VEHOPS I-205 Recommended Bottleneck Solutions

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CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.

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6/28/19

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ACRONYMS AND ABBREVIATIONS

CD	collector-distributer
NCHRP	National Cooperative Highway Research Program
RTC	Southwest Washington Regional Transportation Council
VEHOPS	Vancouver Eastside Highway Operations Study
WSDOT	Washington State Department of Transportation

1. Introduction

1.1 Purpose

The purpose of this memorandum is to provide a summary of the 2018 Existing, 2035 No Build and 2035 Build conditions for the I-205 corridor as part of the Vancouver Eastside Highway Operations Study (VEHOPS). This memorandum provides a list of recommended strategies identified to alleviate northbound and southbound bottleneck locations in the AM and PM Peak periods, a list of potential strategies viable for longer term solutions, and a list of strategies that were evaluated but not recommended for further consideration.

Over the last 20 years, I-205 has been identified as an important high-growth corridor. Current traffic volumes on I-205 exceed the carrying capacity of the corridor. These capacity deficiencies result in mobility and safety limitations and unreliable traffic flow.

The Washington State Department of Transportation (WSDOT), Southwest Washington Regional Transportation Council (RTC), and other stakeholders are working jointly to assess the urban freeway corridors in Southwest Washington. The VEHOPS will help WSDOT understand current 2018/2019 traffic operations, validate the need for the projects identified in the 2014 Corridor study, and assess potential lower cost improvements to key congestion areas. This report will also inform a future Urban Freeway Corridors Study to be led by RTC.

1.2 Study Area

The study area for the VEHOPS is along I-205 between SR 14 and NE Padden Parkway.

The following interchanges were included:

- I-205 and NE Padden Parkway
- I-205 and SR 500
- I-205 and NE 18th Street
- I-205 and Mill Plain Boulevard
- I-205 and SR 14

Figure 1-1. Study Area Map

1.3 Performance Measures

These existing and future conditions analyses included operational performance measures including travel time/speeds, congestion, and bottlenecks. Safety was also analyzed in existing conditions to understand current safety conditions including number of crashes, types of crashes, crash severity, and high-crash locations. The safety analysis was completed along the I-205 corridor as well as at the study interchanges.

Travel times were summarized by segments and for the overall study area. This information was used for calibrating the existing conditions and comparing scenarios to the No Build conditions.

Congestion is an excess of vehicles on a roadway or intersection at a particular time, resulting in speeds that are slower than normal or free flow speeds. Congestion is divided into two categories—recurring and nonrecurring/random. Recurring congestion occurs any time the rate of approaching traffic is greater than the rate of departing traffic. Recurring congestion occurs due to operational influences, which include *decision points* such as on and off ramps, merging areas, weaving areas, lane drops, tollbooth areas, and traffic signals; and *design constraints* such as curves, grades, underpasses, or narrow or non-existent shoulders. Operational influences are tangible root causes of the recurring congestion. Recurring congestion is routine to the point of being predictable in cause, location, time of day, and duration. Nonrecurring congestion is caused by traffic incidents, work zones, bad weather, and special events. The VEHOPS analysis focused on the recurring congestion locations and the operational influences that cause them, rather than the nonrecurring congestion causes.

Bottlenecks were identified from the recurring congestion analysis to help identify strategies to alleviate these recurring congestion bottlenecks.

2. Existing Conditions

The VEHOPS existing conditions analysis identified site-specific recurring bottlenecks that will serve as a base for identifying strategies to reduce congestion and improve traffic operations and safety along I-205 within the study area.

Information and data along the I-205 corridor were collected and analyzed to understand the characteristics of the corridor and problematic locations within it, and to identify current and forecast bottlenecks. The existing conditions analysis included a review of the current operations of the corridor including volumes, speeds, and hours of congestion as well as a review of the safety data including number of crashes, types of crashes, and high-crash locations along I-205 as well as at the ramp terminals.

The identified bottleneck and high-crash locations and associated operational and safety issues served as the basis for identifying potential improvements as well as calibrating the existing conditions VISSIM models. The 2018 existing conditions are summarized in **Appendix A**, VEHOPS I-205 Existing Conditions Summary Memo.

At free flow speeds, travel time on the I-205 corridor is approximately 13 minutes between Airport Way and I-5. Travel times between I-5 and Airport Way reflect congested conditions southbound during the AM peak period and northbound during the PM peak period, with travel times of approximately 17 minutes. On southbound I-205 congestion spilling back from the Glenn Jackson Bridge results in increased travel times (compared to free flow conditions) between SR 500 and Airport Way. Congestion resulting from the weave section between the Mill Plain on-ramp and the SR 14 off-ramp also contributes to increased travel times. On northbound I-205 there are three bottlenecks that contribute to increased travel times (compared to free flow conditions): the two-lane mainline section between SR 500 and Padden Parkway, the merge area at the Mill Plain entrance ramp, and the diverge area at the SR 14 exit ramp.

Congestion is present during both peak commute periods in the peak direction, southbound in the AM peak, and northbound in the PM peak (**Figure 2-1**). During the morning commute, southbound congestion exists at three locations, referred to as S-1 through S-3 below. During the evening commute, northbound congestion exists at three locations, referred to as N-1 through N-3.

Southbound Congestion:

- **S-1: Between NE Padden Parkway and SR 500,** congestion lasts for 3 hours from 6:00 to 9:00 AM. Contributing factors include two closely spaced on-ramps from Padden Parkway, adding volume equivalent to one lane of traffic to the high mainline volumes.
- **S-2: Between SR 500 and SR 14,** congestion lasts for 2 hours from 6:15 to 8:15 AM. Contributing factors include high on-ramp, off-ramp, and mainline volumes as well as high weaving maneuvers between closely spaced ramps. Congestion originating south of SR 14 also spills back into this segment, further worsening traffic congestion.
- **S-3: Between SR 14 and south of the Glenn Jackson Bridge,** congestion lasts for 2.75 hours from 6:00 to 8:45 AM. Contributing factors include high ramp and mainline volumes as well as congestion south of the Columbia River backing up into the study area.

Northbound Congestion:

- **N-1: Between south of the Glenn Jackson Bridge and SR 14,** congestion lasts for 4 hours from 3:00 to 7:00 PM. Contributing factors include high ramp and mainline volumes, grade, weaving maneuvers across the Glenn Jackson Bridge, and the SR 14 off-ramp lane balance design.
- **N-2: Between Mill Plain Boulevard and SR 500,** congestion lasts for 4 hours from 3:00 to 7:00 PM. Contributing factors include high ramp and mainline volumes and weaving maneuvers between high-volume ramps.
- **N-3: Between SR 500 and NE Padden Parkway,** congestion lasts for 3 hours from 3:00 to 6:00 PM. Contributing factors include high ramp and mainline volumes.

More details on each of these southbound and northbound bottlenecks, including additional details on the contributing factors, are summarized in **Appendix A**, VEHOPS I-205 Existing Conditions Summary Memo.

