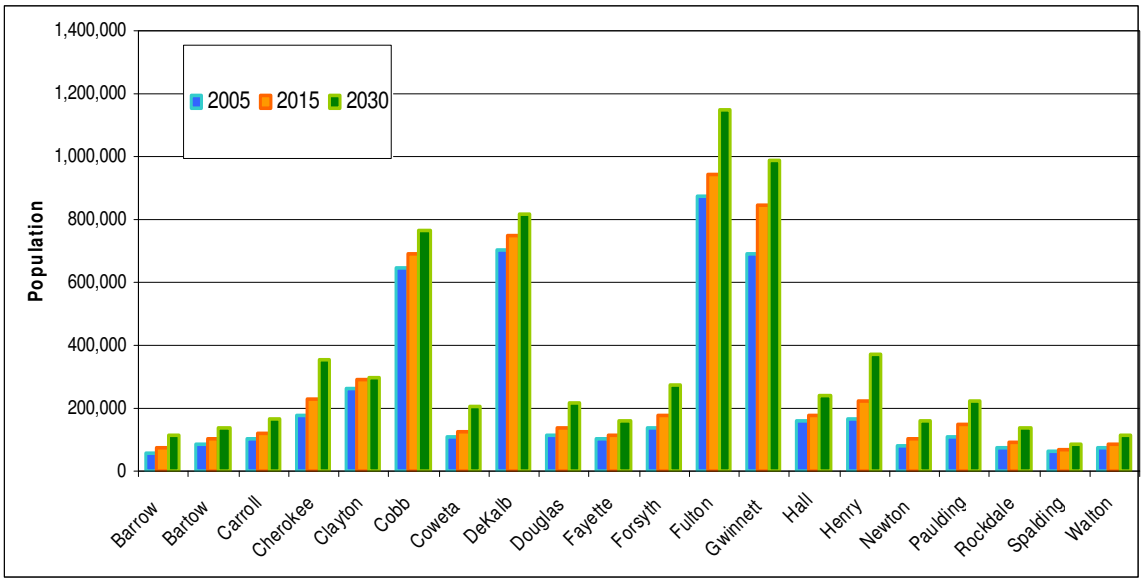
Figure 1-1: Historic and Forecast Study Area Population



Source: Atlanta Regional Commission

Figure 1-2 presents forecast growth for the 20 counties comprising the Atlanta region. Fulton, Gwinnett, DeKalb, and Cobb Counties are, and will remain, the most populous counties in the 20-County metro area in the year 2030. However, Henry County will experience one of the largest population increases between 2005 and 2030; a forecasted percent increase of 121 percent. Clayton County and Spalding County will see modest growth during this same time period. It is clear that with the continued fast-paced growth track that Henry County is on, this will undoubtedly add more congestion to the I-75 South Corridor.

Figure 1-2: Atlanta Region Population Forecast



Source: Atlanta Regional Commission

Figures 1-3 and 1-4 show the net population change and population density change by census tracts between 2005 and 2030 in the 20-county area. Census tracts in Henry County are forecast to have the largest population gains and higher population density change.

Figures 1-5 and 1-6 show the net employment change and employment density change by census tracts between 2005 and 2030 in the 20-county area. As can be seen, Census tracts in Henry County and Spalding County are expected to experience strong job growth in the next 25 years.

Figure 1-3: Net Population Change 2005-2030

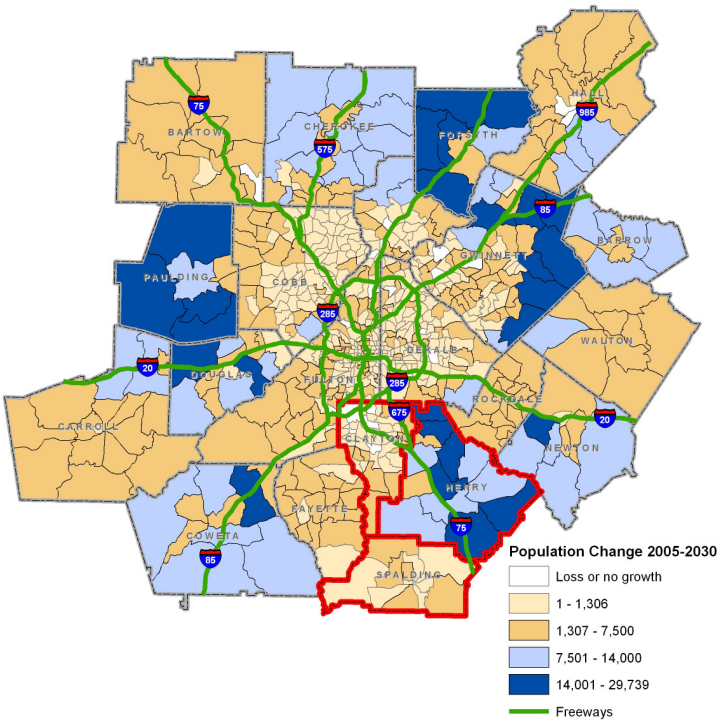
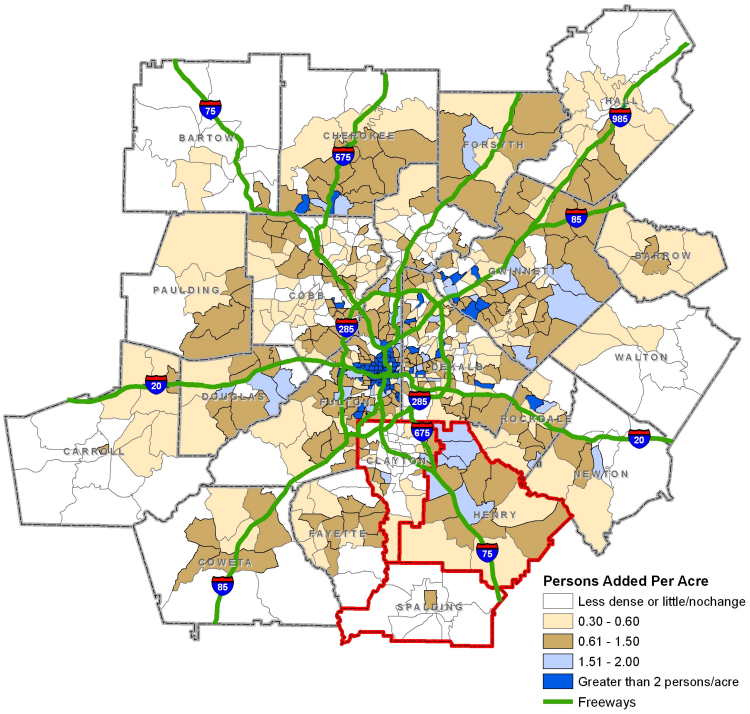


Figure 1-4: Persons Added Per Acre 2005-2030



Source: Atlanta Regional Commission

Figure 1-5: Net Employment Change 2005-2030

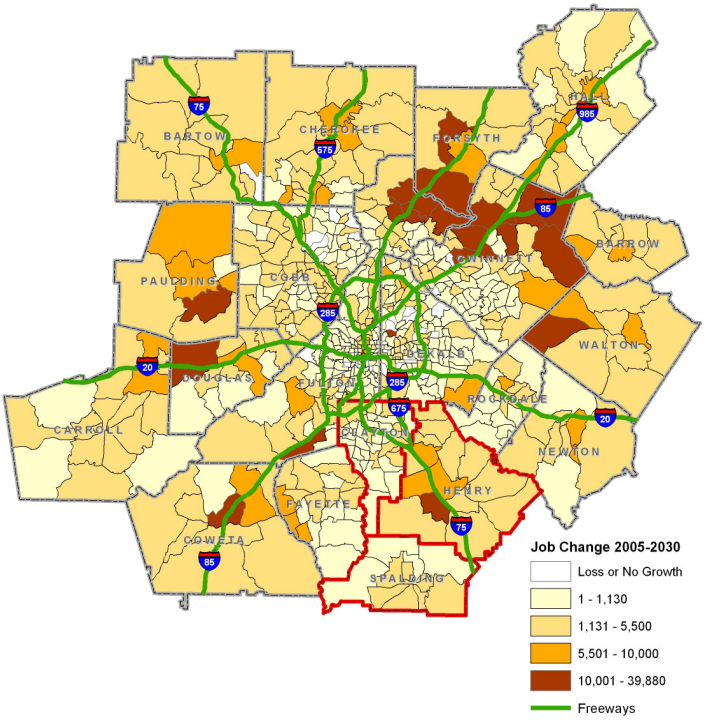
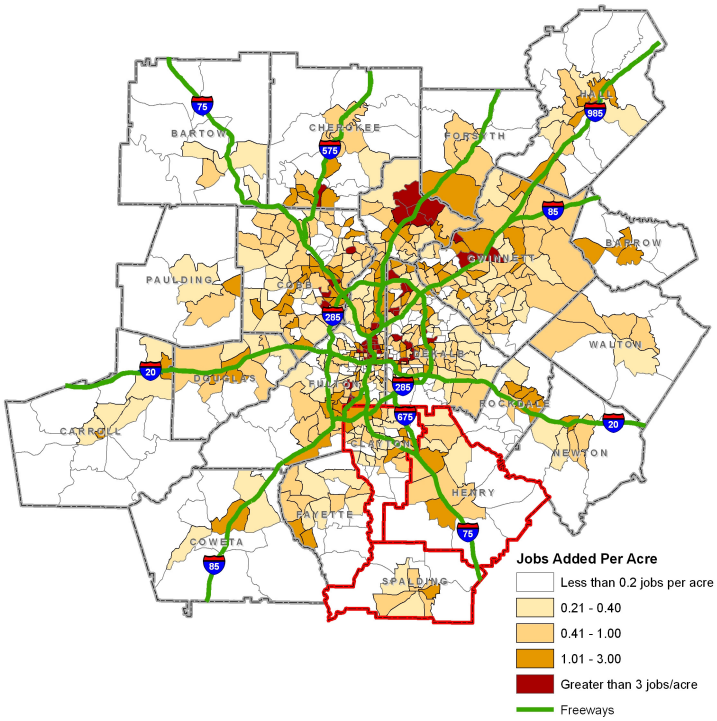


Figure 1-6: Job Added Per Acre 2005-2030



Source: Atlanta Regional Commission

These population and employment growth projections assume maintenance of current levels of mobility. Clearly, the capacity and performance of the transportation system in moving people and goods within the region will influence whether anticipated growth is realized. As experienced in the past, population growth can bring tremendous benefits, and from this perspective is desirable. It must be recognized however, that the accompanying transportation needs must be managed to support these benefits.

1.1.2 Congestion in the Atlanta Region

Accompanying the recent population and employment growth of the 1990's and 2000's was a dramatic increase in traffic volumes and travel demand. One clear manifestation of those increases was congestion levels that have worsened year by year, particularly on major roadways, in the peak commute periods.

Clearly, the rapid growth in travel demand has outpaced improvements to the region's transportation facilities. Despite large investments in our highway system, congestion is on the rise. Commuters, and sometimes those traveling in the off-peak periods, face delays that were not foreseen at the beginning of the plan development process.

These conditions are expected to worsen in the next 25 years. The region's total population is expected to increase by more than 60 percent by 2030, nearing the 7 million mark. However, roadway capacity is planned to increase by less than 24 percent with much of the capacity being realized in the managed lanes system. Essentially, the pace of growth in demand for travel will greatly exceed the abilities of the respective cities, counties, and the State to provide the necessary roadway capacity.

As a result, congestion is forecast to continue to increase. Specific factors contributing to the growing congestion problem include:

- Nationally, and within Georgia, people are driving more and traveling longer distances. Historically, vehicle miles of travel (VMT) are increasing at a greater rate than the population. But with congestion imposing an increasing cost of travel in the Atlanta Region, the trend has leveled off and growth in VMT mirrors growth in population. Figure 1-7 illustrates the regional cumulative growth in population and VMT from 1990 to 2003.

- The private vehicle driven alone to work is the dominant mode of transportation for residents in the Atlanta Region. Figure 1-8 shows the mode split in the Atlanta Region in 2005 and 2030. In existing and future conditions, over 70 percent of trips made are by individuals driving alone. This is understandable given the limited opportunities and incentives to use alternative modes of travel.

- The region has attempted to keep pace with the increase in demand for travel through heavy investment in new and upgraded highways and transit systems. For many reasons, including financial constraints, traffic conditions continue to deteriorate. Even ARC's aspiration plan, a theoretical plan that removes financial constraints, experiences an increase in congested travel. While congested conditions are expected to increase, it should be noted that without any transportation investments the percent of afternoon travel in severe congestion in

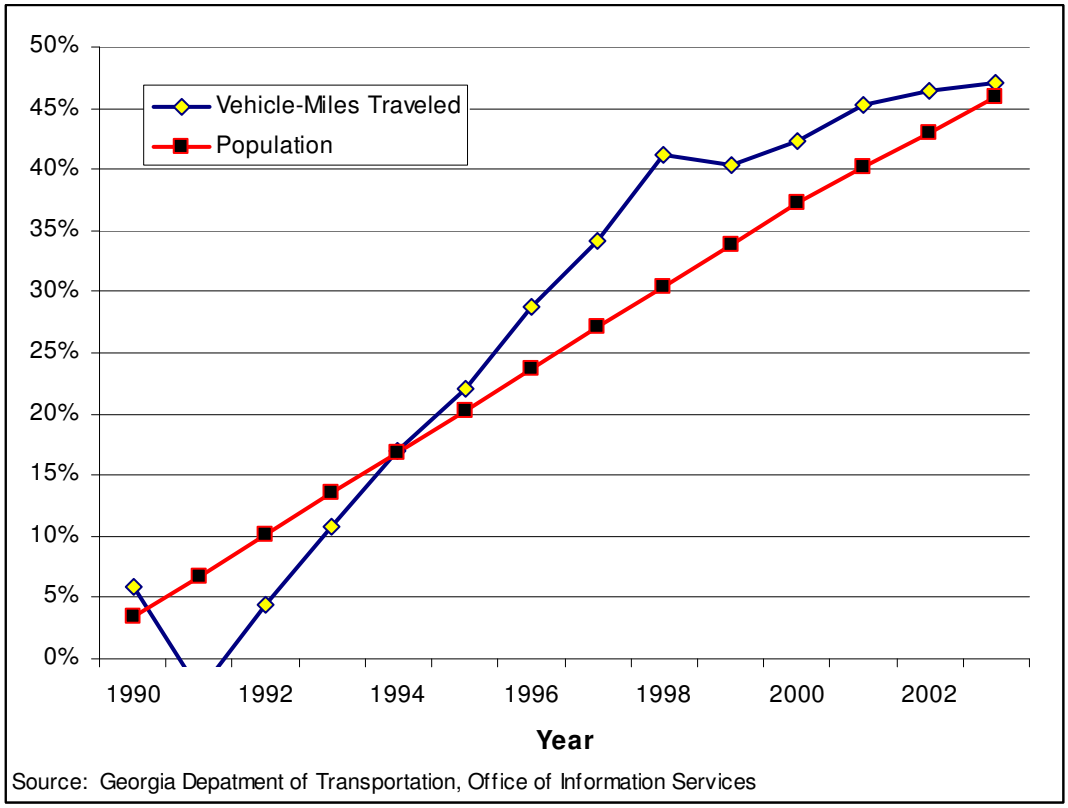
2030 is expected to be 54 % verses 34% and 28 % for ARC's Mobility 2030 and Aspirations Plan respectively. (See Figure 1-9).

- While the region has historically invested heavily in highways, there has not been a similar investment in travel alternatives to the private automobile. Only recently has the region begun to understand the need for a high quality transit system and initiatives such as travel demand management. Figure 1-10 shows the funding by expenditure type in the Mobility 2030 Plan.

- The single, largest contributor to congestion in the Atlanta Region, aside from the high growth rate, is the low-density land development pattern. Often characterized as sprawl, this type of growth results in more and longer automobile trips, with limited opportunity for transit use.

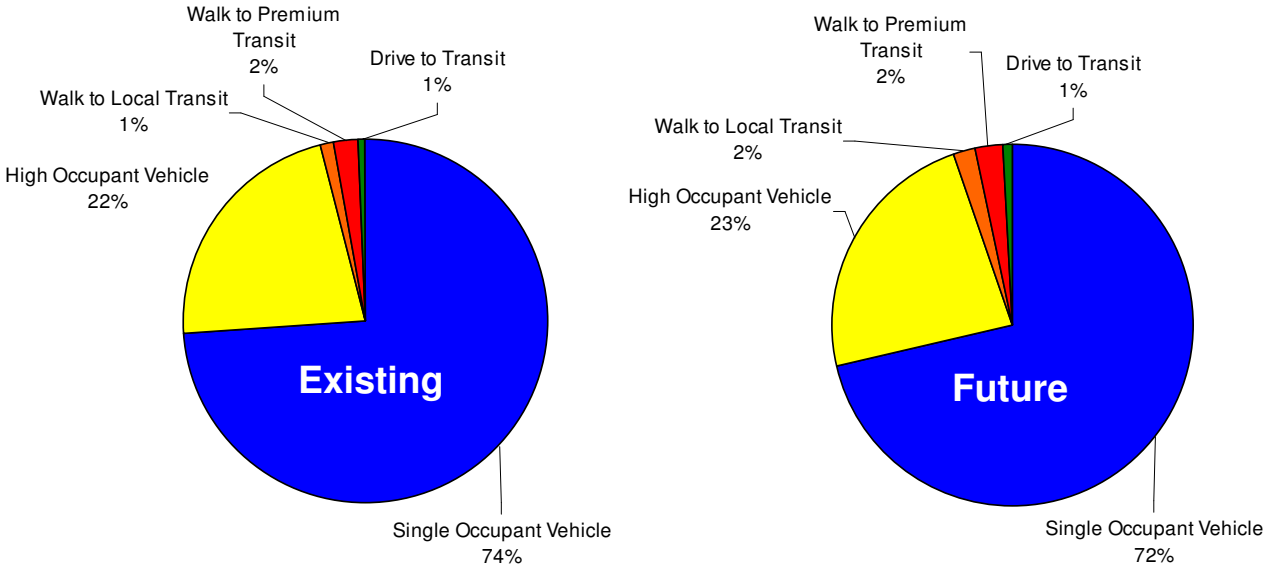
- Freight flows in Georgia are expected to increase dramatically over the next 25 years. Much of the growth will occur in Atlanta metropolitan area and on the Interstate highway system. According to Mobility 2030, 93 percent of the freight moved in Atlanta is moved by trucks. Travel demand projections indicate that truck volume in the Atlanta region will be expected to increase at an annual rate of over three percent through 2030, representing a total growth rate of 110% in the next 25 years. These additional truck trips must be absorbed by the highway system.

Figure 1-7: Region Cumulative Growth in Population and VMT – 1990-2003



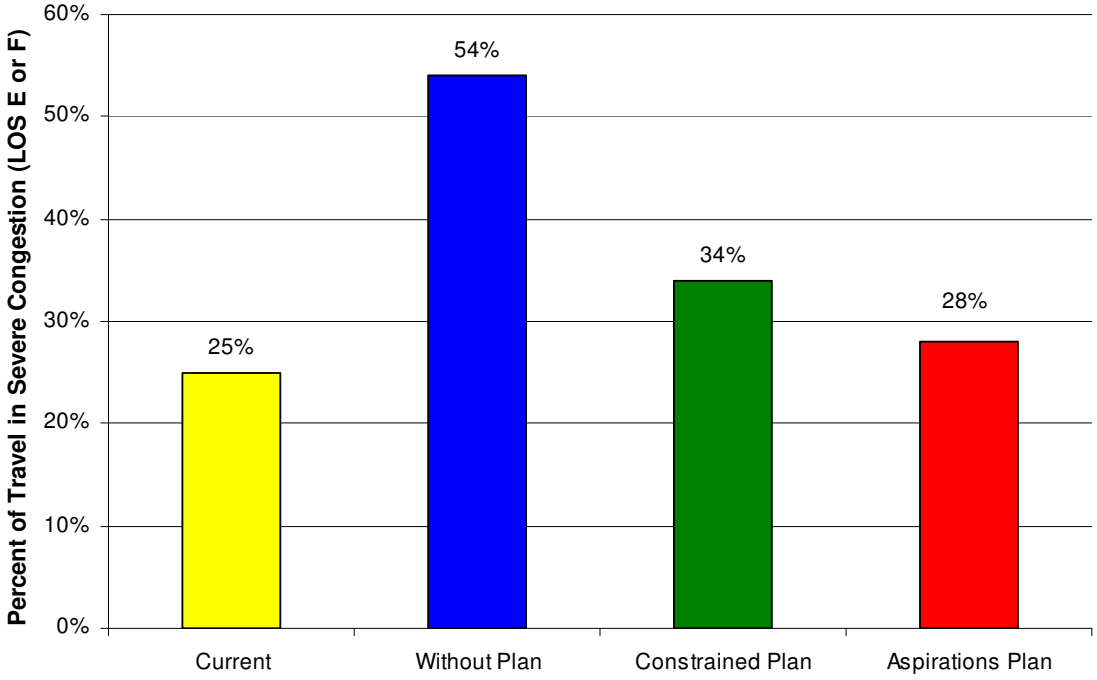
Source: Georgia Depatment of Transportation, Office of Information Services

Figure 1-8: Existing (2005) and Forecast (2030) Mode Split in the Atlanta Region



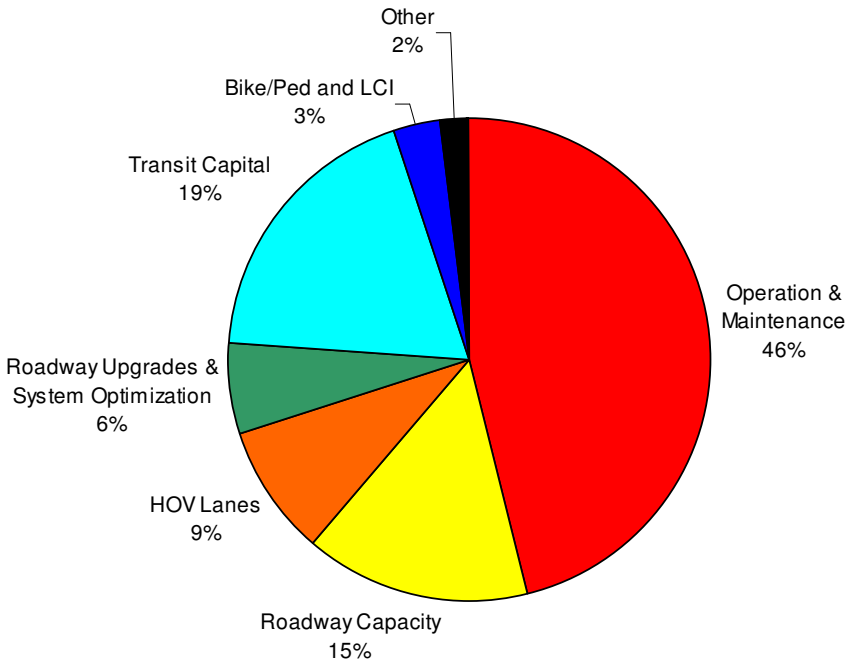
Source: Atlanta Regional Commission

Figure 1-9: Forecast 2030 Percent of Afternoon Travel in Severe Congestion



Source: Atlanta Regional Commission

Figure 1-10: Mobility 2030 System Funding by Expenditure Type



Source: Atlanta Regional Commission

1.1.3 The Impact of Congestion on the I-75 / I-675 Corridors

Interstate 75, south of I-20, experiences severe congestion most often in the AM peak period and PM peak period of the commute. According to the Atlanta Regional Commission's Envision6 Needs Assessment Report, I-75 South is the second fastest growing corridor in the region. Between 2005 and 2030, 41,000 households are expected to be added to this area. Within Henry County, this segment of the I-75 corridor is projected to grow 170% by 2030.

Home-based work trips within Henry County are expected to increase by 300%, or 20,000 new trips, by 2030. This expected increase in growth will severely impact not only interstate traffic, but it will also impact corridor arterial congestion. As a result, corridor vehicle miles traveled will increase 55% and vehicle hours traveled will increase 87%.

The I-75 South Corridor has a number of activity centers that are drawing people to the area, either as a place of work or a place to live. The activity centers include McDonough, Stockbridge, Southlake, the Hartsfield Jackson Atlanta International Airport, and Downtown Atlanta. What further complicates the congestion is the truck activity on both I-75 and I-675. Both of these corridors have been identified as a priority regional freight truck corridor, according to ARC's 2006 Transportation Fact Book. Not only do these corridors have regional significance, but also national significance, as freight is being transported throughout the southeast. A number of airport related land uses, warehouse, and trucking facilities are located in this area since portions of the I-75 South Corridor are just east of the airport. Truck VMT growth is expected to grow 55% by 2030, the second most of all corridors in the metro Atlanta area.

Not only is population forecasted to increase dramatically by 2030, employment is also expected to grow. I-75 South has the third highest employment growth rate of all corridors in the area and represents an additional 60,000 jobs. The majority of this employment increase will be in the retail and service industry to support the increase in residential households. This dramatic increase in growth will lead to increased congestion. The added demand on the roadway network will add a 55% increase in corridor vehicle miles traveled and an 87% increase in vehicle hours traveled. Lower average speeds due to more vehicles, increases the added vehicle hours of travel.

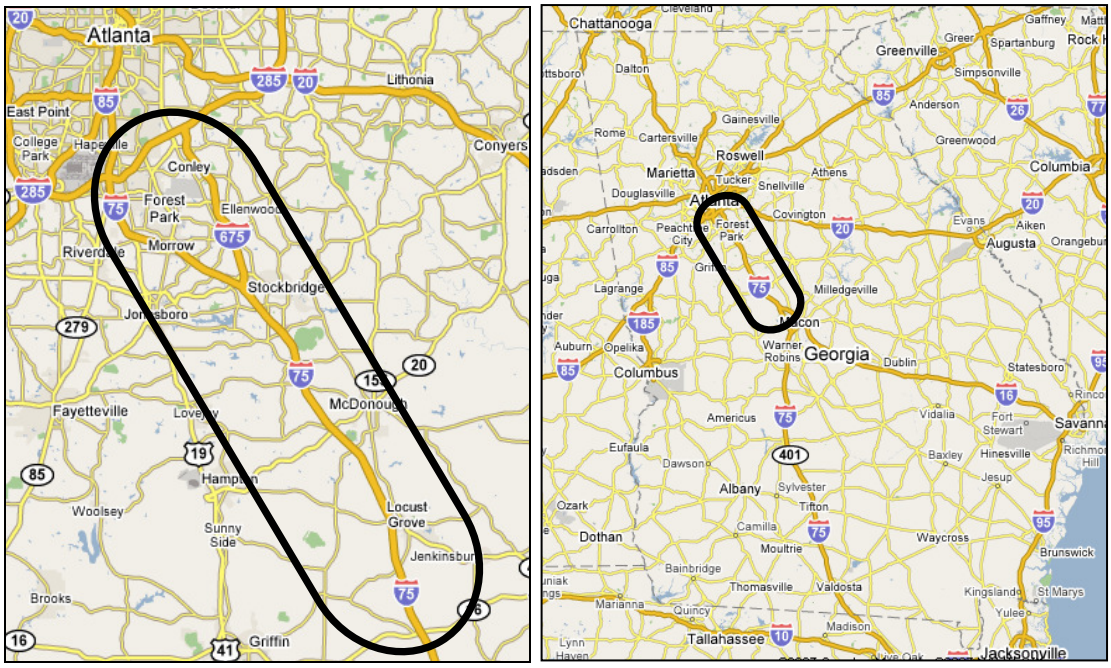
1.2 I-75 / I-675 Existing Traffic Operating Characteristics

1.2.1 Route Reconnaissance

The routes studied for this project include I-75 (approximately 35 miles from the I-285 interchange near Hapeville south to SR 16 in Butts County) and all of I-675 (approximately 11 miles from I-285 to I-75). These corridors (see Figure 1-11) are vital connections for:

- Interstate commercial travel between most of the U.S. and Florida
- Interstate personal travel connecting the Georgia to Florida
- Regional commercial and personal travel between Macon and Atlanta
- Regional commercial and personal travel between Savannah and Atlanta
- Daily Atlanta commuter and personal travel serving the rapidly growing communities in Henry, Clayton, Spalding and Butts counties.

Figure 1-11: Study Area Extent and Location within the State



In general, the I-75 corridor exhibits a high demand for both national and regional travel. Truck traffic passing through Atlanta along the I-75 corridor typically utilizes I-285 westbound to return to I-75 on the northwest side of Atlanta. This bypass around Atlanta is required for most commercial traffic due to truck access restrictions inside the perimeter highway (I-285). Trucks typically do not take I-285 eastbound due to longer distances and higher congestion levels on I-285 top end.

A 2005 GDOT truck count on I-75 in Butts County showed approximately 17,000 trucks per day traveling the southern end of this corridor. Truck volumes closer to I-285 easily reach 20,000 trucks per day.

The 2006 GDOT Truck Only Lanes Study and the 2006 ARC Freight Study conducted origin-destination studies for the state of Georgia. The survey conducted at the I-75 weigh station in Forsyth, Georgia (south of the study area near Macon) showed the broadest spatial diversity of any other site. This shows that the I-75 corridor is also a vital connection to other major interstates. Significant volumes of trucks use this section of highway to access I-85 north, I-20 west, and I-20 east in addition to I-75 South and I-75 North.

The corridor does not have any High Occupancy Vehicles (HOV) facilities but HOV is planned for by 2020. Current HOV facilities do exist on I-75 just outside the study area, north of I-285.

There are 14 interchanges along the I-75 study corridor and 6 interchanges along I-675. Figure 1-12 shows the number of through lanes between each interchange along I-75 S. study corridor.

I-675 has three lanes in each direction north of the Ellenwood Road interchange, and two lanes in each direction south of that point.

A description of the interchanges and surrounding land use in the corridor can be found in the Appendix 1-A.

Figure 1-12: Number of through lanes by interchange along the I-75 corridor

1.2.2 Average Weekly Traffic

Year 2005 average weekday daily traffic volumes were obtained from GDOT to form an understanding of baseline traffic conditions along the corridor. Table 1-1 presents year 2005 average traffic for the length of the study corridor.

Weekday traffic is shown to generally decrease from north to south within the I-75 study corridor. At the north end of the corridor, north of Forest Parkway (SR 331), the weekday traffic averages approximately 212,800 vehicles while at the south end close to SR 16 the weekday traffic volumes average 75,600 vehicles. The weekday average traffic ranges from 111,100 to 155,800 vehicles in the middle segment between I-675 to SR 155.

Table 1-1: 2005 Average Weekly Traffic

Cross Street		2005 GDOT Traffic Counts
From	To	
I-285	Forest Pkwy	212,790
Forest Pkwy	Southfield Pkwy	184,610
SR 41	SR 54	159,640
SR 54	Mt Zion Blvd	137,840
Mt Zion Blvd	SR 138	135,000
SR 138	I-75 @ I-675	113,360
I-75 @ I-675	Hudson Bridge Road	155,740
Hudson Bridge Road	Jodeco Road	147,600
Jodeco Road	Jonesboro Road	145,790
Jonesboro Road	SR 20	130,260
SR 20	SR 155	111,060
SR 155	Hampton Road	87,530
Hampton Road	Locust Grove Road	75,560

Source: GDOT Traffic Database

1.2.3 Hourly Traffic Distribution

Hourly traffic distribution in January 2007 was obtained from Georgia Department of Transportation (GDOT)'s Transportation Management Center (TMC) for three separate locations along the I-75 corridor. The northernmost location is at Mount Zion Blvd, the central location is immediately north of SR138/Stockbridge Highway, and the southernmost location is positioned south of Hudson Bridge Road. Currently, the TMC detection coverage covers from I-285 to Hudson Bridge Road (Exit 224); there is no coverage on I-75 south of Hudson Bridge Road and the I-675 corridor.

Figures 1-13 through 1-18 illustrates both the directional traffic volume and the directional distribution, as a percent of the hourly traffic, by time of day.

The hourly distribution of traffic along the I-75 study corridor demonstrates the typical morning and afternoon periods of increased traffic that are influenced by the work commute. The directional distribution of travel in the corridor is heavier northbound in the

morning and southbound in the afternoon. The NB/SB directional split is approximately 60 percent/40 percent during the morning peak period (6 AM – 10 AM) and 40 percent/60 percent during the afternoon peak period (3 PM -7 PM).

Figure 1-13: Directional Volume by Time of Day – At Mount Zion Road

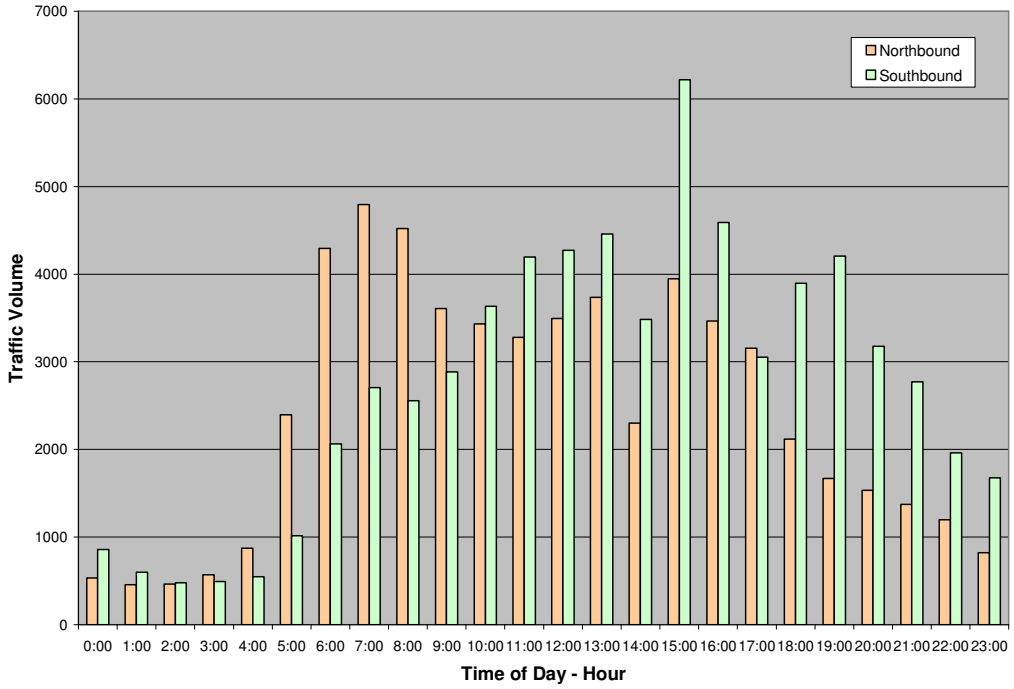
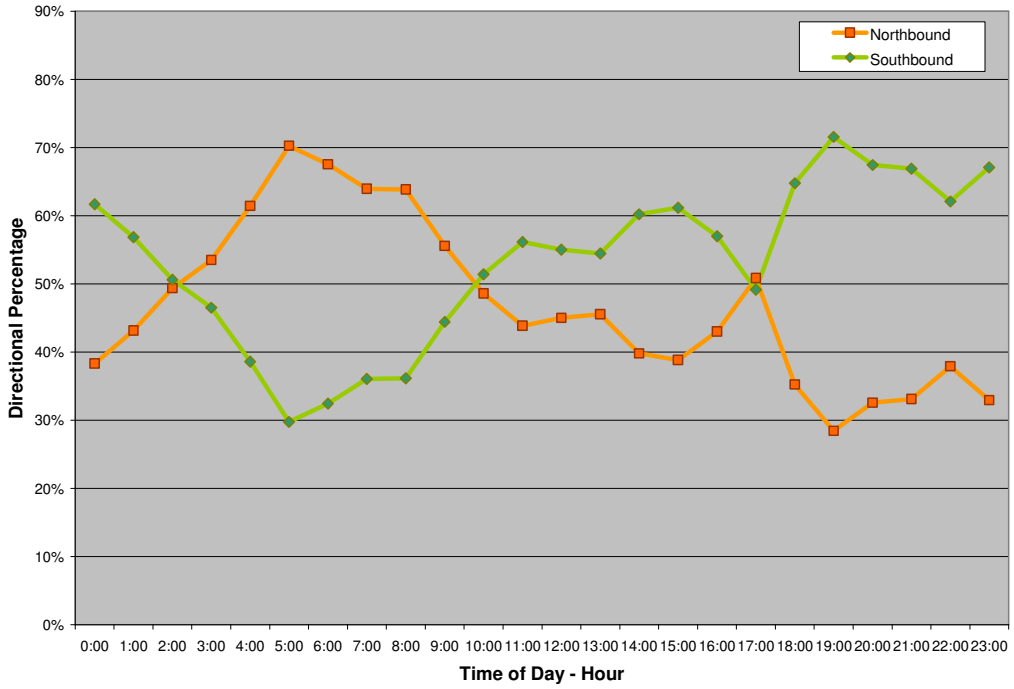


Figure 1-14: Directional Percentage by Time of Day – At Mount Zion Road



Source: GDOT TMC Count Data

Figure 1-15: Directional Volume by Time of Day – I-75 Near SR138/Stockbridge Highway

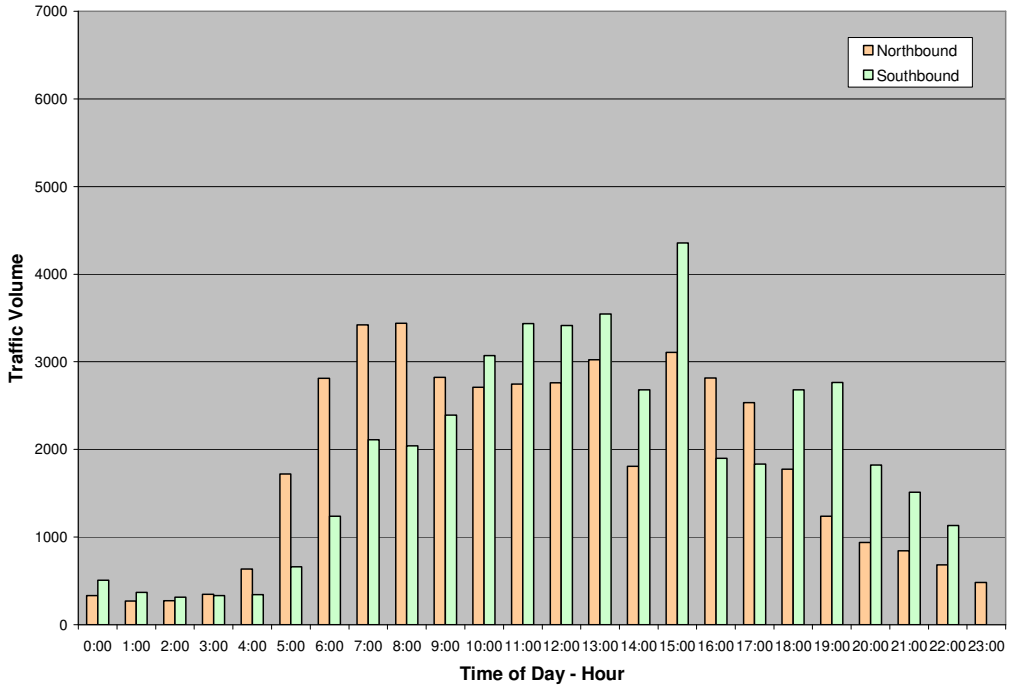
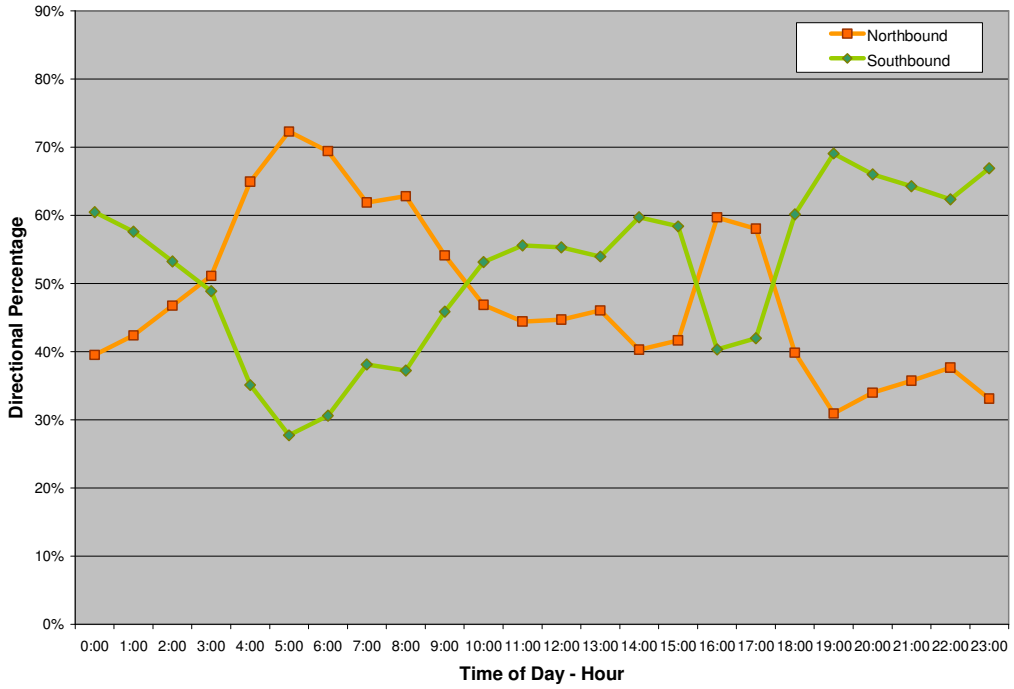


Figure 1-16: Directional Percentage by Time of Day – I-75 Near SR138/Stockbridge Highway



Source: GDOT TMC Count Data

Figure 1-17: Directional Volume by Time of Day – I-75 Near Hudson Bridge Road

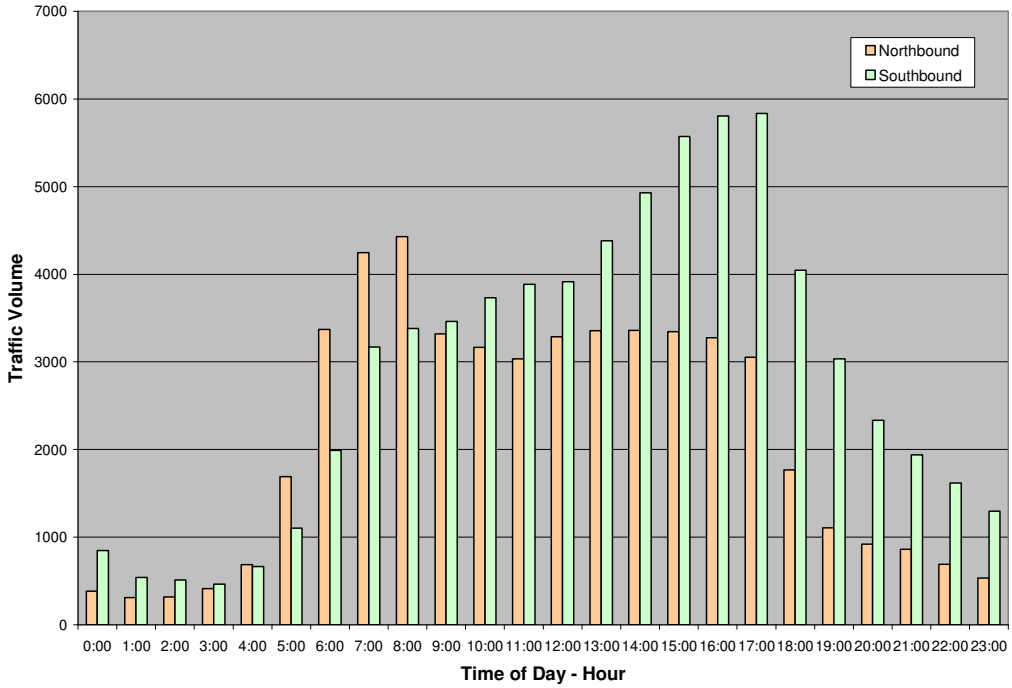
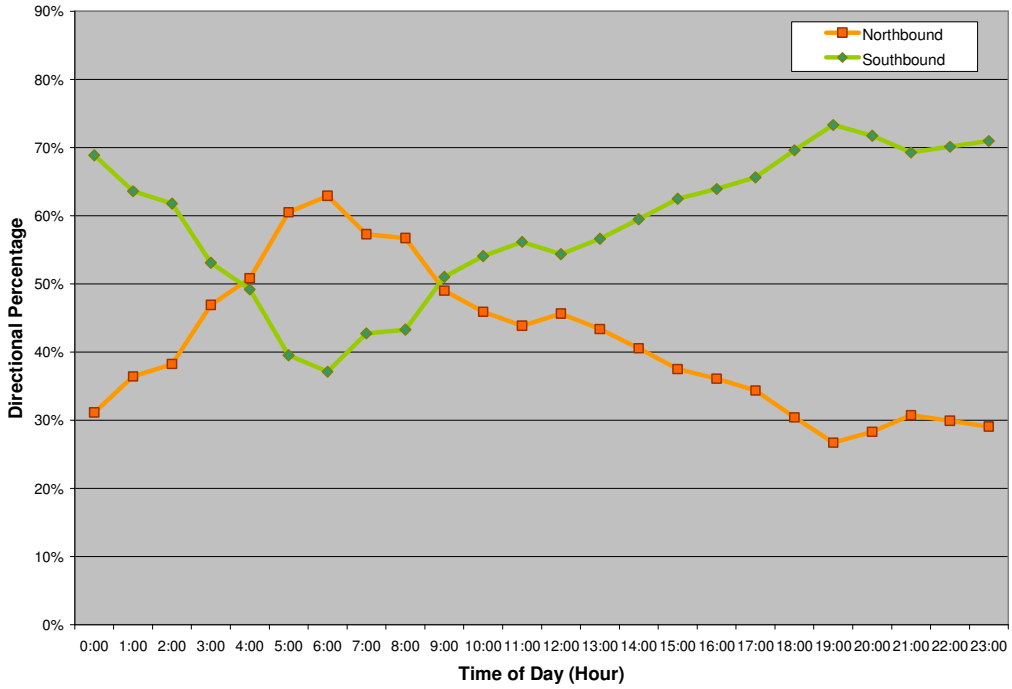


Figure 1-18: Directional Percentage by Time of Day–I-75 Near Hudson Bridge Road



Source: GDOT TMC Count Data

1.2.4 2007 GRTA MAP Report

The 2007 Georgia Regional Transportation Authority (GRTA) Metro-Atlanta Performance (MAP) Report contains a summary analysis of travel times and congestion on I-75 South from Hudson Bridge Road to I-285 (about 14.5 miles). This analysis was generated from GDOT's TMC video detection system. The fixed view cameras collect volume, speed, and density data for this stretch of interstate 24 hours per day, seven days a week. Data is summarized into 15-minute intervals and archived to a database. GRTA analyzed this data to evaluate the performance of major freeway facilities in the Atlanta region.

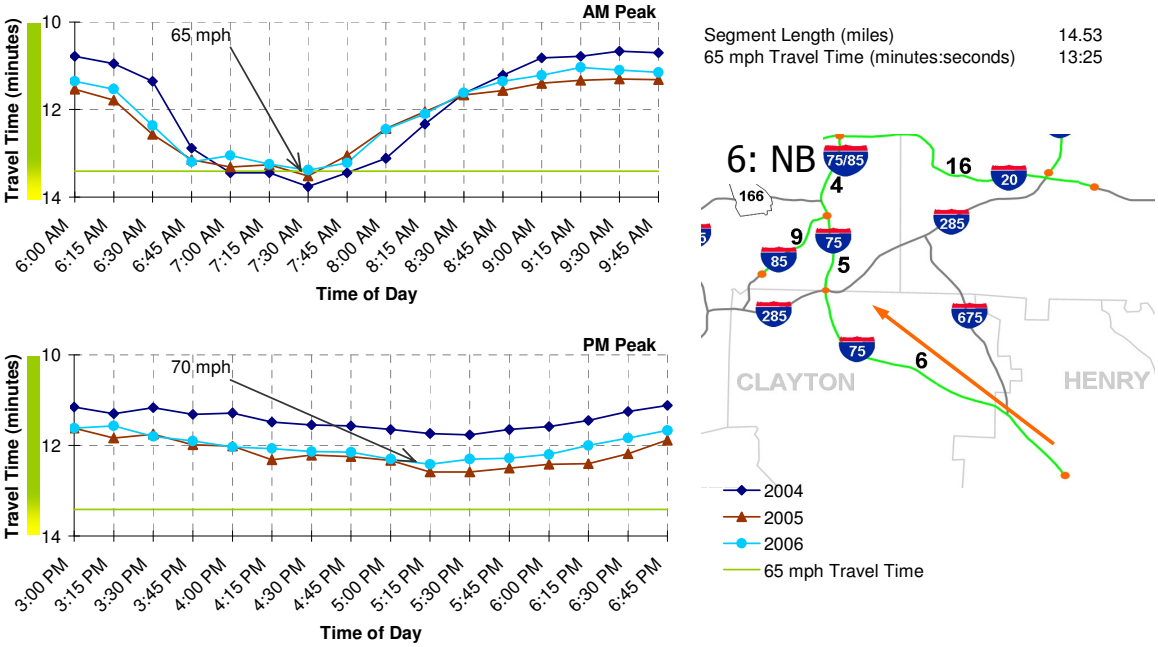
Figure 1-19 present the summary results of average Travel Times during the AM and PM periods for typical weekdays from 2004 to 2006.

Figure 1-20 present the summary results of Planning Time Index during the AM and PM periods for typical weekdays from 2004 to 2006. Planning Time Index is expressed as the ratio of planning time and free flow travel time. Planning time represent the amount of time needed to be on-time 95 percent of the time.

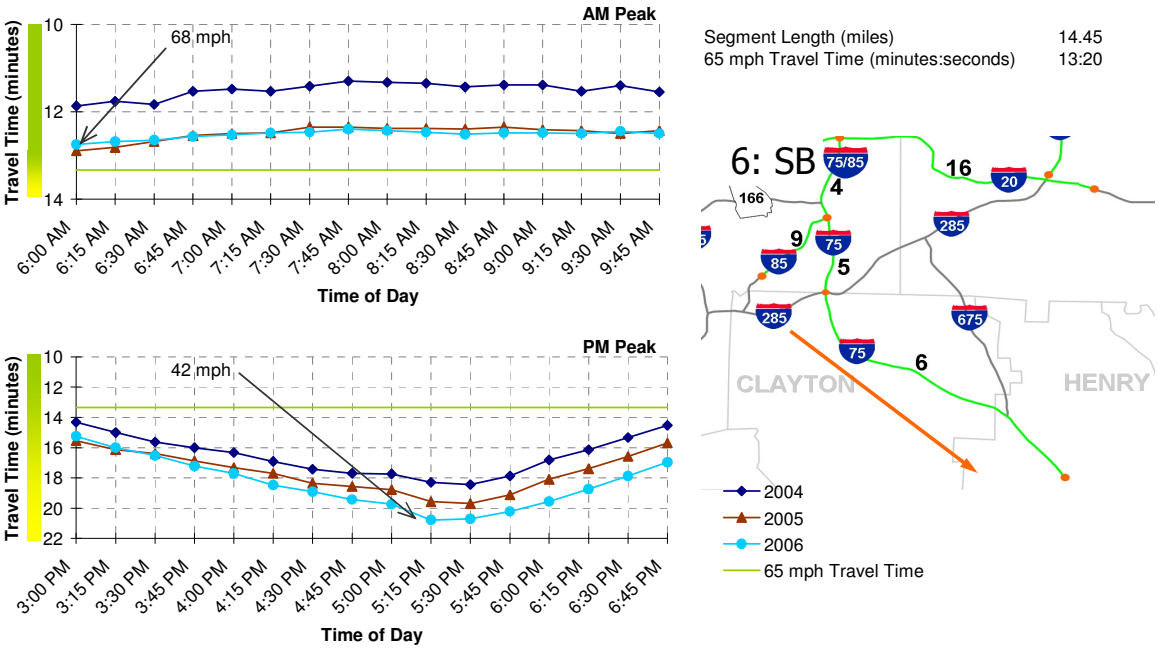
Figure 1-21 present the summary results of Buffer Time Index during the AM and PM periods for typical weekdays from 2004 to 2006. Buffer Time represent the amount of extra "buffer" needed to be on-time 95 percent of the time and is expressed as a percentage of the average travel time.

Figure 1-19: I-75 South NB/SB Average Travel Time Summary

Segment 6: I-75 NB (from Hudson Bridge Road to I-285)

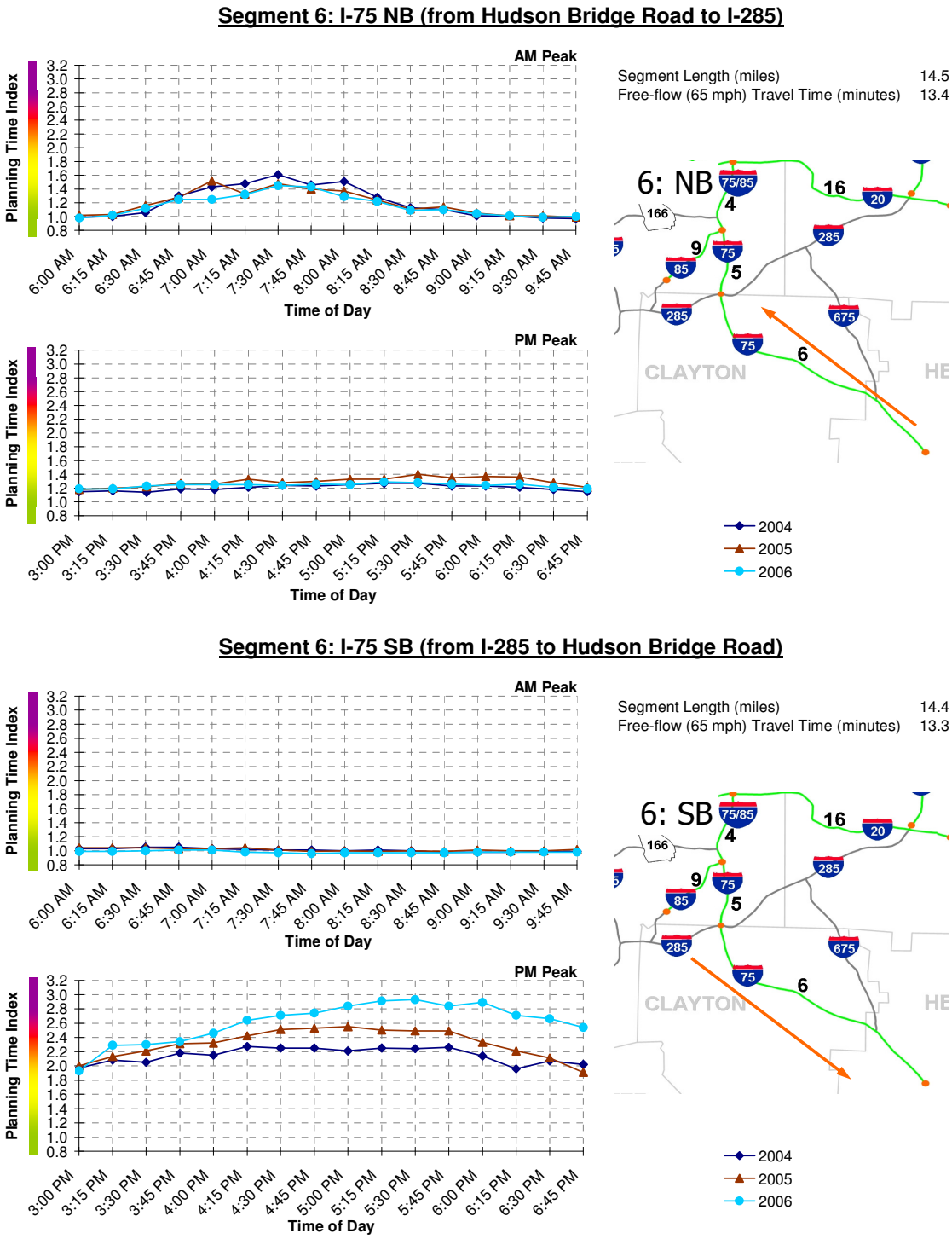


Segment 6: I-75 SB (from I-285 to Hudson Bridge Road)



Source: GRTA 2007 Transportation MAP Report

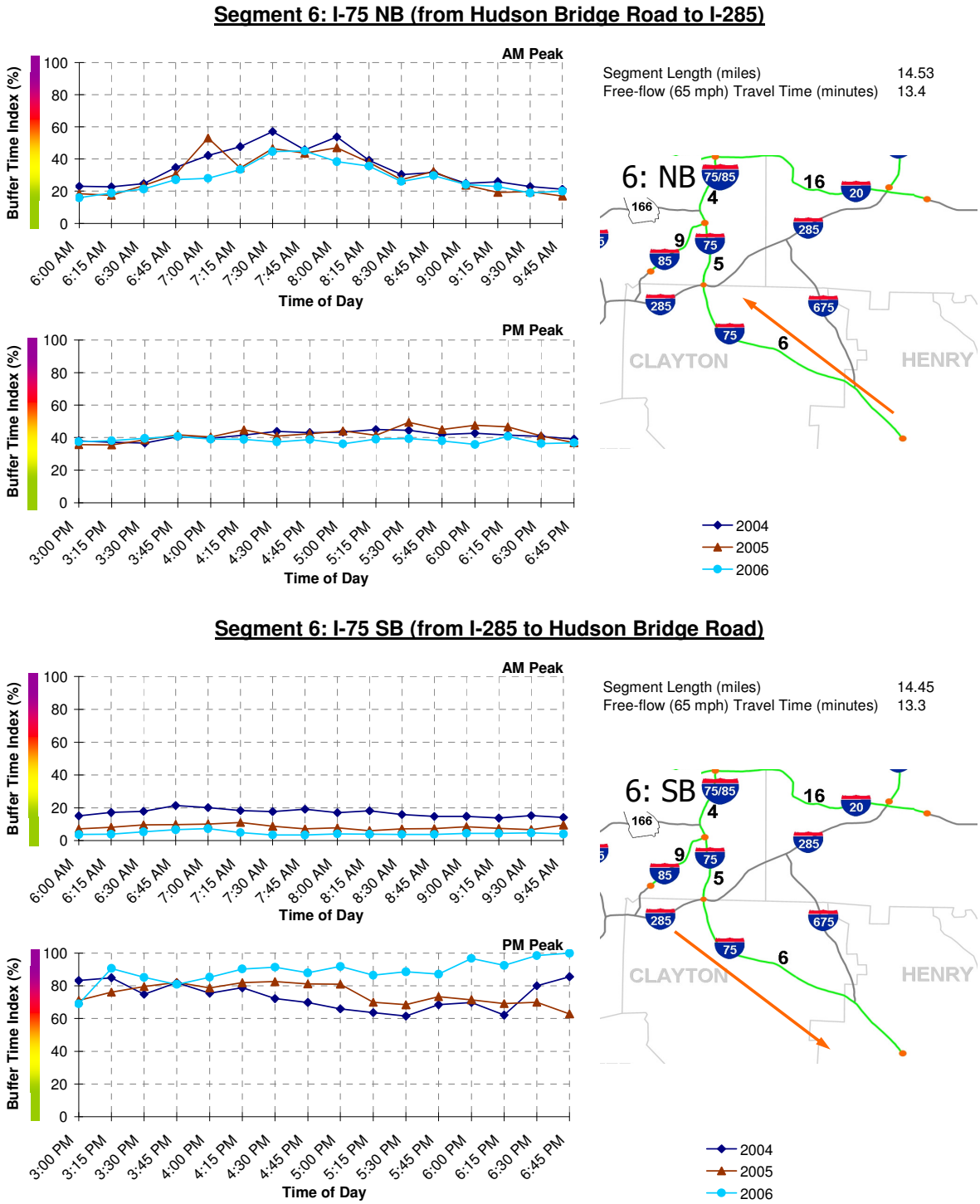
Figure 1-20: I-75 South NB/SB Planning Time Index Summary



Note: Planning Time Index is expressed as the ratio of the planning time and free-flow travel time. Planning time represents the amount of time needed to be on-time 95 percent of the time.

Source: GRTA 2007 Transportation MAP Report

Figure 1-21: I-75 South NB/SB Buffer Time Index Summary



Note: Buffer Time Index represents the amount of extra "buffer" needed to be on-time 95 percent of the time and is expressed as a percentage of the average travel time.

Source: GRTA 2007 Transportation MAP Report

1.2.5 Time-Distance Studies

As part of the data collection effort, time-distance studies were completed using GPS probe vehicles throughout the AM and PM peak periods between January 31st 2007 and March 1st 2007. These studies were designed to identify the location, intensity, extent, and duration of recurrent congestion along I-75 and I-675.

(a) Sampling and Analysis Methodology

The routes were driven using standard probe vehicle approaches using GPS devices to capture second-by-second speeds and delays.

The sampling strategy for the travel time included the following internal quality requirements:

- AM start times varied between 6:00 AM and 9:00 AM
- PM start times varied between 4:00 PM and 7:00 PM
- Off-Peak start times varied between 10:00 AM and 3:00 PM
- Data was only collected on typical weekdays (Tuesday-Thursday)
- Data was only collected in good weather conditions
- Runs were not included in the analysis if major incidents were observed
- Data was collected at one-second intervals

The following routes were defined for data collection:

- I-75 Northbound from SR 16 to Aviation Boulevard
- I-75 Southbound from Aviation Boulevard to SR 16
- I-675 NB from I-75 to I-285
- I-675 SB from I-285 to I-75

A total of 94 runs were conducted throughout the study period. A breakdown of the number of runs by start time, route, and direction is provided in Table 1-2.

Table 1-2: Number of probe vehicle runs by route and start time

Peak Period	Hour	Route				Total
		I-75 NB	I-75 SB	I-675 NB	I-675 SB	
AM	6:00 AM	0	2	0	1	3
	6:30 AM	2	2	1	2	7
	7:00 AM	2	4	2	3	11
	7:30 AM	3	2	2	1	8
	8:00 AM	2	3	2	1	8
	8:30 AM	3	2	1	1	7
	9:00 AM	3	0	1	0	4
PM	4:00 PM	0	1	0	1	2
	4:30 PM	1	2	1	2	6
	5:00 PM	1	2	2	2	7
	5:30 PM	1	4	2	2	9
	6:00 PM	2	2	2	1	7
	6:30 PM	3	1	1	1	6
	7:00 PM	2	0	1	0	3
Off-Peak (10:00 AM- 3:00 PM)		3	3	0	0	3
Total		28	30	18	18	94

(b) Results – Space/Time Diagrams

Space-time diagrams are charts that show individual probe vehicle runs for a given route. The charts are useful for evaluating the location and sometimes determining cause for congestion along a route. The charts plot the distance traveled on the Y-axis (origin point is at the top). The X-axis shows the travel time in seconds. Each horizontal line marks an identified cross street. Individual travel time runs are plotted as a line that starts at the upper left corner of the chart and ends when they cross the route end point. A broad spreading of ending points at the bottom indicates high variability of travel time. Dots represent the beginning or ending point of a “stop” that occurred along the routes (traffic signal, congestions, etc.). Section of steep, parallel, lines indicate free flow conditions with little or no congestion. Flatter, wiggly lines and/or lines with dots indicate congested conditions where the traffic flow is interrupted due to signalization or congestion.

Figure 1-22 shows a space/time trajectory of each probe vehicle run conducted along I-75 SB. Each run starts at the upper left corner of the chart and moves downward with distance (Y axis) and to the right with time (X axis). Faster speeds are represented by steep lines, slower speeds by less steep lines. Congested conditions are evident with less steep lines and dots (indicating the vehicle actually came to a stop). Recurrent congestion is evident from after SR 54 to Hudson Bridge Road with observed delays exceeding 30 minutes to travel about 4 or 5 miles.

Figure 1-23 shows a space-time trajectory chart of I-75 NB. Congestion is evident from just north of Hampton-McDonough Road almost all the way to I-675. Delays are also evident approaching I-285.

Figure 1-22: Space Time trajectory chart of I-75 SB

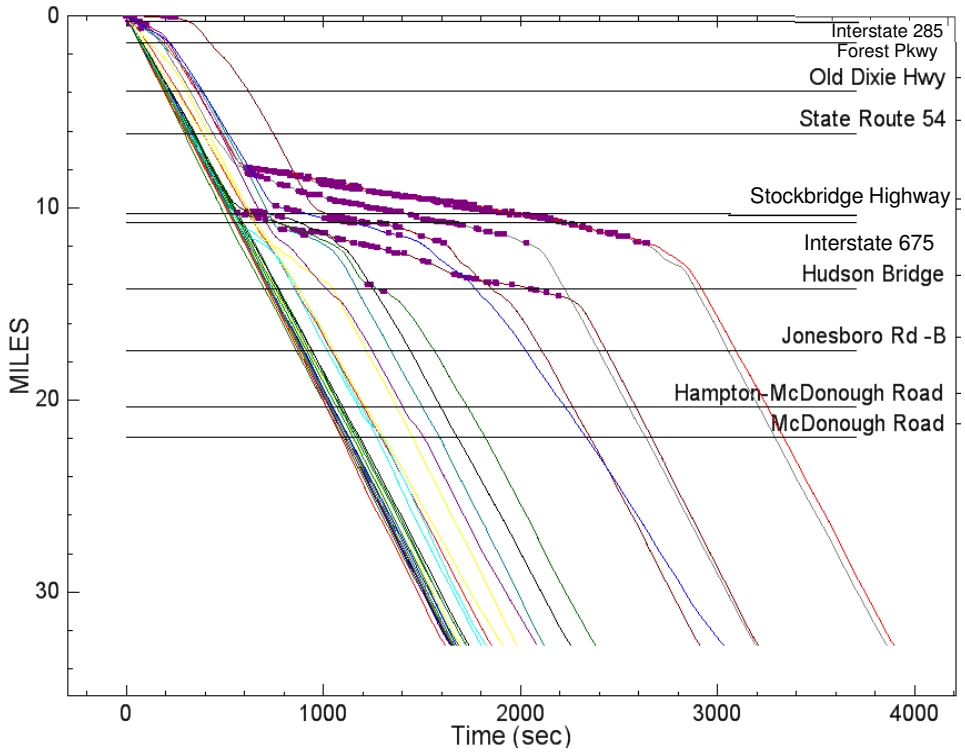
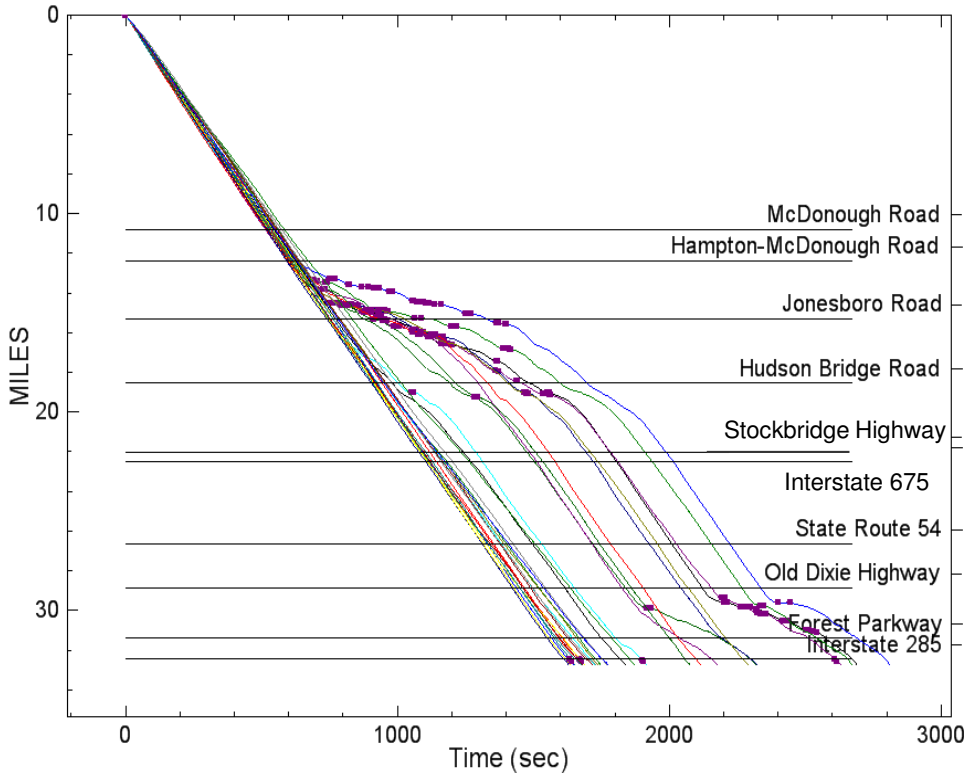


Figure 1-23: Space-time trajectory for I-75 NB



(c) Results – Travel Time/Speed Summary

This section discusses results for each of the key routes evaluated. Detailed results by interchange are shown in Tables 1-3 through Table 1-10 for I-75 South and I-675 corridor for different peak periods: AM Period (6AM-9AM); PM Period (4PM-7PM) and Off-peak Period (10AM-3PM). Interchange-to-interchange statistics include average speed, average travel time, min/max travel time, and Travel Time Index (TTI)[1].

Statistics are also provided for average speed, average travel time, and average delay (time at speeds less than 15 mph) for I-675 segment and the following three segments on I-75 S. corridor:

- Segment I: Aviation Blvd to Hudson Bridge Road/Eagles Landing Parkway;
- Segment II: Hudson Bridge Road/Eagles Landing Parkway to SR 155; and
- Segment III: SR 155 to SR 16.

Figure 1-24 and Figure 1-25 show the average speed for the I-75 NB during AM peak period and I-75 SB during PM peak period by interchange respectively. The bar chart is color-coded to represent sections with TTI above 1.5 (yellow representing congested conditions) and TTI above 2.0 (red representing severe congestion). There is no signification congested observed during other periods and off-peak directions.

A review of the analysis results showed several congested areas. I-75 SB typically experiences severe PM peak delays from I-285 to Forest Parkway and from SR 54 to Hudson Bridge Road. I-75 NB typically experiences severe AM peak delays from Hampton-McDonough Road to I-675 and again from Old Dixie Highway to I-285.

I-675 SB typically experiences brief heavy congestion at the lane drop near Ellenwood Road and then severe congestion where it merges with I-75. I-675 NB typically experiences moderate congestion approaching SR 42 (Macon Highway) and then again as I-675 merges with I-285.

[1] Travel Time Index is the ratio of peak period travel time to free-flow travel time. Free flow speed of 65 mph was used to calculate the TTI along I-75 South corridor.

Table 1-3: I-75 AM NB Travel Statistics by Interchange and by Segment

From Interchange	To Interchange	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	Min. Observed Travel Time (min)	Max. Observed Travel Time (min)	TTI (65 MPH base)	Segment	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	TTI (65 mph base)
SR 16	Locust Grove Road	73.0	5.1	4.9	5.5	0.89	III	72.7	8.9	0.89
Locust Grove Road	McDonough Road	72.4	3.8	3.6	3.9	0.90				
McDonough Road	Hampton-McDonough Road	72.6	1.3	1.2	1.4	0.90	II	37.4	12.5	1.74
Hampton-McDonough Road	Jonesboro Road	32.6	5.4	2.4	11.8	2.00				
Jonesboro Road	Jodeco Road	27.7	3.0	1.2	4.8	2.34				
Jodeco Road	Hudson Bridge Road	40.4	2.8	1.5	4.4	1.61				
Hudson Bridge Road	Interstate 675	47.3	4.4	2.8	5.4	1.38	I	53.9	15.8	1.21
Interstate 675	Stockbridge Highway	65.5	0.5	0.4	0.5	0.99				
Stockbridge Highway	Mt. Zion Blvd	70.4	2.3	2.2	2.5	0.92				
Mt. Zion Blvd	State Route 54	70.5	1.2	1.2	1.4	0.92				
State Route 54	Old Dixie Highway	68.9	1.9	1.8	2.1	0.94				
Old Dixie Highway	Forest Parkway	41.0	3.7	2.2	7.5	1.58				
Forest Parkway	Interstate 285	43.6	1.5	1.0	2.0	1.49				
Interstate 285	Aviation Blvd	59.1	0.3	0.3	0.4	1.10				
							Total	52.9	37.2	1.23

Figure 1-24: I-75 AM NB Average Speed

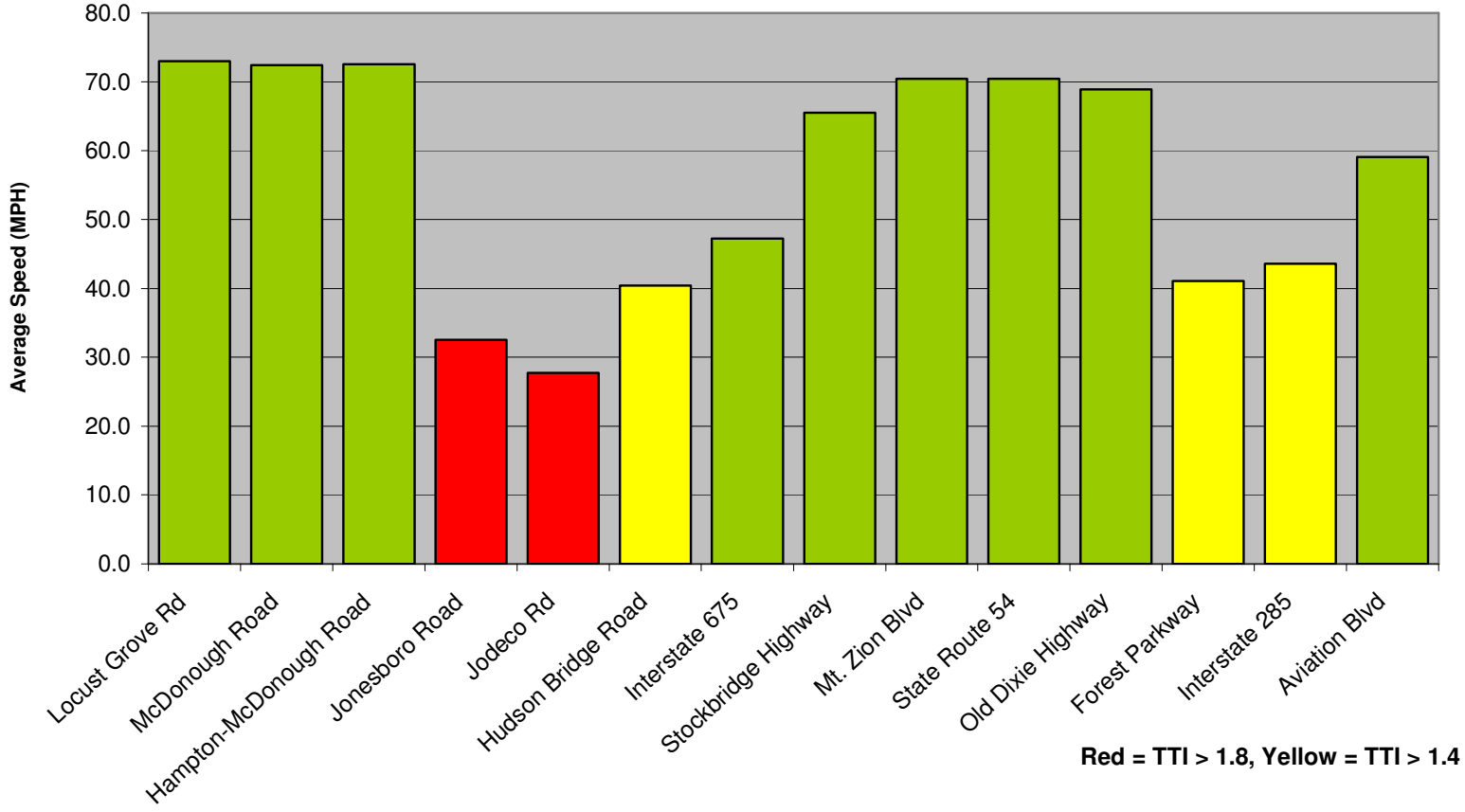


Table 1-4: I-75 AM SB Travel Statistics by Interchange and by Segment

From Interchange	To Interchange	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	Min. Observed Travel Time (min)	Max. Observed Travel Time (min)	TTI (65 MPH base)	Segment	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	TTI (65 mph base)
Aviation Blvd	Interstate 285	67.8	0.3	0.2	0.5	0.96	I	69.1	12.4	0.94
Interstate 285	Forest Pkwy	73.5	0.9	0.8	1.3	0.88				
Forest Pkwy	Old Dixie Highway	67.2	2.3	2.1	2.7	0.97				
Old Dixie Highway	State Route 54	68.8	1.9	1.8	2.1	0.94				
State Route 54	Mt. Zion Blvd	69.4	1.3	1.1	1.4	0.94				
Mt. Zion Blvd	Stockbridge Highway	69.5	2.3	2.2	2.5	0.93				
Stockbridge Highway	Interstate 675	68.9	0.5	0.4	0.5	0.94				
Interstate 675	Hudson Bridge	66.7	3.1	2.8	4.9	0.98				
Hudson Bridge	Jodeco Road	68.2	1.6	1.5	1.9	0.95	II	69.8	6.7	0.93
Jodeco Road	Jonesboro Road	70.7	1.2	1.1	1.2	0.92				
Jonesboro Road	Hampton-McDonough Road	70.5	2.5	2.4	2.7	0.92				
Hampton-McDonough Road	McDonough Road	69.9	1.4	1.3	1.5	0.93				
McDonough Road	Locust Grove Road	72.3	3.8	3.5	3.9	0.90	III	72.0	9.0	0.90
Locust Grove Road	SR 16	71.8	5.3	5.1	5.6	0.91				
							Total	70.0	28.1	0.93

Table 1-5: I-75 PM NB Travel Statistics by Interchange and by Segment

From Interchange	To Interchange	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	Min. Observed Travel Time (min)	Max. Observed Travel Time (min)	TTI (65 MPH base)	Segment	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	TTI (65 mph base)
SR 16	Locust Grove Road	70.3	5.3	5.0	5.7	0.93	III	71.1	9.1	0.91
Locust Grove Road	McDonough Road	72.4	3.8	3.6	4.0	0.90				
McDonough Road	Hampton-McDonough Road	72.1	1.3	1.2	1.5	0.90	II	70.6	6.6	0.92
Hampton-McDonough Road	Jonesboro Road	70.6	2.5	2.4	2.7	0.92				
Jonesboro Road	Jodeco Road	69.2	1.2	1.1	1.3	0.94				
Jodeco Road	Hudson Bridge Road	70.4	1.6	1.4	1.8	0.92				
Hudson Bridge Road	Interstate 675	67.3	3.1	2.9	3.7	0.97	I	66.5	12.9	0.98
Interstate 675	Stockbridge Highway	65.8	0.5	0.4	0.5	0.99				
Stockbridge Highway	Mt. Zion Blvd	68.5	2.4	2.2	2.6	0.95				
Mt. Zion Blvd	State Route 54	68.6	1.3	1.2	1.4	0.95				
State Route 54	Old Dixie Highway	67.2	2.0	1.9	2.2	0.97				
Old Dixie Highway	Forest Parkway	64.7	2.4	2.1	2.7	1.00				
Forest Parkway	Interstate 285	60.3	1.1	1.0	1.2	1.08				
Interstate 285	Aviation Blvd	61.0	0.3	0.2	0.4	1.07				
							Total	68.9	28.6	0.94

Table 1-6: I-75 PM SB Travel Statistics by Interchange and by Segment

From Interchange	To Interchange	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	Min. Observed Travel Time (min)	Max. Observed Travel Time (min)	TTI (65 MPH base)	Segment	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	TTI (65 mph base)
Aviation Blvd	Interstate 285	14.1	1.2	0.2	5.3	4.61	I	33.0	28.5	1.97
Interstate 285	Forest Pkwy	25.0	2.6	0.9	12.9	2.60				
Forest Pkwy	Old Dixie Highway	50.9	3.0	2.3	5.7	1.28				
Old Dixie Highway	State Route 54	66.9	2.0	1.8	2.2	0.97				
State Route 54	Mt. Zion Blvd	67.3	1.3	1.2	1.7	0.97				
Mt. Zion Blvd	Stockbridge Highway	23.3	6.9	2.2	23.5	2.79				
Stockbridge Highway	Interstate 675	12.3	2.6	0.4	5.5	5.31				
Interstate 675	Hudson Bridge	22.9	8.9	4.1	21.2	2.83				
Hudson Bridge	Jodeco Road	45.9	2.4	1.6	5.3	1.42	II	59.0	7.9	1.10
Jodeco Road	Jonesboro Road	64.0	1.3	1.1	1.6	1.02				
Jonesboro Road	Hampton-McDonough Road	66.2	2.7	2.5	3.3	0.98				
Hampton-McDonough Road	McDonough Road	63.2	1.5	1.3	2.0	1.03				
McDonough Road	Locust Grove Road	69.4	3.9	3.6	4.8	0.94	III	69.1	9.4	0.94
Locust Grove Road	SR 16	69.0	5.5	5.1	6.9	0.94				
							Total	43.0	45.8	1.51

Figure 1-25: I-75 PM SB Average Speed

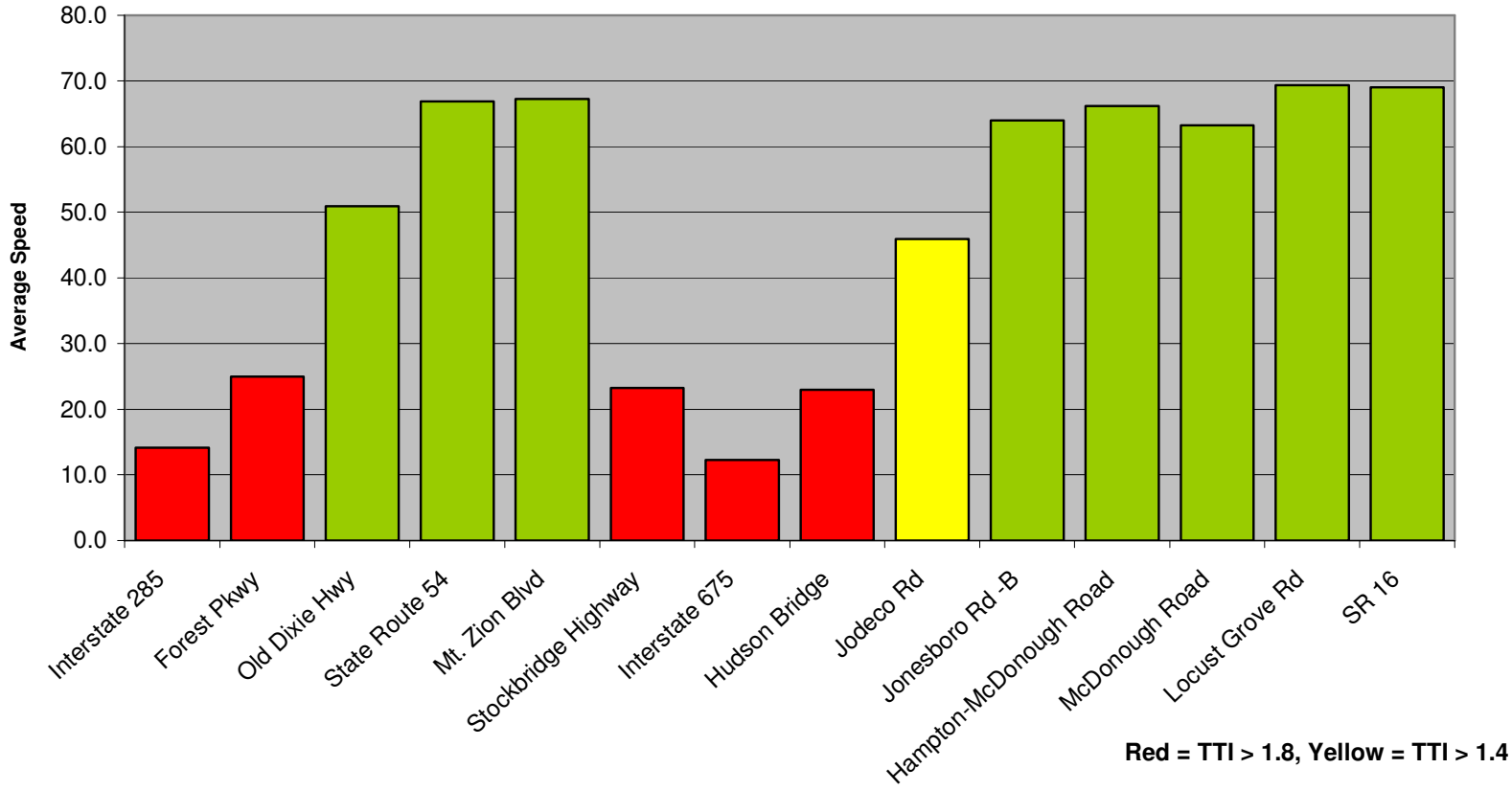


Table 1-7: I-75 Off-Peak NB Travel Statistics by Interchange and by Segment

From Interchange	To Interchange	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	Min. Observed Travel Time (min)	Max. Observed Travel Time (min)	TTI (65 MPH base)	Segment	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	TTI (65 mph base)
SR 16	Locust Grove Road	70.7	5.3	5.0	5.6	0.92	III	71.2	9.1	0.91
Locust Grove Road	McDonough Road	71.8	3.8	3.6	4.0	0.91				
McDonough Road	Hampton-McDonough Road	72.6	1.3	1.2	1.4	0.89	II	71.4	6.5	0.91
Hampton-McDonough Road	Jonesboro Road	72.0	2.4	2.3	2.5	0.90				
Jonesboro Road	Jodeco Road	70.3	1.2	1.1	1.2	0.92				
Jodeco Road	Hudson Bridge Road	70.4	1.6	1.5	1.6	0.92				
Hudson Bridge Road	Interstate 675	68.6	3.0		3.3	0.95	I	67.4	12.7	0.96
Interstate 675	Stockbridge Highway	68.2	0.4	0.4	0.5	0.95				
Stockbridge Highway	Mt. Zion Blvd	68.8	2.3	2.3	2.5	0.94				
Mt. Zion Blvd	State Route 54	68.1	1.3	1.2	1.4	0.95				
State Route 54	Old Dixie Highway	68.2	2.0	1.8	2.1	0.95				
Old Dixie Highway	Forest Parkway	67.9	2.2	2.1	2.4	0.96				
Forest Parkway	Interstate 285	57.7	1.1	1.0	1.2	1.13				
Interstate 285	Aviation Blvd	52.4	0.3	0.3	0.4	1.24				
							Total	69.4	28.4	0.94

Table 1-8: I-75 Off-Peak SB Travel Statistics by Interchange and by Segment

From Interchange	To Interchange	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	Min. Observed Travel Time (min)	Max. Observed Travel Time (min)	TTI (65 MPH base)	Segment	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	TTI (65 mph base)
Aviation Blvd	Interstate 285	66.0	0.3	0.3	0.3	0.98	I	63.1	13.5	1.03
Interstate 285	Forest Pkwy	68.5	1.0	0.9	1.0	0.95				
Forest Pkwy	Old Dixie Highway	60.4	2.5	2.3	2.8	1.08				
Old Dixie Highway	State Route 54	60.8	2.2	2.1	2.2	1.07				
State Route 54	Mt. Zion Blvd	64.0	1.4	1.3	1.5	1.02				
Mt. Zion Blvd	Stockbridge Highway	64.8	2.5	2.3	2.7	1.00				
Stockbridge Highway	Interstate 675	64.6	0.5	0.5	0.5	1.01				
Interstate 675	Hudson Bridge	63.0	3.3	3.0	3.5	1.03				
Hudson Bridge	Jodeco Road	64.2	1.7	1.7	1.8	1.01	II	66.2	7.1	0.98
Jodeco Road	Jonesboro Road	68.2	1.2	1.2	1.3	0.95				
Jonesboro Road	Hampton-McDonough Road	67.4	2.6	2.6	2.7	0.96				
Hampton-McDonough Road	McDonough Road	64.7	1.5	1.4	1.6	1.00				
McDonough Road	Locust Grove Road	67.7	4.0	3.9	4.1	0.96	III	67.1	9.7	0.97
Locust Grove Road	SR 16	66.6	5.7	5.4	5.9	0.98				
							Total	65.2	30.2	1.00

Table 1-9: I-675 AM Travel Statistics by Interchange and by Segment

From Interchange	To Interchange	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	Min. Observed Travel Time (min)	Max. Observed Travel Time (min)	TTI (65 MPH base)	Segment	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	TTI (65 mph base)
I-75	Stockbridge Highway	66.7	0.8	0.8	0.9	0.97	**675 NB**	60.2	10.4	1.08
Stockbridge Highway	State Route 42	48.0	2.2	1.5	7.3	1.35				
State Route 42	Ellenwood Road	57.0	2.8	2.2	3.9	1.14				
Ellenwood Road	Anvil Block Road	66.2	1.4	1.4	1.5	0.98				
Anvil Block Road	I-285	67.2	3.1	3.1	3.3	0.97				
I-285	Anvil Block Road	65.5	3.6	3.4	3.8	0.99	**675 SB**	67.6	9.8	0.96
Anvil Block Road	Ellenwood Road	70.2	1.3	1.3	1.4	0.93				
Ellenwood Road	SR 42	68.8	2.3	2.2	2.3	0.94				
SR 42	Stockbridge Highway	68.8	1.5	1.5	1.6	0.95				
Stockbridge Highway	I-75	67.3	1.1	1.1	1.2	0.97				

Table 1-10: I-675 PM Travel Statistics by Interchange and by Segment

From Interchange	To Interchange	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	Min. Observed Travel Time (min)	Max. Observed Travel Time (min)	TTI (65 MPH base)	Segment	Avg. Observed Speed (mph)	Avg. Observed Travel Time (min)	TTI (65 mph base)
I-75	Stockbridge Highway	67.8	0.8	0.8	0.9	0.96	**675 NB**	68.1	9.2	0.95
Stockbridge Highway	State Route 42	70.2	1.5	1.4	1.6	0.93				
State Route 42	Ellenwood Road	68.6	2.3	2.2	2.5	0.95				
Ellenwood Road	Anvil Block Road	67.8	1.4	1.3	1.5	0.96				
Anvil Block Road	I-285	67.0	3.1	3.0	3.5	0.97				
I-285	Anvil Block Road	63.7	3.7	3.4	4.2	1.02	**675 SB**	50.1	13.3	1.30
Anvil Block Road	Ellenwood Road	55.2	1.7	1.3	4.2	1.18				
Ellenwood Road	SR 42	45.9	3.4	2.3	6.0	1.42				
SR 42	Stockbridge Highway	60.7	1.8	1.5	2.6	1.07				
Stockbridge Highway	I-75	27.4	2.8	1.1	6.6	2.37				

1.3 Overall Key Findings

Congestion is an increasing problem in the I-75 and I-675 corridors. With anticipated growth in population and employment along these corridors, coupled with increasing demand in freight traffic national-wide, congestion is expected to increase dramatically over the next 25 years. Specific findings of the analysis of existing and traffic conditions include:

- I-75 SB typically experiences severe PM peak delays from I-285 to Forest Parkway and from SR 54 to Hudson Bridge Road/Eagles Landing Parkway.
- I-75 NB typically experiences severe AM peak delays from Hampton-McDonough Road to I-675 and from Old Dixie Highway to I-285.
- I-675 SB typically experiences brief heavy congestion at the lane drop near Ellenwood Road and then severe congestion where it merges with I-75.
- I-675 NB typically experiences moderate congestion approaching SR 42 (Macon Highway) and then again as the highway merges with I-285.
- The primary reason for increasing congestion directly correlated to the projected increases in population and employment. Over the next 25 years, households and employment along the I-75 South study corridor are forecasted to increase by 77% and 47% respectively. In 2030, I-75 south corridor is anticipated to be the 3rd most populous corridor in the metro Atlanta area.
- I-75 south corridor carries significant heavy truck through traffic from the mid-west to Florida. The forecasted increase in truck traffic (annual growth rate of three percent) will further worsen traffic congestion along the I-75 south corridor.

CHAPTER 2

Stated Preference Survey

2.1 Role of the Stated Preference Research

The assessment of potential managed lanes users' willingness to pay tolls in exchange for improved transportation services was accomplished through stated preference (SP) research. The SP analysis was designed to provide behavioral values for use in modeling traffic and revenue impacts of alternative strategies in the proposed managed lanes. SP surveying was conducted during April-June 2007. The results of the SP analysis were applied within ARC's travel demand model calibrated along the I-75 South Corridor between I-285 and SR 16.

The primary outputs sought from the SP research were values of travel time savings and possibly 'alternative-specific constants', which measures underlying bias towards an alternative. Values were required for each key market segment within the ARC model. The travel demand model contains a detailed coded and validated network of the Atlanta regional highway system. The managed lanes have been coded into 2020 and 2030 forecast year networks for which vehicle matrices have also been created. The impact of alternative roadway allocations resulting from allowing SOVs to buy into the managed lanes at various toll rates can be tested by modifying the networks and re-running the model. The purpose of this chapter is to present the methodology used to evaluate the SP research, offer conclusions on its suitability for predictive purposes, and detail estimates of value of travel time savings derived from statistical analysis of SP research results.

SP analysis was organized for compatibility with the ARC model. Specific analysis was oriented by time-of-day and trip purpose as illustrated below.

Separated networks exist for four time periods:

- Morning peak (6:00 AM-10:00 PM)
- Midday inter-peak (10:00 AM-3:00 PM)
- Evening peak (3:00 PM-7:00 PM)
- Evening/night (7:00 PM-6:00 AM)

And separate matrices for four trip purposes:

- Home-Based Work (HBW)
- Non-Home Based (NHB)
- Home-Based Other (HBO)
- Home-Based School (HBSchool).

2.1.1 Study Method of Stated Preference Surveys

The application of SP techniques to toll road traffic and revenue forecasting is now widespread. It has the primary advantage of avoiding problems of co-linearity between time and cost, both of which are typically determined by distance traveled. This occurs in real-life choices and makes revealed preference (RP) methods problematic, where econometric choice models are derived from actual choice decisions.

In contrast, SP methods avoid correlation between time and costs by presenting users with hypothetical choices; in this case between using the general and managed lanes on I-75 South. One potential weakness is that users may not subsequently act as they state they would for a number of reasons.

To evaluate travel conditions and the potential for managed lanes in the I-75 Corridor, a Home Telephone Stated Preference (SP) Survey was conducted. The Passenger Car Survey assessed the opinions of drivers (single-occupancy vehicles) on using a HOT lane or Express lane. The sections below document the methods, data collection, sample size, and summary of the stated preference survey. The questionnaire was designed by survey and research firm NuStats. The survey design, implementation and preliminary analysis is described in Appendix 2-A.

2.1.2 Stated Preference Choices for Home Telephone Survey

The questionnaire contained two questions which elicit willingness-to-pay information:

- A set of four stated preference choices; and
- A 'transfer price' question.

In the SP choices, SOV respondents were asked to choose between traveling in the managed lanes or general lanes with these alternatives defined in terms of two attributes; toll assessed and travel time savings. The general lanes were free but more congested and therefore slower; the managed lanes were tolled but faster. Eleven levels of tolls were used, ranging from $0.25 to $9.00, and six levels of travel time difference between the general and managed lanes (5, 10, 15, 20, 25, & 30 minutes). Unlike most SP designs, experimental design methods were not used to create orthogonal (uncorrelated) attribute values. Instead, the toll and travel time savings were selected randomly from the above sets of values.

A third option, 'Carpool with someone to use the carpool lane for free', was also offered. If chosen, respondents were probed as to how realistic this option really was for them. Depending on their response, they were then either asked to choose between the tolled SOV use of the managed lane or the free general lanes, or rejected for further analysis.

Following the SP question, a further 'transfer price' question was posed. In this line of questioning, respondents were asked if they would use the managed lane at the various toll levels until the range within which their transfer price for willingness-to-pay for the managed lanes was determined.

Responses from transfer price questions are considered less reliable than SP choices as they are more prone to policy response bias, caused when respondents guess the purpose of the research and seek to influence its findings in their favor by responding strategically. In the case of I-75 South respondents may try to understate the value they place on time savings to discourage tolling.

2.1.3 Stated Preference Analysis

Data from the survey periods, following general quality checks, were merged into a single file for analysis. The time periods and trip purpose segmentations, consistent with the structure of the ARC travel demand model, were identified as appropriate levels of analysis. The four time periods were subsequently reduced to peak and non-peak for analytical purposes, reflecting their similar traffic conditions and trip purpose profiles.

Stated preference responses were analyzed using Alogit choice modeling software. The logit functional form adopted within Alogit is the most widely applied in consumer choice modeling, in part because of its computational ease. The Alogit software, also used in the calibration of the ARC model's mode choice module, uses maximum likelihood procedures to estimate parameter values for a logit choice model of the general form:

$$Pr\ (m) = 1 / 1 + exp\ (\beta 0 + \beta 1(JT_m - JT_g) + \beta 2(TOLL_m))$$

Where:

Pr (m)	=	probability of using managed lane
β0…β3	=	estimated coefficients
JT	=	journey time in minutes
Toll	=	toll in Dollars
m, g	=	subscripts for managed and general lane alternatives

The value of time is derived from the β1 and β2 coefficients, the marginal utilities of toll and time. The β0, also termed the alternative-specific constant, provides an indication of the net impact of any other determinants of lane choice. Models were run for a range of market segmentations although the focus was the eight combinations of peak/non-peak and HBW, NHB, HBO & HBSchool segments.

Analysis results were judged against a number basic diagnostic criterion, including:

- The sign of the attribute (time & toll) coefficients. Both time and toll coefficients are expected to be negative as increases in either will result in reduced utility.
- The statistical significance of attribute coefficients. The coefficient's t-statistics should be significant at the 95% confidence level (i.e. t-statistic > 1.96).
- The overall "goodness-of-fit" of the model, as measured by the adjusted rho-squared. Note that rho-squared values for choice models are typically relatively low, e.g. 0.10 - 0.20.
- Consistency of the derived values of time when additional explanatory variables are added to the model.

Please refer to Appendix 2-A: I-75 South Stated Preference Survey Final Report for detailed methodology and analysis discussion.

2.1.4 Alternative-Specific Constants

The estimated choice models contained a constant term - often referred to as the Alternative-Specific Constant (ASC). This coefficient was included within the utility function of the managed lane option and captured any systematic preference for either the general-purpose lanes or managed lanes that is not explained by toll or travel time differences.

As specified in the I-75 models, a significant positive ASC indicates an underlying preference for the managed lanes and a significant negative ASC an underlying preference for the general-purpose lanes. An insignificant ASC indicates that the value is not significantly different from zero. In the case of I-75, other lane choice factors might include less stressful driving conditions or more predictable travel times on the managed lanes.

The ASC's obtained are always negative and generally significant, although the peak HBO and non-peak HBW ASC's are only significant at the 90% confidence level. The negative ASC values suggest an underlying preference for the general-purpose lanes.

The underlying preference in favor of the general-lanes is contrary to our expectations and we believe the ASC is likely to be capturing a degree of 'policy response bias' - i.e. some respondents selected the general lanes, contrary to their preferences, in order to deter policy makers from introducing tolling on the managed lanes. In view of this, we recommend that no ASC be applied in traffic modeling.

2.1.5 Other Lane Choice Determinants

A brief analysis was undertaken of other factors which might influence lane choice, in addition to the time and toll variables included in the SP choices. It is often difficult to apply the results of such econometric models within traffic models where there are practical constraints on the number of market segments that can be modeled. However, the analysis provides an indication of the robustness of the recommended values of time to alternative model specifications.

A number of potential lane choice determinants were identified by examination of the correlation matrix, including the number of vehicles in the household, intermediate stops and gender. These were added individually to the managed lane utility function within Alogit and the model re-estimated. The test was undertaken on the peak period home-based work model as this is arguably the most important segment.

The addition of the new variables mainly reduced the significance of the ASC, effectively de-composing it into some of its constituent parts. The new variables had no effect on the significance of the time or toll coefficients and the values of time remained virtually unchanged. The results suggest that the values of time reported above are robust.

2.1.6 Distribution of Values of Time

The ARC traffic model, using TP+ software, accepts a distribution of values of time. This enables more accurate forecasts to be made, especially as the value of time distribution is expected to be skewed.

It was not possible to determine individual values of time from the econometric modeling. Instead, the coefficients provide the average value of time for each market segment. The transfer price questions provided a range for each respondent's value. The distributions are generally skewed to the left, as expected, but often have more than one peak (mode). They are also relatively coarse as values can only be determined to one of a few ranges.

For travel demand modeling purposes we have therefore adopted a theoretical lognormal distribution. The lognormal distribution is skewed to the left as the value of time distribution is expected to be as it is strongly influenced by the underlying, skewed income distribution. The shape of the lognormal distribution varies according to the mean and standard error of the values of time, obtained from the econometric modeling.

2.2 Home Telephone Survey

2.2.1 Growth in the Atlanta Region

The following is technical documentation of the methods used to conduct the I-75 South Stated Preference (SP) Survey for the Georgia State Road and Tollway Authority (SRTA).

2.2.2 Study Purpose

The purpose of the I-75 South SP Survey was twofold:

1) To assess the opinions of passengers who drive the I-75 South corridor between I-285 and SR16 with respect to potential usage of proposed managed lane scenarios.
2) To use Stated Preference techniques (rotating various trade-offs between cost and time savings) to determine the pricing structure for proposed managed lane scenarios.

2.2.3 Survey Population

The population of inference (or population under study) for the I-75 South SP Survey consisted of individuals 18 years of age or older residing within Clayton, Coweta, Dekalb, Fayette, Fulton, Gwinnett, Henry, Newton, Rockdale and/or Spalding Counties that have a telephone in their home and travel a target road segment at least once per week.

2.2.4 Sample Sizes, Targets and Quotas

A total of 1,210 valid interviews were required collected. The project team established quotas to obtain 70 percent of trips in peak periods and 30 percent all other times including Saturday and Sunday. AM Peak is defined as 6 a.m. to 10 a.m., and PM Peak is defined as 3 p.m. to 7 p.m.

2.2.5 Sampling Frame Generation

The sampling frame consisted of listed (known residential address) telephone numbers for households located in Clayton, Coweta, DeKalb, Fayette, Fulton, Gwinnett, Henry, Newton, Rockdale and/or Spalding Counties. The sample was ordered proportional to pre-defined census tract aggregations defined in a technical sampling memorandum developed as part of the survey (included in Appendix 2-A). A total of 28,915 sample records were received for dialing the survey. NuStats procured the sample from Marketing Systems Group (MSG) based in Fort Washington, PA.

2.2.6 Sample Preparation

The sample was prepared for administration by partitioning it into 58 sub-samples (or replicates) of approximately 500 records each. A replicate is a systematically selected sub-sample of a sample that is geographically representative of the entire sample; the primary benefit of which is that the interviewers did not need to contact the entire sample in order to ensure proper representation. These replicates were released sequentially

over the field period. Of the 28,915 records, 25,298 were dialed during survey administration.

2.2.7 Advance Letter

An advance letter was sent to all potential survey respondents, inviting them to participate in the research effort. The letter contained information regarding the objectives of the survey, expectations of survey participants, a confidentiality statement and project manager contact information. The letter is included in Appendix 2-A of this report.

2.2.8 Questionnaire

The HNTB Team and SRTA collaboratively designed the survey instrument. Upon approval of the instrument it was programmed into a computer-assisted telephone interviewing (CATI) environment for dialing. The survey instrument is included in Appendix 2-A.

2.2.9 Data Collection

Survey specialists conducted data collection for the I-75 South Stated Preference Survey. All survey specialists attended a training session and were required to perform simulated interviews before beginning data collection activities. In addition, interviewers were continually monitored to ensure the highest level of quality was maintained.

A total of 1,210 telephone interviews were conducted utilizing CATI software. The use of CATI interviewing was essential to the research process to ensure that the right information was collected in the most efficient manner. The average length of each completed pilot survey was 15.62 minutes. Data collection took place from April 3, 2007 to June 4, 2007. All interviews were conducted in English.

2.2.10 Edit Checks

Prior to any data analysis, a comprehensive edit check was performed for each completed interview. During this phase, each interview was required to pass a routine edit check program before it could be included in the final data set. Routine edit checks include such items as data range limitations, skip patterns, logic checks, coding of open end responses and checks of calculated variables.

2.2.11 Survey Rates

Table 2-1 below provides a description of the final dispositions of the 25,298 sample pieces that were used during the I-75 South SP survey. As indicated in the table, the final response rate was 24 percent and the final refusal rate was 33 percent.

Table 2-1: Passenger Car Final Dispositions

Disposition	Total	
	Count	%
Answering Machine	3,645	14%
Business/Government	427	2%
Busy	321	1%
Completed Surveys	1,210	5%
Disconnect	3,579	14%
Fax/Modem	680	3%
Hang Up	2,247	9%
Caller ID	2,432	10%
Callback	174	1%
Language Barrier	651	3%
No Answer	3,796	15%
Not Qualified	2,266	9%
Initial Refusal	3,180	13%
Partial Complete	3	0%
Final Refusal	629	2%
Partial Refusal	58	0%
Total	**3,645**	**100%**
Survey Parameter	**All Sample**	
Sample Pieces Used	25,298	100%
Completed Surveys	1,210	5%
HHlds eligible for participation	1,900	8%
Ineligible sample	7,603	30%
Unknown eligibility	15,795	62%
Ratio of good to bad sample	19.99%	
Expected eligible sample to come	854	8%
Response Rate	23.92%	
Refusal Rate	33.11%	
Ratio of CM to Eligible	63.68%	
Average Interview Length	15.62	Minutes

2.3 Stated Preference Analysis

2.3.1 SP Method A

Stated preference questions were used to measure respondents' likelihood of using the HOT lane as a function of the toll level and time savings. The questions were asked of 1,210 respondents whose reference trip was made as a driver on I-75. The introduction and wording of the questions is shown below. For each respondent, one of the two orderings of the alternatives shown below was selected at random to avoid order-related bias.

Now assume you're making a future trip on I-75 just like the one that you just told me about. It's a trip on the same day, at the same time of day, for the same purpose, and you're under the same time pressures. You are traveling on the segment of I-75 between I-285 and SR16 and have the option of using the new lanes if you want to.

Order 1: If you were to use the general traffic lanes on this segment of I-75, your trip would take <TT+X> minutes and be free. If you used the new managed lane you would pay $<Y> and your trip would take <TT> minutes, saving <X> minutes. You could also choose to carpool with someone and use the lane for free. Now under these conditions, would you choose to:

Use the managed lane, pay $<Y> and save <X> minutes	*1*
Use the general lane for free	*2*
Carpool with at least 2 other persons to use the managed lane for free	*3*
Don't know/refused	*8*

Order 2: If you were to use the managed lane on this segment of I-75, you would pay $<Y> and your trip would take <TT> minutes. If you were to use the general traffic lanes, your trip would take <TT+X> minutes, <X> minutes longer than in the managed lane, but it would be free. You could also choose to carpool with someone and use the lane for free. Now under these conditions, would you choose to:

Use the general lane for free	*1*
Use the managed lane, pay $<Y> and save <X> minutes	*2*
Carpool with at least 2 other persons to use the managed lane for free	*3*
Don't know/refused	*8*

The wording for the carpool for free option depended on whether it was a HOT lane 2+ or HOT lane 3+ scenario, and was not included at all for the Express Lane scenarios. In the cases where respondents chose option 3, Carpool, they were then asked to imagine that it would not have been possible for them to carpool for that trip, and to choose from one of the two remaining options, 1 or 2, in order to provide additional data for analysis.

Each person received 4 different scenarios of this type, each with a different amount of time savings (X = 5, 10, 15, 20, 25 or 30 minutes) and toll ($ =25 cents, 50 cents, $1, $2, $3, $4, $5, $6, $7, $8, $9 or $10). The value TT used for the tolled lane was based on the respondent's estimate of their travel time with no congestion. Many different sets of 4 scenarios were used across the sample, with each respondent assigned one of the sets

at random. In total, 72 (6 x 12) different scenarios were used, each identifying a different time/cost tradeoff point.

2.3.2 SP Method B

Next, the same type question was asked again, with exactly the same wording, but this time using the "price meter" approach. Each respondent was assigned a level of time savings (S = 5, 10, 15, 20 ,25 or 30 minutes) at random. Then a random toll price point was chosen (P = 25 cents, 50 cents, $1, $2, $3, $4, $5, $6, $7, $8, $9 or $10) and the same question from above was asked (with the same Order 1 or Order 2). If the person said that they would pay the toll, a higher price point was chosen at random, and if they said they would not pay the toll, a lower price point was chosen at random, and the question was asked again at the new toll level. This procedure was continued until the "switching point" was identified – e.g. the respondent would be willing to pay a toll of $2, but not willing to pay the next higher level, $3.

2.4 The SP Response

Table 2-2 below shows the values of time (VOT) in $/hour identified by each of the 72 SP scenarios used. The value of time was determined based on possible travel time savings offered by managed lanes and the toll rates the responders would be willing to pay. For instance, if the respondent said they would be willing to pay $1 to save 15-minutes [1/4hour] of travel time, their VOT in that particular scenario is $4/hour (Please refer to Appendix 2-A: I-75 South Stated Preference Survey Final Report). The VOT range from $0.50/hour (25 cents for a 30 minute savings) up to $120/hour ($10 for a 5 minute savings), with most of the value in the range of $1/hour to $15/hour.

Table 2-3 shows the number of SP responses for each of the 72 combinations. With 4 SP responses per person, and a low incidence of missing data ("don't know" responses are not included), there are 4,646 Method A responses. Most of the responses are for the medium price levels in the $1 to $6 range, as the very low and very high price levels were presented less often by design.

Table 2-4 shows the percent of respondents who said they would pay the toll to save the specified amount of time for each SP combination. This same data is plotted in Figure 1. In general, the percentages rise consistently with the amount of time saved, and drop with the price level. There is some random variation, due mainly to the fact that different sets of respondents faced the various combinations of levels.

Note that even at very low values of time of $1/hour or less, over 20% of respondents say they would not pay the toll. There may be some amount of "protest vote" in such responses, with respondents against the idea of tolling saying they would not pay any price. Because those protest responses do not depend on the specific price level, their effect in modeling analysis (presented later) is mainly to give negative alternative-specific constants on the managed lanes, rather than to give lower VOT estimates.

Figure 2-2 shows an analogous plot for the Method B choice data. Because of the "price meter" approach used to choose the price levels for Method B, the response to price level is much smoother than for Method A by design. However, we tend to find lower willingness to pay the higher price levels in the Method B data, as can be seen by

comparing the two figures. This difference is likely due to the emphasis on price in the Method B approach, which may make the respondents more price-sensitive. Because of this possible bias, we use Method A data for most of the VOT analysis, while using the Method B data to provide an idea of the spread of the distribution of VOT across the population. The Method B approach provides individual-level estimates of VOT, while the Method A does not, so Method B is better suited for looking at the distribution of non-systematic variation in VOT (i.e. variation that cannot be attributed to observed person and trip characteristics).

Figure 2-1 plots the same data, but this time using the identified VOT for the X axis instead of different curves for different time savings (i.e. a 10 minute savings for $1 is plotted together with a $20 minute savings for $2). Figure 4 is the same plot, but cut off at VOT=$30/hour to show more detail. The plots show that Method B begins to give different results from Method A as VOT increases.

Table 2-2: Value of Time Identified by each Combination of Time Save and Toll Level

Time Saved/ Toll Level	5 min	10 min	15 min	20 min	25 min	30 min
$ 0.25	$ 3.00	$ 1.50	$ 1.00	$ 0.75	$ 0.60	$ 0.50
$ 0.50	$ 6.00	$ 3.00	$ 2.00	$ 1.50	$ 1.20	$ 1.00
$ 1.00	$ 12.00	$ 6.00	$ 4.00	$ 3.00	$ 2.40	$ 2.00
$ 2.00	$ 24.00	$ 12.00	$ 8.00	$ 6.00	$ 4.80	$ 4.00
$ 3.00	$ 36.00	$ 18.00	$ 12.00	$ 9.00	$ 7.20	$ 6.00
$ 4.00	$ 48.00	$ 24.00	$ 16.00	$ 12.00	$ 9.60	$ 8.00
$ 5.00	$ 60.00	$ 30.00	$ 20.00	$ 15.00	$ 12.00	$ 10.00
$ 6.00	$ 72.00	$ 36.00	$ 24.00	$ 18.00	$ 14.40	$ 12.00
$ 7.00	$ 84.00	$ 42.00	$ 28.00	$ 21.00	$ 16.80	$ 14.00
$ 8.00	$ 96.00	$ 48.00	$ 32.00	$ 24.00	$ 19.20	$ 16.00
$ 9.00	$ 108.00	$ 54.00	$ 36.00	$ 27.00	$ 21.60	$ 18.00
$ 10.00	$ 120.00	$ 60.00	$ 40.00	$ 30.00	$ 24.00	$ 20.00

Table 2-3: Method A Choice Observations for Each Combination of Time Saved and Toll Level

Time Saved/ Toll Level	5 min	10 min	15 min	20 min	25 min	30 min	Total
0.25	28	39	40	56	63	34	260
0.5	45	44	44	41	33	34	241
1	92	82	91	85	98	86	534
2	94	87	73	83	80	95	512
3	80	85	92	83	91	90	521
4	85	101	97	84	88	82	537
5	80	75	89	86	84	81	495
6	87	85	81	94	78	82	507
7	50	52	43	41	40	58	284

8	45	47	42	39	36	36	245
9	43	40	45	44	45	41	258
10	45	43	43	35	40	46	252
Total	***774***	***780***	***780***	***771***	***776***	***765***	***4,646***

Table 2-4: Method A Percent Willing to Pay for each Combination of Time Saved and Toll Level

Time Saved/ Toll Level	5 min	10 min	15 min	20 min	25 min	30 min	Total
0.25	50.0%	59.0%	57.5%	67.9%	74.6%	73.5%	65.4%
0.50	37.8%	54.5%	59.1%	78.0%	57.6%	79.4%	60.2%
1.00	29.3%	37.8%	44.0%	58.8%	56.1%	64.0%	48.3%
2.00	12.8%	20.7%	39.7%	45.8%	37.5%	45.3%	33.2%
3.00	8.8%	15.3%	15.2%	27.7%	34.1%	25.6%	21.3%
4.00	7.1%	20.8%	16.5%	14.3%	25.0%	25.6%	18.2%
5.00	3.8%	4.0%	6.7%	11.6%	22.6%	14.8%	10.7%
6.00	3.4%	9.4%	4.9%	11.7%	11.5%	15.9%	9.5%
7.00	8.0%	3.8%	4.7%	9.8%	7.5%	19.0%	9.2%
8.00	0.0%	0.0%	2.4%	5.1%	11.1%	0.0%	2.9%
9.00	7.0%	10.0%	17.8%	6.8%	15.6%	12.2%	11.6%
10.00	4.4%	7.0%	4.7%	2.9%	2.5%	4.3%	4.4%
Total	***12.7%***	***19.2%***	***21.9%***	***29.1%***	***31.8%***	***31.0%***	***24.3%***

Figure 2-1: Percent of Respondents Willing to Pay the Toll, by Time and Cost Level –Method A

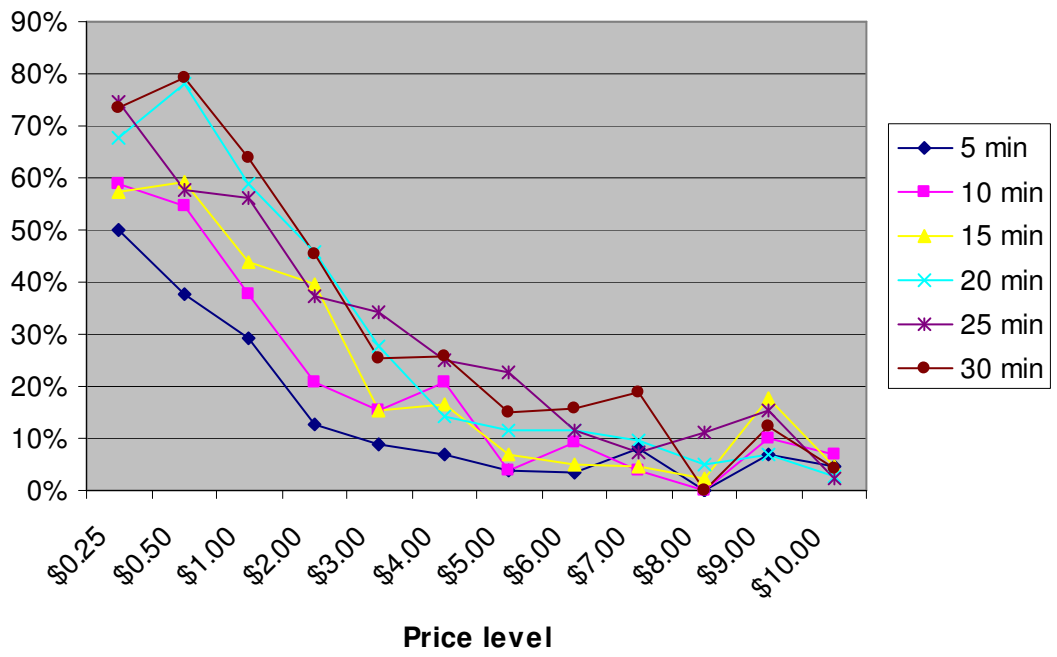


Figure 2- 2: Percent of Respondents Willing to Pay the Toll, by Time and Cost Level – Method B

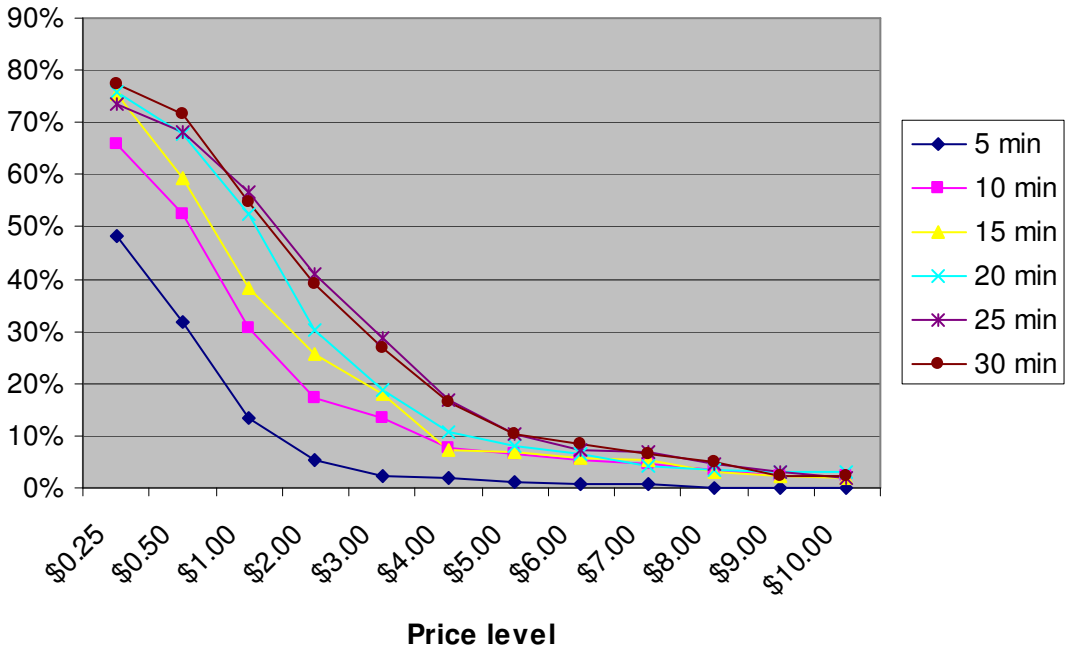


Figure 2- 3: Percent of Respondents Willing to Pay, Depending on Time/Cost Tradeoff

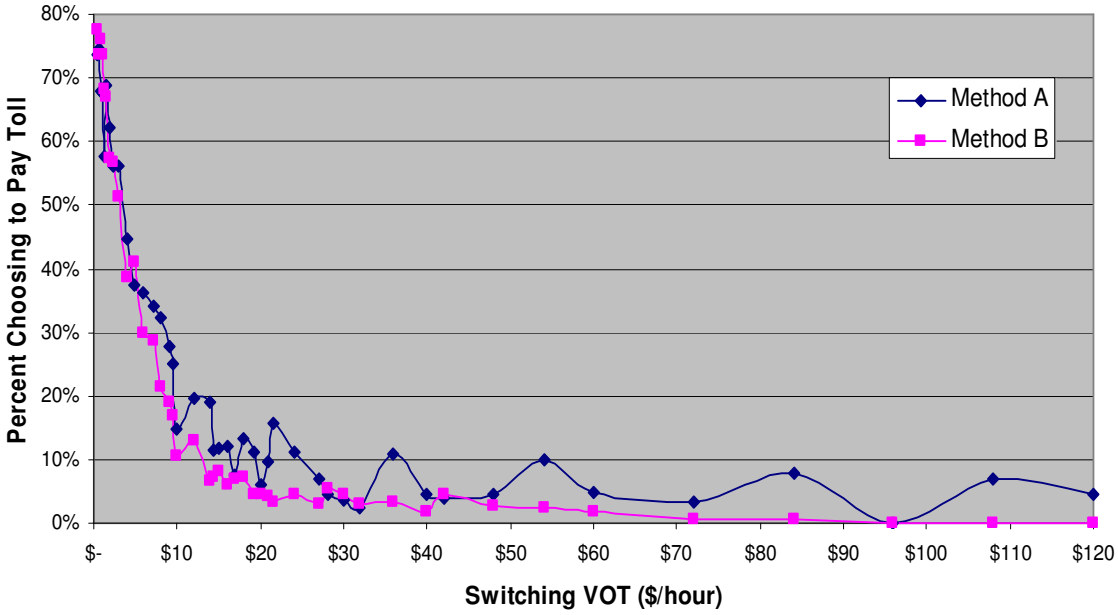
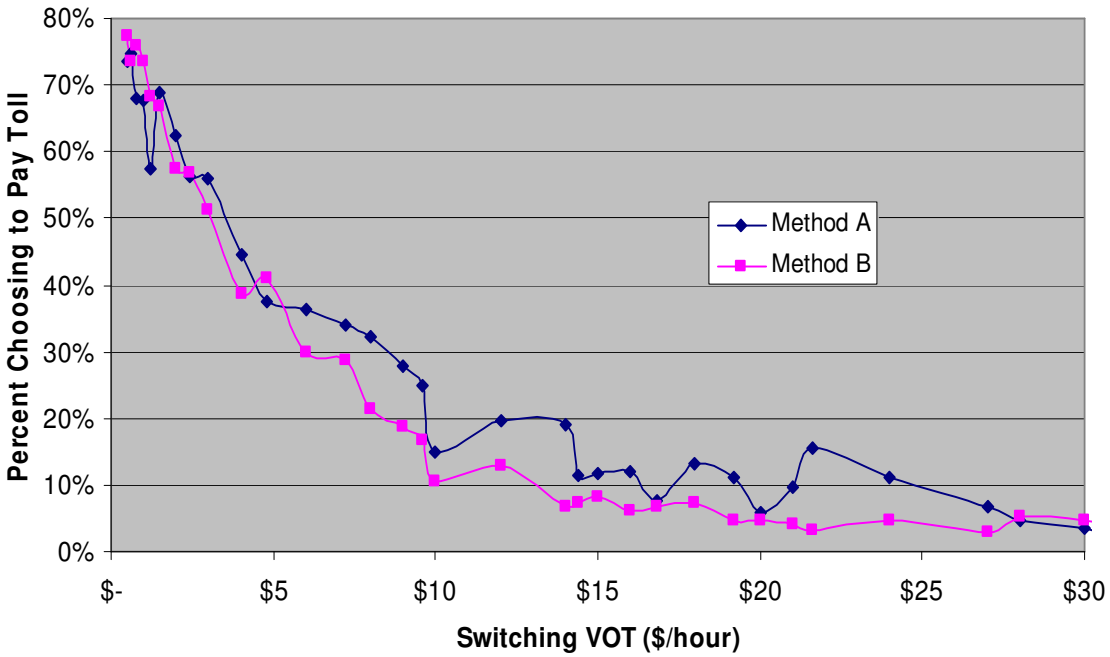


Figure 2-4: Percent of Respondents Willing to Pay, Depending on Time/Cost Tradeoff (Detail at Range Up to $30/HR)



Figures 2-5 and 2-6 are analogous to Figure 2-4, but use only the Method A data, split out by car occupancy (SOV vs. HOV) and time period (AM peak, PM peak, off-peak) respectively. There is no clear difference in willingness to pay across any of these segments. The lines tend to cross, and any differences seem fairly random. As we split the sample, the lower number of observations makes this type of graphical analysis less informative, and a more efficient econometric analysis becomes useful, as presented in the next section.

Note that the tables and graphs jut described do not include the responses where people said they would use the HOT lane for free. For SOV trips, in 9.4% of HOT 2+ lane scenarios they indicated they would find an additional passenger to use the lane for free, and in 7.7% of HOT 3+ lane scenarios, they indicated they would find 2 additional passengers to use the lane for free. For HOV2 trips, in 22.3% of HOT 3+ lane scenarios, they indicated they would find an additional passenger to use the lane for free. We suspect that such responses may be unrealistically high in such an SP approach where people may not fully consider the feasibility of finding additional passengers. That is a reason why we further asked those people to choose between the remaining two options (general lane or managed lane at a price) in such cases, and it is those responses that were used in the graphical analysis. Both types of responses were used in model estimation, described below.

Figure 2-5: Percent of Respondents Willing to Pay, by Occupancy, Depending on Time/Cost Tradeoff (Method A up to $30/hour)

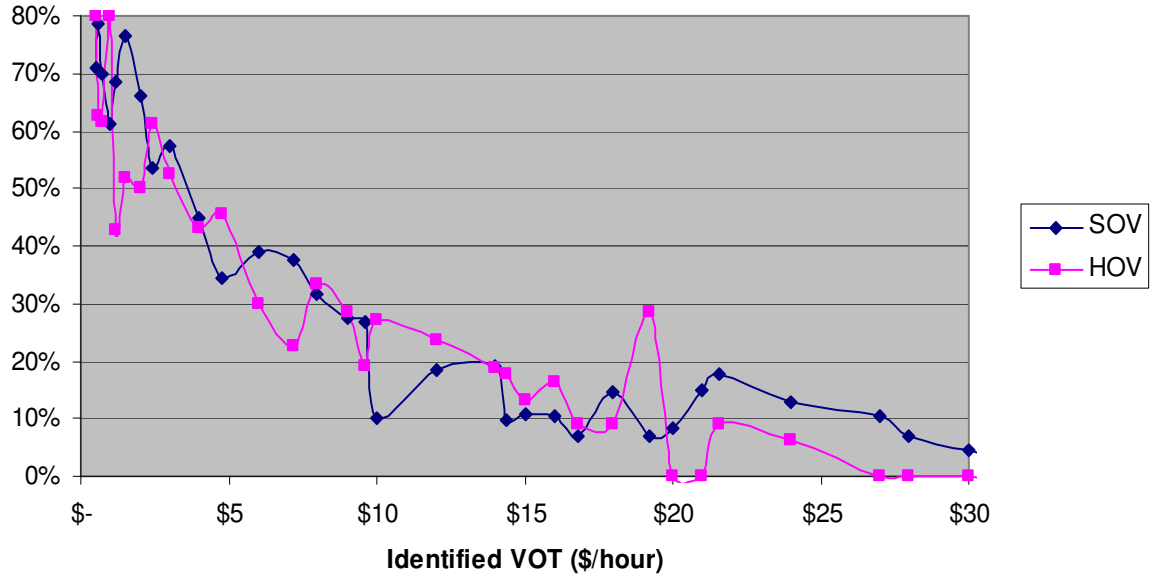
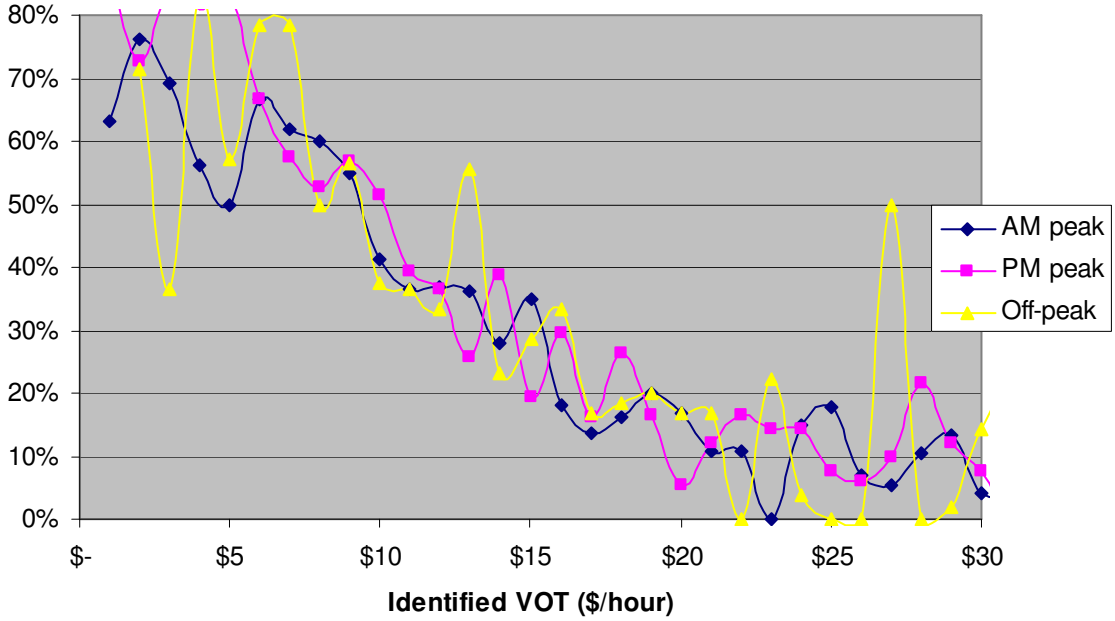


Figure 2-6: Percent of Respondents Willing to Pay, by Period, Depending on Time/Cost Tradeoff (Method A, up to $30/hour)



2.5 Model Estimation Results

Logit models were estimated on the Method A responses. These models had two alternatives, with the following utility specification:

Utility(general purpose lane) = 0

Utility(managed lane) = B1 * Express lane dummy + B2 * HOT 2+ lane dummy + B3 * HOT 3+ lane dummy + B4 * Price + B5 * Time savings + B6 * (Time savings * Trip/respondent characteristic 1) + B7 * (Time savings * Trip/respondent characteristic 2).

