Earthquake Ready Burnside Bridge:
Combined Final Environmental Impact Statement/Record of Decision

# Chapter 4

## Supplementary Analysis and Discussion

For other questions including those related to the Americans with Disabilities Act and Civil Rights Title VI accommodations, call 503-988-5050. You can also call Oregon Relay Service 7-1-1 or email burnsidebridge@multco.us. For information about this project in other languages please call 503-988-5970.

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U.S. Department of Transportation
Federal Highway Administration

Multnomah County

# 4 Supplementary Analysis and Discussion

In response to limited design refinements specific to the Final EIS Preferred Alternative and public and agency comments on the SDEIS, this section provides supplementary analysis and discussion on topics including transportation; parks and recreation; geology; water quality; wetlands and waters; and vegetation, wildlife and aquatic resources. The design refinements and response to agency comments that warranted supplemental analysis include:

1. The use of structures (e.g., starlings or dolphins) to deflect river water and floating debris on the upstream (south) side of the bridge's movable span piers.
2. Active transportation mitigation refinements.
3. Updated traffic analysis results for the Final EIS Preferred Alternative based on comments from the Portland Bureau of Transportation.
4. Bridge width change on the west approach to accommodate bus dwelling space.

## 4.1 Transportation

### 4.1.1 Active Transportation Mitigation

A broad list of potential mitigation measures was included in the Draft EIS to mitigate for the Project's potential impact to active transportation users. Based on comments from the Portland Bureau of Transportation (PBOT) and other stakeholders, a detailed assessment was undertaken to identify more specific mitigation measures. A methodology for assessing active transportation mitigation was developed in consultation with PBOT and includes the following elements:

- Active Transportation Detour Routes – Improvements and upgrades would be needed along designated pedestrian and bicycling detour routes around closures of the Burnside Bridge, the Vera Katz Eastbank Esplanade, and the Waterfront Park Trail.
- Traffic Dispersion Impacts to Active Transportation – These are potential impacts to existing walking and bicycling corridors from traffic diverting around the Burnside Bridge closure. These could include:
  - Impacts to major street bikeways and pedestrian crossings.
  - Spillover impacts to neighborhood greenways from traffic diverting onto the local street network when the major street network is congested.

#### Active Transportation Detour Routes

Active transportation detour routes are intended to be signed detours for pedestrians and bicyclists that happen upon closures of the Burnside Bridge, the Vera Katz Eastbank Esplanade, or the Waterfront Park Trail. As users become more familiar with construction, pedestrians and bicyclists may choose to take a different route to avoid construction and it is important that designated routes be provided around these closures that are safe, comfortable, and accessible.

The following detour routes are updates from the versions included in the Draft EIS; updates are based on comments and consultation with PBOT.

### *Pedestrian Detour Changes*

The pedestrian detour route around the Burnside Bridge closure was updated from the version included in the Draft EIS to address concerns raised by PBOT about personal security and the condition of sidewalks and crossings along the previous route. PBOT recommended that the signed route to the south use the Hawthorne Bridge rather than the Morrison Bridge to address personal security concerns, safety concerns, and the possibility of long delays to pedestrians when trains are passing at the at-grade crossing on SE Yamhill Street. The updated detour route is shown in Figure 4-1 and is described below.

#### ACCESS TO THE STEEL BRIDGE

Pedestrians walking westbound on E Burnside Street would cross the street and use the west sidewalk along NE Martin Luther King, Jr., Boulevard north of E Burnside Street to NE Lloyd Boulevard and then use the south sidewalk and pathway to access the Steel Bridge. From the Steel Bridge, pedestrians would use the Waterfront Park Trail or Better Naito Forever to connect to downtown streets; NW Couch Street and NW 2nd Avenue would be signed as the formal detour route to reconnect with W Burnside Street.

This route is the same distance and has the same travel time as the previous detour route included in the Draft EIS. It also includes signalized crosswalks and separated pedestrian facilities along its length to reduce pedestrian exposure to traffic.

#### ACCESS TO THE HAWTHORNE BRIDGE

Pedestrians walking westbound on E Burnside Street would cross the street and use the west sidewalk along SE Grand Boulevard south of E Burnside Street to SE Madison Street and then use the north sidewalk to access the north side of the Hawthorne Bridge (pedestrians walking eastbound would use the south side of the Hawthorne Bridge and the south sidewalk of SE Hawthorne Street and cross the street to connect with the west sidewalk along SE Grand Boulevard). On the west side of the bridge, pedestrians would use the Waterfront Park Trail or Better Naito Forever to connect to downtown streets; SW Pine Street and SW 5th Avenue would be signed as the formal detour route to reconnect with W Burnside Street.

This route is longer than the detour route included in the Draft EIS. However, using the Hawthorne Bridge rather than the Morrison Bridge provides a more reliable route and fewer security concerns for people walking through the Central Eastside Industrial District. On the west side of the river, the new route with pedestrians using the Waterfront Park Trail or Better Naito Forever would provide a pedestrian facility completely separated from traffic. The route would connect back to W Burnside Street using SW Pine Street and SW 5th Avenue and provide pedestrians with signalized crosswalks at all intersections.

#### EASTBANK ESPLANADE

The pedestrian detour route around the Eastbank Esplanade closure was updated from the version included in the Draft EIS to address concerns raised by PBOT about personal security and the length and circuitousness of the SE Grand route. PBOT recommended that the SE Grand route be removed and that all pedestrians be detoured via the Westside Route shown on the updated detour map in Figure 4-2 The Westside Route is unchanged from the version included in the Draft EIS.

#### WATERFRONT PARK TRAIL

The pedestrian detour route around the Waterfront Park Trail closure has not been changed from that included in the Draft EIS, but it is included in Figure 4-3 for reference.