Figure 2-1

CONGESTION SPEEDS <45 MPH

EXISTING (2018)

WSDOT

0 0.5 1 Miles

Northbound I-205 Congestion Extents

Southbound I-205 Congestion Extents

Eastbound SR-14 Congestion Extents

Westbound SR-14 Congestion Extents

I-205 Study Area

S-1 Southbound I-205 Congestion
- Duration: 6:00 - 9:00 AM, 3.0 hrs
- Extent: NE Padden Pkwy to NE 78th St, 0.3 Miles

S-2 Southbound I-205 Congestion
- Duration: 6:15 - 8:15 AM, 2.0 hrs
- Extent: NE Burton Rd to SR-14, 2.4 Miles

S-3 Southbound I-205 Congestion
- Duration: 6:00 - 8:45 AM, 2.75 hrs
- Extent: SR-14 to NE Airport Way, 2.4 Miles

N-3 Northbound I-205 Congestion
- Duration: 3:00 - 6:00 PM, 3.0 hrs
- Extent: SR-500 to NE 63rd St, 1.2 Miles

N-2 Northbound I-205 Congestion
- Duration: 3:00 - 7:00 PM, 4.0 hrs
- Extent: E Mill Plain Blvd to NE Burton Rd, 1.3 Miles

W-1 Westbound SR-14 Congestion
- Duration: 6:00 - 9:00 AM, 3.0 hrs
- Extent: SE 164th Ave to I-205, 2.9 Miles

E-1 Eastbound SR-14 Congestion
- Duration: 4:30 - 6:00 PM, 1.5 hrs
- Extent: I-205 to SE 164th Ave, 2.3 Miles

N-1 Northbound I-205 Congestion
- Duration: 3:00 - 7:00 PM, 4.0 hrs
- Extent: NE Airport Way to SR-14, 2.4 Miles

Southbound congestion exists south of Glenn Jackson Bridge, extending into study area.

Northbound congestion extends south of study area, south of Glenn Jackson Bridge.

Source: WSDOT, © Mapbox, © OpenStreetMap

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Revised: 01/16/19

I-205 Highway Operations Study SR-14 to NE Padden Pkwy

3. No Build Conditions

The 2035 No Build analysis included future volume development and VISSIM operations analysis. Future 2035 volumes were developed following the post-processing guidelines from the National Cooperative Highway Research Program (NCHRP) Report 765. Specific details on 2035 volume development is summarized in section 2.1 of **Appendix B**, VEHOPS I-205 No Build Conditions Summary Memo.

These future 2035 volumes were input into VISSIM models to analyze 2035 No Build conditions. The 2035 VISSIM models were used to identify expected bottleneck locations in the future and the resulting travel times and hours of congestion throughout the northbound and southbound corridors during both the AM and PM peak periods. The VISSIM analysis indicates that congestion is present during both peak commute periods, but unlike the 2018 Existing condition, congestion along the I-205 corridor in the 2035 No Build condition occurs in both directions during both peaks.

Tables 3-1 and 3-2 show the comparison between the Existing and No Build travel times for each of the segments and the overall totals in the northbound and southbound directions in both peak periods.

Table 3-1. Southbound Existing and No Build Corridor Travel Time (minutes)

Southbound Segments	AM Peak		PM Peak	
	2018 Existing	2035 No Build	2018 Existing	2035 No Build
Segment A: I-5 to south of Padden Pkwy interchange	5.5	15.4	5.5	18.1
Segment B: South of Padden Pkwy interchange to south of SR 500 interchange	2.7	2.8	2.6	2.9
Segment C: South of SR 500 interchange to north of SR 14 interchange	3.7	6.0	2.7	4.4
Segment D: North of SR 14 interchange to north of Airport Way interchange	5.3	5.8	2.6	2.6
Total	**17.2**	**30.0**	**13.4**	**28.0**

Table 3-2. Northbound Existing and No Build Corridor Travel Time (minutes)

Northbound Segments	AM Peak		PM Peak	
	2018 Existing	2035 No Build	2018 Existing	2035 No Build
Segment A: North of Airport Way interchange to north of SR 14 interchange	2.2	2.2	4.0	7.4
Segment B: North of SR 14 interchange to north of Mill Plain interchange	1.8	1.8	2.7	13.9
Segment C: North of Mill Plain interchange to north of SR 500 interchange	3.0	4.4	4.9	15.5
Segment D: North of SR 500 interchange to north of Padden Pkwy interchange	1.8	1.8	1.8	1.8
Segment E: North of Padden Pkwy interchange to I-5	3.9	4.0	3.9	3.9
Total	**12.7**	**14.2**	**17.3**	**42.5**

As shown in **Table 3-1**, the overall travel time on southbound I-205 between I-5 and Airport Way increases by nearly 13 minutes during the AM peak period. The two-lane section of I-205 between the Padden Parkway entrance ramp and SR 500 exit ramp is over capacity, resulting in congestion at the Padden Parkway entrance ramp merges. Congestion spills from the Padden Parkway entrance ramp and merges back north to the connection to I-5, causing travel times between I-5 and Padden Parkway to increase by nearly 10 minutes. Volume growth from the SR 500 and Mill Plain entrance ramps, as well as high weaving maneuvers, put additional pressure on the weave between the Mill Plain entrance ramp and SR 14 exit ramp, increasing congestion and travel times. Travel times across the Glenn Jackson Bridge between SR 14 and Airport way also increase slightly due to congestion spilling back from the Airport Way diverge area. During the PM peak period, the two-lane section between Padden Parkway and SR 500 increases travel times by over 10 minutes. The weaving section between the Mill Plain entrance ramp and SR 14 exit ramp result in congestion and increased travel times of almost 2 minutes on I-205.

As shown in **Table 3-2**, the overall travel time on northbound I-205 between Airport Way and I-5 increases by over 25 minutes during the PM peak period. Congestion spills back from the SR 14 exit ramp diverge area across the Glenn Jackson Bridge to Airport Way, increasing travel time across the bridge by approximately 3.5 minutes. Congestion also occurs between the SR 500 entrance ramp and the Padden Parkway exit ramp, increasing travel times throughout the study area by over 10 minutes and resulting in congestion south through the entire study area. During the AM peak period, I-205 northbound is generally not over capacity, and future travel times are largely similar to existing travel times. One exception during the AM peak period is the SR 500 merge area, which is over capacity for a portion of the peak period, resulting in some congestion and increased travel time of about 1.5 minutes between Mill Plain Boulevard and the SR 500 entrance ramps.

During the AM peak period, southbound congestion across the Glenn Jackson Bridge lasts for more than 3 hours during the morning commute, from before 6:00 AM to after 9:00 AM. Southbound congestion between SR 500 and SR 14, resulting from the weave between the Mill Plain entrance ramp and SR 14 exit ramp, lasts for a little over 2 hours, from 6:15 AM to 8:30 AM. Congested conditions through the weave section are further impacted by congestion spilling back from the Glenn Jackson Bridge. Due to the limited two-lane mainline capacity at NE Padden Parkway, southbound traffic experiences a bottleneck just south of NE Padden Parkway. This congestion lasts for more than 3 hours, from before 6:00 AM to after 9:00 AM, and spills back out of the I-205 corridor and onto the I-5 corridor.

During the PM peak period, southbound congestion formed at the weave between the Mill Plain entrance ramp and the SR 14 exit ramp lasts for about an hour during the evening commute, from 3:15 PM to 4:30 PM. Similar to the morning commute, the two-lane mainline section between the NE Padden Parkway entrance ramp and SR 500 exit ramp is over capacity and causes congestion that lasts for more than 4 hours, from before 3:00 PM to after 7:00 PM, which spills back from the I-205 corridor onto the I-5 corridor.

During the AM peak period, northbound congestion between Mill Plain Boulevard and SR 500 lasts for more than 2 hours, from 7:00 AM to after 9:00 AM, resulting from the limited two-lane capacity between the SR 500 entrance ramp and the NE Padden Parkway exit ramp.

During the PM peak period, congestion originates at the limited capacity two-lane mainline section between SR 500 and NE Padden Parkway. Congestion from this bottleneck spills back through the entire study area and across the Glenn Jackson Bridge. Other bottleneck locations are likely contributing to congestion on the

corridor; however, the primary cause of congestion is the two-lane section between SR 500 and Padden Parkway. Northbound congestion lasts for more than 4 hours during the evening commute, from before 3:00 PM to after 7:00 PM.

The 2035 No Build analysis identified the bottleneck locations and segments that would contribute to the increases in travel time, congestion, and collisions. The 2035 No Build conditions are summarized in **Appendix B**, VEHOPS I-205 No Build Conditions Summary Memo.

