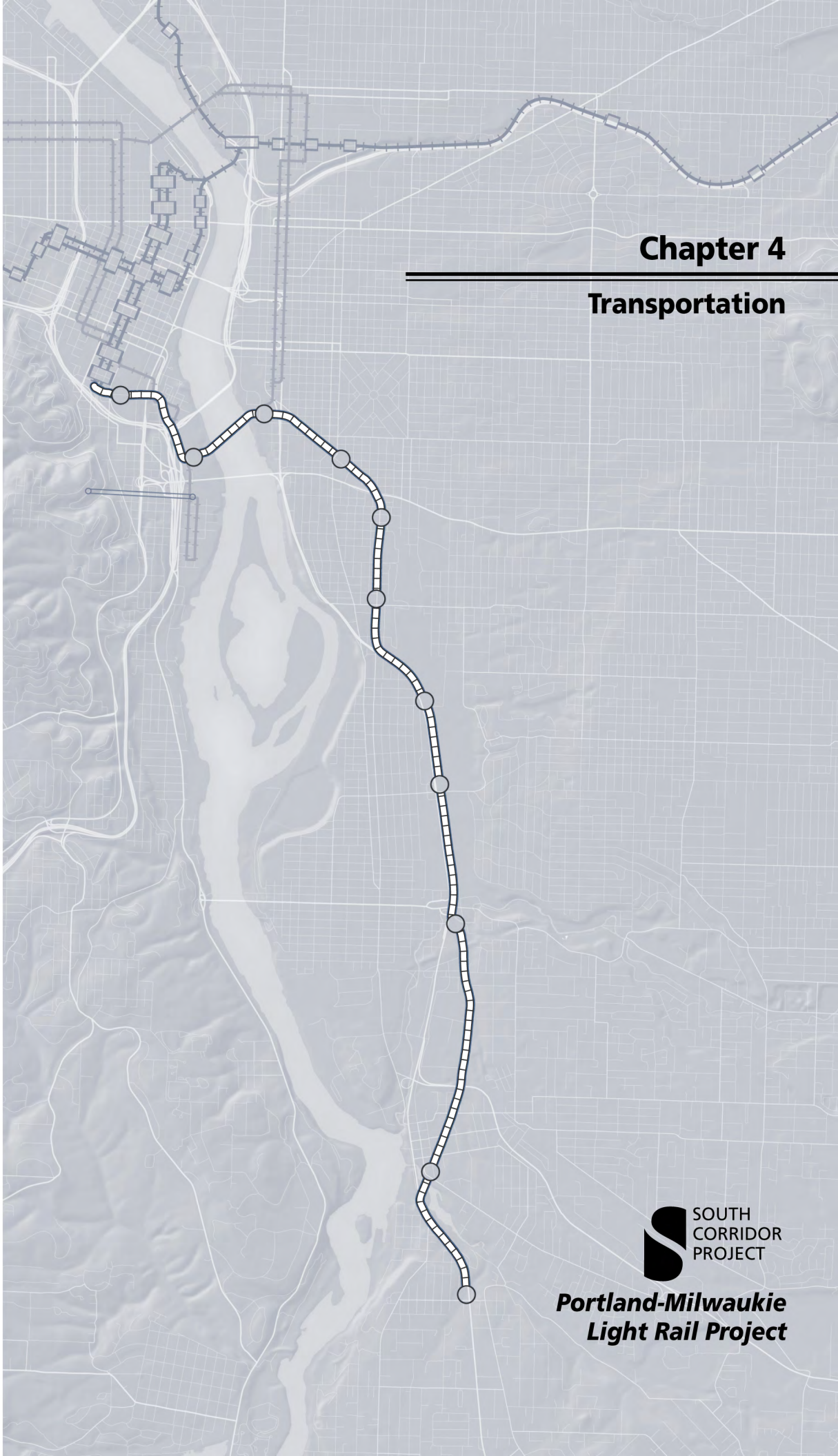

Chapter 4

Transportation

SOUTH CORRIDOR PROJECT

Portland-Milwaukie Light Rail Project

4. TRANSPORTATION

This chapter describes the effects that the Portland-Milwaukie Light Rail Project would have on the regional transportation system. This includes effects on transit, traffic movements, freight movement, and navigable waterways in the project corridor. The analysis considers travel demand by mode, transit service, travel times, parking loss, parking demand reduction, changes of access, bicycle travel, pedestrian activity, and congestion of streets, freeways, and intersections. A brief discussion of the impacts to freight railroads and truck delivery is also provided. The chapter also discusses navigation issues relating to the height of the proposed Willamette River bridge.

For more detailed information on transportation impacts, see the *Transportation Impacts Results Report* (Metro 2010).

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4.1 AFFECTED ENVIRONMENT

This section summarizes characteristics of the existing transportation system and the conditions within the region and corridor, highlighting travel behavior, the public transportation infrastructure and network, the highway infrastructure and network, regional and local parking policies and supplies, regional and local transportation plans, the pedestrian and bicycle infrastructure and network, and freight movements.

4.1.1 Public Transportation

Transit service in the corridor is primarily provided by fixed-route, fixed-schedule buses operating in mixed traffic on freeways, highways, arterials, and collectors. Intra-suburban trips are served by feeder bus lines that connect suburban residential neighborhoods with transit centers in Milwaukie and in Oregon City. These transit centers are linked to downtown Portland with high-frequency trunk line service. The Clackamas County trunk lines primarily operate on SE McLoughlin Boulevard and Highway 224.

4.1.1.1 Public Transportation Providers

There are six fixed-route transit providers in the Portland-Milwaukie Corridor. The Tri-County Metropolitan Transportation District of Oregon (TriMet) is the mass transit operating agency in the Portland/Vancouver metropolitan area. It is the largest transit district in Oregon and the fifth largest on the West Coast. Under Oregon law (ORS 267), TriMet is a nonprofit, municipal corporation operating in the urbanized portion of three Oregon counties: Multnomah, Clackamas, and Washington. Its operating area covers approximately 570 square miles, and it serves a population of approximately 1.48 million. Oregon Health and Science University (OHSU), through an Intergovernmental Agreement (IGA) with the City of Portland, operates the Portland Aerial Tram, while the city is responsible for maintenance and provides oversight. The City of Portland operates the Portland Streetcar, which provides service in the Portland Central City and the South Waterfront area. C-Tran operates seven weekday commuter routes between Vancouver, Washington, and the Portland Central City, connecting to the north end of the corridor.

The two smaller transit providers are: Canby Area Transit, which provides weekday service between Woodburn, Canby, and Oregon City, connecting to the southern end of the corridor; and Tillamook County Transportation District, which provides daily service between Tillamook and downtown Portland, connecting to the north end of the corridor.

4.1.1.2 Transit Lines, Operations, and Facilities

TriMet's current fleet of 652 buses serves 81 bus lines and seasonal shuttles with 7,155 bus stops and 1,040 bus shelters. There are 164 miles of frequent-service bus lines on 12 routes that provide 15-minute or better service throughout the day, seven days a week. The 84-station Metropolitan Area Express (MAX) light rail system is 52 miles long and also operates at least every 15 minutes. The 14.7-mile Westside Express Service (WES) Commuter Rail provides eight peak period trips in each direction during weekdays, serving five stations. In addition to fixed-route bus and MAX service, TriMet operates 254 LIFT vehicles and 15 sedans that provide door-to-door service for people with special needs.

Table 4.1-1 summarizes TriMet's fixed-route service. Overall, 90 percent of people within the TriMet district live within one-half mile of TriMet service.

Table 4.1-1
TriMet Fixed-Route Service Summary

	MAX Light Rail	Frequent–Service Bus	Standard Service Bus
Routes	4	12	81
Length	52 miles	164 miles	792 miles

Source: TriMet 2009.

In addition to the transit service provided by TriMet, the Portland Streetcar operates along 7.2 miles between the intersection of NW 23rd Avenue and NW Northrup Street and SW Lowell Street in the South Waterfront District. Streetcars run approximately every 12 to 14 minutes during most of the day and less frequently in the evening and on weekends. An extension of the Portland Streetcar from NW Northrup Street to the Oregon Museum of Science and Industry

(OMSI) and the Central Eastside Industrial District is currently under construction and is expected to open in 2012. It will provide 12-minute frequency between these two locations.

The aerial tram operates between South Waterfront and the OHSU campus on SW Sam Jackson Park Road on Marquam Hill. Marquam Hill also houses the OHSU Hospital, the Shriners Hospital for Children, and the Portland Veterans Affairs Medical Center.

4.1.1.3 Current Ridership, Operating Revenue, and Operating Expense

For fiscal year (FY) 2009, TriMet weekday system boarding rides (bus and light rail) averaged approximately 322,900 boarding rides, with 215,300 on bus and 107,600 on light rail. Weekend ridership (bus and light rail) averaged 351,800 trips. In addition, weekday boarding rides on streetcar averaged 12,100 during the same period.

Between FY 1999 and FY 2009, TriMet's annual system-wide fare box revenues increased from $40.6 million to $88.7 million. Costs for operations and maintenance during this period increased from $141.5 million to $261.1 million. Fare revenue as a percentage of the cost of operation and maintenance improved from 28.7 percent to 34.0 percent, and the average operations cost per boarding ride for the entire fixed-route system increased from $1.85 to $2.57, reflecting inflation and service expansion to lower ridership areas and times. Cost per boarding ride for light rail, at $1.92, is lower than that for buses, at $2.88 (FY 2009).

4.1.2 Travel Behavior

The basic unit of measurement used in describing travel behavior is the "person trip," which is a trip made by one person from a point of origin to a destination, via any travel mode. Several trip variables, including the origin, destination, mode, and purpose of the trip, further describe travel behavior.

For 2005 (the base year for this Portland-Milwaukie Project Final Environmental Impact Statement (FEIS), the transportation facilities in the Portland-Milwaukie Corridor have been estimated to carry 70,700 person-trips from the corridor to downtown Portland on an average weekday. Of these, approximately 11,600 (16 percent) were on the transit system. Of the 17,300 daily work trips from the corridor to downtown Portland, 5,000 (29 percent) were on transit.

4.1.3 Roadways

The Portland-Milwaukie Light Rail Project corridor is served by a network of roads under the jurisdiction of the Oregon Department of Transportation (ODOT), Clackamas and Multnomah counties, the City of Portland, and the City of Milwaukie. Congestion currently occurs on the corridor's regional highways, local streets, and arterials.

4.1.3.1 Regional Highway Network

Many of the region's freeways and highways serve a portion of the Portland-Milwaukie Light Rail Project corridor. The regional facilities include the Marquam Bridge (I-5), Ross Island Bridge (US 26), I-405, Highway 224, and SE McLoughlin Boulevard (OR 99E).

4.1.3.2 Local Street Network

Motor vehicle performance on local streets analyzed in this FEIS is characterized by intersection level of service (LOS), or volume-to-capacity (V/C) ratio. The LOS and V/C ratio for local streets are based on an assessment of delay and available capacity for existing or forecasted traffic volumes, consistent with the methodology in the *Highway Capacity Manual*.

Intersections are categorized as either signalized (i.e., controlled by a traffic signal) or unsignalized (i.e., controlled by stop and/or yield signs, or uncontrolled). Delay is used to define the LOS at intersections, which is a measure of operational conditions and how those conditions are perceived by motorists. Delay at signalized intersections depends on two factors: the capacity of the intersections (as defined by the number of lanes and lane widths) and signal timing. For unsignalized intersections, delay is also determined using two factors: street capacity and the type of stop or yield sign used to control the intersection. LOS for an intersection is classified into ratings that range from "A" to "F," where "A" represents the least congested operations and "F" represents the most congested operations. Both delay (LOS) and capacity (V/C ratio) at intersections are described in more detail in the *Transportation Impacts Results Report* (Metro and DKS 2010).

The study area is divided into two segments: the Portland-to-Milwaukie Segment and the Milwaukie Terminus Segment. Each segment contains two smaller subareas for a more focused analysis. Figure 4.1-1 indicates the sub-areas defined for the affected environment traffic results.

The Portland-to-Milwaukie Segment contains sub-areas A and B and includes the City of Portland sections on the west and east sides of the Willamette River. The segment extends from Portland State University to SE Tacoma Street and falls within the jurisdictions of the City of Portland and ODOT.

The Milwaukie Terminus Segment contains sub-areas C and D. It extends from SE Tacoma Street to SE Park Avenue. This segment includes ODOT facilities and is within the jurisdictions of the City of Portland, the City of Milwaukie, and Clackamas County.

<u>Motor Vehicle Operations</u>

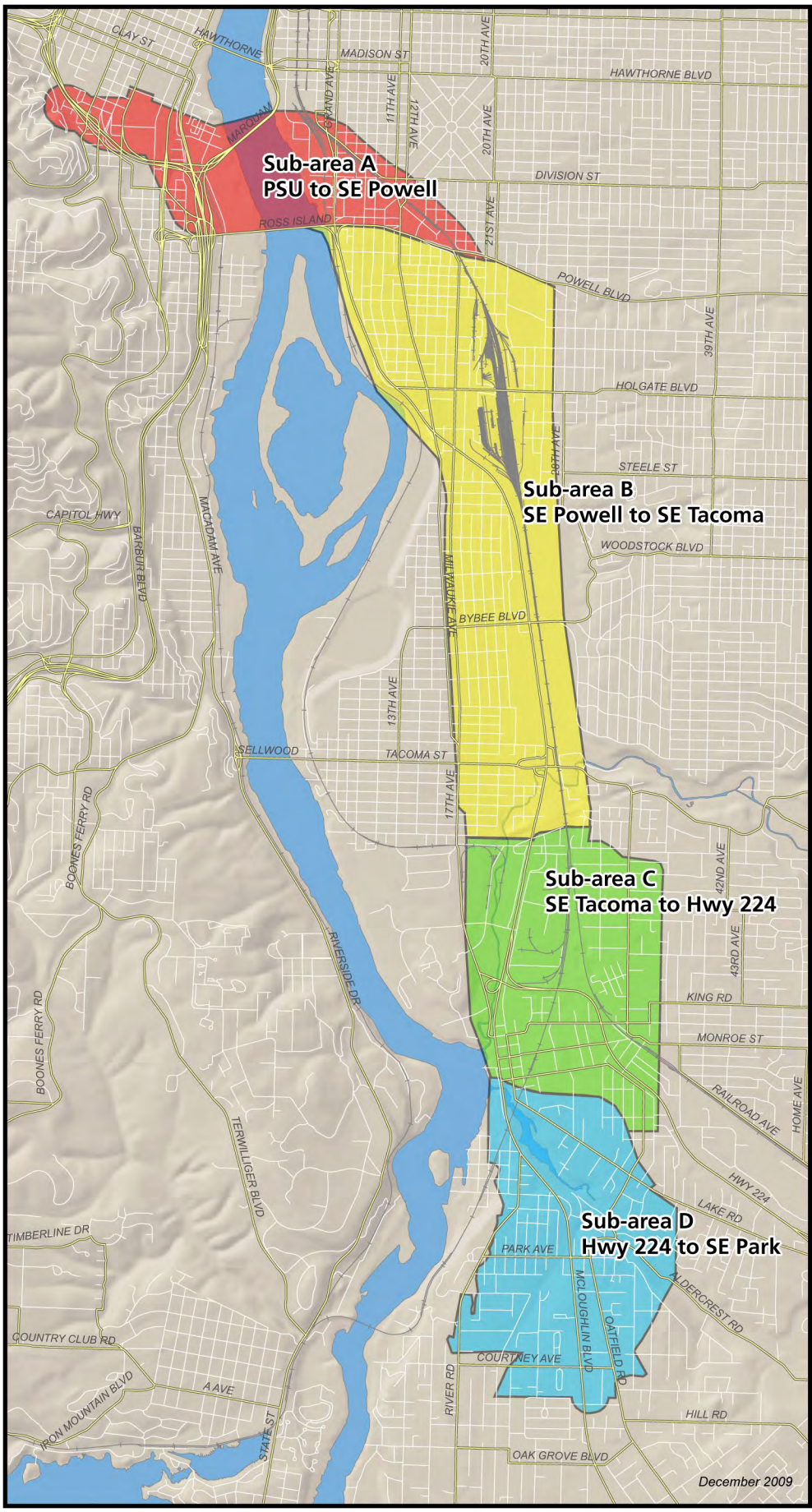
Existing traffic counts available between May 2007 and November 2007 were utilized and supplemented with additional traffic counts conducted in December 2008 to June 2009 to comprise 81 study area intersections. All of the study intersections were counted during the PM peak period, with some of the major intersections counted in the AM peak period as well. All of the study area intersections meet local jurisdictional standards with the exception of the following:

- SE 8th Avenue/SE Woodward Street (three-way stop intersection) – AM peak
- SE Bybee Boulevard/SE 27th Avenue (two-way stop intersection) – PM peak
- SE 32nd Avenue/SE Johnson Creek Boulevard (all-way stop intersection) – AM and PM peak
- SE 42nd Avenue/SE Johnson Creek Boulevard (all-way stop intersection) – AM peak
- SE Harney Drive/SE Johnson Creek Boulevard (signalized intersection) – PM peak

Portland-Milwaukie Light Rail Project

Transportation Affected Environment

Figure 4.1-1



Sub-area A
PSU to SE Powell

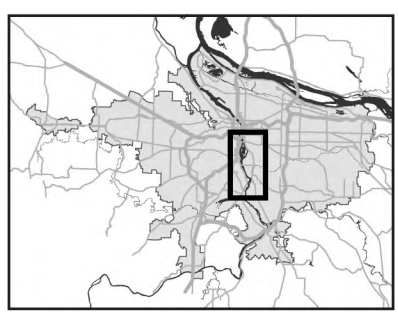
Sub-area B
SE Powell to SE Tacoma

Sub-area C
SE Tacoma to Hwy 224

Sub-area D
Hwy 224 to SE Park

TRIMET

Metro



0 0.5 1 Miles

- SE Park Avenue/SE Oatfield Road (two-way stop intersection) – AM and PM peak
- For a more detailed analysis of existing transportation operating conditions, see the Transportation Impacts Results Report (Metro and DKS 2010).

Queuing

In addition to the intersection operations, queuing (a measure of the extent of backups at intersections) was assessed at study area intersections to determine the 95th percentile queues.[1] The queues were assessed for the PM peak hour for all study area intersections, and for some select intersections for the AM peak hour. Locations of the study area intersections where queuing was analyzed, and information about the amount of existing queuing and available storage space, are described in detail in the *Transportation Impacts Results Report* (Metro and DKS 2010). The following locations have existing queuing that exceeds available storage:

- SW Naito Parkway/SW Harrison Street – southbound through, eastbound left, northbound left directions
- SE Division Place/SE 8th Avenue – eastbound direction
- SE Division Street/SE 8th Avenue – eastbound direction
- SE Division Street/SE 11th Avenue – westbound direction
- SE Clinton Street/SE 11th Avenue – westbound direction
- SE Clinton Street/SE 12th Avenue – eastbound direction
- SE Woodward Street/SE 8th Avenue – westbound and eastbound directions
- SE Woodward Street/SE 9th Avenue – westbound direction
- SE 8th Avenue/SE Powell Boulevard – southbound direction
- SE Powell Boulevard/SE Milwaukie Avenue – northbound, southbound, eastbound, and westbound directions
- SE Powell Boulevard/SE 13th Place – eastbound left direction
- SE 17th Avenue/SE Holgate Boulevard – northbound and southbound directions
- SE Milwaukie Avenue/SE Holgate Boulevard – southbound direction
- SE McLoughlin Boulevard/SE Holgate Boulevard – eastbound and westbound directions
- SE McLoughlin Boulevard/SE 17th Avenue – southbound, eastbound, and northbound directions; and westbound right direction
- SE McLoughlin Boulevard/SE Harold Street – southbound direction
- SE Bybee Boulevard/SE 23rd Avenue – eastbound direction

[1] The 95th percentile queuing analysis was conducted using Synchro, which is based on the *Highway Capacity Manual* methodology.

