Executive Summary
Connecticut I-95 Corridor Congestion Relief Study

Federal Highway Administration

September 2016

Coordinated and Funded Through the
Federal Highway Administration Value Pricing Pilot Program
and the Connecticut Department of Transportation

CDM Smith

Executive Summary

I-95 Corridor Congestion Relief Study

CDM Smith (Project Team) was selected by the Connecticut Department of Transportation (ConnDOT) to perform a corridor congestion relief study of Interstate 95 (I-95) and the Merritt Parkway (Route 15) from New Haven to the New York State Line under the Federal Highway Administration (FHWA) Value Pricing Pilot Program (VPPP). This study included the assembly and collection of traffic and travel time data, a stated preference survey to estimate value of time in the study corridors, and a detailed traffic modeling and toll revenue evaluation for a variety of configuration and pricing alternatives. In addition to the I-95 findings discussed in this executive summary, several other study documents have been submitted covering current Federal tolling laws, the state of tolling readiness in Connecticut, and Public-Private Partnership approaches used for tolling.

Study Objective and Scope

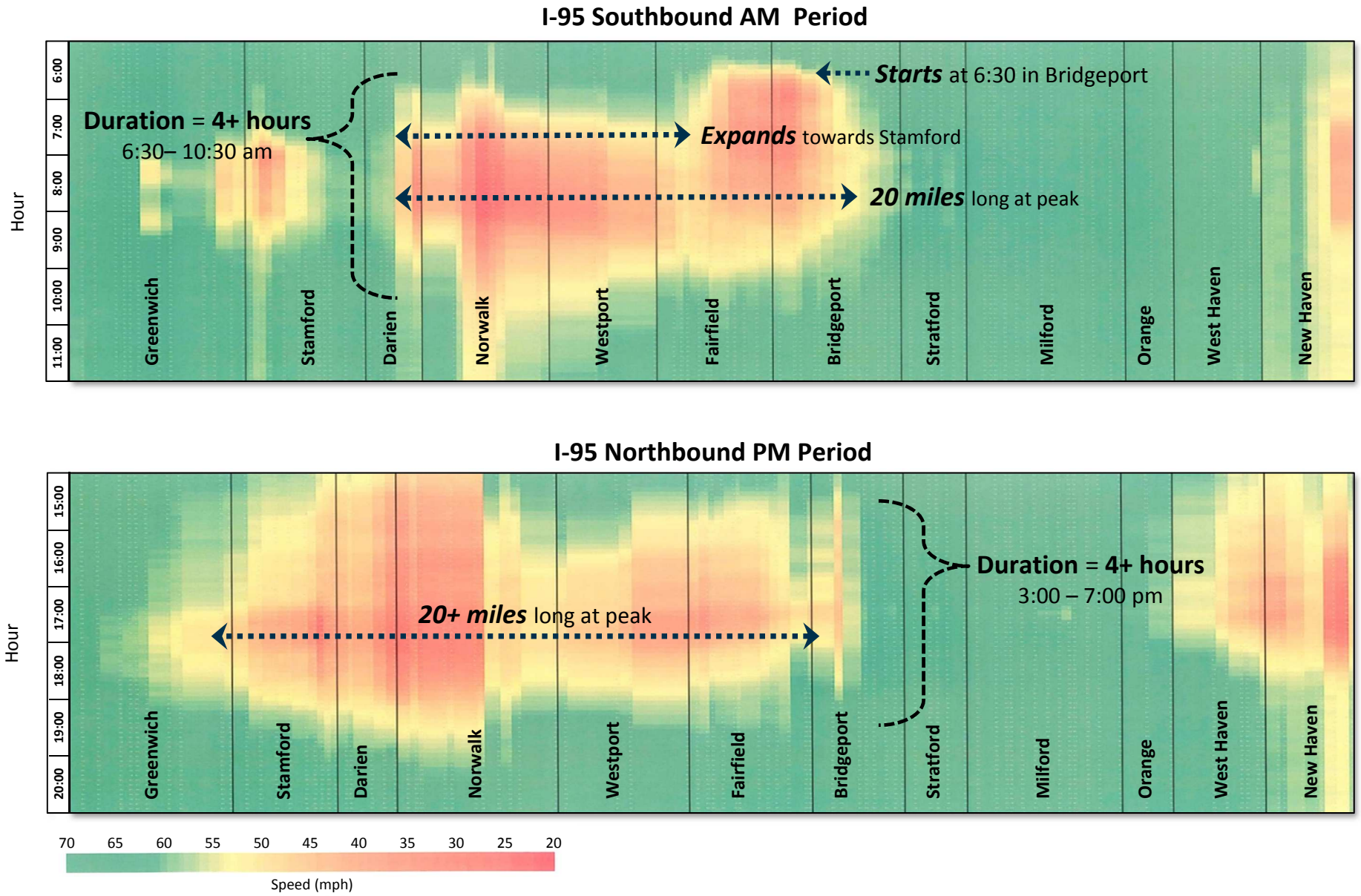
CTDOT submitted a proposal to FHWA in 2011 under the VPPP to study whether congestion pricing on I-95 and Route 15 using All Electronic Tolling (AET) can reduce congestion in the corridor. The I-95 corridor experiences extraordinary amounts of recurring delay over the 47 miles between New Haven and the New York state line. On average, congestion spans over a length of more than 25 miles, lasting for more than 4 hours during both the AM and PM periods **(see Figure ES-1)**. Route 15 experiences similar congestion levels, although these tend to be somewhat shorter in duration. This congestion has been estimated by the Texas Transportation Institute to cost Connecticut close to a billion dollars annually[1].

In addition to the goal of congestion relief, toll revenue was a key factor that was considered across alternatives. The funding of additional highway and transit improvements in the corridor with toll revenue can provide additional congestion relief and choices for travelers. To measure and compare potential congestion relief benefits across alternatives, performance measures such as traffic, vehicle miles travelled, vehicle hours travelled, and travel speeds were summarized for I-95, Route 15, Route 1, separately and as a combined corridor. In addition, a simulation model of I-95 was utilized to quantify and visualize the estimated congestion relief benefits of the various alternatives.

The study was performed in sufficient detail to answer the above objectives and included the following key work efforts:

- Development of a current traffic volume & speed profile for I-95 and Route 15 including detailed analysis by time of day and travel direction; **(see Figure ES-1)**
- Application of a Stated Preference (SP) Survey in the I-95 and Route 15 travel corridors to estimate motorists' value of time and their potential to:
    - reduce trip making,
    - change to transit or other travel modes,

[1] http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/ums/congestion-data/bridgeport.pdf



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2012 I-95 AVERAGE WEEKDAY TRAVEL SPEED

FIGURE ES-1

  - change departure time, or
  - change route when faced with a variable toll on I-95 and Route 15;

- Enhancement of the Statewide Travel Demand Model;
- Development of an I-95 corridor micro-simulation traffic model in order to analyze the operational impacts on I-95 from pricing and capacity improvements;
- Estimation of the traffic diversion that can be anticipated from pricing on I-95 and Route 15;
- Estimation of toll revenues & costs: annual gross toll revenue, tolling capital costs, tolling operating costs, and net toll revenue for final tolling alternatives.

Study Area

The study area was defined as the I-95 corridor from New York State Line to the I-91/I-95/ Rt-34 interchange in New Haven, Connecticut. **Figure ES-2** depicts the regional area, with the highlighting of I-95 and Route 15 (Merritt Parkway / Wilbur Cross Parkway). Route 1 and the Metro North rail line run parallel to I-95, crossing over I-95 at multiple locations throughout the corridor. Due to the interaction and competition between I-95, Route 15, Route 1, and the Metro North line, the Project Team developed a study approach that allows for impacts to be estimated across all of these roadway facilities and modes of transportation within the defined study area.

