I-5 JBLM Vicinity Interchange Justification Report

I-5/Berkeley Street & I-5/Thorne Lane Interchanges
MP 120.5 to MP 124.9

Prepared for: Washington State Department of Transportation

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Introduction

The Washington State Department of Transportation (WSDOT) is proposing a series of improvements along Interstate 5 (I-5) in the vicinity of Joint Base Lewis-McChord (JBLM). Packaged as the I-5 JBLM Vicinity Congestion Relief Project (Project), these improvements include re-configuration of two interchanges, as well as mainline and local street improvements. The purpose of these improvements is to address existing and expected near-term (2020) congestion on the highway mainline as well as providing reconfigured interchanges that are designed to enhance regional mobility and to meet safety needs through 2040.

The addition of mainline capacity (lanes) is constrained at two locations by the cross-section of the existing Berkeley Street and Thorne Lane Interchange overcrossing structures. These structures currently accommodate only three travel lanes in each direction and must be widened to add a fourth lane in each direction, as proposed by the Build Alternative.

The widening of the existing overcrossing structures requires the modification of the ramp terminal intersections and approach streets so that they operate as efficiently and safely as possible.

Thus, while the focus of this IJR is on improvements to the Berkeley Street and Thorne Lane Interchanges, these improvements are triggered by the need to widen I-5 through the I-5 JBLM project corridor. Accordingly, the information presented in this IJR addresses traffic operations and safety at these two interchanges, as well as the highway mainline, local street and multimodal improvements.

What Does the Project Include?

The Project is located in southern Pierce County between the Gravelly Lake Drive Interchange (Exit 124) and Mounts Road Interchange (Exit 116) and is illustrated in **Figure ES-1**. The Project would be constructed in phases, the first of which is the Build Alternative in the North Study Area. The Build Alternative is specifically addressed in this IJR. The limits of the Build Alternative area are between Gravelly Lake Drive on the north and the vicinity of Steilacoom-DuPont Road on the south and would include:

- Reconstruction of the Thorne Lane Interchange with a new bridge approximately 350 feet south of the existing bridge. The new bridge would grade-separate Thorne Lane over I-5, the adjacent rail line and Union Avenue. Ramp intersections would be built as multi-lane roundabouts.
- Reconstruction of the Berkeley Street Interchange with a new bridge centered approximately 120 feet south of the existing bridge. The new bridge would grade-separate the extension of Jackson Avenue over I-5, the adjacent rail lane, and Militia Drive, tying into Berkeley Street near Washington Avenue. Ramp intersections would be built as multi-lane roundabouts.
- Construction of a fourth travel lane on I-5 from just north of Thorne Lane southbound to under Steilacoom - DuPont Road and from north of Steilacoom-DuPont Road northbound to Thorne Lane as GP (General Purpose) lanes.

Figure ES-1: I-5 JBLM Vicinity Congestion Relief Project Corridor

- Construction of a northbound auxiliary lane from the Berkeley Street northbound on-ramp to the Thorne Lane northbound off-ramp.
- Construction of a new southbound local road connection between Gravelly Lake Drive and Thorne Lane to carry local trips that may otherwise use I-5. This improvement includes a southbound vehicle lane and a two-way shared use path, and would enhance access between the Tillicum and Woodbrook neighborhoods and the jobs, schools, services, and commerce in Lakewood.
- A new northbound auxiliary lane on I-5 between the Thorne Lane on-ramp and the Gravelly Lake Drive off-ramp.
- A new shared use path would be established along the I-5 corridor for pedestrians and bicyclists between Steilacoom-DuPont Road and Berkeley Street.

The southern portion of the project (South Study Area) is also shown in Figure ES-1. Improvements in this area are not sufficiently defined at this time to be evaluated in this IJR and they are being treated at a corridor level. When a Build Alternative is identified for the South Study Area, a separate IJR will be prepared for access changes in this area.

Why Is the Project Needed?

Between 1986 and 2014, traffic volumes increased by 76 percent along I–5 in the vicinity of JBLM. Congested traffic, characterized by stop-and-go conditions, has become commonplace during weekday morning (AM) and evening (PM) peak periods, as well as weekends during summer months.

Contributors to the traffic demand are both regional and local. Most of the traffic growth in the corridor occurred before 2003, and is associated with significant growth in Thurston and Pierce counties. Additionally, JBLM, a secure military facility, is the largest single site employer in the state of Washington.

Factors contributing to the chronic traffic congestion include the following:

- **Reduction in number of traffic lanes on I-5 at the Thorne Lane** Interchange (8 lanes north of Thorne, 6 lanes south of Thorne).
- **Six closely spaced I-5 interchanges** over a short distance of approximately seven miles subject the mainline to **high entering and exiting traffic volumes** between Center Drive and Gravelly Lake Drive (approximately 50 percent of peak period trips on I-5 in the study area exit or enter the mainline from these closely spaced interchanges).
- **Heavy existing through volumes** of traffic traveling between Lacey/Olympia and points south to Tacoma/Seattle and points north (also approximately 50 percent of peak period trips on I-5). This traffic mixes with the interchange traffic affecting performance in all travel lanes.
- **Vehicle trips using I-5 for local and short distance travel** in the study area because there are limited alternative routes.
- Military base security requirements, environmental, geophysical (such as lakes and Puget Sound), and right-of-way constraints that **limit travel**

opportunities other than I-5 through and within the area.

- Congestion related crashes especially during peak commute hours

What Is the Project's Purpose?

The Project would reduce chronic traffic congestion and improve person and freight mobility along I-5 in the vicinity of JBLM, while continuing to maintain access to the communities and military installations neighboring the freeway. The proposed Project is being designed to achieve the following objectives:

- Relieve congestion on I-5 within the vicinity of JBLM;
- Improve local and mainline system efficiency;
- Enhance mobility;
- Improve safety and operations; and
- Improve access/connectivity for non-motorized users

Local street improvements would address local traffic circulation needs within the study area. It is anticipated that these improvements would reduce traffic on I-5 for local trips, and improve connectivity to the proposed interchange modifications. These local street improvement projects were programmed and adopted into the *City of Lakewood Transportation Improvement Program* (TIP). The cities of Lakewood and DuPont include the proposed IJR improvements within their TIP's. These agencies TIP's are included as Appendix K.

What Is the Focus of this IJR?

To address the need for Build Alternative improvements in the North Study Area, the Washington State Department of Transportation (WSDOT) has undertaken an effort to prepare this Interchange Justification Report (IJR) for the interchanges of I-5 with Berkeley Street and Thorne Lane. IJRs are required to justify new and/or revised ramps accessing limited access freeways such as I-5. The purpose of these revisions is to provide wider opening for the I-5 roadways beneath the bridges carrying Thorne Lane and Berkeley Street over I-5 so lanes can be added. An IJR includes:

- Identification of the need for proposed interchange improvements
- Evaluation of all other reasonable alternatives (including roadways other than I-5)
- Analysis and evaluation of proposed improvements to meet the need
- Documentation of consistency with local, regional and state land use and transportation plans
- Provision of environmental documentation for the proposed improvements

Federal law requires Federal Highway Administration (FHWA) approval of all revisions to the interstate system, and the IJR is the document used for this process.

What Are the Key Findings and Conclusions of the IJR?

Overall, this IJR documents the existing chronic traffic congestion issues and deteriorating future conditions along the I-5 corridor in the vicinity of JBLM if no I-5 improvements are implemented. Various local street improvements on JBLM and within local communities, as well as transit improvements were also examined. It was found that local street improvements generally enhanced local traffic circulation, but did not adequately reduce congestion on I-5.

The IJR analyzes various multimodal transportation alternatives and recommends the proposed Build Alternative, including access modifications at the Thorne Lane and Berkeley Street interchanges, associated I-5 widening, local access improvements, and non-motorized features.

The proposed Build Alternative is designed to improve existing and near-term (2020) conditions along the I-5 corridor and provide some relief to long-term (2040) traffic conditions. To better relieve long-term traffic conditions along the I-5 corridor, other improvements to the north and south of this study area will need to be identified and implemented. The proposed interchange reconfigurations at Thorne Lane and Berkeley Street are designed to provide good performance in 2040 and will allow for adding new I-5 lanes should that be determined appropriate in the future.

The following key findings of the analyses conducted as part of this IJR are summarized for each of the required policy points.

Policy Point 1: Need for Access Point Revisions

Analyses of the existing transportation system shows that chronic traffic congestion is expected to continue and deteriorate over the coming years. Drivers on I-5 through the JBLM area experience two to three hours of congestion today during the afternoon peak hours, with traffic operations characterized by slow speed and periods of stop-and-go conditions. This situation would worsen in the future, growing to over six hours of slow speeds in the afternoon peak by 2040.

As an interim measure, WSDOT has already implemented several Transportation System Management (TSM) improvements to reduce this congestion. However, even with these TSM improvements traffic operations along I-5 through the JBLM area are expected to decline and congestion would continue to extend over long morning and afternoon peak periods.

Several local street improvements both on JBLM and in local communities were identified by project stakeholders and the general public. These local street improvements were analyzed as part of the *Multi-modal Alternatives Analysis* conducted with the *I-5 JBLM Vicinity Congestion Relief Study*. Although they improved local circulation, most local street improvement options were not found to successfully relieve I-5 congestion and provided little benefit to I-5 traffic operations.

To allow the I-5 capacity improvements identified in the *I-5 JBLM Vicinity Congestion Relief Study*, the interchanges at Berkeley Street and Thorne Lane need to be modified. Because of the limited vertical and horizontal clearances, 'functional obsolete" rating of these two interchanges, congestion issues at the ramp terminals, and the close spacing to active rail crossings, these interchanges need to be reconfigured to operate efficiently and safely as possible, and provide space for the added I-5 lanes.

Policy Point 2: Reasonable Alternatives

As part of the *I-5 JBLM Vicinity Congestion Relief Study* several alternatives were analyzed and evaluated.

- The *Corridor Feasibility Study* assessed a range of I-5 mainline configurations along with alternative design concepts at four key interchanges within the North Study Area – Berkeley Street, Thorne Lane, Main Gate, and Steilacoom-DuPont Road.
- The *Multi-modal Alternative Analysis* identified and evaluated a broad range of options (over 180) including transit enhancements, local on-JBLM and off-JBLM road improvements, Transportation Demand Management (TDM), system performance criteria used in modeling/forecasting future traffic conditions, and access modifications to I-5 and to JBLM.

Using the results of these analyses, 12 alternative packages were identified and then evaluated to produce a short list of preferred alternatives to meet near-term (2020) and long-term (2040) conditions.

As previously discussed, the proposed Build Alternative in the North Study Area is the focus of this IJR and includes an emphasis on improving existing and near-term (2020) traffic operations along I-5. The Build Alternative includes:

- Reconstructing the Thorne Lane and Berkeley Street interchanges as tight diamond interchanges with tear drop roundabouts at the ramp intersections with the cross streets to provide the necessary horizontal and vertical clearances to allow for expansion of I-5.
- Constructing a new lane in each direction along I-5 from the vicinity of Thorne Lane Interchange to the vicinity of the Steilacoom-DuPont Road Interchange.
- Adding a new northbound auxiliary lane between Berkeley Street and Thorne Lane.
- Adding a new local road connection between Gravelly Lake Drive and Thorne Lane with a southbound local road that includes pedestrian and bicycle facilities.
- Adding a northbound auxiliary lane on I-5 from the Thorne Lane interchange to the Gravelly Lake Drive interchange.
- Building a new shared use (non-motorized) facility between Steilacoom-DuPont Road and Berkeley Street.

The focus of this IJR is on the access improvements at the Berkeley Street and Thorne Lane Interchanges and their compatibility with other I-5 improvements.

Policy Point 3: Operation and Collision Analyses

A detailed operational and collision analysis was conducted for the Build Alternative between Gravelly Lake Drive and the Main Gate Interchanges.

The tight diamond interchanges with tear drop roundabouts at Thorne Lane and Berkeley Street would improve traffic operations at the ramp termini intersections, reduce delay, and improve levels of service from LOS C or D at the Berkeley Street Interchange, and LOS D and E at the Thorne Lane Interchange to LOS B or better at both interchanges in the 2020 and 2040 AM and PM peak hours.

The proposed Interchange improvements with the other I-5 capacity improvements would improve I-5 operations in 2020 between the Gravelly Lake Drive Interchange and the Main

Gate Interchange, as compared to the 2020 No Build Alternative.

Key comparisons are summarized below:

- The Build Alternative would accommodate over 89 percent of the 2020 PM peak hour demand while the No Build Alternative would accommodate about 70 percent.
- The Build Alternative would have higher average travel speeds during the 2020 PM peak hour between the Gravelly Lake Drive and Main Gate Interchanges (37 mph vs 8 mph) and about the same average northbound speeds (34 mph vs 35 mph).
- For the Build Alternative, the hours of congestion during the 2020 PM peak period between Gravelly Lake Drive and Main Gate Interchanges would be lower than the No Build Alternative (about two hours northbound and three hours southbound for the Build Alternative versus four to four and 1/2 hours for the No Build Alternative).
- Average travel time for the Build Alternative during the 2020 PM peak hour between Gravelly Lake Drive and Main Gate Interchange would be also be improved (about seven minutes in both directions for the Build Alternative versus 31 minutes southbound and about seven minutes northbound for the No Build Alternative).

A safety analysis was conducted using the Enhanced Interchange Safety Analysis Tool (ISATe) based on the FHWA Highway Safety Manual to predict the number of collisions for the 2020 and 2040 No Build and Build Alternatives. Using the forecasted traffic volumes and geometric characteristics of the two alternatives, the ISATe model estimated that in 2020, the Build Alternative would have about six percent (15) more crashes than the No Build Alternative, but would accommodate about nine percent (11,800) more vehicle trips per day. These values translate to about 1.16 collisions per million vehicle miles (MVM) of travel for the Build Alternative and 1.19 collisions per MVM of travel for the No Build Alternative. In 2040, the analyses indicated that both alternatives would have about 1.21 collisions per MVM of travel.

These analyses showed that the Build Alternative with the two modified interchanges at Berkeley Street and Thorne Lane would improve interchange and mainline operations.

Policy Point 4: Access Connections and Design

The proposed interchange modifications at the Thorne Lane and Berkeley Street interchanges would provide full access for all traffic movements on and off of I-5. The modified interchanges would maintain and improve connections with local public roads.

The modified interchanges were designed to meets applicable design standards, improve vertical clearances and provide sufficient horizontal width to accommodate four highway lanes with full shoulders in each direction. The bridge structures are intended to have sufficient horizontal clearance to add a fifth lane in each direction, consistent with practical design guidelines.

Because the interchange spacing between the Thorne Lane and Berkeley Street interchanges is less than the suggested one-mile minimum spacing for urban area, a variance will be required. As mitigation for the reduced interchange spacing, a new northbound auxiliary lane would be added between the two interchanges and the existing southbound auxiliary lane would be maintained.

Other variances in the Build Alternative include:

- A ramp shoulder width variance for the Thorne Lane northbound on-ramp immediately adjacent to existing JBLM residential properties.
- I-5 lane width and shoulder width. Lane and shoulder width dimensions will be established by quantitative analysis method using safety and capacity analysis tools following WSDOT's Practical Solutions approach.

The proposed access modifications with the Build Alternative were developed in conjunction with possible I-5 improvements in the South Study Area between Steilacoom-DuPont Road and Mounts Road. WSDOT, in cooperation with JBLM and the City of DuPont, is undertaking a continuing study to identify what interchange modifications would be needed to meet proposed and/or potential JBLM access control point (ACP) relocations. The proposed interchange modifications at Berkeley Street and Thorne Lane were designed to be compatible with possible interchange and mainline changes in the South Study Area.

In addition, the access modifications with the Build Alternative are designed to accommodate other future improvements, as outlined in WSDOT's *Highway System Plan*.

Policy Point 5: Consistency with Local Land Use and Transportation Plans

The proposed access improvements at the Thorne Lane and Berkeley Street interchanges and along I-5 are consistent with regional, county, and local transportation plans.

The land use plans adopted by the area's Metropolitan Planning Organizations (MPOs) including both the Puget Sound Regional Council and the Thurston Regional Planning Council, as well as local agencies were used in the development of traffic forecasts and analyses. As a result, the proposed access improvements are consistent with and would support the land use and development plans for the area.

The proposed improvements to I-5 and the two interchanges are consistent with state, regional and local transportation plans.

Policy Point 6: Consistency with Future Interchanges

The proposed access modifications were developed with design consideration for possible I-5 South End improvements.

The proposed access modifications at Berkeley Street and Thorne Lane were designed to be compatible with Tier I, Tier II, Tier III improvements and other future improvements outlined in WSDOT's *Highway System Plan*.

The traffic analyses also included proposed access improvements in Lacey at the Marvin Road Interchange, the Madigan Access Improvements, and improvements contained in Puget Sound Regional Council's Vision 2040 Plan.

Policy Point 7: Coordination

The proposed access improvements at the Berkeley Street and Thorne Lane interchanges and along I-5 between Gravelly Lake Drive and Steilacoom-DuPont Road are included in the 2015 Connecting Washington revenue and investment plan, adopted by the Washington State Legislature during the 2015 session.

In addition to the proposed access improvements, the City of Lakewood, WSDOT and JBLM are adding other local improvements as part of their respective Transportation Improvement Programs (TIPs).

Local agency representatives and project stakeholders were continuously involved in the development of the Build Alternative through their roles in the Executive Stakeholder and Technical Support Group Committees. These committees oversaw the identification, analysis, and evaluation of a wide-range of improvement options and guided the development of the proposed Build Alternative. These agencies included:

- Federal Highway Administration (FHWA)
- WSDOT
- JBLM
- State National Guard at Camp Murray
- Puget Sound Regional Council
- Thurston Regional Planning Council
- Nisqually Tribe
- Pierce County
- City of Lakewood
- City of DuPont
- Town of Steilacoom
- City of Lacey
- City of Yelm
- Pierce Transit
- Intercity Transit
- Sound Transit

Several of these agencies also participated in smaller "Focus Groups" to address detailed analysis of specific study elements during the development of evaluation criteria and the identification and screening of improvement options.

Providing meaningful venues for public participation was an important element of the *I-5 JBLM Vicinity Congestion Relief Study* because the objective of the Build Alternative is to improve I-5 mobility for the travelling public, and provide access for communities and military installations adjacent to I-5.

A specific Public Involvement Plan, tailored to the needs of this project, was developed to encourage the back-and-forth exchange of information and input from the general public. This plan included various strategies to engage the public such as:

- A project website
- Media outreach
- Open Houses
- Neighborhood Meetings
- Briefings at agency meetings
- Listening Sessions

Policy Point 8: Environmental Process

An Environmental Assessment (EA) is being completed for the Build Alternative including the interchange modifications at Berkeley Street and Thorne Lane. Based on the preliminary environmental analysis of the Build Alternative, no significant environmental constraints were identified that would prohibit or affect the proposed implementation of these access modifications at the Thorne Lane and Berkeley Street interchanges.

The EA is being prepared to address Build Alternative improvements consistent with the requirements of the National Environmental Protection Act (NEPA).

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Introduction

The Washington State Department of Transportation (WSDOT) is proposing implementation of strategies to reduce the chronic congestion along Interstate 5 (I-5) in the vicinity of Joint Base Lewis-McChord (JBLM), thereby improving interstate operations and safety. The results of WSDOT investigations identified a Build Alternative that includes adding travel lanes to increase I-5 capacity through the JBLM area.

The addition of I-5 travel lanes is constrained at two locations by the existing Berkeley Street and Thorne Lane interchange overcrossing structures. These structures currently accommodate only three travel lanes in each direction and must be rebuilt to add a fourth lane in each direction.

As a result, the Build Alternative also includes the re-configuration of these two interchanges along I-5 in the study area, as well as mainline and local street improvements. The purpose of these added lanes on I-5 is to address existing and expected near-term (2020) congestion on the I-5 mainline to enhance regional mobility and safety. The proposed reconfigurations of the Thorne Lane and Berkeley Street interchanges are designed to perform well through 2040.

Rebuilding of the existing overcrossing structures requires the modification of the ramp termini intersections and approach streets so that they operate as efficiently and safely as possible in 2020 (opening year) and 2040 (design year).

The focus of this I-5 JBLM Vicinity Interchange Justification Report (IJR) is on the re-configuration of the Berkeley Street and Thorne Lane Interchanges to provide sufficient space for the widening of I-5. This IJR will evaluate the impacts and benefits of the interchange reconfigurations at Berkeley Street and Thorne Lane.

What Is the Purpose of the Project?

The purpose of the overall *I-5 JBLM Vicinity Congestion Relief Project* (Project) is to relieve traffic congestion along the I-5 corridor in the JBLM vicinity with a focus on the interstate segment from Center Drive (M.P. 118) to Gravelly Lake Drive (M.P. 124.6). Development of the Project evaluated options and opportunities to improve the transportation system within the study area. Specifically, the Project addresses:

- Relieving congestion on I-5 within the vicinity of JBLM;
- Improving local and mainline system efficiency;
- Enhancing mobility;
- Improving safety and operations; and

What Is the Purpose of this IJR?

The purpose of this I-5 JBLM Vicinity Interchange Justification Report (IJR) is to assess the impacts and benefits of the interchange modifications at the Berkeley Street and Thorne Lane Interchanges with I-5. This IJR will evaluate how these interchange modifications will affect overall interstate operations and provide the necessary documentation to justify the interchange modifications.

Policy Point 1 documents the need for the interchange modifications, defines the existing and future deficiencies, and explains why local transportation system improvements and traffic mitigation measures would not resolve the deficiencies.

Who Are the Project Leads and Proponents?

There are several federal, state, regional and local agencies actively involved in identifying, analyzing and evaluating potential solutions to relieve congestion along the I-5 corridor through the JBLM area. These agencies include:

- Washington State Department of Transportation (WSDOT)
- Federal Highway Administration (FHWA)
- Joint Base Lewis-McChord
- Washington Military Department (Camp Murray)
- City of Lakewood
- City of DuPont
- Town of Steilacoom
- City of Lacey
- City of Yelm
- Pierce County
- Nisqually Tribe
- Puget Sound Regional Council
- Thurston Regional Planning Council
- Intercity Transit
- Pierce Transit
- Sound Transit

What Is the Study Area for this IJR?

The overall study area for I-5 improvements extends from Mounts Road to Gravelly Lake Drive. As noted in the Executive Summary, the Project would be constructed in phases, the first of which is the Build Alternative in the North Study Area. The North Study Area extends from the I-5/Main Gate Interchange on the south to the I-5/ Gravelly Lake Drive Interchange on the north, as illustrated in Figure PP1-1. The primary focus of this IJR is the following two interchanges where access revisions are proposed:

- Exit 122 Berkeley Street
- Exit 123 Thorne Lane

As noted in the in the Executive Summary, this IJR will document the proposed revisions and changes to the North Study Area. Improvements planned for the South Study Area (Steilacoom-DuPont Road Interchange to Mounts Road Interchange) are undefined and further analyses are needed to determine improvement strategies for this area. It is expected that a separate IJR will be prepared to document the access revisions for the South Study Area.

What Are the Analysis Years?

For this IJR, operational analyses were conducted for the AM and PM peak hours (7 to 8 AM, and 4 to 5 PM) and the three hour peak periods (6 to 9 AM, and 3 to 6 PM) for the following years:

- Existing Base Year – 2013
- Assumed Opening Year – 2020
- Horizon/Design Year – 2040

This IJR will focus on interchange improvements that will allow the near term addition of one lane each direction on I-5, as well as an additional lane in each direction in the future should that be appropriate.

What Is the Description of the Existing Transportation Corridor?

I-5 is part of the National Highway System (NHS) and is classified as a Highway of Statewide Significance (HSS). It is a divided highway with three 12-foot through lanes in each direction

Figure PP1-1: IJR Study Area

south of the I-5/Thorne Lane Interchange and four 12-foot through lanes in each direction north of the Thorne Lane Interchange. Shoulder width ranges from 2-feet to 10-feet. There are four interchanges within this IJR study area:

- Exit 120 Main Gate (41st Division Drive) - a cloverleaf interchange
- Exit 122 Berkeley Street – a diamond interchange
- Exit 123 Thorne Lane – a diamond interchange
- Exit 124 Gravelly Lake Drive – a diamond interchange

Why Is There a Need for Action in the Study Corridor?

I-5 is a national highway of strategic importance as it extends from the US/Mexican Border to the US/Canadian border. It is the primary highway for the movement of goods and people traveling north and south on the west coast of the United States. In Washington, I-5 links key population centers, such as Vancouver, Olympia, Tacoma, Seattle, Everett and Bellingham. Locally, I-5 connects the cities of DuPont and Lakewood and the town of Steilacoom with Thurston County to the south and Tacoma and Seattle to the north. It also is a vital link to military installations, including JBLM and the State National Guard at Camp Murray.

From 1986 to 2014, traffic volumes along I-5 in south Pierce County increased by 76 percent to the point where congested (stop-and-go) traffic has become commonplace during weekday morning and evening peak periods, as well as weekends during summer months. Contributors to the traffic demand along this segment of I-5 are both regional and local, and include:

- Existing and growing traffic demand and associated congestion during peak periods of the day along I-5 and at the corridor interchanges;
- Limited alternate routes through the secure military installations, along with environmental and right-of-way constraints limit driver's options to travel between Thurston County and Tacoma and Seattle;
- Heavy on- and off-ramp volumes at the interchanges from Center Drive to Gravelly Lake Drive;
- Vehicle trips using I-5 for local and short distance travel in the study area;
- Safety and vulnerability to disruptions from collisions and other incidents (discussed under Policy Point 3).

This traffic congestion along I-5 affects all traffic along I-5, including mobility, reliability and efficiency of transit and freight service.

The following sections provide a summary of existing and expected future (2020 and 2040) transportation problems along the I-5 mainline and its key interchanges focusing on the need for access point revisions.

How Are I-5 Traffic Operations Analyzed for this IJR?

The analyses of traffic operations along the I-5 mainline uses output from a series of travel demand models to assess the traffic performance that were developed and used in the *I-5 JBLM Vicinity Congestion Relief Study*. These models include a macroscopic travel model, a transit sketch planning model and a mesoscopic travel model. A brief description of these models is summarized in Policy Point 3.

The *Highway Capacity Manual* (HCM) recognizes that the methodology to analyze freeway (I-5 mainline) segments is limited in assessing over-saturated traffic flow conditions, such as exists along I-5 through the JBLM area. These over-saturated areas are characterized by having heavy lane changes, with high on- and off-ramp volumes, mixed with a high level of through and local traffic. These conditions create bottlenecks to traffic flow along I-5 and cause traffic to slow with frequent stop-and-go movements. As a result, the density calculations using in HCM procedures do not show the true nature of traffic conditions along the I-5 mainline, at merge and diverge locations or through weaving areas.

For this IJR, alternative performance measures from the Mesoscopic Model were used to assess I-5 traffic operations. These measures include travel demand met, travel speeds, hours of congestion and travel times.

Intersections at ramp terminals and adjacent local streets are analyzed using Synchro software for signalized and non-signalized intersections and Sidra software for roundabout intersections based on HCM procedures, as well as data from the mesoscopic model.

What Is the Extent of Existing and Future Traffic and Congestion along I-5?

A summary of the existing and future No Build Alternative (2020 and 2040) traffic operations along I-5, including travel demand met, travel speeds, hours of congestion and travel times, is presented below. A more detailed analysis of the existing and future conditions can be found in Appendix K, the Transportation Technical memorandum.

I-5 Travel Demand

Since the last widening of I-5 through the study area in 1975, there have been significant increases in traffic volumes and accompanying congestion along I-5 in the JBLM vicinity. This growth is associated with increased through traffic, local community development and JBLM commute patterns. Over the next 25 years, travel demand along I-5 is expected to continue to grow; however the ability of I-5 to accommodate this increased demand, especially during the PM peak hour, is expected to decrease.

As illustrated in Figure PP1-2, about 88 percent of the peak hour demand was able to use I-5 in the 2013 base analysis year, by 2020 only about 71 percent is expected to be able to use I-5, and by 2040 only about 30 percent of the demand is able to use I-5 during the PM peak hour.

These increased levels of traffic demand along the I-5 corridor would:

- Reduce the gap distance between vehicles
- Make it more difficult for drivers to change lanes safely
- Cause drivers to slow down or even stop as other drivers try to change lanes with smaller gaps
- Result in more rear-end and sideswipe collisions through this area of I-5
- Result in adverse traffic impacts on local roads such as Union Avenue

Figure PP1-2: Travel Demand Usage along I-5 during the PM Peak Hour for the No Build Alternative

I-5 Travel Speeds and Congestion

Average travel speed along the I-5 corridor is a factor that WSDOT uses to illustrate congestion. In WSDOT's *Highway System Plan 2007-2026*, 70 percent of posted speed (42 mph) is used to signify Level of Service (LOS) F. As can be observed from Figure PP1-3, travel speeds along I-5 in the 2013 PM peak hour are below 42 mph through most of the study area. Southbound peak hour speeds can range from 20 mph to 35 mph between Gravelly Lake Drive and 41st Division Drive (Main Gate Interchange). Northbound speeds range from about 25 mph to 35 mph between Main Gate Interchange to Thorne Lane, where a fourth northbound lane begins.

Without additional capacity improvements, congestion is expected to worsen by 2020. Expected average travel speeds along the I-5 corridor for the 2020 PM peak hour are illustrated in Figure PP1-4. As can be observed from the figure, northbound PM peak hour travel speeds along I-5 are forecasted to be below 42 mph or LOS F from Main Gate Interchange to Thorne Lane. The only exception to the low travel speeds is north of Thorne Lane where speeds return to near the posted speed limit because the number of travel lanes increase from three to four lanes.

By 2020, southbound travel speeds on I-5 between Gravelly Lake Drive and Main Gate Interchange would be less than 42 mph with speeds in the section from Gravelly Lake Drive to Berkeley Street expected to be less than 20 mph. These slow average PM peak hour speeds signify severe congestion with slow moving vehicles and periods of stop-and-go traffic.

As shown in Figure PP1-5, by 2040, northbound PM peak hour travel speeds along I-5 are forecasted to be below 42 mph or LOS F. The only exception would be north of Thorne Lane where speeds would increase because the number of travel lanes increase from three lanes to four lanes.

Figure PP1-3: 2013 PM Peak Hour Travel Speeds along I-5 in North Study Area

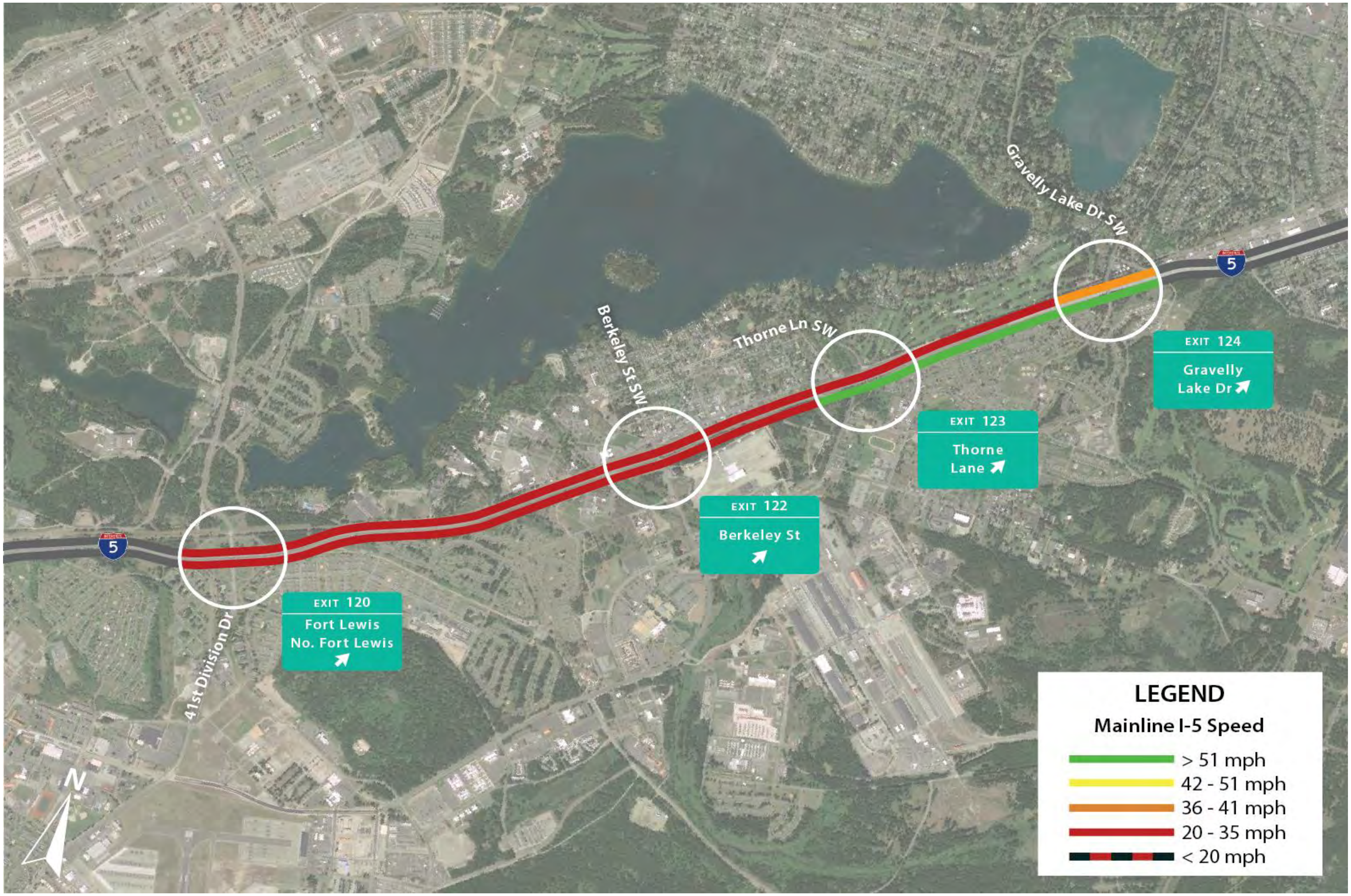
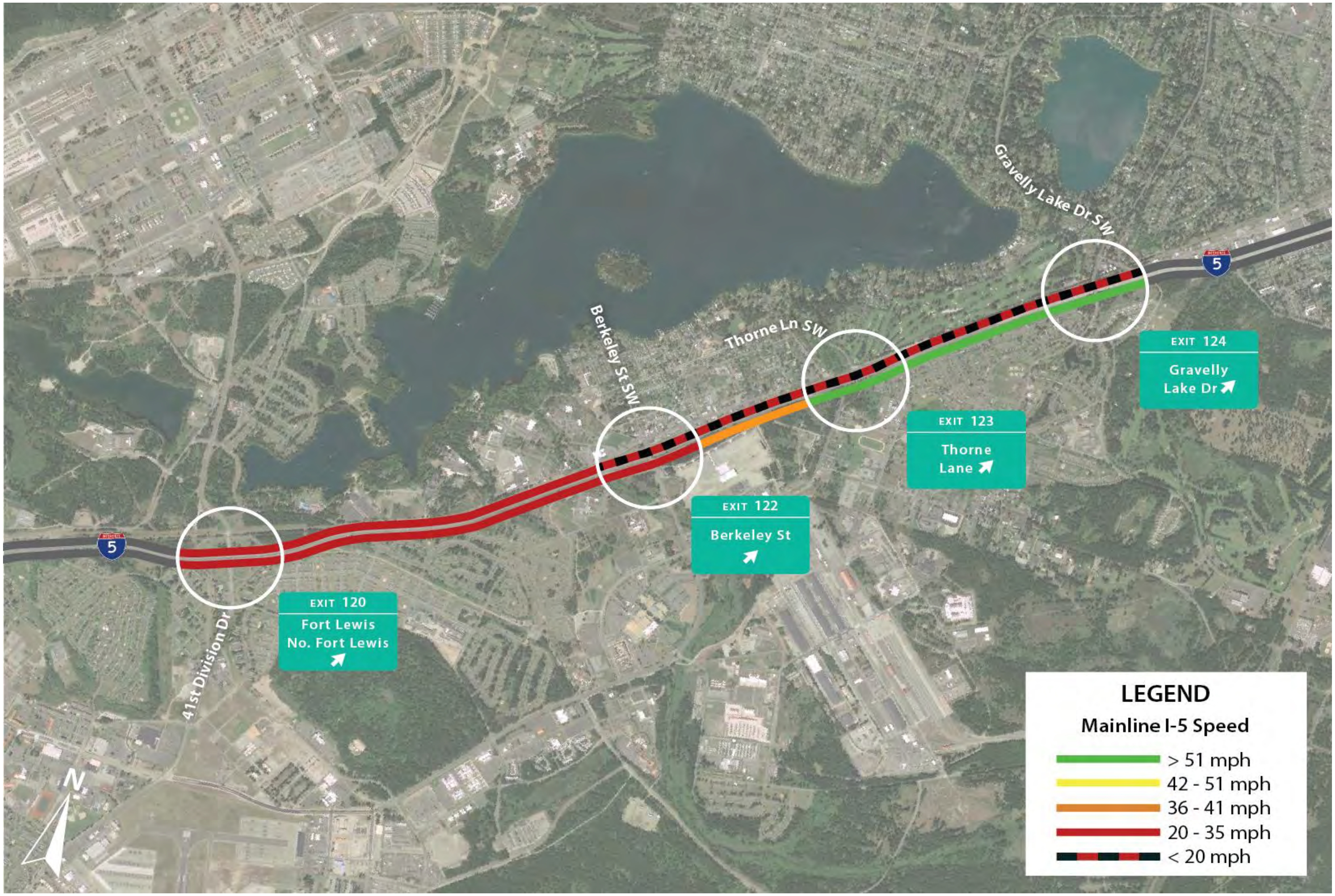


Figure PP1-4: 2020 PM Peak Hour Travel Speeds along I-5 in North Study Area – No Build Alternative



During 2040, southbound travel speeds on I-5 between Gravelly Lake Drive and Berkeley Street are expected to be around 20 mph or less. These northbound and southbound speeds are similar to the 2020 speeds because I-5 is at its practical capacity and PM peak hour volumes along I-5 are expected to be only slightly higher in 2040.

