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TECHNICAL MEMORANDUM 3

Date:	November 10, 2008
To:	George Kovich, WSDOT Project Manager Randy Wessleman, City of Olympia Project Manager
From:	Peter Chen
Subject:	West Olympia Access Study – Traffic Operations Analysis Technical Memorandum 3
cc:	James Colyar, PE, FHWA Doug McClannahan, PE, WSDOT Headquarters John Perlic, PE, Parametrix
Project Number:	554-1631-062 (03/04)
Project Name:	West Olympia Access Study

EXECUTIVE SUMMARY

Need for Improvements

During the last 5 to 10 years, observed congestion along United States route 101 (US 101) and at local intersections in the West Olympia vicinity has resulted in the need to study the area and identify potential operating deficiencies. With the aid of the Thurston Regional Planning Council (TRPC) and the cities of Olympia and Tumwater, existing and future traffic conditions were modeled and the conclusions of that study confirmed operational challenges along the US 101 corridor and the local transportation system in West Olympia (see Technical Memorandum 2, Parametrix 2008).

Short weave sections, frequent lane change maneuvers, and steep grades in some areas currently cause congestion along US 101 in the West Olympia vicinity during peak periods. Substantial traffic volume increases on US 101 and Interstate 5 (I-5) are expected to worsen poor operating conditions in the year 2030. In 2030, 14 sections of US 101 and I-5 are expected to experience heavy traffic congestion and unacceptable level of service (LOS) E and LOS F conditions.

In addition to US 101 and I-5 mainline challenges, the local transportation systems in West Olympia and Tumwater are also forecasted to substantially degrade and experience long delays and queues in the year 2030. Of particular concern are the Black Lake Boulevard Single Point Urban Interchange (SPUI), Black Lake Boulevard SW/Cooper Point Road SW intersection, and the Cooper Point Road SW/Top Foods Driveway intersection. The traffic demand at these locations is estimated to substantially exceed capacity and the resulting queues are expected to create bottleneck traffic congestion along eastbound US 101 from the Black Lake off-ramp to west of the Evergreen Parkway interchange.

The high level of interdependency between the freeway and local transportation systems pointed to a need to study improvements to US 101 and local intersections in the cities of Olympia and Tumwater. Without

improvements, connectivity between regional activity centers would substantially degrade, congestion could become a detriment to local economic activities, and collision rates and severity would likely increase.

Screening Process

The screening process is documented in Technical Memorandum 1—Evaluation and Screening Methods. The first step of the screening process included reviewing suggestions during Phase I of the public involvement effort and conducting a fatal flaw analysis. The purpose of this analysis was to eliminate the options that did not meet the objectives of the study. It was concluded that no new interchange could be considered due to spacing issues between existing interchanges on US 101 as defined by the WSDOT Design Manual.

The options that remained after the fatal flaw analysis were included in the initial screening process. The purpose of this screening was to eliminate scenarios that were not found to merit further consideration because they do not address the study goals. Options were evaluated based on planning level estimates, qualitative technical review and other available information. The initial screening was conducted at a broad, non-quantitative level to rate each option from most impacts (worst) to least impacts (best).

Based on the preliminary screening process, options that were selected for further consideration were packaged into scenarios to assess their effectiveness as a system. A more detailed traffic evaluation of the scenarios was conducted in the second screening process, which this technical memorandum documents. This analysis focused on reviewing traffic changes and identifying whether the scenarios would relieve traffic congestion at failing intersections and congested freeway locations.

Improvement Scenarios

The result of the screening process effort eliminated potential improvement options with fatal flaws and identified a set of reasonable scenarios to be carried forward for further consideration.

Scenarios carried forward for additional analysis originally included the full range of improvements that would be required to meet applicable standards according to the traditional one-hour LOS analysis methodology. This approach maximized additional intersection improvements to the fullest extent and was most applicable to the Local System Only Scenarios (Scenario 2 and 3). A few of these improvements were later identified by the City of Olympia as infeasible and conflicted with adopted City policies to promote and encourage transit, pedestrian, and bicycle travel. Intersection safety for all travelers is the primary concern behind the identification and removal of these infeasible intersection widening improvements. Listed below are mores specific reasons some of the original improvements were deemed infeasible and removed from further consideration in the scenario analysis:

- Non-motorized crossings are the primary concern associated with intersection widening. The higher number of turn lanes added translates to a less pedestrian-friendly environment by lengthening crosswalks and requiring bicyclists to compete with more vehicle travel lanes at intersections.
- All intersections identified as needing expansion are served by Intercity Transit routes with the exception of the Mud Bay Road/Evergreen Parkway intersection. This suggests that the vast majority of intersections serve transit riders that need to safely and conveniently cross these intersections.
- Two-thirds of the affected intersections are located on established high-density corridors where special consideration of urban form and a pedestrian-friendly environment are crucial to achieving City and regional multi-modal objectives. Substantial increases to intersection crossings undermine the transportation and land use objectives for these corridors.

- Increased pedestrian crossing times would be needed to accommodate longer crossings, which would increase friction for opposing traffic.
- The number of conflict points increases with the addition of intersection turn lanes, increasing the potential for vehicle-to-vehicle collisions as well as vehicle-to-pedestrian/bicyclist collisions.

Additional detail on the justifications for removing some of the original intersection improvements is provided in Attachment A. The remaining improvements identified for each scenario were based on the traditional one-hour LOS analysis.

Local System Only (Scenarios 2 and 3)

These scenarios focus on changes to the local transportation system only and do not modify highway access. The difference between Scenario 2 and Scenario 3 is the inclusion of street connections between existing roadway facilities in the southwest residential area of West Olympia. These connections, collectively referred to as the "Southwest Connections," include:

- Decatur Street SW connection between Caton Way SW and Decatur Street SW (a pedestrian and bicycle connection is currently provided, but vehicular access is not allowed),
- Fern Street SW connection to Carriage Loop SW, and
- 16th Avenue SW connection to Fern Street SW (removal of existing barricade).

Scenario 2 does not include the Southwest Connections and Scenario 3 does include the Southwest Connections.

Improvements listed below apply to both Scenarios 2 and 3, except where noted. Intersection improvements were based on the traditional one-hour analysis methodology and include:

- two turn lanes at the Harrison Avenue/Division Street,
- one turn lane at the Black Lake Boulevard/Cooper Point Road intersection,
- one turn lane at the Cooper Point Road/Harrison Avenue intersection,
- one turn lane at the Black Lake Boulevard/Capital Mall Drive intersection for Scenario 2 only,
- one turn lane at the Cooper Point Road/Evergreen Park Drive intersection,
- one turn lane at the Cooper Point Road/Top Foods intersection,
- one through lane for Scenarios 2 and 3, and one additional turn lane for Scenario 3 at the US 101 Westbound Ramps/Crosby Boulevard intersection,
- one turn lane and signalization at the Mud Bay Road/Evergreen Parkway Westbound Ramp intersection,
- signalization of the Mud Bay Road/Evergreen Parkway Eastbound Ramp intersection, and
- signalization at the Lakeridge Drive/Deschutes Parkway intersection for both scenarios and an additional turn lane for Scenario 2.

The number of improvements for Scenario 2 totals nine turn lanes, one through lane, and three signals. For Scenario 3, the total number of improvements consists of eight turn lanes, one through lane, and three signals. Refer to Table 12 (page 107) for a specific listing of turn lanes at each intersection.

Black Lake Interchange (Scenarios 4 and 5)

Similar to Scenarios 2 and 3, the Black Lake interchange improvement scenarios are proposed without the Southwest Connections described above (Scenario 4) and with the Southwest Connections (Scenario 5). Both Scenarios 4 and 5 also include local system improvements as described below. For Scenarios 4 and

5, the existing Black Lake interchange would be modified with an additional lane diverging from the westbound off-ramp that connects to Yauger Way SW, and another lane from Yauger Way SW would connect to the existing eastbound on-ramp prior to merging with the US 101 mainline. The exact interchange modifications have not been designed at this time; however, Scenarios 4 and 5 both rely on modifications to the existing Black Lake Boulevard interchange.

The intersection and freeway traffic operations analysis was fully completed for Scenario 5 with the Southwest Connections, but not for Scenario 4. A freeway analysis was not conducted for Scenario 4 since traffic volumes on the US 101 mainline would be similar to Scenario 5 and the small differences would result in negligible changes to mainline operations.

Intersection improvements listed below apply to Scenarios 4 and 5, except where noted. These improvements were based on the traditional one-hour analysis methodology and include:

- two turn lanes at the Harrison Avenue/Division Street intersection,
- one turn lane at the Black Lake Boulevard/Cooper Point Road intersection for Scenario 4 only,
- one turn lane at the Cooper Point Road/Harrison Avenue intersection,
- one turn lane at the Black Lake Boulevard/Capital Mall Drive intersection,
- one turn lane at the Cooper Point Road/Evergreen Park Drive intersection for Scenario 4 only,
- one through lane and one turn lane at the US 101 Westbound Ramps/Crosby Boulevard intersection for Scenario 5 only,
- signalization of the Mud Bay Road/Evergreen Parkway Westbound and Eastbound Ramp intersections, and
- signalization of the Lakeridge Drive/Deschutes Parkway intersection for both Scenarios 4 and 5 and an additional turn lane for Scenario 4.

Scenario 4 includes a total of seven turn lanes and three signals, while Scenario 5 consists of five turn lanes, one through lane, and three signals. Refer to Table 12 (page 107) for a specific listing of turn lanes at each intersection.

Evergreen Interchange (Scenarios 6 and 7)

The Evergreen improvement scenarios can also be packaged without the Southwest Connections (Scenario 6) or with the Southwest Connections (Scenario 7). Modifications to US 101 under Scenarios 6 and 7 would primarily consist of adding an eastbound off-ramp and a westbound on-ramp, which would provide full access to and from all directions of travel at the Evergreen interchange. The existing eastbound on-ramp and westbound off-ramp would also be re-aligned to provide an at-grade connection with Kaiser Road SW prior to merging/after diverging from the US 101 mainline. Both Scenarios 6 and 7 also include local system improvements as described below. Similar to Scenarios 4 and 5, more specific detail regarding modifications to the interchange have not been designed; however, both Scenario 6 and 7 provide full access at the Evergreen interchange and add modified access ramps to and from the east at Kaiser Road.

The intersection and freeway traffic operations analysis was fully completed for Scenario 7 with the southwest connections, but not for Scenario 6. Similar to Scenarios 4 and 5, the US 101 mainline traffic volumes would be similar between Scenarios 6 and 7 and the small differences would have a negligible effect on freeway mainline operations. As a result, a freeway analysis was not conducted for Scenario 6.

Intersection improvements listed below apply to both Scenarios 6 and 7, except where specifically noted. These improvements were based on the traditional one-hour analysis methodology and include:

- two turn lanes at the Harrison Avenue/Division Street intersection,
- one turn lane at the Black Lake Boulevard/Cooper Point Road intersection,
- one turn lane at the Cooper Point Road/Harrison Avenue intersection,
- one turn lane at the Cooper Point Road/Capital Mall Boulevard intersection for Scenario 6 only,
- two turn lanes for Scenario 6 and one turn lane for Scenario 7 at the Black Lake Boulevard/Capital Mall Drive intersection,
- one turn lane at the Cooper Point Road/Evergreen Park Drive intersection for Scenario 6 only,
- one turn lane at the Cooper Point Road/Top Foods intersection for Scenario 6 only,
- one through lane and one turn lane at the US 101 Westbound Ramps/Crosby Boulevard intersection for Scenario 7 only,
- signalization of the Mud Bay Road/Evergreen Parkway Westbound and Eastbound Ramp intersections, and
- signalization of the Lakeridge Drive/Deschutes Parkway intersection, with an additional turn lane for Scenario 6 only.

The improvements for Scenario 6 total 10 turn lanes and three signals, and Scenario 7 includes six turn lanes, one through lane, and three signals. Refer to Table 12 (page 107) for a specific listing of turn lanes at each intersection.

Freeway Operations on I-5 and US-101

For all build scenarios, traffic volumes increase slightly along northbound and southbound I-5 at the US 101 on-ramps compared to No-Build Scenario 1. These increases in volumes come from the release of bottleneck congestion at the Black Lake interchange with No-Build Scenario 1. Although the densities increase slightly (up to 7 passenger cars per mile per lane (pc/mi/ln) for northbound I-5 and about 1 pc/mi/ln for southbound I-5), the operational effect on travel speeds is 3 mph or less on northbound I-5 and no difference on southbound I-5 speeds. Although some build scenarios result in traffic volume diversions and cause densities to decrease in some areas and increase in other areas, the overall traffic volumes, densities, and speeds for northbound and southbound I-5 are generally similar between No-Build Scenario 1 and the build scenarios. Refer to Table 10 (page 88) for more detailed information on I-5 freeway operations.

For eastbound US 101, all build scenarios substantially improve traffic operations on the mainline. Due to severe congestion at the Black Lake interchange under No-Build Scenario 1, the eastbound US 101 corridor is expected to have an overall average density of 42 pc/mi/ln, compared to the build scenario densities that range between 36 and 38 pc/mi/ln. This is caused by traffic queues on the eastbound off-ramp extending from the Black Lake Boulevard ramps intersection onto mainline US 101.

Although some build scenarios “relocate” congestion, the traffic volumes, average mainline densities, and speeds are fairly similar among all build scenarios. The sum total of all segment densities has been used as an aggregate measure of effectiveness since densities at specific locations vary among scenarios due to upstream bottlenecks and traffic volume changes. The sum total of all segment densities for the build scenarios range from 1,453 pc/mi/ln to 1,542 pc/mi/ln, compared to 1,710 pc/mi/ln under No-Build Scenario 1. This indicates that the build scenarios provide more vehicle throughput and the No-Build Scenario 1 has more congestion. Within the study area, the eastbound US 101 mainline is expected to operate near free flow conditions with average speeds ranging between 47 mph to 50 mph for the build scenarios compared to 29 mph under No-Build Scenario 1. Travel times and average mainline speeds for

westbound US 101 and northbound and southbound I-5 are highly similar between the No-Build and build scenarios with differences of 3 mph or less.

Local Intersection Operations

In addition to freeway mainline operations, local system operations were also considered when identifying recommendations. As described above, the following local intersection improvements are required for each of the build scenarios to meet LOS standards:

- Local System Only Scenario 2; 9 turn lanes, 1 through lane, and 3 signals,
- Local System Only Scenario 3; 8 turn lanes, 1 through lane, and 3 signals,
- Black Lake Interchange Scenario 4; 7 turn lanes and 3 signals,
- Black Lake Interchange Scenario 5; 5 turn lanes, 1 through lane, and 3 signals,
- Evergreen Interchange Scenario 6; 10 turn lanes and 3 signals, and
- Evergreen Interchange Scenario 7; 6 turn lanes, 1 through lane, and 3 signals.

Black Lake Scenario 5 has the least number of required local intersection improvements compared to the other build scenarios. The one-hour intersection LOS methodology was required by WSDOT and FHWA and the two-hour intersection LOS methodology is consistent with City of Olympia transportation concurrency requirements. Refer to the Design Year 2030 Local Intersection Traffic Operations section starting on page 88 and Table 11 for more detail. With the one-hour analysis, Black Lake Scenario 5 also has the highest number of intersections operating at LOS A, B or C (13 intersections) and no intersections operating at LOS F. Scenarios 4 and 7 have the second highest number of intersections operating at LOS A, B, or C (12 intersections), but have 3 (Scenario 4) and 2 (Scenario 7) intersections operating at LOS F.

The intersection operations analysis demonstrates that the Local System Only Scenarios 2 and 3 do not meet the purpose of the study to improve access and circulation in West Olympia for the following reasons:

- The US 101 SPUI/Black Lake Boulevard intersection cannot be improved to meet City of Olympia or WSDOT intersection LOS standards. With maximum improvements at this intersection and adjacent intersections, the two Local System Only Scenarios 2 and 3 cannot achieve better than LOS F conditions with average vehicle delays ranging from 130 to 140 seconds. This results in long vehicle queues on both the eastbound and westbound off-ramps and on Black Lake Boulevard. There is a greater potential for vehicle queues extending back into the US 101 mainline with these scenarios due to the higher degree of congestion.
- The two Local System Only Scenarios 2 and 3 require more intersection turn lane improvements (up to 9 turn lanes) compared to either the Black Lake Scenario 5 or Evergreen Scenario 7 (5 and 6 turn lanes respectively). Most of these turn lane improvements would require property acquisition and displace businesses, and some intersections would continue to operate worse than their applicable LOS standards.

Recommendations

The recommendations from this study are primarily based on the freeway and local system operations analysis results. Black Lake Scenario 5 has the lowest aggregate densities, which indicate higher throughput and less freeway congestion; however, the system-wide freeway densities and speeds are relatively similar among all build scenarios.

Since freeway operations are comparable for all build scenarios, the recommendations place significant emphasis on the local system operations. The local system operations for the build scenarios can be summarized as:

- Local System Only Scenario 2; 11 intersections at LOS A, B, or C and 4 intersections at LOS F
- Local System Only Scenario 3; 9 intersections at LOS A, B, or C and 4 intersections at LOS F
- Black Lake Interchange Scenario 4; 12 intersections at LOS A, B, or C and 4 intersections at LOS F
- Black Lake Interchange Scenario 5; 13 intersections at LOS A, B, or C and 0 intersections at LOS F
- Evergreen Interchange Scenario 6; 11 intersections at LOS A, B, or C and 4 intersections at LOS F
- Evergreen Interchange Scenario 7; 12 intersections at LOS A, B, or C and 2 intersections at LOS F

The number of local intersection improvements is important to consider when identifying recommendations because land uses at the intersections needing improvements are generally built out and construction of the improvements would require property acquisition for right-of-way. Full or partial displacement of existing uses substantially increase project costs, lengthens project schedules, and can be more difficult to implement. Additionally, increasing the number of turn lanes at intersections also increases pedestrian crossing times, which is less conducive to a pedestrian-friendly environment and inconsistent with the City's Comprehensive Plan. As described above, Black Lake Scenario 5 and Evergreen Scenario 7 require the least amount of local intersection improvements (also see Table 12, page 107).

In addition to the best local system operations and least number of intersection improvements, Black Lake Scenario 5 provides the most traffic reduction at the highly congested Black Lake Boulevard SPUI and the Black Lake Boulevard/Cooper Point Road intersections (approximately 800 vph lower than Local System Only Scenario 3) by diverting traffic to the new access ramps at Yauger Way. This is the only scenario that does not require any improvement to the Black Lake Boulevard/Cooper Point Road intersection to meet City of Olympia intersection LOS standards in the year 2030. Black Lake Scenarios 4 and 5, and to a lesser degree, Evergreen Scenarios 6 and 7, also provide important travel time and accessibility benefits to the Capital Medical Center by providing a direct route to and from US 101 for emergency vehicles, avoiding the highly congested Black Lake Boulevard and Cooper Point Road corridors.

Black Lake Scenarios 4 and 5, and to a lesser degree, Evergreen Scenarios 6 and 7 also provide an important secondary route to and from Capital Mall and surrounding retail businesses during peak holiday shopping weekends and seasons. A holiday season peak period traffic analysis was not specifically conducted; however, the new ramp connection to and from Yauger Way would likely improve safety and reduce vehicle queues and congestion that oftentimes extends into the US 101 mainline during these peak shopping days.

In summary, the two study recommendations and reasons for the recommendations are:

1. Eliminate Local System Only Scenarios 2 and 3 from further consideration
    - Local system impacts are substantially higher than other build scenarios
    - There is no traffic volume reduction at the highly congested US 101/Black Lake Boulevard SPUI and Black Lake Boulevard/Cooper Point Road intersections

- With feasible improvements only, several intersections operate at unacceptable LOS E or F conditions with high delay at US 101/Black Lake Boulevard SPUI, Black Lake Boulevard/Cooper Point Road and three to four other intersections
- There is no accessibility or travel time benefit to Capital Medical Center and other key locations compared to other build scenarios
- There is no benefit during holiday shopping time periods compared to other build scenarios

2. Conduct further evaluation of the Black Lake and Evergreen interchange scenarios
    - Concept design, accident/safety analysis, and an environmental screening evaluation would be initiated to provide more detailed information to select a preferred interchange alternative
    - An Interchange Justification Report (IJR) and NEPA/SEPA environmental document would be prepared after selecting a preferred interchange alternative

INTRODUCTION

The purpose of this Technical Memorandum 3 is to document the freeway and local traffic operational analyses for the West Olympia Access Study (WOAS) build scenarios. This documentation includes a review of the existing local and freeway road characteristics, data collection and methodology, micro-simulation model calibration and validation, and existing 2007 traffic conditions as noted in Technical Memorandum 2. It also contains a discussion of the resulting traffic analysis for the future year 2030 No-Build and Build scenarios traffic conditions and operations.

The study area for the WOAS, shown in Figure 1, can be broadly categorized from a traffic operations perspective as two systems: freeway corridors (I-5 and US 101) and the local transportation system in the cities of Olympia and Tumwater. The study area along the I-5 corridor is approximately 2.81 miles long and includes interchanges with US 101 and the southern half of the City Center interchange. The portion of the US 101 corridor within the study area is approximately 4.82 miles long and spans four interchanges, including Mud Bay Road, Evergreen Parkway, Black Lake Boulevard, and Crosby Boulevard/Cooper Point. The study area for the local transportation system is in the cities of Olympia and Tumwater and is located to the north and south of US 101.

As noted in Technical Memorandum 1, the study adopted a planning level approach whereby solutions or concepts were gradually screened to smaller groups of possible improvement options. Options that remained after a fatal flaw analysis were included in an initial screening process. The purpose of this screening was to eliminate scenarios that were not found to merit further consideration because they did not address the study goals. Options were evaluated based on planning level cost estimates, qualitative technical review and other available information. The initial screening was conducted at a broad, non-quantitative level to rate each option from most impacts (worst) to least impacts (best).

Based on the preliminary screening processes, options that were selected for further consideration were packaged into scenarios to assess their effectiveness as a system. This assessment primarily focused on traffic analysis tools to analyze different components of the transportation system. The following sections of this technical memorandum explain in detail each scenario and their operational analyses. This second screening conducted a more detailed evaluation of the scenarios to review changes in traffic operation analysis results and identify whether the scenarios may relieve congestion at failing intersections and congested freeway locations.

EXISTING 2007 ROADWAY CHARACTERISTICS

Freeways and Interchange Areas

The WOAS includes analyzing two freeway corridors, a 2.81-mile section of I-5 (MP 106.23 to MP 103.42) and a 4.82 mile portion of US 101 (MP 367.41 to MP 362.59). This section of the report briefly describes the geometric configurations of each of these freeways and their associated interchanges.

I-5

I-5 is the primary route for north-south interstate travel through Washington and provides connections between some of the largest cities in the Puget Sound region. Between the US 101 and City Center interchanges, I-5 has three to four northbound lanes and three to four southbound lanes, both with a posted speed limit of 60 mph. WSDOT classifies this portion of I-5 as an Urban-Interstate (U5) and as a Highway of Statewide Significance (HSS).

I-5/US 101 Interchange

Note: For the purpose of the report, northbound US 101 will be referred to as eastbound US 101 (increasing milepost) and southbound US 101 will be referred to as westbound US 101 (decreasing milepost) since the directional orientation within the study area is closer to east-west than north-south.

The I-5 southbound off-ramp (Exit 104) and the I-5 northbound off-ramp (Exit 104), which cross under I-5 and receives traffic from Deschutes Parkway SW, join to form westbound US 101 (decreasing milepost). The 2nd Avenue SW off-ramp (Exit 103) from southbound I-5 is located just south, approximately 0.2 miles, of the US 101 exit. Southbound I-5 receives traffic from eastbound US 101 (increasing milepost) approximately 0.4 miles south of the 2nd Avenue SW exit.

Traffic on eastbound US 101 has the option to travel south on 2nd Avenue SW, merge with southbound I-5 traffic, or connect to northbound I-5 traffic via a flyover ramp. The flyover ramp from eastbound US 101 also accepts traffic from Deschutes Parkway SW prior to merging with northbound I-5.

I-5/City Center Interchange

Traveling south on I-5, an exit ramp (Exit 105) splits with one lane that connects to Plum Street and the other to 14th Avenue SE. Two on-ramps, one from 14th Avenue SE and one from Henderson Boulevard SE, merge together prior to merging onto southbound I-5. The City Center northbound off-ramp also splits with one lane that merges into Henderson Boulevard SE and Plum Street, which passes under I-5 for local northbound traffic. The other I-5 northbound off-ramp lane merges into 14th Avenue SE, which crosses over I-5 and leads to local westbound traffic and is the main entrance to the capital campus. The northbound I-5 on-ramp stems from the 14th Avenue SE overpass as a loop ramp.

US 101

US 101 is a state highway that predominantly serves regional travel demand and connects the Olympic Peninsula to major activity centers on the east side of Puget Sound. Within the study area, US 101 is a two- to three-lane highway in each direction. US 101 is classified by WSDOT as an Urban-Principal Arterial (U1) and has a posted speed limit of 60 mph. US 101 is also listed as a HSS.

US 101/Mud Bay Road Interchange

This interchange represents the westernmost study interchange along US 101. At this interchange, the US 101 mainline has two westbound and two eastbound lanes. The westbound ramps terminus exhibits a configuration similar to a full diamond; however, the left and right turns are channelized and the through movement (from off-ramp to on-ramp) is restricted. The eastbound ramps terminus has a diamond-style off-ramp and a trumpet on-ramp. This interchange primarily serves low-density residential areas to the west, a few commercial uses to the east, and a connection to the Evergreen Parkway interchange via Mud Bay Road NW.

US 101/Evergreen Parkway Interchange

Direct movements between US 101 and Evergreen Parkway NW are limited at this interchange. Westbound traffic on US 101 is allowed to exit to Evergreen Parkway NW (westbound off-ramp), but there is no direct connection for traffic on Evergreen Parkway NW to enter onto westbound US 101 (westbound on-ramp). Similarly, there is no exit from eastbound US 101 to Evergreen Parkway NW (eastbound off-ramp); however, eastbound US 101 accepts traffic from Evergreen Parkway NW (eastbound on-ramp). Just north of US 101, the westbound off-ramp and eastbound on-ramp connect with Mud Bay Road NW to form a full diamond-style interchange with Evergreen Parkway NW elevated over Mud Bay Road NW. This interchange provides access to low-density residential areas to the west and north and connection to Mud Bay Road NW, which extends eastward towards higher-density commercial, public, and residential areas.

US 101/Black Lake Boulevard Interchange

The Black Lake Boulevard interchange is configured as a single-point urban interchange (SPUI). With this configuration, left- and right-turns to and from the mainline are separated, with the left-turns converging at a single signalized intersection. This interchange provides the primary access to several

important regional facilities, including the Capital Medical Center, the Westfield Capital Mall, several commercial developments and parks, and a residential area to the south.

US 101/Crosby Boulevard/Cooper Point Interchange

This interchange is similar to a standard full diamond interchange configuration, except a separate access point on the south side of US 101 from Mottman Road SW to eastbound US 101 is located in the middle of the on-ramp. This interchange primarily serves the Capital Auto Mall and commercial office uses north of the interchange, South Puget Sound Community College, single- and multi-family residences in Tumwater south of the interchange, and is the last interchange before US 101 connects to I-5.

Local Streets and Intersections

This section of the report summarizes the functional classifications and characteristics of the local roadway network within the study area. The City of Olympia currently has four functional classifications: Arterial, Major Collector, Neighborhood Collector, and Local Access Street.

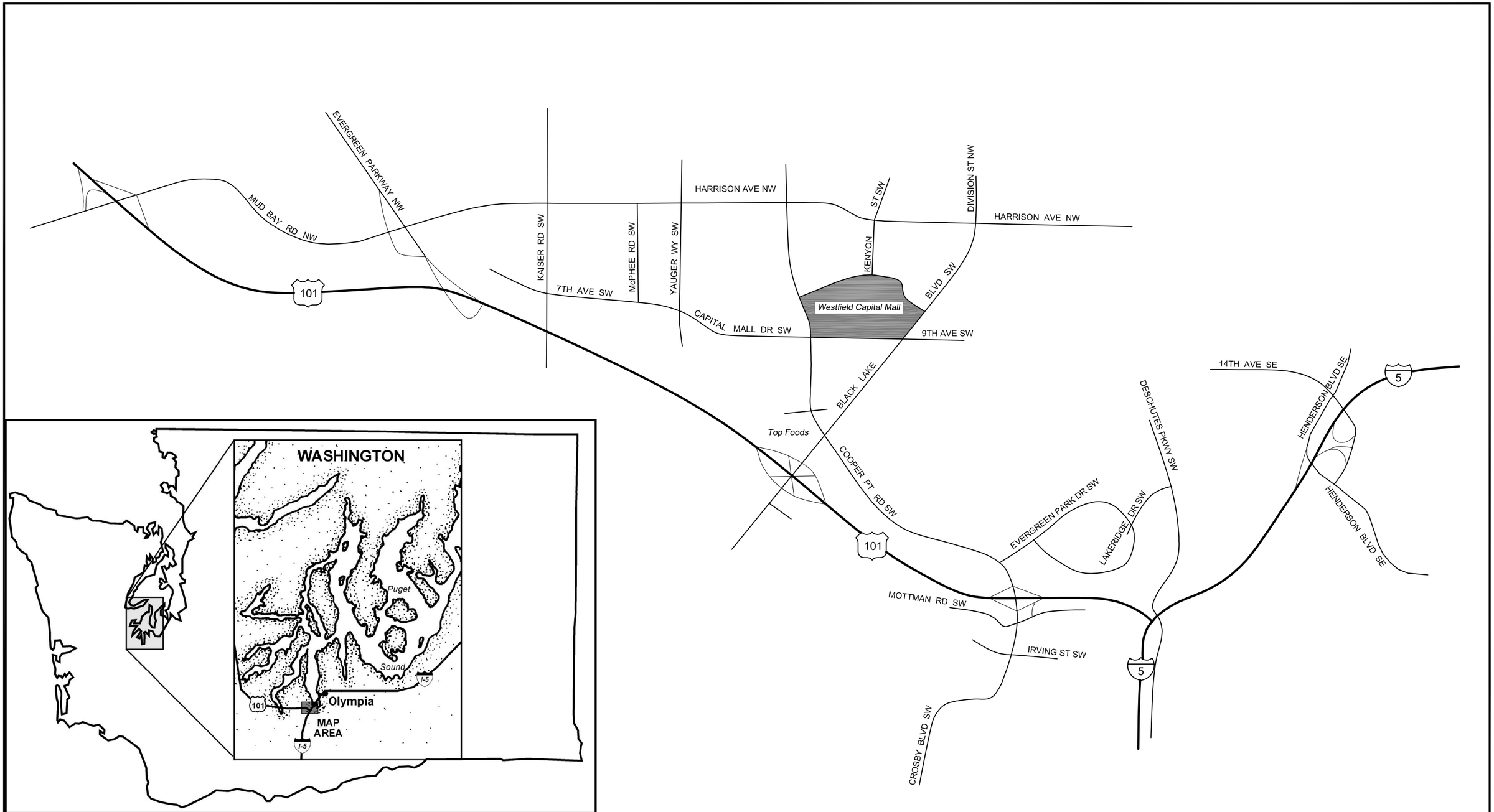
Black Lake Boulevard SW is classified as an arterial spanning from the City of Tumwater north to Harrison Avenue NW. Within the study area, Black Lake Boulevard SW provides access to and from US 101 and serves as a critical four- to five-lane north-south arterial through West Olympia. Several major businesses, including Walgreens, Top Foods, and the Westfield Capital Mall have driveways along the corridor. The posted speed limit varies between 25 and 30 mph throughout the study area.

Cooper Point Road SW provides access from US 101 and continues northwest to the northernmost point of the Cooper Point peninsula. This four- to five-lane arterial provides access to the Capital Auto Mall, the Evergreen Park business park and the Westfield Capital Mall. The posted speed limit is 35 mph in the study area.

Division Street SW is classified by the City of Olympia as an arterial within the study area. This two-lane roadway is the north-south extension of Black Lake Boulevard SW that serves commercial and residential land uses near Harrison Avenue NW. The posted speed limit is 25 mph throughout the study area.

Mud Bay Road NW/Harrison Avenue NW is an arterial roadway that extends from US 101 to W Bay Drive and is the northern study area limit for the WOAS. This roadway operates as a four- to five-lane section between Yauger Way SW and W Bay Drive and has a two-lane cross-section with turn lanes from US 101 to Yauger Way SW. The roadway connects with the 4th and 5th Avenue bridges that cross over Budd Inlet, this roadway provides access between several businesses and residential neighborhoods and serves as the major east-west corridor connecting downtown Olympia to West Olympia. The posted speed limit varies from 30 mph to 35 mph between Division Street SW and the northbound ramps at the US 101/Mud Bay Road interchange. West of the southbound ramps at the US 101/Mud Bay Road interchange, the speed limit along Mud Bay Road NW is 45 mph. Bicycle lanes exist from Evergreen Parkway to Division Street.

7th Avenue SW/Capitol Mall Drive NW is a major collector that begins west of Kaiser Road SW and runs semi-parallel to the north side of US 101. As 7th Avenue SW continues east, this roadway becomes Capitol Mall Drive NW, which fronts Yauger Park and Westfield Capital Mall, and then connects to a residential area as 9th Avenue SW. The western end of 7th Avenue SW begins at Kaiser Road SW as a two-lane roadway that expands to four lanes (one westbound lane, a two-way left-turn lane, and two eastbound lanes) just west of McPhee Road SW and continues with this lane configuration until Black Lake Boulevard SW before reducing down to a two-lane facility again. The posted speed limit is 25 mph. Bicycle lanes exist from McPhee Road SW to Decatur Street.



REGIONAL LOCATION MAP

Parametrix DATE: Jun 05, 2008 FILE: BL1631062P03T05_F01

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Figure 1
Study Area

Decatur Street SW is a major collector throughout the study area that begins south of 15th Avenue SW and continues to the northern study area limit at Harrison Avenue NW. This roadway primarily serves residential traffic and a pedestrian/bicycle connection is provided to Caton Way SW. The posted speed limit along Decatur Street SW is 25 throughout the study area.

Yauger Way SW is a major collector that begins at Capital Mall Drive and terminates in a residential subdivision north of Harrison Avenue NW. This two- to three-lane road provides access to major regional points of interest including Yauger Park and the Capital Medical Center, the primary medical facility for West Olympia. The current posted speed limit is 30 mph within the study area.

Kaiser Road SW is classified as a major collector that extends from just south of US 101, over US 101, and continues northward until it terminates several miles north at Cooper Point Road NW. This two-lane roadway provides access to residential land uses on the west side of Olympia. The posted speed limit is 35 mph.

Deschutes Parkway SW is a major collector that begins with a connection to northbound I-5 at the Exit 103 off-ramp, continues north along the east side of I-5, crosses under I-5 near US 101, then travels north along the western edge of Capitol Lake, and ends with a connection to 5th Avenue SW, which crosses Budd Inlet. This two-lane roadway serves north-south travel with a posted speed limit of 35 mph. A parking lane on the east side of the Deschutes Parkway SW is also provided for the majority of the roadway's length.

Kenyon Street SW is a major collector between Harrison Avenue NW and Westfield Capital Mall. This four-lane roadway primarily serves commercial/industrial land uses within the study area and has a posted speed limit of 25.

Several intersections within the study area were analyzed because they currently or are anticipated in the future to operate poorly, provide access to major regional landmarks, or are ramp terminals for current freeway facilities. In total, 22 locations (24 intersections including the two additional right-turn intersections associated with the Black Lake Boulevard interchange) were studied as part of the WOAS, including:

- Harrison Avenue NW/Division Street NW (Signalized)
- Cooper Point Road SW/Black Lake Boulevard SW (Signalized)
- Black Lake Boulevard SW/US 101 (Signalized)
- Cooper Point Road SW/Harrison Avenue NW (Signalized)
- Black Lake Boulevard SW/9th Avenue SW (Signalized)
- Cooper Point Road/Automall Drive SW/Carriage Street SW (Signalized)
- Cooper Point Road/Automall Drive SW/Evergreen Park Drive SW (Signalized)
- Cooper Point Road SW/Top Food Entrance (Signalized)
- Crosby Boulevard SW/US 101 Westbound Ramps (Signalized)
- Crosby Boulevard SW/US 101 Eastbound Ramps (Signalized)
- Crosby Boulevard SW/Mottman Road SW (Signalized)
- Crosby Boulevard SW/Irving Street SW (Signalized)
- Harrison Avenue NW/Kenyon Street NW (Signalized)
- Black Lake Boulevard SW/Capital Mall Entrance (Signalized)
- Harrison Avenue NW/Yauger Way SW (Signalized)
- Harrison Avenue NW/McPhee Road SW (Unsignalized)
- Harrison Avenue NW /Kaiser Road NW (Unsignalized)
- Mud Bay Road W/Evergreen Parkway NW Eastbound Ramps (Unsignalized)

- Mud Bay Road NW/Evergreen Parkway NW Westbound Ramps (Unsignalized)
- Black Lake Boulevard SW/Top Foods Entrance (Unsignalized)
- Lakeridge Drive SW/Deschutes Parkway SW (Unsignalized)
- Capital Mall Drive SW/Yauger Way SW (Unsignalized)

DATA COLLECTION AND METHODOLOGY

Additional detail on the project's methodology and assumptions is provided in the WOAS Assumptions Document.

A variety of data from different sources were used to develop the traffic analysis models. These data and their sources are identified in Table 1.

Table 1. Data Sources used in the West Olympia Access Study

Source	Data
WSDOT	Freeway ATR traffic count data
WSDOT	Freeway ramp tube counts
WSDOT	Freeway truck classification volumes from past ATRs and the WSDOT 2006 Annual Traffic Report
WSDOT	Freeway speed data
WSDOT	Corridor aerial photos
local.live.com	Intersection geometrics (using bird's eye view)
WSDOT	Freeway grades
WSDOT/Parametrix	Estimated ramp grades
City of Olympia	Signal timing plans
City of Olympia/WSDOT	Local intersection turning movement counts
City of Olympia/WSDOT	Existing conditions Synchro model
Parametrix	Freeway travel times
Parametrix	Field reconnaissance to verify and supplement data, including travel times, queue lengths, and lane channelization
WSDOT	Year 2005, 2010, and Year 2030 travel demand models

Traffic Analysis Tools

Four analysis tools were used for the WOAS traffic analysis. These tools were used to analyze different components of the transportation system, based on the advantages of each tool and WSDOT recommendations. These four analysis tools included:

- VISSIM (freeway operations)
- Synchro (signalized intersection operations)
- HCS+ (unsignalized intersection operations)
- VISUM (travel demand modeling)

VISSIM

VISSIM is a microscopic, behavior-based, multi-purpose traffic simulation program used for signal systems, freeway systems, or a combined signal and freeway system having complex or simple conditions. VISSIM offers a wide variety of urban and highway applications, integrating public and

private transportation modes. VISSIM version 4.3 was used to simulate freeway operations along the I-5 and US 101 corridors, including all mainline basic segments, ramps, interchanges, weave sections, and freeway connections. The analysis was conducted for a two-hour PM peak period analysis period between 4:00 and 6:00 PM, but the results are for the peak one-hour. Ramp terminals and a few local intersections were included in the model to simulate the metering and operational effects of these intersections on freeway operations.

Synchro

Synchro is a software application ideal for optimizing traffic signal splits, offsets, and cycle lengths for individual intersections, an arterial, or a transportation system. This application performs intersection capacity and level of service (LOS) analyses using either the intersection capacity utilization (ICU) method or the HCM method. For the WOAS, the HCS Signals module of Synchro version 7 (build 761) was used to calculate the LOS at signalized intersections. The LOS analysis and results are reported for a one-hour PM peak hour (4:30 to 5:30 PM) and are also reported for a two-hour PM peak period consistent with the City of Olympia's transportation concurrency requirements, depending on the intersection (see the Measures of Effectives and Standards section).

HCS+

HCS+ is the latest version of the traffic operations software package co-developed by the Federal Highway Administration (FHWA) and the University of Florida. This analysis tool is the literal electronic translation of methodologies outlined in the Highway Capacity Manual (HCM) and was used to analyze unsignalized intersections. HCS+ was used for a PM peak hour analysis and is also reported for a two-hour PM peak period, depending on the intersection (see the Measures of Effectives and Standards section).

VISUM

VISUM is a comprehensive software application used for transportation planning, travel demand modeling, and network data management. Designed for multi-modal analyses, VISUM integrates all relevant models of transportation into one network model while providing a variety of assignment procedures. VISUM version 9.4 provided the basic travel demand forecasts, which were then post-processed and used as the volume inputs in the freeway and local traffic operation models.

Model Calibration and Validation

Freeway Model

Per FHWA guidelines, the two-hour VISSIM model was calibrated against several parameters, including: matching model throughput volumes with expected and field measured volumes, field observed queue lengths, and field observed travel times. Model inputs and calibration assumptions are provided in Attachment B.

