Appendix F: Traffic and Transportation Discipline Report

Point Defiance Bypass Project

Transportation Discipline Report

Washington State Department of Transportation

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Summary

What do we know about the Project?

Who is leading the Project and who are the Project partners?

The Federal Railroad Administration (FRA) is the federal project lead and the Washington State Department of Transportation (WSDOT) is the lead state agency for the proposed high-speed rail Project. In leading, WSDOT and FRA sought input from the public and the following Project partners (most are jurisdictions in which the Project is located):

- City of DuPont
- City of Lakewood
- City of Tacoma
- Pierce County
- Sound Transit
- Clover Park School District
- Joint Base Lewis McChord (JBLM)
- Camp Murray
- Federal Highway Administration (FHWA)

Where is the Project located?

The Project is located in Pierce County (see Exhibit 3) along an approximately 20-mile existing corridor.[1] The northern limit of the Project is at TR Junction near the Interstate 5 (I-5) overcrossing of the Puyallup River and East Bay Street in Tacoma. The southern limit of the Project is at Nisqually about one-third of a mile due north of where Nisqually Road crosses the Nisqually River.

How would the Project change the rail network?

The Project would improve railroad track and support facilities, and relocate the Tacoma Amtrak Station. Following are the five major components of the Project:

- Construct a new track adjacent to the existing main line between South Tacoma and Lakewood

[1] *The three owners of the proposed Project corridor are Sound Transit, Tacoma Rail, and BNSF.*

- Reconstruct and rehabilitate the existing main line track
- Improve the connection to the main line near Nisqually
- Construct improvements at existing at-grade crossings to improve safety features and allow high-speed rail operations
- Relocate the Tacoma Amtrak Station to the Tacoma Dome Station at Freighthouse Square in Tacoma

No new at-grade highway or rail crossings are planned within the study area. No at-grade crossings would be closed with the Project.

How would passenger rail operations change with the Project?

Train trip: *A train trip is defined as the movement between one station or point and another, not as a round trip; for example, a train traveling from Tacoma to Portland would be one trip and the return trip from Portland to Tacoma would be another. A round trip is made up of two trips.*

With the Project, Amtrak would increase the frequency of daily passenger trains through the study area by adding two more daily trips. This increase is possible because Amtrak would shift service onto the Bypass Route, which would have the following effects:

- Between TR Junction and East "D" Street in Tacoma, the addition of Amtrak expanded service would increase daily train trips from 28-42.
- Between East "D" Street and South "M" Street in Tacoma, the addition of Amtrak expanded service would increase daily train trips from 16-30.
- Between South "M" Street and the Sound Transit Layover Facility, the addition of Amtrak expanded service would increase daily train trips from 30-44.
- Between the Sound Transit Layover Facility and the Sound Transit Lakewood Station, the addition of Amtrak expanded service would increase daily train trips from 20-34.
- South of the Sound Transit Lakewood Station to the BNSF connection, where *Sounder* commuter rail stops, train frequency would increase from two trips daily (existing freight trains) to 16 trips.

Exhibit 1 summarizes the rail service changes with the Project by segment.

Exhibit 1. Existing and Future Daily Rail Operations Along the Project Rail Line

Project Rail Line Segment	Freight[2]		Sound Transit *Sounder*		Amtrak Cascades		Amtrak Coast Starlight	
	Existing	*Proposed*	*Existing/ Startup 2012*	*Proposed*	*Existing*	*Proposed*	*Existing*	*Proposed*
TR Junction to East "D" Street (Tacoma)	2	2	26[3]/18	26	None	12	None	2
East "D" Street to South "M" Street (Tacoma)[4]	None	None	None/10	14	None	12	None	2
South "M" Street to Sound Transit Layover Facility[5]	2	2	None/10	14	None	12	None	2
Sound Transit Layover Facility to Lakewood Station[6]	2	2	None/20[7]	28	None	12	None	2
Lakewood Station to BNSF Connection	2	2	None	None	None	12	None	2

Proposed passenger train service on the Point Defiance Bypass Route would be the predominant use of the line, with only two freight trains daily. In contrast, the Point Defiance Bypass Route track would have more mobility for freight movements if high-speed passenger rail traffic was moved to the Bypass Route.

How would freight rail operations change with the Project?

With the Project, freight rail service on the water-level Point Defiance Bypass Route would encounter less congestion. On the Point Defiance Bypass Route, the two freight trains daily would encounter more rail congestion because of Amtrak passenger rail traffic.

Why is the Project being considered?

Amtrak provides service today using the Puget Sound Route along the Puget Sound coastline (the No Build Alternative). However, this existing rail alignment through the study area is near capacity and Amtrak ridership has been growing. Physical and operational constraints adversely affect both passenger and freight train scheduling and reliability.

FRA and WSDOT developed the Project in response to deficiencies in the existing rail alignment around Point Defiance. The Project's purpose is to

[2] Tacoma Rail operates one round trip along the S. "M" Street/BNSF Connection route on a less-than-daily schedule, and the BNSF occasionally operates trains for JBLM.
[3] Eighteen daily round-trips from Seattle, including four non-revenue trips (four trains in the morning and the afternoon) from the "L" Street yard to the Tacoma Dome Station
[4] There will be no freight trains between E. "C" Street and S. Chandler Street.
[5] The Sound Transit layover facility is located between 100th Street SW and Steilacoom Boulevard SW, and is used to store Sounder trains overnight and clean their interiors.
[6] The Sound Transit Lakewood Station is located at 11424 Pacific Hwy SW.
[7] Ten of these trips will be non-revenue trips from the Sound Transit layover facility to the Lakewood Station.

provide more frequent high-speed intercity passenger rail service between Tacoma and Nisqually. The Project needs are to enhance rail service frequency, reliability, and efficiency, and to improve safety.

What is the Project timeline?

The Project would likely be completed near the end of 2017. To understand the effects of the Project (the Build Alternative), the Project team used year 2030 as the design year to study Project effects on the transportation system.

How would the Project affect transportation?

Direct Effects

The following summarizes how the Project would directly affect transportation:

Sound Transit made improvements in 2009 and 2010 from Bridgeport Way SW to S. Chandler Street and is building more improvements from S. Chandler Street to E. "D" Street in Tacoma, set to be completed in late 2012. These improvements were designed to accommodate future Amtrak services with some exceptions.

- The addition of Amtrak service would slightly increase the average delay (by approximately five second or less) at some intersections during the morning and evening peak hours. At intersections where signal improvements are being installed to improve safety, delay effects from the Project could be minimized.
- There would be no adverse effects on either rail or on-street transportation from the proposed upgrades to the existing line between Nisqually Junction and Freighthouse Square in Tacoma or from future use of the rail line. Rail capacity and function would be improved for passenger and freight trains by the improvements to the existing rail line.
- The Build Alternative would reduce the number of intersections exceeding the LOS D standard from nine to eight and would not degrade any intersections operating at acceptable levels with the No Build Alternative to substandard levels. A number of intersections would experience reduced delays with the improvements proposed in the Build Alternative.
- There would be no adverse effects on either rail or on-street transportation from the addition of the second rail line between South 66th Street and Bridgeport Way Southwest.
- Safety features at specific at-grade crossings would be improved as a result of the Project to allow for faster

passenger and freight train movements at these crossings, which would benefit both roadway and rail traffic mobility.

Indirect Effects

The only potential indirect effect tied to the Project is that it may indirectly influence limited redevelopment near the relocated Amtrak Station at Freighthouse Square and (see Land Use Discipline Report, Appendix M). Such redevelopment would be consistent with local land use and zoning regulations, and could include the addition of commercial businesses. Redevelopment could attract additional vehicle traffic to the Freighthouse Square area. This increase in traffic could have a minor indirect effect on the transportation resources in the area.

Temporary/Construction Effects

During construction, temporary effects such as lane closures and full closures of the streets at the at-grade crossings would be required to build the Project.

Cumulative Effects

If the Cross-Base Highway were to be constructed, the Freedom Bridge improved, and/or the Camp Murray Gate to be relocated, the cumulative effect of the Project would include benefits to the transportation system because the improvements included with the Project include traffic signal system improvements. When severe congestion from I-5 or JBLM operations extends into the local street system, a train event would have a minimal incremental effect on congestion, similar to the overall traffic effects from the Project.

Would the Project require minimization?

The Project team reviewed the effects of the Project and concluded:

- The Project would not have adverse effects related to transportation system operations (both roadways and railroads) that would require additional minimization. Because the Project includes system improvements to minimize effects such as signal system improvements, the effects are minimal and minimization would not be required beyond what is being proposed. The at-grade crossings to be improved within the limits of the Project would include an improved roadway cross-section (travel lanes and non-motorized facilities) and upgrades to modern active warning standards.

- Where improvements to at-grade crossings are likely to result in temporary traffic delays and periodic lane and/or access revisions during construction, WSDOT and FRA will coordinate with local governments and communities to minimize construction effects. FRA and WSDOT will develop a traffic control plan for each project that includes, but is not limited to the following measures: at least one lane will be kept open at crossings except for short periods of limited duration when new track and new crossing surface panels are being installed at the grade crossings; flaggers and/or signs will be in place when lanes are closed; detour signs will be placed when routes are closed; a uniformed officer will be required at locations where traffic signals will be countermanded; and traffic control plans will be developed in conjunction with the respective agencies.
- The Project would not create any significant unavoidable adverse effects on traffic or transportation.

How does the transportation system work without the Project?

FRA and WSDOT studied existing traffic conditions in the year 2010 and accounted for the planned Sound Transit *Sounder* service in that study. Delays at intersections were rated on a Level of Service (LOS) scale from A to F, with “A” representing the least delay and “F” representing the most delay. The following summarizes existing 2010 conditions:

- In terms of traffic safety, over the last five years from June 2006 through May 2011, there have been two at-grade crossing collisions between trains and vehicles. The collisions occurred at different crossings and did not reflect a frequently recurring safety problem at any one crossing.
- In 2010, two intersections operated worse than local LOS standards: North Thorne Lane Southwest/Union Avenue Southwest, and Berkeley Street Southwest/Union Avenue Southwest. These intersections operated at LOS F in the PM peak hour. In 2030 without the Project improvements (the No Build Alternative), these intersections would continue to operate at LOS F.

The increase in traffic volumes and intersection delay is from actions not associated with the proposed Project, such as the projected growth in population and employment in the area.

For the design year 2030, FRA and WSDOT studied conditions with the planned Sound Transit *Sounder* service but without the Project; this study scenario was the No Build Alternative.

By 2030, traffic volumes would increase, and intersection delay is projected to increase compared to 2010 existing conditions. The increase in traffic volumes and intersection delay is from actions not associated with the Project, such as the projected growth in population and employment in the area. In the 2030 No Build Alternative, the North Thorne Lane Southwest/Union Avenue Southwest and Berkeley Street Southwest/Union Avenue Southwest intersections would continue to operate at LOS F, and the seven intersections summarized in Exhibit 2 would have substandard operations based on LOS standards for local jurisdictions.

Exhibit 2. Year 2030 No Build Alternative – Intersections Operating at LOS E or F

	Level of Service	
Intersection	*AM Peak Hour*	*PM Peak Hour*
East "D" Street and East 26th Street		**E**
East "C" Street and East 26th Street	**F**	**F**
60th Street Southwest and South Tacoma Way		**E**
North Thorne Lane Southwest and Union Avenue Southwest		**F**
North Thorne Lane Southwest and I-5 SB Ramps	**E**	
North Thorne Lane Southwest and I-5 NB Ramps	**E**	**F**
Berkeley Street Southwest and Union Avenue Southwest	**F**	**F**
41st Division Drive and I-5 NB Ramps		**F**
Barksdale Avenue/Locust Road and I-5 NB Ramps	**E**	**E**

With the Project, vehicular traffic volumes would remain the same but train traffic would increase. However, with the train traffic, there would also be improvements to the railroad crossings and signal systems to accommodate the proposed changes.

The net effect of the Project would be that 43 intersections in the AM peak hour and 41 intersections in the PM peak hour would experience slight to no noticeable effect (a delay change of five seconds or less per vehicle). Three intersections in both peak hours (six percent of the study intersections) would experience improved functioning (delay improvements of more than five seconds per vehicle). Only one intersection in the AM peak hour (two percent of the study intersections) and three intersections in the PM peak hour (six percent of the study intersections) would be adversely affected (delay increases greater than five seconds per vehicle); only one of these intersections operates substandard (Thorne Lane Southwest and Union Avenue Southwest at LOS F in the PM peak hour), but the increased delay would be counterbalanced by the reduced delays at the two Thorne Lane Southwest interchange ramp intersections.

Chapter 1 – Project Description

Introduction

Under the High-Speed Intercity Passenger Rail (HSIPR) Program and pursuant to a programmatic Tier I Environmental Assessment (EA) the Federal Railroad Administration (FRA) has approved an application from the Washington State Department of Transportation (WSDOT) to improve the Pacific Northwest Rail Corridor (PNWRC), a federally designated high-speed rail corridor. One project included in the PNWRC application is the Point Defiance Bypass Project (the Project), which would respond to deficiencies in the existing rail operations around Point Defiance. This Discipline Report has been prepared in support of the project-specific EA for the Point Defiance Bypass project.

The Project is located in Pierce County along an existing approximately 20-mile rail corridor between Tacoma and Nisqually.[8] The Project would provide for the re-routing of Amtrak passenger trains from the BNSF rail line that runs along the southern Puget Sound shoreline (Puget Sound route) to the Point Defiance Bypass route, an existing rail corridor that runs along the west side of I-5. The Project would consist of railroad track and support facility improvements, and relocation of the Tacoma Amtrak Station to Freighthouse Square in Tacoma.

Purpose and Need

As described above, the Point Defiance Bypass route is part of the larger PNWRC. Within Washington State, the vision for the PNWRC is to "…improve intercity passenger rail service by reducing travel times and achieving greater schedule reliability in order to accommodate growing intercity travel demand…"[9].

The purpose of the Project is to provide more frequent and reliable high-speed intercity passenger rail service along the PNWRC between Tacoma and Nisqually. In conformity with the decisions under the Tier 1 Programmatic EA, the PNWRC Improvement Program has reduced the overall environmental effects of providing improved passenger rail service with the use of an existing transportation corridor and associated infrastructure, rather than creating a new corridor.

[8] *The three owners of the project corridor are Sound Transit, Tacoma Rail, and BNSF.*
[9] *WSDOT 2009*

The Project is needed to address the deficiencies in the existing rail alignment around Point Defiance. The existing alignment (Puget Sound route), shared by freight and passenger rail traffic, is near capacity and is therefore unable to accommodate additional high-speed intercity passenger rail service without substantial improvements. In addition, the existing alignment has physical and operational constraints that adversely affect both passenger train scheduling and reliability.

Improving intercity passenger rail service in the project area and meeting the Project needs would be accomplished by:

- Enhanced Frequency: Increasing Amtrak Cascades round-trips from four to six by 2017 to meet projected service demands.
- Improved Reliability: Reducing scheduling conflicts with freight trains that often result in delays, and by minimizing or avoiding operational delays (e.g., drawbridge openings) and weather-related delays (e.g., mudslides), and improving on-time performance from 68 percent to 88 percent.
- Enhanced Efficiency: Enhancing the efficient movement of people by decreasing trip times by 10 minutes, and reducing the amount of time passenger trains spend yielding to freight movements.
- Improved Safety: Constructing at-grade crossings with upgraded safety features, including wayside horns, median barriers, advance warning signals, and traffic signal improvements.

What alternatives are being considered for the Point Defiance Bypass Project?

FRA and WSDOT conducted an evaluation of three build alternatives: the Point Defiance Bypass Alternative, the Shoreline Alternative, and the Greenfield Alternative. Two of the alternatives (the Shoreline Alternative, and the Greenfield Alternative) were eliminated from further study. Although both alternatives could meet the Project's purpose and need, they were determined to be impracticable and unfeasible due to technical constraints, high construction costs, and significant environmental effects. Grade separations were also evaluated for further consideration. FRA and WSDOT's preliminary analysis revealed that current and projected future traffic volumes do not warrant the construction of new grade-separated crossings.

What's happening in the bypass corridor today?

The rail line between TR Junction and East "D" Street in Tacoma hosts both freight and commuter trains, including freight operators Tacoma Rail and BNSF, and Sound Transit's *Sounder* commuter rail service. Freight train traffic between TR Junction and East "D" Street averages under two trains per day, while Sound Transit currently operates 18 trains per day between Freighthouse Square and Seattle each weekday, and also offers occasional special event trains, usually on weekends, to serve sporting and other events in Seattle. *Sounder* service to Lakewood begins in late 2012.

What would happen if the Project were not built?

If the Project were not built (the No Build Alternative), Amtrak's Cascades and Coast Starlight passenger train service would continue to use the existing Puget Sound route. The No Build Alternative includes only the minor maintenance and repair activities necessary to keep the existing Puget Sound route operational. With the No Build Alternative, it would be expected that as freight traffic increases, congestion would adversely affect Amtrak service reliability, and the travel time for Amtrak trains between Seattle and Portland would increase.

Along the Point Defiance Bypass route, the Tacoma Rail and BNSF freight services would continue. The at-grade crossings at Clover Creek Drive Southwest, North Thorne Lane Southwest, Berkeley Street Southwest, 41st Division Drive, and Barksdale Avenue Southwest would not be upgraded.

Sound Transit's Sounder commuter passenger trains will become operational in late 2012 between the Tacoma Dome Station at Freighthouse Square in Tacoma and Sound Transit's Lakewood Station (on the Point Defiance Bypass route) with as many as 18 Sounder trains per day.

What are the proposed improvements and related activities of the Point Defiance Bypass Project?

The Project consists of railroad track and support facility improvements, and the relocation of Amtrak's Tacoma Station. Exhibit 3 shows the components of the Build Alternative. The following details specific components of the Build Alternative.

- **Construct New Track Adjacent to the Existing Main Line –** A new 3.5-mile track adjacent to the existing main line would be constructed from South 66th Street (Rail MP 6.9) in Tacoma to between Bridgeport Way SW (Rail MP 10.4) and Clover Creek Drive SW (Rail MP 10.9) in Lakewood.
- **Reconstruct and Rehabilitate the Existing Main Line –** Starting just southwest of Bridgeport Way Southwest (Rail MP 10.4) in Lakewood, the existing track would be reconstructed to a location southeast of the I-

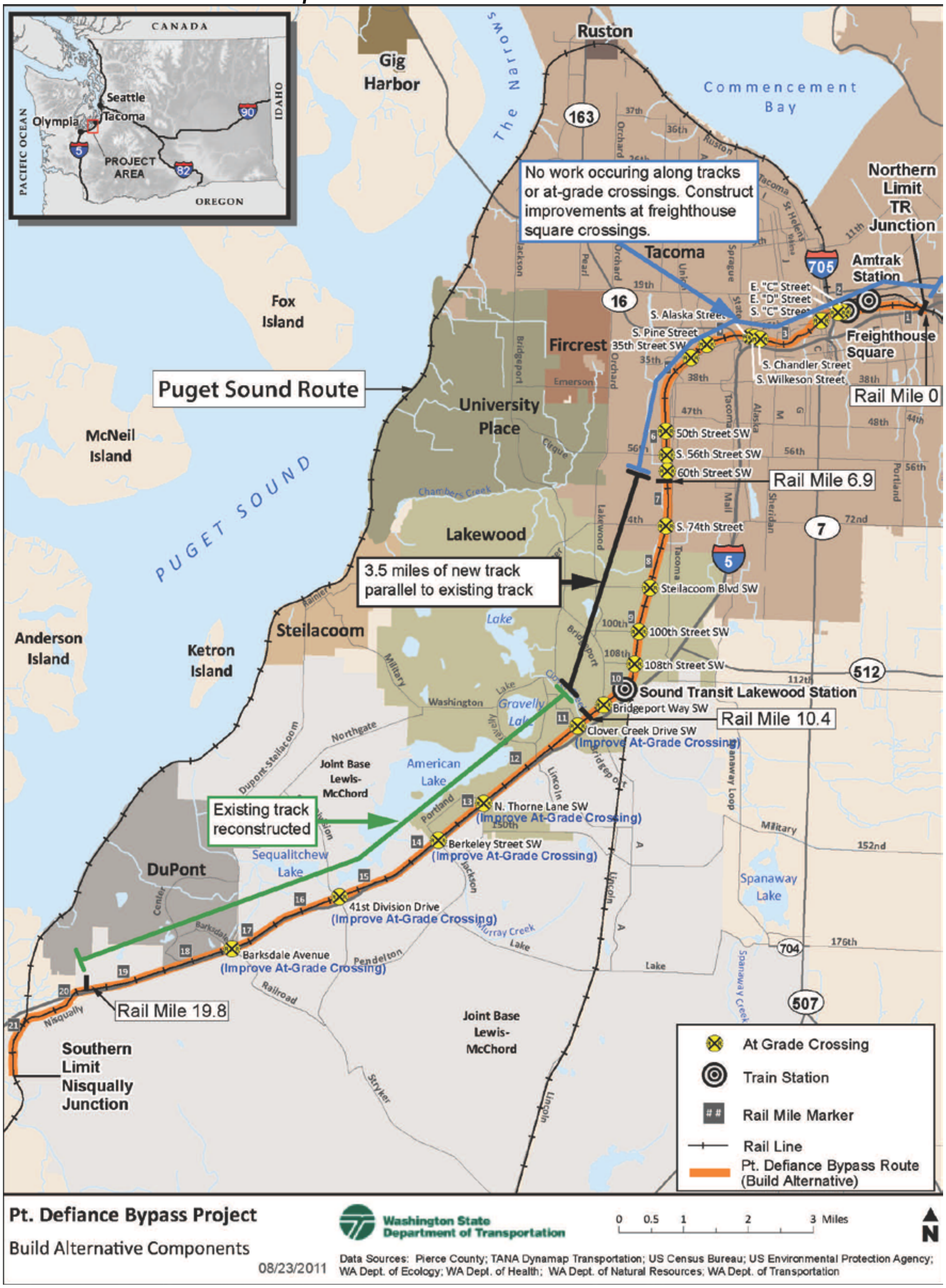
5/Mounts Road Southwest interchange (Rail MP 19.8) at Nisqually Junction.

- **Improvements at at-Grade Crossings –** Several grade crossings would be improved with wayside horns, gates, traffic signals and signage, sidewalks, median separators, and warning devices. These crossings include Clover Creek Drive Southwest, North Thorne Lane Southwest, Berkeley Street Southwest, 41st Division Drive and Barksdale Avenue.
- **Tacoma Amtrak Station Relocation –** The existing Tacoma Amtrak Station would be relocated from its Puyallup Avenue location to the Tacoma Dome Station at Freighthouse Square, at 430 E. 25th Street in Tacoma.

What are the proposed operational changes that would result from the Point Defiance Bypass Project?

Amtrak's existing Cascades and Coast Starlight passenger train service would be rerouted from the Puget Sound route along the Puget Sound shoreline to the Point Defiance Bypass route. The Project would also provide for additional Amtrak Cascades service by increasing the number of round trips provided from 4 to 6, or a total of 12 Cascades service train trips. Amtrak Coast Starlight would also travel on the Point Defiance Bypass route for a total of two Coast Starlight service train trips. The speed of these passenger trains would be up to 79 mph.

Exhibit 3. Build Alternative Components



Chapter 2 – Methodology

How were the Project's effects on transportation evaluated?

Roadways evaluated in this study include every at-grade rail crossing within the 21-mile project corridor. Existing traffic volumes and turning movement data were collected at each at-grade crossing intersection and adjacent intersections affected by the additional train crossings; traffic operations models were used to predict future levels of service and vehicle queue lengths. Grade-separated crossings were not analyzed since crossing traffic is not directly affected when a train passes over or under a crossing. Traffic analysts used specialized transportation models to evaluate traffic operations within the study area (Exhibit 4). The analysts first collected existing travel conditions (traffic volumes and how roadways currently operate now), with the year 2010 chosen to represent current conditions for the Project. Analysts then evaluated how the road system would work today, how the roads would operate in 2030 without the Project (under the No Build Alternative), and how roads would operate in 2030 with a completed project. Analysts paid special attention to the ability for freight to move through the region, both on roads and along the rail lines, and modeled how the Project would affect roadway operations at the railway crossings and nearby intersections. The design year used for modeling was determined to be 2030.[10]

[10] *Although 2040 is now the planning horizon for the Puget Sound Regional Council, the Council's appropriate year to use for future impacts was 2030 when the proposed Project's environmental evaluation commenced.*

Exhibit 4. Study Area

In determining roadway conditions and the Project's likely effects, the analysts modeled current and future traffic volumes on roadways. In order to provide coverage of the entire study area, two computer travel demand models (Lakewood/I-5 VISUM model and Pierce County EMME model) were used to determine roadway volumes. Analysts used these traffic volumes to calculate intersection delay for major intersections (listed in Exhibit 6), which is the average time (in seconds) vehicles wait before moving through an intersection. This time delay is expressed as a Level of Service (LOS), and was evaluated using the methods established by the *Highway Capacity Manual, Special Report 209* (Transportation Research Board, 2000). The standard method used to rate intersection delay is to assign an LOS ranging from 'A' to 'F,' with the letter A describing the least amount of congestion and best operations, and the letter F indicating the highest amount of congestion and worst operations. Exhibit 5 provides the LOS ratings that can be applied to signalized and unsignalized intersections and what the ratings mean.

> ***Intersection delay** is the average time (in seconds) vehicles wait before moving through an intersection.*

Exhibit 5. Level of Service Criteria for Signalized and Unsignalized Intersections

LOS Rating	Signalized Average Delay per Vehicle (in seconds)	Unsignalized Average Delay per Vehicle (in seconds)	Description of Intersection Conditions
A	0-10	0-10	Little or no delay/little congestion
B	> 10-20	> 10-15	Short delays
C	> 20-35	> 15-25	Moderate delays
D	> 35-55	> 25-35	Long delays
E	> 55-80	> 35-50	Very long delays
F	> 80	> 50	Extreme congestion

Source: Highway Capacity Manual (TRB 2000)

Details of the signal phasing and timing plans would be further refined after the NEPA process during final design and construction; for this reason, those details have not been included in this report because the Project cannot commit to them at this stage. FRA and WSDOT will coordinate this effort with local agencies such as the City of Lakewood and use current traffic counts to refine the signal timing plans.

Analysts also determined vehicle queue lengths, which is the length (in feet) of vehicles waiting to move through an intersection. The Project team summarized both average and maximum queue lengths. Average queue lengths are useful for considering relative effects spread over the hour of analysis. However, average queue lengths do not directly reflect the effects of peak in congestion within the hour. Maximum queue lengths are useful for comparing peak traffic congestion in the hour of analysis. For street systems operating without congestion, a train crossing event would likely create maximum queues within the peak hour. For street systems already operating under moderate to severe congestion, a train crossing event may exacerbate the maximum queues; however, it is also possible that maximum queues would not increase if traffic congestion is caused by other factors. The comparison of maximum queues is useful in all cases to

> *A **queue length** is the distance that vehicles extend back from an intersection while waiting to move through.*

compare relative changes between the No Build and Build Alternatives. This information helped to express how traffic moves now on the roadways and how it would move in the future. Finally, a modeling effort was conducted to evaluate specific effects on vehicle traffic at the railroad crossings.

Analysts evaluated the Project's likely effects on pedestrian and bicycle traffic by comparing the non-motorized connections proposed with the Build Alternative to existing facilities.

The sections below provide more detail on how the traffic modeling was conducted.

What information on existing conditions did FRA and WSDOT obtain through field work for this report?

FRA and WSDOT obtained street traffic volumes from manual traffic counts conducted by a consultant for individual days during 2010. The consultant observed how well the study area's intersections were operating by examining the queue lengths. Analysts confirmed the number of travel lanes, length of turning lanes, intersection signal timing, and the type of control at each study area intersection.

For the study areas from North Thorne Lane Southwest to the south, traffic volumes had been collected in 2006 and 2009 from previous studies. The consultant compared these volumes against the 2010 volumes to check for anomalies in the 2010 counts. After checking the data, the most recent 2010 traffic counts were determined most appropriate to use in the analysis. The use of most recent data is also consistent with standard practice.

How was travel demand determined?

Using computer models, analysts determined traffic volumes and the likely allocation of traffic onto the area's roadways in both the morning (AM) and evening (PM) peak traffic periods. This modeling was the starting point for identifying future traffic operations in the study area. Two calibrated models were used for this effort to provide coverage of the study area: 1) the Lakewood/I-5 VISUM travel demand model, which was developed and used in forecasting the traffic volumes completed for Phase 1 of the Project; and 2) the Pierce County EMME travel demand model. Analysts adjusted the two models to accurately portray future conditions. Both models predict traffic volumes and travel patterns based on adopted land use patterns and travel surveys of existing drivers.

Following standard modeling practice, the calibrated Lakewood/I-5 VISUM model was used to forecast year 2030 travel demand within the cities of Lakewood and DuPont, JBLM, and the unincorporated areas of southwestern Pierce County. In this model, the existing year is 2009; therefore, the growth to 2030 reflects 21 years of traffic growth. The existing counts collected for FRA and WSDOT, however, were from year 2010; therefore, the model growth was adjusted to account for 20 years of growth, instead of 21 years. The adjusted growth was applied to the 2010 existing conditions scenario to attain year 2030 travel demand forecasts.

For intersections not included in the Lakewood/I-5 VISUM model described above, analysts used the Pierce County EMME travel demand model. This model was calibrated to its base year of 2007 and included a 2030 forecast year. Similar to the process described for the Lakewood/I-5 travel demand modeling work, the traffic growth rate was adjusted to account for the difference in the model base year of 2007 and the year the traffic counts were collected (2010). Therefore, the resulting traffic volume growth reflects 20 years of traffic growth and was applied to the year 2010 existing conditions scenario to attain year 2030 travel demand forecasts.

Analysts refined the demand modeling results to correct details that the model did not provide by methods such as balancing volumes between adjoining intersections, manually assigning traffic volume growth to each study intersection near the Tacoma Dome to account for the limited amount of model network detail, and applying general growth rates to study area intersections that were not included in the model.

These travel demand models included funded regional improvement projects and projects that are likely to be built. Attachment A lists the roadway projects included in the travel forecast model, which FRA and WSDOT assumed would all be completed by 2030.

What time periods were evaluated?

The periods chosen for travel demand analysis were the peak traffic periods on weekdays during the fall, winter, and spring months at the heaviest commute times of the day. The morning and evening commute periods along the I-5, SR 512, SR 16, and other study area corridors last for several hours. To capture these peak commute periods, the Project team evaluated the following periods:

- General Study Area: *Two-hour periods in the morning (7:00 AM to 9:00 AM) and afternoon (4:00 PM to 6:00 PM)* — Along Bridgeport Way Southwest, at Pacific Highway, and the I-5 ramp terminals, the AM peak period was extended by one hour (6:00 AM to 9:00 AM) because local traffic conditions were anticipated to peak earlier.

- JBLM: A 4-hour period in the morning (5:00 AM to 9:00 AM), a 2-hour period during midday (11:00 AM to 1:00 PM), and a 2-hour period in the afternoon (4:00 PM to 6:00 PM) — JBLM operations begin earlier than general commute traffic and have different travel patterns throughout the average day. The AM peak period was shortened (7:00 AM to 9:00 AM) to study the effects of train crossings here because Amtrak Cascades is not expected to operate between 5:00 AM and 7:00 AM at this location. The period from 5:00 AM to 7:00 AM was, however, used to study the effects of the signal system enhancements around JBLM without train activity.

Once travel demand was established, how were local street operations evaluated?

Traffic analysts used Synchro macroscopic analysis software and VISSIM micro simulation software to model and determine the intersection delay. The standard method used to rate intersection delay is to assign an LOS ranging from 'A' to 'F,' with the letter A describing the least amount of congestion and best operations, and the letter F indicating the highest amount of congestion and worst operations (refer back to Exhibit 5.) With some exceptions in the study area, WSDOT and the cities of Tacoma, Lakewood, and DuPont have designated LOS D or better as an acceptable standard for intersection function. The LOS is based on peak hours. The model also identified queue lengths at each intersection, which indicated whether operations from one intersection would extend back into the next intersection, affecting its operations. Queue lengths are typically reported as the average, maximum, or 95th percentile queue length; this report summarizes the average and maximum queue lengths.

For the local street intersection analysis, the hour of highest traffic volume during the morning and afternoon was used to evaluate operations. The peak hour represents the worst case conditions for the local street operations and presents a conservatively high evaluation of effects. The peak hours used for the operational analysis varied for each at-grade rail crossing study area because the hour with the highest traffic volumes varies by location. For each crossing study area, traffic volumes were balanced between intersections to develop system peak hour volumes.

The results of the travel demand modeling efforts were used as an input to the VISSIM and Synchro traffic operations modeling software. The VISSIM models were used to measure the effects of railroad operations on surrounding roadways and intersections in the study area. This software models the movement of individual vehicles and describes how vehicles accelerate and decelerate, and how traffic queues build and disperse over time. Traffic analysts also used Synchro software to evaluate the effects of railroad operations on intersection operations at specific locations in the study area where traffic volumes were deemed low and the traffic operations relatively simple.

In calculating intersection delays, Synchro and VISSIM are similar in that both are based on traffic flow theory. They differ in that Synchro evaluates delays for groups of vehicles at a time whereas VISSIM simulates individual vehicle movements (at a micro-scale) within a network and the delays for each vehicle factors into the total. Synchro closely emulates HCM procedures; however, VISSIM can account for unique field conditions that the HCM procedures do not address well. For this reason, both tools are often used on transportation projects and applied where they best fit. Delays reported from traffic analysis software provide reasonable approximations for making relative comparisons among project alternatives under NEPA.

Exhibit 6 shows the intersections that were evaluated and the modeling tools used to analyze each of them.

Exhibit 6. Study Intersections and Analysis Tools

Study Intersection	Traffic Signal	Analysis Tool	
		Synchro	*VISSIM*
East "D" Street and East 26th Street	X	X	
East "D" Street and East 25th Street	X	X	
East "C" Street and East 26th Street		X	
East "C" Street and East 25th Street	X	X	
South "C" Street and South Tacoma Way		X	
South "C" Street and South 25th Street		X	
South Chandler Street and South Tacoma Way		X	
South Chandler Street and Center Street		X	
South Alaska Street and South Tacoma Way		X	
South Alaska Street and Center Street		X	
South Wilkeson Street and South Tacoma Way	X	X	
South Wilkeson Street and Center Street	X	X	
South Pine Street and South Tacoma Way	X		X
South Pine Street and Center Street	X		X
35th Street Southwest and South Tacoma Way	X	X	
35th Street Southwest and South Lawrence Street		X	
50th Street Southwest and South Adams Street		X	
50th Street Southwest and South Burlington Way		X	
South 56th Street and South Washington Street	X		X
South 56th Street and South Adams Street/ South Burlington Way			X
South 56th Street and South Tacoma Way	X		X
South 56th Street and South Puget Sound Avenue	X		X

Study Intersection	Traffic Signal	Analysis Tool	
		Synchro	*VISSIM*
60th Street Southwest and South Washington Street		X	
60th Street Southwest and South Adams Street		X	
60th Street Southwest and South Tacoma Way		X	
South 74th Street and South Tacoma Way	X		X
Steilacoom Blvd Southwest and Lakeview Avenue Southwest	X		X
Steilacoom Blvd Southwest and Durango Street Southwest			X
100th Street Southwest and Lakeview Avenue Southwest	X		X
108th Street Southwest and Lakeview Avenue Southwest	X		X
108th Street Southwest and Halcyon Road Southwest			X
Bridgeport Way Southwest and Pacific Highway Southwest	X		X
Bridgeport Way Southwest and I-5 Southbound (SB) Ramps	X		X
Bridgeport Way Southwest and I-5 Northbound (NB) Ramps	X		X
Clover Creek Drive Southwest and Hillcrest Drive Southwest		X	
Clover Creek Drive Southwest and Pacific Highway Southwest		X	
North Thorne Lane Southwest and Union Avenue Southwest	In 2030 Build		X
North Thorne Lane Southwest and I-5 SB Ramps	X		X
North Thorne Lane Southwest and I-5 NB Ramps	X		X
Berkeley Street Southwest and Union Avenue Southwest	In 2030 Build		X
Berkeley Street Southwest and I-5 SB Ramps	X		X
Berkeley Street Southwest and I-5 NB Ramps	X		X
41st Division Drive and I-5 SB Ramps			X
41st Division Drive and I-5 NB Ramps			X
Barksdale Avenue and DuPont-Steilacoom Road	X		X
Barksdale Avenue and I-5 SB Ramps	X		X
Barksdale Avenue/Locust Road and I-5 NB Ramps	X		X

How was the safety of highway and rail crossings studied?

Analysts reviewed the findings of a railroad crossing review completed by a multi-agency diagnostic team in September 2006. The findings were reviewed to identify improvements incorporated by Sound Transit and those proposed to be included with the Build Alternative.

In November 2011, analysts consulted data published by the FRA Office of Safety Analysis on their Web page (mid-August 2011) (http://safetydata.fra.dot.gov/OfficeofSafety/) to confirm the number of traffic accidents that have occurred in the vicinity of the existing at-grade railroad crossings in the study area. At the time, data were available through September 2011 and analysts reviewed the last five years of historical data from October 2006 through September 2011. The FRA database describes the severity and type of accidents and the analysts used that information to describe the safety issues associated with the current rail crossings, as well as the likely safety issues expected with the Project.

In addition to reviewing historical data, analysts used the FRA accident prediction model to consider the effects of the Project on safety. Inputs into the model were taken mostly from the FRA crossing inventory database; however, for the Bypass Route, traffic volumes gathered for the Project were used to estimate annual average daily traffic (AADT) on the roadways. It was estimated that 10 daily vehicle trips occur on the crossing roadways for every PM peak hour trip. For the Bypass Route, the 2030 AADT was determined from growth experienced between 2010 and 2030 PM peak hour volumes. For the Puget Sound Route, the 2030 AADT was obtained using minimal growth at the crossings because much of the land on the water side of the tracks is already occupied by development. On the Bypass Route, freight rail traffic was estimated to remain at existing train volumes based on inputs from Tacoma Rail, Sound Transit *Sounder* volumes were input consistent with the train volumes documented in Chapter 1. On the Puget Sound Route, train volumes were estimated to reach their peak capacity based on train volumes found in Statewide Rail System Capacity and Needs study by the Washington State Transportation Commission.

The Railroad-Highway Grade Crossing Handbook identifies two accident frequency thresholds for considering crossing improvements regardless of whether or not the improvements are economically justifiable:

- When the expected accident frequency predicted by the USDOT Accident Prediction Formula exceeds 0.1 accidents per year (one accident every 10 years) for crossings with active devices without gates, consider active devices with gates.
- When the expected accident frequency predicted by the USDOT Accident Prediction Formula exceeds 0.5 accidents per year (one accident every two years) for crossings with active devices with gates, consider grade separation.

Analysts used these thresholds to conclude whether additional safety improvements are needed to mitigate existing and future safety conditions. The predicted accident experience has been expressed as the number of years between accidents rather than accidents per year, to provide a more understandable accident measure.

Besides expressing accident experience as a frequency in terms of accidents per year, traffic engineers often express accident experience based on the exposure frequency to conditions that might create the potential for an accident. For the Project, the analysts have predicted accident rates for future year 2030 conditions with the No Build and Build Alternatives to provide a relative comparison of overall safety in the rail system based on exposure. The rates were expressed in terms of accidents per million train crossings because, without a train crossing, there is no chance for vehicle and non-motorized traffic to collide with a train.

Chapter 3 – Studies and Coordination

How does this report relate to previous environmental studies completed for the Project?

The Federal Highway Administration (FHWA) issued a NEPA Documented Categorical Exclusion for the Point Defiance Bypass Project in August 2008. The recent American Recovery and Reinvestment Act (ARRA) High Speed Rail award that Washington State received in January 2010 will provide funding to complete construction near the end of 2017. FRA is requiring that an EA is completed under their regulations before the ARRA funding can be made available for construction.

