Feasibility Study
I-95 Corridor
Branford to Rhode Island

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Feasibility of Managed ('Value-Priced') Lanes

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1.0 INTRODUCTION

This report presents the findings of a preliminary assessment of the potential for roadway 'value-pricing' on I-95 between Exit 54 in Branford and Rhode Island (I-95 East), with respect both to possible impacts on traffic operation and to the potential to contribute to the financing of the modifications.

Roadway user fees or charges are gaining attention as a way of advancing highway projects for which traditional funding resources are not sufficient. Recent research and experience have shown that many motorists are willing to pay to avoid the levels of congestion that they currently experience. With the emergence of electronic technology that makes it possible to collect user fees automatically, and to vary the fees by time of day or by level of congestion, interest in this approach has increased. In California, Virginia, and Ontario (Canada), new highway projects have proven the technological and economic feasibility of all the elements of roadway value-pricing. The principal issues for I-95 East, then, are corridor-specific.

1.1 What is 'value-pricing'?

Value-pricing is the generic term for congestion-related charges imposed on new capacity built in a corridor where there is already an unpriced (or 'free') facility of the same functional class. With value-pricing, users of a new highway parallel to an existing unpriced highway are charged a variable fee to use it, depending on the extent of time savings gained versus the unpriced roadway.

Technically, value-pricing is distinct from other forms of user charges, such as:

- Fixed *tolls* charged to all highway users to defray the cost of building and maintaining a roadway that could not otherwise have been funded, usually in a corridor that has no existing alternative facility in the same functional class.

- *Congestion pricing*, where user charges are imposed on an existing unpriced facility in relation to the degree of congestion, with the aim of inducing travelers to change their time or mode of travel, thereby reducing total congestion.

- *High Occupancy Toll (HOT) lanes*, on which vehicles with less than the required minimum high occupancy vehicle (HOV) occupancy are allowed to use established HOV lane(s) for a toll. When applied to new HOV lanes, the HOT concept amounts to a form of value-pricing.

On I-95 East, therefore, value-pricing would not be a 'new toll'. At all times of the day, any motorist would have the option of staying on 'free' lanes, and accepting the congestion that occurs there.

Value-pricing on I-95 East for this assessment would take the form of a separate *managed lane* (ML) in each direction, parallel to two general-purpose lanes.

1.2 Purpose and Organization of this Report

This document is intended to:

- Provide a general description of how value-pricing could be configured on I-95 between Branford and the Rhode Island state line (Section 2);

- Estimate the levels of traffic and revenues for the value-priced configuration for the year 2025, and the overall quality of traffic operations versus adding a single general-purpose (GP) lane (Section 3);

- Estimate the additional costs of building and operating a value-priced configuration, and determine whether the net revenue would make a significant contribution to financing the overall improvements to I-95 (Section 4); and

- Identify the infrastructure needed to provide an additional lane as a value-priced configuration and the order of magnitude of the physical impacts versus adding a single GP lane.

For the purposes of assessing feasibility, technical and operational assumptions generally favorable to implementation of value-pricing have been made, as described herein.

1.3 Executive Summary

On either a peak hour or 24-hour basis, the configuration of two GP lanes plus one ML would experience more total delay than the three GP lanes of the Full Build. This would occur because the share of total traffic in the ML will always be less than in the average GP lane in the Full Build scenario. In effect, the users of the unpriced GP lanes would incur both the delay that the users of the ML would pay to avoid, and additional delay caused by the nonlinear relationship of delay to volume. Total system average speed would be lower with two GP lanes and one ML than with three GP lanes. The ML system provides much, but not all, of the delay savings of the Full Build. Almost all of the total delay in the ML system would be borne by the users of the GP lanes.

At an assumed opening in 2012, the I-95 East ML system is estimated to generate about $8.5 million per year in net revenues, increasing to $13.7 million per year in 2027, the projected last year of stable operation of the segment between Exits 54 and 68. Beyond this timeframe, user fees would have to be raised above the upper limit set for this analysis (35 cents per vehicle-mile).

Over their lifetime, the MLs would generate no more than one-fifth of their incremental construction costs in user fees ($122 million out of $610 million). Not only would the MLs not be able to contribute anything to the construction of new capacity in the corridor, they would actually increase the effective cost of doing so. The cost recovery for a single ML built in addition to the Full Build (three GP lanes) would be even worse.

In sum, the ML configuration as considered herein would be substantially less efficient than the Full Build in moving traffic, and would cost considerably more to construct, even when net user fee revenues are included. The ML would also require a more extensive cross section and would create an overall greater impact upon the physical environment than the Full Build with three GP lanes in each direction. Therefore the ML system is considered to be a less effective approach to addressing the year 2025 travel demand on I-95 when compared to the Full Build.

2.0 VALUE-PRICING (MANAGED LANES) ON I-95 EAST

2.1 Roadway Configuration

A new value-priced third lane in each direction of I-95 would be constructed as a barrier-separated *managed lane* (ML) in each travel direction. The barrier separation would make it impractical to change lanes except at designated locations, and would require an increase in the total roadway width relative to simple addition of a third lane. This width would provide both for physical separation of the managed lanes and for both right and left shoulders for the managed lane with by-pass capability. Figure 2-1 shows the typical cross-sections chosen by the Department for the ML configuration..

Entry and exit from the MLs would occur at directional slip ramps; a similar minimum-length configuration labeled for HOT lanes is shown in Figure 2-2. Slip ramps from the MLs would usually be well in advance of present GP interchanges, allowing motorists to merge onto the GP lanes to use the existing exits. Slip ramps to the MLs would be far enough past entrances to permit vehicles to enter them via the left-hand GP lane (see Figure 2-3). The inside lane location of the MLs would minimize the differences between the ML and GP configurations of the overall highway improvements outside of the right-of-way.

Highway signs would inform motorists on the GP lanes of the next entry point to the value-priced lane, and variable-message signs (VMSs) would indicate the expected time savings and sample prices on the MLs. Motorists on the value-priced lanes would be advised of the I-95 exits served by the next exit slip ramp.

As a general rule, entry and exit slip ramps would be less frequent than the present exits and entrances; however, the average trip distance of about 20 miles on this section of I-95 means that opportunities should exist to use the MLs to or from most exits fairly directly.

For the purposes of estimating construction costs, the overall configuration of ML entrances and exits was assumed to be as shown in Appendix A. MLs also would not be extended across major bridges (*e.g.* the Thames and Connecticut Rivers) where maintaining separate operations would be complicated and expensive, and where improvements have already been made. Transitions of the third directional lane between ML and GP would appear similar to Figures 2-3 and 2-4.

Figure 2-1. Comparison of Managed Lane Typical Section and General Purpose Six-Lane Typical Section