**Figure 4-1. Updated Pedestrian Detour Route for the Burnside Bridge Closure**

**Figure 4-2. Pedestrian Detour Route for the Eastbank Esplanade Closure**

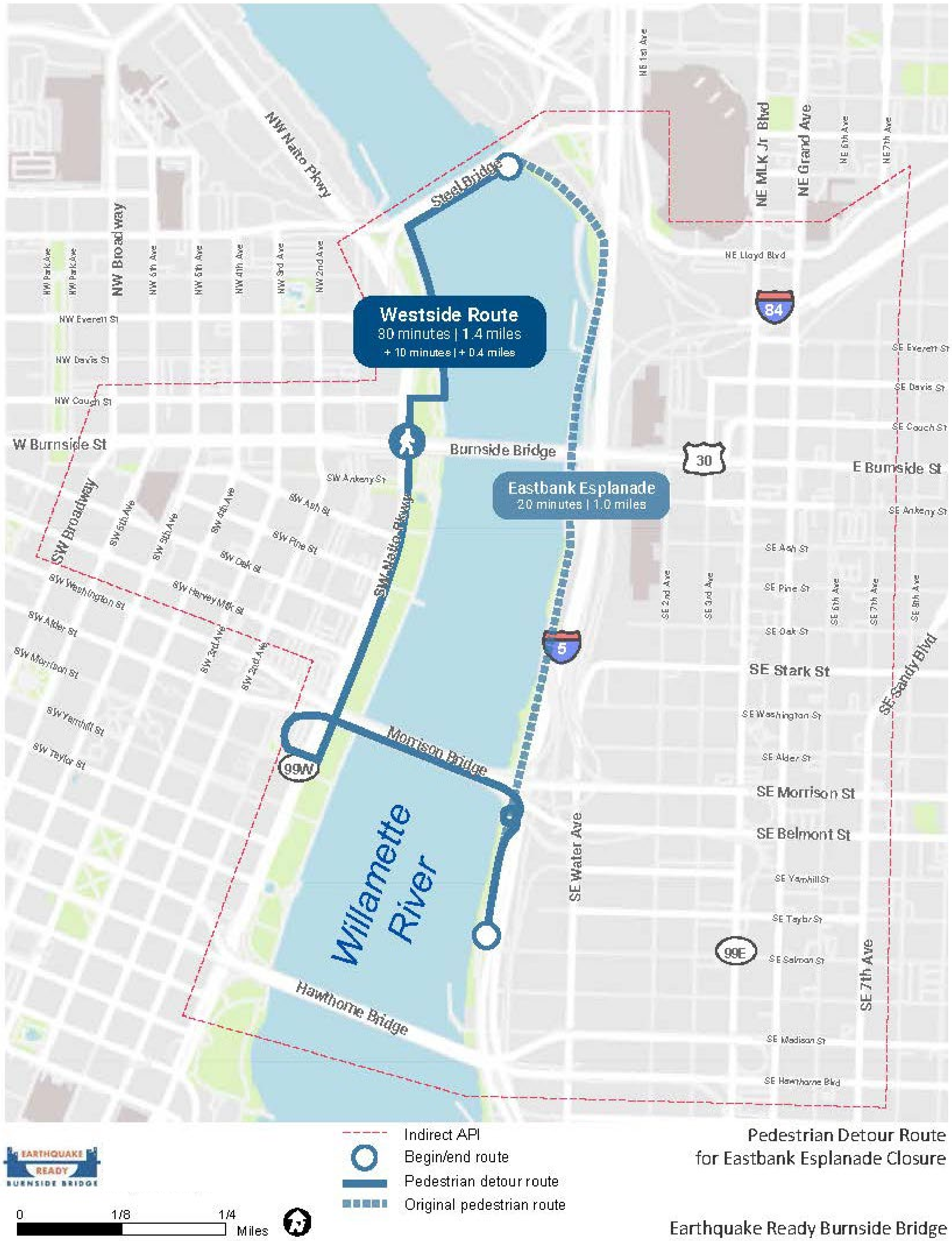


**Figure 4-3. Pedestrian Detour Route for the Waterfront Park Trail Closure**

### *Pedestrian Detour Mitigation*

Mitigation related to the pedestrian detour routes is included in the mitigation list for the Final EIS. These were discussed with PBOT and will be completed including any upgrades needed to ensure that sidewalks are of sufficient width and in good condition, intersections are fitted with ADA-compliant ramps and appropriate crosswalks, consideration is given to crossing enhancements such as curb extensions on side-street crossings, and that there is safe access to transit stops along the route.

Mitigation costs would be calculated by applying unit costs for the items above to the number of locations where these treatments would apply along the pedestrian detour routes.

### *Bicycling Detour Changes*

The bicycling detour route around the Burnside Bridge closure has been updated from the version included in the Draft EIS. The updated route addresses concerns raised by PBOT about the circuitousness of some parts of the route. It also responds to a recommendation that the signed route to the south use the Hawthorne Bridge rather than the Morrison Bridge to reduce safety concerns and address the possibility of long delays to bicyclists when trains are passing at the at-grade crossing on SE Yamhill Street. The updated detour route is shown on Figure 4-4 and is described below.

#### ACCESS TO THE STEEL BRIDGE

Bicyclists will be signed to use the NE 7th Avenue neighborhood greenway to access the Blumenauer Bridge across I-84. They will then be routed along NE Lloyd Boulevard that has striped bicycle lanes and a wide shared-use path on the south side of the street to the lower deck of the Steel Bridge. On the west side of the Burnside Bridge, bicyclists would use the Waterfront Park Trail or Better Naito Forever to connect to downtown streets with NW Couch Street to be signed as the formal detour route to reconnect with W Burnside Street.

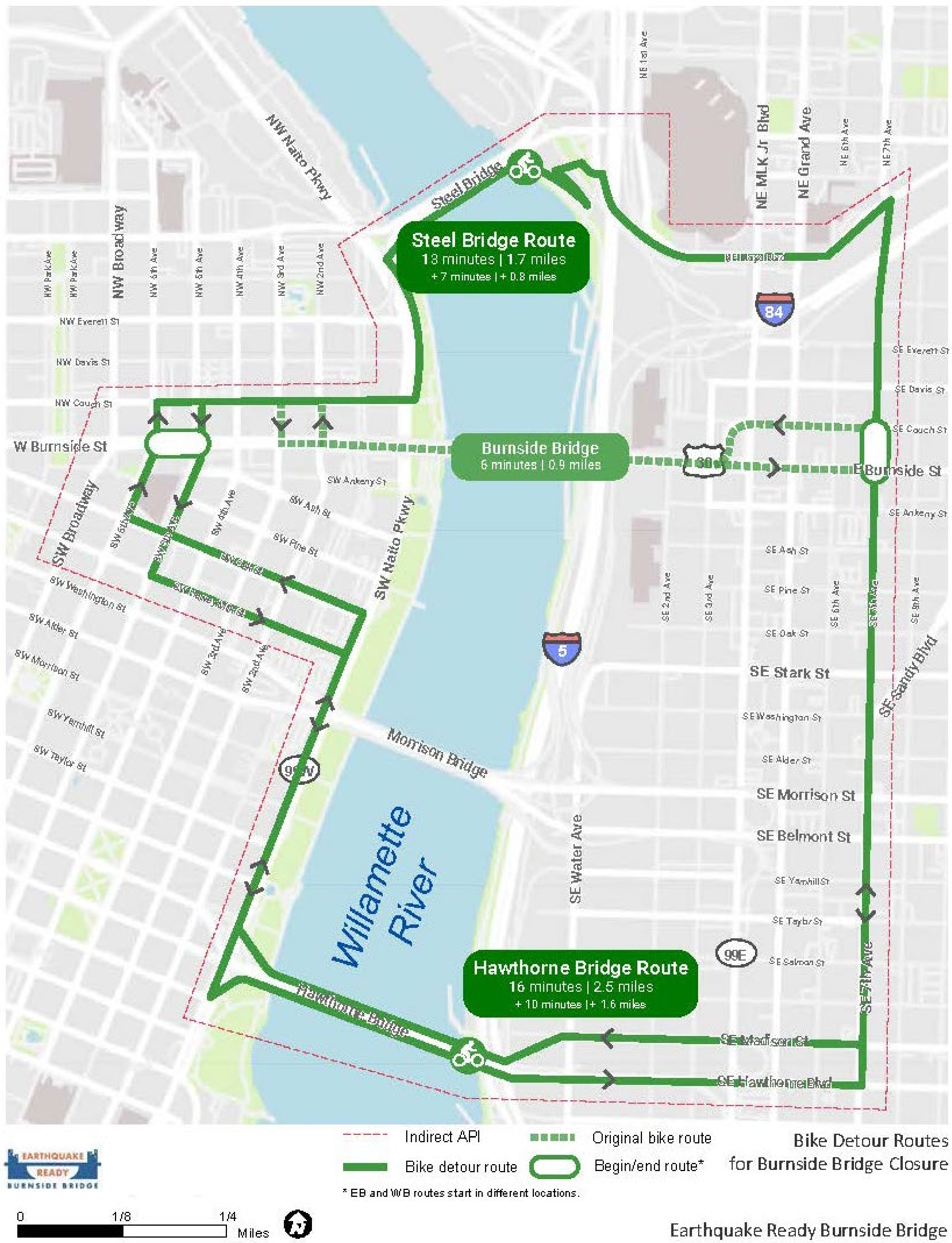
This route is the same distance and has the same travel time as the previous detour route included in the Draft EIS, and it is only slightly modified to use NE 7th Avenue rather than a part of NE 6th Avenue. This is more direct and uses the City’s designated neighborhood greenway network.

#### ACCESS TO THE HAWTHORNE BRIDGE

Bicyclists will be signed to use the bicycle facilities on SE 7th Avenue and on the SE Madison Street (westbound) / SE Hawthorne Boulevard (eastbound) couplet to access the separated pathways on the Hawthorne Bridge. On the west side of the bridge, bicyclists would use the Waterfront Park Trail or Better Naito Forever to connect to downtown streets with the bicycle facilities on SW Oak Street (westbound) and SW Harvey Milk Street (eastbound) and SW 6th Avenue and SW 5th Avenue to be signed as the formal detour routes to reconnect with W Burnside Street.

This route is longer than the detour route included in the Draft EIS. However, using the Hawthorne Bridge rather than the Morrison Bridge would provide a more reliable route. On the west side of the river, bicyclists using the Waterfront Park Trail or Better Naito Forever would have a bicycling facility completely separated from traffic; it would connect back to W Burnside using existing bikeways on SW Oak Street and SW Harvey Milk Street.