This report builds upon environmental work previously completed by FRA and WSDOT for the Project including:

- *Point Defiance Bypass Project Traffic and Transportation Discipline Report* published August 2007, revised March 2008
- *Existing (November 2010) Traffic Volumes Summary – Revision 1 Technical Memorandum*, May 4, 2011
- *Base Year No-Build Conditions Technical Memorandum – Revision 3*, May 4, 2011
- *Base Year Build Conditions Technical Memorandum*, May 4, 2011
- *Future Year Conditions Technical Memorandum*, May 4, 2011
- *Existing (September 2010) Traffic Volumes Summary Technical Memorandum*, October 8, 2010
- *2010 Early AM Peak Hour Analysis at the Berkeley Street Interchange Area Findings Paper*, March 3, 2011
- *2010 Noon Peak Model Calibration and Evaluation of Proposed Traffic Signal Phasing under 2010 Noon Peak Hour Traffic Volumes Technical Memorandum*
- *Existing Conditions Technical Memorandum*, November 19, 2010
- *Proposed Signal Phasing/Timing and Traffic Operations Technical Memorandum*, March 31, 2011

- *Proposed Signal Phasing/Timing and Traffic Operations Technical Memorandum (with Cross-Base Highway),* April 26, 2011
- *Point Defiance Bypass – Phase 1 Traffic Analysis Methodology and Operational Summary Technical Memorandum*, July 2011

How did the Project team coordinate with the public, local cities, Pierce County, and agencies?

Public Involvement

The Project team has conducted a number of public outreach efforts, including open houses, an information booth at a community event, and presentations such as:

- Open House, Clover Park Technical College, August 31, 2011
- Tillicum/Woodbrook Neighborhood Association (Lakewood) – January 6, 2011
- Open House, Tillicum Community Center (Lakewood) – November 15, 2010
- Tacoma Farmers Market (downtown Tacoma) – September 16, 2010
- Open House (Lakewood) – May 17, 2010

WSDOT has also posted information on the Project Website at: http://www.wsdot.wa.gov/Projects/Rail/PNWRC_PtDefiance/default.htm.

The purpose of these outreach efforts was to provide timely information to people interested in and/or affected by the Project and to provide different types of opportunities for the public to provide input. FRA and WSDOT plan to continue with outreach efforts until the Project is constructed. To date, the Project team has conducted more than 40 briefings and outreach events, and comments from the affected communities cover these main areas:[11]

- Safety: concerns about faster, more frequent trains on a track that currently sees only intermittent freight traffic.
- Traffic: concerns about increased congestion due to additional trains passing through busy intersections
- Noise: Increased noise from trains passing through and also from train horns.

[11] *http://www.wsdot.wa.gov/Projects/Rail/PNWRC_PtDefiance/PublicOutreach.htm visited on September 22, 2011.*

- Declining property values: concerns that property values are at risk due to noise, vibration, and traffic effects.
- WSDOT is just "checking the boxes" on their process and has little interest in neighborhood concerns.
- Community connectivity: Increased train service may further isolate Tillicum neighborhood.

Advisory Teams

To ensure meaningful engagement and to maintain steady progress on the Project, the Project team invited key stakeholders and municipalities within the study area to be part of two advisory teams during the environmental process—a Technical Advisory Group (TAG) and an Executive Advisory Team. FRA's and WSDOT's advisory team partners include:

- City of DuPont
- City of Lakewood
- City of Tacoma
- Pierce County
- Sound Transit
- Clover Park School District
- JBLM
- Camp Murray
- FHWA

FRA and WSDOT convened meetings of the TAG to review the technical transportation information and modeling results and findings provided by the Project team. The TAG provided feedback and review, and ultimately forwarded the Project information to an Executive Advisory Team for review. The Executive Advisory Team has met regularly and provided further transportation-related technical review of the data.

FRA and WSDOT also continue to regularly update and receive input from the Governor's Office, Washington State Legislators, and Washington State's US Senators.

Chapter 4 – Affected Environment

This chapter summarizes existing transportation characteristics within the study area. Included are descriptions of the existing rail and road system and how they currently operate, as well as a discussion of how the rail operations and on-road traffic interact.

What is rail service like in the study area?

Both freight and passenger train traffic has increased over time on the existing main line in the Tacoma vicinity. The existing rail alignment around Point Defiance is near capacity and has physical and operational constraints that adversely affect both passenger and freight train scheduling and reliability. A number of ties are worn or otherwise defective, ballast is low in places, the wearing surface of the rails needs work, and some of the existing drains underneath the track are blocked.

As discussed in Chapter 1, both Sound Transit and Amtrak operate passenger trains through the study area.

Sound Transit

Sound Transit currently provides *Sounder* commuter rail service between Tacoma and Seattle, as well as Tacoma Link light rail in downtown Tacoma. Both of these services connect to the Tacoma Dome Station at Freighthouse Square in Tacoma.

Sound Transit currently operates 18 *Sounder* trains per weekday in the area, and also offers occasional special event trains, usually on weekends, to serve sporting and other events in Seattle. Weekday headways for *Sounder* service vary in the morning and afternoon commutes; midday service is not provided. Beginning in 2012, 12 of the 18 weekday trains would also travel between the Tacoma Dome Station and Lakewood Station with ultimately all 18 weekday trains continuing to the Lakewood Station.

Tacoma Link light rail service operates between the Tacoma Dome Station at Freighthouse Square and the Theater District Station in downtown Tacoma. On weekdays, trains run every 12 minutes for the majority of the day and operate every 24 minutes in the early morning and late evening.

On the weekend, trains run every 12 minutes on Saturdays and every 24 minutes on Sundays during the hours of operation.

Amtrak

Amtrak Cascades provides passenger rail service from Eugene/Springfield, Oregon, to Vancouver, British Columbia, Canada. The Tacoma Amtrak Station is located at the north end of the study area near Freighthouse Square. Currently, Amtrak Cascades and Coast Starlight trains run on the BNSF line along Puget Sound. The following trains operate in the morning:

- Southbound trains arrive at the Tacoma Amtrak Station and travel south through the study area at 8:13 AM (Cascades) and 10:31 AM (Coast Starlight).
- A northbound train arrives at the Tacoma Amtrak Station from Olympia-Lacey at 11:04 AM (Cascades).

In the evening, the following trains operate:

- Southbound trains arrive at the Tacoma Amtrak Station and travel south through the study area at 3:03 PM and 6:13 PM (Cascades).
- Northbound trains arrive at the Tacoma Amtrak Station from Olympia/Lacey at 2:49 PM, 5:24 PM (Cascades), and 7:11 PM (Coast Starlight).

The above arrival times are approximate. The current northbound schedule allows 42 minutes (Cascades) and 49 minutes (Coast Starlight) between Olympia/Lacey and Tacoma, and the southbound schedule allows 37 minutes (Cascades) and 50 minutes (Coast Starlight). When Amtrak relocates the Tacoma Amtrak Station, the actual schedule between the new station location and Olympia/Lacey is projected[12] to be reduced to as little as 29 minutes for Cascades while keeping the Coast Starlight operating under the current schedule.

Freight Rail

Tacoma Rail and BNSF are the operators of freight trains in the study area. Currently, there are two or fewer freight trains per day[13] operating in the south end of the study area on the Bypass Route, between Nisqually and South Tacoma. BNSF freight operations extend only between Nisqually and 100th Street Southwest in Lakewood, further serving JBLM

[12] *The actual schedule will be set once construction nears completion.*
[13] *Tacoma Rail related to the Project team that an average of two or less freight trains per day use this segment of rail.*

and the town of Roy via a branch line that extends south to those facilities from 108th Street Southwest in Lakewood. Freight train traffic between TR Junction and East "D" Street also currently averages less than two trains per day.[14] Tacoma Rail is the only freight operator serving customers on their rail line in Frederickson and other points south of Tacoma. Tacoma Rail switches railcars while it builds trains in the Barksdale Avenue crossing area. During this switching operation, Barksdale Avenue can be closed to street traffic for many minutes, which affects the movement of vehicular and non-motorized traffic in the City of DuPont.

Rail Stations

The Tacoma Amtrak Station is currently located downtown at 1001 Puyallup Avenue—one block north and approximately three blocks east of Freighthouse Square. A waiting area is provided at the station as well as free short-term and long-term overnight on-site parking. A 2007 marketing survey[15] showed riders accessing the Amtrak Cascades Seattle to Portland service used the following means of transportation to/from the rail stations:

- 59% used a car
- 14% used a taxi or limousine
- 13% used local transit
- 8% walked
- 2% used a connecting Amtrak bus
- 1% used a connecting Amtrak train

Although no data are provided for riders in Tacoma, these percentages may indicate that riders often are open to multiple transportation options to access rail service. Operating an Amtrak station near or at multimodal transit centers could reduce the travel demand by personal vehicle. The predominant travel pattern for vehicles to and from the existing Tacoma Amtrak Station is between I-5/I-705 slip ramp to East 26th Street and the existing parking lot. A secondary travel pattern also exists between the Tacoma Amtrak Station and I-5 for travelers to and from the north via the East Bay Street/SR 167 interchange.

Freighthouse Square is a multimodal transit center in downtown Tacoma at which the Tacoma Dome (rail) Station is located; the Tacoma Link and *Sounder* commuter rail stop directly at the station. The bus transit center is located one block north of the Freighthouse Square Station and is served by Intercity Transit, Pierce Transit, and Sound Transit Express. The

[14] *Tacoma Rail related to the Project team that an average of two or less freight trains per day use this segment of rail.*
[15] *2007 Marketing Demographic Study, prepared for Amtrak.*

Greyhound bus station is located across East “F” Street from the bus transit center. Amtrak passenger rail is located nearby.

The *Sounder* South Tacoma Station, which was built in 2009, is located within the study area at 60th Street Southwest and South Adams Street. When *Sounder* is fully operational to the South Tacoma Station, 18 trains would arrive and depart from the station each day.[16] During peak commuting times, trains would depart every 30 minutes on the way to Seattle.

Sound Transit’s Lakewood Station, which was completed in 2008, is located within the study area at 11424 Pacific Highway Southwest, and includes a side platform and shelters for passengers. A parking garage at the station provides more than 600 commuter parking spaces.

What are the roadway characteristics?

The study area was determined by including all streets and intersections that could possibly be affected by the Project, based on anticipated queues. Exhibit 7 lists all of the streets in the study area crossed by the Project rail alignment and physically altered by it (see Chapter 2, Exhibit 4 Study Area Map), and presents some of the basic characteristics of these roadways.

Exhibit 7. Existing Roadway Characteristics for Study Area Roadways

Crossing Street	Local Agency	Posted Speed Limit (mph)	Travel Lanes at Crossing	Bike Lanes	Sidewalks
East “D” Street[17]	City of Tacoma	25	3	Both Sides	Both Sides
East “C” Street	City of Tacoma	25	2	Both Sides	Both Sides
South “C” Street	City of Tacoma	30	2	East Side 14-foot Wide Combination Bike Lane/Sidewalk	
South Chandler Street	City of Tacoma	25	2	No	No
South Alaska Street	City of Tacoma	25	2	No	No
South Wilkeson Street	City of Tacoma	30	2	No	Both Sides
South Pine Street	City of Tacoma	35	4 with striped median	No	Both Sides
South 35th Street	City of Tacoma	30	2	No	One Side
South 50th Street	City of Tacoma	25	2	No	One Side
South 56th Street	City of Tacoma	25	4	No	Both Sides
60th Street	City of Tacoma	25	2	No	One Side

[16] *E-mail communication from Eric Beckman of Sound Transit to Kevin Jeffers of WSDOT on September 15, 2011.*
[17] *Separate construction by Sound Transit will result in the conditions described at E. “D” Street, E. “C” Street, and S. “C” Street*

Crossing Street	Local Agency	Posted Speed Limit (mph)	Travel Lanes at Crossing	Bike Lanes	Sidewalks
Southwest					
South 74th Street	City of Tacoma	35	4 with center raised median	No	Both Sides
Steilacoom Blvd Southwest	City of Lakewood	35	5	No	Both Sides
100th Street Southwest	City of Lakewood	35	5	No	No
108th Street Southwest	City of Lakewood	25	2 with center raised median	Both Sides	Both Sides
Bridgeport Way Southwest	City of Lakewood	35	4 with striped median	No	Both Sides
Clover Creek Drive Southwest	City of Lakewood	35	2	No	No
North Thorne Lane Southwest	City of Lakewood	35	3	No	No
Berkeley Street Southwest	City of Lakewood	35	3	No	No
41st Division Drive	JBLM	35	6 with median	No	No
Barksdale Avenue	City of DuPont	35	5 with median	No	No

Source: City of Tacoma govME, previous studies and Google Maps.

How do the roadways operate now?

What are the intersection LOSs during the peak hours?

The LOS for all of the study area's signalized and unsignalized intersections is provided in Exhibit 8 through Exhibit 17. These LOS measures are for the peak hours with Sound Transit *Sounder* trains present. The exhibits show that in the 2010 morning peak hour, the study area intersections range from LOS A through D. In the 2010 afternoon peak hour, no intersections operate at LOS E and two intersections operate at LOS F: 1) North Thorne Lane Southwest and Union Avenue Southwest with 52.4 seconds per vehicle of delay, and 2) Berkeley Street Southwest/Union Avenue Southwest with 72.0 seconds per vehicle of delay. The remaining study area intersections operate at LOS A through D. Intersections operating at LOS E or F do not meet the LOS standard of the jurisdictions in which they are located (see Chapter 2). Intersection LOS is affected at times by train crossings as described below.

Exhibit 8. Intersection LOS – Existing Year 2010, East "D" Street through South "C" Street

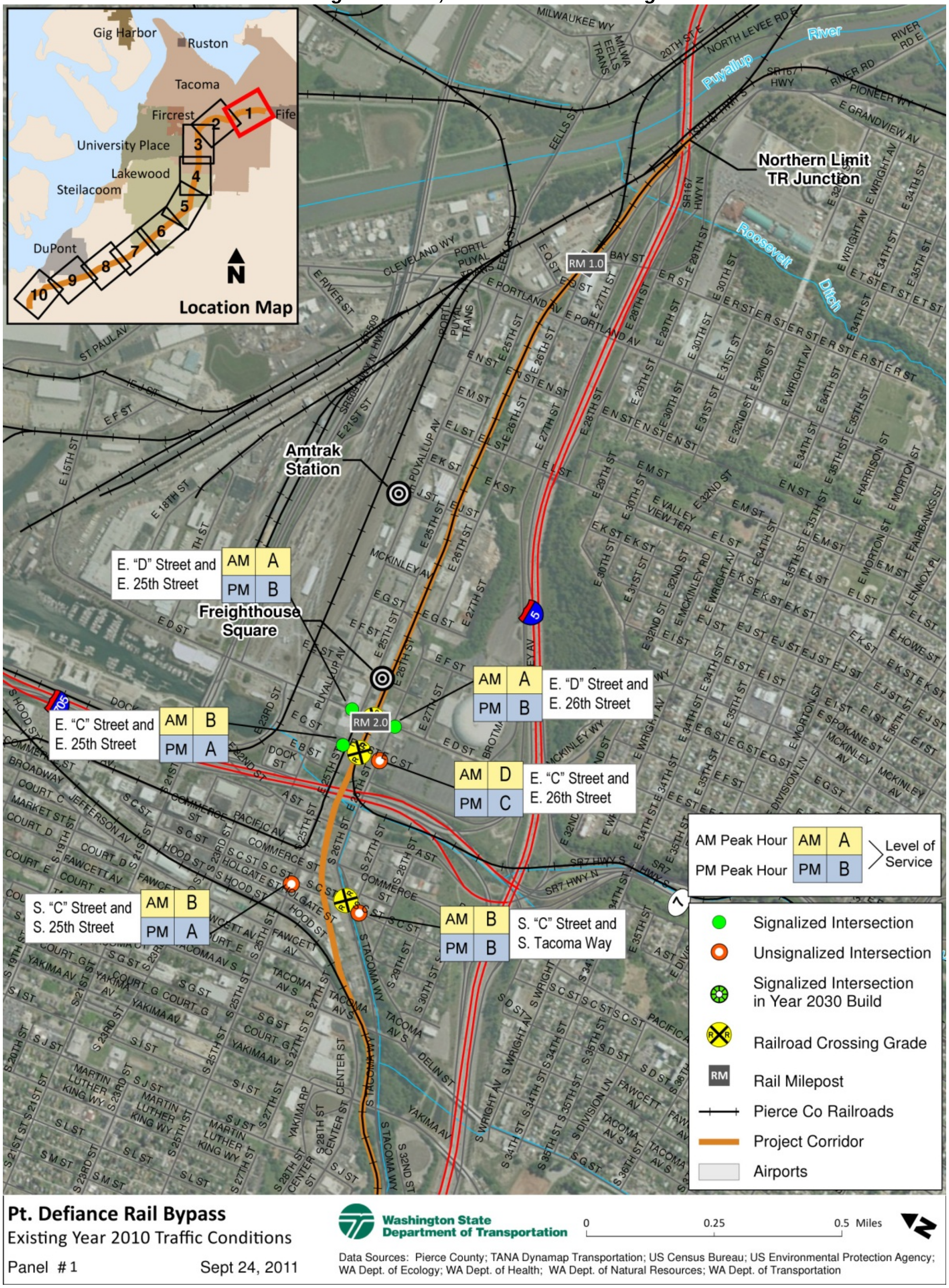


Exhibit 9. Intersection LOS – Existing Year 2010, South Chandler Street through South Pine Street

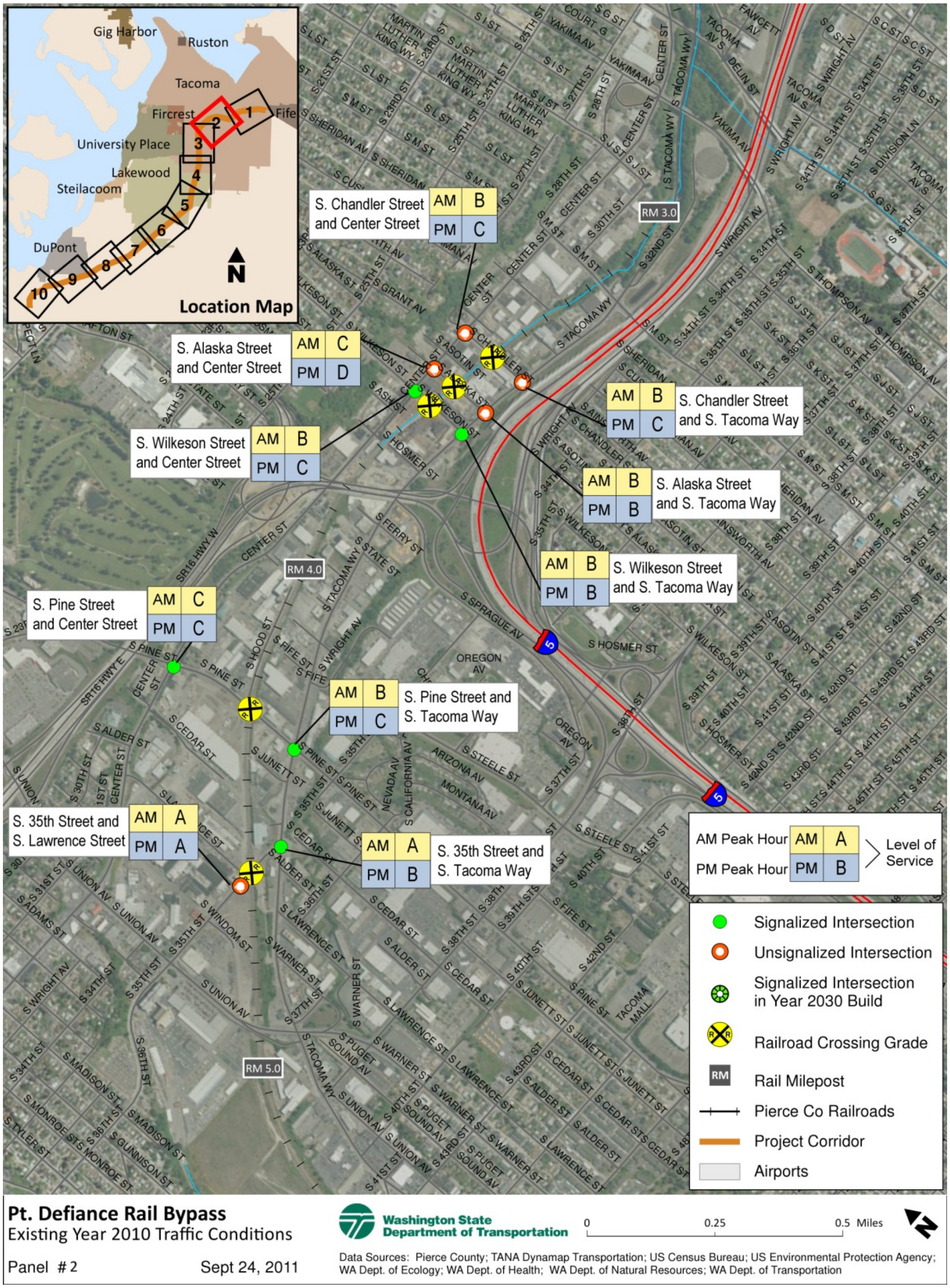
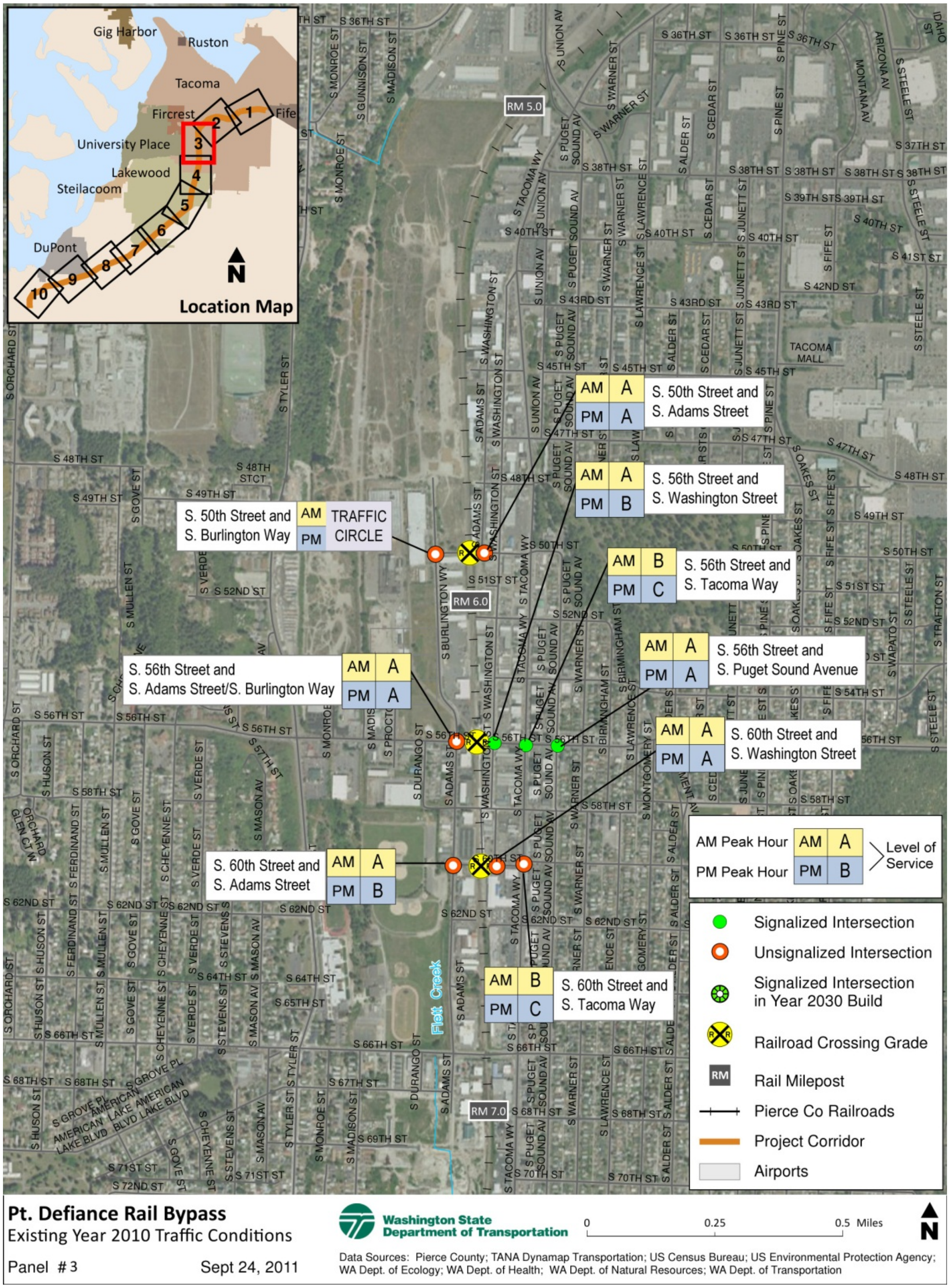


Exhibit 10. Intersection LOS – Existing Year 2010, 50th Street Southwest through 60th Street Southwest[18]



[18] *The intersection of 50th Street SW/S. Burlington Way is controlled by a traffic circle and although not measurable by HCM 2000 methodology, operations there are expected to be LOS D or better since traffic volumes are very low (100 vehicles or less entering the intersection in both peak hours).*

Exhibit 11. Intersection LOS – Existing Year 2010, South 74th Street through Steilacoom Boulevard Southwest

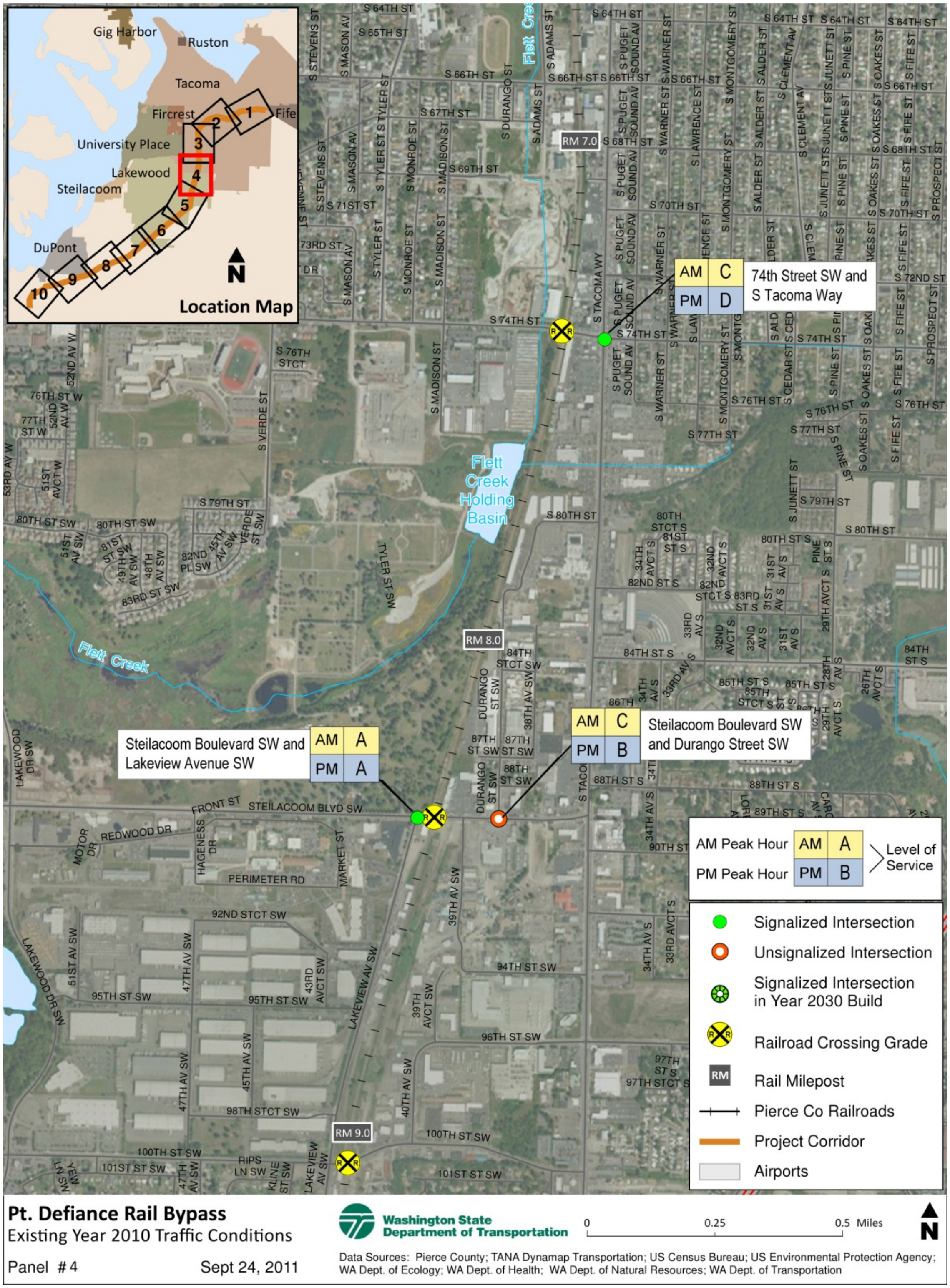


Exhibit 12. Intersection LOS – Existing Year 2010, 100th Street Southwest through Clover Creek Drive Southwest