- SE 17th Avenue/SE Tacoma Street – northbound left and southbound directions
- SE Johnson Creek Boulevard/SE 32nd Avenue – southbound and westbound directions
- SE Johnson Creek Boulevard/SE 42nd Avenue – eastbound and westbound directions
- SE Johnson Creek Boulevard/SE Harney Drive – southbound and westbound directions
- SE McLoughlin Boulevard/SE 17th Avenue/SE Harrison Street – northbound and eastbound directions
- SE McLoughlin Boulevard/SE Jefferson Street – southbound direction
- SE McLoughlin Boulevard/SE Washington Street – westbound direction
- SE McLoughlin Boulevard/SE Bluebird Street – southbound and eastbound directions
- SE Lake Road/SE Oatfield Drive – westbound direction

Warrants

Signal warrants were conducted for the PM peak hour on unsignalized intersections along the corridor to determine whether any intersection that does not meet the jurisdictional standard meets the PM peak hour warrant for installation of a signal.[2] Turn lane warrants were also conducted for unsignalized intersections that do not meet the jurisdictional standard. The following locations meet warrants for the PM peak hour:

- SE 8th Avenue/SE Powell Boulevard – signal warrant met
- SE 8th Avenue/SE Woodward Avenue – eastbound right-turn lane and signal warrant met
- SE Johnson Creek Boulevard/SE 32nd Avenue – signal warrant met
- SE Johnson Creek Boulevard/SE 42nd Avenue – signal warrant met

Access Spacing

Study area roadways were evaluated for compliance with current access spacing standards (the distances between driveways and intersections) by jurisdiction. Although the City of Portland does not have access spacing standards, all access points are reviewed and approved by a City Engineer. Therefore, all City of Portland driveways/intersections are assumed to be compliant. Access spacing standards for other jurisdictions vary based on the functional classification of the roadway. Higher speed roadways, which typically have higher volumes, usually have longer distances between access points. The following summarizes the existing access spacing deficiencies within the study area:

- Interstate 405 (I-405) interchange access ramps at SW 4th Avenue, SW 5th Avenue, SW 6th Avenue, and SW Broadway do not meet ODOT's access spacing standards

[2] Signal warrants are based on the *2003 Manual of Uniform Traffic Control Devices*, and turn lane warrants are based on *Highway Research Board* methodology.

- SE McLoughlin Boulevard at SE Bybee Boulevard and at SE Tacoma Street do not meet ODOT's access spacing standards
- Most roadways within the City of Milwaukie do not meet ODOT's access spacing standards

For a complete listing of all existing access spacing deficiencies, please refer to the *Transportation Impacts Results Report* (Metro and DKS 2010).

Weave analysis was also conducted for the I-405 on-/off-ramp access to I-5. In the northbound direction, the weaving segment on I-405 between I-5 and SW 4th Avenue operates at LOS D conditions during the AM and PM peak hours. In the southbound direction, the weaving segment on I-405 between SW 5th Avenue and I-5 operates at LOS F conditions during the AM and PM peak hours because of the existing configuration and short spacing of the segment.

Collisions

Collisions at study area intersections were evaluated for the period between January 2005 and December 2007. Typically, a calculated collision rate of 1.0 or higher indicates an intersection with a high collision rate. The highest calculated collision rate in this period is 0.84 at the intersection of SE Clinton Street and SE 11th Avenue. While no intersection in the study area was calculated at a rate over 1.0, there are some locations that had fatalities and/or bicycle- or pedestrian-related collisions during the period between January 2005 and December 2007. The following summarizes those locations:

- SE 11th Avenue/SE Division Street (two bicycle collisions)
- SE 9th Avenue/SE Powell Boulevard (pedestrian collision)
- SE 17th Avenue/SE Holgate Boulevard (pedestrian collision)
- SE McLoughlin Boulevard/SE 17th Avenue (two fatalities and one pedestrian collision)
- SE Tacoma Street/SE McLoughlin Boulevard southbound on-ramp (bicycle collision)
- SE McLoughlin Boulevard/SE Ochoco Street (bicycle collision)
- SE McLoughlin Boulevard/SE Harrison Street (pedestrian collision)
- SE McLoughlin Boulevard/SE Park Avenue (pedestrian collision)

4.1.4 Bicycle Activity

As part of the transportation data collection effort, bicycle activity was collected at study area intersections and compiled for the PM peak hour. Bicycle counts are the highest in downtown Portland, near Portland State University. Intersections farther away from downtown Portland generally have less bicycle activity than those closer to downtown Portland. A summary of the bicycle facilities and activity within the project area, organized by sub-area from north to south, follows.

- **Sub-area A - Portland State University to SE Powell Boulevard.** Bicycle activity observed at several intersections within this sub-area is relatively high compared to the other sub-areas. Six intersections have between 30 and 115 bicycle trips in the PM peak

hour. The highest bicycle volumes are near the connection to the Eastbank Esplanade and Springwater Corridor Trail east of the Willamette River, and on SE Division Street near SE 11th and SE 12th avenues. There is minimal PM peak hour bicycle activity on SE Powell Boulevard that occurs only at the intersection with SE Milwaukie Avenue.

- **Sub-area B - SE Powell Boulevard Area to SE Tacoma Street.** The PM peak hour bicycle counts at study area intersections indicate lower bike activity than in sub-area A. Along SE 17th Avenue, the intersection of SE 17th Avenue and SE Holgate Boulevard has the highest bicycle activity (four bicycles) during the PM peak hour. No bicycle activity was observed during the PM peak period along SE McLoughlin Boulevard or SE Bybee Boulevard.
- **Sub-area C - SE Tacoma Street to Highway 224.** The highest on-street bicycle activity in this sub-area is along SE Johnson Creek Boulevard at SE 42nd Avenue (four bicycles). No bicycle activity was observed along SE Tacoma Street or SE McLoughlin Boulevard during the PM peak period. It should be noted that the Springwater Corridor Trail, an off-street multi-use path, also services this sub-area, but was not counted for activity levels.
- **Sub-area D - Highway 224 to SE Park Avenue.** At many of the sub-area intersections, fewer than five bicycle trips per hour were observed at intersections during the PM peak period. The highest bicyclist count (seven) was observed at the intersection of SE Main Street/SE Adams Street during the PM peak hour.

An inventory of bicycle functional classification and bicycle facilities conducted in the study area identified the roadways that provided bicycle connectivity, as well as the potential gaps in the bicycle network. For a more detailed analysis of bicycle facilities and activity, see the *Transportation Impacts Results Report* (Metro and DKS 2010).

4.1.5 Pedestrian Activity

As part of the transportation data collection effort for the intersections studied, pedestrian trips were counted and compiled for the PM peak hour. Pedestrian counts were observed to be highest in downtown Portland, and within other activity centers along the corridor. Intersections farther away from the downtown areas have fewer pedestrian trips than those closer to downtown cores. A summary of pedestrian activity within the project corridor, organized by sub-area from north to south, follows.

- **Sub-area A - Portland State University to SE Powell Boulevard.** Pedestrian volumes are highest near Portland State University; volumes on SW Jackson Street and SW Lincoln Street range from approximately 65 to 175 crossings in the PM peak hour. On the east side of the Willamette River, observed pedestrian volumes ranged from zero to 66 PM peak hour crossings, with the exception of the SE Milwaukie Avenue/SE Powell Boulevard intersection, which has 140 pedestrian trips in the peak hour. The location with the second highest pedestrian crossing volumes, approximately 66 in the PM peak hour, is the intersection of SE Gideon Avenue and SE Milwaukie Avenue.
- **Sub-area B - SE Powell Boulevard Area to SE Tacoma Street.** Along SE 17th Avenue, pedestrian crossing volumes were observed ranging from 1 to 70 in the PM peak hour. The two highest pedestrian crossing volumes for this sub-area occur at SE 17th Avenue/SE Center Street near the TriMet operations center (70 pedestrian crossings), and

at both SE 17th Avenue/SE Mall Street and SE 17th Avenue/SE Holgate Boulevard (31 pedestrian crossings at each intersection). No pedestrian crossing activity was observed along SE McLoughlin Boulevard during the PM peak hour.

- **Sub-area C - SE Tacoma Street to Highway 224.** The highest on-street level of pedestrian activity in this sub-area (nine pedestrian crossings) was observed at the intersection of SE Tacoma Street and SE McLoughlin Boulevard northbound ramps. The next highest level of pedestrian activity was observed at SE Johnson Creek Boulevard at SE 32nd Avenue and at SE Johnson Creek Boulevard at SE Harney Drive (both with seven pedestrian crossings). All other intersections have five or fewer pedestrian crossings during the PM peak hour. It should be noted that the Springwater Corridor Trail, an off-street multi-use path, also services this sub-area, but was not counted for activity levels.
- **Sub-area D - Highway 224 to SE Park Avenue.** The highest level of pedestrian activity in this sub-area was observed at the intersection of SE 21st Avenue and SE Monroe Street, with 142 pedestrian crossings during the PM peak hour. The intersection of SE Monroe Street and SE Main Street has 100 pedestrian crossings during the PM peak hour, and other intersections within the downtown Milwaukie area have between 0 and 82 pedestrian crossings. The remaining sub-area intersections have 15 or fewer pedestrian crossings during the PM peak hour.

An inventory of pedestrian functional classification and existing sidewalks was also conducted that identified the roadways providing pedestrian connectivity, as well as the potential gaps in the sidewalk network. For a more detailed analysis of pedestrian facilities and activity, see the *Transportation Impacts Results Report* (Metro and DKS 2010).

4.1.6 Parking

Numerous on-street parking spaces are located on the roadways that would parallel and intersect the proposed light rail project alignment. Table 4.1-2 documents the supply and utilization of on-street parking in the vicinity of the capital improvements within the Portland-Milwaukie Light Rail Project corridor. It is not expected that on-street parking provides parking for light rail stations; these are only used as a reference location for analysis.

Many of the proposed transit station locations have adjacent on-street parking spaces, some of which have time restrictions and others of which allow unrestricted use. Off-street parking in the corridor is generally privately owned and typically serves commercial activity. In general, off-street parking spaces in downtown Portland are priced or are provided for the exclusive use of one or more adjacent businesses. Almost all of the existing off-street parking lots in the corridor, outside of downtown Portland, are not priced. The City of Milwaukie currently does operate a parking permit program that allows for individuals to purchase parking permits for monthly use.

Table 4.1-2
Existing Portland-Milwaukie Light Rail Project Station Area On-Street Parking Spaces and Use

Station	Option	Spaces Within 1,000 Feet[1]	Utilization (%) Within 1,000 Feet[2]
Lincoln	LPA/MOS	190	79%
South Waterfront	LPA/MOS	0	0%
OMSI	LPA/MOS	55	73%
Clinton	LPA/MOS	650	58%
Rhine	LPA/MOS	230	41%
Holgate	LPA/MOS	135	52%
Bybee	LPA/MOS	100	20%
Tacoma[3]	LPA/MOS	0	0%
Lake Road	LPA/MOS	254	57%
Park Avenue	LPA	79	23%

Source: DKS Associates 2007 and City of Milwaukie (Dec) 2009.
LPA = Locally Preferred Alternative (LPA) to Park Avenue.
MOS = Minimum Operable Segment (MOS) to Lake Road.
[1] Approximate number of on-street spaces near proposed station location.
[2] Weekday, midday estimate of utilization, August 2007, with exception of Lake Road Station, which used December 1, 2009 (Tuesday).
[3] SE McLoughlin Boulevard blocks all access to on-street parking within 1,000 feet of the proposed station location.

4.1.7 Streetcar

This section provides additional detail on projected traffic impacts of the future, separately funded streetcar improvements that cross the Willamette River on the new light rail bridge. Streetcar improvements at each end of the bridge were considered, and the analysis found no additional transportation impacts or need for mitigation. The streetcar project that crosses the river will complement the light rail project, but is not required for the light rail project to be implemented. The streetcar service that crosses the river could be developed by TriMet in partnership with local agencies and may include the use of federal funds, and its environmental impacts are disclosed in this FEIS. See Chapter 2, Section 2.1.1.5, Related Bridge Area Transportation Facilities, for more detail. Related Bridge Area Transportation Facilities include additional trackway in South Waterfront, and roadway reconstruction and streetcar connections to the bridge on both the sides of the Willamette River. New streetcar tracks would replace the existing single-track section between SW River Parkway and SW Gibbs Street to provided separate inbound and outbound tracks. Roadway reconstruction in South Waterfront includes reconstruction of SW Moody Avenue from SW River Parkway to SW Gibbs Street to accommodate the additional trackway. SW Moody Avenue would include three traffic lanes with northbound and southbound streetcar tracks and pedestrian and bicycle facilities. SW Bond Avenue would be extended north. Street improvements are consistent with the City of Portland's South Waterfront North District Street Plan for a new street network in the area of the South Waterfront light rail station.

To accommodate the light rail crossing of SW Moody Avenue and streetcar access to the new transit bridge, a new signalized intersection at SW Moody Avenue would be added. The inclusion of this signal and the completion of the SW Moody Avenue-SW Bond Avenue couplet provide an adequate level of service for auto traffic and an access to the bridge for buses, light rail, and streetcar. The signal at this intersection would not provide for light rail or streetcar

priority treatment. Streetcar stops are located on SW Moody Avenue just north of this intersection.

On the east side, the roadway function of SE Water Avenue would be relocated to the east and the existing SE Water Avenue would be converted to a bicycle and pedestrian facility. SE Water Avenue would be relocated to the east from SE Caruthers Street northward to match the existing alignment of SE 4th Avenue south of SE Caruthers Street. On the north, the relocated alignment would reconnect with the current alignment northwest of OMSI, approximately 500 feet north of the SE Lincoln Street right-of-way. The streetcar tracks would join the light rail alignment just west of the OMSI Station (from the planned east side streetcar line) and would not impact traffic at the signalized intersection just east of the OMSI Station. Streetcar stops are located along the streetcar alignment north of the OMSI Station.

4.1.8 Freight Facilities

Freight movement within the project area comprises two modes: railroad and truck. Details about truck activity can be found in the *Transportation Impacts Results Report* (Metro and DKS 2010).

The existing railroad lines within the project area are owned by Union Pacific Railroad (UPRR), East Portland Traction Company, Oregon Pacific Railroad, and Portland and Western Railroad Company. UPRR's Brooklyn Yard is located east of SE 17th Avenue between SE Powell Boulevard and SE Harold Street.

While peak periods of truck activity typically occur during the midday, when total traffic levels are lower, the PM peak hour was selected for this analysis because it is the most congested period of the day. A summary of truck movements in the project corridor, organized by sub-area, follows.

- **Sub-area A - Portland State University to SE Powell Boulevard.** The truck activity on the west side of the Willamette River during the PM peak hour ranges from 1 to 5 percent of all vehicle trips at any given location. Generally, truck activity increases on the east side of the river, specifically south of SE Division Street. The highest truck activity occurs at SE Milwaukie Avenue and SE Powell Boulevard and represents 3 percent of the total intersection volumes during the PM peak hour. The highest truck percentage occurs on SE Division Place (13 percent), but truck volume is still relatively lower than volumes on SE Powell Boulevard because of low total traffic volumes on that street.
- **Sub-area B - SE Powell Boulevard Area to SE Tacoma Street.** Along SE McLoughlin Boulevard, truck traffic represents about 8 percent of total daily trips, while on SE 17th Avenue truck traffic represents approximately 7 percent of the total daily trips. The busiest intersection with heavy vehicular traffic in this sub-area is SE 17th Avenue and SE McLoughlin Boulevard. During the PM peak hour, heavy vehicular traffic on several of the side streets along SE 17th Avenue is over 15 percent of the total trips, which correlates to approximately 5 to 10 trucks.
- **Sub-area C - SE Tacoma Street to Highway 224.** The truck activity along SE McLoughlin Boulevard during the PM peak hour comprises 2 to 3 percent of all vehicular trips. The activity along the side streets in this area varies between 1 and 21 percent, which correlates to 10 to 50 heavy vehicles. The intersection of SE McLoughlin

Boulevard/SE Ochoco Street has the highest freight activity, with nearly 200 heavy vehicles during the PM peak hour.

- **Sub-area D - Highway 224 to SE Park Avenue.** The truck activity along SE McLoughlin Boulevard consists of approximately 2 to 3 percent of all vehicular trips along this corridor. The activity along the side streets in downtown Milwaukie varies between 2 to 12 percent, which correlates to approximately 2 to 20 heavy vehicles during the PM peak hour.

4.1.9 Navigable Waterways

The project corridor crosses one navigable waterway, the Willamette River. In the vicinity of project corridor, the lift span of the Hawthorne Bridge has the highest clearance at 159 feet, when the deck is raised. Operators raise the bridge an average of 200 times per month (300 times per month in the summer). Both the Ross Island and Marquam bridges have maximum vertical clearances of 120 feet. Adjacent spans on both bridges have lower vertical clearances but wider horizontal clearances. The lowest vertical clearance in the area is upstream at the Sellwood Bridge at 75 feet. The Sellwood Bridge is scheduled for replacement/renovation through a separate project. There are a variety of navigational uses in the area. These include recreational, commercial, and industrial uses, which were surveyed in 2008 in a *River Users Survey Report* (TriMet 2008), with information updated for this FEIS. Additional details are provided in Appendix O, Navigation.

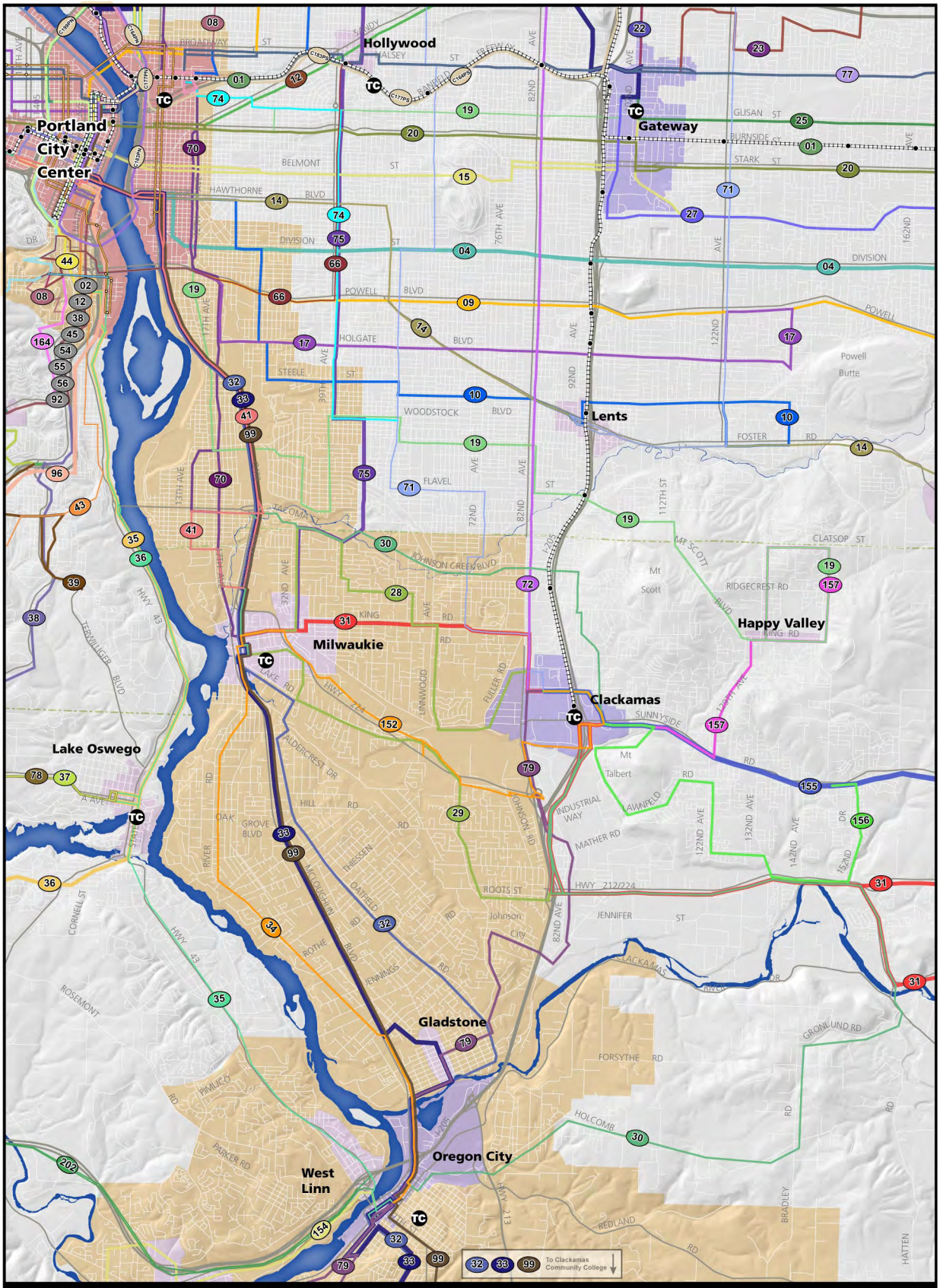
4.2 TRANSPORTATION IMPACTS

This section presents the impacts that the Portland-Milwaukie Light Rail Project would have on the transit system, traffic movements, freight movement, and navigable waterways in the project corridor. Transit impacts are defined by measures of demand including congestion of streets, freeways, and intersections; parking loss; and parking demand reduction. Impacts to freight railroads and truck delivery are discussed, as are issues relating to the height of the proposed Willamette River bridge. The *River Users Survey Report* provides additional information on existing and future river traffic, including the first step in establishing appropriate navigational clearance. Section 4.3 evaluates the impacts of the project to the highway and street network.

For more detailed information on transportation impacts, see the *Transportation Impacts Results Report* (Metro and DKS 2010).

4.2.1 Service Characteristics

The No-Build Alternative represents the service characteristics of the financially constrained transit network associated with the *2004 Regional Transportation Plan* (RTP) (Metro) (see Figure 4.2-1), without the planned investment in light rail to Milwaukie. Figure 4.2-2 shows the RTP with the light rail project. The supporting bus network is different between the LPA to Park Avenue and the MOS to Lake Road compared to the No-Build Alternative. See Section 2.1 for a detailed description of the options.



