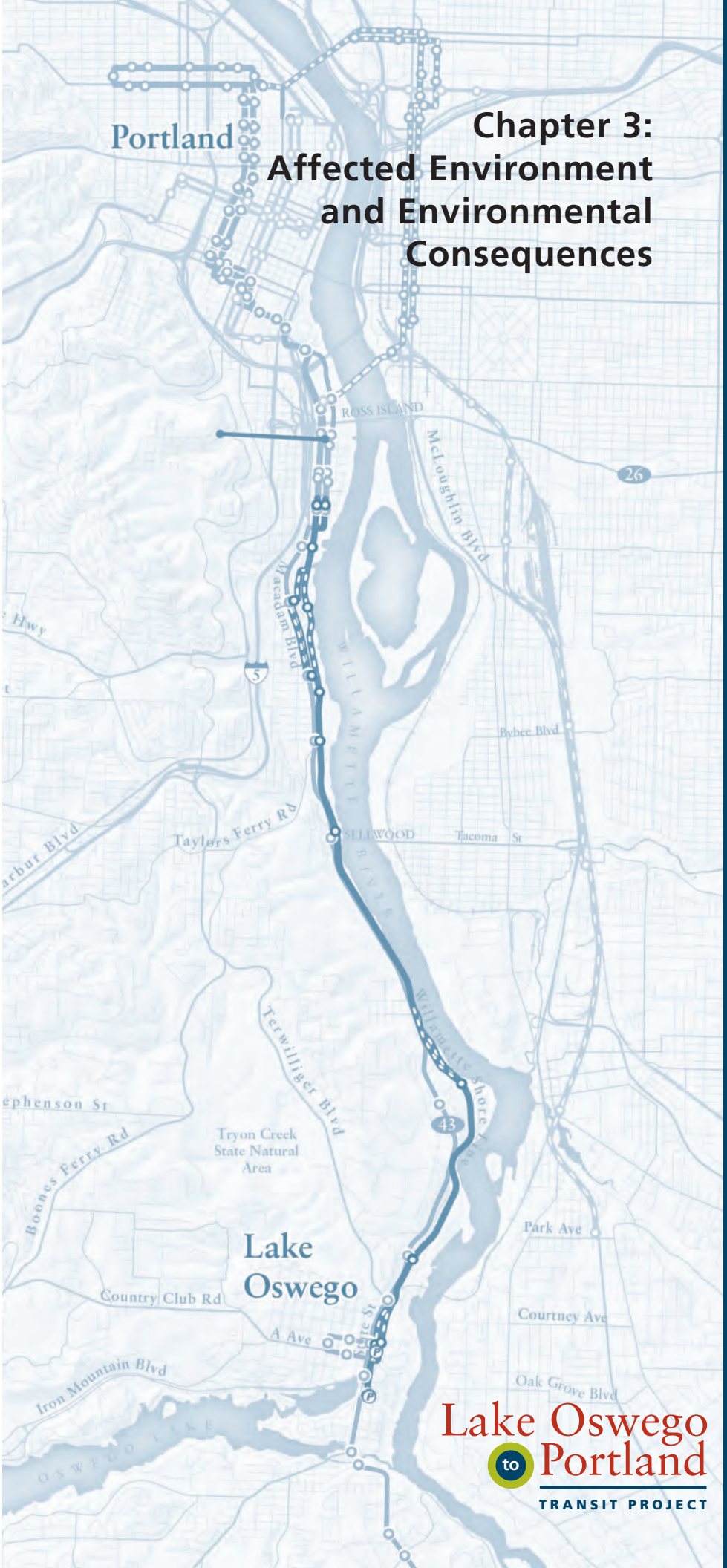
CHAPTER 3

Chapter 3: Affected Environment and Environmental Consequences



Lake Oswego to Portland TRANSIT PROJECT

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3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the likely effects of the study alternatives on the community, natural environment and cultural resources in the corridor. The chapter is organized by topic as listed below. The sections are:

Each section describes the existing environment that could be affected by the study alternatives in the corridor. It then identifies the expected environmental impacts of the three alternatives as described in Chapter 2 of this DEIS, including the:

- No-Build Alternative,
- Enhanced Bus Alternative and
- Streetcar Alternative.

Where there are differences between the effects of the Streetcar Alternative options, the sections describe the differences. Each section addresses direct, indirect and cumulative impacts[1] of the alternatives, as defined in the box to the right. Where appropriate, section introductions include a summary of the relevant regulations and analysis methods. Short-term effects (effects related to construction activities) are addressed at the end of the chapter, in Section 3.16, and Section 3.17 discusses the effects of phased development of the Streetcar Alternative.

What are Direct, Indirect and Cumulative Effects of the Study Alternatives and Design Options?

Direct impacts are effects caused by the proposed action that occur at the same time and location as the action.

Indirect impacts are effects caused by the proposed action that occur later in time and/or farther away, but are still foreseeable. Indirect effects may include growth-inducing effects and associated effects on the natural environment.

Cumulative impacts are effects of the project added to other current and future projects and actions in the area regardless of what entity undertakes those other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over time.

[1] Regulations for Implementing NEPA, http://ceq.hss.doe.gov/nepa/regs/ceq/toc_ceq.htm, Sec. 1508.7

3.1 Land Use and Planning

This section addresses land use impacts and compliance with plans and policies. Section 3.1.1 describes existing land use and planning in the corridor. Section 3.1.2 identifies the potential effects on land use of the alternatives and design options. Section 3.1.3 describes potential mitigation measures. Section 3.1.4 identifies where study alternatives do not comply with applicable comprehensive plan policies. The *Land Use and Planning Technical Report* (URS and TriMet /Metro, November 2010) contains further details, including citations to sources and all plan policies applicable to the study alternatives.

Direct, indirect and cumulative effects are defined in general terms on the previous page. Direct *land use* impacts are defined as conversions of land to transportation use. The methodology for direct land use impacts was to use a geographic information system to estimate the amount of land converted to transportation use based on preliminary design information. For this project, indirect land use impacts are defined as changes in land use resulting from how alternatives affect the likelihood that land would be redeveloped. The methodology relied on mapping the amount of unused allowed floor area and the ratio of the value of land improvements to the value of the land near proposed streetcar stations and referring to studies of how the original Portland Streetcar system affected redevelopment. The methodology also took into account other factors that influence redevelopment, such as interventions by local government, like use of urban renewal. For cumulative impacts, the analysis considered in qualitative terms the interaction of the project alternatives and options with other identified projects and actions.

The principal regulation relevant to land use is that transportation projects must comply with applicable comprehensive plans.

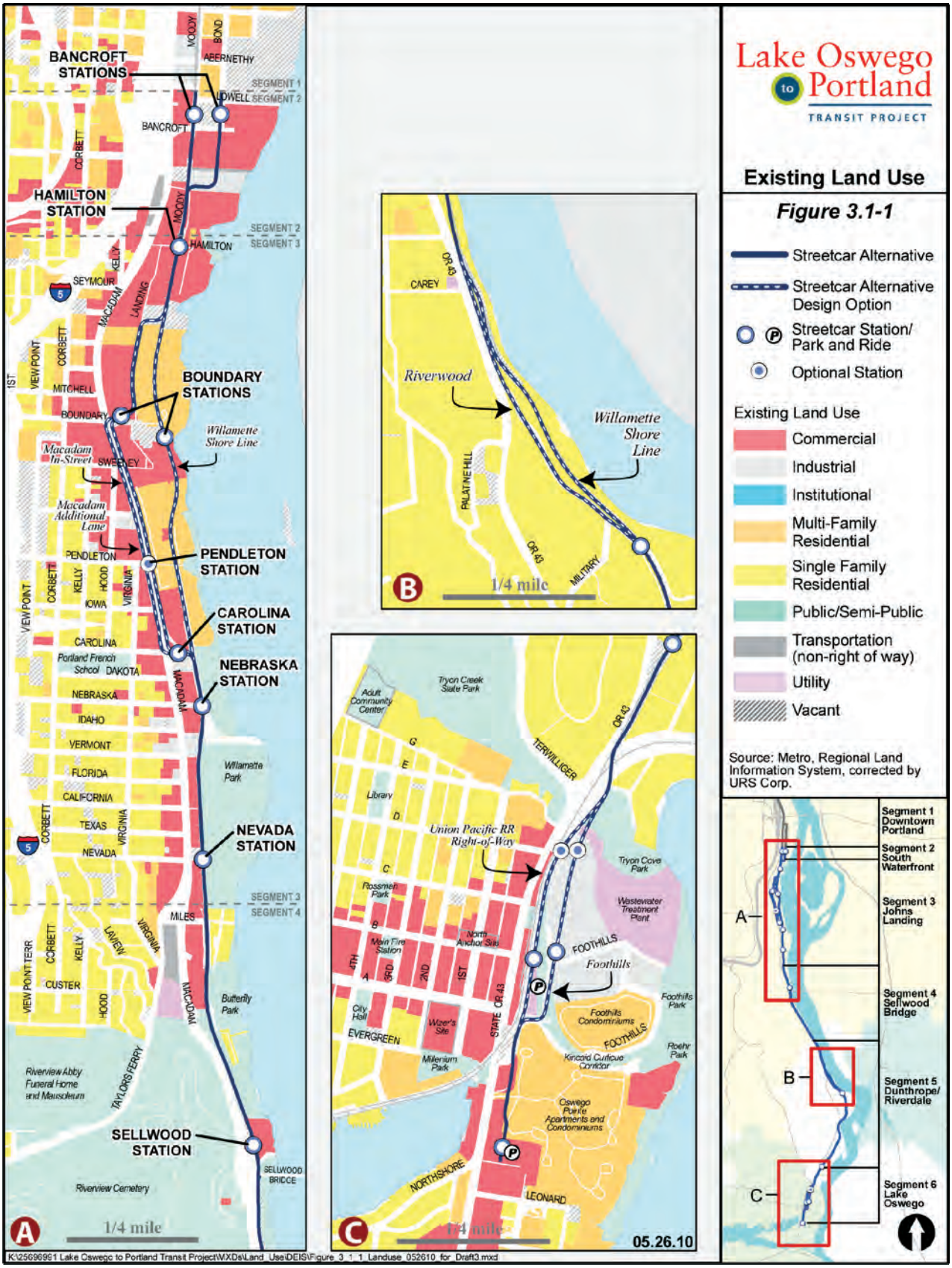
3.1.1 Affected Environment

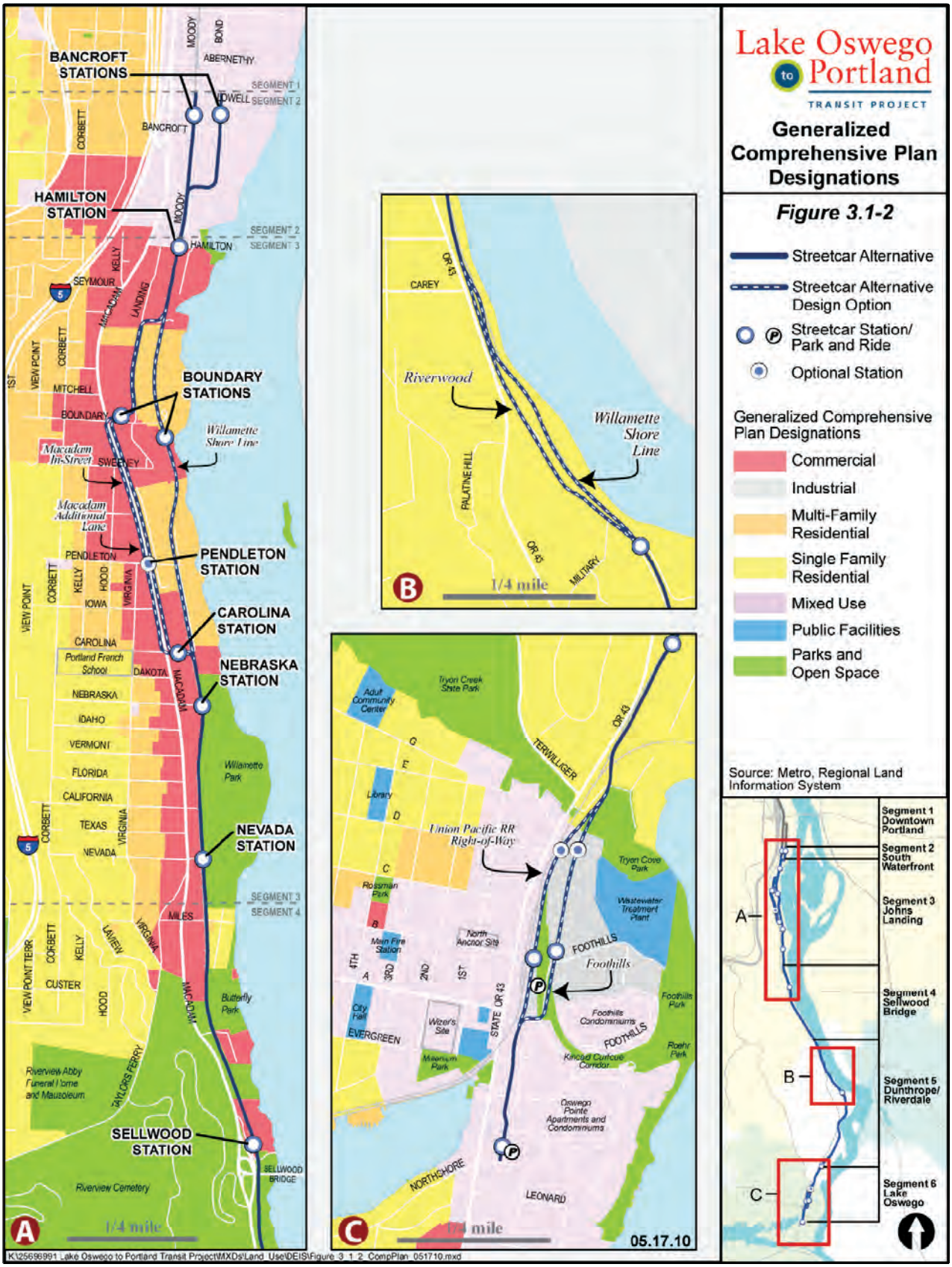
As stated above, this section describes existing land use and planning in the corridor. Figure 3.1-1 shows existing land use in the parts of the corridor where land use impacts would occur. Figure 3.1-2 shows generalized comprehensive plan designations, and Figure 3.1-3 shows generalized zoning.[2]

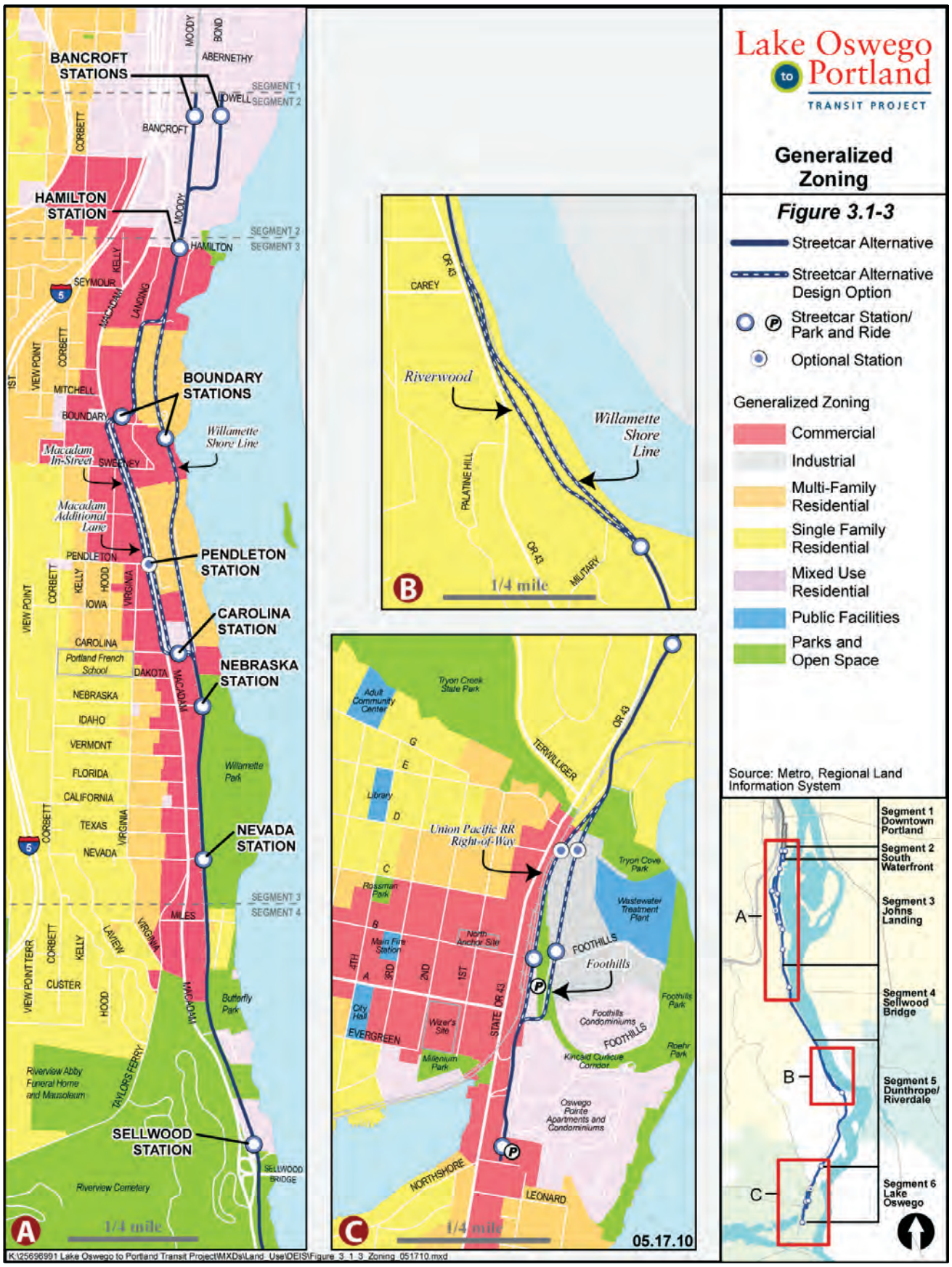
Segment 1 includes downtown Portland, which is the central city of the region, and part of the South Waterfront District. Study alternatives would not include construction of improvements in this segment, but all alternatives would include transit connections into Segment 1.

Segment 2 is toward the south end of Portland's South Waterfront District, which has seen extensive redevelopment since 2000. This redevelopment has included an office and health services tower that is part of Oregon Health Sciences University (OHSU), a tram linking the tower to the main OHSU campus on the hilltop to the west, five high-rise condominium and apartment buildings, a new local street network, and the extension of the existing Portland streetcar from downtown Portland. The redevelopment resulted from collaboration among landowners, land developers, the City of Portland, and other parties. The city's role has included creation and use of the North Macadam Urban

[2] "Generalized" means that the figures do not show actual comprehensive plan designation and zoning districts. Instead, they show categories to which Metro has assigned the plan designations and zoning districts. This because four different comprehensive plans and three zoning codes apply to the project area, Portland's, Multnomah County's, Clackamas County's, and Lake Oswego's (Portland's zoning code applies to the Multnomah County portion of the project area).


Lake Oswego to Portland
TRANSIT PROJECT
Existing Land Use
Figure 3.1-1
Streetcar Alternative
Streetcar Alternative Design Option
Streetcar Station/ Park and Ride
Optional Station
Existing Land Use
Commercial
Industrial
Institutional
Multi-Family Residential
Single Family Residential
Public/Semi-Public
Transportation (non-right of way)
Utility
Vacant
Source: Metro, Regional Land Information System, corrected by URS Corp.
BANCROFT STATIONS
HAMILTON STATION
BOUNDARY STATIONS
PENDLETON STATION
CAROLINA STATION
NEBRASKA STATION
NEVADA STATION
SELLWOOD STATION
Willamette Shore Line
Macadam In-Street
Macadam Additional Lane
Riverwood
Willamette Shore Line
Union Pacific RR Right-of-Way
Segment 1 Downtown Portland
Segment 2 South Waterfront
Segment 3 Johns Landing
Segment 4 Sellwood Bridge
Segment 5 Dunthrope/ Riverdale
Segment 6 Lake Oswego
1/4 mile
05.26.10


Lake Oswego to Portland
TRANSIT PROJECT
Generalized Comprehensive Plan Designations
Figure 3.1-2
Streetcar Alternative
Streetcar Alternative Design Option
Streetcar Station/ Park and Ride
Optional Station
Generalized Comprehensive Plan Designations
Commercial
Industrial
Multi-Family Residential
Single Family Residential
Mixed Use
Public Facilities
Parks and Open Space
Source: Metro, Regional Land Information System
BANCROFT STATIONS
HAMILTON STATION
BOUNDARY STATIONS
PENDLETON STATION
CAROLINA STATION
NEBRASKA STATION
NEVADA STATION
SELLWOOD STATION
Willamette Shore Line
Macadam Additional Lane
Riverwood
Union Pacific RR Right-of-Way
SEGMENT 1
SEGMENT 2
SEGMENT 3
SEGMENT 4
1/4 mile
05.17.10
Segment 1 Downtown Portland
Segment 2 South Waterfront
Segment 3 Johns Landing
Segment 4 Sellwood Bridge
Segment 5 Dunthrope/ Riverdale
Segment 6 Lake Oswego


Lake Oswego to Portland
TRANSIT PROJECT
Generalized Zoning
Figure 3.1-3
Streetcar Alternative
Streetcar Alternative Design Option
Streetcar Station/ Park and Ride
Optional Station
Generalized Zoning
Commercial
Industrial
Multi-Family Residential
Single Family Residential
Mixed Use Residential
Public Facilities
Parks and Open Space
Source: Metro, Regional Land Information System
BANCROFT STATIONS
HAMILTON STATION
BOUNDARY STATIONS
PENDLETON STATION
CAROLINA STATION
NEBRASKA STATION
NEVADA STATION
SELLWOOD STATION
Macadam In-Street
Macadam Additional Lane
Willamette Shore Line
Riverwood
Union Pacific RR Right-of-Way
Foothills
SEGMENT 1
SEGMENT 2
SEGMENT 3
SEGMENT 4
Segment 1 Downtown Portland
Segment 2 South Waterfront
Segment 3 Johns Landing
Segment 4 Sellwood Bridge
Segment 5 Dunthrope/ Riverdale
Segment 6 Lake Oswego
1/4 mile
05.17.10
K:\25696991 Lake Oswego to Portland Transit Project\MXDs\Land_Use\DEIS\Figure_3_1_3_Zoning_051710.mxd

Renewal District to assemble properties and to fund and build public improvements. While the 2008-2009 economic recession slowed development, several projects are under construction or pending. The Matisse, which consists of 270 market-rate apartments and about 15,500 square feet of ground-floor commercial space, is under construction on the block bounded by Southwest Moody Avenue, Bond Avenue, Lowell Street, and Abernethy Street. The Mirabella, a high-rise retirement center, is under construction north of the area the figures cover. The City of Portland is seeking to build 40 units of housing for low-income veterans on the block bounded by Moody Avenue, Bond Avenue, Lowell Street and Bancroft Street. A school is considering redevelopment of the block immediately to the south and the school and U.S. General Services Administration are both considering development on the south side of the parcel between Moody and Macadam avenues south of Bancroft Street. The city plans to extend Moody Avenue south to the vicinity of the proposed Hamilton Court station, as shown on Figure 3.1-1. It also plans to connect the extended street to Macadam Avenue at a new intersection, referred to as the "South Portal." The intersection is intended to provide safer access between the South Waterfront and Macadam Avenue than the existing intersection at Bancroft Street.

Segment 3 includes the Johns Landing. Land uses east of Macadam Avenue are multi-family residential and office, mostly developed in the 1980s. Most of the multifamily housing units are two- and three-story condominiums and are separate from the office buildings, which are four and five stories high. Development is more suburban in character and less mixed-use than development in South Waterfront. Willamette Park, a large park with a heavily-used boat landing, is located in this area. Storefront commercial uses predominate along the west side of Macadam Avenue. West of Macadam Avenue lies a neighborhood of single-family residential uses. The comparatively small amount of vacant land is mostly near Interstate 5 and is impacted by proximity to it. Johns Landing has seen only limited redevelopment since the 1980s. Notable exceptions are a supermarket and condominiums built in the 1990s on the west side of Macadam Avenue near its intersection with Taylors Ferry Road. There are no pending amendments to the comprehensive plan provisions applicable to Segment 3 and no planned interventions, such as use of urban renewal authority.

Segment 4 includes the area in the vicinity of the Sellwood Bridge. The predominate land use is public and semi-public, made up of parks east of Macadam Avenue and Riverview Cemetery west of Macadam Avenue. The single-family residential use shown south of Butterfly Park in Figure 3.1-1 is the parking lot for a boathouse moorage. The north end of Segment 4 contains single-family homes west of Macadam Avenue and commercial uses on its east side. The utility use is an electric power substation. Multnomah County, which owns the Sellwood Bridge, has selected a Locally Preferred Alternative for the replacement of the bridge, which is structurally deficient. Issuance of a Final Environmental Impact Statement is expected in 2010. Construction is expected to begin in 2012 and reach completion in 2015. There are no pending proposals for amending comprehensive plan provisions or any planned interventions applicable to Segment 4.

