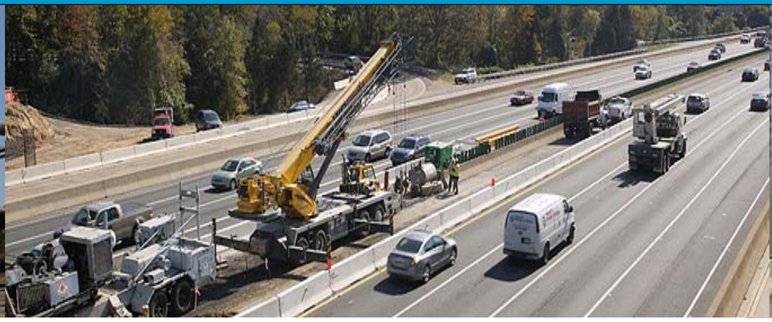
SCDOT HOV/HOT Lane Feasibility Study

EXECUTIVE SUMMARY



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Executive Summary

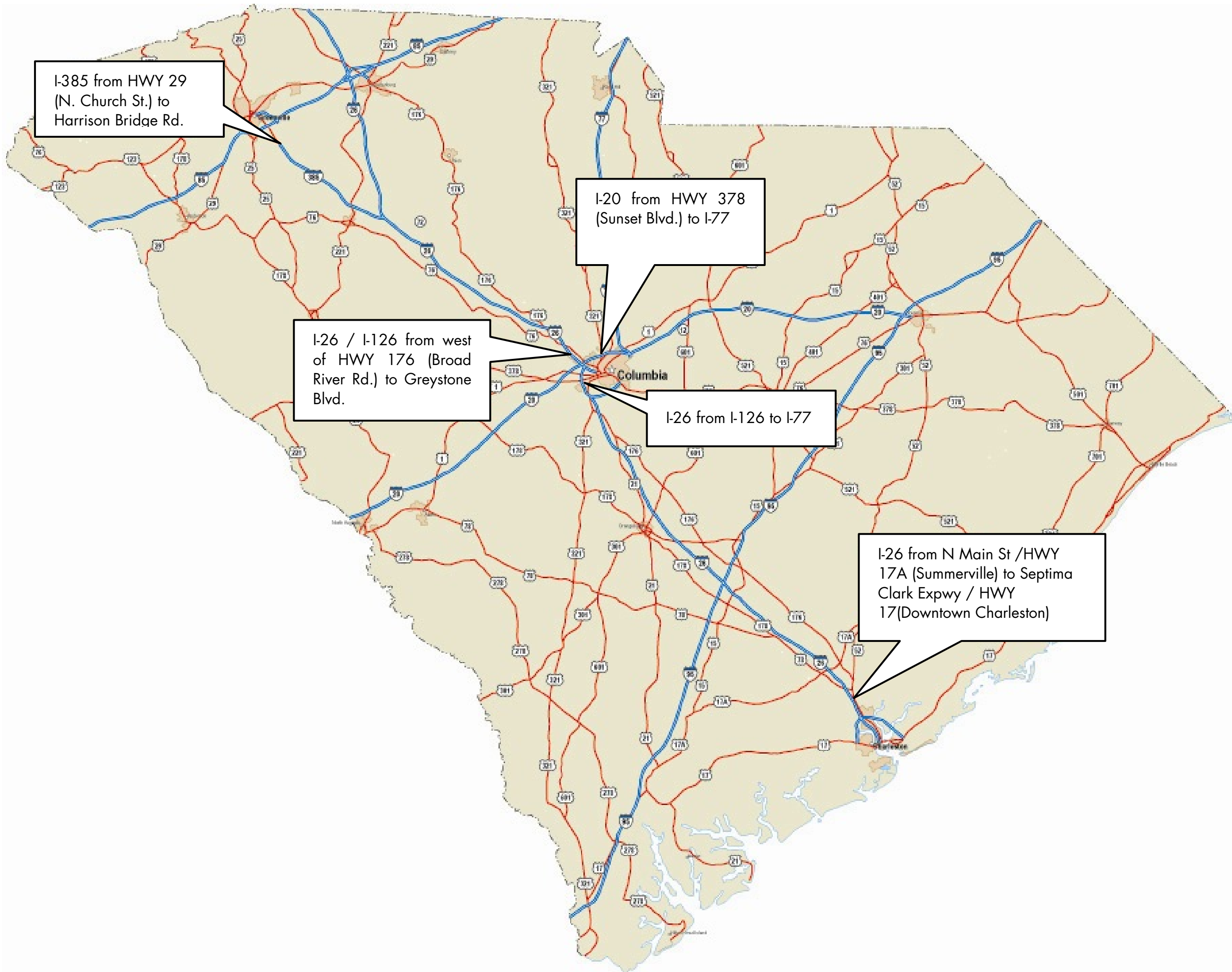
Study Summary

SCDOT has requested the Davis and Floyd / Stantec Team examine five corridors in South Carolina to determine the feasibility of instituting High Occupancy Vehicle (HOV) lanes or High Occupancy Toll (HOT) lanes. The regulations in a HOV lane implementation would confine use to passenger vehicles with two or more passengers, while the HOT lanes would also allow single occupant vehicles that are willing to pay a toll to use the lanes. These initial studies examine whether there is sufficient congestion to warrant a HOV or HOT application. Thus, an initial feasibility study was authorized by SCDOT to provide a preliminary assessment of the applicability of the HOV or HOT concept based upon readily available existing traffic data and forecasts in the study area. If one or more corridors showed potential feasibility, further study beyond this effort would be required, with greater depth of study undertaken including more refined and rigorous traffic forecasting, more detailed physical design, cost estimating, and financial feasibility.

A total of five corridors were examined in this study. These are depicted in Figure ES-1 and listed below:

- I-385 from N. Church St. (US 29) to Harrison Bridge Rd. (CR 453) located in Greenville
- I-20 from Sunset Blvd. (US 378) to I-77 located in Columbia
- I-26 from I-77 to I-126 located in Columbia
- I-26 / I-126 from Broad River Road (US 176 / 76) to Greystone Blvd. located in Columbia
- I-26 from N. Main St. in Summerville (US 17A) to the Septima Clark Expressway (US 17) located in Charleston.

Figure ES-1: Locations of Candidate Study Corridors



The process used to determine the feasibility of HOV or HOT lanes for major corridors in South Carolina involved testing three basic criteria.

The first criterion measures the presence of congestion both today and in the future. If congestion is currently persistent or is expected to be in the future, then mobility benefits can potentially be derived by adding a HOV or HOT lane.

