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Impacts of Changes in HOV/HOT Eligibility Policy on Operations and VMT

Task ID 4072 (65A1048)

Final Project Report

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16. ABSTRACT This study evaluates the operational and network-level impacts of changes to High-Occupancy Vehicle (HOV) and High-Occupancy Toll (HOT) lane eligibility policies along a 15-mile segment of Interstate 210 (I-210) in Los Angeles County. Using a calibrated microsimulation model in Aimsun Next, the research examined both supply-side and demand-side strategies to assess their influence on corridor travel times, Vehicle Miles Traveled (VMT), Vehicle Hours Traveled (VHT), and overall network performance. Supply-side scenarios evaluated the effects of restricting lane eligibility to HOV3+ or higher, converting existing HOV2+ lanes to HOT2+ lanes with dynamic tolling, adding new HOT lanes, and converting general-purpose lanes to HOT lanes. Results indicate that tightening eligibility improves HOV lane performance but leads to excessive queuing and unmet demand. Conversion to HOT2+ with dynamic tolling improves efficiency only when tolling operations are properly managed. Adding HOT capacity yields the greatest systemwide benefit, while converting a general-purpose lane to HOT capacity reduces throughput. Demand-side scenarios assessed increased vehicle occupancy, higher traffic demand, and variations in travelers' value of time. Behavioral changes alone were found insufficient to offset congestion impacts without structural improvements or major shifts in travel behavior. The study concludes that combining supply-side enhancements—such as lane additions and optimized tolling—with moderate demand management provides the most effective and sustainable strategy to reduce congestion, improve reliability, and support Senate Bill 743 (SB 743) objectives for corridor efficiency.		
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DISCLAIMER

The research reported herein was performed by a research team within the California Partners for Advanced Transportation (California PATH) within the Institute of Transportation Studies at the University of California – Berkeley, for the Division of Research, Innovation and System Information (DRISI) at the California Department of Transportation.

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LIST OF ACRONYMS

GP	General Purpose
HOV	High-Occupancy Vehicle
HOT	High-Occupancy Toll
PHT	Person Hours of Travel
PMT	Person Miles Traveled
SOV	Single-Occupancy Vehicle
VHT	Vehicle Hours of Travel
VMT	Vehicle Miles Traveled

EXECUTIVE SUMMARY

This research project evaluated the operational and network effects of potential changes to High-Occupancy Vehicle (HOV) and High-Occupancy Toll (HOT) lane eligibility policies along a 15-mile section of Interstate 210 (I-210) in northern Los Angeles County. The study was conducted by the California Partners for Advanced Transportation Technology (PATH) at the University of California, Berkeley, under Contract 65A1048 with the California Department of Transportation (Caltrans). The objective was to quantify how different policy and infrastructure strategies influence corridor operations, travel times, Vehicle Miles Traveled (VMT), and Vehicle Hours Traveled (VHT) under various demand conditions and behavioral responses.

The project used a calibrated microsimulation model in the Aimsun Next platform representing 2019 baseline traffic conditions. Both supply-side and demand-side strategies were evaluated, including modifications to HOV eligibility, conversion to dynamically tolled HOT lanes, lane additions, lane swaps, and changes in traffic demand and traveler value of time. The scenarios were designed to inform Caltrans' ongoing efforts to manage corridor congestion while supporting the goals of Senate Bill 743 (SB 743) to minimize induced travel and promote sustainable transportation system performance.

Results indicate that tightening HOV eligibility to HOV3+ improves HOV lane performance but produces significant queuing and unmet demand at the corridor level, reducing total throughput and increasing network congestion. Converting HOV2+ lanes to dynamically tolled HOT2+ facilities improves efficiency if tolling operations are managed to reduce friction at entry and exit points. The greatest performance gains occur when an additional HOT lane is added, leading to substantial reductions in corridor travel times and overall delay. Conversely, converting an existing general-purpose lane into a HOT lane decreases capacity and degrades network performance.

Demand-side analysis showed that behavioral changes alone cannot fully offset the operational impacts of restrictive access policies. Shifting 20 to 25 percent of trips to higher-occupancy vehicles would be required to restore baseline performance under HOV3+ conditions, an unrealistic assumption given the current carpooling trend. Increasing total traffic demand predictably worsens congestion, while variations in traveler value of time modestly influence lane choice without significantly affecting total corridor performance.

Overall, the study concludes that integrated strategies combining supply-side improvements and demand management yield the most sustainable operational benefits. Expanding managed lane capacity, optimizing tolling algorithms, and minimizing operational friction produce the most balanced results in terms of travel time, reliability, and throughput. Overly restrictive eligibility policies or lane conversions without added capacity reduce overall system efficiency. The findings provide Caltrans and regional agencies with a quantitative foundation for assessing future express lane projects and policy decisions consistent with SB 743 performance objectives.

1. INTRODUCTION

To address degraded conditions on High-Occupancy Vehicle (HOV) lanes on urban freeways, Caltrans has been considering changes in policies governing who is authorized to use high-occupancy lanes to reduce their level of utilization to an acceptable level. This includes potentially increasing the minimum occupancy of allowed vehicles on HOV lanes or modulating the tolls charged for using High-Occupancy Toll (HOT) lanes based on vehicle occupancy. An example was a 2019 proposal to implement an HOV 5+ requirement for toll-free travel along the I-10 Express Lanes in the Los Angeles area instead of the existing HOV 3+ requirement during peak hours and HOV 2+ at other times.

A key difficulty in evaluating the suitability of proposed eligibility changes to high-occupancy lanes is that relatively little information is available about the potential impacts of such changes on traffic operations and travel demand. This is problematic in the context of SB 743, which requires improvement projects to try to contain induced traffic demand and related increases in Vehicle Miles Traveled (VMT). Without much hard evidence, it is difficult to reliably predict what the likely impacts the proposed changes might have. In turn, this makes it difficult to assess the desirability of proposed changes in relation to other projects and to truly select optimal solutions.

Within the above context, this project proposed to use an existing, already calibrated, simulation model of a 15-mile section of the I-210 corridor in northern Los Angeles County to evaluate in a controlled environment how changes in policies governing the authorized use of high-occupancy lanes, as well as in the number of high-occupancy lanes offered to the traveling public, might affect VMT and other metrics of interest under existing and alternate traffic demands. This is a “what-if” study aiming to provide decision-makers with information on the potential effects of various HOV/HOT strategies and help them select the best strategies to pursue from an operational standpoint. It also aims to help understand how the benefits provided by each strategy can be increased or reduced by changes in travel demand that may be induced by the implemented changes to the high-occupancy facility.

In addition to informing decisions, the assessed impact trends will support future research on how changes to high-occupancy facilities could influence traffic demand and further help research on the determination of specific elasticity factors that could be used by project planners to pre-evaluate the impacts of proposed high-occupancy projects.

The remainder of this report is divided into the following sections:

- **Section 2:** Overview of implemented HOV/HOT projects across the United States, with information about their current tolling approaches.
- **Section 3:** Description of the I-210 study corridor in northern Los Angeles County at its modeling within the Aimsun Next microscopic traffic simulation platform.
- **Section 4:** Description of the dynamic tolling module that was developed within the microscopic simulation platform to enable the evaluation of HOT scenarios along the study corridor.
- **Section 5:** Description of the various evaluation scenarios considered.
- **Section 6:** Presentation of evaluation results for scenarios based on existing traffic demand within the study corridor.
- **Section 7:** Presentation of evaluation results for scenarios factoring in increases in traffic demand and changes in the proportion of vehicles responding to dynamic tolls.
- **Section 8:** Presentation of overall evaluation results.

2. REVIEW OF PAST HOV/HOT IMPLEMENTATION PROJECTS

This section provides a summary of past high-occupancy vehicle (HOV) and high-occupancy toll (HOT) implementation projects. This is the result of an online scan of available literature regarding such projects. This scan included a review of online facility descriptions from operating agencies, project fact sheets, and available implementation reports. It also included a review of academic journal articles documenting experiments conducted on existing facilities, often to demonstrate specific impacts.

The following information is provided in the following subsections:

- Listing of implemented HOV/HOT projects across the United States
- Current tolling policies on existing facilities
- Summary of documented impacts

2.1. REVIEW OF IMPLEMENTED HOV/HOT PROJECTS

This section provides a summary of locations within the United States where HOV/HOT projects have been completed in the past 25 years. This summary distinguishes the following three categories of projects:

- Simple eligibility changes to an existing HOV facility
- Conversion of an existing HOV facility into a HOT facility
- Construction of new HOT facilities

2.1.1. SIMPLE ELIGIBILITY CHANGE TO AN EXISTING HOV FACILITY

No online evidence was found of projects strictly changing the eligibility of an existing HOV lane. All projects with a documented change in access eligibility typically also include the addition of dynamic tolling features for vehicles that would otherwise be ineligible for using the lane.

2.1.2. CONVERSION OF AN EXISTING HOV FACILITY INTO A HOT FACILITY

Since 1998, various projects have converted existing HOV facilities into HOT facilities, often with a concurrent change in vehicle occupancy requirement from two to three occupants for the vehicles that would be allowed to travel for free or at a reduced cost on the new facility. As indicated in Table 2-1, this includes:

- 11 projects converting an existing HOV facility into a HOT 2+ facility, with four located in California.
- 9 projects converting an existing HOV facility into a HOT 3+ facility, with two located in California.

Table 2-1: HOV Facility Conversions into HOT Facility

HOV to HOT2+ Conversion	HOV to HOT3+ Conversion
- California - I-15, San Diego (2009) - SR-237, San Jose (2012) - I-110, Los Angeles (2013) - I-680, Contra Costa County (2017) - Minnesota - I-394, Minneapolis (2005) - I-35W, Minneapolis (2009-2011) - Texas - I-45, Houston (2012) - US-59/I-69 Houston (2012) - I-635E, Dallas (2020) - Utah - I-15, Salt Lake City (2006) - Washington - SR-167, Seattle (2008)	- California - I-10, Los Angeles (2013) - I-880, Alameda County (2020) - Florida - I-95, Miami (2008) - Georgia - I-85, Atlanta (2011) - Texas - I-10, Houston (1998) - US-290, Houston (2000) - Virginia - I-495, Northern Virginia (2012) - I-66, Inside Beltway (2017) - I-66, Outside Beltway (2022)

2.1.3. NEW HOT FACILITIES

Most of the high-occupancy facility projects found online were implementations of new HOT lanes, in most cases with dynamic toll capabilities. Table 2 provides a listing by state of the various projects that were identified with their implementation data. These include:

- 9 projects implementing new HOT lanes with free or reduced tolls for vehicles with two or more occupants (HOT2+), including 2 in California (I-580 Alameda County and I-15 San Diego).
- 14 projects implementing new HOT lanes with free or reduced tolls for vehicles with three or more occupants (HOT3+), including 3 in California (US-101 San Mateo, SR-91 Orange County, and I-405 Orange County).
- 16 projects implementing tolls for all vehicles traveling on the facility, including 2 in California (SR-91 Orange County, and SR-125 San Diego).

In the table, the identified projects are further categorized within each grouping based on the type of access provided. This includes the following distinctions:

- Facilities on lanes concurrent with the general-purpose traffic lanes allow continuous access (typically delimited through dotted or single-lane marking).
- Facilities on lanes that are concurrent with the general-purpose traffic lanes but where access is only allowed through defined gates. This includes facilities delimited by double lane markings, bollards, or physical barriers.
- HOT lanes on reversible facilities.
- HOT lanes on all lanes of a given freeway.

Table 2-2: New HOT Facilities

New HOT 2+ Free Lanes	New HOT 3+ Free Lanes	All-Vehicle Tolling Facility
Concurrent Lane - Continuous Access		
• California • I-580, Alameda County (2016) • Minnesota • I-35E, Minneapolis (2015-2016) • I-35W, Minneapolis (2016-2021) • Virginia • I-64 Chesapeake, Norfolk (2024) • Washington • SR-167, Seattle (2008)	• California • US-101, San Mateo (2022-2023) • Colorado • I-70 Mountain (2015) – <i>Part-time shoulder lane</i>	• <i>None</i>
Concurrent Lane - Gated Access		
• California • I-15, SR-56 to SR-78 north of San Diego (2012) • I-15, Riverside County (2021) • Texas • I-10 Katy, Houston, Texas (2009)	• California • SR-91 (1995, 2017) • I-405, Orange County (2023) • Colorado • US-36, Denver (2016) • C-70, Denver (2023) • I-25 North, Denver (2023) • I-25 Central, Denver (2024) • I-25, Fort Collins (2024) • I-25 South Gap (2024) • Florida • I-95, Miami (2019) • North Carolina • I-77, Charlotte (2019) • Virginia • I-495, Northern Virginia (2012) • Washington • I-405, Seattle (2015)	• Colorado • C-470, Denver (2020) • Florida • I-4, Orlando (2022) • Georgia • I-75/I-575, Atlanta (2018) • Maryland • I-95, Baltimore (2008) • Texas • DFW Connector (SH-114/SH-121), Dallas (2014) • I-820 NTE, Fort Worth (2014) • I-635 LBJ, Dallas County (2015) • MoPac, Austin (2016) • I-35W, Fort Worth (2017-2018) • I-30, Tarrant County (2024)
Reversible Facilities		
• Virginia • I-64, Norfolk (2024) • I-66, Rosslyn, Virginia (2017) • California • I-15, San Diego (1996)	• Virginia • I-95 Northern Virginia (2014) • I-395 Northern Virginia (2019)	• Florida • I-595, Fort Lauderdale (2014) • Georgia • I-75 South, Atlanta (2017) • Texas • I-30, Dallas County (2016) • I-35E, Dallas and Denton Counties (2017)
Toll Freeways		
• <i>None</i>	• <i>None</i> •	• California • SR-91 Orange County (1995) • SR-125, San Diego (2007)

2.2. CURRENT TOLLING POLICIES

Table 2-3 provides a summary of current tolling policies on the various facilities identified in Table 2-1 and Table 2-2. Detailed information about the strategies implemented in each corridor can be found in Appendix A. For each facility, the following information is provided:

- Facility type (continuous access, gated access, reversible facility, or full freeway tolling)
- The period during which tolls are normally applied
- Defined peak hour periods for facilities where different toll strategies are applied during peak and off-peak periods.
- Peak and off-peak toll rates for HOV 2+, HOV 3+, and clean-air vehicles with single occupants.

It should be noted that while the table provides information about tolls charged to single-occupancy vehicles with a valid Clear-Air decal, such an option was removed nationwide on October 1st, 2025, with the expiration of federal regulations allowing states to issue these decals.

Table 2-3: Current Tolling Policies

Corridor	Facility Type	Length (miles)	HOV/HOT Lanes	General Purpose Lanes	Toll Periods	Peak Periods	Toll Rate					
							HOV 2		HOV 3+		Solo Clean Air *	
							Peak	Off-Peak	Peak	Off-Peak	Peak	Off-Peak
California												
I-680, Contra Costa County	Continuous access	14	1	3, 4	Weekdays 5 AM – 8 PM	N/A	Free	Free	Free	Free	Free	Free
I-580, Alameda County	Continuous access	10	1, 2	4, 5	Weekdays 5 AM – 8 PM	N/A	Free	Free	Free	Free	Free	Free
I-880, Alameda County	Continuous access	20	1	3, 4	Weekdays 5 AM – 8 PM	N/A	50%	50%	Free	Free	50%	50%
US-101, San Mateo County	Continuous access	22	1	4	Weekdays 5 AM – 8 PM	N/A	50%	50%	Free	Free	50%	50%
SR-237, San Jose	Continuous access	5	1	2	Weekdays 5 AM – 8 PM	N/A	50%	50%	Free	Free	50%	50%
I-10, Los Angeles	Gated access	33	1, 2	4	24/7	5– 9 AM 4 –7 PM	Full	Free	Free	Free	85%	85%
I-110, Los Angeles	Gated access	10	1, 2	4, 5	24/7	N/A	Free	Free	Free	Free	85%	85%
I-405, Orange County	Gated access	14	1	4, 5	24/7	N/A	Full	Free	Free	Free	85%	85%
SR-91 Orange County	Continuous access	18i	1	4	24/7	4 –6 PM EB Only	Full	Full	50%	Free	Full	Full
I-15, San Diego	Gated access	20	2	5, 6	24/7	N/A	Free	Free	Free	Free	Free	Free
Washington												
I-405, Seattle	Gated access	17	1, 2	2, 3	Weekdays 5 AM – 8 PM	N/A	Full	Free	Free	Free	N/A	N/A
SR-167, Seattle	Continuous access	8	1	2	All Days 5 AM – 8 PM	N/A	Full	Free	Free	Free	N/A	N/A
Colorado												
I-25, Central, Denver	Reversible facility	7	2	4	Weekdays • SB: 5 AM – 11 AM • NB: Noon – 3 AM Weekends • SB all day	N/A	Full	Full	Free	Free	N/A	N/A
I-25 North, Denver	Gated access	5	1	3	24/7	N/A	Full	Full	Free	Free	N/A	N/A
I-25, Fort Collins	Gated access	14	1	2	24/7	N/A	Full	Full	Free	Free	N/A	N/A
I-25 South Gap, Colorado	Gated access	15	1	2	24/7	N/A	Full	Full	Free	Free	N/A	N/A
Central I-70, Denver	Gated access	10	1	3	24/7	N/A	Full	Full	Free	Free	N/A	N/A
I-70 Mountain, Colorado	Part-time shoulder; continuous access	4.5	1	2	Only on weekends and holidays	N/A	Full	Full	Full	Full	N/A	N/A

Corridor	Facility Type	Length (miles)	HOV/HOT Lanes	General Purpose Lanes	Toll Periods	Peak Periods	Toll Rate					
							HOV 2		HOV 3+		Solo Clean Air *	
							Peak	Off-Peak	Peak	Off-Peak	Peak	Off-Peak
C-470, Denver	Gated access	12.5	1	2	24/7	N/A	Full	Full	Full	Full	N/A	N/A
US-36, Denver	Gated access	16	1	2, 3	24/7	N/A	Full	Full	Free	Free	N/A	N/A
Utah												
I-15, Salt Lake City	Gated access	72	1	3, 4	24/7	N/A	Free	Free	Free	Free	Free	Free
Texas												
I-10 Katy, Houston	Gated access	18	2	5, 6	24/7	Weekdays: 5:00 – 11:00 AM 2:00 – 8:00 PM	Free	Full	Free	Free	N/A	N/A
I-45 North Freeway, Houston	Gated access; HOV 2+ during peak hours	16	1	4, 5	All days: • SB: 5 AM – 11 AM • NB: 1 PM – 8 PM	Weekdays: 6:30 – 8:00 AM 5:00 – 6:00 PM	Free	Full	Free	Free	N/A	N/A
I-45 North Freeway, Houston	Reversible, gated access; HOV 2+ during peak hours	18	1	4, 5	All days: • SB: 5 AM – 11 AM • NB: 1 PM – 8 PM	Weekdays: 6:30 – 8:00 AM 5:00 – 6:00 PM	Free	Full	Free	Free	N/A	N/A
I-45 Gulf Freeway, Houston	Reversible, gated Access; HOV 2+ during peak hours	20	1	3, 4	All days: • SB: 5 AM – 11 AM • NB: 1 PM – 8 PM	Weekdays: 6:30 – 8:00 AM 5:00 – 6:00 PM	Free	Full	Free	Free	N/A	N/A
US-290, Houston	Reversible, gated access; HOV 3+ during peak hours	22	1	4, 5, 6	All days: • SB: 5 AM – 11 AM • NB: 1 PM – 8 PM	Weekdays: 6:30 – 8:00 AM 4:30 – 6:00 PM	Full	Full	Free	Free	N/A	N/A
US-59/I-69 Houston	Reversible, gated access; HOV 2+ during Peak Hours	74.9	1	5	All days: • SB: 5 AM – 11 AM • NB: 1 PM – 8 PM	Weekdays: 6:30 – 8:00 AM 4:30 – 6:00 PM	Free	Full	Free	Free	N/A	N/A
I-35W, Fort Worth	Gated access	10.1	2	2, 3	24/7	Weekdays: 6:30 – 9:00 AM 3:00 – 6:30 PM	50%	Full	50%	50%	N/A	N/A
I-820 NTE, Fort Worth	Gated access	6.4	2	2	24/7	Weekdays: 6:30 – 9:00 AM 3:00 – 6:30 PM	50%	Full	50%	50%	N/A	N/A
I-635 LBJ, Dallas County	Gated access	13.3	2, 3	4, 5, 6	24/7	Weekdays: 6:30 – 9:00 AM 3:00 – 6:30 PM	50%	Full	50%	50%	N/A	N/A
I-30, Tarrant County	Gated access	18.7	1	3	24/7	Weekdays: 6:30 – 9:00 AM 3:00 – 6:30 PM	50%	Full	50%	50%	N/A	N/A
I-30, Dallas County	Reversible, gated access	12	1	4	Weekdays: • EB: 9 PM – 11 AM • WB: Noon – 8:00 PM Weekend: • Direction varies	Weekdays: 6:30 – 9:00 AM 3:00 – 6:30 PM	50%	Full	50%	50%	N/A	N/A
I-35E, Dallas and Denton Counties	Reversible, gated access	18	2	5	All Days • SB: 3 AM – 11 AM • NB: 1 PM – 1 AM	Weekdays: 6:30 – 9:00 AM 3:00 – 6:30 PM	50%	Full	50%	50%	N/A	N/A
DFW Connector / SH-114/SH-121, Dallas	Gated access	14.5	1	3	24/7	Weekdays: 6:30 – 9:00 AM 3:00 – 6:30 PM	50%	Full	50%	50%	N/A	N/A
SH-183, Dallas & Tarrant Counties	Gated access	13.7	1, 2	3	24/7	Weekdays: 6:30 – 9:00 AM 3:00 – 6:30 PM	50%	Full	50%	50%	N/A	N/A
I-635E, Dallas County	Gated access	9.3	3	4	24/7	Weekdays: 6:30 – 9:00 AM 3:00 – 6:30 PM	50%	Full	50%	50%	N/A	N/A
MoPac, Austin	Gated access	11	1	3	24/7		Full	Full	Full	Full	N/A	N/A
Minnesota												
I-35 W	Continuous access	11	1	4	Weekday peak hour only	Weekdays: 6:00 – 10:00 AM 3:00 – 7:00 PM	Free	N/A	Free	N/A	N/A	N/A
I-35 E	Continuous access	39	1	2, 3	Weekday peak hour only	Weekdays: 6:00 – 10:00 AM 3:00 – 7:00 PM	Free	N/A	Free	N/A	N/A	N/A
I-394 Minneapolis	Continuous access with a reversible portion	11	1, 2	2, 3	Weekday peak hour only	Weekdays: 6:00 – 10:00 AM 3:00 – 7:00 PM	Free	N/A	Free	N/A	N/A	N/A
Virginia												
					Peak hour only							

Corridor	Facility Type	Length (miles)	HOV/HOT Lanes	General Purpose Lanes	Toll Periods	Peak Periods	Toll Rate					
							HOV 2		HOV 3+		Solo Clean Air *	
							Peak	Off-Peak	Peak	Off-Peak	Peak	Off-Peak
I-64, Norfolk	Reversible, gated Access	8.4	2	3, 4	Weekdays: • EB: 11 AM – 11 PM • WB: 11 PM – 11 AM Weekend: • EB: 11 PM Fri – 11 AM Sun • WB: 11 AM Sun – 11 PM Sun		Free	Free	Free	N/A	N/A	N/A
I-64 Chesapeake, Norfolk	Continuous access	14	1	3	24/7		Free	Free	Free	Free	N/A	N/A
I-66 Outside Beltway	Gated access	22.5	1, 2	2, 3	24/7		Full	Full	Free	Free	N/A	N/A
I-66 Inside Beltway	Full freeway tolling	9	2, 3	n/a	EB: 5:30 AM – 9:30 AM WB: 3 PM – 7 PM		Full	N/A	Free	N/A	N/A	N/A
I-95, Northern Virginia	Reversible, gated access	41	2, 3	3, 4	Weekdays: • NB: 2:30 AM – 10 AM • SB: 12 PM - 1 AM Saturdays: • SB: 12 AM – 2 PM • NB: 4 PM – 12 AM Sundays: • Northbound All Day		Full	Full	Free	Free	N/A	N/A
I-395, Northern Virginia	Reversible, gated access	8	3	3, 4	Weekdays: • NB: 2:30 AM – 10 AM • SB: Noon- 1 AM Saturdays: • SB: 12 AM – 2 PM • NB: 4 PM to 12 AM Sundays: • Northbound All Day		Full	Full	Free	Free	N/A	N/A
I-495, Northern Virginia	Gated access	14	2	4	24/7		Full	Full	Free	Free	N/A	N/A
Maryland												
I-95, Baltimore	Gated access	8	2	3, 4	24/7 Off Peak: 5 AM – 9 PM 2:00 PM – 5:00 PM Sundays	Weekdays 6:00 – 9:00 AM 3:00 – 7:00 PM Saturdays Noon – 2:00 PM	Full	Full	Full	Full	N/A	N/A
North Carolina												
I-77, Charlotte	Gated access	26	2	3, 4	24/7		Full	Full	Free	Free	N/A	N/A
Georgia												
I-75 South, Atlanta	Reversible, gated access	12	2	3	Sunday to Friday: • NB: 1 AM – 11 AM • SB: 1:30 PM – 11 PM Saturdays: • SB: 1 AM – 11 AM • NB: 1:30 PM – 11 PM		Full	Full	Full	Full	N/A	N/A
I-575/I-75 Northwest Corridor, Atlanta	Reversible, gated Access	29.7	1 2	2 5, 6	Weekdays: • SB: 1 AM – 11 AM • NB: 1:30 PM – 11 PM Saturdays: • Southbound all day Sundays • SB: 1 AM – 11 AM • NB: 2 PM – 11 PM		Full	Full	Full	Full	N/A	N/A
I-85, Atlanta	Gated access	16	1	3, 4, 5, 6	24/7		Full	Full	Free	Free		
Florida												
I-595, Fort Lauderdale	Reversible, gated access	12.8 6	3	3, 4	Weekdays: • EB: 4 AM – 1 PM • EB: 2 PM – 2 AM Weekends: • Eastbound all time	N/A	Full	Full	Full	Full	N/A	N/A
I-95, Miami	Gated access	7	2	4	24/7	N/A	Full	Full	Free	Free	Free	Free
I-4, Orlando	Gated access	21 mi	2	3, 4	24/7	N/A	Full	Full	Full	Full	N/A	N/A

NOTES: * Access for solo vehicles with clean-air decals has been revoked nationwide on October 1st, 2025.

3. MODELING OF STUDY CORRIDOR

The following subsections present summary information about the model and the traffic demand that has been modeled to represent 2019 conditions. This includes:

- Location of study corridor
- Modeled network geometry
- Existing HOV2+ Facility
- Network traffic entry and exit points
- Modeled vehicle types
- Overall traffic demand
- Traffic demand by vehicle type
- Transit elements
- Other important modeling elements

3.1. LOCATION OF STUDY CORRIDOR

Figure 3-2 illustrates the location of the study corridor in the Los Angeles area. The corridor centers on the portion of the I-210 freeway running through Pasadena, between the I-605 and SR-134 freeway. This is a corridor that experiences significant congestion during peak hours, as well as over the weekend.

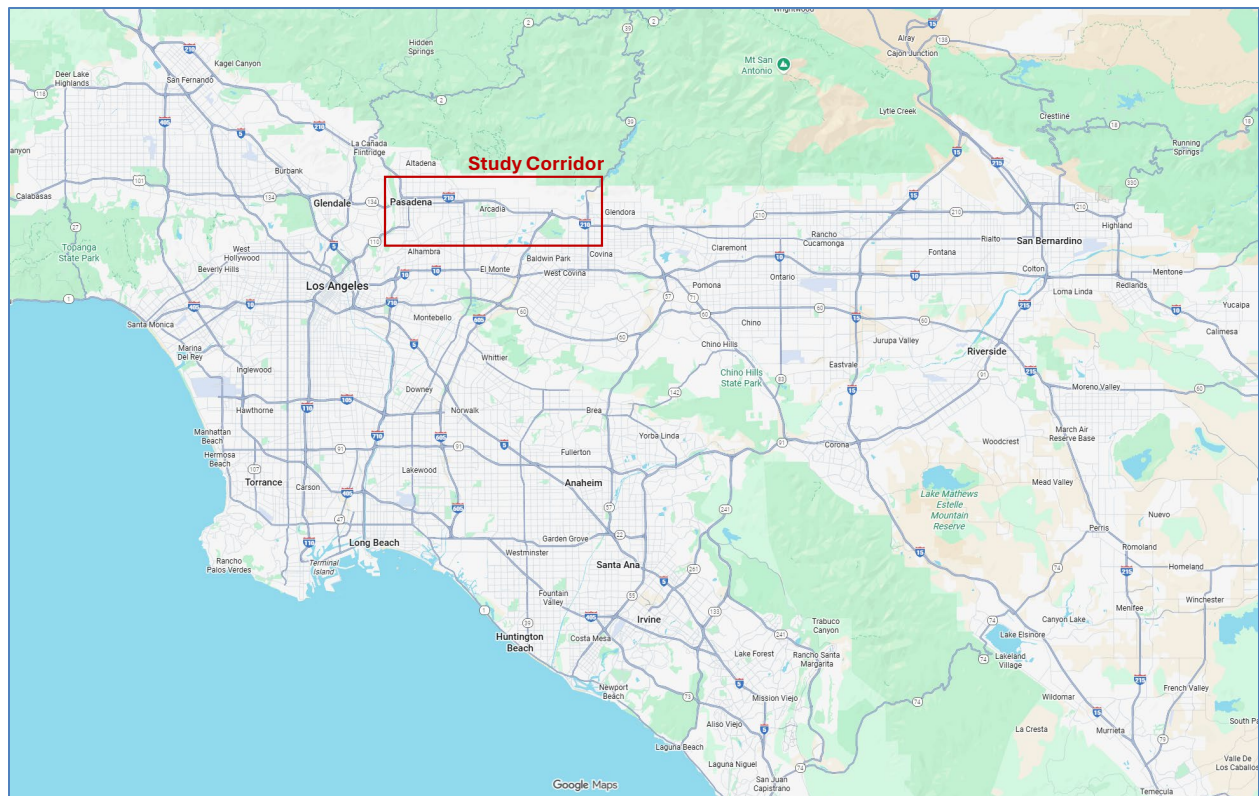


Figure 3-1: I-210 Corridor Area

3.2. MODEL NETWORK GEOMETRY

Figure 3-2 illustrates the section of the I-210 corridor modeled in the Aimsun Next simulation platform. As illustrated, the model roughly encompasses the cities of Pasadena, Arcadia, Monrovia, and Duarte in northern Los Angeles County. It includes the portion of the I-210 freeway running from the north end of Pasadena to Azusa, a portion of the SR-134 freeway connecting to the I-210 freeway in Pasadena, and a portion of the I-605 freeway connecting with the I-210 in Duarte. Outside the freeway, all main arterials within the four mentioned cities have been modeled. This includes all signalized intersections, with a replication of all vehicle-actuated features and time-of-day signal patterns in operation in 2019 based on the timing sheet for each intersection provided by each city.



Figure 3-2: I-210 Aimsun Next Model

3.3. TRANSIT ELEMENTS

For completeness, all bus transit and light-rail lines that operated within the corridor in 2019 were also modeled. This is illustrated in Figure 3-3. This modeling includes transit signal preemption features at at-grade signalized intersections along the light-rail line.



Figure 3-3: Modeled Transit Lines

3.4. EXISTING HOV2+ FACILITY

The model includes a limited-access, 24-hour HOV 2+ facility running along both directions of I-210 from downtown Pasadena to the eastern end of the modeled area, as well as along SR-134. The location of this HOV facility is shown in Figure 3-4 by the red and orange lines, together with the various access gates. The red line marks the core section of interest, while the orange lines indicate edge sections of potential additional interest. Within the figure, the boxes with text further indicate the locations of the various gates allowing vehicles to leave or enter the HOV facility. No vehicles are assumed to enter or leave an HOV section between the gates. While this may be possible for motorists to choose to illegally cross the existing double white line delimiting the facility, the model uses different links to represent the general-purpose and HOV sections, making switch-over between gates impossible.

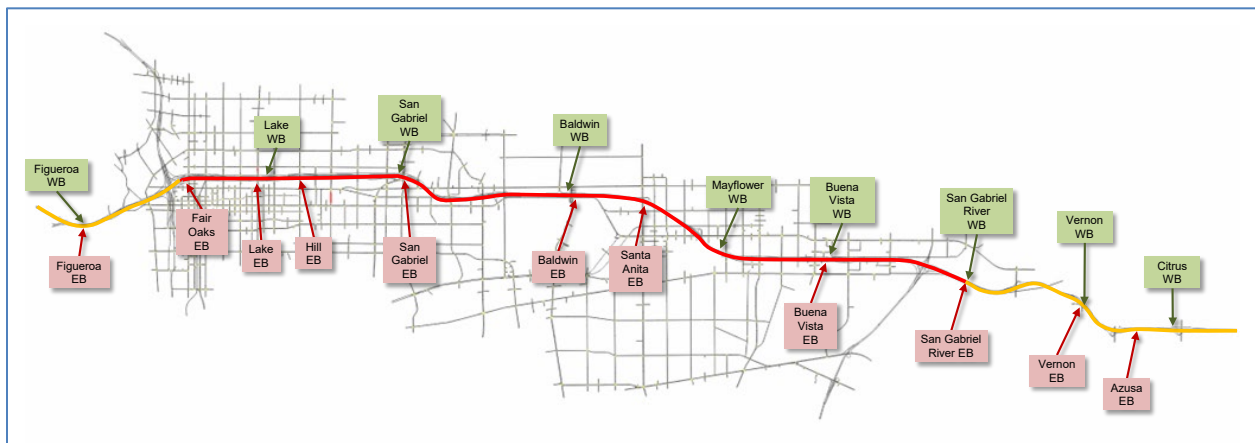


Figure 3-4: HOV2 Facility within Entry/Exit Gates

3.5. NETWORK TRAFFIC ENTRY AND EXIT POINTS

Figure 3-5 illustrates the centroids associated with the road network. 486 centroids are defined. Centroids were positioned throughout the network to try to capture key trip origin and destination zones. Particular attention was put into associating centroids with large malls, hospitals, and business areas with large parking areas. Many schools also have specific centroids to better capture the waves of traffic going to or coming from these institutions around school start and end times. To better capture traffic patterns, multiple centroids have also been used to model the traffic demand associated with some large malls and business areas. Examples include the Arcadia Westfield Mall in Arcadia and the business area between Rosemead Boulevard and Sierra Madre Villa Avenue north of Foothill Boulevard at the east end of Pasadena.

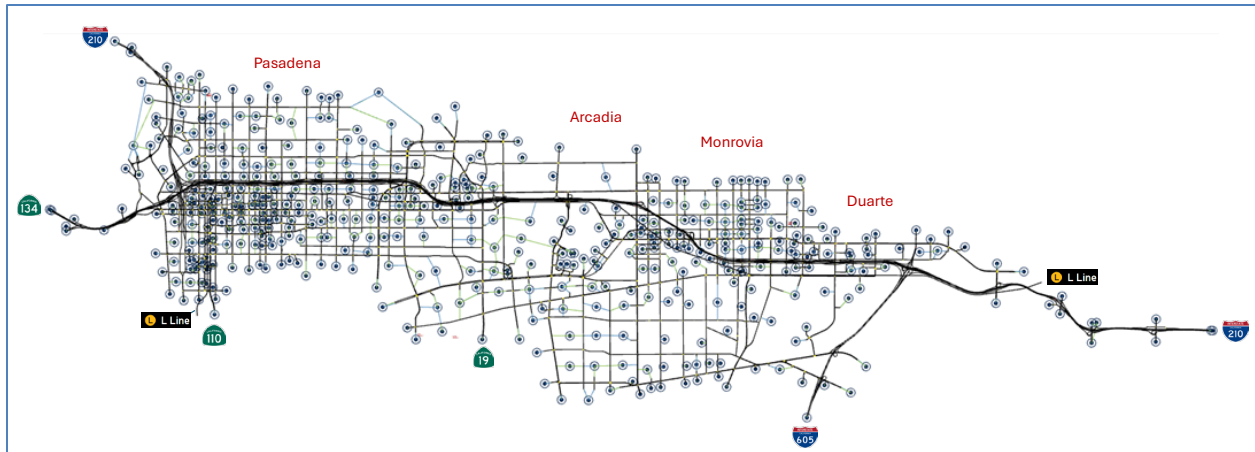


Figure 3-5: Modeled Traffic Centroids

3.6. MODELED VEHICLE TYPES

Six categories of vehicles are currently defined within the model, as listed below:

- **Cars:** Single-occupancy passenger vehicles.
- **Decals:** Single-occupancy vehicles (SOVs) with Clear Air decals allowed on HOV facilities
- **High-occupancy vehicles:** Vehicles with multiple passengers. A distinction is made between vehicles with two passengers (HOV2), 3 passengers (HOV3), and 4 or more passengers (HOV4+)
- **Medium trucks:** Trucks with gross vehicle weights varying between 14,000 lbs and 26,000 lbs.
- **Heavy trucks:** Trucks with gross vehicle weights over 26,000 lbs.
- **Transit buses:** Vehicles representing city transit buses running along fixed routes.

Motorcycles were not included in the model. Based on data from the 2016 Managed Lane Annual Report [Caltrans District 7, 2017], they accounted for between 2.7% and 4.8% of the HOV traffic. Their exclusion originates from a decision to keep the original model as simple as possible for real-time operation, with a focus on rerouting due to congestion. This decision was based on the fact that motorcycles tend to occupy much smaller spaces than vehicles, on the lack of statistics regarding the proportion of motorcycles in general freeway traffic lanes and arterials, and the difficulty of traffic pattern data.

3.7. OVERALL TRAFFIC DEMAND

In terms of traffic demand, the model features separate 24-hour modeling replicating observed 2019 traffic conditions for a typical weekday, a typical Saturday, and a typical Sunday. For weekdays, this demand modeling is further implemented in 30-minute time slices for the 6 AM to 9 AM period to better capture the rapid changes in traffic demand that are observed to occur during the morning peak period, and in 1-hour time slices for all other periods.

Figure 3-2 illustrates the modeled average traffic demand profile for a typical weekday. Within the corridor, traffic demand reaches similar levels during both the AM Peak and PM Peak periods. However, the AM peak period is generally much shorter, with faster increases and decreases in traffic. During the midday period, demand remains relatively high from 9:00 AM to 2:00 PM, with a small peak between Noon and 1:00 PM.

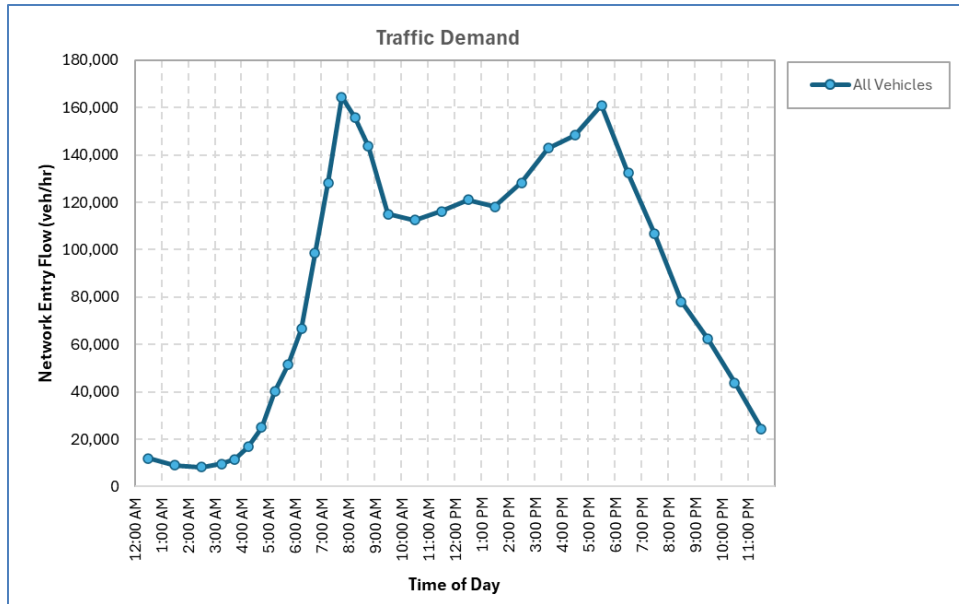


Figure 3-6: Average Weekday Traffic Demand Profiler

3.8. TRAFFIC DEMAND BY VEHICLE TYPES

Figure 3-7 illustrates the proportions of vehicles of various types simulated throughout a typical weekday. Within the profile, both the AM peak and PM peak periods can be identified. The figure also indicates that the modeled traffic demand primarily consists of passenger cars and HOV2 vehicles. Figure 3-8 and Figure 3-9 illustrate the proportions of vehicle types simulated within each interval. Figure 3-8 includes all vehicles while Figure 3-9 removes the passenger cars and HOVs to allow better viewing of the proportions associated with other vehicle types. Overall, passenger cars represent between 70% and 80% of all traffic, HOV2 vehicles about 20%, vehicles with a Clean Air decal about 1.5%, HOV3 vehicles about 1.3%, and HOV4 vehicles about 0.2%.

The above proportions were derived by analyzing local and statewide information about freeway traffic composition. This included:

- Traffic counts covering general-purpose and HOV lanes from the Caltrans Performance Management System (PeMS).
- Vehicle classification data from the Glendora Traffic Census station, the only one locally reporting classification data to PeMS.
- I-210-specific vehicle occupancy surveys from Caltrans and local traffic management agencies, such as Caltrans District 7's 2016 Managed Lane Report [Caltrans District 7, 2017], which shows detailed vehicle type and vehicle occupancy statistics for two cross-sections of I-210, one near Wilson Avenue in Pasadena (milepost 26.57) and another near 2nd Street in Azusa (milepost 39.12).
- Other HOV-related occupancy surveys, such as the Bay Area Infrastructure Financing Authority Express Lane Operations reports [Bay Area Express Lanes, 2024], to confirm the general validity of modeling choices based on more recent data.

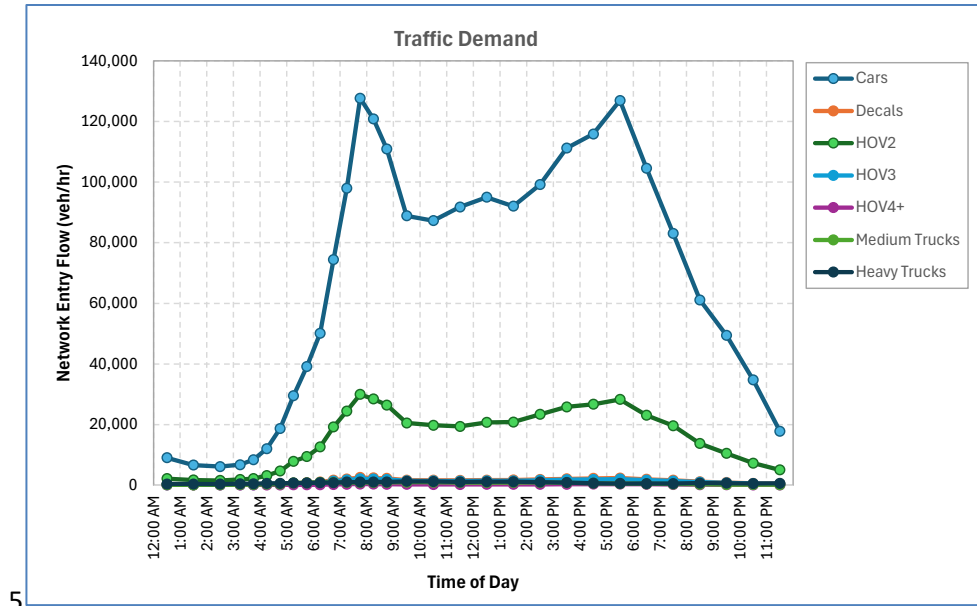


Figure 3-7: Weekday Network Entry Flow Profile

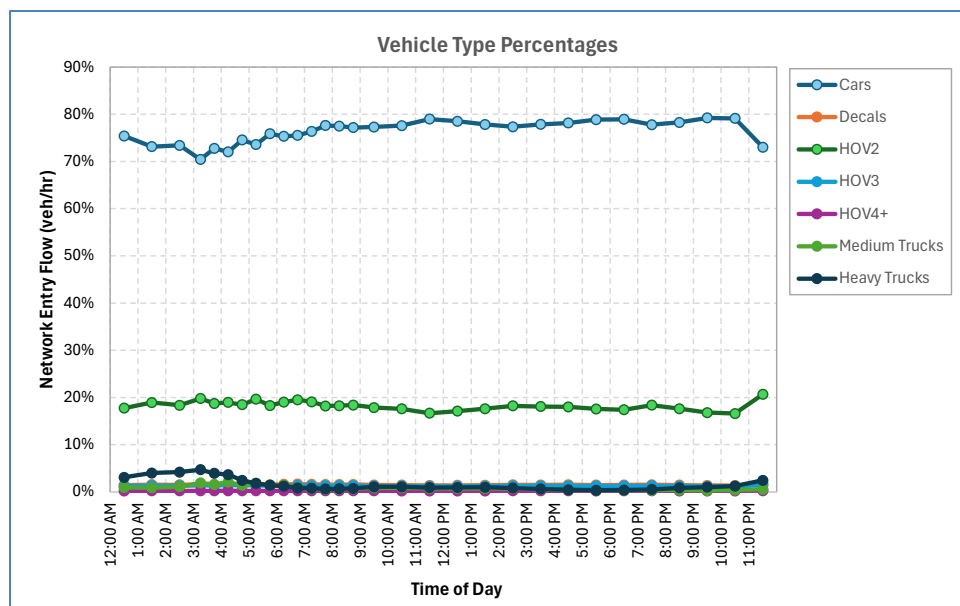


Figure 3-8: Vehicle Type Proportions (All Vehicle Types)

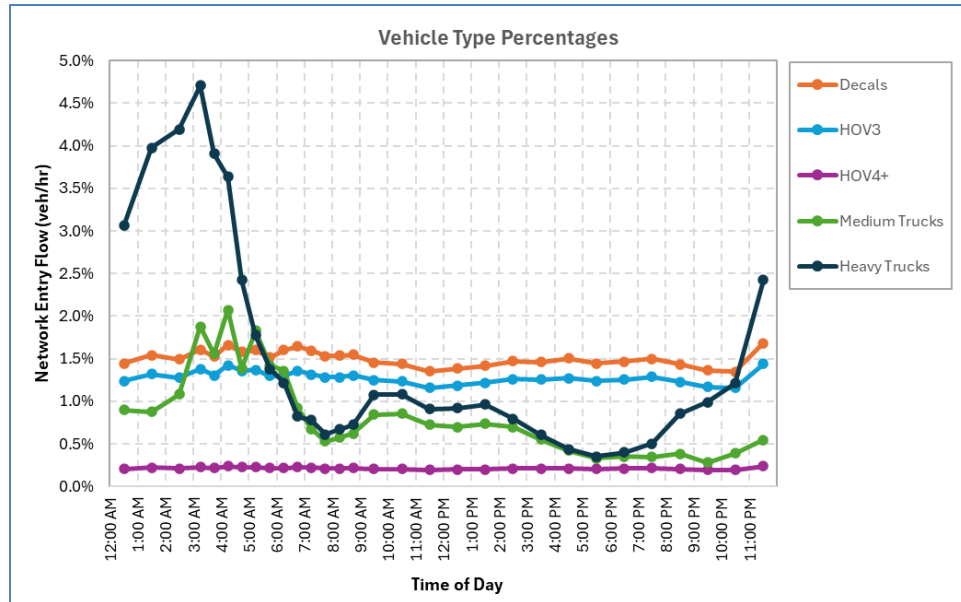


Figure 3-9: Vehicle Type Proportions (Excluding Cars)

3.9. DYNAMIC PATH ADJUSTMENT ACTIONS IN RESPONSE TO CONGESTION

A key element of the I-210 model is the implementation of behavioral elements forcing simulated vehicles to alter their path when encountering specific situations, such as unexpected congestion. These elements primarily consist of the application of Forced Turn, Forced Enroute, and Destination Change commands at specific locations for vehicles meeting some routing conditions when a given set of local conditions exists. Four types of path adjustment actions are defined:

- Continuous actions
- Dynamic mainline freeway actions
- Dynamic off-ramp and on-ramp actions
- Dynamic arterial actions

3.9.1. CONTINUOUS ACTIONS

Continuous actions are applied without any conditions. They are always active. Their primary intent is to force vehicles to make certain route choices matching observed behavior, where the simulation engine was found not to reproduce adequate behavior. A significant effort was made to minimize their use by first attempting to modulate the travel cost associated with specific links or turns. Their use was only considered when cost modulation failed at replicating adequate behavior.

3.9.2. DYNAMIC MAINLINE FREEWAY ACTIONS

Dynamic freeway actions have been implemented with two primary goals:

- Prevent vehicles from exiting the freeway and re-entering one, two, or three on-ramps later when traffic conditions on the freeway are not unusually congested.
- Push vehicles off the freeway when unusual congestion is observed on the freeway.

These actions are typically implemented immediately upstream of an off-ramp. Triggers always come in pairs: one identifying when a congestion situation exists, and one identifying when the situation has ceased to exist. There are typically two sets of triggers with each off-ramp: one set identifying when unusual congestion exists, and the other when relatively severe congestion exists.

3.9.3. DYNAMIC OFF-RAMP AND ON-RAMP ACTIONS

Dynamic off-ramp actions aim to push vehicles seeking to exit a freeway at a particular off-ramp to remain on the freeway if the traffic density on the off-ramp is very high, indicating that the ramp may be congested. Actions defined in this context aim to push vehicles to use the next available off-ramp instead of the next available off-ramp to get to their destination. Such actions are further defined only for off-ramps for which a suitable downstream alternate off-ramp exists.

Dynamic on-ramp actions have the same objective as off-ramp actions. They aim to push vehicles to seek alternate on-ramps if the on-ramp they are trying to take is heavily congested. Their definition follows similar principles to those outlined in the preceding section.

3.9.4. DYNAMIC ARTERIAL ACTIONS

Dynamic arterial actions play a similar role to freeway dynamic actions. They attempt to push vehicles to take an alternate path when significant congestion is encountered on an arterial section.

Action triggers typically look at traffic conditions downstream of a signalized or stop-controlled intersection. If the downstream link is congested, a fraction of vehicles upstream of the intersection aiming to travel through the congested section will instead be pushed to take a right turn or left turn.

To reduce the occurrence of situations where traffic is still being pushed off an arterial when density on the section downstream of an intersection has dropped significantly, “non-congestion” actions are defined for many locations in addition to the congestion actions. These actions are to be taken when the congested conditions do not exist. Like the freeway actions preventing vehicles from exiting an uncongested freeway too early, these actions push vehicles aiming to travel on certain downstream arterial sections to remain on the arterial if there is no compelling reason to take an alternate route.

4. DEVELOPMENT OF THE DYNAMIC TOLLING FUNCTION

This section explains how a dynamic toll function was reconstructed using tolling and traffic monitoring data from the I-110 freeway in Los Angeles County. The basic development goal was to develop a toll prediction algorithm that would attempt to reproduce observed toll rates along the I-110 freeway throughout 2019 using observed flow densities on the HOT facilities returned by PeMS sensors over the same period. Specific elements discussed in this section include:

- Reference toll rate data
- General dynamic tolling approach
- Traffic data source
- Determination of average traffic flow density
- Development of toll function
- Resulting algorithm
- Algorithm implementation

4.1. REFERENCE TOLL RATE DATA

As indicated in the introduction, the development of the tolling algorithm relied on data listing the toll rates that were implemented along the various HOT sections of the I-110 freeway throughout 2019, graciously provided by LA Metro. The provided data included observed toll rates for each of five northbound and six southbound tolling sections along the freeway, at 5-minute intervals. A formatted data sample is shown in Figure 4-1, with the toll rates colored based on their level, with Figure 4-2 identifying the various tolling sections along the freeway.

			POSTEDTOLL										
			I-110 North					I-110 South					
			I110N-SEG1	I110N-SEG2	I110N-SEG3	I110N-SEG4	I110N-SEG5	I110S-SEG1	I110S-SEG2	I110S-SEG3	I110S-SEG4	I110S-SEG5	I110S-SEG6
Wednesday	November 13, 2019	7:15:00 AM	1.50	1.15	1.40	0.95	2.05	0.35	0.40	0.40	0.45	0.60	0.45
Wednesday	November 13, 2019	7:20:00 AM	1.60	1.10	1.35	0.95	2.00	0.35	0.40	0.40	0.45	0.60	0.50
Wednesday	November 13, 2019	7:25:00 AM	1.70	1.05	1.30	1.00	1.95	0.35	0.35	0.35	0.45	0.60	0.50
Wednesday	November 13, 2019	7:30:00 AM	1.60	1.05	1.25	1.00	1.90	0.35	0.35	0.35	0.45	0.55	0.50
Wednesday	November 13, 2019	7:35:00 AM	1.30	1.00	1.20	1.00	1.65	0.35	0.35	0.35	0.45	0.55	0.50
Wednesday	November 13, 2019	7:40:00 AM	2.00	1.00	1.15	1.00	1.80	0.35	0.35	0.35	0.40	0.55	0.50
Wednesday	November 13, 2019	7:45:00 AM	2.00	1.00	1.15	1.05	1.75	0.35	0.35	0.35	0.40	0.50	0.45
Wednesday	November 13, 2019	7:50:00 AM	1.35	1.00	1.15	1.05	1.70	0.35	0.35	0.35	0.40	0.50	0.40
Wednesday	November 13, 2019	7:55:00 AM	1.30	1.00	1.20	1.25	1.65	0.35	0.35	0.35	0.40	0.50	0.40
Wednesday	November 13, 2019	8:00:00 AM	1.65	1.00	1.20	1.25	1.60	0.35	0.35	0.35	0.35	0.45	0.40
Wednesday	November 13, 2019	8:05:00 AM	1.80	1.00	1.15	1.50	1.55	0.35	0.35	0.35	0.35	0.45	0.40
Wednesday	November 13, 2019	8:10:00 AM	1.75	1.00	1.15	1.60	1.55	0.35	0.35	0.35	0.35	0.45	0.40
Wednesday	November 13, 2019	8:15:00 AM	1.70	1.00	1.15	1.60	1.55	0.35	0.35	0.35	0.35	0.45	0.40
Wednesday	November 13, 2019	8:20:00 AM	1.65	1.05	1.15	1.70	1.55	0.35	0.35	0.35	0.35	0.45	0.35
Wednesday	November 13, 2019	8:25:00 AM	1.65	1.05	1.15	1.70	1.75	0.35	0.35	0.35	0.35	0.45	0.35
Wednesday	November 13, 2019	8:30:00 AM	1.60	1.10	1.20	1.95	1.75	0.35	0.35	0.35	0.35	0.40	0.35
Wednesday	November 13, 2019	8:35:00 AM	1.60	1.10	1.30	1.95	1.70	0.35	0.35	0.35	0.35	0.35	0.35
Wednesday	November 13, 2019	8:40:00 AM	1.60	1.10	1.30	2.10	1.70	0.35	0.35	0.35	0.35	0.35	0.35
Wednesday	November 13, 2019	8:45:00 AM	1.60	1.10	1.35	2.10	1.70	0.35	0.35	0.35	0.35	0.35	0.35
Wednesday	November 13, 2019	8:50:00 AM	1.60	1.10	1.35	2.10	1.85	0.35	0.35	0.35	0.35	0.35	0.35
Wednesday	November 13, 2019	8:55:00 AM	1.60	1.10	1.30	2.10	1.80	0.35	0.35	0.35	0.35	0.35	0.35
Wednesday	November 13, 2019	9:00:00 AM	1.60	1.10	1.30	2.05	1.80	0.35	0.35	0.35	0.35	0.35	0.35
Wednesday	November 13, 2019	9:05:00 AM	1.60	1.10	1.30	2.10	1.95	0.35	0.35	0.35	0.35	0.35	0.35
Wednesday	November 13, 2019	9:10:00 AM	1.60	1.10	1.30	2.05	1.95	0.35	0.35	0.35	0.35	0.35	0.35
Wednesday	November 13, 2019	9:15:00 AM	1.60	1.05	1.30	2.05	1.95	0.35	0.35	0.35	0.35	0.35	0.35
Wednesday	November 13, 2019	9:20:00 AM	1.60	1.05	1.30	2.00	1.95	0.35	0.35	0.35	0.35	0.35	0.35
Wednesday	November 13, 2019	9:25:00 AM	1.60	1.15	1.25	1.95	1.95	0.35	0.35	0.35	0.35	0.35	0.35
Wednesday	November 13, 2019	9:30:00 AM	1.60	0.80	0.90	1.50	1.50	0.10	0.10	0.10	0.10	0.10	0.10
Wednesday	November 13, 2019	9:35:00 AM	1.60	0.45	0.55	1.05	1.05	0.10	0.10	0.10	0.10	0.10	0.10
Wednesday	November 13, 2019	9:40:00 AM	1.60	0.10	0.25	0.70	0.70	0.10	0.10	0.10	0.10	0.10	0.10
Wednesday	November 13, 2019	9:45:00 AM	1.60	0.10	0.10	0.35	0.35	0.10	0.10	0.10	0.10	0.10	0.10
Wednesday	November 13, 2019	9:50:00 AM	1.55	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Wednesday	November 13, 2019	9:55:00 AM	1.55	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Wednesday	November 13, 2019	10:00:00 AM	1.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Wednesday	November 13, 2019	10:05:00 AM	0.75	0.10	0.15	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Wednesday	November 13, 2019	10:10:00 AM	0.45	0.10	0.15	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Wednesday	November 13, 2019	10:15:00 AM	0.15	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Wednesday	November 13, 2019	10:20:00 AM	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Figure 4-1: Observed Toll Rates Along I-110 Freeway

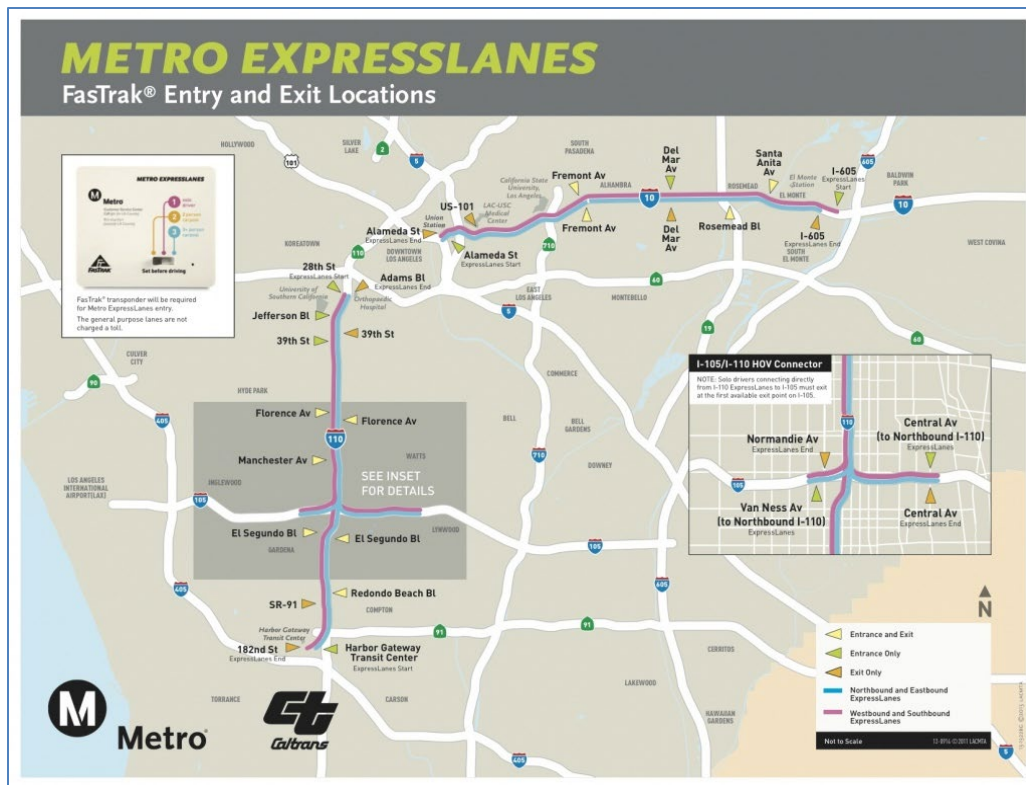


Figure 4-2: I-110 Tolling Section

4.2. GENERAL DYNAMIC TOLLING APPROACH

Based on discussions with staff from LA Metro involved in the tolling operations, it was assumed that tolls along freeways in Los Angeles County are generally set in response to measured traffic density along the HOT facilities. The general goal is to control traffic using the facility so that a target traffic density is ideally not exceeded. For freeways in Los Angeles County, the target appears to be about 35 vehicles/hour/lane. Tolls for a given section are increased above a certain time-of-day minimum if the observed density on the section is measured to exceed the target density. Following a toll increase, additional increases are then implemented if the new toll does not result in a reduction of density below the defined target. Toll reductions are conversely implemented in a density reduction in observed.

4.3. TRAFFIC DATA SOURCES

While the implemented toll rates along the I-110 freeway were obtained from LA Metro, the traffic data used to determine the rates were not included in the provided data. To address this gap, traffic monitoring data that could be obtained from the traffic sensors operated by Caltrans along the freeway were recovered from the online Performance Measurement System (PeMS) over the same performance period. For each tolling section, only data for sensors that produced reliable data were considered. Since sensors do not directly measure density, 5-minute flow counts and speed estimates were collected with the intent to use these parameters to estimate density at the location of each sensor.

When collecting the data, it was hypothesized that the actual data used for establishing the observed toll rates likely came from a separate set of sensors operated by LA Metro. Despite being potentially true, it was also hypothesized that both LA Metro's and PeMS's sensors should have captured similar traffic conditions and that the latter could be used for the development of the algorithm to implement in Aimsun.

4.4. DENSITY ESTIMATION FROM FLOW AND SPEED DATA

To avoid overreacting to temporary changes in traffic density, toll changes are implemented based on changes in average traffic density on the HOT facility measured over a certain period. While inquiries were made regarding the averaging process typically used, no specific information could be obtained due to the proprietary nature of the algorithm developed. However, assumptions could be made by drawing parallels with how average traffic conditions are estimated within dynamic ramp metering systems used by Caltrans within District 7.

The first step was to determine the average traffic density on the HOT facility using 5-minute data provided by PeMS stations along the freeway. Since PeMS stations only provide speed and flow data, the corresponding density associated with each station was estimated using the theoretical relationship between flow, speed, and density.

$$Avg\ Density_t = \frac{Avg\ Flow_t}{Avg\ Speed_t}$$

where: *Avg Density* = Average traffic density, vehicles/mile
Avg Flow = Average hourly traffic flow rate, vehicles/hour
Avg Speed = Average traffic speed, miles/hour
t = Data collection interval

Considering that the PeMS data used for the algorithm design provides vehicle counts per 5 minutes and may cover multiple lanes, the above equation was transformed into the following for determining the density associated with a given traffic monitoring station:

$$Avg\ Density_t = \frac{12 \times Avg\ Count_{5min,t}}{Nb\ Lanes \times Avg\ Speed_t}$$

where: *Avg Density* = Average traffic density, vehicles/mile
Avg Count_{5min} = Average 5-minute vehicle count, vehicles/5 minutes
Avg Speed = Average traffic speed, miles/hour
Nb Lanes = Number of lanes on the HOT facility at the data collection section
t = Data collection interval

4.5. AVERAGE DENSITY OVER TIME

To avoid overreacting to small time-dependent fluctuations in traffic conditions, the possibility of averaging estimated traffic densities over multiple 5-minute intervals was added to the algorithm. To retain flexibility, the number of intervals to consider was set up as a user-defined parameter. For most of the evaluations, a value of 3 was used, representing an averaging process over three 5-minute intervals, or 15 minutes. This matches the average process often used along District 7 freeways for estimating

average traffic conditions fed into the ramp metering control algorithm. An example of the effect of this 15-minute average process is shown in Figure 4-3 below.

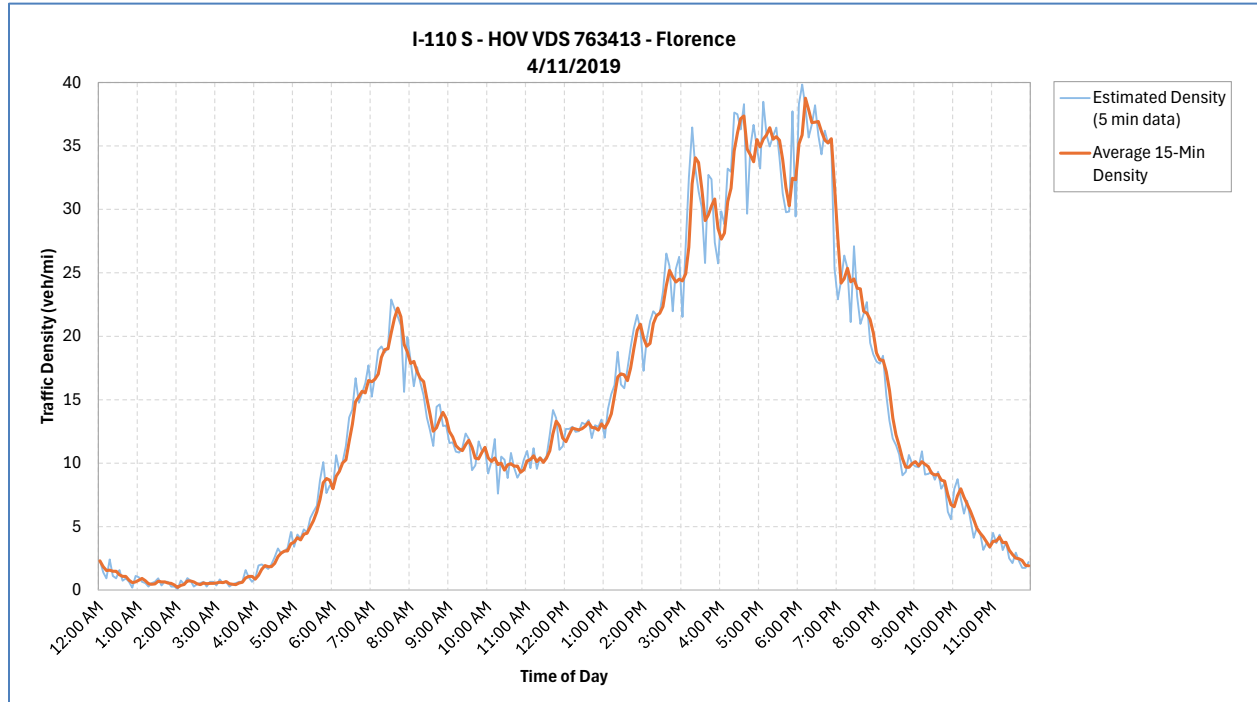


Figure 4-3: 15-Minute Density Averaging Process

To further reduce the potential for overreacting to small time-dependent fluctuations in traffic conditions, an exponentially weighted moving average (EWMA) is also applied to both the count and speed data to smooth the variations over time, as shown in the equation below.

$$Avg\ Count_{5min,t} = (\alpha)(Count_{5min,t}) + (1 - \alpha)(Avg\ Count_{5min,t-1})$$

$$Avg\ Speed_t = (\alpha)(Speed_t) + (1 - \alpha)(Avg\ Speed_{t-1})$$

where: α = Smoothing factor

The smoothing is controlled by the parameter α , which determines the weight given to the most recent traffic measurement related to past observations. This is a user-defined parameter. If α is set to 0.50, the average 5-minute count or speed for a given interval will thus be a combination of 50% of the last count and 50% of the previously estimated average. A value of 0.30 would further result in an updated average count calculated based on 30% of the latest count and 70% of the previously calculated average.

The above approach ensures that both the traffic flow and speed are stabilized over time, providing a more reliable measure of density that reflects long-term traffic trends rather than short-term fluctuations. It is believed that this smoothed density is more accurate in reflecting the traffic conditions used to determine the actual toll rate. It is also consistent with what is done in other traffic management systems, such as the dynamic ramp metering algorithms used on the I-210 freeway.