Segment 5 includes the Dunthorpe/Riverdale area. Single-family residential is the predominate use, comprehensive plan designation and zoning in all of Segment 5, including portions of these neighborhoods not shown on the maps. Lot sizes are typically large. There is little vacant land.

Segment 6 includes the eastern end of downtown Lake Oswego and the residential area to the north. The alternatives and design options are located between the downtown to the west and an area containing residential, commercial and industrial uses to the east. Both have seen substantial redevelopment since the mid-1990s, much of it carried out under the auspices of the City of Lake

Oswego Redevelopment Agency. To the west, redevelopment included Oswego Pointe, built on a former cement plant site. It comprises 522 multifamily housing units (labeled on Figure 3.1-1 as the Oswego Pointe Apartments and Condominiums) 20,000 square feet of office space, a 10,500 square foot restaurant, a waterfront public pathway, a water sports center, an amphitheater and a boat dock. To the east, one project was the complete redevelopment of the block bounded by State Street, A Avenue, 1st Street, and the Union Pacific railroad tracks. It includes over 84,000 square feet of retail and office space and a 366-space parking structure. Another project was the creation of Millennium Park, as shown on Figure 3.1-1.

Two projects are in the planning stages:

- **Foothills redevelopment.** The City of Lake Oswego is partnering with owners of the industrial land shown on Figures 3.1-1, 3.1-2 and 3.1-3 to formulate a plan for what may include eight- to ten-story residential buildings and some commercial uses. The land owners have retained a development consultant. Implementation would require an amendment to the Lake Oswego Comprehensive Plan and zoning map. Build-out would occur over a 20- to 30-year period.

- **North Anchor site**. The City of Lake Oswego Redevelopment Agency is formulating a plan for redeveloping the North Anchor site, identified on Figure 3.1-1, with a 50,000 to 60,000 square foot replacement of the existing library and 35,000 square feet of commercial space.

City officials believe the Wizer's grocery store site shown on Figure 3.1-1 is likely to be redeveloped because of its location and the age of the existing improvements. The City of Lake Oswego expects to prepare a new street system plan for the area near the streetcar line options. No major improvements are planned for State Street. According to the city, it may consider changes in the future to improve pedestrian crossings between downtown and the Foothills area.

3.1.2 Land Use Impacts

This section presents a summary of long-term direct, indirect and cumulative effects of the study alternatives on land use. The effects include acquisition of property and catalyzed redevelopment within existing zoning and policies. Section 3.1.4 addresses compliance with plan policies. Section 3.16 discusses short-term (construction) effects.

3.1.2.1 No-Build Alternative

The No-Build Alternative would not have any direct, indirect, or cumulative land use impacts in the corridor.

- In **Segment 1,** development and redevelopment of the central city would continue to occur as in the past.
- In **Segment 2**, development of the vacant land north of Bancroft Street would occur over time because of the coordinated efforts to promote redevelopment in the South Waterfront area described above. These efforts included the extension of the streetcar system to its existing terminus near Lowell Street. Redevelopment of land south of Bancroft Street would also occur, because of the City of Portland's plans to extend Moody Avenue south and build the South Portal, also described above, and because, like the rest of the South Waterfront District, it is centrally located in the region.
- In **Segment 3**, the pace of redevelopment would be slow, as it has been since the 1980s.

- In **Segment 4**, improved access to the area immediately north of the bridge resulting from the replacement of the Sellwood Bridge would encourage its redevelopment.
- In **Segment 5** there would be very little redevelopment because of the stable, single-family uses there.
- In **Segment 6** some redevelopment of the areas near the alignments of the design options would occur, as indicated by redevelopment that has occurred in the area in the past, as described above.

3.1.2.2 Enhanced Bus Alternative

The Enhanced Bus Alternative would not have any direct, indirect or cumulative land use impacts in Segments 1, 2, 3, 4 and 5.

- In **Segments 1, 2, and 3**, the Enhanced Bus Alternative would not include stations or otherwise require the acquisition of land, and these segments already have regional transit access. While the Enhanced Bus Alternative would improve transit access from the project's transportation corridor to the south, the corridor south of the Lake Oswego to Portland transit corridor is only a fraction of the entire region.
- In **Segment 4**, while the Enhanced Bus Alternative would increase bus frequency, such improvements do not have a material effect on decisions to redevelop commercial uses. The only land with potential for redevelopment is the land in commercial use just north of the Sellwood Bridge, in the north end of Segment 4. The cemetery and park land is unlikely to be redeveloped under any alternative. The same is true of the land in single-family use, because the single-family zoning would be difficult to change in face of opposition from its residents. No mitigation measures are proposed.
- In **Segment 5**, the applicable single-family zoning would not allow changes to other uses. Changes to bus service would not alter land uses in the area.

The Enhanced Bus Alternative would have direct land impacts in **Segment 6**, but not indirect or cumulative impacts. Tables 3.1-1, 3.1-2, and 3.1-3 show the direct impacts of the Enhanced Bus Alternative in downtown Lake Oswego by existing land use, comprehensive plan designation and zoning, respectively. The impacts would result from the park-and-ride lot. The Enhanced Bus Alternative would not change land uses and would not have a material effect on the intensity of land uses resulting from redevelopment. Greater bus frequency to and from downtown Portland would make residential uses in the B Avenue and Lake Oswego terminus station areas more attractive. However, the effect would be insufficient to encourage redevelopment to occur that would not occur under No-Build Alternative.[3] In addition, the amount of residential and commercial redevelopment would be the same as under the No-Build Alternative. Cumulative impacts would be similarly limited.

[3] Unlike streetcar lines, as discussed in Section 3.1.1.3, enhanced bus service has not been documented to result in intensification of development. One reason may be the absence of major capital improvements, making enhanced bus perceived as being more susceptible to being scaled back or eliminated.

Table 3.1-1 Conversion of Land to Transportation Use by Existing Use in Acres

Alternative, Segment and Option	Comme -rcial	Indus- trial	Multi- Family Residential	Single Family Residential	Public/ Semi- Public	Utility	Vacant	Total
Enhanced Bus Alternative[1]	**0.5**		**0.5**					**1.0**
Streetcar Alternative								
2 - South Waterfront[2]								
3 - Johns Landing								
Willamette Shore Line	0.0		0.1				0.1	0.2
Macadam In-Street	1.4		0.5				0.3	2.2
Macadam Add. Lane	2.5		0.6				0.5	3.6
4 - Sellwood Bridge[2]								
5 - Dunthorpe/Riverdale								
Willamette Shore Line								
Riverwood				0.7			0.0	0.7
6 - Lake Oswego								
UPRR	1.0	0.1	0.6	0.0	1.3	0.4	0.0	3.3
Foothills	1.0	10.8	0.6	0.0	1.6	0.8	0.0	14.8
Streetcar Alternative Total[3]								
From	**1.0**	**0.1**	**0.7**	**0.0**	**1.3**	**0.4**	**0.1**	**3.5**
To	**3.5**	**10.8**	**1.2**	**0.7**	**1.6**	**0.8**	**0.5**	**19.1**

Sources: Prepared by URS Corp. Data from the Metro Data Center, corrected by URS Corp. GIS analysis by David Evans and Associates.
Notes: Land use categories come from the Metro Data Center Regional Land Information System, except for utility. No conversions in Segment 1. 0.0 indicates less than .05 acre. No number indicates zero. Numbers may not add across because of rounding. Table does not include land used for the alternatives that already are in transportation use.
[1] With the Enhanced Bus Alternative, the only conversions would occur in Segment 6 – Lake Oswego.
[2] The South Waterfront and Sellwood Bridge segments contain potential construction phasing options associated with the Streetcar Alternative. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.
[3] Totals do not add across to 3.5 and 19.1 because the column totals sum ranges.

Table 3.1-2 Conversion of Land to Transportation Use by Comprehensive Plan Designation Category in Acres

Alternative, Segment and Option	Commer- cial	Indus- trial	Mixed- Use	Multi- Family Residential	Single Family Residential	Parks and Open Space	Total
Enhanced Bus Alternative[1]			**1.0**				**1.0**
Streetcar Alternative							
2 - South Waterfront[2]							
3 - Johns Landing							
Willamette Shore Line	0.0		0.2	0.1			0.2
Macadam In-Street	1.7			0.5			2.2
Macadam Add. Lane	2.9			0.6			3.6
4 - Sellwood Bridge[2]							
5 - Dunthorpe/Riverdale							
Willamette Shore Line							
Riverwood					0.7		0.7
6 - Lake Oswego							
UPRR		0.4	1.5		0.0	1.3	3.3
Foothills		11.5	1.5		0.0	1.7	14.8
Streetcar Alternative Total[3]							
From	**0.0**	**0.4**	**1.5**	**0.1**	**0.0**	**1.3**	**3.5**
To	**2.9**	**11.5**	**1.7**	**0.6**	**0.7**	**1.7**	**19.1**

Sources: Prepared by URS Corp. with data from Metro Data Resource Center and GIS analysis by David Evans and Associates.
Notes: Zoning categories are generalized and come from the Metro Data Resource Center Regional Land Information System. No conversions in Segment 1. 0.0 indicates less than .05 acre. No number indicates zero. Numbers may not add across because of rounding. Table does not include land used for the alternatives that already is in transportation use.
[1] With the Enhanced Bus Alternative, the only conversions would occur in Segment 6 – Lake Oswego.
[2] The South Waterfront and Sellwood Bridge segments contain potential construction phasing options associated with the Streetcar Alternative. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.
[3] Totals do not add across to 3.5 and 19.1 because the column totals sum ranges.

Table 3.1-3 Conversion of Land to Transportation Use by Zoning Category in Acres

Alternative, Segment and Option	Commer-cial	Industrial	Mixed-Use Residen-tial	Multi-Family Residen-tial	Single Family Residen-tial	Parks and Open Space	Total
Enhanced Bus Alternative[1]	**0.5**		**0.5**				**1.0**
Streetcar Alternative							
2 - South Waterfront[2]							
3 - Johns Landing							
Willamette Shore Line			0.2	0.1			0.2
Macadam In-Street			1.7	0.5			2.2
Macadam Add. Lane			2.9	0.6			3.6
4 - Sellwood Bridge[2]							
5 - Dunthorpe/Riverdale							
Willamette Shore Line							
Riverwood					0.7		0.7
6 - Lake Oswego							
UPRR	1.0	0.1	0.9		0.0	1.3	3.3
Foothills	1.0	11.2	0.9		0.0	1.7	14.8
Streetcar Alternative Total[3]							
From	**1.0**	**0.1**	**1.2**	**0.1**	**0.0**	**1.3**	**3.5**
To	**1.0**	**11.2**	**3.9**	**0.6**	**0.7**	**1.7**	**19.1**

Source: Prepared by URS Corp. with data from Metro Data Resource Center and GIS analysis by David Evans and Associates.
Note: Zoning categories are generalized and come from the Metro Data Resource Center Regional Land Information System. No conversions in Segment 1. 0.0 indicates less than .05 acre. No number indicates zero. Numbers may not add across because of rounding. Table does not include land used for the alternatives that already is in transportation use.
[1] With the Enhanced Bus Alternative, the only conversions would occur in Segment 6 – Lake Oswego.
[2] The South Waterfront and Sellwood Bridge segments contain potential construction phasing options associated with the Streetcar Alternative. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.
[3] Totals do not add across to 3.5 and 19.1 because the column totals sum ranges.

3.1.2.3 Streetcar Alternative and Design Options

Regional Impacts. The Streetcar Alternative would not alter total population or employment region-wide. Transportation infrastructure investments like the Streetcar Alternative do not cause additional population or employment growth within a region. Instead, such transit improvements influence the location and characteristics of new development and redevelopment within a region and specifically in the vicinity of the transit investment.

Segment 1 Direct, Indirect and Cumulative Impacts of the Streetcar Alternative. The Streetcar Alternative would have no direct, indirect, or cumulative impacts in Segment 1.

Segment 2 Direct, Indirect and Cumulative Impacts of the Streetcar Alternative. The Streetcar Alternative would have no *direct impacts* in Segment 2 because there would be no acquisition of property. The *indirect land use impacts* of the Streetcar Alternative would likely be more land redevelopment, redevelopment to more intense uses, and redevelopment sooner than under the No-Build Alternative in the south half of Segment 2. The effect on the north half would be marginal because it already benefits from the existing streetcar system; the proposed Bancroft Street stations are very close to the existing station adjoining Lowell Street. The reasons for the effects on the south half of Segment 2 are:

- As a public infrastructure investment, Portland's experience with the original Portland streetcar project was that it encouraged redevelopment and more intense redeveloped uses. Starting after streetcar funding was committed in 1997 until 2004, the amount of square footage of new development within one block of the streetcar line, as a percentage of existing building square

footage, was 46 percent.[4] This compared to 14 percent within two blocks and 8 percent within three blocks. Also, the percentage of allowed square footage developed from 1997 to 2004 within one block of the streetcar line was over 50 percent, compared to about 10 percent within two and three blocks. Some of this redevelopment can be attributed to public infrastructure investments other than the streetcar, especially street improvements and parks in the Pearl District, and to strong market demand. In addition, the Portland streetcar was routed in part to be close to property slated for redevelopment. Similarly, all of Segment 2, including its south half, is within the North Macadam Urban Renewal District, which the City of Portland has used to make infrastructure investments in the project area. With the original streetcar project, little redevelopment occurred west of Interstate 405, which is attributable in part to the scarcity of redevelopment opportunities and absence of other new infrastructure investments there. However, this contrasts with Segment 2, as described in the next two items.

- There is a large amount of capacity for redevelopment in the south half of Segment 2. Table 3.1-4 shows the amount of unused allowed square footage of development within the Hamilton Court station area, as well as the Bancroft Street station area. Allowed floor area is the amount of square footage allowed by applicable zoning regulations. Existing floor area is from city records or estimates. Unused allowed floor area is the difference between allowed and existing floor area. Eighty-six percent of the allowed square footage within the Hamilton Court station area is unused. The *Land Use and Planning Technical Report* (URS, August 2010) contains maps of the data in Table 3.4-1 and a description of the methodology used, including how the station areas were defined.

- At many properties in the project area, the ratio of the value of improvements to the value of the land is low, which suggests that many properties are ripe for redevelopment. Table 3.1-4 shows the percentage of properties by range of this ratio in the Hamilton Court station area. The ratio of improvement value to land value is widely used to indicate likelihood of redevelopment. In central city locations like Segment 2, it can be cost-effective to redevelop properties with ratios as high as four to one. As Table 3.1-4 shows, 75 percent of properties in the Hamilton Court station area have ratios under four to one. Almost half the properties have ratios under one to one.

- Portland's central city has experienced a large amount of the mixed-use development, which the zoning in the Hamilton Court station area allows.[5] While the 2008-2009 recession slowed development in Segment 2 and elsewhere in the region, the life of a large public infrastructure facility like the Streetcar Alternative is much longer than such markets cycles.

The **cumulative land use impacts** of both the Streetcar Alternative and the extension of Moody Avenue and the South Portal project described in Section 3.1.1, above, would likely be greater combined than alone. Redevelopment would likely occur sooner and be more intense if all three are combined, especially if they occur within the same timeframe. "More intense" means more square footage and more likely to be mixed use, rather than separate commercial, office, and residential uses. This is because all three would strengthen the market appeal of properties in the area.

[4] E.D. Hovee & Company, LLC, Portland Streetcar Development Impacts, November 2005, p. 9.
[5] The zoning is Central Commercial north of Hamilton Street and Storefront Commercial south of Hamilton Street. Both zones allow commercial, office and residential uses.

Segment 3 Direct, Indirect and Cumulative Impacts of the Streetcar Alternative. Tables 3.1-1, 3.1-2, and 3.1-3 show the *direct impacts* of the Segment 3 options by existing land use, comprehensive plan designation and zoning, respectively. They would result from the acquisition of property. The Macadam Additional Lane Option would convert to project use an estimated 3.6 acres of land, compared with 2.2 acres under the Macadam In-Street Option and 0.2 acres under the Willamette Shore Line Option. The property acquisition figures in Appendix G of this DEIS show the location of the direct impacts. Most the land converted to project use is currently used as private roads and would remain in use to provide access to adjacent properties.

The Streetcar Alternatives would likely result in *indirect impacts* such as redevelopment of some commercial uses near Macadam Avenue, based on redevelopment experiences on the first Portland streetcar project, as described in the section on Segment 2, above. There is both a large potential for redevelopment and substantial capacity to accommodate intensification of land uses along Macadam Avenue. Table 3.1-4 shows that existing private property improvements represent less than two times the value of the land they occupy on about 85 percent of station area properties. Improvement values are less than land values on about 60 percent of the properties. These percentages indicate high redevelopment potential. Table 3.1-4 also shows that existing development uses only about 65 percent of allowed floor area in the station areas. At the same time, the extent of redevelopment would be less than along the original Portland streetcar route because there are no plans for the kinds of city interventions to foster redevelopment that there were in the Pearl District. In addition, the extent of redevelopment and intensity of uses would be less than in Segment 2. This is because there is virtually no vacant land near the stations in Segment 3 and allowed floor area is lower. In addition, in comparison to Segment 2 and to the Pearl District example, the development in this area would primarily be small-scale redevelopment.

The redevelopment mainly would be of existing commercial uses because, among commercial uses, improvement to land value ratios are lower and unused floor area percentages higher, compared to residential uses. In addition, many of the existing residential uses are condominium complexes, which are unlikely to redevelop during the planning period. At the same time, some of the redevelopment of existing commercial uses would likely including housing over commercial uses, because the applicable Storefront Commercial zoning allows mixed residential and commercial uses.

There would be more redevelopment under the Macadam In-Street and Macadam Additional Lane Options than under the Willamette Shore Line Option. One reason is that more land with low improvement to land value ratios would be close to the Boundary Street station under the Macadam In-Street and Macadam Additional Lane Options, compared to the Willamette Shore Line Option (51 acres with a ratio under two compared to 39 acres). Similarly, there would be nearly twice as much unused allowed floor area in the Boundary Street station area under the Macadam Avenue options as under the Willamette Shore Line Option. See Table 3.1-4. Likewise, while the amount of unused allowed floor area in the Carolina Street and Nebraska Street station areas is nearly the same, 25 acres in the Carolina Street station area have an improvement to land value ratio under two, compared with 14 acres in the Nebraska Street station area. In addition, the location of the Boundary Street and Carolina Street stations on or near Macadam Avenue under the Macadam In-Street and

Table 3.1-4 Station Area Redevelopment Potential

Station Area[1] by Segment	Floor Area Square Feet (X 1,000) Allowed[2]	Existing	Unused	Unused As % of Allowed	Ratio of Value of Improvements to Value of Land[3, 4] Under 1 Acres	%	1 to 1.99 Acres	%	2 to 2.99 Acres	%	3 to 3.99 Acres	%	4 and Over Acres	%	Total Acres	%
2-South Waterfront																
Bancroft[5]	8,477	755	7,722	91	25	83	4	13	0	0	0	0	1	4	30	100
Hamilton	5,513	776	4,736	86	12	47	6	23	1	5	0	0	6	25	25	100
Total	13,990	1,532	12,458	89	37	67	10	17	1	2	0	0	7	13	55	100
3-Johns Landing																
Boundary, Wil. Sh. L.	3,601	1,524	2,077	58	30	71	9	21	3	8	0	0	0	0	42	100
Boundary, Mac. Opts.	5,741	1,936	3,805	66	40	69	11	19	4	7	0	1	3	4	58	100
Carolina	2,188	846	1,342	61	17	58	8	26	2	7	1	4	1	4	29	100
Nebraska	2,008	604	1,404	70	9	48	5	30	2	11	1	5	1	6	18	100
Nevada	1,478	504	974	66	7	39	7	40	1	8	0	1	2	13	18	100
Total, Wil. Sh. L.	7,086	2,632	4,454	63	45	58	21	27	7	9	1	1	3	4	77	100
Total, Mac. In-St.	9,406	3,286	6,121	65	64	61	26	25	8	7	2	2	6	6	105	
Total, Mac. Ad. Ln.	9,406	3,286	6,121	65	64	61	26	25	8	7	2	2	6	6	105	
4-Sellwood Bridge																
Sellwood Bridge	383	16	367	96	2	100	0	0	0	0	0	0	0	0	2	100
6-Lake Oswego[6]																
B Avenue	16,179	2,673	13,505	83	18	37	8	17	8	17	2	4	13	25	50	100
Lake Oswego Terminus	14,664	2,623	12,040	82	7	48	2	12	2	12	2	16	2	12	15	100
Total, Both Options	30,842	5,296	25,546	83	26	39	10	16	10	16	5	7	15	22	65	100
TOTAL[7]																
From	52,302	9,476	42,826	82	110	55	41	21	18	9	6	3	25	13	200	100
To	54,622	10,130	44,492	81	126	55	50	22	19	8	6	3	28	12	230	100

Note: Wil. Sh. L. means Willamette Shore Line; Mac. In-St means Macadam In-Street; Mac. Ad. Ln. means Macadam Additional Lane; L.O. Trm. means Lake Oswego Terminus; MOS means Minimum Operable Segment.

Numbers exclude land zoned for parks and open space.

[1] Redevelopment potential measurement area, as shown on Figures 3.1-4 through 3.1-9.

[2] Allowed by the floor area ratio specified in the applicable zoning regulations, but see footnote 6.

[3] Ratios in Segments 2, 3, and 4 are based on assessed market values in 2008. Ratios in Segment 6 are based on assessed values in 2009.

[4] The ratios of the value of improvements to the value of land do not include residential or commercial condominiums because tax assessments do not separately assess the value improvements and land for them. Figure 3.1-5 identifies the properties that are excluded from the ratios because they are residential or commercial condominiums.

[5] The ratios of the value of improvements to the value of land do not include the lock bounded by Moody, Bond, Lowell, and Abernethy because the apartment buildings on it are under construction. The floor area square footages include the block.

[6] The allowed floor area numbers assume that the City of Oswego rezones to Multi-Family Residential/East End Commercial the land now zoned Industrial. The existing Industrial zoning would not allow the type of commercial and residential uses that make up mixed-use development and allows only one-third as much floor area.

[7] Totals do not add across because the column totals sum ranges.

Sources: Data provided by Metro. Portland data from City of Portland Bureau of Planning and Sustainability "Development Capacity Analysis." Lake Oswego data from Metro. Table prepared by URS Corp. with GIS analysis by David Evans and Associates.

Macadam Additional Lane options would strengthen the perception of Macadam Avenue being served by streetcar. This would improve the marketability of commercial real estate along Macadam, making redevelopment more likely. The Nevada Street Station area would be the same under all the options. A future optional station could be located at Pendleton Street. While the land on the east side of Macadam Avenue near Pendleton Street is mainly residential and unlikely to redevelop, uses on the west side are commercial and would be more likely to redevelop if this station were built.

Application of Section 0060 of the State of Oregon's Transportation Planning Rule (TPR)[6] would not constrain the potential redevelopment in Segment 3 described above. TPR Section 0060 places conditions on amendments to comprehensive plans and zoning if they would contribute to violations of standards for congestion levels on state highways contained in the Oregon Highway Plan (OHP). Macadam Avenue in Segment 3 is a state highway. However, Section 0060 would not apply in Segment 3, because the existing Storefront Commercial zoning allows as permitted uses the commercial, residential and mixed uses that would comprise the redevelopment; amendments to Portland's comprehensive plan or zoning would not be necessary.

No *cumulative land use impacts* of the Streetcar Alternative in Segment 3 have been identified. No other identified projects, plans, policies or trends would combine with the Streetcar Alternatives in a way that would materially alter their land use impacts.

Segment 4 Direct, Indirect, and Cumulative Impacts of the Streetcar Alternative. The Streetcar Alternative would not, in itself, have *direct impacts* in Segment 4, as it would not require the conversion of land to project use. Construction of the Sellwood Bridge new interchange, which is part of the preferred alternative for the new bridge, would necessitate the realignment of the streetcar right of way and a different station configuration. The bridge project would acquire the right of way needed for the streetcar realignment. It would do the same under the No-Build Alternative, because the Willamette Shore Line alignment could be retained as a bicycle and pedestrian path, if rail use were discontinued. This makes land conversion in Segment 4 a consequence of the bridge project, not the Streetcar Alternative.

Indirect impacts of the Streetcar Alternative would include encouraging the redevelopment of the commercial properties on the north end of Segment 4. Some are within two blocks of the Nevada Street station, increasing the attractiveness of the property in the same way as described in the discussion of Segment 3 impacts. Existing development on the properties uses only 4 percent of allowed floor area and has a value less than the value of the land it occupies. These indicate that owners could substantially increase return on investment by redeveloping the properties, making redevelopment more likely.