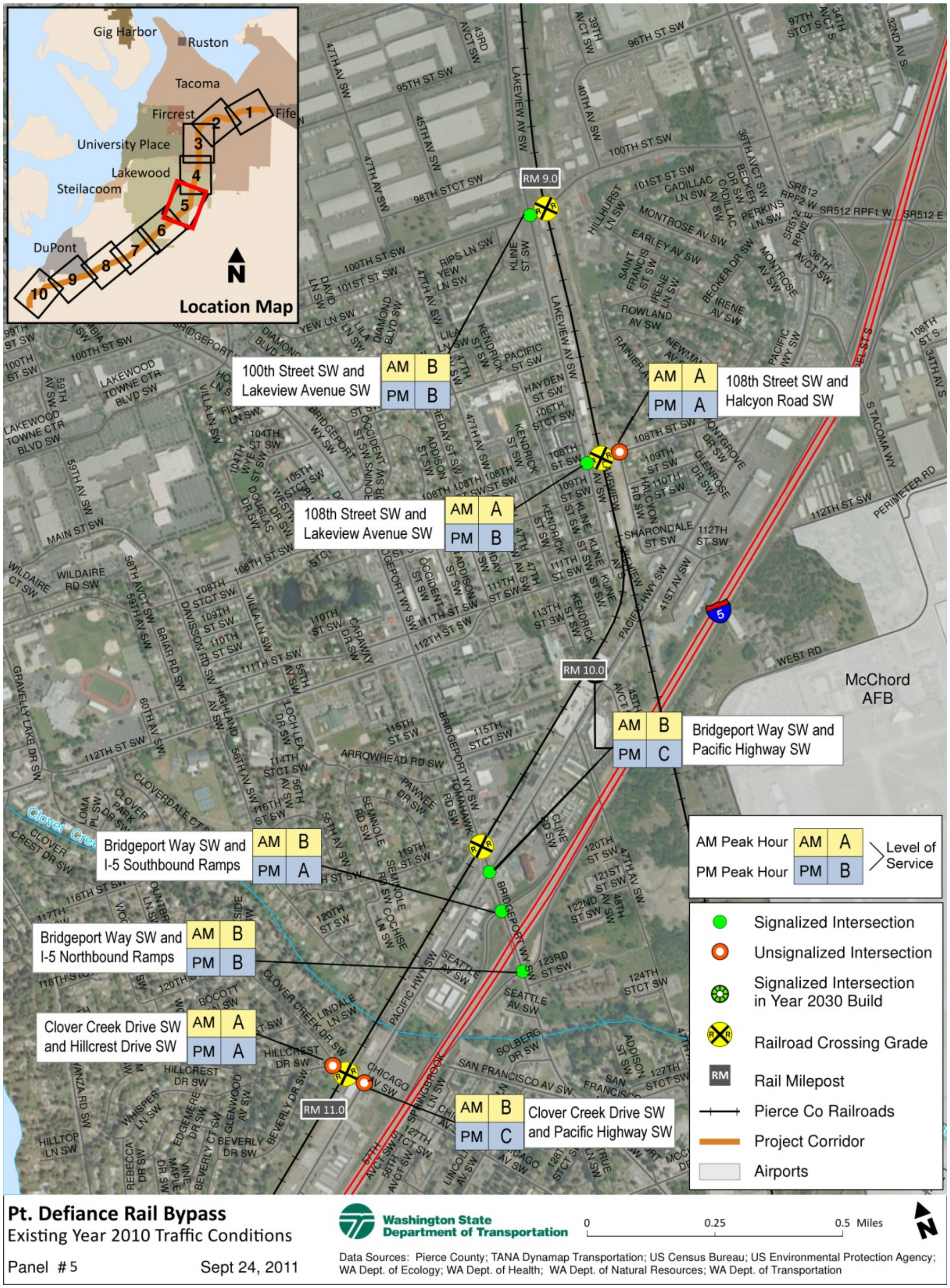


Exhibit 13. Intersection LOS – Existing Year 2010, North Thorne Lane Southwest

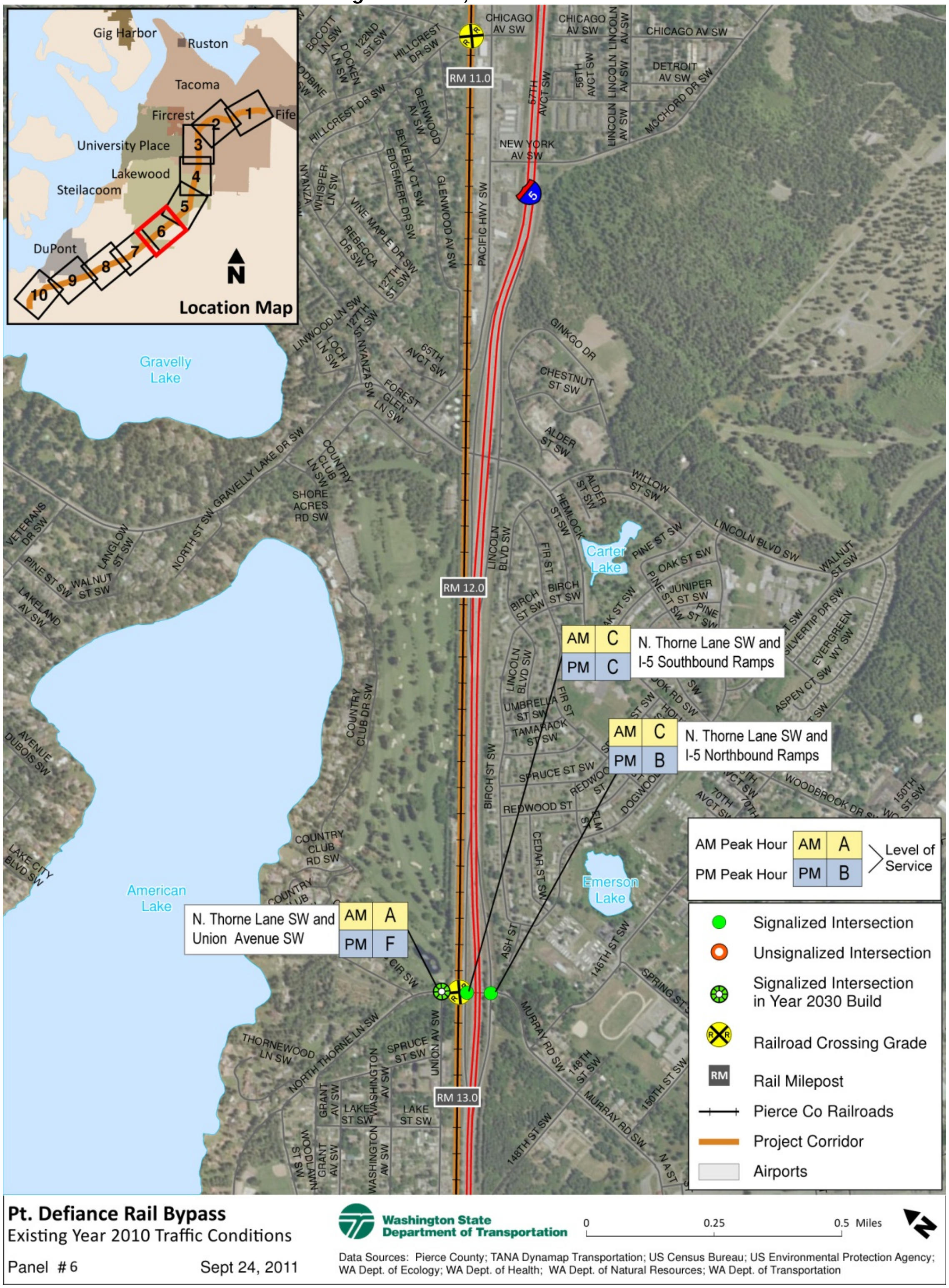


Exhibit 14. Intersection LOS – Existing Year 2010, Berkeley Street Southwest

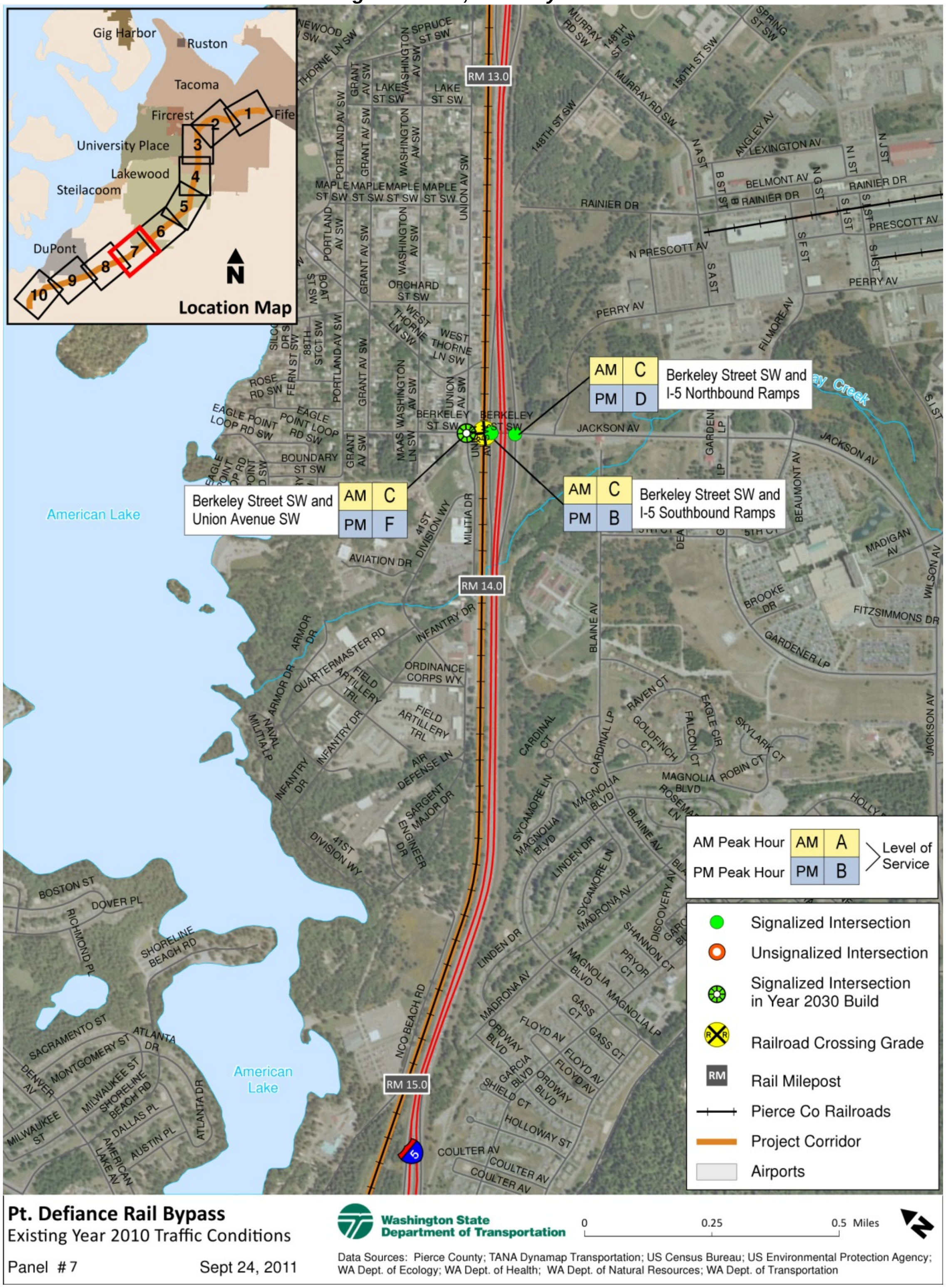


Exhibit 15. Intersection LOS – Existing Year 2010, 41st Division Drive

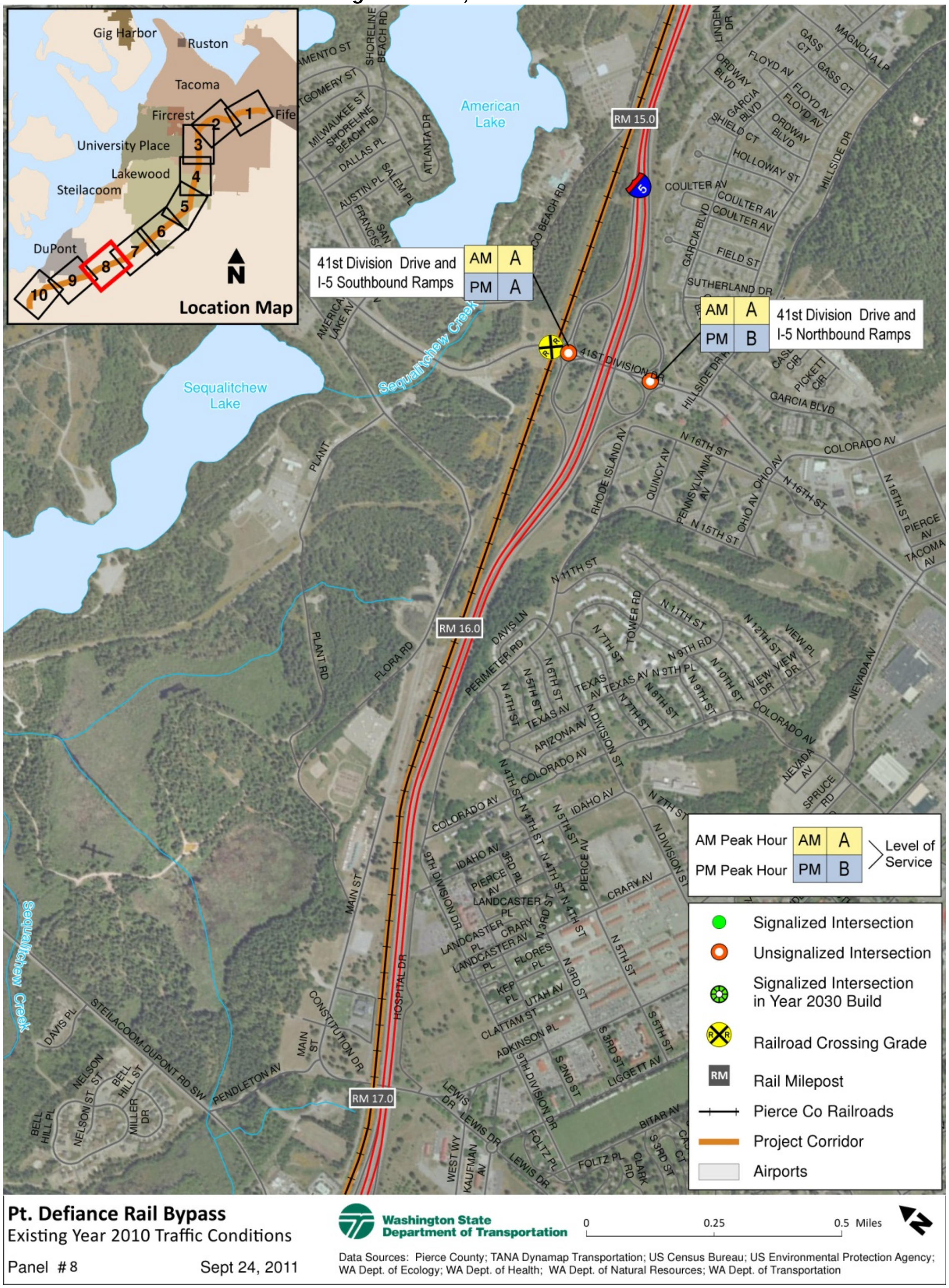


Exhibit 16. Intersection LOS – Existing Year 2010, Barksdale Avenue

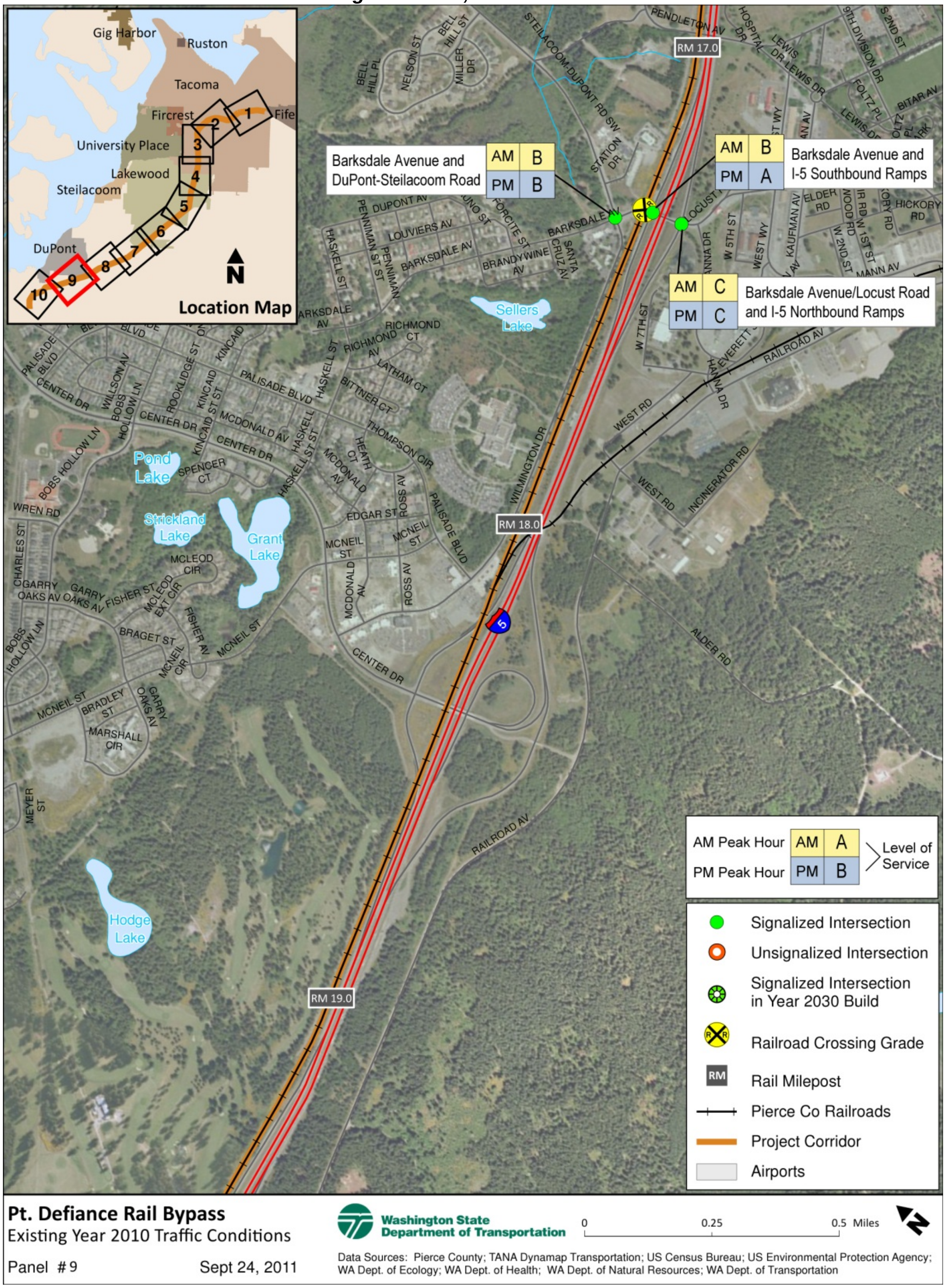
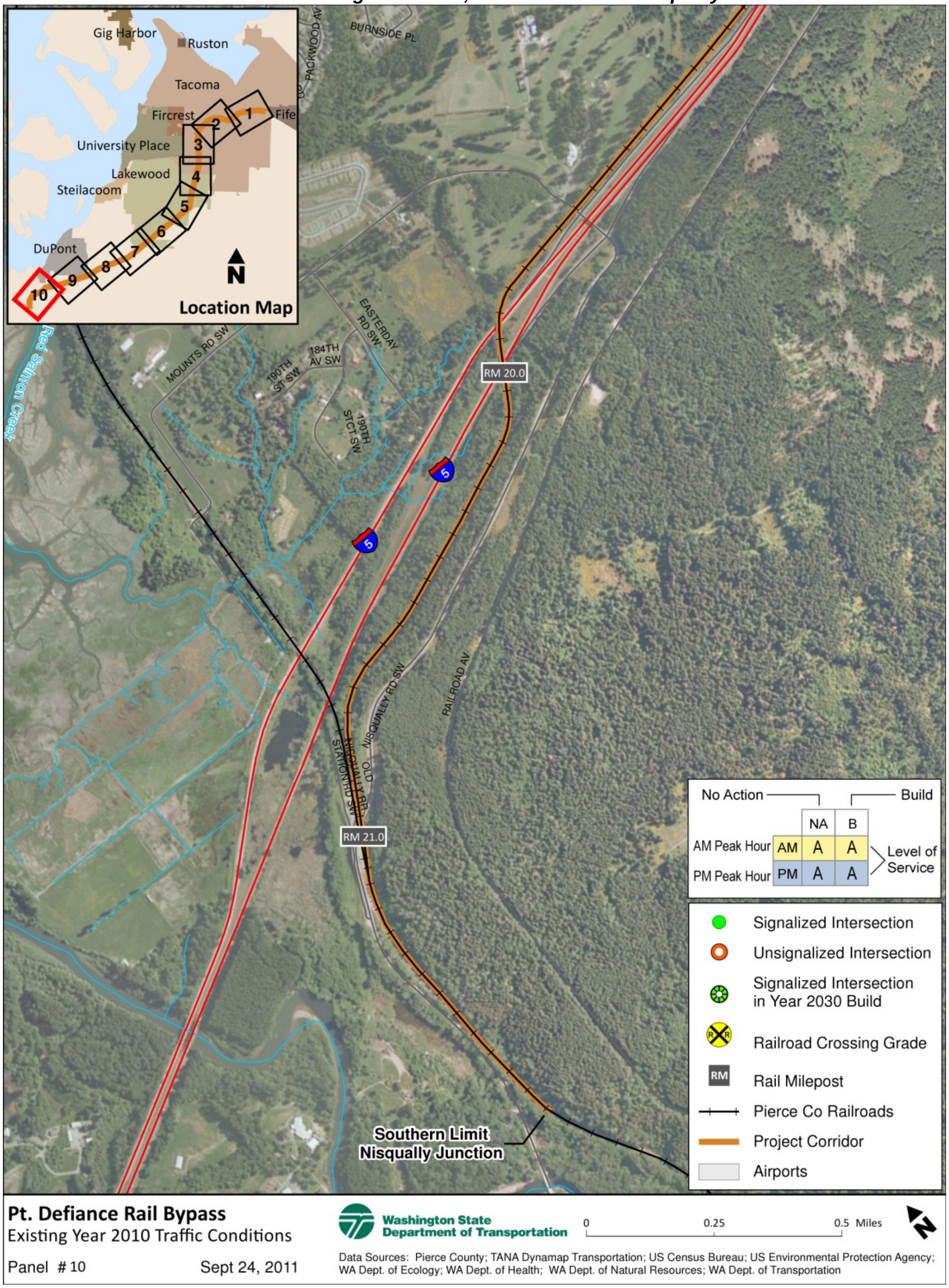


Exhibit 17. Intersection LOS – Existing Year 2010, South Terminus Nisqually Junction[19]



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[19] *Although the 10th panel of the proposed Project study area map is shown here for existing conditions, it will not be repeated in the future conditions discussion because there are no at-grade rail crossings or study area intersections on it.*

Existing Queue Lengths

Exhibit 18 through Exhibit 48 summarize the existing vehicle queues at intersections identified by the City of Tacoma for inclusion in this report and in Lakewood, south of where *Sounder* passenger train service ends and LOS is expected to be substandard in the future. Attachment B is a summary of the existing and future queue lengths (both with the project and without) for each intersection analyzed. Existing conditions are summarized for these locations to provide an understanding of existing traffic effects on the system before future growth. The Project team has noted how far vehicle queues extend back from an intersection today. Vehicle queues can affect traffic operations by blocking access to turn pockets, through lanes, and driveways.

South 56th Street and South Adams Street/South Burlington Way

Exhibit 18 and Exhibit 19 summarize the existing queues at South 56th Street and South Adams Street/South Burlington Way.

Exhibit 18. Existing Queues and Storage at South 56th Street and South Adams Street/South Burlington Way

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
South 56th Street	Eastbound (EB) Left	75	AM	0	20
			PM	0	23
	EB Through	300 I/S	AM	8	297
			PM	14	370 B
	EB Right	Shared	AM	3	212
			PM	5	285
South 56th Street	Westbound (WB) Left	75 RR	AM	0	41
			PM	2	93
	WB Through	75 RR	AM	2	126 B
			PM	4	141 B
	WB Right	Shared	AM	0	62
			PM	0	97
South Adams Street	Northbound (NB) Left	75	AM	1	30
			PM	3	40
	NB Through	650 I/S	AM	0	46
			PM	1	58
	NB Right	Shared	AM	1	54
			PM	1	60
South Burlington Way	Southbound (SB) Left	75	AM	1	29
			PM	0	0
	SB Through	200 RR	AM	0	16
			PM	0	38
	SB Right	Shared	AM	0	0
			PM	0	0

Storage distances estimated to the nearest 25 feet.
I/S Distance to next upstream intersection.
RR Distance reported to upstream railroad crossing.
_ Spillback occurs outside of storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 19. Existing AM and PM Peak Hour Maximum Queue Lengths for South 56th Street and South Adams Street/South Burlington Way

At the South 56th Street and South Adams Street intersection, all AM peak hour maximum queues would be accommodated by the available storage.

Two movements are estimated to have maximum queues that would exceed the available storage during the PM peak hour. The eastbound through queue was estimated to reach a maximum length of 370 feet, compared to a distance of approximately 300 feet to the upstream intersection, which would impede turning movements from South Durango Street (intersects South 56th Street between South Adams Street and South Proctor Street). The westbound left-turn maximum queue of 93 feet would exceed the 75 feet of available storage and would extend into the railroad spur tracks west of the main tracks.

South 56th Street and South Washington Street

Exhibit 20 and Exhibit 21 summarize the existing queues at South 56th Street and South Washington Street.

Exhibit 20. Existing Queues and Storage at South 56th Street and South Washington Street

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
South 56th Street	EB Left	50	AM	8	203
			PM	12	192
	EB Through	125 RR	AM	6	187 B
			PM	11	180 B
	EB Right	Shared	AM	6	187 B
			PM	11	180 B
South 56th Street	WB Left	Shared	AM	1	54
			PM	1	38
	WB Through	225 I/S	AM	21	317
			PM	19	366
	WB Right	Shared	AM	12	280
			PM	19	366
South Washington Street	NB Left	75	AM	1	43
			PM	3	50
	NB Through	600 I/S	AM	4	56
			PM	3	56
	NB Right	Shared	AM	4	58
			PM	4	58
South Washington Street	SB Left	100	AM	5	56
			PM	11	213
	SB Through	600 I/S	AM	3	50
			PM	10	237 B
	SB Right	Shared	AM	2	78
			PM	63	727

Storage distances estimated to the nearest 25 feet.
I/S Distance to next upstream intersection.
RR Distance reported to upstream railroad crossing.
_ Spillback occurs outside of storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 21. Existing AM and PM Peak Hour Maximum Queue Lengths for South 56th Street and South Washington Street

At the South 56th Street and South Washington Street intersection, the eastbound, westbound, and southbound maximum queues are expected to exceed the available storage during the PM peak hours. The same would occur during the AM peak hour for the eastbound and westbound maximum queues. Eastbound maximum queues would back up onto the railroad tracks, but would not reach the upstream intersection at South Adams Street during both AM and PM peak hours. Westbound maximum queues would extend the upstream intersection at South Tacoma Way during both peak hours. During the PM peak hour only, the southbound left-turn maximum queues would spill back into the through lane, and the shared through-right lane maximum queue would extend to the upstream intersection and could block turning movements from South 54th Street.

South 56th Street and South Tacoma Way

Exhibit 22 and Exhibit 23 summarize the existing queues at South 56th Street and South Tacoma Way. As shown below, the eastbound and westbound left (AM and PM) and eastbound and westbound through (PM only) maximum queues would extend beyond available storage and the through movements would block vehicles at the upstream intersections. The northbound left-turn maximum queue would also exceed available storage during the AM and PM peak hours.

Exhibit 22. Existing Queues and Storage at South 56th Street and South Tacoma Way

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
South 56th Street	**EB Left**	**50**	**AM**	**5**	**66**
			PM	**15**	**110**
	EB Through	**225 I/S**	**AM**	**24**	**179 B**
			PM	**41**	**280 B**
	EB Right	**Shared**	**AM**	**24**	**179 B**
			PM	**9**	**191 B**
South 56th Street	**WB Left**	**50**	**AM**	**10**	**93**
			PM	**21**	**259**
	WB Through	**225 I/S**	**AM**	**17**	**163 B**
			PM	**54**	**322 B**
	WB Right	**Shared**	**AM**	**1**	**91**
			PM	**22**	**249**
South Tacoma Way	**NB Left**	**100**	**AM**	**14**	**132**
			PM	**14**	**134**
	NB Through	**600 I/S**	**AM**	**8**	**97**
			PM	**15**	**148 B**
	NB Right	**Shared**	**AM**	**1**	**69**
			PM	**12**	**170 B**
South Tacoma Way	**SB Left**	**125**	**AM**	**5**	**75**
			PM	**7**	**85**
	SB Through	**600 I/S**	**AM**	**23**	**122**
			PM	**68**	**309 B**
	SB Right	**Shared**	**AM**	**0**	**18**
			PM	**17**	**213**

Storage distances estimated to the nearest 25 feet.
I/S *Distance to next upstream intersection.*
RR *Distance reported to upstream railroad crossing.*
_ *Spillback occurs outside of storage.*
B *Blocks access to turn pocket or channelized right-turn.*

Exhibit 23. Existing AM and PM Peak Hour Maximum Queue Lengths for South 56th Street and South Tacoma Way

South 56th Street and South Puget Sound Avenue

Exhibit 24 and Exhibit 25 summarize the existing queues at South 56th Street and South Puget Sound Avenue. Maximum queues at this intersection would only exceed available storage for the northbound left-turn and southbound left-turn movements, and this would only occur during the PM peak hour.

Exhibit 24. Existing Queues and Storage at South 56th Street and South Puget Sound Avenue

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
South 56th Street	EB Left	Shared	AM	0	25
			PM	0	33
	EB Through	225 I/S	AM	3	144
			PM	7	160
	EB Right	Shared	AM	1	78
			PM	1	93
South 56th Street	WB Left	Shared	AM	0	36
			PM	1	48
	WB Through	200 I/S	AM	4	97
			PM	6	117
	WB Right	Shared	AM	0	28
			PM	0	48
South Puget Sound Avenue	NB Left	50	AM	1	29
			PM	2	<u>53</u>
	NB Through	600 I/S	AM	8	97 B
			PM	15	148 B
	NB Right	Shared	AM	1	55 B
			PM	4	106 B
South Puget Sound Avenue	SB Left	50	AM	2	42
			PM	8	<u>94</u>
	SB Through	600 I/S	AM	4	63 B
			PM	14	124 B
	SB Right	Shared	AM	0	10
			PM	<u>1</u>	78 B

Storage distances estimated to the nearest 25 feet.
I/S *Distance to next upstream intersection.*
RR *Distance reported to upstream railroad crossing.*
_ *Spillback occurs outside of storage.*
B *Blocks access to turn pocket or channelized right-turn.*

Exhibit 25. Existing AM and PM Peak Hour Maximum Queue Lengths for South 56th Street and South Puget Sound Avenue

South 74th Street and South Tacoma Way

Exhibit 26 and Exhibit 27 summarize queues for the South 74th Street and South Tacoma Way intersection. The eastbound maximum queues back up through the at-grade railroad crossing during the PM peak hour, but not the AM peak hour. Vehicle queues on the northbound approach block access to turn pockets, and vehicles spill back from the northbound left-turn pocket; the same is true for the southbound and westbound approaches.

Exhibit 26. Existing Queues and Storage at South 74th Street and South Tacoma Way

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
South 74th Street	EB Left	150	AM	14	113
			PM	24	138
	EB Through	350 RR	AM	61	324 B
			PM	85	397 B
	EB Right	Shared	AM	18	233 B
			PM	35	306 B
South 74th Street	WB Left	150	AM	29	196
			PM	43	270
	WB Through	250 I/S	AM	42	252 B
			PM	68	364 B
	WB Right	Shared	AM	7	162 B
			PM	22	274 B
South Tacoma Way	NB Left	225	AM	44	227
			PM	55	286
	NB Through	1850 I/S	AM	39	205
			PM	52	299 B
	NB Right	125	AM	0	0
			PM	0	18
South Tacoma Way	SB Left	175	AM	11	91
			PM	36	197
	SB Through	575 I/S	AM	35	170
			PM	95	433 B
	SB Right	Shared	AM	29	165
			PM	92	429 B

Storage distances estimated to the nearest 25 feet.
I/S Distance to next upstream intersection.
RR Distance reported to upstream railroad crossing.
_ Spillback occurs outside of storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 27. Existing AM and PM Peak Hour Maximum Queue Lengths for South 74th Street and South Tacoma Way

North Thorne Lane Southwest and Union Avenue Southwest

Exhibit 28 and Exhibit 29 summarize queues for the North Thorne Lane Southwest and Union Avenue Southwest intersection. The westbound maximum queues do not back up to the at-grade railroad crossing. Vehicle queues on the northbound approach block access to turn pockets.

Exhibit 28. Existing Queues and Storage at North Thorne Lane Southwest and Union Avenue Southwest

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
North Thorne Lane Southwest	**EB Through**	**250 I/S**	**AM**	**5**	**107**
			PM	**37**	**239**
	EB Right	**Shared**	**AM**	**1**	**53**
			PM	**14**	**186**
North Thorne Lane Southwest	**WB Left**	**Shared**	**AM**	**0**	**13**
			PM	**1**	**60**
	WB Through	**150 RR**	**AM**	**0**	**13**
			PM	**1**	**60**
Union Avenue Southwest	**NB Left**	**600 I/S**	**AM**	**1**	**59 B**
			PM	**193 B**	**682 B**
	NB Right	**50**	**AM**	**5**	**113**
			PM	**235**	**736**

Storage distances estimated to the nearest 25 feet.
I/S Distance to next upstream intersection.
RR Distance reported to upstream railroad crossing.
_ Spillback occurs outside of storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 29. Existing AM and PM Peak Hour Maximum Queue Lengths for North Thorne Lane Southwest and Union Avenue Southwest

North Thorne Lane Southwest and I-5 Southbound Ramps

Exhibit 30 and Exhibit 31 summarize the queues for the North Thorne Lane Southwest and I-5 Southbound Ramps intersection. Eastbound queues extend beyond the Union Avenue Southwest intersection and the southbound right-turn queue blocks access to the shared left/through lane.

Exhibit 30. Existing Queues and Storage at North Thorne Lane Southwest and I-5 Southbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
North Thorne Lane Southwest	EB Through	100 I/S	AM	83	202
			PM	125	203
	EB Right	100 I/S	AM	83	202
			PM	125	203
North Thorne Lane Southwest	WB Left	Shared	AM	3	53
			PM	1	23
	WB Through	175 I/S	AM	3	53
			PM	1	23
I-5 SB Off-Ramp	SB Left	Shared	AM	96	585 B
			PM	102	514 B
	SB Through	1700 I/S	AM	96	585 B
			PM	102	514 B
	SB Right	300	AM	114	615
			PM	122	544

Storage distances estimated to the nearest 25 feet.
I/S *Distance to next upstream roadway.*
RR *Distance reported to upstream railroad crossing.*
_ *Spillback occurs outside of storage.*
B *Blocks access to turn pocket or channelized right-turn.*

Exhibit 31. Existing AM and PM Peak Hour Maximum Queue Lengths for North Thorne Lane Southwest and I-5 Southbound Ramps

North Thorne Lane Southwest and I-5 Northbound Ramps

Exhibit 32 and Exhibit 33 summarize the queues for the North Thorne Lane Southwest and I-5 Northbound Ramps intersection. The westbound right-turn queue extends beyond its available length and blocks access to the adjacent westbound through lane.

Exhibit 32. Existing Queues and Storage at North Thorne Lane Southwest and I-5 Northbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
North Thorne Lane Southwest	EB Left	175 I/S	AM	1	21
			PM	5	66
	EB Through	175 I/S	AM	1	21
			PM	5	66
North Thorne Lane Southwest	WB Through	725 I/S	AM	103	422 B
			PM	94	712 B
	WB Right	200	AM	103	<u>422</u>
			PM	94	<u>712</u>
I-5 NB Off-Ramp	NB Left	Shared	AM	20	183
			PM	16	171
	NB Through	1150 I/S	AM	20	183
			PM	16	171
	NB Right	325	AM	30	196
			PM	27	184

Storage distances estimated to the nearest 25 feet.
IS — *Distance to next upstream roadway.*
RR — *Distance reported to upstream railroad crossing.*
_ — *Spillback occurs outside of storage.*
B — *Blocks access to turn pocket or channelized right-turn.*

Exhibit 33. Existing AM and PM Peak Hour Maximum Queue Lengths for North Thorne Lane Southwest and I-5 Northbound Ramps

Berkeley Street Southwest and Union Avenue Southwest

Exhibit 34 and Exhibit 35 summarize the queues for the Berkeley Street Southwest and Union Avenue Southwest intersection. The eastbound and southbound queues extend to the upstream intersections and the westbound queue extends beyond the railroad crossing. On the northbound approach, the queues interfere with each other in the PM peak hour; right turns spill out of the pocket and the left/through queues back blocking the right-turn pocket. On the southbound approach, the queues in the left-turn lane and in the through/right lane interfere with each other similarly in both peak hours.

Exhibit 34. Existing Queues and Storage at Berkeley Street Southwest and Union Avenue Southwest

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
Berkeley Street Southwest	EB Left	Shared	AM	7	130
			PM	73	508
	EB Through	450 I/S	AM	7	130
			PM	80	520
	EB Right	Shared	AM	7	130
			PM	73	508
Berkeley Street Southwest	WB Left	Shared	AM	46	229 B
			PM	2	109 B
	WB Through	100 RR	AM	46	229 B
			PM	2	109 B
	WB Right	75	AM	46	229
			PM	2	109
Militia Drive	NB Left	Shared	AM	1	49
			PM	200 B	557 B
	NB Through	575 I/S	AM	1	49
			PM	200 B	557 B
	NB Right	50	AM	2	62
			PM	211	570
Union Avenue Southwest	SB Left	575 I/S	AM	14	165 B
			PM	165 B	760 B
	SB Through	100	AM	14	165
			PM	165	760
	SB Right	Shared	AM	14	165
			PM	165	760

Storage distances estimated to the nearest 25 feet.
IS Distance to next upstream roadway.
RR Distance reported to upstream railroad crossing.
_ Spillback occurs outside of storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 35. Existing AM and PM Peak Hour Maximum Queue Lengths for Berkeley Street Southwest and Union Avenue Southwest

Berkeley Street Southwest and I-5 Southbound Ramps

Exhibit 36 and Exhibit 37 summarize the queues for the Berkeley Street Southwest and I-5 Southbound Ramps intersection. The maximum queues on the eastbound approach extend back thought the Union Avenue Southwest intersection in both the AM and PM peak hours. On the southbound approach, the maximum queues for the southbound left-turn and southbound right-turn movement interfere with each other in the AM peak hour to compound the queue, but not the PM peak hour.

Exhibit 36. Existing Queues and Storage at Berkeley Street Southwest and I-5 Southbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
Berkeley Street Southwest	EB Through	100 I/S	AM	94	<u>258</u>
			PM	<u>181</u>	<u>295</u>
	EB Right	100 I/S	AM	<u>113</u>	<u>282</u>
			PM	<u>201</u>	<u>319</u>
Berkeley Street Southwest	WB Left	Shared	AM	4	120
			PM	0	37
	WB Through	175 I/S	AM	5	122
			PM	1	38
I-5 SB Off-Ramp	SB Left	Shared	AM	144	1,009 B
			PM	49	264
	SB Through	1100 I/S	AM	Not listed	Not listed
			PM	Not listed	Not listed
	SB Right	300	AM	144	<u>1010</u>
			PM	50	264

Storage distances estimated to the nearest 25 feet.
IS *Distance to next upstream roadway.*
RR *Distance reported to upstream railroad crossing.*
_ *Spillback occurs outside of storage.*
B *Blocks access to turn pocket or channelized right-turn.*

Exhibit 37. Existing AM and PM Peak Hour Maximum Queue Lengths for Berkeley Street Southwest and I-5 Southbound Ramps

Berkeley Street Southwest and I-5 Northbound Ramps

Exhibit 38 and Exhibit 39 summarize the queues for the Berkeley Street Southwest and I-5 Northbound Ramps intersection. The maximum queues do not back into adjacent intersections.

Exhibit 38. Existing Queues and Storage at Berkeley Street Southwest and I-5 Northbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
Berkeley Street Southwest	**EB Left**	**Shared**	**AM**	**0**	**47**
			PM	**0**	**8**
	EB Through	**175 I/S**	**AM**	**0**	**47**
			PM	**0**	**8**
Berkeley Street Southwest	**WB Through**	**2225 I/S**	**AM**	**207**	**1,207**
			PM	**310**	**1.181**
	WB Right	**Shared**	**AM**	**219**	**1.234**
			PM	**326**	**1.209**
I-5 NB Off-Ramp	**NB Left**	**Shared**	**AM**	**76**	**355**
			PM	**22**	**147**
	NB Through	**1150 I/S**	**AM**	**Not listed**	**Not listed**
			PM	**Not listed**	**Not listed**
	NB Right	**375**	**AM**	**0**	**4**
			PM	**0**	**0**

Storage distances estimated to the nearest 25 feet.
IS *Distance to next upstream roadway.*
RR *Distance reported to upstream railroad crossing.*
_ *Spillback occurs outside of storage.*
B *Blocks access to turn pocket or channelized right-turn.*

Exhibit 39. Existing AM and PM Peak Hour Maximum Queue Lengths for Berkeley Street Southwest and I-5 Northbound Ramps

41st Division Drive and I-5 Ramps

Exhibit 40, Exhibit 41, and Exhibit 42 summarize the queues for the 41st Division Drive and I-5 Southbound Ramps intersection and 41st Division Drive and I-5 Northbound Ramps intersection. No queues spill back into adjacent intersections.

Exhibit 40. Existing Queues and Storage at 41st Division Drive and I-5 Southbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
41st Division Drive	**EB Through**	**2200 I/S**	**AM**	**0**	**0**
			PM	**19**	**170**
	EB Right	**Shared**	**AM**	**0**	**0**
			PM	**19**	**170**
41st Division Drive	**WB Through**	**500 I/S**	**AM**	**6**	**138**
			PM	**0**	**0**
	WB Right	**Shared**	**AM**	**1**	**44**
			PM	**0**	**13**
I-5 SB Off-Ramp	**NB Right (Loop)**	**1150 I/S**	**AM**	**12**	**392**
			PM	**0**	**36**
	SB Right	**1350 I/S**	**AM**	**0**	**32**
			PM	**0**	**0**

Storage distances estimated to the nearest 25 feet.
IS Distance to next upstream roadway.
RR Distance reported to upstream railroad crossing.
_ Spillback occurs outside of storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 41. Existing Queues and Storage at 41st Division Drive and I-5 Northbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
41st Division Drive	**EB Through**	**500 I/S**	**AM**	**0**	**7**
			PM	**67**	**332**
	EB Right	**Shared**	**AM**	**0**	**7**
			PM	**67**	**332**
41st Division Drive	**WB Through**	**1,450 I/S**	**AM**	**0**	**2**
			PM	**250**	**1,197**
	WB Right	**Shared**	**AM**	**0**	**2**
			PM	**250**	**1,197**
I-5 NB Off-Ramp	**NB Right**	**1,200 I/S**	**AM**	**15**	**367**
			PM	**0**	**0**
	SB Right (Loop)	**1,100 I/S**	**AM**	**0**	**0**
			PM	**0**	**0**

Storage distances estimated to the nearest 25 feet.
IS *Distance to next upstream roadway.*
RR *Distance reported to upstream railroad crossing.*
_ *Spillback occurs outside of storage.*
B *Blocks access to turn pocket or channelized right-turn.*

Exhibit 42. Existing AM and PM Peak Hour Maximum Queue Lengths for 41st Division Drive and I-5 Ramps

Barksdale Avenue and Steilacoom-DuPont Road Southwest/Wilmington Drive

Exhibit 43 and Exhibit 44 summarize the queues for the Barksdale Avenue and Steilacoom-DuPont Road Southwest/Wilmington Drive intersection. On the westbound and northbound approaches, the left-turn and through queues interfere with each other in the AM and PM peak hours. On the southbound approach, the left-turn and through queues interfere with each other only in the AM peak hour and backup beyond the curbed-off southerly Station Drive intersection. On the eastbound approach, queues from all movements interfere with each other in the both peak hours.

Exhibit 43. Existing Queues and Storage at Barksdale Avenue and Steilacoom-DuPont Road Southwest/Wilmington Drive

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
Barksdale Avenue	EB Left	35	AM	13	<u>112</u>
			PM	12	<u>96</u>
	EB Through	700 I/S	AM	13	112 B
			PM	12	96 B
	EB Right	Shared	AM	3	86 B
			PM	2	70 B
Barksdale Avenue	WB Left	125	AM	17	<u>146</u>
			PM	26	<u>134</u>
	WB Through	250 RR	AM	17	146 B
			PM	26	134 B
	WB Right	175	AM	5	153
			PM	14	163
Wilmington Drive	NB Left	75	AM	9	<u>83</u>
			PM	15	<u>119</u>
	NB Through	2,175 I/S	AM	9	83 B
			PM	15	119 B
	NB Right	125	AM	4	85
			PM	2	111
Steilacoom-DuPont Road Southwest	SB Left	350	AM	71	<u>365</u>
			PM	41	266
	SB Through	625 I/S	AM	71	365 B
			PM	41	266
	SB Right	Shared	AM	46	322
			PM	20	223

Storage distances estimated to the nearest 25 feet.
IS Distance to next upstream roadway.
RR Distance reported to upstream railroad crossing.
_ Spillback occurs outside of storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 44. Existing AM and PM Peak Hour Maximum Queue Lengths for Barksdale Avenue and Steilacoom-DuPont Road Southwest/Wilmington Drive

Barksdale Avenue and I-5 Southbound Ramps

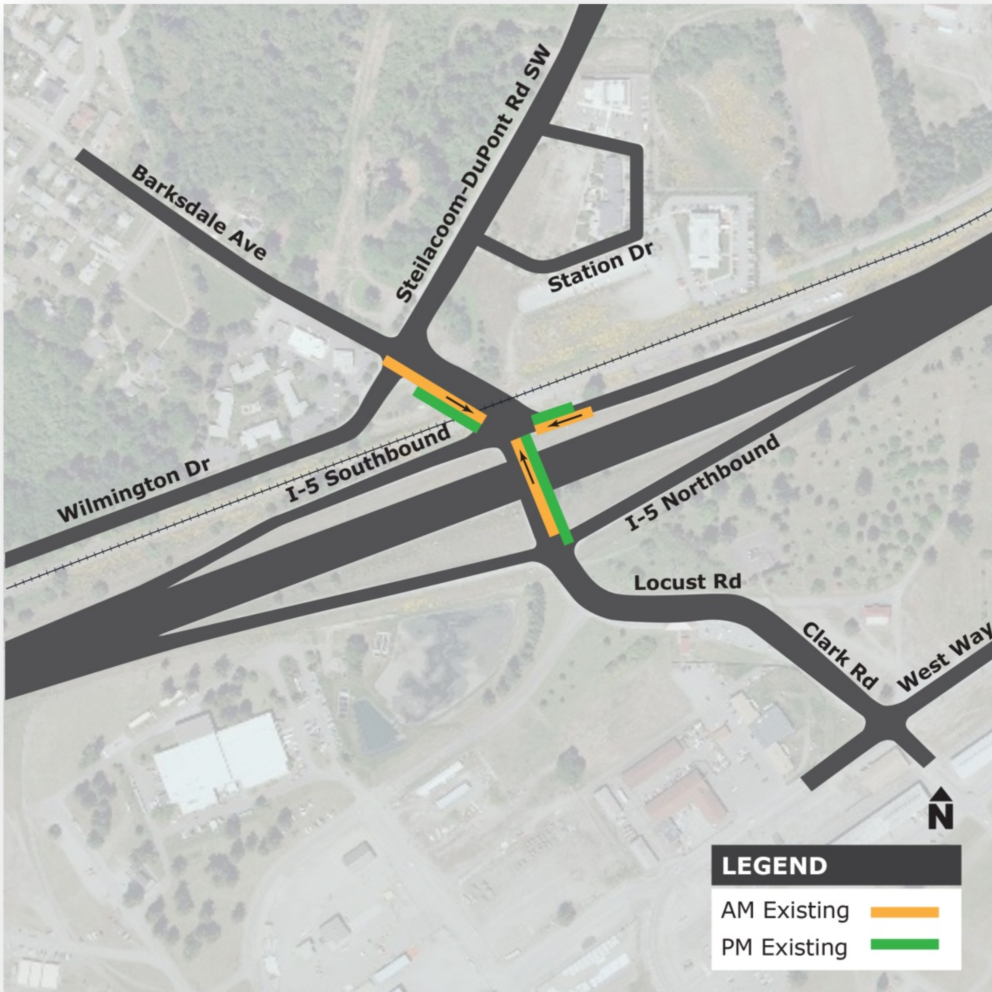
Exhibit 45 and Exhibit 46 summarize the queues for the Barksdale Avenue and I-5 Southbound Ramps intersection. Maximum queues on the westbound approach back through the upstream I-5 Northbound Ramps intersection.