The second criterion is physical feasibility. This criterion measures the corridor's available space for roadway expansion within the existing roadway envelope via a physical examination of the corridor and comparison to design guidance.

The third criterion takes the congestion and cost information and evaluates the user benefits and costs. If benefits and costs are aligned in a positive manner a corridor would be deemed feasible. If the benefits are insufficient and the costs are too high, the corridor would be classified as infeasible.

The assessment of each corridor involved a two-stepped screening process. The first step was an initial screening analysis that identified which if any of the five corridors merited further study. In the first screening step for each corridor:

- Hourly traffic for 2010, 2030 and 2040 was forecasted and the number of hours on a typical weekday with congestion was tallied to identify the duration of congestion.
- The number of miles in the corridor where congestion was present was then determined to identify the extent of the congestion.
- An index score was calculated which multiplied the duration of congestion by the length of the corridor congestion. The index is used in lieu of vehicle hours of travel or vehicle hours of delay. A low index figure would indicate only a few problem hours over a short distance. A high index factor would indicate a greater level of total congestion. Use of the index factor allows a comparison among corridors.
- Physical feasibility was assessed in a general manner by examining the current bridges across the corridor and determining how many would need either rehabilitation or rebuilding. Another feasibility consideration assessed the likelihood of the introduction of substandard design features.

After assessing each of the above the overall feasibility was identified as either likely or unlikely and then a decision was made to advance corridors for further study. This initial screening process, detailed in the Corridor Screening Memorandum for the HOV/HOT Lane Feasibility Study (November 3rd, 2009), resulted in only the Charleston I-26 corridor being recommended for further study in the secondary screening process.