Freeway traffic volumes were determined by using a combination of WSDOT permanent traffic recorders (PTRs) and tube counts on ramps located within the study area. Since only one WSDOT PTR recorder is operational in the study area (R098), freeway volumes were derived by using PTRs outside of the study area, and ramp tube counts were either added or subtracted to produce the expected mainline freeway volume within the study area. The PTRs used to develop freeway volumes include:

- R003 – US 101 at the US 101/SR 8 split
- P4 – I-5 north of the Olympia City Center Interchange
- R097 – I-5 south of Exit 100 in Tumwater
- R098 – US 101 west of the US 101/I-5 Intersection

The derived volume matrix was compared with PTR counts at R098 to verify correct model input volumes, which were developed for 15-minute intervals to account for peaking characteristics. PTR traffic volumes are an average of Tuesday through Thursday volumes taken from October 2006 and ramp tube counts were conducted in January and February 2007. Attachment C shows the expected volumes for each corridor. Figures 2 and 3 illustrate the volume validation at PTR R098, and compare the actual volume, the VISSIM throughput volume, and the derived freeway demand volumes.

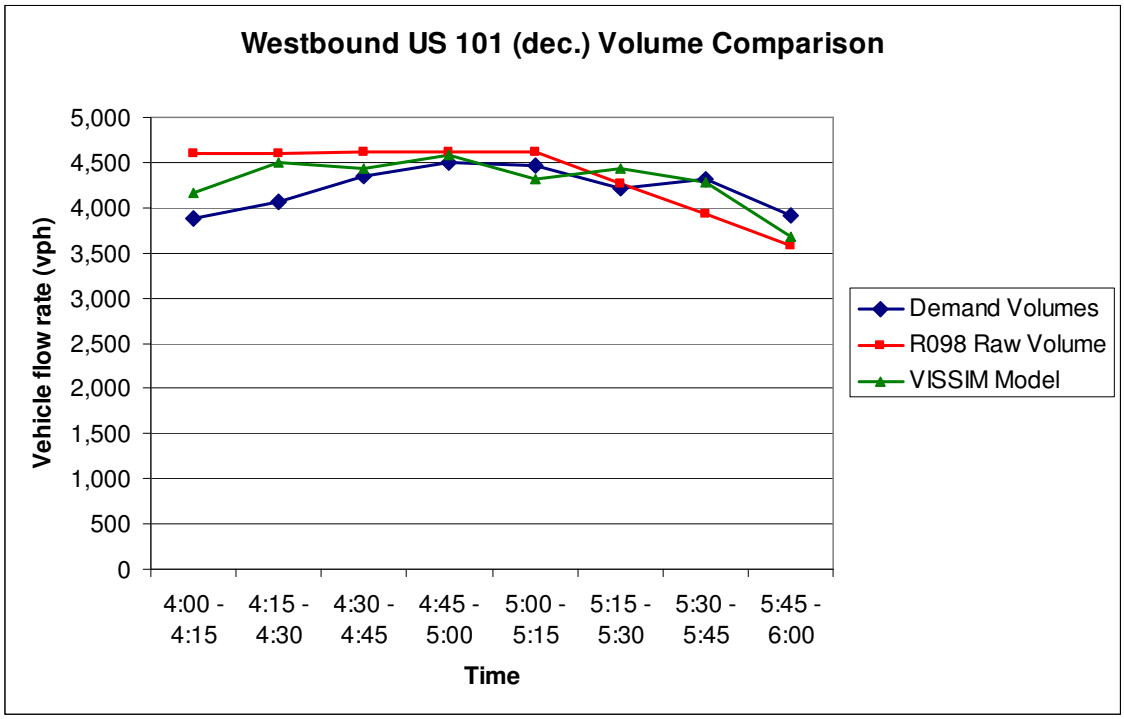


Figure 2. Westbound US 101 Existing and Model Traffic Volumes

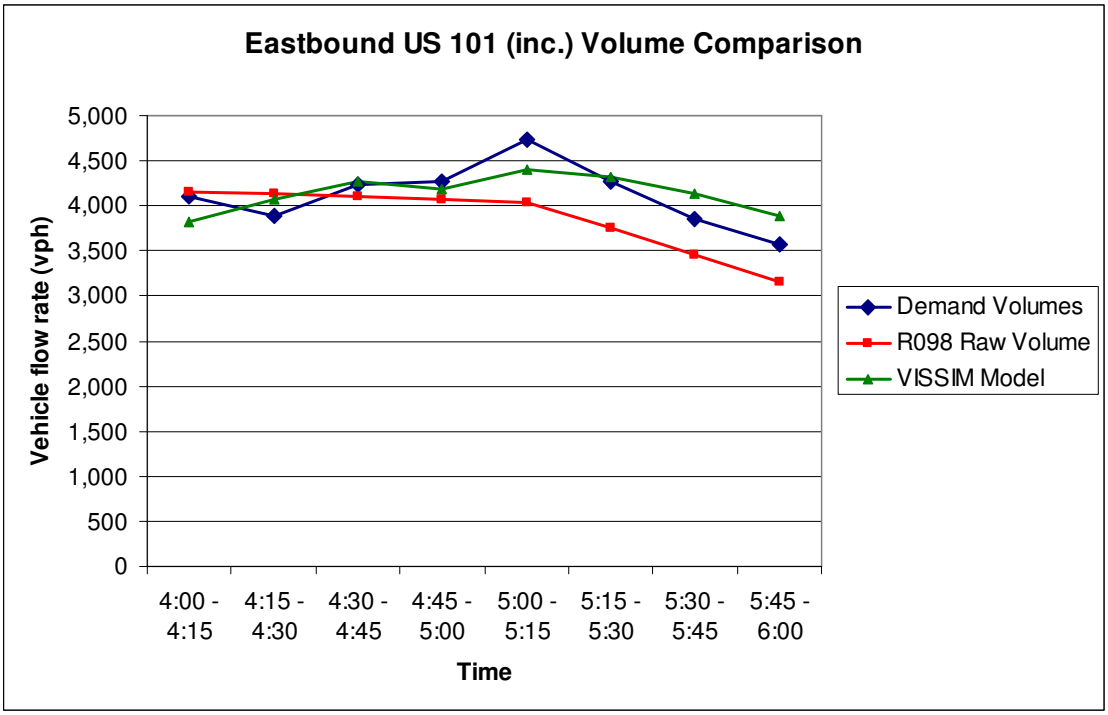


Figure 3. Eastbound US 101 Existing and Model Traffic Volumes

Figure 2 shows a good volume correlation between the observed counts at the R098 PTR and the VISSIM model throughput along westbound US 101. The VISSIM model volume lags the actual counts by approximately 15 minutes; however, by 6:00 PM both the VISSIM model and the PTR counts are approximately equal. Figure 3 indicates the VISSIM model overestimates traffic volumes by about 9 percent during the middle of the peak analysis period. This volume imbalance is partially due to matching freeway ramp volumes to intersection turning movement counts. Although the VISSIM model is conservatively high through this location, comparing the VISSIM model traffic volume against the WSDOT 2006 Peak Hour Report, the traffic volumes are still within the overall range of volumes through the location.

Traffic volumes were calibrated and validated using the Geoff E. Havers (GEH) statistic, which is used to assess the goodness of fit between model results and observed traffic volumes. According to guidelines provided by the FHWA, the model is considered calibrated to observed volumes if the GEH value is less than five for 85 percent or more of the model links and less than four for the sum of all link counts (FHWA 2004). The GEH value is a modified chi-square statistic that incorporates both relative and absolute differences, in comparison of modeled and observed volumes. In the West Olympia model, 100 percent of the links had a GEH value of less than five and the GEH value for the sum of all links was 0.71, suggesting that the model was sufficiently calibrated to FHWA calibration targets. This methodology included measuring all basic freeway sections, ramps, and intersection turning movement counts. Attachment C provides a detailed comparison of the observed field volumes against the model volumes.

Model vehicle queue lengths at selected study locations were visually compared against PM peak period field observations conducted by Parametrix and were used to substantiate model validation. Locations where queues were observed in the field included: southbound I-5 before the US 101 interchange, Black Lake Boulevard SPUI, Black Lake Boulevard/Cooper Point Road SW intersection, and the Cooper Point Road SW/Top Foods/Old Navy intersection. These locations were selected for observation based on known operations and queuing conditions.

Parametrix also conducted a floating car travel time survey during the PM peak period (4:00 PM to 6:00 PM) in August 2007 along I-5 and US 101 to determine existing travel times. Seven travel time runs were conducted for northbound I-5 and eight runs for southbound I-5. Several travel time runs were conducted for eastbound and westbound 101 since both mainlines were observed to operate near free flow conditions, except for westbound US 101 between I-5 and the Crosby Boulevard off-ramp, which operated around 40 mph in the two right-most lanes and slightly higher in the left-most lane. The traffic team observed varied travel times along I-5 throughout the PM peak period, primarily dependant on the travel lane. Typically, the outside southbound I-5 lane north of the US 101 interchange was much slower than the inside two lanes. Since VISSIM cannot measure travel times on a lane-by-lane basis, average vehicle travel times were determined across all lanes for both field measured and model observed travel times. Table 2 compares model travel times against field observed travel times.

Table 2. Modeled and Observed Travel Times

Cross Street	Model Travel Time (sec)	Observed Travel Time (sec)	Percent Difference	Absolute Difference (sec)
NB I-5: Begin at S End of Study Area				
US 101 On-Ramp	31.4	24.0	31%	7.4
14th St Off-Ramp	41.1	55.0	25%	13.9
Total (seconds)	72.5	79.0	8%	6.5
Min (-10% of averaged travel time runs)		71.1		
Max (+10% of averaged travel time runs)		86.9		
SB I-5: Begin at N End of Study Area				
14th St On-Ramp	185.2	145.0	28%	40.2
US 101 Off-Ramp	33.7	47.0	28%	13.3
US 101 On-Ramp	42.6	34.0	25%	8.6
Total (seconds)	261.5	226.0	16%	35.5
Min (shortest travel time run)		207.0		
Max (longest travel time run)		288.0		
EB 101: Begin at E End of Study Area				
Mud Bay Off-Ramp	25.8	29.8	14%	4.0
Mud Bay On-Ramp	16.7	13.9	20%	2.8
EB 101 before Evergreen Prkwy On-Ramp	78.8	85.1	7%	6.3
Evergreen Prkwy On-Ramp	17.1	18.3	6%	1.2
Black Lake Off-Ramp	57.4	67.1	14%	9.7
Black Lake On-Ramp	42.3	32.7	29%	9.6
Crosby Blvd Off-Ramp	25.0	26.2	5%	1.2
Crosby Blvd On-Ramp	25.1	31.6	21%	6.5
101 EB to I-5 Off-Ramp	36.0	28.2	28%	7.8
Total (seconds)	324.2	332.9	3%	8.8
Min (-10% of averaged travel time runs)		299.6		
Max (+10% of averaged travel time runs)		366.1		
WB 101: Begin at W End of Study Area				
Crosby Blvd Off-Ramp	41.5	28.2	47%	13.3
Crosby Blvd On-Ramp	30.6	32.7	6%	2.1
Black Lake Off-Ramp	18.4	24.4	24%	6.0
Black Lake On-Ramp	52.8	43.2	22%	9.6
Evergreen Prkwy Off-Ramp	42.9	60.0	28%	17.1
WB 101 after Evergreen Prkwy Off-Ramp	28.4	32.7	13%	4.3
Mud Bay Off-Ramp	62.9	81.3	23%	18.4
Mud Bay On-Ramp	25.6	21.6	18%	4.0
Model End	32.7	38.2	14%	5.5
Total (seconds)	336.1	362.4	7%	26.3
Min (-10% of averaged travel time runs)		326.1		
Max (+10% of averaged travel time runs)		398.6		

The percent difference for individual travel time segments ranged from five percent to 47 percent; however, the absolute differences in time (seconds) were generally low (less than 10 seconds) for the majority of the travel time segments. These differences were assumed to be attributed to lane utilization since the observed travel times varied substantially depending on the lane of travel. Although observed travel times were averaged for multiple lanes, the data were collected at different times within the peak period; for example, the travel time survey for lane 1 was started at 4:30 PM, while the travel time survey for lane 2 was started at 4:45 PM. This methodology contrasts to VISSIM, which reports an average travel time across all lanes during the same time frame.

Corridor travel times, which are the sum of all travel time segments along a corridor for each direction, estimated by the VISSIM model were within 10 percent of the averaged field observed travel time runs for northbound I-5 and eastbound and westbound US 101. For southbound I-5, the model estimated slightly longer travel times; however, the model results were still within the range of the observed travel times runs. Discrepancies between the observed and modeled travel times could suggest inaccurate levels of congestion; however, modeled traffic volumes were consistent with the expected throughput, which indicates that the cause of travel time differences is likely due to lane utilization. Accordingly, the VISSIM model was assumed to be calibrated to travel times for both I-5 and US 101 for each direction of travel.

Local Streets and Intersections Model

The City of Olympia provided the existing conditions Synchro model that was used for analysis of City streets and freeway ramp terminals. This tool is already used by the City on their local system and works well. In 2005-2006, the City of Olympia worked with WSDOT on updating the model. Existing signal timing and phasing for each of the traffic signals analyzed were collected from City of Olympia. This information was input into the Synchro traffic operations model to update existing signal timing.

Traffic volumes were updated using traffic counts collected within the past three years from WSDOT, City of Olympia, and City of Tumwater. These included 2005-2006 city traffic counts; freeway ramp volumes, and permanent recorder data for US 101 and I-5 located within the study area was collected and provided in early 2007 by the WSDOT Transportation Data Office.

The existing conditions model volumes were compared to 2007 actual counts obtained in May 2007 to ensure that the model data was reflective of the existing field conditions. Some volumes were adjusted in the model based on the 2007 counts analysis, these included the following intersections:

- Harrison Avenue NW/Division Street NW
- Cooper Point Road SW/Black Lake Boulevard SW
- Black Lake Boulevard SW/Capital Mall Entrance
- Black Lake Boulevard SW/Capital Mall Drive SW/9th Avenue SW
- Cooper Point Road/Automall Drive SW/Evergreen Park Drive
- Crosby/US 101 Northbound and Southbound off-ramps
- Crosby Boulevard SW/Mottman Road SW
- Crosby Boulevard SW/Irving Street SW

Field visual observations were made at several of the intersections in the study area during the peak hour including those within the “Triangle” area (area bounded by Harrison Avenue SW/Division Street SW, Cooper Point Road SW/Black Lake Boulevard SW, and Cooper Point Road SW/Harrison Avenue SW intersections) to confirm queue lengths, lane configurations (number of turn lanes) and signal timing in the field.

MEASURES OF EFFECTIVENESS AND STANDARDS

Freeway Traffic

Two primary measures of effectiveness (MOEs) were used to evaluate freeway operations in West Olympia. The MOEs used to analyze freeway conditions are as follows:

- LOS based on density for freeway basic, merge, diverge, and weave locations (each segment based on VISSIM methodology and converted to a HCM analogue). This includes an aggregate MOE based on the sum of all freeway densities along US-101 and I-5 within the study area.
- Travel speeds

WSDOT owns the traffic signals at the Crosby Boulevard/Cooper Point and Black Lake Boulevard interchanges along US 101, but the City of Olympia operates and maintains them by agreement. WSDOT identifies LOS D or better for freeway segments and ramp terminal intersections along urban state highway facilities and state operated signals as acceptable. WSDOT, in consultation with local governments and agencies, sets the level of service standards for Highways of Statewide Significance (HSS). Though WSDOT consults with agencies and local jurisdictions, WSDOT retains final authority to make decisions regarding level of service for HSS routes (RCW 47.06.140). Both US 101 and I-5 within the study area are considered HSS routes.

One industry standard for evaluating freeway traffic conditions is based on the Transportation Research Board's (TRB) methodology outlined in the Highway Capacity Manual (HCM), Special Report 209 (TRB 2000). Using one of the HCM methodologies, freeway traffic conditions can be assessed with respect to densities along various freeway segments. The letter "A" is used to describe the least amount of congestion and best operations, and the letter "F" indicates the highest amount of congestion and worst operations. Table 3 shows how the HCM relates densities to LOS.

Local Intersection Traffic

The MOEs used to evaluate local intersection operations included:

- Level of service based on average vehicle delay (seconds/vehicle)
- Aggregated MOEs, including:
  - Total number of intersections operating at LOS A, B, or C
  - Total number of intersections operating at LOS D or E
  - Total number of intersections operating at LOS F
  - Total vehicle delay at three critical intersections (the "triangle"), including Black Lake Boulevard SW/Cooper Point Road SW, Harrison Avenue NW/Division Street NW, and Harrison Avenue NW/Cooper Point Road NW

Table 3. Level of Service Criteria for Freeways

Basic Segment		Weave Segment		Merge/Diverge Areas	
Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
0	A	0	A	0	A
11	B	12	B	10	B
18	C	24	C	20	C
26	D	32	D	28	D
35	E	36	E	35	E
45	F	40	F	45[a]	F

Source: HCM 2000, Exhibits 23-2, 24-2, and 25-4.

pc/mi/ln = passenger cars per mile per lane

[a] The HCM does not provide a density for LOS F for merge and diverge areas. A density of 45 pc/mi/ln, which is the same for basic segments, was assumed to distinguish between LOS E and F.

The City of Olympia controls the majority of the study intersections, including all intersections north of US 101. The City has defined LOS E as acceptable through the downtown area and along high-density residential corridors. Study intersections that are south of Harrison Avenue NW, west of Black Lake Boulevard SW, and east of Cooper Point Road SW are considered part of the West Olympia high-density residential corridor; therefore, LOS E or better is defined as acceptable (i.e. LOS E is the acceptable standard for the Harrison Avenue/Division Street, Black Lake Boulevard/Cooper Point Road, and Harrison Avenue/Cooper Point Road study intersections). Throughout the rest of the city, urban growth area, and ramp termini at the Crosby Boulevard/Cooper Point and Black Lake Boulevard interchanges along US 101, LOS D is defined as acceptable.

Two study intersections, Crosby Boulevard SW/Mottman Road SW and Crosby Boulevard SW/Irving Street SW, fall within the City of Tumwater. The City of Tumwater has adopted LOS D as the minimum acceptable standard for all intersections and roadways within the city and urban growth area.

Similar to freeway traffic operations, the HCM also provides methodologies for evaluating intersection operations. The HCM derives intersection LOS from average vehicle delays for the intersection as a whole or by worst movement. The LOS lettering nomenclature is consistent with the freeway operations naming convention; the letter "A" is used to describe the least amount of delay and best operations and the letter "F" for the highest amount of delay and worst operations. The 2000 HCM level of service criteria for signalized and unsignalized intersections are shown in Table 4.

Table 4. Level of Service Criteria for Signalized and Unsignalized Intersections

LOS Rating	Average Delay for Signalized Intersections (seconds/vehicle)	Average Delay for Unsignalized Intersections (seconds/vehicle)[a]
A	0 – 10	0 – 10
B	> 10 – 20	> 10 – 15
C	> 20 – 35	> 15 – 25
D	> 35 – 55	> 25 – 35
E	> 55 – 80	> 35 – 50
F	> 80	> 50

Source: HCM 2000, modified from Exhibits 16-2 and 17-2

[a] LOS ratings for all-way stop-controlled intersections are defined by the intersection operations as a whole; LOS ratings for two-way stop-controlled intersections are defined by the worst lane group.

The City of Olympia uses a slightly modified methodology for estimating intersection LOS for their transportation concurrency requirements. While the general equations and the relationship between delay and LOS grade is consistent with the HCM definitions, the City of Olympia's LOS standards are based on a two-hour peak period, as opposed to a one-hour peak hour. To estimate the two-hour LOS, a volume adjustment factor is applied to one-hour peak hour volumes. This volume adjustment factor can be represented as:

2-Hour Adjustment Factor = (2 hour volume/2) / (peak hour volume)

For example, if 8,500 vehicles entered an intersection over two hours and the peak hour volume within those two hours was 4,500 entering vehicles, the 2-Hour Adjustment Factor would be:

2-Hour Adjustment Factor = (8,500/2)/(4,500)

2-Hour Adjustment Factor = (4,250)/(4,500)

2-Hour Adjustment Factor = 0.94

The 2-Hour Adjustment Factors were provided by the City of Olympia and applied to intersection turning movement volumes to estimate the two-hour LOS at locations where the intersections fall under the City of Olympia's jurisdiction (i.e., all study intersections excluding the Crosby Boulevard SW/Mottman Road SW and Crosby Boulevard SW/Irving Street SW intersections in the City of Tumwater and the Mud Bay interchange in Thurston County).

The ramp termini at the Crosby Boulevard/Cooper Point and Black Lake Boulevard interchanges along US 101 are operated and maintained by the City of Olympia and therefore have a LOS D standard. However, the 2-Hour Adjustment Factor was not applied to these locations for planning purposes.

EXISTING 2007 TRAFFIC CONDITIONS

Freeway System Volumes

Northbound I-5 traffic volumes vary substantially throughout the study area. During the PM peak hour (4:30 to 5:30 PM), approximately 3,900 vehicles enter the study area. After roughly 900 vehicles exit to westbound US 101, a substantial volume (nearly 3,000 vehicles) enters the northbound I-5 mainline from eastbound US 101 and Deschutes Parkway SW. Approximately 800 vehicles exit northbound I-5 to Plum Street before the northern limit of the study area where 5,100 vehicles per hour travel the I-5 mainline. Figure 4 shows the VISSIM model traffic volumes along different segment types of the northbound I-5 mainline during the existing 2007 PM peak hour.

Approximately 4,600 vehicles enter the southbound I-5 study area during the PM peak hour and, similar to northbound I-5, traffic volumes vary greatly along the corridor. The City Center on-ramp and US 101 off-ramp are approximately 2,000 feet apart, creating a short weave section. Around this weave section, southbound I-5 mainline volumes increase from 4,600 vehicles to 6,200 vehicles, then decrease to 3,200 vehicles just south of the US 101 off-ramp where approximately 3,000 vehicles exit to US 101. Of this volume exiting to westbound US 101 from southbound I-5, 13 percent from the 14th/Plum Street on-ramp, and the remaining 87 percent comes from southbound I-5 north of the City Center interchange. The weave distribution percentages were based on the VISUM model and applied to the expected freeway volumes that were based on balanced PTR data. A relatively small volume exits to 2nd Avenue SW (roughly 200), then the US 101 on-ramp adds approximately 1,300 vehicles to the southbound I-5 mainline. Figure 5 shows the VISSIM model traffic volumes along different segment types of the southbound I-5 mainline during the existing 2007 PM peak hour.

Eastbound traffic volumes on US 101 exhibit relatively little variation around the Mud Bay Road and Evergreen Parkway interchanges, with on- and off-ramp volumes ranging between 100 to 500 vehicles during the PM peak hour. Continuing east, a substantial volume enters the mainline from the Black Lake

Boulevard (approximately 1,400 vehicles) and Crosby Boulevard/Cooper Point (approximately 1,300 vehicles) interchanges. Figure 6 shows the VISSIM model traffic volumes along different segment types of the eastbound US 101 mainline during the existing 2007 PM peak hour.

Off-ramps from southbound I-5 and northbound I-5 converge to create westbound US 101, which has approximately 4,400 vehicles entering the study area during the PM peak hour. Similar to eastbound US 101, the majority of westbound US 101 mainline traffic volume variation occurs between the Crosby Boulevard/Cooper Point and Black Lake Boulevard interchanges, with exiting volumes ranging between 1,200 to 1,400 vehicles. Traffic volumes entering the westbound US 101 mainline from these interchanges are substantially lower, ranging between 200 and 400 vehicles during the PM peak hour. West of the Black Lake Boulevard interchange, traffic volume changes are generally less than 600 vehicles during the PM peak hour to and from Evergreen Parkway NW and Mud Bay Road NW. Figure 7 shows the VISSIM model traffic volumes along different segment types of the westbound US 101 mainline during the existing 2007 PM peak hour.

Freeway System LOS (Densities)

As described above, freeway operations were analyzed using VISSIM version 4.3, which calculates freeway densities in terms of vehicles per mile per lane. These densities were converted into passenger cars per mile per lane based on heavy vehicle percentages and HCM adjustments to determine the freeway LOS. Table 5 identifies the various study segments by type for I-5 and US 101 that are currently operating at LOS E or F.

As shown in Table 5, three segments of I-5 and one segment of US 101 currently operate worse than LOS D during the PM peak hour. In general, LOS D is the acceptable level of service threshold for urban freeway facilities as set by WSDOT in accordance with RCW 47.06.140. Figures 4 through 7 show the mainline densities and LOS for each I-5 and US 101 mainline segment type. An expanded table that shows the densities and LOS for all segments of I-5 and US 101 is provided in Attachment D.

Table 5. Existing 2007 PM Peak Hour Freeway Operations

Mainline Segment	Segment Type	Density (pc/mi/ln)	LOS (HCM Equivalent)
Northbound I-5			
NB I-5 US 101 On-Ramp	Merge	36	E
Southbound I-5			
SB I-5	Basic	73	F
SB I-5 to US 101 Weave	Weave	53	F
Westbound US 101			
WB US 101 e/o Crosby Blvd	Basic	35	E
WB US 101 Crosby Blvd Off-Ramp	Diverge	48	F

pc/mi/ln = passenger cars per mile per lane

Note: The HCM does not provide a density for LOS F for merge and diverge areas. A density of 45 pc/mi/ln, which is the same for basic segments, was assumed to distinguish between LOS E and F.

As described above, a substantial volume (approximately 3,000 vehicles) of traffic is added to the northbound I-5 mainline from the US 101 and Deschutes Parkway on-ramp. This volume, coupled with a three-lane merge condition, results in the existing congestion at this location of I-5.

On southbound I-5, the short weave segment between the City Center on-ramp (1,700 entering vehicles) and the US 101 off-ramp (3,000 exiting vehicles) experiences a high amount of lane changes, which results in high traffic densities in this area and in the upstream segment of southbound I-5.

Congestion near the westbound Crosby Boulevard interchange is related to several factors, including high traffic volumes (4,400 vehicles), weaving, horizontal curves, and steep grades.

Freeway System Speeds

Travel speeds along I-5 and US 101 were also identified as an operational MOE. The existing PM peak period speed conditions along I-5 are shown in Figures 4 and 5, and Figures 6 and 7 display the speeds along US 101. Note that these figures illustrate the operational speeds during the PM peak period (4:00 to 6:00 PM, two hours), but the LOS, densities, and volumes are for the PM peak hour (4:30 to 5:30 PM, one hour).

As shown in Figure 4, above, existing northbound I-5 mainline speeds are generally around free flow conditions. A slight reduction (from 60 to 70 mph to 50 to 60 mph) in speed occurs around the US 101 off-ramp as a result of exiting traffic on operating conditions at the beginning of westbound US 101. Northbound I-5 speeds also experience a slight speed reduction (40 to 60 mph) around the US 101 on-ramp as a result of the high merging traffic volumes.

Southbound I-5 travel speeds are substantially reduced around the I-5/City Center interchange, and range between 30 to 50 mph for the majority of the PM peak period and 10 to 20 mph between 5:00 and 5:30 PM. This reduction in speeds is primarily due to the high volumes of lane changes between the City Center on-ramp and US 101 off-ramp, which is a short weave section approximately 2,000 feet in length and affects upstream traffic flow. South of the City Center interchange, operational speeds increase to free flow conditions (50 to 70 mph). Figure 5 shows the PM peak period travel speeds along southbound I-5.

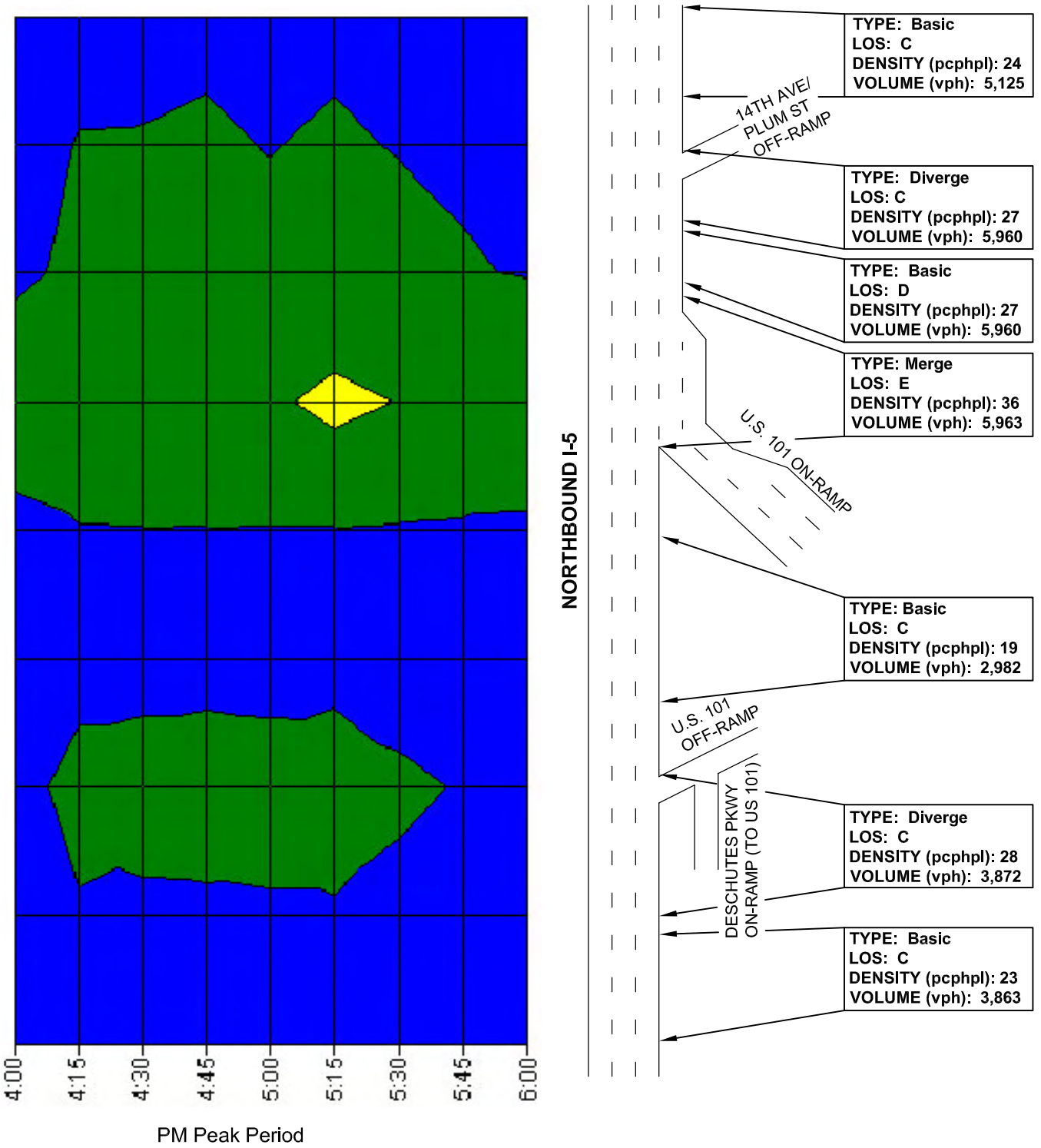
Figure 6 shows the PM peak period travel speeds for eastbound US 101. Eastbound US 101 travel speeds are currently around free flow conditions, with slight decreases (from 60 to 70 mph to 50 to 60 mph) near the Evergreen Parkway, Black Lake Boulevard, and Crosby Boulevard/Cooper Point on-ramps.

Freeway System Travel Times

Freeway travel times are useful for communicating impacts or benefits to freeway mainline operations and can be used to estimate an average travel speed for the freeway as a whole.

Travel times for US 101 and I-5 are provided in Table 2, above. Through the study area, northbound I-5, eastbound US 101, and westbound US 101 all have average travel speeds near free flow conditions. Substantial travel time is added to southbound I-5 around the weave section between the City Center on-ramp and the US 101 off-ramp, which reduces the average travel speed to approximately 29 mph through the study area.

During the PM peak period, travel speeds along westbound US 101 are generally between 40 to 50 mph between I-5 and the Crosby Boulevard interchange. Vertical and horizontal curves, high traffic volumes, and weaving movements all contribute to the speed reductions in this area. Continuing west speeds increase to 50 to 60 mph with a short section operating at 60 to 70 mph near the Evergreen Parkway off-ramp. Figure 7 shows the PM peak period travel speeds along westbound US 101.



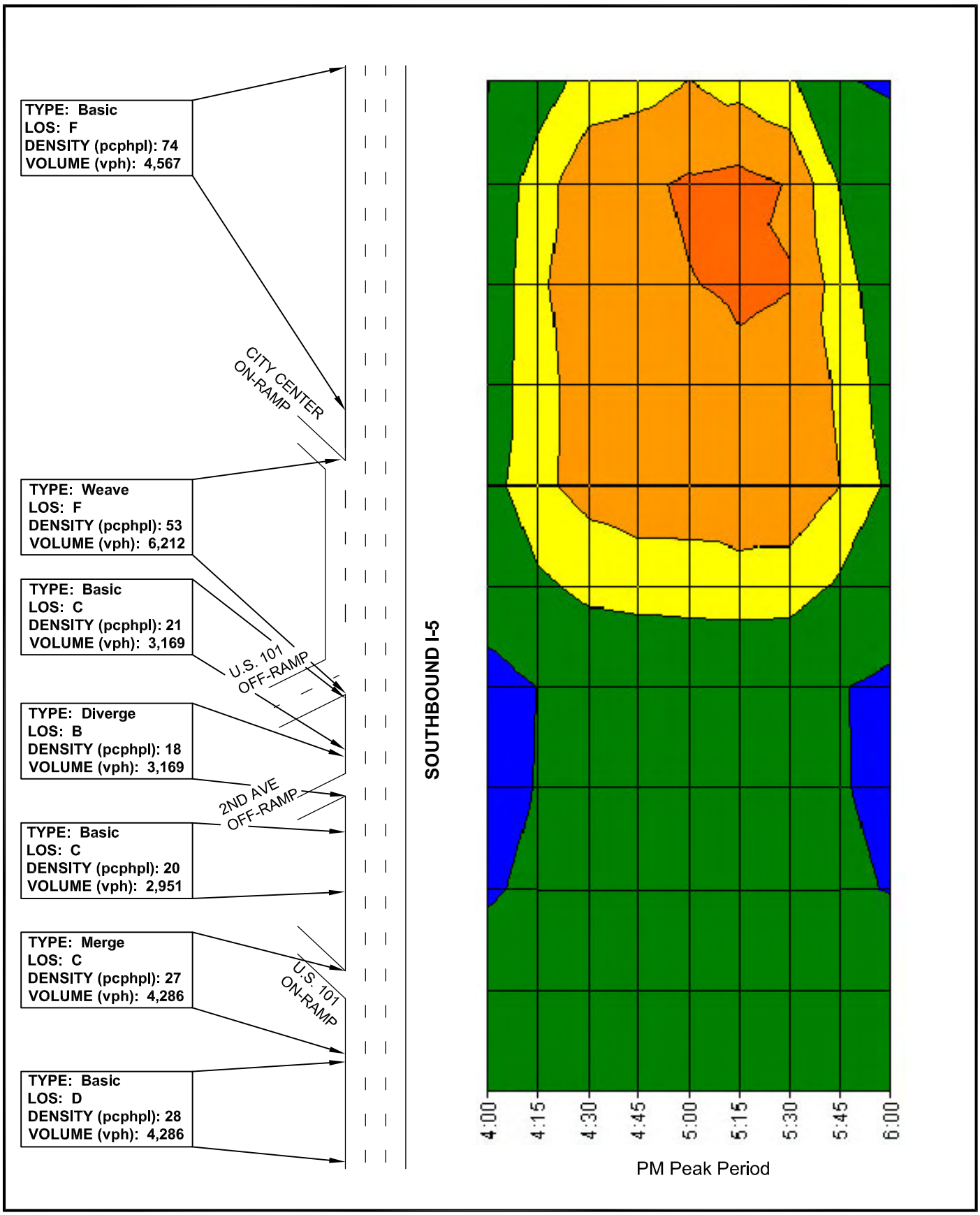
Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F04

N
No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 4
Existing 2007 Northbound I-5 Freeway PM Peak Period Operations



Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F05

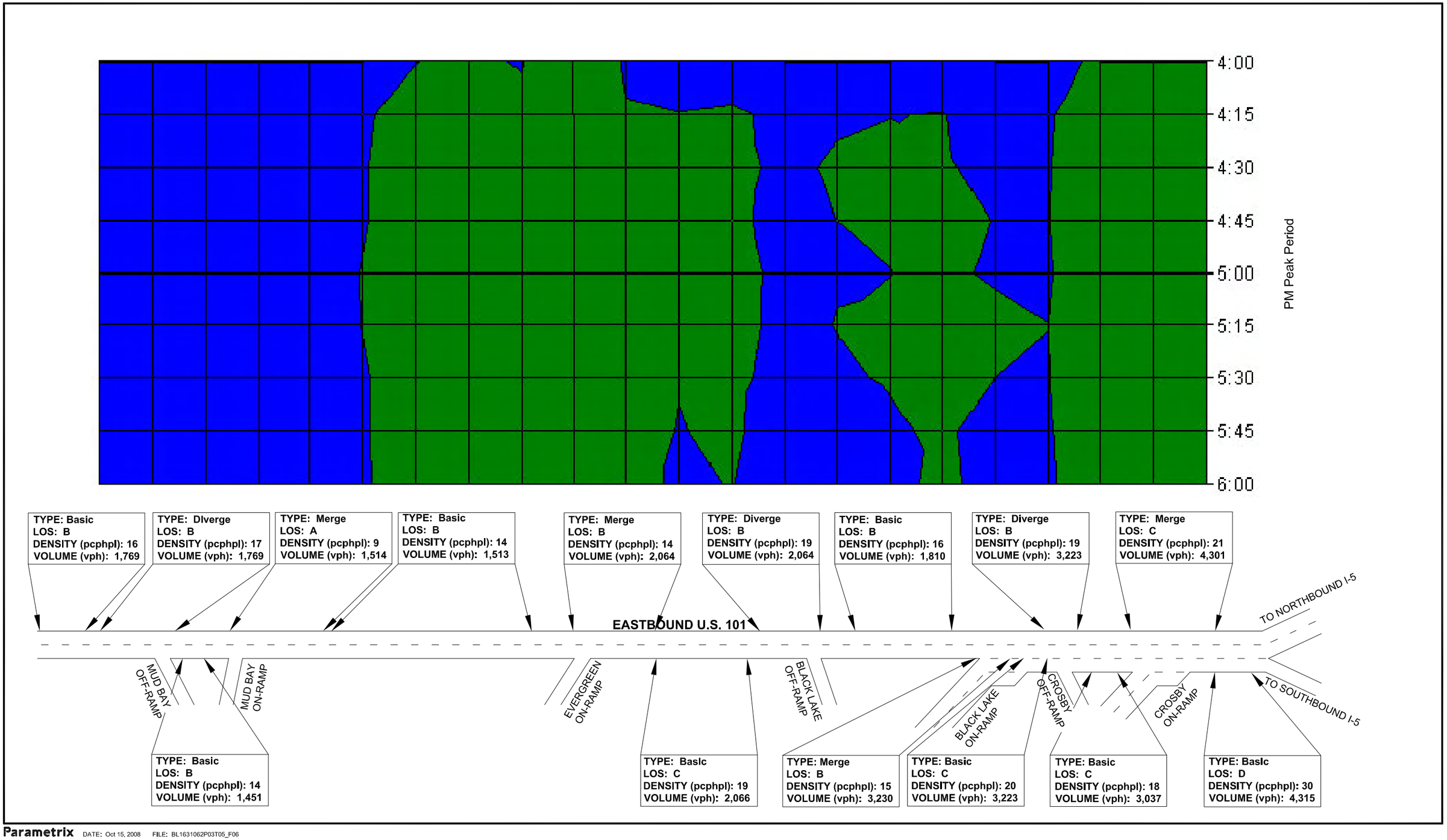
N

No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 5
Existing 2007 Southbound I-5 Freeway PM Peak Period Operations



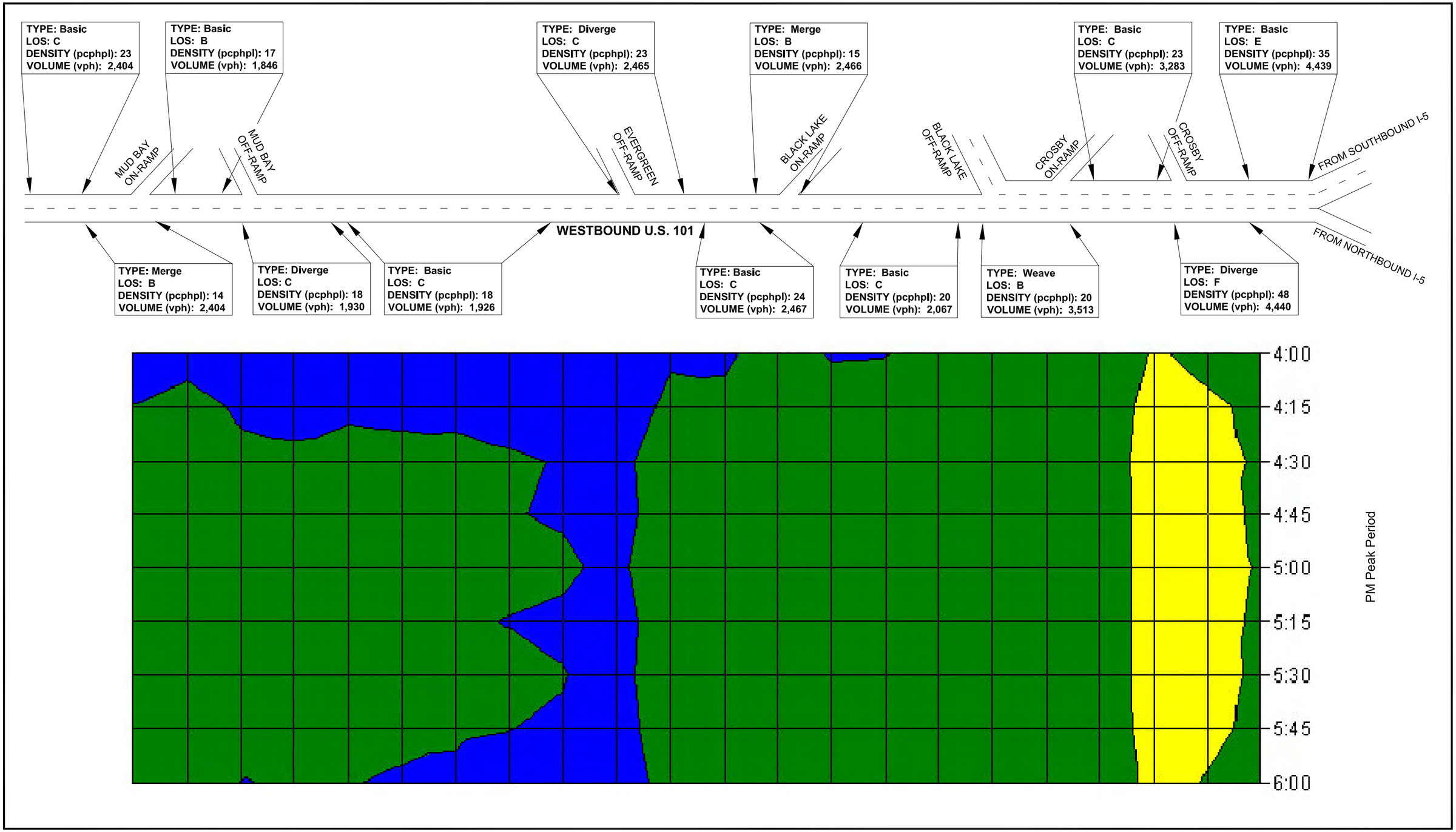
Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F06

N
No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 6
Existing 2007 Eastbound U.S. 101
Freeway PM Peak Period Operations



Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F07

N
No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 7
Existing 2007 Westbound U.S. 101
Freeway PM Peak Period Operations

Local System Volumes

Local turning movement counts were collected from the WSDOT and the cities of Olympia and Tumwater between 2005 and 2007. These traffic volumes were balanced between intersections, and were used in the local intersection analysis and at US 101 ramp termini. The existing PM peak hour turning movement counts are shown in Figure 8.