Exhibit 45. Existing Queues and Storage at Barksdale Avenue and I-5 Southbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
Barksdale Avenue	EB Through	350 I/S	AM	71	302
			PM	32	187
	EB Right	275	AM	1	20
			PM	0	58
Barksdale Avenue	WB Left	Shared	AM	25	274
			PM	18	322
	WB Through	225 I/S	AM	25	274
			PM	18	322
I-5 SB Off-Ramp	SB Left	Shared	AM	18	167
			PM	1	97
	SB Through	1350 I/S	AM	18	167
			PM	1	97
	SB Right	500	AM	5	161
			PM	3	118

Storage distances estimated to the nearest 25 feet.
IS *Distance to next upstream roadway.*
RR *Distance reported to upstream railroad crossing.*
_ *Spillback occurs outside of storage.*
B *Blocks access to turn pocket or channelized right-turn.*

Exhibit 46. Existing AM and PM Peak Hour Maximum Queue Lengths for Barksdale Avenue and I-5 Southbound Ramps



Barksdale Avenue/Locust Road and I-5 Northbound Ramps

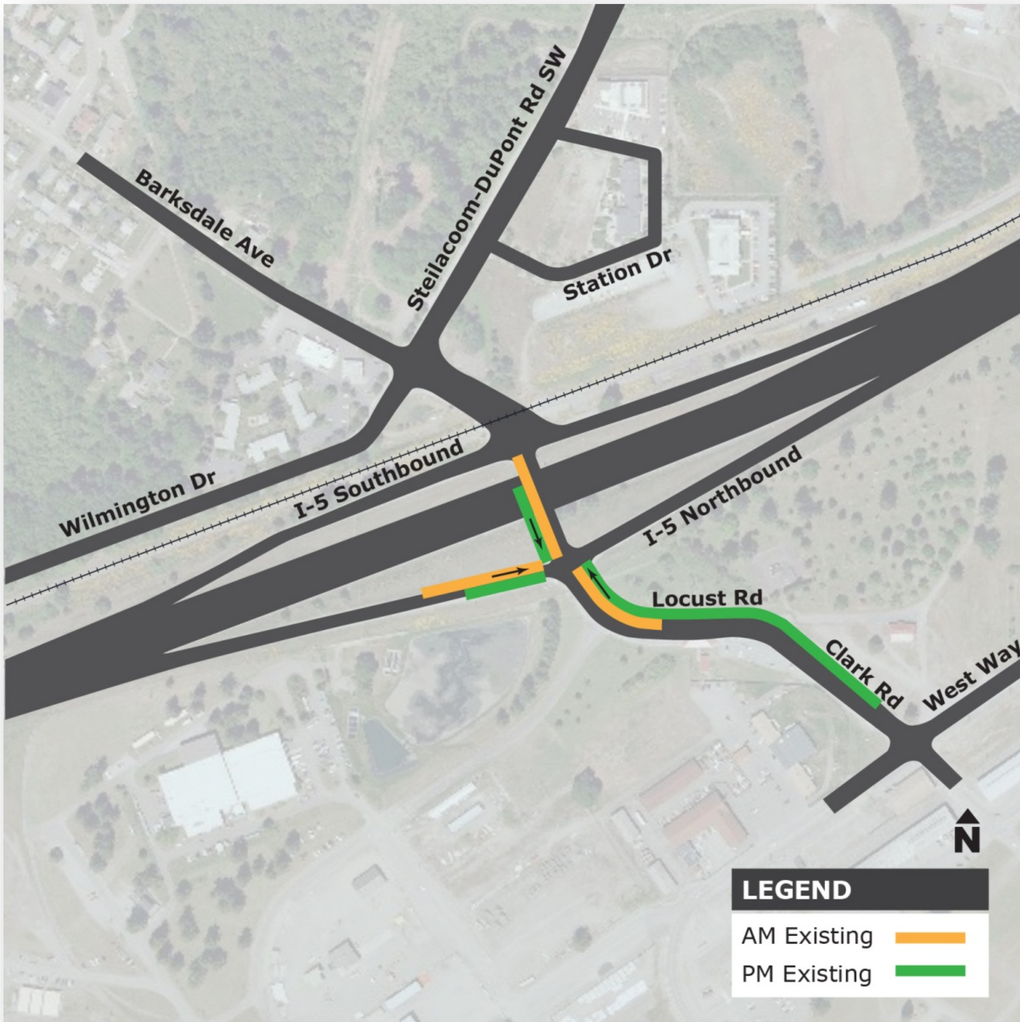
Exhibit 47 and Exhibit 48 summarize the queues for the Barksdale Avenue/Locust Road and I-5 Northbound Ramps intersection. The eastbound approach queue extends through the I-5 Southbound Ramps intersection and the westbound approach queue extends nearly to West Way.

Exhibit 47. Existing Queues and Storage at Barksdale Avenue/Locust Road and I-5 Northbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)
Barksdale Avenue	EB Left	225 I/S	AM	81	308
			PM	41	195
	EB Through	225 I/S	AM	81	308
			PM	41	195
Locust Road	WB Through	1,025 I/S	AM	45	276
			PM	188	900
	WB Right	1,025 I/S	AM	26	276
			PM	172	902
I-5 NB Off-Ramp	NB Left	Shared	AM	52	355
			PM	55	301
	NB Through	1,600 I/S	AM	27	304
			PM	55	301
	NB Right	600	AM	27	304
			PM	25	252

Storage distances estimated to the nearest 25 feet.
IS Distance to next upstream roadway.
RR Distance reported to upstream railroad crossing.
_ Spillback occurs outside of storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 48. Existing AM and PM Peak Hour Maximum Queue Lengths for Barksdale Avenue/Locust Road and I-5 Northbound Ramps



What is bus service like in the study area?

Sound Transit, Pierce Transit, and Olympia Express (Intercity Transit) provide bus transit service in the study area. Exhibit 49 shows the location where routes from the agencies cross the Project alignment.

Exhibit 49. Transit Routes Using Project Highway/Rail Crossings

Crossing Street	Sound Transit	Pierce Transit	Olympia Express (Intercity Transit)
East “D” Street[20]	**574, 593**	**42**	
East “C” Street			
South “C” Street			
South Chandler Street			
South Alaska Street			
South Wilkeson Street		**3**	
South Pine Street		**57**	
35th Street Southwest		**52**	
50th Street Southwest			
South 56th Street			
60th Street Southwest	**593**		
South 74th Street		**202**	
Steilacoom Blvd Southwest		**3**	
100th Street Southwest		**48**	
108th Street Southwest	**574**	**204**	
Bridgeport Way Southwest		**206**	
Clover Creek Drive Southwest			
North Thorne Lane Southwest		**206**	
Berkeley Street Southwest			
41st Division Drive			
Barksdale Avenue			

Sound Transit bus routes in the study area provide passenger service between the cities of DuPont, Lakewood, Tacoma, and Seattle. Pierce Transit provides routes connecting Lakewood, Tacoma, and JBLM. Intercity Transit operates Olympia Express routes that connect downtown Tacoma to downtown Olympia. There are no bus lanes or arterial high-occupancy vehicle (HOV) lanes on the local streets through the at-grade rail crossings. Because buses operate in mixed traffic on the same

[20] *Separate construction by Sound Transit will result in the conditions described at E. “D” Street, E. “C” Street, and S. “C” Street*

roadways described above, local street system delays would also be similar.

How does truck freight move on the local streets?

There are no truck-only lanes on the local streets through the at-grade rail crossings. Because trucks operate in mixed traffic on the same roadways described above, local street system delays would also be similar. No data was found on designated truck routes in the comprehensive plans of the local agencies; however, many of the crossings occur on arterials that accommodate truck traffic.

What are the pedestrian and bicycle facilities in the study area?

Pedestrians are served by sidewalks along most of the streets in the study area. Bike lanes are present on a few of the streets in the project corridor. In Tacoma, bike lanes are provided on both sides of East “D” Street and East “C” Street, but markings do not continue over the railroad crossing. Bicyclists enter the vehicle travel lane to cross the railroad tracks before rejoining the bike lane on the other side. A combination bike lane/sidewalk is provided on the east side of South “C” Street. Most bicycle traffic shares the road with vehicular traffic. Where bicycles are on-road with other vehicles, their crossings of the railroad tracks are controlled in the same manner as motorized vehicles. Additionally, the crossing at 108th Street Southwest in Lakewood has bike lanes; however, the bike lanes are marked through the crossing.

Pedestrians and bicyclists are permitted to cross the tracks at-grade at all of the study area intersections. Many of the railroad crossings provide sidewalks and paved walkways. For all railroad crossings, the rails are recessed into the pavement, which increases pedestrian and bicyclist crossing safety.

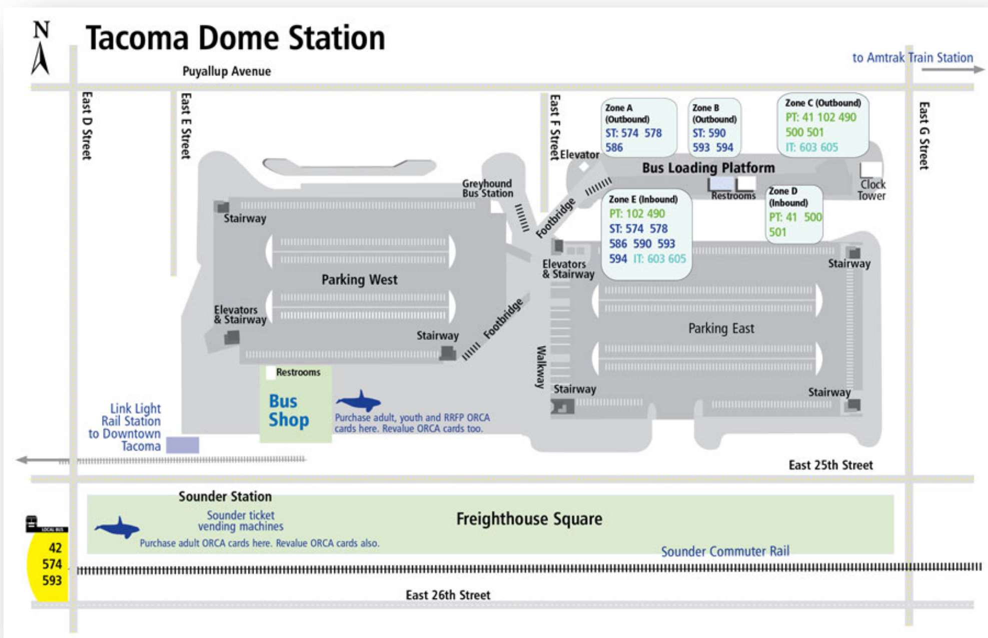
Existing pedestrian connections between the Tacoma Amtrak Station and Tacoma Dome Station rail platforms are approximately 10 minutes to walk and approximately 6 minutes to walk to the Tacoma transit center on Puyallup Avenue. Passengers who drive to the Tacoma Amtrak Station are able to park in a lot adjacent to the platform. This parking lot provides approximately 82 parking spaces; short-term and long-term overnight parking is provided free of charge.

What are the parking conditions in the study area?

The existing Tacoma Amtrak Station has an on-site parking lot with 82 parking spaces that is accessible from Puyallup Avenue. This parking lot access is located approximately three blocks east of the Tacoma Dome Station.

Parking provided for the Tacoma Dome Station at Freighthouse Square is accessed via East “E” Street, Puyallup Avenue, East “G” Street, and East 25th Street. On-street parking is also provided on Puyallup Avenue, East 25th Street, and East 26th Street. Exhibit 50 shows the parking garages attached to the Tacoma Dome Station. Currently, parking is free, but vehicles cannot remain longer than 24 hours in the parking garages. There are 2,283 parking spaces at the Tacoma Dome Station. Exhibit 50shows the layout of the Tacoma Dome Station.

Exhibit 50. Tacoma Dome Station at Freighthouse Square



Source: [*http://www.piercetransit.org/tds2.htm*](http://www.piercetransit.org/tds2.htm)

In addition to the off-street parking lots described above, on-street parking is also available in the general vicinity. A parking survey was completed on December 1, 2011 between 12:45 PM – 2:30 PM to collect information on parking supply and utilization in the following areas:

- Puyallup Avenue – between East 22nd Street and East “G” Street
- East 25th Street – between the I-705 overpass and East “G” Street
- E 26th Street – between the I-705 overpass and East “G” Street
- East “C” Street – between Puyallup Avenue and East 26th Street

- East “D” Street – between Puyallup Avenue and East 26th Street
- East “G” Street – between Puyallup Avenue and East 26th Street

Along these roadways, on-street parking is either restricted to a time limit between one and two hours, or is unrestricted (no time limit specified). The parking data from the survey are summarized in Exhibit 51.

Exhibit 51. Parking Survey Data

Roadway	Restricted (1-Hour)		Restricted (2-Hour)		Unrestricted	
	Occupied/ Supply	*Utilization*	*Occupied/ Supply*	*Utilization*	*Occupied/ Supply*	*Utilization*
Puyallup Avenue	**1 / 4**	**25%**	**4 / 22**	**18%**	**26 / 28**	**93%**
East 25th Street	**NA / NA**	**NA**	**32 / 35**	**91%**	**46 / 47**	**98%**
East 26th Street	**6 / 9**	**67%**	**5 / 12**	**42%**	**61 / 64**	**95%**
East “C” Street	**0 / 2**	**0%**	**NA / NA**	**NA**	**20 / 28**	**71%**
East “D” Street	**NA / NA**	**NA**	**NA / NA**	**NA**	**NA / NA**	**NA**
East “G” Street	**NA / NA**	**NA**	**NA / NA**	**NA**	**6 / 6**	**100%**
Total	**7 / 15**	**47%**	**41 / 69**	**59%**	**159 / 173**	**92%**

Exhibit 51 shows that the general vicinity has approximately 15 one-hour on-street parking spaces, and, during the time frame of the parking survey, was slightly less than half utilized. The supply of on-street two-hour parking, approximately 69 spaces, is much higher than the supply of one-hour parking, and had a utilization rate of more than half. The majority of on-street parking supply is unrestricted and is close to 100% utilized.

How do train operations affect traffic?

The peak period is the time of day when the highest amount of vehicles travel on the roadway network. The Project team defined the morning peak period as 7:00 AM to 9:00 AM and afternoon peak period from 4:00 PM to 6:00 PM. The peak period traffic is used to determine the highest peak hour in the morning and afternoon commute periods, which is used in the local streets operation analysis. Exhibit 52 summarizes the 2010 morning and afternoon peak-hour roadway volumes crossing the railroad tracks along the study area.

Exhibit 52. Existing Highway/Rail Crossing Volumes

Crossing Street		Hourly Vehicle Volumes			
Name	***Direction***	***Morning***	***Afternoon***	***Early Morning***	***Midday / "Noon"***
East "D" Street[21]	**Northbound**	**328**	**202**	**N/A**	**N/A**
	Southbound	**56**	**321**	**N/A**	**N/A**
East "C" Street	**Northbound**	**202**	**59**	**N/A**	**N/A**
	Southbound	**21**	**93**	**N/A**	**N/A**
South "C" Street	**Northbound**	**61**	**53**	**N/A**	**N/A**
	Southbound	**74**	**129**	**N/A**	**N/A**
South Chandler Street	**Northbound**	**21**	**21**	**N/A**	**N/A**
	Southbound	**15**	**25**	**N/A**	**N/A**
South Alaska Street	**Northbound**	**13**	**8**	**N/A**	**N/A**
	Southbound	**12**	**12**	**N/A**	**N/A**
South Wilkeson Street	**Northbound**	**280**	**238**	**N/A**	**N/A**
	Southbound	**166**	**394**	**N/A**	**N/A**
South Pine Street	**Northbound**	**534**	**1,105**	**N/A**	**N/A**
	Southbound	**526**	**946**	**N/A**	**N/A**
35th Street Southwest	**Eastbound**	**124**	**173**	**N/A**	**N/A**
	Westbound	**139**	**193**	**N/A**	**N/A**
50th Street Southwest	**Eastbound**	**30**	**63**	**N/A**	**N/A**
	Westbound	**39**	**19**	**N/A**	**N/A**
South 56th Street	**Eastbound**	**944**	**987**	**N/A**	**N/A**
	Westbound	**711**	**1,408**	**N/A**	**N/A**
60th Street Southwest	**Eastbound**	**34**	**32**	**N/A**	**N/A**
	Westbound	**20**	**42**	**N/A**	**N/A**
South 74th Street	**Eastbound**	**872**	**837**	**N/A**	**N/A**
	Westbound	**774**	**884**	**N/A**	**N/A**
Steilacoom Blvd Southwest	**Eastbound**	**624**	**1,009**	**N/A**	**N/A**
	Westbound	**1,136**	**999**	**N/A**	**N/A**
100th Street Southwest	**Eastbound**	**581**	**1,140**	**N/A**	**N/A**
	Westbound	**1,004**	**983**	**N/A**	**NA**
108th Street Southwest	**Eastbound**	**313**	**774**	**N/A**	**N/A**
	Westbound	**537**	**539**	**N/A**	**N/A**
Bridgeport Way Southwest	**Northbound**	**774**	**1,041**	**N/A**	**N/A**
	Southbound	**753**	**880**	**N/A**	**N/A**
Clover Creek Drive Southwest	**Eastbound**	**61**	**43**	**N/A**	**N/A**
	Westbound	**32**	**85**	**N/A**	**N/A**
North Thorne Lane Southwest	**Eastbound**	**219**	**407**	**87**	**309**
	Westbound	**274**	**467**	**391**	**479**
Berkeley Street Southwest	**Eastbound**	**243**	**530**	**133**	**382**
	Westbound	**497**	**347**	**175**	**575**
41st Division Drive	**Eastbound**	**972**	**1,343**	**420**	**1,135**
	Westbound	**846**	**580**	**1,245**	**685**
Barksdale Avenue	**Eastbound**	**609**	**670**	**375**	**575**
	Westbound	**737**	**795**	**664**	**484**

[21] *Separate construction by Sound Transit will result in the conditions described at E. "D" Street, E. "C" Street, and S. "C" Street*

The volumes summarized in Exhibit 52 are used in the analyses for local streets and the at-grade railroad crossing queues. Traffic volumes provide an understanding of how busy or heavily used a railroad crossing is and the magnitude of effect. Railroad crossings with higher vehicle volumes crossing the tracks are likely to have longer vehicle queues when the gates are down. However, roadway geometrics, adjacent intersection operations, and the length of time it takes for a train to pass (the time the gates are closed) affect the delay to vehicles and non-motorized users.

To address how traffic from JBLM creates peaks outside the typical commuter peaks, traffic analysts summarized vehicle volumes for the early morning[22] peak hour and midday[23] peak hour near JBLM. As shown in Exhibit 52, the total entering volumes for intersections is higher in the morning (AM) peak hour compared to the early morning (AM) peak hour; similarly, the total entering volumes for the afternoon (PM) peak hour are higher compared to the midday peak hour. Therefore, the Project used a common morning and afternoon peak hour in the evaluation of operating conditions.

Most drivers and non-motorized users would experience an increase in wait time (delay) at an intersection affected by a train event; a train event includes the time warning lights flash before the gates, if any, close and the time for any gates to be raised again. Today, there are two or less freight train events per day; each event varies depending on the length of the freight trains. With *Sounder* trains, blockage times would vary from 46-70 seconds. Train events are spread out over the day and typically do not occur immediately after another, providing time for local street operations to return to their normal operating conditions. During the morning and afternoon peak hours, typically no freight train events occur, but *Sounder* revenue trains would cross twice (once during the morning and afternoon peaks) when service begins to the Lakewood Station. At 108th Street Southwest, Sound Transit would operate one non-revenue *Sounder* train during the afternoon peak in addition to the revenue train.

What are the roadway safety concerns in the study area?

Grade Crossing Diagnostic Team Review

In September 2006, early in the planning of the Point Defiance Bypass Project, FRA and WSDOT assembled a diagnostic team to discuss future configurations of grade crossings on the Bypass Route and make recommendations for the crossing designs. The team surveyed most of the grade crossings on the Bypass Route from South 74th Street through Barksdale Avenue. Exhibit 53 summarizes the team's recommendations

[22] *Early morning timeframe is from 5:00 AM to 7:00 AM.*
[23] *Midday timeframe is from 11:00 AM to 1:00 PM.*

for safety improvements and what is currently included in the Project design. Nearly all of the recommendations were incorporated with only a couple of exceptions.

Exhibit 53. Summary of Safety Improvement Opportunities Identified by Diagnostic Team

Grade Crossing	Safety Improvements	
Street (Crossing ID)	***Features Considered by Diagnostic Team***	***Improvements Incorporated by Sound Transit and with the Build Alternative***
South 74th Street (085396R)	• Interconnect with South Tacoma Way signal • Advance pre-emption at crossing • Medians separators on both sides • Pre-signals • “Do Not Stop On Tracks” signage	**Sound Transit incorporated all of the recommendations**
Steilacoom Blvd Southwest (085400D	• Advance pre-emption • Median separator east of crossing • C-curb barrier west of crossing • “Do Not Stop On Tracks” signage • Relocate westbound bus stop to east side of crossing	**Sound Transit incorporated all of the recommendations**
100th Street Southwest (085402S)	• Gates • Wayside horns • Interconnect with Lakeview Avenue signal • Median separators on both sides • “Do Not Stop On Tracks” signage	**Sound Transit incorporated all of the recommendations**
108th Street Southwest (085404F)	• Wayside horns • Interconnect with Lakeview Avenue signal • Median separators on both sides • “Do Not Stop On Tracks” signage	**Sound Transit incorporated all of the recommendations**
Bridgeport Way Southwest (085821P)	• Interconnect with Pacific Highway signal • Median separators on both sides	**Sound Transit incorporated all of the recommendations.**
Clover Creek Drive Southwest (085822W)	• Median separators on both sides • “Do Not Stop On Tracks” signage • Gates and flashing lights	**The Build Alternative would incorporate all of these recommendations.**
North Thorne Lane Southwest (085828M)	• C-curb barriers on both sides • Gates and flashers • New signal at North Thorne Lane Southwest and Union Avenue Southwest coordinated and interconnected with I-5 SB Ramps intersection • Interconnect with I-5 SB Ramps signal or relocate signal heads for eastbound North Thorne Lane at I-5 SB Ramps west of railroad crossing on the cantilever • “Do Not Stop On Tracks” signage	**The Build Alternative would incorporate all of these recommendations, including median separators, with one minor modification:** • **Single signal controller proposed to connect intersections and enhance signal coordination.**

Grade Crossing	Safety Improvements	
Street (Crossing ID)	***Features Considered by Diagnostic Team***	***Improvements Incorporated by Sound Transit and with the Build Alternative***
Berkeley Street Southwest (085829U)	• **C-Curb Barriers on both sides** • **Reinstate signal at Berkeley Street Southwest and Union Avenue Southwest** • **Relocate signal heads for EB Berkeley Street Southwest at I-5 SB Ramps west of the railroad crossing** • **No Right-Turn on red signal from SB off-ramp** • **"Do Not Stop On Tracks" signage**	**The Build Alternative would incorporated all of these recommendations, with a couple minor modifications:** • **Single signal controller proposed to connect intersections and enhance signal coordination.** • **Signal heads remain because the stop bar is located on the near side of the railroad tracks**
41st Division Drive (085830N)	• **New cantilevers and gates (EB)** • **New gates (WB) for 41st Division Drive and I-5 SB off-ramp right turn** • **Advance warning sign with flashing beacon on I-5 SB off-ramp "Prepare to Stop When Flashing"** • **"Do Not Stop On Tracks" signage**	**The Build Alternative would incorporate all of the recommendations, plus add median separators on both sides**
Barksdale Avenue (085836E)	• **Pre-signals coordinated with adjacent intersections** • **Additional set of lights at the median flashers, aimed toward the I-5 SB off-ramp**	**The Build Alternative would incorporate everything but pre-signals; it would also:** • **Single signal controller proposed to connect intersections and enhance signal coordination** • **Add a median separator east of the crossing**

Recent History and Accident Prediction for Existing Conditions

Based on a review of FRA Office of Safety Analysis data accessible from their website at http://safetydata.fra.dot.gov/OfficeofSafety/default.aspx, in the last five years from October 2006 through September 2011, only three at-grade crossing collisions have occurred between roadway vehicles and trains on the Bypass Route and one on the Puget Sound Route. Exhibit 54 summarizes the collision history and collision predictions in the study area for the Bypass Route and the Puget Sound Route. Overall, approximately one accident occurs at a crossing every year based on the combined experience of both routes, and the accident predictions for the overall corridor (1.2 years between accidents) closely match the accident history (1.0 years between accidents).

Exhibit 54. Corridor Accident Experience – 5-Year History and Prediction for Existing Year 2010 Conditions

Corridor Summary	Years between Accidents		
Route	***5-Year Accident History***	***Prediction without Sounder***	***Prediction with Sounder***
Puget Sound Route	**2.5**	**3.4**	**No change**
Bypass Route	**1.7**	**1.9**	**1.5**
Both Routes Combined	**1.0**	**1.2**	**1.0**

Exhibit 55 summarizes the collision history at each crossing for the Bypass Route and the Puget Sound Route. On the Bypass Route, the accidents occurring at East “C” Street and North Thorne Lane Southwest were property-damage only. The accident at 100th Street Southwest involved a collision where passengers in the vehicle were injured. Along the Puget Sound Route, only two accidents occurred and both involved fatalities: one at the Sunnyside Beach pedestrian crossing; and one at the Steilacoom/Union Ferry Terminal crossing.

Analysts also compared the five year accident history with estimated accidents using the FRA accident prediction models. The accident prediction models estimated the highest accident frequency would occur at South Pine Street at a frequency of one accident every 19 years without *Sounder* and at 100th Street Southwest at a frequency of one every 12 years with *Sounder*. The predicted accident frequency at South Pine Street does not meet the FHWA accident frequency threshold for improving the crossing.

With Sound Transit’s *Sounder* service, the predicted accident frequency at some of the crossings on the Bypass Route improves even with the additional service because of improvements from passive control to gated crossings. No changes would occur on the Puget Sound Route. At other crossings where gates were already in place, the predicted accident frequency is higher than before Sound Transit *Sounder* service. None of the individual crossings are predicted to experience accidents more frequently than one every 10 years.

Exhibit 55. Individual Crossing Accident Experience – 5-Year History and Prediction for Existing Year 2010 Conditions

Individual Crossings		Years between Accidents		
Crossing Street	***Crossing ID***	***5-Year Accident History***	***Prediction without Sounder***	***Prediction with Sounder***
Puget Sound Route				
East "D" Street	**085714A**	**-**[24]	**22**	**No change**
McCarver	**085730J**	**-**	**28**	**No change**
Sixth Avenue	**085742D**	**-**	**32**	**No change**
South 19th Street	**085743K**	**-**	**25**	**No change**
Sunnyside Beach Ped	**085754X**	**5**	**20**	**No change**
Steilacoom/Union Ferry Terminal	**085755E**	**5**	**12**	**No change**
Solo Point Road	**085758A**	**-**	**121**	**No change**
Bypass Route				
East "D" Street	**396639A**	**-**	**45**	**31**
East "C" Street	**396640U**	**5**	**13**	**13**
South "C" Street	**n/a NEW**	**N/A**	**N/A**[25]	**56**
South Chandler Street	**085372C**	**-**	**93**	**80**
South Alaska Street	**085373J**	**-**	**114**	**101**
South Wilkeson Street	**085374R**	**-**	**52**	**41**
South Pine Street	**085382H**	**-**	**38**	**26**
35th Street Southwest	**085385D**	**-**	**57**	**37**
50th Street Southwest	**085391G**	**-**	**77**	**54**
South 56th Street	**085392N**	**-**	**35**	**23**
60th Street Southwest	**085394C**	**-**	**87**	**71**
South 74th Street	**085396R**	**-**	**34**	**27**
Steilacoom Blvd Southwest	**085400D**	**-**	**41**	**28**
100th Street Southwest	**085402S**	**5**	**19**	**12**
108th Street Southwest	**085404F**	**-**	**53**	**31**
Bridgeport Way Southwest	**085821P**	**-**	**36**	**No change**[26]
Clover Creek Drive Southwest	**085822W**	**-**	**68**	**No change**
North Thorne Lane Southwest	**085828M**	**5**	**20**	**No change**
Berkeley Street Southwest	**085829U**	**-**	**45**	**No change**
41st Division Drive	**085830N**	**-**	**34**	**No change**
Barksdale Avenue	**085836E**	**-**	**48**	**No change**

24 - Indicates no accident occurred in the five-year history from which to estimate the time between accidents.

25 S. "C" Street will not be used by freight trains and, without Sounder, no other trains would use the crossing.

26 Sounder does not travel through these interchanges and therefore the accident predictions would not change.

Chapter 5 – Potential Project Effects

For the Project, the Project team compared the effects that would occur with the No Build and the Build alternatives. This chapter describes direct long-term operational effects of the Project, as well as the short-term and long-term construction effects, and potential cumulative effects. The following definitions have been provided to deepen the reader's understanding of a project's effects under NEPA:

- Indirect effects: An indirect effect is a reasonably foreseeable effect caused by a project but that would occur in the future or outside of the project study area.
- Direct effects: Changes inside the study area are considered direct effects.
- Cumulative effects: The sum of effects on the environment which results from the incremental impact affect of a project when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

The discussion that follows addresses these different types of effects.

How would the Project affect freight travel?

Rail Freight

The No Build Alternative would continue to affect freight rail mobility along the Puget Sound Route and at its junctions with the Bypass Route as it does today.

The Build Alternative would relocate the Amtrak Cascades train service from the BNSF rail line along Puget Sound to the proposed Bypass Route between Nisqually Junction and Freighthouse Square. Because freight would continue to travel on that BNSF rail line, freight travel on that line would not be negatively affected by the Project and would experience a slight benefit because of less congestion. Freight rail on the Bypass Route would experience more congestion; however, less freight movement occurs on the Bypass Route, resulting in less effect to freight and a slight improvement overall.

Road Freight

Road-based freight would experience similar intersection delay and queue lengths at study area intersections that vehicles and bus transit would experience with the Project.

How would the Project affect passenger rail services?

The No Build Alternative would continue with passenger rail service on the BNSF line where it would be negatively affected by freight operations. Passenger rail service would have a limited ability to expand service and would continue to be delayed by freight operations.

The Build Alternative would relocate the Amtrak Cascades train service from the BNSF rail line along Puget Sound to the proposed Bypass Route between Nisqually Junction and Freighthouse Square. This would improve travel time of the Amtrak Cascades service by ten minutes because of the shorter distance and faster train speeds (approximately 6 miles shorter), and would improve on-time performance by avoiding potential delays from freight trains on the existing route. Additionally, trains traveling on the Bypass Route avoid some operational delays affecting reliability and travel time currently experienced on the Puget Sound Route from landslides, weather-related delays and closures, and drawbridge openings).

With the Build Alternative, Amtrak Cascades would use the rail line also used by Sound Transit's *Sounder* commuter rail service. The Amtrak Cascades schedule would be coordinated with Sound Transit to preserve the line capacity needed for Sound Transit to operate commuter rail service and minimize effects.

How would the Project affect bus transit?

The No Build Alternative would not affect bus transit.

Because there are no HOV or transit-only lanes on streets in the study area, bus transit, including school buses for local school districts, would experience the same intersection delay and queue lengths at study area intersections as vehicles with the Project. The Build Alternative would not affect the location of bus stops or provide transit service enhancements, but would increase the delay for routes crossing the Project route at study area intersections.

How would the new Tacoma Amtrak Station location affect pedestrian connections, parking, and traffic operations?

The Build Alternative would relocate the existing Tacoma Amtrak Station to the Tacoma Dome Station at Freighthouse Square. The Tacoma Dome Station area is also served by Tacoma Link light rail, *Sounder* commuter rail, and Pierce Transit and Sound Transit Express bus service.

Pedestrian Connection Times

With the No Build Alternative, pedestrian connection times would be similar to existing conditions.

The Build Alternative's Tacoma Amtrak Station relocation would reduce the pedestrian walking connection time between Amtrak passenger rail and the transit services provided at the Tacoma Dome Station by approximately nine minutes. Also, this relocation would include a parking area, which would be slightly farther from the station compared to existing conditions. The parking area for the new station would likely be located across the street compared to the current condition at the existing Tacoma Amtrak Station where a parking lot is provided near the train boarding platform. Relocating the Tacoma Amtrak Station would also reduce the connection time between Amtrak rail service and connecting bus services by approximately four minutes, with walking distance between the two shortened by approximately 1,000 feet from the current condition. These changes in service connections would improve passenger connections and convenience when connecting between Amtrak and *Sounder*, Tacoma Link light rail, or bus transit.

Parking

With the No Build Alternative, the existing Tacoma Amtrak Station would continue to provide approximately 82 parking spaces, which would be sufficient because there would be no increase in passenger rail service.

With the Build Alternative, the existing Amtrak parking would be relocated closer to the new Tacoma Dome Station at Freighthouse Square. This relocation would provide the same amount or more parking than is currently available at the Tacoma Amtrak Station. Parking would most likely be located on a parcel near Freighthouse Square that either has parking available for lease or purchase or can be developed into a parking lot for exclusive use by Amtrak passengers. In addition to this proposed parking, there would be some available on-street parking near the station and in the parking garage for the Tacoma Dome Station at Freighthouse Square. By the 2nd quarter of 2012, FRA and WSDOT should have a Freighthouse Square Amtrak Relocation feasibility study completed that would evaluate parking options.

Traffic Operations

With the No Build Alternative, drivers would experience an increase in travel delay around Freighthouse Square due to the projected increase in the number of people traveling compared to today.

As noted in Chapter 4, the predominant travel pattern for vehicles to and from the existing Tacoma Amtrak Station is the I-5/I-705 slip ramp and East 26th Street to reach the existing parking lot. The Build Alternative would relocate the Tacoma Amtrak Station to the Tacoma Dome Station at Freighthouse Square, and this relocation would change how people and vehicles circulate in the immediate area. With parking relocated closer to the freeway ramp, traffic operations on Puyallup Avenue are anticipated to improve. Traffic volumes and LOS at intersections on East "C" Street and East "D" Street would be similar to the No Build Alternative.

How would the Project affect traffic on area roadways?

Travel Demand

Travel demand models were used to project how people would travel and where they would travel in the future, and take into consideration transportation improvements (see Attachment C – List of Assumed Projects) and changes to land use due to other actions. As seen in Attachment C, this analysis included an assumption that the Cross-Base Highway would be constructed and operational in 2030, and demand was estimated with and without the Cross-Base Highway.

Travel demand modeling conducted for the Project found that the addition of Amtrak passenger service to the Point Defiance Bypass Route would not change the number of people traveling in 2030 compared to the No Build Alternative. With the improved Amtrak service, the diversion of travelers from I-5 as a regional route to Amtrak service would be negligible. Therefore, the 2030 morning and evening peak hours summarized in Exhibit 56 are the same for the No Build and Build alternatives. These volumes represent future 2030 traffic without the Cross-Base Highway.

Exhibit 56. 2030 AM and PM Peak Hour Roadway Volumes

Crossing Street		2010 Peak Hour Roadway Volumes		2030 Peak Hour Roadway Volumes	
Street Name	***Direction***	***AM***	***PM***	***AM***	***PM***
East “D” Street	Northbound	328	202	410	360
	Southbound	56	321	175	455
East “C” Street	Northbound	202	59	245	240
	Southbound	21	93	65	140
South “C” Street	Northbound	61	53	70	65
	Southbound	74	129	90	155
South Chandler Street	Northbound	21	21	25	25
	Southbound	15	25	20	25
South Alaska Street	Northbound	13	8	15	10
	Southbound	12	12	15	15
South Wilkeson Street	Northbound	280	238	340	315
	Southbound	166	394	170	440
South Pine Street	Northbound	534	1,105	575	1,225
	Southbound	526	946	545	1,000
35th Street Southwest	Eastbound	124	173	125	175
	Westbound	139	193	170	205
50th Street Southwest	Eastbound	30	63	35	70
	Westbound	39	19	45	20
South 56th Street	Eastbound	944	987	1,080	1,250
	Westbound	711	1,408	840	1,660
60th Street Southwest	Eastbound	34	32	40	45
	Westbound	20	42	25	50
South 74th Street	Eastbound	872	837	1,130	1,110
	Westbound	774	884	975	1,060
Steilacoom Blvd Southwest	Eastbound	624	1,009	690	1,110
	Westbound	1,136	999	1,255	1,090
100th Street Southwest	Eastbound	581	1,140	615	1,240
	Westbound	1,004	983	1,095	1,040
108th Street Southwest	Eastbound	313	774	355	835
	Westbound	537	539	575	610
Bridgeport Way Southwest	Northbound	774	1,041	845	1,310
	Southbound	753	880	895	990
Clover Creek Drive Southwest	Eastbound	61	43	80	60
	Westbound	32	85	45	115
North Thorne Lane Southwest	Eastbound	219	407	210	690
	Westbound	274	467	360	390
Berkeley Street Southwest	Eastbound	243	530	185	360
	Westbound	497	347	430	550
41st Division Drive	Eastbound	972	1,343	1,180	1,450
	Westbound	846	580	1,030	740
Barksdale Avenue	Eastbound	609	670	725	730
	Westbound	737	795	890	1,090

The Build Alternative would increase the number of roadway blockages from train crossings throughout the day and during the morning and evening peak hour, compared to the No Build Alternative.

How would the Project affect safety at rail crossings?

Improved Crossing Locations

The Project would improve safety at several existing at-grade crossings by adding the following improvements (refer to Exhibit 3 in Chapter 1):

- **Signage:** "Do Not Stop On Tracks" signs would be installed at the crossings.
- **Wayside horns:** A wayside horn system is an automated warning system that is installed at a rail/roadway at-grade crossing to warn people of an approaching train.
- **Median barriers:** Median barriers are installed in the middle of the roadway approaching the railroad tracks to discourage vehicles from driving around the railroad crossing gates.
- **Sidewalks:** Sidewalks provide an ADA-accessible route over the tracks. Additionally, tactile strips provided with the improvements alert the sight-impaired to changes ahead.
- **Pre-signals:** Pre-signals control vehicle traffic approaching a railroad crossing and minimize queuing across the at-grade railroad crossing.

Intersection Signal Improvements

The Project would install more advanced signal controllers at the following crossing areas:

- North Thorne Lane Southwest
- Berkeley Street Southwest
- 41st Division Drive
- Barksdale Avenue

The more advanced signal controllers would allow synchronized operation of the nearby signals to reduce the likelihood of vehicles on the tracks, especially at railroad crossings where trains are not as frequent in the south end of the study area. These improvements would include additional vehicle detectors and enhanced traffic management that would reduce the delay following a train crossing event.

Exhibit 57 summarizes the changes that are currently proposed in more detail. FRA and WSDOT will bench test the signal controllers proposed with the Project during the final design and construction process to finalize the signal control and timing plans for the crossing areas.

Exhibit 57. Signal Controller Changes with the Build Alternative

Intersection	Existing Signal Control	With Project
North Thorne Lane Southwest Crossing		
North Thorne Lane Southwest and Union Avenue Southwest	**Unsignalized (stop sign only)**	**Remove all controllers and replace with a single controller for all three intersections.**
North Thorne Lane Southwest and I-5 SB Ramps	**Operates on the same controller located at the I-5 NB Ramps intersection; controlled by WSDOT.**	
North Thorne Lane Southwest and I-5 NB Ramps	**Operates on a controller; controlled by WSDOT.**	
Berkeley Street Southwest Crossing		
Berkeley Street Southwest and Union Avenue Southwest	**Controller was removed and operates on as an all-way flashing red.** ***Operation and Maintenance responsibility unknown.***	**Remove all controllers and replace with a single controller for all three intersections.**
Berkeley Street Southwest and I-5 SB Ramps	**Operates on single controller for both ramp intersections; controlled by WSDOT.**	
Berkeley Street Southwest and I-5 NB Ramps	**Operates on single controller for both ramp intersections; controlled by WSDOT.**	
Barksdale Avenue		
Barksdale Avenue and DuPont-Steilacoom Road	**Operates on its own controller; owned by DuPont, and controlled by WSDOT. Interconnected with the I-5 ramp intersection controllers.**	**Remove all controllers and replace with a single Controller for all three intersections.**
Barksdale Avenue and I-5 SB Ramps	**Operates on individual controller; controlled by WSDOT; interconnected with the other two Barksdale intersections.**	
Barksdale Avenue/ Locust Road and I-5 NB Ramps	**Operates on individual controller; controlled by WSDOT; interconnected with the other two Barksdale intersections.**	

Details of the signal phasing and timing plans would be further refined after the NEPA process during final design and construction; for this reason, those details have not been included in this report because the Project cannot commit to them at this stage. FRA and WSDOT will coordinate this effort with local agencies, such as the City of Lakewood.

Predicted Accident Experience

No Build Alternative

Overall, with the No Build Alternative, 3.6 accidents for every million train crossings are anticipated based on the expected number of average daily train crossings and predicted annual accident frequencies. On the Bypass Route alone, the No Build Alternative would experience 7.0 accidents for every million train crossings. Analysts have also summarized the accident frequencies for the No Build Alternative and expressed the frequency in terms of years between accidents.

Under the No Build Alternative, traffic volumes and the number of crossings have increased compared to those for the existing conditions analysis. As shown by the accident frequencies in Exhibit 58, the No Build Alternative would experience the same overall accident frequency of 1.0 year between accidents as existing conditions (the overall change is small). The accident severities would likely remain the same.