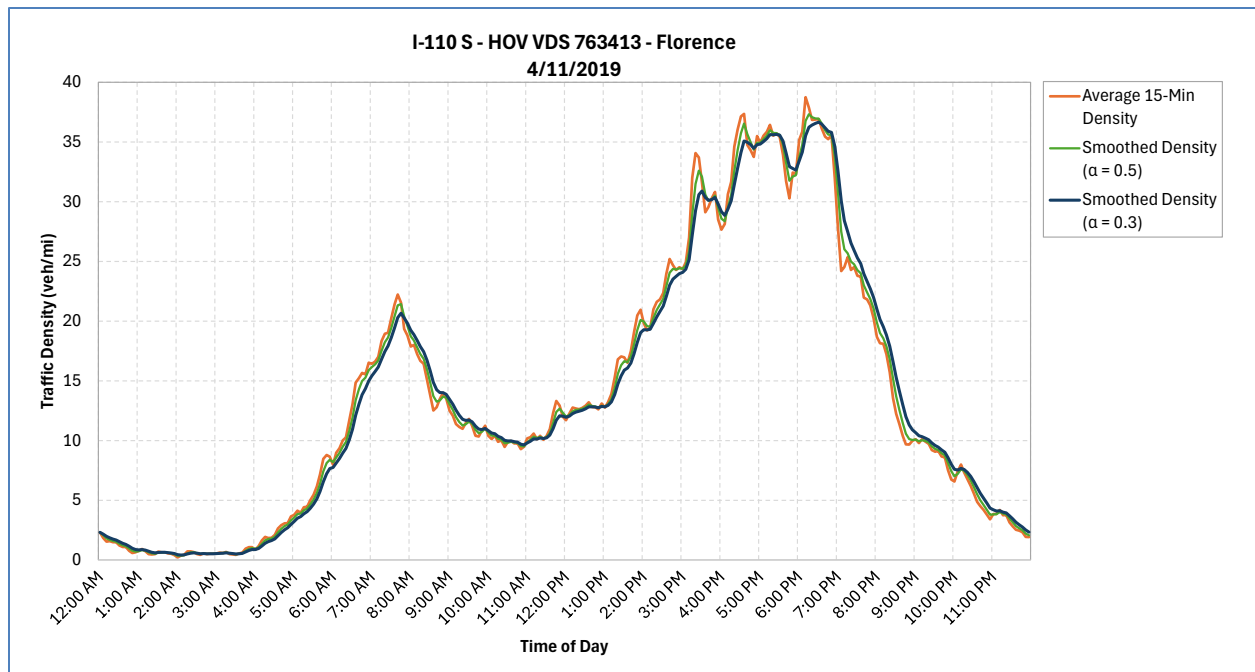


Figure 4-4: Smoothed Traffic Density Example

Figure 4-5 illustrates how the average density estimates change for the example of Figure 4-4 using a 0.5 and 0.3 smoothing coefficient. As can be observed, the adoption of a smoothing coefficient of 0.5 maintains the general shape of the density profile over the day while decreasing fluctuations and producing smaller peaks and drops. Adopting a coefficient of 0.3, which further reduces the importance of the latest observation, smooths the trends even more.

4.6. TOLL FUNCTION ELEMENTS

This section highlights the key observations that served as the foundation for developing the final toll function. This includes considerations regarding:

- Minimum toll rates
- Maximum toll rate
- Target density vs response to density variations
- Roll rate change step
- Differentiation of α coefficients based on time of day
- Hard reset at the end of peak periods

4.6.1. MINIMUM TOLL RATE

In analyzing the I-110 toll rates provided, it was observed that a minimum toll rate is generally applied to any period of the day, including nights, and that this minimum varies across the day. Based on the available data, the following minimum rates were identified:

- AM Peak (5 AM – 10 AM): \$0.35/mi
- Midday (10 AM – 4 PM): \$0.10/mi

- PM Peak (4 PM – 7 PM): \$0.35/mi
- Other periods: \$0.10/mi

4.6.2. MAXIMUM TOLL RATE

In addition to a minimum toll rate, a maximum rate also appears to be applied. This maximum rate was identified to be \$2.00/mile regardless of the time of day or traffic conditions.

4.6.3. TARGET DENSITY VERSUS RESPONSE TO DENSITY VARIATION

It was initially assumed that the main driver of the tolling algorithm was a specific target density, such as 35 vehicles per mile per lane. However, this assumption did not account for limited toll drops that are often observed at high densities when the target density is exceeded. As illustrated in Figure 4-5, particularly over the afternoon peak period, it was instead observed that the implemented toll rates appeared more responsive to changes in density than to the need to maintain a given target density.

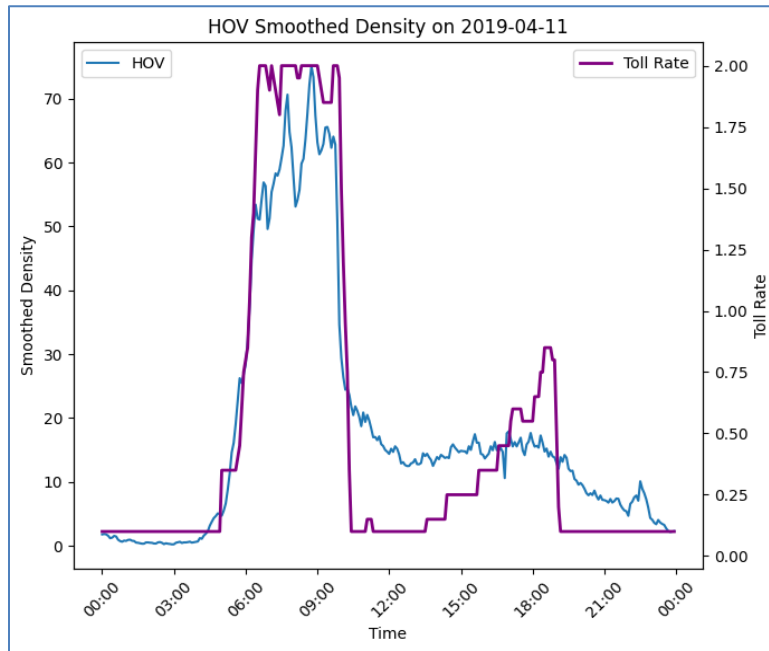


Figure 4-5: Observed Toll Rates Along I-110 Freeway

The above observation suggested that the desired tolling algorithm should be more sensitive to variations in density than to the degree to which the observed density deviates from the target density, while still considering whether the density is above the target or not. This resulted in the development of the following equation for determining whether a toll rate adjustment is needed:

$$Density_t > Target\ Density \rightarrow Toll\ Rate\ Change\ Assessment\ Needed$$

$$Density_t \leq Target\ Density \rightarrow Toll\ Rate_{t-1} > Min\ Toll \rightarrow Toll\ Rate\ Change\ Needed$$

$$Toll\ Rate_{t-1} \leq Min\ Toll \rightarrow Toll\ Rate\ Change\ Not\ Needed$$

and the following equation for calculating the change in toll rate when needed:

$$Toll Rate_t = Toll Rate_{t-1} + \alpha (Avg Density_t - Max(Avg Density_{t-1}, Target Density))$$

$$Toll Rate_t < Min Toll Rate \rightarrow Toll Rate_t = Min Toll Rate$$

$$Toll Rate_t > Max Toll Rate \rightarrow Toll Rate_t = Max Toll Rate$$

where: *Toll Rate* = Toll rate at interval *t*, \$/mile
Min Toll = Minimum allowed toll rate
Max Toll = Maximum allowed toll rate
Avg Density = Average density at interval *t*
Target Density = Target density for toll control
 α = Constant reflecting the algorithm's sensitivity to density variations

The above equation would trigger a change in toll rate only if the current density is above the target density, or if the current density is below the target density but a previously calculated toll rate is still above the defined minimum toll rate. If a change in rate is determined to be necessary, the toll rate would then factor in the change in observed traffic density using the target density as a reference floor.

4.6.4. TOLL RATE CHANGE STEP

Toll rate data from the I-110 freeway indicated that toll rates along the freeway seem to change in fixed increments of either \$0.05/mile or \$10/mile. To mimic this behavior, a parameter was added to allow model users to define the basic steps to be used in toll increments and decrements.

4.6.5. DIFFERENTIATION OF ALPHA COEFFICIENTS BASED ON TIME OF DAY

During the AM and PM peak periods, it was further observed that the toll rate increases more sharply than it decreases. This suggested that the α coefficient controlling how the toll rate changes differs depending on whether the observed density variation is positive or negative. Further analyses indicated that toll rates also tend to decrease much faster once the observed density drops below the target density, suggesting an accelerated return to a basic toll level.

The above observations led to the definition of a dual model where the toll rate is adjusted using an increment coefficient, α_{incr} when the density increases ($\Delta > 0$), a decrement coefficient α_{decr} when the density decreases ($\Delta < 0$), and a higher decrement coefficient α_{decr} when the density decreases below the target density. The equations governing this adjustment are as follows:

$$\Delta Avg Density > 0 :$$

$$Toll Rate_t = Toll Rate_{t-1} + \alpha_{incr} \times \Delta Avg Density$$

$$\Delta Avg Density \leq 0 :$$

$$Density_t > Target Density \rightarrow Toll Rate_t = Toll Rate_{t-1} + \alpha_{decr} \times \Delta Avg Density$$

$$Density_t \leq Target Density \rightarrow Toll Rate_t = Toll Rate_{t-1} + 2 \alpha_{decr} \times \Delta Avg Density$$

Based on an analysis of toll rate changes along the I-110 freeway during the AM and PM peak periods, the following values were more specifically proposed as default values for the increasing and decreasing coefficients. If needed, these values could nevertheless still be changed to any values more suitable to observed local conditions.

Table 4-1: Default Coefficient Values for Increasing and Decreasing Densities

Peak	α_{incr}	α_{decr}
AM Peak	0.015	0.010
PM Peak	0.015	0.010

Figure 4-6 illustrates the results of applying the toll rate calculation model to observed toll rates on one section along I-110 on June 16, 2019. As can be observed, the calculations produce toll rates that generally appear to move in sync with the observed toll rates, considering that the reference density data likely come from different sources than the one used for the actual toll algorithm. Both the rapid rise and decrease associated with the AM peak period are replicated, as well as the gradual rise associated with the PM peak period.

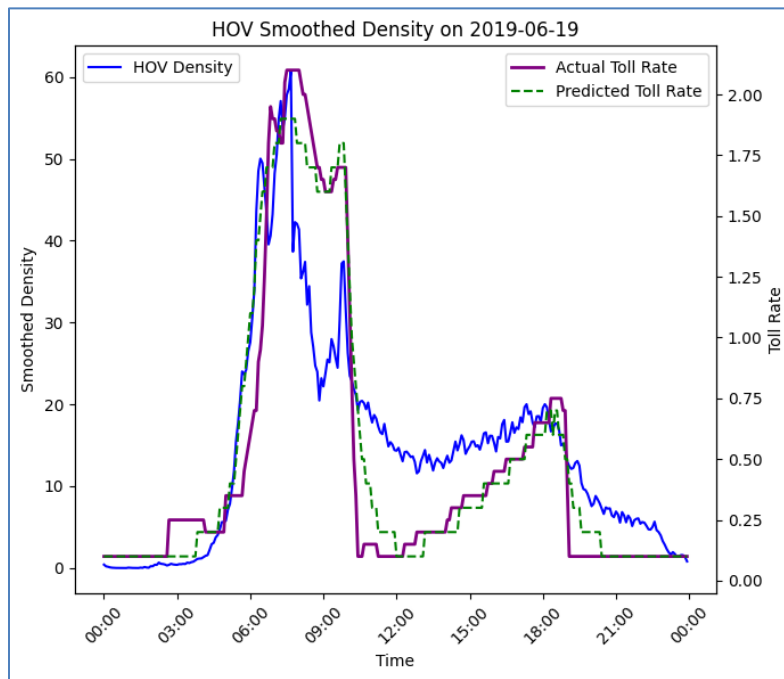


Figure 4-6: Example of Application of Toll Prediction Algorithm

4.6.6. HARD RESET AT THE END OF PEAK PERIODS

Finally, it was observed that the implemented toll rates appear to reset to a minimum value of \$0.10/mile at the end of each peak period. This behavior was then incorporated into the algorithm to ensure that the toll rate always returns to the base level after the peak demand subsides.

4.7. ALGORITHM IMPLEMENTATION IN AIMSUN

This section describes the implementation of the HOT Module algorithms within the Aimsun model. Specific elements covered include:

- Modeling of toll-responding vehicles
- Setup of HOT algorithm parameters

- Definition of HOT segments, with identification of traffic monitoring stations, gates, and decision points
- Segment-specific thresholds used for assessing the benefits of taking the HOT facility
- General simulation parameters
- Application examples

4.7.1. TOLL-RESPONDING VEHICLES VS REGULAR VEHICLES

To allow some vehicles to respond to tolls within the Aimsun model while preserving already defined vehicle-based travel demand matrices, a duplicate vehicle class was created for each vehicle type to represent the portion of vehicles from each class responding to tolls. The Car vehicle type was thus duplicated into a Car-HOT type, the HOV2 type into a HOV2-HOT type, the HOV3 type into a HOV3-HOT type, etc.

During a simulation, vehicles from the base Car, HOV2, HOV3, or HOV4 would not respond to tolls on the HOT lanes. Their access is determined by simple eligibility, asking the following two questions: is the vehicle type allowed on the HOT lane, and is there a time saving associated with using the lane? On the other hand, each of the HOT-type vehicles evaluates at each gate whether using the HOT lanes is beneficial based on a cost perspective. If the expected time savings, converted into a monetary value using an assumed cost of time, outweigh the cost to be paid for the toll, the vehicle then switches to the HOT lane. Vehicles already on the HOT lane similar determine at each gate whether there is a financial gain to keep using the lane. To avoid having vehicles react to relatively small changes in cost, a coefficient is used to increase the threshold for change. For instance, a coefficient of 1.1 in the equation below will result in a vehicle deciding to take or exit an HOT segment only if the monetary savings of the reduced travel time exceed the toll costs by at least 10%.

Figure 4-7 illustrates the setup of the data input files used for defining HOT vehicle characteristics. The first row of the file defines the number of vehicles from the defined list to consider in the simulation. In this case, the top two vehicle types, Car and HOV2, are to be simulated as responding to tolls. HOV3, HOV4, and Decals vehicles will not be considered in the simulation.

Number of Vehicle Types to Simulate (top to bottom)		2				
Non-HOT Vehicle Type Name (Aimsun)	Aimsun Id	HOT Vehicle Type Name (Aimsun)	Aimsun Id	Avg Number of Passengers	Mean Time Value	Var Time Value
Car	53	Car-HOT	18474840	1	35	5
HOV2	21123	HOV2-HOT	18474842	2	35	5
HOV3	18067640	HOV3-HOT	18474843	3	35	5
HOV4+	18067641	HOV4+-HOT	18474844	4	35	5
DECALS	18067642	DECALS-HOT	18474841	1	35	5

Figure 4-7: Vehicle Type Setting File

For each vehicle type, the file associates an Aimsun vehicle type with its corresponding HOT type via their corresponding vehicle type identification number. The file then defines the average occupancy, mean value of time, and value of time variance to be considered. The occupancy is used to adjust the cost assessment to the number of people in the vehicle. A specific value of time is further assigned to each simulated vehicle by generating a value from a normal distribution based on the provided mean and variance. This sampling process was implemented to replicate the fact that not all individuals have a similar value for time.

4.7.2. HOT ALGORITHM PARAMETERS

The implementation of the tolling algorithm within Aimsun allows users to define as many control periods during the day as desired, each with its own set of tolling parameters. For the simulation scenarios considered as part of this project, a typical day was assumed to be divided into five control periods representing the night, AM peak, midday, PM peak, and evening periods. For each of these periods, the key toll control parameters are defined in Table 4-2. The figure further illustrates how the parameters are implemented for the first two periods of the day through the user-defined *HOT Toll Algorithm Property* input file.

Table 4-2: Control Periods with Key Parameters

	Night 12 AM - 5 AM	AM Peak 5 AM – 10 AM	Midday 10 AM -2 PM	PM Peak 2 PM – 7 PM	Evening 7 PM – 12 AM
Alpha increase coefficient	0.010	0.015	0.010	0.015	0.010
Alpha decrease coefficient	0.010	0.010	0.010	0.010	0.010
Min toll rate (\$/mile)	0.10	0.35	0.10	0.35	0.10
Max toll rate (\$/mile)	2.00	2.00	2.00	2.00	2.00
Toll Rate Increment (\$/mile)	0.05	0.05	0.05	0.05	0.05
Target Density (veh/mi/ln)	35.0	35.0	35.0	35.0	35.0

Toll Algorithm ID	1
Number of Periods	5
Period ID	1
Period Name	Night
Period Start Time (HH::MM::SS)	0:00:00
Period End Time (HH:MM:SS)	5:00:00
Coefficient Alpha (Density Increase)	0.015
Coefficient Alpha (Density Decrease)	0.01
Maximum Toll Rate (\$/mile)	2
Minimum Toll Rate (\$/mile)	0.1
Toll Rate Increment (\$/mile)	0.05
Target HOT Density (veh/mi)	35
Period ID	2
Period Name	AM Peak
Period Start Time (HH::MM::SS)	5:00:00
Period End Time (HH:MM:SS)	10:00:00
Coefficient Alpha (Density Increase)	0.015
Coefficient Alpha (Density Decrease)	0.01
Maximum Toll Rate (\$/mile)	2
Minimum Toll Rate (\$/mile)	0.35
Toll Rate Increment (\$/mile)	0.05
Target HOT Density (veh/mi)	35

Figure 4-8: HOT Toll Algorithm Property File

4.7.3. HOT SEGMENT SETTING

Within the model, HOT segments are user-defined. Figure 4-9 illustrates the setup of the file defining each HOT segment. For each segment, the file identifies:

- The name of the segment
- The list of Aimsun sections comprising the HOV segment, ordered from start to end
- The list of Aimsun sections comprising the HOT segment, ordered from start to end. In the case of HOT systems, this will typically be the same as HOV segments.
- List of traffic monitoring stations (PeMS VDS) used to monitor traffic on the defined HOV, HOT, and general-purpose segments.
- Section upstream of the first HOV segment along the HOV facility, where vehicles will assess whether to keep traveling on the HOV facility. This decision point is usually set some distance upstream of the HOV gate to give enough space for vehicles to perform the required lane changes.
- Section upstream of the first HOT segment along the HOT facility at which vehicles will assess whether to keep traveling on the HOT facility.
- Section upstream of the HOT or HOV gate along the general-purpose lanes where vehicles on the general-purpose lanes will determine whether to take the HOT or HOV facility.
- Identification of the HOT segment upstream of the defined segment
- Identification of the gate at the end of the defined segment.

SegmentId (String or Integer)	Figueroa EB						
List of HOV Section Ids (Upstream to Downstream)	8008877	8008880	8008883	8008887	8004006	21591	
List of HOT Section Ids (Upstream to Downstream)	8008877	8008880	8008883	8008887	8004006	21591	
List of GP Section Ids (Upstream to Downstream)	21575	22453	22435	21598	21602	21610	21614
List of HOV VDS Ids (String or Integer)	VDS-7636(VDS-717607						
List of HOT VDS Ids (String or Integer)	VDS-7636(VDS-717607						
List of GP VDS Ids (String or Integer)	VDS-7176(VDS-717606						
Upstream Decision Point HOV Section Id	8009300						
Upstream Decision Point HOT Section Id	8009300						
Upstream Decision Point GP Section Id	8009297						
Upstream HOT Segment Id (String or Integer)	NA						
Downstream HOT Segment Id (String or Integer)	Fair Oaks EB						
Next Gate Section ID	8015788						
SegmentId (String or Integer)	Fair Oaks EB						
List of HOV Section Ids (Upstream to Downstream)	21652	8016318	8008896	8008899	21657		
List of HOT Section Ids (Upstream to Downstream)	21652	8016318	8008896	8008899	21657		
List of GP Section Ids (Upstream to Downstream)	8015785	21651	8004245	21664	21668	21673	
List of HOV VDS Ids (String or Integer)	VDS-761093						
List of HOT VDS Ids (String or Integer)	VDS-761093						
List of GP VDS Ids (String or Integer)	VDS-717633						
Upstream Decision Point HOV Section Id	21591						
Upstream Decision Point HOT Section Id	21591						
Upstream Decision Point GP Section Id	21610						
Upstream HOT Segment Id (String or Integer)	Figueroa EB						
Downstream HOT Segment Id (String or Integer)	Lake EB						
Next Gate Section ID	21677						

Figure 4-9: HOT Segment Property File

4.7.4. TOLL SEGMENT BENEFITS ASSESSMENT PARAMETERS

For each HOT segment, parameters used by individual vehicles to assess the benefits of using the facility instead of the general-purpose traffic lanes can be configured to reflect local behavior. These parameters

are defined in the *HOT Segment Toll Algorithm Setting* file. The setup of this file is shown in Figure 4-7. For each HOT segment, the file indicates:

- The HOT toll algorithm to use, as multiple could be defined in the *HOT Toll Algorithm Property* file.
- The minimum value of time to consider for the segment. In the example, a \$15/hour value is considered. If the mean value of time for vehicles is set at \$35/hour, a \$15/hour value would then only affect vehicles with a very low value of time assigned to them. However, a larger value would affect decisions for an increasing number of vehicles. This parameter intends to allow modeling locations where drivers might have a greater propensity to choose the HOT lane by increasing the minimum value of time considered in the benefit/cost assessment.
- Time-saving thresholds for going from the general-purpose lane to the HOT lane, and inversely from the HOT lane to the general-purpose lanes. In the example, the benefits of taking the HOT lane must be 10% higher than the toll cost for traffic on the general traffic lane to accept paying a toll and go on the HOT facility. However, no such increased threshold exists for the reverse decision, as it does not involve paying a toll.

HOT Segment ID	HOT Toll Algorithm ID (Integer)	Min Value of Time (\$/person-hour)	Time Saving Over Toll Cost Threshold (GP to HOT)	Time Saving Over Toll Cost Threshold (HOT to GP)
Figueroa EB	1	15.00	1.10	1.00
Fair Oaks EB	1	15.00	1.10	1.00
Lake EB	1	15.00	1.10	1.00
Hill EB	1	15.00	1.10	1.00
San Gabriel EB	1	15.00	1.10	1.00
Baldwin EB	1	15.00	1.10	1.00
Santa Anita EB	1	15.00	1.10	1.00
Buena Vista EB	1	15.00	1.10	1.00
San Gabriel River EB	1	15.00	1.10	1.00
Vernon EB	1	15.00	1.10	1.00
Azusa EB	1	15.00	1.10	1.00
Citrus WB	1	15.00	1.10	1.00
Vernon WB	1	15.00	1.10	1.00
San Gabriel River WB	1	15.00	1.10	1.00
Buena Vista WB	1	15.00	1.10	1.00
Mayflower WB	1	15.00	1.10	1.00
Baldwin WB	1	15.00	1.10	1.00
San Gabriel WB	1	15.00	1.10	1.00
Lake WB	1	15.00	1.10	1.00
Figueroa WB	1	15.00	1.10	1.00

Figure 4-10: HOT Segment Toll Algorithm Setting File

4.7.5. GENERAL SIMULATION PARAMETERS

Figure 4-11 illustrates the content of the *HOT Simulation Setting* file, which implements the following general simulation parameters:

- True/False toggle allowing to turn on or off the entire toll system. This allows us to quickly set up simulations with and without toll.

- Start/End times when the HOT toll system is assumed to be active if the preceding toggle is set to True. In the example, the toll system is assumed to be active from 5 AM to 7 PM. Simulated periods outside of this interval will result in no toll being implemented.
- Data update intervals, in seconds. In this case, a 5-minute update interval is specified.
- Maximum number of data points to consider when averaging traffic conditions. In this case, three data points are specified. Since the data collection interval is set at 5 minutes, this means that averaging will occur over 15 minutes.
- Time smoothing factor, defined earlier as the α coefficient.
- The interval at which toll rates are to be updated
- Proportion of vehicles responding to tolls. In this case, 20% of vehicles are assumed to respond to tolls. This percentage is applied to each vehicle type separately, and only to those types for which a corresponding HOT type has been defined.
- True/False toggle used to manage printouts to the screen and output files during simulations.

Enable HOT Simulations (TRUE or FALSE)☐	TRUE
Time To Activate HOT Simulations (In HH:MM:SS)	5:00:00
Time To Deactivate HOT Simulations (in HH:MM:SS)	19:00:00
Interval To Update HOT Traffic Measurements (In Seconds)	300
Maximum Number of Data Points	3
Time Smoothing Factor (0 = Max Data Points Avg; >0 = (Factor)*New + (1-factor)*Prev	0.50
Interval to Update HOT Toll Rates (in seconds)	300
Response to Toll Proportion (From 0 to 1)	0.2
Output Traffic Info to Aimsun Log (TRUE or FALSE)	FALSE
Output Toll Info to Aimsun Log (TRUE or FALSE)	TRUE
Output Routing Info to Aimsun Log (TRUE or FALSE)	FALSE
Output Traffic Info to Files (TRUE or FALSE)	TRUE
Output Toll Info to Files (TRUE or FALSE)	TRUE
Output Routing Info to Files (TRUE or FALSE)	TRUE

Figure 4-11: HOT Simulation Setting File

4.7.6. TOLL SEGMENT BENEFITS ASSESSMENT PARAMETERS

This section provides a few examples of application results of the implemented HOT Module within Aimsun using the I-210 Pasadena model:

- Figure 4-12 illustrates a situation in which the calculated toll rate during the AM peak periods reaches \$1.80/mile at around 7:00 AM and remains high during the remainder of the simulation, up to 11:00 AM, due to high traffic densities.
- Figure 4-13 illustrates a situation in which the calculated toll rate reaches the \$2.00/mile maximum at 8:30 before gradually dropping back to the \$0.35/mi minimum slightly after 9:30 AM as the traffic density quickly drops below the 35 vehicles/mile threshold, and subsequently to \$0.10/mile at 10:00 AM as the density remains below the target.
- Figure 4-14 illustrates a situation in which small tolls are implemented between 7:10 AM and 11 AM as the traffic density keeps oscillating at values slightly above the target density.
- Figure 4-15 illustrates a situation in which the density never exceeds the target density, resulting in the implementation of minimum toll rates throughout the entire simulation period.

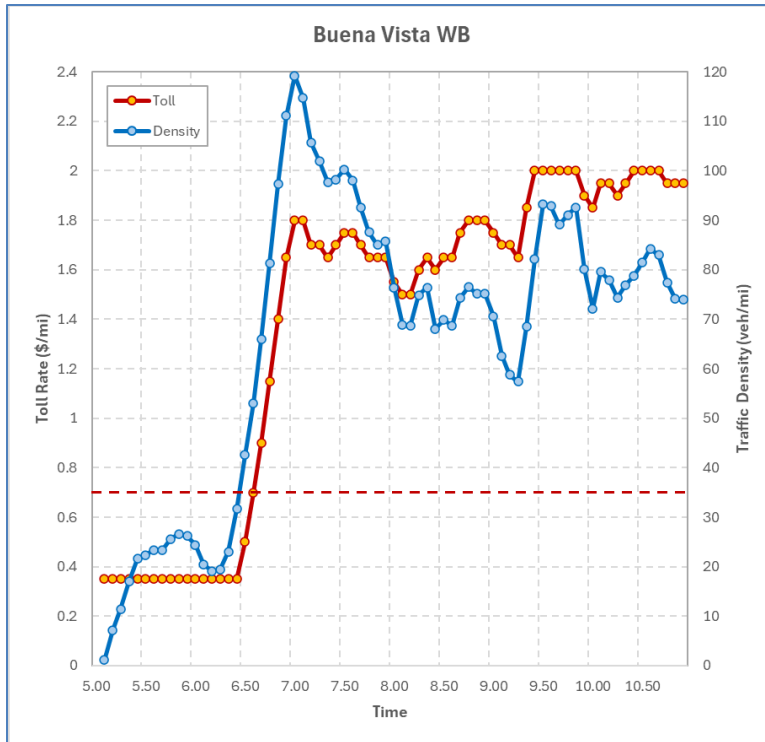


Figure 4-12: Simulated Toll Rate Example 1

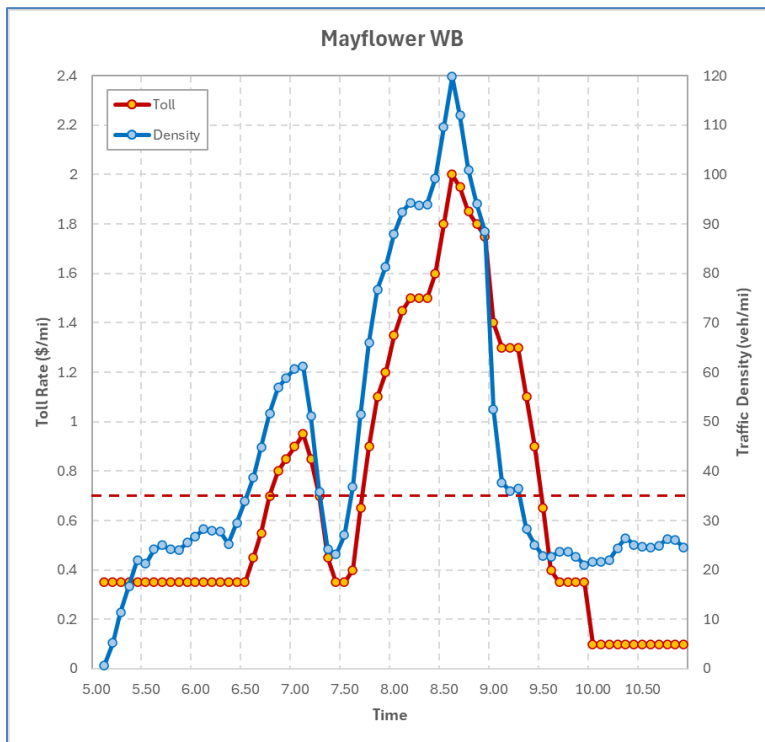


Figure 4-13: Simulated Toll Rate Example 2

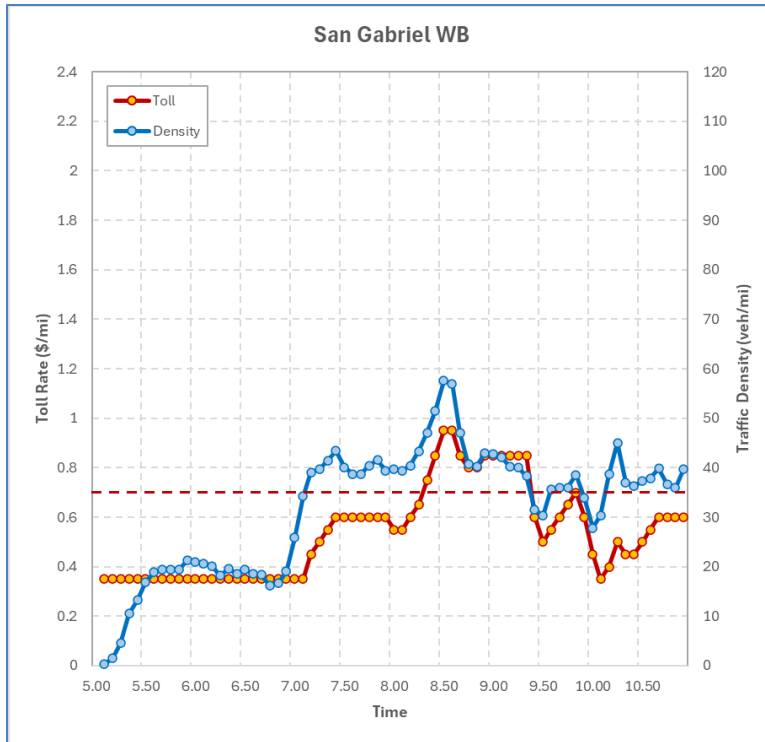


Figure 4-14: Simulated Toll Rate Example 3

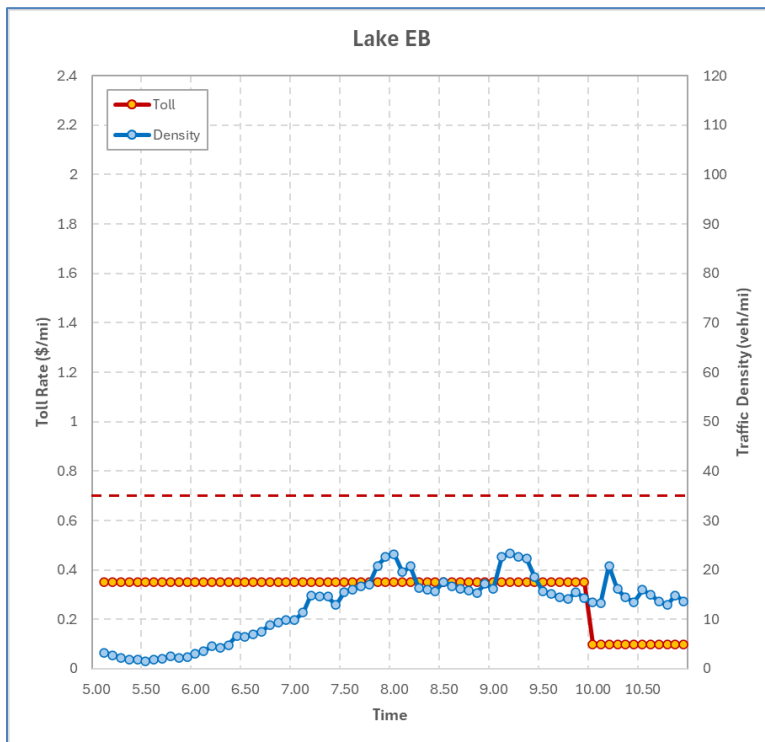


Figure 4-15: Simulated Toll Rate Example 4

5. EVALUATION SCENARIOS

Evaluation scenarios considered for this project include both supply-side and demand-side scenarios, as defined below:

- **Base Scenario:** Scenario representing average weekday traffic conditions along the I-210 corridor in the fall of 2019.
- **Supply-side scenarios:** Scenarios that do not make changes to the estimated travel demand across the I-210 Pasadena corridor. These scenarios assume that traffic volumes remain constant with no change in the proportions of various vehicle types. These scenarios are considered to explore what impacts existing demand changes in HOV eligibility or network geometry could have on corridor performance.
- **Demand-side scenarios:** Scenarios implementing changes in traffic demands, such as a change in the proportion of HOV2, HOV3, and HOV4 vehicles, or changes in overall traffic volumes. These scenarios are considered to assess how corridor performance might be affected by changes in traffic.

5.1. BASE SCENARIO

The base scenario represents average weekday traffic conditions along the I-210 corridor in the fall of 2019. This is the situation for which the I-210 Model has been extensively calibrated over the past few years. Elements of the base scenarios have been described in Section 3.

5.2. SUPPLY-SIDE SCENARIOS

Table 5-1 lists the supply-side scenarios considered. These include:

- **Base scenario:** Scenario simulating the existing one-lane HOV2+ facility.
- **Alternate HOV eligibility:** Scenarios changing access eligibility from the current HOV2+ policy to HOV3+, with and without concurrent access by vehicles with clean-air decals.
- **HOV conversion into HOT:** Scenario converting the current one-lane HOV facility between the SR-134 and I-605 interchanges into a dynamic tolling facility, maintaining free access for HOV vehicles but allowing access to single-occupancy vehicles (SOVs) willing to pay a toll based on traffic conditions on the lane. Existing HOV lanes on SR-134 at the western end of the study area and along I-210 east of the I-605 freeway are not converted to keep constant edge effects.
- **HOT facility with added lane:** Scenarios adding a lane to the HOT facility, either as an additional lane or a lane taken away from the general-purpose traffic.

Within the above list, scenarios restricting access to the HOV or HOT facility to only vehicles having four or more persons (HOV4+) are not considered since these vehicles represent less than 0.2% of the overall traffic.

Table 5-1: Supply-Side Scenarios

Scenario Group	Specific Scenario
Base Scenario	• HOV2+ Access
Alternate HOV Eligibility	• HOV2+ Access / No Decals • HOV3+ Access • HOV3+ Access / No Decals
HOV Conversion into HOT	• HOT2+ Facility with full toll for single-occupancy vehicles
HOT Facility with Added Lane	• HOT2+ Facility with Additional Lane • HOT2+ Facility with Additional Lane Taken from General-Purpose Lanes

The two scenarios considering lane additions on the high-occupancy portion of the freeway focus on the section of I-210 extending from the SR-134 to the I-605 freeways. This is to allow boundary conditions to remain constant. The first scenario will simply add an extra lane to the existing high-occupancy facility, without any regard for physical constraints. The second scenario will also add a lane to the high-occupancy facility, but will consider taking the space for the extra lane from the general-purpose lanes.

Table 5-2: Driver Behavior Parameters

Scenario Group	Specific Scenario
Proportion of single-occupancy vehicles responding to the toll	• 0% • 10% • 20% • 35% • 50%
Value of time	• \$35/hour mean; \$5 standard deviation

For the HOT scenarios, an important parameter for the simulations is the proportion of SOVs responding to tolls, i.e., vehicles considering paying a toll if the benefits outweigh the costs. Table 5-2 indicates the proportions considered for each of the relevant scenarios. As indicated, this proportion varies between 0%, where only HOV vehicles use the HOT lane, and 50%, where half of the simulated traffic would consider paying a toll.

For the proportion of vehicles responding to the toll, a 20% value can be assumed to be typical. Such a value appears to be in line with observations from existing express lane systems. For instance, data from the I-680 and I-880 freeways in the San Francisco Bay Area [Bay Area Express Lanes, 2024] indicates that between 44% and 47% of express lane users in early 2024 were SOVs. Considering that both freeways have three or four general-purpose lanes, it can then be estimated that between 10% and 15% of SOVs on both freeways are willing to pay tolls if it is assumed that all general-purpose traffic is comprised of SOVs. Since not all traffic on the general-purpose lane is made up of SOVs, the actual proportion of vehicles willing to pay toll is likely slightly higher.

For the value of time, \$35 per hour is used as a default. This is based on the median salary for Los Angeles County in 2024. Within each simulation, motorists are not all assigned the same value, but a specific value sampled from a normal distribution with \$35 taken as the average and a \$5 standard deviation. Figure 5-1 illustrates the resulting distribution. As illustrated, the actual value of time assigned to individual travelers can vary between \$20 and \$50, with about 75% falling between \$30 and \$40. An exploration of impacts with alternate values is considered in the demand-based scenarios, with simulations considering mean values of up to \$65, with similar relative standard deviations.

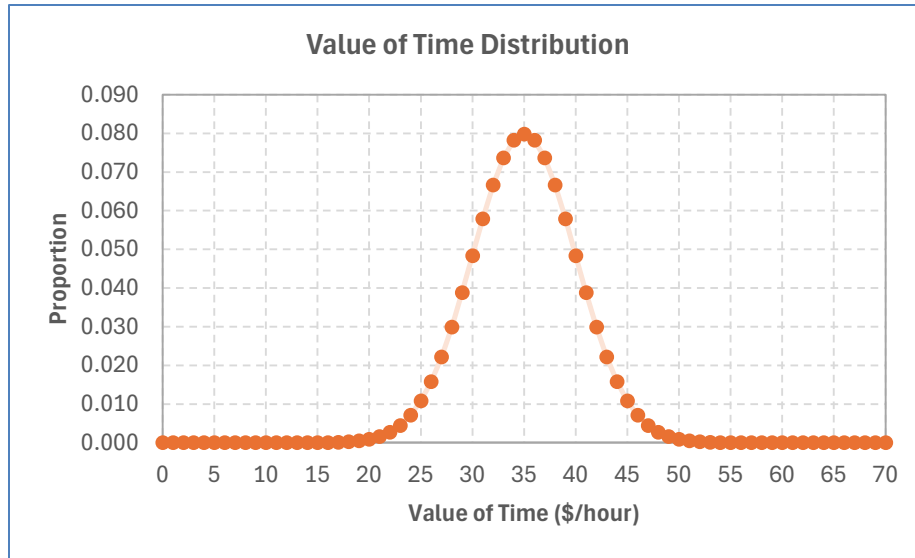


Figure 5-1: Default Distribution of Travel Time Values

5.3. DEMAND-BASED SCENARIOS

Table 5-3 lists the demand-side scenarios considered. These include:

- Increases in the proportion of HOV3 vehicles within the existing overall traffic demand and an HOV3+ access eligibility policy from a shift from single-occupancy and HOV2 vehicles.
- Increases in the overall traffic demand under current HOV2+ eligibility.
- Change in the average value of time used by HOT-responsive single-occupancy vehicles to determine the benefits of paying tolls to save time.

Table 5-3: Demand-Side Scenarios

Demand Category	Network Geometry	Demand Scenarios
Shift toward high-occupancy vehicles (shift from SOVs to HOV2, HOV3, and HOV4+)	Existing 1-lane HOV facility with HOV3+ eligibility	• 2.5% • 5.0% • 7.5% • 10.0% • 12.5% • 15.0%
Increase in overall traffic demand	Existing 1-lane HOV facility with HOV2+ eligibility	• 0% • 5% • 10% • 15%
Change in the value of time	1-lane HOT2+ Facility (simple conversion of existing HOV facility)	• \$15 • \$25 • \$35 • \$50 • \$65

5.4. EVALUATION PERIODS

For all the above scenarios, efforts will be made to evaluate corridor operations for the following three weekday periods:

- AM Peak: 5:00 AM - 11:00 AM
- Midday: 11:00 AM - 2:00 PM
- PM Peak: 3:00 PM - 7:00 PM

5.5. CONSIDERATION OF SIMULATION STOCHASTICITY

For each of the evaluation periods considered, network performance will be evaluated based on the average results of five simulation runs. While more than five runs might ideally be required to reduce the risk that differences between scenarios truly reflect changes in traffic conditions, a higher number of runs was not considered due to the significant time required to conduct all desired evaluations, as individual simulations could take several hours.

5.6. EVALUATION METRICS

The focus of the evaluations is to assess the impacts of changes in HOV/HOT eligibility on both facility and corridor performance. This means not only assessing how the changes affect the operation of the high-occupancy facility considered, but also the impacts on the adjacent general-purpose lanes and overall transportation corridor operations. In addition, the focus is not only on looking at the impacts on traffic volume and speed but also on the impacts on vehicle miles traveled (VMT) and vehicle hours of travel (VHT).

Based on the above considerations, the following metrics are proposed to be compiled:

- Vehicle-based statistics:
 - Vehicle-miles traveled (VMT)
 - Vehicle-hours traveled (VHT)
 - Average travel speed, expressed by VMT/VHT
 - Average travel time
 - Average delay
 - Volume
- Person-based statistics:
 - Person-miles traveled (PMT)
 - Person-hours traveled (PHT)
 - Average travel speed, expressed by PMT/PHT
 - Average travel time
 - Average delay
 - Volume

Each of the above metrics is further compiled for each of the following geometrical elements:

- Core I-210 freeway section, from SR-134 to I-605
 - Directional-specific statistics (eastbound, westbound)

- HOV/HOT lanes
 - General-purpose lanes
 - Freeway (HOV/HOT lanes and general-purpose lanes)
 - Aggregate statistics for both directions
 - HOV/HOT lanes
 - General-purpose lanes
 - Freeway (HOV/HOT lanes and general-purpose lanes)
- Entire corridor
 - All modeled freeways (general purpose and HOV/HOT lanes along modeled I-210, I-605, SR-134, and I-110 sections)
 - Off-freeway segments (arterials, streets)
 - All network segments

6. SUPPLY-SIDE SCENARIO RESULTS

This section presents the results of the simulations conducted for the following scenarios:

- Base scenario
- Change in HOV eligibility.
- Conversion of the existing HOV2+ lane into a HOT2+ facility with dynamic tolling
- Conversion of the existing HOV2+ lane into a 2-lane HOT2+ facility, where the additional lane is a new lane.
- Conversion of the existing HOV2+ lane into a 2-lane HOT2+ facility, where the additional lane is taken from the general-purpose lane

Simulation results are presented in this section and in Appendix B. The review of results is conducted with the general objectives of assessing the specific impacts on the HOV/HOT facility and general-purpose freeway lanes, freeway and off-freeway network components, and the overall corridor. The focus is on assessing impacts on travel times and VMT.

All the simulation results are for a setup that does not include any increase in traffic demand, such as from induced travel demand effects linked to an increase in roadway capacity or reduced travel times. This is due to the complexity of implementing dynamic traffic demand changes within the developed Aimsun model. However, it should be noted that potential effects from induced demand are indirectly considered in the supply-side scenarios reported in Section 7 through scenarios examining system performance under various increases in traffic demand and changes in vehicle occupancy.

6.1. BASE SCENARIO PERFORMANCE

Figure 6-1, Figure 6-2, and Figure 6-3 illustrate simulated traffic densities at the midpoint within the AM peak period (8:00 AM), midday period (1 PM), and PM peak period (5:00 PM) for the base scenario simulating the existing one-lane HOV2+ facility. Densities are shown with a color gradient ranging from green for unimpeded flow to dark red for heavy congestion. Figure 6-4, Figure 6-5, and Figure 6-6 further illustrate, for each period, the simulated average speeds and travel times for each direction along both the freeway mainline and HOV facility. These statistics are for vehicles fully traveling between the two large triangles illustrated in Figure 6-1, Figure 6-2, and Figure 6-3 along the I-210 freeway. Some data points are missing at the beginning of each diagram because statistics are recorded only for vehicles that have completed travel from one point to another, which can take up to 30 minutes during congestion. Figure 6-7, finally, presents a more detailed look at the simulated speeds between HOV gates.

Based on the illustrated information, the following observations can be made:

- Heavy congestion exists along the freeway mainline for the westbound AM peak and eastbound PM peak, with average speeds dropping to or below 20 mph. This corresponds to the main commute directions. In both cases, congestion also exists in the opposite direction, but to a somewhat lesser extent. For the eastbound AM peak, mainline speeds drop below 40 mph for about a two-hour interval. For the PM peak westbound, speeds hover slightly above 30 mph for most of the simulated period. Some congestion is also observed at the beginning of the midday period, but this is primarily a remnant of the AM peak congestion.

- Traffic conditions along the HOV facility exhibit significant degradation for both main commute directions. For the westbound AM peak, average speeds drop below 45 mph between 7:45 and 9:45. For the westbound PM peak, average speeds remain below 30 mph for most of the simulation period, mainly due to a bottleneck created by the merging of I-210 and I-605 traffic east of the study corridor. Some westbound congestion is also observed during the PM peak due to frictions associated with the I-210 Extension/SR-134 split, with average speeds dropping to around 45 mph between 5:30 and 6:30 PM.
- Travel times along the HOV facility generally remain below mainline travel times. This indicates a background incentive to use the high-occupancy facility. The only exception is for the westbound PM peak, where simulated travel times are about the same or slightly above due to the congestion around the I-210/I-605 interchange

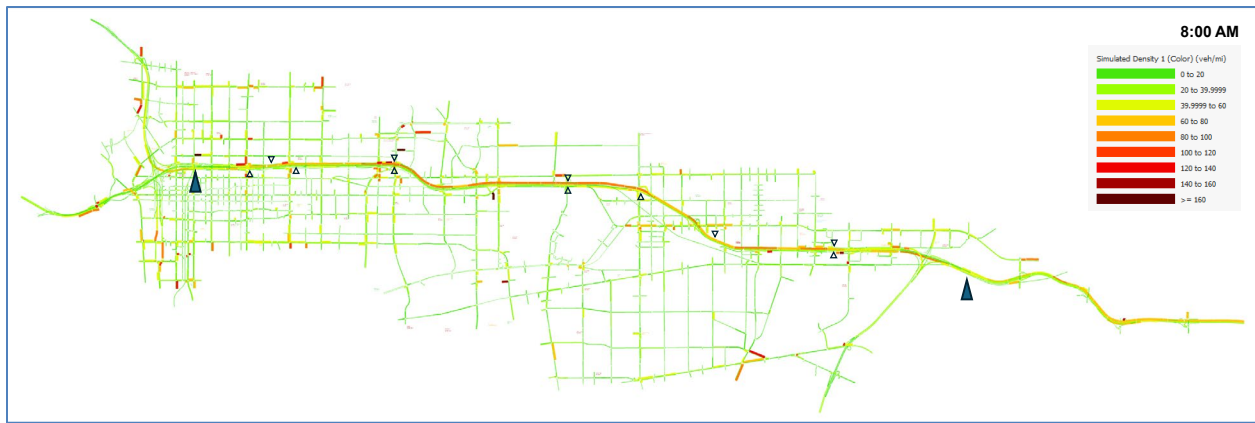


Figure 6-1: Base Scenario Mid-Simulation Traffic Densities – AM Peak



Figure 6-2: Base Scenario Mid-Simulation Traffic Densities – Midday



Figure 6-3: Base Scenario Mid-Simulation Traffic Densities – PM Peak

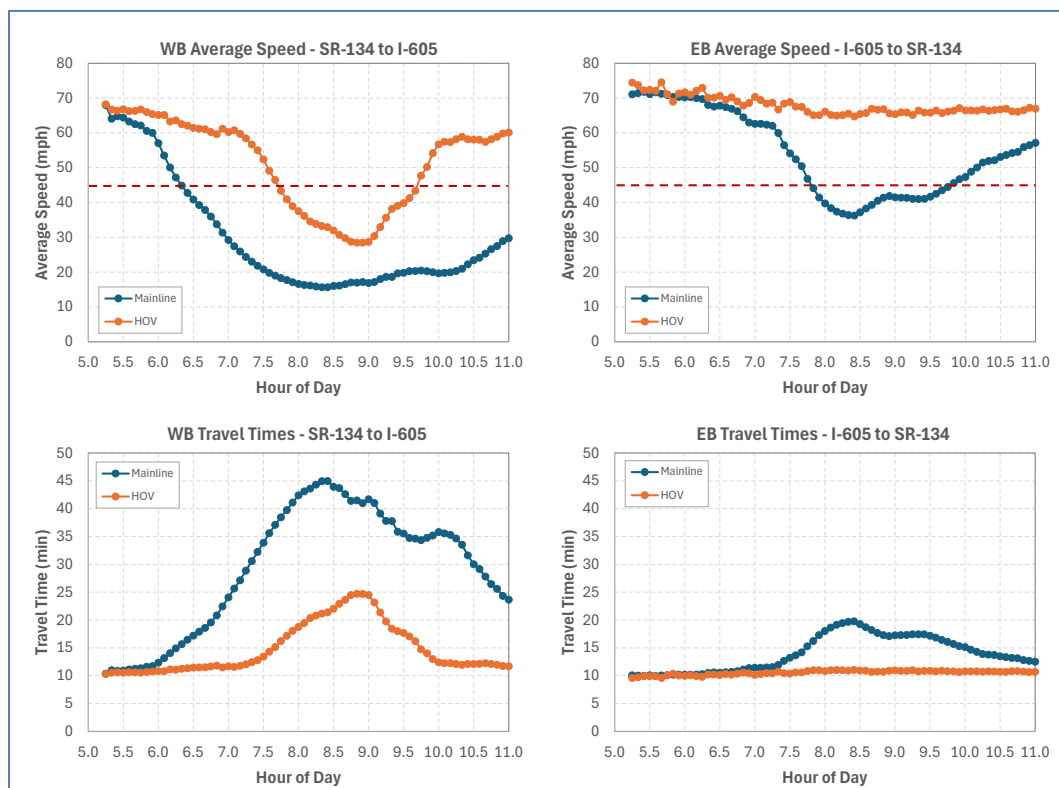


Figure 6-4: Base Scenario Performance – AM Peak

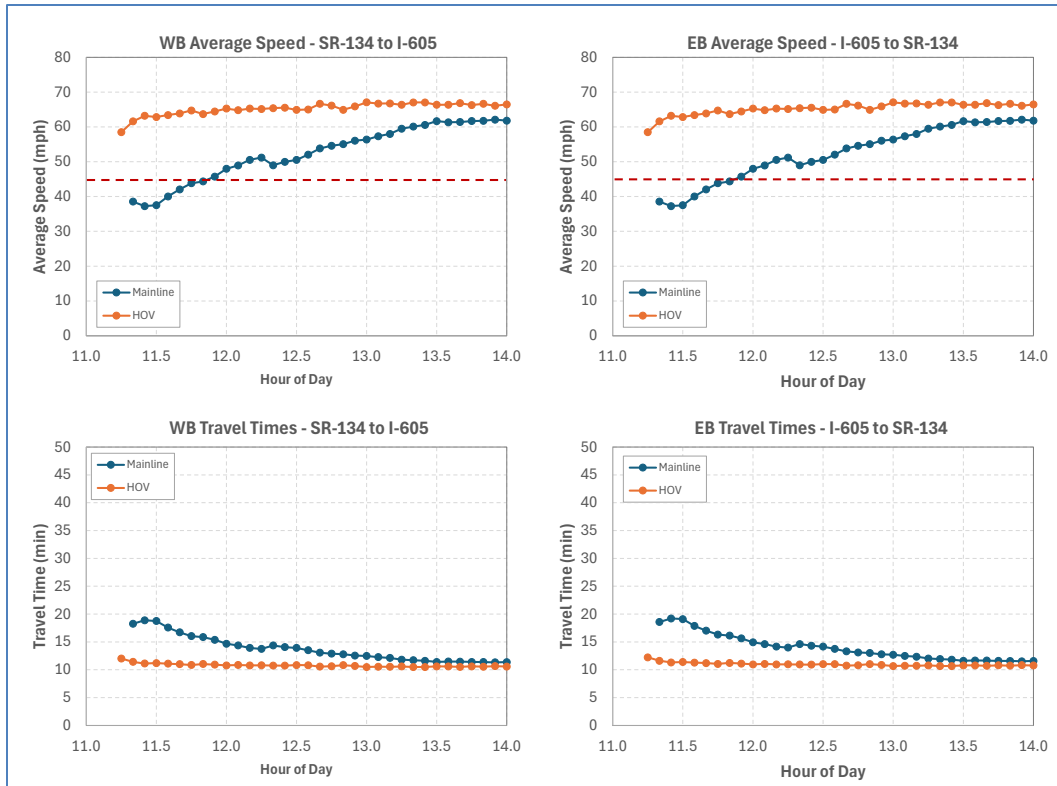


Figure 6-5: Base Scenario Performance – Midday

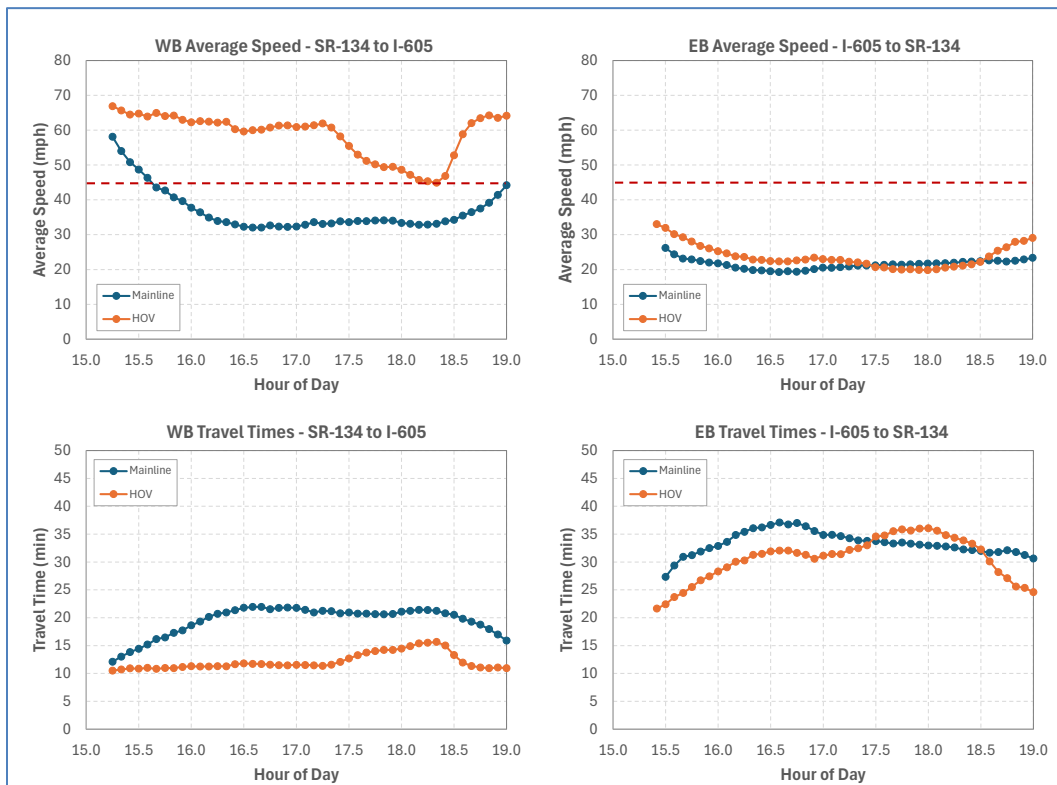


Figure 6-6: Base Scenario Performance – PM Peak

	I-210 HOV - EB												I-210 HOV - WB												I-210 HOV - EB												I-210 HOV - WB													
	Fair Oaks - Hill Lake - Hill Hill - San Gabriel San Gabriel - Bullhead Bullhead - Santa Anita Santa Anita - Buena Vista Buena Vista - San Gabriel River						Lakes - Buena Vista Buena Vista - Myrtle Myrtle - Bullhead Bullhead - San Gabriel San Gabriel - Lake Lake - I-210 Debris						Fair Oaks - Lake Lake - Hill Hill - San Gabriel San Gabriel - Bullhead Bullhead - Santa Anita Santa Anita - Buena Vista Buena Vista - San Gabriel River						Lakes - Buena Vista Buena Vista - Myrtle Myrtle - Bullhead Bullhead - San Gabriel San Gabriel - Lake Lake - I-210 Debris						Fair Oaks - Lake Lake - Hill Hill - San Gabriel San Gabriel - Bullhead Bullhead - Santa Anita Santa Anita - Buena Vista Buena Vista - San Gabriel River						Lakes - Buena Vista Buena Vista - Myrtle Myrtle - Bullhead Bullhead - San Gabriel San Gabriel - Lake Lake - I-210 Debris																			
5:05AM	74.0	72.7	72.7	72.5	72.5	68.9	69.4	67.8	67.3	65.4	68.6	72.1	11:05AM	69.5	70.5	68.0	67.8	65.1	68.7	65.2	65.8	62.3	56.6	45.7	59.4	70.8	3:05PM	64.9	57.1	59.0	63.6	49.0	70.5	64.6	65.1	66.2	60.4	72.9	68.2	67.1	66.2	65.4	61.1	69.7	68.3	66.3	66.4	66.4	59.9	71.0
5:10AM	75.0	74.7	72.5	72.9	71.9	73.6	74.6	67.7	66.1	67.8	67.4	67.7	68.9	11:10AM	68.5	68.1	66.9	66.3	60.8	69.9	66.0	67.2	63.3	49.5	54.2	60.0	71.5	3:10PM	57.5	59.2	62.4	63.3	54.1	36.9	37.7	68.2	67.1	66.2	65.4	61.1	69.7	68.3	66.3	66.4	66.4	59.9	71.0			
5:15AM	74.3	74.9	74.6	74.3	73.4	72.3	72.4	67.0	65.6	65.6	66.1	69.3	71.0	11:15AM	68.5	68.6	67.4	66.6	62.1	69.2	64.9	66.6	64.7	56.7	60.6	56.4	69.6	3:15PM	57.4	57.2	61.8	64.6	52.2	38.1	39.5	68.3	66.3	66.4	66.4	66.4	59.9	71.0								
5:20AM	72.8	74.3	73.6	72.7	73.1	73.4	72.9	67.6	65.7	65.1	66.0	67.3	71.3	11:20AM	69.6	68.8	68.0	66.9	62.6	66.3	63.8	66.2	64.2	60.4	61.5	54.4	71.0	3:20PM	59.9	58.8	63.3	62.6	46.0	24.96	16.2	68.6	65.8	65.4	66.0	55.6	71.1									
5:25AM	74.0	73.7	71.5	72.1	73.1	72.0	71.5	66.8	66.0	65.3	65.3	67.5	71.1	11:25AM	69.3	69.5	67.5	67.1	63.3	67.5	63.6	66.8	64.8	63.0	61.3	56.5	71.2	3:25PM	60.5	56.8	61.1	54.9	52.2	24.32	15.9	67.8	65.0	65.3	65.5	53.2	70.7									
5:30AM	74.0	74.7	73.9	73.7	72.4	73.1	72.5	67.1	65.5	64.7	65.8	67.9	71.3	11:30AM	69.4	68.8	67.1	66.7	63.8	66.9	64.4	67.8	65.5	65.3	57.5	56.4	70.9	3:30PM	61.0	60.1	61.1	47.7	54.8	23.58	14.7	68.3	65.4	64.9	64.3	54.7	70.9									
5:35AM	72.1	73.3	72.2	72.1	72.0	72.5	71.8	67.8	65.6	65.1	65.6	66.7	70.6	11:35AM	69.6	68.6	67.7	67.8	64.1	66.7	64.4	67.5	65.9	65.1	62.8	56.3	71.0	3:35PM	57.6	59.6	62.6	47.4	47.3	22.96	13.8	67.3	64.4	65.4	65.2	52.2	71.4									
5:40AM	72.2	73.1	71.5	71.1	71.7	72.3	72.8	67.3	65.8	65.2	65.6	66.4	71.2	11:40AM	69.2	69.0	66.8	67.1	64.2	67.2	64.7	66.0	64.4	65.6	63.8	54.5	71.4	3:40PM	56.7	53.5	61.6	44.0	47.6	21.22	12.7	67.8	64.7	64.3	65.3	54.5	71.5									
5:45AM	76.3	73.7	71.2	70.7	70.2	69.8	70.1	66.6	64.7	64.8	65.6	66.5	71.8	11:45AM	69.4	69.2	67.4	66.7	63.2	66.6	64.7	66.2	65.0	64.9	63.6	56.8	71.4	3:45PM	58.5	54.9	59.6	38.8	50.0	19.82	12.0	67.5	64.9	65.7	64.5	54.5	70.9									
5:50AM	71.9	72.9	72.4	70.7	70.4	70.1	69.8	65.3	63.7	64.3	64.8	65.7	70.9	11:50AM	69.4	68.8	67.0	66.4	64.1	67.0	64.0	67.5	65.6	66.0	64.2	55.3	70.4	3:50PM	56.8	56.8	60.7	35.3	49.8	18.03	11.8	67.2	64.6	64.4	62.5	54.3	71.1									
5:55AM	73.7	71.9	72.8	71.9	71.0	70.1	69.0	65.3	64.3	63.6	65.7	71.2	11:55AM	69.4	69.1	67.6	66.9	62.5	67.1	65.0	67.0	65.5	65.9	63.3	55.7	71.3	3:55PM	56.0	54.8	60.7	32.0	52.1	17.23	12.0	68.3	64.6	64.0	67.7	54.6	70.5										
6:00AM	73.4	72.8	71.4	70.6	71.3	71.0	71.1	63.0	59.5	64.4	64.8	65.2	71.0	12:00PM	69.3	68.1	67.3	67.0	65.0	66.4	65.8	67.8	65.1	65.1	64.8	57.2	71.0	4:00PM	55.6	53.1	61.1	29.9	53.7	16.98	12.1	67.4	64.6	65.1	67.0	53.7	71.1									
6:05AM	72.7	73.5	72.3	70.6	71.0	71.3	70.6	65.0	55.5	62.6	64.1	65.7	70.9	12:05PM	69.1	68.0	67.1	66.8	63.9	66.6	64.8	67.7	65.3	65.8	65.3	56.7	70.9	4:05PM	62.0	58.9	60.0	30.1	46.2	16.54	12.3	67.6	64.4	64.8	66.7	53.5	71.3									
6:10AM	72.1	72.4	71.5	70.8	71.8	71.4	70.8	64.4	55.3	64.0	64.2	65.1	71.1	12:10PM	69.3	68.7	66.7	66.8	63.4	66.4	65.3	67.8	65.4	64.9	65.6	57.3	70.7	4:10PM	60.9	60.3	59.8	29.1	42.0	16.29	12.2	66.4	64.1	64.7	65.3	54.5	71.3									
6:15AM	72.9	72.5	69.7	69.6	70.2	71.3	72.2	65.0	63.8	62.0	63.7	64.1	70.7	12:15PM	68.3	67.9	66.7	67.1	63.4	67.4	64.5	66.8	65.2	65.6	63.4	57.5	71.0	4:15PM	60.6	61.5	60.8	30.3	41.1	15.59	12.6	66.2	63.7	63.4	64.1	52.0	70.5									
6:20AM	72.9	73.3	71.0	70.4	68.6	69.9	69.8	64.0	54.3	60.3	63.2	63.2	71.0	12:20PM	67.7	67.9	67.0	66.8	62.1	67.2	65.2	67.0	64.5	65.5	65.6	56.8	70.0	4:20PM	50.2	56.5	59.9	31.6	40.4	15.2	12.4	66.0	63.3	59.6	58.4	54.4	71.3									
6:25AM	71.9	71.7	69.8	69.5	69.7	69.7	69.8	64.1	51.8	60.4	62.5	63.5	70.9	12:25PM	67.5	67.5	67.0	67.0	62.7	66.9	65.0	66.6	64.0	64.6	65.2	58.8	70.7	4:25PM	60.7	59.5	65.1	34.1	40.1	14.86	13.0	66.6	64.2	59.5	58.0	51.1	71.1									
6:30AM	72.4	71.8	70.5	69.1	68.0	69.4	69.7	62.2	53.9	59.9	62.9	61.5	70.6	12:30PM	67.9	67.4	66.0	66.5	60.6	66.7	64.7	67.7	65.3	64.9	65.1	58.8	70.9	4:30PM	62.7	59.4	56.1	37.0	36.2	14.85	13.4	66.2	63.2	63.4	65.4	50.0	71.2									
6:35AM	72.4	72.2	69.8	69.6	69.2	69.0	69.6	62.2	54.2	59.6	62.5	60.9	70.6	12:35PM	68.6	67.6	66.3	65.7	61.5	66.7	64.3	67.2	65.4	65.4	63.4	59.4	70.2	4:35PM	63.7	60.7	60.6	40.0	39.3	15.12	14.7	66.3	63.7	63.4	64.1	52.0	70.5									
6:40AM	71.9	71.2	69.2	68.3	68.4	69.9	69.7	61.2	51.5	58.3	62.9	60.8	70.7	12:40PM	67.7	67.5	65.9	65.5	60.0	67.5	64.5	66.4	65.3	64.6	66.3	61.6	70.8	4:40PM	60.2	58.5	63.2	38.5	30.6	15.37	13.7	66.0	63.8	63.5	65.0	52.5	71.4									
6:45AM	71.7	71.5	69.9	69.8	66.8	67.4	68.6	61.6	55.1	56.8	62.1	59.4	70.3	12:45PM	68.0	67.9	66.8	64.9	61.7	66.6	63.7	67.1	63.9	64.9	64.6	61.7	70.0	4:45PM	57.1	58.4	63.8	38.1	35.0	15.26	12.9	65.7	64.0	63.8	66.2	51.1	71.2									
6:50AM	72.0	72.3	70.1	69.8	67.6	68.2	68.9	59.9	56.4	59.7	61.7	58.5	70.9	12:50PM	68.5	67.5	66.8	63.5	61.5	66.8	64.5	67.7	65.7	65.0	64.6	59.8	70.3	4:50PM	58.1	56.9	61.2	40.4	34.3	14.93	13.2	65.8	64.1	64.7	65.3	54.5	71.3									
6:55AM	73.2	72.4	70.5	69.5	67.7	69.2	69.3	60.2	54.2	59.2	59.5	58.5	71.0	12:55PM	67.4	67.2	66.2	62.8	60.9	66.3	64.0	68.0	66.2	66.1	65.5	61.9	70.2	4:55PM	58.5	48.2	58.1	39.5	32.6	14.8	14.5	66.7	62.8	63.8	63.6	53.6	70.8									
7:00AM	73.1	72.8	69.4	69.3	67.6	69.1	69.1	57.7	54.0	61.3	57.8	60.1	70.8	1:00PM	67.8	67.1	66.3	63.1	61.7	66.9	64.8	67.9	66.0	66.2	66.1	64.8	70.7	5:00PM	58.0	49.4	58.2	37.6	32.3	15.03	13.7	66.0	64.3	65.1	65.1	53.6	70.4									
7:05AM	71.8	71.5	70.4	69.3	66.5	68.7	69.1	58.7	56.5	58.5	59.1	59.9	70.9	1:05PM	67.1	67.8	66.2	62.9	60.9	67.1	64.8	67.6	66.1	65.6	65.8	65.1	70.8	5:05PM	60.9	60.1	61.2	34.4	32.6	15.2	13.3	67.0	64.1	65.1	65.7	52.2	70.9									
7:10AM	69.6	70.0	68.7	68.8	66.1	69.1	69.1	60.8	54.7	53.8	57.8	59.2	71.7	1:10PM	66.8	65.7	66.2	63.2	60.9	66.7	64.3	67.2	65.6	65.2	65.5	66.2	70.0	5:10PM	60.4	60.8	63.8	32.8	34.9	14.7	12.9	66.4	64.8	65.1	67.4	50.0	72.2									
7:15AM	71.4	70.2	69.1	67.1	65.3	68.3	68.6	61.6	49.8	49.0	56.6	59.4	70.7	1:15PM	64.9	64.2	65.4	62.1	60.0	66.8	64.9	67.2	65.9	65.7	65.4	66.8	69.8	5:15PM	58.6	55.0	62.4	32.8	35.7	15.09	14.0	65.5	62.2	63.8	65.2	52.3	71.0									
7:20AM	70.1	69.9	67.5	68.3	66.2	68.3	66.8	58.8	43.5	46.5	50.0	56.2	70.8	1:20PM	64.9	64.5	65.8	61.6	59.0	66.8	65.8	67.9	66.7	66.2	66.8	67.6	71.4	5:20PM	55.2	54.3	60.9	38.0	31.6	14.97	12.7	65.8	62.1	61.9	61.1	52.3	70.9									
7:25AM	71.3	70.3	69.0	67.5	65.7	68.3	67.6	57.6	57.6	57.6	57.5	57.5	71.5	1:25PM	66.2	65.9	65.6	61.6	59.7	65.1	61.3	66.9	65.6	66.2	66.2	66.9	71.8	5:25PM	56.6	55.2	60.6	38.0	29.3	14.68	12.2	66.1	59.8	60.1	60.4	50.1	70.7									
7:30AM	70.4	69.4	67.6	67.1	64.0	67.7	67.6	55.5	54.3	38.5	50.3																																							

The following general observations can be made from the results provided:

- **Removing access to single-occupancy vehicles with a Clean Air decal (HOV2+ Only scenario):**
 - Removing access to Clean Air vehicles corresponds to removing about 6% of traffic on the lane.
 - Removing access to Clean Air vehicles provides noticeable impacts on HOV lane operations for the westbound AM peak and eastbound PM peak periods. This is largely due to the congested nature of traffic operations in the specific direction and period considered, as these are the main commute directions. During the AM peak, westbound travel times from the I-605 to SR134 interchanges are reduced by 1.6 minutes, or 13%, from 12.2 to 10.6 minutes. During the PM peak, eastbound travel times from SR-134 to I-605 are reduced by 4.9 minutes, or 21%, from 22.8 to 17.9 minutes (-21.5%).
 - Outside of the commute direction during peak periods, removing access to vehicles with clear-air decals only marginally reduces travel times on the HOV facility. This is due to the uncongested nature of traffic operations.
 - The impact of general-purpose lanes remains muted. Except for the PM peak, where general-purpose lane operations are shown to improve, travel times along general-purpose lanes remain either the same or only slightly increase and are likely within normal statistical variance. The counterintuitive reduction during the PM peak can be attributed to reduced friction at the HOV entry/exit gates, which reduces slowdowns occurring there.
 - Except for the PM peak, where a near 2-minute eastbound and near 1-minute westbound change in overall corridor travel times is observed, changes in overall corridor travel time remain around or below 30 seconds, a value that would be hardly noticed by travelers.
 - Corridor-wide VMT and VHT statistics remain relatively close to the base scenarios, with variations likely due to the simulation stochasticity.
- **Removing access to HOV2 vehicles (HOV3+ & Decals scenario):**
 - Removing access to Clean Air vehicles corresponds to removing about 86% of traffic on the lane.
 - Unsurprisingly, this scenario would provide significant improvements in travel times along the HOV facility, particularly in the commute travel direction during peak hours. Resulting travel times are relatively close to free-flow travel times, with delays mainly occurring near entry/exit gates.
 - However, as indicated by the bottom diagrams of Figure 6-11, Figure 6-12, and Figure 6-13, this scenario results in a high number of vehicles waiting to enter the network at the end of the AM and PM simulations. This indicates a situation where not enough capacity is provided on the freeway to fully allow the modeled demand to enter the network, resulting in network statistics not adequately representing the full extent of congestion generated by such a scenario.
- **Removing access to HOV2 and clean-air vehicles (HOV3+ scenario):**
 - Removing access to Clean Air vehicles corresponds to removing about 93% of traffic on the lane.
 - Similar to what was observed between the HOV2+ & Decals and HOV2+ Only scenarios, the relatively small change in traffic volume on the HOV facility compared with the

HOV3+ & Decals scenario results mainly in marginal changes in HOT facility and corridor operations.