Local System LOS (Average Delays)

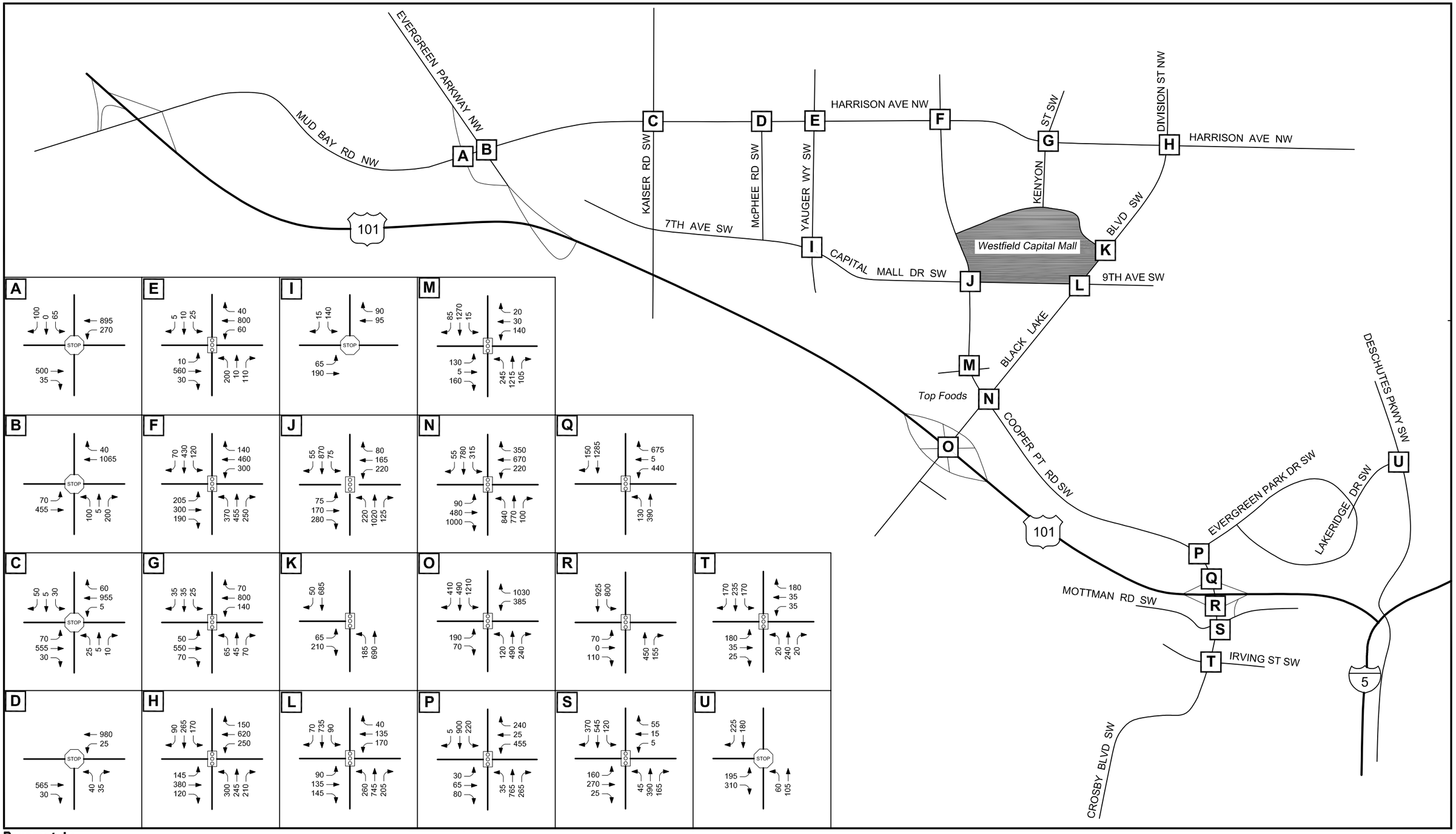
The LOS for local intersections was calculated using the HCS Signals module of Synchro 7 (build 761) for signalized intersections and HCS+ for unsignalized intersections. These traffic analysis software packages were used to measure the total average vehicle delays, which were then equated to LOS grades per the HCM. Table 6 summarizes the existing 2007 local traffic operations and compares the one-hour HCM methodology to the City of Olympia's methodology that incorporates a 2-Hour Adjustment Factor for traffic volumes.

Accounting for the 2-Hour Adjustment Factor, where applicable:

- 16 intersections operate at LOS A, B, or C
- four intersections operate at LOS D or E, and
- four intersections operate at LOS F.

Based on the different LOS standards for WSDOT and the cities of Olympia and Tumwater, this represents five intersections that are currently operating unacceptably below their respective LOS standards.

The "triangle" delay, which is the sum total of intersection delays at the Black Lake Boulevard SW/Cooper Point Road SW, Harrison Avenue NW/Division Street NW, and Harrison Avenue NW/Cooper Point Road NW intersections, is 219.5 seconds/vehicle.



Parametrix DATE: Jul 08, 2008 FILE: BL1631062P03T05_F08

N

No Scale

X Study Intersection

Turning Movement Volume

STOP Stop - Controlled Intersection

Signalized Intersection

Figure 8
2007 Existing
PM Peak Hour
Intersection Volumes

Table 6. Existing 2007 PM Peak Hour Local Traffic Operations

Intersection Description	Intersection Control[a]	One-Hour Analysis[b]			Two-Hour Analysis[b]		
		LOS	Delay (sec/veh)	Max v/c Ratio	LOS	Delay (sec/veh)	Max v/c Ratio
Harrison Ave/Division St	Signalized	F	84.7	1.00	E	73.4	0.96
Black Lake Blvd/Cooper Point Rd	Signalized	F	85.2	1.18	E	74.2	1.12
US 101 SPUI (Through/Lefts)/Black Lake Blvd	Signalized	E	63.2	0.98	E	60.1	0.96
Cooper Point Rd/Harrison Ave/Mud Bay Rd	Signalized	D	49.6	0.81	D	45.0	0.80
Cooper Point Rd/Capitol Mall Blvd	Signalized	D	38.2	0.73	C	34.9	0.70
Black Lake Blvd/9th Ave/Capital Mall Dr	Signalized	C	32.6	0.69	C	31.5	0.66
Cooper Point Rd/Automall Dr/Evergreen Park Dr	Signalized	C	27.6	0.74	C	25.7	0.69
Cooper Point Rd/Top Foods Entrance	Signalized	C	24.5	0.73	C	23.1	0.69
US 101 Westbound Ramps (dec. mp)/Crosby Blvd	Signalized	C	21.0	0.64	B	19.9	0.58
US 101 Eastbound Ramps (inc. mp)/Crosby Blvd	Signalized	B	19.3	0.67	B	18.6	0.62
Crosby Blvd/Mottman Rd	Signalized	B	18.8	0.60	NA	NA	NA
Crosby Blvd/Irving St	Signalized	B	13.9	0.44	NA	NA	NA
Harrison Ave/Kenyon St	Signalized	B	12.4	0.56	B	12.2	0.54
Black Lake Blvd/Capital Mall Entrance	Signalized	B	10.4	0.46	B	10.0	0.43
Harrison Ave/Yauger Wy	Signalized	A	8.6	0.53	A	8.4	0.51
US 101 SPUI Westbound US 101 (dec. mp) Off-Ramp Right Turns/Black Lake Blvd	Signalized	A	8.0	0.73	A	7.8	0.65
US 101 SPUI Eastbound US 101 (inc. mp) Off-Ramp Right Turns/Black Lake Blvd	Signalized	A	2.7	0.35	A	2.7	0.34
Harrison Ave/McPhee Rd	Unsignalized	F	>200	1.16	F	165.7	0.93
Harrison Ave/Kaiser Rd	Unsignalized	F	158.5	0.74	F	104.6	0.61
Mud Bay Rd/Evergreen Prkwy Westbound Ramp	Unsignalized	F	>200	1.30	NA	NA	NA
Mud Bay Rd/Evergreen Prkwy Eastbound Ramp	Unsignalized	F	>200	3.44	NA	NA	NA
Black Lake Blvd/Top Foods Entrance	Unsignalized	C	22.7	0.82	C	20.1	0.78
Lakeridge Dr/Deschutes Prkwy	Unsignalized	C	16.9	0.48	B	14.2	0.39
Capital Mall Dr/Yauger Wy	Unsignalized	B	13.6	0.28	B	11.8	0.19

[a] Unsignalized LOS and delay were calculated by HCS+. The LOS and delay for all-way stop-controlled intersections are reported for the intersection as a whole, whereas the LOS and delay for two-way stop-controlled intersections are reported for the worst approach. Signalized intersection LOS and delay were calculated from the HCM Signals Report feature of Synchro 7 (build 761).

[b] The one-hour analysis is based on HCM methodologies and provided the basis for intersection improvements. The two-hour analysis results account for the 2-Hour Adjustment Factor that the City of Olympia uses to define their LOS standards. A "NA" indicates intersections that are not under the jurisdiction of the City of Olympia and therefore a 2-Hour Adjustment Factor is not applicable.

DESCRIPTIONS OF FUTURE SCENARIOS

The scenarios described below include baseline improvements that were initially identified and assumed in the travel demand forecasting model. Other intersection improvements were added to the baseline improvements to meet City of Olympia LOS standards. This approach maximized additional intersection improvements to the fullest extent and was most applicable to the Local System Only Scenarios (Scenario 2 and 3). Even with the full range of possible improvements, this approach was not enough to achieve the City's LOS standard at some intersections. The added improvements are listed in Table 12 of this technical memorandum.

2030 No-Build Scenario 1

Under this scenario, the future conditions of the transportation network would largely be the same as it occurs today, with the exception of five projects that currently have construction funding secured and are expected to be completed prior to this project's design year. These projects are summarized in Table 7.

Table 7. Projects Included in the 2030 No-Build TRPC Demand Model

Project Name	Project Description
4th/5th Avenue Corridor Bridge Project	Project is completed
Harrison Avenue Widening, Phase II	Widen from 2 lanes to 4/5 lanes from Yauger Way to Kaiser Road
Evergreen Parkway Repair and Upgrade	Reduce number of lanes on Evergreen Parkway from 4 lanes to 2 lanes from 17th Avenue to Kaiser Road
College Station Connection	Connection from Mud Bay to Kaiser Road
Harrison Avenue/Kaiser Road Signal	Add a signal to the Harrison Avenue/Kaiser Road intersection and widen Harrison Avenue to five lanes for 300' of either side of the intersection

2030 Local System Only Scenario 2

A few improvements are common to all build scenarios, including:

- East-west connection between McPhee Road SW and Kaiser Road SW south of Mud Bay Road
- North-south connection between Overhulse Road NW and Mud Bay
- Connection from Harrison Avenue NW to 4th Avenue W in the Kenyon Street NW vicinity
- Extend Kaiser Road SW between US 101 and Black Lake Boulevard SW
- Widen Harrison Avenue NW to four lanes from Kaiser Road to Evergreen Parkway

In addition to these improvements common to all build scenarios, Local System Only Scenario 2 also includes:

- Widen Black Lake Boulevard to three lanes from the SPUI to Black Lake Belmore Road
- Intersection improvements at Harrison Avenue/Black Lake Boulevard/Division Street, Harrison Avenue/Cooper Point, and Black Lake Boulevard/Cooper Point Road
- Widen Harrison Avenue NW to five lanes with a two-way left-turn lane from the Black Lake Boulevard/Division Street NW intersection to the West Bay vicinity
- New east-west connection between Yauger Way to the Top Foods vicinity (near Cooper Point Road SW)

2030 Local System Only Scenario 3

This scenario includes all of the local system improvements as Scenario 2, but also includes the Southwest Connections, which include:

- Decatur Street SW connection between Caton Way SW and Decatur Street SW
- Fern Street SW connection to Carriage Loop SW
- 16th Avenue SW connection to Fern Street SW (removal of existing barricade)

2030 Black Lake Interchange Scenario 4

Scenario 4 includes the local system improvements common to all scenarios and the widening of Black Lake Boulevard SW to three lanes from the SPUI to Black Lake Belmore Road, but other local system improvements described under Scenario 2 are not a part of this scenario.

In addition to the local system improvements, this scenario adds an auxiliary westbound off-ramp from the existing Black Lake Boulevard interchange off-ramp to the vicinity of Yauger Way SW and an auxiliary eastbound on-ramp from Yauger Way SW that connects to the existing Black Lake Boulevard interchange eastbound on-ramp.

Scenario 4 does not include the Southwest Connections (Decatur Street SW, Fern Street SW, and 16th Avenue SW) described under Scenario 3.

2030 Black Lake Interchange Scenario 5

Scenario 5 includes the same local system and interchange improvements described under Scenario 4, and also includes the Southwest Connections (Decatur Street SW, Fern Street SW, and 16th Avenue SW) described under Scenario 3.

2030 Evergreen Interchange Scenario 6

Scenario 6 assumes all of the local system improvements common to all scenarios as well as a new east-west connection between Yauger Way SW to the vicinity of Top Foods (Cooper Point Road SW).

This scenario also includes build-out of the existing Evergreen interchange by adding ramps to and from the east and west to create a full-access interchange from all directions. The westbound off-ramp would diverge from the US 101 mainline further east of its current location and intersect Kaiser Road SW. The eastbound on-ramp would also intersect with Kaiser Road SW prior to merging onto US 101 further east of its existing merge area.

Scenario 6 does not include the Southwest Connections (Decatur Street SW, Fern Street SW, and 16th Avenue SW) described under Scenario 3.

2030 Evergreen Interchange Scenario 7

This scenario includes the same local system and interchange improvements described under Scenario 6, but includes the Southwest Connections (Decatur Street SW, Fern Street SW, and 16th Avenue SW) described under Scenario 3.

Modeled Scenarios

The 2030 Thurston Regional Planning Council (TRPC) travel demand model was used to develop traffic volume forecasts for each 2030 design year scenario. Table 8 summarizes the local system and interchange improvements assumed in the travel demand forecasting model with each scenario. Many of the proposed scenarios differ only by the inclusion or exclusion of the Southwest Connections (Decatur, Fern, and 16th Street extensions). The Southwest Connections primarily affect the local transportation system. As a result, the freeway analysis focuses on No-Build Scenario 1 and Scenarios 3, 5, and 7, which are representative of all build scenarios with respect to freeway operations.

Table 8. Improvements Assumed in the Travel Demand Forecasting Model

Improvement	Local System Only w/o SW Connections Scenario 2	Local System Only w/ SW Connections Scenario 3	Black Lake Interchange w/o SW Connections Scenario 4	Black Lake Interchange w/ SW Connections Scenario 5	Evergreen Interchange w/o SW Connections Scenario 6	Evergreen Interchange w/ SW Connections Scenario 7
1	Complete Comprehensive Plan Grid: New connection bearing east-west between McPhee and Kaiser south of Mud Bay	Complete Comprehensive Plan Grid: New connection bearing east-west between McPhee and Kaiser south of Mud Bay	Complete Comprehensive Plan Grid: New connection bearing east-west between McPhee and Kaiser south of Mud Bay	Complete Comprehensive Plan Grid: New connection bearing east-west between McPhee and Kaiser south of Mud Bay	Complete Comprehensive Plan Grid: New connection bearing east-west between McPhee and Kaiser south of Mud Bay	Complete Comprehensive Plan Grid: New connection bearing east-west between McPhee and Kaiser south of Mud Bay
2	New connection bearing east-west between Overhulse north of Mud Bay from 5th to 6th Ave, includes north-south connection to Mud Bay	New connection bearing east-west between Overhulse north of Mud Bay from 5th to 6th Ave, includes north-south connection to Mud Bay	New connection bearing east-west between Overhulse north of Mud Bay from 5th to 6th Ave, includes north-south connection to Mud Bay	New connection bearing east-west between Overhulse north of Mud Bay from 5th to 6th Ave, includes north-south connection to Mud Bay	New connection bearing east-west between Overhulse north of Mud Bay from 5th to 6th Ave, includes north-south connection to Mud Bay	New connection bearing east-west between Overhulse north of Mud Bay from 5th to 6th Ave, includes north-south connection to Mud Bay
3	New connection from Harrison Ave to 4th Ave. vicinity of Kenyon St	New connection from Harrison Ave to 4th Ave. vicinity of Kenyon St	New connection from Harrison Ave to 4th Ave. vicinity of Kenyon St	New connection from Harrison Ave to 4th Ave. vicinity of Kenyon St	New connection from Harrison Ave to 4th Ave. vicinity of Kenyon St	New connection from Harrison Ave to 4th Ave. vicinity of Kenyon St
4	Extend Kaiser Rd E-W between US 101 to Black Lake	Extend Kaiser Rd E-W between US 101 to Black Lake	Extend Kaiser Rd E-W between US 101 to Black Lake	Extend Kaiser Rd E-W between US 101 to Black Lake	Extend Kaiser Rd E-W between US 101 to Black Lake	Extend Kaiser Rd E-W between US 101 to Black Lake
5	Widen Harrison to 4 lanes from Kaiser Road to Evergreen Parkway	Widen Harrison to 4 lanes from Kaiser Road to Evergreen Parkway	Widen Harrison to 4 lanes from Kaiser Road to Evergreen Parkway	Widen Harrison to 4 lanes from Kaiser Road to Evergreen Parkway	Widen Harrison to 4 lanes from Kaiser Road to Evergreen Parkway	Widen Harrison to 4 lanes from Kaiser Road to Evergreen Parkway
6	Widen Black Lake to 3 lanes (Black Lake Interchange to BL Belmore Rd)	Widen Black Lake to 3 lanes (Black Lake Interchange to BL Belmore Rd)	Widen Black Lake to 3 lanes (Black Lake Interchange to BL Belmore Rd)	Widen Black Lake to 3 lanes (Black Lake Interchange to BL Belmore Rd)	Widen Black Lake to 3 lanes (Black Lake Interchange to BL Belmore Rd)	Widen Black Lake to 3 lanes (Black Lake Interchange to BL Belmore Rd)
7	Improve Harrison/Black Lake & Division intersection	Improve Harrison/Black Lake & Division intersection	Improve Harrison/Black Lake & Division intersection	Improve Harrison/Black Lake & Division intersection	Improve Harrison/Black Lake & Division intersection	Improve Harrison/Black Lake & Division intersection
8	Improve Harrison/Cooper Point intersection	Improve Harrison/Cooper Point intersection	Improve Harrison/Cooper Point intersection	Improve Harrison/Cooper Point intersection	Improve Harrison/Cooper Point intersection	Improve Harrison/Cooper Point intersection
9	Improve Black Lake/Cooper Point intersection	Improve Black Lake/Cooper Point intersection	Improve Black Lake/Cooper Point intersection	Improve Black Lake/Cooper Point intersection	Improve Black Lake/Cooper Point intersection	Improve Black Lake/Cooper Point intersection
10	Add signal at McPhee, when warranted	Add signal at McPhee, when warranted	Add signal at McPhee, when warranted	Add signal at McPhee, when warranted	Add signal at McPhee, when warranted	Add signal at McPhee, when warranted
11	Widen Harrison Ave to 5 lanes with TWLTL (Black Lake & Division to vicinity West Bay	Widen Harrison Ave to 5 lanes with TWLTL (Black Lake & Division to vicinity West Bay	Widen Harrison Ave to 5 lanes with TWLTL (Black Lake & Division to vicinity West Bay	Widen Harrison Ave to 5 lanes with TWLTL (Black Lake & Division to vicinity West Bay	Widen Harrison Ave to 5 lanes with TWLTL (Black Lake & Division to vicinity West Bay	Widen Harrison Ave to 5 lanes with TWLTL (Black Lake & Division to vicinity West Bay
12	New connection bearing E-W between Yauger Way to vic. Top Foods (Cooper Point Rd)	New connection bearing E-W between Yauger Way to vic. Top Foods (Cooper Point Rd)			New connection bearing E-W between Yauger Way to vic. Top Foods (Cooper Point Rd)	New connection bearing E-W between Yauger Way to vic. Top Foods (Cooper Point Rd)
13		Decatur St extension		Decatur St extension		Decatur St extension
14		Fern St extension		Fern St extension		Fern St extension
15		16th St extension		16th St extension		16th St extension
16			Add off ramp WB to vicinity of Yauger Way and add on ramp EB from Yauger Way onto US 101	Add off ramp WB to vicinity of Yauger Way and add on ramp EB from Yauger Way onto US 101		
17					Build Out current Evergreen I/C by adding ramps to/from the West and add ramps to/from East at Kaiser Road with frontage road to Evergreen Parkway	Build Out current Evergreen I/C by adding ramps to/from the West and add ramps to/from East at Kaiser Road with frontage road to Evergreen Parkway

DESIGN YEAR 2030 TRAFFIC CONDITIONS

Freeway System Volumes

The 2030 Thurston Regional Planning Council (TRPC) travel demand model was used to develop traffic volume forecasts for each 2030 design year scenario. The 2030 WOAS model included all transportation improvement projects adopted in the Regional Transportation Plan (RTP) for which funds have been secured (see Table 8, above).

The TRPC EMME/2 travel demand model information has been transferred to VISUM to evaluate the West Olympia sub-area. The EMME/2 travel demand model provided a travel demand matrix output that was assigned to the VISUM subarea model. Further VISUM model assumptions, calibration, and validation results are documented in the West Olympia Access Study Model Documentation (PTV America 2007). Table 9 compares the existing 2007 and forecasted 2030 PM peak hour traffic volumes at key locations within the study area.

Table 9. PM Peak Hour Projected Traffic Volume Growths (2007-2030)

Mainline Segment	2007 Volume	2030 Volume	Absolute Difference	Percent Difference	Annual Growth Rate
Westbound US 101					
Northbound I-5 On	1,403	1,888	485	34.6%	1.5%
Southbound I-5 On	2,978	3,707	730	24.5%	1.1%
US 101 WB Mainline	4,381	5,595	1,215	27.7%	1.2%
Crosby Blvd Off	1,120	1,244	123	11.0%	0.5%
US 101 WB Mainline	3,260	4,352	1,092	33.5%	1.5%
Crosby Blvd On	285	604	319	112.1%	4.9%
US 101 WB Mainline	3,545	4,956	1,411	39.8%	1.7%
Black Lake Blvd Off	1,414	1,457	42	3.0%	0.1%
US 101 WB Mainline	2,131	3,499	1,368	64.2%	2.8%
Black Lake Blvd On	530	795	265	50.0%	2.2%
US 101 WB Mainline	2,660	4,294	1,633	61.4%	2.7%
Eastbound US 101					
US 101 EB Mainline	2,080	3,455	1,376	66.1%	2.9%
Black Lake Blvd Off	260	491	231	89.0%	3.9%
US 101 EB Mainline	1,820	2,965	1,145	62.9%	2.7%
Black Lake Blvd on	1,450	1,580	130	9.0%	0.4%
US 101 EB Mainline	3,270	4,545	1,275	39.0%	1.7%
Crosby Blvd Off	180	286	106	58.7%	2.6%
US 101 EB Mainline	3,090	4,258	1,169	37.8%	1.6%
Crosby Blvd On	1,285	1,478	193	15.0%	0.7%
US 101 EB Mainline	4,375	5,736	1,361	31.1%	1.4%
Northbound I-5 Off	2,645	3,253	608	23.0%	1.0%
Southbound I-5 Off	1,340	1,850	510	38.0%	1.7%
Deschutes Pkwy Off	389	633	244	62.6%	2.7%
Southbound I-5					
I-5 SB Mainline	4,585	6,282	1,697	37.0%	1.6%
Plum Avenue/14th On	1,663	1,729	66	4.0%	0.2%
I-5 SB Mainline	6,248	8,010	1,763	28.2%	1.2%
US 101 Off	2,978	3,707	730	24.5%	1.1%
I-5 SB Mainline	3,270	4,303	1,033	31.6%	1.4%
2nd Avenue Off	276	265	-11	-4.1%	-0.2%
I-5 SB Mainline	2,994	4,038	1,044	34.9%	1.5%
US 101 On	1,340	1,850	509	38.0%	1.7%
I-5 SB Mainline	4,334	5,888	1,553	35.8%	1.6%

Table 9. PM Peak Hour Projected Traffic Volume Growths (2007-2030) (continued)

Mainline Segment	2007 Volume	2030 Volume	Absolute Difference	Percent Difference	Annual Growth Rate
Northbound I-5					
I-5 NB Mainline	3,855	5,475	1,619	42.0%	1.8%
US 101 Westbound Off	907	1,233	326	36.0%	1.6%
I-5 NB Mainline	2,949	4,242	1,293	43.8%	1.9%
US 101 WB/Deschutes Pkwy On	3,021	3,671	650	21.5%	0.9%
I-5 NB Mainline	5,970	7,913	1,943	32.5%	1.4%
Plum Street/14th Off	881	1,049	168	19.0%	0.8%
I-5 NB Mainline	5,089	6,864	1,775	34.9%	1.5%
14th Avenue On	700	756	56	8.0%	0.3%
I-5 NB Mainline	5,789	7,620	1,831	31.6%	1.4%

Note: 2030 volumes are for the No-Build Scenario 1

The 2030 traffic volumes provided above represent the balanced travel demand based on the TRPC demand model and do not account for capacity constraints. Actual VISSIM model throughput volumes, which do account for traffic congestion, are depicted graphically on Figures 9 through 12 and are described for each of the scenarios in their respective sections.

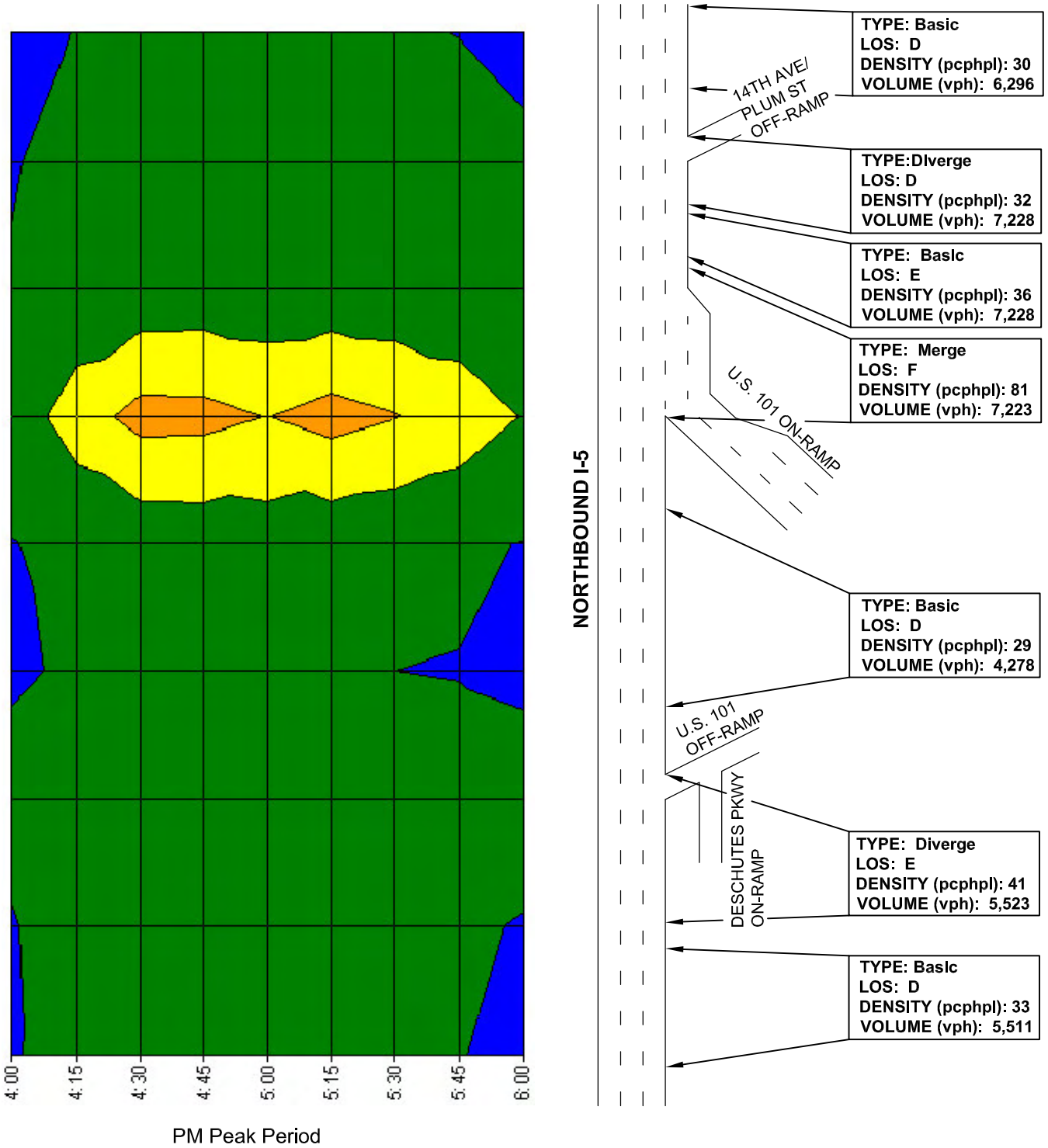
2030 No-Build Scenario 1

Future 2030 No-Build traffic volumes along northbound I-5 are expected to substantially increase by the year 2030. Volumes entering the study area on northbound I-5 are expected to substantially increase from 4,000 vehicles during the PM peak hour to approximately 5,500 vehicles. Similar to the existing conditions, a substantial change in mainline volumes is expected to occur around the US 101 interchange with approximately 1,200 vehicles exiting to US 101 and roughly 3,000 vehicles entering the northbound I-5 mainline from US 101 and Deschutes Parkway SW. Figure 9 shows the VISSIM mainline volumes for northbound I-5 for each of the mainline segment types during the 2030 PM peak hour.

The volume throughput, which is the portion of the demand that is served during a specific time frame, of traffic entering the study area along southbound I-5 is expected to be relatively similar to the existing conditions (4,600 vehicles for existing conditions and 4,700 vehicles for year 2030). Although the demand is expected to be much higher, this portion of southbound I-5 is expected to reach capacity and, therefore, the proportion of the demand that is served (i.e. throughput) will only slightly increase while the unmet demand will increase and be stuck in queue on the mainline or find alternate routes on local streets. Similar to the existing conditions, the short weave section and high volume of lane changes is expected to create a bottleneck and constrain the amount of throughput. South of the US 101 interchange, mainline volumes are expected to slightly increase. Figure 10 shows the modeled volumes for each mainline segment type along southbound I-5 during the 2030 PM peak hour.

From the beginning of the western limit of the study area, eastbound US 101 volumes are expected to substantially increase from approximately 1,800 vehicles per hour to 2,800 vehicles per hour. Substantial changes in mainline traffic volumes are also expected at the Evergreen Parkway on-ramp, Black Lake Boulevard interchange (off- and on-ramps), and Crosby Boulevard/Cooper Point on-ramp. Conversely, the amount of traffic to and from Mud Bay Road SW and to the Crosby Boulevard/Cooper Point off-ramp is expected to experience relatively small changes in traffic volumes compared to the existing conditions. Operations at the Black Lake Boulevard interchange are expected to substantially degrade, causing bottleneck conditions that spill back onto the US 101 mainline up to the Evergreen Parkway interchange. Figure 11 provides the traffic volumes for each mainline segment type along eastbound US 101 during the 2030 PM peak hour.

Traffic volume growth entering the study area for westbound US 101 is expected to be relatively small, largely due to capacity constraints associated with southbound I-5. Continuing west, more pronounced changes in mainline volumes are expected, with volume increases up to 1,200 vehicles per hour around the Black Lake Boulevard and Mud Bay Road interchanges. Westbound US 101 mainline volumes for each segment type during the 2030 PM peak hour are shown in Figure 12



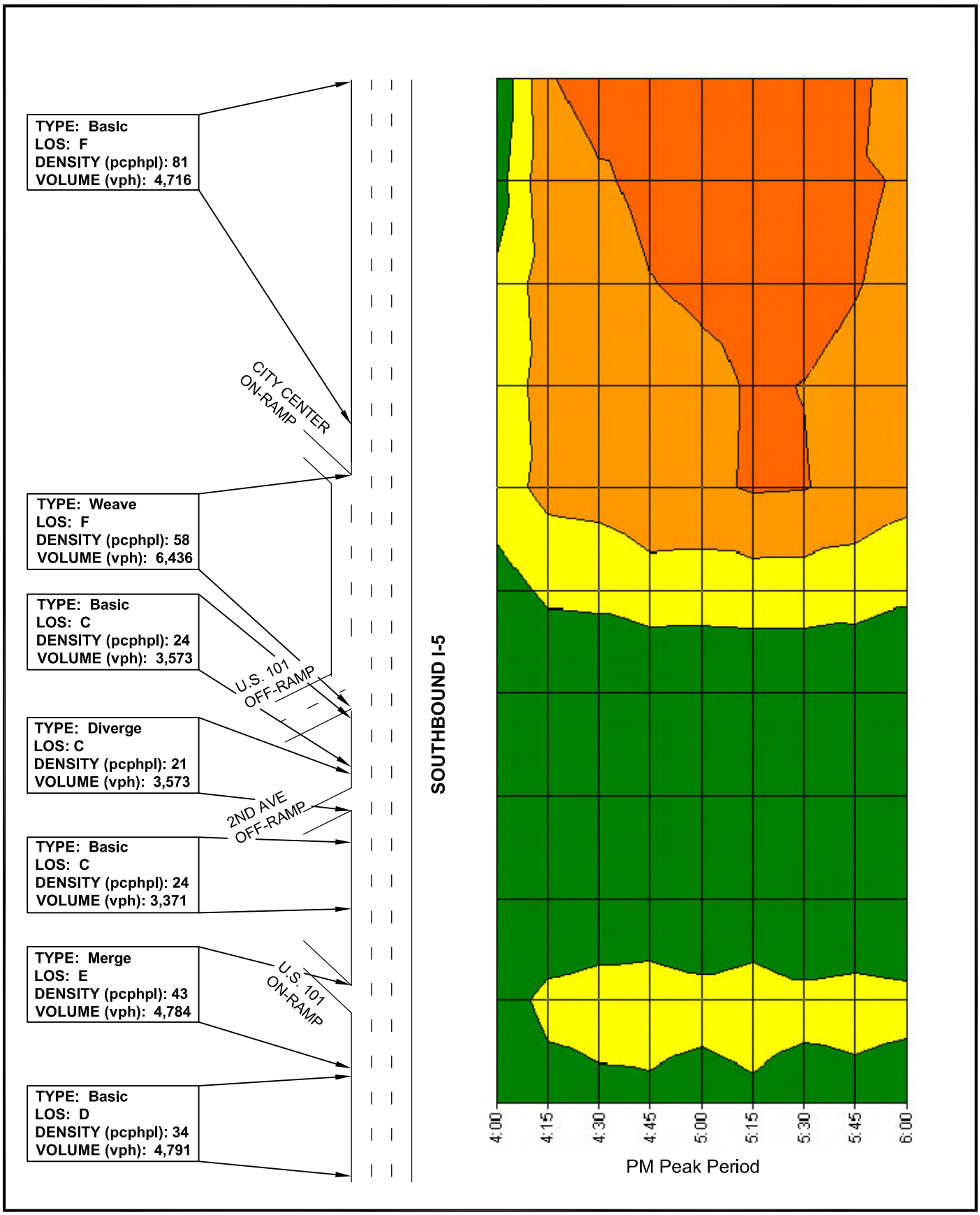
Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F09

N
No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 9
2030 No-Build Scenario 1
Northbound I-5 Freeway
PM Peak Period Operations



Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F10

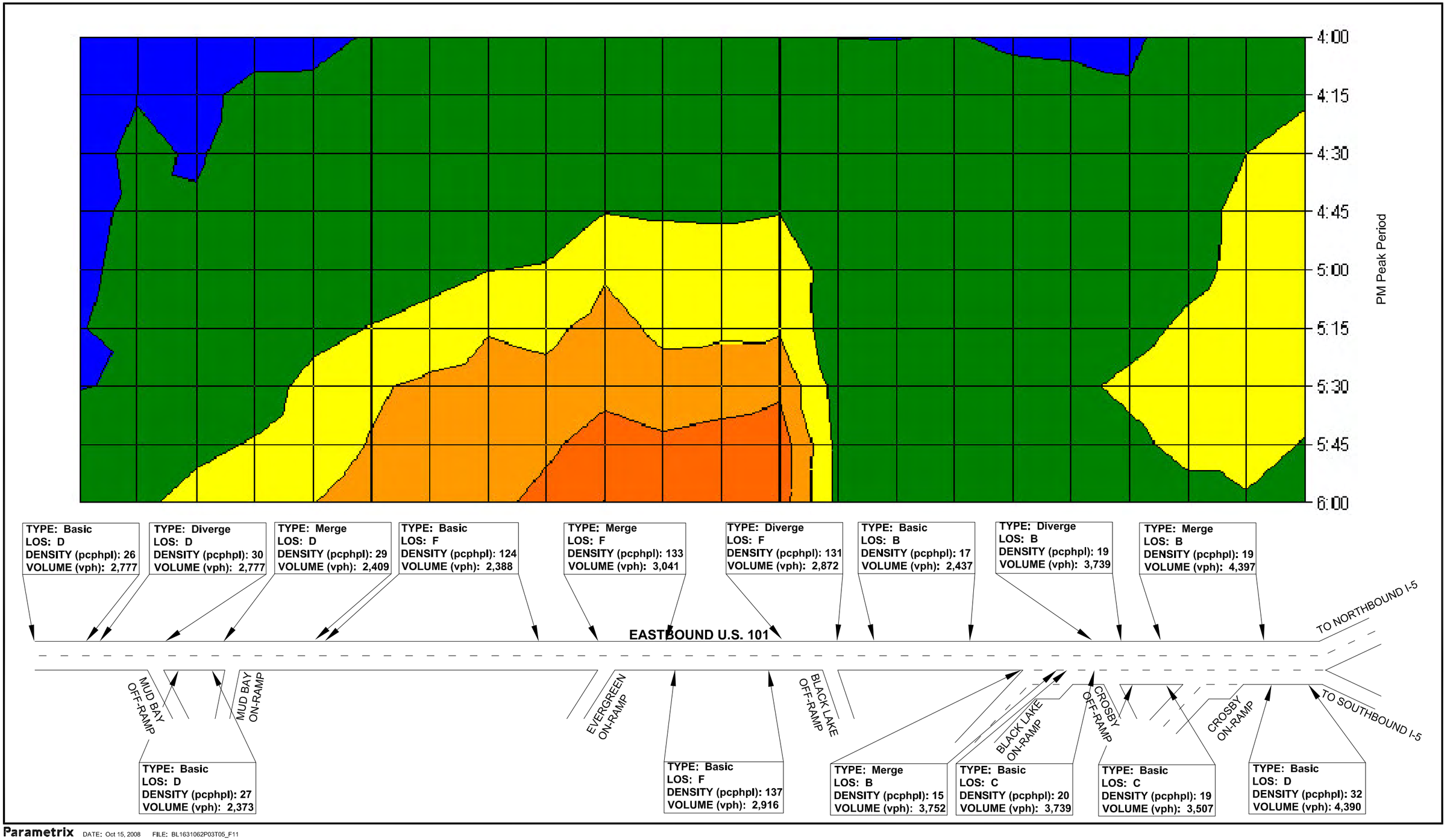
Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