**Figure 4-4. Bicycling Detour Route for the Burnside Bridge Closure**



#### EASTBANK ESPLANADE

The bicycling detour route around the Eastbank Esplanade closure has been updated from the version included in the Draft EIS to address concerns raised by PBOT about the length, circuitousness, and exposure to safety risk of the Eastside Route included in the Draft EIS. PBOT recommended that the Eastside Route be removed and that all bicyclists be detoured via the Westside Route. The Westside Route is unchanged from the version included in the Draft EIS. The updated detour map is shown on Figure 4-5.

#### WATERFRONT PARK TRAIL

The bicycling detour route around the Waterfront Park Trail closure has not been changed from that included in the Draft EIS; it is included in Figure 4-6 for reference.

### *Bicycling Detour Mitigation*

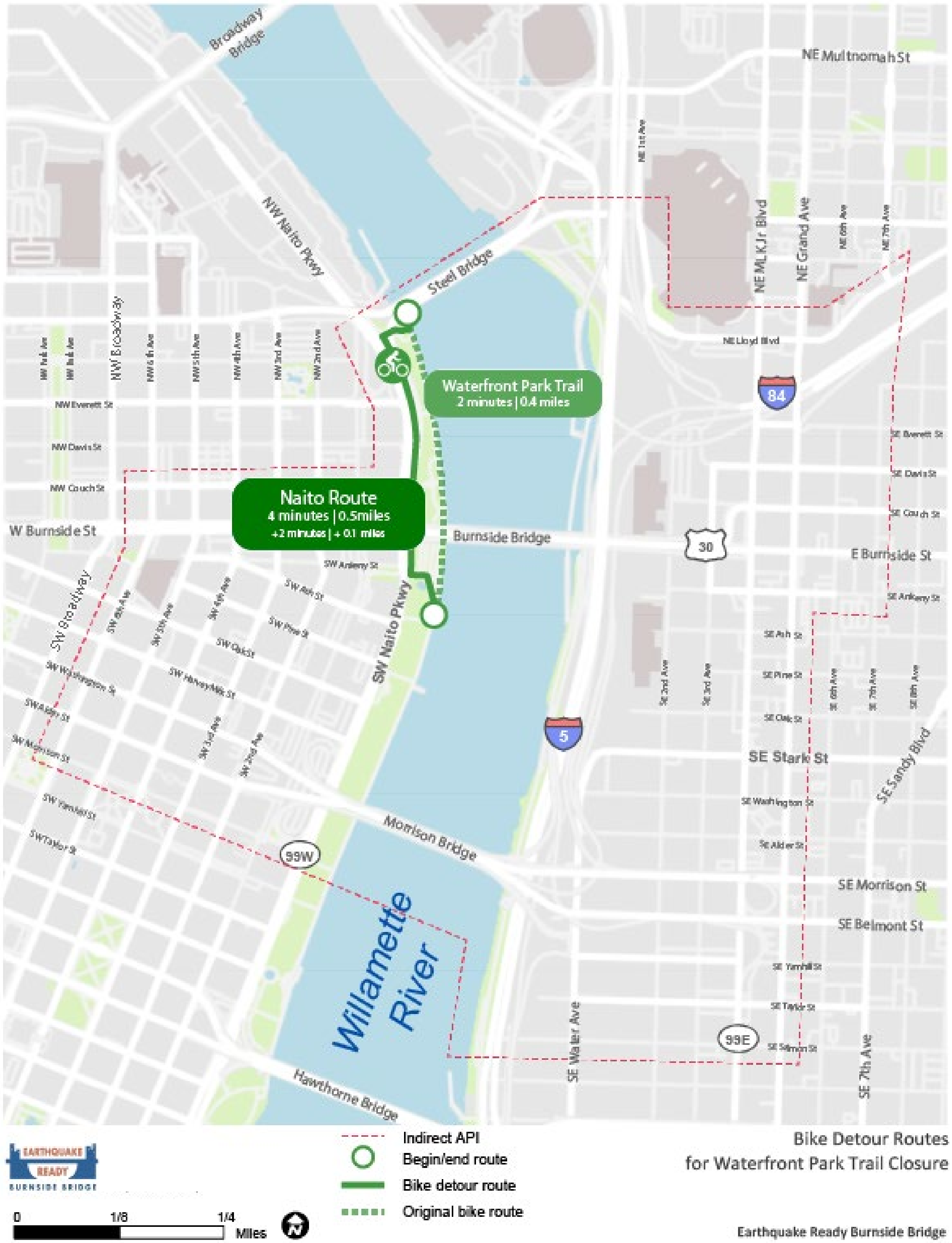
Mitigation related to the bicycling detour routes is included in the mitigation list for the Final EIS. Mitigation measures were discussed with PBOT and include the following:

- Restripe to refresh bike facility markings.
- Make minor signal timing upgrades such as retiming signals, adding protected turn phases, etc.
- Add hardened centerlines to encourage left-turn traffic calming.
- Add traffic wedges, striping, and flexible delineators, for example, to encourage right-turn traffic calming.

Mitigation costs would be calculated by applying unit costs for the items above to the number of locations where these treatments would apply along the detour routes, and by applying a “proportionality” factor to these treatments that considers the percentage of bicyclists expected to use each of the detours to the Steel and Hawthorne Bridges.

**Figure 4-5. Bicycling Detour Route for the Eastbank Esplanade Closure**

**Figure 4-6. Bicycling Detour Route for the Waterfront Park Trail Closure**



## Active Transportation Impacts from Traffic Dispersion

During times when the Burnside Bridge is closed, traffic would be diverted to other routes in the network. This traffic dispersion has the potential to impact existing active transportation users in a number of ways:

1. Pedestrians and bicyclists using the major street network could experience potential safety impacts where traffic is diverted.
2. Neighborhood greenways could experience potential impacts from traffic spilling into the local street network as drivers seek to avoid congestion on the major street network.

Potential traffic dispersion around the Burnside Bridge closure is shown in Figure 4-7 (for the eastbound PM peak hour) and Figure 4-8 (for the westbound AM peak hour). These figures show the anticipated diversion volume (in vehicles per hour), the change in volume compared to No-Build traffic volumes (percentage increase or decrease), and segments that are anticipated to exceed a volume-to-capacity (v/c) ratio of 1.1.[1]

### *Potential Impacts to Pedestrians on Traffic Diversion Routes*

There are potential impacts to the safety of pedestrians using the major street network where traffic is expected to disperse as a result of the Burnside Bridge closure. A general list of safety mitigation measures is included in the Draft EIS and includes the following items.

- Signal equipment retrofits such as additional signal heads for visibility, 12-inch-diameter signal lenses, and reflective backplates for signal heads
- Restriping to refresh crosswalk markings
- Minor signal timing upgrades such as retiming signals, adding protected turn phases, and adding leading pedestrian intervals
- Left-turn traffic calming such as adding hardened centerlines.
- Right-turn traffic calming such as adding traffic wedges, striping, and flexible delineators

Mitigation costs would be calculated by applying unit costs for the items above to the number of signalized and unsignalized intersections where these treatments would apply along the traffic dispersion routes and applying a “proportionality” factor to these treatments that considers the share of traffic related to the Project.

[1] The volume-to-capacity ratio is a measure of the demand for traffic compared to the available capacity of a roadway segment. PBOT uses a volume-to-capacity ratio of 1.1 during the first hour of the peak period as a threshold for arterial streets in the central city; at this point, these routes are considered overly congested and drivers may try to find alternative routes, potentially using the local street network.

**Figure 4-7. Potential Eastbound PM Peak Hour Traffic Dispersion Around the Burnside Bridge Closure**

**Figure 4-8. Potential Westbound AM Peak Hour Traffic Dispersion Around the Burnside Bridge Closure.**

#### *Potential Impacts to Bicyclists on Traffic Diversion Routes*

There are potential impacts to the safety of bicyclists using the major street network where traffic is expected to disperse as a result of the Burnside Bridge closure. These streets currently have a variety of conditions including physically separated bike facilities on the bridge crossings, some street segments with buffered bike lanes, many street segments with regular bike lanes, and some street segments with no bike facility.

Based on consultation with PBOT, mitigation measures for these impacts are included in the mitigation list in this Final EIS/ROD (see Chapter 7) and were calculated using the following methodology. For the streets that are part of the City's Major City Bikeway or City Bikeway networks (as identified in the Transportation System Plan [City of Portland 2018]) and where traffic is anticipated to increase as a result of the Burnside Bridge closure, mitigation related to the Project could include the Project's portion of the cost to upgrade the bicycle facility on these streets to a physically protected bicycle lane. No mitigation would be anticipated on streets that are not identified as part of the City's bikeway network.