4. Strategies and Scenario Development

Strategies were developed to address the current and future bottlenecks, high-crash locations, and associated operational and safety issues within the study area in the I-205 corridor. Strategies are individual projects in an area within the corridor. An internal WSDOT interdisciplinary team combined with the Consultant team used the practical design approach to develop a range of strategies to be analyzed. Improvement strategies included potential short- and long-term practical solutions to improve operations and safety at each identified bottleneck.

Potential strategies included improvements such as auxiliary lanes, ramp modifications, peak-use shoulders, and ramp meters. Individual strategies were grouped in various combinations to develop Southbound and Northbound Scenarios for the I-205 corridor within the study area.

The benefits achieved from proposed strategies may likely be moderate and incremental due to the high levels of traffic demand on I-205, specifically during the peak commute hours. Existing bottlenecks meter traffic flow, which reduces the traffic flow arriving at a downstream bottleneck. When the upstream bottleneck is improved, queuing and delay at downstream bottlenecks may increase (compared to metering the traffic at an upstream bottleneck), essentially moving the existing bottleneck further downstream. VEHOPS focused on relieving recurring congestion at current and forecast bottleneck locations and the operational influences that cause them.

To alleviate current and forecast bottlenecks, strategies were developed along the I-205 Southbound and Northbound corridors that would provide the best value of benefit and cost. To address the directionality of the current and forecast bottlenecks and congestion along I-205 within the study area, separate Southbound and Northbound strategies were developed.

4.1 Southbound I-205 Strategies

The range of proposed southbound I-205 strategies included an auxiliary lane between NE Padden Parkway and SR 500 with different entrance ramp configurations, an auxiliary lane/peak use shoulder between SR 500 and Mill Plain Boulevard, a peak use shoulder across the Glenn Jackson Bridge with different exit ramp lane configurations, and ramp meters.

4.2 Northbound I-205 Strategies

The range of proposed northbound I-205 strategies included the reconfiguration of the SR 14 exit ramp with different lane configurations and a reduction to mainline I-205, either an SR 14 flyover or braided ramp, a two-lane entrance ramp from SR 14, an auxiliary lane/peak use shoulder between Mill Plain Boulevard and SR 500, an auxiliary lane between SR 500 and NE Padden Parkway with different access configurations, and ramp meters.

4.3 Scenario Development

Figure 4-1 shows how southbound I-205 strategies were combined to develop six southbound scenarios. **Figure 4-2** displays the southbound I-205 scenarios on a graphic showing the I-205 southbound configurations and the changes that each southbound scenario proposes to make to a specific location and lane configuration. **Figure 4-3** shows how northbound I-205 strategies were combined to develop

six northbound scenarios. **Figure 4-4** displays the northbound I-205 scenarios on a graphic showing the I-205 northbound configuration and the changes that each northbound scenario proposes to make to a specific location and lane configuration.

These scenarios were developed to analyze different combinations of solutions to determine which strategies should be implemented in the short term. More information on the development of the strategies and scenario development is summarized in **Appendix C**, VEHOPS I-205 Strategies and Scenario Development Summary Memo.

Figure 4-1
SOUTHBOUND I-205 STRATEGIES AND SCENARIOS

WSDOT

Strategy ID	Strategy Name	Strategy Description	No Build	No Build+ Padden	Scenario					
					1	2	3	4	5	6
Southbound I-205										
S-1A	Padden Aux	Construct auxiliary lane from EB Padden Pkwy entrance ramp to SR 500 exit ramp. WB Padden Pkwy entrance ramp will continue to merge as it does currently into existing I-205 2-lane mainline freeway.		X		X				
S-1B		Construct auxiliary lane from WB Padden Pkwy entrance ramp to SR 500 exit ramp. EB Padden Pkwy entrance ramp merges into I-205 3-lane mainline freeway.			X			X		X
S-1C		Construct auxiliary lane from WB Padden Pkwy entrance ramp to SR 500 exit ramp. Both Padden Pkwy ramps will combine into a CD Ramp system before accessing southbound I-205 and enter as one single access point.					X		X	
S-2	Mill Plain Aux	Construct auxiliary lane or use shoulder during peak period from SR 500 entrance ramp to Mill Plain exit ramp. SR 500 entrance ramp will add 2 lanes to Southbound I-205. SR 500 WB to SB enters I-205 as lane 3 and SR 500 EB to SB enters I-205 as lane 4. The Mill Plain exit ramp remains as a single lane exit ramp.					X		X	X
S-3	18th Off	Construct southbound 18th Street exit ramp								
S-4A	5-lane Bridge	Use shoulder during peak periods from SR 14 entrance ramp to Airport Way exit ramp. SR 14 adds 2 lanes to Southbound I-205 at the entrance ramp and 2 lanes exit at Airport Way exit ramp leaving 3 I-205 mainline lanes. (5-3-2 diverge lane balance)					X			
S-4B		Use shoulder during peak periods from SR 14 entrance ramp to Airport Way exit ramp. SR 14 adds 2 lanes to Southbound I-205 at the entrance ramp and 3 lanes exit at Airport Way exit ramp (2 lanes plus a choice lane) leaving 3 I-205 mainline lanes. (5-3-3 diverge lane balance)						X		
S-4C		Use shoulder during peak periods from SR 14 entrance ramp to Airport Way exit ramp. SR 14 adds 2 lanes to Southbound I-205 at the entrance ramp and 2 lanes exit at Airport Way exit ramp (1 lane plus a choice lane) leaving 4 Southbound I-205 mainline lanes south of Airport Way exit ramp. (5-2-4 diverge lane balance). South of Airport Way exit southbound I-205 will have 4 lanes that will taper to 3 lanes before Airport Way entrance ramps.								X
S-5	Ramp Meters	Construct Ramp meters on Southbound I-205 at: EB and WB Padden Pkwy entrance ramps EB and WB SR 500 entrance ramps NE 18th Street entrance ramp EB and WB Mill Plain entrance ramps			X	X	X	X	X	X