This approach is called the "orthogonal segmentation" approach, where a number of additive interaction variables are included along one or more segmentation dimensions. This is the most efficient way to include multiple segmentation variables in a single model. In the five models shown in Table 2-4, a new segmentation variable was added each time:

1. Car occupancy (<u>SOV</u>, HOV)
2. Time period (AM peak, PM peak, <u>off-peak</u>)
3. Trip purpose/type (Home-based work, <u>Home-based other</u>, Non-home-based)
4. Household income (Below 35K$, <u>35 to 75K$,</u>75 to 125K$, Over 125K$)
5. Race (African-American, <u>Other</u>)

In each case, an additional time savings variable was included for every category except one "base" category. The base category for each dimension is underlined above. The effect of the base category then becomes represented in the base time savings coefficient, and the additional variable is the estimate of the difference in travel time savings utility for each group. If the additional variables are not significant, it means that the effect for that group is not significantly different than for the base group.

In all of the models in Table 2-5, the managed lane constants are about -0.6, with the HOT 2+ lane constants slightly higher than the rest. When divided by the price coefficient, which is approximately -0.42/$ in all models, this gives a negative "bias" for the managed lanes worth about $1.40. There may be some real behavioral reasons for this (e.g. some disutility associated with getting into and out of the lanes, or a perceived inconvenience of a transponder or stopping to pay a toll), but a more likely reason is "protest" responses against tolls discussed above. Therefore, using a more positive constant or a constant of 0 in application may be warranted.

In Model 1, the imputed VOT for SOV trips is 3.124 / 0.426 = $7.34/hour. The imputed VOT for HOV trips is (3.124 – 0.339)/ 0.426 = $6.54/hour. However, the t-statistic for the additive HOV variable is only -1.3, so the difference is not highly significant.

In Model 2, time period effects are added in as well. Neither the AM peak nor PM peak appears to have significantly different VOT from the off-peak, and none of the other coefficients change very much. The imputed VOT for the different combinations of occupancy and period is:

Table 2-5: Imputed Value of the Time for SOV and HOV, by Time Period – Model 2

Time Period	SOV	HOV
Off-peak	$ 7.22	$ 6.39
AM peak	$ 6.89	$ 6.06
PM peak	$ 8.04	$ 7.21

Again, none of these differences are statistically significant.

In Model 3, we finally see some significant differences, with both HBW and NHB trips having higher value of time savings than HBO trips. Note that the difference between SOV and HOV virtually disappears, so that difference was due to the fact that HOV trips tend to be more for HBO trips which have lower VOT. If we ignore the occupancy and period effects, the imputed mean VOT for each purpose is:

Table 2-6: Imputed Value of the Time By Trip Type – Model 3

Trip Type	VOT
HB Work	$ 7.39
HB Other	$ 5.73
NHB	$ 8.77

In Model 4, the effect of household income is added. The result is a value of time savings about 15% lower for incomes of less than $35K, and about 20% higher for incomes of greater than $125K. So, there is an effect of income which is marginally significant, but the relationship of VOT with income is clearly less than proportional. This is a typical result in both RP and SP models, and is due to the fact that VOT is related to several person and trip characteristics, and not just income.

Finally, in Model 5, the effect of ethnicity is added in. African-Americans make up a significant proportion of the sample (about 30%), and appear to have significantly higher values of time than other races in the sample, after other differences such as income and trip purpose are taken into account.

Table 2-7: Model Estimate Results – Method A Data

Model	1		2		3		4		5	
Observations	4646		4646		4646		4646		4646	
Final log-likelihood	-2112.9		-2110.8		-2105.2		-2103.8		-2095.7	
Rho-squared (0)	0.344		0.345		0.346		0.347		0.349	
Rho-squared (c)	0.179		0.18		0.182		0.183		0.186	
	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat
Express Lane constant	-0.617	-5.4	-0.617	-5.4	-0.614	-5.4	-0.610	-5.3	-0.604	-5.3
HOT 2+ Lane constant	-0.560	-4.7	-0.558	-4.7	-0.552	-4.6	-0.551	-4.6	-0.543	-4.5
HOT 3+ Lane constant	-0.603	-5.3	-0.602	-5.2	-0.604	-5.3	-0.600	-5.2	-0.593	-5.2
Price level ($)	-0.426	-24.0	-0.427	-24.0	-0.429	-24.0	-0.430	-24.0	-0.432	-24.0
Time savings (hours)	3.124	11.0	3.082	7.5	2.459	5.4	2.479	5.3	2.161	4.5
Additive time variables:										
HOV trip	-0.339	-1.3	-0.356	-1.3	-0.020	-0.1	-0.025	-0.1	-0.048	-0.2
AM peak trip			-0.141	-0.4	-0.118	-0.3	-0.132	-0.4	-0.063	-0.2
PM peak trip			0.350	1.0	0.374	1.0	0.361	1.0	0.449	1.2
Home-based work trip					0.712	2.6	0.679	2.5	0.593	2.2
Non-home-based trip					1.305	2.9	1.271	2.8	1.168	2.6
Income under $35K							-0.370	-1.0	-0.436	-1.1
Income $75K-125K							0.019	0.1	0.043	0.2
Income over $125K							0.462	1.2	0.554	1.5
African-American									0.971	4.0

Table 2-8 is based on a model very similar to Model 3 above, but combining AM peak and PM peak into a single Peak period, and splitting HOV into HOV2 and HOV3+. This was done to provide results comparable to the analysis done on a previous SP survey of residents of Cherokee and Cobb Counties who drove the I-75 corridor between I-285 and I-575. The results from that earlier study are shown in Table 2-8B to allow comparison. Also, in the latter part of each table, the individual-level VOT estimates from the method B data were averaged within each respondent trip segment (purpose x period x occupancy) to provide comparable estimates.

Overall, the results look very similar for the Method A data logit analysis and the Method B data individual level analysis, although the overall mean values from the logit analysis are somewhat higher. Mostly, the trends are the same as in the previous study, with VOT somewhat higher for HOV than for SOV, and somewhat higher in the peak than in the off-peak. The only difference in the current data set is for HBW trips, where there is virtually no difference between peak and off-peak values, and HOV values are lower than SOV values. When we look at the Method B data, however, the HBW value for HOV2 is higher than the SOV value. The lower Method A value may be an outlier due to limited sample size in that particular cell. In application, it may be best to assume a trend with occupancy for HBW similar to that found for the other trip purposes.

Table 2-9 shows the distribution of individual values of time from the Method B analysis by purpose and overall. Table 2-9B shows a very similar analysis from the earlier I-75 SP study. Compared to the earlier study, the overall mean VOT is higher, even though there is now a higher percentage of the sample with very low VOT (less than $1/hour). The reason for the higher mean is that the distribution is now more spread, and there are now higher percentages with high VOT (greater than $9.50/hour). As mentioned above, the overall values from the Method B data are likely to be somewhat low, so the Method A results should be used in application. These results in Table 6 can be useful, however, to give a sense of the shape of the VOT distribution if a lognormal or similar distribution is used in model application.

Table 2-8: Imputed Value of Travel Time Savings ($/Hour)

Purpose	Home Based Work	Home Based Other	Non Home Based
Method A (Logit model)			
Peak period SOV	$ 7.63	$ 5.59	$ 8.97
Off-peak SOV	$ 8.01	$ 4.87	$ 8.25
Peak period HOV2	$ 6.88	$ 5.92	$ 9.30
Off-peak HOV2	$ 7.25	$ 5.19	$ 8.57
Peak period HOV3+	$ 4.93	$ 7.28	$ 10.66
Off-peak HOV3+	$ 5.30	$ 6.56	$ 9.94
Method B (Individual values)			
Peak period SOV	$ 7.25	$ 5.03	$ 7.24
Off-peak SOV	$ 7.15	$ 4.25	$ 5.30
Peak period HOV2	$ 7.82	$ 6.77	$ 8.30
Off-peak HOV2	$ 13.69	$ 5.13	$ 5.14
Peak period HOV3+	$ 4.20	$ 4.73	$ 7.06
Off-peak HOV3+	$ 8.40	$ 8.29	N/A

Table 2-8B: Imputed Value of Travel Time Savings ($/Hour) (Previous I-75 SP Study)

Purpose	Home Based Work	Home Based Other	Non Home Based
Method A (Logit model)			
Peak period SOV	$ 6.04	$ 7.34	$ 8.82
Off-peak SOV	$ 5.34	$ 5.84	$ 6.29
Peak period HOV2	$ 9.89	$ 8.60	$ 6.91
Off-peak HOV2	$ 6.68	$ 6.53	$ 4.25
Peak period HOV3	$ 23.23	$ 8.74	$ 5.16
Off-peak HOV3	$ 9.98	$ 6.97	$ 3.75
Peak period HOV4	$ 10.51	$ 8.01	$ 5.16
Off-peak HOV4	$ 8.28	$ 5.56	$ 3.75
Method B (Individual values)			
Peak period SOV	$ 5.27	$ 5.57	$ 5.50
Off-peak SOV	$ 5.42	$ 4.65	$ 6.48
Peak period HOV2	$ 5.40	$ 4.70	$ 5.07
Off-peak HOV2	$ 9.80	$ 4.77	$ 4.25
Peak period HOV3	$ 13.88	$ 4.50	$ 2.40
Off-peak HOV3	$ 5.22	$ 4.67	$ 5.36
Peak period HOV4	$ 14.27	$ 6.11	$ 5.99
Off-peak HOV4		$ 7.34	

Table 2-9: Value of Time Distribution from Method B Data Individual-level Estimates

Group	Low VOT	High VOT	Cases	Mean VOT	% of Total Trips	% of HBW Trips	% of HBO Trips	% of NHB Trips
1	$0	$0.45	146	$0.31	12.7	11.9	14.0	12.8
2	$0.51	$1.00	133	$0.67	11.5	10.6	14.3	7.0
3	$1.01	$1.50	169	$1.47	14.7	14.7	14.0	17.4
4	$1.46	$2.50	78	$2.11	6.8	6.3	8.8	1.2
5	$2.51	$3.50	73	$3.00	6.3	6.8	5.5	7.0
6	$3.51	$4.50	146	$4.28	12.7	13.4	11.2	14.0
7	$4.51	$6.50	75	$5.71	6.5	6.6	6.2	7.0
8	$6.51	$9.50	133	$8.35	11.5	12.0	10.6	11.6
9	$9.51	$15.50	97	$12.17	8.4	7.6	9.1	11.6
10	$15.51	$90.00	102	$29.27	8.9	10.1	6.2	10.5
Total			***1152***	***$6.16***	***100.0***	***100.0***	***100.0***	***100.0***

Table 2-9B: Value of Time Distribution from Method B Data Individual-level Estimates (Previous I-75 SP Study)

Group	Low VOT	High VOT	Cases	Mean VOT	% of Total Trips	% of HBW Trips	% of HBO Trips	% of NHB Trips
1	$0	$0.50	116	$ 0.48	9.86	8.88	11.89	5.36
2	$0.51	$1.00	101	$ 0.72	8.58	8.15	8.58	10.71
3	$1.01	$1.45	182	$ 1.44	15.46	15.22	16.57	11.61
4	$1.46	$2.50	102	$ 1.81	8.67	9.24	9.16	3.57
5	$2.51 $	$3.50	131	2.99	11.13	13.59	7.41	16.07
6	$3.51	$4.50	166	$ 4.47	14.10	13.04	14.23	18.75
7	$4.51	$6.50	83	$ 5.95	7.05	6.88	6.43	10.71
8	$6.51	$9.50	160	$ 8.98	13.59	12.14	15.59	11.61
9	$9.51	$15.50	58	$ 12.31	4.93	5.98	3.70	5.36
10	$15.51	$90.00	78	$ 24.35	6.63	6.88	6.43	6.25
Total			***1177***	***$ 5.31***	***100.00***	***100.00***	***100.00***	***100.00***

CHAPTER 3

Safety Analysis and VISSIM Analysis

3.1 Overview of the Study Area

The study area for the I-75 Managed Lanes Project is the 33-mile long segment of I-75 from I-285 in Clayton County to SR 16 in Butts County, Georgia. This segment of I-75 is classified as a rural interstate at the southern portion of the study area south of McDonough Road, and as an urban interstate for the remainder. The study area also includes all interchange ramps within this area, up to and including the ramp terminals. For the purpose of an operational and safety analysis for managed lane alternative selection, the focus of the study was on the I-75 mainline.

3.2 Traffic Volumes

Traffic volumes upon which this operational and safety analyses are based were obtained from a variety of sources. Historical traffic volumes were obtained from the Georgia Department of Transportation's (GDOT's) State Traffic and Report Statistics (STARS) website. Current mainline and ramp traffic volumes used in the development of the mirco-simualtion model were provided by GDOT's Office of Transportation Data. Turning movement counts for the ramp terminals were collected specifically for this project by a traffic data collection firm. Historical traffic volumes were also obtained from information provided by GDOT's Office of Traffic Operations from data collected by the NaviGAtor Intelligent Transportation System. This data was used to validate the results of the mirco-simualtion model.

3.3 Safety Analysis

The following section documents the collection and analysis of crash data along the I-75 corridor for years 2003-2006.

3.3.1 Methodology

Roadway crash data in the study area for years 2003, 2004, 2005 and 2006 was collected from the Georgia Department of Transportation's Statewide Crash Database. The raw crash data was analyzed and formatted using the database field descriptions provided by GDOT. Additional information was also received from GDOT's Office of Traffic Safety and Design. Crash rates were calculated using the following method:

- Historical traffic volumes, in terms of Average Daily Traffic (ADT), were obtained from GDOT's Office of Traffic Safety and Design.

- For the purpose of crash rate calculations, the corridor was divided into 16 segments, based on interchanges in the study area. Each segment is identified by its low mile log and high mile log as shown in Table 3-1 and further illustrated in Figures 3-1 to 3-4 below.

Table 3-1: Roadway Segmentation for Crash Data Analysis

County	Segment ID	Start Point	End Point	Description
Butts	1	4.59	5.43	SR 16/Ga. Hwy. 16 (Exit 205) to Butts / Spalding County Line
Butts	2	0.00	1.93	Butts / Spalding County Line to Spalding / Henry County Line
Spalding	3	0.00	3.84	Spalding / Henry County Line to Locust Grove Rd. (CR 648) (Exit 212)
Henry	4	3.84	8.4	Locust Grove Rd. (CR 648) to McDonough Road
Henry	5	8.4	10.03	McDonough Road to McDonough-Hampton Road
Henry	6	10.03	12.88	McDonough-Hampton Road to Jonesboro Road (CR 920)
Henry	7	12.88	14.38	Jonesboro Road (CR 920) to Jodeco Road / Flippen Road (CR 824)
Henry	8	14.38	16.26	Jodeco Road / Flippen Road (CR 824) to Hudson Bridge Rd. (CR 659) / Eagles Landing Pkwy.
Henry	9	16.26	19.76	Hudson Bridge Rd. (CR 659) / Eagles Landing Pkwy. to I-675
Henry	10	19.76	20.24	I-675 to Stockbridge Highway
Henry	11	20.24	20.58	Stockbridge Highway to Henry / Clayton County Line
Henry	12	0	2.4	Henry / Clayton County Line to Mt. Zion Blvd. (CR 28)
Clayton	13	2.4	3.86	Mt. Zion Blvd. (CR 28) to SR 54 / Jonesboro Road
Clayton	14	3.86	6.19	SR 54 / Jonesboro Road to SR 3/US 19/US 41/Old Dixie Highway/Tara Blvd.
Clayton	15	6.19	8.63	SR 3/US 19/US 41/Old Dixie Highway/Tara Blvd. to SR 331/Forest Pkwy.
Clayton	16	8.63	9.72	SR 331/Forest Pkwy. to I-285

Figure 3-1: Portion of the I-75 Study Area in Butts County

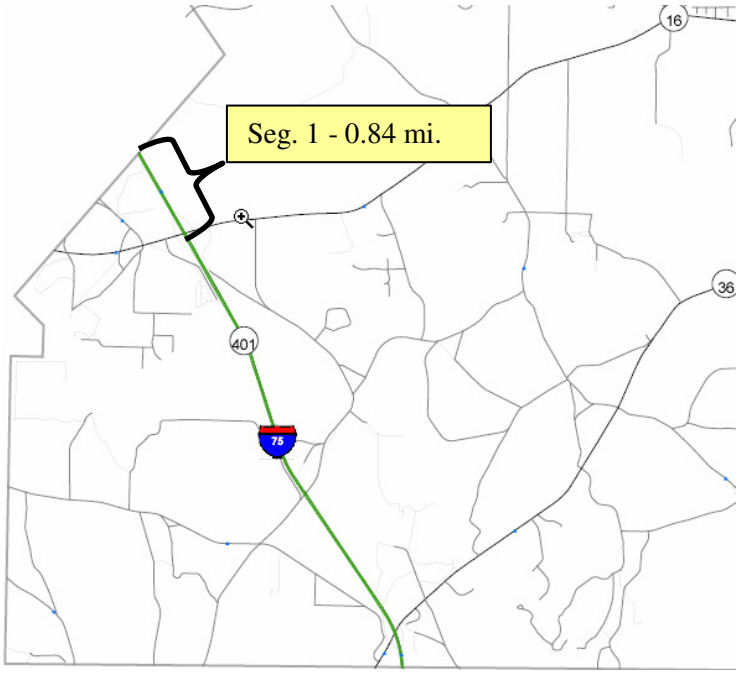


Figure 3-2: Portion of the I-75 Study Area in Spalding County

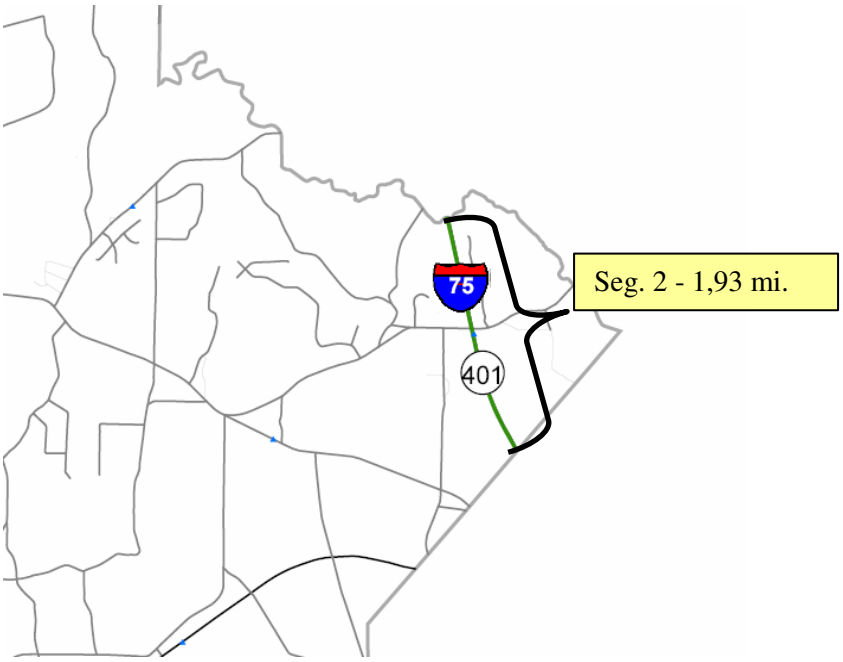


Figure 3-3: Portion of the I-75 Study Area in Henry County

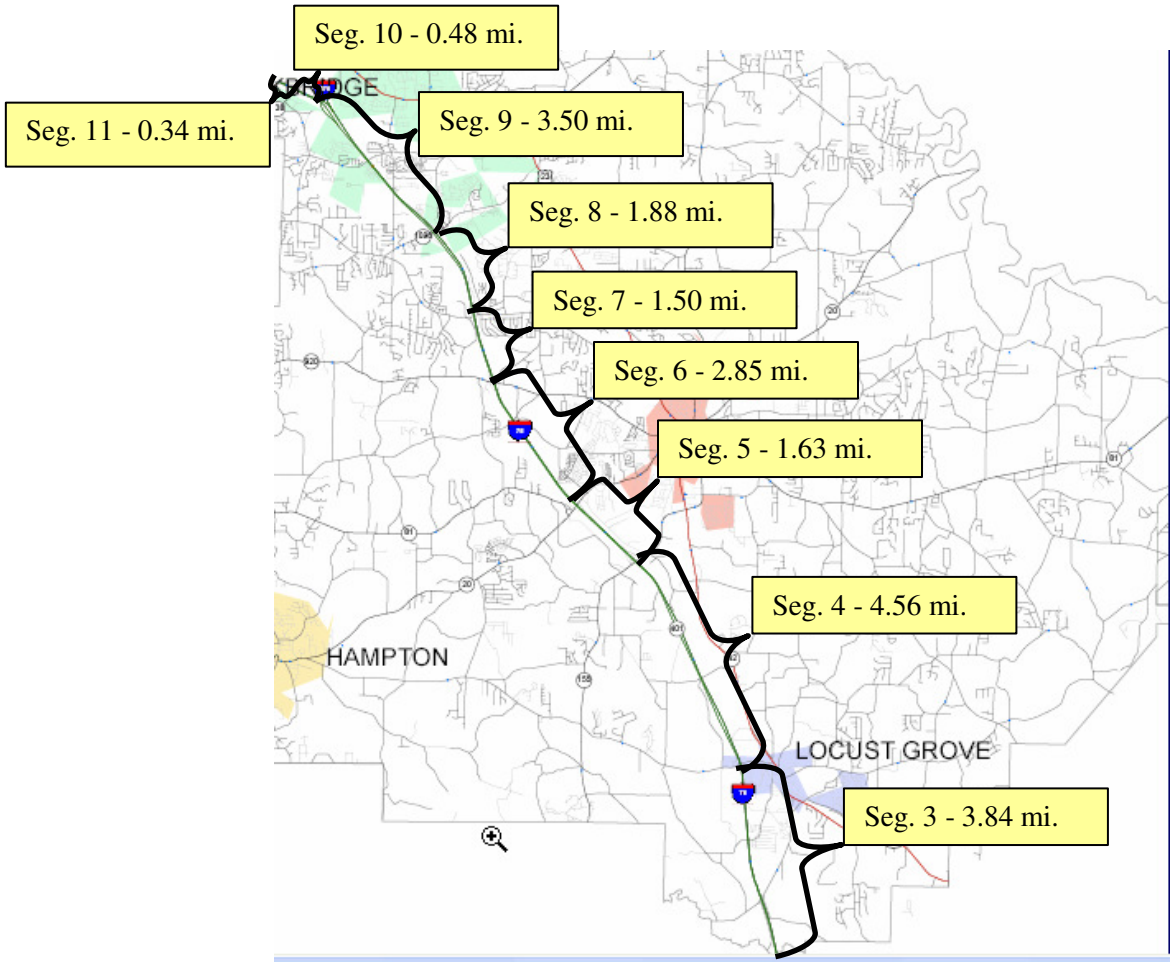
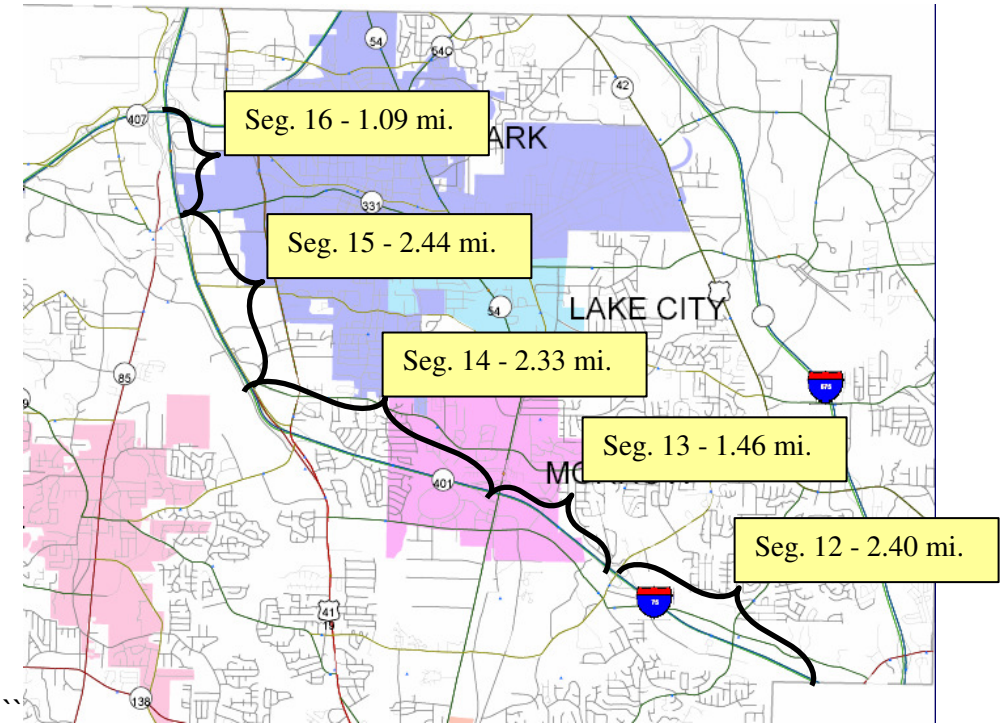


Figure 3-4: Portion of the I-75 Study Area in Clayton County



- The following three rates were calculated using the following equations:
  - Crash rate - total crashes per 100 million Vehicle Miles Traveled (VMT)

$$\text{Crash Rate} = \frac{No.of\ Crashes * 10^8}{ADT * 365 days / year * L miles}$$

NOTE: - Rates are per 100 Million Vehicle Miles

  - Injury rate — total injuries per 100 million VMT

$$\text{Injury Rate} = \frac{No.of\ Injuries * 10^8}{ADT * 365 days / year * L miles}$$

NOTE: - Rates are per 100 Million Vehicle Miles

  - Fatality rate — total fatalities per million VMT

$$\text{Fatality Rate} = \frac{No.of\ Fatalitis * 10^8}{ADT * 365 days / year * L miles}$$

NOTE: - Rates are per 100 Million Vehicle Miles

Average Daily Traffic (ADT) data used for rate calculations were not available for 2006. Crash, injury, and fatality rates could therefore not be calculated for this year, however the total number and types of crashes is presented in the crash summary.

3.3.2 Crash Data Summary

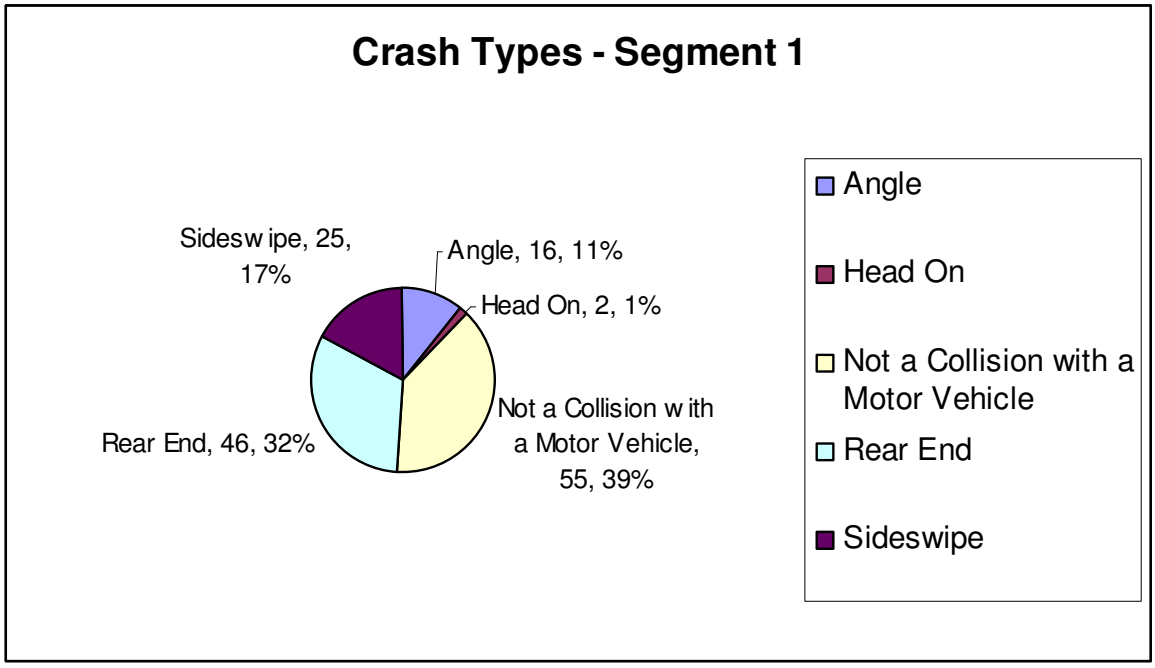
The crash data collected for each of the study segments was reviewed and compared against statewide averages. A summary of the various crash types identified per segment over the entire four-year period are shown in graphical format in Figure 3-5 through Figure 3-20, and in tabular format per year in the Appendix 3-A. Rate calculations can be found in Tables 3-3 through 3-8. Following the crash data summary graphs and rate tables are analysis findings for each segment.

Table 3-2: Average Number of Crashes per Roadway Segment (2003-2006)

	County	Segment ID	Start Point	End Point	Distance	Average Total Crashes	Types of Crashes
Rural Interstate	Butts	1	4.59	5.43	0.84	36	See figure 3-5
	Butts	2	0.00	1.93	1.93	30	See figure 3-6
	Spalding	3	0.00	3.84	3.84	101	See figure 3-7
	Henry	4	3.84	8.4	4.56	160	See figure 3-8
Urban Interstate	Henry	5	8.4	10.03	1.63	186	See figure 3-9
	Henry	6	10.03	12.88	2.85	254	See figure 3-10
	Henry	7	12.88	14.38	1.50	220	See figure 3-11
	Henry	8	14.38	16.26	1.88	227	See figure 3-12
	Henry	9	16.26	19.76	3.50	432	See figure 3-13
	Henry	10	19.76	20.24	0.48	74	See figure 3-14
	Henry	11	20.24	20.58	0.34	115	See figure 3-15
	Henry	12	0	2.4	2.40	196	See figure 3-16
	Clayton	13	2.4	3.86	1.46	153	See figure 3-17
	Clayton	14	3.86	6.19	2.33	292	See figure 3-18
	Clayton	15	6.19	8.63	2.44	256	See figure 3-19
	Clayton	16	8.63	9.72	1.09	230	See figure 3-20

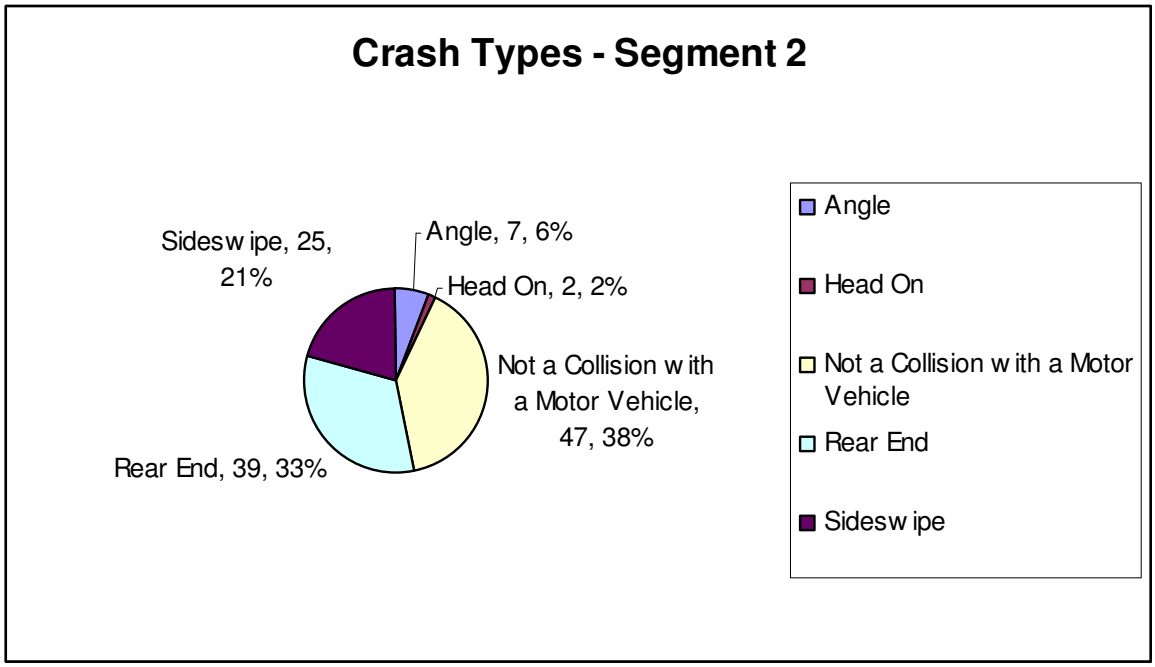
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-5: Crash Types – Segment 1, SR 16 to Butts / Spalding County Line



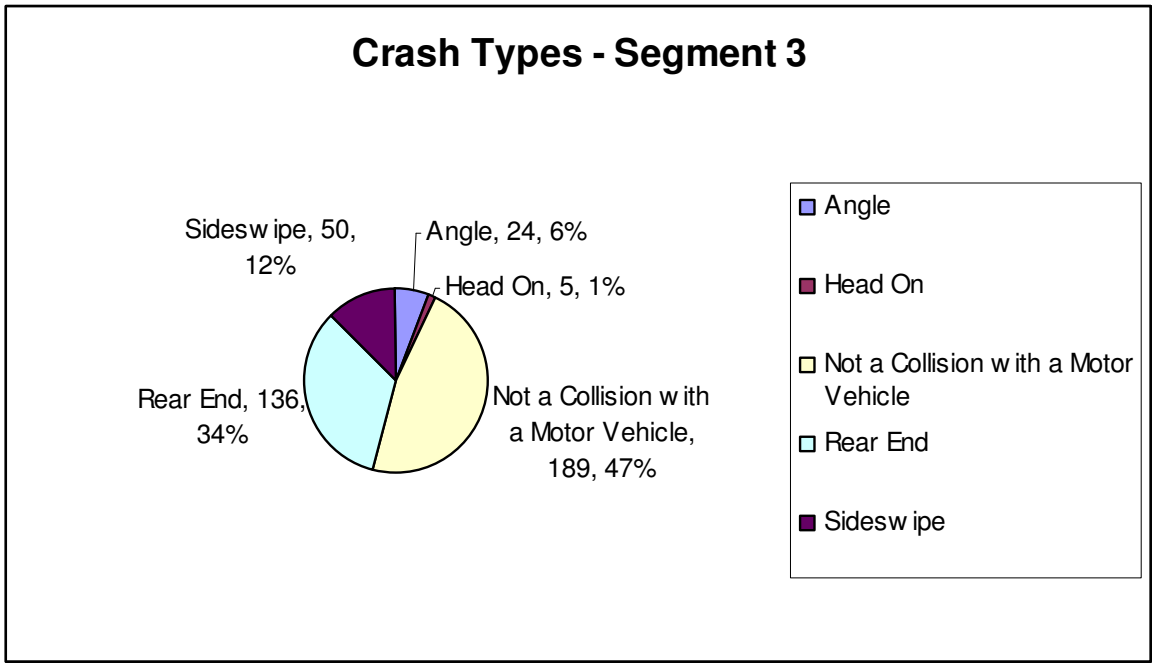
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-6: Crash Types – Segment 2,
Butts / Spalding County Line to Spalding / Henry County Line



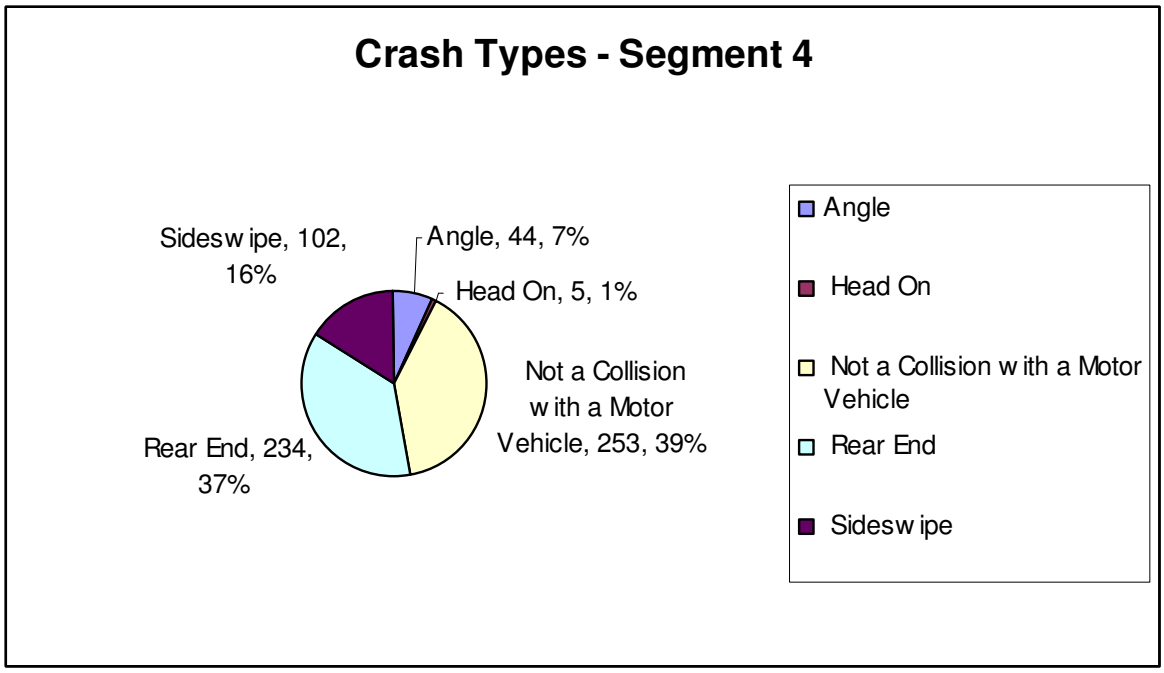
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-7: Crash Types –
Segment 3, Spalding / Henry County Line to Locust Grove Rd. (CR 648)



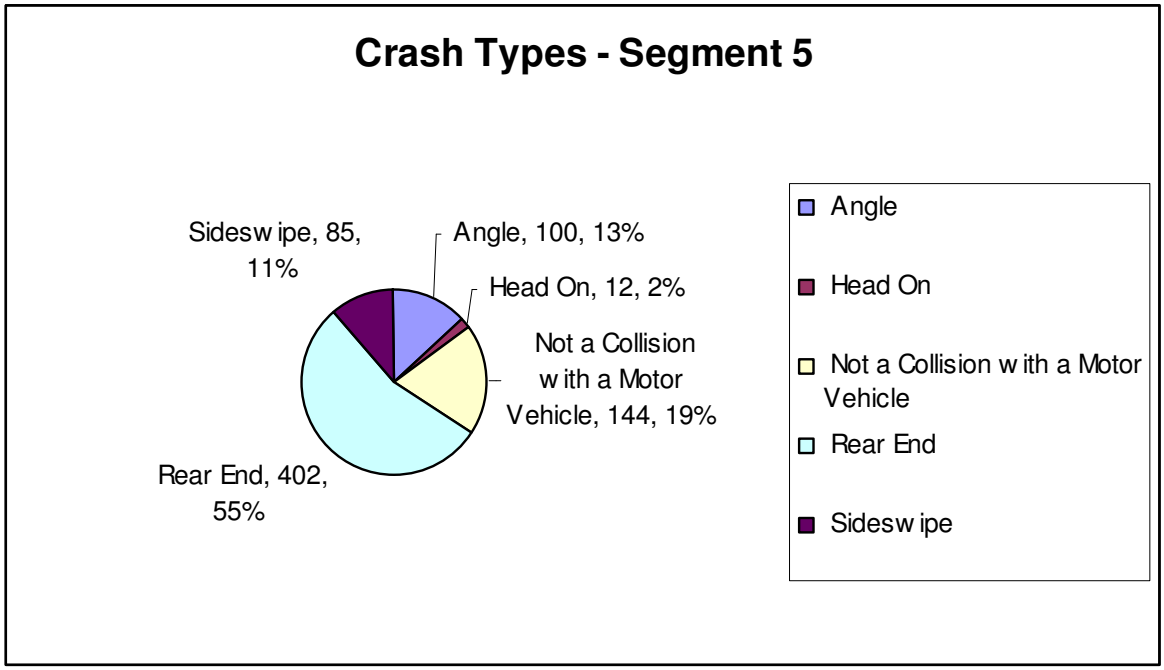
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-8: Crash Types – Segment 4,
Locust Grove Rd. (CR 648) to McDonough Road



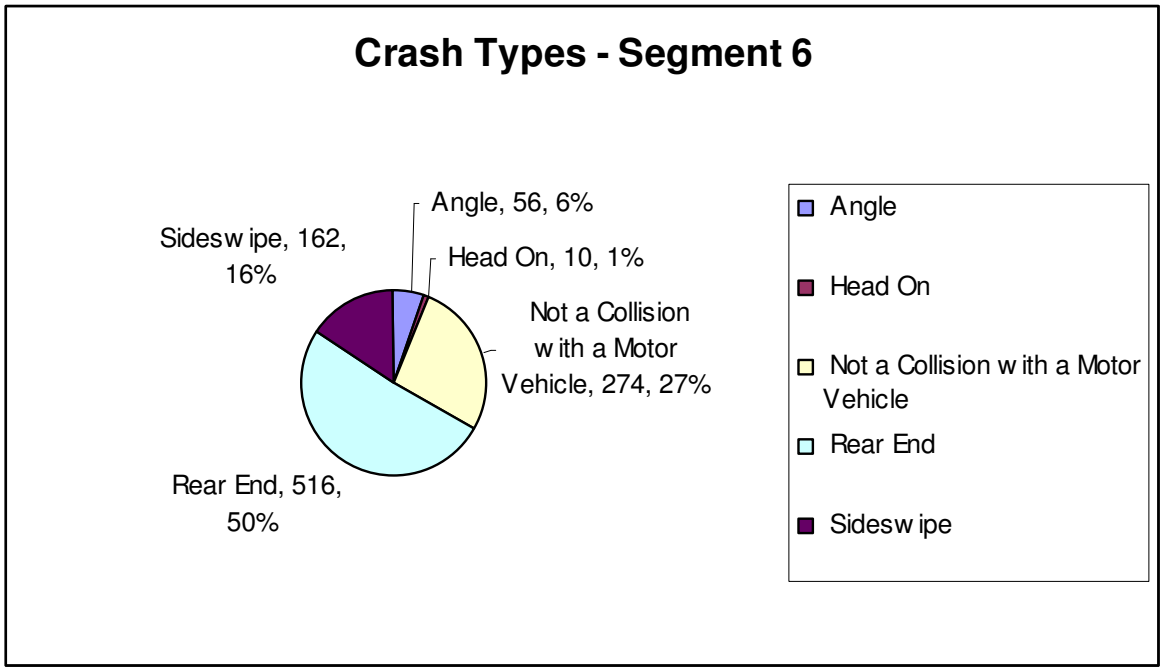
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-9: Crash Types – Segment 5, McDonough Road to McDonough-Hampton Road



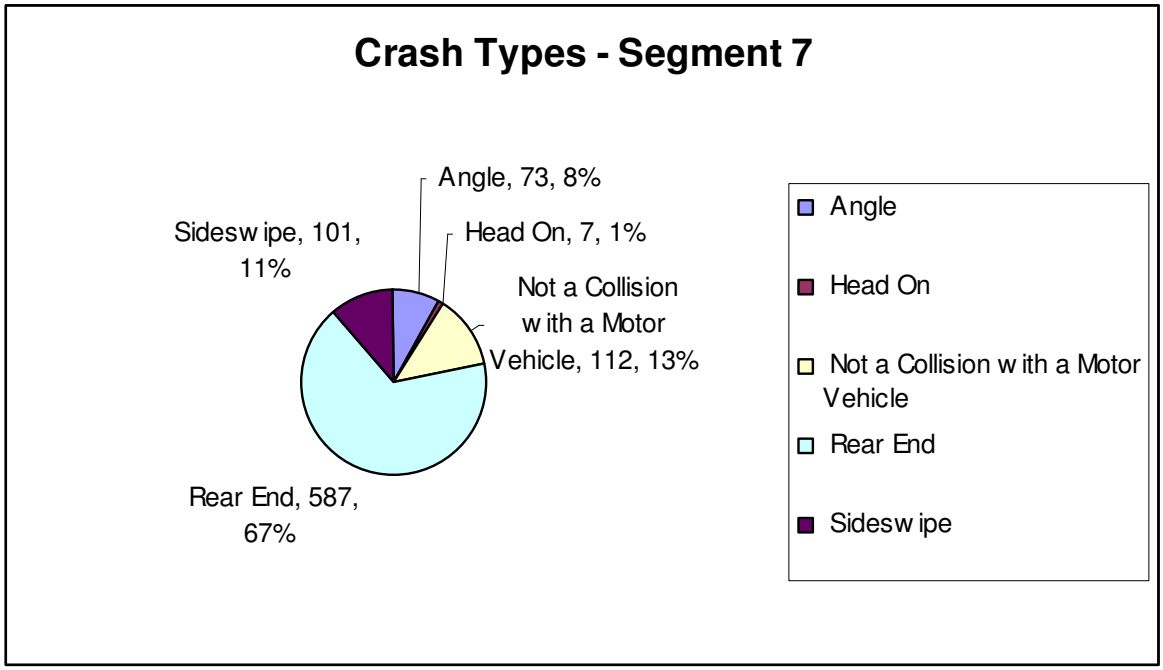
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-10: Crash Types – Segment 6, McDonough-Hampton Road to Jonesboro Road (CR 920)



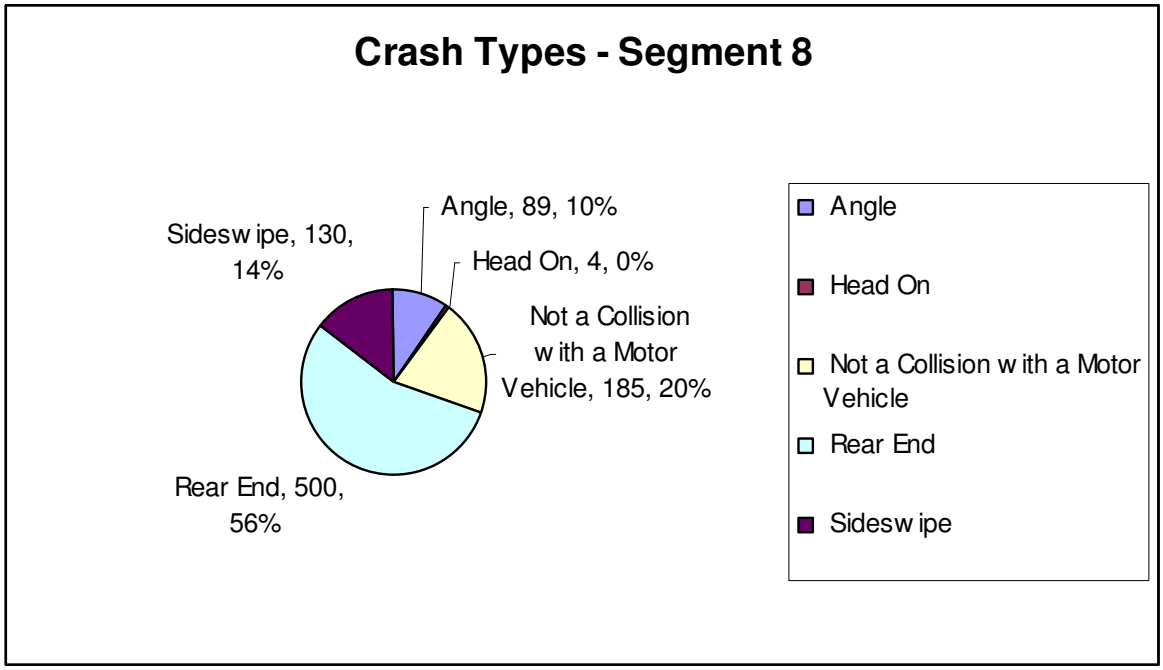
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-11: Crash Types – Segment 7, Jonesboro Road (CR 920) to Jodeco Road / Flippen Road (CR 824)



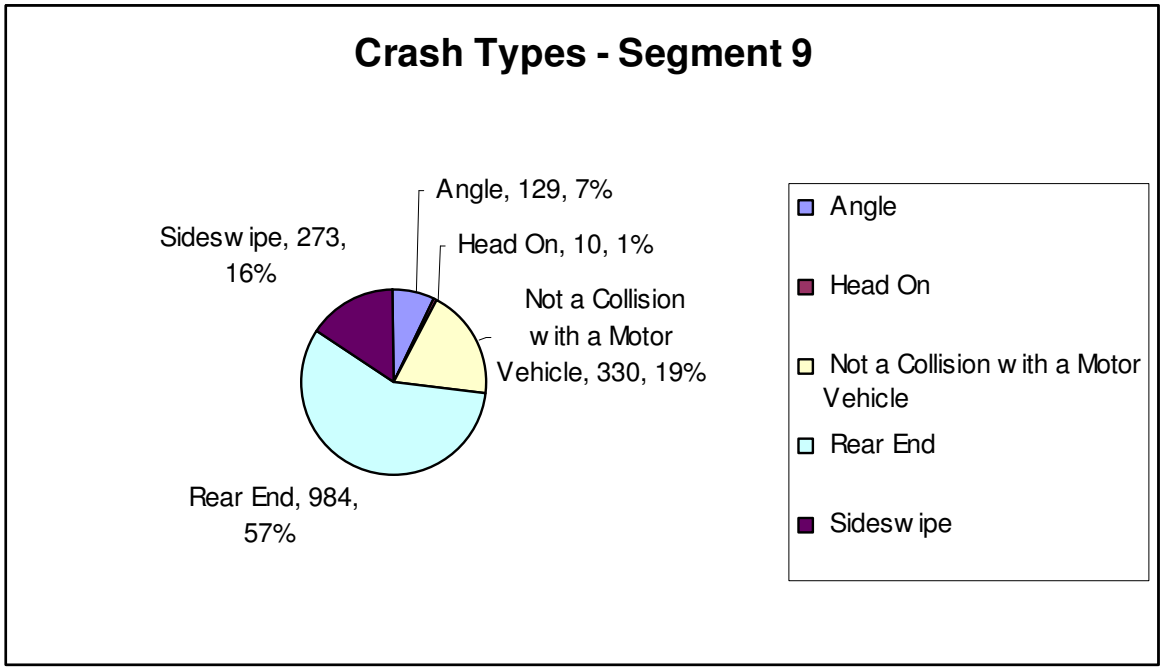
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-12: Crash Types – Segment 8, Jodeco Road / Flippen Road (CR 824) to Hudson Bridge Rd. (CR 659) / Eagles Landing Pkwy.



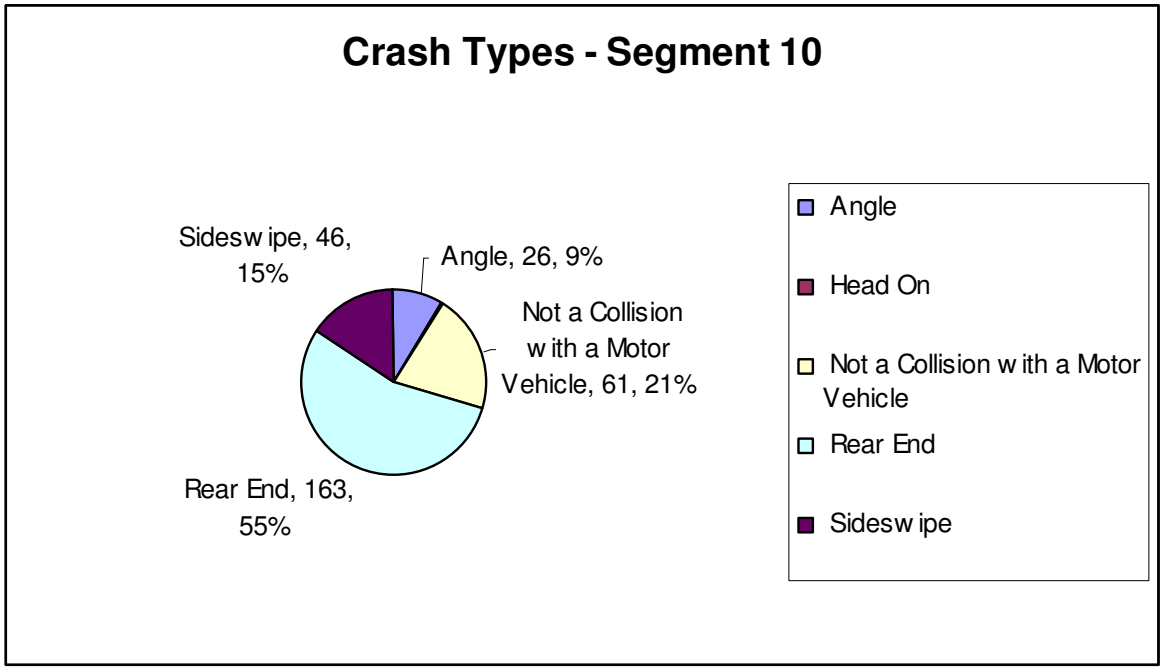
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-13: Crash Types – Segment 9,
Hudson Bridge Rd. (CR 659) / Eagles Landing Pkwy. to I-675



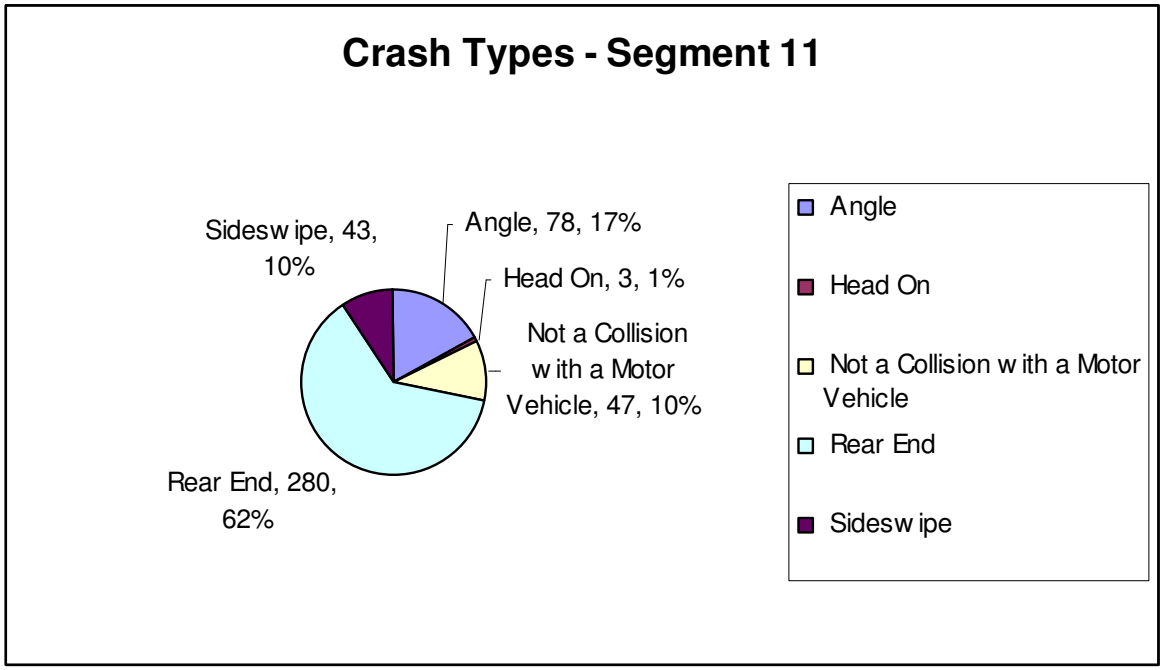
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-14: Crash Types – Segment 10, I-675 to Stockbridge Highway



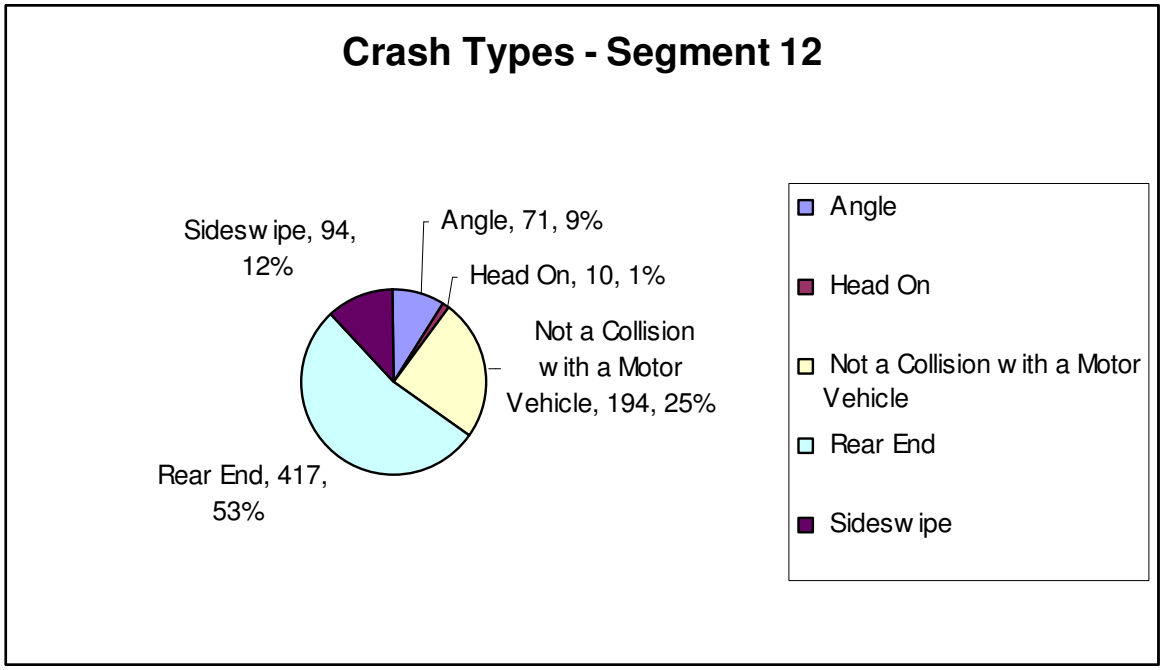
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-15: Crash Types – Segment 11, Stockbridge Highway to Henry / Clayton County Line



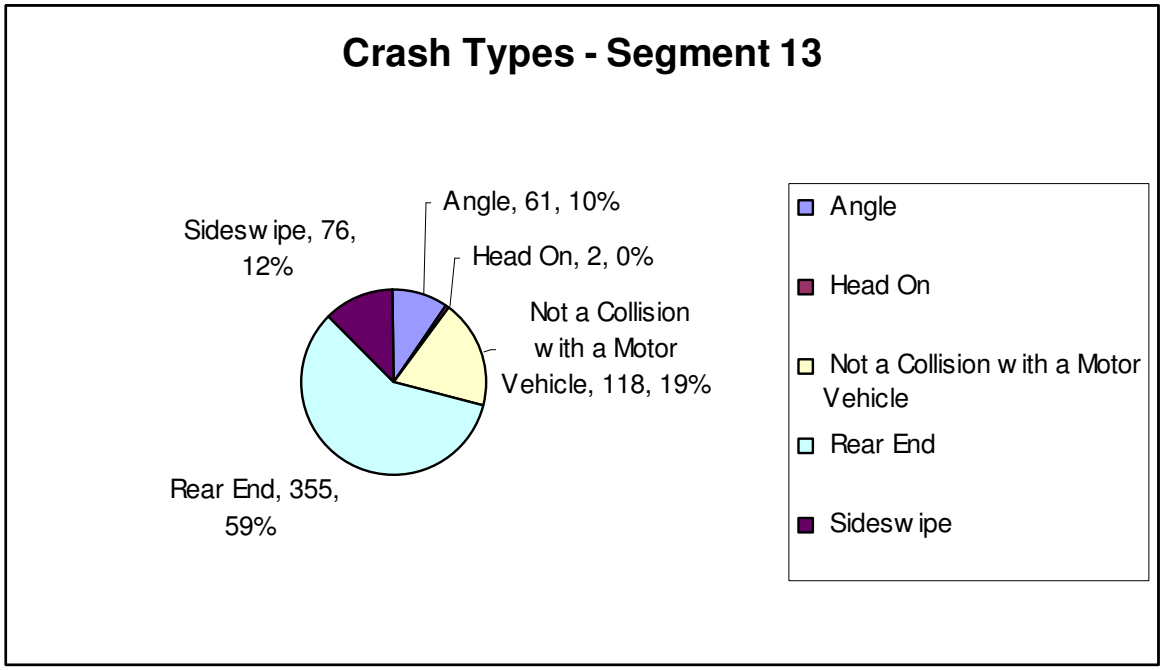
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-16: Crash Types – Segment 12, Henry / Clayton County Line to Mt. Zion Blvd. (CR 28)



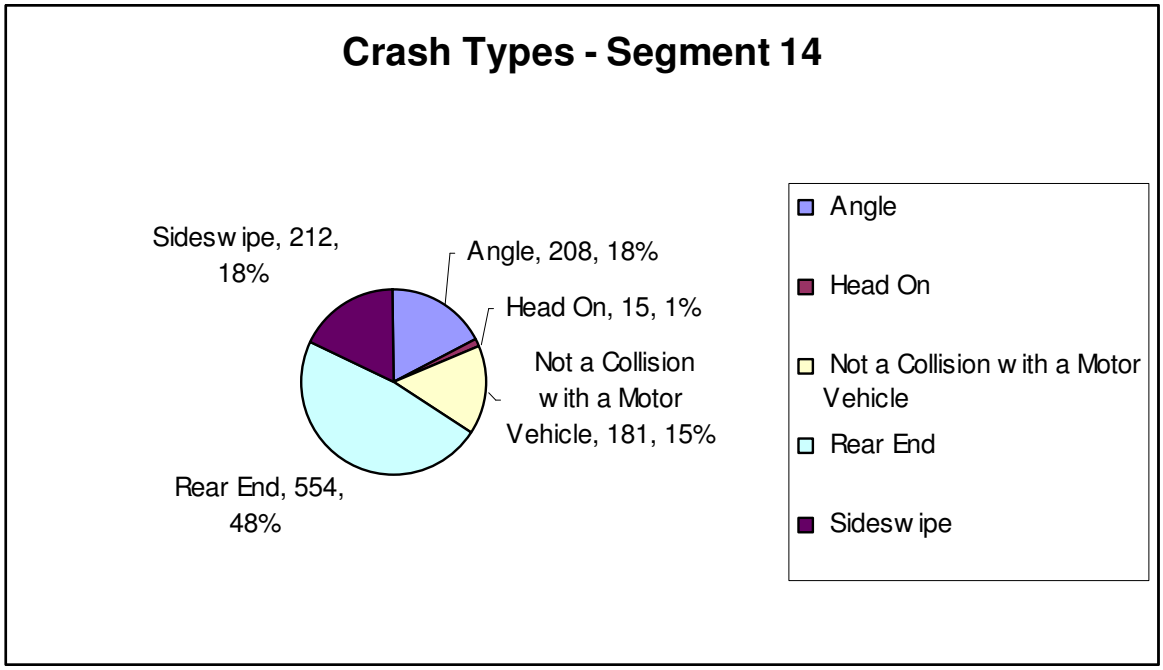
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-17: Crash Types – Segment 13,
Mt. Zion Blvd. (CR 28) to SR 54 / Jonesboro Road



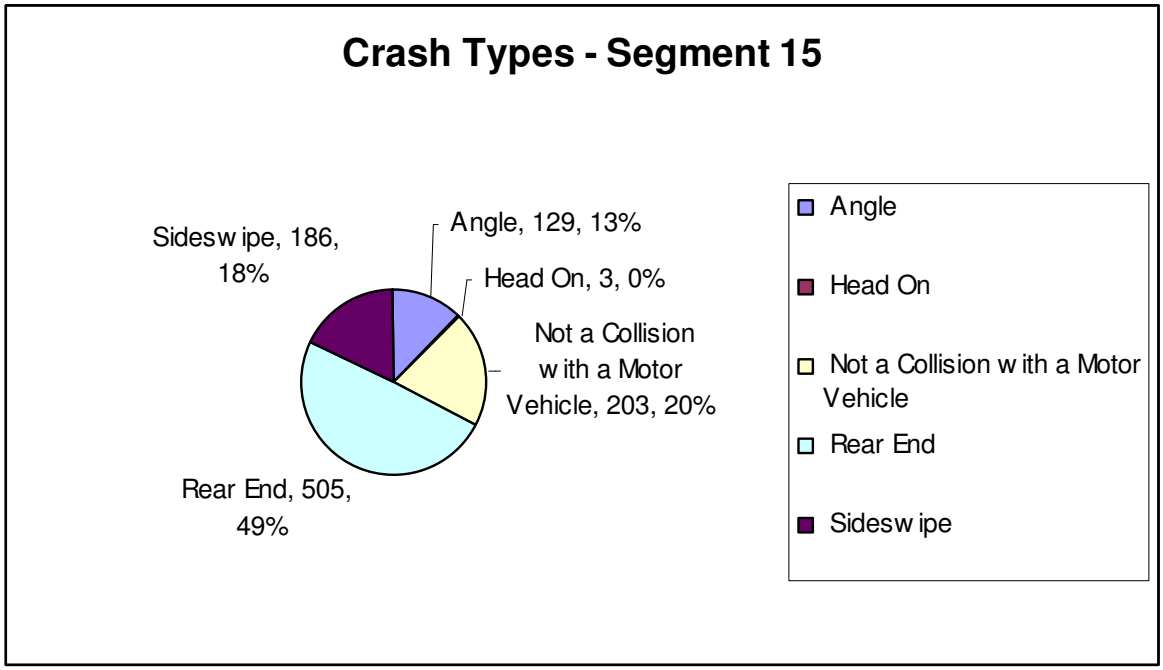
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-18: Crash Types – Segment 14,
SR 54 / Jonesboro Road to SR 3/US 19/US 41/Old Dixie Highway/Tara Blvd.



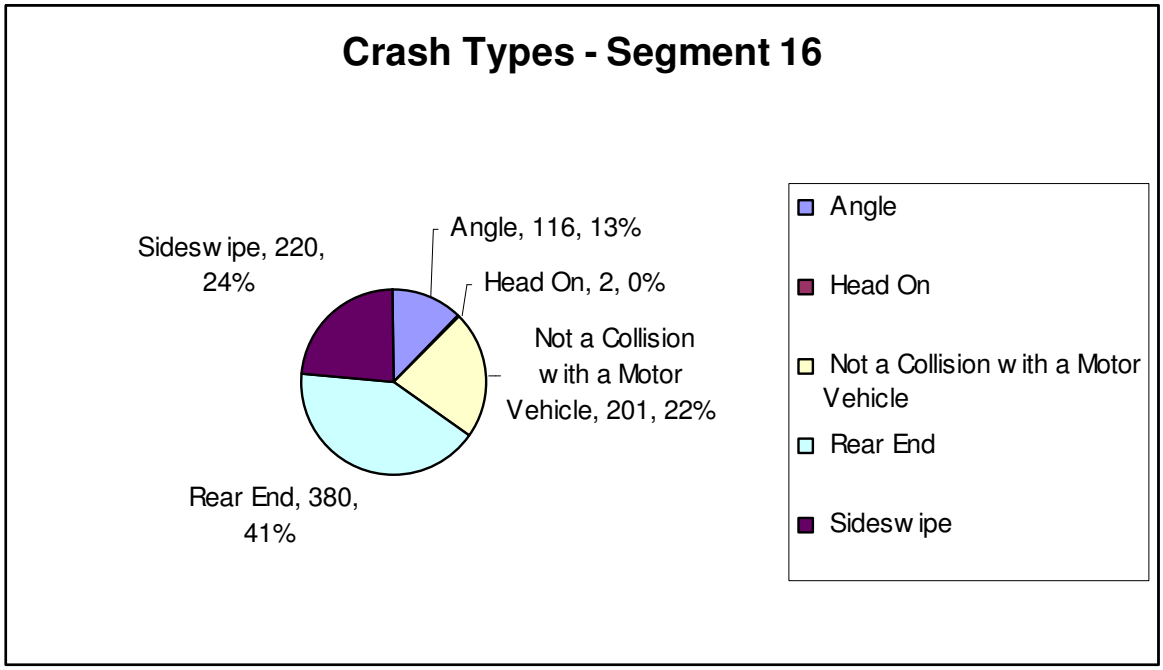
Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-19: Crash Types – Segment 15,
SR 3/US 19/US 41/Old Dixie Highway/Tara Blvd. to SR 331/Forest Pkwy.



Data Source: Georgia Department of Transportation's Statewide Crash Database

Figure 3-20: Crash Types – Segment 16, SR 331/Forest Pkwy. To I-285



Data Source: Georgia Department of Transportation's Statewide Crash Database

Table 3-3: 2003 Crash, Injury, and Fatality Rates*

	County	Segment ID	Start Point	End Point	Distance	ADT	Vehicle Miles	Total Crashes	Crash Rate	Total Injuries	Injury Rate	Total Fatalities	Fatality Rate
Rural Interstate	Butts	1	4.59	5.43	0.84	96,600	81,144	39	131.68	25	84.41	0	0.00
	Butts	2	0.00	1.93	1.93	96,400	186,052	38	55.96	19	27.98	0	0.00
	Spalding	3	0.00	3.84	3.84	96,400	370,176	133	98.44	37	27.38	2	1.48
	Henry	4	3.84	8.4	4.56	102,500	467,400	189	110.78	47	27.55	3	1.76
Urban Interstate	Henry	5	8.4	10.03	1.63	112,900	184,027	185	275.42	51	75.93	1	1.49
	Henry	6	10.03	12.88	2.85	120,000	342,000	232	185.85	53	42.46	1	0.80
	Henry	7	12.88	14.38	1.50	130,800	196,200	224	312.79	45	62.84	1	1.40
	Henry	8	14.38	16.26	1.88	135,900	255,492	226	242.35	48	51.47	0	0.00
	Henry	9	16.26	19.76	3.50	145,900	510,650	391	209.78	107	57.41	1	0.54
	Henry	10	19.76	20.24	0.48	104,200	50,016	77	421.78	11	60.25	0	0.00
	Henry	11	20.24	20.58	0.34	125,200	42,568	109	701.54	44	283.19	0	0.00
	Henry	12	0	2.4	2.40	124,100	297,840	175	160.98	87	80.03	1	0.92
	Clayton	13	2.4	3.86	1.46	120,800	176,368	165	256.31	50	77.67	0	0.00
	Clayton	14	3.86	6.19	2.33	147,100	342,743	298	238.21	101	80.73	0	0.00
	Clayton	15	6.19	8.63	2.44	179,100	437,004	311	194.98	92	57.68	0	0.00
	Clayton	16	8.63	9.72	1.09	209,500	228,355	240	287.94	80	95.98	1	1.20

Data source: Georgia Department of Transportation, Office of Traffic Safety and Design
*Highlighted segments experience a higher than average rate of crashes, injuries, and/or fatalities as indicated.)

Table 3-4: 2003 Statewide Mileage, Travel, and Accident Data

Highway System	Vehicle Miles Traveled	All Crashes	Crash Rate	Injuries	Injury Rate	Fatalities	Fatality Rate
	100 MVM	Number	Per 100 MVM	Number	Per 100 MVM	Number	Per 100 MVM
Interstate, Rural	121	8,952	74	4,357	36	110	0.91
Interstate, Urban	180	35,866	200	12,663	70	127	0.71

Data source: Georgia Department of Transportation, Office of Traffic Safety and Design

Table 3-5: 2004 Crash, Injury, and Fatality Rates*

	County	Segment ID	Start Point	End Point	Distance	ADT	Vehicle Miles	Total Crashes	Crash Rate	Total Injuries	Injury Rate	Total Fatalities	Fatality Rate
Rural Interstate	Butts	1	4.59	5.43	0.84	72,390	60,808	30	135.17	25	112.64	0	0.00
	Butts	2	0.00	1.93	1.93	72,390	139,713	29	56.87	22	43.14	1	1.96
	Spalding	3	0.00	3.84	3.84	72,390	277,978	99	97.57	46	45.34	0	0.00
	Henry	4	3.84	8.4	4.56	83,730	381,809	153	109.79	43	30.86	2	1.44
Urban Interstate	Henry	5	8.4	10.03	1.63	101,770	165,885	189	312.15	64	105.70	1	1.65
	Henry	6	10.03	12.88	2.85	117,600	335,160	252	205.99	80	65.40	1	0.82
	Henry	7	12.88	14.38	1.50	127,820	191,730	211	301.51	56	80.02	0	0.00
	Henry	8	14.38	16.26	1.88	129,650	243,742	223	250.66	58	65.19	0	0.00
	Henry	9	16.26	19.76	3.50	134,370	470,295	469	273.22	151	87.97	2	1.17
	Henry	10	19.76	20.24	0.48	97,130	46,622	77	452.49	24	141.04	0	0.00
	Henry	11	20.24	20.58	0.34	117,560	39,970	136	932.21	49	335.87	0	0.00
	Henry	12	0	2.4	2.40	117,480	281,952	192	186.57	74	71.91	0	0.00
	Clayton	13	2.4	3.86	1.46	115,320	168,367	149	242.46	48	78.11	1	1.63
	Clayton	14	3.86	6.19	2.33	141,530	329,765	311	258.38	97	80.59	2	1.66
	Clayton	15	6.19	8.63	2.44	173,560	423,486	245	158.50	94	60.81	1	0.65
	Clayton	16	8.63	9.72	1.09	204,600	223,014	255	313.27	67	82.31	0	0.00

Data source: Georgia Department of Transportation, Office of Traffic Safety and Design
*Highlighted segments experience a higher than average rate of crashes, injuries, and/or fatalities as indicated.)

Table 3-6: 2004 Statewide Mileage, Travel, and Accident Data

Highway System	Vehicle Miles Traveled	All Crashes	Crash Rate	Injuries	Injury Rate	Fatalities	Fatality Rate
	100 MVM	Number	Per 100 MVM	Number	Per 100 MVM	Number	Per 100 MVM
Interstate, Rural	102	8,333	82	4,364	43	142	1.39
Interstate, Urban	204	38,668	190	13,252	65	120	0.59

Data source: Georgia Department of Transportation, Office of Traffic Safety and Design

Table 3-7: 2005 Crash, Injury, and Fatality Rates*

	County	Segment ID	Start Point	End Point	Distance	ADT	Vehicle Miles	Total Crashes	Crash Rate	Total Injuries	Injury Rate	Total Fatalities	Fatality Rate
Rural Interstate	Butts	1	4.59	5.43	0.84	75,560	63,470	32	138.13	27	116.55	1	4.32
	Spalding	2	0.00	1.93	1.93	75,560	145,831	22	41.33	10	18.79	0	0.00
	Henry	3	0.00	3.84	3.84	75,560	290,150	89	84.04	39	36.83	0	0.00
	Henry	4	3.84	8.4	4.56	87,530	399,137	168	115.32	53	36.38	0	0.00
Urban Interstate	Henry	5	8.4	10.03	1.63	111,060	181,028	187	283.01	63	95.35	0	0.00
	Henry	6	10.03	12.88	2.85	130,260	371,241	230	169.74	69	50.92	0	0.00
	Henry	7	12.88	14.38	1.50	145,790	218,685	207	259.33	59	73.92	0	0.00
	Henry	8	14.38	16.26	1.88	147,600	277,488	222	219.19	64	63.19	1	0.99
	Henry	9	16.26	19.76	3.50	155,740	545,090	430	216.13	110	55.29	3	1.51
	Henry	10	19.76	20.24	0.48	113,360	54,413	67	337.35	27	135.95	2	10.07
	Henry	11	20.24	20.58	0.34	135,000	45,900	119	710.30	60	358.13	0	0.00
	Clayton	12	0	2.4	2.40	135,000	324,000	211	178.42	72	60.88	0	0.00
	Clayton	13	2.4	3.86	1.46	137,840	204,003	142	190.70	44	59.09	0	0.00
	Clayton	14	3.86	6.19	2.33	159,640	375,154	293	213.98	108	78.87	2	1.46
	Clayton	15	6.19	8.63	2.44	184,610	448,602	264	161.23	87	53.13	2	1.22
	Clayton	16	8.63	9.72	1.09	212,790	225,557	187	227.14	54	65.59	1	1.21

Data source: Georgia Department of Transportation, Office of Traffic Safety and Design
*Highlighted segments experience a higher than average rate of crashes, injuries, and/or fatalities as indicated.)

Table 3-8: 2005 Statewide Mileage, Travel, and Accident Data

Highway System	Vehicle Miles Traveled	All Crashes	Crash Rate	Injuries	Injury Rate	Fatalities	Fatality Rate
	100 MVM	Number	Per 100 MVM	Number	Per 100 MVM	Number	Per 100 MVM
Interstate, Rural	100	6,728	67	3,642	36	118	1.18
Interstate, Urban	204	41,983	206	14,767	72	156	0.77

Data source: Georgia Department of Transportation, Office of Traffic Safety and Design

3.3.3 Summary of Findings

(a) Segment 1 - SR 16 to Butts / Spalding County Line

This portion of I-75 is classified as a rural interstate. An analysis of the available crash data reveals that this segment experienced a higher than average crash rate over all three years studied. The majority of crashes in this segment were not collisions with other motor vehicles, but were instead run-off-the-road collisions involving single vehicles striking fixed objects such as guardrail, ditches, median barrier, and embankments. There were also a significant number of rear end crashes in this segment. There were several crashes at the top of the ramp to SR 16 involving rear end, angle, and sideswipe collisions. The injury rate in this segment is also notably higher than the statewide average, indicating that many of the crashes occurring in the area are severe. This typically correlates to collisions involving high speeds. There was one fatality during the three years analyzed. Crashes were divided relatively evenly between the southbound and northbound directions over the study years.

(b) Segment 2 – Butts/Spalding County Line to Spalding Henry County Line

This portion of I-75 is classified as a rural interstate. In comparing it to the statewide average for this facility type, it consistently exhibited a lower than average crash and injury rate over the analysis period. There was one fatality noted during the analysis period. More collisions occurred on the northbound side than on the south bound side of the interstate. Vehicles striking fixed objects were the predominant type of collision, with guardrail being the object most struck.

(c) Segment 3 - Spalding/Henry County Line to Locust Grove Rd. (CR 648)

This portion of the study area is a rural interstate with a crash rate found to be slightly higher than the statewide average for this type of facility. The vast majority of crashes over the analysis period involved collisions with fixed objects off the roadway, such as guardrail, median barrier, and bridge piers. There were also some collisions with deer reported. Also in the segment, there was a large number of rear end collisions noted. The injury rate in this segment closely follows the statewide average. It can be surmised that crashes in this area are not significantly severe. There were two fatalities reported during the period studied, both occurring in 2003, resulting in that year's fatality rate being higher than the statewide average. The majority of crashes occurred on the northbound side of the roadway.

(d) Segment 4 - Locust Grove Rd. (CR 648) to McDonough Road

An analysis of crash data along this segment indicates that the crash rate is higher than the statewide average over the three year period. The vast majority of crashes were not collisions with other motor vehicles, but with fixed and non-fixed objects. These collisions involved a notable number of crashes with deer. There were also several collisions with culverts, ditches, and trees among these single-vehicle crashes. Several collisions with other non-fixed objects in the roadway were noted, likely referring to debris being struck.

A significant number of rear end and sideswipe crashes were also reported. The majority of crashes occurred on the northbound side of the interstate. The injury rate in the segment is lower than the statewide average for rural interstates, indicating that the severity of the majority of these crashes is not overly high. There were however, five fatalities documented over the analysis period, resulting in the fatality rate being higher than the statewide average for two years.

(e) Segment 5 - McDonough Road to McDonough-Hampton Road

This segment, as well as the remaining segments of I-75 northward to I-285, is classified as an urban interstate. With the higher traffic volumes that would be expected on this type of facility, comes higher numbers of vehicle crashes. The portion of I-75 between McDonough Road and McDonough-Hampton Road has a significantly higher than average crash rate. The majority of crashes occurring over the three year period involved rear end collisions. There were also several collisions with fixed objects off the roadway, but also non-fixed objects in the roadway. In the segment the number of collisions occurring at the top of the ramps is also significant. These involved angle and rear end crashes. The injury rate is higher than the statewide average for all three years, and the fatality rate is higher than average for two years with two fatalities reported.

(f) Segment 6 - McDonough-Hampton Road to Jonesboro Rd. (CR 920)

This portion of the study area has a crash rate that closely follows the statewide average, with it being lower than the statewide average for two years, and only slightly higher in 2004. The injury rate also generally correlates to the statewide average. The injury rate is lower than the statewide average in two years and average for 2004. The predominant types of crashes are rear end collisions and collisions with fixed and non-fixed objects. The fixed objects struck included curb, median barrier, guardrail, and trees. Most of the collisions with objects other than motor vehicles were with non-fixed objects in the roadway. The prevalence of rear end collisions correlates to the higher congestion levels that are experienced along this segment. Typically these conditions lead to stop and go traffic, which results in a higher frequency of rear end collisions. The severity of these collisions is usually relatively low, which correlates to the low injury and fatality rates. There were also several incidents identified at the top of the ramp to Jonesboro Road. The vast majority of incidents occurred on the northbound side of the interstate.

(g) Segment 7 - Jonesboro Rd. (CR 920) to Jodeco Rd./Flippen Rd. (CR 824)

This segment is characterized by a significant number of rear end collisions. While the crash rate is notably higher than the statewide average for urban interstates, the injury and fatality rates are lower. This indicates the prevalence of lower severity, lower speed crashes. Many of these collisions occurred at the top of the ramp to Jodeco Road. In addition to collisions with objects other than motor vehicles, there were several sideswipe collisions noted. These are likely due to merging and other lane changing maneuvers. The majority of crashes occurred in the northbound direction.

(h) Segment 8 - Jodeco Rd./Flippen Rd. (CR 824) to Hudson Bridge Rd (CR 659)/Eagles Landing Pkwy.

The crash rate along this portion of I-75 is slightly higher than the statewide average, but the injury rates are consistently lower for all three years. There was one fatality noted during the analysis period. The vast majority of collisions were rear end collisions, followed by collisions with non-fixed objects, and sideswipes. This again correlates to the higher congestion levels and resulting stop and go traffic. The slower speeds that characterize heavy congestion also reduce the severity of these types of crashes. Most incidents occurred on the northbound side of the roadway.

(i) Segment 9 - Hudson Bridge Rd (CR 659) / Eagles Landing Pkwy. to I-675

This segment of roadway had a higher than average crash rate. The injury rate was lower than the statewide average in two years and higher in 2004. The fatality rate was lower in 2003, but higher than the statewide average in the other years. There were six fatal crashes during the three years. One fatality did not involve a motor vehicle collision at all, and one involved a pedestrian. Again the predominant types of collisions were rear ends, collisions with non-motor vehicles, and sideswipes. The majority of crashes occurred in the northbound direction.

(j) Segment 10 - I-675 to Stockbridge Highway

This portion of I-75 experienced a significantly high frequency of crashes even though it is a short segment of the study area. The crash rate was higher than the statewide average. The injury rate was also higher for two of the three years studied. There were only two fatalities reported. These were in 2005 and involved one rear end collision and one off-road collision with a tree. Most of the incidents were rear end and sideswipe collisions. Of the collisions with non-motor vehicles, the objects struck included deer, trees, sign posts, median barrier and guardrail.

(k) Segment 11 - Stockbridge Highway to Henry / Clayton County Line

This portion of the study area experienced the highest crash and injury rates of the entire corridor, in some instances more than triple the statewide average. These rates were significantly higher than the statewide average over all three years. There were no fatalities noted for the entire analysis period. The heavy traffic congestion at the I-75 at I-675 merge resulted in a large number of rear end crashes on the southbound side of the interstate. The speed differential going from the less congested, higher speed portion of the interstate upstream, to the slower speed congested conditions at the merge is the likely cause of the injury rate being higher than the statewide average. Of the collisions with fixed objects, the median barrier was the primary object struck.

(l) Segment 12 - Henry / Clayton County Line to Mt. Zion Blvd. (CR28)

The crash rate along this portion of the study area was consistently lower than the statewide average for urban interstates. The injury rate is slightly higher for two years, and slightly lower for 2005. The majority of crashes involved rear end collisions. Collisions with non-motor vehicles and sideswipe collisions followed in order of frequency. Most crashes occurred on the southbound side of the roadway. The median barrier was struck a noticeable number of times along this segment. The large number of sideswipe and rear end crashed on this side correlates to the high levels of traffic congestion typically experienced during the pm peak periods. There was one fatality reported during the analysis period.

(m) Segment 13 - Mt. Zion Blvd. (CR28) to SR 54 / Jonesboro Rd

The crash and injury rates for this segment were higher than the statewide average for 2003 and 2004, and slightly lower in 2005. Rear end crashes on the southbound side were the predominant crash type. Collisions with non-motor vehicles appear to have increased noticeably over the three year period. Median barrier, ditches, trees, and even deer, were struck numerous times over the study period, but more so in 2005. There was one fatality documented in this area, which involved a lane changing maneuver.

(n) Segment 14 - SR 54/Jonesboro Rd to SR3/US19/US41/Old Dixie Highway/Tara Blvd.

The crash and injury rates for this area were higher than the statewide average for all three years studied. The fatality rate was higher for two of the three years. The principal crash type was rear end collisions. Collisions with fixed and non-fixed objects and side swipe collisions were also noted, but were significantly fewer in number. Of these, the median barrier was struck numerous times. There were also several angle collisions reported at the ramp terminal. There also a higher incidence of head-on collisions in this area than in subsequent portions of the study area. Several of these occurred at the top of the ramp segments, and none involved fatalities, and few involved injuries, indicating the low severity of these crashes.

(o) Segment 15 - SR3/US19/US41/Old Dixie Highway/Tara Blvd. to SR 331/ Forest Pkwy.

The crash and injury rates for this area were consistently lower than the statewide average for all three years studied. There were two fatalities noted, both occurring in 2005. Rear end collisions represented the largest number of crashes, followed by crashes with fixed and non-fixed objects, and sideswipes. Crashes are divided relatively equally between southbound and northbound, with slightly higher numbers occurring on the northbound side of the roadway. This likely correlates to the higher volumes approaching I-285 experienced along this segment during the am peak periods.

(p) Segment 16 - SR 331 / Forest Pkwy. to I-285

The I-75 and I-285 interchange marks the end of the study area. This segment experienced higher than average crash rates over all three years. The injury rate was also higher than average for 2003 and 2004, and lower than average in 2005. There were two fatalities reported over the three year analysis period. The majority of collisions occurred on the southbound side of the interstate; however the frequency of northbound collisions was not significantly lower. The prevalent crash type was rear end collisions. Crashes involving vehicles striking fixed and non-fixed objects and sideswipes ranked second and third in terms of frequency. There were also a large number of angle collisions on the ramp segments noted.

(q) Commercial Vehicle Crashes

The I-75 study area has a high percentage of commercial vehicle traffic. The total number of commercial vehicle crashes is accounted for in the crash totals summarized above. The vast majority of incidents involving commercial vehicles throughout all three years were sideswipe collisions with vehicles engaged in lane-changing maneuvers. There were also several read-end collisions noted. Injury resulting from commercial vehicles crashes appears to be high, as would be expected.

3.3.4 Safety Analysis Conclusions

Crash data analysis indicates that much of the study area experienced a higher than average crash frequency and severity over the three year period evaluated. The crash types, severity and direction of travel appeared to correlate closely with peak period congestion and its corresponding changes in vehicular speed. In areas of high congestion, and likely lower speeds, crashes were more frequent, but less severe. In areas of lower congestion levels (and possibly higher speeds), crashes were less frequent but often more severe as indicated by the higher injury and fatality rates. In areas where speed differentials are typically highest, such as approaching areas with congested conditions from free-flowing conditions, the crash severity is also higher. Rear end crashes are prevalent in congested conditions, with single vehicle crashes more frequent in less congested areas. Overall for the entire study area, the predominant crash type over all three years was rear-end crash.

Several non-fixed objects in the roadway were struck, which could indicate the pervasiveness of debris in the roadway. This would indicate the need for a greater frequency of lane clearing activity by maintenance, incident management, or public safety forces. The frequency of fixed objects struck does not appear to be over-represented in terms of what can be expected for an interstate facility. These run-off-the road collisions likely involve vehicles leaving the roadway at high speeds more so than any clear zone violations, however this should be considered.

In terms of the selection of managed lane strategies, it is important that infrastructure and driver information media be positioned far enough upstream so that drivers can assimilate the information without being distracted in areas approaching congested conditions, where collisions are already high. Further distractions with additional fixed and changeable message signs could increase this condition. Obviously clear zone

requirements should be adhered to with any infrastructure installation, both on the inside and outside shoulder. The prevalence of commercial vehicle crashes indicates that separate truck only lanes may reduce the frequency of crashes between heavy trucks and passenger cars. It is also important that managed lane strategies include incident management operations to clear debris from the roadway and relocate crash vehicles out of the travel lane. These lane blocking incidents greatly increase the potential for primary and secondary crashes, and reduce the efficiency of managed lane operations.

3.4 Model Development

A VISSIM microscopic multi-modal simulation model and a VISUM macroscopic model were used to replicate existing conditions during the AM and PM peak periods along the I-75 study corridor. These existing conditions will be used as a baseline to model and evaluate the selected managed lane scenario.

Volume, network, and origin destination data was extracted from the ARC regional travel demand model and imported into VISUM format. These were then calibrated to match the existing ARC model, and a sub-area cut of the I-75 study area was generated. Once generated this VISUM model had to be further refined to ensure that its roadway links and lane geometry were accurate.

The VISUM model was then exported into VISSIM. VISUM's export feature transferred all of the model features including the traffic network, lane geometry, traffic control, and traffic volumes (OD matrices and paths), maintaining consistency with the original ARC model. The VISSIM model had to be further refined to add in those features not imported from VISUM, such as traffic signal data for the signalized ramp terminals, and ramp lane utilization. The VISSIM model was then calibrated to accurately reflect base year traffic conditions as indicated by the volumes, turning movement counts and the travel time video log created for this project.

The operational analysis that follows is based on measures of effectiveness (MOEs) evaluated from the calibrated base model. These MOE's evaluated include:

Table 3-9: Traffic Analysis MOEs

MOE	Unit	Description
Lost Time	Seconds (s/s)	Based on travel time sections, VISSIM can generate delay data for networks and/or user defined segments. A delay segment is based on one or more travel time section. All vehicles that pass these travel time sections are captured by the delay segment, independently of the vehicle classes selected in these travel time sections. Delay times can also be generated for user-defined links or nodes. Delay times apply to all travel modes
Speed	Miles per hour (mph)	A link evaluation MOE for all types of vehicles
Density	Speed	A link evaluation MOE for all types of vehicles
Volume	Vehicles per lane per hour (vplph)	A link evaluation MOE for all types of vehicles

3.5 Operational Analysis

VISSIM simulation runs of the calibrated I-75 model generated MOE values of the freeway facility along I-75 between I-285 on the north and SR 16 on the south. The following MOEs for the AM and PM peak periods, respectively, are summarized in this section:

- Volume – vehicles per hour (vph)
- Speed – miles per hour (mph)
- Density – vehicles per mile (vpm)
- Lost time – delay time / vehicle's total travel time (seconds/ seconds)

The relationship of volume, speed and density can be described by the following equation:

$$density = \frac{volume}{speed}$$

All the above MOEs are generated for continuous freeway sections along the study corridor. Each section is defined as a portion of the freeway facility between two adjacent interchanges within the study area. It should be noted that a section includes a basic freeway segment and one or more merging/diverging areas.

3.5.1 AM Peak – Existing Conditions

The modeled AM peak period is 7am—9am and was analyzed for two one-hour intervals, i.e., 7am—8am and 8am—9am, respectively. The MOEs for the AM peak period based on VISSIM simulation model are summarized below.

(a) Volume

Figure 3-21 and Figure 3-22 illustrate variation of the AM peak volumes on different sections along the study corridor. Figure 3-21 shows the northbound traffic, while Figure 3-22 shows the southbound traffic. The following observations regarding AM peak freeway traffic volumes are made based on Figure 3-21 and Figure 3-22:

- Freeway volumes of both directions increase from SR 16 to I-285. Northbound volume (Figure 3-21) increases from about 1,000 vph close to SR 16 up to more than 7,000 vph close to I-285. Southbound traffic (Figure 3-22) increases from about 1,600 vph close to SR 16 up to around 4,000 vph close to I-285.

- Northbound traffic (illustrated in Figure 3-21) is significantly higher than southbound traffic (illustrated in Figure 3-22) at most sections, especially those in or close to the City of Atlanta. E.g., for I-75 sections close to the I-285/I-75 interchange, northbound volume is about 7,000 vph vs. southbound volume of about 4,000 vph.

- Freeway volumes of the two hourly intervals are close to each other, with volumes of 8am—9am (shown as deep blue in Figures 3-21 and 3-22) being slightly higher than of 7am—8am (shown as red in Figures 3-21 and 3-22), and have similar variation patterns along different sections.

- The freeway through traffic up-and-down variation along the study corridor, as shown in Figures 3-21 and 3-22, reflect the volume reduction at off-ramps and increase at on-ramps. For example, the drop points between I-675 and Stockbridge Highway as illustrated in Figure 3-21 display that northbound traffic drops from about 5,500 south of I-675 to about 4,000 north of I-675; then increase to about 5,000 north of Stockbridge Highway.

(b) Speed

Figure 3-23 and Figure 3-24 illustrate variation of vehicular speed during the AM peak period on different sections along the study corridor. Figure 3-23 shows the northbound traffic, while Figure 3-24 shows the southbound traffic. The following observations regarding AM peak freeway vehicular speed are made based on Figure 3-23 and Figure 3-24:

- Vehicular speed of both directions exhibits a general decreasing trend from SR 16 to I-285, i.e., the closer to the City of Atlanta, the lower the vehicular speed. As illustrated in Figures 3-23 and 3-24, the average speed on basic freeway segments drop from about 70 mph in the vicinity of SR 16 to lower than 55 mph north of I-285.

- As shown in Figure 3-23, northbound traffic shows significant speed decrease (at least 10 mph) at the following locations and then a bounce-back, indicating that congestion would occur at these locations.
    - In the vicinity of the Jonesboro Road interchange
    - In the vicinity of the Jodeco Road interchange
    - In the vicinity of the Hudson Bridge Road interchange
    - In the vicinity of the I-675 interchange
    - In the vicinity of the SR 54 interchange
    - In the vicinity of the I-285 interchange

- As shown in Figure 3-24, southbound traffic shows significant speed decrease (at least 10 mph) at the following locations and then a bounce-back, indicating that congestion would occur at these locations.
    - In the vicinity of the Forest Parkway interchange
    - In the vicinity of the Stockbridge Highway interchange
    - In the vicinity of the Hudson Bridge Road interchange
    - In the vicinity of the Jonesboro Road interchange
    - In the vicinity of the Hampton-McDonough Road interchange
    - In the vicinity of the McDonough Road interchange

- Vehicular speeds of the two hourly intervals (red lines and dots for the 7am-8am interval and deep blue lines and dots for the 8am-9am interval, as illustrated in Figures 3-23 and 3-24) are close to each other and have similar variation patterns along different sections.

(c) Density

Figure 3-25 and Figure 3-26 illustrate variations of vehicular density during the AM peak period on different sections along the study corridor. Figure 3-25 shows the northbound traffic, while Figure 3-26 shows the southbound traffic. The following observations regarding AM peak freeway vehicular density are made based on Figure 3-25 and Figure 3-26:

- Density of both directions exhibits a general increasing trend from SR 16 on the south to I-285 on the north, i.e., the closer to the City of Atlanta, the higher the density. Specifically, Figure 3-25 shows that northbound traffic density increases from about 20 vehicles per mile (vpm) in the vicinity of SR 16 to about 150 vpm north of I-285; Figure 3-26 reflects that southbound traffic density decreases from about 70 vpm north of I-285 to around 20 vpm in the vicinity of SR 16.

- For northbound traffic as illustrated in Figure 3-25, the following locations display unusually high density compared with upstream and downstream locations, indicating congestion and/or delay would occur at these locations:

- In the vicinity of the Hampton-McDonough Road interchange
- In the vicinity of the I-675 interchange
- In the vicinity of the I-285 interchange

- For northbound traffic as illustrated in Figure 3-26, the following location displays unusually high density compared with upstream and downstream locations, indicating congestion and/or delay would occur:
  - In the vicinity of the Stockbridge Highway interchange

- Densities of the two hourly intervals (red lines and dots for the 7am-8am interval and deep blue lines and dots for the 8am-9am interval, as illustrated in Figures 3-25 and 3-26) are close to each other and have similar variation patterns along different sections.

(d) Lost Time

Figure 3-27 and Figure 3-28 illustrate variation of lost time during the AM peak period on different sections along the study corridor. Figure 3-27 shows the northbound traffic, while Figure 3-28 shows the southbound traffic. The following observations regarding vehicular lost time during the AM peak period along the study corridor are made based on Figure 3-27 and Figure 3-28:

- Northbound traffic (as illustrated in Figure 3-27) experiences significantly higher lost time than southbound traffic (as illustrated in Figure 3-28).

- As displayed in Figure 3-27, northbound traffic through the following locations have relatively high lost time (higher than 0.2):
  - In the vicinity of the Hampton-McDonough Road interchange
  - In the vicinity of the Jonesboro Road interchange
  - In the vicinity of the Hudson Bridge Road interchange
  - In the vicinity of the Stockbridge Highway interchange
  - In the vicinity of the Old Dixie Highway interchange
  - In the vicinity of the I-285 interchange

- As displayed in Figure 3-28, southbound traffic through the following locations have relatively high lost time (higher than 0.2):
  - In the vicinity of the Forest Parkway interchange
  - In the vicinity of the Stockbridge Highway interchange
  - In the vicinity of the Hudson Bridge Road interchange
  - In the vicinity of the Jonesboro Road interchange
  - In the vicinity of the Hampton-McDonough Road interchange

- Lost times of the two hourly intervals (red lines and dots for the 7am-8am interval and deep blue lines and dots for the 8am-9am interval, as illustrated in Figures 3-27 and 3-28)are close to each other and have similar variation patterns along different sections.

3.5.2 PM Peak – Existing Conditions

The modeled PM peak period is 4pm—6pm and is analyzed for two one-hour intervals, i.e., 4pm—5pm and 5pm—6pm, respectively. The MOEs for the PM peak period based on VISSIM simulation model are summarized below.

(a) Volume

Figure 3-29 and Figure 3-30 illustrate variation of the PM peak volumes on different sections along the study corridor. Figure 3-29 shows the northbound traffic, while Figure 3-30 shows the southbound traffic. The following observations regarding PM peak freeway traffic volumes are made based on Figure 3-29 and Figure 3-30:

- Freeway volumes of both directions generally increase from SR 16 to I-285. Northbound volume (Figure 3-29) increases from about 2,000 vph close to SR 16 up to more than 6,000 vph close to I-285. Southbound traffic (Figure 3-30) increases from about 2,000 vph close to SR 16 up to around 7,300 vph close to I-285.

- Southbound traffic (illustrated in Figure 3-30) is significantly higher than northbound traffic (illustrated in Figure 3-29) at many sections. For example, for I-75 sections close to the Tara Blvd, southbound volume is about 7,200 vph vs. northbound volume of about 4,500 vph.

- Freeway volumes of the two hourly intervals are close to each other, with volumes of 5pm—6pm (shown as deep blue in Figures 3-29 and 3-30) being slightly higher than of 4pm—5pm (shown as red in Figures 3-29 and 3-30), and have similar variation patterns along different sections.

- The freeway through traffic up-and-down variation along the study corridor, as shown in Figures 3-29 and 3-30, reflect the volume reduction at off-ramps and increase at on-ramps. For example, the drop points between I-675 and Stockbridge Highway as illustrated in Figure 3-29 display that northbound traffic drops from about 4,200 south of I-675 to about 2,300 north of I-675; then increase to about 3,400 north of Stockbridge Highway.

(b) Speed

Figure 3-31 and Figure 3-32 illustrate variation of vehicular speed during the PM peak period on different sections along the study corridor. Figure 3-31 shows the northbound traffic, while Figure 3-32 shows the southbound traffic. The following observations regarding PM peak freeway vehicular speed are made based on Figure 3-31 and Figure 3-32:

- Vehicular speed of both directions exhibits a general decreasing trend from SR 16 to I-285, i.e., the closer to the City of Atlanta, the lower the vehicular speed. As illustrated in Figures 3-31 and 3-32, the average speed on basic freeway segments drop from about 70 mph in the vicinity of SR 16 to lower than 55 mph north of I-285.

- As shown in Figure 3-31, northbound traffic shows significant speed decrease (at least 10 mph) at the following locations and then a bounce-back, indicating that congestion would occur at these locations.
    - In the vicinity of the Hampton-McDonough Road interchange
    - In the vicinity of the Jonesboro Road interchange
    - In the vicinity of the Jodeco Road interchange
    - In the vicinity of the Hudson Bridge Road interchange
    - In the vicinity of the SR 54 interchange
    - In the vicinity of the I-285 interchange

- As shown in Figure 3-32, southbound traffic shows significant speed decrease (at least 10 mph) at the following locations and then a bounce-back, indicating that congestion would occur at these locations.
    - In the vicinity of the I-285 interchange
    - In the vicinity of the Forest Parkway interchange
    - In the vicinity of the I-675 interchange
    - In the vicinity of the Hudson Bridge Road interchange
    - In the vicinity of the Jodeco Road interchange
    - In the vicinity of the Hampton-McDonough Road interchange
    - In the vicinity of the McDonough Road interchange
    - In the vicinity of the Bill Gardner Parkway interchange
    - In the vicinity of the SR 16 interchange

- Vehicular speeds of the two hourly intervals (red lines and dots for the 4pm-5pm interval and deep blue lines and dots for the 5pm-6pm interval, as illustrated in Figures 3-31 and 3-32) are close to each other and have similar variation patterns along different sections.

(c) Density

Figure 3-33 and Figure 3-34 illustrate variations of vehicular density during the PM peak period on different sections along the study corridor. Figure 3-33 shows the northbound traffic, while Figure 3-34 shows the southbound traffic. The following observations regarding PM peak freeway vehicular density are made based on Figure 3-33 and Figure 3-34:

- Density of both directions exhibits a general increasing trend from SR 16 on the south to I-285 on the north, i.e., the closer to the City of Atlanta, the higher the density. Specifically, Figure 3-33 shows that northbound traffic density increases from about 35 vehicles per mile (vpm) in the vicinity of SR 16 to about 100 vpm north of I-285, while reaching over 250 mph in congested areas; Figure 3-34 reflects that southbound traffic density decreases from about 150 vpm north of I-285 to around 35 vpm in the vicinity of SR 16.

- For northbound traffic as illustrated in Figure 3-33, the following locations display unusually high density compared with upstream and downstream locations, indicating congestion and/or delay would occur at these locations:
    - In the vicinity of the Hampton-McDonough Road interchange
    - In the vicinity of the Hudson Bridge Road interchange
    - In the vicinity of the SR 54 interchange
    - In the vicinity of the Forest Parkway interchange
    - In the vicinity of the I-285 interchange

- For southbound traffic as illustrated in Figure 3-34, the following location displays unusually high density compared with upstream and downstream locations, indicating congestion and/or delay would occur:
    - In the vicinity of the I-285 interchange
    - In the vicinity of the Forest Parkway interchange
    - In the vicinity of the I-675 interchange
    - In the vicinity of the Hudson Bridge Road interchange
    - In the vicinity of the Jodeco Road interchange
    - In the vicinity of the Jonesboro Road interchange

- Densities of the two hourly intervals (red lines and dots for the 4pm-5pm interval and deep blue lines and dots for the 5pm-6pm interval, as illustrated in Figures 3-33 and 3-34) are close to each other and have similar variation patterns along different sections.

(d) Lost Time

Figure 3-35 and Figure 3-36 illustrate variation of lost time during the PM peak period on different sections along the study corridor. Figure 3-35 shows the northbound traffic, while Figure 3-36 shows the southbound traffic. The following observations regarding vehicular lost time during the PM peak period along the study corridor are made based on Figure 3-35 and Figure 3-36:

- As displayed in Figure 3-35, northbound traffic through the following locations have relatively high lost time (higher than 0.2), and therefore long delays:
    - In the vicinity of the Hampton-McDonough Road interchange
    - In the vicinity of the Jonesboro Road interchange

- In the vicinity of the Jodeco Road interchange
- In the vicinity of the Hudson Bridge Road interchange
- In the vicinity of the Old Dixie Highway interchange
- In the vicinity of the I-285 interchange

- As displayed in Figure 3-36, southbound traffic through the following locations have relatively high lost time (higher than 0.2), and therefore long delays:
  - In the vicinity of the I-285 interchange
  - In the vicinity of the Forest Parkway interchange
  - In the vicinity of the I-675 interchange
  - In the vicinity of the Hudson Bridge Road interchange
  - In the vicinity of the Jodeco Road interchange
  - In the vicinity of the Jonesboro Road interchange
  - In the vicinity of the Hampton-McDonough Road interchange
  - In the vicinity of the McDonough Road interchange

- Lost times of the two hourly intervals (red lines and dots for the 4pm-5pm interval and deep blue lines and dots for the 5pm-6pm interval, as illustrated in Figures 3-35 and 3-36) are close to each other and have similar variation patterns along different sections.

3.6 Overall Key Findings

The following key findings are drawn from operational analysis of the AM and PM peak period under existing conditions.

- Along the study corridor, through volumes on I-75 generally increase from SR 16 on the south to I-285 on the north. At most interchanges, volume drops at off-ramps and increases often significantly at on-ramps.

- The AM freeway traffic displays an apparent directional distribution, with northbound volumes significantly higher than southbound volumes.

- The PM freeway traffic displays an apparent directional distribution, with southbound volumes significantly higher than northbound volumes especially in the area in or close to the City of Atlanta.

- Vehicular speed of both directions exhibits a general decreasing trend from SR 16 to I-285, i.e., the closer to the City of Atlanta, the lower the vehicular speed.

- Density of both directions exhibits a general increasing trend from SR 16 on the south, to I-285 on the north, i.e., the closer to the City of Atlanta, the higher the density.

- Significant congestions, reflected by high lost time, high density and low average speed, occur In the vicinity of the following interchanges along I-75: I-285, Old Dixie Highway, SR 54, Stockbridge Highway, I-675, Hudson Bridge Road, Jonesboro Road/CR 920, McDonough Road and Hampton-McDonough Road. Notable causes of congestions in these areas include high traffic volumes, insufficient capacity and merging/diverging.