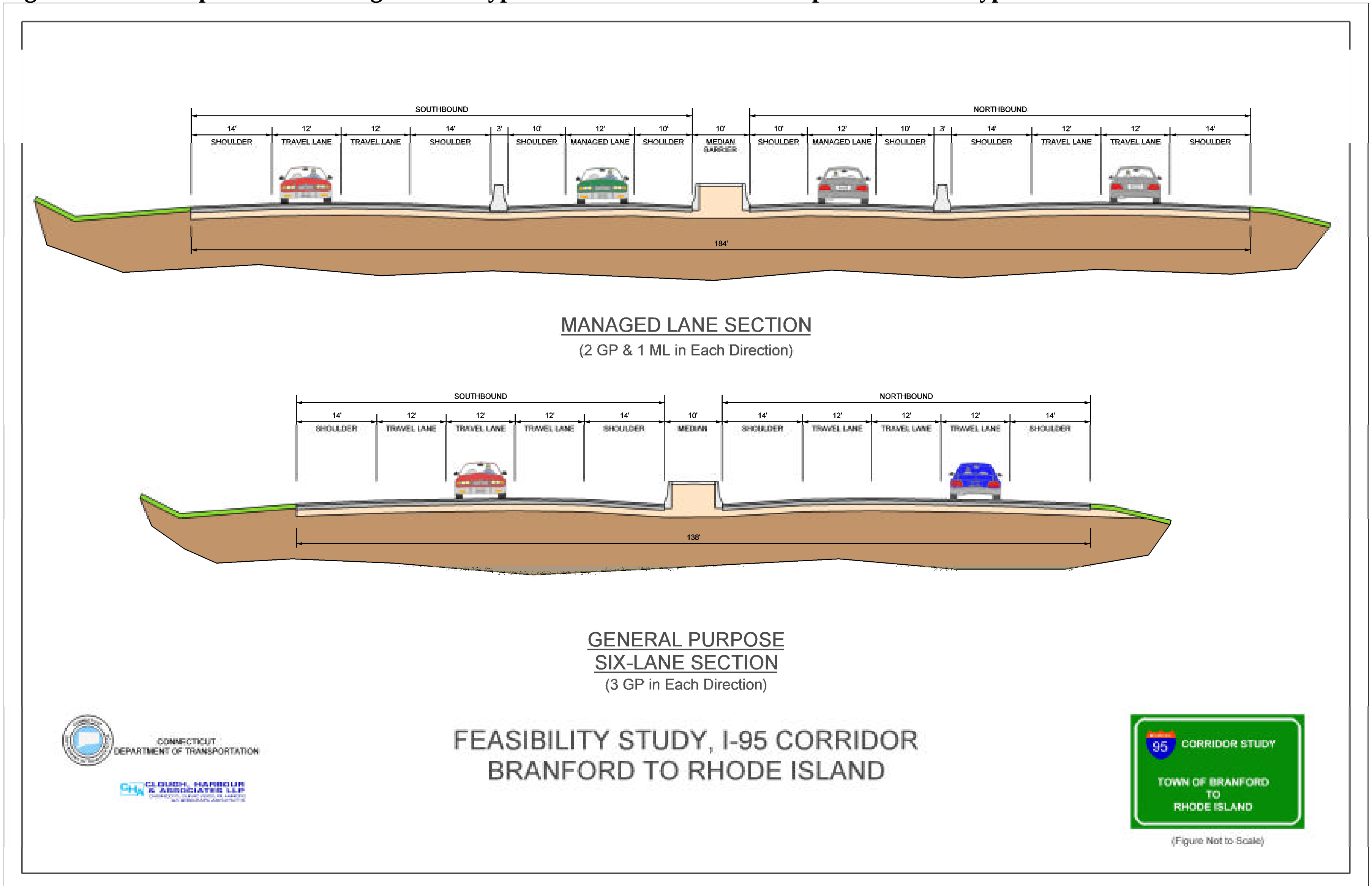

Figure 2-2. Example of slip ramp configuration
Source: ***A Guide for HOT Lane Development*****, FHWA, March 2003**

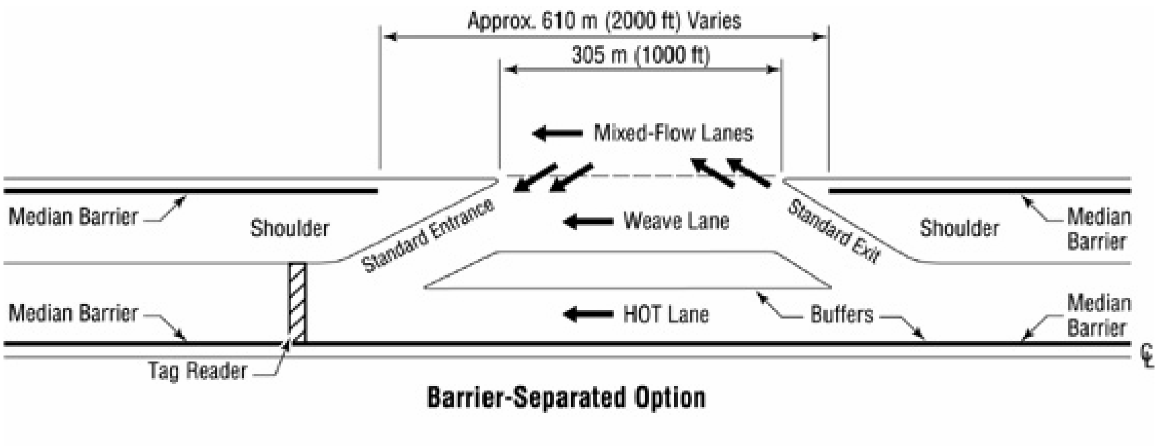

Figure 2-3. Example ML entrance from GP Lanes
I-405, Orange County, CA
Source: ***A Guide for HOT Lane Development*****, FHWA, March 2003**

Figure 2-4. Example ML Entrance from GP Lanes
I-15, Orange County, CA
Source: ***A Guide for HOT Lane Development*****, FHWA, March 2003**

2.2 ML Operation

Use of the value-priced lanes would be restricted to passenger vehicles (two-axle light vehicles[1] and buses carrying passengers for hire) with a transponder. Heavy trucks, which accounted for 11.5% of vehicle-miles on I-95 in the study area in 2000, would be excluded from the MLs. The MLs would be equipped with overhead gantry-mounted equipment to receive and transmit information from vehicle-borne transponders or 'tags' immediately 'downstream' of every entrance slip ramp and every transition point from GP to ML lane. Transponders would be read while the vehicles are moving at highway speeds; drivers would not have to stop.

Motorists would be charged for their use of the MLs based on the distance traveled ($0.04 per vehicle-mile) plus how much time they saved over the GP lanes ($0.20 per vehicle-minute), up to a per-mile maximum upper limit ($0.35 per vehicle-mile)[2]. For example, a year 2025 motorist traveling the 9.6 miles from Exit 56 (Leetes Island Road) to Exit 61 (Route 79) in the middle of the night would pay $0.40 (rounded to the nearest 5 cents), and would have the same travel time (8.9 minutes) as a driver in the GP lanes. In the morning rush hour, going against the prevailing traffic flow, ML drivers would save about 45 seconds, paying $0.55 to travel in uncongested conditions. In the evening peak hour, traveling with the prevailing flow, the ML user would pay $2.90 to make the trip in 9.7 minutes, avoiding an estimated 11.3 minutes of additional delay incurred by the GP user.

It was assumed that the value-priced lanes would accept the Fast Lane™ transponders presently in use for the MassPike, the EZPass™ in use in New York and other states, and other transponders that are interoperable with them. It was furthermore assumed that about 80% of eligible I-95 East users either would already have these devices, or would find it worthwhile to acquire them to take advantage of the managed lanes. Given the present state and rapid development of Intelligent Transportation System (ITS) and Electronic Toll Collection (ETC) technology, it is reasonable to assume that these capabilities (interoperability and operation at highway speeds) can be attained.

Billing and enforcement methods for managed lanes are evolving rapidly. Toronto's ETR-407 toll highway relies on photo identification of license plates, obtained while the vehicle is moving, to generate invoices for users who do not have 'tags'; the operator is willing to forego the revenues from one-time out-of-province users. Most ML systems provide locations for police cruisers to be stationed for periodic 'spot' enforcement. For the purposes of this feasibility analysis, the following was assumed:

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[1] Most turnpikes assign this a 'Class I' designation

[2] The per-minute fee levels are representative of present practice elsewhere (California SR 91 and Toronto's ETR-407). The per-mile base charge recovers the direct effects of the vehicle's consumption of roadway resources; the maximum (equivalent to average peak hour per-mile charges on SR 91 in early 2004) prevents the ML lanes being perceived as 'Lexus lanes' by the traveling public.

- All overhead tag-reading gantries would also be equipped with video equipment to record license plate images. Frequent repeat users identified by processing these images would either be billed or fined.

- All gantry locations would also have a position for a police cruiser to be stationed, positioned to enter the ML in pursuit of a violator. The overhead gantries would be equipped to identify violating (non-tag) vehicles to the cruiser. Cruisers would be stationed so as to monitor 2% of all operational hours at each ML entrance.

These provisions are likely to be effective in minimizing ML violations, and would be reasonably representative of the costs necessary to enforce the system.