The conclusions reached after the secondary screening of the I-26 Charleston corridor indicate the following: Near term congestion is not sufficient to warrant either a HOV or HOT lane at this time. In the intermediate term (5 to 10 years) a HOV lane implementation would provide mobility benefits, and in the long term (20 to 30 years) a HOT lane implementation may be appropriate. Despite these future benefits, in the absence of significant approved design exceptions as detailed in this report, the physical feasibility of implementing a design for a HOV or HOT lane at a reasonable cost is not achievable. Since the congestion index was the highest for the I-26 Charleston corridor, this conclusion further supports the early conclusion that the other four corridors, aside from any improvements that are currently planned, do not warrant further investigation at this time.

The following sections briefly describe the procedures used to analyze the I-26 Corridor in Charleston.

Development of Existing and Future Traffic Volumes

Existing Conditions

Existing volumes in the I-26 corridor in Charleston were obtained from SCDOT's permanent and other official count stations. Using these data, hourly traffic profiles were developed by day of the week and areas of congestion were identified by v/c ratios greater than 0.9. Recent electronic speed data in the corridor were also obtained. While speeds in the corridor, particularly between Ashley Phosphate and I-526, may have been negatively impacted by on-going construction to widen I-26 from 6 to 8 lanes, the data provided an understanding of general corridor travel conditions during peak hours and were used to verify the areas of congestion as indicated by the volumes.

Carpool data collected by SCDOT indicate that about 7% of vehicles on I-26 eastbound in the morning (7:10 am to 7:25 am) had 2 or more occupants, translating to 464 vehicles in an hour. Similarly, on I-26 westbound about 7% of all vehicles, or about 384 vehicles had 2 or more occupants in the PM peak hour. These surveyed carpool rates corresponded well to the US Census estimate of 6% of the total commuter traffic in the Charleston MSA are carpool vehicles.

Data on average occupancy of high-occupancy vehicles are not available, so for the purposes of this study, an average HOV occupancy of 2.5 persons per vehicle was assumed.

Future Conditions

Future traffic volumes were developed for 2010, 2020 and 2030 using the CHATS (Charleston Area Transportation Study) E & C (existing and committed) model. Traffic projections assume all existing and committed projects with identified funding. However the model does not assume HOV or HOT lanes on I-26. The CHATS model volumes corresponded well with the historical trend analysis provided by SCDOT and also to the forecasted future employment and population in the area. The CHATS model's traffic projections for years 2010, 2020, and 2030 show average annual traffic growth in the corridor of approximately 1% per year. The CHATS model does not forecast year 2040 traffic, so horizon year 2040 traffic for the I-26 corridor was estimated by extending the trend-line established by its projections for the years 2020 and 2030.

Future carpool rates were assumed to be similar to existing rates in the no-build analysis but were assumed to increase with the availability of the HOV treatments in the build scenarios.

Acceptance Factors

To understand the potential acceptance of HOV lanes and HOT lanes in the Charleston area both the collective experience nationwide of the public's opinion of HOV lanes, tolling in general, and HOT lanes, and the demographic characteristics of areas with HOV and HOT lanes as compared to the Charleston area were investigated. The two major hurdles faced by other HOV lanes, in terms of public acceptance, have been "empty lane syndrome" and enforcement. Empty-lane syndrome refers to the visual impression that non-HOV users perceive if the HOV lane is not well used, particularly if the general purpose lanes are very congested. To avoid this syndrome, national HOV experience indicates that mature HOV lanes should carry a minimum of 400 to 800 vph during the peak. Enforcement also needs to be prominent and effective to avoid the perception of HOV lane misuse, real or exaggerated. National experience also indicates that a tolled road or lane is generally accepted and successful if it provides a reliable trip with a significant time or distance savings.

In terms of demographics of the Charleston area, the general income characteristics and commuting habits (both in terms of mode of travel and length of trip) compare favorably with other locations where HOV and HOT lanes have been implemented successfully.