Figure 3-21: AM Peak Volume – I-75 Northbound

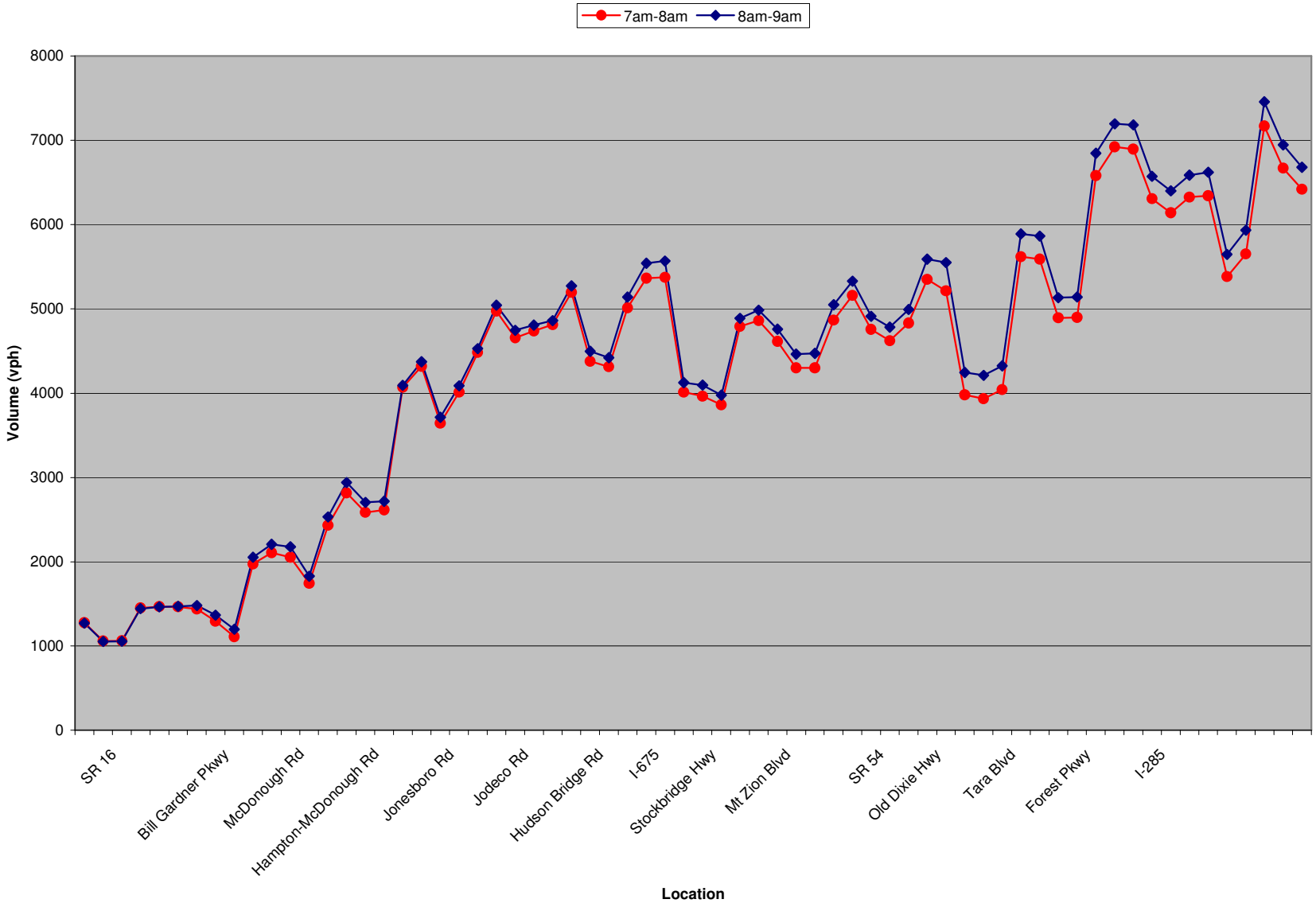


Figure 3-22: AM Peak Volume – I-75 Southbound

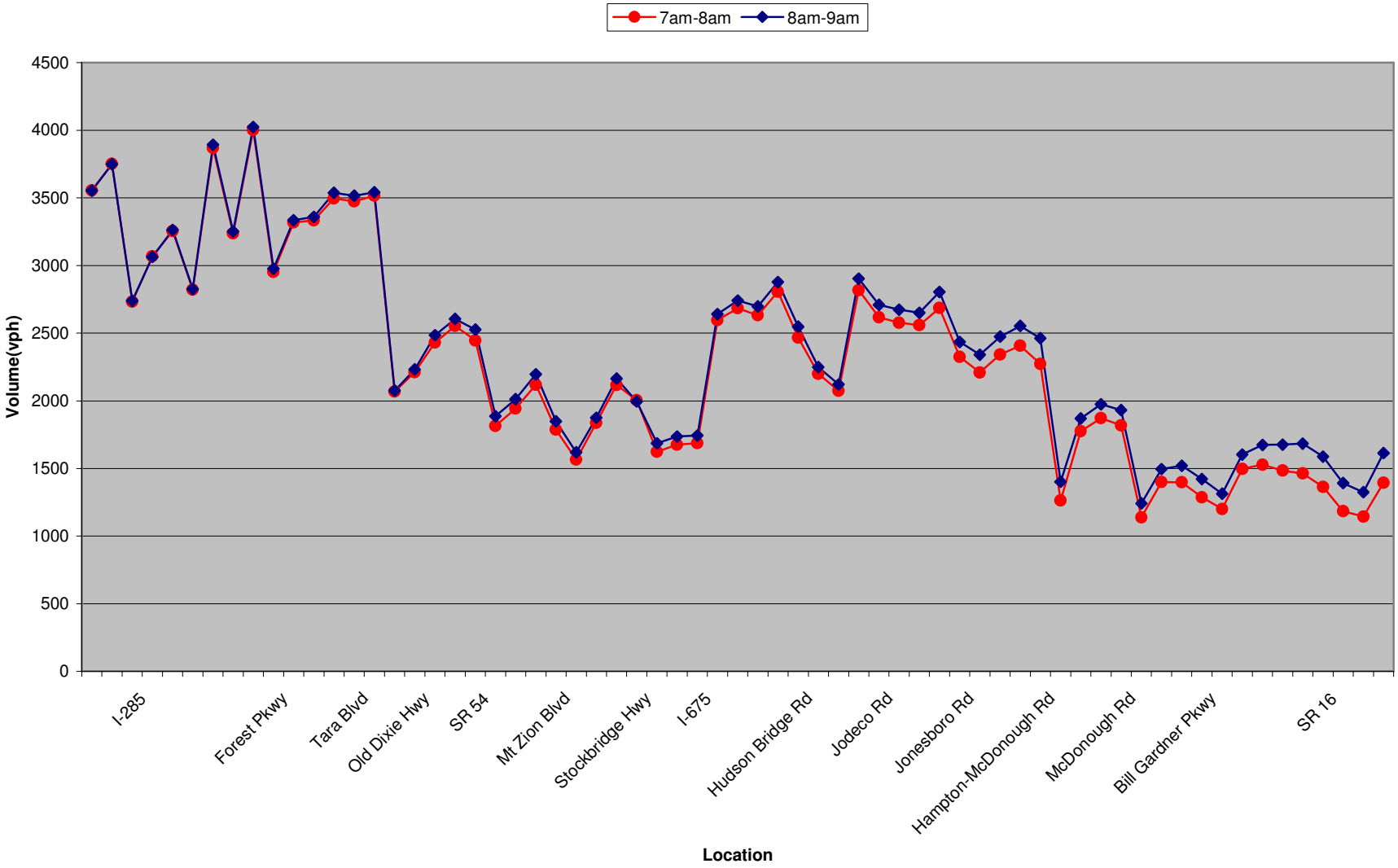


Figure 3-23: AM Peak Speed – I-75 Northbound

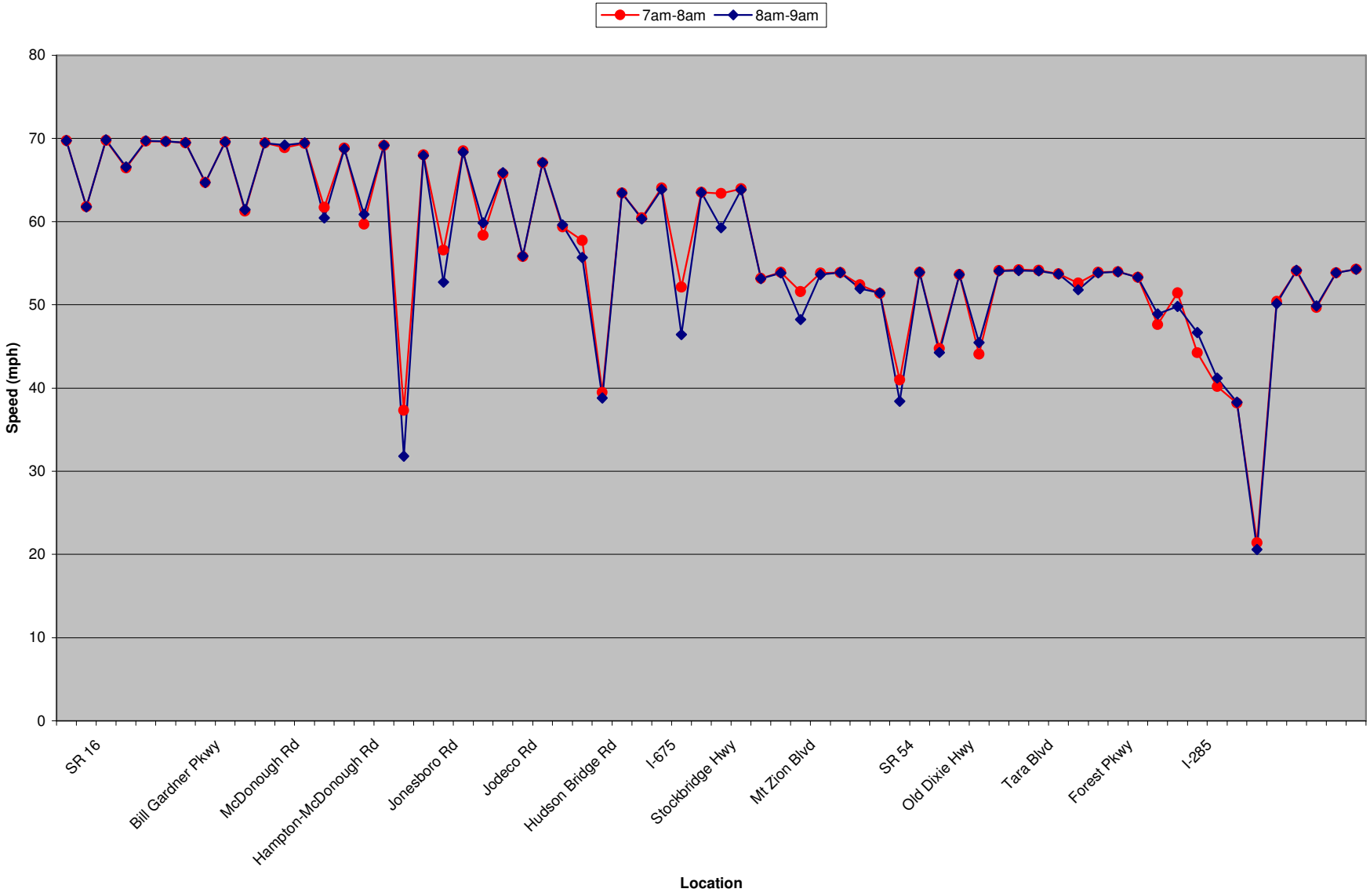


Figure 3-24: AM Peak Speed – I-75 Southbound

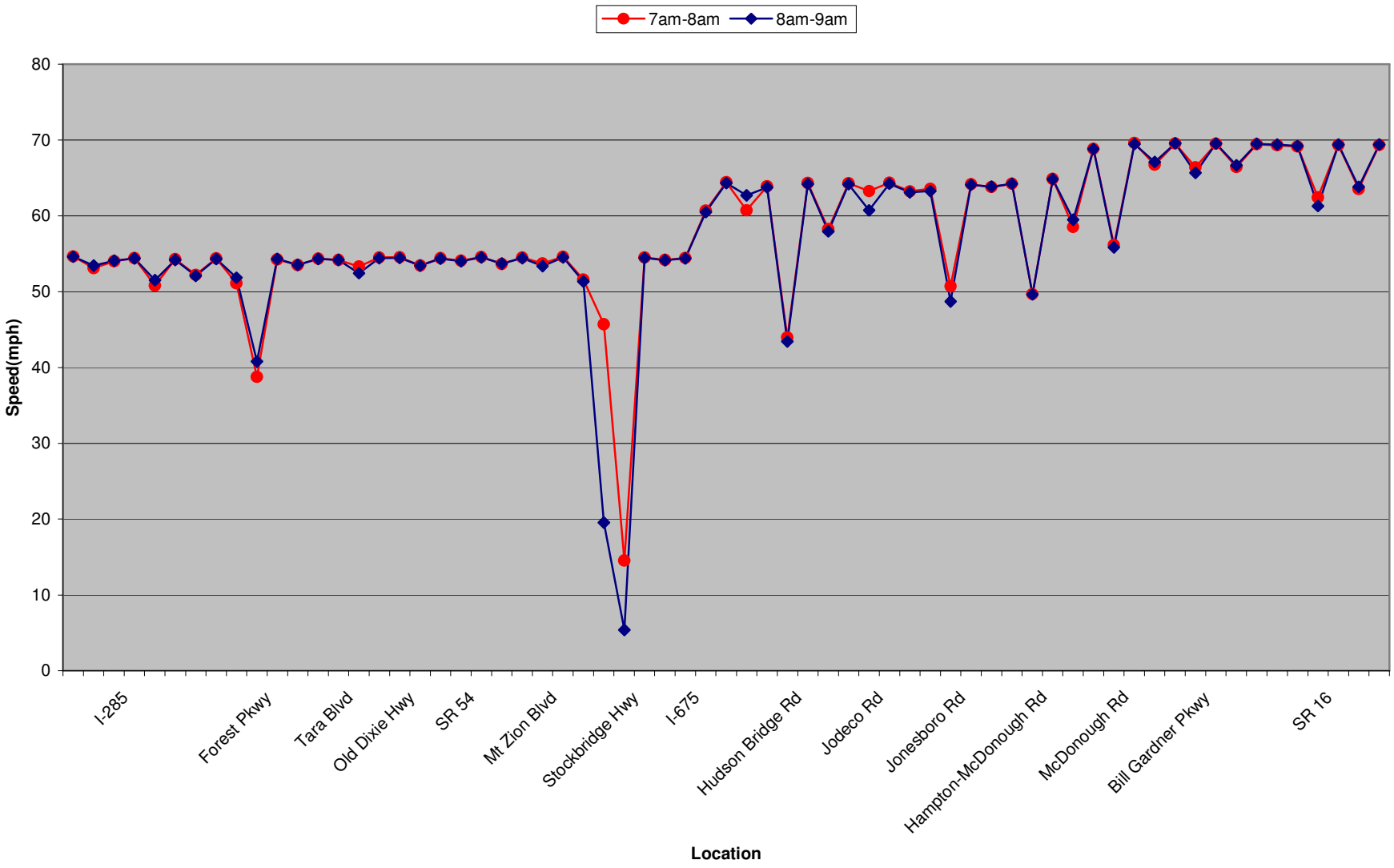


Figure 3-25: AM Peak Density – I-75 Northbound

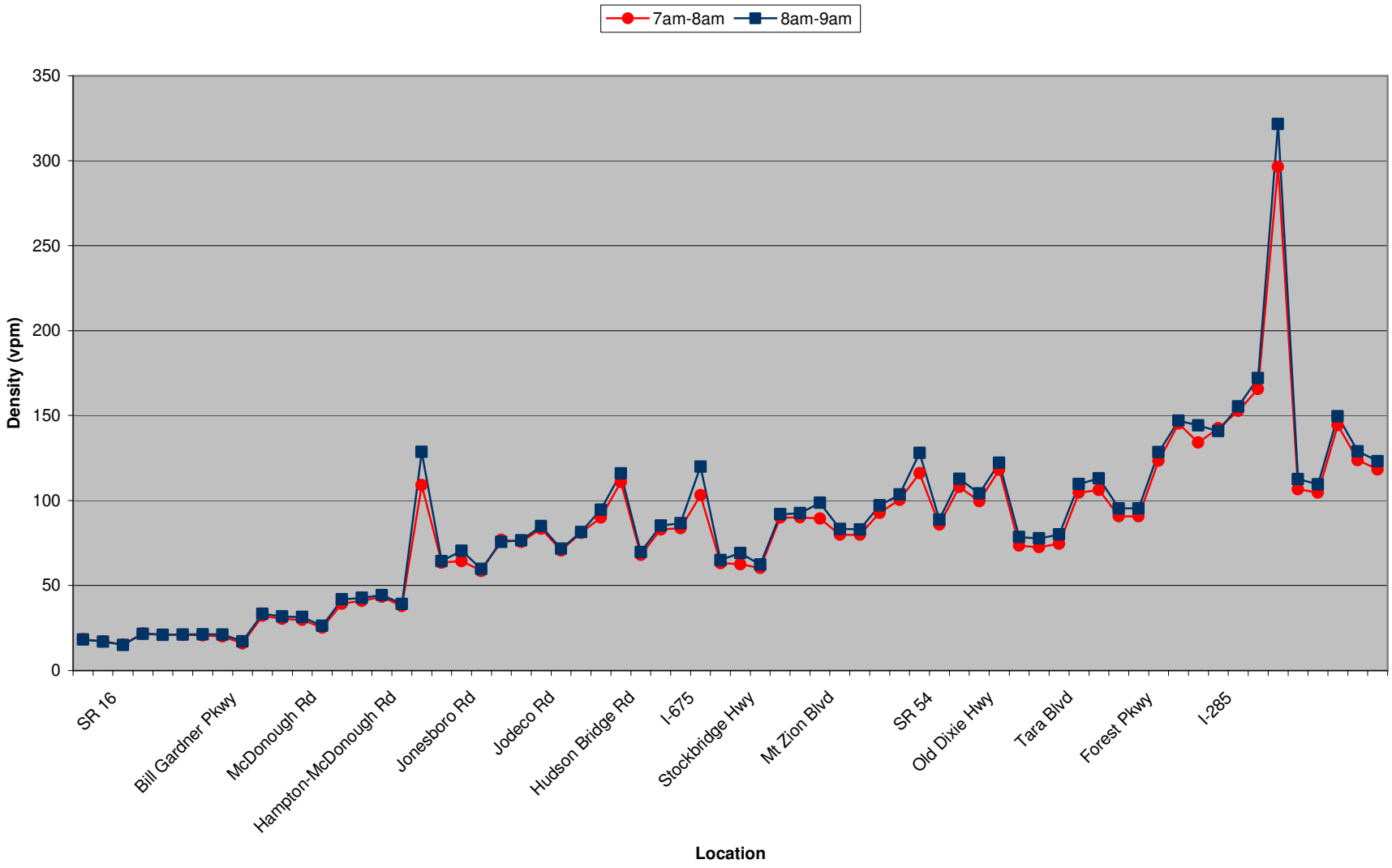


Figure 3-26: AM Peak Density – I-75 Southbound

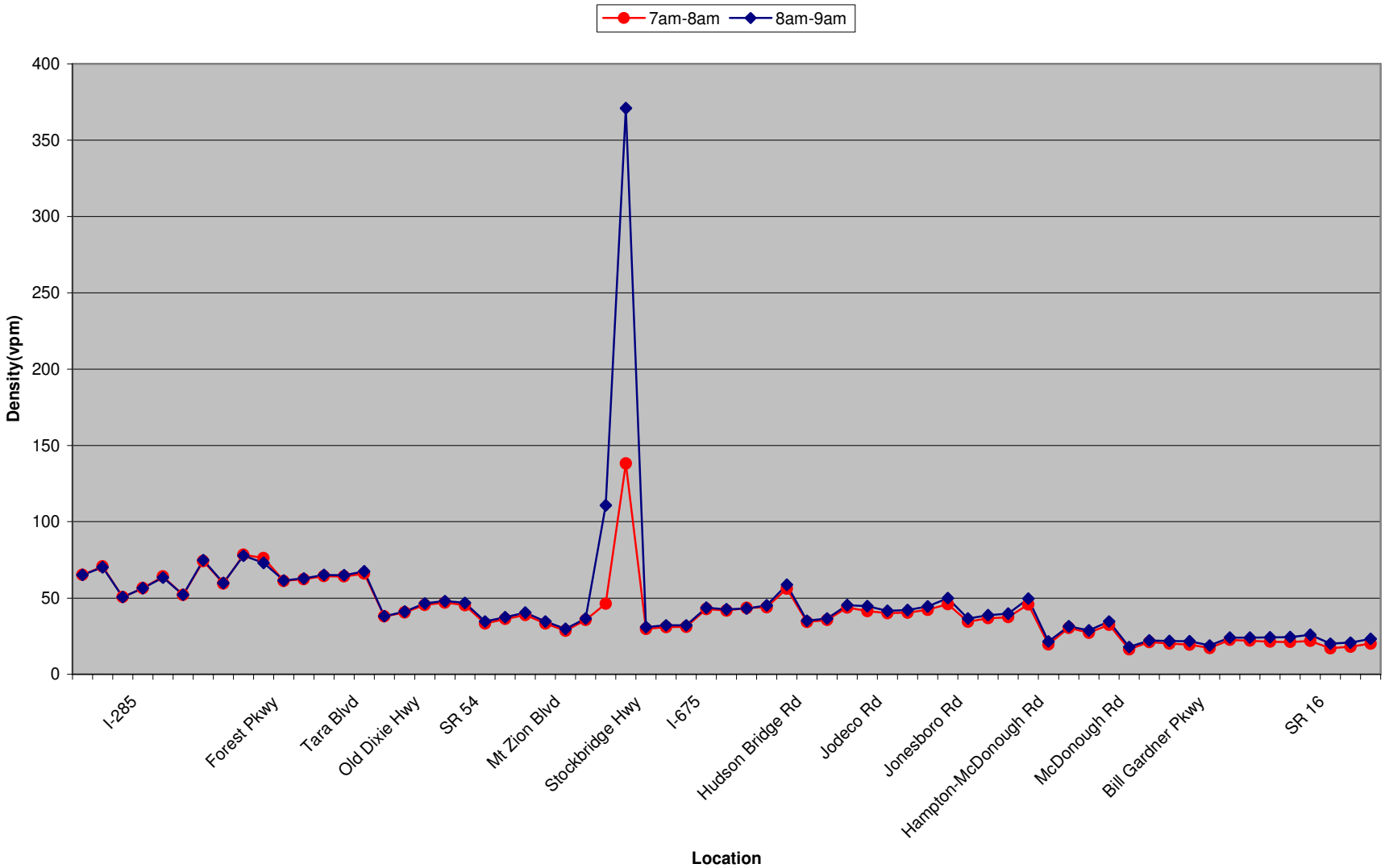


Figure 3-27: AM Peak Lost Time – I-75 Northbound

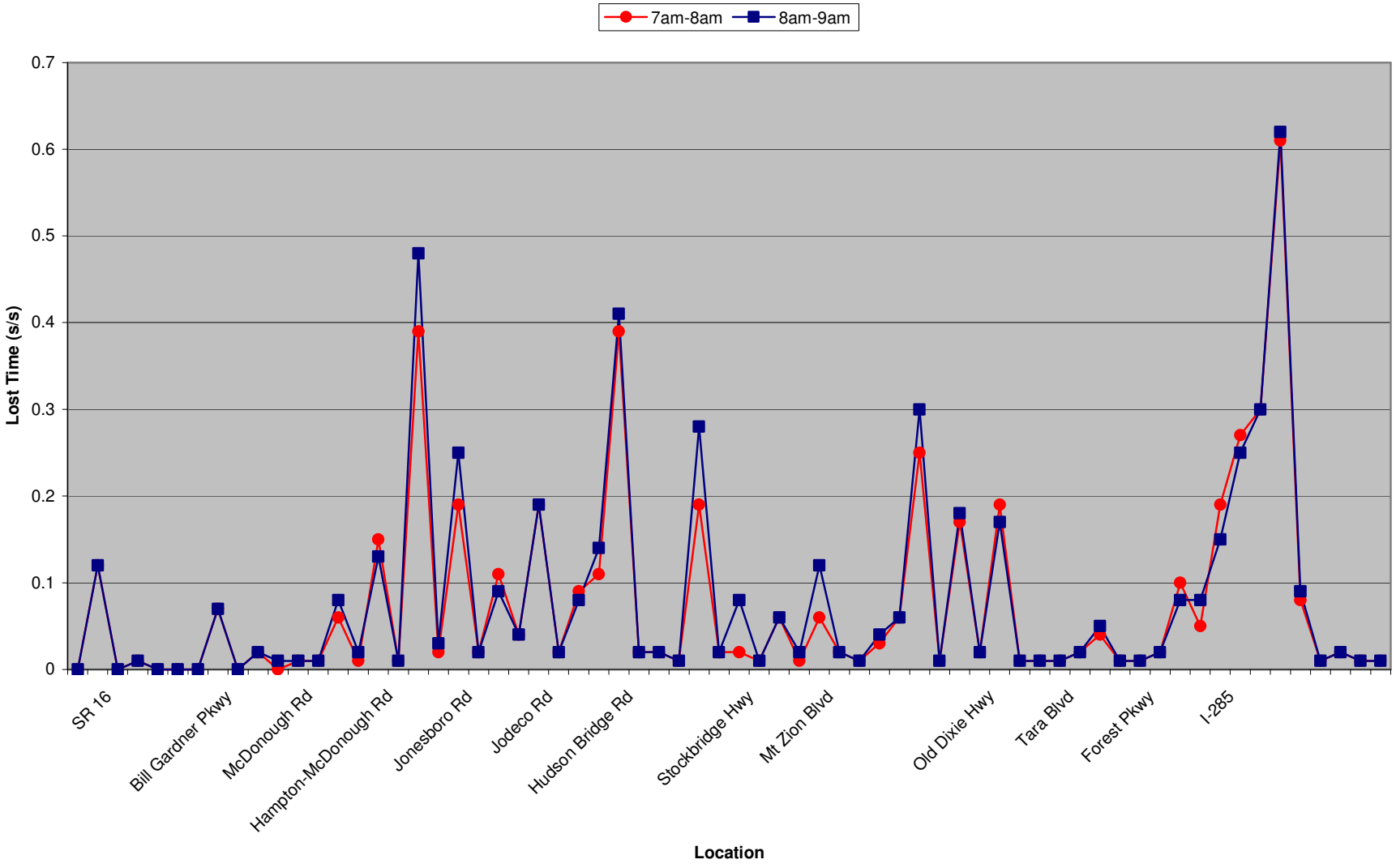


Figure 3-28: AM Peak Lost Time – I-75 Southbound

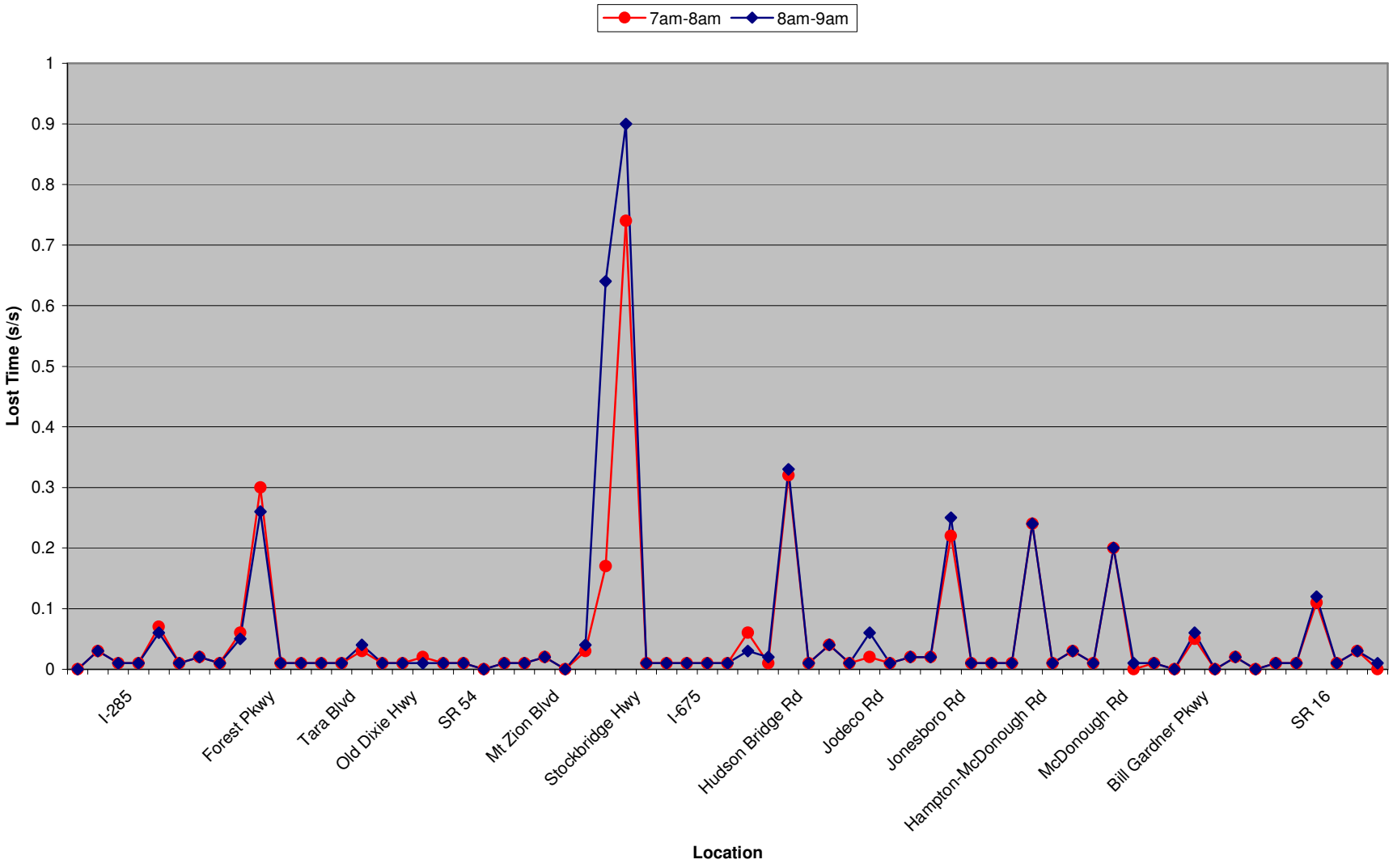


Figure 3-29: PM Peak Volume – I-75 Northbound

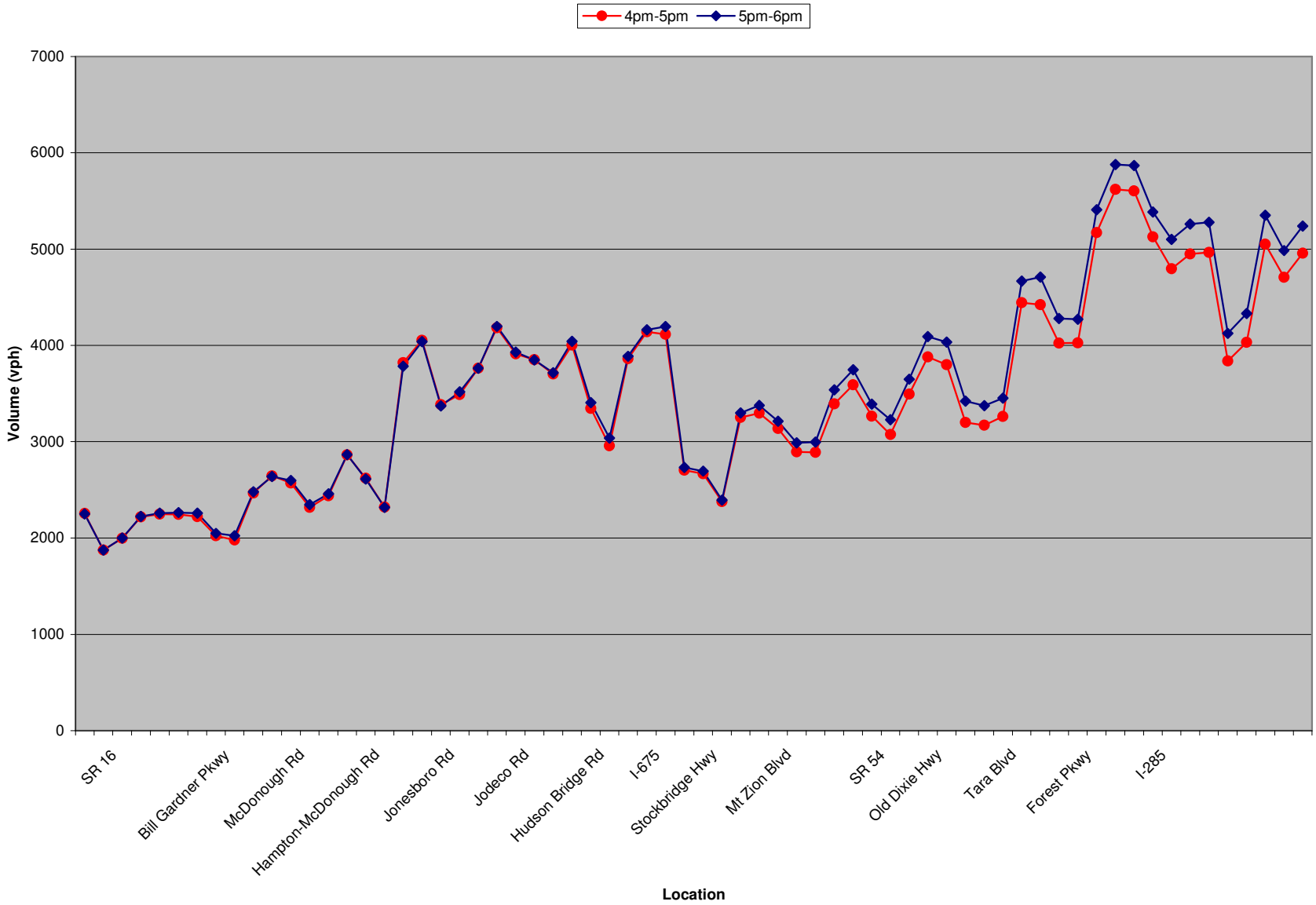


Figure 3-30: PM Peak Volume – I-75 Southbound

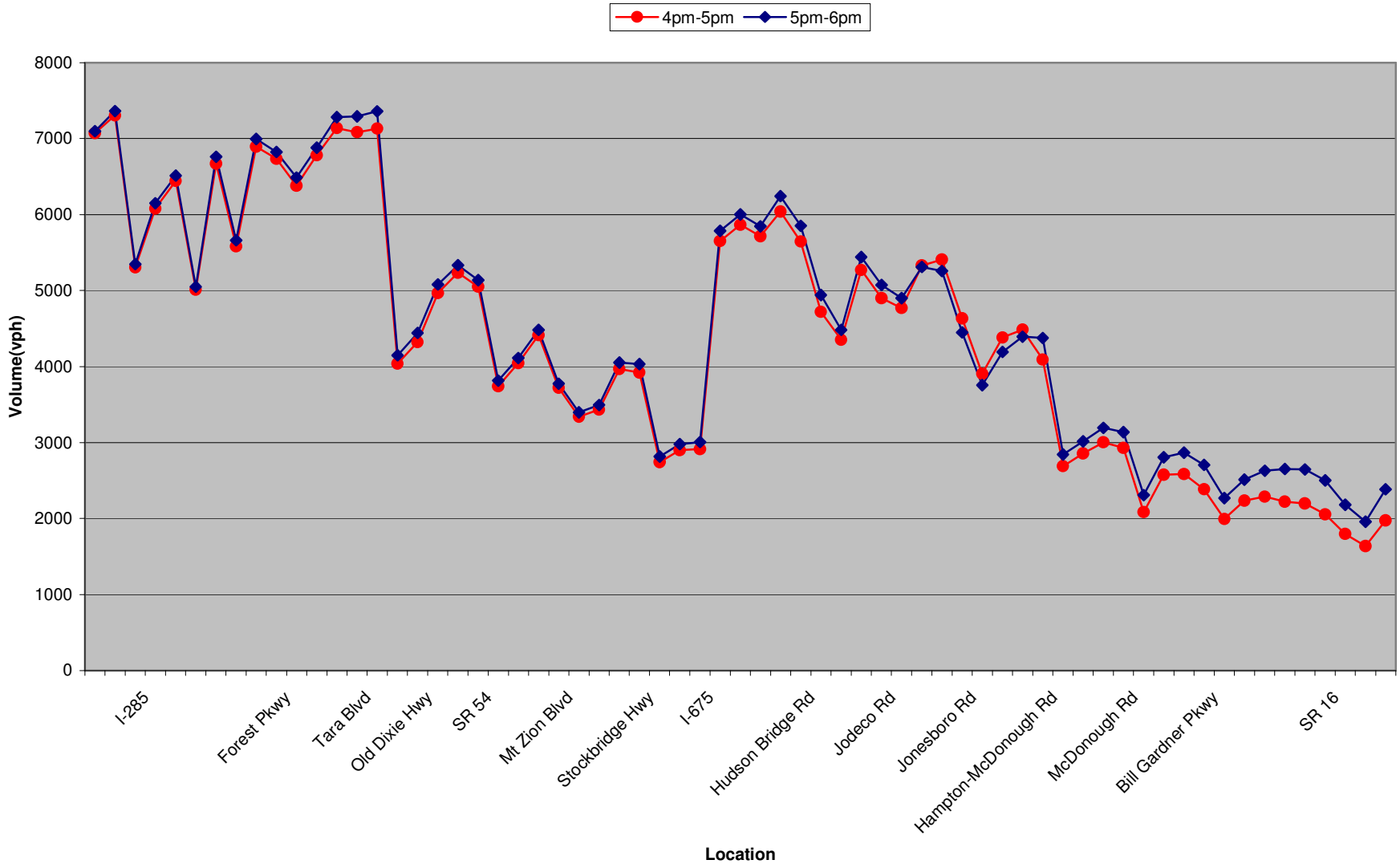


Figure 3-31: PM Peak Speed – I-75 Northbound

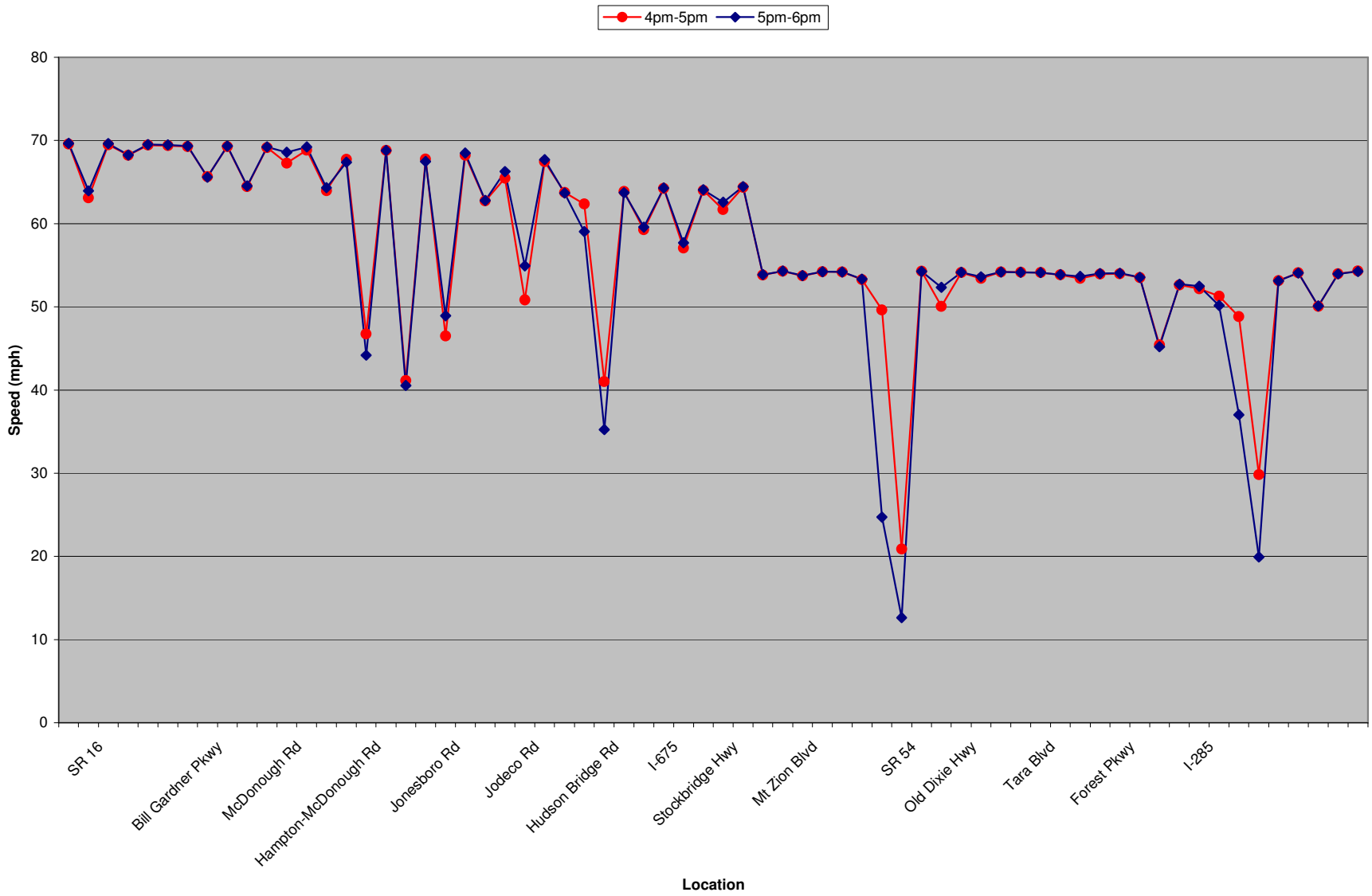


Figure 3-32: PM Peak Speed – I-75 Southbound

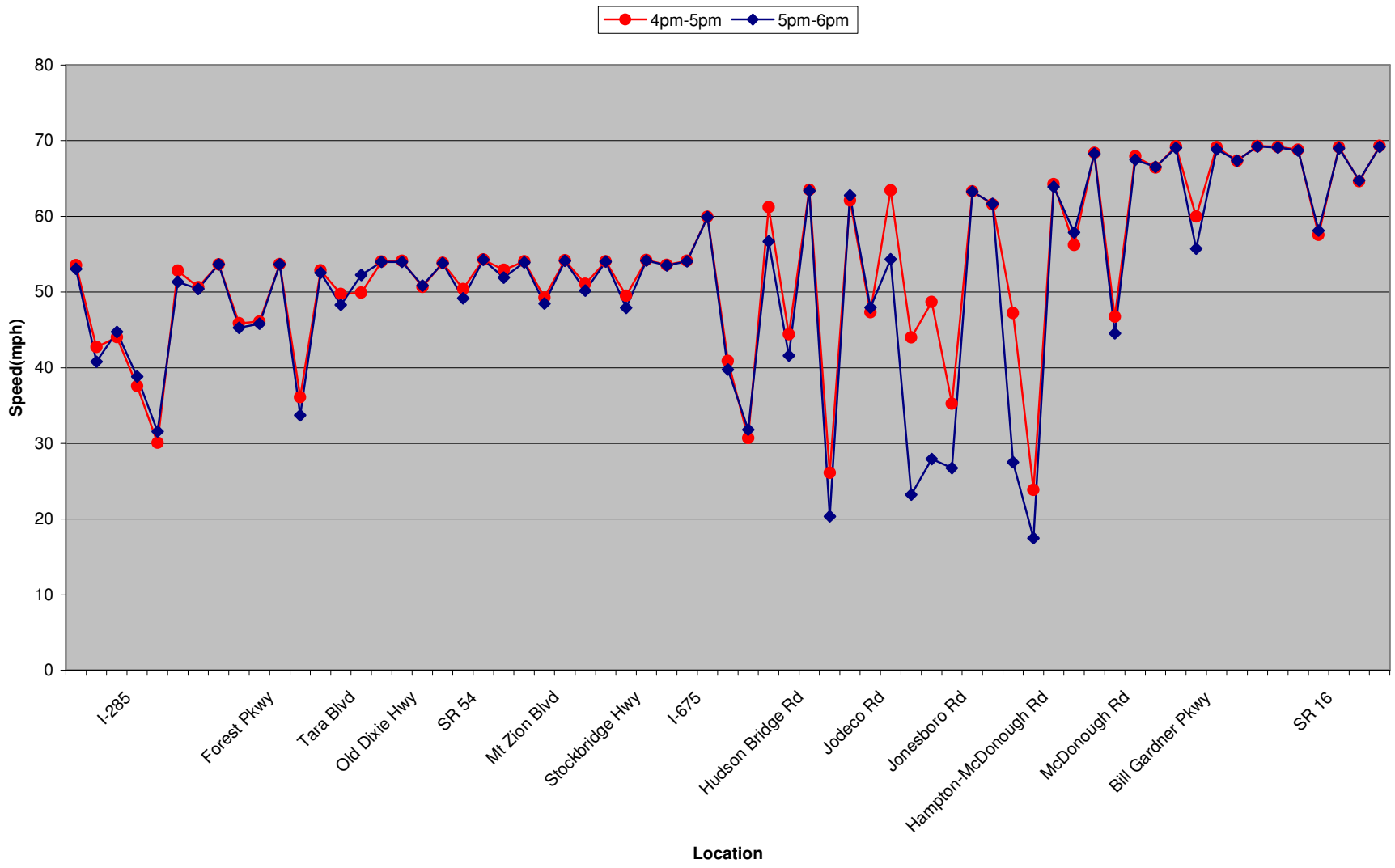


Figure 3-33: PM Peak Density – I-75 Northbound

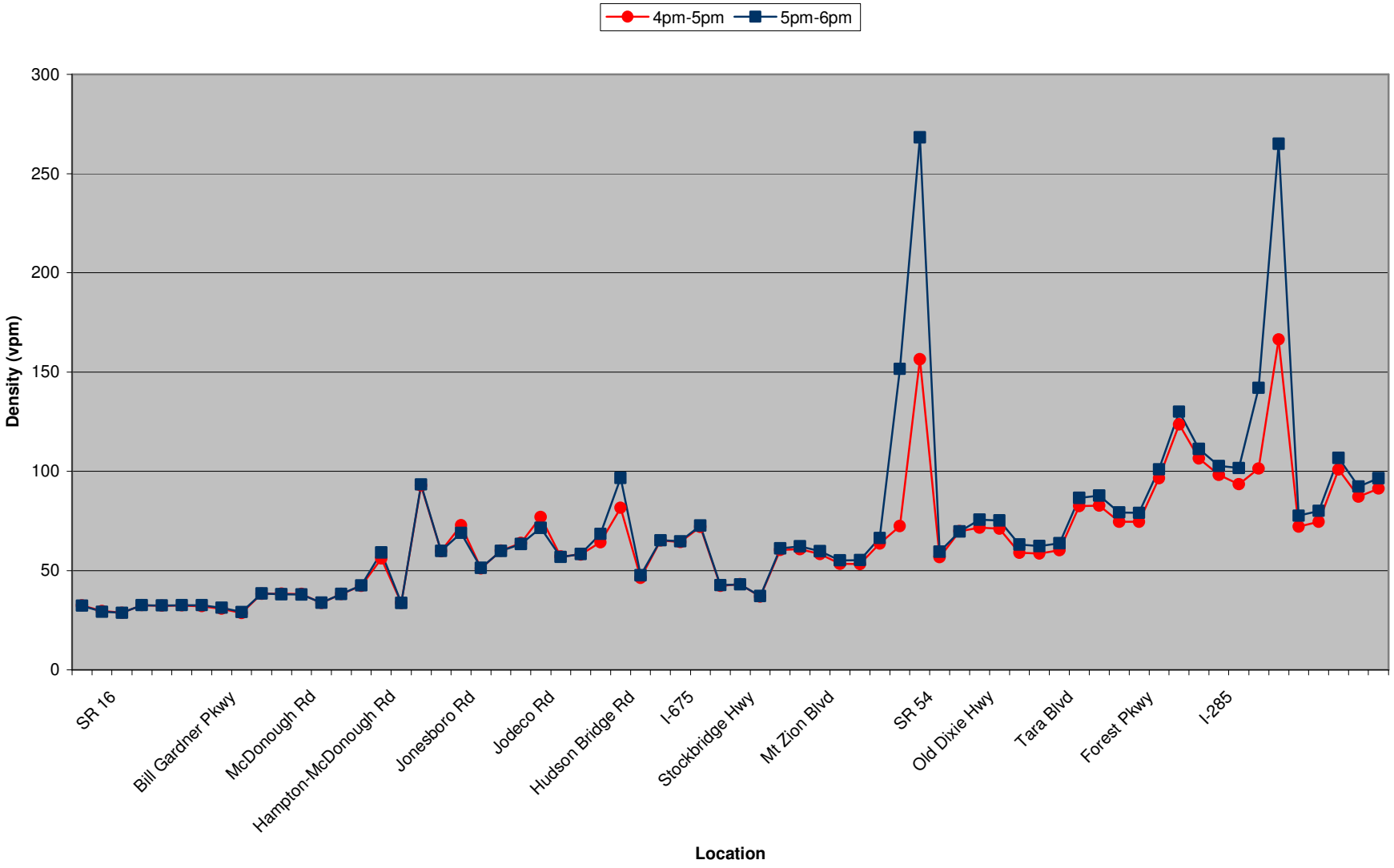


Figure 3-34: PM Peak Density – I-75 Southbound

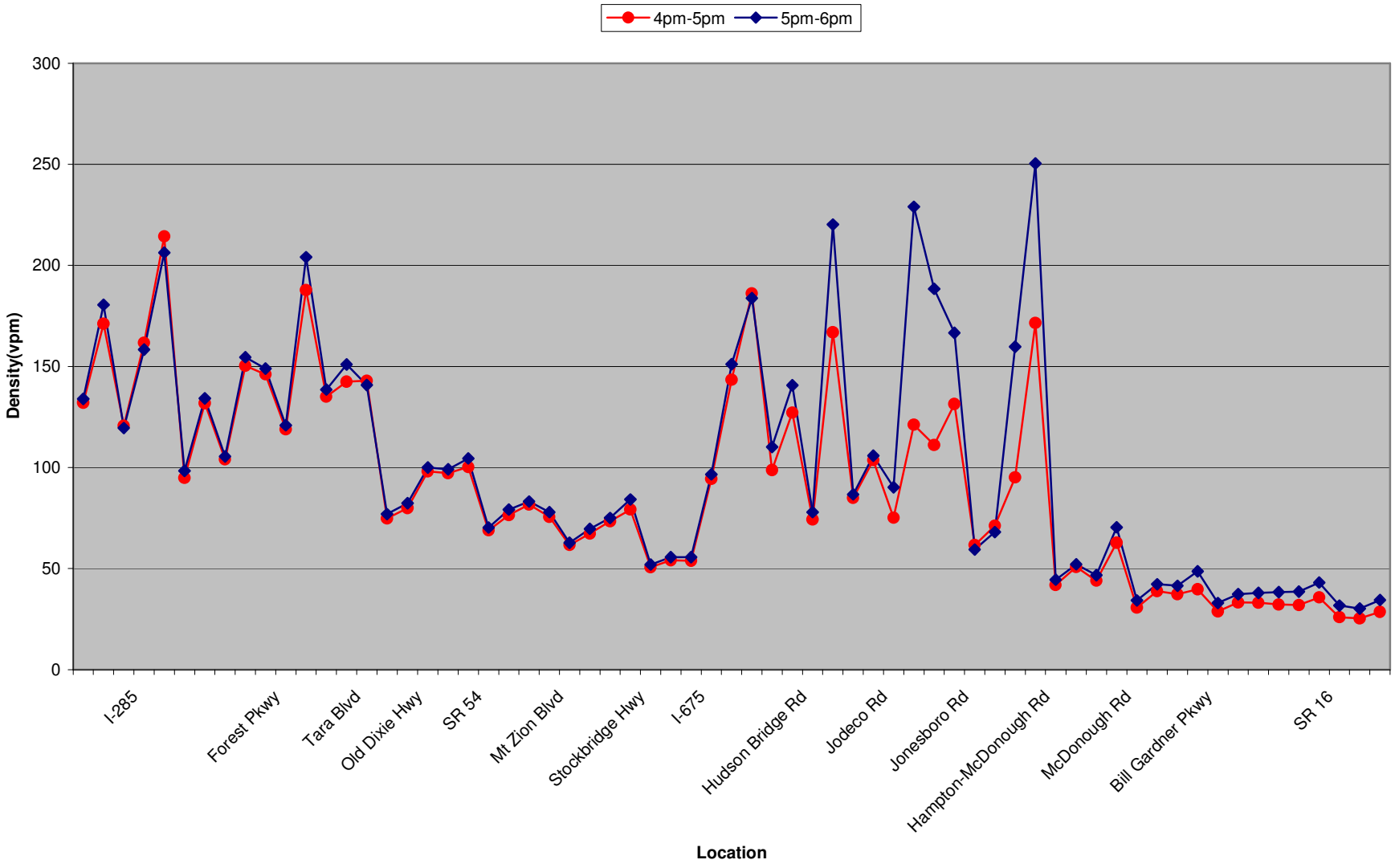


Figure 3-35: PM Peak Lost Time – I-75 Northbound

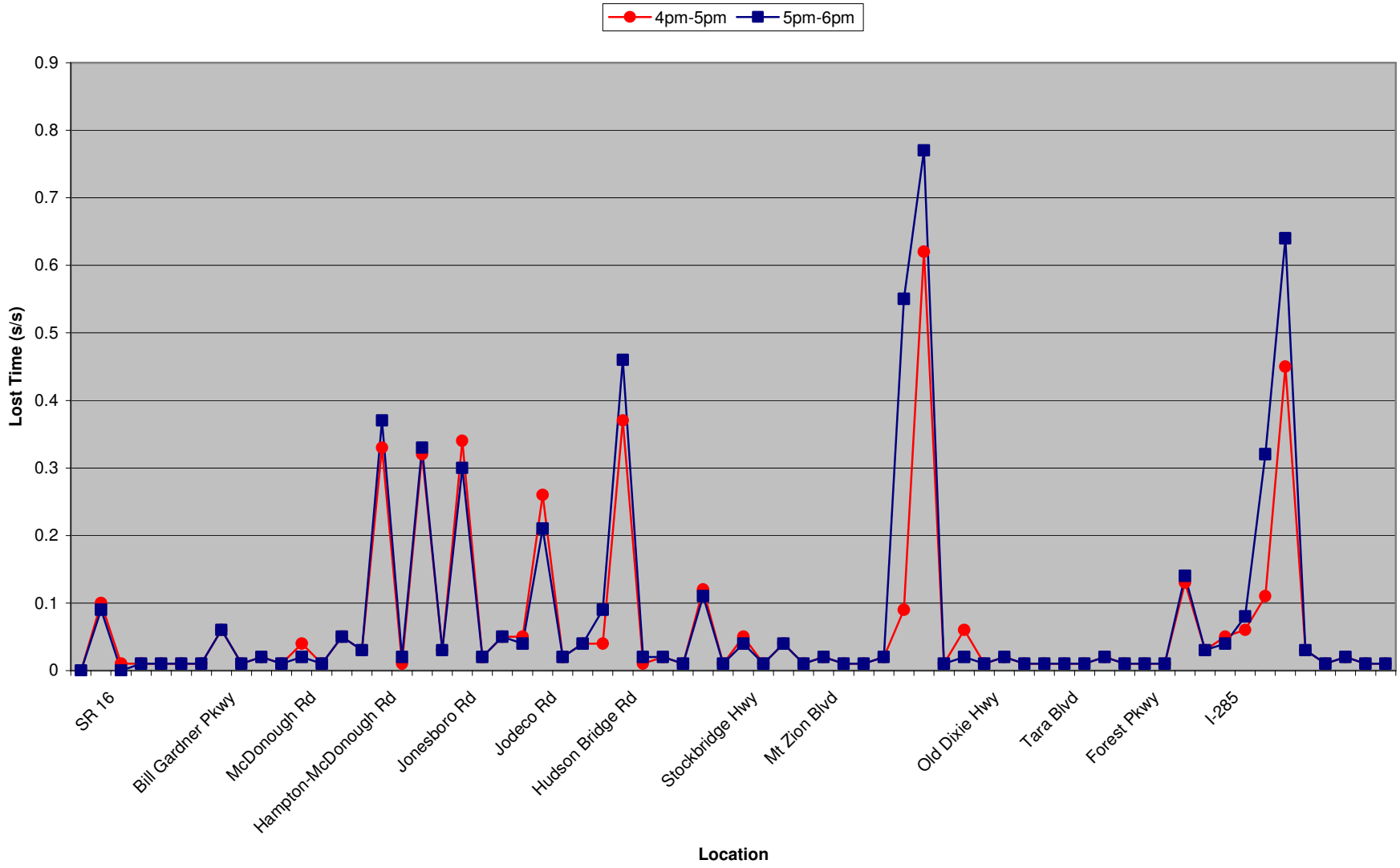
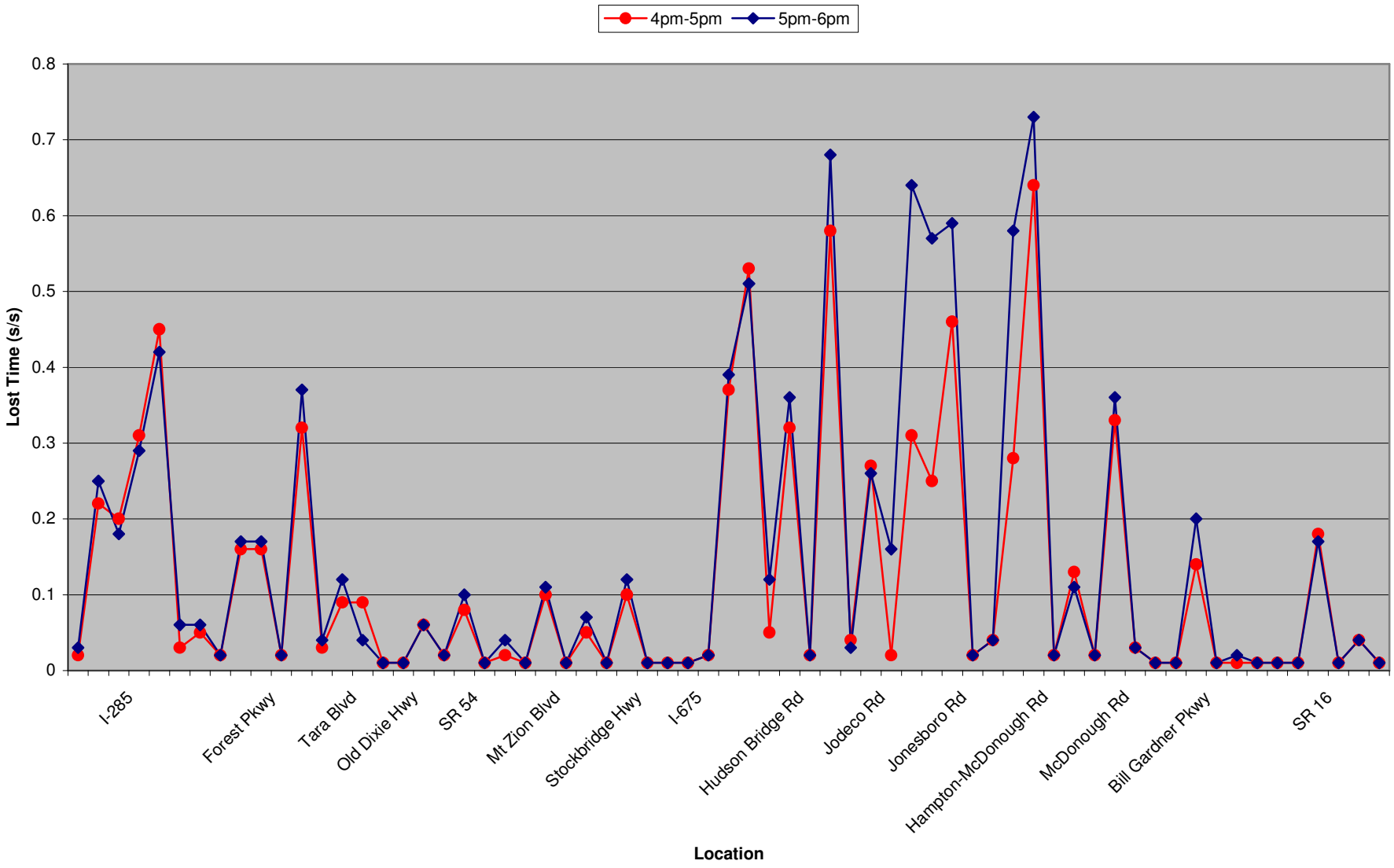


Figure 3-36: PM Peak Lost Time – I-75 Southbound



CHAPTER 4

Traffic and Toll Revenue Estimates

This chapter presents an overview of the methodology used in developing traffic and revenue forecasts and the traffic levels and revenue streams resulting from the construction of High Occupancy Toll (HOT) lanes, Truck Only Toll (TOT) lanes and Express Toll Lanes (ETL) in the I-75 South corridor. The objectives of this effort are to: (1) determine the overall financial and operational feasibility of implementing a range of management techniques, which include a variety of occupancy policies (HOT 2+, HOT 3+ and ETL for cars) and pricing opportunities; and (2) evaluate the feasibility and impact to traffic and revenue with the construction of TOT lanes.

Traffic and revenue estimates are included for each of the eight investment alternatives. Each alternative is compared to one another in terms of toll sensitivities, operational characteristics, and gross/net revenue potential.

4.1 Investment Alternatives Evaluated

Eight investment alternatives were identified for evaluation along I-75 South corridor. They are described in the following sections.

Alternative A-1: This alternative assumed the construction of two managed lanes in each direction along the I-75 South corridor from I-285 to SR 16 with a HOT 2+ occupancy policy. HOT-2+ refers to a tolling alternative that would allow HOVs with two or more people to ride free along with transit vehicles, emergency/police vehicles, and motorcycles. Single Occupant Vehicles (SOV) and Commercial Vehicles (CV) including commercially registered autos, pickup trucks, and vans would pay a toll to use the HOT lanes. It was assumed that medium-duty and heavy-duty trucks would not be allowed to utilize the HOT lanes in this alternative.

Alternative A-2: This alternative assumed the construction of two managed lanes in each direction along the I-75 South corridor from I-285 to SR 16 with a HOT 3+ occupancy policy. HOT-3+ refers to a tolling alternative that would allow HOVs with three or more people to ride free along with transit vehicles, emergency/police vehicles, and motorcycles. Single Occupant Vehicles (SOV) and Commercial Vehicles (CV) including commercially registered autos, pickup trucks, and vans would pay a toll to use the HOT lanes. It was assumed that medium-duty and heavy-duty trucks would not be allowed to utilize the HOT lanes in this alternative.

Alternative A-3: This alternative assumed the construction of two Express Toll Lanes (ETL) for passenger cars in each direction along the I-75 South corridor from I-285 to SR 16. ETL refers to a tolling alternative that all passenger car traffic including SOVs, HOVs, and CVs would pay a toll to use the Express Tolling Lanes. Transit vehicles, emergency/police vehicles, and motorcycles would be allowed to use the ETL for free. It

was assumed that medium-duty and heavy-duty trucks would not be allowed to utilize the ETL in this alternative.

Alternative B: This alternative assumed the construction of two voluntary Truck Only Toll (TOT) lanes in each direction along the length of I-675 and I-75 South corridor from I-675 to SR 16. Voluntary TOT lane refers to a truck tolling alternative that would allow medium-duty trucks (FHWA classes 8-13) and heavy duty trucks (FHWA classes 8-13) to pay a toll to use the lanes. It was assumed that passenger cars and commercial vehicles would not be allowed to utilize the TOT lanes.

Alternative C-1: This alternative is the combination of Alternative A-1 and Alternative B. It assumed the construction of two managed lanes along the I-75 South corridor from I-285 to SR 16 with occupancy policy of HOT2+; and two voluntary Truck Only Toll (TOT) Lanes in each direction along the length of I-675 and I-75 South corridor from I-675 to SR 16.

Alternative C-2: This alternative is the combination of Alternative A-2 and Alternative B. It assumed the construction of two managed lanes along the I-75 South corridor from I-285 to SR 16 with occupancy policy of HOT3+; and two voluntary Truck Only Toll (TOT) Lanes in each direction along the length of I-675 and I-75 South corridor from I-675 to SR 16.

Alternative C-3: This alternative is the combination of Alternative A-3 and Alternative B. It assumed the construction of two Express Toll Lanes (ETL) for passenger cars along the I-75 South corridor from I-285 to SR 16; and two voluntary Truck Only Toll (TOT) Lanes in each direction along the length of I-675 and I-75 South corridor from I-675 to SR 16.

Alternative D: This alternative assumed the construction of two Express Toll Lanes for all vehicles in each direction along the I-75 South corridor from I-285 to SR 16. It was assumed that all vehicles including SOVs, HOVs, commercial vehicles, medium-duty trucks and heavy-duty trucks would pay a toll to use the Express Toll Lanes in this case.

Figures 4-1 through 4-4 illustrate the assumed lane configuration of Alternative A through Alternative D.

Figure 4-1: Lane Configuration – Alternatives A-1 – A-3

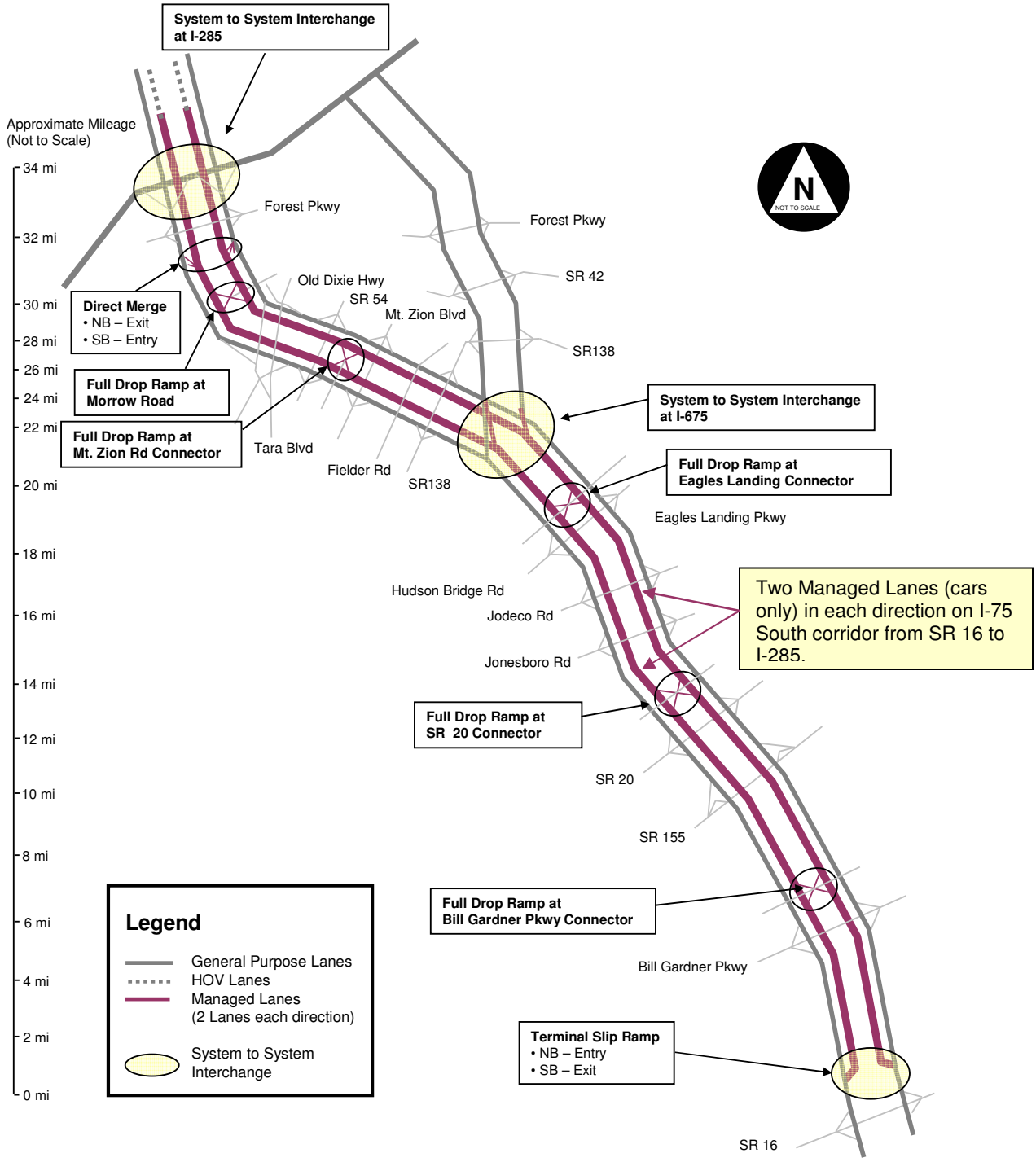


Figure 4-2: Lane Configuration – Alternatives B

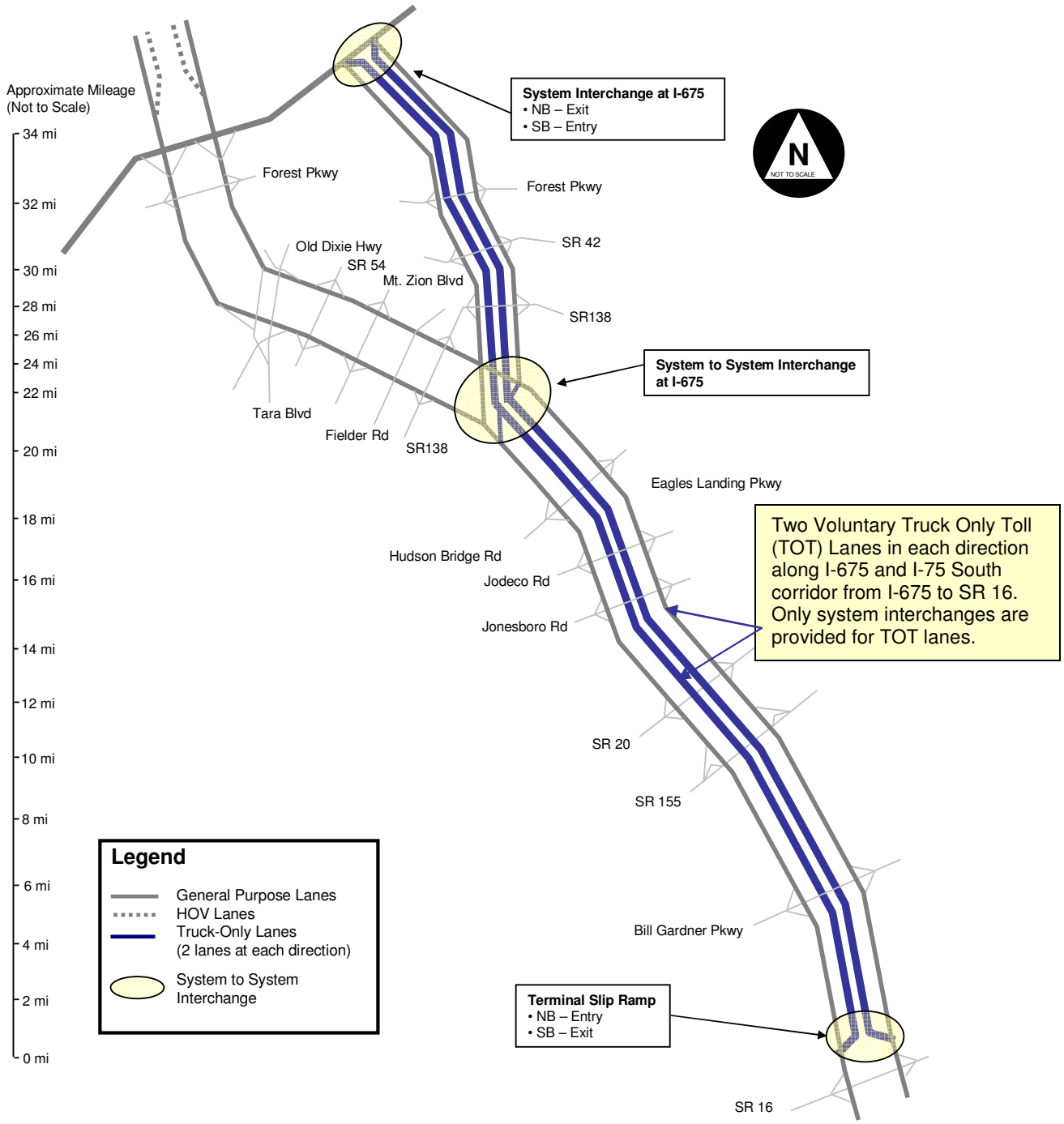


Figure 4-3: Lane Configuration – Alternatives C-1 – C-3

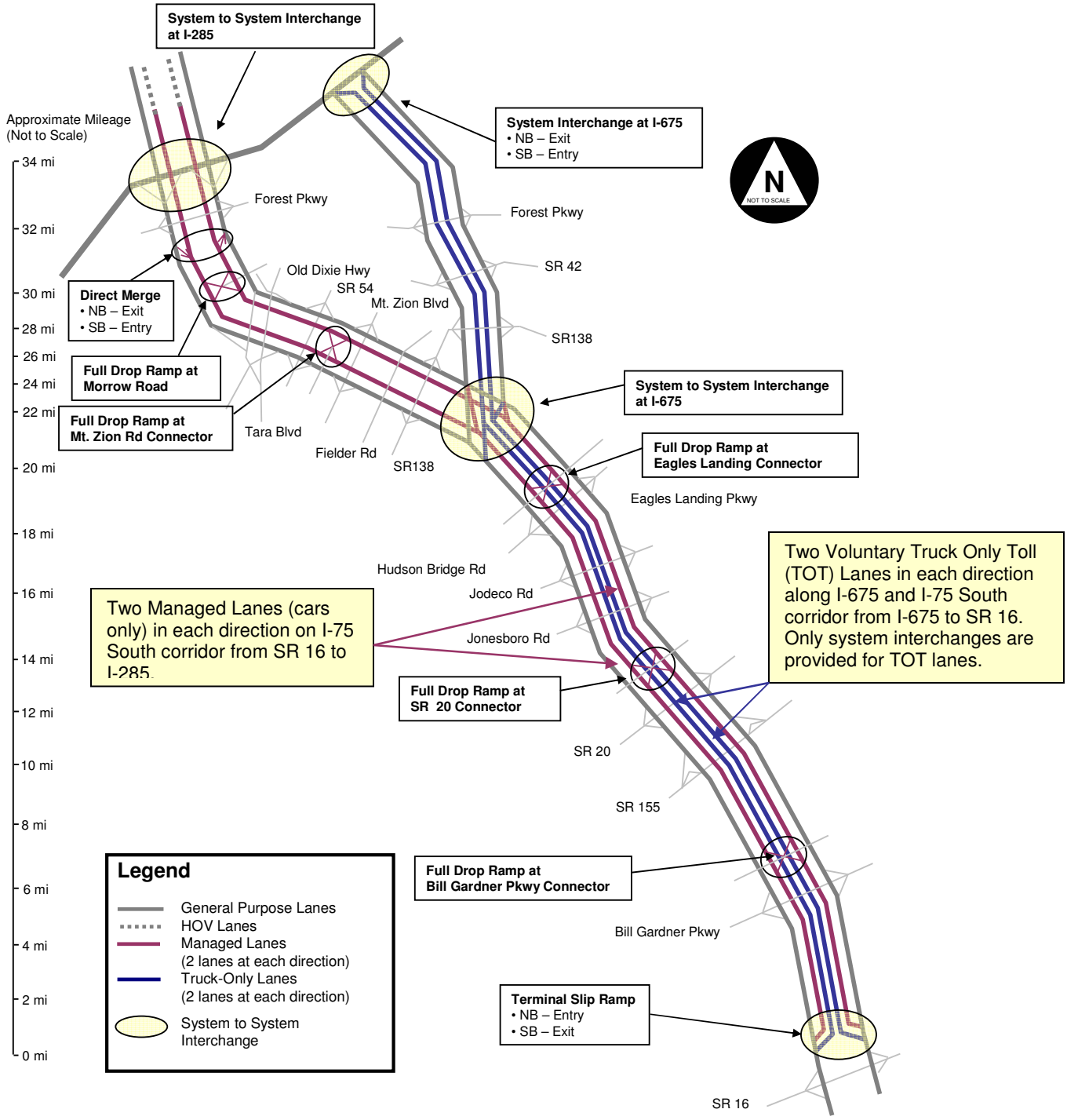
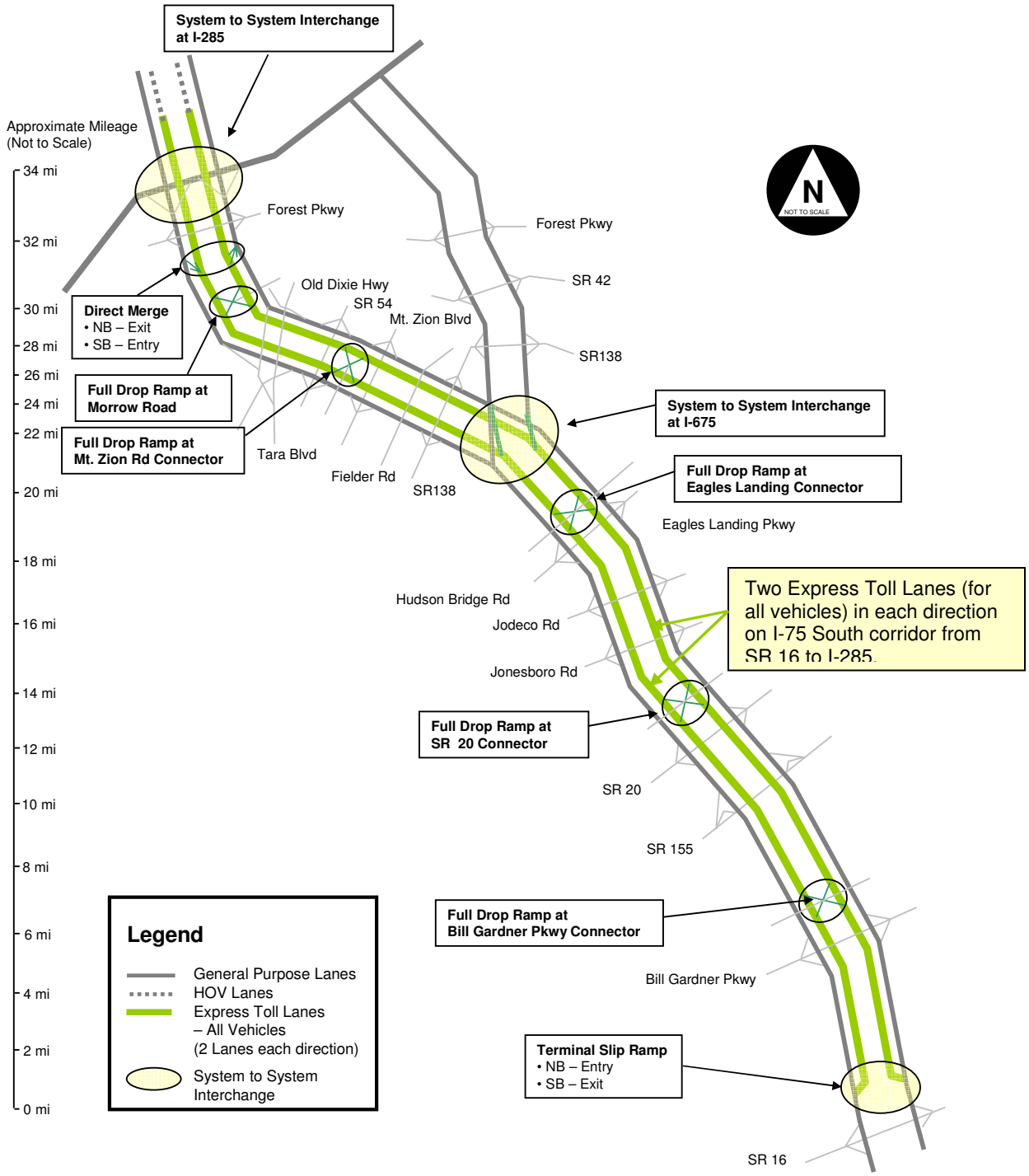


Figure 4-4: Lane Configuration – Alternatives D



The following table summarized the pricing policy evaluated for each of the investment alternatives analyzed.

Table 4-1: Evaluated Alternatives

	Managed Lane Treatments					TOT Lane Treatments	
	SOV	HOV2	HOV3	HOV4+	CV	Medium Duty Truck	Heavy Duty Truck
	2 Managed Lanes in each direction					None	
A-1	$	√	√	√	$	X	X
A-2	$	$	√	√	$	X	X
A-3	$	$	$	$	$	X	X
	None					2 TOT Lane in each direction (Optional)	
B	X	X	X	X	X	$	$
	2 Managed Lanes in each direction					2 TOT Lane in each direction (Optional)	
C-1	$	√	√	√	$	$	$
C-2	$	$	√	√	$	$	$
C-3	$	$	$	√	$	$	$
	2 Express Tolling Lanes in each direction						
D	$	$	$	$	$	$	$

Legend: $ - Priced √ - Free X - Not Allowed

4.2 Modeling Methodology

All of the above alternatives were evaluated using a modified version of Atlanta Regional Commission's (ARC) Mobility 2030 travel demand model sets. The modifications were used to validate the model at a corridor level to the data collected along the corridor, including daily traffic volume, travel time data, occupancy data, etc.

4.2.1 Regional Travel Demand Model Inputs

ARC's highway network was validated against aerial photography and further modified to include additional detail in the study corridor.

The Single Occupancy Vehicle (SOV) trip table, High Occupancy Vehicles (HOV) trip table and Commercial Vehicle (CV) trip table used for this analysis reflect the latest socio-economic forecasts available for the 20-County region, developed in the ARC's Mobility 2030 plan. The HOV trip table was then further segregated into three occupancy categories: HOV2, HOV3 and HOV4+ based on ARC's mode choice model and field occupancy data.

The Medium-Duty Truck trip table and Heavy-Duty Truck trip table employed in this analysis reflect the latest truck growth forecast in the Statewide Truck Lanes Needs Identification Study conducted by Georgia Department of Transportation (GDOT). The

Statewide Truck Lanes Needs Identification Study updated future daily commodity truck table in the Statewide Travel Demand Model. The 2004 TRANSERACH database was used in combination with the annual growth rate developed from the FHWA's Freight Analysis Framework in the Statewide Transportation Plan (SWTP). The TRANSERACH database of annual tons by trucks was then converted to forecast trucks per year and trucks per day. A FRATAR model was developed in the Statewide Truck Lanes Needs Identification Study to convert statewide truck matrix to the 20-county truck matrix used in ARC model.

Table 4-2 provides a summary of the vehicle categories used in the I-75 South corridor Managed Lane Assessment and their data sources.

Table 4-2: Vehicle Categories Comparison

ARC Vehicle Categories	Segregated Vehicle Categories	Sources
Single-Occupant passenger cars (SOV);	○ Single-occupant passenger cars (SOV);	ARC's Mobility 2030 20-County Travel Demand Model
High Occupancy Passenger Cars (HOV);	○ Two-occupant passenger cars (HOV-2); ○ Three-occupant passenger cars (HOV-3); ○ Passenger cars with four or more occupants (HOV-4+);	ARC's Mobility 2030 20-County Travel Demand Model and Field Occupancy Data
Commercial Vehicles/Trucks;	○ Commercial Vehicles (CV);	ARC's Mobility 2030 20-County Travel Demand Model
	○ Medium-Duty Trucks (FHWA classes 4-7)	GDOT Statewide Truck Lanes Needs Identification Study Modified Truck Table
	○ Heavy-Duty Trucks (FHWA 8-13) with origin or destination inside of I-285	
	○ Heavy-Duty Trucks (FHWA 8-13) through trips	

Trip tables for all vehicle types were provided for the following four time periods:

- AM peak period (6:00 AM - 10:00 AM);
- PM peak period (3:00 PM - 7:00 PM);
- Midday (10:00 AM – 3:00 PM), and
- Night-time (7:00 PM – 6:00 AM).

In this analysis, Passenger Car Equivalent (PCE) factors were utilized to estimate the effect of heavy vehicles (Medium-Duty Trucks and Heavy-Duty Trucks) on operating conditions. A PCE factor of 1.5 was applied to Medium-Duty Trucks and a PCE factor of 2.0 was applied to for Heavy-Duty Trucks. No PCE factors were applied to other commercial vehicles.

4.2.2 Willingness to Pay Methodology

The willingness to pay methodology was recommended and utilized for the toll modeling for I-75 South corridor managed lane study. This approach seeks to expand the detail of the toll diversion curve between the two extremes; either 100 or 0 percent to toll and toll-free routs. For example, SOV and CV travelers are delineated to those willing to pay to use the managed lanes and those who chose to continue on free alternatives; Medium-Duty Truck and Heavy-Duty Truck travelers are delineated to those willing to pay to use the truck only lanes and those who chose to continue using free alternatives such as general-purpose lanes.

The willingness to pay curve for candidate managed lane users was developed by occupancy type and vehicle type (SOV, HOV2, HOV3+, and CV) and by travel period. Based on the passenger car stated preference survey conducted along I-75 South corridor, there is no statistical significant difference in willingness to pay among the different trip types and therefore, all trip types were combined. The average passenger car willingness to pay curve for managed lanes is illustrated in Figure 4-5.

The willingness to pay curve for candidate TOT lane users was developed based on Truck Operator and Truck Shipper Stated Preference Surveys conducted in 2006 for I-75 NW corridor by Georgia Department of Transportation (GDOT). Truck Operator sample consisted of a universal frame of all six or more axle trucks passing through the south Forsyth Weigh Station outside Atlanta, Georgia, between the hours of 7:00 AM and 5:30 PM from March 7 to 10, 2006. In-person interviews of 306 truck operators were conducted utilizing Computer-Assisted Personal Interviewing (CAPI) software to ensure that the right information was collected in the most efficient manner. Truck Shipper sample was established using a dual sampling frame - a portion of sample records were obtained via a truck intercept survey while the remainder of the sample was obtained via a commercial database, maintained by the Federal Motor Carrier Administration (FMCA), containing all commercial trucking companies in the United States. A total of 176 shippers participated in telephone interviews and a total of 156 shippers participated in web interviews from March 13, 2006 to April 12, 2006. The stated preference survey shows that truck shippers are less willing to pay the toll than truck operators, particularly at the lower levels of travel time savings. The combined shipper and driver willingness to pay curve was developed for TOT lane users as illustrated in Figure 4-6.

Figure 4-5: Average Passenger Car Willingness to Pay Curve

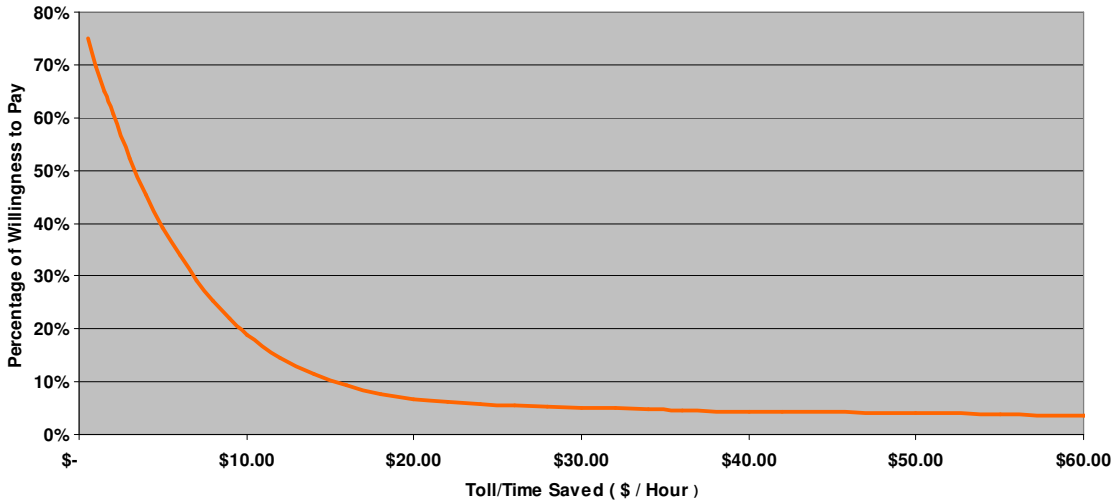
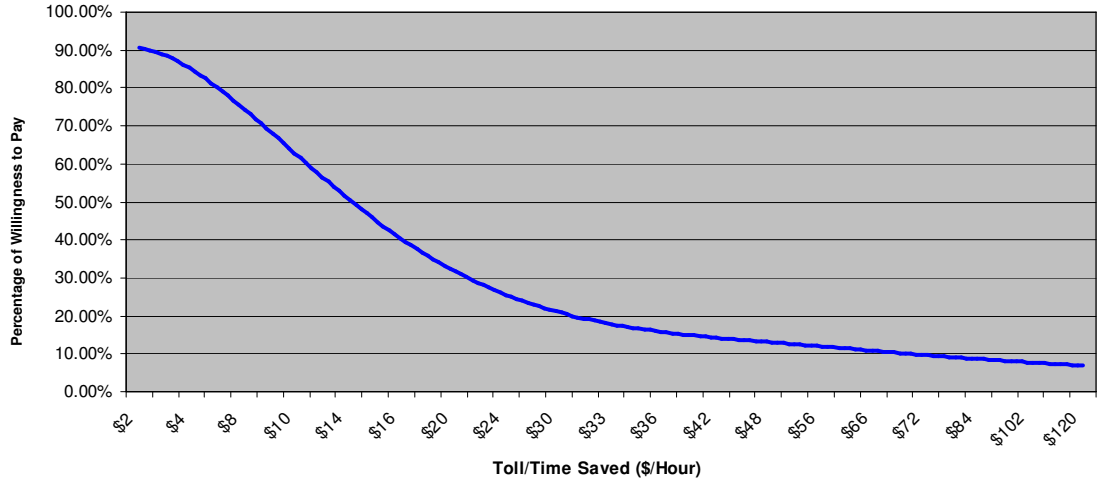


Figure 4-6: Average Truck Shipper/Operator Willingness to Pay Curve



Willingness to pay is calculated by comparing the costs of utilizing the managed lanes and/or TOT lanes to time savings provided. This relationship drives the fraction of the population who are willing to pay. Several examples are provided below.

<u>Managed Lanes (Passenger Cars):</u>

<u>$0.10 per mile toll traveling 10 mile = $1.00 and with 10 minutes of travel time savings</u>

Equation 4-1 $$\frac{toll(\$)}{travel\ time\ savings\ (\text{min.})} * \frac{60\ \text{minutes}}{hour} = \frac{toll(\$)}{hour}$$

$$\frac{\$1.00}{10\,\text{min. saving}} * \frac{60\,\text{minutes}}{hour} = 6.0(\$/Hr) \xrightarrow{\text{lookup (Figure 2)}}$$

34% are willing to pay.

<u>$0.10 per mile toll traveling 10 mile = $1.00 and with 30 minutes of travel time savings</u>

Equation 4-2 $$\frac{toll(\$)}{travel\ time\ savings\ (\text{min.})} * \frac{60\,\text{minutes}}{hour} = \frac{toll(\$)}{hour}$$

$$\frac{\$1.00}{30\,\text{min. saving}} * \frac{60\,\text{minutes}}{hour} = 2.0(\$/Hr) \xrightarrow{\text{lookup (Figure 2)}}$$

61% are willing to pay.

<u>$0.30 per mile toll traveling 10 mile = $3.00 and with 20 minutes of travel time savings</u>

Equation 4-3 $$\frac{toll(\$)}{travel\ time\ savings\ (\text{min.})} * \frac{60\,\text{minutes}}{hour} = \frac{toll(\$)}{hour}$$

$$\frac{\$3.00}{20\,\text{min. saving}} * \frac{60\,\text{minutes}}{hour} = 9(\$/Hr) \xrightarrow{\text{lookup (Figure 2)}}$$

22% are willing to pay.

<u>TOT Lanes:</u>

<u>$0.10 per mile traveling 10 mile = $1.00 and with 10 minutes of travel time savings</u>

Equation 4-1 $$\frac{toll(\$)}{travel\ time\ savings\ (\text{min.})} * \frac{60\,\text{minutes}}{hour} = \frac{toll(\$)}{hour}$$

$$\frac{\$1.00}{10\,\text{min. saving}} * \frac{60\,\text{minutes}}{hour} = 6.0(\$/Hr) \xrightarrow{\text{lookup (Figure 3)}}$$

80% are willing to pay.

<u>$0.10 per mile traveling 10 mile = $1.00 and with 30 minutes of travel time savings</u>

Equation 4-2 $$\frac{toll(\$)}{travel\ time\ savings\ (\text{min.})} * \frac{60\,\text{minutes}}{hour} = \frac{toll(\$)}{hour}$$

$$\frac{\$1.00}{30\,\text{min. saving}} * \frac{60\,\text{minutes}}{hour} = 2.0(\$/Hr) \xrightarrow{\text{lookup (Figure 3)}}$$

91% are willing to pay.

<u>$0.35 per mile traveling 10 mile = $3.50 and with 20 minutes of travel time savings</u>

Equation 4-3 $$\frac{toll(\$)}{travel\ time\ savings\ (\text{min.})} * \frac{60\,\text{minutes}}{hour} = \frac{toll(\$)}{hour}$$

$$\frac{\$3.50}{20\,\text{min. saving}} * \frac{60\,\text{minutes}}{hour} = 10.5(\$/Hr) \xrightarrow{\text{lookup (Figure 3)}}$$

61% are willing to pay.

After the determination of willingness to pay, standard TP+ equilibrium assignment methodologies were applied. The various vehicle categories (i.e., SOV, HOV-2, HOV-3, HOV4+, CV, Medium-Duty Trucks and Heavy-Duty Truck) were handled separately in the TP+ assignment process to recognize different restrictions on specific lane uses (HOT lane, TOT lane, ETL lane, etc.) and toll charges. For example, Medium-Duty Truck and Heavy-Duty Truck traffic were not permitted to use the HOT lanes. SOV, HOV, CV and Medium-Duty Truck traffic were not allowed to use the TOT lanes.

A step-by-step description of how this approach was applied within the model framework is presented below:

1. Travel time skims are run for different vehicle types (SOV, HOV-2, HOV-3, HOV-4+, CV, Medium-Duty Trucks and Heavy-Duty Truck), with and without use of the managed lanes system (HOT, TOT and ETL).
2. The appropriate willingness to pay curve is then used to determine the percentage of travelers (SOV, HOV-2, HOV-3, HOV-4+, CV, Medium-Duty Trucks and Heavy-Duty Truck), who are willing to pay to use the managed lanes for the predetermined price. This percent willing to pay is determine by: value of time, per mile toll rate, and the travel time saving offered by the managed lanes (see above examples of these calculations).
3. Once the fraction of motorists (SOV, HOV, CV, Medium-Duty Trucks and Heavy-Duty Truck) who are willing to pay is determined, the corresponding trip table is separated resulting in two trips table – those willing to pay, and those not willing to pay.
4. A standard assignment process is then applied with eligibility restrictions lifted on the managed lanes for the “willing to pay” travelers for different vehicle types (SOV, HOV, CV, Medium-Duty Trucks and Heavy-Duty Truck). The willing to pay trip table represents the universe of those eligible to use the managed lanes (HOT, TOT, ETL, etc) for a price and does not reflect actual usage. Actual usage is determined through the assignment process and assigned based on minimum composite impedance.
5. This process is performed iteratively for each analysis period until the prescribed equilibrium tolerance is achieved.

For each of the different alternatives, traffic assignments were completed at each of the four time periods independently (AM peak period, PM perk period, Midday period, and night-time period). Various toll rates ranging from 2 cents/mile to 80 cents/mile were tested for each pricing strategy and each period of the day. This was to determine the recommended toll rates both in terms of optimizing revenue potential and ensuring free flowing conditions for managed lane and TOT lane traffic.

4.3 Traffic and Toll Revenue Analysis

4.3.1 Toll Sensitivity Analysis

Toll sensitivity analysis is designed to quantify the impact on usage of the managed lanes and/or truck only toll lanes under a series of toll rates. Toll sensitivity analysis was performed for each of the eight investment alternatives for the opening year (2020) and horizon year (2030) by time-of-day and by direction of travel.

To facilitate this analysis, the I-75 South corridor was split to the following three segments based on the similar travel characteristics and/or existing traffic flow bottlenecks:

- Segment I: I-75 South from I-285 to Hudson Bridge Road/Eagles Landing Parkway
- Segment II: I-75 South from Hudson Bridge Road/Eagles Landing Parkway to SR 155
- Segment III: I-75 South from SR 155 to SR 16

For the TOT lane analysis purpose, the study corridor was split to the following two segments:

- Segment I: I-675
- Segment II: I-75 from I-675 to SR 16

A series of toll sensitivity curves were created to illustrate the relationships between the toll rates and revenue collected for each segment. Based on these toll sensitivity curves, the maximum toll rates, defined as the rates that produced the highest amount of revenue were established for each alternative. The results of the toll sensitivity analysis are presented in detail for each alternative in Sections 4.4 - 4.11 of this technical memorandum.

4.3.2 Toll Revenue Verses Operational Tradeoffs

There is a high degree of sensitivity and compromise between revenue maximization and optimizing travel efficiency. Generally, lower toll rates in the managed lanes and truck only toll lanes result in higher usage of the facility. With a higher percent of the corridor's global demand in the managed lanes, demand, and more specifically operating speeds, in the general-purpose lanes improve, which leads to an overall reduction in congestion. Consequently, improving the conditions in the general-purpose lanes erodes the value of the managed lane to paying traffic. Constantly changing conditions results in a delicate balance between the operating conditions in the managed lanes and the general-purpose lanes and the price associated with the managed lanes.

The toll sensitivity analysis discussed above resulted in the identification of maximum toll rates for each analysis period and direction. Depending on policy assumptions it is important to investigate revenue maximization, travel efficiency maximization, utilization rates in the general-purpose lanes and managed lanes, travel pattern impacts for different vehicle categories (SOV, HOV, CV, Medium-Duty Trucks and Heavy-Duty Truck) and other factors when selecting pricing strategies and rate levels.

To illustrate the tradeoffs between revenue optimization and operational efficiency, toll rate operational profiles were developed for each of the twelve alternatives for the opening year of 2020 and horizon year of 2030 under various toll rates, separately by time-of-day and direction.

Each toll rate operational profile portrays three sets of curves:

- The revenue vs. toll rate;
- Vehicle-Miles Traveled (VMT) by vehicle categories vs. toll rate; and
- The travel speed in the managed lanes, and/or truck only lanes and general-purpose lanes vs. toll rate.

These operational profiles illustrates the impact of pricing on operating conditions which in turn can help guide the achievement of policy objectives of the managed lanes in the I-75 South corridor. They are presented in detail for each alternative in sections 4.4-4.11 of this technical memorandum.

4.3.3 Toll Rate Selection Process

There are four management techniques available to protect managed lanes operations: access, eligibility, occupancy and price. Among the eight investment alternatives evaluated for I-75 South corridor, access locations remained constant, with price, eligibility and occupancy being the available mechanisms to protect mobility.

The operational profiles discussed above help ascertain the most desirable combination of price and eligibility to achieve the goals of each alternative; specifically, the feasibility of selling capacity in the managed lanes and the resulting traffic and revenue forecasts and impacts.

Since the toll rate selection process framework blends demand management requirements with the revenue optimization, the selection of toll rates must:

- Not erode HOT/ TOT/ETL lane average travel speed below 45 mph;
- Optimize available toll rates for HOT/TOT/ETL lane; and
- Optimize usage of HOT/TOT/ETL lane.

Based on the three selection criteria, the recommended toll rate was selected for each of the eight investment alternatives for the opening year of 2020 and horizon year of 2030 by time-of-day and by direction of travel. The summary table of optimal toll rate for each alternative is provided in sections 4.4-4.11 of this technical memorandum.

4.3.4 Estimated Weekday Traffic

A series of traffic diagrams were generated for each alternative with the recommended toll rates for different periods for the opening year of 2020 and horizon year of 2030. Each diagram presents the estimated traffic in the general-purpose lanes, HOT lanes (if available), TOT lanes (if available), ETL (if available), ramp access locations as well as the intersecting major arterials by different time-of-day (AM peak period, PM peak period, Midday period and Total Daily Period).

In each diagram, mainline traffic volumes are shown in blue; traffic volumes on managed lanes and Express Toll Lanes are shown in red; traffic volumes on TOT lanes are shown in green and traffic volumes on the general-purpose lane ramps and arterials are shown in black.

The estimated weekday traffic for each alternative from 2020 to 2030 is provided in detail in Appendix 4-B.

4.3.5 Revenue Projections

There are many ways to explain and measure toll revenue, each with a distinct purpose. For the toll objectives considered in this study, revenues have been categorized into two general sets of numbers – modeled gross revenue and net revenue estimates.

Modeled Gross Revenue

Modeled Gross Revenue is the predicted toll collections in every year of the forecast horizon, in which it is assumed that the modeled nominal toll rates will be adjusted annually for growing demand so as to maintain optimality for the assumed tolling objectives.

This study did not specifically evaluate weekend conditions. While traffic levels can sometimes be quite high on weekends, hourly traffic variations are generally significantly different than weekdays, resulting in both different utilization patterns and different pricing patterns for the managed lanes facility.

The estimated annual gross revenue for managed lanes was computed by multiplying average weekday revenue by 250 weekdays per year and 115 weekend/holiday per year. Weekends and holidays were assumed to produce HOT lane revenue equivalent to 50 percent of the estimated weekday HOT lane revenue. The estimated annual gross revenue for TOT lanes was also computed by multiplying daily weekday revenues by 250 weekdays per year and 115 weekend/holidays per year. Weekend revenue for TOT lanes was estimated to be approximately 20 percent of weekday revenue. The weekend revenue factors are generally based upon comparable experience on currently operating managed lanes facilities around the country.

Based upon the projected traffic volumes and toll rates recommended, the gross revenue was calculated for each model year (2020 and 2030); then the revenue streams were developed by linearly interpolating from the intermediate years through 2050. A ramp-up period is assumed for the first four years of operation during which public acceptance is developing; Ramp Up schedule was provided as follows:

- Year 2020: 55%;
- Year 2021 :65% ;
- Year 2022: 80% ; and
- Year 2023: 97%.

For the financial calculations, revenues are in 2007 dollars, with no inflation, to provide a direct comparison to potential capital financing packages. The annual gross revenue in 2007 un-inflated dollars and inflated dollars for each alternative from 2020 to 2050 is provided in detail in sections 4.4-4.11 of this technical memorandum.

Net Revenue Estimates

Net Revenue is a measure of net financial revenue during the years that potential bonds are outstanding, which is based on the modeled adjusted gross revenue in the year of opening, less tolling and infrastructure operation and maintenance costs.

To compute the net revenue, the following costs are deducted from the gross annual gross revenue:

- Tolling Operation Cost - - $0.21 per tolled transaction.

  For the purposes of this study, a rate of $0.21 per tolled transaction was used to cover overall tolling operation cost. This per tolled transaction cost was provided by State Road and Tollway Authority (SRTA) and is based upon based upon their data and experience. The cost includes the following major categories for operation: (1) Billing and Administration Cost; (2) Violation Center Operation Cost; (3) Customer Service Center Cost; (4) Toll Equipment Maintenance Costs and (5) Enforcement Cost.

- Infrastructure Operation and Maintenance Costs

  Infrastructure operation and maintenance costs were developed for each I-75 South managed lane investment alternative on a 30-year life period. Infrastructure operation and maintenance per year was assumed to be 0.5% of total initial project costs.

Again, all revenue and cost numbers are in 2007 dollars, with no inflation, to provide a direct comparison to estimated cost of construction and potential capital financing packages.

The net gross revenue in 2007 inflated dollars for each alternative from 2020 to 2050 is provided in detail in sections 4.4-4.11 of this technical memorandum.

4.4 Traffic and Toll Revenue Estimates - Alternative A-1

This alternative assumed the construction of two managed lanes in each direction along the I-75 South corridor from I-285 to SR 16. The tolling and policy framework evaluated in this managed lane alternative is HOT-2+. HOT2+ refers to a tolling alternative that would allow HOVs with two or more people to ride free along with transit vehicles, emergency/police vehicles, and motorcycles. Single-Occupant Vehicles (SOV) and Commercial Vehicles (CV) including commercially registered autos, pickup trucks, and vans would pay a toll to use the managed lanes. It was assumed that Medium-Duty Trucks (MDT) and Heavy-Duty Trucks (HDT) would not be allowed to utilize the managed lane system at this time. No Truck Only Toll (TOT) lanes were assumed to be constructed in this Alternative.

4.4.1 Toll Sensitivity Analysis Results

A summary of the results of the toll sensitivity analysis for Alternative A-1 in 2020 and 2030 is presented in Figures 4-7 through 4-12.

As shown in Figure 4-7, the toll rate resulting in the maximum AM peak period revenue is expected to be $0.20 per mile northbound for segment I and $0.15 per mile for segment II and segment III. The toll rate resulting in the maximum AM peak period revenue is expected to be $0.10 per mile southbound for all three segments. The difference between the toll rates is expected since AM peak period demand in the northbound direction exceeds the southbound direction.

Figure 4-8 illustrates the revenue of three segments for the Midday peak period; the toll rate resulting in the maximum Midday period revenue is expected to be $0.10 per mile northbound for segment I and $0.15 per mile for segment II and III. The toll rate resulting in the maximum Midday period revenue is expected to be $0.10 per mile southbound for all three segments. The similar toll rate is expected during the Midday period since the distribution of demand between the northbound and southbound direction is fairly uniform.

Figure 4-9 shows the revenue for three segments for the PM peak period. The toll rate resulting in the maximum PM peak period revenue is expected to be $0.15 per mile northbound for all three segments; and $0.15 per mile southbound for segment I and $0.20 per mile for segment II and segment III. When compared to AM peak period, the directional results were reversed as northbound morning commuters are returning home.

The toll sensitivity analysis was also conducted for the night periods. The I-75 South corridor is typically congestion-free during the night-time hours of 7 PM to 6 AM resulting in flat sensitivity curves for both directions of travel. The recommended toll rates for the over night period are $0.02 per mile in 2020 for both directions.

Similar conclusions can be drawn from studying toll sensitivity in year 2030.

Figure 4-7: 2020 AM Peak Period Sensitivity Curves – Alternative A-1

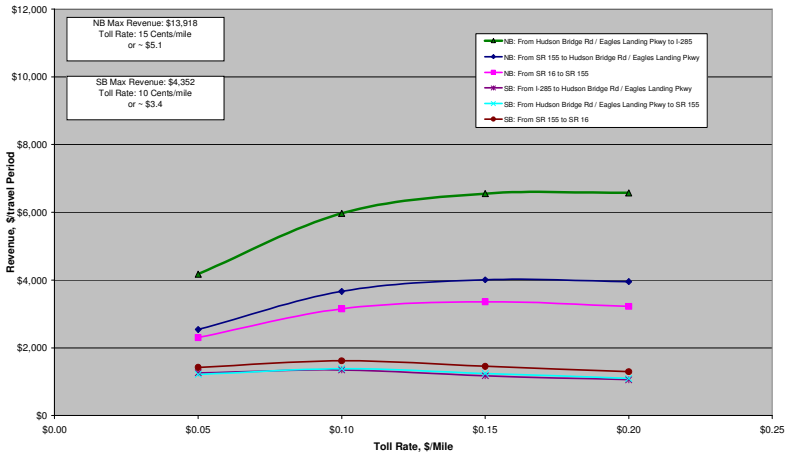


Figure 4-8: 2020 Midday Period Sensitivity Curves – Alternative A-1

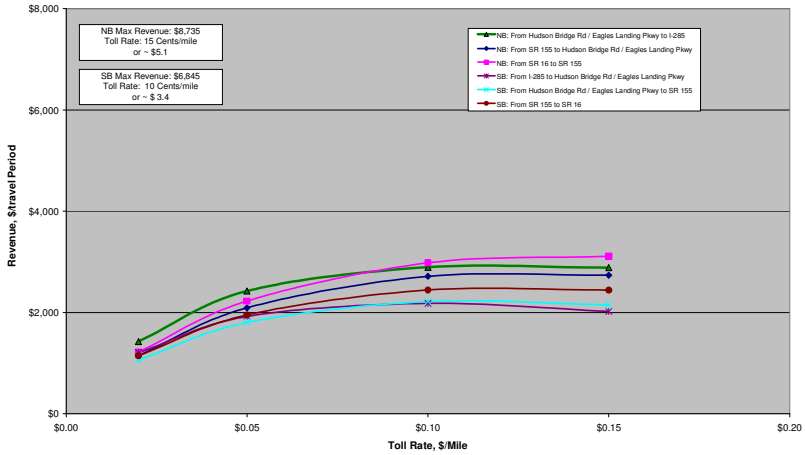


Figure 4-9: 2020 PM Peak Period Sensitivity Curves – Alternative 1

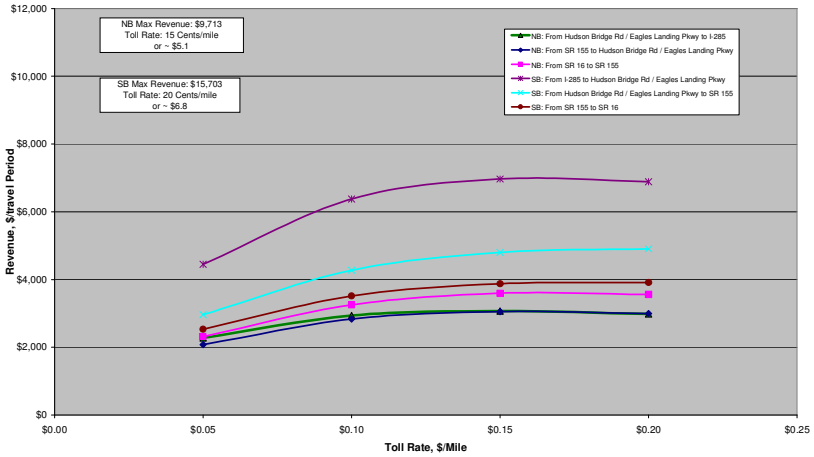


Figure 4-10: 2030 AM Peak Period Sensitivity Curves – Alternative A-1

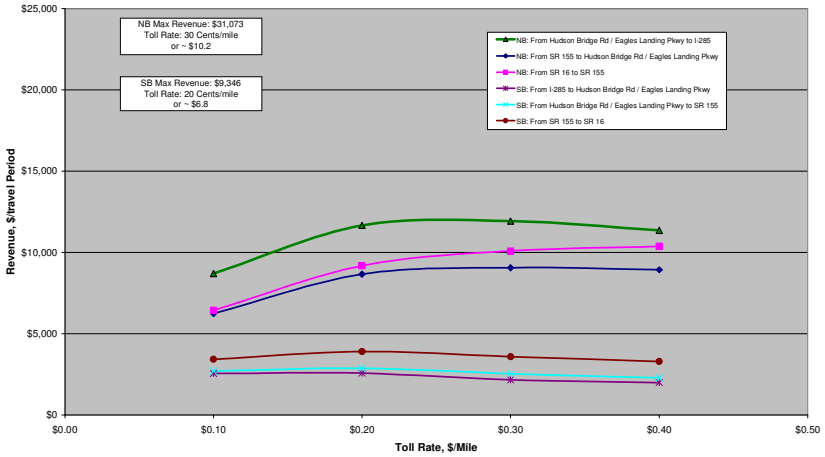


Figure 4-11: 2030 Midday Peak Period Sensitivity Curves – Alternative A-1

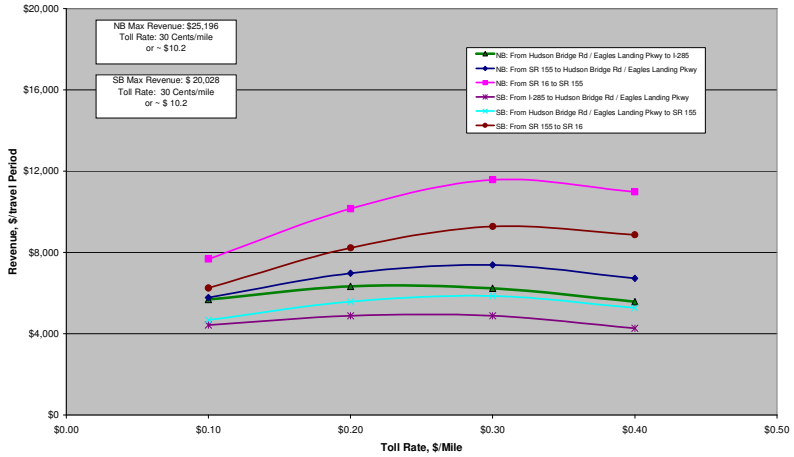
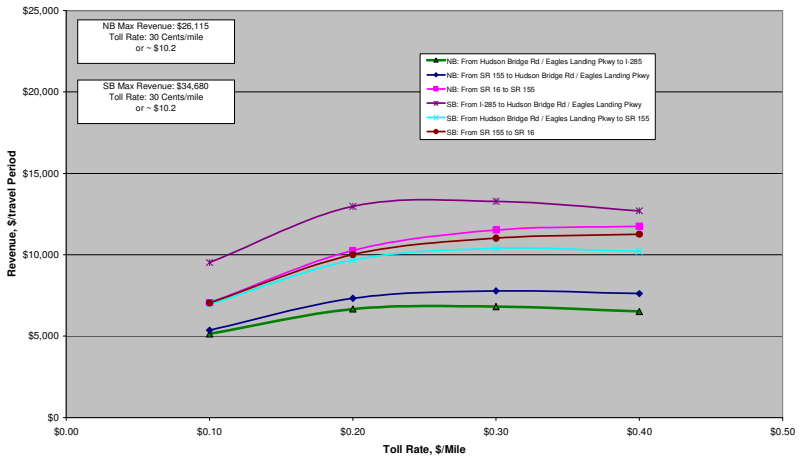


Figure 4-12: 2030 PM Peak Period Sensitivity Curves – Alternative A-1



4.4.2 Toll Revenue Verses Operational Tradeoffs

To illustrate the tradeoffs between revenue optimization and operational efficiency, toll rate operational profiles were developed for the opening year of 2020 and horizon year of 2030 under various toll rates, separately by time-of-day and by direction of travel.

Figure 4-13 provides a comparative operating profile for opening year 2020 AM peak period. The first two upper figures illustrate the relationship between revenue and toll rate by travel direction. In the northbound direction, the peak direction in the morning, the revenue generated is much higher than that of the southbound direction.

In the second series of charts, vehicle-miles of travel (VMT) by direction are shown for:

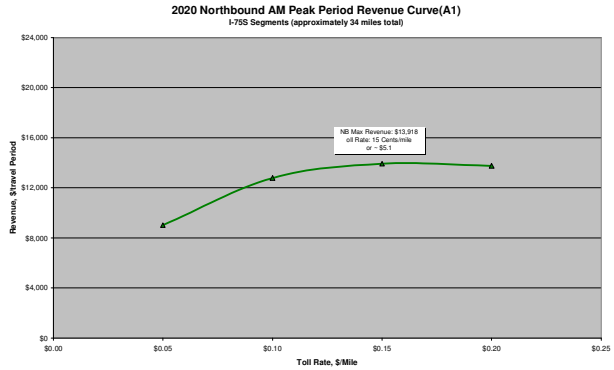
- Total vehicles on the managed lanes;
- Priced vehicles on the managed lanes (SOVs and CVs in this application); and
- Free vehicles on the managed lanes (all HOV2+s in this application).

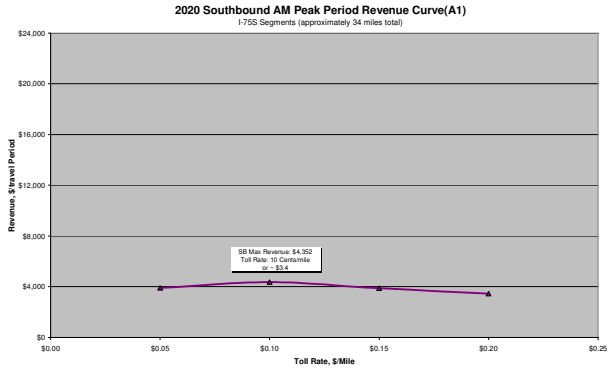
Again, VMT during the AM peak period in the northbound direction substantially exceeds that of the southbound direction for each vehicle class.

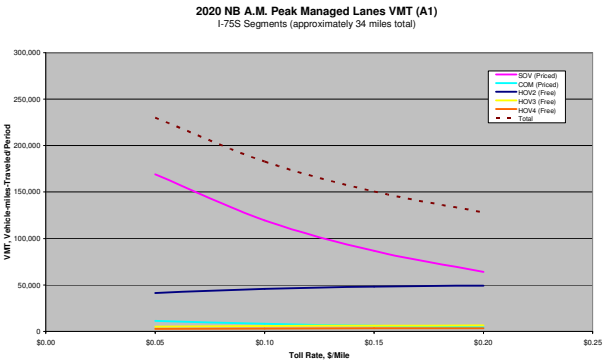
The two lower figures illustrate average speed drawn from the traffic assignment results in the general-purpose and managed lanes with respect to various toll rates. As toll rates increase, average speed in the managed lanes increases slightly as more SOVs and CVs migrate back to the general-purpose lanes. At very low toll rates the travel time savings provided by the managed lanes has tremendous value, attracting many SOV motorists and CV travelers. As a result, the managed lanes are inundated with SOV and CVs traffic driving the average speed down. Speeds in the managed lanes steadily rebound because willingness to pay decreases as the toll rate increases.

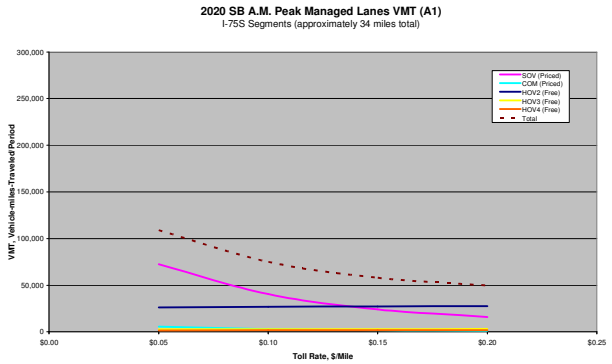
In the PM peak periods, the major distinction is the reversal of travel patterns as the northbound peak direction swivels to the southbound peak direction. In the Midday analysis period, revenue, VMT and average travel speed are comparable for northbound direction and southbound direction. Similar logic for revenue, VMT and average travel speed are observed for the horizon year of 2030, thus a detailed description will not be repeated. Refer to Appendix 4-A for a complete set of operating profiles developed for the opening year 2020 and horizon year of 2030.

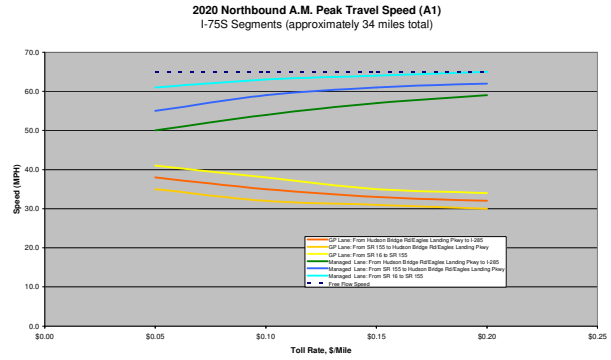
Figure 4-13: 2020 AM Peak Period Toll Rate Operational Profile – Alternative A-1

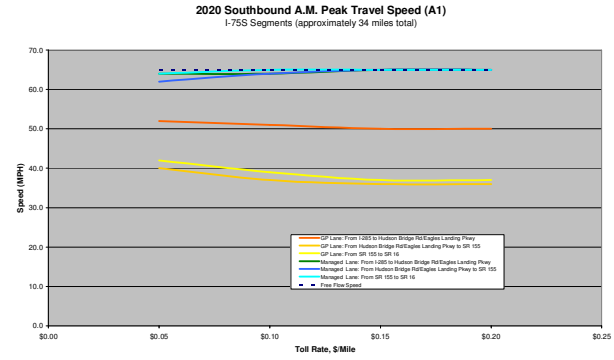












4.4.3 Selected Toll Rate

As discussed in the earlier section (4.3.3), the selection of toll rates for the managed lanes must not erode managed lane average travel speed below 45 mph, must optimize available toll rates for managed lane, and must optimize the usage of managed lane. The detailed steps are summarized as follows:

- Identify the toll rate that produced the most revenue.
- Lower the toll rate by $0.05 - $0.08 per mile to allow the facility's operation to increase revenue as needed.
- Check to make sure the managed lanes are operating above 45 mph.
- If not, increase the toll rate until the desired operating conditions is achieved.

Table 4-3 presents the recommended managed lane toll rates. In both 2020 and 2030, a desired operating speed of 45 mph or above can be maintained at the recommended toll rates.

4.4.4 Estimated Weekday Traffic

Refer to Appendix 4-B for Alternative A-1 2020 and 2030 traffic diagrams of:

- Daily Total Trips;
- AM Total Trips;
- PM Total Trips; and
- MD Total Trips.

4.4.5 Revenue Projections

Table 4-4 presents estimated gross toll revenue by period. Revenues shown in the table for each period were obtained at the recommended toll levels for Alternative A-1 described previously, for each travel direction and then aggregated to a daily total. For example, approximately $32,290 in daily revenue is expected on a typical opening year weekday; whereas $16,145 in daily revenue is expected on a typical opening year weekend day.

The net revenue stream in un-inflated 2007 dollars and inflated dollars are presented in Table 4-5 and 4-6 respectively. From year 2020 to year 2050, Alternative A-1 will generate approximately $927 million cumulative net revenue in un-inflated 2007 dollars and approximately $1.931 billion cumulative net revenue in inflated dollars.

Table 4-3: Recommended Toll Rates – Alternative A-1

Year	Analysis Period	Dir	Maximum Revenue Toll Rates			Recommended Toll Rates			ML Speed @ Recommended Toll Rate		
			Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3
2020	AM Peak Period	NB	$0.20	$0.15	$0.15	$0.15	$0.10	$0.10	57	59	63
		SB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	64	62	64
	Midday Period	NB	$0.10	$0.15	$0.15	$0.05	$0.05	$0.05	62	62	64
		SB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	63	63	64
	PM Peak Period	NB	$0.15	$0.15	$0.15	$0.10	$0.10	$0.10	63	62	64
		SB	$0.15	$0.20	$0.20	$0.15	$0.15	$0.15	58	61	64
	Night	NB	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	65	65	65
		SB	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	65	64	65
2030	AM Peak Period	NB	$0.30	$0.30	$0.40	$0.20	$0.20	$0.20	51	55	60
		SB	$0.20	$0.20	$0.20	$0.10	$0.10	$0.10	63	62	63
	Midday Period	NB	$0.20	$0.20	$0.30	$0.10	$0.10	$0.10	61	60	61
		SB	$0.30	$0.30	$0.30	$0.10	$0.10	$0.10	62	61	62
	PM Peak Period	NB	$0.20	$0.20	$0.30	$0.10	$0.10	$0.10	59	57	59
		SB	$0.30	$0.30	$0.40	$0.20	$0.20	$0.20	50	56	61
	Night	NB	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	64	64	64
		SB	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	64	64	64

Table 4-4: Annual Gross Toll Revenue (un-inflated dollars) – Alternative A-1

Year (1)	Weekday Revenue By Period (2)				Total Weekday	Weekend Day (3)	Estimated Annual Gross Revenue (4)	Cumulative Gross Revenue
	AM Peak	Midday	PM Peak	Night				
2020	$ 10,210	$ 6,790	$ 14,580	$ 710	$ 32,290	$ 16,145	$ 9,929,175	$ 9,929,175
2021	$ 13,470	$ 9,510	$ 18,980	$ 1,000	$ 42,960	$ 21,480	$ 13,210,200	$ 23,139,375
2022	$ 18,310	$ 13,540	$ 25,530	$ 1,440	$ 58,820	$ 29,410	$ 18,087,150	$ 41,226,525
2023	$ 24,300	$ 18,620	$ 33,570	$ 1,990	$ 78,480	$ 39,240	$ 24,132,600	$ 65,359,125
2024	$ 27,210	$ 21,480	$ 37,310	$ 2,310	$ 88,310	$ 44,155	$ 27,155,325	$ 92,514,450
2025	$ 29,370	$ 23,770	$ 40,020	$ 2,560	$ 95,720	$ 47,860	$ 29,433,900	$ 121,948,350
2026	$ 31,520	$ 26,050	$ 42,720	$ 2,810	$ 103,100	$ 51,550	$ 31,703,250	$ 153,651,600
2027	$ 33,680	$ 28,330	$ 45,420	$ 3,070	$ 110,500	$ 55,250	$ 33,978,750	$ 187,630,350
2028	$ 35,840	$ 30,610	$ 48,120	$ 3,320	$ 117,890	$ 58,945	$ 36,251,175	$ 223,881,525
2029	$ 38,000	$ 32,900	$ 50,830	$ 3,580	$ 125,310	$ 62,655	$ 38,532,825	$ 262,414,350
2030	$ 40,160	$ 35,180	$ 53,530	$ 3,830	$ 132,700	$ 66,350	$ 40,805,250	$ 303,219,600
2031	$ 41,240	$ 36,320	$ 54,880	$ 4,080	$ 136,520	$ 68,260	$ 41,979,900	$ 345,199,500
2032	$ 42,320	$ 37,460	$ 56,230	$ 4,340	$ 140,350	$ 70,175	$ 43,157,625	$ 388,357,125
2033	$ 43,400	$ 38,600	$ 57,580	$ 4,590	$ 144,170	$ 72,085	$ 44,332,275	$ 432,689,400
2034	$ 44,480	$ 39,750	$ 58,940	$ 4,850	$ 148,020	$ 74,010	$ 45,516,150	$ 478,205,550
2035	$ 45,560	$ 40,890	$ 60,290	$ 5,100	$ 151,840	$ 75,920	$ 46,690,800	$ 524,896,350
2036	$ 46,640	$ 42,030	$ 61,640	$ 5,350	$ 155,660	$ 77,830	$ 47,865,450	$ 572,761,800
2037	$ 47,720	$ 43,170	$ 62,990	$ 5,610	$ 159,490	$ 79,745	$ 49,043,175	$ 621,804,975
2038	$ 48,800	$ 44,310	$ 64,340	$ 5,860	$ 163,310	$ 81,655	$ 50,217,825	$ 672,022,800
2039	$ 49,880	$ 45,450	$ 65,690	$ 6,120	$ 167,140	$ 83,570	$ 51,395,550	$ 723,418,350
2040	$ 50,960	$ 46,600	$ 67,050	$ 6,370	$ 170,980	$ 85,490	$ 52,576,350	$ 775,994,700
2041	$ 52,030	$ 47,740	$ 68,400	$ 6,620	$ 174,790	$ 87,395	$ 53,747,925	$ 829,742,625
2042	$ 53,110	$ 48,880	$ 69,750	$ 6,880	$ 178,620	$ 89,310	$ 54,925,650	$ 884,668,275
2043	$ 54,190	$ 50,020	$ 71,100	$ 7,130	$ 182,440	$ 91,220	$ 56,100,300	$ 940,768,575
2044	$ 55,270	$ 51,160	$ 72,450	$ 7,390	$ 186,270	$ 93,135	$ 57,278,025	$ 998,046,600
2045	$ 56,350	$ 52,300	$ 73,800	$ 7,640	$ 190,090	$ 95,045	$ 58,452,675	$ 1,056,499,275
2046	$ 57,430	$ 53,440	$ 75,150	$ 7,890	$ 193,910	$ 96,955	$ 59,627,325	$ 1,116,126,600
2047	$ 58,510	$ 54,590	$ 76,510	$ 8,150	$ 197,760	$ 98,880	$ 60,811,200	$ 1,176,937,800
2048	$ 59,590	$ 55,730	$ 77,860	$ 8,400	$ 201,580	$ 100,790	$ 61,985,850	$ 1,238,923,650
2049	$ 60,670	$ 56,870	$ 79,210	$ 8,660	$ 205,410	$ 102,705	$ 63,163,575	$ 1,302,087,225
2050	$ 61,750	$ 58,010	$ 80,560	$ 8,910	$ 209,230	$ 104,615	$ 64,338,225	$ 1,366,425,450

(1) A ramp-up period is assumed for the first four years of operation
(2) 2007 Dollars
(3) Weekend day revenue for HOT2+ is estimated to be 50 percent of weekday revenue
(4) Annual revenue calculations assume 250 weekdays and 115 weekend/holidays

Table 4-5: Net Revenue Summary--- un-inflated dollars (000) – Alternative A-1

Year	Gross Annual Toll Revenue (1)	Annual Transactions (2)	Operation Cost (3)	Infrastructure Operation and Maintenance Cost (4)	Net Annual Revenue	Cumulative Annual Net Revenue
2020	$ 9,929	8,147	$ 1,711	$ 10,266	$ (2,048)	$ (2,048)
2021	$ 13,210	9,884	$ 2,076	$ 10,266	$ 869	$ 869
2022	$ 18,087	12,480	$ 2,621	$ 10,266	$ 5,200	$ 6,069
2023	$ 24,133	15,513	$ 3,258	$ 10,266	$ 10,609	$ 16,678
2024	$ 27,155	16,387	$ 3,441	$ 10,266	$ 13,448	$ 30,126
2025	$ 29,434	16,780	$ 3,524	$ 10,266	$ 15,644	$ 45,770
2026	$ 31,703	17,174	$ 3,607	$ 10,266	$ 17,831	$ 63,601
2027	$ 33,979	17,567	$ 3,689	$ 10,266	$ 20,024	$ 83,624
2028	$ 36,251	17,961	$ 3,772	$ 10,266	$ 22,213	$ 105,838
2029	$ 38,533	18,355	$ 3,854	$ 10,266	$ 24,412	$ 130,250
2030	$ 40,805	18,750	$ 3,937	$ 10,266	$ 26,602	$ 156,852
2031	$ 41,980	18,937	$ 3,977	$ 10,266	$ 27,737	$ 184,589
2032	$ 43,158	19,127	$ 4,017	$ 10,266	$ 28,875	$ 213,464
2033	$ 44,332	19,318	$ 4,057	$ 10,266	$ 30,010	$ 243,473
2034	$ 45,516	19,511	$ 4,097	$ 10,266	$ 31,153	$ 274,626
2035	$ 46,691	19,706	$ 4,138	$ 10,266	$ 32,286	$ 306,913
2036	$ 47,865	19,903	$ 4,180	$ 10,266	$ 33,420	$ 340,332
2037	$ 49,043	20,102	$ 4,221	$ 10,266	$ 34,556	$ 374,888
2038	$ 50,218	20,303	$ 4,264	$ 10,266	$ 35,688	$ 410,576
2039	$ 51,396	20,506	$ 4,306	$ 10,266	$ 36,823	$ 447,399
2040	$ 52,576	20,711	$ 4,349	$ 10,266	$ 37,961	$ 485,360
2041	$ 53,748	20,919	$ 4,393	$ 10,266	$ 39,089	$ 524,449
2042	$ 54,926	21,128	$ 4,437	$ 10,266	$ 40,223	$ 564,672
2043	$ 56,100	21,339	$ 4,481	$ 10,266	$ 41,353	$ 606,025
2044	$ 57,278	21,552	$ 4,526	$ 10,266	$ 42,486	$ 648,511
2045	$ 58,453	21,768	$ 4,571	$ 10,266	$ 43,615	$ 692,127
2046	$ 59,627	21,986	$ 4,617	$ 10,266	$ 44,744	$ 736,871
2047	$ 60,811	22,205	$ 4,663	$ 10,266	$ 45,882	$ 782,753
2048	$ 61,986	22,428	$ 4,710	$ 10,266	$ 47,010	$ 829,763
2049	$ 63,164	22,652	$ 4,757	$ 10,266	$ 48,141	$ 877,904
2050	$ 64,338	22,878	$ 4,804	$ 10,266	$ 49,268	$ 927,172

(1) Uninflated revenues are in 2007 dollars.
(2) Annual transaction do not include non-toll paying vehicles.
(3) Operation cost is assumed to be $0.21 per tolled transaction and it includes Billing and Administration Cost; Violations Center Operations Cost and Customer Service Center Cost; Enforcement cost and Toll Equipment Maintenance Cost.
(4) Annual Infrastructure Operation and Maintenance Cost is assumed to be 0.5% of the total capital cost.

Table 4-6: Annual Toll Revenue in Inflated Dollars (000) – Alternative A-1

Year	UNINFLATED DOLLARS (000)				Inflation Factors		INFLATED DOLLARS (000)			
	Total Gross Annual Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Net Cumulative Annual	Toll Revenue	O&M	Gross Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Cumulative Annual Revenue
2020	$ 9,929	$ 11,977	$ (2,048)	$ (2,048)	1.379	1.469	$ 13,692	$ 17,594	$ (3,902)	$ (3,902)
2021	$ 13,210	$ 12,342	$ 869	$ (1,179)	1.413	1.513	$ 18,666	$ 18,673	$ (7)	$ (3,909)
2022	$ 18,087	$ 12,887	$ 5,200	$ 4,021	1.448	1.558	$ 26,190	$ 20,077	$ 6,113	$ 2,204
2023	$ 24,133	$ 13,524	$ 10,609	$ 14,630	1.485	1.605	$ 35,837	$ 21,706	$ 14,131	$ 16,335
2024	$ 27,155	$ 13,707	$ 13,448	$ 28,078	1.522	1.653	$ 41,330	$ 22,658	$ 18,672	$ 35,008
2025	$ 29,434	$ 13,790	$ 15,644	$ 43,722	1.560	1.702	$ 45,917	$ 23,470	$ 22,447	$ 57,454
2026	$ 31,703	$ 13,873	$ 17,831	$ 61,553	1.599	1.754	$ 50,693	$ 24,332	$ 26,361	$ 83,815
2027	$ 33,979	$ 13,955	$ 20,024	$ 81,577	1.639	1.806	$ 55,691	$ 25,203	$ 30,488	$ 114,304
2028	$ 36,251	$ 14,038	$ 22,213	$ 103,790	1.680	1.860	$ 60,902	$ 26,110	$ 34,792	$ 149,095
2029	$ 38,533	$ 14,120	$ 24,412	$ 128,202	1.722	1.916	$ 66,354	$ 27,055	$ 39,299	$ 188,394
2030	$ 40,805	$ 14,203	$ 26,602	$ 154,804	1.765	1.974	$ 72,021	$ 28,038	$ 43,984	$ 232,377
2031	$ 41,980	$ 14,243	$ 27,737	$ 182,541	1.809	2.033	$ 75,942	$ 28,956	$ 46,986	$ 279,363
2032	$ 43,158	$ 14,283	$ 28,875	$ 211,416	1.854	2.094	$ 80,014	$ 29,908	$ 50,106	$ 329,470
2033	$ 44,332	$ 14,323	$ 30,010	$ 241,426	1.900	2.157	$ 84,231	$ 30,894	$ 53,337	$ 382,807
2034	$ 45,516	$ 14,363	$ 31,153	$ 272,578	1.948	2.221	$ 88,665	$ 31,901	$ 56,764	$ 439,571
2035	$ 46,691	$ 14,404	$ 32,286	$ 304,865	1.996	2.288	$ 93,195	$ 32,957	$ 60,238	$ 499,809
2036	$ 47,865	$ 14,446	$ 33,420	$ 338,285	2.046	2.357	$ 97,933	$ 34,049	$ 63,884	$ 563,693
2037	$ 49,043	$ 14,487	$ 34,556	$ 372,840	2.098	2.427	$ 102,893	$ 35,161	$ 67,731	$ 631,425
2038	$ 50,218	$ 14,530	$ 35,688	$ 408,529	2.150	2.500	$ 107,968	$ 36,324	$ 71,644	$ 703,069
2039	$ 51,396	$ 14,572	$ 36,823	$ 445,352	2.204	2.575	$ 113,276	$ 37,524	$ 75,752	$ 778,821
2040	$ 52,576	$ 14,615	$ 37,961	$ 483,313	2.259	2.652	$ 118,770	$ 38,760	$ 80,010	$ 858,831
2041	$ 53,748	$ 14,659	$ 39,089	$ 522,402	2.315	2.732	$ 124,426	$ 40,048	$ 84,378	$ 943,209
2042	$ 54,926	$ 14,703	$ 40,223	$ 562,625	2.373	2.814	$ 130,339	$ 41,374	$ 88,965	$ 1,032,174
2043	$ 56,100	$ 14,747	$ 41,353	$ 603,978	2.433	2.898	$ 136,492	$ 42,737	$ 93,755	$ 1,125,929
2044	$ 57,278	$ 14,792	$ 42,486	$ 646,464	2.493	2.985	$ 142,794	$ 44,154	$ 98,640	$ 1,224,569
2045	$ 58,453	$ 14,837	$ 43,615	$ 690,079	2.556	3.075	$ 149,405	$ 45,625	$ 103,780	$ 1,328,349
2046	$ 59,627	$ 14,883	$ 44,744	$ 734,823	2.620	3.167	$ 156,224	$ 47,134	$ 109,089	$ 1,437,438
2047	$ 60,811	$ 14,929	$ 45,882	$ 780,705	2.685	3.262	$ 163,278	$ 48,699	$ 114,579	$ 1,552,017
2048	$ 61,986	$ 14,976	$ 47,010	$ 827,715	2.752	3.360	$ 170,585	$ 50,319	$ 120,266	$ 1,672,284
2049	$ 63,164	$ 15,023	$ 48,141	$ 875,856	2.821	3.461	$ 178,184	$ 51,994	$ 126,190	$ 1,798,474
2050	$ 64,338	$ 15,070	$ 49,268	$ 925,124	2.892	3.565	$ 186,066	$ 53,726	$ 132,340	$ 1,930,814

Notes: Uninflated revenues and costs are in 2007 dollars.
Annual inflation rates of 2.5% and 3.0% are applied for toll revenue and O&M cost respectively.

4.5 Traffic and Toll Revenue Estimates - Alternative A-2

This alternative assumed the construction of two managed lanes in each direction along I-75 South corridor from I-285 to SR 16. The tolling and policy framework evaluated in this managed lane alternative is HOT-3+. HOT-3+ refers to a tolling alternative that would allow HOVs with three or more people to ride free along with transit vehicles, emergency /police vehicles, and motorcycles. SOVs, HOV-2s and Commercial Vehicles (CV) including commercially registered autos, pickup trucks, and vans would pay a toll to use the managed lanes. It was assumed that Medium-Duty Trucks (MDT) and Heavy-Duty Trucks (HDT) would not be allowed to utilize the managed lane system at this time. No Truck Only Toll (TOT) lanes were assumed to be constructed in this Alternative.

4.5.1 Toll Sensitivity Analysis Results

A summary of the results of the toll sensitivity analysis for Alternative A-2 in 2020 and 2030 is presented in Figures 4-14 through 4-19.

As shown in Figure 4-14, the toll rate resulting in the maximum AM peak period revenue is expected to be $0.15 per mile northbound and $0.10 per mile southbound for all three segments. The difference between the toll rates is expected since AM peak period demand in the northbound direction exceeds the southbound direction.

Figure 4-15 illustrates the revenue of three segments for the Midday peak period; the toll rate resulting in the maximum Midday period revenue is expected to be $0.10 per mile northbound for segment I and $0.15 per mile for segment II and III. The toll rate resulting in the maximum Midday period revenue is expected to be $0.10 per mile southbound for all three segments. The similar toll rate is expected during the Midday period since the distribution of demand between the northbound and southbound direction is fairly uniform.

Figure 4-16 shows the revenue for three segments for the PM peak period. The toll rate resulting in the maximum PM peak period revenue is expected to be $0.15 per mile northbound for all three segments; and $0.15 per mile southbound for segment I and $0.20 per mile for segment II and segment III. When compared to AM peak period, the directional revenue results were reversed as northbound morning commuters are returning home.

The recommended toll rates for the over night period are $0.02 per mile in 2020 for both directions. Similar conclusions can be drawn from studying toll sensitivity in year 2030.

It was observed that with the similar toll rates, Alternative A-2 generates higher revenue in the managed lanes than the revenue generated in Alternative A-1. For example, in 2020 during PM peak period, with the recommended toll rate of $0.10 per mile for the northbound and recommended toll rate of $0.15 per mile for southbound, Alterative 2 would generate $18,190, a 25% revenue increase when compared the revenue of $14,580 in Alternative A-1. This is expected since in this Alternative, HOV-2s are not eligible to use managed lanes for free, which resulted in higher unused capacity of managed lane and correspondingly more achievable time savings in the managed lanes.

Figure 4-14: 2020 AM Peak Period Sensitivity Curves – Alternative A-2

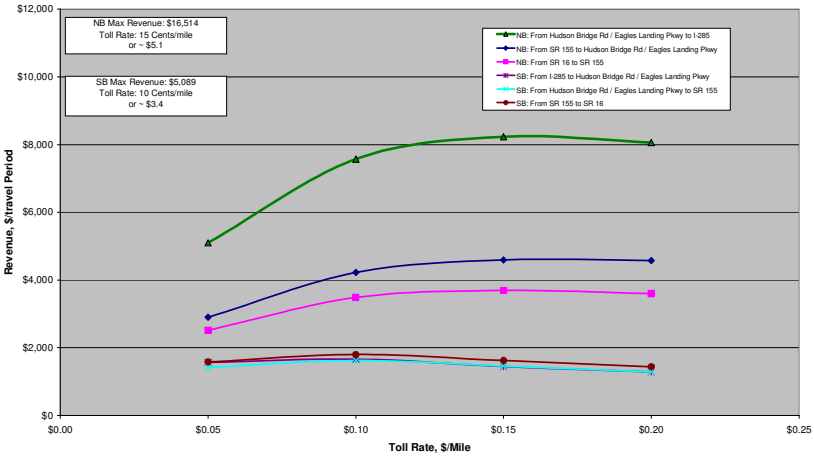


Figure 4-15: 2020 Midday Peak Period Sensitivity Curves – Alternative A-2

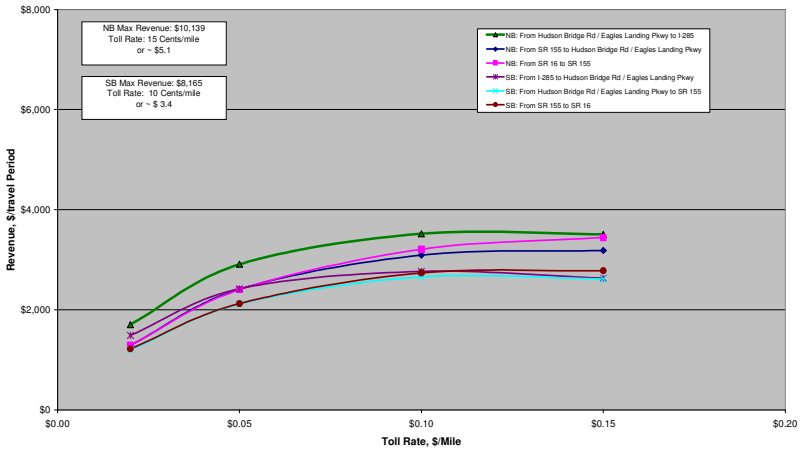


Figure 4-16: 2020 PM Period Sensitivity Curves – Alternative A-2

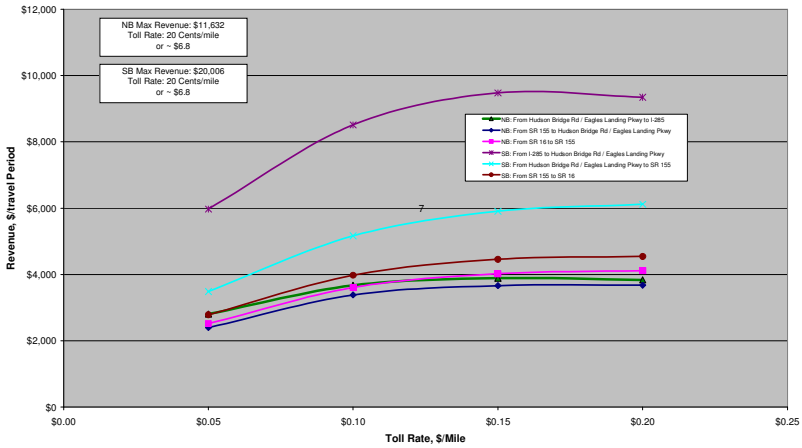


Figure 4-17: 2030 AM Peak Period Sensitivity Curves – Alternative A-2

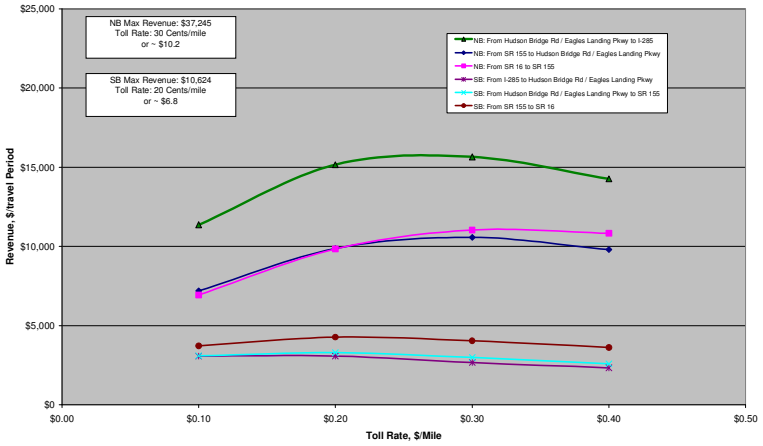


Figure 4-18: 2030 Midday Period Sensitivity Curves – Alternative A-2

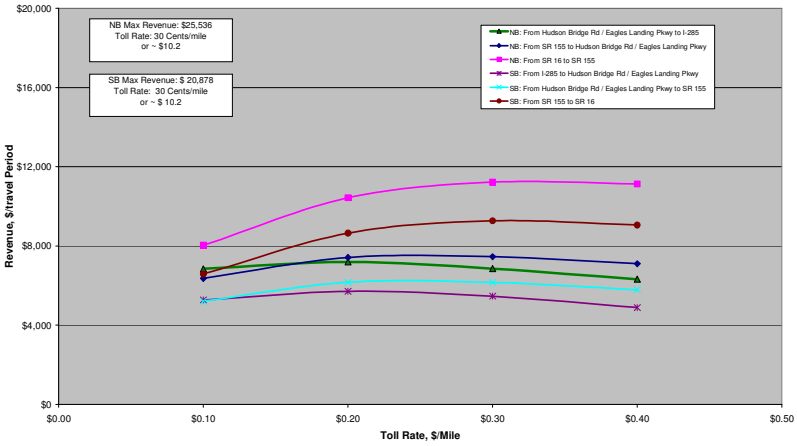
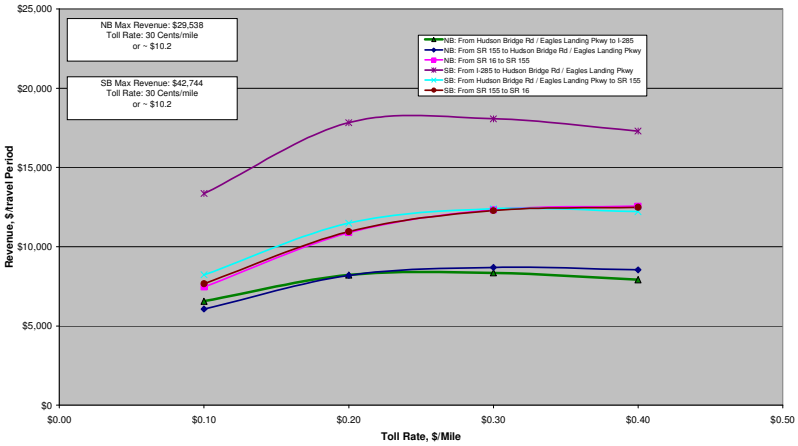


Figure 4-19: 2030 PM Peak Period Sensitivity Curves – Alternative A-2



4.5.2 Toll Revenue Verses Operational Tradeoffs

To illustrate the tradeoffs between revenue optimization and operational efficiency, toll rate operational profiles were developed for the opening year of 2020 and horizon year of 2030 under various toll rates, separately by time-of-day and by direction of travel.

Figure 4-20 provides a comparative operating profile for opening year 2020 AM peak period. The first two upper figures illustrate the relationship between revenue and toll rate by travel direction. In the northbound direction, the peak direction in the morning, the revenue generated is much higher than that of the southbound direction.

In the second series of charts, vehicle-miles of travel (VMT) by direction are shown for:

- Total vehicles on the managed lanes;
- Priced vehicles on the managed lanes (SOVs, HOV2s, and CVs in this application); and
- Free vehicles on the managed lanes (all HOV3+s in this application).

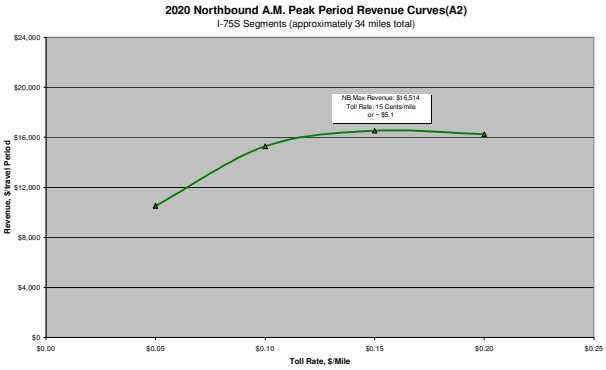
Again, VMT during AM peak period in the northbound direction substantially exceeds that of the southbound direction for each vehicle class.

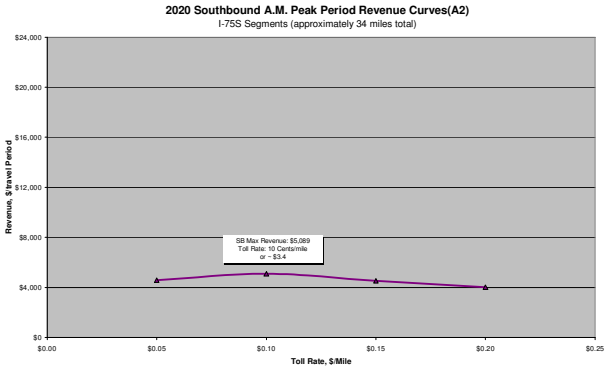
The two lower figures illustrate average speed drawn from the traffic assignment results in the general-purpose and managed lanes with respect to various toll rates. As toll rates increase, average speed in the managed lanes increase slightly as more SOVs, HOV2s, and CVs migrate back to the general-purpose lanes. At very low toll rates the travel time savings provided by the managed lanes has tremendous value, attracting many SOV and HOV2 motorists and CV travelers. As a result, the managed lanes are inundated with SOV, HOV2, and CV traffic driving the average speed down. Speeds in the managed lanes steadily rebound as willingness to pay decreases as the toll rate increases.

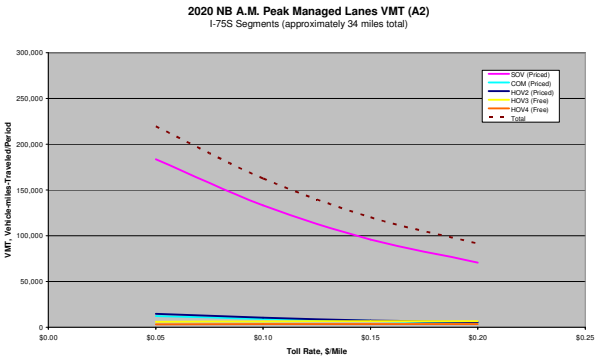
In the PM peak periods, the major distinction is the reversal of travel patterns as the northbound peak direction swivels to the southbound direction. In the Midday analysis period, revenue, VMT and average travel speed are comparable for northbound direction and southbound direction. Similar logic for revenue, VMT and average travel speed are observed for the horizon year of 2030, thus a detailed description will not be repeated.

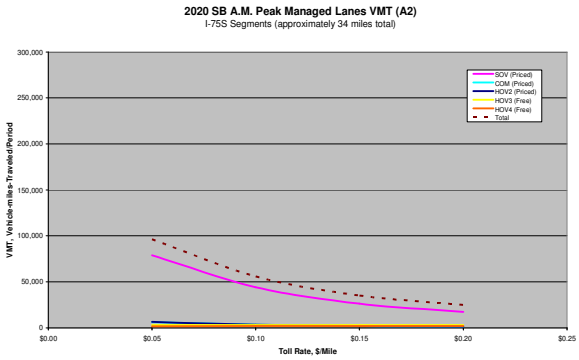
Refer to Appendix-A for a complete set of operating profiles for opening year 2020 and horizon year of 2030 AM peak period, PM peak period and Midday period.