Portland-Milwaukie Light Rail Project **Figure 4.2-1**

2030 No-Build Transit Network

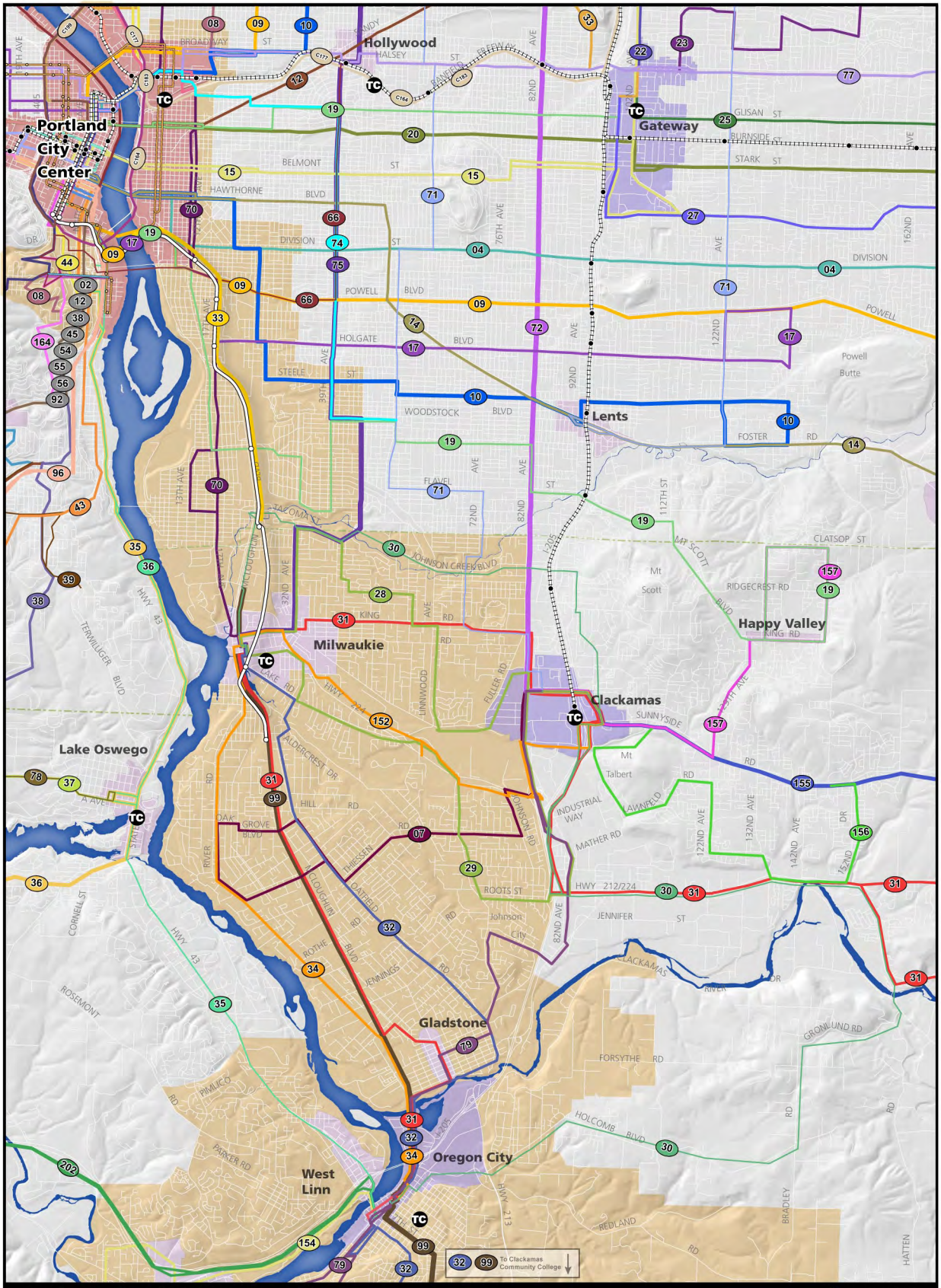
- Bus Route
- Light Rail and Station
- Streetcar and Station
- Portland Aerial Tram
- Transit Center
- City Center
- Regional Center
- Town Center
- Portland-Milwaukie Corridor

TRIMET

Metro

0 0.5 1 1.5 Miles

December 2009



Portland-Milwaukie Light Rail Project **Figure 4.2-2**

2030 Light Rail Alternative Transit Network

- Bus Route
- Light Rail Alternative and Station
- Light Rail and Station
- Streetcar and Station
- Portland Aerial Tram
- Transit Center
- City Center
- Regional Center
- Town Center
- Portland-Milwaukie Corridor

TRIMET

Metro

0 0.5 1 1.5 Miles

December 2009

4.2.1.1 Amount of Service

The amount of transit service provided is measured by daily vehicle hours traveled (VHT) in revenue service, daily vehicle miles traveled (VMT) in revenue service, and daily place-miles of service. Daily VHT represent the cumulative time that transit vehicles are in service and daily VMT represent the distance they travel, independent of the size of the vehicle. "Daily" is defined as an average weekday in the year 2030. Place-miles refers to the total carrying capacity (seated and standing) of each bus or train and is calculated by multiplying the vehicle capacity of each bus or light rail vehicle by the daily VMT. Place-miles highlight differences between alternatives caused by a different mix of vehicles and levels of service. Table 4.2-1 summarizes these transit service characteristics.

Table 4.2-1
Average Weekday Corridor[1] Transit Service Characteristics, Year 2030

			LPA to Park Ave.			MOS to Lake Rd.	
	Existing (2005)	**No-Build**	**without Streetcar Loop**	**with Streetcar Loop**	**LPA Phasing Option**	**without Streetcar Loop**	**with Streetcar Loop**
Transit VMT							
Bus	10,140	13,120	13,300	13,300	13,300	13,300	13,300
LRT[2]	0	0	1,060	1,060	1,020	920	920
Streetcar[2]	0	210	210	390	210	210	380
Total	10,140	13,330	14,570	14,750	14,530	14,430	14,600
% Change[3]	N/A	31%	9%	11%	9%	8%	10%
Transit VHT							
Bus	0	810	820	820	820	810	810
LRT[2]	590	0	40	40	40	40	40
Streetcar[2]	0	20	20	30	20	20	30
Total	590	830	880	890	880	870	880
% Change[3]	N/A	41%	6%	7%	5%	5%	7%
Place-Miles[4]							
Bus	517,240	669,170	678,300	678,300	678,300	678,290	678,290
LRT[2]	0	0	282,760	282,760	270,790	244,240	244,240
Streetcar[2]	0	19,410	19,410	35,420	19,410	19,370	35,380
Total	517,240	688,580	980,470	996,480	968,500	941,900	957,910
% Change[3]	N/A	33%	42%	45%	41%	37%	39%

Source: Metro 2010. Numbers may not sum due to rounding.
Note: LRT = light rail transit; VMT = vehicle miles traveled in revenue service; VHT = vehicle hours traveled in revenue service
[1] Excludes Downtown Portland, Lloyd District, and Portland Central Eastside Industrial District.
[2] For LRT and Streetcar, *transit VMT* is measured in train miles, rather than in car miles.
[3] For the No-Build Alternative, the % change is from existing; for all other alternatives, the % change is from the No-Build Alternative.
[4] Place miles = transit vehicle capacity (seated and standing) for each vehicle type multiplied by VMT for each vehicle type. Bus capacity is 51, LRT capacity is 266 (LRT consists of two-car trains; each car carries 133 people), streetcar capacity = 92.

4.2.1.2 Service Growth

Service growth under the No-Build Alternative would be constrained by available revenue sources, consistent with the financially constrained transit network in Metro's 2004 RTP. With the No-Build Alternative, weekday corridor transit VMT and VHT would increase compared to existing levels by 31 and 41 percent, respectively. The greater percentage increase in VHT compared to VMT indicates that transit speeds in the corridor would slow relative to existing conditions due to increasingly congested and slowing traffic on highways, arterials, and local streets.

The LPA to Park Avenue and the LPA Phasing Option include an approximately 7.3-mile, double-tracked light rail alignment between downtown Portland and SE Park Avenue south of downtown Milwaukie; the MOS to Lake Road terminates at SE Lake Road in Milwaukie. With the LPA to Park Avenue and the MOS to Lake Road, two-car trains would operate every 7.5 minutes in the peak direction to meet projected demand. With the LPA Phasing Option, trains would operate every 8.6 minutes in the peak direction. The bus feeder network would be reconfigured to provide better connectivity with light rail stations and transit centers. Bus service that would be parallel to and duplicative of light rail service is assumed to be eliminated[3] (see Section 2.1.1.8 for details). Two new park-and-ride lots would be constructed as part of the light rail project—adjacent to the Tacoma and Park Avenue stations with the LPA to Park Avenue and adjacent to the Tacoma and Lake Road stations with the MOS to Lake Road.

4.2.1.3 Travel Time

Transit and auto travel times are assessed using in-vehicle time and total travel time, as shown in Table 4.2-2. This table summarizes the change in PM peak hour in-vehicle and total travel times between the No-Build Alternative, the LPA to Park Avenue, the LPA Phasing Option, and the MOS to Lake Road.

[3] TriMet will determine final bus routing to serve the light rail.

Table 4.2-2
Transit and Auto Average Weekday PM Peak Hour Travel Times to Selected Locations from Selected Downtown Portland Locations, Year 2030

	No-Build		LPA to Park Ave.			MOS to Lake Rd.	
Origin/Destination	**Auto**	**Transit**	**Auto**	**Transit**	**Transit- LPA Phasing Option[3]**	**Auto**	**Transit**
In-Vehicle Travel Time[1]							
To Milwaukie - Lake Rd. from:							
Pioneer Square	24	28	24	24	24	24	24
Portland State University	23	27	23	19	19	23	19
South Waterfront	22	38	22	15	15	22	15
To Milwaukie - Park Ave. from:							
Pioneer Square	27	33	26	26	26	26	31
Portland State University	26	32	25	20	20	25	24
South Waterfront	25	43	24	16	16	24	20
Total Travel Time[2]							
To Milwaukie- Lake Rd. from:							
Pioneer Square	29	34	29	31	32	29	31
Portland State University	28	41	28	26	27	28	26
South Waterfront	27	54	27	22	23	27	22
To Milwaukie- Park Ave. from:							
Pioneer Square	32	39	31	33	34	31	40
Portland State University	31	46	30	28	28	30	34
South Waterfront	30	60	29	24	24	29	29

Source: Metro 2010.
[1] In minutes; in-vehicle time is only the time that a passenger would spend within a public transit vehicle or an automobile.
[2] In minutes; total time is the sum of in-vehicle time and all other time related to completing the trip, including walking and waiting time.
[3] Total travel time with LPA Phasing Option is one-half minute longer between origins and destinations compared to LPA to Park Avenue due to less frequent service in the peak period (8.6-minute headways vs. 7.5-minute headways).

4.2.1.4 Reliability

In the TriMet system, existing light rail lines, which use reserved or separated right-of-way, exhibit greater percentages of on-time arrivals than buses operating in mixed traffic. Transit service that would utilize no reserved right-of-way or small amounts of reserved right-of-way would operate in mixed traffic and would be subject to traffic congestion and delay.

Table 4.2-3 summarizes three measures of transit reliability in the corridor: miles of light rail right-of-way, the number of passenger miles that would occur on that light rail right-of-way, and the percentage of passenger miles that would occur on the light rail right-of-way. The No-Build Alternative would provide no light rail passenger miles in the corridor. The LPA to Park Avenue would add 7.3 miles of light rail right-of-way, which would result in 87,500 passenger miles on light rail. The LPA Phasing Option would provide the same right-of-way length as the LPA to Park Avenue, with 80,000 passenger miles on light rail. The MOS to Lake Road would add 6.5 miles of light rail right-of-way, which would result in 79,900 passenger miles on light rail. Of the

average weekday passenger miles in the corridor in 2030, approximately 24, 22, and 22 percent would be on light rail with the LPA to Park Avenue, the LPA Phasing Option, and the MOS to Lake Road, respectively.

Table 4.2-3
Measures of Transit Reliability in the Corridor[1]

Light Rail Right-of-Way Measure	No-Build	LPA to Park Ave.	LPA Phasing Option	MOS to Lake Rd.
Miles of Light Rail	0	7.3	7.3	6.5
Average Weekday Passenger Miles (2030)[2]	0	87,500	80,000	79,900
% of Total Corridor Passenger Miles[2]	0	24%	22%	22%

Source: Metro 2010.
[1] Light rail provides an exclusive grade-separated and/or barrier-separated transit right-of-way.
[2] Excludes downtown Portland and inner NW Portland in order to isolate transit lines that primarily serve the corridor.

4.2.1.5 Transit Ridership

This section includes the following ridership figures: Portland-Milwaukie light rail ridership, total corridor transit ridership, total transit system ridership, work and non-work transit trips and mode share, and Portland-Milwaukie light rail station boardings and peak load points.

Portland-Milwaukie Light Rail Line and Light Rail System Ridership

The light rail ridership figures presented in Table 4.2-4 include average weekday trips for the line between the proposed Lincoln Station and the terminus in Milwaukie. The LPA to Park Avenue would produce 25,480 projected trips, the LPA Phasing Option would produce 22,770 projected trips, and the MOS to Lake Road would produce 24,780 projected trips.

Table 4.2-4
Average Weekday Light Rail, Streetcar, and Commuter Rail Ridership, Year 2030

		LPA to Park Ave.			MOS to Lake Rd.	
	No-Build	**without Streetcar Loop**	**with Streetcar Loop**	**LPA Phasing Option**	**without Streetcar Loop**	**with Streetcar Loop**
Average Weekday Ridership[1]						
Portland-Milwaukie Light Rail[2]	N/A	25,480	25,570	22,770	24,780	24,810
Interstate MAX (Yellow Line)[3]	13,840	13,280	13,250	12,750	13,320	13,270
I-205 MAX (Green Line)	46,410	45,900	45,840	45,980	45,950	45,920
East-West MAX (Blue Line)	106,790	107,080	107,120	106,860	107,130	107,130
Airport MAX (Red Line)	31,770	31,910	31,930	31,910	32,040	32,040
Mall Circulator	400	400	390	400	410	390
Total Light Rail System	199,220	224,060	224,100	221,440	223,630	223,560
Portland Streetcar - NW 23rd Ave. to SW Lowell St.	25,480	20,330	19,910	20,230	20,320	19,890
Portland Streetcar Loop	13,490	13,930	16,540	13,880	13,890	16,500
Westside Express Service (Commuter Rail)	1,990	1,990	1,980	1,980	1,990	1,980
Total Rail System	240,180	260,310	262,530	257,530	259,830	261,930
PM Peak-Hour, Peak-Direction Peak Load Point[4]						
Portland-Milwaukie Light Rail[2]	N/A	1,870	1,890	1,620	1,840	1,840
Interstate MAX (Yellow Line)[3]	750	740	740	740	750	750
I-205 MAX (Green Line)	2,360	2,310	2,300	2,330	2,310	2,300
East-West MAX (Blue Line) EB	2,660	2,600	2,610	2,650	2,600	2,600
East-West MAX (Blue Line) WB	3,220	3,250	3,250	3,250	3,250	3,250
Airport MAX (Red Line) EB	530	530	530	530	530	530
Airport MAX (Red Line) WB	480	490	490	490	490	490
Portland Streetcar - NW 23rd Ave. to SW Lowell St.	1,100	770	710	770	760	710
Portland Streetcar Loop	720	620	620	610	620	610
Westside Express Service (Commuter Rail)	280	280	280	280	280	280

Source: Metro 2009. Numbers may not sum due to rounding.
Note: N/A = Not Applicable; EB = Eastbound, WB = Westbound.

[1] LRT ridership is boarding rides per line. Linked trips are counted twice if the passenger transfers from one LRT line to another LRT line.

[2] Portland-Milwaukie Light Rail will connect to the MAX Yellow Line at the southern end of the transit mall. Portland Milwaukie Light Rail ridership consists of trips that would board or deboard south of the transit mall.

[3] Portland-Milwaukie Light Rail will connect to the MAX Yellow Line at the southern end of the transit mall. Interstate MAX (Yellow Line) ridership includes trips that would not travel south of the transit mall.

[4] With LPA to Park Ave. *without streetcar loop,* and MOS to Lake Rd. *without streetcar loop*, Portland Streetcar Loop alignment is identical to No-Build Alternative. With LPA to Park Ave. *with streetcar loop,* and MOS to Lake Rd. *with streetcar* loop, Portland Streetcar Loop includes connection between South Waterfront and OMSI over the Milwaukie LRT Bridge.

[5] The peak-load points for each line would be in the following locations: Portland-Milwaukie Light Rail -- south of Holgate Station; MAX Yellow Line -- north of Rose Quarter; MAX Green Line -- south of Gateway; MAX Blue Line West -- west of Goose Hollow; MAX Blue Line East -- east of Lloyd Center; MAX Red Line West -- west of Goose Hollow; MAX Red Line East -- east of Lloyd Center.

Corridor and Total System-wide Ridership

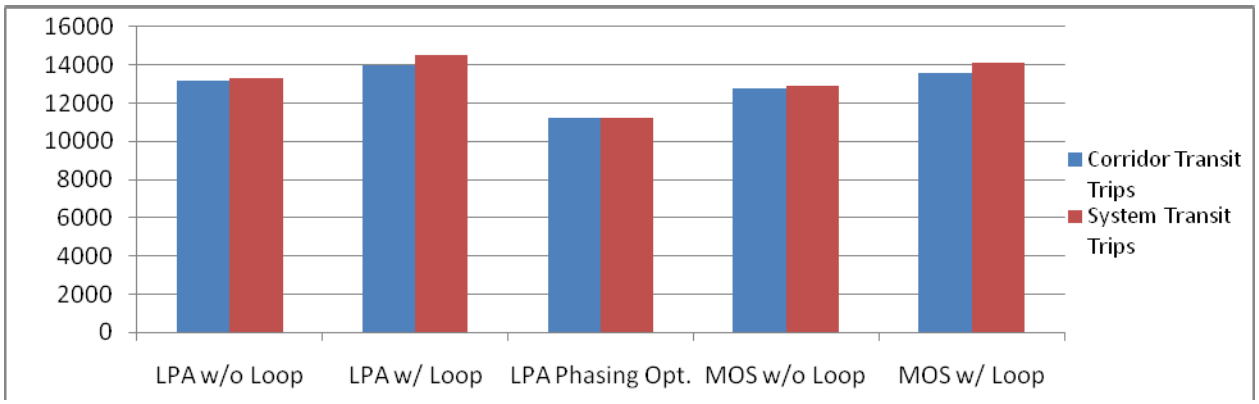
Total transit ridership in the corridor would increase over the No-Build Alternative by 13,200 with the LPA to Park Avenue, by 10,700 with the LPA Phasing Option, and by 12,800 with the MOS to Lake Road (Table 4.2-5). The completion of the Portland Streetcar Loop, in which streetcar would extend between South Waterfront and OMSI across the bridge constructed as part of the Portland-Milwaukie Light Rail Project, would increase corridor transit ridership by over 800 trips for both the LPA to Park Avenue and the MOS to Lake Road (Figure 4.2-3).

Table 4.2-5
Average Weekday Total System-wide and Portland-Milwaukie Corridor Transit Trips,[1] Year 2030

			LPA to Park Ave.			MOS to Lake Rd.	
	Existing (2005)	**No-Build**	**without Streetcar Loop**	**with Streetcar Loop**	**LPA Phasing Option**	**without Streetcar Loop**	**with Streetcar Loop**
Total Corridor Transit Trips (originating rides)	143,500	285,600	298,800	299,600	296,310	298,400	299,200
Change from Existing	N/A	142,100	155,300	156,100	152,850	154,900	155,700
% Change from Existing	N/A	+99%	+108%	+109%	+106%	+108%	+109%
Change from No-Build	N/A	N/A	13,200	14,000	10,700	12,800	13,600
% Change from No-Build	N/A	N/A	+5%	+5%	+4%	+5%	+5%
Total System-wide Transit Trips	277,100	532,500	545,800	547,000	541,000	545,400	546,600

Source: Metro 2010. Numbers may not sum due to rounding.
Note: N/A = not applicable.
[1] Transit trips are one-way linked trips from an origin (e.g., home) to a destination (e.g., place of work or school), independent of whether the trip requires a transfer or not. A person traveling from home, to work, and back, counts as two trips. Total corridor transit trips include all light rail, bus, and streetcar trips produced in or attracted to the Portland-Milwaukie Corridor. Trips within the Central Business District are not included.

Figure 4.2-3.
Average Weekday Corridor and System Transit Trips[1]:
Change from No-Build Alternative, Year 2030, with and without Streetcar



1 Transit trips are one-way linked trips from an origin (e.g., home) to a destination (e.g., place of work or school), independent of whether the trip requires a transfer or not. A person traveling from home to work and back counts as two trips. Total corridor transit trips include all light rail, bus, and streetcar trips produced in or attracted to the corridor, with or without the completion of streetcar connections over the Willamette River bridge. Trips within the Central Business District are not included.