Exhibit 58. Corridor Accident Experience – Predicted for Year 2030 Conditions

Corridor Summary	**Years between Accidents**		**Change Build vs. No Build**
Route	***No Build Alternative Prediction***	***Build Alternative Prediction***	***Time between Accidents***
Puget Sound Route	**3.2**	**3.3**	**0.1 years longer**
Bypass Route	**1.4**	**1.2**	**0.2 years shorter**
Both Routes Combined	**1.0**	**0.9**	**0.1 years shorter**

Build Alternative

With the Build Alternative, 3.2 accidents for every million train crossings are anticipated based on the expected number of average daily train crossings and predicted annual accident frequencies. This accident rate would be better than the No Build Alternative (3.6 accidents per million train crossings). On the Bypass Route alone, the Build Alternative would experience 4.1 accidents for every million train crossings, which is better than the No Build Alternative (7.0 accidents for every million train crossings). Analysts have also summarized the accident frequencies for the Build Alternative and expressed the frequency in terms of years between accidents to illustrate the Project effects in greater detail.

With the Build Alternative, street traffic volumes do not increase when compared to the No Build Alternative. Train volumes increase compared to the No Build Alternative on the Bypass Route, but decrease on the Puget Sound Route. On the Bypass Route, along with the increased train traffic, improvements have been included at several railroad crossings (refer to Exhibit 3 in Chapter 1) that improve safety (for example, gates). The predicted accident frequencies for the Build Alternative are shown in Exhibit 58. When accidents do occur, the severity of the accidents would increase along the Bypass Route south of the Lakewood *Sounder* Station because high-speed trains do not currently operate along this segment. Overall, the time between accidents would be 0.1 years less with the Build Alternative than with the No Build Alternative; however, the number of crossing events increases and the accident rate per million train crossings improves with the Build Alternative.

When Amtrak service shifts from the Puget Sound Route, some improvement in accident frequency is predicted on the Puget Sound Route at individual crossings, and the overall frequency between accidents would be longer.

On the Bypass Route, the accident frequency would increase and accidents would occur 0.2 years earlier than the No Build Alternative; this is in part due to the number of total daily crossing events on the Bypass Route increasing by 105 percent. Despite the shorter frequency between accidents, the Build Alternative would reduce the accident rate per train crossing event. Analysts reviewed the route in greater detail as summarized in Exhibit 59 and no crossing would meet the accident frequency thresholds described in Chapter 2 for the next level of crossing improvements (grade separation). The largest effects occur at Bridgeport Way Southwest and Barksdale Avenue, where the train volumes increase seven times (700 percent) over the No Build Alternative and the time between accidents would be shortened by 37 percent. Still, with the Project design, accident thresholds would not be exceeded for these locations, demonstrating that the design improvements included with the Project would be sufficient.

Exhibit 59. Individual Crossing Accident Experience – Predicted for Year 2030 Conditions

Individual Crossings		Years between Accidents		Change Build vs. No Build	
Crossing	***Crossing ID***	***No Build Alternative Prediction***	***Build Alternative Prediction***	***In Years***	***In Train Volume***
Puget Sound Route					
East "D" Street	**085714A**	**21**	**21**	**0**	**-19%**
McCarver	**085730J**	**25**	**26**	**+1**	**-19%**
Sixth Avenue	**085742D**	**30**	**31**	**+1**	**-19%**
South 19th Street	**085743K**	**23**	**24**	**+1**	**-19%**
Sunnyside Beach Ped	**085754X**	**19**	**20**	**+1**	**-19%**
Steilacoom/Union Ferry Terminal	**085755E**	**12**	**12**	**0**	**-19%**
Solo Point Road	**085758A**	**109**	**115**	**+6**	**-19%**
Bypass Route					
East “D” Street	**396639A**	**26**	**24**	**-2**	**88%**
East “C” Street	**396640U**	**13**	**12**	**-1**	**88%**
South “C” Street	**n/a NEW**	**50**	**43**	**-7**	**88%**
South Chandler Street	**085372C**	**72**	**61**	**-9**	**88%**
South Alaska Street	**085373J**	**87**	**74**	**-13**	**88%**
South Wilkeson Street	**085374R**	**37**	**32**	**-5**	**88%**
South Pine Street	**085382H**	**25**	**22**	**-3**	**88%**
35th Street Southwest	**085385D**	**35**	**31**	**-4**	**88%**
50th Street Southwest	**085391G**	**49**	**43**	**-6**	**88%**
South 56th Street	**085392N**	**21**	**20**	**-1**	**88%**
60th Street Southwest	**085394C**	**61**	**52**	**-9**	**88%**
South 74th Street	**085396R**	**25**	**19**	**-6**	**88%**
Steilacoom Blvd Southwest	**085400D**	**26**	**20**	**-6**	**88%**
100th Street Southwest	**085402S**	**12**	**12**	**0**	**47%**
108th Street Southwest	**085404F**	**29**	**23**	**-6**	**47%**
Bridgeport Way Southwest	**085821P**	**35**	**22**	**-13**	**700%**[27]
Clover Creek Drive Southwest	**085822W**	**62**	**53**	**-9**	**700%**
North Thorne Lane Southwest	**085828M**	**19**	**12**	**-7**	**700%**
Berkeley Street Southwest	**085829U**	**44**	**33**	**-11**	**700%**
41st Division Drive	**085830N**	**33**	**25**	**-8**	**700%**
Barksdale Avenue	**085836E**	**46**	**29**	**-17**	**700%**

[27] *Train volumes increase by 700 percent from Bridgeport Way SW and to the south because Sound Transit* Sounder *trains would not operate along the route through those crossings, and the other background train volumes are low (two freight trains per day).*

Quiet Zones

The Use of Locomotive Horns at Highway-Rail Grade Crossings; Final Rule (Parts 222 and 229 of title 49 of the Code of Federal Regulations (CFR)) describes what quiet zones are and how they can be used in transportation systems. Quiet zones are segments of rail lines where locomotive horns are not routinely sounded when trains approach crossings. Communities can establish quiet zones to reduce noise from train crossings provided that appropriate safety measures are taken to minimize the potential effect on travel safety at highway-rail grade crossings. The public authorities involved with a public highway-rail grade crossing must agree on the establishment of the quiet zone (49 CFR §222.37).

Public authorities may establish quiet zones by providing supplemental safety measures at all of the crossings in the quiet zone to mitigate the reduction in safety experienced with the silencing of locomotive horns. Four-quadrant gate systems and gates with medians or channelization devices are examples of supplement safety measures that can be applied to create quiet zones.

Wayside horns may be used in lieu of locomotive horns at any highway-rail grade crossing equipped with an active warning system including flashing lights and gates (at a minimum). Grade crossings equipped with wayside horns are also considered as crossings with supplemental safety measures when measuring the length of quiet zones, but not when calculating risk indices. Wayside horns focus the warning sound directly towards street traffic at crossings, which can reduce noise effects without a quiet zone being established. Wayside horns also negate the requirement for advance warning signs advising travelers that trains do not sound horns at crossings.

No Build Alternative

Under the No Build Alternative, no quiet zones would be established.

Build Alternative

Under the Build Alternative, no quiet zones would be established; however, the crossing improvements that would be made with the Project (median separators and wayside horns) would improve the eligibility of communities to establish quiet zones.

How would the Project affect local traffic operations?

The one additional train crossing (Amtrak Cascades train) during the morning and afternoon peak hours associated with the Build Alternative would mostly cause a slight change in traffic congestion for the overall hour. This is because the vehicle volumes are the same for the No Build and Build alternatives and the train events are relatively short in comparison to the overall amount of time in the hour.

Intersection Geometry Changes

No Build Alternative

The No Build Alternative would not modify intersection geometry at the study intersections from existing operations.

Build Alternative

Analysts studied the Build Alternative assuming that travel lanes would be minimally widened (no new lanes) and turn radii would be improved between the I-5 SB ramp terminal and Union Avenue on both Berkeley Street and North Thorne Lane Southwest. These improvements would be built with the railroad crossing improvements. No additional intersection geometry changes were assumed in the analysis.

Street Operations During a Train Event

Along the Bypass Route, trains crossing roadways at-grade would close streets for varying periods of time for each train depending on the crossing location, speed and length of each train.

For the existing conditions analysis, Sound Transit *Sounder* trains were assumed to operate between Freighthouse Square and the Lakewood Station. This level of commuter rail operations would continue in the future year 2030 with either the No Build or Build Alternative.

For the No Build Alternative, Sound Transit is scheduled to operate one *Sounder* train along the project corridor to the Lakewood Station during the AM and PM peak hours. The total overall duration of road blockage modeled during the morning and afternoon peak hour ranges from 46 to 190 seconds. The longer overall blockages at 100th Street Southwest and 108th Street Southwest in the PM peak hour are from two *Sounder* trains crossing the streets: one revenue train (a train in-service) and one non-revenue train (a train traveling between the Lakewood Station and the layover facility).

With the added Amtrak service, the overall total amount of blocked time in the hour approximately doubles at most locations with *Sounder* trains; however, this is due to separate train events and not one continuous blockage. This increased time represents approximately 1-5 percent of the total morning and afternoon peak hour. The difference in the blockage time for study area intersections is due to train speed and crossing distance.

Exhibit 60 provides a comparison of the blockage time between an Amtrak Cascades train and *Sounder*. An Amtrak Cascades train is slightly longer than a *Sounder* train, but would be traveling faster, causing less road blockage time per train. The blockage times shown for *Sounder* trains crossing East "D" Street, South 56th Street, and 60th Street Southwest were based on preliminary information available when the traffic analysis was completed. Recent information provided by Sound Transit (December 2011) indicates that the street blockage times at these crossings would likely be longer as indicated below:

- At East "D" Street, the blockage time may be as long as two and a half minutes (150 seconds) while *Sounder* trains load and unload passengers at the Tacoma Dome Station at Freighthouse Square. At South 56th Street, northbound *Sounder* trains arriving at the South Tacoma Station would trigger the gates to come down as the train approaches the station and slows to a stop, but would go up again during passenger loading and unloading, creating an additional street closure where no train crosses.
- At 60th Street Southwest, the blockage time would likely be nearly two and a half minutes for each southbound *Sounder* train because the gates would be down while passengers enter and exit the train at the South Tacoma Station.

Amtrak trains would likely result in similar blockages at the East "D" Street crossing, but not at South 56th Street or 60th Street Southwest because Amtrak trains would not stop at the South Tacoma Station.

***Exhibit 60. Future Year 2030 Peak Hour Overall Roadway Blockage by Trains*[28]**

Crossing Street	No Build		Build Alternative		
	Sound Transit *Sounder* Trains		Amtrak Cascades Trains	Combination of *Sounder* and Amtrak Cascades Service	
	Total Blockage Time (seconds)	*Overall Percent Time Blocked (percent of one hour)*	*Total Blockage Time (seconds)*	*Total Blockage Time (seconds)*	*Overall Percent Time Blocked (percent of one hour)*
East "D" Street[29]	70	2%	74	144	4%
East "C" Street	62	2%	65	127	4%
South "C" Street	51	1%	52	103	3%
South Chandler Street	52	1%	53	105	3%
South Alaska Street	51	1%	52	103	3%
South Wilkeson Street	50	1%	48	98	3%
South Pine Street	50	1%	50	100	2%
35th Street Southwest	48	1%	46	94	3%
50th Street Southwest	46	1%	44	90	3%
South 56th Street	66	2%	54	120	3%
60th Street Southwest	61	2%	42	103	3%
South 74th Street	59	2%	59	108	3%
Steilacoom Blvd Southwest	51	1%	51	100	3%
100th Street Southwest	53 (AM) 141 (PM)[30]	2% (AM) 3% (PM)	53	106 (AM) 194 (PM)	3% (AM) 5% (PM)
108th Street Southwest	51 (AM) 105 (PM)[31]	2% (AM) 3% (PM)	50	108 (AM) 155 (PM)	3% (AM) 4% (PM)
Bridgeport Way Southwest	0	0%	53	53	1%
Clover Creek Drive Southwest	0	0%	42	42	1%
North Thorne Lane Southwest	0	0%	52	52	1%

[28] *Sound Transit* Sounder *and Amtrak* Cascades *are the predominant trains occurring in the peak hour. Freight trains would tend to travel in the midday and avoid the peak periods of congestion on streets. The freight trains are approximately 2,500 feet long and travel at 10 mph, creating blockages lasting approximately three to four minutes.*
[29] *Separate construction by Sound Transit will result in the conditions described at E. "D" Street, E. "C" Street, and S. "C" Street*
[30] *In the PM peak hour, in addition to the one revenue train, one non-revenue train traveling approximately 10 mph will use the 100th Street SW crossing, which would block 100th Street SW for approximately 88 seconds.*
[31] *In the PM peak hour, in addition to the one revenue train, one non-revenue train traveling approximately 35 mph will use the 108th Street SW crossing, which would block 108th Street SW for approximately 55 seconds.*

Crossing Street	No Build		Build Alternative		
	Sound Transit *Sounder* Trains		Amtrak Cascades Trains	Combination of *Sounder* and Amtrak Cascades Service	
	Total Blockage Time (seconds)	***Overall Percent Time Blocked (percent of one hour)***	***Total Blockage Time (seconds)***	***Total Blockage Time (seconds)***	***Overall Percent Time Blocked (percent of one hour)***
Berkeley Street Southwest	**0**	**0%**	**52**	**52**	**1%**
41st Division Drive	**0**	**0%**	**54**	**54**	**2%**
Barksdale Avenue	**0**	**0%**	**54**	**54**	**2%**

The Build Alternative would increase the overall time roadways are blocked compared to the No Build Alternative.

Pre-signals

Pre-signals would be installed at specific crossing locations. These signals stop vehicles from queuing over the railroad tracks instead of the intersection signal. This improvement would allow the intersection to maintain normal operation, which would reduce congestion and vehicle delays at intersections.

Intersection Delay (LOS)

No Build Alternative Intersection Delay

By 2030, traffic volumes would increase, and intersection delay is projected to increase compared to 2010 existing conditions. The increase in traffic volumes and intersection delay is from actions not associated with the Project, such as the projected growth in population and employment in the area.

Under the No Build Alternative, most of the study area intersections are expected to operate within the LOS D standards set by local jurisdictions and WSDOT (LOS A through D). Typically, intersections failing to meet an LOS standard indicate that some improvement is necessary, or a local jurisdiction can change the LOS during updates to their Comprehensive Plan. Study intersections failing to meet the LOS standard are summarized in Exhibit 61. The LOS and average intersection delay for the 2030 morning and afternoon peak hour are illustrated in Exhibit 62 through Exhibit 70.

Exhibit 61. Year 2030 No Build Alternative – Intersections Failing to Meet the LOS Standard

	AM Peak Hour		PM Peak Hour	
Intersection	***LOS***	***Delay (sec./veh.)***	***LOS***	***Delay (sec./veh.)***
East "D" Street and East 26th Street	**--**	**--**	**E**	**72.6**
East "C" Street and East 26th Street	**--**	**--**	**F**	**>300**
60th Street Southwest and South Tacoma Way	**--**	**--**	**E**	**43.8**
North Thorne Lane Southwest and Union Avenue Southwest	**--**	**--**	**F**	**182.9**
North Thorne Lane Southwest and I-5 SB Ramps	**E**	**70.3**	**--**	**--**
North Thorne Lane Southwest and I-5 NB Ramps	**E**	**75.2**	**F**	**91.3**
Berkeley Avenue Southwest and Union Avenue Southwest	**F**	**102.2**	**F**	**64.1**
41st Division Drive and I-5 NB Ramps	**--**	**--**	**F**	**105.5**
Barksdale Avenue/Locust Road and I-5 NB Ramps	**E**	**61.3**	**E**	**56.0**

Exhibit 62. Intersection LOS – Future Year 2030, East "D" Street through South "C" Street

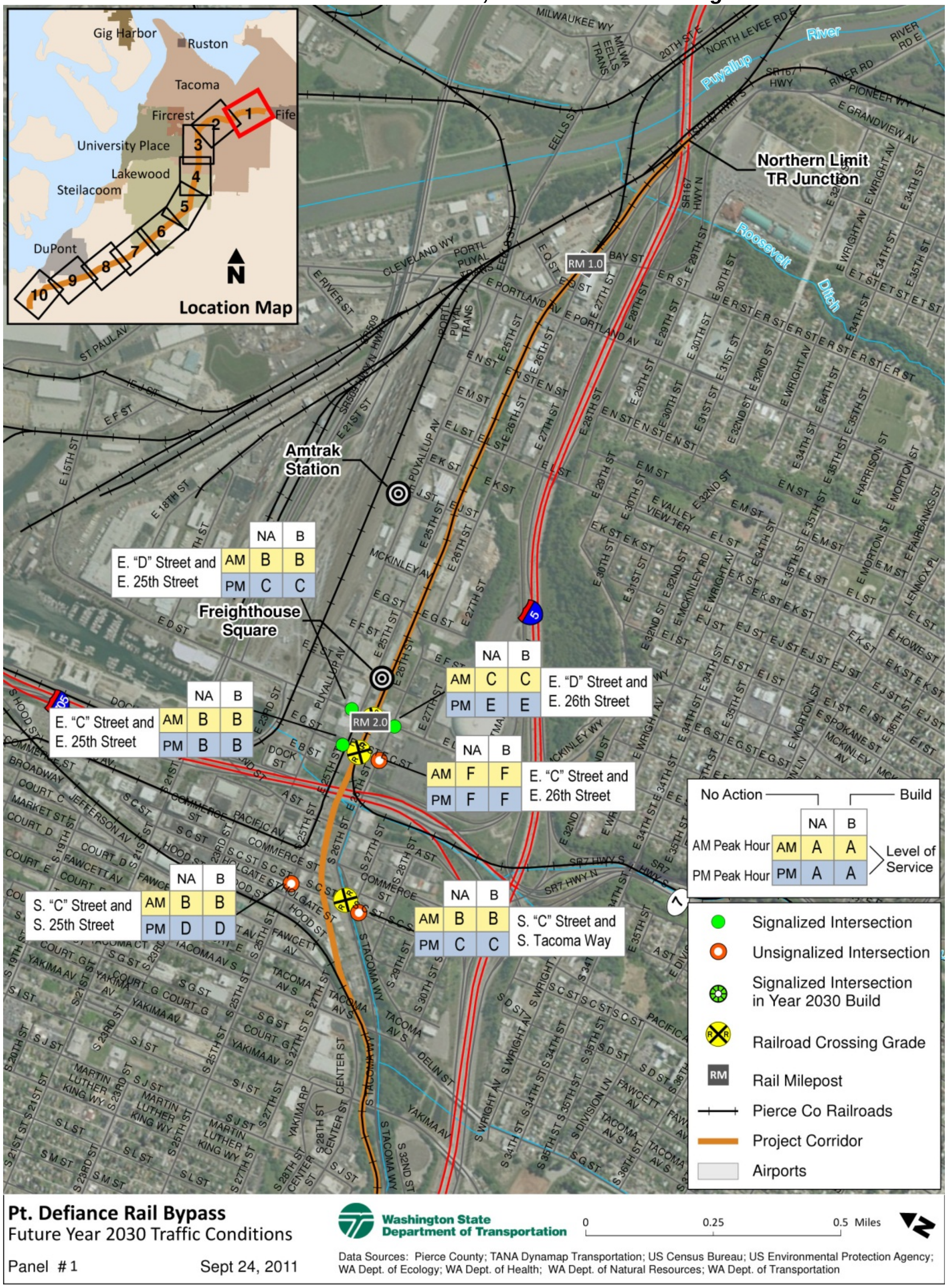


Exhibit 63. Intersection LOS – Future Year 2030, South Chandler Street through South Pine Street

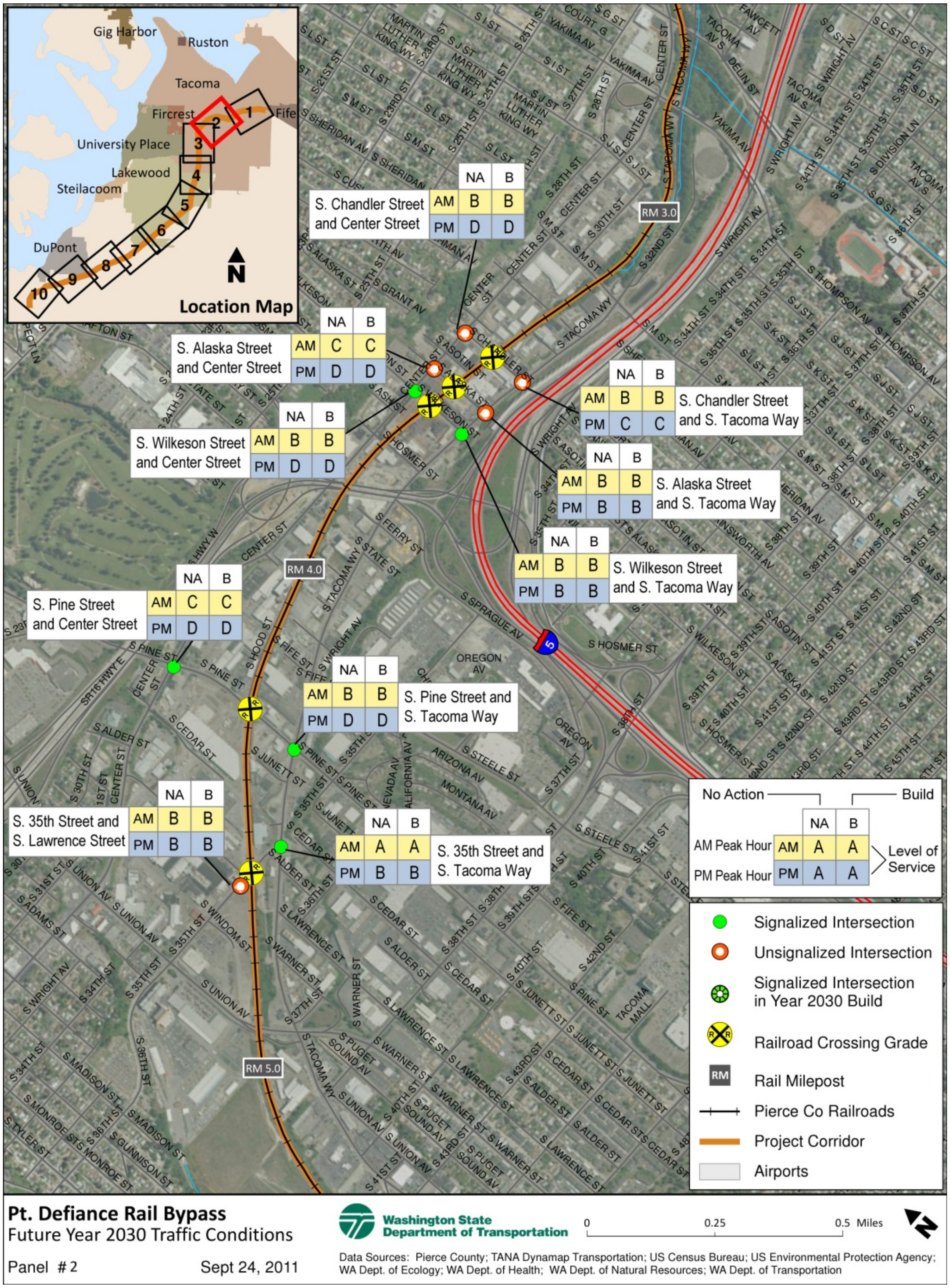
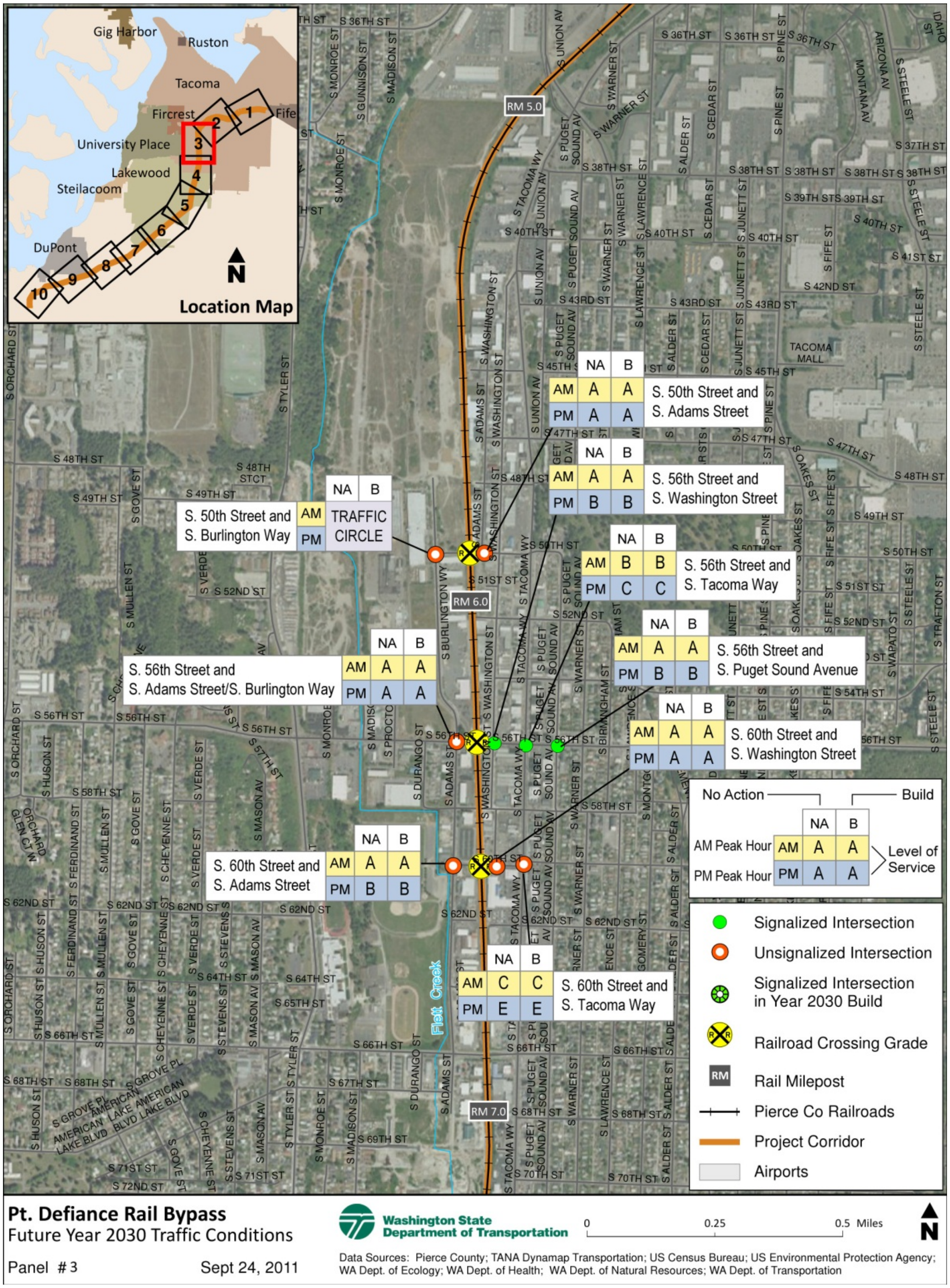


Exhibit 64. Intersection LOS – Future Year 2030, 50th Street Southwest through 60th Street Southwest[32]



[32] The intersection of 50th Street SW/S. Burlington Way is controlled by a traffic circle and, although not measurable by HCM 2000 methodology, operations there are expected to be LOS D or better since traffic volumes are very low (100 vehicles or less entering the intersection in both peak hours).

Exhibit 65. Intersection LOS – Future Year 2030, South 74th Street through Steilacoom Blvd Southwest

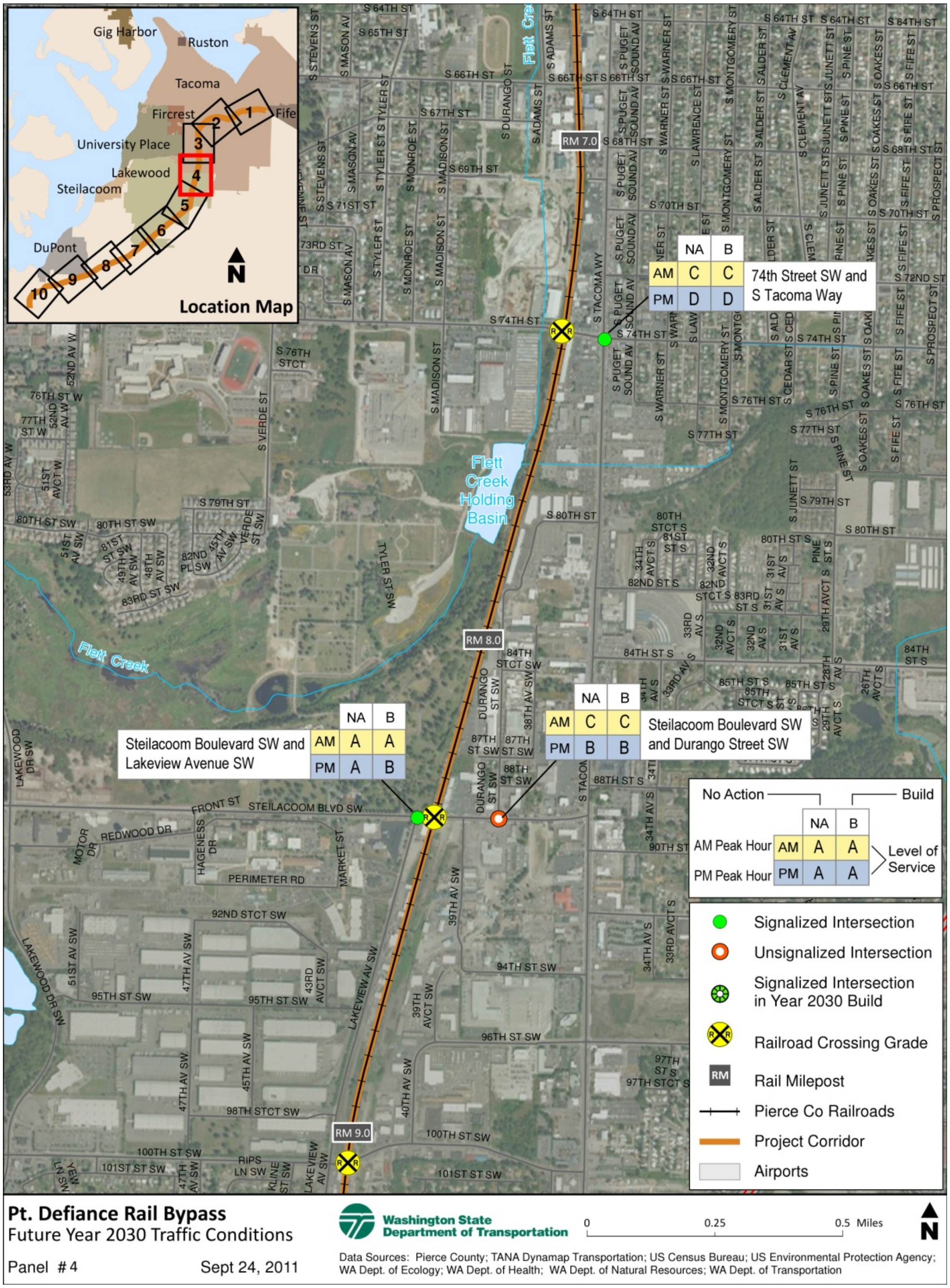


Exhibit 66. Intersection LOS – Future Year 2030, 100th Street Southwest through Clover Creek Drive Southwest