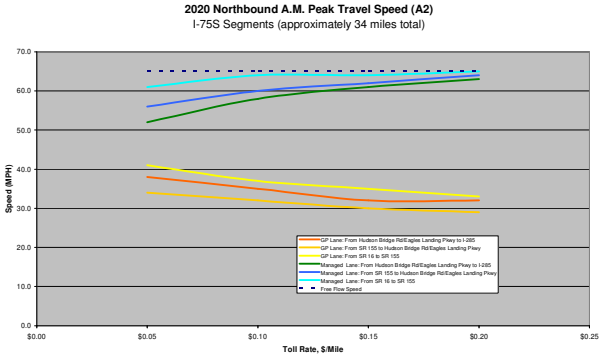
Figure 4-20: 2020 AM Peak Period Toll Rate Operational Profile – Alternative A-2

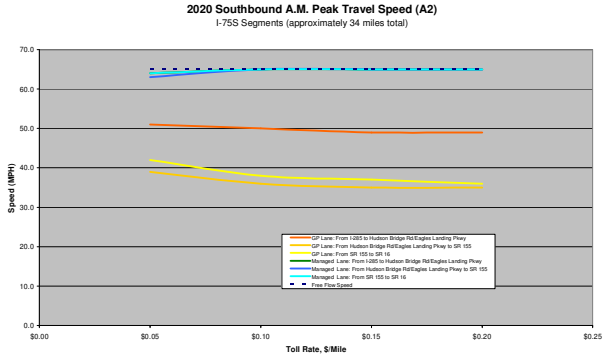












4.5.3 Selected Toll Rate

As discussed in the earlier section (4.3.3), the selection of toll rates for the managed lanes must not erode managed lanes average travel speed below 45 mph; and must optimize available toll rates for managed lanes. The detailed steps are summarized as follows:

- Identify the toll rate that produced the most revenue.
- Lower the toll rate by $0.05 - $0.08 per mile to allow the facility's operation to increase revenue as needed.
- Check to make sure the managed lanes are operating above 45 mph.
- If not, increase the toll rate until the desired operating conditions is achieved.

Table 4-7 presents the recommended managed lane toll rates. In 2020 and 2030, a desired operating speed of 45 mph or above can be maintained at the optimal toll rates.

4.5.4 Estimated Weekday Traffic

Refer to Appendix 4-B for Alternative A-2 2020 and 2030 traffic diagrams of:

- Daily Total Trips;
- AM Total Trips;
- PM Total Trips; and
- MD Total Trips.

4.5.5 Revenue Projections

Table 4-8 presents estimated gross toll revenue by period. Revenues shown in the table for each period were obtained at the recommended toll levels for Alternative A-2 described previously, for each travel direction and then aggregated to a daily total. For example, approximately $38,740 in daily revenue is expected on a typical opening year weekday; whereas $19,370 in daily revenue is expected on a typical opening year weekend day.

The net revenue stream in un-inflated 2007 dollars and inflated dollars are presented in Table 4-9 and 4-10 respectively. From year 2020 to year 2050, Alternative A-2 will generate approximately $1.119 billion cumulative net revenue in un-inflated 2007 dollars and approximately $2.343 billion cumulative net revenue in inflated dollars.

Table 4-7: Recommended Toll Rates – Alternative A-2

Year	Analysis Period	Dir	Maximum Revenue Toll Rates			Recommended Toll Rates			ML Speed @ Recommended Toll Rate		
			Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3
2020	AM Peak Period	NB	$0.15	$0.15	$0.15	$0.10	$0.10	$0.10	58	60	64
		SB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	64	63	64
	Midday Period	NB	$0.10	$0.15	$0.15	$0.05	$0.05	$0.05	63	63	64
		SB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	64	63	64
	PM Peak Period	NB	$0.15	$0.15	$0.15	$0.10	$0.10	$0.10	64	63	64
		SB	$0.15	$0.20	$0.20	$0.15	$0.15	$0.15	62	62	64
	Night	NB	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	65	65	65
		SB	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	65	65	65
2030	AM Peak Period	NB	$0.30	$0.30	$0.30	$0.20	$0.20	$0.20	57	58	61
		SB	$0.20	$0.20	$0.20	$0.10	$0.10	$0.10	64	63	63
	Midday Period	NB	$0.20	$0.30	$0.30	$0.10	$0.10	$0.10	63	61	61
		SB	$0.20	$0.20	$0.30	$0.10	$0.10	$0.10	64	62	63
	PM Peak Period	NB	$0.30	$0.30	$0.40	$0.10	$0.10	$0.10	61	58	59
		SB	$0.30	$0.30	$0.40	$0.20	$0.20	$0.20	58	59	62
	Night	NB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	65	64	64
		SB	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	65	64	65

Table 4-8: Annual Gross Toll Revenue (un-inflated dollars) – Alternative A-2

Year (1)	Weekday Revenue By Period (2)				Total Weekday	Weekend Day (3)	Estimated Annual Gross Revenue (4)	Cumulative Gross Revenue
	AM Peak	Midday	PM Peak	Night				
2020	$ 11,310	$ 8,400	$ 18,190	$ 840	$ 38,740	$ 19,370	$ 11,912,550	$ 11,912,550
2021	$ 15,050	$ 11,360	$ 23,630	$ 1,180	$ 51,220	$ 25,610	$ 15,750,150	$ 27,662,700
2022	$ 20,600	$ 15,740	$ 31,700	$ 1,700	$ 69,740	$ 34,870	$ 21,445,050	$ 49,107,750
2023	$ 27,490	$ 21,220	$ 41,620	$ 2,350	$ 92,680	$ 46,340	$ 28,499,100	$ 77,606,850
2024	$ 30,930	$ 24,080	$ 46,190	$ 2,720	$ 103,920	$ 51,960	$ 31,955,400	$ 109,562,250
2025	$ 33,520	$ 26,290	$ 49,470	$ 3,020	$ 112,300	$ 56,150	$ 34,532,250	$ 144,094,500
2026	$ 36,110	$ 28,490	$ 52,740	$ 3,320	$ 120,660	$ 60,330	$ 37,102,950	$ 181,197,450
2027	$ 38,700	$ 30,690	$ 56,020	$ 3,620	$ 129,030	$ 64,515	$ 39,676,725	$ 220,874,175
2028	$ 41,290	$ 32,890	$ 59,300	$ 3,920	$ 137,400	$ 68,700	$ 42,250,500	$ 263,124,675
2029	$ 43,880	$ 35,100	$ 62,570	$ 4,220	$ 145,770	$ 72,885	$ 44,824,275	$ 307,948,950
2030	$ 46,470	$ 37,300	$ 65,850	$ 4,520	$ 154,140	$ 77,070	$ 47,398,050	$ 355,347,000
2031	$ 47,770	$ 38,400	$ 67,490	$ 4,820	$ 158,480	$ 79,240	$ 48,732,600	$ 404,079,600
2032	$ 49,060	$ 39,500	$ 69,130	$ 5,120	$ 162,810	$ 81,405	$ 50,064,075	$ 454,143,675
2033	$ 50,360	$ 40,600	$ 70,770	$ 5,420	$ 167,150	$ 83,575	$ 51,398,625	$ 505,542,300
2034	$ 51,650	$ 41,710	$ 72,400	$ 5,720	$ 171,480	$ 85,740	$ 52,730,100	$ 558,272,400
2035	$ 52,950	$ 42,810	$ 74,040	$ 6,020	$ 175,820	$ 87,910	$ 54,064,650	$ 612,337,050
2036	$ 54,240	$ 43,910	$ 75,680	$ 6,320	$ 180,150	$ 90,075	$ 55,396,125	$ 667,733,175
2037	$ 55,540	$ 45,010	$ 77,320	$ 6,620	$ 184,490	$ 92,245	$ 56,730,675	$ 724,463,850
2038	$ 56,830	$ 46,110	$ 78,960	$ 6,920	$ 188,820	$ 94,410	$ 58,062,150	$ 782,526,000
2039	$ 58,130	$ 47,210	$ 80,600	$ 7,220	$ 193,160	$ 96,580	$ 59,396,700	$ 841,922,700
2040	$ 59,420	$ 48,320	$ 82,240	$ 7,520	$ 197,500	$ 98,750	$ 60,731,250	$ 902,653,950
2041	$ 60,720	$ 49,420	$ 83,870	$ 7,820	$ 201,830	$ 100,915	$ 62,062,725	$ 964,716,675
2042	$ 62,010	$ 50,520	$ 85,510	$ 8,120	$ 206,160	$ 103,080	$ 63,394,200	$ 1,028,110,875
2043	$ 63,310	$ 51,620	$ 87,150	$ 8,420	$ 210,500	$ 105,250	$ 64,728,750	$ 1,092,839,625
2044	$ 64,600	$ 52,720	$ 88,790	$ 8,720	$ 214,830	$ 107,415	$ 66,060,225	$ 1,158,899,850
2045	$ 65,900	$ 53,820	$ 90,430	$ 9,020	$ 219,170	$ 109,585	$ 67,394,775	$ 1,226,294,625
2046	$ 67,190	$ 54,920	$ 92,070	$ 9,320	$ 223,500	$ 111,750	$ 68,726,250	$ 1,295,020,875
2047	$ 68,490	$ 56,030	$ 93,700	$ 9,620	$ 227,840	$ 113,920	$ 70,060,800	$ 1,365,081,675
2048	$ 69,780	$ 57,130	$ 95,340	$ 9,920	$ 232,170	$ 116,085	$ 71,392,275	$ 1,436,473,950
2049	$ 71,080	$ 58,230	$ 96,980	$ 10,220	$ 236,510	$ 118,255	$ 72,726,825	$ 1,509,200,775
2050	$ 72,370	$ 59,330	$ 98,620	$ 10,520	$ 240,840	$ 120,420	$ 74,058,300	$ 1,583,259,075

(1) A ramp-up period is assumed for the first four years of operation
(2) 2007 Dollars
(3) Weekend day revenue for HOT3+ is estimated to be 50 percent of weekday revenue
(4) Annual revenue calculations assume 250 weekdays and 115 weekend/holidays

Table 4-9: Net Revenue Summary--- un-inflated dollars (000) – Alternative A-2

Year	Gross Annual Toll Revenue (1)	Annual Transactions (2)	Operation Cost (3)	Infrastructure Operation and Maintenance Cost (4)	Net Annual Revenue	Cumulative Net Annual Revenue
2020	$ 11,913	9,442	$ 1,983	$ 10,266	$ (336)	$ (336)
2021	$ 15,750	11,495	$ 2,414	$ 10,266	$ 3,070	$ 3,070
2022	$ 21,445	14,561	$ 3,058	$ 10,266	$ 8,121	$ 11,192
2023	$ 28,499	18,159	$ 3,813	$ 10,266	$ 14,420	$ 25,611
2024	$ 31,955	19,237	$ 4,040	$ 10,266	$ 17,650	$ 43,261
2025	$ 34,532	19,754	$ 4,148	$ 10,266	$ 20,118	$ 63,379
2026	$ 37,103	20,270	$ 4,257	$ 10,266	$ 22,580	$ 85,959
2027	$ 39,677	20,787	$ 4,365	$ 10,266	$ 25,045	$ 111,004
2028	$ 42,251	21,307	$ 4,474	$ 10,266	$ 27,510	$ 138,515
2029	$ 44,824	21,823	$ 4,583	$ 10,266	$ 29,975	$ 168,490
2030	$ 47,398	22,340	$ 4,691	$ 10,266	$ 32,441	$ 200,931
2031	$ 48,733	22,563	$ 4,738	$ 10,266	$ 33,728	$ 234,659
2032	$ 50,064	22,789	$ 4,786	$ 10,266	$ 35,012	$ 269,671
2033	$ 51,399	23,016	$ 4,833	$ 10,266	$ 36,299	$ 305,971
2034	$ 52,730	23,247	$ 4,882	$ 10,266	$ 37,582	$ 343,553
2035	$ 54,065	23,479	$ 4,931	$ 10,266	$ 38,868	$ 382,421
2036	$ 55,396	23,714	$ 4,980	$ 10,266	$ 40,150	$ 422,571
2037	$ 56,731	23,951	$ 5,030	$ 10,266	$ 41,435	$ 464,006
2038	$ 58,062	24,191	$ 5,080	$ 10,266	$ 42,716	$ 506,722
2039	$ 59,397	24,432	$ 5,131	$ 10,266	$ 44,000	$ 550,722
2040	$ 60,731	24,677	$ 5,182	$ 10,266	$ 45,283	$ 596,005
2041	$ 62,063	24,924	$ 5,234	$ 10,266	$ 46,563	$ 642,568
2042	$ 63,394	25,173	$ 5,286	$ 10,266	$ 47,842	$ 690,410
2043	$ 64,729	25,425	$ 5,339	$ 10,266	$ 49,124	$ 739,534
2044	$ 66,060	25,679	$ 5,393	$ 10,266	$ 50,402	$ 789,935
2045	$ 67,395	25,936	$ 5,446	$ 10,266	$ 51,682	$ 841,618
2046	$ 68,726	26,195	$ 5,501	$ 10,266	$ 52,959	$ 894,577
2047	$ 70,061	26,457	$ 5,556	$ 10,266	$ 54,239	$ 948,816
2048	$ 71,392	26,721	$ 5,611	$ 10,266	$ 55,515	$ 1,004,331
2049	$ 72,727	26,989	$ 5,668	$ 10,266	$ 56,793	$ 1,061,124
2050	$ 74,058	27,259	$ 5,724	$ 10,266	$ 58,068	$ 1,119,192

(1) Uninflated revenues are in 2007 dollars.
(2) Annual transaction do not include non-toll paying vehicles.
(3) Operation cost is assumed to be $0.21 per tolled transaction and it includes Billing and Administration Cost; Violations Center Operations Cost and Customer Service Center Cost; Enforcement cost and Toll Equipment Maintenance Cost.
(4) Annual Infrastructure Operation and Maintenance Cost is assumed to be 0.5% of the total capital cost.

Table 4-10: Annual Toll Revenue in Inflated Dollars (000) – Alternative A-2

Year	UNINFLATED DOLLARS (000)				Inflation Factors		INFLATED DOLLARS (000)			
	Total Gross Annual Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Net Cumulative Annual Revenue	Toll Revenue	O&M	Gross Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Cumulative Annual Revenue
2020	$ 11,913	$ 12,249	$ (336)	$ (336)	1.379	1.469	$ 16,427	$ 17,994	$ (1,566)	$ (1,566)
2021	$ 15,750	$ 12,680	$ 3,070	$ 2,734	1.413	1.513	$ 22,255	$ 19,185	$ 3,070	$ 1,504
2022	$ 21,445	$ 13,324	$ 8,121	$ 10,855	1.448	1.558	$ 31,052	$ 20,758	$ 10,294	$ 11,798
2023	$ 28,499	$ 14,079	$ 14,420	$ 25,275	1.485	1.605	$ 42,321	$ 22,597	$ 19,724	$ 31,522
2024	$ 31,955	$ 14,306	$ 17,650	$ 42,925	1.522	1.653	$ 48,636	$ 23,648	$ 24,989	$ 56,510
2025	$ 34,532	$ 14,414	$ 20,118	$ 63,042	1.560	1.702	$ 53,870	$ 24,533	$ 29,337	$ 85,848
2026	$ 37,103	$ 14,523	$ 22,580	$ 85,623	1.599	1.754	$ 59,328	$ 25,473	$ 33,855	$ 119,702
2027	$ 39,677	$ 14,631	$ 25,045	$ 110,668	1.639	1.806	$ 65,030	$ 26,424	$ 38,606	$ 158,308
2028	$ 42,251	$ 14,740	$ 27,510	$ 138,178	1.680	1.860	$ 70,981	$ 27,417	$ 43,564	$ 201,872
2029	$ 44,824	$ 14,849	$ 29,975	$ 168,154	1.722	1.916	$ 77,187	$ 28,450	$ 48,737	$ 250,609
2030	$ 47,398	$ 14,957	$ 32,441	$ 200,594	1.765	1.974	$ 83,658	$ 29,526	$ 54,132	$ 304,741
2031	$ 48,733	$ 15,004	$ 33,728	$ 234,323	1.809	2.033	$ 88,157	$ 30,504	$ 57,654	$ 362,395
2032	$ 50,064	$ 15,052	$ 35,012	$ 269,335	1.854	2.094	$ 92,819	$ 31,518	$ 61,301	$ 423,695
2033	$ 51,399	$ 15,099	$ 36,299	$ 305,634	1.900	2.157	$ 97,657	$ 32,570	$ 65,088	$ 488,783
2034	$ 52,730	$ 15,148	$ 37,582	$ 343,217	1.948	2.221	$ 102,718	$ 33,643	$ 69,075	$ 557,858
2035	$ 54,065	$ 15,197	$ 38,868	$ 382,085	1.996	2.288	$ 107,913	$ 34,770	$ 73,143	$ 631,001
2036	$ 55,396	$ 15,246	$ 40,150	$ 422,235	2.046	2.357	$ 113,340	$ 35,935	$ 77,406	$ 708,407
2037	$ 56,731	$ 15,296	$ 41,435	$ 463,670	2.098	2.427	$ 119,021	$ 37,123	$ 81,898	$ 790,305
2038	$ 58,062	$ 15,346	$ 42,716	$ 506,386	2.150	2.500	$ 124,834	$ 38,365	$ 86,469	$ 876,774
2039	$ 59,397	$ 15,397	$ 44,000	$ 550,386	2.204	2.575	$ 130,910	$ 39,647	$ 91,264	$ 968,037
2040	$ 60,731	$ 15,448	$ 45,283	$ 595,669	2.259	2.652	$ 137,192	$ 40,968	$ 96,223	$ 1,064,261
2041	$ 62,063	$ 15,500	$ 46,563	$ 642,232	2.315	2.732	$ 143,675	$ 42,346	$ 101,329	$ 1,165,590
2042	$ 63,394	$ 15,552	$ 47,842	$ 690,074	2.373	2.814	$ 150,434	$ 43,764	$ 106,670	$ 1,272,261
2043	$ 64,729	$ 15,605	$ 49,124	$ 739,197	2.433	2.898	$ 157,485	$ 45,224	$ 112,261	$ 1,384,522
2044	$ 66,060	$ 15,659	$ 50,402	$ 789,599	2.493	2.985	$ 164,688	$ 46,741	$ 117,947	$ 1,502,469
2045	$ 67,395	$ 15,712	$ 51,682	$ 841,281	2.556	3.075	$ 172,261	$ 48,316	$ 123,945	$ 1,626,415
2046	$ 68,726	$ 15,767	$ 52,959	$ 894,241	2.620	3.167	$ 180,063	$ 49,934	$ 130,129	$ 1,756,543
2047	$ 70,061	$ 15,822	$ 54,239	$ 948,479	2.685	3.262	$ 188,113	$ 51,611	$ 136,502	$ 1,893,046
2048	$ 71,392	$ 15,877	$ 55,515	$ 1,003,994	2.752	3.360	$ 196,472	$ 53,348	$ 143,123	$ 2,036,169
2049	$ 72,727	$ 15,934	$ 56,793	$ 1,060,787	2.821	3.461	$ 205,162	$ 55,146	$ 150,016	$ 2,186,185
2050	$ 74,058	$ 15,990	$ 58,068	$ 1,118,855	2.892	3.565	$ 214,177	$ 57,005	$ 157,171	$ 2,343,356

Notes: Uninflated revenues and costs are in 2007 dollars.
Annual inflation rates of 2.5% and 3.0% are applied for toll revenue and O&M cost respectively.

4.6 Traffic and Toll Revenue Estimates - Alternative A-3

This alternative assumed the construction of two managed lanes in each direction along I-75 from I-285 to SR 16. The tolling and policy framework evaluated in this managed lane alternative is Express Tolling Lanes (ETL) for cars only. ETL refers to a tolling alternative that all traffic including SOVs, HOVs and Commercial Vehicles (CV) including commercially registered autos, pickup trucks, and vans would pay a toll to use the managed lanes. It was assumed that Medium-Duty Trucks (MDT) and Heavy-Duty Trucks (HDT) would not be allowed to utilize the ETL system at this time. No Truck Only Toll (TOT) lanes were assumed to be constructed in this Alternative.

4.6.1 Toll Sensitivity Analysis Results

A summary of the results of the toll sensitivity analysis for Alternative A-3 is presented in Figures 4-21 through 4-26.

As shown in Figure 4-21, the toll rate resulting in the maximum AM peak period revenue is expected to be $0.15 per mile northbound and $0.10 per mile southbound; the difference between the toll rates is expected since AM peak period demand in the northbound direction exceeds the southbound direction.

Figure 4-22 illustrates the revenue of three segments for the Midday peak period; the toll rate resulting in the maximum Midday period revenue is expected to be $0.10 per mile northbound for segment I and segment II and $0.15 per mile for segment III. The toll rate resulting in the maximum Midday period revenue is expected to be $0.10 per mile southbound for all three segments. The similar toll rate is expected during the Midday period since the distribution of demand between the northbound and southbound direction is fairly uniform.

Figure 4-23 illustrates the revenue of three segments for the PM peak period; the toll rate resulting in the maximum PM peak period revenue is expected to be $0.15 per mile southbound for segment I and $0.20 per mile for southbound for segment II and segment III and northbound for all three segments. In PM peak period, the directional revenue results varied when compared to AM peak period as northbound experiences heavier traffic volumes.

The recommended toll rates for the over-night period are $0.02 per mile in 2020 for both directions. Similar conclusions can be drawn from studying toll sensitivity in year 2030.

Among all the three alternatives with different managed lane policy ranging from HOT2+ to HOT3+ to ETL, Alternative A-3 - ETL generates the highest revenue. For example, in 2020 during PM peak period, with the recommended toll rate of $0.10 per mile for the northbound and recommended toll rate of $0.15 per mile for southbound, Alternative A-3 generates $18,970 daily revenue, which is approximately four percent higher than Alternative A-2, approximately 30 percent higher than Alternative A-1. The increase in revenue is in part due to restriction on free vehicles, which resulted in higher unused capacity of HOT lane and correspondingly more achievable time savings in the managed lanes.

Figure 4-21: 2020 AM Peak Period Sensitivity Curves – Alternative A-3

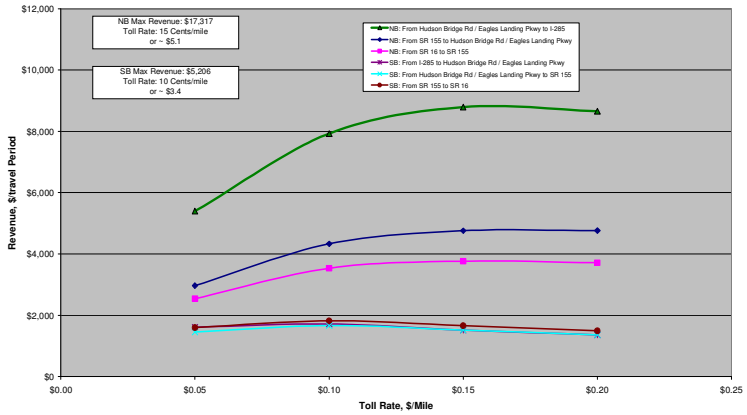


Figure 4-22: 2020 Midday Period Sensitivity Curves – Alternative A-3

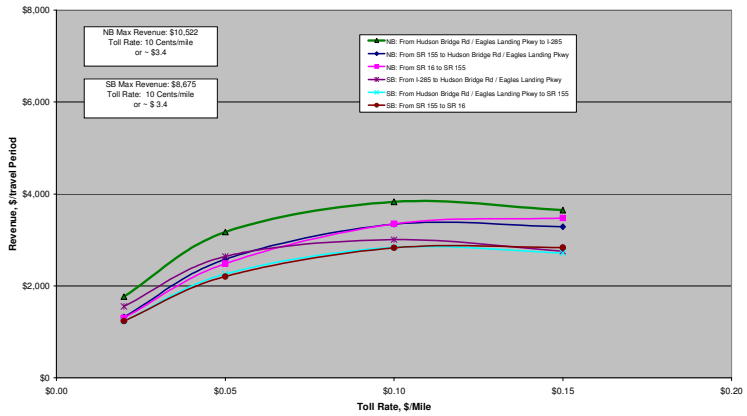


Figure 4-23: 2020 PM Peak Period Sensitivity Curves – Alternative A-3

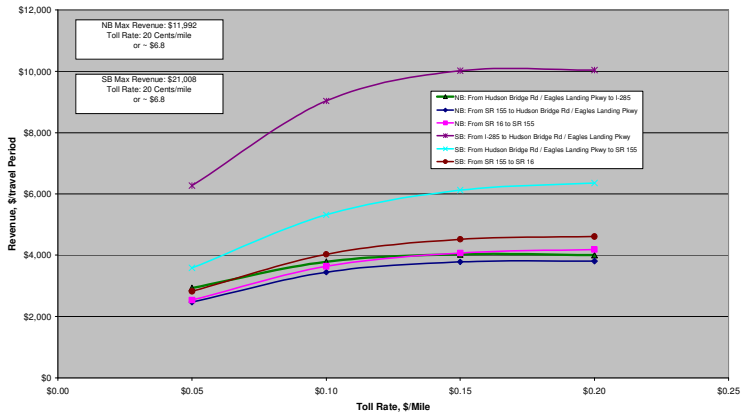


Figure 4-24: 2030 AM Peak Period Sensitivity Curves – Alternative A-3

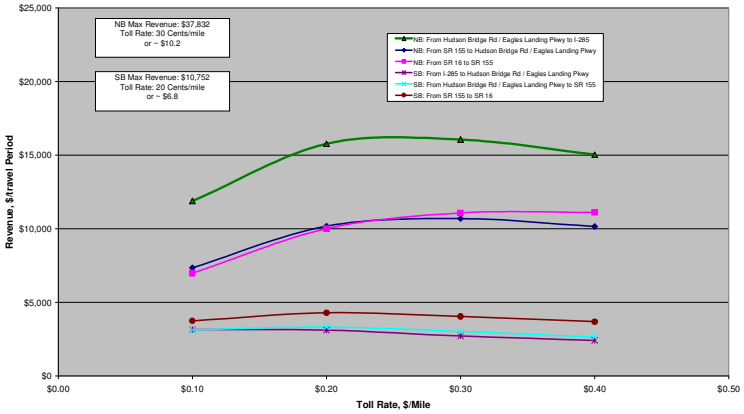


Figure 4-25: 2030 Midday Period Sensitivity Curves – Alternative A-3

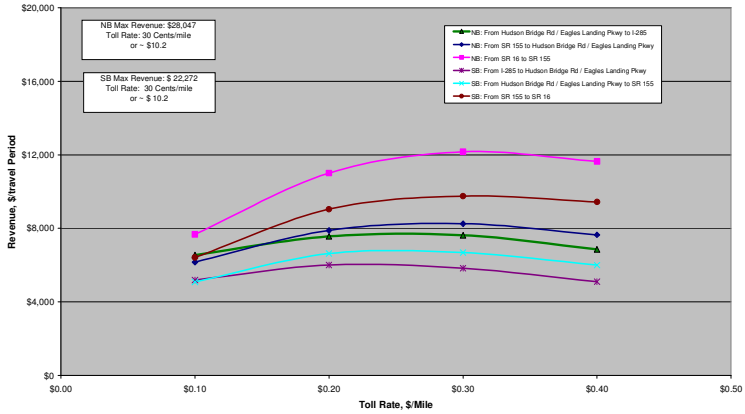
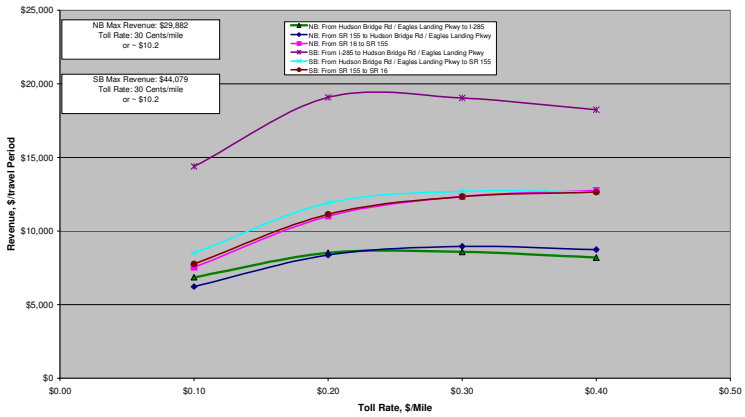


Figure 4-26: 2030 PM Peak Period Sensitivity Curves – Alternative A-3



4.6.2 Toll Revenue Verses Operational Tradeoffs

To illustrate the tradeoffs between revenue optimization and operational efficiency, toll rate operational profiles were developed for the opening year of 2020 and horizon year of 2030 under various toll rates, separately by time-of-day and by direction of travel.

Figure 4-27 provides a comparative operating profile for opening year 2020 AM peak period. The first two upper figures illustrate the relationship between revenue and toll rate by travel direction. In the southbound direction, the peak direction in the morning, the revenue generated is much higher than that of the northbound direction.

In the second series of charts, vehicle-miles of travel (VMT) by direction are shown for:

- Total vehicles on the managed lanes; and
- Priced vehicles on the managed lanes (SOVs, HOV2+s, and CVs in this application).

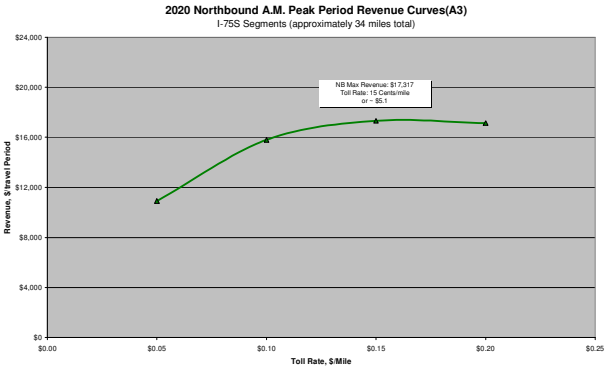
Again VMT in the northbound direction substantially exceeds that of the southbound direction for each vehicle class.

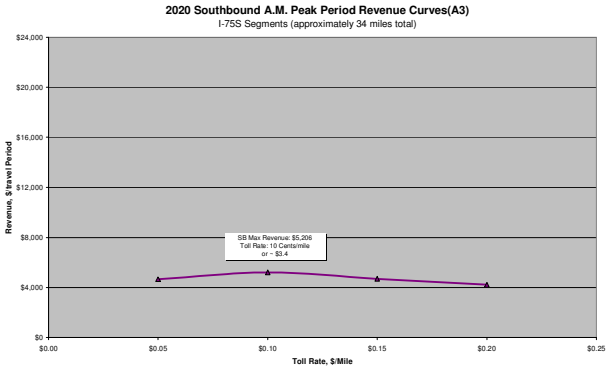
The two lower figures illustrate average speed drawn from the traffic assignment results in the general-purpose and managed lanes with respect to various toll rates. As toll rates increase, average speed in the managed lanes increase slightly as more SOVs, HOV2+s and CVs migrate back to the general-purpose lanes. At very low toll rates the travel time savings provided by the managed lanes has tremendous value, attracting many SOV and HOV2+ motorists and CV travelers. As a result, the Managed lanes are inundated with SOV, HOV2+ and CV traffic driving the average speed down. Speeds in the managed lanes steadily rebound as willingness to pay decreases as the toll rate increases.

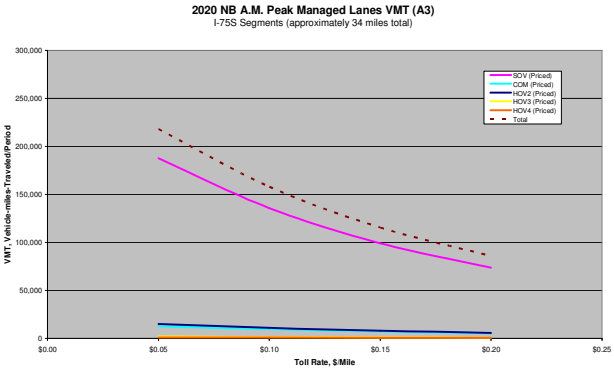
In the PM peak periods, the major distinction is the reversal of travel patterns as the northbound peak direction swivels to the southbound direction. In the Midday analysis period, revenue, VMT and average travel speed are comparable for northbound direction and southbound direction. Similar logic for revenue, VMT and average travel speed are observed for the horizon year of 2030, thus a detailed description will not be repeated.

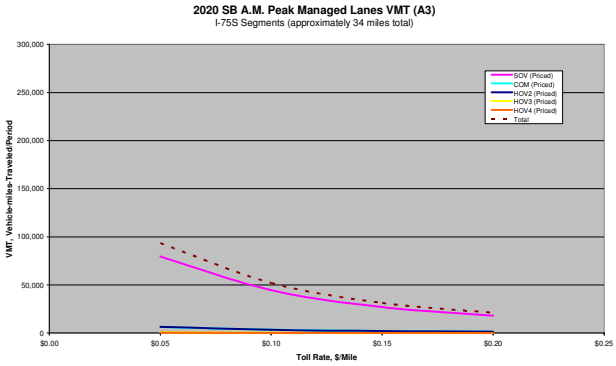
Refer to Appendix 4-A for a complete set of profiles for the opening year 2020 and horizon year of 2030 AM peak period, PM peak period and Midday period.

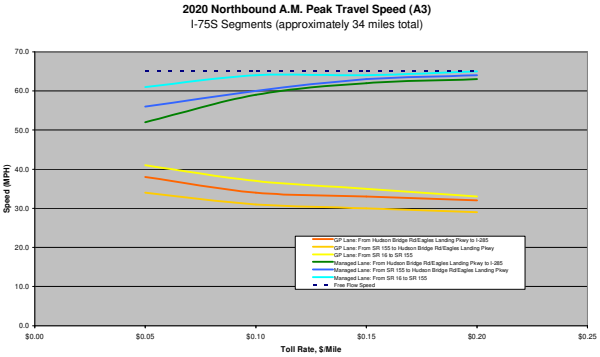
Figure 4-27: 2020 AM Peak Period Toll Rate Operational Profile – Alternative A-3

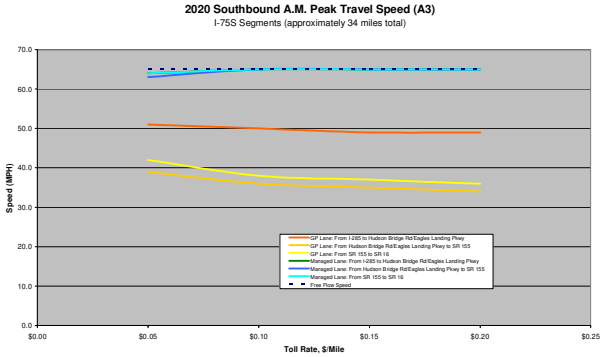












4.6.3 Selected Toll Rate

As discussed in the earlier section (4.3.3), the selection of toll rates for the managed lanes must not erode managed lanes average travel speed below 45 mph; and optimize available toll rates for managed lanes. The detailed steps are summarized as follows:

- Identify the toll rate that produced the most revenue.
- Lower the toll rate by $0.05 - $0.08 per mile to allow the facility's operation to increase revenue as needed.
- Check to make sure the managed lanes are operating above 45 mph.
- If not, increase the toll rate until the desired operating conditions is achieved.

Table 4-11 presents the recommended managed lanes toll rates. In 2020 and 2030, a desired operating speed of 45 mph or above can be maintained at the optimal toll rates.

4.6.4 Estimated Weekday Traffic

Refer to Appendix 4-B for Alternative-3 2020 and 2030 traffic diagrams of:

- Daily Total Trips;
- AM Total Trips;
- PM Total Trips; and
- MD Total Trips.

4.6.5 Revenue Projections

Table 4-12 presents estimated gross toll revenue by period. Revenues shown in the table for each period were obtained at the optimum toll levels for Alternative A-3 described previously, for each travel direction and then aggregated to a daily total. For example, approximately $40,330 in daily revenue is expected on a typical opening year weekday; whereas $20,165 in daily revenue is expected on a typical opening year weekend day;

The net revenue stream in un-inflated 2007 dollars and inflated dollars are presented in Table 4-13 and 4-14 respectively. From year 2020 to year 2050, Alternative A-3 will generate approximately $1.159 billion cumulative net revenue in un-inflated 2007 dollars and approximately $2.429 billion cumulative net revenue in inflated dollars.

Table 4-11: Recommended Toll Rates – Alternative A-3

Year	Analysis Period	Dir	Maximum Revenue Toll Rates			Recommended Toll Rates			ML Speed @ Recommended Toll Rate		
			Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3
2020	AM Peak Period	NB	$0.15	$0.15	$0.15	$0.10	$0.10	$0.10	59	60	64
		SB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	64	63	64
	Midday Period	NB	$0.10	$0.10	$0.15	$0.05	$0.05	$0.05	63	63	64
		SB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	64	63	64
	PM Peak Period	NB	$0.15	$0.20	$0.20	$0.10	$0.10	$0.10	64	63	64
		SB	$0.20	$0.20	$0.20	$0.15	$0.15	$0.15	62	62	64
	Night	NB	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	65	65	65
		SB	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	65	65	65
2030	AM Peak Period	NB	$0.30	$0.30	$0.30	$0.20	$0.20	$0.20	59	58	61
		SB	$0.10	$0.20	$0.20	$0.10	$0.10	$0.10	64	63	63
	Midday Period	NB	$0.30	$0.30	$0.30	$0.10	$0.10	$0.10	63	62	62
		SB	$0.20	$0.30	$0.30	$0.10	$0.10	$0.10	64	63	63
	PM Peak Period	NB	$0.30	$0.30	$0.40	$0.10	$0.10	$0.10	62	59	59
		SB	$0.20	$0.30	$0.40	$0.20	$0.20	$0.20	59	59	62
	Night	NB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	65	64	64
		SB	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	65	64	65

Table 4-12: Annual Gross Toll Revenue (un-inflated dollars) – Alternative A-3

Year (1)	Weekday Revenue By Period (2)				Total Weekday	Weekend Day (3)	Estimated Annual Gross Revenue (4)	Cumulative Gross Revenue
	AM Peak	Midday	PM Peak	Night				
2020	$ 11,670	$ 8,830	$ 18,970	$ 860	$ 40,330	$ 20,165	$ 12,401,475	$ 12,401,475
2021	$ 15,520	$ 11,860	$ 24,630	$ 1,220	$ 53,230	$ 26,615	$ 16,368,225	$ 28,769,700
2022	$ 21,230	$ 16,360	$ 33,030	$ 1,750	$ 72,370	$ 36,185	$ 22,253,775	$ 51,023,475
2023	$ 28,320	$ 21,960	$ 43,350	$ 2,420	$ 96,050	$ 48,025	$ 29,535,375	$ 80,558,850
2024	$ 31,860	$ 24,840	$ 48,090	$ 2,800	$ 107,590	$ 53,795	$ 33,083,925	$ 113,642,775
2025	$ 34,520	$ 27,040	$ 51,490	$ 3,110	$ 116,160	$ 58,080	$ 35,719,200	$ 149,361,975
2026	$ 37,180	$ 29,240	$ 54,890	$ 3,420	$ 124,730	$ 62,365	$ 38,354,475	$ 187,716,450
2027	$ 39,840	$ 31,440	$ 58,290	$ 3,730	$ 133,300	$ 66,650	$ 40,989,750	$ 228,706,200
2028	$ 42,500	$ 33,630	$ 61,690	$ 4,030	$ 141,850	$ 70,925	$ 43,618,875	$ 272,325,075
2029	$ 45,160	$ 35,830	$ 65,090	$ 4,340	$ 150,420	$ 75,210	$ 46,254,150	$ 318,579,225
2030	$ 47,820	$ 38,030	$ 68,490	$ 4,650	$ 158,990	$ 79,495	$ 48,889,425	$ 367,468,650
2031	$ 49,150	$ 39,130	$ 70,190	$ 4,960	$ 163,430	$ 81,715	$ 50,254,725	$ 417,723,375
2032	$ 50,480	$ 40,230	$ 71,890	$ 5,270	$ 167,870	$ 83,935	$ 51,620,025	$ 469,343,400
2033	$ 51,810	$ 41,330	$ 73,590	$ 5,570	$ 172,300	$ 86,150	$ 52,982,250	$ 522,325,650
2034	$ 53,140	$ 42,430	$ 75,290	$ 5,880	$ 176,740	$ 88,370	$ 54,347,550	$ 576,673,200
2035	$ 54,470	$ 43,530	$ 76,990	$ 6,190	$ 181,180	$ 90,590	$ 55,712,850	$ 632,386,050
2036	$ 55,800	$ 44,620	$ 78,690	$ 6,500	$ 185,610	$ 92,805	$ 57,075,075	$ 689,461,125
2037	$ 57,130	$ 45,720	$ 80,390	$ 6,810	$ 190,050	$ 95,025	$ 58,440,375	$ 747,901,500
2038	$ 58,460	$ 46,820	$ 82,090	$ 7,110	$ 194,480	$ 97,240	$ 59,802,600	$ 807,704,100
2039	$ 59,790	$ 47,920	$ 83,790	$ 7,420	$ 198,920	$ 99,460	$ 61,167,900	$ 868,872,000
2040	$ 61,120	$ 49,020	$ 85,490	$ 7,730	$ 203,360	$ 101,680	$ 62,533,200	$ 931,405,200
2041	$ 62,450	$ 50,120	$ 87,190	$ 8,040	$ 207,800	$ 103,900	$ 63,898,500	$ 995,303,700
2042	$ 63,780	$ 51,220	$ 88,890	$ 8,350	$ 212,240	$ 106,120	$ 65,263,800	$ 1,060,567,500
2043	$ 65,110	$ 52,320	$ 90,590	$ 8,650	$ 216,670	$ 108,335	$ 66,626,025	$ 1,127,193,525
2044	$ 66,440	$ 53,420	$ 92,290	$ 8,960	$ 221,110	$ 110,555	$ 67,991,325	$ 1,195,184,850
2045	$ 67,770	$ 54,520	$ 93,990	$ 9,270	$ 225,550	$ 112,775	$ 69,356,625	$ 1,264,541,475
2046	$ 69,100	$ 55,610	$ 95,690	$ 9,580	$ 229,980	$ 114,990	$ 70,718,850	$ 1,335,260,325
2047	$ 70,430	$ 56,710	$ 97,390	$ 9,890	$ 234,420	$ 117,210	$ 72,084,150	$ 1,407,344,475
2048	$ 71,760	$ 57,810	$ 99,090	$ 10,190	$ 238,850	$ 119,425	$ 73,446,375	$ 1,480,790,850
2049	$ 73,090	$ 58,910	$ 100,790	$ 10,500	$ 243,290	$ 121,645	$ 74,811,675	$ 1,555,602,525
2050	$ 74,420	$ 60,010	$ 102,490	$ 10,810	$ 247,730	$ 123,865	$ 76,176,975	$ 1,631,779,500

(1) A ramp-up period is assumed for the first four years of operation
(2) 2007 Dollars
(3) Weekend day revenue for ETL (Cars) is estimated to be 50 percent of weekday revenue
(4) Annual revenue calculations assume 250 weekdays and 115 weekend/holidays

Table 4-13: Net Revenue Summary--- un-inflated dollars (000) – Alternative A-3

Year	Gross Annual Toll Revenue (1)	Annual Transactions (2)	Operation Cost (3)	Infrastructure Operation and Maintenance Cost (4)	Net Annual Revenue	Cumulative Net Annual Revenue
2020	$ 12,401	11,098	$ 2,331	$ 10,266	$ (195)	$ (195)
2021	$ 16,368	13,318	$ 2,797	$ 10,266	$ 3,306	$ 3,306
2022	$ 22,254	16,642	$ 3,495	$ 10,266	$ 8,493	$ 11,798
2023	$ 29,535	20,480	$ 4,301	$ 10,266	$ 14,969	$ 26,767
2024	$ 33,084	21,427	$ 4,500	$ 10,266	$ 18,318	$ 45,085
2025	$ 35,719	21,737	$ 4,565	$ 10,266	$ 20,888	$ 65,974
2026	$ 38,354	22,048	$ 4,630	$ 10,266	$ 23,458	$ 89,432
2027	$ 40,990	22,361	$ 4,696	$ 10,266	$ 26,028	$ 115,460
2028	$ 43,619	22,672	$ 4,761	$ 10,266	$ 28,592	$ 144,052
2029	$ 46,254	22,986	$ 4,827	$ 10,266	$ 31,161	$ 175,213
2030	$ 48,889	23,296	$ 4,892	$ 10,266	$ 33,731	$ 208,944
2031	$ 50,255	23,529	$ 4,941	$ 10,266	$ 35,048	$ 243,992
2032	$ 51,620	23,764	$ 4,991	$ 10,266	$ 36,363	$ 280,355
2033	$ 52,982	24,002	$ 5,040	$ 10,266	$ 37,676	$ 318,031
2034	$ 54,348	24,242	$ 5,091	$ 10,266	$ 38,991	$ 357,022
2035	$ 55,713	24,485	$ 5,142	$ 10,266	$ 40,305	$ 397,327
2036	$ 57,075	24,729	$ 5,193	$ 10,266	$ 41,616	$ 438,943
2037	$ 58,440	24,977	$ 5,245	$ 10,266	$ 42,929	$ 481,872
2038	$ 59,803	25,226	$ 5,298	$ 10,266	$ 44,239	$ 526,111
2039	$ 61,168	25,479	$ 5,351	$ 10,266	$ 45,551	$ 571,663
2040	$ 62,533	25,733	$ 5,404	$ 10,266	$ 46,863	$ 618,526
2041	$ 63,899	25,991	$ 5,458	$ 10,266	$ 48,174	$ 666,700
2042	$ 65,264	26,251	$ 5,513	$ 10,266	$ 49,485	$ 716,185
2043	$ 66,626	26,513	$ 5,568	$ 10,266	$ 50,792	$ 766,978
2044	$ 67,991	26,778	$ 5,623	$ 10,266	$ 52,102	$ 819,079
2045	$ 69,357	27,046	$ 5,680	$ 10,266	$ 53,411	$ 872,490
2046	$ 70,719	27,317	$ 5,736	$ 10,266	$ 54,716	$ 927,207
2047	$ 72,084	27,590	$ 5,794	$ 10,266	$ 56,024	$ 983,231
2048	$ 73,446	27,866	$ 5,852	$ 10,266	$ 57,329	$ 1,040,560
2049	$ 74,812	28,144	$ 5,910	$ 10,266	$ 58,635	$ 1,099,195
2050	$ 76,177	28,426	$ 5,969	$ 10,266	$ 59,942	$ 1,159,137

(1) Uninflated revenues are in 2007 dollars.
(2) Annual transaction do not include non-toll paying vehicles.
(3) Operation cost is assumed to be $0.21 per tolled transaction and it includes Billing and Administration Cost; Violations Center Operations Cost and Customer Service Center Cost; Enforcement cost and Toll Equipment Maintenance Cost.
(4) Annual Infrastructure Operation and Maintenance Cost is assumed to be 0.5% of the total capital cost.

Table 4-14: Annual Toll Revenue in Inflated Dollars (000) – Alternative A-3

Year	UNINFLATED DOLLARS (000)				Inflation Factors		INFLATED DOLLARS (000)			
	Total Gross Annual Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Net Cumulative Annual	Toll Revenue	O&M	Gross Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Cumulative Annual Revenue
2020	$ 12,401	$ 12,597	$ (195)	$ (195)	1.379	1.469	$ 17,102	$ 18,504	$ (1,403)	$ (1,403)
2021	$ 16,368	$ 13,063	$ 3,306	$ 3,110	1.413	1.513	$ 23,128	$ 19,764	$ 3,364	$ 1,962
2022	$ 22,254	$ 13,761	$ 8,493	$ 11,603	1.448	1.558	$ 32,223	$ 21,439	$ 10,784	$ 12,746
2023	$ 29,535	$ 14,567	$ 14,969	$ 26,572	1.485	1.605	$ 43,860	$ 23,380	$ 20,480	$ 33,226
2024	$ 33,084	$ 14,766	$ 18,318	$ 44,890	1.522	1.653	$ 50,354	$ 24,408	$ 25,946	$ 59,173
2025	$ 35,719	$ 14,831	$ 20,888	$ 65,779	1.560	1.702	$ 55,722	$ 25,242	$ 30,480	$ 89,652
2026	$ 38,354	$ 14,896	$ 23,458	$ 89,237	1.599	1.754	$ 61,329	$ 26,128	$ 35,201	$ 124,854
2027	$ 40,990	$ 14,962	$ 26,028	$ 115,265	1.639	1.806	$ 67,182	$ 27,021	$ 40,161	$ 165,015
2028	$ 43,619	$ 15,027	$ 28,592	$ 143,857	1.680	1.860	$ 73,280	$ 27,950	$ 45,329	$ 210,344
2029	$ 46,254	$ 15,093	$ 31,161	$ 175,018	1.722	1.916	$ 79,650	$ 28,918	$ 50,731	$ 261,075
2030	$ 48,889	$ 15,158	$ 33,731	$ 208,749	1.765	1.974	$ 86,290	$ 29,922	$ 56,368	$ 317,443
2031	$ 50,255	$ 15,207	$ 35,048	$ 243,797	1.809	2.033	$ 90,911	$ 30,916	$ 59,995	$ 377,438
2032	$ 51,620	$ 15,257	$ 36,363	$ 280,160	1.854	2.094	$ 95,704	$ 31,947	$ 63,756	$ 441,194
2033	$ 52,982	$ 15,306	$ 37,676	$ 317,836	1.900	2.157	$ 100,666	$ 33,016	$ 67,650	$ 508,844
2034	$ 54,348	$ 15,357	$ 38,991	$ 356,827	1.948	2.221	$ 105,869	$ 34,108	$ 71,761	$ 580,606
2035	$ 55,713	$ 15,408	$ 40,305	$ 397,132	1.996	2.288	$ 111,203	$ 35,253	$ 75,950	$ 656,556
2036	$ 57,075	$ 15,459	$ 41,616	$ 438,748	2.046	2.357	$ 116,776	$ 36,437	$ 80,338	$ 736,894
2037	$ 58,440	$ 15,511	$ 42,929	$ 481,677	2.098	2.427	$ 122,608	$ 37,645	$ 84,962	$ 821,856
2038	$ 59,803	$ 15,564	$ 44,239	$ 525,916	2.150	2.500	$ 128,576	$ 38,909	$ 89,667	$ 911,523
2039	$ 61,168	$ 15,617	$ 45,551	$ 571,468	2.204	2.575	$ 134,814	$ 40,213	$ 94,601	$ 1,006,125
2040	$ 62,533	$ 15,670	$ 46,863	$ 618,331	2.259	2.652	$ 141,262	$ 41,557	$ 99,706	$ 1,105,830
2041	$ 63,899	$ 15,724	$ 48,174	$ 666,505	2.315	2.732	$ 147,925	$ 42,958	$ 104,967	$ 1,210,797
2042	$ 65,264	$ 15,779	$ 49,485	$ 715,990	2.373	2.814	$ 154,871	$ 44,401	$ 110,470	$ 1,321,267
2043	$ 66,626	$ 15,834	$ 50,792	$ 766,783	2.433	2.898	$ 162,101	$ 45,886	$ 116,215	$ 1,437,482
2044	$ 67,991	$ 15,889	$ 52,102	$ 818,884	2.493	2.985	$ 169,502	$ 47,430	$ 122,072	$ 1,559,554
2045	$ 69,357	$ 15,946	$ 53,411	$ 872,295	2.556	3.075	$ 177,276	$ 49,033	$ 128,243	$ 1,687,797
2046	$ 70,719	$ 16,002	$ 54,716	$ 927,012	2.620	3.167	$ 185,283	$ 50,680	$ 134,603	$ 1,822,400
2047	$ 72,084	$ 16,060	$ 56,024	$ 983,036	2.685	3.262	$ 193,546	$ 52,387	$ 141,159	$ 1,963,559
2048	$ 73,446	$ 16,118	$ 57,329	$ 1,040,365	2.752	3.360	$ 202,124	$ 54,156	$ 147,969	$ 2,111,527
2049	$ 74,812	$ 16,176	$ 58,635	$ 1,099,000	2.821	3.461	$ 211,044	$ 55,986	$ 155,058	$ 2,266,585
2050	$ 76,177	$ 16,235	$ 59,942	$ 1,158,941	2.892	3.565	$ 220,304	$ 57,879	$ 162,425	$ 2,429,009

Notes: Uninflated revenues and costs are in 2007 dollars.
Annual inflation rates of 2.5% and 3.0% are applied for toll revenue and O&M cost respectively.

4.7 Traffic and Toll Revenue Estimates - Alternative B

This alternative assumed the construction of two voluntary Truck Only Toll (TOT) lanes in each direction along I-675 and I-75 from I-675 to SR 16. Voluntary TOT lane refers to a truck tolling alternative that would allow Medium-Duty Trucks (FHWA classes 8-13) and Heavy-Duty Trucks (FHWA classes 8-13) to pay a toll to use the lanes. It was assumed that passenger cars and commercial vehicles would not be allowed to utilize the TOT lanes.

4.7.1 Toll Sensitivity Analysis Results

Figures 4-28 through 4-33 illustrate the TOT revenue of two segments: I-75 from SR 16 to I-675 and I-675, for the AM peak period, Midday period and PM peak period in 2020 and 1030.

In general, as toll rate increases, TOT revenue generated by the TOT lanes increases slightly. The TOT revenue generated on the segment of I-75 South corridor from SR 16 to I-675 is much higher than the revenue generated on I-675 segment.

Overall, the TOT lane revenue curves are less sensitive and pronounced than the managed lane revenue curve in the previous managed lane alternatives. This pattern is expected since the willingness to pay level of truck operators and truck shippers is higher than the level of passenger car travelers. The pattern is also in part due to lower hourly truck demand for TOT lanes when compared to the SOV and CV demand for the managed lanes in peak periods.

As observed in the figures, the maximum revenue generated by TOT lanes during the Midday period even exceeds the maximum revenue generated in the AM and PM peak periods. This is expected since the Midday period exhibits higher Heavy-Duty and Medium-Duty truck demand when compared to other peak periods, which results in a higher demand and usage for the TOT lanes.

The recommended toll rates for the over-night period are $0.05 per mile in 2020 for both directions. Similar conclusions can be drawn from studying toll sensitivity in year 2030.

Figure 4-28: 2020 AM Peak Period Sensitivity Curves – Alternative B

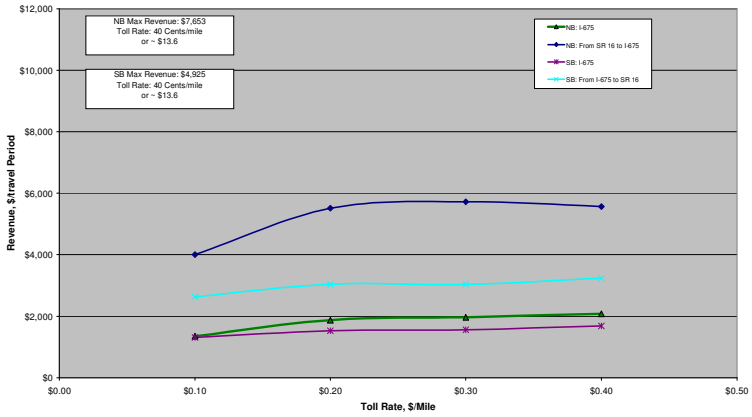


Figure 4-29: 2020 Midday Period Sensitivity Curves – Alternative B

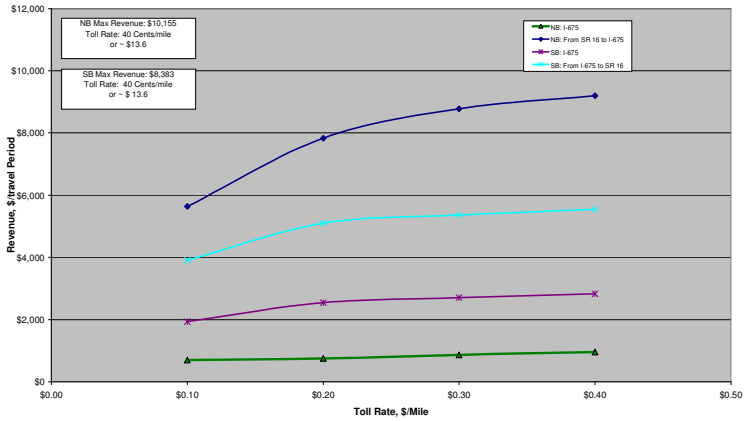


Figure 4-30: 2020 PM Peak Period Sensitivity Curves – Alternative B

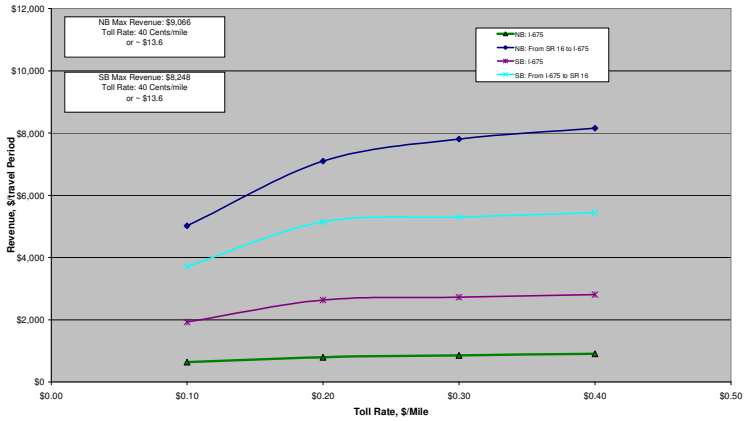


Figure 4-31: 2030 AM Peak Period Sensitivity Curves – Alternative B

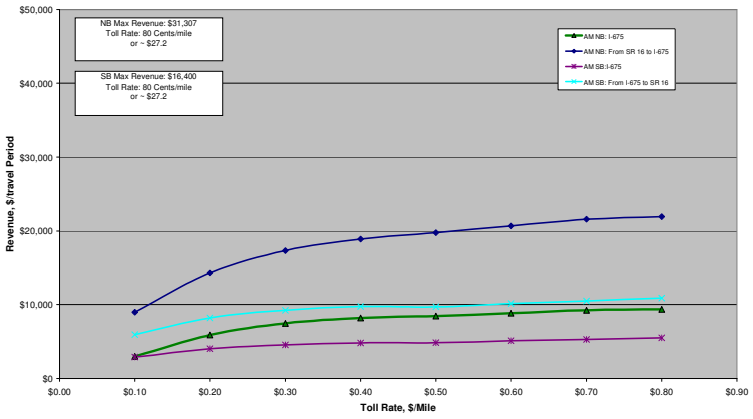


Figure 4-32: 2030 Midday Period Sensitivity Curves – Alternative B

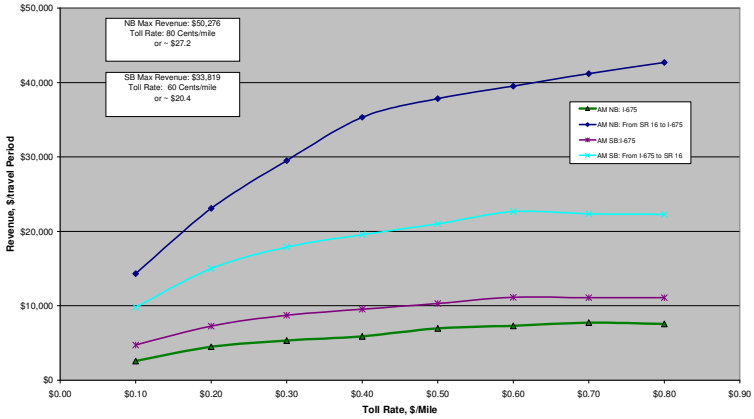
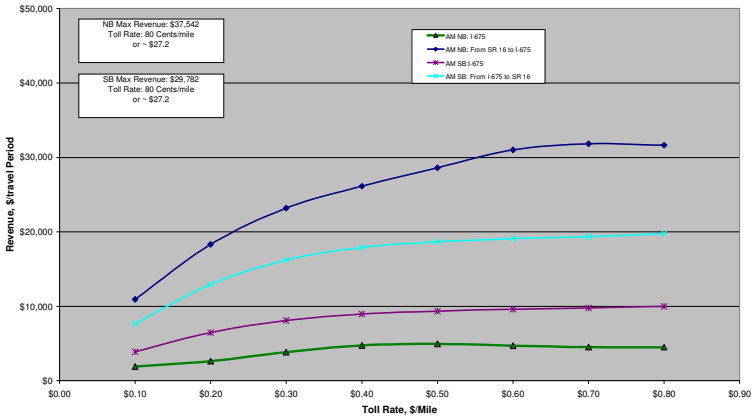


Figure 4-33: 2030 PM Peak Period Sensitivity Curves – Alternative B



4.7.2 Toll Revenue Verses Operational Tradeoffs

To illustrate the tradeoffs between revenue optimization and operational efficiency, toll rate operational profiles on TOT lanes were developed for the opening year of 2020 and horizon year of 2030 under various toll rates, separately by time-of-day and by direction of travel.

Figure 4-34 provides a comparative operating profile for opening year 2020 AM peak period for TOT lanes. Again, the first two upper figures illustrate the relationship between the TOT lane revenue and toll rate by travel direction. In the northbound direction, the peak direction in the morning, the TOT lane revenue generated is slightly higher than that of the southbound direction.

In the second series of charts, vehicle-miles of travel (VMT) by direction are shown for:

- Total vehicles on the TOT lanes; and
- Each priced vehicle type on the TOT lanes (medium-duty truck and heavy-duty truck in this application);

VMT in the northbound direction slightly exceeds that of the southbound direction for each vehicle class.

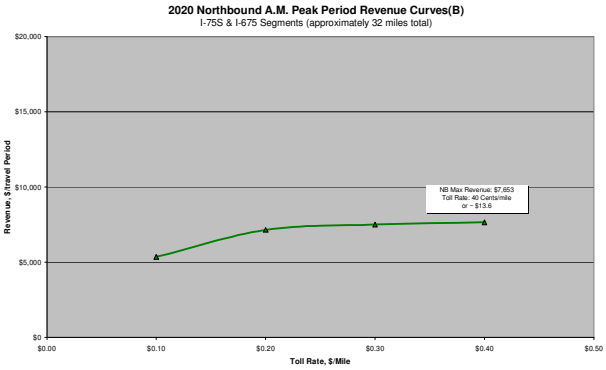
The two lower figures illustrate average speed drawn from the traffic assignment results in the general-purpose and TOT lanes with respect to various toll rates. As toll rates increase, average speed in the general purpose lanes decrease slightly as more heavy-duty and medium-duty trucks migrate back to the general-purpose lanes. Due to the relatively lower through truck demand for TOT lanes during AM peak period in 2020, the average operating speed on TOT lanes can be maintained at the free-flow speed of 65 mph under the various toll rates.

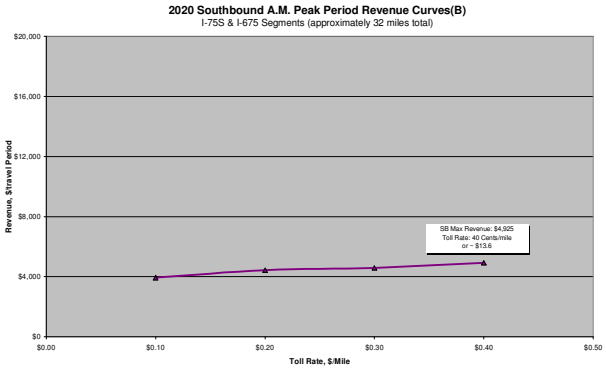
In the PM and Midday peak analysis periods, revenue, VMT and average travel speed are pretty comparable for northbound direction and southbound direction.

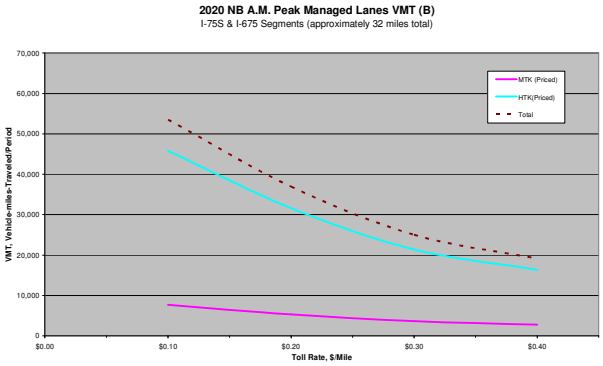
Similar logic for revenue, VMT and average travel speed are observed for the horizon year of 2030, thus a detailed description will not be repeated.

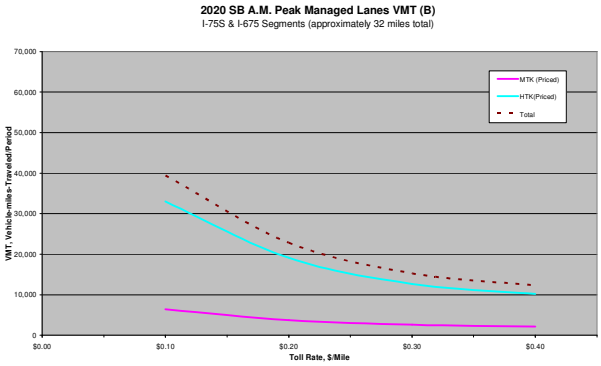
Refer to Appendix-A for a complete set of operating profiles for opening year 2020 and horizon year of 2030 AM peak period, PM peak period and Midday period.

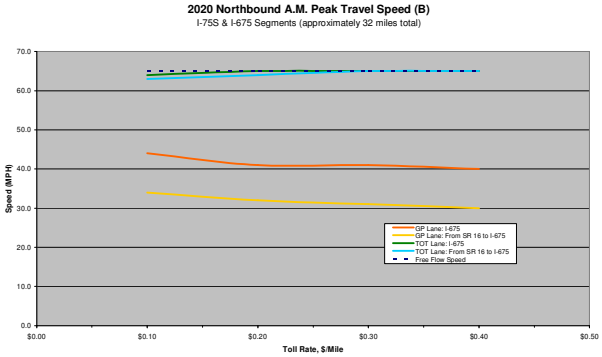
Figure 4-34: 2020 AM Peak Period Toll Rate Operational Profile – Alternative B

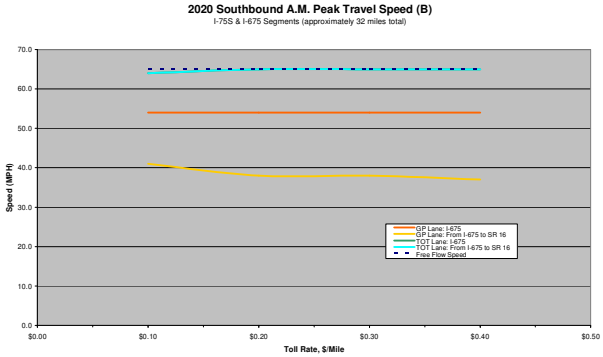












4.7.3 Selected Toll Rate

As discussed in the earlier section (4.3.3), the selection of toll rates for the TOT lanes must not erode average travel speed below 45 mph; and optimize the available toll rates and the usage of the TOT lanes.

In general, the TOT revenue increases steadily as toll rate increase. The TOT utility rate was calculated to select the recommended toll rates so that the usage of TOT lanes and revenue can be optimized.

$$\text{TOT Utility Rate} = \frac{Truck\ Volume\ on\ TOT\ Lanes\ @\ Toll\ Rate}{Truck\ Volume\ on\ TOL\ (No-Toll)}$$

The recommended toll rate contains at least 40% of TOT utility rate when compared to free truck only lane condition. Table 4-15 presents the recommended TOT toll rates. In 2020 and 2030, TOT lane will operate at a desired operating speed of 50 mph or above.

4.7.4 Estimated Weekday Traffic

Refer to Appendix 4-B for Alternative B 2020 and 2030 traffic diagrams of:

- Daily Total Trips;
- AM Total Trips;
- PM Total Trips; and
- MD Total Trips.

4.7.5 Revenue Projections

Table 4-16 presents estimated gross toll revenue by period. Revenues shown in the table for each period were obtained at the recommended toll levels for Alternative B described previously, for each travel direction and then aggregated to a daily total. For example, approximately $22,385 in daily revenue is expected on a typical opening year weekday; whereas $4,477 in daily revenue is expected on a typical opening year weekend day.

The net revenue stream in un-inflated 2007 dollars and inflated dollars are presented in Table 4-17 and Table 4-18 respectively. From year 2020 to year 2050, Alternative B will generate approximately $1.186 billion cumulative net revenue in un-inflated 2007 dollars and approximately $2.585 billion cumulative net revenue in inflated dollars.

Table 4-15: Recommended Toll Rates – Alternative B

Year	Analysis Period	Dir	Toll Rates Analyzed		TOT Utility Rate @ Minimum Toll Rate		TOT Utility Rate @ Maximum Toll Rate		Recommended Toll Rates		ML Speed @ Recommended Toll Rate	
			Minimum	Maximum	I-675	I-75 S	I-675	I-75 S	I-675	I-75 S	I-675	I-75 S
2020	AM Peak Period	NB	$0.10	$0.40	80%	72%	31%	25%	$0.10	$0.20	64	64
		SB	$0.10	$0.40	40%	43%	13%	13%	$0.10	$0.10	64	64
	Midday Period	NB	$0.10	$0.40	45%	53%	15%	22%	$0.10	$0.20	65	64
		SB	$0.10	$0.40	40%	43%	15%	15%	$0.10	$0.10	64	64
	PM Peak Period	NB	$0.10	$0.40	60%	68%	21%	28%	$0.10	$0.10	65	63
		SB	$0.10	$0.40	64%	70%	23%	26%	$0.10	$0.20	64	65
2030	AM Peak Period	NB	$0.10	$0.80	77%	82%	30%	25%	$0.40	$0.40	63	62
		SB	$0.10	$0.80	63%	64%	15%	15%	$0.20	$0.20	63	63
	Midday Period	NB	$0.10	$0.80	64%	78%	23%	29%	$0.20	$0.30	64	60
		SB	$0.10	$0.80	70%	72%	20%	20%	$0.20	$0.20	62	62
	PM Peak Period	NB	$0.10	$0.80	80%	79%	31%	29%	$0.30	$0.30	64	60
		SB	$0.10	$0.80	78%	82%	25%	27%	$0.30	$0.30	62	63

Table 4-16: Annual Gross Toll Revenue (un-inflated dollars) – Alternative B

Year (1)	Weekday TOT Revenue By Period (2)				TOT Total Weekday	TOT Total Weekend	Estimated Annual Gross Revenue (4)	Cumulative Gross Revenue
	AM Peak	Midday	PM Peak	Night				
2020	$ 6,336	$ 7,992	$ 7,563	$ 495	$ 22,385	$ 4,477	$ 6,111,105	$ 6,111,105
2021	$ 9,328	$ 12,168	$ 11,486	$ 761	$ 33,742	$ 6,748	$ 9,211,430	$ 15,322,535
2022	$ 13,744	$ 18,328	$ 17,272	$ 1,144	$ 50,488	$ 10,098	$ 13,783,224	$ 29,105,759
2023	$ 19,410	$ 26,287	$ 24,745	$ 1,649	$ 72,090	$ 14,418	$ 19,680,679	$ 48,786,438
2024	$ 22,840	$ 31,290	$ 29,430	$ 1,960	$ 85,520	$ 17,104	$ 23,346,960	$ 72,133,398
2025	$ 25,670	$ 35,490	$ 33,350	$ 2,230	$ 96,740	$ 19,348	$ 26,410,020	$ 98,543,418
2026	$ 28,500	$ 39,680	$ 37,270	$ 2,490	$ 107,940	$ 21,588	$ 29,467,620	$ 128,011,038
2027	$ 31,330	$ 43,870	$ 41,190	$ 2,760	$ 119,150	$ 23,830	$ 32,527,950	$ 160,538,988
2028	$ 34,160	$ 48,060	$ 45,110	$ 3,020	$ 130,350	$ 26,070	$ 35,585,550	$ 196,124,538
2029	$ 36,990	$ 52,250	$ 49,030	$ 3,290	$ 141,560	$ 28,312	$ 38,645,880	$ 234,770,418
2030	$ 39,820	$ 56,440	$ 52,950	$ 3,550	$ 152,760	$ 30,552	$ 41,703,480	$ 276,473,898
2031	$ 41,240	$ 58,540	$ 54,910	$ 3,820	$ 158,510	$ 31,702	$ 43,273,230	$ 319,747,128
2032	$ 42,650	$ 60,630	$ 56,870	$ 4,080	$ 164,230	$ 32,846	$ 44,834,790	$ 364,581,918
2033	$ 44,070	$ 62,730	$ 58,830	$ 4,350	$ 169,980	$ 33,996	$ 46,404,540	$ 410,986,458
2034	$ 45,480	$ 64,820	$ 60,790	$ 4,610	$ 175,700	$ 35,140	$ 47,966,100	$ 458,952,558
2035	$ 46,900	$ 66,920	$ 62,750	$ 4,880	$ 181,450	$ 36,290	$ 49,535,850	$ 508,488,408
2036	$ 48,310	$ 69,010	$ 64,710	$ 5,140	$ 187,170	$ 37,434	$ 51,097,410	$ 559,585,818
2037	$ 49,730	$ 71,110	$ 66,670	$ 5,410	$ 192,920	$ 38,584	$ 52,667,160	$ 612,252,978
2038	$ 51,140	$ 73,200	$ 68,630	$ 5,670	$ 198,640	$ 39,728	$ 54,228,720	$ 666,481,698
2039	$ 52,560	$ 75,300	$ 70,590	$ 5,940	$ 204,390	$ 40,878	$ 55,798,470	$ 722,280,168
2040	$ 53,970	$ 77,400	$ 72,550	$ 6,200	$ 210,120	$ 42,024	$ 57,362,760	$ 779,642,928
2041	$ 55,390	$ 79,490	$ 74,510	$ 6,470	$ 215,860	$ 43,172	$ 58,929,780	$ 838,572,708
2042	$ 56,800	$ 81,590	$ 76,470	$ 6,730	$ 221,590	$ 44,318	$ 60,494,070	$ 899,066,778
2043	$ 58,220	$ 83,680	$ 78,430	$ 7,000	$ 227,330	$ 45,466	$ 62,061,090	$ 961,127,868
2044	$ 59,630	$ 85,780	$ 80,390	$ 7,260	$ 233,060	$ 46,612	$ 63,625,380	$ 1,024,753,248
2045	$ 61,050	$ 87,870	$ 82,350	$ 7,530	$ 238,800	$ 47,760	$ 65,192,400	$ 1,089,945,648
2046	$ 62,460	$ 89,970	$ 84,310	$ 7,790	$ 244,530	$ 48,906	$ 66,756,690	$ 1,156,702,338
2047	$ 63,880	$ 92,060	$ 86,270	$ 8,060	$ 250,270	$ 50,054	$ 68,323,710	$ 1,225,026,048
2048	$ 65,290	$ 94,160	$ 88,230	$ 8,320	$ 256,000	$ 51,200	$ 69,888,000	$ 1,294,914,048
2049	$ 66,710	$ 96,250	$ 90,190	$ 8,590	$ 261,740	$ 52,348	$ 71,455,020	$ 1,366,369,068
2050	$ 68,120	$ 98,350	$ 92,150	$ 8,850	$ 267,470	$ 53,494	$ 73,019,310	$ 1,439,388,378

(1) A ramp-up period is assumed for the first four years of operation
(2) 2007 Dollars
(3) Weekend day revenue for TOT lanes is estimated to be 20 percent of weekday revenue
(4) Annual revenue calculations assume 250 weekdays and 115 weekend/holidays for TOT Lanes

Table 4-17: Net Revenue Summary--- un-inflated dollars (000) – Alternative B

Year	Gross Annual Toll Revenue (1)	Annual Transactions (2)	Operation Cost (3)	Infrastructure Operation and Maintenance Cost (4)	Net Annual Revenue	Cumulative Annual Net Revenue
2020	$ 6,111	1,618	$ 340	$ 6,948	$ (1,177)	$ (1,177)
2021	$ 9,211	2,085	$ 438	$ 6,948	$ 1,826	$ 1,826
2022	$ 13,783	2,780	$ 584	$ 6,948	$ 6,251	$ 8,077
2023	$ 19,681	3,631	$ 762	$ 6,948	$ 11,970	$ 20,047
2024	$ 23,347	4,008	$ 842	$ 6,948	$ 15,557	$ 35,605
2025	$ 26,410	4,275	$ 898	$ 6,948	$ 18,564	$ 54,169
2026	$ 29,468	4,543	$ 954	$ 6,948	$ 21,566	$ 75,734
2027	$ 32,528	4,808	$ 1,010	$ 6,948	$ 24,570	$ 100,305
2028	$ 35,586	5,075	$ 1,066	$ 6,948	$ 27,572	$ 127,877
2029	$ 38,646	5,343	$ 1,122	$ 6,948	$ 30,576	$ 158,453
2030	$ 41,703	5,608	$ 1,178	$ 6,948	$ 33,578	$ 192,030
2031	$ 43,273	5,741	$ 1,206	$ 6,948	$ 35,120	$ 227,150
2032	$ 44,835	5,875	$ 1,234	$ 6,948	$ 36,653	$ 263,803
2033	$ 46,405	6,009	$ 1,262	$ 6,948	$ 38,195	$ 301,998
2034	$ 47,966	6,143	$ 1,290	$ 6,948	$ 39,728	$ 341,726
2035	$ 49,536	6,274	$ 1,317	$ 6,948	$ 41,270	$ 382,996
2036	$ 51,097	6,407	$ 1,346	$ 6,948	$ 42,804	$ 425,800
2037	$ 52,667	6,541	$ 1,374	$ 6,948	$ 44,346	$ 470,146
2038	$ 54,229	6,675	$ 1,402	$ 6,948	$ 45,879	$ 516,025
2039	$ 55,798	6,809	$ 1,430	$ 6,948	$ 47,421	$ 563,445
2040	$ 57,363	6,940	$ 1,457	$ 6,948	$ 48,957	$ 612,403
2041	$ 58,930	7,073	$ 1,485	$ 6,948	$ 50,496	$ 662,899
2042	$ 60,494	7,207	$ 1,514	$ 6,948	$ 52,033	$ 714,932
2043	$ 62,061	7,341	$ 1,542	$ 6,948	$ 53,571	$ 768,503
2044	$ 63,625	7,475	$ 1,570	$ 6,948	$ 55,108	$ 823,611
2045	$ 65,192	7,609	$ 1,598	$ 6,948	$ 56,647	$ 880,257
2046	$ 66,757	7,740	$ 1,625	$ 6,948	$ 58,183	$ 938,441
2047	$ 68,324	7,873	$ 1,653	$ 6,948	$ 59,722	$ 998,163
2048	$ 69,888	8,007	$ 1,681	$ 6,948	$ 61,259	$ 1,059,422
2049	$ 71,455	8,141	$ 1,710	$ 6,948	$ 62,797	$ 1,122,219
2050	$ 73,019	8,275	$ 1,738	$ 6,948	$ 64,334	$ 1,186,553

(1) Uninflated revenues are in 2007 dollars.
(2) Annual transaction do not include non-toll paying vehicles.
(3) Operation cost is assumed to be $0.21 per tolled transaction and it includes Billing and Administration Cost; Violations Center Operations Cost and Customer Service Center Cost; Enforcement cost and Toll Equipment Maintenance Cost.
(4) Annual Infrastructure Operation and Maintenance Cost is assumed to be 0.5% of the total capital cost.

Table 4-18: Annual Toll Revenue in Inflated Dollars (000) – Alternative B

Year	UNINFLATED DOLLARS (000)				Inflation Factors		INFLATED DOLLARS (000)			
	Total Gross Annual Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Net Cumulative Annual	Toll Revenue	O&M	Gross Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Cumulative Annual Revenue
2020	$ 6,111	$ 7,288	$ (1,177)	$ (1,177)	1.379	1.469	$ 8,427	$ 10,706	$ (2,279)	$ (2,279)
2021	$ 9,211	$ 7,386	$ 1,826	$ 649	1.413	1.513	$ 13,016	$ 11,175	$ 1,841	$ (438)
2022	$ 13,783	$ 7,532	$ 6,251	$ 6,900	1.448	1.558	$ 19,958	$ 11,735	$ 8,223	$ 7,786
2023	$ 19,681	$ 7,710	$ 11,970	$ 18,871	1.485	1.605	$ 29,226	$ 12,375	$ 16,851	$ 24,636
2024	$ 23,347	$ 7,790	$ 15,557	$ 34,428	1.522	1.653	$ 35,534	$ 12,876	$ 22,658	$ 47,294
2025	$ 26,410	$ 7,846	$ 18,564	$ 52,992	1.560	1.702	$ 41,200	$ 13,354	$ 27,846	$ 75,140
2026	$ 29,468	$ 7,902	$ 21,566	$ 74,558	1.599	1.754	$ 47,119	$ 13,860	$ 33,259	$ 108,399
2027	$ 32,528	$ 7,958	$ 24,570	$ 99,128	1.639	1.806	$ 53,313	$ 14,371	$ 38,942	$ 147,341
2028	$ 35,586	$ 8,014	$ 27,572	$ 126,700	1.680	1.860	$ 59,784	$ 14,906	$ 44,878	$ 192,219
2029	$ 38,646	$ 8,070	$ 30,576	$ 157,276	1.722	1.916	$ 66,548	$ 15,462	$ 51,086	$ 243,305
2030	$ 41,703	$ 8,126	$ 33,578	$ 190,854	1.765	1.974	$ 73,607	$ 16,040	$ 57,567	$ 300,872
2031	$ 43,273	$ 8,154	$ 35,120	$ 225,973	1.809	2.033	$ 78,281	$ 16,576	$ 61,705	$ 362,577
2032	$ 44,835	$ 8,182	$ 36,653	$ 262,626	1.854	2.094	$ 83,124	$ 17,133	$ 65,991	$ 428,568
2033	$ 46,405	$ 8,210	$ 38,195	$ 300,821	1.900	2.157	$ 88,169	$ 17,709	$ 70,460	$ 499,028
2034	$ 47,966	$ 8,238	$ 39,728	$ 340,549	1.948	2.221	$ 93,438	$ 18,296	$ 75,142	$ 574,169
2035	$ 49,536	$ 8,265	$ 41,270	$ 381,820	1.996	2.288	$ 98,874	$ 18,911	$ 79,962	$ 654,132
2036	$ 51,097	$ 8,294	$ 42,804	$ 424,623	2.046	2.357	$ 104,545	$ 19,548	$ 84,997	$ 739,129
2037	$ 52,667	$ 8,322	$ 44,346	$ 468,969	2.098	2.427	$ 110,496	$ 20,197	$ 90,299	$ 829,428
2038	$ 54,229	$ 8,350	$ 45,879	$ 514,848	2.150	2.500	$ 116,592	$ 20,874	$ 95,717	$ 925,146
2039	$ 55,798	$ 8,378	$ 47,421	$ 562,269	2.204	2.575	$ 122,980	$ 21,573	$ 101,407	$ 1,026,553
2040	$ 57,363	$ 8,405	$ 48,957	$ 611,226	2.259	2.652	$ 129,582	$ 22,291	$ 107,292	$ 1,133,844
2041	$ 58,930	$ 8,433	$ 50,496	$ 661,722	2.315	2.732	$ 136,422	$ 23,040	$ 113,382	$ 1,247,227
2042	$ 60,494	$ 8,462	$ 52,033	$ 713,755	2.373	2.814	$ 143,552	$ 23,811	$ 119,742	$ 1,366,968
2043	$ 62,061	$ 8,490	$ 53,571	$ 767,326	2.433	2.898	$ 150,995	$ 24,603	$ 126,392	$ 1,493,360
2044	$ 63,625	$ 8,518	$ 55,108	$ 822,434	2.493	2.985	$ 158,618	$ 25,425	$ 133,193	$ 1,626,553
2045	$ 65,192	$ 8,546	$ 56,647	$ 879,081	2.556	3.075	$ 166,632	$ 26,278	$ 140,353	$ 1,766,906
2046	$ 66,757	$ 8,573	$ 58,183	$ 937,264	2.620	3.167	$ 174,903	$ 27,152	$ 147,751	$ 1,914,657
2047	$ 68,324	$ 8,601	$ 59,722	$ 996,986	2.685	3.262	$ 183,449	$ 28,058	$ 155,391	$ 2,070,049
2048	$ 69,888	$ 8,629	$ 61,259	$ 1,058,245	2.752	3.360	$ 192,332	$ 28,995	$ 163,337	$ 2,233,385
2049	$ 71,455	$ 8,658	$ 62,797	$ 1,121,042	2.821	3.461	$ 201,575	$ 29,964	$ 171,611	$ 2,404,996
2050	$ 73,019	$ 8,686	$ 64,334	$ 1,185,376	2.892	3.565	$ 211,172	$ 30,964	$ 180,207	$ 2,585,203

Notes: Uninflated revenues and costs are in 2007 dollars.
Annual inflation rates of 2.5% and 3.0% are applied for toll revenue and O&M cost respectively.

4.8 Traffic and Toll Revenue Estimates - Alternative C-1

Alternative C-1 assumed the construction of two managed lanes in each direction on I-75 South corridor from I-285 to SR 16 and the construction of two voluntary Truck Only Toll (TOT) Lanes in each direction along I-675 and I-75 South corridor from I-675 to SR 16.

The tolling and policy framework evaluated in this alternative for managed lanes is HOT-2+. HOT-2+ refers to a tolling alternative that would allow HOVs with two or more people to ride free along with transit vehicles, emergency/police vehicles, and motorcycles. SOVs and Commercial Vehicles (CV) including commercially registered autos, pickup trucks, and vans would pay a toll to use the managed lanes. It was assumed that Medium-Duty Trucks (MDT) and Heavy-Duty Trucks (HDT) would not be allowed to utilize the managed lane system in this alternative.

The truck tolling and policy framework evaluated in this alternative is optional TOT. Optional TOT refers to a truck tolling alternative that would allow MDT (FHWA classes 4-7) and HDT (FHWA classes 8-13) to pay a toll to use the TOT lanes.

4.8.1 Toll Sensitivity Analysis Results

A summary of the results of the managed lane and TOT lane toll sensitivity analysis for Alternative C-1 in 2020 and 2030 is presented in Figures 4-35 through 4-46.

As shown in Figure 4-35, the managed lane toll rate resulting in the maximum AM peak period revenue is expected to be $0.15 per mile northbound and $0.10 per mile southbound for all three segments. The difference between the toll rates is expected since AM peak period demand in the northbound direction exceeds the southbound direction.

Figure 4-36 illustrates the managed lane revenue of three segments for the Midday peak period; the toll rate resulting in the maximum Midday period revenue is expected to be $0.10 per mile northbound for segment I and II and $0.15 per mile for segment III. The toll rate resulting in the maximum Midday period revenue is expected to be $0.10 per mile southbound for all three segments. The similar toll rate is expected during the Midday period since the distribution of demand between the northbound and southbound direction is fairly uniform.

Figure 4-37 shows the managed lane revenue for three segments for the PM peak period. The toll rate resulting in the maximum PM peak period revenue is expected to be $0.10 per mile northbound for all three segments; and $0.15 per mile southbound for segment I and $0.20 per mile for segment II and segment III. When compared to AM peak period, the directional results were reversed as northbound morning commuters are returning home.

Figures 4-38 through 4-40 illustrate the TOT revenue of two segments: I-75 from SR 16 to I-675 and I-675, for the AM peak period, Midday period and PM peak period. In general, as toll rates increase, TOT revenue generated by the TOT lanes increase slightly. The TOT lane revenue curve is less sensitive to the toll rates since the truck operators and shippers has higher willingness to pay level and there is lower hourly truck

demand for TOT lanes when compared to the SOV and CV demand for the managed lanes.

The toll sensitivity curves for managed lanes in Alternative C-1 follow a similar pattern as the Alternative A-1. However, it was observed that with the same toll rate, the revenue generated by managed lanes along I-75 South corridor in this Alternative is slightly lower when compared to Alternative A-1. This is anticipated since the provision of TOT along the I-75 South corridor relieves some of the congestion in the general-purpose lanes by diverting Medium-Duty and Heavy-Duty truck volumes from general-purpose lanes to TOT lanes; and correspondingly reducing achievable time savings in the managed lanes.

The recommended toll rates for the over night period are $0.02 per mile for managed lanes and $0.05 per mile for TOT lanes in 2020 for both directions. Similar conclusions can be drawn from studying toll sensitivity curves in the year 2030.

Figure 4-35: 2020 AM Peak Period HOT Sensitivity Curves – Alternative C-1

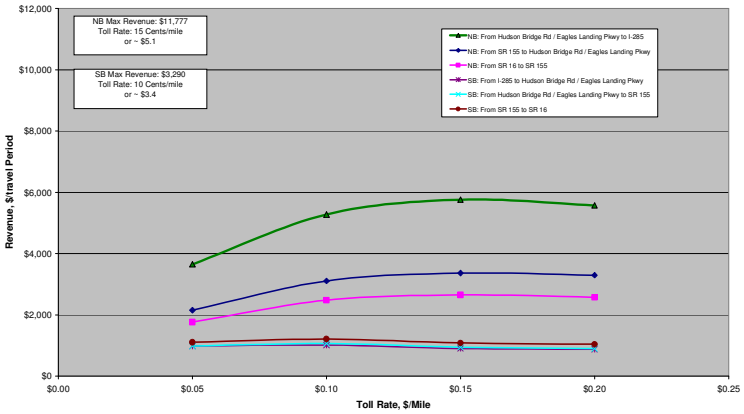


Figure 4-36: 2020 Midday Period HOT Sensitivity Curves – Alternative C-1

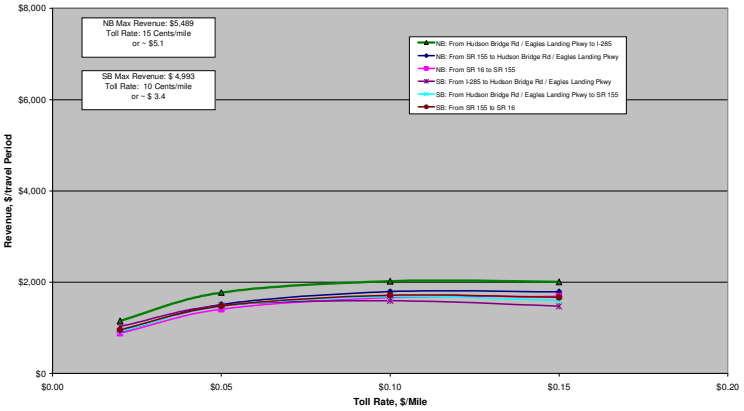


Figure 4-37: 2020 PM Peak Period HOT Sensitivity Curves – Alternative C-1

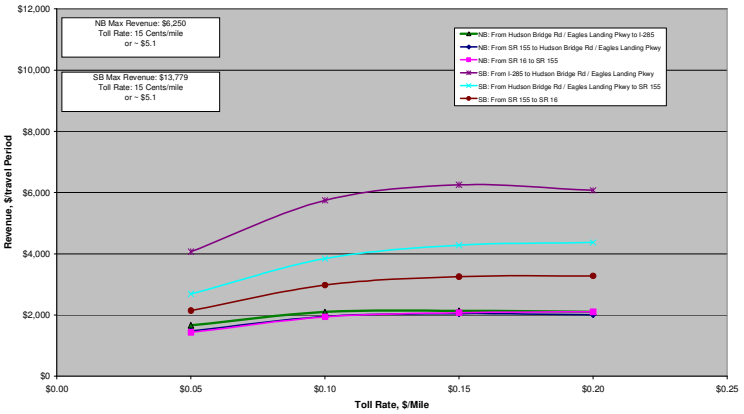


Figure 4-38: 2020 AM Peak Period TOT Sensitivity Curves – Alternative C-1

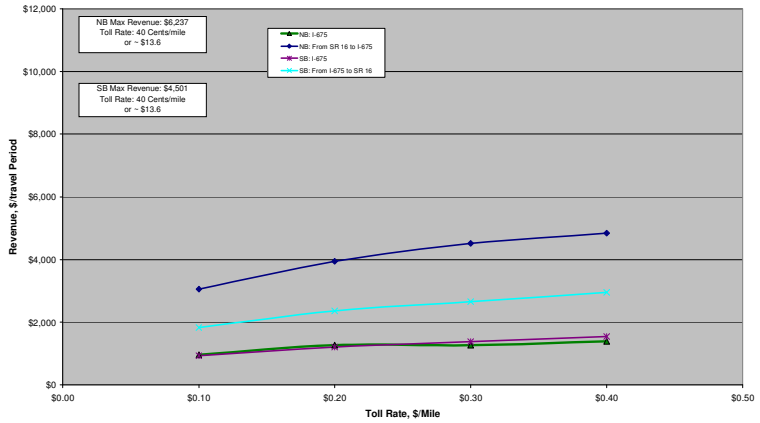


Figure 4-39: 2020 Midday Peak Period TOT Sensitivity Curves – Alternative C-1

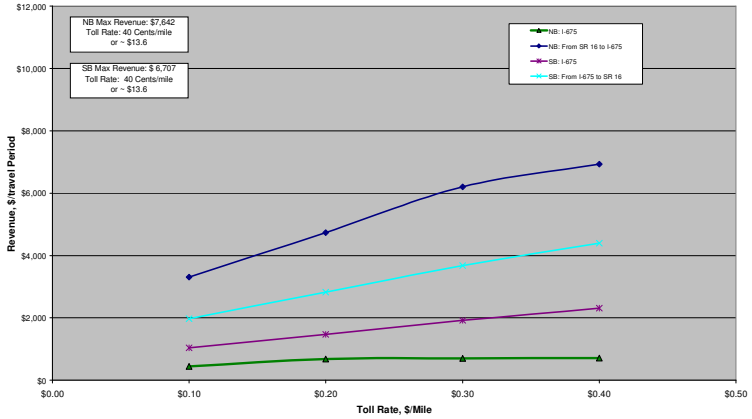


Figure 4-40: 2020 PM Peak Period TOT Sensitivity Curves – Alternative C-1

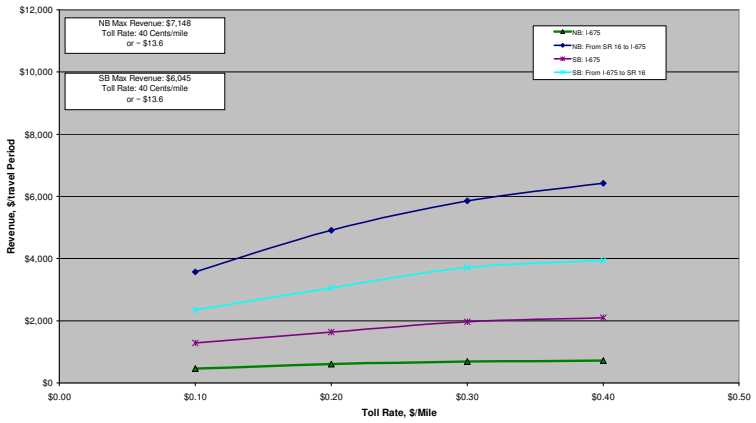


Figure 4-41: 2030 AM Peak Period HOT Sensitivity Curves – Alternative C-1

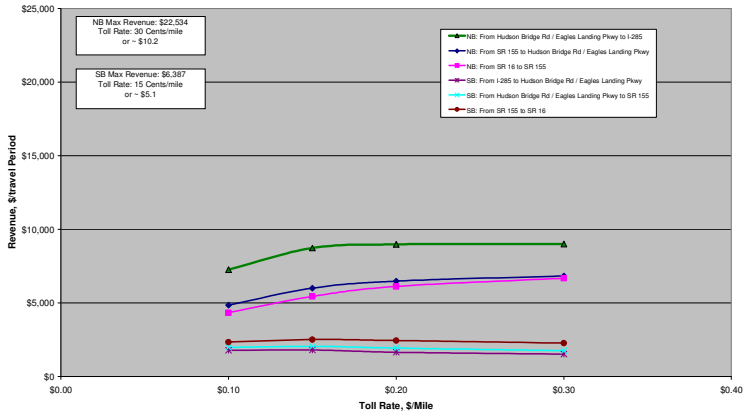


Figure 4-42: 2030 Midday Period HOT Sensitivity Curves – Alternative C-1

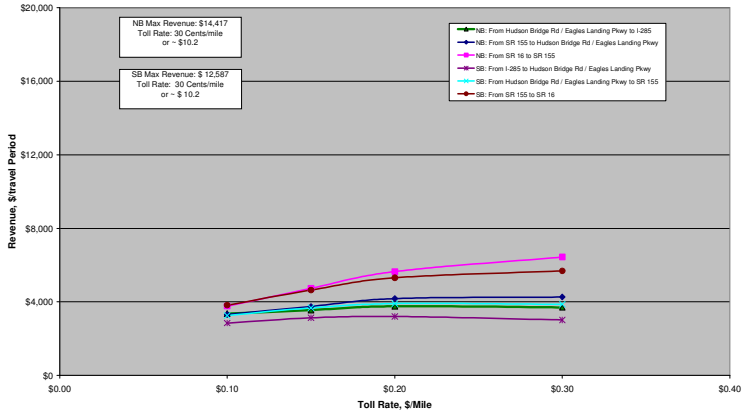


Figure 4-43: 2030 PM Peak Period HOT Sensitivity Curves – Alternative C-1

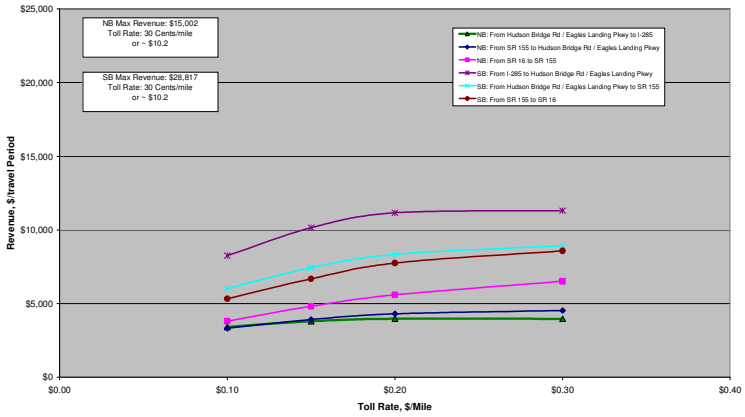


Figure 4-44: 2030 AM Peak Period TOT Sensitivity Curves – Alternative C-1

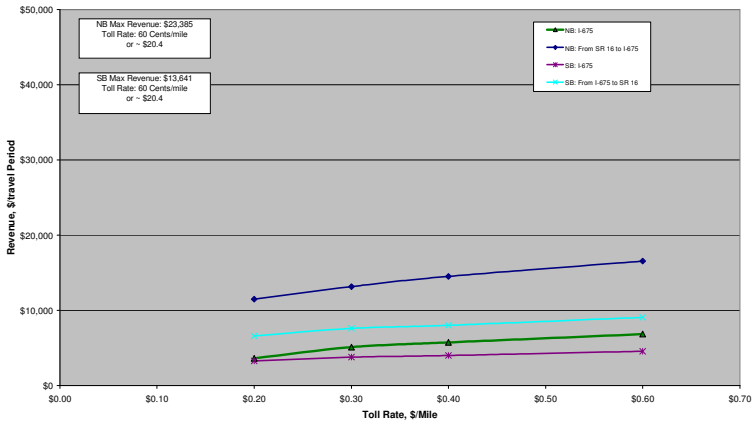


Figure 4-45: 2030 Midday Peak Period TOT Sensitivity Curves – Alternative C-1

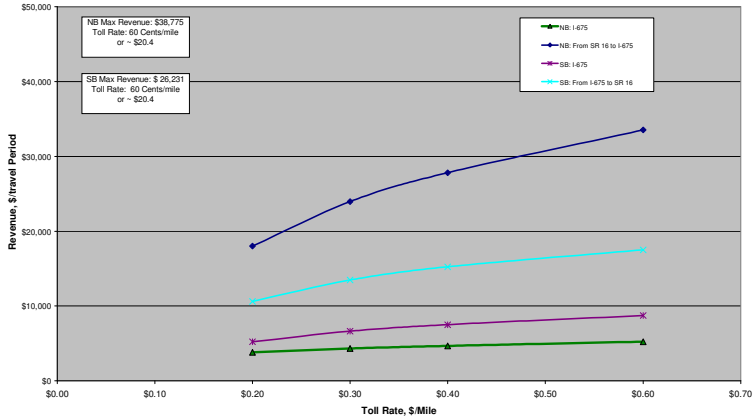
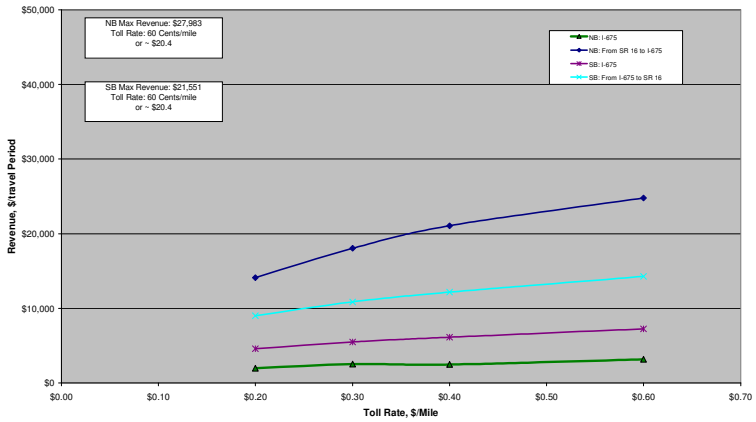


Figure 4-46: 2030 PM Peak Period TOT Sensitivity Curves – Alternative C-1



4.8.2 Toll Revenue Verses Operational Tradeoffs

To illustrate the tradeoffs between revenue optimization and operational efficiency, toll rate operational profiles on managed lanes and truck-only-toll lanes were developed for the opening year of 2020 and horizon year of 2030 under various toll rates, separately by time-of-day and by direction of travel.

Figure 4-47 provides a comparative operating profile for opening year 2020 AM peak period for managed lanes. The first two upper figures illustrate the relationship between managed lane revenue and toll rate by travel direction. In the northbound direction, the peak direction in the morning, the managed lane revenue generated is much higher than that of the southbound direction.

In the second series of charts, vehicle-miles of travel (VMT) by direction are shown for:

- Total vehicles on the managed lanes;
- Priced vehicles on the managed lanes (SOVs and CVs in this application); and
- Free vehicles on the managed lanes (all HOV2+s in this application).

Again VMT in the northbound direction substantially exceeds that of the southbound direction for each vehicle class.

The two lower figures illustrate average speed drawn from the traffic assignment results in the general-purpose and managed lanes with respect to various toll rates. As toll rates increase, average speed in the managed lanes increase slightly as more SOVs and CVs migrate back to the general-purpose lanes. At very low toll rates the travel time savings provided by the managed lanes has tremendous value, attracting many SOV motorists and CV travelers. As a result, the managed lanes are inundated with SOV and CV traffic driving the average speed down. Speeds in the managed lanes steadily rebound as willingness to pay decreases as the toll rate increases.

In the PM peak periods, the major distinction is the reversal of travel patterns as the northbound peak direction swivels to the southbound direction. In the Midday analysis period, revenue, VMT and average travel speed are comparable for northbound direction and southbound direction.

Figure 4-48 provides a comparative operating profile for opening year 2020 AM peak period for TOT lanes. Again, the first two upper figures illustrate the relationship between the TOT lane revenue and toll rate by travel direction. In the northbound direction, the peak direction in the morning, the TOT lane revenue generated is slightly higher than that of the southbound direction.

In the second series of charts, vehicle-miles of travel (VMT) by direction are shown for:

- Total vehicles on the TOT lanes; and
- Priced vehicles on the TOT lanes (medium-duty truck and heavy-duty truck in this application);

VMT in the northbound direction slightly exceeds that of the southbound direction for each vehicle class.

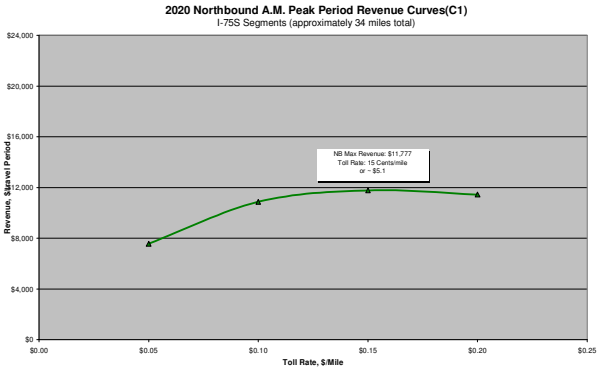
The two lower figures illustrate average speed drawn from the traffic assignment results in the general-purpose and TOT lanes with respect to various toll rates. As toll rates increase, average speed in the general purpose lanes decrease slightly as more heavy-duty and medium-duty trucks migrate back to the general-purpose lanes. Due to the relatively lower through truck demand for TOT lanes, the average operating speed on TOT lanes can be maintained at the free-flow speed of 65 mph under the various toll rates.

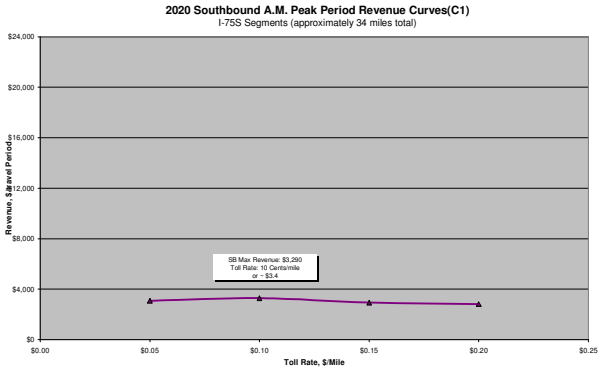
In the PM and Midday peak analysis periods, revenue, VMT and average travel speed are pretty comparable for northbound direction and southbound direction.

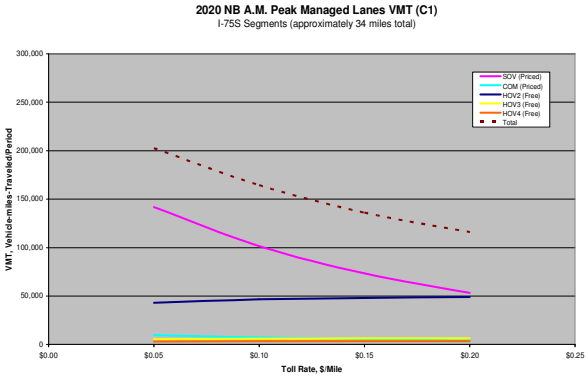
Similar logic for revenue, VMT and average travel speed are observed for the horizon year of 2030, thus a detailed description will not be repeated.

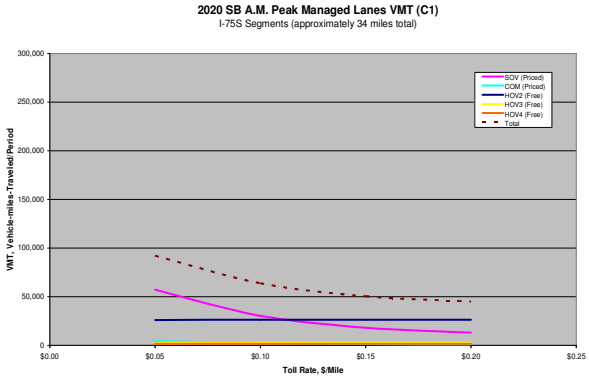
Refer to Appendix 4-A for a complete set of operating profiles for opening year 2020 and horizon year of 2030 AM peak period, PM peak period and Midday period.

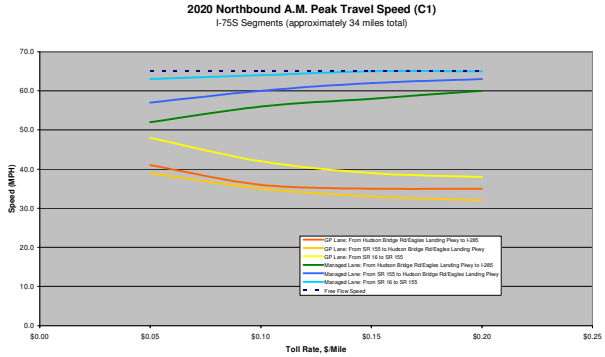
Figure 4-47: 2020 AM Peak Period Toll Rate Operational Profile – Alternative C-1 (Managed Lanes)











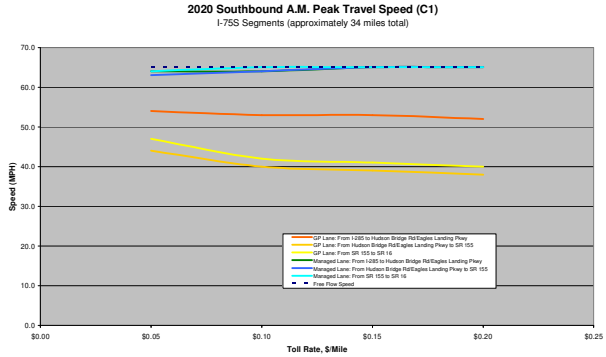
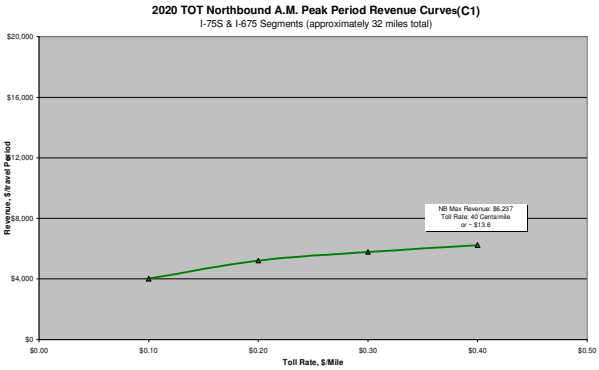
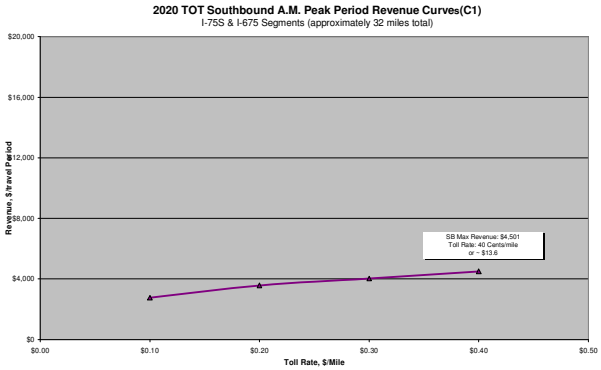
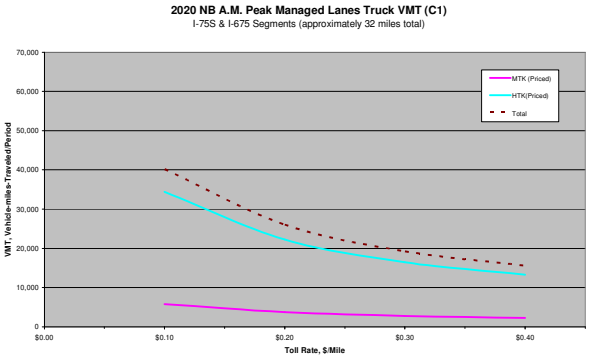
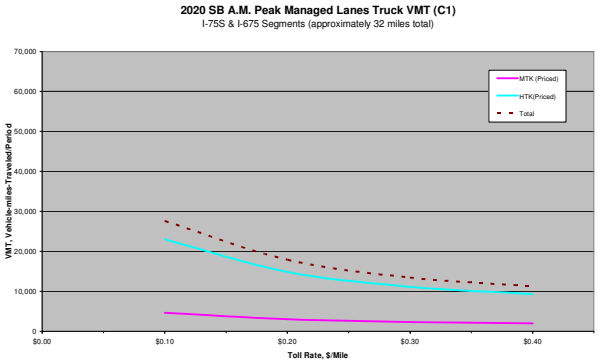


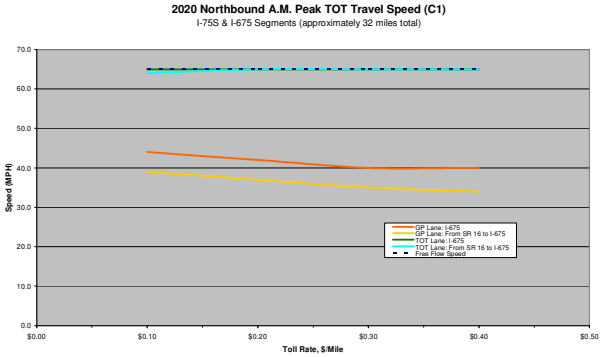
Figure 4-48: 2020 AM Peak Period Toll Rate Operational Profile – Alternative C-1 (TOT Lanes)

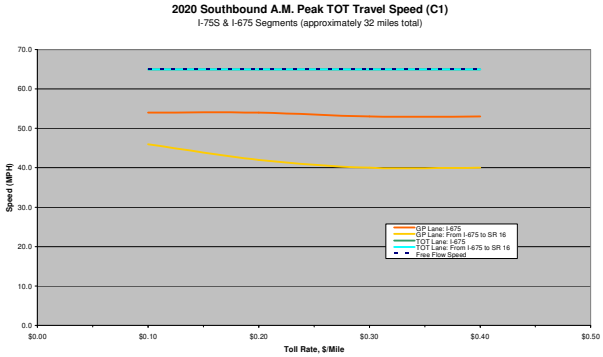












4.8.3 Selected Toll Rate

As discussed in the earlier section (4.3.3), the selection of toll rates for the managed lanes and TOT lanes must:

- Not erode HOT/ TOT/ETL lane average travel speed below 45 mph;
- Optimize available toll rates for HOT/TOT/ETL lane; and
- Optimize usage for HOT/TOT/ETL lane.

The detailed steps for selecting toll rate for managed lanes are summaries as follows:

- Identify the optimum toll rate (the rate that produced the most revenue).
- Lower the toll rate by $0.05 - $0.08 per mile to allow the facility's operation to increase revenue as needed.
- Check to make sure the managed lanes are operating above 45 mph.
- If not, increase the toll rate until the desired operating conditions is achieved.

Table 4-19 presents the selected managed lanes toll rates. In 2020 and 2030, a desired operating speed of 45 mph or above can be maintained at the recommended toll rates.

In general, the TOT revenue increases steadily as toll rate increase. The TOT utility rate was calculated to select the recommended toll rates so that the usage of TOT lanes and revenue can be optimized.

$$\text{TOT Utility Rate} = \frac{Truck\ Volume\ on\ TOT\ Lanes\ @\ Toll\ Rate}{Truck\ Volume\ on\ TOL\ (No-Toll)}$$

The recommended toll rate contains at least 40% of TOT utility rate when compared to free truck only lane condition. Table 4-20 presents the recommended TOT toll rates. In 2020 and 2030, TOT lane will operate at a desired operating speed of 50 mph or above.

4.8.4 Estimated Weekday Traffic

Refer to Appendix 4-B for Alternative C-1 2020 and 2030 traffic diagrams of:

- Daily Total Trips;
- AM Total Trips;
- PM Total Trips; and
- MD Total Trips.

4.8.5 Revenue Projections

Table 4-21 presents estimated gross toll revenue by period for the managed lanes and TOT lanes. Revenues shown in the table for each period were obtained at the optimum toll levels for Alternative C-1 described previously for managed lanes and TOT lanes; for each travel direction and then aggregated to a daily total. For example, approximately $23,139 and $14,234 in daily revenue is expected on a typical opening year weekday for managed lanes and TOT lanes respectively; approximately $11,569 in daily revenue is

expected on a typical opening year weekend day for HOT lanes; whereas $2,847 in daily revenue is expected on a typical opening weekend day for TOT lanes.

The net revenue stream in un-inflated 2007 dollars and inflated dollars are presented in Table 4-22 and 4-23 respectively. From year 2020 to year 2045, Alternative C-1 will generate approximately $1.208 billion cumulative net revenue in un-inflated 2007 dollars and approximately $2.514 billion cumulative net revenue in inflated dollars.

Table 4-19: Recommended Toll Rates – HOT Lane – Alternative C-1

Year	Analysis Period	Dir	Maximum Revenue Toll Rates			Recommended Toll Rates			ML Speed @ Recommended Toll Rate		
			Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3
2020	AM Peak Period	NB	$0.15	$0.15	$0.15	$0.10	$0.10	$0.10	56	60	64
		SB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	64	63	64
	Midday Period	NB	$0.10	$0.10	$0.15	$0.05	$0.05	$0.05	63	63	64
		SB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	64	63	64
	PM Peak Period	NB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	62	62	64
		SB	$0.15	$0.20	$0.20	$0.10	$0.10	$0.10	56	60	64
	Night	NB	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	65	65	65
		SB	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	65	64	65
2030	AM Peak Period	NB	$0.30	$0.30	$0.15	$0.15	$0.15	$0.15	52	57	62
		SB	$0.15	$0.15	$0.15	$0.10	$0.10	$0.10	64	63	64
	Midday Period	NB	$0.20	$0.30	$0.30	$0.10	$0.10	$0.10	62	63	64
		SB	$0.20	$0.20	$0.30	$0.10	$0.10	$0.10	63	63	64
	PM Peak Period	NB	$0.20	$0.30	$0.30	$0.10	$0.10	$0.10	61	61	63
		SB	$0.30	$0.30	$0.30	$0.15	$0.15	$0.15	50	56	62
	Night	NB	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	64	64	65
		SB	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	64	64	65

Table 4-20: Recommended Toll Rates – Truck Only Lane – Alternative C-1

Year	Analysis Period	Dir	Toll Rates Analyzed		TOT Utility Rate @ Minimum Toll Rate		TOT Utility Rate @ Maximum Toll Rate		Recommended Toll Rates		ML Speed @ Recommended Toll Rate	
			Minimum	Maximum	I-675	I-75 S	I-675	I-75 S	I-675	I-75 S	I-675	I-75 S
2020	AM Peak Period	NB	$0.10	$0.40	58%	55%	21%	22%	$0.10	$0.20	65	65
		SB	$0.10	$0.40	30%	31%	12%	13%	$0.10	$0.10	65	65
	Midday Period	NB	$0.10	$0.40	30%	32%	12%	17%	$0.10	$0.10	65	64
		SB	$0.10	$0.40	24%	25%	13%	14%	$0.10	$0.10	65	65
	PM Peak Period	NB	$0.10	$0.40	44%	49%	17%	22%	$0.10	$0.10	65	64
		SB	$0.10	$0.40	44%	45%	18%	19%	$0.10	$0.20	65	65
2030	AM Peak Period	NB	$0.20	$0.60	54%	52%	34%	25%	$0.30	$0.30	64	63
		SB	$0.20	$0.60	36%	36%	17%	17%	$0.20	$0.20	64	64
	Midday Period	NB	$0.20	$0.60	56%	58%	26%	36%	$0.20	$0.20	64	61
		SB	$0.20	$0.60	40%	40%	22%	22%	$0.20	$0.20	64	64
	PM Peak Period	NB	$0.20	$0.60	48%	51%	26%	30%	$0.20	$0.30	64	62
		SB	$0.20	$0.60	47%	48%	25%	26%	$0.20	$0.20	64	64

Table 4-21: Annual Gross Toll Revenue (un-inflated dollars) – Alternative C-1

Year (1)	Weekday HOT Lane Revenue By Period (2)				HOT Total Weekday	HOT Weekend Day (3)	Weekday TOT Revenue By Period (2)				TOT Total Weekday	TOT Weekend Day (4)	Estimated Annual Gross Revenue (5)	Cumulative Gross Revenue
	AM Peak	Midday	PM Peak	Night			AM Peak	Midday	PM Peak	Night				
2020	$ 7,975	$ 4,741	$ 9,856	$ 567	$ 23,139	$ 11,569	$ 4,329	$ 4,653	$ 4,879	$ 374	$ 14,234	$ 2,847	$ 11,000,971	$ 11,000,971
2021	$ 10,257	$ 6,416	$ 12,825	$ 722	$ 30,219	$ 15,109	$ 6,429	$ 7,391	$ 7,371	$ 592	$ 21,782	$ 4,356	$ 15,238,538	$ 26,239,509
2022	$ 13,640	$ 8,904	$ 17,224	$ 960	$ 40,728	$ 20,364	$ 9,528	$ 11,416	$ 11,040	$ 912	$ 32,896	$ 6,579	$ 21,504,468	$ 47,743,977
2023	$ 17,780	$ 12,009	$ 22,640	$ 1,242	$ 53,670	$ 26,835	$ 13,522	$ 16,665	$ 15,782	$ 1,319	$ 47,288	$ 9,458	$ 29,413,043	$ 77,157,020
2024	$ 19,600	$ 13,630	$ 25,140	$ 1,370	$ 59,740	$ 29,870	$ 15,960	$ 20,080	$ 18,730	$ 1,590	$ 56,360	$ 11,272	$ 33,756,330	$ 110,913,350
2025	$ 20,880	$ 14,890	$ 26,950	$ 1,450	$ 64,170	$ 32,085	$ 17,980	$ 22,990	$ 21,200	$ 1,820	$ 63,990	$ 12,798	$ 37,201,545	$ 148,114,895
2026	$ 22,150	$ 16,140	$ 28,750	$ 1,530	$ 68,570	$ 34,285	$ 20,000	$ 25,900	$ 23,660	$ 2,050	$ 71,610	$ 14,322	$ 40,634,805	$ 188,749,700
2027	$ 23,430	$ 17,390	$ 30,560	$ 1,620	$ 73,000	$ 36,500	$ 22,020	$ 28,800	$ 26,130	$ 2,280	$ 79,230	$ 15,846	$ 44,077,290	$ 232,826,990
2028	$ 24,700	$ 18,640	$ 32,360	$ 1,700	$ 77,400	$ 38,700	$ 24,050	$ 31,710	$ 28,590	$ 2,500	$ 86,850	$ 17,370	$ 47,510,550	$ 280,337,540
2029	$ 25,980	$ 19,900	$ 34,170	$ 1,790	$ 81,840	$ 40,920	$ 26,070	$ 34,610	$ 31,060	$ 2,730	$ 94,470	$ 18,894	$ 50,956,110	$ 331,293,650
2030	$ 27,250	$ 21,150	$ 35,970	$ 1,870	$ 86,240	$ 43,120	$ 28,090	$ 37,520	$ 33,520	$ 2,960	$ 102,090	$ 20,418	$ 54,389,370	$ 385,683,020
2031	$ 27,890	$ 21,780	$ 36,870	$ 1,950	$ 88,490	$ 44,245	$ 29,100	$ 38,970	$ 34,750	$ 3,070	$ 105,890	$ 21,178	$ 56,118,645	$ 441,801,665
2032	$ 28,530	$ 22,400	$ 37,780	$ 2,040	$ 90,750	$ 45,375	$ 30,110	$ 40,430	$ 35,990	$ 3,190	$ 109,720	$ 21,944	$ 57,859,185	$ 499,660,850
2033	$ 29,160	$ 23,030	$ 38,680	$ 2,120	$ 92,990	$ 46,495	$ 31,120	$ 41,880	$ 37,220	$ 3,300	$ 113,520	$ 22,704	$ 59,585,385	$ 559,246,235
2034	$ 29,800	$ 23,660	$ 39,580	$ 2,210	$ 95,250	$ 47,625	$ 32,130	$ 43,330	$ 38,450	$ 3,420	$ 117,330	$ 23,466	$ 61,320,465	$ 620,566,700
2035	$ 30,440	$ 24,280	$ 40,480	$ 2,290	$ 97,490	$ 48,745	$ 33,150	$ 44,790	$ 39,680	$ 3,530	$ 121,150	$ 24,230	$ 63,052,125	$ 683,618,825
2036	$ 31,080	$ 24,910	$ 41,390	$ 2,370	$ 99,750	$ 49,875	$ 34,160	$ 46,240	$ 40,920	$ 3,640	$ 124,960	$ 24,992	$ 64,787,205	$ 748,406,030
2037	$ 31,710	$ 25,540	$ 42,290	$ 2,460	$ 102,000	$ 51,000	$ 35,170	$ 47,690	$ 42,150	$ 3,760	$ 128,770	$ 25,754	$ 66,519,210	$ 814,925,240
2038	$ 32,350	$ 26,160	$ 43,190	$ 2,540	$ 104,240	$ 52,120	$ 36,180	$ 49,140	$ 43,380	$ 3,870	$ 132,570	$ 26,514	$ 68,245,410	$ 883,170,650
2039	$ 32,990	$ 26,790	$ 44,090	$ 2,630	$ 106,500	$ 53,250	$ 37,190	$ 50,600	$ 44,610	$ 3,990	$ 136,390	$ 27,278	$ 69,983,220	$ 953,153,870
2040	$ 33,630	$ 27,420	$ 45,000	$ 2,710	$ 108,760	$ 54,380	$ 38,200	$ 52,050	$ 45,850	$ 4,100	$ 140,200	$ 28,040	$ 71,718,300	$ 1,024,872,170
2041	$ 34,260	$ 28,040	$ 45,900	$ 2,790	$ 110,990	$ 55,495	$ 39,210	$ 53,500	$ 47,080	$ 4,210	$ 144,000	$ 28,800	$ 73,441,425	$ 1,098,313,595
2042	$ 34,900	$ 28,670	$ 46,800	$ 2,880	$ 113,250	$ 56,625	$ 40,220	$ 54,960	$ 48,310	$ 4,330	$ 147,820	$ 29,564	$ 75,179,235	$ 1,173,492,830
2043	$ 35,540	$ 29,290	$ 47,700	$ 2,960	$ 115,490	$ 57,745	$ 41,230	$ 56,410	$ 49,540	$ 4,440	$ 151,620	$ 30,324	$ 76,905,435	$ 1,250,398,265
2044	$ 36,180	$ 29,920	$ 48,610	$ 3,050	$ 117,760	$ 58,880	$ 42,240	$ 57,860	$ 50,780	$ 4,560	$ 155,440	$ 31,088	$ 78,646,320	$ 1,329,044,585
2045	$ 36,810	$ 30,550	$ 49,510	$ 3,130	$ 120,000	$ 60,000	$ 43,260	$ 59,320	$ 52,010	$ 4,670	$ 159,260	$ 31,852	$ 80,377,980	$ 1,409,422,565
2046	$ 37,450	$ 31,170	$ 50,410	$ 3,210	$ 122,240	$ 61,120	$ 44,270	$ 60,770	$ 53,240	$ 4,780	$ 163,060	$ 32,612	$ 82,104,180	$ 1,491,526,745
2047	$ 38,090	$ 31,800	$ 51,310	$ 3,300	$ 124,500	$ 62,250	$ 45,280	$ 62,220	$ 54,470	$ 4,900	$ 166,870	$ 33,374	$ 83,839,260	$ 1,575,366,005
2048	$ 38,730	$ 32,430	$ 52,220	$ 3,380	$ 126,760	$ 63,380	$ 46,290	$ 63,670	$ 55,710	$ 5,010	$ 170,680	$ 34,136	$ 85,574,340	$ 1,660,940,345
2049	$ 39,360	$ 33,050	$ 53,120	$ 3,470	$ 129,000	$ 64,500	$ 47,300	$ 65,130	$ 56,940	$ 5,130	$ 174,500	$ 34,900	$ 87,306,000	$ 1,748,246,345
2050	$ 40,000	$ 33,680	$ 54,020	$ 3,550	$ 131,250	$ 65,625	$ 48,310	$ 66,580	$ 58,170	$ 5,240	$ 178,300	$ 35,660	$ 89,035,275	$ 1,837,281,620

(1) A ramp-up period is assumed for the first four years of operation
(2) 2007 Dollars
(3) Weekend day revenue for HOT2+ is estimated to be 50 percent of weekday revenue
(4) Weekend day revenue for TOT lanes is estimated to be 20 percent of weekday revenue
(5) Annual revenue calculations assume 250 weekdays and 115 weekend/holidays

Table 4-22: Net Revenue Summary--- un-inflated dollars (000) – Alternative C-1

Year	Gross Annual Toll Revenue (1)	Annual Transactions (2)	Operation Cost (3)	Infrastructure Operation and Maintenance Cost (4)	Net Annual Revenue	Cumulative Annual Net Revenue
2020	$ 11,001	8,448	$ 1,774	$ 16,791	$ (7,564)	$ (7,564)
2021	$ 15,239	10,174	$ 2,136	$ 16,791	$ (3,689)	$ (3,689)
2022	$ 21,504	12,755	$ 2,679	$ 16,791	$ 2,035	$ 2,035
2023	$ 29,413	15,744	$ 3,306	$ 16,791	$ 9,316	$ 11,351
2024	$ 33,756	16,523	$ 3,470	$ 16,791	$ 13,496	$ 24,846
2025	$ 37,202	16,815	$ 3,531	$ 16,791	$ 16,879	$ 41,726
2026	$ 40,635	17,101	$ 3,591	$ 16,791	$ 20,253	$ 61,978
2027	$ 44,077	17,393	$ 3,653	$ 16,791	$ 23,634	$ 85,612
2028	$ 47,511	17,682	$ 3,713	$ 16,791	$ 27,006	$ 112,618
2029	$ 50,956	17,975	$ 3,775	$ 16,791	$ 30,390	$ 143,009
2030	$ 54,389	18,264	$ 3,835	$ 16,791	$ 33,763	$ 176,772
2031	$ 56,119	18,433	$ 3,871	$ 16,791	$ 35,457	$ 212,228
2032	$ 57,859	18,602	$ 3,906	$ 16,791	$ 37,162	$ 249,390
2033	$ 59,585	18,772	$ 3,942	$ 16,791	$ 38,852	$ 288,242
2034	$ 61,320	18,941	$ 3,978	$ 16,791	$ 40,552	$ 328,794
2035	$ 63,052	19,110	$ 4,013	$ 16,791	$ 42,248	$ 371,042
2036	$ 64,787	19,279	$ 4,049	$ 16,791	$ 43,948	$ 414,990
2037	$ 66,519	19,448	$ 4,084	$ 16,791	$ 45,644	$ 460,634
2038	$ 68,245	19,618	$ 4,120	$ 16,791	$ 47,335	$ 507,969
2039	$ 69,983	19,790	$ 4,156	$ 16,791	$ 49,036	$ 557,005
2040	$ 71,718	19,956	$ 4,191	$ 16,791	$ 50,737	$ 607,742
2041	$ 73,441	20,125	$ 4,226	$ 16,791	$ 52,424	$ 660,166
2042	$ 75,179	20,297	$ 4,262	$ 16,791	$ 54,126	$ 714,292
2043	$ 76,905	20,463	$ 4,297	$ 16,791	$ 55,817	$ 770,109
2044	$ 78,646	20,633	$ 4,333	$ 16,791	$ 57,522	$ 827,631
2045	$ 80,378	20,805	$ 4,369	$ 16,791	$ 59,218	$ 886,849
2046	$ 82,104	20,971	$ 4,404	$ 16,791	$ 60,909	$ 947,759
2047	$ 83,839	21,140	$ 4,439	$ 16,791	$ 62,609	$ 1,010,367
2048	$ 85,574	21,312	$ 4,476	$ 16,791	$ 64,308	$ 1,074,675
2049	$ 87,306	21,479	$ 4,511	$ 16,791	$ 66,004	$ 1,140,680
2050	$ 89,035	21,651	$ 4,547	$ 16,791	$ 67,698	$ 1,208,377

(1) Uninflated revenues are in 2007 dollars.
(2) Annual transaction do not include non-toll paying vehicles.
(3) Operation cost is assumed to be $0.21 per tolled transaction and it includes Billing and Administration Cost; Violations Center Operations Cost and Customer Service Center Cost; Enforcement cost and Toll Equipment
(4) Annual Infrastructure Operation and Maintenance Cost is assumed to be 0.5% of the total capital cost.