Bridge Ridership

Table 4.2-6 illustrates the average daily ridership by transit mode across the new bridge that would be constructed as part of the project. In addition to the new light rail line, three bus routes would use the bridge. The Portland Streetcar is proposed to use the bridge through separate infrastructure improvements. Buses would carry between 48 percent and 56 percent of transit riders across the bridge, and streetcars would carry 7 percent.

Table 4.2-6
Average Weekday Ridership Across the Willamette River Bridge[1] by Transit Mode, Year 2030

	LPA to Park Ave.			MOS to Lake Rd.	
	without Streetcar Loop	**with Streetcar Loop**	**LPA Phasing Option**	**without Streetcar Loop**	**with Streetcar Loop**
Total Bridge Crossings	35,400	37,300	32,600	34,600	37,000
LRT	16,700	16,800	14,400	16,300	16,400
% LRT	47%	45%	44%	47%	44%
Bus[2]	18,700	18,000	18,200	18,300	18,100
% Bus	53%	48%	56%	53%	49%
Streetcar	N/A	2,500	N/A	N/A	2,500
% Streetcar	N/A	7%	N/A	N/A	7%

Source: Metro 2010.
Note: LRT = Light Rail Transit; N/A = not applicable.
[1] The Willamette River bridge is the new bridge crossing the Willamette River that would be constructed with the LPA to Park Ave. or the MOS to Lake Rd.
[2] Bus routes 9-Powell, 17-Holgate, and 19-Woodstock.

4.2.1.6 Transit Trip Productions

Figure 4.2-4 shows the change in transit trip productions (i.e., where trips would originate) for the LPA to Park Avenue compared to the No-Build Alternative. The map indicates areas within the Portland-Milwaukie Corridor that would experience an increase or decrease in transit ridership production compared to the No-Build Alternative.

Of the 217 transportation analysis zones in the corridor, 196 zones would see an increase or no change in weekday transit trip productions compared to the No-Build Alternative. In total, the corridor would gain 9,897 average weekday transit trip productions. Increases in transit trip productions would be due to improvements in travel time and accessibility with the proposed light rail line and bus line modifications. Reductions in transit trip productions occur in areas that would not have direct access to light rail and would have less bus service compared to the No-Build Alternative.

4.2.1.7 Work and Nonwork Transit Trips and Mode Share

Table 4.2-7 shows projected transit trips and transit mode share for trips produced in the corridor that would be destined to Portland's downtown for work and nonwork purposes. Downtown Portland is projected to have 139,770 jobs in 2030, accounting for 41 percent of the jobs in the corridor. The LPA to Park Avenue, the LPA Phasing Option, and the MOS to Lake Road would have higher transit mode shares for both home-based work and nonwork trips destined to downtown Portland, compared to the No-Build Alternative.

Table 4.2-7
Average Weekday Work and Nonwork Corridor Transit Trips and Transit Mode Share to Downtown Portland, Year 2030

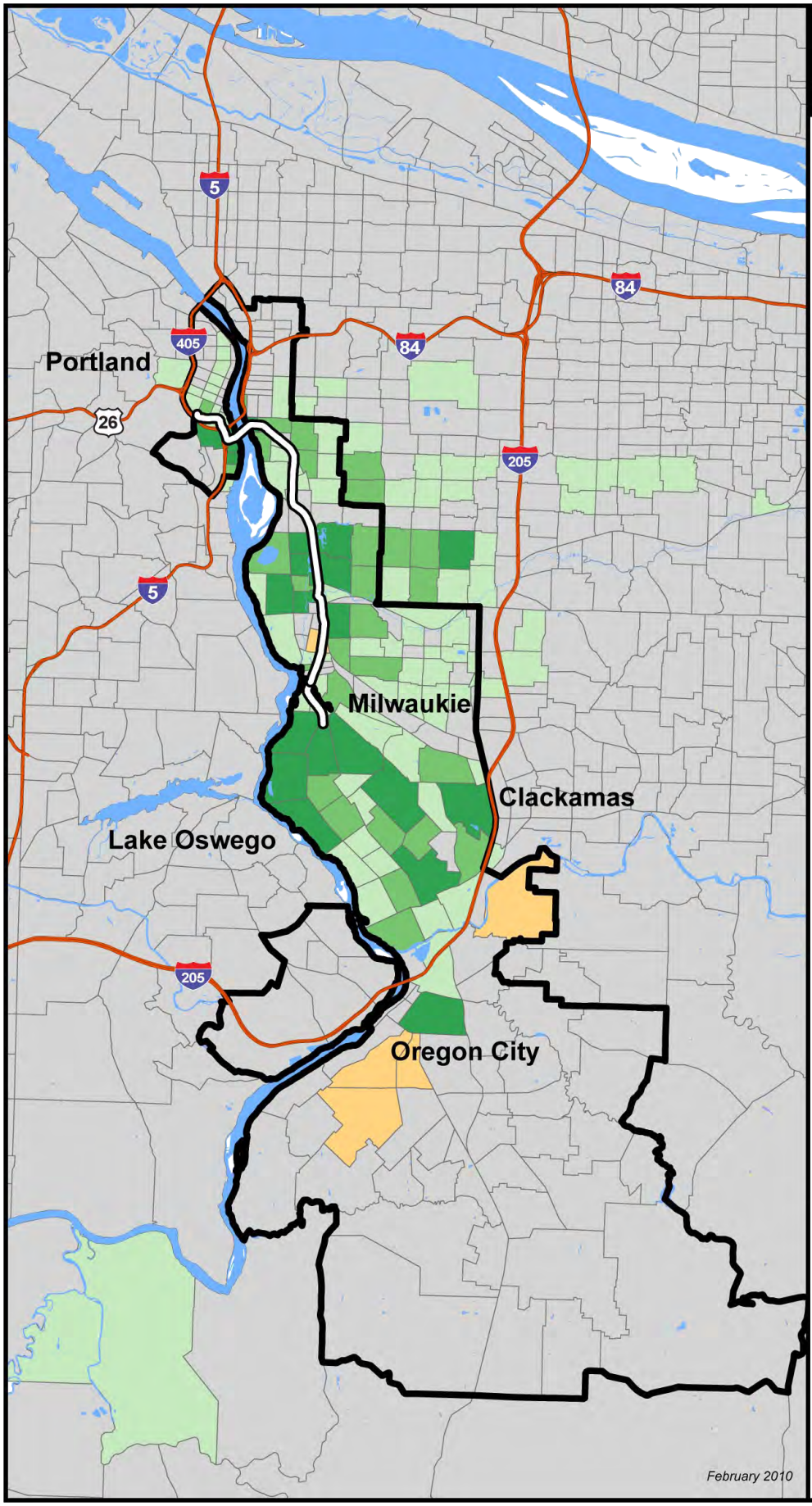
			LPA to Park Ave.			MOS to Lake Rd.	
	Existing (2005)	No-Build	without Streetcar Loop	with Streetcar Loop	LPA Phasing Option	without Streetcar Loop	with Streetcar Loop
Home-Based Work[1]							
Transit	5,040	10,990	12,830	12,840	12,040	12,790	12,800
Transit Mode Share	29%	47%	56%	56%	54%	56%	56%
Nonwork[2]							
Transit	6,600	13,990	15,620	15,680	15,270	15,550	15,600
Transit Mode Share	12%	17%	19%	19%	19%	19%	19%
Total							
Transit	11,640	24,980	28,450	28,520	27,310	28,340	28,400
Transit Mode Share	16%	23%	27%	27%	26%	27%	27%

Source: Metro 2010. Numbers may not sum due to rounding.
[1] Home-based work trips are defined as trips taken directly between one's home and one's place of work.
[2] Nonwork trips are defined as all trips that are not home-based work trips.

4.2.1.8 Station Usage and Mode Access and Egress

Table 4.2-8 summarizes individual station use, trip levels, and mode of access and egress to the light rail project for the LPA to Park Avenue and the MOS to SE Lake Road.

With both the LPA to Park Avenue and the MOS to SE Lake Road, the most frequently used station would be the Lake Road Station in downtown Milwaukie. The station would account for 22 percent of the line's boardings and alightings for the LPA to Park Avenue, and 33 percent for the MOS to Lake Road.



Portland-Milwaukie Light Rail Project

Change in Transit Trip Productions

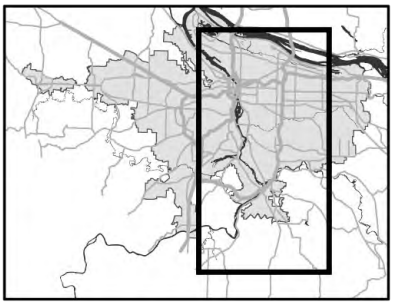
Figure 4.2-4

Change in Trips by TAZ[1], LPA to Park Avenue Compared to No-Build Alternative Year 2030

- Loss of 60 to 26
- Loss of 25 to Gain of 25
- Gain of 26 to 75
- Gain of 76 to 125
- Gain of more than 125

- LRT alignment
- Portland - Milwaukie Corridor

[1]Metro Transportation Analysis Zone



0 1 2 3 Miles

Table 4.2-8
Milwaukie LRT Average Weekday Station Usage (Ons and Offs) by Mode of Access and Egress, Year 2030

Station	LPA to Park Ave. (LPA Phasing Option)				MOS to Lake Rd.			
	Station Ons/Offs	% of Total Ons/Offs	% by Mode of Access		Station Ons/Offs	% of Total Ons/Offs	% by Mode of Access	
Lincoln Station	1,940 (1,916)	6% (6%)	81% (82%)	Walk	1,916	6%	82%	Walk
			19% (18%)	Transfer			18%	Transfer
			0% (0%)	Park-and-Ride			0%	Park-and-Ride
SOWA – Porter St. Station	5,873 (5,565)	17% (17%)	79% (80%)	Walk	5,909	17%	79%	Walk
			21% (20%)	Transfer			21%	Transfer
			0% (0%)	Park-and-Ride			0%	Park-and-Ride
OMSI Station	2,133 (1,995)	6% (6%)	55% (57%)	Walk	2,062	6%	56%	Walk
			45% (43%)	Transfer			44%	Transfer
			0% (0%)	Park-and-Ride			0%	Park-and-Ride
Clinton Station	1,895 (1,766)	5% (6%)	59% (61%)	Walk	1,797	5%	62%	Walk
			40% (38%)	Transfer			37%	Transfer
			1% (2%)	Park-and-Ride			2%	Park-and-Ride
Rhine Station	1,150 (1,077)	3% (3%)	95% (94%)	Walk	1,135	3%	95%	Walk
			0% (0%)	Transfer			0%	Transfer
			5% (6%)	Park-and-Ride			5%	Park-and-Ride
Holgate Station	1,277 (1,212)	4% (4%)	70% (70%)	Walk	1,243	4%	71%	Walk
			30% (30%)	Transfer			29%	Transfer
			0% (0%)	Park-and-Ride			0%	Park-and-Ride
Bybee Station	3,574 (3,478)	10% (11%)	93% (92%)	Walk	3,537	10%	94%	Walk
			4% (3%)	Transfer			3%	Transfer
			3% (5%)	Park-and-Ride			3%	Park-and-Ride

Table 4.2-8
Milwaukie LRT Average Weekday Station Usage (Ons and Offs) by Mode of Access and Egress, Year 2030

	LPA to Park Ave. (LPA Phasing Option)				MOS to Lake Rd.			
Tacoma Station	4,675 (3,382)	13% (11%)	43% (58%)	Walk	5,228	15%	38%	Walk
			15% (20%)	Transfer			13%	Transfer
			42% (22%)	Park-and-Ride			49%	Park-and-Ride
Lake Road Station	7,873 (7,666)	22% (24%)	20% (21%)	Walk	11,184	33%	14%	Walk
			80% (79%)	Transfer			80%	Transfer
			0% (0%)	Park-and-Ride			6%	Park-and-Ride
Park Avenue Station	4,678 (3,979)	13% (12%)	28% (33%)	Walk	0	0%	0%	Walk
			42% (47%)	Transfer			0%	Transfer
			31% (20%)	Park-and-Ride			0%	Park-and-Ride

	Total Station Ons/Offs by Mode of Access		% of Total Ons/Offs	Total Station Ons/Offs by Mode of Access		% of Total Ons/Offs
	Walk	18,725 (18,125)	53% (57%)	Walk	17,373	51%
	Transfer	12,735 (12,086)	36% (38%)	Transfer	13,265	39%
	Park-and-Ride	3,608 (1,784)	10% (5%)	Park-and-Ride	3,373	10%
	Total Station Ons/Offs	**35,068 (31,995)**	**100% (100%)**	**Total Station Ons/Offs**	**34,011**	**100%**

4.2.1.9 Year 2016 Forecast

A ridership forecast was developed for an average weekday one year after the opening year of service, assuming the LPA to Park Avenue. The transit network used in the modeling represents a logical incremental build-up toward the service levels assumed for the 2030 forecasts. The highway network includes all roadway projects in the corridor identified as having committed funding, as well as improvements to be made with the LPA to Park Avenue. The population and employment assumed for 2016 represents a forecast projection between the 2005 base year and the 2030 forecast year.

The average weekday ridership for the LPA to Park Avenue between SE Park Avenue and Lincoln Station is projected to be 19,500 boardings, with a PM, peak hour, peak direction, peak load point of 1,440. For the LPA Phasing Option, projected weekday ridership is estimated to be 17,000, with 1,180 at the peak hour, peak direction.

4.2.1.10 Alignment, Design, and Park-and-Ride Options

The following section describes alignment and design options related to the proposed stations and park-and-ride opportunities that affect the local transportation network. For additional information related to the description of alignments and alternatives considered, refer to Chapter 2, Alternatives, found in this FEIS.

Future Harold Station. Under the LPA to Park Avenue, LPA Phasing Option and MOS to Lake Road alignments, a future potential station has been proposed at SE Harold Street. This station would be a transit-only station and would not include a park-and-ride, and may not be constructed or operated in the initial phases of the project.

Tacoma Park-and-Ride. This park-and-ride is associated with all of the light rail alignment options. With the LPA to Park Avenue, the Tacoma Park-and-Ride would consist of an 800-space parking structure. With the MOS to Lake Road, the park-and-ride would be increased to 1,000 spaces. With the LPA Phasing Option, the facility would be a surface lot consisting of 320 spaces. For all design options, the park-and-ride would be located on the east side of SE McLoughlin Boulevard just south of SE Tacoma Street. Under the LPA to Park Avenue, this park-and-ride would generate approximately 560 vehicle trips (400 out and 160 in) during the PM peak hour. The LPA Phasing Option would decrease this trip generation to approximately 225 vehicle trips (160 out and 65 in). The MOS to Lake Road would increase the trip generation to approximately 700 vehicle trips (500 out and 200 in) during the PM peak hour.

The Tacoma Park-and-Ride includes two vehicular access points (a full access pre-existing signalized intersection to SE Tacoma Street, and a pre-existing right-in/right-out access on SE McLoughlin Boulevard). The right-in/right-out access point on SE McLoughlin Boulevard is proposed to be a right-in access only, with right-out as emergency vehicle access only. Conversion of this access to a right-in only for motor vehicles minimizes weaving and safety concerns along SE McLoughlin Boulevard within the interchange area. The SE McLoughlin Boulevard access point is 1,375 feet south of the northbound ramps from SE Tacoma Street and 1,100 feet north of the SE Ochoco Street intersection. While this would meet ODOT spacing standards, the proposed access on SE McLoughlin Boulevard would be nonconforming to

ODOT's access spacing standards at this location (990 feet), because there are two existing right-in/right-out accesses, located approximately 100 and 300 feet to the south.

Lake Road Park-and-Ride. This park-and-ride is associated with the MOS to Lake Road. The park-and-ride would provide a 275-space parking structure at the southwest corner of SE Washington Street/SE Main Street, just north of Kellogg Lake. The park-and-ride would generate approximately 200 vehicle trips (140 out and 60 in) during the PM peak hour.

There are two proposed access points for the park-and-ride. One is a right-in/right-out access located on SE Washington Street halfway between SE McLoughlin Boulevard and SE Main Street, and the second is a full access located on SE Main Street just north of SE Adams Street. The proposed access points are nonconforming to the City of Milwaukie's 300-foot access spacing standard for designated collectors, such as SE Washington Street.

Park Avenue Park-and-Ride. This park-and-ride is associated with the LPA to Park Avenue and with the LPA Phasing Option. This station would provide a 600-space parking structure at the southwest corner of SE McLoughlin Boulevard and SE Park Avenue with the LPA to Park Avenue, and a 355-space structure with the LPA Phasing Option. The park-and-ride would generate approximately 420 vehicle trips (300 out and 120 in) during the PM peak hour under the LPA to Park Avenue, and approximately 240 vehicle trips (170 out and 70 in) for the LPA Phasing Option.

The park-and-ride would be accessible from the full access intersection of SE 27th Avenue/SE Park Avenue, and from the right-in/right-out intersection on the west side of SE McLoughlin Boulevard located approximately 425 feet south of the intersection of SE McLoughlin Boulevard and SE Park Avenue. This right-in/right-out access point would not meet ODOT's access spacing standards of 500 feet for a right-in/right-out driveway.

4.3 HIGHWAY AND STREET IMPACTS

This section evaluates the impacts to the highway and street network based on the Portland-Milwaukie Light Rail Project alternatives and design options. Impacts to the highway and street system are separated into system-wide and local impacts. Transit improvements in the Portland-Milwaukie Corridor could affect traffic operations and congestion in two ways. First, these improvements could divert trips from automobiles to transit, resulting in reduced system-wide vehicular travel, as discussed in Section 4.3.1. Second, transit facilities could affect localized traffic operations on highways and streets in the corridor, as discussed in Section 4.3.2.

4.3.1 System-wide Impacts

System-wide traffic impacts could result from transit alternatives that substantially affect the way transportation choices are made. The system-wide traffic measures include the roadway vehicle miles and hours traveled (VMT and VHT), the vehicle hours of delay (VHD), and the traffic across selected screenlines; see Tables 4.3-1 and 4.3-2.

Table 4.3-1 shows the projected change in regional roadway VMT for the LPA to Park Avenue, the LPA Phasing Option, and the MOS to Lake Road compared with the No-Build Alternative.

VMT on the region's roadways would decrease by a range of 51,600 to 69,500 miles with the project.

Table 4.3-1
Average Weekday Regional Roadway Data, Year 2030

		LPA to Park Ave.			MOS to Lake Rd.	
	No-Build	without Streetcar Loop	with Streetcar Loop	LPA Phasing Option[3]	without Streetcar Loop	with Streetcar Loop
Vehicle Miles Traveled (VMT)[1]	58,388,500	58,327,200	58,322,400	58,336,900	58,324,400	58,319,000
VMT Change from No-Build	N/A	-61,300	-66,100	-51,600	-64,100	-69,500
Vehicle Hours Traveled (VHT)[1]	2,263,800	2,258,100	2,257,700	2,259,00	2,257,700	2,257,200
VHT Change from No-Build	N/A	-5,700	-6,100	-4,800	-6,100	-6,600
Vehicle Hours of Delay (VHD)[1,2]	39,900	39,500	39,600	39,600	39,500	39,500
VHD Change from No-Build	N/A	-400	-300	-300	-400	-400

Source: Metro 2010. Numbers may not sum due to rounding.
[1] Based on average weekday conditions in 2030.
[2] Based on PM peak-hour conditions in 2030 on freeways, major and minor arterials, and collector streets.
[3] Sensitivity analysis based on vmt/vht/vhd reduction per new transit rider with LPA to Park Ave without Streetcar Loop model results

Table 4.3-2 shows the total 2030 traffic volumes forecasted at two screenline locations in the Portland-Milwaukie Corridor, one south of SE Powell Boulevard, and one north of downtown Milwaukie. With the LPA to Park Avenue, the LPA Phasing Option, and the MOS to Lake Road, PM peak two-hour vehicle volumes near SE Powell Boulevard would decrease by 500 vehicles compared to the No-Build Alternative. North of downtown Milwaukie, vehicle volumes would decrease by 200 vehicles in the PM peak two-hour period with the LPA to Park Avenue.

Table 4.3-2
Average Weekday PM Peak Vehicle Volumes at Select Corridor Screenlines, Year 2030

	No-Build	LPA to Park Ave.	LPA Phasing Option	MOS to Lake Rd.
SE McLoughlin Blvd. and Parallel Streets at SE Powell Blvd.[1]	19,700	19,200	19,500	19,200
SE McLoughlin Blvd. and Parallel Streets North of Milwaukie[2]	17,800	17,600	17,800	17,700

Source: Metro 2010.
[1] Screenline comprises the following roadways: SE McLoughlin Boulevard, SE Milwaukie Avenue, and SE 17th Avenue.
[2] Screenline comprises the following roadways: SE 17th Avenue, SE McLoughlin Boulevard, SE Main Street, and SE 32nd Avenue.