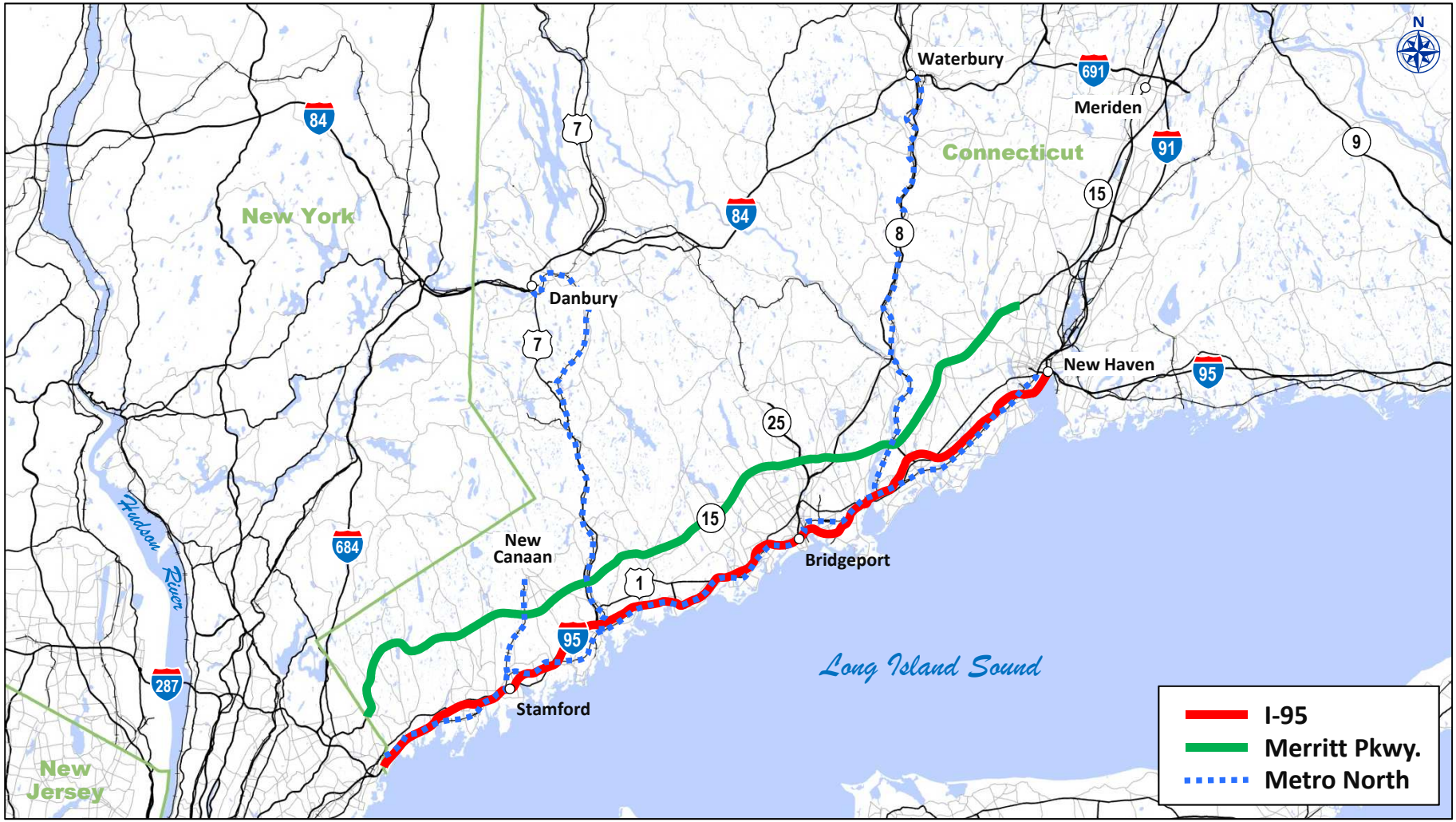
This summary document provides a discussion of the final alternatives evaluated, estimates of traffic and toll revenue, and roadway operational benefits that could be achieved from pricing the I-95 corridor.

Alternatives Description

During the first half of this study and prior to the collection of data from the SP survey, the Project Team conducted preliminary analysis of several tolling alternatives, including tolled managed lanes on I-95 between New Haven and New York. The managed lane alternative consisted of adding additional lanes to I-95 and tolling only this new capacity. The existing lanes on I-95 were assumed to remain toll free. This alternative was found to generate a relatively small amount of revenue compared to the significant capital cost of implementing the unique geometric requirements associated with managed lanes in the corridor. While managed lanes could provide congestion relief to the corridor, the relatively small amount of revenue generation as compared to the cost of construction and as compared to the revenue generated from tolling all the lanes resulted in this alternative being dropped from the final set of alternatives carried forward.

The final set of alternatives considered in this study assumed AET across all lanes on I-95 or on both I-95 and Route 15 between New Haven and the New York border. The final set of alternatives also included a scenario where I-95 would be expanded with an additional general purpose lane in each direction between Bridgeport and Stamford; which is the most congested stretch of I-95. Twelve (12) AET locations were assumed on I-95 and ten (10) AET locations on Route 15.

Figure ES-3 displays the assumed tolling locations on I-95 and Route 15 and the toll rates (2014 dollars) assumed in this study. Under all tolling scenarios within the VPPP, time of day congestion pricing would be required. For this study, off-peak toll rates were assumed to be 30 percent lower than peak period toll rates. A brief description of the Alternatives is provided below.



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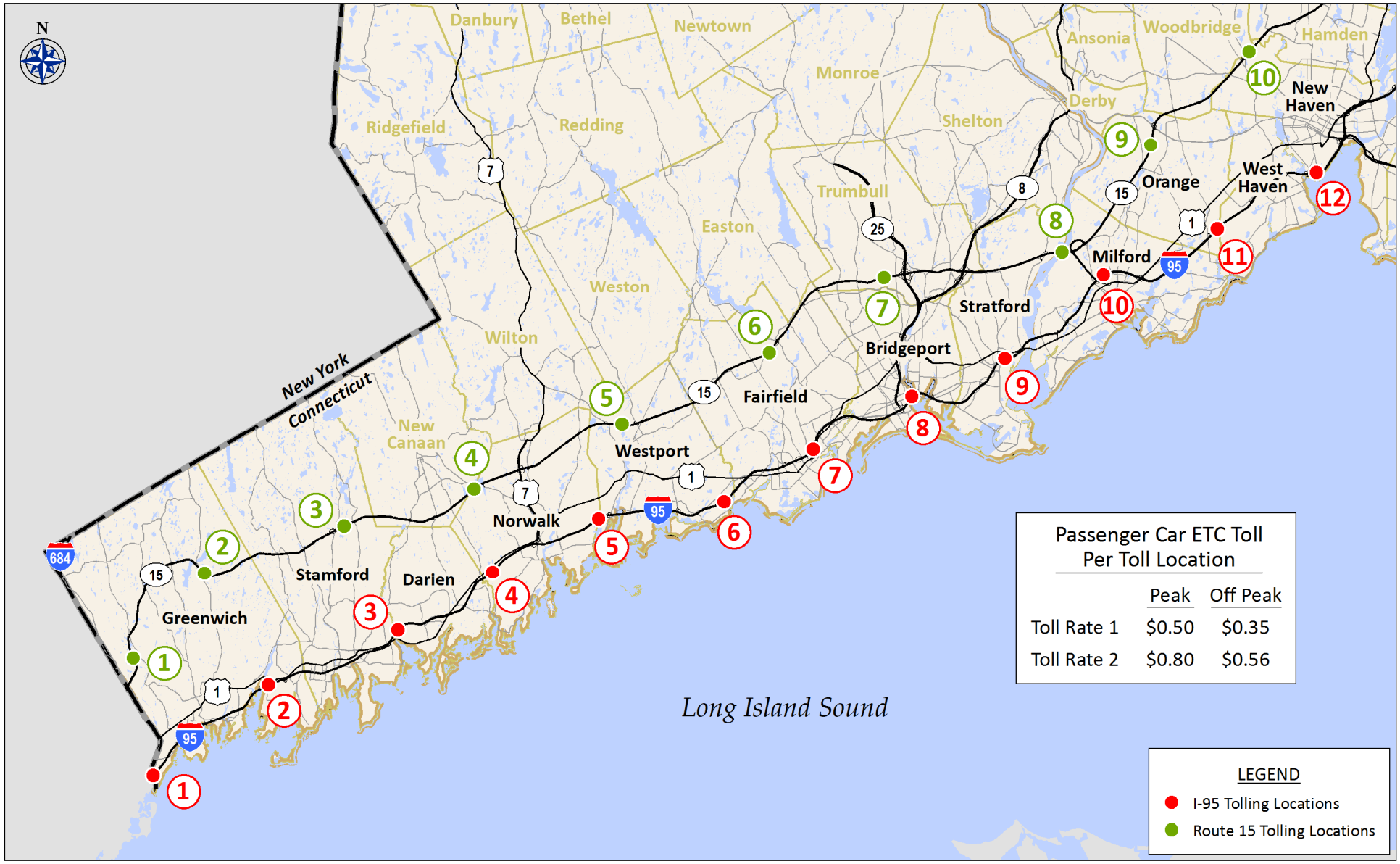
I-95 CORRIDOR: NEW YORK TO NEW HAVEN

FIGURE ES-2



I-95 AND ROUTE 15 ASSUMED TOLLING LOCATIONS

FIGURE ES-3

- **Alternative 1 (Tolling I-95 only) –** Toll existing lanes with no widening of I-95. Includes 12 AET locations along the existing lanes of I-95 between New Haven and the New York border. Tolls at each tolling location for passenger vehicles equipped with a transponder were assumed to be $0.50 and $0.35 for peak and off peak time periods, respectively. A full length trip between New Haven and New York would be $6.00, or roughly $0.125 per mile during peak periods, and $4.20 (roughly $0.09 per mile) during off peak periods. Assumed toll rates for the study are comparable to other Turnpike facilities. Actual tolling locations and toll rates would need to be refined should it be decided to toll I-95.