Table 4-23: Annual Toll Revenue in Inflated Dollars (000) – Alternative C-1

Year	UNINFLATED DOLLARS (000)				Inflation Factors		INFLATED DOLLARS (000)			
	Total Gross Annual Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Net Cumulative Annual	Toll Revenue	O&M	Gross Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Cumulative Annual Revenue
2020	$ 11,001	$ 18,565	$ (7,564)	$ (7,564)	1.379	1.469	$ 15,170	$ 27,272	$ (12,102)	$ (12,102)
2021	$ 15,239	$ 18,927	$ (3,689)	$ (11,253)	1.413	1.513	$ 21,532	$ 28,637	$ (7,105)	$ (19,207)
2022	$ 21,504	$ 19,470	$ 2,035	$ (9,218)	1.448	1.558	$ 31,138	$ 30,334	$ 805	$ (18,402)
2023	$ 29,413	$ 20,097	$ 9,316	$ 98	1.485	1.605	$ 43,678	$ 32,256	$ 11,422	$ (6,980)
2024	$ 33,756	$ 20,261	$ 13,496	$ 13,593	1.522	1.653	$ 51,377	$ 33,491	$ 17,886	$ 10,906
2025	$ 37,202	$ 20,322	$ 16,879	$ 30,473	1.560	1.702	$ 58,034	$ 34,588	$ 23,446	$ 34,353
2026	$ 40,635	$ 20,382	$ 20,253	$ 50,725	1.599	1.754	$ 64,975	$ 35,750	$ 29,225	$ 63,577
2027	$ 44,077	$ 20,444	$ 23,634	$ 74,359	1.639	1.806	$ 72,243	$ 36,921	$ 35,322	$ 98,899
2028	$ 47,511	$ 20,504	$ 27,006	$ 101,365	1.680	1.860	$ 79,818	$ 38,138	$ 41,680	$ 140,578
2029	$ 50,956	$ 20,566	$ 30,390	$ 131,756	1.722	1.916	$ 87,746	$ 39,404	$ 48,343	$ 188,921
2030	$ 54,389	$ 20,626	$ 33,763	$ 165,519	1.765	1.974	$ 95,997	$ 40,717	$ 55,281	$ 244,202
2031	$ 56,119	$ 20,662	$ 35,457	$ 200,975	1.809	2.033	$ 101,519	$ 42,006	$ 59,513	$ 303,715
2032	$ 57,859	$ 20,697	$ 37,162	$ 238,137	1.854	2.094	$ 107,271	$ 43,341	$ 63,930	$ 367,645
2033	$ 59,585	$ 20,733	$ 38,852	$ 276,989	1.900	2.157	$ 113,212	$ 44,721	$ 68,491	$ 436,136
2034	$ 61,320	$ 20,769	$ 40,552	$ 317,541	1.948	2.221	$ 119,452	$ 46,127	$ 73,325	$ 509,461
2035	$ 63,052	$ 20,804	$ 42,248	$ 359,789	1.996	2.288	$ 125,852	$ 47,600	$ 78,252	$ 587,714
2036	$ 64,787	$ 20,840	$ 43,948	$ 403,737	2.046	2.357	$ 132,555	$ 49,119	$ 83,436	$ 671,149
2037	$ 66,519	$ 20,875	$ 45,644	$ 449,381	2.098	2.427	$ 139,557	$ 50,664	$ 88,893	$ 760,043
2038	$ 68,245	$ 20,911	$ 47,335	$ 496,716	2.150	2.500	$ 146,728	$ 52,277	$ 94,451	$ 854,494
2039	$ 69,983	$ 20,947	$ 49,036	$ 545,752	2.204	2.575	$ 154,243	$ 53,938	$ 100,305	$ 954,799
2040	$ 71,718	$ 20,982	$ 50,737	$ 596,489	2.259	2.652	$ 162,012	$ 55,644	$ 106,368	$ 1,061,167
2041	$ 73,441	$ 21,017	$ 52,424	$ 648,913	2.315	2.732	$ 170,017	$ 57,419	$ 112,598	$ 1,173,764
2042	$ 75,179	$ 21,053	$ 54,126	$ 703,039	2.373	2.814	$ 178,400	$ 59,244	$ 119,156	$ 1,292,920
2043	$ 76,905	$ 21,088	$ 55,817	$ 758,856	2.433	2.898	$ 187,111	$ 61,114	$ 125,997	$ 1,418,917
2044	$ 78,646	$ 21,124	$ 57,522	$ 816,378	2.493	2.985	$ 196,065	$ 63,055	$ 133,010	$ 1,551,928
2045	$ 80,378	$ 21,160	$ 59,218	$ 875,596	2.556	3.075	$ 205,446	$ 65,067	$ 140,379	$ 1,692,307
2046	$ 82,104	$ 21,195	$ 60,909	$ 936,505	2.620	3.167	$ 215,113	$ 67,124	$ 147,989	$ 1,840,296
2047	$ 83,839	$ 21,230	$ 62,609	$ 999,114	2.685	3.262	$ 225,108	$ 69,254	$ 155,855	$ 1,996,150
2048	$ 85,574	$ 21,267	$ 64,308	$ 1,063,422	2.752	3.360	$ 235,501	$ 71,456	$ 164,045	$ 2,160,195
2049	$ 87,306	$ 21,302	$ 66,004	$ 1,129,426	2.821	3.461	$ 246,290	$ 73,725	$ 172,566	$ 2,332,761
2050	$ 89,035	$ 21,338	$ 67,698	$ 1,197,124	2.892	3.565	$ 257,490	$ 76,069	$ 181,421	$ 2,514,182

Notes: Uninflated revenues and costs are in 2007 dollars.
Annual inflation rates of 2.5% and 3.0% are applied for toll revenue and O&M cost respectively.

4.9 Traffic and Toll Revenue Estimates - Alternative C-2

Alternative C-2 assumed the construction of two managed lanes in each direction on I-75 South corridor from I-285 to SR 16 and the construction of two voluntary Truck Only Toll (TOT) Lanes in each direction along I-675 and I-75 South corridor from I-675 to SR 16.

The tolling and policy framework evaluated in this alternative for managed lanes is HOT-3+. HOT-3+ refers to a tolling alternative that would allow HOVs with three or more people to ride free along with transit vehicles, emergency/police vehicles, and motorcycles. SOVs, HOV-2s and Commercial Vehicles (CV) including commercially registered autos, pickup trucks, and vans would pay a toll to use the managed lanes. It was assumed that Medium-Duty Trucks (MDT) and Heavy-Duty Trucks (HDT) would not be allowed to utilize the managed lane system in this alternative.

The truck tolling and policy framework evaluated in this alternative is optional TOT. Optional TOT refers to a truck tolling alternative that would allow MDT (FHWA classes 4-7) and HDT (FHWA classes 8-13) to pay a toll to use the TOT lanes.

4.9.1 Toll Sensitivity Analysis Results

A summary of the results of the managed lane and TOT lane toll sensitivity analysis for Alternative C-2 in 2020 and 2030 is presented in Figures 4-49 through 4-60.

The sets of sensitivity curves for managed lanes and TOT lanes follow a similar pattern when compared to the sensitivity curves in Alternative C-1, so a detailed description will not be repeated.

With the same recommended toll rate, Alternative C-2 generates higher revenue in the managed lanes than the revenue generated in Alternative C-1. For example, in 2020 during PM peak period, with the recommended toll rate of $0.05 per mile for the northbound and recommended toll rate of $0.10 per mile for southbound, Alterative C-2 would generate $12,524, a 27% revenue increase when compared the revenue of $9,856 in Alternative C-1. As noted in the section of Alternative A-2 analysis, the increase in revenue is expected since in this alternative, HOV-2s are not eligible to use managed lanes, which resulted in higher unused capacity in the managed lanes and correspondingly more achievable time savings in the managed lanes. The TOT lane revenue in this alternative is very similar as in Alternative C-1.

Figure 4-49: 2020 AM Peak Period HOT Sensitivity Curves – Alternative C-2

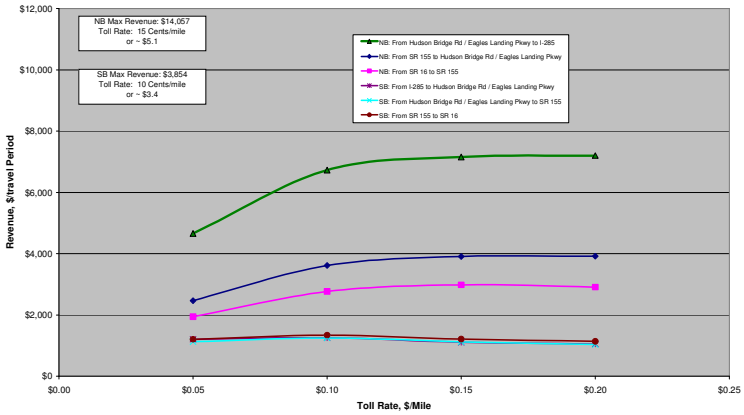


Figure 4-50: 2020 Midday Period HOT Sensitivity Curves – Alternative C-2

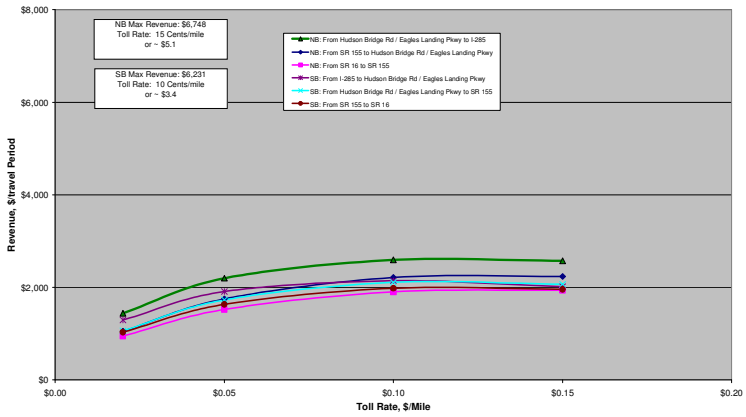


Figure 4-51: 2020 PM Peak Period HOT Sensitivity Curves – Alternative C-2

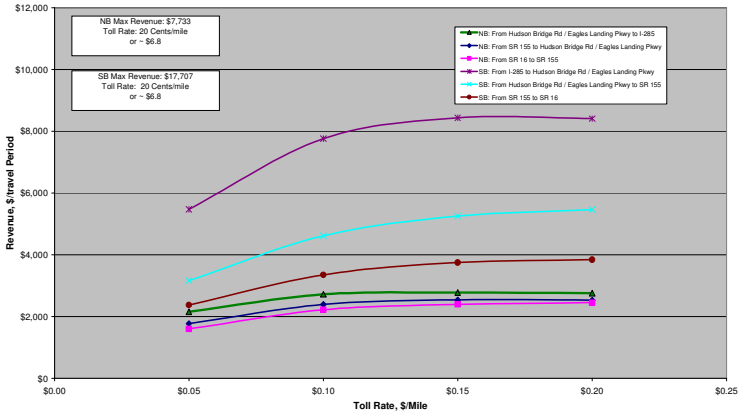


Figure 4-52: 2020 AM Peak Period TOT Sensitivity Curves – Alternative C-2

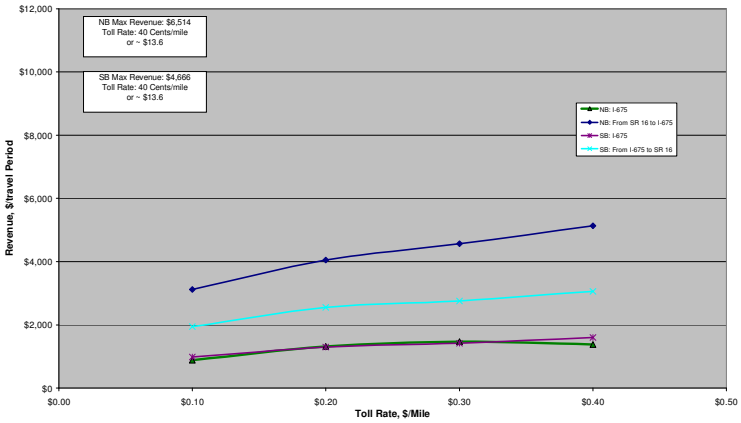


Figure 4-53: 2020 Midday Period TOT Sensitivity Curves – Alternative C-2

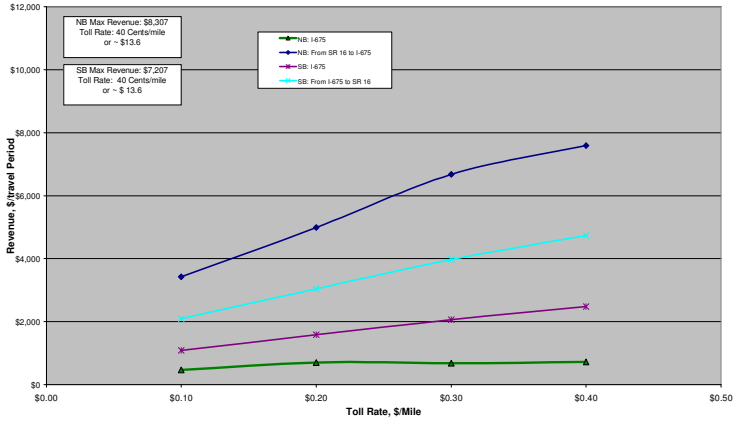


Figure 4-54: 2020 PM Peak Period TOT Sensitivity Curves – Alternative C-2

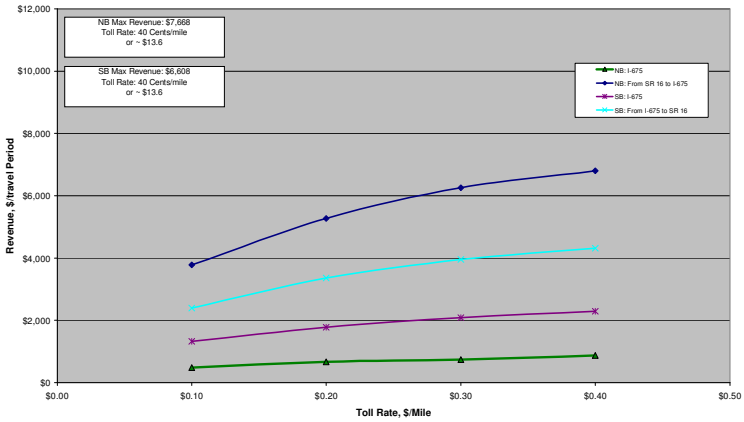


Figure 4-55: 2030 AM Peak Period HOT Sensitivity Curves – Alternative C-2

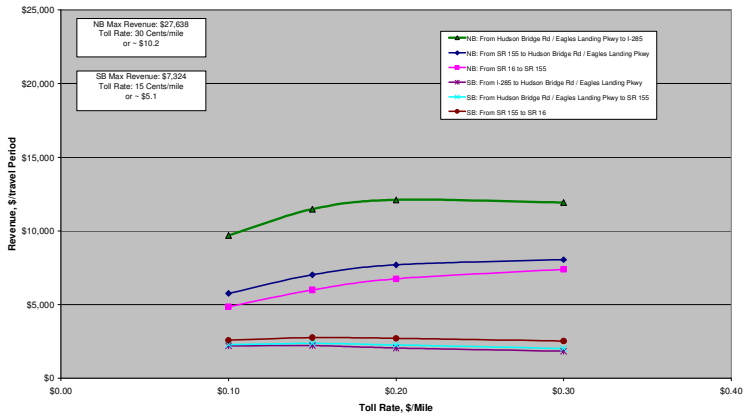


Figure 4-56: 2030 Midday Period HOT Sensitivity Curves – Alternative C-2

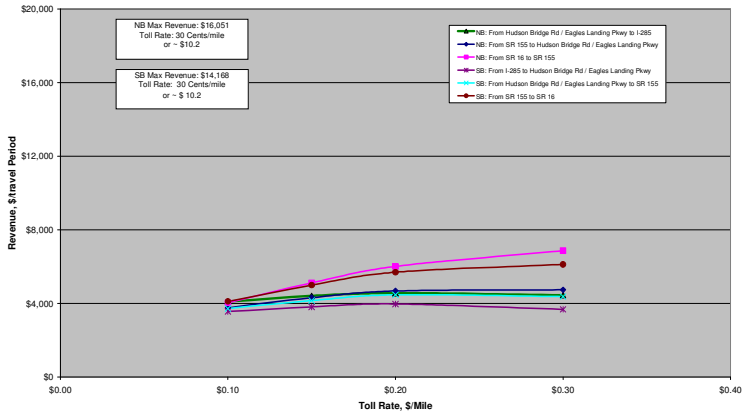


Figure 4-57: 2030 PM Peak Period HOT Sensitivity Curves – Alternative C-2

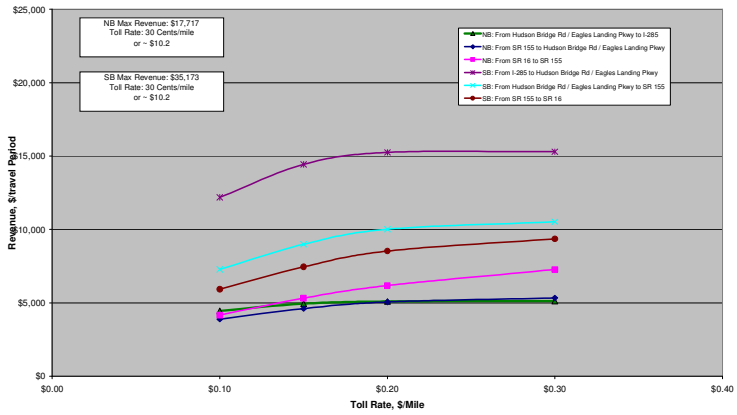


Figure 4-58: 2030 AM Peak Period TOT Sensitivity Curves – Alternative C-2

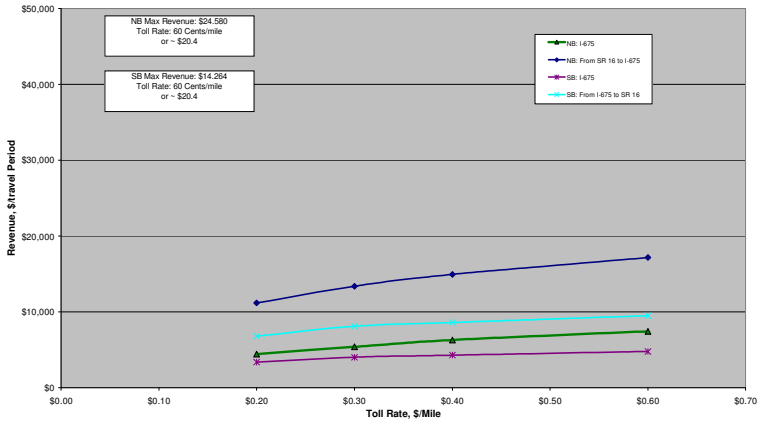


Figure 4-59: 2030 Midday Period TOT Sensitivity Curves – Alternative C-2

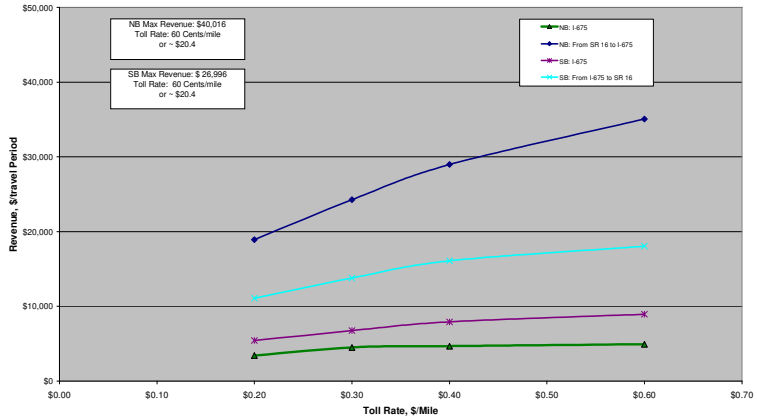
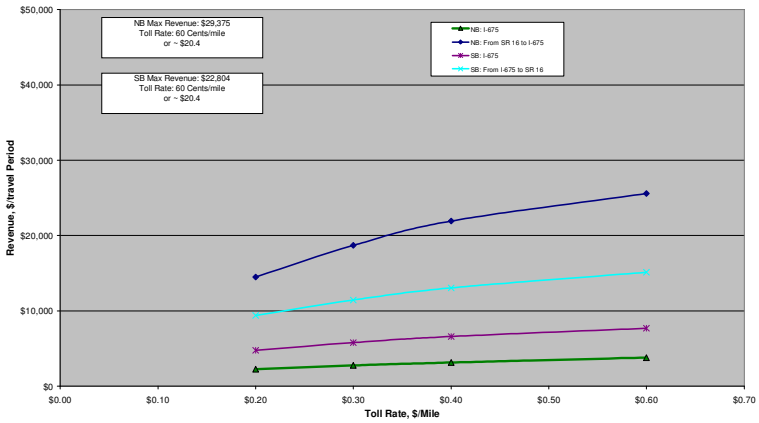


Figure 4-60: 2030 PM Peak Period TOT Sensitivity Curves – Alternative C-2



4.9.2 Toll Revenue Verses Operational Tradeoffs

To illustrate the tradeoffs between revenue optimization and operational efficiency, toll rate operational profiles on managed lanes and truck-only-toll lanes were developed for the opening year of 2020 and horizon year of 2030 under various toll rates, separately by time-of-day and by direction of travel.

Figure 4-61 provides a comparative operating profile for opening year 2020 AM peak period for the managed lanes. The first two upper figures illustrate the relationship between managed lane revenue and toll rate by travel direction. In the northbound direction, the peak direction in the morning, the managed lane revenue generated is much higher than that of the southbound direction.

In the second series of charts, vehicle-miles of travel (VMT) by direction are shown for:

- Total vehicles on the managed lanes;
- Priced vehicles on the managed lanes (SOVs, HOV2s, and CVs in this application); and
- Free vehicles on the managed lanes (all HOV3+s in this application).

Again VMT in the northbound direction substantially exceeds that of the southbound direction for each vehicle class.

The two lower figures illustrate average speed drawn from the traffic assignment results in the general-purpose and managed lanes with respect to various toll rates. As toll rates increase, average speed in the Managed lanes increase slightly as more SOVs, HOV-2s and CVs migrate back to the general-purpose lanes. At very low toll rates the travel time savings provided by the Managed lanes has tremendous value, attracting many SOV motorists, HOV2 motorists and CV travelers. As a result, the managed lanes are inundated with SOV, HOV2 and CV traffic driving the average speed down. Speeds in the managed lanes steadily rebound as willingness to pay decreases as the toll rate increases.

In the PM peak periods, the major distinction is the reversal of travel patterns as the northbound peak direction swivels to the southbound direction. In the Midday analysis period, revenue, VMT and average travel speed are comparable for northbound direction and southbound direction.

Figure 4-62 provides a comparative operating profile for opening year 2020 AM peak period for the TOT lanes. Again, the first two upper figures illustrate the relationship between the TOT lane revenue and toll rate by travel direction. In the northbound direction, the peak direction in the morning, the TOT revenue generated is slightly higher than that of the southbound direction.

In the second series of charts, vehicle-miles of travel (VMT) by direction are shown for:

- Total vehicles on the TOT lanes; and
- Priced vehicles on the TOT lanes (medium-duty truck and heavy-duty truck in this application);

VMT in the northbound direction slightly exceeds that of the southbound direction for both medium-duty trucks and heavy-duty trucks.

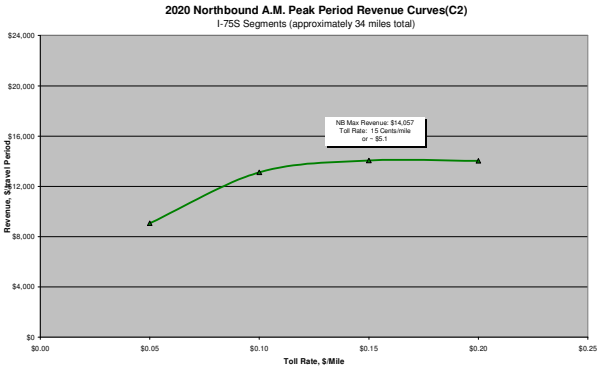
The two lower figures illustrate average speed drawn from the traffic assignment results in the general-purpose and TOT lanes with respect to various toll rates. As toll rates increase, average speed in the general purpose lanes decrease slightly as more heavy-duty and medium-duty trucks migrate back to the general-purpose lanes. Due to the relatively low through truck demand for TOT lanes, the average operating speed on TOT lanes can be maintained at the free-flow speed of 65 mph under the various toll rates.

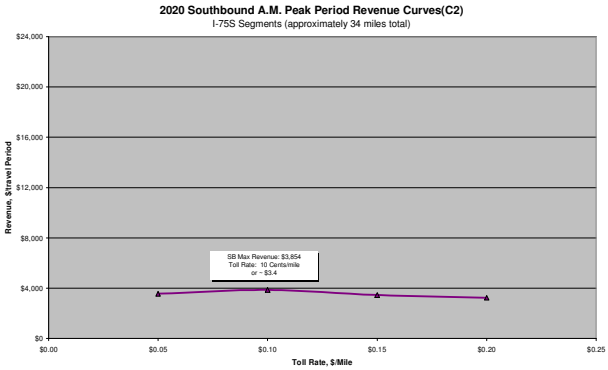
In the PM and Midday peak analysis periods, revenue, VMT and average travel speed are pretty comparable for northbound direction and southbound direction.

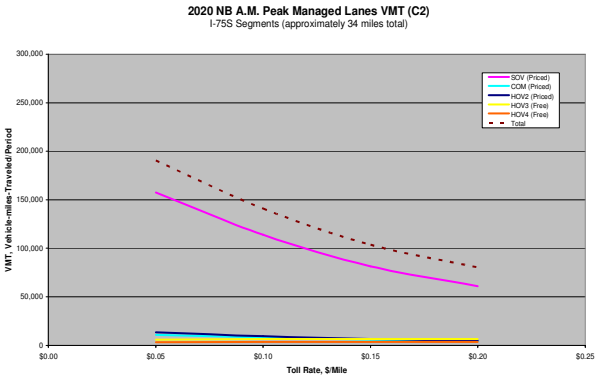
Similar logic for revenue, VMT and average travel speed are observed for the horizon year of 2030, thus a detailed description will not be repeated.

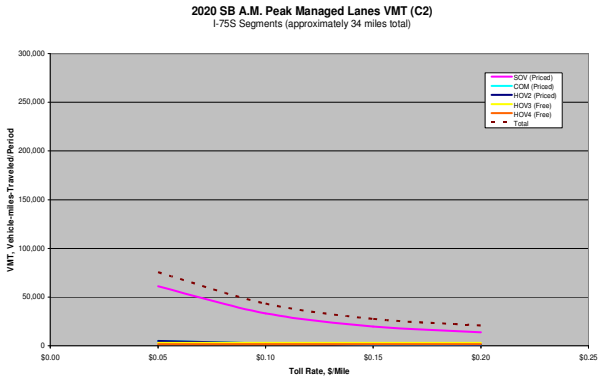
Refer to Appendix 4-A for a complete set of operating profiles for opening year 2020 and horizon year of 2030 AM peak period, PM peak period and Midday period.

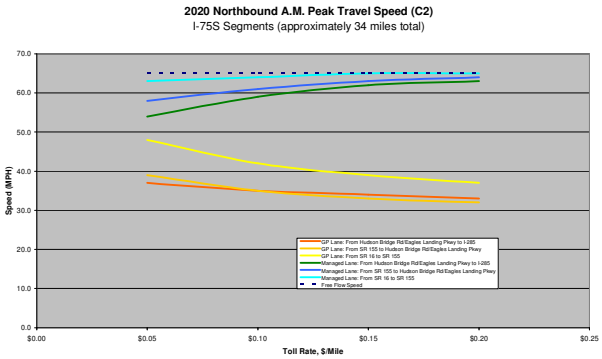
Figure 4-61: 2020 AM Peak Period Toll Rate Operational Profile – Alternative C-2 (Managed Lanes)











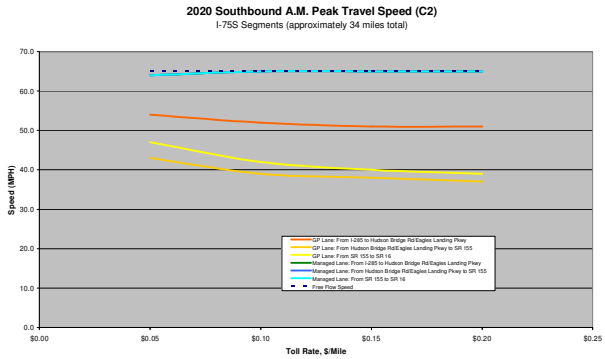
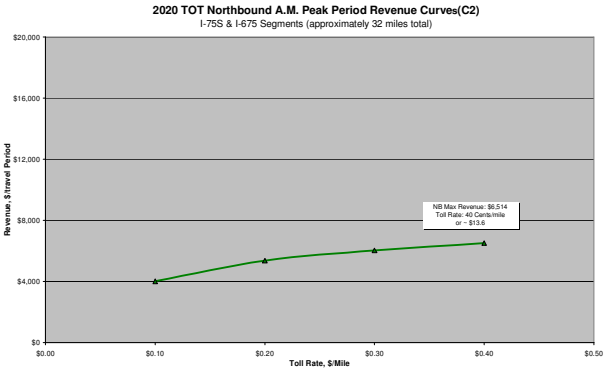
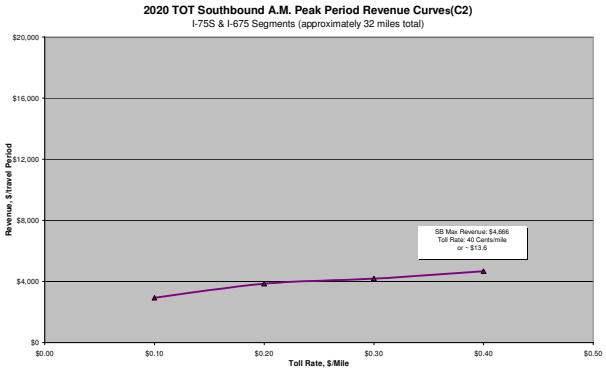
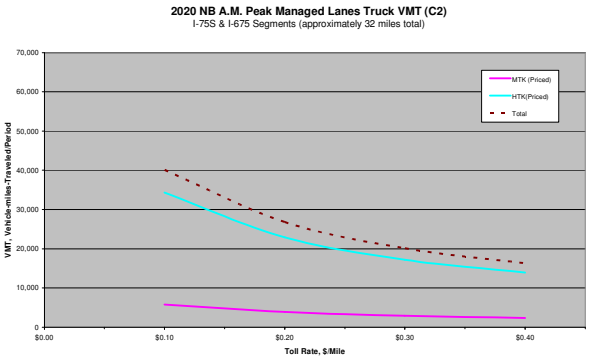
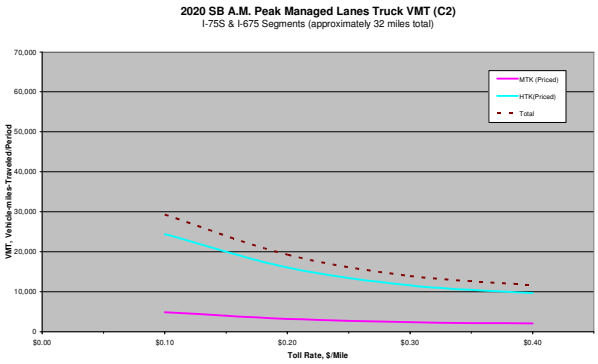


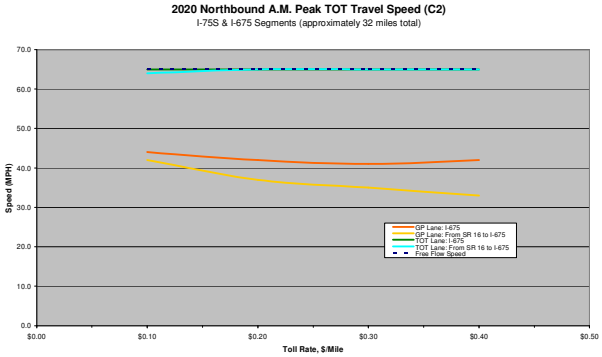
Figure 4-62: 2020 AM Peak Period Toll Rate Operational Profile – Alternative C-2 (TOT Lanes)

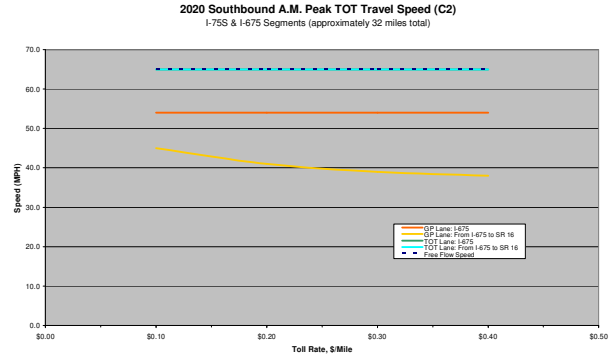












4.9.3 Selected Toll Rate

As discussed in the earlier section (4.3.3), the selection of toll rates for the managed lanes and TOT lanes must:

- Not erode HOT/ TOT/ETL lane average travel speed below 45 mph;
- Optimize available toll rates for HOT/TOT/ETL lane; and
- Optimize usage for HOT/TOT/ETL lane.

The detailed steps for selecting toll rate for managed lanes are summaries as follows:

- Identify the toll rate that produced the most revenue
- Lower the toll rate by $0.05 - $0.08 per mile to allow the facility's operation to increase revenue as needed.
- Check to make sure the managed lanes are operating above 45 mph.
- If not, increase the toll rate until the desired operating conditions is achieved.

Table 4-24 presents the selected managed lanes toll rates. In 2020 and 2030, a desired operating speed of 45 mph or above can be maintained at the recommended toll rates.

In general, the TOT revenue increases steadily as toll rate increase. The TOT utility rate was calculated to select the recommended toll rates so that the usage of TOT lanes and revenue can be optimized.

$$\text{TOT Utility Rate} = \frac{Truck\ Volume\ on\ TOT\ Lanes\ @\ Toll\ Rate}{Truck\ Volume\ on\ TOL\ (No-Toll)}$$

The recommended toll rate contains at least 40% of TOT utility rate when compared to free truck only lane condition. Table 4-25 presents the recommended TOT toll rates. In 2020 and 2030, TOT lane will operate at a desired operating speed of 50 mph or above.

4.9.4 Estimated Weekday Traffic

Refer to Appendix 4-B for Alternative C-2 2020 and 2030 traffic diagrams of:

- Daily Total Trips;
- AM Total Trips;
- PM Total Trips; and
- MD Total Trips.

4.9.5 Revenue Projections

Table 4-26 presents estimated gross toll revenue by period for the managed lanes and TOT lanes.

Managed lane revenues shown in the table for each period were obtained at the recommended managed lane toll levels for Alternative C-2 described previously for each travel direction and then aggregated to a daily total. For example, approximately $28,600 in daily revenue is expected on a typical opening year weekday; whereas $14,300 in daily revenue is expected on a typical opening year weekend day.

Similarly, TOT lane revenues shown in the table for each period were obtained at the recommended TOT lane toll levels for Alternative C-2 described previously for each travel direction and then aggregated to a daily total. For example, approximately $15,065 in daily revenue is expected on a typical opening year weekday; whereas $3,013 in daily revenue is expected on a typical opening year weekend day.

The net revenue stream in un-inflated 2007 dollars and inflated dollars are presented in Table 4-27 and 4-28 respectively. From year 2020 to year 2050, Alternative C-2 will generate approximately $1.380 billion cumulative net revenue in un-inflated 2007 dollars and approximately $2.889 billion cumulative net revenue in inflated dollars.

Table 4-24: Recommended Toll Rates – HOT lane – Alternative C-2

Year	Analysis Period	Dir	Maximum Revenue Toll Rates			Recommended Toll Rates			ML Speed @ Recommended Toll Rate		
			Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3
2020	AM Peak Period	NB	$0.20	$0.15	$0.15	$0.10	$0.10	$0.10	59	61	64
		SB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	64	64	64
	Midday Period	NB	$0.10	$0.15	$0.15	$0.05	$0.05	$0.05	64	64	64
		SB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	64	64	64
	PM Peak Period	NB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	63	63	64
		SB	$0.20	$0.20	$0.20	$0.10	$0.10	$0.10	60	61	64
	Night	NB	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	65	65	65
		SB	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	65	65	65
2030	AM Peak Period	NB	$0.20	$0.30	$0.30	$0.15	$0.15	$0.15	57	59	63
		SB	$0.15	$0.15	$0.15	$0.10	$0.10	$0.10	65	64	64
	Midday Period	NB	$0.20	$0.20	$0.30	$0.10	$0.10	$0.10	64	64	64
		SB	$0.20	$0.20	$0.30	$0.10	$0.10	$0.10	64	64	64
	PM Peak Period	NB	$0.20	$0.20	$0.20	$0.10	$0.10	$0.10	63	62	63
		SB	$0.20	$0.20	$0.20	$0.15	$0.15	$0.15	57	58	62
	Night	NB	$0.15	$0.15	$0.15	$0.05	$0.05	$0.05	65	65	65
		SB	$0.15	$0.15	$0.15	$0.05	$0.05	$0.05	65	65	65

Table 4-25: Recommended Toll Rates – Truck Only Lane – Alternative C-2

Year	Analysis Period	Dir	Toll Rates Analyzed		TOT Utility Rate @ Minimum Toll Rate		TOT Utility Rate @ Maximum Toll Rate		Recommended Toll Rates		ML Speed @ Recommended Toll Rate	
			Minimum	Maximum	I-675	I-75 S	I-675	I-75 S	I-675	I-75 S	I-675	I-75 S
2020	AM Peak Period	NB	$0.10	$0.40	53%	56%	21%	23%	$0.10	$0.20	65	65
		SB	$0.10	$0.40	31%	33%	13%	13%	$0.10	$0.10	65	65
	Midday Period	NB	$0.10	$0.40	31%	33%	12%	19%	$0.10	$0.10	65	64
		SB	$0.10	$0.40	25%	27%	14%	15%	$0.10	$0.10	65	65
	PM Peak Period	NB	$0.10	$0.40	45%	52%	21%	23%	$0.10	$0.10	65	64
		SB	$0.10	$0.40	45%	46%	20%	21%	$0.10	$0.20	65	65
2030	AM Peak Period	NB	$0.20	$0.60	67%	51%	37%	26%	$0.30	$0.30	64	63
		SB	$0.20	$0.60	37%	37%	18%	17%	$0.20	$0.20	64	64
	Midday Period	NB	$0.20	$0.60	50%	61%	24%	38%	$0.20	$0.20	64	61
		SB	$0.20	$0.60	41%	42%	23%	23%	$0.20	$0.20	64	64
	PM Peak Period	NB	$0.20	$0.60	54%	53%	30%	31%	$0.20	$0.30	64	62
		SB	$0.20	$0.60	48%	50%	26%	27%	$0.20	$0.30	64	64

Table 4-26: Annual Gross Toll Revenue (un-inflated dollars) – Alternative C-2

Year (1)	Weekday HOT Lane Revenue By Period (2)				HOT Total Weekday	HOT Weekend Day (3)	Weekday TOT Revenue By Period (2)				TOT Total Weekday	TOT Weekend Day (4)	Estimated Annual Gross Revenue (4)	Cumulative Gross Revenue
	AM Peak	Midday	PM Peak	Night			AM Peak	Midday	PM Peak	Night				
2020	$ 9,680	$ 5,731	$ 12,524	$ 666	$ 28,600	$ 14,300	$ 4,571	$ 4,939	$ 5,159	$ 396	$ 15,065	$ 3,013	$ 12,907,109	$ 12,907,109
2021	$ 12,383	$ 7,612	$ 16,172	$ 858	$ 37,024	$ 18,512	$ 6,754	$ 7,781	$ 7,768	$ 624	$ 22,926	$ 4,585	$ 17,643,542	$ 30,550,650
2022	$ 16,400	$ 10,392	$ 21,584	$ 1,136	$ 49,512	$ 24,756	$ 9,984	$ 11,960	$ 11,616	$ 960	$ 34,520	$ 6,904	$ 24,648,900	$ 55,199,550
2023	$ 21,292	$ 13,852	$ 28,217	$ 1,484	$ 64,845	$ 32,422	$ 14,123	$ 17,402	$ 16,577	$ 1,397	$ 49,499	$ 9,900	$ 33,452,938	$ 88,652,488
2024	$ 23,400	$ 15,560	$ 31,200	$ 1,640	$ 71,800	$ 35,900	$ 16,640	$ 20,930	$ 19,660	$ 1,680	$ 58,910	$ 11,782	$ 38,160,930	$ 126,813,418
2025	$ 24,850	$ 16,850	$ 33,310	$ 1,750	$ 76,760	$ 38,380	$ 18,730	$ 23,920	$ 22,230	$ 1,920	$ 66,800	$ 13,360	$ 41,840,100	$ 168,653,518
2026	$ 26,300	$ 18,130	$ 35,410	$ 1,850	$ 81,690	$ 40,845	$ 20,810	$ 26,900	$ 24,800	$ 2,160	$ 74,670	$ 14,934	$ 45,504,585	$ 214,158,103
2027	$ 27,750	$ 19,420	$ 37,520	$ 1,960	$ 86,650	$ 43,325	$ 22,890	$ 29,890	$ 27,370	$ 2,400	$ 82,550	$ 16,510	$ 49,181,025	$ 263,339,128
2028	$ 29,200	$ 20,700	$ 39,630	$ 2,070	$ 91,600	$ 45,800	$ 24,970	$ 32,880	$ 29,940	$ 2,640	$ 90,430	$ 18,086	$ 52,854,390	$ 316,193,518
2029	$ 30,650	$ 21,990	$ 41,730	$ 2,170	$ 96,540	$ 48,270	$ 27,060	$ 35,860	$ 32,510	$ 2,880	$ 98,310	$ 19,662	$ 56,524,680	$ 372,718,198
2030	$ 32,100	$ 23,270	$ 43,840	$ 2,280	$ 101,490	$ 50,745	$ 29,140	$ 38,850	$ 35,080	$ 3,120	$ 106,190	$ 21,238	$ 60,198,045	$ 432,916,243
2031	$ 32,830	$ 23,910	$ 44,890	$ 2,390	$ 104,020	$ 52,010	$ 30,180	$ 40,340	$ 36,370	$ 3,240	$ 110,130	$ 22,026	$ 62,051,640	$ 494,967,883
2032	$ 33,550	$ 24,560	$ 45,950	$ 2,490	$ 106,550	$ 53,275	$ 31,220	$ 41,840	$ 37,650	$ 3,360	$ 114,070	$ 22,814	$ 63,905,235	$ 558,873,118
2033	$ 34,280	$ 25,200	$ 47,000	$ 2,600	$ 109,080	$ 54,540	$ 32,260	$ 43,330	$ 38,940	$ 3,480	$ 118,010	$ 23,602	$ 65,758,830	$ 624,631,948
2034	$ 35,000	$ 25,840	$ 48,050	$ 2,710	$ 111,600	$ 55,800	$ 33,310	$ 44,820	$ 40,220	$ 3,600	$ 121,950	$ 24,390	$ 67,609,350	$ 692,241,298
2035	$ 35,730	$ 26,480	$ 49,110	$ 2,820	$ 114,140	$ 57,070	$ 34,350	$ 46,320	$ 41,510	$ 3,720	$ 125,900	$ 25,180	$ 69,468,750	$ 761,710,048
2036	$ 36,450	$ 27,130	$ 50,160	$ 2,920	$ 116,660	$ 58,330	$ 35,390	$ 47,810	$ 42,790	$ 3,840	$ 129,830	$ 25,966	$ 71,316,540	$ 833,026,588
2037	$ 37,180	$ 27,770	$ 51,210	$ 3,030	$ 119,190	$ 59,595	$ 36,430	$ 49,300	$ 44,080	$ 3,960	$ 133,770	$ 26,754	$ 73,170,135	$ 906,196,723
2038	$ 37,900	$ 28,410	$ 52,270	$ 3,140	$ 121,720	$ 60,860	$ 37,470	$ 50,800	$ 45,360	$ 4,080	$ 137,710	$ 27,542	$ 75,023,730	$ 981,220,453
2039	$ 38,630	$ 29,050	$ 53,320	$ 3,240	$ 124,240	$ 62,120	$ 38,510	$ 52,290	$ 46,650	$ 4,200	$ 141,650	$ 28,330	$ 76,874,250	$ 1,058,094,703
2040	$ 39,350	$ 29,700	$ 54,380	$ 3,350	$ 126,780	$ 63,390	$ 39,560	$ 53,790	$ 47,930	$ 4,320	$ 145,600	$ 29,120	$ 78,733,650	$ 1,136,828,353
2041	$ 40,080	$ 30,340	$ 55,430	$ 3,460	$ 129,310	$ 64,655	$ 40,600	$ 55,280	$ 49,220	$ 4,440	$ 149,540	$ 29,908	$ 80,587,245	$ 1,217,415,598
2042	$ 40,800	$ 30,980	$ 56,480	$ 3,560	$ 131,820	$ 65,910	$ 41,640	$ 56,770	$ 50,500	$ 4,560	$ 153,470	$ 30,694	$ 82,431,960	$ 1,299,847,558
2043	$ 41,530	$ 31,620	$ 57,540	$ 3,670	$ 134,360	$ 67,180	$ 42,680	$ 58,270	$ 51,790	$ 4,680	$ 157,420	$ 31,484	$ 84,291,360	$ 1,384,138,918
2044	$ 42,250	$ 32,270	$ 58,590	$ 3,780	$ 136,890	$ 68,445	$ 43,720	$ 59,760	$ 53,070	$ 4,800	$ 161,350	$ 32,270	$ 86,142,225	$ 1,470,281,143
2045	$ 42,980	$ 32,910	$ 59,640	$ 3,890	$ 139,420	$ 69,710	$ 44,760	$ 61,250	$ 54,360	$ 4,920	$ 165,290	$ 33,058	$ 87,995,820	$ 1,558,276,963
2046	$ 43,700	$ 33,550	$ 60,700	$ 3,990	$ 141,940	$ 70,970	$ 45,800	$ 62,750	$ 55,640	$ 5,040	$ 169,230	$ 33,846	$ 89,846,340	$ 1,648,123,303
2047	$ 44,430	$ 34,190	$ 61,750	$ 4,100	$ 144,470	$ 72,235	$ 46,850	$ 64,240	$ 56,930	$ 5,160	$ 173,180	$ 34,636	$ 91,702,665	$ 1,739,825,968
2048	$ 45,150	$ 34,840	$ 62,800	$ 4,210	$ 147,000	$ 73,500	$ 47,890	$ 65,730	$ 58,210	$ 5,280	$ 177,110	$ 35,422	$ 93,553,530	$ 1,833,379,498
2049	$ 45,880	$ 35,480	$ 63,860	$ 4,310	$ 149,530	$ 74,765	$ 48,930	$ 67,230	$ 59,500	$ 5,400	$ 181,060	$ 36,212	$ 95,409,855	$ 1,928,789,353
2050	$ 46,600	$ 36,120	$ 64,910	$ 4,420	$ 152,050	$ 76,025	$ 49,970	$ 68,720	$ 60,780	$ 5,520	$ 184,990	$ 36,998	$ 97,257,645	$ 2,026,046,998

(1) A ramp-up period is assumed for the first four years of operation
(2) 2007 Dollars
(3) Weekend day revenue for HOT2+ is estimated to be 50 percent of weekday revenue
(4) Weekend day revenue for TOT lanes is estimated to be 20 percent of weekday revenue
(5) Annual revenue calculations assume 250 weekdays and 115 weekend/holidays

Table 4-27: Net Revenue Summary--- un-inflated dollars (000) – Alternative C-2

Year	Gross Annual Toll Revenue (1)	Annual Transactions (2)	Operation Cost (3)	Infrastructure Operation and Maintenance Cost (4)	Net Annual Revenue	Cumulative Annual Net Revenue
2019						
2020	$ 12,907	10,600	$ 2,226	$ 16,791	$ (6,110)	$ (6,110)
2021	$ 17,644	12,610	$ 2,648	$ 16,791	$ (1,796)	$ (1,796)
2022	$ 24,649	15,623	$ 3,281	$ 16,791	$ 4,577	$ 4,577
2023	$ 33,453	19,070	$ 4,005	$ 16,791	$ 12,657	$ 17,234
2024	$ 38,161	19,788	$ 4,155	$ 16,791	$ 17,214	$ 34,449
2025	$ 41,840	19,917	$ 4,182	$ 16,791	$ 20,867	$ 55,315
2026	$ 45,505	20,045	$ 4,209	$ 16,791	$ 24,504	$ 79,820
2027	$ 49,181	20,171	$ 4,236	$ 16,791	$ 28,154	$ 107,974
2028	$ 52,854	20,302	$ 4,263	$ 16,791	$ 31,800	$ 139,774
2029	$ 56,525	20,430	$ 4,290	$ 16,791	$ 35,443	$ 175,217
2030	$ 60,198	20,559	$ 4,317	$ 16,791	$ 39,090	$ 214,307
2031	$ 62,052	20,687	$ 4,344	$ 16,791	$ 40,916	$ 255,223
2032	$ 63,905	20,818	$ 4,372	$ 16,791	$ 42,742	$ 297,966
2033	$ 65,759	20,944	$ 4,398	$ 16,791	$ 44,570	$ 342,535
2034	$ 67,609	21,072	$ 4,425	$ 16,791	$ 46,393	$ 388,928
2035	$ 69,469	21,201	$ 4,452	$ 16,791	$ 48,226	$ 437,154
2036	$ 71,317	21,329	$ 4,479	$ 16,791	$ 50,046	$ 487,200
2037	$ 73,170	21,461	$ 4,507	$ 16,791	$ 51,872	$ 539,073
2038	$ 75,024	21,589	$ 4,534	$ 16,791	$ 53,699	$ 592,772
2039	$ 76,874	21,715	$ 4,560	$ 16,791	$ 55,523	$ 648,295
2040	$ 78,734	21,843	$ 4,587	$ 16,791	$ 57,356	$ 705,650
2041	$ 80,587	21,974	$ 4,615	$ 16,791	$ 59,182	$ 764,832
2042	$ 82,432	22,103	$ 4,642	$ 16,791	$ 60,999	$ 825,831
2043	$ 84,291	22,231	$ 4,669	$ 16,791	$ 62,832	$ 888,663
2044	$ 86,142	22,360	$ 4,696	$ 16,791	$ 64,656	$ 953,319
2045	$ 87,996	22,485	$ 4,722	$ 16,791	$ 66,483	$ 1,019,802
2046	$ 89,846	22,617	$ 4,749	$ 16,791	$ 68,306	$ 1,088,108
2047	$ 91,703	22,745	$ 4,776	$ 16,791	$ 70,135	$ 1,158,243
2048	$ 93,554	22,874	$ 4,803	$ 16,791	$ 71,959	$ 1,230,202
2049	$ 95,410	23,002	$ 4,830	$ 16,791	$ 73,788	$ 1,303,990
2050	$ 97,258	23,133	$ 4,858	$ 16,791	$ 75,609	$ 1,379,599

(1) Uninflated revenues are in 2007 dollars.
(2) Annual transaction do not include non-toll paying vehicles.
(3) Operation cost is assumed to be $0.21 per tolled transaction and it includes Billing and Administration Cost; Violations Center Operations Cost and Customer Service Center Cost; Enforcement cost and Toll Equipment Maintenance Cost.
(4) Annual Infrastructure Operation and Maintenance Cost is assumed to be 0.5% of the total capital cost.

Table 4-28: Annual Toll Revenue in Inflated Dollars (000) – Alternative C-2

Year	UNINFLATED DOLLARS (000)				Inflation Factors		INFLATED DOLLARS (000)			
	Total Gross Annual Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Net Cumulative Annual	Toll Revenue	O&M	Gross Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Cumulative Annual Revenue
2020	$ 12,907	$ 19,017	$ (6,110)	$ (6,110)	1.379	1.469	$ 17,799	$ 27,936	$ (10,137)	$ (10,137)
2021	$ 17,644	$ 19,439	$ (1,796)	$ (7,905)	1.413	1.513	$ 24,930	$ 29,411	$ (4,481)	$ (14,618)
2022	$ 24,649	$ 20,072	$ 4,577	$ (3,328)	1.448	1.558	$ 35,692	$ 31,272	$ 4,420	$ (10,198)
2023	$ 33,453	$ 20,796	$ 12,657	$ 9,329	1.485	1.605	$ 49,678	$ 33,377	$ 16,301	$ 6,102
2024	$ 38,161	$ 20,946	$ 17,214	$ 26,543	1.522	1.653	$ 58,081	$ 34,625	$ 23,456	$ 29,559
2025	$ 41,840	$ 20,973	$ 20,867	$ 47,410	1.560	1.702	$ 65,271	$ 35,697	$ 29,574	$ 59,132
2026	$ 45,505	$ 21,000	$ 24,504	$ 71,914	1.599	1.754	$ 72,762	$ 36,835	$ 35,927	$ 95,059
2027	$ 49,181	$ 21,027	$ 28,154	$ 100,068	1.639	1.806	$ 80,608	$ 37,974	$ 42,633	$ 137,693
2028	$ 52,854	$ 21,054	$ 31,800	$ 131,868	1.680	1.860	$ 88,795	$ 39,161	$ 49,634	$ 187,327
2029	$ 56,525	$ 21,081	$ 35,443	$ 167,312	1.722	1.916	$ 97,335	$ 40,392	$ 56,944	$ 244,271
2030	$ 60,198	$ 21,108	$ 39,090	$ 206,401	1.765	1.974	$ 106,250	$ 41,668	$ 64,582	$ 308,852
2031	$ 62,052	$ 21,135	$ 40,916	$ 247,318	1.809	2.033	$ 112,251	$ 42,968	$ 69,283	$ 378,136
2032	$ 63,905	$ 21,163	$ 42,742	$ 290,060	1.854	2.094	$ 118,480	$ 44,315	$ 74,165	$ 452,301
2033	$ 65,759	$ 21,189	$ 44,570	$ 334,630	1.900	2.157	$ 124,942	$ 45,705	$ 79,237	$ 531,537
2034	$ 67,609	$ 21,216	$ 46,393	$ 381,023	1.948	2.221	$ 131,703	$ 47,121	$ 84,582	$ 616,119
2035	$ 69,469	$ 21,243	$ 48,226	$ 429,248	1.996	2.288	$ 138,660	$ 48,604	$ 90,055	$ 706,174
2036	$ 71,317	$ 21,270	$ 50,046	$ 479,295	2.046	2.357	$ 145,914	$ 50,134	$ 95,780	$ 801,954
2037	$ 73,170	$ 21,298	$ 51,872	$ 531,167	2.098	2.427	$ 153,511	$ 51,690	$ 101,821	$ 903,776
2038	$ 75,024	$ 21,325	$ 53,699	$ 584,866	2.150	2.500	$ 161,301	$ 53,312	$ 107,989	$ 1,011,765
2039	$ 76,874	$ 21,351	$ 55,523	$ 640,389	2.204	2.575	$ 169,431	$ 54,979	$ 114,452	$ 1,126,217
2040	$ 78,734	$ 21,378	$ 57,356	$ 697,745	2.259	2.652	$ 177,859	$ 56,695	$ 121,165	$ 1,247,381
2041	$ 80,587	$ 21,406	$ 59,182	$ 756,927	2.315	2.732	$ 186,559	$ 58,480	$ 128,079	$ 1,375,461
2042	$ 82,432	$ 21,433	$ 60,999	$ 817,926	2.373	2.814	$ 195,611	$ 60,311	$ 135,300	$ 1,510,760
2043	$ 84,291	$ 21,460	$ 62,832	$ 880,758	2.433	2.898	$ 205,081	$ 62,190	$ 142,891	$ 1,653,651
2044	$ 86,142	$ 21,487	$ 64,656	$ 945,413	2.493	2.985	$ 214,753	$ 64,137	$ 150,615	$ 1,804,267
2045	$ 87,996	$ 21,513	$ 66,483	$ 1,011,896	2.556	3.075	$ 224,917	$ 66,152	$ 158,765	$ 1,963,032
2046	$ 89,846	$ 21,540	$ 68,306	$ 1,080,202	2.620	3.167	$ 235,397	$ 68,219	$ 167,179	$ 2,130,210
2047	$ 91,703	$ 21,567	$ 70,135	$ 1,150,337	2.685	3.262	$ 246,222	$ 70,353	$ 175,869	$ 2,306,079
2048	$ 93,554	$ 21,594	$ 71,959	$ 1,222,296	2.752	3.360	$ 257,459	$ 72,557	$ 184,902	$ 2,490,981
2049	$ 95,410	$ 21,621	$ 73,788	$ 1,296,085	2.821	3.461	$ 269,151	$ 74,832	$ 194,319	$ 2,685,301
2050	$ 97,258	$ 21,649	$ 75,609	$ 1,371,694	2.892	3.565	$ 281,269	$ 77,179	$ 204,090	$ 2,889,391

Notes: Uninflated revenues and costs are in 2007 dollars.
Annual inflation rates of 2.5% and 3.0% are applied for toll revenue and O&M cost respectively.

4.10 Traffic and Toll Revenue Estimates - Alternative C-3

Alternative C-3 assumed the construction of two managed lanes in each direction on I-75 South corridor from I-285 to SR 16 and the construction of two voluntary Truck Only Toll (TOT) Lanes in each direction along I-675 and I-75 South corridor from I-675 to SR 16.

The tolling and policy framework evaluated in this alternative for managed lanes is Express Tolling Lanes (ETL) for cars only. ETL refers to a tolling alternative that all traffic including SOVs, HOVs and Commercial Vehicles (CV) including commercially registered autos, pickup trucks, and vans would pay a toll to use the managed lanes. It was assumed that Medium-Duty Trucks (MDT) and Heavy-Duty Trucks (HDT) would not be allowed to utilize the managed lane system in this alternative.

The truck tolling and policy framework evaluated in this alternative is optional TOT. Optional TOT refers to a truck tolling alternative that would allow MDT (FHWA classes 4-7) and HDT (FHWA classes 8-13) to pay a toll to use the TOT lanes.

4.10.1 Toll Sensitivity Analysis Results

A summary of the results of the managed lane and TOT lane toll sensitivity analysis for Alternative C-3 in 2020 and 2030 is presented in Figures 4-63 through 4-74.

The sets of sensitivity curves follow a similar pattern when compared to the sensitivity curves in Alternative C-1 and Alternative C-2, so a detailed description will not be repeated.

Under similar recommended toll rates, Alternative C-3 generates higher revenue in the managed lanes than the revenue generated in Alternative C-1 and Alternative C-2. For example, in 2020 during PM peak period, with the recommended toll rate of $0.05 per mile for the northbound and recommended toll rate of $0.10 per mile for southbound, Alterative C-3 would generate $13,079, a 4% increase when compared the revenue of $12,524 in Alternative C-2, and a 33% revenue increase when compared the revenue of $9,856 in Alternative C-1. As noted in the section of Alternative A-3 analysis, the increase in revenue is due to restricting free HOV-2 and HOV-3 vehicles which, in turn, leads to higher unused capacity in the HOT lanes and correspondingly more achievable time savings in the HOT lanes when compared to the general-purpose lanes.

The same amount of TOT lane revenue is generated in Alternative C-3 as previous two alternatives.

Figure 4-63: 2020 AM Peak Period ETL Sensitivity Curves – Alternative C-3

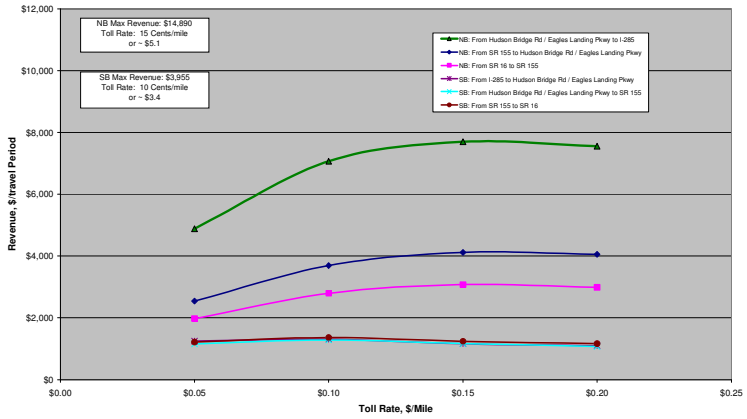


Figure 4-64: 2020 Midday Period ETL Sensitivity Curves – Alternative C-3

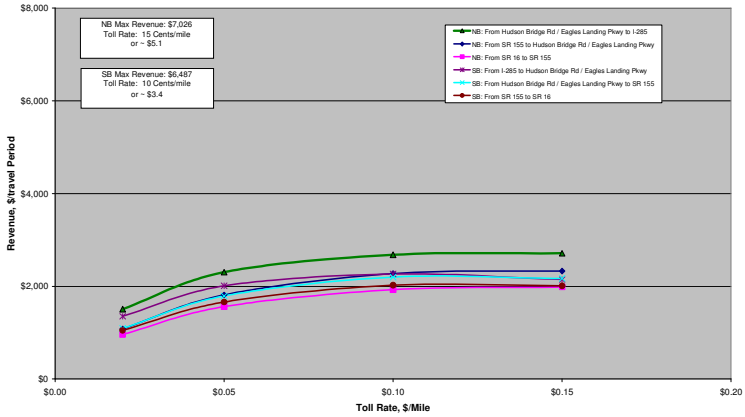


Figure 4-65: 2020 PM Peak Period ETL Sensitivity Curves – Alternative C-3

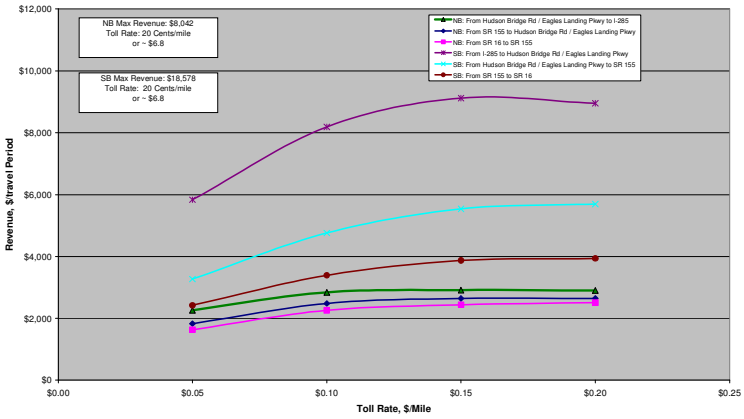


Figure 4-66: 2020 AM Peak Period TOT Sensitivity Curves – Alternative C-3

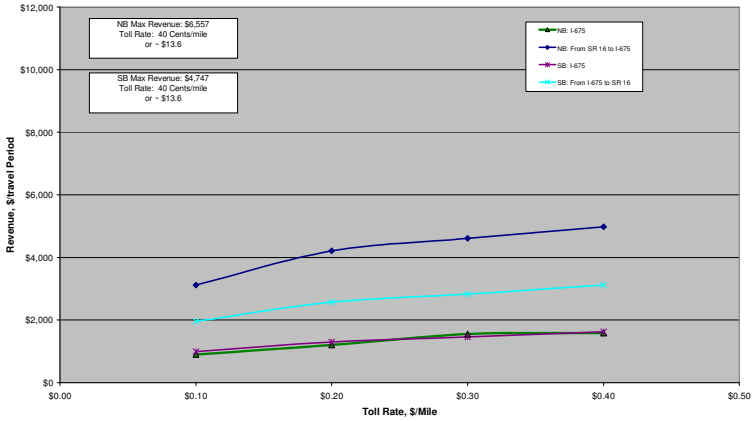


Figure 4-67: 2020 Midday Peak Period TOT Sensitivity Curves – Alternative C-3

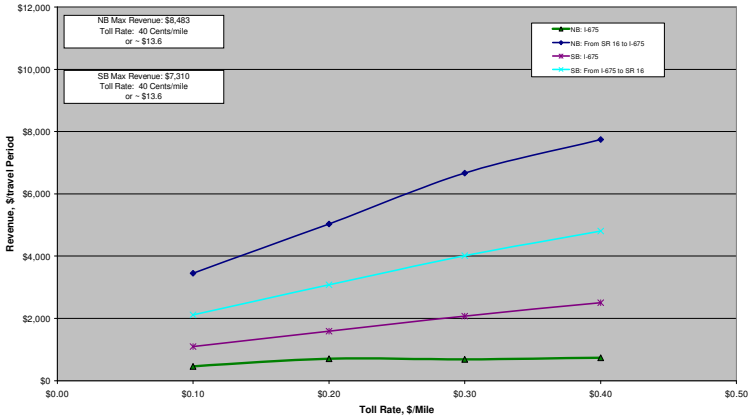


Figure 4-68: 2020 PM Peak Period TOT Sensitivity Curves – Alternative C-3

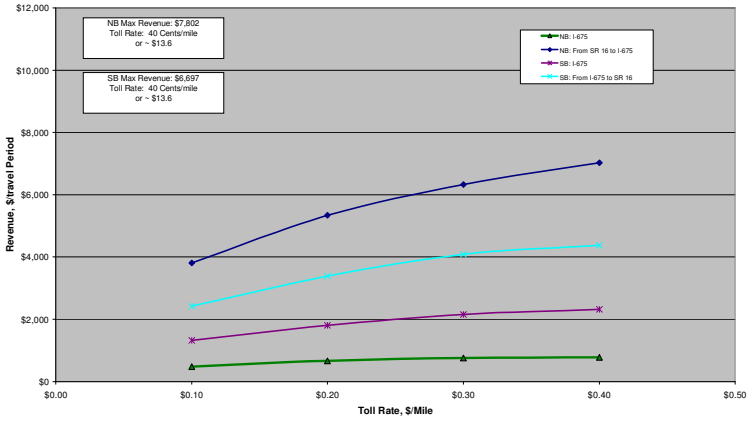


Figure 4-69: 2030 AM Peak Period ETL Sensitivity Curves – Alternative C-3

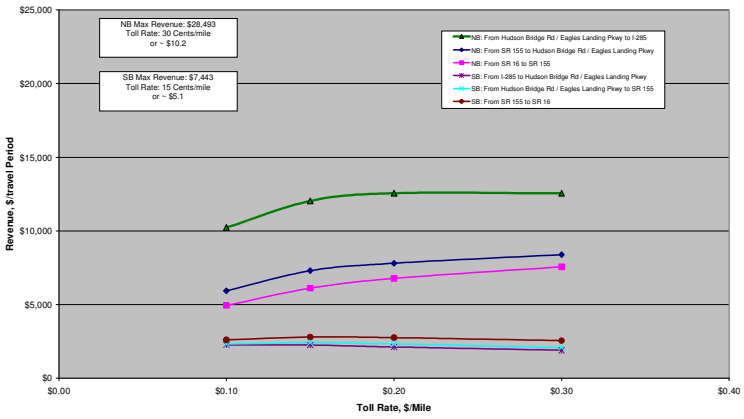


Figure 4-70: 2030 Midday Period ETL Sensitivity Curves – Alternative C-3

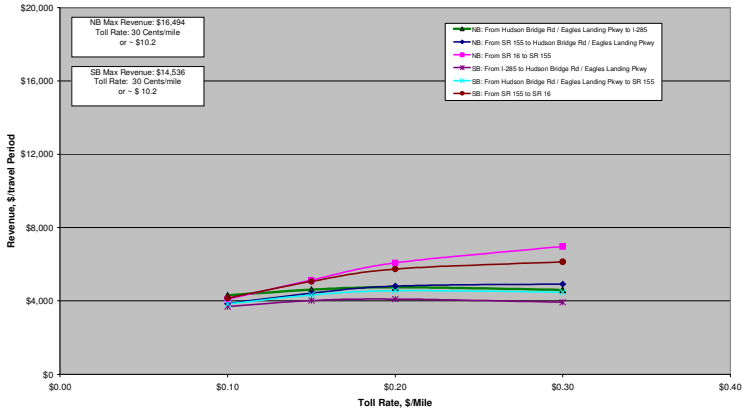


Figure 4-71: 2030 PM Peak Period ETL Sensitivity Curves – Alternative C-3

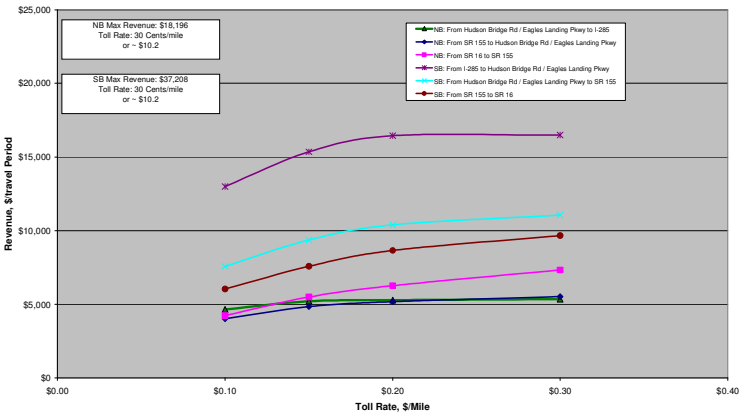


Figure 4-72: 2030 AM Peak Period TOT Sensitivity Curves – Alternative C-3

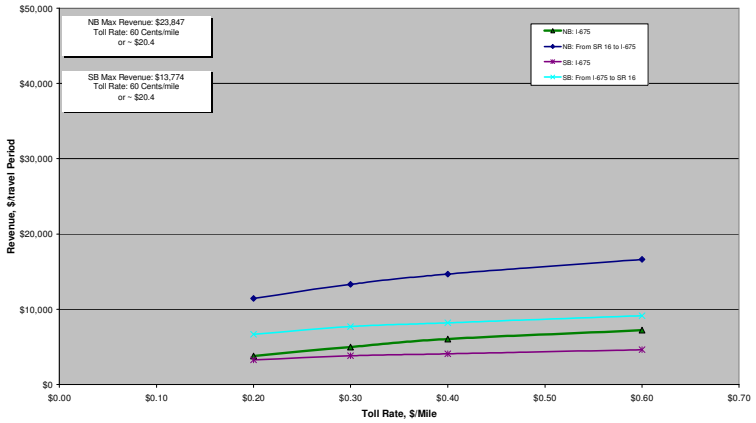


Figure 4-73: 2030 Midday Peak Period TOT Sensitivity Curves – Alternative C-3

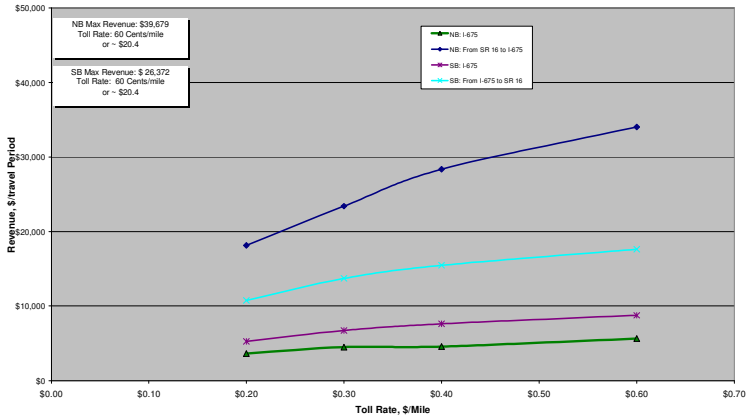
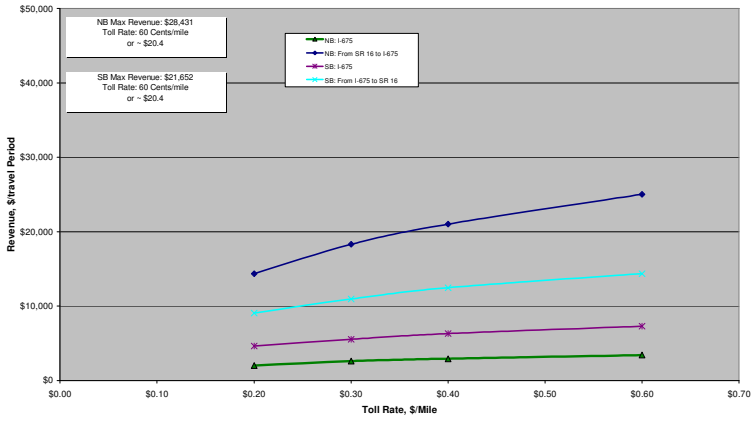


Figure 4-74: 2030 PM Peak Period TOT Sensitivity Curves – Alternative C-3



4.10.2 Toll Revenue Verses Operational Tradeoffs

To illustrate the tradeoffs between revenue optimization and operational efficiency, toll rate operational profiles on managed lanes and truck-only-toll lanes were developed for the opening year of 2020 and horizon year of 2030 under various toll rates, separately by time-of-day and by direction of travel.

Figure 4-75 provides a comparative operating profile for opening year 2020 AM peak period for the managed lanes. The first two upper figures illustrate the relationship between managed lane revenue and toll rate by travel direction. In the northbound direction, the peak direction in the morning, the managed lane revenue generated is much higher than that of the southbound direction.

In the second series of charts, vehicle-miles of travel (VMT) by direction are shown for:

- Total vehicles on the managed lanes; and
- Priced vehicles on the managed lanes (SOVs, HOV2+s, and CVs in this application).

Again, VMT in the northbound direction substantially exceeds that of the southbound direction for each vehicle class.

The two lower figures illustrate average speed drawn from the traffic assignment results in the general-purpose and managed lanes with respect to various toll rates. As toll rates increase, average speed in the managed lanes increase slightly as more SOVs, HOV-2s and CVs migrate back to the general-purpose lanes. At very low toll rates the travel time savings provided by the managed lanes has tremendous value, attracting many SOV motorists, HOV2+ motorists and CV travelers. As a result, the managed lanes are inundated with SOV, HOV2+ and CV traffic driving the average speed down. Speeds in the managed lanes steadily rebound as willingness to pay decreases as the toll rate increases.

In the PM peak periods, the major distinction is the reversal of travel patterns as the northbound peak direction swivels to the southbound direction. In the Midday analysis period, revenue, VMT and average travel speed are comparable for northbound direction and southbound direction.

Figure 4-76 provides a comparative operating profile for opening year 2020 AM peak period for the TOT lanes. Again, the first two upper figures illustrate the relationship between the TOT lane revenue and toll rate by travel direction. In the northbound direction, the peak direction in the morning, the TOT revenue generated is slightly higher than that of the southbound direction.

In the second series of charts, vehicle-miles of travel (VMT) by direction are shown for:

- Total vehicles on the TOT lanes; and
- Priced vehicles on the TOT lanes (medium-duty truck and heavy-duty truck in this application);

VMT in the northbound direction slightly exceeds that of the southbound direction for both medium-duty trucks and heavy-duty trucks.

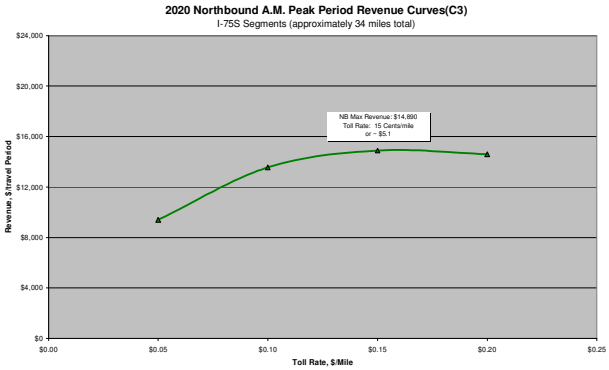
The two lower figures illustrate average speed drawn from the traffic assignment results in the general-purpose and TOT lanes with respect to various toll rates. As toll rates increase, average speed in the general purpose lanes decrease slightly as more heavy-duty and medium-duty trucks migrate back to the general-purpose lanes. Due to the relatively low through truck demand for TOT lanes, the average operating speed on TOT lanes can be maintained at the free-flow speed of 65 mph under the various toll rates.

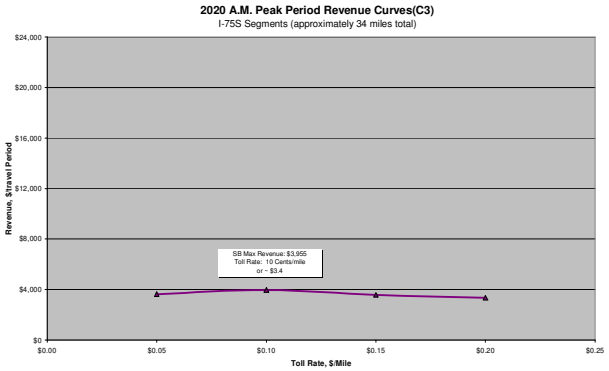
In the PM and Midday peak analysis periods, revenue, VMT and average travel speed are pretty comparable for northbound direction and southbound direction.

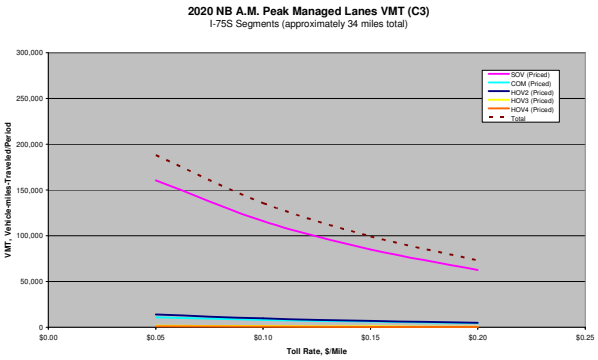
Similar logic for revenue, VMT and average travel speed are observed for the horizon year of 2030, thus a detailed description will not be repeated.

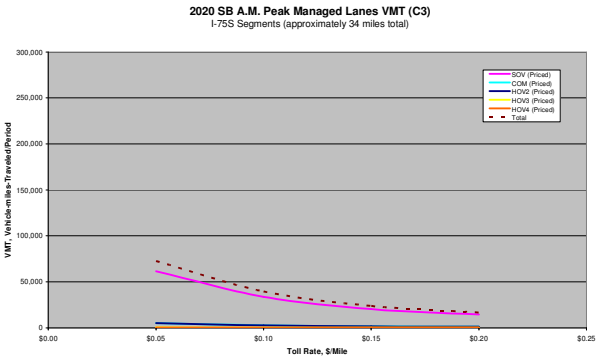
Refer to Appendix 4-A for a complete set of operating profiles for opening year 2020 and horizon year of 2030 AM peak period, PM peak period and Midday period.

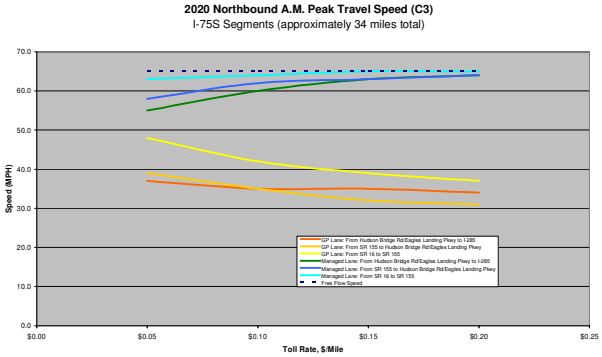
Figure 4-75: 2020 AM Peak Period Toll Rate Operational Profile – Alternative C-3 (Managed Lanes)











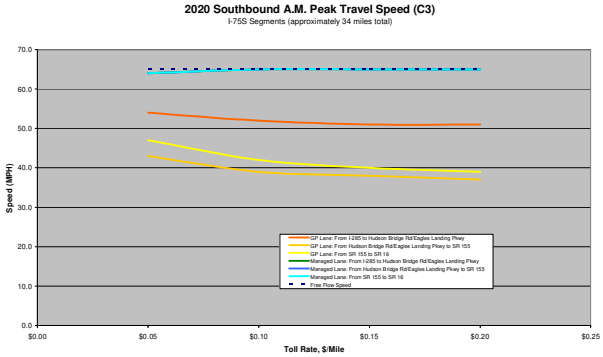
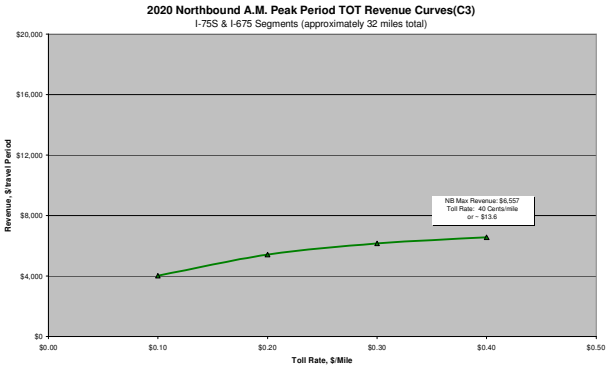
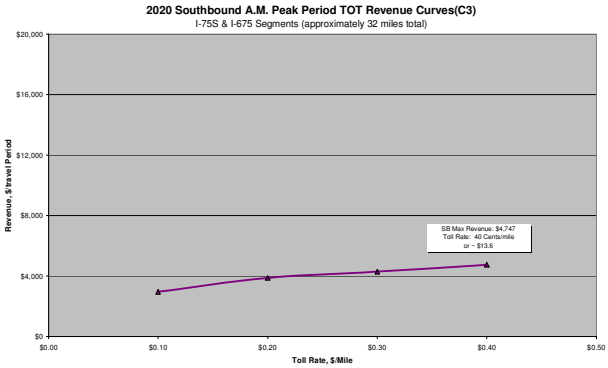
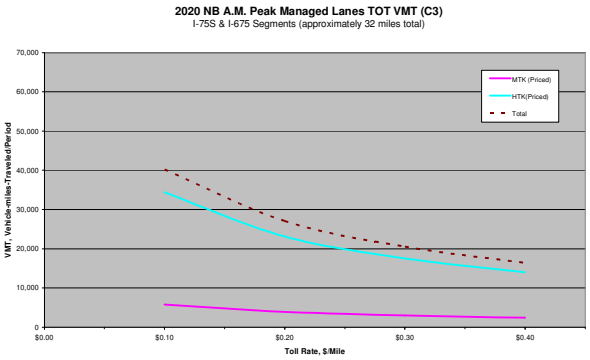
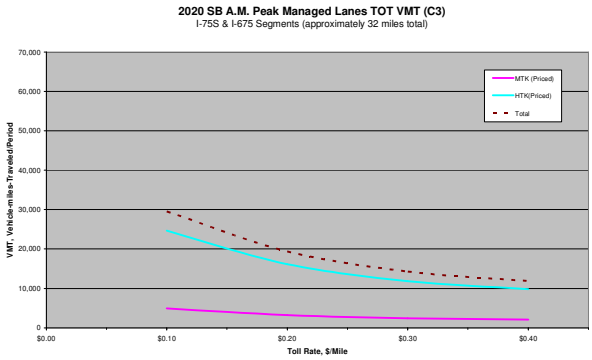


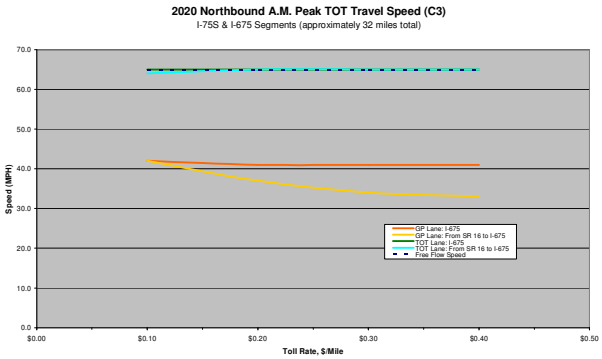
Figure 4-76: 2020 AM Peak Period Toll Rate Operational Profile – Alternative C-3 (TOT Lanes)

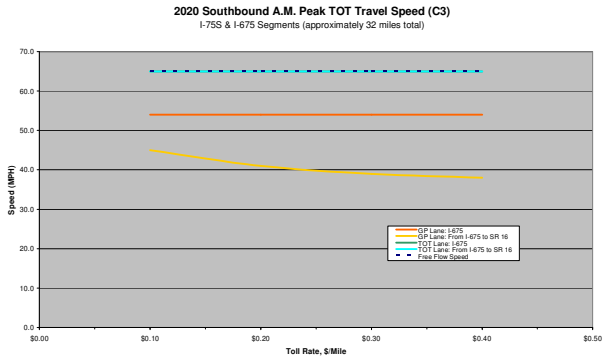












4.10.3 Selected Toll Rate

As discussed in the earlier section (4.3.3), the selection of toll rates for the managed lanes and TOT lanes must:

- Not erode HOT/ TOT/ETL lane average travel speed below 45 mph;
- Optimize available toll rates for HOT/TOT/ETL lane; and
- Optimize usage for HOT/TOT/ETL lane.

The detailed steps for selecting toll rate for managed lanes are summaries as follows:

- Identify the toll rate that produced the most revenue
- Lower the toll rate by $0.05 - $0.08 per mile to allow the facility's operation to increase revenue as needed.
- Check to make sure the managed lanes are operating above 45 mph.
- If not, increase the toll rate until the desired operating conditions is achieved.

Table 4-29 presents the selected managed lanes toll rates. In 2020 and 2030, a desired operating speed of 45 mph or above can be maintained at the recommended toll rates.

In general, the TOT revenue increases steadily as toll rate increase. The TOT utility rate was calculated to select the recommended toll rates so that the usage of TOT lanes and revenue can be optimized.

$$\text{TOT Utility Rate} = \frac{Truck\ Volume\ on\ TOT\ Lanes\ @\ Toll\ Rate}{Truck\ Volume\ on\ TOL\ (No-Toll)}$$

The recommended toll rate contains at least 40% of TOT utility rate when compared to free truck only lane condition. Table 4-30 presents the recommended TOT toll rates. In 2020 and 2030, TOT lane will operate at a desired operating speed of 50 mph or above.

4.10.4 Estimated Weekday Traffic

Refer to Appendix 4-B for Alternative C-3 2020 and 2030 traffic diagrams of:

- Daily Total Trips;
- AM Total Trips;
- PM Total Trips; and
- MD Total Trips.

4.10.5 Revenue Projections

Table 4-31 presents estimated gross toll revenue by period for the ETL (cars only) lanes and TOT lanes. Revenues shown in the table for each period were obtained at the recommended toll levels for Alternative C-3 described previously for ETL lanes and TOT lanes; for each travel direction and then aggregated to a daily total. For example, approximately $29,601 and $14,801 in daily revenue is expected on a typical opening year weekday for HOT lanes and TOT lanes respectively. Approximately $15,158 in daily revenue is expected on a typical opening year weekend day for ETL lanes;

whereas $3,032 in daily revenue is expected on a typical opening year weekend day for TOT lanes.

The net revenue stream in un-inflated 2007 dollars and inflated dollars are presented in Table 4-32 and 4-33 respectively. From year 2020 to year 2050, Alternative C-3 will generate approximately $1.452 billion cumulative net revenue in un-inflated 2007 dollars and approximately $3.044 billion cumulative net revenue in inflated dollars.

Table 4-29: Recommended Toll Rates – Alternative C-3

Year	Analysis Period	Dir	Maximum Revenue Toll Rates			Recommended Toll Rates			ML Speed @ Recommended Toll Rate		
			Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3
2020	AM Peak Period	NB	$0.15	$0.15	$0.15	$0.10	$0.10	$0.10	60	62	64
		SB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	64	64	64
	Midday Period	NB	$0.15	$0.15	$0.10	$0.05	$0.05	$0.05	64	64	64
		SB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	64	64	64
	PM Peak Period	NB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	64	63	64
		SB	$0.15	$0.20	$0.20	$0.10	$0.10	$0.10	61	61	64
	Night	NB	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	65	65	65
		SB	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	65	65	65
2030	AM Peak Period	NB	$0.20	$0.30	$0.30	$0.15	$0.15	$0.15	59	59	63
		SB	$0.10	$0.15	$0.15	$0.10	$0.10	$0.10	65	64	64
	Midday Period	NB	$0.20	$0.20	$0.30	$0.10	$0.10	$0.10	64	64	64
		SB	$0.20	$0.20	$0.30	$0.10	$0.10	$0.10	64	64	64
	PM Peak Period	NB	$0.20	$0.30	$0.30	$0.10	$0.10	$0.10	64	62	63
		SB	$0.30	$0.30	$0.30	$0.15	$0.15	$0.15	59	58	62
	Night	NB	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	65	65	65
		SB	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	65	65	65

Table 4-30: Recommended Toll Rates – Truck Only Lane – Alternative C-3

Year	Analysis Period	Dir	Toll Rates Analyzed		TOT Utility Rate @ Minimum Toll Rate		TOT Utility Rate @ Maximum Toll Rate		Recommended Toll Rates		ML Speed @ Recommended Toll Rate	
			Minimum	Maximum	I-675	I-75 S	I-675	I-75 S	I-675	I-75 S	I-675	I-75 S
2020	AM Peak Period	NB	$0.10	$0.40	54%	56%	24%	22%	$0.10	$0.20	65	65
		SB	$0.10	$0.40	32%	34%	13%	13%	$0.10	$0.10	65	65
	Midday Period	NB	$0.10	$0.40	31%	34%	12%	19%	$0.10	$0.10	65	64
		SB	$0.10	$0.40	26%	27%	15%	15%	$0.10	$0.10	65	65
	PM Peak Period	NB	$0.10	$0.40	46%	52%	18%	24%	$0.10	$0.10	65	64
		SB	$0.10	$0.40	46%	47%	20%	21%	$0.10	$0.20	65	65
2030	AM Peak Period	NB	$0.20	$0.60	57%	52%	36%	25%	$0.30	$0.30	64	63
		SB	$0.20	$0.60	37%	37%	17%	17%	$0.20	$0.20	64	64
	Midday Period	NB	$0.20	$0.60	54%	59%	28%	37%	$0.20	$0.20	64	61
		SB	$0.20	$0.60	40%	41%	22%	22%	$0.20	$0.20	64	64
	PM Peak Period	NB	$0.20	$0.60	48%	52%	27%	30%	$0.20	$0.30	64	62
		SB	$0.20	$0.60	47%	49%	25%	26%	$0.20	$0.20	64	64

Table 4-31: Annual Gross Toll Revenue (un-inflated dollars) – Alternative C-3

Year (1)	Weekday ETL Lane Revenue By Period (2)				ETL Total Weekday	ETL Weekend Day (3)	Weekday TOT Revenue By Period (2)				TOT Total Weekday	TOT Weekend Day (4)	Estimated Annual Gross Revenue (4)	Cumulative Gross Revenue
	AM Peak	Midday	PM Peak	Night			AM Peak	Midday	PM Peak	Night				
2020	$ 9,928	$ 5,913	$ 13,079	$ 682	$ 29,601	$ 14,801	$ 4,587	$ 5,005	$ 5,170	$ 396	$ 15,158	$ 3,032	$ 13,240,442	$ 13,240,442
2021	$ 12,818	$ 7,904	$ 17,037	$ 878	$ 38,636	$ 19,318	$ 6,773	$ 7,852	$ 7,794	$ 618	$ 23,036	$ 4,607	$ 18,169,398	$ 31,409,840
2022	$ 17,112	$ 10,848	$ 22,920	$ 1,176	$ 52,056	$ 26,028	$ 10,008	$ 12,056	$ 11,656	$ 944	$ 34,664	$ 6,933	$ 25,470,492	$ 56,880,332
2023	$ 22,378	$ 14,521	$ 30,148	$ 1,533	$ 68,579	$ 34,290	$ 14,152	$ 17,509	$ 16,645	$ 1,368	$ 49,674	$ 9,935	$ 34,648,963	$ 91,529,294
2024	$ 24,740	$ 16,380	$ 33,510	$ 1,690	$ 76,320	$ 38,160	$ 16,670	$ 21,040	$ 19,750	$ 1,640	$ 59,100	$ 11,820	$ 39,602,700	$ 131,131,994
2025	$ 26,410	$ 17,790	$ 35,950	$ 1,810	$ 81,960	$ 40,980	$ 18,760	$ 24,020	$ 22,340	$ 1,870	$ 66,990	$ 13,398	$ 43,490,970	$ 174,622,964
2026	$ 28,080	$ 19,190	$ 38,380	$ 1,920	$ 87,570	$ 43,785	$ 20,840	$ 27,000	$ 24,920	$ 2,100	$ 74,860	$ 14,972	$ 47,364,555	$ 221,987,519
2027	$ 29,750	$ 20,600	$ 40,810	$ 2,030	$ 93,190	$ 46,595	$ 22,920	$ 29,990	$ 27,510	$ 2,330	$ 82,750	$ 16,550	$ 51,246,675	$ 273,234,194
2028	$ 31,430	$ 22,010	$ 43,240	$ 2,140	$ 98,820	$ 49,410	$ 25,000	$ 32,970	$ 30,100	$ 2,560	$ 90,630	$ 18,126	$ 55,129,140	$ 328,363,334
2029	$ 33,100	$ 23,410	$ 45,680	$ 2,260	$ 104,450	$ 52,225	$ 27,090	$ 35,960	$ 32,680	$ 2,790	$ 98,520	$ 19,704	$ 59,014,335	$ 387,377,669
2030	$ 34,770	$ 24,820	$ 48,110	$ 2,370	$ 110,070	$ 55,035	$ 29,170	$ 38,940	$ 35,270	$ 3,020	$ 106,400	$ 21,280	$ 62,893,725	$ 450,271,394
2031	$ 35,610	$ 25,520	$ 49,330	$ 2,480	$ 112,940	$ 56,470	$ 30,210	$ 40,430	$ 36,560	$ 3,140	$ 110,340	$ 22,068	$ 64,851,870	$ 515,123,264
2032	$ 36,440	$ 26,230	$ 50,540	$ 2,600	$ 115,810	$ 57,905	$ 31,250	$ 41,920	$ 37,860	$ 3,250	$ 114,280	$ 22,856	$ 66,810,015	$ 581,933,279
2033	$ 37,280	$ 26,930	$ 51,760	$ 2,710	$ 118,680	$ 59,340	$ 32,290	$ 43,420	$ 39,150	$ 3,370	$ 118,230	$ 23,646	$ 68,770,890	$ 650,704,169
2034	$ 38,110	$ 27,630	$ 52,980	$ 2,820	$ 121,540	$ 60,770	$ 33,340	$ 44,910	$ 40,440	$ 3,480	$ 122,170	$ 24,434	$ 70,725,960	$ 721,430,129
2035	$ 38,950	$ 28,340	$ 54,190	$ 2,940	$ 124,420	$ 62,210	$ 34,380	$ 46,400	$ 41,740	$ 3,600	$ 126,120	$ 25,224	$ 72,689,910	$ 794,120,039
2036	$ 39,790	$ 29,040	$ 55,410	$ 3,050	$ 127,290	$ 63,645	$ 35,420	$ 47,890	$ 43,030	$ 3,710	$ 130,050	$ 26,010	$ 74,645,325	$ 868,765,364
2037	$ 40,620	$ 29,740	$ 56,630	$ 3,160	$ 130,150	$ 65,075	$ 36,460	$ 49,380	$ 44,320	$ 3,830	$ 133,990	$ 26,798	$ 76,600,395	$ 945,365,759
2038	$ 41,460	$ 30,450	$ 57,840	$ 3,270	$ 133,020	$ 66,510	$ 37,500	$ 50,880	$ 45,620	$ 3,940	$ 137,940	$ 27,588	$ 78,561,270	$ 1,023,927,029
2039	$ 42,290	$ 31,150	$ 59,060	$ 3,390	$ 135,890	$ 67,945	$ 38,540	$ 52,370	$ 46,910	$ 4,060	$ 141,880	$ 28,376	$ 80,519,415	$ 1,104,446,444
2040	$ 43,130	$ 31,860	$ 60,280	$ 3,500	$ 138,770	$ 69,385	$ 39,590	$ 53,860	$ 48,210	$ 4,170	$ 145,830	$ 29,166	$ 82,483,365	$ 1,186,929,809
2041	$ 43,970	$ 32,560	$ 61,490	$ 3,610	$ 141,630	$ 70,815	$ 40,630	$ 55,350	$ 49,500	$ 4,290	$ 149,770	$ 29,954	$ 84,438,435	$ 1,271,368,244
2042	$ 44,800	$ 33,260	$ 62,710	$ 3,730	$ 144,500	$ 72,250	$ 41,670	$ 56,840	$ 50,790	$ 4,400	$ 153,700	$ 30,740	$ 86,393,850	$ 1,357,762,094
2043	$ 45,640	$ 33,970	$ 63,920	$ 3,840	$ 147,370	$ 73,685	$ 42,710	$ 58,340	$ 52,090	$ 4,520	$ 157,660	$ 31,532	$ 88,357,455	$ 1,446,119,549
2044	$ 46,470	$ 34,670	$ 65,140	$ 3,950	$ 150,230	$ 75,115	$ 43,750	$ 59,830	$ 53,380	$ 4,630	$ 161,590	$ 32,318	$ 90,309,795	$ 1,536,429,344
2045	$ 47,310	$ 35,370	$ 66,360	$ 4,070	$ 153,110	$ 76,555	$ 44,790	$ 61,320	$ 54,670	$ 4,750	$ 165,530	$ 33,106	$ 92,271,015	$ 1,628,700,359
2046	$ 48,150	$ 36,080	$ 67,570	$ 4,180	$ 155,980	$ 77,990	$ 45,830	$ 62,810	$ 55,970	$ 4,860	$ 169,470	$ 33,894	$ 94,229,160	$ 1,722,929,519
2047	$ 48,980	$ 36,780	$ 68,790	$ 4,290	$ 158,840	$ 79,420	$ 46,880	$ 64,300	$ 57,260	$ 4,980	$ 173,420	$ 34,684	$ 96,186,960	$ 1,819,116,479
2048	$ 49,820	$ 37,480	$ 70,010	$ 4,400	$ 161,710	$ 80,855	$ 47,920	$ 65,800	$ 58,550	$ 5,090	$ 177,360	$ 35,472	$ 98,145,105	$ 1,917,261,584
2049	$ 50,650	$ 38,190	$ 71,220	$ 4,520	$ 164,580	$ 82,290	$ 48,960	$ 67,290	$ 59,850	$ 5,210	$ 181,310	$ 36,262	$ 100,105,980	$ 2,017,367,564
2050	$ 51,490	$ 38,890	$ 72,440	$ 4,630	$ 167,450	$ 83,725	$ 50,000	$ 68,780	$ 61,140	$ 5,320	$ 185,240	$ 37,048	$ 102,061,395	$ 2,119,428,959

(1) A ramp-up period is assumed for the first four years of operation
(2) 2007 Dollars
(3) Weekend day revenue for HOT2+ is estimated to be 50 percent of weekday revenue
(4) Weekend day revenue for TOT lanes is estimated to be 20 percent of weekday revenue
(5) Annual revenue calculations assume 250 weekdays and 115 weekend/holidays

Table 4-32: Net Revenue Summary--- un-inflated dollars (000) – Alternative C-3

Year	Gross Annual Toll Revenue (1)	Annual Transactions (2)	Operation Cost (3)	Infrastructure Operation and Maintenance Cost (4)	Net Annual Revenue	Cumulative Annual Net Revenue
2020	$ 13,240	11,064	$ 2,323	$ 16,791	$ (5,874)	$ (5,874)
2021	$ 18,169	13,298	$ 2,793	$ 16,791	$ (1,414)	$ (1,414)
2022	$ 25,470	16,642	$ 3,495	$ 16,791	$ 5,185	$ 5,185
2023	$ 34,649	20,512	$ 4,307	$ 16,791	$ 13,550	$ 18,735
2024	$ 39,603	21,487	$ 4,512	$ 16,791	$ 18,299	$ 37,035
2025	$ 43,491	21,831	$ 4,584	$ 16,791	$ 22,116	$ 59,150
2026	$ 47,365	22,174	$ 4,657	$ 16,791	$ 25,917	$ 85,067
2027	$ 51,247	22,515	$ 4,728	$ 16,791	$ 29,728	$ 114,795
2028	$ 55,129	22,859	$ 4,800	$ 16,791	$ 33,538	$ 148,332
2029	$ 59,014	23,203	$ 4,873	$ 16,791	$ 37,351	$ 185,683
2030	$ 62,894	23,544	$ 4,944	$ 16,791	$ 41,159	$ 226,842
2031	$ 64,852	23,761	$ 4,990	$ 16,791	$ 43,071	$ 269,913
2032	$ 66,810	23,982	$ 5,036	$ 16,791	$ 44,983	$ 314,896
2033	$ 68,771	24,200	$ 5,082	$ 16,791	$ 46,898	$ 361,793
2034	$ 70,726	24,418	$ 5,128	$ 16,791	$ 48,807	$ 410,600
2035	$ 72,690	24,636	$ 5,174	$ 16,791	$ 50,725	$ 461,326
2036	$ 74,645	24,857	$ 5,220	$ 16,791	$ 52,634	$ 513,960
2037	$ 76,600	25,072	$ 5,265	$ 16,791	$ 54,544	$ 568,504
2038	$ 78,561	25,293	$ 5,312	$ 16,791	$ 56,459	$ 624,963
2039	$ 80,519	25,512	$ 5,357	$ 16,791	$ 58,371	$ 683,334
2040	$ 82,483	25,729	$ 5,403	$ 16,791	$ 60,289	$ 743,623
2041	$ 84,438	25,948	$ 5,449	$ 16,791	$ 62,198	$ 805,821
2042	$ 86,394	26,168	$ 5,495	$ 16,791	$ 64,107	$ 869,929
2043	$ 88,357	26,384	$ 5,541	$ 16,791	$ 66,026	$ 935,955
2044	$ 90,310	26,604	$ 5,587	$ 16,791	$ 67,932	$ 1,003,887
2045	$ 92,271	26,823	$ 5,633	$ 16,791	$ 69,847	$ 1,073,734
2046	$ 94,229	27,040	$ 5,678	$ 16,791	$ 71,760	$ 1,145,494
2047	$ 96,187	27,259	$ 5,724	$ 16,791	$ 73,672	$ 1,219,165
2048	$ 98,145	27,480	$ 5,771	$ 16,791	$ 75,583	$ 1,294,749
2049	$ 100,106	27,695	$ 5,816	$ 16,791	$ 77,499	$ 1,372,248
2050	$ 102,061	27,916	$ 5,862	$ 16,791	$ 79,408	$ 1,451,656

(1) Uninflated revenues are in 2007 dollars.
(2) Annual transaction do not include non-toll paying vehicles.
(3) Operation cost is assumed to be $0.21 per tolled transaction and it includes Billing and Administration Cost; Violations Center Operations Cost and Customer Service Center Cost; Enforcement cost and Toll Equipment Maintenance Cost.
(4) Annual Infrastructure Operation and Maintenance Cost is assumed to be 0.5% of the total capital cost.

Table 4-33: Annual Toll Revenue in Inflated Dollars (000) – Alternative C-3

Year	UNINFLATED DOLLARS (000)				Inflation Factors		INFLATED DOLLARS (000)			
	Total Gross Annual Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Net Cumulative Annual Revenue	Toll Revenue	O&M	Gross Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Cumulative Annual Revenue
2020	$ 13,240	$ 19,114	$ (5,874)	$ (5,874)	1.379	1.469	$ 18,259	$ 28,079	$ (9,821)	$ (9,821)
2021	$ 18,169	$ 19,584	$ (1,414)	$ (7,288)	1.413	1.513	$ 25,673	$ 29,630	$ (3,957)	$ (13,777)
2022	$ 25,470	$ 20,286	$ 5,185	$ (2,103)	1.448	1.558	$ 36,881	$ 31,605	$ 5,276	$ (8,501)
2023	$ 34,649	$ 21,098	$ 13,550	$ 11,447	1.485	1.605	$ 51,454	$ 33,863	$ 17,591	$ 9,090
2024	$ 39,603	$ 21,303	$ 18,299	$ 29,746	1.522	1.653	$ 60,275	$ 35,214	$ 25,061	$ 34,151
2025	$ 43,491	$ 21,375	$ 22,116	$ 51,862	1.560	1.702	$ 67,846	$ 36,381	$ 31,465	$ 65,616
2026	$ 47,365	$ 21,448	$ 25,917	$ 77,779	1.599	1.754	$ 75,736	$ 37,619	$ 38,117	$ 103,732
2027	$ 51,247	$ 21,519	$ 29,728	$ 107,506	1.639	1.806	$ 83,993	$ 38,864	$ 45,130	$ 148,862
2028	$ 55,129	$ 21,591	$ 33,538	$ 141,044	1.680	1.860	$ 92,617	$ 40,160	$ 52,457	$ 201,319
2029	$ 59,014	$ 21,664	$ 37,351	$ 178,395	1.722	1.916	$ 101,623	$ 41,507	$ 60,115	$ 261,435
2030	$ 62,894	$ 21,735	$ 41,159	$ 219,554	1.765	1.974	$ 111,007	$ 42,905	$ 68,102	$ 329,537
2031	$ 64,852	$ 21,781	$ 43,071	$ 262,625	1.809	2.033	$ 117,317	$ 44,281	$ 73,036	$ 402,573
2032	$ 66,810	$ 21,827	$ 44,983	$ 307,607	1.854	2.094	$ 123,866	$ 45,706	$ 78,159	$ 480,733
2033	$ 68,771	$ 21,873	$ 46,898	$ 354,505	1.900	2.157	$ 130,665	$ 47,180	$ 83,484	$ 564,217
2034	$ 70,726	$ 21,919	$ 48,807	$ 403,312	1.948	2.221	$ 137,774	$ 48,682	$ 89,092	$ 653,309
2035	$ 72,690	$ 21,965	$ 50,725	$ 454,038	1.996	2.288	$ 145,089	$ 50,255	$ 94,834	$ 748,143
2036	$ 74,645	$ 22,011	$ 52,634	$ 506,672	2.046	2.357	$ 152,724	$ 51,880	$ 100,844	$ 848,988
2037	$ 76,600	$ 22,056	$ 54,544	$ 561,216	2.098	2.427	$ 160,708	$ 53,530	$ 107,177	$ 956,165
2038	$ 78,561	$ 22,103	$ 56,459	$ 617,675	2.150	2.500	$ 168,907	$ 55,257	$ 113,650	$ 1,069,815
2039	$ 80,519	$ 22,148	$ 58,371	$ 676,046	2.204	2.575	$ 177,465	$ 57,032	$ 120,433	$ 1,190,248
2040	$ 82,483	$ 22,194	$ 60,289	$ 736,335	2.259	2.652	$ 186,330	$ 58,859	$ 127,471	$ 1,317,719
2041	$ 84,438	$ 22,240	$ 62,198	$ 798,533	2.315	2.732	$ 195,475	$ 60,760	$ 134,715	$ 1,452,434
2042	$ 86,394	$ 22,286	$ 64,107	$ 862,641	2.373	2.814	$ 205,013	$ 62,714	$ 142,299	$ 1,594,733
2043	$ 88,357	$ 22,332	$ 66,026	$ 928,667	2.433	2.898	$ 214,974	$ 64,717	$ 150,257	$ 1,744,990
2044	$ 90,310	$ 22,378	$ 67,932	$ 996,599	2.493	2.985	$ 225,142	$ 66,798	$ 158,344	$ 1,903,334
2045	$ 92,271	$ 22,424	$ 69,847	$ 1,066,446	2.556	3.075	$ 235,845	$ 68,953	$ 166,892	$ 2,070,225
2046	$ 94,229	$ 22,469	$ 71,760	$ 1,138,205	2.620	3.167	$ 246,880	$ 71,161	$ 175,720	$ 2,245,945
2047	$ 96,187	$ 22,515	$ 73,672	$ 1,211,877	2.685	3.262	$ 258,262	$ 73,445	$ 184,817	$ 2,430,762
2048	$ 98,145	$ 22,562	$ 75,583	$ 1,287,461	2.752	3.360	$ 270,095	$ 75,807	$ 194,288	$ 2,625,050
2049	$ 100,106	$ 22,607	$ 77,499	$ 1,364,960	2.821	3.461	$ 282,399	$ 78,242	$ 204,157	$ 2,829,207
2050	$ 102,061	$ 22,653	$ 79,408	$ 1,444,368	2.892	3.565	$ 295,162	$ 80,759	$ 214,403	$ 3,043,609

Notes: Uninflated revenues and costs are in 2007 dollars.
Annual inflation rates of 2.5% and 3.0% are applied for toll revenue and O&M cost respectively.

4.11 Traffic and Toll Revenue Estimates - Alternative D

This alternative assumed the construction of two managed lanes in each direction along I-75 South corridor from I-285 to SR 16.

The tolling and policy framework evaluated in this managed lane alternative is Express Tolling Lanes (ETL) for all vehicle. ETL for all vehicles refers to a tolling alternative that all traffic including SOVs, HOVs, Commercial Vehicles (CV) including commercially registered autos, pickup trucks, and vans, Medium-Duty trucks (FHWA classes 4-7) and Heavy-Duty trucks (FHWA classes 8-13) would pay a toll to use the managed lanes.

4.11.1 Toll Sensitivity Analysis Results

A summary of the results of the ETL (all vehicles) toll sensitivity analysis for Alternative D in 2020 and 2030 is presented in Figures 4-77 through 4-88.

Figures 4-77 through 4-79 illustrate the revenue of three segments generated by passenger cars (SOVs, HOVs and CVs) for the AM peak, Midday, and PM peak period respectively in 2020. The toll rate resulting in the maximum AM peak period revenue is expected to be $0.15 per mile northbound and $0.10 per mile southbound and $0.10 per mile northbound for all three segments. During the Midday period, the toll rate resulting in the maximum revenue is expected to be $0.15 per mile northbound for all three segments; $0.10 per mile for segment I and $0.15 per mile for segment II and III southbound. During the PM peak period, the toll rate resulting in the maximum revenue is expected to be $0.10 per mile northbound and $0.15 per mile southbound for all three segments.

Figures 4-80 through 4-82 illustrate the revenue of three segments generated by Medium-Duty and Heavy-Duty trucks for the AM peak, Midday, and PM peak period respectively in 2020. The toll rate for trucks was assumed to be two times of the toll rate for passenger cars during the toll sensitivity analysis. Again, in general, as toll rates increase, TOT revenue generated by the TOT lanes increase slightly. The TOT lane revenue curve is less sensitive to the toll rates since the truck operators and shippers has higher willingness to pay level and there is lower hourly truck demand for TOT lanes when compared to the SOV, HOV and CV demand for the managed lanes.

The recommended toll rates for the over night period are $0.02 per mile for managed lanes and $0.04 per mile for TOT lanes in 2020 for both directions. Similar conclusions can be drawn from studying toll sensitivity curves in the year 2030.

Figure 4-77: 2020 AM Peak Period PC Sensitivity Curves – Alternative D

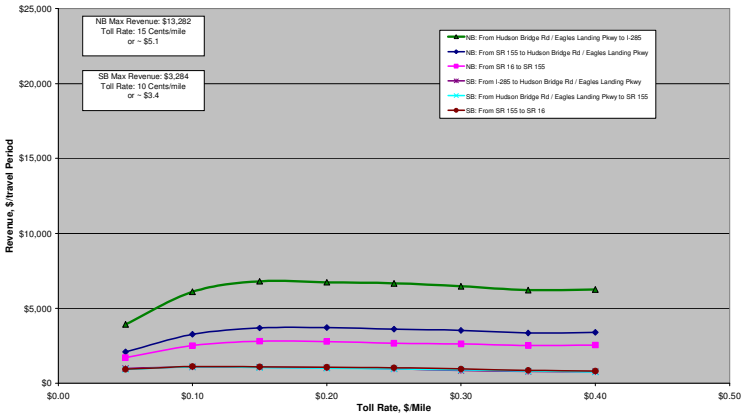


Figure 4-78: 2020 Midday Period PC Sensitivity Curves – Alternative D

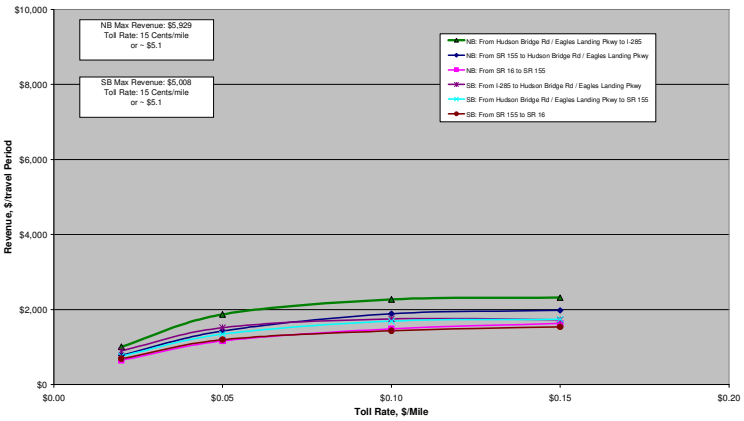


Figure 4-79: 2020 PM Peak Period PC Sensitivity Curves – Alternative D

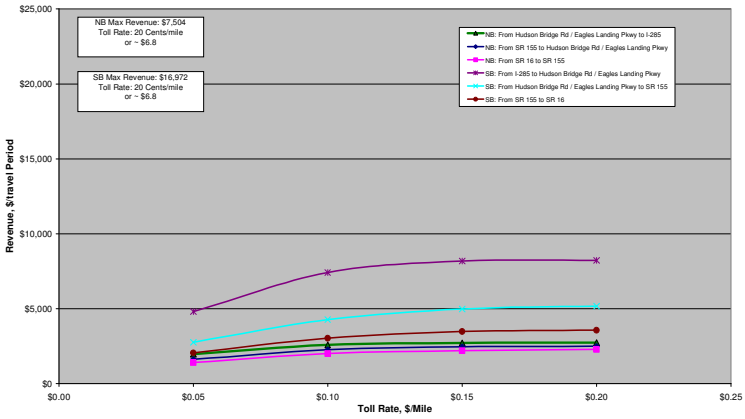


Figure 4-80: 2020 AM Peak Period Truck Sensitivity Curves – Alternative D

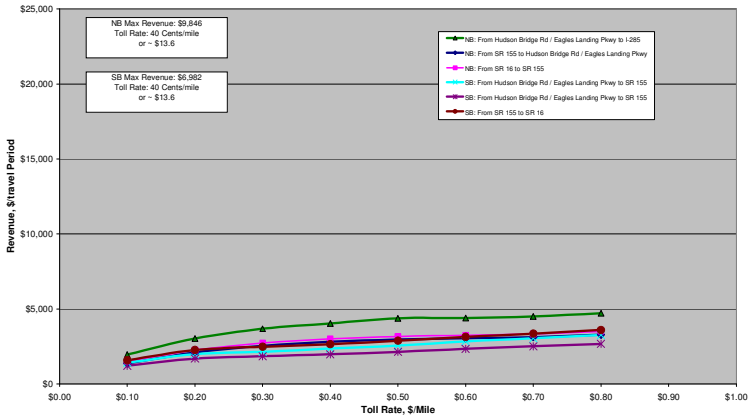


Figure 4-81: 2020 Midday Peak Period Truck Sensitivity Curves – Alternative D

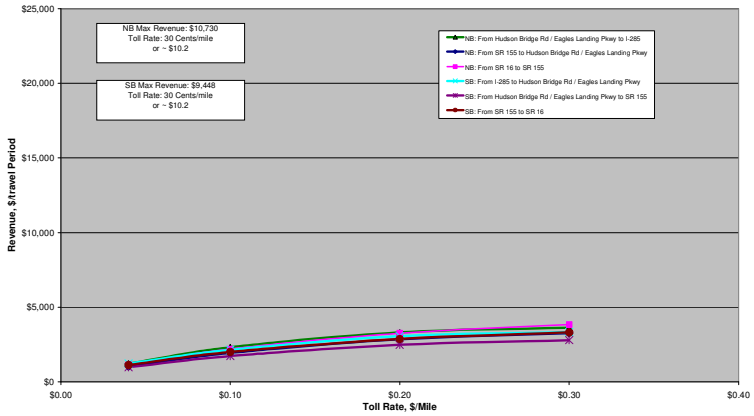


Figure 4-82: 2020 PM Peak Period Truck Sensitivity Curves – Alternative D

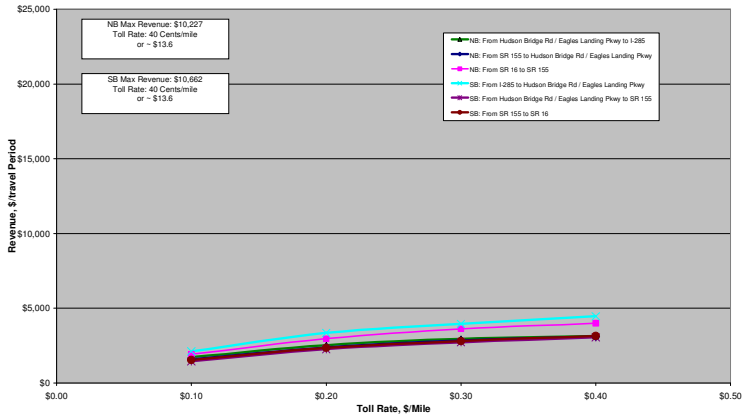


Figure 4-83: 2030 AM Peak Period PC Sensitivity Curves – Alternative D

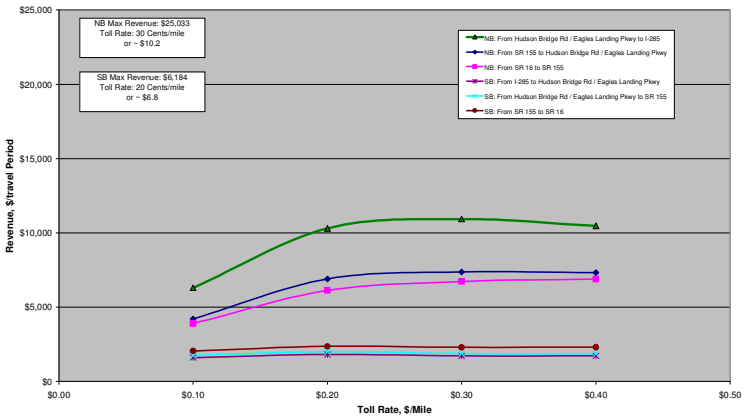


Figure 4-84: 2030 Midday Period PC Sensitivity Curves – Alternative D

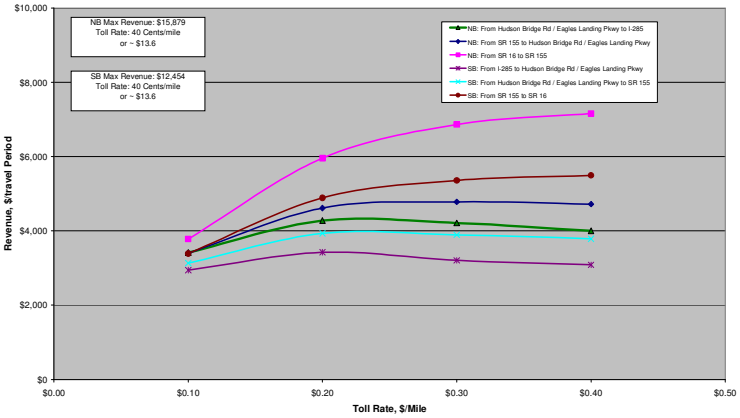


Figure 4-85: 2030 PM Peak Period PC Sensitivity Curves – Alternative D

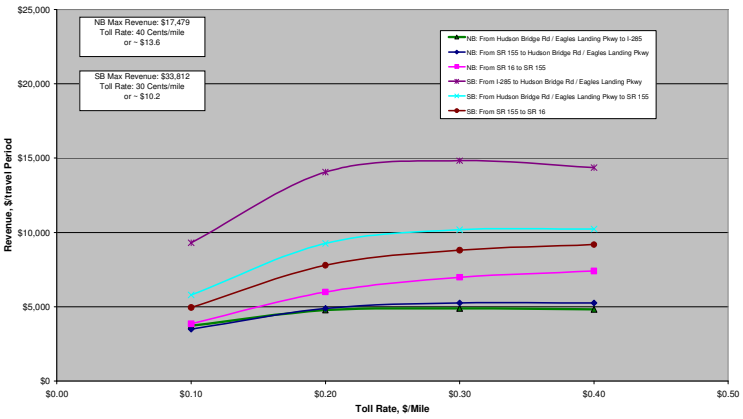


Figure 4-86: 2030 AM Peak Period Truck Sensitivity Curves – Alternative D

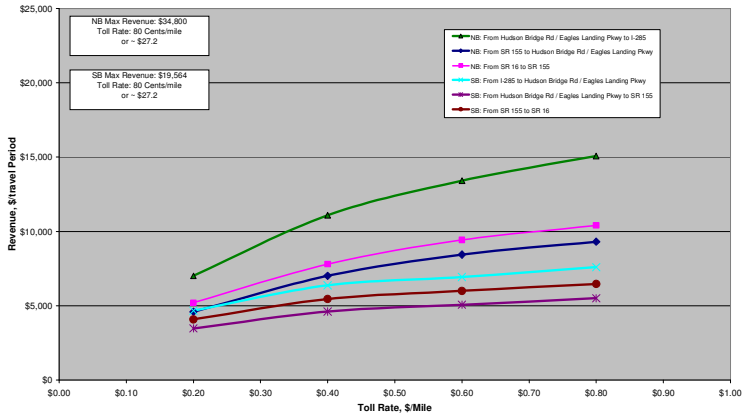


Figure 4-87: 2030 Midday Peak Period Truck Sensitivity Curves – Alternative D

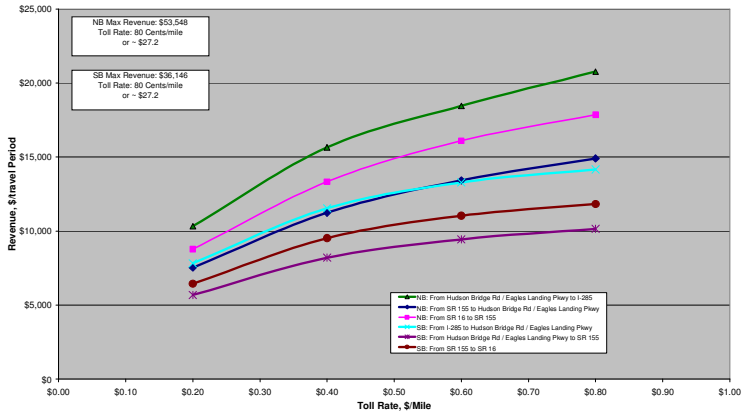
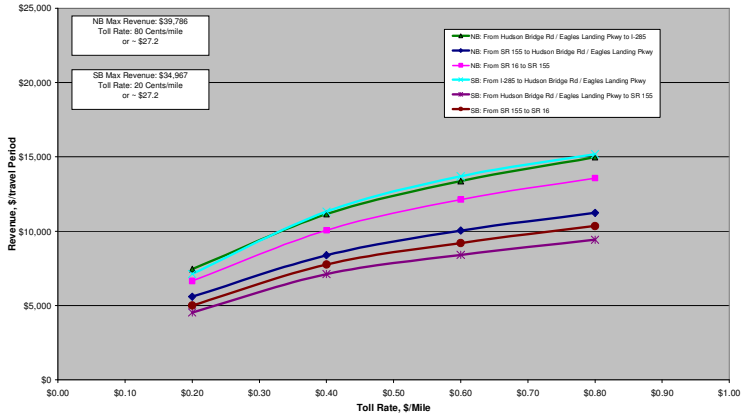


Figure 4-88: 2030 PM Peak Period Truck Sensitivity Curves – Alternative D



4.11.2 Toll Revenue Verses Operational Tradeoffs

To illustrate the tradeoffs between revenue optimization and operational efficiency, toll rate operational profiles on express toll lanes (for all vehicles) were developed for the opening year of 2020 and horizon year of 2030 under various toll rates, separately by time-of-day and by direction of travel.

Figure 4-89 provides a comparative operating profile for opening year 2020 AM peak period for the express tolled lanes (all vehicles). The first two upper figures illustrate the relationship between express toll lanes passenger car revenue/truck revenue and toll rate by travel direction. In the northbound direction, the peak commute direction in the morning, the revenue generated by passenger cars is higher than the one generated by trucks. However, in the southbound direction, the off-peak commute direction in the morning, the revenue generated by trucks exceeds the passenger car revenue. This is expected since the passenger car commuting traffic is more concentrated during the AM and PM peak period when compared to the truck traffic. Overall, the total express lane revenue generated in northbound in the morning is higher than that of the southbound direction.

In the second series of charts, vehicle-miles of travel (VMT) by direction are shown for:

- Total vehicles on the Express Toll Lanes (all vehicles); and
- Priced vehicles on the Express Toll Lanes (SOVs, HOVs, CVs, Medium-Duty Trucks and Heavy-Duty Trucks in this application).

Again, VMT in the northbound direction exceeds that of the southbound direction for each vehicle class.

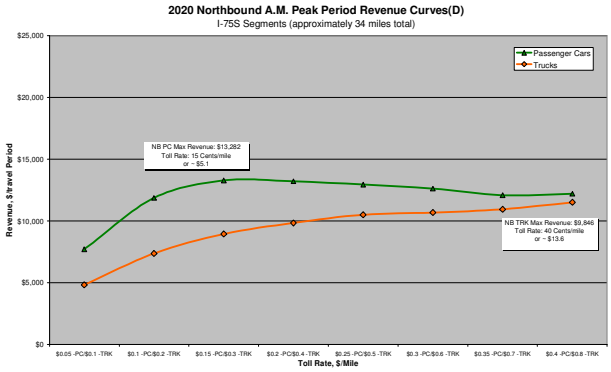
The two lower figures illustrate average speed drawn from the traffic assignment results in the general-purpose and express toll lanes with respect to various toll rates. As toll rates increase, average speed in the express toll lanes increase slightly as more SOVs, HOVs, CVs and trucks migrate back to the general-purpose lanes. At very low toll rates the travel time savings provided by the express toll lanes has tremendous value, attracting many SOV, HOV motorists, and CV and truck travelers. As a result, the express toll lanes are inundated with SOV, HOV, CV and truck traffic driving the average speed down. Speeds in the express toll lanes steadily rebound as willingness to pay decreases as the toll rate increases.

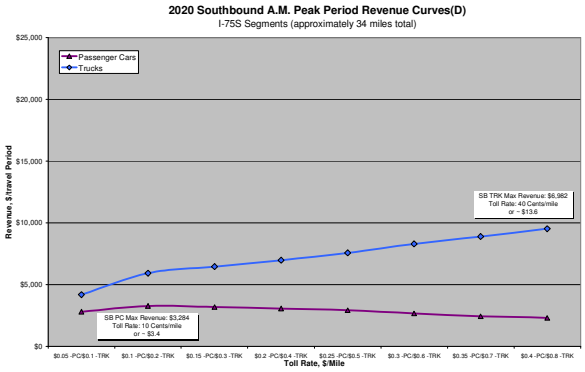
In the PM peak periods, the major distinction is the reversal of travel patterns for the passenger cars as the northbound peak direction swivels to the southbound direction. In the Midday analysis period, revenue, VMT and average travel speed are comparable for northbound direction and southbound direction.

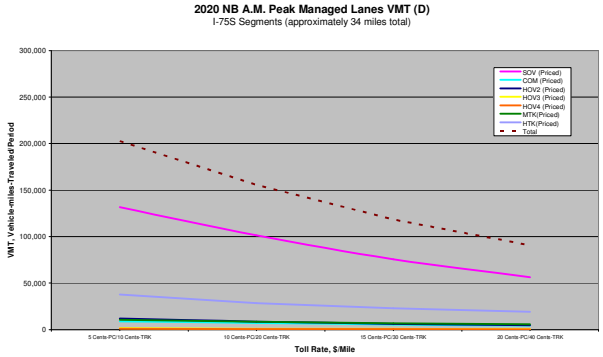
Similar logic for revenue, VMT and average travel speed are observed for the horizon year of 2030, thus a detailed description will not be repeated.

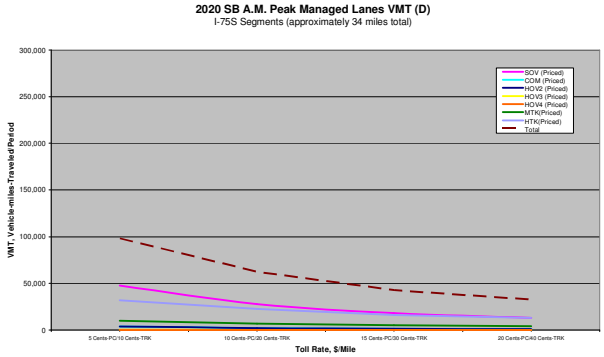
Refer to Appendix 4-A for a complete set of operating profiles for opening year 2020 and horizon year of 2030 AM peak period, PM peak period and Midday period.