4.3.2 Local Impacts, Mitigation, and Project Improvements

The following sections analyze the localized impacts, mitigation, and other improvements that could be considered for each mode of travel to maximize the benefits of the project. Similar to the affected environment, the impacts have been analyzed based on the previously defined sub-areas for the corridor. This approach allows for a more focused analysis by mode of travel.

4.3.2.1 Pedestrian Facilities

The following section summarizes opportunities to improve connections in the pedestrian system within each sub-area of the project corridor.

Table 4.3-3 summarizes the identified pedestrian features that are designed as part of the project near proposed stations (within a 500-foot radius).

Table 4.3-3
Pedestrian Facilities Provided by the Project by Transit Station

Location	LPA to Park Ave.	MOS to Lake Rd.	Facilities
Lincoln Station	♦	♦	Provide pedestrian improvements on SW Lincoln Street between SW 1st Avenue and SW 4th Avenue.
South Waterfront*	♦	♦	Provide pedestrian improvements (including sidewalks and crosswalks) between the streetcar station located on SW Moody Avenue, to the proposed light rail station located within the South Waterfront area.
OMSI Station*	♦	♦	Provide sidewalks along SE 4th Avenue between SE Division Place and SE Caruthers Street.
Clinton Station	♦	♦	Provide new traffic signals with crosswalks in the SE 11th Avenue/SE 12th Avenue/SE Clinton Street area to address gaps in the pedestrian system. Enhance pedestrian station access with the provision of a new pedestrian bridge between SE 14th Avenue and SE Gideon Street,** and through the elimination of complexities at the existing SE Clinton Street railroad crossing.
Rhine Station	♦	♦	Provide sidewalks, crosswalks, and pedestrian facilities for the new SE 17th Avenue overcrossing of SE Powell Boulevard. Provide a reconstructed pedestrian bridge with stairs and a ramp over the heavy-rail line to the east of SE 17th Avenue along SE Rhine Street to allow additional access to the Rhine Station.***
Holgate Station	♦	♦	Provide pedestrian improvements along SE 17th Avenue.
Tacoma Station	♦	♦	Provide pedestrian access along the Tacoma Station access ramp from SE Tacoma Street to the station. This includes a multi-use path along the north edge of the Tacoma Park-and-Ride connecting the access road to the Tacoma Station and a multi-use path between Springwater Corridor Trail and the Tacoma Station.
Lake Road Station	♦	♦	Provide sidewalks along SE Adams Street from SE Main Street to SE 21st Avenue.
Park Avenue Station	♦		Provide new traffic signal at SE 27th Avenue/SE Park Avenue for access to park-and-ride with sidewalks along SE Park Avenue from SE 27th Avenue to SE McLoughlin Boulevard. Provide pedestrian bridge connecting park-and-ride south of SE Park Avenue to station north of SE Park Avenue.**

* Indicates stations with streetcar stop in the adjacent area (South Waterfront has streetcar stops on SW Moody Avenue, and OMSI has streetcar stops north of the station).
** Deferred under the LPA Phasing Option.
*** Deferred under the LPA Phasing Option although existing overcrossing would remain.

LPA Phasing Option

With the LPA Phasing Option, three of the above-listed projects would be deferred. For the Clinton Station area, the pedestrian bridge at SE 14th Avenue and SE Gideon Street would be deferred and an existing bridge would be removed. For the Rhine Station area, the ADA pedestrian bridge would be deferred, and an the existing bridge there would remain. For the Park Avenue Station, the pedestrian bridge would be deferred. However, the additional pedestrian enhancements provided by the project for the Clinton Station area, Rhine Station (described in Table 4-3.3), and Park Avenue Station will enhance overall the pedestrian network near the stations.

Other Potential Improvements. In addition to the proposed project improvements listed above, there are a number of potential improvements that could further build on the benefits of the project. These are not assumed as part of the project, but could provide an opportunity to enhance local as well as regional pedestrian connectivity and accessibility. Please refer to the Transportation Impacts Results Report (Metro and DKS 2010) for a full listing and description of these potential improvements.

4.3.2.2 Bicycle Network Gaps and Improvements

The following section summarizes gaps, proposed project improvements, and other potential improvements related to bicycle facilities and connectivity. The bicycle environment was inventoried on roadways accessing proposed stations within 500 feet of the proposed station. For a more detailed analysis of these findings, please refer to the *Transportation Impacts Results Report* (Metro and DKS 2010).

Bicycle Network Gaps. This section identifies gaps in the dedicated bicycle network that would connect the bicycle network to the stations.

There is a gap along SW Lincoln Street between the existing bike lanes on SW 1st Avenue and SW 4th Avenue. There are gaps between the OMSI Station and the Clinton Station, to the existing City Bikeways along SE Division Place, SE Clinton Street, SE 11th Avenue, and SE 12th Avenue. There are two gaps in the bicycle network accessing the Tacoma Station. The first gap is linking the bicycle lanes on SE Tacoma Street south to the platform via the park-and-ride access road. The second gap is between the Springwater Corridor Trail and the Tacoma Station platform.

Within the downtown Milwaukie area, there are gaps in the proposed bicycle network within the immediate station area. These exist along SE 21st Avenue from SE Washington Street to SE Lake Road, and along SE Lake Road from SE 21st Avenue to approximately SE 23rd Avenue.

There is a gap in the bicycle network accessing the Park Avenue Station along SE Park Avenue between SE McLoughlin Boulevard and the bike lanes on SE Oatfield Road.

Other Project Improvements . In addition to locations where the project incorporates measures to improve the bicycle network and address impacts of the project, it also includes appropriate bike/pedestrian warnings and conflict prevention at intersections where light rail crosses the existing bicycle network will be provided for safe and adequate crossings of bicyclists. The

following table summarizes proposed project improvements based on the identified gaps in the bicycle network near proposed stations.

Table 4.3-4
Bicycle Facility Improvements Locations by Transit Station

Location	LPA to Park Ave.	MOS to Lake Rd.	Improvements
Lincoln Station	♦	♦	Provide bicycle improvements on SW Lincoln Street between SW 1st Avenue and SW 4th Avenue.
South Waterfront*	♦	♦	Provide bicycle connectivity from streetcar station (on SW Moody Avenue) to proposed light rail station in South Waterfront area.
OMSI Station*	♦	♦	Provide new bicycle facilities crossing the Willamette River on the transit bridge and the conversion of the existing SE Water Avenue to a bicycle-, pedestrian-, and streetcar-only facility. The new alignment of SE Water Avenue to the east would be retained.
Clinton Station	♦	♦	Provide bicycle access along SE Clinton Street for the portion of roadway that crosses SE 11th Avenue and SE 12th Avenue. This would provide direct access to the Clinton Station to/from the west.
Rhine Station	♦	♦	Provide multi-use path for the new SE 17th Avenue overcrossing of SE Powell Boulevard.
Holgate Station	♦	♦	Provide bike lanes along SE 17th Avenue.
Tacoma Station	♦	♦	Provide bicycle access along the Tacoma Station access ramp from SE Tacoma Street to the station. This includes a multi-use path along the north edge of the Tacoma Park-and-Ride connecting the access road to the Tacoma Station and a multi-use path between Springwater Corridor Trail and the Tacoma Station.
Lake Road Station	♦	♦	Provide bike lanes along SE 21st Avenue and SE Lake Road from SE Washington Street to approximately SE 23rd Avenue.
Park Avenue Station	♦	♦	Provide bike lanes along SE Park Avenue from SE McLoughlin Boulevard to SE Oatfield Road.

LPA Phasing Option

All bicycle improvements listed in Table 4.3-4 for the LPA to Park Avenue alternative would remain the same for the LPA Phasing Option.

Other Potential Improvements. In addition to the project improvements that are designed as part of the project, there are a number of other opportunities for improvements within the study area. Addressing these gaps would further enhance the connectivity for the area and regional bicycle network, and increase the mobility benefits of the light rail project.

4.3.2.3 Parking Impacts

The following section summarizes impacts related to the transit alternatives and parking within the proposed station areas along the transit alternatives. The project identifies where mitigation measures will be provided, and where mitigation is not required but effects could be minimized through additional coordination with local jurisdictions and neighborhoods. A more detailed

discussion of parking impacts and mitigation measures considered can be found in the *Transportation Impacts Results Report* (Metro and DKS 2010).

Sub-area A - Portland State University to SE Powell Boulevard: The LPA to Park Avenue and the MOS to Lake Road would remove on-street parking in some locations and affect off-street parking lots within the sub-area. Approximately 35 on-street parking spaces would be removed on SW Lincoln Street. The Lincoln Station would impact approximately seven off-street parking spaces at 2000 SW 5th Avenue. Approximately four on-street spaces would be removed on the north side of SW Hall Street as part of the bus routing to the bus mall.

On the east side of the river near the OMSI Station, upon completion of a Bureau of Environmental Services (BES) project, the Portland Opera House parking lots will be reconfigured. Reconfiguring the Portland Opera House parking lots may displace up to nine off-street parking spaces, and the LPA to Park Avenue and MOS to Lake Road may displace up to four on-street spaces on the north side of SE Caruthers Street. Also on the east side of the river, the LPA to Park Avenue and the MOS to Lake Road may displace approximately 25 on-street parking spaces in the Clinton Station area.

Sub-area B - SE Powell Boulevard to SE Tacoma Street: The alignment would remove on-street parking along SE 17th Avenue as well as approximately 105 parking spaces between SE Pershing Street and SE McLoughlin Boulevard. Off-street parking impacts would occur in two parking lots on the west side of SE 17th Avenue near SE Center Street. Other off-street parking would be removed. The two off-street lots on SE 17th Avenue are exclusively for TriMet employees (near TriMet's administration building and bus maintenance facility). These lots currently are near 100 percent occupancy and approximately 110 parking spaces would be lost.

Sub-area C - SE Tacoma Street to Highway 224: The LPA to Park Avenue and the MOS to Lake Road have no impact within this area.

Sub-area D - Highway 224 to SE Park Avenue: On-street parking to be impacted/removed by the project includes a total of 52 on-street spaces, with 6 spaces along SE Monroe Street, six spaces along SE Washington Street, 21 spaces along SE 21st Avenue, 10 spaces along SE Adams Street, and 9 spaces along SE Lake Road. The majority of these spots are short-term parking spaces managed by the City of Milwaukie. Off-street spaces that would be impacted include six spaces off of SE Monroe Street, which are on private property, and would be addressed through compensation as described in Section 3.1.

Potential Improvements. The following table summarizes potential options to help address the loss of off-street parking near the proposed stations:

Table 4.3-5
Off-Street Parking Reduction Impact Minimization Measures

Location	LPA to Park Ave.	MOS to Lake Rd.	Potential Impact Minimization Measures
Lincoln Station	♦	♦	Compensate the property owner for the loss of approximately seven off-street parking spaces at 2000 SW 5th Avenue. Station also increases access and helps offset demand. See Section 3.1 for further details of property acquisition mitigation commitments.
OMSI Station	♦	♦	Reconfiguring the Portland Opera House parking lots may displace up to nine off-street parking spaces. Compensation will also be provided.
Clinton Station	♦	♦	The loss of off-street parking between SE 11th and SE 12th avenues south of SE Clinton Street, with approximately 20 parking spaces, would be addressed through compensation to the property owner. It is likely that demand would be reduced through the provision of a station.
17th Avenue/Holgate Station	♦	♦	TriMet's off-street parking capacity for employees will be replaced, or an adequate supply will be provided through a combination of relocation and a parking management measures. The loss of other off-street lots would be addressed through compensation to affected property owners.
Tacoma Station	♦[1]		Coordinate with the City of Portland and the City of Milwaukie to monitor for increases in parking activity in station area neighborhoods and if impacts occur, apply the cities' existing parking management program measures.
Lake Road Station	♦	♦	Coordinate with the City of Milwaukie to apply its existing parking management program and maximize station access benefits to minimize effects of parking removal.
Park Avenue Station	♦[1]		Coordinate with Clackamas County to monitor for increases in transit-related parking activity in station area neighborhoods, and if impacts occur, apply parking management strategies.

[1] LPA Phasing Option

With the exception of the parking displaced along the SE 17th Avenue area, all other sub-areas appear to have an adequate supply of off-street parking to accommodate displaced parking without requiring replacement as mitigation. Light rail stations are expected to help reduce parking demand. In several cases uses associated with off-street parking spaces would be displaced, reducing the localized demand.

For the SE 17th Avenue, area, TriMet will be reducing parking demand for its current lots on SE 17th Avenue by moving its administrative function to an off-site location. Other travel demand reduction measures could further reduce the number of parking spots required, but TriMet will maintain an adequate off-street parking supply to accommodate remaining staff based at the SE Center Street facility.

There is limited potential for transit-related parking impacts within a neighborhood or a downtown area near the stations in most locations. This is due in part to the proposed park-and-ride facilities at the stations near the southern portion of the line, where demand would be higher, the ability of transit patrons to use other modes of access to reach a station, and also due to the

lower availability of unrestricted parking in most other station vicinities. The LPA Phasing Option provides lower park-and-ride capacity than the LPA to Park Avenue, and has a higher potential for transit-related parking to occur near the Tacoma and Park Avenue Station neighborhoods. However, if this type of activity becomes an issue within the first few years of light rail operation, TriMet will work with the local jurisdiction(s) and the community to develop and implement parking management solutions to prevent transit-related parking in neighborhoods. The cities of Portland and Milwaukie both already have parking management plans that provide examples of potential measures, including parking permit programs, or restricted time limits.

4.3.2.4 Motor Vehicle Impacts and Potential Improvements

Motor vehicle operations were evaluated at study area intersections under 2030 No-Build Alternative conditions as well as under all transit alternatives and design options. In addition to standard intersection operations (LOS and V/C ratio), additional operations and safety aspects were evaluated. These additional factors were queuing, signal warrants, turn lane warrants, and access spacing. The following section summarizes the impacts by sub-area and potential mitigation strategies based on these impacts. A full analysis of all motor vehicle operations can be found in more detail in the *Transportation Impacts Results Report* (Metro and DKS 2010).

Mitigation Criteria

The project identifies mitigation when specific criteria are met in comparison to the No-Build Alternative. The areas where evaluation may identify mitigation include intersection operations (LOS or V/C ratio), queuing, warrants, and access. Criteria for mitigation for intersection operations includes added delay of 10 seconds or more, or increase in the V/C ratio of 0.05 or more, when the No-Build Alternative condition meets jurisdictional standard and the light rail project does not. Criteria for mitigation for queuing includes when the project backs up over an adjacent signalized intersection and the No-Build Alternative does not. Multiple warrants (left turn, right turn, and signal) will be looked at under the LPA to Park Avenue and the MOS to Lake Road to determine whether they meet these warrants. The same will be done for the No-Build Alternative. New access locations will be evaluated against jurisdictional standards to determine whether they meet access spacing standards. A detailed description of methodology for mitigation criteria can be found in the *Transportation Impacts Results Report* (Metro and DKS 2010).

Sub-area A - Portland State University to SE Powell Boulevard: Under the No-Build Alternative, five intersections would not meet jurisdictional performance standards, including:

- SW Naito Parkway/SW Harrison Street (intersection V/C ratio over 0.99)
- SE 11th Avenue/SE Clinton Street (intersection delay of LOS A/F)
- SE 12th Avenue/SE Clinton Street (intersection delay of LOS A/F)
- SE Powell Boulevard/SE Milwaukie Boulevard (intersection V/C ratio over 0.99)
- SE Woodward Street/SE 8th Avenue (intersection delay of LOS A/F)

In addition to the intersections listed for the No-Build Alternative not meeting jurisdictional standard by 2030, Table 4.3-6 summarizes impacts of the LPA to Park Avenue and the MOS to Lake Road.

Table 4.3-6
Sub-Area A - Portland State University to SE Powell Boulevard
Potential Motor Vehicle Impacts in 2030 PM Peak Hour

Intersection/Location	LPA to Park Ave.	MOS to Lake Rd.	Impact
SW Naito Parkway/SW Harrison Street	♦	♦	Queuing issue associated with proximity to new signalized intersection to the south of SW Naito Parkway/SW Lincoln Street.
SE Woodward Street/SE 8th Avenue	♦	♦	Queuing issues in the southbound approach direction due to new signalized intersection of SE 8th Avenue/SE Division Place to the north.

In addition to the intersections listed in Table 4.3-6, there are some locations that need additional consideration based on the implementation and/or impacts associated with the light rail project alternatives. The following summarizes these locations.

I-405 on-/off-ramps with SW 4th Avenue/SW 5th Avenue/SW 6th Avenue/SW Broadway

These ramps were evaluated for the AM and PM peak hour operations due to peak directional usage. The additional delay from light rail operations would not have operational or queuing impacts at these intersections.

SW 5th Avenue/SW Jackson Street – LPA to Park Avenue and MOS to Lake Road

This intersection has a slightly higher V/C ratio for the LPA to Park Avenue and the MOS to Lake Road because additional time is factored into the traffic signal to allow for the eastbound light rail to cross SW 5th Avenue toward SW Lincoln Street. Although the V/C ratios would be slightly higher, the increase would be less than 0.05, and no mitigation would be required.

SW 4th Avenue/SW Lincoln Street – LPA to Park Avenue and MOS to Lake Road

This intersection has a slightly higher V/C ratio for the LPA to Park Avenue and the MOS to Lake Road because additional time is factored into the traffic signal to allow for the light rail to cross SW 4th Avenue. Although the V/C ratios would be slightly higher, the increase is less than 0.05; no mitigation would be required.

SW Naito Parkway/SW Lincoln Street – LPA to Park Avenue and MOS to Lake Road

The intersection at SW Lincoln Street/SW Naito Parkway would become a signalized intersection. Because SW Lincoln Street would be a transit-only facility through this intersection, the majority of green time can be allocated to through traffic on SW Naito Parkway. The future analysis shows the proposed intersection operating with a V/C ratio well below 0.99.

SE 8th Avenue/SE Powell Boulevard – 2030 No-Build Alternative, LPA to Park Avenue, and MOS to Lake Road

During the PM peak hour, the free-flow movement from SE 8th Avenue is currently heavy and continues to be heavy in 2030. Relatively free-flow conditions in the westbound direction on SE Powell Boulevard allow for the SE Woodward Street eastbound to SE 8th Avenue southbound movement to be free flow to access SE Powell Boulevard. This does not allow for gaps in the traffic flow for southbound stop-controlled traffic on SE 8th Avenue at SE Woodward Street to discharge at an adequate rate, and consequently queuing on SE 8th Avenue becomes problematic (as previously described). During the AM peak hour, the merge area on SE Powell Boulevard (westbound) creates congestion due to heavy traffic flow that has queuing spillback to the intersection of SE 8th Avenue/SE Woodward Street, but the southbound queue on SE 8th Avenue is not problematic. The merge area cannot be relocated due to the constraints of the Ross Island Bridge and therefore represents an existing non-project-related problem that has impacts to surrounding study area intersections.

SE 12th Avenue/SE Division Street (due to closing SE Clinton between SE 11th and SE 12th)

With the light rail alignment, SE Clinton Street will be closed between SE 11th and SE 12th Avenues. Vehicles that currently travel through this portion of SE Clinton Street eastbound will be directed to a new traffic signal at SE Milwaukie Avenue/SE Gideon Street, and westbound vehicles on SE Clinton Street will be directed to existing traffic signals at SE 12th Avenue/SE Division Street and SE 11th Avenue/SE Division Street. Without an improvement at SE 12th Avenue/SE Division Street, larger trucks would need to continue to travel north through the neighborhood (out of direction) on SE 12th to SE Madison Avenue before turning westbound.

In order to allow westbound trucks to be redirected to SE Division Street, the project has identified mitigation at SE 12th Avenue/SE Division Street. This intersection would be modified to allow trucks to turn northbound to westbound, providing adequate turning radii for WB 67 trucks (with 53-foot trailers). This improvement should minimize freight access impacts for the CEID.

SE 11th/SE 12th/SE Milwaukie Avenues from SE Division Street to SE Powell Boulevard

There is a need to develop and coordinate appropriate mitigation strategies with ODOT and the City of Portland that address the vehicle operations at SE 11th Avenue/SE Division Street with the project and other traffic-related concerns in this segment of roadways. Mitigation strategies should address the following concerns:

- Potential southbound queuing along SE Milwaukie Avenue from SE Powell Boulevard to eliminate potential for queue to extend to, and over, the light rail and heavy rail tracks
- Identify and analyze potential diversion for vehicles to surrounding roadway network due to delay and develop strategies (if necessary) to address diversion
- Additional delay at SE 11th Avenue/SE Division Street intersection due to light rail crossings of SE 11th Avenue

The work that is needed to develop these mitigation strategies will be determined through coordination and detailed analysis within the scope of extended Preliminary Engineering.

