

95 EL: WHAT IS IT WORTH?

Charles Robbins, PE
Vice President
AECOM USA, Inc.
13450 West Sunrise Boulevard, Suite 200
Sunrise, FL 33323 USA
+1-954-745-5028, charles.robbins@aecom.com

Javier Rodriguez, PE
ITS Operations Engineer
Florida Department of Transportation District Six
1001 NW 111th Avenue
Miami, FL 33172 USA
+1-305-470-5341, javier.rodriquez2@dot.state.fl.us

Rory Santana, PE, PTOE
ITS Program Manager
Florida Department of Transportation District Six
1001 NW 111th Avenue
Miami, FL 33172 USA
+1-305-470-6934, rory.santana@dot.state.fl.us

ABSTRACT

The Florida Department of Transportation (FDOT) is evaluating the value of the 95 EL Project from many perspectives. This paper looks at the value thus far to the FDOT and the public regarding:

- Dynamic Pricing – The comparison of dynamic pricing versus time-of-day pricing is assessed.
- Trip Value to Non Transit Customer – Traffic volumes and speeds are evaluated for various scenarios to assess motorists' behavior to variable toll amounts.
- Sustainability – Revenues are compared to operations and maintenance costs to determine if the project will need additional operations and maintenance funding.

Key Words:

Managed Lanes, EL, High Occupancy Toll Lanes, TMC Operations, Congestion Mitigation, Benefits, Dynamic Tolling, 95 EL

INTRODUCTION

The Florida Department of Transportation (FDOT) has implemented Florida's first High Occupancy Toll (HOT) lanes project, known as "95 Express." 95 Express converts the single High Occupancy Vehicle (HOV) lane into two HOT lanes while maintaining the same number of general purpose lanes, as well as enhancing and expanding Bus Rapid Transit service on I-95 from downtown Miami to Broward Boulevard in Fort Lauderdale. 95 Express corridor improvements also included ramp signaling and additional incident management resources. The combination of these strategies has helped reduce congestion on the heavily traveled north-south corridor. 95 Express operates as HOT lanes (a.k.a. Express Lanes) that drivers can choose to use by paying the toll with their SunPass transponder. Tolls vary with the level of congestion within the Express Lanes (EL), with the goal being to keep traffic in the EL moving at speeds of 45 miles per hour (MPH) or greater at least 90% of the time during peak periods while simultaneously maximizing total facility throughput. Registered transit vehicles, vanpools, carpools of 3+ occupants, hybrid vehicles, and over-the-road coach buses can use the EL without paying a toll. Motorcycles do not have to register and can use the EL without paying a toll. Trucks of three or more axles are not allowed to use the EL.

The project is being implemented under two construction contracts in three phases, see Figure 1. The first construction contract included Phase 1A and Phase 1B, while a second contract will include Phase 2. Phase 1A runs northbound on I-95 from SR-112 to the Golden Glades Interchange (GGI) area just north of NW 151 Street in Miami-Dade County. Phase 1B runs southbound on I-95 from the GGI area to I-395. Phase 1B also extended the northbound EL further to the south from SR 112 to I-395. Phase 2 will create HOT lanes in both directions on I-95 between the GGI area in Miami-Dade County and Broward Boulevard Park-n-Ride Lot in Broward County.

On December 5, 2008, the FDOT commenced tolling operations for Phase 1A of the project. After one year of operations, the FDOT is in the process of assessing the value of EL from many perspectives. From December 5, 2008 to June 30, 2009, northbound motorists (95 Express and general purpose lanes) saved \$8.7 million dollars in delay related costs. Additional benefits documented in the "95 Express Midyear Report" (1) include:

- Person throughput increased by 12% during the PM Peak Period.
- I-95 transit ridership increased 30%.
- 95 Express provided a more reliable trip by operating in excess speed of 45 MPH during the PM Peak Period 95.5% of the time (99.5% for all times) and was only closed due to incidents 0.7% of the time.
- 95 Express speeds on average are 16 MPH greater than the general purpose lanes during the PM Peak Period.