- **Alternative 2 (Tolling I-95 only) -** Toll existing lanes with no widening of I-95. Includes 12 AET locations along the existing lanes of I-95 between New Haven and the New York border under a *higher toll rate level than Alternative 1*. Tolls at each tolling location for passenger vehicles equipped with a transponder were assumed to be $0.80 and $0.56 for peak and off peak time periods, respectively. A full length trip between New Haven and New York would be $9.60, or roughly $0.205 per mile during peak periods, and $6.72 (roughly $0.145 per mile) during off peaks.

- **Alternative 3 (Tolling I-95 & Rt. 15)** – Toll existing lanes with no widening of I-95 and Route 15. Includes 12 AET locations along the existing lanes of I-95 and 10 AET locations along Route 15 between New Haven and the New York border. Toll rate levels were assumed to be the same as discussed in Alternative 1 and were applied to both I-95 and Route 15. A full length trip between New Haven and New York on Route 15 would be $5.00 during peak periods and $3.00 during off peaks.

- **Alternative 4 (Tolling I-95 only)** – Includes widening of I-95 between Bridgeport and Stamford to accommodate 1 additional general purpose lane in each direction in combination with 12 AET locations along I-95 between New Haven and the New York border. Toll rate levels were assumed to be the same as discussed in Alternative 1.

- **Alternative 5 (Tolling I-95 & Rt. 15)** – Includes widening of I-95 only between Bridgeport and Stamford in combination with 12 AET locations along I-95 and 10 AET locations along Route 15 between New Haven and the New York border. Toll rate levels were assumed to be the same as discussed in Alternative 3 and were applied to both I-95 and Route 15.

These five alternatives were run utilizing the travel demand toll model specifically enhanced and refined for this study at 2020 and 2040 conditions. In addition, toll free runs were prepared for the current configuration (No Build), as well as for the widened alternative. These toll free runs serve as the baseline to compare the tolled alternatives against in terms of traffic diversion at the specific tolling locations and along the corridor in general. **Table ES-1** provides a summary of the runs conducted, which routes are tolled, and at what toll rate. Output from the travel demand model runs were analyzed and summarized for each of these alternatives.

Table ES-1
I-95 Corridor Congestion Relief Study
Final Alternatives Evaluated

Scenario	Description	Tolled Routes		
		None	I-95	Route 15
No Build Toll Free	No Build - Toll Free	X		
Alt 1	No Build - Toll I-95 only (Toll Rate 1)		X	
Alt 2	No Build - Toll I-95 only (Toll Rate 2)		X	
Alt 3	No Build - Toll Both I-95 and Route 15 (Toll Rate 1)		X	X
Build Toll Free	I-95 Widening (Brgpt-Stmfd) - Toll Free	X		
Alt 4	I-95 Widening (Brgpt-Stmfd) - Toll I-95 only (Toll Rate 1)		X	
Alt 5	I-95 Widening (Brgpt-Stmfd) - Toll I-95 and Route 15 (Toll Rate 1)		X	X

Note:
Toll Rate 1: Assumes $0.50 peak / $0.35 off peak toll per tolling location
Toll Rate 2: Assumes $0.80 peak / $0.56 off peak toll per tolling location
All tolling scenarios assume tolling from NY State Line to New Haven

Summary of Traffic Estimates

Table ES-2 presents 2020 estimated average weekday mainline traffic volumes (in thousands) on I-95 and Route 15 in the southbound direction during the AM Peak Period, the northbound direction during the PM Peak Period, and for the total average weekday. These traffic volumes represent the average of all segments between New Haven and the New York border.

The summary table below shows seven scenarios in the left column. This includes the 5 tolling alternatives discussed earlier, as well as No Build Toll Free (TF) and Build TF scenarios. The next column of numbers summarizes the AM Peak Period traffic estimates in the southbound direction for I-95 and Route 15, as well as the sum total of both corridors. The traffic estimates for the PM Peak Period in the northbound direction are shown next. Finally, the daily traffic total is shown on the right side. The middle portion of the table shows the average net traffic impacts when compared to the No Build TF condition. The bottom portion of the tables presents the percent change when compare against the No Build TF condition.

For Alternative 1, a significant amount of traffic reduction is estimated on I-95 in the southbound direction during the AM peak period (-12.1 percent) and in the northbound direction during the PM peak period (-11.4 percent). On Route 15, traffic during the same periods and travel directions is estimated to increase by 4.5 percent and 3.3 percent, respectively. The reduction of traffic on I-95 is a combination of some traffic shifting to off-peak time periods, a shift to alternative modes (transit), trip suppression, and diversion.

Between the tolling alternatives, Alternative 2 results in the largest loss of traffic from I-95 and the largest increase in traffic to Route 15. Alternative 2 assumed a much higher toll rate. Based on a review of the findings between Alternative 1 and Alternative 2, all other alternatives were analyzed with the Alternative 1 toll rates.

Alternative 4 is estimated to have the least overall impact, particularly during the AM and PM peak period major travel directions. The widening of I-95 attracts more volume as displayed by the results of the Build TF run. However, the volume is then "managed" back down to roughly No Build TF volumes, resulting in an improved I-95 condition, while also not overburdening Route 15 in the peak travel direction.

Alternative 5 also shows promising results, where the tolling of Route 15 diverts some traffic back to I-95, resulting in I-95 traffic levels that are closest to the No Build TF numbers. Tolling both corridors can also ensure a "balancing" of traffic between the two facilities while also providing congestion relief for Route 15 as well.

Table ES-2
Summary Comparison of 2020 Estimated Average Segment Traffic Volumes

Average Weekday Segment Traffic Volumes (000's) - New Haven to NY

	AM (6AM-10AM) Southbound			PM (3PM-7PM) Northbound			Total Average Weekday		
Alternative	I-95	Route 15	Total	I-95	Route 15	Total	I-95	Route 15	Total
No Build TF	19.9	11.1	31.0	21.9	12.3	34.2	159.7	72.3	232.0
1	17.5	11.6	29.1	19.4	12.7	32.1	133.8	82.6	216.4
2	15.4	12.0	27.4	17.4	13.0	30.4	116.9	87.7	204.6
3	17.9	9.0	26.9	19.9	10.2	30.1	145.1	57.9	203.0
Build TF	21.8	10.3	32.1	24.4	11.3	35.7	169.7	65.7	235.4
4	18.6	11.2	29.8	21.2	11.9	33.1	140.0	78.7	218.7
5	19.7	8.0	27.7	22.5	8.4	30.9	153.4	51.4	204.8

Traffic Volume Difference as Compared to No Build Toll Free Traffic (000's)

	AM (6AM-10AM) Southbound			PM (3PM-7PM) Northbound			Total Average Weekday		
Alternative	I-95	Route 15	Total	I-95	Route 15	Total	I-95	Route 15	Total
No Build TF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	-2.4	0.5	-1.9	-2.5	0.4	-2.1	-25.9	10.3	-15.6
2	-4.5	0.9	-3.6	-4.5	0.7	-3.8	-42.8	15.4	-27.4
3	-2.0	-2.1	-4.1	-2.0	-2.1	-4.1	-14.6	-14.4	-29.0
Build TF	1.9	-0.8	1.1	2.5	-1.0	1.5	10.0	-6.6	3.4
4	-1.3	0.1	-1.2	-0.7	-0.4	-1.1	-19.7	6.4	-13.3
5	-0.2	-3.1	-3.3	0.6	-3.9	-3.3	-6.3	-20.9	-27.2

Percent Change in Traffic Volume as Compared to No Build Toll Free Traffic

	AM (6AM-10AM) Southbound			PM (3PM-7PM) Northbound			Total Average Weekday		
Alternative	I-95	Route 15	Total	I-95	Route 15	Total	I-95	Route 15	Total
No Build TF	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1	-12.1%	4.5%	-6.1%	-11.4%	3.3%	-6.1%	-16.2%	14.2%	-6.7%
2	-22.6%	8.1%	-11.6%	-20.5%	5.7%	-11.1%	-26.8%	21.3%	-11.8%
3	-10.1%	-18.9%	-13.2%	-9.1%	-17.1%	-12.0%	-9.1%	-19.9%	-12.5%
Build TF	9.5%	-7.2%	3.5%	11.4%	-8.1%	4.4%	6.3%	-9.1%	1.5%
4	-6.5%	0.9%	-3.9%	-3.2%	-3.3%	-3.2%	-12.3%	8.9%	-5.7%
5	-1.0%	-27.9%	-10.6%	2.7%	-31.7%	-9.6%	-3.9%	-28.9%	-11.7%

Traffic Operations Findings

A special operations model was created for I-95 from New Haven to New York to provide the most realistic assessment of how pricing and widening would likely impact traffic operations on I-95. This microsimulation model was calibrated to the AM and PM peak period conditions to reflect existing bottlenecks, queuing, travel speeds, and volumes by direction. The simulation model was exercised at 2040 levels for the various alternatives.