Figure 4-2

SOUTHBOUND I-205 SCENARIO DIAGRAMS

WSDOT

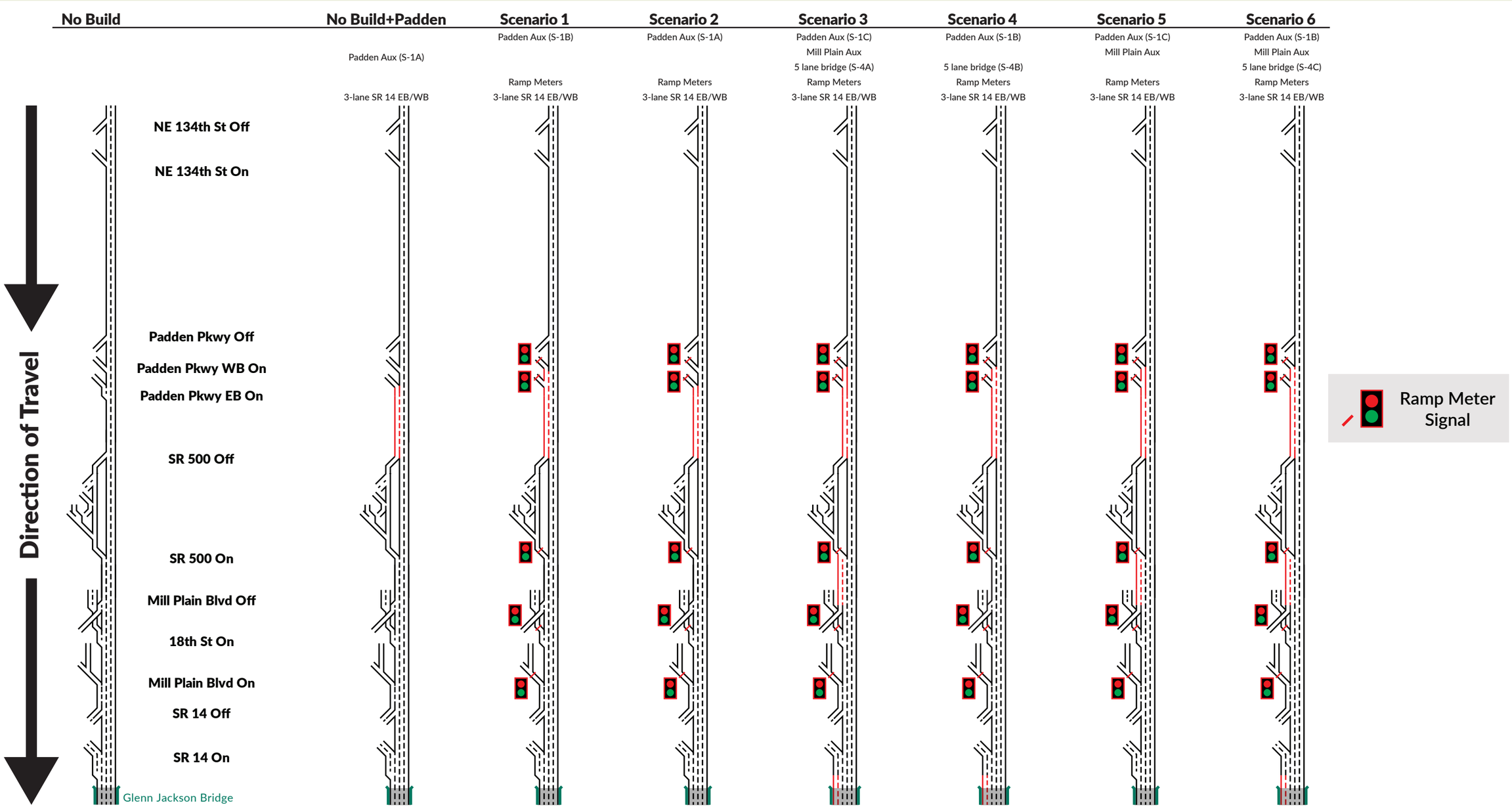

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Figure 4-3
NORTHBOUND I-205 STRATEGIES AND SCENARIOS