Concept Development

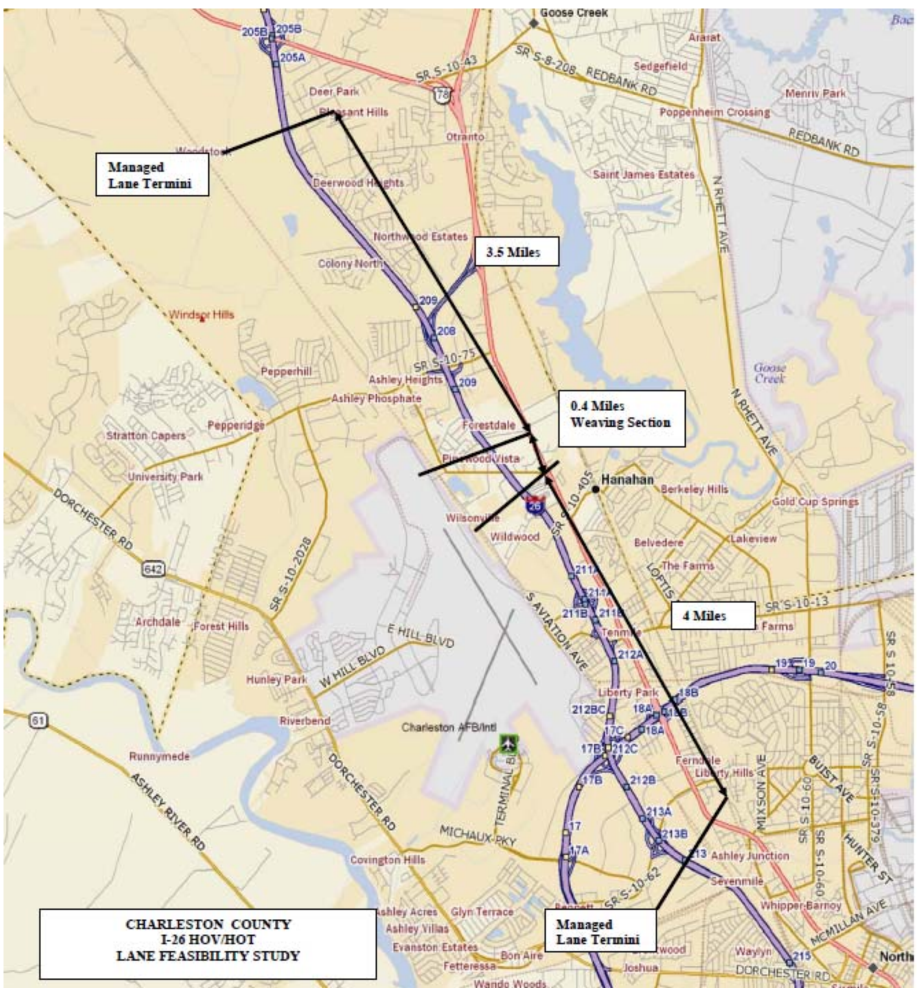
Operational Concept

Based upon direction of the SCDOT, an occupancy requirement of HOV-2+ was assumed for both the HOV and HOT lane scenarios. All vehicles with two or more occupants, including transit vehicles, could use the HOV lane and the HOT lane for free. The managed lanes in both the HOV and HOT lane scenarios were assumed to be operational 24 hours a day and enforced primarily during the peak periods and during any other high volume period. In the HOT lane scenario, toll-paying vehicles would be required to have a sticker-type transponder on their vehicle to allow for both toll payment and for assisting in enforcement (the costs of the transponders are assumed to be paid by the user).

Physical Limits

The future no-build and build scenarios assume that all programmed projects in the I-26 corridor will be built as planned. Both build concepts include one concurrent managed lane per direction in the median area of the I-26 corridor. Based upon projected traffic volumes and the travel patterns in the corridor, an 8-mile section of the corridor is proposed for the managed lane treatment; the western end of the managed lanes is proposed approximately three-quarters of a mile east of University Boulevard and the eastern end would be just east of Montague Avenue. An intermediate HOV/HOT entry/exit point, with a 2000 ft weaving area would be located approximately halfway between the termini between the Ashley Phosphate Road. and the Aviation Avenue interchanges. Figure ES-2 shows the limits of the HOV and HOT build alternatives.

Figure ES-2: Proposed Project Limits and Access Points



Design Concept

Two design concepts were considered for the managed lane build scenarios: the preferred design and the retrofit design. These two concepts are summarized below and would be the same should the managed lane be used as an HOV or a HOT lane. For the HOT scenarios, additional electronic equipment would be needed to facilitate the toll collection and the enforcement of the lanes.