I-5 Hours of Congestion

To examine the speed changes over the 6-hour PM peak period, congestion contours were developed, as shown in Figure PP1-6. These diagrams show the expected change in speeds and durations of slow speeds along I-5 for the 2013, 2020 and 2040 PM peak period from 2:00 PM to 8:00 PM for a typical weekday. These diagrams illustrate the duration that the speeds along I-5 would be less than 42 mph, signifying the hours of congestion. In 2013, congestion during the PM peak period lasted for about three hours. In 2020, the hours of congestion are expected to increase to about four and ½ hours and by 2040, congestion is expected to last for more than six hours.

I-5 Travel Times

A comparison of travel times along I-5 between ramps on the north side of SR 510 (Marvin Road) in Lacey and ramps on the south side of SR 512 in Lakewood was made using output from the mesoscopic model. Traveling along I-5 between SR 510 and SR 512 at the posted speed limit of 60 mph would normally take about 14.5 minutes to cover the 14.5 miles between the two interchanges.

Table PP1-1 shows a comparison between 2013 AM and PM peak period conditions and those expected in 2020 (opening year) and 2040 (design year). As noted in Table PP1-1, by 2040 PM travel times are expected to more than double from travel times in 2013 between SR 510 and SR 512.

In the southbound direction, PM travel time would increase to about 50 to 62 minutes from 4:15 PM to 6:15 PM and still be around 24 minutes at 8:00 PM. In the northbound direction, PM travel times are expected to increase to nearly two hours (100- 114 minutes) between 6:00 PM to about 6:40 PM. Northbound travel times are expected to exceed one hour between 4:00 PM and 7:45 PM and continue over 50 minutes past 8:00 PM which is the end of the six-hour analysis period.

Table PP1-1: Comparison of No Build Travel Times along I-5 between SR 510 and SR 512 Ramps

Year	AM Peak (minutes)		PM Peak (minutes)	
	Northbound	Southbound	Northbound	Southbound
2013 Existing	14.5	14.5	24-25[4]	25-30[7]
2020 No Build (Open Year)	20.0[1]	14.5	50-68[5]	40-45[8]
2040 No Build (Horizon Year)	22-23[2]	23.0[3]	100-114[6]	50-62[9]

Note: Posted speed would result in a total corridor travel time of 14.5 minutes.

[1] 8:00-8:45 am
[2] 7:00-9:00 am
[3] 7:45-8:45 am
[4] 5:00-6:00 pm
[5] 5:00-7:00 pm
[6] 6:00-6:40 pm
[7] 5:00-6:00 pm
[8] 5:00-6:30 pm
[9] 4:15-6:15 pm

Figure PP1-5: 2040 PM Peak Hour Travel Speeds along I-5 in Study Area – No Build Alternative

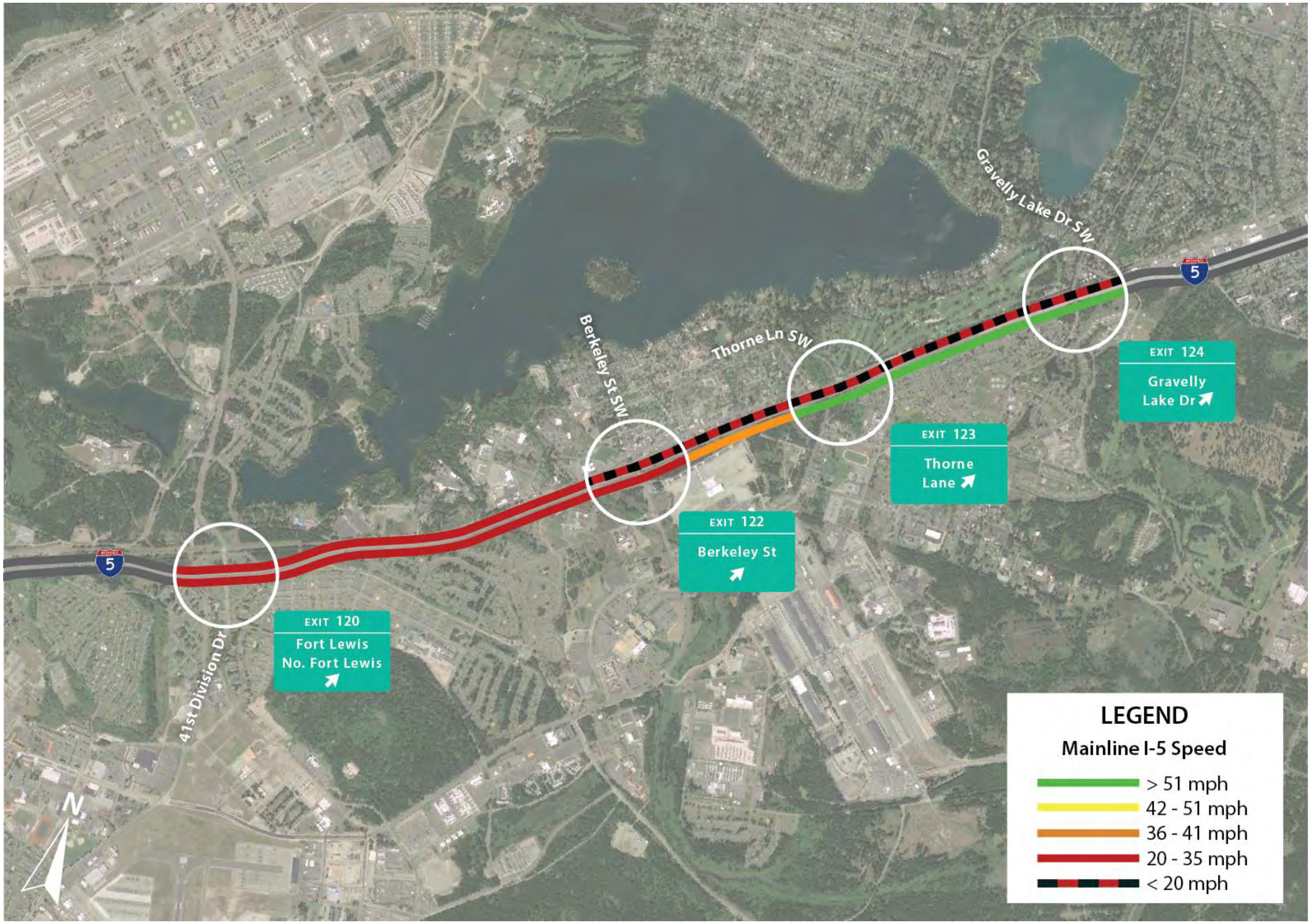
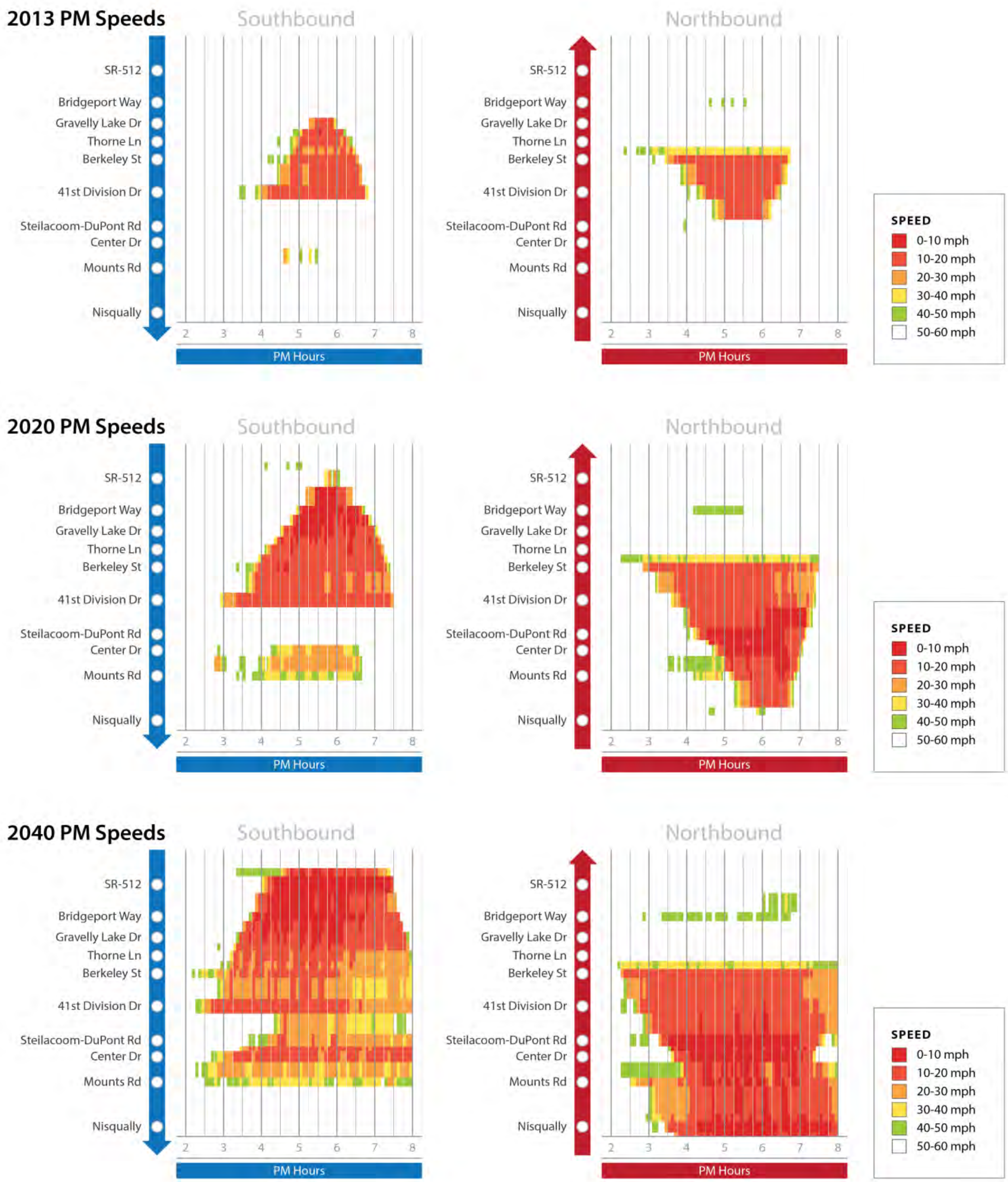


Figure PP1-6: No Build Travel Speeds along I-5, 2013, 2020 & 2040 PM Peak Periods



Source: Meso Model output

Heavy I-5 On- and Off-Ramp Volumes

Because of the secure military installations along the freeway, I-5 is the main traffic artery through the study area, serving as a link between adjacent residential and employment destinations. This results in:

- Heavy on and off-ramp volumes that compete with high through traffic volumes, and;
- A high level of merging and weaving activity.

About 50 percent of the peak period traffic on I-5 in the study area are "through trips", which are vehicles traveling between Thurston County and points north of SR 512. The other 50 percent of traffic on I-5 use the various study area interchanges. Through the study area, vehicles must weave, merge and/or change lanes to enter and exit I-5. At several interchanges these weaving volumes are substantial.

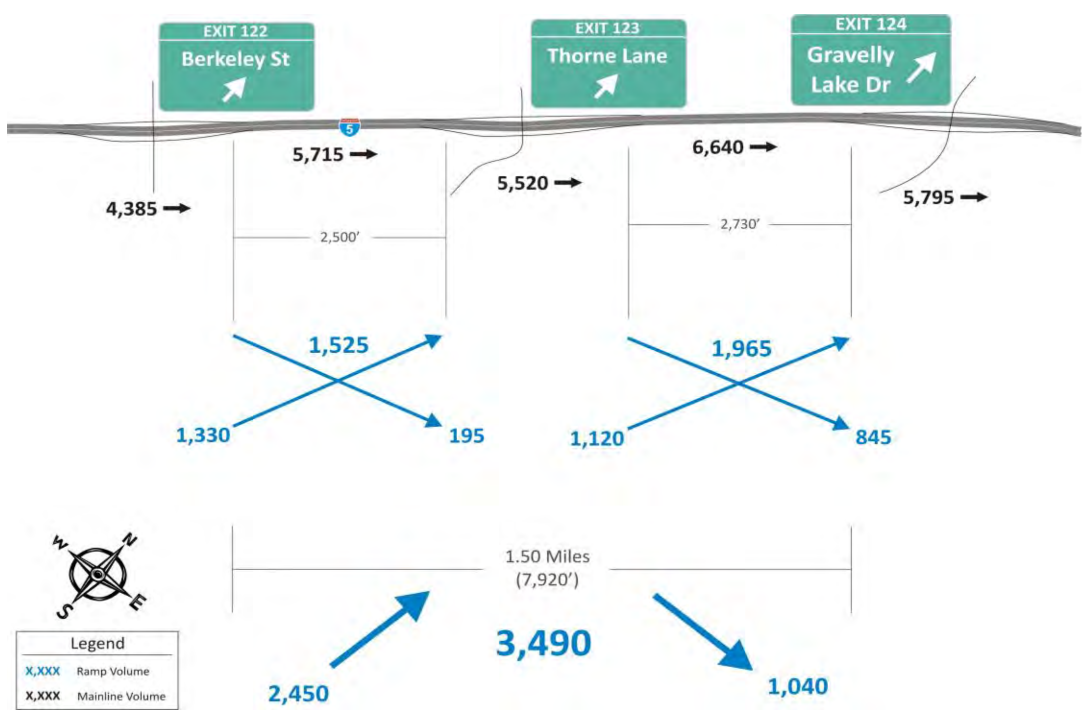
Figure PP1-7 shows northbound weaving between Berkeley Street and Gravelly Lake Drive during a typical 2013 PM peak hour. Within a 1.5 mile distance nearly 3,500 vehicles are engaged in weaving on or off the highway and merging with existing through traffic.

This traffic cannot all be in the outside lanes, so drivers must change lanes. These lane changes create "side friction" that slows traffic, increases congestion, increases the likelihood of collisions, reduces the per lane capacity of I-5 and affects traffic throughput in all travel lanes.

Short Trip Traffic on I-5

Because of the secure military installations, I-5 is the main artery through this portion of southern Pierce County. There are several locations that have a significant volume of trips

Figure PP1-7: 2013 PM I-5 Northbound On- and Off-ramp Volumes Berkeley Street to Gravelly Lake Drive



that begin and end within the study area. These are called short trips. Many of these short trips are made by military personnel living off-base with their families in Lacey, DuPont, Steilacoom, Lakewood or other nearby communities, and generally use the gates closest to where they are stationed on the military base. Many of these short trips use I-5 as there are no or only limited alternatives for traveling between destinations within the study area.

Other short trips are made to and from the Tillicum and Woodbrook neighborhoods. Residents of these neighborhoods have to use I-5 to reach their destinations in Lakewood and other areas.

Overall, these short trips contribute to the congestion and safety problems experienced in the corridor by distributing the flow of through traffic, increasing I-5 traffic volumes, and contributing to the high level of weaving and merging activity.

What Is the Impact of Existing and Future Traffic Congestion at I-5 Interchanges?

Existing 2013 and future year intersection analyses at the key I-5 interchanges (Gravelly Lake Drive, Thorne Lane, and Berkeley Street) were conducted using Synchro software. Because the Main Gate cloverleaf interchange does not have traditional intersections, a separate analysis was conducted. The results of these analyses are summarized below.

Existing 2013 Intersection Operations

The analyses show that during the AM peak hour the following intersections operated below LOS D:

- I-5 SB Ramps / Berkeley Street,
- I-5 SB Ramps / Thorne Lane, and
- I-5 NB Ramps/ Thorne Lane.

During the PM peak hour, the following intersections operate below LOS D:

- I-5 NB Ramps / Thorne Lane, and
- I-5 NB Ramps / Gravelly Lake Drive

In 2014, WSDOT added an auxiliary lane on southbound I-5 between Thorne Lane and Berkeley Street, as well as ramp meters in 2015 to improve operations along I-5 and the interchanges. The City of Lakewood is building additional improvements at Berkeley Street as part of the *Madigan Access Improvement Project,* which will open in 2016. This Madigan Access Project is an interim measure to address existing capacity and intersection deficiencies.

Main Gate Interchange

The cloverleaf configuration of the Main Gate Interchange does not have traditional intersections with traffic control devices, such as stop signs or traffic signals. To analyze the merge and diverge points on 41st Division Drive with the various I-5 ramps, output from the Mesoscopic Model was used to estimate average approach delays. A summary of these approach delays are shown in Table PP1-2.

Based on a review of the estimated approach delays at the I-5 northbound ramps, the northbound approach along 41st Division Drive had an average delay of over five minutes per vehicle during the 2013 PM peak hour. The other approaches had delays of less than 30 seconds. At the I-5 southbound ramps, the southbound approach along 41st Division Drive had an average delay of over three minutes per vehicle during the PM peak hour. The other approaches had delays of less than 30 seconds per vehicle.

These long delays were caused by traffic congestion along the I-5 mainline which backs up traffic on the on-ramps to their junction with 41st Division Drive.

Table PP1-2: 2013 Delay Summary at Main Gate Interchange

Approach	Volume AM/PM	Delay (seconds per vehicle) AM/PM
NB I-5 Ramp / 41st Division Drive		
NB on 41st Division Drive	790/1,830	0.1/311
SB on 41st Division Drive	1,335/1,195	0.4/26.1
EB on I-5 NB Off-ramp	285/120	0.0/0.0
WB on I-5 NB Loop Off-ramp	200/60	0.1/12.2
SB I-5 Ramp / 41st Division Drive		
NB on 41st Division Drive	690/1,445	0.6/24.2
SB on 41st Division Drive	1,095/1,375	1.1/188
EB on I-5 NB Loop Off-ramp	420/225	0.9/23.4
WB on I-5 NB Off-ramp	240/180	0.2/0.0

Note: Delay based on Mesoscopic Model Output

Future Year (after 2013) Intersection Operations:

Future year intersection analyses at the I-5 interchanges assumed that the following planned improvements would be implemented:

- A southbound auxiliary lane added between the Thorne Lane on-ramp to the Berkeley Street off-ramp (completed in 2014).
- Ramp meters added to the on-ramps at all interchanges except the northbound Thorne Lane ramp (completed in 2015).
- The Madigan Access improvements at the Berkeley Street Interchange, including a second left-turn lane on the southbound off-ramp, a second lane on the Berkeley Street bridge easterly towards JBLM, and the third lane on Jackson Avenue will be extended to the northbound off-ramps into JBLM.

Future No Build Alternative 2020 and 2040 intersection operational analysis results are illustrated in Figure PP1-8. This figure includes intersections at Berkeley Street, Thorne Lane and Gravelly Lake Drive Interchanges and adjacent local street intersections that are strongly influenced by the interchanges. The figure also shows expected conditions in both the AM and PM peak hours.

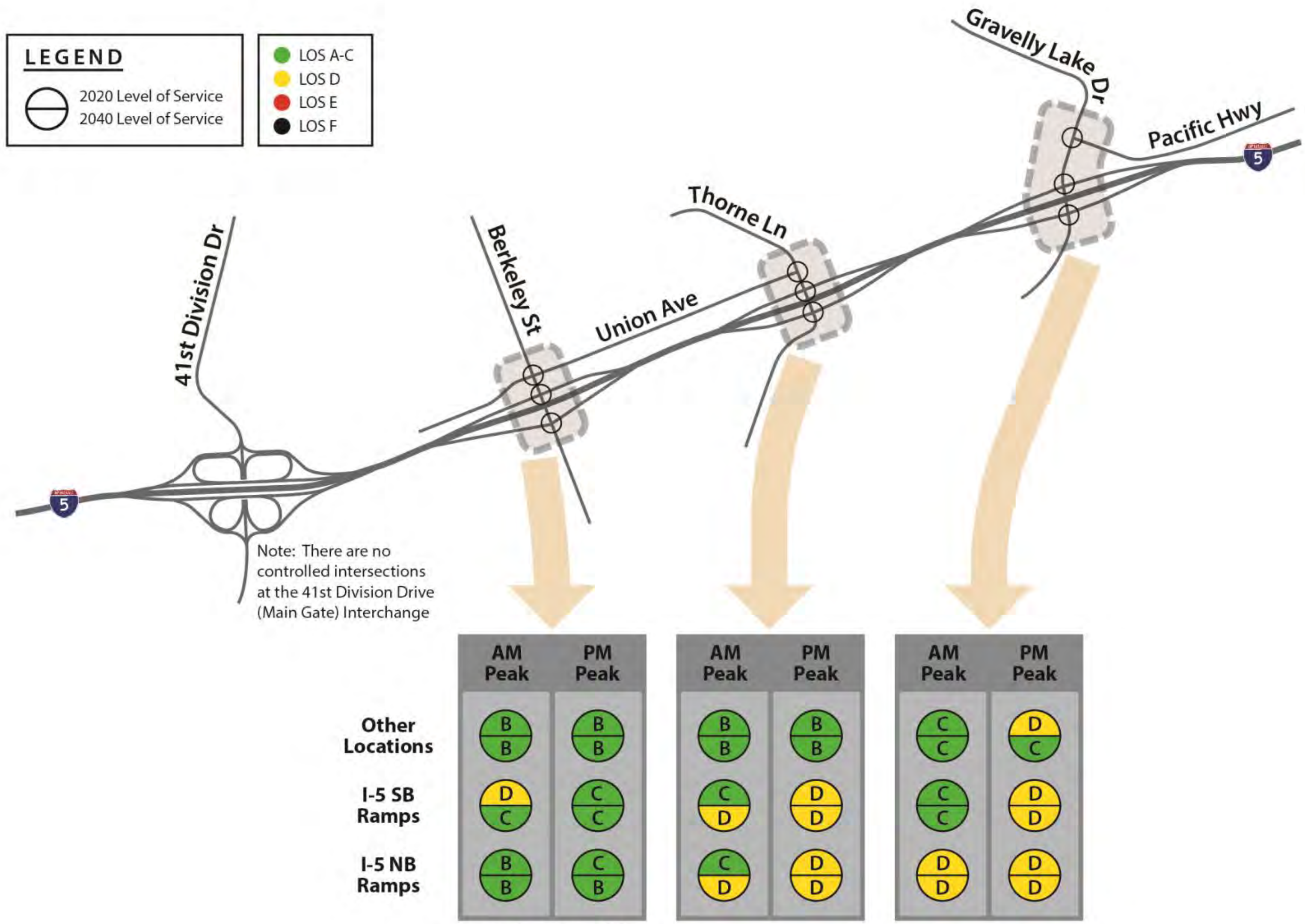
A more detailed summary of the intersection analyses, including turning movements for both the Synchro analyses and from the mesoscopic model, is contained in Appendix B.

Diamond Interchanges: Expected levels of service and average intersection delays are indicated in Figure PP1-8 and listed in Table PP1-3 for the Berkeley Street, Thorne Lane and Gravelly Lake Drive diamond interchanges.

The Madigan Access Improvements will allow the ramp intersections at the Berkeley Street Interchange to operate at LOS D or better in 2020 and 2040.

The analyses show that during the AM and PM peak hours, ramp intersections at the Thorne Lane Interchange would operate at LOS D or better in both 2020 and 2040.

Figure PP1-8: 2020 & 2040 Peak Hour Intersection Levels of Service for the No Build Alternative



Source: Synchro model runs

Table PP1-3: Summary of Intersection Delays and Levels of Service (LOS) at the Area Interchanges for the No Build Alternative ***

Intersection*	2013 Existing		2020 No Build**		2040 No Build**	
	AM	PM	AM	PM	AM	PM
I-5 NB Ramps / Berkeley Street** (Signal Control)						
Average Delay (sec) / LOS	25.7/C	29.7/C	16.3/B	20.8/C	11.4/B	14.5/B
I-5 SB Ramps / Berkeley Street** (Signal Control)						
Average Delay (sec) / LOS	**69.2/E**	54.0/D	36.0/D	26.0/C	32.4/C	23.8/C
Berkeley Street / Union Avenue**						
Control Type	All-way Stop		Signal		Signal	
Average Delay (sec) / LOS	10.6/B	12.1/B	11.0/B	12.0/B	10.0/B	12.7/B
Berkeley Street / Washington Avenue (2-Way Stop Control)						
Average Delay (sec) / LOS	NA	NA	12.6/B	14.3/B	14.2/B	12.2/B
I-5 NB Ramps / Thorne Lane (Signal Control)						
Average Delay (sec) / LOS	**56.9/E**	**71.2/E**	34.2/C	37.9/D	37.3/D	36.6/D
I-5 SB Ramps / Thorne Lane (Signal Control)						
Average Delay (sec) / LOS	**58.7/E**	49.1/D	33.9/C	47.5/D	49.5/D	44.4/D
Thorne Lane / Union Avenue (2-Way Stop Control)						
Average Delay (sec) / LOS	9.6/B	11.1/B	10.4/B	11.6/B	11.2/B	12.8/B
I-5 NB Ramps / Gravelly Lake Drive (Signal Control)						
Average Delay (sec) / LOS	39.8/D	**70.3/E**	46.5/D	41.6/D	35.4/D	49.6/D
I-5 SB Ramps / Gravelly Lake Drive (Signal Control)						
Average Delay (sec) / LOS	41.9/D	47.3/D	31.3/C	37.2/D	32.8/C	40.8/D
Gravelly Lake Drive / Pacific Highway (Signal Control)						
Average Delay (sec) / LOS	25.5/C	29.0/C	32.0/C	37.1/D	34.6/C	34.7/C

Notes* Signalized & non-signalized intersections analyzed using Synchro software
Please note that the Synchro analysis does not account for back-ups on on-ramp from the ramp meter or freeway.
** Assumes Madigan Access Improvements at the Berkeley Street Interchange are implemented in 2020 and 2040 No Build Alternatives
*** LOS E and LOS F values shown in bold

At Gravelly Lake Drive, all ramp intersections are also expected to operate at LOS D or better during the 2020 and 2040 AM and PM peak hours.

Main Gate Interchange: A review of the traffic operations for the cloverleaf configuration of the Main Gate Interchange was also conducted using output from the Mesoscopic Model, as summarized in Table PP1-4. Based on a review of the estimated approach delays at the I-5 northbound ramps, the northbound approach along 41st Division Drive would continue to have long delays of about five minutes or more in 2020 and 2040 with the No Build Alternative. Other approaches would have delays of less than 15 seconds.

Table PP1-4: Delay Summary at Main Gate Interchange – No Build Alternative

	2013 Existing		2020 No Build		2040 No Build	
Approach	**Volume AM/PM**	**Delay (seconds per vehicle) AM/PM**	**Volume AM/PM**	**Delay (seconds per vehicle) AM/PM**	**Volume AM/PM**	**Delay (seconds per vehicle) AM/PM**
NB I-5 Ramp / 41st Division Drive						
NB on 41st Division Drive	790/1,830	0.1/311	710/1,835	4.7/294	820/1,710	4.3/330
SB on 41st Division Drive	1,335/1,195	0.4/26.1	1,220/1,075	0.3/1.6	1,070/1,075	0.3/12.1
EB on I-5 NB Off-ramp	285/120	0.0/0.0	305/50	0.0/0.0	355/45	0.0/0.0
WB on I-5 NB Loop Off-ramp	200/60	0.1/12.2	75/25	0.0/0.0	135/50	0.1/0.1
SB I-5 Ramp / 41st Division Drive						
NB on 41st Division Drive	690/1,445	0.6/24.2	525/1,425	0.3/0.9	650/1,320	5.4/0.4
SB on 41st Division Drive	1,095/1,375	1.1/188	1,015/1,435	2.5/28.2	985/1,350	2.0/61.7
EB on I-5 NB Loop Off-ramp	420/225	0.9/23.4	390/50	0.8/0.7	290/180	0.4/0.3
WB on I-5 NB Off-ramp	240/180	0.2/0.0	120/50	0.5/0.0	75/100	5.4/0.5

Note: Delay based on Mesoscopic Model Output

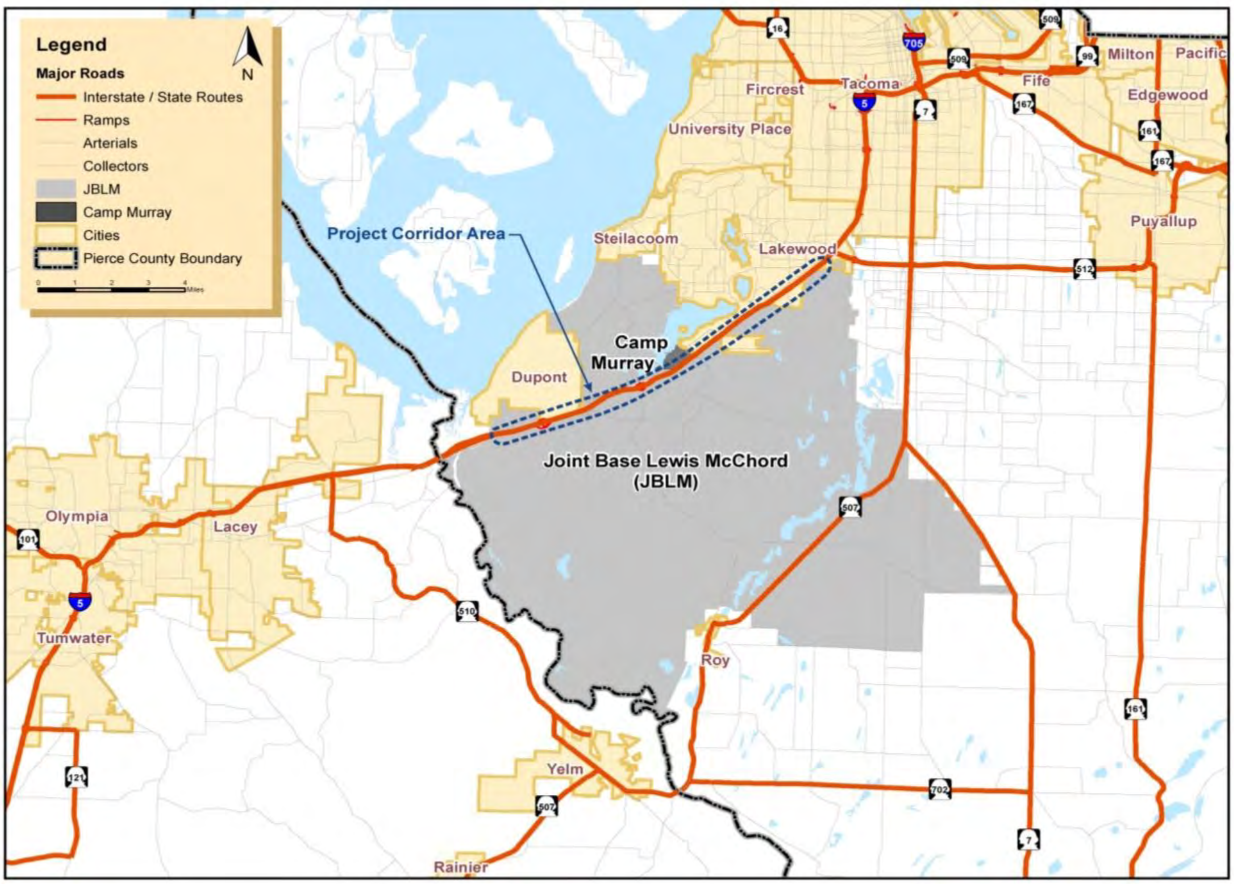
At the I-5 southbound ramps, the southbound approach along 41st Division Drive would also have delays of less than 30 seconds in 2020 and around 60 seconds in 2040. Other approaches would have little delays. The long delays are caused by traffic congestion along the I-5 mainline which would back up traffic onto the on-ramps to their junction with 41st Division Drive. Some delays are expected to be less than existing 2013 delays, especially in the southbound direction, because some trips cannot get to the Main Gate Interchange during the PM peak hour in the future analysis years

Why Are There Limited Alternative Routes?