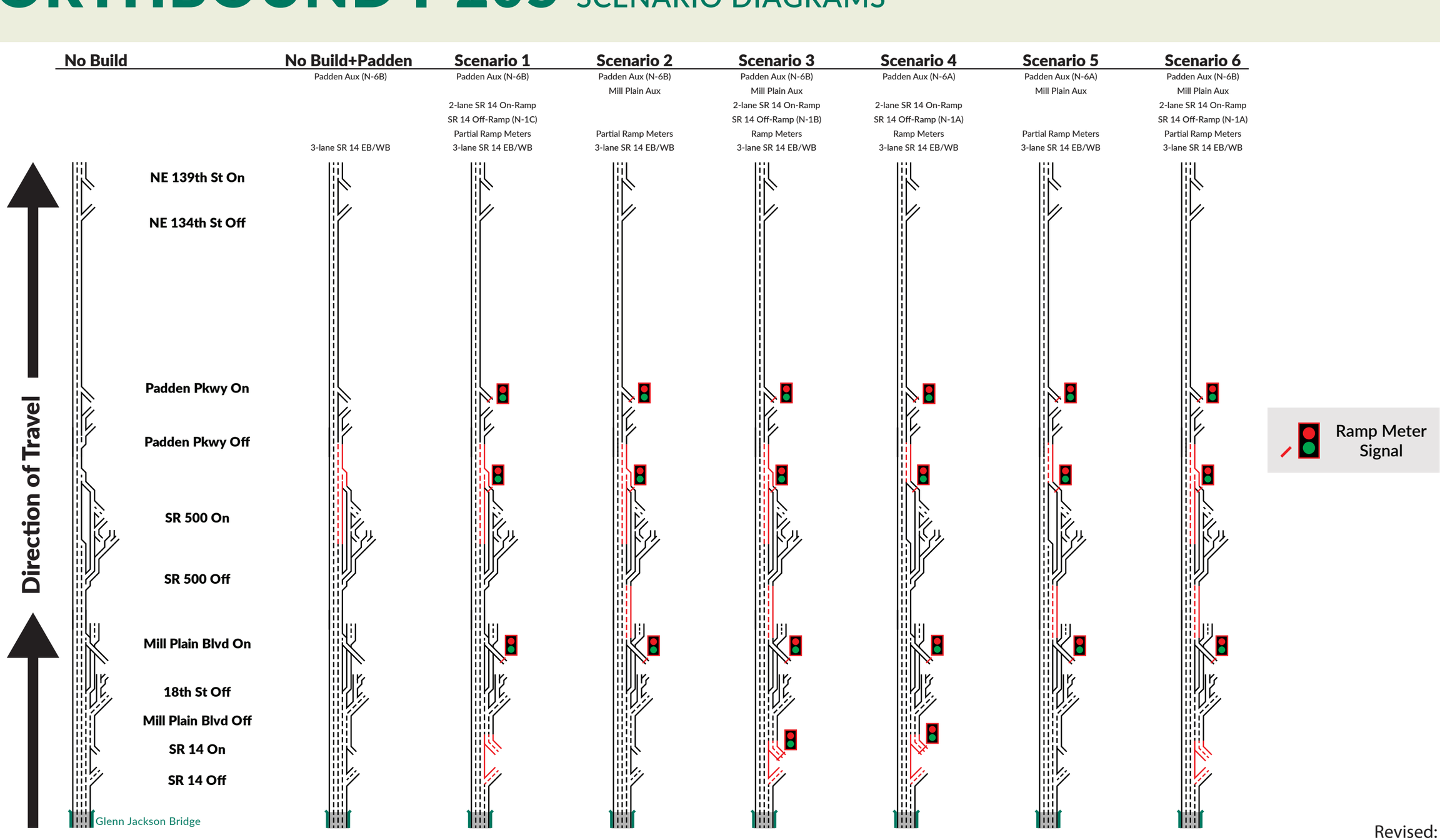
WSDOT

Strategy ID	Strategy Name	Strategy Description	No Build	No Build+ Padden	Scenario					
					1	2	3	4	5	6
Northbound I-205										
N-1A	SR 14 Off-ramp	Restripe the I-205 northbound exit ramp to SR 14 as a drop lane plus an option lane, and remove one mainline lane between the SR 14 exit ramp and SR 14 entrance ramp (reduces mainline from four to three lanes). No change to northbound SR 14 exit ramp split.						X		X
N-1B		Restripe the I-205 northbound exit ramp to SR 14 as a drop lane plus an option lane, and remove one mainline lane between the SR 14 exit ramp and SR 14 entrance ramp (reduces mainline from four to three lanes). The SR 14 exit ramp will be modified to allow 2 lanes to head eastbound towards SR 14 and the SB I-205 to EB SR 14 ramp will be ramp metered so the southbound bridge over SR 14 doesn't need to be widened to 3 lanes. Traffic destined to WB SR 14 will diverge to the westbound cloverleaf interchange instead of being a drop lane as it is today.					X			
N-1C		Restripe the I-205 northbound exit ramp to SR 14 as a drop lane plus an option lane, and remove one mainline lane between the SR 14 exit ramp and SR 14 entrance ramp (reduces mainline from four to three lanes). The SR 14 exit ramp will be modified to allow 2 lanes to head eastbound towards SR 14. Combining this to the SB I-205 to EB SR 14 ramp results in 3 lanes over the southbound bridge over SR 14 which will require widening. Traffic destined to WB SR 14 will diverge to the westbound cloverleaf interchange instead of being a drop lane as it is today.			X					
N-2A	SR 14 Off-ramp	Construct a flyover ramp from northbound I-205 to westbound SR 14. The flyover ramp would include a two-lane exit from northbound I-205 with the flyover ramp diverging from the left (outside) lane going over I-205 and merging with the ramp form southbound I-205 before merging onto westbound SR 14.	Strategy N-2 will be evaluated separately to assess operations on SR 14 westbound only.							
N-2B		Braid the existing northbound I-205 to westbound SR 14 loop ramp with the westbound SR 14 CD road to remove the weaving section on the CD road.								
N-3	2-lane SR 14 On-ramp	Restripe the SR 14 entrance ramp to I-205 northbound from a 1-lane entrance ramp to a 2-lane entrance ramp. The 3-lane mainline I-205 section and 2-lane SR 14 entrance ramp would tie into the existing 5-lane section of I-205 north of the SR 14 entrance ramp.			X		X	X		X
N-4	Mill Plain Aux	Construct auxiliary lane or use shoulder during peak periods from Mill Plain entrance ramp to SR 500 exit ramp.				X	X		X	X
N-5	18th On	Construct northbound 18th Street entrance ramp.								
N-6A	Padden Aux	Construct auxiliary lane from SR 500 entrance ramp to Padden Pkwy exit ramp. I-205 mainline will continue to merge to 2 lanes just before the SR 500 entrance ramp, as it does currently.						X	X	
N-6B		Extend the third lane on I-205 mainline from the existing merge, south of the SR 500 entrance. The SR 500 entrance ramp will merge as it does currently into the third lane of the I-205 mainline. The third lane drops off at the Padden exit ramp.		X	X	X	X			X
N-7A	Ramp Meters	Construct Ramp meters on Northbound I-205 at: SR 14 EB and WB entrance ramps Mill Plain entrance ramps EB and WB SR 500 entrance ramps Padden Pkwy entrance ramp					X	X		
N-7B		Construct Ramp meters on Northbound I-205 at: Mill Plain entrance ramps EB and WB SR 500 entrance ramps Padden Pkwy entrance ramp			X	X			X	X

Figure 4-4

NORTHBOUND I-205 SCENARIO DIAGRAMS

WSDOT



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5. Build Conditions

The proposed scenarios were analyzed using the VISSIM simulation models to see how the different combination of strategies operated. The proposed scenarios do not create any new access points or otherwise modify the network in a manner that would change traffic patterns or volumes compared to the year 2035 No Build volumes and therefore were consistent with the No Build Conditions analysis.

For a detailed discussion on the traffic operations of the different scenarios, including travel times and hours of congestion, see **Appendix D**, VEHOPS I-205 Build Conditions Summary Memo.

5.1 Southbound AM Peak Period

All the scenarios include the auxiliary lane between Padden Parkway and SR 500 (Strategy S-1), which eliminates the bottleneck at the Padden Parkway merge and substantially reduces the congestion north of Padden Parkway.

Scenarios 3, 4, and 6 include a peak use shoulder across the Glenn Jackson Bridge (Strategy S-4), which eliminates congestion spilling back from the bridge. Congestion persists through the weaving section between the Mill Plain entrance ramp and the SR 14 exit ramp; however, it only spills back as far as the SR 500 interchange and lasts less than 3 hours.

Scenarios 1 and 2 do not include the peak use shoulder across the Glenn Jackson Bridge (Strategy S-4); therefore, congestion between SR 500 and the Glenn Jackson Bridge is slightly worse compared to the No Build Scenario because more traffic is being added to the back of the congestion spilling back from the Glenn Jackson Bridge due to the addition of the auxiliary lane between Padden Parkway and SR 500.

Scenario 5 is similar to Scenarios 1 and 2; however, it includes the added auxiliary lane between SR 500 and Mill Plain (Strategy S-2), which allows more traffic from SR 500 to access mainline I-205, adding more traffic to the congestion spilling back from the Glenn Jackson Bridge. Congestion across the Glenn Jackson Bridge still lasts for more than 3 hours, similar to the No Build Scenario; however, it extends beyond the SR 500 interchange in Scenarios 1 and 2. Congestion in Scenario 5 extends back to the Padden Parkway interchange.

Key Findings:

- Providing an auxiliary lane between Padden Parkway and SR 500 (Strategy S-1), along with providing the peak use shoulder across the Glenn Jackson Bridge (Strategy S-4) and adding ramp metering (Strategy S-5) together result in the fastest travel times on the corridor.
- Providing an auxiliary lane between SR 500 and Mill Plain (Strategy S-2) helps with SR 500 merging maneuvers but the benefit to the full corridor is limited without the inclusion of the peak use shoulder across the Glenn Jackson Bridge (Strategy S-4).

5.2 Southbound PM Peak Period

All the scenarios include the auxiliary lane between Padden Parkway and SR 500 (Strategy S-1), which eliminates most of the congestion between Padden Parkway and I-5. Some congestion remains at the 134th Street on-ramp, but no improvements were considered at the 134th Street interchange as it is outside the

scope of this study. Congestion on the corridor (south of the 134th Street interchange) is minor with all scenarios except **Scenario 3**.

Scenario 3 has congestion from I-5 to SR 14 because the exit ramp from I-205 southbound to SR 14 eastbound is ramp metered (to accommodate Strategy N-1B) and the ramp meter is over capacity, causing a queue to spill back onto the I-205 southbound mainline.

All scenarios also include a third lane on SR 14 eastbound, which reduces the backup from SR 14 onto the I-205 mainline and improves congestion on SR 500 and SR 14.

Key Findings:

- Providing an auxiliary lane between Padden Parkway and SR 500 (Strategy S-1) is beneficial in the PM peak period as well as the AM peak period.
- The ramp meter from I-205 southbound to SR 14 eastbound in Strategy N-1B has a negative impact on southbound I-205 travel times through multiple segments.

5.3 Northbound AM Peak Period

All scenarios have minor congestion near the Padden Parkway entrance ramp as a result of traffic congestion spilling back from the limited-capacity two-lane section north of the Padden Parkway entrance ramp. This congestion generally occurs for up to 2 hours, from 7:00 AM to 9:00 AM.

Key Findings:

- Providing an auxiliary lane between SR 500 and Padden Parkway (Strategy N-6) has benefits, although these are limited during the AM peak period.

5.4 Northbound PM Peak Period

Scenario 1 includes providing a two-lane SR 14 exit ramp (Strategy N-1) and a two-lane SR 14 entrance ramp (Strategy N-3), which allows more volume onto the I-205 mainline and increases congestion on the mainline between the Glenn Jackson Bridge and SR 500.

Scenarios 3, 4, and 6 also provide the two-lane SR 14 exit ramp (Strategy N-1) and two-lane SR 14 entrance ramp (Strategy N-3), but the ramp is either ramp metered (Strategy N-7) in Scenario 4, or an auxiliary lane is provided between Mill Plain and SR 500 (Strategy N-4) in Scenario 6, or both the ramp meter (Strategy N-7) and auxiliary lane (Strategy N-4) are provided in Scenario 3. These additional improvements (ramp meters or auxiliary lane between Mill Plain and SR 500) limit the negative downstream effect of the two-lane SR 14 entrance ramp compared to Scenario 1; however, congestion still occurs north of the Padden Parkway interchange where the I-205 mainline consists of two lanes.

Scenarios 2 and 5 do not have congestion north of the Padden Parkway interchange, but the reason for this is that they do not include the changes to the SR 14 exit ramp (Strategy N-1) or the two-lane entrance ramp at SR 14 (Strategy N-3), which limit the throughput at the SR 14 entrance ramp. While Scenarios 2 and 5 improve conditions on the I-205 mainline, they result in substantial congestion on SR 14.