Preferred Design Concept

The Preferred Design Concept would provide a single barrier-separated managed lane in each direction within the median area of the corridor. However, because of the centerline piers on overpass bridges, this would require the complete reconstruction of bridges at several locations, including some that have been recently or will be soon reconstructed within the corridor. The replacement of these bridges would bring the cost of implementing a managed lane into the range of hundreds of millions of dollars. Because of the high cost associated with this type of reconstruction, this concept was not further defined.

Retrofit Design Concept

The Retrofit Design Concept is designed within the physical limitations of the horizontal envelope of the corridor. This design concept would provide a retrofit type/buffer separated concurrent (not barrier separated) single lane with double white line separation or a minimal flush painted median in each direction. In other words, the new lanes would fit within the existing constraints of bridges and other areas with critical lateral clearances by adjusting lane widths and shoulders. In referencing the typical sections in Appendix B, several locations along the corridor can incorporate a concurrent flow buffer separating general purpose lanes from the HOT/HOV lane; however, it cannot be accomplished throughout the corridor. Areas with no buffer are referred to as areas with non-separated concurrent flow.

Because of the geometrics of the corridor and physical limitations due to the existing bridges, the retro-fit design would result in substandard features in several locations that would require either variances or design exceptions including:

- Substandard shoulder widths (inside and outside).

- Substandard/narrow lane widths – General purpose lane widths must be reduced to 11 ft with the exception of a single 12 ft right lane for trucks between Aviation Avenue and Remount Road. HOV lane widths of 12 ft were possible everywhere along the corridor except between Aviation Avenue and Remount Road.

- Ramp terminal geometry will need to be adjusted for ramp entrances/exits at:
    - US 78/52 Connector (WB on ramp, EB exit ramp, and EB entrance ramp),
    - Ashley Phosphate (EB on ramp and WB CD road),
    - Aviation Avenue & Remount Road (CD road entrance/exit terminals EB & WB),
    - I-526 (WB all exit/entrance ramps & EB CD road entrance/exit terminals), and
    - Montague Avenue (all EB & WB exit/entrance ramps & loop auxiliary lane).

  Resultant tie-in curvature will violate current standards along with development of proper cross slope superelevation. These changes may require additional warning signs and pavement markings.

- The overpass bridge at S-195 (Eagle Drive) is recommended to be replaced due to the very narrow shoulders and lane widths.

- I-26 from US 78 to Midland Park Drive utilizes an asphalt section and I-26 from Midland Park Drive to Montague Avenue utilizes a concrete section The lane reconfiguration poses problems with achieving correct cross slopes along concrete segments and in the vicinity of longitudinal joints. In some cases the wheel path could overlap with longitudinal joints thereby impacting safety and premature failure of pavement structure. Shoulders/travel lanes may have to be completely reconstructed in order to achieve proper cross slope and eliminate longitudinal joint location within the wheel path.