The Streetcar Alternative would have a similar effect on the commercial property immediately north of the Sellwood Bridge. The property is a family-owned recreational boating dealership was in continuous operation at the site between 1929 and 2010. Table 3.1-4 shows that existing improvements use less than 25 percent of allowed floor area and have a value less than the value of the land. The proposed station adjoining the property would make the property the only waterside location in the region with adjacent access by motor vehicle, streetcar and boat.

[6] Oregon Administrative Rule 660-012-0060.

The *cumulative impact* of the Streetcar Alternative and replacement of the Sellwood Bridge would be to encourage redevelopment of the boating dealership property even more than the Streetcar Alternatives alone. The reason is that the new interchange built in conjunction with bridge replacement would improve motor vehicle access to the property. Under existing conditions and without the new interchange, direct access and egress are limited to northbound traffic. Southbound traffic access and egress are via a local street several blocks to the north of the property, which has an unsignalized intersection with Macadam Avenue. With the new bridge, the interchange would provide the site signalized routing for traffic coming from and going to all directions.

Segment 5 Direct, Indirect and Cumulative Impacts of the Streetcar Alternative. Tables 3.1-1, 3.1-2 and 3.1-3 show the *direct impacts* of the Segment 5 options by existing land use, comprehensive plan designation and zoning, respectively. The impact of the Riverwood design option would result from the acquisition of a 0.7-acre property. The Willamette Shore Line design option would not have any direct land use impacts. The property acquisition figures in Appendix G of this DEIS show the location of the direct impact under the Riverwood design option.

The Streetcar Alternative would not *indirectly* cause any land uses to change, because the area is already developed in compliance with its single-family residential zoning and its residents oppose rezoning to allow other uses. There is no proposal for such rezoning.

No *cumulative impacts* on land use would occur in Segment 5. No other identified projects, plans, policies or trends would combine with the Streetcar Alternative in a way that would alter the direct impact of the Riverwood design option or have indirect land use impacts.

Segment 6 Direct, Indirect and Cumulative Impacts of the Streetcar Alternative. Tables 3.1-1, 3.1-2, and 3.1-3 show the *direct impacts* of the Segment 6 options by existing land use, comprehensive plan designation and zoning, respectively. The Foothills design option would convert to project use a total of an estimated 5.4 acres of land, compared to an estimated 2.3 acres under the Union Pacific Railroad Right of Way design option. The extension of Foothills Road accounts for most of the difference between the two options. The streetcar would operate in mixed traffic in a rebuilt Foothills Road.

The *indirect impacts* of the Streetcar Alternative options would be the same because the B Avenue and Lake Oswego terminus station areas are the same. The locations of the B Avenue station under both options are close to each other and the Lake Oswego terminus station location is the same under both options.

Under both options, the Streetcar Alternative would likely result in more land redevelopment, redevelopment to more intense uses, and redevelopment sooner in the B Avenue and Lake Oswego terminus station areas than under the No-Build Alternative. The following three reasons are similar to the reasons the Streetcar Alternative would have similar effects in Segment 2:

- Portland's experience with the original streetcar project encouraging redevelopment and more intense redeveloped uses, as describe in item in Section 3.1.2.3. Like the Pearl District in Portland, the City of Lake Oswego has made street improvements and built new parks in and near the station areas and plans additional street improvements. As with the Pearl District, the City of Lake Oswego is partnering with land owners and developers to facilitate redevelopment of the

Foothills industrial area. It is likely to similarly partner with the owner of the Oswego Village commercial center that includes the Albertsons grocery store and adjacent land near the Lake Oswego terminus station.

- There would be a large amount of capacity for redevelopment in Segment 6, if the City Lake Oswego carries out its plans for Foothills redevelopment, as described in Section 3.1.1. Table 3.1-4 on page 3-13 assumes that the land now zoned Industrial in the Foothills area is rezoned to Multi-Family Residential/East End Commercial. It shows that 83 percent of the floor area allowed by existing and planned zoning of the B Avenue and Lake Oswego terminus station areas is unused by existing development.[7] It should be noted that city officials think that only a fraction of allowed square footage is likely because of parking requirements and because the scale of development likely to be proposed is lower than the floor area regulations would allow.

- Many properties in the station areas are ripe for redevelopment, as indicated by their improvement to land value ratios. Table 3.1-4 shows that 39 percent have ratios of less than one, 55 percent less than two, and 71 percent less than three.

Realization of the redevelopment potential described above is contingent on the City of Lake Oswego finding a way to comply with Section 0060 of the State of Oregon TPR.[8] As described in Section 3.1.2.3, the provision places conditions on changes to comprehensive plans and zoning if they would contribute to violations of congestion standards on state highways. It would apply to the Foothills redevelopment project because of the need for plan and zoning map amendments and because development there would increase traffic on Highway 43, a state highway. The city may be able to comply using approaches available under the TPR and the OHP, such as by establishing a "special transportation area," which allows higher congestion levels. In addition, Metro is working with the Oregon Department of Transportation to formulate OHP amendments that would provide new ways to achieve TPR compliance for development in town centers like downtown Lake Oswego.[9]

The Streetcar Alternative would not impact land use in the vicinity of the Briarwood Road station because the area is already developed in compliance with its single-family residential zoning and its residents oppose rezoning to allow other uses. There is no proposal for such rezoning.

The indirect and *cumulative land use impacts* would be the same because, as analyzed above, the indirect impacts take into account the combined land use impacts of the Streetcar Alternative, planned Foothills redevelopment, the city's plans to amend the comprehensive plan and zoning map as they apply to the Foothills area, and the city's plans to formulate a street plan for the area near the alignments of the Union Pacific Railroad and Foothills options. No other actions have been identified that would combine with the land use impacts of the Streetcar Alternative in an identifiable way.

3.1.3 Potential Land Use Impact Mitigation Measures

No potential mitigation measures are proposed because neither the Enhanced Bus Alternative nor the Streetcar Alternative would have adverse land use impacts. The redevelopment the Streetcar

[7] The existing Industrial zoning would not allow the type of commercial and residential uses that make up mixed-use development and allows only one-third as much floor area.
[8] Oregon Administrative Rule 660-012-0060.
[9] Referred to as "Safe Harbors," the concept is to waive the TPR requirement as applied to designated town centers, etc., (like downtown Lake Oswego) and possibly entire corridors in exchange for meeting criteria addressing, for example, parking, transit, other alternative modes, and mixed-use zoning.

Alternative would encourage would comply with applicable plans and zoning or with planned changes in them. In the Foothills industrial area in Segment 6, the City of Lake Oswego plans to amend the comprehensive plan and zoning map to allow the residential and commercial redevelopment the Streetcar Alternative would encourage.

3.1.4 Compliance with Applicable Plans Policies

This section has two subsections. The first subsection compares the alternatives and options in terms of whether they comply with regional and city policies that specifically mention an alternative or address what mode of transportation is appropriate in the corridor. The second subsection identifies instances where alternatives and options would not comply with other applicable regional, city and county policies. It also describes how an alternative or option could be modified to comply or how the policy could be modified to make the alternative or option comply with it.

The two subsections summarize detailed analysis contained in the *Land Use and Planning Technical Report* (URS, August 2010). The technical report quotes all applicable policies and explains why the alternatives and options comply or do not comply with them. It and this section address only policies in plans state law requires compliance with. These are the Oregon Transportation Plan, Oregon Highway Plan, Oregon Bicycle and Pedestrian Plan, Regional Transportation Plan (RTP), Portland Transportation System Plan (TSP), Portland South Waterfront Plan, Portland North Macadam Transportation Development Strategy, Portland Willamette Greenway Plan, Lake Oswego Comprehensive Plan, Clackamas County Comprehensive Plan, and Multnomah County Comprehensive Framework Plan.

This section does not address compliance with the Statewide Planning Goals because they do not apply to project alternatives. Oregon's statewide land use planning laws and regulations, first enacted in 1973, require all regional and local governments, including Metro, to adopt and periodically update comprehensive plans. These plans must comply with Oregon's 19 Statewide Planning Goals. The plans must include maps of planned land use, urban growth boundaries to delineate the boundary between urban and rural lands, and TSPs. TSPs must provide for transportation facilities that support planned land use.[10] Projects like the Lake Oswego to Portland Transit Project must comply with applicable TSPs. Once the Land Conservation and Development Commission (LCDC) has "acknowledged" a plan as consistent with the Statewide Planning Goals, the goals no longer apply directly to projects such as the lake Oswego to Portland Transit Project. LCDC has acknowledged all the plans applicable to the project.

3.1.4.1 Policies that Address the Alternatives or the Appropriate Mode of Transportation

Regional Transportation Plan

The Streetcar Alternative would comply with the RTP, but neither the Enhanced Bus nor No-Build Alternative would comply with it. Relevant provisions are:

- The RTP's financially-constrained project list.
- Objective 1.1, Compact Urban Form and Design, states:

[10] Oregon Administrative Rule 660-012-0015(3)(a).

Use transportation investments to reinforce growth in and multimodal access to 2040 Target Areas and ensure that development in 2040 Target Areas is consistent with and supports the transportation investments.[11]

- The definition of "target areas" includes town centers, main streets and corridors.[12] The 2040 Growth Concept map:
  - Classifies downtown Lake Oswego as a town center.
  - Classifies downtown Portland as part of the central city.
  - Classifies as "main streets" an area along the Willamette Shore Line alignment from Hamilton Court south to near Pendleton Street and west along Boundary Street to west of Corbett Avenue.[13]

- Policies in the 2035 RTP's "Regional Transit Network Vision," which include "build the total system and transit-supportive land uses to leverage investments" and "expand high capacity transit."

- Figure 2.15, Regional Transit Network, which shows "rapid streetcar" in the Lake Oswego to Portland transit corridor. The RTP describes "rapid streetcar" as "streetcars running in mostly exclusive right-of-way so that they are able to travel faster safely."[14]

The Streetcar Alternative would comply with the RTP because it is on the financially constrained project list, would meet Objective 1.1, and would provide "rapid streetcar" in the Lake Oswego to Portland transit corridor. It would meet Objective 1.1 because extension of the streetcar system would encourage the types and intensities of development the 2040 Growth Concept designations call for. See the analyses of indirect land use impact, above. The Streetcar Alternative design options would not materially differ regarding Objective 1.1. The Enhanced Bus Alternative would not comply with the RTP because it is not on the financially constrained project list and would not encourage 2040 Growth Concept development types and intensities. Similarly, the No-Build Alternative would not comply with Objective 1.1 because it would not encourage 2040 Growth Concept development types and intensities.

Lake Oswego Comprehensive Plan

Both the Enhanced Bus and Streetcar Alternatives would comply with City of Lake Oswego Comprehensive Plan policies, but not the No-Build Alternative. Below are the policies that specifically address the alternatives or the appropriate mode of transportation for the corridor.

- Three policies under Goal 8, Transit System, and an associated Recommended Action Measure. The three policies are:
  1. Transit shall be a viable alternative to the single-occupant automobile in the City's highest density employment and housing areas. The City shall develop, in conjunction with Tri-Met, a network of transit routes to connect these areas with Main Streets, Town Centers, Employment Centers, downtown Portland and major transit and transfer stations. * * *

[11] Metro, 2035 Regional Transportation Plan Final Draft, March 2010, p. 2-8.
[12] *Ibid*., p. 2-5.
[13] Metro, 2040 Growth Concept Map, last amended November, 17, 2005.
[14] Metro, 2035 Regional Transportation Plan Final Draft, March 2010, p. 2-47.

2. Develop transit centers in Town Centers and Employment Centers where there is a need for transfer points between bus lines and local shuttle services or transit trunk routes. Transit centers will be conveniently located for all modes of transportation, in particular pedestrian, bike and transit.

* * *

6. The City shall work to preserve existing railroad rights-of-ways and other easements to maintain opportunities for future mass transit, bike and pedestrian paths.[15]

The Plan identifies downtown Lake Oswego as having a main street and being a town center.[16] One of the Recommended Action Measures for the Goal 8 policies states:

> Coordinate with Metro, Tri-Met, Multnomah County, Clackamas County, the City of Portland and other regional partners in the planning and design of high capacity transit on the Willamette Shore Rail line to ensure:
> a. Adequate access to the regional transportation system;
> b. Adequate termini facilities; and
> c. Adequate access to the line for all modes of travel.[17]

- Figure 20D of the Plan, Transit Network and Facilities Plan, shows:
  - the Willamette Shore Line alignment as "Right-of-Way Preservation, Future High Capacity Transit"
  - "Frequent Bus Network (High Frequency, Frequent Stops)"along State Street/Highway 43 through downtown
  - A park and ride lot and "major transit stop" near the park-and-ride structure under both the Enhanced Bus and Streetcar Alternatives[18]

- The Comprehensive Plan's "Public Facilities Plan: Transportation Improvement Program 1-10 Years," includes "Track/trestle rehabilitation" of the "Willamette Shores Trolley"[19] and "Park and Ride/relocated transit center" in "Downtown Lake Oswego - East of State Street."[20]

The Enhanced Bus would comply with City of Lake Oswego Comprehensive Plan policies because it would provide the "Frequent Bus Network (High Frequency, Frequent Stops)" the plan calls for. The Streetcar Alternative would comply because it would provide the "high capacity transit on the Willamette Shore Rail" the plan calls for. The Streetcar Alternative design options would be the same in this respect. Both the Enhanced Bus and Streetcar Alternatives would provide the "Park and Ride/relocated transit center" in "Downtown Lake Oswego – East of State Street." The No-Build Alternative would provide none of these and so does not comply with the Lake Oswego Comprehensive Plan.

[15] City of Lake Oswego, Comprehensive Plan, December 1994, as amended, p. 12-18, ff.
[16] *Ibid*., Figures 26 – 28.
[17] *Ibid*., measure vi., p. 12-19.
[18] *Ibid*., Figure 20D.
[19] *Ibid.*, p. 12-28.
[20] *Ibid.*, p. 12-34.

Portland Transportation System Plan, South Waterfront Plan and Portland Streetcar System Concept Plan

Of the policies in the Portland TSP and South Waterfront Plan specifically applicable to them or addressing the appropriate mode of transportation in the corridor, the Streetcar Alternative would comply with more of the policies than the Enhanced Bus Alternative. The No-Build Alternative would not comply with these policies. Similarly, the Streetcar Alternative is in Portland Streetcar System Concept Plan; the Enhanced Bus and No-Build alternatives are inconsistent with the plan. The policies that specifically apply to the Streetcar Alternative or Enhanced Bus Alternative or address the appropriate mode of transportation in the corridor are quoted or described below.

- TSP Policy 6.17, Coordinate Land Use and Transportation, of the TSP states, "Implement the Comprehensive Plan Map and the 2040 Growth Concept through long-range transportation and land use planning and the development of efficient and effective transportation projects and programs."[21] See the description of 2040 Growth Concept classifications in the RTP discussion, above.

- Two objectives under TSP Policy 6.24, Public Transportation, are:
  - C. Expand primary and secondary bus service to meet the growing demand for work and non-work trips, operate as the principal transit service for access and mobility needs, help reduce congestion, and support the economic activities of the City.
  - H. Develop streetcar lines in Portland to connect new or redeveloping neighborhoods to employment opportunities and other destinations, including shopping, education, and recreation.[22]

- Objective A under TSP Policy 6.41, Southwest Transportation District, states:
  Use the Willamette Shore Line right-of-way, the corridor identified in the Macadam Corridor Improvement Plan, or other alignment as appropriate to provide future streetcar commuter service or light rail in the Macadam corridor.[23]

- Two objectives under the transportation policy of the South Waterfront Plan (which applies to Segment 2 south to Southwest Hamilton Court) are:
  - 3. Support the development of the Central City streetcar and a regional streetcar line that connects the district to downtown, Lake Oswego, and adjacent neighborhoods.
  - 9. Encourage increased transit service in the district while maintaining existing service levels in adjacent districts and neighborhoods.[24]

- The Portland Streetcar System Concept Plan includes "Lake Oswego to Portland: Lake Oswego to SW Lowell St" as a Planned Regional Project in its table of "Existing Streetcar Corridors and System Concept Corridors."[25]

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[21] *Ibid*., p. 2-28
[22] City of Portland, Transportation System Plan, op. cit., p. 2-32.
[23] *Ibid*., p. 2-99.
[24] City of Portland, South Waterfront Plan, November 13, 002, p. A-5.
[25] City of Portland, Portland Streetcar System Concept Plan, Public Review Draft, July 1, 2009, p. 45. The Portland City Council "accepted" September 9, 2009, and the City plans to adopt it as part of its TSP.

The Streetcar Alternative would comply with all of the TSP and South Waterfront Plan policies quoted above except objective C under TSP Policy 6.24, Public Transportation. The Segment 3 design options would be the same in this respect. The Enhanced Bus Alternative would comply with only objective C under TSP Policy 6.24. The No-Build Alternative would comply with none of these policies. The Streetcar Alternative is in the Portland Streetcar System Concept Plan. The No-Build and Enhanced Bus Alternatives are inconsistent with inclusion of the Streetcar Alternative in the Portland Streetcar System Concept Plan.

3.1.4.2 Other Policies

As described above, this subsection summarizes: a) instances where design features of the build alternatives and options would not comply with applicable regional, city, and county policies; b) how an alternative or option could be modified to comply; and c) how the policy could be modified to make the alternative or option comply with it. Except in the instances listed here, the build alternatives would comply with policies addressing design features. This subsection summarizes analysis contained in the *Land Use and Planning Technical Report* (URS, August 2010).

Enhanced Bus Alternative

- Would not meet 2035 RTP Objective 6.1, which states, "Avoid or minimize undesirable impacts on fish and wildlife habitat conservation areas, wildlife corridors, significant flora and open spaces." This is because the Enhanced Bus Alternative would adversely impact aquatic habitat, while the Streetcar Alternative would not. See Section 3.8 Ecosystems.

- Would be inconsistent with a provision of Portland TSP Policy 6.6, which states, "Employ transit-preferential measures, such as signal priority and bypass lanes."[26] Adding bypass lanes to the Enhanced Bus Alternative would not be feasible in much of the corridor. Analysis conducted during the alternatives analysis concluded that such lanes would have to be continuous, because of the length of traffic queues. Adding additional lanes was found to be infeasible in much of the corridor. Adding signal priority without bypass lanes would achieve partial compliance. While it would not substantially improve speeds without adding bypass lanes, it would achieve compliance with TSP Policy 6.10, described below. To avoid noncompliance, "where feasible" could be added to the TSP Policy 6.6 sentence quoted above, so that it would read, "Where feasible, employ transit-preferential measures, such as signal priority and bypass lanes."

- Would not comply with Portland TSP Policy 6.10, which states "Design treatments on Major Emergency Response Streets should enhance mobility for emergency response vehicles by employing preferential or priority treatments."[27] The TSP classifies Macadam Avenue/Highway 43 as a major emergency response route.[28] As with Policy 6.6, discussed above, adding signal priority would achieve compliance. Alternatively, as with Policy 6.6, to avoid noncompliance, "where feasible" could be added to the SP Policy 6.10 sentence quoted above, so that it would read, "Where feasible, design treatments on Major Emergency Response Streets should enhance mobility for emergency response vehicles by employing preferential or priority treatments."

[26] *Ibid*., p. 2-10.
[27] *Ibid*., p. 2-15.
[28] *Ibid*., Map 6.41.6, p. 2-106.

Streetcar Alternative

- Would be in substantial, but not technical, compliance with providing an "Off-Street Path" in the vicinity of the existing Willamette Shore Line alignment south of Miles Street. This is because there would be no off-street path for about 600 feet of the length of the path, as shown on the Portland TSP bicycle and pedestrian classifications maps for the Southwest District.[29] A draft report prepared for Metro has identified how an off-street trail could be routed, if a streetcar alternative were implemented, including in conjunction with the replacement of the Sellwood Bridge.[30] It shows the path as the "Greenway Off-Street Path," which would parallel the WSL alignment south to a point north of Radcliffe Road. South of this point, the report shows only an "On-Street Facility" on Highway 43. This point is a short distance north of the Portland city limits, where the city's comprehensive planning jurisdiction ends.[31] This implies that only the Willamette Shore Line alignment is feasible as an "Off-Street Path" for the approximately 600-foot distance to the city limits. Regarding Off-Street Paths, TSP Policy 6.7.B states:

  > Off-Street Paths are intended to serve as transportation corridors and recreational routes for bicycling, walking, and other non-motorized modes.
  > - Connections. Use Off-Street Paths as convenient shortcuts to link urban destinations and origins along continuous greenbelts such as rivers, park and forest areas, and other scenic corridors, and as elements of a regional, citywide, or community recreational trail plan.
  > - Location. Establish Off-Street Paths in corridors not well served by the street system.[32]

To avoid this instance of technical noncompliance, the TSP could be amended to indicate that substantial provision of an "Off-Street Path" would comply with the plan, even if the path is not provided for along the entire length shown on classification maps.

Streetcar Design Options

- The Macadam In-Street and Macadam Additional Lane design options would not comply with the provision of Portland TSP Policy 6.6 which states, "Employ transit-preferential measures, such as signal priority and bypass lanes."[33] As with the Enhanced Bus Alternative, adding bypass lanes would not be feasible. Analysis conducted during the alternatives analysis concluded that such lanes would have to be continuous, because of the length of traffic queues. Adding additional lanes was found to be infeasible. Adding signal priority without bypass lanes would achieve partial compliance. While it would not substantially improve speeds without adding bypass lanes, it would achieve compliance with TSP Policy 6.10, described below. To avoid this noncompliance, "where feasible" could be added to the TSP Policy 6.6 sentence, to read, "Where feasible, employ transit-preferential measures, such as signal priority and bypass lanes."

- The Macadam In-Street and Macadam Additional Lane design options would not comply with Portland TSP Policy 6.10, which states "Design treatments on Major Emergency Response

[29] City of Portland, Transportation System Plan, April 5, 2007, Map 6.41.3, p. 2-103, and Map 6.41.4, p. 2-104. Because the TSP map and the Metro map referred to are schematic, the 600-foot figure is a rough estimate.
[30] Alta Planning and Design, Lake Oswego to Portland Trail, Draft, July 2009, Map 3.
[31] Under contract with Multnomah County, the City of Portland exercises land use regulatory authority in an area south of the city limits which extends to the boundary between Multnomah and Clackamas Counties. However, Multnomah County retains comprehensive planning authority over the area.
[32] Ibid., p. 2-13.
[33] Ibid., p. 2-10.

Streets should enhance mobility for emergency response vehicles by employing preferential or priority treatments."[34] The TSP classifies Macadam Avenue/Highway 43 as a major emergency response route.[35] As with Policy 6.6, discussed above, adding signal priority would achieve compliance. Alternatively, as with Policy 6.6, to avoid noncompliance, "where feasible" could be added to the SP Policy 6.10 sentence reading, "Design treatments on Major Emergency Response Streets should enhance mobility for emergency response vehicles by employing preferential or priority treatments, where feasible."

[34] Ibid., p. 2-15.
[35] Ibid., Map 6.41.6, p. 2-106.

3.2 Economic Activity

This section addresses the economic impacts of the project's proposed alternatives. Most transportation projects help to provide the mobility necessary for economic activity in an area, but most have a relatively small direct impact on economic conditions. Direct economic effects are defined as jobs or spending caused by the project. Indirect effects are defined as jobs or spending that the project may cause or contribute to causing by changing the level of access and mobility within the corridor and region. For additional detail see the *Lake Oswego to Portland Transit Corridor Economic Activity Technical Report* (BGY and TriMet/Metro, November 2010).

The analysis of employment impacts within this section is based on economic data for the four-county metropolitan area, capital and operating cost estimates for the project (see Sections 2.3 and 2.4, respectively) and use of the IMPLAN[36] economic impacts assessment model to estimate the number of jobs generated as a result of this project.