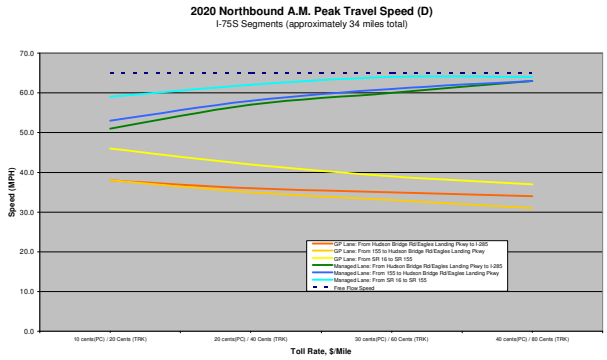
Figure 4-89: 2020 AM Peak Period Toll Rate Operational Profile – Alternative D

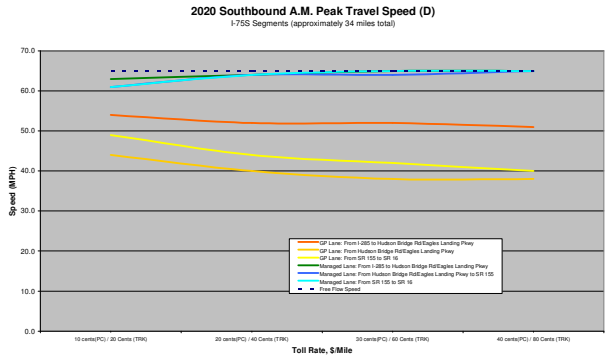












4.11.3 Selected Toll Rate

As discussed in the earlier section (4.3.3), the selection of toll rates for the managed lanes and TOT lanes must:

- Not erode HOT/ TOT/ETL lane average travel speed below 45 mph;
- Optimize available toll rates for HOT/TOT/ETL lane; and
- Optimize usage for HOT/TOT/ETL lane.

The detailed steps for selecting express lane toll rate for passenger cars are summarized as follows:

- Identify the toll rate that produced the most revenue
- Lower the toll rate by $0.05 - $0.08 per mile to allow the facility's operation to increase revenue as needed.
- Check to make sure the managed lanes are operating above 45 mph.
- If not, increase the toll rate until the desired operating conditions is achieved.

Table 4-34 presents the selected express lane toll rates for passenger cars. The toll rates for trucks were assumed to be two times of rates for passenger cars. In 2020 and 2030, a desired operating speed of 45 mph or above can be maintained on the express toll lanes at the recommended toll rates.

4.11.4 Estimated Weekday Traffic

Refer to Appendix 4-B for Alternative D 2020 and 2030 traffic diagrams of:

- Daily Total Trips;
- AM Total Trips;
- PM Total Trips; and
- MD Total Trips.

4.11.5 Revenue Projections

Table 4-35 presents estimated gross toll revenue by period for the express toll lanes generated by passenger cars and by trucks. Revenues shown in the table for each period were obtained at the recommended toll levels for Alternative D described previously; for each travel direction and then aggregated to a daily total. For example, approximately $51,657 in daily revenue is expected on a typical opening year weekday; among the total daily revenue, $26,043 is generated by passenger car usage, whereas $25,614 is generated by trucks usage. $18,144 in daily revenue is expected on a typical opening year weekend day for express toll lanes; $13,021 is generated by passenger car usage, whereas $3,355 is generated by trucks usage.

The net revenue stream in un-inflated 2007 dollars and inflated dollars are presented in Table 4-36 and 4-37 respectively. From year 2020 to year 2050, Alternative D will generate approximately $1.896 billion cumulative net revenue in un-inflated 2007 dollars and approximately $4.083 billion cumulative net revenue in inflated dollars.

Table 4-34: Recommended Toll Rates – Alternative D

Year	Analysis Period	Dir	Maximum Revenue Toll Rates			Optimum Toll Rates (Passenger Car)			Optimum Toll Rates (Truck)			ML Speed @ Optimum Toll Rate		
			Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3	Seg. 1	Seg. 2	Seg. 3
2020	AM Peak Period	NB	$0.15	$0.15	$0.15	$0.10	$0.10	$0.10	$0.20	$0.20	$0.20	57	58	62
		SB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	$0.10	$0.10	$0.10	63	61	61
	Midday Period	NB	$0.15	$0.15	$0.15	$0.10	$0.10	$0.10	$0.20	$0.20	$0.20	64	63	64
		SB	$0.10	$0.15	$0.15	$0.05	$0.05	$0.05	$0.10	$0.10	$0.10	63	62	63
	PM Peak Period	NB	$0.10	$0.10	$0.10	$0.05	$0.05	$0.05	$0.10	$0.10	$0.10	62	59	61
		SB	$0.20	$0.20	$0.20	$0.10	$0.10	$0.10	$0.20	$0.20	$0.20	58	58	62
	Night	NB	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.04	$0.04	$0.04	65	64	65
		SB	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.04	$0.04	$0.04	64	64	64
2030	AM Peak Period	NB	$0.30	$0.30	$0.30	$0.20	$0.20	$0.20	$0.40	$0.40	$0.40	54	53	58
		SB	$0.10	$0.15	$0.15	$0.10	$0.10	$0.10	$0.20	$0.20	$0.20	62	58	59
	Midday Period	NB	$0.20	$0.20	$0.40	$0.10	$0.10	$0.10	$0.20	$0.20	$0.20	59	54	57
		SB	$0.20	$0.20	$0.40	$0.10	$0.10	$0.10	$0.20	$0.20	$0.20	61	58	60
	PM Peak Period	NB	$0.20	$0.30	$0.30	$0.10	$0.10	$0.10	$0.20	$0.20	$0.20	58	51	55
		SB	$0.30	$0.30	$0.30	$0.20	$0.20	$0.20	$0.40	$0.40	$0.40	56	54	59
	Night	NB	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.10	$0.10	$0.10	64	64	64
		SB	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.10	$0.10	$0.10	64	64	64

Table 4-35: Annual Gross Toll Revenue (un-inflated dollars) – Alternative D

Year (1)	Weekday HOT Lane Revenue By Period (2)				HOT Total Weekday	HOT Weekend Day (3)	Weekday TOT Revenue By Period (2)				TOT Total Weekday	TOT Weekend Day (4)	Estimated Annual Gross Revenue (4)	Cumulative Gross Revenue
	AM Peak	Midday	PM Peak	Night			AM Peak	Midday	PM Peak	Night				
2020	$ 8,470	$ 5,517	$ 11,479	$ 578	$ 26,043	$ 13,021	$ 6,424	$ 8,525	$ 7,310	$ 3,355	$ 25,614	$ 5,123	$ 15,000,554	$ 15,000,554
2021	$ 10,998	$ 7,202	$ 15,132	$ 767	$ 34,099	$ 17,050	$ 9,328	$ 12,103	$ 10,758	$ 4,830	$ 37,018	$ 7,404	$ 20,591,220	$ 35,591,774
2022	$ 14,752	$ 9,696	$ 20,544	$ 1,048	$ 46,040	$ 23,020	$ 13,616	$ 17,392	$ 15,848	$ 7,016	$ 53,872	$ 10,774	$ 28,864,356	$ 64,456,130
2023	$ 19,361	$ 12,775	$ 27,247	$ 1,407	$ 60,790	$ 30,395	$ 19,099	$ 24,114	$ 22,378	$ 9,797	$ 75,388	$ 15,078	$ 39,273,927	$ 103,730,058
2024	$ 21,480	$ 14,210	$ 30,490	$ 1,580	$ 67,760	$ 33,880	$ 22,360	$ 27,980	$ 26,330	$ 11,440	$ 88,110	$ 17,622	$ 44,890,230	$ 148,620,288
2025	$ 23,010	$ 15,260	$ 32,900	$ 1,710	$ 72,880	$ 36,440	$ 25,030	$ 31,100	$ 29,590	$ 12,770	$ 98,490	$ 19,698	$ 49,298,370	$ 197,918,658
2026	$ 24,530	$ 16,310	$ 35,310	$ 1,840	$ 77,990	$ 38,995	$ 27,690	$ 34,220	$ 32,840	$ 14,100	$ 108,850	$ 21,770	$ 53,697,975	$ 251,616,633
2027	$ 26,050	$ 17,350	$ 37,710	$ 1,970	$ 83,080	$ 41,540	$ 30,360	$ 37,340	$ 36,100	$ 15,440	$ 119,240	$ 23,848	$ 58,099,620	$ 309,716,253
2028	$ 27,570	$ 18,400	$ 40,120	$ 2,110	$ 88,200	$ 44,100	$ 33,030	$ 40,460	$ 39,360	$ 16,770	$ 129,620	$ 25,924	$ 62,507,760	$ 372,224,013
2029	$ 29,090	$ 19,440	$ 42,520	$ 2,240	$ 93,290	$ 46,645	$ 35,700	$ 43,580	$ 42,620	$ 18,110	$ 140,010	$ 28,002	$ 66,909,405	$ 439,133,418
2030	$ 30,610	$ 20,490	$ 44,930	$ 2,370	$ 98,400	$ 49,200	$ 38,370	$ 46,700	$ 45,880	$ 19,440	$ 150,390	$ 30,078	$ 71,314,470	$ 510,447,888
2031	$ 31,370	$ 21,010	$ 46,130	$ 2,500	$ 101,010	$ 50,505	$ 39,700	$ 48,260	$ 47,510	$ 20,110	$ 155,580	$ 31,116	$ 73,533,915	$ 583,981,803
2032	$ 32,130	$ 21,540	$ 47,340	$ 2,630	$ 103,640	$ 51,820	$ 41,040	$ 49,820	$ 49,140	$ 20,770	$ 160,770	$ 32,154	$ 75,759,510	$ 659,741,313
2033	$ 32,890	$ 22,060	$ 48,540	$ 2,770	$ 106,260	$ 53,130	$ 42,370	$ 51,380	$ 50,770	$ 21,440	$ 165,960	$ 33,192	$ 77,982,030	$ 737,723,343
2034	$ 33,650	$ 22,580	$ 49,740	$ 2,900	$ 108,870	$ 54,435	$ 43,710	$ 52,940	$ 52,400	$ 22,110	$ 171,160	$ 34,232	$ 80,204,205	$ 817,927,548
2035	$ 34,410	$ 23,110	$ 50,950	$ 3,030	$ 111,500	$ 55,750	$ 45,040	$ 54,500	$ 54,030	$ 22,780	$ 176,350	$ 35,270	$ 82,429,800	$ 900,357,348
2036	$ 35,170	$ 23,630	$ 52,150	$ 3,160	$ 114,110	$ 57,055	$ 46,380	$ 56,060	$ 55,660	$ 23,440	$ 181,540	$ 36,308	$ 84,649,245	$ 985,006,593
2037	$ 35,930	$ 24,150	$ 53,350	$ 3,290	$ 116,720	$ 58,360	$ 47,710	$ 57,620	$ 57,290	$ 24,110	$ 186,730	$ 37,346	$ 86,868,690	$ 1,071,875,283
2038	$ 36,690	$ 24,670	$ 54,550	$ 3,430	$ 119,340	$ 59,670	$ 49,050	$ 59,180	$ 58,920	$ 24,780	$ 191,930	$ 38,386	$ 89,093,940	$ 1,160,969,223
2039	$ 37,450	$ 25,200	$ 55,760	$ 3,560	$ 121,970	$ 60,985	$ 50,380	$ 60,740	$ 60,550	$ 25,440	$ 197,110	$ 39,422	$ 91,316,805	$ 1,252,286,028
2040	$ 38,220	$ 25,720	$ 56,960	$ 3,690	$ 124,590	$ 62,295	$ 51,720	$ 62,300	$ 62,180	$ 26,110	$ 202,310	$ 40,462	$ 93,542,055	$ 1,345,828,083
2041	$ 38,980	$ 26,240	$ 58,160	$ 3,820	$ 127,200	$ 63,600	$ 53,050	$ 63,860	$ 63,800	$ 26,780	$ 207,490	$ 41,498	$ 95,758,770	$ 1,441,586,853
2042	$ 39,740	$ 26,770	$ 59,370	$ 3,950	$ 129,830	$ 64,915	$ 54,380	$ 65,420	$ 65,430	$ 27,440	$ 212,670	$ 42,534	$ 97,981,635	$ 1,539,568,488
2043	$ 40,500	$ 27,290	$ 60,570	$ 4,090	$ 132,450	$ 66,225	$ 55,720	$ 66,980	$ 67,060	$ 28,110	$ 217,870	$ 43,574	$100,206,885	$ 1,639,775,373
2044	$ 41,260	$ 27,810	$ 61,770	$ 4,220	$ 135,060	$ 67,530	$ 57,050	$ 68,540	$ 68,690	$ 28,780	$ 223,060	$ 44,612	$102,426,330	$ 1,742,201,703
2045	$ 42,020	$ 28,340	$ 62,980	$ 4,350	$ 137,690	$ 68,845	$ 58,390	$ 70,100	$ 70,320	$ 29,450	$ 228,260	$ 45,652	$104,654,655	$ 1,846,856,358
2046	$ 42,780	$ 28,860	$ 64,180	$ 4,480	$ 140,300	$ 70,150	$ 59,720	$ 71,660	$ 71,950	$ 30,110	$ 233,440	$ 46,688	$106,871,370	$ 1,953,727,728
2047	$ 43,540	$ 29,380	$ 65,380	$ 4,610	$ 142,910	$ 71,455	$ 61,060	$ 73,220	$ 73,580	$ 30,780	$ 238,640	$ 47,728	$109,093,545	$ 2,062,821,273
2048	$ 44,300	$ 29,900	$ 66,580	$ 4,750	$ 145,530	$ 72,765	$ 62,390	$ 74,780	$ 75,210	$ 31,450	$ 243,830	$ 48,766	$111,316,065	$ 2,174,137,338
2049	$ 45,060	$ 30,430	$ 67,790	$ 4,880	$ 148,160	$ 74,080	$ 63,730	$ 76,340	$ 76,840	$ 32,110	$ 249,020	$ 49,804	$113,541,660	$ 2,287,678,998
2050	$ 45,820	$ 30,950	$ 68,990	$ 5,010	$ 150,770	$ 75,385	$ 65,060	$ 77,900	$ 78,470	$ 32,780	$ 254,210	$ 50,842	$115,761,105	$ 2,403,440,103

(1) A ramp-up period is assumed for the first four years of operation
(2) 2007 Dollars
(3) Weekend day revenue for HOT2+ is estimated to be 50 percent of weekday revenue
(4) Weekend day revenue for TOT lanes is estimated to be 20 percent of weekday revenue
(5) Annual revenue calculations assume 250 weekdays and 115 weekend/holidays

Table 4-36: Net Revenue Summary--- un-inflated dollars (000) – Alternative D

Year	Gross Annual Toll Revenue (1)	Annual Transactions (2)	Operation Cost (3)	Infrastructure Operation and Maintenance Cost (4)	Net Annual Revenue	Cumulative Annual Net Revenue
2020	$ 15,001	12,737	$ 2,675	$ 10,266	$ 2,060	$ 2,060
2021	$ 20,591	15,309	$ 3,215	$ 10,266	$ 7,110	$ 7,110
2022	$ 28,864	19,158	$ 4,023	$ 10,266	$ 14,575	$ 14,575
2023	$ 39,274	23,611	$ 4,958	$ 10,266	$ 24,050	$ 38,625
2024	$ 44,890	24,741	$ 5,196	$ 10,266	$ 29,429	$ 68,054
2025	$ 49,298	25,135	$ 5,278	$ 10,266	$ 33,754	$ 101,808
2026	$ 53,698	25,529	$ 5,361	$ 10,266	$ 38,071	$ 139,878
2027	$ 58,100	25,923	$ 5,444	$ 10,266	$ 42,390	$ 182,268
2028	$ 62,508	26,320	$ 5,527	$ 10,266	$ 46,715	$ 228,983
2029	$ 66,909	26,714	$ 5,610	$ 10,266	$ 51,033	$ 280,016
2030	$ 71,314	27,109	$ 5,693	$ 10,266	$ 55,356	$ 335,372
2031	$ 73,534	27,406	$ 5,755	$ 10,266	$ 57,513	$ 392,884
2032	$ 75,760	27,708	$ 5,819	$ 10,266	$ 59,675	$ 452,559
2033	$ 77,982	28,006	$ 5,881	$ 10,266	$ 61,835	$ 514,394
2034	$ 80,204	28,305	$ 5,944	$ 10,266	$ 63,994	$ 578,388
2035	$ 82,430	28,603	$ 6,007	$ 10,266	$ 66,157	$ 644,545
2036	$ 84,649	28,902	$ 6,069	$ 10,266	$ 68,314	$ 712,859
2037	$ 86,869	29,203	$ 6,133	$ 10,266	$ 70,470	$ 783,329
2038	$ 89,094	29,502	$ 6,195	$ 10,266	$ 72,633	$ 855,962
2039	$ 91,317	29,803	$ 6,259	$ 10,266	$ 74,792	$ 930,754
2040	$ 93,542	30,102	$ 6,321	$ 10,266	$ 76,955	$ 1,007,709
2041	$ 95,759	30,400	$ 6,384	$ 10,266	$ 79,109	$ 1,086,818
2042	$ 97,982	30,699	$ 6,447	$ 10,266	$ 81,269	$ 1,168,087
2043	$ 100,207	30,997	$ 6,509	$ 10,266	$ 83,432	$ 1,251,518
2044	$ 102,426	31,296	$ 6,572	$ 10,266	$ 85,588	$ 1,337,106
2045	$ 104,655	31,594	$ 6,635	$ 10,266	$ 87,754	$ 1,424,860
2046	$ 106,871	31,895	$ 6,698	$ 10,266	$ 89,907	$ 1,514,768
2047	$ 109,094	32,194	$ 6,761	$ 10,266	$ 92,067	$ 1,606,834
2048	$ 111,316	32,492	$ 6,823	$ 10,266	$ 94,227	$ 1,701,061
2049	$ 113,542	32,794	$ 6,887	$ 10,266	$ 96,389	$ 1,797,450
2050	$ 115,761	33,092	$ 6,949	$ 10,266	$ 98,546	$ 1,895,996

(1) Uninflated revenues are in 2007 dollars.
(2) Annual transaction do not include non-toll paying vehicles.
(3) Operation cost is assumed to be $0.21 per tolled transaction and it includes Billing and Administration Cost; Violations Center Operations Cost and Customer Service Center Cost; Enforcement cost and Toll Equipment Maintenance Cost.
(4) Annual Infrastructure Operation and Maintenance Cost is assumed to be 0.5% of the total capital cost.

Table 4-37: Annual Toll Revenue in Inflated Dollars (000) – Alternative D

Year	UNINFLATED DOLLARS (000)				Inflation Factors		INFLATED DOLLARS (000)			
	Total Gross Annual Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Net Cumulative Annual	Toll Revenue	O&M	Gross Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Cumulative Annual Revenue
2020	$ 15,001	$ 12,941	$ 2,060	$ 2,060	1.379	1.469	$ 20,686	$ 19,010	$ 1,676	$ 1,676
2021	$ 20,591	$ 13,481	$ 7,110	$ 9,170	1.413	1.513	$ 29,095	$ 20,397	$ 8,699	$ 10,374
2022	$ 28,864	$ 14,289	$ 14,575	$ 23,745	1.448	1.558	$ 41,796	$ 22,262	$ 19,533	$ 29,908
2023	$ 39,274	$ 15,224	$ 24,050	$ 47,795	1.485	1.605	$ 58,322	$ 24,435	$ 33,887	$ 63,794
2024	$ 44,890	$ 15,462	$ 29,429	$ 77,224	1.522	1.653	$ 68,323	$ 25,558	$ 42,765	$ 106,559
2025	$ 49,298	$ 15,544	$ 33,754	$ 110,978	1.560	1.702	$ 76,905	$ 26,456	$ 50,449	$ 157,008
2026	$ 53,698	$ 15,627	$ 38,071	$ 149,048	1.599	1.754	$ 85,863	$ 27,410	$ 58,453	$ 215,461
2027	$ 58,100	$ 15,710	$ 42,390	$ 191,438	1.639	1.806	$ 95,225	$ 28,372	$ 66,853	$ 282,315
2028	$ 62,508	$ 15,793	$ 46,715	$ 238,153	1.680	1.860	$ 105,013	$ 29,375	$ 75,638	$ 357,953
2029	$ 66,909	$ 15,876	$ 51,033	$ 289,186	1.722	1.916	$ 115,218	$ 30,418	$ 84,800	$ 442,752
2030	$ 71,314	$ 15,959	$ 55,356	$ 344,542	1.765	1.974	$ 125,870	$ 31,503	$ 94,367	$ 537,120
2031	$ 73,534	$ 16,021	$ 57,513	$ 402,055	1.809	2.033	$ 133,023	$ 32,571	$ 100,451	$ 637,571
2032	$ 75,760	$ 16,085	$ 59,675	$ 461,729	1.854	2.094	$ 140,458	$ 33,681	$ 106,777	$ 744,348
2033	$ 77,982	$ 16,147	$ 61,835	$ 523,564	1.900	2.157	$ 148,166	$ 34,830	$ 113,336	$ 857,684
2034	$ 80,204	$ 16,210	$ 63,994	$ 587,558	1.948	2.221	$ 156,238	$ 36,002	$ 120,235	$ 977,919
2035	$ 82,430	$ 16,273	$ 66,157	$ 653,715	1.996	2.288	$ 164,530	$ 37,232	$ 127,298	$ 1,105,217
2036	$ 84,649	$ 16,335	$ 68,314	$ 722,029	2.046	2.357	$ 173,192	$ 38,502	$ 134,690	$ 1,239,907
2037	$ 86,869	$ 16,399	$ 70,470	$ 792,499	2.098	2.427	$ 182,251	$ 39,800	$ 142,451	$ 1,382,358
2038	$ 89,094	$ 16,461	$ 72,633	$ 865,132	2.150	2.500	$ 191,552	$ 41,153	$ 150,399	$ 1,532,757
2039	$ 91,317	$ 16,525	$ 74,792	$ 939,924	2.204	2.575	$ 201,262	$ 42,551	$ 158,711	$ 1,691,468
2040	$ 93,542	$ 16,587	$ 76,955	$ 1,016,879	2.259	2.652	$ 211,312	$ 43,990	$ 167,322	$ 1,858,790
2041	$ 95,759	$ 16,650	$ 79,109	$ 1,095,988	2.315	2.732	$ 221,682	$ 45,488	$ 176,194	$ 2,034,984
2042	$ 97,982	$ 16,713	$ 81,269	$ 1,177,257	2.373	2.814	$ 232,510	$ 47,029	$ 185,481	$ 2,220,465
2043	$ 100,207	$ 16,775	$ 83,432	$ 1,260,688	2.433	2.898	$ 243,803	$ 48,615	$ 195,188	$ 2,415,653
2044	$ 102,426	$ 16,838	$ 85,588	$ 1,346,276	2.493	2.985	$ 255,349	$ 50,262	$ 205,087	$ 2,620,740
2045	$ 104,655	$ 16,901	$ 87,754	$ 1,434,030	2.556	3.075	$ 267,497	$ 51,970	$ 215,528	$ 2,836,268
2046	$ 106,871	$ 16,964	$ 89,907	$ 1,523,938	2.620	3.167	$ 280,003	$ 53,725	$ 226,278	$ 3,062,546
2047	$ 109,094	$ 17,027	$ 92,067	$ 1,616,004	2.685	3.262	$ 292,916	$ 55,541	$ 237,375	$ 3,299,921
2048	$ 111,316	$ 17,089	$ 94,227	$ 1,710,231	2.752	3.360	$ 306,342	$ 57,420	$ 248,922	$ 3,548,842
2049	$ 113,542	$ 17,153	$ 96,389	$ 1,806,620	2.821	3.461	$ 320,301	$ 59,365	$ 260,936	$ 3,809,778
2050	$ 115,761	$ 17,215	$ 98,546	$ 1,905,166	2.892	3.565	$ 334,781	$ 61,373	$ 273,408	$ 4,083,186

Notes: Uninflated revenues and costs are in 2007 dollars.
Annual inflation rates of 2.5% and 3.0% are applied for toll revenue and O&M cost respectively.

4.12 Summary

Eight managed lane investment alternatives were analyzed as part of this study and can be summarized as follows:

- Alternatives A-1 - A-3
  - Add Two (2) Managed Lanes in each direction along I-75 South from I-285 to SR 16.
- Alternatives B
  - Add Two (2) voluntary Truck Only Toll Lanes in each direction along I-675 and I-75 South from I-675 to SR 16.
- Alternatives C-1 - C-3
  - Add Two (2) Managed Lanes in each direction along I-75 South from I-285 to SR 16; and
  - Add Two (2) voluntary Truck Only Toll Lanes in each direction along I-675 and I-75 South from I-675 to SR 16.
- Alternatives D
  - Add Two (2) Express Toll Lanes (for all vehicles) in each direction along I-75 South from I-285 to SR 16.

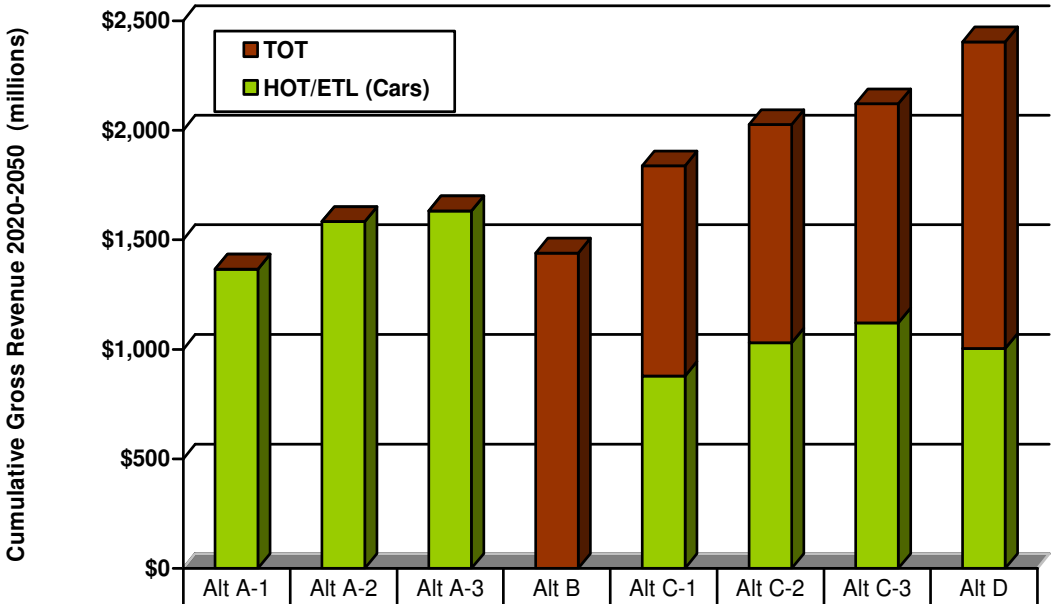
Modeled Gross Revenue

Modeled Gross Revenue is the predicted toll collections in every year of the forecast horizon (year 2020 – year 2050), in which it is assumed that the modeled nominal toll rates will be adjusted annually for both inflation and growing demand so as to maintain optimality for the assumed tolling objectives.

Based upon the projected traffic volumes and toll rates recommended, the gross revenue was calculated for each model year (2020 and 2030); then the revenue streams were developed through 2050. A ramp-up period is assumed for the first four years of operation during which public acceptance is developing; Ramp Up schedule = 55% (Year 2020); 65% (Year 2021); 80% (Year 2022); and 97% (year 2023).

Figure 4-90 shows the calculated gross revenue in 2007 $ for each of the eight managed lane investment alternatives. Figure 4-91 shows the calculated gross revenue in inflated $ for each of the eight managed lane investment alternatives.

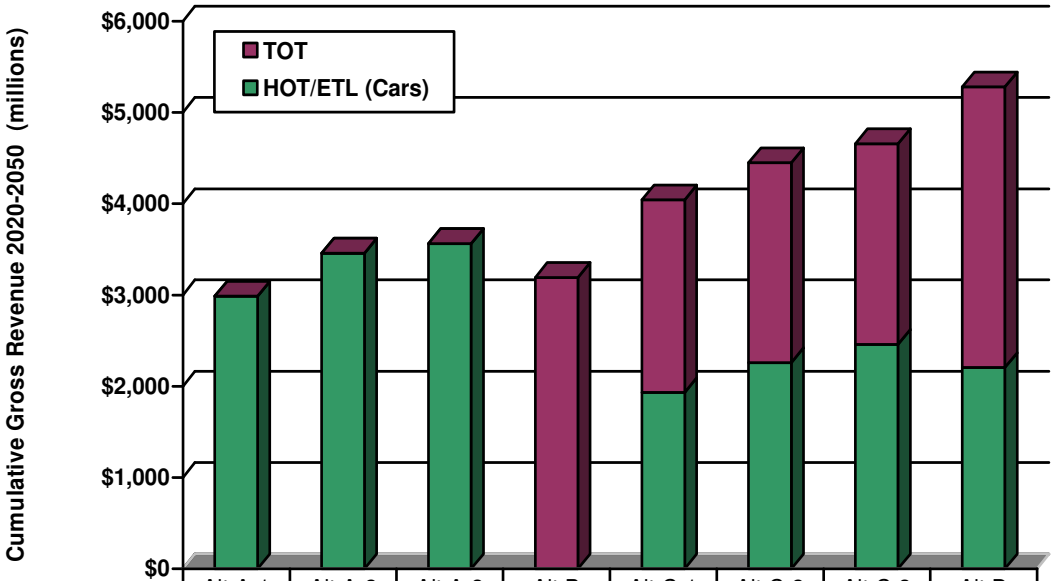
Figure 4-90: Cumulative Gross Revenue Summary 2020-2050 (in 2007 $)



	Alt A-1	Alt A-2	Alt A-3	Alt B	Alt C-1	Alt C-2	Alt C-3	Alt D
TOT	0	0	0	1,439	959	997	999	1,399
HOT/ETL (Cars)	1,366	1,583	1,632	0	878	1,029	1,121	1,004

Investment Alternatives

Figure 4-91: Cumulative Gross Revenue Summary 2020-2050 (in inflated $)



	Alt A-1	Alt A-2	Alt A-3	Alt B	Alt C-1	Alt C-2	Alt C-3	Alt D
TOT	0	0	0	3,193	2,110	2,189	2,194	3,073
HOT/ETL (Cars)	2,988	3,458	3,562	0	1,931	2,259	2,461	2,206

Investment Alternatives

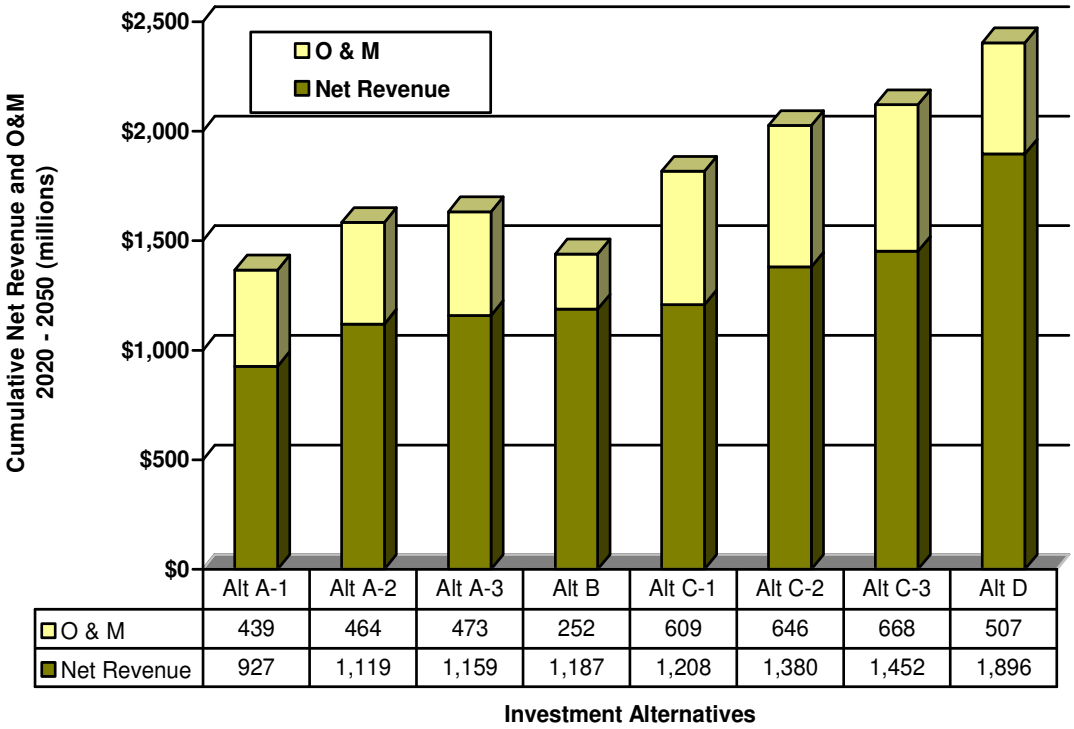
Net Revenue Estimates

Net Revenue is a measure of net financial revenue during the years that potential bonds are outstanding, which is based on the modeled adjusted gross revenue in the year of opening, less tolling and infrastructure operating and maintenance costs.

To compute the net revenue, tolling and infrastructure operating and maintenance costs are deducted from the gross annual gross revenue.

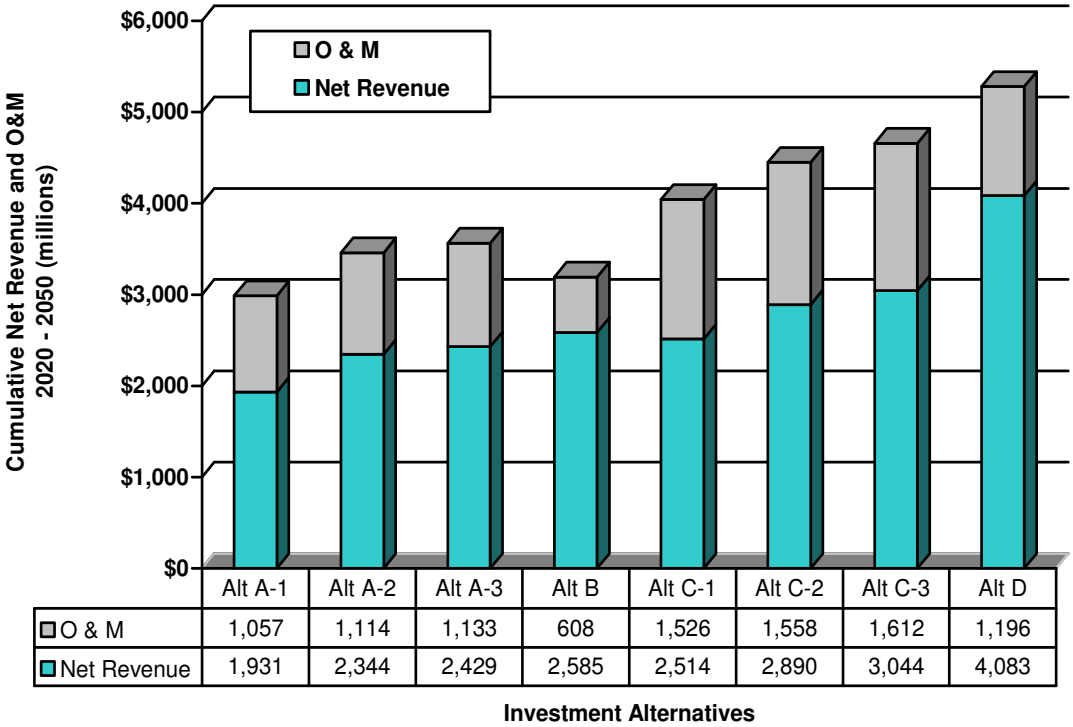
Figure 4-92 shows the cumulated net revenue and operation and maintenance cost in 2007 $ from 2020 to 2050 for each of the eight managed lane investment alternatives. Figure 4-93 shows the cumulated net revenue and operation and maintenance cost in inflated $ from 2020 to 2050 for each of the eight managed lane investment alternatives.

Figure 4-92: Cumulative Net Revenue Summary 2020-2050 (in 2007 $)



	Alt A-1	Alt A-2	Alt A-3	Alt B	Alt C-1	Alt C-2	Alt C-3	Alt D
O & M	439	464	473	252	609	646	668	507
Net Revenue	927	1,119	1,159	1,187	1,208	1,380	1,452	1,896

Figure 4-93: Cumulative Net Revenue Summary 2020-2050 (in inflated $)



	Alt A-1	Alt A-2	Alt A-3	Alt B	Alt C-1	Alt C-2	Alt C-3	Alt D
O & M	1,057	1,114	1,133	608	1,526	1,558	1,612	1,196
Net Revenue	1,931	2,344	2,429	2,585	2,514	2,890	3,044	4,083

CHAPTER 5

System Analysis

5.1 Introduction

The purpose of the system analysis was to assess how the managed lanes will operate within the existing corridor, and quantify the impacts to the parallel and competing corridors and the overall transportation system.

This chapter details the corridor and system level transportation impacts of eight potential managed lanes investment concepts in I-75 South study corridor, when compared to the baseline scenario. The baseline scenario refers to a scenario that no managed lanes will be constructed in the corridor. The transportation impacts were evaluated for both the study area as a whole and the major highway corridors that would be affected by the managed lane project.

5.2 Evaluation Levels and Criteria

The proposed managed lanes and Truck Only Toll (TOT) lanes will provide direct travel time benefits and improved reliability to travelers who choose to use the managed lanes/TOT lanes in the study area. The investment will also provide indirect transportation impacts on the I-75 South general-purpose (GP) lanes, parallel corridors, and regional network due to the shift of automobiles and trucks to the managed lane and TOT lane systems.

To fully understand the magnitude of impacts to the transportation system, each of the eight potential managed lane investment alternatives were analyzed within the contest of the following evaluation framework:

- Direct impacts in the project corridor (managed lanes and GP Lanes);
- Secondary impacts to the parallel and competing corridors; and
- Secondary impacts to the south Atlanta region transportation system.

The eight potential managed lane investment alternatives were discussed in detail in Chapter 4 - Traffic and Revenue Study and are listed as follows:

- Alternative A-1: Two (2) managed lanes in each direction on I-75 South (HOT2+)
- Alternative A-2: Two (2) managed lanes in each direction on I-75 South (HOT3+)
- Alternative A-3: Two (2) managed lanes in each direction on I-75 South (ETL: cars only)
- Alternative B: Two (2) voluntary truck only toll lanes in each direction on I-75 South and I-675

- Alternative C-1: Two (2) managed lanes in each direction on I-75 South (HOT2+) and Two (2) voluntary truck only toll lanes in each direction on I-75 South and I-675
- Alternative C-2: Two (2) managed lanes in each direction on I-75 South (HOT3+) and Two (2) voluntary truck only toll lanes in each direction on I-75 South and I-675
- Alternative C-3: Two (2) managed lanes in each direction on I-75 South (ETL: cars only) and Two (2) voluntary truck only toll lanes in each direction on I-75 South and I-675
- Alternative D: Two (2) Express Toll Lanes (ETL) for all vehicles in each direction on I-75 South

Managed lane and TOT lane investment alternatives were coded into the Atlanta Regional Commission (ARC)'s Mobility 2030 travel demand model with enhancement to the pricing. Travel demand models were run with managed lane willingness-to-pay methodologies. Transportation performance measures such as daily person trips, daily vehicle trips, travel times, speeds and delays during different time periods of the day were calculated from the output of the travel demand models. These performance measures were then compared to the baseline scenario (i.e. no managed lanes are constructed in the corridor) to understand and quantify the transportation impacts resulting from managed lane and/or TOT lane system investments.

Performance measures employed for eight managed lane investment alternatives and the baseline scenario under each analysis level are listed in the table below.

Table 5-1: Transportation Impact Analysis Performance Measures

Level	Description	Performance Measures
Level I – Direct Impacts	Project Corridor (managed lanes and General Purpose Lanes)	Total Daily Vehicle Volume
		Total Daily Person Volume
		Travel Speed
		Transit Benefits
Level II – Secondary Impacts	Parallel Corridors	Total Vehicle Delay
		Vehicle Miles Traveled
		Vehicle Hours Traveled
Level III – Secondary Impacts	Transportation System (5 mile buffer)[1]	Total Vehicle Delay
		Vehicle Miles Traveled
		Vehicle Hours Traveled

[1] A 5 miles buffer (on each side) was placed around I-75 south and I-675 corridors to capture the transportation benefits on the major surrounding corridors.

5.3 Project Corridor Level Analysis

Under project corridor level analysis, three quantitative performance measures were evaluated - Total Daily Vehicle Volume; Total Daily Person Volume and Travel Speed. These three performance measures were assessed for eight managed lane alternatives, the baseline scenario and the two-extra General Purpose (GP) lane scenario. The two-extra GP lane scenario refers to a scenario that two additional GP Lanes will be constructed in the I-75 South corridor in each direction.

5.3.1 Total Daily Vehicle Volume

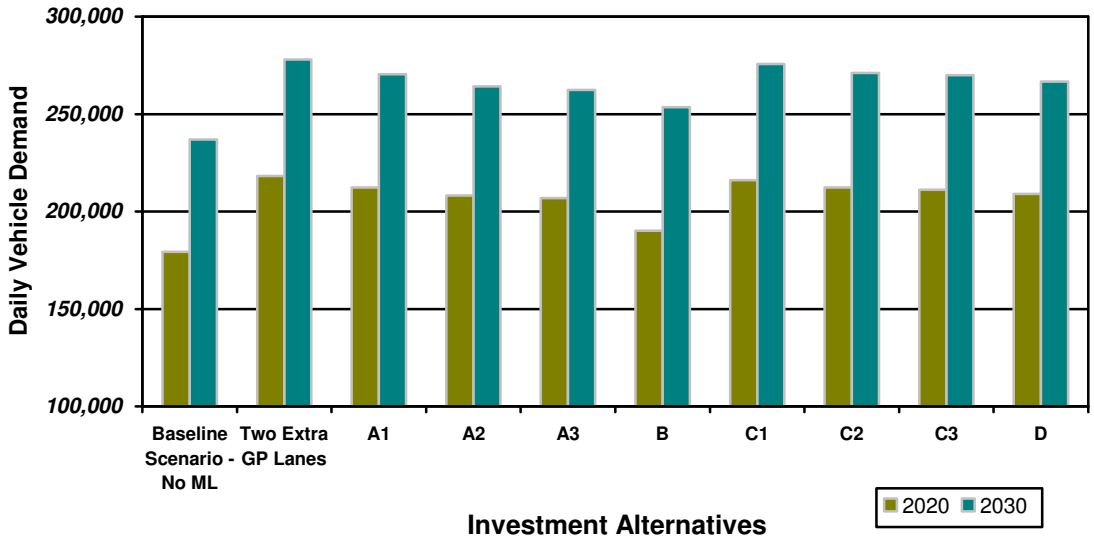
Selecting a key location just north of Hudson Bridge Road on I-75 South as a reference point, total daily vehicle demand on the corridor for the baseline scenario, two-extra GP lane scenario and eight managed lane investment alternatives is illustrated in Figure 5-1 for 2020 and 2030.

As observed in the figure, increases in total daily vehicle volume on I-75 South corridor at the selected key location can be expected with the implementation of general purpose lanes, managed lanes and/or TOT lane investments. In 2020, the implementation of two general purpose lanes in each direction on I-75 South corridor results in an overall increase in daily vehicles of 22 percent at this key location; the implementation of managed lanes and/or TOT lanes on I-75 South corridor results in an overall increase in daily vehicles of six percent to 20 percent at this key location. In 2030, when compared to the baseline scenario, the daily vehicle volume at the key location is forecasted to increase by 18 percent with the two general purpose lanes in each direction; and the daily vehicle volume is forecasted to increase in a range of seven percent to 16 percent with the managed lane and/or TOT lane investments.

The increase on total vehicle volume under the managed lane investment alternatives is expected due to the shift of the automobiles and/or trucks to the managed lane and/or TOT lane system, thereby allowing more automobiles and trucks to use GP lanes. Compared to all managed lane investment alternatives, the two-extra GP lane scenario is forecasted to have the greatest increase in vehicle volumes in the study corridor. This is because that, in this scenario, everybody is allowed to use the two additional GP lanes in each direction for free.

Since the overall demand in the region remained unchanged, experiencing an increase in demand on I-75 South would result in an overall decrease on the surrounding major arterial systems.

Figure 5-1: Total Daily Corridor Vehicle Volumes (2020 & 2030)



5.3.2 Total Daily Person Volume

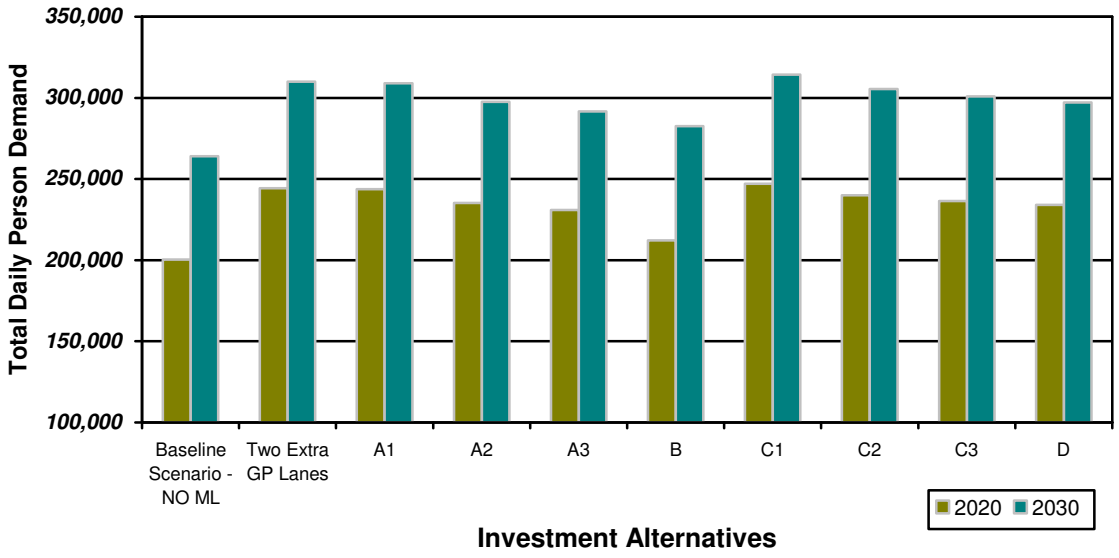
Total daily person volume was used to measure the total number of persons traveling on I-75 South. It was calculated by multiplying the number of vehicles with the average vehicle occupancy factor.

Figure 5-2 shows the total daily person volume on I-75 South in 2020 and 2030 at the key location just north of Hudson Bridge Road for the baseline scenario, the two-extra GP lane scenario and eight managed lane investment alternatives.

As illustrated in Figure 5-2, the two-extra GP lane scenario and all eight managed lane investment alternatives in 2020 and 2030 are expected to move more people when compared to the baseline scenario. In 2020, the total daily person volume increases by 22 percent at this key location with two-extra GP lanes in each direction on I-75 south corridor; the increase of total daily person volume with managed lane and/or TOT lane investment ranges from six percent to 22 percent at this key location depending on different managed lane configurations and policies. In 2030, the total daily person volume in this key location is forecasted to increase by 18 percent with the implementation of two general purpose lanes in each direction and increase in a range of eight percent to 20 percent with the managed lane and/or TOT lane investment when compared to the baseline scenario.

Similar to total daily vehicle volume results, total daily person volumes are expected to increase at higher rate under the two-extra GP lane scenario when compared to most of managed lane investment alternatives. Among all eight managed lane investments, investment Alternative B, which includes the construction of voluntary TOT lanes only, is expected to experience the lowest increase in total daily person volume. This is due to the lower occupancy rates and less access locations associated with the voluntary TOT lanes.

Figure 5-2: Total Daily Corridor Person Volumes (2020 & 2030)



5.3.3 Average Travel Speed

The average speed in the GP lanes, managed lanes and TOT lanes, for the baseline scenario, the two-extra GP lane scenario and all eight managed lane investment alternatives, was calculated by weighting the congested travel speed during four time periods of the day by distance along the corridor.

Four time periods included in ARC's travel demand model for traffic assignments are:

- AM peak period from 6:00 AM to 10:00 AM,
- Midday (MD) period from 10:00 AM to 3:00 PM,
- PM peak period from 3:00 PM to 7:00 PM, and
- Night (NT) period from 7:00 PM to 6:00 AM.

A summary of the weighted average travel speeds during the most congested travel periods, AM peak period and PM peak period in 2020, are illustrated in Figure 5-3 and Figure 5-4 respectively. As shown in these two figures, without any improvements (extra GP lanes, managed lane and/or TOT lane investments), the average travel speeds during peak periods in 2020 in the GP lanes range from 26 mph to 27 mph, which is indicative of extremely congested conditions.

With two extra GP lanes in each direction, travel speed is forecasted to range from 40 mph to 42 mph during the AM and PM peak period. With the implementation of managed lanes and/or TOT lanes, travel speeds in managed lanes/TOT lanes can be maintained at a rate of 55 mph or higher for all eight investment alternatives, which is an increase of over 100 percent when compared to the GP lane speeds under the baseline scenario. The average peak period speeds in the GP lanes for eight managed lane investment alternatives are forecasted to increase slightly resulting from the construction of managed lanes and/or TOT lanes. During the AM peak period, the operating speeds in

the GP lanes are expected to improve by four to eight mph; and by four to 13 mph during the PM peak period in 2020 when compared to the GP lane travel speeds under the baseline scenario.

A summary of the weighted average travel speeds during AM peak period and PM peak period in 2030 are illustrated in Figure 5-5 and Figure 5-6 respectively. By 2030, the average daily speeds during peak periods on I-75 south corridor in the GP lanes are expected to get even more congested dipping to 13 mph.

With construction of two extra GP lanes in each direction, the travel speed is forecasted to increase by 17 mph, which is still well below desired operating speed of 45 mph. With the implementation of managed lanes and/or TOT lanes, the travel speeds in the managed lanes and TOT lanes can still be maintained at a rate of 50 mph or higher for all eight investment alternatives, which is an increase of over 300 percent when compared to the GP lane travel speeds under the baseline scenario. The average peak period speeds in the GP lanes for eight managed lane investment alternatives are forecasted to improve by six to 12 mph during AM peak period and six to 13 mph during PM peak period respectively.

Therefore, building more general purpose lanes will spread congestion and will not provide guaranteed mobility in the long run. Additionally, limited room for expansion and high costs of land acquisition of right-of-way for transportation uses make building more general purpose lanes less desirable than managed lanes. The active congestion management capabilities provided by managed lanes contribute the most to mobility and to preserving capacity within the corridor.

Figure 5-3: 2020 I-75 South AM Peak Period Travel Speed

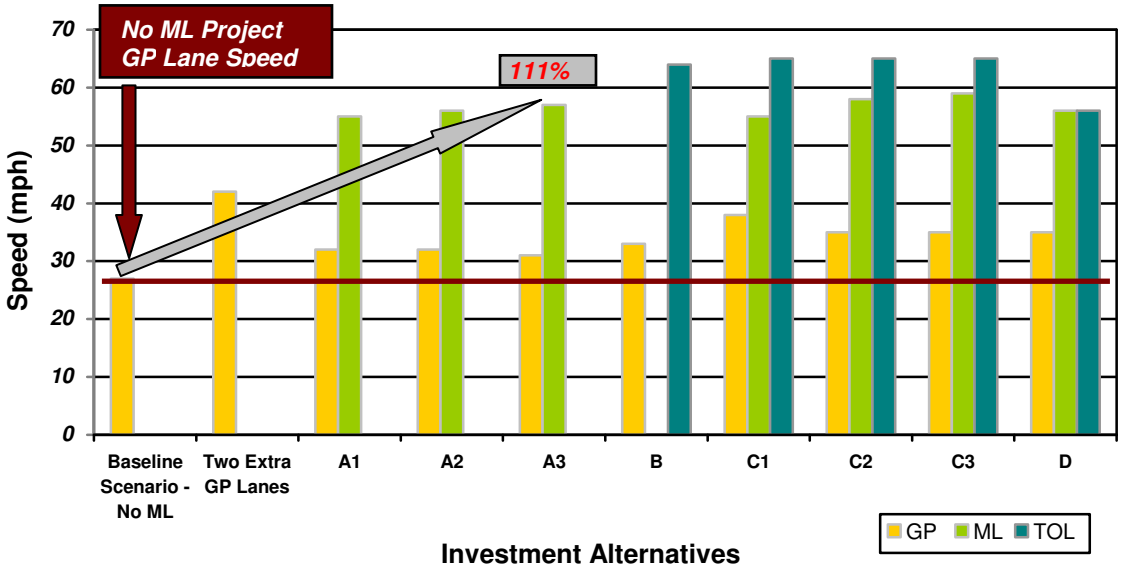


Figure 5-4: 2020 I-75 South PM Peak Period Travel Speed

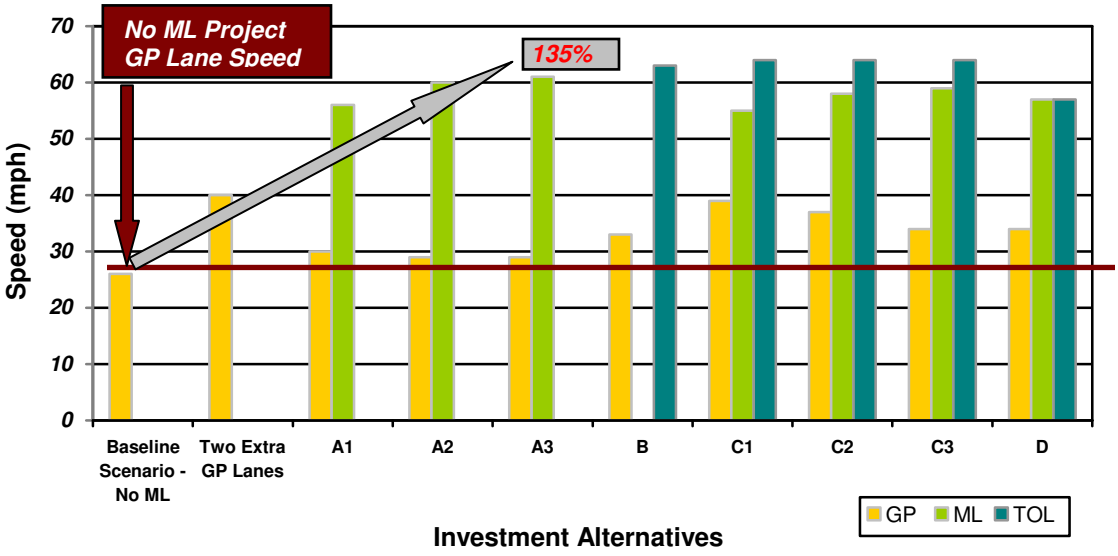


Figure 5-5: 2030 I-75 South AM Peak Period Travel Speed

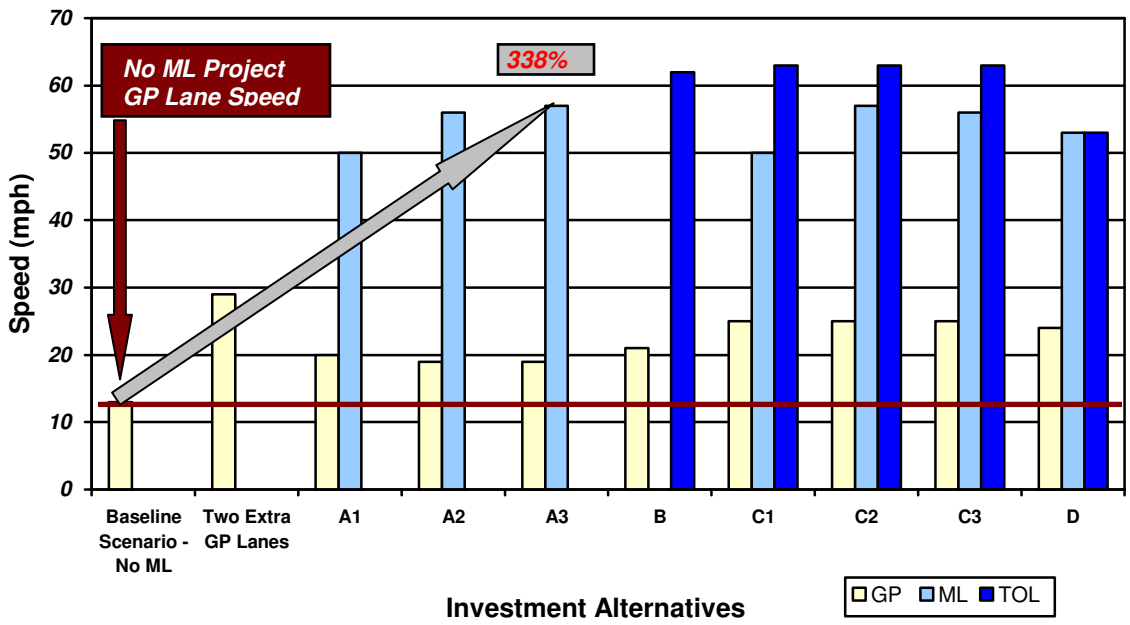
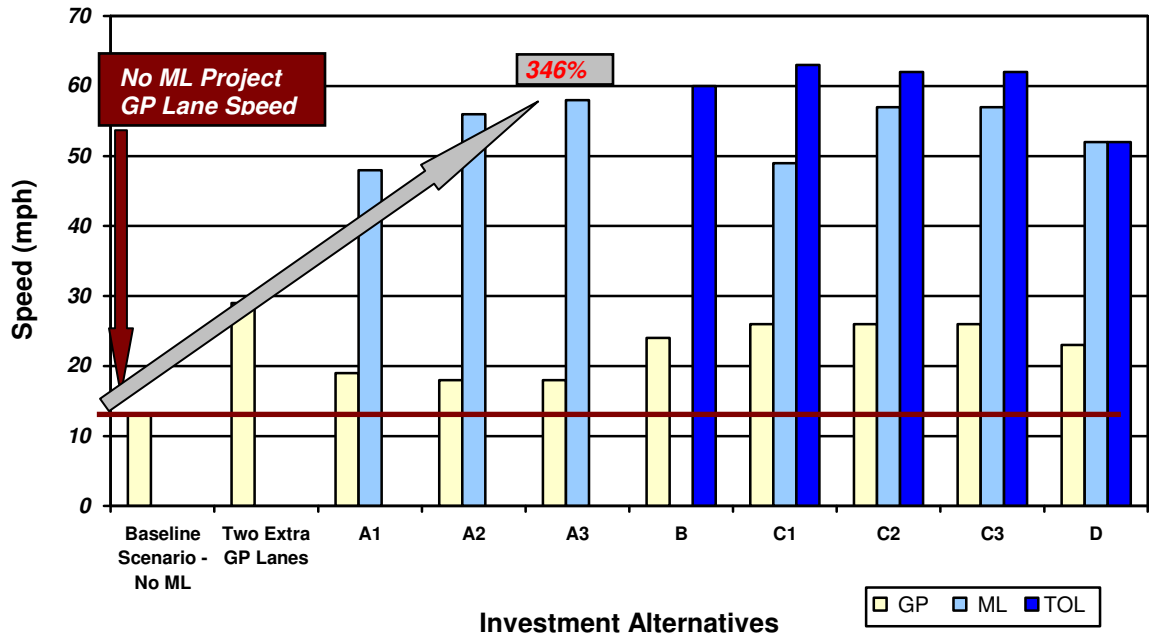


Figure 5-6: 2030 I-75 South PM Peak Period Travel Speed



5.3.4 Transit Benefits

Managed lanes can help transit vehicles avoid delays caused by congestion and provide reliable service times. The managed lane strategies increase operating efficiency (since transit vehicles can carry more passengers in a given period of time) and make transit more competitive with automobile travel.

A Bus Rapid Transit or Express Bus system could be a critical component of the managed lane network along I-75 South corridor. The benefits of combined transit services with managed lane investment include:

- User benefits result from improved convenience, speed, comfort or financial savings to current transit users.
- Efficiency benefits result when transit reduces the costs of traffic congestion, road and parking facilities, accidents and pollution emissions.
- Mobility benefits result from the additional mobility provided by a transportation service.
- Performance benefits result from reduced and reliable travel times.

By providing reduce travels times, a result of higher operating speeds in the managed lanes, transit services are able to maintain reliable travel times. When transit vehicles have to rely on using general purpose lanes, or even HOV lanes, reliable travel times are dictated by the variable conditions of these lanes. Another benefit of reducing travel time is that it may be possible to increase headways or reduce the number of buses it takes to serve a particular route.

Examining the I-75 South Corridor, the northern section is currently served by GRTA's Xpress bus services. These routes include:

- Route 430 - McDonough to Downtown and Midtown Atlanta
- Route 431 – Stockbridge to Midtown Atlanta
- Route 432 – Stockbridge to Downtown Atlanta
- Route 440 – Hampton / Jonesboro to Downtown Atlanta
- Route 441 – Jonesboro to Midtown Atlanta
- Route 442 – Riverdale to Downtown Atlanta

In the I-75 segment south of McDonough Road, however, transit service is not available. These routes provide fourteen buses operating 37 morning trips and 38 afternoon trips during the AM (5:30 – 9:00 AM) and PM (3:30 –7:30 PM) periods. Routes 430, 432 and 441 provide reverse commute options at reduced fares. Additional transit lines are planned along this corridor from Jodeco Road including a new 1,000 space parking lot.

During June 2008, the Xpress services along this corridor averaged 2,755 daily passenger boardings with a peak day of 3,207 passenger boardings. This equates to approximately 800 vehicle trips removed during the peak hour from the I-75 south corridor.

It will be important to consider enhancing transit services to meet the projected future demand. With the benefits of managed lanes, there is a good possibility that transit

services would be expanded providing these services and benefits to a great number of customers.

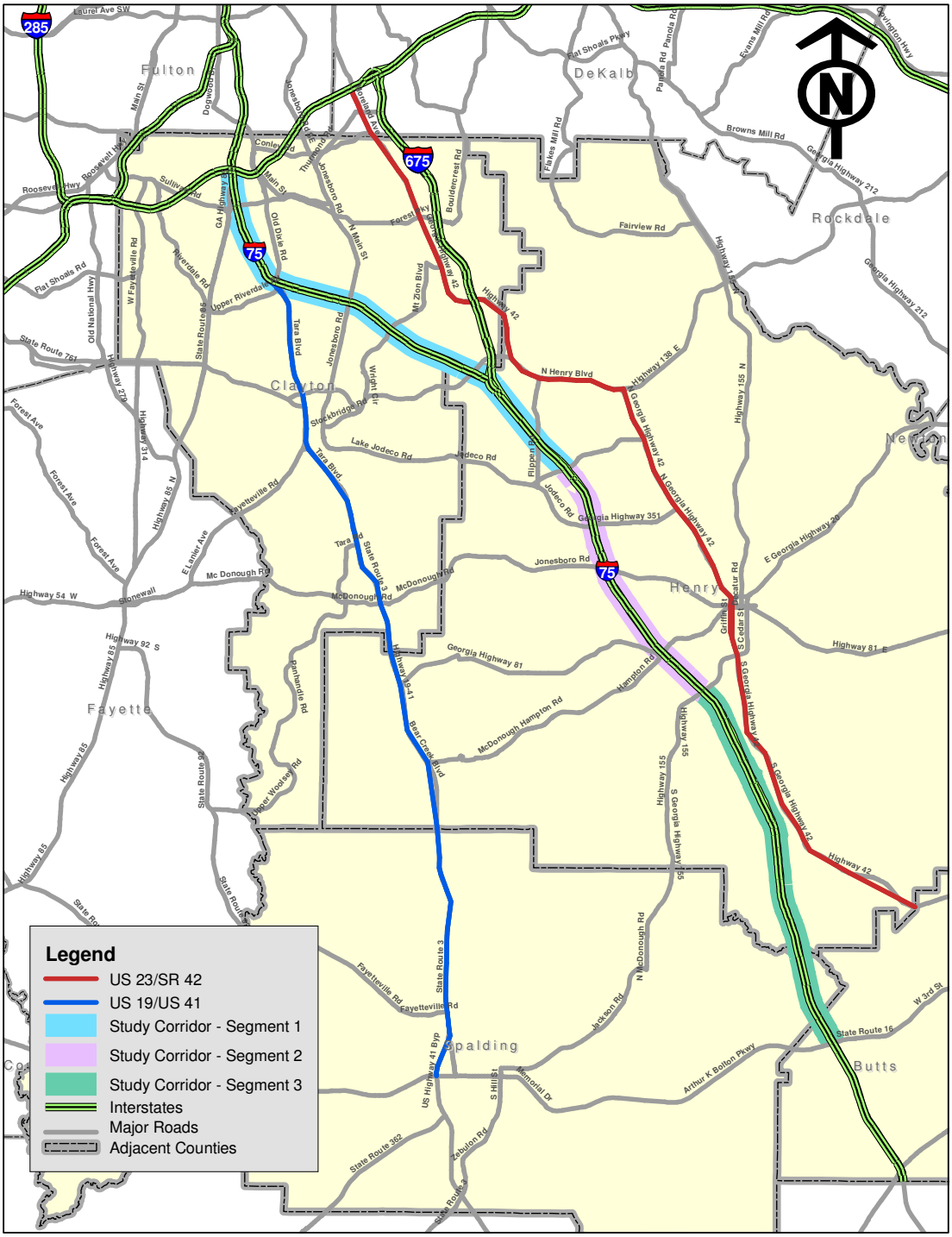
5.4 Parallel Corridor Analysis

As discussed in the previous section, vehicle and person volumes on I-75 South are forecasted to increase by eight to 20 percent with the addition of the managed lane and/or TOT lane investments in 2030. The vehicle and person volume increases on I-75 South corridor facilities (GP lanes, managed lanes and TOT lanes) are attributed to traffic shifting from parallel facilities and other surrounding facilities. It is expected that this traffic shift will impact individual corridors considerably. In order to evaluate traffic impacts due to the travel patterns shifting, performances on the two major parallel corridors were examined in detail. The two parallel corridors are:

- US 23/SR 42 from I-285 to Henry County Line; and
- US 19/US 41 from I-75 to SR 16 in Spalding County.

Figure 5-7 shows the location of the two corridors.

Figure 5-7: Locations of Parallel Corridors

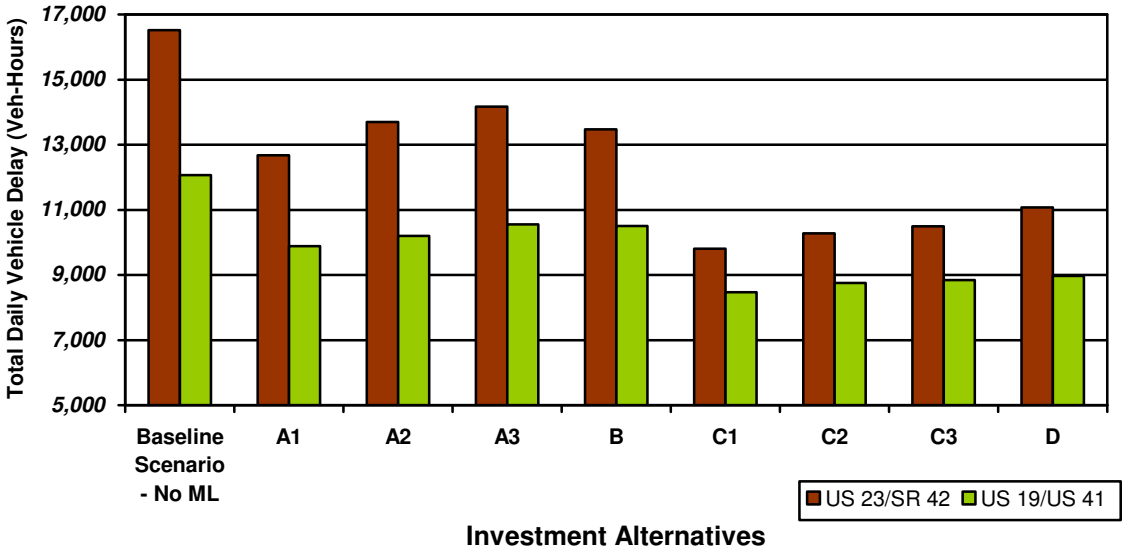


5.4.1 Total Daily Vehicle Delay

Total daily vehicle delay provides an indication of congestion on the parallel corridors. Initially, the delay in four analysis periods (AM, MD, PM and NT) was computed by subtracting free flow travel time from congested travel time for each network link that consisted of the parallel corridors. Total vehicles were multiplied by the delay in each direction to arrive at total-vehicle-delay on the parallel corridors for each of the four analyses time periods. The total-vehicle-delay during the four analysis periods was then added up to arrive at daily vehicle delay.

Figure 5-8 presents the 2030 total daily vehicle delay on the parallel facilities for both directions of travel. As visible from the figure, total daily vehicle delay for both parallel corridors is estimated to decrease considerably. In 2030, for US 23/SR 42, the total daily vehicle delay hours are reduced by a range of 14 percent to 41 percent; while for US19/US 41, the total daily vehicle delay hours are reduced by 13 percent to 30 percent. Among all the eight managed lane investment alternatives, Investment Alternative C1, which includes the construction of both managed lanes and voluntary TOT lanes, is expected to experience the lowest level of totally daily vehicle delay on the parallel corridors – an expected decrease of 41 percent on US 23/SR 42 and 30 percent on US19/US 41.

Figure 5-8: 2030 I-75S Parallel Corridors Total Daily Vehicle Delay



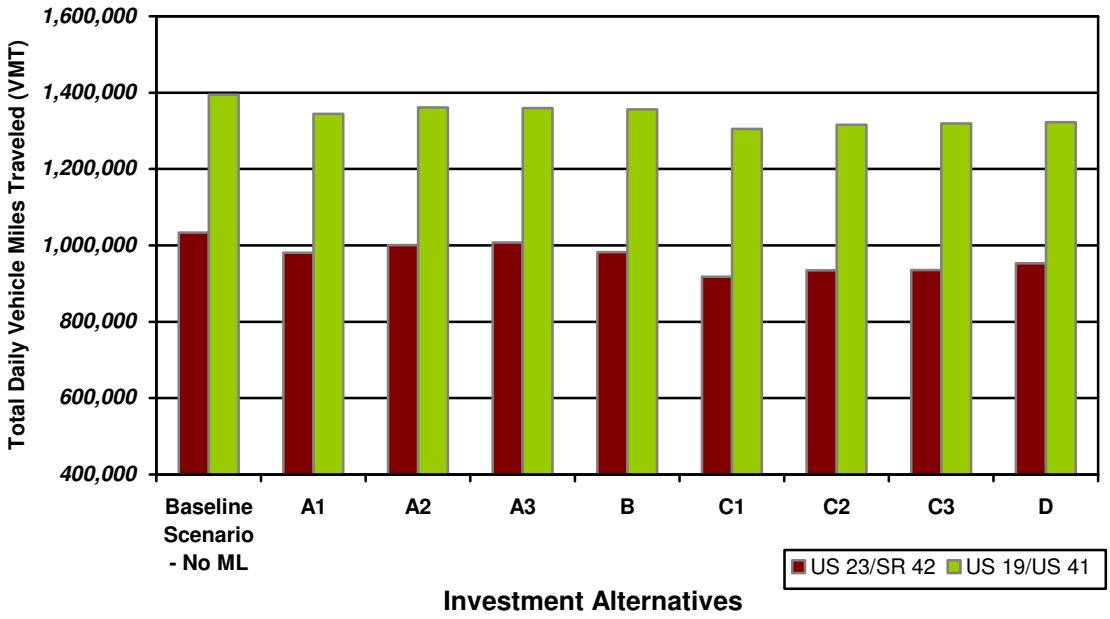
5.4.2 Vehicle Miles Traveled

Vehicle Miles Traveled (VMT) is the total motorized vehicle miles traveled in a specific time period. Based on the travel demand model outputs, total vehicles were multiplied by the travel distance for the four analysis periods (AM, PM, MD and NT) in each direction. The VMT in the four analysis periods was then added up to arrive at total daily VMT.

Figure 5-9 illustrates the total daily VMT for US 23/SR 42 and US19/US 41 in 2030.

Compared with the baseline scenario, all eight managed lane investment alternatives will have low to moderate impacts on the VMT of parallel corridors. For US 23/SR 42, the total daily VMT is reduced by a range of two percent to 10 percent; while for US19/US 41, the total daily VMT is reduced by two percent to six percent in 2030 among eight investment alternatives. Once again, Investment Alternative C1, which includes the construction of both managed lanes and voluntary TOT lanes, is expected to experience the largest impact on the total daily VMT on the parallel corridors – an expected decrease of 10 percent on US 23/SR 42 and six percent on US19/US 41.

Figure 5-9: 2030 I-75S Parallel Corridors Total Daily Vehicle Miles Traveled



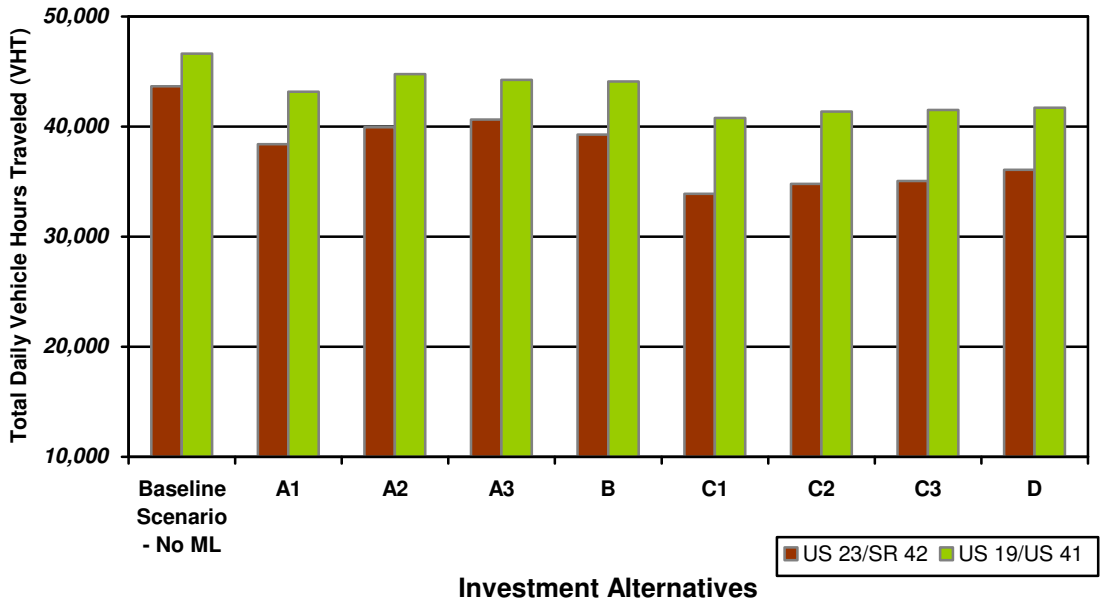
5.4.3 Vehicle Hours Traveled

Vehicle Hours Traveled (VHT) is the total number of hours of vehicle travel on the designated set of roadways. VHT was calculated from the total vehicle volume multiplied by the total travel time in hours for each analysis period. The VHT in the four analysis periods was then added up to arrive at total daily VHT.

Figure 5-10 represents the total daily vehicle hours of travel on parallel corridors in the year of 2030. As travel time drops and travel speed increases on parallel corridors, total vehicle hours of travel are expected to be reduced with the managed lane and/or TOT lane investments.

The VHT is expected to be reduced by a range of seven percent to 22 percent on US 23/ SR 42 and a range of four percent to 13 percent on US 19 / US 41 when compared to the baseline scenario.

Figure 5-10: 2030 I-75S Parallel Corridors Total Daily Vehicle Hours Traveled

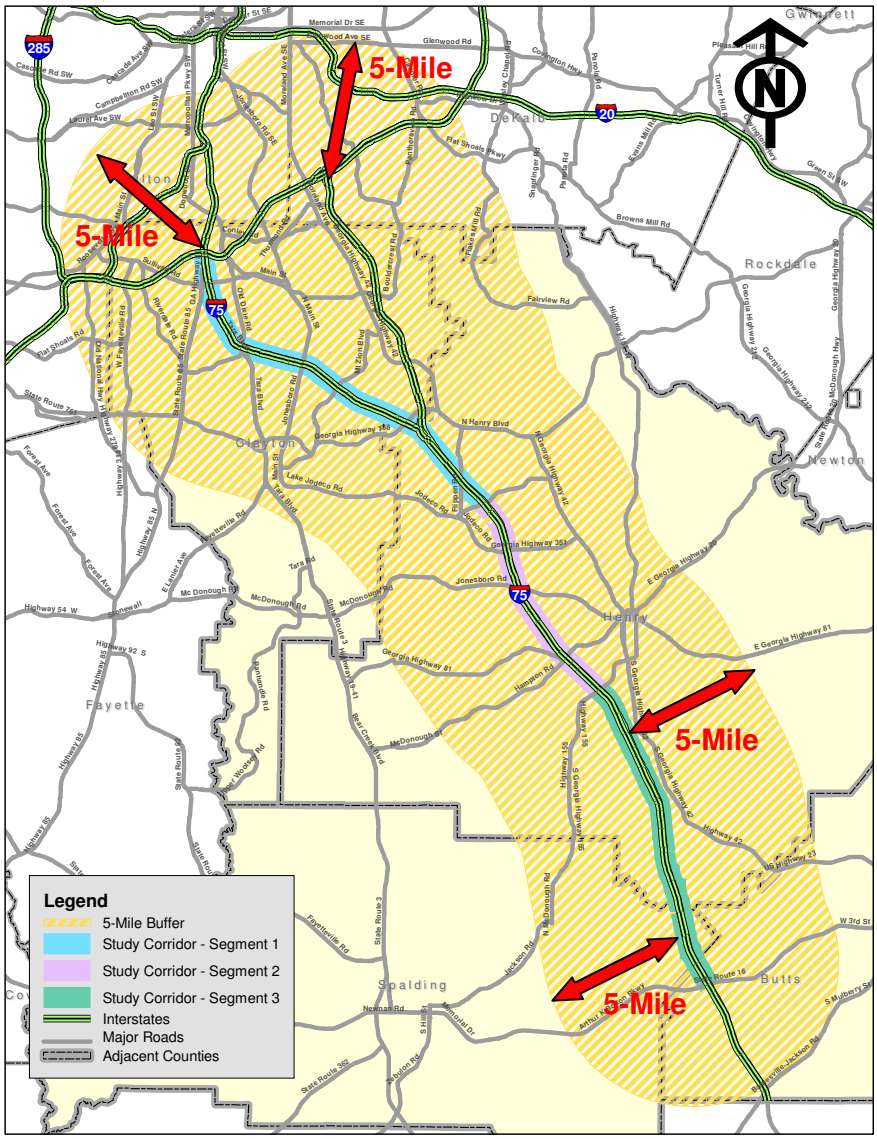


5.5 Transportation System Analysis

To capture transportation system benefits introduced due to managed lane and/or TOT lane investments, a 5-mile buffer was placed around the study corridor using Geographic Information System (GIS) software. Figure 5-11 shows a buffer of 5 miles around I-75 south and I-675 corridors, which includes segments of I-285, I-75 (North of I-285), I-85, I-20 East inside of I-285 and other major arterials, such as US 23, SR 331, SR 54, SR 155, etc.

For each managed lane investment alternative and the baseline scenario, transportation performance including total vehicle delay, VHT, VMT, etc inside of the 5-mile buffer were calculated to evaluate system impacts in detail. The results are described in the following section.

Figure 5-11: Sub-area Transportation System within 5-Mile Buffer



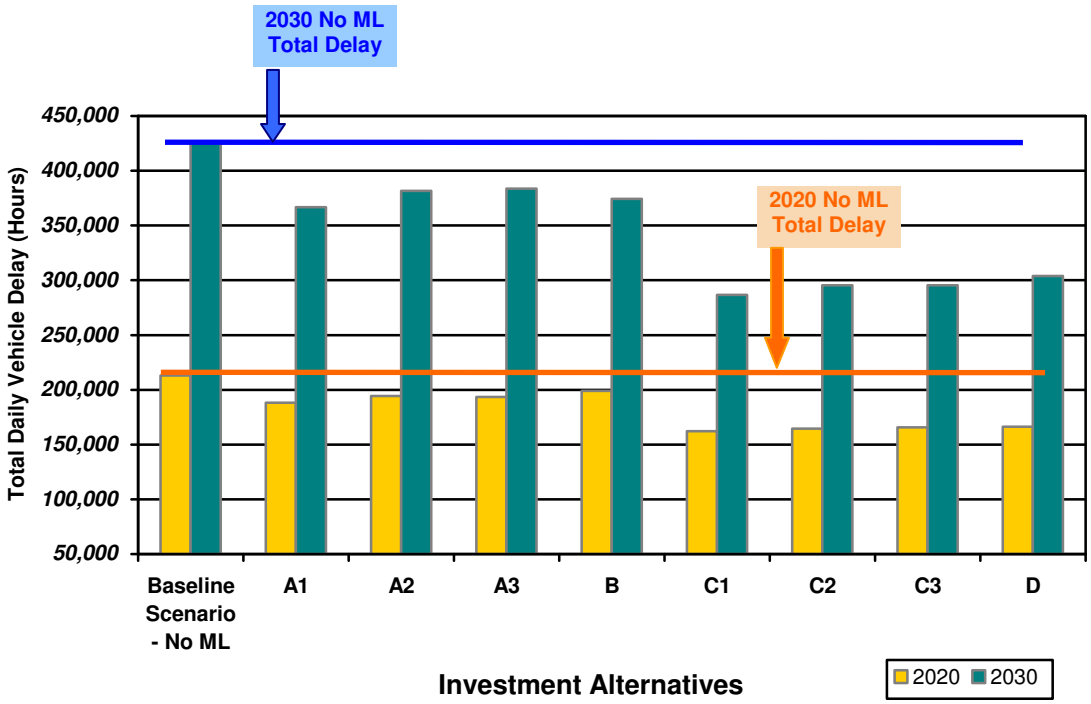
5.5.1 Total Daily Vehicle Delay

A major portion of traveler benefits is represented by the reduction in total daily vehicle delay. Total daily vehicle delay was estimated for both "previous" travelers as well as diverted or "induced" travelers.

As discussed in previous sections, total vehicle delay was calculated based on the travel demand model outputs. The delay in four analysis periods (AM, PM, MD and NT) was computed by subtracting free flow travel time from congested travel time for each network link inside of 5-mile buffer area. Total vehicles are then multiplied by the delay in each direction to arrive at total-vehicle-delay for each of the four analyses time periods. The total-vehicle-delays for each network link inside of 5-mile buffer area and during four analysis periods were then added up to a sub-area transportation system total delay.

Figure 5-12 illustrates the total daily vehicle delay on a 5-mile buffer transportation system along I-75 South/I-675 in 2020 and 2030. As shown in Figure 5-12, total daily vehicle delay on the 5-mile buffer area is estimated to decrease in 2020 and decrease more considerably in 2030 with the introduction of managed lane investments along I-75 South. In 2020, the total daily vehicle delay in the 5-mile buffer area is expected to be reduced by a range of seven percent to 24 percent; while in 2030, the total daily vehicle delay is expected to be reduced by 10 percent to 33 percent among eight managed lane investment alternatives.

Figure 5-12: 2020 and 2030 Total Daily Vehicle Delay on a 5-Mile Buffer Transportation System along I-75S/I-675

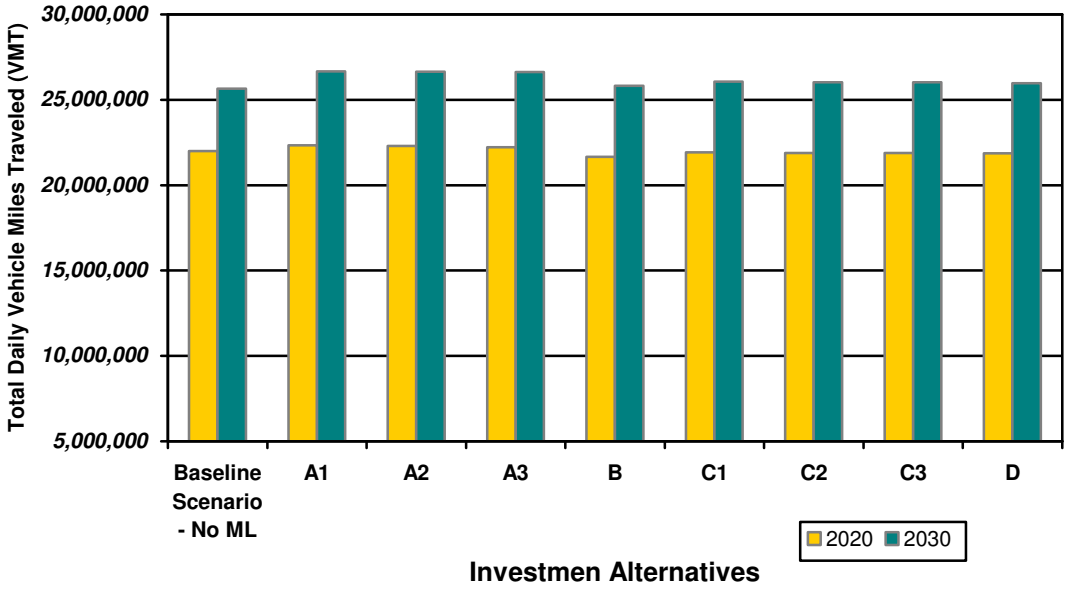


5.5.2 Vehicle Miles Traveled

As discussed in previous sections, daily Vehicle Miles Traveled (VMT) is the cumulative total number of miles of motorized vehicle travel in an average day. This indicator can be used to evaluate transportation system utilization and performance. Figure 5-13 shows the daily vehicle miles traveled (VMT) for the 5-mile buffer sub-area system in 2020 and 2030.

Compared with the baseline scenario, all of the managed lane investment alternatives illustrate relatively low impacts on the VMT within the 5-mile buffer. In 2030, the total daily VMT increases by one percent to four percent among all the eight investment alternatives. This is due to the unchanged overall demand in the region. The slight increase in VMT is attributed to diverting traffic from outside of buffer area to the I-75 South corridor facilities (GP lanes, managed lanes and TOT lanes).

Figure 5-13: 2020 and 2030 Total Vehicle Miles Traveled on a 5-Mile Buffer Transportation System along I-75S/I-675



5.5.3 Vehicle Hours Traveled

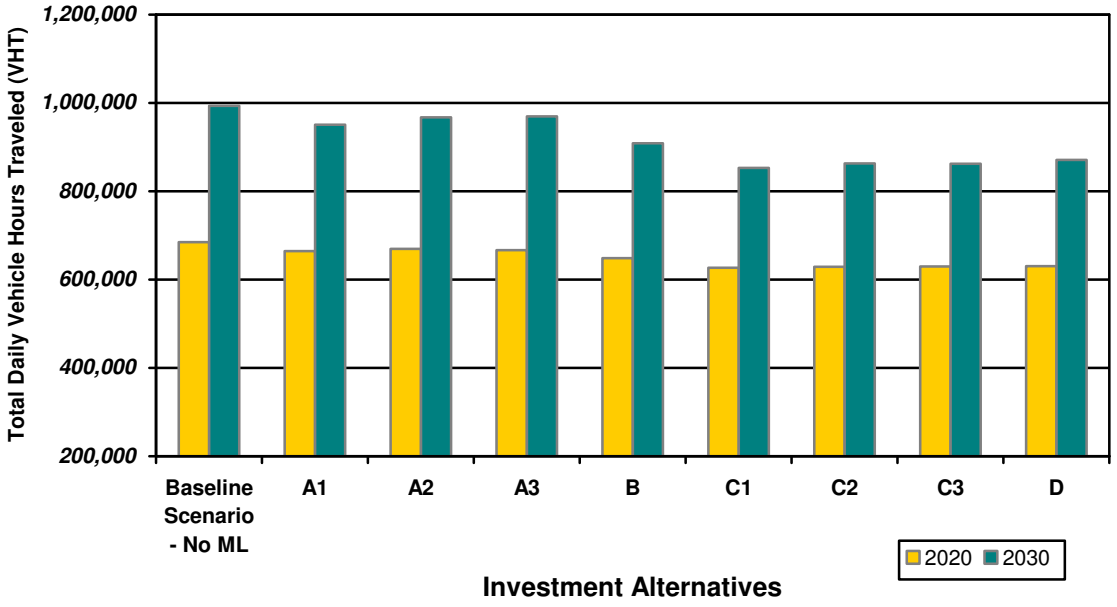
As discussed in Parallel Corridor Analysis section, daily Vehicle Hours Traveled (VHT) is the cumulative total vehicle hours expended traveling on the network in the area. The VHT is also used as a measure of system utilization and performance.

The VHT for each network link was calculated using four analysis periods data (AM, PM, MD and NT) from the 2030 year model run. The total daily VHT in the sub-area transportation system is the summation of VMT on the entire network links within the 5-mile buffer area during four analysis periods.

Figure 5-14 illustrates the daily VHT for the 5-mile buffer sub-area system in 2020 and 2030. Compared with the baseline scenario, all of the managed lane investment alternatives illustrate a significant benefit in VHT savings for the transportation network within the 5-mile buffer. Managed Lane alternatives are forecasted to decrease by a range of two percent to 14 percent in VHT when compared to the baseline scenario. Among eight investment alternatives, Investment Alternative C1, which includes the construction of both managed lanes and voluntary TOT lanes, is expected to experience greatest benefits on VHT savings in the 5-mile network.

The VMT and VHT analysis illustrate that with the managed lane and/or TOT lane investments, the transportation network within the 5-mile buffer of the study corridor is expected to have a slightly higher VMT but much lower VHT. The longer total travel distance (VMT) with shorter total travel time (VHT) indicates higher transportation system utilization and lower levels of system congestion.

Figure 5-14: 2020 and 2030 Total Vehicle Hours Traveled on a 5-Mile Buffer Transportation System along I-75S/I-675



5.6 Summary of key findings

The following summary observations can be made based upon the analyses conducted in this study:

- All eight managed lane investment alternatives have an overall impact on the travel demand, travel patterns, and traffic operations in the I-75 south corridor.

- The travel demand analyses show increases in person and vehicle volumes with all eight managed lane investment alternatives. Compared to the baseline scenario (i.e. no managed lanes are constructed in the corridor), the total daily vehicle volume is forecasted to increase by a range of six percent to 20 percent in 2020 and seven percent to 16 percent in 2030; while the total daily person volume is forecasted to increase by a range of six percent to 22 percent in 2020 and eight percent to 20 percent in 2030. Investment Alternatives C1- C3, which include the construction of both managed lanes and voluntary TOT lanes, are forecasted to have the greatest increase in both person and vehicle volumes in the study corridor.

- Constructing managed lanes and TOT lanes can provide reliable travel time and travel speed (at or above 45 mph) for people who choose to use managed lanes. The analysis also shows improvements to operating conditions on the I-75 South GP lanes with managed lane/TOT lane investments. The weighted average speeds on the GP lanes along the corridor improve by the range of four to 13 mph in peak period in 2020 and six to 13 mph by 2030. However, congestion is not eliminated in the existing lanes, due to the attraction of additional vehicles from parallel facilities.

- Building two-extra general purpose lanes each direction along the corridor will increase both total daily vehicle volumes and person volumes, but it can not provide guaranteed mobility in the long run. The operating travel speed in 2030 under two-extra GP lane scenario is below 30 mph.

- The additional capacity offered by Managed Lanes, results in the diversion of traffic from the two major parallel corridors in 2030:
    - US23/SR42
        - 14 percent to 41 percent decreases in total vehicle delay
        - two percent to 10 percent decreases in Vehicle Miles Traveled
        - seven percent to 22 percent decreases in Vehicle Hours Traveled
    - US19/US41
        - 13 percent to 30 percent decreases in total vehicle delay
        - two percent to six percent decreases in Vehicle Miles Traveled
        - four percent to 13 percent decreases in Vehicle Hours Traveled

- The analysis shows a significant reduction in total vehicle delay within the 5-mile transportation system. The total daily vehicle delay deceases by a range of 10 percent to 33 percent.

- While all of the eight managed lane investment alternatives have a slightly higher VMT compared to the baseline scenario, they all have greater positive impacts on VHT. Once again, Alternatives C1- C3, which include the construction of both managed lanes and voluntary TOT lanes, have larger absolute and percentage changes on VHT within the 5-mile transportation system.

- Managed lanes provide an incentive to transit riders as these transit vehicles achieve a travel time advantage as opposed to vehicles in the general-purpose lanes. By using the managed lanes, transit operators create a competitive option to the single occupant vehicle and help to reduce the number of cars in the general purpose lane that were driving alone.

CHAPTER 6

Toll Technology Assessment and Toll Collection Capital Cost

As priced facilities, managed lanes entail operational needs above and beyond those of traditional facilities – such as toll collection and enforcement. This chapter provides a narrative of the operational elements required to successfully plan and implement managed lanes in the I-75 South corridor. Managed lanes encapsulate a variety of traffic management techniques including High Occupancy Toll (HOT) lanes, Express Toll Lanes (ETL) and Truck Only Toll (TOT) Lanes. An overview of Electronic Toll Collection (ETC) technologies, examples of their successful applications, different potential scenario applications of ETC on the study corridor and associated scenario costs, will be outlined. These broader descriptions of managed lane technology will then be applied specifically to the I-75 South corridor with illustrations of the design concepts and toll collection configuration. The I-75 South corridor may be comprised of two possible separate managed lane systems: one to facilitate passenger car movement and the other dedicated to trucks. Based on a toll, both systems enable each vehicle type to traverse through the I-75 South corridor with more reliable travel times.

Toll collection technology has evolved in response to the introduction of managed lane systems that require complex transactions and have multiple occupancy and eligibility requirements. This adaptation is evident in the use of ETC technology on the majority of new tollway systems or lanes currently in planning, design, or implementation stage. Even mature facilities such as New Jersey have spent millions of dollars retrofitting their system from traditional ticket systems utilizing toll collectors to a state-of-practice fully electronic system.

Given the conceptual characteristics of the managed lanes project on I-75 South corridor, it is inevitable that the collection mechanism should be fully electronic. Similar Managed lane facilities in California, Texas and Minnesota are all fully electronic systems.

Truck Only Toll Lanes or Truck Only Lanes (TOL) represents a developing concept in the United States. Feasibility studies for TOL in California have brought to light several unique issues related with them. The Georgia Department of Transportation (GDOT) recently completed a Statewide Truck Lanes Needs Identification Study, which explored the feasibility of implementing Truck Only Lanes on sections of interstate and other limited-access highways across the state. In the study, I-75 South corridor was identified as one of the top candidate corridors for truck only lanes.

It is assumed that this project will be open for traffic in 2020. Due to the length of time prior to opening, it is safe to assume that ETC technology will significantly advance

before opening day. It is quite possible that occupancy detection and enforcement systems maybe developed and in place, with all vehicles equipped with some form of pricing and detection equipment on opening day. This anticipated evolution notwithstanding, discussion of current technology, issues and opportunities are presented in this section as a foundation for planning.

6.1 Toll Collection Technology - Overview

6.1.1 Criteria for Selection of an Appropriate Toll Collection Technology

The selection of an appropriate toll collection technology is driven by many factors, some of which are discussed below:

- **Toll rate structure:**

Depending on the objective and the level-of-service provided to the users of the managed lanes, various toll rate structures are available.

Toll Rate Option 1 - Single Rate
Regardless of where the vehicle enters the managed lane, a flat rate would be charged. This discourages short trips, reduces weaving problems on the general purpose lanes, and improves the service on the managed lane. The operator would have the flexibility of changing this one rate periodically.

Toll Rate Option 2 - Mileage-Based
In a mileage-based tolling system, the vehicle is charged from point to point. This option allows the operator to manage the per-mile rates and thus the toll is based on the distance traveled. This method requires that the entry and exit of vehicles be correctly and accurately determined.

Toll Rate Option 3 - Segment Rate
Each ingress/egress is considered a segment and depending on segments traveled, the toll is calculated. It may seem that long trips may not benefit from such a toll structure, but back-office processing can allow greater flexibility when charging for the final trip. Segment rates allow the operator to change rates on individual segments of the managed lanes to manage the traffic flow. Segment rates are simpler to implement since they are based on single transponder reads within the segment and the complications of trying to match the entry and exit are eliminated.

Also, toll charges might vary by vehicle classification, either determined based on the number of axles (for trucks) or occupancy (for autos). This requires that the toll technology be able to classify vehicles and charge them appropriately. The technology should also be capable of verifying the vehicle classification and designated lane usage.

In case of dynamic tolling on a managed lane facility, the toll technology should be able to adjust the toll rate according to demand levels, communicate this to users, and charge users the calculated rate. The toll collection system for dynamic tolling requires the following data:

- Time of entry;
- The toll rate in effect at entry;

- The place of entry into the managed lane;
- Every tolling location that is passed through by the vehicle, and the time of passage at each location; and
- The location and time the vehicle passes through the final tolling point for that trip.

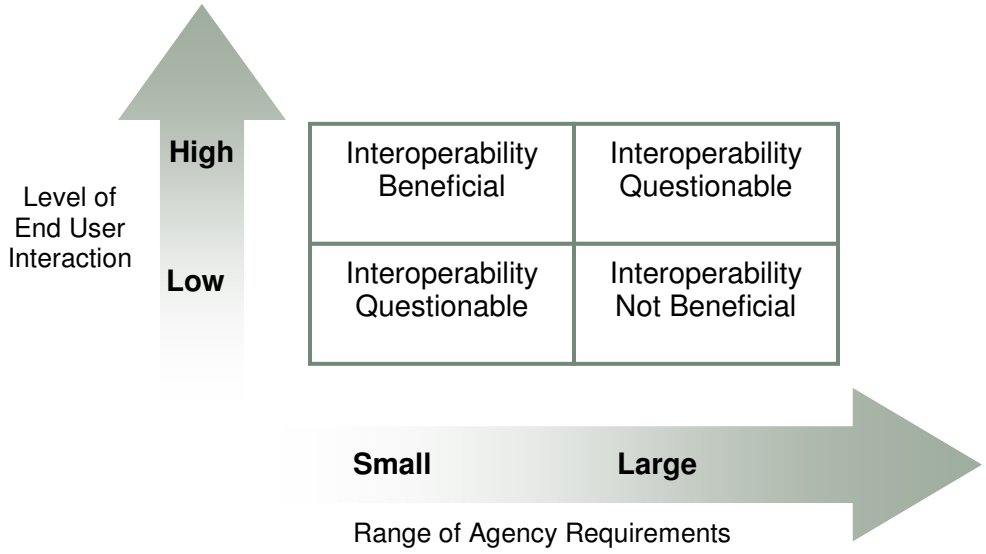
Using the data listed above, the central processing system will be able to determine the length of the trip and the rate that was in effect at the time the vehicle passed the tolling location. The toll can be calculated using a variety of methods and configurations based on the ideal fit for system. The managed lanes system offers an alternative to general purpose lanes, which are subject to fluctuating travel times. Potential managed lanes users calculate their personal value of time to decide whether to pay for the travel time benefit provided by the managed lanes system. The requirements of a dynamically priced managed lanes system are discussed in further detail in later sections of this document.

- **Enforcement against violations:** In order to maximize the revenue intake of a toll facility and minimize losses, an efficient enforcement system should be put in place. The enforcement system should be compatible with the toll charging equipment.

- **Cost:** Toll collection costs impacts both users of the system as well as the operating agency. The system transaction costs should not overwhelm the expected revenue that is predicted to be generated from the tolled facility.

- **Interoperability:** Interoperability between different toll systems and agencies allows users to acquire and maintain a single account. Factors like the level of interaction between users and toll agency requirements determine the net benefits of interoperability (refer Figure 6-1).

Figure 6-1: Interoperability Benefits



Adapted from E-ZPass: Case Study of Institutional and Organizational Issues in Technology Standards Development, JL Gifford, L Yermack, CA

6.1.2 Managed Lane Management

A fully operational "managed lane" employs a series of strategies to ensure reliable travel speed advantages over adjacent general purpose lanes. Absent this advantage, managed lanes can exhibit the same congested conditions as general travel lanes, eliminating the potential for an enhanced customer experience. There are two underlying principals to ensure successful managed lanes:

- Different strategies can be employed and adjusted to influence demand to preserve ideal speeds; and
- Traffic characteristics may be constantly monitored to determine the availability of excess managed lane capacity for sale to travelers that do not meet eligibility or occupancy requirements.

A discussion of these themes is presented in the following sections.

Management Tools
The elements associated with facility management are dynamic and complex. Historically, the term managed lanes stirs thoughts of pricing, when in fact it is one of four categories used to maintain superior operational levels. The four categories are:

- **Pricing** – Imposing a users fee on the lanes helps regulate demand. Traditionally this floats on a fixed schedule to varying prescribed demand levels by time-of-day and day-of-week. The introduction of dynamic pricing has propelled this concept into real time, meaning users fees are adjusted instantaneously (every 5 minutes or so) depending on the conditions in the managed lanes and adjacent general purpose lanes. This management technique is the most adaptable and flexible tool for managing traffic operations on a day-to-day basis.
- **Occupancy** – Occupancy restrictions establish the passenger requirements for free or discounted use. Most facilities require two (HOV 2) or three (HOV 3) minimum occupancy constraints. The Atlanta region maintains an HOV 2 occupancy policy, currently. If at some point in time demand management cannot be accomplished with price, occupancy requirements should be examined.
- **Eligibility** – Limiting lane use to specific types of users, such as HOV, motorcycle or trucks provides a broad management of global demand. Eligibility management can be enforced by location or time-of-day. For example, the managed facility could limit use in the peak periods to HOVs and then convert eligibility to all users, or even truck only use, in the midday and over night hours.
- **Access** – Controlling access points and rates ensures that lane demand does not flood downstream capacity. This is typically accomplished by spacing access points. Since the proposed managed lane facility on I-75 South has limited access locations, the ability to manage the facility through access is predetermined. In the unlikely event that a combination of other management strategies are unsuccessful in limiting use, operational access controls, such as ramp metering, could be put into place.

Employed in combination, these management strategies provide a broad mechanism to manage demand and protect the integrity of the managed lanes. The implementation and continual adjustment of these strategies requires a constant stream of information to

monitor managed lanes operations, analyze the cause and effect of each of the management strategies on the overall demand, and formulate policies to achieve operational and customer service performance goals.

6.1.3 Opportunities for System Interoperability for Commercial Vehicles– The PrePass System: A Case Study[1][2][3]

There are programs in place that use electronic systems at weigh stations that allow registered and compliant trucks to bypass the stations. PrePass is one such program. It is briefly discussed below to provide an overview of truck classification technology and interoperability concepts.

PrePass is an automated system that allows registered commercial vehicles to proceed through designated weigh stations, port-of-entry facilities and agricultural interdiction facilities without the need to stop. Commercial vehicle participation is subject to state qualification standards. Started in California in 1995, the PrePass program has been implemented as a public-private partnership. It is interoperable between:

- New York State Thruway Authority;
- MTA Bridges and Tunnels;
- New York State Bridge Authority;
- Port Authority of NY & NJ;
- Peace Bridge;
- Virginia DOT;
- DelDOT;
- Atlantic City Expressway;
- Massachusetts Turnpike;
- New Jersey Highway Authority;
- Burlington County Bridge Commission;
- Delaware River Joint Toll Bridge Authority;
- Delaware River port Authority;
- West Virginia Turnpike Authority;
- Pennsylvania Turnpike Commission;
- Delaware River and Bay Authority;
- Maryland Transportation Authority;
- Maine Turnpike; and
- New Hampshire DOT.

PrePass system has 280 operational sites at weigh stations in 28 different states across the country. The multi-protocol transponder used by the system allows trucks the opportunity to make electronic toll payments at nearly 400 E-ZPass toll plaza facilities through the PrePass ^{Plus} program. A survey by the National Survey of Drivers Wages in 2003 stated that a truck saves at least five minutes and about half a gallon of fuel with every successful bypass. With 3.8 million trucks carrying PrePass transponders as of April 1st, 2006, this means that PrePass provides tremendous time and fuel saving benefits for the trucking industry.

System Components

PrePass is a complex system that has multiple operational components. The major components are discussed below briefly:

[1] PrePass website http://www.prepass.com/whatsprepass.htm

[2] MARK IV Transportation Technologies Group website http://www.ivhs.com/products_services/index.htm

[3] E-ZPass, Road Traffic Technology website http://www.roadtraffic-technology.com/projects/ny_thruway/

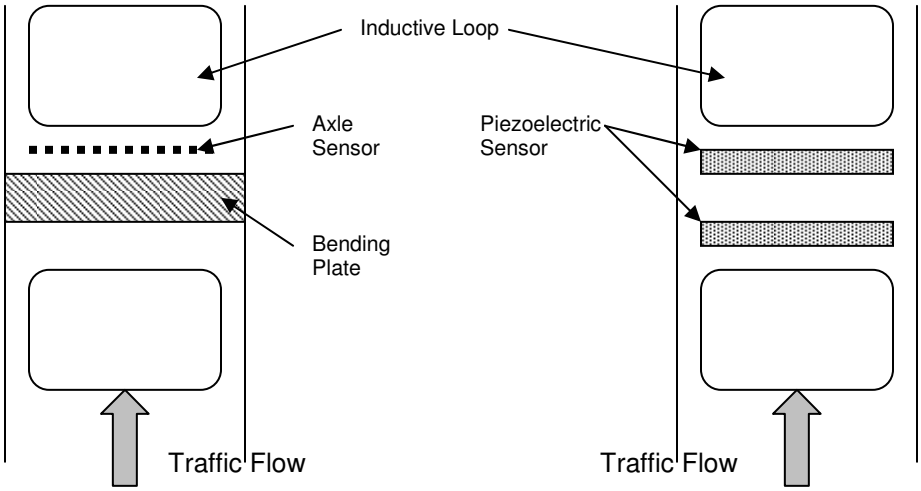
- Vehicle registration: Commercial vehicles wanting to participate in the PrePass program have to submit safety records and other credentials which are verified routinely with State and Federal agencies.

- Transponders: Registered vehicles are supplied with free transponders (In Cab Device) that are installed on the vehicle's windshield. The system uses Mark IV transponders that are commonly used in North America for screening motor vehicle carriers. Other systems like the NORPASS system and Oregon's Green Light Program also use Mark IV transponders. Mark IV's Fusion Commercial Vehicle Operations (CVO) transponders are multi-protocol transponders i.e. they can read two popular protocols – E-ZPass and TDMA V6. Thus, a Fusion CVO transponder allows a truck to pass through a weigh station as well as ETC tolling zones, like E-ZPAss, at high speeds as long as the truck is registered with both systems. This has several advantages:

  - It reduces total cost for on-board equipment;
  - It allows for toll system efficiency; and
  - It promotes interoperability.

- Weigh in Motion (WIM) technology: As the name implies, Weigh-In-Motion technology weighs trucks and their axles while the vehicles are traveling at highway speeds. The main operating principle for a WIM technology is that it has a sensor that measures deformation in a medium. The sensor transmits the information to a processor unit that produces information on vehicle axle mass. Advanced WIM technologies can measure weights of vehicles at very low as well as very high speeds. Three main types of WIM sensors are Piezoelectric Sensors, Bending Plates and Load Cells. Piezoelectric Sensors produce a charge proportional to the pavement surface's deformation induced by the truck tires load. Bending Plates measure the bending of a steel or rubber plate produced by the weight of a truck over them. Load Cells measure the hydraulic pressure induced by the vehicle's weight.

Figure 6-2: Commonly Used Weigh-in-Motion Technology

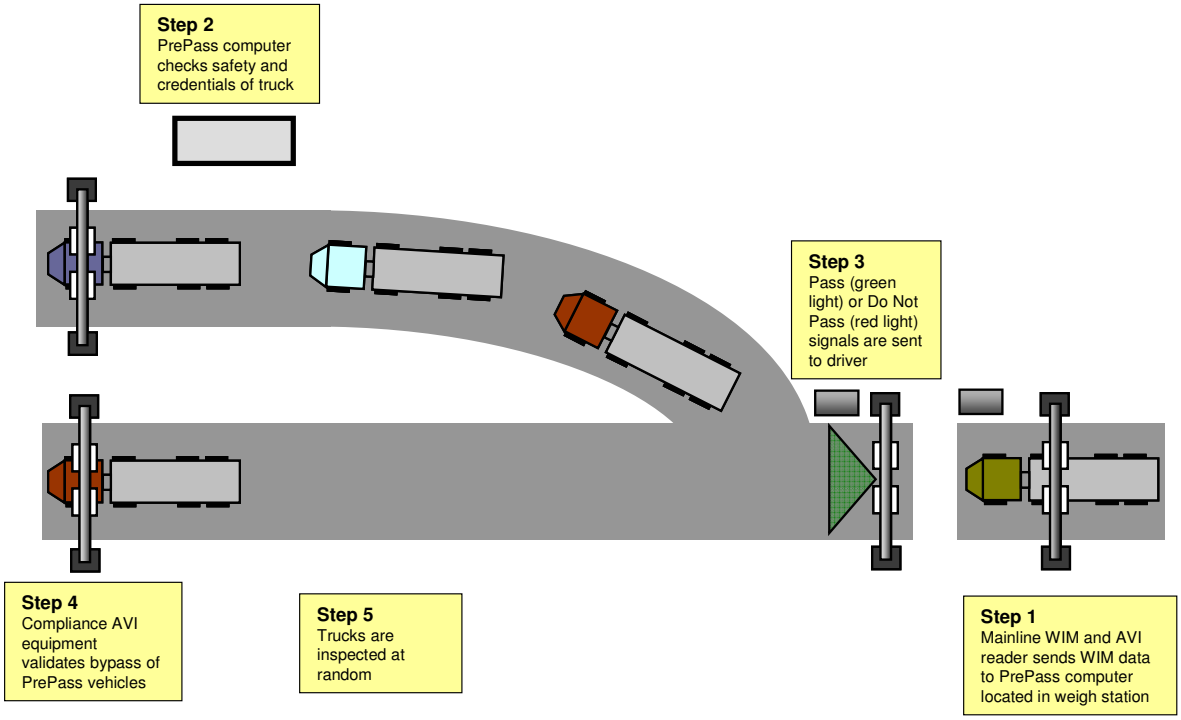


Adapted from Truck Traffic Analysis using Weigh-In-Motion (WIM) Data in California - Draft, 2002, Available at http://www.its.berkeley.edu/pavementresearch/PDF/WIMreport.pdf

System Operation

As a registered truck approaches a weigh station, and passes over the WIM loops, a signal is transmitted to the PrePass computer center in the weigh station that verifies the vehicle weight and credentials. The system then communicates with the transponder located in the truck. If the truck meets the required criteria, the transponder emits a green light and an audible signal, if it does not, the transponder emits a red light and the truck has to go through the normal weigh station.

Figure 6-3: Illustrative Operation Concept of the PrePass System



Institutional Set-up - Interagency Group (E-ZPass)

The Interagency Group (IAG) is a cooperative organization of toll agencies in New York State, Massachusetts, Delaware, Pennsylvania, West Virginia, Maryland, and New Jersey. IAG was formed with seven members in 1991 from three states (NY, NJ and PA) with a goal to develop a regionally compatible toll system. Currently, IAG has twenty two member agencies and over seven millions account holders with more than twelve million transponders.[4] IAG members use consistent technology so that travel for customers across all participating terminals is seamless. However, the agencies have separate billing and customer service centers that are connected by a reciprocity network. Each state or agency has its own billing and customer service center (CSC). The agencies also set their own customer account policies. Areas of variation include the refundable deposit or nonrefundable charge for a tag, periodic maintenance fees, paper statement fees, the low balance threshold, and replenishment amounts. Despite these variations,

[4] E-ZPass Interagency Group (IAG) website http://www.e-zpassiag.com/IAG-AboutUs.htm

the IAG provides a successful user-oriented institutional model for toll operations.

The PrePass system and the IAG provide several interesting lessons that can be considered as Atlanta develops its toll network:

- Achieving interoperability at the outset, both from a system as well as institutional perspective, can provide benefits both to the toll agency as well as the system users. This is especially valid for long-haul trucks that may travel through multiple toll points during a given trip.

- Integrating the toll collection technology with the Mainline Automated Clearance System (MACS) 75 weigh station technology may make the system more desirable to a greater number of users.

6.1.4 Design Challenges and Opportunities

In developing the toll collection and operational concepts, numerous design challenges and opportunities were identified as key issues that needed to be addressed as part of this study. These challenges and opportunities are discussed under two managed lanes categories –truck only toll lanes and HOT lanes.

Design of truck only toll lanes

The design issues involving truck only toll lanes are influenced by many factors like social and environmental constraints along an existing facility, operational effectiveness, user convenience, and project cost. A few issues are discussed below.

- One significant trade off in truck only toll lane design is limiting access points (more through traffic driven) and the need to generate high levels of demand (more local traffic driven). Increasing access points would increase demand and thus, for a tolled facility, increase revenue. However, planning for increased access points, along with their design would increase project costs that would influence the benefit cost ratio. For example, the SR-60 truck lane feasibility study in California identified a high cost access option involving physically separated, exclusive truck exit and entry ramps for freeway-to-freeway interchanges. The lower cost option added truck only lanes to existing mixed flow ramps. Mixed-flow ramps coupled with frequent access points create conflicting merging and weaving maneuvers that compromise operational effectiveness of the truck only toll lanes. In case of the I-75 South corridor, it is anticipated that a large proportion of trucks will be through trucks. Thus, providing limited access points, situated at the beginning and end of the facility, are recommended.

- Since one major objective of truck only lanes is to provide reliable travel times, the lane configuration should account for the possibility of delay due to accidents or construction activity. A single barrier separated truck lane would provide a limited passing mechanism for trucks in case of an incident. In contrast, a multi-lane configuration consisting of two truck only lanes in either direction would provide greater operational flexibility. However, providing two truck lanes in either direction would require additional right-of-way and thus, significantly increase the project cost.

- Truck lanes can be located in three configurations in the I-75 South corridor –

innermost lanes adjacent to the median, between managed lanes and general purpose lanes or outermost lanes. The truck only toll lanes have fewer access points than managed lanes and general purpose lanes. Thus, locating them between these two systems reduces merging and weaving conflicts and allows easy access to innermost managed lanes through dedicated interchanges.

A combination of financial analysis techniques and demand estimation methods should help determine the optimum solution for balancing user benefits and project cost.

Design of Managed Lanes

Depending on the toll pricing schedule and eligibility requirements different toll collection design and configurations can be used. The ability to differentiate tolled from non-tolled traffic must be addressed to ensure vehicles are charged correctly based upon occupancy and eligibility. There are two ways to separate vehicles by occupancy and eligibility.

- Assuming all users would be required to register with an operating agency and have an ETC transponder, eligibility enforcement would be through gantry mounted indicator lights and random enforcement.
- Assuming that non-tolled eligible traffic is not required to possess a transponder and that tolled eligible vehicles would have to register with the operating agency prior to use, enforcement would be through separation of non-tolled and tolled traffic at the tolling zones. For example, if an adopted toll pricing policy allows vehicles with two of more passengers to enter the system without paying a toll and without a need for a transponder, enforcement methods would be in place to inspect the vehicle for visible occupants as it passed through the separation zone and permit continued passage through the managed lane system based upon policy compliance. However, if a SOV enters this same managed lane system as a toll eligible vehicle, but fails to possess a valid transponder at the separation area, it would be detected as a violator and would be subject to appropriate fines.

Ongoing research in the field of automated vehicle occupancy systems shows promise that occupancy requirements can be monitored and enforced via a variety of human characteristics such as skin recognition, heat, and profile. However, the development of such systems is just beginning and may not be sufficiently advanced in time for implementation.

6.2 Pricing and Operations

6.2.1 Toll Pricing Options

Depending on the level of congestion, direction of congestion, and time of congestion various toll pricing options are available.

Toll Pricing Option 1 - Dynamic Value Based Pricing

This option allows the toll rate to be changed instantaneously based on the managed lane capacity and the traffic in the general purpose lanes. Sensors installed at various locations in the both the general purpose lanes and managed lanes report data to the

system in real-time that allows the system to determine the appropriate value-based price. Such a pricing scheme is totally dependant on traffic congestion with pre-set values for the minimum and maximum amounts. Through software configurations, the system will ensure that pricing is not changed too often and the changes are not too large. For example, on SR-91 in Southern California, a restriction in changing the pricing in smaller time frames resulted in large changes at a given interval resulting in congestion caused by vehicles trying to get in just before the increase.

This option requires additional equipment and software. Since the toll rate is dynamic, variable message signs are needed to notify the customer in advance of all ingress locations of any changes to the toll.

Toll Pricing Option 2 – Fixed Variable Pricing

In this option, the toll rates are based on the time of the day/day of the week. The rates are pre-determined and depending on the time of travel, the appropriate rate is charged. The rate structure is not directly determined by traffic at the time, but is pre-determined based on historical traffic information. Since dynamic pricing is not performed additional hardware is not required.

Toll Pricing Option 3 - Fixed Pricing

In this option, the toll rates do not change and remain the same the entire day. This is the most simplistic approach since the managed lane user knows exactly what the toll is at all times. If rates need to be different over the weekend or holidays, it can be adjusted accordingly.

The study has assumed the use of a mileage-based toll structure. Tolls could be either fixed variable or dynamically priced. While dynamic pricing offers the greatest flexibility to manage demand on an hour-by-hour, day-by-day basis on the facility, a fixed variable price structure was assumed in this study.

When developing pricing concepts, or toll schedules, certain fundamental ground rules were established providing the framework upon which the ultimate recommendations were formed. Pricing strategies and electronic toll collection equipment required to achieve these goals create several challenges to system design.

6.2.2 Truck Only Toll Lanes Pricing Strategies and Operations

- Truck only toll lane pricing can account for different toll rates depending on the number of axles. Even though the policy decision has not been reached on an axle based pricing strategy, considering this as a future possibility can reduce costly system overhauls in the future. For this, a vehicle classification system can be considered in the ETC design for future incorporation. Further study can be done to quantify the benefits of this strategy.

- Interoperability is an important consideration in designing truck only toll lanes. Long haul trucks travel long distances and in the course of one trip, may pass through multiple tolling areas and even weigh stations. The toll collection technology adopted in the truck only toll lanes should be such that it is compatible with other ETC systems along truck routes in the nation to the greatest possible extent.

6.2.3 Managed Lane Pricing Strategies and Operations

- The potential for a multi-use smart-card or a read-write transponder technology is a great opportunity for seamless transactions between a variety of uses and applications. The platform should be flexible enough to cover not only the managed lanes and other priced roadway facilities in the State of Georgia, but also have the ability to be integrated into parking systems and transit operations. The ability to control price across multiple applications would create opportunities to implement a broad variety of travel demand management measures. A price and fare system could potentially result in modal and temporal shifts in travel behavior.

- Establishing a policy of requiring all users of the managed lane system to register with the operating agency can make both toll collection as well as enforcement easier. Also, it provides flexibility to change toll pricing structures in the future.

- Enforcement of both toll collection and occupancy compliance continues to be a challenge in the toll arena. Minimizing violations and preserving revenue is critical to the operational efficiency and financial health of managed lanes.

- Toll collection enforcement is traditionally accomplished via license plate recognition. A vehicle is considered to be in violation if a valid transponder is not detected when traversing the tolling zone. Video enforcement is supplemented through roving enforcement officers. While video enforcements are reliable, the processing costs are significant.

- Occupancy enforcement is also a continual challenge for those operators employing varying toll schedules by occupancy class. As mentioned previously, the ability to accurately identify managed lane eligible vehicles is accomplished by either establishing registered car pools; separating eligible and non-eligible traffic in the tolling zone; or implementing an automated vehicle occupancy system.

- Interoperability between the managed lanes and the current ETC enterprise on SR 400. The technology must be compatible across both applications.

- Advanced information management remains a challenge for all priced facilities, but it is especially difficult for fixed variable and dynamic facilities. Relaying the toll rates in effect at each entry point is critical at every entry and exit point throughout the approximately 34-mile system.

6.3 Electronic Toll Collection Assessment

Electronic Toll Collection (ETC) is a family of technologies that results in the ability of highway users to pay tolls electronically. Current ETC systems employ vehicle-to-roadside communication technologies including Automatic Vehicle Identification (AVI), or transponders, and Automatic Vehicle Classification (AVC), to perform an electronic monetary transaction between a vehicle passing through a toll zone and the toll collection agency. In a managed lanes application, ETC equipment takes the place of a human toll collector who manually collects tolls at tollbooths. Electronic Toll Collection is

quickly becoming a globally accepted method of toll collection, a trend greatly aided by the growth of interoperable ETC technologies.
ETC systems offer many advantages over manual toll collection techniques:

- Increase system efficiency by providing high throughput ;
- Reduce motorist delay caused by queues at tolling stations as well as need to slow down to pay toll; and
- Increase fuel economy and reduce emissions by eliminating deceleration, waiting times and acceleration.

6.3.1 Open Road Electronic Tolling

All of the potential alternatives discussed in this assessment employ full ETC systems. A full or all electronic toll collection system is as it sounds, all electronic, there are no traditional toll plazas, no toll collection personnel, and no introduced delay at toll plazas. This non-intrusive and user oriented collection system is called Open Road Tolling.

Open Road Tolling (ORT) has the following main characteristics[5]:

- It allows toll collection at a high range of speeds – from zero mph to free flow highway speed.
- Its design consists of free-flow adjacent lanes without the need for separation.
- It can be a multi lane facility as per the requirements of the tolling design.

Electronic Toll Collection is a complex system that relies on coordination between several distinct technology components. The following main components are required:

A. **Automatic Vehicle Identification System (AVI)** communicates between the vehicle and system, establishing eligibility, registering usage and assessing the appropriate toll.
B. **Automatic Vehicle Classification System (AVC)** gathers electronic information about the physical characteristics of a vehicle in order to distinguish between different vehicle classes that can then be charged different toll rates according to a pre-classified system.
C. **Vehicle Enforcement System (VES)** is used to enforce toll payments and captures license plates through imaging if a vehicle is in violation.
D. **Lane Controller** is a computer system that coordinates the working of all toll collection system employed in a single lane.

These components are discussed in detail in the following section.

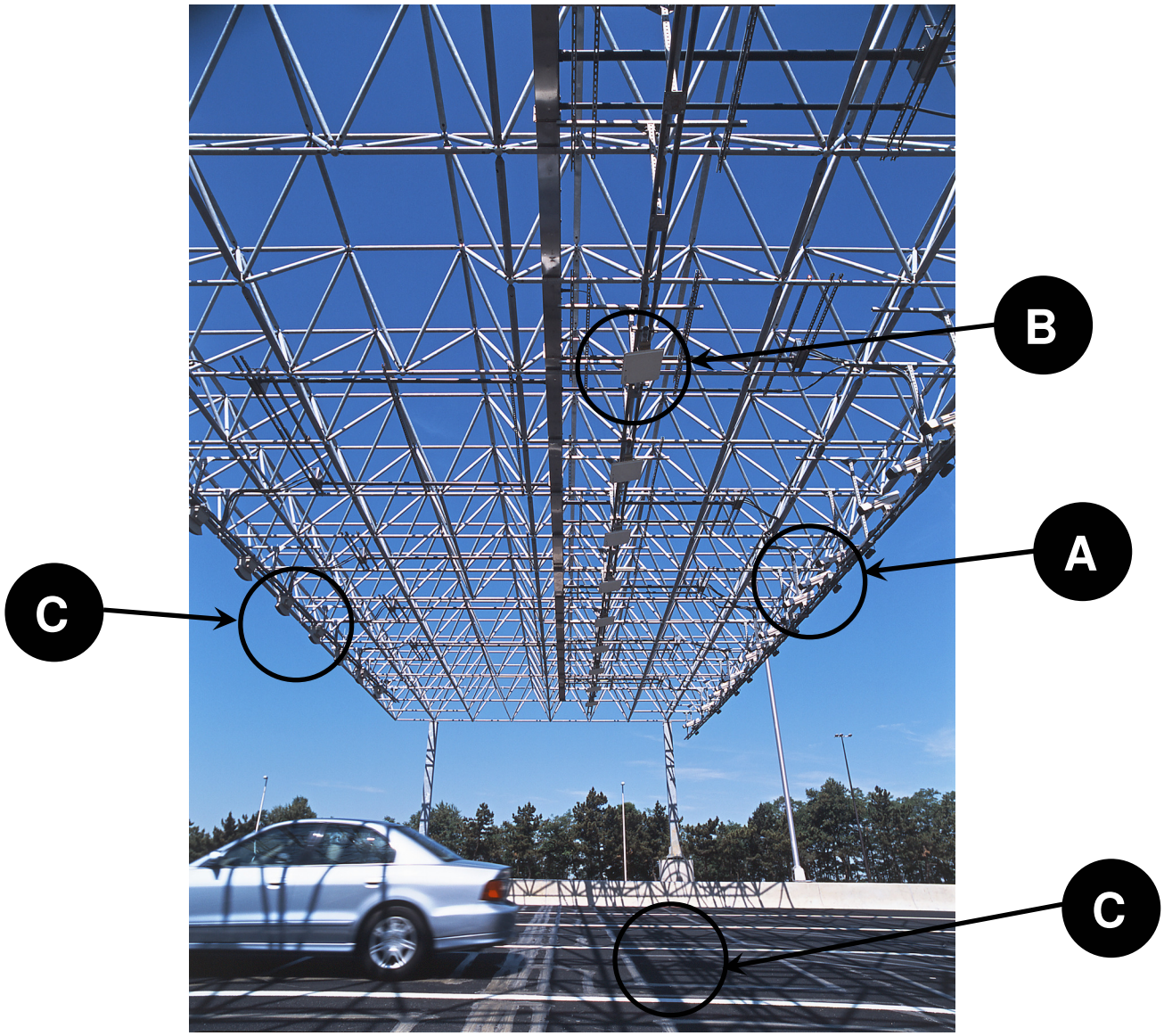
Figure 6-4 illustrates a typical ETC tolling zone with both a toll collection and enforcement system. While there are numerous configurations, the illustration depicts the state-of-the-practice toll zone structure. The hardware consists of a single gantry that hosts both the toll collection and enforcement equipment along with support systems such as lighting and vehicle separator equipment.

[5] T O Gallagher, Electronic Transaction Consultants Corporation, 'Dedicated AVI Lane versus ORT Zone – What's the Difference?, Front-end Challenges: The Lane Level', November 14, 2005, Presented at IBTTA, November 13-15, 2005, Washington DC

The specific hardware elements located on the gantry system are, from right to left – the direction of the traffic flow:

A. The Vehicle Enforcement System (VES) – The video-based violation enforcement system is used to capture license plates via imaging if a vehicle is determined to be in violation.
B. ETC Antenna and Reader
C. The laser vehicle separator – this equipment is used to detect the beginning and end of each vehicle. This information is critical in determining vehicle classification, violation enforcement, and ensures the linkage between identified toll transponders and associated vehicles. This can be an in-ground or overhead system.

Figure 6-4: Typical Electronic Tolling Zone

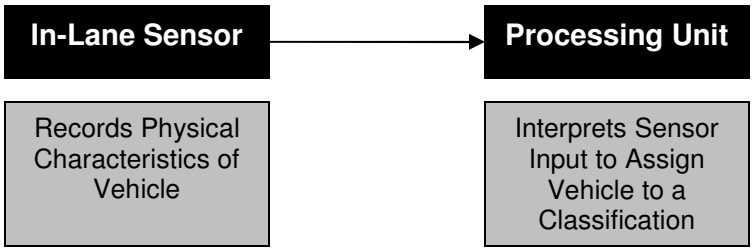


NEW JERSEY TURNPIKE, RARITAN, NJ

6.3.2 Automatic Vehicle Classification (AVC)

It is important to be clear about the distinction between an Automatic Vehicle Classification (AVC) System and an Automatic Vehicle Identification (AVI) System. While the AVC System determines vehicle class to determine the appropriate toll charge, the AVI system determines vehicle ownership to actually levy the toll charge or trigger the enforcement device. Figure 6-5 diagrammatically illustrates the functioning of an AVC system. The AVC system used in managed lanes system design functions as a vehicle separator. The AVC system is an essential component in truck only toll lane design where the pricing strategy is based on axle count.

Figure 6-5: AVC System



An AVC System should fulfill three primary purposes:

- It should be able to separate and classify vehicles with reasonable accuracy;
- It should be able to 'communicate' between the vehicle and tracking unit once vehicles have been classified; and
- It should be able to provide information to the tracking system to determine violations.

a. Policy Implications of AVC Technology Selection

If a pricing policy is adopted where only heavy trucks will be allowed access to barrier separated truck only lanes and charged at a fixed variable rate, then distinction by axle will not be necessary. If AVC technology is considered as an alternative, it will later allow for implementing a more complex axle-based pricing scenario for trucks.

One important system-level policy consideration while developing a vehicle class system is that it should be technologically possible to implement. AVC systems use an algorithm that interprets axle spacing to determine vehicle class. The class system driving the toll rates should be compatible with the AVC algorithm.

b. Types of AVC Technology

With technological development and demonstrated advantages, Open Road Tolling (ORT) is rapidly gaining acceptance. Traditionally used vehicle detection applications are light curtains and treadles, which are currently used on the GA 400 plaza. Light curtains consist of multiple horizontal light beams used to measure vehicle presence and profile. Treadles are pressure-sensitive devices placed in the road surface and used to determine number of axles and direction of vehicle movement. If ORT is adopted, these applications will not be appropriate since they do not function well at high speeds. Two

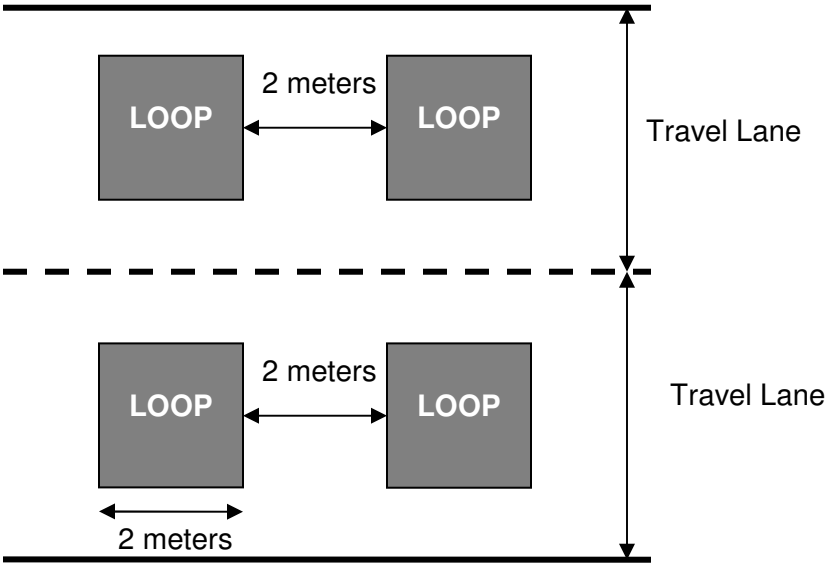
types of Automatic Vehicle Classification technologies appropriate for Open Road Tolling are discussed below.