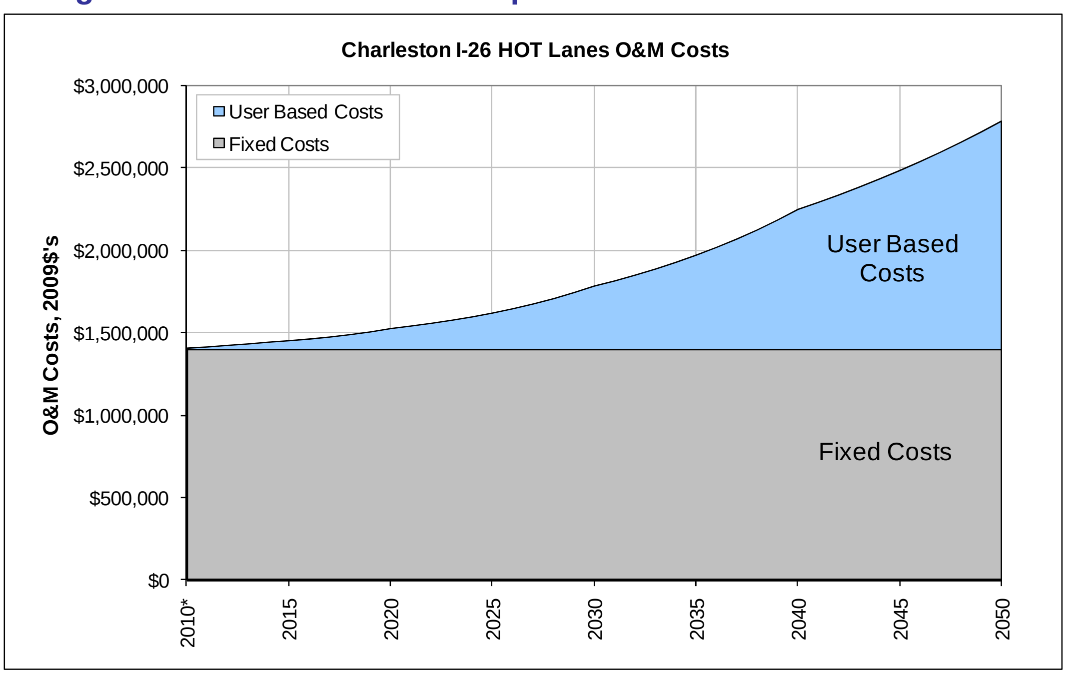
- Providing/replacing adequate clear zone will result in shift of roadside ditches which may have utility and right of way impacts. A rigid barrier or guardrail could be used in locations where proper clear zone or right of way cannot be obtained to mitigate impacts.

Cost Estimates

Capital costs for the Preferred Design Concept were not refined as they would include major bridge reconstruction and were therefore considered prohibitive. The Retrofit Design Concept could be explored as a lower-cost alternative; however, based on previous discussions between SCDOT and FHWA it is understood that design exceptions of less than 12 feet lane widths will not be appropriate.

Operation and maintenance (O&M) costs for the HOT scenario included both fixed and variable costs. Fixed costs are estimated for the roadway and toll system and are a function of the length of roadway and number of toll gantries. Variable costs change with the amount of transactions being processed. Fixed roadway maintenance costs are largely due to routine pavement maintenance, with lesser amounts allocated to signs and contingency items. The toll system costs also include an allowance for maintaining the ITS system, enforcement and courtesy patrol, staffing and general & administrative items. Costs do not assume any major roadway or equipment upgrades in the 2010 to 2040 period. Variable expenses include the cost of processing each toll transaction, un-recovered costs of violation enforcement, and finally the fee on processing credit card transactions. Yearly O&M costs on a constant dollar basis are estimated to be $1.4 million in 2010, $2.25 million by 2040, and continuing growing thereafter as patronage grows.

Figure ES-3: I-26 HOT Lanes Operations and Maintenance Costs



Patronage and HOT Lane Revenue Forecasts

Total persons traveling in the corridor was assumed to be constant between the no build and both build scenarios. For the HOV scenario, 50% of the HOV vehicles in the corridor were assumed to use the HOV lane, primarily because of access limitations. An additional 25% growth in HOV vehicles was assumed as HOV usage is likely to increase as capacity is targeted to them (total person trips in the corridor were assumed constant).

For the HOT scenario, toll rates were increased as volumes in the HOT lane increase toward capacity. Toll rates in the HOT lanes were based on Stantec's market share curves, derived primarily from the SR 91 Express Lanes experience in California. These toll rates and market share curves were adjusted to correspond to the cost of living differential between Riverside County (CA) and the Charleston area. Toll rates were increased as volumes in the HOT lane increased and speeds decreased. HOT lane volumes were estimated hourly, by day of the week and then annualized.

Table ES-1 summarizes the volume and speed characteristics of the no build, HOV, and HOT scenarios. As shown, future HOV volumes range from a low of 323 vph in the peak in 2010 to a high of 852 vph in the peak in 2040. While the Transportation Research Board in their 1998 *NCHRP Report 414, HOV Systems Manual* indicates a minimum HOV lane volume of 400 vph per lane in the peak, some agencies such as the Southern California Association of Governments (SCAG) estimate the minimum HOV lane volume for a freeway lane as to avoid "empty-lane syndrome" to be 800 vph in the peak. As shown, the minimum HOT lane volumes would be higher than this threshold by 2030.