N

No Scale

Figure 10
2030 No-Build Scenario 1
Southbound I-5 Freeway
PM Peak Period Operations



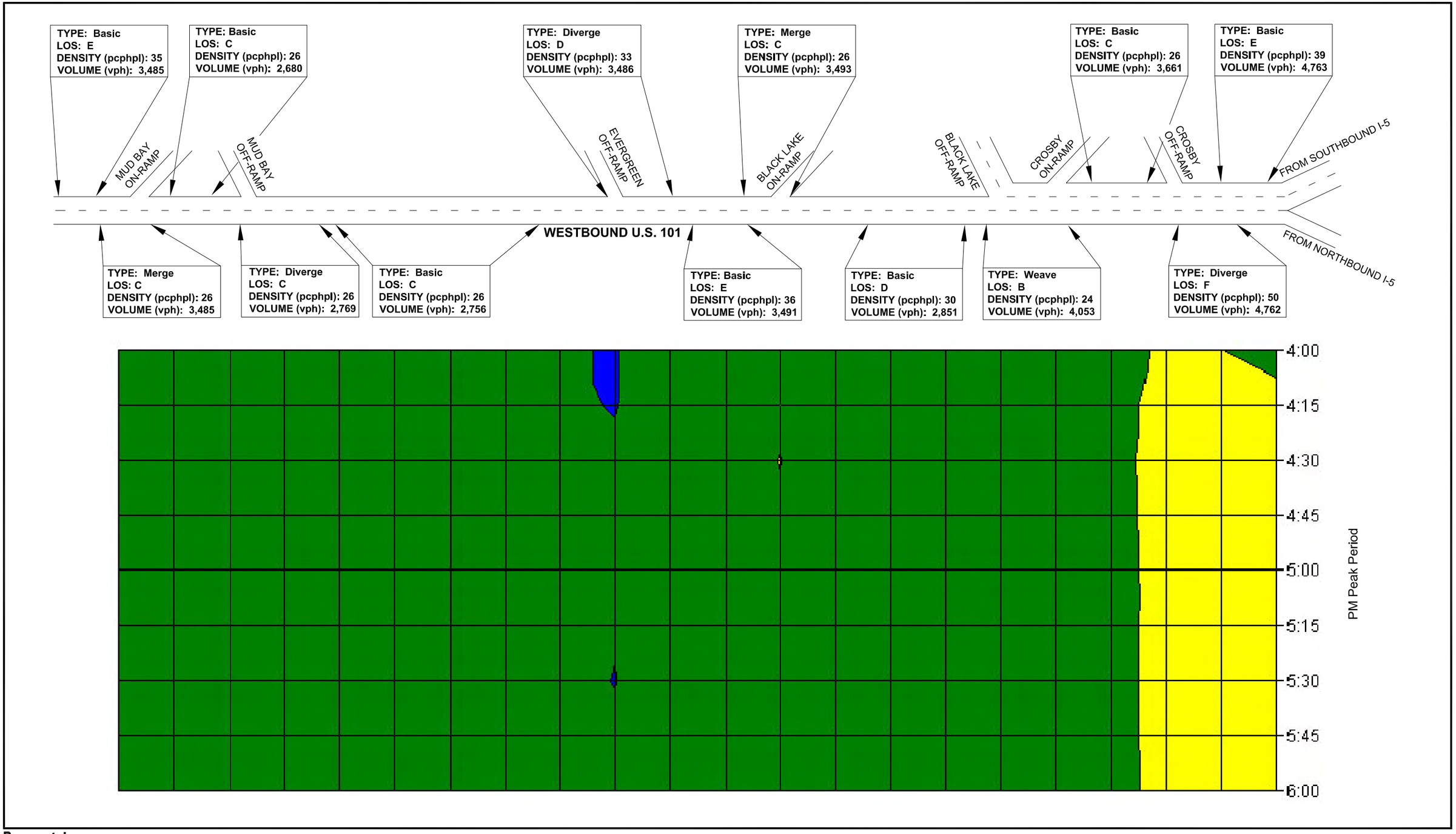
Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F11

N
No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 11
2030 No-Build Scenario 1
Eastbound U.S. 101 Freeway
PM Peak Period Operations



Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F12

N
No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 12
2030 No-Build Scenario 1
Westbound U.S. 101 Freeway
PM Peak Period Operations

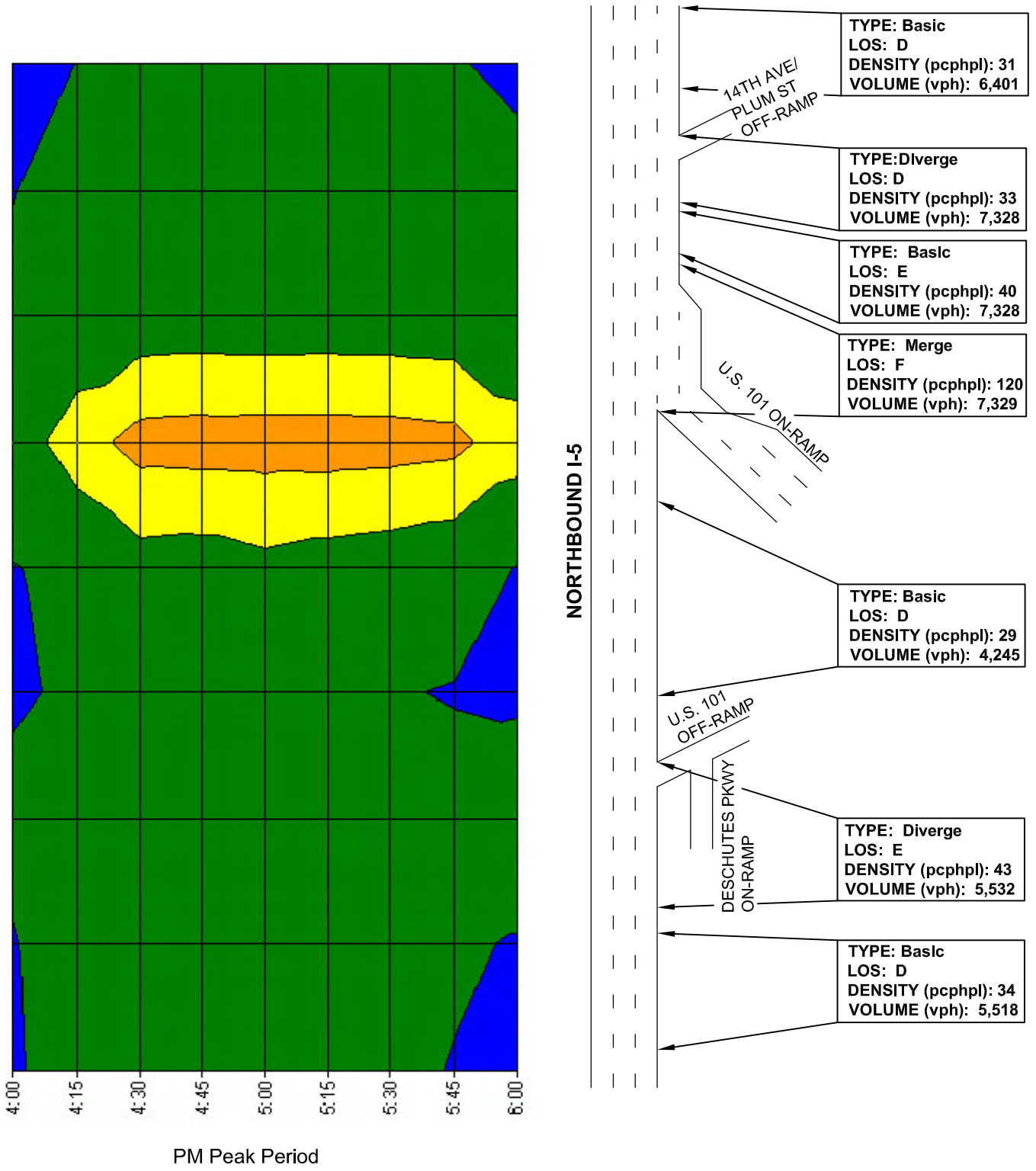
2030 Local System Only Scenario 3

Future 2030 traffic volumes along northbound I-5 under Scenario 3 are fairly similar to No-Build Scenario 1 volumes. Scenario 3 has increased volumes coming onto the northbound I-5 mainline from eastbound US 101, however, this relatively small increase in volume is not the result of additional demand, rather the release of bottleneck conditions at the Black Lake interchange, which is supported by a volume difference of less than 20 vehicles in the travel demand model. Figure 13 shows the 2030 traffic volumes along northbound I-5 under Scenario 3.

Local System Only Scenario 3 and No-Build Scenario 1 traffic volumes on southbound I-5 are comparable. Minor volume differences, less than 150 vehicles during the PM peak hour, suggests that southbound I-5 traffic volumes would be negligibly affected by local system improvements in the West Olympia vicinity since the total demand volumes along some portions of southbound I-5 exceed 6,000 vehicles per hour. Figure 14 shows the 2030 traffic volumes along southbound I-5 under Local System Only Scenario 3.

Approximately 2,800 vehicles enter the western limit of the study area on eastbound US 101 in the PM peak hour, which is the same as the No-Build Scenario 1. The amount of traffic to and from Mud-Bay Road SW is expected to be similar to No-Build. However, substantial changes in traffic volumes along eastbound US 101 are seen at the Evergreen on-ramp, Black Lake interchange and Crosby Boulevard interchange areas. Local improvements at the Black Lake and Crosby Boulevard interchanges substantially improve operations and serve a greater portion of the unmet demand exiting and entering the eastbound US 101 mainline. On- and off-ramp volumes are similar, but US 101 mainline volumes are generally between 450 and 600 vehicles higher with the Local System Only Scenario 3 compared to No-Build Scenario 1 due to the release of bottleneck conditions that precluded vehicles from being served as a result of heavy traffic congestion under No-Build Scenario 1. Figure 15 shows the 2030 traffic volumes along eastbound US 101 under the Local System Only Scenario 3.

Local System Only Scenario 3 is expected to have slightly higher traffic volumes (up to 250 vehicles) along the westbound US 101 mainline compared to No-Build Scenario 1. The demand between these two scenarios is generally the same, however, local improvements associated with the Local System Only Scenario 3 improve ramp termini operations and allow additional traffic volumes (upwards of 150 vehicles) to exit and enter the westbound US 101 mainline at the Crosby Boulevard and Black Lake interchanges. Figure 16 shows the 2030 traffic volumes along eastbound US 101 for the Local System Only Scenario 3.



Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F13

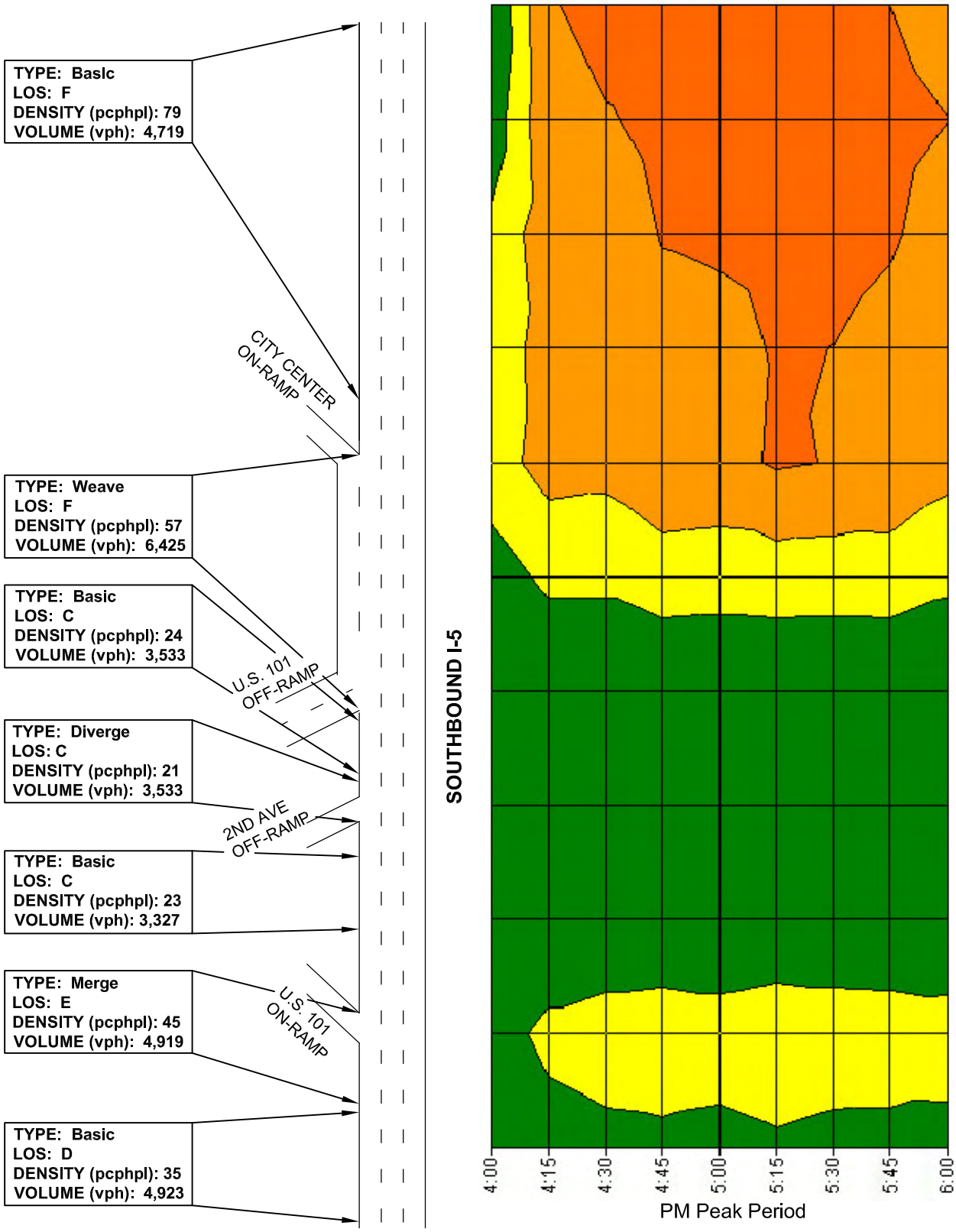
N

No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 13
2030 Local System Only Scenario 3
Northbound I-5 Freeway
PM Peak Period Operations



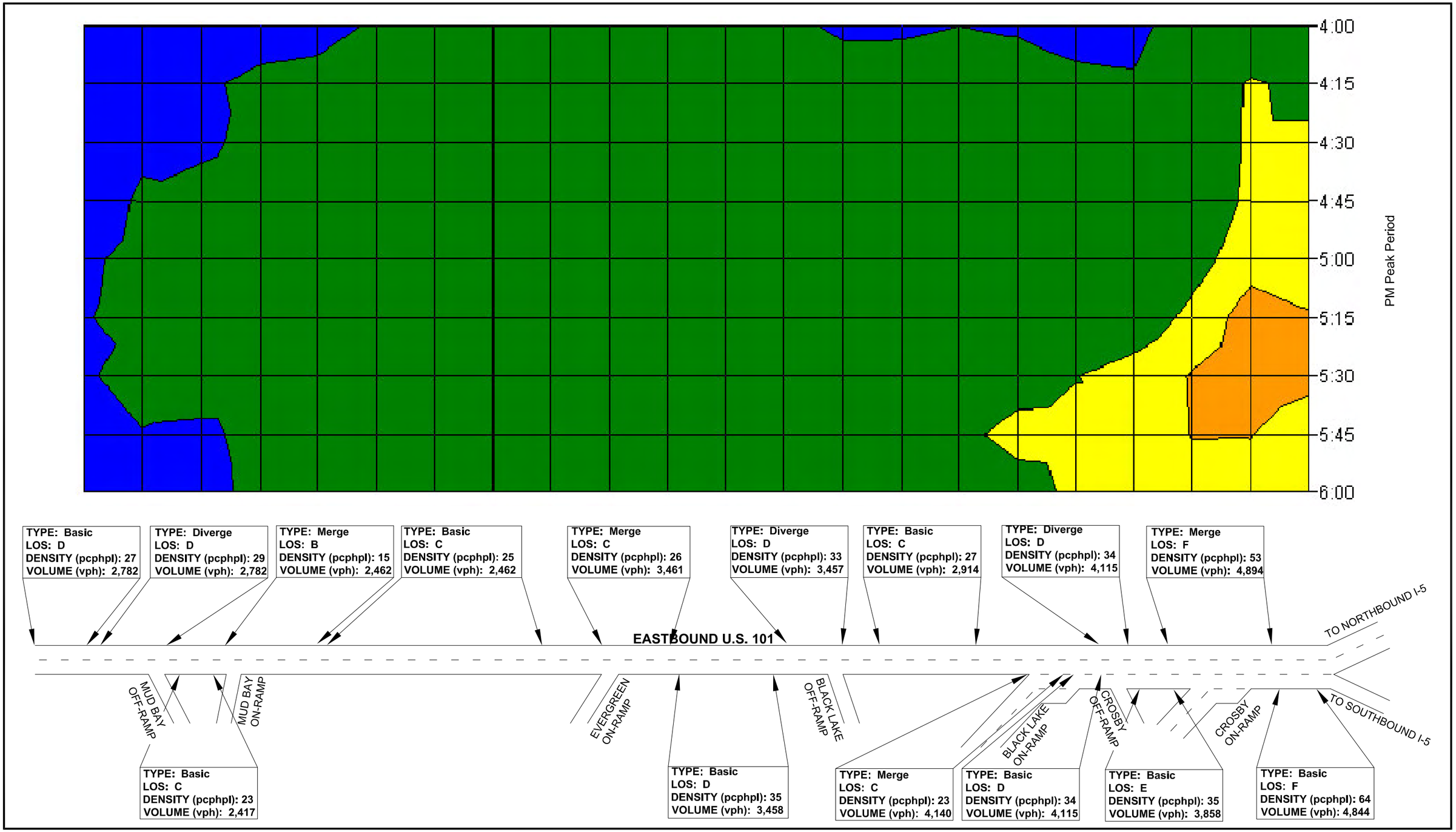
Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F14

N
No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 14
2030 Local System Only Scenario 3
Southbound I-5 Freeway
PM Peak Period Operations



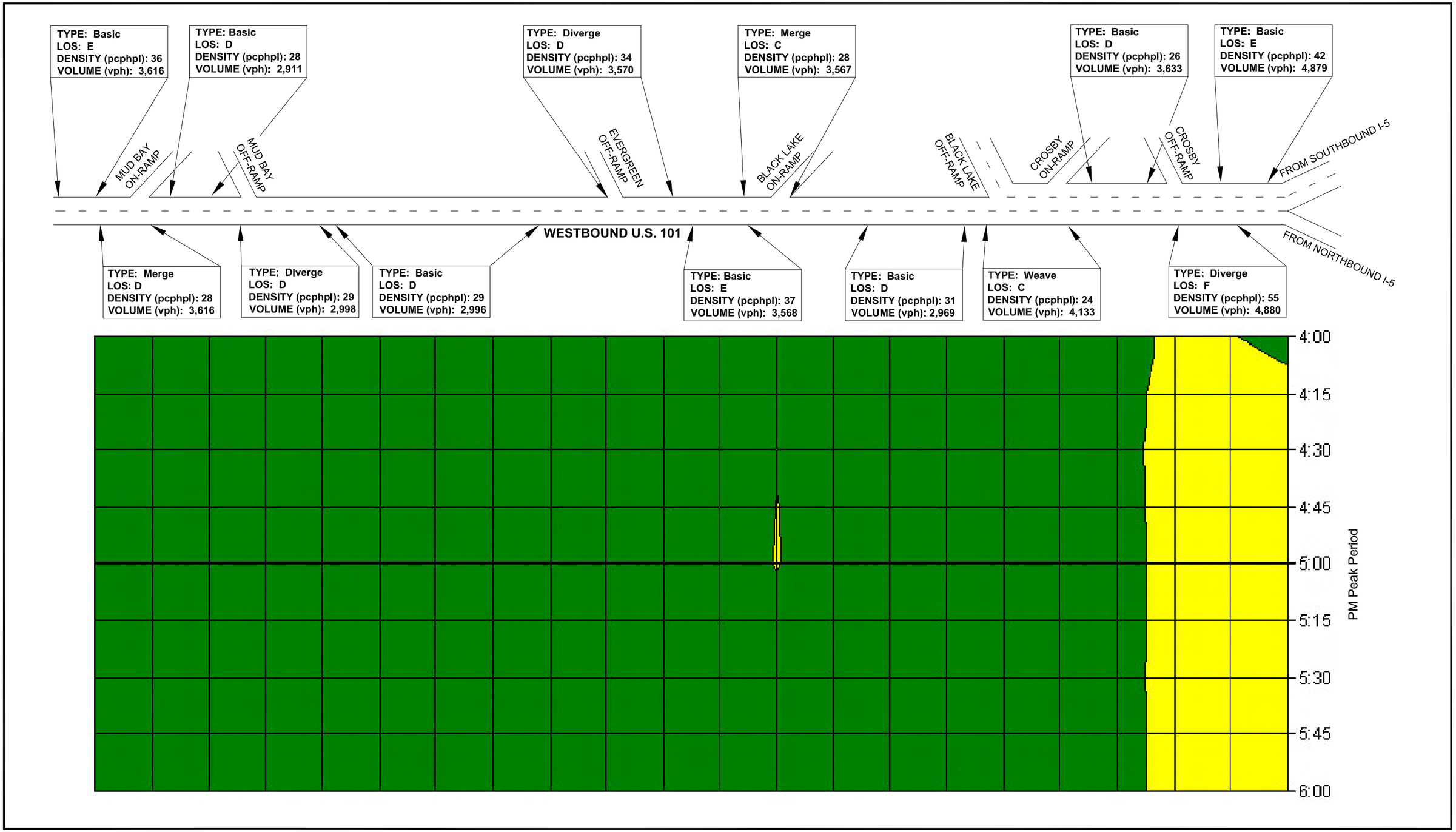
Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F15

N
No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 15
2030 Local System Only Scenario 3
Eastbound U.S. 101 Freeway
PM Peak Period Operations



Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F16

N
No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 16
2030 Local System Only Scenario 3
Westbound U.S. 101 Freeway
PM Peak Period Operations

2030 Black Lake Interchange Scenario 5

Traffic volumes along northbound I-5 for Scenario 5 are comparable to Local System Only Scenario 3 conditions along all the study segments. Compared to No-Build Scenario 1, Black Lake Scenario 5 has a small volume increase coming from eastbound US 101 to northbound I-5. As previously described, this small increase is attributed to the release of constrained demand at the Black Lake interchange. Figure 17 shows the 2030 traffic volumes along northbound I-5 for Black Lake Scenario 5

Traffic volumes for Scenarios 1, 3, and 5 on southbound I-5 are also generally similar. South of the US 101 on-ramp, the southbound I-5 mainline volume increases slightly as a result of releasing the constrained demand in queue at the Black Lake interchange under No-Build Scenario 1. Figure 18 shows the 2030 traffic volumes along southbound I-5 for Black Lake Scenario 5.

Traffic volumes entering eastbound US 101 under Black Lake Scenario 5 are similar to that of Local System Only Scenario 3 at the beginning of the study area and around the Mud Bay interchange. East of the Mud Bay interchange, US 101 mainline volumes increase with Black Lake Scenario 5 since better operations provide increased demand throughput. Figure 19 shows the 2030 traffic volumes along eastbound US 101 under Black Lake Scenario 5.

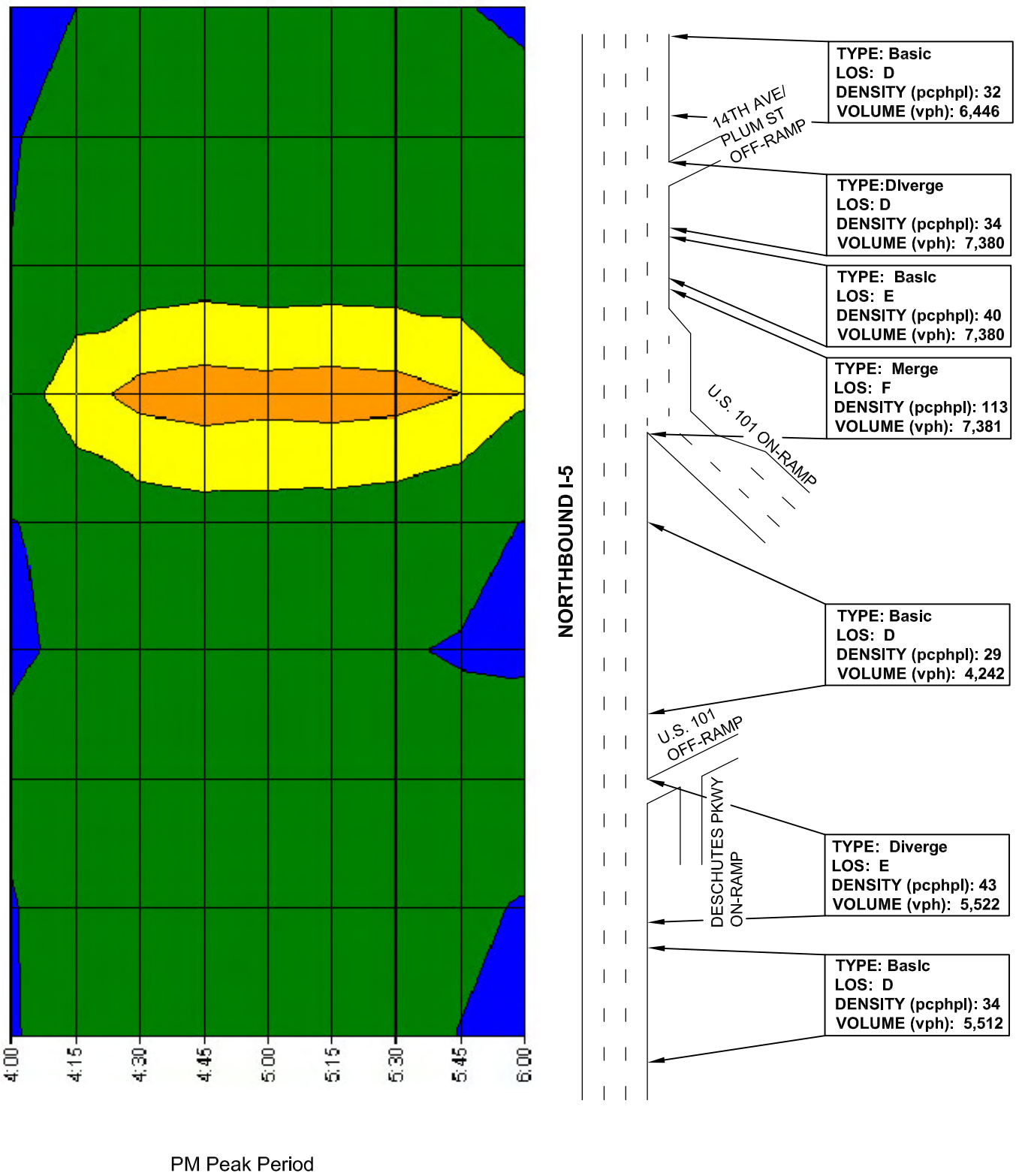
Westbound US 101 mainline volumes for Scenarios 5 and 3 are generally similar, however, a small volume (around 50 vehicles) is diverted from the Evergreen off-ramp to the Black Lake off-ramp. Figure 20 shows the 2030 traffic volumes along westbound US 101 under Black Lake Scenario 5.

2030 Evergreen Interchange Scenario 7

Scenario 7 traffic volumes along northbound and southbound I-5 are similar to those of Local System Only Scenario 3 and Black Lake Scenario 5. As with Scenarios 3 and 5, the Evergreen interchange improvements on US 101 and the local system improvements under Scenario 7 have a small effect on northbound and southbound I-5 traffic volumes. Figure 21 and Figure 22 show the 2030 traffic volumes along northbound I-5 and southbound I-5 under Evergreen Scenario 7.

The traffic volumes entering the western end of the study area on eastbound US 101 for Evergreen Scenario 7 are generally consistent with the traffic volumes of Scenarios 3 and 5. A small volume, approximately 25 vehicles, is expected to utilize the new eastbound Evergreen off-ramp during the PM peak hour. The existing eastbound Evergreen on-ramp volume increases by approximately 200 vehicles compared to Scenarios 3 and 5 as a result of the connection between the on-ramp and Kaiser Road SW. East of Evergreen interchange, eastbound US 101 mainline volumes for Evergreen Scenario 7 are similar to Scenarios 3 and 5. Figure 23 shows the 2030 traffic volumes along eastbound US 101 under Evergreen Scenario 7.

Traffic volumes along westbound US 101 for Evergreen Scenario 7 are generally similar to Scenarios 3 and 5 up to the Black Lake interchange. At the reconfigured westbound Evergreen off-ramp, which connects to Kaiser Road SW, an additional 300 vehicles exit the westbound US 101 mainline under Evergreen Scenario 7. The new westbound Evergreen on-ramp is expected to serve approximately 150 vehicles during the PM peak hour. Figure 24 shows the 2030 traffic volumes along westbound US 101 under Evergreen Scenario 7.



Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F17

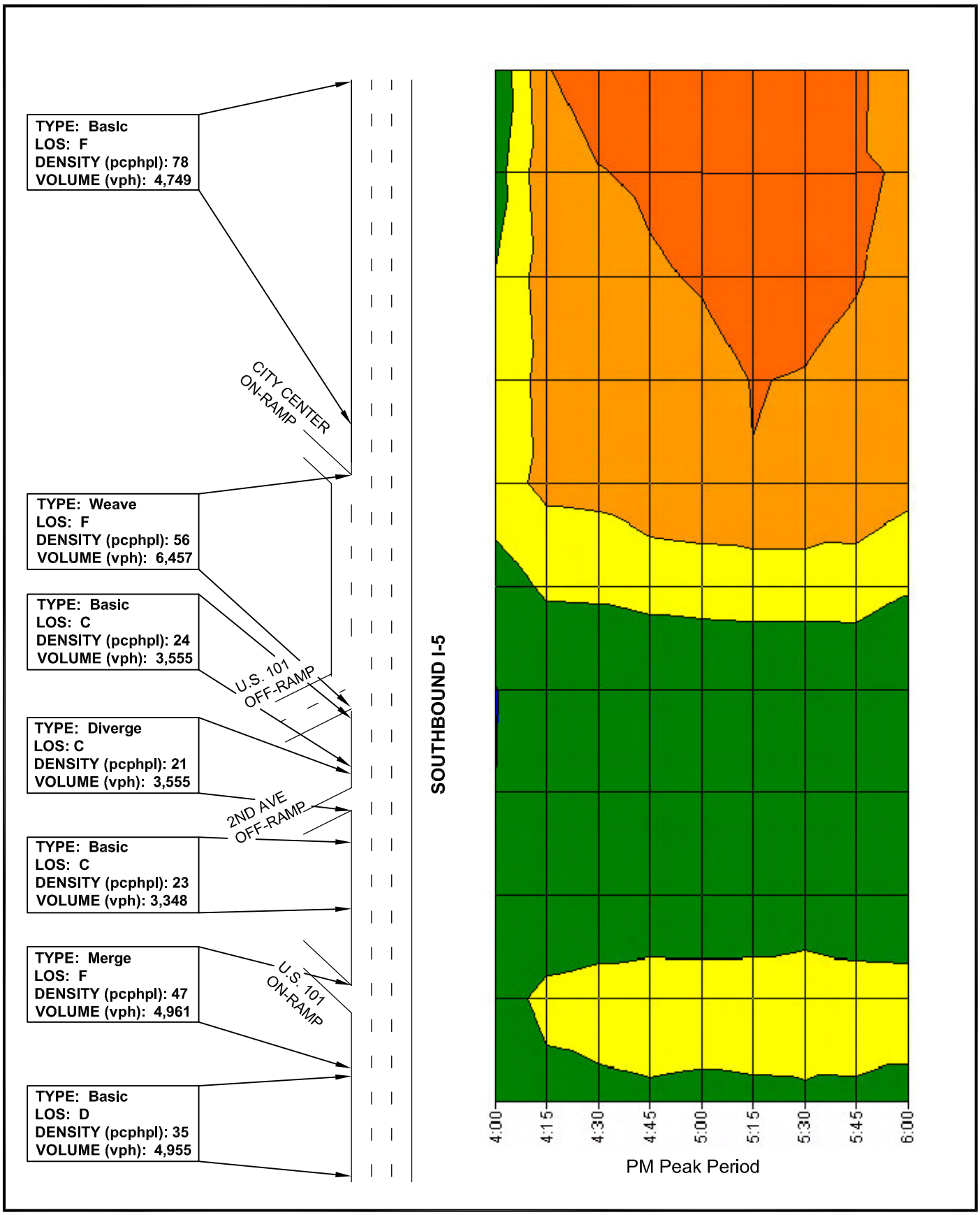
Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

N

No Scale

Figure 17
2030 Black Lake Interchange Scenario 5
Northbound I-5 Freeway
PM Peak Period Operations



Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F18

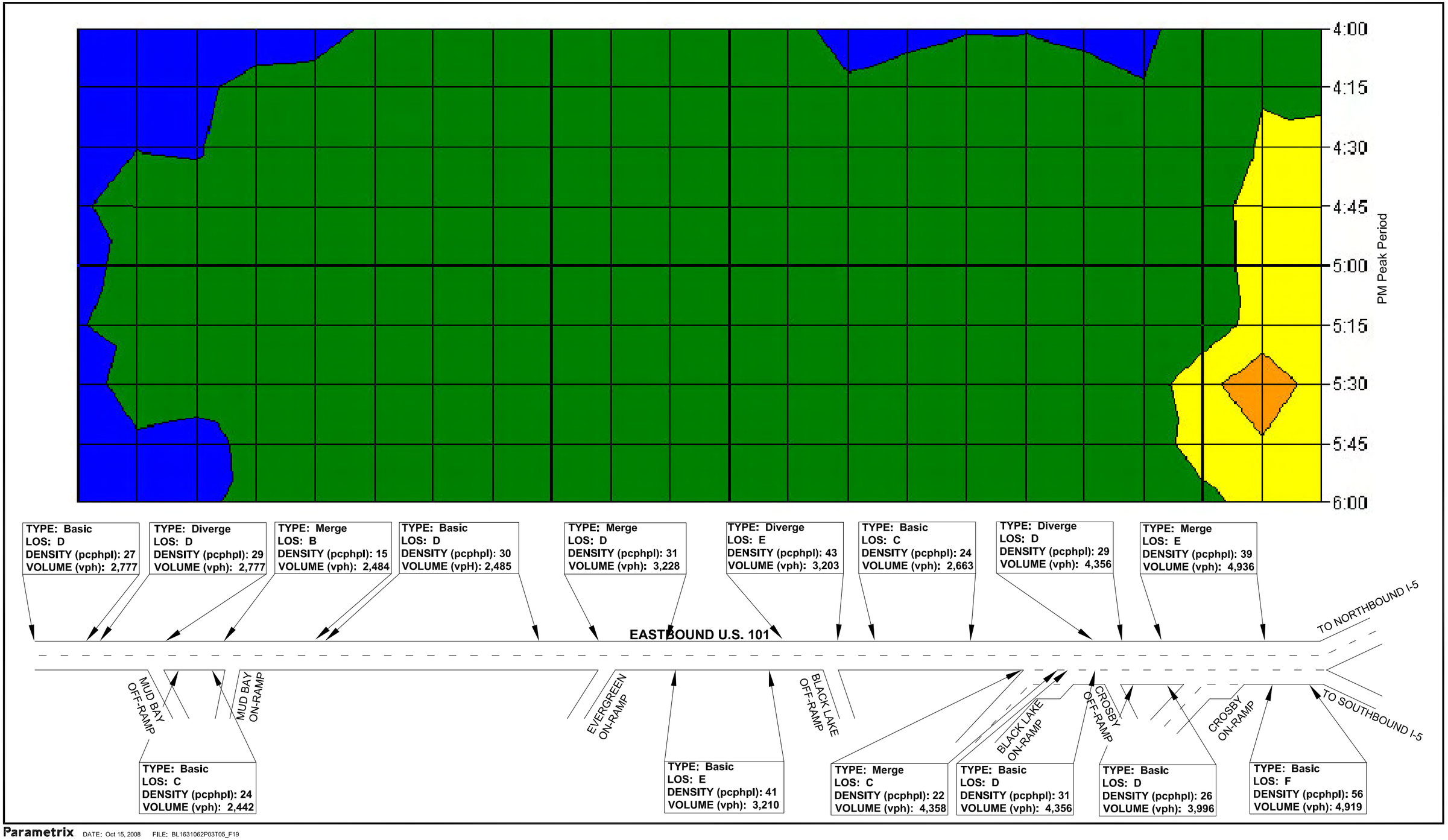
Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

N

No Scale

Figure 18
2030 Black Lake Interchange Scenario 5
Southbound I-5 Freeway
PM Peak Period Operations



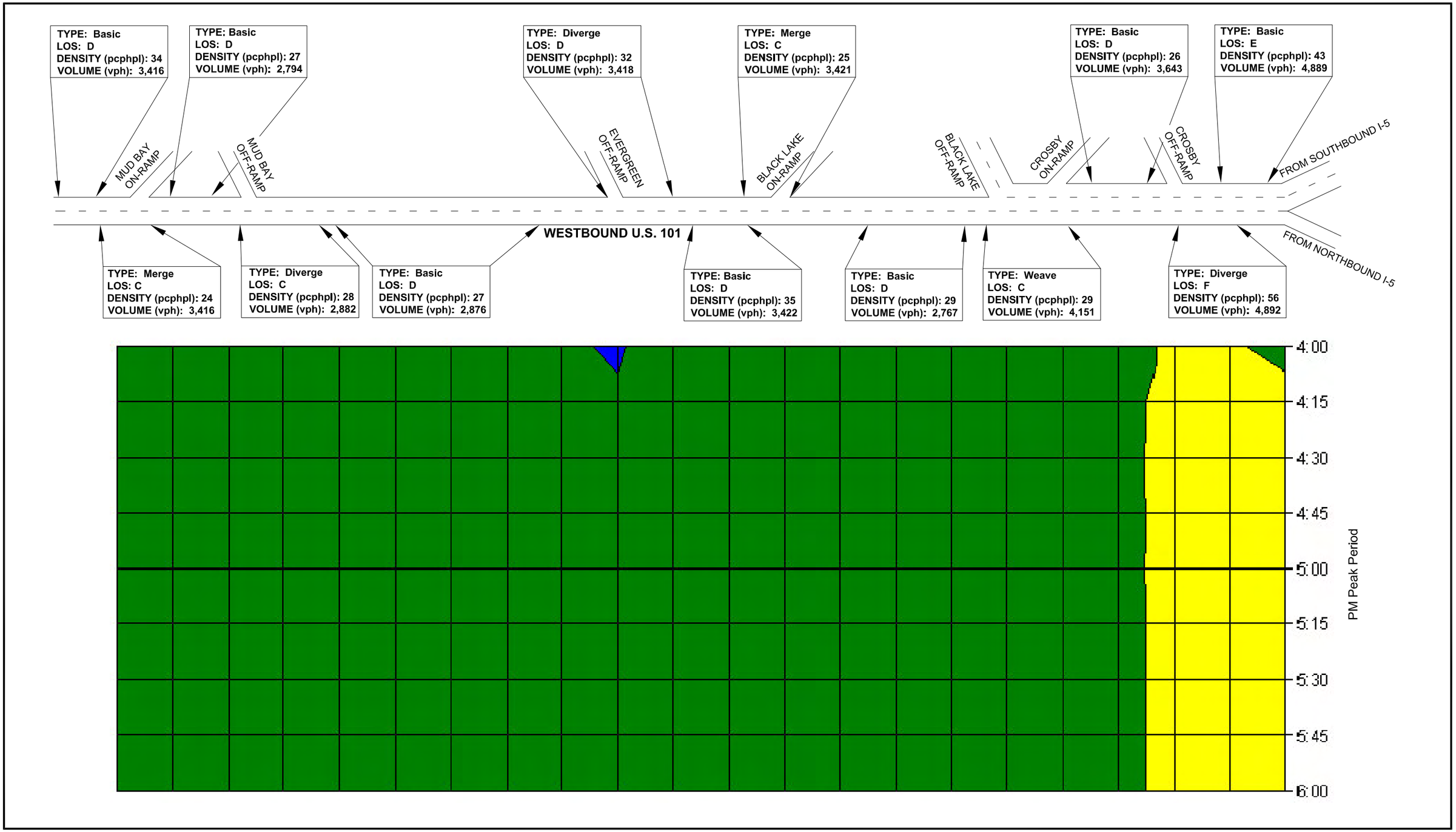
Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F19