As shown in Figure PP1-9, I-5 passes through JBLM and serves as the principal access route to the military installation, as well as for the cities of DuPont and Lakewood and the town of Steilacoom. The alignment of I-5 in relation to these and other destinations, and to other travel routes in the area is shown this figure Because of the secure nature of the military installation, I-5 is the principle continuous corridor through the northwest side of JBLM.

Through the study area, I-5 follows the historic alignment of SR 99. A detour around this

Figure PP1-9: I-5 Corridor through JBLM



Northeast Thurston County and Southwest Pierce County Area
Source: Pierce County

military installation would require the use of other north-south arterials on the southeast side of JBLM that may include SR 510, SR 7/SR 507, and SR 161. These other routes add considerable distance and time for drivers avoiding the I-5 corridor. The detours would use local service (typically two-lane) roadways that are not capable of accommodating the added demand of the detouring traffic.

What Are the Physical Limitations and Constraints of I-5 through the Study Area?

There are several physical limitations and constraints along the I-5 corridor that affect traffic operations, including inconsistent number of travel lanes, closely spaced interchanges, geometrical design of the existing interchanges and the presence of an adjacent rail line. These issues are discussed below.

Change in Number of Travel Lanes on I-5

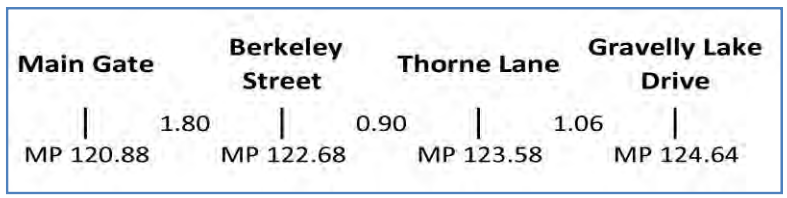
A key contributing factor to existing congestion on I-5 stems from the difference in number of travel lanes through the study corridor. North of the Thorne Lane Interchange, there are four lanes in each direction but south of the Thorne Lane Interchange, there are only three lanes in each direction.

For southbound travel, the effect of reducing the number of travel lanes at Thorne Lane requires drivers to merge in addition to accommodating on- and off-movements at the interchange. In the northbound direction, traffic is constrained to three lanes through most of the study area. With heavy travel volumes, traffic on I-5 is further impacted by on- and off-movements at several interchanges until it reaches the Thorne Lane Interchange. At that point I-5 increases to four travel lanes that allow congestion to ease, and travel speeds to increase.

Several Closely Spaced Interchanges

The existing spacing between interchanges from the Main Gate Interchange to the Gravelly Lake Drive Interchange is shown in Figure PP1-10. The suggested minimum spacing between urban interchanges is one mile. The spacing between the Berkeley Street and Thorne Lane interchanges does not meet the suggested interchange spacing for urban-area interchanges. The spacing between the Thorne Lane and Gravelly Lake Drive interchanges is just over the one-mile minimum spacing.

Figure PP1-10: Interchange Spacing along I-5



Physical Limitations of Interchanges

The existing interchanges Berkeley Street and Thorne Lane were constructed in 1954, and several geometric elements do not meet current design guidelines. The vertical clearances at these interchanges ranges from 14’ 7” to 15’ 3” which does not provide the required clearance for legal height loads and is less than the current design standard of 16’ 6”. In addition, the location of bridge abutments and center piers minimize the available horizontal clearances at these interchanges, limiting the ability to expand I-5 without rebuilding the entire interchanges. Existing shoulder widths at these interchanges range from about 5-foot to 10-foot outside shoulders and 3-foot to 4-foot inside shoulders. These widths are less than the recommended 10-foot shoulder widths.

The geometric data for the two focus interchanges that have vertical and horizontal constraints are presented below:

- **Berkeley Street Interchange** is a diamond interchange and the bridge is shown in Figure PP1-11. This Interchange was built in 1954 with a minimum vertical clearance of 15’ 3”, and a horizontal width of 46 feet for each directional roadway. Mainline widening in 1973 resulted in outside shoulder widths of about 6-feet and inside shoulder widths of about 4 feet. The interchange bridge is rated as functionally obsolete.
- **Thorne Lane Interchange** is a diamond interchange and the bridge is shown in Figure PP1-12. This interchange was built in 1954 with a minimum vertical clearance of 14’ 7”, and a horizontal clearance of 45 feet for each directional roadway. Mainline widening in 1973 resulted in outside shoulder widths of about 5 feet and inside shoulder widths of about 4 feet. The interchange bridge is rated as functionally obsolete.

Adjacent Rail Line: Another constraint affecting I-5 widening as well as the operation of the interchanges at Berkeley Street and Thorne Lane is the presence of the Sound Transit rail corridor adjacent to and west of I-5 and the at-grade rail crossings within the study area. Trains that currently use the rail corridor include BNSF and Tacoma Rail. Tacoma Rail operates two to three trains per week on this line.

Currently, Amtrak passenger rail service regularly uses the BNSF mainline tracks along

Figure PP1-11: Berkeley Street Bridge

Figure PP1-12: Thorne Lane Bridge

the Puget Sound coast operating 10 trains per day. With completion of the Point Defiance Bypass Project (Construction started in 2015) Amtrak rail service will be moved from the BNSF mainline tracks to the rail line owned by Sound Transit along I-5. This relocated rail service is scheduled to begin in 2017. The Point Defiance Bypass project will result in an increase of trains crossing at-grade at Thorne Lane, Berkeley

Street, and 41st Division Drive at higher speeds. These additional trains are expected to cause increased vehicle delay at these crossings that can be somewhat off-set by improved signal timing.

What Are Impacts to Transit and Ride-share Operations and Efficiency?

There are currently three public transit providers operating fixed route and express service within the study area: Intercity Transit, Pierce Transit and Sound Transit.

- Based in Thurston County, Intercity Transit operates five routes along I-5 through the study area, and sub-contracts service for a sixth route.
- Pierce Transit is responsible for local bus service in Pierce County and operates four routes that provide access to or close to JBLM.
- The Central Puget Sound transit provider, Sound Transit, operates three express bus routes along the I-5 corridor within the study area.

All three agencies provide transit service during peak periods in the morning and evening; Intercity also provides mid-day service. In late 2013, weekday ridership on all of these routes averaged just fewer than 500 persons during the PM peak hour and nearly 1,100 persons during the three-hour PM peak period. While Pierce Transit offers limited service to JBLM, neither Intercity Transit nor Sound Transit provides local bus service to JBLM. The closest stops are located at the Lakewood Sounder Station and at area park and ride lots.

Unlike fixed route bus service, vanpools and carpools that carry base personnel have ready access to and from JBLM. There are many vanpools sponsored by the major transit providers in the area that currently connect JBLM and other major employers with destinations throughout the region. In 2013, these vanpools carried approximately 725 people through the study area during the PM peak hour.

Total transit and vanpool ridership equates to over 1,200 persons during the PM peak hour. It is estimated that this level of ridership removes approximately 1,000 vehicles from I-5 in the corridor during the PM peak hour.

Both transit service and vanpools are affected by freeway congestion, with existing PM peak travel times exceeding off-peak travel time by 75 percent. By 2040, travel times would worsen due to congestion in the study area. This would have negative impacts on the cost of transit service, reliability, and attractiveness.

What Are the Impacts on Freight Mobility?

I-5 is the most significant freight corridor in Washington State and is essential to the economic vitality of the Puget Sound region and the State's trade-dependent economy. I-5 is designated as a Class T1 freight highway indicating that it carries over 10,000,000 annual tons of freight, the highest category in the State. North of the Steilacoom-DuPont Road Interchange, trucks currently comprise 12 percent of total daily traffic on I-5, of which seven percent were semi-tractor trailers or semi-tractors with two trailers. These high truck volumes both contribute to congestion and are impacted by congestion. As indicated in research done for the Washington Freight Plan, congestion translates into a direct increase in the cost of doing business for freight-dependent businesses. This cost increase is often passed along to consumers.

Could Local Street Improvements Address I-5 Congestion?

WSDOT has already made Transportation System Management (TSM) improvements to the I-5 corridor between SR 510 and SR 512 using TIGER III grant funding. These improvements, as illustrated on Figure PP1-13, were implemented in 2014 and 2015, and include variable message signs, traffic cameras, ramp meters, and a southbound auxiliary lane on I-5 between Thorne Lane and Berkeley Street. In addition, the City of Lakewood is currently implementing the Madigan Access Improvements at the Berkeley Street Interchange to reduce morning back-ups on the southbound off-ramp. The last of these improvements are expected to be completed and open to traffic in 2016.

An analysis of various local improvements was completed as part of the *I-5 JBLM Vicinity Congestion Relief Study* and documented in Policy Point 2. A brief summary of its findings are discussed here to show that the proposed local improvements do not significantly relieve congestion along I-5.

Benefits of Local Street Improvement Options

In the multimodal alternatives analysis conducted for the I-5 corridor, various local road improvement options (both on JBLM and off-JBLM), transit and TDM options, I-5 access options, and other TSM options were identified and analyzed. These improvement options were identified through a series of five brainstorming sessions with project stakeholders and input

Figure PP1-13: Interim Improvements Using Federal Grant Funding

received at a public open house, attended by more than 100 citizens. Over 180 ideas were identified through this outreach process including 25 local off-JBLM road improvements, 31 on-JBLM road improvements, 44 transit options, and 30 TSM options. The complete list of options are identified in the *I-5 JBLM Vicinity Congestion Relief Study, Phase 2A Alternatives Analysis – Development and Screening of Multimodal Options*, dated August 2014.

Based on the results of a two-step screening and evaluation process, it was determined that none of the local road improvement options would significantly reduce overall traffic congestion on I-5 or improve overall travel speeds along the I-5 corridor between Center Drive and Gravelly Lake Drive in 2013. However, some of these improvements, like the Gravelly-Thorne Connector, did show localized benefit and were identified to receive further analysis by the responsible implementing agency. This finding is further discussed under Policy Point 2.

Transit options were also considered as part of the multimodal alternatives evaluation of the *I-5 JBLM Vicinity Congestion Relief Study*. Various routing options were considered that doubled existing service along I-5 with stops in DuPont, JBLM and Lakewood, as well as increased on-JBLM bus circulation. The results of these analysis show that the transit options reduced traffic by about two to three percent (about 100 vehicles) in the southbound, while increasing trips in the northbound direction by about one to three percent. These small changes in vehicle trips did not improve overall travel speeds along I-5 or reduce congestion, as up to five hours of congestion would still be expected in 2020 during the PM peak period.

Summary of the Need for Action

Why are Improvements needed at the Thorne Lane and Berkeley Street Interchanges?

The I-5 JBLM Vicinity Congestion Relief Study concluded that capacity improvements to I-5 are needed to reduce congestion and improve mobility along I-5. To add capacity to I-5, the interchanges at Thorne Lane and Berkeley Street need to be modified so the structures over I-5 can be widened. In addition, there are several physical and operational issues at the Thorne Lane and Berkeley Street Interchanges that need to be improved, including:

- Vertical clearances at the Thorne Lane (14’ 07”) and Berkeley Street (15’ 03”) Interchanges do not meet current interstate standards.
- The northbound ramp intersection with Thorne Lane operated at LOS E during the 2013 AM and PM peak hours. Because of increased congestion on I-5 without additional capacity improvement, peak hour traffic at this intersection is expected to be reduced in future years.
- The southbound ramp intersection with Thorne Lane operated at LOS E during the 2013 AM peak hour and is expected to continue in 2020 and 2040 analysis years.
- With the start of increased rail activity along the Sound Transit rail corridor by Amtrak in 2017, the close proximity of the southbound ramp intersections at Thorne Lane and Berkeley Street with the adjacent at-grade railroad crossings may affect intersection operations.

In summary, improvements to the Thorne Lane and Berkeley Street Interchanges are needed to improve operations along I-5 and reduce congestion level by increasing the capacity along I-5.

Introduction

While this IJR was prepared to address proposed access revisions on Interstate 5 at the Thorne Lane and Berkeley Street Interchanges, this policy point addresses the comprehensive alternatives analysis process conducted for improvements along the I-5 corridor through JBLM including these interchanges. The comprehensive alternatives process considered various configurations and options at these two interchanges.

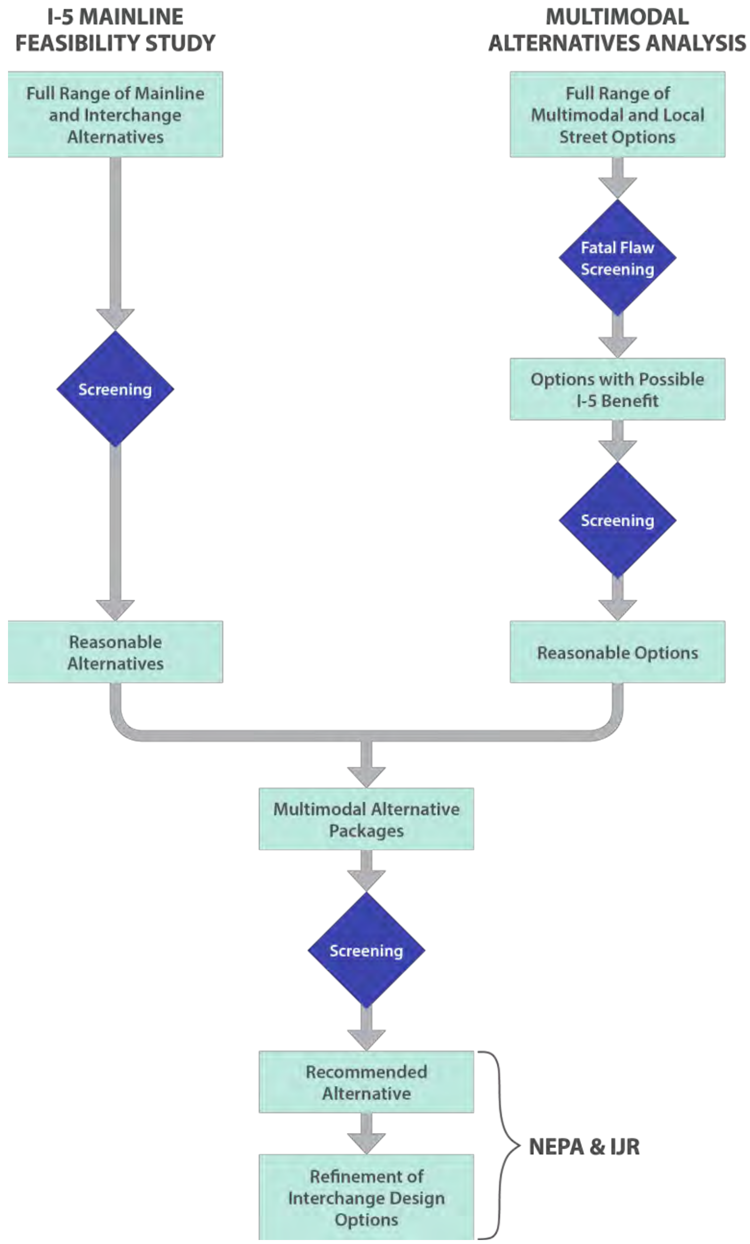
The corridor level analysis focuses on I-5 from Exit 118 (Center Drive) through Exit 124 (Gravelly Lake Drive). Policy Point 2 summarizes the analysis process using the Least Cost Planning methodology. The purpose of this analysis was to identify strategies and facilities that would relieve chronic peak period traffic congestion in the I-5 corridor, while also maintaining access to neighboring communities and military facilities. This effort was conducted in two phases as follows:

1. Corridor Feasibility Study focused on the I-5 mainline and interchanges
2. Multimodal Alternative Analysis considered options other than the I-5 mainline and interchanges.

Figure PP2-1 illustrates the process used to develop and screen a wide range of alternatives leading to the Build Alternative that is the focus of this IJR.

The Corridor Feasibility Study evaluated a range of I-5 mainline configurations along with alternative configurations at each of the interchanges between Steilacoom-DuPont Road and Gravelly Lake Drive. This evaluation resulted in a short list of alternative configurations for both the I-5 mainline and the interchanges that were advanced into the next phase.

Figure PP2-1: I-5 JBLM Process to Develop & Evaluate Reasonable Alternatives



The Multimodal Alternative Analysis identified and evaluated a broad range of options including:

- Transit enhancements
- Local road improvements on JBLM
- Local road improvements off JBLM (open to the general public)
- Transportation Demand Management
- System performance criteria used in modeling/forecasting future traffic conditions.

These options were screened and reduced to a short list of improvements that were advanced for further study.

The short listed alternatives and options were then used to build alternative packages in a layering approach that built sequentially on the following types of improvements:

- Transportation Demand Management
- Transit enhancements
- Local road improvements
- I-5 mainline and interchange improvements.

Using this approach, 12 alternative packages were identified and then evaluated to produce a short list of preferred alternatives.

The result of this Least Cost planning process was a recommendation for phased implementation of improvements. The initial phase was to address immediate and short-term (2020) deficiencies and a future phase to be implemented when warranted by performance of the corridor.

This IJR is focused on the Thorne Lane and Berkeley Street interchange reconfigurations of the proposed Build Alternative.

What I-5 Mainline Alternatives Were Considered?

The *I-5 JBLM Congestion Relief Feasibility Study* assessed a range of I-5 mainline improvements, as well as specific interchange concepts at the Steilacoom-DuPont Road, Main Gate, Berkeley Street and Thorne Lane Interchanges. Full analysis is documented in the *Phase 1 – Corridor Plan Feasibility Study* report dated January 2014.

The development of I-5 mainline alternatives used a “layering” approach to identify six separate improvement scenarios. These scenarios were developed by adding lanes of various types (managed/high-occupancy (HOV), collector/distributor (CD), auxiliary, and/or general purpose (GP) lanes) to the existing highway. The six scenarios considered in the *Corridor Plan Feasibility Study* are listed below and shown in Figure PP2-2:

- **Scenario 1a**: Adds one managed/HOV lane in each direction combined with the existing three GP lanes south of Thorne Lane and four GP lanes to the north to increase carpool, transit and ride-share opportunities, reduce congestion and improve safety.
- **Scenario 1b**: Adds a combination of CD roads or auxiliary lanes at strategic points along I-5 to the existing three and four GP lane configurations to reduce side friction by limiting the number of access and egress points with I-5, reduce congestion and improve safety.
- **Scenario 2**: Adds one GP lane in each direction along I-5 south of Thorne Lane to create continuity in travel lanes along

Figure PP2-2: I-5 Mainline Improvement Scenarios

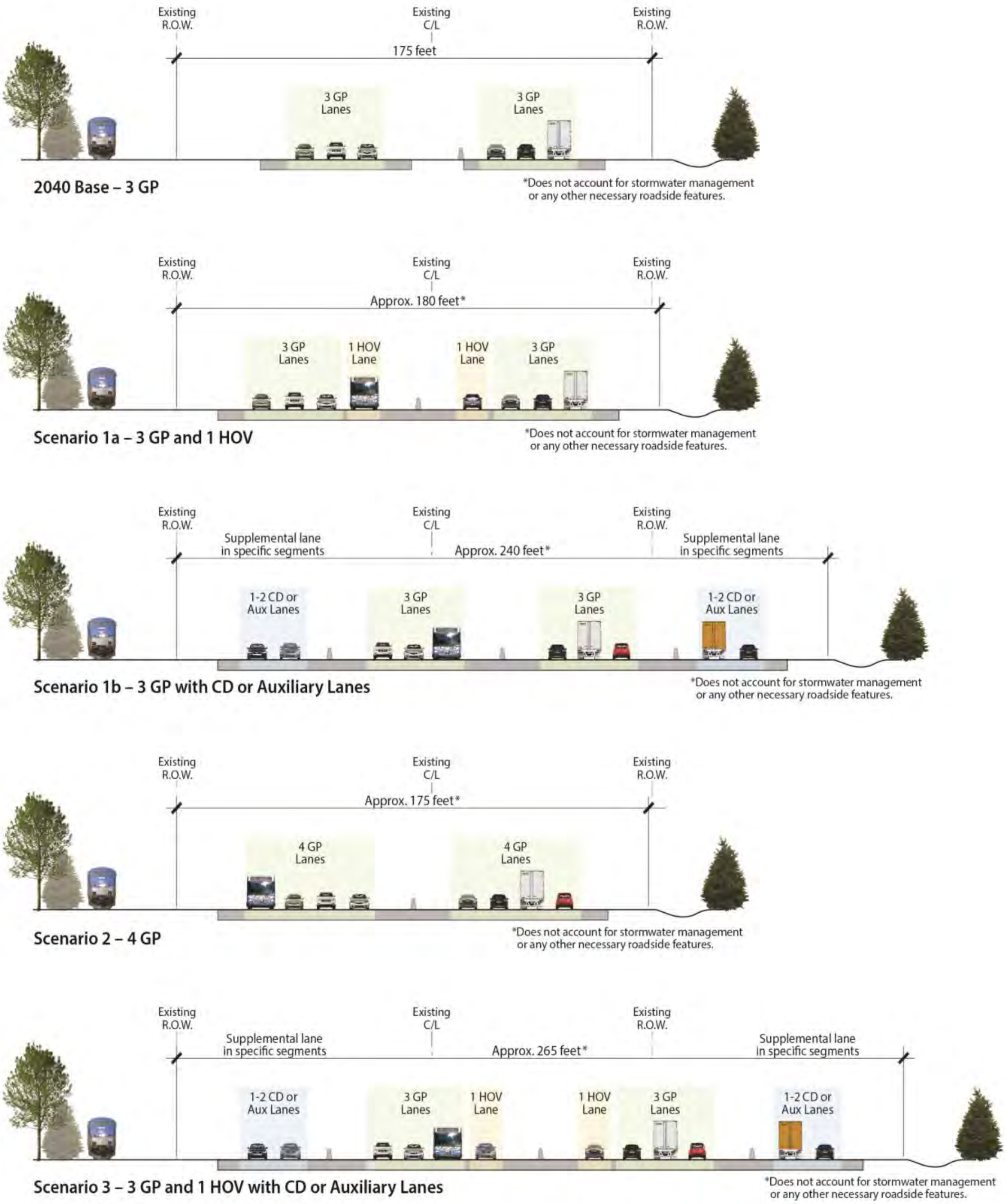
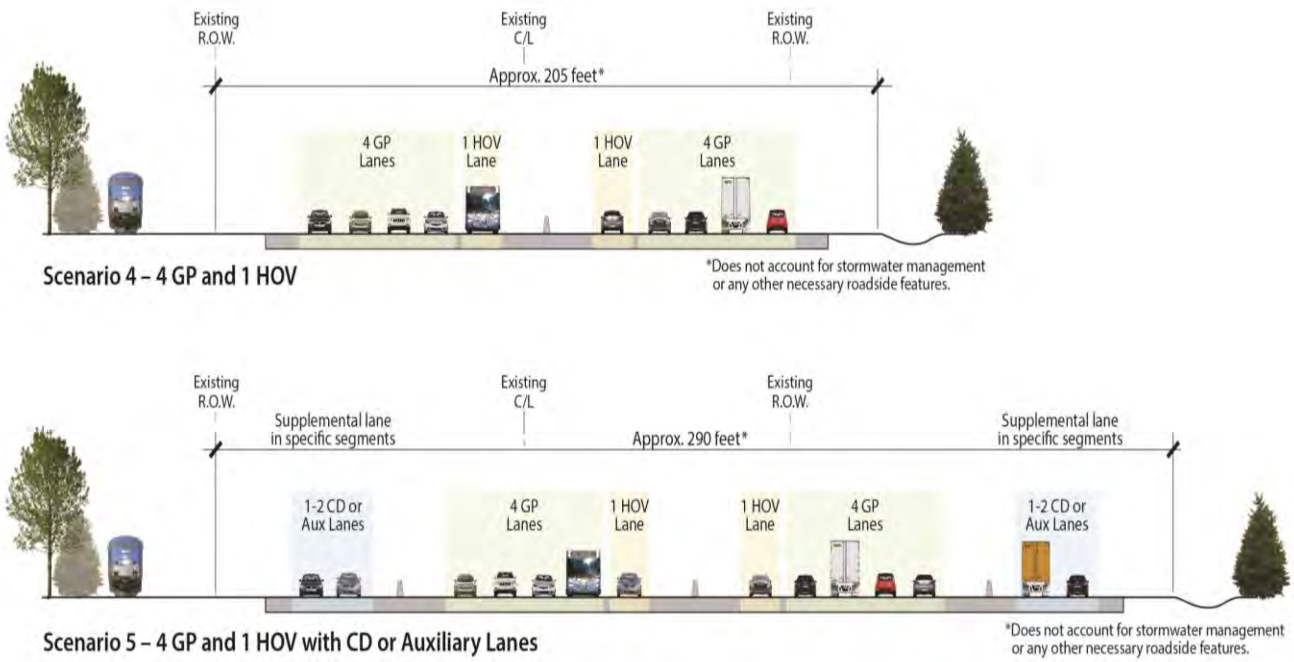


Figure PP2-2: I-5 Mainline Improvement Scenarios (continued)



I-5 through the corridor study area, reduce congestion and improve safety.

- **Scenario 3:** Adds one managed lane/HOV lane and a combination of CD roads or auxiliary lanes at strategic locations along I-5. This combines the features of Scenarios 1a and 1b.
- **Scenario 4**: Adds one managed lane/HOV lane throughout the corridor study area and one GP lane in each direction south of Thorne Lane. This combines the features of Scenarios 1a and 2.
- **Scenario 5**: Adds one managed lane/HOV lane throughout the corridor study area, one GP lane in each direction south of Thorne Lane, and a combination of CD roads or auxiliary lanes at strategic locations along I-5.

To analyze and evaluate the mainline improvement scenarios in the *Corridor Plan Feasibility Study*, a set of evaluation criteria was identified in accordance with the *Moving Washington* initiative. The following criteria were used in this evaluation:

- Changes in corridor speeds and total hours of congestion for GP and HOV lanes
- Person trips served
- Relief of existing highway lane-change (“side”) friction and vehicle conflicts resulting from high volumes entering and exiting vehicles
- Potential environmental impacts based on the results of a corridor environmental scan.
- Magnitude of cost

Table PP2-1: Evaluation Summary of I-5 Mainline Scenario Improvements

Scenario	Evaluation Criteria								Score
	Speed GP Lanes	Speed HOV Lanes	Hours of Congestion GP Lanes	Hours of Congestion HOV Lanes	Person Trips	Friction / Conflict Relief	Environment	Cost	
Weight	1.0	1.0	1.5	1.0	2.0	1.5	1.0	1.0	10.0
2040 Base Condition	2.25	NA	1.5	NA	2.75	1.0	5.0	5.0	**21.50**
1A	2.75	5.0	2.0	5.0	3.25	2.0	3.0	4.0	**32.25**
1B	3.25	NA	2.0	NA	3.5	4.0	3.0	3.0	**25.25**
2	3.25	NA	2.75	NA	3.5	2.0	3.0	4.0	**24.38**
3	3.75	4.75	2.75	5.0	4.0	4.0	2.0	2.0	**35.63**
4	4.0	5.0	3.25	5.0	4.0	3.0	3.0	3.0	**37.38**
5	5.0	5.0	4.5	5.0	4.0	4.0	2.0	1.0	**38.75**

Source: *I-5 JBLM Vicinity IJR and Environmental Documentation, Phase 1 – Corridor Plan Feasibility Study*, prepared in January 2014

The results of the evaluation scoring for the mainline scenarios are shown in Table PP2-1. The scores for each scenario were compiled across all criteria using a weighting structure that reflected the relative importance of each criterion. Scores from the 2040 Base Condition (or No Build Alternative) were added to the table for comparison. This No Build Alternative was not considered to be viable because it would not meet the stated goals and purpose of the project.

Even though Scenario 5 had the highest score, project stakeholders viewed it as over-building the corridor for expected 2040 design year travel demand and determined it to not be a viable alternative. An important element of this decision is continuity with the I-5 corridor to the north and south of this study area. Scenario 5 provided an I-5 cross section well beyond anything being considered for the I-5 corridor to the north or south and would not be practical. As a result, it was not considered in any further evaluation.

The scores for Scenario 1a through Scenario 4 ranged from 24.38 to 37.38. The scenarios with the most consistent high performance and point totals were Scenario 3 (3 GP lanes and an HOV lane with CD roads connected with auxiliary lanes) and Scenario 4 (4 GP lanes and an HOV Lane). These two scenarios showed improved GP lane speeds, free-flowing HOV lanes with high utilization, limited hours of congestion, high person trip estimates, and reduced impacts of multiple side friction and conflict points. However, the moderate to moderately high level of environmental impacts and costs for these two scenarios needed to be further researched and evaluated to distinguish between them.

A more detailed discussion of the I-5 mainline scenarios and analysis results is contained in the *I-5 JBLM Vicinity IJR and Environmental Documentation, Phase 1 – Corridor Plan Feasibility Study* on WSDOT's website at http://www.wsdot.wa.gov/Projects/I5/JBLMImprovements/FuturePlans.htm

What I-5 Interchange Design Alternatives Were Considered?

When the conclusion was reached that additional I-5 mainline capacity would be needed to fulfill the project purpose of relieving peak period traffic congestion, revisions to interchanges were evaluated that would allow for additional mainline capacity. Although the analysis focused on the four I-5 focus interchanges in the study area, this IJR is concentrating on the two interchanges proposed for modification in the Build Alternative:

- Berkeley Street (Exit 122)
- Thorne Lane (Exit 123)

As part of the *Phase 1 – Corridor Plan Feasibility Study*, various interchange types were reviewed and analyzed to determine how well each would improve I-5 operations and relieve congestion. Based on discussions with the study team and stakeholders, the most promising interchange types were advanced for further consideration and refinement including:

- Tight Diamond Interchange
- Diverging Diamond Interchange (DDI)
- Single Point Urban Interchange (SPUI)

Each interchange type was assessed to determine the most promising design concepts to be carried forward for operational analysis and design assessment.

Design concepts were evaluated by the project team based on potential mobility and environmental impacts or benefits, as well as JBLM access issues and opportunities. Based on this assessment, two or three concepts were identified at each location. These concepts and their key impacts and/or benefits are described in Figure PP2-3. These concepts were reviewed with the WSDOT Core Technical Team and the Technical Support Group who concurred with the findings and conclusions.

What Was the Preliminary Evaluation of the Interchange Concepts?

The interchange design concepts identified in Figure PP2-3 were further refined and evaluated during a preliminary stage in this IJR process. The objective was to identify the most effective configuration that would meet the needs and goals of the project. This refinement was based on information from the I-5 JLBM area dynamic traffic operations model and the preliminary design effort.

The Build Alternative includes interchange revisions at the Thorne Lane and Berkeley Street Interchanges. These changes are needed to accommodate the proposed wider Build Alternative footprint and to meet current design standards.

The refinement process ensures that the chosen interchange configuration would be compatible with the selected mainline improvements. The results of this analysis are described below for the two focus interchanges including I-5 at Berkeley Street, and I-5 at Thorne Lane.

Figure PP2-3: Preliminary Evaluation of Design Concepts at the Focus Interchanges

Interchange Option	Description		Mobility		Environmental		JBLM Access	
			Issues	Opportunities	Issues	Opportunities	Issues	Opportunities
Thorne Lane Interchange Concept A	**Concept A** – Offset Diverging Diamond Interchange over I-5 with grade separation over the railroad		• Requires loop road back to Union Avenue	• Simplifies signal phasing and allows free left and right turns • Grade separates over the railroad • Does not preclude possible Cross-Base Highway • Offset interchange reduces mobility impacts during construction	• Impacts wetlands		• Requires realignment of Murray Road	
Thorne Lane Interchange Concept B	**Concept B** – Offset Tight Diamond Interchange over I-5 with grade separation over the railroad		• Requires loop road back to Union Avenue	• May operate acceptably in the design year. • Grade separates over the railroad • Does not preclude possible Cross-Base Highway • Offset interchange reduces mobility impacts during construction	• Impacts wetlands		• Requires realignment of Murray Road	
Thorne Lane Interchange Concept C	**Concept C** – Offset SPUI over I-5 with grade separation over the railroad		• Requires loop road back to Union Avenue	• Consolidates ramp terminals to one signal • Grade separates over the railroad • Does not preclude possible Cross-Base Highway • Offset interchange improves mobility during construction	• Complicates bridge design and increases costs • Impacts wetlands		• Requires realignment of Murray Road	
Berkeley Street Interchange Concept A	**Concept A** - Tight Diamond Interchange over I-5		• Does not grade separate the railroad	• Operates acceptably in the opening year • May operate acceptably in the design year (2040)	• May impact Murray Creek	• Simplifies the bridge and reduces structures costs		
Berkeley Street Interchange Concept B	**Concept B** - SPUI over I-5		• Does not grade separate the railroad	• Consolidates ramp terminals to one signal • Improves spacing to the Union intersection	• Complicates bridge design and increases costs • May impact Murray Creek			

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What Berkeley Street Interchange Concepts Were Considered?

The Berkeley Street Interchange provides access to the Tillicum neighborhood and Camp Murray on the west side of I-5. On the east side of I-5, Berkeley Street becomes Jackson Avenue and provides access to JBLM through the Madigan Gate. Interchange improvement concepts identified for further study at the Berkeley Street Interchange are described below. Graphic illustrations of most of these concepts are shown in Figure PP2-3.

Concept A – Tight Diamond Interchange with Signals and At-grade Railroad Crossing

This concept would maintain the existing tight diamond interchange configuration with signals at intersections. Berkeley Street would be widened to a-six lane cross section over I-5 with bike lanes and sidewalks. This concept would maintain existing spacing with the Thorne Lane Interchange and the existing at-grade railroad crossing just west of the Interchange. Because of the physical constraints of the adjacent rail line, the desire to minimize mainline lane shifts, and the presence of a secure military installation, the distance between signalized intersections at this location would be about 300 feet. This short distance would require widening of the structure over I-5 to six lanes to provide parallel turning lanes. Retaining the very close at-grade crossing with the rail line is a notable disadvantage of this configuration. Later development of a grade-separated configuration (Concept C) resulted in a superior alternative. As a result this alternative is no longer being considered.