2.3 Traffic Operation

Given the preliminary nature of this feasibility analysis, operating results for the MLs were estimated by a spreadsheet method adapted from Parsons' 2002 *HOV System Implementation Plan* for metropolitan Atlanta, Georgia. This spreadsheet added features for modeling HOT lanes to a time-of-day congestion model originally developed for the I-95 *New Haven Harbor Crossing EIS* (1997). As adapted for this assignment, the spreadsheet can effectively model both the historical 'spreading' of the peak hour traffic over the Pearl Harbor Memorial Bridge ('Q Bridge') and the overall use of HOV lanes in greater Atlanta. It was adapted by Parsons to estimate HOT lane use for metropolitan Atlanta. Although not calibrated to detailed traffic data for Connecticut HOV lanes, it is believed to be a reasonable basis for a preliminary assessment.

With three GP lanes in place in each direction, the spreadsheet indicates a relationship between average daily traffic (ADT) and average operating speeds over 24 hours as shown in Figure 2-5. The ADT forecast by the travel demand model for any six-lane (Full Build) section of I-95 is indicated along the horizontal axis. The gray line represents the average operating speed estimated over both directions for 24 hours in mph for the Full Build. The red line indicates the average speed over 24 hours for the four general-purpose (GP) lanes, and the green line represents the average 24-hour speed in the two MLs (one in each direction). The black line indicates the average speed for the GP and ML lanes combined (a total of six lanes).

Comparing the red and green lines shows how the benefits for users who choose to pay increase over the 'free' users as overall traffic demand increases. The average 24-hour difference reaches 5 mph at about 55,000 ADT, and 10 mph at about 80,000. Comparing the black and gray lines shows that when all traffic is combined, there is a net *loss* of efficiency with the ML system over the Full Build. This is most pronounced at about 80,000 ADT; above this level, congestion in the MLs begins to close the gap.

Figure 2-6 shows the same operational comparison for just the peak hour (the average speed for the peak hours in each direction), with the same color coding as for Figure 2-5. Because the peak hour is so popular, some congestion is evident at relatively low ADTs.

The gap between the MLs and GP lanes reaches 5 mph at an ADT of about 35,000, a point where spreading of GP lane traffic to less congested times becomes noticeable. The gap increases to 10 mph at about 45,000 ADT, and continues to increase until about 105,000, when congestion in the MLs begins to close the gap

On either a peak hour or 24-hour basis, the two GP lanes would experience more delay than the average for three GP lanes, because the share of traffic in the ML will always be less than in the third GP lane under the Full Build scenario. In effect, the users of the unpriced GP lanes would incur both the delay that the users of the ML would pay to avoid, and additional delay caused by the nonlinear relationship of delay to volume. Total system average speed would be lower with two GP lanes and one ML than with three GP lanes.

Another way of looking at this is to consider the total vehicle-hours of delay estimated to occur on summer Fridays on I-95 East for the Full Build, managed lane, and No-Build (retain current configuration) for 2025. These estimates are shown by ML segment in Figure 2-7. They show that the ML system provides much, but not all, of the delay savings of the Full Build, and that virtually all of the delay in the ML system is borne by the users of the GP lanes. For example, between Exits 88 and 93, only 11 of an estimated 2,000 vehicle-hours of delay would occur in the MLs.