3.2.1 Affected Environment

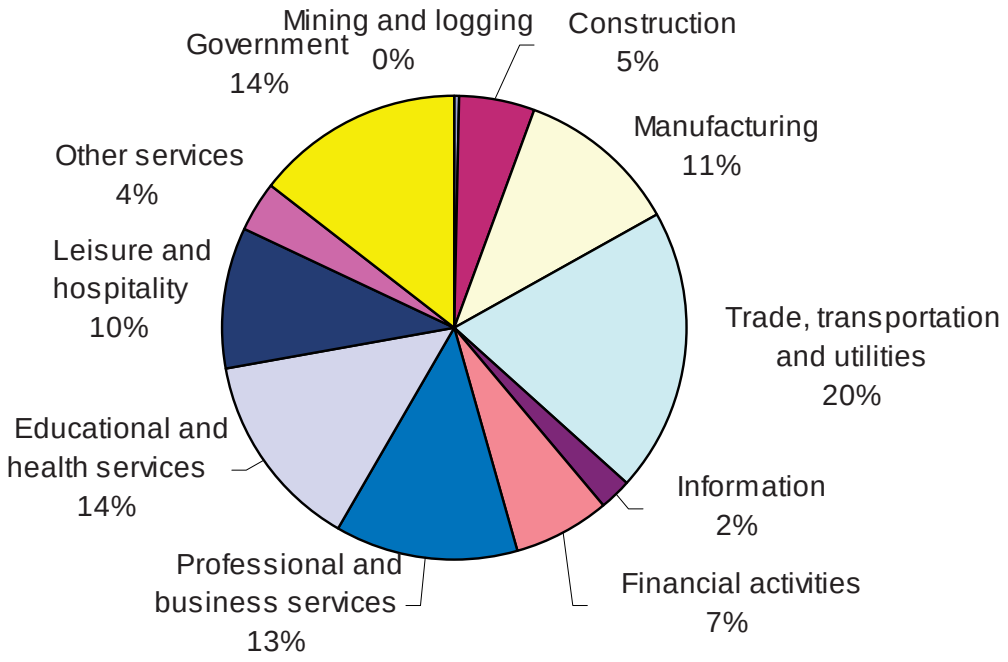
The Portland/Vancouver metropolitan area is the economic center of an extensive area that includes most of Oregon, Southwest Washington and portions of Idaho. The metro region, with downtown Portland as its urban center, is located near the confluence of the Columbia and Willamette rivers. The Portland/Vancouver metropolitan area is defined as the four-county region, which is made up of Multnomah, Clackamas and Washington counties in Oregon and Clark County in Washington. Between 1980 and 2005, the area's population grew by approximately 56 percent, to a population of approximately 1.9 million, as shown in Table 3.2-1. Over the same period, households increased by 61 percent to a total of approximately 767,000. Population and household growth in Portland, which contains the northern portion of the Lake Oswego to Portland transit corridor, were lower than in the wider Portland/Vancouver metropolitan area. However, the South Corridor and Johns Landing Districts are experiencing faster population and employment growth than the rest of the City of Portland, as described later in this section. Population and household growth in Lake Oswego, which contains the southern end of the transit corridor, were higher than in the wider Portland/Vancouver metropolitan area.

In 2005, there were over 1 million jobs within the metropolitan area, with 424,000 and 19,300 jobs within the cities of Portland and Lake Oswego, respectively. Metropolitan area employment grew by approximately 110 percent from 1980 to 2005, outpacing state employment growth (45 percent). The recent economic downturn has resulted in increasing levels of unemployment within the region, estimated at a seasonally adjusted 11.1 percent for the Metropolitan Statistical Area in September 2009, up from 6.1 percent the previous year, compared to the Oregon average unemployment rate of 11.0 percent and the United States average of 9.8 percent. The Oregon Employment Department estimated total nonfarm employment in the Metropolitan Statistical Area in September 2009 of approximately 975,800 jobs, across a wide range of industry groups. The largest employment sectors are trade, transportation and utilities (20 percent); education and health services (14 percent); and

[36] IMPLAN is a static equilibrium input-output model first developed in 1979 by the U.S. Forest Service in cooperation with the Federal Emergency Management Agency and the U.S. Bureau of Land Management to assist the Forest Service in land and resource planning and management. The program has been updated and improved over subsequent years and is now one of the most commonly-used economic modeling tools for measuring the economic impacts of development projects. This analysis utilizes year 2007 data for Multnomah, Washington, and Clackamas counties in Oregon, and Clark County, Washington.

government (14 percent). Figure 3.2-1 illustrates the breakdown of employment for the Metropolitan Statistical Area.

Figure 3.2-1 Portland/Vancouver Regional Employment by Industry, September 2009



Source: Oregon Employment Department; September 2009

The Lake Oswego to Portland transit corridor includes six districts: Portland Central Business District (CBD), Northwest Portland, South Waterfront/OHSU, Johns Landing, Dunthorpe/Riverdale, and Lake Oswego (see Figure 1.2-1). Table 3.2-1 summarizes historic household and employment growth from 1990 to 2005 within the corridor districts, the Lake Oswego to Portland transit corridor, and the Portland/Vancouver metropolitan area. The corridor comprises approximately 15 percent of the region's employment and approximately 4 percent of the region's households. From 1990 to 2005, household growth in the corridor (37 percent) was comparable to household growth in the region (40 percent), with the greatest household growth in the corridor occurring within the Portland CBD (118 percent). The corridor's employment growth rate of 25 percent during the same period has been slower than the metropolitan area's (at 48 percent), though employment growth in the South Waterfront/OHSU area was greater at 68 percent.

Table 3.2-1 Local, Regional and State Population and Households 1980 through 2005

Location	1980	1990	2000	2005	Change 1980 to 2005 Percent	Change 1980 to 2005 Actual
Population						
City of Portland[1]	366,400	437,300	529,100	556,400	52	190,000
City of Lake Oswego[2]	22,900	30,600	35,300	40,900	79	18,100
Portland/Vancouver area [2,3]	1,242,600	1,412,300	1,759,100	1,946,000	57	703,400
State of Oregon[1]	2,633,100	2,842,300	3,421,400	3,638,900	38	1,005,800
Households						
City of Portland[1]	158,900	187,300	223,800	235,200	48	76,300
City of Lake Oswego[2]	8,500	12,600	14,800	17,200	102	8,700
Portland/Vancouver area[2,3]	477,800	548,700	696,700	767,000	61	289,200
State of Oregon[1]	991,600	1,103,300	1,333,700	1,425,300	44	433,700
Employment						
City of Portland[1]	173,800	218,800	276,100	424,000	144	250,100
City of Lake Oswego[2]	11,800	16,600	18,300	19,300	64	7,500
Portland/Vancouver area[2,3]	491,200	697,300	906,800	1,032,200	110	541,000
State of Oregon[1]	1,138,400	1,320,000	1,627,800	1,654,400	45	516,000

[1] Source: US Census except for 2005 (PSU Population Research Center, 2008).
[2] Source: Metro, 2009.
[3] The four-county Portland/Vancouver metropolitan area includes all of Multnomah, Clackamas, and Washington Counties in Oregon, and Clark County in Washington.

The future growth rate of households in the Lake Oswego to Portland transit corridor from 2005 to 2035 is projected to be double that of the region (i.e., 113 percent compared to 58 percent, respectively), with the number of households in the corridor reaching nearly 66,500 from the 2005 estimate of 31,200. Comparatively, the number of households in the region is expected to grow from 767,000 to over 1,208,600. The future employment growth rate in the corridor will be about two-thirds of the regional average (estimated at nearly 157,200 in 2005, employment in the corridor is expected to grow to 235,500 by 2035 for a growth rate of 50 percent, compared to regional employment growth to nearly 1,799,200 from 1,032,300, or a regional rate of 74 percent). See Table 3.2-2.

Table 3.2-2 Households and Employment, 2005 Estimate and 2035 Forecast

	Households				Employment			
			Growth				Growth	
District	**2005**	**2035**	**Number**	**Percent**	**2005**	**2035**	**Number**	**Percent**
Portland CBD	13,013	34,637	21,624	166	101,203	147,834	46,631	46
Northwest Portland	6,058	7,852	1,794	30	15,198	19,858	4,660	31
South Waterfront/OHSU	2,246	7,324	5,078	226	25,730	42,267	16,537	64
Johns Landing	1,145	3,688	2,543	222	8,083	12,937	4,854	60
Dunthorpe	1,136	1,518	382	34	1,564	2,377	813	52
Lake Oswego	7,578	11,477	3,899	51	5,415	10,235	4,820	89
Corridor Total	**31,176**	**66,496**	**35,320**	**113**	**157,193**	**235,508**	**78,315**	**50**
Region Total	**767,016**	**1,208,649**	**441,633**	**58**	**1,032,316**	**1,799,212**	**766,896**	**74**

Source: Metro, 2009.

The corridor's districts that are forecast to have household growth rates approximately equal to or greater than the regional average are the Portland CBD (166 percent), the South Waterfront/OHSU (226 percent), Johns Landing (222 percent), and Lake Oswego (51 percent). The districts with the

greatest employment growth rate over the next 25 years are forecast to be Lake Oswego (89 percent), South Waterfront/OHSU (64 percent), Johns Landing (60 percent), and Dunthorpe/Riverdale (52 percent).

3.2.2 Economic Impacts

Transit-related projects generate distinct economic impacts during both the construction and operations phases. Project construction results in a one-time increase in economic activity, while operations produce long-term economic benefits to the local community. Both sources of economic activity result in increased economic output, employee compensation and employment throughout the region. There are additional long-term economic impacts, including changes to jurisdictions' tax bases that would occur due to acquisition of property and the displacement of residences and businesses. These fiscal impacts are also evaluated in this section.

Total economic effects include direct[37] effects of the transit employment, as well as indirect[38] and induced[39] effects resulting from resulting spending in the economy. Table 3.2-3 summarizes economic impacts by alternative in terms of economic output, employee compensation, and employment.

Table 3.2-3 Summary of Economic Impacts, By Alternative

	Enhanced Bus		Streetcar	
Economic Impact	**O&M (annual)**	**Construction (one-time)**	**O&M (annual)**	**Construction (one-time)**
Output (millions 2009$)				
Direct	$3.54	$26.00	$2.64	$154.6 to $165.6
Indirect	$1.53	$6.80	$1.14	$40.2 to $43.1
Induced	$1.84	$6.30	$1.38	$37.5 to $40.2
Total Output	**$6.92**	**$39.10**	**$5.16**	**$232.3 to $248.8**
Employee Compensation (millions 2009$)				
Direct	$2.34	$6.30	$1.74	$37.7 to $40.4
Indirect	$0.51	$2.10	$0.38	$12.7 to $13.6
Induced	$0.55	$1.90	$0.41	$11.3 to $12.1
Total Employee Compensation	**$3.40**	**$10.40**	**$2.54**	**$61.6 to $66.0**
Employment (Jobs)				
Direct	36	137	27	810 to 870
Indirect	11	49	8	290 to 310
Induced	16	55	12	320 to 350
Total Employment	**63**	**240**	**47**	**1,430 to 1,530**

Source: Metro/TriMet; January 2010, and IMPLAN Pro 2.0.1025.

The IMPLAN economic impact assessment model estimates that every $10 million in transit operations costs would result in 101 direct long-term jobs, including vehicle operators, maintenance staff, and administrative and supervisory staff. Because the analysis compares the operating costs of

[37] Direct economic effects refer to changes in output, income, and employment attributable to expenditures and/or production values specified as direct final demand.
[38] Indirect economic effects refer to changes in output, income, and employment resulting from iterations of businesses making expenditures initially caused by the direct economic effects.
[39] Induced economic effects refer to changes in output, income, and employment caused by expenditures associated with increased household income generated by the direct and indirect effects.

each build alternative to the No-Build Alternative, the Enhanced Bus Alternative operating cost of $2.79 million over the No-Build Alternative yields roughly 28 jobs, while the Streetcar Alternative operating cost of $1.25 million over the No-Build Alternative yields approximately 13 jobs. See Section 2.4 for a summary of the operating cost estimates for each alternative. Design options under consideration would not affect the long-term employment resulting from the Streetcar Alternative. The degree to which these jobs would be an actual economic benefit would depend on the source of funding for the project. Locally funded operations yield a smaller economic benefit than federally funded operations, because the local funds would be otherwise be spent on other projects in the region. According to the finance report summarized in Chapter 5, funding for construction would largely be from federal sources and as-of-yet-undetermined state, regional, and local funds, other than a local right of way match.

Also according to Chapter 5, operations and maintenance (O&M) costs relating to the No-Build Alternative at 2035 service levels is estimated at $28.41 million in 2010 dollars, compared to $31.20 million for the Enhanced Bus Alternative or $29.66 million for the Streetcar Alternative. In other words, corridor O&M costs for the Streetcar Alternative would be $2.64 million higher than the No-Build Alternative, due to the increased service levels. The corridor O&M costs for the Enhanced Bus Alternative would be $1.54 million higher than those for the Streetcar Alternative, as shown in Table 3.2-4.

Table 3.2-4 Long-Term Operating Costs and Estimated Employment Resulting from the No-Build, Enhanced Bus, and Streetcar Alternatives

	No-Build	Enhanced Bus	Streetcar
Operating Costs over No-Build	0	$2.79	$1.25
Long-Term Employment[1]	0	28	13

Source: Metro/TriMet; January 2010, and IMPLAN Pro 2.0.1025.
[1] Based on increases in annual transit operating costs in 2035, compared to the No-Build Alternative. See Section 2.4 and Section 5.1 for the operating cost estimates by alternative. Streetcar design options under consideration would not affect long-term employment estimates.

Because operating costs are estimated to be lower for the Streetcar Alternative than the Enhanced Bus Alternative, the long-term employment would also be lower for that alternative. The No-Build Alternative would not result in any increase in long-term employment, compared to the Enhanced Bus and Streetcar alternatives that would result in 28 and 13 long-term jobs, respectively, estimated using the IMPLAN factors.

Another notable economic impact of the alternatives would result from the removal of private property from the property tax rolls through public acquisition for the project. Additional issues include land use or market changes that affect assessed values of private properties surrounding streetcar stations.

The No-Build Alternative would not require the acquisition of any properties, while the Enhanced Bus Alternative would potentially require the partial acquisition of seven parcels and the full acquisition of one parcel. The Streetcar Alternative could potentially result in TriMet's acquisition of approximately 26 to 63 partial or full parcels (see Section 3.3 and Appendix A of this DEIS for additional detail on property acquisitions). Property acquired for the project would result in the removal of private property from the local tax base. Table 3.2-5 shows the estimates of assessed value and estimated property tax impacts of removing the properties that would be displaced by the alternatives, by jurisdiction.

Table 3.2-5 Estimate of Assessed Value and Estimated Taxes[1] from Displaced Properties, by Jurisdiction and Alternative

Alternative	Assessed Value (millions)	Estimated Annual Loss in Tax Revenue		
		Portland	Lake Oswego	Total
No-Build	$0	$0	$0	$0
Enhanced Bus	$1.18	$0	$6,710	$6,710
Streetcar	$1.8 to $10.1	$1,600 to $37,400	$8,800 to $22,920	$10,500 to $67,900

Source: Metro/TriMet; January 2010.

[1] This analysis applies an estimated tax rate by jurisdiction to the assessed value in the GIS database to estimate the impact on assessed value and the resulting annual impact on property tax revenue. It applies a per-square-footage value based on the assessed land value and the square footage of the parcel. It adds the value of the building if the building is identified as a building "take" in the right-of-way analysis. The analysis further applies an estimated tax rate of 0.007392 percent for Portland and 0.005683 percent for Lake Oswego (including bonds). These values were derived from the *2008-09 Oregon Property Tax Statistics Supplement*, a companion document to the *2008-09 Oregon Property Tax Statistics*, published by the Oregon Department of Revenue. Actual property taxes are levied on the net assessed value of the property. The estimated tax impacts would be distributed among the various taxing districts within the areas where the properties would be acquired.

In summary, the Streetcar Alternative would result in the loss of approximately $10,500 to $67,900 in annual tax revenues for the applicable taxing districts ($1,600 to $45,000 for the City of Portland, up to $7,570 for unincorporated Multnomah County, and $8,800 to $22,920 for the City of Lake Oswego), depending on the Streetcar design option (see Table 3.2-6).

Table 3.2-6 Summary of Estimated Assessed Value of Displaced Property and Estimated Annual Tax Impact[1] by Segment and Streetcar Design Option

Alternative / Segment	Design Option	Displaced Property Value	Annual Loss in Tax Revenues
Enhanced Bus Alternative	None	$1,180,310	$6,710
Streetcar Alternative			
1 – Downtown Portland	None	$0	$0
2 – South Waterfront[2]	None	$100,520	$740
3 – Johns Landing	Willamette Shore Line	$122,430	$910
	Macadam In-Street	$2,663,410	$19,690
	Macadam Additional Lane	$5,058,760	$37,390
4 – Sellwood Bridge[3]	None	$0	$0
5 – Dunthorpe/Riverdale	Willamette Shore Line	$0	$0
	Riverwood	$1,024,060	$7,570
6 – Lake Oswego	UPRR[4]	$1,548,490	$8,800
	Foothills[5]	$4,033,750	$22,920

Source: URS and Oregon Department of Revenue; January 2010.

[1] These estimates do not include right-of-way and other property already owned or controlled by public entities or railroads.

[2] These displacements are in addition to those related to the south portal project, whose right-of-way will also be made available to streetcar. The South Waterfront Segment contains potential construction phasing options associated with the Streetcar alignments. The Willamette Shore Line and Moody/Bond Couplet are considered phasing options rather than design options. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

[3] The Sellwood Bridge Segment contains potential construction phasing options associated with the Streetcar alignments. The Willamette Shore Line and New Interchange are considered phasing options rather than design options. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

[4] In addition to acquisition of property from UPRR.

[5] Streetcar would be responsible for $4,033,750 of the $12,648,030 total value of displaced property in the foothills area, which results in an estimated $71,880 total loss in annual tax revenue.

Many of the displaced businesses and residences would likely relocate and/or rebuild within the same area, thereby increasing assessed value and property tax revenue elsewhere. Despite a short-term loss

in assessed value and property tax revenue caused by displacement of properties, properties close to streetcar stations would likely experience an increase in value upon completion of the project, thereby increasing property tax revenue in the long term. The likely impact of this type of activity is described more fully in the *Land Use Technical Report* (URS, August 2010).

The Streetcar Alternative could also result in the potential loss in business tax revenue to the City of Portland if businesses within the Portland city limits are required or decide to close or relocate out of the taxing district due to property acquisitions. Lake Oswego does not collect business taxes. The Streetcar Alternative would result in between one and six building acquisitions, depending on the design options chosen (see Section 3 for additional detail). Of these, one of the building displacements is within the Portland city limits and designated for commercial land uses. According to the City of Portland Revenue Bureau, the displaced property has four business accounts associated with it. Most likely these businesses pay the city business license fee and county income tax;[40] however, the displaced businesses would likely relocate within the same area, thereby offsetting the loss of business revenues and business tax revenues.

The Enhanced Bus Alternative would result in approximately 240 construction-related, short-term jobs and about $10.5 million in additional regional income, compared to the 1,430 to 1,530 jobs and $61.6 to $66.0 million in additional personal income that would be generated by the Streetcar Alternative (see Table 3.2-7), depending on the design option. Table 3.2-8 summarizes construction costs and short-term jobs for the Streetcar Alternative by segment and design option.

Table 3.2-7 Short-Term Employment1 and Change in Personal Income by Alternative

Alternative	Short-Term Jobs[2]	Personal Income[2] (millions)
No-Build	0	$0.0
Enhanced Bus	240	$10.5
Streetcar	1,430 to 1,530	$61.6 to $66.0

Source: TriMet, URS Corporation, and IMPLAN Pro 2.0.1025.
[1] Short-term employment are those jobs created during construction of the project.
[2] The IMPLAN economic impacts assessment model estimates that every $10 million in streetcar or enhanced bus construction would result in an estimated 92.3 jobs, with direct average compensation of $28.500.

The overall effects of the Lake Oswego to Portland Transit Project would be minor in the context of the number of jobs and income generated in the metropolitan area. With approximately 1 million jobs in the metropolitan area, the high end of employment generated by streetcar construction would represent less than two-tenths of one percent of all employment in the area, with the Enhanced Bus Alternative representing less than one-tenth of that estimate. As compared to the No-Build Alternative, cumulative effects of the project could include redevelopment along the proposed streetcar line, particularly station areas in established commercial areas, including Johns Landing and downtown Lake Oswego. The likely impact of this type of activity is described more fully in the *Land Use Technical Report* (URS, November 2010).

[40] Confidentiality rules prevent the disclosure of business tax and license revenue data as it relates to specific businesses.

Table 3.2-8 Summary of Streetcar Alternative Construction Costs (2010 dollars)[1] and Total Short-Term Employment[2] by Segment and Design Option

Segment	Design Option	Construction Costs[1] (millions)	Short-Term Jobs
1 – Downtown Portland	None	$1.0	30
2 – South Waterfront[3]	None	$21.1	70
3 – Johns Landing	Willamette Shore Line	$19.0	90
	Macadam In-Street	$27.9	170
	Macadam Additional Lane	$32.7	210
4 – Sellwood Bridge[4]	None	23.7	220
5 – Dunthorpe/ Riverdale	Willamette Shore Line	$52.6	220
	Riverwood	$52.1	490
6 – Lake Oswego	UPRR	$48.6	460
	Foothills	$69.9	470
Storage Facility Allowance		$2.5	400

Source: URS Corporation (for capital costs provided to TriMet to prepare the finance plan summarized in Chapter 5), and IMPLAN Pro 2.0.1025 (economic analysis).
Note: There is an additional $48.4M estimated for the purchase of 11 streetcar vehicles. These vehicles are expected to be manufactured by Oregon Iron Works, resulting in an additional quantifiable local economic impact. Streetcar manufacturing is classified as NAICS code 336510 (Railroad rolling stock manufacturing), which corresponds to IMPLAN industry code 289 (Railroad rolling stock manufacturing). IMPLAN estimates that $48.4M in streetcar manufacturing results in 144 jobs in this industry, with an estimated aggregated compensation of $8.7M.
[1] All amounts exclude property acquisition costs.
[2] Short-term jobs are those that are associated with the construction of a project. The IMPLAN economic impacts assessment model estimates that every $10 million in streetcar construction results in an estimated total impact of 92.3 jobs, with direct average compensation of $28.500.
[3] The South Waterfront Segment contains potential construction phasing options associated with the Streetcar alignments. The Willamette Shore Line and Moody/Bond Couplet are considered phasing options rather than design options. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.
[4]The Sellwood Bridge Segment contains potential construction phasing options associated with the Streetcar alignments. The Willamette Shore Line and New Interchange are considered phasing options rather than design options. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

3.2.3 Potential Mitigation Measures

The effects of the project's proposed alternatives would be relatively minor in the context of the number of jobs and income generated by the metropolitan region; additionally, the project has been designed to minimize the extent and number of residences, businesses, jobs and property access that would be permanently adversely affected. Compensation for partial acquisitions and easements would be provided at fair market value and relocation of displaced residences or businesses would be determined through negotiations with the property owners. Any acquisition of property and relocation of displaced residents will follow the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

For the Enhanced Bus Alternative and more for the Streetcar Alternative, public information relating to the project's construction timing and proximity would help to mitigate some of the potential temporary effects of the project on local businesses. A comprehensive package of public information and business assistance measures would be developed, which could include conducting public information campaigns to encourage patronage of businesses during construction. A primary goal of construction planning is to maintain adequate access to all businesses so their operations can continue during the construction phase of the project.

3.2.4 Potential Economic Development and Redevelopment Effects

Section 3.1.2 Land Use Impacts, describes the redevelopment effects of the alternatives. These redevelopment effects are part of the economic development impact of the alternatives. Another part of the economic development impact of the alternatives is how they would affect employment and economic activity; Section 3.2.2 addresses these impacts.

3.3 Neighborhoods, Displacements and Relocations

This section summarizes the effects that the alternatives and options would have on community resources, focusing on neighborhoods within the six segments of the Lake Oswego to Portland transit corridor. Community impacts are generally categorized as changes to neighborhood cohesion, neighborhood quality of life and neighborhood mobility. Potential property acquisitions and displacements/relocations are also considered community impacts and are included in this section. Section 3.18 addresses the project's compliance with environmental justice regulations. Additional information on the assessment of community impacts is included in the *Lake Oswego to Portland Transit Project: Community Impact Assessment Technical Report* (URS and TriMet/Metro, November 2010).

The analysis within this section has been conducted pursuant to the following laws and regulations:

- Americans with Disabilities Act of 1990;
- Title VI of the Civil Rights Act of 1964;
- Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended;
- 49 CFR Part 24, titled Uniform Relocation Assistance and Real Property Acquisition.