Concept B – Single Point Urban Interchange (SPUI) and At-grade Railroad Crossing

This configuration would consolidate ramp signals to one location for efficiency, and increase the space between the interchange ramp termini and Union Avenue intersections. The Berkeley Street overpass would be widened to a five-lane cross section with bike lanes and sidewalks. This concept would maintain the existing spacing with the Thorne Lane Interchange, and the existing at-grade railroad crossing just west of the interchange. It would also increase spacing to the Berkeley Street/Union Avenue intersection. Retaining the very close at-grade crossing with the rail line is a notable disadvantage of this configuration. The model results indicated that this SPUI configuration would not operate well. Later development of a grade-separated configuration (Concept C) resulted in a superior alternative. As a result, this alternative is no longer being considered.

Concept C – Tight Diamond Interchange Grade-Separated with Railroad

During the Multimodal Alternatives analysis process, a new concept was identified for the Berkeley Street Interchange that was not considered during the initial screening of interchange design concepts. This new concept would provide a grade separation over the rail line, and would relocate the interchange approximately 120 feet south of the existing I-5 structure. The concept would also elevate the Jackson Avenue extension over Militia Drive and would then curve to a new intersection with Berkeley Street, just west of Washington Avenue. The existing Berkeley Street/Union Avenue connection would be changed to a "Tee" intersection.

Teardrop roundabouts at the ramp intersections were selected for analysis and preliminary design. Based on preliminary operational analyses, this concept is expected to operate at LOS C or better in 2040.

Diverging Diamond Interchange (DDI)

Consideration was given to application of a DDI configuration at this location. It was not considered suitable due to the distance necessary between ramp terminal intersections and the tight site constraints including JBLM's Madigan Gate, the railroad, Union Avenue and the Militia Drive entrance to Camp Murray.

The DDI concept was not considered to be reasonable for this location because the physical constraints (including the adjacent rail line, the desire to minimize mainline lane shifts, and presence of the Woodbridge neighborhood and the secure military installation) would limit the distance between intersections to about 300 feet. Based on the *Diverging Diamond Interchange – Informational Guide*, FHWA, August 2014, DDI intersections need to be at least 400 to 500 feet apart to accommodate reverse curve radii through the intersections (so that large vehicles can maneuver) and tangents sections between crossovers (that can accommodate merging / diverging traffic from the ramps).

What Thorne Lane Interchange Concepts Were Considered?

West of I-5, Thorne Lane accesses the Tillicum neighborhood. East of the freeway, Thorne Lane becomes Murray Road and accesses the Woodbrook neighborhood of Lakewood and the Logistics Gate to JBLM. Interchange improvement concepts identified for further study at the Thorne Lane Interchange are described below. Graphic illustrations of these concepts are shown in Figure PP2-3.

Concept A – Offset Diverging Diamond Interchange Grade-Separated with Railroad

The offset diverging diamond concept would grade-separate Thorne Lane over the adjacent railroad and Union Avenue. Thorne Lane would be widened to a four-lane cross section. The interchange would be shifted approximately 350 feet south to better align with Murray Road on the south side of I-5. A new loop connector road would be added to provide access to Union Avenue from Thorne Lane. This concept would reduce the interchange spacing with the Berkeley Street Interchange.

Concept B – Offset Tight Diamond Grade-Separated with Railroad

This concept would be similar to Concept A, but would include a tight diamond interchange. Teardrop roundabouts at the ramp intersections with Thorne Lane were selected for analysis and preliminary design. The teardrop roundabouts would allow traffic to freely operate between the intersections, even with reduced intersection spacing, would improve safety of the intersection by eliminating several vehicle conflict points, and would provide a grade-separated crossing of the adjacent rail line. Based on preliminary operational analyses, this concept would operate at LOS C or better in 2040. This concept was chosen to advance through further design and operational analysis as part of this IJR.

Concept C – Offset Single Point Urban Interchange (SPUI) Grade Separated with Railroad

This configuration would consolidate ramp signals to one location for efficiency. The

Thorne Lane overpass would be widened to a five-lane cross section with bike lanes and sidewalks. In comparison to Concept B, this alternative would be more difficult to construct, have higher construction and maintenance costs, and maybe less safe than Concept B with roundabouts rather than signals. The model results indicated that this SPUI configuration would not operate well. As a result, this alternative is no longer being considered.

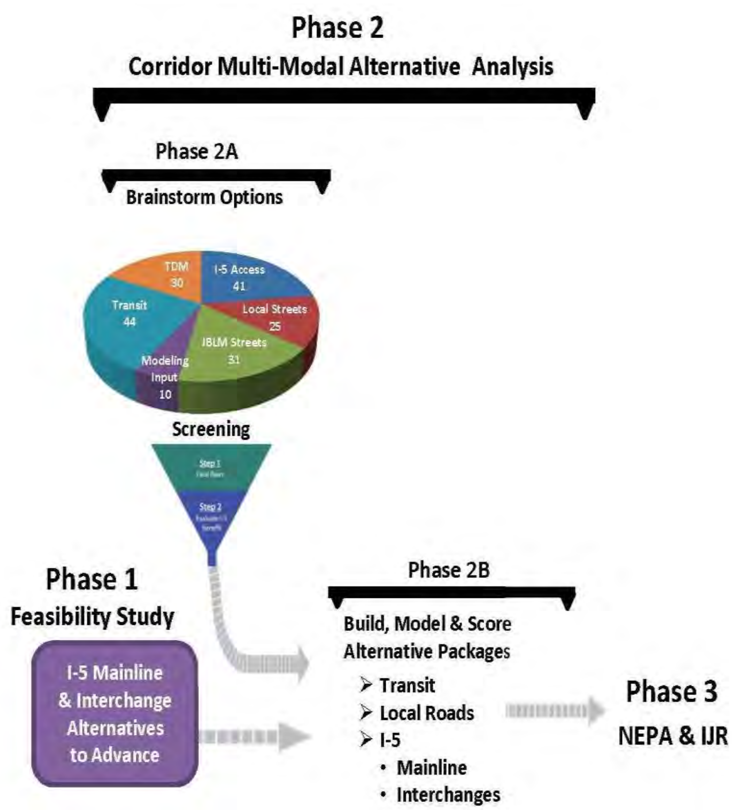
How Were Multimodal Alternatives Developed and Evaluated?

The development and evaluation of multimodal alternatives was conducted using a multi-step process that is illustrated in Figure PP2-4 and described below. As illustrated in this figure, the multimodal alternatives analyses were conducted following the feasibility evaluation of I-5 mainline and interchange design concepts, and included two sub-phases. The first sub-phase involved developing and screening a broad range of options. The second sub-phase involved grouping reasonable options into packaged multimodal alternatives for robust modeling and scoring of attributes. At the end of the Multimodal Alternatives Analysis process, recommended improvements were identified for advancing into the NEPA and IJR processes.

Step 1 (Fatal Flaw) Assessment

At the outset of the multimodal alternatives analysis, a broad range of options were identified beyond those identified in the I-5 Feasibility Study. Through a brainstorming process with project stakeholders conducted in March 2014, and augmented at a public Open House in June 2014, 181 options for transportation improvements largely off the I-5 mainline were identified. These included:

Figure PP2-4: Process to Develop and Evaluate Multimodal Alternative Packages



- Category A: Options to improve access to/from I-5.
- Category B: Options to enhance local (open to the public) road infrastructure (these options are shown in Figure PP2-5).
- Category C: Options to enhance JBLM (not open to the public) road infrastructure (these are shown in Figure PP2-6)
- Category D: Selected options to test the sensitivity of 2040 travel forecasts
- Category E: Transit service options
- Category F: TDM/TSM options (Transportation Demand Management/ Transportation System Management)

Category A through D options were assessed using a "Fatal Flaw" screening that focused on:

- Regulatory or legal constraints
- Operating and/or security feasibility related to JBLM and/or Camp Murray
- Potential for combination with other options to create a potentially more viable improvement package.

Options E and F (transit and TDM/TSMO) required input from a refined JBLM-area travel demand model and more in-depth analysis than the fatal flaw screening. Accordingly, options in these categories were advanced automatically for consideration in the development of multimodal alternative packages.

Figure PP2-7 illustrates the results of the Step 1 screening of multimodal options. Of the 181 options that were evaluated for fatal flaws, 117 were rejected because they were fatally flawed or components of other brainstormed options. Forty-four options were considered to have sufficient merit to be carried forward in the development of multimodal alternative packages. Twenty options were carried forward for further evaluation in the Step 2 of the analysis process using a dynamic traffic operations model.

Step 2 – Assessment of Benefits to I-5

Step 2 began with a short list of the most promising ideas that passed of the fatal flaw analysis for evaluation in greater detail. The Step 2 assessment focused on assessing local (public) streets and on-JBLM road network improvement options. The Step 2 assessment was conducted using the following screening criteria:

- Changes in traffic volumes on the I-5 mainline and at interchanges caused by traffic rerouting due to local improvements
- Changes in traffic volumes on local streets (both on- and off-JBLM) caused by this traffic rerouting
- Changes in I-5 speeds in general purpose (GP) lanes
- Consistency with area plans and policies
- Readily apparent environmental issues
- Any other information that would be pertinent or useful in assessing an individual option.

Figure PP2-7: Step 1 (Fatal Flaw) Screening Results

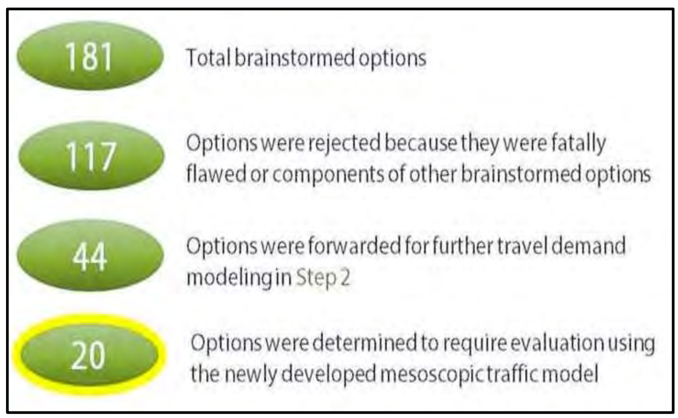


Figure PP2-8: Step 2 Screening Results

Figure PP2-5: Off-JBLM (Open to the Public) Local Improvement Options

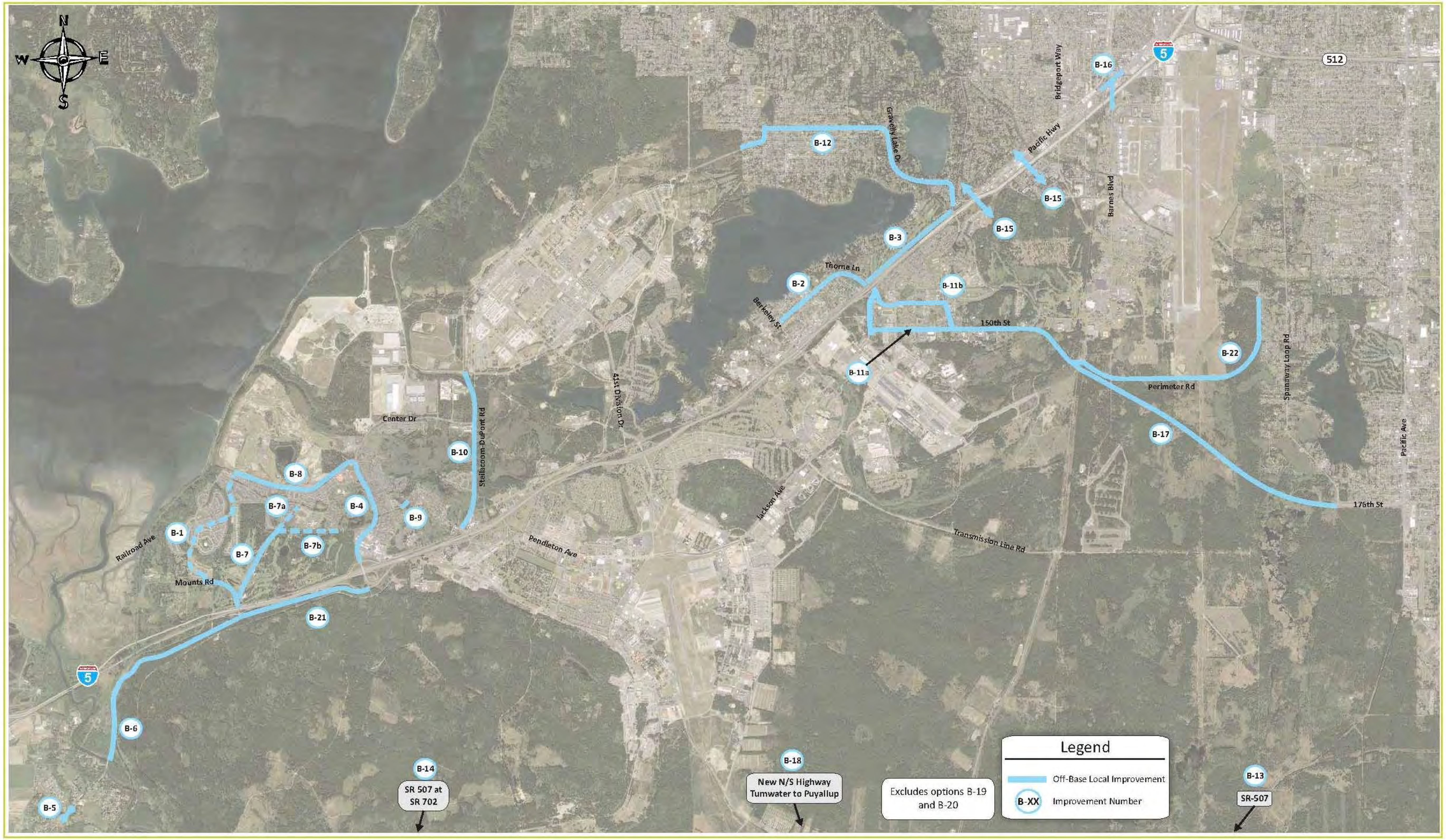
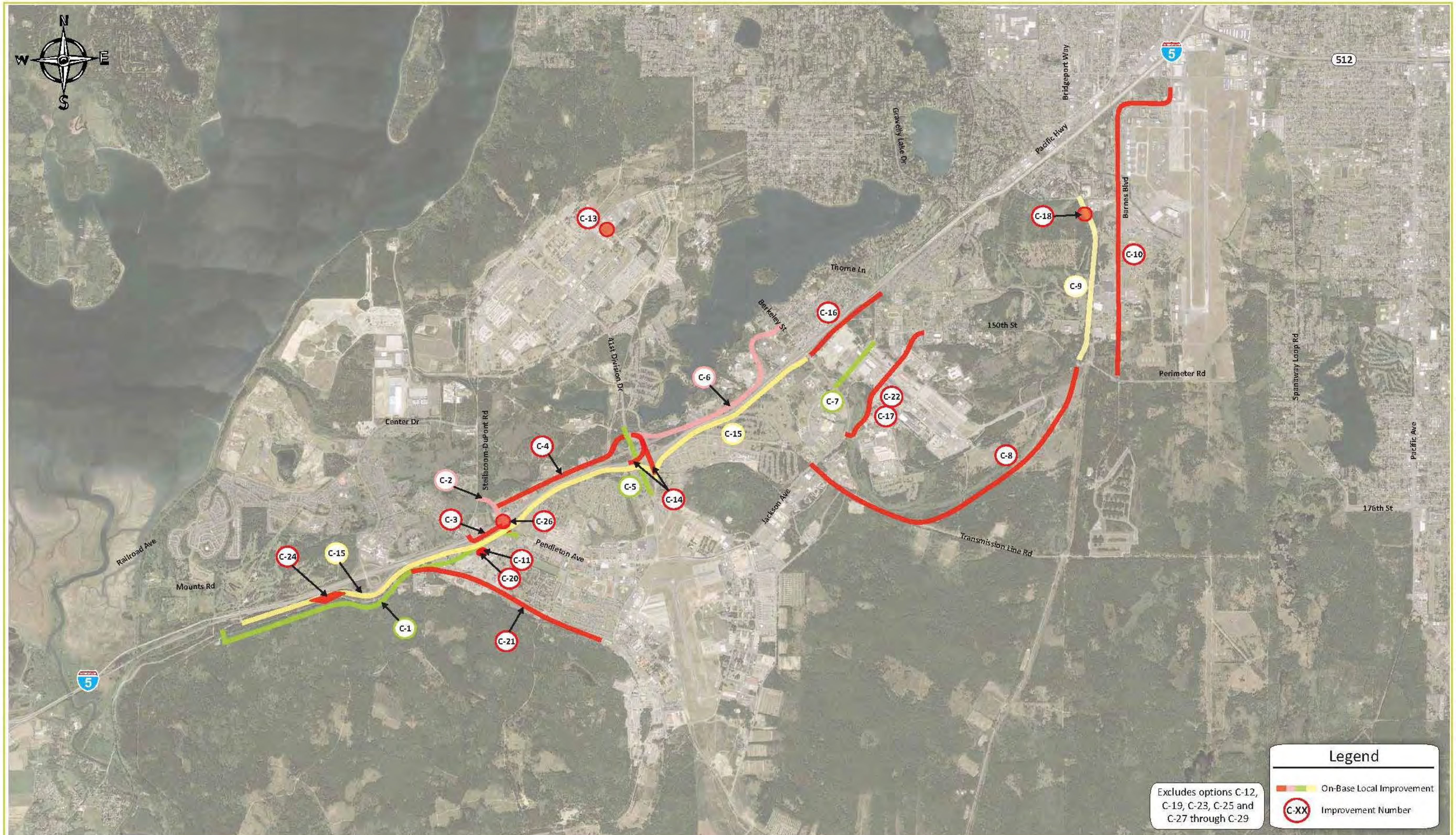


Figure PP2-6: On-JBLM (Not Open to the Public) Local Improvement Options



As illustrated in Figure PP2-8, after Step 2 screening 15 options were eliminated as not providing sufficient benefit to I-5, and 29 were identified for consideration in the development of multimodal alternative packages. A total of 49 options (20 from Step 1 and 29 from Step 2) were carried forward as possible options in developing multimodal alternative packages.

What Multimodal Alternatives Were Developed and Evaluated?

The Multimodal Alternatives Analysis analyzed 12 packages of combined options including transit, local roads and I-5 scenarios. The alternative packages were developed as a series of building blocks by first considering local road and transit improvements, and then adding I-5 mainline and interchange improvements as reviewed and approved by project stakeholders. These multimodal alternative packages included:

- P1 – No Build (No Action)
- P2 – Enhanced Transit
- P3 – Local Street Improvements with Enhanced Transit
- P4 – I-5 Express Lanes
- P4a – I-5 Express Lanes with Local Improvements
- P5 – I-5 HOV Lanes with CD/Auxiliary Lanes
- P5a – I-5 HOV Lanes with CD/Auxiliary Lanes with Local Street Improvements
- P6 – I-5 HOV Lanes and GP Lanes
- P6a – I-5 HOV Lanes and GP Lanes with Local Street Improvements
- P7 – I-5 HOV Lanes
- P7a – I-5 HOV Lanes with Local Street Improvements and Enhanced Transit
- P7b – I-5 HOV Lanes with Local Street Improvements

A description of these alternative packages is presented in Appendix D. The off-JBLM and on-JBLM local street improvements considered in this analysis of Alternative P3 are illustrated in Figure PP2-9. The local street improvements analyzed with Alternatives P4a, P5a, P6a, P7a and P7b are illustrated in Figure PP2-10.

How Were the Multimodal Alternative Packages Evaluated?

To analyze and screen the multimodal alternative packages, a set of evaluation criteria was identified through a project working group drawn from the project's Technical Support Group. Two categories of evaluation criteria were developed (i.e. quantitative criteria and qualitative criteria). The quantitative criteria are performance-based data derived from the various analysis tools used in this study. The quantitative criteria include:

- Travel Speeds along I-5 – PM peak hour speeds for HOV and SOV vehicles;
- Hours of Congestion – Peak spreading over a 6-hour PM peak period;
- Travel Time – Average travel time on I-5 between Mounts Road and Bridgeport Way for a 3-hour PM peak period;
- Person Throughput – Regional person trips on I-5 over a 6-hour PM peak period;
- Percent of Person Demand Served – Measures percent of projected demand accommodated along the I-5 corridor over a 2-hour PM peak period; and
- Potential Regional Person Trips via Transit and HOV – Number of transit trips using the corridor in a 3-hour PM peak period and number of HOV trips using the I-5 corridor in a 6-hour PM peak period.

Figure PP2-9: Selected Local Road Improvements in Alternative Package P3

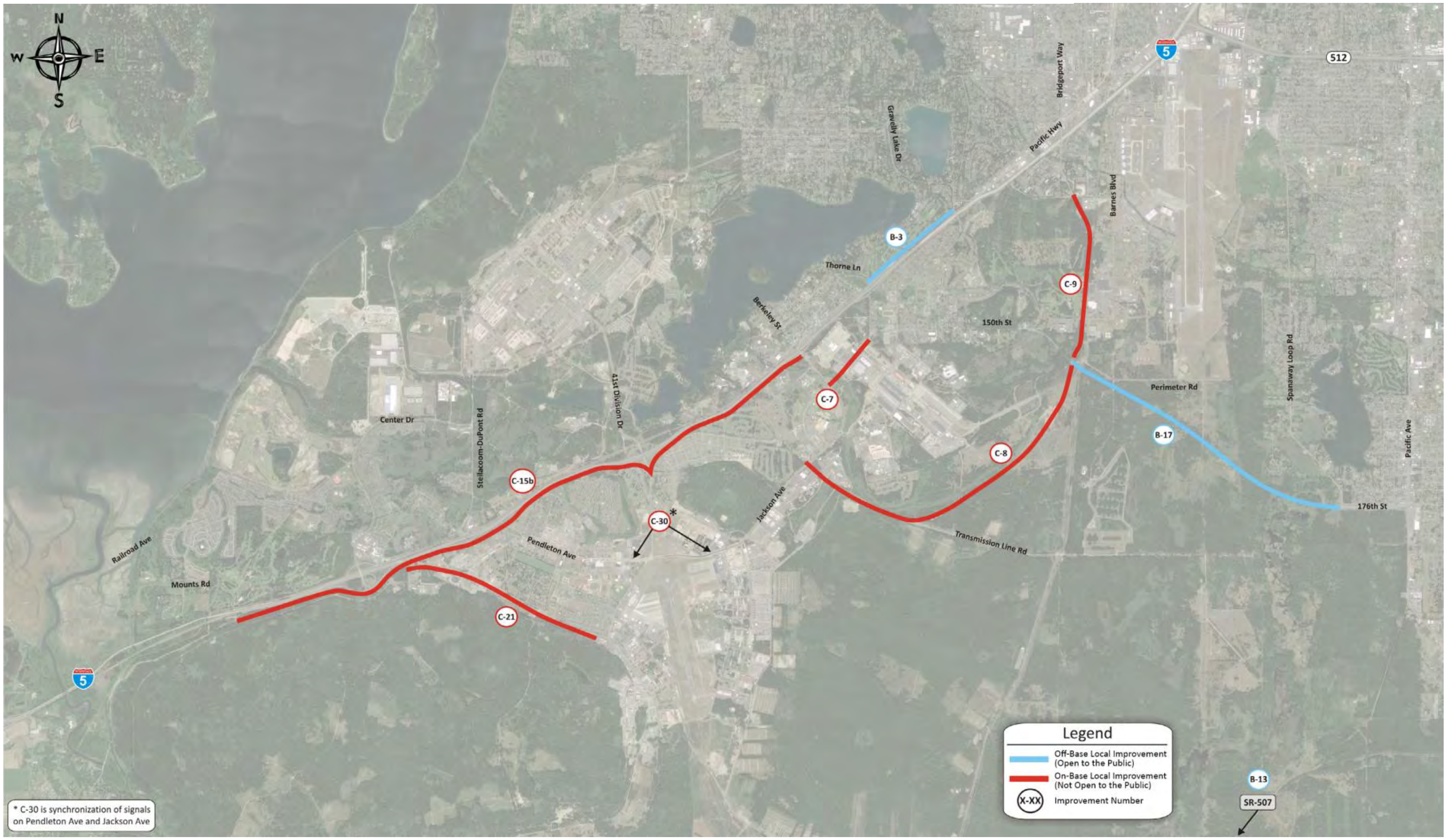


Figure PP2-10: Selected Local Road Improvements in other Alternative Packages (P4a, P5a, P6a, P7a and P7b)

The qualitative criteria are based on an assessment of implementation characteristics, and the updated environmental scan conducted for this study. These qualitative criteria include:

- Implementation Assessment – A qualitative review of their ability for staged construction, right-of-way needs, and costs of each alternative with respect to other alternatives; and
- Environmental Considerations – A qualitative review of the possible environmental impacts for each alternative package with respect to other alternatives.

Separate 2020 and 2040 evaluations of the alternative packages were conducted to determine which alternative packages showed the most promise in addressing the I-5 congestion, both near-term and long-term. The evaluation criteria and scoring method are documented in the *Multimodal Alternatives Analysis Report for the I-5 JBLM Vicinity Congestion Relief Study*.

What Are the Recommended I-5 Mainline and Interchange Improvements?

Project recommendations are based on the findings and conclusions of the feasibility study, multimodal alternatives analysis and the preliminary IJR analysis. This process identified the most promising course of action to address congestion and improve mobility along I-5 in the vicinity of JBLM.

For the I-5 mainline, the Build Alternative, as illustrated in Figure PP2-11, was recommended for advancing into the NEPA and formal IJR process. This strategy provides notable improvements in comparison to existing I-5 conditions. The Build Alternative is expected to provide good traffic operational performance in the opening year (target 2020) peak travel periods. This alternative includes the following elements.

- Add one through lane to each direction of the I-5 mainline between Thorne Lane and Steilacoom-DuPont Road
- Add new northbound auxiliary lanes between the Berkeley Street and Thorne Lane interchanges and also the Thorne Lane and Gravelly Lake Drive interchanges
- Interchange reconfigurations at Berkeley street and Thorne Lane
- Shared use (pedestrian/bicycle) path
- Southbound Gravelly Lake Drive to Thorne Lane local connector road

These improvements are described below.

Mainline Widening

Mainline widening would add a fourth northbound lane from the vicinity of Steilacoom-DuPont Road to Thorne Lane. In the southbound direction, a fourth lane would be added from the vicinity of Thorne Lane Interchange through the Steilacoom-DuPont Road Interchange. The added lanes are intended to be initially operated as general purpose lane. The proposed cross-section for I-5 including this widening project is shown in Figure PP2-12.

The added lanes can be converted to HOV lanes in the future when the HOV system is extended south from Tacoma.

Northbound auxiliary lanes would also be added between the Berkeley Street and Thorne Lane interchanges, as well as the Thorne Lane and Gravelly Lake Drive interchanges.

Figure PP2-11: Recommended I-5 JBLM Area Improvements

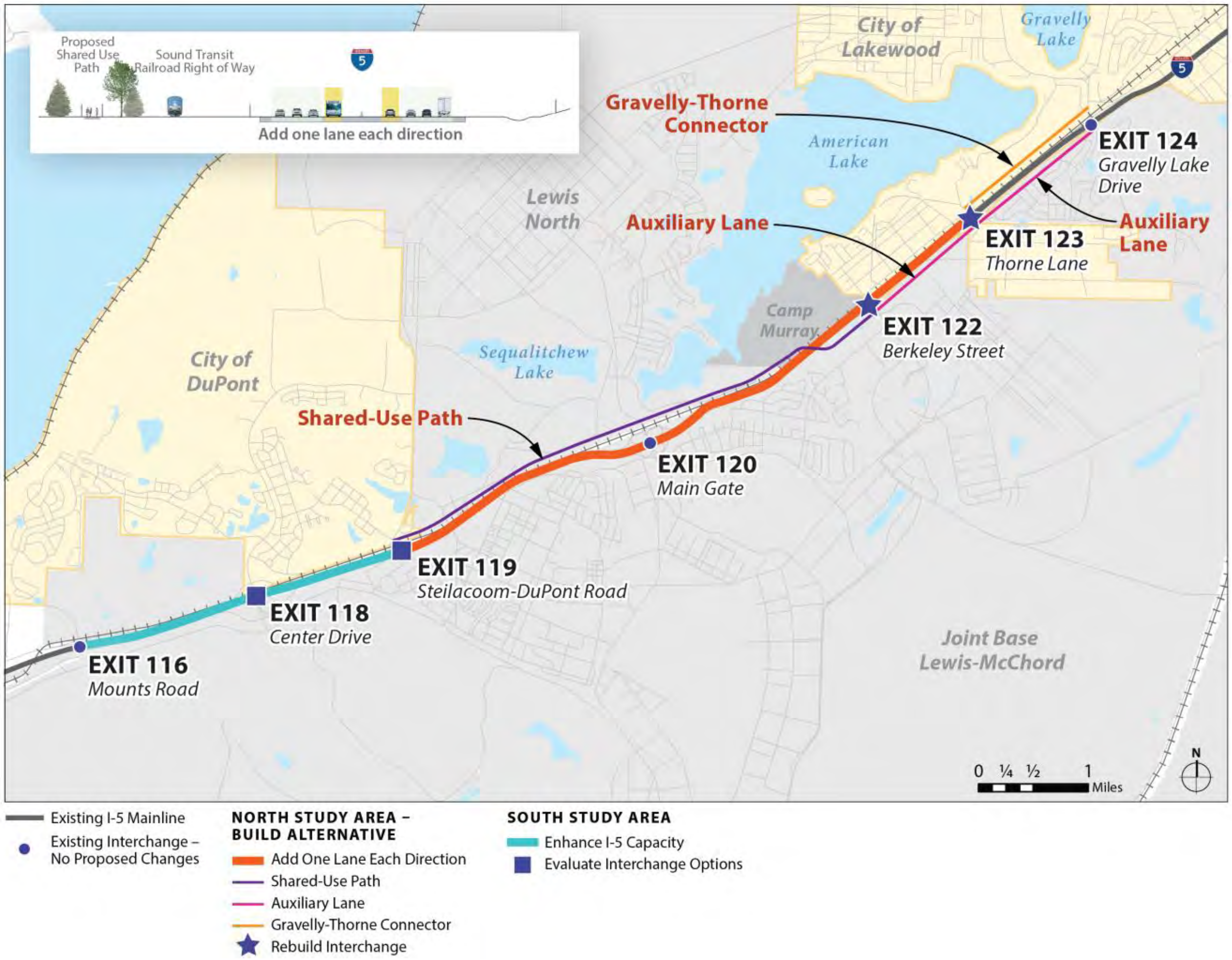


Figure PP2-12: Recommended I-5 Cross-section Improvements

Interchange Reconfigurations

For the IJR and NEPA environmental analyses, interchange reconfigurations are proposed at Thorne Lane and Berkeley Street that would:

- Accommodate I-5 mainline widening;
- Improve traffic operations and carrying capacity of the interchanges and to better accommodate community growth and activity at JBLM and Camp Murray; and
- Grade-separate interchange-related traffic from the existing Sound Transit rail line which will carry Amtrak service starting in 2017.

Specific interchange configurations at each location have been recommended and are listed below.

- Berkeley Street Interchange concept - Tight Diamond Interchange with roundabouts. This concept is illustrated in Figure PP2-13.
- Thorne Lane Interchange concept - Tight Diamond Interchange with roundabouts. This concept is illustrated in Figure PP2-14.

Figure PP2-13: Recommended I-5 / Berkeley Street Interchange Concept

Figure PP2-14: Recommended I-5 / Thorne Lane Interchange Concept

Shared Use Path

A shared use bicycle and pedestrian path would be added along the I-5 corridor between Berkeley Street and Steilacoom-DuPont Road to provide a non-motorized connection to JBLM and local communities. The location of and connection points to this bicycle/pedestrian path will be further addressed during preliminary design.

Gravelly Lake Drive to Thorne Lane Connector

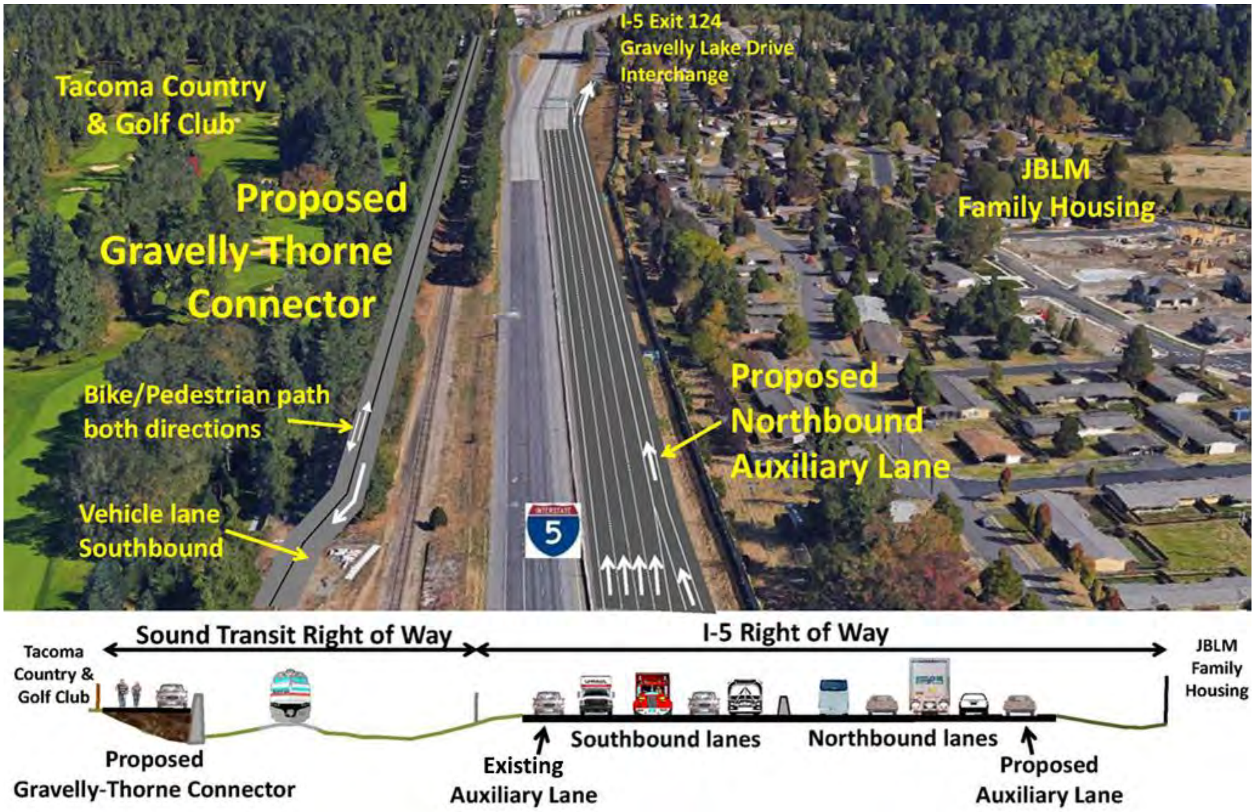
This local street improvement is included with the other recommended improvements to reduce short trips on I-5 between the Tillicum neighborhood and Lakewood. It would be parallel to I-5 between Gravelly Lake Drive and Thorne Lane.