Figure 2-5. 24-hour Operational Comparison

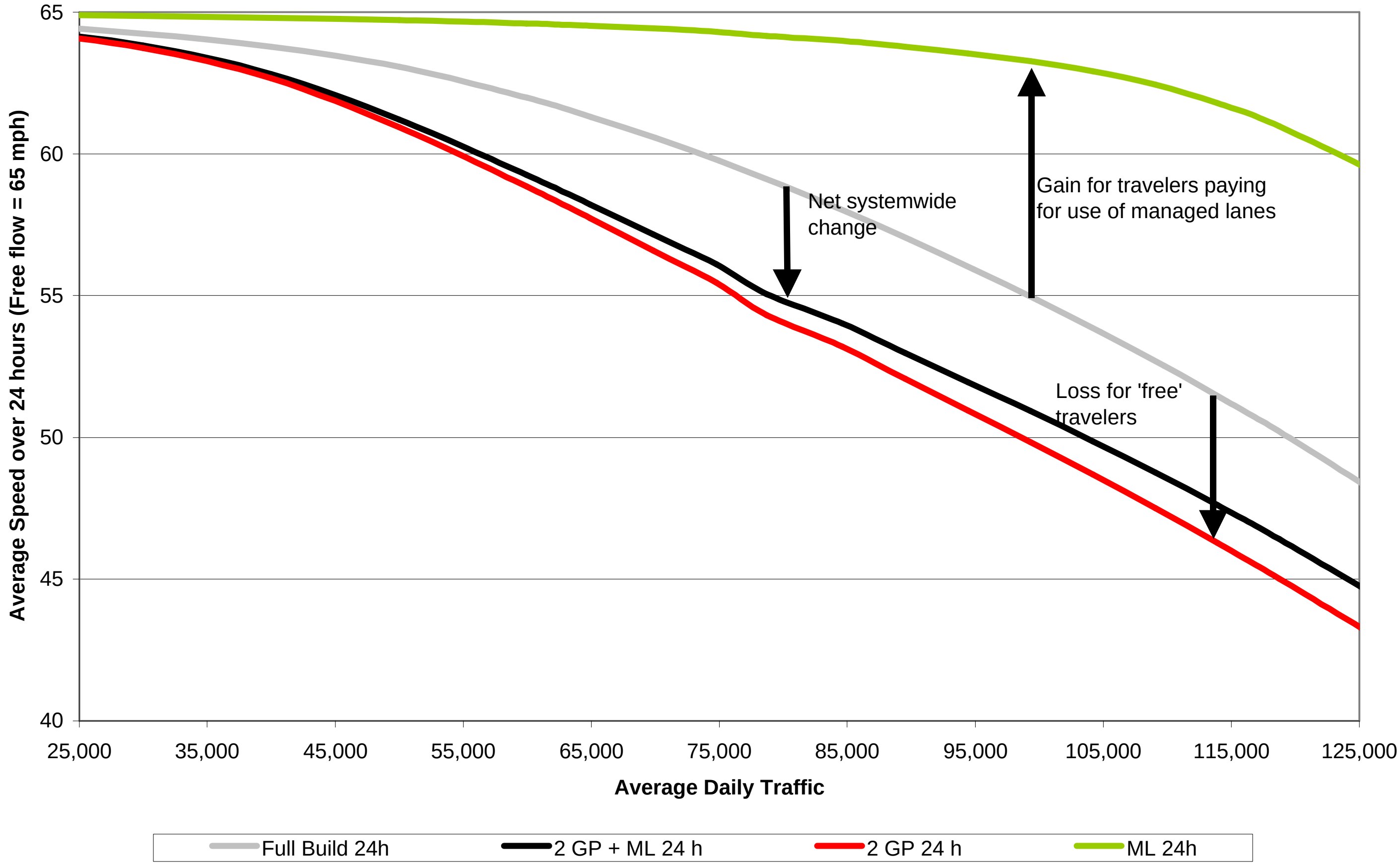


Figure 2-6. Peak Hour Peak Direction Operational Comparison

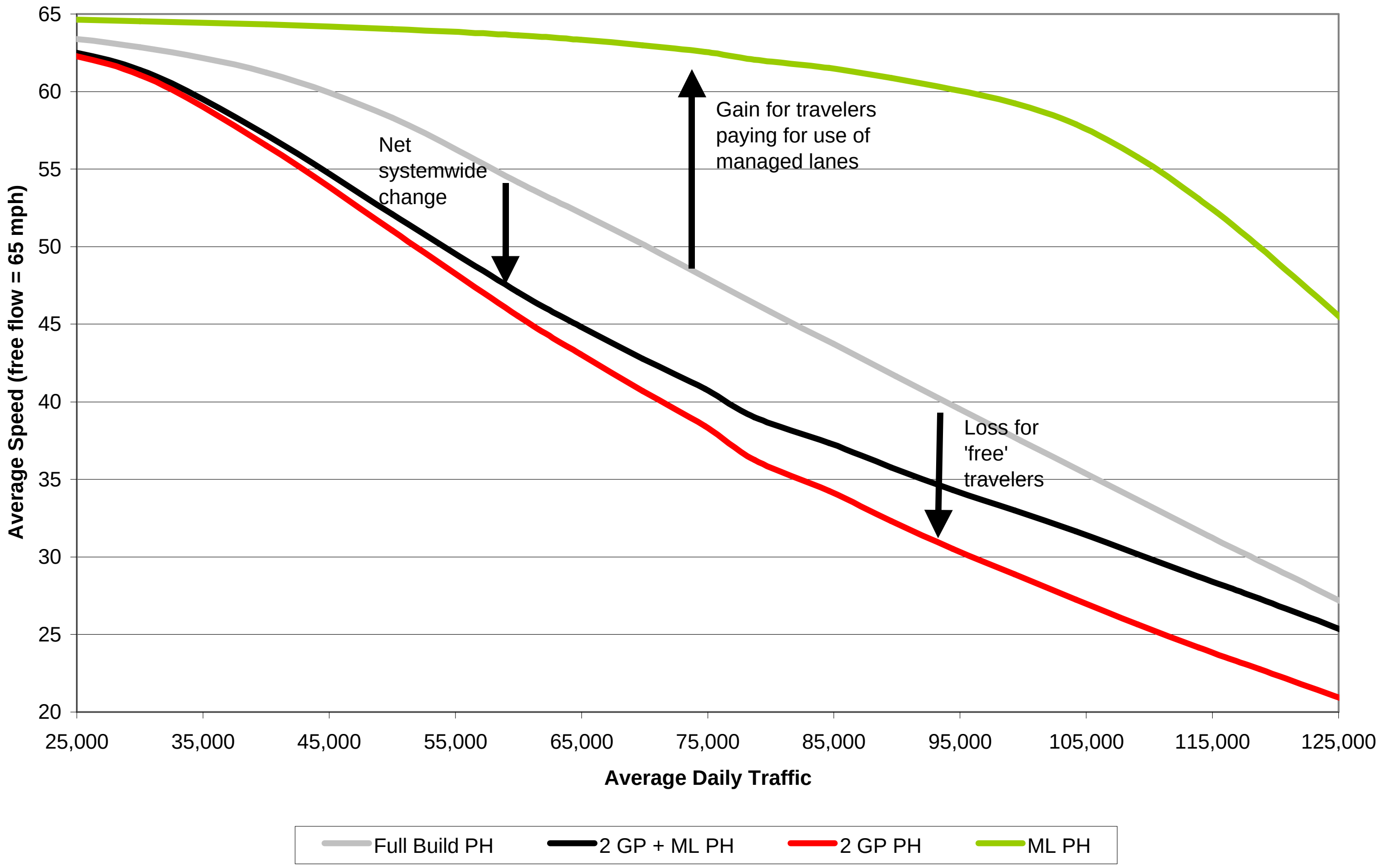
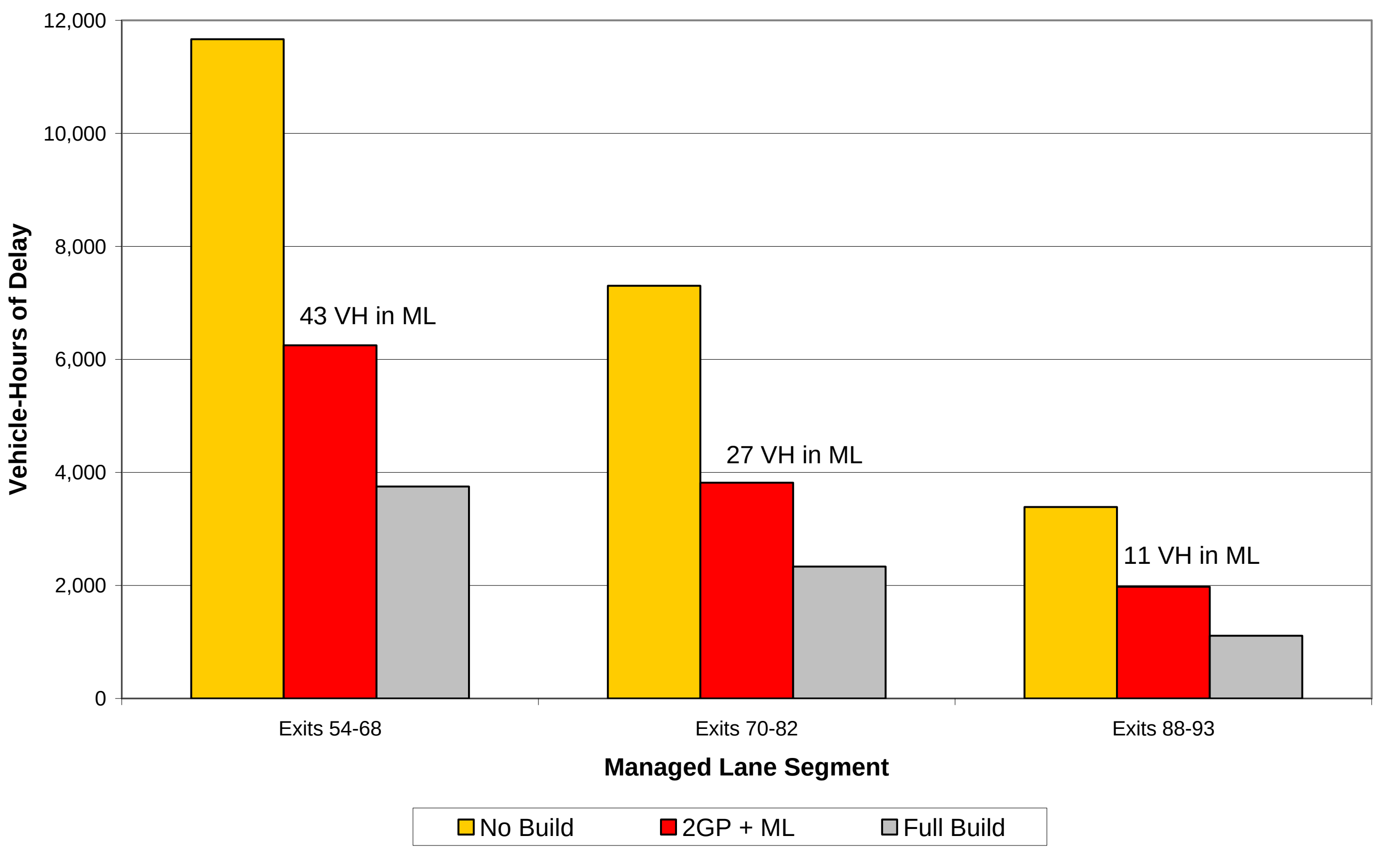


Figure 2-7. Comparison of Estimated Delay for Summer Fridays (2025)



3.0 TRAFFIC AND REVENUES

The variable user fee for the ML results in a concentration of ML use at more congested times. More significantly, the overall use of the MLs depends on the overall directional vehicles. Until congestion becomes significant, relatively few motorists will be willing to pay to use the MLs. Figure 3-1 shows how the estimated fraction of total traffic in the MLs varies with ADT, both in each directional peak hour and on a 24-hour basis. On a daily basis, less than 15 percent of traffic is estimated to choose the MLs, even with relatively high ADTs (the horizontal axis is sized to show only the approximate range of ADTs in the proposed six-lane Full Build sections). In the peak hours, the relative use of the MLs is much higher, as is true of Connecticut’s existing HOV lanes. Above 100,000 ADT it approaches 1/3, and ML volume per lane would approach the GP lanes; however, the user fees would always keep ML volume per lane enough lower to realize a significant travel time saving.

Figure 3-1 also shows the estimated user fee revenue per route-mile of MLs, versus ADT. At about 55,000 ADT, as the congestion-driven portion of the user fees begins to become significant, revenue begins to grow faster than total traffic. The average motorist choosing to use the MLs is estimated to pay about 11 cents per vehicle-mile at 25,000 ADT; at 100,000 ADT and above, most ML users would be paying the maximum charge of 35 cents per vehicle-mile.