- **Removing access to HOV2 and HOV3 vehicles (HOV4+ scenario):**
 - Retaining access to HOV4+ vehicles only was not considered, as this scenario would be akin to fully closing the HOV lane and would leave less than 1% of the base scenario traffic on the lane.

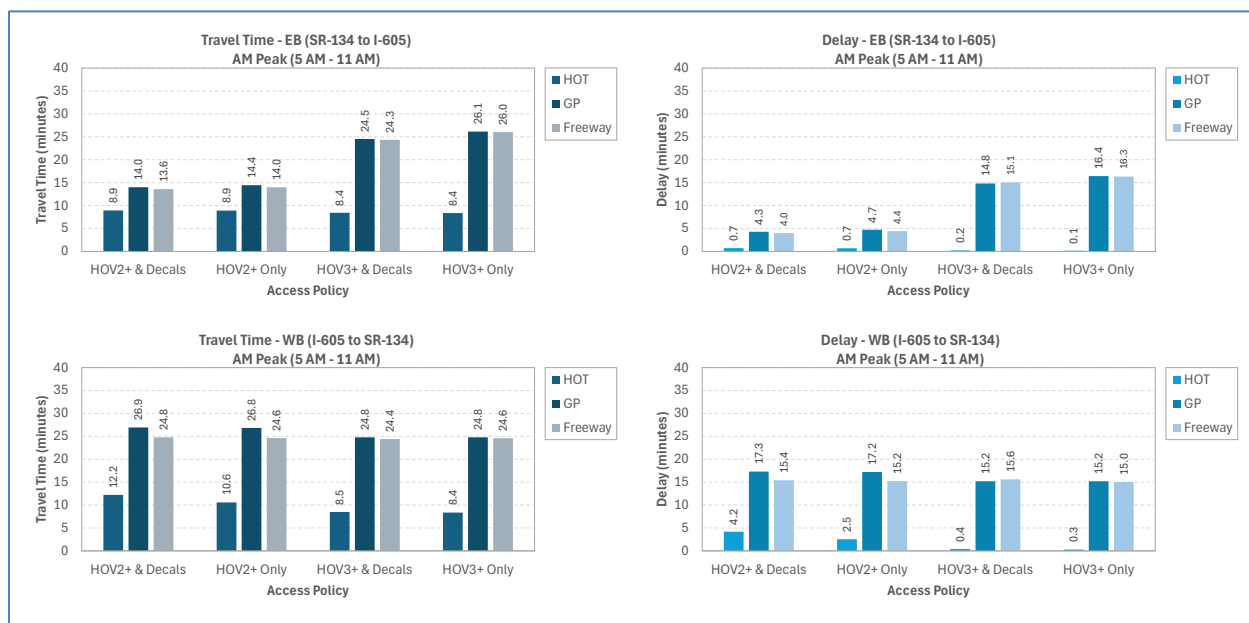


Figure 6-8: Travel Time and Delay along I-210, Change in HOV Eligibility, AM Peak

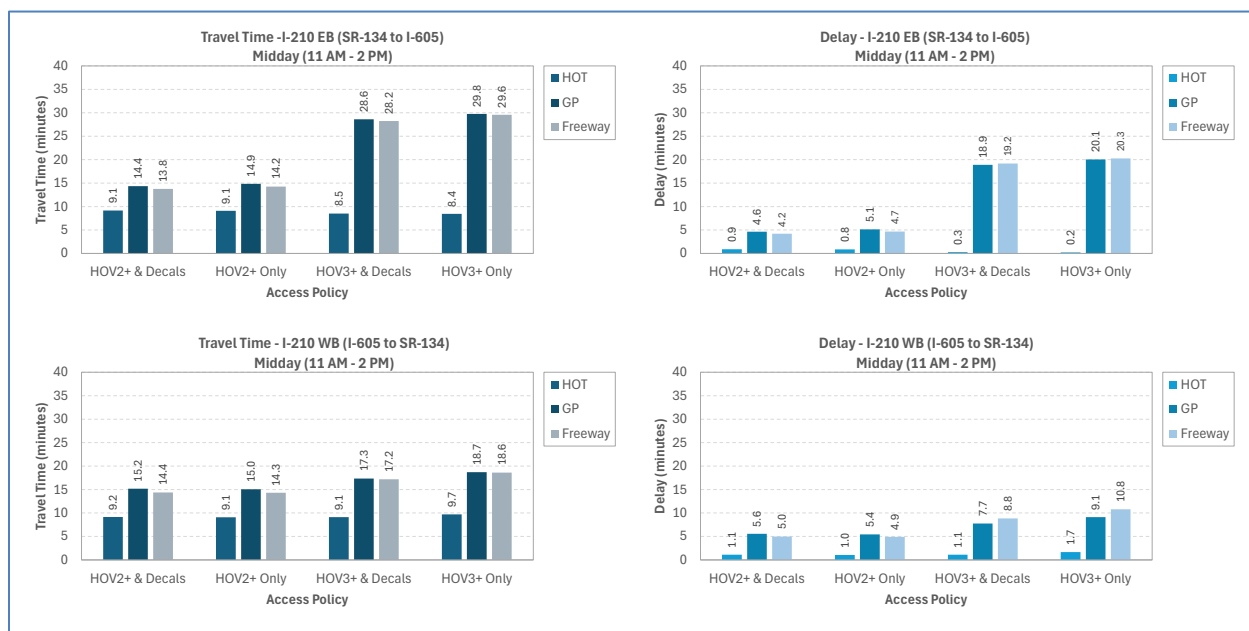


Figure 6-9: Travel Time and Delay along I-210, Change in HOV Eligibility, Midday

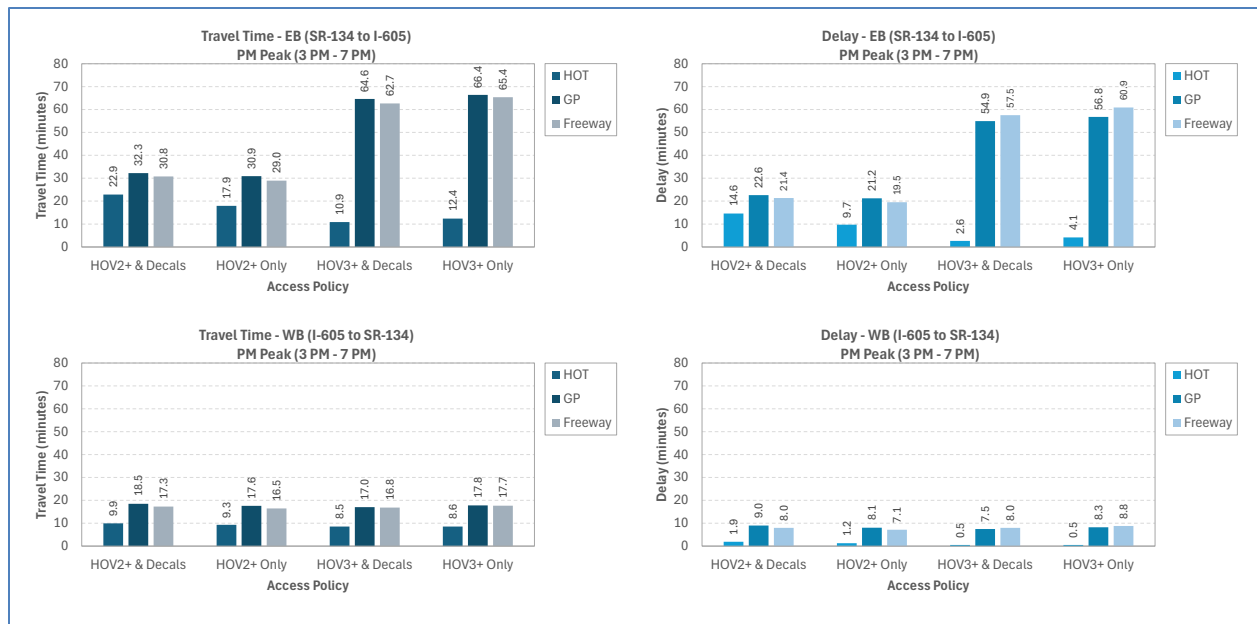


Figure 6-10: Travel Time and Delay along I-210, Change in HOV Eligibility, PM Peak

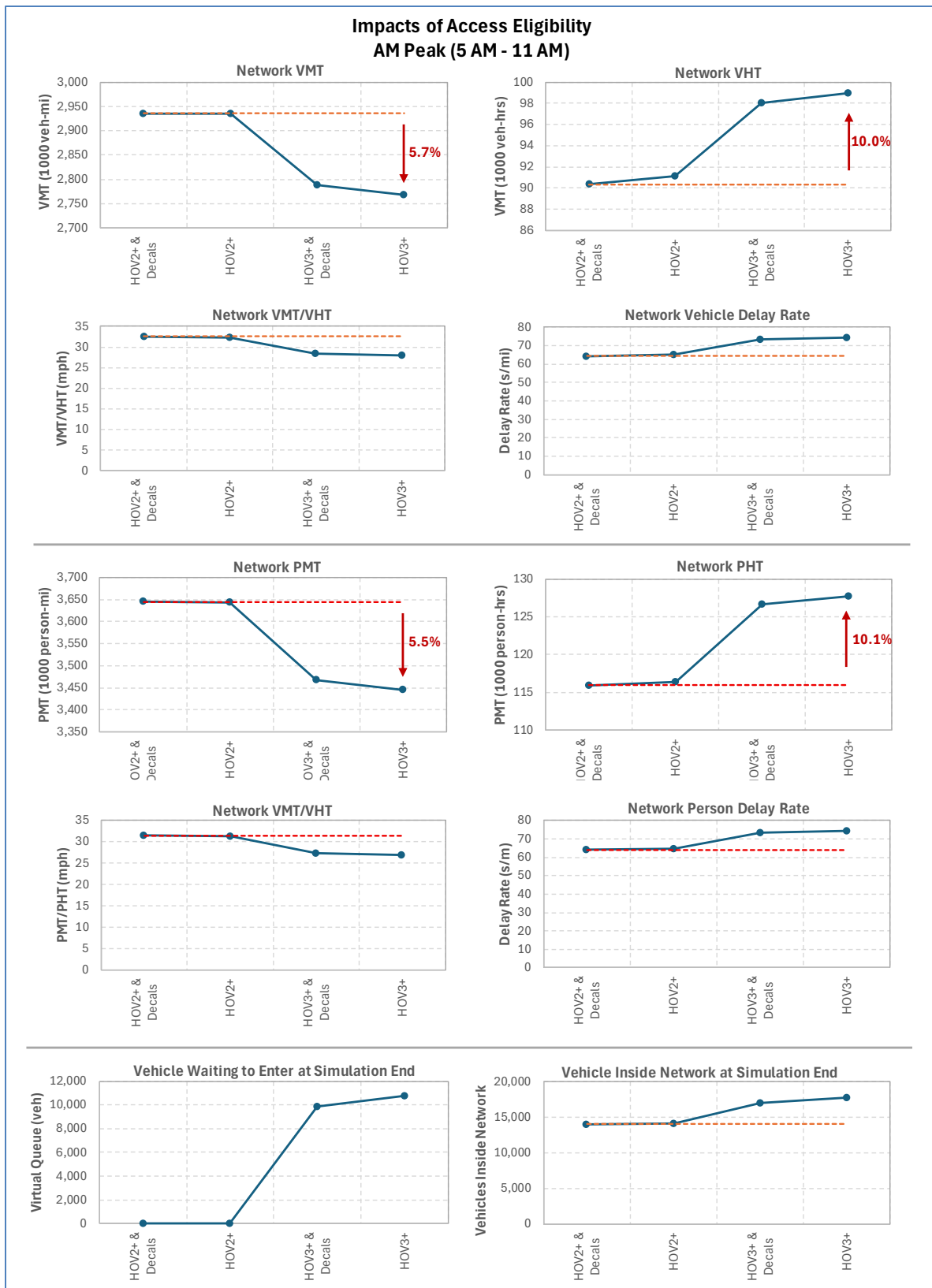


Figure 6-11: Network Performance Metrics, Change in HOV Eligibility, AM Peak

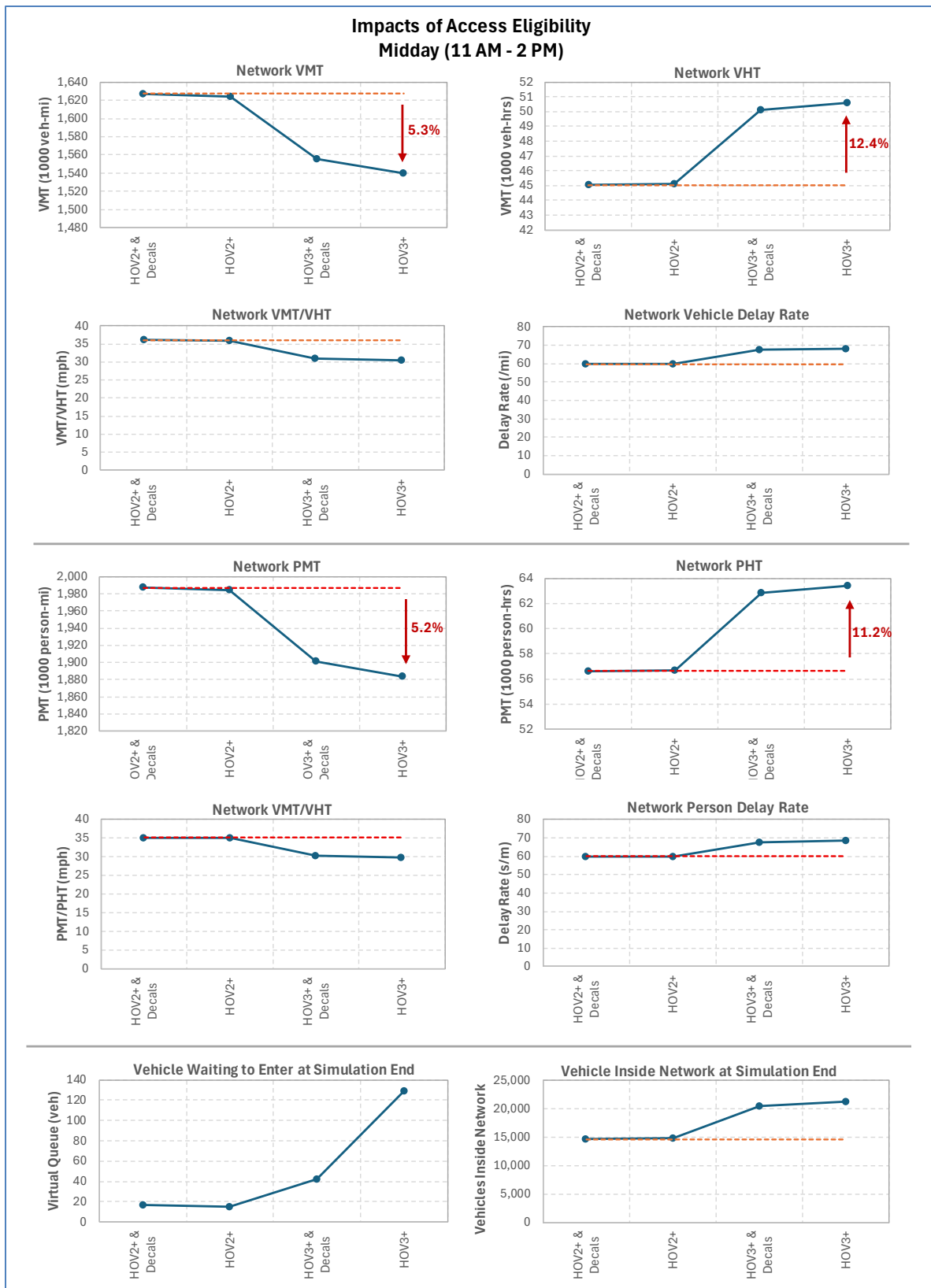


Figure 6-12: Network Performance Metrics, Change in HOV Eligibility, Midday

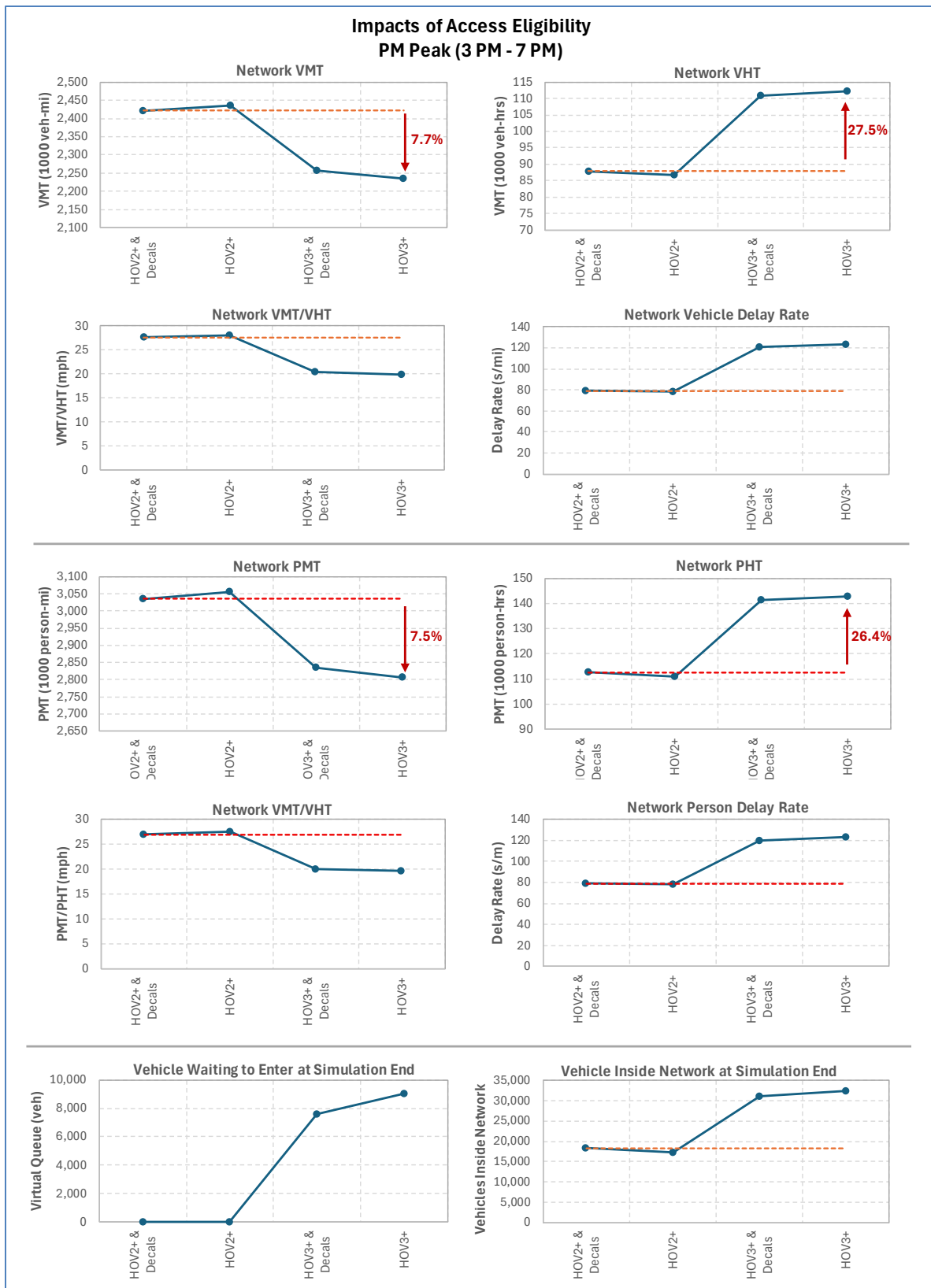


Figure 6-13: Network Performance Metrics, Change in HOV Eligibility, PM Peak

6.3. HOV2+ TO HOT2+ CONVERSION WITH DYNAMIC TOLLING

This scenario focuses on operational changes associated with converting the existing HOV lane into a HOT lane with dynamic tolling. Simulation results are presented for scenarios changing the proportion of single-occupancy vehicles (SOVs) responding to displayed tolls from 0% to 50%. The 0% configuration corresponds to the base HOV2+ & Decals situation, where no SOV considers taking the HOT facility, whether there is a benefit to them or not. A 50% proportion corresponds to a situation in which half of the freeway SOVs consider using the HOT lane. This does mean they all use the facility. It means that half of the SOVs would assess at each HOT gate if there is a benefit of doing so, and then switch from the mainline lanes to the HOT lanes only if there is a net benefit to doing so. The reverse decision could also occur, with SOVs returning to the mainline lanes if the cost of staying on the HOT lane is too high. Through all simulations, access is maintained for SOVs with Clean Air decal. Motorists are further assumed to have a mean value of time of \$35/hour, with a \$5 standard deviation, as described in Section 5.2. Impacts of a higher value of time are explored in Section 7.3.

Figure 6-14 to Figure 6-16 summarize the impacts on travel time and delays along each direction of travel for the HOV lanes, general-purpose lanes, and overall freeway over the AM peak (5-11 AM), midday (11 AM-2 PM), and PM peak (3-7 PM) for travel between the SR-134 and I-605 interchanges. Figure 6-17 to Figure 6-19 further presents directional VMT, VHT, and travel time statistics for the core HOT section (SR-134 to I-605), while Figure 6-20 to Figure 6-22 illustrate networkwide VMT, VHT, PMT, and PHT statistics, with end-of-simulation statistics about the number of vehicles in the network and waiting to enter it. More detailed results tables are provided in Appendix B2.

The following general observations can be made from the results provided:

- Expectedly, the primary effect of the HOV-to-HOT conversion is to increase traffic on the high-occupancy lanes, particularly when underused. This is evidenced in Figure 6-17 to Figure 6-19 by increases in VMT on HOT lanes as the proportion of vehicles responding to tolls increases. The only exceptions are for the westbound AM peak and eastbound PM peak directions, where the simulations show gradual reductions in VMT of up to 1.8% and 9.7%, respectively, as the proportion of vehicles responding to toll increases. This is largely due to increased congestion on the HOT lanes due to increased traffic. However, added congestion was also found to be due to added friction at the entry/exit gates as more vehicles try to access the HOT facility. In the base scenario, only HOV vehicles are allowed on the facility. In the alternate scenarios, the pool of vehicles is increased to include both HOV and HOT-type vehicles. While not all HOT-type vehicles would necessarily elect to enter the HOT facility, an increasing number of vehicles may do so with an increasing proportion of SOVs responding to tolls, resulting in a potential increase in traffic entering or exiting the HOT facility at gates. This causes increasing slowdowns around the gates. This tends to affect the HOT lanes more significantly than the mainline lanes, as there is only one traffic lane there. This prevents vehicles not exiting the facility from going around the slowing traffic. On the mainline, the regular traffic retains more possibility to go around slower traffic by staying on the slower lanes, resulting in less overall impact.
- Allowing more vehicles on the HOT facilities can significantly increase travel times in congested situations. For the peak commute directions, the AM peak westbound travel times increase from 12.2 minutes in the base HOV-only scenario to 17.7 minutes (+5.5 minutes) in the scenario with 50% SOVs considering tolls, while eastbound PM travel times increase from 22.5 to 35.8 minutes (+13.3 minutes). For the non-commute directions, changes remain at around 1 minute or less. During the midday period, when some congestion exists, eastbound and westbound

travel times are further observed to increase by up to 10.0 and 3.7 minutes. While these added travel times indicate increased congestion, they may be the result of toll rates being too permissive. Increasing the toll rate during periods of congestion would likely result in fewer vehicles using the HOT facility and in improved travel times.

- Travel times along the HOT lanes tend to proportionally increase with the fraction of vehicles responding to tolls, except when significant congestion develops on the HOT lanes. In the absence of congestion, both higher traffic densities and added friction at the entry/exit gates push the traffic to move more slowly. When severe congestion occurs, travel times tend to be dictated by the ability of vehicles to move through the gated areas at a crawl speed.
- Mainline travel times are generally lower in tolling scenarios than in the base HOV-only scenarios. In most cases, travel times are lowered by 1 or 2 minutes or less. The only exception is in the westbound AM peak direction, the main commute direction, where travel times are reduced from 26.9 minutes in the HOV-only scenario to 19.3 minutes (-7.6 minutes) in the scenario with 50% SOVs considering paying tolls. These reductions largely reflect the ensuing reduction in the number of vehicles using the mainline lanes.
- The differing impacts between the westbound AM peak and eastbound PM peak described above might in part be attributed to the directionality of traffic. During the AM peak, traffic mainly originates from outside the simulated area. This results in capacity issues being observed at the network boundaries, mainly in the form of vehicles unable to enter the network piling up in virtual queues. During the PM peak, most of the traffic originates from within the network. Capacity issues thus tend to be reflected within the modeled network in the form of longer physical queues or slower traffic speeds.
- Overall HOT facility performance depends on the proportion of vehicles responding to tolls. Travel times tend to increase with increasing proportions of SOVs responding to tolls. However, this increase is not necessarily proportional, as increased friction at the entry/exit gates and slower speeds on the HOT lanes due to higher traffic densities may result in fewer vehicles opting to use the lanes and in performance that reaches a plateau.
- Overall freeway gains can be achieved if the increase in HOT traffic does not cause significant friction to develop at the HOT entry/exit gates. For instance, average westbound travel times along I-210 from the I-605 and SR-134 interchanges are observed to drop from 24.8 to 19.1 minutes (-5.7 minutes) as the proportion of HOT vehicles increases. This is mainly due to a better use of unused capacity along the HOT lanes. However, during the PM peak, eastbound travel times from the SR134 and I-605 interchanges are observed to increase from 30.9 to 32.2 minutes (+1.3 minutes), mainly because of congestion occurring at the HOT entry/exit gates. A similar increase is observed during midday, with eastbound travel times increasing from 13.8 to 19.1 minutes (+5.3 minutes).
- Changes in the proportion of vehicles responding to tolls can have noticeable impacts on overall network performance.
- At the network level, simulated changes in VMT level are linked to congestion building up or reducing within the network. Because the same overall traffic demand is simulated for all cases, except for the proportion of SOVs responding to tolls, similar VMT levels should be obtained across all runs. However, increases or decreases are observed. While some of these differences could be attributed to vehicles taking longer detours or shorter routes, a significant portion is linked to the number of vehicles left in the network at the end of a simulation. More congestion

results in more internal queuing and fewer vehicles being able to complete their trip by the end of a simulation, thus reducing VMT. Inversely, less congestion results in more vehicles being able to go through and higher VMT.

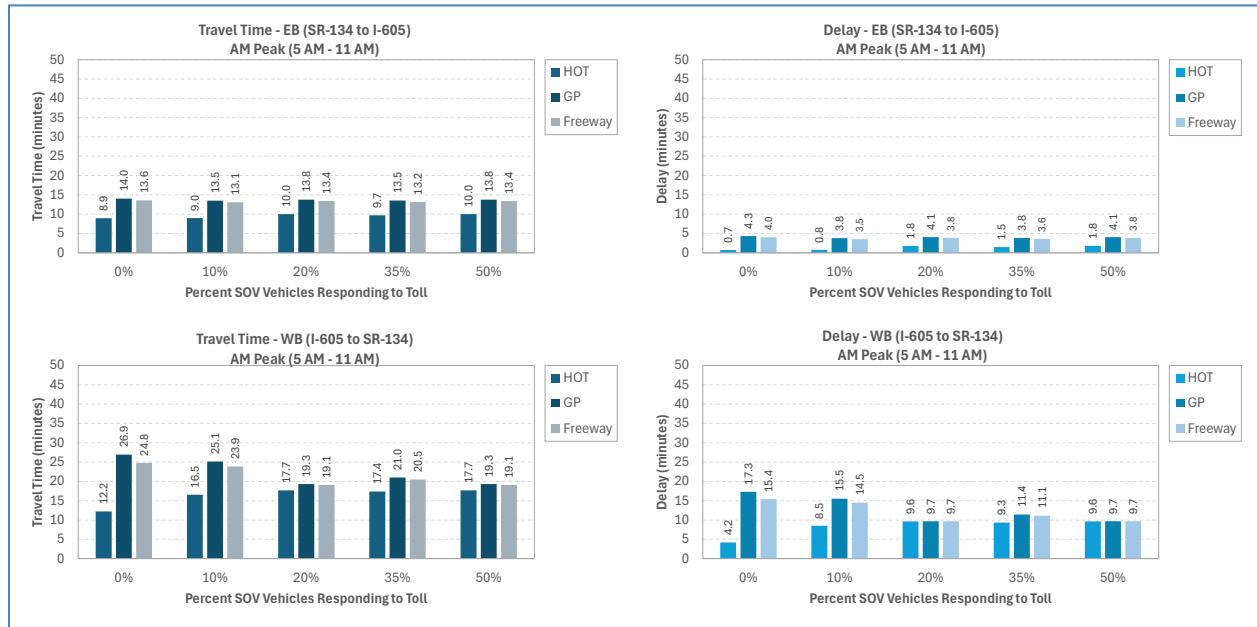


Figure 6-14: Travel Time and Delay along I-210, HOT Conversion, AM Peak

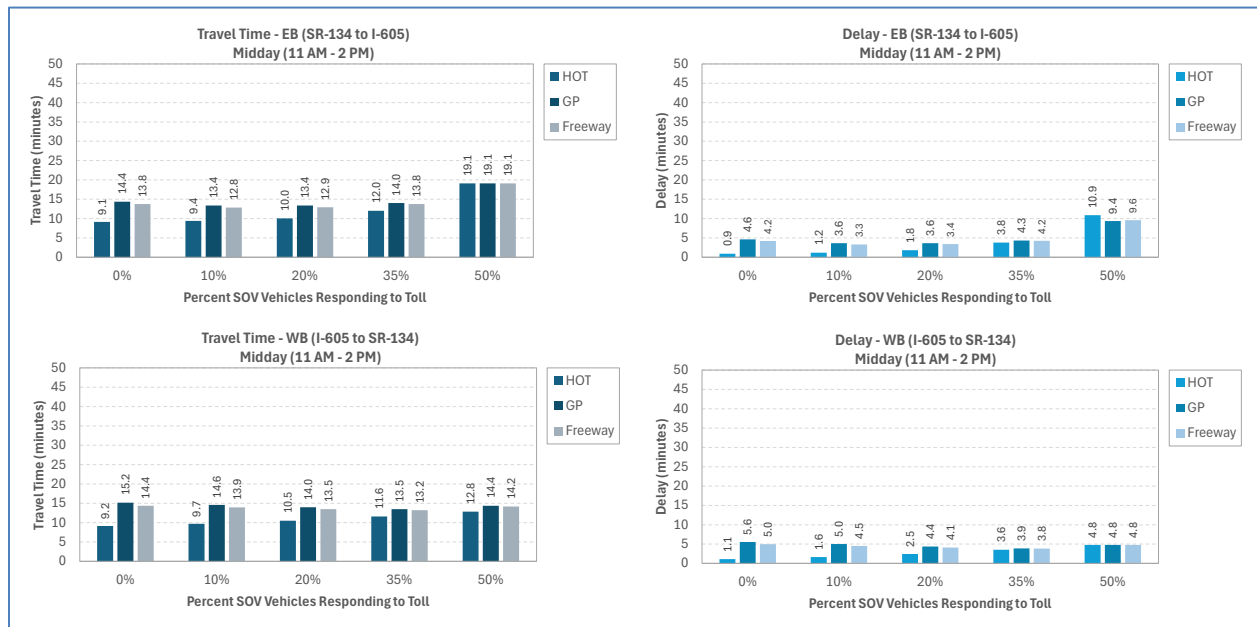


Figure 6-15: Travel Time and Delay along I-210, HOT Conversion, Midday

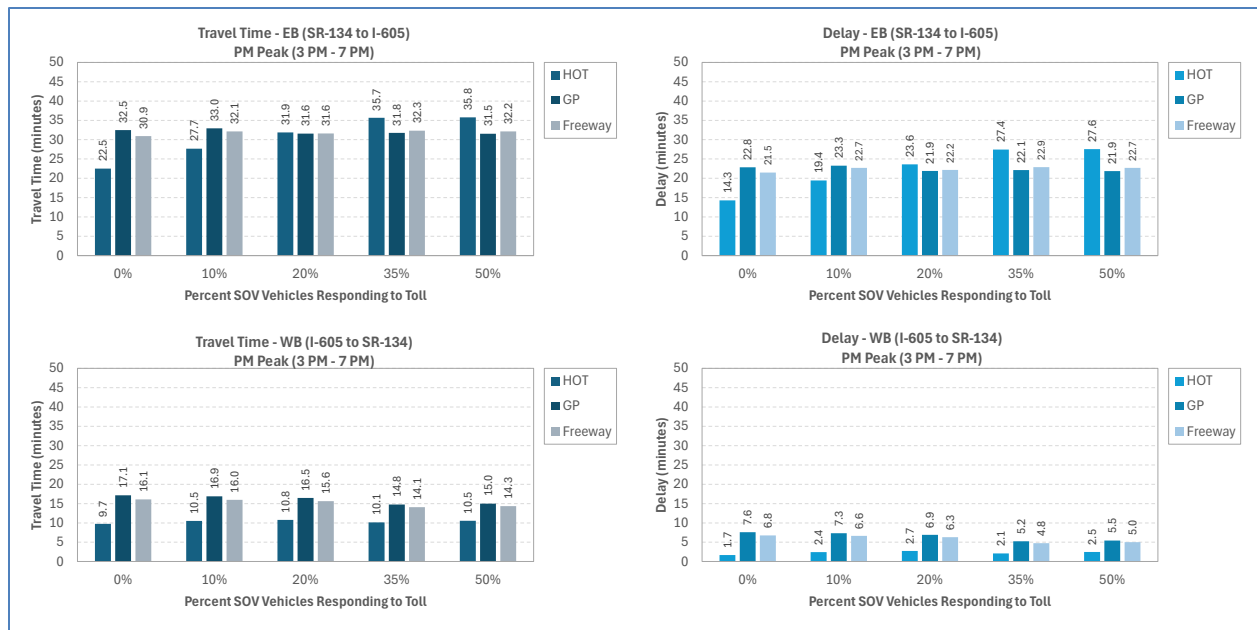


Figure 6-16: Travel Time and Delay along I-210, HOT Conversion, PM Peak

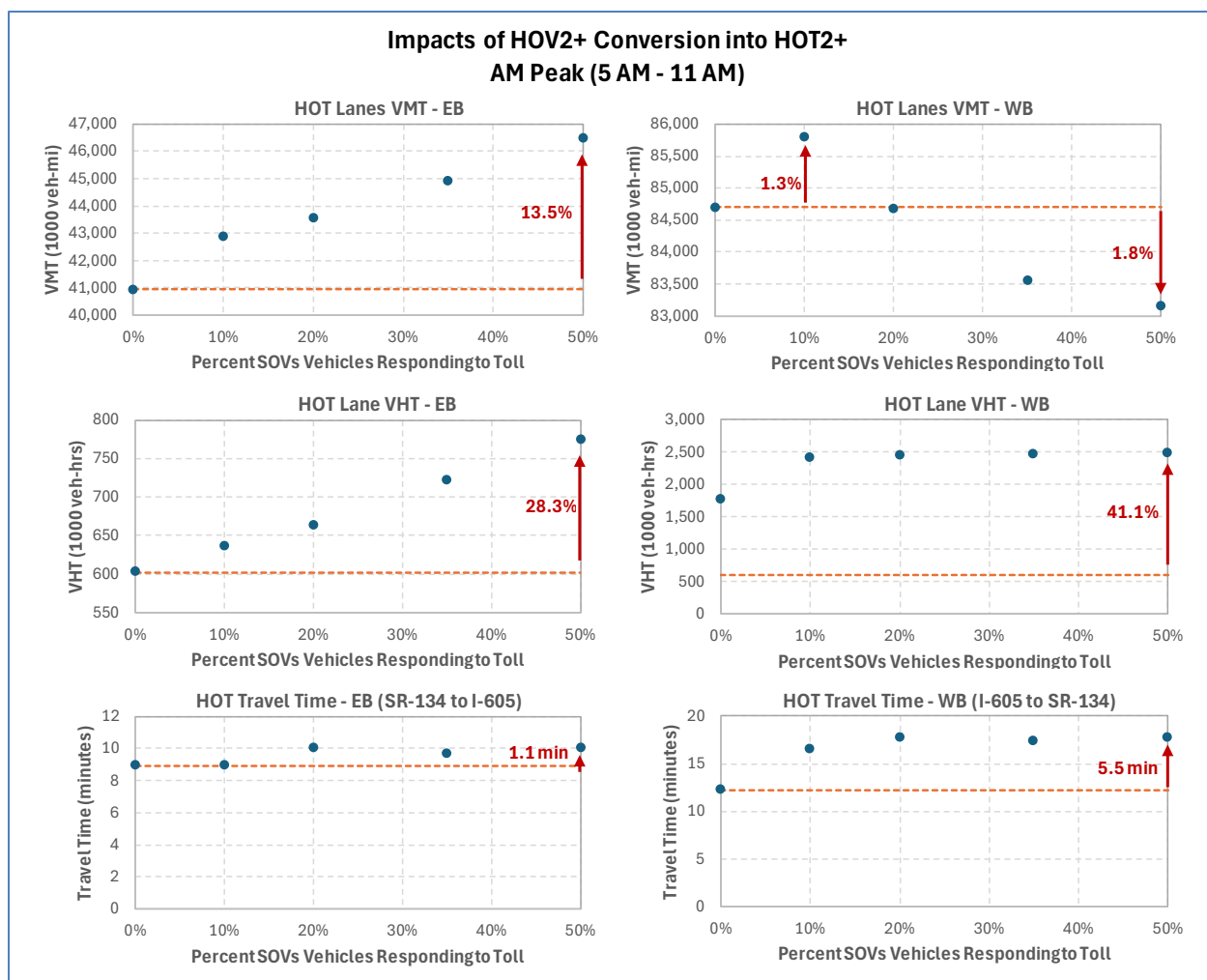


Figure 6-17: HOT Performance Metrics, HOT Conversion, AM Peak

Impacts of HOV2+ Conversion into HOT2+ Midday (11 AM - 2 PM)

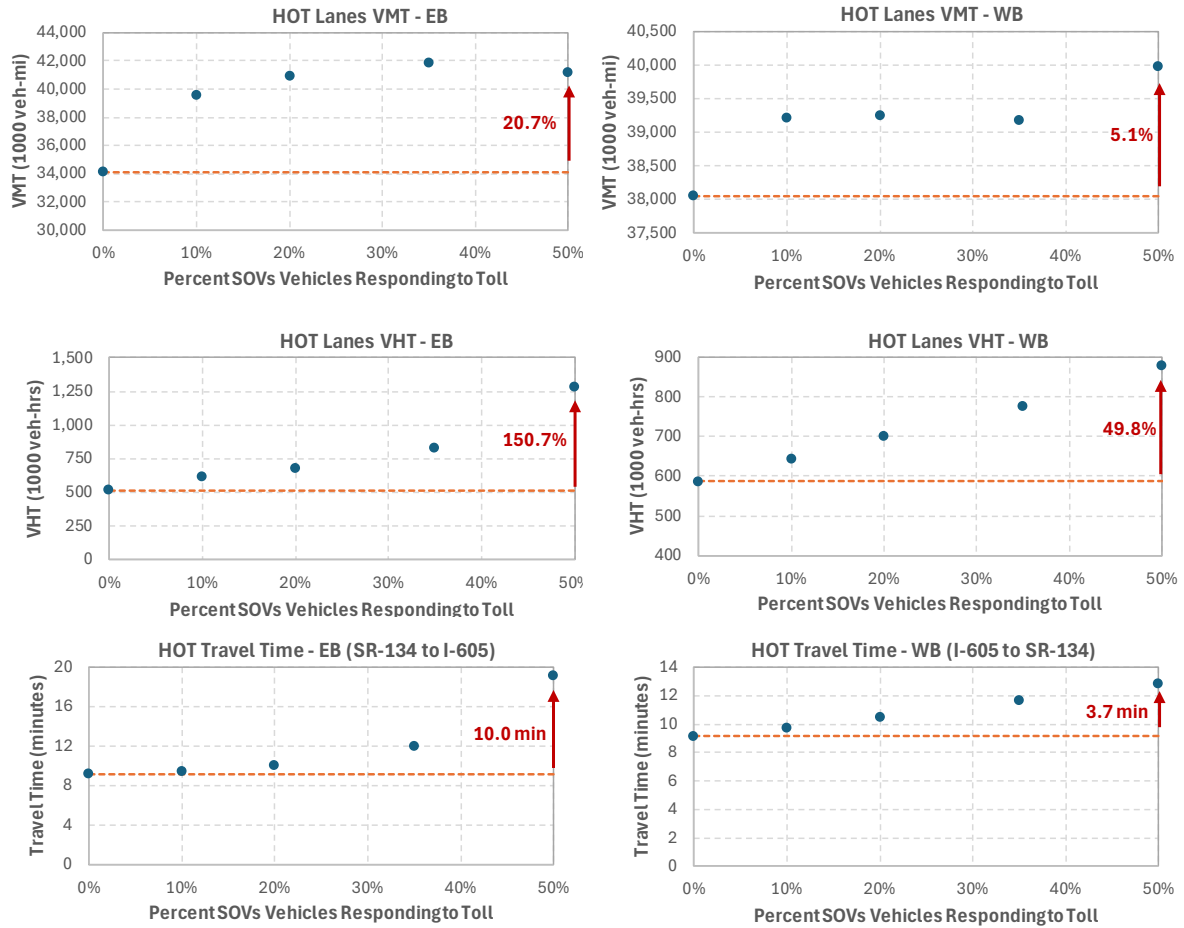


Figure 6-18: HOT Performance Metrics, HOT Conversion, Midday

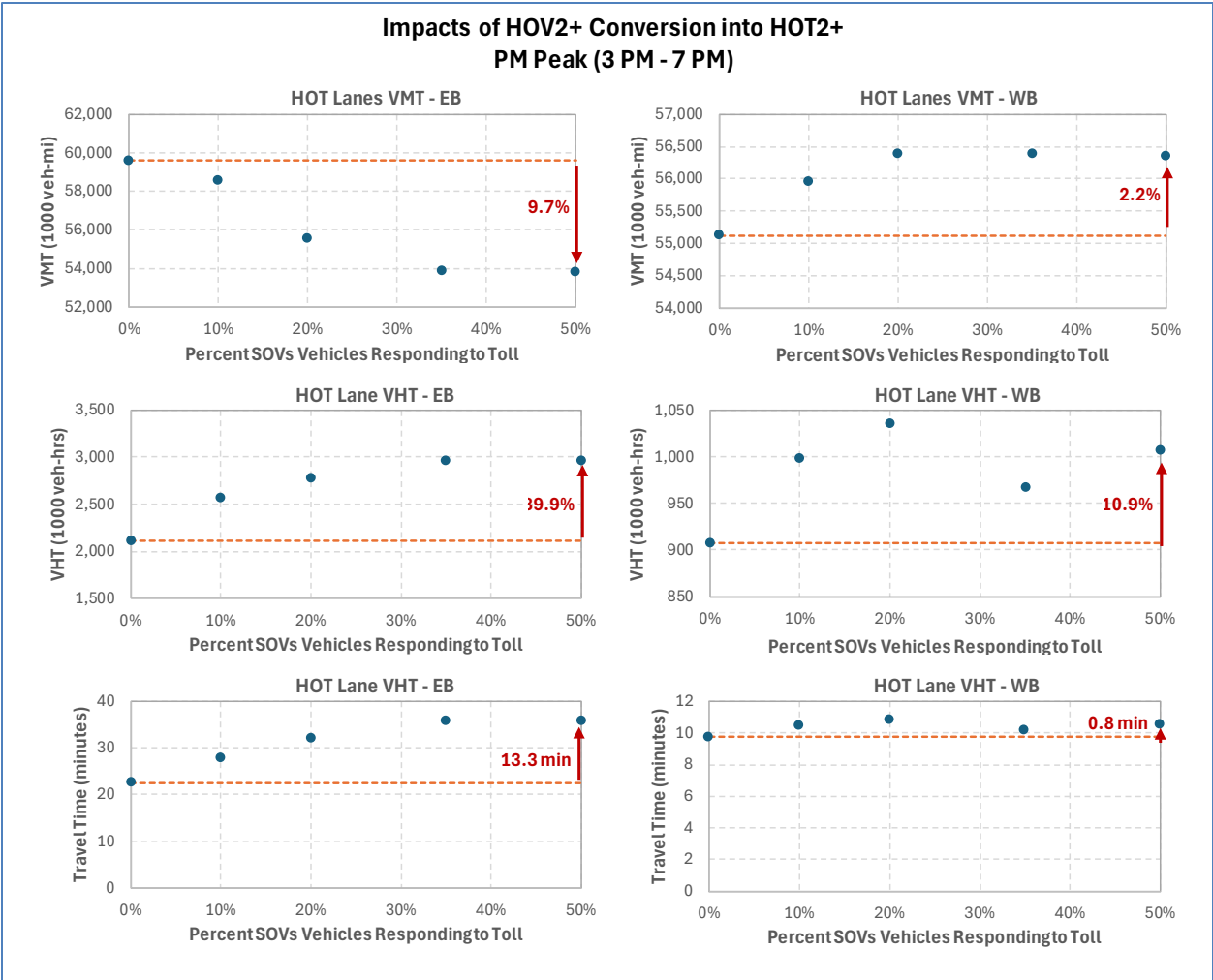


Figure 6-19: HOT Performance Metrics, HOT Conversion, PM Peak

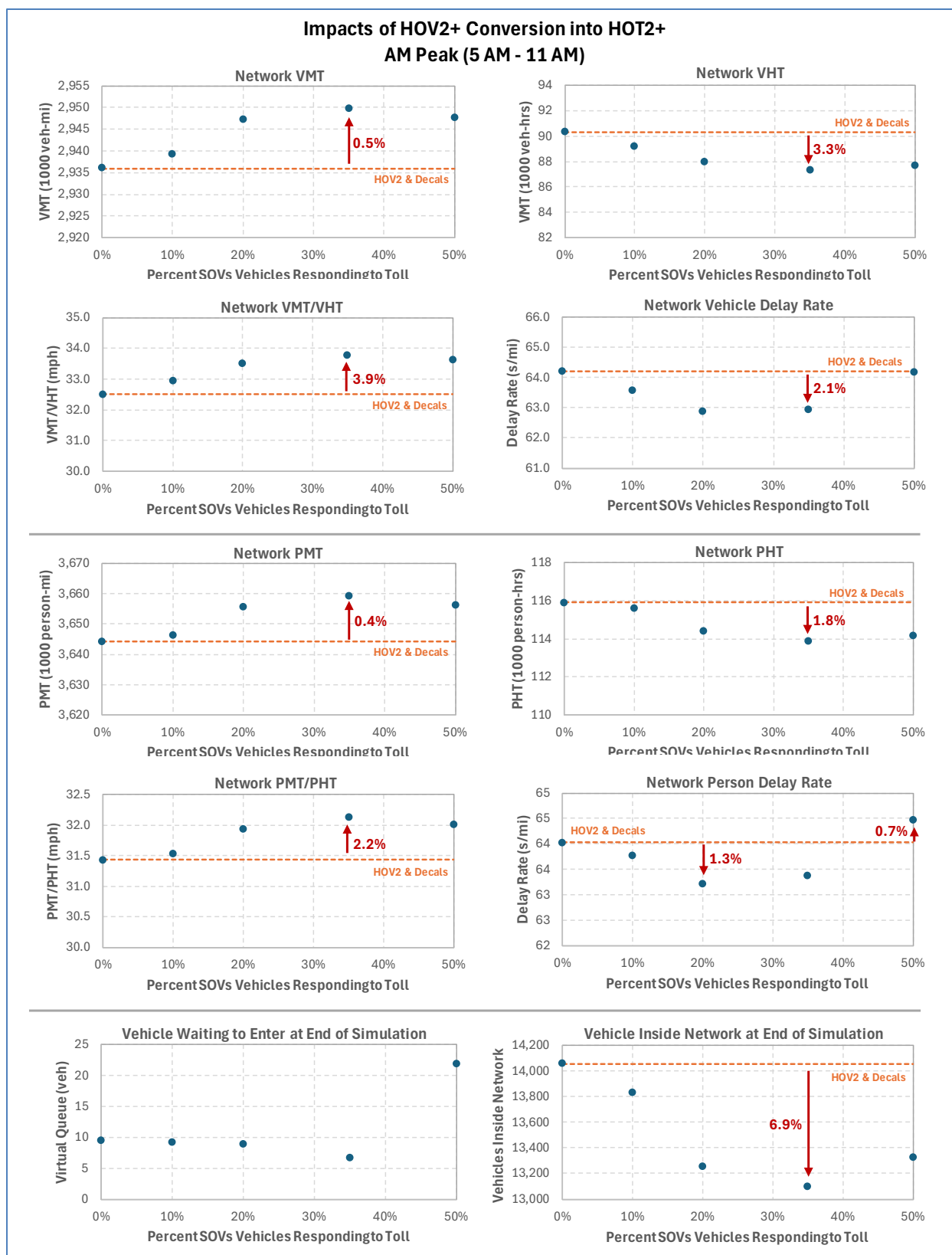


Figure 6-20: Network Performance Metrics, HOT Conversion, AM Peak

Impacts of HOV2+ Conversion into HOT2+ Midday (11 AM - 2 PM)

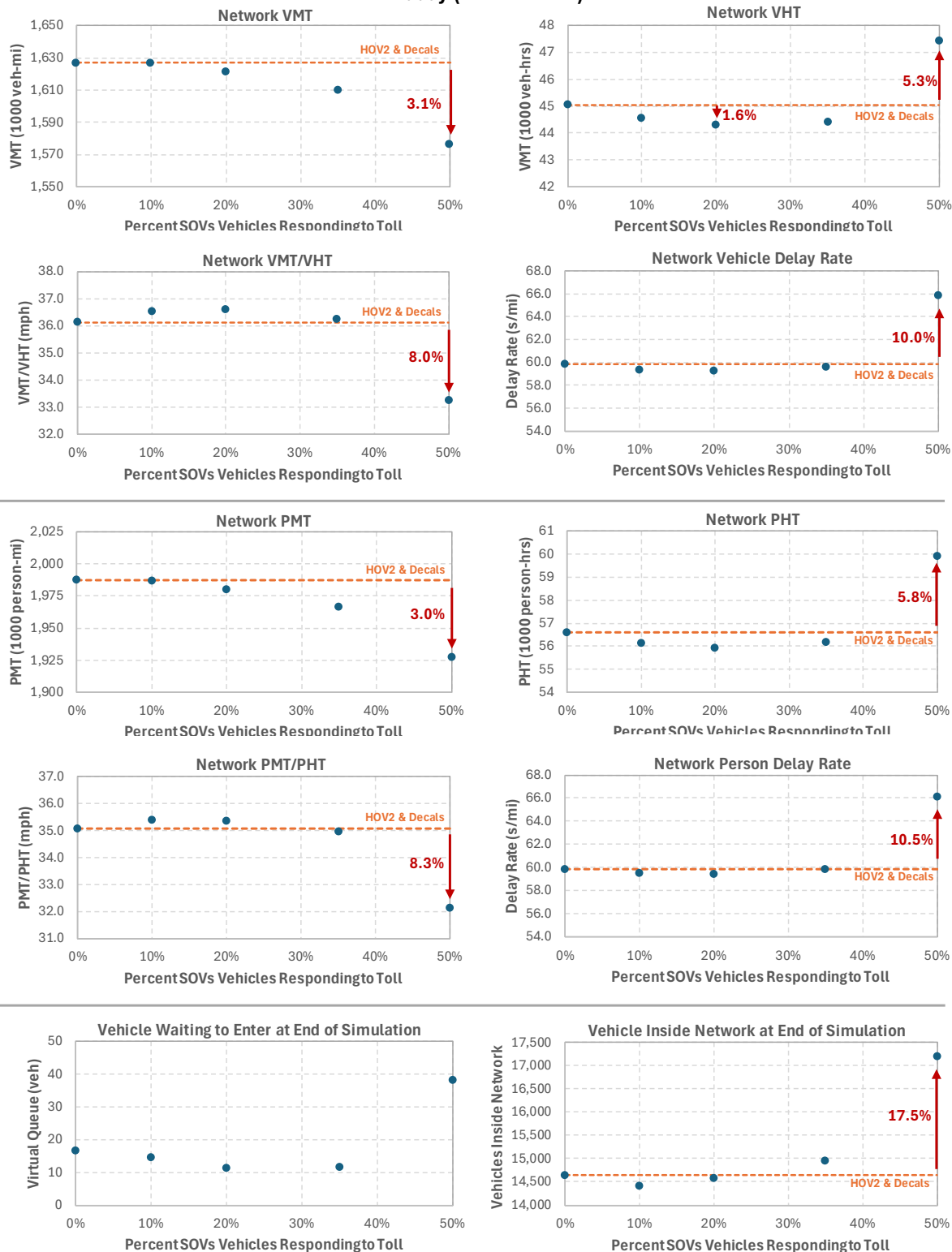


Figure 6-21: Network Performance Metrics, HOT Conversion, Midday

Impacts of HOV2+ Conversion into HOT2+ PM Peak (3 PM - 7 PM)

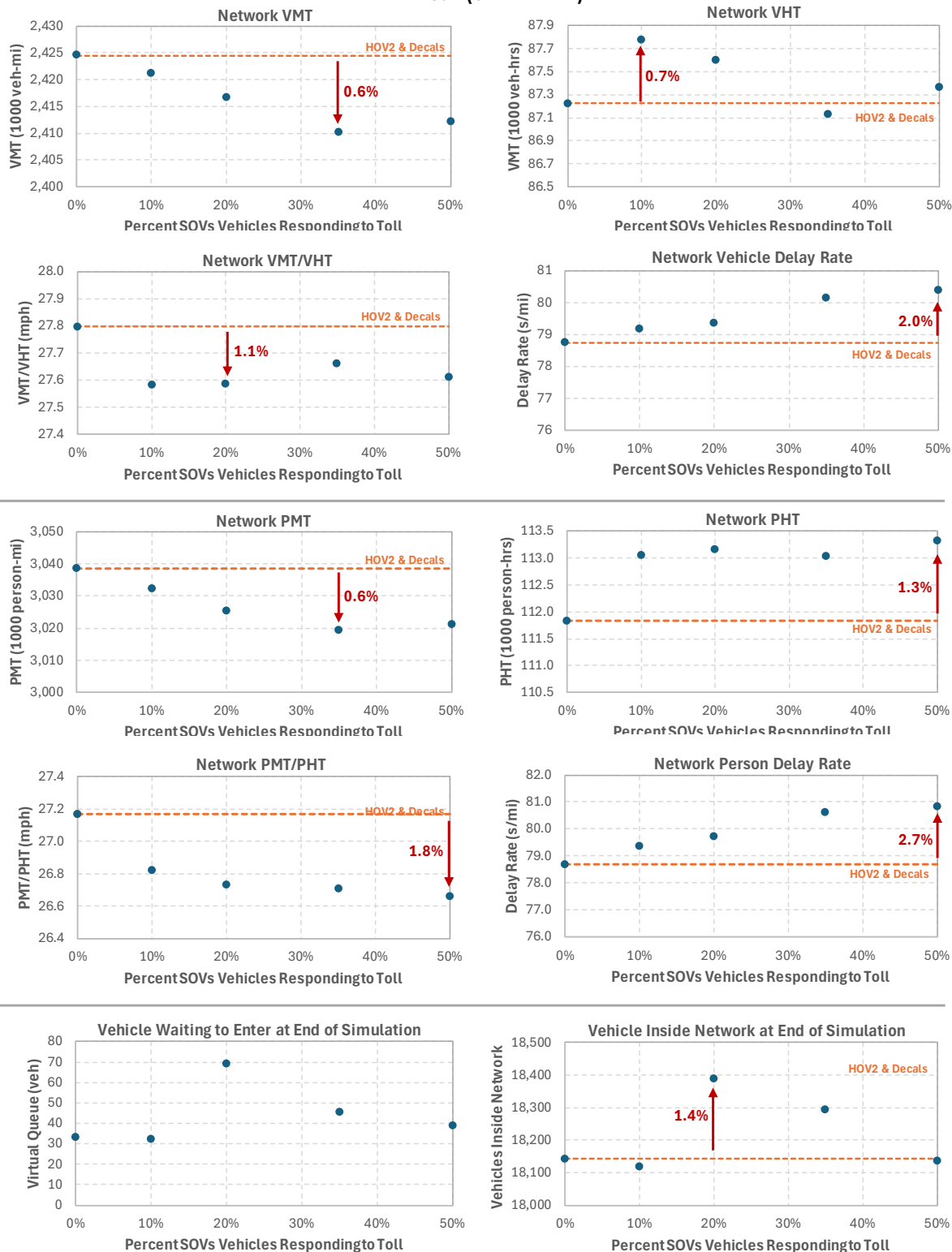


Figure 6-22: Network Performance Metrics, HOT Lane Addition, PM Peak

6.4. HOV2+ TO HOT2+ CONVERSION WITH DYNAMIC TOLL AND LANE ADDITION

This scenario is similar to the previous one but introduces a new lane on the HOT facility. This is assumed to be an addition to the total number of lanes on the freeway. While the actual corridor would not have the physical space for such an addition, there is no such constraint in the simulation environment. As in the previous scenario, simulation results are presented for scenarios with a proportion of SOVs responding to displayed tolls varying from 0% to 50%, with the 0% configuration corresponding to the base HOV2+ & Decals situation. Throughout all simulations, access is maintained for SOVs with a Clean Air decal. Motorists are further assumed to have a mean value of time of \$35/hour, with a \$5 standard deviation, as described in Section 5.2.

Figure 6-23 to Figure 6-25 summarize the impacts on travel time and delays along each direction of travel for the HOV lanes, general-purpose lanes, and overall freeway over the AM peak (5-11 AM), midday (11 AM – 2 PM), and PM peak (3-7 PM) for travel between SR-134 and I-605 interchanges. Figure 6-26 to Figure 6-28 further presents directional VMT, VHT, and travel time statistics for the core HOT section (SR-134 to I-605), while Figure 6-29 to Figure 6-31 illustrate networkwide VMT, VHT, PMT, and PHT statistics, with end-of-simulation statistics about the number of vehicles in the network and waiting to enter it. More detailed results tables are provided in Appendix B3.

The following general observations can be made from the results provided:

- Expectedly, adding a HOT lane to the core section of the freeway (SR-134 to I-605) significantly benefits high-occupancy vehicles. Compared to the 1-lane scenario, westbound AM peak travel times are reduced by 6.8 minutes and eastbound PM peak travel times by 9.5 minutes. Eastbound and westbound midday travel times are further reduced by 8.9 and 4 minutes, respectively, while off-peak travel times during the AM and PM peak periods are reduced between 1 and 2 minutes.
- In addition to reducing travel times along HOT lanes, this scenario also reduces travel times along the general-purpose lanes in many instances. During the midday period, eastbound and westbound travel times on the general-purpose lanes are reduced by 5.4 and 1.2 minutes. During peak periods, reductions of less than 0.5 minutes are obtained in the non-commute direction, and increases between 0.5 and 1.0 minutes are obtained in the commute direction. In this case, travel time reductions are mainly associated with reductions in friction at the HOT entry/exit gates.
- Improvements in travel times along the HOT lanes generally translate into higher recorded VMT and VHT, as less congestion on the lanes results in lower tolls being displayed and in attracting more SOVs to use the lanes. During the AM peak, VMT increases by 22.4% eastbound and 26.5% westbound, while VHT increases by 23.1% and 13.8%, reflecting the higher number of vehicles using the facility. During midday, VMT increases are 70.8% eastbound and 14.1% westbound, with corresponding VHT increases of 91.5% and 10.0%. During the PM peak, VMT increases are 28.3% eastbound, 9.3% westbound, with corresponding VHT increases of 61.9% and 4.8%.
- Performance improvements along the HOT lanes generally translate into overall network improvements. This is evidenced by larger recorded increases or decreases in performance metrics in Figure 6-29 to Figure 6-31 compared to the simple conversion results from Figure 6-20 to Figure 6-22. In this case, higher VMT translates into more vehicles being able to

complete trips during the simulation period, while lower VHT and delay rates reflect reduced congestion.

- While this scenario shows significant systemwide benefits, it may not be feasible at many locations due to physical right-of-way constraints and high build costs.