Non-Intersection Impacts

Delays from gated crossings would add approximately 50 seconds of delay per light rail occurrence and/or 20 seconds per bus occurrence (if bus crossings for the dedicated transitway are gate-operated) to trucks/motor vehicles. These would occur along SE Water Avenue (north of SE Caruthers Street) and SE 8th Avenue (south of SE Division Street). All other light rail crossings are proposed to occur at signalized locations.

Table 4.3-7 summarizes the motor vehicle operations (LOS or V/C ratio) for each alternative within Sub-area A for the 2030 PM peak hour.

Table 4.3-7
Sub-area A - Portland State University to SE Powell Boulevard
2030 PM Peak Hour Motor Vehicle Operations by Jurisdiction

Jurisdiction / Intersection	Jurisdictional Standard	No-Build	LPA to Park Ave.	MOS to Lake Rd.
ODOT				
A1 - SW 6th Ave. /SW Jackson St. **	0.85 / D	0.29 / B	0.28 / B	0.28 / B
A2 – SW 5th Ave./SW Jackson St. **	0.85 / D	0.56 / A	0.59 / B	0.60 / B
A3 - SW Lincoln St./SW 4th Ave. **	0.85 / D	0.61 / B	0.65 / B	0.65 / B
SW Lincoln St./SW 5th Ave. **	0.85 / D	n/a	0.38 / A	0.38 / A
A5 - SW Naito Pkwy/SW Harrison St. **	0.99 / D	1.06 / E	1.00 / E	1.02 / E
A6 - SW Naito Pkwy/SW Lincoln St. **	0.99 / D	n/a	0.62 / A	0.62 / A
A21 - SE 8th Ave./SE Woodward St.[3] **	0.99 / D	1.54 / F	1.48 / F	1.48 / F
A25 - SE Powell Blvd./SE 8th Ave.	0.99	0.86*	0.85*	0.85*
A26 - SE Powell Blvd./SE 9th Ave.	0.99	0.84	0.84	0.84
A27 - SE Powell Blvd./SE Milwaukie Ave.	0.99	1.08	1.06	1.07
A28 - SE 13th Pl./SE Powell Blvd.	0.99	0.68	0.67	0.67
City of Portland				
A4 - SW Lincoln St./SW 1st Ave.	D	C	B	B
A7 - SW Moody Ave./SW Sheridan St.[2]	D	C	C	C
A8 - SW Moody Ave./light rail crossing	D	n/a	A[1]	A[1]
A9 - SE Water Ave./light rail crossing	D	n/a	A[1]	A[1]
A10 - SE 4th Ave./SE Caruthers St.	D	A/C	A/C	A/C
A11 - SE 5th Ave./SE Caruthers St.	D	A/A	A/B	A/B
A12 - SE 6th Ave./SE Division Place	D	A/B	A/B	A/B
A13 - SE 8th Ave./SE Division Place	D	A/D	B[1]	B[1]
A14 - SE 8th Ave./SE Division St.	D	B	B	C
A15 - SE 9th Ave./SE Division Place	D	A/A	n/a	n/a
A16 - SE 11th Ave/.SE Division St.	D	C	E*	E*
A17 - SE 12th Ave./SE Division St.	D	C	C*	C*
A18 - SE 11th Ave./SE Clinton St.	D	A/F	D[1*]	D[1*]

Table 4.3-7
Sub-area A - Portland State University to SE Powell Boulevard
2030 PM Peak Hour Motor Vehicle Operations by Jurisdiction

Jurisdiction / Intersection	Jurisdictional Standard	No-Build	LPA to Park Ave.	MOS to Lake Rd.
A19 - SE 12th Ave/.SE Clinton St.	D	A/F	A[1*]	A[1*]
A20 - SE Milwaukie Ave./SE Gideon St.	D	A/C	C[1*]	C[1*]
A22 - SE 9th Ave/.SE Woodward St.	D	A/A	A/A	A/A
A23 - SE 10th Ave./SE Woodward St.	D	A/B	A/B	A/B
A24 - SE Milwaukie Ave./SE Woodward St.	D	A/D	A/D	A/D

Source: DKS Associates 2009.

Notes: **BOLD** values do not meet jurisdictional standards.
Shaded values indicate a project impact with a delay greater than 10 seconds or a V/C ratio change greater than 0.05.

* Indicates VISSIM results. **Indicates an unsignalized intersection.

** Indicates an intersection under both ODOT and City of Portland standards either now or in the future.

[1] Indicates a new signalized intersection.

[2] Moody/Bond couplet assumed to be constructed by 2030 for all scenarios. At SW Moody Avenue/SW Sheridan Street, this configuration assumes a WBL lane with 150 feet of storage, one WBT lane, two SBT lanes and one SBR lane with 150 feet of storage, one EBT lane and one EBR lane.

[3] SE 8th Avenue/SE Woodward Street is unsignalized and has a jurisdictional standard of 0.99. If the intersection were signalized, it would become a ramp terminal and the jurisdictional standard becomes 0.85. The V/C ratio at this intersection assumes a two-way stop during the PM peak period for the northbound and southbound approaches and the V/C ratio represents the leg with the highest V/C ratio, which is the southbound movement. A three-way strop-controlled intersection with one free flow approach cannot be analyzed using *Highway Capacity Manual* methodology.

LPA Phasing Option

Similar mitigations as found in the LPA to Park Avenue alternative would be needed under this alternative.

Table 4.3-8
Sub-area A - Portland State University to SE Powell Boulevard
Summary of 2030 Potential Motor Vehicle Operation Improvements

Intersection	Type of Impact				Measures	Criteria to Meet	Operations	
	Operations	Queuing	Access	Warrants			No-Build	Proposed Project (Mitigated)
LPA to Park Ave., LPA Phasing Option and MOS to Lake Rd.								
SW 4th Avenue/SW Lincoln Street					Install loop detectors on the northbound approach from the I-405 exit ramp to ensure vehicle queuing does not interfere with safety on I-405 (requested by ODOT).	500 ft	Queue lengths: PM peak 125 ft AM peak 150 ft	Queue lengths: PM peak 75 ft AM peak 150 ft
SW Naito Parkway/SW Harrison Street		◆			Increase green time for the northbound movement for the AM peak hour Provide vehicle queue detection northbound at SW Lincoln Street and provide a northbound clear-out phase; this clear-out phase will need to consider the northbound vehicle queue to the Hawthorne Bridge.	500 ft	N/A	Queue lengths: PM peak <325 ft AM peak >500 ft
SE Water Avenue/light rail alignment	◆				Install signals at the east and west ends of the OMSI Station that are triggered when buses and light rail trains are entering and leaving the station.	safety	N/A	improved safety
SE 8th Avenue between SE Division Place and SE Division Street	◆				Add gates on SE 8th Avenue at the light rail tracks to prevent conflicting movements between light rail and vehicles.	N/A	N/A	improved safety
SE 8th Avenue/SE Division Street	◆				Include a clear-out phase for vehicles on SE 8th Avenue to avoid conflicts with trains and light rail. Prohibit eastbound right turns on red.	N/A	N/A	queue clear-out
SE 8th Avenue/SE Division Place	◆				Include a clear-out phase for vehicles on SE 8th Avenue to avoid conflicts with trains and light rail.	100 ft	n/a	queue clear-out

Table 4.3-8
Sub-area A - Portland State University to SE Powell Boulevard
Summary of 2030 Potential Motor Vehicle Operation Improvements

Intersection	Type of Impact				Measures	Criteria to Meet	Operations	
	Operations	Queuing	Access	Warrants			No-Build	Proposed Project (Mitigated)
SE 11th Avenue/SE Division Street	◆	◆			Signal timing at this intersection will need to be coordinated with the other signals in the near vicinity (12th/Division, 11th/Clinton, 12th/Clinton, Milwaukie/Gideon, 8th/Division Street, and 8th/Division Place); advanced traffic signal control strategies and/or other innovative software and hardware may be necessary.	LOS D SB 2,000 ft EB 400 ft WB 200 ft	LOS C SB 1,125 ft EB 775 ft WB 150 ft	LOS E[1] SB 900 ft EB 375 ft WB 175 ft
SE 12th Avenue/SE Division Street			◆		Improve intersection to allow larger trucks to turn northbound to westbound. The new street improvement will allow for adequate turning radii for WB-67 trucks (with 53 foot trailers). Signal timing at this intersection will need to be coordinated with the other signals in the near vicinity (11th/Division, 11th/Clinton, 12th/Clinton, Milwaukie/Gideon, 8th/Division Street, and 8th/Division Place).	LOS D	LOS C	LOS C
SE 11th Avenue/SE Clinton Street		◆			Implement advanced traffic signal control strategies to coordinate signal timing and allow for progression of southbound movement at this intersection with the traffic signals at SE 11th Avenue/SE Division Street and SE Milwaukie Avenue/SE Powell Boulevard to operate with a clear-out phase as trains approach the at-grade crossing on SE 11th Avenue New signals in this area should include 2070 controllers or conform to the most up-to-date City of Portland standards.	SB 275 ft	N/A	SB 150 ft[1]

Table 4.3-8
Sub-area A - Portland State University to SE Powell Boulevard
Summary of 2030 Potential Motor Vehicle Operation Improvements

Intersection	Type of Impact				Measures	Criteria to Meet	Operations	
	Operations	Queuing	Access	Warrants			No-Build	Proposed Project (Mitigated)
SE Clinton Street/SE 12th Avenue		◆			Implement advanced traffic signal control strategies to coordinate signal timing and allow for progression of vehicles along SE 11th and 12th avenues and adequate clear-out phasing for vehicles to get off the light rail tracks as trains approach. New signals in this area should include 2070 controllers or conform to the most up-to-date City of Portland standards.	NB 200 ft	N/A	NB 100 ft
SE Milwaukie Avenue/SE Gideon Street	◆				Restripe the second eastbound lane as a shared through/left; with the reconfigured intersection the left turning volume is significantly greater than the through movement. By providing the left-turn capability from both lanes, queuing and operations will improve in this short connecting segment. New signals in this area should include 2070 controllers or conform to the most up-to-date City of Portland standards.	LOS D	N/A	LOS C
SE Milwaukie Avenue/SE Powell Boulevard		◆			Extend striping of southbound left-turn pocket north to approximately SE Gideon Street. Roadway cross section would also include bicycle lanes on both the east and west sides of the roadway in this section.	SB 500 ft	N/A	SB 250 ft

Table 4.3-8
Sub-area A - Portland State University to SE Powell Boulevard
Summary of 2030 Potential Motor Vehicle Operation Improvements

Intersection	Type of Impact				Measures	Criteria to Meet	Operations	
	Operations	Queuing	Access	Warrants			No-Build	Proposed Project (Mitigated)
SE 8th Avenue/SE Woodward Street		◆			Install a traffic signal at this intersection. Install advance queue warning detectors and flashing beacons for the northbound SE McLoughlin Boulevard exit ramp.	SB 950 ft EB 200 ft [2] 0.99 without signal or 0.85 with signal	SB 1,000 ft (PM peak) EB 300 ft (PM peak) V/C = 1.54	SB 300 ft (PM peak) EB 500 ft (AM peak)[3] V/C = 0.74 (PM) V/C = 0.73 (AM)
SW Naito Parkway/SW Lincoln Street and SE 12th Avenue/SE Gideon Street					Emergency vehicle preemption strategies need to be addressed at these locations. Light rail trains can either be held at nearby stations during emergency response or a preemption method can be implemented so that emergency responders do not experience additional delay due to the light rail.	Emergency response	N/A	appropriate preemption for emergency response vehicles

Notes: Jurisdictional operational standard.
LOS = Level of service based on average intersection delay.
V/C = Volume-to-capacity ratio.

[1] The results shown here are based on VISSIM analysis that do not account for the possibility of adaptive signal timing or other advanced signal timing methods. As part of the final engineering design phase, the 11th/12th/Division/Clinton area will continue to be analyzed using specialized signal timing methods.

[2] The length of the roadway segment is about 1,000 feet between the gore area on SE McLoughlin Boulevard and SE 8th Avenue/SE Woodward Street: however, for adequate sight distance around the exit ramp, the maximum queue length is 200 feet. Due to the limited sight distance, an end of queue warning system is recommended for the exit ramp.

[3] The eastbound queue may increase due to downstream congestion at SE 8th Avenue/SE Powell Boulevard and westbound across the Ross Island Bridge. There is a westbound merge on SE Powell Boulevard at the east end of the Ross Island Bridge from three lanes to two lanes. This merge area creates westbound vehicle queues, particularly during the AM peak period, that impact the eastbound vehicle queue at SE 8th Avenue/SE Woodward Street by limiting vehicles from flowing freely onto SE Powell Boulevard.

Sub-area B - SE Powell Boulevard to SE Tacoma Street: A more detailed analysis of motor vehicle operations for this area can be found in the *Transportation Impacts Results Report* (Metro and DKS 2010). Under the No-Build Alternative, two intersections do not meet jurisdictional performance standards:

- SE 17th Avenue/SE Schiller Street (intersection delay of LOS A/F)
- SE Bybee Boulevard/SE 27th Avenue (intersection delay of LOS A/F)

The intersection of SE Holgate Boulevard and SE 17th Avenue would meet operational standards in the No-Build Alternative, in 2030; however, a westbound left-turn lane is warranted today with existing conditions and continues to be warranted with the No-Build Alternative in 2030 due to the projected increase in queue length.

Table 4.3-9 summarizes impacts in Sub-area B for the Light Rail Project.

Table 4.3-9
Sub-area B: SE Powell Boulevard to SE Tacoma Street
Motor Vehicle Impacts

Intersection/Location	LPA to Park Ave.	MOS to Lake Rd.	Impact
SE Holgate Boulevard/SE 17th Avenue	♦	♦	Additional motor vehicle delay on multiple approaches due to light rail operations. Additional capacity constraints and queuing (specifically in the westbound and southbound directions) due to light rail operations.

In addition to the intersection listed in Table 4.3-9, there are some locations that also warrant additional discussion based on the implementation and/or impacts associated with the project. The following summarizes these locations.

SE 17th Avenue/SE McLoughlin Boulevard

The current project design for the LPA to Park Avenue includes a dual southbound left turn. This would improve the queuing over a single southbound left-turn lane, but would require protected turns for the north and southbound movements, and improved signal timing and phasing. In addition, the current project design adds a pedestrian crossing on the west leg of the intersection.

SE 17th Avenue/SE Holgate Boulevard

This intersection is expected to operate below jurisdictional standards with an LOS E as a result of the introduction of light rail operations. Although the intersection has available capacity, additional delays occur with new protected left-turn phasing at the intersection, which pushes the overall intersection delay beyond the jurisdictional standard for the light rail project. The heavier

volume movements (typically the through directions) would operate with acceptable delays by jurisdictional standard, and would also not be over capacity.

Additionally, different signal cycle lengths were pursued to help mitigate the potential delays at this intersection and meet jurisdictional standard. It was determined that this intersection could operate at a 110-second cycle length and meet the jurisdictional standard of LOS D with the light rail project in place. This cycle length does not match surrounding cycle lengths of adjacent signals on SE Holgate Boulevard or SE 17th Avenue. Operation at this cycle length would require being run under a "free" mode (meaning not in coordination with surrounding signals). The frequency of light rail crossings would make it difficult to operate this signal in a coordinated system, and running "uncoordinated" is a potential mitigation strategy.

SE 17th Avenue/SE Pershing Street

At the intersection of SE 17th Avenue/SE Pershing Street, the northbound traffic conflicts with the light rail tracks and a pedestrian/bike path. This intersection was analyzed as a gated crossing, and the analysis shows the intersection would operate with very little delay and minimal queuing.

Non-Intersection Impacts

The modification of driveways from full access to right-in/right-out along SE 17th Avenue would create out-of-direction travel for some trips where left-turn access would be restricted. At most, this out-of-direction travel would be approximately three blocks. Streets modified to right-in/right-out access include: SE Pershing Street, SE Haig Street, SE Lafayette Street, SE Rhone Street, SE Bush Street, SE Boise Street, SE Mall Street, and SE Pardee Street. Delay may also be experienced as a result of priority being given to light rail trains at gated crossings. This delay could be a maximum of 50 seconds for vehicles that experience a light rail gate closure, from start to finish. The average vehicle delay at a light rail crossing would be less.

Table 4.3-10 summarizes the intersection operations during the 2030 PM peak hour for the light rail project and the No-Build Alternative and identifies those intersections where project-related impacts may occur.

In addition, AM analysis was done at select locations for the No-Build Alternative and the light rail project alternatives. The AM analysis includes the ODOT intersections found in Table 4.3-10, with the addition of SE Holgate Boulevard/SE 17th Avenue. All intersections met jurisdictional standard under the No-Build Alternative, the LPA to Park Avenue, and the MOS to Lake Road.

Potential Impact Minimization Measures. Table 4.3-11 summarizes the potential measures to minimize the impacts associated with the LPA to Park Avenue and the MOS to Lake Road and allow for operations similar to the No-Build Alternative.

Table 4.3-10
Sub-area B - SE Powell Boulevard to SE Tacoma Street
2030 PM Peak Hour No-Build Alternative and Light Rail Project Intersection Operations

Jurisdiction / Intersection	Jurisdictional Standard	No-Build	LPA to Park Ave.	MOS to Lake Rd.
ODOT				
B11 – SE McLoughlin Blvd./SE Holgate Blvd.	1.10	0.97	0.94	0.95
B14 – SE McLoughlin Blvd./SE 17th Ave.	1.10	1.17	0.97	0.98
B15 – SE McLoughlin Blvd./SE Harold St.	1.10	1.00	0.95	0.96
City of Portland (Standard = Level of Service)				
B1 – SE 17th Ave./SE Pershing St.*	D/E	A/C	A	A
B2 – SE 17th Ave./SE Haig St.*	D/E	A/C	B/B	B/B
B3 – SE 17th Ave./SE Rhine St.	D/E	A/C	B[1]	B[1]
B4 – SE 17th Ave./SE Lafayette St.*	D/E	A/C	B/B	B/B
B5 – SE 17th Ave./SE Rhone St.*	D/E	A/C	B/B	B/B
B6 – SE 17th Ave./SE Center St.	D/E	A/D	B[1]	B[1]
B7 – SE 17th Ave./SE Boise St.	D/E	A/C	A[1]	A[1]
B8 – SE 17th Ave./SE Mall St.*	D/E	A/C	B/B	B/B
B9 – SE 17th Ave./SE Holgate Blvd.	D	D	**E**[2]	**E**[2]
B10 – SE Milwaukie Ave./SE Holgate Blvd.	D	C	C	C
B12 – SE 17th Ave./SE Pardee St.*	D/E	A/C	B/B	B/B
B13 – SE 17th Ave./SE Schiller St.	D/E	A/F	B[1,2]	B[1,2]
B16 – SE Bybee Blvd./SE 23rd Ave.*	D	B	B	B
B17 – SE Bybee Blvd./SE 27th Ave.*	D/E	A/F	A/F	A/F

Source: DKS Associates 2009.
Notes: **BOLD** values do not meet jurisdictional standards.
Shaded values indicate a project impact with a delay greater than 10 seconds or a V/C ratio change greater than 0.05.
* Indicates an unsignalized intersection.
[1] Indicates a new signalized intersection.
[2] Includes mitigation called out in previous traffic impacts results report for the Supplemental Draft Environmental Impact Statement (SDEIS).

LPA Phasing Option

Similar mitigations as found in the LPA to Park Avenue alternative would be needed under this alternative.

Table 4.3-11
Sub-area B - SE Powell Boulevard to SE Tacoma Street
Summary of 2030 Potential Motor Vehicle Impact Minimization Measures

Intersection	Type of Impact				Measures	Criteria to Meet	Operations	
	Operations	Queuing	Access	Warrants			No-Build	Mitigated Proposed Project
LPA to Park Ave., LPA Phasing Option & MOS to Lake Rd.								
SE 17th Ave. between SE Powell Blvd. and SE McLoughlin Blvd.			◆		Intersections and driveways along SE 17th Avenue should be designed to meet jurisdictional design standards and accommodate trucks and buses.	N/A	N/A	N/A
17th Ave./SE Pershing Street			◆		Traffic control to provide a safe crossing for motor vehicles, light rail, and pedestrians/bikes is required. A gated crossing is anticipated to provide safe operations with minimal queuing and delay.	N/A	N/A	N/A
SE 17th Ave./SE Holgate Blvd.	◆	◆			Provide a minimum of 300 feet for the southbound left turn. Provide a minimum of 300 feet for the westbound left turn. Provide a minimum of 100 feet for the eastbound left turn. Operate intersection with a 110-second cycle length. Coordinate light rail operations with north-south vehicle phases.	SBL 300 ft WBL 300 ft EBL 100 ft LOS D	SBL 275 ft WBL N/A EBL N/A LOS D	SBL 300 ft WBL 300 ft EBL 25 ft LOS D
SE 17th Ave./SE McLoughlin Blvd.		◆			Provide dual southbound left-turn lanes. Add pedestrian crossing on west leg of intersection. Provide a minimum of 300 feet for the westbound right-turn lane. Adjust signal timing to optimize southbound left-turn lane green time without impacting green time along SE McLoughlin Boulevard.	SBL 400 ft WBR 300 ft V/C 1.10	SB Queue >500 ft WBR N/A V/C 1.17	SB Queue >500 ft WBR 300 ft V/C 0.97

Notes: LOS = Level of service based on average intersection delay.
V/C = Volume to capacity ratio.