Table 3-1 shows the estimated year 2025 summer Friday traffic on each of the segments of I-95 East that would have MLs under the value-pricing proposal, for both the Full Build and value-pricing proposal. This table also shows the estimated percent of ADT in the MLs. On an annual basis, average daily traffic (ADT) was estimated to be about 6 percent lower on the segment between Exits 70 and 81, and about 10 percent lower between Exits 82 and 93.

Average daily revenue losses would be even higher than differences for summer Friday traffic flow would suggest, because revenues grow faster than traffic (as shown in Figure 3-1). On the segment between Exits 70 and 82, average annual daily revenue was estimated to be 86.6% of summer Friday revenue; between Exists 88 and 93, only 80.5%. Table 3-2 summarizes the estimated year 2025 operating statistics and revenues by ML segment. Average speeds over 24 hours are compared to estimates for the Full Build (three GP lanes in each direction) and the No-Build (two GP lanes in each direction).

Figure 3-1. Lane Use and Revenue Comparison

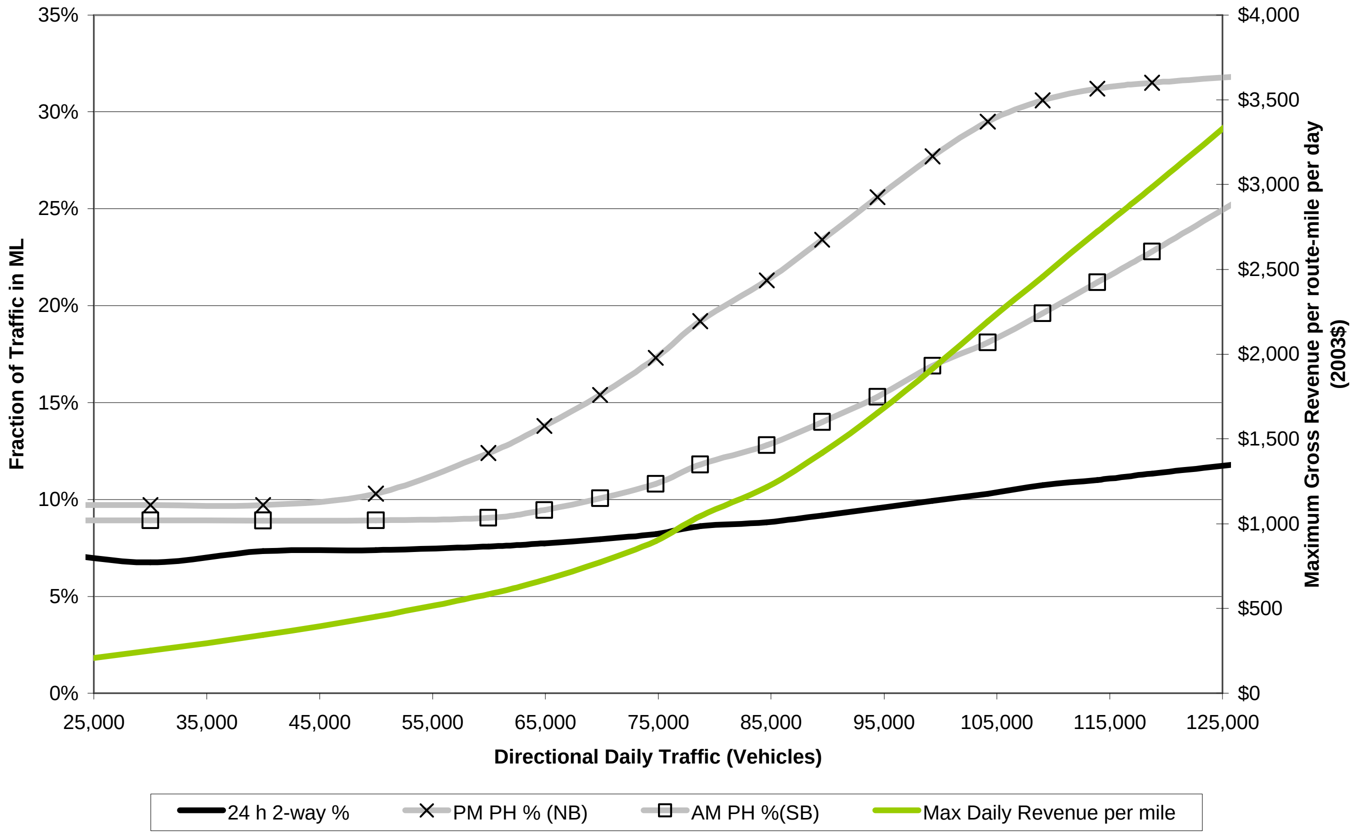


Table 3-1. Year 2025 Summer Friday Traffic Comparison

South End of Segment	North End of Segment	Full Build	Value-Pricing (Managed Lanes)		
		GP lanes	GP lanes	ML lanes	% in MLs
Exit 54	Exit 55	110,273	101,777	8,496	7.7%
Exit 55	Exit 56	97,917	90,587	7,330	7.5%
Exit 56	Exit 57	97,333	90,055	7,278	7.5%
Exit 57	Exit 58	85,994	79,698	6,296	7.3%
Exit 58	Exit 59	86,001	79,705	6,296	7.3%
Exit 59	Exit 60	89,257	82,686	6,571	7.4%
Exit 60	Exit 61	89,257	82,686	6,571	7.4%
Exit 61	Exit 62	78,727	73,029	5,698	7.2%
Exit 62	Exit 63	83,014	76,966	6,048	7.3%
Exit 63	Exit 64	78,861	73,152	5,709	7.2%
Exit 64	Exit 65	76,378	70,868	5,510	7.2%
Exit 65	Exit 66	73,284	68,019	5,265	7.2%
Exit 66	Exit 67	71,482	66,359	5,123	7.2%
Exit 67	Exit 68	69,409	64,447	4,962	7.1%
Exit 70	Exit 71	90,983	84,264	6,719	7.4%
Exit 71	Exit 72	96,734	89,510	7,224	7.5%
Exit 72	Exit 73	94,324	87,314	7,010	7.4%
Exit 73	Exit 74	94,203	87,203	7,000	7.4%
Exit 74	Exit 75	104,347	96,424	7,923	7.6%
Exit 75	Exit 76	111,576	102,951	8,625	7.7%
Exit 76	Exit 80	77,010	71,450	5,560	7.2%
Exit 80	Exit 81	76,140	70,649	5,491	7.2%
Exit 81	Exit 82	76,367	70,858	5,509	7.2%
Exit 88	Exit 89	92,973	86,081	6,892	7.4%
Exit 89	Exit 90	83,849	77,732	6,117	7.3%
Exit 90	Exit 91	64,632	60,037	4,595	7.1%
Exit 91	Exit 92	60,359	56,088	3,746	7.1%
Exit 92	Exit 93	53,288	62,649	4,848	7.0%

Table 3-2. Summer Friday Highway Operation and Revenue Comparison (2025)

	Exits 54-68	Exits 70-82	Exits 88-93	Total
Summer Friday VMT[1]	1,893,424	1,067,530	890,953	3,851,908
Three GP Lanes each direction (Full Build)				
Summer Friday VHT[2]	32,881	18,760	14,817	66,458
Summer Friday 24-hour Speed (mph)	57.5	56.9	60.1	58.0
Two GP Lanes Plus One Managed Lane (Value-Priced) each direction				
Summer Friday VHT (GP Lanes)	33,196	19,003	14,690	66,889
Summer Friday 24-hour Speed (GP Lanes)	52.8	52.0	56.3	53.4
Summer Friday VHT (MLs)	2,183	1,241	995	4,420
Summer Friday 24-hour Speed (MLs)	63.7	63.6	64.3	63.8
Summer Friday 24-hour Speed (Combined)	53.5	52.7	56.8	54.0
Summer Friday Revenue	$29,048	$17,340	$10,831	$57,219
Average Daily Revenue	$29,048	$15,016	$8,719	$52,783
Two GP Lanes Only (No-Build)				
Summer Friday VHT	40,798	23,729	17,098	81,625
Summer Friday 24-hour Speed (mph)	46.4	45.0	52.1	47.2

1 VMT – vehicle-miles traveled
2 VHT – vehicle-hours traveled

4.0 COSTS AND EFFECTIVENESS

4.1 Incremental Capital Costs of Managed Lanes

The costs of building the additional lane and an ML rather than an immediately adjacent general-purpose lane, as shown in Figure 2-1, have been estimated to be substantial[3]. Pavement surface area is about 36 percent higher than for a GP lane, and the volume of earthwork is nearly twice as much. Compared to these increases, the estimated $26 million cost for the facilities and systems necessary to operate the ML is relatively small. As summarized in Table 4-1, the estimated total additional cost of the managed lane system is $616 million, in year 2004 dollars.