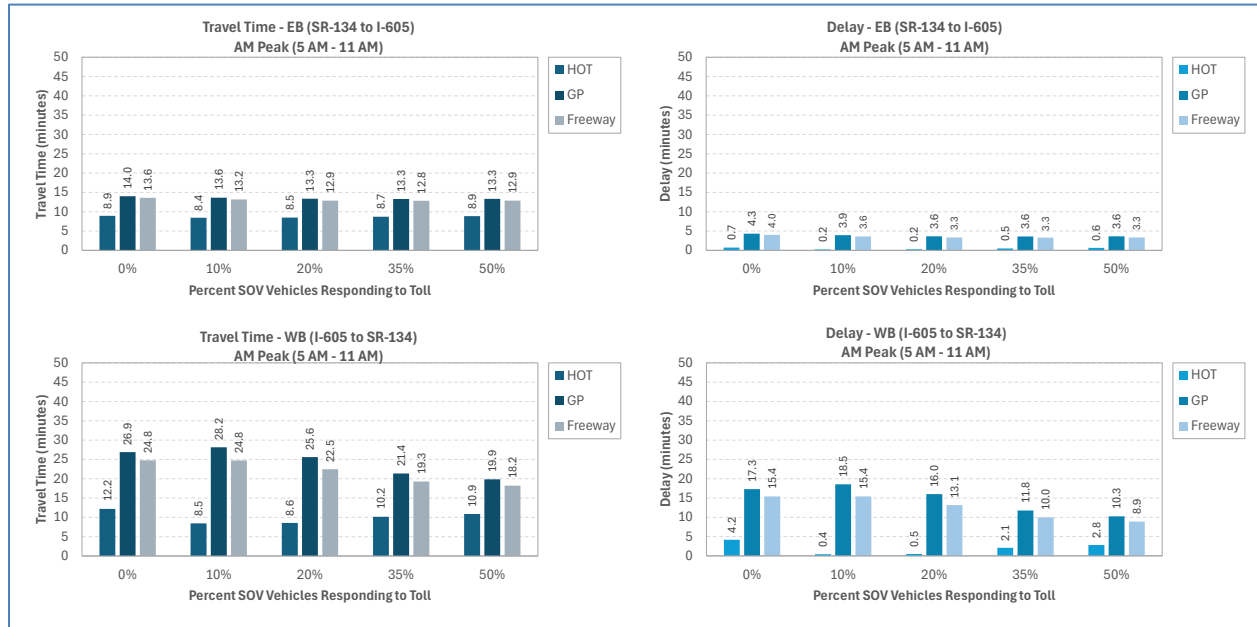


Figure 6-23: Travel Time and Delay along I-210, HOT Lane Addition, AM Peak

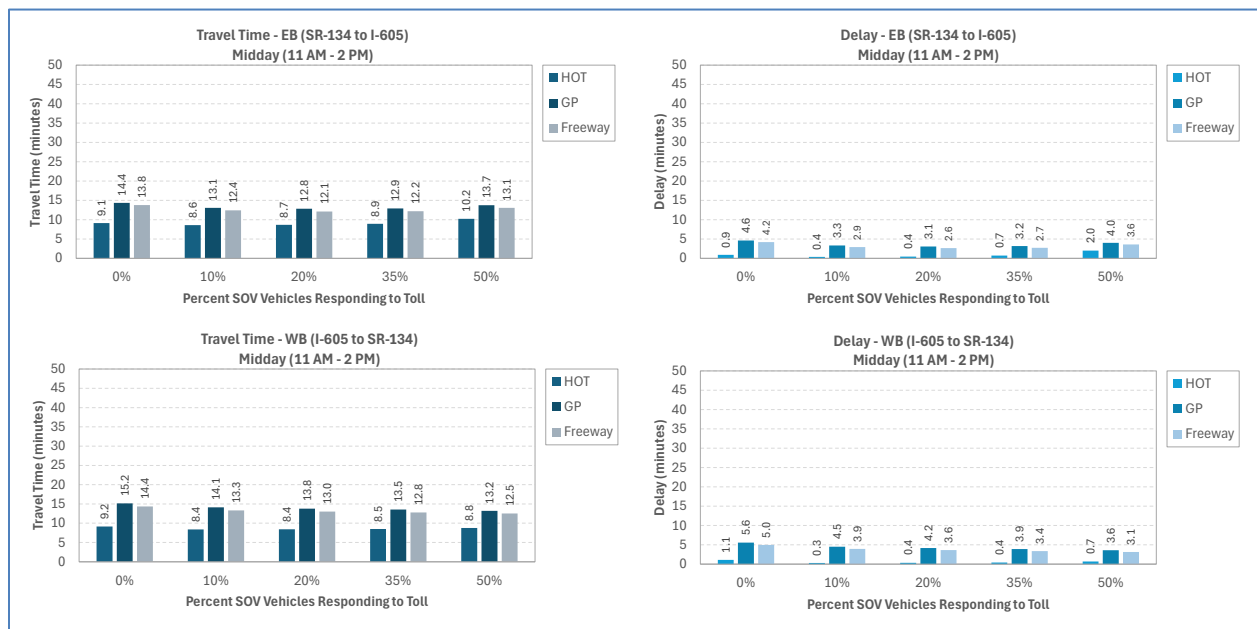


Figure 6-24: Travel Time and Delay along I-210, HOT Lane Addition, Midday

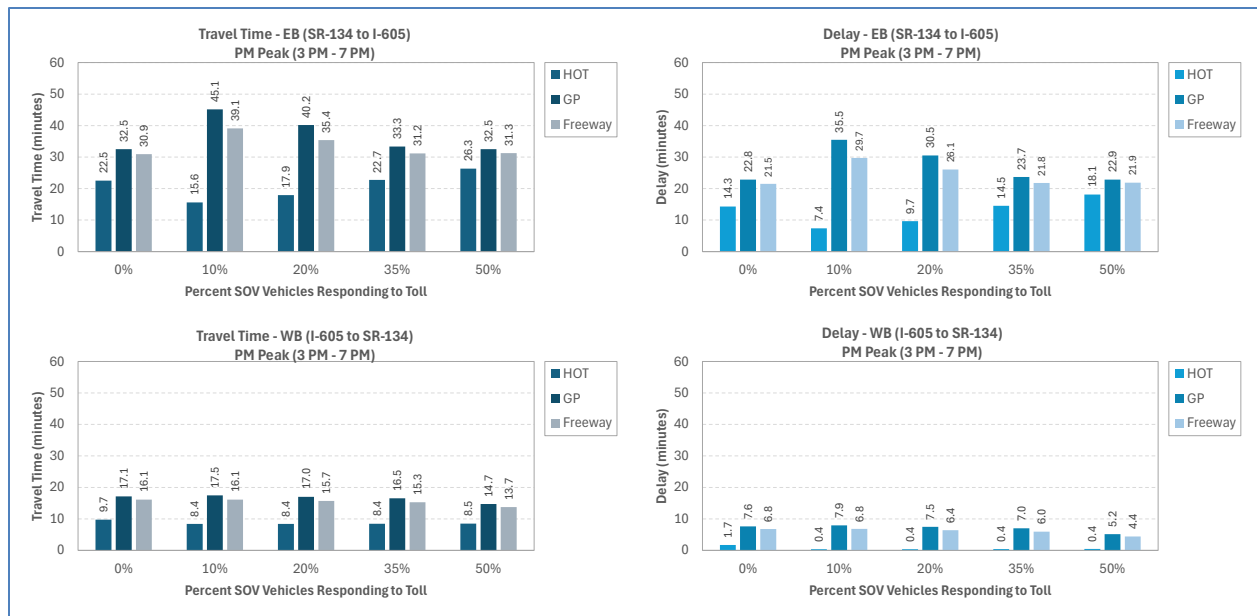


Figure 6-25: Travel Time and Delay along I-210, HOT Lane Addition, PM Peak

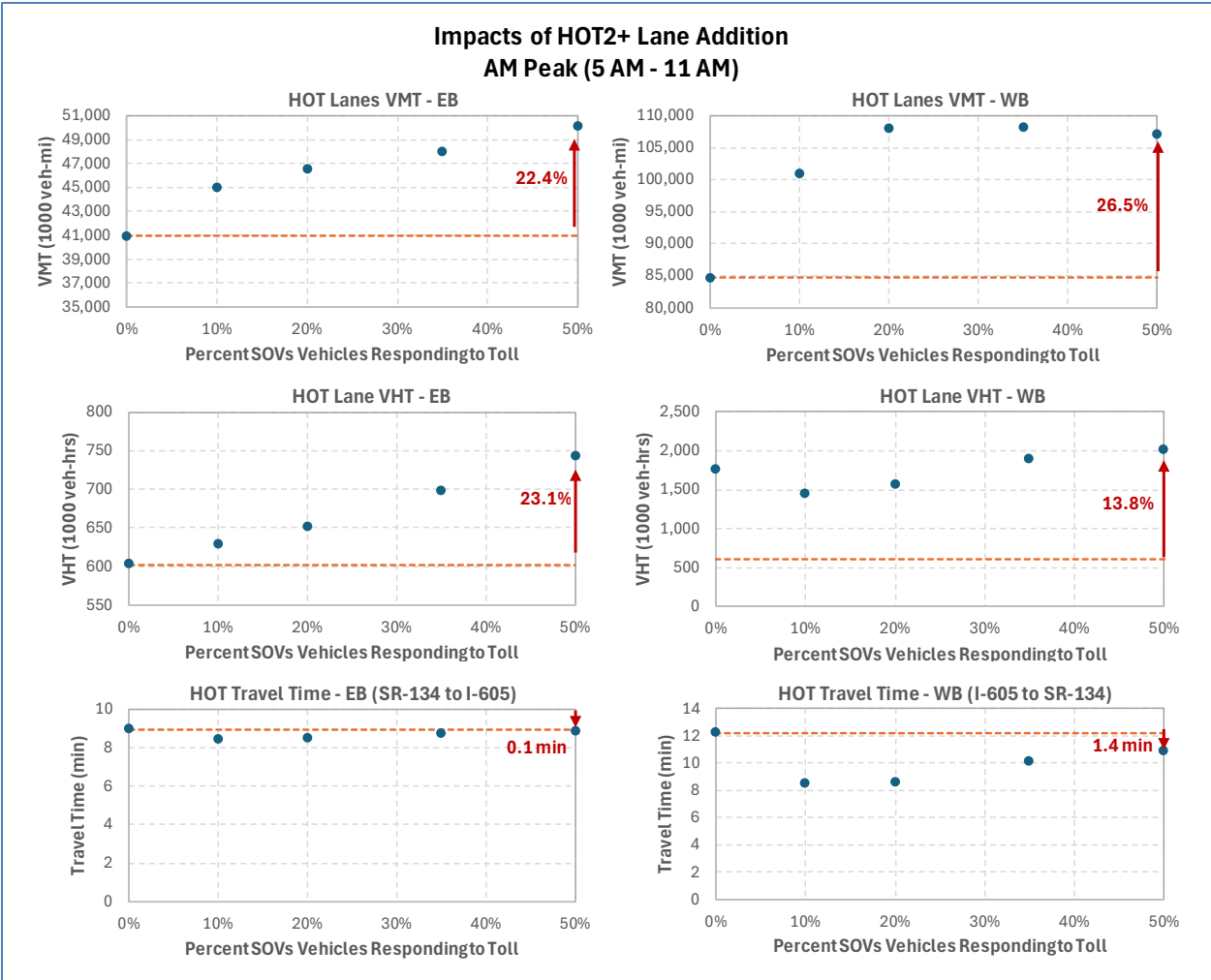


Figure 6-26: HOT Performance Metrics, HOT Lane Addition, AM Peak

Impacts of HOT2+ Lane Addition Midday (11 AM - 2 PM)

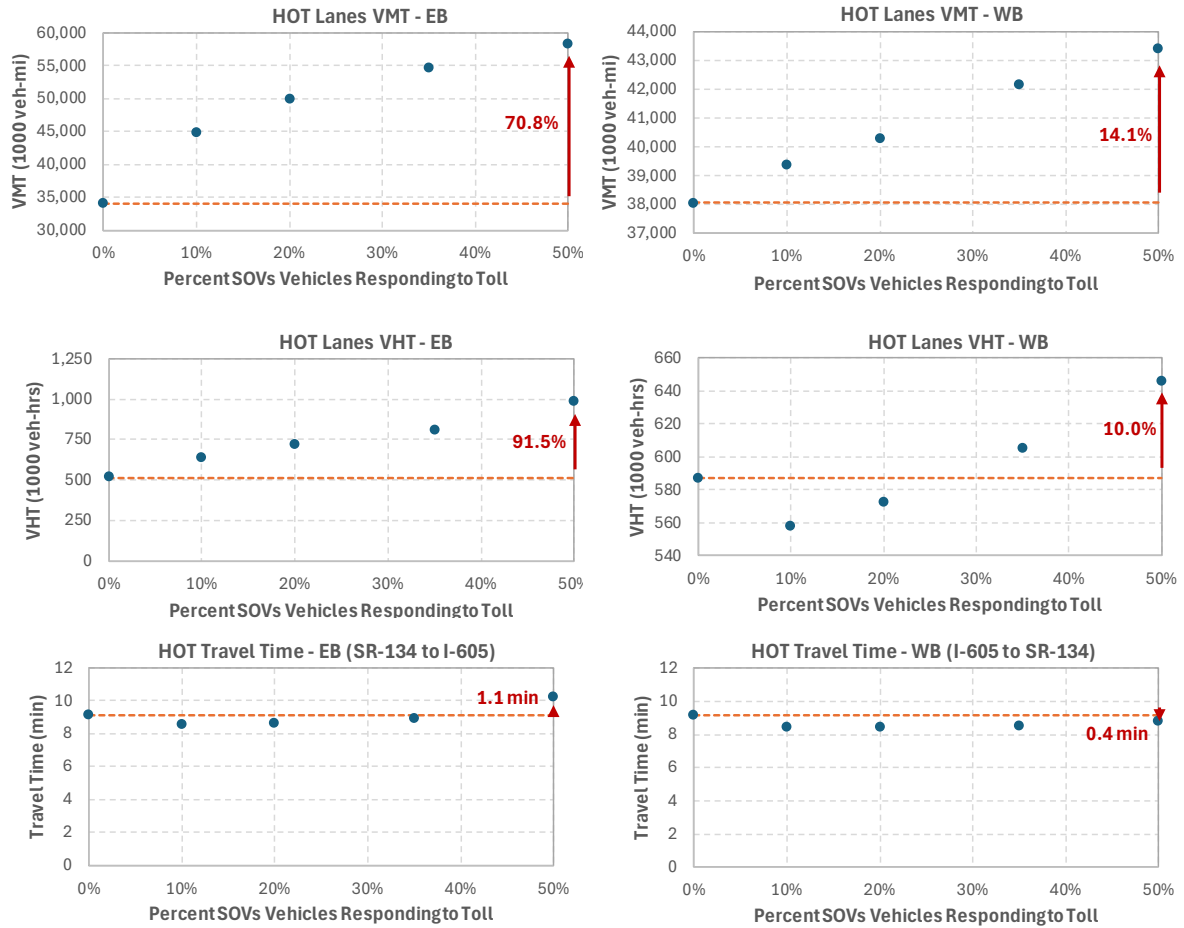


Figure 6-27: HOT Performance Metrics, HOT Lane Addition, Midday

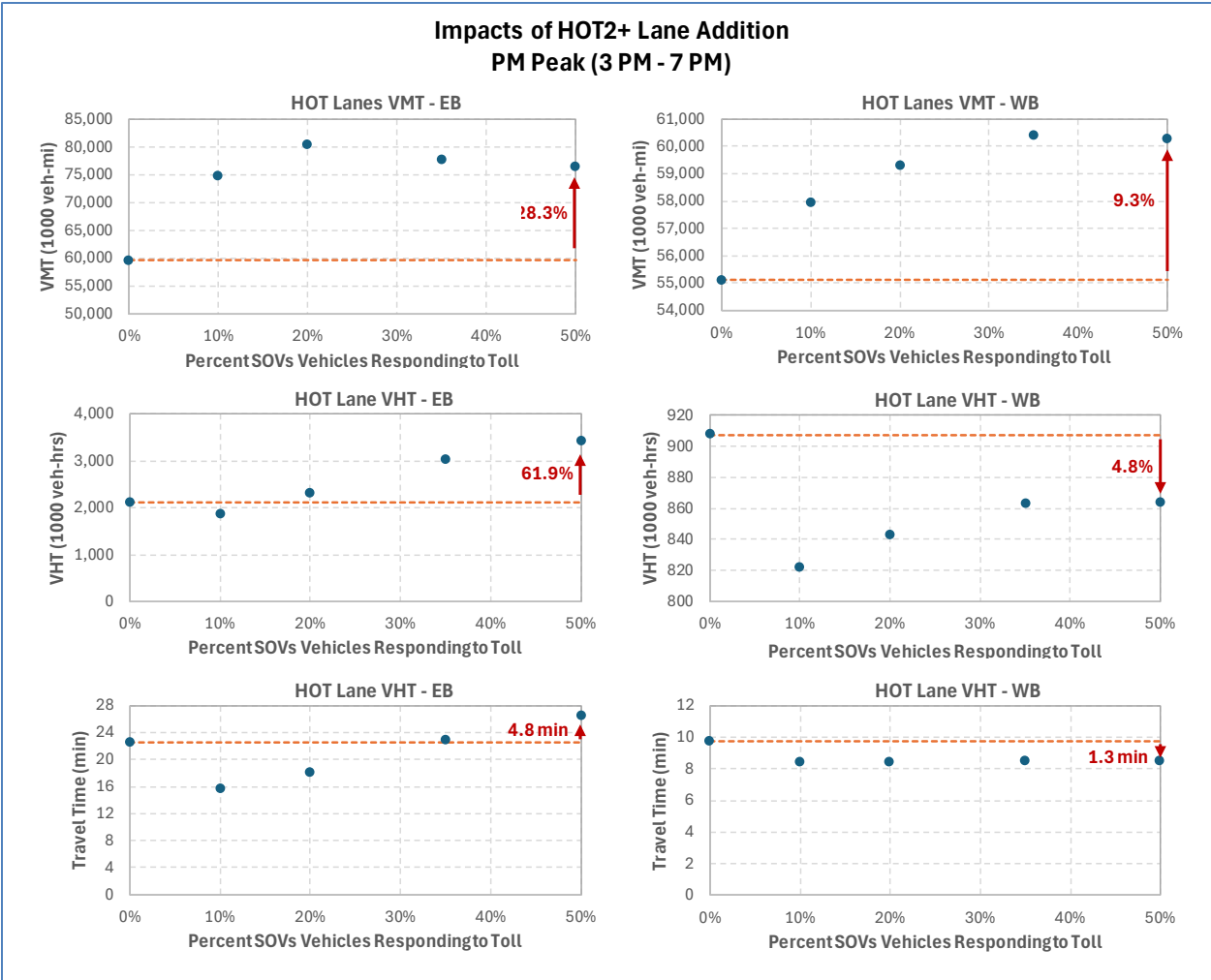


Figure 6-28: HOT Performance Metrics, HOT Lane Addition, PM Peak

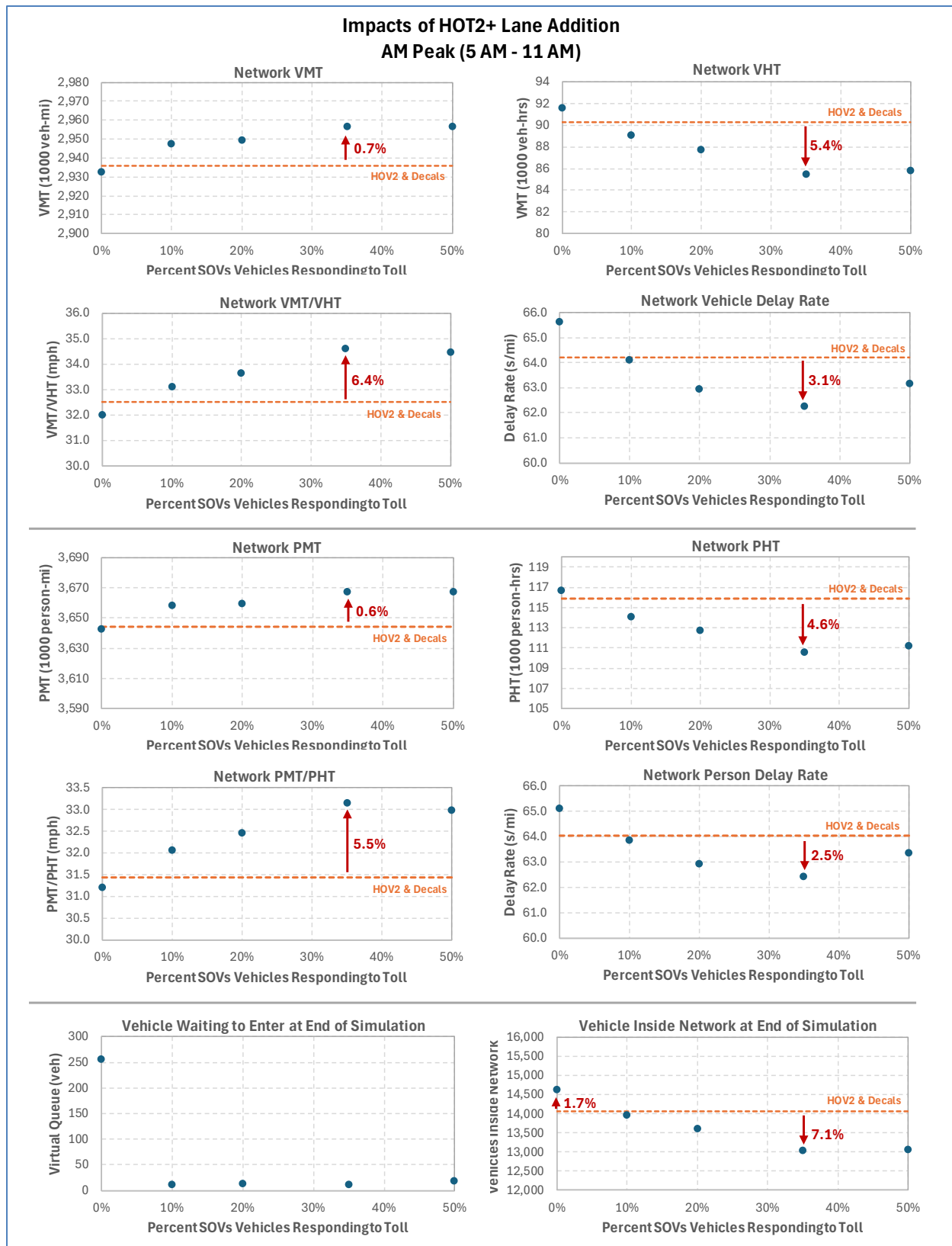


Figure 6-29: Network Performance Metrics, HOT Lane Addition, AM Peak

Impacts of HOT2+ Lane Addition Midday (11 AM - 2 PM)

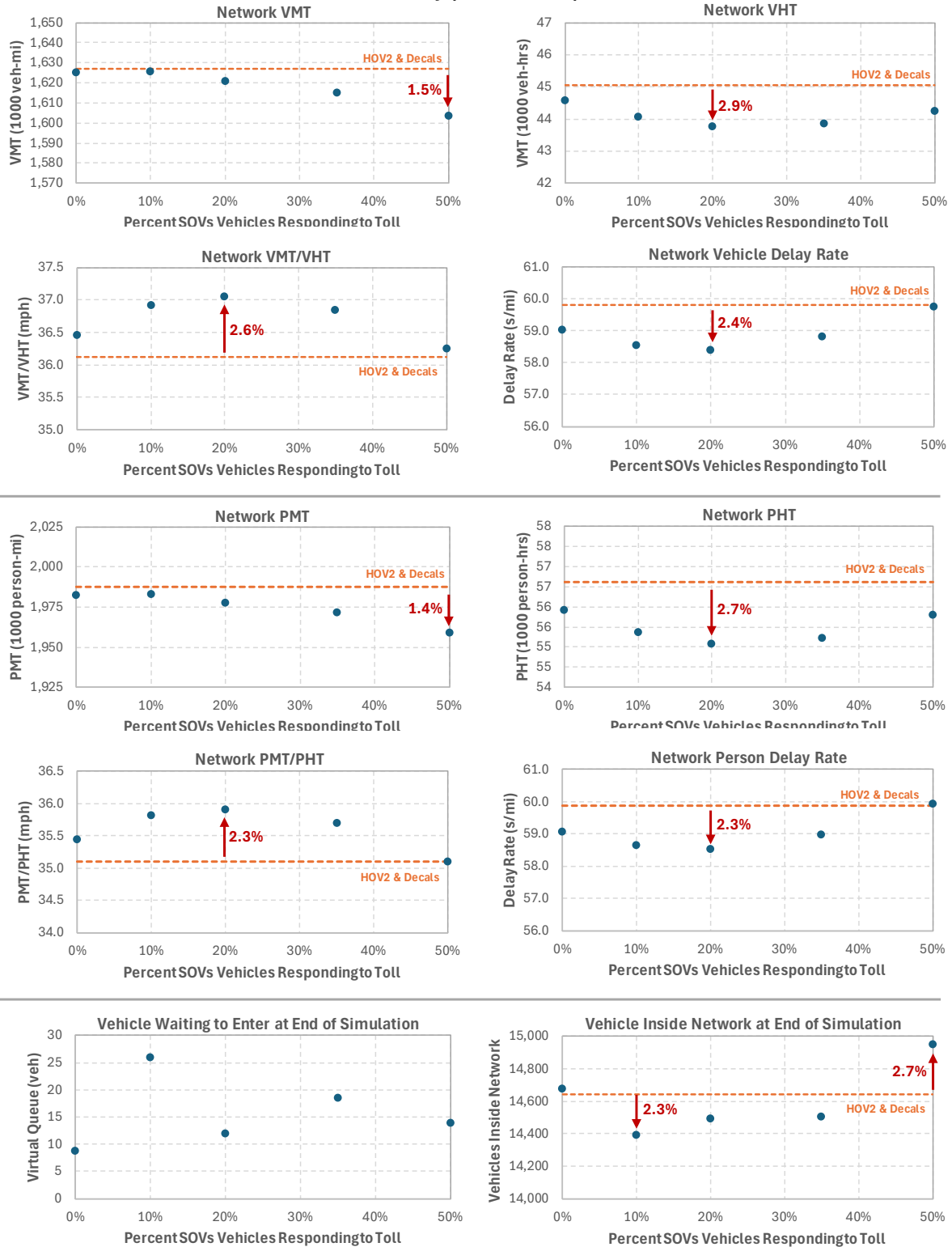


Figure 6-30: Network Performance Metrics, HOT Lane Addition, Midday

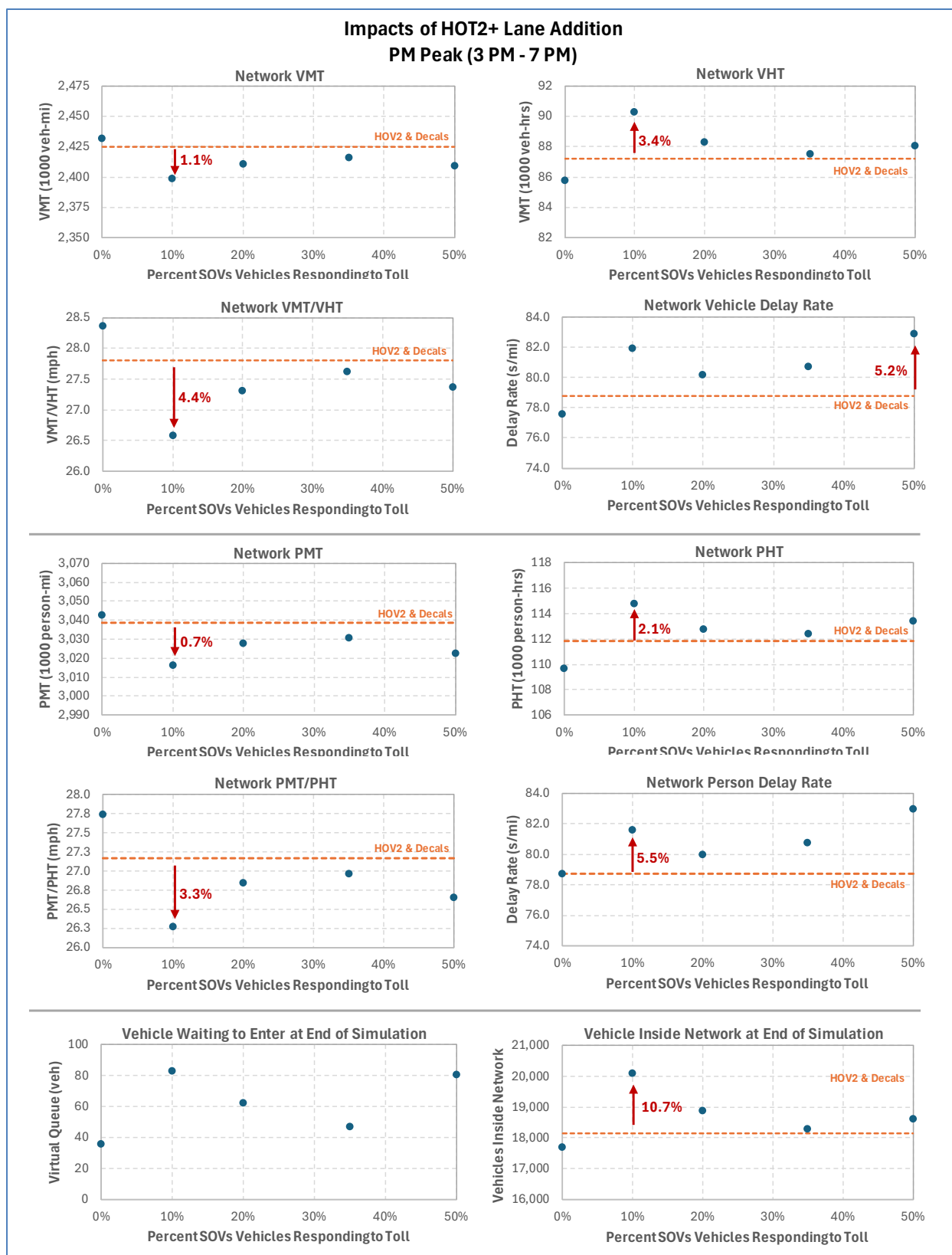


Figure 6-31: Network Performance Metrics, HOT Lane Addition, PM Peak

6.5. HOV2+ TO HOT2+ CONVERSION WITH DYNAMIC TOLL AND GP LANE SWAP

This scenario is similar to the previous one but assumes instead that the new HOT lane is converted from one of the adjacent general-purpose lanes. This scenario thus reduces capacity on the freeway for the general traffic. As in the two previous scenarios, simulation results are presented for proportions of SOVs responding to displayed tolls varying from 0% to 50%, with the 0% configuration corresponding to the base HOV2+ & Decals situation. Throughout all simulations, access is further maintained for the SOVs with a Clean Air decal, and motorists are assumed to have a mean value of time of \$35/hour, with a \$5 standard deviation, as described in Section 5.2.

Figure 6-32 to Figure 6-34 summarize the impacts on travel time and delays along each direction for the HOV lanes, general-purpose lanes, and overall freeway over the AM peak (5-11 AM), midday (11 AM-2 PM), and PM peak (3-7 PM). Figure 6-38 to Figure 6-40 further presents directional VMT, VHT, and travel time statistics for the core HOT section (SR-134 to I-605), while Figure 6-35 to Figure 6-37 illustrate networkwide VMT, VHT, PMT, and PHT statistics, with end-of-simulation statistics about the number of vehicles in the network and waiting to enter it. More detailed results tables are provided in Appendix B4.

The following general observations can be made from the results provided:

- Eliminating a general-purpose traffic lane has a significant detrimental effect on freeway and corridor performance. This is evidenced by the large increase in vehicles waiting to enter the network at the end of all simulation periods. This indicates that there is not enough capacity left on the freeway to handle the simulated demand, leading to significant congestion outside the simulated area.
- Despite the overall negative impacts, increases in the proportion of SOVs responding to tolls generally have beneficial impacts. Overall, freeway travel times tend to reduce with increasing proportions as more vehicles can use available capacity on the HOT lanes. This translates into more vehicles being able to enter the network and complete trips, as evidenced by increases in measured VMT and VHT.

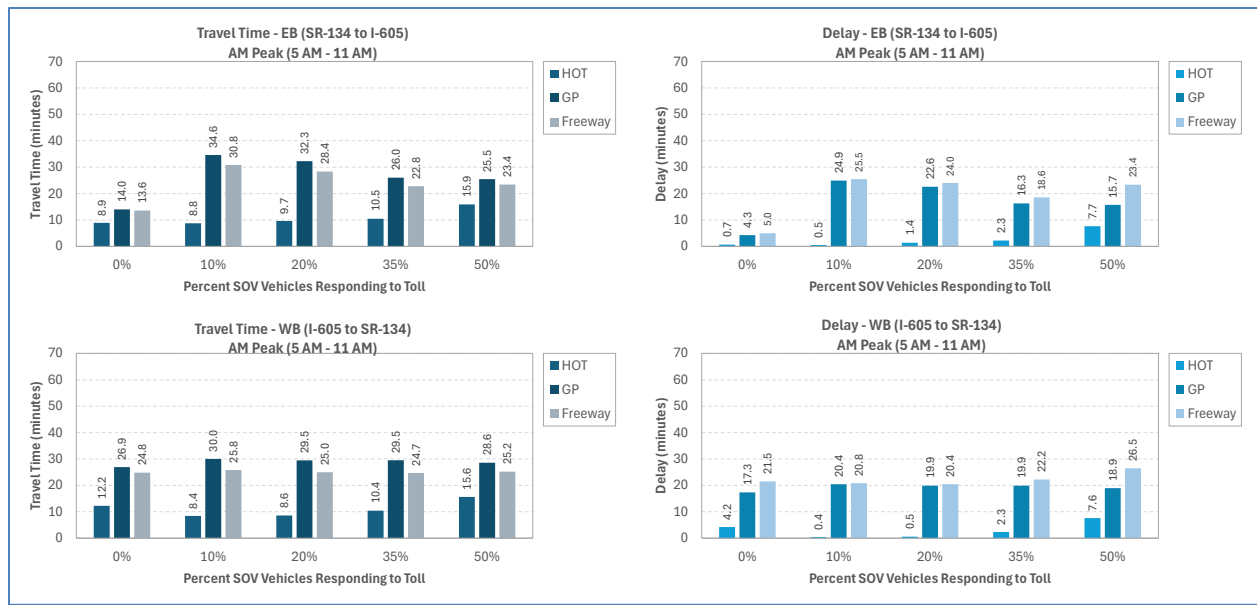


Figure 6-32: Network Performance Metrics, HOT Lane Addition by GP Swap, AM Peak

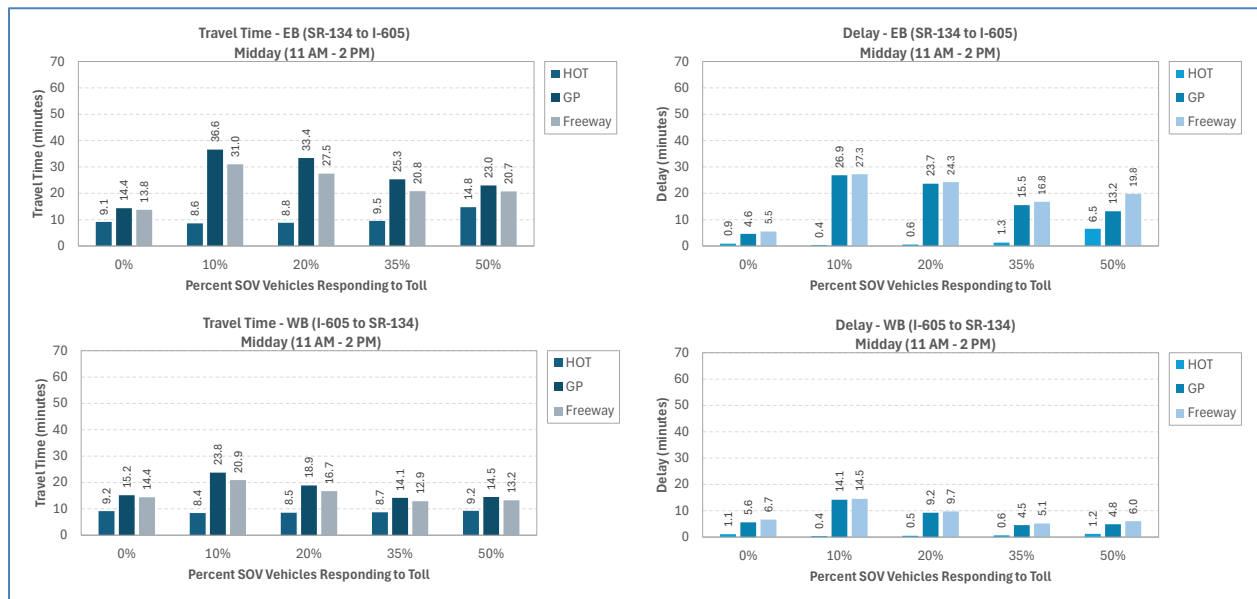


Figure 6-33: Network Performance Metrics, HOT Lane Addition by GP Swap, Midday

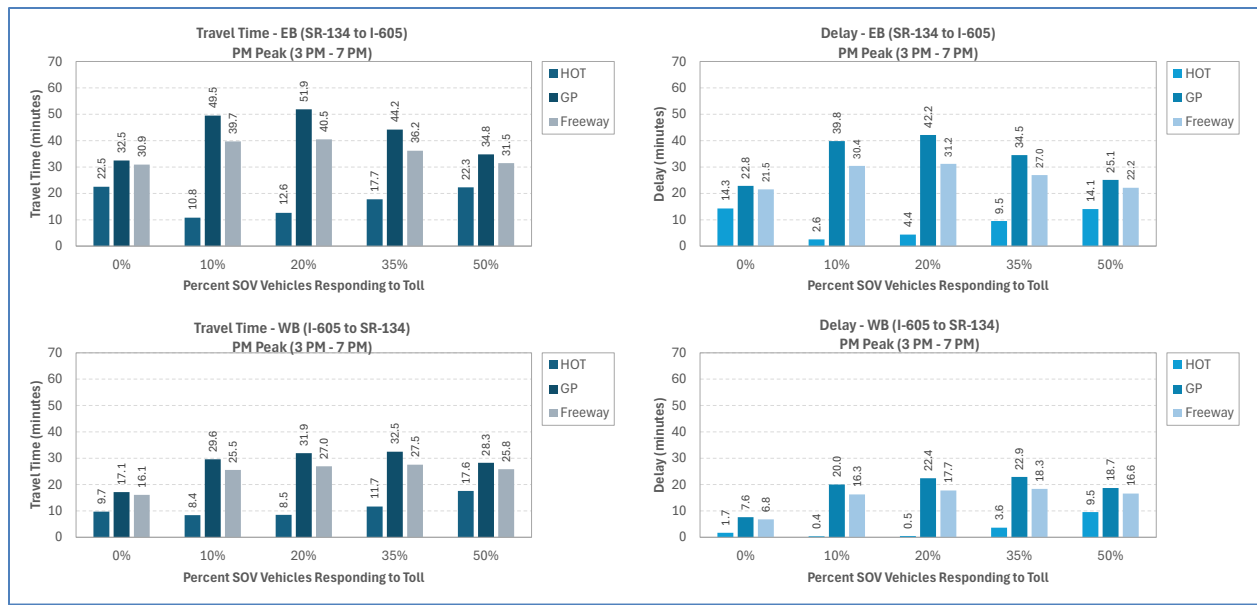


Figure 6-34: Network Performance Metrics, HOT Lane Addition by GP Swap, PM Peak

Impacts of HOT2+ Lane Addition by Swapping General-Purpose Lane AM Peak (5 AM - 11 AM)

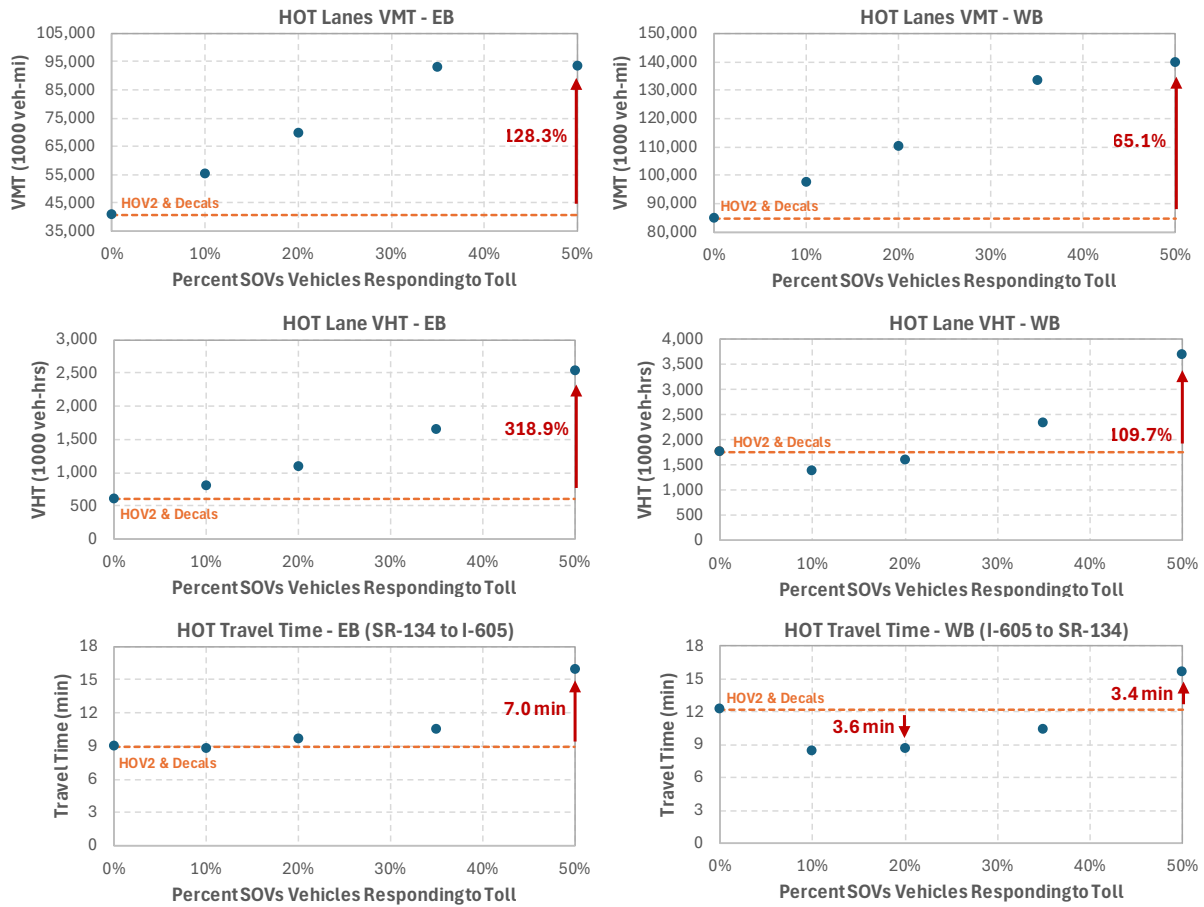


Figure 6-35: HOT Performance Metrics, HOT Lane Addition by GP Swap, AM Peak

Impacts of HOT2+ Lane Addition by Swapping General-Purpose Lane Midday (11 AM - 2 PM)

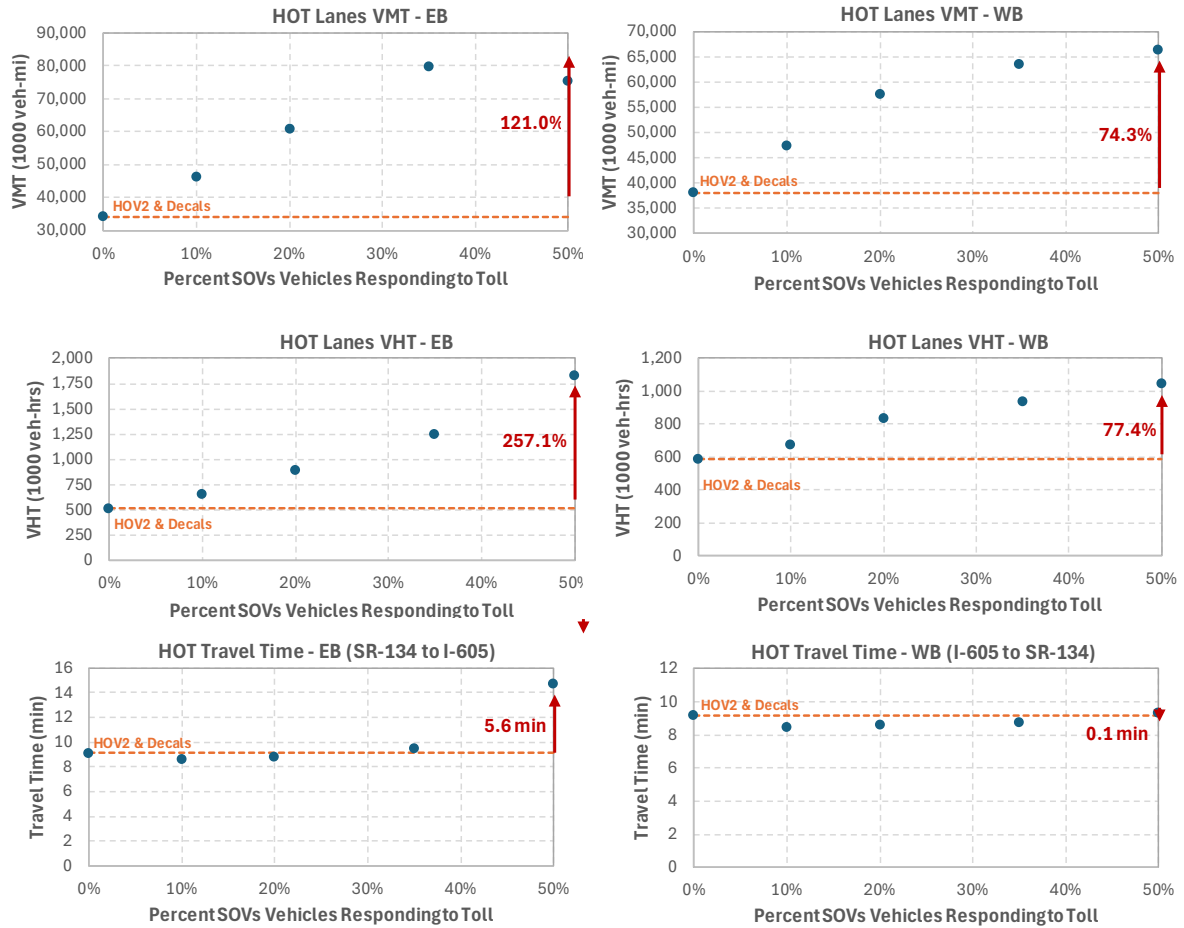


Figure 6-36: HOT Performance Metrics, HOT Lane Addition by GP Swap, Midday Peak

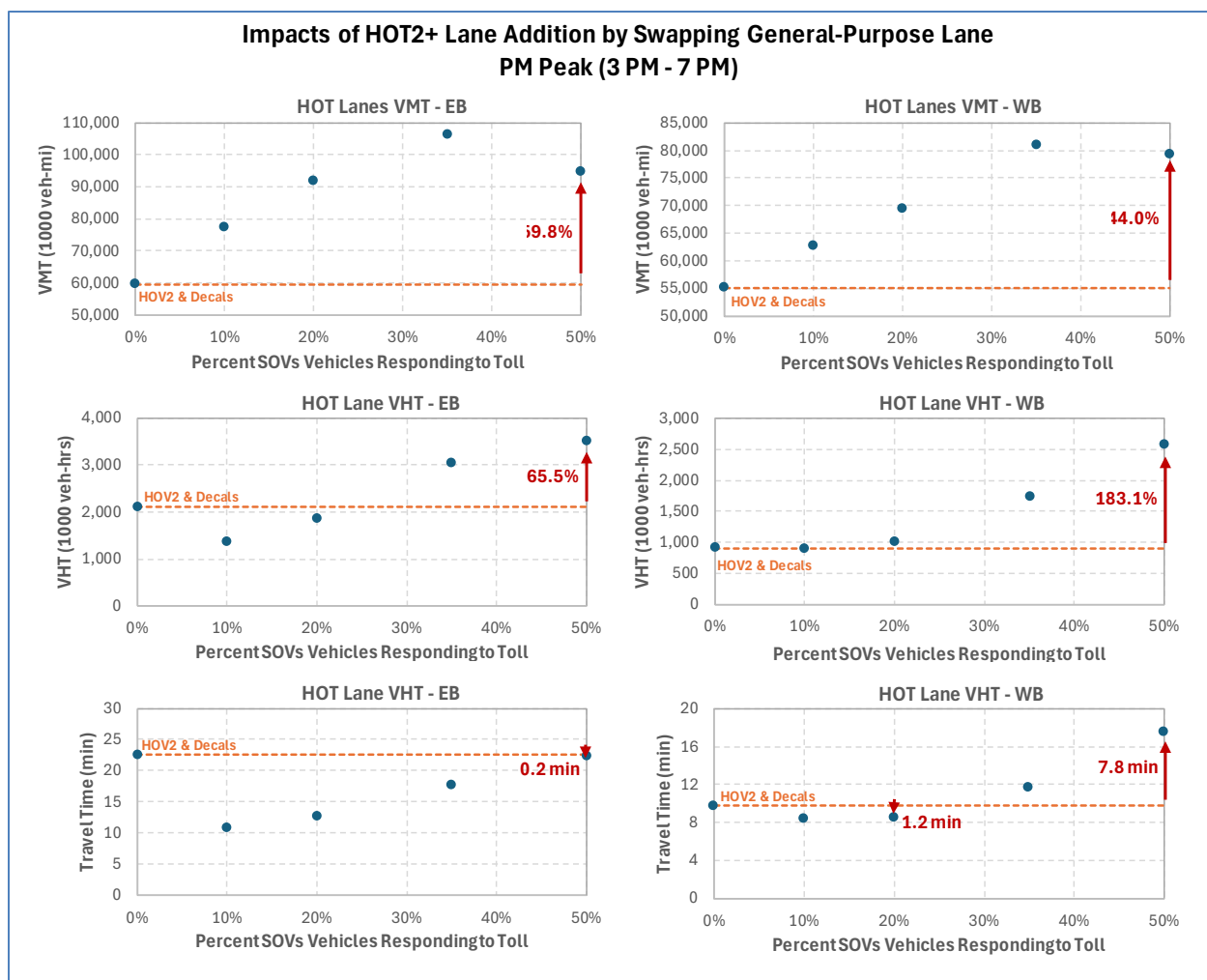


Figure 6-37: HOT Performance Metrics, HOT Lane Addition by GP Swap, PM Peak

Impacts of HOT2+ Lane Addition by Swapping General-Purpose Lane AM Peak (5 AM - 11 AM)

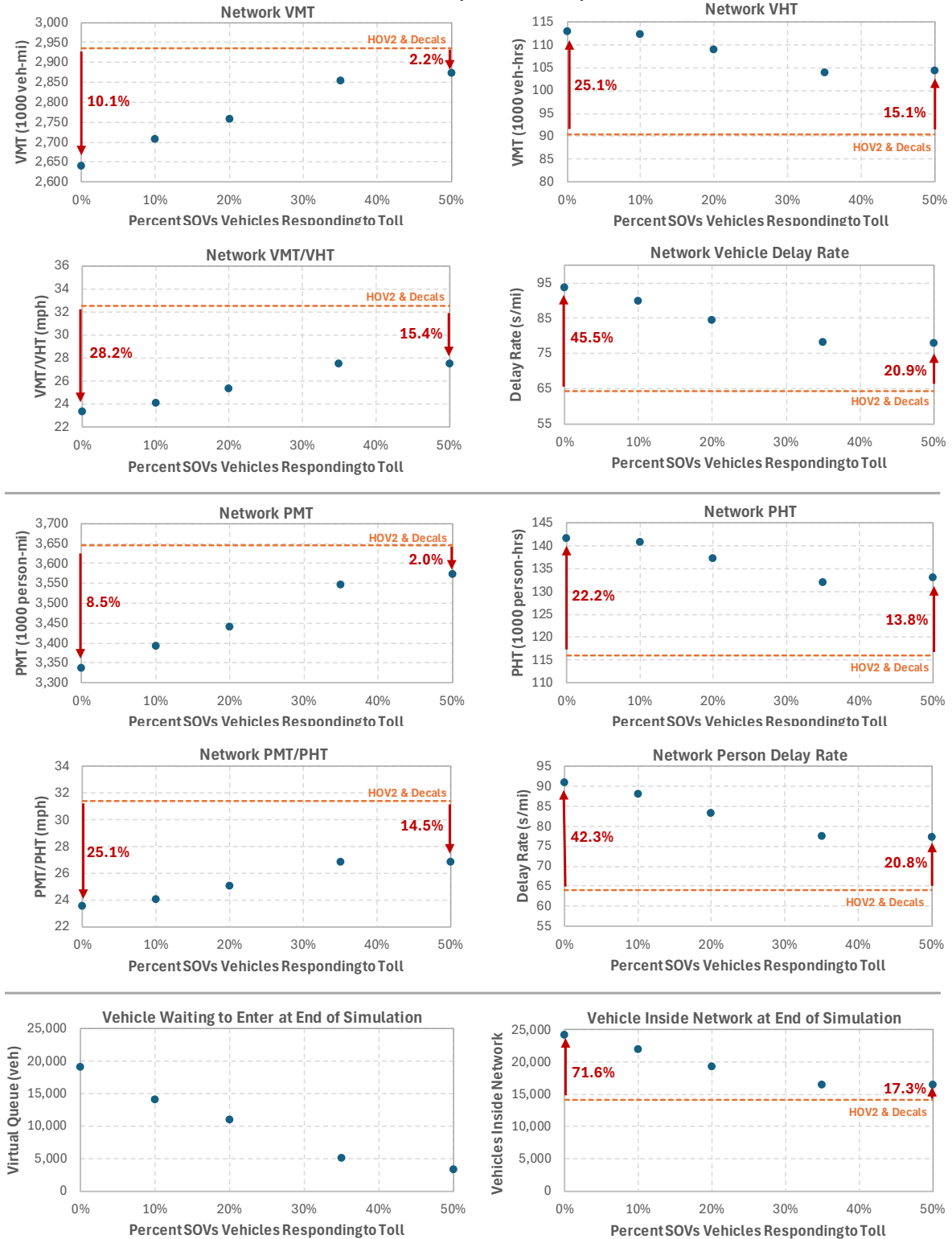


Figure 6-38: Network Performance Metrics, HOT Lane Addition by GP Swap, AM Peak

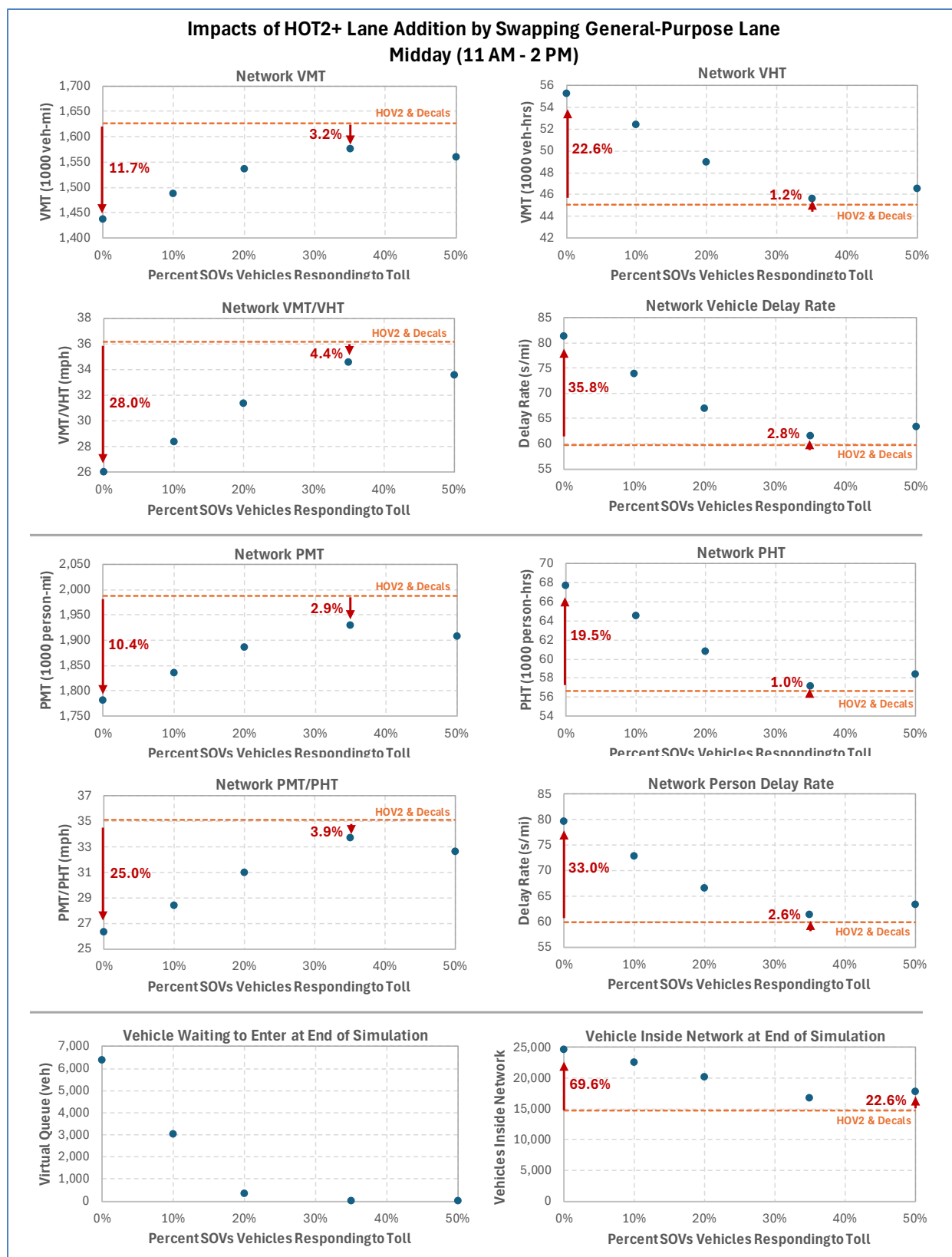


Figure 6-39: Network Performance Metrics, HOT Lane Addition by GP Swap, Midday

Impacts of HOT2+ Lane Addition by Swapping General-Purpose Lane PM Peak (3 PM - 7 PM)

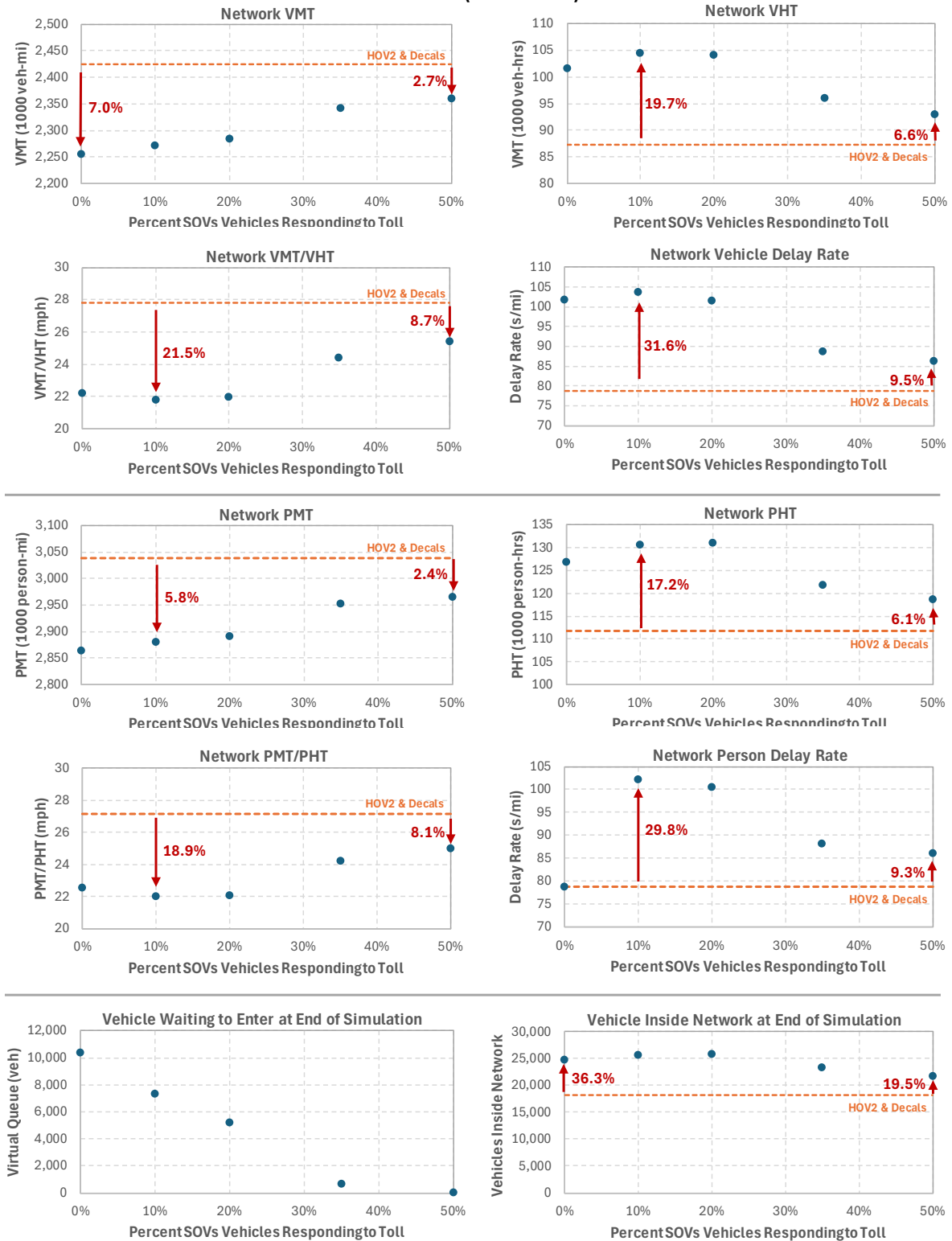


Figure 6-40: Network Performance Metrics, HOT Lane Addition by GP Swap, PM Peak

6.6. OVERALL OBSERVATIONS

Converting or restricting HOV lanes significantly affects freeway performance. Limiting access to single-occupancy clean-air vehicles slightly improves HOV travel times during peak periods, while stricter HOV3+ restrictions yield near free-flow speeds but cause severe queuing and unrealistic demand buildup on general-purpose lanes. Converting HOV to HOT lanes with dynamic tolling increases usage and efficiency only when managed carefully; unmanaged congestion at entry and exit gates can sharply increase travel times. Adding an extra HOT lane delivers the greatest overall benefit, improving both HOV and general-purpose travel times and raising network throughput. In contrast, converting an existing general-purpose lane to HOT drastically worsens congestion and system performance. Overall, strategies that expand capacity or optimize underused lanes produce the most balanced and sustainable gains.

Below is a summary of key observations from the simulated scenarios:

- **Restricting HOV eligibility to high-occupancy vehicles:** Restricting access to vehicles with higher occupancy improves HOV lane efficiency, particularly during peak commute times, but these benefits can be counterbalanced by deteriorating conditions on general-purpose traffic lanes and lead to overall network performance degradation.
 - Removing Clean Air vehicles has a positive impact on HOV operations, but mainly during peak hours. AM peak eastbound travel times along I-210 between SR-134 and I-605 are reduced by 1.6 minutes, while westbound PM peak times are reduced by 4.9 minutes. Only marginal improvements are obtained outside these two cases. General-purpose lanes see minimal change, except for slight improvements during the PM peak due to reduced friction at HOV entry/exit points. This leads to changes in average corridor travel times of less than 2 minutes, and overall network performance remains close to the initial scenario.
 - When access is restricted to HOV3+ vehicles, travel times on the high-occupancy facility approach free-flow conditions due to the removal of about 86% of traffic on the lane, and 93% of traffic if Clean Air vehicles are also restricted. This results in excessive queueing on the general-purpose lanes and adjacent arterials in periods of high traffic, as well as unserved demand at the network boundaries, due to the lack of sufficient capacity on the general-purpose lanes.
 - Further restricting to HOV4+ is equivalent to closing the HOV lane.
- **HOV2+ to HOT2+ conversion with dynamic tolling:** Converting the HOV lane to a dynamically tolled HOT lane increases traffic in high-occupancy lanes, improving efficiency when underused.
 - Moderate toll participation increases VMT on HOT lanes, except in congested directions, such as westbound AM peak and eastbound PM peak.
 - While the simulations show increases in travel times on the HOT facility, these increases may be due to the use of a tolling policy being too permissive, a value of times that may be too low, or a combination of both.
 - Non-peak travel times on the high-occupancy lanes only had minor (<1 min) impacts.
 - If congestion at toll entry/exit gates is adequately addressed, average corridor travel times can improve. In the study, average westbound travel times from the I-605 to SR-134 interchanges dropped by 5.7 minutes. In the opposite direction, congestion effects instead caused travel times to increase by 1.3 minutes.

- Performance gains depend heavily on managing friction and the proportion of toll-responding vehicles.
- **HOV2+ to HOT2+ conversion with added HOT lane:** Adding an HOT lane to the freeway yields the largest overall improvements, mainly due to the added capacity.
 - HOT lane travel times drop sharply, particularly during periods of heavy traffic. Drops of 6.8 and 9.5 minutes were simulated for the westbound AM peak and eastbound PM peak, while eastbound and westbound midday travel times dropped by 8.9 and 4.0 minutes.
 - Traffic along general-purpose lanes also benefit, especially midday. Simulated midday travel times dropped by 5.4 minutes eastbound and 1.2 minutes westbound. Reductions are also obtained during other periods, but typically of less than 1.0 minute.
 - Improvements on the HOT and general-purpose lanes translate into overall freeway and networkwide performance improvements. This is evidenced by increased VMT, resulting from more vehicles being able to travel through the network, and lower VHT and speeds, reflecting less congestion.
 - While this scenario shows significant systemwide benefits, it may not be feasible at many locations due to physical right-of-way constraints and high construction costs.
- **HOV2+ to HOT2+ conversion with general-purpose lane swap:** Converting one general-purpose lane into a HOT lane severely harms performance.
 - Network capacity drops, creating large queues and unserved demand.
 - Despite overall congestion, higher toll participation slightly mitigates delays as more vehicles shift to HOT lanes.
 - However, the net effect remains negative due to insufficient overall capacity.

Overall takeaways from the supply-side scenarios considered can finally be summarized as follows:

- Restricting access to higher occupancy vehicles (in this case, HOV3+) improves performance of the high-occupancy facility but can cause major system bottlenecks, particularly during peak travel periods.
- Toll-based conversion works only with careful management of lane access and friction.
- Adding lanes delivers the best balance of throughput and travel time but may not be feasible at many locations due to physical constraints and costs.
- Lane swaps between the general-purpose and high-occupancy lanes or excessive access restrictions can harm overall efficiency and increase delays, both along the freeway and corridor.

7. DEMAND-SIDE SCENARIO RESULTS

This section presents the results of the simulations conducted for the following scenarios:

- Shift toward HOV3 vehicles within existing traffic demand and eligibility HOV3+ policy.
- Increase in overall traffic demand under existing HOV2+ eligibility.
- Change in the value of time.

Similar to the supply-side scenarios, simulation results are presented in this section and in Appendix B. The review of results is conducted with the general objectives of assessing the specific impacts on the HOV/HOT facility and general-purpose freeway lanes, as well as on freeway and off-freeway network components and the overall corridor. The focus is on assessing impacts on travel times and VMT.

7.1. SHIFT TOWARD HOV3 WITHIN HOV3+ ELIGIBILITY

This scenario explores changes in corridor operation when access eligibility to the HOT facility is set to vehicles with three or more occupants (HOV3+) with an increasing proportion of eligible high-occupancy vehicles. Specifically, this scenario explores what happens when increasing proportions of single-occupancy and two-occupant vehicles switch to three occupants. As was demonstrated in Section 6.1, a shift to an HOV3+ eligibility would ban about 86% of existing traffic on the high-occupancy facility. The scenario thus looks at how far motorists would have to switch to vehicles with three or more occupants to regain initial network performance. Throughout all simulations, access is again maintained for single-occupancy vehicles with a Clean Air decal. Motorists are also assumed to have a mean value of time of \$35/hour, with a \$5 standard deviation, as described in Section 5.2.

Figure 7-1 to Figure 7-3 summarize the impacts on travel time and delays along each direction for the HOV lanes, general-purpose lanes, and overall freeway over the AM peak (5-11 AM), midday (11 AM-2 PM), and PM peak (3-7 PM). Figure 6-38 to Figure 6-40 Figure 6-19 further presents directional VMT, VHT, and travel time statistics for the core HOT section (SR-134 to I-605), while Figure 7-7 to Figure 7-9 illustrate networkwide VMT, VHT, PMT, and PHT statistics, with end-of-simulation statistics about the number of vehicles in the network and waiting to enter it. More detailed results tables are provided in Appendix B5.

The following general observations can be made from the results provided:

- In all scenarios, a point is reached where increases in the proportion of HOV3+ vehicles start to negatively impact the travel times along the HOV lanes. Typically, travel times between the SR-135 and I-605 start to increase, in both directions, with shifts in HOV3+ vehicles greater than 15%, of 12.5% for the eastbound PM peak scenario.
- Beyond a 15% shift, overall gains in freeway performance are still obtained despite longer travel times along the HOV lanes, as the resulting increase in HOV travel times is more than fully compensated by further reductions in travel times along the general-purpose lanes.
- When looking at the network performance metrics, restricting access to HOV3+ vehicles results in an initial drop in network VMT, reflecting a drop in the number of vehicles able to go through the network, and an increase in VHT and a drop in average network speed (VMT/VHT ratio), reflecting increased congestion within the network. The difficulty of traveling through the network is further evidenced by the larger initial virtual queues at the edge of the network

compared to the reference scenario, particularly for the AM and PM peaks, and the large number of vehicles remaining within the network at the end of a simulation.

- Following the above-mentioned initial impacts, a certain shift in occupancy is required to eliminate congestion at network entry points. For both the AM and PM peak periods, a 20% shift is required. For the midday period, only a 2.5% shift is required as there is already ample capacity available on the general-purpose lanes to accommodate the vehicles banned from the HOV lanes.
- Shifting traffic demand towards HOV3+ vehicles gradually reduces congestion within the network but does not necessarily eliminate it. This can be observed by the decreasing number of vehicles remaining within the network at the end of a simulation. For the AM peak and midday, a full recovery to a level corresponding to the reference scenario is achieved with a shift of about 25%, as evidenced by the VMT values returning to levels close to the base scenario while VHT values remain at lower levels, indicating higher average network speeds. For the PM peak, a full recovery is not achieved with the scenarios considered, as VHT levels remain higher than the reference level, indicating that shifts greater than 35% might be required to fully eliminate the added congestion.
- All scenarios indicate the difficulty of recovering from an accessibility shift to HOV3 using only demand-related changes, as shifts of 15%, 25% or more would imply major changes in travel behavior, considering that only a very small fraction of vehicles have more than one occupant, and significantly less have more than two.