Sub-area C - SE Tacoma Street to Highway 224: A more detailed analysis of motor vehicle operations can be found in the *Transportation Impacts Results Report* (Metro and DKS 2010). Under the No-Build Alternative, five intersections do not meet jurisdictional performance standards:

- SE Tacoma Street/SE 17th Avenue
- SE Johnson Creek Boulevard/SE 32nd Avenue
- SE Johnson Creek Boulevard/SE 36th Avenue
- SE Johnson Creek Boulevard/SE 42nd Avenue
- SE Harney Drive/SE Johnson Creek Boulevard

Projected traffic volumes in year 2030 along SE Johnson Creek Boulevard would use most of the intersection capacity along this corridor and in some locations the demand would exceed capacity.

Table 4.3-12 summarizes impacts that are beyond the operations found in the No-Build Alternative.

Table 4.3-12
Sub-area C - SE Powell Boulevard to SE Tacoma Street
Potential Motor Vehicle Impacts

Intersection/Location	LPA to Park Ave.	MOS to Lake Rd.	Impact
SE Tacoma St./SE McLoughlin Blvd. southbound off-ramp	◆	◆	Intersection has additional delay due to the motor vehicle trips associated with the Tacoma Park-and-Ride
SE Tacoma St./SE McLoughlin Blvd. northbound on-/off-ramp	◆	◆	Intersection has additional delay due to the motor vehicle trips associated with the Tacoma Park-and-Ride
SE Johnson Creek Blvd./SE 32nd Ave.	◆	◆	Intersection has additional delay due to the motor vehicle trips associated with the Tacoma Park-and-Ride

In addition to the intersections listed in Table 4.3-12, there are some locations that also warrant additional discussion based on the implementation and/or impacts associated with the light rail project. The following summarizes these locations.

SE Tacoma Street/SE McLoughlin Boulevard Southbound Off-ramp

The intersection of SE Tacoma Street and the SE McLoughlin Boulevard southbound off-ramp (unsignalized) would not operate within jurisdictional standards during the AM peak hour for both the LPA to Park Avenue and the MOS to Lake Road. This intersection would not meet signal warrants; however, restriping SE Tacoma Street to allow for dual stage left turns onto the street would allow for operations within jurisdictional standards.

SE Tacoma Street/SE McLoughlin Boulevard Northbound On-/Off-ramp

Restriping the intersection and signal modifications and timing adjustments at this intersection would improve operations. The restriping would include separate southbound left-turn, through-, and right-turn lanes. Signal modification that would allow for protected/permissive left turns from SE Tacoma Street onto the ramp and into the park-and-ride would also improve operations. However, with these modifications the intersection does not quite meet ODOT jurisdictional standards. The project will need to seek a design exception to allow operations over 0.85 V/C ratio rather than widening SE Tacoma Street to meet the standard.

SE Johnson Creek Boulevard/SE 32nd Avenue

Similar to the No-Build Alternative, both the LPA to Park Avenue and the MOS to Lake Road (unsignalized) do not meet jurisdictional standard at this intersection during the AM or PM peak hours. The eastbound queue from this intersection spills over the adjacent SE McLoughlin Boulevard/SE Tacoma Street interchange. This queue spillover further cascades onto the ramps and mainlines of SE McLoughlin Boulevard and represents a serious safety concern for the roadway users. Under the LPA to Park Avenue and the MOS to Lake Road, signalization combined with the construction of a westbound right-turn lane at this intersection would improve queuing and allow for intersection operations to meet jurisdictional standards during the AM and PM peak hours.

SE Johnson Creek Boulevard/SE 42nd Avenue

Similar to the No-Build Alternative, both the LPA to Park Avenue and the MOS to Lake Road do not meet jurisdictional standard at this intersection during the AM and PM peak hours. Currently, this intersection operates with all-way stop control. The intersection meets signal warrants with the No-Build Alternative and continues to meet signal warrants with the light rail project. City of Milwaukie staff recommended that this intersection be signalized as part of the project mitigation. On April 20, 2010, the signalization of this intersection was brought before the Milwaukie City Council, and the council made a decision to leave this intersection as it is today. A design exception would be sought to leave this intersection controlled with stop signs for all approaches. With the LPA Phasing Option, the project assumes no signalized intersection at this location.

SE Johnson Creek Boulevard Corridor

In the No-Build Alternative westbound traffic volumes in the AM peak hour and eastbound traffic volumes in the PM peak hour are such that delay approaches LOS E and F conditions. The use of all-way stop control intersections assumed in the No-Build Alternative restricts the flow of vehicles along SE Johnson Creek Boulevard, and is the source of long queues and delay. Improvements are needed at several locations along the corridor to achieve jurisdictional standards and reduce queuing at the study intersections.

Weaving and Merging Analysis

A weaving and merging analysis was performed for the SE McLoughlin Boulevard on- and off-ramps at SE Tacoma Street and at the Tacoma Park-and-Ride access. In general, the addition of park-and-ride trips to the network would not have a noticeable impact on the V/C ratio at these locations.

Table 4.3-13 summarizes the intersection operations during the 2030 PM peak hour (except at SE Tacoma Street/SE McLoughlin Boulevard southbound off-ramp, which has intersection operations for both the AM and PM peak hours) for these conditions and identifies those intersections where project-related impacts may occur. In addition, AM analysis was done at select locations for the No-Build Alternative and the LPA to Park Avenue and the MOS to Lake Road. The AM analysis focused on the ODOT ramp heads that have intersections on SE Tacoma Street, and the same City of Portland and City of Milwaukie intersections found in Table 4.3-13. For detailed information on AM operations, see the *Transportation Impacts Results Report* (Metro and DKS 2010).

Table 4.3-13
Sub-area C - SE Tacoma Street to Highway 224
2030 PM Peak Hour No-Build Alternative and Light Rail Project Intersection Operations

Jurisdiction / Intersection	Jurisdictional Standard	No-Build	LPA to Park Ave.	MOS to Lake Rd.
ODOT				
C2-SE Tacoma St./SE McLoughlin Blvd. southbound off-ramp	0.85	0.72[3]	0.86[3]	0.96[3]
C3-SE Tacoma St./SE McLoughlin Blvd. southbound on-ramp	0.85	0.75	0.76	0.73
C4-SE Tacoma St./SE McLoughlin Blvd. northbound on-/off-ramp[4]	0.85	0.64	0.87[2]	0.98[2]
C11-SE McLoughlin Blvd./SE Moores St.	1.10	0.07	0.05	0.05
C10-SE McLoughlin Blvd./SE Ochoco St.	1.10	0.98	1.01	1.03
City of Portland				
C1-SE Tacoma St./SE 17th Ave.	D	F	F	F
C5-SE 32nd Ave./SE Johnson Creek Blvd.	E	F	D[1]	D[1]
C7-SE Harney Dr./SE Johnson Creek Blvd.	E	F	F[2]	F[2]
C9-SE 36th Ave./SE Johnson Creek Blvd.	E	E	F[2]	F[2]
City of Milwaukie				
C6-SE 42nd Ave./SE Johnson Creek Blvd.	E	F	F[2]	F[2]

Source: DKS Associates 2009.
Notes **BOLD** values do not meet jurisdictional standards.
Shaded values indicate a project impact with a delay greater than 10 seconds or a V/C ratio change greater than 0.05.
[1] Indicates a new signalized intersection.
[2] Indicates intersection with a delay impact greater than 10 seconds or a demand-to-capacity ratio change greater than 0.05.
[3] No-Build Alternative and The light rail project reflect a 2030 AM peak one hour, all other results on this table are for a 2030 PM peak one hour period.
[4] With the LPA Phasing Option, the reduction in park-and-ride size reduces the impact at this intersection, and it would operate at 0.72 V/C ratio and meet the jurisdictional standard.

Potential Impact Minimization Measures. Table 4.3-14 summarizes the potential measures to minimize the impacts associated with the light rail project and allow for operations similar to the No-Build Alternative.

Table 4.3-14
Sub-area C - SE Tacoma Street to Highway 224
Summary of 2030 Potential Motor Vehicle Impact Minimization Measures

Intersection	Type of Impact				Measure	Criteria to Meet	Operations	
	Operations	Queuing	Access	Warrants			No-Build	Proposed Project
LPA to Park Ave. and LPA Phasing Option								
Tacoma Park-and-Ride south access			◆		Consolidate business accesses south of park-and-ride with access road. Only allow right-in operations to minimize effects of weaving on SE McLoughlin Boulevard.	990 ft	n/a	990 ft access spacing
SE Tacoma St./ SE McLoughlin Blvd. SB Off-Ramp	◆				Restripe for dual stage left turn onto SE Tacoma St. or Modify interchange and signalize intersection. or Do nothing and seek a design exception.	V/C = 0.85	V/C = 0.22 V/C = 0.72	V/C = 0.50 V/C = 0.45[1]
SE Tacoma St./ SE McLoughlin Blvd. NB On-/Off-Ramp		◆			Restripe SE Tacoma Street between park-and-ride access and SE Tenino Drive to be a two-way center turn lane. Seek design exception to allow for operations over 0.85 V/C ratio rather than widen SE Tacoma Street to meet standard.[2]	150 ft V/C = 0.85	n/a V/C = 0.64	150 ft storage V/C = 0.87
SE Johnson Creek Blvd./SE 32nd Ave.	◆	◆		◆	Add westbound right-turn pocket of 100 feet. Signalize intersection.	LOS D	LOS F	LOS D
SE Johnson Creek Blvd./SE 36th Ave.	◆	◆			Signalize intersection and coordinate operations with SE 32nd Avenue/SE Johnson Creek Boulevard. or Do nothing and seek a design exception.	LOS D	LOS F	LOS F
SE Johnson Creek Blvd./SE 42nd Ave.	◆			◆	Signalize intersection. or Do nothing and seek a design exception.	LOS D	LOS F	LOS F

Table 4.3-14
Sub-area C - SE Tacoma Street to Highway 224
Summary of 2030 Potential Motor Vehicle Impact Minimization Measures

Intersection	Type of Impact				Measure	Criteria to Meet	Operations	
	Operations	Queuing	Access	Warrants			No-Build	Proposed Project
MOS to Lake Rd.								
Tacoma Park-and-Ride south access			◆		Consolidate business accesses south of park-and-ride with access road. Only allow right-in operations in order to minimize effects of weaving on SE McLoughlin Boulevard.	990 ft	N/A	990 ft access spacing
SE Tacoma St./ SE McLoughlin Blvd. SB Off-Ramp	◆				Restripe for dual stage left turn onto SE Tacoma St. or Modify interchange and signalize intersection. or Do nothing and seek a design exception.	V/C = 0.85	V/C = 0.22 V/C = 0.72	V/C = 0.53 V/C = 0.48[1]
SE Tacoma St./ SE McLoughlin Blvd. NB On-/Off-Ramp	◆	◆	◆		Restripe westbound left-turn lane to be back to back with eastbound left-turn lane at SE Tacoma St./SE Tenino Dr. Seek design exception to allow for operations over 0.85 V/C ratio rather than widen SE Tacoma Street to meet standard. [2]	150 ft V/C = 0.85	N/A V/C = 0.64	150 ft storage V/C = 0.98
SE Johnson Creek Blvd./SE 32nd Ave.	◆	◆		◆	Add westbound right-turn pocket of 100 feet. Signalize intersection.	LOS D	LOS F	LOS D
SE Johnson Creek Blvd./SE 36th Ave.	◆	◆			Signalize intersection and coordinate operations with SE 32nd Avenue/SE Johnson Creek Boulevard. or No additional improvements per direction of City of Milwaukie.	LOS D	LOS F	LOS F
SE Johnson Creek Blvd./SE 42nd Ave.	◆			◆	Signalize intersection. or No additional improvements per direction of City of Milwaukie.	LOS D	LOS F	LOS F

Notes:
LOS = Level of service based on average intersection delay.
V/C = Volume-to-capacity ratio.
[1] Light rail project reflects a mitigated 2030 AM peak one hour V/C, all other results on this table are for a 2030 PM peak one hour period..
[2] LPA Phasing Option does not require this mitigation.

LPA Phasing Option

Intersection analysis was conducted on the four intersections that are closest to the park-and-ride to determine whether similar mitigation measures as proposed for the LPA to Park Avenue would be necessary. The four intersections were SE Tacoma Street/SE McLoughlin Boulevard southbound off-ramp, SE Tacoma Street/SE McLoughlin Boulevard southbound on-ramp, SE Tacoma Street/SE McLoughlin Boulevard northbound on/off-ramp (park-and-ride entrance), and SE Tacoma Boulevard/SE 32nd Avenue/SE Johnson Creek Boulevard.

Based on the analysis, all but one of the proposed mitigations would remain. There would be no need to seek a design exception at the signalized park-and-ride access point on SE Tacoma Street. The reduction in park-and-ride size reduces the potential impacts at this intersection and would operate at a 0.72 V/C ratio during the PM peak hour and meet jurisdictional standards. The other intersections (with proposed mitigation) are as follows:

- SE Tacoma Street/SE McLoughlin Boulevard off-ramp (0.44 V/C ratio)
- SE Tacoma Street/SE McLoughlin Boulevard on/off-ramp (0.76 V/C ratio)
- SE Tacoma Boulevard/SE 32nd Avenue/SE Johnson Creek Boulevard (LOS C)

Sub-area D - Highway 224 to SE Park Avenue: A more detailed analysis of motor vehicle operations can be found in the *Transportation Impacts Results Report* (Metro and DKS 2010). Under the No-Build Alternative, eight intersections do not meet jurisdictional performance standards, and one other intersection shows the potential for queuing that would block an adjacent signalized intersection.

- SE McLoughlin Boulevard/SE Harrison Street (V/C ratio over 1.10)
- SE McLoughlin Boulevard/SE Washington Street (V/C ratio over 1.10)
- SE McLoughlin Boulevard/SE Sparrow Street (V/C ratio over 0.99)
- SE McLoughlin Boulevard/SE Park Avenue (V/C ratio over 0.99)
- SE McLoughlin Boulevard/SE Courtney Road (V/C ratio over 0.99)
- SE Harrison Street/SE Main Street (intersection delay of LOS E)
- SE Washington Street/SE Oak Street (intersection delay of LOS A/F)
- SE Park Avenue/SE Oatfield Road (intersection delay of LOS A/F)

Traffic volumes along SE McLoughlin Boulevard have increased over time and are projected to continue increasing. The increased demand-to-capacity ratio is apparent at the intersections of SE McLoughlin Boulevard/SE Harrison Street, SE McLoughlin Boulevard/SE Sparrow Street, SE McLoughlin Boulevard/SE Washington Street, SE McLoughlin Boulevard/SE Park Avenue, and SE McLoughlin Boulevard/SE Courtney Road.

Table 4.3-15 summarizes impacts of the light rail project, compared to operations for the No-Build Alternative.

Table 4.3-15
Sub-area D - Highway 224 to SE Park Avenue
Motor Vehicle Impact Locations

Intersection/Location	LPA to Park Ave.	MOS to Lake Rd.	Impact
SE McLoughlin Blvd./SE Harrison St.		♦	Intersection is over capacity due to additional park-and-ride related trips.
SE McLoughlin Blvd./SE Washington St.		♦	Intersection is over capacity due to additional park-and-ride related trips.
SE McLoughlin Blvd./SE River Rd.		♦	Intersection is over capacity due to heavy southbound volumes, some of which are associated with park-and-rides to the north.
SE Washington St./SE Oak St.		♦	Delay at intersection increases due to additional park-and-ride related trips.
SE Harrison St./SE Main St.		♦	Delay at intersection increases due to additional park-and-ride related trips.
SE Park Ave./SE Oatfield Rd.	♦		Intersection is experiencing more than an additional 10 seconds of delay due to additional park-and-ride related trips in the LPA to Park Avenue.[1]

[1] LPA Phasing Option has a smaller park-and-ride at Park Avenue Station and does not have an additional 10 seconds of delay due to park-and-ride related trips.

A few of the intersections listed in Table 4.3-15 have more complicated operations beyond the 2030 intersection operations, or interrelations with park-and-ride locations, and warrant further explanation of operations/deficiencies. The following discussion summarizes those locations.

SE McLoughlin Boulevard

In the future there will continue to be heavy commuter traffic volume present on SE McLoughlin Boulevard during the AM and PM peak hours. During the morning the majority of the vehicles are heading north toward Portland, and during the evening the majority of the vehicles are heading south. This trend can also be seen in the queues. During the AM peak, the longer queues are formed by the northbound traffic on SE McLoughlin Boulevard, or on the side streets trying to access SE McLoughlin Boulevard. Similarly in the PM peak, the longer queues are resulting from southbound motor vehicle traffic.

SE McLoughlin Boulevard/SE Harrison Street/SE 17th Avenue

Under the No-Build Alternative, AM peak hour queues along SE McLoughlin Boulevard in the northbound direction exceed the available storage and spill past the adjacent signalized intersection of SE Monroe Street. Signal timing adjustments to this intersection and adjacent intersections would facilitate the flow of traffic through downtown Milwaukie and remove the tendency for spillover traffic.

It should be noted that the 95th percentile queue (southbound direction) at the intersection of SE McLoughlin Boulevard/SE Harrison Street/SE 17th Avenue would be over 1,000 feet during the PM peak hour. This queue length can be adequately handled at this intersection because it does not spill over to an adjacent signalized intersection. The nearest signalized intersection to the

north is SE McLoughlin Boulevard/SE Milport Road (2,775 feet) and the on-ramp for Highway 224 is 1,500 feet away. Approximately 600 vehicles are projected to enter SE McLoughlin Boulevard from SE 17th Avenue at this location. Queues for this movement would also exceed the available storage. Improvements identified in the motor vehicle operations section would help with the queues at this location. Modifications to the signal timing at this location would also improve queuing, but should also be conducted at the adjacent signalized intersections to maintain bandwidth along SE McLoughlin Boulevard.

SE McLoughlin Boulevard/SE Monroe Street

Under the No-Build Alternative, AM peak hour queues along SE McLoughlin Boulevard in the northbound direction exceed the available storage at SE McLoughlin Boulevard/SE 17th Avenue/SE Harrison Street and spill past this intersection. In turn, the queues at this intersection then spill back past the adjacent intersection of SE McLoughlin Boulevard/SE Washington Street.

During the PM peak hour, queues in the westbound direction would exceed the available storage and extend past the adjacent unsignalized intersection of SE Monroe Street/SE Main Street. Modifications to the signal timing at the signalized intersections to the north and south of this location to promote vehicle progression through downtown Milwaukie would improve queuing along SE McLoughlin Boulevard at this intersection such that there would not be spillover.

SE McLoughlin Boulevard/SE Washington Street

Motor vehicle demand at the intersection of SE McLoughlin Boulevard/SE Washington Street during both the AM and PM peak hours cause the northbound queue to exceed 1,000 feet. Similar to the intersection of SE McLoughlin Boulevard/SE 17th Avenue/SE Harrison Street, this long of a queue can be adequately handled at this intersection. It should also be noted that westbound left-turn queues at this intersection would extend beyond the available storage during the AM and PM peak hours. Modifications to the signal timing at this location would improve queuing, but should also be conducted at the adjacent signalized intersections to maintain operating capacity along SE McLoughlin Boulevard.

SE Washington Street/SE Oak Street

Queues for the westbound left-turn lane are projected to exceed the available capacity at this intersection.

SE McLoughlin Boulevard/SE Bluebird Road/SE River Road

Queues during the AM and PM peak hours along SE McLoughlin Boulevard northbound and southbound would extend past adjacent unsignalized intersections, but would not spill back past a signalized intersection. The same can be said for the queue on SE River Road. It would extend past an adjacent unsignalized intersection, but would not block any signalized intersection.

SE McLoughlin Boulevard/SE Park Avenue

During the AM and PM peak hours, traffic volumes on SE Park Avenue would exceed the capacity of the intersection of SE McLoughlin Boulevard and SE Park Avenue, given the current

signal timing. This results in queues that exceed the available storage space for the westbound direction and spill over to the adjacent unsignalized intersection of SE Park Avenue and SE Oatfield Road. During the PM peak hour, traffic volume in the southbound direction on SE McLoughlin Boulevard would cause queues in excess of 1,000 feet. This queue length can be adequately handled at this intersection since it does not extend beyond an adjacent signalized intersection.

SE Park Avenue/SE Oatfield Road

Potential mitigation at this intersection is predicated on the size of the park-and-ride that is constructed and can range from implementing a new (separate) eastbound right turn pocket, to as much as signalization of the intersection with new eastbound right turn, northbound left turn and southbound left turn pockets. The FEIS identifies the eastbound right turn pocket only for the LPA Phasing Option, while the full signal with additional turn pockets is identified in the 2008 LPA. For cost estimating purposes, the full signal and additional turn pockets at three locations has been used. The final improvements at this location will be developed and finalized through coordination with Clackamas County through the final design portion of the Portland-Milwaukie LRT Project which includes a development review process for the park-and-ride for final permitting.