The public was also surveyed to gauge feedback by daily users of I-95 through the corridor. The results of a May 2009 survey that was distributed to commuters showed that:

- 76% of those who have used 95 Express believe it is a more reliable trip than the general purpose lanes; and,
- 58% of commuters familiar with the EL would like to see EL developed on other roadways in southeast Florida.

Additionally, media coverage indicated that public perception of the project improved once the project was fully operational.

EL has brought value in many areas, as indicated above. This paper analyzes the empirical data collected during the first year of operations in an attempt to provide a better operational knowledge for the future planning, design and implementation of other Express Lane (HOT) projects. This paper specifically looks at:

- Dynamic Pricing
- Trip Value to Customer
- Sustainability

Figure 1: 95 Express Project Construction Phases



BACKGROUND

It is important for agencies to understand the geometric/operational characteristics of the 95 Express project to be able to apply the information in this paper to their respective facility accordingly. With the completion of Phase 1B, a total of six lanes are provided in the northbound direction of I-95 within the project limits, two EL and four general purpose lanes (GPL). I-95 mainline traffic enters the two EL just north of the I-395 interchange, and additional traffic from eastbound SR 112 and NW 39 Street/NW 10 Avenue merges onto the EL in the vicinity of NW 54 Street.

Egress from the EL occurs just north of NW 151 Street, where the outside Express Lane joins I-95 mainline traffic, while the inside Express Lane continues onto the flyover (former HOV flyover) to access the Park-and-Ride facility or continue north along I-95. Figure 2 from “Operational Improvements I-95 Northbound at GGI” (2) technical memorandum depicts the northbound egress lane configurations at the completion of Phase 1. As illustrated in Figure 2, there are several factors that negatively impact the operations at the egress of the northbound EL, resulting in traffic queues and spill back onto the EL. It is important to note that FDOT has advertised a design-build project to improve the geometric and operational conditions in the vicinity of the egress from the northbound EL.