Mitigation costs would be calculated using unit costs identified in the Portland Protected Bicycle Lane Planning and Design Guide (PBOT n.d.) applied to the length of each segment. The proportion of cost related to the Project would be calculated using the percentage of traffic expected to be dispersed to each segment compared to the total traffic for that segment.

#### *Potential Impacts to Neighborhood Greenways from Traffic Spillover*

During congested conditions, there could be times when traffic spills over from the major street network to the local street network. This has the potential to impact neighborhood greenways that run parallel or provide an alternative route to the major street network. A general list of streets and mitigation measures is included in the Draft EIS. Mitigation was refined to be located on select neighborhood greenways adjacent to streets where a traffic detour or diversion is expected. Mitigation measures would be developed in coordination with the PBOT as part of the Final Design phase.

Mitigation for impacted neighborhood greenways could include installing traffic diverters at key locations and some localized use of traffic circles, curb extensions, and speed humps. Mitigation costs would be calculated by applying unit costs to locations identified for these treatments. Mitigation for these impacts is included in the mitigation list for this Final EIS/ROD.

## 4.1.2 Traffic Detour Routes

General-purpose traffic detour routes are intended to be signed detours for vehicles upon closures of the Burnside Bridge. The following detour routes are updates from the versions included in the Draft EIS, and the updates are based on comments and consultation with PBOT since publication of the SDEIS.

### Traffic Detour Changes

The general-purpose traffic routes around the Burnside Bridge closure were updated from the version included in the Draft EIS to address comments from PBOT. Interstate 5 Rose Quarter Improvement Project construction may overlap with Burnside Bridge construction, so two sets of Burnside Bridge detour routes are being proposed: Option A and Option B. Option A includes detour routes via the Steel Bridge to the north and the Morrison Bridge to the south and is designed to avoid possible detour traffic from construction of the I-5 Rose Quarter project if construction of the two projects overlap. Option B includes detour routes via the Broadway Bridge to the north and the

Morrison Bridge to the south and is designed to protect TriMet transit operations over the Steel Bridge and at the Rose Quarter Transit Center. The updated traffic detour routes are shown in Figure 4-9 and Figure 4-10 and are described below. It should be noted that localized, minor roadway improvements may be needed to implement these detours, and those improvements would be determined as part of the Final Design phase.

#### *Detour via the Morrison Bridge (Options A and B)*

Traffic moving eastbound on W Burnside Street would be signed to turn right onto SW Alder Street at SW 19th Avenue. Eastbound traffic that turns onto W Burnside Street east of SW 19th Avenue would be signed to turn right at SW 11th Avenue and SW 3rd Avenue, and then left onto SW Alder Street. The signed detour route would continue onto the Morrison Bridge and then SE Belmont Street. Traffic would be signed to turn left onto SE 12th Avenue and then right onto E Burnside Street.

Traffic moving westbound on NE Couch Street would be signed to turn left onto SE Martin Luther King, Jr., Boulevard. The signed detour route would turn left onto the loop ramp to SE Morrison Street and then continue onto the Morrison Bridge and SW Washington Street. Traffic would be signed to turn right onto SW12th Avenue and then left onto W Burnside Street.

#### *Detour via the Steel Bridge (Option A)*

Traffic moving eastbound on W Burnside Street would be signed to turn left onto NW 2nd Avenue. The signed detour route would turn right onto NW Everett Street and then continue onto the Steel Bridge and NE Oregon Street. Traffic would be signed to turn left onto NE 1st Avenue and then right on NE Holladay Street. Traffic would be signed to turn right onto NE Martin Luther King, Jr., Boulevard and then left onto E Burnside Street.

Traffic moving westbound on NE Couch Street would be signed to turn right onto NE Grand Avenue. The signed detour route would turn left onto NE Multnomah Street and then continue onto the Steel Bridge and NW Glisan Street. Traffic would be signed to turn left onto NW Broadway and then right onto W Burnside Street.

#### *Detour via the Broadway Bridge (Option B)*

Traffic moving eastbound on W Burnside Street would be signed to turn left onto NW Broadway. The signed detour route would continue onto the Broadway Bridge and NE Weidler Street. Traffic would be signed to turn right onto NE Martin Luther King, Jr., Boulevard and then left onto E Burnside Street.

Traffic moving westbound on NE Couch Street would be signed to turn right onto NE Grand Avenue. The signed detour route would turn left onto NE Broadway, and then continue onto the Broadway Bridge and NW Broadway. Traffic would be signed to turn right onto W Burnside Street.

**Figure 4-9. Updated General-Purpose Traffic Detour Route – Option A**
Map shows eastbound and westbound traffic detour routes.

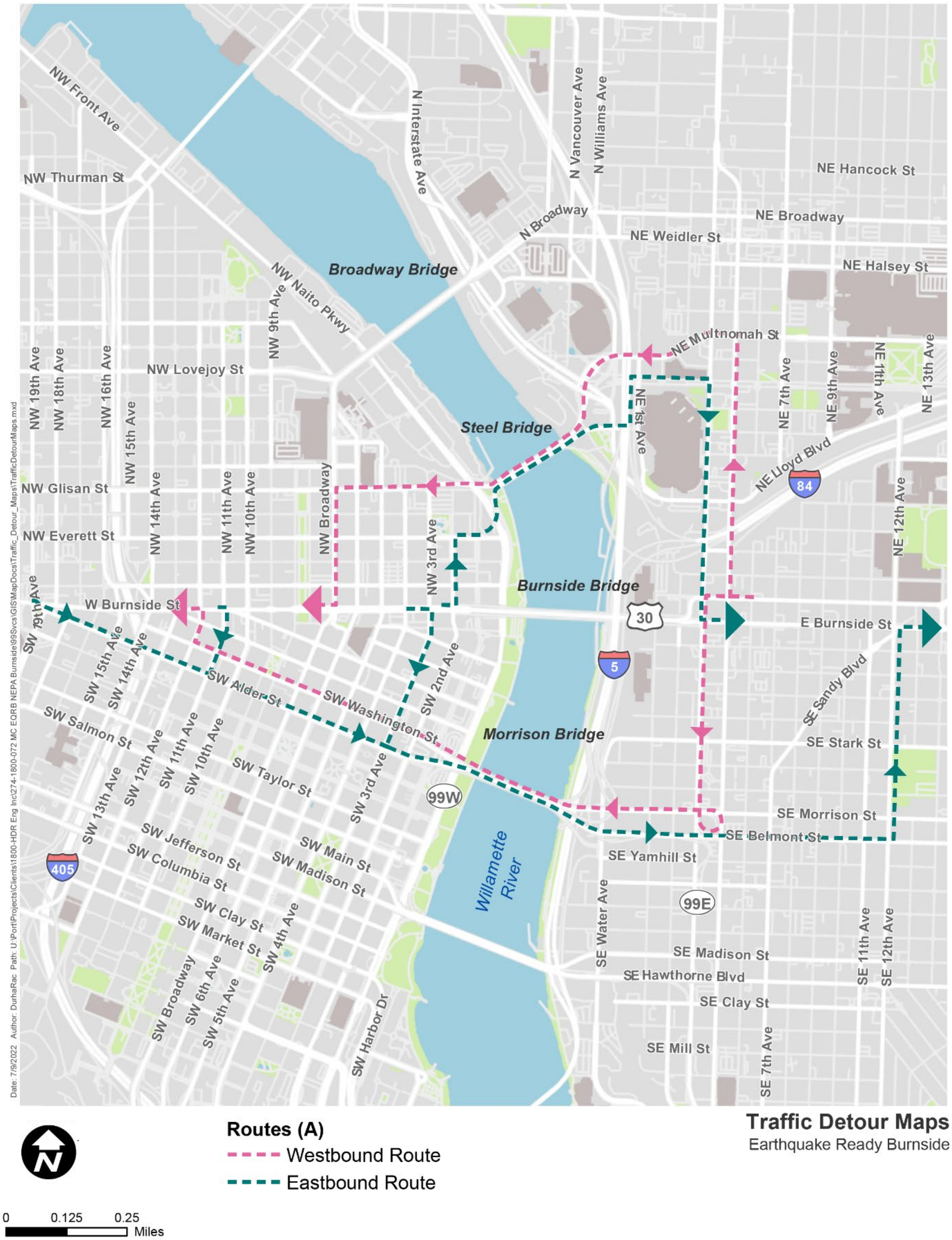


**Figure 4-10. Updated General-Purpose Traffic Detour Route – Option B**

Map shows eastbound and westbound traffic detour routes.