Table ES-1: HOV/HOT Lanes Patronage Forecast Summary

Year 2010

	Statistic	No-Build	Build HOV	Build HOT
	Annual Revenue (09$'s)	n/a	n/a	$67,000
Peak Hour, Peak Direction	**GP Speed Low (mph)**	45	52	52
	GP Speed High (mph)	61	66	66
	HOV/HOT Speed	n/a	Free-flow	Free-flow
	HOV/HOT Volume Low	n/a	323	323
	HOV/HOT Volume High	n/a	734	831
	People Moved Low	4,824	5,021	5,021
	People Moved High	7,973	8,771	8,771
	Full Trip Toll, Low (09$'s)	n/a	n/a	$1.20
	Full Trip Toll, High (09$'s)	n/a	n/a	$1.76

Year 2030

	Statistic	No-Build	Build HOV	Build HOT
	Annual Revenue (09$'s)	n/a	n/a	$1,119,000
Peak Hour, Peak Direction	**GP Speed Low (mph)**	10	32	42
	GP Speed High (mph)	47	60	61
	HOV/HOT Speed	n/a	Free-flow	Free-flow
	HOV/HOT Volume Low	n/a	620	839
	HOV/HOT Volume High	n/a	835	1,209
	People Moved Low	6,011	7,017	7,017
	People Moved High	8,073	9,741	10,122
	Full Trip Toll, Low (09$'s)	n/a	n/a	$2.25
	Full Trip Toll, High (09$'s)	n/a	n/a	$2.80