The proposed plan for the Gravelly-Thorne Connector would provide a southbound motor vehicle lane from Gravelly Lake Drive to Thorne Lane with a two-way non-motorized path.

What Are the Focus Elements for this IJR?

This IJR focuses on the interchange improvements at Thorne Lane and Berkeley Street Interchanges to assess their operational and safety impacts in the opening year (2020) and the design year (2040) and their compatibility with other Build Alternative components.

Figure PP2-15: Proposed Gravelly-Thorne Connector and I-5 Northbound Auxiliary Lane



Introduction

Policy Point 3 in this IJR summarizes the transportation operations and safety impacts associated with the Build Alternative. This alternative includes re-configuration of two interchanges along the I-5 corridor through the JBLM area, as well as mainline widening and a new local street. The purpose of the interchange improvements is to remove constraints on the I-5 mainline that prevent any increase in capacity such as that determined necessary to provide congestion relief.

Mainline I-5 widening is constrained at two locations by the opening at existing Berkeley Street and Thorne Lane interchange overcrossing structures. These structures currently accommodate only three travel lanes in each direction and must be widened to add a fourth lane in each direction, as proposed by the Build Alternative.

The widening of the existing overcrossing structures requires modification of the ramp termini intersections and approach streets so that they operate as efficiently and safely as possible.

Thus, while the focus of this IJR is on improvements to the Berkeley Street and Thorne Lane interchanges, these improvements are triggered by the need to widen I-5 through the north end of the I-5 JBLM study area. Accordingly, the information presented in Policy Point 3 addresses traffic operations and safety at the two interchanges, as well as the highway mainline, local street and multimodal improvements.

Proposed improvements in the Build Alternative include:

- Modifications to interchanges at Berkeley Street and Thorne Lane.
- The addition of a fourth travel lane from Thorne Lane southbound to Center Drive and from Steilacoom-DuPont Road northbound to Thorne Lane.
- A southbound local street connector (Gravelly-Thorne Connector).
- Northbound auxiliary lanes would also be added between the Berkeley Street and Thorne Lane interchanges, as well as the Thorne Lane and Gravelly Lake Drive interchanges.
- A shared-use path for pedestrians and bicyclists from Steilacoom-DuPont Road to Berkeley Street and along the Gravelly-Thorne Connector.

This policy point includes an overview of the operating assumptions, travel forecasting approach, analysis methodologies and findings for the Build Alternative, as compared with the No Build Alternative. Analysis focuses on the operational and safety performance of the Build Alternative interchanges in both 2020 and 2040.

Overall, the analyses show that the proposed interchange modifications on I-5 at the Berkeley Street and the Thorne Lane Interchanges, together with other near-term I-5 mainline improvements, would improve the safety and operation of the interstate and ramp intersections. The new interchanges, with associated highway widening, would maintain or improve operating conditions in 2020 and also provide some 2040 operational benefits.

What Tools Were Used to Forecast Travel along the I-5 Corridor?

The travel forecasting procedures developed for and documented in the *I-5 JBLM Vicinity Congestion Relief Study* were used in this IJR. 2020 and 2040 travel forecasts were developed using a series of interrelated and complimentary modeling tools including a Macroscopic Model, a Transit Sketch Planning Model, and a Mesoscopic Model. The following is a general description of each model and how they were integrated to conduct traffic forecasting analysis.

Macroscopic (Macro) Model

The I-5 JBLM Macro Model was used to develop travel forecasts in the study area and to understand changes in travel patterns that would result from various alternative improvement packages. The Macro Model has a base year of 2013, and two forecast horizon years of 2020 and 2040. The model area includes Pierce County south of the Puyallup River and northern Thurston County. The model includes mode splits and trip assignments for both high-occupancy vehicles (HOV) and single-occupancy vehicles (SOV) for two time periods: an AM peak period (6 AM to 9 AM), and a PM peak period (3 PM to 6 PM). The Macro Model is consistent with local land use plans, and the Puget Sound Regional Council (PSRC) and Thurston Regional Planning Council (TRPC) regional models and modeling assumptions.

Transit Sketch Planning (Transit) Model

The Transit Model was developed to provide a more comprehensive, multimodal assessment of how corridor-level improvements can help achieve the congestion reduction goals of the project. The Transit Model captures the effects that commuter-oriented transportation demand management programs (subsidized transit passes, vanpools, shuttles, etc.), investments in high-occupancy vehicle facilities, and improvements to commuter transit service can have on congestion in the corridor. Using the Transit Model in the planning process also allowed the project team to better understand the commuter transit market in this corridor.

The Transit Model was designed to build upon the existing Macro Model. It uses data from the established regional models, as well as data from industry-wide research that is important for forecasting commuter transit ridership.

The Transit Model was integrated into the overall modeling process, interfacing directly with the Macro Model. A variety of data inputs from the Macro Model fed into the Transit Model including SOV and HOV travel times. Once transit ridership forecasts for each alternative package were developed, the data were imported back into the Macro Model to account for expected changes in mode share. Ridership forecasts were also used directly in performance assessments of the alternative improvement packages.

Mesoscopic (Meso) Model

The I-5 JBLM Meso Model was developed to evaluate and compare the various alternative improvement packages with a series of detailed transportation performance measures. The Meso Model was built using Dynameq software and is based upon the Macro Model. As a result, it is consistent with local and regional land use plans and the regional transportation models.

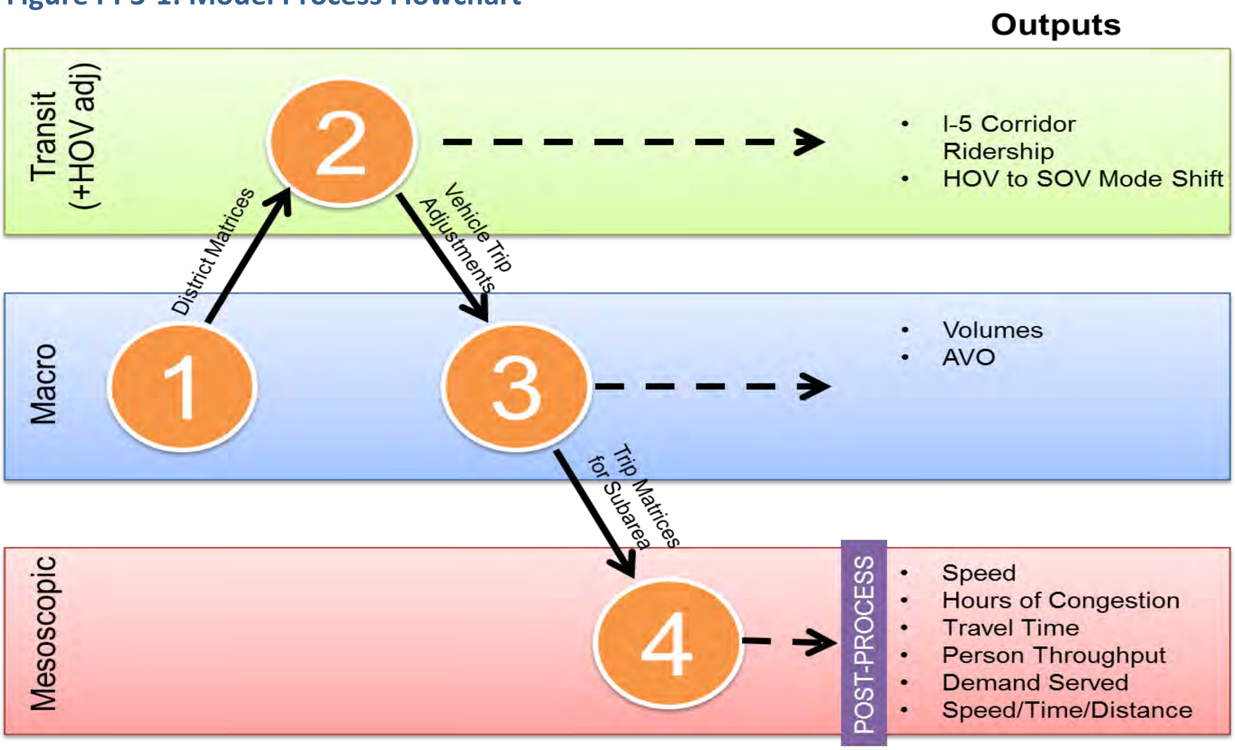
The general analysis area of the Meso Model is the I-5 corridor between SR 512 and SR 510, including the adjoining local on-JBLM and off-JBLM arterials. The Meso Model incorporates specific roadway and intersection operational details such as signal timing, roadway channelization, ramp metering, and merging/weaving conflicts along the I-5 mainline. It also includes operational impacts from at-grade railroad crossings and military gate operations. These features enable the Meso Model to dynamically balance traffic volumes as the various alternative routes become congested.

Modeling Procedure

Outputs from the modeling efforts are coordinated between the three different models. Figure PP3-1 illustrates the general four-step procedure for modeling each alternative package. These steps include:

- **Step 1** includes coding the alternative improvement package assumptions in the Macro Model, running the model, and outputting SOV and HOV travel time trip tables for use in the Transit Model.
- **Step 2** includes coding the alternative improvement package assumptions in the Transit Model, running the model, and outputting transit ridership and vehicle trip adjustments (changes in amount of vehicle trips due to changes in transit ridership) for use back in the Macro Model.
- **Step 3** includes revising the Macro Model with the transit ridership adjustments, re-running the model, and outputting vehicle volume metrics and subarea trip tables for use in the Meso Model.

Figure PP3-1: Model Process Flowchart



- **Step 4** includes detailed operational coding of the Meso Model, running the model, and then outputting various performance metrics, such as travel volumes, speeds, travel times, hours of congestion and mode share.

How Was the Traffic along I-5 and at Intersections Analyzed?

The analyses and procedures used in evaluating traffic operations along I-5 and at corridor intersections are summarized in the *Methods & Assumptions Document for the I-5 Joint Base Lewis-McChord Vicinity Interchange Justification Report & Environmental Documentation*, contained in Appendix A. The analyses of traffic along I-5 were conducted using output from the Meso Model and included travel speeds, travel times, hours of congestion and demand.

Because of corridor constraints, such as the close proximity of multiple entrance and exit points along I-5, slow travel speeds, and frequent lane changes, the traditional Highway Capacity Manual (HCM) level of service (LOS) method using vehicle density does not depict the actual congestion issues along I-5 through the study area. As a result, the method used to analyze mainline traffic along I-5 was taken from WSDOT's *2007-2016 Highway System Plan* that uses the relationship between LOS and the percent of posted speed. Based on this method, speeds below 70 percent of posted speed are identified as LOS F.

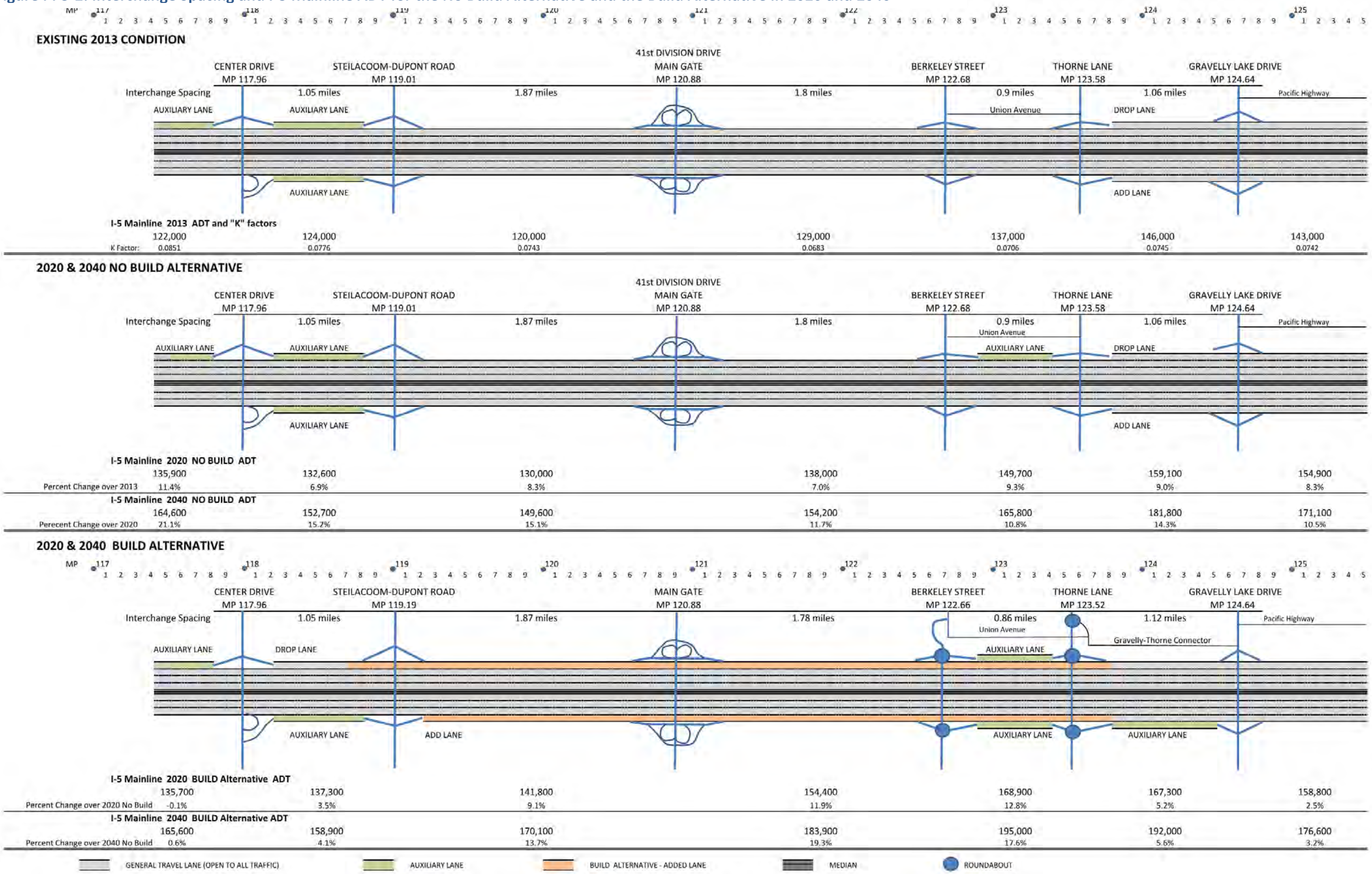
Intersection operations were analyzed using data outputs from both the Macro and Meso models. This data was processed with Synchro software for signalized and non-signalized intersections, and Sidra software for roundabouts in accordance with the HCM.

What Is the Existing and Proposed Spacing of Interchanges along the I-5 Corridor within the Study Area?

The existing and proposed spacing of interchanges and interchange configurations for the No Build Alternative and the proposed Build Alternative are displayed in Figure PP3-2 for 2020 and 2040 conditions.
Current design standards state that the minimum spacing between urban interchanges should be at least one mile. The existing spacing between the Berkeley Street and Thorne Lane Interchanges is about 0.9 miles, which is less than the one mile minimum spacing. The existing spacing in the Design Manual between the Thorne Lane and Gravelly Lake Drive interchanges is just over the one-mile minimum at 1.06 miles.

The proposed Build Alternative would increase the spacing between the Thorne Lane and Gravelly Lake Drive Interchange to 1.12 miles. However, the spacing between the Berkeley Street and the Thorne Lane Interchanges would be slightly reduced to 0.86 miles. To compensate for this shorter interchange spacing, the existing southbound auxiliary lane would be maintained and a new northbound auxiliary lane between the Berkeley Street and Thorne Lane ramps would be added with the Build Alternative.

Figure PP3-2: Interchange Spacing and I-5 Mainline ADT for the No Build Alternative and the Build Alternative in 2020 and 2040



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The reconfigured interchanges at Thorne Lane and at Berkeley Street are designed with the centerlines of the new bridge crossings being offset from the existing crossings. The reasons for these offsets include both constructability under traffic, as well as connectivity to the local road system with the cross roadways grade-separated over the railroad.

What Are the Existing and Forecasted Average Daily Traffic Volumes along the I-5 Corridor?

The existing and future average daily traffic (ADT) volumes along I-5 between Center Drive and Gravelly Lake Drive for existing 2013 conditions, the 2020 and 2040 No Build Alternative, and the 2020 and 2040 Build Alternative are also shown on Figure PP3-2.

Peak hour traffic projections were developed for the No Build and Build Alternatives for the 2020 opening year and 2040 design. This was accomplished by combining the area's demographic forecasts and local highway networks in the validated I-5 JBLM Macro and Meso Models. 'K Factors' were derived from February 2013 data for each segment between interchanges. These K Factors were then applied to the PM peak hour volumes to estimate the ADT volumes for both alternatives and time periods.

For the No Build Alternative, 2020 ADT volumes along I-5 is expected to grow from 6.9 percent to 11.4 percent over corresponding 2013 volumes (depending on location), with a two-way maximum of about 159,100 daily vehicles expected between Thorne Lane and Gravelly Lake Drive. Between 2020 and 2040, volumes with the No Build Alternative are expected to grow from 10.5 percent north of Gravelly Lake Drive Interchange to 21.1 percent south of the Center Drive Interchange. A maximum daily two-way traffic volume of 181,800 vehicles is expected between Thorne Lane and Gravelly Lake Drive Interchanges.

When comparing the Build Alternative with the No Build Alternative, 2020 Build Alternative volumes are expected to range from a slight change in daily traffic volume south of Center Drive to 12.8 percent higher than the 2020 No Build Alternative volumes (between Berkeley Street and Thorne Lane Interchanges) with a maximum daily two-way volume of 168,900 vehicles south of Thorne Lane.

Compared to the 2040 No Build Alternative, more traffic is expected to use I-5 with the 2040 Build Alternative. ADT volumes would increase by about 0.6 percent south of Center Drive to about 19.3 percent between the 41st Division Drive Main Gate and Berkeley Street.

These increased volumes for the Build Alternative would occur because of the increased capacity along I-5 and better access at the modified Berkeley Street and Thorne Lane Interchanges. Detailed 2020 and 2040 AM and PM peak hour traffic volume projections along the I-5 mainline and access ramps for the No Build and Build Alternatives are contained in Appendix E. The AM and PM intersection turning movements in 2020 and 2040 are summarized in Appendix F.

What Traffic Design Criteria and Adjustment Factors Were Used to Develop and Analyze Interchange Layouts?

A summary of the traffic design criteria used in development of the proposed interchange improvements and widening of the I-5 mainline is listed in Table PP3-1. A detailed listing of design data is presented in Policy Point 4 and in Appendix H. The adjusted factors, including truck percentages, Peak Hour Factors (PHF) and PM Peak Hour to Daily (K) Factor used in the traffic analyses are also summarized in this table and in associated appendices.

Table PP3-1: Traffic Design Criteria and Factors

Speeds	
Mainline	
Design Speed	60 mph
Posted Speed	60 mph
Ramps	
Design Speed	40 mph
Cross Street	
Design Speed	35 mph
Posted Speed	25 mph
Grades	
Meets Current Standards	
See InRoads Data in Appendix H	
Truck Percentages	
I-5 Mainline: Heavy vehicle percent (including class 4 and above) along I-5 for Existing condition (calculated based on 2013 counts)	
PM Peak Hour	
Northbound	8.42%
Southbound	7.43%
Daily	
Northbound	13.91%
Southbound	13.19%
Future heavy truck percentages are assumed to be proportional to traffic growth	
Intersections	Varies by intersection (See Appendix F)
Adjustment Factors	
Intersection PHF	Varies according to count data (See Appendix F)
K Factor (PM peak hour to daily)	Varies according to count data (See Figure PP3-2)

How Do the Proposed Access Modifications Improve Operations at Area Interchanges?

With the proposed interstate access modifications at the Berkeley Street and Thorne Lane Interchanges, overall traffic operations at these ramp terminal intersections and at adjacent interchanges would be improved with the Build Alternative.

2020 Interchange Analysis

Comparisons of 2020 traffic operations during the AM and PM peak hours for the No Build Alternative and the Build Alternative at the Berkeley Street and Thorne Lane Interchanges are shown in Table PP3-2. This information is also illustrated graphically in Figure PP3-3 for the AM and PM peak hours.
Discussion of expected traffic operations at the I-5 interchanges with Steilacoom-DuPont Road and Center Drive in the South Study Area is included in the project's Environmental Assessment.

Berkeley Street Interchange: In addition to providing a grade separation over the adjacent rail line, the proposed Build Alternative reconfiguration for the Berkeley Street interchange would improve traffic operations at this interchange. As discussed and illustrated in Policy Point 4, the new freeway interchange ramp termini would be built as

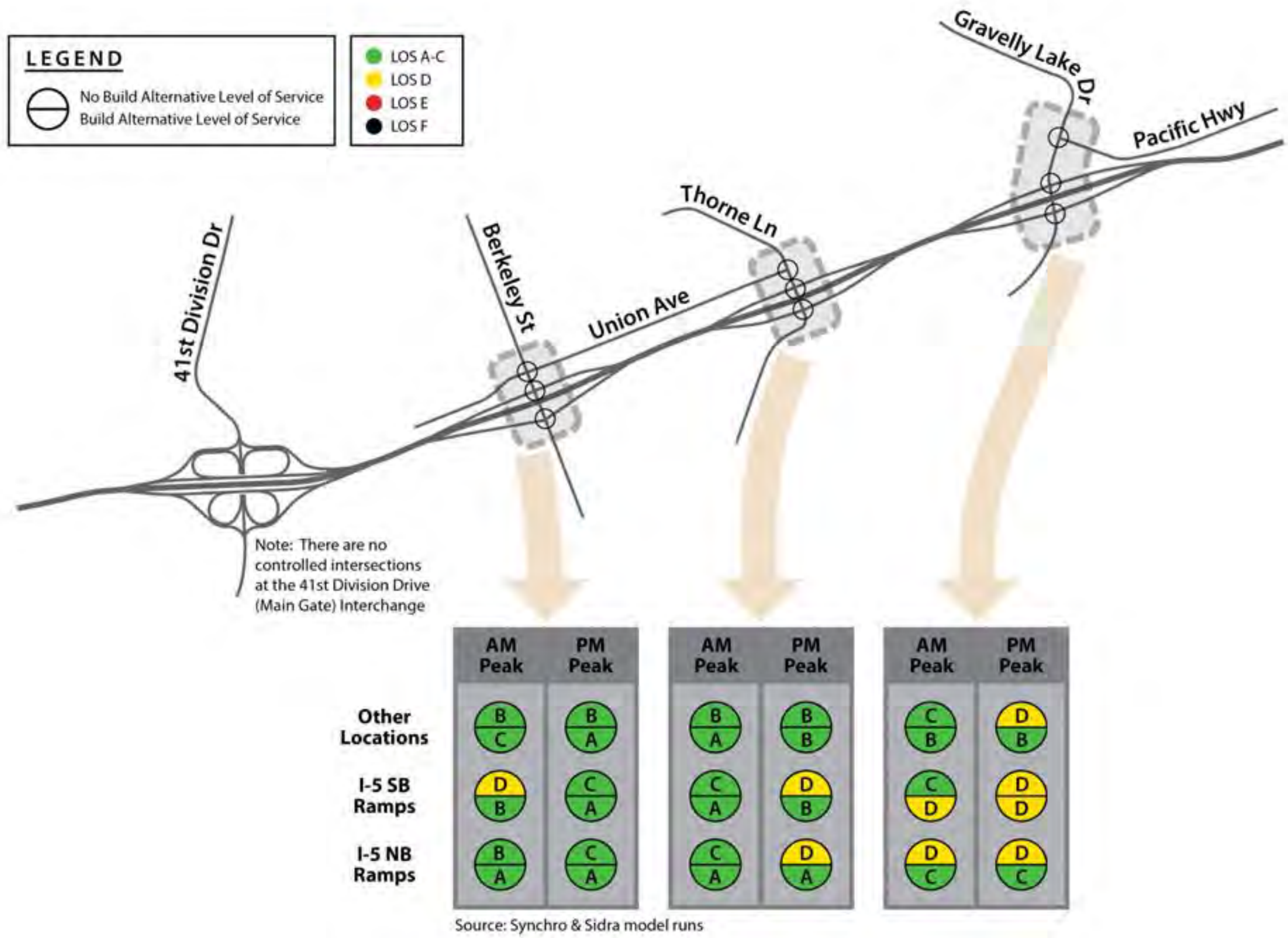
Table PP3-2: 2020 AM and PM Peak Hour Intersection Level of Service at the Reconfigured Interchanges -- No Build Alternative vs. Build Alternative

Intersection*	2020 No Build AM	2020 No Build PM	2020 Build AM	2020 Build PM
I-5 NB Ramps / Berkeley Street**				
Control Type	Signal		Roundabout	
Average Delay (sec) / LOS	16.3/B	20.8/C	4.4/A	5.2/A
I-5 SB Ramps / Berkeley Street**				
Control Type	Signal		Roundabout	
Average Delay (sec) / LOS	36.0/D	26.0/C	13.2/B	9.1/A
Berkeley Street / Union Avenue				
Control Type	Signal		2-way Stop	
Average Delay (sec) / LOS	11.0/B	12.0/B	15.2/C	9.0/A
Berkeley Street / Washington Avenue				
Control Type	2-way Stop		2-way Stop	
Average Delay (sec) / LOS	12.6/B	14.3/B	9.3/A	9.2/A
Berkeley Street / Jackson Avenue Extension				
Control Type	NA		All-way Stop	
Average Delay (sec) / LOS	NA	NA	13.9/B	23.8/C
I-5 NB Ramps / Thorne Lane				
Control Type	Signal		Roundabout	
Average Delay (sec) / LOS	34.2/C	37.9/D	5.5/A	7.1/A
I-5 SB Ramps / Thorne Lane				
Control Type	Signal		Roundabout	
Average Delay (sec) / LOS	33.9/C	47.5/D	8.8/A	14.6/B
Thorne Lane/Union Avenue Loop (New Intersection)				
Control Type	NA		Roundabout	
Average Delay (sec) / LOS	NA	NA	6.5/A	21.1/C
Thorne Lane / Union Avenue (with Southbound Gravelly-Thorne Connector with Build Alternative)				
Control Type	2-way Stop		2-way Stop	
Average Delay (sec) / LOS	10.4/B	11.6/B	9.6/A	11.2/B

Notes* Signalized & non-signalized intersections analyzed using Synchro software. Please note that the Synchro analysis does not account for back-ups on on-ramp from the ramp meter or freeway. Roundabout intersection analyzed using Sidra software.

** Madigan Access Improvements at the Berkeley Street interchange were completed and operational in July 2016.

Figure PP3-3. 2020 AM and PM Peak Hour Levels of Service for No Build and Build Alternatives



teardrop roundabouts. Overall, the levels of service at the Berkeley Street intersections are expected to be LOS C or better for the Build Alternative, and the roundabouts would operate at LOS B or better. For the No Build Alternative, the levels of service at the Berkeley Street intersections with the I-5 ramp would be LOS D or better with the interim Madigan Access improvements.

Thorne Lane Interchange: The proposed Build Alternative reconfiguration includes a grade separation over the adjacent rail line for the Thorne Lane interchange and teardrop roundabouts at the ramp termini intersections. This reconfiguration would improve traffic operations at the interchange. With the No Build Alternative the levels of service would generally be at LOS D or better. The reconfigured Build Alternative interchange with teardrop roundabouts is expected to operate at LOS B or better.

The study also looked at the Gravelly Lake Drive interchange and the Main Gate Interchanges. Expected 2020 intersection operations at the Gravelly Lake Drive Interchange are listed in Table PP3-3 and illustrated in Figure PP3-3.

Intersection Level of Service (LOS) Criteria

LOS	Signalized Intersection	Unsignalized Intersection
	Delay (sec)	Delay (sec)
A	≤10 sec	≤10 sec
B	10–20 sec	10–15 sec
C	20–35 sec	15–25 sec
D	35–55 sec	25–35 sec
E	55–80 sec	35–50 sec
F	≥80 sec	≥50 sec

Source: *2010 Highway Capacity Manual*

With the cloverleaf configuration of the Main Gate Interchange, a separate analysis was conducted at the ramp connections to 41st Division Drive. The results of this analysis are presented in Table PP3-4. Traffic operations analysis results at these adjacent interchanges are described in the paragraphs below.

Gravelly Lake Drive Interchange: During the 2020 AM and PM peak hours, the ramp intersections at Gravelly Lake Drive are expected to operate at LOS D or better for both the No Build and Build Alternatives. At the

Table PP3-3: 2020 AM and PM Peak Hour Intersection Level of Service at Other Area Interchanges – No Build Alternative vs. Build Alternative

	2020 No Build		2020 Build	
Intersection*	**AM**	**PM**	**AM**	**PM**
I-5 NB Ramps / Gravelly Lake Drive(Signal)				
Average Delay (sec) / LOS	46.5/D	46.1/D	24.0/C	35.0/C
I-5 SB Ramps / Gravelly Lake Drive(Signal)				
Average Delay (sec) / LOS	31.3/C	37.2/D	38.4/D	37.9/D
Gravelly Lake Drive / Pacific Highway(Signal)				
Average Delay (sec) / LOS	32.0/C	37.1/D	12.6/B	17.9/B

Notes: * Signalized & non-signalized intersections analyzed using Synchro software. Please note that the Synchro analysis does not account for back-ups on on-ramp from the ramp meter or freeway.

intersection of Gravelly Lake Drive and Pacific Highway, the PM peak hour LOS would be D or better for the No Build Alternative, but is expected to improve to LOS B with the Build Alternative.

Main Gate Interchange: A review of the 2020 traffic operations for the cloverleaf configuration of the Main Gate Interchange was conducted using output from the Meso Model. A diagram of the interchange is shown in Figure PP3-4. The results of the Meso Model are shown on Table PP3-4. The analysis indicates that for the No Build Alternative in the PM peak hour the northbound approach along 41st Division Drive would have long delays (nearly five minutes) at the northbound ramp connections, while there would be minimal delay on the other approaches. At the southbound ramp connections, delays would be less than 30 seconds on all approaches.

For the Build Alternative, traffic operations are expected to improve with delays of about 36 seconds or less for all approaches at the northbound ramp connections to 41st Division Drive. The southbound ramp connections would have delays of approximately 25 seconds for all approaches. With the improvements at the reconfigured interchanges, drivers have opportunities to take alternate routes with less delay, reducing the traffic volumes at 41st Division Drive. Overall, traffic operations at the Main Gate Intersection are expected to improve with the Build Alternative.

Figure PP3-4. Exit 120 - 41st Division Drive/Main Gate Diagram

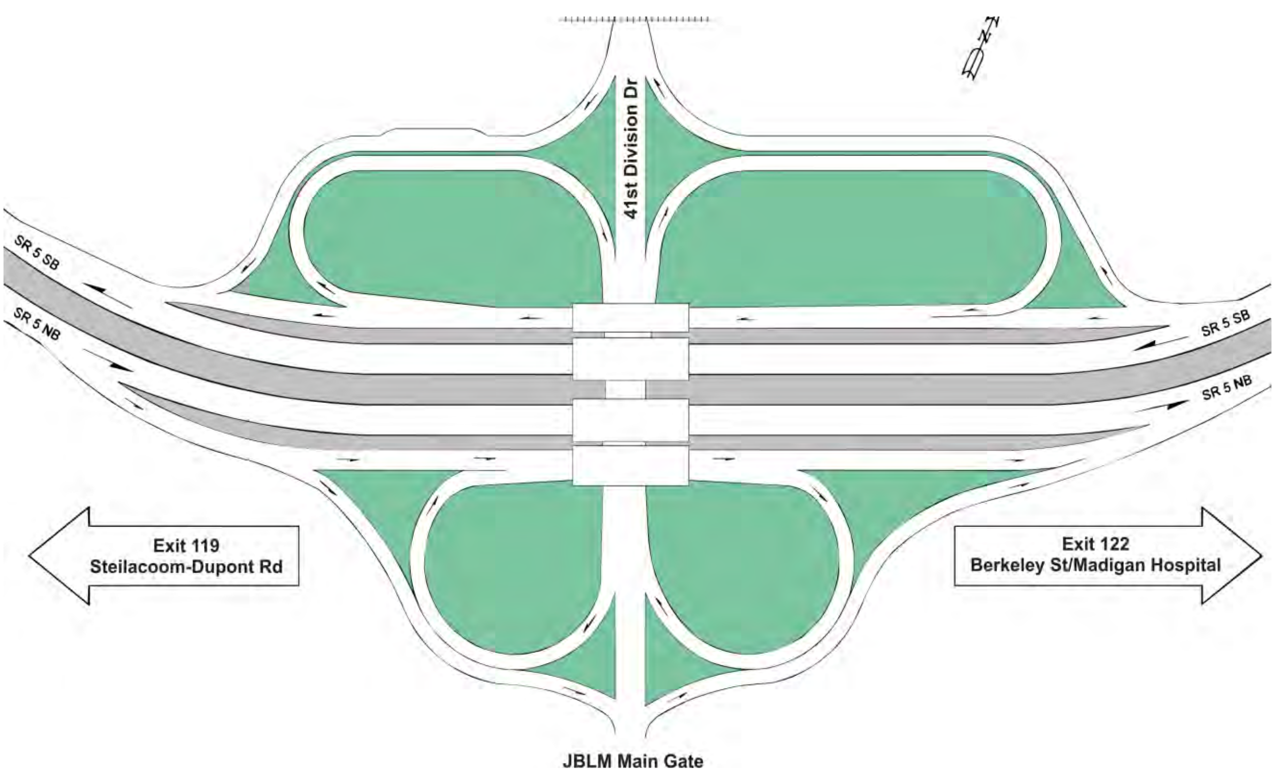


Table PP3-4: 2020 Delay Summary at Main Gate Interchange – No Build vs. Build Alternative

	2020 No Build		2020 Build	
Approach	Volume AM/PM	Delay (seconds per vehicle) AM/PM	Volume AM/PM	Delay (seconds per vehicle) AM/PM
NB I-5 Ramp / 41st Division Drive				
NB on 41st Division Drive	710/1,835	4.7/294	735/1,395	4.0/36.4
SB on 41st Division Drive	1,220/1,075	0.3/1.6	1,220/995	0.4/13.8
EB on I-5 NB Off-ramp	305/50	0.0/0.0	300/80	0.0/0.0
WB on I-5 NB Loop Off-ramp	75/25	0.0/0.0	65/40	0.0/0.0
SB I-5 Ramp / 41st Division Drive				
NB on 41st Division Drive	525/1,425	0.3/0.9	530/915	0.4/24.6
SB on 41st Division Drive	1,015/1,435	2.5/28.2	1,061/990	2.1/3.2
EB on I-5 NB Loop Off-ramp	390/50	0.8/0.7	345/125	0.7/0.3
WB on I-5 NB Off-ramp	120/50	0.5/0.0	135/165	0.5/9.9

Source: Meso Model

These comparisons show that traffic operations at the two modified interchanges would improve in 2020 with the Build Alternative and that the access modifications would not affect operations at adjacent interchanges.