### 4.1.3 Bus Detour Routes

Bus detour routes are potential detours that TriMet could use for buses that cross the Burnside Bridge. The following detour routes were not included in the Draft EIS or SDEIS, but have been added as options based on continued coordination with PBOT and TriMet since publication of the SDEIS.

#### Bus Detour Changes

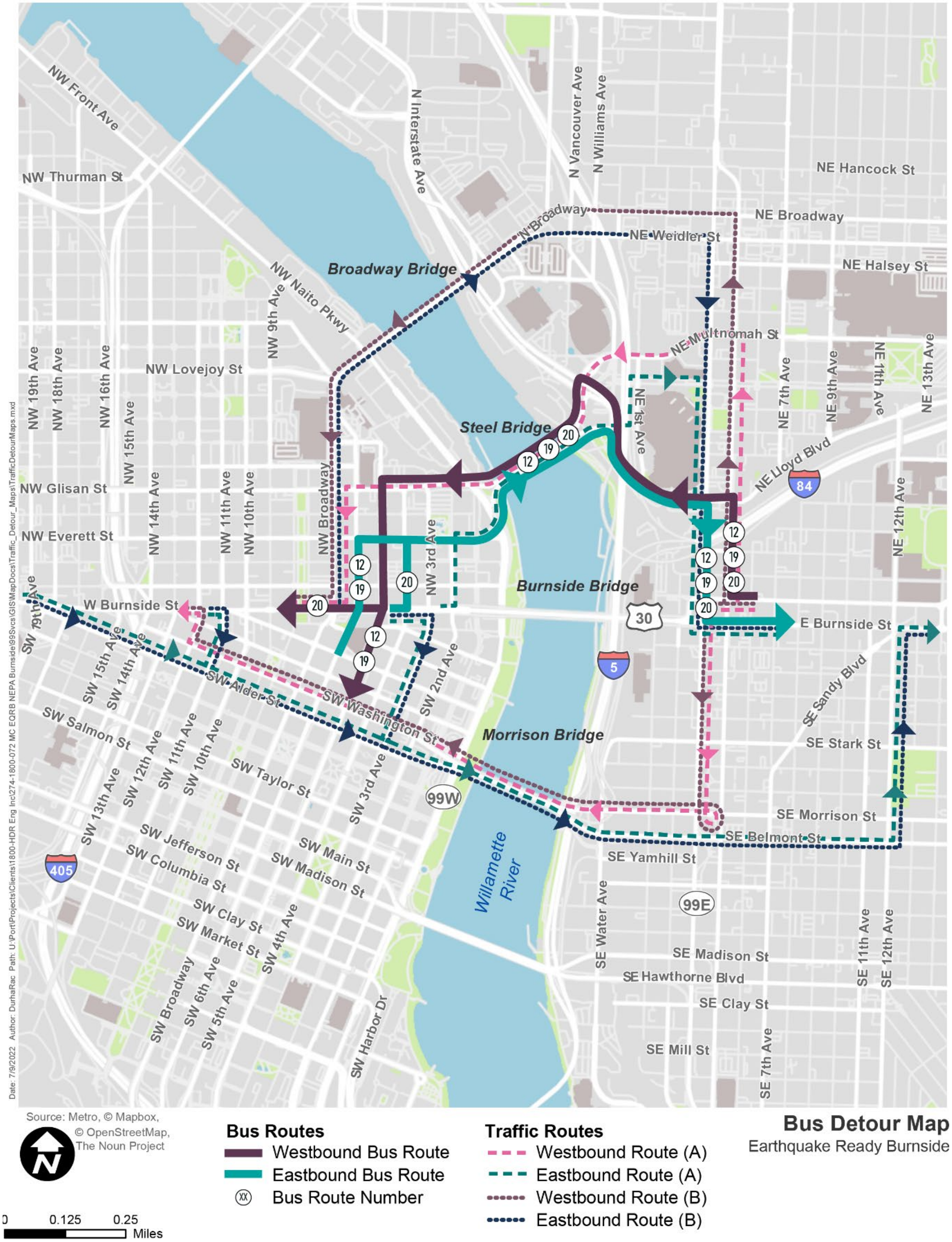
The bus routes around the Burnside Bridge closure were developed in coordination with PBOT and TriMet. The bus routes are intended to minimize overlap with general-purpose traffic detour routes where possible. The updated bus detour routes are shown in Figure 4-11 and are described below. It should be noted that localized, minor roadway improvements may be needed to implement these detours, and those improvements would be determined as part of the Final Design phase.

Line 20 buses travelling eastbound on W Burnside Street would turn left onto NW 4th Avenue and right on NW Everett Street. Line 12 and 19 buses travelling northbound on SW 6th Avenue that normally turn right onto W Burnside Street would continue north onto NW 6th Avenue, and then turn right on NW Everett Street. All three bus lines would continue onto the Steel Bridge and NE Oregon Street. The bus detour route would turn right onto NE Lloyd Boulevard, then right on NE Martin Luther King, Jr., Boulevard, and then left on E Burnside Street.

Lines 12, 19, and 20 buses travelling westbound on NE Couch Street would turn right on NE Grand Avenue. All three bus lines would turn left onto NE Lloyd Boulevard, continue onto N Interstate Avenue, and then left onto NE Multnomah Street. The bus detour route would continue onto the Steel Bridge, and then NW Glisan Street. All three bus lines would turn left onto NW 5th Avenue. Lines 12 and 19 buses would continue southbound on SW 5th Avenue. Line 20 buses would turn right onto W Burnside Street.

**Figure 4-11. Updated Bus Traffic Detour Route**

Map shows potential eastbound and westbound bus detour routes. Map also shows both options for eastbound and westbound traffic detour routes.



### 4.1.4 Final EIS Preferred Alternative Future Traffic Operations

The traffic analysis results for the Final EIS Preferred Alternative were updated based on comments from PBOT and the selection of a merge capacity of 1,400 vehicles per hour for the eastbound merge in the Final EIS Preferred Alternative. (SimTraffic output worksheets are included in Attachment G.) Similar to the SDEIS version of the traffic operations analysis, Synchro/SimTraffic 11 studio suite was used to analyze the Final EIS Preferred Alternative. Synchro is a macroscopic analysis and optimization software application. Synchro is based on the *Highway Capacity Manual* (TRB 2016) for signalized intersections, unsignalized intersections, and roundabouts. Synchro's signal optimization routine allows the user to weight specific phases, thus providing users more options when developing signal timing plans. With SimTraffic, individual vehicles are modeled and displayed traversing a street network. Based on PBOT comments, the following changes were made to the Synchro models:

- Use a mandatory length of 50 feet and a positioning length of 150 feet for the merge
- Use a turning speed of 15 miles per hour for all links along the NE Couch Street S-curve

Table 4-1 displays the 2045 Balanced Option AM and PM peak-hour traffic volumes across the Burnside Bridge. These results include peak-hour volume demand, peak-hour vehicle volume throughput, and percent of volume demand served.

**Table 4-1. 2045 Balanced Option Burnside Bridge Traffic Volumes**

| Direction | AM Peak Hour Vehicle Volume Demand (vph) | AM Peak Hour Vehicle Volume Throughput (vph) | AM Peak Hour Percent Served | PM Peak Hour Vehicle Volume Demand (vph) | PM Peak Hour Vehicle Volume Throughput (vph) | PM Peak Hour Percent Served |
|---|---|---|---|---|---|---|
| **EB Burnside Bridge** | 890 | 890 | 100% | 1,385 | 1,305 (-25) | 94% (-2%) |
| **WB Burnside Bridge** | 1,400 | 1,320 | 94% | 1,105 | 1,105 | 100% |

Source: Parametrix
Note: Differences from SDEIS Lane Option 1 (Balanced) are shown in parentheses.
EB = eastbound; vph = vehicles per hour; WB = westbound

The Balanced Option narrows from two eastbound general-purpose lanes east of the W Burnside Street and NW/SW 2nd Avenue intersection to one eastbound general-purpose lane across the bridge. Modeling predicts that only 94 percent of the westbound volume demand would be served during the AM peak hour, likely due to the S-curve. During the PM peak hour, 94 percent of the eastbound volume demand would be served; 80 vehicles would be unserved.