N
No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 19
2030 Black Lake Interchange Scenario 5
Eastbound U.S. 101 Freeway
PM Peak Period Operations



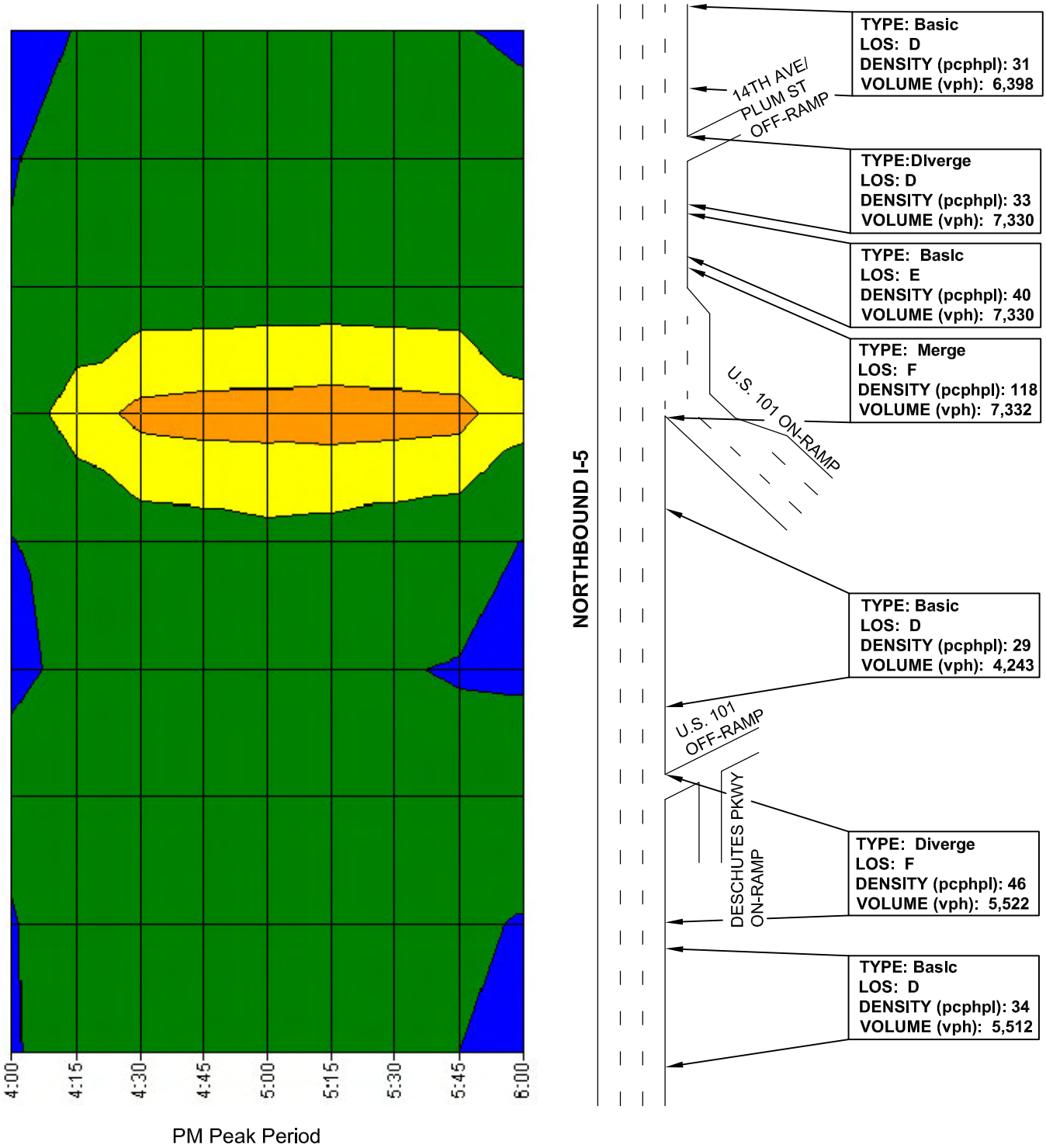
Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F20

N
No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 20
2030 Black Lake Interchange Scenario 5
Westbound U.S. 101 Freeway
PM Peak Period Operations



Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F21

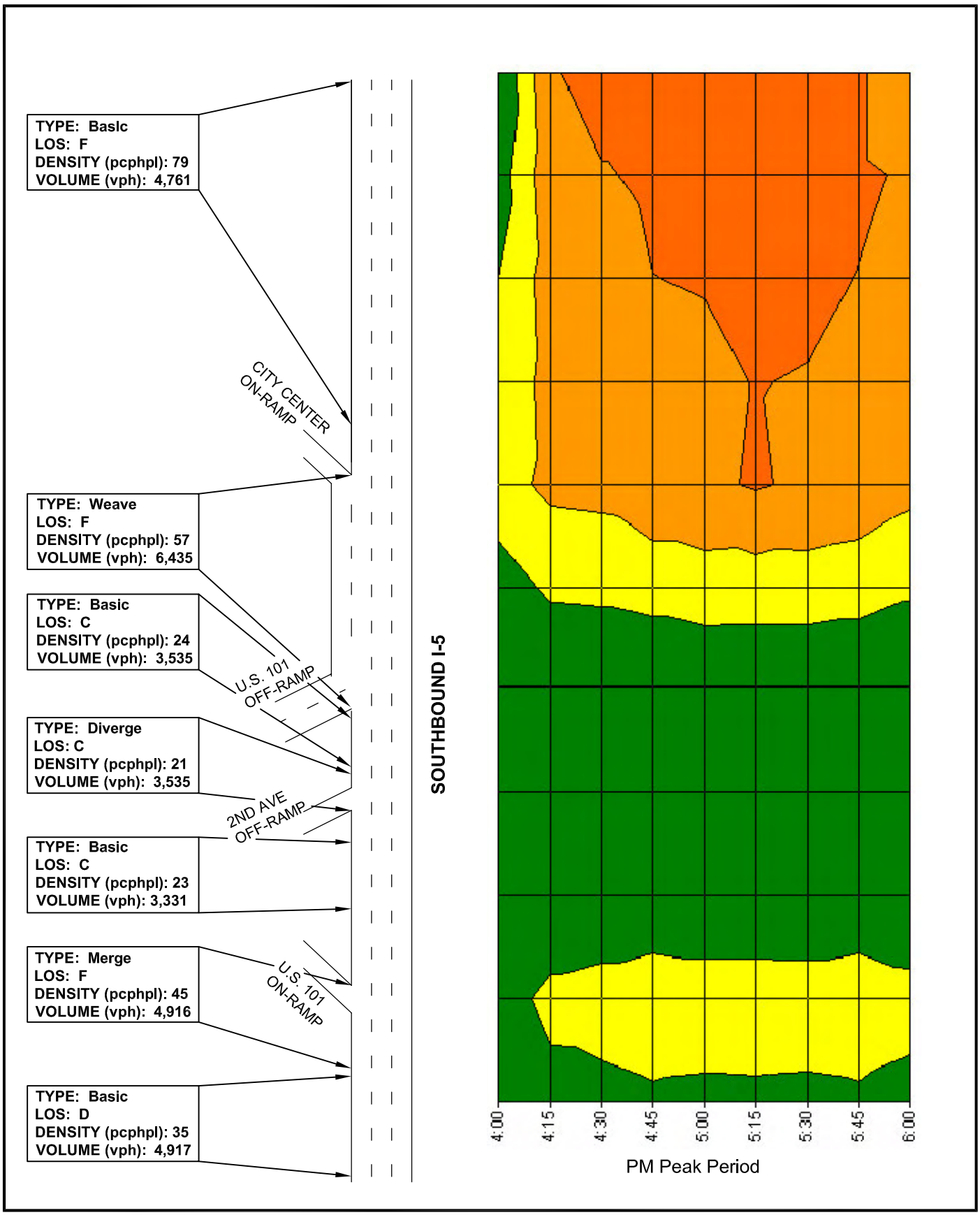
Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

N

No Scale

Figure 21
2030 Evergreen Interchange Scenario 7
Northbound I-5 Freeway
PM Peak Period Operations



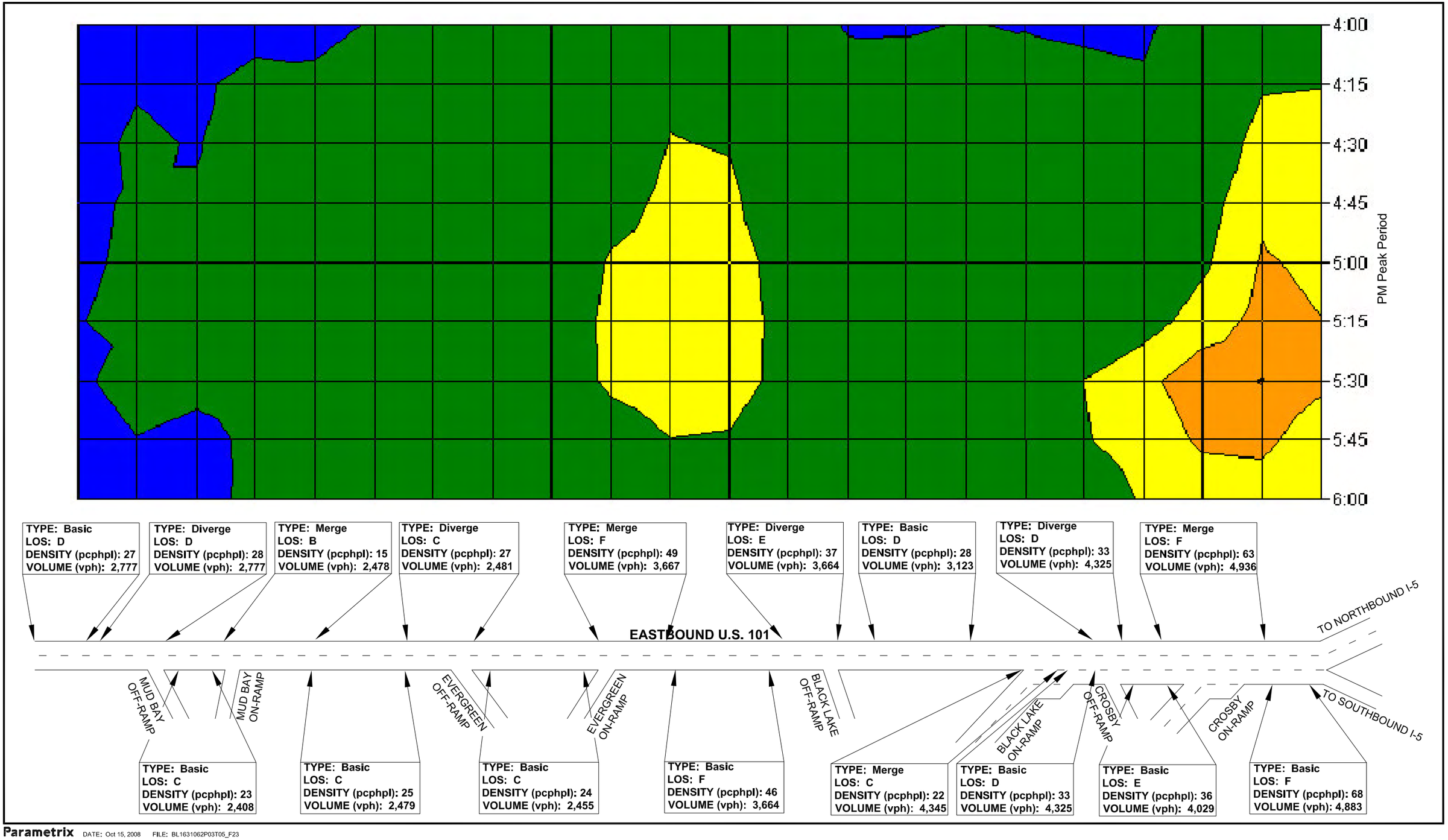
Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F22

N
No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 22
2030 Evergreen Interchange Scenario 7
Southbound I-5 Freeway
PM Peak Period Operations



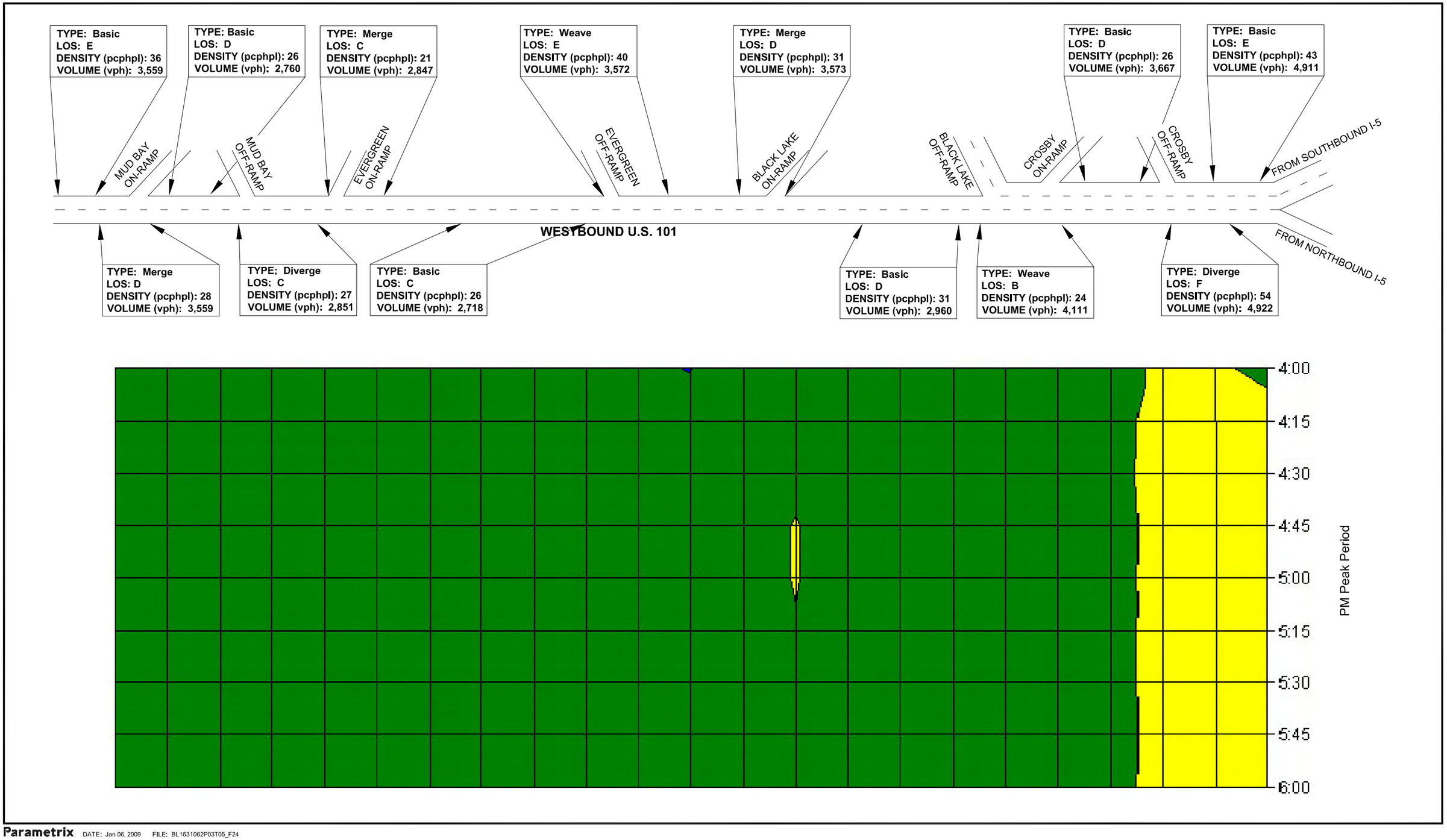
Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F23

N
No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 23
2030 Evergreen Interchange Scenario 7
Eastbound U.S. 101 Freeway
PM Peak Period Operations



Parametrix DATE: Jan 06, 2009 FILE: BL1631062P03T05_F24

N
No Scale

Travel Speeds

60-70 mph	30-40 mph	0-10 mph
50-60 mph	20-30 mph	
40-50 mph	10-20 mph	

Figure 24
2030 Evergreen Interchange Scenario 7
Westbound U.S. 101 Freeway
PM Peak Period Operations

Freeway System LOS (Densities)

Similar to the existing conditions freeway analysis, VISSIM version 4.3 was used to calculate freeway densities in terms of vehicles per mile per lane. Heavy vehicle percentages obtained from the WSDOT and HCM adjustment factors were used to convert vehicles per mile per lane to passenger cars per mile per lane to determine the freeway LOS.

In general, LOS D is the acceptable level of service threshold for urban freeway facilities as set by WSDOT. Table 10 compares existing and future I-5 and US 101 mainline segment types expected to operate at LOS E or F and Attachment D provides an expanded version of this table.

2030 No-Build Scenario 1

As shown in Table 10, three segments each of northbound and southbound I-5, four segments of eastbound US 101, and four segments of westbound US 101 are expected to operate worse than LOS D for No-Build Scenario 1.

The three segments along the northbound I-5 mainline that operate at LOS E/F are around the US 101 off-ramp, US 101 on-ramp, and I-5 mainline north of the US 101 on-ramp. Vehicles exiting to westbound US 101 face horizontal and vertical curves that slow traffic speeds, especially for heavy vehicles. Coupling off-ramp geometrics with high exiting volumes reduces flow and creates high densities in the outside lane of the northbound I-5 mainline. The densities and LOS along the northbound I-5 mainline are shown on Figure 9.

The three segments along the southbound I-5 mainline that operate at LOS E/F are the southbound mainline around Plum Street, US 101 off-ramp, and US 101 on-ramp. Similar to existing conditions, the primary contributor to high traffic densities and LOS E/F congestion in these areas is the short weave section between the Plum Street on-ramp and the US 101 off-ramp, but is exacerbated by higher traffic volumes and more lane change maneuvers. The geometrics of the US 101 off-ramp, which includes horizontal and vertical curves, also contribute to congestion. Figure 10 shows the densities and LOS along the southbound I-5 mainline.

From west of the Evergreen on-ramp to east of the Black Lake off-ramp the eastbound US 101 mainline is expected to experience substantially high densities and LOS F conditions. This is caused due to the bottleneck conditions at the Black Lake interchange that limit the volume of exiting vehicles and causes queues that spillback onto the US 101 mainline. East of the Black Lake interchange the densities substantially decrease as a result of Black Lake bottleneck. Figure 11 shows the LOS and density along the eastbound US 101 mainline.

Westbound US 101, around the Crosby Boulevard interchange, is expected to experience high densities and LOS E/F conditions. This congestion is due to the weaving of vehicles coming from southbound I-5 attempting to move into the left-most lane to bypass the Crosby off-ramp and vehicles coming from northbound I-5 weaving towards the Crosby off-ramp coupled with the steep grade. In addition to the Crosby Boulevard interchange area, the US 101 mainline west of the Evergreen off-ramp is expected to operate at LOS E. Figure 12 shows the LOS and density along the westbound US 101 mainline.

2030 Local System Only Scenario 3

Three segments each of northbound and southbound I-5, three segments of eastbound US 101, and four segments of westbound US 101 operate worse than LOS D for Local System Only Scenario 3.

Density and LOS values along northbound I-5 for Local System Only Scenario 3 are similar to those of No-Build Scenario 1 except at the US 101 on-ramp, where the density increases by a considerable amount. This is attributed to the increase in the traffic volume from eastbound US 101 to northbound I-5 caused by

clearing the bottleneck at the Black Lake interchange. The densities and LOS for northbound I-5 under Local System Only Scenario 3 are shown on Figure 13.

Density and LOS values along southbound I-5 for Local System Only Scenario 3 are also similar to No-Build Scenario 1. Near the eastbound US 101 on-ramp to southbound I-5, the density increases slightly as a result of improved operating conditions around the Black Lake interchange. Figure 14 shows the densities and LOS along the southbound I-5 mainline for Local System Only Scenario 3.

Operations along eastbound US 101 for Local System Only Scenario 3 substantially improve in some areas and worsen in other areas compared to No-Build Scenario 1 as a result of the Black Lake bottleneck clearance. Eastbound US 101 operates at or above the LOS standards from the west end of the study area to the Crosby on-ramp. The Crosby Boulevard on-ramp and two mainline segments before and after the on-ramp operate at LOS E/F. This relocation of congestion is caused by the increase in the throughput volumes in the eastbound direction as a result of clearing the Black Lake bottleneck. Overall, the eastbound US 101 mainline operates substantially better with Local System Only Scenario 3 compared to No-Build Scenario 1. Figure 15 shows the LOS and density along the eastbound US 101 mainline for Local System Only Scenario 3.

The densities and LOS along westbound US 101 for Local System Only Scenario 3 are similar to No-Build Scenario 1. Although the densities increase by a small amount (up to 5 pc/mi/ln) in some locations, the overall difference in westbound US 101 densities is only 2 pc/mi/ln and the LOS does not change. These negligible changes are likely the result of the stochastic nature of the model since no improvements to westbound US 101 are included in Local System Only Scenario 3. Figure 16 shows the densities and LOS along the westbound US 101 mainline for Local System Only Scenario 3.

2030 Black Lake Interchange Scenario 5

Three segments each of northbound and southbound I-5, four segments of eastbound US 101, and two segments of westbound US 101 operate worse than LOS D for Black Lake Scenario 5.

Black Lake Scenario 5 densities and LOS values for northbound I-5 are very similar to those of Local System Only Scenario 3. Both Scenarios 3 and 5 slightly increase densities on northbound I-5 around the US 101 on-ramp since traffic volumes at the Black Lake bottleneck are released. Figure 17 shows the densities and LOS for the northbound I-5 mainline for Black Lake Scenario 5.

Southbound I-5 densities and LOS are similar to Scenarios 3; densities increase slightly around the US 101 on-ramp by up to 4 pc/mi/ln. Densities and LOS for the southbound I-5 mainline are shown on Figure 18 for Black Lake Scenario 5.

Differences in eastbound US 101 operations between Black Lake Scenario 5 and Local System Only Scenario 3 are most notable east of the Black Lake on-ramp, where the Scenario 5 densities are higher than Scenario 3. The increase in the density at Black Lake on-ramp is caused by the diversion of traffic from the Evergreen on-ramp to the new Yauger Way on-ramp. The increase in the density at the Black Lake on-ramp causes slight reduction in speeds which in turn reduces densities downstream. Figure 19 shows the densities and LOS along eastbound US 101 mainline for Black Lake Scenario 5.

Westbound US 101 operations in Black Lake Scenario 5 are similar to Local System Only Scenario 3; congestion continues to occur around the Crosby Boulevard interchange, but operates at nearly free flow conditions westward. Westbound US 101 densities and LOS associated with Black Lake Scenario 5 are shown on Figure 20.

2030 Evergreen Interchange Scenario 7

Three segments each of northbound and southbound I-5, six segments of eastbound US 101, and four segments of westbound US 101 operate worse than LOS D for Evergreen Scenario 7.

Evergreen Scenario 7 densities and LOS values for northbound I-5 are similar to those of Local System Only Scenario 3 and Black Lake Scenario 5. Three segments of the northbound I-5 mainline are expected to experience high densities and LOS E/F conditions, including the US 101 merge and diverge areas and a basic segment downstream (north) of the US 101 on-ramp. Figure 21 shows the densities and LOS conditions along the northbound I-5 mainline for Evergreen Scenario 7.

Similar to Scenarios 3 and 5, southbound I-5 densities are expected to result in LOS E/F conditions around the Plum Street/US 101 weave section and around the US 101 on-ramp as a result of heavy lane change maneuvers and high traffic volumes. The southbound I-5 densities and LOS conditions for Evergreen Scenario 7 are shown on Figure 22.

Segments of the eastbound US 101 mainline from the Evergreen on-ramp to the I-5 interchange are expected to have high densities and LOS E/F conditions as a result of increased traffic volumes from the re-aligned eastbound Evergreen on-ramp. These additional volumes (about 200 vehicles during the PM peak hour), as described above, are the result of the connection between the re-align on-ramp and Kaiser Road SW. Figure 23 shows the eastbound US 101 densities and LOS for Evergreen Scenario 7.

Westbound US 101 densities and LOS for Scenario 7 are similar to Scenarios 3 and 5 and the operational characteristics and causes for high densities are generally the same. Figure 24 shows the densities and LOS along the westbound US 101 mainline for Evergreen Scenario 7.

Table 10. 2030 No-Build and Build Scenarios, Failing Densities and LOS

Segment	Type	2030 No-Build Scenario 1		2030 Local System Only w/ SW Connections Scenario 3		2030 Black Lake Interchange w/ SW Connections Scenario 5		2030 Evergreen Interchange w/ SW Connections Scenario 7	
		Density (pc/mi/ln)	LOS (HCM Equivalent)	Density (pc/mi/ln)	LOS (HCM Equivalent)	Density (pc/mi/ln)	LOS (HCM Equivalent)	Density (pc/mi/ln)	LOS (HCM Equivalent)
Northbound I-5									
NB I-5 US 101 Off-Ramp	Diverge	40.7	E	43.0	E	43.3	E	45.6	F
NB I-5 US 101 On-Ramp	Merge	81.4	F	119.5	F	112.7	F	117.5	F
NB I-5	Basic	37.5	E	40.2	E	40.4	E	39.9	E
Northbound I-5 Average [1]		**40.5**		**47.1**		**46.3**		**47.2**	
Southbound I-5									
SB I-5	Basic	80.7	F	78.5	F	78.4	F	79.1	F
SB I-5 US 101 Weave	Weave	57.3	F	57.0	F	56.3	F	57.2	F
SB I-5 US 101 On-Ramp	Merge	42.8	E	45.0	E	47.4	F	45.3	F
Southbound I-5 Average [1]		**40.4**		**40.4**		**40.8**		**40.6**	
Eastbound US 101									
EB US 101	Basic	124.0	F	24.8	C	29.5	D	24.9	C
EB US 101 Evergreen On-Ramp	Merge	133.3	F	25.7	C	30.7	D	48.9	F
EB US 101	Basic	136.9	F	34.7	D	41.2	E	45.7	F
EB US 101 Black Lake Off-Ramp	Diverge	130.6	F	33.2	D	42.9	E	37.4	E
EB US 101	Basic	18.7	C	35.1	E	26.2	D	36.2	E
EB US 101 Crosby Blvd On-Ramp	Merge	19.3	B	52.8	F	38.6	E	62.6	F
EB US 101	Basic	31.6	D	63.6	F	55.9	F	67.6	F
Eastbound US 101 Average [1]		**51.9**		**32.1**		**31.0**		**34.3**	
Westbound US 101									
WB US 101 e/o Crosby Blvd	Basic	38.5	E	42.4	E	42.6	E	43.4	E
WB US 101 Crosby Blvd Off-Ramp	Diverge	49.7	F	54.9	F	55.9	F	54.3	F
WB US 101	Basic	35.6	E	36.6	E	34.6	D	NA	NA
WB US 101 Evergreen Off-Ramp	Weave	32.9	D	34.0	D	32.2	D	40.0	E
WB US 101	Basic	35.2	E	36.4	E	33.9	D	35.9	E
Westbound US 101 Average [1]		**30.8**		**32.9**		**31.8**		**31.5**	
Average of All Densities		**41.7**		**36.2**		**35.4**		**37.6**	
Sum of All Densities		**1710**		**1484**		**1453**		**1542**	

[1] Average of all mainline segments, including segments operating at LOS A, B, C, and D (not shown).

Freeway System Speeds

Travel speeds along I-5 and US 101 were also identified as an operational MOE. Similar to existing conditions, the freeway speeds were collected for every 250 feet along the I-5 and US 101 mainlines.

2030 No-Build Scenario 1

No-Build Scenario 1 PM peak period speed conditions along I-5 are shown in Figures 9 and 10, and Figures 11 and 12 display the speeds along US 101. Note that these figures illustrate the operational speeds during the PM peak period (4:00 to 6:00 PM, two hours), but the densities, LOS, and volumes are for the PM peak hour (4:30 to 5:30 PM, one hour).

As shown in Figure 9, year 2030 northbound I-5 mainline speeds are generally around free flow conditions except at the US 101 on-ramp. High volumes coming from US 101 and a three-lane on-ramp merge area are expected to reduce the operating speeds to 30 to 50 mph around the US 101 on-ramp.

The 2030 No-Build operating speeds for southbound I-5 are shown in the Figure 10. The operational speeds along the mainline north of the City Center on-ramp are expected to be around 20 to 40 mph for most of the PM peak period. Southbound I-5 speeds south of the City Center on-ramp to the US 101 off-ramp are expected to be around 30 to 50 mph for most of the peak period. The reduction in speeds is caused by the weave created between the City Center on-ramp and US 101 off-ramp, which causes the queue to spill back north of the study area limits. Operating speeds at the US 101 on-ramp are also expected to reduce slightly (from 50 to 60 mph to 40 to 50 mph) as a result of high traffic volumes coming from US 101.

Eastbound US 101 travel speeds generally vary between 50 to 70 mph for the first half of the peak period (from 4:00 PM to 5:00 PM). During the second half of the PM peak period (after 5:00 PM) the operational speeds beginning at the west end of the study area are expected to decrease to 40 to 50 mph around the Mud Bay interchange, progressively worsen to 30 to 40 mph just after the Mud Bay Road on-ramp, and continue to decrease to 20 to 30 mph for short segments at the Evergreen on-ramp and Black Lake off-ramp. The worsening of speeds is the result of queues at the Black lake off-ramp spilling back onto the US 101 mainline. Because a substantial volume of traffic is queued behind the Black Lake interchange, volumes that do pass this area operate around 50 to 60 mph. Near the Crosby Boulevard on-ramp, travel speeds are expected to decrease to 40 to 50 mph as a result of high traffic volumes coming onto the US 101 mainline from Crosby Boulevard. Figure 11 shows the travel speeds along eastbound US 101 for No-Build Scenario 1.

The 2030 No-Build Scenario 1 operating speeds along westbound US 101 are shown on Figure 12. Westbound US 101 operates at free flow speeds except for the segment between I-5 and the Crosby Boulevard off-ramp where the speeds vary around 40 to 50 mph. This is caused due to the weaving of vehicles coming from southbound I-5 attempting to move into the left-most lane to bypass the Crosby off-ramp and vehicles coming from northbound I-5 weaving towards the Crosby off-ramp coupled with the steep grade.

2030 Local System Only Scenario 3

Operational speeds along northbound and southbound I-5 for Local System Only Scenario 3 are very similar to No-Build Scenario 1. Scenario 3 northbound I-5 speeds at the US 101 off-ramp are slightly worse than No-Build Scenario 1 because of the increased traffic coming from US 101. As previously mentioned, this increased volume is not additional demand, rather released demand previously queued before the Black Lake interchange. Figure 13 shows the travel speeds along northbound I-5 for Local System Only Scenario 3.

Southbound I-5 travel speeds for Local System Only Scenario 3 are also very similar to No-Build Scenario 1 speeds. The locations, causes for speed differentials, and magnitude of speed changes are also similar. From the northern study area limit, southbound I-5 speeds are substantially reduced, then increase to near free flow conditions after the US 101 on-ramp.

Eastbound US 101 travel speeds for Local System Only Scenario 3 improve compared to No-Build Scenario 1, which is attributed the cleared bottle neck around the Black Lake off-ramp. Speeds along eastbound US 101 generally vary between 50 to 70 mph except east of the Crosby on-ramp. Scenario 3 speeds east of the Crosby on-ramp are lower compared to Scenario 1, which is due to increased throughput at near free flow conditions around Black Lake off-ramp. At the US 101 to I-5 exit, speeds slowdown to 30 to 50 mph for almost the entire PM period of the peak hour. Figure 15 shows the travel speeds along eastbound US 101 for Local System Only Scenario 3.

The westbound US 101 speeds for Local System Only Scenario 3 are shown in the Figure 16 and are very similar to No-Build Scenario 1 speeds.

2030 Black Lake Interchange Scenario 5

Operational speeds along northbound and southbound I-5 for Black Lake Scenario 5 are very similar to No-Build Scenario 1 and Local System Only Scenario 3. Figure 17 and Figure 18 show the travel speeds along northbound and southbound I-5 for Black Lake Scenario 5.

Similar to Scenario 3, speeds along eastbound US 101 for Scenario 5 improve compared to Scenario 1, No-Build. Operational speeds along the eastbound US 101 mainline vary between 60 to 70 mph around the Mud Bay interchange, and 50 to 70 mph until the Black Lake on-ramp. For the last 30 minutes of the PM peak period, the speeds at Black Lake on-ramp drop down to 40 to 50 mph from 50 to 60 mph because of the increased volume from the new Yauger Way on-ramp connection. Similar to Scenario 3, east of the Crosby on-ramp the speeds reduce to 30 to 50 mph before exiting to I-5. Figure 19 shows the travel speeds along eastbound US 101 for Scenario 5.

The westbound US 101 speeds for Scenario 5 are shown in the Figure 20 and are very similar to Scenario 1 and Scenario 3.

2030 Evergreen Interchange Scenario 7

Figure 21 and Figure 22 show the travel speeds along northbound and southbound I-5 for Evergreen Scenario 7, which are similar to Scenarios 1, 3 and 5.

Similar to Scenarios 3 and 5, speeds along eastbound US 101 for Evergreen Scenario 7 increase compared to Scenario 1. Speeds along eastbound US 101 are generally around 50 to 60 mph except near the Evergreen on-ramp where the speeds reduce to 40 to 50 mph as a result of the additional volume (about 200 vph) on the Evergreen on-ramp and at the Crosby on-ramp where the speeds go down to 30 to 50 mph. Figure 23 shows the travel speeds along eastbound US 101 for Scenario 7. The westbound US 101 speeds for Evergreen Scenario 7 are shown on Figure 24 and are very similar to Scenarios 1, 3, and 5.

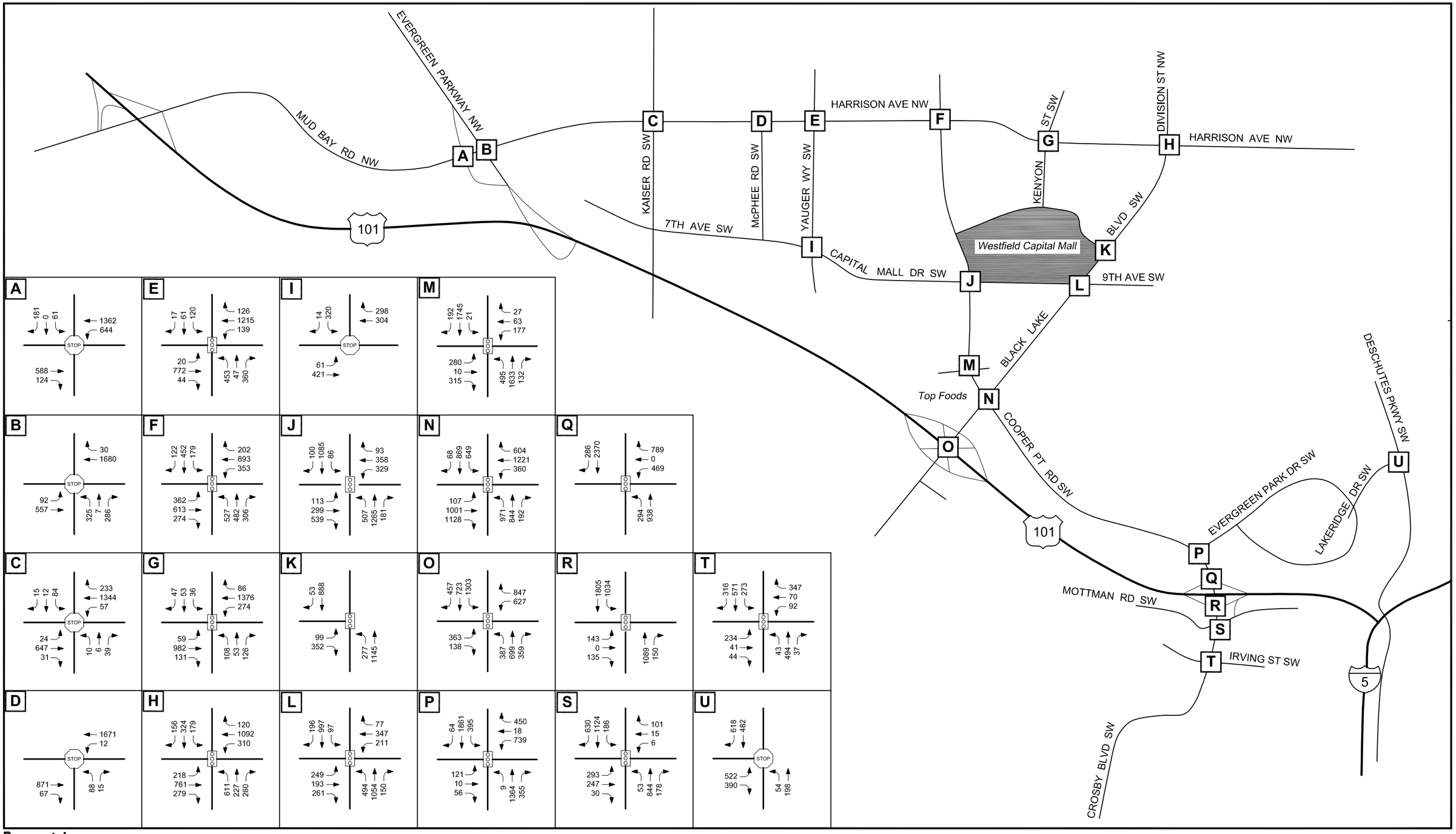
Freeway System Travel Times

PM peak hour travel times along I-5 and US 101 for the No-Build and build scenarios are summarized in Table 11.

As shown in Table 11, the travel times are generally very similar between the No-Build and all build scenarios; however, all build scenarios substantially reduce the travel time along eastbound US 101 compared to No Build Scenario 1. For all build scenarios, the resulting average travel speeds vary by 3 mph or less.