Northbound Turnpike Connector Locations and Causes of Congestion

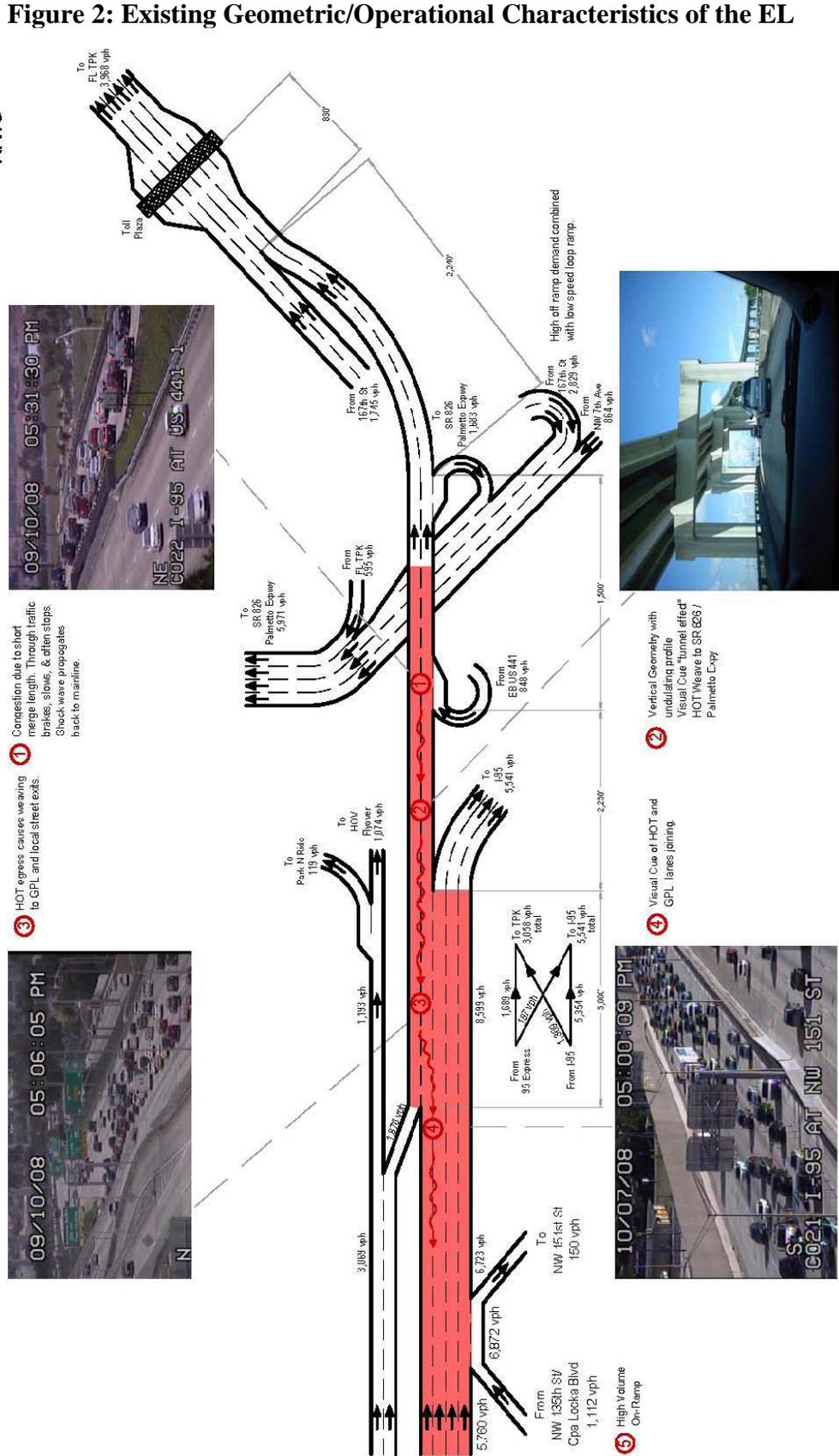


Figure 2: Existing Geometric/Operational Characteristics of the EL

DYNAMIC PRICING

Over the past several years, the FDOT has implemented a statewide ITS management software (SunGuide® Software) that is used by the various FDOT TMC's. Early in the planning/design stages of the 95 Express Project, the FDOT decided to add a module (Pricing Subsystem) to the existing SunGuide Software to support 95 Express operations. Due to an aggressive 95 Express Project schedule, the initial version of the SunGuide Software Pricing Subsystem module (prior to launch) did not provide dynamic pricing functionality. The SunGuide Software Pricing Subsystem module had limited means for varying the toll amounts in order to manage demand in the EL. It has two means; scheduled time-of-day toll amount tables and manual entry of toll amounts by the TMC Operators based on a hard copy schedule of toll amounts for congested conditions. In addition, the TMC Operators would not have had a structured tool to monitor demand and determine when to adjust the toll amounts through the manual entry operating mode. The FDOT D6 TMC identified two potential risks with the original SunGuide Software Pricing Subsystem module:

1. The FDOT D6 TMC would not be able to effectively manage demand in the EL with scheduled toll amounts from the time-of-day toll amount tables.
2. The use of manual entry introduced potential errors by the TMC Operators that could negatively impact public perception.

Recognizing these risks, the FDOT D6 TMC prioritized the development of the Express Lane Manager (ELM) software to implement dynamic pricing and mitigate risks. ELM calculates toll amounts based on real time traffic conditions along the EL. The dynamic pricing algorithm concept relates toll amount boundaries to the facility's level of service and adjusts the toll amount within and across these boundaries based on how quickly traffic conditions deteriorate or improve. The level of service (LOS) is defined in accordance with the Highway Capacity Manual (HCM) using traffic density (TD), which is a combination of speed and volume. The algorithm is configured to provide the maximum throughput with speeds generally greater than 45 mph when tolls are between \$2.50 and \$3.00. The toll amount calculations are based on a system wide average of real-time traffic data that is collected and processed to exclude missing and invalid data. The traffic data is processed every 15 minutes to dynamically change the toll amount based on traffic density. The algorithm settings are configurable and define how quickly the toll amounts will increase/decrease based on changes in traffic density.