Table 4-2 displays the 2045 Balanced Option intersection traffic operations including total entering vehicles (TEV), intersection delay (in seconds), level of service (LOS)[2] for each of the study intersections, and worst movement if the intersection is unsignalized for both the AM and PM peak hours. Intersection TEV is shown for both vehicle volume demand and vehicle volume throughput. Downstream congestion from E Burnside Street and NE/SE 14th Avenue and from the metered on-ramp from NE Grand Avenue to I-84 would impact intersection operations along E Burnside Street.

[2] Level of service is a term used to qualitatively describe the operating conditions of a roadway based on factors such as speed, travel time, maneuverability, delay, and safety. The level of service of a facility is designated with a letter, A to F, with A representing the best operating conditions and F the worst.

**Table 4-2. 2045 Balanced Option Intersection Traffic Operations**

| | Study Intersection | Signalized or Unsignalized | AM Peak Hour Demand TEV (vph) | AM Peak Hour Throughout TEV (vph) | AM Peak Hour Delay (sec) | AM Peak Hour LOS | AM Peak Hour Worst Movement (if Unsignalized) | PM Peak Hour Demand TEV (vph) | PM Peak Hour Throughout TEV (vph) | PM Peak Hour Delay (sec) | PM Peak Hour LOS | PM Peak Hour Worst Movement (if Unsignalized) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | NW Everett Street and NW 4th Avenue | Signalized | 590 | 590 | 10 | B | N/A | 945 | 720 *(-145)* | 74 *(+41)* | E | N/A |
| 2 | NW Everett Street and NW 3rd Avenue | Signalized | 630 | 630 | 6 | A | N/A | 1,185 | 865 *(-210)* | 79 *(+49)* | E | N/A |
| 3 | NW Couch Street and NW Broadway | Signalized | 775 | 765 *(-10)* | 11 **(-2)** | B | N/A | 1,185 | 1,185 | 24 **(-5)** | C | N/A |
| 4 | NW Couch Street and NW 6th Avenue | Signalized | 285 | 285 | 10 | B | N/A | 335 | 335 | 13 **(-1)** | B | N/A |
| 5 | NW Couch Street and NW 5th Avenue | Signalized | 240 | 240 | 10 *(+1)* | B | N/A | 425 | 420 *(-5)* | 25 **(-4)** | C | N/A |
| 6 | NW Couch Street and NW 4th Avenue | Unsignalized | 380 | 380 | 9 **(-1)** | A | EB | 500 | 485 *(-15)* | 52 *(+15)* | F | EB |
| 7 | NW Couch Street and NW 3rd Avenue | Unsignalized | 545 | 545 | 16 | C | WB | 760 | 595 *(-90)* | 210 *(+79)* | F | WB |
| 8 | NW Couch Street and NW 2nd Avenue | Unsignalized | 700 | 700 | 21 *(+2)* | C | EB | 655 | 655 **(+5)** | 105 **(-69)** | F | WB |
| 9 | NW Couch Street and NW Naito Parkway | Signalized | 1,145 | 1,135 *(-10)* | 8 **(-10)** | A | N/A | 1,495 | 1,495 **(+30)** | 8 **(-3)** | A | N/A |
| 10 | NE Couch Street and NE MLK Blvd | Signalized | 2,460 | 2,400 **(+5)** | 19 | B | N/A | 2,845 | 2,845 | 21 | C | N/A |

| | Study Intersection | Signalized or Unsignalized | AM Peak Hour Demand TEV (vph) | AM Peak Hour Throughout TEV (vph) | AM Peak Hour Delay (sec) | AM Peak Hour LOS | AM Peak Hour Worst Movement (if Unsignalized) | PM Peak Hour Demand TEV (vph) | PM Peak Hour Throughout TEV (vph) | PM Peak Hour Delay (sec) | PM Peak Hour LOS | PM Peak Hour Worst Movement (if Unsignalized) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | NE Couch Street and NE Grand Avenue | Signalized | 2,485 | 2,385 *(-5)* | 23 | C | N/A | 2,660 | 2,660 | 22 | C | N/A |
| 12 | W Burnside Street and Broadway | Signalized | 2,400 | 2,400 **(+5)** | 10 **(-2)** | B | N/A | 2,685 | 2,685 | 13 **(-5)** | B | N/A |
| 13 | W Burnside Street and 6th Avenue | Signalized | 2,140 | 2,140 | 6 *(+1)* | A | N/A | 2,080 | 2,080 | 8 **(-2)** | A | N/A |
| 14 | W Burnside Street and 5th Avenue | Signalized | 2,120 | 2,110 **(+5)** | 6 | A | N/A | 2,190 | 2,190 | 10 **(-2)** | B | N/A |
| 15 | W Burnside Street and 4th Avenue | Signalized | 2,300 | 2,300 | 5 **(-6)** | A | N/A | 2,545 | 2,520 | 21 *(+1)* | C | N/A |
| 16 | W Burnside Street and 3rd Avenue | Signalized | 2,375 | 2,375 **(+25)** | 10 *(+2)* | B | N/A | 2,630 | 2,490 *(-60)* | 27 *(+3)* | C | N/A |
| 17 | W Burnside Street and 2nd Avenue | Signalized | 2,590 | 2,590 | 10 | B | N/A | 2,800 | 2,755 *(-40)* | 25 *(+2)* | C | N/A |
| 18 | E Burnside Street and SE MLK Blvd | Signalized | 1,950 | 1,950 | 16 | B | N/A | 3,130 | 3,065 *(-5)* | 26 *(+3)* | C | N/A |
| 19 | E Burnside Street and SE Grand Avenue | Signalized | 2,225 | 2,225 **(+10)** | 25 | C | N/A | 2,840 | 2,775 *(-25)* | 22 **(-1)** | C | N/A |
| 20 | SW Oak Street and SW Broadway | Signalized | 430 | 430 | 6 **(-1)** | A | N/A | 715 | 710 *(-5)* | 6 **(-1)** | A | N/A |
| 21 | SW Oak Street and SW 6th Avenue | Signalized | 345 | 345 | 10 | B | N/A | 470 | 470 **(+5)** | 12 | B | N/A |
| 22 | SW Oak Street and SW 5th Avenue | Signalized | 295 | 295 | 9 **(-1)** | A | N/A | 340 | 340 | 9 **(-1)** | A | N/A |

| | Study Intersection | Signalized or Unsignalized | AM Peak Hour Demand TEV (vph) | AM Peak Hour Throughout TEV (vph) | AM Peak Hour Delay (sec) | AM Peak Hour LOS | AM Peak Hour Worst Movement (if Unsignalized) | PM Peak Hour Demand TEV (vph) | PM Peak Hour Throughout TEV (vph) | PM Peak Hour Delay (sec) | PM Peak Hour LOS | PM Peak Hour Worst Movement (if Unsignalized) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | SW Oak Street and SW 4th Avenue | Signalized | 650 | 650 | 8 **(-1)** | A | N/A | 850 | 830 **(+5)** | 19 *(+4)* | B | N/A |
| 24 | SW Oak Street and SW 3rd Avenue | Signalized | 475 | 475 | 7 **(-4)** | A | N/A | 775 | 705 *(-40)* | 11 | B | N/A |
| 25 | SW Oak Street and SW 2nd Avenue | Signalized | 695 | 695 | 10 | B | N/A | 715 | 700 *(-15)* | 11 **(-1)** | B | N/A |
| 26 | SW Oak Street and SW Naito Parkway | Signalized | 1,260 | 1,260 | 12 **(-2)** | B | N/A | 1,525 | 1,525 **(+20)** | 8 **(-2)** | A | N/A |

Source: Parametrix

Note: Differences from the SDEIS Lane Option 1 (Balanced) are shown in parentheses.

LOS = level of service; N/A = not applicable; sec = seconds; TEV = total entering vehicles; vph = volume per hour.