Table 11. Future 2030 PM Peak Hour Travel Times (seconds)

Cross Street	2030 No-Build Scenario 1	2030 Local System Only w/ SW Connections Scenario 3	2030 Black Lake Interchange w/ SW Connections Scenario 5	2030 Evergreen Interchange w/ SW Connections Scenario 7
Eastbound 101				
Mud Bay Off Ramp	27	27	27	26
Mud Bay On Ramp	18	17	17	17
EB 101 before Evergreen Prkwy On Ramp	164	81	83	82
Evergreen Pky On Ramp	63	18	22	51
Black Lake Off Ramp	199	61	79	35
Black Lake On Ramp	44	44	43	43
Crosby Blvd Off Ramp	29	31	28	29
Crosby Blvd On Ramp	42	40	28	41
101 EB to I-5 Off Ramp	67	71	57	77
Eastbound 101 Total Travel Time	**652**	**389**	**383**	**402**
Eastbound 101 Speed (mph)	**29**	**49**	**50**	**47**
Westbound 101				
Crosby Blvd Off Ramp	44	45	45	45
Crosby Blvd On Ramp	32	31	32	31
Black Lake Off Ramp	21	19	21	19
Black Lake On Ramp	55	55	55	55
Evergreen Prkwy Off Ramp	46	46	45	45
WB 101 after Evergreen Prkwy Off Ramp	29	29	29	29
Mud Bay Off Ramp	64	64	64	64
Mud Bay On Ramp	26	26	26	26
Model End	35	36	35	36
Westbound 101 Total Travel Time	**350**	**351**	**351**	**350**
Westbound 101 Speed (mph)	**55**	**54**	**54**	**55**
Northbound I-5				
US 101 Off Ramp	34	34	32	34
US 101 On Ramp	33	34	33	34
14th St Off Ramp	66	75	71	73
Model End	23	23	23	23
Northbound I-5 Total Travel Time	**155**	**165**	**159**	**163**
Northbound I-5 Speed (mph)	**48**	**45**	**46**	**45**
Southbound I-5				
14th St On Ramp	205	204	202	202
US 101 Off Ramp	35	34	34	34
US 101 On Ramp	43	43	43	43
Southbound I-5 Total Travel Time	**282**	**282**	**279**	**279**
Southbound I-5 Speed (mph)	**27**	**27**	**27**	**27**



Parametrix DATE: Jul 08, 2008 FILE: BL1631062P03T05_F25

N
No Scale

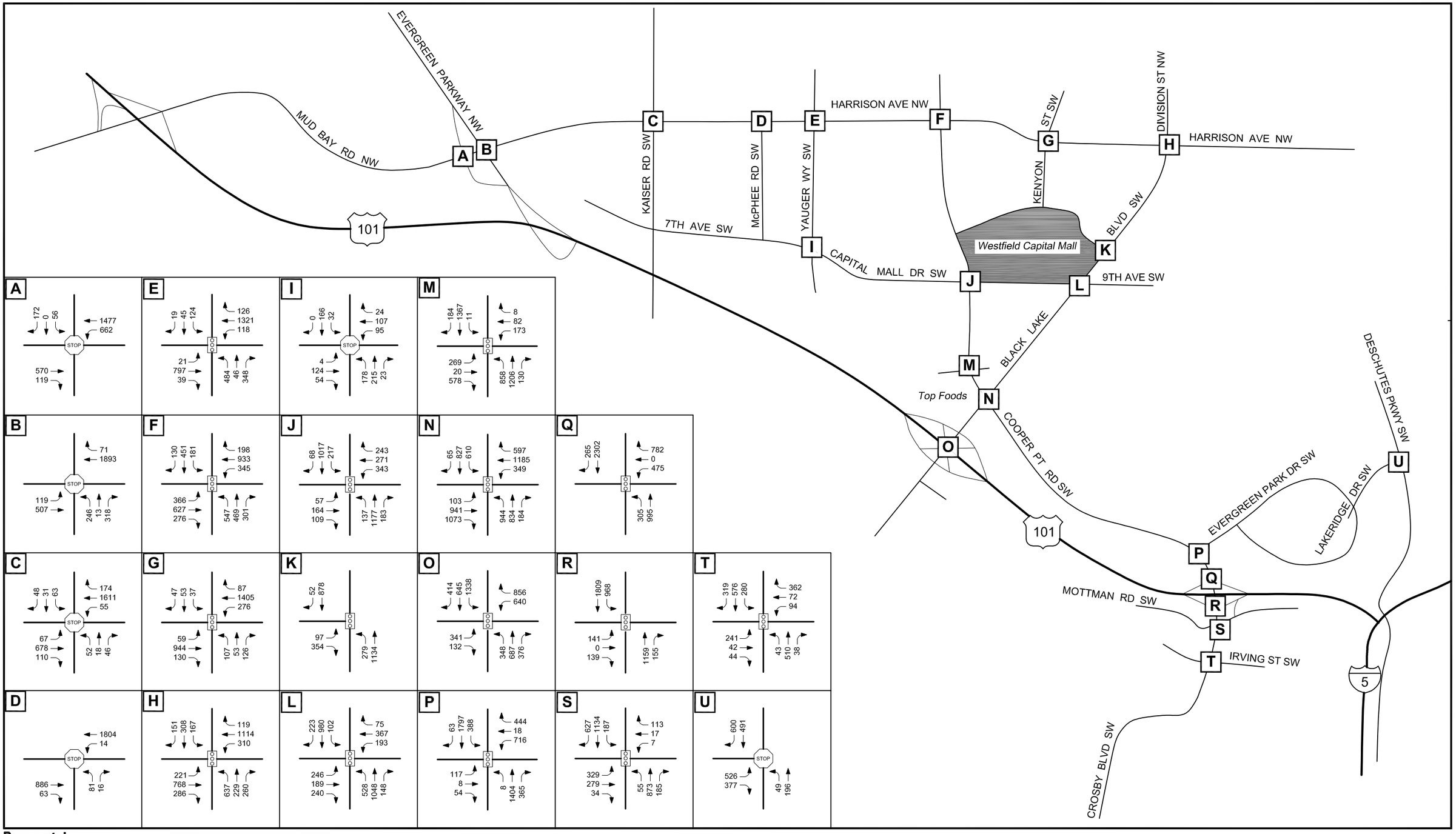
X Study Intersection

Turning Movement Volume

STOP Stop - Controlled Intersection

Signalized Intersection

Figure 25
2030 No-Build Scenario 1
PM Peak Hour Intersection Volumes



Parametrix DATE: Jul 08, 2008 FILE: BL1631062P03T05_F26

N
No Scale

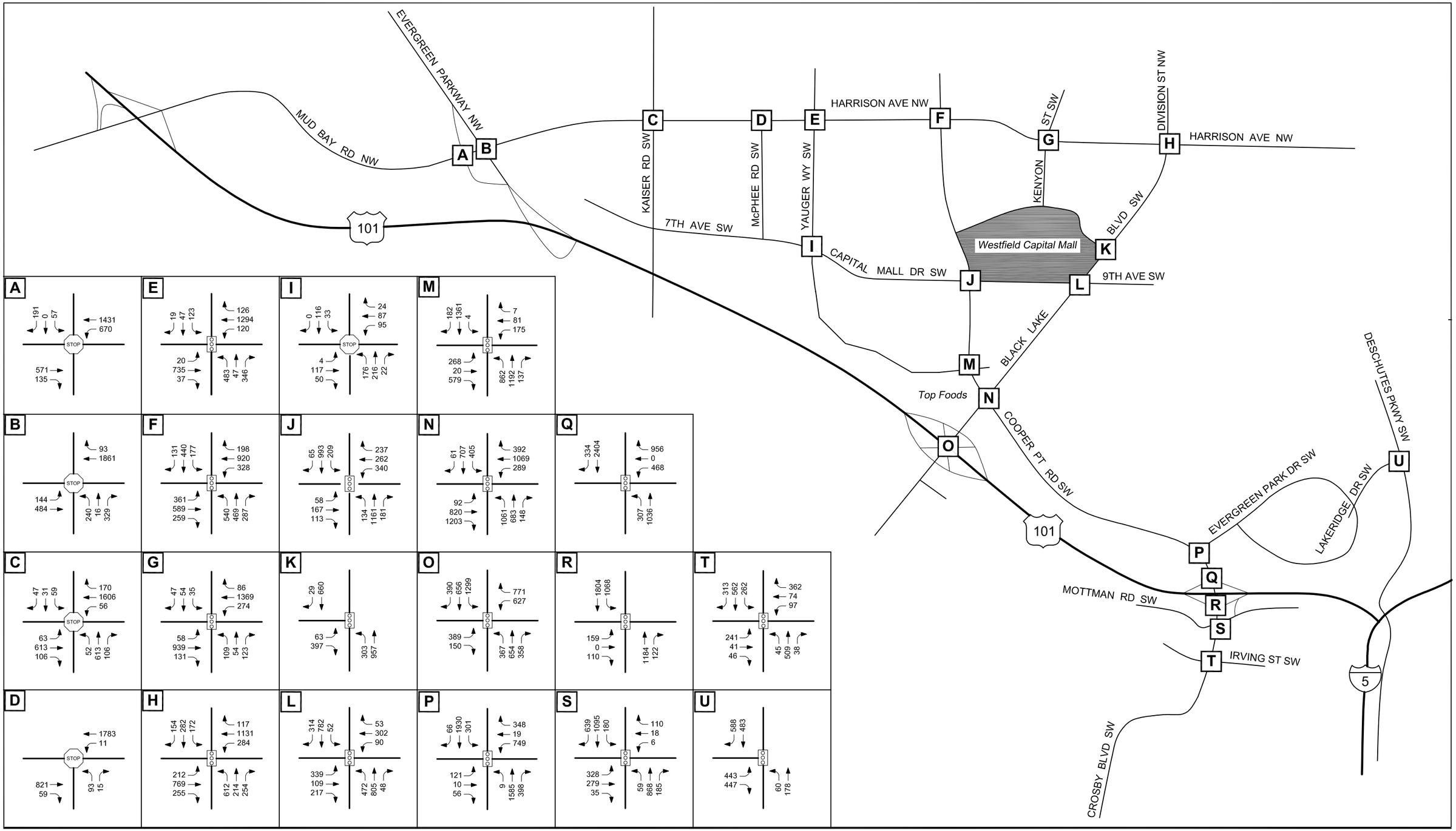
X Study Intersection

Turning Movement Volume

STOP Stop - Controlled Intersection

Signalized Intersection

Figure 26
2030 Local System Only
Without Southwest Connections Scenario 2
PM Peak Hour Intersection Volumes



Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F27

N

No Scale

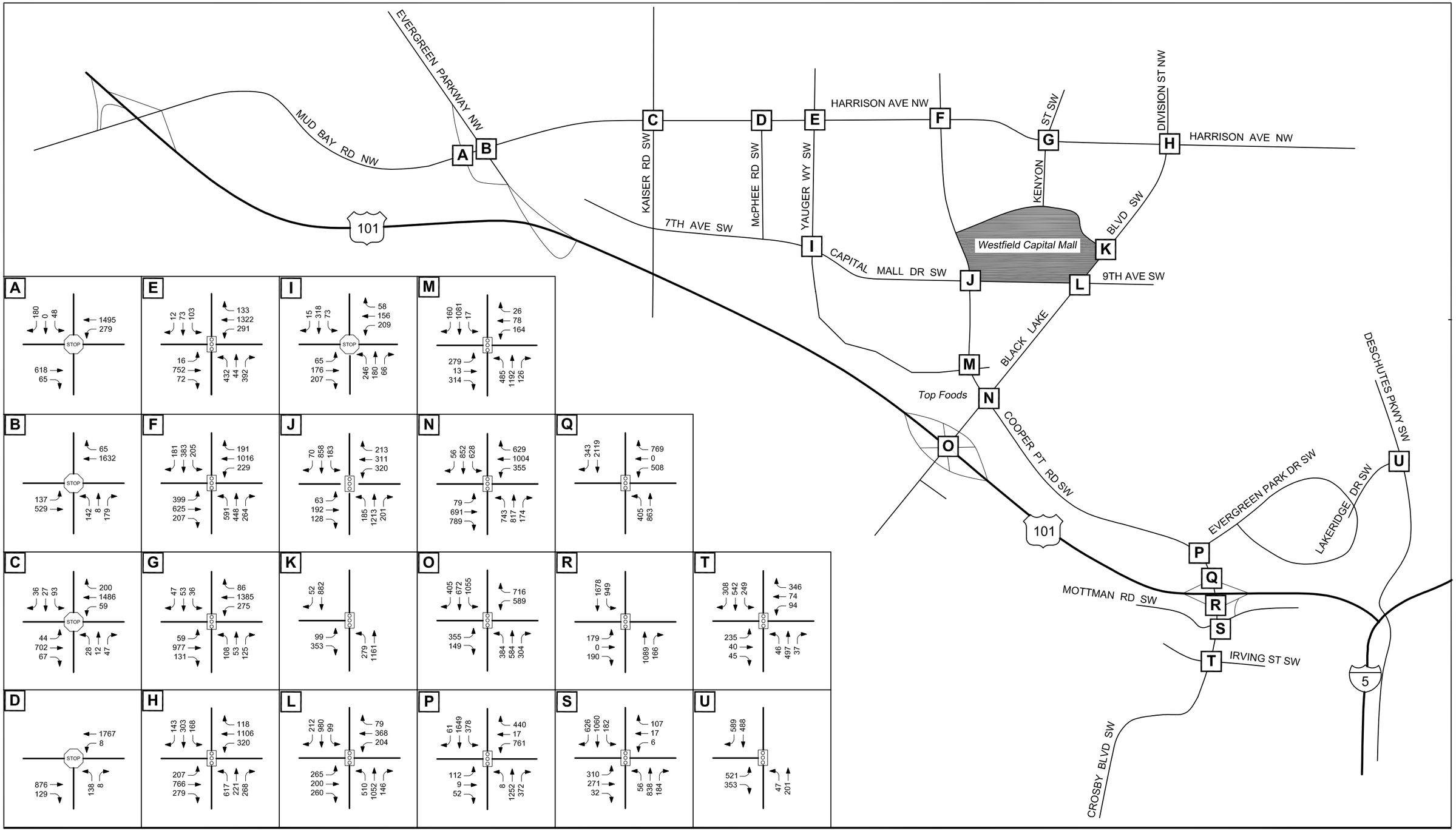
X Study Intersection

Turning Movement Volume

Stop - Controlled Intersection

Signalized Intersection

Figure 27
2030 Local System Only
With Southwest Connections Scenario 3
PM Peak Hour Intersection Volumes



Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F28

N
No Scale

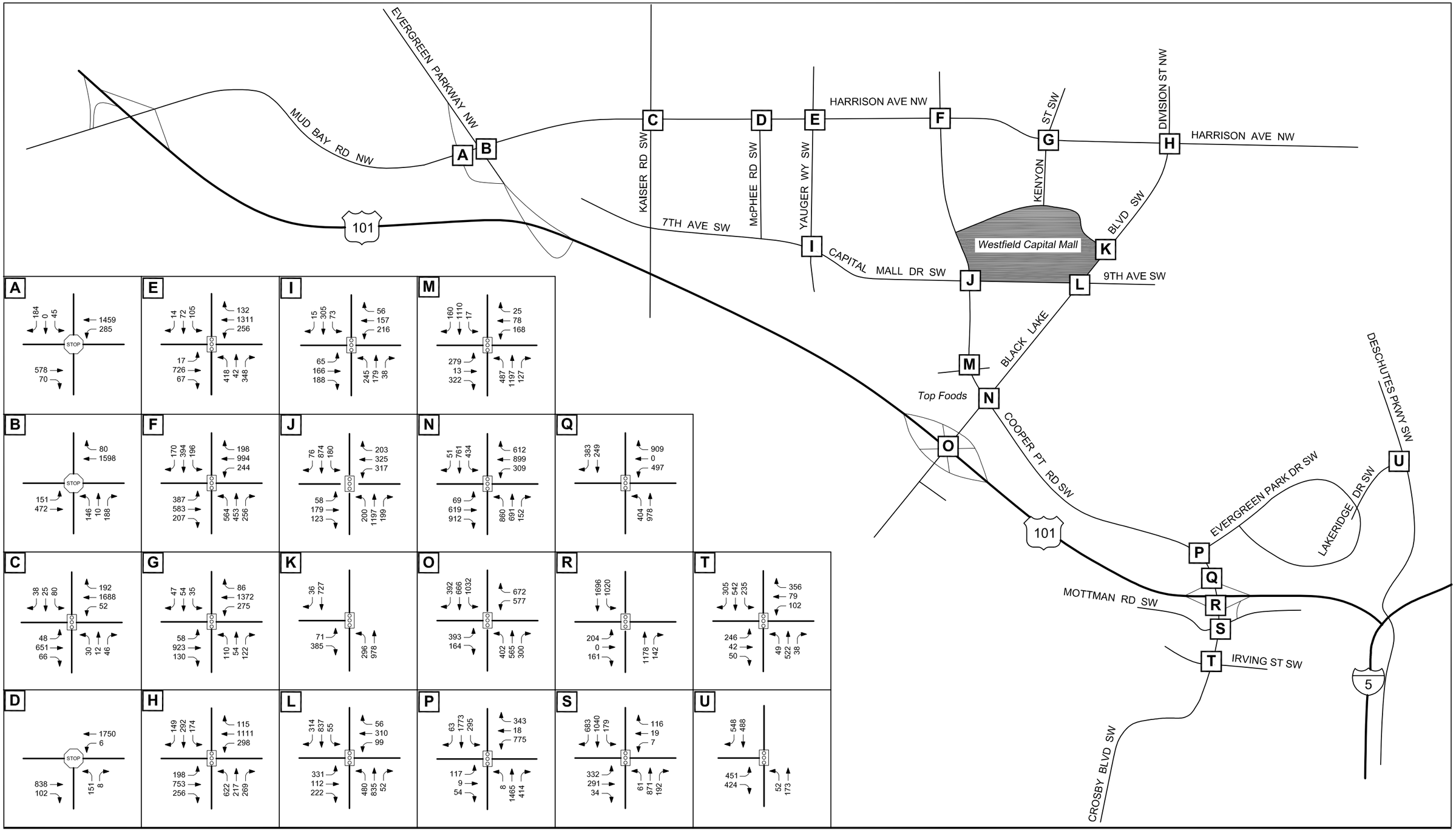
X Study Intersection

Turning Movement Volume

STOP Stop - Controlled Intersection

Signalized Intersection

Figure 28
2030 Black Lake Interchange
Without Southwest Connections Scenario 4
PM Peak Hour Intersection Volumes



Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F29

N

No Scale

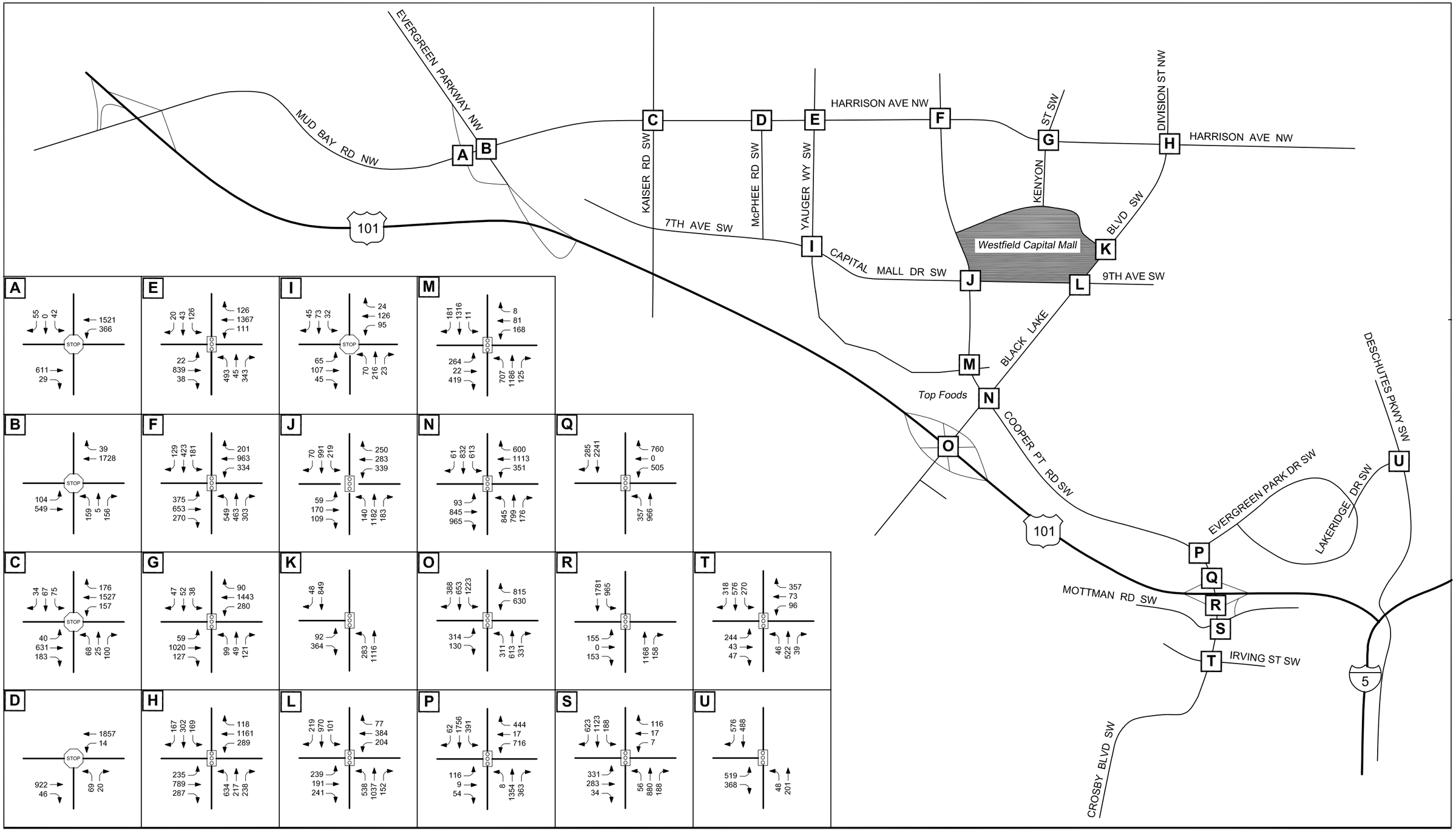
X Study Intersection

Turning Movement Volume

STOP Stop - Controlled Intersection

Signalized Intersection

Figure 29
2030 Black Lake Interchange
With Southwest Connections Scenario 5
PM Peak Hour Intersection Volumes



Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F30

N
No Scale

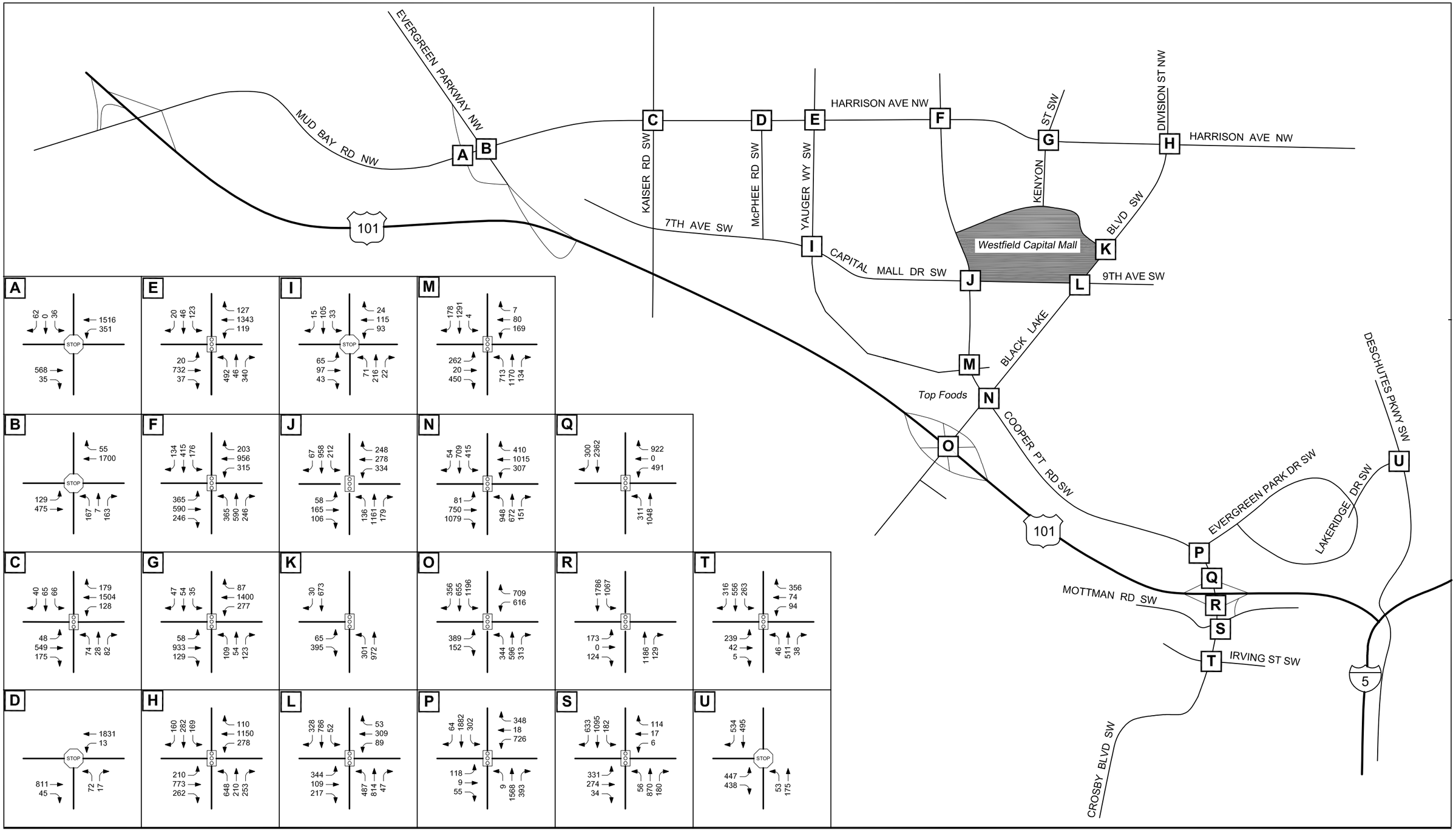
X Study Intersection

Turning Movement Volume

STOP Stop - Controlled Intersection

Signalized Intersection

Figure 30
2030 Evergreen Interchange
Without Southwest Connections Scenario 6
PM Peak Hour Intersection Volumes



Parametrix DATE: Oct 15, 2008 FILE: BL1631062P03T05_F31

N
No Scale

X Study Intersection

Turning Movement Volume

STOP Stop - Controlled Intersection

Signalized Intersection

Figure 31
2030 Evergreen Interchange
With Southwest Connections Scenario 7
PM Peak Hour Intersection Volumes

Summary of Design Year 2030 Freeway System Conditions

For all build scenarios, traffic volumes increase slightly along northbound I-5 at the US 101 on-ramp compared to the No-Build scenario. This increase in volume comes from the release of bottleneck congestion at the Black Lake interchange. Although the densities slightly increase (about 7 pc/mi/ln), the operational effect on travel speeds is negligible.

Although some build scenarios result in traffic volume diversions and cause densities to decrease in some areas and increase in other areas, the overall traffic volumes, densities, and speeds for southbound I-5 and westbound US 101 are generally similar between the No-Build and build scenarios.

For eastbound US 101, all build scenarios substantially improve traffic operations on the mainline. Due to severe congestion at the Black Lake interchange under the No-Build scenario, the eastbound US 101 corridor is expected to have an overall average density of 52 pc/mi/ln, compared to the build scenario densities that range between 31 and 34 pc/mi/ln. Queues formed from poor operations at the Black Lake interchange are expected to extend onto the US 101 mainline and extend west of the Evergreen interchange. Conversely, all build scenarios are expected to experience adequate traffic operations from the western study area limit to the Crosby Boulevard interchange.

When comparing the US 101 and I-5 mainlines as a whole, the sum total of all segment densities for the No-Build scenario is 1,710 pc/mi/ln, compared to a range of 1,453 pc/mi/ln to 1,542 pc/mi/ln for the build scenarios. This indicates that the build scenarios provide more vehicle throughput and the No-Build scenario has more congestion.

Although some build alternatives “relocate” congestion, the traffic volumes, average mainline densities, and speeds are fairly similar among all build scenarios. The similarity in freeway operations among the build alternatives is especially evident when evaluating the PM peak hour travel times and average speeds, which vary by 3 mph or less.

DESIGN YEAR 2030 LOCAL INTERSECTION TRAFFIC OPERATIONS

Local System Volumes

Local turning movement counts were forecasted by the TRPC demand model. The turning movement counts obtained from the demand model were balanced for throughput inconsistencies before using them for analysis. The intersection turning movement counts for the No-Build and build scenarios are shown in Figures 25 through 31.

LOS (Average Delays)

The LOS for local intersections was calculated using the HCS Signals module of Synchro 7 (build 761) for signalized intersections and HCS+ for unsignalized intersections. These traffic analysis software packages were used to measure the total average vehicle delays, which were then equated to LOS grades per the HCM.

An original set of improvements were initially applied to each scenario to achieve applicable LOS standards. However, the City of Olympia identified several of these original improvements as infeasible (see Attachment A). Original and feasible improvements are summarized in Table 12. Descriptions of both sets of analyses are presented.

Based on the feasible improvements shown in Table 12, the LOS results for the No-Build and build scenarios using the traditional one-hour analysis are shown in Table 13, while Table 14 shows the LOS results that account for the City of Olympia’s 2-Hour Adjustment Factor for volumes.

With the original improvement initially identified, Table 15 shows the one-hour LOS results and Table 16 shows the LOS results using the 2-Hour Adjustment Factor.

Table 12. Original [1] and Feasible Intersection Improvements

Intersection	2030 Local System Only w/o SW Connections Scenario 2	2030 Local System Only w/ SW Connections Scenario 3	2030 Black Lake Interchange w/o SW Connections Scenario 4	2030 Black Lake Interchange w/ SW Connections Scenario 5	2030 Evergreen Interchange w/o SW connections Scenario 6	2030 Evergreen Interchange w/ SW connections Scenario 7
Harrison Ave/Division St	2 NBL Turn Lanes ~~1 SBL Turn Lane~~	2 NBL Turn Lanes ~~1 SBL Turn Lane~~	2 NBL Turn Lanes ~~1 SBL Turn Lane~~	2 NBLTurn Lanes	2 NBLTurn Lanes ~~1 SBL Turn Lane~~	2 NBLTurn Lanes
Black Lake Blvd/Cooper Point Rd	~~1 NER Turn Lane~~ 1 SER Turn Lane ~~1 SWL Turn Lane~~	~~1 NER Turn Lane~~ 1 SER Turn Lane ~~1 SWL Turn Lane~~	1 SER Turn Lane ~~1 SWL Turn Lane~~		~~1 NER Turn Lane~~ 1 SER Turn Lane ~~1 SWL Turn Lane~~	1 SER Turn Lane
US 101 SPUI (Through/Lefts)/Black Lake Blvd						
Cooper Point Rd/Harrison Ave/Mud Bay Rd	1 NBL Turn Lane	1 NBL Turn Lane	1 NBL Turn Lane	1 NBL Turn Lane	1 NBL Turn Lane	1 NBL Turn Lane
Cooper Point Rd/Capitol Mall Blvd					1 WBR Turn Lane	
Black Lake Blvd/9th Ave/Capital Mall Dr	~~1 EBL Turn Lane~~ 1 SWR Turn Lane	~~1 EBL Turn Lane~~	~~1 EBL Turn Lane~~ 1 SWR Turn Lane	1 SWR Turn Lane	~~1 EBL Turn Lane~~ 1 SWR Turn Lane 1 SWL Turn Lane	1 SWR Turn Lane
Cooper Point Rd/Automall Dr/Evergreen Park Dr	~~1 SEL Turn Lane~~ 1 SWR Turn Lane	~~1 SEL Turn Lane~~ 1 SWR Turn Lane	~~1 SEL Turn Lane~~ 1 SWR Turn Lane	~~1 SEL Turn Lane~~	~~1 SEL Turn Lane~~ 1 SWR Turn Lane	~~1 SEL Turn Lane~~
Cooper Point Rd/Top Foods Entrance	1 EBR Turn Lane	1 EBR Turn Lane			1 EBR Turn Lane	
US 101 Westbound Ramps (dec. MP)/Crosby Blvd	1 NB Through Lane	1 SBR Turn Lane 1 NB Through Lane		1 SBR Turn Lane 1 NB Through Lane		1 SBR Turn Lane 1 NB Through Lane
US 101 Eastbound Ramps (inc. MP)/Crosby Blvd						
Crosby Blvd/Mottman Rd						
Crosby Blvd/Irving St						
Harrison Ave/Kenyon St						
Black Lake Blvd/Capital Mall Entrance						
Harrison Ave/Yauger Wy						
US 101 SPUI Westbound US 101 (dec. MP) Off-Ramp Right Turns/Black Lake Blvd						
US 101 SPUI Eastbound US 101 (inc. MP) Off-Ramp Right Turns/Black Lake Blvd						
Harrison Ave/McPhee Rd						
Harrison Ave/Kaiser Rd						
Mud Bay Rd/Evergreen Prkwy Westbound Ramp	Add Signal 1 NBL Turn Lane	Add Signal 1 NBL Turn Lane	Add Signal	Add Signal	Add Signal	Add Signal
Mud Bay Rd/Evergreen Prkwy Eastbound Ramp	Add Signal	Add Signal	Add Signal	Add Signal	Add Signal	Add Signal
Black Lake Blvd/Top Foods Entrance						
Lakeridge Dr/Deschutes Prkwy	Add Signal 1 SBR Turn Lane	Add Signal	Add Signal 1 SBR Turn Lane	Add Signal	Add Signal 1 SBR Turn Lane	Add Signal
Capital Mall Dr/Yauger Wy						
Original Total Turn Lanes Added	14	13	11	6	15	7
Original Total Through Lanes Added	1	1	0	1	0	1
Original Total Signals Added	3	3	3	3	3	3
Feasible Total Turn Lanes Added	9	8	7	5	10	6
Feasible Total Through Lanes Added	1	1	0	1	0	1
Feasible Total Signals Added	3	3	3	3	3	3

[1] Original improvements identified by the City of Olympia as infeasible are indicated by strikeout text format (see Attachment A).

2030 No-Build Scenario 1

Based on the traditional one-hour analysis methodology:

- eight intersections operate at LOS A, B, or C (compared to 15 in 2007),
- three intersections operate at LOS D or E (compared to three in 2007),
- 13 intersections operate at LOS F (compared to six in 2007),
- total triangle and SPUI delay is 684.3 seconds/vehicle (compared to 282.7 seconds in 2007), and
- 15 total intersections would operate below their respective LOS standard (compared to seven in 2007)

Accounting for the 2-Hour Adjustment Factor, where applicable:

- eight intersections operate at LOS A, B, or C (compared to 16 in 2007),
- five intersections operate at LOS D or E (compared to four in 2007),
- 11 intersections operate at LOS F (compared to four in 2007),
- total triangle and SPUI delay is 611.4 seconds/vehicle (compared to 252.7 seconds in 2007), and
- 12 total intersections would operate below their respective LOS standard (compared to five in 2007).

2030 Local System Only Scenario 2

Assuming construction of the feasible improvements and based on the traditional one-hour analysis methodology:

- 11 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- nine intersections operate at LOS D or E (compared to three for No-Build Scenario 1),
- four intersections operate at LOS F (compared to 13 for No-Build Scenario 1),
- total triangle and SPUI delay is 426.5 seconds/vehicle (compared to 684.3 seconds for No-Build Scenario 1), and
- six total intersections would operate below their respective LOS standard (compared to 15 for No-Build Scenario 1).

Assuming construction of the feasible improvements and accounting for the 2-Hour Adjustment Factor, where applicable:

- 12 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 10 intersections operate at LOS D or E (compared to five for No-Build Scenario 1),
- two intersections operate at LOS F (compared to 11 for No-Build Scenario 1),
- total triangle and SPUI delay is 388.3 seconds/vehicle (compared to 611.4 seconds for No-Build Scenario 1), and
- three total intersections would operate below their respective LOS standard (compared to 12 for No-Build Scenario 1).

Assuming construction of all of the originally identified improvements, which the City of Olympia identified some as infeasible, and based on the traditional one-hour analysis methodology:

- 11 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),

- 10 intersections operate at LOS D or E (compared to three for No-Build Scenario 1),
- three intersections operate at LOS F (compared to 13 for No-Build Scenario 1),
- total triangle and SPUI delay is 392.7 seconds/vehicle (compared to 684.3 seconds for No-Build Scenario 1), and
- five total intersections would operate below their respective LOS standard (compared to 15 for No-Build Scenario 1).

Assuming construction of all of the originally identified improvements, which the City of Olympia identified some as infeasible, and accounting for the 2-Hour Adjustment Factor, where applicable:

- 13 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- nine intersections operate at LOS D or E (compared to five for No-Build Scenario 1),
- two intersections operate at LOS F (compared to 11 for No-Build Scenario 1),
- total triangle and SPUI delay is 355.7 seconds/vehicle (compared to 611.4 seconds for No-Build Scenario 1), and
- two total intersections would operate below their respective LOS standard (compared to 12 for No-Build Scenario 1).

2030 Local System Only Scenario 3

Assuming construction of the feasible improvements and based on the traditional one-hour analysis methodology:

- nine intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 11 intersections operate at LOS D or E (compared to three for No-Build Scenario 1),
- four intersections operate at LOS F (compared to 13 for No-Build Scenario 1),
- total triangle and SPUI delay is 365.3 seconds/vehicle (compared to 684.3 seconds for No-Build Scenario 1), and
- six total intersections would operate below their respective LOS standard (compared to 15 for No-Build Scenario 1).

Assuming construction of the feasible improvements and accounting for the 2-Hour Adjustment Factor, where applicable:

- 12 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 10 intersections operate at LOS D or E (compared to five for No-Build Scenario 1),
- two intersections operate at LOS F (compared to 11 for No-Build Scenario 1),
- total triangle and SPUI delay is 332.3 seconds/vehicle (compared to 611.4 seconds for No-Build Scenario 1), and
- three total intersections would operate below their respective LOS standard (compared to 12 for No-Build Scenario 1).

Assuming construction of all of the originally identified improvements, which the City of Olympia identified some as infeasible, and based on the traditional one-hour analysis methodology:

- 10 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 12 intersections operate at LOS D or E (compared to three for No-Build Scenario 1),

- two intersections operate at LOS F (compared to 13 for No-Build Scenario 1),
- total triangle and SPUI delay is 339.6 seconds/vehicle (compared to 684.3 seconds for No-Build Scenario 1), and
- four total intersections would operate below their respective LOS standard (compared to 15 for No-Build Scenario 1).

Assuming construction of all of the originally identified improvements, which the City of Olympia identified some as infeasible, and accounting for the 2-Hour Adjustment Factor, where applicable:

- 13 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 10 intersections operate at LOS D or E (compared to five for No-Build Scenario 1),
- one intersection operates at LOS F (compared to 11 for No-Build Scenario 1),
- total triangle and SPUI delay is 308.7 seconds/vehicle (compared to 611.4 seconds for No-Build Scenario 1), and
- one intersection would operate below its respective LOS standard (compared to 12 for No-Build Scenario 1).

2030 Black Lake Interchange Scenario 4

Assuming construction of the feasible improvements and based on the traditional one-hour analysis methodology:

- 12 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- eight intersections operate at LOS D or E (compared to three for No-Build Scenario 1),
- four intersections operate at LOS F (compared to 13 for No-Build Scenario 1),
- total triangle and SPUI delay is 345.6 seconds/vehicle (compared to 684.3 seconds for No-Build Scenario 1), and
- six total intersections would operate below their respective LOS standard (compared to 15 for No-Build Scenario 1).

Assuming construction of the feasible improvements and accounting for the 2-Hour Adjustment Factor, where applicable:

- 12 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 10 intersections operate at LOS D or E (compared to five for No-Build Scenario 1),
- two intersections operate at LOS F (compared to 11 for No-Build Scenario 1),
- total triangle and SPUI delay is 308.0 seconds/vehicle (compared to 611.4 seconds for No-Build Scenario 1), and
- three total intersections would operate below their respective LOS standard (compared to 12 for No-Build Scenario 1).

Assuming construction of all of the originally identified improvements, which the City of Olympia identified some as infeasible, and based on the traditional one-hour analysis methodology:

- 12 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 11 intersections operate at LOS D or E (compared to three for No-Build Scenario 1),
- one intersection operates at LOS F (compared to 13 for No-Build Scenario 1),

- total triangle and SPUI delay is 295.4 seconds/vehicle (compared to 684.3 seconds for No-Build Scenario 1), and
- three total intersections would operate below their respective LOS standard (compared to 15 for No-Build Scenario 1).

Assuming construction of all of the originally identified improvements, which the City of Olympia identified some as infeasible, and accounting for the 2-Hour Adjustment Factor, where applicable:

- 12 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 12 intersections operate at LOS D or E (compared to five for No-Build Scenario 1),
- zero intersections operate at LOS F (compared to 11 for No-Build Scenario 1),
- total triangle and SPUI delay is 264.2 seconds/vehicle (compared to 611.4 seconds for No-Build Scenario 1), and
- one intersection would operate below its respective LOS standard (compared to 12 for No-Build Scenario 1).

2030 Black Lake Interchange Scenario 5

Assuming construction of the feasible improvements and based on the traditional one-hour analysis methodology:

- 13 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 11 intersections operate at LOS D or E (compared to three for No-Build Scenario 1),
- zero intersections operate at LOS F (compared to 13 for No-Build Scenario 1),
- total triangle and SPUI delay is 302.1 seconds/vehicle (compared to 684.3 seconds for No-Build Scenario 1), and
- three total intersections would operate below their respective LOS standard (compared to 15 for No-Build Scenario 1).

Assuming construction of the feasible improvements and accounting for the 2-Hour Adjustment Factor, where applicable:

- 14 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 10 intersections operate at LOS D or E (compared to five for No-Build Scenario 1),
- zero intersections operate at LOS F (compared to 11 for No-Build Scenario 1),
- total triangle and SPUI delay is 271.1 seconds/vehicle (compared to 611.4 seconds for No-Build Scenario 1), and
- two total intersections would operate below their respective LOS standard (compared to 12 for No-Build Scenario 1).

Assuming construction of all of the originally identified improvements, which the City of Olympia identified some as infeasible, and based on the traditional one-hour analysis methodology:

- 13 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 11 intersections operate at LOS D or E (compared to three for No-Build Scenario 1),
- zero intersections operate at LOS F (compared to 13 for No-Build Scenario 1),

- total triangle and SPUI delay is 302.1 seconds/vehicle (compared to 684.3 seconds for No-Build Scenario 1), and
- two total intersections would operate below their respective LOS standard (compared to 15 for No-Build Scenario 1).

Assuming construction of all of the originally identified improvements, which the City of Olympia identified some as infeasible, and accounting for the 2-Hour Adjustment Factor, where applicable:

- 14 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 10 intersections operate at LOS D or E (compared to five for No-Build Scenario 1),
- zero intersections operate at LOS F (compared to 11 for No-Build Scenario 1),
- total triangle and SPUI delay is 271.1 seconds/vehicle (compared to 611.4 seconds for No-Build Scenario 1), and
- one intersection would operate below its respective LOS standard (compared to 12 for No-Build Scenario 1).

2030 Evergreen Interchange Scenario 6

Assuming construction of the feasible improvements and based on the traditional one-hour analysis methodology:

- 11 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- nine intersections operate at LOS D or E (compared to three for No-Build Scenario 1),
- four intersections operate at LOS F (compared to 13 for No-Build Scenario 1),
- total triangle and SPUI delay is 363.4 seconds/vehicle (compared to 684.3 seconds for No-Build Scenario 1), and
- seven total intersections would operate below their respective LOS standard (compared to 15 for No-Build Scenario 1).

Assuming construction of the feasible improvements and accounting for the 2-Hour Adjustment Factor, where applicable:

- 13 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- nine intersections operate at LOS D or E (compared to five for No-Build Scenario 1),
- two intersections operate at LOS F (compared to 11 for No-Build Scenario 1),
- total triangle and SPUI delay is 322.9 seconds/vehicle (compared to 611.4 seconds for No-Build Scenario 1), and
- four total intersections would operate below their respective LOS standard (compared to 12 for No-Build Scenario 1).