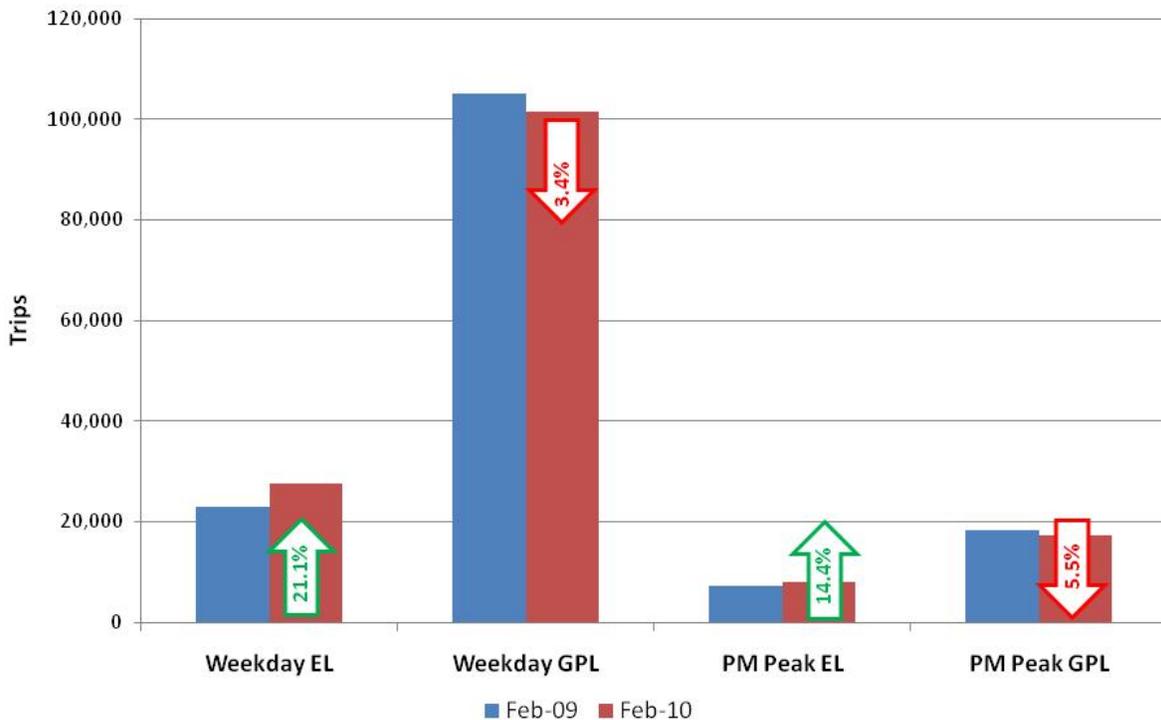
The ELM software was developed one and half years ahead of schedule and has brought value to the 95 Express by:

1. Effectively managing demand in the EL. For the first year of tolling operations, the EL have maintained speeds greater than 45 miles per hour (mph) for 99.6% all of the time and 96.4% during the PM peak period (4pm to 7pm). This exceeds the project goal of 90%.
2. Increased revenue. The dynamic pricing algorithm varied the toll amounts every 15 minutes to reflect the varying day-to-day traffic conditions along the corridor from incidents and seasonal demand. By implementing dynamic pricing, the FDOT has been able to collect approximately 15% additional revenue from January 1, 2009 to December 31, 2009.

- Public Acceptance. The 95 Express Project was well received by the public and media for providing a more reliable trip. The 95 Express Project was awarded the SAASHTO Innovative Management, Medium Project and AASHTO People’s Choice Award for America’s Best Transportation Project in 2009.

Data gathered from February 2009 and February 2010 shows that the overall weekday number of trips along I-95 northbound within the project limits has grown slightly (0.9%) year-over-year. However, the weekday number of trips along the EL has increased by approximately 21.1%, and the weekday number of trips in along the GPL decreased 3.4%, as shown on Figure 3. Similarly, although the overall weekday number of trips along I-95 during the PM peak period has remained constant year-over-year, the PM peak period number of trips along the EL has increased by approximately 14.4%, and the weekday number of trips along the GPL decreased 5.5%. Based on this data, there has been a shift in demand from the GPL to the EL.