*Italics* indicate worse performance; **bold** indicates improved performance.

All study intersections are anticipated to operate within City LOS standards with the exception of the following intersections, which are forecast to operate at LOS F or worse during the PM peak:

- NW Couch Street and NW 4th Avenue (Intersection 6)
- NW Couch Street and NW 3rd Avenue (Intersection 7)
- NW Couch Street and NW 2nd Avenue (Intersection 8)

During the AM peak hour, the largest differences between the SDEIS Balanced Option and the Final EIS Balanced Option are the intersection delays at NW Couch Street and NW 2nd Avenue (Intersection 8) and W Burnside Street and 3rd Avenue (Intersection 16), which would have intersection delays that are 2 seconds longer than the SDEIS Balanced Option.

During the PM peak hour, the largest differences between the SDEIS Balanced Option and the Final EIS Balanced Option are the operations at the following locations:

- Along NW Couch Street between NW/SW 4th Avenue and NW/SW 3rd Avenue, the intersection delay would increase between 15 and 79 seconds with the Final EIS Balanced Option.
- Along NW Everett Street between NW/SW 4th Avenue and NW/SW 3rd Avenue, the intersection delay would increase between 41 and 49 seconds with the Final EIS Balanced Option.

These increases in intersection delay during the PM peak hour are due to the zipper merge in the eastbound direction along Burnside Street where the general-purpose lanes narrow from two lanes to one lane. Delays and queuing from the zipper merge would impact the rest of the roadway system west of the bridge including the intersections along NW Couch Street and NW Everett Street.

The 95th percentile queuing analysis is summarized in Table 4-3. Many of the queue lengths would be less than 200 feet and would be within the existing storage length between intersections. Some intersection approaches would have queue lengths that exceed the existing storage length and back into an adjacent intersection. These approaches are indicated in bold text in the table below.

The 95th percentile queues shown in Table 4-3 are for the critical movement on each approach.

Many of the queue lengths shown are similar to or shorter than the SDEIS Balanced Option with the exception of the following locations:

- For the northbound approach at NW Everett Street and NW 4th Avenue (Intersection 1), the queuing would increase by 190 feet during the PM peak hour.
- For the eastbound approach at E Burnside Street and SE Martin Luther King, Jr., Boulevard (Intersection 18), the queuing would increase by 310 feet during the AM peak hour and 240 feet during the PM peak hour.

**Table 4-3. 2045 Balanced Option Intersection Queuing**

| | | | AM Peak Hour | PM Peak Hour |
|---|---|---|---|---|
| | **Intersection, Approach** | **Signalized or Unsignalized** | **95th Queue Length (feet)** | **95th Queue Length (feet)** |
| 1 | NW Everett Street and NW 4th Avenue | Signalized | | |
| | Northbound approach | | 140 | **530** (+190) |
| | Eastbound approach | | 190 | **250** (-20) |

| | Intersection, Approach | Signalized or Unsignalized | AM Peak Hour<br>95th Queue Length (feet) | PM Peak Hour<br>95th Queue Length (feet) |
|---|---|---|---|---|
| 2 | NW Everett Street and NW 3rd Avenue | Signalized | | |
| | Southbound approach | | 120 | **290** (+50) |
| | Eastbound approach | | 90 | **290** (+50) |
| 3 | NW Couch Street and NW Broadway | Signalized | | |
| | Northbound approach | | 70 | 130 (-10) |
| | Southbound approach | | 150 (-30) | 200 (-40) |
| | Eastbound approach | | 110 (+10) | **270** (+10) |
| | Westbound approach | | 130 | 110 (-10) |
| 4 | NW Couch Street and NW 6th Avenue | Signalized | | |
| | Northbound approach | | 90 | 90 |
| | Eastbound approach | | 60 | 120 (-20) |
| | Westbound approach | | 80 | 70 |
| 5 | NW Couch Street and NW 5th Avenue | Signalized | | |
| | Southbound approach | | 50 | 150 (-20) |
| | Eastbound approach | | 60 | 130 (-10) |
| | Westbound approach | | 70 | 120 (-10) |
| 6 | NW Couch Street and NW 4th Avenue | Unsignalized | | |
| | Northbound approach | | 70 (-10) | **190** (+50) |
| | Eastbound approach | | 60 | 170 (+20) |
| | Westbound approach | | 70 (+10) | 60 (+10) |
| 7 | NW Couch Street and NW 3rd Avenue | Unsignalized | | |
| | Southbound approach | | 70 (+10) | **610** (+10) |
| | Eastbound approach | | 60 | 180 |
| | Westbound approach | | 120 | **250** |
| 8 | NW Couch Street and NW 2nd Avenue | Unsignalized | | |
| | Northbound approach | | 80 (-10) | 90 (-10) |
| | Eastbound approach | | 80 (+10) | 100 |
| | Westbound approach | | 100 (+10) | **290** (-80) |
| 9 | NW Couch Street and NW Naito Parkway | Signalized | | |
| | Northbound approach | | 120 (-310) | 160 (-90) |
| | Southbound approach | | 130 | 140 |
| | Eastbound approach | | 80 | 120 |
| 10 | NE Couch Street and NE MLK Blvd | Signalized | | |
| | Southbound approach | | **250** | **230** |
| | Westbound approach | | 180 | 170 (-10) |
| 11 | NE Couch Street and NE Grand Avenue | Signalized | | |
| | Northbound approach | | 160 (-10) | 150 (-10) |
| | Westbound approach | | **240** | **240** (+10) |

| | Intersection, Approach | Signalized or Unsignalized | AM Peak Hour<br>95th Queue Length (feet) | PM Peak Hour<br>95th Queue Length (feet) |
|---|---|---|---|---|
| 12 | W Burnside Street and Broadway | Signalized | | |
| | Northbound approach | | 90 (+10) | **150** |
| | Southbound approach | | **200** (-10) | **210** (-20) |
| | Eastbound approach | | 170 | **190** |
| | Westbound approach | | 80 (+10) | 120 (-100) |
| 13 | W Burnside Street and 6th Avenue | Signalized | | |
| | Northbound approach | | 130 (+10) | 140 (-10) |
| | Eastbound approach | | 150 (+10) | 140 (-70) |
| | Westbound approach | | 110 (+50) | 120 (-50) |
| 14 | W Burnside Street and 5th Avenue | Signalized | | |
| | Southbound approach | | 130 (+50) | **210** |
| | Eastbound approach | | 70 | 110 (-40) |
| | Westbound approach | | 150 (-40) | 140 (-30) |
| 15 | W Burnside Street and 4th Avenue | Signalized | | |
| | Northbound approach | | **190** | **210** |
| | Eastbound approach | | 60 (-130) | **220** (+10) |
| | Westbound approach | | 80 (-50) | **190** (-30) |
| 16 | W Burnside Street and 3rd Avenue | Signalized | | |
| | Southbound approach | | 170 | **240** |
| | Eastbound approach | | 150 (+70) | **270** |
| | Westbound approach | | 140 | 180 (+20) |
| 17 | W Burnside Street and 2nd Avenue | Signalized | | |
| | Northbound approach | | **270** (+40) | **230** |
| | Eastbound approach | | 120 (-20) | **230** (-20) |
| | Westbound approach | | 180 | 210 (+20) |
| 18 | E Burnside Street and SE MLK Blvd | Signalized | | |
| | Southbound approach | | 110 | 180 |
| | Eastbound approach | | 500 (+310) | 510 (+240) |
| 19 | E Burnside Street and SE Grand Avenue | Signalized | | |
| | Northbound approach | | **240** (-10) | **240** |
| | Eastbound approach | | 100 | 100 (+10) |
| 20 | SW Oak Street and SW Broadway | Signalized | | |
| | Southbound approach | | 110 | 140 (-40) |
| | Westbound approach | | 80 | 80 (-20) |
| 21 | SW Oak Street and SW 6th Avenue | Signalized | | |
| | Northbound approach | | 130 (+10) | 170 |
| | Westbound approach | | 50 (+10) | 60 (+20) |

| | Intersection, Approach | Signalized or Unsignalized | AM Peak Hour 95th Queue Length (feet) | PM Peak Hour 95th Queue Length (feet) |
|---|---|---|---|---|
| 22 | SW Oak Street and SW 5th Avenue | Signalized | | |
| | Southbound approach | | 80 (-20) | 100 (-10) |
| | Westbound approach | | 90 | 80 (-30) |
| 23 | SW Oak Street and SW 4th Avenue | Signalized | | |
| | Northbound approach | | 170 (+10) | **250** (+10) |
| | Westbound approach | | 70 (-30) | 110 |
| 24 | SW Oak Street and SW 3rd Avenue | Signalized | | |
| | Southbound approach | | 130 (+10) | 160 |
| | Westbound approach | | 70 (-60) | 90 (-30) |
| 25 | SW Oak Street and SW 2nd Avenue | Signalized | | |
| | Northbound approach | | 180 (+10) | 190 (+10) |
| | Westbound approach | | 120 | 80 (-10) |
| 26 | SW Oak Street and SW Naito Parkway | Signalized | | |
| | Northbound approach | | **260** (+70) | **240** (-10) |
| | Southbound approach | | 120 (-140) | 140 (-40) |

Source: Parametrix

Note: Queue lengths in **bold** exceed the available storage length.