Assuming construction of all of the originally identified improvements, which the City of Olympia identified some as infeasible, and based on the traditional one-hour analysis methodology:

- 11 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 12 intersections operate at LOS D or E (compared to three for No-Build Scenario 1),
- one intersection operates at LOS F (compared to 13 for No-Build Scenario 1),

- total triangle and SPUI delay is 306.6 seconds/vehicle (compared to 684.3 seconds for No-Build Scenario 1), and
- four total intersections would operate below their respective LOS standard (compared to 15 for No-Build Scenario 1).

Assuming construction of all of the originally identified improvements, which the City of Olympia identified some as infeasible, and accounting for the 2-Hour Adjustment Factor, where applicable:

- 14 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 10 intersections operate at LOS D or E (compared to five for No-Build Scenario 1),
- zero intersections operate at LOS F (compared to 11 for No-Build Scenario 1),
- total triangle and SPUI delay is 271.1 seconds/vehicle (compared to 611.4 seconds for No-Build Scenario 1), and
- one intersection would operate below its respective LOS standard (compared to 12 for No-Build Scenario 1).

2030 Evergreen Interchange Scenario 7

Assuming construction of the feasible improvements and based on the traditional one-hour analysis methodology:

- 12 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 10 intersections operate at LOS D or E (compared to three for No-Build Scenario 1),
- two intersections operate at LOS F (compared to 13 for No-Build Scenario 1),
- total triangle and SPUI delay is 298.2 seconds/vehicle (compared to 684.3 seconds for No-Build Scenario 1), and
- three total intersections would operate below their respective LOS standard (compared to 15 for No-Build Scenario 1).

Assuming construction of the feasible improvements and accounting for the 2-Hour Adjustment Factor, where applicable:

- 16 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- eight intersections operate at LOS D or E (compared to five for No-Build Scenario 1),
- zero intersections operate at LOS F (compared to 11 for No-Build Scenario 1),
- total triangle and SPUI delay is 266.8 seconds/vehicle (compared to 611.4 seconds for No-Build Scenario 1), and
- two total intersections would operate below their respective LOS standard (compared to 12 for No-Build Scenario 1).

Assuming construction of all of the originally identified improvements, which the City of Olympia identified some as infeasible, and based on the traditional one-hour analysis methodology:

- 12 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- 11 intersections operate at LOS D or E (compared to three for No-Build Scenario 1),
- one intersection operates at LOS F (compared to 13 for No-Build Scenario 1),

- total triangle and SPUI delay is 298.2 seconds/vehicle (compared to 684.3 seconds for No-Build Scenario 1), and
- three total intersections would operate below their respective LOS standard (compared to 15 for No-Build Scenario 1).

Assuming construction of all of the originally identified improvements, which the City of Olympia identified some as infeasible, and accounting for the 2-Hour Adjustment Factor, where applicable:

- 16 intersections operate at LOS A, B, or C (compared to eight for No-Build Scenario 1),
- eight intersections operate at LOS D or E (compared to five for No-Build Scenario 1),
- zero intersections operate at LOS F (compared to 11 for No-Build Scenario 1),
- total triangle and SPUI delay is 266.8 seconds/vehicle (compared to 611.4 seconds for No-Build Scenario 1), and
- one intersection would operate below its respective LOS standard (compared to 12 for No-Build Scenario 1).

Table 13. PM Peak Hour LOS Comparison with Feasible Improvements (One-Hour Analysis)

	2030 No-Build Scenario 1	2030 Local System Only w/o SW Connections Scenario 2	2030 Local System Only w/ SW Connections Scenario 3	2030 Black Lake Interchange w/o SW Connections Scenario 4	2030 Black Lake Interchange w/ SW Connections Scenario 5	2030 Evergreen Interchange w/o SW Connections Scenario 6	2030 Evergreen Interchange w/ SW Connections Scenario 7
Intersection Description	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**
Harrison Ave/Division St	F (187.1)	F (84.7)	E (77.9)	F (81.3)	E (76.2)	F (89.4)	E (79.4)
Black Lake Blvd/Cooper Point Rd	F (199.9)	F (126.9)	F (86.6)	F (114.4)	E (78.5)	F (120.4)	E (65.1)
US 101 SPUI (Through/Lefts)/Black Lake Blvd	F (187)	F (140.7)	F (130.8)	E (70.3)	E (72.5)	E (77.9)	F (82.4)
Cooper Point Rd/Harrison Ave/Mud Bay Rd	F (110.3)	E (74.2)	E (70)	E (79.6)	E (74.9)	E (75.7)	E (71.3)
Cooper Point Rd/Capitol Mall Blvd	F (112.8)	E (75)	E (75)	E (77.2)	E (70.8)	E (57.8)	E (69.2)
Black Lake Blvd/9th Ave/Capital Mall Dr	F (101.2)	F (88.5)	F (100.1)	F (102.8)	E (77.5)	F (101.4)	E (78.1)
Cooper Point Rd/Automall Dr/Evergreen Park Dr	F (162.4)	E (71.4)	E (77.4)	E (57.3)	E (71.1)	F (82.5)	F (84.9)
Cooper Point Rd/Top Foods Entrance	F (85.7)	E (77.9)	E (77.8)	D (42.3)	D (41.5)	D (49.8)	E (67.4)
US 101 Westbound Ramps (dec. MP)/Crosby Blvd	E (65.9)	E (64.5)	E (64.8)	F (87)	E (57.5)	E (76.6)	E (58.2)
US 101 Eastbound Ramps (inc. MP)/Crosby Blvd	F (114.5)	C (33.5)	D (36.9)	E (68.5)	C (33.4)	E (69.4)	C (26.2)
Crosby Blvd/Mottman Rd	E (64.4)	D (38.8)	D (38.6)	D (38.7)	C (29.1)	D (42.6)	C (24.9)
Crosby Blvd/Irving St	C (24.7)	D (39.3)	D (39.2)	C (21.7)	C (26.8)	C (25.7)	C (20.5)
Harrison Ave/Kenyon St	C (20.7)	C (20.5)	C (20.4)	C (20.8)	C (20.4)	C (20.9)	C (20.5)
Black Lake Blvd/Capital Mall Entrance	B (12.3)	B (12.3)	B (10.6)	B (12.3)	B (11.1)	B (12.2)	B (10.7)
Harrison Ave/Yauger Wy	C (20.7)	C (25.9)	C (24.7)	C (32.4)	C (28.7)	C (26.8)	C (28.3)
US 101 SPUI Westbound US 101 (dec. MP) Off-Ramp Right Turns/Black Lake Blvd	A (6.4)	B (10)	A (9.1)	A (7.9)	A (6.2)	A (8.2)	A (6.7)
US 101 SPUI Eastbound US 101 (inc. MP) Off-Ramp Right Turns/Black Lake Blvd	A (7.3)	A (3.2)	A (3.4)	A (3.2)	A (3.5)	A (4.2)	A (2.8)
Harrison Ave/McPhee Rd	C (21.7)	C (21.7)	C (20.9)	D (29.6)	D (28.9)	C (21.3)	C (19)
Harrison Ave/Kaiser Rd	A (8.2)	B (13.2)	B (12.2)	B (10.5)	B (11)	B (11.2)	B (11.4)
Mud Bay Rd/Evergreen Prkwy Westbound Ramp	F (>200)	C (30.4)	C (32.5)	C (32.3)	C (34.3)	B (16.6)	C (30.7)
Mud Bay Rd/Evergreen Prkwy Eastbound Ramp	F (>200)	B (19.6)	C (20.8)	B (16.7)	B (15.5)	C (22.7)	B (19.2)
Black Lake Blvd/Top Foods Entrance	E (45.8)	E (41.1)	F (55.8)	C (21)	C (23.1)	D (30.1)	D (31.3)
Lakeridge Dr/Deschutes Prkwy	F (>200)	B (14.3)	D (50.3)	B (13.9)	D (43.3)	B (15)	D (41.6)
Capital Mall Dr/Yauger Wy	F (138.4)	D (34)	D (29.6)	B (15.1)	B (15)	D (31.3)	D (29.1)
LOS A, B, C	**8**	**11**	**9**	**12**	**13**	**11**	**12**
LOS D or E	**3**	**9**	**11**	**8**	**11**	**9**	**10**
LOS F	**13**	**4**	**4**	**4**	**0**	**4**	**2**
Total Turn Lanes Added	**NA**	**9**	**8**	**7**	**5**	**10**	**6**
Total Through Lanes Added	**NA**	**1**	**1**	**0**	**1**	**0**	**1**
Total Signals Added	**NA**	**3**	**3**	**3**	**3**	**3**	**3**

Table 14. PM Peak Hour LOS Comparison with Feasible Improvements (2-Hour Adjustment Factor)

	2030 No-Build Scenario 1	2030 Local System Only w/o SW Connections Scenario 2	2030 Local System Only w/ SW Connections Scenario 3	2030 Black Lake Interchange w/o SW Connections Scenario 4	2030 Black Lake Interchange w/ SW Connections Scenario 5	2030 Evergreen Interchange w/o SW Connections Scenario 6	2030 Evergreen Interchange w/ SW Connections Scenario 7
Intersection Description	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**
Harrison Ave/Division St	F (163.6)	E (76.6)	E (70.1)	E (69.5)	E (66.4)	E (77.4)	E (68.2)
Black Lake Blvd/Cooper Point Rd	F (173.5)	F (111)	E (75)	F (100.7)	E (68)	F (104.7)	E (56.8)
US 101 SPUI (Through/Lefts)/Black Lake Blvd	F (178.6)	F (134.8)	F (124.3)	E (67.6)	E (70.2)	E (74)	E (77.9)
Cooper Point Rd/Harrison Ave/Mud Bay Rd	F (95.7)	E (65.9)	E (62.9)	E (70.2)	E (66.5)	E (66.8)	E (63.9)
Cooper Point Rd/Capitol Mall Blvd	F (94.3)	E (62.6)	E (61.6)	E (63.4)	E (59)	D (50.6)	E (59.1)
Black Lake Blvd/9th Ave/Capital Mall Dr	F (89.3)	E (78.4)	F (87.5)	F (91.9)	E (69.1)	F (90.5)	E (69.4)
Cooper Point Rd/Automall Dr/Evergreen Park Dr	F (121.4)	E (57.4)	E (60.7)	D (49.3)	E (59.7)	E (67.5)	E (60.5)
Cooper Point Rd/Top Foods Entrance	E (67.2)	E (67.7)	E (68.6)	D (39.8)	D (38.2)	D (43.5)	E (59.4)
US 101 Westbound Ramps (dec. MP)/Crosby Blvd	D (35.2)	D (38.5)	D (42.3)	D (54.8)	D (38.9)	D (47.6)	C (34.9)
US 101 Eastbound Ramps (inc. MP)/Crosby Blvd	F (86.3)	C (32.4)	C (33.8)	D (50.6)	C (28.3)	D (48.6)	C (22.6)
Crosby Blvd/Mottman Rd	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)
Crosby Blvd/Irving St	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)
Harrison Ave/Kenyon St	B (19.7)	B (19.7)	B (19.5)	B (19.7)	B (19.5)	B (19.9)	B (19.6)
Black Lake Blvd/Capital Mall Entrance	B (11.6)	B (11.6)	B (10.2)	B (11.6)	B (10.6)	B (11.7)	B (10.2)
Harrison Ave/Yauger Wy	B (19.1)	C (22.9)	C (22.1)	C (28.9)	C (24)	C (24.1)	C (24)
US 101 SPUI Westbound US 101 (dec. MP) Off-Ramp Right Turns/Black Lake Blvd	A (6.2)	A (9.6)	A (8.8)	A (7.8)	A (6.2)	A (8.1)	A (6.5)
US 101 SPUI Eastbound US 101 (inc. MP) Off-Ramp Right Turns/Black Lake Blvd	A (7.1)	A (3.2)	A (3.4)	A (3.2)	A (3.4)	A (3.9)	A (2.7)
Harrison Ave/McPhee Rd	C (20.3)	C (20.3)	C (19.6)	D (26.6)	D (25.9)	C (20)	C (18)
Harrison Ave/Kaiser Rd	A (7.7)	B (11.5)	B (10.5)	A (9.6)	A (9.3)	B (11.5)	B (10.4)
Mud Bay Rd/Evergreen Prkwy Westbound Ramp	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)
Mud Bay Rd/Evergreen Prkwy Eastbound Ramp	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)
Black Lake Blvd/Top Foods Entrance	D (32.8)	D (31.1)	E (38.3)	C (18)	C (19.5)	C (23.8)	C (24.9)
Lakeridge Dr/Deschutes Prkwy	F (>200)	B (11.4)	C (25.5)	B (11.5)	C (23.5)	B (11.5)	C (22.9)
Capital Mall Dr/Yauger Wy	D (32.7)	C (18.1)	C (17.3)	B (11.2)	A (9)	C (18.8)	C (18.1)
LOS A, B, C	**8**	**12**	**12**	**12**	**14**	**13**	**16**
LOS D or E	**5**	**10**	**10**	**10**	**10**	**9**	**8**
LOS F	**11**	**2**	**2**	**2**	**0**	**2**	**0**
Total Turn Lanes Added	**NA**	**9**	**8**	**7**	**5**	**10**	**6**
Total Through Lanes Added	**NA**	**1**	**1**	**0**	**1**	**0**	**1**
Total Signals Added	**NA**	**3**	**3**	**3**	**3**	**3**	**3**

Table 15. PM Peak Hour LOS Comparison with Original Improvements (One-Hour Analysis)

	2030 No-Build Scenario 1	2030 Local System Only w/o SW Connections Scenario 2	2030 Local System Only w/ SW Connections Scenario 3	2030 Black Lake Interchange w/o SW Connections Scenario 4	2030 Black Lake Interchange w/ SW Connections Scenario 5	2030 Evergreen Interchange w/o SW Connections Scenario 6	2030 Evergreen Interchange w/ SW Connections Scenario 7
Intersection Description	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**
Harrison Ave/Division St	F (187.1)	E (70.2)	E (63.2)	E (66.8)	E (76.2)	E (72.7)	E (79.4)
Black Lake Blvd/Cooper Point Rd	F (199.9)	F (108.3)	E (75.6)	E (78.7)	E (78.5)	F (80.3)	E (65.1)
US 101 SPUI (Through/Lefts)/Black Lake Blvd	F (187)	F (140)	F (130.8)	E (70.3)	E (72.5)	E (77.9)	F (82.4)
Cooper Point Rd/Harrison Ave/Mud Bay Rd	F (110.3)	E (74.2)	E (70)	E (79.6)	E (74.9)	E (75.7)	E (71.3)
Cooper Point Rd/Capitol Mall Blvd	F (112.8)	E (75)	E (75)	E (77.2)	E (70.8)	E (57.8)	E (69.2)
Black Lake Blvd/9th Ave/Capital Mall Dr	F (101.2)	E (76.6)	E (75.3)	E (76.3)	E (77.5)	E (78.3)	E (78.1)
Cooper Point Rd/Automall Dr/Evergreen Park Dr	F (162.4)	E (56.4)	E (64.4)	D (49.6)	D (55)	D (51.5)	E (60.1)
Cooper Point Rd/Top Foods Entrance	F (85.7)	E (78.3)	E (77.8)	D (42.3)	D (41.5)	D (49.8)	E (67.4)
US 101 Westbound Ramps (dec. MP)/Crosby Blvd	E (65.9)	E (58)	E (64.6)	F (87)	E (57.5)	E (76.6)	E (58.2)
US 101 Eastbound Ramps (inc. MP)/Crosby Blvd	F (114.5)	C (33.5)	D (36.5)	E (68.5)	C (33.4)	E (69.4)	C (26.2)
Crosby Blvd/Mottman Rd	E (64.4)	D (38.8)	C (34.1)	D (38.7)	C (29.1)	D (42.6)	C (24.9)
Crosby Blvd/Irving St	C (24.7)	D (39.3)	D (38.9)	C (21.7)	C (26.8)	C (25.7)	C (20.5)
Harrison Ave/Kenyon St	C (20.7)	C (20.5)	C (20.4)	C (20.8)	C (20.4)	C (20.9)	C (20.5)
Black Lake Blvd/Capital Mall Entrance	B (12.3)	B (12.3)	B (10.6)	B (12.3)	B (11.1)	B (12.2)	B (10.7)
Harrison Ave/Yauger Wy	C (20.7)	C (25.9)	C (24.7)	C (32.4)	C (28.7)	C (26.8)	C (28.3)
US 101 SPUI Westbound US 101 (dec. MP) Off-Ramp Right Turns/Black Lake Blvd	A (6.4)	B (10)	A (9.1)	A (7.9)	A (6.2)	A (8.2)	A (6.7)
US 101 SPUI Eastbound US 101 (inc. MP) Off-Ramp Right Turns/Black Lake Blvd	A (7.3)	A (3.1)	A (3.4)	A (3.2)	A (3.5)	A (4.2)	A (2.8)
Harrison Ave/McPhee Rd	C (21.7)	C (21.7)	C (20.9)	D (29.6)	D (28.9)	C (21.3)	C (19)
Harrison Ave/Kaiser Rd	A (8.2)	B (13.2)	B (12.2)	B (10.5)	B (11)	B (11.2)	B (11.4)
Mud Bay Rd/Evergreen Prkwy Westbound Ramp	F (>200)	C (30.4)	C (32.5)	C (32.3)	C (34.3)	B (16.6)	C (30.7)
Mud Bay Rd/Evergreen Prkwy Eastbound Ramp	F (>200)	B (19.6)	C (20.8)	B (16.7)	B (15.5)	C (22.7)	B (19.2)
Black Lake Blvd/Top Foods Entrance	E (45.8)	F (66.6)	F (55.8)	C (21)	C (23.1)	D (30.1)	D (31.3)
Lakeridge Dr/Deschutes Prkwy	F (>200)	B (14.3)	D (50.3)	B (13.9)	D (43.3)	B (15)	D (41.6)
Capital Mall Dr/Yauger Wy	F (138.4)	D (34)	D (29.6)	B (15.1)	B (15)	D (31.3)	D (29.1)
LOS A, B, C	**8**	**11**	**10**	**12**	**13**	**11**	**12**
LOS D or E	**3**	**10**	**12**	**11**	**11**	**12**	**11**
LOS F	**13**	**3**	**2**	**1**	**0**	**1**	**1**
Total Turn Lanes Added	**NA**	**14**	**13**	**11**	**6**	**15**	**7**
Total Through Lanes Added	**NA**	**1**	**1**	**0**	**1**	**0**	**1**
Total Signals Added	**NA**	**3**	**3**	**3**	**3**	**3**	**3**

Table 16. PM Peak Hour LOS Comparison with Original Improvements (2-Hour Adjustment Factor)

	2030 No-Build Scenario 1	2030 Local System Only w/o SW Connections Scenario 2	2030 Local System Only w/ SW Connections Scenario 3	2030 Black Lake Interchange w/o SW Connections Scenario 4	2030 Black Lake Interchange w/ SW Connections Scenario 5	2030 Evergreen Interchange w/o SW Connections Scenario 6	2030 Evergreen Interchange w/ SW Connections Scenario 7
Intersection Description	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**	**LOS (Delay)**
Harrison Ave/Division St	F (163.6)	E (61.4)	E (56)	E (58.4)	E (66.4)	E (64.1)	E (68.2)
Black Lake Blvd/Cooper Point Rd	F (173.5)	F (94.6)	E (65.6)	E (68)	E (68)	E (69.7)	E (56.8)
US 101 SPUI (Through/Lefts)/Black Lake Blvd	F (178.6)	F (133.8)	F (124.3)	E (67.6)	E (70.2)	E (74)	E (77.9)
Cooper Point Rd/Harrison Ave/Mud Bay Rd	F (95.7)	E (65.9)	E (62.8)	E (70.2)	E (66.5)	E (66.8)	E (63.9)
Cooper Point Rd/Capitol Mall Blvd	F (94.3)	E (62.6)	E (61.6)	E (63.4)	E (59)	D (50.6)	E (59.1)
Black Lake Blvd/9th Ave/Capital Mall Dr	F (89.3)	E (67.4)	E (65.5)	E (67.2)	E (69.1)	E (69.2)	E (69.4)
Cooper Point Rd/Automall Dr/Evergreen Park Dr	F (121.4)	D (48.2)	D (51.4)	D (44.2)	D (46)	D (45.9)	D (42.5)
Cooper Point Rd/Top Foods Entrance	E (67.2)	E (68.4)	E (68.6)	D (39.8)	D (38.2)	D (43.5)	E (59.4)
US 101 Westbound Ramps (dec. MP)/Crosby Blvd	D (35.2)	C (33.3)	D (42.3)	D (54.8)	D (38.9)	D (47.6)	C (34.9)
US 101 Eastbound Ramps (inc. MP)/Crosby Blvd	F (86.3)	C (32.2)	C (34)	D (50.6)	C (28.3)	D (48.6)	C (22.6)
Crosby Blvd/Mottman Rd	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)
Crosby Blvd/Irving St	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)
Harrison Ave/Kenyon St	B (19.7)	B (19.7)	B (19.5)	B (19.7)	B (19.5)	B (19.9)	B (19.6)
Black Lake Blvd/Capital Mall Entrance	B (11.6)	B (11.6)	B (10.2)	B (11.6)	B (10.6)	B (11.7)	B (10.2)
Harrison Ave/Yauger Wy	B (19.1)	C (22.9)	C (22.1)	C (28.9)	C (24)	C (24.1)	C (24)
US 101 SPUI Westbound US 101 (dec. MP) Off-Ramp Right Turns/Black Lake Blvd	A (6.2)	A (9.6)	A (8.8)	A (7.8)	A (6.2)	A (8.1)	A (6.5)
US 101 SPUI Eastbound US 101 (inc. MP) Off-Ramp Right Turns/Black Lake Blvd	A (7.1)	A (3.1)	A (3.4)	A (3.2)	A (3.4)	A (3.9)	A (2.7)
Harrison Ave/McPhee Rd	C (20.3)	C (20.3)	C (19.6)	D (26.6)	D (25.9)	C (20)	C (18)
Harrison Ave/Kaiser Rd	A (7.7)	B (11.5)	B (10.5)	A (9.6)	A (9.3)	B (11.5)	B (10.4)
Mud Bay Rd/Evergreen Prkwy Westbound Ramp	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)
Mud Bay Rd/Evergreen Prkwy Eastbound Ramp	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)	NA (NA)
Black Lake Blvd/Top Foods Entrance	D (32.8)	E (43.8)	E (38.3)	C (18)	C (19.5)	C (23.8)	C (24.9)
Lakeridge Dr/Deschutes Prkwy	F (>200)	B (11.4)	C (25.5)	B (11.5)	C (23.5)	B (11.5)	C (22.9)
Capital Mall Dr/Yauger Wy	D (32.7)	C (18.1)	C (17.3)	B (11.2)	A (9)	C (18.8)	C (18.1)
LOS A, B, C	**8**	**13**	**13**	**12**	**14**	**13**	**16**
LOS D or E	**5**	**9**	**10**	**12**	**10**	**11**	**8**
LOS F	**11**	**2**	**1**	**0**	**0**	**0**	**0**
Total Turn Lanes Added	**NA**	**14**	**13**	**11**	**6**	**15**	**7**
Total Through Lanes Added	**NA**	**1**	**1**	**0**	**1**	**0**	**1**
Total Signals Added	**NA**	**3**	**3**	**3**	**3**	**3**	**3**

Summary of Design Year 2030 Local System Conditions

Tables 13 through 16 compares the No-Build and build scenarios in terms of the number of intersections operating at particular LOS grade, the "triangle" and Black Lake SPUI delay, and the number of improvements assumed.

Tables 13 through 16 show that the total delay at critical intersections ("triangle" delay plus Black Lake SPUI delay) is expected to be substantially less with the Black Lake and Evergreen interchange scenarios compared to the Local System Only Scenarios. When considering the amount of feasible improvements, the LOS analysis also indicates that the Southwest Connections also result in substantial delay savings at critical intersections. Tables 17 and 18 summarize the one- and two-hour aggregate MOEs assuming construction of the feasible improvements.

The number of local intersection improvements is important because land uses at the intersections needing improvements are generally built out and construction of the improvements would require property acquisition for right-of-way. Full or partial displacement of existing uses can substantially increase project costs, lengthen project schedules and be more difficult to implement. Additionally, increasing the number of turn lanes at intersections also increases pedestrian crossing times, which is less conducive to a pedestrian-friendly environment and inconsistent with the City's Comprehensive Plan.

Based on the number and extent of intersection improvements required to achieve acceptable LOS conditions, the Black Lake and Evergreen interchange scenarios (specifically Scenarios 5 and 7) represent the best alternatives since they are expected to result in the best operations and would likely cost the least to construct within the local transportation system.

The intersection operations analysis demonstrates that the Local Only Scenarios do not meet the purpose of the study to improve access and circulation in West Olympia for the following reasons:

- The US 101 SPUI/Black Lake Boulevard intersection cannot be improved to meet City of Olympia or WSDOT intersection LOS standards. With maximum improvements at this intersection and adjacent intersections, the two Local Only Scenarios cannot achieve better than LOS F conditions with average vehicle delays ranging from 125 to 140 seconds. This results in long vehicle queues on both the eastbound and westbound off-ramps and on Black Lake Boulevard. There is a greater potential for vehicle queues extending back into the US 101 mainline with this scenario due to the higher degree of congestion.
- The two Local Only Scenarios require substantially more intersection turn lane improvements (eight to nine feasible turn lanes) and continue to operate worse than the applicable LOS standards at some locations, compared to either the Black Lake Scenario or Evergreen Scenario (five to six feasible turn lanes respectively). Most of these turn lane improvements would require property acquisition and displace businesses and the costs could be prohibitive.

Recommendations

The recommendations from this study are primarily based on the freeway and local system operations analysis results. Black Lake Scenario has the lowest aggregate densities, which indicate higher throughput and less freeway congestion; however, the system-wide freeway densities and speeds are relatively similar among all build scenarios.

Since freeway operations are comparable for all build scenarios, the recommendations place substantial emphasis on the local system operations. The local system operations for the build scenarios can be summarized as:

- Local System Only Without Southwest Connections Scenario 2 – 11 intersections at LOS A, B, or C and 4 intersections at LOS F

- Local System Only With Southwest Connections Scenario 3 – 9 intersections at LOS A, B, or C and 4 intersections at LOS F
- Black Lake Interchange Without Southwest Connections Scenario 4 – 12 intersections at LOS A, B, or C and 4 intersections at LOS F
- Black Lake Interchange With Southwest Connections Scenario 5 – 13 intersections at LOS A, B, or C and 0 intersections at LOS F
- Evergreen Interchange Without Southwest Connections Scenario 6 – 11 intersections at LOS A, B, or C and 4 intersections at LOS F
- Evergreen Interchange With Southwest Connections Scenario 7 – 12 intersections at LOS A, B, or C and 2 intersections at LOS F

The number of local intersection improvements is important to consider when identifying recommendations because land uses at the intersections needing improvements are generally built out and construction of the improvements would require property acquisition for right-of-way. Full or partial displacement of existing uses substantially increase project costs, lengthens project schedules, and can be more difficult to implement. Additionally, increasing the number of turn lanes at intersections also increases pedestrian crossing times, which is less conducive to a pedestrian-friendly environment and inconsistent with the City's Comprehensive Plan. As described above, Black Lake Scenario 5 and Evergreen Scenario 7 require the least amount of local intersection improvements (also see Table 12, above).

In addition to the best local system operations and least number of intersection improvements, Black Lake Scenario 5 provides the most traffic reduction at the highly congested Black Lake Boulevard SPUI and the Black Lake Boulevard/Cooper Point Road intersections (approximately 800 vph lower than Local System Only Scenario 3) by diverting traffic to the new access ramps at Yauger Way. This is the only scenario that does not require any improvement to the Black Lake Boulevard/Cooper Point Road intersection to meet City of Olympia intersection LOS standards in the year 2030. Black Lake Scenarios 4 and 5, and to a lesser degree, Evergreen Scenarios 6 and 7, also provide important travel time and accessibility benefits to the Capital Medical Center by providing a direct route to and from US 101 for emergency vehicles, avoiding the highly congested Black Lake Boulevard and Cooper Point Road corridors.

Black Lake Scenarios 4 and 5, and to a lesser degree, Evergreen Scenarios 6 and 7 also provide an important secondary route to and from Capital Mall and surrounding retail businesses during peak holiday shopping weekends and seasons. A holiday season peak period traffic analysis was not specifically conducted; however, the new ramp connection to and from Yauger Way would likely improve safety and reduce vehicle queues and congestion that oftentimes extends into the US 101 mainline during these peak shopping days.

In summary, the two study recommendations and reasons for the recommendations are:

1. Eliminate Local System Only Scenarios 2 and 3 from further consideration
    - Local system impacts are substantially higher than other build scenarios
    - There is no traffic volume reduction at the highly congested US 101/Black Lake Boulevard SPUI and Black Lake Boulevard/Cooper Point Road intersections
    - With feasible improvements only, several intersections operate at unacceptable LOS E or F conditions with high delay at US 101/Black Lake Boulevard SPUI, Black Lake Boulevard/Cooper Point Road and 3-4 other intersections
    - There is no accessibility or travel time benefit to Capital Medical Center and other key locations compared to other build scenarios

- There is no benefit during holiday shopping time periods compared to other build scenarios

2. Conduct further evaluation of the Black Lake and Evergreen interchange scenarios
    - Concept design, accident/safety analysis, and an environmental screening evaluation would be initiated to provide more detailed information to select a preferred interchange alternative
    - An Interchange Justification Report (IJR) and NEPA/SEPA environmental document would be prepared after selecting a preferred interchange alternative

Table 17. Summary Comparison of Aggregate MOEs (One-Hour Analysis)

Number of Intersections Operating at	2030 No-Build Scenario 1	2030 Local System Only w/o SW Connections Scenario 2	2030 Local System Only w/ SW Connections Scenario 3	2030 Black Lake Interchange w/o SW Connections Scenario 4	2030 Black Lake Interchange w/ SW Connections Scenario 5	2030 Evergreen Interchange w/o SW Connections Scenario 6	2030 Evergreen Interchange w/ SW Connections Scenario 7
LOS A - C	8	11	9	12	13	11	12
LOS D - E	3	9	11	8	11	9	10
LOS F	13	4	4	4	0	4	2
Triangle Delay (sec/veh)	497.3	285.8	234.5	275.3	229.6	285.5	215.8
Triangle + SPUI Delay (sec/veh)	684.3	426.5	365.3	345.6	302.1	363.4	298.2
Total Turn Pockets Added	NA	9	8	7	5	10	6
Total Through Lanes Added	NA	1	1	0	1	0	1
Total Signals Added	NA	3	3	3	3	3	3
Number Failing	**15**	**6**	**6**	**6**	**3**	**7**	**3**

Table 18. Summary Comparison of Aggregate MOEs (Two-Hour Analysis)

Number of Intersections Operating at	2030 No-Build Scenario 1	2030 Local System Only w/o SW Connections Scenario 2	2030 Local System Only w/ SW Connections Scenario 3	2030 Black Lake Interchange w/o SW Connections Scenario 4	2030 Black Lake Interchange w/ SW Connections Scenario 5	2030 Evergreen Interchange w/o SW Connections Scenario 6	2030 Evergreen Interchange w/ SW Connections Scenario 7
LOS A - C	8	12	12	12	14	13	16
LOS D - E	5	10	10	10	10	9	8
LOS F	11	2	2	2	0	2	0
Triangle Delay (sec/veh)	432.8	253.5	208.0	240.4	200.9	248.9	188.9
Triangle + SPUI Delay (sec/veh)	611.4	388.3	332.3	308.0	271.1	322.9	266.8
Total Turn Pockets Added	NA	9	8	7	5	10	6
Total Through Lanes Added	NA	1	1	0	1	0	1
Total Signals Added	NA	3	3	3	3	3	3
Number Failing	**12**	**3**	**3**	**3**	**2**	**4**	**2**

REFERENCES

FHWA (Federal Highway Administration). 2004. *Traffic Analysis Toolbox, Volume 3, Guidelines for Applying Traffic Microsimulation Modeling Software.*

WSDOT Transportation Planning 2008. *Evaluation Methods and Screening.*

PTV America. 2007. *West Olympia Access Study, Model Documentation*.

TRB (Transportation Research Board). 2000. *Highway Capacity Manual (HCM), Special Report 209.*

STAKEHOLDER ACCEPTANCE

The undersigned parties concur with the assumptions, methodologies, and conclusions of the traffic analysis presented in this document.

WSDOT Assistant Design Engineer

Signature

Asst. State Design Engineer

Title

12/16/08

Date

FHWA

Signature

FHWA – OLYMPIC REGION – AREA ENGINEER

Title

11/18/2008

Date

WSDOT Headquarters

Signature

Access & Hearing Manager

Title

12-15-08

Date

City of Olympia

Signature

Transportation Engineering & Planning Manager

Title

12/17/08

Date

WSDOT Olympic Region

Signature

Olympic Region Traffic

Title

12/12/2008

Date

TRPC

Signature

Senior Planner.

Title

12.29.08

Date

ATTACHMENT A

City of Olympia Justifications of Infeasible Improvements

City of Olympia
Impacts of WOAS Intersection Improvements Associated with Scenarios
August 22, 2008

Issues of community scale, urban form, pedestrian, and bicycle safety are defined in the *Olympia Comprehensive Plan (see below)*. The additional lanes as proposed with the "local only" scenarios create safety concerns for pedestrians, transit riders and bicyclists, and are detrimental to the urban form Olympia is trying to create. Wide intersections are perceived as unsafe and intimidating to cross as a bicyclist and pedestrian, and can deter a person from walking and biking and using transit. Increasing use of these modes is an important cornerstone of the City's Comprehensive Plan goals and policies. Wide, busy intersections are out of scale with the vision of a pedestrian scale urban environment as defined in the comprehensive plan.

***Olympia Comprehensive Plan* Vision, Goals and Policies**

Two of the guiding visions for the comprehensive plan are:

- *Focus on moving people, instead of only moving vehicles. To encourage people to walk, streets, homes and businesses need to be built in a way that makes the streets inviting.*

- *Transportation Demand Management (TDM) is used to reduce the rate of growth of traffic volumes by encouraging commuters to use alternatives to driving alone. TDM is primarily focused on employee travel to and from work because these trips are made at the same time by large numbers of people and are, therefore, easier to replace with alternative modes of travel. TDM is important in maintaining the entire transportation system.*

Supporting policies include:

Policy T 1.15
In downtown and along High Density Corridors, priority shall be given to building pedestrian-friendly streets.

Note: among the City's High Density Corridors are: Cooper Point from Harrison to Black Lake, Black Lake from 101to Harrison, and Harrison Avenue from Budd Inlet to Cooper Point.

T 1.14
The City shall support bicyclists and pedestrians by providing safe, convenient, and inviting routes and walkways between activity centers and in areas where the use of alternatives to driving alone for commuters is encouraged. In these areas, facilities and services needed to support the use of alternatives shall be identified and a funding strategy put into place. Bike and pedestrian facilities shall be included in the multi-modal level of service policy. (See T 2.1)

Excerpt from Policy T 2.1
Road Width and Community Scale: Generally, a road should not be widened beyond two through lanes in each direction with auxiliary turn lanes as appropriate. Roads with more than five lanes are perceived by the public as beyond the scale that is appropriate for this community.
(Resolution #11866, 12/21/98)

Policy T 2.2
Downtown, and along High Density Residential Corridors, level of service E will be acceptable. In these areas road widening should be a last resort since it may discourage the Pedestrians that are to be encouraged and accommodated in these areas and since the results of the Urban Design Strategy indicate a strong preference for narrower roads. Development in these areas may need to contribute funds for improvements that can help the function or safety of the Road (such as signals, bike lanes, turn pockets, special lanes for buses). In the rest of the City and Urban Growth Area LOS D will be acceptable. Higher levels of service may be maintained in Parts of the city because of low traffic demand. Unsolved problem areas are noted on the transportation improvement map. For some intersections, the LOS is F.

Justification for Removal of Infeasible Projects

The width of some intersections described in the original scenarios is out of scale and counter to Olympia's adopted goals and vision defined by the *Olympia Comprehensive Plan*. In order to meet other goals in the comprehensive plan related to vehicle movement, management of congestion and concurrency, it is acknowledged that some additional intersection turn lanes are needed. However, the original scenarios included some excessive intersection widenings. Listed below are reasons why some of the original projects should be deemed infeasible and removed from further consideration in any scenario

1. When comparing local only to connection scenarios, the amount of widening at intersections is doubled or tripled with local only scenarios.
2. Pedestrian crossings are the primary concern of the widening. Pedestrians and transit riders will be exposed to longer crossings and more lanes of turning vehicles.
3. Of the nine intersections affected by the local only scenarios, 8 have transit routes, indicating a relatively high use by pedestrians (see table below).
4. Right on red movements by vehicles and conflicts with pedestrians in this circumstance increase with local only scenarios. Rights on red are one of the top circumstances in which conflict occurs between pedestrians and motorists.
5. Six of the nine intersection affected are considered high density corridors, where special consideration of urban form, and building a pedestrian friendly environment are crucial.
6. Longer signal times will be needed to accommodate pedestrian crossings in the local only scenarios which will increase friction for opposing traffic.
7. Mid blocks crossings and refuge islands would be needed to facilitate pedestrian crossings.
8. The number of conflict points increases which decreases safety and increase potential for vehicular side-swipe collisions as well as vehicle-pedestrian or vehicle-bicyclist collisions.

Based on these principles of we are providing a list of vehicle improvements that are counter intuitive to the City's Comprehensive Plan visions for safe pedestrian environment and the promotion multi-modal facilities. See the following table for those improvements that should be removed from the original list along with associated justification as described above.

As stated on the City's comprehensive plan, roads with more than five lanes are perceived by the public as beyond the scale that is appropriate for this community. Some exception can be made to add auxiliary turn lanes for vehicle level of service consideration and concurrency requirements. The City would have to consider removing the pedestrian crossings of six or seven lanes wide due to increase exposure to traffic and pedestrian crossing times. In these cases alternative designs to cross the street safely would be needed.

Conclusion

Intersection safety for all travelers is the primary concern behind this request to remove the infeasible intersection widenings. These intersection modifications are all related to the "Local Only" alternative improvements that increase intersection crossing distance and conflict points beyond reasonable safety for pedestrians and bicyclists. While the "build scenarios" also include some widening at intersections, the number of widening project and their resulting impact is far less. Subsequent analysis should focus only on those feasible intersection projects.

	2030 Local System Only Scenario		
Intersection	**Original Improvements**	**Feasible Improvements**	**Justification**
Black Lake and Cooper Point	1 NER Turn Lane 1 SER Turn Lane 1 SWL Turn Lane	~~1 NER Turn Lane~~ 1 SER Turn Lane ~~1 SWL Turn Lane~~	• Amount of widening at intersections is doubled or tripled with local only scenarios. • Pedestrians and transit riders will be exposed to longer crossings and more lanes of turning vehicles • Longer signal times will be needed to accommodate pedestrian crossings • Black Lake and Cooper Point intersection accommodates two transit routes, indicating a relatively high use by pedestrians. • Right on red movements by vehicles and conflicts with pedestrians in this circumstance increase with local only scenarios. Rights on red are one of the top circumstances in which conflict occurs between pedestrians and motorists • The intersection is part of a high density corridor, where the city has identified special consideration of urban form, and building a pedestrian friendly environment are crucial • Would have to consider removing the pedestrian crossings of six or seven lanes wide due to increase exposure to traffic and pedestrian crossing times. • The number of conflict points increases which decreases safety and increases potential for side-swipe collisions increase.
Black Lake/9th/Capital Mall Drive	1 EBL Turn Lane 1 SWR Turn Lane	~~1 EBL Turn Lane~~ 1 SWR Turn Lane	• Amount of widening at intersections is doubled or tripled with local only scenarios. • Pedestrians and transit riders will be exposed to longer crossings and more lanes of turning vehicles • Black Lake/9th St/Capital Mall Drive intersection accommodates a transit route, indicating a relatively high use by pedestrians • The intersection is part of a high density corridor, where the city has identified special consideration of urban form, and building a pedestrian friendly environment are crucial. • The number of conflict points increases which decreases safety and increases potential for side-swipe collisions increase.
Cooper Point/Auto Mall/Evergreen Pk	1 SEL Turn Lane 1 SWR Turn Lane	~~1 SEL Turn Lane~~ 1 SWR Turn Lane	• Amount of widening at intersections is doubled or tripled with local only scenarios. • Pedestrians and transit riders will be exposed to longer crossings and more lanes of turning vehicles • Cooper Point/Auto Mall/Evergreen Parkway Drive intersection accommodates a transit route, indicating a relatively high use by pedestrians • Longer signal times will be needed to accommodate pedestrian crossings • The number of conflict points increases which decreases safety and increases potential for side-swipe collisions increase.
Harrison and Division	2 NBL Turn Lanes 1 SBL Turn Lane	2 NBL Turn Lanes ~~1 SBL Turn Lane~~	• Amount of widening at intersections is doubled or tripled with local only scenarios. • Pedestrians and transit riders will be exposed to longer crossings and more lanes of turning vehicles • Harrison and Division intersection accommodates three transit routes, indicating a relatively high use by pedestrians. • The intersection is part of a high density corridor, where the city has identified special consideration of urban form, and building a pedestrian friendly environment are crucial. • The number of conflict points increases which decreases safety and increases potential for side-swipe collisions increase.