Figure 3: Express Lanes Impact on Demand



Note: “EL” = Express Lanes, “GPL” = General Purpose Lanes

While the northbound EL are able to handle the increase in demand, the existing conditions at the egress of the EL, which were described in the “Background” section of this document, limit the amount of vehicles that can be processed by the EL. The increase in the number of trips within the EL, coupled with the constrained egress condition, has made it increasingly challenging to continue providing speeds of 45 MPH or better 90% of the time during the PM peak period. In February 2010, the EL operated at speeds greater than 45 MPH 80.3% of the time during the PM peak period. To mitigate the impacts of the growing demand within the northbound EL, the

dynamic pricing algorithm parameters have been adjusted to more aggressively react to increases in traffic density within the EL.

FDOT D6 TMC conducted an assessment to address the increased frequency of speeds dropping below 45 mph in the EL during the month of February 2010. The rate of change (delta table) and the limits for a given traffic density (LOS table) were increased. As a result, the dynamic pricing was more proactive to deteriorating conditions in the EL and improved trip reliability.

- Delta Table Changes:
 - The existing delta table contained zero toll amount change for a delta of one and traffic densities ranging from 15 to 26. These values were increased from \$0.00 to \$0.25.
 - The traffic density range from 12 to 14 has a rate change of \$0.25 for deltas 4, 5, and 6. These values were increased from \$0.25 to \$0.50.
 - The traffic density range from 46 to 50 has a toll amount change of \$0.00 for a delta of one. These values were increased from \$0.00 to \$0.50.
- LOS Table Changes:
 - The existing LOS D maximum toll amount from \$3.75 to \$5.00; the existing LOS E maximum rate from \$5.00 to \$6.00; and the existing LOS F maximum rate from \$6.20 to \$7.10 because Phase 1B increased the shortest northbound trip from 6.20 miles to 7.10 miles.

After adjustments to the dynamic pricing algorithm parameters were made on March 11, 2010, the northbound EL operated at speeds greater than 45 MPH 87.5% of the time for the balance of March. Further demonstrating that dynamic pricing can help manage demand to provide a more reliable trip in the EL. FDOT D6 TMC staff will continue to adjust the parameters until the EL operate at speeds greater than 45 MPH at least 90% of the time during the PM peak period.

TRIP VALUE TO CUSTOMER

In early 2008, FDOT conducted floating car travel time runs to establish a baseline average PM peak period (4pm to 7pm) speed along the Phase 1A project area (I-95 from SR 112 to GGI) in both the existing HOV lanes and GPL. This baseline was established to measure the benefits of the overall project. By implementing the 95 Express Project, average speeds across all lanes increased from 18 MPH to 45 MPH. This increase in speeds reduced vehicle delay resulting in \$8.7 million in savings to all motorists along the I-95 corridor for the first six months of tolling operations.