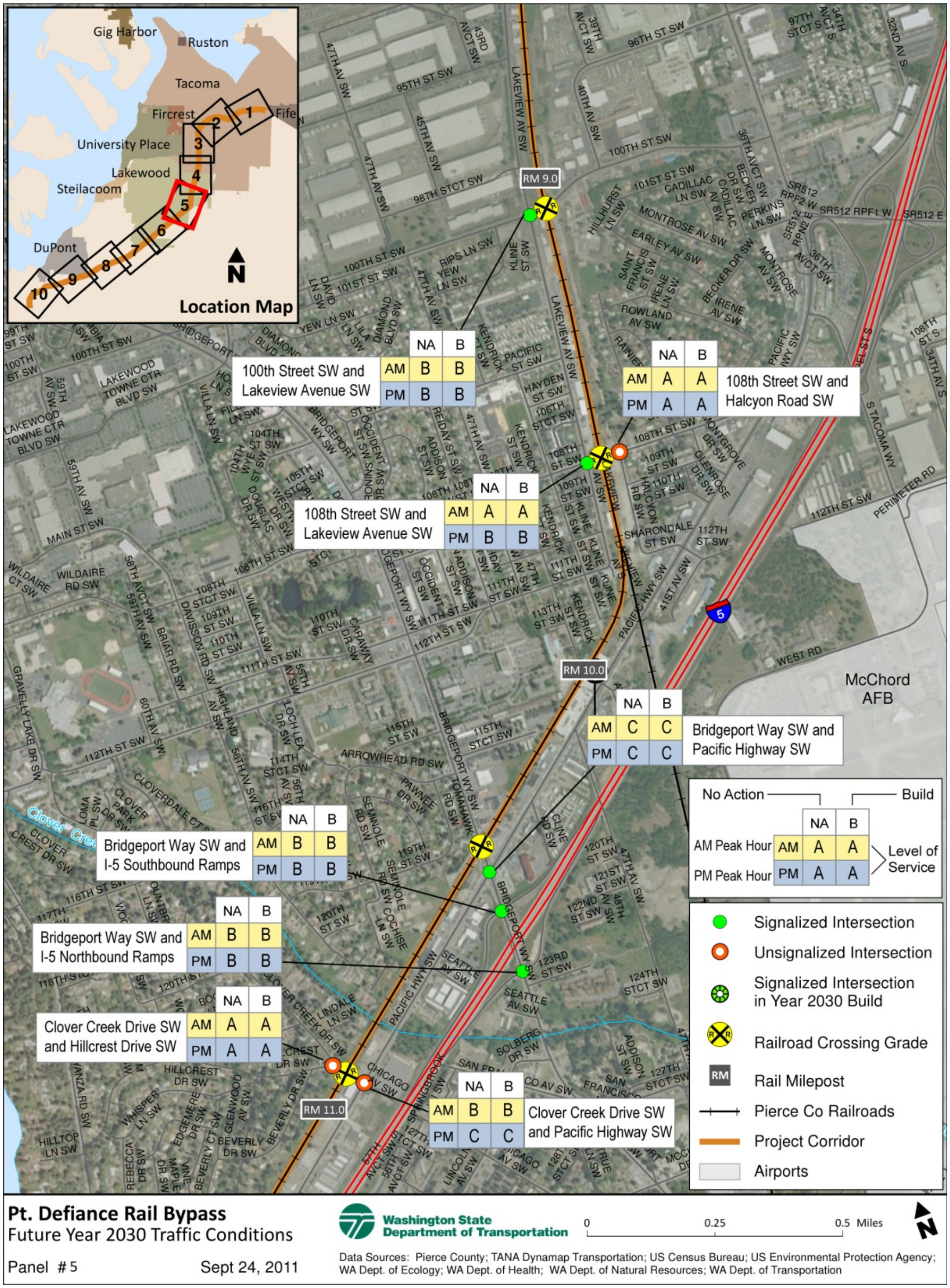


Exhibit 67. Intersection LOS – Future Year 2030, North Thorne Lane Southwest

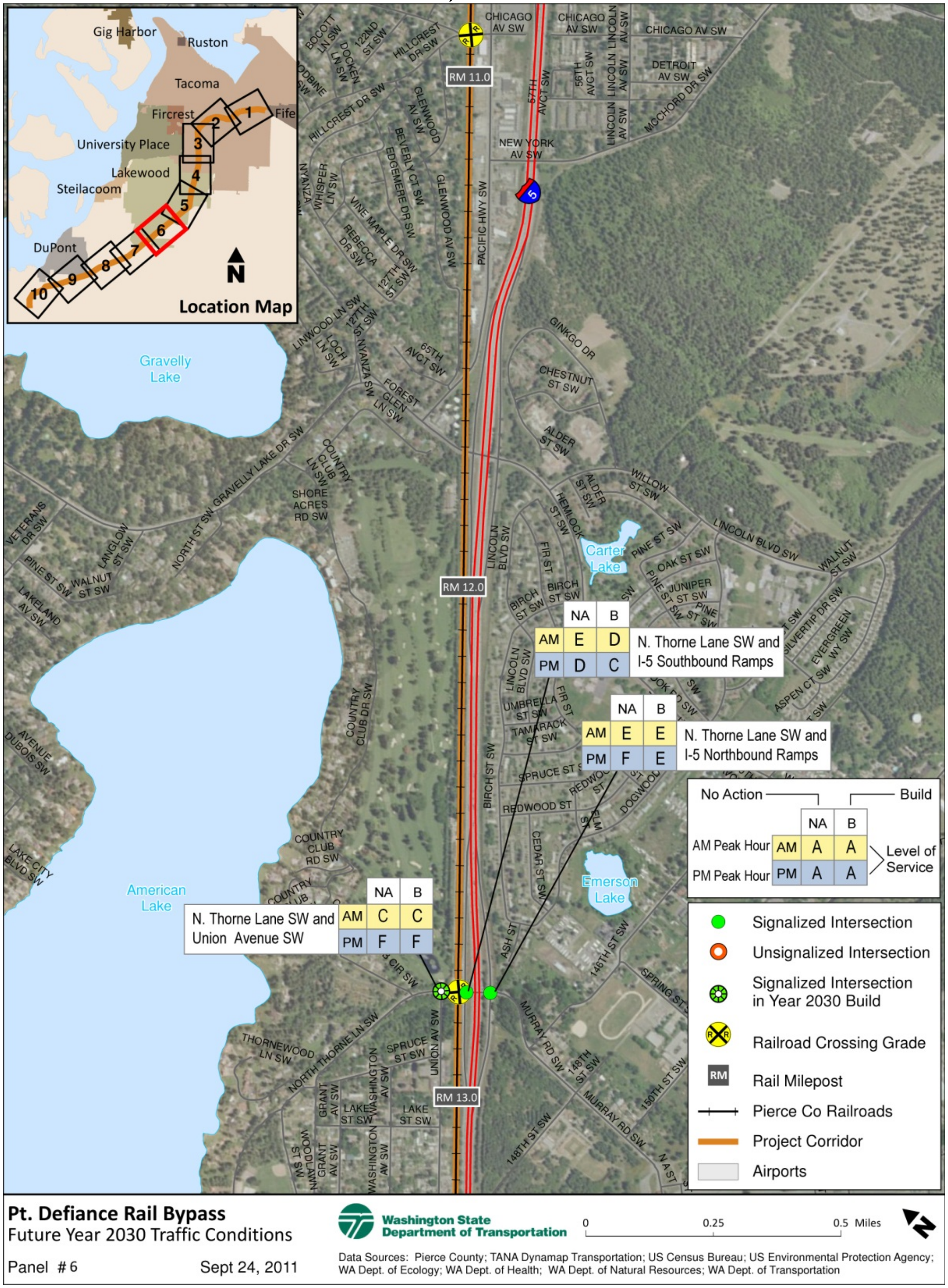


Exhibit 68. Intersection LOS – Future Year 2030, Berkeley Street Southwest

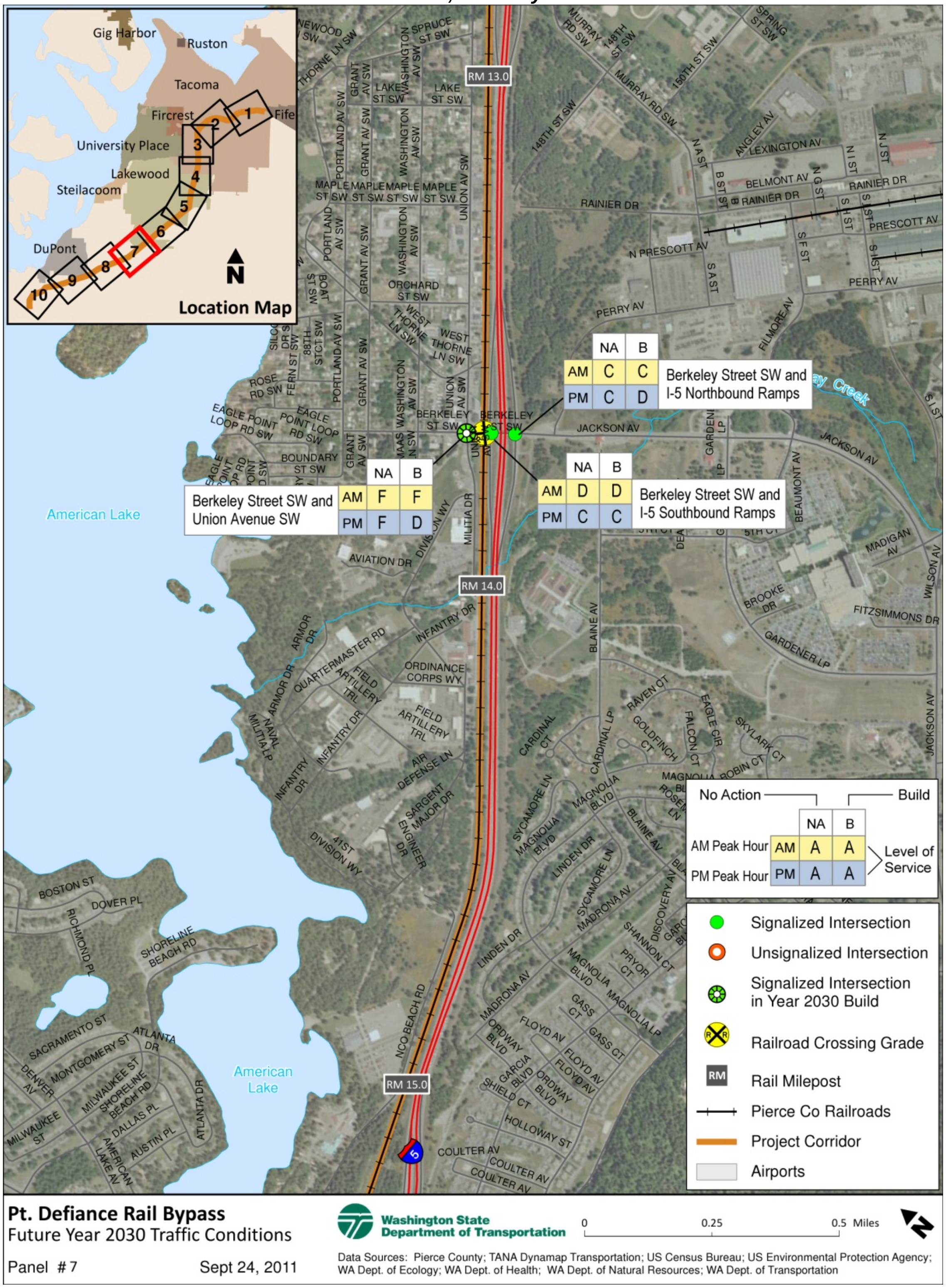


Exhibit 69. Intersection LOS – Future Year 2030, 41st Division Drive

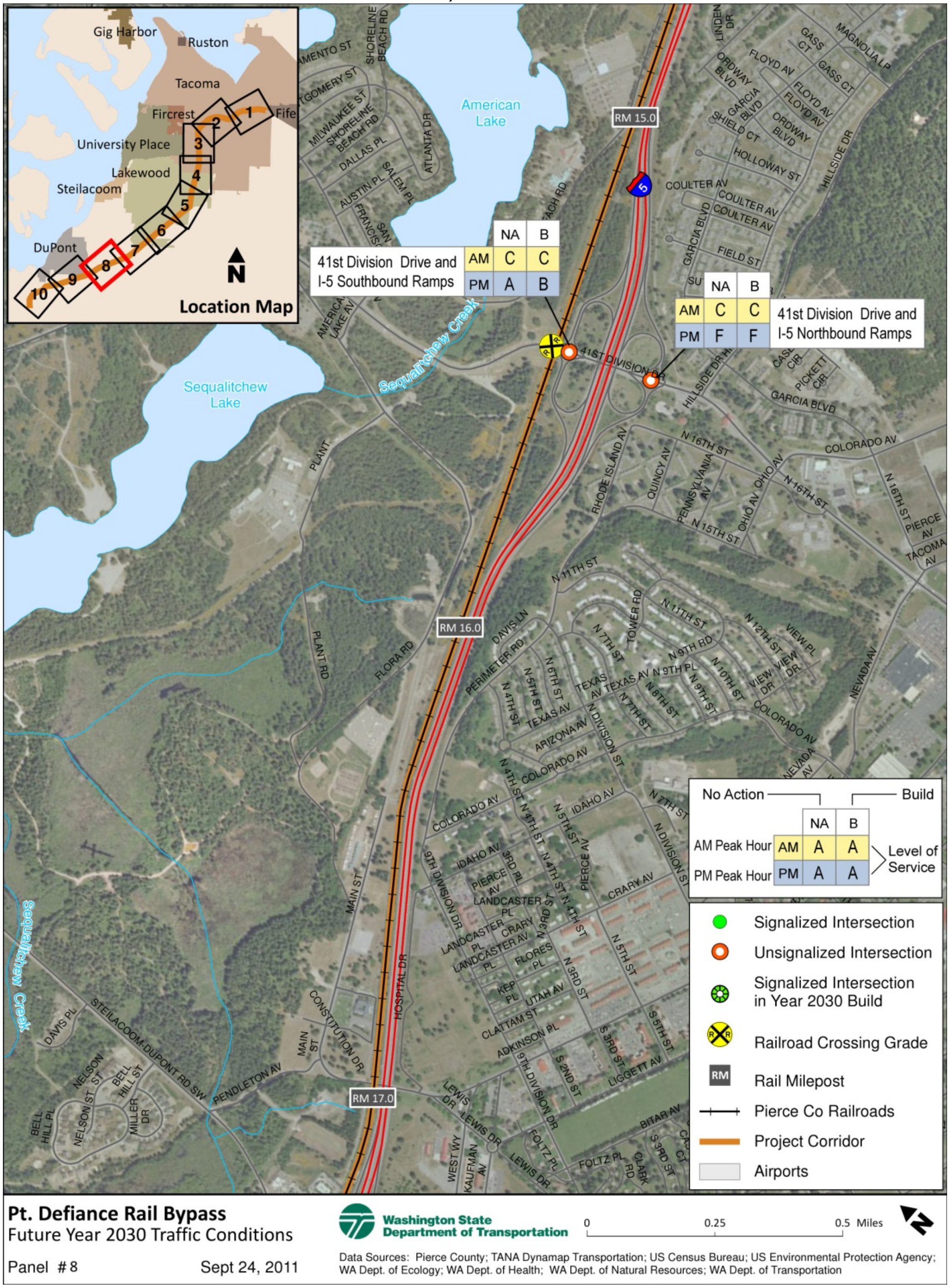
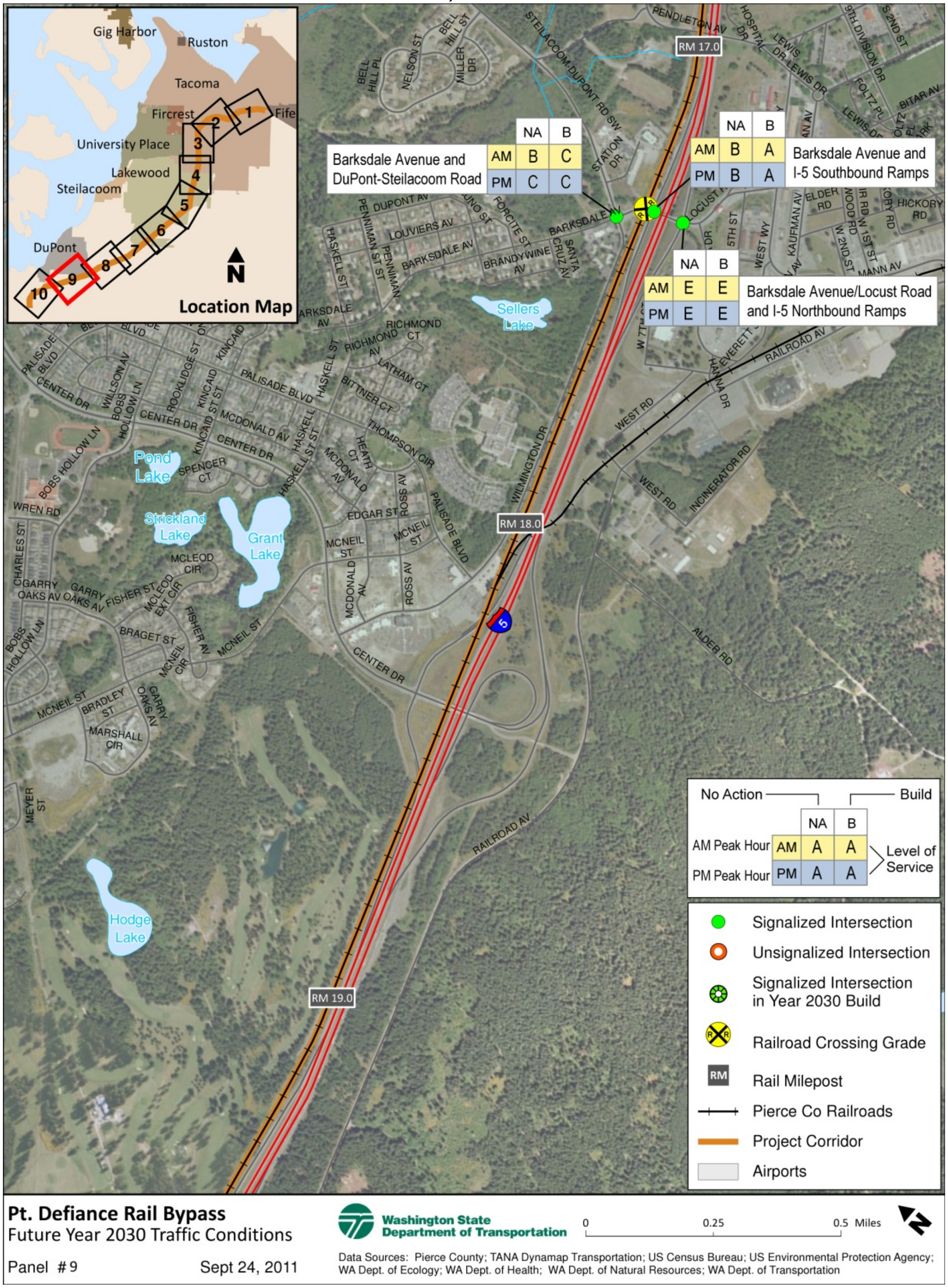


Exhibit 70. Intersection LOS – Future Year 2030, Barksdale Avenue



Build Alternative Intersection Delay

The Build Alternative would reduce the number of intersections exceeding the LOS D standards set by local jurisdictions and WSDOT from nine to eight compared to the No Build Alternative and would not degrade an acceptable No Build Alternative LOS condition to a substandard LOS condition. The Build Alternative would improve substandard LOS conditions at the following locations summarized in Exhibit 71 because of improvements proposed with the Project.

Exhibit 71. Year 2030 Intersections Improved by the Build Alternative

Intersection	AM Peak Hour LOS and Delay (sec./veh.)		PM Peak Hour LOS and Delay (sec./veh.)	
	No Build Alternative	*Build Alternative*	*No Build Alternative*	*Build Alternative*
North Thorne Lane Southwest and I-5 SB Ramps	**E (70.3)**	**D (44.3)**	**D (40.7)**	**C (30.9)**
North Thorne Lane Southwest and I-5 NB Ramps	**E (75.2)**	**E (70.7)**	**F (91.3)**	**E (74.8)**
Berkeley Street Southwest and Union Avenue Southwest	**F (102.2)**	**F (83.5)**	**F (64.1)**	**D (42.9)**
Barksdale Avenue/Locust Road and I-5 NB Ramps	**E (62.5)**	**E (57.6)**	**E (56.0)**	**E (55.8)**

The following locations would experience minor effects resulting in a worse LOS with the Build Alternative but would continue to meet local jurisdiction and WSDOT LOS standards:

- Steilacoom Boulevard Southwest and Lakeview Avenue Southwest: PM peak hour LOS would worsen from LOS A (9.9 sec./veh.) to LOS B (10.2 sec./veh.).
- Berkeley Street Southwest and I-5 NB ramps: PM peak hour LOS would worsen from LOS C (29.8 sec/veh) to LOS D (41.9 sec./veh.).
- 41st Division Drive and I-5 SB ramps: PM peak hour LOS would worsen from LOS A (9.7 sec./veh.) to LOS B (11.9 sec./veh.).
- Barksdale Avenue and DuPont-Steilacoom Road: AM peak hour LOS would worsen from LOS B (19.4 sec./veh.) to LOS C (22.2 sec./veh.).

The remaining intersections would experience some change in delay but no LOS changes.

The net effect of the Project would be that 43 intersections in the AM peak hour and 41 intersections in the PM peak hour would experience slight to no noticeable effect (a delay change of five seconds or less per vehicle). Three intersections in both peak hours (six percent of the study intersections) would experience improved functioning (delay improvements of more than five seconds per vehicle). Only one intersection in the AM peak hour (two percent of the study intersections) and three intersections in the PM peak hour (six percent of the study intersections) would be adversely affected (delay increases greater than five seconds per vehicle); only one of these intersections operates substandard (Thorne Lane Southwest and Union Avenue Southwest at LOS F in the PM peak hour), but the increased delay would be counterbalanced by the reduced delays at the two Thorne Lane Southwest interchange ramp intersections.

Future Year 2030 Queue Lengths

Traffic analysts used VISSIM to calculate the maximum number of vehicles (the queue) stopped at an intersection during the morning and afternoon peak hours. Queues have been summarized for the following at-grade rail crossings because under the No Build Alternative trains do not typically use these crossings in the peak hour, and intersection operations are substandard:

- North Thorne Lane Southwest
- Berkeley Street Southwest
- 41st Division Drive
- Barksdale Avenue

The City of Tacoma specifically requested that queue lengths also be summarized for the South 56th Street and South 74th Street crossings. Attachment B includes a detailed output of the existing and proposed queue lengths for each intersection analyzed.

No Build Alternative Queue Lengths

In 2030, the maximum queue lengths are anticipated to increase because of the increased traffic volumes at study area intersections (see Exhibit 72 through Exhibit 117) compared to 2010 existing conditions. Generally, the maximum queues illustrated in Exhibit 72 through Exhibit 117 are representative of queuing events when a train crosses the roadway; one exception is at the intersection of North Thorne Lane Southwest and Union Avenue Southwest in the PM peak hour, where the system congestion creates the maximum queues regardless of the train crossing.

Exhibit 72. 2030 Queues and Storage at South 56th Street and South Adams Street/South Burlington Way

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	***Build***	***No Action***	***Build***
South 56th Street	**EB Left**	**75**	**AM**	**0**	**0**	**24**	**28**
			PM	**0**	**0**	**31**	**31**
	EB Through	**300 I/S**	**AM**	**10**	**14**	**306 B**	**355 B**
			PM	**19**	**23**	**377 B**	**389 B**
	EB Right	**Shared**	**AM**	**3**	**5**	**221 B**	**271 B**
			PM	**5**	**8**	**291 B**	**304 B**
South 56th Street	**WB Left**	**75 RR**	**AM**	**1**	**1**	**59**	**59**
			PM	**5**	**5**	**156**	**165**
	WB Through	**75 RR**	**AM**	**5**	**5**	**183**	**183**
			PM	**7**	**7**	**170**	**176**
	WB Right	**Shared**	**AM**	**1**	**1**	**119**	**119**
			PM	**1**	**5**	**116**	**165**
South Adams Street	**NB Left**	**75**	**AM**	**1**	**1**	**38**	**36**
			PM	**3**	**3**	**51**	**51**
	NB Through	**650 I/S**	**AM**	**0**	**0**	**58**	**60**
			PM	**3**	**3**	**75**	**84 B**
	NB Right	**Shared**	**AM**	**1**	**1**	**63**	**64**
			PM	**3**	**3**	**77**	**86 B**
South Burlington Way	**SB Left**	**75**	**AM**	**1**	**1**	**34**	**34**
			PM	**0**	**0**	**0**	**0**
	SB Through	**200 RR**	**AM**	**1**	**1**	**42**	**42**
			PM	**1**	**1**	**50**	**51**
	SB Right	**Shared**	**AM**	**0**	**0**	**0**	**0**
			PM	**0**	**0**	**0**	**0**

Storage distances estimated to the nearest 25 feet.
IS Distance to next upstream roadway.
RR Distance reported to upstream railroad crossing.
_ Queue extends beyond lane storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 73. 2030 AM Peak Hour Maximum Queue Lengths for South 56th Street and South Adams Street/South Burlington Way

Exhibit 74. 2030 PM Peak Hour Maximum Queue Lengths for South 56th Street and South Adams Street/South Burlington Way

Exhibit 75. 2030 Queues and Storage at South 56th Street and South Washington Street

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	*Build*	*No Action*	*Build*
South 56th Street	EB Left	50	AM	15	15	231	234
			PM	20	19	240	242
	EB Through	125 RR	AM	9	9	224 B	225 B
			PM	16	15	237 B	238 B
	EB Right	Shared	AM	9	9	224 B	225 B
			PM	16	15	237 B	238 B
South 56th Street	WB Left	Shared	AM	1	1	107	110
			PM	2	2	154	160
	WB Through	225 I/S	AM	25	27	342	351
			PM	47	50	391	391
	WB Right	Shared	AM	16	17	306	314
			PM	47	50	391	391
South Washington Street	NB Left	75	AM	2	2	42	42
			PM	2	3	48	50
	NB Through	600 I/S	AM	4	4	58	58
			PM	3	4	64	64
	NB Right	Shared	AM	4	5	60	60
			PM	4	4	66	66
South Washington Street	SB Left	100	AM	5	5	67	69
			PM	31	87	505	830
	SB Through	600 I/S	AM	3	3	50	50
			PM	42	135 B	800 B	1,219 B
	SB Right	Shared	AM	2	3	91	95
			PM	310	517 B	1,330	1633

Storage distances estimated to the nearest 25 feet.
IS *Distance to next upstream roadway.*
RR *Distance reported to upstream railroad crossing.*
_ *Queue extends beyond lane storage.*
B *Blocks access to turn pocket or channelized right-turn.*

Exhibit 76. 2030 AM Peak Hour Maximum Queue Lengths for South 56th Street and South Washington Street

Exhibit 77. 2030 PM Peak Hour Maximum Queue Lengths for South 56th Street and South Washington Street

Exhibit 78. 2030 Queues and Storage at South 56th Street and South Tacoma Way

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	***Build***	***No Action***	***Build***
South 56th Street	**EB Left**	**50**	**AM**	**7**	**7**	**69**	**70**
			PM	**21**	**21**	**135**	**135**
	EB Through	**225 I/S**	**AM**	**24**	**25**	**180 B**	**201 B**
			PM	**66**	**68**	**315 B**	**325 B**
	EB Right	**Shared**	**AM**	**24**	**25**	**180 B**	**201 B**
			PM	**20**	**21**	**227 B**	**237 B**
South 56th Street	**WB Left**	**50**	**AM**	**11**	**11**	**101**	**101**
			PM	**30**	**29**	**291**	**309**
	WB Through	**225 I/S**	**AM**	**25**	**25**	**199 B**	**199 B**
			PM	**85**	**86**	**331 B**	**328 B**
	WB Right	**Shared**	**AM**	**4**	**4**	**127 B**	**127 B**
			PM	**41**	**43**	**259 B**	**256 B**
South Tacoma Way	**NB Left**	**100**	**AM**	**20**	**20**	**165**	**165**
			PM	**15**	**15**	**139**	**135**
	NB Through	**600 I/S**	**AM**	**34**	**34**	**183 B**	**183 B**
			PM	**51**	**51**	**258 B**	**250 B**
	NB Right	**Shared**	**AM**	**3**	**3**	**108 B**	**108 B**
			PM	**13**	**13**	**183 B**	**174 B**
South Tacoma Way	**SB Left**	**125**	**AM**	**5**	**5**	**77**	**78**
			PM	**8**	**8**	**94**	**102**
	SB Through	**600 I/S**	**AM**	**27**	**27**	**144 B**	**144 B**
			PM	**78**	**77**	**368 B**	**360 B**
	SB Right	**Shared**	**AM**	**0**	**0**	**46**	**46**
			PM	**24**	**24**	**272 B**	**264 B**

Storage distances estimated to the nearest 25 feet.
IS *Distance to next upstream roadway.*
RR *Distance reported to upstream railroad crossing.*
_ *Queue extends beyond lane storage.*
B *Blocks access to turn pocket or channelized right-turn.*

Exhibit 79. 2030 AM Peak Hour Maximum Queue Lengths for South 56th Street and South Tacoma Way

Exhibit 80. 2030 PM Peak Hour Maximum Queue Lengths for South 56th Street and South Tacoma Way

Exhibit 81. 2030 Queues and Storage at South 56th Street and South Puget Sound Avenue

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	*Build*	*No Action*	*Build*
South 56th Street	EB Left	Shared	AM	0	0	29	29
			PM	1	1	47	54
	EB Through	225 I/S	AM	7	7	217	236
			PM	31	33	357	358
	EB Right	Shared	AM	2	2	159	178
			PM	19	20	291	292
South 56th Street	WB Left	Shared	AM	1	1	44	44
			PM	2	2	62	60
	WB Through	200 I/S	AM	5	5	106	106
			PM	11	11	174	169
	WB Right	Shared	AM	0	0	38	37
			PM	1	1	105	95
South Puget Sound Avenue	NB Left	50	AM	1	1	32	32
			PM	3	3	46	47
	NB Through	600 I/S	AM	9	9	98 B	98 B
			PM	16	16	157 B	157 B
	NB Right	Shared	AM	1	1	56 B	56 B
			PM	4	4	115 B	115 B
South Puget Sound Avenue	SB Left	50	AM	2	2	43	43
			PM	9	9	102	102
	SB Through	600 I/S	AM	5	5	65 B	65 B
			PM	14	14	131 B	131 B
	SB Right	Shared	AM	0	0	17	17
			PM	1	1	82 B	82 B

Storage distances estimated to the nearest 25 feet.
IS Distance to next upstream roadway.
RR Distance reported to upstream railroad crossing.
_ Queue extends beyond lane storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 82. 2030 AM Peak Hour Maximum Queue Lengths for South 56th Street and South Puget Sound Avenue

Exhibit 83. 2030 PM Peak Hour Maximum Queue Lengths for South 56th Street and South Puget Sound Avenue

Exhibit 84. 2030 Queues and Storage at South 74th Street and South Tacoma Way

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	*Build*	*No Action*	*Build*
South 74th Street	EB Left	150	AM	18	18	129	129
			PM	23	54	138	138
	EB Through	350 RR	AM	100	98	415 B	415 B
			PM	111	111	416 B	416 B
	EB Right	Shared	AM	46	45	324 B	324 B
			PM	52	54	325 B	325 B
South 74th Street	WB Left	150	AM	38	46	213	261
			PM	49	56	283	304
	WB Through	250 I/S	AM	59	63	307 B	362 B
			PM	83	83	378 B	384 B
	WB Right	Shared	AM	16	19	217 B	272 B
			PM	31	31	289 B	295 B
South Tacoma Way	NB Left	225	AM	73	77	331	342
			PM	71	73	301	304
	NB Through	1850 I/S	AM	49	49	270 B	268 B
			PM	57	58	316 B	325 B
	NB Right	125	AM	0	0	1	1
			PM	0	0	34	28
South Tacoma Way	SB Left	175	AM	13	13	104	105
			PM	39	40	256	287
	SB Through	575 I/S	AM	36	36	184 B	179 B
			PM	119	128	487 B	533 B
	SB Right	Shared	AM	30	30	180 B	174 B
			PM	115	124	484 B	529 B

Storage distances estimated to the nearest 25 feet.
IS Distance to next upstream roadway.
RR Distance reported to upstream railroad crossing.
_ Queue extends beyond lane storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 85. 2030 AM Peak Hour Maximum Queue Lengths for South 74th Street and South Tacoma Way

Exhibit 86. 2030 PM Peak Hour Maximum Queue Lengths for South 74th Street and South Tacoma Way

Exhibit 87. 2030 Queues and Storage at North Thorne Lane Southwest and Union Avenue Southwest

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	*Build*	*No Action*	*Build*
North Thorne Lane Southwest	EB Through	250 I/S	AM	14	24	151	184
			PM	39	27	227	190
	EB Right	Shared	AM	3	10	98	148
			PM	14	12	174	154
North Thorne Lane Southwest	WB Left	Shared	AM	0	2	24	62
			PM	1	3	31	77
	WB Through	150 RR	AM	0	2	24	62
			PM	1	3	31	77
Union Avenue Southwest	NB Left	600 I/S	AM	4	48	110 B	266 B
			PM	1,109 B	1,176 B	1,345 B	1,397 B
	NB Right	50	AM	15	51	165	264
			PM	1162	1,175	1,399	1,396

Storage distances estimated to the nearest 25 feet.
I/S *Distance to next upstream intersection.*
RR *Distance reported to upstream railroad crossing.*
_ *Queue extends beyond lane storage.*
B *Blocks access to turn pocket or channelized right-turn.*

Exhibit 88. 2030 AM Peak Hour Maximum Queue Lengths for North Thorne Lane Southwest and Union Avenue Southwest

Exhibit 89. 2030 PM Peak Hour Maximum Queue Lengths for North Thorne Lane Southwest and Union Avenue Southwest

Exhibit 90. 2030 Queues and Storage at North Thorne Lane Southwest and I-5 Southbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	***Build***	***No Action***	***Build***
North Thorne Lane Southwest	**EB Through**	**100 I/S**	**AM**	**109**	**2**	**208**	**46**
			PM	**132**	**2**	**200**	**82**
	EB Right	**100 I/S**	**AM**	**109**	**2**	**208**	**46**
			PM	**132**	**2**	**200**	**82**
North Thorne Lane Southwest	**WB Left**	**Shared**	**AM**	**9**	**59**	**95**	**274**
			PM	**3**	**6**	**45**	**220**
	WB Through	**175 I/S**	**AM**	**9**	**59**	**95**	**274**
			PM	**3**	**6**	**45**	**220**
I-5 SB Off-Ramp	**SB Left**	**Shared**	**AM**	**786 B**	**381 B**	**1,717 B**	**1,587 B**
			PM	**245**	**149**	**1,018 B**	**745 B**
	SB Through	**1700 I/S**	**AM**	**786 B**	**381 B**	**1,717 B**	**1,587 B**
			PM	**245**	**149**	**1,018 B**	**745 B**
	SB Right	**300**	**AM**	**808**	**381**	**1,743**	**1,587**
			PM	**269**	**149**	**1,047**	**745**

Storage distances estimated to the nearest 25 feet.
I/S *Distance to next upstream roadway.*
RR *Distance reported to upstream railroad crossing.*
_ *Queue extends beyond lane storage.*
B *Blocks access to turn pocket or channelized right-turn.*

Exhibit 91. 2030 AM Peak Hour Maximum Queue Lengths for North Thorne Lane Southwest and I-5 Southbound Ramps

Exhibit 92. 2030 PM Peak Hour Maximum Queue Lengths for North Thorne Lane Southwest and I-5 Southbound Ramps

Exhibit 93. 2030 Queues and Storage at North Thorne Lane Southwest and I-5 Northbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	*Build*	*No Action*	*Build*
North Thorne Lane Southwest	EB Left	175 I/S	AM	2	3	38	160
			PM	5	30	53	266
	EB Through	175 I/S	AM	2	3	38	160
			PM	5	30	53	266
North Thorne Lane Southwest	WB Through	725 I/S	AM	876 B	831 B	1,199 B	1,198 B
			PM	427 B	214 B	1,188 B	1,159 B
	WB Right	200	AM	876	831	1,199	1,198
			PM	427	214	1,188	1,159
I-5 NB Off-Ramp	NB Left	Shared	AM	93	92	366 B	357 B
			PM	790 B	752 B	1184 B	1,184 B
	NB Through	1150 I/S	AM	93	92	366 B	357 B
			PM	790 B	752 B	1,184 B	1,184 B
	NB Right	325	AM	107	105	379	368
			PM	803	752	1,197	1,184

Storage distances estimated to the nearest 25 feet.
I/S *Distance to next upstream roadway.*
RR *Distance reported to upstream railroad crossing.*
_ *Queue extends beyond lane storage.*
B *Blocks access to turn pocket or channelized right-turn.*

Exhibit 94. 2030 AM Peak Hour Maximum Queue Lengths for North Thorne Lane Southwest and I-5 Northbound Ramps

Exhibit 95. 2030 PM Peak Hour Maximum Queue Lengths for North Thorne Lane Southwest and I-5 Northbound Ramps

Exhibit 96. 2030 Queues and Storage at Berkeley Street Southwest and Union Avenue Southwest

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	***Build***	***No Action***	***Build***
Berkeley Street Southwest	**EB Left**	**Shared**	**AM**	**93**	**47**	**345**	**231**
			PM	**85**	**31**	**550**	**222**
	EB Through	**450 I/S**	**AM**	**93**	**47**	**345**	**231**
			PM	**93**	**31**	**562**	**222**
	EB Right	**Shared**	**AM**	**93**	**42**	**345**	**227**
			PM	**85**	**27**	**550**	**217**
Berkeley Street Southwest	**WB Left**	**Shared**	**AM**	**43**	**1**	**237 B**	**55**
			PM	**34**	**16**	**239 B**	**203 B**
	WB Through	**100 RR**	**AM**	**43**	**1**	**237 B**	**55**
			PM	**34**	**16**	**239 B**	**203 B**
	WB Right	**75**	**AM**	**43**	**1**	**237**	**55**
			PM	**34**	**16**	**239**	**203**
Militia Drive	**NB Left**	**Shared**	**AM**	**4**	**22**	**64 B**	**111 B**
			PM	**69 B**	**156 B**	**453 B**	**546 B**
	NB Through	**575 I/S**	**AM**	**4**	**22**	**64 B**	**111 B**
			PM	**69 B**	**156 B**	**453 B**	**546 B**
	NB Right	**50**	**AM**	**8**	**22**	**77**	**111**
			PM	**78**	**156**	**466**	**546**
Union Avenue Southwest	**SB Left**	**575 I/S**	**AM**	**463 B**	**338 B**	**1,159 B**	**932 B**
			PM	**323**	**88**	**1,049 B**	**380 B**
	SB Through	**100**	**AM**	**463**	**338**	**1,159**	**932**
			PM	**323**	**88**	**1,049**	**380**
	SB Right	**Shared**	**AM**	**463**	**312**	**1,159**	**905**
			PM	**323**	**65**	**1,049**	**353**

Storage distances estimated to the nearest 25 feet.
IS *Distance to next upstream roadway.*
RR *Distance reported to upstream railroad crossing.*
_ *Queue extends beyond lane storage.*
B *Blocks access to turn pocket or channelized right-turn.*

Exhibit 97. 2030 AM Peak Hour Maximum Queue Lengths for Berkeley Street Southwest and Union Avenue Southwest

Exhibit 98. 2030 PM Peak Hour Maximum Queue Lengths for Berkeley Street Southwest and Union Avenue Southwest

Exhibit 99. 2030 Queues and Storage at Berkeley Street Southwest and I-5 Southbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	*Build*	*No Action*	*Build*
Berkeley Street Southwest	**EB Through**	**100 I/S**	**AM**	**160**	**1**	**267**	**71**
			PM	**177**	**1**	**293**	**82**
	EB Right	**100 I/S**	**AM**	**181**	**1**	**291**	**65**
			PM	**198**	**2**	**317**	**76**
Berkeley Street Southwest	**WB Left**	**Shared**	**AM**	**9**	**22**	**165**	**237**
			PM	**3**	**17**	**167**	**243**
	WB Through	**175 I/S**	**AM**	**9**	**24**	**165**	**237**
			PM	**4**	**18**	**167**	**243**
I-5 SB Off-Ramp	**SB Left**	**Shared**	**AM**	**370**	**381**	**1,476 B**	**1,530 B**
			PM	**104**	**124**	**430 B**	**448 B**
	SB Through	**1100 I/S**	**AM**	**Not listed**	**Not listed**	**Not listed**	**Not listed**
			PM	**Not listed**	**Not listed**	**Not listed**	**Not listed**
	SB Right	**300**	**AM**	**371**	**382**	**1,477**	**1,531**
			PM	**101**	**125**	**431**	**449**

Storage distances estimated to the nearest 25 feet.
I/S Distance to next upstream roadway.
RR Distance reported to upstream railroad crossing.
_ Queue extends beyond lane storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 100. 2030 AM Peak Hour Maximum Queue Lengths for Berkeley Street Southwest and I-5 Southbound Ramps

Exhibit 101. 2030 PM Peak Hour Maximum Queue Lengths for Berkeley Street Southwest and I-5 Southbound Ramps

Exhibit 102. 2030 Queues and Storage at Berkeley Street Southwest and I-5 Northbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	*Build*	*No Action*	*Build*
Berkeley Street Southwest	EB Left	Shared	AM	0	3	3	137
			PM	0	14	0	200
	EB Through	175 I/S	AM	0	3	3	137
			PM	0	14	0	200
Berkeley Street Southwest	WB Through	2,225 I/S	AM	153	160	642	546
			PM	222	370	1,416	1,697
	WB Right	Shared	AM	143	151	666	573
			PM	209	365	1,439	1,722
I-5 NB Off-Ramp	NB Left	Shared	AM	147	123	705 B	674 B
			PM	98	102	457 B	413 B
	NB Through	1,150 I/S	AM	Not listed	Not listed	Not listed	Not listed
			PM	Not listed	Not listed	Not listed	Not listed
	NB Right	375	AM	0	0	1	14
			PM	0	0	0	0

Storage distances estimated to the nearest 25 feet.
I/S Distance to next upstream roadway.
RR Distance reported to upstream railroad crossing.
_ Queue extends beyond lane storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 103. 2030 AM Peak Hour Maximum Queue Lengths for Berkeley Street Southwest and I-5 Northbound Ramps

Exhibit 104. 2030 PM Peak Hour Maximum Queue Lengths for Berkeley Street Southwest and I-5 Northbound Ramps

Exhibit 105. 2030 Queues and Storage at 41st Division Drive and I-5 Southbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	*Build*	*No Action*	*Build*
41st Division Drive	EB Through	2,200 I/S	AM	0	1	5	158
			PM	81	110	468	670
	EB Right	Shared	AM	0	1	5	158
			PM	81	110	468	670
41st Division Drive	WB Through	500 I/S	AM	427	475	1,284	1,293
			PM	0	1	0	134
	WB Right	Shared	AM	239	309	913	975
			PM	0	0	0	0
I-5 SB Off-Ramp	NB Right (Loop)	1,150 I/S	AM	257	261	1,782	1,742
			PM	0	0	34	16
	SB Right	1,350 I/S	AM	78	92	642	680
			PM	0	0	0	17

Storage distances estimated to the nearest 25 feet.
IS Distance to next upstream roadway.
RR Distance reported to upstream railroad crossing.
_ Queue extends beyond lane storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 106. 2030 Queues and Storage at 41st Division Drive and I-5 Northbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	*Build*	*No Action*	*Build*
41st Division Drive	EB Through	500 I/S	AM	2	1	119	106 B
			PM	123	117	448 B	434 B
	EB Right	Shared	AM	2	1	119	106
			PM	123	117	448	434
41st Division Drive	WB Through	1,450 I/S	AM	21	96	354	673
			PM	1,773	1,758	2,163	2,163
	WB Right	Shared	AM	21	96	354	673
			PM	1,773	1,758	2,163	2,163
I-5 NB Off-Ramp	NB Right	1,200 I/S	AM	491	484	1,905	1,904
			PM	0	0	0	0
	SB Right (Loop)	1,100 I/S	AM	16	1	151	23
			PM	0	0	0	0

Storage distances estimated to the nearest 25 feet.
IS Distance to next upstream roadway.
RR Distance reported to upstream railroad crossing.
_ Queue extends beyond lane storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 107. 2030 AM Peak Hour Maximum Queue Lengths for 41st Division Drive and I-5 Ramps

Exhibit 108. 2030 PM Peak Hour Maximum Queue Lengths for 41st Division Drive and I-5 Ramps

Exhibit 109. 2030 Queues and Storage at Barksdale Avenue and Steilacoom-DuPont Road Southwest/ Wilmington Drive

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	*Build*	*No Action*	*Build*
Barksdale Avenue	EB Left	35	AM	15	13	111	97
			PM	13	6	96	86
	EB Through	700 I/S	AM	15	13	111 B	97 B
			PM	13	6	96 B	86 B
	EB Right	Shared	AM	3	2	85 B	71 B
			PM	2	1	69 B	60 B
Barksdale Avenue	WB Left	125	AM	21	38	211	218
			PM	34	25	206	221
	WB Through	250 RR	AM	21	38	211	218
			PM	34	25	206	221
	WB Right	175	AM	12	22	229	215
			PM	21	21	228	244
Wilmington Drive	NB Left	75	AM	9	8	99	87
			PM	17	31	132	181
	NB Through	2,175 I/S	AM	9	8	99 B	87 B
			PM	17	31	132 B	181 B
	NB Right	125	AM	2	2	84	89
			PM	2	20	124	184
Steilacoom-DuPont Road Southwest	SB Left	350	AM	114	115	525	498
			PM	187	142	659	544
	SB Through	625 I/S	AM	114	115	525 B	498 B
			PM	187	142	659 B	544 B
	SB Right	Shared	AM	84	86	482 B	455 B
			PM	153	108	616 B	501 B

Storage distances estimated to the nearest 25 feet.
IS Distance to next upstream roadway.
RR Distance reported to upstream railroad crossing.
_ Queue extends beyond lane storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 110. 2030 AM Peak Hour Maximum Queue Lengths for Barksdale Avenue and Steilacoom-DuPont Road Southwest/Wilmington Drive

Exhibit 111. 2030 PM Peak Hour Maximum Queue Lengths for Barksdale Avenue and Steilacoom-DuPont Road Southwest/Wilmington Drive

Exhibit 112. 2030 Queues and Storage at Barksdale and I-5 Southbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	*Build*	*No Action*	*Build*
Barksdale Avenue	EB Through	50 RR	AM	25	0	214	2
			PM	65	0	254	12
	EB Right	275	AM	0	0	68	0
			PM	0	0	25	0
Barksdale Avenue	WB Left	Shared	AM	30	5	285	206
			PM	12	19	275	336
	WB Through	225 I/S	AM	31	6	285	206
			PM	13	20	275	336
I-5 SB Off-Ramp	SB Left	Shared	AM	31	37	222	252
			PM	22	22	220	234
	SB Through	1,350 I/S	AM	31	37	222	252
			PM	22	22	220	234
	SB Right	500	AM	7	11	199	226
			PM	18	19	238	248

Storage distances estimated to the nearest 25 feet.
I/S — *Distance to next upstream roadway.*
RR — *Distance reported to upstream railroad crossing.*
_ — *Queue extends beyond lane storage.*
B — *Blocks access to turn pocket or channelized right-turn.*

Exhibit 113. 2030 AM Peak Hour Maximum Queue Lengths for Barksdale Avenue and I-5 Southbound Ramps

Exhibit 114. 2030 PM Peak Hour Maximum Queue Lengths for Barksdale Avenue and I-5 Southbound Ramps

Exhibit 115. 2030 Queues and Storage at Barksdale Avenue/Locust Road and I-5 Northbound Ramps

Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)		Maximum Queues (feet)	
				No Action	*Build*	*No Action*	*Build*
Barksdale Avenue	**EB Left**	**225 I/S**	**AM**	**73**	**32**	**300**	**214**
			PM	**109**	**82**	**298**	**284**
	EB Through	**225 I/S**	**AM**	**73**	**32**	**300**	**214**
			PM	**109**	**82**	**298**	**284**
Locust Road	**WB Through**	**1,025 I/S**	**AM**	**100**	**88**	**490**	**489**
			PM	**641**	**643**	**1,666**	**1,651**
	WB Right	**1,025 I/S**	**AM**	**74**	**64**	**481**	**478**
			PM	**614**	**629**	**1,678**	**1,661**
I-5 NB Off-Ramp	**NB Left**	**Shared**	**AM**	**394**	**393**	**1,337 B**	**1,464 B**
			PM	**120**	**102**	**541**	**489**
	NB Through	**1,600**	**AM**	**351**	**351**	**1,285 B**	**1,413 B**
			PM	**120**	**66**	**541**	**438**
	NB Right	**600**	**AM**	**351**	**351**	**1,285**	**1,413**
			PM	**84**	**66**	**491**	**438**

Storage distances estimated to the nearest 25 feet.
IS Distance to next upstream roadway.
RR Distance reported to upstream railroad crossing.
_ Queue extends beyond lane storage.
B Blocks access to turn pocket or channelized right-turn.