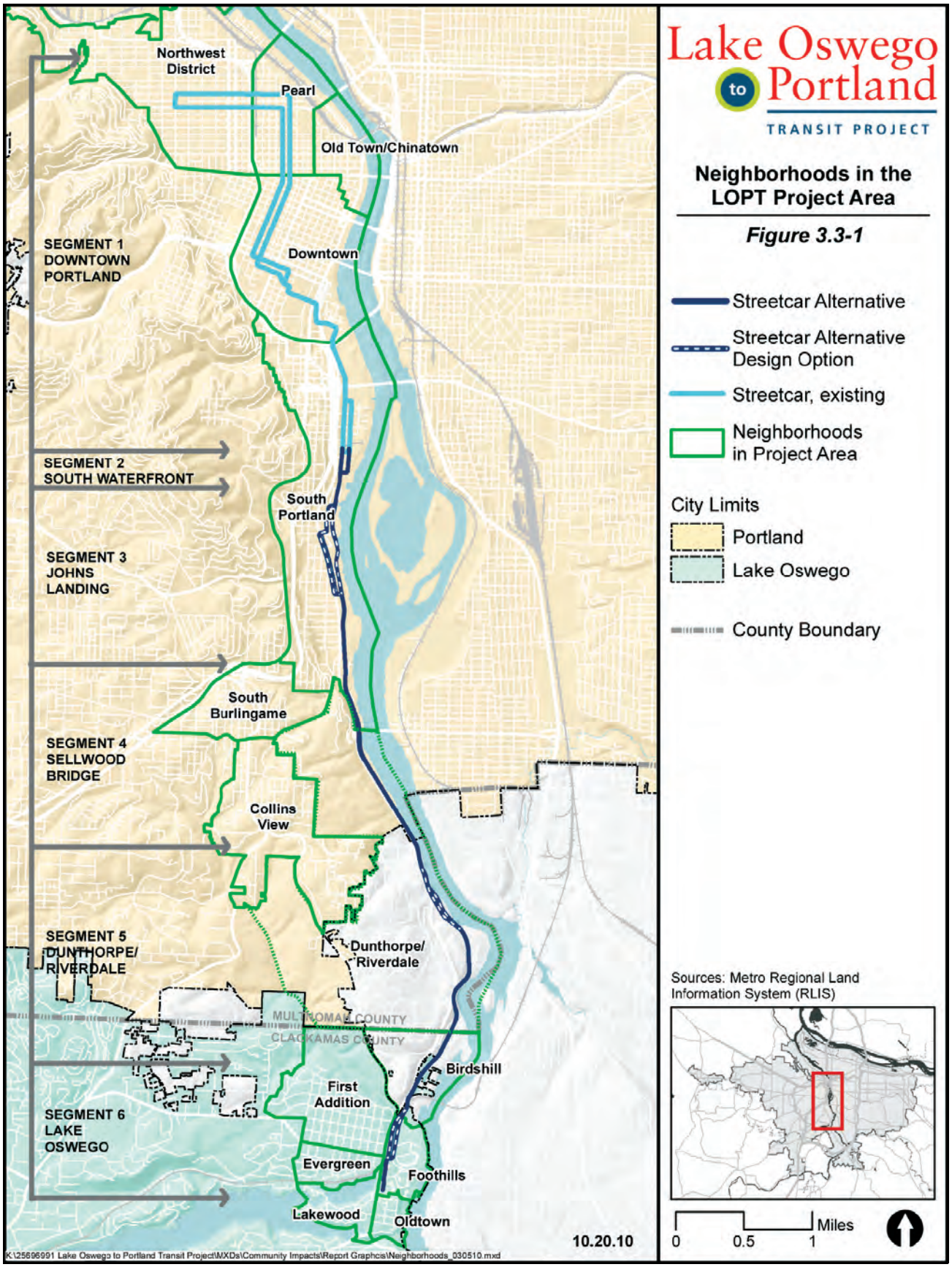
The analysis units for this evaluation are the neighborhoods that are located fully or predominantly within the project corridor and recognized by the cities of Portland and Lake Oswego. In addition to the recognized neighborhoods, this analysis includes areas of unincorporated Clackamas and Multnomah counties that are located between the cities of Portland and Lake Oswego, adjacent to the Willamette River, generally encompassing the suburban communities in the area known as Dunthorpe or Riverdale. The neighborhoods are illustrated in Figure 3.3-1. Locations of community facilities were obtained from Metro's Regional Land Information System data set and via fieldwork in the area.

This section first describes the affected community environment. It is followed by an assessment of long-term, direct, indirect and cumulative effects of the alternatives and options on that environment, and an assessment of potential mitigation measures that could address effects of the alternatives and options on neighborhoods and communities in the vicinity of the project.

3.3.1 Affected Environment

This section provides a general description of each neighborhood in the project area, highlighting sensitive demographic groups that exceed the regional average percentile and key community facilities. The region is defined as Multnomah, Washington and Clackamas counties. Details on the specific urban amenities and affordable housing units within each neighborhood can be found in the *LOPT Community Impact Assessment Technical Report* (URS and TriMet/Metro, November 2010). Tables 3.3-1 and 3.3-2 summarize the demographic characteristics, including total population and household, racial/ethnic composition, housing tenure, income, age and disability, of the corridor's neighborhoods. Figures 3.3-2 to 3.3-4 illustrate the locations of community facilities and urban amenities within the corridor's neighborhoods.[41] Impacts to the neighborhoods to the south are not analyzed because there would be no direct, physical impacts there and their residents would access transit to downtown Portland by transferring to faster, more reliable routes.

[41] Urban amenities are defined in the 2007 report by Johnson Gardner: *An Assessment of the Marginal Impact of Urban Amenities on Residential Pricing.*


Lake Oswego to Portland
TRANSIT PROJECT
Neighborhoods in the LOPT Project Area
Figure 3.3-1
Streetcar Alternative
Streetcar Alternative Design Option
Streetcar, existing
Neighborhoods in Project Area
City Limits
Portland
Lake Oswego
County Boundary
Sources: Metro Regional Land Information System (RLIS)
Miles
0
0.5
1
Northwest District
Pearl
Old Town/Chinatown
Downtown
South Portland
South Burlingame
Collins View
Dunthorpe/ Riverdale
First Addition
Birdshill
Evergreen
Foothills
Lakewood
Oldtown
SEGMENT 1 DOWNTOWN PORTLAND
SEGMENT 2 SOUTH WATERFRONT
SEGMENT 3 JOHNS LANDING
SEGMENT 4 SELLWOOD BRIDGE
SEGMENT 5 DUNTHORPE/ RIVERDALE
SEGMENT 6 LAKE OSWEGO
MULTNOMAH COUNTY
CLACKAMAS COUNTY
10.20.10
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Demographic data for this analysis of neighborhoods and communities were obtained through the 2000 U.S. Census. Poverty statistics for each neighborhood refer to the percentage of households with incomes below the Federally-defined poverty level, based on the 2000 U.S. Census. Demographic statistics are presented below by neighborhood and are compared to the regional average.

Table 3.3-1 Demographic Characteristics of Neighborhoods within in the City of Portland, Unincorporated Multnomah County and City of Lake Oswego (2000)

Jurisdiction Neighborhood[1]	Persons	Households	Residents 65 or older	Renter Occupied	Disabled	Below Poverty	Minority[2]
City of Portland							
Northwest District	10,309	4,388	**13%**	37%	12%	10%	10%
Pearl District	1,702	858	**33%**	**56%**	9%	9%	9%
Old-Town/Chinatown	603	284	**12%**	**41%**	9%	**12%**	14%
Downtown	7,653	4,987	**11%**	**80%**	12%	**16%**	13%
South Portland	6,877	4,390	10%	**88%**	13%	**31%**	**22%**
South Burlingame	1,829	1,065	**12%**	**62%**	12%	**17%**	14%
Collins View	726	407	9%	**49%**	10%	**11%**	11%
Unincorporated Multnomah County							
Dunthorpe/Riverdale	1,025	592	**11%**	11%	11%	8%	10%
Unincorporated Clackamas County							
BirdsHill[3]	213	97	**11%**	13%	14%	2%	11%
City of Lake Oswego							
BirdsHill	21	9	**11%**	13%	14%	2%	11%
First Addition	2,879	1,004	10%	21%	9%	6%	11%
Foothills	413	171	**11%**	11%	10%	4%	9%
Old Town	186	76	**11%**	10%	10%	4%	9%
Evergreen	795	357	7%	24%	8%	**11%**	11%
Lakewood	424	174	**11%**	10%	10%	4%	9%
Tri-County Region[4]	*1,444,219*	*569,461*	*10%*	*39%*	*17%*	*10%*	*17%*

Source: U.S. Census Bureau. Census 2000, Summary File 1 and Summary File 3.
Note: **Bold** percentages indicate that that census tract had a percentage greater than the Tri-County Region for that demographic characteristic.
[1] See the *Community Impacts Technical Report* for a description of the method used to define the neighborhood boundaries relative to census block group boundaries for this analysis.
[2] See Table 3.3-2 for additional detail by minority group. The total of minority groups shown in Table 3.3-2 does not equal the minority data in this table because individuals may be members of two or more minority groups.
[3] The Birdshill neighborhood encompasses portions of the City of Lake Oswego and portions of unincorporated Clackamas County.
[4] The Tri-County Region includes all of Multnomah, Clackamas and Washington Counties.

Northwest District. The Northwest District is a densely populated mixed-use neighborhood with large residential and commercial areas. It is bordered by West Burnside Street to the south, Interstate 405 and the Willamette River to the east and northeast, and the base of the West Hills to the west and northwest. It is roughly bordered by Northwest Nicolai Street and St. Helens Road to the north. It is an older neighborhood containing many structures dating over 80 years. Two streets in this neighborhood, 21st Avenue and 23rd Avenue, are well established shopping and dining districts. Zoning in this neighborhood is primarily multi-family residential, employment, commercial and mixed-use. The Northwest District is currently served by the Portland streetcar along Northrup and Lovejoy streets, and 23rd Avenue. Community facilities in this neighborhood include Forest Park, Legacy Good Samaritan Hospital, Portland Fire and Rescue (17th Avenue and Johnson Street), the Metropolitan Learning Center, Cathedral School, the Northwest Library, Wallace Park and Couch Park. The Northwest District contains an above-average concentration of residents age 65 or older.

Pearl District. The Pearl District is one of Portland's newly redeveloped communities. It is bounded by West Burnside Street to the south, Interstate 405 to the west and northwest, and the Willamette River, the Broadway Bridge and Northwest Broadway Street to the east. The district is primarily zoned mixed-use and contains a mix of high-density residences and higher-end retail and dining establishments. The Pearl District is currently served by the Portland streetcar along Northrup and Lovejoy streets, and 10th and 11th avenues. Community facilities in the Pearl District include the Pacific Northwest College of Art, the Emerson School, Oregon Council for Hispanic Advancement, Tanner Springs Park, Jamison Square, the North Park Blocks and Liberty Ship Memorial Park. The Pearl District contains many urban amenities, including retail and dining establishments that are particularly centered on the existing Portland streetcar line and surrounding Jamison Square. The Pearl District contains an above-average concentration of residents age 65 or older and renter-occupied housing units.

Old Town/Chinatown. The Old Town/Chinatown neighborhood contains a variety of retail stores, restaurants and bars, nightclubs, commercial office spaces and apartment buildings. It is bordered by Southwest Stark Street, Oak Street, Pine Street and West Burnside Street to the south, the Willamette River to the east and northeast, the Broadway Bridge to the northwest, and Southwest 1st Avenue, 2nd Avenue, 3rd Avenue and Broadway Street to the west. Old Town/ Chinatown is primarily zoned mixed-use commercial. It includes the New Chinatown/Japan Historic District. Community facilities in this neighborhood include the Portland Saturday Market, the Classical Chinese Gardens, Union Station, the Greyhound Bus Depot and the north part of Waterfront Park. Old Town/Chinatown is also home to many social service providers. Old Town/Chinatown contains many urban amenities, particularly along 3rd Avenue, 4th Avenue and Burnside Street. It is currently served by the MAX light rail and the Portland Mall, downtown's transit mall. Old Town/Chinatown contains an above-average concentration of residents age 65 or older, renter-occupied housing and low-income residents. The portion of residents who identify as "Black Alone" is higher in this neighborhood than in the region as a whole.

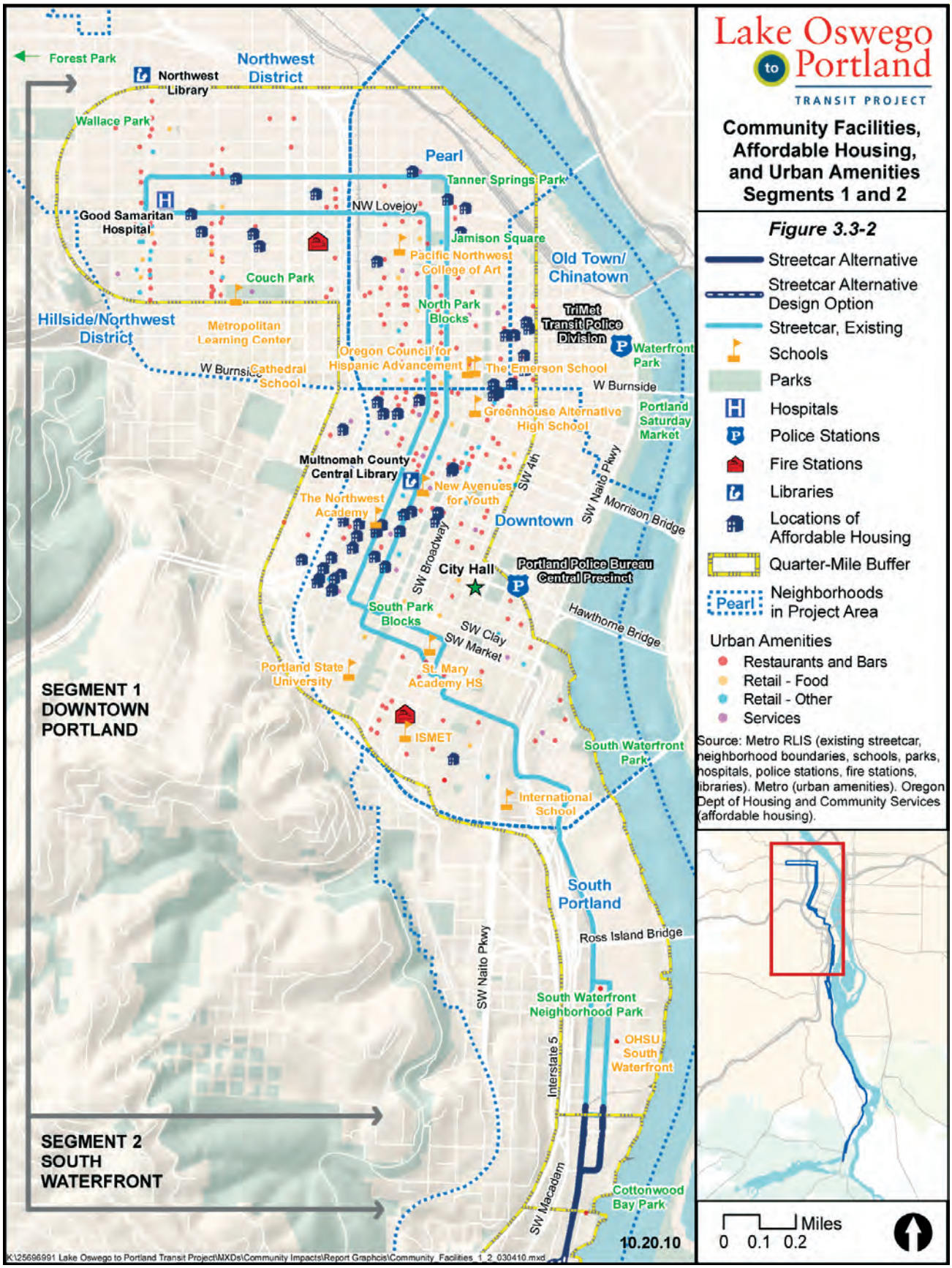
Downtown. The Portland Downtown neighborhood functions as Portland's central business district. It is bounded by Interstate 405 to the south and west, the Willamette River to the east, and West Burnside Street, Southwest 1st Avenue, 2nd Avenue and 3rd Avenue to the north. This neighborhood is primarily zoned central commercial and contains a high concentration of office uses, with areas towards the west of the neighborhood zoned high-density residential. Downtown Portland is served by the existing Portland streetcar and MAX light rail. It contains the Portland Mall, used by over one hundred bus lines that serve the greater Portland region. Community facilities in downtown Portland include the following parks: Pioneer Courthouse Square, Pettygrove Park, Chapman Square, Lovejoy Fountain Park, Portland Center Park, O'Bryant Square, Ira Keller Fountain, Waterfront Park and the South Park Blocks. The Downtown neighborhood also includes the following schools: Portland State University, St. Mary's Academy, the Islamic School of Muslim Educational Trust, the Northwest Academy, the International School, New Avenues for Youth, and the Greenhouse Alternative High School. The Multnomah County Central Library, Portland City Hall and Portland Fire and Rescue (511 SW College St.) are also community facilities located in this neighborhood. The Portland Downtown neighborhood contains hundreds of urban amenities, including many restaurants, bars, shopping districts, fitness centers, movie theaters and other services. The Portland Downtown neighborhood contains an above-average concentration of residents age 65 or older, renter-occupied housing and low-income residents.

South Portland. The South Portland Neighborhood is generally bounded by Interstate 405 to the north, the Willamette River to the east, Southwest 6th Avenue and Barbur Boulevard to the west and by the Sellwood Bridge to the south. The northern part of this neighborhood, South Waterfront, is served by the existing Portland streetcar. South Waterfront is one of Portland's newest neighborhoods and contains many mixed-use commercial and residential buildings. There are two restaurants in the South Waterfront that are within one-quarter mile of the existing streetcar alignment. South Waterfront is a high-density development area with many condominiums retail uses and offices, and it includes the eastern station of the Portland Aerial Tram as well as part of the Oregon Health Sciences University campus. The southern part of the neighborhood includes a commercial area surrounding Southwest Macadam Avenue; this contains many retail and dining uses that serve the community. This area also contains high-density residences along the Willamette River and a primarily single-family residential neighborhood west of Macadam Avenue. There are no libraries, fire stations, or civic buildings in this neighborhood. Community facilities include the Portland French School, Oregon Health Sciences University South Waterfront campus, Cottonwood Bay Park, Willamette Park and Willamette Moorage Park. The South Portland neighborhood contains an above-average concentration of renter-occupied housing units, low-income residents and residents of minority racial/ethnic status. The portion of residents who identify as "Black Alone," "Asian Alone," and "Two or More Races," is higher in this neighborhood than in the region as a whole.

Table 3.3-2 Racial and Ethnic Composition by Neighborhood in the City of Portland, Unincorporated Multnomah County and City of Lake Oswego (2000)

Jurisdiction/ Neighborhood	Persons	Black Alone	American Indian and Alaska Native alone	Asian alone	Two or More Races	Hispanic (any race)
City of Portland						
Northwest	10,309	1%	1%	2%	3%	4%
Pearl	1,702	2%	1%	2%	3%	3%
Old-Town/Chinatown	603	**6%**	1%	2%	2%	4%
Downtown	7,653	2%	1%	3%	3%	4%
South Portland	6,877	**4%**	1%	**9%**	**4%**	5%
South Burlingame	1,829	1%	0%	7%	2%	3%
Collins View	726	1%	0%	3%	2%	4%
Unincorporated Multnomah County						
Dunthorpe/Riverdale	1,078	1%	0%	3%	3%	4%
Unincorporated Clackamas County						
Birds Hill	213	1%	1%	4%	3%	2%
City of Lake Oswego						
Birds Hill	21	1%	1%	4%	3%	2%
First Addition	3,007	1%	0%	3%	3%	2%
Foothills	448	1%	0%	4%	3%	2%
Old Town	3,391	1%	1%	3%	2%	2%
Evergreen	829	0%	0%	4%	3%	4%
Lakewood	460	1%	0%	4%	3%	2%
Tri-County Region	*1,444,219*	*3%*	*1%*	*5%*	*3%*	*8%*

Source: U.S. Census Bureau. Census 2000, Summary File 3.
Note: **Bold** percentages indicate that that census tract had a minority population percentage greater than for the tri-county region for that minority group.