- Induction Loop Technology

This technology application consists of multiple turns of wire, called loops, which are buried in the road surface at specific distances and are connected to a detection device. The general engineering principle that drives this technology is fairly simple. As a vehicle passes over a loop, its metallic mass reduces the inductance in the loop and increases the loop's oscillator frequency. The frequency change is compared to a preset threshold to determine the vehicle's presence. Different vehicles will cause different induction changes in the loop. In this technology, vehicle classification is driven not by weight of vehicle but by the vehicle's unique inductive footprint or signature.

One example of induction loops technology is Idris's vehicle classification technology which is a combination of patented loops (figure-of-eight or coil-in-coil design), algorithms and specific software programs. This technology is used by the Illinois State Toll Highway Authority (ISTHA). The Idris loops are buried in the road surface at specific distances. An example of loop layout in travel lanes is shown in Figure 6-6. As a vehicle passes over these loops, a change in inductance in the loops produces a unique vehicle signature, or a unique line graph, that is transmitted to the Idris software which translates this into per vehicle records (PVRs). The PVR provides information on the vehicle's speed, length, class and number of axles. In conjunction with the vehicle's transponder, the system either lets the vehicle pass or triggers the vehicle enforcement system (Figure 6-7).

Figure 6-6: Main Loop Array Layout and Dimensions



Note: Figure is not to scale and for illustrative purposes only
Source: IDRIS website

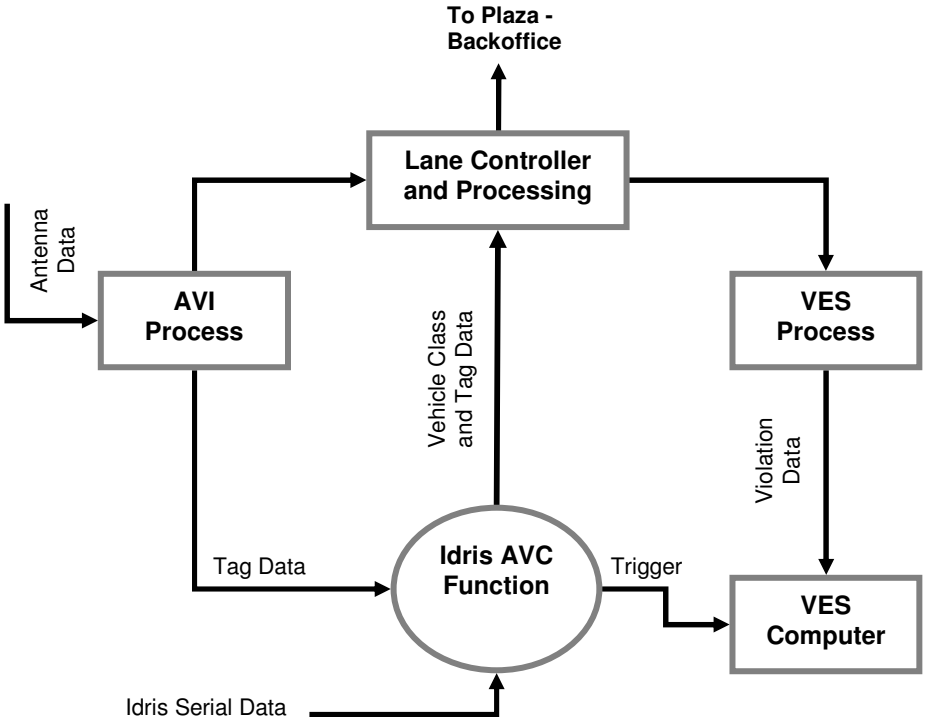
The advantages of this technology are:

- It can accurately count and classify vehicles. It can differentiate between trailers and

tailgating vehicles and can even classify twin tire vehicles. Its accuracy levels are stated to be at 1 in 10,000.

- The technology accounts for slow moving or queuing traffic, high speeds, tail-gating and lane changing. It is resistant to adverse weather such as fog, rain or electric storms.

Figure 6-7: Idris Embedded Lane System

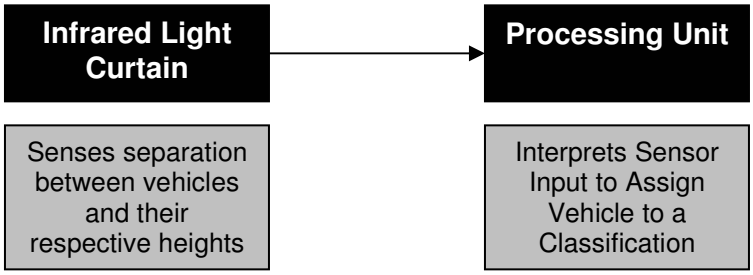


Adapted from L2-The Next Era in ETC Technology, by E. Carr (OSI LaserScan) and B. Lees (Diamond Consulting Services), Presentation at IBTTA Annual Meeting (2005)

- Laser Scanner Technology

This technology uses laser beams to scan and create a 3-dimensional profile of a vehicle passing through the projected beam. Figure 6-8 provides a diagrammatic overview of the technology function.

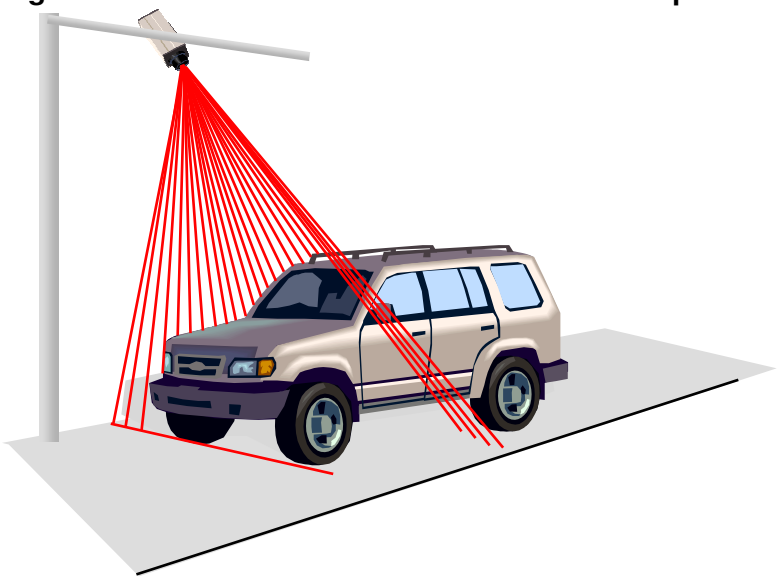
Figure 6-8: Laser Scanner Technology



OSI's LaserScan Autosense series employ this technology. The AutoSense units can be mounted overhead on the gantry system or alongside the traffic lane depending on tolling technology requirements. An overhead AutoSense (600 series) system scans the

travel lane with two laser beams (Figure 6-9). As the vehicle enters the first beam, the system calculates it height based on the decrease of measured distance from the overhead sensor. As the vehicle enters the second beam, the system calculates the speed of the vehicle from the difference in time between the vehicle entry into the first beam and vehicle entry into the second beam. The information is processed to generate a profile of the vehicle and assign it to one of thirteen specific categories.

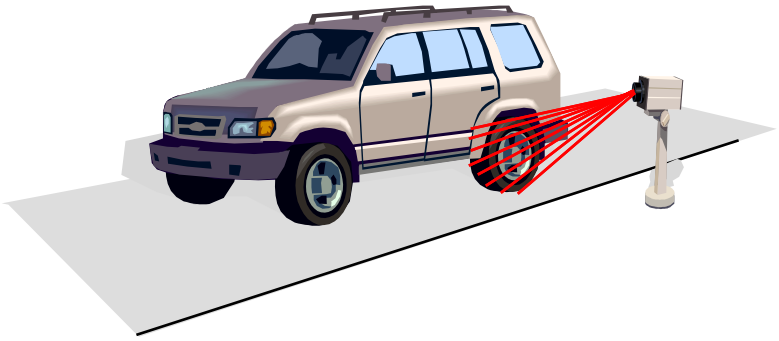
Figure 6-9: AutoSense 600 Series Laser Beam Operation



Adapted from AutoSense 600 User Guide, OSI Laser Scan website

The AutoSense 700 series is mounted along the side of the roadway and is designed to provide axle count information for each vehicle (Figure 6-10).

Figure 6-10: AutoSense 700 Series Laser Beam Operation

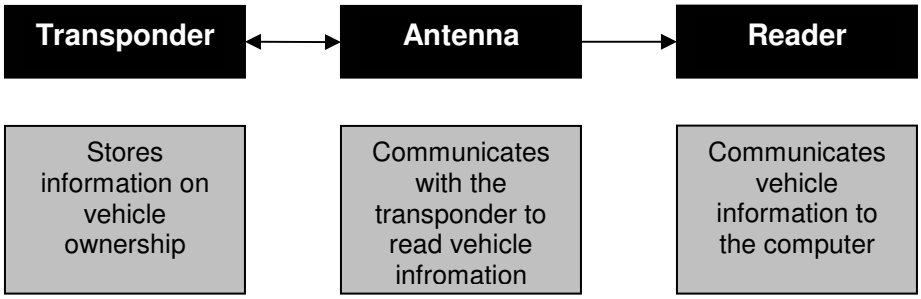


Adapted from AutoSense 700 User Guide, OSI Laser Scan website

6.3.3 Automatic Vehicle Identification System (AVI)

AVI Systems determine vehicle ownership to check its registration status, charge a toll and trigger the VES system if the vehicle is in violation. Figure 6-11 diagrammatically illustrates the functioning of an AVI system.

Figure 6-11: AVI System



a. Policy Implications of AVI Technology Selection

The selection of the transponder to use in an AVI system impacts interoperability between different systems. This policy decision regarding desired interoperability should be made at the beginning of the process to provide maximum user benefits during operations. The radio frequency technology, commonly used by transponders, varies in frequency by transponder type. These frequencies may not compatible with each other and thus, form a barrier to interoperability between systems.

b. Types of AVI Technology

Many types of transponders or tags are available nowadays. Transponders can be either read-write tags or read only. Read-write or active tags are those that can record information relayed by the reader/antenna like the point of vehicle entry or exit. Read only or passive tags only have fixed information storage capabilities. Furthermore, tags can have different toll charging capabilities. They can be pre-paid cards that are debited at the time of transaction (pay-as-you-go system) or tags that are invoiced on a periodic basis.

Transponders for distance based tolling are based on radio frequency (RF) technology. The antenna emits a signal over an area called the read zone that is altered by the vehicle transponder as it is reflected back. This information contains the transponder‘s unique identification number that is electronically encoded on it. The time, date and location of this information transmittal along with the ID are then communicated by the reader to the central computer.

TransCore’s Amtech Wireless RFID Communications Technology[6] consists of dedicated short-range communications (DSRC) that work on radio frequency technology. The unique technology used – modulated backscatter technology, allows communication between the readers and transponders at high speeds.

TransCore’s eGo transponder is a paper thin sticker tag that does not require a battery or connection to the vehicle’s electrical system. It is a read-write system with an electronic vehicle registration application that can allow agencies to scan vehicles for compliance with state and federal regulations.

[6] Amtech Wireless RFID Communications Technology, Available on TransCore website http://www.transcore.com/technology/techapps.htm

6.3.4 Violation Enforcement Systems (VES)

Automated VES systems usually consist of a video imaging technology that captures rear and/or front images of vehicles that are found in violation.

a. Policy Implications of VES Technology Selection

Violations may occur due to several reasons:

- Unauthorized vehicle in a designated lane e.g. light truck in a heavy truck only lane.
- Vehicle without a transponder in a transponder only lane.
- Vehicle with insufficient account balance in case of a pay-as-you-go system.

The policy structure for imposing fines on violators should be able to account for different types of violations. For example, vehicles with insufficient account balance may be given an opportunity to pay the difference to the tolling agency while vehicles without transponders in a transponder-only lane may be levied a high fine. The VES technology used should be capable of detecting and penalizing violators in a cost-effective manner.

b. Types of VES Technology

Since both SOV and HOV vehicles are allowed to use HOT managed lanes, while being in different toll rate brackets, it raises many issues for the enforcement system to be used. Some enforcement methods are discussed below:

- Enforcement Gantry Indicator Light

A system activated indicator light, mounted on the gantry can be used to confirm a valid transponder read and therefore payment. This technology is a common practice in managed lanes and in toll applications in general. To be effective for vehicle eligibility enforcement, the system-assisted light must be used in combination with manual enforcement. In the case of HOT lanes, the indicator should be mounted above each lane on the upstream side of the gantry to allow an enforcement vehicle to easily view whether the indicator light has been activated. The indicator lights can be standard green traffic lights (used on I-15 Managed lanes) or a matrix of light emitting diodes (used on I-394). The indicator light is connected to the toll system lane controller so it is activated each time a valid transponder is read in the same lane, which then triggers a green light to flash, indicating a valid payment.

- License Plate Check

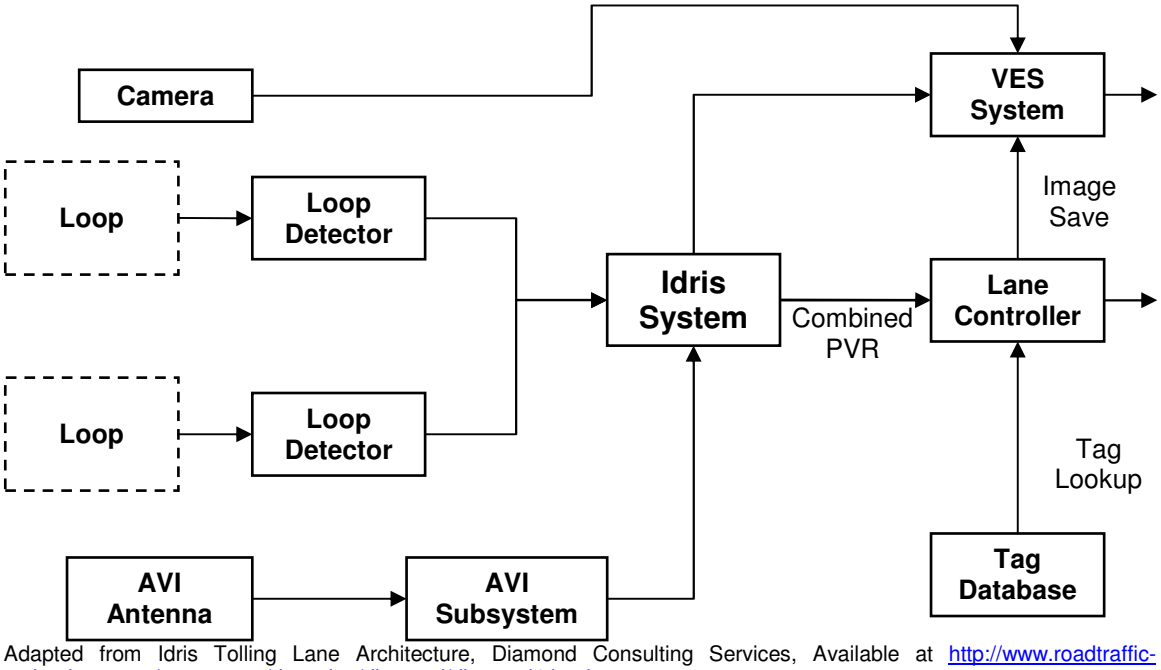
Another enforcement technology application uses a license plate check that can be either technology assisted or automated. A technology assisted license plate check can be performed by an enforcement officer to verify vehicle eligibility. The enforcement officer enters the vehicle's license plate number into a touch screen or voice activated system linked to a database. This system is used on the I-15 HOT lanes where all HOV users are required to pre-register their license plates with the tolling agency in order to travel on the HOT lanes without a transponder. If a vehicle is visually identified by an enforcement officer as not having a transponder mounted (or if the vehicle travels through a toll point and the overhead indicator does not flash), the next step would be for

the officer to verify that the vehicle was registered as an HOV. On querying the database of registered license plates, if the enforcement officer finds that the vehicle's license plate is not associated with a registered HOV, the vehicle can be stopped for a citation. An alternative application of this option would be if the enforcement officer sees that no overhead indicator was activated at the tolling point by a vehicle and the vehicle appears to be single-occupied and the officer then determines via license plate check that the vehicle is HOV registered. In this case the violator could be stopped, given a citation and the vehicle could also lose its HOV privileges.

Alternatively, an automated system using video-based digital imaging cameras can read and capture vehicle license plates. In case of a scenario where all vehicles are required to pre-register with the tolling agency, a check could be made against a database, either at the lane level or at a central location. If the vehicle registration is found to be consistent with lane usage and associated eligibility, then the vehicle is assumed to be a valid user and the image is not retained. If not, the vehicle is assumed to be a violator. This information could be acted upon in either or both of two ways: information could be set up to be conveyed to enforcement vehicles downstream via a wireless connection, or an automatic violation notice could be sent to the registered owner of the vehicle.

One important common component of automated VES design is the lane trigger that identifies a vehicle that is violation. A high accuracy of trigger position is necessary to maximize the license plate capture rate. One example is Idris's AVC technology that compares the per vehicle record (PVR) with the allowed vehicle lane class. In case of an eligibility violation the AVC system can trigger the violation enforcement camera. Similarly, if the AVI system detects an unauthorized vehicle tag in a given lane, it can trigger the cameras. Figure 6-12 shows the integration of the VES system with other elements in an Idris ETC system.

Figure 6-12: Integration of VES systems in Tolling Lane Architecture



Adapted from Idris Tolling Lane Architecture, Diamond Consulting Services, Available at http://www.roadtraffic-technology.com/contractors/detection/diamond/diamond4.html

- Voice Activated License Plate Look-Up

This system also relies on license plate look-up but in this case the look-up is for a cross reference to the transponder associated with the license plate of the vehicle being monitored. The enforcement officer would speak the license plate number of the vehicle being monitored into a voice activated on-board unit (OBU) in his vehicle. This unit would have a wireless connection to the central toll processing database where license plate and transponders are cross-referenced. The enforcement officer would query the system as to the time of last transponder read and the voice recognition software in his OBU would then communicate the results to the officer. If there is no recent valid transponder read and the vehicle appears to be single occupied, the enforcement officer could stop the vehicle for a possible citation.

- License Plate Image (LPR) Spotter Enforcement

This method can be used for the scenario where SOV vehicles and HOV vehicles are separated for eligibility determination at tolling points. This is a semi-automated system for vehicle eligibility enforcement where a spotter, located in a booth near the tolling zone, checks for vehicle occupancy. If the spotter sees fewer occupants in a vehicle as compared to HOV eligibility requirement, he/she presses a button on a unit in the booth which transmits a real time wireless message containing an image of the license plate and surrounding area, an image of the vehicle and transaction data. The message would be sent to a display unit that is mounted in an enforcement vehicle. The violator could then be stopped for violation enforcement.

- Mobile Enforcement Transponder On Board Unit

The mobile transponder unit is a standard transponder that is specially encoded to be

used in enforcement vehicles that are shadowing a vehicle at a tolling point. The technology is employed on the I-394 HOT Lane project. When a transponder is read on the leading vehicle and is then rewritten, the shadowing vehicle's enforcement transponder also receives an audible tone indicating a valid read. The shadowing vehicle must be within three seconds of the leading vehicle (configurable parameter). The technology for the message being sent to an enforcement transponder is located in the reader, not the transponder.

- Mobile Enforcement Reader On-Board Unit

The mobile enforcement reader is installed in an enforcement vehicle and allows an enforcement officer to check an adjacent vehicle for the presence of a valid transponder and the time of the last transponder read. The full reader system currently installed includes a single antenna, mounted on the roof of the vehicle, a controller unit in the trunk of the enforcement vehicle and a reader display unit mounted next to the driver. The operator must only touch the display screen one time to initiate a read. A different audible sound will indicate a valid versus invalid transponder read. The reader also can display a "No Transponder" message in the absence of a valid transponder.

- Infrared Image Occupancy Detection

The CYCLOPS system, developed by Vehicle Occupancy Ltd, is a conceptual prototypical application of image occupancy detection technology. The prototype is based on the use of a combination of infrared and visible light imaging. The system is currently being installed for further testing in the Edinburgh area of Scotland on the Forth Road Bridge by the Forth Estuary Transport Authority. The purpose of the test is to determine if the system could be used in the future, to allow the Authority to charge different fees based on occupancy. It should be noted that the Forth Road Bridge application will be in manual toll lanes. Occupancy will be determined by CYCLOPS and the correct toll then assigned and displayed for both the toll agent and the driver. The basic operation of the CYCLOPS system is as follows:

  - Dual cameras are mounted in a single housing to take images in both the visible and infrared light spectrum. Infrared and visible light illumination is used.
  - The images are melded into a single composite that identifies vehicle occupancy and can distinguish between dummies and live occupants.
  - Manufacturer claims 95% accuracy in field trials.
  - Manufacturer claims automatic facial detection and people counting. The system can also perform LPR. The license plate/occupancy record can be transmitted to a violation database for automatic violation processing.

- Smart Card Validating on Board Unit (OBU)

The use of smart cards in automobiles has been under investigation and test for a number of years and is also rapidly becoming state of the art in transit fare collection applications. EFKON of Austria has recently announced the production of a smart card on-board unit (OBU) that can be used in HOV applications. According to EFKON, the unit is Infrared (IR) based and can accept two contact-less smart cards that are inserted into a pocket on an OBU "for read and storage of the data prior to entering the HOT/HOV zone". According to EFKON, HOV occupancy enforcement with the smart

card transponder could be accomplished using an Intelligent Mobile Enforcement Unit. The unit can be used in manual point and shoot mode or it can be fixed to an enforcement vehicle. The IR interrogator has a read distance of 40 meters. The unit can read the OBU for the number of occupants (i.e., the number of smart cards in the OBU) and confirm that the correct toll was paid based on occupancy. Note that occupancy still must be confirmed by a visual inspection by the enforcement officer. Another example of an OBU with smart card capability is the MD598, produced by Q-Free ASA of Norway. The OBU accepts a contact smart card. This system uses an RF transponder that communicates at 5.8GHz, which is not an approved United States FCC communications standard for this application.

Automated Occupancy Detection

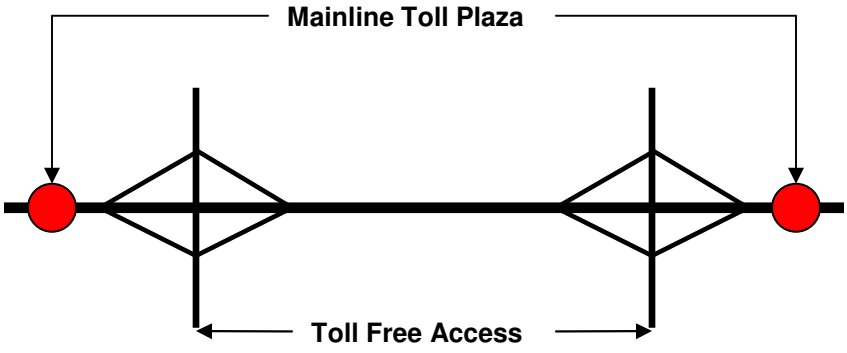
Though Infrared (IR) video imaging technology has been used to detect human beings, it has not been tested in the United States to have the accuracy levels required for HOT lane implementation. At the recent International Bridge, Tunnel and Turnpike Association (IBTTA) Technology Workshop in Edinburgh, Scotland; a new approach was reported. This technique, developed by a researcher from Loughborough University in England, analyzes an image of the interior of the vehicle in the infrared portion of the spectrum and is able to match the unique signature of human skin in this frequency band. The results are preliminary, but show promise. The very preliminary nature of this work and the cost of the unit preclude its consideration for the initial deployment of this project.

6.4 Electronic Tolling Concepts

Generally, two main system concepts can be applied while tolling a corridor:

- **Open-Barrier Toll Collection System –** This design consists of multiple toll stations along a facility (Figure 6-13). A single trip on the facility may require payments at all the toll stations that are traversed. The success of this system is dependent on the locations of the mainline toll plazas. The locations of the mainline tolling zones should minimize the possibility of diversion of users to an alternate non-toll route while being spaced at intervals that are acceptable to facility users.

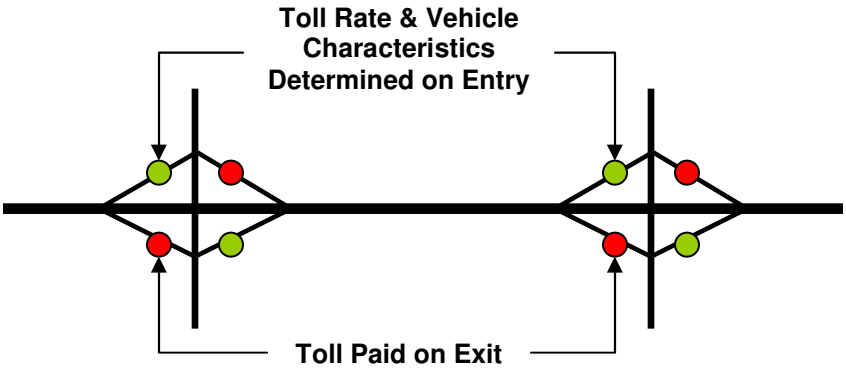
Figure 6-13: Open-Barrier Toll Collection System



- **Closed-Barrier Toll Collection System –** This design has toll collection points at all

entrances and exits (Figure 6-14). Since tolls are distance based, the system records the vehicle's point of entry and based on the miles traveled, charges it a toll rate at the point of exit.

Figure 6-14: Closed Barrier Toll Collection System



Irrespective of which system is used, the toll collection system design should be able to record the following significant parameters of a vehicle's travel through the managed lane or truck only toll lane system:

- Time and place of vehicle's entry in the tolled lane;
- Number of tolling zones passed through; and
- Time and place of vehicle's exit from the tolled lane.

Enforcement of toll payment in managed lanes raises some significant design issues. Current technology in use in the U.S. does not have the capability to automatically detect vehicle occupancy. In case of different tolling rates for eligible and non-eligible vehicles using managed lanes, occupant count is determined by visual inspection. For both toll collection concept studied in this analysis, visual inspection requirements for occupancy eligibility can be done in two ways:

- Tolling zone based enforcement – This involves separating eligible vehicles from non-eligible vehicles in the managed lanes at the tolling points in the system. In case of mainline tolling zones, the managed lane section would be expanded from two to three lanes to accommodate this separation. An observation area would be provided with an enforcement officer to verify HOV lane usage by visual inspection. There are some limitations to this approach:

    - Separation of eligible versus non-eligible traffic in the managed lanes compromises system operational efficiency by introducing weaving movements in the flow of traffic.
    - Project capital cost is increased due to construction of additional lanes to achieve vehicle separation by occupancy.
    - Project capital and operation cost is increased due to construction and staffing of visual enforcement locations.

- Random enforcement – This involves random checking of vehicle eligibility by enforcement officers along the length of the managed lane system. The greatest

advantage of this approach is that it eliminates the need to widen the standard managed lanes section to accommodate vehicle separation between eligible and non-eligible vehicles. Also, separating points of enforcement and tolling may introduce a surprise factor in checking violations. This system is currently being used in the I-15 HOT Lanes in California.

Understanding the assumptions that tolls in the managed lanes shall be levied based upon distance traveled; two operational plans have been developed. Sub-concepts within each plan are determined based on method of tolling enforcement in the managed lanes. The truck only toll lanes configuration remains the same for all concepts and sub-concepts.

CONCEPT T-A – This is based on the Open Toll Collection System i.e. a series of mainline tolling zones are located at strategic locations spanning the managed lanes and truck lane system. This concept is similar to the all ETC system now in use on SR 91, Melbourne City Link, and the New Jersey Turnpike. It has two sub-concepts:

- Concept T-A-1 – Enforcement is through separation of eligible and non-eligible vehicles in different lanes at the mainline tolling zones.
- Concept T-A-2 – Enforcement is through random checks of eligibility throughout the corridor.

CONCEPT T-B – This is based on a Closed Toll Collection System i.e. toll readers are placed on each entry and exit location. Tolls are assessed based on the point of entry and point of exit. Toll zones are mounted on gantries similar to Concept T-A. This concept is currently employed on Highway 407 in Toronto, Canada. It has two sub-concepts:

- Concept T-B-1 – Enforcement is through separation of eligible and non-eligible vehicles in different lanes at the ramp tolling zones.
- Concept T-B-2 – Enforcement is through random checks of eligibility throughout the corridor.

Both Tolling Concepts T-A and T-B have some common sub-components related to access (see Figure 6-15):

- Managed lane access: Since the managed lanes are barrier separated from the general purpose lanes, they can be accessed only at a limited number of locations. Direct access ramps provide access directly to and from the managed lanes and intersecting streets at specific locations. As these ramps will be physically separated from general access ramps, placing tolling equipment on them will identify the precise point of entry and exit of a vehicle to and from the managed lanes system. Five direct access ramps provide entry or exit from the managed lane system along the I-75 South corridor at the following junctions:

  - Morrow Road
  - Mt. Zion Road Connector
  - Hudson Bridge Road/Eagle's Landing Connector
  - SR 20 Connector
  - Bill Gardner Parkway Connector

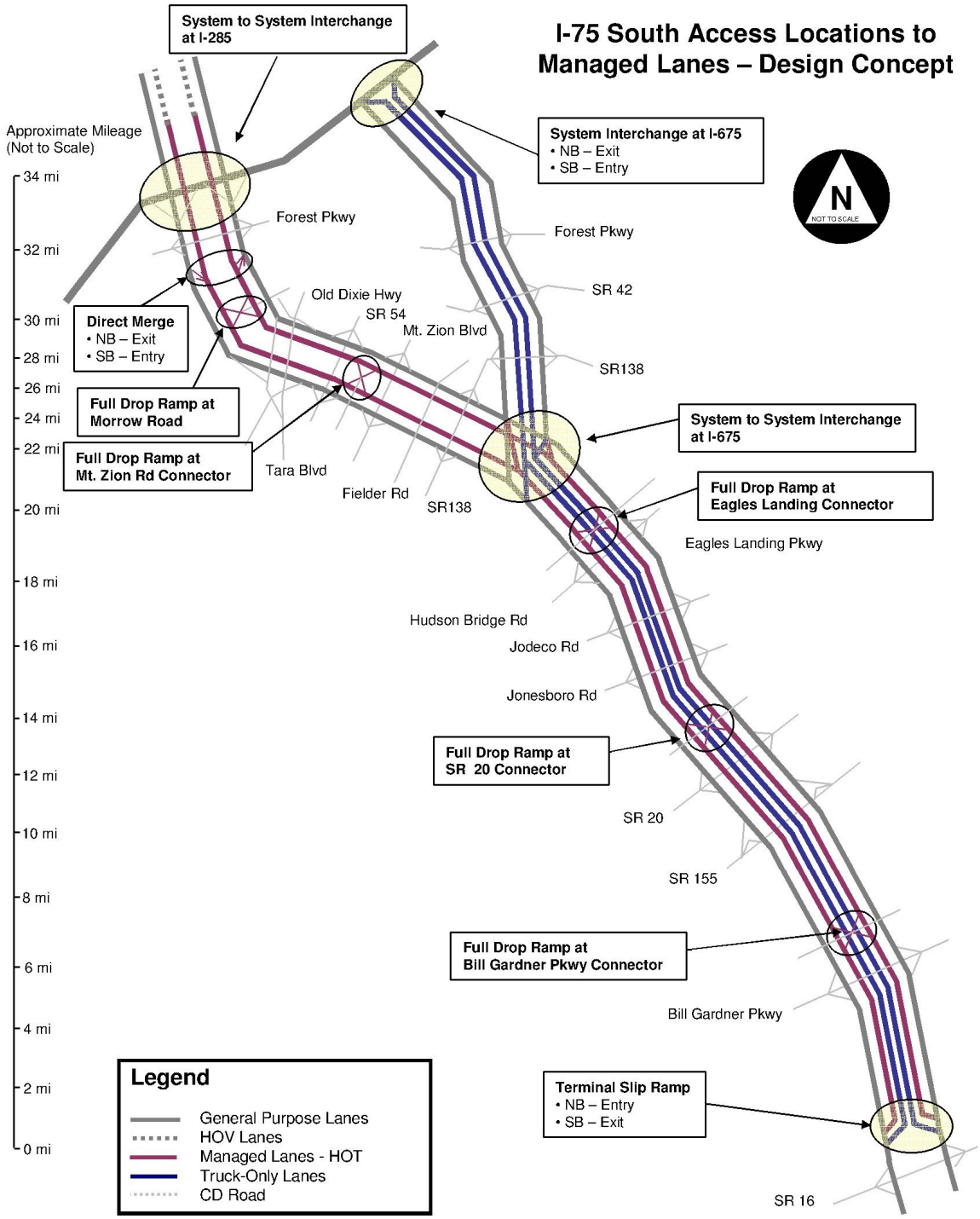
System to system direct access is provided between I-75 and I-285.

- Truck only lanes access: Since truck trips involve longer distances than automobile trips, fewer access points are provided for the truck toll lanes. System interchanges are provided for truck only toll lanes along the I-75 South corridor at I-285 and at I-675. There is also terminal access to and from general purpose lanes at I-75 South corridor north of SR 16.

Table 6-1: Design Concepts

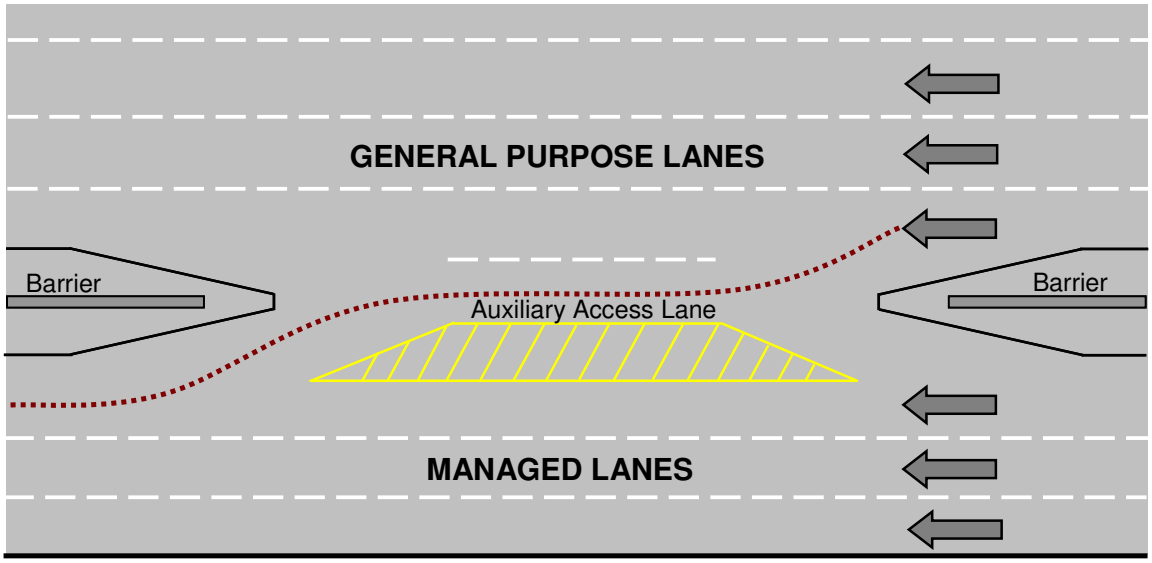
Concept	ETC System		Toll/Non-Tolled Separation at Toll Zones	Truck Only Toll Lanes
	Open	Closed		
T-A-1	●		●	●
T-A-2	●			●
T-B-1		●	●	●
T-B-2		●		●

Figure 6-15: I-75 South Managed Lanes Design Concept



- Transition areas are another form of access. There is one proposed transition area in the I-75 south corridor, located between Forest Parkway and Morrow Road. The transition area will allow for vehicles to move between the general purpose and managed lanes. Figure 6-16 shows a diagrammatic representation of a transition area. At the transition area, an opening is provided in the barrier between the general purpose and managed lanes. An auxiliary weaving lane provides for movement to and from the managed lanes. The final design of the transition area may involve a barrier or buffer separation between the auxiliary and managed lanes.

Figure 6-16: Transition Area Configuration



Source: Adapted from Figure 6-1, I-15 Managed Lanes Value Pricing Planning Study – Concept Plan, Prepared by Wilbur Smith Associates

While the pricing policy for the system remains flexible to the operator's goals and objectives of the system, the physical location of the access points can be assumed. The overall system design concepts are similar for Concept T-A and Concept T-B in terms of managed lane location and access points. The differences between Concept T-A and Concept T-B relate back to the toll collection configuration and associated design requirements that each entails. The truck only lanes facility will be described separately from the passenger vehicles portion of the managed lane system because while they occupy the same general area, they have difference operational characteristics.

The tolling zones, both for trucks as well at autos, would be essentially invisible to the users; meaning the user would not be required to stop or slow down from prevailing travel speeds. As the vehicle enters the managed lane system, the transponder reader identifies its eligibility, checks the transaction balance of the vehicles transponder identification, and sends the entry point and toll rate in effect to the operations center. In the managed lane system, the vehicle's progress is tracked as each toll location is passed and tolls are levied until exit.

In contrast to the HOT managed lanes tolling system, the truck only lane tolling system is limited in access locations and the toll zones are common for all concepts (see Figure 6-17). The truck only toll zones are located at the same southern point, Truck Lane

Tolling Zone 1. Trucks can also enter the system and at the northern end of I-675 at Truck Lane Tolling Zone 2. Direct ramp access is provided between I-285 and I-675 general purpose lanes and the truck only toll lanes. There are no transition areas provided between the truck only toll lanes and the general purpose lanes. Trucks traveling south may exit the truck only lanes from I-675 at the I-75 interchange. Truck Lane Tolling Zone 2 captures this truck movement. Trucks continuing south in the truck only lanes will be charged a toll at Truck Lane Toll Zone 1. Trucks traveling north on I-75 may exit on to I-675 and I-75 general purpose lanes at the I-675/I-75 interchange as well; since they have already paid the toll at Truck Lane Tolling Zone 1. If the trucks continue north on I-675, they will be charged a toll at Truck Lane Toll 2. Trucks are alerted to the toll rate per mile in effect in the truck only toll lanes through variable message signs placed prior to points of entry.

The signage required for the managed lane system is illustrated in the Pricing Assumptions and Signage Requirements section.

6.4.1 Design Concept T-A

The electronic tolling Concept T-A is shown in Figure 6-17. The locations of the mainline tolling locations for the managed lanes are positioned to capture all significant vehicle movements in the corridor. Under the managed lane exit/entry and tolling configuration, it will not be possible to utilize the managed lanes without passing one of the seven tolling locations. The associated toll rate with each tolling zone would be set according to the distance traveled and the toll rate in effect at the time of entry.

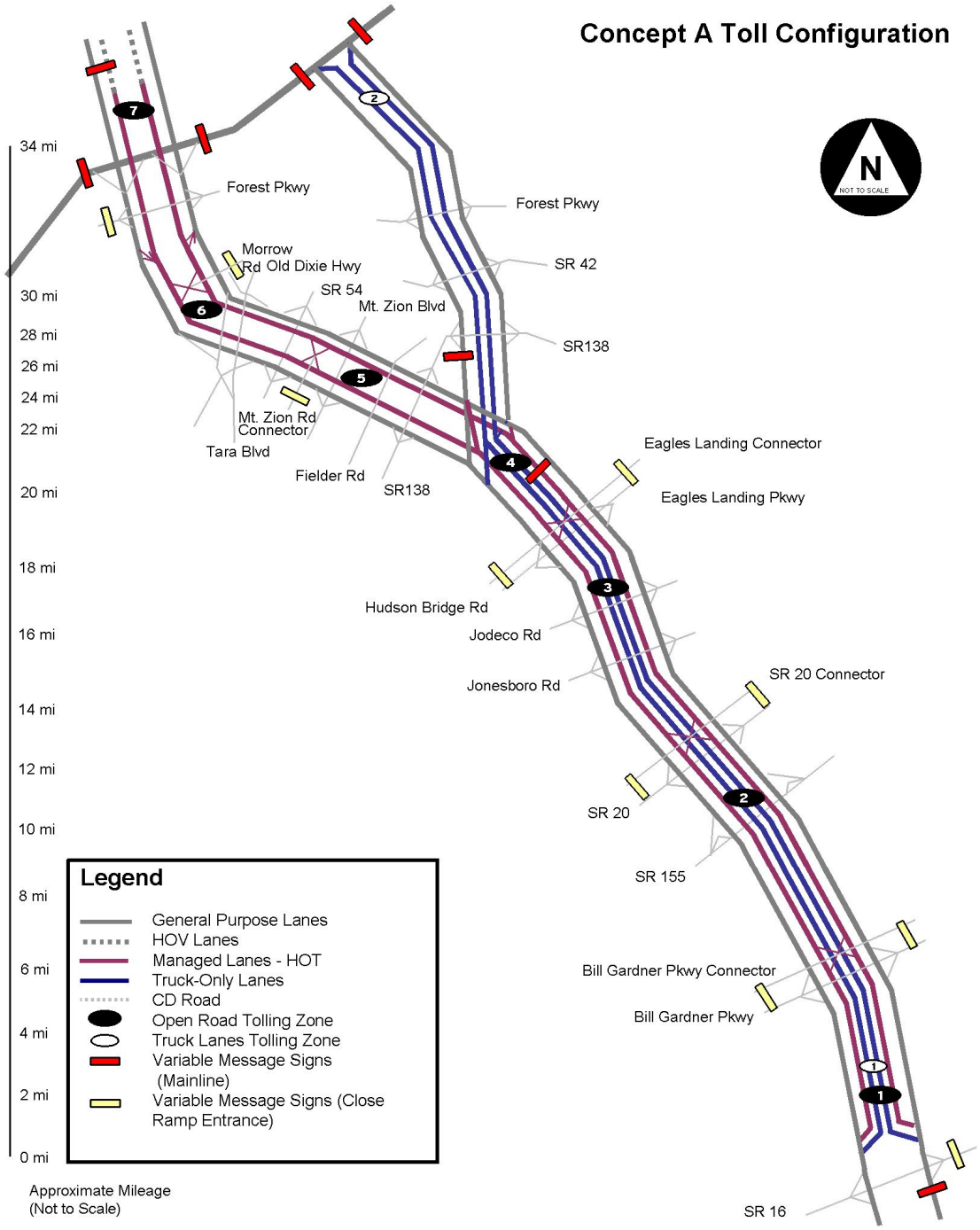
In order to charge a distance based toll rate, the electronic toll collection system will use a transponder reader. A transponder reader captures the following information as the vehicle passes:

- Vehicle eligibility
- Vehicle identification
- Toll rate at point of first entry into the system
- Point of first entry in system
- Toll transaction balance
- Toll rate in effect at exit from system
- Point of exit from system

Toll Zones for passenger vehicles are located between the following existing exits:

- SR 16 and Bill Gardner Parkway
- SR 155 and SR 20
- Jodeco and Hudson Bridge
- Hudson Bridge and I-675 interchange
- SR 138 and Mt. Zion Blvd
- Mt. Zion Road Connector and Morrow Road
- Morrow Road and north of I-285

Figure 6-17: Electronic Tolling Collection Concept T-A



As shown in Figure 6-17, a generalized sample trip could progress as follows: A single occupant vehicle traveling on Bill Gardner Parkway Connector decides that the toll rate displayed on the roadside variable message sign is an acceptable amount to pay for a reliable travel time, so the driver uses the direct access ramp at Bill Gardner Parkway Connector to enter the managed lane system to travel north. Now on the managed lane system, the vehicle passes under the open road tolling location identified as Zone 2. Here, the vehicle's transponder is read, identified as a valid customer, and charged the current toll rate. As the vehicle travels in the managed lane, each toll zone passed processes this same information until the vehicle exits. If the driver of the vehicle decides to exit from the managed lanes at Eagles Landing Connector, tolls would be assessed at Toll Zone 2 and 3. The accounting of the vehicle's trip is conducted at the managed lanes system's operations center based on the information sent by the transponder reader.

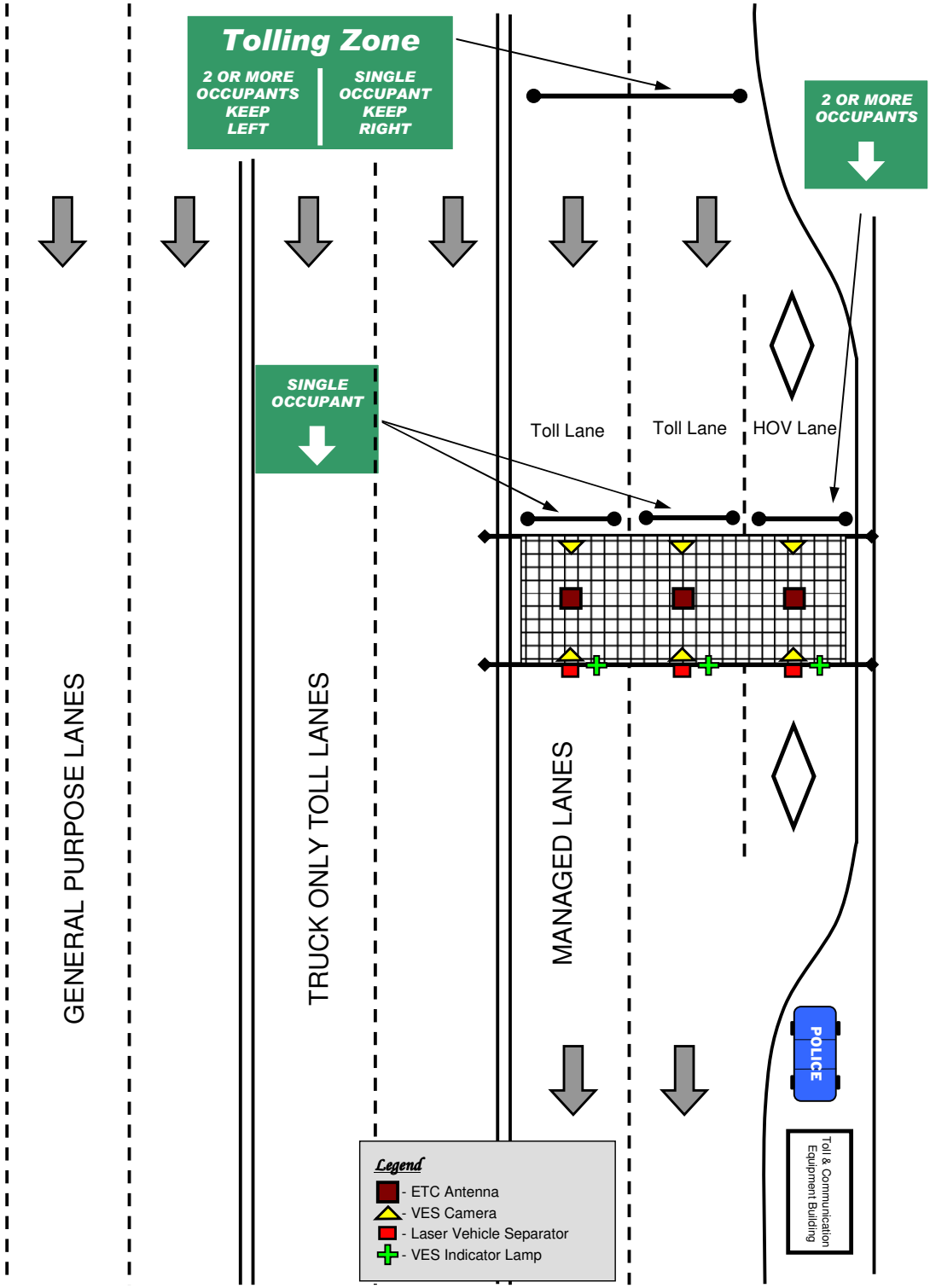
As discussed earlier, depending on how the managed lane system plan handles occupancy enforcement, the physical system design may vary. This introduces two sub options within Concept T-A which are discussed below. In both options, the truck only toll lane design remains the same.

Figure 6-18: Mainline Tolling Zone

Concept T-A-1 involves separation of the vehicles that do not pay a toll from the vehicles that pay a full toll rate. This approach is currently in effect on SR 91 Express Toll Lanes project in southern California. The photograph illustrates the channelization concept where HOV 3+ vehicles are permitted to use the HOT lanes for free for most hours (exception is Monday through Friday 4:00 p.m. to 6:00 p.m. in the eastbound direction when HOV 3+ users pay 50 percent of the toll) while all others are subject to the toll. As you can see in the photograph in the tolling zone, HOV 3+ vehicles are required to use the inside lane, while all others utilize the two outside lanes.

Given the nature of the facility, it maybe difficult to construct tolling zones at some of the locations identified especially if each zone is required to accommodate three lanes per direction for occupancy delineation. These design issues are further complicated with potential "splitting" of the managed lanes system as illustrated in Concept T-A-1(Figure 6-19).

Figure 6-19: Mainline Tolling Zone Configuration on I-75 under Concept T-A-1

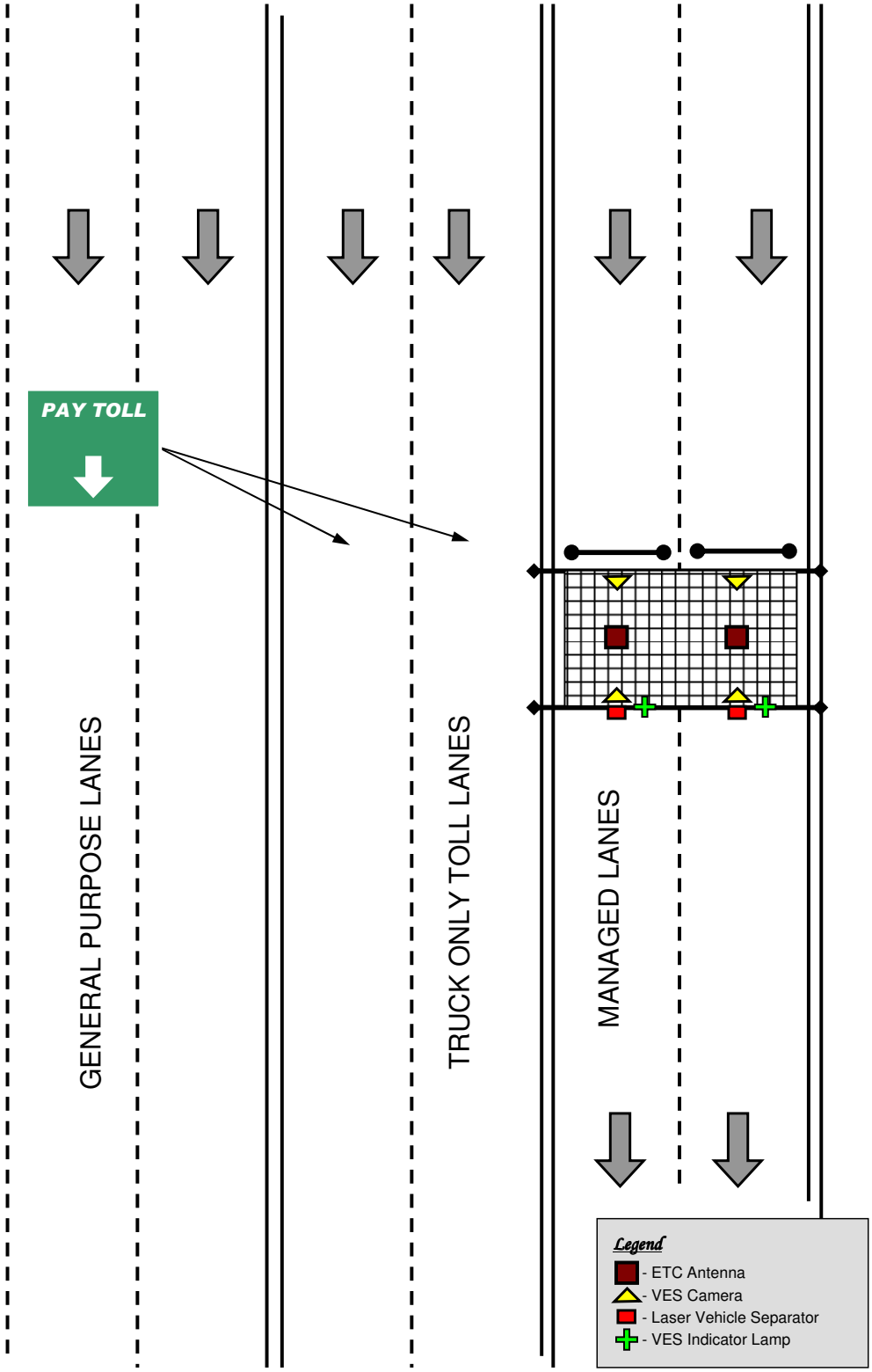


Enforcement for this concept is through visual inspection from a station location adjacent to the tolling zone. Under the example provided, only SOV vehicles will require to register with the operating agency and carry a valid transponder. Enforcement officers can observe vehicles passing through the HOV only lanes at the tolling zones and note the number of occupants and see if they meet eligibility requirements. They can also look at the system activated indicator lights on the gantry that indicates if the toll transaction was accomplished or if there was a violation. This approach will require widening of the mainline from the standard two lane managed lane section to three lanes. Since Concept T-A has seven mainline tolling locations, adopting this approach may lower operational efficiency and increase system costs.

Concept T-A-2 may require all managed lane user's vehicles to register with an operating agency and create a user account. The biggest advantage of this approach is that it eliminates the need to widen the managed lane sections to achieve occupancy delineation (see Figure 6-20). Enforcement is through random checking of vehicle eligibility throughout the corridor. Enforcement officers, located downstream from a tolling zone will be able to query a vehicle's payment record in a central database system through its license number plate. If a non-eligible vehicle (as observed by visual inspection) is found to have declared itself as a eligible or toll exempt vehicle at the tolling zone, then it will be held in violation. Alternatively, if the system activated gantry mounted indicator light does not show a green signal on the passage of a non-eligible vehicle through a toll location, then an enforcement officer can pull the vehicle over for a possible violation.

In this case read-only transponder technology is used, trip reporting would not be as robust since entry and exit locations would not be known. This could limit the operating agency's ability to maximize facility use and/or toll revenue during future updates of traffic and revenue projections.

Figure 6-20: Mainline Tolling Zone Configuration on I-75 under Concept T-A-2



6.4.2 Design Concept T-B

Concept T-B employs an entry/exit system for the managed lane configuration where users are tracked by point of entry into system and charged a distance based fare at point of departure. The truck only toll lane system remains same as previously. Concept T-B addresses some of the passenger managed lane operations disadvantages observed in Concept T-A. Whereas in Concept T-A, all of the hardware is located along the mainline, Concept T-B locates toll collection equipment on direct access ramps. This adds some flexibility to the design of the facility.

If vehicle eligibility is enforced at exit points, then each of the exit ramp locations would have to be widened for a short distance into two lanes to accommodate one lane for eligible (non-paying vehicles), and one lane for non-eligible (paying vehicles). This scenario is used in Concept T-B-1. The smart card technology discussed previously offers one possible solution in this closed system concept. By employing an entry/exit style approach in concert with smart card (read/write capability) trip specific information can be written, or stored to the smart card upon entry. When the vehicle exits the system, an exit reader marks the point of exit, collects the information on the smart card, and calculates the toll to be charged to the account. This scenario is used in Concept T-B-2.

The managed lanes operational concept is illustrated in Figure 6-21 that reconstructs a sample managed lane trip from Bill Gardner Parkway Connector direct access ramp to the Eagles Landing Connector direct exit ramp under Concept T-B. This scenario assumes that read-write transponder technology will be used in the system. As in Concept T-A, a vehicle traveling on Bill Gardner Parkway Connector will be alerted of the toll rate in effect on the managed lanes through a variable message sign. If concept T-B-1 is used, the vehicle will enter the managed lane system through a split lane read zone where eligible vehicles will be separated from non-eligible vehicles. If concept T-B-2 is used, the vehicle will enter the system through a single lane read zone where vehicles are not separated to determine eligibility. The read zones are located at entry points in the managed lane system and the tolling zones are located at the exit points from the managed lane system. At the read zone or the entry point into the managed lane system (Bill Gardner Parkway Connector direct access ramp), a reader will communicate with the vehicle transponder to determine vehicle eligibility and write the appropriate toll rate on the tag. It will also record information on the vehicle's time and point of entry in the system. At the tolling zone or exit point (Eagles Landing Connector direct exit ramp), the ETC reader takes all this information that is written on the transponder and levies the appropriate toll.

Toll Zones are located between the following existing exits:

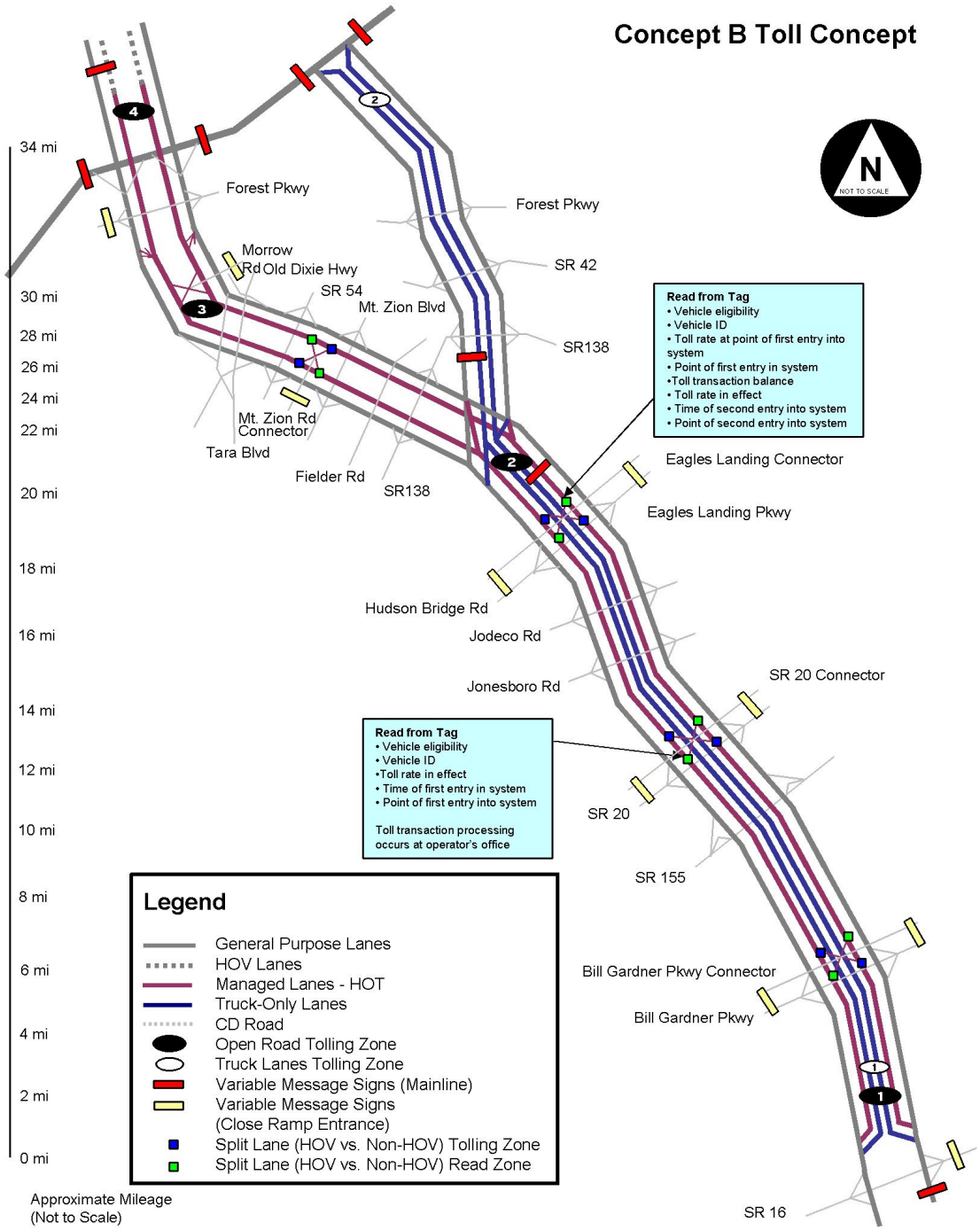
- SR 16 and Bill Gardner Parkway Connector
- Eagles Landing Pkwy Connector and I-675 interchange
- Mt. Zion Blvd Connector and Morrow Road
- Morrow Road and north of I-285

Managed lanes system entry/ext points are located at the following points:

- Mt. Zion Blvd Connector
- Eagles Landing Connector

- SR 20 Connector
- Bill Gardner Parkway Connector

Figure 6-21: Sample Managed Lane Trip under Concept T-B



The two sub-concepts developed under this generic concept are discussed below.

Concept T-B-1 (Figure 6-22) would feature split-lane entry points so that occupancy delineation can be achieved. Concept T-B-1 would require toll paying users (non-eligible) using the managed lanes to register with the operating agency and carry a valid transponder. This would require that each entry location be capable of accommodating split-lanes (two lanes) to achieve occupancy delineation.

Figure 6-23 illustrates a typical slip lane ramp tolling zone where a single lane exit ramp is widened for a short distance to accommodate the delineation of vehicle occupancy. An observational station is included to monitor vehicle eligibility compliance. This configuration is also used at the direct access entry points located at the extreme edges of the system. Depending on which lane is utilized, a vehicle would be identified as eligible or non-eligible. Occupancy classification would essentially be accomplished automatically without any user interface. Periodic enforcement would be required via visual inspection. In addition to occupancy enforcement, a violation enforcement system (VES) would be required to ensure non-eligible vehicles have active transponders and valid accounts. This system would include cameras that photograph the license plate of the vehicle upon entry. These images are matched through the Department of Motor Vehicle database and citations issued. A similar system is currently in place on SR 400.

Figure 6-22: Electronic Tolling Collection Concept T-B-1

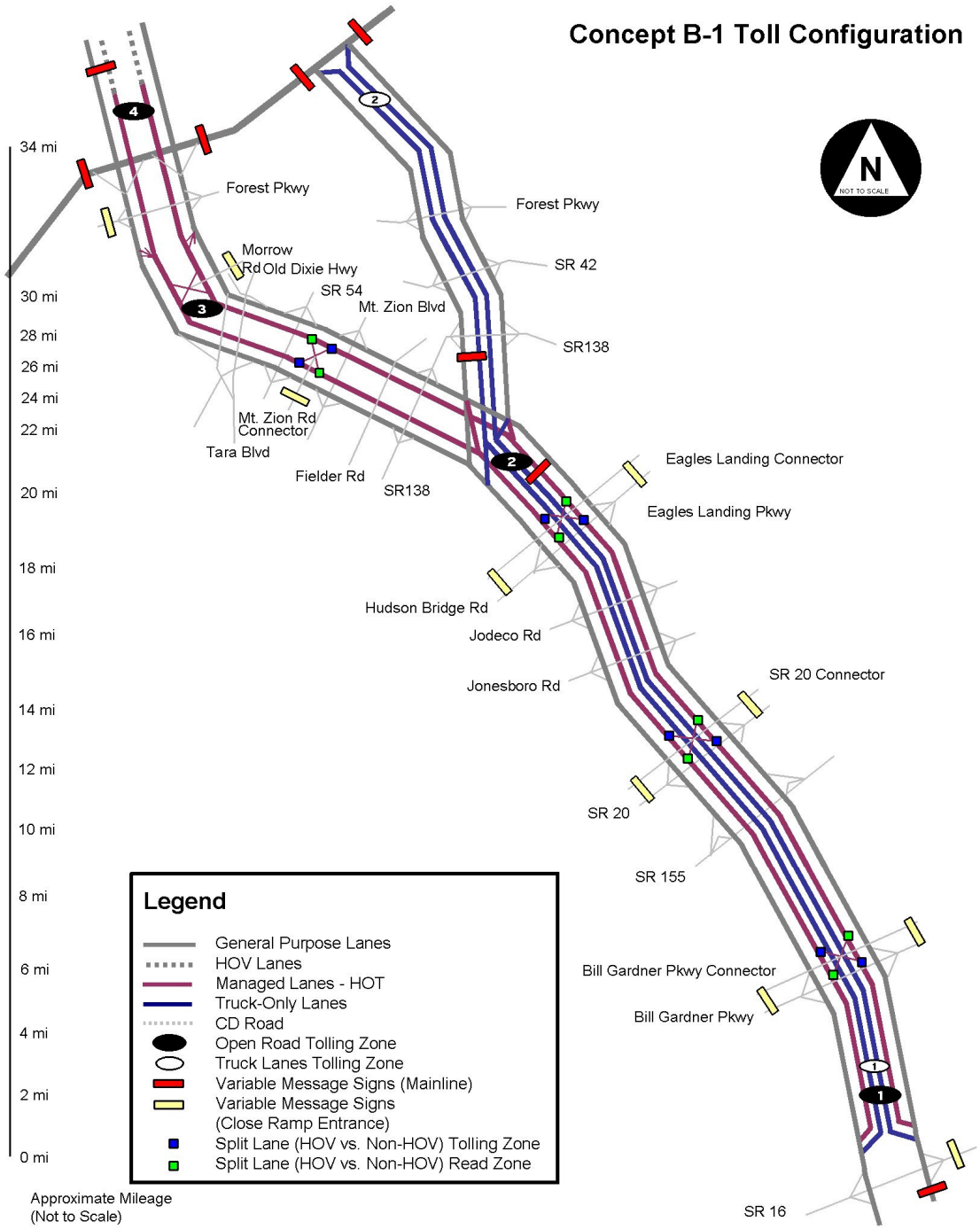
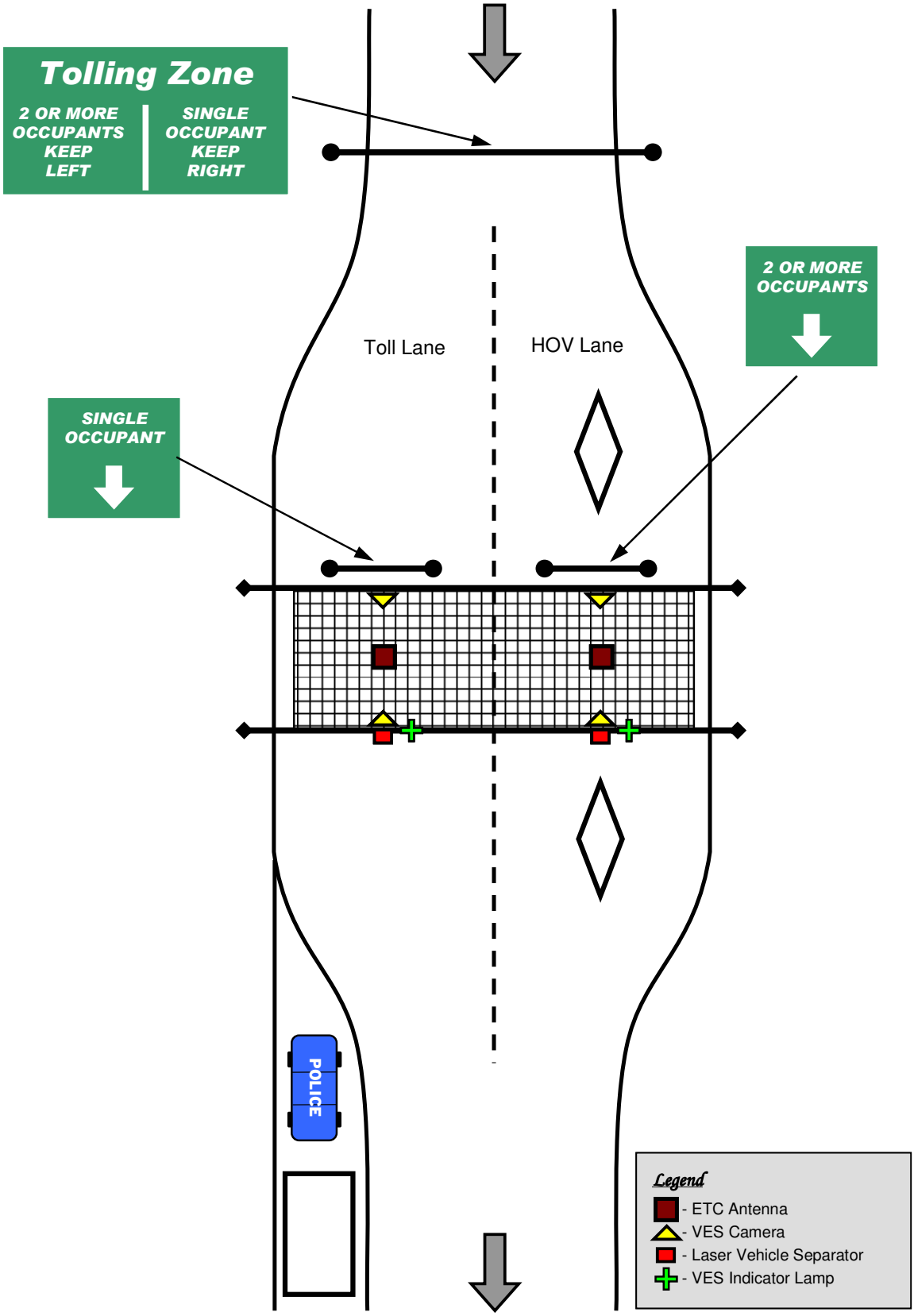


Figure 6-23: Typical Slip Ramp Tolling Zone



Concept T-B-2 (Figure 6-24) would not provide split-lane entry points but would rely on eligible vehicle registration or onsite visual inspection to delineate and enforce occupancy requirements.

Figure 6-25 illustrates a typical single lane exit configuration as proposed in Concept T-B exit ramps. Once again, with read/write capability the exit location would read the information written to the transponder upon entry and calculate the associated toll charge. Since occupancy was previously determined, the distance based toll would be adjusted appropriately. The exit location would be outfitted with vehicle enforcement indicator lights. These lights would either illuminate indicating a valid transaction or illuminate green or red indicating a legitimate transponder or a violator.

If no channelization is provided on either entry or exit, occupancy enforcement would be limited to visual inspection. Toll enforcement could still be accomplished via the VES for those users with transponders. If HOV traffic was not required to have transponders, toll enforcement would be extremely complex and require substantial investment potentially negatively impacting the ability of the facility to generate adequate revenue to cover operational costs.

Figure 6-24: Electronic Tolling Collection Concept T-B-2

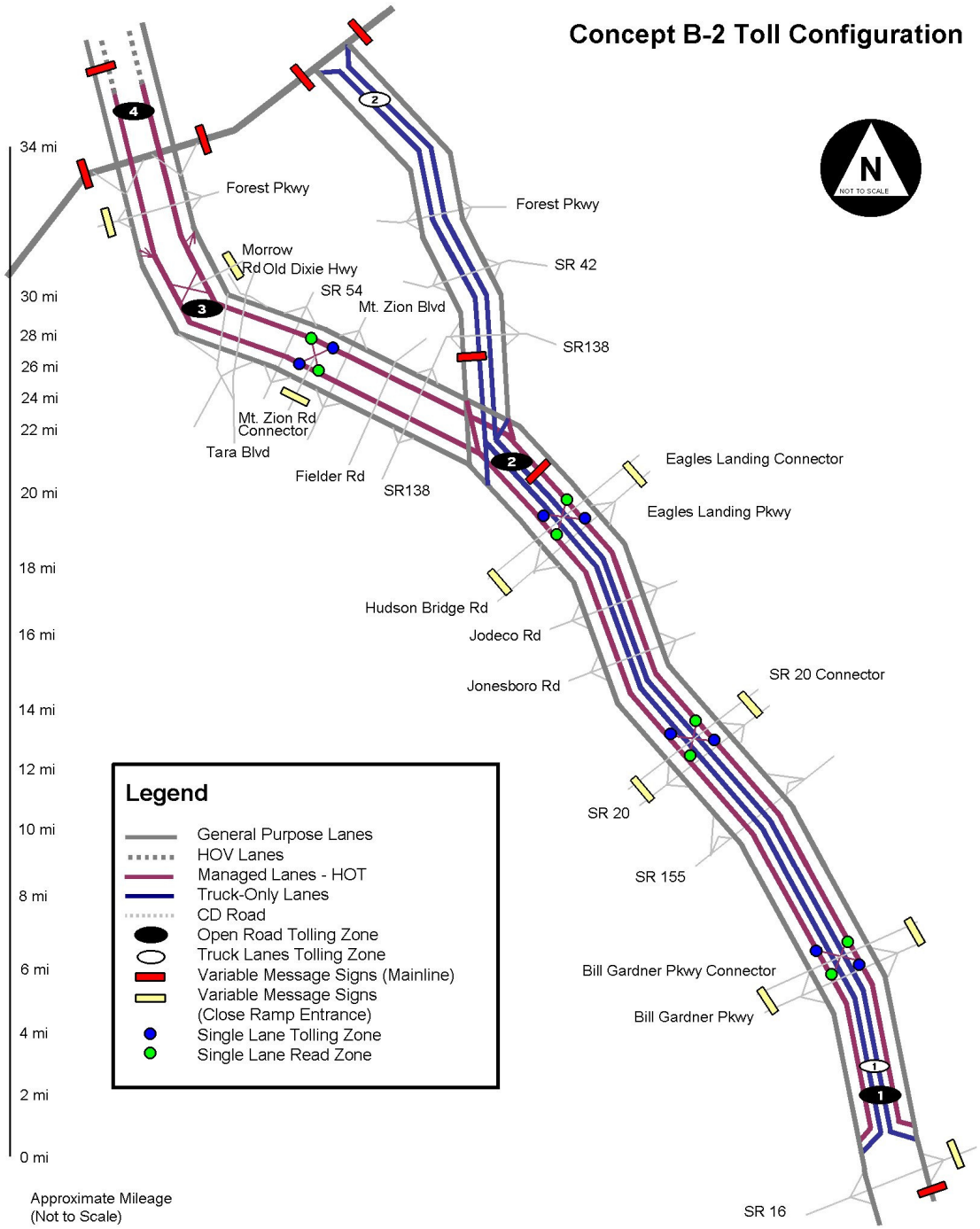
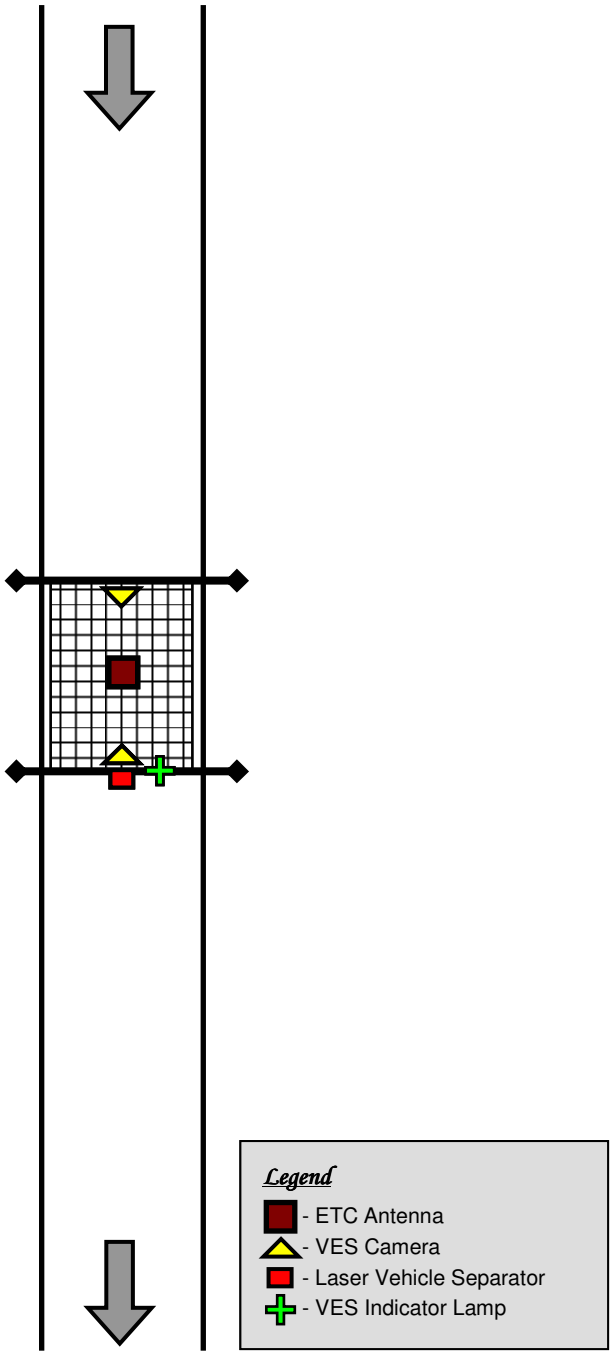


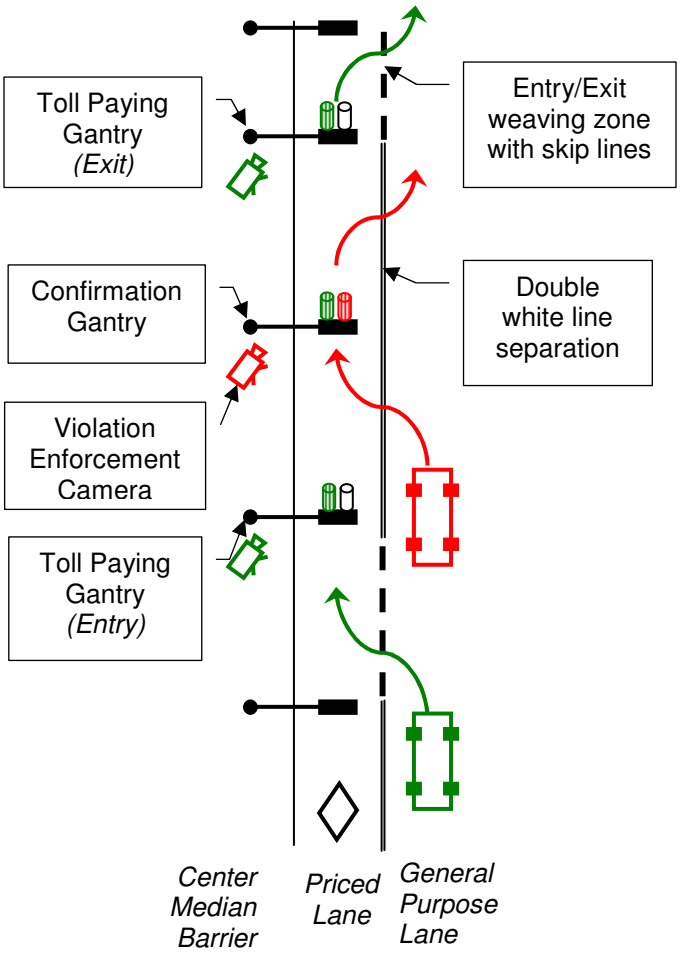
Figure 6-25: Typical Single Lane Entry/Exit Configuration



6.4.3 Gantry Controlled Access

Another emerging electronic tolling concept with potential applicability on the I-75 South corridor is Gantry Controlled Access[7]. Gantry Controlled Access (GCA) eliminates the need for a physical barrier between tolled lanes and general purpose lanes by creating an electronic barrier. The electronic barrier (Figure 6-26) is created by a set of monitoring stations placed at strategic locations along the tolled lane to record the presence of vehicles as they pass by each station. By monitoring the progress of a vehicle's location from station to station, and comparing the physical location of the vehicle to known barrier entry/egress zones and the monitoring station locations, the system can automatically determine when a vehicle has illegally crossed the electronic barrier. When a vehicle is identified as having entered the system illegally, the system records the identity of the vehicle for enforcement purposes via license plate readers and a video enforcement system. A citation for the violation is then automatically mailed or electronically remitted to the driver. A sufficient number of confirmation gantries are installed and a significant financial penalty is levied in order to deter vehicles from dodging in and out of the priced lanes.

Figure 6-26: Gantry Controlled Access[7]



[7] Patent Pending

GCA offers some advantages over traditional physical barrier systems because it does not require right-of-way and increased roadway width as with a physical barrier system. Instead, painted striping indicates lane division and access/egress points. This results in fewer impacts, less costs, and faster implementation since roadway design and construction elements are more limited. Enforcement using GCA is continuous - 24 hours a day, 7 days a week - since it is fully automated. This lessons the burden on law enforcement officers to pull over vehicles in the congested corridors.

6.4.4 Pricing Assumptions and Signage Requirements

Specifically, the assumptions that framed price points and toll rates for this project are discussed below:

- The truck only toll lanes will be used by heavy trucks only (8-13 axles as defined by FHWA vehicle classification). The current proposal charges all trucks using the system at a fixed variable rate. A more complex axle based fare system may be desirable in the future. Axle-based charging provides an equitable distribution of toll charges by taxing trucks carrying more cargo, and thus, greater value, at a higher rate.

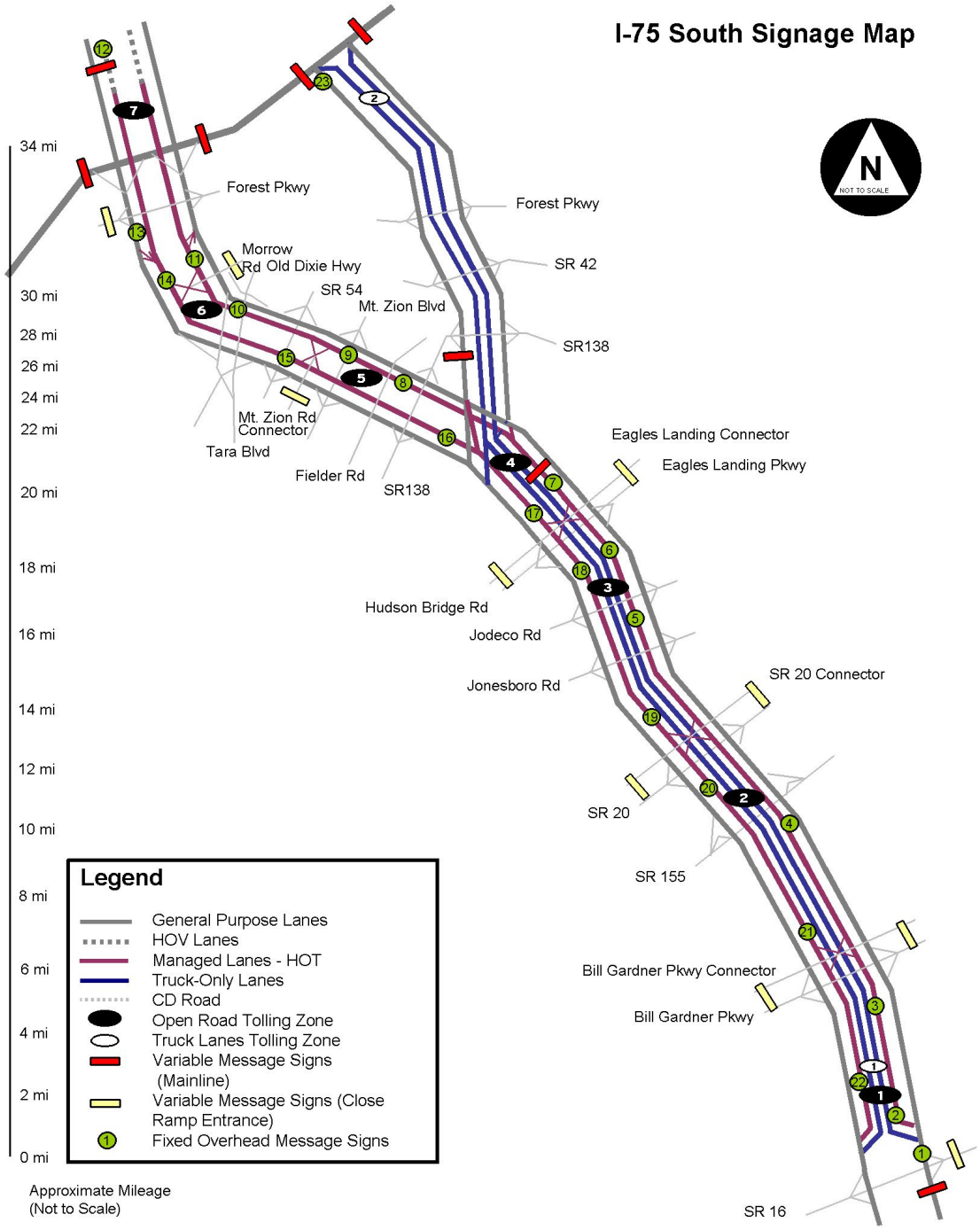
- Pricing for passenger vehicles in the managed lanes will be comprised of fixed variable tolling by segment. This distance-based toll charged for use of the facility will be directly related to the distance of travel on the facility. Tolls can be collected by tolling zone and/or entry and exit locations.

- The toll assessed in the managed lanes is variable in the sense that higher per mile rates will be in effect during the most congested times of the day and lower rates in place during less congested times of the day. While the toll schedule is variable, the pricing scheme is fixed as the toll schedule will be established prior to implementation and will be active until deemed ineffective to manage the demand for the facility. This is in contrast to a dynamic pricing schedule that varies depending upon the level of congestion on an approximate cycle of five minutes.

- The eligibility requirements for vehicles that will be tolled for use of the managed lanes system have not been determined. As noted previously, the challenge associated with varying the toll structure based on occupancy is identification and enforcement. Allowing eligible traffic to travel without paying a toll does not mean they are exempt from having a transponder. The transponder requirement will be based on the managed lanes system's operational policies.

Figure 6-27 illustrates the signage placement required at entry and exit points to managed lane system to announce the toll rate in effect.

Figure 6-27: I-75 South Signage Map



6.4.5 Recommended Approach

Each concept was subjected to a qualitative assessment. The assessment includes the following evaluation criteria. Since the Truck Only Lane scenario remained the same for all four Concepts, it was assumed as a constant and thus, was not included in the evaluation. Results from the evaluation are presented in Tables 6-2 and 6-3.

Ease of Toll Collections: The ease and ability to collect revenue is an integral component of any toll system. If toll rates will be based upon distance traveled, a closed system (Concept T-B) entry-exit system provides a more comprehensive vehicle account of the trip than an open barrier style approach (Concept T-A). This is especially true for fixed variable and dynamically priced applications where the toll rate for a particular trip is assessed upon entry to the system. However, the multiple access points of the closed barrier toll collection configuration create a more complex system compared to the open barrier style system. Since Concepts T-A-1 and T-A-2 capture tolls, rates, and eligibility at a single location with fewer combinations, they were considered more favorable than Concepts T-B-1 and T-B-2. A fixed variable toll schedule administrated through an open barrier system ranks favorably on this system because the toll collection points are positioned to capture most of the significant vehicle movement.

Ability to Dynamically Price: With the evolution of toll technology, dynamically pricing a facility is becoming a more attractive option to manage demand than fixed variable pricing. At the federal level, dynamic pricing is now required to be evaluated under the Value Pricing Program. As technology advances and mainstreams, the ability to dynamically price a facility may become easier and more acceptable to potential users. Dynamically adjusting toll rates to manage demand requires an extensive communications network and the ability to monitor entering and exiting traffic. Additionally, dynamic pricing would ensure that the same per-mile toll rate would be charged, or written to the toll tag, upon entry to the system. The ability to effectively dynamically price a facility requires an entry/exit system with a sophisticated information system. For this reason, Concepts T-B-1 and T-B-2 were considered more favorably than Concepts T-A-1 and T-A-2.

Ease of Traffic Movement: One of the prime goals of a managed lane system is to provide an assured level of service to motorists with minimal disruptions to traffic flow. Concept T-A-1 requires mainline widening at all tolling locations to achieve delineation between eligible and non-eligible vehicles for tolling and enforcement purposes. This would create diverge and merge movements at every tolling zone that may reduce efficient movement of traffic. For this reason, Concept T-A-1 is ranked least favorably.

Ease of Enforcement: Enforcement issues generally gravitate towards occupancy since toll enforcement (having a transponder and valid account) is performed collectively via the VES. As described in previous sections, occupancy enforcement will be accomplished by delineating eligible and non-eligible vehicles in each tolling zone. Enforcement occurs through visual inspection. In Concepts T-A-2 and T-B-2 eligible traffic would not be separated from the non-eligible traffic, but eligible traffic would be required to register as a car pool to be eligible for free or discounted travel. Enforcement would be administered through random checks. Since the rules of

occupancy enforcement were the same for all four Concepts, the amount of enforcement required was the driving factor in the evaluation process. Concept T-A was considered more favorably than Concept T-B due to fewer locations to monitor. Concepts T-A-2 and T-B-2 were considered more complex than Concepts T-A-1 and T-B-1 since there would not be any delineation and enforcement would rely solely on visual inspection.

Cost of Implementation: Implementation costs are an important consideration when evaluating toll operating systems. Since this study builds upon planned infrastructure, the majority of implementation costs are associated with toll collection hardware and software. Concept T-B-1 would require widening each entry ramp to two lanes to accommodate the delineation of eligible and non-eligible vehicles. Similarly, each mainline tolling zone under Concept T-A-1 would need to be widened to accommodate a three lane cross-section on I-75 South. Estimated capital cost of implementing managed lanes for each Concept is:

- Concept T-A-1 - $20.1 million
- Concept T-A-2 - $17.1 million
- Concept T-B-1 - $25.7 million
- Concept T-B-2 - $21.0 million

The estimated capital cost of providing ETC equipment of the Truck Only Toll Lanes is $11.5 million.

Cost of Enforcement: Enforcement costs can be provided by local police and highway patrol with revenues generated from the project as a supportive funding source. For example, SANDAG contracts with the California Highway Patrol to provide enforcement services to the managed lane system with policing service performed on a voluntary over-time basis by off-duty officers. Enforcement officers are stationed at the entrance to the facility and are notified by a light if a non-eligible vehicle enters or a driver's transponder does not trigger the detection system. In New Jersey, the Turnpike rules and regulations are enforced by 214 state police patrols that are assigned exclusively to the Turnpike. These patrols are funded with toll revenues. The authority receives no state tax money and actually contributes $12 million annually to the state transportation fund.

Case studies indicate that enforcement is primarily facilitated by the presence of dedicated law enforce officers, and secondarily, by the design of the facility (presence of enforcement areas and no or few intermediate access points). Moreover, violations rates are lowest when enforcement officers have minimal tasks to perform (e.g., occupancy verification only versus occupancy coupled with tag verification) and are assisted by technology.

The concepts (Concept T-A-1 and T-B-1) that provide eligible and non-eligible vehicle separation are more desirable because they provide lane delineation for the patrol officers to verify vehicle eligibility and occupancy. Concept T-B with its entry/exit ramps channels vehicles based on eligibility requirements provides a clear opportunity for enforcement officers to identify when a system violation occurs.

***Policy Flexibility*:** The policy framework sets the parameters of the managed lanes system – which vehicles are eligible to use the managed lanes; what are the

occupancy requirements to receive free or reduced tolls; what are the toll rates. The ability to exercise each of these management strategies to manage demand provides a level of flexibility and adoptability to the operating agency. Having all the hardware in place, as illustrated in Concept T-B, affords the operating agency the flexibility to modify occupancy requirements, toll rates, etc without substantial investment in additional hardware and software. Concept T-B-1 possesses the most flexibility of the four concepts considered.

Accounting and Trip Reconstruction: The ability to reconstruct trips of managed lanes patrons provides valuable information to the operating agency when analyzing travel patterns and usage, especially if demand increases above manageable levels and counter measures have to be implemented. Point-to-point transactions are much more conducive to trip reconstruction activities. Similarly, the accounting system is simplified when specific origins and destinations are known. Concept T-B-1 possesses the greatest ability to understand travel patterns and motorist behavior of the four concepts considered.

Operations and Maintenance: Operations and maintenance costs can accrue rapidly when dealing with complex toll systems. A rate of $0.21 per tolled transaction was used to cover overall tolling operation and maintenance cost. This per tolled transaction cost was provided by State Road and Tollway Authority (SRTA) and is based upon based upon their data and experience. The cost includes the following major categories for operation: (1) Billing and Administration Cost; (2) Violation Center Operation Cost; (3) Customer Service Center Cost; (4) Toll Equipment Maintenance Costs and (5) Enforcement Cost.

Customer Service and Public Understanding: Customer service and public understanding are critical success factors for any tolled facility. The public must fully understand the toll structure and experience real benefits for continued loyalty.

Table 6-2 summarizes the application of these criteria to the four scenarios. Table 6-3 provides a ranking for all four concepts. The highest rank concept – Concept T-B-2 is considered the most favorable option.

Table 6-2: Tolling Concept Evaluation Criteria

Scenario	Ease of Toll Collections	Ability to Dynamically Price?	Ease of Traffic Movement	Ease of Enforcement	Cost of Enforcement	Cost of Implementation	Policy Flexibility and Equity	Accounting / Trip Reconstruction	Operations and Maintenance	Customer Relations and Public Understanding
Concept T-A-1	○	●	●	○	◉	◉	◉	◉	◉	●
Concept T-A-2	○	●	○	●	●	○	●	●	○	●
Concept T-B-1	◉	○	◉	◉	○	●	○	○	●	○
Concept T-B-2	◉	○	○	●	○	◉	◉	○	◉	○

○ **Most Desirable** ◉ **Less Desirable** ● **Least Desirable**

Table 6-3: Tolling Concept Ranking

Scenario	Ease of Toll Collections	Ability to Dynamically Price?	Ease of Traffic Movement	Ease of Enforcement	Cost of Enforcement	Cost of Implementation	Policy Flexibility and Equity	Accounting / Trip Reconstruction	Operations and Maintenance	Customer Relations and Public Understanding	**Total**
Concept T-A-1	2	0	0	2	1	1	1	1	1	0	**9**
Concept T-A-2	2	0	2	0	0	2	0	0	2	0	**8**
Concept T-B-1	1	2	1	1	2	0	2	2	0	2	**13**
Concept T-B-2	1	2	2	0	2	1	1	2	1	2	**14**

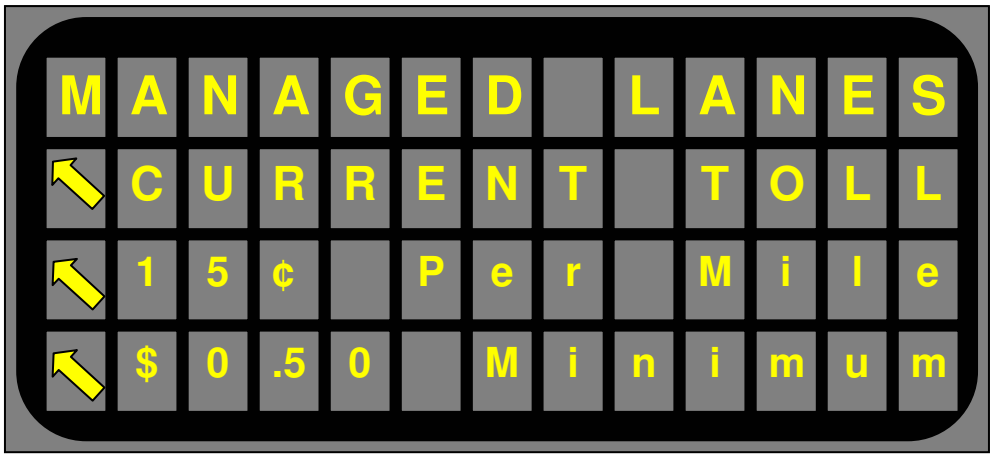
(1) Points were assigned to each Tolling Concept – 2 points for the most desirable, 1 point for less desirable and 0 points for least desirable. The highest scoring concept is considered the most favorable.

6.4.6 Motorist Information Systems

One of the most challenging aspects of any variable pricing scheme is communicating the appropriate toll rates to potential users before they choose to enter the managed lanes system. Current applications in California utilize single points of entry and exit making this task relatively simple. As described previously, the managed lanes facility pricing is likely to employ a distance-based rate that is variable, if not dynamic in the future, and includes multiple entry and exit locations resulting in the need for a complicated information system. Due to the infinite number of charges motorist could be assessed dependent upon the entry locations, a simplistic display of the current toll rate is required.

One possible concept could be to show the prevailing per-mile toll rate in effect at the time of entry coupled with a minimum charge were applicable. These signs would be located at each of the entry points to the system sufficiently in advance to allow motorists to safely choose their course of action. Figure 6-28 depicts a typical variable message sign.

Figure 6-28: Typical Variable Message Sign



All of the variable messages signs would need to be fully integrated into the electronic toll system to ensure vehicles are being charged the advertised rate. The ability to marry the vehicle information system with the electronic toll collection system effectively is one of the advantages of an entry / exit design (Concept T-B) over a barrier style system (Concept T-A). Concept T-A would require the introduction of tolerance criteria due to the time required to travel from the entry point through the tolling zones. This would prove challenging to maintain and administer especially during times of high congestion, extremely variable rates, and incidents.

6.4.7 Electronic Toll Integrated Users

Integrated users would be somewhat limited with traditional toll tags since the technology would be vehicle based. Integrated use with parking facilities could be achieved; however, integrated uses with transit providers would be much more complicated. Recent advances in smart card technology allow this technology to be transportable and interoperable between modes and other applications seamless. This

type of technology is likely to continue to evolve which may yield new managed lanes system applications by opening day.

6.4.8 Transaction Processing

Current ETC processing is accomplished by each user desiring to use the managed lanes to establish an account with the operating agency. Each time the facility is utilized, the toll is subtracted from the customer's established account. When the account balance reaches a pre-determined low level, it is supplemented by an agreed upon amount via a guaranteed revenue source such as a credit card.

While at one time efficient, this method is now relatively expensive and frequently requires customers to maintain accounts with multiple operators. Even when a single account can be used with multiple agencies, the agencies are required to distribute transponders number between agencies which is time consuming and cumbersome in a real time environment.

Once again, smart cards offer a potential technology solution. Smart card technology can store funds from a financial institution, similar to a pre-paid credit card, which then in turn can be used in concert with a transponder. The smart card would be inserted into the transponder when using the managed lanes and the fee would be subtracted from the smart card. Each transaction would result in the financial institution, or its processing clearing house, transmitting vital information back to the toll agency. Utilizing this approach, the transponders and antenna must be interoperable between agencies, a technological hurdle that has already been mastered. Importantly, the smart card controls the movement of funds, and the toll agency is relieved of this responsibility.

Since a smart card is not tied to a vehicle it could be efficiently used for other transportation modes. Readers could be located at transit stations for use with rail and bus services. Parking facilities are another prime candidate for this technology. Furthermore, transponders could be capable of hosting multiple smart cards eliminating the need for occupancy delineation. In each of these applications, the customer controls the value of the card and the toll operating agency back office processing can focus on statistical reporting and violation processing functions.

The use of smart cards for transportation fee collection is an emerging technology in the Untied States. Since technology development is extremely dynamic and changes frequently, the state of practice opening day is well beyond what can be predicted, monitoring the research and development of these technologies over the life of the project is critical to the development cycle.

6.5 Toll Collection Capital Cost

For the purposes of this study, a preliminary estimate of system toll collection capital cost were developed for the managed lanes and truck toll lanes components based on the four operational Concepts described previously (Concept T-A-1, Concept T-A-2, Concept T-B-1, and Concept T-B-2).

The capital estimates were developed for a full scale Customer Service Center (CSC) / Violations Center (VC). While the cost of providing a violations center for processing

violators was estimated, no attempt was made to assess the magnitude of the fine or associated fee revenue streams. It was assumed that with an enforceable license plate detection system, collected revenue would cover the processing cost that is typical of the industry. Capital investment costs for a fully electronic toll collection system are almost negligible when compared with the costs of constructing the managed lane system.

It is important to note that the level of detail associated with the toll collection capital costs cited herein should not be construed as investment-grade. These capital costs are subject to considerable refinement during the detailed design phase. The table below summarizes anticipated capital cost expenditures for TOT lanes and HOT lanes by tolling concept. All costs are shown in 2007 dollars and subject to inflation.

Table 6-4: Toll Equipment Capital Expenditures (in 2007 $) by Tolling Concept

Managed Lane Type - Toll Concept	Toll Equipment Capital Cost
HOT Lanes - CONCEPT T-A-1	$20,078,450
HOT Lanes - CONCEPT T-A-2	$17,080,850
HOT Lanes - CONCEPT T-B-1	$25,650,500
HOT Lanes - CONCEPT T-B-2	$21,030,500
Truck Only Toll Lanes (TOT)	$11,499,500

Spreadsheets detailing the calculations of toll equipment capital expenditures are included in Appendix 6-A.

Based on a qualitative assessment of various tolling concept, Concept T-B-2, a Closed Toll Collection System with enforcement through random checks of eligibility along the corridor, is considered the most favorable option. Therefore, the tolling capital cost of $21,030,500 for Concept T-B-2 is used for the managed lane and ETL alternatives (A1-A3 and D). The tolling capital cost of Concept T-B-2 ($21,030,500) and Truck Only Toll Lanes ($11,499,500) are summed up to illustrate the total tolling equipment cost for managed lane alternatives C1-C3 (the combination of Alternative A1-A3 and TOT lanes).

Table 6-5 lists the tolling equipment capital cost for each of the eight managed lane investment alternatives.

Table 6-5: Toll Equipment Capital Expenditures (in 2007 $) for Managed Lane Alternatives

Managed Lanes Alternatives	Description	Tolling Capital Cost (,000)
A1	**HOT 2+**	$21,031
A2	**HOT 3+**	$21,031
A3	**ETL (Cars Only)**	$21,031
B	**TOT**	$11,500
C1	**HOT 2+ & TOT**	$32,531
C2	**HOT 3+ & TOT**	$32,531
C3	**ETL (Cars Only) + TOT**	$32,531
D	**ETL (All vehicles)**	$21,031

CHAPTER 7

Roadway Capital Cost Estimates

7.1 Introduction

The purpose of developing roadway capital cost estimates is to help inform the overall discussion regarding the costs and revenues associated with the development of managed lane facilities on I-75 South corridor.

This chapter presents the methodology, key assumptions and preliminary roadway capital cost estimates for each managed lane investment alternative. The roadway capital cost estimates included in this chapter are in present dollars and are not adjusted for possible year of expenditure. It is important to note that decisions still outstanding i.e. engineering and policy issues may significantly increase roadway capital cost.

The roadway capital cost estimates are preliminary in nature and should not be considered as actual project costs. As further detail is developed for the engineering concepts, project cost estimates will be refined and updated to include cost escalations, risk, staging, financing costs, right-of-way, utilities, contingencies, etc. over the life time of the managed lane facilities.

7.2 Methodology and Key Assumptions

Roadway capital costs were developed to provide a conceptual level estimate in 2007 construction dollars. Six major elements were included in the roadway capital cost estimation, they are:

- Right of Way Cost ;
- Construction Cost (including Utility Cost);
- Contingency;
- Preliminary Engineering Cost;
- Mobilization Cost; and
- Cost Escalation over the construction length.

Key assumptions and development parameters are discussed below. The development of roadway capital costs were developed by a licensed professional engineer but are still considered planning grade.

7.2.1 Right of Way Cost

Right of way cost relates to the total cost associated with the purchase of land and/or easement rights for the managed lanes and/or Truck Only Toll (TOT) lanes. This includes relocation assistance and demolition costs. Property values and acquisition costs can range from quite modest in undeveloped areas, to quite significant in areas of high-value commercial properties. These costs include those for title searches, appraisals, legal fees, legal fees, title insurance, surveys, and various other processes.

Right-of-way impacts were calculated based on existing right-of-way and the proposed managed lane configuration for different alternatives. The cost of right-of-way was estimated by taking the number of additional acres required for each managed lanes /TOT lane investment alternative multiplied by the cost per acre.

7.2.2 Construction Cost

Construction costs were estimated using a spreadsheet that develops quantities based on the inputted typical section and section length then uses recent GDOT unit costs for these quantities and adjusts costs to 2007.

Key assumptions are listed below:

- The managed lane system and TOT lane system would begin and end with flyover ramps on the south end of the project;
- Project starts one mile to the north of SR 16;
- Utility costs were considered to be 5% of base construction cost;
- Under the investment alternatives that include the construction of both managed lanes and voluntary TOT lanes (Alternative C1 – C3), a typical half section has general purpose lanes on the outside, TOT lanes in the middle and managed lanes on the inside;
- Under the investment alternatives that include the construction of managed lanes/Express Toll Lanes only (Alternative A1-A3 and Alternative B), a typical half section has general purpose lanes on the outside and managed lanes on the inside;
- Under the investment alternative that includes the construction of TOT lanes only (Alternative B), a typical half section has general purpose lanes on the outside and TOT lanes on the inside;
- All managed lane sets are assumed to be barrier separated with standard shoulders;
- Construction cost includes installation of a general ITS system;
- Ramp, collector distributor and side road costs were estimated with a cost per linear foot method;

- There are only a few limited areas were all construction can be done in the existing median, everywhere else general purpose lanes would need to be at minimum overlaid and more often completely reconstructed;
- Assumed use of an asphalt pavement section designed to handle estimated passenger car and/or truck traffic.
- Each bridge replacement's total area was estimated and multiplied by $90.00 per square foot or more depending on complexity
- Retaining walls were assumed to be used to avoid right of way displacements, where possible. Noise barriers quantities were estimated based on reviewing the proposed roadway widening proximity to residential areas.

Construction costs were developed for three (3) major configurations of managed lanes and/or TOT lanes along the study corridor. They are:

- Managed Lanes or Express Toll Lanes (ETL) Only – two (2) lanes per direction;
- TOT Lanes Only – two (2) lanes per direction; and
- Combined Managed Lanes and TOT Lanes
    - Four (4) lanes per direction on I-75 South from I-675 to SR16
    - Two (2) TOT lanes per direction on I-675
    - Two (2) managed lanes per direction on I-75 South from I-285 to I-675

Costs developed for exclusive managed lane exits and TOT exits include structures as well as any new supporting roadway components needed to connect the managed lane facilities to the existing roadway network. While there was consideration for the type of existing road new exits would connect to, no additional costs were developed for potential improvements that may be needed to existing roadway network to handle the additional traffic.

At interchanges, attempts were made to have the least amount of impact to the existing system. However, in some cases general purpose ramps or roadway reconstruction would be needed. Improvements to the general purpose ramp system were only done when needed to fit in proposed systems.

7.2.3 Contingency

A 25% contingency was added to the base construction cost for all managed lane alternative roadway cost estimates.

7.2.4 Preliminary Engineering Cost

Preliminary Engineering cost was assumed to be 10% of the base construction cost plus contingency.

7.2.5 Mobilization

Mobilization costs were based on 12% of the base construction cost plus contingency.

7.2.6 Cost Escalation over the construction length

Cost escalation over the construction length was estimated for all managed lane alternatives. It was assumed to be 5% per year over the entire length of the construction period.

However, cost escalations over the life of a project's schedule were not included. In addition, costs are in 2007 dollars and not adjusted for possible year of expenditure. It is important to note that both of these factors can significantly increase cost given current general inflation as well as cost escalation in the industry over the last few years.

7.3 Roadway Capital Cost Estimates

7.3.1 Managed Lanes or Express Toll Lanes

The preliminary cost estimate for constructing two (2) managed lanes in each direction (alternative series A + D) is provided in Table 7-1.

Table 7-1: Preliminary Roadway Capital Cost Estimate for Alternative As (A1- A3) and D

Right of Way Cost	Segment I: Managed Lanes (HOT, ETL)	11.1	Mile	$269,097,274
	Segment II: Managed Lanes (HOT, ETL)	20.2	Mile	$138,402,890
	ROW Cost Total			$407,500,164
Construction Cost	Segment I: Managed Lanes (HOT, ETL)	11.1	Mile	$389,743,228
	Segment II: Managed Lanes (HOT, ETL)	20.2	Mile	$508,650,496
	Total Construction Cost			$898,393,725
Contingency	25% of Base Construction cost			$224,598,431
Base Construction Cost + Contingency	Base Construction Cost + Contingency			$1,122,992,156
PE	10% of Base Construction Cost + Contingency			$112,299,216
Mobilization	12% of Base Construction Cost + Contingency			$134,759,059
Escalation	Escalation costs over construction length (5% over 9 years)			$275,720,706
Subtotal	Base Construction Cost + Contingency + PE + Mobilization + Escalation			$1,645,771,136
Total	ROW + Base Construction Cost + PE + Contingency + Escalation			$2,053,271,300

Note:
- Segment I: Two (2) Managed Lanes/Express Toll Lanes in each direction from I-285 to I-675;
- Segment II: Two (2) Managed Lanes/Express Toll Lanes in each direction from I-675 to 1 mile north of SR16.

7.3.2 TOT Lanes

The preliminary cost estimate for constructing two (2) truck only toll lanes in each direction (alternative B) is provided in Table 7-3. Reduced roadway capital cost for TOT lanes is due to route selection to I-675.

Table 7-2: Preliminary Roadway Capital Cost Estimate for Alternative B – TOT lanes

Right of Way Cost	I-75 South Segment II: TOT Lanes	20.2	Mile	$138,402,891
	I-675 TOT Lanes	4	Mile	$14,960,000
	ROW Cost Total			$153,362,891
Construction Cost	I-75 South TOT Lanes	20.2	Mile	$527,799,275
	I-675 TOT Lanes	9	Mile	$202,102,059
	Total Construction Cost			$729,901,333
Contingency	25% of Base Construction cost			$182,475,333
Base Construction Cost + Contingency	Base Construction Cost + Contingency			$912,376,667
PE	10% of Base Construction Cost + Contingency			$91,237,667
Mobilization	12% of Base Construction Cost + Contingency			$109,485,200
Escalation	Escalation costs over construction length			$123,174,920
Subtotal	Base Construction Cost + Contingency + PE + Mobilization + Escalation			$1,236,274,453
Total	ROW + Base Construction Cost + PE + Contingency + Escalation			$1,389,637,344

Note:
- Segment II: Two (2) TOT Lanes in each direction from I-675 to 1 mile north of SR16.
- Right of Way only needed for the 4 northern miles of I-675.

7.3.3 Combination of Managed Lanes and TOT Lanes

The preliminary cost estimate for constructing two (2) managed lanes and two (2) TOT lanes in each direction (alternative series C) is provided in Table 7-4.

Table 7-3: Preliminary Roadway Capital Cost Estimate for Alternative Cs (C1 – C3) – Combination of Managed Lanes and TOT lanes

Right of Way Cost	I-75 South Segment I: Managed Lanes (HOT, ETL)	11.1	Mile	$269,097,274
	I-75 South Segment II: Managed Lanes (HOT, ETL)	20.2	Mile	$129,936,890
	I-75 South Segment II: TOT Lanes	20.2	Mile	$129,936,890
	I-675 TOT Lanes	4	Mile	$14,960,000
	ROW Cost Total			$543,931,054
Construction Cost	I-75 South Segment I: Managed Lanes (HOT, ETL)	11.1	Mile	$389,743,228
	I-75 South Segment II: Managed Lanes (HOT, ETL) and TOT Lanes	20.2	Mile	$967,771,064
	I-675 TOT lanes	9	Mile	$202,102,059
	Total Construction Cost			$1,559,626,351
Contingency	25% of Base Construction cost			$389,904,088
Base Construction Cost + Contingency	Base Construction Cost + Contingency			$1,949,520,439
PE	10% of Base Construction Cost + Contingency			$194,952,044
Mobilization	12% of Base Construction Cost + Contingency			$233,942,453
Escalation	Escalation costs over construction length			$435,808,654
Subtotal	Base Construction Cost + Contingency + PE + Mobilization + Escalation			$2,814,223,590
Total	ROW + Base Construction Cost + PE + Contingency + Escalation			$3,358,154,645

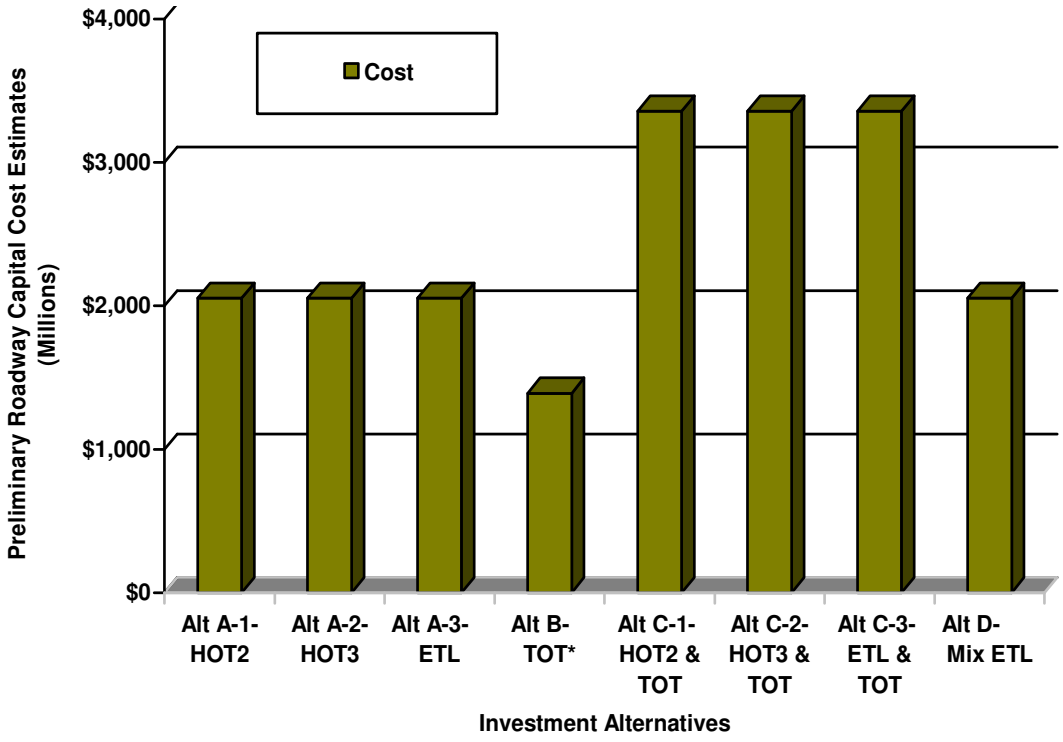
Note:
- Segment I: Two (2) Managed Lanes/Express Toll Lanes in each direction from I-285 to I-675;
- Segment II: Two (2) Managed Lanes/Express Toll Lanes and two (2) TOT lanes in each direction from I-675 to 1 mile north of SR16.
- Right of Way only needed for the 4 northern miles of I-675.

7.3.4 Summary

Figure 7-1 shows the preliminary roadway capital cost estimates in 2007 $ for each of the eight managed lane investment alternatives. Eight managed lane investment alternatives can be summarized as follows:

- Alternatives A-1 - A-3
  - Add Two (2) Managed Lanes in each direction along I-75 South from I-285 to SR 16.
- Alternatives B
  - Add Two (2) voluntary Truck Only Toll Lanes in each direction along I-675 and I-75 South from I-675 to SR 16.
- Alternatives C-1 - C-3
  - Add Two (2) Managed Lanes in each direction along I-75 South from I-285 to SR 16; and
  - Add Two (2) voluntary Truck Only Toll Lanes in each direction along I-675 and I-75 South from I-675 to SR 16.
- Alternatives D
  - Add Two (2) Express Toll Lanes (for all vehicles) in each direction along I-75 South from I-285 to SR 16.

Figure 7-1: Preliminary Roadway Capital Cost Estimates (Millions)



CHAPTER 8

Sensitivity Test Analysis

8.1 Introduction

As with any feasibility study the resulting traffic and toll revenue forecasts are based on a variety of assumptions such as user's willingness to pay, demographic and economic growth, macro-economic predictions, improvements on transportation systems either on competing routes or modes, etc.

Given the uncertainty associated with some of the key assumptions used in the traffic and revenue analysis, sensitivity tests were carried out to determine the effects of a change in some of these assumptions. The objective of the sensitivity tests is to gain an understanding of the economic forces at work within the I-75 South Corridor and quantify the potential impacts to the resulting concepts and traffic and toll revenue streams.

This chapter describes three sensitivity scenarios conducted for I-75 South corridor potential managed lane study and presents the results of these three sensitivity analyses.

8.2 Sensitivity Test Scenarios

8.2.1 Scenario Test 1 - Sensitivity of Willingness to Pay

A key determinant as to whether people chose to pay a toll to use the managed lanes or use alternative free routes (General-Purpose Lanes or arterials) is how they value time savings or other benefits that managed lanes can offer, such as reliability and safety. The sensitivity of willingness to pay will further evaluate how receptive motorists are to the idea of managed lanes and quantify the impact of changes on willingness to pay curves.

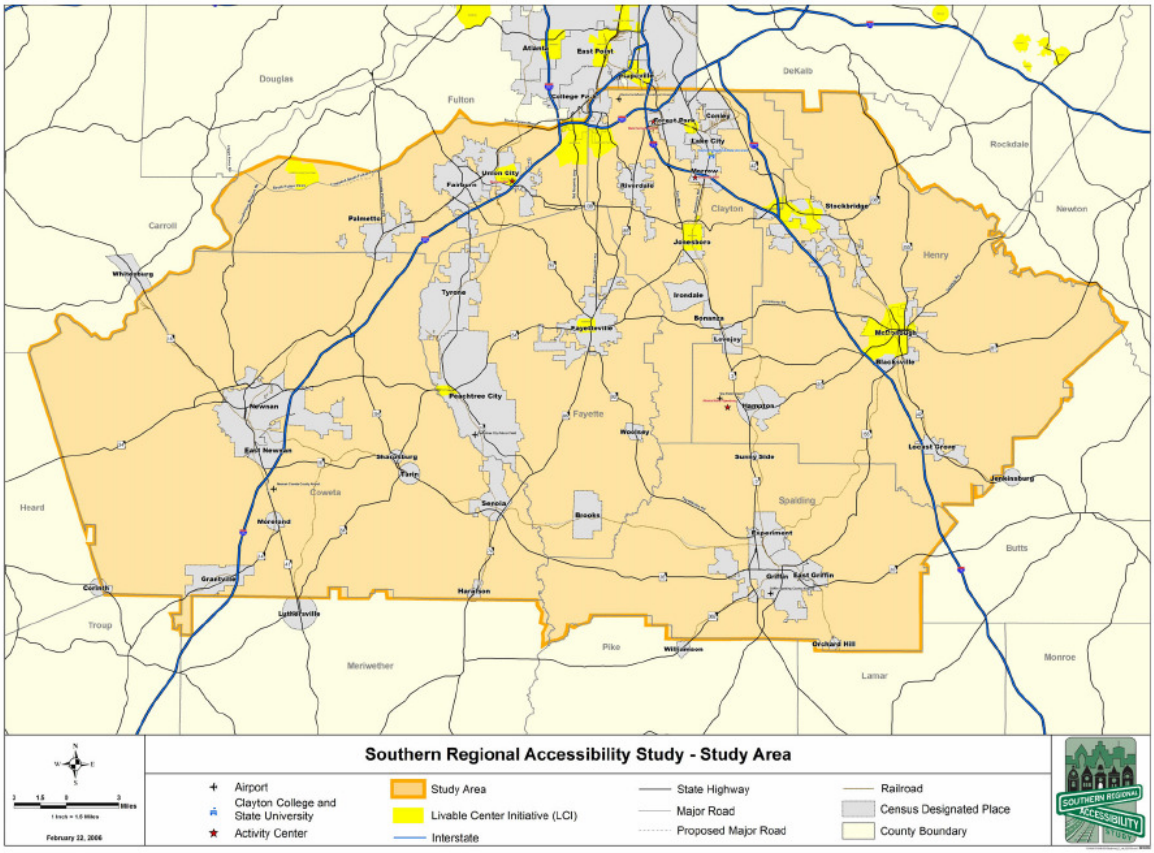
As mentioned in the Traffic and Toll Revenue Estimation section (Chapter 4), the refinement of Atlanta Regional Commission's (ARC) travel demand model for pricing applications reflect the most recent local data for Willingness to Pay (WTP) based on Stated Preference Surveys conducted in summer 2007. The willingness to pay curves were used to determine the percentage of managed lanes eligible users who are willing to pay to use the managed lanes for a predetermined price. In this sensitivity test, the managed lane willingness to pay curve was modified to reflect an average willingness to pay increase by 50 percent for passenger-car travelers.

8.2.2 Scenario Test 2 - Southern Regional Accessibility Study (SRAS)

The southern region of Atlanta has experienced an explosive growth in the past and there are no signs that this growth will slow in the immediate future. The population in the southern region of Atlanta is forecasted to double by 2030. This level of growth has resulted in a severe deterioration in mobility and transportation infrastructure capacity. To address the transportation needs in the southern region of Atlanta, the Atlanta Regional Commission (ARC) initiated the Southern Regional Accessibility Study (SRAS) to develop a comprehensive area-wide strategic vision for the transportation investment and land use.

The study area for SRAS consists of a six county sub region including the counties of Coweta, Fayette, Clayton, Spalding, Henry, and South Fulton (Figure 8-1).

Figure 8-1: Southern Regional Accessibility Study Area



Source: ARC's Southern Regional Accessibility Study

The SRAS project team used the ARC 20-County model system as the base. The team further adapted the model system by subdividing a limited selection of study area Traffic Analysis Zones (TAZ), and improved the highway coding of a number of network links. As part of the SRAS, an alternative land use scenario was developed and 2030 socioeconomic data was adjusted to evaluate how well the transportation system performs under different development patterns when compared to the official 2030 regional forecast for employment growth and allocation.

The SRAS also developed recommendations for roadway and transit projects based on a series of transportation performance measures, such as Travel Time Index (TTI, the ratio of the congested speed to free-flow speed); Hours-of-Delay; VMT & VHT; Percent Travel in Congested Conditions; Total Delay per Lane-Mile and Transit Mode Share. Appendix 8-A details the full listing of recommendations developed by the SRAS.

This sensitivity test adopted the final recommendations from the study, both land use and transportation improvement projects, and assessed the impacts to traffic and toll revenue.

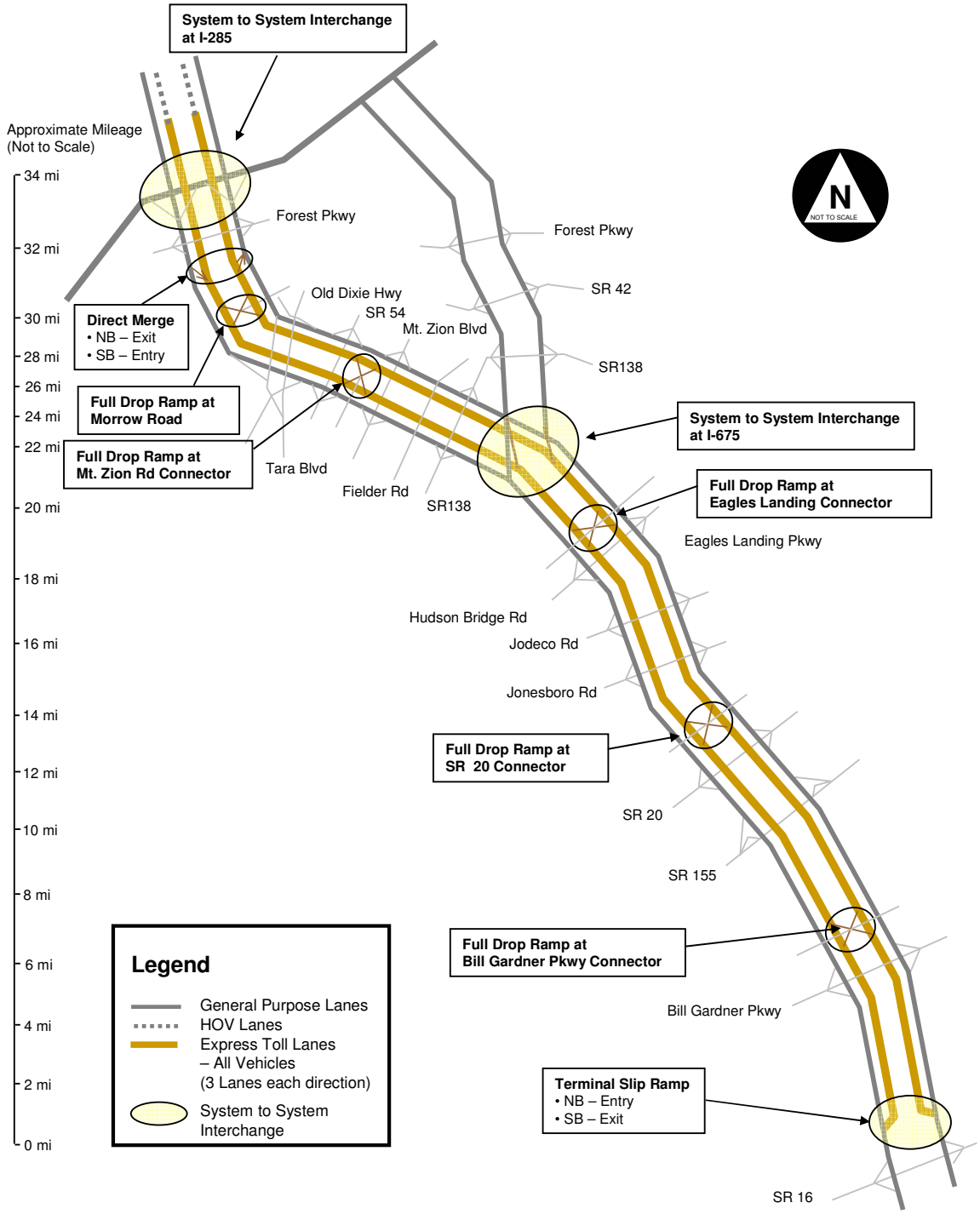
8.2.3 Scenario Test 3 – Mixed Express Tolling Lanes (3-lane each direction)

A sensitivity test of mixed Express Toll Lanes (ETL) was performed to evaluate the impacts of three-lane configuration in each direction on potential managed lane traffic and revenue.

This sensitivity test scenario assumed the construction of three Express Toll Lanes (which would be open to all vehicles - cars and trucks) in each direction on I-75 South corridor from SR 16 to I-285. Figure 8-2 illustrates the assumed lane configuration. Same as Alternative D, all vehicles (including Medium-Duty Trucks and Heavy-Duty Trucks) can access the Express Toll Lanes through:

- System-to-system interchanges;
- Direct access ramps (Morrow Road, Mount Zion Connector, Eagles Landing Parkway Connector, SR 20 Connector and Bill Gardner Parkway Connector); and
- Terminal ramp.

Figure 8-2: Lane Configuration – Sensitivity Test 3



8.3 Sensitivity Test Results

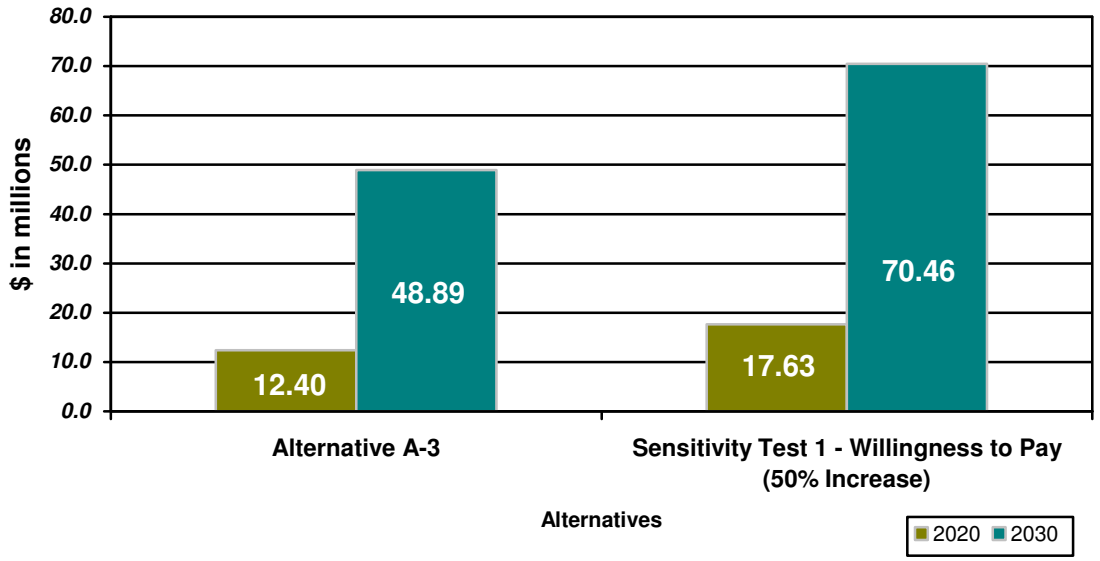
8.3.1 Results of Scenario Test 1 - Sensitivity of Willingness to Pay

As described previously, this sensitivity test increased the willingness to pay from $7.00 to $10.50 per hour for passenger-car travelers, an overall increase of 50 percent. Alternative A-3 (Two Express Toll Lanes for passenger cars in each direction along the I-75 South corridor from I-285 to SR 16) was used as the base case for this test. For comparison purposes, the same optimized toll rates derived from Alternative A-3 were employed.

The estimated gross toll revenues and net revenues in current and nominal dollars are presented in Tables 8-1 through 8-3. From year 2020 to year 2050, the managed lane facilities are forecasted to generate approximately $2.36 billion cumulative gross revenue; $1.80 billion cumulative net revenue in un-inflated 2007 dollars and approximately $3.80 billion cumulative net revenue in inflated dollars.

With the modified willingness to pay curve, the annual managed lanes revenue in 2020 increases from $12.40 million to $17.63 million (approximately 42.2% increase), and the annual managed lanes revenue in 2030 increases from $48.89 million to $70.46 million (approximately 44.1% increase). The increase in managed lane revenues generation is anticipated since with the same travel time savings, higher willingness to pay level results in higher usage on managed lanes and hence higher revenue. A comparison of 2030 estimated gross revenue (un-inflated dollars in millions) between Alternative A-3 and Sensitivity Test 1 is illustrated in the Figure 8-3.