Table 4-1. Estimated Incremental Capital Cost of Managed Lanes

Additional highway construction, Exits 54-68	$270,800,000
Additional highway construction, Exits 70-82	$171,300,000
Additional highway construction, Exits 88-93	$147,900,000
Managed lane systems and equipment, Exits 54-68	$9,900,000
Managed lane systems and equipment, Exits 70-82	$6,000,000
Managed lane systems and equipment, Exits 88-93	$4,100,000
Managed lane operations/finance control center	$6,000,000
TOTAL	$616,000,000

For the purposes of this analysis, the capital costs of the managed lane systems and equipment have been annualized, because their lifetimes are much shorter than that of the roadway of the control center facility. For comparison with net revenues, therefore, an adjusted total capital cost of $610 million should be used.

4.2 Operating Costs of Managed Lanes

The estimated year 2025 operating costs of the ML lane system are shown in Table 4-2. They include only the estimated maintenance annualized replacement costs of the ML lane hardware and the revenue collection and ML lane enforcement costs. No differential costs for items reflecting only the different physical configuration (*i.e*. cross-section) of the roadway itself have been estimated or included.

The total estimated operating cost of the ML system for 2025 is just under $6.4 million (year 2004 dollars). This averages about 9.4 cents per user fee transaction, comparable to other modern electronic toll collection systems.

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[3] Highway and civil construction costs provided by Clough Harbour & Associates, March 17, 2004. Design standards and clearances were established by the Connecticut Department of Transportation.

Table 4-2. Estimated Year 2025 ML System Operating Costs

	Unit	Unit Cost	Quantity	Extended Amount
Operations center operations	Each	$990,300	1	$990,300
Operations center equipment renewal	Each	$466,600	1	$466,600
Exits 54-68				
Police cruiser enforcement	Hours	$75.00	3,154	$236,600
Transaction fees	Each	$.01	34.6 M	$345,600
Credit card fees	Revenue	3%	$10.6 M	$318,100
ML control equipment and signs	LS	N/A	N/A	$1,361,800
Communications	LS	N/A	N/A	$219,100
Subtotal Exits 54-68				$2,481,200
Exits 70-82				
Police cruiser enforcement	Hours	$75.00	1,927	$144,600
Transaction fees	Each	$.01	18.4 M	$184,000
Credit card fees	Revenue	3%	$5.5 M	$164,400
ML control equipment and signs	LS	N/A	N/A	$829,800
Communications	LS	N/A	N/A	$150,500
Subtotal Exits 70-82				$1,473,300
Exits 88-93				
Police cruiser enforcement	Hours	$75.00	1,051	$78,800
Transaction fees	Each	$.01	14.8 M	$147,700
Credit card fees	Revenue	3%	$3.2 M	$95,500
ML control equipment and signs	LS	N/A	N/A	$500,100
Communications	LS	N/A	N/A	$165,400
Subtotal Exits 88-93				$987,500
Total Estimated System Operating Costs (year 2004 dollars)				*$6,398,900*

4.3 Economic Effectiveness of Managed Lanes

Over their lifetime, the managed lanes will generate an increasing amount of user fee revenue per year as traffic and congestion grow. However, at high traffic levels, congestion will become apparent in the MLs, and their travel time advantage will both diminish and become less predictable, unless user fees are raised to a level higher than the maximum assumed for this analysis. For the ML system, this is estimated to occur when the median ADT in a segment reached 100,000. At that point, user fees would have to be raised above 35 cents (year 2004 dollars) per vehicle-mile to preserve a high level of service in the MLs (see Figure 3-1).

Assuming an opening year of 2012 for the ML system, the limit of instability is estimated to occur by the following years: 2028 for Exits 54-68; 2029 for Exits 70-82; and 2034 for Exits 88-93. Based on these assumptions, net revenue (total user fees less operating costs) was estimated for each year between 2012 and 2034. The results are shown in Figure 4-1. At their opening in 2012, the I-95 East ML system is estimated to generate about $8.5 million per year in net revenues, increasing to $13.7 million per year in 2027, the projected last year of stable operation of the segment between Exits 54 and 68.

To compare these results with the system construction costs from Section 4.1, this projected revenue stream was converted to a net present value (NPV) using two different discount rates: 4 and 7 percent. These values bracket a range that has typically been used for transportation projects. The results are shown in Table 4-3, both for the opening year (2012) and for an assumed midpoint of construction of 2009. The comparison with the construction cost estimate is most appropriately made with the midpoint-of-construction NPV.

Table 4-3. Net Present Value of ML System Net Revenues

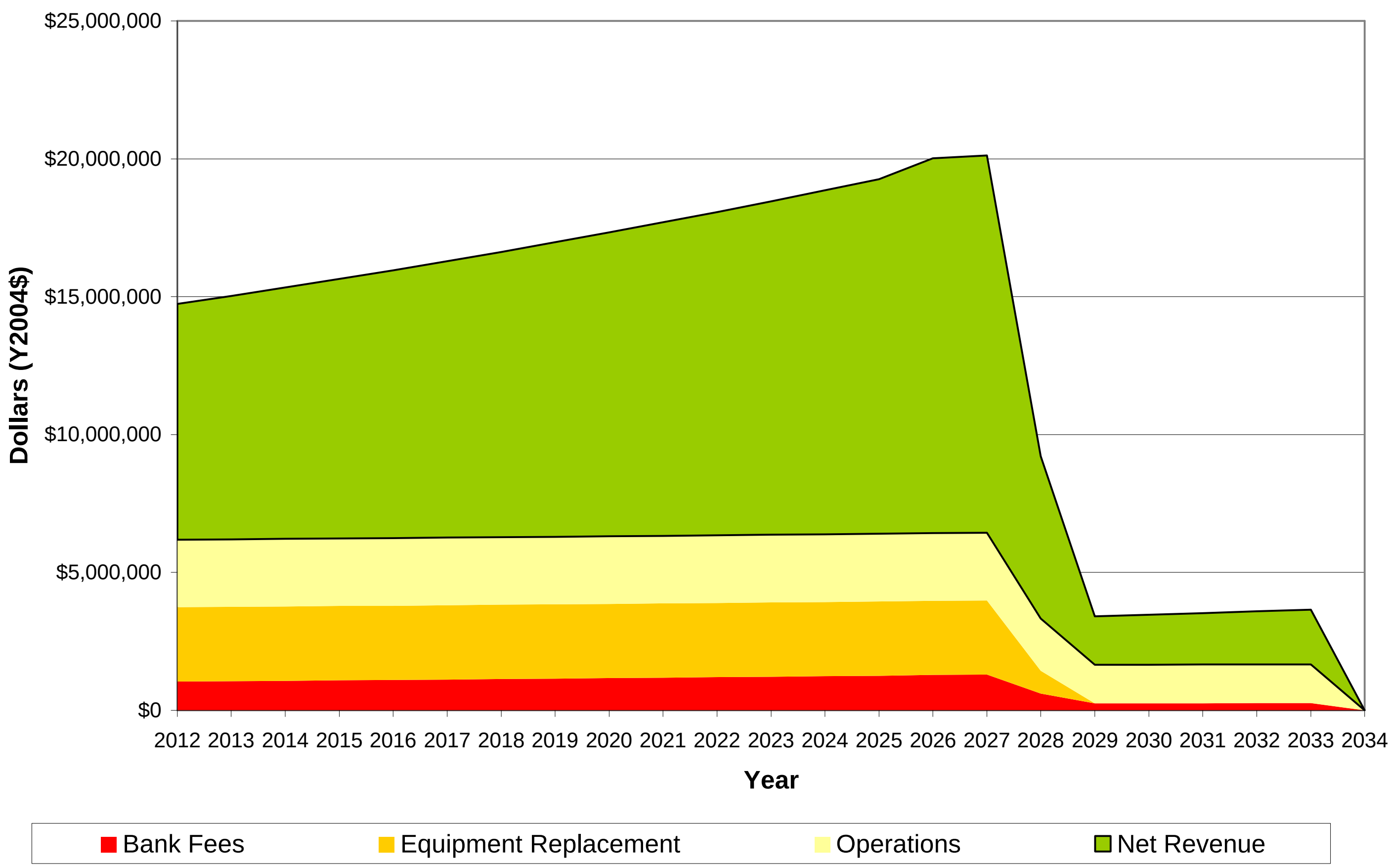
	Discount Rate = 0.04	Discount Rate = 0.07
NPV of Net Revenues in Opening Year (2012)	$137,024,000	$110,533,000
NPV of Net Revenues in 2009 (for Comparison with Construction Estimate)	$121,814,000	$98,263,000