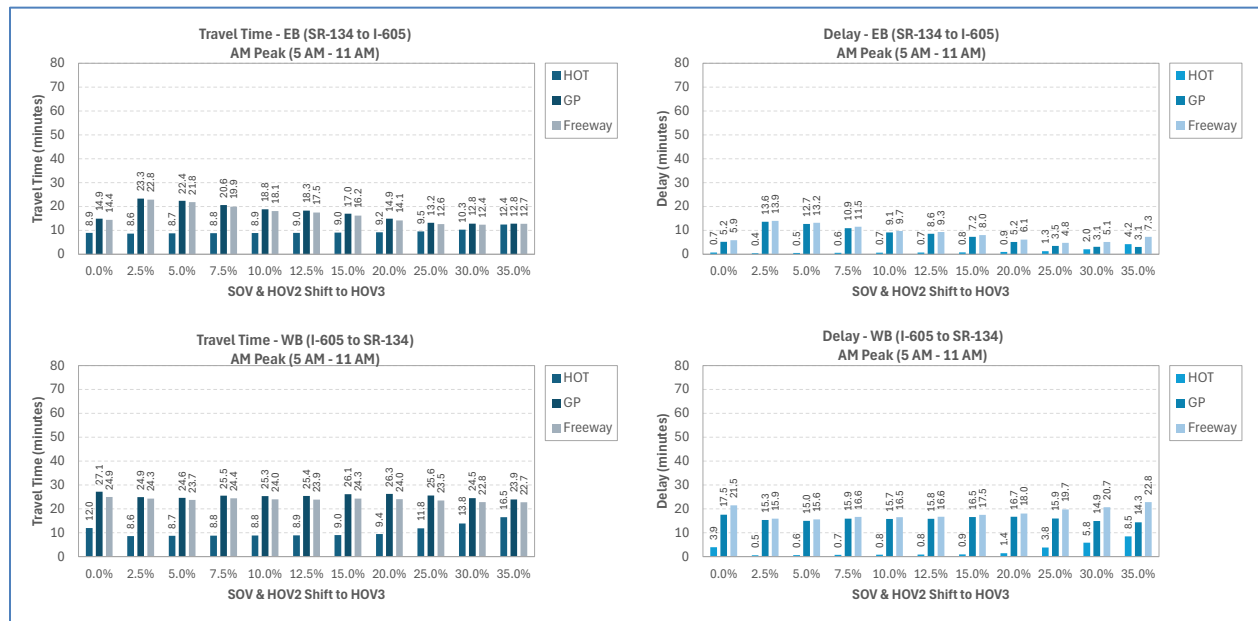


Figure 7-1: Network Performance Metrics, Shift to HOV3+, AM Peak

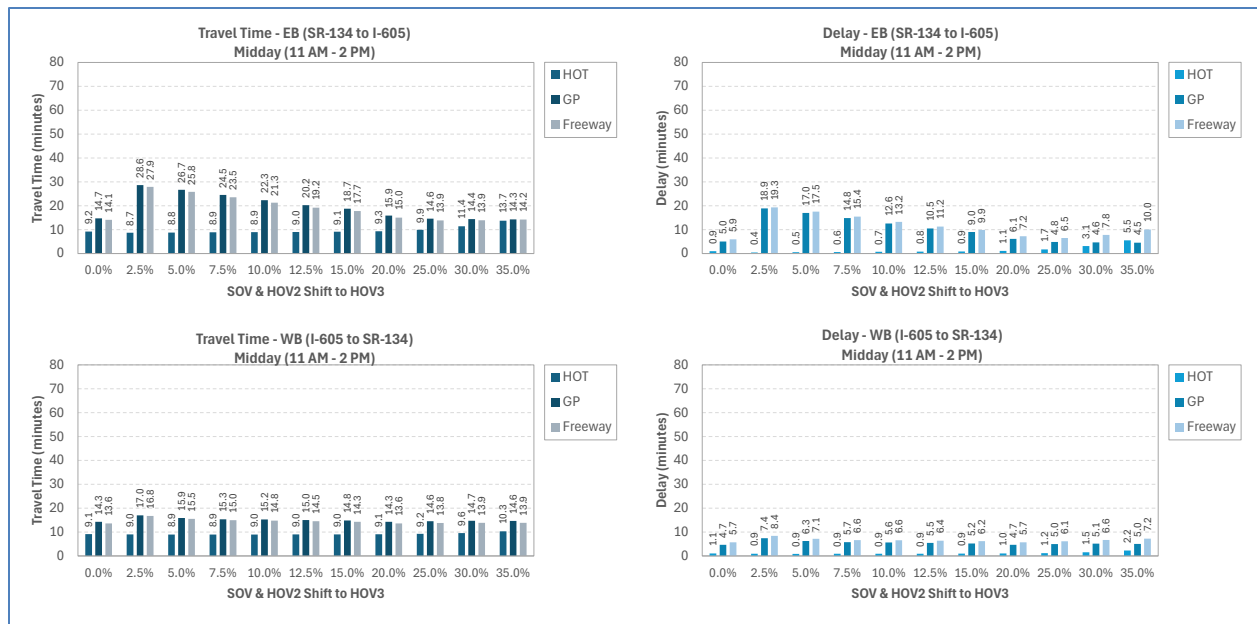


Figure 7-2: Network Performance Metrics, Shift to HOV3+, Midday

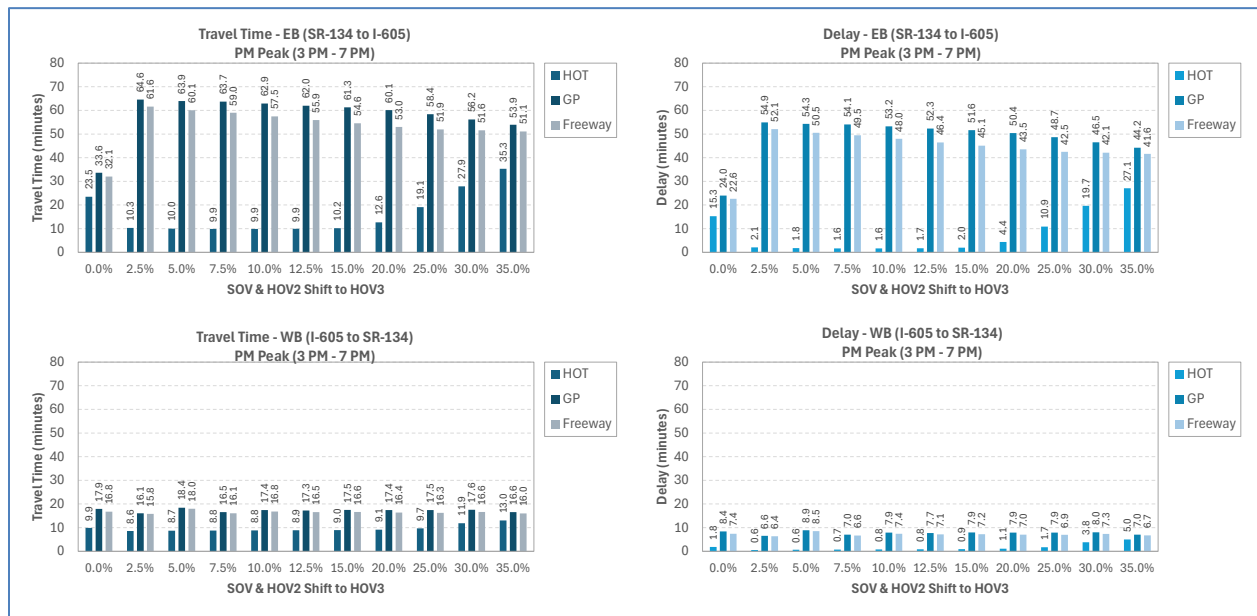


Figure 7-3: Network Performance Metrics, Shift to HOV3+, PM Peak

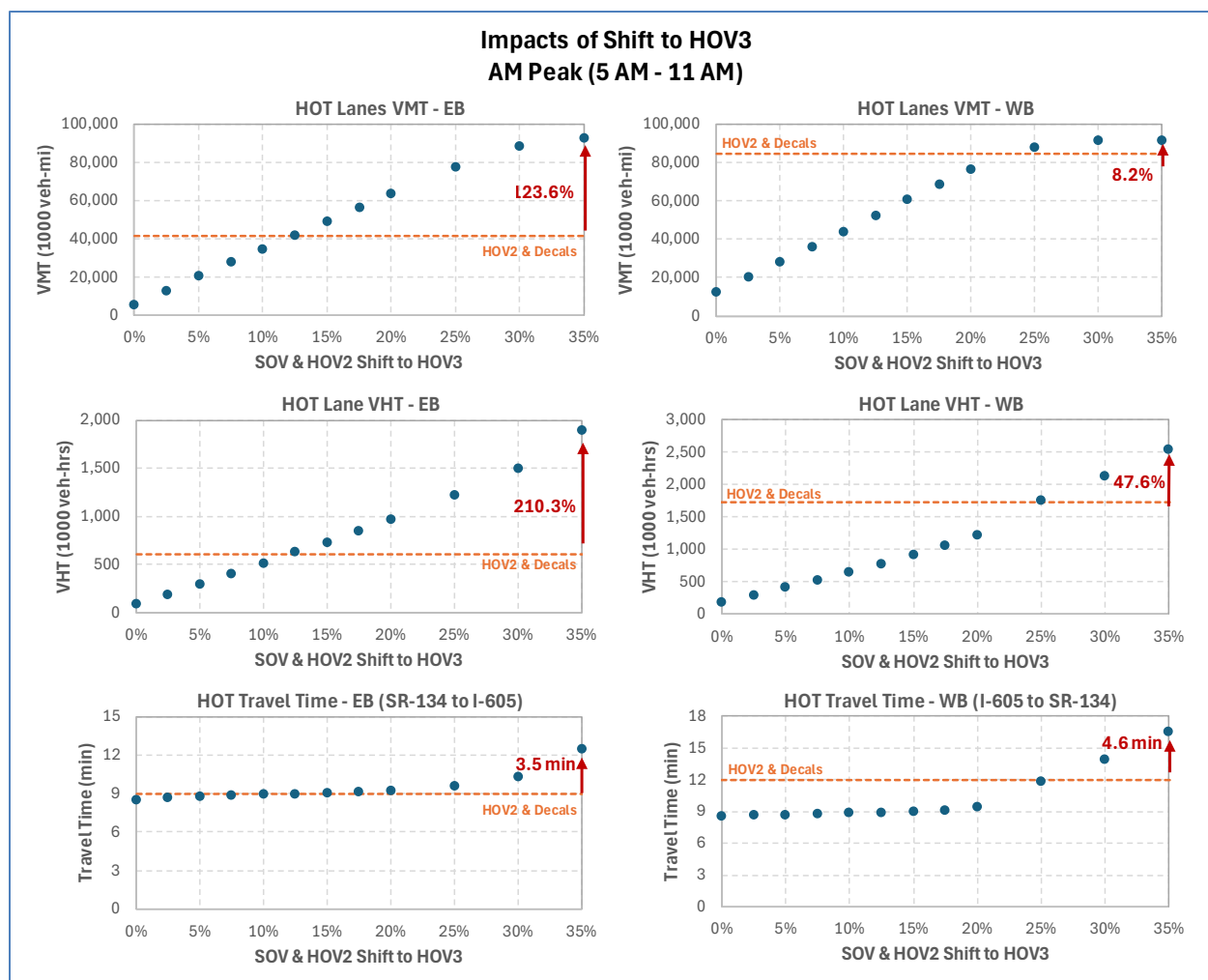


Figure 7-4: HOT Performance Metrics, Shift to HOV3+, AM Peak

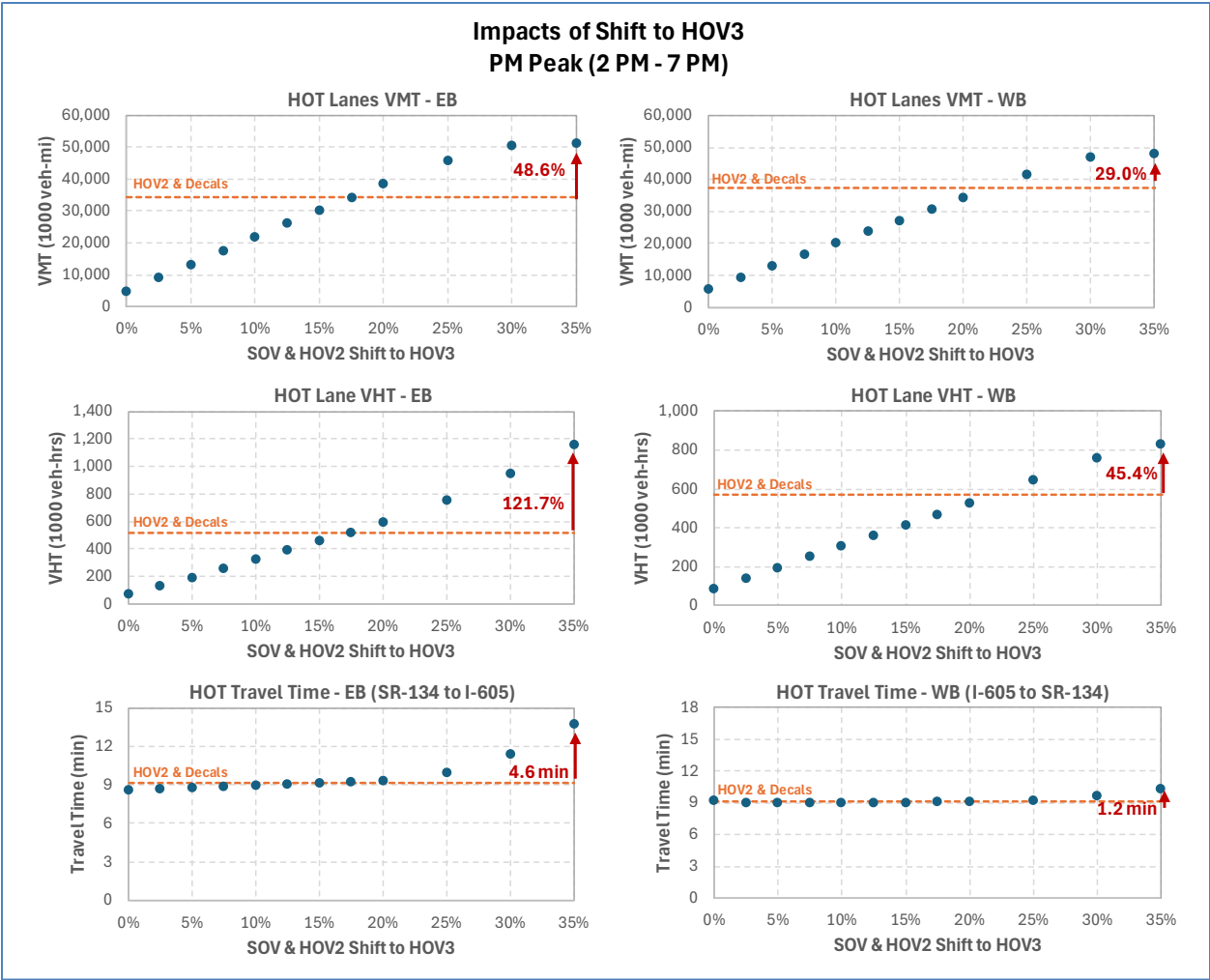


Figure 7-5: HOT Performance Metrics, Shift to HOV3+, Middy

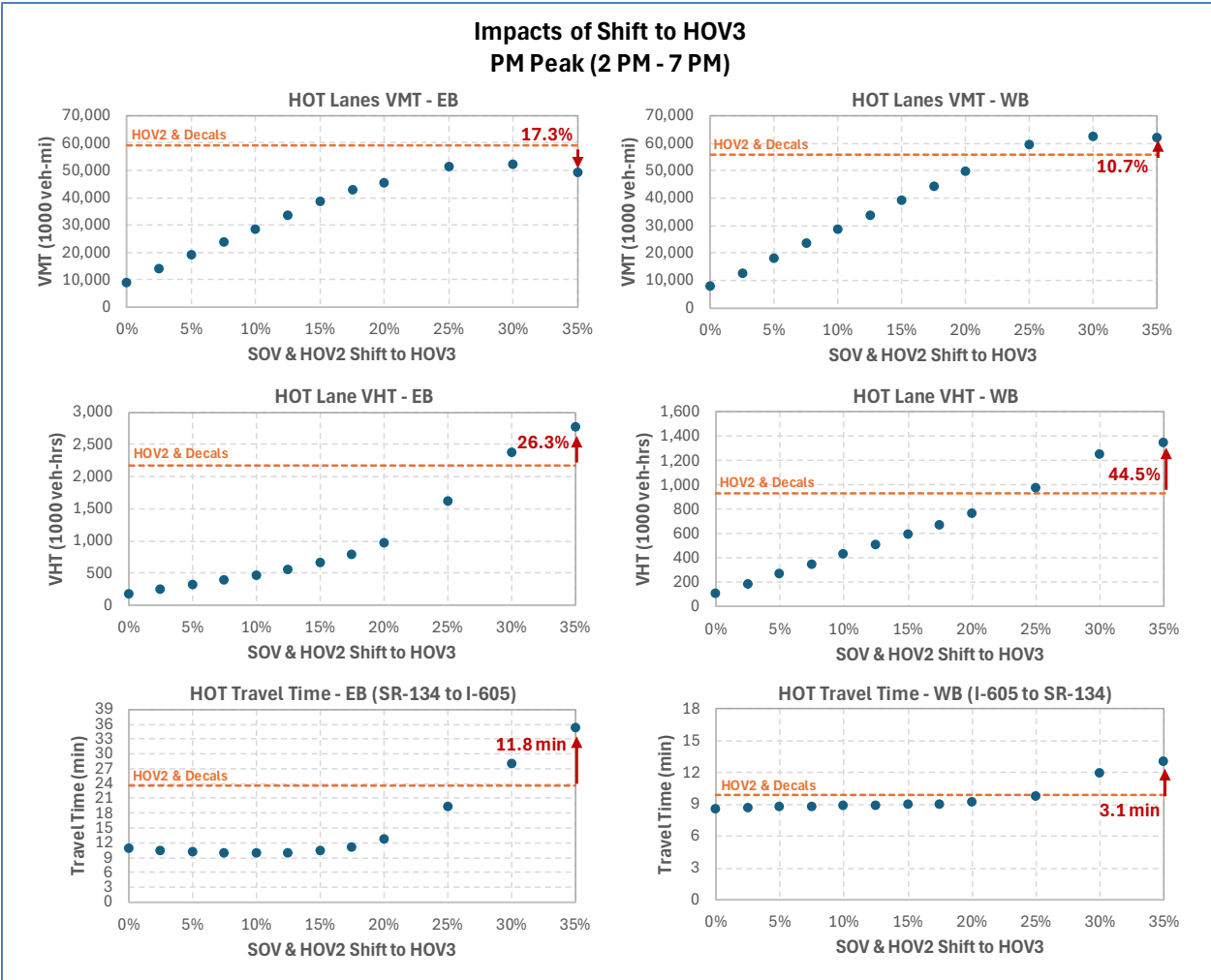


Figure 7-6: HOT Performance Metrics, Shift to HOV3+, PM Peak

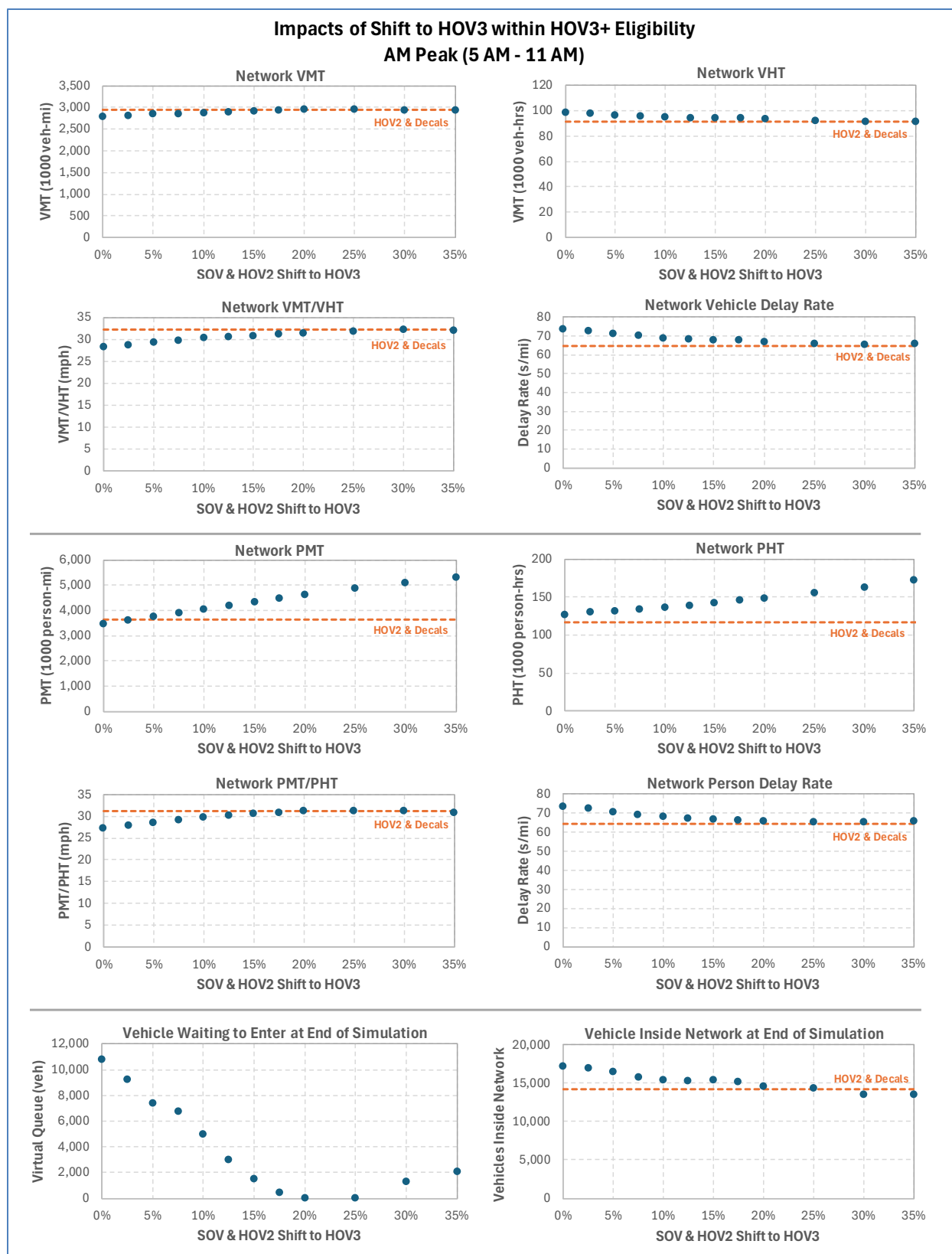


Figure 7-7: Network Performance Metrics, Shift to HOV3, AM Peak

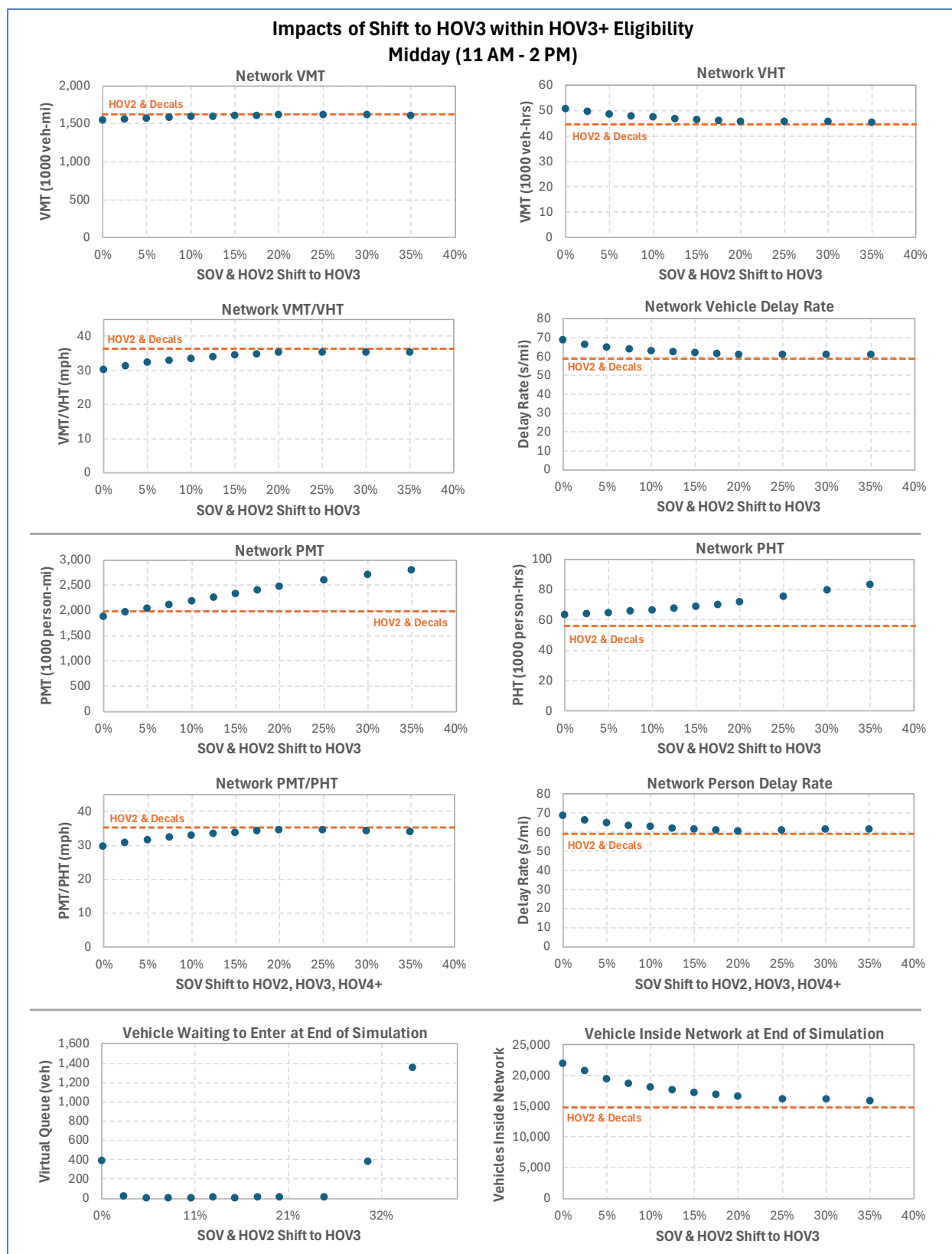


Figure 7-8: Network Performance Metrics, Shift to HOV3, Midday

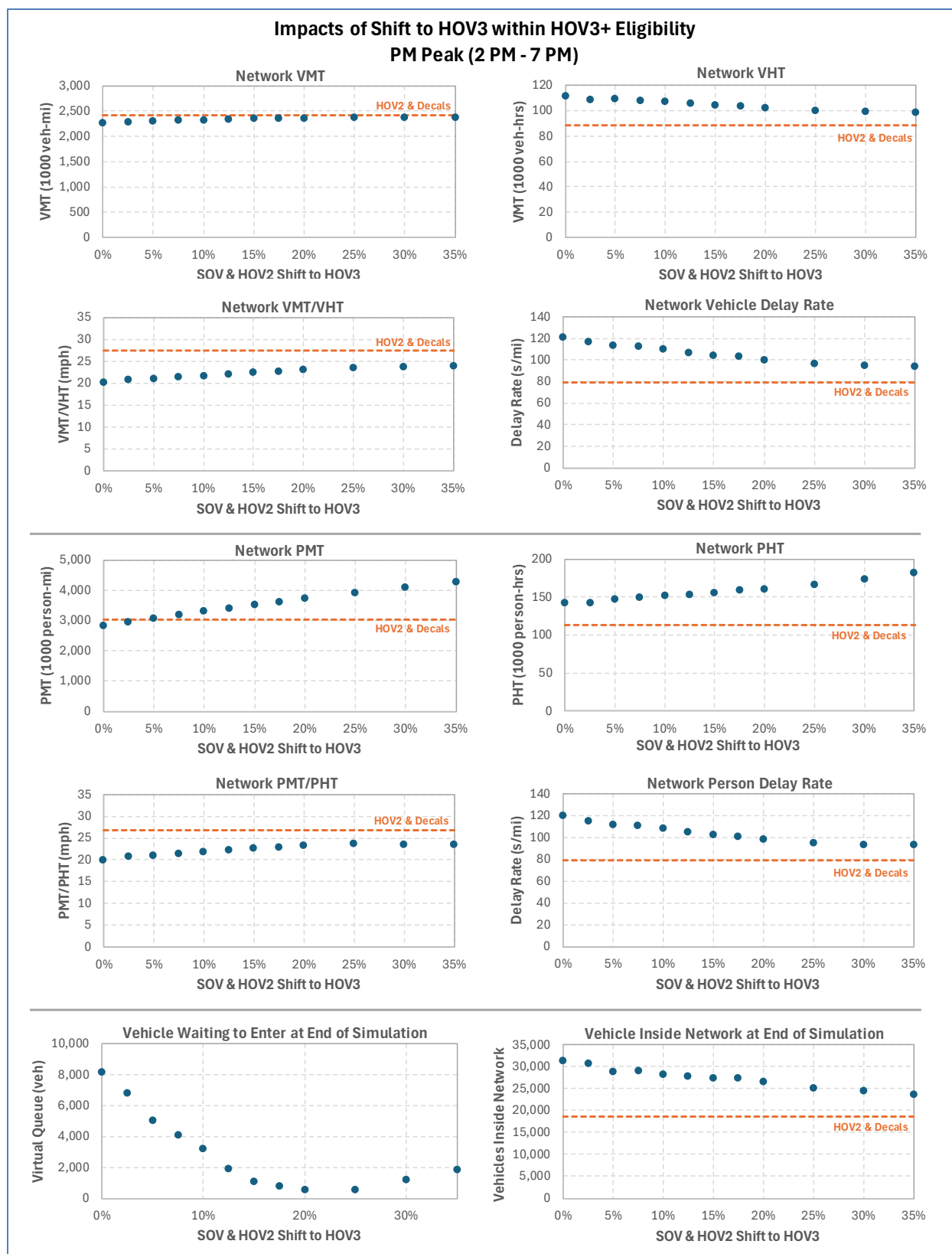


Figure 7-9: Network Performance Metrics, Shift to HOV3, PM Peak

7.2. INCREASE IN OVERALL TRAFFIC DEMAND

This scenario examines the sensitivity of corridor performance to increases in overall traffic demand. Demand growth is particularly relevant in the context of induced travel, population growth, economic activity, and long-term regional travel trends. For this analysis, total traffic demand was increased uniformly across all passenger-vehicle categories, while truck and transit volumes were maintained at their base levels. Simulations were conducted for demand increases of up to 15 percent under two alternative managed-lane configurations:

- Existing one-lane HOV2+ operations.
- Conversion of the HOV facility to a dynamically tolled one-lane HOT2+ facility.

The two configurations were evaluated to assess whether dynamic tolling can improve the corridor's ability to accommodate additional traffic demand. In both cases, access for single-occupancy clean-air vehicles was retained. Drivers were further assumed to retain a mean value of time of \$35/hour with a standard deviation of \$5/hour, consistent with the assumptions described in Section 5.2.

Figure 7-10 through Figure 7-12 summarize the travel time and delay impacts along each direction for the HOV lanes, general-purpose lanes, and overall freeway during the AM peak (5 AM - 11 AM), midday (11 AM - 2 PM), and PM peak (3 PM - 7 PM) periods. Figure 7-13 through Figure 7-15 further illustrate networkwide VMT, VHT, PMT, and PHT statistics, as well as end-of-simulation statistics about the number of vehicles remaining in the network and waiting to enter it. More detailed results tables are provided in Appendix B.6.

The following general observations can be made from the results provided:

- Increasing traffic demand degrades corridor performance under both the HOV2+ and HOT2+ operating strategies. As demand increases, average speeds decline, travel times and delays increase, and congestion becomes more widespread throughout the corridor. The deterioration is most pronounced during the AM and PM peak periods, when several freeway segments are already operating near capacity under baseline conditions.
- Travel times on the managed lanes increase as demand grows, particularly in the primary commute direction. Under HOT operation, additional vehicles are attracted to the managed lane when travel-time savings justify paying the toll, increasing managed-lane utilization but also reducing operating speeds. While this diminishes some of the travel-time advantage of the managed lane, it reflects more complete utilization of available corridor capacity.
- During the PM peak, the largest increases in managed-lane travel times occur in the eastbound direction between the SR-134 and I-605 interchanges. Congestion develops near managed-lane entry and exit gates, where intensive lane-changing activity creates operational bottlenecks that affect both managed-lane and adjacent general-purpose-lane traffic. Similar travel-time increases are not observed in the westbound AM peak direction because of the directional nature of travel demand. As discussed in Section 6.3, AM peak demand primarily originates outside the modeled area, causing capacity constraints to manifest as virtual queues at network entry points. During the PM peak, a much larger share of trips originates within the modeled network, causing congestion to appear as physical queues and reduced speeds on freeway segments within the study area.

- When evaluating the general-purpose lanes, the HOT alternatives generally produce shorter travel times than the corresponding HOV alternatives because some vehicles are diverted to the managed lane, reducing density and delaying the onset of congestion on the general-purpose lanes. The primary exception is the eastbound AM peak direction, where increased lane-changing activity near the HOT lane access points offsets these benefits and results in slightly higher travel times.
- From an overall freeway perspective, the relative effectiveness of HOT operation reflects a balance between improved utilization of managed-lane capacity and additional operational friction associated with entry and exit maneuvers. The HOT scenario produces longer average freeway travel times during both AM peak directions and the eastbound PM peak direction, where gate-related turbulence and higher managed-lane volumes offset the benefits of traffic diversion. In contrast, lower overall freeway travel times are observed during both midday directions and the westbound PM peak direction, where the reduction in general-purpose-lane demand more than compensates for any additional congestion generated within the HOT facility.
- Networkwide performance measures indicate that demand increases produce disproportionate increases in congestion. While VMT and PMT generally increase with demand, VHT, PHT, delay rates, and end-of-simulation vehicle accumulation increase at a faster rate, indicating that the network is approaching its practical operating capacity. This nonlinear response is particularly evident during the peak periods.
- The number of vehicles waiting to enter the network and the number remaining within the network at the end of the simulation increase substantially as demand rises. These measures indicate that portions of the corridor become capacity constrained and are increasingly unable to accommodate additional demand within the analysis period.
- Compared with the HOV2+ configuration, the HOT2+ configuration generally results in fewer vehicles trapped within the network and smaller virtual queues at network entry points. This suggests that dynamic tolling improves overall throughput and network resilience by making more effective use of available managed-lane capacity.
- Although the HOT operation provides measurable benefits over the HOV alternative, neither strategy fully offsets the impacts of continued demand growth. As demand approaches corridor capacity, congestion increasingly dominates system performance, highlighting the importance of complementary strategies such as improved managed-lane access design, transit enhancements, transportation demand management programs, and targeted capacity improvements.

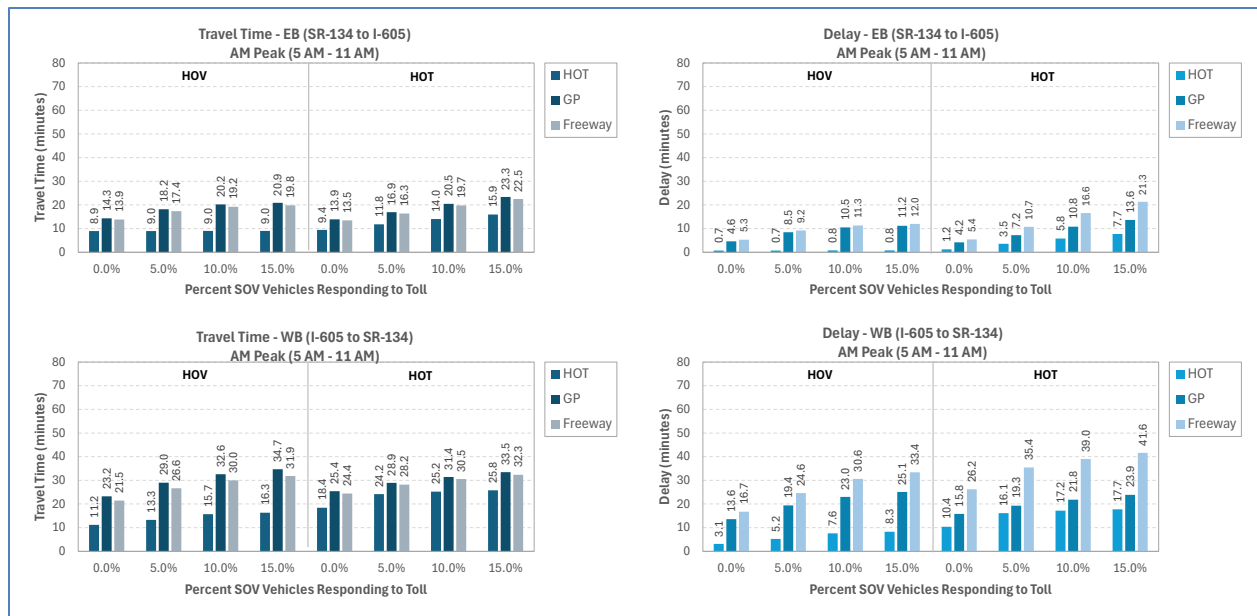


Figure 7-10: Network Performance Metrics, Demand Increase, AM Peak

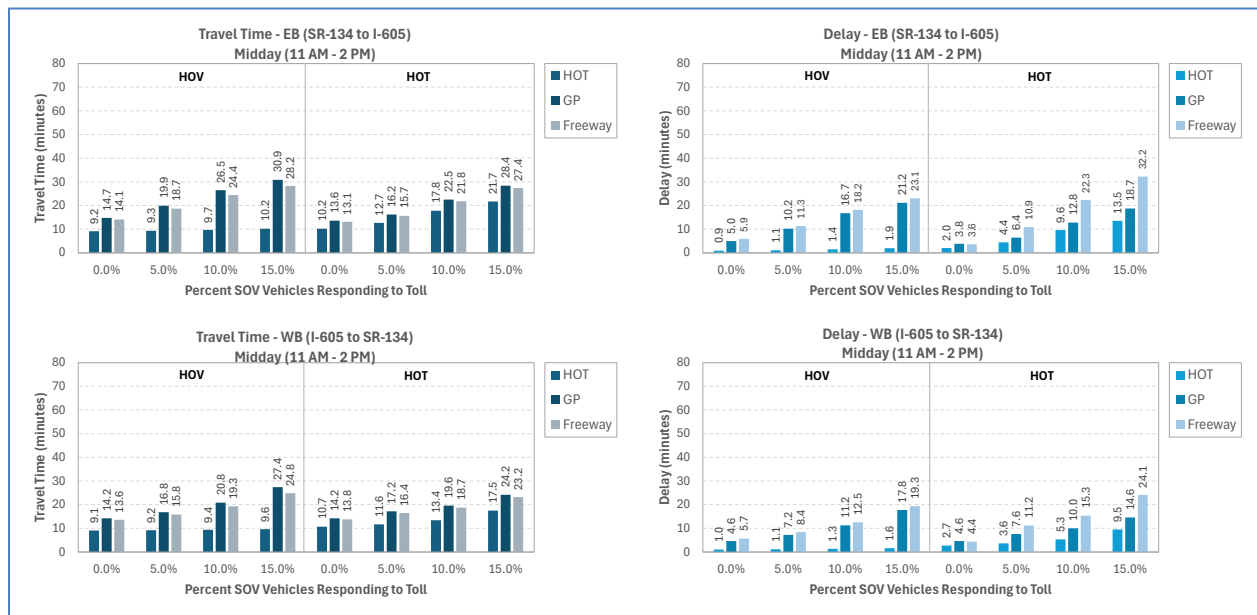


Figure 7-11: Network Performance Metrics, Demand Increase, Midday

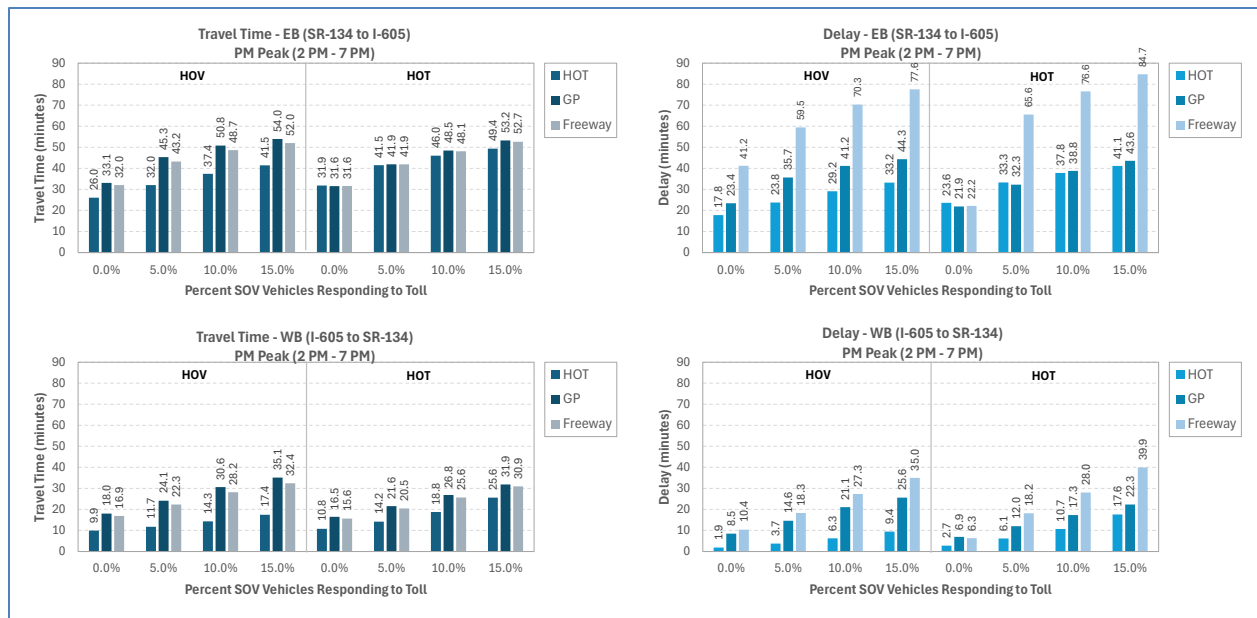


Figure 7-12: Network Performance Metrics, Demand Increase, PM Peak

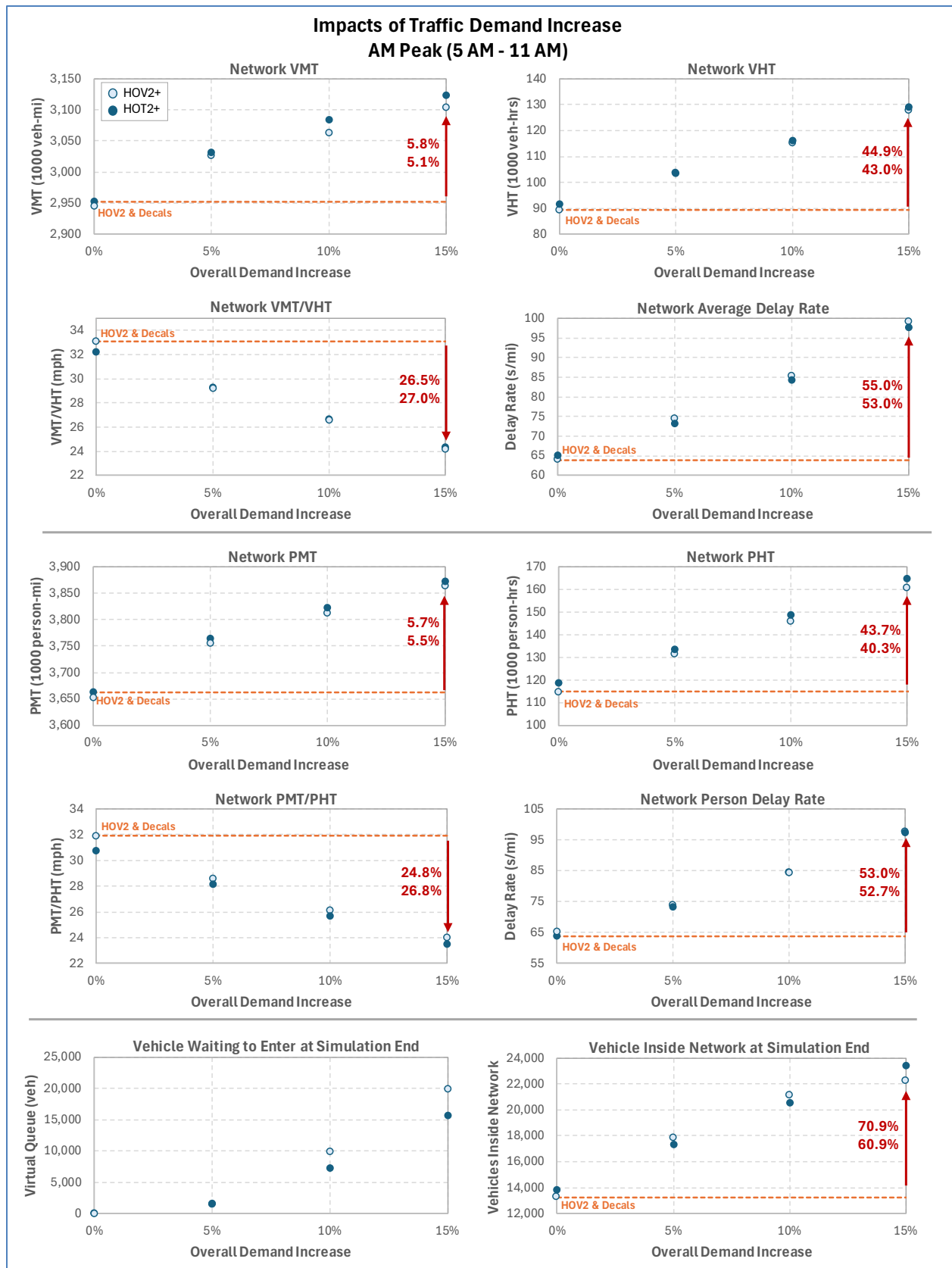


Figure 7-13: Network Performance Metrics, Demand Increase, AM Peak

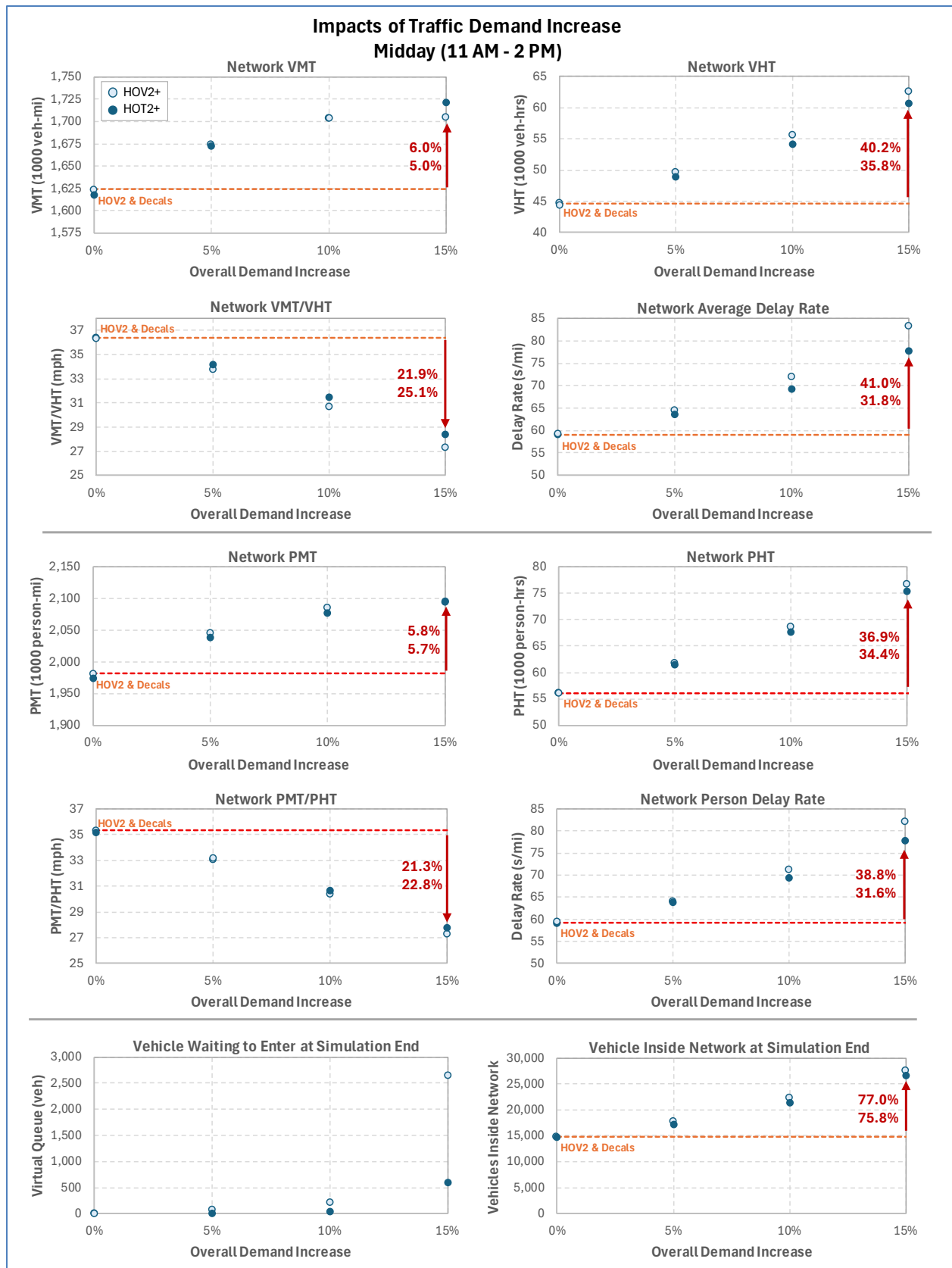


Figure 7-14: Network Performance Metrics, Demand Increase, Midday

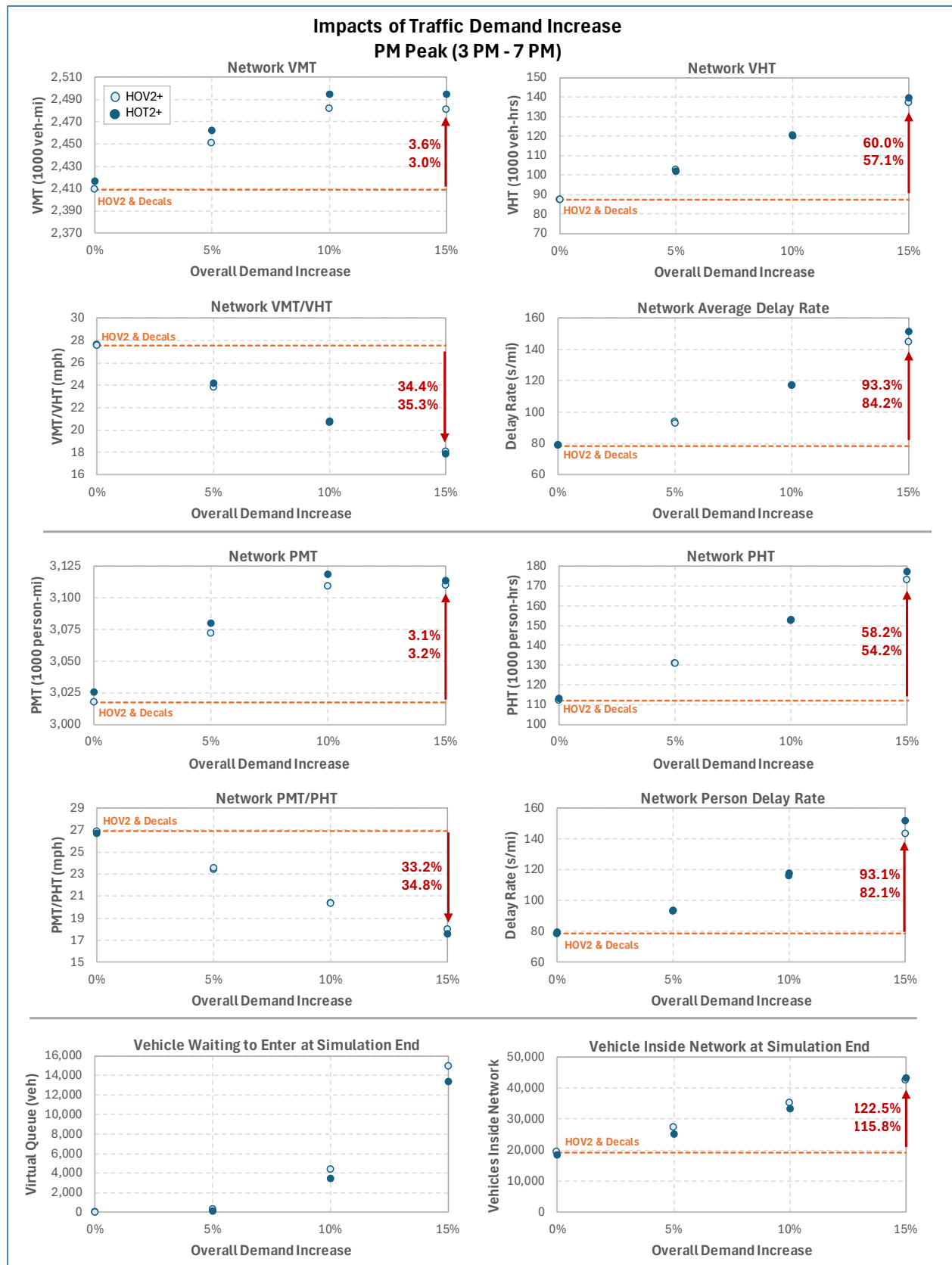


Figure 7-15: Network Performance Metrics, Demand Increase, PM Peak

7.3. CHANGE IN VALUE OF TIME

This scenario examines the value of time that travelers consider when assessing the benefits of paying a toll to avoid congestion. In all previous scenarios, the value of time was set at \$35/hour, with a standard deviation of \$5/hour. This value was selected to reflect the median salary in Los Angeles County in 2024. Explorations are made to see how lower or higher values affect driver behavior and corridor operations. Simulations examine values of time specifically between \$15/hour and \$65/hour.

Figure 7-16 to Figure 7-18 summarize the impacts on travel time and delays along each direction for the HOV lanes, general-purpose lanes, and overall freeway over the AM peak (5-11 AM), midday (11 AM-2 PM), and PM peak (3-7 PM). Figure 7-19 to Figure 7-21 further presents directional VMT, VHT, and travel time statistics for the core HOT section (SR-134 to I-605), while Figure 7-22 to Figure 7-25 illustrate networkwide VMT, VHT, PMT, and PHT statistics, with end-of-simulation statistics about the number of vehicles in the network and waiting to enter it. More detailed results tables are provided in Appendix B7.

The following general observations can be made from the results provided:

- Changes in the value of time affect HOT lane performance, primarily when there is congestion on the general-purpose lanes. Lower values reduce the incentive to save time by paying a toll. This leads to lower volumes, higher speeds, and shorter travel times on the HOT lanes. Conversely, higher values increase the attractiveness of the HOT lane, leading to increased traffic and lower performance.
- The largest impact on HOT lane performance is observed for the midday period, with eastbound and westbound travel time increases of 10.0 and 3.7 minutes, respectively. Changes in travel times during the AM peak remain below 2 minutes, and below 1.0 minutes during the PM peak. The largest impacts during midday are associated with the reduced traffic conditions along the freeway. As there is less difference in travel times between the HOT and general-purpose lanes, drivers of single-occupancy vehicles have less incentive to use the HOT lane. In this context, changes in the value of time have a greater impact on tilting the balance toward using or not using the HOT lane than during peak periods when travel time differences tilt the balance more in favor of using the HOT lanes.
- Changes in the value of time can noticeably impact the performance of general-purpose traffic lanes. As increasing values move more vehicles to the HOT lanes, lower traffic on the general-purpose lanes increases speed between the SR-134 and I-605 interchanges and lowers travel times. Within the simulations, increases in the value of time reduce eastbound travel times by 0.8 minutes and westbound travel times by 2.4 minutes during the AM peak, by 1.2 and 0.4 minutes midday, and by 2.0 and 1.6 minutes during the PM peak.
- At the overall freeway level, the combined, and often opposite, impacts on the HOT and general-purpose lanes generally result in performance improvements with increasing values of time. This is due to better balancing of traffic between the various lanes. Across the simulations, increases in the value of time reduce eastbound and westbound travel times by 0.7 and 3.2 minutes, respectively, during the AM peak, by 1.0 and 0.5 minutes midday, and 0.8 and 1.2 minutes during the PM peak.
- At the network level, no clear trends are observed, both at the vehicle and person levels. For the AM and PM peaks, observed changes generally remain below 0.5%, with both positive and negative impacts. Slightly cleared but still muted trends are observed for midday. The lack of a

clear trend is associated with the fact that the impacts of changes to the value of time remain largely contained within the freeway. While some vehicles may choose to use the HOT lane instead of the general-purpose lane, or vice versa, the resulting changes in freeway performance gains are too small to noticeably propagate to the surrounding arterials. It may also be pointed out that a portion of the observed variability may be associated with the stochasticity of the simulation engine used to conduct the evaluations.

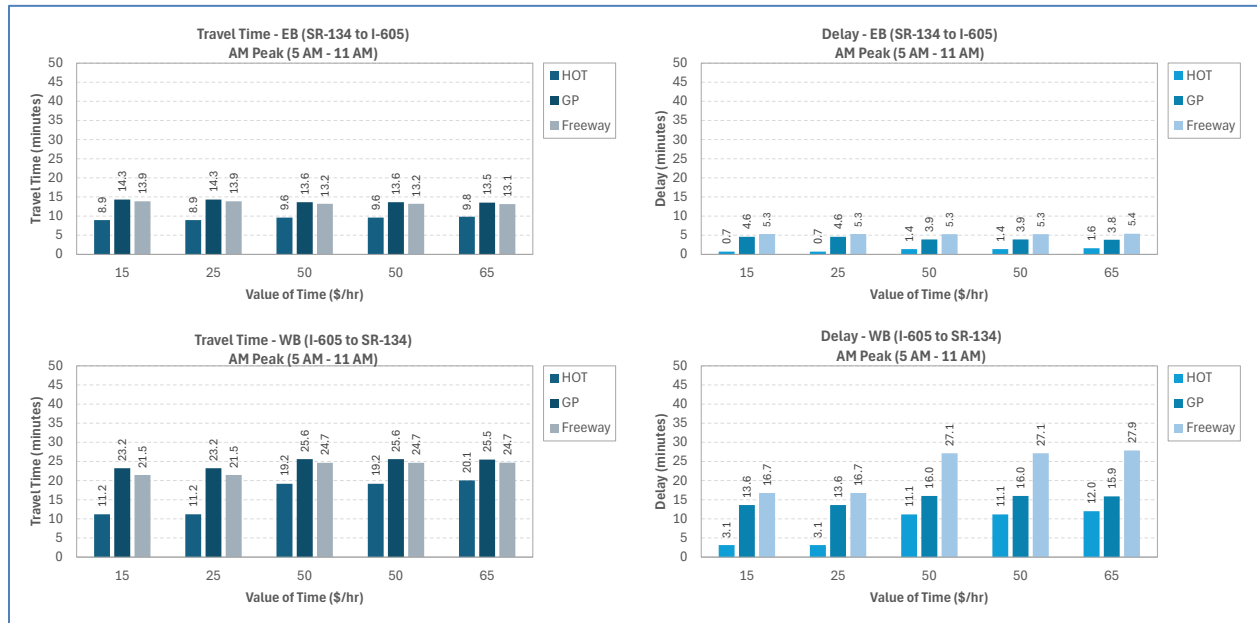


Figure 7-16: Network Performance Metrics, Change in Value of Time, AM Peak

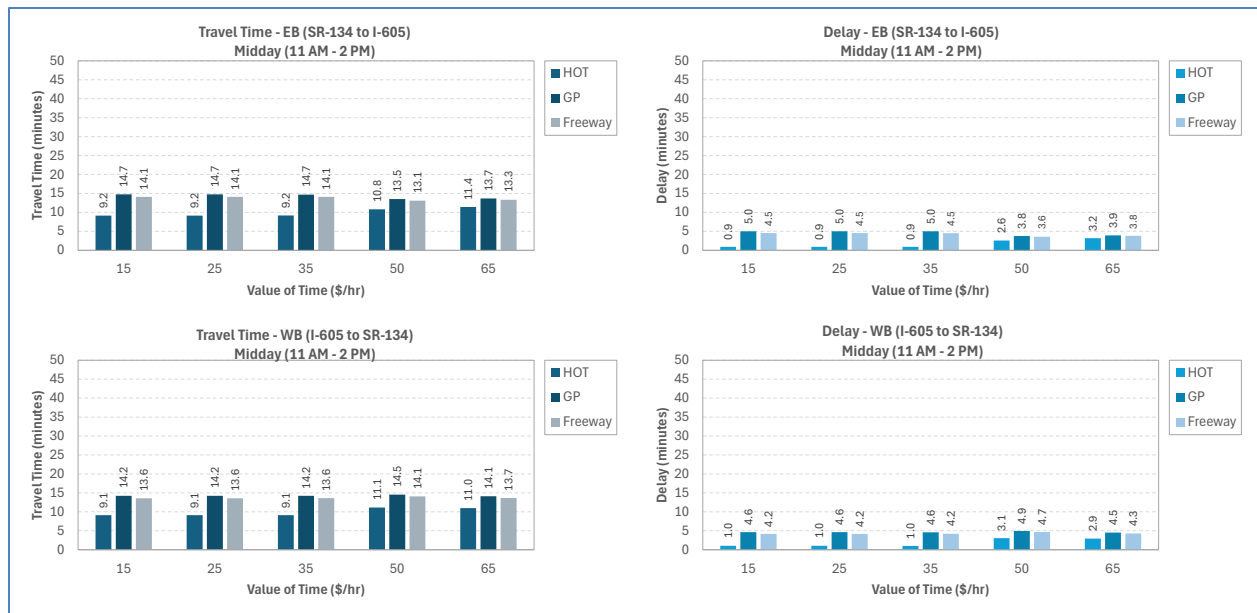


Figure 7-17: Network Performance Metrics, Change in Value of Time, Midday

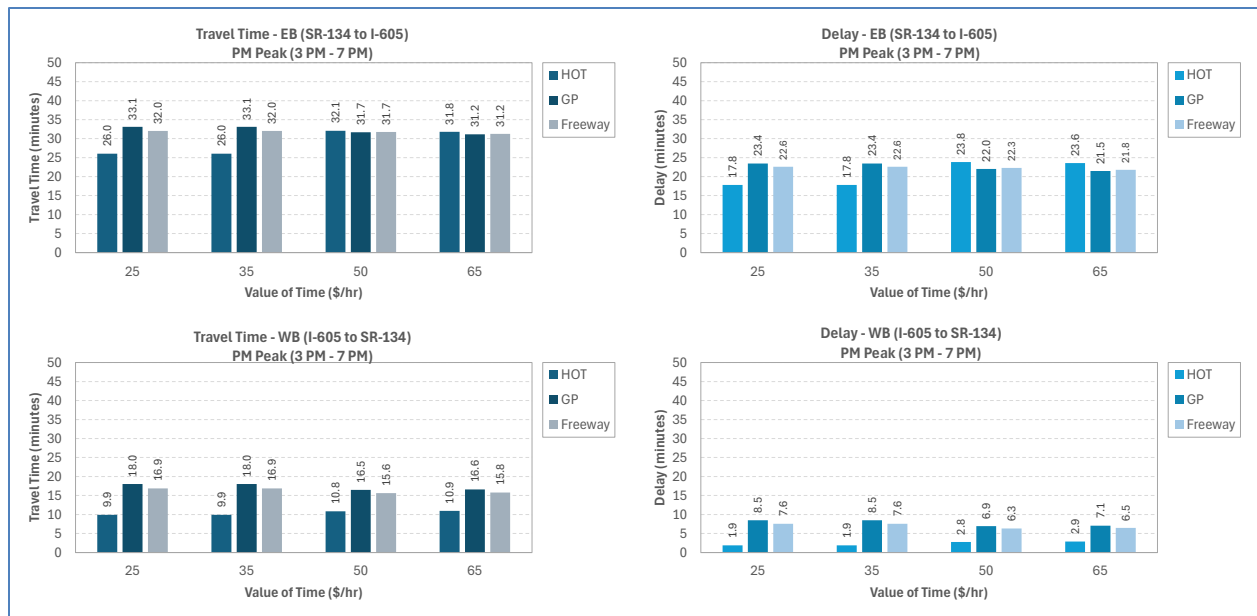


Figure 7-18: Network Performance Metrics, Change in Value of Time, PM Peak

Impacts of Value of Time AM Peak (5 AM - 11 AM)