Key Findings:

- Providing an auxiliary lane between SR 500 and Padden Parkway (Strategy N-6) has substantial benefits during the PM peak period.
- Providing the two-lane exit ramp at SR 14 (Strategy N-1), combined with the two-lane SR 14 entrance ramp (Strategy N-3) with either ramp meters (Strategy N-7) or the auxiliary lane between Mill Plain and SR 500 (Strategy N-4), reduces congestion on SR 14 without negative impacts to the I-205 mainline.

6. Recommended Scenarios

Based on the results from the scenarios analyzed, the proposed strategies were divided into three categories: a list of recommended strategies that would help alleviate bottleneck locations immediately in the AM and PM peak periods, a list of potential viable strategies for further consideration, and a list of strategies that were evaluated but are not recommended for further consideration. Cost estimate information is summarized for each strategy, and more information on cost estimates, including assumptions, is summarized in **Appendix E**, VEHOPS I-205 Strategy Cost Estimates.

6.1 Recommended Strategies

The following strategies are recommended and prioritized as solutions that would help alleviate bottleneck locations along the I-205 corridor.

6.1.1 Southbound I-205 Strategies

- ***Padden Parkway Auxiliary Lane Strategy S-1B*** would construct an auxiliary lane from the westbound NE Padden Parkway entrance ramp to the SR 500 exit ramp. The eastbound NE Padden Parkway entrance ramp merges into the I-205 three-lane mainline freeway. Strategy S-1B was recommended over Strategy S-1A as the capacity enhancement would occur in advance of the volume entering from both NE Padden Parkway entrance ramps, helping limit the mainline capacity issue shown in the No Build analysis at the NE Padden Parkway entrance ramps. Adding the auxiliary lane from the westbound NE Padden Parkway entrance ramp (Strategy S-1B) would not require additional right-of-way under the NE Padden Parkway overcrossing, resulting in a cost similar to that of Strategy S-1A while improving mainline and ramp operations. Therefore, this is the recommended strategy for NE Padden Parkway entrance ramp. The cost range for this strategy is $9,000,000-$18,000,000.
- ***Glenn Jackson Bridge Peak Use Shoulder Strategy S-4A*** would reconfigure the existing Glenn Jackson Bridge to include the use of the shoulder from the SR 14 entrance ramp to the Airport Way exit ramp during peak periods. SR 14 adds two lanes to southbound I-205 at the entrance ramp, and two lanes exit at the Airport Way exit ramp, leaving three mainline lanes on I-205. While Strategy S-4A is recommended, any of the three strategies (S-4A, S-4B, or S-4C) for the Airport Way exit ramp could be chosen. More in-depth analysis is recommended, as downstream congestion outside of the VEHOPS study area does impact the Airport Way exit ramp and therefore the exit ramp was not calibrated to the same extent as the SR 14 to Padden Parkway section of I-205. The cost range for this strategy is $1,400,000-$2,900,000.
- ***Ramp Meters Strategy S-5*** would construct ramp meters along the southbound I-205 entrance ramps at eastbound and westbound NE Padden Parkway, eastbound and westbound SR 500, NE 18th Street, and eastbound and westbound Mill Plain Boulevard. The cost range for this strategy is $1,500,000-$3,000,000.

Figure 6-1 summarizes the recommended Southbound I-205 Strategies, including a summary of the current issues, a diagram of the existing and proposed corridor configuration, operational analysis including congestion and travel times, a planning level cost estimate range, and a summary of the key benefits.

6.1.2 Northbound I-205 Strategies

- ***SR 14 Off-ramp Strategy N-1A*** would restripe the SR 14 exit ramp to a two-lane off-ramp with a drop lane plus a choice lane. The strategy would also remove one mainline lane between the SR 14 exit ramp and SR 14 entrance ramp, which would reduce the northbound I-205 mainline from four lanes to three lanes between the SR 14 exit and entrance ramps. This strategy would not require changes to the northbound SR 14 exit ramp diverge or merge with the southbound I-205 to eastbound SR 14 ramp. It does require all of the northbound I-205 traffic destined for eastbound or westbound SR 14 to line up in advance and complete all weaving maneuvers within the current footprint before the diverge to each individual ramp. The cost range for this strategy is $1,800,000-$3,600,000.
- ***Two-Lane SR 14 On-ramp Strategy N-3*** builds upon Strategy N-1A and can only be implemented as an addition to it. By utilizing the reduction of northbound I-205 to three through lanes, this strategy would restripe the existing single-lane SR 14 entrance ramp from one lane to a two-lane entrance ramp which, combined with the three-lane mainline, would utilize the existing five-lane northbound I-205 mainline section north of the SR 14 entrance ramp. The cost range for this strategy is $300,000-$600,000.
- ***Padden Parkway Auxiliary Lane Strategy N-6A*** would construct an auxiliary lane between the SR 500 entrance ramp and the NE Padden Parkway exit ramp. Northbound I-205 would continue to merge from three lanes down to two mainline lanes just south of the SR 500 entrance ramp, as it does currently. The cost range for this strategy is $5,000,000-$11,000,000.
- ***Ramp Meter Strategy N-7A*** would construct ramp meters along northbound I-205 entrance ramps at eastbound and westbound SR 14, eastbound and westbound Mill Plain Boulevard, eastbound and westbound SR 500, and NE Padden Parkway. The cost range for this strategy is $900,000-$1,800,000.

Figure 6-2 summarizes the recommended Southbound I-205 Strategies including a summary of the current issues; a diagram of the existing and proposed corridor configuration; operational analysis comparing the future conditions with and without the proposed strategies, including congestion and travel times; a planning level cost estimate range; and a summary of the key benefits.

6.2 Strategies Still Viable but Not Selected

The following strategies have been identified as viable potential solutions that would help improve I-205 operations, but they were not selected because the recommended strategies provide a better value. These strategies could be implemented, but only after the recommended strategies have been implemented along I-205.

6.2.1 Southbound I-205 Strategy

- ***Mill Plain Auxiliary Lane Strategy S-2*** would construct an auxiliary lane or use the shoulder between the SR 500 entrance ramp and the Mill Plain Boulevard exit ramp during peak periods. The SR 500 entrance ramp would add two lanes to the southbound I-205 mainline, resulting in a four-lane southbound freeway. The Mill Plain Boulevard exit ramp would remain a single lane. The cost range for this strategy is $5,000,000-$9,000,000.

6.2.2 Northbound I-205 Strategy

- ***Mill Plain Auxiliary Lane Strategy N-4*** would construct an auxiliary lane or use the shoulder between the Mill Plain Boulevard entrance ramp and the SR 500 exit ramp during peak periods. The cost range for this strategy is $6,000,000-$12,000,000.

6.3 Strategies Evaluated but Not Recommended for Further Consideration

The following strategies were evaluated but are not recommended for further consideration due to operational issues or cost.

6.3.1 Southbound I-205 Strategy

- ***Padden Parkway Auxiliary Lane Strategies S-1A and S-1C*** – Padden Parkway entrance ramp configurations were eliminated from further considerations due to operational issues. Strategy S-1A would operate acceptably at the eastbound Padden Parkway entrance ramp but the westbound Padden Parkway entrance ramp would enter into the two-lane I-205 southbound mainline, resulting in congested conditions. In Strategy S-1C, both entrance ramps from Padden Parkway would form a collector-distributor (CD) ramp system before accessing southbound I-205, which would result in backups and congestion on the CD system that spill onto the local system.
- ***18th Street Exit Ramp Strategy S-3*** – Screened out due to feasibility, cost, and corridor volume redistribution, and because it would be a long-term solution outside the timeframe being considered for this study.