Number of Transit Routes	Net additional widening of local scenarios	Description of Improvements	Applicable Scenarios	
			Local Only Scenarios 2 and 3	Connections to 101 Scenarios 5 and 7
3	1 lane	Harrison and Division • 2 northbound left-turn lanes • 1 southbound left-turn lane	 2 and 3 2 and 3	 5 and 7
2	2 lanes	Black Lake and Cooper Point • 1 north/east right-turn lane • 1 south/east right-turn lane • 1 south/west left-turn lane	 2 and 3 2 and 3 2 and 3	 7
3	None	Cooper Point and Harrison • 1 northbound left-turn lane	 2 and 3	 5 and 7
1	1 lane	Black Lake/9th/Capital Mall Drive • 1 eastbound left-turn lane • 1 south/west right-turn lane	 2 and 3 2 and 3	 5 and 7
1	1 lane	Cooper Point/Auto Mall/Evergreen Pk • 1 south/east left-turn lane • 1 south/west left-turn lane	 2 and 3 2 and 3	 5 and 7
1	1 lane	Cooper Point at Top Foods Entrance • 1 eastbound right-turn lane	 2 and 3	
1	None	101 Westbound Ramps and Crosby • 1 northbound turn lane • 1 southbound right-turn lane	 2 and 3 3	 5 and 7 5 and 7
0	1 lane	Mud Bay Road/Evergreen Park (westbound ramps) • Add signal • 1 northbound turn lane	 2, 3, 2 and 3	 5 and 7
0	None	Mud Bay Road/Evergreen Park (eastbound ramps) • Add signal	 2, 3,	 5 and 7
2	1 lane	Lakeridge Drive and Deschutes Pkwy • Add signal • 1 southbound turn lane	 2, 3 2	 5 and 7

ATTACHMENT B

Model Inputs and Calibration Assumptions

Model Inputs and Calibration Assumptions

Model Input	Data Source(s)	Relevant Values	Remarks
Vehicle Speeds	WSDOT Annual Speed Report for 60 mph facilities Speed group distribution (R097, R003E, and P4)	55-58 mph (7%), 58-60 mph (43%), 60-67 mph (36%), 67-70 mph (12%), 70-75 mph (2%)	Northbound P4 speeds were used as representative of network (best available data)
Vehicle Compositions	Freeway: WSDOT P4 ADC and WSDOT R003E ADC Classification Summaries Annual Traffic Summary Local: City of Olympia Turning Movement Counts	US 101 Heavy Vehicles = 7% I-5 Heavy Vehicles = 9% Local Heavy Vehicles = 3%	PM Peak Period Heavy Vehicle Percentages
Volumes	***Freeway Volumes:*** WSDOT ADC Locations P4, R003E, R097, R098 (October 2006) ***On- and Off-Ramp Volumes:*** WSDOT Tube Counts (January 2007) ***Local Turning Movement Counts***: City of Olympia Existing Conditions Synchro Model (Base 2005) , City of Olympia Turning Movement Counts (2005-2007)	See Figures Tech Memo Figure 2, 3, and 4	Freeway: Average weekday PM peak period (4:00-6:00) counts. Local: Two hour weekday PM peak period(4:00 - 6:00) turning movement counts
Signal Timings	City of Olympia Existing Conditions Synchro Model, Consultant Field Measurements	n/a	Field Verified Signal Timings per field visit
Network Channelization	WSDOT Aerial SID File (Year 2007) local.live.com Consultant Field Visits	n/a	Existing channelization measured from scaled SID file. Number of lanes and channelization verified using local.live.com and consultant field visits

Model Inputs and Calibration Assumptions

Model Input	Data Source(s)	Relevant Values	Remarks
Vehicle Routing	Existing Turning Movement Splits, Existing Conditions VISUM Model	Static Routing	Used VISSIM static routing feature utilizing existing turning movement splits and on-and off-ramp percentages. For SB I-5 from 14th/Plum Avenue, utilized the existing conditions VISUM model to estimate O-D in the I-5/US 101 weave section.
Calibration Parameters	Primary: Lane Change Distances Secondary: Driver Behavior Parameter CC1 (Headway Time)	Modified CC1 on Southbound I-5 between 14th/Plum Avenue On-Ramp and US-101 Off Ramp from 0.9 to 1.3. Lane change distances varied between 2,500' to 7,500'	Modified driver behavior parameters to replicate field measured travel times and speeds. The model would not replicate the queue across all lanes by only changing lane change distances.

ATTACHMENT C

Modeled and Expected Volumes Comparison and GEH Statistics

2007 Existing
PM Peak VISSIM Model Volumes

2007 Existing									
Intersection Name	**Expected Volume**	**Model Volume**				**Total Volume**	**Percent Difference**	**Absolute Difference**	**GEH**
	4:30 - 5:30	**4:30**	**4:45**	**5:00**	**5:15**	**4:30 - 5:30**	**4:30 - 5:30**	**4:30 - 5:30**	
Freeway Volumes									
Southbound I-5									
Model Entry	4585	1197	1165	1139	1039	4540	1%	45	0.668
SB I-5 Mainline	4585	1167	1174	1112	1114	4567	0%	18	0.265
Plum On/US 101 Off Weave	6248	1560	1567	1544	1541	6212	1%	36	0.452
SB I-5 Mainline	3270	800	779	818	773	3169	3%	101	1.773
2nd Avenue Off	3270	800	779	818	773	3169	3%	101	1.773
SB I-5 Mainline	2994	744	725	760	722	2951	1%	43	0.791
US 101 On	4334	1066	1050	1098	1073	4286	1%	48	0.733
Model Exit	4334	1067	1050	1096	1073	4286	1%	48	0.734
Northbound I-5									
Model Entry	3855	986	978	1007	892	3863	0%	-8	0.135
US 101 Off	3855	987	979	1010	896	3872	0%	-17	0.280
NB I-5 Mainline	2960	767	745	773	697	2982	-1%	-22	0.396
US 101 On-ramp Merge	5958	1495	1446	1563	1459	5963	0%	-5	0.062
US 101/14th Ave Off-ramp Diverge	5958	1497	1446	1555	1462	5960	0%	-2	0.021
NB I-5 Mainline	5077	1290	1242	1333	1261	5125	-1%	-48	0.676
Plum On	5777	1456	1379	1521	1463	5818	-1%	-41	0.536
Model Exit	5789	1456	1379	1521	1463	5818	0%	-29	
Westbound 101									
Model Entry	4381	1106	1147	1078	1108	4439	-1%	-58	0.866
Crosby Blvd Off	4381	1104	1145	1083	1108	4440	-1%	-59	0.887
WB 101 Mainline	3261	819	842	805	817	3283	-1%	-22	0.383
Crosby Blvd/Black Lake Weave	3487	876	896	868	872	3513	-1%	-26	0.433
WB 101 Mainline	2073	514	537	503	512	2067	0%	6	0.125
Black Lake On	2467	603	644	595	624	2466	0%	1	0.020
WB 101 Mainline	2467	600	640	601	626	2467	0%	0	0.004
Evergreen Off	2467	599	641	599	626	2465	0%	2	0.034
WB 101 Mainline	1891	469	502	466	488	1926	-2%	-35	0.797
Mud Bay Off	1891	470	503	474	483	1930	-2%	-39	0.885
WB 101 Mainline	1805	449	484	450	462	1846	-2%	-41	0.948
Mud Bay On	2401	593	623	594	594	2404	0%	-3	0.065
WB 101 Mainline	2401	593	623	594	594	2404	0%	-3	0.065
Model Exit	2401	593	623	594	594	2404	0%	-3	0.065
Eastbound 101									
Model Entry	1773	433	443	455	438	1769	0%	5	0.107
Mudbay Off	1773	433	443	455	438	1769	0%	5	0.107
EB 101 Mainline	1460	357	361	375	359	1451	1%	9	0.236
Mudbay On	1520	376	376	391	371	1514	0%	6	0.159
EB 101 Mainline	1520	375	375	393	370	1513	0%	7	0.175
Evergreen On	2080	511	515	531	507	2064	1%	16	0.354
EB 101 Mainline	2080	511	517	532	506	2066	1%	15	0.318
Black Lake Off	2080	509	517	532	506	2064	1%	16	0.356
EB 101 Mainline	1820	449	452	466	443	1810	1%	10	0.239
Black Lake On	3270	791	801	829	810	3230	1%	41	0.710
EB 101 Mainline	3270	789	788	829	818	3223	1%	47	0.820
Crosby Blvd Off	3270	789	788	829	818	3223	1%	47	0.820
EB 101 Mainline	3090	749	743	770	775	3037	2%	53	0.965
Crosby Blvd On	4375	1057	1037	1117	1090	4301	2%	74	1.120
Model Exit	4375	1067	1047	1112	1089	4315	1%	60	0.910
	85119					**84911**	Comprehensive Model GEH -->		**0.71**

2030 No-Build Scenario 1
PM Peak VISSIM Model Volumes

2030 Scenario 1, No-Build								
Intersection Name	**Expected Volume**	**Model Volume**				**Total Volume**	**Percent Difference**	**Abs Difference**
	4:30 - 5:30	**4:30**	**4:45**	**5:00**	**5:15**	**4:30 - 5:30**	**4:30 - 5:30**	**4:30 - 5:30**
Freeway Volumes								
Southbound I-5								
Model Entry	6282	1249.9	1189	1175	1142	4756	32%	1526
SB I-5 Mainline	6282	1216.5	1204	1160	1137	4716	33%	1566
Plum On/US 101 Off Weave	8011	1617.3	1614	1609	1596	6436	24%	1575
SB I-5 Mainline	4304	898.5	877	912	885	3573	20%	731
2nd Avenue Off	4304	898.5	877	912	885	3573	20%	731
SB I-5 Mainline	4039	850.2	826	862	832	3371	20%	668
US 101 On	5889	1230.7	1169	1221	1163	4784	23%	1105
Model Exit	5889	1237.4	1168	1218	1168	4791	23%	1098
Northbound I-5								
Model Entry	5475	1404.7	1401	1435	1270	5511	-1%	-36
US 101 Off	5475	1408.5	1401	1439	1275	5523	-1%	-48
NB I-5 Mainline	4242	1085	1097	1102	995	4278	-1%	-36
US 101 On-ramp Merge	7913	1847.5	1789	1831	1756	7223	10%	691
US 101/14th Ave Off-ramp Diverge	7913	1851.1	1793	1825	1758	7228	9%	685
NB I-5 Mainline	6864	1613.8	1566	1588	1529	6296	9%	568
Plum On	7620	1792.8	1710	1792	1747	7042	8%	579
Model Exit	7620	1792.8	1710	1792	1747	7042	8%	579
Westbound 101								
Model Entry	5595	1204.1	1213	1175	1171	4763	17%	832
Crosby Blvd Off	5595	1201.8	1215	1180	1166	4762	17%	833
WB 101 Mainline	4337	925.9	929	910	897	3661	18%	676
Crosby Blvd/Black Lake Weave	4917	1030.4	1005	1022	996	4053	21%	864
WB 101 Mainline	3443	729.5	711	713	698	2851	21%	592
Black Lake On	4287	882.6	873	878	860	3493	23%	795
WB 101 Mainline	4287	883.2	868	878	861	3491	23%	797
Evergreen Off	4287	879.6	872	873	862	3486	23%	801
WB 101 Mainline	3406	697.9	693	683	682	2756	24%	650
Mud Bay Off	3406	700	694	691	684	2769	23%	637
WB 101 Mainline	3271	676.1	678	667	660	2680	22%	591
Mud Bay On	4111	883.1	880	876	846	3485	18%	626
WB 101 Mainline	4111	883.1	880	876	846	3485	18%	626
Model Exit	4111	883.1	880	876	846	3485	18%	626
Eastbound 101								
Model Entry	2766	682.9	694	715	685	2777	0%	-11
Mudbay Off	2766	682.9	694	715	685	2777	0%	-11
EB 101 Mainline	2387	587.5	594	609	582	2373	1%	14
Mudbay On	2437	603.9	604	625	577	2409	1%	28
EB 101 Mainline	2437	602.6	601	628	556	2388	2%	49
Evergreen On	3456	834.2	744	756	707	3041	14%	415
EB 101 Mainline	3456	803.4	703	747	662	2916	19%	541
Black Lake Off	3456	779.9	713	749	630	2872	20%	584
EB 101 Mainline	2955	660.8	612	639	525	2437	21%	518
Black Lake On	4617	992.4	942	971	847	3752	23%	865
EB 101 Mainline	4617	996.5	926	965	852	3739	23%	878
Crosby Blvd Off	4617	996.5	926	965	852	3739	23%	878
EB 101 Mainline	4339	946.5	862	893	806	3507	24%	832
Crosby Blvd On	5853	1177.9	1069	1117	1034	4397	33%	1456
Model Exit	5853	1180.8	1073	1092	1044	4390	33%	1463

2030 Local System Only Scenario 3
PM Peak VISSIM Model Volumes

2030 Scenario 3, Local System Only								
Intersection Name	**Expected Volume**	**Model Volume**				**Total Volume**	**Percent Difference**	**Abs Difference**
	4:30 - 5:30	**4:30**	**4:45**	**5:00**	**5:15**	**4:30 - 5:30**	**4:30 - 5:30**	**4:30 - 5:30**
Freeway Volumes								
Southbound I-5								
Model Entry	6282	1257.2	1178	1166	1128	4728	33%	1554
SB I-5 Mainline	6282	1219.1	1193	1135	1172	4719	33%	1563
Plum On/US 101 Off Weave	8011	1626.5	1607	1579	1612	6425	25%	1586
SB I-5 Mainline	4289	903.9	854	890	886	3533	21%	756
2nd Avenue Off	4289	903.9	854	890	886	3533	21%	756
SB I-5 Mainline	4038	856.7	797	844	829	3327	21%	711
US 101 On	5933	1261.1	1213	1236	1209	4919	21%	1014
Model Exit	5933	1263.5	1220	1232	1207	4923	21%	1011
Northbound I-5								
Model Entry	5475	1397.8	1410	1436	1275	5518	-1%	-43
US 101 Off	5475	1399.4	1414	1439	1280	5532	-1%	-57
NB I-5 Mainline	4242	1067.1	1103	1084	991	4245	0%	-3
US 101 On-ramp Merge	7915	1844.7	1850	1820	1814	7329	8%	586
US 101/14th Ave Off-ramp Diverge	7915	1847.7	1847	1819	1814	7328	8%	587
NB I-5 Mainline	6928	1613	1619	1587	1582	6401	8%	527
Plum On	7691	1802.1	1771	1801	1799	7173	7%	518
Model Exit	7691	1802.1	1771	1801	1799	7173	7%	518
Westbound 101								
Model Entry	5696	1229.5	1247	1188	1215	4879	17%	817
Crosby Blvd Off	5696	1217	1254	1199	1210	4880	17%	816
WB 101 Mainline	4272	907	930	886	910	3633	18%	639
Crosby Blvd/Black Lake Weave	4911	1030.1	1055	1012	1036	4133	19%	778
WB 101 Mainline	3513	741.6	763	723	741	2969	18%	544
Black Lake On	4270	893.7	920	868	886	3567	20%	703
WB 101 Mainline	4270	893.7	917	878	880	3568	20%	702
Evergreen Off	4270	891	917	881	882	3570	20%	700
WB 101 Mainline	3534	740.9	779	738	739	2996	18%	538
Mud Bay Off	3534	756.7	766	745	730	2998	18%	536
WB 101 Mainline	3402	732.6	741	727	711	2911	17%	491
Mud Bay On	4078	915.8	917	905	878	3616	13%	462
WB 101 Mainline	4078	915.8	917	905	878	3616	13%	462
Model Exit	4078	915.8	917	905	878	3616	13%	462
Eastbound 101								
Model Entry	2766	676.4	704	707	694	2782	-1%	-16
Mudbay Off	2766	676.4	704	707	694	2782	-1%	-16
EB 101 Mainline	2409	591.8	610	609	606	2417	0%	-8
Mudbay On	2448	606.6	618	622	616	2462	-1%	-14
EB 101 Mainline	2448	605.2	618	623	615	2462	-1%	-14
Evergreen On	3450	859.5	859	885	857	3461	0%	-11
EB 101 Mainline	3450	855.7	855	884	864	3458	0%	-8
Black Lake Off	3450	856.1	854	882	865	3457	0%	-7
EB 101 Mainline	2911	726.4	718	749	721	2914	0%	-3
Black Lake On	4568	1041.9	1034	1059	1005	4140	10%	429
EB 101 Mainline	4568	1042.6	1036	1054	983	4115	11%	453
Crosby Blvd Off	4568	1042.6	1036	1054	983	4115	11%	453
EB 101 Mainline	4299	985.7	974	983	916	3858	11%	441
Crosby Blvd On	5819	1259.4	1249	1216	1170	4894	19%	925
Model Exit	5819	1253.8	1230	1161	1200	4844	20%	975

2030 Black Lake Interchange Scenario 5
PM Peak VISSIM Model Volumes

2030 Scenario 5, Black Lake Interchange								
Intersection Name	**Expected Volume**	**Model Volume**				**Total Volume**	**Percent Difference**	**Abs Difference**
	4:30 - 5:30	**4:30**	**4:45**	**5:00**	**5:15**	**4:30 - 5:30**	**4:30 - 5:30**	**4:30 - 5:30**
Freeway Volumes								
Southbound I-5								
Model Entry	6236	1246.9	1206	1167	1162	4781	30%	1455
SB I-5 Mainline	6236	1207.8	1211	1149	1182	4749	31%	1487
Plum On/US 101 Off Weave	7965	1625.5	1605	1609	1617	6457	23%	1508
SB I-5 Mainline	4273	902	865	903	885	3555	20%	718
2nd Avenue Off	4273	902	865	903	885	3555	20%	718
SB I-5 Mainline	4013	846.2	814	854	834	3348	20%	665
US 101 On	5894	1252.3	1222	1243	1243	4961	19%	933
Model Exit	5894	1253.9	1219	1247	1235	4955	19%	939
Northbound I-5								
Model Entry	5475	1406	1400	1435	1272	5512	-1%	-37
US 101 Off	5475	1407.6	1399	1441	1274	5522	-1%	-47
NB I-5 Mainline	4242	1072.9	1091	1092	987	4242	0%	0
US 101 On-ramp Merge	7886	1851.5	1862	1863	1805	7381	7%	505
US 101/14th Ave Off-ramp Diverge	7886	1844.7	1868	1863	1805	7380	7%	506
NB I-5 Mainline	6899	1612.9	1633	1628	1572	6446	7%	453
Plum On	7669	1796.7	1776	1844	1788	7205	6%	464
Model Exit	7669	1796.7	1776	1844	1788	7205	6%	464
Westbound 101								
Model Entry	5666	1232.8	1241	1205	1210	4889	16%	777
Crosby Blvd Off	5666	1229	1238	1217	1208	4892	16%	774
WB 101 Mainline	4260	913.7	922	906	902	3643	17%	617
Crosby Blvd/Black Lake Weave	5047	1039.3	1053	1019	1039	4151	22%	897
WB 101 Mainline	3378	696.9	702	680	688	2767	22%	611
Black Lake On	4172	869	860	840	852	3421	22%	751
WB 101 Mainline	4172	870.6	858	841	852	3422	22%	750
Evergreen Off	4172	866.9	860	840	851	3418	22%	754
WB 101 Mainline	3516	725.2	732	700	720	2876	22%	640
Mud Bay Off	3516	730.8	728	709	714	2882	22%	634
WB 101 Mainline	3382	708.5	705	691	690	2794	21%	588
Mud Bay On	4037	865.1	867	845	838	3416	18%	622
WB 101 Mainline	4037	865.1	867	845	838	3416	18%	622
Model Exit	4037	865.1	867	845	838	3416	18%	622
Eastbound 101								
Model Entry	2766	682.9	694	715	685	2777	0%	-11
Mudbay Off	2766	682.9	694	715	685	2777	0%	-11
EB 101 Mainline	2427	601.9	608	625	607	2442	-1%	-15
Mudbay On	2468	614.9	616	638	616	2484	-1%	-16
EB 101 Mainline	2468	614	618	636	617	2485	-1%	-17
Evergreen On	3252	801.3	815	833	779	3228	1%	24
EB 101 Mainline	3252	800.2	801	810	798	3210	1%	42
Black Lake Off	3252	802.3	792	808	801	3203	2%	49
EB 101 Mainline	2695	665.2	659	672	667	2663	1%	32
Black Lake On	4647	1101.9	1088	1066	1101	4358	7%	289
EB 101 Mainline	4647	1101.4	1082	1062	1111	4356	7%	291
Crosby Blvd Off	4647	1101.4	1082	1062	1111	4356	7%	291
EB 101 Mainline	4282	1010.5	998	969	1019	3996	7%	286
Crosby Blvd On	5774	1262.1	1227	1211	1236	4936	17%	838
Model Exit	5774	1241.2	1258	1172	1248	4919	17%	855

2030 Evergreen Interchange Scenario 7
PM Peak VISSIM Model Volumes

2030 Scenario 7, Evergreen Interchange								
Intersection Name	**Expected Volume**	**Model Volume**				**Total Volume**	**Percent Difference**	**Abs Difference**
	4:30 - 5:30	**4:30**	**4:45**	**5:00**	**5:15**	**4:30 - 5:30**	**4:30 - 5:30**	**4:30 - 5:30**
Freeway Volumes								
Southbound I-5								
Model Entry	6236	1257.2	1206	1174	1148	4785	30%	1451
SB I-5 Mainline	6236	1214.3	1218	1148	1180	4761	31%	1476
Plum On/US 101 Off Weave	7932	1612.7	1607	1598	1618	6435	23%	1497
SB I-5 Mainline	4269	895.7	861	898	882	3535	21%	734
2nd Avenue Off	4269	895.7	861	898	882	3535	21%	734
SB I-5 Mainline	4023	843.4	814	848	825	3331	21%	692
US 101 On	5922	1238	1217	1235	1226	4916	20%	1006
Model Exit	5922	1239.9	1215	1235	1227	4917	20%	1005
Northbound I-5								
Model Entry	5475	1405.8	1400	1435	1272	5512	-1%	-37
US 101 Off	5475	1403.5	1405	1439	1275	5522	-1%	-47
NB I-5 Mainline	4242	1070.6	1093	1091	988	4243	0%	-1
US 101 On-ramp Merge	7921	1823.5	1848	1837	1824	7332	8%	589
US 101/14th Ave Off-ramp Diverge	7921	1824.1	1851	1832	1823	7330	8%	591
NB I-5 Mainline	6934	1594.3	1611	1603	1589	6398	8%	536
Plum On	7697	1771	1761	1810	1810	7152	8%	545
Model Exit	7697	1771	1761	1810	1810	7152	8%	545
Westbound 101								
Model Entry	5631	1234.7	1248	1207	1223	4911	15%	720
Crosby Blvd Off	5631	1242.4	1246	1215	1218	4922	14%	709
WB 101 Mainline	4218	923.7	930	907	905	3667	15%	551
Crosby Blvd/Black Lake Weave	4829	1029.8	1043	1020	1019	4111	17%	718
WB 101 Mainline	3504	742.2	757	729	732	2960	18%	544
Black Lake On	4204	897.3	907	876	892	3573	18%	632
WB 101 Mainline	4204	896.3	909	875	892	3572	18%	632
Evergreen Off	4204	682.3	696	664	676	2718	55%	1486
WB 101 Mainline	3185	680.6	695	664	676	2716	17%	469
Evergreen On	3315	712	733	699	703	2847	16%	468
WB 101 Mainline	3315	712	733	699	703	2847	16%	468
Mud Bay Off	3315	716.7	726	709	699	2851	16%	465
WB 101 Mainline	3182	692.8	704	683	681	2760	15%	422
Mud Bay On	4016	898.3	904	887	870	3559	13%	457
WB 101 Mainline	4016	898.3	904	887	870	3559	13%	457
Model Exit	4016	898.3	904	887	870	3559	13%	457
Eastbound 101								
Model Entry	2766	682.9	694	715	685	2777	0%	-11
Mudbay Off	2766	682.9	694	715	685	2777	0%	-11
EB 101 Mainline	2409	592	601	616	599	2408	0%	2
Mudbay On	2477	613.2	616	636	613	2478	0%	-1
EB 101 Mainline	2477	612	618	636	613	2479	0%	-2
Evergreen Off	2477	610.2	619	633	619	2481	0%	-4
EB 101 Mainline	2457	606.2	611.4	626.4	610.9	2455	0%	2
Evergreen On	3683	908.5	917	937	904	3667	0%	16
EB 101 Mainline	3683	903.7	920	934	907	3664	1%	19
Black Lake Off	3683	904.5	918	934	907	3664	1%	20
EB 101 Mainline	3142	769.8	777	802	775	3123	1%	19
Black Lake On	4651	1091.5	1063	1125	1065	4345	7%	306
EB 101 Mainline	4651	1091.1	1062	1112	1060	4325	8%	326
Crosby Blvd Off	4651	1091.1	1062	1112	1060	4325	8%	326
EB 101 Mainline	4354	1014.4	1006	1017	992	4029	8%	325
Crosby Blvd On	5880	1252.4	1230	1243	1211	4936	19%	944
Model Exit	5880	1242.5	1216	1208	1216	4883	20%	997

ATTACHMENT D

Expanded Freeway Density and LOS Tables

2007 Existing
PM Peak Freeway Density and LOS

Segment	Type	Volume (total)	Density (pc/mi/ln)	LOS (HCM Equivalent)
Southbound I-5	Basic	4,519	73.5	F
Southbound I-5 to US 101 Weave	Weave	6,212	53.4	F
Southbound I-5	Basic	3,159	20.9	C
Southbound I-5 Deschutes Pkwy Off-Ramp	Diverge	3,107	17.8	B
Southbound I-5	Basic	2,952	19.8	C
Southbound I-5 US 101 On-Ramp	Merge	3,872	27.2	C
Southbound I-5	Basic	4,285	27.9	D
Northbound I-5	Basic	3,871	22.6	C
Northbound I-5 to US 101 Off-Ramp	Diverge	3,871	27.6	C
Northbound I-5	Basic	2,980	19.2	C
Northbound I-5 US 101 On-Ramp	Merge	5,857	35.6	E
Northbound I-5	Basic	5,957	27.3	D
Northbound I-5 Plum/14th Off-Ramp	Diverge	5,588	26.9	C
Northbound I-5	Basic	5,118	24.1	C
Westbound US 101 e/o Crosby Blvd	Basic	4,411	35.1	E
Westbound US 101 Crosby Blvd Off-Ramp	Diverge	4,433	48.4	F
Westbound US 101	Basic	3,244	22.7	C
Westbound US 101 Crosby Blvd/Black Lake Weave	Weave	3,022	19.9	B
Westbound US 101	Basic	2,031	20.2	C
Westbound US 101 Black Lake On-Ramp	Merge	2,278	14.9	B
Westbound US 101	Basic	2,456	23.6	C
Westbound US 101 Evergreen Off-Ramp	Diverge	2,393	22.7	C
Westbound US 101	Basic	1,925	18.0	C
Westbound US 101 Mud Bay Off-Ramp	Diverge	1,922	18.1	C
Westbound US 101	Basic	1,845	17.4	B
Westbound US 101 Mud Bay On-Ramp	Merge	2,218	14.3	B
Westbound US 101	Basic	2,403	22.9	C
Eastbound US 101	Basic	1,768	16.3	B
Eastbound US 101 Mud Bay Off-Ramp	Diverge	1,760	16.5	B
Eastbound US 101	Basic	1,460	13.5	B
Eastbound US 101 Mud Bay On-Ramp	Merge	1,511	8.9	A
Eastbound US 101	Basic	1,513	14.4	B
Eastbound US 101 Evergreen On-Ramp	Merge	2,049	13.5	B
Eastbound US 101	Basic	2,065	19.4	C
Eastbound US 101 Black Lake Off-Ramp	Diverge	2,037	19.1	B
Eastbound US 101	Basic	1,726	15.7	B
Eastbound US 101 Black Lake On-Ramp	Merge	3,136	14.5	B
Eastbound US 101	Basic	3,227	19.6	C
Eastbound US 101 Crosby Blvd Off-Ramp	Diverge	3,109	19.2	B
Eastbound US 101	Basic	3,010	18.2	C
Eastbound US 101 Crosby Blvd On-Ramp	Merge	4,296	20.6	C
Eastbound US 101	Basic	4,280	30.1	D

2030 No-Build Scenario 1
PM Peak Freeway Density and LOS

Segment	Type	Volume (total)	Density (pc/mi/ln)	LOS (HCM Equivalent)
Southbound I-5	Basic	4,663	80.7	F
Southbound I-5 to US 101 Weave	Weave	6,432	57.3	F
Southbound I-5	Basic	3,561	24.1	C
Southbound I-5 Deschutes Pkwy Off-Ramp	Diverge	3,513	20.6	C
Southbound I-5	Basic	3,365	23.6	C
Southbound I-5 US 101 On-Ramp	Merge	4,324	42.8	E
Southbound I-5	Basic	4,788	33.6	D
Northbound I-5	Basic	5,518	33.1	D
Northbound I-5 to US 101 Off-Ramp	Diverge	5,519	40.7	E
Northbound I-5	Basic	4,274	28.7	D
Northbound I-5 US 101 On-Ramp	Merge	7,086	81.4	F
Northbound I-5	Basic	7,226	37.5	E
Northbound I-5 Plum/14th Off-Ramp	Diverge	6,813	31.7	D
Northbound I-5	Basic	6,287	30.2	D
Westbound US 101 e/o Crosby Blvd	Basic	4,734	38.5	E
Westbound US 101 Crosby Blvd Off-Ramp	Diverge	4,758	49.7	F
Westbound US 101	Basic	3,618	25.8	C
Westbound US 101 Crosby Blvd/Black Lake Weave	Weave	3,436	23.5	B
Westbound US 101	Basic	2,799	29.7	D
Westbound US 101 Black Lake On-Ramp	Merge	3,224	26.4	C
Westbound US 101	Basic	3,476	35.6	E
Westbound US 101 Evergreen Off-Ramp	Diverge	3,387	32.9	D
Westbound US 101	Basic	2,756	26.0	C
Westbound US 101 Mud Bay Off-Ramp	Diverge	2,760	26.4	C
Westbound US 101	Basic	2,680	25.7	C
Westbound US 101 Mud Bay On-Ramp	Merge	3,212	25.5	C
Westbound US 101	Basic	3,484	35.2	E
Eastbound US 101	Basic	2,776	26.2	D
Eastbound US 101 Mud Bay Off-Ramp	Diverge	2,761	29.8	D
Eastbound US 101	Basic	2,383	27.1	D
Eastbound US 101 Mud Bay On-Ramp	Merge	2,406	29.2	D
Eastbound US 101	Basic	2,247	124.0	F
Eastbound US 101 Evergreen On-Ramp	Merge	2,995	133.3	F
Eastbound US 101	Basic	2,936	136.9	F
Eastbound US 101 Black Lake Off-Ramp	Diverge	2,819	130.6	F
Eastbound US 101	Basic	2,364	17.3	B
Eastbound US 101 Black Lake On-Ramp	Merge	3,647	14.9	B
Eastbound US 101	Basic	3,746	20.1	C
Eastbound US 101 Crosby Blvd Off-Ramp	Diverge	3,603	19.3	B
Eastbound US 101	Basic	3,480	18.7	C
Eastbound US 101 Crosby Blvd On-Ramp	Merge	4,383	19.3	B
Eastbound US 101	Basic	4,353	31.6	D

2030 Local System Only Scenario 3
PM Peak Freeway Density and LOS

Segment	Type	Volume (total)	Density (pc/mi/ln)	LOS (HCM Equivalent)
Southbound I-5	Basic	4,659	78.5	F
Southbound I-5 to US 101 Weave	Weave	6,421	57.0	F
Southbound I-5	Basic	3,520	23.8	C
Southbound I-5 Deschutes Pkwy Off-Ramp	Diverge	3,473	20.7	C
Southbound I-5	Basic	3,321	23.1	C
Southbound I-5 US 101 On-Ramp	Merge	4,441	45.0	E
Southbound I-5	Basic	4,920	34.6	D
Northbound I-5	Basic	5,527	33.6	D
Northbound I-5 to US 101 Off-Ramp	Diverge	5,528	43.0	E
Northbound I-5	Basic	4,243	28.7	D
Northbound I-5 US 101 On-Ramp	Merge	7,197	119.5	F
Northbound I-5	Basic	7,327	40.2	E
Northbound I-5 Plum/14th Off-Ramp	Diverge	6,914	33.4	D
Northbound I-5	Basic	6,390	31.2	D
Westbound US 101 e/o Crosby Blvd	Basic	4,851	42.4	E
Westbound US 101 Crosby Blvd Off-Ramp	Diverge	4,875	54.9	F
Westbound US 101	Basic	3,589	26.2	D
Westbound US 101 Crosby Blvd/Black Lake Weave	Weave	3,501	24.3	C
Westbound US 101	Basic	2,909	31.0	D
Westbound US 101 Black Lake On-Ramp	Merge	3,294	27.8	C
Westbound US 101	Basic	3,553	36.6	E
Westbound US 101 Evergreen Off-Ramp	Diverge	3,491	34.0	D
Westbound US 101	Basic	2,997	28.7	D
Westbound US 101 Mud Bay Off-Ramp	Diverge	2,989	28.8	D
Westbound US 101	Basic	2,910	27.9	D
Westbound US 101 Mud Bay On-Ramp	Merge	3,336	28.3	D
Westbound US 101	Basic	3,612	36.4	E
Eastbound US 101	Basic	2,780	26.7	D
Eastbound US 101 Mud Bay Off-Ramp	Diverge	2,768	29.2	D
Eastbound US 101	Basic	2,427	23.4	C
Eastbound US 101 Mud Bay On-Ramp	Merge	2,458	14.7	B
Eastbound US 101	Basic	2,464	24.8	C
Eastbound US 101 Evergreen On-Ramp	Merge	3,435	25.7	C
Eastbound US 101	Basic	3,459	34.7	D
Eastbound US 101 Black Lake Off-Ramp	Diverge	3,403	33.2	D
Eastbound US 101	Basic	2,772	26.9	D
Eastbound US 101 Black Lake On-Ramp	Merge	4,026	23.0	C
Eastbound US 101	Basic	4,123	33.5	D
Eastbound US 101 Crosby Blvd Off-Ramp	Diverge	3,967	33.6	D
Eastbound US 101	Basic	3,832	35.1	E
Eastbound US 101 Crosby Blvd On-Ramp	Merge	4,878	52.8	F
Eastbound US 101	Basic	4,825	63.6	F

2030 Black Lake Interchange Scenario 5
PM Peak Freeway Density and LOS

Segment	Type	Volume (total)	Density (pc/mi/ln)	LOS (HCM Equivalent)
Southbound I-5	Basic	4,684	78.4	F
Southbound I-5 to US 101 Weave	Weave	6,454	56.3	F
Southbound I-5	Basic	3,543	24.0	C
Southbound I-5 Deschutes Pkwy Off-Ramp	Diverge	3,495	21.0	C
Southbound I-5	Basic	3,345	23.3	C
Southbound I-5 US 101 On-Ramp	Merge	4,482	47.4	F
Southbound I-5	Basic	4,954	35.0	D
Northbound I-5	Basic	5,519	33.6	D
Northbound I-5 to US 101 Off-Ramp	Diverge	5,519	43.3	E
Northbound I-5	Basic	4,239	28.8	D
Northbound I-5 US 101 On-Ramp	Merge	7,249	112.7	F
Northbound I-5	Basic	7,381	40.4	E
Northbound I-5 Plum/14th Off-Ramp	Diverge	6,962	33.6	D
Northbound I-5	Basic	6,435	31.5	D
Westbound US 101 e/o Crosby Blvd	Basic	4,862	42.6	E
Westbound US 101 Crosby Blvd Off-Ramp	Diverge	4,884	55.9	F
Westbound US 101	Basic	3,601	26.1	D
Westbound US 101 Crosby Blvd/Black Lake Weave	Weave	3,539	28.5	C
Westbound US 101	Basic	2,714	28.6	D
Westbound US 101 Black Lake On-Ramp	Merge	3,158	25.0	C
Westbound US 101	Basic	3,407	34.6	D
Westbound US 101 Evergreen Off-Ramp	Diverge	3,345	32.2	D
Westbound US 101	Basic	2,875	27.3	D
Westbound US 101 Mud Bay Off-Ramp	Diverge	2,873	27.6	C
Westbound US 101	Basic	2,793	26.7	D
Westbound US 101 Mud Bay On-Ramp	Merge	3,152	24.4	C
Westbound US 101	Basic	3,412	33.9	D
Eastbound US 101	Basic	2,776	26.6	D
Eastbound US 101 Mud Bay Off-Ramp	Diverge	2,764	28.7	D
Eastbound US 101	Basic	2,451	23.5	C
Eastbound US 101 Mud Bay On-Ramp	Merge	2,480	14.8	B
Eastbound US 101	Basic	2,467	29.5	D
Eastbound US 101 Evergreen On-Ramp	Merge	3,203	30.7	D
Eastbound US 101	Basic	3,214	41.2	E
Eastbound US 101 Black Lake Off-Ramp	Diverge	3,142	42.9	E
Eastbound US 101	Basic	2,488	23.7	C
Eastbound US 101 Black Lake On-Ramp	Merge	4,234	22.2	C
Eastbound US 101	Basic	4,359	31.4	D
Eastbound US 101 Crosby Blvd Off-Ramp	Diverge	4,138	28.7	D
Eastbound US 101	Basic	3,961	26.2	D
Eastbound US 101 Crosby Blvd On-Ramp	Merge	4,929	38.6	E
Eastbound US 101	Basic	4,889	55.9	F

2030 Evergreen Interchange Scenario 7
PM Peak Freeway Density and LOS

Segment	Type	Volume (total)	Density (pc/mi/ln)	LOS (HCM Equivalent)
Southbound I-5	Basic	4,703	79.1	F
Southbound I-5 to US 101 Weave	Weave	6,432	57.2	F
Southbound I-5	Basic	3,523	23.8	C
Southbound I-5 Deschutes Pkwy Off-Ramp	Diverge	3,475	20.7	C
Southbound I-5	Basic	3,328	23.1	C
Southbound I-5 US 101 On-Ramp	Merge	4,438	45.3	F
Southbound I-5	Basic	4,916	34.9	D
Northbound I-5	Basic	5,519	33.9	D
Northbound I-5 to US 101 Off-Ramp	Diverge	5,519	45.6	F
Northbound I-5	Basic	4,240	29.1	D
Northbound I-5 US 101 On-Ramp	Merge	7,201	117.5	F
Northbound I-5	Basic	7,330	39.9	E
Northbound I-5 Plum/14th Off-Ramp	Diverge	6,914	33.2	D
Northbound I-5	Basic	6,387	31.2	D
Westbound US 101 e/o Crosby Blvd	Basic	4,886	43.4	E
Westbound US 101 Crosby Blvd Off-Ramp	Diverge	4,915	54.3	F
Westbound US 101	Basic	3,624	26.4	D
Westbound US 101 Crosby Blvd/Black Lake Weave	Weave	3,478	23.9	B
Westbound US 101	Basic	2,903	30.9	D
Westbound US 101 Black Lake On-Ramp	Merge	3,525	31.0	D
Westbound US 101 Evergreen Off-Ramp	Weave	3,505	40.0	E
Westbound US 101	Basic	2,715	25.9	C
Westbound US 101 Evergreen On-Ramp	Merge	1,474	20.6	C
Westbound US 101	Basic	2,862	27.2	D
Westbound US 101 Mud Bay Off-Ramp	Diverge	2,842	27.4	C
Westbound US 101	Basic	2,759	26.4	D
Westbound US 101 Mud Bay On-Ramp	Merge	3,282	28.3	D
Westbound US 101	Basic	3,555	35.9	E
Eastbound US 101	Basic	2,776	26.5	D
Eastbound US 101 Mud Bay Off-Ramp	Diverge	2,764	28.4	D
Eastbound US 101	Basic	2,418	23.2	C
Eastbound US 101 Mud Bay On-Ramp	Merge	2,474	14.8	B
Eastbound US 101	Basic	2,479	24.9	C
Eastbound US 101 Evergreen Off-Ramp	Diverge	2,477	26.8	C
Eastbound US 101	Basic	2,442	24.1	C
Eastbound US 101 Evergreen On-Ramp	Merge	3,635	48.9	F
Eastbound US 101	Basic	3,489	45.7	F
Eastbound US 101 Black Lake Off-Ramp	Diverge	3,557	37.4	E
Eastbound US 101	Basic	2,968	27.9	D
Eastbound US 101 Black Lake On-Ramp	Merge	4,224	21.9	C
Eastbound US 101	Basic	4,333	32.7	D
Eastbound US 101 Crosby Blvd Off-Ramp	Diverge	4,154	33.2	D
Eastbound US 101	Basic	4,001	36.2	E
Eastbound US 101 Crosby Blvd On-Ramp	Merge	4,911	62.6	F
Eastbound US 101	Basic	4,854	67.6	F