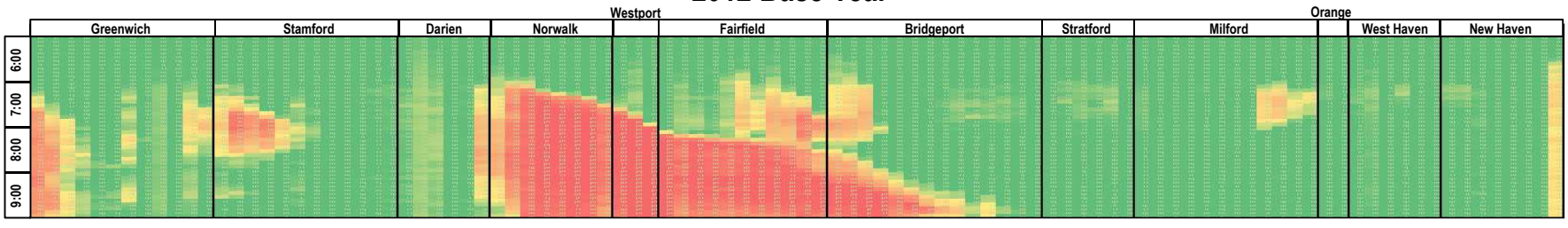
Figure ES-4 and ES-5 display heat maps of estimated travel speeds between New Haven and New York during the AM peak period in the southbound direction and during the PM peak period in the northbound direction, respectively. The 2012 base year heat map is included on the top, followed by the 2040 No Build to represent a baseline for 2040 results. The four graphics underneath present results of analysis of scenarios run and analyzed in the simulation model.

Overall, the addition of an extra travel lane in each direction between the most congested portions of I-95 between Stamford and Bridgeport showed additional benefits when combined with localized selective interchange improvements. Simulation results showed there would be even more substantial benefits if the selective widening was continued further south to meet the I-287 interchange near the New York Stateline, particularly in the southbound direction. The addition of an extra lane with tolling on I-95 showed potential for dramatic improvements in the future year operations of I-95 when compared to the No Build scenario.

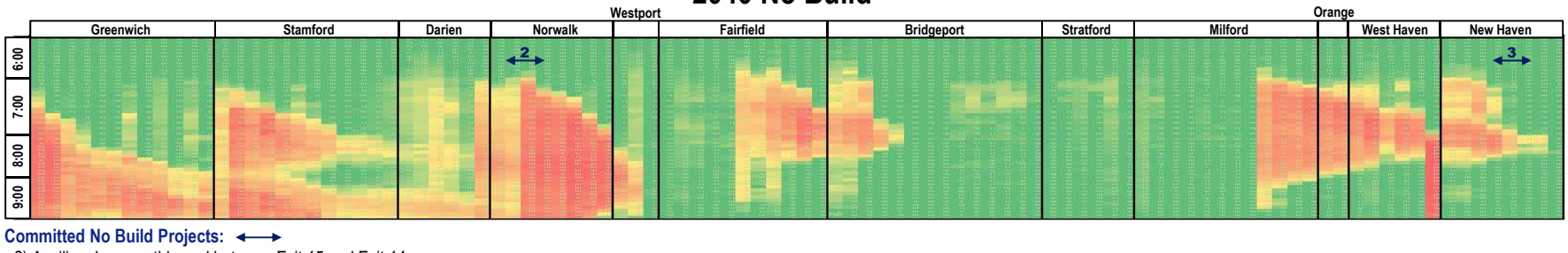
In addition to the travel speeds, travel times were pulled out of the AM and PM peak period simulation models for a Bridgeport to Stamford movement and for a full length movement between New Haven and New York. **Table ES-3** shows the estimated 2040 I-95 southbound AM travel times. The top portion of the table shows travel times between Bridgeport and Stamford. The left portion of the table shows the No Build (No Toll) travel times. The next column shows the estimated travel times for the tolling alternatives and the net difference in travel times versus the No Build No Toll. For example, tolling I-95 under No Build conditions will result in a time savings of 0 to 10 minutes depending on time period. A full length trip would save anywhere from 1 to 19 minutes. It should be noted, that a planned widening between Exits 14 and 15 is estimated to have a significant positive impact on the current congestion levels in the southbound direction. There is a significant influx of demand from Route 7 along the existing I-95 segment between Exits 14 and Exit 15. The southbound entrance ramp from Exit 15 carries Route 7 traffic (15,000 vehicles on an average weekday and 1,400 during the AM peak hour) onto I-95. The exit ramp to Boston Post Road at Exit 14 in the southbound direction carries 11,000 vehicles on an average weekday is roughly just 0.5 miles from the Exit 15 on ramp. This combination of heavy entering traffic from Route 7 and exiting traffic to Boston Post Road currently causes major friction and operational issues along this segment.

In addition, the widening assumption of I-95 between Bridgeport and Stamford would need considerable further refinement, particularly at the southern terminus of the widening. The findings from the Build Toll Free, as well as the Build tolling alternatives indicate that the widening should be extended southward to the NY border, at least in the southbound direction. The assumed current terminus of the widening is itself creating a bottleneck location, thereby reducing the benefit achieved from pricing and widening.

2012 Base Year



2040 No Build

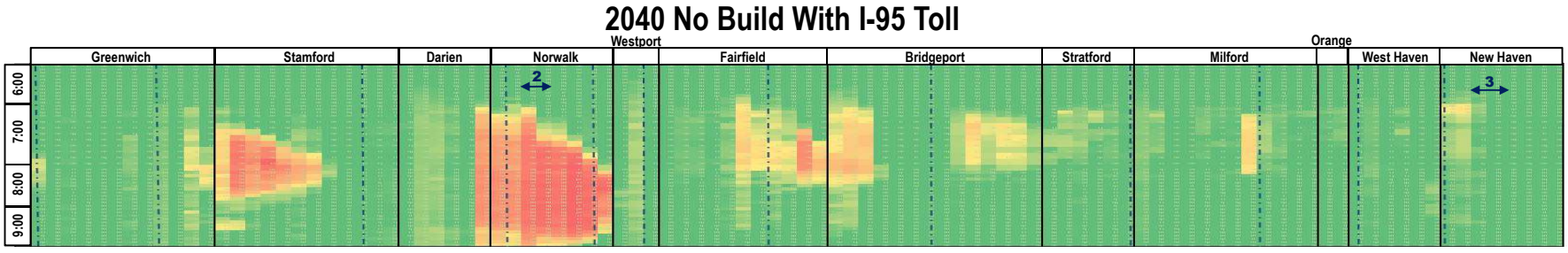


Committed No Build Projects: ←→

2) Auxiliary lane southbound between Exit 15 and Exit 14.

3) Redesigned I-91 and I-95 interchange at New Haven.

2040 No Build With I-95 Toll



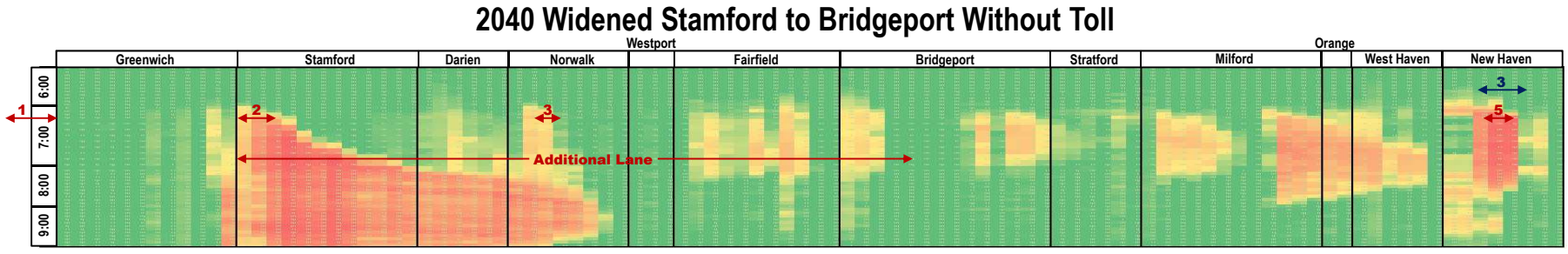
Committed No Build Projects: ←→

2) Auxiliary lane southbound between Exit 15 and Exit 14.

3) Redesigned I-91 and I-95 interchange at New Haven.

Approximate Toll Gantry Locations

2040 Widened Stamford to Bridgeport Without Toll



Committed No Build Projects: ←→

3) Redesigned I-91 and I-95 interchange at New Haven.