6.3.2 Northbound I-205 Strategy

- ***SR 14 Off-ramp Strategies N-1B and N-1C*** – SR 14 exit ramp configurations were eliminated from further consideration due to operational issues forecast under Strategy N-1B and cost issues of rebuilding the bridge over SR 14 in Strategy N-1C.
- ***SR 14 Flyover or Braided Ramp Strategy N-2*** – To realize the full benefits, Strategy N-2 would need to be paired with Strategy S-1 and include a two-lane loop ramp from SR 14 westbound to I-205 southbound, which is outside the scope and budget of the planned widening project on SR 14.
- ***18th Street Entrance Ramp Strategy N-5*** – Screened out due to feasibility, cost, and volume redistribution, and because it would be a long-term solution outside the timeframe being considered for this study.
- ***Padden Parkway Auxiliary Lane Strategy N-6B*** – Operated similarly to Strategy N-6A but with a greater cost; therefore, this strategy was not recommended for further consideration.
- ***Ramp Meter Strategy N-7B*** – Not including the SR 14 ramp meters results in more congestion on I-205 northbound when combined with other strategies.

Figure 6-1

I-205 SOUTHBOUND CORRIDOR SR-14 to NE Padden Pkwy

Vancouver Eastside Highway Operations Study

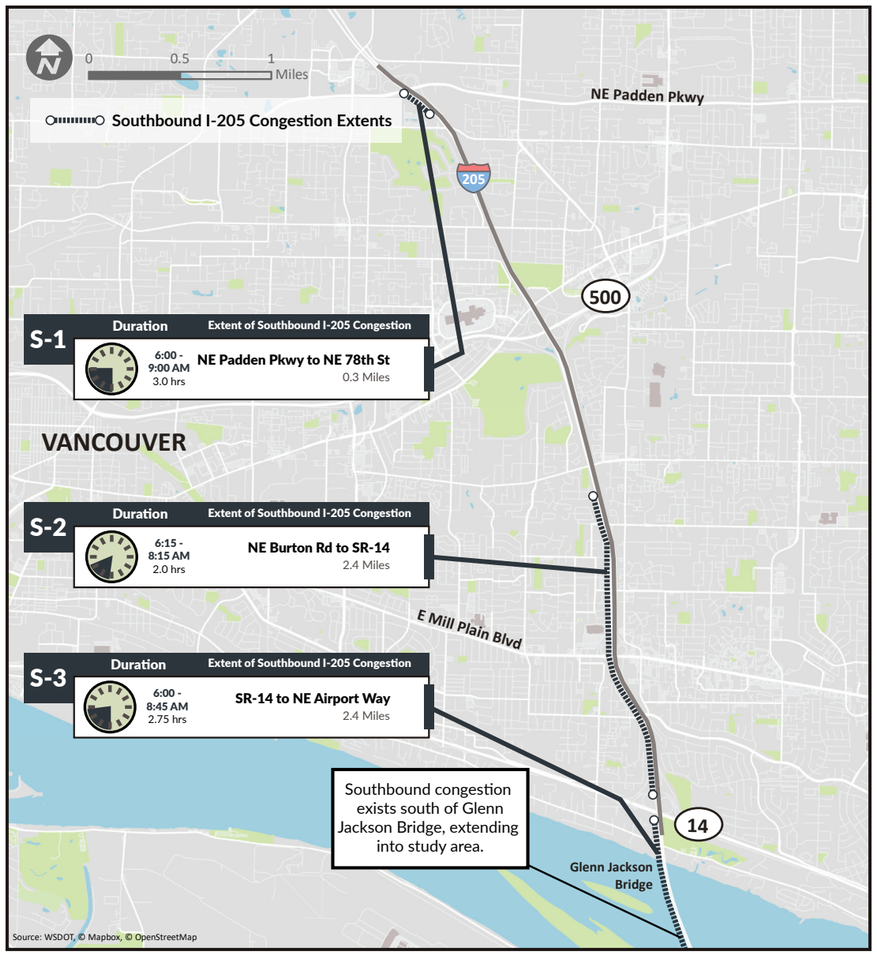
Purpose and Need

Over the last 20 years, I-205 has been identified as an important high-growth corridor. Current traffic volumes on I-205 exceed the carrying capacity of the corridor. These capacity deficiencies result in mobility and safety limitations and congested and unreliable traffic flow.

Existing Corridor Issues

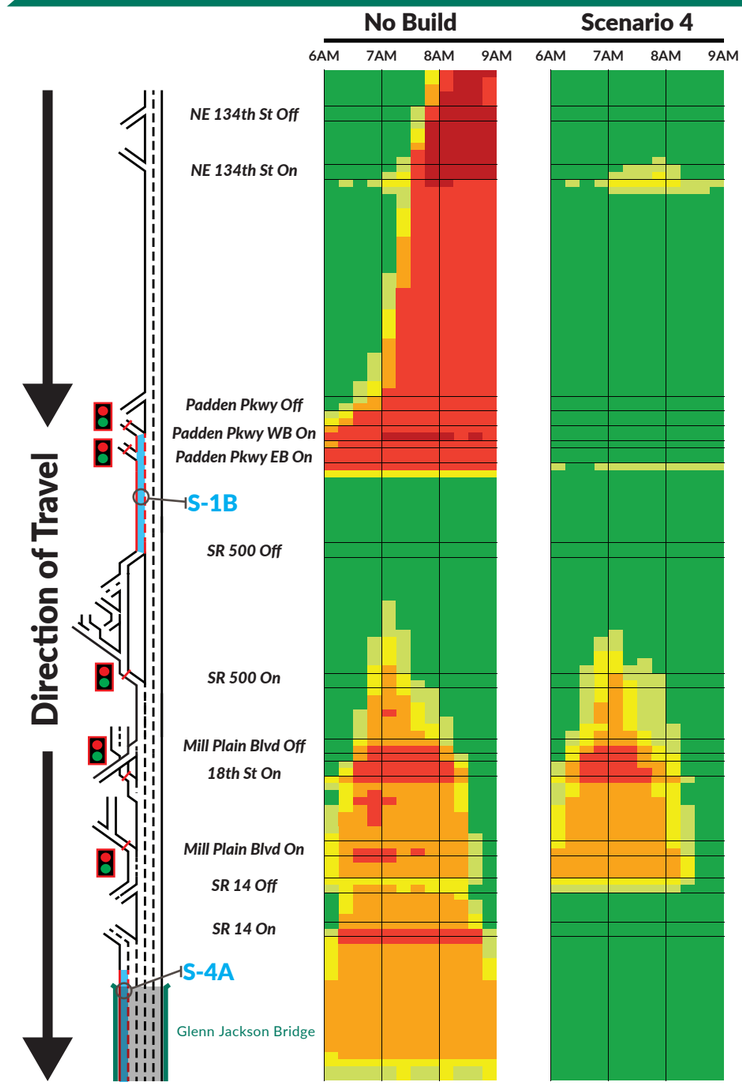
Southbound congestion is present during both peak commute periods but is more heavily congested in the AM peak period. Three southbound bottlenecks exist at the following locations:

- Between NE Padden Parkway and SR 500
- Between SR 500 and SR 14
- Between SR 14 and north of Airport Way



Date: 11/20/2018 Author: TownSky Path: U:\PDX\Projects\Clients\3012-DEA\274-3012-029 Y1\1940 VEH\OPS\905\cad\GIS\Mapdoc\Crashes_Template_v3.mxd

No Build & Proposed Scenario Operations



No Build Configuration
Proposed Auxiliary Lane
Proposed Ramp Meter

Speed (Miles per hour)
0 10 20 30 40 50 60

I-205 Corridor Total Southbound Travel Time (min)

	No Build	Scenario 4
I-5 to Airport Way exit ramp	30.0	16.3

Recommended Bottleneck Strategies

The following strategies are recommended for the southbound I-205 corridor which would help alleviate the bottlenecks:

- ***Strategy S-1B*** would construct an auxiliary lane from westbound NE Padden Parkway entrance ramp to the SR 500 exit ramp. Eastbound NE Padden Parkway entrance ramp merges into the I-205 three-lane mainline freeway.