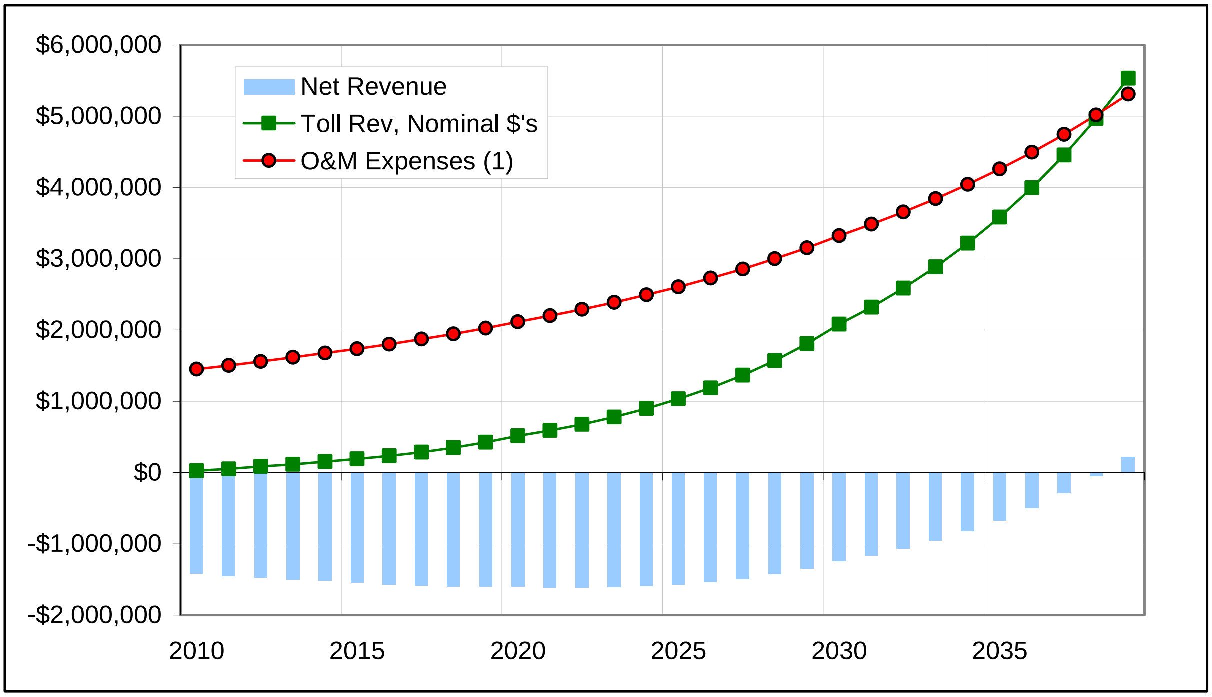
Year 2040

	Statistic	No-Build	Build HOV	Build HOT
	Annual Revenue (09$'s)	n/a	n/a	$2,468,000
Peak Hour, Peak Direction	**GP Speed Low (mph)**	5	7	28
	GP Speed High (mph)	29	49	53
	HOV/HOT Speed	n/a	Free-flow	Free-flow
	HOV/HOT Volume Low	n/a	664	968
	HOV/HOT Volume High	n/a	852	1,378
	People Moved Low	6,075	7,404	7,842
	People Moved High	8,123	9,809	10,309
	Full Trip Toll, Low (09$'s)	n/a	n/a	$2.50
	Full Trip Toll, High (09$'s)	n/a	n/a	$3.52

HOT Lane Financial Feasibility

A comparison of the facility's expected revenue and O&M costs shows a shortfall until year 2039 when toll traffic and revenue are expected to exceed the fixed and variable costs of operating and maintaining the HOT lanes.

Figure ES-4: I-26 HOT Lanes Revenue and O&M Costs, Nominal Dollars



[(1)] M&O Expenses do not provide for major rehabilitation

Conclusions

The analysis of the potential for an HOV/HOT lane in the I-26 corridor in Charleston indicates the following:

- The most economical means to include a HOV/HOT lane on I-26 would be to widen into the current median and separate the lane from the general purpose lanes by a double solid white line. This Retrofit Design Concept was utilized for purposes of this study. While this design would be most economical, it does have the following safety deficiencies that would need approval by regulating agencies:
    - Lack of desirable outside and inside shoulder width through most of the corridor.
    - Limited stopping sight distances at some curves.
    - Limited lateral clearances through some overpasses.
    - Requirement for patrons to weave to left most lane to utilize the lane (as opposed to a direct connector).
    - Higher potential for violations due to lack of physical separation of lane from general purpose lanes.
    - Lack of designated area for enforcement vehicles.

Clearly a superior design would be a barrier separated HOV/HOT lane with direct access ramps to major interchanges. Due to substantially higher costs, this alternative was not considered.

- With continued growth and development, traffic projections indicate congestion will worsen to the point of needing to consider future improvements between 2015 and 2020. At that time, HOV/HOT lanes would be a viable improvement alternative and would demonstrate noticeable improvement to person throughput.
    - By 2020 demand for the HOV lane would range from 500 to 800 vehicles in the peak travel direction during the peak hour, exceeding the TRB guideline minimum HOV volume of 400 vehicles per hour.
    - While demand of 500 to 800 vehicles per hour may be sufficient to start operation of a HOV lane, the lanes will be operating well under capacity and the public may criticize the road for "empty lane syndrome". Other transportation agencies*

recommend an HOV lane volume of at least 800 VPH to avoid empty lane syndrome.

- This under-utilization of the lane can be addressed by implementing a HOT lane.

- Although congestion is expected to increase in future years, it is unlikely that implementing a HOT lane can support the additional operations and maintenance costs associated with operating a HOT lane in the near or intermediate future.
  - If HOT-2+ lanes are developed, given an existing HOV-2+ lane, it would not be until approximately after 2035 or 2040 before HOT revenues will exceed operating and maintenance expenses for the toll collection elements of the project.
  - If a HOT-3+ policy were adopted, HOT revenues would increase and could exceed operating and maintenance costs for the toll collection elements of the project between 2020 and 2025.
  - Additionally, if the lane were constructed as barrier separated, violations would be reduced and the cost of recovering revenue lost to violations may decrease.

The conclusions reached after the secondary screening of the I-26 Charleston corridor indicate the following: Near term congestion is not sufficient to warrant either a HOV or HOT lane at this time. In the intermediate term (5 to 10 years) a HOV lane implementation would provide mobility benefits, and in the long term (20 to 30 years) a HOT lane implementation may be appropriate. Despite these future benefits, in the absence of significant approved design exceptions as detailed in this report, the physical feasibility of implementing a design for a HOV or HOT lane at a reasonable cost is not achievable. Since the congestion index was the highest for the I-26 Charleston corridor, this conclusion further supports the early conclusion that the other four corridors, aside from any improvements that are currently planned, do not warrant further investigation at this time.