A detailed summary of the intersection analyses for the No Build Alternative is included in Appendix C, while Appendix G presents analysis results for the Build Alternative.

2040 Interchange Analyses

Berkeley Street and Thorne Lane Interchanges: To see how the proposed interchange improvements affected 2040 intersection operations at the Berkeley Street and Thorne Lane Interchanges, a comparison of traffic operations during the 2040 AM and PM peak hours was conducted. The results of this comparison are summarized in Table PP3-5, and graphically illustrated in Figure PP3-5 for the AM and PM peak hours.

At these interchanges, the Build Alternative would provide grade separations over the adjacent rail line to eliminate delays caused by the added Amtrak passenger rail service. The proposed interchange improvements are also designed to enhance 2040 intersection operations at these interchanges. As discussed and illustrated in Policy Point 4, the new freeway interchange ramp termini would be built as roundabouts.

For the No Build Alternative, the 2040 levels of service are summarized below:

- At the Berkeley Street intersections with the I-5 ramp, the level of service would be LOS C or better for both the No Build Alternative during AM and PM peak hours.

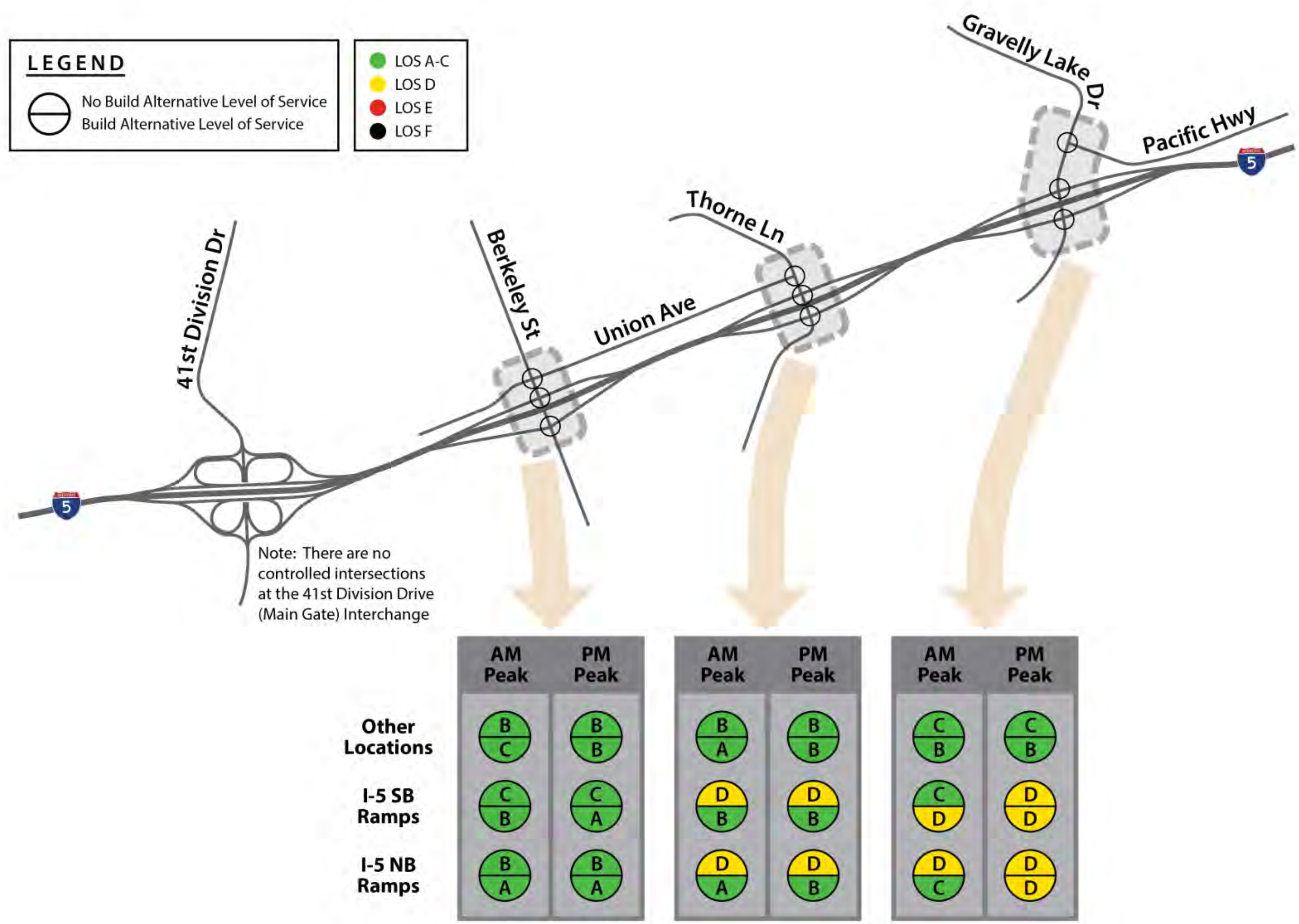
Table PP3-5: 2040 AM and PM Peak Hour Intersection Level of Service at the Reconfigured Interchanges – No Build Alternative vs. Build Alternative

Intersection*	2040 No Build AM	2040 No Build PM	2040 Build AM	2040 Build PM
I-5 NB Ramps / Berkeley Street**				
Control Type	Signal		Roundabout	
Average Delay (sec) / LOS	11.4/B	14.5/B	4.5/A	4.6/A
I-5 SB Ramps / Berkeley Street**				
Control Type	Signal		Roundabout	
Average Delay (sec) / LOS	32.4/C	23.8/C	16.7/B	8.7/A
Berkeley Street / Union Avenue**				
Control Type	Signal		2-Way Stop	
Average Delay (sec) / LOS	10.0/B	12.7/B	15.5/C	13.2/B
Berkeley Street / Washington Avenue				
Control Type	2-way Stop		All-way Stop	
Average Delay (sec) / LOS	14.2/B	12.2/B	9.6/A	9.2/A
Berkeley Street / Jackson Avenue Extension				
Control Type	NA		All-way Stop	
Average Delay (sec) / LOS	NA	NA	12.3/B	10.9/B
I-5 NB Ramps / Thorne Lane				
Control Type	Signal		Roundabout	
Average Delay (sec) / LOS	37.3/D	36.6/D	7.0/A	11.9/B
I-5 SB Ramps / Thorne Lane				
Control Type	Signal		Roundabout	
Average Delay (sec) / LOS	49.5/D	44.4/D	12.6/B	17.7/B
Thorne Lane/Union Avenue Loop (New Intersection)				
Control Type	NA		Roundabout	
Average Delay (sec) / LOS	NA	NA	6.9/A	9.1/A
Thorne Lane / Union Avenue (with Southbound Gravelly-Thorne Connector for the Build Alternative)				
Control Type	2-way Stop		2-way Stop	
Average Delay (sec) / LOS	11.2/B	12.8/B	9.6/A	12.0/B

Notes* Signalized & non-signalized intersections analyzed using Synchro software. Please note that the Synchro analysis does not account for back-ups on on-ramp from the ramp meter or freeway. Roundabout intersection analyzed using Sidra software.

** Madigan Access Improvements at the Berkeley Street interchange were completed and operational in July 2016..

Figure PP3-5. 2040 AM and PM Peak Hour Levels of Service for No Build and Build Alternatives



Source: Synchro model runs

- At the Thorne Lane intersection with I-5, the level of service would be LOS D or better for the No Build Alternative during AM and PM peak hours.

Overall, the levels of service at these intersections are expected to improve to LOS B or better with the Build Alternative.

This comparison shows that traffic operations at the two reconfigured interchanges would be improved with the Build Alternative.

Gravelly Lake Drive Interchange: Traffic operations at the adjacent interchange of Gravelly Lake Drive were also analyzed and the results summarized in Table PP3-6 and illustrated in Figure PP3-5. A detailed summary of intersection analysis for the No Build Alternative is included in Appendix C, while Appendix G presents analysis results for the Build Alternative.

During the 2040 AM and PM peak hours, the northbound and southbound ramp intersections for the No Build Alternative and the Build Alternative are expected to operate at LOS D or better. The intersection of Gravelly Lake Drive with Pacific Highway is expected to operate at LOS C during the AM and PM peak hours with the No Build Alternative. The Build Alternative includes the Gravelly-Thorne connector, which would add a roadway for southbound vehicles, and a northbound I-5 auxiliary lane between Gravelly Lake Drive and Thorne Lane to provide additional capacity for northbound trip. This adjacent intersection is expected to operate at LOS B during the AM and PM peak hours.

Table PP3-6: 2040 AM and PM Peak Hour Intersection Level of Service at the Other Area Interchanges – No Build Alternative vs. Build Alternative

	2040 No Build		2040 Build	
Intersection*	**AM**	**PM**	**AM**	**PM**
I-5 NB Ramps / Gravelly Lake Drive (Signal)				
Average Delay (sec) / LOS	35.4/D	49.6/D	26.1/C	50.2/D
I-5 SB Ramps / Gravelly Lake Drive(Signal)				
Average Delay (sec) / LOS	32.8/C	40.8/D	47.0/D	39.3/D
Gravelly Lake Drive / Pacific Highway(Signal)				
Average Delay (sec) / LOS	34.6/C	34.7/C	15.8/B	12.8/B

Notes: * Signalized & non-signalized intersections analyzed using Synchro software and Highway Capacity Manual
Please note that the Synchro analysis does not account for back-ups on on-ramp from the ramp meter or freeway.

Main Gate Interchange: A review of the 2040 traffic operations for the cloverleaf configuration of the Main Gate Interchange was conducted using output from the Meso Model, as shown on Table PP3-7. For the No Build Alternative during the AM peak hour, little delay is expected at the ramp intersections with 41st Division Drive. However, the PM peak hour analysis shows that there would be long delays (more than five minutes) at the northbound approach with the northbound ramp connections at 41st Division Drive for the No Build Alternative.

At the southbound ramp connections with 41st Division Drive, the southbound approach would have delays of around one minute and little delay on the other approaches

For the Build Alternative, delays at the northbound ramp intersection would be less than six seconds during the AM peak hour. During the PM peak hour, the northbound approach would have delays of about one and a half minutes, while the southbound approach would have delays of about 3.3 minutes and little or no delay at the other approaches. At the southbound ramp connections with 41st Division Drive, the Build Alternative is expected to have delays of about 9.5 minutes on the southbound approach and about 33 seconds on the eastbound approach.

These longer delays at the southbound ramp connections with 41st Division Drive would not be caused by the interchange modifications at the Build Alternative interchanges, but are more a result of the increased volume of traffic that could be accommodated by the new I-5 travel lanes. This increase in volume relative to the No Build condition would increase delays and reduce speeds on the freeway in the southbound direction. This delay in turn would reduce the ability of traffic from 41st Division Drive to access I-5, and would reduce the overall level of service of the Main Gate Interchange.

Table PP3-7: 2040 Delay Summary at Main Gate Interchange – No Build vs. Build Alternative

	2040 No Build		2040 Build	
Approach	Volume AM/PM	Delay (seconds per vehicle) AM/PM	Volume AM/PM	Delay (seconds per vehicle) AM/PM
NB I-5 Ramp / 41st Division Drive				
NB on 41st Division Drive	820/1,710	4.3/330	595/1,415	5.5/95.7
SB on 41st Division Drive	1,070/1,075	0.3/12.1	1,095/1,090	0.4/200
EB on I-5 NB Off-ramp	355/45	0.0/0.0	360/100	0.0/0.0
WB on I-5 NB Loop Off-ramp	135/50	0.1/0.1	100/160	0.0/14.0
SB I-5 Ramp / 41st Division Drive				
NB on 41st Division Drive	650/1,320	5.4/0.4	610/1,140	4.3/0.8
SB on 41st Division Drive	985/1,350	2.0/61.7	1,075/1,090	2.4/570
EB on I-5 NB Loop Off-ramp	290/180	0.4/0.3	330/120	0.6/32.6
WB on I-5 NB Off-ramp	75/100	5.4/0.5	75/50	3.8/0.0

Source: Meso Model

What Are the Impacts of the Access Modifications on I-5?

The following sections will provide context and analysis of how the reconfiguration of the Berkeley Street and the Thorne Lane interchanges would affect I-5 mainline performance and would identify if specific impacts could be attributed to Build Alternative improvements at the interchanges.

Because of corridor constraints such as the close proximity of entrance and exit points along I-5, slow travel speeds, frequent lane changes and generally over-saturated traffic flow conditions, the *Highway Capacity Manual* (HCM) level of service (LOS) method using vehicle density does not depict the actual congestion issues along the I-5 mainline, at merge and diverge locations, or through weaving areas. As a result, the method used to analyze mainline traffic along I-5 focused used the methodology in WSDOT's *2007-2016 Highway System Plan* that defines the relationship between LOS and the percent of posted speed. Based on this method, speeds below 70 percent of posted speed are identified as LOS F. For I-5, which is posted at 60 mph, LOS F would be defined as speeds below 42 mph.

For this IJR, alternative performance measures that are derived from the Meso Model were used to assess the impact of the reconfigured interchanges on traffic operations along the I-5 corridor between Center Drive and Gravelly Lake Drive. Highway performance for the No Build and Build Alternatives is expressed in terms of:

- The ability to accommodate travel demand during the peak hour
- Peak hour travel speeds
- Hours of congestion
- Travel times

These performance measures are described in the Methods and Assumptions Document (See Appendix A). A summary of these performance measures for the proposed Build Alternative in comparison to the No Build Alternative is discussed below.

Ability to Meet Travel Demand

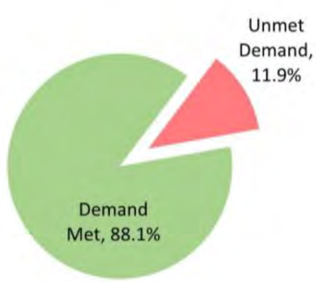
Figure PP3-6 depicts the ability of the proposed Build Alternative to meet the expected PM peak hour travel demand along the I-5 corridor in comparison to 2013 conditions, and the 2020 and 2040 No Build Alternative.

The PM peak hour was chosen for this analysis as it represents the highest traffic volume and most heavily congested travel period. As shown, the Build Alternative is expected to accommodate more of the PM peak hour travel demand on I-5 than the No Build Alternative. In 2020, the Build Alternative could accommodate slightly more demand than the 2013 existing system and about 26 percent (89.2% vs. 70.5%) more than the 2020 No Build Alternative.

In 2040 during the PM peak hour, the Build Alternative is expected to accommodate nearly 60 percent more demand (48.7% to 30.5%) than the No Build Alternative. In other words, as compared to the No Build Alternative, the Build Alternative would keep more of the traffic demand on I-5 during the PM peak hour and would reduce the amount of demand that must shift to other times of the day.

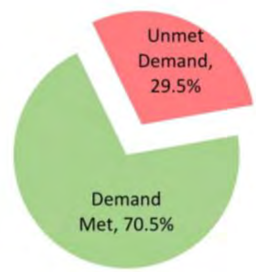
Figure PP3-6: Comparison of PM Peak Hour Demand Met on I-5 in the Vicinity of JBLM for 2013 Existing, and Future Year No Build Alternative and Build Alternative

Travel Demand along I-5 Met in 2013 during PM Peak Hour

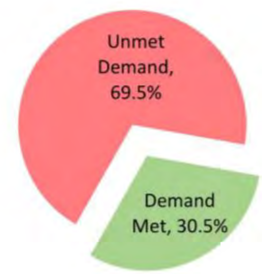


Source: Meso Model output

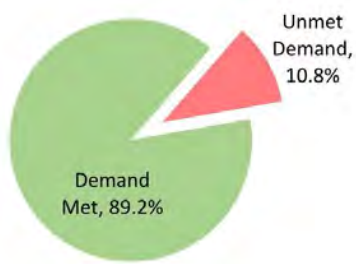
2020 No Build Demand Met on I-5 during PM Peak Hour



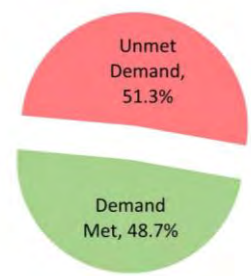
2040 No Build Demand Met on I-5 during PM Peak Hour



2020 Build Demand Met on I-5 during PM Peak Hour



2040 Build Demand Met on I-5 during PM Peak Hour



2020 Estimated Travel Speeds

Another key metric to understand is the peak hour travel speed along the corridor and if vehicle speeds are impacted by the interchange modifications.

No Build Alternative: During the AM peak hour in 2020, travel speeds would generally be above the LOS F threshold of 42 mph for the No Build Alternative. Exceptions would occur near the project termini where southbound speeds would be around 30 mph between Gravelly Lake Drive and Thorne Lane as the highway narrows from four lanes to three lanes. Northbound speeds would be above 42 mph for between Main Gate and Gravelly Lake Drive Interchanges.

Freeway Level of Service (LOS) based on Posted Speeds

Level of Service	Relationship to Posted Speed
A	Not defined but would be above posted speed (60+ mph)
B	Above posted speed (60 + mph)
C	Posted speed (60 mph)
D	Above 85% of posted speed to posted speed (52 mph to 60 mph)
E	70% to 85% of posted speed (42 mph to 51 mph)
F	Below 70% of posted speed (Below 42 mph)

Source: WSDOT's *2007-2016 Highway System Plan*

As can be observed from Figure PP3-7, 2020 No Build Alternative average northbound travel speeds along I-5 for all lanes in the PM peak hour would generally be above 42 mph north of Thorne Lane where the travel lanes increase from three lanes to four lanes. No Build Alternative southbound speeds would be below 42 mph between Gravelly Lake Drive and Main Gate Interchanges.

Build Alternative: With the Build Alternative, 2020 AM travel speeds would be above 50 mph between Main Gate and Gravelly Lake Drive Interchanges. During the PM peak hour, northbound average speeds would be above 42 mph from Main Gate to Berkeley Street. North of Berkeley Street, speeds would begin to fall below 42 mph as more traffic is expected to enter I-5 from the Berkeley Street and Thorne Lane Interchanges. This increased demand would begin to reach the practical capacity of I-5.

In the southbound direction, 2020 Build Alternative speeds would be mostly above 42 mph from the Gravelly Lake Drive Interchange to the Berkeley Street Interchange. South of the Berkeley Street Interchange, travel speeds would fall below 42 mph because of the high on-ramp volumes from Berkeley Street and Main Gate, and the effect of the reduction in travel lanes from four to three at the Center Drive Interchange. This high level of vehicle merging activity is expected to slow traffic in all lanes along I-5 and back up traffic to the Berkeley Street Interchange.

Between Gravelly Lake Drive and Main Gate Interchanges, southbound Build Alternative average speeds (37 mph) would be better than the No Build Alternative average speeds (8 mph). No Build speeds would be affected by the lane reduction at Thorne Lane. Northbound travel speeds with the Build Alternative (34 mph) are expected to be about the same No Build Alternative (35 mph). Northbound No Build speeds would be slightly higher because of the added lane at Thorne Lane, and the lower traffic volumes that can get through the three lane section south of Thorne Lane.

2020 Estimated Hours of Congestion

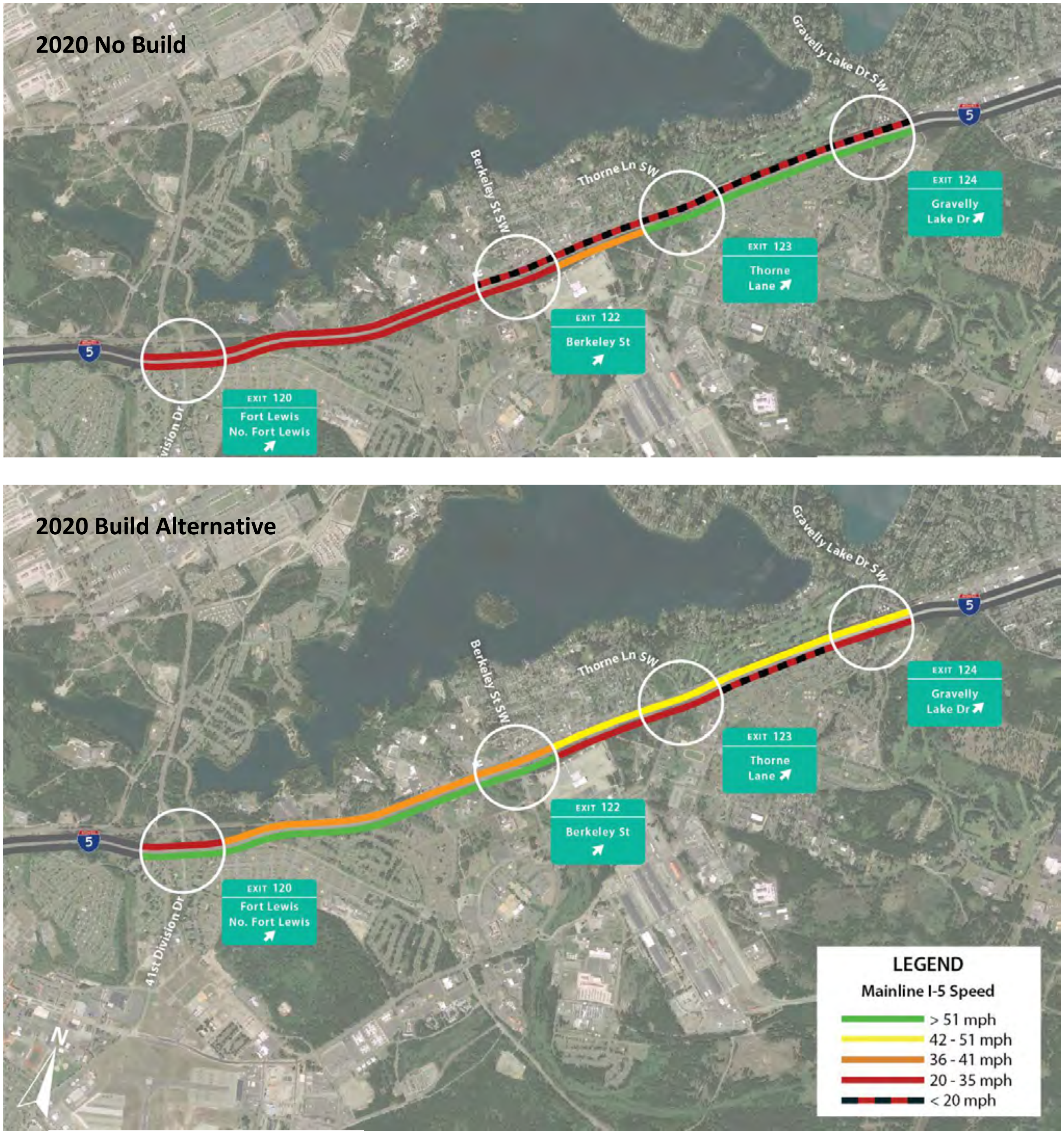
For this analysis the hours of congestion were estimated based on the duration for which average traffic speeds were below 42 mph of LOS F. This performance measure was calculated using data from the Meso Model. Figure PP3-8 shows how average traffic speeds would change along the I-5 corridor during the six-hour PM peak analysis period.

No Build Alternative: As can be observed from the congestion contour in Figure PP 3-8, southbound speeds for the No Build Alternative would be below 40 mph north of the 41st Division Road and most concentrated from 3:30 PM to 7:30 PM through the Gravelly Lake Drive Interchange. There would be some additional slow travel speeds north of Mounts Road which are expected to result from merging traffic between Center Drive and Steilacoom-DuPont Road.

In the northbound direction, slowing traffic is expected to begin just north of the Nisqually Bridge and extend to the Thorne Lane Interchange between 3:00 PM to about 7:30 PM with the No Build Alternative.

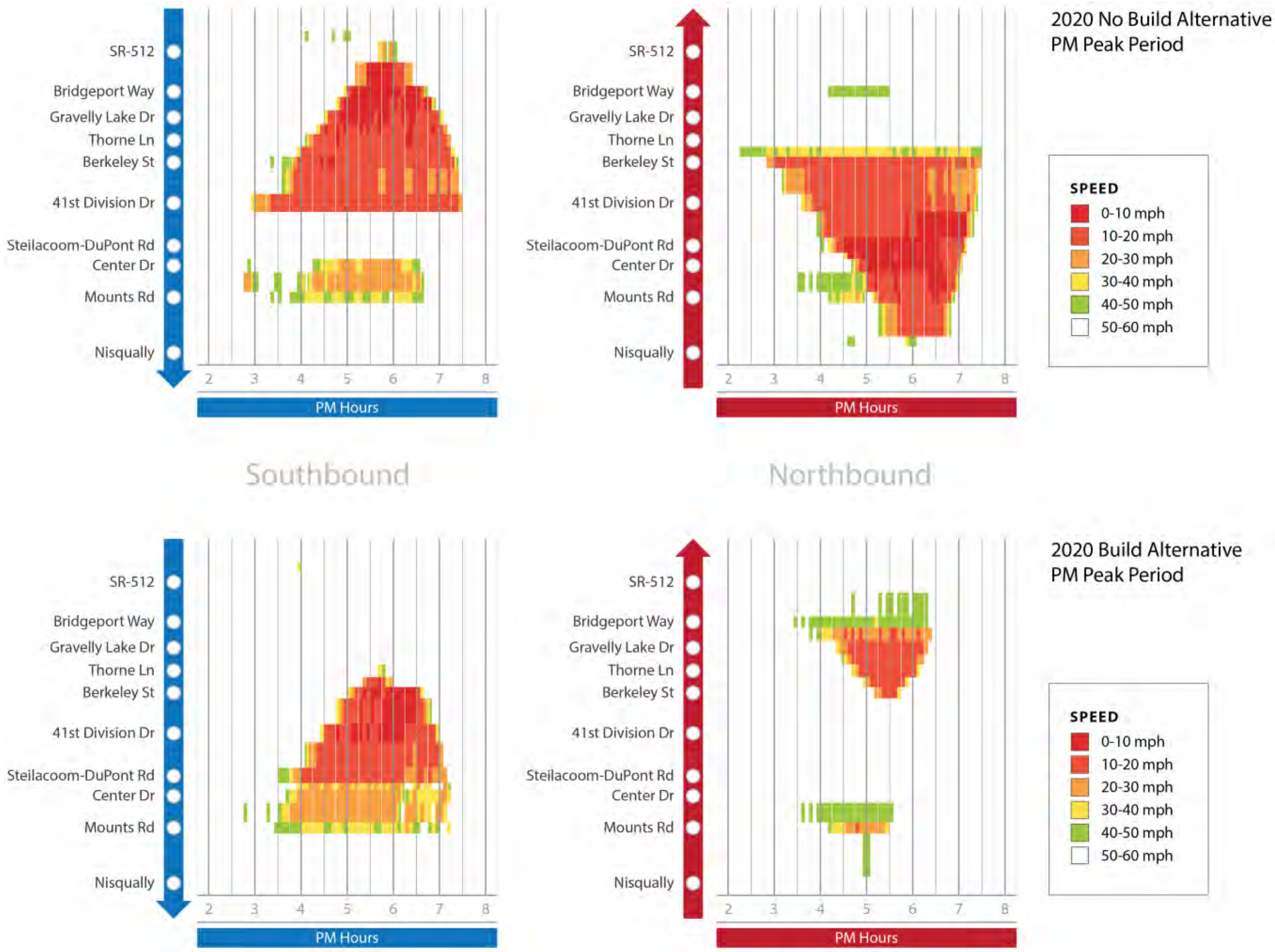
Build Alternative: For the Build Alternative during the PM peak period, low southbound speeds would extend south of Thorne Lane to

Figure PP3-7: Comparison of 2020 PM Peak Hour Travel Speeds along I-5 between Main Gate and Gravelly Lake Drive – No Build Alternative and Build Alternative



Source: Meso Model output

Figure PP3-8: 2020 PM Peak Hour Travel Speeds along I-5 by Time of Day and Location for the No Build Alternative and the Build Alternative



Source: Meso Model output

Mounts Road and extend from around 3:30 PM to around 7:00 PM. This congestion would be caused by the reduction in travel lanes from four to three at the Center Drive Interchange and the high on-ramp volumes from Main Gate, Steilacoom-DuPont Road and Center Drive Interchanges that would merge onto I-5 with other traffic heading into Thurston County.

In the northbound direction, heavy traffic congestion would occur from north of Berkeley Street to south of Bridgeport Way for about two hours because of increased traffic volumes.

As can be observed from Figure PP3-8, the overall extent of congestion along I-5 through the JBLM area would be less for the Build Alternative with the added travel lanes than the No Build Alternative and improved Berkeley Street and Thorne Lane Interchanges.

2020 Estimated Travel Times

Comparisons of 2020 peak hour travel times along I-5 between Gravelly Lake Drive and 41st Division Drive (also referred to as Main Gate) were made using output from the Meso Model for the No Build and Build Alternatives.

Traveling along I-5 between Gravelly Lake Drive and Main Gate at the posted speed limit would normally take about 4.3 minutes to cover the 4.3 miles between the two interchanges. During the AM 2020 peak hour, drivers traveling in either direction on I-5 between these interchanges would experience about the same travel times (about 4.0 to 4.5 minutes for the No Build Alternative, and about 4.1 to 5.3 minutes with the Build Alternative). Traffic during this time would generally operate near the posted speed limit.

During the 2020 PM peak hour, as shown on Figure PP3-9, overall northbound travel times along I-5 from Main Gate to Gravelly Lake Drive for the Build Alternative would be about the same as the 2020 No Build Alternative (7.2 minutes vs. 7.4 minutes). At an interim point like the Berkeley Street interchange, northbound travel time savings would be approximately three minutes less with the Build Alternative.

During the 2020 PM peak period, overall southbound travel along I-5 between Gravelly Lake Drive and Main Gate with the Build Alternative would be about 24 minutes shorter than the No Build Alternative (6.8 minutes vs. 30.8 minutes).

How Would the Proposed Build Alternative Affect the Connections with Local Roads and Intersections?

The redesign and offset of interchanges at Thorne Lane and Berkeley Street would affect local travel patterns and change how drivers access I-5 from the local street system. Traffic on local roads would also be affected by the amount of congestion on I-5. As either northbound or southbound congestion increases on I-5 more traffic is expected to shift to the local roads.

The reconfigured interchanges would include grade-separated crossings over the railroad tracks. This can improve roadway network operations by eliminating the delays caused by train blockages that occur with the existing configuration.

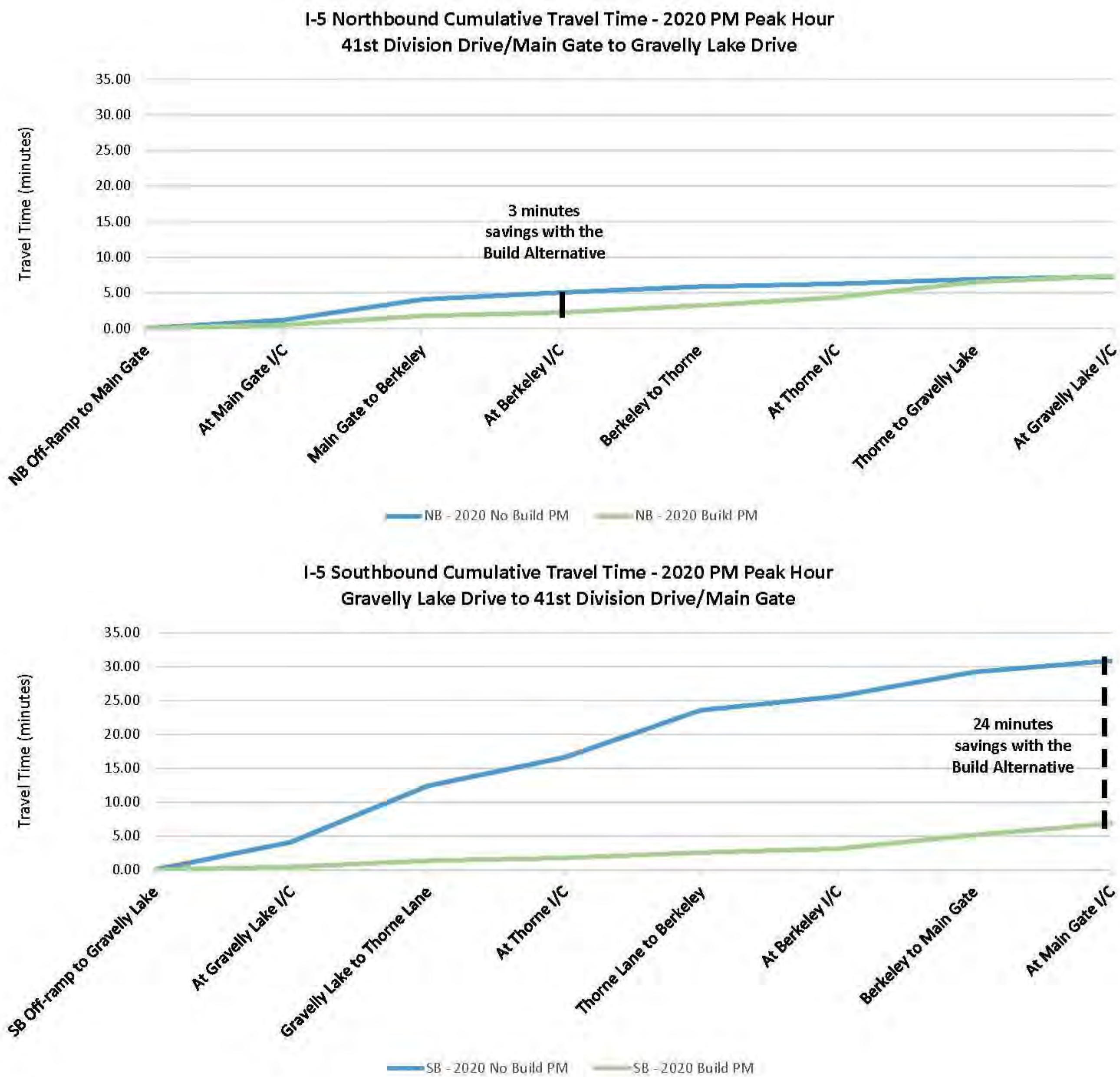
Traffic changes at the two Build Alternative interchanges are discussed below.