Mitigation Projects: ←→

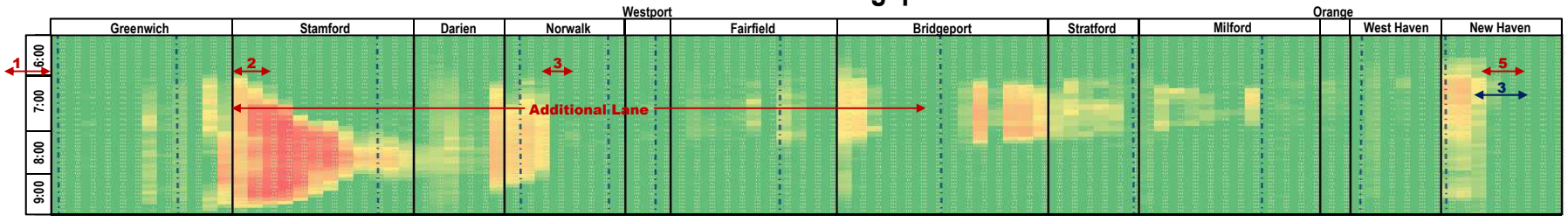
1) Two lane exit and deceleration lane for off ramp to I-287 from I-95 Southbound.

2) Auxiliary lane southbound between Exits 7 and 6.

3) Auxiliary lane southbound between Exits 15 and 14.

5) Additional 5th lane southbound between Exits 48 and 47.

2040 Widened Stamford to Bridgeport With I-95 Toll



Committed No Build Projects: ←→

3) Redesigned I-91 and I-95 interchange at New Haven.

Mitigation Projects: ←→

1) Two lane exit and deceleration lane for off ramp to I-287 from I-95 Southbound.

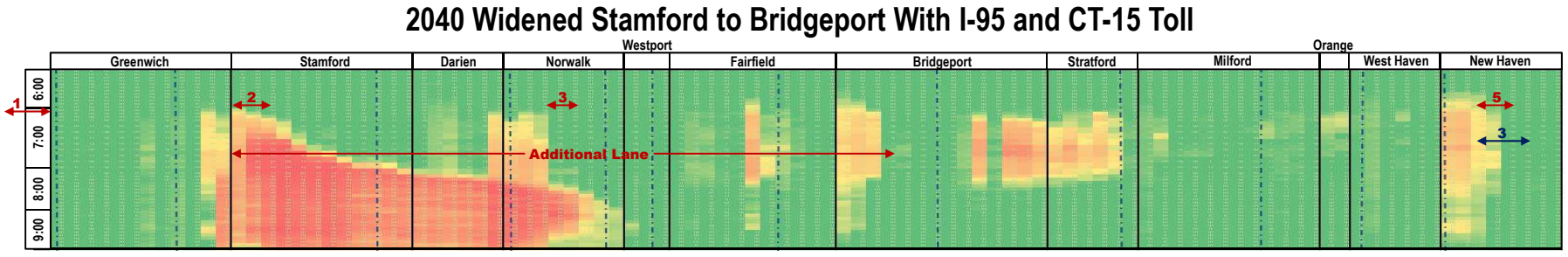
2) Auxiliary lane southbound between Exits 7 and 6.

3) Auxiliary lane southbound between Exits 15 and 14.

5) Additional 5th lane southbound between Exits 48 and 47.

Approximate Toll Gantry Locations

2040 Widened Stamford to Bridgeport With I-95 and CT-15 Toll



Committed No Build Projects: ←→

3) Redesigned I-91 and I-95 interchange at New Haven.

Mitigation Projects: ←→

1) Two lane exit and deceleration lane for off ramp to I-287 from I-95 Southbound.

2) Auxiliary lane southbound between Exits 7 and 6.

3) Auxiliary lane southbound between Exits 15 and 14.

5) Additional 5th lane southbound between Exits 48 and 47.

Approximate Toll Gantry Locations

5 20 40 60

Speed (MPH)

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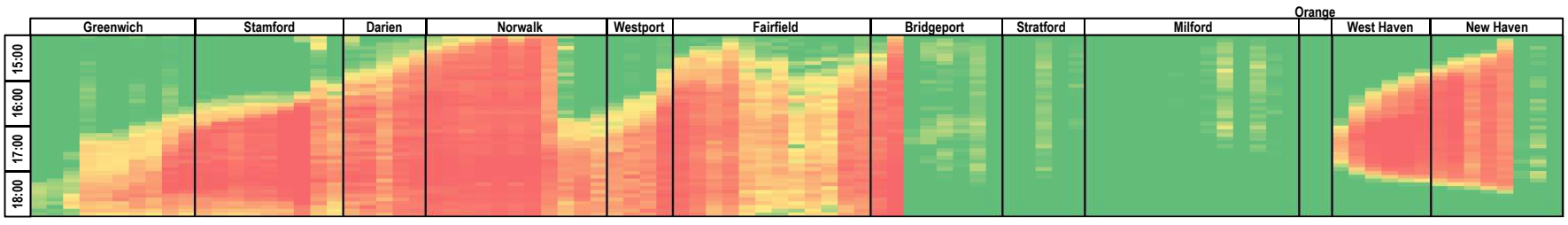
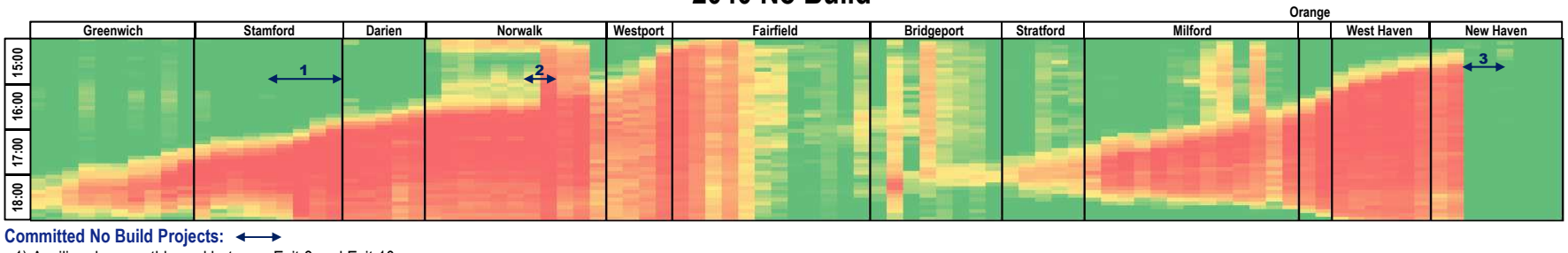
AM PEAK SOUTHBOUND SPEED CONTOURS

FIGURE ES-4

2012 Base Year



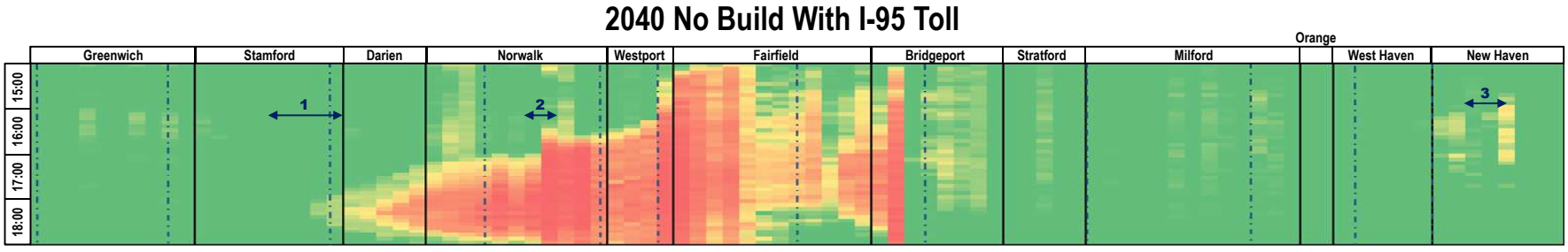
2040 No Build



Committed No Build Projects: ⟷

1) Auxiliary lane northbound between Exit 8 and Exit 10.
2) Auxiliary lane northbound between Exit 14 and Exit 15.
3) Redesigned I-91 and I-95 interchange at New Haven.