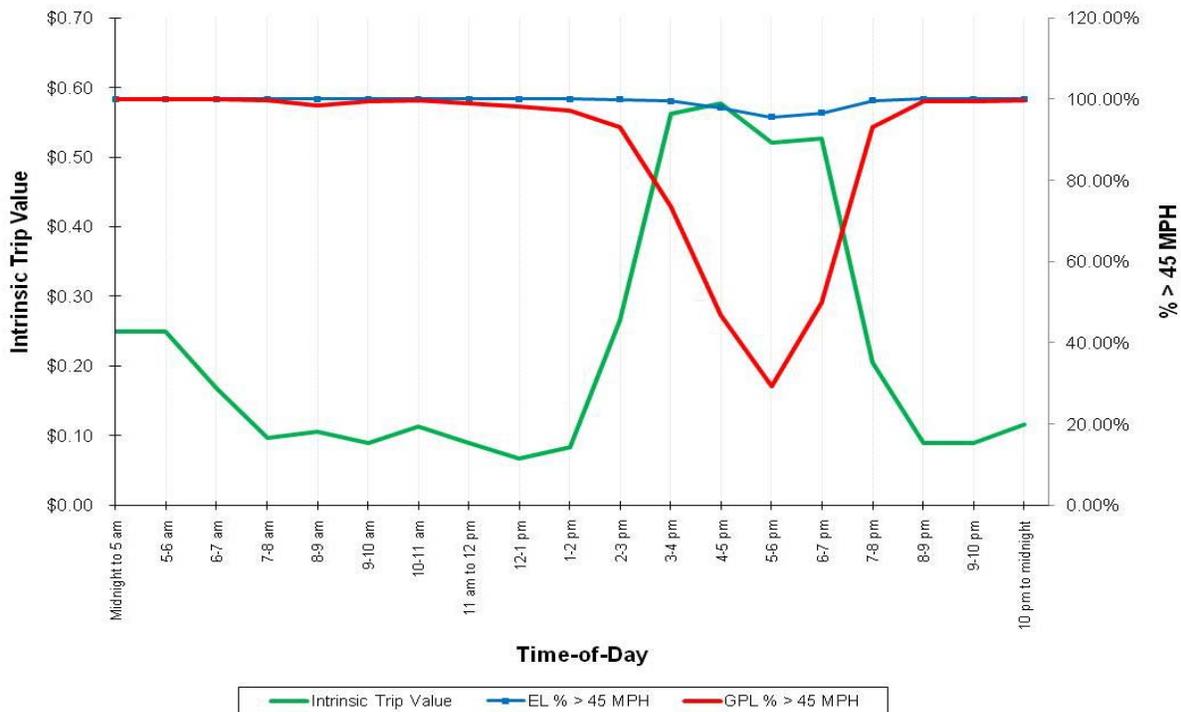
This analysis focuses on the comparison between the EL and GPL to evaluate the trip value of 95 Express paying customers because of their willingness to pay a premium to travel the EL. The analysis does not take into account benefits resulting from improved transit and HOV operations and resulting mode shifts. The decision to pay a premium (toll) to travel the EL is made by each customer based on their perceived value for the trip on any particular day. This perceived value is referred as intrinsic trip value. The intrinsic trip value is based on an individual's situation as they approach the EL entrance. This value can be based on a variety of financial or convenience reasons. For example, a financially based reason may be if someone is late for a meeting or any situation where there is a "time is money" scenario. Others may prefer a more comfortable trip

by avoiding the truck traffic and weaving/friction within the GPL. Whatever the reason, they can most likely associate it with trip reliability (percentage of time they travel at speeds greater than 45 MPH). The intrinsic trip value of customers was calculated by taking the toll amount and subtracting the dollar amount associated with the estimated savings from a reduced travel time. The estimated savings was calculated by multiplying an average cost per hour (\$15.47/hr in 2007 dollars) times the reduce travel time by choosing the EL over the GPL. The average cost per hour is from the “Urban Mobility Report 2009” (3) and reflects the cost of time and not the average wage rate.

Toll amount and travel time data was extracted from Express Lane Manger software (ELM) for weekdays in 2009 for the northbound direction only (Phase 1A). It is important to note that the FDOT sends the toll amounts to the Florida’s Turnpike Enterprise (FTE), who maintains the official final toll amounts charged. ELM data was only used for operational analysis to identify trends. Travel time data in ELM is based on average spot speeds collected from side fire radar detectors typically spaced every 1/3 mile. As expected, the travel time calculations are rough estimates because of the inherent limitations with radar detection accuracy when speeds drop below 20 MPH and the use of spot speeds to calculate travel times. FDOT is in the process of obtaining other more reliable technologies to calculate travel times along the EL.

Figure 4 below compares the intrinsic trip value to trip reliability by time-of-day for weekdays during 2009. The intrinsic trip value is between \$0.50 and \$0.60 from 3 pm to 7 pm and is directly correlated to the decrease in trip reliability within the GPL. This suggests EL customers have a higher perceived value of their time or the time they save by choosing to travel in the EL.