Comparison with the construction estimates in Table 4-1 indicates that even under the more favorable 4 percent discount rate, the MLs would only generate one-fifth of their incremental construction costs in net user fees ($122 million out of $610 million). Not only would the MLs not be able to contribute anything to the construction of new capacity in the corridor, they would actually increase the effective cost of doing so. The incremental civil construction costs of the ML system would have to be reduced to about $114 million before they could be expected to make a real contribution towards defraying the cost of new capacity.

The economics for managed lanes would be even less attractive if they were built in addition to the Full Build (three GP lanes in each direction). In this case, delay savings for the ML system would be very modest, and usage would be at a very low level, perhaps not even enough to recover the cost of collecting the user fees.

In summary, then, the ML system does not appear to be effective within the defined parameters, especially the maximum fee of 35 cents per vehicle-mile. It would be less efficient in moving traffic than the Full Build, and would cost more. This conclusion is specific to the specific links, fee schedule, and cross section assumed, and should not be assumed to be transferable to other Interstate sections in Connecticut or elsewhere.

Figure 4-1. Estimated ML System Operating Results by Year



5.0 PHYSICAL IMPACTS

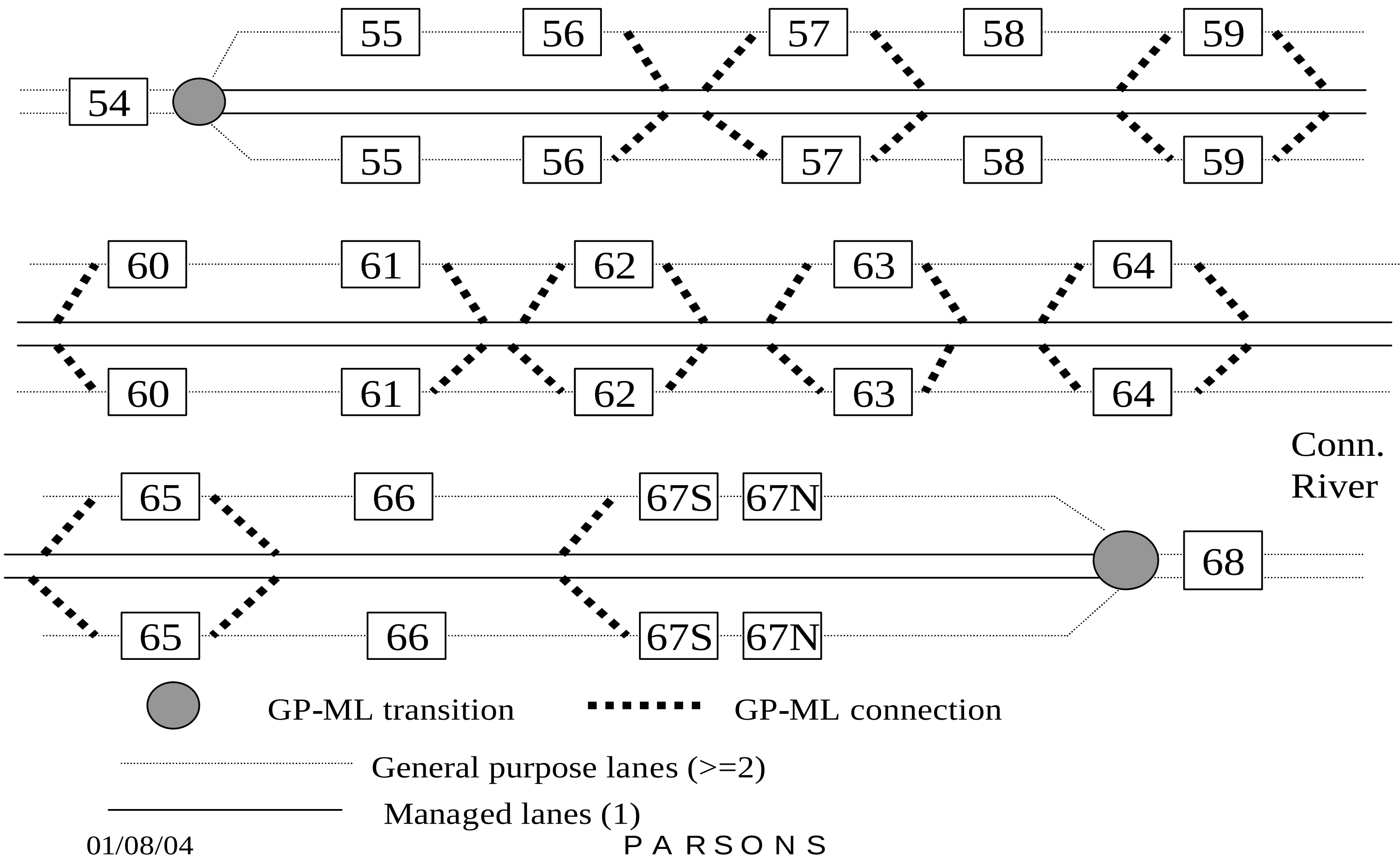
As presented previously in Section 2.1, the typical six-lane section for the GP lane configuration is approximately 138 feet wide. This is an average width increase of 40 to 50 feet over the existing roadway configuration. Evaluation of the full-build improvement recommendations which incorporated the six-GP lane configuration showed that the GP lanes can generally be accommodated within the existing I-95 right-of-way. Impacts to existing interchange ramps caused by the increased roadway width would require moderate modifications to the ramp alignments at the mainline and ramp junctions in most locations. In particular, this is the case along the corridor between Exit 54 and the Thames River where the widening would be accommodated to the outside of the existing pavement surface. The GP lane configuration would also require the replacement of the majority of bridge structures along the corridor. In addition, mitigation of approximately 60 acres of fresh water and tidal wetlands would be required due to the slope impacts caused by the widening.

The typical ML section is approximately 184 feet wide. This is an average width increase of approximately 46 feet over the GP lane configuration and 86 to 94 feet over the existing roadway configuration. The additional widening to accommodate the ML configuration would likely require right-of-way takings on both the northbound and southbound sides of I-95 along the majority of the section located between Exit 54 and the Thames River. Beyond Exit 88 where the widening can typically be accommodated in the existing median, right-of-way requirements would likely be much less extensive. It is also likely the additional widening would cause major impacts to existing interchange ramps. These impacts would warrant the complete realignment or reconfiguration of the majority of the existing ramps within the limits of the ML facility. Replacement of all bridge structures located within the ML limits would also be required. In addition, wetland impacts would be expected to greatly exceed the 60 acres impacted by the GP lane configuration.