2040 No Build With I-95 Toll

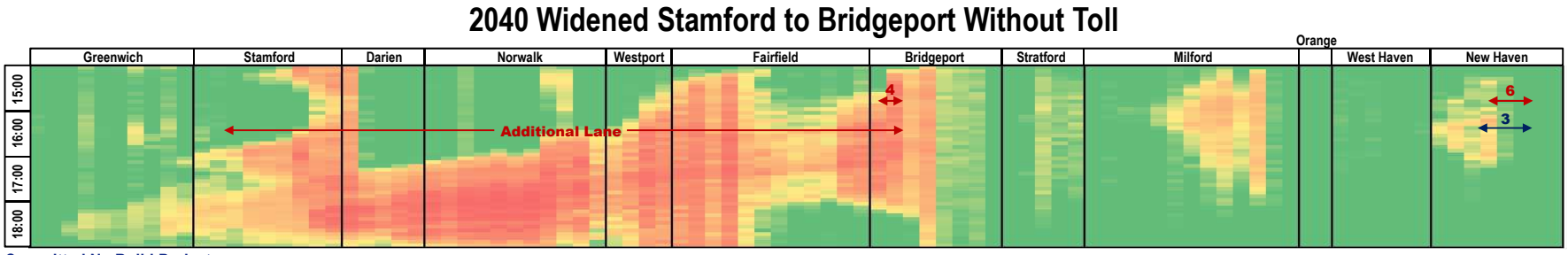


Committed No Build Projects: ⟷

1) Auxiliary lane northbound between Exit 8 and Exit 10.
2) Auxiliary lane northbound between Exit 14 and Exit 15.
3) Redesigned I-91 and I-95 interchange at New Haven.

Approximate Toll Gantry Locations

2040 Widened Stamford to Bridgeport Without Toll



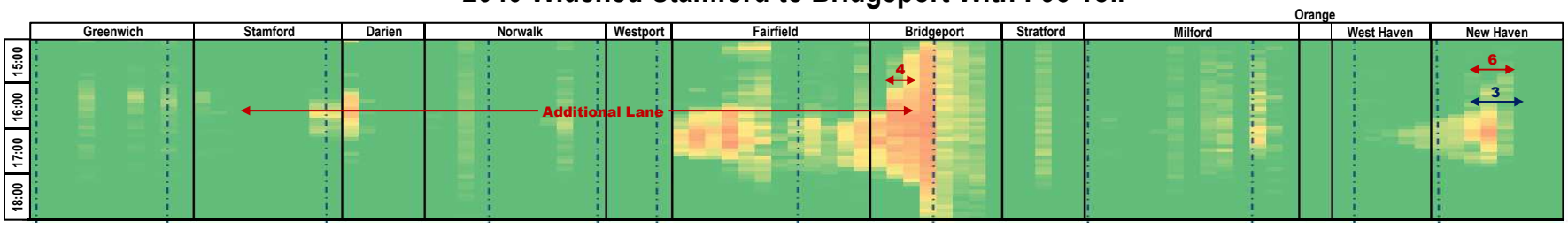
Committed No Build Projects: ⟷

3) Redesigned I-91 and I-95 interchange at New Haven.

Mitigation Projects: ⟷

4) NB Exit 27A: Two lane off ramp and northbound auxiliary lane between Exits 26 & 27A.
6) Lane configuration changes to northbound I-95 to I-91 Interchange ramps.

2040 Widened Stamford to Bridgeport With I-95 Toll



Committed No Build Projects: ⟷

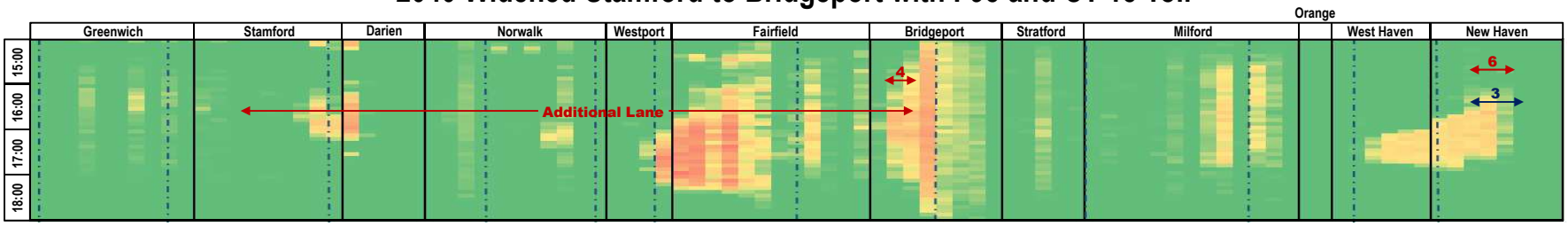
3) Redesigned I-91 and I-95 interchange at New Haven.

Mitigation Projects: ⟷

4) NB Exit 27A: Two lane off ramp and northbound auxiliary lane between Exits 26 & 27A.
6) Lane configuration changes to northbound I-95 to I-91 Interchange ramps.

Approximate Toll Gantry Locations

2040 Widened Stamford to Bridgeport with I-95 and CT-15 Toll



Committed No Build Projects: ⟷

3) Redesigned I-91 and I-95 interchange at New Haven.

Mitigation Projects: ⟷

4) NB Exit 27A: Two lane off ramp and northbound auxiliary lane between Exits 26 & 27A.
6) Lane configuration changes to northbound I-95 to I-91 Interchange ramps.

Approximate Toll Gantry Locations

5 20 40 60

Speed (MPH)

CDM Smith

PM PEAK NORTHBOUND SPEED CONTOURS

FIGURE ES-5

Table ES-3
2040 I-95 Southbound AM Travel Times

Bridgeport to Stamford (Exit 27A to Exit 7) 22 Miles

Hour	No Build (No Toll)	No Build (I-95 Tolled)		Widen Brgpt-Stmfd (No Toll)		Widen Brgpt-Stmfd (I-95 Tolled)		Widen Brgpt-Stmfd (I-95 & CT-15 Tolled)	
AM	(H:MM)	(H:MM)	Difference	(H:MM)	Difference	(H:MM)	Difference	(H:MM)	Difference
6-7 AM	0:21	0:21	0	0:21	0	0:21	0	0:21	0
7-8 AM	0:28	0:25	-3	0:25	-3	0:23	-5	0:25	-3
8-9 AM	0:37	0:31	-6	0:32	-5	0:27	-10	0:37	0
9-10 AM	0:36	0:26	-10	0:34	-2	0:23	-13	0:28	-8

New Haven to New York (I-91 to I-287 Interchange) 48 Miles

Hour	No Build (No Toll)	No Build (I-95 Tolled)		Widen Brgpt-Stmfd (No Toll)		Widen Brgpt-Stmfd (I-95 Tolled)		Widen Brgpt-Stmfd (I-95 & CT-15 Tolled)	
AM	(H:MM)	(H:MM)	Difference	(H:MM)	Difference	(H:MM)	Difference	(H:MM)	Difference
6-7 AM	0:48	0:47	-1	0:48	0	0:47	-1	0:48	0
7-8 AM	1:04	0:53	-11	1:00	-4	0:52	-12	0:55	-9
8-9 AM	1:16	0:58	-18	1:05	-11	0:55	-21	1:06	-15
9-10 AM	1:12	0:53	-19	1:02	-10	0:51	-21	1:03	-9

Table ES-4 shows the estimated 2040 I-95 northbound PM travel times in the same format as discussed above. Tolling I-95 under No Build conditions will result in an estimated time savings of 8 to 23 minutes depending on time period. A full length trip would save anywhere from 11 to 61 minutes depending on time period. Widening, plus tolling of I-95 shows the highest gains, where time savings between Stamford and Bridgeport are estimated to be 9 to 48 minutes, depending on the time period of travel.

Table ES-4
2040 I-95 Northbound PM Travel Times

Stamford to Bridgeport (Exit 7 to Exit 27A) 22 Miles

Hour	No Build (No Toll)	No Build (I-95 Tolled)		Widen Brgpt-Stmfd (No Toll)		Widen Brgpt-Stmfd (I-95 Tolled)		Widen Brgpt-Stmfd (I-95 & CT-15 Tolled)	
PM	(H:MM)	(H:MM)	Difference	(H:MM)	Difference	(H:MM)	Difference	(H:MM)	Difference
3-4 PM	0:30	0:22	-8	0:26	-4	0:21	-9	0:22	-8
4-5 PM	0:46	0:32	-14	0:36	-10	0:23	-23	0:23	-23
5-6 PM	1:11	0:48	-23	0:53	-18	0:23	-48	0:26	-45
6-7 PM	0:55	0:44	-11	0:46	-11	0:21	-32	0:21	-32

New York to New Haven (Exit I-287 to I-91 Interchange) 48 Miles

Hour	No Build (No Toll)	No Build (I-95 Tolled)		Widen Brgpt-Stmfd (No Toll)		Widen Brgpt-Stmfd (I-95 Tolled)		Widen Brgpt-Stmfd (I-95 & CT-15 Tolled)	
PM	(H:MM)	(H:MM)	Difference	(H:MM)	Difference	(H:MM)	Difference	(H:MM)	Difference
3-4 PM	0:59	0:48	-11	0:55	-4	0:48	-11	0:49	-10
4-5 PM	1:26	0:58	-28	1:07	-19	0:51	-35	0:52	-34
5-6 PM	2:15	1:14	-61	1:21	-53	0:51	-84	0:55	-80
6-7 PM	1:51	1:10	-41	1:14	-37	0:47	-64	0:48	-63

Figure ES-6 depicts the estimated average annual net time savings accumulated over I-95, Route 15, and Route 1 between New Haven and NY as compared to the No Build Alternative. The first bar shows the estimated annual time savings from tolling I-95 under the existing configuration. About 8 million hours are estimated to be saved annually. The largest amount of hours saved are estimated to occur under a widening of I-95 and a tolling of both I-95 and Route 15. More than 12 million hours of time savings annually are estimated under this alternative.