Figure 4: Intrinsic Trip Value vs. Trip Reliability (2009 Weekdays)

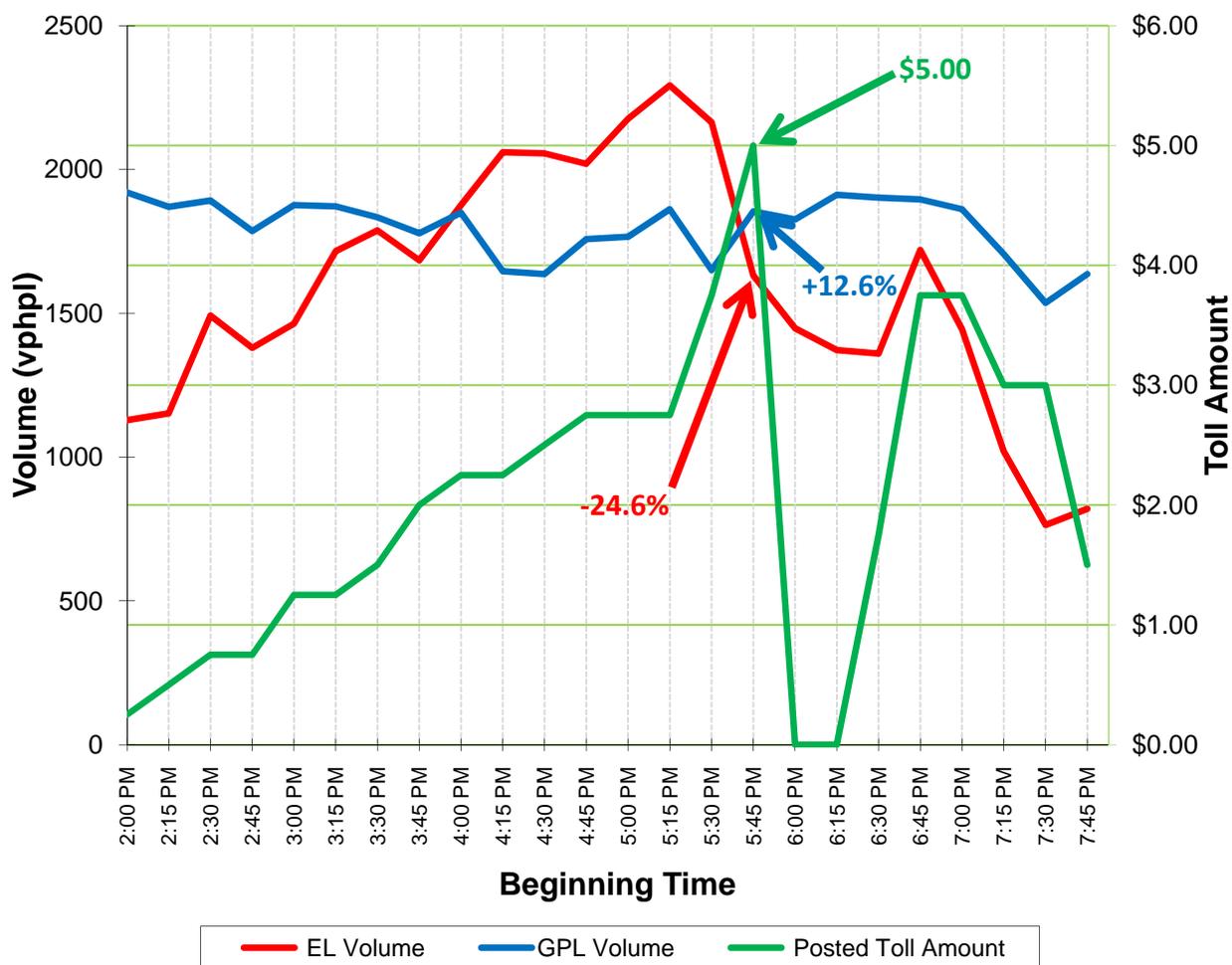


Note: “EL” = Express Lanes, “GPL” = General Purpose Lanes

The previous analysis averaged data over the entire 2009 calendar year. To further investigate the impact toll amount has on a customer's decision to use the EL, an analysis was conducted on a particular day when toll amounts reached \$5.00; much higher than the average PM peak period of \$1.61 for 2009. Traffic data from a detector station at the beginning of the facility was compared to the posted tolls prior to the entrance along the I-95 mainline only. The traffic data was also collected for the two GPL adjacent to the EL to narrow the focus of the analysis. Figure 5 depicts the relationship between the EL volume (VPHPL) and the GPL volume (VPHPL) to that of the toll amount. Each point represents the number of motorists that observed the associated toll amount in 15-minute increments. The data was collected from September 17, 2009. There was an event at Land Shark Stadium that generated unusually high demand for the EL and GPL. There were no major events in the GPL, but there was an event in the EL that blocked one travel lane for 23 minutes. The TMC performed a "soft" closure of the facility for approximately 30 minutes. A "soft" closure is performed by posting "Closed" on the toll amount dynamic message signs (DMS) and lane status DMS in advance of the entrance, but not physically blocking entrance ramps. As shown in Figure 5, volumes entering the EL continue higher until the toll amounts rise above \$3.00. At this point (5:30 pm), volumes in both the EL and GPL decrease, -5.6% and -11.4% respectively. However, the decrease for the EL is lesser than the GPL suggesting a toll amount of \$3.75 begins to manage demand, but not enough to shift motorists back into the GPL. At 5:45 pm, the toll amount rises again to \$5.00 and the EL experience a significant decrease in demand (-24.6%), while there is an increase in demand (+12.6%) for the GPL. This suggests that a toll amount of \$5.00 becomes the upper decision amount of the trip value motorists place for using the EL.

It is interesting to note that while the entrance toll amount DMS and lane status DMS posted "Closed", motorists continued to enter the EL. This suggests that motorists who use the facility on a regular basis, may not base their decisions to use the EL on the toll amounts being displayed; further strengthening the public's confidence in the EL providing a more reliable trip.

Figure 5: Flow Rate vs. Toll Amount



*Note: Flow Rate was collected from one detector at the beginning of the facility and compares I-95 mainline with the 95 Express on-ramps from the I-95 mainline.