- ***Strategy S-4A*** would reconfigure the existing Glenn Jackson Bridge to have five mainline lanes across the bridge by permitting the use of the shoulder from the SR 14 entrance ramp to the Airport Way exit ramp during peak periods. SR 14 adds two lanes to southbound I-205 at the entrance ramp and two lanes exit at Airport Way exit ramp leaving three I-205 mainline lanes. (Diverge lane balance: 5-3-2).

Note: The Airport Way exit ramp configuration was outside the study area and an in-depth analysis was not performed. Three configurations of the exit ramp have been identified at the Airport Way Interchange and further analysis is recommended.

- ***Strategy S-5*** would construct ramp meters on southbound I-205 entrance ramps at the eastbound and westbound NE Padden Parkway, eastbound and westbound SR 500, NE 18th Street, and eastbound and westbound Mill Plain Boulevard.

Cost Estimate

Strategy S-1B: $ 9.0 to 18.0 Million
Strategy S-4A: $ 1.4 to 2.9 Million
Strategy S-5: $ 1.5 to 3.0 Million

Total: $ 11.9 to 23.9 Million

Findings

The construction of the Padden Parkway auxiliary lane and the use of the shoulder across the Glenn Jackson Bridge during peak periods is expected to improve mobility operations along the I-205 southbound corridor due to a reduced amount of weaving maneuvers and additional time and distance for vehicles to make a decision. The addition of ramp meters on the entrance ramps help to bring vehicles on the freeway consistently and more evenly spaced, which improves merging operations. With these three recommended solutions, the total travel will improve by almost 15 minutes compared to the No Build.

Revised: 06/28/19

Figure 6-2

I-205 NORTHBOUND CORRIDOR SR-14 to NE Padden Pkwy

Vancouver Eastside Highway Operations Study

Purpose and Need

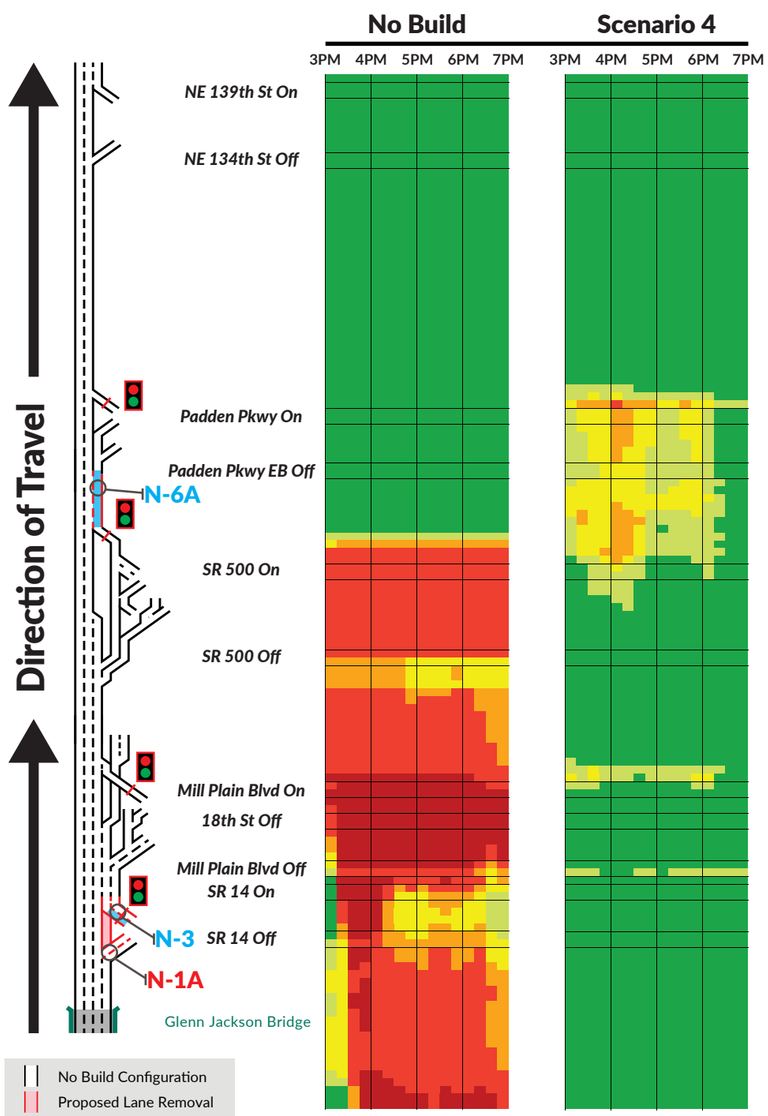
Over the last 20 years, I-205 has been identified as an important high-growth corridor. Current traffic volumes on I-205 exceed the carrying capacity of the corridor. These capacity deficiencies result in mobility and safety limitations and congested and unreliable traffic flow.

Existing Corridor Issues

Northbound congestion is present during both peak commute periods but is more heavily congested in the PM peak period. Three northbound bottlenecks exist at the following locations:

- Between Airport Way and SR 14
- Between Mill Plain Boulevard and SR 500
- Between SR 500 and NE Padden Parkway

No Build & Proposed Strategy Operations



I-205 Corridor Total Northbound Travel Time (min)		
	No Build	Scenario 4
Airport Way entrance ramp to I-5	42.5	15.0

Recommended Bottleneck Strategies

The following strategies are recommended for the northbound I-205 corridor which would help alleviate the bottlenecks:

- ***Strategy N-1A*** would restripe the SR 14 exit ramp to a two-lane off-ramp with a drop lane plus a choice lane. This concept would remove one mainline lane between SR 14 exit ramp and SR 14 entrance ramp, which would reduce the northbound I-205 mainline from four lanes to three lanes.

  Note: No change would be made to the northbound SR 14 exit ramp diverge or merge with the southbound to eastbound SR 14 entrance ramp. This concept requires all of the northbound I-205 traffic destined for eastbound or westbound SR 14 to line up in advance and complete all weaving maneuvers within the current footprint before the diverge to each individual ramp.

- ***Strategy N-3*** uses the reduction of northbound I-205 from four lanes to three lanes between the SR 14 exit and entrance ramps in Strategy N-1A to provide a two-lane entrance ramp from SR 14 onto the existing five-lane section of I-205. This strategy requires Strategy N-1A.

- ***Strategy N-6A*** would construct an auxiliary lane between SR 500 entrance ramp and the NE Padden Parkway exit ramp. Northbound I-205 would continue to merge down to two mainline lanes just south of the SR 500 entrance ramp, as it does currently.

- ***Strategy N-7A*** would construct ramp meters on northbound I-205 entrance ramps at the eastbound and westbound SR 14, eastbound and westbound Mill Plain Boulevard, eastbound and westbound SR 500, and NE Padden Parkway.

Cost Estimate

Strategy N-1A: $ 1.8 to 3.6 Million
Strategy N-3: $ 0.3 to 0.6 Million
Strategy N-6A: $ 5.0 to 11.0 Million
Strategy N-7A: $ 0.9 to 1.8 Million

Total: $ 8.0 to 17.0 Million

Findings

The restriping of the SR 14 exit and entrance ramp and removal of one mainline lane between these ramps, and construction of the Padden Parkway auxiliary lane is expected to improve mobility operations along the I-205 northbound corridor due to a reduced amount of weaving maneuvers and additional time and distance for vehicles to make a decision. The addition of ramp meters on the entrance ramps help to bring vehicles on the freeway consistently and more evenly spaced, which improves merging operations. With these four recommended solutions, the total travel will improve by more than 25 minutes compared to the No Build.

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