Exhibit 116. 2030 AM Peak Hour Maximum Queue Lengths for Barksdale Avenue/Locust Road and I-5 Northbound Ramps

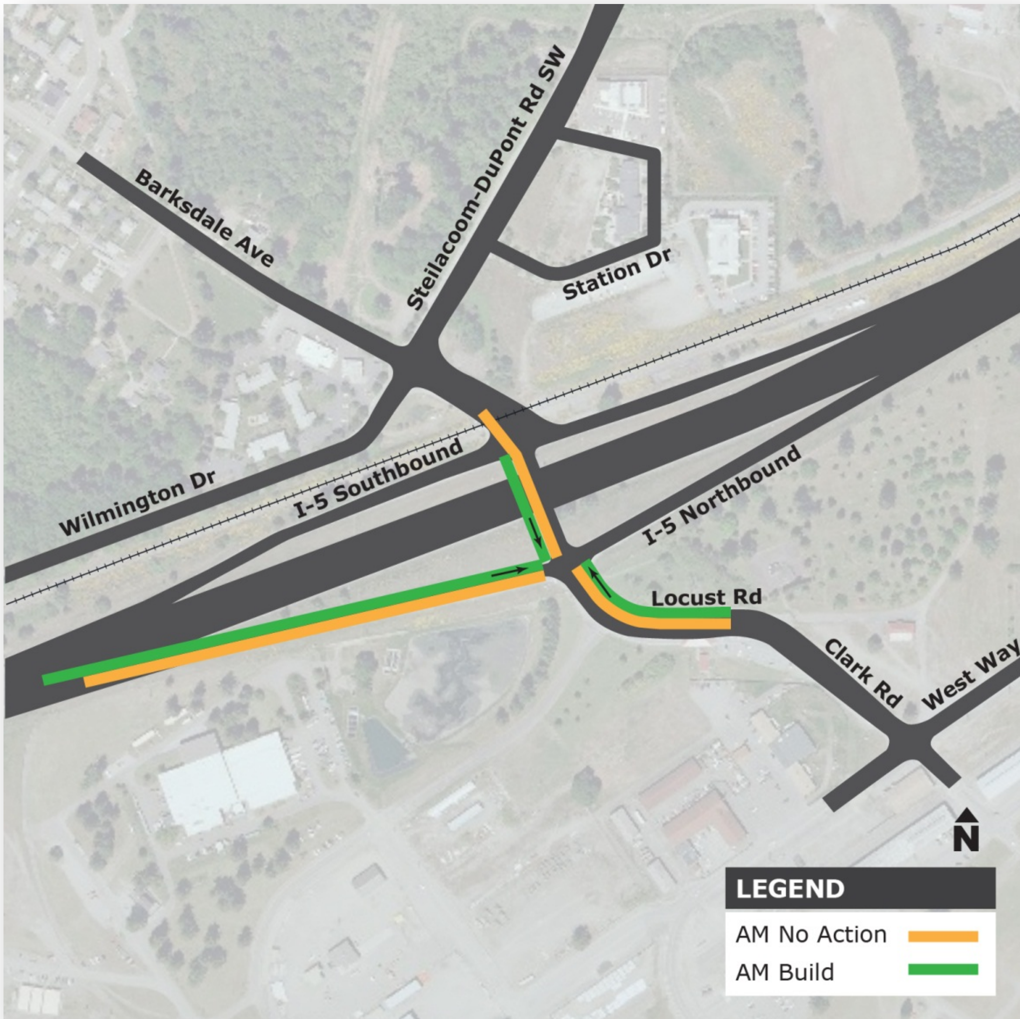


Exhibit 117. 2030 PM Peak Hour Maximum Queue Lengths for Barksdale Avenue/Locust Road and I-5 Northbound Ramps

Build Alternative Queue Lengths

In 2030, queue lengths at study area intersections are anticipated to increase slightly with the addition of Amtrak Cascades service. The road closure time for a train crossing would be similar to crossing closures for *Sounder* trains (approximately one minute or less when at a crossing not near a station). Intersections south of Lakewood would have both Amtrak and freight service.

The anticipated maximum queue length increase would be approximately two to four more vehicles compared to the No Build Alternative because of signal control system enhancements incorporated into the Project. This minor increase indicates that study area intersections are affected slightly by the additional train crossing event during the morning and evening peak hour commute time periods. At some study area locations, the queue length, when compared to the No Build Alternative, would be reduced because signal improvements needed for safety would also optimize the movement of vehicle travel parallel to the railroad tracks. These signal improvements, which would install more advanced devices to control intersections, would reduce the delay and vehicle queues at improved intersections to better than No Build conditions.

With the proposed improvements, the change in maximum queue lengths at improved intersections would shift somewhat but result in similar overall queuing in the areas around the railroad crossings during the peak-hour commute periods for the Build Alternative compared to the No Build Alternative (see Exhibit 72 through Exhibit 117).

Overall, one additional intersection would be blocked by maximum queues from the Build Alternative when compared to the No Build Alternative: South Washington Street and South 51st Street in the City of Tacoma during the PM peak hour. However, the street grid nearby would allow drivers to make slight adjustments to their routes to minimize the effect of this queue. Additionally, recent information indicates the overall gates-down time for *Sounder* trains would be longer than the gates-down time for Amtrak trains, which would likely create a longer maximum queue that would occur with the No Build Alternative and Build Alternative.

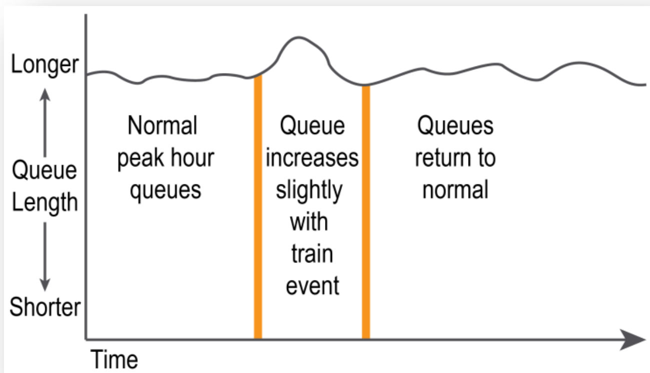
Time to Recover from Train Crossing Events

The time for the local street system to recover from a train crossing event depends on the number of vehicles affected by the train event, the roadway geometrics (i.e., number of traffic lanes, intersection spacing), and how the traffic signals manage the roadway. Closely spaced intersections can usually communicate with one another to optimize vehicle flow between them; this is called traffic signal coordination and minimizes intersection delay and queuing. Train events disrupt this signal coordination (similar to emergency vehicles) because movements across the railroad tracks are usually stopped, especially when the intersection is close to the railroad tracks. Generally, traffic signal coordination recovers from train events in one to two signal cycles.

Intersections at or nearing their vehicle capacity (already congested prior to a train crossing event) can be greatly affected by train events. Under the No Build and Build alternatives, vehicle queue lengths are expected to return to their typical queue lengths approximately three signal cycles (approximately five minutes) after a passenger train event. During this recovery period, delays for vehicles in queue approaching the railroad crossing are higher than during the rest of the peak hour. However, this is also balanced by other traffic movements moving away from or parallel to the crossing experiencing less delay because the signals would remain green for those movements.

As illustrated in Exhibit 118, the number of vehicles stopped at the railroad crossing and adjacent intersections changes throughout the morning and afternoon peak hour commutes. Train crossings would cause the number of vehicles waiting to increase slightly and then queues return to normal levels shortly after the roadway is reopened.

Exhibit 118. Example Effect of Train Crossing on Queue Lengths



How would the Project affect pedestrian travel?

The Build Alternative would improve sidewalks at the following railroad crossings:

- North Thorne Lane Southwest
- Berkeley Street Southwest
- Barksdale Avenue

The Build Alternative would have an additional train crossing during the peak hour of the morning and afternoon commute, which could delay pedestrians by approximately one minute. This delay would be the same whenever a train crosses throughout the day.

How would the Project affect bicycle travel?

The Build Alternative would have an additional train crossing during the peak hour of the morning and afternoon commute, which could delay bicyclists by approximately one minute. This delay would be the same whenever a train crosses throughout the day.

How would the Project affect airport and aviation facilities?

The Build Alternative proposes improvements within a 2-mile radius of the JBLM air field, but would not construct new roadway or transportation structures within its airspace.

How would the Project affect parking?

Parking in the study area would be largely unaffected by the Build Alternative. Locally around Freighthouse Square, there would be a change to parking (see *Parking* under *How would the new Tacoma Amtrak Station location affect pedestrian connections, parking, and traffic operations?*).

How would the Project affect transportation during construction?

The Project would construct a new second track adjacent to the existing main line between South Tacoma and Lakewood, improve safety at some existing at-grade crossings, and relocate the existing Tacoma Amtrak Station to the Tacoma Dome at Freighthouse Square in Tacoma. FRA and WSDOT expect construction to take approximately 24 months, but construction activity at most individual locations would take substantially less time.

Effect of Construction Traffic on the Transportation Network

Most of the Project construction vehicles would haul dirt and materials to and from the construction sites. Construction vehicles would increase traffic delay in the study area during the construction period. The truck routes would not be known until a construction contract is signed, but FRA and WSDOT anticipate the majority of construction vehicles would use I-5 and major arterials.

Temporary lane closures and occasional weekend road closures would be required to rebuild the track across the Clover Creek Drive Southwest, North Thorne Lane Southwest, Berkeley Street Southwest, 41st Division Drive, and Barksdale Avenue roadways. This action would minimize the effect on the morning and afternoon commute periods, but would cause an increase in travel times during those times. Construction activities at railroad crossing locations are expected to take two or three weekends per location. Traffic control plans for these closures would include signage and prior notice to alert local and I-5 drivers of the work and to allow coordination with local authorities. Work on adjacent local roadways to widen lanes, improve vertical alignments, relocate utilities, etc., would require localized lane restrictions or closures for a few hours at a time.

Effect of Construction Activities on Rail Travel

During construction, it is anticipated the existing railroad along the Project would be out of service for up to four days per week for up to 15 months. These service outages would be determined through discussions with rail companies to minimize disruptions to freight rail customers. This determination would allow free access to Project work areas. During construction of the Lakewood-to-Tacoma rail section, the closure would not affect *Sounder* trains running on the adjacent track because connections between the second track and the existing track would be made when *Sounder* trains are not operating. Also, Tacoma Rail freight service would be rerouted to available Tacoma Rail tracks.

Relocation of the existing crossing warning systems at Clover Creek Drive Southwest, North Thorne Lane Southwest, Berkeley Street Southwest, 41st Division Drive, and Barksdale Avenue would cause many of the crossing signal warning systems to be out of service until the new warning system is installed. This would require the freight trains to stop at locations where signal systems are temporarily out of service during construction, however, FRA and WSDOT will coordinate with Tacoma Rail to minimize this effect. These crossings would be manually controlled by construction traffic management personnel to control train, vehicle, and non-motorized traffic. This action would not delay freight trains because they travel at only about 10 mph, often stopping before proceeding through the five crossings to allow vehicles to clear the crossing.

Effect of Construction Activities on Non-Motorized Transportation

Temporary lane closures and occasional weekend road closures would be required to rebuild track crossings in the communities of Lakewood and DuPont. Construction activities at railroad crossing locations are expected to take two or three weekends per location. Bicycle traffic would follow posted detour routes consistent with motor vehicle traffic detours. Pedestrians would follow posted detours for safe routes around construction work zones. Traffic control plans for these closures would include signage and prior notice to alert local non-motorized travelers of the work and to allow coordination with local authorities. Work on adjacent local roadways to widen lanes, improve vertical alignments, relocate utilities, etc., would require localized lane restrictions or closures for a few hours at a time.

Effect of Construction Activities on Parking and Transit

Staging and stockpiling sites for storing construction materials would occur within railroad right-of-way and therefore would not affect local parking. During construction for the remodeling of Freighthouse Square to accommodate a new Amtrak station, adjacent local parking areas may be used to stage equipment and/or materials. Parking spaces used for equipment staging or materials storage may require motorists to temporarily park at a greater distance from their destination.

Existing transit routes would be affected by the temporary lane closures and occasional weekend road closures necessary to construct the project. Traffic control plans for these closures would include signage and prior notice to alert transit agencies of the work. Construction on adjacent local roadways to widen lanes, improve vertical alignments, relocate utilities, etc., would require localized lane restrictions or closures for a few hours at a time. Transit service at Freighthouse Square may be affected if adjacent parking is reconfigured or is used for equipment staging or materials storage.

What are the indirect effects of the Project?

The only potential indirect effect tied to the Project is that it may indirectly influence limited redevelopment near the relocated Amtrak Station at Freighthouse Square (see Land Use Discipline Report[33]). Such redevelopment would be consistent with local land use and zoning regulations, and could include the addition of commercial businesses. Redevelopment could attract additional vehicle traffic to the Freighthouse Square area. This increase in traffic could have a minor indirect effect on the transportation resources in the area.

What are the cumulative effects of the Project?

The traffic analysis conducted for the Project, specifically the I-5/Lakewood travel demand model, includes existing traffic conditions and reasonably foreseeable future transportation projects in the area that would affect traffic conditions. By including existing traffic and the effects of planned transportation projects in the development of traffic forecasts, the Project team was able to assess cumulative effects of the Project on traffic. The following identifies the planned transportation projects that, when considered with the existing conditions and the Project, would improve traffic conditions in the Project area. Therefore, the Build Alternative, when considered with the reasonably foreseeable future actions, would not result in significant cumulative effects on transportation.

Cross-Base Highway

The Cross-Base Highway would construct a new 4-lane, limited-access highway between the I-5/North Thorne Lane Southwest interchange and SR 7 in Spanaway. This Project is a proposed regional connector to

[33] *WSDOT 2012c.*

improve mobility in Pierce County, but is not currently funded. If the Cross-Base Highway were constructed, the effect on the Project would be negligible. LOS was evaluated with and without the Cross-Base Highway and generally improved when compared with the Build Alternative, although a few intersections did worsen slightly in delay, but not to substandard levels. Exhibit 119 summarizes the LOS results with the Cross-Base Highway.

Exhibit 119. Future 2030 Level of Service with Cross-Base Highway and Project Alternatives

Study Intersection		No Build Alternative AM Peak Hour		Build Alternative AM Peak Hour		No Build Alternative PM Peak Hour		Build Alternative PM Peak Hour	
Name	*Traffic Signal*	*LOS*	*Average Delay (seconds per vehicle)*	*LOS*	*Average Delay (seconds per vehicle)*	*LOS*	*Average Delay (seconds per vehicle)*	*LOS*	*Average Delay (seconds per vehicle)*
Bridgeport Way Southwest and Pacific Highway Southwest	**X**	**N/A**	**Not studied**	**C**	**20.6**	**N/A**	**Not studied**	**C**	**22.8**
Bridgeport Way Southwest and I-5 Southbound Ramps	**X**	**N/A**	**Not studied**	**B**	**11.1**	**N/A**	**Not studied**	**B**	**13.9**
Bridgeport Way Southwest and I-5 Northbound Ramps	**X**	**N/A**	**Not studied**	**B**	**15.0**	**N/A**	**Not studied**	**B**	**17.5**
Berkeley Street Southwest and Union Avenue Southwest	**In 2030 Build**	**F**	**81.1**	**E**	**57.3**	**F**	**179.9**	**D**	**42.4**
Berkeley Street Southwest and I-5 Southbound Ramps	**X**	**D**	**43.6**	**C**	**35.0**	**C**	**24.3**	**B**	**18.1**
Berkeley Street Southwest and I-5 Northbound Ramps	**X**	**C**	**25.4**	**C**	**20.3**	**C**	**22.9**	**C**	**29.9**
41st Division Drive and I-5 Southbound Ramps		**C**	**32.5**	**C**	**22.8**	**B**	**12.3**	**B**	**14.8**
41st Division Drive and I-5 Northbound Ramps		**B**	**18.8**	**B**	**19.9**	**F**	**100.7**	**F**	**101.3**
Barksdale Avenue and DuPont-Steilacoom Road	**X**	**B**	**19.7**	**C**	**23.9**	**C**	**23.1**	**D**	**41.0**
Barksdale Avenue and I-5 Southbound Ramps	**X**	**B**	**12.0**	**A**	**8.1**	**B**	**16.9**	**A**	**7.6**
Barksdale Avenue/ Locust Road and I-5 Northbound Ramps	**X**	**E**	**58.7**	**D**	**54.8**	**D**	**52.9**	**E**	**57.9**

Key to LOS and Delay Mark-Ups:
Build Alternative conditions are better than the No Build Alternative. (shaded)
_ *Build Alternative conditions are worse than the No Build Alternative.* (underlined)

Berkeley Street Freedom Bridge Improvements

In November 2011, the City of Lakewood received a $5.7 million grant from the U.S. Department of Defense to improve Freedom Bridge, which connects Berkeley Street Southwest over I-5. The improvements would add one lane on the bridge. As a result, access to Madigan Army Medical Center and overall traffic conditions would improve. With both the No Build and Build alternatives, traffic operations would be expected to improve with the Freedom Bridge improvement. The Project would not contribute to a cumulative effect with the bridge improvements.

Relocation of Camp Murray Gate

The Washington Military Department has described a plan to relocate the Main Gate from the Berkeley Street Southwest interchange (referred to as Main Gate) to the North Thorne Lane Southwest interchange (referred to as Camp Murray). This gate relocation would divert traffic away from roadways connecting to the Berkeley Street Southwest interchange to roadways connecting to North Thorne Lane Southwest. Traffic congestion would decrease around Berkeley Street Southwest and Main Gate and increase around the North Thorne Lane Southwest interchange and Camp Murray gate. This is documented in the technical memorandum titled *Camp Murray Gate Relocation Transportation Analysis – Comparison of Options*, dated February 17, 2011. With the signal upgrades included with the Project, options would be improved to manage congestion related to queuing at the North Thorne Lane Southwest interchange.

Other Reasonably Foreseeable Future Transportation Projects

FRA and WSDOT examined Puget Sound Regional Council's current program, which includes many preservation projects (also known as "state of good repair") and the funded improvement projects in the state transportation improvement program (STIP). Reasonably foreseeable future projects are listed below (Exhibit 120).

Exhibit 120: Transportation Related Projects – Current and Reasonably Foreseeable[34]

Pedestrian and Transit Improvements	Responsible Entity
Dower Elementary Safe Route to School - Construct curb, gutter and sidewalk, flashing pedestrian signal, and two marked crosswalks on John Dower Rd.	Lakewood
ADA Service - Provide complementary ADA service for disabled patrons in Pierce County	Pierce Transit
Lakewood Station Connection - Construct pedestrian crossing of rail road tracks, bus stop facilities, and bus turn around.	Lakewood
Tacoma/Lakewood Commuter Rail Project - Design and construct stations, parking, bus/transfer, pedestrian, and bike facilities; grade separated crossing at Pacific Ave. and S. 26th St.; complete environmental documentation.	Sound Transit

[34] *WSDOT 2012a, PSRC 2011, and WSDOT 2012b*

Pedestrian and Transit Improvements	Responsible Entity
Tacoma Link Expansion Project - FTA Small Starts alternatives analysis for Link service expansion in downtown Tacoma, conceptual engineering and NEPA Scoping.	Sound Transit
Local Roadway Improvements	
Gravelly Lake Drive - Construct curb, gutter and sidewalk, street lighting, upgrade signals and ADA ramps on both sides of Gravelly Lake Drive between 100th St. and Bridgeport Way.	Lakewood
Madigan Access Improvement - Construct roadway, bridge, ramp and signal modifications to improve safety from Berkeley St. to Union Ave S. W.	Lakewood
Bridgeport Way – Steilacoom Blvd. to 83rd Street S.W. - Widen to provide continuous two-way left-turn lane, street lighting, bicycle facilities, storm drainage and landscaping. Signalize 86th Street intersection.	Lakewood
Steilacoom Blvd. – Farwest Dr. to 87th Ave. S. W. - Upgrade traffic signal and improve intersection lighting. Upgrade cross-walk and trim vegetation to improve sight distance.	Lakewood
Lakewood Traffic Signal Upgrades Phase 3 – Fiber Interconnect- Provide fiber cable interconnect to upgrade signals for ITS.	Lakewood
Regional Roadway Improvements	
I-5 DuPont to Lakewood Corridor Planning - Joint Base Lewis-McChord and cities of Lakewood and DuPont in coordination are submitting grants for the Interchange Justification Report and NEPA. $1,001,000 (including $630,000 in federal funds, balance in state/local funds)	WSDOT
I-5 SR 510 to SR 512 Mobility Improvements - Construct ITS, strategic intersection improvements, hard shoulder running to reduce congestion in the vicinity of JBLM.	WSDOT
I-5 Fort Lewis Congestion Fiber Optics - Extend fiber optic cable from Olympia to Thorne Lane to enable ITS project intertie.	WSDOT
I-5 and I-705 and Railroad Crossing SB Seismic Retrofit- Retrofit southbound bridge to meet current earthquake standards.	WSDOT
I-5 and I-705 and Railroad Crossing NB Seismic Retrofit - Retrofit northbound bridge to meet current earthquake standards.	WSDOT
I-5 M St. to Portland Ave. Northbound Widening and Bridges - Add NB and SB HOV lanes to I-5 from M Street to Portland Ave. to I-5. Demolish and reconstruct Pacific Ave., McKinley Ave. and L Street overcrossings.	WSDOT
I-5 M St. Bridge Seismic Retrofit - Retrofit bridge to meet current earthquake standards.	WSDOT
I-5 Port of Tacoma Rd. to King Co. Line HOV Lanes - Construct HOV lanes from MP 136.61 to MP 139.50.	WSDOT
I-5 Portland Ave. to Port of Tacoma Rd Northbound HOV - Construct NB HOV lanes, new northbound bridges across the Puyallup River, begins work to reconstruct I-5/SR 167 interchange and replaces I-5/Portland interchange.	WSDOT
I-5 Portland Ave. to Port of Tacoma Rd. Southbound HOV - Construct SB HOV lanes, new southbound bridges across the Puyallup River, and completes work on the I-5/SR 167 interchange.	WSDOT
I-5 SR 16 Interchange: Rebuild Interchange- Replaces the Nalley Valley bridge, reconstructs ramps and structures. Prepares I-5 and SR 16 for HOV lanes.	WSDOT
I-5 SR 16 Eastbound Nalley Valley HOV- Reconstruct eastbound Nalley Valley interchange, ramps, and structures. Prepares for HOV lanes on I-5 and SR 16.	WSDOT
I-5 SR 16 Interchange: South to North Ramp Seismic Retrofit - Retrofit south to north ramp bridge to meet current earthquake standards.	WSDOT
I-5 SR 510 to SR 512 Mobility Improvements - Construct ITS, strategic intersection improvements and hard shoulder running to maximize system efficiency.	WSDOT
I-5 Vicinity of Joint Base Lewis McChord: Install Ramp Meters - Install ramp meters, cameras, detection loops, stop bars and illumination, interconnect cameras to Tacoma TSMC.	WSDOT
I-5 Vicinity Center Drive - Realign Center Drive and change access control to improve JBLM egress	WSDOT
SR 162 Puyallup River Bd. Replacement - Construct new bridge to replace existing structurally deficient bridge...	WSDOT
SR 512 108th St. E. to SR 167 Install Cable Barrier - Upgrade existing 3-cable median barrier to 4-cable median barrier.	WSDOT

Pedestrian and Transit Improvements	Responsible Entity
Regional Rail Improvements	
Vancouver - Rail Yard Bypass Track - Construct new bypass tracks in rail yard to allow passenger trains to bypass congestion caused by freight trains and new vehicle/pedestrian/bicycle bridge overcrossing.	FRA / WSDOT
Kelso Martins Bluff – Toteff Siding Extension - Extend existing siding one and construct overcrossing at Toteff Road.	FRA / WSDOT
Kelso Martins Bluff – New Siding - Construct new and upgrade existing siding track to allow freight trains to move on and off of main line at higher speeds.	FRA / WSDOT
Kelso Martins Bluff – Kelso to Longview Junction - Construct new track segment and upgrade existing track to allow freight and passenger trains to pass each other and reduce congestion.	FRA / WSDOT
Seattle – King Street Track Upgrade - Reconfigure main line tracks accessing King Street Station to improve passenger train access and increase service for Amtrak, Sound Transit, and BNSF.	FRA / WSDOT
Everett – Storage Track - Construct two new departure/receiving tracks parallel to existing delta Yard tracks to eliminate passenger/freight conflicts.	FRA / WSDOT
Corridor Reliability Upgrades (South) -Clean ditches and grading to improve drainage, cleaning and replacing ballast, replace ties and resurface rail as needed to improve track reliability and improve travel time.	FRA / WSDOT
Advanced Wayside Signal System -Upgrade advanced signal systems components at all control points, sidings and turnouts between the US-Canada border and Vancouver, WA.	FRA / WSDOT

Chapter 6 – Recommended Minimization Measures

The Project has been designed to include measures to minimize and reduce congestion caused by at-grade rail crossings along the project corridor. This chapter describes the minimization efforts that would be taken to improve or reduce construction traffic and Project effects.

What measures would be taken to minimize the effects during construction?

Improvement of the railroad tracks may temporarily hinder freight activity on the rail line. FRA and WSDOT will work with BNSF and Tacoma Rail to ensure that freight delivery meets their customers' needs during construction. The Project will use the coordination framework that was established during the design and construction of the *Sounder* commuter rail project.

During construction, stabilized construction entrances will be installed for trucks accessing the construction sites in order to protect existing roadways and railroad tracks and to minimize the track-out of soil onto local roadways.

Improvements to at-grade crossings are likely to result in temporary traffic delays and periodic lane and/or access revisions during construction. A traffic control plan will be developed that includes (but is not limited to) the following measures:

- At least one lane will be kept open at crossings except for a short period of time when the new track is being installed across the roadway.
- Traffic control personnel and/or traffic control signs will be provided at locations where construction activities are occurring.
- Detour routes will be provided when roads are closed due to track construction.
- A uniformed police officer would manage traffic movements when traffic signals are temporarily turned off.
- FRA and WSDOT will coordinate the development of the traffic control plans with local jurisdictions.

- Local agencies, the public, school districts, emergency service providers, and transit agencies would be informed of the changes to travel in advance through the media and the Project website.
- Pedestrian and bicycle circulation will be maintained as much as possible during construction.

References

Transpo Group. 2011. Camp Murray Gate Relocation Transportation Analysis – Comparison of Options. February 17, 2011.

TRB (Transportation Research Board). 2000. Highway Capacity Manual. National Research Council, Washington, D.C.

US DOT. 2006. Use of Locomotive Horns at Highway-Rail Grade Crossings; Final Rule (Parts 222 and 229 of Title 49 of the Code of Federal Regulations). Federal Railroad Administration. August 2006.

US DOT. 2007. Railroad-Highway Grade Crossing Handbook – Revised Second Edition 2007. Federal Highway Administration. August 2007.

WSDOT (Washington State Department of Transportation). 2008. Point Defiance Bypass Project Traffic and Transportation Discipline Report. Published August 2007, revised March 2008.

WSDOT. 2009. *Pacific Northwest Rail Corridor Tier 1 Environmental Assessment*. Available at: http://wadot.wa.gov/Freight/publications/PNWRCReports.htm

WSDOT. 2010a. Existing (September 2010) Traffic Volumes Summary Technical Memorandum. October 8, 2010.

WSDOT. 2010b. 2010 Noon Peak Model Calibration and Evaluation of Proposed Traffic Signal Phasing under 2010 Noon Peak Hour Traffic Volumes Technical Memorandum.

WSDOT. 2010c. Existing Conditions Technical Memorandum. November 19, 2010.

WSDOT. 2010d. I-5 Transportation Alternatives Analysis & Traffic Operational Model. September 2010.

WSDOT 2011a. Existing (November 2010) Traffic Volumes Summary – Revision 1 Technical Memorandum. May 4, 2011.

WSDOT. 2011b. Base Year No-Build Conditions Technical Memorandum – Revision 3. May 4, 2011.

WSDOT. 2011c. Base Year Build Conditions Technical Memorandum. May 4, 2011.

WSDOT. 2011d. Future Year Conditions Technical Memorandum. May 4, 2011.

WSDOT. 2011e. 2010 Early AM Peak Hour Analysis at the Berkeley Street Interchange Area. Findings Paper, March 3, 2011.

WSDOT. 2011f. Proposed Signal Phasing/Timing and Traffic Operations Technical Memorandum (without Cross-Base Highway). March 31, 2011, Revised April 18, 2011.

WSDOT. 2011g. Proposed Signal Phasing/Timing and Traffic Operations Technical Memorandum (with Cross-Base Highway). April 26, 2011.

WSDOT. 2011h. Point Defiance Bypass – Phase 1 Traffic Analysis Methodology and Operational Summary Technical Memorandum. July 2011.

WSDOT. 2011i. Grade Separation Concept Evaluation.

WSDOT 2012a. Approved 2012 – 2015 State Transportation Improvement Program (STIP); January 2012.

WSDOT 2012b. WSDOT High Speed Rail Program website, accessed August 2012 (http://www.wsdot.wa.gov/Rail/Projects.htm).

WSDOT 2012C. Point Defiance Bypass Project Land Use Discipline Report. September 2012.

Attachment A – LOS Tables

Intersection Level of Service – Existing Year 2010

Study Intersection		2010 AM Peak Hour (morning)		2010 PM Peak Hour (afternoon)	
Name	***Traffic Signal***	***LOS***	***Average Delay (seconds per vehicle)***	***LOS***	***Average Delay (seconds per vehicle)***
East "D" Street and East 26th Street	**X**	**A**	**8.3**	**B**	**10.7**
East "D" Street and East 25th Street	**X**	**A**	**9.8**	**B**	**12.8**
East "C" Street and East 26th Street		**D**	**26.2**	**C**	**15.0**
East "C" Street and East 25th Street	**X**	**B**	**10.8**	**A**	**10.0**
South "C" Street and South Tacoma Way		**B**	**10.8**	**B**	**13.9**
South "C" Street and South 25th Street		**B**	**13.0**	**C**	**18.1**
South Chandler Street and South Tacoma Way		**B**	**10.7**	**C**	**15.7**
South Chandler Street and Center Street		**B**	**13.5**	**C**	**24.5**
South Alaska Street and South Tacoma Way		**B**	**11.1**	**B**	**13.3**
South Alaska Street and Center Street		**C**	**17.8**	**D**	**30.9**
South Wilkeson Street and South Tacoma Way	**X**	**B**	**10.3**	**B**	**13.3**
South Wilkeson Street and Center Street	**X**	**B**	**12.4**	**C**	**24.1**
South Pine Street and South Tacoma Way	**X**	**B**	**14.5**	**C**	**26.8**
South Pine Street and Center Street	**X**	**C**	**21.8**	**C**	**32.3**
35th Street Southwest and South Tacoma Way	**X**	**A**	**6.4**	**B**	**17.1**
35th Street Southwest and South Lawrence Street		**A**	**9.5**	**A**	**9.9**
50th Street Southwest and South Adams Street		**A**	**8.9**	**A**	**9.0**
50th Street Southwest and South Burlington Way		**N/A**	**Traffic Circle**	**N/A**	**Traffic Circle**
South 56th Street and South Washington Street	**X**	**A**	**8.2**	**B**	**13.6**
South 56th Street and South Adams Street/South Burlington Way		**A**	**2.6**	**A**	**3.3**

Intersection Level of Service – Existing Year 2010

Study Intersection		2010 AM Peak Hour (morning)		2010 PM Peak Hour (afternoon)	
Name	***Traffic Signal***	***LOS***	***Average Delay (seconds per vehicle)***	***LOS***	***Average Delay (seconds per vehicle)***
South 56th Street and South Tacoma Way	**X**	**B**	**18.7**	**C**	**24.4**
South 56th Street and South Puget Sound Avenue	**X**	**A**	**4.8**	**A**	**8.0**
60th Street Southwest and South Washington Street		**A**	**9.3**	**A**	**9.2**
60th Street Southwest and South Adams Street		**A**	**9.4**	**B**	**10.1**
60th Street Southwest and South Tacoma Way		**B**	**14.9**	**C**	**23.7**
South 74th Street and South Tacoma Way	**X**	**C**	**27.6**	**D**	**36.9**
Steilacoom Blvd Southwest and Lakeview Avenue Southwest	**X**	**A**	**6.6**	**A**	**9.6**
Steilacoom Blvd Southwest and Durango Street Southwest		**C**	**15.4**	**B**	**11.8**
100th Street Southwest and Lakeview Avenue Southwest	**X**	**B**	**10.5**	**B**	**13.1**
108th Street Southwest and Lakeview Avenue Southwest	**X**	**A**	**8.7**	**B**	**11.1**
108th Street Southwest and Halcyon Road Southwest		**A**	**6.1**	**A**	**8.8**
Bridgeport Way Southwest and Pacific Highway Southwest	**X**	**B**	**19.1**	**C**	**21.5**
Bridgeport Way Southwest and I-5 Southbound (SB) Ramps	**X**	**B**	**13.9**	**A**	**9.3**
Bridgeport Way Southwest and I-5 Northbound (NB) Ramps	**X**	**B**	**14.0**	**B**	**15.4**
Clover Creek Drive Southwest and Hillcrest Drive Southwest		**A**	**9.1**	**A**	**9.2**
Clover Creek Drive Southwest and Pacific Highway Southwest		**B**	**10.2**	**B**	**11.6**
North Thorne Lane Southwest and Union Avenue Southwest	**In 2030 Build**	**A**	**7.6**	**F**	**52.4**
North Thorne Lane Southwest and I-5 SB Ramps	**X**	**C**	**26.9**	**C**	**25.6**
North Thorne Lane Southwest and I-5 NB Ramps	**X**	**C**	**20.1**	**B**	**17.2**
Berkeley Street Southwest and Union Avenue Southwest	**In 2030 Build**	**C**	**22.6**	**F**	**72.0**
Berkeley Street Southwest and I-5 SB Ramps	**X**	**C**	**28.2**	**B**	**19.2**
Berkeley Street Southwest and I-5 NB Ramps	**X**	**C**	**24.1**	**D**	**35.1**
41st Division Drive and I-5 SB Ramps		**A**	**4.1**	**A**	**4.0**

Intersection Level of Service – Existing Year 2010

Study Intersection		2010 AM Peak Hour (morning)		2010 PM Peak Hour (afternoon)	
Name	***Traffic Signal***	***LOS***	***Average Delay (seconds per vehicle)***	***LOS***	***Average Delay (seconds per vehicle)***
41st Division Drive and I-5 NB Ramps		**A**	**2.7**	**B**	**17.3**
Barksdale Avenue and DuPont-Steilacoom Road	**X**	**B**	**18.6**	**B**	**14.5**
Barksdale Avenue and I-5 SB Ramps	**X**	**B**	**14.1**	**A**	**7.8**
Barksdale Avenue/Locust Road and I-5 NB Ramps	**X**	**C**	**24.5**	**C**	**29.1**

Intersection Level of Service – Future Year 2030

Study Intersection		No Build Alternative AM Peak Hour		Build Alternative AM Peak Hour		No Build Alternative PM Peak Hour		Build Alternative PM Peak Hour	
Name	*Traffic Signal*	*LOS*	*Average Delay (seconds per vehicle)*	*LOS*	*Average Delay (seconds per vehicle)*	*LOS*	*Average Delay (seconds per vehicle)*	*LOS*	*Average Delay (seconds per vehicle)*
East "D" Street and East 26th Street	X	C	20.9	C	21.2	E	72.6	E	72.8
East "D" Street and East 25th Street	X	B	10.7	B	10.8	C	21.9	C	22.3
East "C" Street and East 26th Street		F*	>300*	F*	>300*	F*	>300*	F*	>300*
East "C" Street and East 25th Street	X	B	11.6	B	11.6	B	17.4	B	17.5
South "C" Street and South Tacoma Way		B*	11.9*	B*	11.9*	C*	16.6*	C*	16.6*
South "C" Street and South 25th Street		B*	14.3*	B*	14.3*	D*	29.7*	D*	29.7*
South Chandler Street and South Tacoma Way		B*	11.0*	B*	11.0*	C*	18.3*	C*	18.3*
South Chandler Street and Center Street		B*	13.3*	B*	13.3*	D*	26.0*	D*	26.0*
South Alaska Street and South Tacoma Way		B*	10.8*	B*	10.8*	B*	14.4*	B*	14.4*
South Alaska Street and Center Street		C*	24.1*	C*	24.1*	D*	33.0*	D*	33.0*
South Wilkeson Street and South Tacoma Way	X	B	10.8	B	11.0	B	19.4	B	19.4
South Wilkeson Street and Center Street	X	B	12.9	B	13.0	D	38.2	D	38.3
South Pine Street and South Tacoma Way	X	B	16.4	B	16.5	D	38.0	D	38.9
South Pine Street and Center Street	X	C	22.5	C	22.6	D	35.3	D	36.6
35th Street Southwest and South Tacoma Way	X	A	6.4	A	6.4	B	18.2	B	18.3
35th Street Southwest and South Lawrence Street		B*	10.1*	B*	10.1*	B*	10.6*	B*	10.6*
50th Street Southwest and South Adams Street		A*	9.0*	A*	9.0*	A*	9.0*	A*	9.0*
50th Street Southwest and South Burlington Way		N/A*	Traffic Circle	N/A*	Traffic Circle	N/A*	Traffic Circle	N/A*	Traffic Circle
South 56th Street and South Washington Street	X	A	8.2	A	8.4	B	16.7	B	18.4

Intersection Level of Service – Future Year 2030

Study Intersection		No Build Alternative AM Peak Hour		Build Alternative AM Peak Hour		No Build Alternative PM Peak Hour		Build Alternative PM Peak Hour	
Name	*Traffic Signal*	*LOS*	*Average Delay (seconds per vehicle)*	*LOS*	*Average Delay (seconds per vehicle)*	*LOS*	*Average Delay (seconds per vehicle)*	*LOS*	*Average Delay (seconds per vehicle)*
South 56th Street and South Adams Street/South Burlington Way		A	4.1	A	4.7	A	5.3	A	5.8
South 56th Street and South Tacoma Way	X	B	19.3	B	19.4	C	27.2	C	27.9
South 56th Street and South Puget Sound Avenue	X	A	5.6	A	5.6	B	10.4	B	10.5
60th Street Southwest and South Washington Street		A*	9.6*	A*	9.6*	A*	9.3*	A*	9.3*
60th Street Southwest and South Adams Street		A*	9.6*	A*	9.6*	B*	10.7*	B*	10.7*
60th Street Southwest and South Tacoma Way		C*	18.7*	C*	18.7*	E*	43.8*	E*	43.8*
South 74th Street and South Tacoma Way	X	C	30.4	C	31.0	D	36.1	D	37.2
Steilacoom Blvd Southwest and Lakeview Avenue Southwest	X	A	6.7	A	7.0	A	9.9	B	10.2
Steilacoom Blvd Southwest and Durango Street Southwest		C	16.5	C	16.6	B	13.5	B	13.7
100th Street Southwest and Lakeview Avenue Southwest	X	B	10.7	B	11.1	B	16.5	B	16.9
108th Street Southwest and Lakeview Avenue Southwest	X	A	9.0	A	9.3	B	12.7	B	13.0
108th Street Southwest and Halcyon Road Southwest		A	6.1	A	6.2	A	8.9	A	8.9
Bridgeport Way Southwest and Pacific Highway Southwest	X	C	22.4	C	22.5	C	27.2	C	26.8
Bridgeport Way Southwest and I-5 Southbound (SB) Ramps	X	B	11.8	B	11.8	B	14.5	B	19.8
Bridgeport Way Southwest and I-5 Northbound (NB) Ramps	X	B	15.0	B	15.2	B	16.3	B	17.0