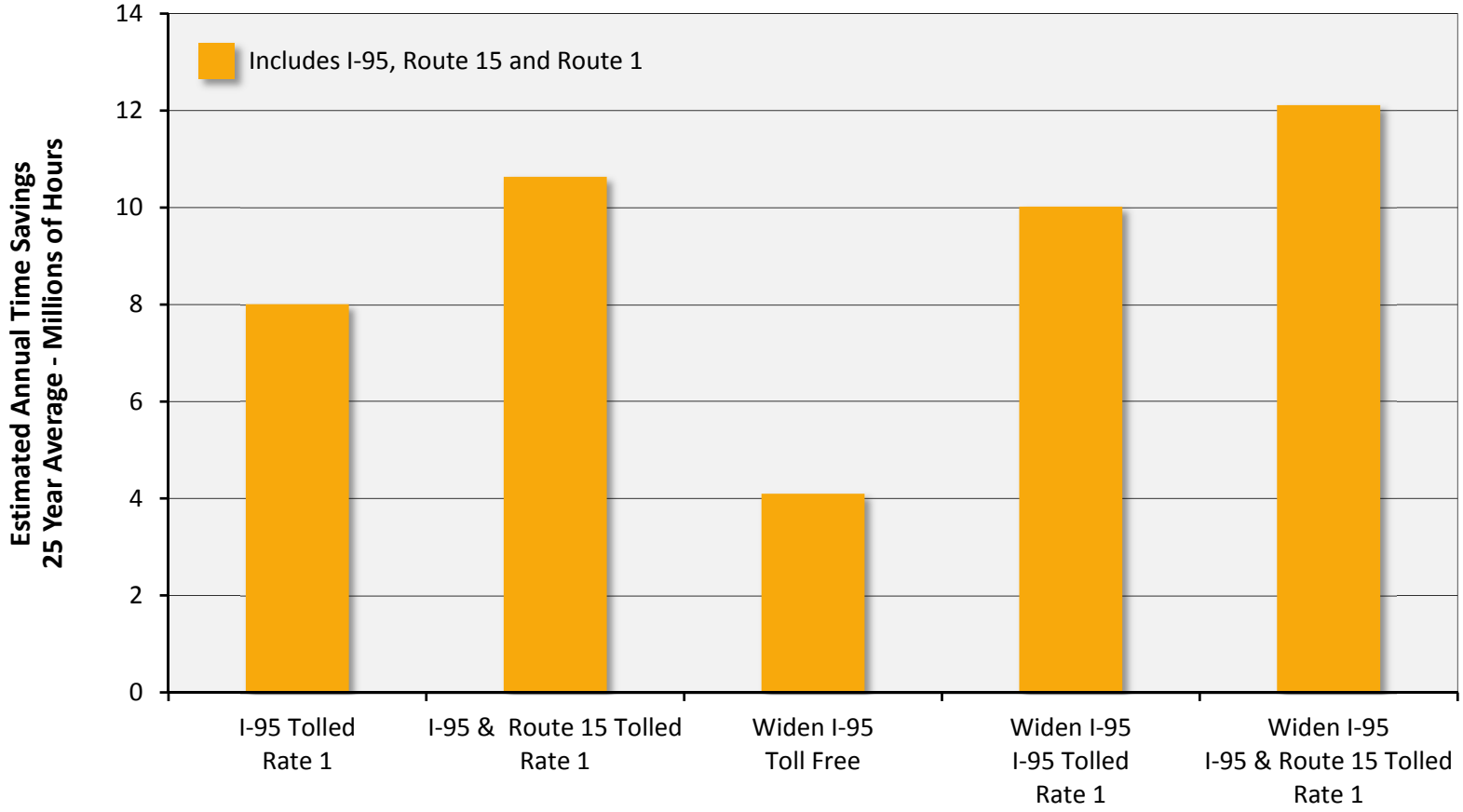
Estimated Annual Gross and Net Toll Revenue

Average weekday toll revenue was summarized for each alternative and expanded to reflect an annual estimate for modeled years 2020 and 2040. A 25-year stream of revenue was created by interpolating between the forecast years and extrapolating through 2044. **Figure ES-7** displays the estimated average annual gross toll revenue over a 25-year span (2020 through 2044) for each alternative. Average annual gross toll revenue is estimated to fall between $275M from tolling the existing I-95 configuration and $380M when I-95 is widened and both I-95 and Route 15 are tolled.

In addition to estimating toll revenue, preliminary tolling capital costs and tolling operations and maintenance costs were estimated for the five tolling alternatives. Tolling operations and maintenance costs were estimated for both a Connecticut self-operated tolling operation and an outsourced tolling operation.

Table ES-5 shows the average annual net toll revenue that could be expected for each tolling alternative. Tolling operations and maintenance costs, as well as tolling capital costs amortized over ten years, are subtracted from the gross toll revenue estimates to produce the net annual toll revenue estimates. The last column shows the cumulative net toll revenue that could be produced over a 25-year period (2020 thru 2044). The net toll calculations were conducted for both the State managed and outsourced toll operations. Depending on the Alternative, cumulative net toll revenue over a 25-year period is estimated to range between $6.2 Billion to $9.2 Billon.

I-95 CORRIDOR POTENTIAL ANNUAL TRAVEL TIME SAVINGS
MILLIONS OF HOURS PER YEAR
(25 YEAR AVERAGE: 2020 - 2044)