Note: Differences from the SDEIS Lane Option 1 (Balanced) are shown in parentheses

### 4.1.5 Final EIS Preferred Alternative Future Transit Operations

The updated Final EIS Preferred Alternative future traffic volumes and intersection LOS resulted in additional vehicle delay and queuing that would impact person throughput and transit reliability across the Burnside Bridge. Table 4-4 shows the predicted auto and transit person-trip throughput for each direction of travel during the PM peak hour under the 2045 Final EIS Preferred Alternative compared to the prediction for SDEIS Lane Option 1 (Balanced Option). Overall, fewer vehicles would cross the Burnside Bridge while transit ridership across the bridge would remain unchanged, resulting in a slightly higher ratio of transit person-trips compared to auto person-trips across the bridge.

**Table 4-4. 2045 Final EIS Preferred Alternative, Future Person-Trip Throughput, PM Peak Hour**

| Direction (Bus Lines 12, 19, 20) | Auto + Commercial-use Vehicle | Transit Person-Trips | Total Person-Trips | Transit/Auto Person-Trips |
|---|---|---|---|---|
| Eastbound (PM Peak Hour) | 1,815 **(+15)** | 1,790 (unch) | 3,605 **(+15)** | .99 (unch) |
| Westbound (PM Peak Hour) | 1,530 *(-135)* | 1,055 (unch) | 2,585 *(-135)* | .69 **(+0.06)** |
| Total | 3,345 *(-120)* | 2,845 (unch) | 6,190 *(-120)* | .85 **(+0.03)** |

Sources: Metro, Parametrix

Notes: Differences from the SDEIS Lane Option 1 (Balanced) are shown in parentheses.

(unch) indicate no difference from the SDEIS Lane Option 1 (Balanced).

*Italics* indicate worse performance; **bold** indicates improved performance.

Transit travel time reliability for Lines 12, 19, and 20 at the intersections at either end of the Burnside Bridge would remain unchanged compared to the SDEIS Lane Option 1 (Balanced) traffic operations. Table 4-5 shows the anticipated reliability impacts that the Balanced Option would experience due to auto delay and queuing at intersections.

**Table 4-5. 2045 FEIS Preferred Alternative, Transit Reliability Impacts, PM Peak Hour**

| Intersection | Direction (Bus Lines 12, 19, 20) | Average Intersection Delay (sec) | 95th Queue (feet) | | Percent Spillback |
|---|---|---|---|---|---|
| 18 Burnside/MLK | Eastbound | 27 (unch) | N/A | | N/A |
| 17 Burnside/2nd | Westbound | 11 (unch) | Through | 210 *(+20)* | 0% (unch) |
| | | | Right | 160 (unch) | |

Source: Parametrix
Note: Differences from the SDEIS Lane Option 1 (Balanced) are shown in parentheses.
(unch) notes no difference compared to the SDEIS Lane Option 1 (Balanced).
*Italics* indicate worse performance.
sec = seconds

## 4.2 Parks and Recreation

The proposed temporary bicycle and pedestrian detour routes discussed in Draft EIS Section 3.10.2 have been changed to accommodate requests from the City of Portland. The detour route for Willamette River Greenway Trail users in Waterfront Park was not changed, so out-of-direction travel times would remain the same as described in the Draft EIS.

In the Draft EIS, the proposed detour for Eastbank Esplanade pedestrians or bicyclists offered a Westside Route and an Eastside Route. The Final EIS proposes to include the Westside Route and remove the proposed detour routes on the east side of the river. The Westside Route is the same as previously proposed; it crosses the Morrison Bridge at the southern end and the Steel Bridge at the northern end and travels on Better Naito and the Willamette River Greenway Trail. *The Westside Route is shorter and adds less out-of-direction travel than the previously included Eastside Route.* See Section 4.1 for more information regarding the detour route.

The Section 4(f) Analysis in Attachment D has also been updated to reflect this change.

## 4.3 Geology

The in-water debris structures (referred to starlings or dolphins, as described in Chapter 6) that are anticipated to be constructed as part of the Preferred Alternative would not result in a notable difference in impact to soils and geology from that analyzed in the Draft EIS or SDEIS. For each starling, five driven (not drilled) 3-foot-diameter piles would extend down to the same depth as the adjacent in-water bent drilled shafts. As the starling piles are driven not drilled, it is assumed that formation material penetrated by the driven pile would remain inside the pile. However, based on contractor construction method preference, soil could be removed from inside the driven pile and the interior of the pile could be filled with cement. In contrast, soil penetrated by the larger-diameter drilled shafts would be removed during installation of the shaft. The starling would extend down to the bottom of the bent footing and the wedge-shaped structure would extend out 30 feet on the upstream side. The interior of each starling would be hollow to absorb impacts of vessels or floating materials and would require only minor substrate removal to accommodate placement. If dolphins are selected, they are anticipated to have less impact to soils and geology than starlings because they are smaller in area. Therefore, impacts to soils and geology from starlings or dolphins would be within the range analyzed in the Draft EIS and SDEIS replacement alternatives. See Section 4.5 for additional information on removal-fill quantities related to the starlings.

## 4.4 Water Quality

The west approach bridge width is anticipated to be narrower than the bridge width evaluated in the Draft EIS. The total impervious area would decrease compared to the Draft EIS Preferred Alternative. This portion of the project area is in the West Bank combined sewer overflow drainage area. The change in bridge width would decrease the impervious area that would contribute to the West Bank combined sewer overflow.

## 4.5 Wetlands and Waters

The debris structures that are now anticipated to be constructed with the Preferred Alternative would replace the existing debris fenders in the same location. The additional impacts to the Willamette River are not specifically discussed in the Draft EIS or SDEIS; however, they would be minimal and caused by the placement of permanent structure below the ordinary high water mark (OHWM). Either starlings or dolphins would be constructed (as described above in Section 4.3) occupying up to approximately 410 square feet below the OHWM. Dolphins would occupy a smaller area than starlings; this would result in less permanent structure placement in the river. Both structures would consist of steel and concrete and would be permanently installed on the upstream sides of the main river piers. Besides permanent fill, no other impacts to waters are anticipated to occur. The addition of permanent structure below the OHWM associated with the debris structures would be a negligible increase in comparison to the total amount required for construction of the Preferred Alternative.

## 4.6 Vegetation, Wildlife, and Aquatic Resources

The debris structures would impact wildlife and aquatic resources but would not impact vegetation. During construction of the structures, pile driving would be required causing hydroacoustic impacts to fish as well as noise to birds and other terrestrial wildlife. This could result in injury or death to fish and could deter terrestrial wildlife out of the API. However, these impacts would be temporary and occur only during construction. Additionally, hydroacoustic impacts would be minimized through the use of bubble curtains and by limiting pile driving to the in-water work window. Permanent impacts from the debris structures would include a direct loss of up to approximately 410 square feet of aquatic habitat if starlings are constructed. If dolphins are constructed, they would occupy less area below the OHWM of the Willamette River and lead to slightly less permanent impact to aquatic habitat. Compared to the total permanent structure placed below the OHWM associated with the Preferred Alternative, the addition of debris structures would have a minimal impact to aquatic resources. No permanent impacts from the debris structures would occur to wildlife.

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