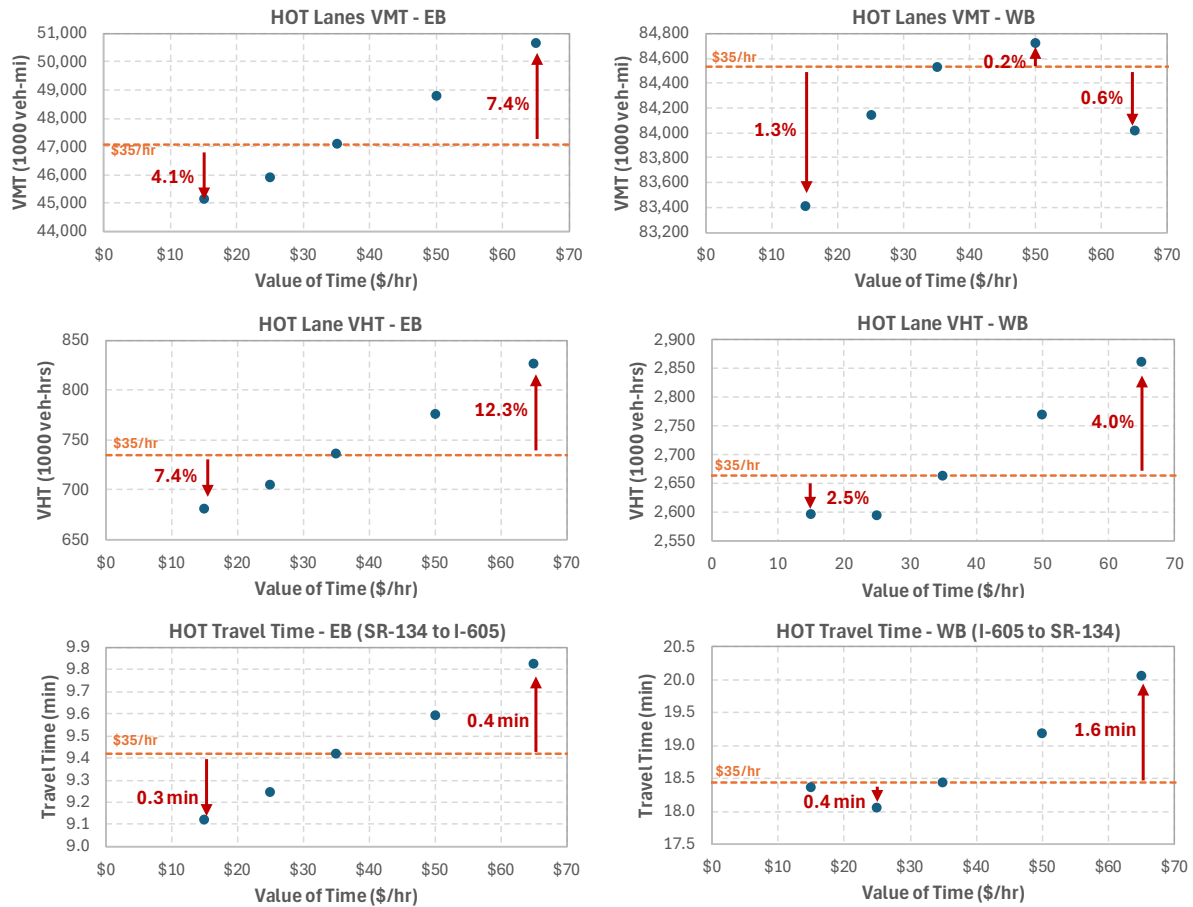


Figure 7-19: HOT Performance Metrics, Change in Value of Time, AM Peak

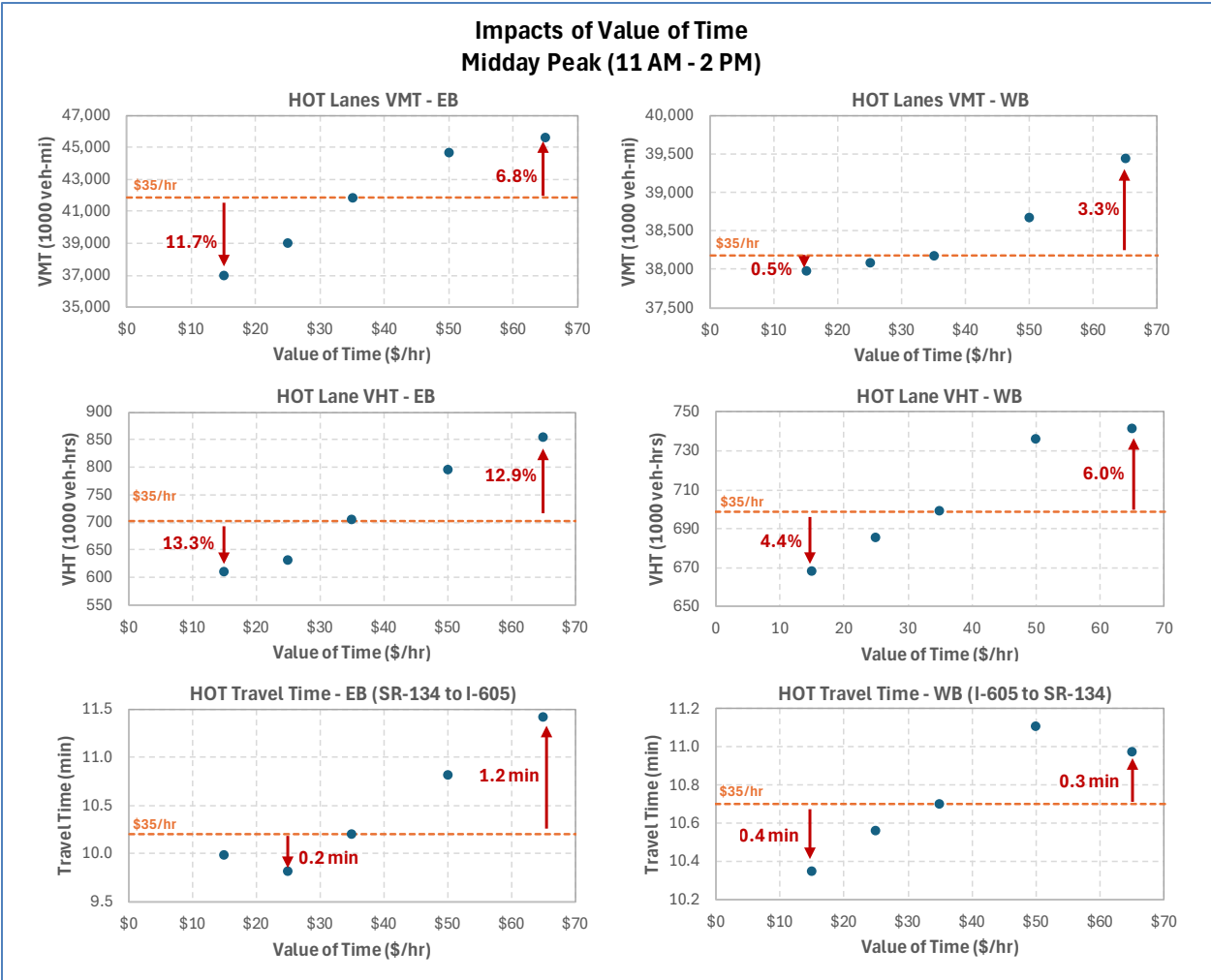


Figure 7-20: HOT Performance Metrics, Change in Value of Time, Midday

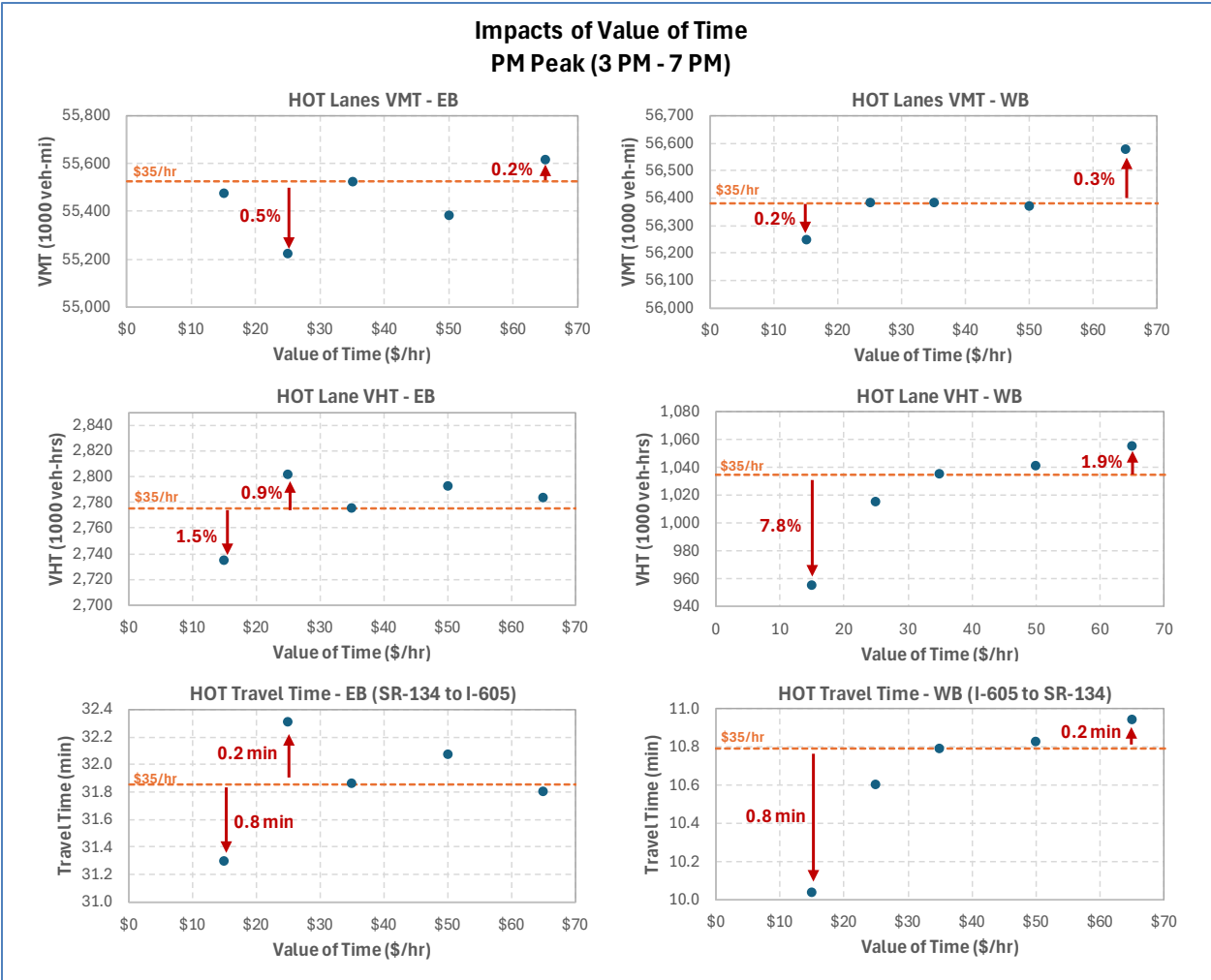


Figure 7-21: HOT Performance Metrics, Change in Value of Time, PM Peak

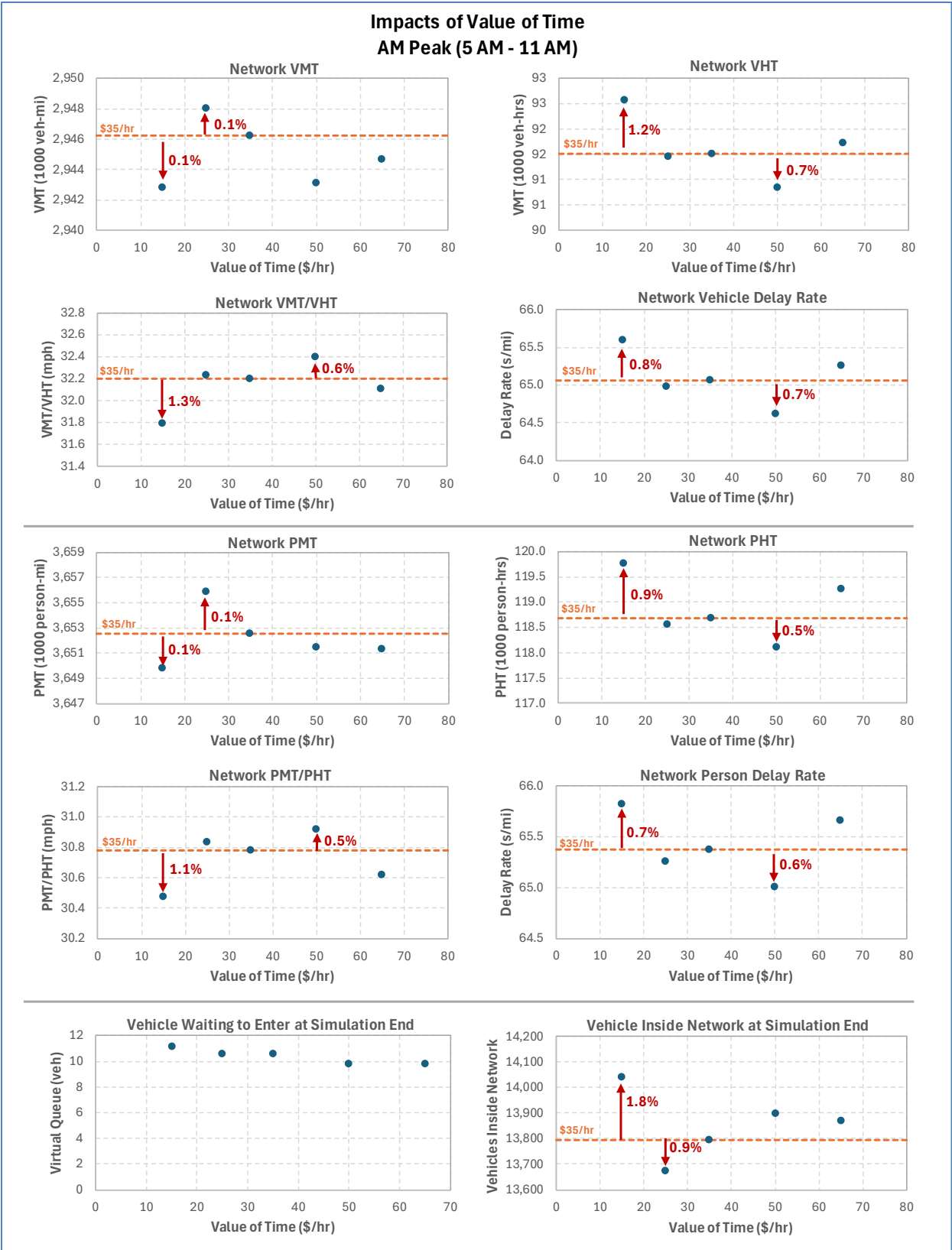


Figure 7-22: Network Performance Metrics, Change in Value of Time, AM Peak

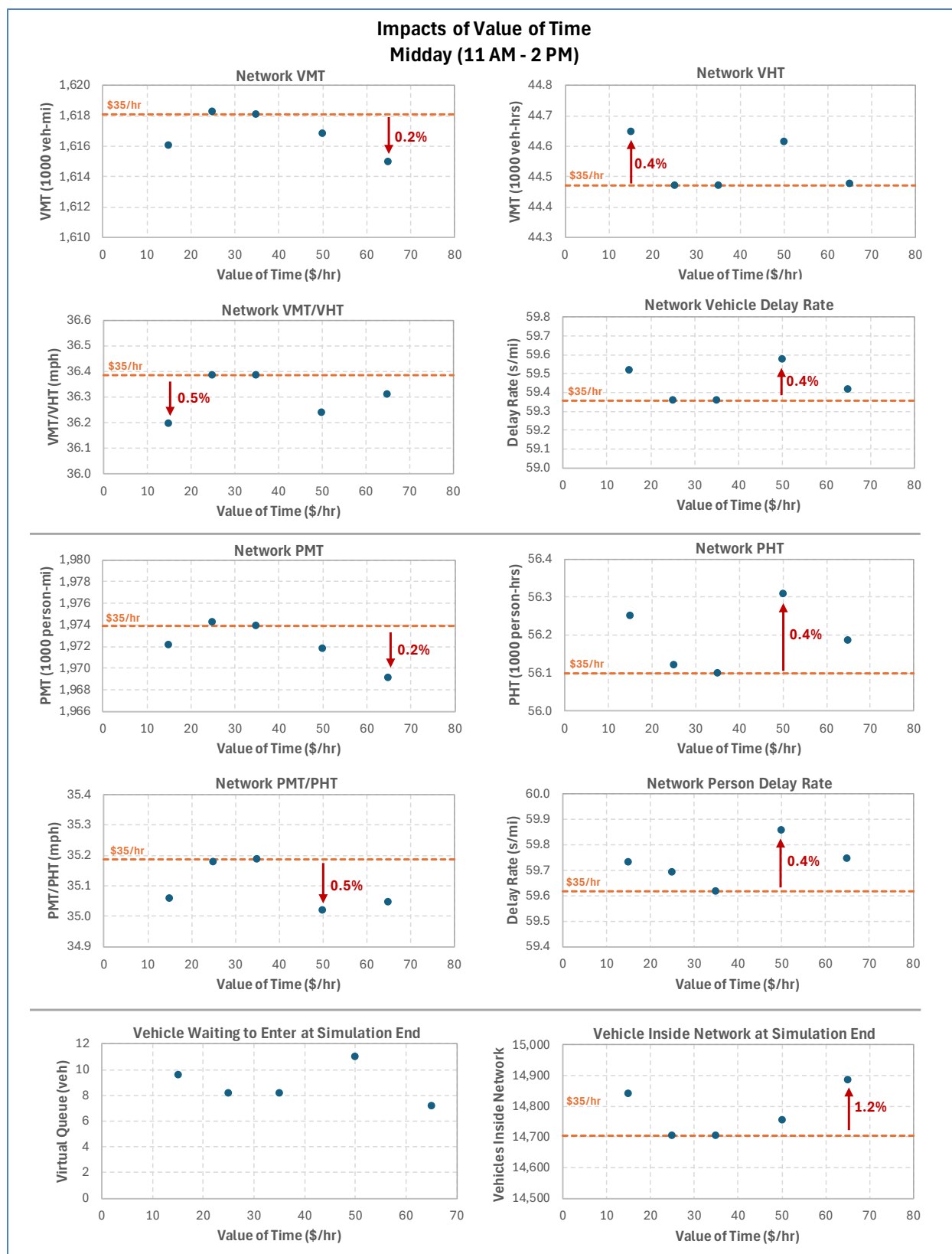


Figure 7-23: Network Performance Metrics, Change in Value of Time, Midday

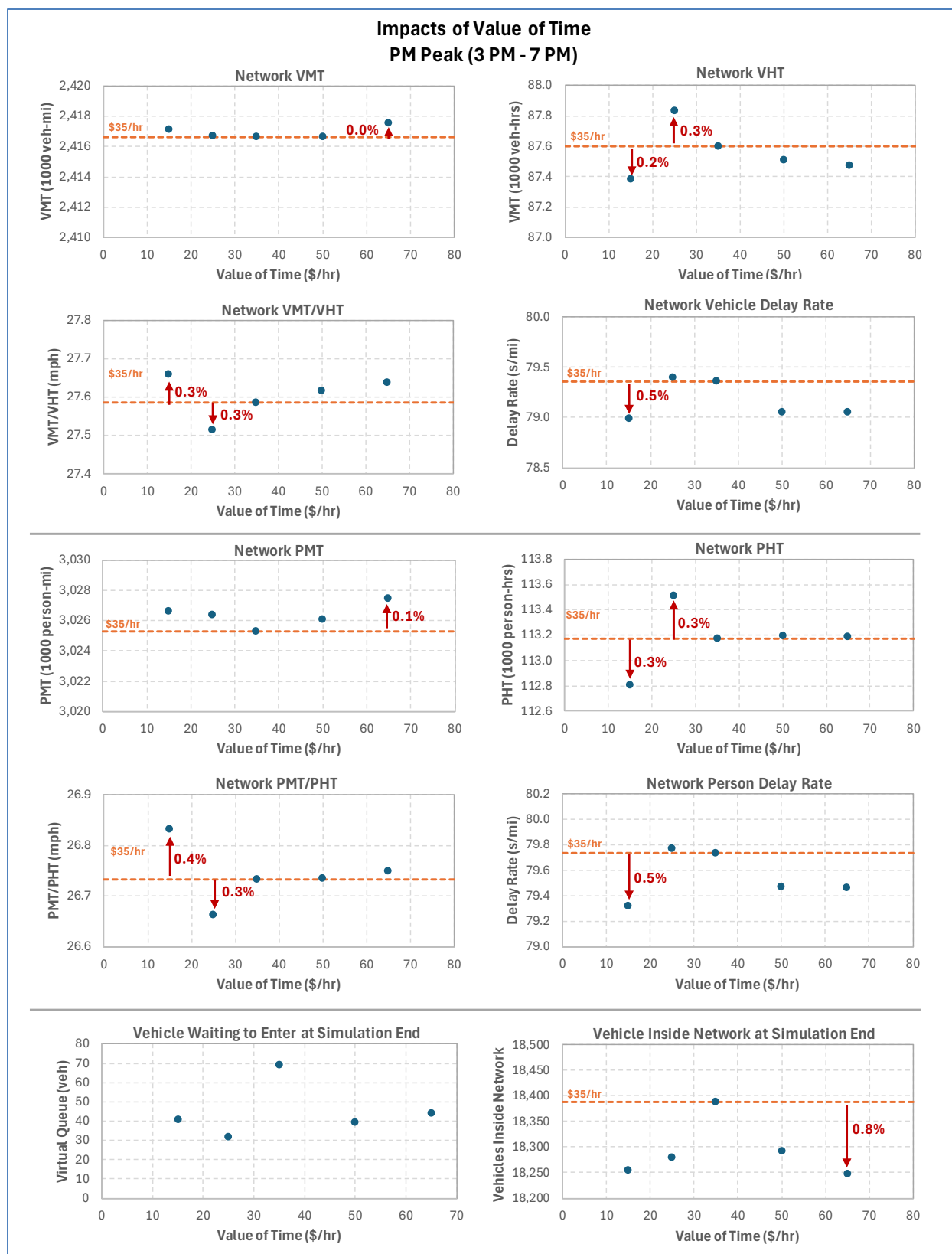


Figure 7-24: Network Performance Metrics, Change in Value of Time, PM Peak

7.4. OVERALL OBSERVATIONS

Demand-side simulations show that behavioral and economic adjustments alone are insufficient to resolve corridor congestion. Moving to HOV3+ eligibility initially degrades performance and requires at least a 20–25% shift toward higher-occupancy vehicles to recover baseline conditions, a level unrealistic without major behavioral change. As expected, increases in overall traffic demand worsen congestion across the freeway and network. However, negative impacts might be contained by implementing dynamic tolls by allowing traffic to more efficiently use available capacity across the HOT and general-purpose lanes. Variations in traveler value of time affect lane choice and travel times, and thus freeway performance, but have minimal impact on overall network performance. Overall, demand management strategies can moderate congestion but must be combined with supply-side improvements, such as lane expansion, access control, and dynamic tolling, to achieve sustained operational efficiency.

Below is a summary of key observations from the simulated scenarios:

- **Shift Toward HOV3+ Vehicles:** While restricting access to the high-occupancy lanes to HOV3+ vehicles significantly deteriorates traffic conditions on the general-purpose lanes, performance observed with the base HOV2 scenario can be regained if a sufficiently large proportion of vehicles take additional passengers to regain access.
 - For the AM peak and midday scenarios, a shift of about 20–25% toward HOV3+ was needed to restore network performance to baseline levels. For the PM peak scenarios, a full recovery was still not reached with a 35% shift toward HOV3+ vehicles.
 - Gains on general-purpose lanes offset rising travel times in HOV lanes after the 15% threshold, showing a tradeoff between equity and efficiency.
 - A key takeaway is that demand-side behavior changes can significantly affect network operations, but large changes in average vehicle occupancy might be required to fully compensate for the negative impacts from a more restrictive access policy. However, such large changes might be unrealistic in practice.
- **Increase in overall traffic demand:** Increases in overall traffic demand typically led to performance degradation across all scenarios. Both HOV and HOT facilities experience higher travel times, congestion, and lower average speeds. Simulation results show the following impacts for demand increases of up to 15%:
 - HOT lanes show longer travel times due to congestion near entry/exit gates, particularly when there is significant traffic on the general-purpose lanes, such as in the commute direction of the AM and PM peak periods.
 - On the general-purpose lanes, shorter travel times are typically obtained from the ability to reduce the number of vehicles traveling on them. However, increased congestion at the HOT entry/exit gates due to large volumes of vehicles attempting to change lanes could increase travel times.
 - At the network level, HOT configurations help absorb additional demand more efficiently than HOV setups by improving throughput and reducing vehicles waiting to enter the network, though overall freeway and network delays might still rise.
 - The results highlight the limits of infrastructure under rising demand and emphasize the importance of efficient adaptive tolling and entry/exit gate design to manage congestion.

- **Change in the value of time (VOT):** Varying the assumed traveler value of time between \$15/hour and \$65/hour shows predictable but moderate impacts:
 - Higher values of time increase the attractiveness of paying a toll to save some travel time. Traffic volumes on the HOT lanes were observed to increase with each increase in the value of time. This led to higher traffic densities, more friction at the entry/exit gates, and increased travel times.
 - Increased volume on the HOT lanes eased pressure on the general-purpose lanes, resulting in lower travel times that were often sufficient to produce average travel time reductions when considering all lanes on the freeway. During the AM peak, increases in the value of time reduced eastbound travel times by 0.7 minutes and westbound times by 3.2 minutes. Reductions of 1.0 and 0.5 minutes were obtained for the midday, and of 0.8 and 1.2 minutes for the PM peak.
 - Performance changes at the network level were minimal (<0.5%), suggesting limited impacts beyond freeway performance across different traveler cost sensitivities under normal daily traffic operations.

Overall takeaways from the supply-side scenarios considered can finally be summarized as follows:

- Demand-side strategies, such as encouraging carpooling, managing traffic growth, or adjusting perceived toll value, can influence corridor performance, but their effects can be limited compared to supply-side measures. Meaningful congestion reduction would require combining behavioral incentives with infrastructure and toll design adjustments to maintain balanced and efficient flow.

8. CONCLUSIONS

This study conducted a simulation study to evaluate the operational impacts of policy and infrastructure changes to high-occupancy vehicle (HOV) and high-occupancy toll (HOT) facilities along a 15-mile section of the I-210 corridor in northern Los Angeles County. A calibrated Aimsun Next microsimulation model that had previously been developed and that was expanded to include a dynamic toll module mimicking the system in place along I-10 and I-110, was used to assess both supply-side and demand-side strategies and quantify their effects on Vehicle Miles Traveled (VMT), Vehicle Hours Traveled (VHT), and corridor travel times under varying demand and behavioral assumptions.

8.1. KEY FINDINGS

Key findings from this study are as follows:

- **Restricting HOV Eligibility:** Limiting access to higher-occupancy vehicles (HOV3+ or higher) improves HOV lane travel times but can lead to significant congestion on the general-purpose lanes and nearby arterials, as well as unmet demand at the network level, due to insufficient capacity on the general-purpose lanes. These effects can be relatively light if only removing Clean Air vehicles since they account for a relatively small proportion of traffic (6% in the simulation), but can be significant if restricting HOV2 vehicles, as this would remove access to 86% of all traffic on the high-occupancy facility.
- **Conversion to HOT with Dynamic Tolling:** Converting the HOV2+ lane to a HOT2+ facility with dynamic tolling redistributes demand more effectively, particularly under uncongested or moderately congested conditions. However, when congestion occurs at entry and exit gates, travel times can rise sharply on the HOT and general-purpose lanes, negating the positive effects of dynamic demand balancing. Tolling performance is highly dependent on how friction at the entry/exit gates is managed and how drivers respond to price signals.
- **HOT Conversion with Added Lane:** Adding an HOT lane provides the most consistent systemwide benefit, reducing travel times across both high-occupancy and general-purpose lanes and increasing total VMT and VHT throughput. This scenario demonstrates that increasing managed lane capacity can meaningfully improve corridor performance if such a solution is deemed feasible.
- **HOT Conversion with GP Lane Swap:** Removing a general-purpose lane to create a HOT facility substantially degrades system performance. Overall capacity reduction leads to increased congestion and long network entry queues, outweighing any local gains from managed lane operations.
- **Demand-Side Strategies:** Behavioral changes, such as shifting toward higher occupancy vehicles, moderating travel demand, or changing the perceived value of time, can influence travel patterns but produce modest improvements compared to infrastructure measures. A 20% to 25% shift toward HOV3+ vehicles might be required to restore baseline conditions after HOV3+ restrictions, a likely unrealistic level of change under current behavioral trends.

8.2. POLICY IMPLICATIONS

The simulation results indicate that policies affecting how existing roadway capacity is allocated and managed can have a substantial influence on corridor performance. While demand-management strategies such as encouraging carpooling, reducing travel demand, or influencing travelers' willingness to pay tolls can contribute to improved performance, their impacts were generally smaller than those associated with changes in managed-lane operations and capacity utilization.

The findings suggest that restricting access to managed lanes should be approached cautiously. Policies that increase occupancy requirements without corresponding increases in eligible vehicle demand can improve operating conditions within the managed lane but may increase congestion on adjacent general-purpose lanes and reduce overall corridor efficiency. The simulations indicate that restoring baseline corridor performance under more restrictive eligibility requirements would require significant shifts toward higher-occupancy travel that may be difficult to achieve in practice.

By contrast, strategies that improve utilization of existing managed-lane capacity generally provide greater systemwide benefits. Dynamic tolling allows available capacity within managed lanes to be used more efficiently, increasing corridor throughput and reducing pressure on general-purpose lanes. However, the results also demonstrate that the effectiveness of HOT operations depends not only on pricing strategy but also on facility design and operations. Congestion associated with lane-changing activity near managed-lane entry and exit gates frequently emerged as a limiting factor, particularly during peak periods. Consequently, access design, gate spacing, weaving management, and operational controls should be considered critical components of managed-lane implementation and operation.

The analysis further suggests that maintaining a balance between managed-lane performance and general-purpose-lane performance is essential. Policies that improve managed-lane operations but significantly degrade conditions on adjacent lanes may not produce overall system benefits. Effective corridor management therefore requires evaluating performance from a network perspective rather than focusing exclusively on managed-lane operating conditions.

The demand-growth scenarios demonstrate that operational improvements alone cannot fully offset the effects of increasing travel demand. As corridor demand approaches available capacity, delays increase rapidly, and operational bottlenecks become more pronounced. Dynamic tolling can improve network resilience and delay the onset of severe congestion, but it cannot eliminate the underlying constraints imposed by finite roadway capacity. Long-term congestion-management strategies should therefore combine efficient managed-lane operations with broader approaches such as transit investment, transportation demand management programs, traveler-information systems, and land-use strategies that support more efficient travel patterns.

More broadly, the results support integrated corridor-management strategies that balance mobility, reliability, person movement, and efficient use of existing infrastructure. These findings are consistent with the objectives of Senate Bill 743, which encourage transportation decisions based on broader system performance rather than vehicle delay alone. Adaptive tolling optimized managed-lane operations, targeted incentives for higher-occupancy travel, and multimodal transportation investments should therefore be viewed as complementary tools within a comprehensive corridor-management framework rather than as independent solutions.

8.3. FUTURE APPLICATIONS

The simulation framework developed through this study provides a scalable analytical platform that can support future planning, design, and operational evaluations of managed-lane facilities throughout California. Beyond the specific I-210 corridor examined in this research, the methodology demonstrates how integrated microsimulation and dynamic tolling models can be used to evaluate the interactions among roadway capacity, traveler behavior, pricing strategies, and network performance under a wide range of operating conditions.

One immediate application is the evaluation of future managed-lane policies and pricing strategies. The framework can be used to assess alternative occupancy requirements, toll structures, toll caps, discount programs, and eligibility rules for emerging vehicle classes. It also provides a means of evaluating how changes in traveler value of time, pricing elasticity, and market penetration of electronic tolling technologies may influence facility utilization and corridor performance.

The modeling platform also provides a tool for evaluating future infrastructure investments. Potential applications include assessing managed-lane extensions, lane additions, direct connector facilities, revised access-point configurations, and other geometric improvements intended to reduce operational friction associated with lane-changing activity near entry and exit gates. Because the study demonstrated the importance of access design and weaving operations, future analyses could focus on identifying infrastructure improvements that maximize the effectiveness of dynamic pricing while minimizing operational bottlenecks.

The framework is also well-suited to supporting transportation planning objectives associated with Senate Bill 743 (SB 743). Future studies can expand the analysis beyond traditional traffic measures to include vehicle miles traveled (VMT), person throughput, multimodal accessibility, transit interactions, greenhouse-gas emissions, energy consumption, and equity-related performance measures. Such analyses would allow agencies to better understand the tradeoffs among mobility, sustainability, reliability, and environmental objectives when evaluating managed-lane projects.

As transportation systems continue to evolve, the framework can be adapted to evaluate emerging mobility technologies and operating concepts. Examples include connected and automated vehicles, dynamic ridesharing programs, mobility-as-a-service platforms, real-time traveler information systems, and integrated corridor-management strategies that coordinate freeway, arterial, transit, and managed-lane operations. These applications could provide valuable insight into how future transportation technologies may influence managed-lane demand and operational effectiveness.

Finally, the demand-response relationships identified in this study provide a foundation for developing simplified planning-level tools that estimate the impacts of managed-lane projects without requiring full microsimulation. Future research could use the scenario results to derive elasticity factors, performance curves, and screening methodologies that support early-stage project development and corridor planning studies. Such tools would enable transportation agencies to rapidly evaluate potential managed-lane concepts while reserving more detailed simulation analyses for projects that demonstrate the greatest potential benefits.

9. REFERENCES

Bay Area Express Lanes, 2024. *BAIFA Express Lanes Operations Report 1st Quarter 2024: January -March, I-680 Contra Costa and I-880 Express Lanes*. Bay Area Infrastructure Financing Authority Network and Operations Committee, July 12, 2024.

Caltrans District 7, 2017. *2016 Managed Lane Annual Report*. Division of Traffic Operations, Office of System Performance, Managed Lanes Branch, California Department of Transportation District 7, May 2017.

APPENDIX A. DOCUMENTED IMPACTS OF PAST HOV/HOT PROJECTS

This section provides a summary of documented impacts associated with specific implementation projects. This predominantly includes impacts on travel times and the share of toll-free high-occupancy vehicles within the general traffic. Information about violation percentages, toll revenue, as well as impacts on safety and vehicle emissions, is also provided for some facilities. Most of the documented impacts that were found are for projects that converted an existing HOV facility into a HOT facility. Very few documented impacts were found for projects that added new HOV or HOT facilities or that specifically changed the vehicle occupancy eligibility threshold associated with a given facility.

For each project, the following information is provided:

- Facility type
- A bullet list summarizing the key assessed impacts
- Document from where the impact assessments were retrieved

A.1. HOV TO HOT CONVERSIONS

Impact information is provided for the following projects:

- Control Costa I-680 Express Lanes, San Francisco Bay Area (2017)
- I-880 Express Lanes, San Francisco Bay Area (2020)
- I-394 MnPass Express Lanes, Minneapolis (2005)
- I-85 Express Lanes, Atlanta (2011)
- I-10 KATY, Houston (1998)
- I-95 Express, Miami (2008)
- SR-167 HOT Lanes, Seattle (2008)
- MOPAC Express Lanes, Austin (2016)

A.1.1. CONTRA COSTA I-680 EXPRESS LANES, SAN FRANCISCO BAY AREA (2017)

- **Facility type**
 - Continuous access facility.
 - HOV 2+ toll-free and solo-occupant vehicles with a valid clean-air decal.
- **Documented impacts**
 - In the most congested peak direction (northbound PM peak period), modest improvements in many performance measures were observed in both the express lane and the general-purpose lanes. These include improvements in average travel times and speeds, travel time reliability, queue duration, and delay. The level of service also improved compared to data collected in 2014, but this can partly be attributed to changes in traffic observed before the express lane opening in 2017.
 - In the southbound direction during the AM peak period, performance measures for travel times, speeds, travel time reliability, queue duration, and delay held relatively steady before and after the implementation of the express lane.

- The share of toll-free HOV 2+ trips has ranged between 30% and 46% over the history of the lane and was highest in Q1 2020. From Q3 2022 to Q3 2023, 23-25% were HOV 3+ vehicles, and 16% were HOV 2 vehicles.
- Paying vehicles were typically comprised of 1% CAV, 19-21% single-occupancy vehicles with an access decal, and 26-28% single-occupancy vehicles that were billed through license plate reading.
- 11% to 13% of trips were violations from Q2 2023 to Q3 2023.
- Revenues per quarter varied between 2.90 and 3.62 million dollars out of between 1.017 and 1.121 million toll trips.

- **Information sources**

- *I-680 Contra Costa Express Lanes Before/After Study*. Final Report, Bay Area Infrastructure Financing Authority (BAIFA) and Metropolitan Transportation Commission (MTC), December 2020.
- *BAIFA Express Lanes Performance Report – 3rd Quarter 2023 – July-September – I-680 Contra Costa and I-880 Express lanes*. Bay Area Infrastructure Financing Authority, January 2024.

A.1.1.2. I-880 EXPRESS LANES, SAN FRANCISCO BAY AREA (2020)

- **Facility type**

- Continuous access facility.
- HOV 3+ toll-free; reduced toll for HOV 2 and solo-occupant vehicles with a valid clean-air decal.

- **Documented impacts**

- The share of toll-free HOV 3+ trips has ranged between 39% and 40% from the third quarter of 2022 to the third quarter of 2023.
- Paying vehicles typically were comprised of 7% HOV 2 vehicles, 1% CAV, 19% single-occupancy vehicles with an access decal, and 19-21% single-occupancy vehicles that were billed through license plate reading.
- 12% to 15% of trips were violations.
- Revenues per quarter varied between 10.10 and 14.03 million dollars out of between 1.832 and 2.067 million toll trips.

- **Information sources**

- *BAIFA Express Lanes Performance Report – 3rd Quarter 2023 – July-September – I-680 Contra Costa and I-880 Express lanes*. Bay Area Infrastructure Financing Authority, January 2024.

A.1.3. I-394 MNPASS EXPRESS LANES, MINNEAPOLIS (2005)

- **Facility type**

- Continuous access facility.
- HOV 2+ toll-free

- **Documented impacts**

- Estimated benefit/cost ratio of 2.19.
- On average, MnPASS users save 2 to 3 minutes on their trip over the general-purpose lanes.
- Vehicle throughput has increased by 48% while person throughput has increased by 25%.
- The wide variability of travel times between the MnPASS and general-purpose lanes points to the reliability of the MnPASS lanes as a strong motivation for their use.
- While travel time and travel time reliability savings are important sources of benefits, they are not the dominant sources of benefits. Travel time savings were found to compensate for only about 7% of total costs, while travel time reliability savings contributed an additional 23%.
- Safety benefits dominate the total benefits, especially in fatal crash reductions. A study from the University of Minnesota found that the HOV to HOT conversion reduced crashes by 5.3% and crash-related costs by \$5 million over two years, against annual toll revenues of \$1.2 million.
- The specific contribution of safety benefits to cost compensation also depends on the standard economic values used.
- The safety benefits of the I-394 MnPASS program are associated with converting underused HOV lanes to HOT lanes, accompanied by designating access points. Therefore, the safety benefits have limited generalizability for scenarios in which HOT lanes are added to existing freeways.

- **Information sources**

- K.R. Buckeye. *Performance Evaluation of I-394 MnPASS Express Lanes in Minnesota*. Transportation Research Record: Journal of the Transportation Research Board, No. 2278, Transportation Research Board of the National Academies, Washington, D.C., 2012, pp. 153–162.
- X. Cao, L. Munnich, H. Liu, X. He, Z. Xu, and Y. Huang. *Benefit and Cost Analysis of the I-394 MnPASS Program*. Report CTS 12-03, Department of Civil Engineering, University of Minnesota, February 2012.
- X. Cao, Z. Xu, and Y. Huang. *Safety Benefits of Converting HOV Lanes to HOT Lanes: Case Study of the I-394 MnPASS*. ITS Journal, February 2012, pp. 32-37.

A.1.4. I-85 EXPRESS LANES, ATLANTA (2011)

- **Facility type**

- Gated access facility.

- HOV 3+ toll-free.
- HOV 2+ to HOT 3+ conversion.

- **Documented impacts**

- Vehicle throughput decreased by about 6.6% (2698 vehicles) during the morning peak period, but only by about 2.9% (1148 vehicles) during the afternoon peak period.
- Person throughput concurrently declined by about 9.9% (4868 individuals) during the morning peak period, and by about 6.3% (3123 individuals) during the afternoon peak period.
- Average managed lane vehicle occupancy decreased from approximately 2.0 persons/vehicle to approximately 1.2 person/vehicle.
- Most two-person carpools have been diverted from the HOV lane into the general-purpose lanes after HOT lane implementation.
- The new HOT lanes did not incentivize carpooling and may have even disincentivized it. Carpool mode share declined by more than 30% in the AM peak and by 25% in the PM peak.
- Pre-deployment modeling predicted extremely small increases in mass emissions for NO_x, CO, PM_{2.5}, and PM₁₀, and an extremely small decrease in mass emissions for HC.
- The median willingness to pay for travel time savings was estimated to be \$33.17/hour for southbound travelers during the AM peak period, and \$17.76/hour in the northbound direction during the peak period. The median willingness to pay value across all periods and directions was estimated to be \$19.45/hour.

- **Information sources**

- D. Randall, L. Guensler, M. Rodgers, and V. Pandey. *Effect of High-Occupancy Toll Lanes on Mass Vehicle Emissions*. In Transportation Research Record: Journal of the Transportation Research Board, No. 2123, Transportation Research Board of the National Academies, Washington, D.C., 2009, pp. 88–96.
- N. Wood, M. Burris, and S. Rao Danda. *Examination of Paid Travel on I-85 Express Lanes*. In Transportation Research Record: Journal of the Transportation Research Board, No. 2450, Transportation Research Board of the National Academies, Washington, D.C., 2014, pp. 44–51.
- R. Guensler et al. *Atlanta I-85 HOV-to-HOT Conversion: Analysis of Vehicle and Person Throughput*. Report FHWA-GA-13-10-03, School of Civil and Environmental Engineering, Georgia Institute of Technology, Atlanta, GA, October 2013.

A.1.5. I-10 KATY, HOUSTON (1998)

- **Facility type**

- Gated access facility.
- HOV 3+ toll-free all day, HOV 2+ free during peak hours only

- **Documented impacts**

- Travel time savings are approximately 5 minutes in the morning and 14 minutes in the afternoon in the peak directions, and the travel time advantage over the general-purpose lanes (GPLs) has increased as volumes have grown.
- Off-peak speeds in the managed lanes ran consistently at 70 mph but dropped to a low of 52 mph in the morning peak and 50 mph in the afternoon peak. Both of these speed levels correspond to the most congested periods of travel in the GPLs.
- Over 1.5 million different transponders were observed on the Katy Freeway in 2011; 68 percent of those only used the GPLs. Of the remaining half million who used the managed lanes, over 80 percent used them for 60 or fewer trips during the entire year, which averaged slightly over one trip on the managed lanes per week. Approximately 11 percent used the managed lanes for more than two trips per week. A small percentage of just over 3 percent use the managed lanes for all their trips on the Katy Freeway.
- According to a user survey, 49 percent of the managed lane users change their usual freeway access points to reach the managed lanes.
- Improved geometric design and reduction in congestion had a positive effect on reducing crashes, which dropped from 128.3 crashes per million vehicle miles before construction to 57.3 crashes per million vehicle miles after the project opened.

- **Information sources**

- G. Goodin, R. Benz, M. Burris, M. Brewer, N. Wood, and T. Geiselbrecht. *Katy Freeway: An Evaluation of a Second-Generation Managed Lanes Project*. Report FHWA/TX-13/0-6688-1, Texas Transportation Institute, College Station, Texas, September 2013, 240 pages.

A.1.6. I-95 EXPRESS, MIAMI (2008)

- **Facility type**

- Gated access facility.
- HOV 3+ toll-free.

- **Documented impacts**

- Customers, including transit riders, using the Express Lanes have significantly increased their travel speed during the AM peak (6 AM-9 AM, southbound) and PM peak (4 PM-7 PM, northbound):
 - On a monthly average basis, the average speed on the HOV facility increased from approximately 20 mph to 62 mph southbound and 56 mph northbound.
 - General-purpose lane speeds increased from approximately 15 mph to 50 mph southbound, and from 20 mph to 41 mph northbound.
- Improvements in travel time reliability were viewed as more important than the speed improvements:
 - Average volume along the express lanes in the AM and PM peak periods was 12.2% higher in 2011 compared to 2010.

- Vehicles were traveling at speeds greater than 45 mph during the AM peak period nearly 100% of the time, and almost 92% of the time in the northbound direction during the PM peak period.
- From 2008 to 2009, the average vehicle occupancy on the Express Lanes dropped from 1.95 to 1.39 due to single-occupancy vehicles (SOVs) being allowed on them. Average occupancy on the general-purpose lanes remains at around 1.39-1.40 occupants per vehicle.
- From 2008 to 2009, person throughput during the PM peak hour (4 PM-5 PM) increased by 23% on the Express lanes and by 8% on the general-purpose lanes, for an overall 12% increase across the entire freeway.
- The observed increase in SOV volume on the Express Lanes is mostly due to mode shift from within the corridor and not to an overall increase in travelers.
- An overall decrease in HOV 2 vehicles was also observed. This decrease shows a portion of two-person carpools either shifted to a single-occupancy mode (SOV volume increased by 33%) or to a higher occupancy mode (HOV 3 volume increased by 9.6%). The decrease in HOV 2 volume in the managed lanes could be due to the toll imposed on them, as well as a reduction in access points to either end of the facility. However, the decrease in access points would also affect the HOV 3 vehicle volumes in the Express Lanes.
- The estimated value of travel time of express lane users is approximately 49% of their hourly wage based on annual household income, with a range of \$2.27/hour to \$79.32/hour and a mean of approximately \$32.00/hour.
- Summary of observations from comparing crashes for the three years (2005-2007) before express lanes to the six years (2010-2015) after:
 - Fatal crashes dropped from 6.3 to 5.3 per year.
 - Injury crashes dropped from 662 to 651 per year, basically the same.
 - The crash rate increased from 1.81 to 2.23. Consistent with statewide trends, this increase may be associated with distracted driving.
 - The results are inconclusive in demonstrating either an increase or a decrease in safety. The number of fatal and injury crashes has not increased while traffic has increased 15% since 2005.
 - The results also suggest that the express lanes do not make the I-95 facility less safe. The crash rate on the express lane is 15% lower than on the general-purpose lanes. Of the 2,460 crashes reported in 2015, 1,975 were for the general-purpose lanes (78%), and 545 (22%) were for the express lanes.

- **Information sources**

- Florida Department of Transportation. *95 Express Midyear Report – Project Status for Urban Partnership Agreement*. October 2009.
- V. Perk, J. DeSalvo, T. Risrigues, N. Verzosa, and S. Bovino. *Improving the Value of Travel Time Savings Estimation for More Effective Transportation Project Evaluation*. Center for Urban Transportation Research, University of South Florida, Tampa, Florida, December 2011.
- Florida Department of Transportation. *95 Express Midyear Report – Project Status for Urban Partnership Agreement (Phase 1 Complete)*. April 2013.

- CTS Engineering, Inc. *I-95 Historical Crash Data Evaluation Report*. Report prepared for the Florida Department of Transportation, District 6, Doral, Florida, February 2017.

A.1.7. SR-167, SEATTLE (2008)

- **Facility type**

- Continuous access facility.
- HOV 3+ toll-free all day; HOV 2+ toll-free only during off-peak periods

- **Documented impacts**

- 77% of trips in 2023 were either toll-free or under \$1.00
 - 56% free
 - 41% at the minimum toll
 - 8% at the maximum \$10.00
- In 2008, during most times and along most portions of the corridor, the number of illegal entry and exit movements was negligible. However, at a small number of locations and under specific congestion conditions, violation rates exceeded 1 per minute, with the worst location north of the South 180th Street on-ramp in the northbound direction, just before the end of the HOT lane and after the last toll collection gantry. Violations at this location appeared to be caused by:
 - Vehicles jumping in early, in anticipation of the lane becoming a general-purpose lane in less than another 500 feet
 - The location is often the point to which the queue from the I-405 interchange ramp backs up.
 - Many vehicles enter the freeway at the S. 180th Street ramp and move as directly as possible to the left lane of the freeway to merge into the HOT lane. In congested conditions, these movements result in lane-line violations because the slow, heavy traffic allows the weaving process to occur over a short distance. Under faster free-flow conditions, this weave requires a much longer distance, resulting in vehicle merges at the intended legal locations.

- **Information sources**

- M. Hallenbeck, J. Corey, T. Patterson. *Examination of SR-167 HOT Lane Violation Patterns*. Report WA-RD-766.1, Washington State Transportation Center (TRAC), University of Washington, May 2011.
- C. See, K. Rubenstein, E. Barry, and K Westby. *I-405 / SR 167 Express Toll Lanes*. Presentation at the 2024 Rate Setting Meeting, Washington State Transportation Commission, January 2024.

A.1.8 – MOPAC EXPRESS LANES, AUSTIN (2016)

- **Facility type**

- 24/7 gated access all-vehicle tolling facility.
- No discount for HOV vehicles.

- **Documented impacts**

- Carpool vehicle occupancy of the express lane trips was higher than that of the GP lane trips during both peak periods.
- Reduction in fuel consumption and vehicle emissions
 - Fuel consumption: -9%
 - VOC: - 17%
 - Greenhouse gases: -9%
 - NOx: -8%
- The monetary savings from fuel consumption reductions and vehicle emissions are similar to the daily tolls collected, indicating that these two benefits alone reimburse Mopac Expressway users at large with tangible benefits funded by express lane users.
- Fuel consumption savings by time of day are greatest during weekday peak periods.
 - AM peak reductions: 10-15% for two hours.
 - PM peak reductions of 15-20% for three hours.

- **Information sources**

- *MoPac Express Lane Performance Review & Operations Update*. Central Texas Regional Mobility Authority. Meeting document, October 2019.

A.2. HOT LANE ADDITIONS

Operational statistics for facilities where HOT lanes were added to existing lanes can only be found for the following facilities:

- I-405 Express Toll Lanes, Seattle (2016)

A.2.1. I-405 EXPRESS TOLL LANES, SEATTLE (2016)

- **Facility type**

- Gated access facility.
- HOV 3+ toll-free all day; HOV 2+ toll-free only during off-peak periods.

- **Documented impacts**

- 70% of trips in 2023 were either toll-free or under \$1.00.
 - 29% free
 - 41% at the minimum toll
 - 4% at the maximum \$10.00

- **Information sources**

- C. See, K. Rubenstein, E. Barry, and K Westby. *I-405 / SR 167 Express Toll Lanes*. Presentation at the 2024 Rate Setting Meeting, Washington State Transportation Commission, January 2024.

APPENDIX B. SIMULATION RESULT TABLES

B.1. CHANGE IN HOV ELIGIBILITY

Table B-1: Simulation Metrics, Change in HOV Eligibility, AM Peak

		Vehicles				Persons				
Metrics		HOV2+ & Decals	HOV2+	HOV3+ & Decals	HOV3+	HOV2+ & Decals	HOV2+	HOV3+ & Decals	HOV3+	
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB									
	VMT	veh-mi (x1000)	40.9	38.2	5.6	2.8	82.4	79.7	11.7	8.9
	VHT	veh-hrs (x1000)	0.6	0.6	5.6	0.0	1.2	1.2	0.2	0.1
	Average speed	mph	68.0	68.2	71.7	72.3	68.0	68.2	71.7	72.3
	Traveltime	min	8.9	8.9	8.4	8.4	8.9	8.9	8.4	8.4
	Delay	min	0.7	0.7	0.2	72.3	0.7	0.7	0.2	0.1
	I-210 Core: General Purpose Lanes - EB									
	VMT	veh-mi (x1000)	444.9	446.7	436.0	428.3	475.6	477.4	481.9	472.2
	VHT	veh-hrs (x1000)	8.6	8.9	436.0	15.4	9.2	9.5	16.2	16.9
	Average speed	mph	51.6	50.1	29.8	27.9	51.7	50.2	29.8	27.9
	Traveltime	min	14.0	14.4	24.5	26.1	14.0	14.4	24.5	26.1
	Delay	min	4.3	4.7	14.8	27.9	4.3	4.7	14.8	16.4
	I-210 Core: General Purpose Lanes & HOT Lanes - EB									
	VMT	veh-mi (x1000)	485.8	484.9	441.5	431.2	558.0	557.1	493.6	481.1
	VHT	veh-hrs (x1000)	9.2	9.5	441.5	15.4	10.4	10.7	16.3	17.0
	Average speed	mph	52.7	51.1	30.0	28.0	53.6	52.2	30.2	28.3
	Traveltime	min	13.6	14.0	24.3	26.0	13.2	13.6	24.1	25.8
	Delay	min	4.0	4.4	15.1	28.0	5.0	4.1	15.0	16.1
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB									
	VMT	veh-mi (x1000)	84.7	79.6	12.0	6.0	172.0	167.8	26.6	20.6
	VHT	veh-hrs (x1000)	1.8	1.4	12.0	0.1	3.6	3.0	0.4	0.3
	Average speed	mph	48.0	55.6	69.9	70.7	47.9	55.5	69.3	69.9
	Traveltime	min	12.2	10.6	8.5	8.4	12.2	10.6	8.5	8.5
	Delay	min	4.2	2.5	0.4	70.7	4.2	2.5	0.4	0.3
	I-210 Core: General Purpose Lanes - WB									
	VMT	veh-mi (x1000)	499.1	502.4	505.5	504.8	553.6	556.7	602.1	600.0
	VHT	veh-hrs (x1000)	18.6	18.6	505.5	17.1	20.4	20.4	20.3	20.2
	Average speed	mph	26.9	27.0	29.5	29.5	27.1	27.2	29.7	29.7
	Traveltime	min	26.9	26.8	24.8	24.8	26.9	26.8	24.7	24.7
	Delay	min	17.3	17.2	15.2	29.5	17.3	17.2	15.1	15.1
	I-210 Core: General Purpose Lanes & HOT Lanes - WB									
	VMT	veh-mi (x1000)	583.8	582.1	517.5	510.8	725.6	724.5	628.7	620.7
	VHT	veh-hrs (x1000)	20.3	20.0	517.5	17.2	24.0	23.5	20.7	20.5
	Average speed	mph	28.7	29.1	29.9	29.7	30.2	30.9	30.4	30.3
	Traveltime	min	24.8	24.6	24.4	24.6	23.4	23.1	24.0	24.1
	Delay	min	15.4	15.2	15.6	29.7	21.5	13.8	15.5	14.6
Network	Freeways (General purpose lanes and HOV)									
	VMT	veh-mi (x1000)	1,069.6	1,067.0	959.0	942.0	1,283.7	1,281.5	1,122.3	1,101.8
	VHT	veh-hrs (x1000)	29.5	29.5	959.0	32.6	34.4	34.1	37.0	37.5
	Average speed	mph	36.2	36.2	29.9	28.9	37.3	37.5	30.3	29.4
	Delay	s/mi	26.5	25.2	30.7	28.9	26.5	25.2	30.5	31.9
	Off-Freeway (Arterials)									
	VMT	veh-mi (x1000)	837.2	839.3	879.0	886.3	1,107.6	1,109.4	1,187.0	1,196.7
	VHT	veh-hrs (x1000)	38.1	38.3	879.0	41.3	54.1	54.3	58.7	59.3
	Average speed	mph	22.0	21.9	21.5	21.5	20.5	20.4	20.2	20.2
	Delay	s/mi	591.6	593.3	613.3	21.5	593.9	595.9	614.5	615.9
	Entire Network									
	VMT	veh-mi (x1000)	2,935.9	2,935.1	2,788.9	2,769.3	3,644.2	3,644.1	3,468.1	3,445.8
	VHT	veh-hrs (x1000)	90.3	91.1	98.1	99.0	115.9	116.3	126.6	127.7
	Average speed	mph	32.5	32.2	28.4	28.0	31.4	31.3	27.4	27.0
	Delay	s/mi	64.2	65.0	73.3	74.5	64.0	64.6	73.3	74.5
	Entering network	veh	653,145	653,144	643,269	642,383	814,381	814,380	802,625	801,602
	Inside network at end	veh	14,058	14,148	17,005	17,730	18,129	18,170	21,611	22,417
	Waiting to enter at end	veh	10	11	9,886	10,772	13	14	11,769	12,792

Table B-2: Simulation Metrics, Change in HOV Eligibility, Midday

		Vehicles				Persons			
Metrics		HOV2+ & Decals	HOV2+	HOV3+ & Decals	HOV3+	HOV2+ & Decals	HOV2+	HOV3+ & Decals	HOV3+
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB								
	VMT veh-mi (x1000)	34.1	31.8	4.7	2.4	68.6	66.3	10.0	7.5
	VHT veh-hrs (x1000)	0.5	0.5	4.7	0.0	1.0	1.0	0.1	0.1
	Average speed mph	66.5	66.9	71.1	71.8	66.5	66.9	71.2	71.9
	Traveltime min	9.1	9.1	8.5	8.4	9.1	9.1	8.5	8.4
	Delay min	0.9	0.8	0.3	71.8	0.9	0.8	0.3	0.2
	I-210 Core: General Purpose Lanes - EB								
	VMT veh-mi (x1000)	267.7	268.8	249.9	247.4	289.4	290.4	281.3	280.1
	VHT veh-hrs (x1000)	5.3	5.5	249.9	10.1	5.7	5.9	10.9	11.4
	Average speed mph	50.5	48.9	25.7	24.6	50.7	49.2	25.9	24.7
	Traveltime min	14.4	14.9	28.6	29.8	14.3	14.8	28.5	29.7
	Delay min	4.6	5.1	18.9	24.6	4.6	5.1	18.8	20.0
	I-210 Core: General Purpose Lanes & HOT Lanes - EB								
	VMT veh-mi (x1000)	301.9	300.7	254.7	249.8	358.0	356.8	291.3	287.6
	VHT veh-hrs (x1000)	5.8	6.0	254.7	10.1	6.7	6.9	11.0	11.5
	Average speed mph	51.9	50.4	26.0	24.8	53.1	51.7	26.4	25.1
	Traveltime min	13.8	14.2	28.2	29.6	13.3	13.7	27.8	29.1
	Delay min	4.2	4.7	19.2	24.8	5.5	5.9	19.1	19.5
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB								
	VMT veh-mi (x1000)	38.1	35.6	5.3	2.8	76.5	74.2	11.1	8.4
	VHT veh-hrs (x1000)	0.6	0.5	5.3	0.0	1.2	1.1	0.2	0.1
	Average speed mph	64.8	65.3	64.1	59.6	64.8	65.3	64.4	63.0
	Traveltime min	9.2	9.1	9.1	9.7	9.2	9.1	9.1	9.3
	Delay min	1.1	1.0	1.1	59.6	1.1	1.0	1.1	1.2
	I-210 Core: General Purpose Lanes - WB								
	VMT veh-mi (x1000)	248.6	250.8	273.3	272.4	273.7	275.9	325.6	324.6
	VHT veh-hrs (x1000)	5.4	5.4	273.3	7.0	6.0	6.0	7.8	8.3
	Average speed mph	45.7	46.2	41.5	38.9	45.7	46.2	41.7	39.1
	Traveltime min	15.2	15.0	17.3	18.7	15.1	14.9	17.2	18.6
	Delay min	5.6	5.4	7.7	38.9	5.5	5.3	7.7	9.0
	I-210 Core: General Purpose Lanes & HOT Lanes - WB								
	VMT veh-mi (x1000)	286.6	286.4	278.7	275.2	350.3	350.1	336.7	333.0
	VHT veh-hrs (x1000)	6.0	6.0	278.7	7.1	7.2	7.1	8.0	8.4
	Average speed mph	47.6	48.0	41.8	39.0	48.9	49.3	42.2	39.5
	Traveltime min	14.4	14.3	17.2	18.6	13.8	13.7	17.0	18.4
	Delay min	5.0	4.9	8.8	39.0	6.6	6.4	8.7	8.8
Network	Freeways (General purpose lanes and HOV)								
	VMT veh-mi (x1000)	588.5	587.1	533.3	525.0	708.3	706.8	627.9	620.6
	VHT veh-hrs (x1000)	11.8	11.9	533.3	17.1	13.9	14.0	19.0	19.9
	Average speed mph	49.7	49.2	32.4	30.6	50.9	50.5	33.1	31.2
	Delay s/mi	12.2	12.5	28.0	30.6	12.1	12.3	27.8	30.5
	Off-Freeway (Arterials)								
	VMT veh-mi (x1000)	480.2	480.7	508.1	508.4	612.4	612.9	660.4	658.2
	VHT veh-hrs (x1000)	21.9	21.9	508.1	23.3	29.4	29.4	31.7	31.6
	Average speed mph	21.9	21.9	21.8	21.8	20.8	20.8	20.8	20.8
	Delay s/mi	561.9	562.4	572.4	21.8	567.4	567.9	577.4	577.1
	Entire Network								
	VMT veh-mi (x1000)	1,627.0	1,623.9	1,555.6	1,540.3	1,987.4	1,984.4	1,901.6	1,883.3
	VHT veh-hrs (x1000)	45.0	45.1	50.1	50.6	56.6	56.7	62.9	63.4
	Average speed mph	36.1	36.0	31.1	30.4	35.1	35.0	30.2	29.7
	Delay s/mi	59.8	59.9	67.3	68.3	59.9	60.0	67.4	68.3
	Entering network veh	356,253	356,254	356,617	356,185	436,003	436,004	436,542	435,985
	Inside network at end veh	14,645	14,878	20,418	21,330	18,689	18,915	25,617	26,711
	Waiting to enter at end veh	17	15	42	129	20	19	49	153

Table B-3: Simulation Metrics, Change in HOV Eligibility, PM Peak

		Vehicles				Persons			
Metrics		HOV2+ & Decals	HOV2+	HOV3+ & Decals	HOV3+	HOV2+ & Decals	HOV2+	HOV3+ & Decals	HOV3+
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB								
	VMT veh-mi (x1000)	59.6	57.5	9.0	4.7	121.4	121.6	20.3	16.2
	VHT veh-hrs (x1000)	2.1	1.6	9.0	0.1	4.4	3.5	0.4	0.3
	Average speed mph	27.9	35.0	56.0	47.9	27.8	35.1	56.3	53.8
	Traveltime min	22.9	17.9	10.9	12.4	22.8	17.9	10.8	11.2
	Delay min	14.6	9.7	2.6	47.9	14.6	9.6	2.4	2.8
	I-210 Core: General Purpose Lanes - EB								
	VMT veh-mi (x1000)	323.7	327.9	244.1	240.2	359.0	362.5	297.9	297.2
	VHT veh-hrs (x1000)	13.4	13.1	244.1	21.4	14.8	14.3	25.8	26.4
	Average speed mph	24.2	25.1	11.5	11.2	24.3	25.3	11.5	11.3
	Traveltime min	32.3	30.9	64.6	66.4	32.2	30.8	64.5	66.0
	Delay min	22.6	21.2	54.9	11.2	22.6	21.1	54.9	56.4
	I-210 Core: General Purpose Lanes & HOT Lanes - EB								
	VMT veh-mi (x1000)	383.3	385.5	253.1	244.9	480.4	484.2	318.2	313.4
	VHT veh-hrs (x1000)	15.5	14.7	253.1	21.5	19.1	17.8	26.1	26.7
	Average speed mph	24.7	26.2	11.9	11.4	25.1	27.2	12.2	11.7
	Traveltime min	30.8	29.0	62.7	65.4	29.8	27.5	61.1	63.2
	Delay min	21.4	19.5	57.5	11.4	37.2	30.8	57.3	59.2
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB								
	VMT veh-mi (x1000)	55.1	51.8	7.2	3.8	110.7	107.6	14.9	11.7
	VHT veh-hrs (x1000)	0.9	0.8	7.2	0.1	1.9	1.7	0.2	0.2
	Average speed mph	59.4	63.8	69.3	69.0	59.4	63.8	69.4	69.8
	Traveltime min	9.9	9.3	8.5	8.6	9.9	9.3	8.5	8.5
	Delay min	1.9	1.2	0.5	69.0	1.9	1.2	0.5	0.4
	I-210 Core: General Purpose Lanes - WB								
	VMT veh-mi (x1000)	331.9	336.1	368.5	369.2	366.6	370.7	447.4	449.1
	VHT veh-hrs (x1000)	8.9	8.6	368.5	9.1	9.8	9.5	10.6	11.0
	Average speed mph	37.3	39.3	42.1	40.6	37.2	39.2	42.1	40.7
	Traveltime min	18.5	17.6	17.0	17.8	18.4	17.5	17.0	17.8
	Delay min	9.0	8.1	7.5	40.6	8.8	7.9	7.5	8.2
	I-210 Core: General Purpose Lanes & HOT Lanes - WB								
	VMT veh-mi (x1000)	387.0	387.9	375.7	373.0	477.3	478.3	462.2	460.8
	VHT veh-hrs (x1000)	9.8	9.4	375.7	9.1	11.7	11.1	10.9	11.2
	Average speed mph	39.4	41.4	42.4	40.8	40.8	42.9	42.6	41.1
	Traveltime min	17.3	16.5	16.8	17.7	16.4	15.6	16.7	17.5
	Delay min	8.0	7.1	8.0	40.8	10.7	9.2	8.0	8.7
Network	Freeways (General purpose lanes and HOV)								
	VMT veh-mi (x1000)	770.3	773.3	628.8	617.9	957.7	962.5	780.4	774.2
	VHT veh-hrs (x1000)	25.4	24.1	628.8	30.7	30.8	28.9	37.0	37.9
	Average speed mph	30.4	32.1	20.8	20.1	31.1	33.3	21.1	20.4
	Delay s/mi	48.1	40.2	65.5	20.1	47.9	39.9	65.3	67.9
	Off-Freeway (Arterials)								
	VMT veh-mi (x1000)	838.6	839.0	914.7	915.7	1,074.0	1,073.1	1,172.2	1,167.3
	VHT veh-hrs (x1000)	41.7	41.7	914.7	59.2	56.1	56.0	77.1	78.0
	Average speed mph	20.1	20.1	15.7	15.5	19.2	19.2	15.2	15.0
	Delay s/mi	668.1	668.0	978.7	15.5	673.0	672.7	980.2	1,040.5
	Entire Network								
	VMT veh-mi (x1000)	2,421.3	2,436.1	2,257.5	2,234.2	3,034.9	3,054.7	2,833.4	2,807.0
	VHT veh-hrs (x1000)	87.8	86.8	110.9	112.2	112.5	110.8	141.4	142.8
	Average speed mph	27.6	28.1	20.3	19.9	27.0	27.6	20.0	19.7
	Delay s/mi	79.0	78.2	120.6	123.5	79.0	78.0	120.2	123.1
	Entering network veh	585,318	585,315	577,738	575,979	722,040	722,037	712,864	710,687
	Inside network at end veh	18,349	17,362	30,962	32,285	23,623	22,259	39,292	41,023
	Waiting to enter at end veh	30	32	7,606	9,029	38	42	9,211	10,901

B.2. HOV CONVERSION TO HOT WITH DYNAMIC TOLL

Table B-4: Simulation Metrics, HOV to Dynamic Toll HOT Conversion, AM Peak

		Vehicles					Persons				
Metrics		HOV2 & Decals	HOT2 10%	HOT2 20%	HOT2 35%	HOT2 50%	HOV2 & Decals	HOT2 10%	HOT2 20%	HOT2 35%	HOT2 50%
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB										
	VMT veh-mi (x1000)	40.9	42.9	43.5	44.9	46.5	82.4	84.4	85.0	86.3	87.5
	VHT veh-hrs (x1000)	0.6	42.9	43.5	44.9	46.5	1.2	1.2	1.3	1.4	1.4
	Average speed mph	68.0	67.5	65.7	62.2	60.1	68.0	67.6	66.1	63.0	61.3
	Traveltime min	8.9	10.0	10.0	9.7	10.0	8.9	9.0	9.2	9.6	9.9
	Delay min	0.7	1.8	1.8	1.5	1.8	0.7	0.8	0.9	1.4	1.6
	I-210 Core: General Purpose Lanes - EB										
	VMT veh-mi (x1000)	444.9	442.3	440.3	436.6	431.6	475.6	473.1	471.2	467.5	462.5
	VHT veh-hrs (x1000)	8.6	442.3	440.3	436.6	431.6	9.2	8.8	8.7	8.7	8.8
	Average speed mph	51.6	53.7	54.1	53.6	52.7	51.7	53.8	54.1	53.6	52.7
	Traveltime min	14.0	13.8	13.8	13.5	13.8	14.0	13.5	13.4	13.5	13.8
	Delay min	4.3	4.1	4.1	3.8	4.1	4.3	3.8	3.7	3.8	4.1
	I-210 Core: General Purpose Lanes & HOT Lanes - EB										
	VMT veh-mi (x1000)	485.8	485.1	483.9	481.5	478.0	558.0	557.5	556.2	553.8	550.0
	VHT veh-hrs (x1000)	9.2	485.1	483.9	481.5	478.0	10.4	10.0	10.0	10.1	10.2
	Average speed mph	52.7	54.7	55.0	54.3	53.4	53.6	55.5	55.7	54.9	53.9
	Traveltime min	13.6	13.4	13.4	13.2	13.4	13.2	12.8	12.7	12.9	13.1
	Delay min	4.0	3.9	3.8	3.6	3.8	3.8	3.3	3.3	3.4	3.7
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB										
	VMT veh-mi (x1000)	84.7	85.8	84.7	83.6	83.2	172.0	168.6	166.1	164.2	163.4
	VHT veh-hrs (x1000)	1.8	85.8	84.7	83.6	83.2	3.6	4.8	4.8	4.8	4.9
	Average speed mph	48.0	35.5	34.5	33.9	33.4	47.9	35.4	34.4	33.9	33.3
	Traveltime min	12.2	17.7	17.7	17.4	17.7	12.2	16.6	17.1	17.4	17.7
	Delay min	4.2	9.6	9.6	9.3	9.6	4.2	8.5	9.0	9.3	9.7
	I-210 Core: General Purpose Lanes - WB										
	VMT veh-mi (x1000)	499.1	495.7	496.6	494.0	492.6	553.6	553.1	556.1	554.8	554.2
	VHT veh-hrs (x1000)	18.6	495.7	496.6	494.0	492.6	20.4	19.4	18.0	16.6	15.4
	Average speed mph	26.9	28.6	31.1	33.7	36.6	27.1	28.5	30.8	33.3	36.1
	Traveltime min	26.9	19.3	19.3	21.0	19.3	26.9	25.3	23.2	21.2	19.5
	Delay min	17.3	9.7	9.7	11.4	9.7	17.3	15.7	13.6	11.7	9.9
	I-210 Core: General Purpose Lanes & HOT Lanes - WB										
	VMT veh-mi (x1000)	583.8	581.5	581.3	577.5	575.7	725.6	721.7	722.2	718.9	717.6
	VHT veh-hrs (x1000)	20.3	581.5	581.3	577.5	575.7	24.0	24.1	22.9	21.5	20.3
	Average speed mph	28.7	29.4	31.5	33.7	36.1	30.2	29.9	31.6	33.5	35.4
	Traveltime min	24.8	19.1	19.1	20.5	19.1	23.4	23.2	21.8	20.4	19.1
	Delay min	15.4	9.7	9.7	11.1	9.7	14.2	14.0	12.5	11.1	9.9
Network	Freeways (General purpose lanes and HOV)										
	VMT veh-mi (x1000)	1,069.6	1,066.7	1,065.1	1,059.0	1,053.8	1,283.7	1,279.2	1,278.4	1,272.7	1,267.6
	VHT veh-hrs (x1000)	29.5	1,066.7	1,065.1	1,059.0	1,053.8	34.4	34.2	32.9	31.6	30.5
	Average speed mph	36.2	37.3	39.1	40.8	42.3	37.3	37.4	38.9	40.3	41.6
	Delay s/mi	26.5	28.5	26.9	26.0	25.2	26.5	28.7	27.2	26.2	25.3
	Off-Freeway (Arterials)										
	VMT veh-mi (x1000)	837.2	843.6	849.4	859.2	866.9	1,107.6	1,114.9	1,120.4	1,129.9	1,137.0
	VHT veh-hrs (x1000)	38.1	843.6	849.4	859.2	866.9	54.1	54.5	54.8	55.6	56.5
	Average speed mph	22.0	22.0	21.9	21.8	21.6	20.5	20.5	20.4	20.3	20.1
	Delay s/mi	591.6	590.3	592.0	595.6	603.2	593.9	593.1	594.9	598.4	605.7
	Entire Network										
	VMT veh-mi (x1000)	2,935.9	2,939.2	2,947.1	2,949.7	2,947.5	3,644.2	3,646.1	3,655.6	3,659.1	3,656.1
	VHT veh-hrs (x1000)	90.3	89.2	87.9	87.3	87.7	115.9	115.6	114.4	113.9	114.2
	Average speed mph	32.5	32.9	33.5	33.8	33.6	31.4	31.5	31.9	32.1	32.0
	Delay s/mi	64.2	63.6	62.9	62.9	64.2	64.0	63.8	63.2	63.4	64.5
	Entering network veh	653,145	653,146	653,146	653,148	653,133	814,381	814,382	814,383	814,385	814,356
	Inside network at end veh	14,058	13,835	13,255	13,095	13,323	18,129	17,959	17,275	17,049	17,362
	Waiting to enter at end veh	10	9	9	7	22	13	12	11	9	38

Table B-5: Simulation Metrics, HOV to Dynamic Toll HOT Conversion, Midday

		Vehicles					Persons				
Metrics		HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%	HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB										
	VMT veh-mi (x1000)	34.1	39.6	40.9	41.9	41.2	68.6	74.1	75.0	74.7	69.6
	VHT veh-hrs (x1000)	0.5	0.6	0.7	0.8	1.3	1.0	1.1	1.2	1.5	2.2
	Average speed mph	66.5	64.6	60.5	50.6	32.0	66.5	64.7	60.7	50.9	31.9
	Traveltime min	9.1	10.0	10.0	12.0	19.1	9.1	9.4	10.0	11.9	19.1
	Delay min	0.9	64.6	60.5	3.8	10.9	0.9	1.2	1.8	3.7	10.9
	I-210 Core: General Purpose Lanes - EB										
	VMT veh-mi (x1000)	267.7	263.1	260.6	255.6	236.8	289.4	284.8	282.3	277.9	260.3
	VHT veh-hrs (x1000)	5.3	4.9	4.8	5.0	6.3	5.7	5.3	5.2	5.4	7.0
	Average speed mph	50.5	54.1	54.1	51.5	37.4	50.7	54.2	54.1	51.4	37.2
	Traveltime min	14.4	13.8	13.4	14.0	19.1	14.3	13.3	13.4	14.0	19.2
	Delay min	4.6	54.1	54.1	4.3	9.4	4.6	3.6	3.6	4.3	9.5
	I-210 Core: General Purpose Lanes & HOT Lanes - EB										
	VMT veh-mi (x1000)	301.9	302.7	301.5	297.5	278.0	358.0	358.9	357.3	352.6	329.9
	VHT veh-hrs (x1000)	5.8	5.5	5.5	5.8	7.6	6.7	6.4	6.5	6.9	9.2
	Average speed mph	51.9	55.3	54.9	51.4	36.5	53.1	56.1	55.3	51.3	36.0
	Traveltime min	13.8	13.3	12.9	13.8	19.1	13.3	12.5	12.7	13.6	19.2
	Delay min	4.2	55.3	54.9	4.2	9.6	5.5	3.1	5.4	4.2	20.3
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB										
	VMT veh-mi (x1000)	38.1	39.2	39.2	39.2	40.0	76.5	77.6	77.4	76.7	76.5
	VHT veh-hrs (x1000)	0.6	0.6	0.7	0.8	0.9	1.2	1.3	1.4	1.5	1.6
	Average speed mph	64.8	60.8	55.9	50.4	45.5	64.8	61.1	56.3	51.3	46.5
	Traveltime min	9.2	17.7	10.5	11.6	12.8	9.2	9.7	10.5	11.4	12.6
	Delay min	1.1	60.8	55.9	3.6	4.8	1.1	1.6	2.4	3.4	4.5
	I-210 Core: General Purpose Lanes - WB										
	VMT veh-mi (x1000)	248.6	246.2	245.0	243.5	238.5	273.7	271.5	270.6	269.7	265.4
	VHT veh-hrs (x1000)	5.4	5.2	4.9	4.7	4.9	6.0	5.7	5.4	5.2	5.5
	Average speed mph	45.7	47.6	49.9	51.9	48.7	45.7	47.5	49.8	51.6	48.4
	Traveltime min	15.2	19.3	14.0	13.5	14.4	15.1	14.5	13.9	13.5	14.4
	Delay min	5.6	47.6	49.9	3.9	4.8	5.5	4.9	4.3	3.9	4.8
	I-210 Core: General Purpose Lanes & HOT Lanes - WB										
	VMT veh-mi (x1000)	286.6	285.4	284.3	282.6	278.4	350.3	349.1	347.9	346.4	341.9
	VHT veh-hrs (x1000)	6.0	5.8	5.6	5.5	5.8	7.2	7.0	6.8	6.7	7.1
	Average speed mph	47.6	49.1	50.7	51.7	48.2	48.9	50.0	51.1	51.6	48.0
	Traveltime min	14.4	19.1	13.5	13.2	14.2	13.8	13.4	13.1	13.0	14.0
	Delay min	5.0	49.1	50.7	3.8	4.8	6.6	4.2	6.7	3.8	9.3
Network	Freeways (General purpose lanes and HOV)										
	VMT veh-mi (x1000)	588.5	588.1	585.8	580.2	556.5	708.3	708.0	705.3	699.0	671.8
	VHT veh-hrs (x1000)	11.8	11.3	11.1	11.3	13.4	13.9	13.4	13.3	13.6	16.3
	Average speed mph	49.7	52.1	52.7	51.5	41.6	50.9	52.9	53.2	51.4	41.2
	Delay s/mi	12.2	52.1	52.7	15.5	29.8	12.1	11.3	12.1	15.3	29.7
	Off-Freeway (Arterials)										
	VMT veh-mi (x1000)	480.2	483.2	486.1	490.9	502.8	612.4	615.3	618.2	622.9	635.4
	VHT veh-hrs (x1000)	21.9	22.0	22.2	22.4	23.5	29.4	29.5	29.7	29.9	31.2
	Average speed mph	21.9	21.9	21.9	21.9	21.4	20.8	20.8	20.8	20.8	20.4
	Delay s/mi	561.9	21.9	21.9	559.6	582.7	567.4	567.5	566.3	565.5	588.0
	Entire Network										
	VMT veh-mi (x1000)	1,627.0	1,626.8	1,621.1	1,609.9	1,576.4	1,987.4	1,986.7	1,979.6	1,966.2	1,926.9
	VHT veh-hrs (x1000)	45.0	44.6	44.3	44.4	47.4	56.6	56.1	56.0	56.2	59.9
	Average speed mph	36.1	36.5	36.6	36.2	33.2	35.1	35.4	35.4	35.0	32.2
	Delay s/mi	59.8	59.3	59.2	59.5	65.8	59.9	59.5	59.4	59.9	66.2
	Entering network veh	356,253	356,254	356,258	356,253	356,226	436,003	436,005	436,009	436,004	435,976
	Inside network at end veh	14,645	14,402	14,577	14,946	17,192	18,689	18,479	18,746	19,260	22,014
	Waiting to enter at end veh	17	15	11	12	38	20	18	14	14	42