Intersection Level of Service – Future Year 2030

Study Intersection		No Build Alternative AM Peak Hour		Build Alternative AM Peak Hour		No Build Alternative PM Peak Hour		Build Alternative PM Peak Hour	
Name	*Traffic Signal*	*LOS*	*Average Delay (seconds per vehicle)*	*LOS*	*Average Delay (seconds per vehicle)*	*LOS*	*Average Delay (seconds per vehicle)*	*LOS*	*Average Delay (seconds per vehicle)*
Clover Creek Drive Southwest and Hillcrest Drive Southwest		A*	9.4*	A*	9.4*	A*	9.5*	A*	9.5*
Clover Creek Drive Southwest and Pacific Highway Southwest		B*	11.9*	B*	11.9*	C*	15.3*	C*	15.3*
North Thorne Lane Southwest and Union Avenue Southwest	In 2030 Build	C	15.9	C	26.8	F	182.9	F	188.0
North Thorne Lane Southwest and I-5 SB Ramps	X	E	70.3	D	44.3	D	40.7	C	30.9
North Thorne Lane Southwest and I-5 NB Ramps	X	E	75.2	E	70.7	F	91.3	E	74.8
Berkeley Street Southwest and Union Avenue Southwest	In 2030 Build	F	102.2	F	83.5	F	64.1	D	42.9
Berkeley Street Southwest and I-5 SB Ramps	X	D	47.7	D	37.9	C	25.7	C	22.7
Berkeley Street Southwest and I-5 NB Ramps	X	C	23.2	C	23.0	C	29.8	D	41.9
41st Division Drive and I-5 SB Ramps		C	32.5	C	32.1	A	9.7	B	11.9
41st Division Drive and I-5 NB Ramps		C	28.2	C	31.3	F	105.5	F	103.7
Barksdale Avenue and DuPont-Steilacoom Road	X	B	19.4	C	22.2	C	24.2	C	25.9
Barksdale Avenue and I-5 SB Ramps	X	B	10.6	A	6.8	B	11.4	A	6.6
Barksdale Avenue/Locust Road and I-5 NB Ramps	X	E	62.5	E	57.6	E	56.0	E	55.8

Attachment B – Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)			Change in Max Queues from Existing to Year 2030 (feet)		Diff in 2030 Max Queues = Build - No Action (feet)
						Existing	2030 No Action	2030 Build	2030 No Action	2030 Build	
S. 56th Street and S. Adams Street/S. Burlington Way	S. 56th Street	Eastbound (EB) Left	75	AM	0	20	24	28	4	8	4
				PM	0	23	31	31	8	8	0
		EB Through	300 I/S	AM	8	297	306	355	9	58	49
				PM	14	370	377	389	7	19	12
		EB Right	Shared	AM	3	212	221	271	9	59	50
				PM	5	285	291	304	6	19	13
	S. 56th Street	Westbound (WB) Left	75 RR	AM	0	41	59	59	18	18	0
				PM	2	93	156	165	63	72	9
		WB Through	75 RR	AM	2	126	183	183	57	57	0
				PM	4	141	170	176	29	35	6
		WB Right	Shared	AM	0	62	119	119	57	57	0
				PM	0	97	116	165	19	68	49
	S. Adams Street	Northbound (NB) Left	75	AM	1	30	38	36	8	6	-2
				PM	3	40	51	51	11	11	0
		NB Through	650 I/S	AM	0	46	58	60	12	14	2
				PM	1	58	75	84	17	26	9
		NB Right	Shared	AM	1	54	63	64	9	10	1
				PM	1	60	77	86	17	26	9
	S. Burlington Way	Southbound (SB) Left	75	AM	1	29	34	34	5	5	0
				PM	0	0	0	0	0	0	0
		SB Through	200 RR	AM	0	16	42	42	26	26	0
				PM	0	38	50	51	12	13	1
		SB Right	Shared	AM	0	0	0	0	0	0	0
				PM	0	0	0	0	0	0	0

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)			Change in Max Queues (feet)		Net Change = 2030 Build - 2030 No Action (feet)
						Existing	2030 No Action	2030 Build	2030 No Action	2030 Build	
S. 56th Street and S. Washington Street	S. 56th Street	EB Left	50	AM	8	203	231	234	28	31	3
				PM	12	192	240	242	48	50	2
		EB Through	125 RR	AM	6	187	224	225	37	38	1
				PM	11	180	237	238	57	58	1
		EB Right	Shared	AM	6	187	224	225	37	38	1
				PM	11	180	237	238	57	58	1
	S. 56th Street	WB Left	Shared	AM	1	54	107	110	53	56	3
				PM	1	38	154	160	116	122	6
		WB Through	225 I/S	AM	21	317	342	351	25	34	9
				PM	19	366	391	391	25	25	0
		WB Right	Shared	AM	12	280	306	314	26	34	8
				PM	19	366	391	391	25	25	0
	S. Washington Street	NB Left	75	AM	1	43	42	42	-1	-1	0
				PM	3	50	48	50	-2	0	2
		NB Through	600 I/S	AM	4	56	58	58	2	2	0
				PM	3	56	64	64	8	8	0
		NB Right	Shared	AM	4	58	60	60	2	2	0
				PM	4	58	66	66	8	8	0
	S. Washington Street	SB Left	100	AM	5	56	67	69	11	13	2
				PM	11	213	505	830	292	617	325
		SB Through	600 I/S	AM	3	50	50	50	0	0	0
				PM	10	237	800	1219	563	982	419
		SB Right	Shared	AM	2	78	91	95	13	17	4
				PM	63	727	1330	1633	603	906	303

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)			Change in Max Queues (feet)		Net Change = 2030 Build - 2030 No Action (feet)
						Existing	2030 No Action	2030 Build	2030 No Action	2030 Build	
S. 56th Street and S. Tacoma Way	S. 56th Street	EB Left	50	AM	5	66	69	70	3	4	1
				PM	15	110	135	135	25	25	0
		EB Through	225 I/S	AM	24	179	180	201	1	22	21
				PM	41	280	315	325	35	45	10
		EB Right	Shared	AM	24	179	180	201	1	22	21
				PM	9	191	227	237	36	46	10
	S. 56th Street	WB Left	50	AM	10	93	101	101	8	8	0
				PM	21	259	291	309	32	50	18
		WB Through	225 I/S	AM	17	163	199	199	36	36	0
				PM	54	322	331	328	9	6	-3
		WB Right	Shared	AM	1	91	127	127	36	36	0
				PM	22	249	259	256	10	7	-3
	S. Tacoma Way	NB Left	100	AM	14	132	165	165	33	33	0
				PM	14	134	139	135	5	1	-4
		NB Through	600 I/S	AM	8	97	183	183	86	86	0
				PM	15	148	258	250	110	102	-8
		NB Right	Shared	AM	1	69	108	108	39	39	0
				PM	12	170	183	174	13	4	-9
	S. Tacoma Way	SB Left	125	AM	5	75	77	78	2	3	1
				PM	7	85	94	102	9	17	8
		SB Through	600 I/S	AM	23	122	144	144	22	22	0
				PM	68	309	368	360	59	51	-8
		SB Right	Shared	AM	0	18	46	46	28	28	0
				PM	17	213	272	264	59	51	-8

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)			Change in Max Queues (feet)		Net Change = 2030 Build - 2030 No Action (feet)
						Existing	2030 No Action	2030 Build	2030 No Action	2030 Build	
S. 56th Street and S. Puget Sound Avenue	S. 56th Street	EB Left	Shared	AM	0	25	29	29	4	4	0
				PM	0	33	47	54	14	21	7
		EB Through	225 I/S	AM	3	144	217	236	73	92	19
				PM	7	160	357	358	197	198	1
		EB Right	Shared	AM	1	78	159	178	81	100	19
				PM	1	93	291	292	198	199	1
	S. 56th Street	WB Left	Shared	AM	0	36	44	44	8	8	0
				PM	1	48	62	60	14	12	-2
		WB Through	200 I/S	AM	4	97	106	106	9	9	0
				PM	6	117	174	169	57	52	-5
		WB Right	Shared	AM	0	28	38	37	10	9	-1
				PM	0	48	105	95	57	47	-10
	S. Puget Sound Avenue	NB Left	50	AM	1	29	32	32	3	3	0
				PM	2	53	46	47	-7	-6	1
		NB Through	600 I/S	AM	8	97	98	98	1	1	0
				PM	15	148	157	157	9	9	0
		NB Right	Shared	AM	1	55	56	56	1	1	0
				PM	4	106	115	115	9	9	0
	S. Puget Sound Avenue	SB Left	50	AM	2	42	43	43	1	1	0
				PM	8	94	102	102	8	8	0
		SB Through	600 I/S	AM	4	63	65	65	2	2	0
				PM	14	124	131	131	7	7	0
		SB Right	Shared	AM	0	10	17	17	7	7	0
				PM	1	78	82	82	4	4	0

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet) Existing	Maximum Queues (feet) 2030 No Action	Maximum Queues (feet) 2030 Build	Change in Max Queues (feet) 2030 No Action	Change in Max Queues (feet) 2030 Build	Net Change = 2030 Build - 2030 No Action (feet)
S. 74th Street and S. Tacoma Way	S. 74th Street	EB Left	150	AM	14	113	129	129	16	16	0
				PM	24	138	138	138	0	0	0
		EB Through	350 RR	AM	61	324	415	415	91	91	0
				PM	85	397	416	416	19	19	0
		EB Right	Shared	AM	18	233	324	324	91	91	0
				PM	35	306	325	325	19	19	0
	S. 74th Street	WB Left	150	AM	29	196	213	261	17	65	48
				PM	43	270	283	304	13	34	21
		WB Through	250 I/S	AM	42	252	307	362	55	110	55
				PM	68	364	378	384	14	20	6
		WB Right	Shared	AM	7	162	217	272	55	110	55
				PM	22	274	289	295	15	21	6
	S. Tacoma Way	NB Left	225	AM	44	227	331	342	104	115	11
				PM	55	286	301	304	15	18	3
		NB Through	1850 I/S	AM	39	205	270	268	65	63	-2
				PM	52	299	316	325	17	26	9
		NB Right	125	AM	0	0	1	1	1	1	0
				PM	0	18	34	28	16	10	-6
	S. Tacoma Way	SB Left	175	AM	11	91	104	105	13	14	1
				PM	36	197	256	287	59	90	31
		SB Through	575 I/S	AM	35	170	184	179	14	9	-5
				PM	95	433	487	533	54	100	46
		SB Right	Shared	AM	29	165	180	174	15	9	-6
				PM	92	429	484	529	55	100	45

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet) Existing	Maximum Queues (feet) 2030 No Action	Maximum Queues (feet) 2030 Build	Change in Max Queues (feet) 2030 No Action	Change in Max Queues (feet) 2030 Build	Net Change = 2030 Build - 2030 No Action (feet)
N. Thorne Lane SW and Union Avenue SW	N. Thorne Lane SW	EB Through	250 I/S	AM	5	107	151	184	44	77	33
				PM	37	239	227	190	-12	-49	-37
		EB Right	Shared	AM	1	53	98	148	45	95	50
				PM	14	186	174	154	-12	-32	-20
	N. Thorne Lane SW	WB Left	Shared	AM	0	13	24	62	11	49	38
				PM	1	60	31	77	-29	17	46
		WB Through	150 RR	AM	0	13	24	62	11	49	38
				PM	1	60	31	77	-29	17	46
	Union Avenue SW	NB Left	600 I/S	AM	1	59	110	266	51	207	156
				PM	193	682	1345	1397	663	715	52
		NB Right	50	AM	5	113	165	264	52	151	99
				PM	235	736	1399	1396	663	660	-3

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)			Change in Max Queues (feet)		Net Change = 2030 Build - 2030 No Action (feet)
						Existing	2030 No Action	2030 Build	2030 No Action	2030 Build	
N. Thorne Lane SW and I-5 Southbound Ramps	N. Thorne Lane SW	EB Through	100 I/S	AM	83	202	208	46	6	-156	-162
				PM	125	203	200	82	-3	-121	-118
		EB Right	100 I/S	AM	83	202	208	46	6	-156	-162
				PM	125	203	200	82	-3	-121	-118
	N. Thorne Lane SW	WB Left	Shared	AM	3	53	95	274	42	221	179
				PM	1	23	45	220	22	197	175
		WB Through	175 I/S	AM	3	53	95	274	42	221	179
				PM	1	23	45	220	22	197	175
	I-5 SB Off-Ramp	SB Left	Shared	AM	96	585	1717	1587	1132	1002	-130
				PM	102	514	1018	745	504	231	-273
		SB Through	1700 I/S	AM	96	585	1717	1587	1132	1002	-130
				PM	102	514	1018	745	504	231	-273
		SB Right	300	AM	114	615	1743	1587	1128	972	-156
				PM	122	544	1047	745	503	201	-302

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet) Existing	Maximum Queues (feet) 2030 No Action	Maximum Queues (feet) 2030 Build	Change in Max Queues (feet) 2030 No Action	Change in Max Queues (feet) 2030 Build	Net Change = 2030 Build - 2030 No Action (feet)
N. Thorne Lane SW and I-5 Northbound Ramps	N. Thorne Lane SW	EB Left	175 I/S	AM	1	21	38	160	17	139	122
				PM	5	66	53	<u>266</u>	-13	200	213
		EB Through	175 I/S	AM	1	21	38	160	17	139	122
				PM	5	66	53	<u>266</u>	-13	200	213
	N. Thorne Lane SW	WB Through	725 I/S	AM	103	422	<u>1199</u>	<u>1198</u>	777	776	-1
				PM	94	712	<u>1188</u>	<u>1159</u>	476	447	-29
		WB Right	200	AM	103	<u>422</u>	<u>1199</u>	<u>1198</u>	777	776	-1
				PM	94	<u>712</u>	<u>1188</u>	<u>1159</u>	476	447	-29
	I-5 NB Off-Ramp	NB Left	Shared	AM	20	183	366	357	183	174	-9
				PM	16	171	<u>1184</u>	<u>1184</u>	1013	1013	0
		NB Through	1150 I/S	AM	20	183	366	357	183	174	-9
				PM	16	171	<u>1184</u>	<u>1184</u>	1013	1013	0
		NB Right	325	AM	30	196	<u>379</u>	<u>368</u>	183	172	-11
				PM	27	184	<u>1197</u>	<u>1184</u>	1013	1000	-13

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)			Change in Max Queues (feet)		Net Change = 2030 Build - 2030 No Action (feet)
						Existing	2030 No Action	2030 Build	2030 No Action	2030 Build	
Berkeley Street SW and Union Avenue SW	Berkeley Street SW	EB Left	Shared	AM	7	130	345	231	215	101	-114
				PM	73	508	550	222	42	-286	-328
		EB Through	450 I/S	AM	7	130	345	231	215	101	-114
				PM	80	520	562	222	42	-298	-340
		EB Right	Shared	AM	7	130	345	227	215	97	-118
				PM	73	508	550	217	42	-291	-333
	Berkeley Street SW	WB Left	Shared	AM	46	229	237	55	8	-174	-182
				PM	2	109	239	203	130	94	-36
		WB Through	100 RR	AM	46	229	237	55	8	-174	-182
				PM	2	109	239	203	130	94	-36
		WB Right	75	AM	46	229	237	55	8	-174	-182
				PM	2	109	239	203	130	94	-36
	Militia Drive	NB Left	Shared	AM	1	49	64	111	15	62	47
				PM	200	557	453	546	-104	-11	93
		NB Through	575 I/S	AM	1	49	64	111	15	62	47
				PM	200	557	453	546	-104	-11	93
		NB Right	50	AM	2	62	77	111	15	49	34
				PM	211	570	466	546	-104	-24	80
	Union Avenue SW	SB Left	575 I/S	AM	14	165	1159	932	994	767	-227
				PM	165	760	1049	380	289	-380	-669
		SB Through	100	AM	14	165	1159	932	994	767	-227
				PM	165	760	1049	380	289	-380	-669
		SB Right	Shared	AM	14	165	1159	905	994	740	-254
				PM	165	760	1049	353	289	-407	-696

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet) Existing	Maximum Queues (feet) 2030 No Action	Maximum Queues (feet) 2030 Build	Change in Max Queues (feet) 2030 No Action	Change in Max Queues (feet) 2030 Build	Net Change = 2030 Build - 2030 No Action (feet)
Berkeley Street SW and I-5 Southbound Ramps	Berkeley Street SW	EB Through	100 I/S	AM	94	258	267	71	9	-187	-196
				PM	181	295	293	82	-2	-213	-211
		EB Right	100 I/S	AM	113	282	291	65	9	-217	-226
				PM	201	319	317	76	-2	-243	-241
	Berkeley Street SW	WB Left	Shared	AM	4	120	165	237	45	117	72
				PM	0	37	167	243	130	206	76
		WB Through	175 I/S	AM	5	122	165	237	43	115	72
				PM	1	38	167	243	129	205	76
	I-5 SB Off-Ramp	SB Left	Shared	AM	144	1009	1476	1530	467	521	54
				PM	49	264	430	448	166	184	18
		SB Through	1100 I/S	AM	Not listed	Not listed	Not listed	Not listed	N/A	N/A	N/A
				PM	Not listed	Not listed	Not listed	Not listed	N/A	N/A	N/A
		SB Right	300	AM	144	1010	1477	1531	467	521	54
				PM	50	264	431	449	167	185	18

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)			Change in Max Queues (feet)		Net Change = 2030 Build - 2030 No Action (feet)
						Existing	2030 No Action	2030 Build	2030 No Action	2030 Build	
Berkeley Street SW and I-5 Northbound Ramps	Berkeley Street SW	EB Left	Shared	AM	0	47	3	137	-44	90	134
				PM	0	8	0	200	-8	192	200
		EB Through	175 I/S	AM	0	47	3	137	-44	90	134
				PM	0	8	0	200	-8	192	200
	Berkeley Street SW	WB Through	2225 I/S	AM	207	1207	642	546	-565	-661	-96
				PM	310	1181	1416	1697	235	516	281
		WB Right	Shared	AM	219	1234	666	573	-568	-661	-93
				PM	326	1209	1439	1722	230	513	283
	I-5 NB Off-Ramp	NB Left	Shared	AM	76	355	705	674	350	319	-31
				PM	22	147	457	413	310	266	-44
		NB Through	1150 I/S	AM	Not listed	Not listed	Not listed	Not listed	N/A	N/A	N/A
				PM	Not listed	Not listed	Not listed	Not listed	N/A	N/A	N/A
		NB Right	375	AM	0	4	1	14	-3	10	13
				PM	0	0	0	0	0	0	0

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)			Change in Max Queues (feet)		Net Change = 2030 Build - 2030 No Action (feet)
						Existing	2030 No Action	2030 Build	2030 No Action	2030 Build	
41st Division Drive and I-5 Southbound Ramps	41st Division Drive	EB Through	2200 I/S	AM	0	0	5	158	5	158	153
				PM	19	170	468	670	298	500	202
		EB Right	Shared	AM	0	0	5	158	5	158	153
				PM	19	170	468	670	298	500	202
	41st Division Drive	WB Through	500 I/S	AM	6	138	1284	1293	1146	1155	9
				PM	0	0	0	134	0	134	134
		WB Right	Shared	AM	1	44	913	975	869	931	62
				PM	0	13	0	0	-13	-13	0
	I-5 SB Off-Ramp	NB Right (Loop)	1150 I/S	AM	12	392	1782	1742	1390	1350	-40
				PM	0	36	34	16	-2	-20	-18
		SB Right	1350 I/S	AM	0	32	642	680	610	648	38
				PM	0	0	0	17	0	17	17

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet) Existing	Maximum Queues (feet) 2030 No Action	Maximum Queues (feet) 2030 Build	Change in Max Queues (feet) 2030 No Action	Change in Max Queues (feet) 2030 Build	Net Change = 2030 Build - 2030 No Action (feet)
41st Division Drive and I-5 Northbound Ramps	41st Division Drive	EB Through	500 I/S	AM	0	7	119	106	112	99	-13
				PM	67	332	448	434	116	102	-14
		EB Right	Shared	AM	0	7	119	106	112	99	-13
				PM	67	332	448	434	116	102	-14
	41st Division Drive	WB Through	1450 I/S	AM	0	2	354	673	352	671	319
				PM	250	1197	2163	2163	966	966	0
		WB Right	Shared	AM	0	2	354	673	352	671	319
				PM	250	1197	2163	2163	966	966	0
	I-5 NB Off-Ramp	NB Right	1200 I/S	AM	15	367	1905	1904	1538	1537	-1
				PM	0	0	0	0	0	0	0
		SB Right (Loop)	1100 I/S	AM	0	0	151	23	151	23	-128
				PM	0	0	0	0	0	0	0

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)			Change in Max Queues (feet)		Net Change = 2030 Build - 2030 No Action (feet)
						Existing	2030 No Action	2030 Build	2030 No Action	2030 Build	
Barksdale Avenue and Steilacoom-DuPont Road SW/Wilmington Drive	Barksdale Avenue	EB Left	35	AM	13	112	111	97	-1	-15	-14
				PM	12	96	96	86	0	-10	-10
		EB Through	700 I/S	AM	13	112	111	97	-1	-15	-14
				PM	12	96	96	86	0	-10	-10
		EB Right	Shared	AM	3	86	85	71	-1	-15	-14
				PM	2	70	69	60	-1	-10	-9
	Barksdale Avenue	WB Left	125	AM	17	146	211	218	65	72	7
				PM	26	134	206	221	72	87	15
		WB Through	250 RR	AM	17	146	211	218	65	72	7
				PM	26	134	206	221	72	87	15
		WB Right	175	AM	5	153	229	215	76	62	-14
				PM	14	163	228	244	65	81	16
	Wilmington Drive	NB Left	75	AM	9	83	99	87	16	4	-12
				PM	15	119	132	181	13	62	49
		NB Through	2175 I/S	AM	9	83	99	87	16	4	-12
				PM	15	119	132	181	13	62	49
		NB Right	125	AM	4	85	84	89	-1	4	5
				PM	2	111	124	184	13	73	60
	Steilacoom-DuPont Road SW	SB Left	350	AM	71	365	525	498	160	133	-27
				PM	41	266	659	544	393	278	-115
		SB Through	625 I/S	AM	71	365	525	498	160	133	-27
				PM	41	266	659	544	393	278	-115
		SB Right	Shared	AM	46	322	482	455	160	133	-27
				PM	20	223	616	501	393	278	-115

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet)			Change in Max Queues (feet)		Net Change = 2030 Build - 2030 No Action (feet)
						Existing	2030 No Action	2030 Build	2030 No Action	2030 Build	
Barksdale Avenue and I-5 Southbound Ramps	Barksdale Avenue	EB Through	350 I/S	AM	71	302	214	2	-88	-300	-212
				PM	32	187	254	12	67	-175	-242
		EB Right	275	AM	1	20	68	0	48	-20	-68
				PM	0	58	25	0	-33	-58	-25
	Barksdale Avenue	WB Left	Shared	AM	25	274	285	206	11	-68	-79
				PM	18	322	275	336	-47	14	61
		WB Through	225 I/S	AM	25	274	285	206	11	-68	-79
				PM	18	322	275	336	-47	14	61
	I-5 SB Off-Ramp	SB Left	Shared	AM	18	167	222	252	55	85	30
				PM	1	97	220	234	123	137	14
		SB Through	1350 I/S	AM	18	167	222	252	55	85	30
				PM	1	97	220	234	123	137	14
		SB Right	500	AM	5	161	199	226	38	65	27
				PM	3	118	238	248	120	130	10

Existing and Proposed Queue Lengths by Intersection

Intersection	Street	Movement	Storage (feet)	Peak Hour	Average Queues (feet)	Maximum Queues (feet) Existing	Maximum Queues (feet) 2030 No Action	Maximum Queues (feet) 2030 Build	Change in Max Queues (feet) 2030 No Action	Change in Max Queues (feet) 2030 Build	Net Change = 2030 Build - 2030 No Action (feet)
Barksdale Avenue/Locust Road and I-5 Northbound Ramps	Barksdale Avenue	EB Left	225 I/S	AM	81	308	300	214	-8	-94	-86
				PM	41	195	298	284	103	89	-14
		EB Through	225 I/S	AM	81	308	300	214	-8	-94	-86
				PM	41	195	298	284	103	89	-14
	Locust Road	WB Through	1025 I/S	AM	45	276	490	489	214	213	-1
				PM	188	900	1666	1651	766	751	-15
		WB Right	1025 I/S	AM	26	276	481	478	205	202	-3
				PM	172	902	1678	1661	776	759	-17
	I-5 NB Off-Ramp	NB Left	Shared	AM	52	355	1337	1464	982	1109	127
				PM	55	301	541	489	240	188	-52
		NB Through	1600 I/S	AM	27	304	1285	1413	981	1109	128
				PM	55	301	541	438	240	137	-103
		NB Right	600	AM	27	304	1285	1413	981	1109	128
				PM	25	252	491	438	239	186	-53

Attachment C – Lists of Assumed Projects in Travel Demand Models

Roadway Capacity Improvements Assumed by 2012

Map ID	Project Name	Project Limits	Project Description	Jurisdiction
1	Canyon Rd East	116th Street East to 172nd Street East	Widen to 7 lanes	County
2	Canyon Rd East Southerly Ext	192nd Street East to 224th Street East	New 3-lane roadway	County
3	"D" Street Overpass	Puyallup Avenue to Dock Street	New 4-lane railroad overpass	City
4	I-5	South 320th Street (Federal Way) to SR-16	Add HOV lanes	WSDOT
5	Lakeland Hills Way Ext	Lake Tapps Pkwy to Forest Canyon Rd	New 2-lane roadway	Developer
6	Military Rd East/122nd Avenue East	830 feet S/O 136th Street East to Reservoir Rd East	Widened/re-aligned 3-lane roadway	County
7	Old Man Thomas Rd East	62nd Street Southeast to Lake Tapps Pky East	New 2-lane roadway	Developer
8	Olympic Drive /56 Street	38th Avenue East to Point Fosdick Rd	Widen to 5 lanes	City
9	Pacific Hwy East	Alexander Avenue to Port of Tacoma Road	Widen to 5 lanes	City
10	Radiance Blvd East ('A' Street East)	54th Avenue East to 70th Avenue East	New 2-lane roadway	City
11	Shaw Rd Ext	Pioneer Way to Main Avenue East	New 5-lane roadway	City
12	Sky Island Blvd	Connection South to Rhodes Lake Rd East	New 2-lane roadway	City
13	South Prairie Rd East	SR-410 to 200th Avenue Ct East	Widen to 5 lanes	City
14	Spanaway Loop Rd South	174th Street South to Tule Lake Rd South	Restripe to 4 lanes	County
15	Spanaway Loop Rd South	S/O Garfield Street South to N/O Wheeler Street South	Widen to 5 lanes	County
16	SR-16	I-5 to Olympic Drive Northwest	New HOV lanes, bridge	WSDOT
17	SR-161	360th Street South (Federal Way) to Jovita Blvd East	Widen to 5 lanes	WSDOT

Roadway Capacity Improvements Assumed by 2012

Map ID	Project Name	Project Limits	Project Description	Jurisdiction
18	SR-161	Jovita Blvd East to 36th Street East	Widen to 5 lanes	WSDOT
19	SR-410	214th Avenue to 234th Avenue	Widen to 5 lanes	WSDOT
20	Steward Rd Southwest	SR-167 to Lake Tapps Pky East	Widen to 5 lanes	City
21	Tyler Street	South 38th Street to South 74th Street	Widen to 3 lanes	City
22	Valley Avenue East	70th Avenue to Freeman Rd East	Widen to 5 lanes	City
23	Wollochet Drive Northwest	Artondale Drive Northwest to 40th Street Northwest	Add 1 southbound lane	County
24	Wollochet Drive Northwest	Fillmore Drive Northwest to Artondale Drive Northwest	Widen to 5 lanes	County
25	12th Street East	54th Avenue East to Alexander Street	Widen to 3 lanes	City
26	20th Street East	54th Avenue to 63rd Avenue East	Widen to 3 lanes	City
27	32nd Street East Ext	54th Avenue East to Frank Albert Rd	New 3-lane roadway	City
28	48th Street East	70th Avenue East to Freeman Rd East	Widen to 3 lanes	City
29	56th Street/Point Fosdick Drive	Olympic/Point Fosdick Drive to Olympic Drive/56th Street	Widen to 3 lanes	City
30	70th Avenue East	SR-99 to North Levee Rd	Widen to 5 lanes	City
31	70th Avenue East Ext	176th Street East to 184th Street East	New 2-lane roadway	Developer
32	86th Avenue East Ext	184th Street East to 192nd Street East	New 2-lane roadway	Developer
33	92nd Avenue East Ext	204th Street East to 192nd Street East	New 3-lane roadway	County
34	94th Avenue East	112th Street East to 116th Street East	Widen to 5 lanes	City
35	94th Avenue East	116th Street East to 136th Street East	Widen to 5 lanes	County
36	112th Street East	300' E/O Woodland Avenue East to 86th Avenue East	Widen to 5 lanes	County
37	112th Street East	58th Avenue to 300' E/O Woodland Avenue East	Widen to 5 lanes	County
38	112th Street East Ext	198th Avenue East to 300' W/O 203rd Avenue East	New 2-lane roadway	County
39	122th Avenue East Ext	185th Street East to 200th Street East	New 3-lane roadway	Developer
40	136th Street East Ext	62nd Avenue East to Woodland Avenue East	New 2-lane roadway	Developer

Roadway Capacity Improvements Assumed by 2012

Map ID	Project Name	Project Limits	Project Description	Jurisdiction
41	160th Street East Ext	SR-161 to 110th Avenue East	New 3-lane roadway	Developer
42	168th Street East Ext	Gem Heights Drive East to SR-161	New 2-lane roadway	Developer
43	176th Street East	Waller Rd East to SR-161	Widen to 5 lanes	County
44	184th Street East Ext	70th Avenue East to 74th Avenue East	New 2-lane roadway	County
45	184th Street East Ext	86th Avenue East to Gem Heights Drive East	New 3-lane roadway	Developer
46	187th Street East Ext (Lipoma Firs East)	Current terminus to 122nd Avenue East	Extend 3-lane roadway	Developer
47	192nd Street East Ext	86th Avenue East to 92nd Avenue East	New 3-lane roadway	Developer
48	198th Avenue East	144th Street East to 120th Street East	Widen to 4 lanes	Developer
49	198th Avenue East/199th Avenue Ct East/ 200th Avenue Ct East	120th Street East to South Prairie Rd East	Construct/widen to 5 lanes	County/City

County Roadway Improvements Needed to Serve New Growth (2005 – 2030)

Project ID	Facility Name	Facility Limits	Improvement Description
1	86th Avenue East	176th Street East to 152nd Street East	New 3-lane roadway
2	92nd Avenue East	204th Street East to 192nd Street East	New 3-lane roadway
3	94th Avenue East	136th Street East to 116th Street East	Widen from 2 to 5 lanes
4	94th Avenue East	144th Street East to 136th Street East	Widen from 2 to 5 lanes
5	94th Avenue East	152nd Street East to 144th Street East	Widen from 2 to 3 lanes
6	112th Street East	300' E/O Woodland Avenue East to 86th Avenue East	Widen from 2 to 5 lanes
7	122nd Street East/Military Rd East	Shaw Rd East to SR-162	Widen from 2 to 3 lanes
8	128th Street East	86th Avenue East to 90th Avenue East	Add channelization
9	128th Street East	94th Avenue East to SR-161	Add channelization
10	152nd Street East	94th Avenue East to SR-161	Widen from 2 to 3 lanes
11	160th Street East	78th Avenue East to SR-161	Widen from 2 to 5 lanes, Access control
12	160th Street East	Canyon Rd East to Woodland Avenue East	Widen from 2 to 5 lanes, Access control
13	160th Street East	Woodland Avenue East to 78th Avenue East	Widen from 2 to 5 lanes, Access control
14	176th Street East	1000' E/O Canyon Rd East to 78th Avenue East	Widen from 2 to 5 lanes, Access control
15	176th Street East	14th Avenue East to Waller Rd East	Widen from 2 to 5 lanes, Access control
16	176th Street East	78th Avenue East to Gem Heights Drive East	Widen from 2 to 5 lanes, Access control
17	176th Street East	"B" Street East to 14th Avenue East	Widen from 2 to 5 lanes, Access control
18	176th Street East	Gem Heights Drive East to SR-161	Widen from 2 to 5 lanes, Access control
19	176th Street East	Waller Rd East to 500' w/o 51st Avenue East	Widen from 2 to 5 lanes, Access control
20	176th Street East Extension	BR #31195-A - Calistoga Avenue East to Urban Growth Boundary	New 3-lane roadway
21	176th Street East Extension	Urban Growth Area Boundary to 130th Avenue East	New 5-lane roadway
22	184th Street East	70th Avenue East to 74th Avenue East	New 2-lane roadway
23	184th Street East	78th Avenue East to Gem Heights Drive East	New 2-lane roadway
24	198th Avenue East	120th Street East to Rhodes Lake Rd	Widen from 3 to 5 lanes
25	198th Avenue East/ 199th Avenue Ct East	Rhodes Lake Rd East to 112th Street East and Bonney Lake C/L to 104th Street East	Widen from 2 to 5 lanes
26	224th Street East	SR-7 to SR-161	Widen from 2 to 3 lanes
27	Brookdale Rd East	152nd Street East to Canyon Rd East	Widen from 2 to 3 lanes

County Roadway Improvements Needed to Serve New Growth (2005 – 2030)

Project ID	Facility Name	Facility Limits	Improvement Description
28	Canyon Rd East	131st Street Ct East to 116th Street East	Widen from 4 to 7 lanes
29	Canyon Rd East	144th Street East to 131st Street Ct East	Widen from 4 to 7 lanes
30	Canyon Rd East	160th Street East to 144th Street East	Widen from 4 to 7 lanes
31	Canyon Rd East	172nd Street East to 160th Street East	Widen from 4 to 7 lanes
32	Canyon Rd East	192nd Street East to 1000' s/o 176th Street East	Widen from 4 to 5 lanes
33	Canyon Rd East	72nd Street East to Pioneer Way East	Widen from 2 to 5 lanes
34	Canyon Rd East	96th Street East to 72nd Street East	Widen from 2 to 5 lanes
35	Canyon Rd East	106th Street East to 96th Street East	Widen from 4 to 5 lanes
36	Canyon Rd East Northerly Ext	Pioneer Way East to 70th Avenue East	New 5-lane roadway
37	Canyon Rd East Southerly Ext	224th Street East to 192nd Street East	New 5-lane roadway
38	Military Rd East/122nd Avenue East	Sunrise Pkwy East to Reservoir Rd East	Widen from 2 to 3 lanes, realign at 136th Street East
39	Pioneer Way East	Waller Rd East to Canyon Rd East	Widen from 2 to 3 lanes
40	Portland Av East	112th Street East to SR-512 EB on/off ramps	Widen to 5 lanes
41	Shaw Rd East/Military Rd East	Reservoir Rd East to 39th Avenue Southeast	Widen from 2 to 3 lanes
42	Spanaway Loop Rd S	Military Rd S to 116th Street S	Widen from 4 to 5 lanes
43	Spanaway Loop Rd S	174th Street S to Military Rd S	Convert from 3 to 4 lanes (Restripe)
44	Wollochet Drive Northwest	40th Street Northwest to Artondale Drive Northwest	Widen from 2 to 3 lanes (southbound lane)
45	Wollochet Drive Northwest	Artondale Drive Northwest to East Bay Drive Northwest	Widen from 2 to 5 lanes
46	Wollochet Drive Northwest	East Bay Drive Northwest to Fillmore Drive Northwest	Widen from 2 to 5 lanes

Note: 1 - Projected V/S ratio was created by placing 2025 travel demand on 2004 road network.

Other Improvements Included in 2030 Model Roadway Network

Facility Name	Facility Limits	Improvement Description	Proponent
20th Street East	54th Avenue East to 70th Avenue East	Widen from 2 to 3 lanes	Fife
70th Avenue East	176th Street East to 184th Street East	New 3-lane roadway	Developer/Pierce Co
70th Avenue East	North Levee Rd East to 20th Street East	Widen from 2 to 5 lanes	Fife
86th Avenue East	184th Street East to 192nd Street East	New 3-lane roadway	Developer/Pierce Co
94th Avenue East	112th Street East to 116th Street East	Widen from 2 to 5 lanes	Puyallup
112th Street East	58th Avenue East to 300' e/o Woodland Avenue East	Widen from 2 to 5 lanes (under construction)	Pierce County
122th Avenue East	187th Street East to 200th Street East	New 3-lane roadway	Developer/Pierce Co
136th Street East	62nd Avenue East to Woodland Avenue East	New 2-lane roadway	Developer/Pierce Co
160th Street East	SR-161 to 110th Avenue East	New 3-lane roadway	Developer/Pierce Co
168th Street East	Gem Heights Drive East to SR-161	New 2-lane roadway	Developer/Pierce Co
187th Street East	122nd Avenue East to SR-161	New 3-lane roadway	Developer/Pierce Co
187th Street East	Gem Heights Drive East to SR-161	New 3-lane roadway (under construction)	Developer/Pierce Co
192nd Street East	86th Avenue East to 92nd Avenue East	New 3-lane roadway	Developer/Pierce Co
198th Avenue East	120th Street East to Rhodes Lake Rd	Widen from 2 to 3 lanes	Developer/Pierce Co
198th Avenue East	144th Street East to 120th Street East	Widen from 2 to 4 lanes	Developer/Pierce Co
198th Avenue East/ 199th Avenue Ct East/ 200th Avenue Ct East	Rhodes Lake Rd East to South Prairie Rd East	New/Reconstructed 2-lane road way	Developer/County/City
199th Avenue Ct East/ 200th Avenue Ct East	112th Street East to Bonney Lake C/L and 104th Street East to South Prairie Rd East	New/Widened 5-lane roadway	Bonney Lake/Developer
Cascadia Westerly Access	198th Avenue East to SR-162	Construct new 4-lane roadway	Developer/Pierce Co
I-5	Federal Way to Port of Tacoma Rd	Add HOV lanes	WSDOT
I-5	Port of Tacoma Rd to SR-16	Add HOV lanes	WSDOT
I-5	South 48th Street to Pacific Avenue	Improve SR-16 Interchange and Collector/Distributor	WSDOT
Lake Tapps Pkwy East	Sumner-Tapps Hwy to 182nd Avenue East	New 3-lane roadway (under construction)	Pierce Co
Lakeland Hills Way	Lake Tapps Pkwy to Forest Canyon Rd	New 3-lane roadway	Developer/Pierce Co

Other Improvements Included in 2030 Model Roadway Network

Facility Name	Facility Limits	Improvement Description	Proponent
Old Man Thomas Rd East	Lakeland Hills Way to Lake Tapps Pkwy	New 2-lane roadway	Auburn/Developer
Shaw Rd East	Pioneer Way to Main Avenue East	New 5-lane roadway	Puyallup
Sky Island Blvd	Connection south to Rhodes Lake Rd	New 2-lane roadway	Bonney Lake
South Prairie Rd East	SR-410 to 200th Avenue Ct East	Widen from 2 to 5 lanes	Bonney Lake/Developer
SR-16	Olympic Drive Northwest to I-5	Add HOV lanes/new bridge, interchange improvements	WSDOT
SR-161	176th Street East to 234th Street East	Widen from 2 to 5 lanes (under construction)	WSDOT
SR-167	SR-410 to 15th Street Northwest (Auburn)	Add HOV lanes	WSDOT
SR-410	214th Avenue East to 234th Avenue East	Widen from 2 to 5 lanes	WSDOT
SR-704 (Cross-Base Hwy)	176th Street East to I-5	New 4-6 lane highway, Close Perimeter Rd	WSDOT
Stewart Rd Southeast (8th Street East)	SR-167 to Lake Tapps Pkwy	Widen from 2 to 5 lanes	Pacific/Sumner
Valley Avenue East	54th Avenue East to 70th Avenue East	Widen from 2 to 3 lanes	Fife
Valley Avenue East	Freeman Rd East to 70th Avenue East	Widen from 2 to 5 lanes	Fife

Map of Improvements included in the 2030 Demand Model for the Tacoma Area