SUSTAINABILITY

HOT Lane type projects are receiving more popularity across the country because of their ability to reduce congestion. However, one key question agencies need to consider is the operational sustainability of the project. This section compares the operations and maintenance costs with revenue generated to ensure the project can continue to fund itself (sustainability).

The estimated revenue used in the analysis contains actual revenues for January and February 2010, plus projected revenues (4) for March 2010 through December 2010. Based on the information gathered, the estimated Phase 1 revenue for calendar year 2010 is projected to be \$9,300,000. This is a conservative estimate because the revenues collected in January and February exceeds the projections. While the facility has been operating for over a year, the actual operations and maintenance (O&M) cost for most of the facility (with the exception of the TMC operations and support and the incident management) has been absorbed by the Design-Build

Team and it was included as part of their bid price. Therefore, engineering estimates are being used to supplement actual maintenance costs to obtain a comprehensive O&M cost (shown on Table 1) for sustainability analysis purposes. The transit element to the 95 Express Project introduces additional operational and maintenance costs that were excluded from the analysis. The FTE fees are for the toll operations back office support, such as customer service, payment processing, etc. Based on this information, the estimated O&M is \$6,800,000. It is important to note that the O&M costs used in this analysis doesn't include recovery payments for capital costs.

Unlike traditional roadway projects, where agencies must absorb O&M cost for the life of the project, initial analysis from the 95 Express project seems to indicate that HOT type projects can sustain themselves once they become operational.

Table 1: Year 2010 Operations & Maintenance Cost

TMC Operations and Support ^(a)	\$ 1,500,000
Incident Management ^(a)	\$ 2,000,000
FTE fees ^(b)	\$1,400,000
ITS Equipment ^(b)	\$ 700,000
Utilities ^(b)	\$100,000
Roadway Maintenance ^(b)	\$ 1,100,000
Total^(c)	\$ 6,800,000

Note:(a)actual cost, (b) estimated cost, (c) does not include transit O&M and capital cost payments

REFERENCES

- (1)FDOT District Six, “95 Express Mid-Year Report”, October 2009.
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- (3)Texas Transportation Institute, “Urban Mobility Report 2009”, July 2009
- (4)Wilbur Smith & Associates, Technical Memorandum “Estimated Monthly Transactions and Revenue – I-95 EL”, January 27, 2010