Thorne Lane

At Thorne Lane, the existing bridge over I-5 is proposed to be removed and replaced with a new bridge about 350 feet south. This new interchange would grade-separate Thorne Lane over I-5, the adjacent rail line and Union Avenue, as previously shown in Figure PP2-14. The new bridge would change portions of Thorne Lane and Murray Road as they connect to the existing street system. In addition, a new loop connector road would be added to tie Union Avenue to Thorne Lane. The proposed southbound Gravelly-Thorne Connector and new northbound auxiliary lane between Thorne Lane and Gravelly Lake Drive would also affect traffic movements to and from the Tillicum and Woodbrook neighborhoods. The new interchange is proposed to have roundabouts at the I-5 ramp intersections instead of traffic signals.

These interchange revisions together with the Gravelly -Thorne Connector and the northbound Thorne Lane to Gravelly Lake Drive auxiliary lane would likely affect local travel patterns in the vicinity of the Thorne Lane interchange. Because of the Gravelly-Thorne Connector, some trips would be diverted from

Figure PP3-9: 2020 Cumulative PM Peak Hour Travel Times along I-5 between Main Gate and Gravelly Lake Drive – No Build Alternative and Build Alternative



I-5 and use the new roadway which would be connected to Union Avenue near Thorne Lane.

Changes in two-way traffic volumes on local roads near the Thorne Lane interchange are shown in Table PP3-8 for the No Build and Build Alternatives. With the No Build Alternative, two-way traffic along Union Avenue near Thorne Lane in 2020 and 2040 is expected to be less than 400 vehicles during the AM peak hour and less than 525 vehicles during the PM peak hour. With the Build

Alternative, AM peak hour two-way volume on Union Avenue is expected to be less than 205 vehicles in 2020 and 2040, and the PM peak hour volume would be less than 300 vehicles in 2020, but reduced to about 185 vehicles by 2040. In general, traffic volumes on Union Avenue are expected to be lower with the Build Alternative as a result of the added capacity on I-5 and the improved interchanges.

On Thorne Lane west of Union Avenue, traffic volumes are expected to increase with the Build Alternative by 200 to 610 vehicles in 2020, and by 275 to 455 vehicles in 2040 during the AM and PM peak hours, respectively. On the bridge over I-5, 2020 Build Alternative traffic on Thorne Lane would increase by about 105 to 540 vehicle trips in comparison to the No Build Alternative, but by only between 240 to 445 vehicles in 2040.

In the 2020 PM peak hour on Thorne Lane west of Union Avenue, eastbound trips toward I-5 would increase by 570 (from 290 to 860) from the No Build to Build Alternatives. During the PM peak hour, westbound trips would increase by 40 (from 280 to 320). Union Avenue trips would decrease from 525 to 290 in the 2020 PM peak hour, and decrease from 385 to 210 in the 2040 PM peak hour.

The improved northbound operation of the I-5 mainline north of Thorne Lane, along with the improved operation of the reconfigured interchange would most likely attract more local trips along Thorne Lane than may otherwise have used Union Avenue.

Based on the predicted level of traffic, the current and newly constructed roadways serving the Thorne Lane Interchange are expected to have adequate carrying capacity and would not be adversely impacted by these slight changes in traffic volumes.

Berkeley Street

At Berkeley Street, the existing bridge over I-5 is proposed to be removed and replaced with the new bridge centerline about 120 feet south of the existing bridge centerline. The new interchange would have roundabouts at the I-5 ramp intersections. The new bridge would extend Jackson Avenue over I-5, the adjacent rail line and Militia Drive. The Jackson Avenue extension would tie into Berkeley Street near Washington Avenue, as previously shown in Figure PP2-13.

Table PP3-8. 2020 and 2040 AM and PM Peak Hour Two-way Volume on Local Streets near the Thorne Lane Interchange – No Build Alternative vs. Build Alternative

	Baseline		No Build Alternative				Build Alternative			
Location	**2013 AM**	**2013 PM**	**2020 AM**	**2020 PM**	**2040 AM**	**2040 PM**	**2020 AM**	**2020 PM**	**2040 AM**	**2040 PM**
Union Avenue south of Thorne Lane	645	350	355	525	390	385	265	290	180	210
Thorne Lane west of Union Avenue or Union Avenue Loop Connector	30	375	375	570	440	455	575	1,180	715	910
Thorne Lane over I-5	1,000	940	1,020	1,105	1,165	1,095	1,125	1,645	1,405	1,540

The section of Berkeley Street east of Union Avenue, including the railroad at-grade crossing and the existing bridge over I-5 would be removed. A new residential street would be added and connected to Grant Avenue to provide access for properties along the section of Washington Avenue south of the existing apartment complexes.

Changes in two-way traffic volumes on local roads near the Berkeley Street interchange are shown in Table PP3-9 for the No Build and Build Alternatives. Two-way traffic along Berkeley Street west of Washington Avenue in 2020 and 2040 is expected to be less than 525 vehicles during the AM and PM peak hours for either the No Build or the Build Alternatives.

For the portion of Berkeley Street between Union Avenue and Washington Avenue, traffic is generally expected to be reduced with the Build Alternative, as traffic to and from Camp Murray would use the new interchange and the new extension to Jackson Avenue, and connect to Berkeley Street north of Washington Avenue. However, because of increased congestion along southbound I-5 during the 2040 PM peak hour, some I-5 southbound drivers would likely exit at Thorne Lane, and use Union Avenue and Berkeley Street to reach their destination. Traffic along Union Avenue is expected to be about the same under the No Build Alternative during the 2020 and 2040, with a difference of less than 140 vehicles.

Traffic volumes crossing I-5 are expected to generally increase with the capacity added by the Build Alternative. An exception would be during the PM peak hour in 2040, when a decrease of about 100 vehicle trips is expected. Based on the operations analyses of the intersections along these local roads with the Build Alternative, traffic is expected to operate at LOS C or better during both the AM and PM peak hours in 2020 and 2040.

Traffic volumes crossing I-5 on the new bridge are expected to generally increase with the added capacity, except during the PM peak hour in 2020, which would see a slight decrease. Based on the Build Alternative analyses of the intersections along these local

Table PP3-9. 2020 and 2040 AM and PM Peak Hour Two-way Volume on Local Streets near the Berkeley Street Interchange – No Build Alternative vs. Build Alternative

	No Build Alternative				Build Alternative			
	2020		2040		2020		2040	
Location	AM	PM	AM	PM	AM	PM	AM	PM
Berkeley Street west of Washington Avenue	415	510	525	450	415	365	445	380
Berkeley Street between Union Avenue and Washington Avenue	460	545	575	515	375	300	385	250
Berkeley Street Bridge over I-5	1,475	1,190	1,370	1,280	1,590	1,570	1,675	1,255
Washington Avenue north of Berkeley Street	55	75	70	85	50	75	70	140
Union Avenue north of Berkeley Street	380	365	395	500	365	295	375	300

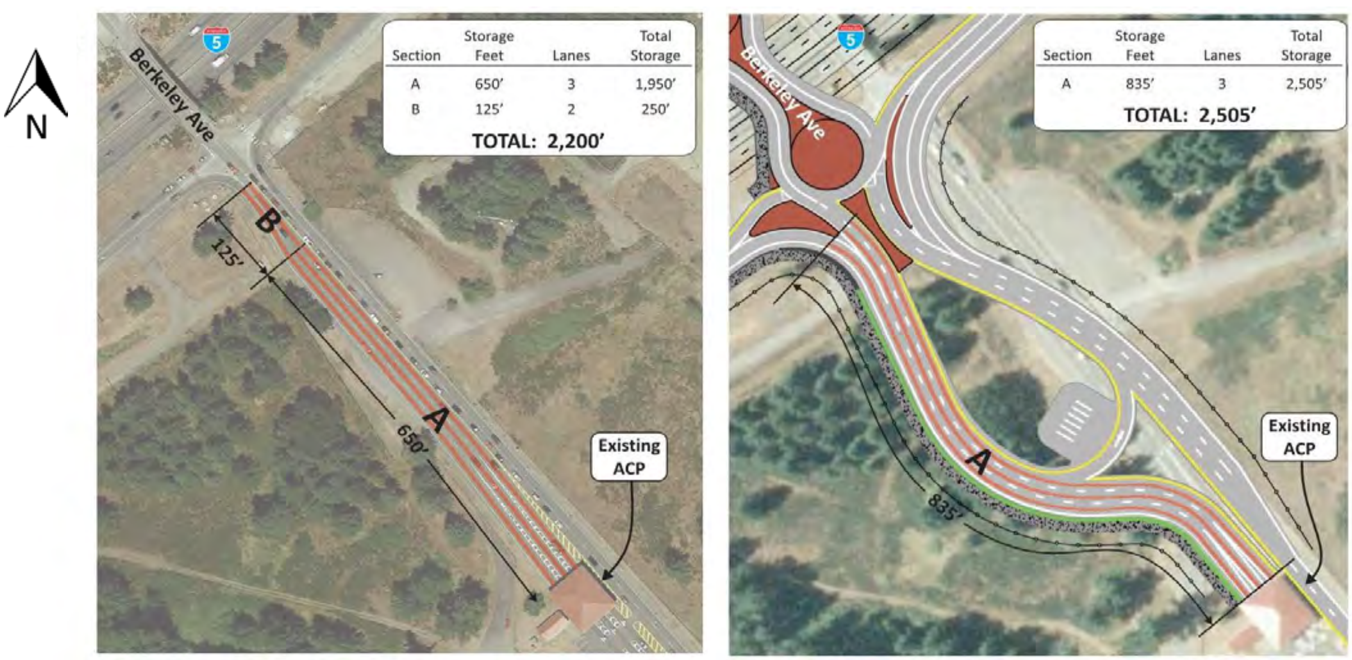
roads, traffic is expected to operate at LOS C or better during both the AM and PM peak hours in 2020 and 2040.

The change in travel patterns would be isolated to a small area of the Tillicum neighborhood and the subsequent change would not impact or create any adverse conditions on the local roadways. The revised intersection at Berkeley Street/Washington Avenue can be designed to discourage cut-through traffic on Washington Avenue. Possible mitigations can include right-in/right-out operations at the intersection and traffic calming features on Washington Avenue north of Berkeley. The final intersection layout would be designed to discourage both commuter and commercial traffic from using Washington Avenue as a cut-through route to reach destinations beyond the nearby neighborhoods.

The Madigan Gate Access Control Point (ACP) is located just east of I-5 and is accessed from the Berkeley Street Interchange via Jackson Avenue. Currently the Madigan ACP experiences approximately 1,600 entering vehicles during the AM peak hour and provides three entry lanes. The total available vehicle storage space between the ACP and the interchange is approximately 2,200 feet, as illustrated on Figure PP3-10.

The proposed reconstruction of the Berkeley Street Interchange would alter the roadway segment accessing the Madigan ACP. With conversion of the ramp intersections to roundabouts and re-aligning Jackson Avenue as a chicane to slow inbound traffic, the distance between the interchange intersections and the Madigan ACP would increase. With this re-aligned roadway the proposed interchange design would increase the total available vehicle storage to approximately 2,500 feet.

Figure PP3-10: Existing and Proposed Storage Space at the Madigan Access Control Point



Existing Queue Storage for Madigan Gate ACP | Projected Queue Storage for Madigan Gate ACP

The 2020 AM peak hour traffic volume is expected to increase only slightly to 1,660 entering vehicles. This increase should easily be accommodated by the additional 300 feet of vehicle storage provided by the proposed interchange design.

Gravelly Lake Drive to Thorne Lane Connector

A new southbound connector road, referred to as the Gravelly-Thorne Connector, is proposed to be constructed to provide a local road connection between Lakewood and the Tillicum and Woodbrook neighborhoods.

Traffic along this new southbound connector road is expected to be about 25 vehicles (in 2020 AM peak hour) and 75 vehicles (in 2020 PM peak hour). In 2040, traffic along this new southbound connector road is expected to be about 40 vehicles in the AM peak hour and 240 vehicles in the PM peak hour.

Southbound drivers have the option to use this new connector instead of I-5 or other roads within the secure military installations to travel from Lakewood to the Tillicum and Woodbrook neighborhoods, Camp Murray and JBLM. These diversions are an intended benefit of the Build Alternative. Northbound travel to Lakewood from the Tillicum and Woodbrook neighborhoods can use the new northbound auxiliary lane on I-5.

How Would the Project Affect Bicycle and Pedestrian Traffic?

The redesigned interchanges at Berkeley Street and Thorne Lane would have bicycle lanes with sidewalks or shared-use areas to improve non-motorized access over I-5 and the adjacent rail line to connect Lakewood areas with JBLM. The improved connections would allow persons stationed or working at JBLM, but living in the adjacent communities, to have the opportunity to walk or bicycle to their duty station or work activities.

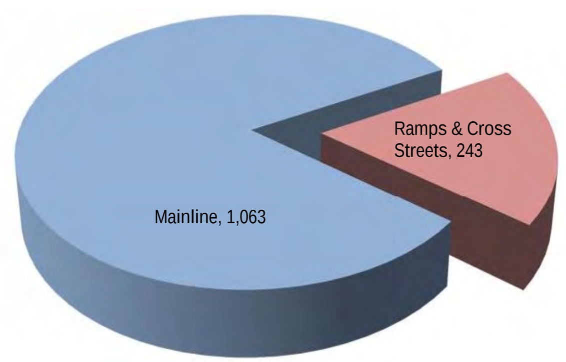
The shared use path along the re-configured Berkeley Street Interchange would also be connected to the non-motorized path along I-5 as proposed in the Build Alternative from Steilacoom-DuPont Road to Berkeley Street.

The bicycle and pedestrian facilities on the re-configured Thorne Lane Interchanges would be connected to the shared use path along the Gravelly-Thorne Connector.

In addition, the connector roadway between Gravelly Lake Drive and Thorne Lane would have a two-way separated pedestrian and bicycle facility on the west side of the roadway.

All of these pieces help to form a contiguous non-motorized network infrastructure that

Figure PP3-11: Number of Collisions along I-5 Main Gate to Gravelly Lake Drive – 2010 to 2014



"Under Section 409 of Title 23 of the United States Code, any collision data furnished is prohibited from use in any litigation against state, tribe or local government that involves the location(s) mentioned in the collision data."

provides opportunities for people to choose to complete their trips though other travel modes than by motor vehicles.

What Is the Existing Collision History along I-5 in the Vicinity of JBLM?

Using data from January 2010 through December 2014, a five-year collision analysis was conducted along the I-5 mainline from milepost (MP) 120.52 (south of the Main Gate Interchange) to MP 124.87 (north of the Gravelly Lake Drive Interchange). This analysis addressed mainline, ramp and cross street collisions within the limited access area. It included a review of existing collision rates, location, severity, type, and contributing factors.

During this five-year period there were 1,306 reported collisions along the I-5 corridor, an average of 261 collisions per year. Approximately 81 percent occurred on the I-5 mainline, with 19 percent occurring at the four interchanges between Main Gate and Gravelly Lake Drive, and on the limited-access segments of the cross streets, as indicated by Figure PP3-11.

Collision distribution on the I-5 mainline is higher near the interchanges, as shown in Figure PP3-12. This higher frequency of collisions is expected because there is more weaving, merging, slowing and accelerating in the vicinity of interchanges as drivers maneuver to and from exits and entrances. Particularly note-worth is the relatively high collision experience on I-5 southbound approaching Thorne Lane where travel lanes drop from four to three.

A summary of the annual collision rates by severity along the I-5 is shown in Table PP3-10. These numbers include reported collisions along the I-5 mainline, ramps and all cross-streets from Main Gate Interchange to the Gravelly Lake Drive Interchange within the limited access area.

Table PP3-10: I-5 Collision Rates by Severity from Main Gate to Gravelly Lake Drive

Severity of Collisions Mainline, Ramps and Cross Streets	2010 to 2014 Collisions	Average Annual Collisions	Collision Rate per 100 MVMT *
Fatal	2	0.4	0.18
Serious Injuries	11	2.2	1.01
Evident Injuries	158	11.6	5.33
Possible Injuries	290	58.0	26.66
Property Damage Only	945	189.0	86.89
All Collisions	1,306	261	120.08

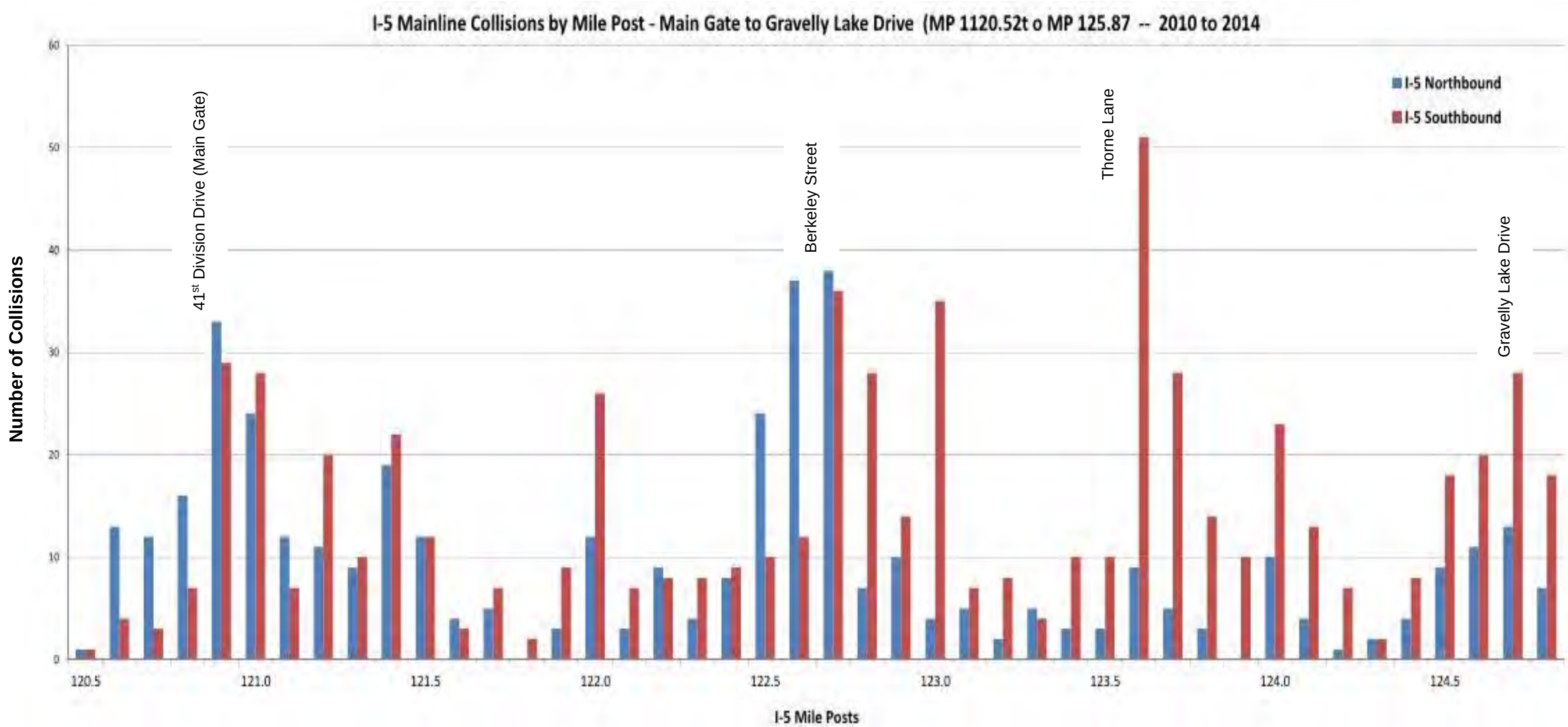
*100 MVMT = 100 Million Vehicle Miles Traveled

Based on available data, the average collision rates on I-5 through the JBLM area are below the average Pierce County collision rate for all highways (177.5 collisions per 100 MVMT), as documented in WSDOT's *2013 Annual Collision Summary*.

Fatal and serious injury collision rates are also below the county wide averages of 0.62 fatalities per 100 MVMT and 3.36 serious injuries per 100 MVMT.

WSDOT regularly conducts safety assessments for all state highways in Washington State. Based on WSDOT's 2015 safety assessment and using 2009-2013 data, WSDOT identified one Collision Analysis Segment (CAS) located on I-5 within the IJR study area. This location is between the Clover Creek bridge north of Gravelly Lake Drive (MP 125.64) and the

Figure PP3-12: I-5 Mainline Collision Distribution by Milepost – 2010 to 2014



"Under Section 409 of Title 23 of the United States Code, any collision data furnished is prohibited from use in any litigation against state, tribe or local government that involves the location(s) mentioned in the collision data."

southbound off-ramp at Thorne Lane (MP 123.94).

The recently completed Tiger III projects may improve this location, but two years of data are needed to assess the effectiveness of the ramp meters and other improvements that have recently been installed.

Severity of I-5 Collisions

The severity of I-5 collisions is summarized in Figure PP3-13. Collisions involving property damage only (no injuries) make up the majority (over 72 percent) of all collisions in the study area, with almost 80 percent occurring along the I-5 mainline between Main Gate and Gravelly Lake Drive Interchanges. Two fatalities occurred along this section of I-5 during the five-year study period and 11 collisions involved serious injuries.

Types of I-5 Collisions

As shown in Figure PP3-14, nearly 68 percent of collisions along the I-5 corridor between Main Gate and Gravelly Lake Drive are rear end collisions, and almost 14 percent are sideswipe collisions. About 12 percent of the collisions involve hitting fixed objects, such as median barriers, guardrails, retaining walls, fences, bridges, and ditches.

Rear-end and sideswipe collisions are a common occurrence in areas with congested stop-and go conditions, like I-5 through the study area. Traffic on I-5 in this area is characterized by heavy entering and exiting traffic and by drivers frequently changing lane along this section of I-5. Drivers who were distracted or did not grant others the right of way to merge or change lanes contributed another 12 percent of the I-5 collisions.

Figure PP3-13: Number of I-5 Collisions by Severity – Main Gate to Gravelly Lake Drive – 2010 to 2014

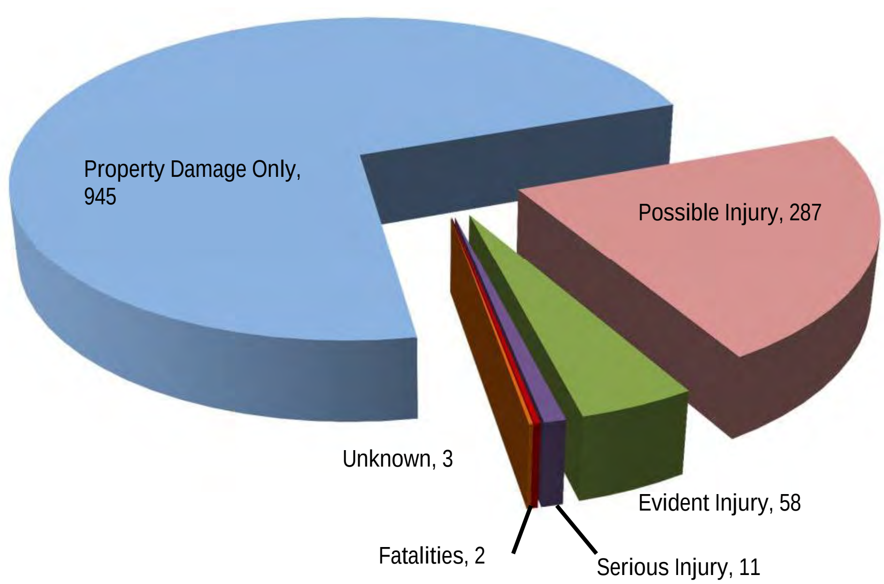


Figure PP3-14: I-5 Collisions by Type – Main Gate to Gravelly Lake Drive – 2010-2014

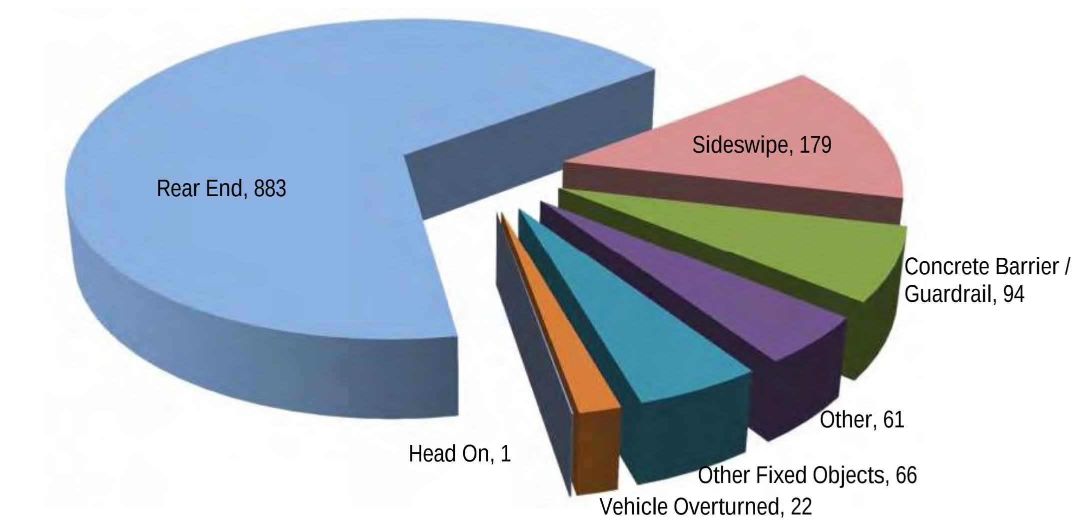
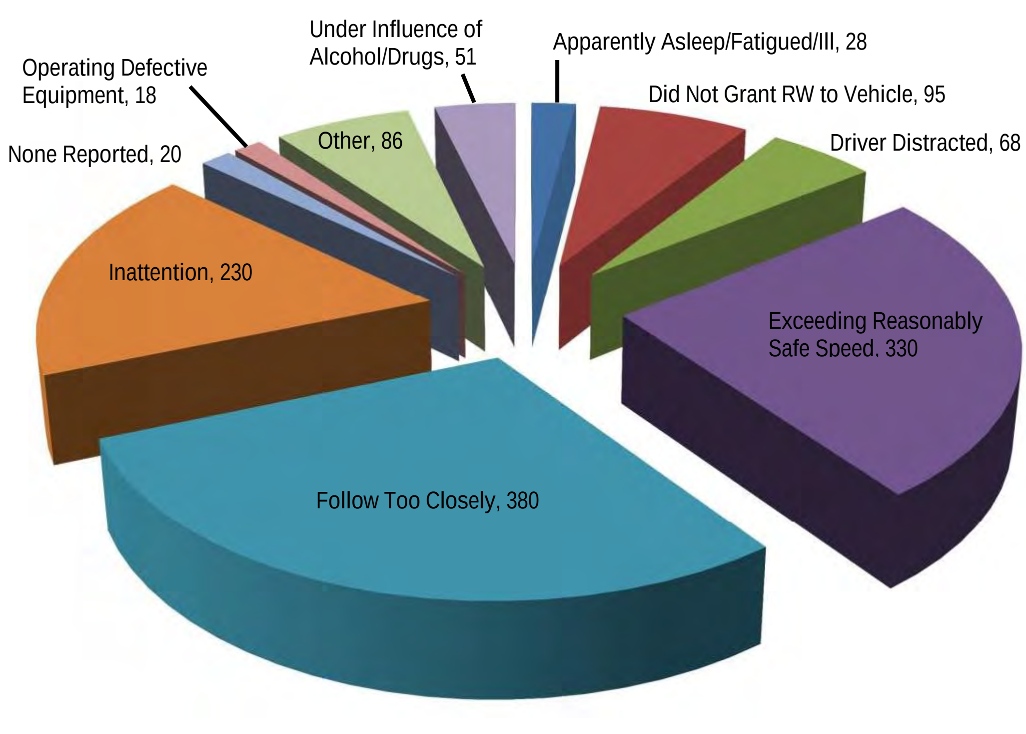


Figure PP3-15: I-5 Collisions by Contributing Circumstances – Main Gate to Gravelly Lake Drive – 2010-2014



How Would the Proposed Build Alternative affect Collisions along the I-5 Corridor?

A number of model runs based on the Enhanced Interchange Safety Analysis Tool (ISATe) were used to predict the safety performance of the 2020 and 2040 Build Alternatives and compare it to future baseline conditions (i.e., the No Build Alternative). These models were developed based on the FHWA *Highway Safety Manual*.

The 2014 base model was created and calibrated using the traffic collision data from 2010 through 2014. The models use geometric data for the mainline, ramps, and terminal intersections, include Average Daily Trip (ADT) data for the mainline, ramps, and terminal intersections, and consider roadside features such as rumble bars and guardrails.

Once the data was collected and entered into the program, the ISATe tool was used to estimate the frequency and severity of collisions expected in the study area for the analyses years. The tool is also used to predict types of collisions and whether one or multiple vehicles would likely be involved.

One of the constraints of the ISATe tool is that it doesn't recognize roundabouts as a means of controlling traffic at an intersection. The model does recognize traffic signal control. In situations where planned improvements include reconfiguring an intersection to a roundabout, a Crash Modification Factor (CMF) can be applied. The CMF values reflect the safety and operational improvements typically realized with a roundabout when compared to traffic signal controls. In this study, coding for a traffic signal was used in the 2020 and 2040 Build Alternative for the ramp intersections at Berkeley Street and Thorne Lane. Then a Crash Modification Factor of 0.34 was applied to the injury and fatal collision predictions for those intersections to reflect the proposed roundabouts. ADTs used to calculate collision rates are measured at count station R091 just north of the 41st Division/Main Gate interchange.

Table PP3-11 summarizes the predicted collisions derived by the ISATe model. According to the model, the annual number of predicted mainline, ramp and intersection terminal collisions with the 2020 No Build Alternative is expected to be 246 with an ADT of 130,000 vehicles. With the 2020 Build Alternative, the total collisions are predicted to increase to 261 with an ADT of 141,800 vehicles.

While the analysis predicts an increase of 15 collisions per year with the Build Alternative over the No Build Alternative, the ADT is expected to increase by 11,800 trips with the Build Alternative. An expected collision rate was estimated that correlates expected collisions with traffic volumes. Using this approach, the predicted collision rate is expected to drop from 1.19 crashes per million vehicle miles traveled with the No Build Alternative to 1.16 collisions per million vehicle miles traveled with the Build Alternative, indicating an overall improvement in safety along this section of I-5.

For 2040, about 326 collisions per year are predicted to occur with the Build Alternative, which are about 39 annual collisions more than anticipated with the 2040 No Build Alternative. However, the Build Alternative would accommodate an increase in ADT of 20,500 vehicles over the No Build

Table PP3-11: Predicted Annual Collisions for I-5 between Mileposts (MP) 120.52 and MP 124.87

Study Year	Scenario	Mainline	Ramps	Terminals	Total Collisions	Total Collisions/ 100 MVM
		Annual Number of Crashes				
2020	No Build	204	18	24	246	1.19
2020	Build	214	22	25	261	1.16
2040	No Build	247	15	25	287	1.21
2040	Build	281	20	25	326	1.21

Notes: MVM = Million Vehicle Miles of Travel

Source: ISATe Model

Alternative. As a result, the collision rate calculated for both the 2040 No Build and Build Alternatives would be similar with 1.21 annual collisions per million vehicle miles traveled expected.

Summaries of the ISATe model outputs for the No Build and Build Alternatives in 2020 and 2040 are contained in Appendix I.

Introduction

Policy Point 4 in this IJR discusses how the proposed access modifications at the Berkeley Street and Thorne Lane Interchanges are fully directional, connected to public roads, and designed to meet identified performance standards. The Build Alternative addressed in this IJR is focused on improvements to the Thorne Lane and Berkeley Street Interchanges with I-5, as described in Policy Point 2.

At the Steilacoom-DuPont Road Interchange, improvements would be limited to transitioning the interstate to its existing cross-section include the narrowing and restriping of the southbound lanes, and converting the southbound on-ramp from an add-lane to a merge lane.

The proposed interchange revisions at Berkeley Street and Thorne Lane are designed to be:

- Fully-directional interchanges
- Connected to the public street system
- Compatible with other mainline and interchange improvements
- Capable of meeting identified performance needs

With the planning level design completed to date, a ramp shoulder width design variation and interchange spacing variation would be required.

What Are the Proposed Berkeley Street Interchange and Thorne Lane Interchange Modifications?

The proposed Berkeley Street and Thorne Lane Interchanges would be fully-directional interchanges with northbound and southbound on- and off-ramps that provide connections for all vehicular movements, as illustrated on Figures PP4-1 and PP4-2.

Berkeley Street Interchange

The proposed interchange at Berkeley Street would include the following improvements:

- The reconfigured interchange would be a diamond interchange with roundabouts at the ramp terminals and connected to Jackson Avenue on the east and to Berkeley Street near Washington Avenue on the west;
- The reconfigured interchange would be centered approximately 120 feet south of the existing interchange;
- The existing rail crossing on the west side would be grade-separated;
- The intersection at Berkeley Street would be stop controlled and offset from the Washington Avenue SW intersection by approximately 60 feet;
- The new roadway connecting the interchange to Berkeley Street would pass over the Militia Drive access to Camp Murray;
- The existing Berkeley Street/Union Avenue/Militia Drive intersection would be modified into a tee intersection by removing the section of Berkeley Street between Union Avenue and I-5;
- On-ramps would include ramp metering with an HOV bypass lane and would be designed as single lane connections;
- Off-ramps would be designed as single lane off-ramps (the off-ramp would be widened to include turning and storage lanes approaching the roundabouts at ramp terminals);

- All ramp lengths and turn lanes would be designed based on the latest traffic analysis;
- Structure over I-5 would include two lanes in each direction with pedestrian and bicycle facilities; and
- Jackson Avenue would be re-aligned to tie the new interchange with the existing Madigan Access Control Point to JBLM.