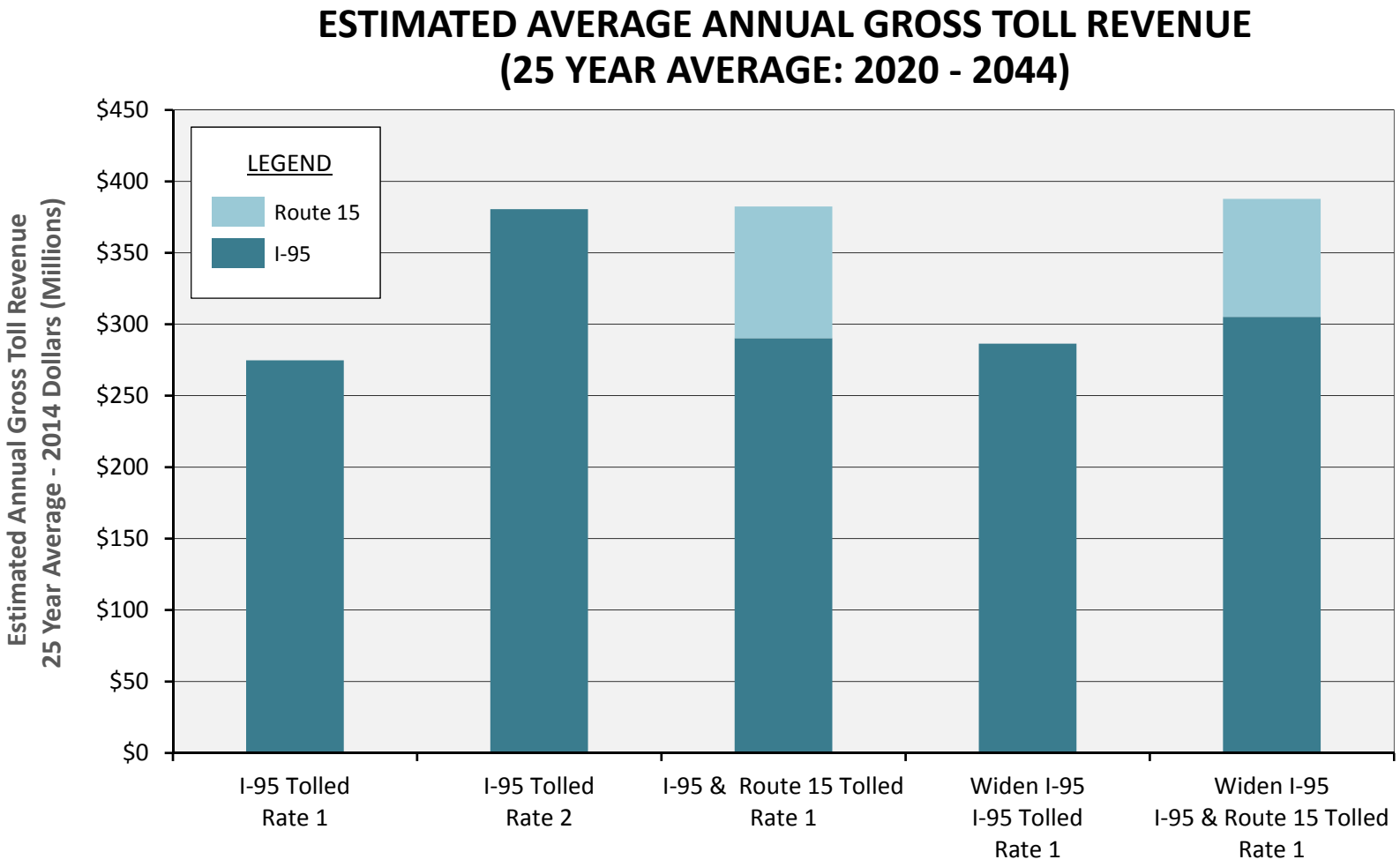

ESTIMATED AVERAGE ANNUAL GROSS TOLL REVENUE
(25 YEAR AVERAGE: 2020 - 2044)
Estimated Annual Gross Toll Revenue
25 Year Average - 2014 Dollars (Millions)
$450
$400
$350
$300
$250
$200
$150
$100
$50
$0
LEGEND
Route 15
I-95
I-95 Tolled Rate 1
I-95 Tolled Rate 2
I-95 & Route 15 Tolled Rate 1
Widen I-95 I-95 Tolled Rate 1
Widen I-95 I-95 & Route 15 Tolled Rate 1

Table ES-5
Estimated Net Toll Revenue - 2014 Dollars

Self Operating Toll Operations and Maintenance

	25 Year Annual Average (2020 thru 2044)				25 Year Total
Alternative	Gross Toll Revenue	O&M Cost	Cap Cost Amortized (1)	Net Toll Revenue (2)	Net Toll Revenue
1	$274,760,000	$10,700,000	$3,557,870	$260,502,130	$6,512,553,000
2	$380,529,000	$9,835,900	$3,557,870	$367,135,230	$9,178,381,000
3	$382,426,000	$16,136,400	$4,973,140	$361,316,460	$9,032,912,000
4	$286,408,000	$10,829,800	$3,682,370	$271,895,830	$6,797,396,000
5	$387,764,000	$16,197,500	$5,069,040	$366,497,460	$9,162,437,000

Outsourced Toll Operations and Maintenance

	25 Year Annual Average (2020 thru 2044)				25 Year Total
Alternative	Gross Toll Revenue	O&M Cost	Cap Cost Amortized (1)	Net Toll Revenue (2)	Net Toll Revenue
1	$274,760,000	$23,289,500	$3,557,870	$247,912,630	$6,197,816,000
2	$380,529,000	$19,963,300	$3,557,870	$357,007,830	$8,925,196,000
3	$382,426,000	$36,302,800	$4,973,140	$341,150,060	$8,528,752,000
4	$286,408,000	$23,788,800	$3,682,370	$258,936,830	$6,473,421,000
5	$387,764,000	$36,537,700	$5,069,040	$346,157,260	$8,653,932,000

Notes:
(1) Tolling capital cost spread over a 10 year period.
(2) Net toll revenue = gross toll revenue minus O&M and capital cost amortized.

Conclusions

The primary objective of this study was to determine whether congestion pricing on I-95 and Route 15 using All Electronic Tolling could reduce congestion along the I-95 corridor. A robust data collection plan and detailed modeling exercise was performed for a number of alternatives to assess their congestion relief potential for I-95. During the study, it also became clear that toll revenue would also be a critical component to the feasibility of a solution, given the transportation funding challenges and deteriorating buying power of the gas tax facing most states in the U.S., including Connecticut. The two primary performance metrics utilized across alternatives for this study were:

1. Congestion reduction (speed improvements) for I-95 drivers; and
2. Net toll revenue.

As discussed in this Executive Summary and throughout the Report, the findings from this study demonstrate the potential for a significant reduction in the severe congestion levels being experienced along I-95 between New Haven and New York through the use of congestion pricing. The substantial revenue that could be generated through tolling could also be used to support most (if not all) of the cost of widening I-95, depending on the actual magnitude and extent of the widening. It should be noted that early on in the initial screening and testing of study alternatives, managed lanes was found to be an effective tool in providing congestion relief to the corridor. Unfortunately, the high construction cost of the managed lanes alternative largely outweighed the revenue potential and was dismissed from more detailed analysis. Adding capacity and tolling all lanes not only provided

congestion relief, but also provided for substantially higher revenue at a lower cost to construct and implement.

Table ES-6 summarizes the estimated time savings potential and net toll revenue of the most viable alternatives evaluated. The alternatives shown in Table ES-6 are limited to those that were evaluated with the detailed traffic operations model. The estimated time savings shown for each alternative was calculated by comparing each alternative to the estimated No Build condition travel times at 2040 levels. As was supported by the findings throughout the Executive Summary and the report, Alternative 4 and 5 demonstrated the most potential to provide substantial congestion reductions over the No Build condition. While Alternative 1 would provide substantial travel time improvements on I-95 and generate significant toll revenue, it would likely be a tough sell given that no new capacity would be added to the corridor. However, the toll revenue might be used to increase alternative travel modes such as express bus service along I-95 and investment in the Metro North line.

Table ES-6
I-95 Corridor Congestion Relief Study
Summary Comparison of Alternatives Relative to Time Savings and Toll Revenue

		2040 Potential Time Savings (minutes) Versus No Build No Toll Condition I-95 New Haven to New York				Net Toll Revenue ($Billions) 25 Year Cumulative Total	
Scenario	Description	8-9 AM SB	Rank	5-6 PM NB	Rank	Net Revenue	Rank
Alt 1	No Build - Toll I-95 only	18	2	61	3	$6.5	3
Build Toll Free	I-95 Widening (Brgpt-Stmfd) - Toll Free	11	4	53	4	N/A	N/A
Alt 4	I-95 Widening (Brgpt-Stmfd) - Toll I-95 only	21	1	84	1	$6.8	2
Alt 5	I-95 Widening (Brgpt-Stmfd) - Toll I-95 and Route 15	15	3	80	2	$9.2	1

Note:
Toll Rate 1: Assumes $0.50 peak / $0.35 off peak toll per tolling location
All tolling scenarios assume tolling from NY State Line to New Haven

A widening of I-95 with no tolling (Build Toll Free) provides some congestion relief to the corridor. However, significant in-fill volume is estimated to be added along the most congested sections between Bridgeport and Stamford with the widening. It was found that this additional volume at interchanges causes increased weaving and merging friction near already heavily used interchanges along the corridor, as traffic would now have to weave over 4 lanes, rather than 3. This finding illustrates the relative inability to build your way out of congestion in a corridor that is heavily saturated throughout the day and has many operational issues due to closely spaced interchanges with very high demand.

Alternative 4 provides the most potential for congestion relief as it provides an extra lane in each direction on I-95 between Bridgeport and Stamford, while tolling only I-95. While a widening of the I-95 corridor would pull in demand from heavily used Route 15 and Route 1 under a toll free condition, the selected toll rates are estimated to manage the demand during peak hours to levels that are slightly lower than No Build volumes during the peak periods. This has a tremendous positive impact on travel speeds as it provides the much needed extra lane of capacity on the same or lower No Build demand. It should be noted that based on the operational analysis, the southbound terminus of the extra lane should be extended southward to the New York border, as its assumed termini in Stamford results in a lane drop and a potential bottleneck. This is one of the contributing factors as to why the AM operational benefits from widening and tolling is much less than the PM benefits.

Similarly, Alternative 5 is estimated to provide substantial time savings over the No Build condition. Alternative 5 assumes a widening of I-95 between Bridgeport and Stamford and a tolling of both I-95

and Route 15. The congestion relief benefits to I-95 are estimated to be a little lower than Alternative 4 as some additional traffic would choose to use the widened I-95 and pay a toll, rather than continue to use Route 15 and pay a toll. Alternative 5 is also estimated to generate 35 percent more revenue as compared to Alternative 4 since both the I-95 and Route 15 corridors would be tolled. The additional benefit of tolling both corridors is the ability to balance traffic between the two corridors through price differentials between the two corridors, if necessary. The additional revenue might help to provide additional funding toward Route 15 improvements and/or transit and Metro North investment.

While any of the tolling alternatives could provide for significant reductions in congestion and new revenue streams for transportation, Alternatives 4 and 5 were found to be the best options for the entire corridor. It should be noted that if tolling of the I-95 corridor is ultimately selected, additional technical analysis should be conducted around the specific location of tolling points, the toll rates during the peak and off peak time periods by travel direction, any toll discount policies, and revised tolling capital and operational cost estimates under a refined tolling configuration. In addition, the geographic limits and potential sequencing of the I-95 widening would need to be studied.