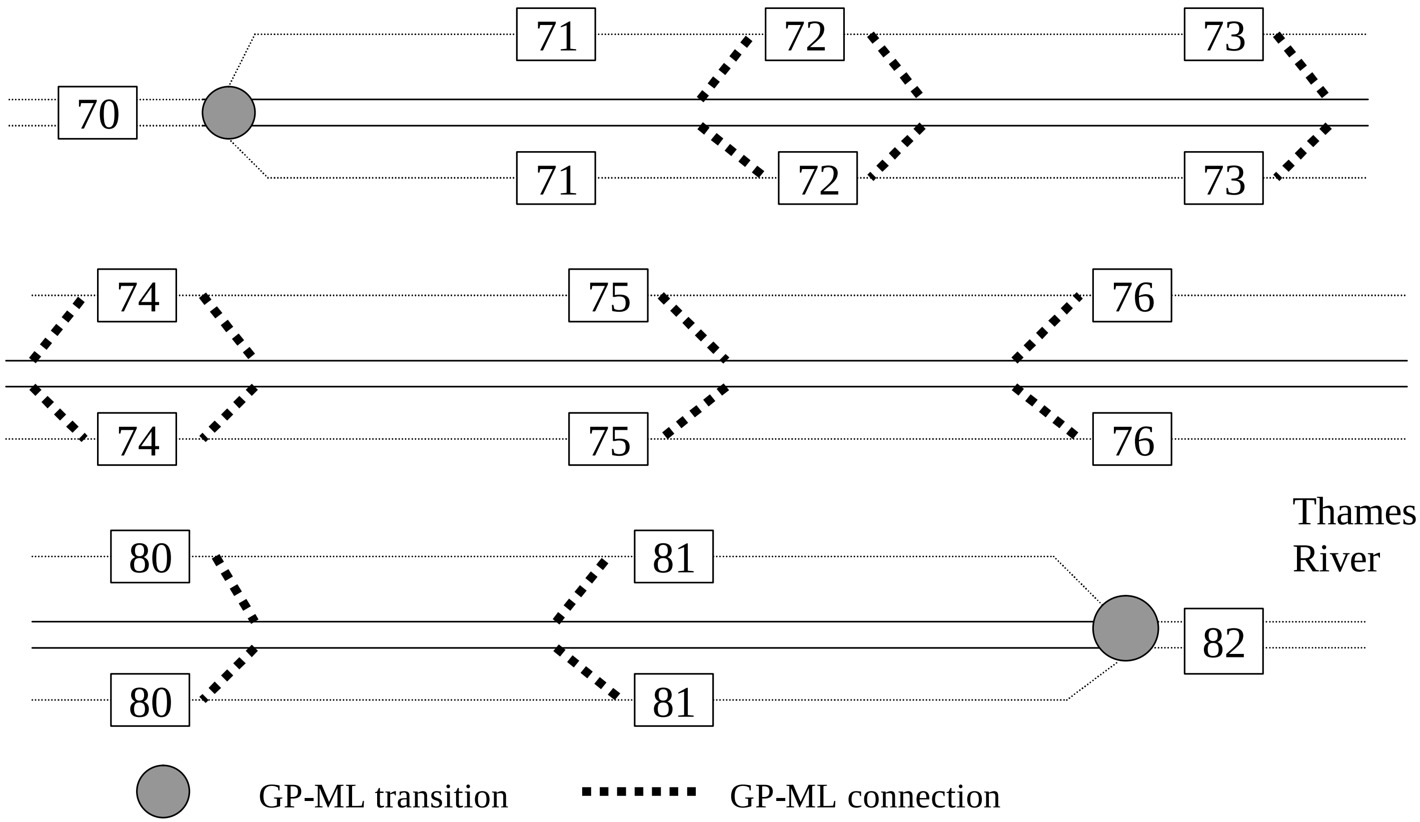
In conclusion, it is anticipated that the overall impacts imposed by the ML configuration on the physical environment within the I-95 corridor would be significantly greater than the impacts imposed by the implementation of the six-GP lane configuration.

APPENDIX A

I-95 East Managed Lanes Schematic (Exits 54-68)



I-95 East Managed Lanes Schematic (Exits 70-82)



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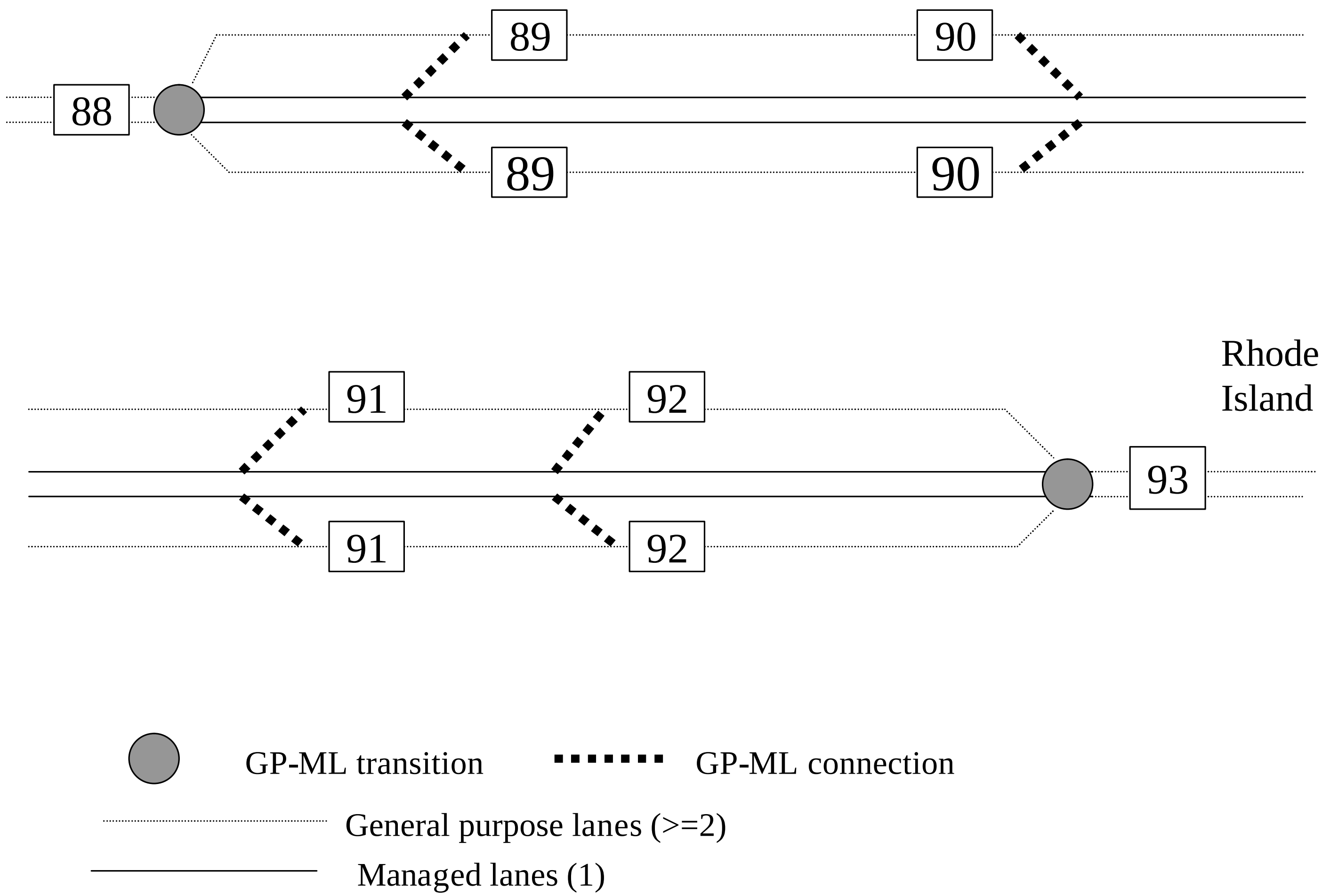
I-95 East Managed Lanes Schematic (Exits 88-93)



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