Lake Oswego to Portland
TRANSIT PROJECT
Community Facilities, Affordable Housing, and Urban Amenities Segments 1 and 2
Figure 3.3-2
Streetcar Alternative
Streetcar Alternative Design Option
Streetcar, Existing
Schools
Parks
Hospitals
Police Stations
Fire Stations
Libraries
Locations of Affordable Housing
Quarter-Mile Buffer
Pearl
Neighborhoods in Project Area
Urban Amenities
Restaurants and Bars
Retail - Food
Retail - Other
Services
Source: Metro RLIS (existing streetcar, neighborhood boundaries, schools, parks, hospitals, police stations, fire stations, libraries). Metro (urban amenities). Oregon Dept of Housing and Community Services (affordable housing).
Forest Park
Northwest Library
Northwest District
Wallace Park
Pearl
Tanner Springs Park
NW Lovejoy
Good Samaritan Hospital
Jamison Square
Pacific Northwest College of Art
Old Town/ Chinatown
Couch Park
North Park Blocks
TriMet Transit Police Division
Hillside/Northwest District
Metropolitan Learning Center
Oregon Council for Hispanic Advancement
Waterfront Park
W Burnside
Cathedral School
The Emerson School
W Burnside
Greenhouse Alternative High School
Portland Saturday Market
Multnomah County Central Library
New Avenues for Youth
SW 4th
SW Naito Pkwy
The Northwest Academy
Morrison Bridge
Downtown
SW Broadway
City Hall
Portland Police Bureau Central Precinct
South Park Blocks
Hawthorne Bridge
SW Clay
SW Market
Portland State University
St. Mary Academy HS
SEGMENT 1 DOWNTOWN PORTLAND
ISMET
South Waterfront Park
International School
South Portland
Ross Island Bridge
SW Naito Pkwy
South Waterfront Neighborhood Park
OHSU South Waterfront
Interstate 5
SEGMENT 2 SOUTH WATERFRONT
SW Macadam
Cottonwood Bay Park
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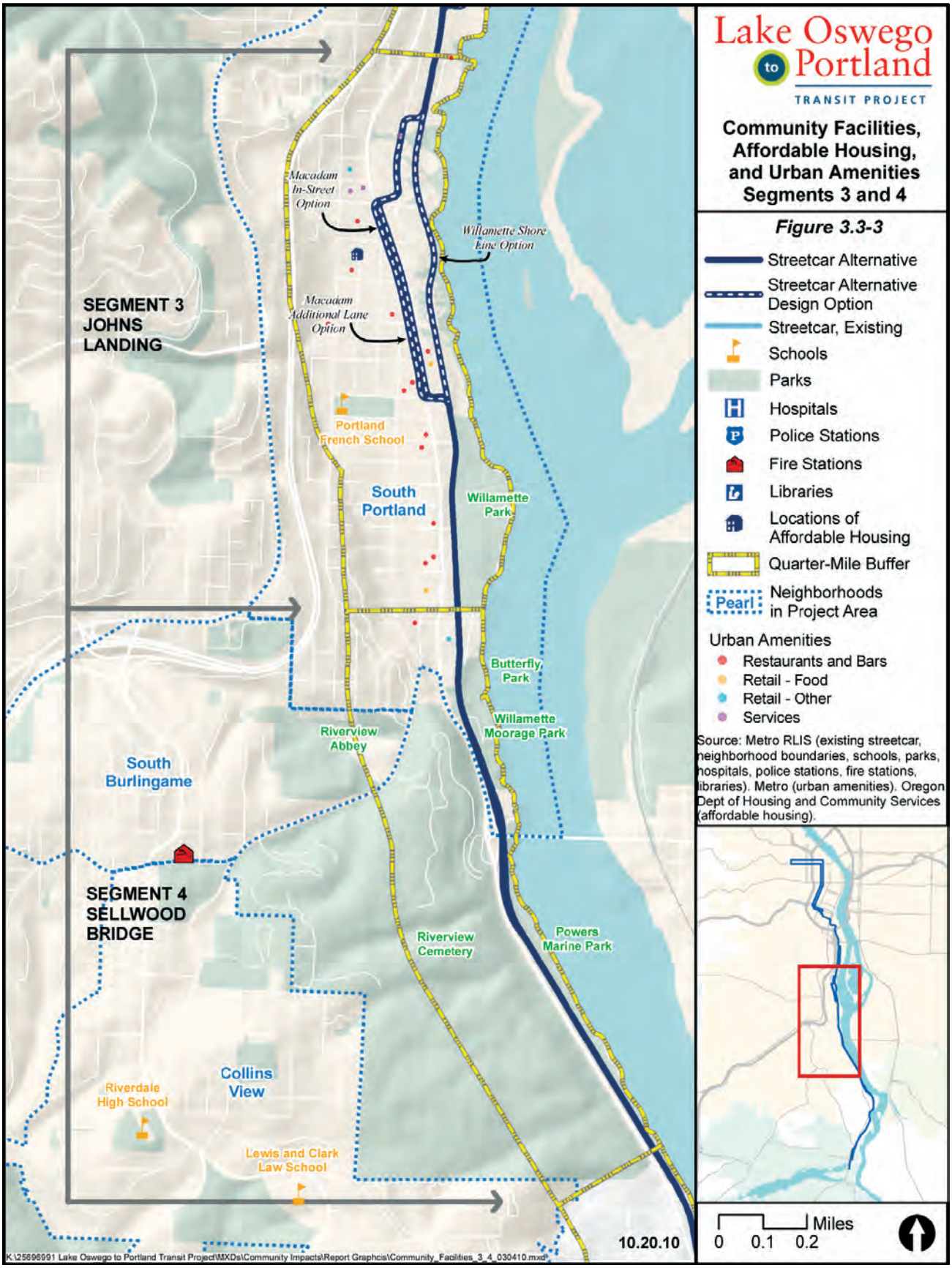
Lake Oswego to Portland
TRANSIT PROJECT
Community Facilities, Affordable Housing, and Urban Amenities Segments 3 and 4
Figure 3.3-3
Streetcar Alternative
Streetcar Alternative Design Option
Streetcar, Existing
Schools
Parks
Hospitals
Police Stations
Fire Stations
Libraries
Locations of Affordable Housing
Quarter-Mile Buffer
Pearl
Neighborhoods in Project Area
Urban Amenities
Restaurants and Bars
Retail - Food
Retail - Other
Services
Source: Metro RLIS (existing streetcar, neighborhood boundaries, schools, parks, hospitals, police stations, fire stations, libraries). Metro (urban amenities). Oregon Dept of Housing and Community Services (affordable housing).
Macadam In-Street Option
Willamette Shore Line Option
Macadam Additional Lane Option
SEGMENT 3 JOHNS LANDING
Portland French School
South Portland
Willamette Park
Butterfly Park
Willamette Moorage Park
Riverview Abbey
South Burlingame
SEGMENT 4 SELLWOOD BRIDGE
Riverview Cemetery
Powers Marine Park
Collins View
Riverdale High School
Lewis and Clark Law School
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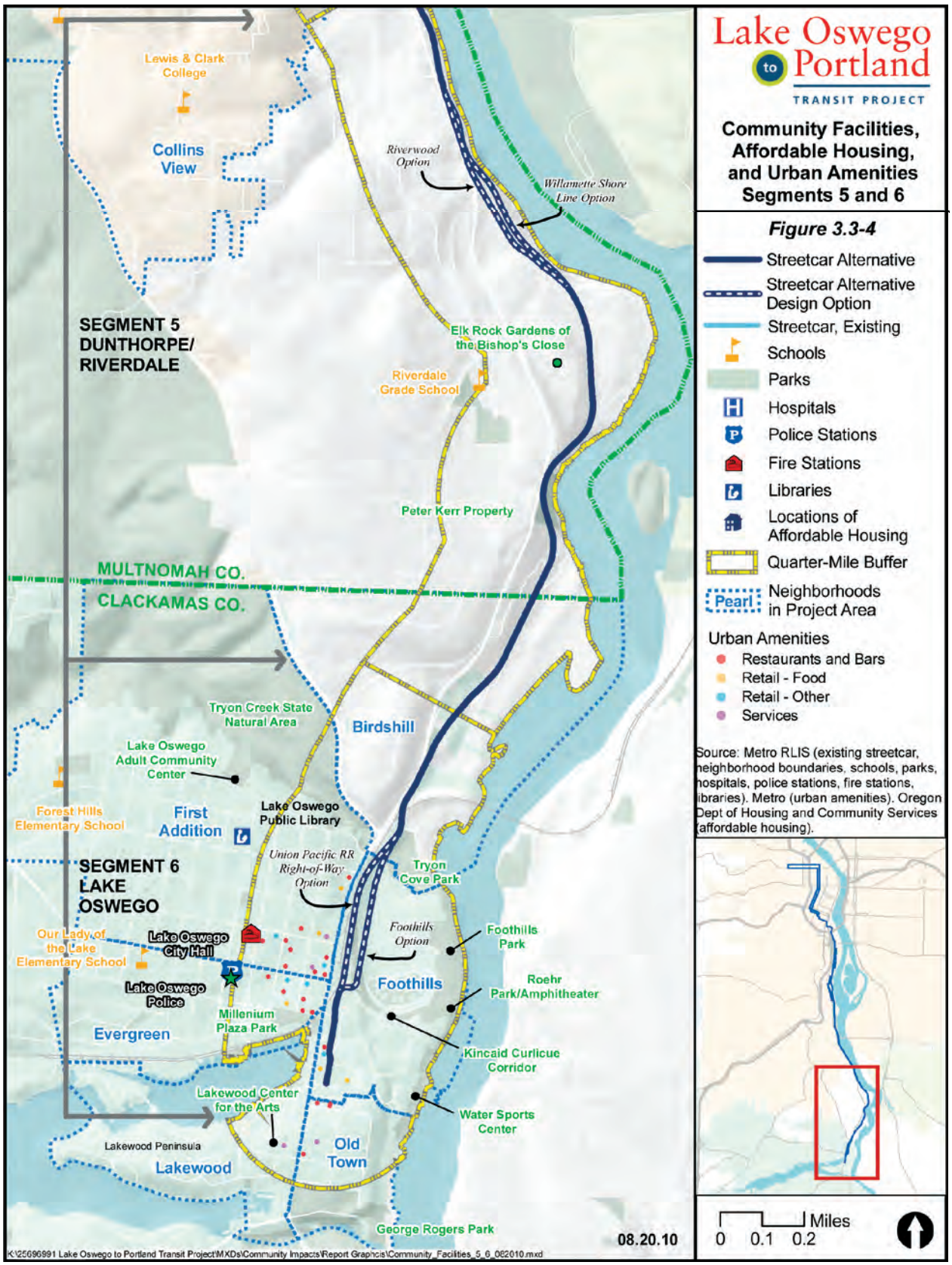
Lake Oswego to Portland
TRANSIT PROJECT
Community Facilities, Affordable Housing, and Urban Amenities Segments 5 and 6
Figure 3.3-4
Streetcar Alternative
Streetcar Alternative Design Option
Streetcar, Existing
Schools
Parks
Hospitals
Police Stations
Fire Stations
Libraries
Locations of Affordable Housing
Quarter-Mile Buffer
Pearl
Neighborhoods in Project Area
Urban Amenities
Restaurants and Bars
Retail - Food
Retail - Other
Services
Source: Metro RLIS (existing streetcar, neighborhood boundaries, schools, parks, hospitals, police stations, fire stations, libraries). Metro (urban amenities). Oregon Dept of Housing and Community Services (affordable housing).
Miles
0 0.1 0.2
Lewis & Clark College
Collins View
Riverwood Option
Willamette Shore Line Option
SEGMENT 5 DUNTHORPE/ RIVERDALE
Elk Rock Gardens of the Bishop's Close
Riverdale Grade School
Peter Kerr Property
MULTNOMAH CO.
CLACKAMAS CO.
Tryon Creek State Natural Area
Birdshill
Lake Oswego Adult Community Center
Forest Hills Elementary School
First Addition
Lake Oswego Public Library
Union Pacific RR Right-of-Way Option
SEGMENT 6 LAKE OSWEGO
Tryon Cove Park
Foothills Option
Foothills Park
Our Lady of the Lake Elementary School
Lake Oswego City Hall
Lake Oswego Police
Foothills
Roehr Park/Amphitheater
Millenium Plaza Park
Evergreen
Kincaid Curlicue Corridor
Lakewood Center for the Arts
Water Sports Center
Lakewood Peninsula
Old Town
Lakewood
George Rogers Park
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South Burlingame. The South Burlingame neighborhood is bordered by Southwest Barbur Boulevard to the north, Intestate 5 to the west, and Taylors Ferry Road to the south and east. Interstate 5 cuts through the northern part of the neighborhood, separating the Fulton Park area from the rest of South Burlingame. This neighborhood is largely low-density residential with commercial uses along Barbur Boulevard. Community facilities in this neighborhood include the Riverview Cemetery (used as open space) and Portland Fire and Rescue at 451 SW Taylors Ferry Road. South Burlingame contains an above-average concentration of residents age 65 or older, renter-occupied housing and low-income residents.

Collins View. The Collins View neighborhood lies directly to the south of South Burlingame. It is composed primarily of single-family residential developments with a small commercial center at Southwest Taylors Ferry Road and Terwilliger Boulevard. Collins View is characterized by hilly terrain and a largely rural feel. This neighborhood is adjacent to portions of Tryon Creek State Park. Collins View is bordered by Taylors Ferry Road to the north, 8th Avenue and Boones Ferry Road to the west, Lewis and Clark College to the south and the Riverview Cemetery to the east. Lewis and Clark College is the community facility in this neighborhood. Collins View contains an above-average concentration of low-income residents and renter-occupied housing.

Dunthorpe/Riverdale. Though it is not an officially designated neighborhood, the portion of unincorporated Multnomah County that is south of the Powers Marine Park and Riverview Cemetery, and north of the county boundary, is commonly referred to as Dunthorpe or Riverdale. The development called Dunthorpe was platted in the 1910s and developed by William S. Ladd, who developed many notable areas in Portland. Riverdale is the name of the school district in this area, which is administered separately from the Lake Oswego and Portland Public School districts. Dunthorpe/Riverdale contains low-density residential development and has no commercial or industrial areas. It is one of the oldest bedroom communities of Portland. Community facilities in this area include the Riverdale Grade School, the Peter Kerr Property and the Elk Rock Gardens of the Bishop's Close. This area contains an above-average concentration of residents age 65 or older.

Birdshill. The Birdshill neighborhood lies to the south of Dunthorpe/Riverdale. It is bounded by the county boundary to the north, the Willamette River to the east, Southwest Terwilliger Boulevard to the west and the northern portion of Foothills Park to the south. The neighborhood boundary extends slightly south of the Clackamas County boundary into the City of Lake Oswego city limits. This area includes low-density residential communities. The Tryon Cove Park is the community facility in this area. This neighborhood contains an above-average concentration of residents age 65 or older.

First Addition. First Addition contains several blocks of historic and newer homes that are within walking distance of Lake Oswego's commercial core. The development pattern is a traditional urban grid with alleys in between houses. First Addition is bounded by State Street to the east, A Avenue to the south, the Clackamas County boundary to the north, and the edge of Tryon Creek State Park and Iron Mountain Boulevard to the west. There are several urban amenities in First Addition within one-quarter mile of the project alignment, including restaurants, dry cleaners, sporting goods stores and other services along State Street and A Avenue. The northern portion of this neighborhood includes portions of Tryon Creek State Park. First Addition includes a vibrant commercial area in the blocks surrounding A, B and C avenues between State Street and 6th Street. Community facilities in this neighborhood include the Lake Oswego Adult Community Center, the Lake Oswego City Hall,

the Lake Oswego Public Library, Lake Oswego Fire and Rescue and Life Safety at 300 B Ave., portions of the Tryon Creek State Natural Area, Rossman Park and Forest Hills Elementary School.

Foothills. The Foothills neighborhood lies to the east of First Addition. It is bounded by State Street to the west, the Willamette River to the east, Green Street to the south and the edge of the Foothills development cul-de-sacs to the north. This neighborhood contains industrial uses adjacent to Foothills Park and multi-family housing and commercial uses along State Street. Community facilities in this neighborhood include Foothills Park and the Kincaid Curlicue Corridor. The Foothills neighborhood contains some urban amenities along State Street. This neighborhood contains an above-average concentration of residents age 65 or older.

Old Town. The Old Town neighborhood is the oldest settlement in the Lake Oswego area and contains homes that date to the 1860s. It is a small area immediately to the south of the Foothills neighborhood. Community facilities in Old Town include George Rogers Park. There are several urban amenities in Old Town within one-quarter mile of the project alignment, including fitness centers, restaurants and clothing stores. This neighborhood contains an above-average concentration of residents age 65 or older.

Evergreen. The Evergreen neighborhood is generally bordered by A Avenue to the north, Lakewood Bay to the south, State Street to the east and Berwick Road to the west. The neighborhood is primarily single-family residential, with a few multi-family residential parcels fronting Lakewood Bay and commercial uses along A Avenue. The Evergreen neighborhood contains several urban amenities within one-quarter mile of the project alignment, including grocery stores, restaurants and clothing stores. Community facilities in this neighborhood include Millennium Park and Our Lady of the Lake School. The Evergreen neighborhood contains an above-average concentration of low-income residents.

Lakewood. The Lakewood neighborhood is located west of State Street and south of Lakewood Bay. It is immediately to the west of the Old Town neighborhood. This neighborhood contains single-family residential development with commercial uses along State Street. Lakewood Center is the community facility in this neighborhood. This neighborhood contains an above-average concentration of residents age 65 or older.

3.3.2 Environmental Consequences

This section summarizes the effects that the project's alternatives and options would have on communities and neighborhoods. The effects of a project to communities and neighborhoods are defined as changes in neighborhood cohesion, quality of life and mobility; potential property acquisitions; and resulting potential displacements and relocations.

- **Neighborhood cohesion** is the amount to which a neighborhood is identifiable as a distinct place, separate from other neighborhoods and composed of a given geographic area. Cohesive neighborhoods have clear boundaries and landmarks and include community gathering spots, such as schools or parks, that help to give the neighborhood its identity. Cohesiveness within a neighborhood is also influenced by the neighborhood's mix of land uses and visual environment. Neighborhoods can be considered cohesive from the point of view of the residents and businesses within them, or from the point of view of an outsider.

- **Neighborhood quality of life** is a subjective assessment of the living conditions of a neighborhood, based on noise conditions, air quality conditions and open space within the neighborhood. Impacts to community facilities, affordable housing units and urban amenities can influence neighborhood quality of life.
- **Neighborhood mobility** is the degree to which residents and businesses in the neighborhood are able to move freely throughout the neighborhood and to other neighborhoods in the region. It is measured by the quantity and quality of pedestrian, bicycle, transit and vehicular transportation infrastructure. A neighborhood with a high level of mobility will typically have extensive sidewalks and bike lanes, good access to transit and a well-functioning street system for auto travel.

- Potential **property acquisitions** are privately-owned properties that have been identified through the conceptual design of the build alternatives as needing to be partially or fully purchased in order to build the alternative.

- Potential **displacements** occur when an activity that has been occurring on a parcel of land can no longer occur there due to a property acquisition. A full acquisition does not result in a displacement when there are no buildings or other activities that would be interrupted by the acquisition.

- **Relocations** would be offered to displaced activities through TriMet's Acquisition and Relocation program, which is consistent with USDOT guidelines.

3.3.2.1 Direct, Indirect and Cumulative Impacts

Following is a summary of the anticipated direct and indirect effects of the No-Build, Enhanced Bus and Streetcar alternatives on neighborhood cohesion, quality of life, mobility, and potential property acquisitions and displacements/relocations. Because all of the following analysis is based on the region's adopted land use and development plans and policies and on the transportation projects included in the financially-constrained list of the current Regional Transportation Plan (see Chapter 2), there would be no cumulative impacts to communities and neighborhoods beyond than those described within this section.

No-Build Alternative

There would be no direct or indirect effects from the No-Build Alternative to the cohesion or quality of life within the neighborhoods in the project area. There would be no property acquisitions or displacements/relocations from the No-Build Alternative. Neighborhood mobility would decrease as a result of the No-Build Alternative due to greater congestion in the area compared to the Enhanced Bus and Streetcar alternatives.

Enhanced Bus Alternative

The primary effect that the Enhanced Bus Alternative would have on the corridor's neighborhoods, compared to the No-Build Alternative, would be the result of changes to the operation of bus service on Highway 43, between downtown Lake Oswego and downtown Portland, as described in Chapter 2. Effects to neighborhood cohesion, quality of life, mobility, and potential property acquisitions and displacements/relocations are described below and summarized in Table 3.3-4.

- **Neighborhood Cohesion.** The Enhanced Bus Alternative would have limited effect on neighborhood cohesion in the project area. There would be low but no moderate to high visual impacts.

- **Neighborhood Quality of Life**. The Enhanced Bus Alternative would have no effect on neighborhood quality of life in the project area.

- **Neighborhood Mobility**. The Enhanced Bus Alternative would result in the removal of 13 of 26 bus stops served by Line 35 on Highway 43, between downtown Lake Oswego and Southwest Bancroft Street, leading to reduced travel times between the remaining 13 bus stops (see Figure 2.2-2 for an illustration of the remaining bus stops). Further, the frequency of Line 35 would increase to a bus every six minutes, compared to a bus every 15 minutes under the No-Build Alternative. In general, for areas of the corridor's neighborhoods that would have access to the remaining 13 bus stops, transit travel times would be improved through reduced transit travel and wait times. However, some areas of the corridor's neighborhoods within Segments 3 and 5 would experience longer walk distances and times to transit or the elimination of access to transit due to the removal of one or more of the bus stops. Within the Portland central city, Line 35 would be rerouted from the Portland Mall to 10th and 11th avenues, generally between Southwest Market and Clay streets and Northwest Lovejoy Street/Union Station, resulting in improved transit access along 10th and 11th avenues, with reduced transit access along the Portland Mall. In general, connections between Line 35 and other transit lines operating within downtown Portland would remain; some of them would occur at different and/or fewer locations. The Enhanced Bus Alternative would also create improved bicycle and pedestrian facilities near the park-and-ride lot in Segment 6. The Enhanced Bus Alternative would result in a slight increase in traffic volumes in Segment 6, within the Old Town neighborhood, due to the park-and-ride facility. However, this would not result in a major change in traffic congestion levels in the area.

- **Potential Property Acquisitions and Displacements.** The Enhanced Bus Alternative would result in the purchase of property for the construction of a 300-space structured park-and-ride lot at the Oswego Village Shopping Center on Highway 43 in downtown Lake Oswego. Eight parcels would potentially be partially or fully acquired by the project. There would be no displacements/relocations with the Enhanced Bus Alternative.

Streetcar Alternative

The effect that the Streetcar Alternative would have on the corridor's neighborhoods, compared to the No-Build Alternative, would primarily be the result of: 1) construction and operation of an extension of the existing Portland streetcar line from Southwest Bancroft Street to downtown Lake Oswego; 2) the elimination of Line 35 bus service, generally on Highway 43, between Lake Oswego and downtown Portland; and 3) localized changes to traffic, bicycle and pedestrian facilities. Following is a description of how the Streetcar Alternative would affect the cohesion, quality and mobility of the corridor's neighborhoods, and the potential property acquisitions and displacements/relocations. Note that there are two or three design options under study within three of the six segments of the Streetcar Alternative alignment, which result in ranges or variations in some of the effects that the Streetcar Alternative would have on the corridor's neighborhoods. This section concludes with a summary of the differences in effects that the different design options in those three segments would have effect on the corridor's neighborhoods.

- **Neighborhood Cohesion.** The Streetcar Alternative would not alter established community landmarks or neighborhood boundaries or result in any effects to community facilities, urban amenities or affordable housing units. However, both the potential for land use changes and the changes in the visual environment could affect community cohesion in neighborhoods throughout the project area. The Streetcar Alternative could contribute to redevelopment occurring more quickly in the South Portland and Foothills neighborhoods. Because any redevelopment would be in line with community-adopted plans, this change in community cohesion would not need to be mitigated. The Streetcar Alternative is expected to result in a moderate visual impact in Segments 3 and 6, and a moderate or moderate-high visual impact in Segment 5. Mitigation measures for visual impacts are discussed in Section 3.4. Final decisions on the appropriate mitigation measures for visual impacts would be coordinated with the community in order to ensure that the visual environment remains appropriate for the community as a whole.

- **Neighborhood Quality of Life.** The Streetcar Alternative would not result in any air quality impacts or major impacts to parks. However, it would result in moderate noise impacts in Segments 3 and 4, and moderate to severe noise impacts to Segment 5. The severe noise impacts in Segment 5 could be mitigated, using noise walls, to at least the moderate level. These impacts have the potential to negatively impact the quality of life for the South Portland neighborhood and the Dunthorpe/Riverdale area of Multnomah County.

- **Neighborhood Mobility.** The Streetcar Alternative would improve neighborhood mobility in all segments of the project area. It would do so by decreasing transit travel times, providing new bicycle and pedestrian facilities in Segments 4, 5 and 6, and improving traffic operations throughout the project area. However, it would result in a decrease in access to transit in the South Portland neighborhood within Segment 3; it would provide a total of six stations for the neighborhood, which is currently served by nine northbound and southbound bus stops. It would reduce access to transit in the Dunthorpe/Riverdale area and Birdshill neighborhood in Segment 5 by limiting the neighborhood to two stations, compared to the seven northbound and eight southbound that currently serve the area. It would also reduce access to transit in the First Addition and Evergreen neighborhoods of Segment 6 through the removal of the transit center at A Avenue and 4th Street. This would require residents of First Addition and Evergreen who live west of 4th Street to either walk further or take a short bus ride to the streetcar station at B Avenue in order to reach downtown Portland. The Streetcar Alternative would result in increased congestion at two intersections in Segment 6 as a result of traffic generated from the park-and-ride lot. These intersections are on the border of the Foothills, Old Town and Lakewood neighborhoods. Chapter 4 of this DEIS addresses potential mitigation for the impact to traffic of the park-and-ride facilities.

- **Potential Property Acquisition and Displacements.** The Streetcar Alternative would potentially result in the full or partial acquisition of 28 to 60 parcels, potentially resulting in zero to seven displacements. Details on potential property acquisitions by project segment are listed in Table 3.3-3.

  The potential commercial displacement in Segment 3 is a commercial fueling station located at 6140 SW Macadam Ave. The potential residential displacement in Segment 5 is located at 10808 SW Riverwood Road. The industrial displacements/relocations in Segment 6 are at the following locations: 801 N State St., currently in use as Public Storage-Self Storage; account number

182046 (no address available), currently part of the Public Storage-Self Storage complex; account number 182108 (no address available), currently part of the Public Storage-Self Storage complex; 99 Foothills Road, currently in use as All Purpose Design; 113 Foothills Road, currently in use as Skyline Northwest auto dealership; 101 Foothills Road, currently in use as Jeepers It's Erickson's auto dealership; and 100 Foothills Road, currently in use as Lakeshore Concrete.

Table 3.3-3 Streetcar Alternative Property Acquisitions and Displacements* by Type, Segment and Design Option

Segment/ Option	Residential	Commercial	Public Institution	Industrial	Total
	Acquisitions *(Displacements)*	**Acquisitions *(Displacements)***	**Acquisitions *(Displacements)***	**Acquisitions *(Displacements)***	**Acquisitions *(Displacements)***
3 - Johns Landing					
Willamette Shore Line	1	6			7
Macadam In Street	3	14			17
Macadam Add Lane	6	19 *(1)*			25 *(1)*
5 - Dunthorpe					
Willamette Shore Line					
Riverwood	8 *(1)*				8 *(1)*
6 - Lake Oswego					
UPRR	2	9	9	1	21
Foothills	2	9	9	7 *(5)*	27 *(5)*
Minimum Total (assuming selection of Willamette Shore Line in Segment 3, Willamette Shore Line in Segment 5 and UPRR in Segment 6)	**3 *(0)***	**15 *(0)***	**9 *(0)***	**1 *(0)***	**28 *(0)***
Maximum Total (assuming selection of Macadam Additional Lane in Segment 3, Riverwood in Segment 5 and Foothills in Segment 6)	**16 *(1)***	**28 *(1)***	**9 *(0)***	**7 *(5)***	**60 *(7)***

Note: Table does not include 1 property owned by ODOT and two properties owned by UPRR. Use of these properties for the Streetcar Alternative is not expected to require acquisition of the properties. ODOT may allow use of its property without acquisition and use of the UPRR property may be by permit.
*Displacements occur when an activity that has been occurring on a parcel of land can no longer occur there. A full acquisition does not result in a displacement when there are no buildings or other activities that would be interrupted by the acquisition.

Streetcar Design Options

Following is a description of the differences in effects that the Streetcar Alternative would have on neighborhoods based on the design options currently under study. Two or three design options are under study in three segments: Segment 3 – Johns Landing, Segment 5 – Dunthorpe/Riverdale, Segment 6 – Lake Oswego.

Segment 3 – Johns Landing

- **Willamette Shore Line Option.** The Willamette Shore Line design option would result in noise impacts to adjacent residences; the Macadam Avenue options would not result in noise impacts. The Willamette Shore Line design option would also result in a moderate visual impact to the South Portland neighborhood. The Macadam Avenue options would have no major effect on the visual environment.

- **Macadam In-Street Option.** The Macadam In-Street and Macadam Additional Lane design options would result in the greater likelihood for unauthorized parking[42] in the South Portland neighborhood, which would be a decrease in neighborhood mobility. Both the Macadam In-Street option and the Macadam Additional Lane design option would have a substantially higher potential for creating redevelopment in the South Portland neighborhood than the Willamette Shore Line design option would. The Macadam In-Street and Macadam Additional Lane options would require installation of a signal at Southwest Macadam Avenue and Carolina Street; this would lead to traffic congestion that exceeds ODOT standards at that intersection. This would be an impact to neighborhood mobility in the South Portland neighborhood.

- **Macadam Additional Lane Option.** The Macadam Additional Lane design option would result in one commercial displacement. The Macadam In-Street and Willamette Shore Line options would not result in any displacements. The Macadam Additional Lane option would result in a moderate visual impact; the Macadam In-Street option would not result in a visual impact.

Segment 5 – Dunthorpe/Riverdale

- **Willamette Shore Line Option.** The Willamette Shore Line design option would not provide additional bicycle and pedestrian facilities.

- **Riverwood Option.** The Riverwood design option would provide a bicycle lane and sidewalks along Riverwood Drive. The Riverwood design option would result in up to eight residential acquisitions. One of these acquisitions would result in a displacement.