Figure 8-3: 2030 Uninflated Gross Revenue Comparison–Sensitivity Test 1



8.3.2 Results of Scenario Test 2 – Southern Regional Accessibility Study

As mentioned previously, sensitivity test 2 adopted the final recommendations from the Southern Regional Accessibility Study, both land use and transportation improvement projects, and assessed the impacts to traffic and toll revenue.

This sensitivity test reflected the latest socio-economic forecasts updated in the SRAS, based on Atlanta Regional Commission's (ARC) Mobility 2030 plan. It is noted that the Medium-Duty Truck trip table and Heavy-Duty Truck trip table used for this sensitivity test are still primarily based on ARC's truck growth forecast in the Mobility 2030 plan. It does not incorporate the latest truck growth rate forecasted in the Statewide Truck Lanes Needs Identification Study conducted by the Georgia Department of Transportation (GDOT).

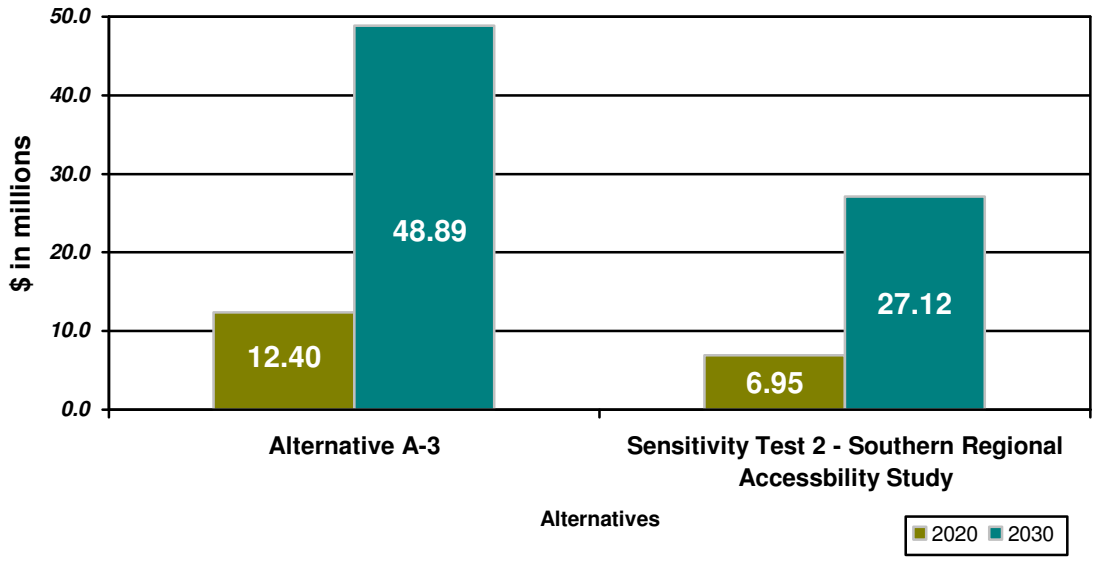
Alternative A-3 (Two Express Toll Lanes for passenger cars in each direction along the I-75 South corridor from I-285 to SR 16) was used as the base case for this test. For comparison purposes, the same optimized toll rates derived in Alternative A-3 were employed.

The estimated gross toll revenues and net revenues in current and nominal dollars are presented in Tables 8-4 through 8-6. From year 2020 to year 2050, the managed lane facilities are forecasted to generate approximately $903.70 million cumulative gross revenue; $504.41 million cumulative net revenue in un-inflated 2007 dollars, and approximately $1.01 billion cumulative net revenue in inflated dollars.

With the transportation project recommendations and the socio-economic forecasts from the SRAS, in particular the Medium-Duty Truck trip table and Heavy-Duty Truck trip table forecast, the annual managed lanes revenue in 2020 decreases from $12.40 million to $6.95 million (approximately 43.9% decrease); the annual managed lanes revenue in 2030 decreases from $48.89 million to $27.12 million (approximately 44.5% decrease); The decreased managed lanes revenue generation is reasonable since the ARC's lower truck growth rate in combination with improvements on competing arterials resulted in less overall demand in the corridor and reduced travel time savings, hence lower percentage usage on the managed lanes.

A comparison of 2030 estimated gross revenue (un-inflated dollars in millions) between Alternative A-3 and Sensitivity Test 2 is illustrated in the Figure 8-4.

Figure 8-4: 2030 Uninflated Gross Revenue Comparison–Sensitivity Test 2



8.3.3 Results of Scenario Test 3 – Mixed Express Tolling Lanes (3-lane each direction)

As mentioned previously, sensitivity test 3 assessed the impacts to traffic and toll revenue of three-lane mixed ETL configuration in each direction on I-75 South corridor from SR 16 to I-285.

For comparison purposes, the same optimized toll rates established in Alternative D (Two mixed Express Toll Lanes for all vehicles in each direction along the I-75 South corridor from I-285 to SR 16) were employed.

The estimated gross toll revenues and net revenues in current and nominal dollars are presented in Tables 8-7 through 8-9. From year 2020 to year 2050, the ETL facilities are forecasted to generate approximately $2.55 billion cumulative gross revenue; $1.88 billion cumulative net revenue in un-inflated 2007 dollars, and approximately $3.99 billion cumulative net revenue in inflated dollars.

With the expansion of express lanes from two lanes in each direction to three lanes in each direction, the annual managed lanes revenue in 2020 increases from $15.00 million to $15.70 million (approximately 4.7% increase); the annual managed lanes revenue in 2030 increases from $71.31 million to $75.49 million (approximately 5.8% increase). It is noted that the difference on revenue generation for three-lane ETL scenario is not significantly different from the two-lane ETL scenario. The slight increase on the managed lanes revenue generation is attributed to the extra capacity on the managed lanes resulting in relatively higher usage.

The comparison of 2030 estimated gross revenue (un-inflated dollars in millions) between Alternative D-4 and Sensitivity Test 3 are illustrated in the Figure 8-5.

Figure 8-5: 2030 Uninflated Gross Revenue Comparison–Sensitivity Test 3

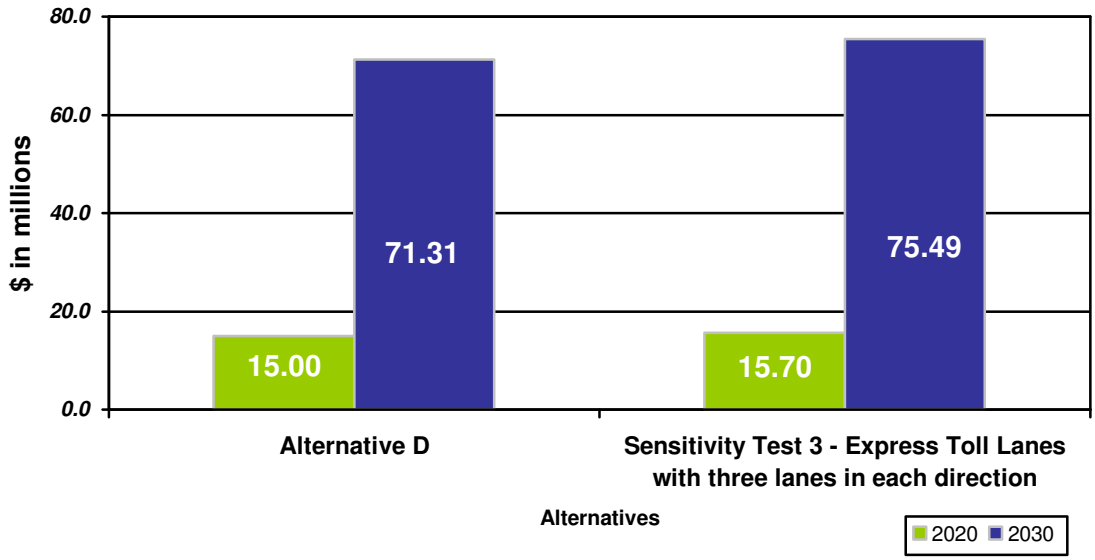


Table 8- 1 : Annual Gross Toll Revenue (un-inflated dollars) – Scenario Test 1 - Sensitivity of Willingness to Pay

Year (1)	Weekday HOT Lane Revenue By Period (2)				Total Weekday	Weekend Day (3)	Estimated Annual Gross Revenue (4)	Cumulative Gross Revenue
	AM Peak	Midday	PM Peak	Night				
2020	$ 16,159	$ 11,594	$ 28,171	$ 1,425	$ 57,349	$ 28,674	$ 17,634,664	$ 17,634,664
2021	$ 21,736	$ 16,120	$ 36,049	$ 1,989	$ 75,894	$ 37,947	$ 23,337,405	$ 40,972,069
2022	$ 30,000	$ 22,808	$ 47,752	$ 2,832	$ 103,392	$ 51,696	$ 31,793,040	$ 72,765,109
2023	$ 40,323	$ 31,263	$ 62,012	$ 3,890	$ 137,488	$ 68,744	$ 42,277,499	$ 115,042,607
2024	$ 45,630	$ 35,940	$ 68,160	$ 4,480	$ 154,210	$ 77,105	$ 47,419,575	$ 162,462,182
2025	$ 49,690	$ 39,660	$ 72,400	$ 4,960	$ 166,710	$ 83,355	$ 51,263,325	$ 213,725,507
2026	$ 53,750	$ 43,380	$ 76,630	$ 5,430	$ 179,190	$ 89,595	$ 55,100,925	$ 268,826,432
2027	$ 57,810	$ 47,090	$ 80,870	$ 5,900	$ 191,670	$ 95,835	$ 58,938,525	$ 327,764,957
2028	$ 61,880	$ 50,810	$ 85,100	$ 6,370	$ 204,160	$ 102,080	$ 62,779,200	$ 390,544,157
2029	$ 65,940	$ 54,520	$ 89,340	$ 6,850	$ 216,650	$ 108,325	$ 66,619,875	$ 457,164,032
2030	$ 70,000	$ 58,240	$ 93,570	$ 7,320	$ 229,130	$ 114,565	$ 70,457,475	$ 527,621,507
2031	$ 72,030	$ 60,100	$ 95,690	$ 7,790	$ 235,610	$ 117,805	$ 72,450,075	$ 600,071,582
2032	$ 74,060	$ 61,960	$ 97,810	$ 8,270	$ 242,100	$ 121,050	$ 74,445,750	$ 674,517,332
2033	$ 76,090	$ 63,810	$ 99,920	$ 8,740	$ 248,560	$ 124,280	$ 76,432,200	$ 750,949,532
2034	$ 78,120	$ 65,670	$ 102,040	$ 9,210	$ 255,040	$ 127,520	$ 78,424,800	$ 829,374,332
2035	$ 80,160	$ 67,530	$ 104,160	$ 9,690	$ 261,540	$ 130,770	$ 80,423,550	$ 909,797,882
2036	$ 82,190	$ 69,390	$ 106,280	$ 10,160	$ 268,020	$ 134,010	$ 82,416,150	$ 992,214,032
2037	$ 84,220	$ 71,250	$ 108,390	$ 10,630	$ 274,490	$ 137,245	$ 84,405,675	$ 1,076,619,707
2038	$ 86,250	$ 73,100	$ 110,510	$ 11,100	$ 280,960	$ 140,480	$ 86,395,200	$ 1,163,014,907
2039	$ 88,280	$ 74,960	$ 112,630	$ 11,580	$ 287,450	$ 143,725	$ 88,390,875	$ 1,251,405,782
2040	$ 90,310	$ 76,820	$ 114,750	$ 12,050	$ 293,930	$ 146,965	$ 90,383,475	$ 1,341,789,257
2041	$ 92,340	$ 78,680	$ 116,860	$ 12,520	$ 300,400	$ 150,200	$ 92,373,000	$ 1,434,162,257
2042	$ 94,370	$ 80,540	$ 118,980	$ 13,000	$ 306,890	$ 153,445	$ 94,368,675	$ 1,528,530,932
2043	$ 96,400	$ 82,390	$ 121,100	$ 13,470	$ 313,360	$ 156,680	$ 96,358,200	$ 1,624,889,132
2044	$ 98,430	$ 84,250	$ 123,220	$ 13,940	$ 319,840	$ 159,920	$ 98,350,800	$ 1,723,239,932
2045	$ 100,470	$ 86,110	$ 125,330	$ 14,420	$ 326,330	$ 163,165	$ 100,346,475	$ 1,823,586,407
2046	$ 102,500	$ 87,970	$ 127,450	$ 14,890	$ 332,810	$ 166,405	$ 102,339,075	$ 1,925,925,482
2047	$ 104,530	$ 89,830	$ 129,570	$ 15,360	$ 339,290	$ 169,645	$ 104,331,675	$ 2,030,257,157
2048	$ 106,560	$ 91,680	$ 131,690	$ 15,830	$ 345,760	$ 172,880	$ 106,321,200	$ 2,136,578,357
2049	$ 108,590	$ 93,540	$ 133,800	$ 16,310	$ 352,240	$ 176,120	$ 108,313,800	$ 2,244,892,157
2050	$ 110,620	$ 95,400	$ 135,920	$ 16,780	$ 358,720	$ 179,360	$ 110,306,400	$ 2,355,198,557

(1) A ramp-up period is assumed for the first four years of operation
(2) 2007 Dollars
(3) Weekend day revenue for HOT2+ is estimated to be 50 percent of weekday revenue
(4) Annual revenue calculations assume 250 weekdays and 115 weekend/holidays

Table 8- 2: Net Revenue Summary--- un-inflated dollars (000) – Scenario Test 1 - Sensitivity of Willingness to Pay

Year	Gross Annual Toll Revenue (1)	Annual Transactions (2)	Operation Cost (3)	Infrastracture Operation and Maintenace Cost (4)	Net Annual Revenue	Cumulative Annual Revenue
2020	$ 17,635	15,531	$ 3,261	$ 10,266	$ 4,107	$ 4,107
2021	$ 23,337	18,752	$ 3,938	$ 10,266	$ 9,133	$ 9,133
2022	$ 31,793	23,572	$ 4,950	$ 10,266	$ 16,577	$ 25,710
2023	$ 42,277	29,174	$ 6,127	$ 10,266	$ 25,885	$ 51,595
2024	$ 47,420	30,689	$ 6,445	$ 10,266	$ 30,709	$ 82,304
2025	$ 51,263	31,300	$ 6,573	$ 10,266	$ 34,424	$ 116,729
2026	$ 55,101	31,912	$ 6,702	$ 10,266	$ 38,133	$ 154,862
2027	$ 58,939	32,527	$ 6,831	$ 10,266	$ 41,842	$ 196,704
2028	$ 62,779	33,139	$ 6,959	$ 10,266	$ 45,554	$ 242,258
2029	$ 66,620	33,751	$ 7,088	$ 10,266	$ 49,266	$ 291,524
2030	$ 70,457	34,364	$ 7,216	$ 10,266	$ 52,975	$ 344,499
2031	$ 72,450	34,975	$ 7,345	$ 10,266	$ 54,839	$ 399,338
2032	$ 74,446	35,590	$ 7,474	$ 10,266	$ 56,706	$ 456,044
2033	$ 76,432	36,202	$ 7,602	$ 10,266	$ 58,564	$ 514,608
2034	$ 78,425	36,814	$ 7,731	$ 10,266	$ 60,428	$ 575,036
2035	$ 80,424	37,426	$ 7,859	$ 10,266	$ 62,298	$ 637,334
2036	$ 82,416	38,038	$ 7,988	$ 10,266	$ 64,162	$ 701,496
2037	$ 84,406	38,653	$ 8,117	$ 10,266	$ 66,023	$ 767,519
2038	$ 86,395	39,265	$ 8,246	$ 10,266	$ 67,884	$ 835,402
2039	$ 88,391	39,877	$ 8,374	$ 10,266	$ 69,751	$ 905,153
2040	$ 90,383	40,489	$ 8,503	$ 10,266	$ 71,615	$ 976,768
2041	$ 92,373	41,104	$ 8,632	$ 10,266	$ 73,475	$ 1,050,243
2042	$ 94,369	41,715	$ 8,760	$ 10,266	$ 75,342	$ 1,125,586
2043	$ 96,358	42,327	$ 8,889	$ 10,266	$ 77,203	$ 1,202,789
2044	$ 98,351	42,939	$ 9,017	$ 10,266	$ 79,068	$ 1,281,857
2045	$ 100,346	43,551	$ 9,146	$ 10,266	$ 80,935	$ 1,362,791
2046	$ 102,339	44,166	$ 9,275	$ 10,266	$ 82,798	$ 1,445,589
2047	$ 104,332	44,778	$ 9,403	$ 10,266	$ 84,662	$ 1,530,252
2048	$ 106,321	45,390	$ 9,532	$ 10,266	$ 86,523	$ 1,616,775
2049	$ 108,314	46,002	$ 9,660	$ 10,266	$ 88,387	$ 1,705,162
2050	$ 110,306	46,614	$ 9,789	$ 10,266	$ 90,251	$ 1,795,414

(1) Uninflated revenues are in 2007 dollars.
(2) Annual transaction do not include non-toll paying vehicles.
(3) Operation cost is assumed to be $0.21 per tolled transaction and it includes Billing and Administration Cost; Violations Center Operations Cost and Customer Service Center Cost; Enforcement cost and Toll Equipment Maintenance Cost.
(4) Annual Infrastructure Operation and Maintenance Cost is assumed to be 0.5% of the total capital cost.

Table 8- 3: Annual Toll Revenue in Inflated Dollars (000) – Scenario Test 1 - Sensitivity of Willingness to Pay

Year	UNINFLATED DOLLARS (000)				Inflation Factors		INFLATED DOLLARS (000)			
	Total Gross Annual Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Net Cumulative Annual Revenue	Toll Revenue	O&M	Gross Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Cumulative Annual Revenue
2020	$ 17,635	$ 13,527	$ 4,107	$ 4,107	1.379	1.469	$ 24,318	$ 19,872	$ 4,446	$ 4,446
2021	$ 23,337	$ 14,204	$ 9,133	$ 13,241	1.413	1.513	$ 32,976	$ 21,491	$ 11,485	$ 15,931
2022	$ 31,793	$ 15,216	$ 16,577	$ 29,818	1.448	1.558	$ 46,036	$ 23,707	$ 22,330	$ 38,261
2023	$ 42,277	$ 16,393	$ 25,885	$ 55,702	1.485	1.605	$ 62,782	$ 26,310	$ 36,472	$ 74,733
2024	$ 47,420	$ 16,711	$ 30,709	$ 86,411	1.522	1.653	$ 72,173	$ 27,623	$ 44,550	$ 119,283
2025	$ 51,263	$ 16,839	$ 34,424	$ 120,836	1.560	1.702	$ 79,971	$ 28,660	$ 51,311	$ 170,594
2026	$ 55,101	$ 16,968	$ 38,133	$ 158,969	1.599	1.754	$ 88,106	$ 29,761	$ 58,345	$ 228,939
2027	$ 58,939	$ 17,097	$ 41,842	$ 200,811	1.639	1.806	$ 96,600	$ 30,877	$ 65,724	$ 294,663
2028	$ 62,779	$ 17,225	$ 45,554	$ 246,365	1.680	1.860	$ 105,469	$ 32,039	$ 73,430	$ 368,093
2029	$ 66,620	$ 17,354	$ 49,266	$ 295,631	1.722	1.916	$ 114,719	$ 33,250	$ 81,470	$ 449,562
2030	$ 70,457	$ 17,482	$ 52,975	$ 348,606	1.765	1.974	$ 124,357	$ 34,510	$ 89,847	$ 539,409
2031	$ 72,450	$ 17,611	$ 54,839	$ 403,445	1.809	2.033	$ 131,062	$ 35,803	$ 95,260	$ 634,669
2032	$ 74,446	$ 17,740	$ 56,706	$ 460,151	1.854	2.094	$ 138,022	$ 37,147	$ 100,875	$ 735,544
2033	$ 76,432	$ 17,868	$ 58,564	$ 518,715	1.900	2.157	$ 145,221	$ 38,542	$ 106,679	$ 842,223
2034	$ 78,425	$ 17,997	$ 60,428	$ 579,143	1.948	2.221	$ 152,772	$ 39,971	$ 112,800	$ 955,023
2035	$ 80,424	$ 18,125	$ 62,298	$ 641,441	1.996	2.288	$ 160,525	$ 41,471	$ 119,054	$ 1,074,078
2036	$ 82,416	$ 18,254	$ 64,162	$ 705,603	2.046	2.357	$ 168,623	$ 43,025	$ 125,599	$ 1,199,677
2037	$ 84,406	$ 18,383	$ 66,023	$ 771,626	2.098	2.427	$ 177,083	$ 44,616	$ 132,467	$ 1,332,144
2038	$ 86,395	$ 18,512	$ 67,884	$ 839,509	2.150	2.500	$ 185,750	$ 46,279	$ 139,471	$ 1,471,615
2039	$ 88,391	$ 18,640	$ 69,751	$ 909,260	2.204	2.575	$ 194,813	$ 47,998	$ 146,815	$ 1,618,430
2040	$ 90,383	$ 18,769	$ 71,615	$ 980,875	2.259	2.652	$ 204,176	$ 49,774	$ 154,402	$ 1,772,832
2041	$ 92,373	$ 18,898	$ 73,475	$ 1,054,350	2.315	2.732	$ 213,843	$ 51,629	$ 162,215	$ 1,935,047
2042	$ 94,369	$ 19,026	$ 75,342	$ 1,129,693	2.373	2.814	$ 223,937	$ 53,540	$ 170,397	$ 2,105,444
2043	$ 96,358	$ 19,155	$ 77,203	$ 1,206,896	2.433	2.898	$ 234,440	$ 55,510	$ 178,929	$ 2,284,373
2044	$ 98,351	$ 19,283	$ 79,068	$ 1,285,964	2.493	2.985	$ 245,189	$ 57,561	$ 187,628	$ 2,472,001
2045	$ 100,346	$ 19,412	$ 80,935	$ 1,366,898	2.556	3.075	$ 256,486	$ 59,691	$ 196,794	$ 2,668,795
2046	$ 102,339	$ 19,541	$ 82,798	$ 1,449,697	2.620	3.167	$ 268,128	$ 61,886	$ 206,242	$ 2,875,038
2047	$ 104,332	$ 19,669	$ 84,662	$ 1,534,359	2.685	3.262	$ 280,131	$ 64,162	$ 215,969	$ 3,091,007
2048	$ 106,321	$ 19,798	$ 86,523	$ 1,620,882	2.752	3.360	$ 292,596	$ 66,521	$ 226,075	$ 3,317,082
2049	$ 108,314	$ 19,926	$ 88,387	$ 1,709,270	2.821	3.461	$ 305,553	$ 68,965	$ 236,588	$ 3,553,670
2050	$ 110,306	$ 20,055	$ 90,251	$ 1,799,521	2.892	3.565	$ 319,006	$ 71,496	$ 247,510	$ 3,801,180

Notes: Uninflated revenues and costs are in 2007 dollars.
Annual inflation rates of 2.5% and 3.0% are applied for toll revenue and O&M cost respectively.

Table 8- 4: Annual Gross Toll Revenue ---(un-inflated dollars) – Scenario Test 2 - Southern Regional Accessibility Study

Year (1)	Weekday HOT Lane Revenue By Period (2)				HOT Total Weekday	HOT Weekend Day (3)	Estimated Annual Gross Revenue (4)	Cumulative Gross Revenue
	AM Peak	Midday	PM Peak	Night				
2020	$ 7,522	$ 3,236	$ 11,436	$ 401	$ 22,595	$ 11,297	$ 6,947,901	$ 6,947,901
2021	$ 10,004	$ 4,349	$ 14,846	$ 566	$ 29,764	$ 14,882	$ 9,152,276	$ 16,100,178
2022	$ 13,688	$ 5,992	$ 19,912	$ 816	$ 40,408	$ 20,204	$ 12,425,460	$ 28,525,638
2023	$ 18,255	$ 8,051	$ 26,132	$ 1,125	$ 53,563	$ 26,782	$ 16,470,746	$ 44,996,383
2024	$ 20,530	$ 9,110	$ 28,990	$ 1,300	$ 59,930	$ 29,965	$ 18,428,475	$ 63,424,858
2025	$ 22,250	$ 9,910	$ 31,040	$ 1,440	$ 64,640	$ 32,320	$ 19,876,800	$ 83,301,658
2026	$ 23,960	$ 10,720	$ 33,090	$ 1,590	$ 69,360	$ 34,680	$ 21,328,200	$ 104,629,858
2027	$ 25,680	$ 11,520	$ 35,140	$ 1,730	$ 74,070	$ 37,035	$ 22,776,525	$ 127,406,383
2028	$ 27,390	$ 12,330	$ 37,190	$ 1,870	$ 78,780	$ 39,390	$ 24,224,850	$ 151,631,233
2029	$ 29,110	$ 13,130	$ 39,240	$ 2,020	$ 83,500	$ 41,750	$ 25,676,250	$ 177,307,483
2030	$ 30,820	$ 13,940	$ 41,290	$ 2,160	$ 88,210	$ 44,105	$ 27,124,575	$ 204,432,058
2031	$ 31,680	$ 14,340	$ 42,310	$ 2,300	$ 90,630	$ 45,315	$ 27,868,725	$ 232,300,783
2032	$ 32,530	$ 14,750	$ 43,340	$ 2,450	$ 93,070	$ 46,535	$ 28,619,025	$ 260,919,808
2033	$ 33,390	$ 15,150	$ 44,360	$ 2,590	$ 95,490	$ 47,745	$ 29,363,175	$ 290,282,983
2034	$ 34,250	$ 15,550	$ 45,390	$ 2,730	$ 97,920	$ 48,960	$ 30,110,400	$ 320,393,383
2035	$ 35,110	$ 15,950	$ 46,410	$ 2,880	$ 100,350	$ 50,175	$ 30,857,625	$ 351,251,008
2036	$ 35,960	$ 16,360	$ 47,440	$ 3,020	$ 102,780	$ 51,390	$ 31,604,850	$ 382,855,858
2037	$ 36,820	$ 16,760	$ 48,460	$ 3,160	$ 105,200	$ 52,600	$ 32,349,000	$ 415,204,858
2038	$ 37,680	$ 17,160	$ 49,490	$ 3,300	$ 107,630	$ 53,815	$ 33,096,225	$ 448,301,083
2039	$ 38,530	$ 17,570	$ 50,510	$ 3,450	$ 110,060	$ 55,030	$ 33,843,450	$ 482,144,533
2040	$ 39,390	$ 17,970	$ 51,540	$ 3,590	$ 112,490	$ 56,245	$ 34,590,675	$ 516,735,208
2041	$ 40,250	$ 18,370	$ 52,560	$ 3,730	$ 114,910	$ 57,455	$ 35,334,825	$ 552,070,033
2042	$ 41,110	$ 18,770	$ 53,590	$ 3,880	$ 117,350	$ 58,675	$ 36,085,125	$ 588,155,158
2043	$ 41,960	$ 19,180	$ 54,610	$ 4,020	$ 119,770	$ 59,885	$ 36,829,275	$ 624,984,433
2044	$ 42,820	$ 19,580	$ 55,640	$ 4,160	$ 122,200	$ 61,100	$ 37,576,500	$ 662,560,933
2045	$ 43,680	$ 19,980	$ 56,660	$ 4,310	$ 124,630	$ 62,315	$ 38,323,725	$ 700,884,658
2046	$ 44,530	$ 20,390	$ 57,690	$ 4,450	$ 127,060	$ 63,530	$ 39,070,950	$ 739,955,608
2047	$ 45,390	$ 20,790	$ 58,710	$ 4,590	$ 129,480	$ 64,740	$ 39,815,100	$ 779,770,708
2048	$ 46,250	$ 21,190	$ 59,740	$ 4,740	$ 131,920	$ 65,960	$ 40,565,400	$ 820,336,108
2049	$ 47,110	$ 21,590	$ 60,760	$ 4,880	$ 134,340	$ 67,170	$ 41,309,550	$ 861,645,658
2050	$ 47,960	$ 22,000	$ 61,790	$ 5,020	$ 136,770	$ 68,385	$ 42,056,775	$ 903,702,433

(1) A ramp-up period is assumed for the first four years of operation
(2) 2007 Dollars
(3) Weekend day revenue for HOT2+ is estimated to be 50 percent of weekday revenue
(4) Annual revenue calculations assume 250 weekdays and 115 weekend/holidays

Table 8- 5: Table 8-5: Net Revenue Summary ---un-inflated dollars (000) – Scenario Test 2 - Southern Regional Accessibility Study

Year	Gross Annual Toll Revenue (1)	Annual Transactions (2)	Operation Cost (3)	Infrastracture Operation and Maintenace Cost (4)	Net Annual Revenue	Cumulative Annual Revenue
2020	$ 6,948	6,218	$ 1,306	$ 10,266	$ (4,624)	$ (4,624)
2021	$ 9,152	7,447	$ 1,564	$ 10,266	$ (2,678)	$ (2,678)
2022	$ 12,425	9,292	$ 1,951	$ 10,266	$ 208	$ (2,469)
2023	$ 16,471	11,421	$ 2,398	$ 10,266	$ 3,806	$ 1,337
2024	$ 18,428	11,935	$ 2,506	$ 10,266	$ 5,656	$ 6,993
2025	$ 19,877	12,096	$ 2,540	$ 10,266	$ 7,071	$ 14,064
2026	$ 21,328	12,260	$ 2,575	$ 10,266	$ 8,488	$ 22,551
2027	$ 22,777	12,425	$ 2,609	$ 10,266	$ 9,901	$ 32,452
2028	$ 24,225	12,591	$ 2,644	$ 10,266	$ 11,315	$ 43,767
2029	$ 25,676	12,760	$ 2,680	$ 10,266	$ 12,731	$ 56,498
2030	$ 27,125	12,925	$ 2,714	$ 10,266	$ 14,144	$ 70,642
2031	$ 27,869	13,048	$ 2,740	$ 10,266	$ 14,863	$ 85,505
2032	$ 28,619	13,175	$ 2,767	$ 10,266	$ 15,586	$ 101,091
2033	$ 29,363	13,302	$ 2,793	$ 10,266	$ 16,304	$ 117,395
2034	$ 30,110	13,431	$ 2,821	$ 10,266	$ 17,024	$ 134,419
2035	$ 30,858	13,561	$ 2,848	$ 10,266	$ 17,744	$ 152,162
2036	$ 31,605	13,694	$ 2,876	$ 10,266	$ 18,463	$ 170,626
2037	$ 32,349	13,826	$ 2,903	$ 10,266	$ 19,180	$ 189,805
2038	$ 33,096	13,961	$ 2,932	$ 10,266	$ 19,898	$ 209,704
2039	$ 33,843	14,097	$ 2,960	$ 10,266	$ 20,617	$ 230,321
2040	$ 34,591	14,235	$ 2,989	$ 10,266	$ 21,335	$ 251,656
2041	$ 35,335	14,373	$ 3,018	$ 10,266	$ 22,051	$ 273,707
2042	$ 36,085	14,514	$ 3,048	$ 10,266	$ 22,771	$ 296,478
2043	$ 36,829	14,656	$ 3,078	$ 10,266	$ 23,486	$ 319,963
2044	$ 37,577	14,800	$ 3,108	$ 10,266	$ 24,203	$ 344,166
2045	$ 38,324	14,945	$ 3,138	$ 10,266	$ 24,919	$ 369,085
2046	$ 39,071	15,092	$ 3,169	$ 10,266	$ 25,636	$ 394,721
2047	$ 39,815	15,239	$ 3,200	$ 10,266	$ 26,349	$ 421,070
2048	$ 40,565	15,391	$ 3,232	$ 10,266	$ 27,067	$ 448,137
2049	$ 41,310	15,541	$ 3,264	$ 10,266	$ 27,780	$ 475,917
2050	$ 42,057	15,694	$ 3,296	$ 10,266	$ 28,495	$ 504,412

(1) Uninflated revenues are in 2007 dollars.
(2) Annual transaction do not include non-toll paying vehicles.
(3) Operation cost is assumed to be $0.21 per tolled transaction and it includes Billing and Administration Cost; Violations Center Operations Cost and Customer Service Center Cost; Enforcement cost and Toll Equipment Maintenance Cost.
(4) Annual Infrastructure Operation and Maintenance Cost is assumed to be 0.5% of the total capital cost.

Table 8- 6: Annual Toll Revenue in Inflated Dollars (000) – Scenario Test 2 - Southern Regional Accessibility Study

Year	UNINFLATED DOLLARS (000)				Inflation Factors		INFLATED DOLLARS (000)			
	Total Gross Annual Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Net Cumulative Annual	Toll Revenue	O&M	Gross Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Cumulative Annual Revenue
2020	$ 6,948	$ 11,572	$ (4,624)	$ (4,624)	1.379	1.469	$ 9,581	$ 16,999	$ (7,418)	$ (7,418)
2021	$ 9,152	$ 11,830	$ (2,678)	$ (7,301)	1.413	1.513	$ 12,932	$ 17,898	$ (4,966)	$ (12,384)
2022	$ 12,425	$ 12,217	$ 208	$ (7,093)	1.448	1.558	$ 17,992	$ 19,035	$ (1,043)	$ (13,426)
2023	$ 16,471	$ 12,664	$ 3,806	$ (3,287)	1.485	1.605	$ 24,459	$ 20,326	$ 4,133	$ (9,294)
2024	$ 18,428	$ 12,772	$ 5,656	$ 2,369	1.522	1.653	$ 28,048	$ 21,113	$ 6,935	$ (2,358)
2025	$ 19,877	$ 12,806	$ 7,071	$ 9,440	1.560	1.702	$ 31,008	$ 21,796	$ 9,212	$ 6,853
2026	$ 21,328	$ 12,841	$ 8,488	$ 17,927	1.599	1.754	$ 34,104	$ 22,523	$ 11,581	$ 18,435
2027	$ 22,777	$ 12,875	$ 9,901	$ 27,829	1.639	1.806	$ 37,331	$ 23,253	$ 14,078	$ 32,512
2028	$ 24,225	$ 12,910	$ 11,315	$ 39,143	1.680	1.860	$ 40,698	$ 24,013	$ 16,685	$ 49,197
2029	$ 25,676	$ 12,946	$ 12,731	$ 51,874	1.722	1.916	$ 44,215	$ 24,804	$ 19,411	$ 68,608
2030	$ 27,125	$ 12,980	$ 14,144	$ 66,018	1.765	1.974	$ 47,875	$ 25,623	$ 22,252	$ 90,860
2031	$ 27,869	$ 13,006	$ 14,863	$ 80,881	1.809	2.033	$ 50,415	$ 26,441	$ 23,973	$ 114,833
2032	$ 28,619	$ 13,033	$ 15,586	$ 96,467	1.854	2.094	$ 53,060	$ 27,291	$ 25,769	$ 140,602
2033	$ 29,363	$ 13,059	$ 16,304	$ 112,771	1.900	2.157	$ 55,790	$ 28,169	$ 27,621	$ 168,223
2034	$ 30,110	$ 13,087	$ 17,024	$ 129,795	1.948	2.221	$ 58,655	$ 29,065	$ 29,590	$ 197,813
2035	$ 30,858	$ 13,114	$ 17,744	$ 147,539	1.996	2.288	$ 61,592	$ 30,005	$ 31,587	$ 229,400
2036	$ 31,605	$ 13,142	$ 18,463	$ 166,002	2.046	2.357	$ 64,664	$ 30,975	$ 33,689	$ 263,089
2037	$ 32,349	$ 13,169	$ 19,180	$ 185,181	2.098	2.427	$ 67,868	$ 31,962	$ 35,906	$ 298,995
2038	$ 33,096	$ 13,198	$ 19,898	$ 205,080	2.150	2.500	$ 71,157	$ 32,994	$ 38,162	$ 337,157
2039	$ 33,843	$ 13,226	$ 20,617	$ 225,697	2.204	2.575	$ 74,591	$ 34,058	$ 40,533	$ 377,690
2040	$ 34,591	$ 13,255	$ 21,335	$ 247,032	2.259	2.652	$ 78,140	$ 35,153	$ 42,987	$ 420,678
2041	$ 35,335	$ 13,284	$ 22,051	$ 269,083	2.315	2.732	$ 81,800	$ 36,293	$ 45,508	$ 466,185
2042	$ 36,085	$ 13,314	$ 22,771	$ 291,854	2.373	2.814	$ 85,630	$ 37,466	$ 48,164	$ 514,350
2043	$ 36,829	$ 13,344	$ 23,486	$ 315,339	2.433	2.898	$ 89,606	$ 38,670	$ 50,935	$ 565,285
2044	$ 37,577	$ 13,374	$ 24,203	$ 339,542	2.493	2.985	$ 93,678	$ 39,921	$ 53,757	$ 619,042
2045	$ 38,324	$ 13,404	$ 24,919	$ 364,461	2.556	3.075	$ 97,955	$ 41,218	$ 56,737	$ 675,779
2046	$ 39,071	$ 13,435	$ 25,636	$ 390,097	2.620	3.167	$ 102,366	$ 42,550	$ 59,816	$ 735,595
2047	$ 39,815	$ 13,466	$ 26,349	$ 416,446	2.685	3.262	$ 106,904	$ 43,927	$ 62,977	$ 798,572
2048	$ 40,565	$ 13,498	$ 27,067	$ 443,513	2.752	3.360	$ 111,636	$ 45,353	$ 66,283	$ 864,855
2049	$ 41,310	$ 13,530	$ 27,780	$ 471,293	2.821	3.461	$ 116,534	$ 46,826	$ 69,708	$ 934,563
2050	$ 42,057	$ 13,562	$ 28,495	$ 499,788	2.892	3.565	$ 121,628	$ 48,347	$ 73,281	$ 1,007,844

Notes: Uninflated revenues and costs are in 2007 dollars.
Annual inflation rates of 2.5% and 3.0% are applied for toll revenue and O&M cost respectively.

Table 8- 7: Annual Gross Toll Revenue (un-inflated dollars) – Scenario Test 3 - Express Toll Lanes with Three Lane in each direction

Year (1)	Weekday HOT Lane Revenue By Period (2)				HOT Total Weekday	HOT Weekend Day (3)	Weekday TOT Revenue By Period (2)				TOT Total Weekday	TOT Weekend Day (4)	Estimated Annual Gross Revenue (5)	Cumulative Gross Revenue
	AM Peak	Midday	PM Peak	Night			AM Peak	Midday	PM Peak	Night				
2020	$ 9,246	$ 5,665	$ 12,348	$ 682	$ 27,940	$ 13,970	$ 6,848	$ 8,696	$ 7,755	$ 2,734	$ 26,032	$ 5,206	$ 15,698,150	$ 15,698,150
2021	$ 11,999	$ 7,436	$ 16,270	$ 884	$ 36,589	$ 18,294	$ 9,906	$ 12,428	$ 11,395	$ 4,193	$ 37,921	$ 7,584	$ 21,603,397	$ 37,301,546
2022	$ 16,080	$ 10,064	$ 22,088	$ 1,184	$ 49,416	$ 24,708	$ 14,424	$ 17,944	$ 16,768	$ 6,352	$ 55,488	$ 11,098	$ 30,343,644	$ 67,645,190
2023	$ 21,098	$ 13,308	$ 29,284	$ 1,562	$ 65,252	$ 32,626	$ 20,195	$ 24,968	$ 23,658	$ 9,137	$ 77,959	$ 15,592	$ 41,347,739	$ 108,992,929
2024	$ 23,390	$ 14,860	$ 32,770	$ 1,730	$ 72,750	$ 36,375	$ 23,610	$ 29,050	$ 27,820	$ 10,910	$ 91,390	$ 18,278	$ 47,320,095	$ 156,313,024
2025	$ 25,040	$ 16,010	$ 35,350	$ 1,850	$ 78,250	$ 39,125	$ 26,400	$ 32,360	$ 31,250	$ 12,390	$ 102,400	$ 20,480	$ 52,017,075	$ 208,330,099
2026	$ 26,680	$ 17,150	$ 37,930	$ 1,970	$ 83,730	$ 41,865	$ 29,190	$ 35,670	$ 34,680	$ 13,870	$ 113,410	$ 22,682	$ 56,707,905	$ 265,038,004
2027	$ 28,330	$ 18,290	$ 40,510	$ 2,090	$ 89,220	$ 44,610	$ 31,980	$ 38,980	$ 38,110	$ 15,360	$ 124,430	$ 24,886	$ 61,404,540	$ 326,442,544
2028	$ 29,970	$ 19,430	$ 43,090	$ 2,220	$ 94,710	$ 47,355	$ 34,770	$ 42,290	$ 41,540	$ 16,840	$ 135,440	$ 27,088	$ 66,098,445	$ 392,540,989
2029	$ 31,620	$ 20,570	$ 45,670	$ 2,340	$ 100,200	$ 50,100	$ 37,560	$ 45,600	$ 44,970	$ 18,330	$ 146,460	$ 29,292	$ 70,795,080	$ 463,336,069
2030	$ 33,260	$ 21,710	$ 48,250	$ 2,460	$ 105,680	$ 52,840	$ 40,350	$ 48,910	$ 48,400	$ 19,810	$ 157,470	$ 31,494	$ 75,485,910	$ 538,821,979
2031	$ 34,080	$ 22,280	$ 49,540	$ 2,580	$ 108,480	$ 54,240	$ 41,750	$ 50,570	$ 50,120	$ 20,550	$ 162,990	$ 32,598	$ 77,853,870	$ 616,675,849
2032	$ 34,910	$ 22,850	$ 50,830	$ 2,700	$ 111,290	$ 55,645	$ 43,140	$ 52,220	$ 51,830	$ 21,290	$ 168,480	$ 33,696	$ 80,216,715	$ 696,892,564
2033	$ 35,730	$ 23,420	$ 52,120	$ 2,830	$ 114,100	$ 57,050	$ 44,540	$ 53,880	$ 53,550	$ 22,040	$ 174,010	$ 34,802	$ 82,590,480	$ 779,483,044
2034	$ 36,550	$ 23,990	$ 53,410	$ 2,950	$ 116,900	$ 58,450	$ 45,930	$ 55,530	$ 55,260	$ 22,780	$ 179,500	$ 35,900	$ 84,950,250	$ 864,433,294
2035	$ 37,370	$ 24,560	$ 54,700	$ 3,070	$ 119,700	$ 59,850	$ 47,330	$ 57,190	$ 56,980	$ 23,520	$ 185,020	$ 37,004	$ 87,318,210	$ 951,751,504
2036	$ 38,200	$ 25,130	$ 55,990	$ 3,190	$ 122,510	$ 61,255	$ 48,720	$ 58,840	$ 58,690	$ 24,260	$ 190,510	$ 38,102	$ 89,681,055	$ 1,041,432,559
2037	$ 39,020	$ 25,700	$ 57,280	$ 3,310	$ 125,310	$ 62,655	$ 50,120	$ 60,500	$ 60,410	$ 25,000	$ 196,030	$ 39,206	$ 92,049,015	$ 1,133,481,574
2038	$ 39,840	$ 26,270	$ 58,570	$ 3,440	$ 128,120	$ 64,060	$ 51,510	$ 62,150	$ 62,120	$ 25,750	$ 201,530	$ 40,306	$ 94,414,590	$ 1,227,896,164
2039	$ 40,660	$ 26,840	$ 59,860	$ 3,560	$ 130,920	$ 65,460	$ 52,910	$ 63,810	$ 63,840	$ 26,490	$ 207,050	$ 41,410	$ 96,782,550	$ 1,324,678,714
2040	$ 41,490	$ 27,420	$ 61,150	$ 3,680	$ 133,740	$ 66,870	$ 54,300	$ 65,460	$ 65,550	$ 27,230	$ 212,540	$ 42,508	$ 99,148,470	$ 1,423,827,184
2041	$ 42,310	$ 27,990	$ 62,440	$ 3,800	$ 136,540	$ 68,270	$ 55,700	$ 67,120	$ 67,270	$ 27,970	$ 218,060	$ 43,612	$ 101,516,430	$ 1,525,343,614
2042	$ 43,130	$ 28,560	$ 63,730	$ 3,920	$ 139,340	$ 69,670	$ 57,090	$ 68,770	$ 68,980	$ 28,710	$ 223,550	$ 44,710	$ 103,876,200	$ 1,629,219,814
2043	$ 43,950	$ 29,130	$ 65,020	$ 4,050	$ 142,150	$ 71,075	$ 58,490	$ 70,430	$ 70,700	$ 29,460	$ 229,080	$ 45,816	$ 106,249,965	$ 1,735,469,779
2044	$ 44,780	$ 29,700	$ 66,310	$ 4,170	$ 144,960	$ 72,480	$ 59,880	$ 72,080	$ 72,410	$ 30,200	$ 234,570	$ 46,914	$ 108,612,810	$ 1,844,082,589
2045	$ 45,600	$ 30,270	$ 67,600	$ 4,290	$ 147,760	$ 73,880	$ 61,280	$ 73,740	$ 74,130	$ 30,940	$ 240,090	$ 48,018	$ 110,980,770	$ 1,955,063,359
2046	$ 46,420	$ 30,840	$ 68,890	$ 4,410	$ 150,560	$ 75,280	$ 62,670	$ 75,390	$ 75,840	$ 31,680	$ 245,580	$ 49,116	$ 113,340,540	$ 2,068,403,899
2047	$ 47,240	$ 31,410	$ 70,180	$ 4,530	$ 153,360	$ 76,680	$ 64,070	$ 77,050	$ 77,560	$ 32,420	$ 251,100	$ 50,220	$ 115,708,500	$ 2,184,112,399
2048	$ 48,070	$ 31,980	$ 71,470	$ 4,660	$ 156,180	$ 78,090	$ 65,460	$ 78,700	$ 79,270	$ 33,170	$ 256,600	$ 51,320	$ 118,077,150	$ 2,302,189,549
2049	$ 48,890	$ 32,550	$ 72,760	$ 4,780	$ 158,980	$ 79,490	$ 66,860	$ 80,360	$ 80,990	$ 33,910	$ 262,120	$ 52,424	$ 120,445,110	$ 2,422,634,659
2050	$ 49,710	$ 33,120	$ 74,050	$ 4,900	$ 161,780	$ 80,890	$ 68,250	$ 82,010	$ 82,700	$ 34,650	$ 267,610	$ 53,522	$ 122,804,880	$ 2,545,439,539

(1) A ramp-up period is assumed for the first four years of operation
(2) 2007 Dollars
(3) Weekend day revenue for HOT2+ is estimated to be 50 percent of weekday revenue
(4) Weekend day revenue for TOT lanes is estimated to be 20 percent of weekday revenue
(5) Annual revenue calculations assume 250 weekdays and 115 weekend/holidays

Table 8- 8: Net Revenue Summary -- un-inflated dollars (000) – Scenario Test 3 - Express Toll Lanes with Three Lane in each direction

Year	Gross Annual Toll Revenue (1)	Annual Transactions (2)	Operation Cost (3)	Infrastracture Operation and Maintenace Cost (4)	Net Annual Revenue	Cumulative Annual Revenue
2020	$ 15,698	13,329	$ 2,799	$ 15,399	$ (2,500)	$ (2,500)
2021	$ 21,603	16,062	$ 3,373	$ 15,399	$ 2,831	$ 2,831
2022	$ 30,344	20,139	$ 4,229	$ 15,399	$ 10,715	$ 13,547
2023	$ 41,348	24,858	$ 5,220	$ 15,399	$ 20,729	$ 34,275
2024	$ 47,320	26,080	$ 5,477	$ 15,399	$ 26,444	$ 60,720
2025	$ 52,017	26,521	$ 5,569	$ 15,399	$ 31,049	$ 91,768
2026	$ 56,708	26,960	$ 5,662	$ 15,399	$ 35,647	$ 127,416
2027	$ 61,405	27,398	$ 5,754	$ 15,399	$ 40,252	$ 167,668
2028	$ 66,098	27,832	$ 5,845	$ 15,399	$ 44,855	$ 212,522
2029	$ 70,795	28,265	$ 5,936	$ 15,399	$ 49,460	$ 261,983
2030	$ 75,486	28,694	$ 6,026	$ 15,399	$ 54,061	$ 316,044
2031	$ 77,854	29,017	$ 6,093	$ 15,399	$ 56,361	$ 372,405
2032	$ 80,217	29,338	$ 6,161	$ 15,399	$ 58,657	$ 431,062
2033	$ 82,590	29,661	$ 6,229	$ 15,399	$ 60,963	$ 492,025
2034	$ 84,950	29,980	$ 6,296	$ 15,399	$ 63,256	$ 555,280
2035	$ 87,318	30,299	$ 6,363	$ 15,399	$ 65,556	$ 620,836
2036	$ 89,681	30,620	$ 6,430	$ 15,399	$ 67,852	$ 688,688
2037	$ 92,049	30,945	$ 6,498	$ 15,399	$ 70,152	$ 758,840
2038	$ 94,415	31,264	$ 6,565	$ 15,399	$ 72,450	$ 831,290
2039	$ 96,783	31,587	$ 6,633	$ 15,399	$ 74,750	$ 906,041
2040	$ 99,148	31,906	$ 6,700	$ 15,399	$ 77,049	$ 983,090
2041	$ 101,516	32,228	$ 6,768	$ 15,399	$ 79,350	$ 1,062,439
2042	$ 103,876	32,545	$ 6,835	$ 15,399	$ 81,643	$ 1,144,082
2043	$ 106,250	32,866	$ 6,902	$ 15,399	$ 83,949	$ 1,228,031
2044	$ 108,613	33,186	$ 6,969	$ 15,399	$ 86,245	$ 1,314,276
2045	$ 110,981	33,504	$ 7,036	$ 15,399	$ 88,546	$ 1,402,822
2046	$ 113,341	33,826	$ 7,103	$ 15,399	$ 90,838	$ 1,493,660
2047	$ 115,709	34,146	$ 7,171	$ 15,399	$ 93,139	$ 1,586,799
2048	$ 118,077	34,466	$ 7,238	$ 15,399	$ 95,440	$ 1,682,239
2049	$ 120,445	34,788	$ 7,305	$ 15,399	$ 97,741	$ 1,779,980
2050	$ 122,805	35,106	$ 7,372	$ 15,399	$ 100,034	$ 1,880,014

(1) Uninflated revenues are in 2007 dollars.
(2) Annual transaction do not include non-toll paying vehicles.
(3) Operation cost is assumed to be $0.21 per tolled transaction and it includes Billing and Administration Cost; Violations Center Operations Cost and Customer Service Center Cost; Enforcement cost and Toll Equipment Maintenance Cost.
(4) Annual Infrastructure Operation and Maintenance Cost is assumed to be 0.5% of the total capital cost.

Table 8- 9: Annual Toll Revenue in Inflated Dollars (000) – Scenario Test 3 - Express Toll Lanes with Three Lane in each direction

Year	UNINFLATED DOLLARS (000)				Inflation Factors		INFLATED DOLLARS (000)			
	Total Gross Annual Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Net Cumulative Annual	Toll Revenue	O&M	Gross Toll Revenue	Tolling and Infrastructure O&M Cost	Net Annual Revenue	Cumulative Annual Revenue
2020	$ 15,698	$ 18,198	$ (2,500)	$ (2,500)	1.379	1.469	$ 21,648	$ 26,733	$ (5,085)	$ (5,085)
2021	$ 21,603	$ 18,772	$ 2,831	$ 331	1.413	1.513	$ 30,526	$ 28,402	$ 2,124	$ (2,962)
2022	$ 30,344	$ 19,628	$ 10,715	$ 11,047	1.448	1.558	$ 43,938	$ 30,581	$ 13,357	$ 10,395
2023	$ 41,348	$ 20,619	$ 20,729	$ 31,775	1.485	1.605	$ 61,401	$ 33,094	$ 28,308	$ 38,703
2024	$ 47,320	$ 20,876	$ 26,444	$ 58,220	1.522	1.653	$ 72,021	$ 34,508	$ 37,513	$ 76,216
2025	$ 52,017	$ 20,968	$ 31,049	$ 89,268	1.560	1.702	$ 81,147	$ 35,688	$ 45,458	$ 121,675
2026	$ 56,708	$ 21,061	$ 35,647	$ 124,916	1.599	1.754	$ 90,676	$ 36,940	$ 53,736	$ 175,410
2027	$ 61,405	$ 21,153	$ 40,252	$ 165,168	1.639	1.806	$ 100,642	$ 38,201	$ 62,441	$ 237,851
2028	$ 66,098	$ 21,244	$ 44,855	$ 210,022	1.680	1.860	$ 111,045	$ 39,513	$ 71,532	$ 309,383
2029	$ 70,795	$ 21,335	$ 49,460	$ 259,483	1.722	1.916	$ 121,909	$ 40,877	$ 81,032	$ 390,415
2030	$ 75,486	$ 21,425	$ 54,061	$ 313,544	1.765	1.974	$ 133,233	$ 42,293	$ 90,940	$ 481,355
2031	$ 77,854	$ 21,492	$ 56,361	$ 369,905	1.809	2.033	$ 140,838	$ 43,694	$ 97,143	$ 578,498
2032	$ 80,217	$ 21,560	$ 58,657	$ 428,562	1.854	2.094	$ 148,722	$ 45,147	$ 103,575	$ 682,073
2033	$ 82,590	$ 21,628	$ 60,963	$ 489,525	1.900	2.157	$ 156,922	$ 46,651	$ 110,271	$ 792,344
2034	$ 84,950	$ 21,695	$ 63,256	$ 552,780	1.948	2.221	$ 165,483	$ 48,184	$ 117,299	$ 909,643
2035	$ 87,318	$ 21,762	$ 65,556	$ 618,336	1.996	2.288	$ 174,287	$ 49,791	$ 124,496	$ 1,034,139
2036	$ 89,681	$ 21,829	$ 67,852	$ 686,188	2.046	2.357	$ 183,487	$ 51,451	$ 132,036	$ 1,166,175
2037	$ 92,049	$ 21,897	$ 70,152	$ 756,340	2.098	2.427	$ 193,119	$ 53,145	$ 139,974	$ 1,306,149
2038	$ 94,415	$ 21,964	$ 72,450	$ 828,790	2.150	2.500	$ 202,991	$ 54,911	$ 148,080	$ 1,454,230
2039	$ 96,783	$ 22,032	$ 74,750	$ 903,541	2.204	2.575	$ 213,309	$ 56,733	$ 156,576	$ 1,610,805
2040	$ 99,148	$ 22,099	$ 77,049	$ 980,590	2.259	2.652	$ 223,976	$ 58,607	$ 165,369	$ 1,776,175
2041	$ 101,516	$ 22,167	$ 79,350	$ 1,059,939	2.315	2.732	$ 235,011	$ 60,560	$ 174,451	$ 1,950,625
2042	$ 103,876	$ 22,234	$ 81,643	$ 1,141,582	2.373	2.814	$ 246,498	$ 62,565	$ 183,933	$ 2,134,558
2043	$ 106,250	$ 22,301	$ 83,949	$ 1,225,531	2.433	2.898	$ 258,506	$ 64,628	$ 193,878	$ 2,328,437
2044	$ 108,613	$ 22,368	$ 86,245	$ 1,311,776	2.493	2.985	$ 270,772	$ 66,768	$ 204,003	$ 2,532,440
2045	$ 110,981	$ 22,435	$ 88,546	$ 1,400,322	2.556	3.075	$ 283,667	$ 68,987	$ 214,680	$ 2,747,120
2046	$ 113,341	$ 22,502	$ 90,838	$ 1,491,160	2.620	3.167	$ 296,952	$ 71,265	$ 225,687	$ 2,972,807
2047	$ 115,709	$ 22,570	$ 93,139	$ 1,584,299	2.685	3.262	$ 310,677	$ 73,622	$ 237,055	$ 3,209,862
2048	$ 118,077	$ 22,637	$ 95,440	$ 1,679,739	2.752	3.360	$ 324,948	$ 76,060	$ 248,889	$ 3,458,750
2049	$ 120,445	$ 22,704	$ 97,741	$ 1,777,480	2.821	3.461	$ 339,776	$ 78,580	$ 261,196	$ 3,719,946
2050	$ 122,805	$ 22,771	$ 100,034	$ 1,877,514	2.892	3.565	$ 355,152	$ 81,179	$ 273,972	$ 3,993,918

Notes: Uninflated revenues and costs are in 2007 dollars.
Annual inflation rates of 2.5% and 3.0% are applied for toll revenue and O&M cost respectively.

CHAPTER 9

Recommendations and Next Steps

9.1 Introduction

This chapter summarizes recommendations and next steps to advance the development and future implementation of the managed lanes within the I-75 South corridor. Four major sections are presented in this chapter: preferred alternative, project phasing, financial packages, and recommendations for next steps.

9.2 Preferred Alternative

Based on the combined assessment of traffic and toll revenue, system analysis, toll technology, and capital costs, Alternative A-3 Express Toll Lanes (Cars Only) was considered to be the alternative that provides the most efficient use of public funds. Alternative A-3 has good revenue potential vs. its estimated costs and also operational advantages by limiting to autos only without the need for occupancy enforcement.

Alternative D (mixed ETL) is another alternative to keep in close consideration for further evaluation. Operationally, Alternative D (mixed ETL) needs further analysis of larger vehicles mixing with smaller vehicles when planning roadway characteristics of the managed lane facility. Extra planning is required to guarantee that cars and trucks, with different operational characteristics, can share the facility safely and efficiently.

Alternatives A-1 (HOT2+) and A-2 (HOT3+) were eliminated based on service provided, financial viability (cost vs. benefits), and vehicle occupancy enforcement limitations. Alternative B (TOT) does not maximize benefits during the peak periods since passenger cars cannot take advantage of the lane. Alternatives C-1 (HOT2+/TOT), C-2 (HOT3+/TOT), and C-3 (ETL/TOT) have a very large footprint due to the number of lanes (4 additional lanes each direction) and therefore have a very high cost for the amount of traffic that will benefit.

9.3 Project Phasing

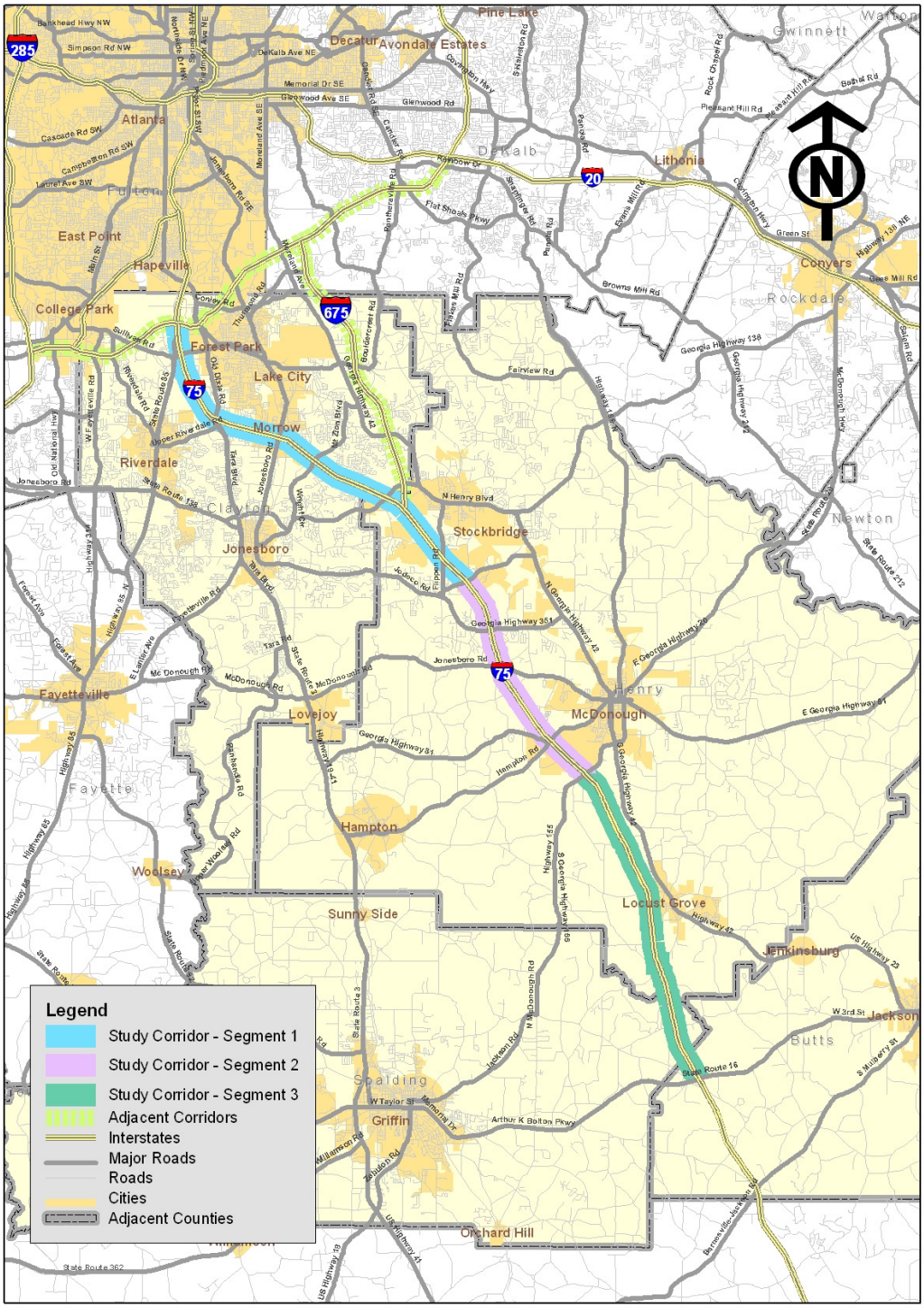
The purpose of the project phasing analysis is to provide SRTA with a process to assess transportation conditions and establish a priority ranking for action along the I-75 South corridor. The entire I-75 South corridor was split to the following three segments based on the travel characteristics and/or existing traffic flow bottlenecks:

- Segment I: I-75 South from I-285 to Hudson Bridge Road/Eagles Landing Parkway
- Segment II: I-75 South from Hudson Bridge Road/Eagles Landing Parkway to
- SR 155

- Segment III: I-75 South from SR 155 to SR 16

Figure 9-1 illustrates the three segments along the I-75 South Corridor.

Figure 9-1: Study Corridor by Segments



This section details the evaluation criteria, summarizes the methodology used in evaluating and prioritizing I-75 South managed lane segments based on the evaluation criteria; and finally presents the ranking/prioritization results.

9.3.1 Evaluation criteria

It is important to establish the evaluation criteria available to assist with ranking efforts. The established key performance evaluation criteria focused on access, congestion and estimated travel benefits, system connectivity, potential safety and reliability, and link to Regional Transportation Plan and design activities.

Table 9-1 presents the criteria used to rank the I-75 South project segments.

Table 9-1: Ranking Performance Measures

Performance Categories	Performance Measures
Access	Population Served within 5-mile buffer
	Jobs/Employment served within 5-mile buffer
Congestion and Estimated Travel Benefits	Total Daily Demand
	Travel Time Index (Peak Period)
	Total Vehicle Delay Reduction (Peak Period)
System Connectivity	Connectivity to existing HOV system
	Connectivity to future managed lane system
	Connectivity to activity centers
Potential Safety and Reliability	Accident rate on the existing system
Envision6 Regional Transportation Plan (RTP) and Design Activities	Segment included the Envision6 RTP
	Design activities underway

Access

This performance category evaluates the level of access and connectivity that the project segment provides to the population and employment in the study area. Geographic Information System (GIS) tools were used to create a buffer zone of a 5-mile radius for each project segment. The segment that has higher level of access or market (larger population and employment served) will be considered more favorably than those with lower level of access.

Congestion and Mobility Benefits

This performance category evaluates the following evaluation factors.

- Total Daily Demand

  Generally, transportation benefits correspond to the number of users. The greater the traffic volume or person throughput – the more benefit is typically derived from an improvement. For this reason the total daily demand including (SOVs, HOVs, Commercial Vehicles and Trucks) was evaluated. Project segments with high total daily demand were ranked higher than those with lower total daily demand.

- Travel Time Index (Peak Period)

  Congestion on the project segment is an important measure of performance. One of the tools used to measure congestion is the Travel Time Index (TTI) – which compares congested travel speeds in peak periods to free flow travel speeds. The higher the TTI the more congested a segment is considered. The composite TTI was calculated by extracting the highest TTI value from the AM and PM peak period analysis by direction. Project segments with higher composite TTI scores were ranked higher than those with lower composite TTI scores.

- Total Vehicle Delay Reduction (Peak Period)

  Derived from year 2030 travel demand models, this performance measure reflects the effects of managed lane segments on reducing total vehicle hours of delay that occur on I-75 South General-Purpose lanes due to traffic congestion during peak period. This measure calculates the differences in total vehicle delay on each segment with and without managed lane investment during the AM and PM peak periods. The higher the delay reduction, the more effective the segment is in reducing peak traffic congestion. Project segments with greater total vehicle delay reduction were ranked higher than those with less total vehicle delay reduction.

System Connectivity

This performance category evaluates analysis segments in terms of connectivity to:

- Existing HOV system;
- Future managed lane system; and
- Major activity centers.

Project segments that provide connectivity to the existing/future HOV/managed lane system and major activity centers were considered more favorably than isolated segments. In addition, segments that demonstrate independent utility will have higher priority than segments that require one or more project sections implemented to become fully operational.

Potential Safety and Reliability

Based on the safety analysis conducted for existing conditions on I-75 South corridor, it was found that crash types, severity and direction of travel appeared to correlate closely with peak period congestion and its corresponding changes in vehicular speed. For example, segments of high congestion and likely lower speeds demonstrate higher crash rate than segments with low congestion. It was assumed that barrier-separated managed lane facilities would provide improved travel reliability and less delay, and therefore, potentially enhance the safety along the study corridor. Project segments with higher overall crash rate were ranked higher than those with lower overall crash rate.

Envision6 RTP and Design Activities

This performance category favors constructability with special consideration towards project segments in the Atlanta Regional Commission (ARC)'s Envision6 2030 Regional Transportation Plan. It also gives higher priority to project segments with completed or ongoing design activities.

9.3.2 Project Segment Phase Ranking

Table 9-2 presents the values for each performance measure discussed above. The performance values were obtained from the field, GDOT crash databases, ARC's latest socio-economic forecasts (population and employment) and outputs from the travel demand model.

The rating of each performance measure was set to the lowest number zero when the evaluation results are least desirable, and the highest score two was assigned for the most beneficial evaluations. Project segments were staged and prioritized according to the overall rating summation of individual indicators. The results of the Project Segment Phase Ranking are shown in table 9-3.

Table 9-2: Segments Ranking Values

Segments	Access		Congestion and Estimated Travel Benefits			System Connectivity			Potential Safety and Reliability	Envision6 RTP and Design Activities	
	Population Served within 5-mile buffer	Jobs/ Employment served within 5-mile buffer	Total Daily Demand	Travel Time Index (Peak Period)	Total Vehicle Delay Reduction (Peak Period)	Conn. to existing HOV system	Conn. to future managed lane system	Conn. to activity centers	Accident rate on the existing system (2000-2005)	Included the Envision 6 RTP	Design activities underway
Segment I: From I-285 to Hudson Bridge Rd / Eagles Landing Pkwy	443,826	286,113	201,598	2.49	6,438	Yes	Yes	Yes (3)	286	Yes	Yes
Segment II: From Hudson Bridge Rd / Eagles Landing Pkwy to SR 155	126,150	61,937	184,211	3.68	10,930	No	No	Yes (1)	289	No	Yes
Segment III: From SR 155 to SR 16	59,875	16,050	175,994	3.50	14,679	No	No	Yes (1)	133	No	No

Table 9-3: Segments Ranking Scores

Segments	Access		Congestion and Estimated Travel Benefits			System Connectivity			Potential Safety and Reliability	Envision6 RTP and Design Activities		Total Score
	Population Served within 5-mile buffer	Jobs/ Employment served within 5-mile buffer	Total Daily Demand	Travel Time Index (Peak Period)	Total Vehicle Delay Reduction (Peak Period)	Conn. to existing HOV system	Conn. to future managed lane system	Conn. to activity centers	Accident rate on the existing system	Included the Envision 6 RTP	Design activities underway	
Segment I: From I-285 to Hudson Bridge Rd / Eagles Landing Pkwy	*2*	*2*	*2*	*0*	*0*	*2*	*2*	*2*	*1*	*2*	*2*	*17*
Segment II: From Hudson Bridge Rd / Eagles Landing Pkwy to SR 155	*1*	*1*	*1*	*2*	*1*	*0*	*0*	*1*	*2*	*0*	*2*	*11*
Segment III: From SR 155 to SR 16	*0*	*0*	*0*	*1*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*3*

9.4 Financial Packages

9.4.1 Introduction

The traditional resource pool that the United States government has relied upon to fund transportation projects is evaporating. To supplement the depleting supply, other ways of funding projects should be analyzed. In the past, and as part of the current funding approach, State and local taxes and fees have served as the primary financial mechanism to pay for transportation infrastructure projects. Federal grants based on the national motor fuel taxes are also a component in the transportation funding mix. As these funds become available, the transportation projects move forward in phases or incrementally over time. The traditional transportation financing system does not account for costs associated with the delay or time it takes to complete the construction of a project. The "pay-as-you-go" method conservatively plots projects over a period of years and is tied closely to Federal and State cash management policies, with state and local public transportation agencies carrying the burden of responsibility.

State and local governments recognize the costs inherent in construction delay such as inflation, foregone economic development, and increased construction and right-of-way costs, but the traditional financing system limits creative solutions. Exacerbating the funding crisis, public resources are becoming inadequate as increasing demands are placed on the transportation infrastructure. The relatively simplistic funding approach and low risk associated with the pay-as-you-go method is no longer a viable approach. Previously, the risks and interest costs associated with incurring debt may have deterred transportation agencies from exploring innovative financial approaches. Given growing demand for transportation projects and pressure to implement projects quickly, one solution is to use innovative financial techniques fairly new to the public transportation sectors.

The passage of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) provides the framework that shapes the process for highway infrastructure projects and sets the parameters for funding and implementing transportation projects. The legislation recognizes the funding crisis confronting transportation infrastructure and responds by encouraging financial creativity and innovation to fill the gap between available resources and transportation funding needs. Passed on August 10, 2005, SAFETEA-LU enhances existing finance programs and entices private sector investment. The legislation alters the financial guidelines to allow for financial flexibility. New funding programs and policies and the use of tolls and bonds are important changes that make financing highway infrastructure projects more attractive to the private sector. Management of the roadway network to promote real-time traffic management, to improve transportation security, and to better inform travelers and emergency responders of conditions is also included in SAFETEA-LU. These policies lend transportation professionals tools to increase funding flexibility, efficiency, and effectiveness.

9.4.2 Financing Options

The funding approach should be tailored to the transportation project's goals and objectives. Several financing options are listed in the table below.

Table 9-4: Financing Options

Funding Mechanism	Description	Program Highlights	Application Procedure/ Requirements	Project Type	Benefits/ Risks
Transportation Infrastructure Finance and Innovation Act (TIFIA)	A Federal program under which the U.S. Department of Transportation (USDOT) provides credit assistance to major surface transportation projects of national or regional significance, which include: ***Secured (Direct) Loan***: Maximum term of 35 years from substantial completion. Repayments must start 5 years after substantial completion. ***Loan Guarantee***: Guarantees a project sponsor's repayments to non-Federal lender. Loan repayments to lender must commence no later than 5 years after substantial completion of project. ***Line of Credit***: Contingent loan available for draws as needed up to 10 years after substantial completion of project.	SAFETEA-LU continues the TIFIA credit program established under TEA-21. A total of $610 million is authorized through 2009 to pay the subsidy cost of supporting Federal credit under TIFIA. TIFIA loan and loan guarantee proceeds to refinance long-term project obligations or Federal credit instruments if such refinancing provides additional funding capacity for the completion, enhancement, or expansion of new transportation infrastructure. The annual credit assistance limitation is removed and the annual budgetary limitation, which represents the cost to the government of providing TIFIA credit assistance, is set at $122 million per year. The TIFIA office estimates that these budget resources can fund up to $2.5 billion of credit assistance annually. The TIFIA eligibility threshold is lowered from $100 million to $50 million generally, or from 50 percent to 33 percent of a state's annual Federal-aid apportionment for highway projects, whichever is lower. The threshold for Intelligent Transportation System projects is also lowered from $30 million to $15 million. Eligibility for TIFIA credit assistance is extended to public freight rail facilities, private freight rail facilities providing public benefits, intermodal freight transfer facilities and port improvements necessary for intermodal access.	U.S. DOT posts a Notice of Funding Availability in the Federal Register each year. Projects that the U.S. DOT find meet criteria can then apply for credit assistance based on their scheduling needs. Senior project debt must be rated Investment grade. Federal requirements (Civil Rights, NEPA, Uniform Relocation, Titles 23/49) of the appropriate U.S. DOT grant program apply to the use of TIFIA loan proceeds; Projects are scored according to the following weighted selection criteria: • Significance - 20 % • Environment - 20 % • Private Participation - 20 % • Creditworthiness - 12.5 % • Project Acceleration - 12.5 % • Use of Technology - 5 % • Budget Authority - 5 % • Reduced Grant Assistance - 5 % **Steps** **1.** The TIFIA Joint Program Office (JPO) can accept letters of interest from potential applicants at any time. Limited to 10 pages, letters should include: • Brief project description • Description of proposed financing • List of project participants • Summary of project benefits • Summary of the status of environmental reviews **2.** Sponsor prepares and submits application to the DOT **3.** U.S. DOT staff prepare preliminary evaluation and arrange sponsor presentation **4.** U.S. DOT staff prepare final evaluation and make recommendation to TIFIA Credit Council **5.** TIFIA Credit Council provides recommendations to the Secretary, who selects projects to receive TIFIA Credit Assistance **6.** U.S. DOT issues term sheet and obligates funds **7.** U.S. DOT executes credit agreement and disburses funds	Revenue Projects that Require Credit Assistance	**Benefits** Improved access to capital markets; Flexible repayment terms; Potentially more favorable interest rates than can be found in private capital markets for similar instruments; **Risks** Dedicated revenues must be pledged to repay the TIFIA loan; **Fees** The TIFIA JPO requires each applicant to pay a non-refundable application fee of $30,000; Each borrower will be required to pay a credit processing fee equal to a portion of the costs incurred by the TIFIA JPO in negotiating the credit agreement. This fee typically range from $100,000-$300,000. Borrowers are also required to pay a $11,000+ loan servicing fee annually. These fees cannot be included among eligible project costs.

Funding Mechanism	Description	Program Highlights	Application Procedure/ Requirements	Project Type	Benefits/ Risks
Section 129 Loans	The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) amended Section 129 of Title 23 United States Code (U.S.C.) to allow Federal participation in a state loan to a toll project. The National Highway System Designation Act of 1995 (NHS Act) further expanded this Federal-aid eligibility to include state loans to non-toll projects with a dedicated revenue stream. Such revenue streams can include excise taxes, sales taxes, real property taxes, motor vehicle taxes, incremental property taxes, or other beneficiary fees.	States may make Section 129 loans to a public or private entity to construct either a toll project that is eligible for Federal-aid funding or a non-toll highway project that has a revenue source specifically dedicated to support the project. The amount loaned by the state is considered an eligible Federal-aid project cost.	There are no Federal requirements that apply to how a state selects a public or private entity to be a recipient of a Section 129 loan. Rather, this selection process is governed by state law, and it is the state's responsibility to ensure that the recipient uses the loan for the specified purposes. Assuming that a project meets the test for eligibility, a loan can be made at any time. The Federal-aid loan may be for any amount, provided the maximum Federal share (typically 80 percent) of the total eligible project costs is not exceeded. Total eligible project costs are limited to the costs of engineering, right-of-way acquisition, and construction at the time the FHWA authorizes the loan to be made. In other words, a loan can be made to an active, eligible project, but the amount cannot include the cost of work done prior to the loan authorization. A project loan can be authorized in conjunction with advance construction. Loans must be repaid to the state, beginning within five years after construction is completed and the project is open to traffic. Repayment must be completed within 30 years after the date Federal funds were authorized for the loan.	Revenue Projects that Require Credit Assistance	Section 129 loans allow states to leverage additional transportation resources and recycle assistance to other eligible projects. States have the flexibility to negotiate interest rates and other terms of Section 129 loans. When a loan is repaid, the state is required to use the funds for a Title 23 eligible project or credit enhancement activities, such as the purchase of insurance or a capital reserve to improve credit market access or lower interest rate costs for a Title 23 eligible project.

Funding Mechanism	Description	Program Highlights	Application Procedure/ Requirements	Project Type	Benefits/ Risks
State Infrastructure Banks (SIBs)	The SIB programs authorizes all States to enter into cooperative agreements with the Secretary of Transportation to establish infrastructure revolving funds eligible to be capitalized with Federal transportation funds authorized for fiscal years 2005-2009. SIBs offer a range of loans and credit assistance enhancement products to public and private sponsors of Title 23 highway construction projects or Title 49 transit capital projects.	States participating in the new SIB program may capitalize the account(s) in their SIBs with Federal surface transportation funds for each of fiscal years 2005-2009 as follows: • **Highway account** – up to 10 percent of the funds apportioned to the state for the National Highway System Program, the Surface Transportation Program, the Highway Bridge Program, and the Equity Bonus; • **Transit account** – up to 10 percent of funds made available for capital projects under Urbanized Area Formula Grants, Capital Investment Grants, and Formula Grants for Other Than Urbanized Areas; and • **Rail account** – funds made available for capital projects under subtitle V (Rail Programs) of Title 49, United States Code. A state must match the Federal funds used to capitalize the SIB on an 80-20 Federal/non-Federal basis, except that for the highway account, the sliding scale provisions apply.	SIBs may provide the following forms of assistance: **Loans:** • Loans at subsidized rates and/or with flexible repayment provisions • Grant Anticipation Notes (GANs) • Short-term construction or long-term debt financing • Certificates of Participation **Credit Enhancement:** • Capital reserves and other security for bond or debt instrument financing • Letters of credit (direct pay or stand by) • Lines of credit • Bond insurance and loan guarantees	Revenue Projects that Require Credit Assistance and Traditional Non-Revenue	**Benefits** Leveraged SIB funds enhance funding for transportation projects by offering the sponsor a chance to attract private, local, and additional state financial resources SIB capital can be used as collateral to borrow in the bond market or to establish a guaranteed reserve fund. SIB funds can accelerate construction timelines for projects with dedicated revenue source, and recycle assistance for future transportation projects **Risks** Loan demand, timing of needs, and debt financing considerations are factors to be considered by states in evaluating a leveraged SIB approach.
GARVEE Bonds	A GARVEE is a designation applied to a debt financing instrument that has a pledge of future Federal-aid for debt service and is authorized for Federal reimbursement of debt service and related financing costs.	This financing mechanism generates up-front capital for major highway projects that the state may be unable to construct in the near term using traditional pay-as-you-go funding approaches.	States can receive Federal-aid reimbursements for a wide array of debt-related costs incurred in connection with an eligible debt financing instrument, such as a bond, note, certificate, mortgage, or lease, the proceeds of which are used to fund a project eligible for assistance under Title 23. The issuer may be a state, political subdivision, or a public authority.	Traditional Non-Revenue	**Benefits** Enables a state to accelerate construction timelines and spread the cost of a transportation facility over its useful life rather than just the construction period. Serves to expand access to capital markets, as an alternative or in addition to potential general obligation or revenue bonding capabilities.

Funding Mechanism	Description	Program Highlights	Application Procedure/ Requirements	Project Type	Benefits/ Risks
Funds Management Techniques	• Matching flexibility includes Tapered Match, Toll Credits, Third Party Donations • Advance Construction			Traditional Non-Revenue	
Toll Revenue Credits	The Transportation Equity Act for the 21st Century (TEA-21) codifies provisions similar to those authorized by section 1044 of the ISTEA which allows the States to accumulate credits to be applied to the non-Federal share of certain highway and transit projects. The credits are based on toll revenues used to build, improve, or maintain certain highways, bridges, or tunnels.	Section 1044 of the Intermodal Surface Transportation Efficiency Act (ISTEA) and, later, Section 1111(c) of TEA-21 permitted states to substitute certain previous toll-financed investments for State matching funds on current Federal-aid projects. This means that the non-federal share of a project's cost may be met through a "soft match" of toll credits. This increases the flexibility of state transportation finance programs by allowing states to use toll revenues when other state highway funds are not available to meet non-Federal share matching requirements.	Toll credits are earned when the state, a toll authority, or a private entity funds a capital transportation investment with toll revenues earned on existing toll facilities (excluding revenues needed for debt service, returns to investors, or the operation and maintenance of toll facilities). The amount of credit earned equals the amount of excess toll revenues spent on non-Federal highway capital improvement projects. To utilize this tool, the state must pass an annual maintenance of effort (MOE) test. The MOE determination covers a state's non-Federal transportation capital expenditures over a 4-year period, and must certify that its toll facilities are being properly maintained before excess revenues can be credited. The expenditures in the last year of the 4-year period must exceed the annual average of the expenditures in the preceding three years of the 4-year period.	Traditional Non-Revenue	By using toll credits to substitute for the required non-Federal share on a new Federal-aid project, the Federal share can effectively be increased to 100 percent. Toll credits are designed to 1) encourage states to increase capital investment in infrastructure; 2) increase the flexibility of state transportation finance programs; and 3) enable states to more effectively utilize existing resources. Over $8 billion of toll credits have been approved in 19 states (FHWA 2001).

Source: Innovative Financing. Web accessed Thursday, December 13, 2007: << http://www.innovativefinance.org/ >>

9.4.3 Pubic Private Partnership (PPP)

Public-private partnerships can be applied to a large range of transportation functions across all modes. These include:

- Project conceptualization and origination;
- Design;
- Financial Planning and finance;
- Construction;
- Operation;
- Maintenance;
- Toll Collection; and
- Program Management.

These activities are typically bundled into contract packages reflecting the public agency's objectives related to: schedule and cost certainty; innovative finance; or transfer of management and/or operational responsibility.

Typical procurement packages include:

- Private sector operations and maintenance on a performance basis;
- Private sector program management for a fee and/or with program costs and schedule maintenance incentives;
- Design-build for fixed fee on fixed time frame;
- Project build-operate-transfer (BOT);
- Design-build finance-operate-transfer (DBFO); and
- Build-own-operate (BOO)

Table 9-5 and table 9-6 present the distribution of roles and responsibilities between the public and private sectors with different PPP options.

Table 9-5: PPP Options - Public vs. Private Responsibilities

Design Bid Build	Private Contract Fee Services	Design Build	Build Operate Transfer (BOT)	Long-Term Lease Agreements	Design Build Finance Operate (DBFO)	Build Own Operate (BOO)	Other Innovative PPPs
PUBLIC Responsibility					PRIVATE Responsibility		

Source: FHWA

Table 9-6: Basic Project Delivery Options

	Own	Conceive	Design	Build	O&M	Financial Responsibility
Design-Bid-Build	Public	Public	Private by fee contract		Public	Public
Design-Build	Public	Public	Private by fee contract		Public	Public
Build-Operate Transfer (BOT)	Public	Public	Private by fee contract			Public
Design-Build-Finance-Operate (DBFO)	Public	Public or Private	Private by fee contract			
Build-Own- Operate (BOO)	Public	Public or Private	Private by contract (concession)			

Source: FHWA

It is noted that PPP projects are often undertaken to supplement conventional procurement practices by taking additional revenue sources and mixing a variety of funding sources, thereby reducing demands on constrained public budgets. Some of the revenue sources used to support PPPs includes:

- Shareholder equity;
- Grant anticipation bonds (GARVEEs and GANs);
- General obligation bonds;
- State infrastructure bank loans;
- Direct user charges (tolls and transit fares) leveraged to obtain bonds; and,
- Other public agency dedicated revenue streams made available to a private franchisee or concessionaire: Leases, Direct user charges from other tolled, facilities, and Shadow tolls

The risks of PPP projects are allocated to either the public or private sector depending on the type of risk and the ability of either sector to control and manage them. In some cases the risks are shared between the parties. The preliminary allocation of risk is used as a guide for the development of the invitation to negotiate documents, and is updated as bids are received and alternative divisions of risk are suggested to offer a value-for-money solution. The final allocation of risks may not be established until the end of the negotiation process. Table 9-7 presents the typical PPP risk allocation by eight major categories.

Table 9-7: Typical PPP Risk Allocation

Risk Type	Describe	Allocation	Mitigation
Technology Performance	• Existing technology unproven in terms of revenue service	Private (vendors)	• Warranties
Environmental Flaws or Delay	• Lengthy studies • Permitting delays • Regulatory approval periods	Public	• Strong process Management • Private Partner assistance
Market Revenues	• Customer willingness to pay for level of service (LOS) unknown; affects interest rate and marketability for project-based revenues financing • Traffic and revenue below projections • Competing/alternative projects • Excessive capital maintenance • Insufficient revenues to fund ongoing O&M	Public and Private (funders/ lenders)	• Investment grade traffic and revenue studies accepted by rating agencies • Adequate debt coverage ratios • Adequate reserves • Credit enhancement, insurance • Toll adjustment flexibility • Careful budgeting processes and O&M controls • Non-compete protections
Completion Costs	• Cost and schedule overruns	Private (construction contractor) and Public	• Use of fixed price/guaranteed maximum contract • Adequate contingency funds • Liquidated damages • Force major insurance • Design and construction management/oversight by Public Partners (which may be • outsourced) • Financially viable Private Partners • Specialized surety products • Allowing Private Partners to undertake majority of design
O&M Costs	• Excessive costs of • Operations • Excessive capital maintenance expenditures • Unpredictability of costs • Regulation of DUC rates and contractor ROR	Private (O&M contractor) and Public	• Non-recourse financing • Minimum guarantees • Toll adjustment flexibility • Credit enhancement, insurance • Careful budgeting processes • Capital asset replacement assurances • Warranties, incentives, and penalties • Financially viable Private Partners • Use of private O&M contract • Use of fixed price/guaranteed maximum pricing, with escalations and adjustments over time
Policy/Political Constraints/ Support	• Uncertainties regarding public policy and change in law • Regulatory uncertainties • Funding support	Public and Private	• Persuasive and supported arguments for project • Early regulatory agency involvement • Public relations and citizen/policymaker education campaign • Community engagement and buy-in strategy
Phasing Timing and Resources	• Uncertainties regarding initial vs. subsequent phase economics	Public and Private	• Strong process Management • Early regulatory agency involvement • Expedited and streamlined procurement process • Early and continuous contact with other states and local governments
Liability	• Construction Defects • Day-to-day operational • Subcontractor claims • Environmental	Public and Private	• Warranties • Insurance • Well-thought out allocation of liability in contract based upon party best able to control and mitigate • Innovative insurance products

Source: FHWA. Web Accessed Thursday, December 13, 2007: << http://www.fhwa.dot.gov/ppp/faq_3.pdf >>

9.4.4 State of Georgia Public-Private-Initiative Process

The State of Georgia "Public-private initiative" is broadly defined in §32-2-78(5) and allows both solicited and unsolicited proposals for PPP projects. Upon prior notice to the Governor, GDOT may solicit proposals. Unsolicited proposals may also be accepted.

Prior legislative approval is not required when an individual PPP proposal is received; however, PPP legislation requires that the report of the proposed letters of intent to negotiate must be submitted to the Governor and the House and Senate Transportation committees, but their approval is not required. In addition, there are not any similar requirements that subject the PPP proposal or the negotiated PPP agreement to a local veto. The relevant law permits all kinds of procurements for PPP project delivery. These include:

- calls for projects;
- competitive RFQ and RFPs;
- qualifications review followed by an evaluation of proposer concepts;
- use of design build;
- procurements based on financial terms such as return on equity rather than on price;
- long-term asset leases for some period of up to 60 years or longer from the time operations commence.

The Georgia Department of Transportation has the authority to enter into PPP contracts in which the State Road and Tollway Authority is a partner in this process. The following sections discuss the implementation steps, funding parameters, PPP project restrictions, and PPP general submittal guidelines.

(a) Implementation Steps

Phase I – Evaluation Phase Activities

- Conceptual RFP Process
- Detailed RFP Process

Phase II – Committee Recommendations

Phase III – Board Consideration of Letter of Intent (LOI)

Phase IV – Development Phase Activities

Phase V – Final Contract Negotiations

(b) Funding Parameters

The current law permits local, state, and federal funds to be combined with private sector investment, and GDOT may make grants and loans. The PPP agreement authorizes the use of tolls and the current law allows TIFIA loans to be used on PPP projects. There is no restriction that prevents the revenues from PPP projects from being diverted to the state's general fund or for other unrelated uses. The relevant law authorizes the public

sector to grant long-term leases/franchises for the construction, operation and maintenance of toll facilities.

In the State of Georgia, the public sector does not have the authority to issue toll revenue bonds or notes. However, the public sector does have the authority to form non-profit corporations that let them issue debt on behalf of a public agency. As amended by Senate Bill (SB) 270, PPP legislation authorizes the creation of non-profit corporations as subsidiaries of the Georgia Highway Authority. The relevant public agency does have the authority to hire its own technical and legal consultants.1

The relevant law does not permit the public sector to make payments to unsuccessful bidders for work product contained in their proposals. In addition, the agency can charge application fees to offset its proposal review costs. PPP legislation permits fees to be set by rules and regulations of the Georgia DOT. A $10,000 fee was established in its PPP guidelines.

(c) PPP Project Restrictions

There are neither expressed limitations on the number of PPP projects nor geographic location restrictions. There are no restrictions on the particular mode of transportation eligible to be developed as a PPP project (e.g., truck, passenger auto, freight rail, passenger rail). There is no legal requirement to remove tolls after the repayment of project debt. The relevant law permits the conversion of existing or partially constructed highways into toll roads. The public sector is not required to maintain comparable non-toll routes when it establishes new toll roads. There are not any non-compete clause prohibitions.

(d) PPP Submittal Guidelines

There is a 2-step submittal process that is authorized by related PPP guidelines. There are explicit exemptions/supplemental procurement authority from the application of the state's general procurement laws and the PPP legislation exempts contracts from public bid requirements. The relevant law protects the confidentiality of PPP proposals and any related negotiations in the period prior to execution of the PPP agreement. After receipt of proposals and completion of competitive interviews, proposals are subject to disclosure, except that proprietary and trade secret information is protected.

The relevant law allows adequate time for the preparation, submission and evaluation of competitive proposals. The agency should have the authority to establish these deadlines on a case-by-case basis depending on the complexity and scope of the initial proposal or other factors that might promote competition (e.g., more review time during holiday periods). The PPP legislation provides that the period for submission of competing proposals is 135 days.

The relevant law specifies evaluation criteria for PPP proposals received under a given procurement approach. Evaluation Committee consisting of a designee of the Governor, a Governor's designee with finance background, the Commissioner of GDOT, the

[1] FHWA Public Private Partnerships Legislative Review. Analysis for the State of Georgia. Web Accessed Thursday, December 13, 2007: << http://www.fhwa.dot.gov/ppp/legis_georgia.htm >>

Director of the Tollway Authority and the Director of the Georgia Regional Transportation Authority established §32-2-78, as amended by SB 270. GDOT Initial Review Committee and Advisory Panel created in PPP guidelines.

9.4.5 Application of funding techniques to I-75 south corridor

The previous sections have outlined the bounds of the PPP process. This section uses these guidelines and suggests how they can be applied to the I-75 South Corridor. Assumptions regarding the design and operation of the facility, the extent of private sector participation, and variety of funding sources are required in order to assign the appropriate funding mechanism. The construction of a managed lane system is assumed as integration into the regional managed lanes system plan. As described previously, SAFETEA-LU encourages innovative financing techniques and private sector participation.

The extent of private sector participation needs to be assessed by the governing agency, but it is assumed that active private sector funding and management is desired to capitalize on private funding sources. Although long-term lease agreements have the opportunity for significant upfront investment, the added a level of political complexity involved with return on investment expectations driven by predominantly foreign investment and the loss of local public control over toll rates and revenue streams may dissuade transportation decision-makers from choosing this option. The efficiencies and effectiveness of design-build or design-build-operate-maintain, also called “turnkey,” project delivery options may provide a more appropriate method for the I-75 South corridor. Under a turn-key project delivery method, the public sector retains the operating revenue risk and supplies the financing. The private sector efficiencies are captured under a “turnkey” project with the added benefit of any surplus operating revenue collected by the public sponsoring agency. Georgia PPP law allows for the diversion of funds to State’s general fund or other unrelated uses and this flexibility may prove as a useful revenue generation tool for the State.

Dependent on the funding mechanism, a non-profit entity formation is required as the public sector does not have the authority to issue toll revenue bonds or notes. It is assumed that toll revenue bonds would be included in the funding mixture; therefore a non-profit corporation established as a subsidiary of the Georgia Highway Authority would be required. Toll Revenue Bonds use the anticipated toll revenue stream to finance projects expected to provide funds in the future for the repayment of debt and need to be issued by a non-profit corporation.

Additional funding options are TIFIA loans, the GARVEE Bond program, General Obligation Bonds, and National Highway System or SIB program. If TIFIA loans are to be used, as shown previously the following criteria must be met:

- The project's estimated eligible costs must be at least $50 million or 33 percent of the state's annual Federal-aid highway apportionments, whichever is less;
- Senior project debt must be rated Investment grade;
- Dedicated revenues must be pledged to repay the TIFIA loan;
- Federal requirements (Civil Rights, NEPA, Uniform Relocation, Titles 23/49) of the appropriate U.S. DOT grant program apply to the use of TIFIA loan proceeds.

Other projects in the Atlanta region have used the GARVEE Bond program to finance the preliminary engineering phase. The procurement of right-of-way has employed General Obligation Bonds.

States participating in the new SIB program may capitalize the account(s) in their SIBs with Federal surface transportation funds for each of fiscal years 2005-2009 with up to 10 percent of the funds apportioned to the state for the National Highway System Program, the Surface Transportation Program, the Highway Bridge Program, and the Equity Bonus for highways.

If a transit component is included in the I-75 South corridor, SIB financing of up to 10 percent of funds made available for capital projects under Urbanized Area Formula Grants, Capital Investment Grants, and Formula Grants for Other Than Urbanized Areas can be used.

A state must match the Federal funds used to capitalize the SIB on an 80-20 Federal/non-Federal basis, except that for the highway account, the sliding scale provisions apply. While the state SIBs authorized by the USDOT under the pilot program began with an initial infusion of Federal funds and non-Federal matching contributions, states also have the opportunity to contribute additional state or local funds beyond the required non-Federal match.

9.5 Recommendations for Next Steps

The intent of this study is to determine the financial and operational feasibility of the managed lanes (HOT, ETL, TOT) on the I-75 South corridor, through a planning-level analysis, and to initiate a process that may ultimately lead to future project implementation and operations. It was found in the study that the potential to implement Managed Lanes in the I-75 South corridor is promising and managed lanes could provide benefits to both I-75 South corridor and the surrounding transportation system.

The next steps will include: briefings to area leadership of the study key findings; educating the public on managed lanes concepts to gain public understanding; and garnering local and political support for I-75 South Managed Lane project. The key findings of this project will be also included in the Georgia Department of Transportation's Managed Lane System Plan.

If a decision is made to proceed with the future implementation of managed lanes on the I-75 South corridor, further detailed studies and analyses will be necessary. The studies include but are not limited to: a more detailed financial feasibility study, investment-grade traffic and revenue analyses, comprehensive engineering design and operational analysis and more comprehensive consideration of the institutional and political/public issues. In the following section of the technical memorandum, those studies and analyses are presented in detail.

9.5.1 Financial Feasibility Study

The assessment of the potential for Managed Lanes on the I-75 South Corridor revealed a promising outlook for implementation. While the assumptions for cost and revenue estimates were appropriate for that phase, a future analysis is necessary to determine

how cost and revenue relate in context of finance: (1) Capital costs will be dependent on construction period and phasing; (2) Revenues will be dependent on opening date. It is in the next phase that a financial feasibility study would need to be conducted in greater detail at an investment grade level to determine the financial feasibility and financing options available to proceed with project implementation.

Investment Grade Traffic and Revenue Analysis

Investment grade traffic and revenue analysis of the proposed managed lane project needs to be conducted to support and secure financing. The investment grade traffic and revenue analysis is intended to refine traffic forecasts and revenue estimates for accuracy. The analysis would include extensive studies with new data regarding traffic volumes and patterns during different times of the year and different times of the day, travel times by various alternative routes, trips origins and destinations (O-D) in the corridor, future economic conditions and development/growth patterns and opportunities. It would explore the potential upside and downside risks associated with numerous assumptions to promote investor confidence in project financing using either public or private sector bonds. The investment grade traffic and revenue analysis also finalizes funding arrangements in the project financial plan, and serves as a prospectus of toll road revenue performance for bond rating agencies.

Traffic and revenue estimates for managed lanes are influenced by the existing and projected land use and development in the proximity of the facility. Assumptions need to be clearly defined and should include base year population, socioeconomic data, and land use. The optimum toll rate should be established. The financial plan needs to be developed to identify the potential bonding capacity of the project. The factors should be based on conservative assumptions and include:

- cost of finance;
- period of finance and interest rate; and
- debt service coverage ratios and reserve accounts.

The tolling agency should consult a financial advisor to evaluate debt structures to maximize bond proceeds and determine the most efficient debt service payment schedule. The investment quality of rating needs to be at least BBB in order to secure market investment. A prospectus on the project provides a potential investor with the risk assumptions and capability of the project to repay debt on the bond issue. To issue investment quality debt, a study must be done to outline the risk to the potential investor. Objective analysis on the local economy and growth potential, along with numerous scenario tests and sensitivity testing, help to show the potential range of revenue generation and the capacity to repay the bond debt. Event and political risk are out of the control of forecaster and the timing of alternative improvements can greatly change the expected revenue results. Other risks include the cycles of the economy and the elasticity of demand for the managed lane.

Ramp-Up is a term used to describe the period from when a toll road first opens to traffic until it achieves the steady traffic flow predicted by the travel model. The Ramp-Up period is when the user decides if and when the use of the managed lanes makes economic sense; this may take months or even years.

Cost of Finance

An evaluation by a financial advisor should be conducted to determine the best financial package. The cost of finance includes bond underwriters' fees, rating agency costs,

preparation of bond documents, and other cost of issuance. Cost of issuance is often estimates at 1.5 percent of the bond size.

Period of Finance and Interest Rates
The period of finance needs to be determined. Projects use a variety of time frames including 40, 50 or even 99 years. Interest rates change over time and can impact the feasibility of projects and financial structure. Test should be conducted to see how higher interest rates impact project finances.

Debt Service Coverage Ratio and Reserve Accounts
Projects financed with bonds use a debt service coverage ratio as a mechanism to protect investors from revenue risk. Coverage ratio is the net revenues divided by annual debt service. The riskier the project, the higher this ratio will be. A debt service coverage ratio range of 1.4 to 1.7 times the annual debt service repayment amount is typically required for senior lien debt. There will be a construction period where bond repayments are being made but no revenue is being collected. Interest rate payment for the period between issuance of bonds and the start-up of revenue collection needs to be capitalized and included in the bond amount.

The financial plan needs to include debt service reserve accounts funded by the bond issue. The reserve accounts in the preliminary finance plan are usually 125 percent of the average annual debt service amount. Other sources of funds can be used to create these reserves to achieve an investment-grade rating. These include federal loans, TIFIA bonds, and the use of SIBs as outlined in the Financial Options section of this report.

9.5.2 Engineering Design and Traffic Analyses

More detailed engineering and traffic analyses need to be performed to develop the final typical cross sections for the managed lanes, to identify and finalize the ingress and egress locations, and to determine the specific tolling zone locations and overall tolling scheme. The items to be further studied are listed below:

- Cross Section
  A more detailed analysis of the cross section of the managed lane configuration is required to specifically address the buffer width and ways to maximize the width while minimizing impact to the general purpose lanes and shoulders.

- Ingress and Egress Locations
  This study has analyzed the ingress and egress points recommended in the Georgia Department of Transportation (GDOT)'s HOV System Implementation Plan for the managed lanes, but the ingress and egress points need to be further refined to carry forward into design and implementation. The general origins and destinations (O-D) of travel in the I-75 South corridor should be collected to match the access point locations with the corridor's travel patterns so that the interruption to traffic flow on the managed lanes can be minimized.

- Refine Tolling Zone Locations
  The analysis of the approximate locations for the tolling zones along the managed lane system was performed as part of the study to ensure equitable tolling and complete coverage of the system. The approximate tolling zone locations was

determined to ensure the ability of establishing a tolling policy and toll rates that are relatively easy to understand and explain as well as feasible to sign. The tolling zone locations needs to be further refined through a solid understanding of the corridor's O-D travel patterns and through working with public opinion on the tolling information interface.

- Signing and Striping Schematics
  Once the geometry, access, and tolling locations are finalized, development of a signing and striping schematic can proceed. Appropriate guide, warning, regulatory, and informational signing will need to be determined in order to effectively guide managed lane users into and out of the facility and advice them of the toll amounts.

- Refine Cost Estimates and Schedule
  A planning level capital cost and operation/maintenance cost was developed as part of the study. As further detail is developed for the engineering concepts and design, the project total cost estimates will be refined and updated to include the cost escalations, risk, mobilization, staging, financing costs, right-of-way, utilities, contingencies, operations and maintenance over the life time of the managed lane facility. The implementation schedule by phases for the managed lane along the I-75 South corridor will needs to be developed.

  Estimated construction costs are subject to price volatility for a variety of factors including construction volumes, material supply and demand, oil prices, and environmental issues. These are all difficult cost factors to foresee. The table below show expected ranges in cost estimation accuracy as provided by the Association for the Advancement of Cost Engineering. The cost estimation presented in this study falls under the Class 5 level.

Estimate Class	Level of Project Definition	End Usage	Expected Accuracy Range (L= Low; H= High)
Class 5	0% to 2%	Screening of Feasibility	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Concept Study or Feasibility	L: -5% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget, Authorization, or Control	L: -10% to -20% H: +10% to +30%
Class 2	30% to 70%	Control or Bid/Tender	:L -5% to -15% H: +5% to +20%
Class 1	50% to 100%	Check Estimate or Bid/Tender	L: -3% to -10% H: +3% to +15%
Source: Skills & Knowledge of Cost Estimating, AACE International, Fifth Edition			

Assuming a decision is made to move forward, final engineering design and plan development will proceed. Final geometry, grading, paving, drainage, and other construction details will be developed and incorporated into the plans. Specialty design items will also be developed and described in the plan set, which will include ingress and egress details, signing and striping, toll collection infrastructure requirements, and other unique items. Detailed specifications, construction plans, as necessary, and engineers cost estimates will also be developed during this phase of the project.

It is important to note that any alternative identified is for the purpose of judging its feasibility and potential for implementation. All alternatives are subject to modification based on a National Environmental Policy Act (NEPA) review which will need to be performed subsequent to this feasibility study.

9.5.3 NEPA Process

As discussed earlier, the preliminary feasibility analysis is subject to more detailed review and refinement in the NEPA process. Environmental review and approval is required under federal NEPA legislation in order to quality for federal funds of any kind and following the process is standard practice for substantial investment even if no federal funds are sought. The environmental process will identify the precise location of the facility, its engineering design features, its right-of-way footprint, and the project's environment impacts, commitments, and mitigation measures. The NEPA process solicits input from agency stakeholders and the community to ensure they have a role in project development. Assuming a project opening year in 2020 and the construction beginning in 2015, the NEPA process should begin by 2010. Depending on the impacts, an appropriate degree of analysis (Categorical Exclusion, Environmental Assessment, or Environmental Impact Statement) will be selected and applied.

9.5.4 Public Outreach Program and Marketing Program

The formal development and execution of the public outreach program should be carried out. Public participation and understanding in the development of the managed lane plan and the implementation of the managed lanes is critical to the success of the project. It is important to establish the profile of the anticipated customer base in order to effectively design a system that will meet their needs. Public involvement from the beginning of the project will result in enhanced public acceptance when the system is ultimately deployed.

The outreach program should include elected county and state officials who will play a critical role in communicating the managed lane concept to the public. It will be important to foster a project champion who can tout the benefits and keep the momentum up throughout the implementation process. As the public outreach process moves forward, the need for a clear, detailed description of how the managed lane facility will operate and how the toll revenue will be collected is important to the effectiveness of the outreach. Arrangements and interagency agreements for the means and payment of enforcement will need to be developed.

A marketing effort is seen as an important step to ensure the success and the ultimate long-term implementation of the managed lane project. The marketing program can be developed and implemented to explain the concept of the managed lanes, develop communication strategies and improve user and agency communications by establishing a toll-free hotline, media kits, customer service etc.

9.5.5 FHWA Coordination and Approval

Since the managed lane project is proposed for an interstate highway, Federal Highway Administration (FHWA) approval is necessary. Close and early coordination with FHWA is required to ensure that the managed lanes on the I-75 South corridor are compliant with FHWA guidelines. Appropriate documentation is currently available to begin

discussions and coordination with FHWA for the review and eventual approval of the project before its implementation.

It is recommended that FHWA be briefed on the project and solicited for submission requirements for project approval if the project is decided to move forward.

9.5.6 Atlanta Metro and Local Transit and Transportation System Connections

The Regional Transportation Plan (RTP) acts as the policy plan that guides transportation planning for at least the next 20 years. In the Atlanta region, the RTP is re-visited every four years due to its air quality non-attainment designation from the United States Environmental Protection Agency (USEPA). GDOT's Managed Lanes System Plan, a comprehensive study of various managed lanes investment, currently underway will provide a regional framework and guidance for the development and implementation of managed lanes in the Atlanta metro area. Being an important piece of the Atlanta interstate network, the I-75 South managed lane project should integrate into this system.

The project planning and vision in the I-75 South corridor need to coordinate with other projects in region. I-75 South is an important corridor independently and as a component of a regional system. The Atlanta Regional Commission's RTP contains managed lanes projects for the region and County's should coordinate their transportation planning efforts with the Transportation Improvement Program (TIP), which is a priority spending program developed out of the RTP that is prepared, at a minimum, every four years and is recognized as the metro area's portion of the Statewide Transportation Improvement Program (STIP). Additional coordination between the transportation planning projects in the RTP's TIP and the County's construction work program should occur to synchronize transportation project implementation.

In order to be considered as a project on the RTP, a proposed project must pass a number of criteria. Transportation planners and engineers determine how the project will benefit the regional transportation network. The project must be sponsored by agencies authorized under Federal law such as a county or municipal government, DOT, regional transportation authority, or private, non-profit or civic organizations that can coordinate with a government agency. These sponsors prioritize strategies or projects according to goals of their respective jurisdiction, which are then incorporated in the regional priority list by the ARC to begin the regional planning process and create the long-range RTP. After a public involvement period, the projects are prioritized based on public input and the plan undergoes testing for financial constraints and conformity to federal air quality standards. The draft RTP is released for public comment and the RTP goes before the ARC committees and Board for consideration and eventual adoption. The first six years of the highest priority projects are further ranked and evaluated for inclusion into the TIP, which is then released for public comment. The TIP goes before ARC committees and Board for consideration and eventual adoption. The TIP then goes to state (GRTA) and federal authorities for approval. Following approval, funds flow to project sponsors to begin preliminary engineering and right-of-way acquisition, followed by construction.

Coordination with GRTA and other transit agencies will be needed as the Managed Lanes allow transit to operate on congestion-free highways, making transit more

competitive with car use as a transportation mode. Additionally, the toll revenue generated could be made available to fund other transportation modes such as transit and carpooling.

9.5.7 Operations and Enforcements

The needs of operations and enforcement for the managed lanes on the I-75 South corridor will be further refined. If it is decided to contract out operations of the facility, the procurement of those services needs to occur. The development of a request for proposals (RFP) for such services will occur allowing sufficient time to have the contractor selected in advance of the implementation. Concurrent with the procurement of an operations contractor (if outsourced), establishment of operating agreements with state or local police agencies is required in advance of the opening of the facility. A full understanding of the operation and enforcement needs for the facility is needed in order to effectively partner with police agencies for enforcement of traffic and toll regulations on the facility.

9.5.8 Monitoring Program

A series of monitoring program should be implemented when the managed lane system is open to traffic. The monitoring program can evaluate the success of the managed lane system in reducing congestion and overall travel times during different times of the day. The public acceptance survey, levels of managed lane usage, traffic and revenue tracking, evaluation of violation and enforcement issues can be conducted to measure the managed lane system performance. This monitoring program is especially important for a region's first or first few demonstration projects.

CHAPTER 10

Public Outreach Report

10.1 Introduction

This Public Outreach Report provides follow-up documentation to the Public Outreach Plan developed at the beginning of the I-75 South Managed Lanes Study (See Appendix 10-A: Public Outreach Plan). Specifically, it outlines the activities completed, summarizes public input and Project Team responses, and documents agency and steering committee coordination activities.

The following items are included as part of the documentation process:

- Public Outreach Plan Overview
- Meeting Summaries and Presentations
- Educational Materials (including fact sheets, handouts, and website materials)

10.2 Public Outreach Plan Overview

The Public Outreach Plan sought to accomplish the following:

- Definition of the purpose and objectives for initiating public dialogue on transportation and land use planning issues related to managed lanes and value pricing;
- Identification of the affected public and other stakeholder groups;
- Identification of techniques for engaging the public in the planning process;
- Notification procedures that target potentially affected groups; and.
- Education and assistance techniques that result in accurate and full public understanding of transportation, land use, and issues relevant to managed lanes and value pricing.

10.3 Project Purpose

The purpose of the study is to examine the potential for implementing a managed lane system on I-75 South. The efforts of this study seek to establish a dialogue and discussion on the concept of managed lanes. Specifically, the study searches for answers to the following questions:

1. What role can tolling play in effectively managing congestion in the I-75 South Corridor?
2. What are the variable pricing options?

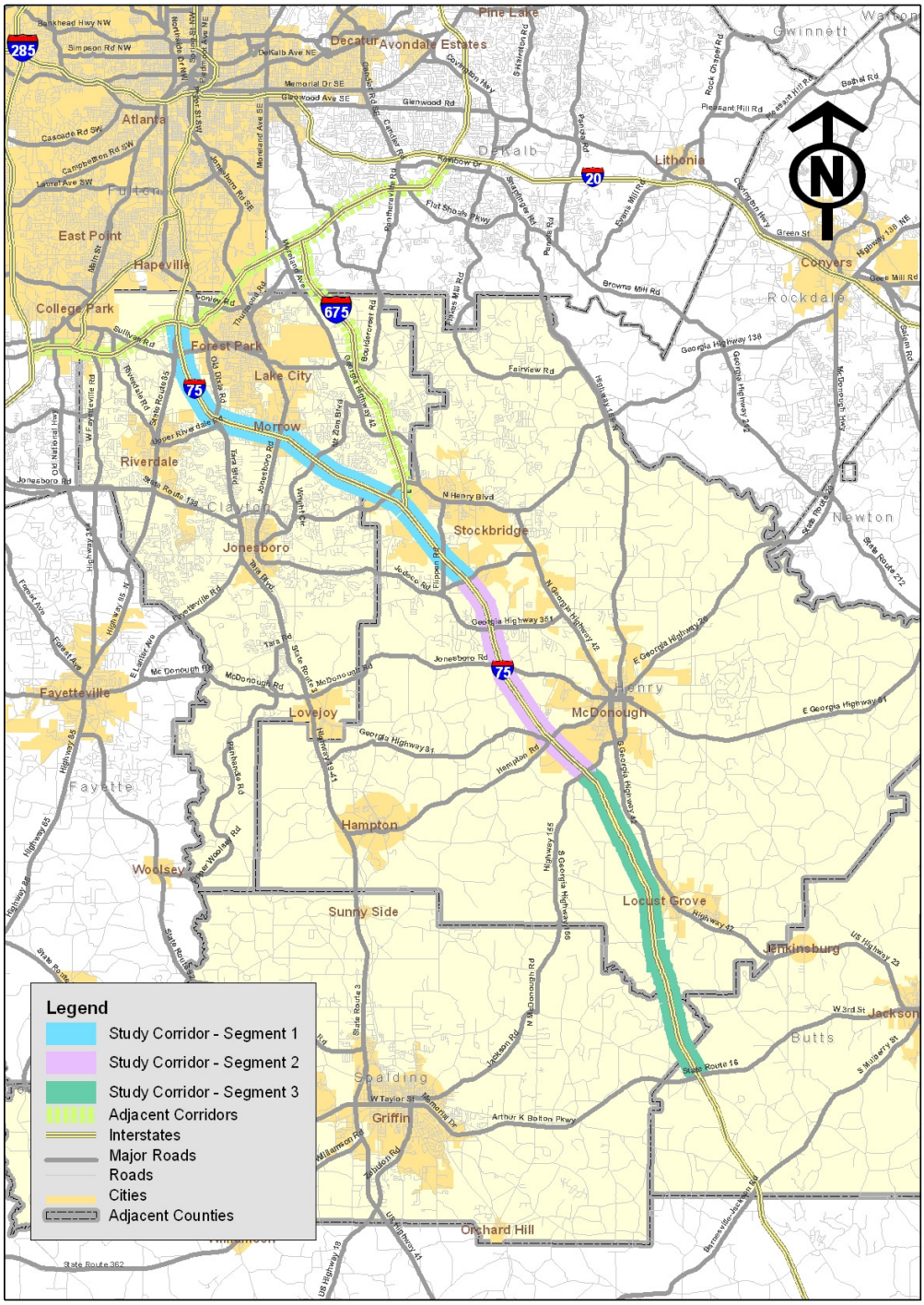
3. What is the willingness to pay of commuters and the freight industry?
4. To what extent will benefits, such as increased safety and reliable travel times, be recognized?
5. What is the anticipated, long-term toll revenue stream?
6. How will managed lanes improve mobility for Southside commuters?
7. What is the appropriate managed lanes configuration?

While the study's technical analysis was designed to answer the questions above, the purpose of this public outreach effort was largely educational. The project team set out to give the public an understanding of what managed lanes are, what the benefits might be for the corridor; and what managed lanes can do for the corridor.

10.3.1 Study Area

The study area includes the I-75 South Corridor from I-285 South to State Route 16 (near Jackson) in Butts County. In addition, I-675 and I-285 (from I-20 East to I-85 South) will be given consideration due to the potential for truck only lanes on I-675, as well as maximizing the utility of the potential managed lane investments on I-285. Figure 10-1 shows the study area.

Figure 10-1: Study Area of the I-75 South Corridor



10.3.2 Relationship to Other Plans and Initiatives

This project relates to a number of other completed on-going studies. These include:

- I-75 South Managed Lanes Environmental Assessment (GDOT);
- Southern Regional Accessibility Study (ARC);
- Metro Atlanta Managed Lane System Plan (GDOT);
- Atlanta Radial Freeway Strategic Improvement Plan (GDOT)
- I-285 Strategic Implementation Plan (GDOT);
- Statewide Truck Lanes Needs Identification Study (GDOT);
- I-75 Northwest Corridor Managed Lanes EIS (GDOT);
- Public Private Proposals (GDOT)
- Atlanta Regional Freight Mobility Plan (ARC);
- Regional Transportation Plan, Envision6 Update (ARC);
- HOV System Plan (GDOT);
- Value Pricing on the I-75 North HOV/BRT Project (SRTA);
- High Occupancy Toll (HOT) Lane / Truck Only Toll (TOT) Lane Feasibility Study (SRTA); and
- County Long Range Transportation Plans – Henry, Clayton, Spalding, Fulton, and Butts Counties

The above studies have included extensive data collection relevant to managed lanes, HOV, HOT, and TOT lanes. Several of the above studies have also included a specific focus on the freight industry and the southern region of Metro Atlanta. These existing data sources and reference materials were examined for relevance and inclusion within this study.

10.4 Stakeholders, Participants, and Meeting Summaries

Stakeholders are integral to the success and outcomes of transportation projects, particularly those that introduce new concepts to a region such as managed lanes. SRTA has developed a working relationship with citizens, community groups, government officials, agency staff, and the freight community. Adherence to the following public involvement and stakeholder coordination structure ensured that three important principles guided the public outreach efforts:

1. Exchange of key information through the public involvement and stakeholder coordination processes are conveyed to the technical team for use in the development of the project.
2. Direct communication and interaction between SRTA's project manager and the project steering committee to minimize any confusion in the overall direction of the project at the policy level.
3. Continuous communication is maintained throughout the project between the steering committee and the public involvement team and all of the parties interested in participating in the study.

The study team worked with SRTA to appropriately identify stakeholder groups for involvement at key milestones in the study process.

A project steering committee was formed to provide guidance as the study progressed. In addition, the Project Team reached out to and gathered feedback from the freight industry, elected officials, and community groups. The strategies and tools that were used to communicate varied based on appropriate and proven strategies for each group.

10.4.1 Project Steering Committee

A project steering committee (PSC) was formed to serve as an advisory body as the study progressed. The committee was comprised of SRTA's planning partners, including the Federal Highway Administration (FHWA), the Georgia Department of Transportation (GDOT), the Georgia Regional Transportation Authority (GRTA), the Atlanta Regional Commission (ARC), the Georgia Motor Trucking Association (GMTA), the McIntosh Trail Regional Development Center (MTRDC), as well as the jurisdictions and municipalities in the I-75 South Corridor who are influenced or directly impacted by the corridor.

The purpose of the Committee was to:

- Assist SRTA in achieving its overall goals and objectives for the project;
- Provide input and guidance to SRTA for analyzing proposed transportation policies, technical procedures, and study recommendations;
- Provide industry-specific expertise to assist SRTA in the consideration of potential strategies.

Project steering committee meetings were held throughout the course of the study.

Date	Location
March 19, 2007	Project Steering Committee Kickoff Meeting Clayton State University
July 17, 2007	Henry County Government Administration Building, 140 Henry Parkway, McDonough
November 15, 2007	Henry County Government Administration Building, 140 Henry Parkway, McDonough
June 12, 2008	Henry County Government Administration Building, 140 Henry Parkway, McDonough

PSC Kick-Off Meeting #1

At the kick-off meeting, the current funding crisis situation in Georgia was explained to the PSC. It was highlighted that Georgia has the second lowest gas tax in the country and Atlanta is the fourth fastest growing region in the country. Additionally, Georgia is confronting funding shortage and cost escalation, resulting in a delay of project initiation and completion. Taxes and tolling are the two potential revenue streams that may be tapped to finance projects. Tolling is a user-financed system that only the user of the facility pays the toll, in contrast to taxes, which require citizens to pay for roadways even if they do not use them.

Managed lanes were defined as a set of lanes where operational strategies are proactively implemented and managed in response to changing conditions. The concept of variable tolling and issues regarding the equity of the system were explained along with the details of vehicle eligibility requirements and enforcement of the managed lanes. The study area was defined as the I-75 south corridor from I-285 to SR 16 in Butts County and I-675 was identified as an alternative in the GDOT truck lane network because I-75 has physical constraints.

The tasks to be completed during the study were specifically identified. The public involvement aspect was discussed including the study's relationship of this study to the many completed and on-going studies in the region. With emphasis on the importance of public involvement, the group was asked bring this info to their constituents and report back their opinions. Other public involvement activities include educating the leadership of the counties and cities participating on the steering committee about the managed lanes concepts through public outreach including a special leadership briefing and a freight industry roundtable. The project schedule was presented which explained when the freight and leadership meetings would take place. Additionally, a website dedicated to the Value Pricing Pilot Studies and the I-75 South project was described, which will provide educational and presentation materials.

The PSC was split into three groups to discuss issues and opportunities in the I-75 south corridor. In general, the issues and opportunities raised within the groups focused around the design of the existing system and how new managed lanes for cars and trucks would fit in, how it would impact other roads near the managed lanes facility, and how it would provide increased safety. A point was made that the characteristics of trips different dependent upon time of day and day of week. Questions were raised as to the studies relationship to other facilities and development in the area and how best to educate the public.

A detailed account of this meeting resides in Appendix 10-B, Meeting Minutes.

PSC Meeting #2

The second PSC meeting occurred on July 17, 2007. The progress made on the tasks of study was reported to the group. Results of the baseline conditions analysis, highlighting travel times and average speeds along the I-75 South Corridor during AM and PM peak period in both existing and future conditions were presented. The results of the Stated Preference Survey of 1,210 residents from across the Metro Atlanta Region was presented, which showed the preliminary results related to public attitude towards the managed lanes concept including High Occupancy Toll Lanes (HOT) and Express Toll Lanes (ETL). Also, the Project Team presented the results of the Truck Survey conducted in March 2006 on I-75 North, summarizing a truck operator's willingness to pay to drive in a truck toll lane.

The status of model development task was described, which included the refinement of the ARC regional travel demand model and how it will be applied to analyze the different alternatives of managed lanes along the study corridor and how the willingness to pay curve based on the Stated Preference Survey would be incorporated for the traffic and revenue forecast. The micro-simulation model was shared via a sample video taken of the I-75 South corridor and an update of the public outreach conducted to date and next steps were provided.

Appendix 10-B includes a detailed account of this meeting.

PSC Meeting # 3
The third PSC meeting occurred on November 15, 2007. An introduction to traffic and revenue analysis, an explanation of the associated assumptions to the group, and a review of the eight alternatives evaluated as part of the managed lane assessment task were presented. The pricing policy alternatives associated with each scenario was also explained.

The toll sensitivity analysis and the travel demand model were explained. The recommended per mile toll schedules in 2007 dollars for both passenger cars and trucks were shared. The alternatives which showed the specific access and egress points for the managed lanes and that the truck only lanes only include system-to-system access and egress at the interchanges at I-675 and I-285 were illustrated. A reviewed of performance measure results on parallel corridors, including US23/SR42 and US19/US41 were provided.

Toll collection technology options and messaging were then summarized for the group. The presentation showed cumulative gross and net cumulative toll revenues including operations and maintenance cost assumptions and key drivers of risk and uncertainty. The process used to determine the preferred alternative was explained. Two managed lanes for cars in each direction along the I-75 South corridor – Express Toll Lanes (ETL) (Alternative A3) was selected as the preferred alternative.

PSC Meeting # 4
The final PSC meeting occurred on June 12, 2008. The meeting provided a recap of the managed lanes assessment and a review of the eight alternatives evaluated including the pricing polices associated with each scenario. The variable per mile toll rate range in peak period and in peak direction in 2007 dollars for both passenger cars and trucks was presented. Managed lanes will increase throughput for both persons and vehicles, improve the travel speeds in the general purpose lanes, and provide a reliable level of service for those who choose to use the managed lane either in private vehicles or public transit.

Capital estimates in 2007 dollars for the managed lane alternatives were presented to the group, which were preliminary in nature and would need to be refined and updated during concept development. The revenue estimates and the preferred alternative were presented. The assumptions and revenue impact results of three sensitive tests were explained in relation to the project priority ranking of the preferred alternative – A-3.

The financeability of the preferred alternative was explained. The project inflated costs versus the 40-year inflated net revenue were presented, with the assumptions based on construction starting in 2015 and the project opening in 2020. Based on 1.5 debt coverage ratio and 5% interest rate, the ETL - Alternative A3 can have $1.29 billion principal and $2.65 billion interest from the net toll revenues over a 40 year period. Compared to $2.58 billion inflated cost, there would be a $1.3 billion funding gap between the cost and financeable amount. To bridge the funding gap, several innovative financing options could be considered such as TIFIA Loans, Public-Private Partnerships, or GARVEE Bonds.

The next steps include Leadership Briefings, public education of local and political stakeholders, and an investment grade traffic and revenue analysis. The potential to implement Managed Lanes in the I-75 South corridor is promising and the decision to more forward would benefit from further detailed study and analysis.

A detailed account of this meeting can be found in Appendix 10-B.

10.4.2 Freight Roundtable

The Project Team hosted a roundtable meeting with the trucking industry on September 12, 2007. This meeting was used as a forum for the trucking industry to speak and express their opinions on the concept of managed lanes. With assistance from the SRTA, and working with the Georgia Motor Trucking Association (GMTA), the Project Team assembled a group of 17 representatives of the trucking community. The participants received a packet of background information prior to the meeting so that everyone had a common familiarity. The Executive Director of SRTA, Rosa Rountree, led the group by introducing the issues and the key question areas to be addressed. The outcome of this event was a report that outlined key elements and options with the group's pros and cons and final recommendations.

At the Freight Industry Roundtable discussion, a snapshot of SRTA's operational and financial aspects of the I-75 South corridor was presented. The concept of managed lanes and Truck Only Toll (TOT) Lanes and the different combination of alternatives was reviewed, along with the potential benefits of TOT Lanes. Additionally, the trucking industry survey conducted in March 2006 as part of the I-75 NW Corridor Value Pricing Study sponsored by Georgia Department of Transportation and Statewide Truck Lane Needs Identification Study was provided.

The truck industry representatives expressed the following support of a managed lanes and truck only toll lanes.

- Company perspectives may be different from the drivers' perspective, so it is good that the survey sample includes both drivers as well as the companies.
- The truck industry would support the TOT lanes if they were voluntary.
- A system level approach is understood and would be accepted.
- Congestion on I-675 currently equals I-75, especially at the merge to I-285 and Bouldercrest Road; however, it once functioned well.
- If the TOT lanes are voluntary instead of mandatory, the truck industry would choose to use those lanes during the congested period since lower congestion levels will improve safety and provide more reliable service.
- The trucking industry is focused on safety, service (time of transit), and cost in their business, with safety being the most important aspect.
- It was stated that choice is the key and hopefully managed lanes would help improve the performance of General Purpose lanes as well.

The group expressed critical views of truck only lanes related to the following concepts:

- Access is a critical issue and it will be a problem if trucks cannot get off the TOT lanes and make local deliveries in the Atlanta area.

- Lack of toll roads compared to other locations like the Northeast is one of the reasons that the trucking and freight industry is located in Georgia.
- There is only limited ability to pass through costs related to tolls.
- Mandatory TOT lanes ignore the common sense of supply, demand and productivity.
- Truck only lanes should not be mandatory - it puts an extra cost burden on the trucking industry.
- If there is no travel-time savings, the company will not choose to use a toll road.

Appendix 10-B includes a detailed account of this meeting.

10.4.3 Speaker's Bureau

In coordination with SRTA, Project Team representatives scheduled meetings with key community groups at their standing meetings to provide an overview of the study and to educate them on study related issues.

Six presentations were given to the following groups:

Date	Group / Location
July 13, 2007	Henry County Chamber of Commerce - Transportation Committee 1709 Highway 20 West, McDonough
July 18, 2007	Griffin Spalding Area Transportation Committee Spalding County Courthouse Annex, 119 E. Solomon Street, Griffin
August 9, 2007	Henry County Development Authority 124 Westridge Industrial Blvd, McDonough
August 14, 2007	Airport Area Chamber of Commerce Georgia International Convention Center
August 14, 2007	Clayton County Board of Commissioners 112 Smith Street, Jonesboro
August 27, 2007	Hartsfield Area Transportation Management Association Board Meeting

The presentation from SRTA included existing conditions on I-75 South and projected conditions in 2030. The various aspects of managed lanes, High Occupancy Toll Lanes (HOT), Express Lanes, and Truck Only Toll Lanes (TOT) were explained along with the supporting tolling requirements.

Appendix 10-B includes a copy of the speaker's bureau presentation.

10.4.4 ARC's Public Involvement Advisory Group

The Project Team attended the ARC's Public Involvement Advisory Group (PIAG) meeting on May 17, 2007 and provided a presentation about the I-75 South study (See Appendix 10-B). The presentation highlighted the public involvement techniques utilized as part of the study and provided an opportunity to share tools and lessons learned with other professionals involved in transportation planning efforts across the Atlanta region.

10.4.5 Leadership Briefings

It is important that elected officials understand the concept of managed lanes and the benefits that they can bring to the I-75 South Corridor. SRTA will brief various state and local elected officials and other identified leaders in the study corridor. This will allowed for an informed discussion that educated them on the benefits of managed lanes so that they may communicate effectively with their constituencies and form their own conclusions regarding managed lanes. This type of exchange will provide SRTA with the opportunity to gauge the perspectives of the broader community on issues related to the potential for managed lanes on I-75 South.

10.5 Educational Techniques and Materials

The study team utilized several methods to inform the public of study activities and to solicit public input. The following educational techniques were employed:

10.5.1 Fact Sheets

An educational fact sheets was developed and used to convey study information at speaker's bureau events and steering committee meetings. The fact sheet was also made available for download from the project website and was provided upon request to interested parties (See Educational Materials in Appendix 10-C). A brochure highlighting the study's findings for use after its completion is also currently under development.

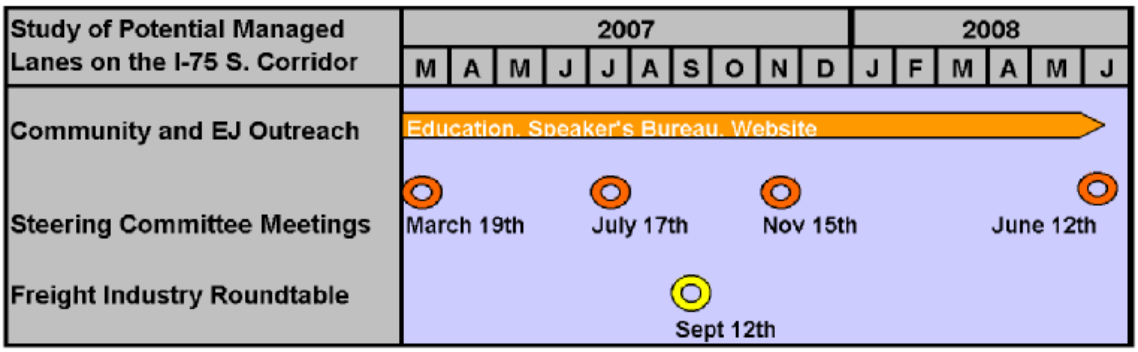
10.5.2 Website

The study website provided background information on the I-75 South Managed Lane Study and provided a repository for all study related documentation as well as educational materials on managed lanes. The site also included a feature where steering committee members could log-in to access meeting-related materials. http://srta- valuepricing.net/i75_south/i75_south.htm

10.6 Public Involvement Schedule

The public involvement program and associated activities were scheduled at key milestones to encourage public and stakeholder input prior to major decisions being made during the study. The following figure provides the schedule for meetings and outreach activities.

Figure 10-2: Project Meetings and Outreach Schedule



STATE ROAD AND TOLLWAY AUTHORITY

Study of Potential Managed Lanes on I-75 South Corridor

HNTB