Thorne Lane Interchange

The proposed interchange at Thorne Lane would include the following improvements:

- The new interchange would be a diamond interchange with roundabouts at the ramp terminals and connected to Murray Road on the east and a re-aligned Thorne Lane on the west;
- The new interchange would be located approximately 350 feet south of the existing interchange;
- A new loop connector road would be constructed to provide access between the relocated Thorne Lane and Union Avenue;
- The new intersection at Thorne Lane with the new loop connector road would be a single lane roundabout, while the new intersection with Union Avenue and the Gravelly-Thorne Connector would be stop controlled;
- The re-aligned Thorne Lane would be grade separated over the adjacent rail line and Union Avenue;
- On-ramps would include ramp metering with an HOV bypass lanes and would be designed as single lane connections;
- Off-ramps would be designed as single lane off-ramps (the off-ramps would be widened to include turning and storage lanes approaching the roundabouts at ramp terminals);
- All ramp lengths and turn lanes would be designed based on the latest traffic analysis; and
- Structure over I-5 would include two lanes eastbound and one lane westbound with pedestrian and bicycle facilities.

What Other I-5 Mainline and Local Road Improvements Are Proposed to Support the Interchange Modifications?

Improvements to the I-5 mainline and the local street system are also proposed as part of the Build Alternative to provide near-term congestion relief and allow for other long-term I-5 improvements. The following I-5 mainline and local improvements are also constructed.

I-5 Widening

One additional northbound and southbound lane would be added to the I-5 mainline from Thorne Lane Interchange to the Steilacoom-DuPont Road Interchange. The southbound added lanes would transition into the existing lane configuration by connecting the outside fourth lane into the existing auxiliary lane south of the Steilacoom-DuPont Road Interchange and merging the southbound on-ramp into it. A northbound lane would be built as an add lane from the northbound on-ramp at the Steilacoom-DuPont Road Interchange. The added lanes would initially operate as general purpose travel lanes.

Figure PP4-1: I-5 Berkeley Street Interchange

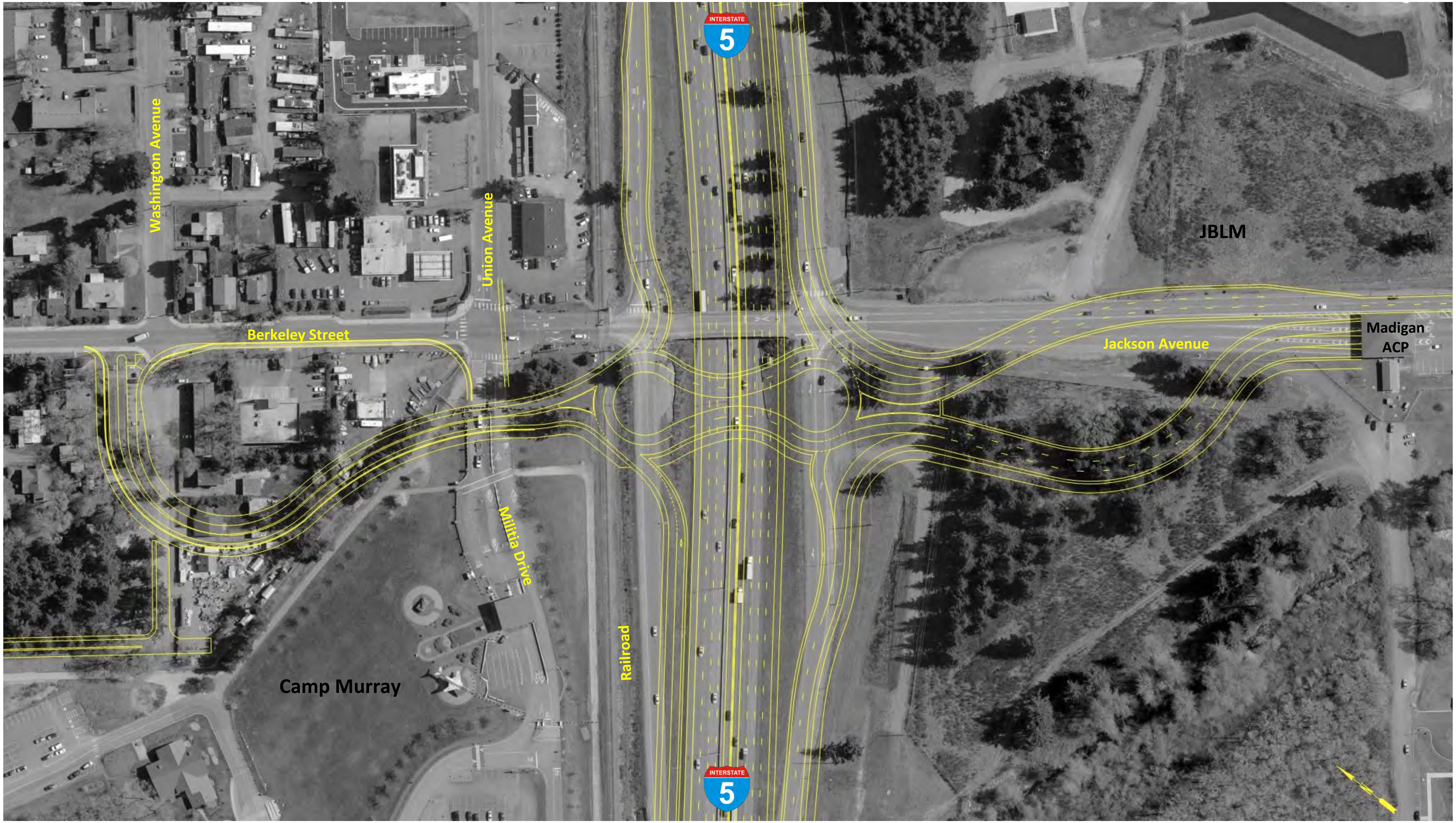
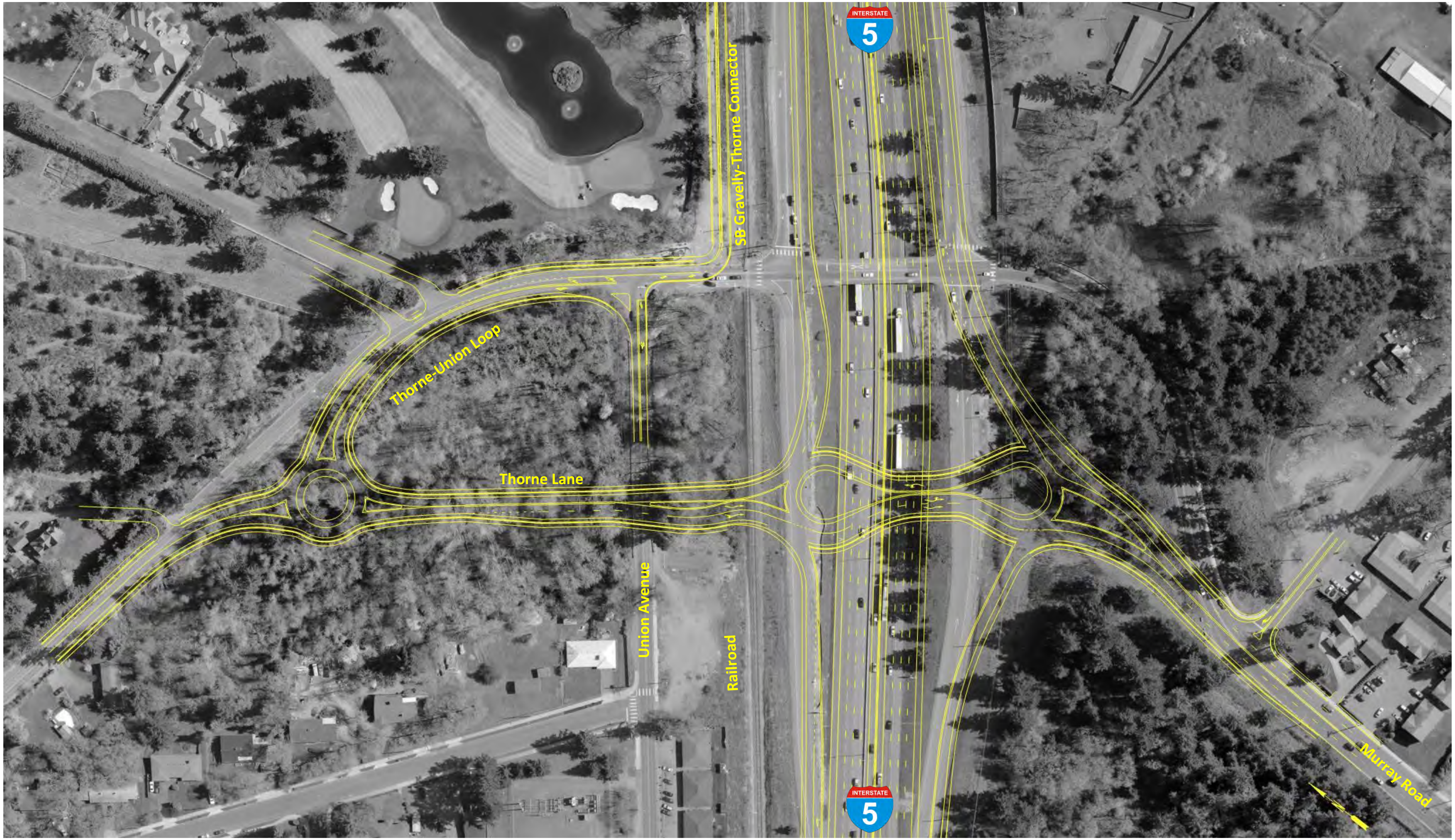


Figure PP4-2: I-5 Thorne Lane Interchange



I-5 Auxiliary Lane

Because of the close spacing between the Thorne Lane and Berkeley Street Interchanges (less than one mile), a northbound auxiliary lane would be added from the northbound Berkeley Street on-ramp to the Thorne Lane off-ramp. The existing southbound auxiliary lane between these interchanges would be maintained. A new northbound auxiliary lane would also be added along I-5 from the Thorne Lane on-ramp to the off-ramp to Gravelly Lake Drive.

Gravelly Lake Road to Thorne Lane Connector

A southbound local connector roadway would be constructed between Gravelly Lake Drive and Thorne Lane to connect the City of Lakewood with the Tillicum and Woodbrook neighborhoods without requiring that motorists use I-5. Two-way pedestrian and bicycle facilities would be included along this southbound roadway.

Shared Use Path

A shared use path would be constructed along I-5 from Steilacoom-DuPont Road to Berkeley Street for use by pedestrians and bicyclists, as a non-motorized alternative mode of travel for local trips.

What Are the Conceptual Layout Plans for the I-5 JBLM Corridor Modifications?

The conceptual layout plans for the two interchanges, mainline improvements, local connector roads and the shared use path are provided in Appendix J. The weaving distances, merge and diverge, and channelization shown on the plans were based on current traffic analysis. These plans will be refined during the design phase of the project. Signing plans were not developed for the proposed interchange modifications as the general ramp arrangement and destinations are not significantly altered by the proposed interchanges.

The proposed design meets the current design standards with the following exceptions:

- Interchange spacing between the Berkeley Street and Thorne Lane Interchanges would be less than the one mile suggested spacing for urban interchanges (approximately 0.85 miles). Northbound and southbound auxiliary lanes would be added between these two interchange to improve traffic access and egress;
- Ramp shoulder widths on the northbound on ramp from Thorne Lane Interchange would be reduced to three feet to avoid impacts to residential land uses on JBLM; and
- Ramp shoulder widths on the southbound on-ramp from Berkeley Street Interchange would be reduced to avoid impacts to the adjacent railroad (Sound Transit) right-of-way.

The specific design details for these conceptual plans, including number of lanes, horizontal and vertical curvatures, lateral clearances, lane widths, shoulder widths, weaving distances, ramp tapers, are summarized in the Design Criteria Worksheets contained in Appendix H.

Would the Proposed Interchanges Be Fully Directional and Connected to Public Streets or Roads?

The modified Berkeley Street and Thorne Lane Interchanges are being developed to support full traffic movements at all access points and connected to public roads.

Berkeley Street Interchange

The revised interchange would have northbound and southbound on- and off-ramps to provide full traffic movements between local streets and I-5. It would be connected to Jackson Avenue on the east which is a primary access road to JBLM and Madigan Hospital. On the west side, a connector road is designed to connect with Berkeley Street just west of the Washington Avenue/Berkeley Street intersection.

Thorne Lane Interchange

The revised interchanges would have northbound and southbound on- and off-ramps to provide full traffic movements between the local streets and I-5. It would be connected to Murray Road on the east which provides access to the Woodbrook neighborhood, Lewis Main through the Logistics Gate and east to Spanaway. On the west side, Thorne Lane would be re-aligned and connects to the Tillicum neighborhood. A new loop connector road is designed to connect with Union Avenue and the proposed Gravelly-Thorne Connector.

How Do the Proposed Interchanges Relate to Present and Future Interchange Configurations?

The redesign of the interchanges at Thorne Lane and Berkeley Street would not have adverse effects on adjacent interchanges, and operations are expected to be the same or better. The proposed interchange modifications at Berkeley Street and Thorne Lane are also designed to be compatible with possible interchange and mainline changes currently being analyzed by WSDOT between Mounts Road and Steilacoom-DuPont Road.

In addition, the interchanges at Berkeley Street and Thorne Lane are designed to accommodate possible future additional I-5 travel lanes in each direction to meet identified performance needs.

Introduction

Policy Point 5 addresses the question of whether the proposed access point revisions are compatible with the relevant land use and transportation plans for the area. This includes both local and regional land use plans, as well as local, regional and statewide transportation plans and planning requirements

Are the Proposed Access Point Revisions Compatible with Land Use Plans for the Area?

The proposed access revisions along I-5 at the interchanges with Berkeley Street (Exit 122) and Thorne Lane (Exit 123) are consistent with local and countywide land use plans. Pierce County and the city of Lakewood have prepared land use plans that comply with the Washington State Growth Management Act (GMA) (Revised Code of Washington (RCW), Chapter 36.70A). These plans include:

- City of Lakewood, *Comprehensive Plan*, 2014
- Pierce County, *Countywide Planning Policies*, 2014

Compatibility with land use plans is measured in two ways:

- Plans call for continued urban development in southern Pierce County and the city of Lakewood which this project supports.
- These plans provide the basis from which travel forecasts were developed and used in evaluating the need for access revisions and in identifying the preferred alternative. Travel forecasts are based on household and employment projections that are consistent with Comprehensive Plan land uses. This data, along with data from other plans in southern Pierce County and northern Thurston County, was used by the Puget Sound Regional Council (PSRC) and the Thurston Regional Planning Council (TRPC) in developing the regional travel demand model employed to prepare travel forecasts for the IJR.

In addition to public agency land use plans, the evaluation of access revisions along this portion of I-5 also considered land use studies and master plans prepared by Joint Base Lewis-McChord and Camp Murray in the development of traffic forecasts and the assessment of improvement options. These plans included:

- City of Lakewood, *JBLM Growth Coordination Plan*, 2010
- *JBLM Joint Land Use Study*, 2014
- *JBLM Master Plan and Supporting Documents*, 2014
- *Camp Murray Site Development Plan*, 2010

Are the Proposed Access Revisions Consistent with State, Regional and Local Transportation Plans?

The proposed improvements to I-5 and the reconfiguration of two interchanges are consistent with state, regional and local transportation plans. These plans include:

- *Washington State Transportation Plan, 2035* (WTP) - Establishes a 20-year vision for the state’s transportation system and recommends statewide transportation policies and strategies to the legislature and Governor. This Plan provides broad, policy-level support for improvements that enhance transportation mobility and safety, supports economic development, encourages stewardship and protects the environment. The proposed improvements support several strategies and actions in the 2035 WTP including prioritizing improvements in major corridors like I-5, partnering with the military to prioritize improvements that support military-related economic activities, applying practical design concepts and encouraging multi-agency partnerships.

- *Washington State Highway System Plan (HSP),* WSDOT, 2007-2026 – Addresses current and future forecasted state highway needs based on investment options identified in the Washington Transportation Plan. The HSP identifies the project area corridor as one which currently operates "less than efficiently," with performance expected to continue to deteriorate if not addressed.[1] Several component elements of the recommended improvements to the I-5 corridor through the project area are identified in the HSP Appendices. These are presented in the discussion of Policy Point 6.
- *Transportation 2040,* PSRC – Outlines an action plan for transportation in the central Puget Sound Region. Transportation 2040 presents a project list (updated June 2015) that includes new interchanges at the three locations identified above for access point revisions, along with corridor widening and other improvements. The current plan shows HOV lanes through the corridor.
- *Transportation Improvement Program*, City of Lakewood, 2014 – Identifies engagement of the city in I-5 improvements through Lakewood.
- *JBLM Growth Coordination Plan* (2010)– This collaborative effort between JBLM, Washington State and over 100 community leaders focused on planning and effectively preparing to maintain and enhance the quality of life in the region as JBLM grows. Among the Plan's key recommendations are strategies to improve regional mobility on I-5 through multimodal enhancements, and to improve JBLM gate access and on-post traffic circulation.

[1] HSP Mobility chapter, pp.63-70.

Introduction

Policy Point 6 addresses the question as to whether the proposed access point revisions are compatible with other planned access points and revisions to existing points.

Are There Other Planned Access Points or Revisions to Existing Points?

There are no new planned access points within this corridor study area. Planned revisions to access points within this study area are limited to the following:

- The Center Drive Interchange was designed with an intended future stage including a northbound on loop ramp. There is currently no plan to implement this revision.
- If in the future a fifth lane is added to each direction of I-5 through this corridor, it may be necessary to reconfigure the Main Gate and Gravelly Lake Drive Interchanges.
- A follow-on study will evaluate the Steilacoom-DuPont Road (Exit 119) interchange along with JBLM's DuPont Gate. This may result in a reconfiguration of the Steilacoom-DuPont Road interchange, or possibly the Center Drive (Exit 118) interchange if the JBLM DuPont Gate were to be relocated.

Are There Other Proposed Area Improvements?

The proposed improvements discussed within this report are consistent with other proposed interstate improvements near the JBLM project limits, as identified in the WSDOT *Highway System Plan 2007-2026*, completed in December 2007 and updated in 2008. The WSDOT *Highway System Plan* does reference mobility and capacity improvements for the I-5 JBLM area and will be updated to acknowledge the recommendations from the I-5 JBLM planning studies.

The *Highway System Plan* (HSP) organizes projects into three tiers and also identifies projects that require further analysis before more specific improvement needs and recommendations can be determined. These levels are as follows:

- **Tier I**: Low cost projects with a high return on investment and short delivery schedules.
- **Tier II**: Moderate to Higher cost projects with potential network benefits.
- **Tier III**: Higher cost projects with corridor-wide benefits.
- **Solutions that Require Further Analysis:** This section of the HSP lists other projects that require further analyses before a recommendation can be made.

Study area projects listed in the HSP are summarized in Table PP6-1.

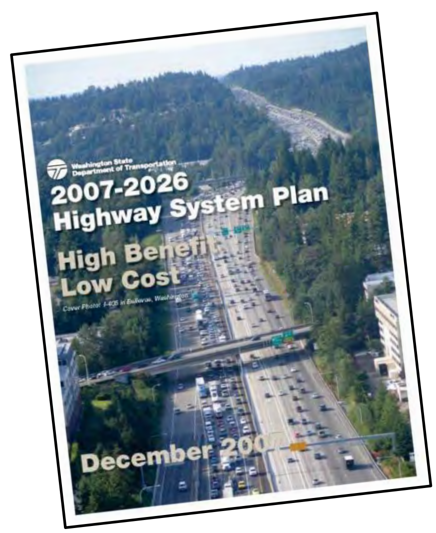


Table PP6-1: Study Area Projects from WSDOT's Highway System Plan

Projects	Improvement	Project Completed	Consistent with IJR
TIER I	I-5 Pierce County Line to Thorne Lane – ITS	Complete	Yes
	I-5 Mounts Road to 48th Street – Install Ramp Metering	Complete	Yes
TIER II	I-5 Fort Lewis to Thorne Lane – Construct SB and NB Auxiliary Lanes. A SB auxiliary lane between Berkeley and Thorne was recently added as part of the TIGER III improvement project. The NB capacity lane will be added as part of the I-5 JBLM Area planning study.	SB Complete	Yes
	I-5 Mounts – Old Nisqually Road to Gravelly Lake Drive – Construct Auxiliary Lanes and Noise Walls – Elements of this project (NB auxiliary lane between Berkeley Street and Thorne Lane) are part of the solution set recommended in the I-5 JBLM Area planning studies.	Certain elements are funded	Yes
TIER III	I-5 – Thorne Lane undercrossing to Gravelly Lake Drive – Add SB and NB HOV lanes, new interchange at Gravelly Lake Drive and ITS	Not Funded	Yes
	I-5 – Gravelly Lake Drive to BN RR undercrossing – Add SB and NB HOV lanes, new interchange at Bridgeport Way and ITS	Not Funded	Yes
	I-5 – BN RR undercrossing to S 96th Street (SR 512 Interchange) – Construct Core HOV lanes, a freeway to freeway interchange at SR 512 and ITS	Not Funded	Yes
	I-5 – I-5 and SR 512 Interchange – Construct a new southbound I-5 to eastbound SR 512 two lane flyover ramp	Not Funded	Yes
	I-5 – SR 512 to SR 16 – Construct Core HOV lanes, reconstruct interchanges at S 56th Street, S 84th Street, and S 72nd Street, modify S 38th Street interchange, replace 48th Street Bridge and add ITS	Not Funded	Yes

Table PP6- 2: Study Area Projects from WSDOT's Highway System Plan Needing Further Analysis

Projects	Improvement	Project Completed	Consistent with IJR
Solutions Requiring Further Analysis	I-5 SR 510 – SR 512 – Network Analysis Study	Underway	Yes
	I-5 – East Tillicum I/C (Thorne Lane undercrossing) – I/C improvements (included in proposed improvements)	No	Yes
	I-5 Thurston/Pierce County Line to Mounts Road – Add HOV Lanes	No	Yes
	I-5 Mounts Road/Old Nisqually Road to South DuPont Interchange – Add HOV Lanes and complete Center Drive Interchange	No	Yes
	I-5 South DuPont Interchange to DuPont Interchange – (Center Drive Interchange to Steilacoom-DuPont Road Interchange – Widen to 11 lanes, including 6 GP lanes, 2 HOV lanes, SB auxiliary lane and a 2-lane northbound CD road)	No	Yes
	I-5 DuPont interchange to Thorne Lane interchange – Add HOV Lanes	No	Yes

Are Interchange Improvements Compatible with Other Known Improvement Projects?

There are other interstate improvement projects currently underway or recently completed that analyzed and evaluated improvements along the I-5 corridor in Pierce County.

These projects include:

- Projects to improve traffic flow from SR 510 in Lacey to SR 512 have been recently implemented. The improvements include installation of ramp meters, travel time information signing and JBLM access improvements. The proposed interchange improvements within the JBLM project limits are compatible with the improvements implemented as part of the SR 510 to SR 512 Congestion Management projects.
- The Madigan Access Improvement project is implementing signalization enhancements, an upgraded railroad crossing, and widening of the Berkeley Street Bridge over I-5 to provide a second lane inbound toward the Madigan ACP.

  The interchange revisions proposed in this IJR would replace the existing interchange, including the enhancements being built by the Madigan Access Improvements project.
- Puget Sound Regional Council's *Vision 2040* provides a framework for transportation planning in the four

county region (Snohomish, King, Pierce and Kitsap counties). The *Vision 2040* plan includes improvements to major transportation corridors within the central Puget Sound, including improvements to I-5 through the project study area. The current plan shows added HOV lanes through the corridor. The proposed improvement would add a general purpose lane in each direction that could be converted to an HOV lane when the existing system is extended further south to the study area.

- The WSDOT *Highway System Plan* uses a three-pronged approach to reduce congestion on Washington's primary urban corridors by improving travel time and reliability, increasing safety, using existing roadways more effectively, and reducing single occupancy vehicles by improving transit reliability and efficiency. Strategies include the following:
    - Managing demand by providing various mobility choices;
    - Operating existing roadways efficiently through preservation, maintenance and low-cost investments; and
    - Adding capacity strategically.

Introduction

This policy point requires a commitment to complete all other non-interchange/non-intersection improvements that are necessary for the proposed interchange access revisions to function as proposed.

How Are the Proposed I-5 Improvement Projects Being Funded?

The proposed Interstate 5 interchange improvements at the Berkeley Street and the Thorne Lane locations are included in the 2015 Connecting Washington Revenue and Investment Plan, adopted by the Washington State Legislature during the 2015 session. The improvements at these interchanges and to the I-5 mainline are funded through construction as a part of the investment plan. This I-5 JBLM Improvement Project also includes:

- Adding an auxiliary lane between the northbound Berkeley Street on-ramp and the Thorne Lane off-ramp.
- Construction of a shared use (bicycle/pedestrian) path from Steilacoom-DuPont Road to Thorne Lane.
- Gravelly Lake Drive to Thorne Lane Connector – A southbound connector road with bike and pedestrian features between Gravelly Lake Drive in Lakewood and the Tillicum neighborhood;
- A parallel northbound auxiliary lane along I-5 from the Thorne Lane northbound on-ramp and the off-ramp to Gravelly Lake Drive.

Are There Other WSDOT Improvements that Need to Be Coordinated?

Improvements to I-5 JBLM South Study Area will be further studied to identify a Build Alternative strategy for this section of I-5. Improvements may include I-5 widening consistent with the planning studies and possible revisions to interchanges located within the area along I-5 between Steilacoom-DuPont Road to the north and Mounts Road to the south.

Are There Other Local Improvements that Need to Be Coordinated?

In addition to the proposed I-5 improvements, the City of Lakewood, WSDOT and JBLM are adding other local improvements as part of their respective Transportation Improvement Programs (TIPs). The following improvement projects are underway, funded or proposed for future implementation, and need to be coordinated with the implementation of the proposed Build Alternative. TIP projects in the project area are described below:

- Union Avenue – Berkeley Street to N Thorne Lane – Widen street to add turn lane, shared bike/travel lane, sidewalks, street lighting and intersection improvements. This improvement is fully compatible with the proposed revisions to the Berkeley Street and Thorne Lane interchanges.
- Madigan Access Improvement Project – Provide improved access to Madigan including: Freedom bridge, ramp, & roadway widening; signalization improvements; and Union Avenue/Berkeley Street Improvements. This project is funded and currently

underway, several components of this project would be removed upon completion of the new reconfigured Berkeley Street Interchange.

- Gravelly Lake Drive – Widen roadway from Nyanza Road to the I-5 southbound on-ramp to provide a dedicated right-turn lane.
- Murray Road and 150th Street Corridor Capacity – Widen Murray Road and 150th Street for industrial traffic with bike/pedestrian facilities.
- Joint Base Connector – Improves access between Fort Lewis and McChord Air Force Base (bridge linking Lewis Main with McChord Field opened to traffic in 2015).
- Point Defiance Bypass Project – Upgrade the adjacent rail line owned by Sound Transit to allow Amtrak service to relocate to this more direct route between Nisqually and Tacoma. This project is slated for completion by the fall of 2017.

These street improvements will improve local circulation within the study area to reduce travel on I-5 for local trips and improve connectivity to the proposed interchange improvements. These local street improvement projects were programmed and adopted into the *City of Lakewood Transportation Improvement Program* (TIP). The City of Lakewood included the proposed Berkeley Street and Thorne Lane IJR improvements within their TIPs. The agencies' TIPs are included as Appendix K.

In addition to these local improvements, JBLM is also planning for long-term changes at the Madigan ACP. The design of the new Berkeley Street Interchange would be coordinated with JBLM to allow for future changes at the Madigan ACP.

How Are Local Agencies Involved?

Active participation by public agencies and the Nisqually Indian Tribe has been on-going since the *I-5 JBLM Vicinity – Congestion Relief Study* effort began in 2013. These stakeholders were formed into two working groups – the Executive Stakeholders Committee and the Technical Support Group, identified below.

Executive Stakeholder and Technical Support Committees

Local agency representatives were actively involved in the project through their roles in the Executive Stakeholder and Technical Support Group Committees throughout the identification, analysis, and evaluation of a wide range of improvements and in the development of the proposed Build Alternative. These agencies include:

- Federal Highway Administration
- Washington State Department of Transportation
- Joint Base Lewis-McChord
- Camp Murray
- Thurston Regional Planning Council
- Puget Sound Regional Council
- Nisqually Tribe
- Pierce County
- City of Lakewood
- City of DuPont
- Town of Steilacoom
- City of Lacey
- City of Yelm
- Pierce Transit
- Intercity Transit
- Sound Transit

The Executive Stakeholder Committee served as an advisory group to WSDOT and the project team. The Technical Support Group participated in every phase of the study to collaboratively address member organization needs and concerns, and move effectively through the alternatives analysis and documentation process. Transportation agencies involved in the planning effort largely participated through the Technical Support Group and the Executive Stakeholders Committee.

Several of these agencies also participated in smaller "Focus Groups" to address detailed analysis of specific study elements during the development of evaluation criteria and the identification and screening of improvement options.

How Is the Public Involved?

Providing meaningful venues for public participation was an important element of the *I-5 JBLM Vicinity – Congestion Relief Study* because the objective of the project is to improve I-5 mobility for the traveling public, and provide access for neighborhoods and businesses adjacent to I-5. A specific Public Involvement Plan, tailored to the needs of this project, supported the back-and-forth exchange of information and input that a project of this magnitude requires.

As information regarding the project and potential congestion relief strategies was generated, it was provided to the general public using a variety of tools. These tools include the following elements:

Website: The primary vehicle for providing ongoing information to the public was a project website hosted by WSDOT. Designed to be easily navigable, visitors to the site could obtain details about the project from easy-to-understand content on the project home page. There was a link to a form where the public could leave detailed questions, comments, and complaints.

Media: Media outreach was an important mechanism for raising awareness about the study effort, generating community interest, and promoting public events. This included radio, television, print, and online media sources, in addition to specialized media sources such as those targeted to the military community.

Open Houses: Two open houses (June 2014 and May 2015) provided in-depth opportunity for broad community engagement. These meetings were styled in such a way that the public could get an overview or dive into project detail. Topic stations featured large, graphics-rich displays staffed by subject matter experts. Roving project staff helped orient visitors, answer general questions, and gather comments and insights.

Neighborhood Meeting: Community meetings for the Tillicum and Woodbrook neighborhoods were hosted by the project team in September 2015 and May 2016. These neighborhoods are directly affected by changes to the Berkeley Street and Thorne Lane Interchanges because I-5 serves as the main route (in the case of Tillicum neighborhood, the only route) to business and activities in Lakewood. These meetings were held to increase understanding of the project as well as solicit any new information to be considered in the project evaluation or design. A community meeting was also hosted in DuPont in May 2016.

Briefings and Listening Sessions: Presentations were made to other public groups, including:

the City Councils of DuPont, Lakewood, and Yelm; the Pierce County Council; a joint meeting of Thurston Regional Planning Council and the Intercity Transit Authority; the Puget Sound Regional Council; and the Lakewood Chamber of Commerce Military Affairs Committee. Special briefings were also made to a joint meeting of elected officials, and to the Environmental Protection Agency. Three "listening posts" were held in the study area during spring of 2014 in which members of the Executive Stakeholder Committee and Technical Support Group could talk one-on-one with project staff about specific aspects of the project or process for which they had any concerns or ideas. Additionally, numerous briefings were held with various departments and disciplines within both JBLM and WSDOT.

Summary

WSDOT, in coordination with the communities within the project area, is undertaking preliminary design to improve safety, operations and capacity along I-5, as described in other sections of this IJR. This proposed improvement is included in WSDOT's *2007-2026 Highway System Plan* and has also been coordinated within the IJR. Funding for design and construction was approved by the Washington State Legislature in 2015.

Introduction

This policy point highlights the required environmental process for the improvements described in this IJR. The IJR report is intended to result in a "finding of engineering and operational acceptability" and will be approved at the same time as a formal decision on the NEPA environmental document that is being prepared concurrently with the IJR.

A preliminary screening of potential environmental impacts was conducted as part of the I-5 JBLM Planning study, and was used as a foundation for the environmental analysis performed to investigate possible impacts associated with the design options considered during the IJR process. Environmental review for the Build Alternative focused on disciplines for which potential impacts were anticipated. Highlights of the analysis approach, key findings, conclusions and any mitigation recommendations for each discipline are discussed in the remainder of this chapter. This information is a summary of the more detailed technical memoranda (Appendix K) prepared to support the NEPA environmental review process. Transportation and land use assumptions inherent in these technical memoranda are consistent with assumptions made for this IJR.

What Type of Environmental Document Will Be Prepared for the Project?

Consistent with the requirements of the National Environmental Policy Act (NEPA), WSDOT and the Federal Highway Administration (FHWA) determined that an Environmental Assessment (EA) is the appropriate level of environmental documentation for the Project. One of the purposes of this EA is to identify the level of significance of the project impacts, and to address both environmental effects and appropriate mitigation measures. The issuance of this EA and the interaction with the public, agencies, and Tribes will allow the FHWA to determine the significance of project impacts on the environment.

As part of the EA, the project team analyzed the fourteen discipline areas for both the No Build and Build Alternatives to document impacts, benefits and/or mitigation requirements associated with:

- Transportation operations and safety
- Air quality
- Noise
- Geology and soils
- Water resources including surface water, groundwater, floodplains and stormwater management
- Wetlands
- Fish, wildlife and vegetation
- Hazardous materials
- Visual quality
- Archaeological and historic resources
- Section 4(f) resources
- Socioeconomic and environmental justice
- Land use
- Utilities
- Economics
- Indirect and cumulative effects

What is the NEPA Schedule and Process for Approval?

The Preliminary Environmental Assessment (PEA) is currently under review by FHWA in order to ensure that required potential environmental effects of the Build Alternative and measures to mitigate those effects where needed, have been identified. Comments from FHWA reviewers will be addressed, with a planned issue date for the PEA to stakeholders and the general public in mid-October 2016. An open house and public hearing will be conducted in November 2016 to share updated project information, including the findings contained in the PEA, and to allow attendees to provide comments as prescribed by the NEPA process.

Once comments received from the public have been addressed, the Final EA will be submitted to FHWA. The project team anticipates that FHWA will accept the Final EA and issue a Finding of No Significant Impact (FONSI) in early 2017.