Segment 6 – Lake Oswego

- **Union Pacific Railroad Right of Way Option.** The Union Pacific Railroad design option would result in fewer acquisitions and displacements/relocations than the Foothills design option. The Union Pacific Railroad design option would result in a total of 21 acquisitions.

- **Foothills Option.** The Foothills design option would result in up to 27 acquisitions. This would include five industrial displacements.

[42] Unauthorized parking is what occurs when users of a transit system park on neighborhood streets adjacent to stations, due to lack of available parking spots at the station itself.

Table 3.3-4 Summary of Effects on Neighborhoods by Alternative

Effect on Neighborhoods	No-Build Alternative	Enhanced Bus Alternative	Streetcar Alternative
Cohesion			
Change to established community boundaries or landmarks	No Effects	No Effects	No Effects
Impacts to community facilities or urban amenities	No Effects	No Effects	No Effects
Change in land use	No Effects	No Effects	- Increased potential for redevelopment in Segment 2 (both options) - Increased potential for redevelopment in Segment 3 (Macadam options only) - Increased potential for redevelopment in the northern end of Segment 4 - Increased potential for redevelopment in Segment 6
Change in visual environment	No Effects	- No moderate or high visual impacts	- Moderate visual impact in Segment 3 (all options) - Moderate visual impact in Segment 5 (WSL option) - Moderate-high degree of visual impact in Segment 5 (Riverwood option) - Moderate visual impact in Segment 6 (both options)
Quality of Life			
Noise or air quality impacts	No Effects	No Effects	- Moderate noise impacts in Segment 3 (WSL option only) - Moderate noise impacts in Segment 4 - One potential severe noise impact to a residential property in Segment 5 (both options) however, this could be mitigated with sound walls to at least a moderate level - Moderate noise impacts to 14-15 residences in Segment 5 (WSL option) or 11-12 residences in Segment 5 (Riverwood option)
Impacts to parks and recreational facilities	No Effects	- Improved transit access to parks	- Improved transit access to parks
Impacts to affordable housing units	No Effects	No Effects	No Effects
Mobility			
Traffic	- Increased VMT - Increased congestion at several intersections	- Slight increase in traffic volumes in Segment 6 due to the park and ride, but this would not result in substantial additional congestion	- Overall improvement to traffic operations in Segments 2-5 - The installation of a traffic signal at SW Macadam Avenue and SW Carolina Street in Segment 3, under the Macadam options, would lead to congestion in that area - Potential for unauthorized parking in Segment 3 (Macadam options only) - Congestion in Segment 6 (both options)
Transit Travel Times	No Effects	- Decrease in transit travel times	- Decrease in transit travel times in all segments
Access to Transit	No Effects	- Decrease in access to transit in Segment 3 - Decrease in access to transit in Segment 5 - Decrease in access to transit in Segment 6	- Small decrease in access to transit in Segments 3 and 4 - Large decrease in access to transit in Segment 5 - Moderate decrease in access to transit in Segment 6
Change in bicycle and pedestrian facilities	No Effects	- Improved facilities associated with the park and ride facility	- New bicycle/pedestrian overcrossing in Segment 4 - Improvements to sidewalks and bicycle lanes in Segment 5 (Riverwood In-Street Option only) - New bicycle and pedestrian connections under UPRR rail line and over Tryon Creek in Segment 6 (both options)
Property Acquisition/ Displacement			
Residential (Partial/Full)	None	- 1 residential acquisition in Segment 6	- Maximum 16 acquisitions (assuming Macadam Add-Lane and Riverwood options are chosen) - 1 residential displacement in Segment 5, if Riverwood option is chosen
Commercial (Partial/Full)	None	- 7 commercial acquisitions in Segment 6	- Maximum 28 acquisitions (assuming Macadam Add-Lane is chosen) - 1 commercial displacement in Segment 3 under Macadam Add-Lane
Public/Institution (Partial/Full)	None	None	- Maximum 9 acquisitions
Industrial	None	None	- Maximum 7 acquisitions, assuming Foothills option is chosen - 5 displacements in Segment 6 under the Foothills option

3.3.3 Potential Neighborhood Mitigation Measures

The development of mitigation measures for the community impacts discussed above would be based on continued public involvement within all of the communities in the LOPT project area. The most prominent impact to communities and neighborhoods is an improvement in neighborhood mobility. This is generally considered a beneficial impact and does not require mitigation. Mitigation for visual impacts and noise impacts are discussed within the sections of this DEIS that are specific to those disciplines (Section 3.4 Visual Quality and Aesthetics and Section 3.10 Noise and Vibration). Each of these mitigation strategies should be discussed with the community throughout the public involvement process in order to ensure that they incorporate concerns of residences and businesses in the project area.

Mitigation of displacements to residences could be achieved in the following ways:

- Further refinement of the project design to avoid or minimize these displacements;
- Compensation to property owners based on fair market value of the property and a comprehensive relocation program that is consistent with USDOT guidelines.

The following mitigation measures would lessen adverse impacts to businesses and residences during construction of the project:

- Inform and update police, fire and emergency service providers of the construction activities that could affect emergency vehicles;
- Provide clear signage and warnings for temporary closures during construction;
- Coordinate with other nearby construction projects so that delays and intense equipment usage periods do not overlap;
- Maintain a route for emergency vehicles at all times; and
- Spray water to control dust in work areas.

3.4. Visual Quality and Aesthetics

This section summarizes information on the existing visual environment in the study corridor and the expected visual impacts of the project alternatives. For additional information on the visual analysis see the *Lake Oswego to Portland Transit Project: Visual Quality and Aesthetics Technical Report* (DEA/URS and TriMet/Metro, November 2010).

3.4.1 Introduction, Approach and Methodology

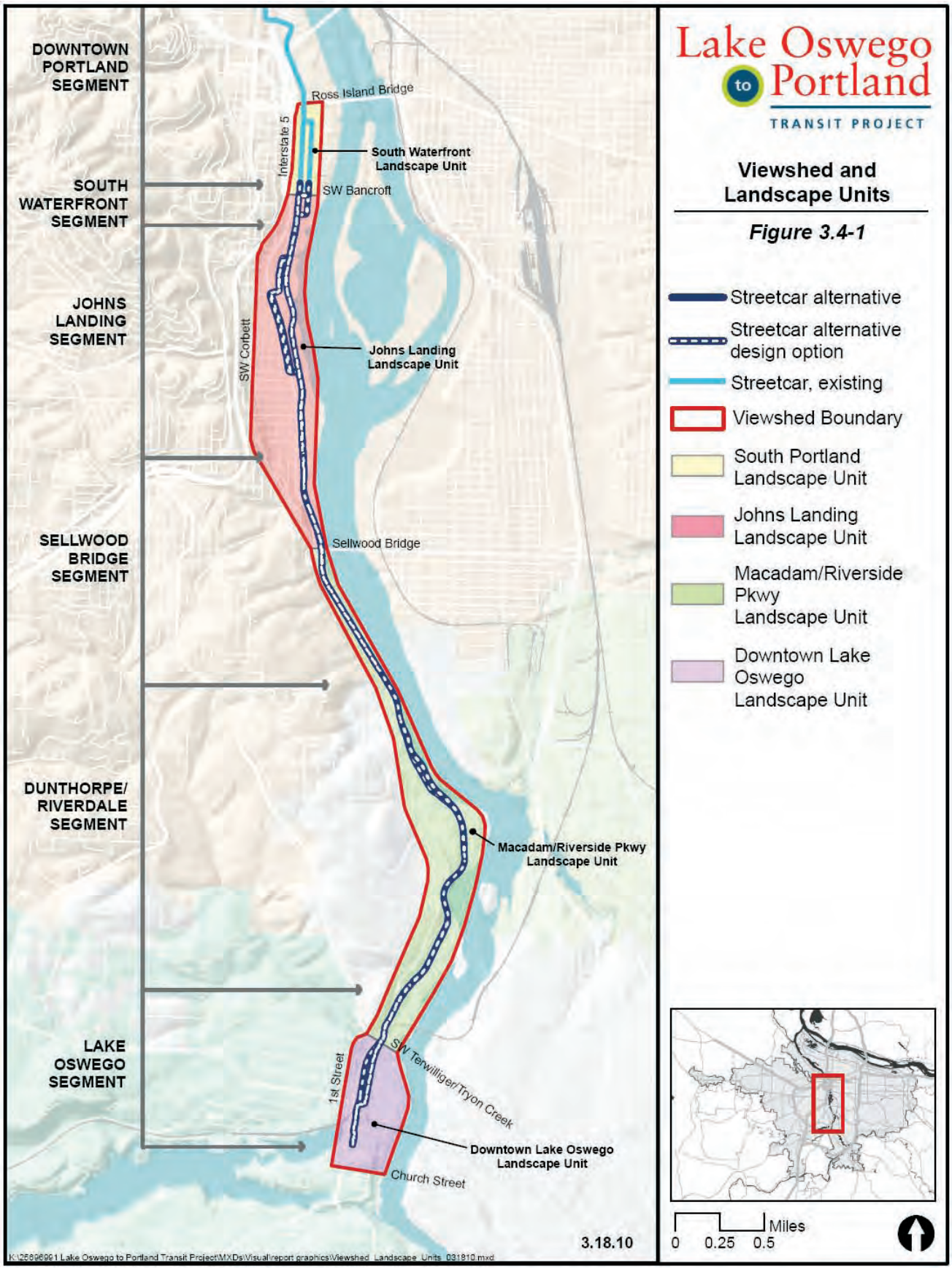
The analysis followed the Federal Highway Administration's (FHWA's) visual quality and aesthetics assessment methodology (FHWA, 1989). Identification of visual elements and determinations of potential effects were made through a series of field visits, analysis of the concept design plans and evaluation of elements of the current transit system. The visual quality and aesthetics analysis considers potential changes to the quality of the visual environment, including regional landscape patterns and local visual resources. This analysis describes:

- Existing visual character and patterns in the corridor;
- Current dominant and recognized visual features, including those identified through adopted; neighborhood plans and previous planning efforts as important neighborhood features, or formally designated in local or state planning documents;
- Landscape units and associated project segments have been identified within the project area, including a discussion of the general types of viewers, and their exposure and sensitivity;
- Changes to visual conditions that would result from construction and operation of the alternatives; and
- Potential mitigation measures.

New transit facilities can become highly visible public resources and can affect the visual character of the surrounding landscapes and the perception of visual resources. They can also be designed to fit sensitively into the existing visual environment, improving the visual environment, particularly when the existing visual environment lacks unity and cohesion. Significant transit improvements frequently serve as a catalyst for other improvements in an area through separate efforts such as urban renewal or local improvement districts. This assessment examines the possible effects of the study alternatives and design options on existing views and visual resources.

Section 3.4.2 Affected Environment describes existing visual resources in the corridor, and their context, in order to evaluate effects of the study alternatives and design options in Section 3.4.3 Environmental Consequences. The affected environment describes the overall existing landscape character of the area and identifies important views, landscapes or landmarks that serve as character-defining elements of the study area. The visual resources identified include major public views as well as dominant and recognized visual features (based on accepted practice in the field of visual analysis). Locations with notable views have also been identified through public feedback. The analysis also considers features or views identified in local plans or ordinances. Figure 3.4-1 shows a map of the project area, the landscape units and the project segments.

In addition, visual simulations have been prepared to illustrate what the changes associated with the Streetcar Alternative could look like. The simulations include a photograph of an existing view within the corridor compared with the same location in a simulation of how the proposed project improvements could change the view. The simulations are illustrative of the conceptual level of design that has been developed so far. No simulations were prepared for the Enhanced Bus


DOWNTOWN PORTLAND SEGMENT
SOUTH WATERFRONT SEGMENT
JOHNS LANDING SEGMENT
SELLWOOD BRIDGE SEGMENT
DUNTHORPE/ RIVERDALE SEGMENT
LAKE OSWEGO SEGMENT
Ross Island Bridge
Interstate 5
South Waterfront Landscape Unit
SW Bancroft
SW Corbett
Johns Landing Landscape Unit
Sellwood Bridge
Macadam/Riverside Pkwy Landscape Unit
1st Street
SW Terwilliger/Tryon Creek
Downtown Lake Oswego Landscape Unit
Church Street
3.18.10
K:\25896991 Lake Oswego to Portland Transit Project\MXDs\Visual\report graphics\Viewshed_Landscape_Units_031810.mxd
Lake Oswego to Portland
TRANSIT PROJECT
Viewshed and Landscape Units
Figure 3.4-1
Streetcar alternative
Streetcar alternative design option
Streetcar, existing
Viewshed Boundary
South Portland Landscape Unit
Johns Landing Landscape Unit
Macadam/Riverside Pkwy Landscape Unit
Downtown Lake Oswego Landscape Unit
Miles
0 0.25 0.5

Alternative, because the changes would not be significant compared to existing bus service in the area.

3.4.2 Affected Visual Environment

The study area is in the urbanized northern portion of the Willamette River Valley. The Cascade Mountains including Mount Hood provide a distant backdrop in the east; the Tualatin Mountains, also known as the West Hills, frame the western edge of the viewshed. The study corridor generally runs along the west bank of the Willamette River between downtown Portland and downtown Lake Oswego.

Urban development of the Portland region began in the mid-1800s. Early development was tied to a dense network of streetcars and interurban rail lines. A railroad built in 1886 connected Portland to Lake Oswego in the study corridor. From 1914 to 1929 interurban trains ran on the line from Portland to Lake Oswego and extended south as far as Corvallis. These trains stimulated residential development in the 1920s and 1930s. After passenger service was terminated in the corridor, freight service continued on the railroad tracks until the 1980s. During the same time, the line was purchased by a consortium of government agencies to preserve the right of way for future transit use. Beginning in1987 the Willamette Shore Trolley began excursion type operation between Lake Oswego and Portland; the service operates primarily in the summer.

3.4.2.1 Landscape Units and Project Segments

This project describes the existing visual environment in terms of landscape units. To describe the existing visual environment and understand the level of visual changes that would occur with the project alternatives and design options; five “landscape units” have been identified. The landscape units and project segments are illustrated on Figure 3.4-1 and defined in more detail below. Each landscape unit is a subset of the project area that has a distinctive visual character and a specific geographic location. For each landscape unit the applicable project segments are noted. The five landscape units include Downtown Portland, South Waterfront, Johns Landing, Macadam/Riverside Parkway, and Downtown Lake Oswego.

This project describes the visual effects by project segment. The project segments do not match the landscape units however in most cases the landscape units and project segments have similar north south boundaries. Project segments are based on project functional or operational factors. Visual impacts are described by project segment to provide consistency with the other sections of the Environmental Impact Statement. Figure 3.4-1 illustrates the boundaries of the landscape units and the segments.

A. Downtown Portland. The downtown Portland landscape unit extends north from the Ross Island Bridge and includes parts of downtown Portland along the existing streetcar alignment. It is located entirely in Segment 1. It is an urban environment with medium- to large-scale buildings and a small-grid street system. There is a mix of older buildings, modern high rise buildings, urban parks and plazas, and well established ornamental landscaping. Much of the street system is a standard 200-foot block pattern, except where it is disrupted by topographical changes and major transportation features such as Interstate 5, Interstate 405 and the Willamette River.

Dominant visual features within the downtown Portland landscape unit include streetscape and architectural views, the skyline of downtown Portland, and views of the Willamette River and

downtown bridges. Throughout the unit, the West Hills form the western edge of the viewshed and Mount Hood and the Cascades can be seen to the east. Buildings, street signs, street trees and the miscellaneous furnishings typical of an urban core are in the foreground and middle ground of most views. The City of Portland's *Scenic Views, Sites, and Corridors* (1991) formally identifies numerous view corridors and view points throughout the landscape unit.

B. South Waterfront. The South Waterfront landscape unit lies between the Ross Island Bridge and Southwest Bancroft Street. This landscape unit is located mostly in Segment 1, with one block in Segment 2. On the east is the Willamette River, and Macadam Avenue and Interstate 5 form the western boundary. The forested canopy of the West Hills and structures associated with Oregon Health Sciences University (OHSU) are visible to the west above Interstate 5. Ross Island, Willamette River riparian vegetation, distant foothills and the Cascade Range are visible in the middle and background views to the east. The Ross Island and Marquam bridges and associated on/off ramps are visible to the north primarily along public streets. The Portland Aerial Tram is also visible to the north. Most visual features to the south are blocked by existing structures. It is a dynamic, urban environment on the edge of the downtown core.

The visual character of this unit is an emerging urban area with a combination of modern high rise buildings and older industrial uses. Surface parking lots and undeveloped sites are interspersed with formal landscaping, urban parks, and urban street furnishings. Currently, the area has a limited but growing street network. Moody and Bond streets accommodate the existing Portland streetcar service.

The City of Portland's *Central City 2035 Subdistrict Profiles* (2010) designates minor viewpoints in the South Waterfront landscape unit along the Willamette River at Gaines Street, Gibbs Street and approximately midway between the Marquam and Ross Island bridges in alignment with the City of Portland's proposed street network. Several view corridors are also designated along Gaines Street, Gibbs Street and approximately Meade Street from Interstate 5 toward the Willamette River. *Scenic Views, Sites, and Corridors* identifies public viewpoints along Terwilliger Boulevard, but vegetation and trees in the green space below Terwilliger Boulevard obscure most views of the South Waterfront landscape unit.

C. Johns Landing. The Johns Landing landscape unit is defined by Southwest Bancroft Street on the north, the Willamette River on the east, the Sellwood Bridge on the south, and Interstate 5 and Corbett Avenue on the west. This landscape unit includes a small portion of Segment 2, all of Segment 3 and about half of Segment 4.

The visual character of this landscape unit is dominated by Southwest Macadam Avenue/Highway 43, a four-lane state highway with a boulevard type streetscape that divides the area. In the northern half of the segment, it has auto-oriented commercial, office and industrial uses on both sides mixed with medium- and low-density housing along with segments of mature landscaping. Macadam Avenue is a busy street that serves as a barrier between the western and eastern parts of the landscape unit. On the west behind the commercial uses is an older, predominately single-family neighborhood with a grid street system and smaller block sizes. The commercial and retail uses on the west side of Macadam Avenue are generally smaller parcels and more pedestrian oriented than the buildings and landscaping east of Macadam Avenue.

On the east side of Macadam Avenue, the parcels are larger and the streets are irregular, and both relate more to the Willamette River. The Willamette River Greenway Trail, a significant public feature, and the Willamette Shore Line run parallel to the river. Large parcel sizes create visual similarity with structures that are primarily three- to four-story office buildings, residential condominiums, industrial and/or river related sites, and public open space. The existing railroad tracks run north and south through this area between Macadam Avenue and the Willamette River. Many buildings on the east side of Macadam Avenue are oriented toward the river, but many commercial buildings along Macadam are oriented toward Macadam Avenue. Many buildings between the existing railroad tracks and Macadam Avenue include surface parking lots adjacent to the buildings.

The southern half of this landscape unit includes a small residential neighborhood and several parks on the east side of Macadam Avenue along with the existing Willamette Shore Line railroad tracks and the Willamette River Greenway trail, both running north and south, parallel to Macadam Avenue.

Visual features within the Johns Landing landscape unit include views of the Willamette River and associated bridges, boats, marinas and houseboats; Willamette Park; Ross Island; the Willamette Greenway Trail; the Willamette Shore Line railroad right of way; distant foothills; and the Cascade Range to the east. Downtown Portland, the Lloyd District and South Waterfront skylines, including the Portland Aerial Tram, are visible in background views to the north. The tree-covered West Hills, the Willamette River and the Sellwood Bridge are visible to the south and west.

The City of Portland Macadam Plan District identifies view corridors along Richardson, Pendleton, Carolina, Nebraska, Vermont, California, Nevada and Miles streets. View points are identified along the Willamette River at locations north of Boundary Street and at Florida Street. A minor viewpoint is identified between Bancroft and Hamilton streets. Scenic resources are protected by the Willamette Greenway Overlay Zones and the Design Overlay Zones which apply to many properties in the area. *Scenic Views, Sites, and Corridors* identifies two scenic viewpoints on the west side of the Willamette River near the Sellwood Bridge.

D. Macadam Avenue/Riverside Parkway. The Macadam Avenue/Riverside Parkway landscape unit is defined on the north by the Sellwood Bridge, on the east by the Willamette River, on the west by the natural bluff above Southwest Macadam Avenue/Highway 43, and on the south by Terwilliger Boulevard and the Tryon Creek. This landscape unit includes almost half of Segment 4, all of Segment 5 and a portion of Segment 6.

This landscape unit is predominantly a forested transportation corridor along Macadam Avenue with the parallel Willamette Shore Line right of way between the highway and Willamette River. The railroad corridor predates development in the area and often defines parcel boundaries. The area has natural vegetation along the Willamette River, creeks and tributaries running west to east, and large lot residential neighborhoods interspersed with some parks and open space. Mixed deciduous and conifer tree canopy, significant grade changes dropping off toward the river and curvatures in the roadway limit views in all directions along Macadam Avenue and Riverside Drive. Occasional openings in the trees provide views to the Willamette River and further east. The existing railroad corridor is generally below the highway. In the vicinity of Powers Marine Park, the existing railroad right of way runs between the river and Macadam Avenue. The Dunthorpe/Riverdale neighborhood

are large lot single family areas with narrow rural roads and mature vegetation. Many houses have views oriented to the Willamette River.

Visual resources in the Macadam Avenue/Riverside Parkway landscape unit include the Macadam/ Terwilliger scenic corridor and the Willamette River corridor as identified in *Scenic Views, Sites, and Corridors*. The Macadam/Terwilliger scenic corridor runs along Macadam Avenue from Terwilliger Boulevard to the Portland city limits. This area is protected by the Scenic Overlay Zone. The Willamette River corridor runs the length of the Willamette River in Portland and unincorporated Multnomah County and is protected through the Environmental Overlay Zones and Willamette River Greenway Overlay Zones. South of Portland in unincorporated Multnomah County, the Riverside Drive corridor and areas extending east to the Willamette River are identified as "Scenic Corridor Resource Site 117A" in the *Inventory of Natural, Scenic, and Open Space Resources for Multnomah County Unincorporated Areas* (2001). Additionally, the Elk Rock Gardens is located in the Dunthorpe/Riverdale area and designed as a scenic site in the same inventory.

E. Downtown Lake Oswego. The downtown Lake Oswego landscape unit is defined on the north by Terwilliger Boulevard and Tryon Creek, on the west by the Willamette River, on the south by Church Street, and on the west by 1st Street. This landscape unit is entirely within Segment 6.

The visual character of this unit is that of a small well established downtown city center with an evolving industrial area, office park and open space to the east. State Street/Highway 43 divides the downtown and clearly differentiates the east and west areas both visually and physically. West of State Street the area is mixed-use, with a grid street system and strong pedestrian environment. The streetscape, furnishings, high quality materials and landscaping provide visual continuity.

East of State Street the grade drops toward the Willamette River where access is limited. A narrow row of storefront buildings front onto State Street. They limit views from downtown toward the river and provide a visual edge. The area is physically defined on the north by Tryon Creek and the structures associated with the railroad tracks to the east of the highway. City of Lake Oswego owned and undeveloped open space borders the Willamette River to the east and is different in visual character from the adjacent industrial uses. In the north, the area has large lots with industrial uses. To the southeast are an office campus, residential community and auto-oriented retail uses. This area lacks the visual continuity present west of State Street.

Visual resources in downtown Lake Oswego include view corridors along A, B and D avenues and unobstructed view sites at intersections of A, B, C and D avenues and State Street as identified in the *Foothills District Refinement Plan Alternatives Evaluation and Refinement Report* (OTAK 2005). The City of Lake Oswego's Willamette Greenway Overlay extends 150 feet shoreward from the ordinary low waterline of the Willamette River and includes provisions protecting and enhancing significant natural and scenic areas, viewpoints and vistas.

3.4.3 Environmental Consequences

Project related effects to the visual and aesthetic environment include changes that would be brought about by construction and operation of the study alternatives and design options. These changes may detract from or enhance the visual environment.

Assessment of visual impacts relies on subjective criteria. This assessment focuses on changes to the visual environment measured as high, moderate, or low degrees of change. Table 3.4-1 describes some typical thresholds for high, moderate or low levels of change. For project related changes the analysis also considers viewer sensitivity to these changes. "Viewer sensitivity" is a measure of potential preferences, values and opinions of different groups of viewers, including considerations of the length of time for which the project could be seen, the distance of the viewer from the project improvements and the type of viewer (e.g., neighborhood resident, traveler on a highway).