Table B-6: Simulation Metrics, HOV to Dynamic Toll HOT Conversion, PM

		Vehicles					Persons				
Metrics		HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%	HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB										
	VMT veh-mi (x1000)	59.6	58.6	55.5	53.8	53.8	121.5	116.8	108.4	104.9	104.6
	VHT veh-hrs (x1000)	2.1	2.6	2.8	3.0	3.0	4.3	5.1	5.4	5.7	5.7
	Average speed mph	28.2	22.8	20.0	18.2	18.2	28.2	22.8	20.0	18.2	18.2
	Traveltime min	22.5	27.7	31.9	35.7	35.8	22.5	27.7	31.9	35.7	36.0
	Delay min	14.3	22.8	20.0	27.4	27.6	14.3	19.4	23.7	27.5	27.7
	I-210 Core: General Purpose Lanes - EB										
	VMT veh-mi (x1000)	323.0	318.9	318.6	314.3	314.5	358.3	356.1	361.0	358.3	358.6
	VHT veh-hrs (x1000)	13.4	13.4	12.8	12.6	12.6	14.8	14.9	14.6	14.6	14.6
	Average speed mph	24.0	23.9	24.9	24.9	25.0	24.2	23.9	24.8	24.5	24.6
	Traveltime min	32.5	33.0	31.6	31.8	31.5	32.4	33.0	31.8	32.1	31.9
	Delay min	22.8	23.9	24.9	22.1	21.9	22.8	23.3	22.1	22.5	22.2
	I-210 Core: General Purpose Lanes & HOT Lanes - EB										
	VMT veh-mi (x1000)	382.6	377.4	374.1	368.1	368.3	479.8	473.0	469.4	463.3	463.2
	VHT veh-hrs (x1000)	15.5	15.9	15.6	15.6	15.5	19.1	20.0	20.0	20.4	20.3
	Average speed mph	24.6	23.7	24.0	23.6	23.7	25.1	23.6	23.5	22.8	22.8
	Traveltime min	30.9	32.1	31.6	32.3	32.2	29.9	31.7	31.8	32.9	32.8
	Delay min	21.5	23.7	24.0	22.9	22.7	37.0	42.8	22.5	23.6	49.9
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB										
	VMT veh-mi (x1000)	55.1	55.9	56.4	56.4	56.3	110.7	111.3	111.7	111.8	111.6
	VHT veh-hrs (x1000)	0.9	1.0	1.0	1.0	1.0	1.8	2.0	2.0	1.9	2.0
	Average speed mph	60.8	56.1	54.5	58.3	56.0	60.8	56.2	54.6	58.5	56.3
	Traveltime min	9.7	10.5	10.8	10.1	10.5	9.7	10.5	10.8	10.1	10.5
	Delay min	1.7	56.1	54.5	2.1	2.5	1.7	2.4	2.8	2.1	2.5
	I-210 Core: General Purpose Lanes - WB										
	VMT veh-mi (x1000)	333.3	330.8	329.3	327.7	327.3	368.1	365.8	364.3	363.0	362.7
	VHT veh-hrs (x1000)	8.3	8.1	7.8	7.0	7.1	9.2	9.0	8.7	7.8	7.9
	Average speed mph	40.2	41.0	42.0	47.0	46.3	40.1	40.8	41.8	46.7	46.0
	Traveltime min	17.1	16.9	16.5	14.8	15.0	17.0	16.8	16.4	14.7	14.9
	Delay min	7.6	41.0	42.0	5.2	5.5	7.5	7.2	6.8	5.2	5.4
	I-210 Core: General Purpose Lanes & HOT Lanes - WB										
	VMT veh-mi (x1000)	388.4	386.7	385.6	384.1	383.7	478.8	477.1	476.0	474.8	474.3
	VHT veh-hrs (x1000)	9.2	9.1	8.9	7.9	8.1	11.0	10.9	10.8	9.7	9.9
	Average speed mph	42.2	42.6	43.4	48.4	47.5	43.5	43.6	44.2	49.0	48.1
	Traveltime min	16.1	16.0	15.6	14.1	14.3	15.3	15.3	15.1	13.6	13.9
	Delay min	6.8	42.6	43.4	4.8	5.0	9.2	9.7	5.9	4.4	7.9
Network	Freeways (General purpose lanes and HOV)										
	VMT veh-mi (x1000)	771.0	764.2	759.7	752.2	752.0	958.6	950.0	945.4	938.1	937.5
	VHT veh-hrs (x1000)	24.7	25.0	24.4	23.5	23.6	30.1	31.0	30.8	30.0	30.2
	Average speed mph	31.2	30.6	31.1	32.0	31.9	31.8	30.7	30.7	31.2	31.1
	Delay s/mi	46.4	30.6	31.1	56.9	57.4	46.2	52.5	55.4	57.2	57.8
	Off-Freeway (Arterials)										
	VMT veh-mi (x1000)	838.3	848.2	854.1	865.6	866.3	1,073.5	1,084.6	1,089.3	1,101.7	1,102.5
	VHT veh-hrs (x1000)	41.7	42.3	42.7	43.9	44.0	56.1	56.8	57.2	58.6	58.7
	Average speed mph	20.1	20.0	20.0	19.7	19.7	19.1	19.1	19.0	18.8	18.8
	Delay s/mi	670.0	20.0	20.0	686.7	687.7	674.6	675.9	685.1	691.8	692.6
	Entire Network										
	VMT veh-mi (x1000)	2,424.5	2,421.1	2,416.6	2,410.1	2,412.1	3,038.5	3,032.3	3,025.3	3,019.2	3,021.2
	VHT veh-hrs (x1000)	87.2	87.8	87.6	87.1	87.4	111.8	113.1	113.2	113.0	113.3
	Average speed mph	27.8	27.6	27.6	27.7	27.6	27.2	26.8	26.7	26.7	26.7
	Delay s/mi	78.8	79.2	79.4	80.2	80.4	78.7	79.4	79.7	80.6	80.8
	Entering network veh	585,330	585,315	585,384	585,317	585,324	722,051	722,037	721,753	722,036	722,044
	Inside network at end veh	18,143	18,117	18,388	18,292	18,134	23,393	23,528	24,073	23,876	23,713
	Waiting to enter at end veh	33	32	69	46	39	42	42	85	58	49

B.3. HOV CONVERSION INTO HOT WITH LANE ADDITION

Table B-7: Simulation Metrics, HOV to HOT Conversion with Lane Addition, AM Peak

		Vehicles					Persons				
Metrics		HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%	HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB										
	VMT veh-mi (x1000)	40.9	45.0	46.5	48.0	50.1	82.4	86.7	88.2	89.6	91.7
	VHT veh-hrs (x1000)	0.6	0.6	0.7	0.7	0.7	1.2	1.2	1.2	1.3	1.3
	Average speed mph	68.0	71.7	71.4	68.8	67.6	68.0	71.8	71.5	69.6	68.7
	Traveltime min	8.9	8.4	8.5	8.7	8.9	8.9	8.4	8.5	8.6	8.8
	Delay min	0.7	71.7	71.4	0.5	0.6	0.7	0.2	0.2	0.4	0.5
	I-210 Core: General Purpose Lanes - EB										
	VMT veh-mi (x1000)	444.9	443.3	440.2	436.9	433.1	475.6	474.4	471.4	468.1	464.3
	VHT veh-hrs (x1000)	8.6	8.4	8.1	8.0	8.0	9.2	8.9	8.7	8.6	8.5
	Average speed mph	51.6	53.0	54.2	54.5	54.4	51.7	53.2	54.3	54.6	54.5
	Traveltime min	14.0	13.6	13.3	13.3	13.3	14.0	13.6	13.3	13.3	13.3
	Delay min	4.3	53.0	54.2	3.6	3.6	4.3	3.9	3.6	3.6	3.6
	I-210 Core: General Purpose Lanes & HOT Lanes - EB										
	VMT veh-mi (x1000)	485.8	488.3	486.7	484.9	483.2	558.0	561.1	559.5	557.7	556.0
	VHT veh-hrs (x1000)	9.2	9.0	8.8	8.7	8.7	10.4	10.1	9.9	9.9	9.9
	Average speed mph	52.7	54.4	55.5	55.7	55.5	53.6	55.4	56.5	56.6	56.4
	Traveltime min	13.6	13.2	12.9	12.8	12.9	13.2	12.8	12.6	12.5	12.6
	Delay min	4.0	54.4	55.5	3.3	3.3	3.8	4.1	3.9	4.0	4.2
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB										
	VMT veh-mi (x1000)	84.7	101.0	108.1	108.2	107.2	172.0	190.9	197.9	197.6	195.8
	VHT veh-hrs (x1000)	1.8	1.4	1.6	1.9	2.0	3.6	2.7	2.9	3.4	3.6
	Average speed mph	48.0	70.0	69.1	57.3	53.4	47.9	69.9	69.1	58.6	55.0
	Traveltime min	12.2	8.5	8.6	10.2	10.9	12.2	8.5	8.6	10.0	10.6
	Delay min	4.2	70.0	69.1	2.1	2.8	4.2	0.4	0.5	1.9	2.6
	I-210 Core: General Purpose Lanes - WB										
	VMT veh-mi (x1000)	499.1	482.7	476.3	476.4	474.8	553.6	536.7	530.5	531.3	530.2
	VHT veh-hrs (x1000)	18.6	18.7	17.0	14.4	13.4	20.4	20.5	18.8	16.1	15.0
	Average speed mph	26.9	25.9	28.1	33.2	35.5	27.1	26.2	28.2	33.1	35.3
	Traveltime min	26.9	28.2	25.6	21.4	19.9	26.9	28.1	25.7	21.5	19.9
	Delay min	17.3	25.9	28.1	11.8	10.3	17.3	18.5	16.1	11.9	10.3
	I-210 Core: General Purpose Lanes & HOT Lanes - WB										
	VMT veh-mi (x1000)	583.8	583.7	584.4	584.6	582.0	725.6	727.7	728.4	728.8	726.0
	VHT veh-hrs (x1000)	20.3	20.1	18.5	16.2	15.4	24.0	23.2	21.7	19.4	18.6
	Average speed mph	28.7	29.0	31.5	36.0	37.9	30.2	31.3	33.6	37.5	39.1
	Traveltime min	24.8	24.8	22.5	19.3	18.2	23.4	23.0	21.0	18.3	17.4
	Delay min	15.4	29.0	31.5	10.0	8.9	14.2	18.9	16.6	13.8	12.9
Network	Freeways (General purpose lanes and HOV)										
	VMT veh-mi (x1000)	1,069.6	1,072.0	1,071.1	1,069.5	1,065.1	1,283.7	1,288.8	1,288.0	1,286.5	1,282.0
	VHT veh-hrs (x1000)	29.5	29.1	27.3	25.0	24.1	34.4	33.4	31.6	29.3	28.4
	Average speed mph	36.2	36.8	39.2	42.9	44.2	37.3	38.6	40.8	43.9	45.1
	Delay s/mi	26.5	36.8	39.2	17.9	17.3	26.5	23.1	20.4	17.8	17.1
	Off-Freeway (Arterials)										
	VMT veh-mi (x1000)	837.2	844.5	848.1	854.2	862.1	1,107.6	1,113.7	1,117.0	1,122.8	1,130.7
	VHT veh-hrs (x1000)	38.1	38.8	38.7	39.4	40.0	54.1	54.9	54.8	55.5	56.2
	Average speed mph	22.0	21.8	21.9	21.7	21.6	20.5	20.3	20.4	20.2	20.1
	Delay s/mi	591.6	21.8	21.9	601.7	605.7	593.9	601.5	595.4	604.6	608.7
	Entire Network										
	VMT veh-mi (x1000)	2,935.9	2,947.0	2,948.9	2,956.3	2,956.4	3,644.2	3,658.1	3,659.4	3,667.2	3,667.1
	VHT veh-hrs (x1000)	90.3	89.0	87.7	85.5	85.8	115.9	114.1	112.8	110.6	111.2
	Average speed mph	32.5	33.1	33.6	34.6	34.4	31.4	32.1	32.5	33.2	33.0
	Delay s/mi	64.2	64.1	62.9	62.2	63.1	64.0	63.9	62.9	62.4	63.4
	Entering network veh	653,145	654,203	653,733	653,674	653,666	814,381	815,614	814,907	814,874	814,856
	Inside network at end veh	14,058	13,952	13,603	13,020	13,058	18,129	18,004	17,633	16,971	17,053
	Waiting to enter at end veh	10	13	13	11	19	13	19	18	16	33

Table B-8: Simulation Metrics, HOV to HOT Conversion with Lane Addition, Midday

		Vehicles					Persons				
Metrics		HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%	HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB										
	VMT veh-mi (x1000)	34.1	44.9	50.0	54.6	58.3	68.6	79.5	84.6	89.2	92.3
	VHT veh-hrs (x1000)	0.5	0.6	0.7	0.8	1.0	1.0	1.1	1.2	1.3	1.5
	Average speed mph	66.5	70.5	70.0	67.8	59.3	66.5	70.5	70.1	68.2	60.4
	Traveltime min	9.1	8.6	8.7	8.9	10.2	9.1	8.6	8.7	8.9	10.1
	Delay min	0.9	70.5	70.0	0.7	2.0	0.9	0.4	0.4	0.7	1.8
	I-210 Core: General Purpose Lanes - EB										
	VMT veh-mi (x1000)	267.7	259.1	253.5	247.7	241.1	289.4	280.9	275.2	269.5	262.9
	VHT veh-hrs (x1000)	5.3	4.7	4.5	4.4	4.6	5.7	5.1	4.9	4.8	5.0
	Average speed mph	50.5	55.2	56.2	55.8	52.9	50.7	55.4	56.4	55.9	52.9
	Traveltime min	14.4	13.1	12.8	12.9	13.7	14.3	13.0	12.8	12.9	13.7
	Delay min	4.6	55.2	56.2	3.2	4.0	4.6	3.3	3.1	3.1	4.0
	I-210 Core: General Purpose Lanes & HOT Lanes - EB										
	VMT veh-mi (x1000)	301.9	304.0	303.5	302.3	299.4	358.0	360.3	359.9	358.7	355.2
	VHT veh-hrs (x1000)	5.8	5.3	5.2	5.2	5.5	6.7	6.2	6.1	6.1	6.5
	Average speed mph	51.9	57.1	58.1	57.7	54.0	53.1	58.2	59.1	58.5	54.7
	Traveltime min	13.8	12.4	12.1	12.2	13.1	13.3	12.1	11.8	11.9	12.8
	Delay min	4.2	57.1	58.1	2.7	3.6	5.5	3.7	3.5	3.8	5.8
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB										
	VMT veh-mi (x1000)	38.1	39.4	40.3	42.2	43.4	76.5	76.8	77.7	79.6	80.8
	VHT veh-hrs (x1000)	0.6	0.6	0.6	0.6	0.6	1.2	1.1	1.1	1.1	1.2
	Average speed mph	64.8	70.6	70.4	69.7	67.2	64.8	70.6	70.5	69.9	67.9
	Traveltime min	9.2	8.4	8.4	8.5	8.8	9.2	8.4	8.4	8.5	8.7
	Delay min	1.1	70.6	70.4	0.4	0.7	1.1	0.3	0.4	0.4	0.6
	I-210 Core: General Purpose Lanes - WB										
	VMT veh-mi (x1000)	248.6	243.4	241.0	237.7	234.6	273.7	267.9	265.6	262.3	259.3
	VHT veh-hrs (x1000)	5.4	4.9	4.8	4.6	4.4	6.0	5.4	5.2	5.1	4.9
	Average speed mph	45.7	49.3	50.7	51.7	53.1	45.7	49.4	50.7	51.7	53.1
	Traveltime min	15.2	14.1	13.8	13.5	13.2	15.1	14.0	13.7	13.4	13.1
	Delay min	5.6	49.3	50.7	3.9	3.6	5.5	4.4	4.1	3.9	3.5
	I-210 Core: General Purpose Lanes & HOT Lanes - WB										
	VMT veh-mi (x1000)	286.6	282.8	281.3	279.9	278.1	350.3	344.7	343.3	341.9	340.1
	VHT veh-hrs (x1000)	6.0	5.5	5.3	5.2	5.1	7.2	6.5	6.3	6.2	6.1
	Average speed mph	47.6	51.5	52.8	53.8	54.9	48.9	53.0	54.2	55.0	56.0
	Traveltime min	14.4	13.3	13.0	12.8	12.5	13.8	12.8	12.5	12.3	12.1
	Delay min	5.0	51.5	52.8	3.4	3.1	6.6	4.8	4.5	4.3	4.2
Network	Freeways (General purpose lanes and HOV)										
	VMT veh-mi (x1000)	588.5	586.7	584.8	582.2	577.4	708.3	705.1	703.2	700.6	695.3
	VHT veh-hrs (x1000)	11.8	10.8	10.6	10.4	10.6	13.9	12.7	12.4	12.3	12.6
	Average speed mph	49.7	54.2	55.4	55.7	54.4	50.9	55.5	56.6	56.8	55.3
	Delay s/mi	12.2	54.2	55.4	8.2	10.3	12.1	8.4	7.9	8.1	10.0
	Off-Freeway (Arterials)										
	VMT veh-mi (x1000)	480.2	482.1	484.9	489.3	493.7	612.4	613.4	616.2	620.6	624.9
	VHT veh-hrs (x1000)	21.9	21.9	22.1	22.3	22.6	29.4	29.4	29.5	29.8	30.1
	Average speed mph	21.9	22.0	22.0	21.9	21.9	20.8	20.9	20.9	20.8	20.8
	Delay s/mi	561.9	22.0	22.0	560.3	561.9	567.4	567.0	564.9	566.4	568.0
	Entire Network										
	VMT veh-mi (x1000)	1,627.0	1,625.5	1,620.7	1,614.7	1,603.2	1,987.4	1,983.0	1,977.6	1,971.7	1,958.8
	VHT veh-hrs (x1000)	45.0	44.0	43.7	43.8	44.2	56.6	55.4	55.1	55.2	55.8
	Average speed mph	36.1	36.9	37.0	36.8	36.3	35.1	35.8	35.9	35.7	35.1
	Delay s/mi	59.8	58.5	58.4	58.8	59.7	59.9	58.6	58.5	59.0	59.9
	Entering network veh	356,253	355,909	355,923	355,916	355,921	436,003	435,375	435,392	435,384	435,389
	Inside network at end veh	14,645	14,387	14,489	14,505	14,948	18,689	18,437	18,592	18,608	19,150
	Waiting to enter at end veh	17	26	12	19	14	20	30	13	21	16

Table B-9: Simulation Metrics, HOV to HOT Conversion with Lane Addition, PM Peak

		Vehicles					Persons				
Metrics		HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%	HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB										
	VMT veh-mi (x1000)	59.6	74.8	80.4	77.6	76.5	121.5	140.0	145.5	141.1	138.5
	VHT veh-hrs (x1000)	2.1	1.8	2.3	3.0	3.4	4.3	3.5	4.1	5.2	5.8
	Average speed mph	28.2	40.5	35.1	25.7	22.4	28.2	40.4	35.4	27.1	23.8
	Traveltime min	22.5	15.6	17.9	22.7	26.3	22.5	15.7	18.0	22.5	26.0
	Delay min	14.3	40.5	35.1	14.5	18.1	14.3	7.4	9.7	14.3	17.7
	I-210 Core: General Purpose Lanes - EB										
	VMT veh-mi (x1000)	323.0	290.6	295.8	299.9	297.4	358.3	324.0	330.0	335.4	334.2
	VHT veh-hrs (x1000)	13.4	16.4	14.2	11.8	11.5	14.8	18.0	15.7	13.3	13.1
	Average speed mph	24.0	17.8	20.9	25.4	25.8	24.2	18.0	21.0	25.3	25.5
	Traveltime min	32.5	45.1	40.2	33.3	32.5	32.4	45.0	40.2	33.5	32.8
	Delay min	22.8	17.8	20.9	23.7	22.9	22.8	35.3	30.5	23.8	23.1
	I-210 Core: General Purpose Lanes & HOT Lanes - EB										
	VMT veh-mi (x1000)	382.6	365.3	376.2	377.6	373.9	479.8	464.0	475.5	476.5	472.6
	VHT veh-hrs (x1000)	15.5	18.2	16.5	14.8	14.9	19.1	21.5	19.8	18.5	18.9
	Average speed mph	24.6	20.1	22.9	25.5	25.0	25.1	21.6	24.0	25.8	25.0
	Traveltime min	30.9	39.1	35.4	31.2	31.3	29.9	36.1	33.4	30.3	30.8
	Delay min	21.5	20.1	22.9	21.8	21.9	37.0	42.8	24.1	21.0	40.8
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB										
	VMT veh-mi (x1000)	55.1	57.9	59.3	60.4	60.3	110.7	114.5	115.9	116.6	116.4
	VHT veh-hrs (x1000)	0.9	0.8	0.8	0.9	0.9	1.8	1.6	1.6	1.7	1.7
	Average speed mph	60.8	70.5	70.4	70.0	69.8	60.8	70.5	70.4	70.1	69.9
	Traveltime min	9.7	8.4	8.4	8.4	8.5	9.7	8.4	8.4	8.4	8.5
	Delay min	1.7	70.5	70.4	0.4	0.4	1.7	0.4	0.4	0.4	0.4
	I-210 Core: General Purpose Lanes - WB										
	VMT veh-mi (x1000)	333.3	329.5	327.1	324.3	322.9	368.1	364.5	362.2	359.3	358.1
	VHT veh-hrs (x1000)	8.3	8.3	8.0	7.6	6.8	9.2	9.2	8.9	8.5	7.5
	Average speed mph	40.2	39.7	40.9	42.4	47.6	40.1	39.7	40.8	42.3	47.5
	Traveltime min	17.1	17.5	17.0	16.5	14.7	17.0	17.3	16.9	16.4	14.6
	Delay min	7.6	39.7	40.9	7.0	5.2	7.5	7.8	7.3	6.9	5.1
	I-210 Core: General Purpose Lanes & HOT Lanes - WB										
	VMT veh-mi (x1000)	388.4	387.4	386.4	384.7	383.2	478.8	479.0	478.1	475.9	474.5
	VHT veh-hrs (x1000)	9.2	9.1	8.8	8.5	7.6	11.0	10.8	10.5	10.2	9.2
	Average speed mph	42.2	42.5	43.7	45.2	50.1	43.5	44.4	45.5	46.9	51.5
	Traveltime min	16.1	16.1	15.7	15.3	13.7	15.3	15.2	14.8	14.4	13.1
	Delay min	6.8	42.5	43.7	6.0	4.4	9.2	8.1	5.6	5.3	5.5
Network	Freeways (General purpose lanes and HOV)										
	VMT veh-mi (x1000)	771.0	752.7	762.6	762.2	757.1	958.6	942.9	953.6	952.4	947.1
	VHT veh-hrs (x1000)	24.7	27.3	25.3	23.3	22.6	30.1	32.3	30.3	28.6	28.1
	Average speed mph	31.2	27.5	30.1	32.7	33.5	31.8	29.2	31.5	33.3	33.7
	Delay s/mi	46.4	27.5	30.1	45.6	46.5	46.2	50.9	47.9	45.4	46.3
	Off-Freeway (Arterials)										
	VMT veh-mi (x1000)	838.3	851.4	851.0	858.8	867.4	1,073.5	1,084.8	1,084.0	1,092.0	1,100.3
	VHT veh-hrs (x1000)	41.7	42.7	42.7	43.8	45.2	56.1	57.2	57.0	58.3	60.0
	Average speed mph	20.1	19.9	20.0	19.6	19.2	19.1	19.0	19.0	18.7	18.3
	Delay s/mi	670.0	19.9	20.0	690.1	719.6	674.6	681.2	679.1	695.0	723.8
	Entire Network										
	VMT veh-mi (x1000)	2,424.5	2,398.4	2,410.2	2,415.4	2,408.4	3,038.5	3,016.3	3,027.7	3,030.3	3,022.3
	VHT veh-hrs (x1000)	87.2	90.2	88.3	87.5	88.0	111.8	114.8	112.8	112.4	113.4
	Average speed mph	27.8	26.6	27.3	27.6	27.4	27.2	26.3	26.8	27.0	26.7
	Delay s/mi	78.8	81.9	80.1	80.7	82.8	78.7	81.6	80.0	80.8	83.0
	Entering network veh	585,330	585,553	585,574	585,723	585,689	722,051	722,113	722,140	722,310	722,269
	Inside network at end veh	18,143	20,087	18,859	18,266	18,601	23,393	25,375	24,114	23,623	24,059
	Waiting to enter at end veh	33	83	62	47	81	42	104	77	60	100

B.4. HOV CONVERSION INTO HOT WITH GENERAL PURPOSE LANE SWAP

Table B-10: Simulation Metrics, HOV to HOT Conversion with GP Lane Swap, AM Peak

		Vehicles					Persons				
Metrics		HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%	HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB										
	VMT veh-mi (x1000)	40.9	55.3	69.6	92.9	93.5	82.4	94.6	109.0	133.9	132.7
	VHT veh-hrs (x1000)	0.6	0.8	1.1	1.6	2.5	1.2	1.4	1.7	2.3	3.5
	Average speed mph	68.0	69.4	63.9	56.5	37.0	68.0	69.5	64.3	57.3	38.4
	Traveltime min	8.9	8.8	9.7	10.5	15.9	8.9	8.8	9.6	10.4	15.4
	Delay min	0.7	69.4	63.9	2.3	7.7	0.7	0.5	1.4	2.1	7.2
	I-210 Core: General Purpose Lanes - EB										
	VMT veh-mi (x1000)	444.9	322.4	332.0	355.3	347.1	475.6	349.4	359.5	384.3	376.6
	VHT veh-hrs (x1000)	8.6	15.4	14.8	12.5	12.0	9.2	16.7	15.9	13.5	13.1
	Average speed mph	51.6	20.9	22.5	28.3	28.8	51.7	21.0	22.6	28.5	28.8
	Traveltime min	14.0	34.6	32.3	26.0	25.5	14.0	34.6	32.3	26.0	25.6
	Delay min	4.3	20.9	22.5	16.3	15.7	4.3	24.9	22.6	16.3	15.8
	I-210 Core: General Purpose Lanes & HOT Lanes - EB										
	VMT veh-mi (x1000)	485.8	377.7	401.6	448.2	440.6	558.0	443.9	468.5	518.3	509.3
	VHT veh-hrs (x1000)	9.2	16.2	15.9	14.2	14.6	10.4	18.0	17.6	15.8	16.5
	Average speed mph	52.7	23.3	25.3	31.6	30.2	53.6	24.6	26.6	32.7	30.8
	Traveltime min	13.6	30.8	28.4	22.8	23.4	13.2	29.1	27.0	22.0	22.9
	Delay min	4.0	23.3	25.3	18.6	23.4	3.8	25.5	24.0	18.5	23.0
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB										
	VMT veh-mi (x1000)	84.7	97.6	110.1	133.4	139.9	172.0	182.9	192.7	217.5	225.1
	VHT veh-hrs (x1000)	1.8	1.4	1.6	2.3	3.7	3.6	2.6	2.8	3.8	5.8
	Average speed mph	48.0	70.3	69.0	56.9	37.8	47.9	70.2	69.0	57.5	38.7
	Traveltime min	12.2	8.4	8.6	10.4	15.6	12.2	8.4	8.6	10.3	15.2
	Delay min	4.2	70.3	69.0	2.3	7.6	4.2	0.4	0.5	2.2	7.2
	I-210 Core: General Purpose Lanes - WB										
	VMT veh-mi (x1000)	499.1	403.3	402.6	397.1	394.6	553.6	454.8	453.3	448.9	447.8
	VHT veh-hrs (x1000)	18.6	15.6	15.5	15.6	15.2	20.4	17.3	17.1	17.4	17.1
	Average speed mph	26.9	25.8	26.0	25.5	26.0	27.1	26.4	26.5	25.8	26.2
	Traveltime min	26.9	30.0	29.5	29.5	28.6	26.9	29.9	29.4	29.6	28.7
	Delay min	17.3	25.8	26.0	19.9	18.9	17.3	20.3	19.8	20.0	19.1
	I-210 Core: General Purpose Lanes & HOT Lanes - WB										
	VMT veh-mi (x1000)	583.8	500.9	512.6	530.5	534.5	725.6	637.7	646.0	666.4	672.9
	VHT veh-hrs (x1000)	20.3	17.0	17.1	17.9	18.9	24.0	19.9	19.9	21.2	22.9
	Average speed mph	28.7	29.4	30.1	29.6	28.3	30.2	32.1	32.5	31.5	29.4
	Traveltime min	24.8	25.8	25.0	24.7	25.2	23.4	23.8	23.2	23.3	24.2
	Delay min	15.4	29.4	30.1	22.2	26.5	14.2	20.7	20.3	22.2	26.2
Network	Freeways (General purpose lanes and HOV)										
	VMT veh-mi (x1000)	1,069.6	878.6	914.3	978.7	975.1	1,283.7	1,081.6	1,114.5	1,184.7	1,182.2
	VHT veh-hrs (x1000)	29.5	33.3	32.9	32.1	33.4	34.4	37.9	37.5	37.0	39.4
	Average speed mph	36.2	26.4	27.8	30.5	29.2	37.3	28.6	29.7	32.0	30.0
	Delay s/mi	26.5	26.4	27.8	40.8	49.9	26.5	46.2	44.3	40.7	49.2
	Off-Freeway (Arterials)										
	VMT veh-mi (x1000)	837.2	928.3	915.0	904.9	919.4	1,107.6	1,201.3	1,187.1	1,177.2	1,193.3
	VHT veh-hrs (x1000)	38.1	45.9	44.4	43.5	44.3	54.1	63.0	61.3	60.4	61.2
	Average speed mph	22.0	20.2	20.6	20.8	20.8	20.5	19.1	19.4	19.5	19.5
	Delay s/mi	591.6	20.2	20.6	635.3	641.3	593.9	669.9	648.2	637.6	642.9
	Entire Network										
	VMT veh-mi (x1000)	2,935.9	2,705.1	2,757.5	2,852.9	2,871.2	3,644.2	3,392.3	3,439.9	3,546.6	3,570.9
	VHT veh-hrs (x1000)	90.3	112.3	108.9	103.9	104.4	115.9	140.9	137.4	132.0	133.1
	Average speed mph	32.5	24.1	25.3	27.4	27.5	31.4	24.1	25.0	26.9	26.8
	Delay s/mi	64.2	89.7	84.3	77.9	77.7	64.0	88.0	83.3	77.5	77.3
	Entering network veh	653,145	640,155	642,627	648,574	650,509	814,381	799,667	801,725	808,538	811,122
	Inside network at end veh	14,058	21,959	19,258	16,421	16,489	18,129	26,884	23,861	20,740	20,919
	Waiting to enter at end veh	10	14,093	11,060	5,176	3,353	13	15,741	13,131	6,381	3,910

Table B-11: Simulation Metrics, HOV to HOT Conversion with GP Lane Swap, Midday

		Vehicles					Persons				
Metrics		HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%	HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB										
	VMT veh-mi (x1000)	34.1	46.2	60.8	79.6	75.4	68.6	78.7	93.8	113.5	106.8
	VHT veh-hrs (x1000)	0.5	0.7	0.9	1.2	1.8	1.0	1.1	1.4	1.8	2.6
	Average speed mph	66.5	70.4	68.7	63.7	41.2	66.5	70.4	68.7	63.7	41.7
	Traveltime min	9.1	8.6	8.8	9.5	14.8	9.1	8.6	8.8	9.5	14.6
	Delay min	0.9	70.4	68.7	1.3	6.5	0.9	0.4	0.6	1.3	6.3
	I-210 Core: General Purpose Lanes - EB										
	VMT veh-mi (x1000)	267.7	184.9	190.8	201.9	194.6	289.4	203.8	210.4	222.7	215.7
	VHT veh-hrs (x1000)	5.3	9.3	8.7	6.7	6.2	5.7	10.1	9.5	7.3	6.8
	Average speed mph	50.5	19.8	22.0	30.1	31.6	50.7	20.1	22.3	30.4	31.7
	Traveltime min	14.4	36.6	33.4	25.3	23.0	14.3	36.3	33.2	25.2	23.0
	Delay min	4.6	19.8	22.0	15.5	13.2	4.6	26.6	23.5	15.4	13.2
	I-210 Core: General Purpose Lanes & HOT Lanes - EB										
	VMT veh-mi (x1000)	301.9	231.0	251.6	281.6	270.0	358.0	282.6	304.1	336.2	322.5
	VHT veh-hrs (x1000)	5.8	10.0	9.6	8.0	8.0	6.7	11.3	10.8	9.1	9.4
	Average speed mph	51.9	23.1	26.3	35.4	33.8	53.1	25.1	28.1	36.9	34.4
	Traveltime min	13.8	31.0	27.5	20.8	20.7	13.3	28.6	25.7	19.9	20.2
	Delay min	4.2	23.1	26.3	16.8	19.8	5.5	27.0	24.1	16.7	19.5
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB										
	VMT veh-mi (x1000)	38.1	47.4	57.6	63.6	66.3	76.5	84.6	95.2	101.2	103.7
	VHT veh-hrs (x1000)	0.6	0.7	0.8	0.9	1.0	1.2	1.2	1.4	1.5	1.6
	Average speed mph	64.8	70.3	69.4	68.2	63.7	64.8	70.3	69.4	68.3	64.3
	Traveltime min	9.2	8.4	8.5	8.7	9.2	9.2	8.4	8.5	8.7	9.2
	Delay min	1.1	70.3	69.4	0.6	1.2	1.1	0.4	0.5	0.6	1.1
	I-210 Core: General Purpose Lanes - WB										
	VMT veh-mi (x1000)	248.6	208.0	215.5	214.7	209.7	273.7	232.0	239.7	239.2	234.2
	VHT veh-hrs (x1000)	5.4	6.5	5.5	4.3	4.3	6.0	7.0	6.0	4.7	4.7
	Average speed mph	45.7	32.1	39.2	50.4	49.3	45.7	33.0	39.9	50.6	49.6
	Traveltime min	15.2	23.8	18.9	14.1	14.5	15.1	23.5	18.7	14.1	14.4
	Delay min	5.6	32.1	39.2	4.5	4.8	5.5	13.9	9.1	4.5	4.8
	I-210 Core: General Purpose Lanes & HOT Lanes - WB										
	VMT veh-mi (x1000)	286.6	255.4	273.1	278.3	276.0	350.3	316.6	334.9	340.4	337.8
	VHT veh-hrs (x1000)	6.0	7.2	6.3	5.2	5.3	7.2	8.2	7.4	6.2	6.3
	Average speed mph	47.6	35.7	43.2	53.6	52.2	48.9	38.4	45.4	54.8	53.3
	Traveltime min	14.4	20.9	16.7	12.9	13.2	13.8	19.5	15.8	12.5	12.8
	Delay min	5.0	35.7	43.2	5.1	6.0	6.6	14.3	9.6	5.1	5.9
Network	Freeways (General purpose lanes and HOV)										
	VMT veh-mi (x1000)	588.5	486.5	524.7	559.8	546.0	708.3	599.2	639.0	676.7	660.3
	VHT veh-hrs (x1000)	11.8	17.1	15.9	13.1	13.3	13.9	19.5	18.2	15.3	15.7
	Average speed mph	49.7	28.4	33.0	42.6	41.1	50.9	30.7	35.1	44.2	42.0
	Delay s/mi	12.2	28.4	33.0	21.9	25.8	12.1	41.3	33.7	21.8	25.4
	Off-Freeway (Arterials)										
	VMT veh-mi (x1000)	480.2	517.7	507.1	495.5	503.4	612.4	650.1	639.4	627.2	635.3
	VHT veh-hrs (x1000)	21.9	24.1	23.3	22.6	23.1	29.4	31.8	30.9	30.1	30.7
	Average speed mph	21.9	21.5	21.8	21.9	21.8	20.8	20.5	20.7	20.8	20.7
	Delay s/mi	561.9	21.5	21.8	561.4	566.5	567.4	589.7	576.8	567.6	572.2
	Entire Network										
	VMT veh-mi (x1000)	1,627.0	1,486.3	1,534.8	1,574.7	1,558.6	1,987.4	1,834.2	1,885.4	1,929.1	1,907.5
	VHT veh-hrs (x1000)	45.0	52.4	49.0	45.6	46.5	56.6	64.6	60.9	57.2	58.4
	Average speed mph	36.1	28.4	31.3	34.5	33.5	35.1	28.4	31.0	33.7	32.7
	Delay s/mi	59.8	73.9	66.9	61.5	63.3	59.9	72.9	66.5	61.5	63.4
	Entering network veh	356,253	352,897	355,540	355,887	355,925	436,003	431,971	434,936	435,355	435,267
	Inside network at end veh	14,645	22,547	20,197	16,775	17,731	18,689	27,413	24,937	21,117	22,454
	Waiting to enter at end veh	17	3,044	372	26	15	20	3,314	449	31	18

Table B-12: Simulation Metrics, HOV to HOT Conversion with GP Lane Swap, PM Peak

		Vehicles					Persons				
Metrics		HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%	HOV2+ & Decals	HOT2+ 10%	HOT2+ 20%	HOT2+ 35%	HOT2+ 50%
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB										
	VMT veh-mi (x1000)	59.6	77.4	91.9	106.4	94.9	121.5	141.8	156.6	170.6	156.0
	VHT veh-hrs (x1000)	2.1	1.4	1.9	3.0	3.5	4.3	2.5	3.2	4.9	5.5
	Average speed mph	28.2	57.1	49.4	35.0	27.2	28.2	56.7	48.8	35.2	28.1
	Traveltime min	22.5	10.8	12.6	17.7	22.3	22.5	10.9	12.7	17.7	21.8
	Delay min	14.3	57.1	49.4	9.5	14.1	14.3	2.6	4.5	9.4	13.5
	I-210 Core: General Purpose Lanes - EB										
	VMT veh-mi (x1000)	323.0	228.4	225.0	245.8	259.6	358.3	259.6	256.6	279.4	294.8
	VHT veh-hrs (x1000)	13.4	15.1	15.3	13.8	11.5	14.8	16.7	17.2	15.5	13.0
	Average speed mph	24.0	15.2	14.7	17.9	22.5	24.2	15.5	15.0	18.1	22.6
	Traveltime min	32.5	49.5	51.9	44.2	34.8	32.4	49.1	51.6	44.1	34.9
	Delay min	22.8	15.2	14.7	34.5	25.1	22.8	39.4	41.9	34.4	25.2
	I-210 Core: General Purpose Lanes & HOT Lanes - EB										
	VMT veh-mi (x1000)	382.6	305.7	316.8	352.2	354.5	479.8	401.4	413.3	449.9	450.8
	VHT veh-hrs (x1000)	15.5	16.4	17.2	16.8	15.0	19.1	19.2	20.4	20.3	18.6
	Average speed mph	24.6	18.6	18.4	21.0	23.6	25.1	20.9	20.3	22.2	24.3
	Traveltime min	30.9	39.7	40.5	36.2	31.5	29.9	35.6	36.9	34.1	30.3
	Delay min	21.5	18.6	18.4	27.0	22.2	37.0	42.0	46.4	43.8	38.7
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB										
	VMT veh-mi (x1000)	55.1	62.6	69.5	80.9	79.4	110.7	117.6	123.7	135.3	131.2
	VHT veh-hrs (x1000)	0.9	0.9	1.0	1.7	2.6	1.8	1.7	1.8	2.8	4.0
	Average speed mph	60.8	70.4	69.1	46.9	30.9	60.8	70.4	69.3	48.3	32.7
	Traveltime min	9.7	8.4	8.5	11.7	17.6	9.7	8.4	8.5	11.6	17.3
	Delay min	1.7	70.4	69.1	3.6	9.5	1.7	0.4	0.5	3.5	9.2
	I-210 Core: General Purpose Lanes - WB										
	VMT veh-mi (x1000)	333.3	263.6	257.9	260.3	266.9	368.1	297.0	290.9	293.8	301.3
	VHT veh-hrs (x1000)	8.3	9.6	9.9	10.0	9.3	9.2	10.5	10.8	11.0	10.3
	Average speed mph	40.2	27.5	26.1	26.0	28.8	40.1	28.4	27.0	26.8	29.4
	Traveltime min	17.1	29.6	31.9	32.5	28.3	17.0	29.3	31.6	32.3	28.2
	Delay min	7.6	27.5	26.1	22.9	18.7	7.5	19.7	22.1	22.7	18.6
	I-210 Core: General Purpose Lanes & HOT Lanes - WB										
	VMT veh-mi (x1000)	388.4	326.3	327.4	341.3	346.3	478.8	414.5	414.6	429.1	432.5
	VHT veh-hrs (x1000)	9.2	10.5	10.9	11.7	11.8	11.0	12.1	12.6	13.8	14.3
	Average speed mph	42.2	31.1	30.1	29.1	29.3	43.5	34.2	33.0	31.1	30.3
	Traveltime min	16.1	25.5	27.0	27.5	25.8	15.3	23.3	24.7	25.7	24.9
	Delay min	6.8	31.1	30.1	18.3	16.6	9.2	20.1	22.6	26.3	27.8
Network	Freeways (General purpose lanes and HOV)										
	VMT veh-mi (x1000)	771.0	632.0	644.3	693.4	700.8	958.6	815.9	827.9	879.1	883.3
	VHT veh-hrs (x1000)	24.7	26.9	28.1	28.5	26.8	30.1	31.4	32.9	34.1	32.9
	Average speed mph	31.2	23.5	23.0	24.3	26.1	31.8	26.0	25.1	25.8	26.9
	Delay s/mi	46.4	23.5	23.0	70.6	67.4	46.2	62.1	69.0	70.1	66.6
	Off-Freeway (Arterials)										
	VMT veh-mi (x1000)	838.3	906.3	909.1	891.5	893.1	1,073.5	1,141.4	1,145.0	1,126.1	1,127.2
	VHT veh-hrs (x1000)	41.7	49.5	49.3	46.2	46.4	56.1	65.0	64.8	61.0	61.3
	Average speed mph	20.1	18.3	18.4	19.3	19.2	19.1	17.6	17.7	18.5	18.4
	Delay s/mi	670.0	18.3	18.4	712.6	721.6	674.6	784.7	769.0	716.7	725.6
	Entire Network										
	VMT veh-mi (x1000)	2,424.5	2,271.4	2,283.6	2,341.0	2,358.8	3,038.5	2,879.3	2,890.1	2,951.1	2,964.1
	VHT veh-hrs (x1000)	87.2	104.4	104.0	96.0	92.9	111.8	130.8	131.0	121.8	118.7
	Average speed mph	27.8	21.8	21.9	24.4	25.4	27.2	22.0	22.1	24.2	25.0
	Delay s/mi	78.8	103.6	101.5	88.6	86.2	78.7	102.1	100.5	88.1	86.0
	Entering network veh	585,330	578,727	579,834	584,651	586,011	722,051	714,904	716,103	721,161	722,479
	Inside network at end veh	18,143	25,652	25,779	23,275	21,686	23,393	31,820	32,143	29,196	27,711
	Waiting to enter at end veh	33	7,358	5,238	657	75	42	7,674	5,551	730	99

B.5. INCREASE IN PROPORTION OF HIGH-OCCUPANCY VEHICLES

Table B-13: Simulation Metrics, Increase in Proportion of HOV3, AM Peak

			Vehicles												
Metrics			HOV2 & Decals	HOV3 & Decals	+2.5%	+5%	+7.5%	+10%	+12.5%	+15%	+17.5%	+20%	+25%	+30%	+35%
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB														
	VMT	veh-mi (x1000)	41.3	5.8	13.0	20.4	27.7	34.7	42.1	49.0	56.1	63.5	77.7	88.4	92.4
	VHT	veh-hrs (x1000)	0.6	5.8	13.0	20.4	27.7	34.7	42.1	49.0	56.1	63.5	77.7	88.4	92.4
	Average speed	mph	67.9	71.6	70.3	69.5	68.9	68.3	67.8	67.4	66.9	66.3	64.0	59.3	49.0
	Traveltime	min	8.9	8.4	8.6	8.7	8.8	8.9	9.0	9.0	9.1	9.2	9.5	10.3	12.4
	Delay	min	0.7	0.2	0.4	0.5	0.6	0.7	0.7	0.8	0.9	0.9	1.3	2.0	4.2
	I-210 Core: General Purpose Lanes - EB														
	VMT	veh-mi (x1000)	447.1	443.6	443.5	443.4	446.7	445.4	441.3	436.7	431.1	424.2	410.6	399.3	393.9
	VHT	veh-hrs (x1000)	9.2	443.6	443.5	443.4	446.7	445.4	441.3	436.7	431.1	424.2	410.6	399.3	393.9
	Average speed	mph	48.6	30.0	31.0	32.3	35.2	39.0	40.5	43.6	47.0	49.6	55.3	56.4	56.1
	Traveltime	min	14.9	24.0	23.3	22.4	20.6	18.8	18.3	17.0	15.7	14.9	13.2	12.8	12.8
	Delay	min	5.2	14.3	13.6	12.7	10.9	9.1	8.6	7.2	6.0	5.2	3.5	3.1	3.1
	I-210 Core: General Purpose Lanes & HOT Lanes - EB														
	VMT	veh-mi (x1000)	488.4	449.4	456.5	463.8	474.3	480.1	483.3	485.6	487.2	487.6	488.3	487.7	486.3
	VHT	veh-hrs (x1000)	9.8	449.4	456.5	463.8	474.3	480.1	483.3	485.6	487.2	487.6	488.3	487.7	486.3
	Average speed	mph	49.8	30.3	31.5	33.0	36.3	40.2	41.9	45.2	48.7	51.3	56.5	56.9	54.6
	Traveltime	min	14.4	23.8	22.8	21.8	19.9	18.1	17.5	16.2	15.0	14.1	12.6	12.4	12.7
	Delay	min	5.9	14.5	13.9	13.2	11.5	9.7	9.3	8.0	6.9	6.1	4.8	5.1	7.3
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB														
	VMT	veh-mi (x1000)	84.6	12.5	20.2	28.0	35.6	44.1	52.1	60.5	68.8	76.3	87.7	91.3	91.5
	VHT	veh-hrs (x1000)	1.7	12.5	20.2	28.0	35.6	44.1	52.1	60.5	68.8	76.3	87.7	91.3	91.5
	Average speed	mph	49.0	69.7	69.0	68.3	67.7	67.2	66.7	66.0	65.2	62.9	49.8	42.7	36.0
	Traveltime	min	12.0	8.5	8.6	8.7	8.8	8.8	8.9	9.0	9.1	9.4	11.8	13.8	16.5
	Delay	min	3.9	0.4	0.5	0.6	0.7	0.8	0.8	0.9	1.1	1.4	3.8	5.8	8.5
	I-210 Core: General Purpose Lanes - WB														
	VMT	veh-mi (x1000)	495.7	511.8	511.0	511.2	508.5	509.4	510.5	507.3	505.0	502.3	490.3	482.2	475.3
	VHT	veh-hrs (x1000)	18.6	511.8	511.0	511.2	508.5	509.4	510.5	507.3	505.0	502.3	490.3	482.2	475.3
	Average speed	mph	26.7	30.0	29.4	29.7	28.6	28.7	28.6	27.8	27.3	27.6	28.1	29.1	29.7
	Traveltime	min	27.1	24.4	24.9	24.6	25.5	25.3	25.4	26.1	26.6	26.3	25.6	24.5	23.9
	Delay	min	17.5	14.8	15.3	15.0	15.9	15.7	15.8	16.5	17.0	16.7	15.9	14.9	14.3
	I-210 Core: General Purpose Lanes & HOT Lanes - WB														
	VMT	veh-mi (x1000)	580.3	524.3	531.2	539.2	544.1	553.5	562.6	567.7	573.8	578.6	578.0	573.5	566.7
	VHT	veh-hrs (x1000)	20.3	524.3	531.2	539.2	544.1	553.5	562.6	567.7	573.8	578.6	578.0	573.5	566.7
	Average speed	mph	28.6	30.4	30.0	30.6	29.8	30.1	30.2	29.6	29.4	29.8	30.1	30.7	30.5
	Traveltime	min	24.9	24.0	24.3	23.7	24.4	24.0	23.9	24.3	24.5	24.0	23.5	22.8	22.7
	Delay	min	21.5	15.3	15.9	15.6	16.6	16.5	16.6	17.5	18.1	18.0	19.7	20.7	22.8
Network	Freeways (General purpose lanes and HOV)														
	VMT	veh-mi (x1000)	1,942.8	973.7	987.7	1,003.0	1,018.4	1,033.5	1,046.0	1,053.4	1,060.9	1,066.2	1,066.3	1,061.2	1,053.0
	VHT	veh-hrs (x1000)	47.2	973.7	987.7	1,003.0	1,018.4	1,033.5	1,046.0	1,053.4	1,060.9	1,066.2	1,066.3	1,061.2	1,053.0
	Average speed	mph	41.2	30.4	30.7	31.7	32.5	34.1	34.7	35.2	35.9	36.8	38.3	38.9	38.3
	Delay	s/mi	39.2	29.8	29.8	28.8	28.1	26.3	25.9	25.5	24.9	24.1	24.5	25.8	30.1
	Off-Freeway (Arterials)														
	VMT	veh-mi (x1000)	841.3	858.5	857.5	855.7	847.5	845.7	846.2	847.4	847.3	848.2	849.1	850.1	853.1
	VHT	veh-hrs (x1000)	38.3	858.5	857.5	855.7	847.5	845.7	846.2	847.4	847.3	848.2	849.1	850.1	853.1
	Average speed	mph	22.0	21.8	21.8	21.8	21.9	21.9	21.9	21.9	21.8	21.9	21.9	21.9	21.8
	Delay	s/mi	592.6	600.3	599.6	599.8	596.9	595.3	593.7	594.7	595.5	594.4	592.5	593.6	596.4
	Entire Network														
	VMT	veh-mi (x1000)	2,935.4	2,781.4	2,803.9	2,829.7	2,844.6	2,868.8	2,891.4	2,907.7	2,923.7	2,934.9	2,937.4	2,933.5	2,923.3
	VHT	veh-hrs (x1000)	91.4	98.2	98.1	96.6	95.9	94.7	94.4	94.3	94.1	93.3	92.1	91.1	91.3
	Average speed	mph	32.1	28.3	28.6	29.3	29.7	30.3	30.6	30.8	31.1	31.5	31.9	32.2	32.0
	Delay	s/mi	64.7	73.2	72.4	70.9	69.9	68.6	67.9	67.7	67.3	66.6	65.6	65.0	65.4
	Entering network	veh	653,271	642,425	644,198	646,125	646,894	648,552	650,314	651,874	652,974	653,339	653,080	651,861	651,024
	Inside network at end	veh	14,162	17,199	16,990	16,492	15,774	15,406	15,328	15,446	15,172	14,582	14,276	13,476	13,496
	Waiting to enter at end	veh	10	10,790	9,291	7,432	6,810	5,001	3,009	1,504	448	17	23	1,334	2,077

		Persons													
Metrics		HOV2 & Decals	HOV3 & Decals	+2.5%	+5%	+7.5%	+10%	+12.5%	+15%	+17.5%	+20%	+25%	+30%	+35%	
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB														
	VMT	veh-mi (x1000)	82.9	11.6	33.7	55.8	77.5	98.4	120.6	141.3	162.6	184.9	227.6	259.9	272.7
	VHT	veh-hrs (x1000)	1.2	0.2	0.5	0.8	1.1	1.4	1.8	2.1	2.4	2.8	3.6	4.4	5.6
	Average speed	mph	67.9	71.6	70.3	69.5	68.8	68.4	67.8	67.4	66.9	66.3	64.0	59.4	49.0
	Traveltime	min	8.9	8.4	8.6	8.7	8.8	8.9	9.0	9.0	9.1	9.2	9.5	10.3	12.4
	Delay	min	0.7	0.2	0.4	0.5	0.6	0.7	0.7	0.8	0.9	0.9	1.3	2.0	4.2
	I-210 Core: General Purpose Lanes - EB														
	VMT	veh-mi (x1000)	477.9	504.2	510.4	516.6	527.2	532.8	535.7	538.1	539.4	539.4	539.3	547.1	572.2
	VHT	veh-hrs (x1000)	9.8	16.9	16.5	16.0	14.9	13.6	13.1	12.2	11.4	10.8	9.8	9.8	10.4
	Average speed	mph	48.8	29.9	31.0	32.3	35.4	39.2	40.8	43.9	47.3	49.8	55.1	55.8	54.9
	Traveltime	min	14.9	24.1	23.3	22.4	20.6	18.8	18.2	16.9	15.7	14.8	13.2	12.9	12.9
	Delay	min	5.2	14.4	13.6	12.7	10.9	9.1	8.5	7.2	6.0	5.1	3.5	3.2	3.3
	I-210 Core: General Purpose Lanes & HOT Lanes - EB														
	VMT	veh-mi (x1000)	560.8	515.8	544.0	572.4	604.7	631.2	656.3	679.4	701.9	724.2	766.9	807.1	844.9
	VHT	veh-hrs (x1000)	11.0	17.0	16.9	16.8	16.0	15.0	14.9	14.3	13.8	13.6	13.3	14.2	16.0
Average speed	mph	50.9	30.3	32.1	34.1	37.7	42.0	44.0	47.4	50.7	53.2	57.5	56.9	52.8	
Traveltime	min	14.0	23.8	22.4	21.1	19.1	17.2	16.5	15.3	14.1	13.4	12.1	12.0	12.8	
Delay	min	5.9	14.7	14.0	13.2	11.5	9.7	9.3	8.0	6.8	6.1	4.8	5.2	7.5	
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB														
	VMT	veh-mi (x1000)	171.9	27.6	51.1	74.4	97.4	122.7	146.6	171.8	196.6	219.2	254.1	266.3	268.2
	VHT	veh-hrs (x1000)	3.5	0.4	0.7	1.1	1.4	1.8	2.2	2.6	3.0	3.5	5.1	6.3	7.5
	Average speed	mph	49.0	69.1	68.7	68.2	67.6	67.1	66.6	66.0	65.2	62.8	49.6	42.5	35.8
	Traveltime	min	12.0	8.6	8.6	8.7	8.8	8.8	8.9	9.0	9.1	9.4	11.9	13.9	16.6
	Delay	min	3.9	0.4	0.5	0.6	0.7	0.8	0.8	0.9	1.0	1.4	3.8	5.8	8.5
	I-210 Core: General Purpose Lanes - WB														
	VMT	veh-mi (x1000)	549.8	622.4	629.8	637.9	642.6	651.9	661.5	665.7	671.6	677.9	684.3	698.3	721.5
	VHT	veh-hrs (x1000)	20.5	20.8	21.5	21.5	22.4	22.6	23.0	23.8	24.4	24.4	24.1	23.7	24.1
	Average speed	mph	26.9	30.0	29.3	29.7	28.7	28.8	28.8	28.0	27.6	27.8	28.4	29.4	29.9
	Traveltime	min	27.1	24.5	25.0	24.6	25.5	25.4	25.4	26.1	26.6	26.3	25.5	24.4	23.9
	Delay	min	17.6	14.9	15.4	15.1	16.0	15.8	15.9	16.6	17.0	16.7	16.0	14.9	14.3
	I-210 Core: General Purpose Lanes & HOT Lanes - WB														
	VMT	veh-mi (x1000)	721.7	650.0	680.8	712.3	740.0	774.5	808.1	837.5	868.2	897.1	938.4	964.6	989.8
	VHT	veh-hrs (x1000)	24.0	21.2	22.2	22.6	23.8	24.4	25.2	26.4	27.4	27.9	29.2	30.0	31.6
Average speed	mph	30.1	30.7	30.6	31.5	31.1	31.7	32.1	31.7	31.7	32.2	32.1	32.2	31.3	
Traveltime	min	23.5	23.8	23.8	23.0	23.3	22.7	22.4	22.6	22.6	22.1	21.8	21.5	21.9	
Delay	min	21.5	15.4	15.9	15.7	16.7	16.6	16.7	17.5	18.1	18.1	19.8	20.7	22.9	
Network	Freeways (General purpose lanes and HOV)														
	VMT	veh-mi (x1000)	1,282.5	1,165.8	1,224.9	1,284.7	1,344.7	1,405.7	1,464.4	1,516.9	1,570.2	1,621.3	1,705.3	1,771.7	1,834.7
	VHT	veh-hrs (x1000)	35.0	38.2	39.2	39.4	39.8	39.5	40.1	40.7	41.2	41.5	42.5	44.2	47.6
	Average speed	mph	36.6	30.5	31.3	32.6	33.7	35.6	36.5	37.2	38.1	39.1	40.1	40.1	38.5
	Delay	s/mi	27.3	30.0	30.0	28.9	28.1	26.3	26.0	25.5	24.9	24.2	24.6	26.0	30.3
	Off-Freeway (Arterials)														
	VMT	veh-mi (x1000)	1,112.0	1,135.3	1,172.1	1,208.1	1,236.0	1,271.0	1,309.2	1,348.4	1,385.2	1,424.0	1,501.9	1,579.1	1,661.6
	VHT	veh-hrs (x1000)	54.3	55.7	57.4	59.0	60.2	61.8	63.5	65.3	67.1	68.8	72.3	76.0	80.0
	Average speed	mph	20.5	20.4	20.4	20.5	20.5	20.6	20.6	20.6	20.6	20.7	20.8	20.8	20.8
	Delay	s/mi	595.4	602.7	602.1	601.8	598.7	597.2	595.5	596.1	597.3	596.0	594.1	595.2	598.0
	Entire Network														
	VMT	veh-mi (x1000)	3,643.2	3,459.0	3,606.9	3,758.0	3,895.8	4,045.5	4,195.9	4,337.2	4,478.6	4,615.5	4,860.8	5,076.1	5,288.7
	VHT	veh-hrs (x1000)	117.1	126.6	129.9	131.6	134.1	136.0	139.0	142.3	145.6	148.2	155.8	162.7	171.8
	Average speed	mph	31.1	27.3	27.8	28.6	29.1	29.8	30.2	30.5	30.8	31.1	31.2	31.2	30.8
	Delay	s/mi	64.5	73.3	72.2	70.5	69.3	67.9	67.1	66.8	66.4	65.7	65.4	65.2	66.0
Entering network	veh	814,464	801,560	831,426	861,650	890,710	920,640	950,840	980,853	1,010,257	1,038,710	1,094,204	1,146,876	1,200,657	
Inside network at end	veh	18,266	21,841	22,173	22,164	21,886	22,065	22,502	23,242	23,518	23,352	24,158	24,248	25,583	
Waiting to enter at end	veh	12	12,827	11,089	8,908	8,199	6,031	3,642	1,831	554	32	58	3,858	6,016	

Table B-14: Simulation Metrics, Increase in Proportion of HOV3, Midday

			Vehicles												
Metrics			HOV2 & Decals	HOV3 & Decals	+2.5%	+5%	+7.5%	+10%	+12.5%	+15%	+17.5%	+20%	+25%	+30%	+35%
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB														
	VMT	veh-mi (x1000)	34.5	4.8	9.1	13.0	17.4	21.7	26.0	30.2	34.2	38.5	45.8	50.4	51.2
	VHT	veh-hrs (x1000)	0.5	4.8	9.1	13.0	17.4	21.7	26.0	30.2	34.2	38.5	45.8	50.4	51.2
	Average speed	mph	66.4	71.0	70.0	69.2	68.6	68.0	67.5	66.9	66.3	65.4	61.4	53.7	44.5
	Traveltime	min	9.2	8.5	8.7	8.8	8.9	8.9	9.0	9.1	9.2	9.3	9.9	11.4	13.7
	Delay	min	0.9	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.9	1.1	1.7	3.1	5.5
	I-210 Core: General Purpose Lanes - EB														
	VMT	veh-mi (x1000)	268.3	246.0	251.9	255.8	259.5	261.9	263.0	262.7	261.9	259.9	254.7	249.8	247.3
	VHT	veh-hrs (x1000)	5.4	246.0	251.9	255.8	259.5	261.9	263.0	262.7	261.9	259.9	254.7	249.8	247.3
	Average speed	mph	49.4	23.3	25.4	27.4	29.9	33.1	36.8	39.7	43.4	46.3	50.1	50.5	50.4
	Traveltime	min	14.7	31.0	28.6	26.7	24.5	22.3	20.2	18.7	17.0	15.9	14.6	14.4	14.3
	Delay	min	5.0	21.3	18.9	17.0	14.8	12.6	10.5	9.0	7.3	6.1	4.8	4.6	4.5
	I-210 Core: General Purpose Lanes & HOT Lanes - EB														
	VMT	veh-mi (x1000)	302.8	250.9	260.9	268.8	276.9	283.6	289.1	292.9	296.1	298.4	300.5	300.3	298.5
	VHT	veh-hrs (x1000)	5.9	250.9	260.9	268.8	276.9	283.6	289.1	292.9	296.1	298.4	300.5	300.3	298.5
	Average speed	mph	50.9	23.6	26.0	28.2	31.0	34.5	38.3	41.5	45.2	48.1	51.6	51.0	49.3
	Traveltime	min	14.1	30.6	27.9	25.8	23.5	21.3	19.2	17.7	16.1	15.0	13.9	13.9	14.2
	Delay	min	5.9	21.6	19.3	17.5	15.4	13.2	11.2	9.9	8.2	7.2	6.5	7.8	10.0
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB														
	VMT	veh-mi (x1000)	37.2	5.4	9.1	12.9	16.5	20.2	23.7	27.2	30.7	34.3	41.5	46.8	47.9
	VHT	veh-hrs (x1000)	0.6	5.4	9.1	12.9	16.5	20.2	23.7	27.2	30.7	34.3	41.5	46.8	47.9
	Average speed	mph	65.1	63.8	65.6	66.1	66.2	66.1	66.0	65.9	65.6	65.3	64.2	61.9	57.7
	Traveltime	min	9.1	9.2	9.0	8.9	8.9	9.0	9.0	9.0	9.0	9.1	9.2	9.6	10.3
	Delay	min	1.1	1.1	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.2	1.5	2.2
	I-210 Core: General Purpose Lanes - WB														
	VMT	veh-mi (x1000)	246.4	272.2	271.6	270.0	266.6	262.9	259.3	255.6	252.1	248.4	240.7	233.1	227.3
	VHT	veh-hrs (x1000)	5.0	272.2	271.6	270.0	266.6	262.9	259.3	255.6	252.1	248.4	240.7	233.1	227.3
	Average speed	mph	48.9	40.2	42.3	45.0	46.2	46.3	46.7	47.3	48.6	49.1	47.7	46.9	47.1
	Traveltime	min	14.3	18.0	17.0	15.9	15.3	15.2	15.0	14.8	14.4	14.3	14.6	14.7	14.6
	Delay	min	4.7	8.4	7.4	6.3	5.7	5.6	5.5	5.2	4.8	4.7	5.0	5.1	5.0
	I-210 Core: General Purpose Lanes & HOT Lanes - WB														
	VMT	veh-mi (x1000)	283.6	277.6	280.7	282.9	283.1	283.0	283.0	282.7	282.8	282.7	282.3	279.9	275.2
	VHT	veh-hrs (x1000)	5.6	277.6	280.7	282.9	283.1	283.0	283.0	282.7	282.8	282.7	282.3	279.9	275.2
	Average speed	mph	50.5	40.5	42.8	45.6	47.0	47.3	47.9	48.6	50.0	50.6	49.6	48.9	48.7
	Traveltime	min	13.6	17.8	16.8	15.5	15.0	14.8	14.5	14.3	13.9	13.6	13.8	13.9	13.9
	Delay	min	5.7	9.5	8.4	7.1	6.6	6.6	6.4	6.2	5.8	5.7	6.1	6.6	7.2
Network	Freeways (General purpose lanes and HOV)														
	VMT	veh-mi (x1000)	1,028.8	528.5	541.6	551.7	560.0	566.6	572.1	575.7	578.9	581.0	582.8	580.1	573.7
	VHT	veh-hrs (x1000)	18.7	528.5	541.6	551.7	560.0	566.6	572.1	575.7	578.9	581.0	582.8	580.1	573.7
	Average speed	mph	55.1	30.3	32.6	35.1	37.5	39.9	42.5	44.7	47.4	49.3	50.6	50.0	49.0
	Delay	s/mi	17.2	31.1	27.7	24.6	22.0	19.8	17.6	16.0	14.1	12.9	12.6	14.4	17.3
	Off-Freeway (Arterials)														
	VMT	veh-mi (x1000)	480.8	498.7	494.6	491.9	489.1	487.0	485.7	485.2	484.9	484.6	485.5	486.5	486.7
	VHT	veh-hrs (x1000)	21.9	498.7	494.6	491.9	489.1	487.0	485.7	485.2	484.9	484.6	485.5	486.5	486.7
	Average speed	mph	22.0	21.9	21.9	22.0	22.0	22.0	22.0	22.0	21.9	22.0	21.9	21.9	21.9
	Delay	s/mi	561.6	569.4	565.9	564.2	563.8	563.2	562.5	562.0	562.5	561.8	561.8	562.9	562.4
	Entire Network														
	VMT	veh-mi (x1000)	1,625.0	1,535.0	1,552.8	1,567.6	1,577.1	1,584.4	1,590.6	1,595.6	1,600.8	1,605.0	1,609.2	1,607.5	1,599.5
	VHT	veh-hrs (x1000)	44.7	50.7	49.5	48.6	47.9	47.3	46.8	46.4	46.0	45.7	45.6	45.7	45.5
	Average speed	mph	36.4	30.3	31.4	32.3	33.0	33.5	34.0	34.4	34.8	35.2	35.3	35.2	35.2
	Delay	s/mi	59.0	68.4	66.2	64.7	63.6	62.8	62.2	61.7	61.2	60.8	60.5	60.7	60.5
	Entering network	veh	356,161	355,797	356,174	356,145	356,122	356,069	356,109	356,149	356,299	356,124	356,158	355,910	354,811
	Inside network at end	veh	14,836	21,980	20,687	19,465	18,663	18,081	17,615	17,238	16,912	16,519	16,193	16,106	15,857
	Waiting to enter at end	veh	8	396	28	10	8	8	11	9	15	12	14	386	1,357