SE McLoughlin Boulevard/SE Courtney Road

During the AM and PM peak hours, queues for eastbound, northbound, and westbound left-turn movements would exceed the available storage space at this intersection. Signal timing modification could improve the queues at this location. Any modification to the signal timing should minimize the impact to progression and operating capacities along SE McLoughlin Boulevard to be within jurisdictional standards.

Non-intersection Impacts

Proposed at-grade light rail crossings associated with all transit alignments would create additional delay on eastbound/westbound travel along SE Harrison Street, SE Monroe Street, and SE Washington Street. Table 4.3-16 summarizes the average delay and the 95th percentile queues associated with these locations. These results show no queuing that would interfere with a signalized intersection or adversely affect any other traffic criteria. Accordingly, no impact is found and no project mitigation would be required.

Table 4.3-16
Sub-Area D - Highway 224 to SE Park Avenue
2030 PM Peak Hour Average Delay and 95th Percentile Queuing at
Light Rail At-Grade Crossings in Downtown Milwaukie

Location	Direction	Average Delay	95th Percentile Queue
SE Harrison Street	Eastbound	6 seconds	250 feet
	Westbound	13 seconds	325 feet
SE Monroe Street	Eastbound	4 seconds	75 feet
	Westbound	4 seconds	125 feet
SE Washington Street	Eastbound	5 seconds	125 feet
	Westbound	12 seconds	175 feet
SE Adams Street	Northbound	7 seconds	175 feet
	Southbound	5 seconds	75 feet
	Westbound	17 seconds	50 feet

Table 4.3-17 summarizes the intersection operations during the 2030 PM peak hour for these conditions and identifies those intersections where project-related impacts may occur.

Table 4.3-17
Sub-Area D - Highway 224 to SE Park Avenue
2030 PM Peak Hour No-Build Alternative and Light Rail Project Intersection Operations

Jurisdiction / Intersection	Jurisdictional Standard	No-Build	LPA to Park Ave.	MOS to Lake Rd.
ODOT				
D1-SE McLoughlin Blvd/.SE Harrison St.	1.10	1.15	1.15	1.19
D4-SE McLoughlin Blvd./SE Jackson St.	1.10	0.13	0.14	0.14
D5-SE McLoughlin Blvd./SE Monroe St.	1.10	0.95	0.96	1.08
D8-SE McLoughlin Blvd./SE Jefferson St.	1.10	0.10	0.12	0.11
D9-SE McLoughlin Blvd./SE Washington St.	1.10	1.12	1.09	1.23
D17-SE McLoughlin Blvd./SE 22nd Ave.	1.10	0.01	0.01	0.01
D18-SE McLoughlin Blvd./SE River Rd.	1.10	0.97	0.98	0.99
D19-SE McLoughlin Blvd./SE Sparrow St.	0.99	>2.0	-	-
D22-SE McLoughlin Blvd./SE Park Ave.	0.99	1.00	1.02	1.04
D25-SE McLoughlin Blvd./Park Ave. Park-and-Ride access	0.99	-	0.67	-
D26-SE McLoughlin Blvd./SE Courtney Ave.	0.99	1.07	1.07	1.07
City of Milwaukie				
D2-SE Harrison St./SE Main St.	D	E	E	F
D3-SE Harrison St./SE 21st Ave.	D	C	C	C
D6-SE Monroe St./SE Main St.	D	A	A	A
D7-SE Monroe St./SE 21st Ave.	D	A	A	A
D10-SE Washington St./SE Main St.	D	B	B	C
D11-SE 21st Ave./SE Washington St.	D	C	C	C
D13-SE 21st Ave./SE Adams St.	D	A/B	A/B	A/B

Table 4.3-17
Sub-Area D - Highway 224 to SE Park Avenue
2030 PM Peak Hour No-Build Alternative and Light Rail Project Intersection Operations

Jurisdiction / Intersection	Jurisdictional Standard	No-Build	LPA to Park Ave.	MOS to Lake Rd.
D12-SE Main St./SE Adams St. (park-and-ride access)	D	-	-	A
D14-SE Lake Rd./SE 21st Ave.	D	-	-	-
D15-SE Washington St./SE Oak St.	D	A/F	A/F	A/F
D16-SE Lake Rd./SE Oatfield Rd./SE 34th Ave.	D	D	D	D
D27-SE Washington St./Lake Rd. Park-and-Ride access	D		-	A/B
Clackamas County				
D20-SE Park Ave./SE River Rd.	D	A/C	A/C	A/C
D21-SE Park Ave./SE Park Ave. Park-and-Ride west access	D		C[1]	-
D23-SE Park Ave./SE Oatfield Rd.	D	A/F	A/F[3]	A/F
D24-SE Oatfield Rd./SE Aldercrest Rd.	D	A/D	A/D	A/D

Notes: **BOLD** values do not meet jurisdictional standards.
Shaded values indicate a project impact with a delay greater than 10 seconds or a V/C ratio change greater than 0.05.
* Indicates an unsignalized intersection.
[1] Indicates a new signalized intersection.
[2] Includes mitigation called out in previous traffic impacts results report for the SDEIS.
[3] LPA Phasing Option has a smaller park-and-ride at Park Avenue Station and does not have a delay greater than 10 seconds or a V/C ratio change greater than 0.05.

In addition, AM analysis was done at select locations for the No-Build Alternative and the LPA to Park Avenue and the MOS to Lake Road. The AM analysis focused primarily on the ODOT intersections in Table 4.3-17.

LPA Phasing Option

Intersection analysis was conducted on the three intersections that are closest to the park-and-ride to determine whether similar mitigation measures as proposed for the LPA to Park Avenue would be necessary. The three intersections were SE Park Avenue/SE 27th Avenue (park-and-ride entrance), SE Park Avenue/SE McLoughlin Boulevard, and SE Park Avenue/Oatfield Road.

Based on the analysis, two of the three intersections could have reduced mitigation compared to the LPA to Park Avenue alternative. The two intersections are those of SE Park Avenue/SE McLoughlin Boulevard and SE Park Avenue/SE Oatfield Road. The smaller park-and-ride has fewer motor vehicle trips associated with it and therefore less of an impact.

The following summarizes the intersection operations for the two intersections with reduced impacts and summarizes the potential mitigations:

- SE Park Avenue/SE McLoughlin Boulevard – Retain existing southbound geometry of left turn and two through lanes. Modify eastbound approach geometry to include separate left-turn pocket and shared through/right-turn lane. All other previously identified

mitigations remain. Intersection would operate at 0.98 V/C ratio and meet jurisdictional standard with this configuration and mitigation.

- SE Park Avenue/SE Oatfield Road – Retain intersection control as east/west stop controlled and north/south free-flow. Modify eastbound approach geometry to have separate right-turn pocket of 200 feet in length. Retain southbound, northbound, and westbound approach geometry. Intersection would operate at LOS F conditions, but has less than ten seconds of delay impact over No-Build conditions with delay 38.7 seconds during the PM peak hour (No-Build has delay of 29.4 seconds).

Impact Minimization Measures. Table 4.3-18 summarizes proposed strategies to minimize the impacts associated with the light rail project and allow for operations similar to the No-Build Alternative.

4.3.3 Freight Impacts

The light rail project has the potential to affect freight operations within the corridor. The following section summarizes impacts and improvements related to freight operations within each sub-area of the Portland-Milwaukie Light Rail Project. Similar to motor vehicle operations, freight operations could be impacted due to light rail gate closures, roadway realignments creating out-of-direction travel, changes to curb radii that restrict large vehicle turning movements, and/or potential roadway closures creating out-of-direction travel. These impacts have been identified in the motor vehicle section. A full analysis of all freight operations can be found in more detail in the *Transportation Impacts Results Report* (Metro 2010).

Portland State University to SE Powell Boulevard: Freight activity is generally low through intersections in this area on the west side of the river. Local delivery access will be affected along SW Lincoln Street, where the center-running light rail alignment would restrict access to right-in/right-out movements only and increase the potential for out-of-direction travel.

On the east side of the Willamette River, the area is classified as a Freight District, with SE 11th Avenue and SE 12th Avenue classified as major truck streets by the City of Portland. All streets within a freight district are intended to allow truck movements. The LPA to Park Avenue and the MOS to Lake Road would not affect freight route alignments, although some intersections will be reconstructed to maintain freight circulation and access within the freight district. Delays from gated crossings would add approximately 30 seconds (on average) of motor vehicle delay per occurrence to truck/motor vehicles.

SE Powell Boulevard to SE Tacoma Street: Freight operations could be affected from driveway access changes. Along SE 17th Avenue, most of the driveways and unsignalized intersections would be modified to right-in/right-out access due to the center-running light rail alignment. Because of the change in access, several businesses with driveways on SE 17th Avenue might be affected, and some out-of-direction travel could result.

Table 4.3-18
Sub-Area D - Highway 224 to SE Park Avenue
Summary of 2030 Potential Motor Vehicle Impact Minimization Measures

Intersection	Type of Impact				Measures	Criteria to Meet	Operations	
	Operations	Queuing	Access	Warrants			No-Build	Mitigated Proposed Project
LPA to Park Ave.								
SE Park Ave./SE Oatfield Rd.	◆	◆		◆	Signalize intersection Add eastbound right-turn pocket Add northbound left-turn lane Add southbound left-turn lane	LOS D	LOS F	LOS A
SE Park Ave. between SE 27th Ave. and SE McLoughlin Blvd		◆			Stripe for back to back left turns/slight side-by-side left turns in middle of section to accommodate eastbound and westbound queuing	280 ft	EBL Queue = 250 ft WBL Queue = n/a	EBL Queue = 125 ft WBL Queue = 175 ft
LPA Phasing Option								
SE Park Ave/SE McLoughlin Blvd	◆	◆			Retain southbound approach Modify eastbound approach to be separate left-turn pocket and shared through right-turn lane	V/C 0.99	V/C = 1.00	V/C = 0.98
SE Park Ave./SE Oatfield Rd.	◆	◆		◆	Add eastbound right-turn pocket Retain east-west stop controlled intersection Retain southbound, northbound, and westbound approaches	LOS D	LOS F	LOS F
SE Park Ave. between SE 27th Ave. and SE McLoughlin Blvd		◆			Stripe for back-to-back left turns/slight side-by-side left turns in middle of section to accommodate eastbound and westbound queuing	280 ft	EBL Queue = 250 ft WBL Queue = n/a	EBL Queue = 125 ft WBL Queue = 175 ft

Table 4.3-18
Sub-Area D - Highway 224 to SE Park Avenue
Summary of 2030 Potential Motor Vehicle Impact Minimization Measures

Intersection	Type of Impact				Measures	Criteria to Meet	Operations	
	Operations	Queuing	Access	Warrants			No-Build	Mitigated Proposed Project
MOS to Lake Rd.								
SE Harrison St./SE Main St.	◆				Signalize intersection or Add eastbound right-turn lane	LOS D	LOS F	LOS B LOS C
SE McLoughlin Blvd./SE Washington St.	◆	◆			Add second westbound left-turn lane or Remove and relocate west leg of intersection (currently City of Milwaukie is pursuing this)	d/c ratio = 1.10 Queue Storage ~500 ft	d/c ratio = 1.10 SB Queue = 450 ft	d/c ratio = 1.10 SB Queue = 300 ft d/c ratio = 1.06 SB Queue = 175 ft
SE Washington St./SE Oak St..	◆	◆			Signalize or Roundabout or Restrict eastbound left turns or Seek a design exception	d/c ratio = 1.10 Queue Storage ~500 ft	d/c ratio = 1.10 SB Queue = 450 ft	d/c ratio = 1.10 SB Queue = 300 ft d/c ratio = 1.06 SB Queue = 175 ft

Notes: LOS = Level of service based on average intersection delay.
d/c ratio = demand-to-capacity ratio.

[1] Improvement needed under No-Build Alternative as well to meet jurisdictional standard.

Heavy trucks that currently access SE McLoughlin Boulevard via SE 18th Avenue could experience up to 800 feet of out-of-direction travel. Assuming a travel speed of 25 miles per hour, this would add approximately 22 seconds of travel time.

SE Tacoma Street to Highway 224: Potential impact to freight operations could result from disruptions due to additional vehicle/truck activity in the area as a result of construction of the light rail alignment. After construction of the light rail project, the alignment should not directly affect freight operations within this area.

Highway 224 to SE Park Avenue: Local freight access and circulation within downtown Milwaukie could be affected by gate closures at SE Harrison Street (a minor local freight route).

During the PM peak hour, the largest 95th percentile queue length on SE Harrison Street that could be expected is 13 to 15 vehicles, and the average delay could be approximately 11 to 13 seconds for the peak vehicle direction during the PM peak hour.

Mitigation. With the improvements outlined above, it is not expected that any additional improvements or mitigation beyond those already assumed under the motor vehicle analysis as part of the current project design would need to occur to address freight impacts. It is expected that the motor vehicle improvements would allow for adequate freight operations.

4.3.4 Navigation Impacts

As described in Chapter 2, the project will construct a new Willamette River bridge, which would be a cable-stayed structure with two in-water piers. The bridge is designed to accommodate light rail trains, streetcars, buses, pedestrians, bicycles, and emergency vehicles. Two 14-foot multi-use paths would be on the sides of the bridge, separated from the transit vehicles and tracks by barriers. The bridge will cross the Willamette River between the Marquam and Ross Island bridges (River Mile (RM) 13.5 and RM 14, respectively). In developing the design concept for the proposed new bridge, the project initiated a review of current and future navigational needs, beginning with the SDEIS efforts in 2007 and 2008, and continuing through the preparation of this FEIS. These efforts included document research, field investigations, and outreach to navigational users and interests, coupled with an extensive open public process to review and refine various design concepts. As a result, the proposed vertical clearance for the project was increased from the SDEIS alternatives. The current navigational clearance proposal was balanced with detailed engineering and constructability considerations for the complex new bridge structure, and also considered such factors as land-side urban fit, visual and aesthetic appeal, Americans with Disabilities Act requirements, and costs. The bridge would provide 77.52 feet of vertical clearance as measured from the Columbia River Datum (CRD) for approximately 300 feet in the middle of the center span of the bridge.

Federal authority to permit new bridges is delegated to the U.S. Coast Guard (USCG), according to Section 9 of the Rivers and Harbors Act of 1899 and the General Bridge Act of 1946. The purpose of the two acts is to preserve the public right of navigation and to prevent interference with interstate and foreign commerce. The Willamette River to RM 183.2 is designated a navigable waterway by the USCG. None of the other streams crossed by the project are navigable. Issuance of the bridge permit that defines the required clearances is based on the USCG consideration of existing navigation uses. This consideration includes vessel heights,

location of onshore facilities, frequency of use, seasonality of use, availability of alternative facilities or operation, and other factors.

In the vicinity of the proposed crossing, the lift span of the Hawthorne Bridge has the highest clearance at 159 feet, when the deck is raised. Operators raise the bridge an average of 200 times per month (300 times per month in the summer). Both the Ross Island and Marquam bridges (which would be immediately adjacent to a proposed transit bridge) have maximum vertical clearances of 120 feet. Adjacent spans on both bridges have lower vertical clearances but wider horizontal clearances.

The lowest vertical clearance in the vicinity of the new crossing is at the current Sellwood Bridge at 75 feet. The Sellwood Bridge is scheduled for replacement/renovation through a separate project, but its replacement height has not yet been finalized. There are potential navigational uses between the proposed bridge and the Sellwood Bridge. If the proposed new transit bridge has a clearance that matches or is greater than the Sellwood Bridge clearance, the constraint would be shared at both locations and limit use between them by taller vessels.

An analysis of existing and future river navigation needs (including commercial and recreational users) found that a 77.52 feet vertical clearance would allow for the passage of the majority of the anticipated navigational users. Any restrictions in passage would be primarily in the winter, during high water events, and could be minimized or reduced through existing river management systems, including dams and control devices on the Columbia River and Willamette River. The estimate of the current and future passage rates reflects an additional 3.5-foot allowance for safety and river level fluctuations, including the potential future effects of climate change.

A river user, the owner of a charter sail company, Sail Scovare Yachts & Expeditions, Inc., expressed concerns regarding the project's vertical navigation restrictions for one of its vessels. The affected vessel has a vertical clearance of 65.8 feet. The effects to Sail Scovare would be similar to other charter operations in the area with an estimated 90 percent and above passage rate under the bridge (discussed in more detail in Appendix O).

Additional details on the results of the navigation and climate change analysis are provided in Appendix O of this FEIS. The USCG will make the final decision regarding vertical clearance after TriMet submits its bridge permit request, after the publication of this FEIS.

4.4 SHORT-TERM CONSTRUCTION IMPACTS

Construction of the light rail project within the Portland-Milwaukie Corridor would result in temporary short-term impacts to local and regional transportation operations. These impacts could potentially include temporary lane closures, temporary signals, detours, and disruption of traffic during peak and nonpeak times.

Potential outcomes of these impacts could result in the temporary intrusion of through traffic into local neighborhoods because of congestion and/or detours, disruption of access by motorized and non-motorized modes to local businesses, and the temporary loss of on-street parking.

Construction impacts along the corridor fall into four primary categories: Station Area Impacts, Corridor/Street Impacts, Intersection Impacts, and Navigation Impacts. The following discussion

describes the types of areas where construction impacts could occur and potential mitigation measures.

4.4.1 Station Area Impacts

Construction impacts related to station areas are location-specific and would occur where new park-and-rides or stations are being proposed. Impacts associated with park-and-ride lot construction (surface or garage) would potentially include (but are not limited to) temporary impacts such as increased freight within the surrounding area, detours, lane closures, and/or loss of on-street parking. Station construction impacts are similar to park-and-ride impacts; however, there could be fewer impacts with the station construction because of reduced freight activity for areas that would now be occupied by stations and their construction. Most of these construction impacts would be temporary and would be related to the construction of the station areas.

4.4.2 Corridor/Street Impacts

The construction impacts for these areas are defined as a length of roadway that would be affected due to construction of the project beyond a single location, such as an intersection. Project elements, like bridges, that affect a corridor could have construction impacts such as temporary detours, lane closures, intrusion of traffic into local neighborhoods due to congestion, and loss of on-street parking. Most of these impacts would be temporary, with the exception of the loss of some on-street parking in certain locations. Please refer to the parking impacts discussion in Section 4.1.6 to see which areas would be affected by loss of on-street parking.

4.4.3 Intersection Area Impacts

The implementation of the light rail project would have some adverse operational effects at specific intersections within segments. The construction of the potential mitigation measures would create short-term temporary construction impacts at individual intersections. These temporary construction impacts would generally be related to lane closures, temporary signals, and/or detours. These impacts would be temporary during the implementation of the mitigation measures at intersections.

4.4.4 Navigation

Construction of the bridge may require temporary periods where barges, in-water construction, or overhead construction would constrain the channel or cause delays to vessels.

There is also a separate and unique temporary construction impact to a navigation user, the Portland Spirit. Portland Spirit moors its vessels at Caruthers Landing, which is just south of the east bridge span. The proximity between the bridge construction and Caruthers Landing may cause maneuvering difficulties for two of Portland Spirit's vessels.

Construction of the east span of the bridge may result in temporary loss of dock access for the Portland Spirit. As discussed further in Appendix O, Portland Spirit moors its two largest vessels, the Portland Spirit and the Sternwheeler Columbia Gorge, at the northern portion of Caruthers Landing. The northernmost portion of Caruthers Landing is in close proximity to anticipated bridge construction activities, such as barge and crane movements. This proximity

may cause maneuvering difficulties for these two large vessels as they access to and from the dock to avoid the bridge activities.

4.4.5 Mitigation for Short-Term Construction Impacts

Several potential mitigation measures could be explored to help minimize construction impacts. The potential mitigation strategies range from the provision of temporary facilities to replace affected facilities to limiting work areas and working hours. The following is a list of some potential construction mitigation measures. This list is not comprehensive, but represents a range of alternatives that could be implemented.

- During construction, affected transit stops would be temporarily relocated to the nearest possible location on the same transit route without interfering with the construction process.
- During construction, temporary sidewalks and/or pathways would be provided to replace any sidewalks and/or trails adjacent to the project that are affected by construction.
- To minimize the amount of truck excavation trips to and from the sites, efforts should be made to recycle as much of the excavated earth from the project sites as practical.
- A comprehensive public outreach program would be developed to inform local residents and businesses of potential delays and impacts to the local street network due to temporary construction.
- To help minimize on-street parking impacts, temporary parking could be identified to mitigate the temporary loss of on-street parking due to construction.
- Staging areas should be identified along the alignment to help minimize the impact of materials and equipment intruding into surrounding residential or commercial areas.
- If Portland Spirit mooring impacts cannot be avoided and to avoid the potential for permanent displacement and relocation as described in Section 3.1, the project would provide off-site temporary mooring facilities so that Portland Spirit may dock its two largest vessels at another location during construction, while still maintaining operations.