			Persons												
Metrics		HOV2 & Decals	HOV3 & Decals	+2.5%	+5%	+7.5%	+10%	+12.5%	+15%	+17.5%	+20%	+25%	+30%	+35%	
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB														
	VMT	veh-mi (x1000)	69.0	9.7	22.4	34.5	47.4	60.4	73.3	85.8	97.6	110.5	132.8	146.9	149.7
	VHT	veh-hrs (x1000)	1.0	0.1	0.3	0.5	0.7	0.9	1.1	1.3	1.5	1.7	2.2	2.7	3.4
	Average speed	mph	66.4	71.0	70.0	69.2	68.6	68.0	67.5	66.9	66.3	65.4	61.4	53.7	44.4
	Traveltime	min	9.2	8.5	8.7	8.8	8.9	8.9	9.0	9.1	9.2	9.3	9.9	11.4	13.7
	Delay	min	0.9	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.9	1.1	1.7	3.1	5.5
	I-210 Core: General Purpose Lanes - EB														
	VMT	veh-mi (x1000)	290.0	287.2	297.8	306.5	314.8	321.9	327.8	331.7	335.3	337.4	341.0	348.7	364.3
	VHT	veh-hrs (x1000)	5.8	12.3	11.7	11.2	10.5	9.6	8.8	8.3	7.7	7.2	6.8	6.9	7.3
	Average speed	mph	49.6	23.3	25.4	27.5	30.1	33.4	37.0	40.0	43.7	46.6	50.1	50.2	49.7
	Traveltime	min	14.7	31.1	28.6	26.6	24.5	22.2	20.1	18.6	16.9	15.8	14.5	14.4	14.4
	Delay	min	4.9	21.4	18.9	17.0	14.8	12.5	10.4	8.9	7.2	6.1	4.8	4.7	4.7
	I-210 Core: General Purpose Lanes & HOT Lanes - EB														
	VMT	veh-mi (x1000)	359.0	297.0	320.2	341.0	362.2	382.3	401.1	417.5	432.9	447.9	473.8	495.5	514.0
	VHT	veh-hrs (x1000)	6.9	12.5	12.0	11.7	11.2	10.5	9.9	9.6	9.1	8.9	9.0	9.7	10.7
	Average speed	mph	52.1	23.8	26.6	29.2	32.5	36.3	40.4	43.6	47.3	50.1	52.8	51.2	48.0
	Traveltime	min	13.6	30.4	27.2	24.8	22.4	20.1	18.1	16.7	15.2	14.2	13.2	13.5	14.2
	Delay	min	5.9	21.7	19.4	17.5	15.4	13.2	11.2	9.8	8.2	7.2	6.5	7.8	10.2
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB														
	VMT	veh-mi (x1000)	74.5	11.1	22.0	33.5	44.2	55.3	65.9	76.3	86.8	97.7	119.5	135.4	139.3
	VHT	veh-hrs (x1000)	1.1	0.2	0.3	0.5	0.7	0.8	1.0	1.2	1.3	1.5	1.9	2.2	2.4
	Average speed	mph	65.1	64.0	66.3	66.8	66.7	66.6	66.4	66.2	65.9	65.6	64.5	62.1	57.9
	Traveltime	min	9.1	9.2	8.9	8.9	8.9	8.9	8.9	9.0	9.0	9.0	9.2	9.5	10.3
	Delay	min	1.1	1.1	0.9	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.2	1.5	2.2
	I-210 Core: General Purpose Lanes - WB														
	VMT	veh-mi (x1000)	270.9	326.7	330.1	332.7	332.6	332.3	332.1	331.7	331.8	331.5	330.9	329.9	334.0
	VHT	veh-hrs (x1000)	5.5	8.1	7.8	7.4	7.2	7.1	7.1	7.0	6.8	6.7	6.9	7.0	7.1
	Average speed	mph	48.9	40.5	42.5	45.2	46.5	46.6	47.1	47.7	49.0	49.5	48.1	47.2	47.3
	Traveltime	min	14.2	17.9	16.9	15.7	15.2	15.1	14.9	14.7	14.3	14.1	14.3	14.5	14.4
	Delay	min	4.6	8.3	7.4	6.2	5.6	5.5	5.3	5.1	4.7	4.5	4.8	4.9	4.8
	I-210 Core: General Purpose Lanes & HOT Lanes - WB														
	VMT	veh-mi (x1000)	345.4	337.8	352.1	366.2	376.8	387.5	398.0	408.0	418.6	429.1	450.4	465.3	473.3
	VHT	veh-hrs (x1000)	6.7	8.2	8.1	7.9	7.8	8.0	8.0	8.1	8.1	8.2	8.7	9.2	9.5
	Average speed	mph	51.7	41.0	43.5	46.6	48.2	48.7	49.5	50.3	51.8	52.4	51.6	50.7	50.0
	Traveltime	min	13.1	17.6	16.4	15.1	14.5	14.2	13.9	13.6	13.2	12.9	13.0	13.1	13.2
	Delay	min	5.6	9.5	8.2	7.0	6.5	6.4	6.2	6.0	5.7	5.5	5.9	6.5	7.1
Network	Freeways (General purpose lanes and HOV)														
	VMT	veh-mi (x1000)	704.4	634.7	672.2	707.2	739.0	769.8	799.1	825.6	851.6	877.1	924.1	960.8	987.4
	VHT	veh-hrs (x1000)	13.6	20.7	20.1	19.5	19.0	18.5	18.0	17.7	17.2	17.1	17.7	18.9	20.2
	Average speed	mph	51.9	30.6	33.4	36.2	38.9	41.6	44.4	46.7	49.4	51.2	52.2	51.0	49.0
	Delay	s/mi	11.5	31.2	27.6	24.5	21.8	19.6	17.4	15.8	13.8	12.7	12.5	14.3	17.3
	Off-Freeway (Arterials)														
	VMT	veh-mi (x1000)	612.5	634.5	651.5	670.8	688.0	706.8	726.3	747.0	768.1	788.8	832.7	876.5	918.8
	VHT	veh-hrs (x1000)	29.3	30.5	31.2	32.0	32.8	33.6	34.6	35.5	36.5	37.4	39.4	41.5	43.4
	Average speed	mph	20.9	20.8	20.9	20.9	21.0	21.0	21.0	21.0	21.1	21.1	21.1	21.1	21.2
	Delay	s/mi	567.2	574.6	570.9	569.0	568.3	567.7	566.7	566.1	566.3	565.7	565.1	566.0	565.3
	Entire Network														
	VMT	veh-mi (x1000)	1,982.3	1,873.6	1,958.3	2,041.0	2,114.5	2,187.1	2,258.2	2,327.2	2,396.7	2,465.1	2,591.4	2,705.7	2,802.3
	VHT	veh-hrs (x1000)	56.2	63.4	63.8	64.6	65.4	66.5	67.6	68.9	70.1	71.5	75.4	79.4	82.8
	Average speed	mph	35.3	29.5	30.7	31.6	32.3	32.9	33.4	33.8	34.2	34.5	34.4	34.1	33.8
	Delay	s/mi	59.1	68.6	66.2	64.7	63.5	62.7	62.1	61.6	61.2	60.8	60.9	61.4	61.5
Entering network	veh	435,631	435,187	451,145	466,838	481,909	497,155	512,683	528,208	544,007	559,186	590,231	620,249	648,112	
Inside network at end	veh	18,933	27,597	26,703	25,948	25,581	25,480	25,531	25,706	25,987	26,174	27,490	28,889	29,913	
Waiting to enter at end	veh	9	476	37	12	10	10	17	15	23	18	24	1,108	3,963	

Table B-15: Simulation Metrics, Increase in Proportion of HOV3, PM Peak

			Vehicles												
Metrics			HOV2 & Decals	HOV3 & Decals	+2.5%	+5%	+7.5%	+10%	+12.5%	+15%	+17.5%	+20%	+25%	+30%	+35%
I-210 EB (SR-135to I-605)	I-210 Core: HOT Lanes - EB														
	VMT	veh-mi (x1000)	59.3	9.0	14.0	19.0	23.9	28.5	33.4	38.6	42.7	45.5	51.2	52.1	49.0
	VHT	veh-hrs (x1000)	2.2	9.0	14.0	19.0	23.9	28.5	33.4	38.6	42.7	45.5	51.2	52.1	49.0
	Average speed	mph	27.2	56.1	59.7	61.3	62.1	62.2	61.5	59.5	54.8	47.2	31.8	22.1	17.8
	Traveltime	min	23.5	10.9	10.3	10.0	9.9	9.9	9.9	10.2	11.0	12.6	19.1	27.9	35.3
	Delay	min	15.3	2.6	2.1	1.8	1.6	1.6	1.7	2.0	2.7	4.4	10.9	19.7	27.1
	I-210 Core: General Purpose Lanes - EB														
	VMT	veh-mi (x1000)	322.0	242.1	245.3	246.9	247.9	250.2	252.6	254.4	255.7	257.8	261.8	266.9	271.3
	VHT	veh-hrs (x1000)	13.8	242.1	245.3	246.9	247.9	250.2	252.6	254.4	255.7	257.8	261.8	266.9	271.3
	Average speed	mph	23.3	11.3	11.6	11.7	11.8	11.9	12.2	12.3	12.4	12.7	13.2	13.9	14.6
	Traveltime	min	33.6	65.7	64.6	63.9	63.7	62.9	62.0	61.3	61.0	60.1	58.4	56.2	53.9
	Delay	min	24.0	56.0	54.9	54.3	54.1	53.2	52.3	51.6	51.4	50.4	48.7	46.5	44.2
	I-210 Core: General Purpose Lanes & HOT Lanes - EB														
	VMT	veh-mi (x1000)	381.3	251.2	259.3	265.9	271.7	278.6	286.1	293.0	298.4	303.2	312.9	319.0	320.3
	VHT	veh-hrs (x1000)	16.0	251.2	259.3	265.9	271.7	278.6	286.1	293.0	298.4	303.2	312.9	319.0	320.3
	Average speed	mph	23.8	11.7	12.1	12.4	12.7	13.0	13.4	13.8	14.0	14.2	14.6	14.8	15.0
	Traveltime	min	32.1	63.7	61.6	60.1	59.0	57.5	55.9	54.6	53.9	53.0	51.9	51.6	51.1
	Delay	min	22.6	54.1	52.1	50.5	49.5	48.0	46.4	45.1	44.4	43.5	42.5	42.1	41.6
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB														
	VMT	veh-mi (x1000)	55.9	7.7	12.6	18.1	23.5	28.7	33.7	39.0	44.2	49.6	59.6	62.5	61.8
	VHT	veh-hrs (x1000)	0.9	7.7	12.6	18.1	23.5	28.7	33.7	39.0	44.2	49.6	59.6	62.5	61.8
	Average speed	mph	59.8	69.2	68.8	68.1	67.7	67.3	66.8	66.3	65.8	64.9	61.0	50.1	45.8
	Traveltime	min	9.9	8.5	8.6	8.7	8.8	8.8	8.9	9.0	9.0	9.1	9.7	11.9	13.0
	Delay	min	1.8	0.5	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.1	1.7	3.8	5.0
	I-210 Core: General Purpose Lanes - WB														
	VMT	veh-mi (x1000)	332.2	367.8	369.0	364.9	362.0	356.3	351.6	345.9	341.3	335.6	325.1	319.0	318.1
	VHT	veh-hrs (x1000)	8.6	367.8	369.0	364.9	362.0	356.3	351.6	345.9	341.3	335.6	325.1	319.0	318.1
	Average speed	mph	38.4	41.4	44.4	38.1	42.5	40.0	40.2	39.6	41.3	39.5	39.3	38.9	41.4
	Traveltime	min	17.9	17.4	16.1	18.4	16.5	17.4	17.3	17.5	16.8	17.4	17.5	17.6	16.6
	Delay	min	8.4	7.8	6.6	8.9	7.0	7.9	7.7	7.9	7.2	7.9	7.9	8.0	7.0
	I-210 Core: General Purpose Lanes & HOT Lanes - WB														
	VMT	veh-mi (x1000)	388.1	375.5	381.6	383.0	385.5	385.0	385.3	384.9	385.5	385.2	384.7	381.5	380.0
	VHT	veh-hrs (x1000)	9.6	375.5	381.6	383.0	385.5	385.0	385.3	384.9	385.5	385.2	384.7	381.5	380.0
	Average speed	mph	40.5	41.7	44.9	38.9	43.5	41.3	41.7	41.3	43.1	41.6	41.6	40.4	42.0
	Traveltime	min	16.8	17.2	15.8	18.0	16.1	16.8	16.5	16.6	15.9	16.4	16.3	16.6	16.0
	Delay	min	7.4	7.7	6.4	8.5	6.6	7.4	7.1	7.2	6.5	7.0	6.9	7.3	6.7
Network	Freeways (General purpose lanes and HOV)														
	VMT	veh-mi (x1000)	1,415.3	626.7	640.9	648.8	657.2	663.6	671.4	677.9	683.9	688.5	697.6	700.5	700.3
	VHT	veh-hrs (x1000)	39.8	626.7	640.9	648.8	657.2	663.6	671.4	677.9	683.9	688.5	697.6	700.5	700.3
	Average speed	mph	35.6	20.5	21.4	20.8	21.7	21.6	22.0	22.2	22.6	22.5	22.7	22.6	23.0
	Delay	s/mi	71.7	67.0	64.1	65.6	63.4	63.5	62.6	62.5	62.3	63.8	69.2	78.0	83.3
	Off-Freeway (Arterials)														
	VMT	veh-mi (x1000)	840.3	912.9	909.2	913.1	911.5	910.7	907.6	905.6	904.5	900.1	893.2	890.6	892.1
	VHT	veh-hrs (x1000)	41.8	912.9	909.2	913.1	911.5	910.7	907.6	905.6	904.5	900.1	893.2	890.6	892.1
	Average speed	mph	20.1	15.8	16.3	16.7	16.6	16.9	17.2	17.5	17.5	17.9	18.3	18.5	18.4
	Delay	s/mi	669.4	977.1	979.0	902.5	912.8	919.0	870.2	838.2	856.8	820.1	782.0	770.6	775.4
	Entire Network														
	VMT	veh-mi (x1000)	2,420.3	2,250.3	2,273.5	2,296.0	2,305.7	2,316.0	2,327.6	2,336.5	2,344.3	2,347.3	2,354.0	2,353.8	2,354.7
	VHT	veh-hrs (x1000)	88.1	111.2	108.9	109.1	107.8	107.3	105.5	104.3	103.6	102.1	100.0	99.2	98.9
	Average speed	mph	27.5	20.2	20.9	21.1	21.4	21.6	22.1	22.4	22.6	23.0	23.5	23.7	23.8
	Delay	s/mi	79.0	120.6	116.1	113.1	112.0	110.0	106.3	103.9	102.8	99.8	95.9	94.1	93.7
	Entering network	veh	585,514	577,337	578,664	580,799	581,472	582,448	583,866	584,739	584,831	585,044	585,093	584,507	583,673
	Inside network at end	veh	18,668	31,425	30,600	28,835	28,989	28,195	27,704	27,373	27,264	26,460	25,136	24,411	23,700
	Waiting to enter at end	veh	28	8,202	6,832	5,041	4,131	3,245	1,923	1,094	818	598	586	1,203	1,895

			Persons												
Metrics			HOV2 & Decals	HOV3 & Decals	+2.5%	+5%	+7.5%	+10%	+12.5%	+15%	+17.5%	+20%	+25%	+30%	+35%
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB														
	VMT	veh-mi (x1000)	120.9	20.4	35.3	50.4	64.8	78.8	93.6	108.8	121.4	129.9	147.7	151.3	143.3
	VHT	veh-hrs (x1000)	4.4	0.4	0.6	0.8	1.0	1.2	1.5	1.8	2.2	2.7	4.6	6.8	8.1
	Average speed	mph	27.2	56.4	60.8	62.4	63.1	63.1	62.3	60.2	55.3	47.5	31.9	22.1	17.8
	Traveltime	min	23.5	10.8	10.1	9.8	9.7	9.7	9.8	10.1	10.9	12.5	19.1	27.9	35.3
	Delay	min	15.2	2.4	1.8	1.5	1.4	1.4	1.5	1.8	2.6	4.3	10.8	19.7	27.1
	I-210 Core: General Purpose Lanes - EB														
	VMT	veh-mi (x1000)	357.9	299.4	307.7	313.6	319.8	327.6	334.9	341.7	348.6	356.0	370.5	390.3	414.9
	VHT	veh-hrs (x1000)	15.3	26.3	26.4	26.5	26.8	27.1	27.1	27.2	27.5	27.6	27.6	27.6	28.2
	Average speed	mph	23.4	11.4	11.6	11.8	11.9	12.1	12.3	12.6	12.7	12.9	13.4	14.1	14.7
	Traveltime	min	33.6	65.4	64.1	63.4	63.2	62.4	61.5	60.8	60.6	59.8	58.3	56.5	54.7
	Delay	min	23.9	55.7	54.5	53.8	53.5	52.7	51.9	51.2	51.0	50.2	48.7	46.8	45.1
	I-210 Core: General Purpose Lanes & HOT Lanes - EB														
	VMT	veh-mi (x1000)	478.8	319.8	343.0	364.0	384.6	406.4	428.5	450.5	470.0	486.0	518.1	541.7	558.2
	VHT	veh-hrs (x1000)	19.7	26.7	27.0	27.3	27.9	28.3	28.6	29.0	29.7	30.3	32.2	34.5	36.2
	Average speed	mph	24.3	12.0	12.7	13.3	13.8	14.4	15.0	15.5	15.8	16.0	16.1	15.7	15.4
	Traveltime	min	31.0	61.9	58.6	56.0	54.2	52.2	50.2	48.6	47.8	47.2	47.1	48.5	49.8
	Delay	min	39.2	58.2	56.3	55.3	55.0	54.2	53.4	53.0	53.6	54.5	59.5	66.5	72.2
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB														
	VMT	veh-mi (x1000)	112.0	15.7	30.6	47.3	63.0	78.7	93.8	109.6	125.2	141.4	171.4	181.0	179.9
	VHT	veh-hrs (x1000)	1.9	0.2	0.4	0.7	0.9	1.2	1.4	1.7	1.9	2.2	2.8	3.6	3.9
	Average speed	mph	59.8	69.2	69.0	68.3	67.8	67.4	66.8	66.3	65.9	64.9	61.1	50.1	45.8
	Traveltime	min	9.9	8.5	8.6	8.7	8.7	8.8	8.9	8.9	9.0	9.1	9.7	11.9	13.0
	Delay	min	1.8	0.5	0.5	0.6	0.7	0.8	0.8	0.9	1.0	1.1	1.7	3.8	5.0
	I-210 Core: General Purpose Lanes - WB														
	VMT	veh-mi (x1000)	367.3	448.0	454.8	455.0	458.1	456.7	455.9	454.8	457.1	454.3	453.6	464.3	491.6
	VHT	veh-hrs (x1000)	9.6	10.8	10.2	11.9	10.8	11.4	11.3	11.5	11.1	11.5	11.6	12.0	12.1
	Average speed	mph	38.4	41.4	44.4	38.1	42.6	40.0	40.2	39.6	41.2	39.4	39.1	38.6	40.8
	Traveltime	min	17.8	17.3	16.0	18.4	16.5	17.3	17.2	17.3	16.6	17.3	17.3	17.5	16.6
	Delay	min	8.2	7.8	6.5	8.9	7.0	7.8	7.6	7.8	7.1	7.8	7.8	8.0	7.1
	I-210 Core: General Purpose Lanes & HOT Lanes - WB														
	VMT	veh-mi (x1000)	479.3	463.7	485.5	502.3	521.1	535.4	549.7	564.4	582.3	595.7	625.0	645.3	671.5
	VHT	veh-hrs (x1000)	11.4	11.0	10.7	12.6	11.7	12.6	12.7	13.1	13.0	13.7	14.4	15.7	16.0
	Average speed	mph	41.9	42.0	45.4	39.8	44.6	42.6	43.1	42.9	44.8	43.5	43.4	41.2	42.0
	Traveltime	min	15.9	17.0	15.6	17.5	15.5	16.1	15.7	15.7	15.0	15.4	15.2	15.9	15.6
	Delay	min	10.1	8.3	7.1	9.5	7.7	8.6	8.5	8.7	8.1	8.9	9.5	11.8	12.1
Network	Freeways (General purpose lanes and HOV)														
	VMT	veh-mi (x1000)	958.2	783.5	828.5	866.4	905.7	941.8	978.2	1,014.9	1,052.3	1,081.7	1,143.1	1,187.0	1,229.6
	VHT	veh-hrs (x1000)	31.2	37.7	37.7	40.0	39.6	40.9	41.4	42.2	42.7	44.0	46.6	50.1	52.2
	Average speed	mph	30.7	20.8	22.0	21.7	22.9	23.0	23.6	24.1	24.6	24.6	24.5	23.7	23.5
	Delay	s/mi	49.3	66.5	63.4	64.8	62.6	62.8	61.9	61.7	61.7	63.3	68.9	78.3	84.3
	Off-Freeway (Arterials)														
	VMT	veh-mi (x1000)	1,075.6	1,165.1	1,199.7	1,245.3	1,282.1	1,320.9	1,355.6	1,392.2	1,430.8	1,465.0	1,538.5	1,620.4	1,709.5
	VHT	veh-hrs (x1000)	56.1	76.4	76.1	77.0	79.5	80.6	80.9	81.8	83.8	84.3	86.6	90.2	95.5
	Average speed	mph	19.2	15.2	15.8	16.2	16.1	16.4	16.8	17.0	17.1	17.4	17.8	18.0	17.9
	Delay	s/mi	674.0	980.8	981.8	906.1	912.6	919.7	869.4	836.4	856.6	819.6	780.8	771.5	777.9
	Entire Network														
	VMT	veh-mi (x1000)	3,036.3	2,826.7	2,949.2	3,074.6	3,184.3	3,292.9	3,400.0	3,508.5	3,618.2	3,711.6	3,909.0	4,079.9	4,259.5
	VHT	veh-hrs (x1000)	113.0	141.7	142.6	146.6	148.8	151.9	153.1	155.3	158.4	160.2	165.8	173.8	182.4
	Average speed	mph	26.9	20.0	20.7	21.0	21.4	21.7	22.2	22.6	22.8	23.2	23.6	23.5	23.4
	Delay	s/mi	79.0	120.2	115.3	112.0	110.6	108.3	104.7	102.3	101.1	98.3	94.8	93.7	93.7
	Entering network	veh	722,088	712,184	738,976	767,296	793,390	820,296	847,379	873,992	899,748	925,353	976,352	1,025,553	1,074,582
	Inside network at end	veh	24,015	39,834	39,963	38,709	39,877	39,803	40,234	40,688	41,664	41,717	41,895	43,233	44,329
	Waiting to enter at end	veh	35	9,935	8,457	6,380	5,337	4,312	2,661	1,620	1,256	941	1,037	3,014	5,008

B.6. INCREASE IN OVERALL TRAFFIC DEMAND

Table B-16: Simulation Metrics, Increase in Overall Traffic Demand, AM Peak

		Vehicles								Persons								
Metrics		100% HOV2+	105% HOV2+	110% HOV2+	115% HOV2+	100% HOT2+	105% HOT2+	110% HOT2+	115% HOT2+	100% HOV2+	105% HOV2+	110% HOV2+	115% HOV2+	100% HOT2+	105% HOT2+	110% HOT2+	115% HOT2+	
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB																	
	VMT	veh-mi (x1000)	41.1	43.2	44.3	45.0	47.1	55.0	58.1	59.6	82.7	86.9	89.0	90.4	88.0	97.7	101.3	103.3
	VHT	veh-hrs (x1000)	0.6	43.2	44.3	45.0	47.1	55.0	58.1	59.6	1.2	1.3	1.3	1.3	1.4	1.9	2.3	2.7
	Average speed	mph	67.9	67.7	67.4	67.3	64.1	50.5	42.3	37.6	67.9	67.7	67.4	67.3	64.6	51.5	43.2	38.1
	Traveltime	min	8.9	9.0	9.0	9.0	9.4	11.8	14.0	15.9	8.9	9.0	9.0	9.0	9.4	11.6	13.8	15.7
	Delay	min	0.7	0.7	0.8	0.8	1.2	3.5	5.8	7.7	0.7	0.7	0.8	0.8	1.1	3.4	5.6	7.5
	I-210 Core: General Purpose Lanes - EB																	
	VMT	veh-mi (x1000)	445.6	454.6	460.3	465.1	439.0	448.9	451.7	451.5	475.9	485.9	492.0	497.8	470.2	481.0	484.7	485.2
	VHT	veh-hrs (x1000)	8.8	454.6	460.3	465.1	439.0	448.9	451.7	451.5	9.4	12.2	13.7	14.4	9.0	11.2	13.7	15.6
	Average speed	mph	50.7	39.7	35.8	34.4	52.1	43.0	35.5	31.3	50.8	39.9	35.9	34.6	52.2	43.0	35.5	31.2
	Traveltime	min	14.3	18.2	20.2	20.9	13.9	16.9	20.5	23.3	14.3	18.1	20.2	20.8	13.9	16.9	20.5	23.4
	Delay	min	4.6	8.5	10.5	11.2	4.2	7.2	10.8	13.6	4.6	8.4	10.5	11.2	4.2	7.2	10.8	13.7
	I-210 Core: General Purpose Lanes & HOT Lanes - EB																	
	VMT	veh-mi (x1000)	486.8	497.8	504.5	510.1	486.1	503.9	509.8	511.1	558.6	572.8	581.0	588.2	558.1	578.8	586.0	588.5
	VHT	veh-hrs (x1000)	9.4	497.8	504.5	510.1	486.1	503.9	509.8	511.1	10.6	13.5	15.0	15.7	10.4	13.1	16.0	18.3
	Average speed	mph	51.8	41.2	37.3	36.0	53.1	43.7	36.2	31.9	52.8	42.5	38.7	37.4	53.8	44.3	36.6	32.2
Traveltime	min	13.9	17.4	19.2	19.8	13.5	16.3	19.7	22.5	13.5	16.7	18.5	19.0	13.2	16.0	19.4	22.1	
Delay	min	5.3	9.2	11.3	12.0	5.4	10.7	16.6	21.3	5.3	9.2	11.2	11.9	5.4	10.6	16.4	21.2	
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB																	
	VMT	veh-mi (x1000)	84.9	87.2	85.4	84.3	84.5	83.2	82.3	81.2	172.8	177.7	173.7	171.5	164.6	161.6	159.0	156.0
	VHT	veh-hrs (x1000)	1.6	87.2	85.4	84.3	84.5	83.2	82.3	81.2	3.3	4.0	4.6	4.7	5.2	6.5	6.6	6.8
	Average speed	mph	52.5	44.2	37.7	36.1	31.7	25.0	24.2	23.4	52.5	44.2	37.7	36.2	31.6	24.8	24.0	23.0
	Traveltime	min	11.2	13.3	15.7	16.3	18.4	24.2	25.2	25.8	11.2	13.3	15.6	16.3	18.5	24.2	25.3	26.0
	Delay	min	3.1	5.2	7.6	8.3	10.4	16.1	17.2	17.7	3.1	5.2	7.6	8.2	10.5	16.1	17.2	17.9
	I-210 Core: General Purpose Lanes - WB																	
	VMT	veh-mi (x1000)	498.2	491.7	478.6	469.4	490.1	488.9	479.8	470.4	552.5	547.7	536.1	527.5	550.3	551.4	541.5	532.4
	VHT	veh-hrs (x1000)	16.2	491.7	478.6	469.4	490.1	488.9	479.8	470.4	17.9	21.8	23.6	24.6	19.6	22.1	23.4	24.4
	Average speed	mph	30.7	25.0	22.5	21.3	28.2	25.1	23.2	21.9	30.8	25.2	22.7	21.4	28.0	25.0	23.1	21.8
	Traveltime	min	23.2	29.0	32.6	34.7	25.4	28.9	31.4	33.5	23.2	29.0	32.7	34.8	25.6	29.2	31.8	33.9
	Delay	min	13.6	19.4	23.0	25.1	15.8	19.3	21.8	23.9	13.6	19.4	23.1	25.3	16.0	19.6	22.2	24.3
	I-210 Core: General Purpose Lanes & HOT Lanes - WB																	
	VMT	veh-mi (x1000)	583.1	578.9	564.0	553.8	574.6	572.1	562.1	551.7	725.3	725.4	709.8	699.0	714.9	713.0	700.5	688.5
	VHT	veh-hrs (x1000)	17.9	578.9	564.0	553.8	574.6	572.1	562.1	551.7	21.2	25.8	28.2	29.3	24.9	28.6	30.1	31.2
	Average speed	mph	32.6	26.7	24.0	22.7	28.6	25.0	23.4	22.1	34.2	28.1	25.1	23.8	28.8	24.9	23.3	22.1
Traveltime	min	21.5	26.6	30.0	31.9	24.4	28.2	30.5	32.3	20.3	25.1	28.5	30.3	24.0	28.0	30.3	32.1	
Delay	min	16.7	24.6	30.6	33.4	26.2	35.4	39.0	41.6	16.7	24.6	30.7	33.5	26.5	35.7	39.4	42.3	
Network	Freeways (General purpose lanes and HOV)																	
	VMT	veh-mi (x1000)	1,940.8	1,076.7	1,068.6	1,063.9	1,060.7	1,076.0	1,071.9	1,062.8	1,283.9	1,298.2	1,290.7	1,287.1	1,273.1	1,291.8	1,286.5	1,277.0
	VHT	veh-hrs (x1000)	44.1	1,076.7	1,068.6	1,063.9	1,060.7	1,076.0	1,071.9	1,062.8	31.8	39.3	43.3	45.1	35.2	41.7	46.1	49.4
	Average speed	mph	44.0	31.9	28.9	27.6	36.3	31.3	28.1	25.9	40.4	33.1	29.8	28.5	36.1	31.0	27.9	25.8
	Delay	s/mi	33.8	33.8	41.9	45.4	31.6	46.2	55.6	62.9	22.0	33.8	41.9	45.5	31.9	46.3	55.9	63.5
	Off-Freeway (Arterials)																	
	VMT	veh-mi (x1000)	852.2	904.0	952.5	995.4	859.9	913.2	967.6	1,022.9	1,125.0	1,187.5	1,246.6	1,298.0	1,132.4	1,196.4	1,262.3	1,328.5
	VHT	veh-hrs (x1000)	38.9	904.0	952.5	995.4	859.9	913.2	967.6	1,022.9	55.0	60.5	66.5	74.0	55.5	60.4	67.1	75.4
	Average speed	mph	21.9	20.9	19.8	18.4	21.9	21.1	19.9	18.5	20.4	19.6	18.7	17.5	20.4	19.8	18.8	17.6
	Delay	s/mi	598.3	639.2	698.1	795.2	601.1	636.0	697.7	782.2	600.7	640.1	697.7	791.7	604.0	637.7	698.1	781.0
	Entire Network																	
	VMT	veh-mi (x1000)	2,952.3	3,026.4	3,061.6	3,102.8	2,946.2	3,031.2	3,084.8	3,123.7	3,663.1	3,764.2	3,812.3	3,864.8	3,652.5	3,756.6	3,823.4	3,872.4
	VHT	veh-hrs (x1000)	89.2	103.4	115.1	127.6	91.5	103.6	116.1	129.2	114.8	131.7	146.0	161.0	118.7	133.5	148.7	164.9
	Average speed	mph	33.1	29.3	26.6	24.3	32.2	29.3	26.6	24.2	31.9	28.6	26.1	24.0	30.8	28.1	25.7	23.5
	Delay	s/mi	63.9	74.4	85.3	99.0	65.1	73.3	84.4	97.7	63.8	73.8	84.4	97.6	65.4	73.5	84.3	97.4
	Entering network	veh	652,854	684,099	708,266	730,946	653,596	684,180	711,009	735,359	814,076	852,460	882,439	910,432	814,870	852,025	884,574	914,212
Inside network at end	veh	13,258	17,788	21,082	22,265	13,796	17,299	20,581	23,435	17,237	22,308	26,173	27,735	18,049	22,356	26,027	29,459	
Waiting to enter at end	veh	16	1,486	9,945	19,860	11	1,602	7,263	15,713	22	1,542	11,174	22,785	15	1,741	8,732	18,923	

Table B-17: Simulation Metrics, Increase in Overall Traffic Demand, Midday

		Vehicles								Persons							
Metrics		100% HOV2+	105% HOV2+	110% HOV2+	115% HOV2+	100% HOT2+	105% HOT2+	110% HOT2+	115% HOT2+	100% HOV2+	105% HOV2+	110% HOV2+	115% HOV2+	100% HOT2+	105% HOT2+	110% HOT2+	115% HOT2+
I-210 EB (SR-135 to I-805)	I-210 Core: HOT Lanes - EB																
	VMT	veh-mi (x1000)	34.3	35.6	36.2	36.2	41.8	45.6	45.4	43.9	68.8	71.4	72.6	72.6	75.1	79.0	77.5
	VHT	veh-hrs (x1000)	0.5	35.6	36.2	36.2	41.8	45.6	45.4	43.9	1.0	1.1	1.2	1.2	1.3	1.7	2.3
	Average speed	mph	66.5	65.2	62.7	59.6	59.5	48.0	34.3	28.1	66.5	65.2	62.7	59.6	59.6	47.6	33.6
	Traveltime	min	9.2	9.3	9.7	10.2	10.2	12.7	17.8	21.7	9.2	9.3	9.7	10.2	10.2	12.8	18.1
	Delay	min	0.9	1.1	1.4	1.9	2.0	4.4	9.6	13.5	0.9	1.1	1.4	1.9	2.0	4.6	9.9
	I-210 Core: General Purpose Lanes - EB																
	VMT	veh-mi (x1000)	268.1	269.8	260.6	248.9	259.9	264.3	260.4	249.5	289.8	291.7	282.4	271.1	282.2	287.8	284.3
	VHT	veh-hrs (x1000)	5.4	269.8	260.6	248.9	259.9	264.3	260.4	249.5	5.8	7.8	10.1	11.4	5.3	6.3	8.7
	Average speed	mph	49.4	37.0	27.6	23.6	53.3	45.4	32.8	25.8	49.6	37.3	27.8	23.7	53.3	45.4	32.7
	Traveltime	min	14.7	19.9	26.5	30.9	13.6	16.2	22.5	28.4	14.7	19.8	26.3	30.8	13.5	16.2	22.6
	Delay	min	5.0	10.2	16.7	21.2	3.8	6.4	12.8	18.7	5.0	10.1	16.6	21.1	3.8	6.4	12.9
	I-210 Core: General Purpose Lanes & HOT Lanes - EB																
	VMT	veh-mi (x1000)	302.4	305.4	296.7	285.2	301.7	309.9	305.8	293.4	358.6	363.1	355.0	343.7	357.3	366.8	361.8
	VHT	veh-hrs (x1000)	5.9	305.4	296.7	285.2	301.7	309.9	305.8	293.4	6.9	8.9	11.3	12.6	6.6	8.0	11.0
	Average speed	mph	50.9	39.0	29.6	25.5	54.1	45.8	33.0	26.1	52.1	40.7	31.4	27.2	54.5	45.9	32.9
	Traveltime	min	14.1	18.7	24.4	28.2	13.1	15.7	21.8	27.4	13.6	17.8	22.9	26.4	12.8	15.4	21.6
	Delay	min	5.9	11.3	18.2	23.1	3.6	10.9	22.3	32.2	5.9	11.2	18.1	23.0	5.8	11.0	22.7
I-210 WB (I-805 to SR-134)	I-210 Core: HOT Lanes - WB																
	VMT	veh-mi (x1000)	37.1	38.6	40.5	42.1	38.2	40.8	43.2	44.2	74.6	77.6	81.3	84.5	75.1	79.3	82.9
	VHT	veh-hrs (x1000)	0.6	38.6	40.5	42.1	38.2	40.8	43.2	44.2	1.1	1.2	1.3	1.4	1.4	1.6	1.9
	Average speed	mph	65.2	64.5	63.3	61.6	54.6	49.7	43.0	33.2	65.2	64.5	63.3	61.6	55.1	50.1	43.4
	Traveltime	min	9.1	9.2	9.4	9.6	10.7	11.6	13.4	17.5	9.1	9.2	9.4	9.6	10.7	11.6	13.4
	Delay	min	1.0	1.1	1.3	1.6	2.7	3.6	5.3	9.5	1.0	1.1	1.3	1.6	2.6	3.6	5.3
	I-210 Core: General Purpose Lanes - WB																
	VMT	veh-mi (x1000)	246.2	254.2	260.0	253.8	242.3	250.7	258.2	258.5	270.6	279.5	285.9	280.3	267.3	276.6	285.2
	VHT	veh-hrs (x1000)	5.0	254.2	260.0	253.8	242.3	250.7	258.2	258.5	5.5	6.8	8.5	10.7	5.5	6.9	8.0
	Average speed	mph	49.0	41.2	33.6	25.9	48.9	40.4	35.6	29.2	49.0	41.2	33.6	26.2	48.8	40.2	35.5
	Traveltime	min	14.2	16.8	20.8	27.4	14.2	17.2	19.6	24.2	14.1	16.7	20.6	27.1	14.2	17.1	19.5
	Delay	min	4.6	7.2	11.2	17.8	4.6	7.6	10.0	14.6	4.6	7.1	11.1	17.5	4.6	7.5	9.9
	I-210 Core: General Purpose Lanes & HOT Lanes - WB																
	VMT	veh-mi (x1000)	283.3	292.8	300.5	295.8	280.5	291.5	301.3	302.7	345.1	357.0	367.2	364.8	342.3	355.9	368.1
	VHT	veh-hrs (x1000)	5.6	292.8	300.5	295.8	280.5	291.5	301.3	302.7	6.7	8.0	9.8	12.1	6.8	8.5	9.9
	Average speed	mph	50.6	43.3	35.8	28.3	49.6	41.5	36.5	29.7	51.8	44.7	37.5	30.2	50.1	42.1	37.0
	Traveltime	min	13.6	15.8	19.3	24.8	13.8	16.4	18.7	23.2	13.1	15.1	18.1	23.1	13.4	15.9	18.1
	Delay	min	5.7	8.4	12.5	19.3	4.4	11.2	15.3	24.1	5.6	8.2	12.4	19.1	7.2	11.1	15.2
Network	Freeways (General purpose lanes and HOV)																
	VMT	veh-mi (x1000)	1,025.2	598.2	597.2	581.0	582.3	601.4	607.1	596.1	703.7	720.2	722.2	708.5	699.6	722.6	729.9
	VHT	veh-hrs (x1000)	18.6	598.2	597.2	581.0	582.3	601.4	607.1	596.1	13.6	16.9	21.1	24.7	13.4	16.5	20.9
	Average speed	mph	55.1	41.0	32.5	26.9	51.9	43.6	34.7	27.8	51.9	42.6	34.3	28.7	52.2	43.9	34.9
	Delay	s/mi	17.1	19.6	30.7	42.4	13.1	22.1	37.7	56.3	11.5	19.4	30.4	42.1	13.0	22.1	38.0
	Off-Freeway (Arterials)																
	VMT	veh-mi (x1000)	483.3	512.4	546.8	581.7	486.7	511.6	541.8	580.5	615.5	650.2	690.2	700.3	618.4	649.6	685.7
	VHT	veh-hrs (x1000)	21.9	512.4	546.8	581.7	486.7	511.6	541.8	580.5	29.4	31.6	34.4	34.6	29.7	31.6	33.8
	Average speed	mph	22.1	21.6	21.0	20.3	21.9	21.6	21.2	20.6	21.0	20.6	20.1	20.3	20.8	20.6	20.3
	Delay	s/mi	562.3	577.2	600.4	628.2	563.7	574.9	588.7	617.1	567.8	582.0	604.9	628.1	569.5	581.2	594.6
	Entire Network																
	VMT	veh-mi (x1000)	1,624.0	1,674.4	1,704.5	1,705.3	1,618.1	1,672.1	1,704.3	1,721.6	1,981.2	2,045.5	2,086.3	2,094.3	1,973.9	2,037.9	2,076.6
	VHT	veh-hrs (x1000)	44.7	49.6	55.6	62.6	44.5	48.9	54.2	60.6	56.1	61.8	68.7	76.8	56.1	61.4	67.6
	Average speed	mph	36.4	33.8	30.7	27.2	36.4	34.2	31.5	28.4	35.3	33.1	30.4	27.3	35.2	33.2	30.7
	Delay	s/mi	59.1	64.3	71.9	83.2	59.4	63.7	69.2	77.8	59.2	64.1	71.3	82.1	59.6	63.8	69.3
	Entering network	veh	355,950	373,540	391,140	406,571	355,953	373,597	391,314	408,622	435,420	456,498	477,663	496,258	435,422	456,565	477,872
	Inside network at end	veh	14,797	17,692	22,196	27,442	14,704	17,138	21,312	26,636	18,900	22,081	27,275	33,225	18,898	21,844	26,948
	Waiting to enter at end	veh	8	67	217	2,642	8	13	45	593	9	80	266	2,999	9	16	60

Table B-18: Simulation Metrics, Increase in Overall Traffic Demand, PM Peak

		Vehicles								Persons							
Metrics		100% HOV2+	105% HOV2+	110% HOV2+	115% HOV2+	100% HOT2+	105% HOT2+	110% HOT2+	115% HOT2+	100% HOV2+	105% HOV2+	110% HOV2+	115% HOV2+	100% HOT2+	105% HOT2+	110% HOT2+	115% HOT2+
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB																
	VMT veh-mi (x1000)	58.2	55.4	53.2	51.1	55.5	51.1	48.7	47.1	118.6	112.9	108.5	104.2	108.4	99.2	94.6	92.0
	VHT veh-hrs (x1000)	2.3	55.4	53.2	51.1	55.5	51.1	48.7	47.1	4.8	5.7	6.5	7.0	5.4	6.6	7.1	7.5
	Average speed mph	25.0	19.8	16.7	14.8	20.0	15.2	13.5	12.4	24.9	19.8	16.6	14.8	20.0	15.0	13.3	12.2
	Traveltime min	26.0	32.0	37.4	41.5	31.9	41.5	46.0	49.4	26.1	32.1	37.4	41.5	31.9	41.9	46.4	49.9
	Delay min	17.8	23.8	29.2	33.2	23.6	33.3	37.8	41.1	17.8	23.8	29.2	33.3	23.7	33.6	38.2	41.6
	I-210 Core: General Purpose Lanes - EB																
	VMT veh-mi (x1000)	321.2	297.8	281.5	273.1	318.6	304.7	286.3	271.5	357.7	333.6	316.2	307.7	361.0	347.9	326.7	309.3
	VHT veh-hrs (x1000)	13.5	297.8	281.5	273.1	318.6	304.7	286.3	271.5	15.0	19.9	21.4	22.3	14.6	19.0	21.1	22.3
	Average speed mph	23.7	16.7	14.8	13.8	24.9	18.4	15.6	14.0	23.8	16.8	14.8	13.8	24.8	18.3	15.5	13.9
	Traveltime min	33.1	45.3	50.8	54.0	31.6	41.9	48.5	53.2	33.1	45.4	50.9	54.2	31.8	42.3	48.9	53.8
	Delay min	23.4	35.7	41.2	44.3	21.9	32.3	38.8	43.6	23.5	35.7	41.3	44.5	22.1	32.7	39.3	44.2
	I-210 Core: General Purpose Lanes & HOT Lanes - EB																
	VMT veh-mi (x1000)	379.4	353.1	334.7	324.2	374.1	355.9	335.0	318.6	476.3	446.5	424.6	412.0	469.4	447.1	421.3	401.3
	VHT veh-hrs (x1000)	15.9	353.1	334.7	324.2	374.1	355.9	335.0	318.6	19.8	25.6	27.9	29.4	20.0	25.6	28.2	29.8
	Average speed mph	23.9	17.1	15.0	13.9	24.0	17.9	15.2	13.7	24.1	17.4	15.2	14.0	23.5	17.5	14.9	13.5
	Traveltime min	32.0	43.2	48.7	52.0	31.6	41.9	48.1	52.7	31.4	42.0	47.5	51.0	31.8	42.2	48.4	52.9
	Delay min	41.2	59.5	70.3	77.6	22.2	65.6	76.6	84.7	41.3	59.5	70.4	77.8	22.5	66.3	77.4	85.8
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB																
	VMT veh-mi (x1000)	54.8	56.9	57.9	57.3	56.4	58.5	58.0	55.8	110.0	114.2	116.2	115.2	111.7	114.5	112.9	106.9
	VHT veh-hrs (x1000)	0.9	56.9	57.9	57.3	56.4	58.5	58.0	55.8	1.8	2.3	2.8	3.3	2.0	2.8	3.6	4.6
	Average speed mph	59.7	49.8	41.0	34.6	54.5	41.2	31.1	23.4	59.7	49.8	41.0	34.6	54.6	41.3	31.1	23.3
	Traveltime min	9.9	11.7	14.3	17.4	10.8	14.2	18.8	25.6	9.9	11.7	14.3	17.4	10.8	14.2	18.8	25.6
	Delay min	1.9	3.7	6.3	9.4	2.7	6.1	10.7	17.6	1.9	3.7	6.3	9.4	2.8	6.2	10.7	17.6
	I-210 Core: General Purpose Lanes - WB																
	VMT veh-mi (x1000)	333.1	334.2	329.9	320.4	329.3	333.7	332.5	325.3	367.8	369.2	365.5	357.1	364.3	370.6	371.1	365.7
	VHT veh-hrs (x1000)	8.7	334.2	329.9	320.4	329.3	333.7	332.5	325.3	9.7	12.7	15.5	17.2	8.7	11.5	14.1	16.3
	Average speed mph	38.2	29.1	23.3	20.5	42.0	32.2	26.4	22.4	38.1	29.2	23.5	20.7	41.8	32.1	26.4	22.5
	Traveltime min	18.0	24.1	30.6	35.1	16.5	21.6	26.8	31.9	17.9	23.9	30.4	34.9	16.4	21.4	26.8	31.9
	Delay min	8.5	14.6	21.1	25.6	6.9	12.0	17.3	22.3	8.4	14.4	20.9	25.4	6.8	11.9	17.2	22.3
	I-210 Core: General Purpose Lanes & HOT Lanes - WB																
	VMT veh-mi (x1000)	387.9	391.1	387.8	377.8	385.6	392.2	390.5	381.2	477.8	483.5	481.7	472.3	476.0	485.0	483.9	472.6
	VHT veh-hrs (x1000)	9.6	391.1	387.8	377.8	385.6	392.2	390.5	381.2	11.5	15.0	18.4	20.6	10.8	14.3	17.7	20.9
	Average speed mph	40.2	30.9	24.9	21.8	43.4	33.3	27.0	22.6	41.6	32.3	26.2	23.0	44.2	33.9	27.4	22.7
	Traveltime min	16.9	22.3	28.2	32.4	15.6	20.5	25.6	30.9	16.0	21.1	26.5	30.7	15.1	19.7	24.9	30.5
	Delay min	10.4	18.3	27.3	35.0	6.3	18.2	28.0	39.9	10.2	18.1	27.1	34.8	5.9	18.1	28.0	40.0
Network	Freeways (General purpose lanes and HOV)																
	VMT veh-mi (x1000)	1,407.0	744.2	722.4	702.0	759.7	748.1	725.5	699.8	954.1	930.0	906.3	884.2	945.4	932.2	905.2	873.9
	VHT veh-hrs (x1000)	39.7	744.2	722.4	702.0	759.7	748.1	725.5	699.8	31.3	40.6	46.3	49.9	30.8	39.9	45.9	50.6
	Average speed mph	35.5	22.4	19.1	17.3	31.1	23.6	19.9	17.5	30.5	22.9	19.6	17.7	30.7	23.4	19.7	17.3
	Delay s/mi	74.2	77.7	97.7	112.5	55.2	83.7	104.6	124.6	51.5	77.6	97.5	112.6	55.4	84.3	105.4	125.7
	Off-Freeway (Arterials)																
	VMT veh-mi (x1000)	842.5	914.0	980.9	1,019.0	854.1	922.5	990.3	1,037.1	1,077.8	1,163.2	1,242.8	1,287.2	1,089.3	1,171.1	1,251.8	1,305.9
	VHT veh-hrs (x1000)	41.5	914.0	980.9	1,019.0	854.1	922.5	990.3	1,037.1	55.7	64.2	77.4	93.2	57.2	65.4	79.5	99.2
	Average speed mph	20.3	18.9	16.6	14.2	20.0	18.7	16.3	13.5	19.3	18.1	16.1	13.8	19.0	17.9	15.7	13.2
	Delay s/mi	665.8	742.0	928.0	1,203.5	679.7	759.8	971.4	1,346.0	670.8	745.9	930.1	1,201.5	685.1	765.0	973.9	1,346.5
	Entire Network																
	VMT veh-mi (x1000)	2,409.2	2,450.8	2,481.7	2,481.0	2,416.6	2,462.1	2,494.6	2,494.8	3,017.6	3,071.9	3,109.4	3,110.3	3,025.3	3,079.8	3,119.0	3,113.7
	VHT veh-hrs (x1000)	87.4	102.9	120.5	137.3	87.6	102.0	120.0	139.8	112.2	131.0	152.4	173.0	113.2	130.8	153.0	177.4
	Average speed mph	27.6	23.8	20.6	18.1	27.6	24.1	20.8	17.8	26.9	23.4	20.4	18.0	26.7	23.5	20.4	17.5
	Delay s/mi	78.4	93.5	116.6	144.5	79.4	93.3	117.3	151.6	78.5	93.3	116.1	143.6	79.7	93.6	117.5	151.6
	Entering network veh	585,297	614,253	639,421	658,051	585,384	614,451	640,252	659,557	721,737	756,731	787,300	810,365	721,753	756,892	788,219	811,379
	Inside network at end veh	19,224	27,073	35,013	42,342	18,388	25,105	33,302	43,292	24,861	34,307	44,177	53,645	24,073	32,408	42,651	55,308
	Waiting to enter at end veh	28	304	4,353	14,952	69	138	3,492	13,345	35	366	5,078	17,362	85	171	4,074	16,160

B.7. CHANGE IN VALUE OF TIME

Table B-19: Simulation Metrics, Change in Value of Time, AM Peak

		Vehicles						Persons					
Metrics		HOV2 & Decals	HOT2+ \$15	HOT2+ \$25	HOT2+ \$35	HOT2+ \$50	HOT2+ \$65	HOV2 & Decals	HOT2+ \$15	HOT2+ \$25	HOT2+ \$35	HOT2+ \$50	HOT2+ \$65
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB												
	VMT veh-mi (x1000)	41.1	45.2	45.9	47.1	48.8	50.7	82.7	86.2	86.9	88.0	89.9	91.4
	VHT veh-hrs (x1000)	0.6	45.2	45.9	47.1	48.8	50.7	1.2	1.3	1.3	1.4	1.4	1.5
	Average speed mph	67.9	66.4	65.2	64.1	63.0	61.4	67.9	66.7	65.6	64.6	63.6	62.0
	Traveltime min	8.9	9.1	9.2	9.4	9.6	9.8	8.9	9.1	9.2	9.4	9.5	9.7
	Delay min	0.7	0.9	1.0	1.2	1.4	1.6	0.7	0.9	1.0	1.1	1.3	1.5
	I-210 Core: General Purpose Lanes - EB												
	VMT veh-mi (x1000)	445.6	440.9	440.6	439.0	437.4	436.1	475.9	472.1	471.8	470.2	468.8	467.7
	VHT veh-hrs (x1000)	8.8	440.9	440.6	439.0	437.4	436.1	9.4	9.5	9.1	9.0	8.8	8.7
	Average speed mph	50.7	49.7	51.6	52.1	53.2	53.6	50.8	49.9	51.6	52.2	53.2	53.5
	Traveltime min	14.3	14.6	14.1	13.9	13.6	13.5	14.3	14.6	14.1	13.9	13.6	13.5
	Delay min	4.6	4.9	4.4	4.2	3.9	3.8	4.6	4.9	4.4	4.2	3.9	3.8
	I-210 Core: General Purpose Lanes & HOT Lanes - EB												
	VMT veh-mi (x1000)	486.8	486.0	486.5	486.1	486.1	486.8	558.6	558.2	558.7	558.1	558.7	559.0
	VHT veh-hrs (x1000)	9.4	486.0	486.5	486.1	486.1	486.8	10.6	10.8	10.5	10.4	10.2	10.2
	Average speed mph	51.8	50.9	52.6	53.1	54.1	54.3	52.8	51.9	53.4	53.8	54.7	54.8
	Traveltime min	13.9	14.1	13.6	13.5	13.2	13.1	13.5	13.7	13.3	13.2	13.0	12.9
	Delay min	5.3	5.8	5.4	5.4	5.3	5.4	5.3	5.8	5.4	5.4	5.2	5.3
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB												
	VMT veh-mi (x1000)	84.9	83.4	84.1	84.5	84.7	84.0	172.8	163.3	164.5	164.6	164.9	162.0
	VHT veh-hrs (x1000)	1.6	83.4	84.1	84.5	84.7	84.0	3.3	5.1	5.1	5.2	5.4	5.6
	Average speed mph	52.5	32.1	32.4	31.7	30.6	29.4	52.5	32.0	32.3	31.6	30.5	29.1
	Traveltime min	11.2	18.4	18.0	18.4	19.2	20.1	11.2	18.4	18.1	18.5	19.3	20.2
	Delay min	3.1	10.3	10.0	10.4	11.1	12.0	3.1	10.3	10.0	10.5	11.2	12.2
	I-210 Core: General Purpose Lanes - WB												
	VMT veh-mi (x1000)	498.2	490.7	491.6	490.1	488.9	489.3	552.5	551.0	551.9	550.3	549.1	551.1
	VHT veh-hrs (x1000)	16.2	490.7	491.6	490.1	488.9	489.3	17.9	20.4	19.7	19.6	19.7	19.8
	Average speed mph	30.7	27.2	28.2	28.2	28.0	28.1	30.8	27.1	28.0	28.0	27.8	27.8
	Traveltime min	23.2	26.5	25.4	25.4	25.6	25.5	23.2	26.7	25.7	25.6	25.8	25.8
	Delay min	13.6	16.8	15.8	15.8	16.0	15.9	13.6	17.1	16.1	16.0	16.2	16.2
	I-210 Core: General Purpose Lanes & HOT Lanes - WB												
	VMT veh-mi (x1000)	583.1	574.1	575.8	574.6	573.6	573.4	725.3	714.3	716.4	714.9	714.0	713.2
	VHT veh-hrs (x1000)	17.9	574.1	575.8	574.6	573.6	573.4	21.2	25.5	24.8	24.9	25.2	25.4
	Average speed mph	32.6	27.8	28.7	28.6	28.3	28.3	34.2	28.1	28.9	28.8	28.4	28.1
	Traveltime min	21.5	25.3	24.4	24.4	24.7	24.7	20.3	24.8	23.9	24.0	24.3	24.5
	Delay min	16.7	27.2	25.8	26.2	27.1	27.9	16.7	27.4	26.1	26.5	27.4	28.3
Network	Freeways (General purpose lanes and HOV)												
	VMT veh-mi (x1000)	1,940.8	1,060.1	1,062.3	1,060.7	1,059.7	1,060.2	1,283.9	1,272.5	1,275.1	1,273.1	1,272.7	1,272.2
	VHT veh-hrs (x1000)	44.1	1,060.1	1,062.3	1,060.7	1,059.7	1,060.2	31.8	36.2	35.2	35.2	35.4	35.6
	Average speed mph	44.0	35.1	36.3	36.3	36.2	36.2	40.4	35.1	36.2	36.1	36.0	35.8
	Delay s/mi	33.8	33.0	31.2	31.6	32.4	33.3	22.0	33.2	31.5	31.9	32.6	33.7
	Off-Freeway (Arterials)												
	VMT veh-mi (x1000)	852.2	858.2	857.8	859.9	858.9	859.0	1,125.0	1,130.2	1,130.0	1,132.4	1,131.6	1,131.4
	VHT veh-hrs (x1000)	38.9	858.2	857.8	859.9	858.9	859.0	55.0	55.4	55.4	55.5	55.5	55.6
	Average speed mph	21.9	21.9	21.9	21.9	21.9	21.8	20.4	20.4	20.4	20.4	20.4	20.4
	Delay s/mi	598.3	600.8	601.4	601.1	600.4	602.2	600.7	604.0	604.5	604.0	603.8	605.3
	Entire Network												
	VMT veh-mi (x1000)	2,952.3	2,942.8	2,948.0	2,946.2	2,943.1	2,944.7	3,663.1	3,649.8	3,655.9	3,652.5	3,651.5	3,651.4
	VHT veh-hrs (x1000)	89.2	92.6	91.5	91.5	90.9	91.7	114.8	119.8	118.6	118.7	118.1	119.3
	Average speed mph	33.1	31.8	32.2	32.2	32.4	32.1	31.9	30.5	30.8	30.8	30.9	30.6
	Delay s/mi	63.9	65.6	65.0	65.1	64.6	65.3	63.8	65.8	65.3	65.4	65.0	65.7
	Entering network veh	652,854	653,596	653,596	653,596	653,497	653,597	814,076	814,870	814,871	814,870	814,772	814,872
	Inside network at end veh	13,258	14,042	13,672	13,796	13,898	13,870	17,237	18,258	17,839	18,049	18,143	18,110
	Waiting to enter at end veh	16	11	11	11	10	10	22	15	14	15	14	13

Table B-20: Simulation Metrics, Change in Value of Time, Midday

		Vehicles						Persons					
Metrics		HOV2 & Decals	HOT2+ \$15	HOT2+ \$25	HOT2+ \$35	HOT2+ \$50	HOT2+ \$65	HOV2 & Decals	HOT2+ \$15	HOT2+ \$25	HOT2+ \$35	HOT2+ \$50	HOT2+ \$65
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB												
	VMT veh-mi (x1000)	34.3	36.9	39.0	41.8	44.7	45.6	68.8	70.6	72.6	75.1	77.6	78.0
	VHT veh-hrs (x1000)	0.5	36.9	39.0	41.8	44.7	45.6	1.0	1.2	1.2	1.3	1.4	1.5
	Average speed mph	66.5	60.6	61.9	59.5	56.3	53.5	66.5	61.1	62.1	59.6	56.2	53.1
	Traveltime min	9.2	10.0	9.8	10.2	10.8	11.4	9.2	9.9	9.8	10.2	10.8	11.5
	Delay min	0.9	1.7	1.6	2.0	2.6	3.2	0.9	1.7	1.6	2.0	2.6	3.3
	I-210 Core: General Purpose Lanes - EB												
	VMT veh-mi (x1000)	268.1	264.4	263.2	259.9	256.3	254.8	289.8	286.5	285.4	282.2	278.8	277.6
	VHT veh-hrs (x1000)	5.4	264.4	263.2	259.9	256.3	254.8	5.8	5.7	5.4	5.3	5.2	5.3
	Average speed mph	49.4	50.6	52.5	53.3	53.4	52.8	49.6	50.6	52.5	53.3	53.3	52.6
	Traveltime min	14.7	14.4	13.8	13.6	13.5	13.7	14.7	14.4	13.8	13.5	13.5	13.7
	Delay min	5.0	4.6	4.1	3.8	3.8	3.9	5.0	4.6	4.1	3.8	3.8	4.0
	I-210 Core: General Purpose Lanes & HOT Lanes - EB												
	VMT veh-mi (x1000)	302.4	301.3	302.2	301.7	301.0	300.4	358.6	357.1	358.0	357.3	356.4	355.6
	VHT veh-hrs (x1000)	5.9	301.3	302.2	301.7	301.0	300.4	6.9	6.8	6.6	6.6	6.6	6.7
	Average speed mph	50.9	51.6	53.5	54.1	53.8	52.9	52.1	52.4	54.2	54.5	53.9	52.7
	Traveltime min	14.1	13.8	13.3	13.1	13.1	13.3	13.6	13.5	13.0	12.8	12.9	13.2
	Delay min	5.9	4.3	3.8	3.6	3.6	3.8	5.9	6.3	5.6	5.8	6.4	7.2
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB												
	VMT veh-mi (x1000)	37.1	38.0	38.1	38.2	38.7	39.4	74.6	74.9	75.1	75.1	75.6	76.2
	VHT veh-hrs (x1000)	0.6	38.0	38.1	38.2	38.7	39.4	1.1	1.3	1.3	1.4	1.4	1.4
	Average speed mph	65.2	56.8	55.6	54.6	52.5	53.2	65.2	57.3	56.0	55.1	53.0	53.6
	Traveltime min	9.1	10.3	10.6	10.7	11.1	11.0	9.1	10.3	10.5	10.7	11.1	10.9
	Delay min	1.0	2.3	2.5	2.7	3.1	2.9	1.0	2.2	2.5	2.6	3.0	2.9
	I-210 Core: General Purpose Lanes - WB												
	VMT veh-mi (x1000)	246.2	242.5	242.4	242.3	241.5	241.1	270.6	267.4	267.1	267.3	266.4	266.1
	VHT veh-hrs (x1000)	5.0	242.5	242.4	242.3	241.5	241.1	5.5	5.5	5.5	5.5	5.6	5.4
	Average speed mph	49.0	48.9	49.1	48.9	47.9	49.4	49.0	48.8	49.0	48.8	47.7	49.3
	Traveltime min	14.2	14.2	14.2	14.2	14.5	14.1	14.1	14.2	14.1	14.2	14.4	14.0
	Delay min	4.6	4.6	4.6	4.6	4.9	4.5	4.6	4.6	4.5	4.6	4.9	4.4
	I-210 Core: General Purpose Lanes & HOT Lanes - WB												
	VMT veh-mi (x1000)	283.3	280.5	280.5	280.5	280.2	280.5	345.1	342.3	342.2	342.3	342.0	342.3
	VHT veh-hrs (x1000)	5.6	280.5	280.5	280.5	280.2	280.5	6.7	6.8	6.8	6.8	7.0	6.8
	Average speed mph	50.6	49.9	49.9	49.6	48.5	49.9	51.8	50.4	50.4	50.1	48.8	50.2
	Traveltime min	13.6	13.7	13.7	13.8	14.1	13.7	13.1	13.3	13.3	13.4	13.7	13.3
	Delay min	5.7	4.3	4.3	4.4	4.7	4.3	5.6	6.8	7.0	7.2	7.9	7.3
Network	Freeways (General purpose lanes and HOV)												
	VMT veh-mi (x1000)	1,025.2	581.8	582.7	582.3	581.2	580.9	703.7	699.4	700.3	699.6	698.3	697.9
	VHT veh-hrs (x1000)	18.6	581.8	582.7	582.3	581.2	580.9	13.6	13.6	13.4	13.4	13.6	13.6
	Average speed mph	55.1	50.8	51.7	51.9	51.1	51.4	51.9	51.4	52.3	52.2	51.3	51.4
	Delay s/mi	17.1	13.3	12.7	13.1	14.3	14.5	11.5	13.2	12.6	13.0	14.3	14.5
	Off-Freeway (Arterials)												
	VMT veh-mi (x1000)	483.3	486.9	486.8	486.7	487.0	486.8	615.5	618.7	618.5	618.4	618.7	618.5
	VHT veh-hrs (x1000)	21.9	486.9	486.8	486.7	487.0	486.8	29.4	29.7	29.7	29.7	29.7	29.7
	Average speed mph	22.1	21.9	21.9	21.9	21.9	21.9	21.0	20.8	20.8	20.8	20.8	20.8
	Delay s/mi	562.3	563.8	564.4	563.7	564.6	564.1	567.8	569.9	570.4	569.5	570.3	570.2
	Entire Network												
	VMT veh-mi (x1000)	1,624.0	1,616.1	1,618.3	1,618.1	1,616.9	1,615.0	1,981.2	1,972.1	1,974.2	1,973.9	1,971.8	1,969.1
	VHT veh-hrs (x1000)	44.7	44.6	44.5	44.5	44.6	44.5	56.1	56.3	56.1	56.1	56.3	56.2
	Average speed mph	36.4	36.2	36.3	36.4	36.2	36.3	35.3	35.1	35.2	35.2	35.0	35.0
	Delay s/mi	59.1	59.5	59.5	59.4	59.6	59.4	59.2	59.7	59.7	59.6	59.9	59.7
	Entering network veh	355,950	355,951	355,953	355,953	355,950	355,954	435,420	435,420	435,423	435,422	435,419	435,424
	Inside network at end veh	14,797	14,840	14,701	14,704	14,753	14,886	18,900	19,015	18,901	18,898	19,015	19,199
	Waiting to enter at end veh	8	10	7	8	11	7	9	11	8	9	12	8

Table B-21: Simulation Metrics, Change in Value of Time, PM Peak

		Vehicles						Persons					
Metrics		HOV2 & Decals	HOT2+ \$15	HOT2+ \$25	HOT2+ \$35	HOT2+ \$50	HOT2+ \$65	HOV2 & Decals	HOT2+ \$15	HOT2+ \$25	HOT2+ \$35	HOT2+ \$50	HOT2+ \$65
I-210 EB (SR-135 to I-605)	I-210 Core: HOT Lanes - EB												
	VMT veh-mi (x1000)	58.2	55.5	55.2	55.5	55.4	55.6	118.6	108.9	107.7	108.4	108.0	108.3
	VHT veh-hrs (x1000)	2.3	55.5	55.2	55.5	55.4	55.6	4.8	5.4	5.5	5.4	5.5	5.4
	Average speed mph	25.0	20.3	19.7	20.0	19.8	20.0	24.9	20.2	19.6	20.0	19.8	19.9
	Traveltime min	26.0	31.3	32.3	31.9	32.1	31.8	26.1	31.5	32.5	31.9	32.3	32.0
	Delay min	17.8	23.1	24.1	23.6	23.8	23.6	17.8	23.2	24.2	23.7	24.0	23.7
	I-210 Core: General Purpose Lanes - EB												
	VMT veh-mi (x1000)	321.2	319.1	318.8	318.6	318.2	319.2	357.7	361.6	361.9	361.0	360.9	362.3
	VHT veh-hrs (x1000)	13.5	319.1	318.8	318.6	318.2	319.2	15.0	14.6	14.6	14.6	14.7	14.5
	Average speed mph	23.7	24.9	24.9	24.9	24.8	25.2	23.8	24.7	24.7	24.8	24.6	25.0
	Traveltime min	33.1	31.6	31.6	31.6	31.7	31.2	33.1	31.8	31.8	31.8	31.9	31.4
	Delay min	23.4	22.0	21.9	21.9	22.0	21.5	23.5	22.2	22.2	22.1	22.3	21.7
	I-210 Core: General Purpose Lanes & HOT Lanes - EB												
	VMT veh-mi (x1000)	379.4	374.6	374.1	374.1	373.6	374.8	476.3	470.5	469.6	469.4	468.9	470.6
	VHT veh-hrs (x1000)	15.9	374.6	374.1	374.1	373.6	374.8	19.8	20.0	20.1	20.0	20.1	19.9
	Average speed mph	23.9	24.1	24.0	24.0	23.9	24.3	24.1	23.5	23.3	23.5	23.3	23.6
	Traveltime min	32.0	31.6	31.7	31.6	31.7	31.2	31.4	31.7	32.0	31.8	32.0	31.5
	Delay min	41.2	22.1	22.2	22.2	22.3	21.8	41.3	22.4	22.6	22.5	22.7	22.2
I-210 WB (I-605 to SR-134)	I-210 Core: HOT Lanes - WB												
	VMT veh-mi (x1000)	54.8	56.2	56.4	56.4	56.4	56.6	110.0	111.8	111.8	111.7	111.7	111.9
	VHT veh-hrs (x1000)	0.9	56.2	56.4	56.4	56.4	56.6	1.8	1.9	2.0	2.0	2.1	2.1
	Average speed mph	59.7	58.9	55.6	54.5	54.2	53.6	59.7	58.9	55.7	54.6	54.3	53.8
	Traveltime min	9.9	10.0	10.6	10.8	10.8	10.9	9.9	10.0	10.6	10.8	10.8	10.9
	Delay min	1.9	2.0	2.6	2.7	2.8	2.9	1.9	2.0	2.6	2.8	2.8	2.9
	I-210 Core: General Purpose Lanes - WB												
	VMT veh-mi (x1000)	333.1	329.7	328.9	329.3	329.4	328.6	367.8	364.6	363.8	364.3	364.4	363.6
	VHT veh-hrs (x1000)	8.7	329.7	328.9	329.3	329.4	328.6	9.7	8.8	9.0	8.7	8.7	8.8
	Average speed mph	38.2	41.6	40.7	42.0	42.0	41.7	38.1	41.5	40.6	41.8	41.8	41.5
	Traveltime min	18.0	16.6	17.0	16.5	16.5	16.6	17.9	16.5	16.8	16.4	16.4	16.5
	Delay min	8.5	7.1	7.4	6.9	6.9	7.1	8.4	7.0	7.3	6.8	6.8	7.0
	I-210 Core: General Purpose Lanes & HOT Lanes - WB												
	VMT veh-mi (x1000)	387.9	386.0	385.3	385.6	385.8	385.2	477.8	476.4	475.6	476.0	476.2	475.5
	VHT veh-hrs (x1000)	9.6	386.0	385.3	385.6	385.8	385.2	11.5	10.7	11.0	10.8	10.8	10.8
	Average speed mph	40.2	43.5	42.4	43.4	43.4	43.1	41.6	44.6	43.3	44.2	44.2	43.9
	Traveltime min	16.9	15.6	16.0	15.6	15.6	15.8	16.0	15.0	15.4	15.1	15.1	15.2
	Delay min	10.4	6.3	6.7	6.3	6.3	6.5	10.2	5.8	6.2	5.9	5.9	6.0
Network	Freeways (General purpose lanes and HOV)												
	VMT veh-mi (x1000)	1,407.0	760.6	759.4	759.7	759.4	760.0	954.1	946.9	945.2	945.4	945.1	946.1
	VHT veh-hrs (x1000)	39.7	760.6	759.4	759.7	759.4	760.0	31.3	30.7	31.1	30.8	30.9	30.7
	Average speed mph	35.5	31.1	30.7	31.1	31.0	31.2	30.5	30.8	30.4	30.7	30.6	30.8
	Delay s/mi	74.2	54.1	56.0	55.2	55.6	55.0	51.5	54.3	56.3	55.4	55.9	55.3
	Off-Freeway (Arterials)												
	VMT veh-mi (x1000)	842.5	853.7	854.9	854.1	854.7	854.4	1,077.8	1,088.8	1,090.2	1,089.3	1,090.2	1,089.6
	VHT veh-hrs (x1000)	41.5	853.7	854.9	854.1	854.7	854.4	55.7	57.0	57.2	57.2	57.1	57.0
	Average speed mph	20.3	20.0	20.0	20.0	20.0	20.0	19.3	19.1	19.1	19.0	19.1	19.1
	Delay s/mi	665.8	676.0	678.0	679.7	676.3	675.9	670.8	681.2	683.3	685.1	681.6	681.0
	Entire Network												
	VMT veh-mi (x1000)	2,409.2	2,417.1	2,416.7	2,416.6	2,416.6	2,417.5	3,017.6	3,026.6	3,026.4	3,025.3	3,026.0	3,027.5
	VHT veh-hrs (x1000)	87.4	87.4	87.8	87.6	87.5	87.5	112.2	112.8	113.5	113.2	113.2	113.2
	Average speed mph	27.6	27.7	27.5	27.6	27.6	27.6	26.9	26.8	26.7	26.7	26.7	26.7
	Delay s/mi	78.4	79.0	79.4	79.4	79.0	79.0	78.5	79.3	79.8	79.7	79.5	79.5
	Entering network veh	585,297	585,412	585,421	585,384	585,414	585,409	721,737	721,786	721,796	721,753	721,788	721,780
	Inside network at end veh	19,224	18,255	18,280	18,388	18,292	18,248	24,861	23,830	23,854	24,073	23,912	23,825
	Waiting to enter at end veh	28	41	32	69	39	44	35	52	42	85	50	58