Table 3.4-1 Characteristics of High, Moderate, and Low Levels of Visual Change[1]

High Level of Visual Change[1]	Moderate Level of Visual Change[1]	Low Level of Visual Change[1]
Significant new elevated structure	Moderate new grade separation	At-grade/below-grade
Significant displacement of structures	Moderate displacement of structures	Low displacement of structures
Significant new parking	Moderate new parking	Limited new parking
Significant view disruption	Moderate view disruption	Low view disruption
Removal of existing screening to residential uses	Partial removal of existing screening to residential uses	Minor removal of existing screening to residential uses
Significant visual change to public parkland	Moderate visual change to public parkland	Minor visual change to public parkland
Blocks significant scenic feature	Disrupts significant scenic feature	Limited change to significant scenic feature
Significant removal of vegetation	Removal of some vegetation	Limited removal of vegetation
Significant changes to streetscape character	Moderate changes to streetscape character	Limited changes to streetscape character
Significant changes to NRHP eligible historic structure	Significant or moderate changes to NRHP eligible historic site	Limited changes to a NRHP eligible site
Significant new night lighting and associated glare	Moderate new night lighting and associated glare	Low new night lighting and associated glare

[1] Some changes associated with transportation projects, such as screening, landscaping, lighting, sound walls, pedestrian and bike improvements, etc., can be a positive improvement compared to existing conditions.

3.4.3.1 Direct Visual Effects

The assessment considers a variety of factors, including the level of visual change anticipated, the context and scale of the surrounding area, effects on major public views, the sensitivity of viewers and the potential benefit of the project related changes in the area. As noted above, the ratings for the sensitivity of viewers can be more subjective than the other factors, but they consider the expectations of a viewer, the length of exposure he or she would have to the changed view and the viewpoint, including proximity. For example, residential viewers would be considered more highly sensitive to major changes of view and setting nearby because they would encounter the change on a daily basis. People at an established viewpoint, such as a public park, would also be more sensitive to change. Viewers in workplaces, particularly industrial areas, are expected to be less sensitive to changes in views than residential viewers. Motorists traveling through a corridor would be less sensitive to localized changes, but they would still notice major changes in views.

No-Build Alternative. The No-Build Alternative would include transportation improvements as defined in the Regional Transportation Plan financially constrained network. Other projects and additional development or redevelopment changes within the project area would have an effect on existing visual resources but would likely tend to be gradual and localized and not affect the length of the project area. The No-Build Alternative would not include new transit project related changes that would significantly alter the visual environment in the corridor.

Enhanced Bus Alternative. In addition to changes as noted with the No-Build Alternatives, visual changes with the Enhanced Bus Alternative would be limited. In the Lake Oswego project segment construction of a new 300-space park-and-ride structure and new two-lane roadway to connect the park and ride with Foothills Road would result in moderate visual changes to the existing environment; however, they would generally be compatible with the existing urban nature the area. Overall visual impacts with the Enhanced Bus Alternative would be low.

Streetcar Alternative. Implementation of the Streetcar Alternative would result in the addition of a variety of streetcar related elements that would cause visual changes in the corridor. Improvements would include extension of the streetcar system for approximately 5.9 miles from South Portland to downtown Lake Oswego, generally within the existing Willamette Shore Line railroad right of way, except as described for various design options. Related streetcar improvements would include trackway upgrades, generally replacing existing single tracks with double tracks (including some new retaining walls below and above the trackway), addition of 10 passenger stations between Southwest Bancroft Street and Lake Oswego, addition of overhead catenary lines to power the streetcars and associated features such as crossings, signals and lighting.

Potential long-term impacts resulting from the Streetcar Alternative improvements to the existing visual and aesthetic environment are discussed below. Table 3.4-2 summarizes the visual effects of all of the study alternatives. Table 3.4-3 provides detail on viewer sensitivity, degree of change, and overall visual impacts by project segment and design option. Table 3.4-4 summarizes the impacts of the Streetcar Alternative by segment, landscape unit and design option. A narrative description including some visual simulations that are intended to assist the reader in understanding the types of changes that could occur with various design options follows Table 3.4-3.

Table 3.4-2 Summary of Visual Impacts by No-Build, Enhanced Bus and Streetcar Alternatives

Project Segment	No-Build Alternative	Enhanced Bus Alternative	Streetcar Alternative[1]
1 - Downtown Portland	NA	L	L
2 - South Waterfront	NA	L	L
3 - Johns Landing	NA	NA	M
4 - Sellwood Bridge	NA	NA	L-M
5 - Dunthorpe/Riverdale	NA	NA	M-H
6 - Lake Oswego	NA	L	M

Source: Lake Oswego to Portland Transit Project: Visual and Aesthetics Technical Report, DEA August 2010.
Notes: H = High; M = Moderate; L = Low.
NA - Improvements not within the landscape unit or not applicable.
[1]Ranges are the result of various combinations of design options under study. See Table 3.4-3 for details on visual impacts for design options.

Table 3.4-3 Viewer Sensitivity, Degree of Change, and Overall Visual Impact Score for the Streetcar Alternative By Segment and Design Option

Segment/ Design Option	Visual Impacts			Changing Features (in addition to new trackway and centenary system)
	Viewer Sensitivity	Degree of Change	Overall Score[1]	
1 – Downtown Portland	L	L	L	New turnaround at Portland State University.
2 – South Waterfront [2]	L	L	L	New stations, relocate existing trolley station, intersection improvements, and new public access from SW Macadam Ave. to station. (Building removal, retaining walls, and new roadway connections done by others as part of South Portland Circulation Project).[3]
3 – Johns Landing				
Willamette Shore Line	L-H	M	M	New stations, retaining walls, regrading, and potential fencing. SW Boundary St. widening and improvements. Modifications to existing carport and parking lot. Removal of Jones Trestle. Potential vegetation removal in various locations including in Willamette Park. New pedestrian improvements and crossings.
Macadam In-Street	M	M	M	New stations and retaining walls. SW Landing Drive widening. Modifications to parking lots. SW Boundary St. reconfiguration, intersection improvements, widening of SW Macadam at SW Carolina, and SW Carolina reconfiguration. Potential vegetation removal in various locations including in Willamette Park. New pedestrian improvements and crossings.
Macadam Additional Lane	M	M-H	M	New stations and retaining walls. SW Landing Drive widening. Modifications to parking lots. SW Boundary St. reconfiguration, widening of SW Macadam from SW Boundary to SW Carolina, and SW Carolina reconfiguration. Building removal. Potential vegetation removal in various locations including in Willamette Park and along SW Macadam. New pedestrian improvements and crossings.
4 – Sellwood Bridge [3]	L-M	L-M	L-M	New stations and retaining walls. Potential vegetation removal and regrading. (Bridge, associated interchange and driveway relocation are part of the Sellwood Bridge Project)
5 – Dunthorpe/Riverdale				
Willamette Shore Line	L-H	L-H	M	New retaining walls, fences, stations, and SW Briarwood overcrossing. Driveway reconfiguration, intersection improvements, and replaced trestles. Potential vegetation removal.
Riverwood In-Street	L-H	L-H	M-H	New retaining walls, fences, station and SW Briarwood overcrossing. Replace 2 trestles with one long trestle. Close intersection of SW Riverwood Road and SW Riverside Drive. Widen SW Riverwood Road. Significant regrading. Building and potential vegetation removal.
6 – Lake Oswego				
UPRR	L-M	M	M	New retaining walls, pedestrian and bike connection from SW Fielding Road, freight under crossing, trestle over Tryon Creek, stations, and stairway connection from SW B Ave. New surface parking lots and parking structure. Roadway widening and reconfiguration, Stampher Road at-grade crossing, UPRR track shifted 15' west, intersection improvements, parking and driveway relocation, and regrading. Potential vegetation removal.
Foothills	L-M	M-H	M	New retaining walls, pedestrian and bike connection from SW Fielding Road, freight under crossing, trestle over Tryon Creek, stations, and stairway connection from SW B Ave. New surface parking lots and parking structure. Stampher Road reconfiguration and extension, SW Foothills road realignment and reconfiguration, intersection improvements, parking and driveway relocation, and regrading. Building (up to 11 structures) and potential vegetation removal.

Source: Source: Lake Oswego to Portland Transit Project: Visual and Aesthetics Technical Report, DEA August 2010.
Note: H = High; M = Moderate; L = Low. MOS = minimum operable segment.
[1] Overall score is the degree of change plus viewer sensitivity.
[2] The South Waterfront Segment contains potential construction phasing options associated with the Streetcar alignments. The Willamette Shore Line and Moody/Bond Couplet are considered phasing options rather than design options. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.
[3] The Sellwood Bridge Segment contains potential construction phasing options associated with the Streetcar alignments. The Willamette Shore Line and New Interchange are considered phasing options rather than design options. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

Table 3.4-4 Summary of Overall Visual Impacts for the Streetcar Alternative By Segment and Design Option

Segment/Design Option	Landscape Unit	Overall Visual Impact[1]
1 – Downtown Portland	Downtown Portland (Downtown Portland to the Ross Island Bridge)	L
2 – South Waterfront[2]	South Waterfront (Ross Island Bridge to SW Bancroft)	L
3 – Johns Landing	Johns Landing (SW Bancroft to the Sellwood Bridge)	
Willamette Shore Line		M
Macadam In-Street		M
Macadam Additional Lane		M
4 – Sellwood Bridge[2]	Johns Landing (SW Bancroft to the Sellwood Bridge) Macadam/Riverside Parkway (Sellwood Bridge to SW Terwilliger)	L-M
5 – Dunthorpe/Riverdale	Macadam/Riverside Parkway (Sellwood Bridge to SW Terwilliger)	
Willamette Shore Line		M
Riverwood		M-H
6 – Lake Oswego	Downtown Lake Oswego (SW Terwilliger to Church Street)	
UPRR		M
Foothills		M

Source: Lake Oswego to Portland Transit Project: Visual and Aesthetics Technical Report, DEA August 2010.
[1] Visual impacts include the addition of tracks and catenary system and are rated as: L = Low, M = Moderate, or H = High. Overall score is the degree of change plus viewer sensitivity.
For more details see Table 3.4-3 Ranges represent the variety of change within the full segment.
[2] The South Waterfront and Sellwood Bridge Segments contain potential construction phasing options associated with the Streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

Segment 1 – Downtown Portland

Visual changes in this segment would be insignificant (only include a streetcar turnaround at Portland State University within the existing street right of way). The overall visual impacts within this segment would be low.

Segment 2 – South Waterfront

Viewers in the South Waterfront segment include motorists, streetcar riders, pedestrians, bicyclists, tourists, OHSU patients and students, employees/business people, industrial workers, construction workers, residents and recreationists. It is a dynamic, urban environment on the edge of the downtown core. Most viewers anticipate changes to the visual environment east of Southwest Naito Parkway where land has been rapidly developing. Viewers from residential units in the area anticipate changes to the evolving environment. Businesses adjacent to the existing railroad tracks would have foreground and middleground filtered and short duration views due to building orientation. Their sensitivity would be low to moderate. Commuters would have low sensitivity to the visual changes due to the speed at which they would be traveling, grade differentiation and the short duration they would be exposed to it. The overall viewer sensitivity would be low.

Visual changes in the area would include new stations, intersection improvements, and new public access from Macadam Avenue to the stations. These features would be added in existing road or railroad right of way. Due to topography, building orientation and regional transportation corridors, these features would not block existing views to the Willamette River or other scenic resources. New features and associated development would assist in visually uniting and enhancing intactness as the area evolves into an urban setting. The overall degree of change would be low.

Other visual changes, associated with the Moody/Bond Couplet, include building removal, retaining walls and new roadway connections. These visual changes would occur due to the South Portland Circulation Project and would be evaluated as part of that project.

The overall visual impacts within this segment would be low.

Segment 3 – Johns Landing

Willamette Shore Line Design Option. Viewers in the Johns Landing segment in near the Willamette Shore Line design option would include pedestrians, bicyclists, boaters, tourists, employees/business people and residents. Neighborhood residents would have foreground and middle ground views of the project and moderate to high sensitivity depending on proximity to the project area. Adjacent business people would have foreground and middle ground views and low to moderate sensitivity. Recreational users at Willamette Park would have moderate to high sensitivity depending on their proximity to the project area. The overall viewer sensitivity would range from low to high depending on proximity to the project area.

Visual changes in the area would include new stations, retaining walls varying in height, regrading, and potential fencing. Southwest Boundary Street would be widened and improved to include sidewalks. The Jones Trestle would be removed and the trackway would be lowered. Some vegetation would be removed in various locations including adjacent to Willamette Park. Visual changes would be higher in some locations where the project would be constructed between residential structures and the Willamette River as shown in Figure 3.4-2. Significant views could be partially disrupted by potential fencing and other project components, including catenary wires and support structures, formal landscaping would be removed, and lighting near stations and pedestrian crossings would alter the current visual environment. As shown in Figure 3.4-3, visual changes near Willamette Park would occur adjacent to the western boundary. In most areas the visual changes would be obscured by existing vegetation and would not detract from existing views toward the Willamette River. The visual changes could also improve the visual continuity of the western edge of the park by replacing the view of the back sides of industrial structures and building service areas (garbage, recycling, loading areas) with more active visually intact views. The overall degree of change for the segment as a whole would be moderate.

Overall visual impacts with this design option would be moderate. Mitigation could include screening where appropriate, selecting lighting components that shielding station and reduce impacts from glare, and designing the facilities to complement or blend with the surrounding landscapes and communities.

Macadam In-Street Design Option. Viewers in proximity to the Macadam In-Street design option would include motorists, transit riders, pedestrians, bicyclists, employees/business people, shoppers, industrial workers and residents. Neighborhood residents would have foreground and middle ground views of the project and moderate sensitivity depending on proximity to the project area. Business people and employees adjacent to Southwest Landing Drive and Macadam Avenue would have foreground and middle ground views and low to moderate sensitivity. Commuters would have low to moderate sensitivity to the visual changes due to the speed at which they would be traveling and the short duration they would be exposed to it. The overall viewer sensitivity would be moderate.

As shown in Figures 3.4-4 and 3.4-5, visual changes include new stations and retaining walls varying in height. Landing Drive would be widened and improved with sidewalks, street lighting and

vegetation. Portions of existing surface parking lots would be converted to street improvements. Boundary Street would be reconfigured. Macadam Avenue would be widened at Carolina Street. Some vegetation would be removed in various locations, potentially including areas within Willamette Park. Many of visual changes associated with this design option would occur within existing road right of way. Although improvements to Landing Drive are in close proximity to residential structures, the new features do not block or obscure views toward the Willamette River. Many of the residential structures are oriented away from Landing Drive to capitalize on the scenic views toward the river. The adjacent uses along the west side of Landing Drive are primarily surface parking lots. Converting surface parking lots to streetcar and roadway infrastructure is not a significant visual change. Visual change along Macadam Avenue would be low due to the existing nature of Macadam Avenue as a transportation corridor. Landscape screening would be maintained between the adjacent businesses and the roadway. The streetcar could add an additional visual buffer between the pedestrians and the fast moving vehicles along Macadam Avenue. The overall degree of change would be moderate.

Overall visual impacts with this design option would be moderate. Mitigation could include screening where appropriate, minimizing project width where appropriate, selecting lighting components that shielding station and reduce impacts from glare, and designing the facilities to complement or blend with the surrounding landscapes and communities.

Macadam Additional Lane Design Option. Viewers in proximity to the Macadam Additional Lane design option are the same as the Macadam In-Street design option. The overall viewer sensitivity would be moderate. However, the viewer sensitivity may be higher where the residential development is adjacent to the proposed additional lane, because this option would eliminate the existing screening between the residences and the street.

As shown in Figures 3.4-4 and 3.4-6, visual changes would be similar to the Macadam In-Street design option but would also include widening of Southwest Macadam Avenue between Boundary and Carolina streets, removing existing vegetation, potentially including areas within Willamette Park, and reconfiguring adjacent parking areas. Removing the mature vegetation on the east side of the roadway would reduce visual screening between adjacent businesses and residential structures and Macadam Avenue. A small building would be removed at the corner of Macadam Avenue and Carolina Street, widening the transportation corridor slightly. Because this design option would construct the streetcar additional lane in an area that is currently parking and vegetation as well as a buffer between residents and the roadway, the overall degree of change would be moderate to high.

Overall visual impacts with this design option would be moderate. Mitigation could include screening where feasible, minimizing project width where appropriate; and designing the facilities to complement or blend with the surrounding landscapes and communities to the degree possible.

Segment 4 – Sellwood Bridge

Viewers in the Sellwood Bridge segment would include motorists, transit riders, park users, recreationalists, residents and employees of adjacent businesses. Motorists would have short duration and filtered views of the project because much of the project associated with this design option would either occur below view from Macadam Avenue or would be blocked by existing buildings. The project would run behind a number of residences on Miles Place. Residents would have moderate to high sensitivity due to the proximity and duration of visual changes, but the project could improve the visual unity and intactness by enhancing screening. Users of Butterfly, Willamette

A - Existing view looking north from near SW Richardson Street.

B - Future view looking north from near SW Richardson Street with Streetcar Alternative (Willamette Shore Line design option).

2.23.10

Lake Oswego to Portland TRANSIT PROJECT

Existing View and Visual Simulation from Heron Pointe Condominiums

Figure 3.4-2

A - Existing view looking north from Willamette Park.

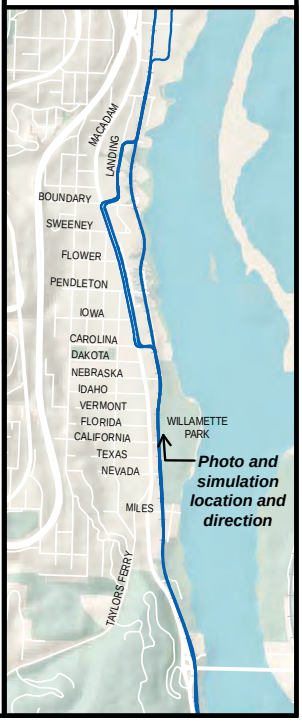
B - Future view looking north from Willamette Park with Streetcar Alternative (all design options).

5.6.10

Lake Oswego to Portland TRANSIT PROJECT

Existing View and Visual Simulation from Willamette Park

Figure 3.4-3



A - Existing view looking north from SW Boundary Street.

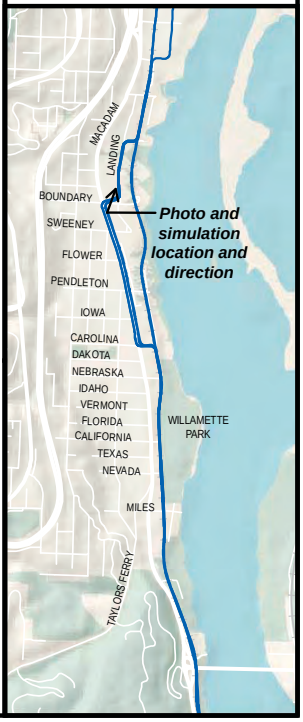
B - Future view looking north from SW Boundary Street with Streetcar Alternative (Macadam In-Street or Macadam Additional Lane design option).

5.6.10

Lake Oswego to Portland TRANSIT PROJECT

Existing View and Visual Simulation along SW Landing Drive

Figure 3.4-4



A - Existing view looking north from south of SW Flower Street.

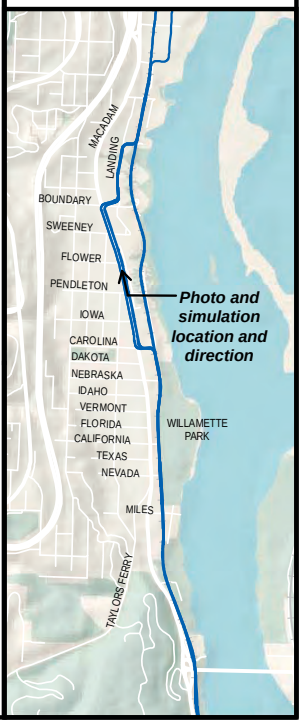
B - Future view looking north from south of SW Flower Street with Streetcar Alternative (Macadam In-Street design option).

5.6.10

Lake Oswego to Portland TRANSIT PROJECT

Existing View and Visual Simulation along SW Macadam Avenue

Figure 3.4-5



A - Existing view looking north from south of SW Flower Street.

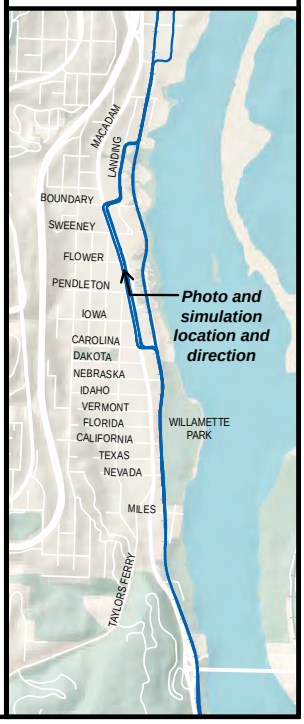
B - Future view looking north from south of SW Flower Street with Streetcar Alternative (Macadam Additional Lane design option).

5.6.10

Lake Oswego to Portland TRANSIT PROJECT

Existing View and Visual Simulation along SW Macadam Avenue

Figure 3.4-6



Moorage and Powers Marine parks would have moderate sensitivity due to the location of the project in relation to the parks. The project would occur on the western boundaries of the parks and would not block park users' views to the Willamette River or interfere with park functions. Businesses in the area would have low to moderate sensitivity depending on proximity. The overall viewer sensitivity would be low to moderate.

Visual changes would include new stations, retaining walls varying in height, a new structure over Stephens Creek, fencing and a pedestrian overpass to Powers Marine Park. Existing vegetation would be removed in multiple locations. These visual changes would occur due to the Sellwood Bridge project, and have been evaluated as part of that project. The overall degree of change associated with this design option would be low to moderate.

Overall visual impacts with this design option would be low to moderate.

Segment 5 – Dunthorpe/Riverdale

Willamette Shore Line Design Option. Viewers in the Dunthorpe/Riverdale segment in proximity to the Willamette Shore Line design option include residents, visitors and motorists. Neighborhood residents would have foreground and middleground views of the project and moderate to high sensitivity depending on their proximity to the project area. Motorists would have low sensitivity to the visual impacts due to elevation differences, the speed at which they would be traveling and the short duration they would be exposed to it. The overall viewer sensitivity would range from low to high depending on the viewers proximity to the project area.

Visual changes would include trackway improvements, new stations, retaining walls varying in height, fences, lighting around the stations, reconstruction of existing trestles and a reconstructed Southwest Briarwood Road overcrossing. Intersection improvements would occur and existing trestles would be replaced. Some existing vegetation and landscaping would be removed in various locations. The area is predominately a residential neighborhood, and while topography reduces the visual impacts for properties on the west side of the project, the project could potentially disrupt views toward the Willamette River. The removal of vegetation could reduce the visual buffering between the existing railroad corridor and the adjacent residences. Introducing streetcar stations and related infrastructure would be somewhat of a departure from the existing visual character of the neighborhood. The overall degree of change would range from low to high.

Overall visual impacts with this design option would be moderate. Mitigation in areas with higher visual impacts could include enhanced screening and use of vegetation to soften visual impacts of retaining walls, shielding station lighting to reduce impacts from glare, minimizing project width where appropriate, and designing the facilities to complement or blend with the surrounding landscapes and communities.

Riverwood Design Option. Viewers in proximity to the Riverwood design option would be the same as the Willamette Shore Line design option. The overall viewer sensitivity would range from low to high depending on the viewers proximity to the project area.

Visual changes in the area include trackway improvements, a new trestle, new stations, retaining walls varying in height, fences, lighting around the stations and a new Southwest Briarwood Road overcrossing. The intersection of Riverwood Road and Riverside Drive/Highway 43 would be closed. Riverwood Road would be widened and regraded. One house would be removed. Some

existing vegetation and landscaping would be removed in various locations. Visual changes would occur primarily in and adjacent to the existing road right of way, but the changes would alter the visual character of the street. Retaining walls would be built on the downhill side of SW Riverwood Road, potentially removing mature vegetation and screening between the roadway and the adjacent residences. The visual character of the road would change from a meandering unimproved residential street to a more urban roadway with sidewalks, curbs and bike lanes. Introducing streetcar stations and related infrastructure could be a departure from the visual character of the neighborhood. The overall degree of change would range from low to high.

Overall visual impacts with this design option would be moderate to high. Mitigation could include enhanced screening and use of vegetation to soften visual impacts of retaining walls, shielding station lighting to reduce impacts from glare, minimizing project width and street standards where appropriate, and designing the facilities to complement or blend with the surrounding landscapes and communities.

Segment 6 – Lake Oswego

Union Pacific Railroad Right of Way Design Option. Viewers in the Lake Oswego segment in proximity to the Union Pacific Railroad design option include motorists, residence, pedestrians, bicyclists, employees/business people, industrial workers and shoppers. Neighborhood residents would have foreground and middleground views of the project and moderate sensitivity depending on proximity to the project area. Adjacent business people, industrial workers and shoppers would have foreground and middleground views and low to moderate sensitivity. Commuters would have low sensitivity. Recreation users would have moderate sensitivity. The overall viewer sensitivity would be low to moderate.

Visual changes in the area would include new retaining walls height, a pedestrian and bike connection from Southwest Fielding Road, transit undercrossing of the freight rail line, a trestle over Tryon Creek, new stations, a stairway connection from B Avenue, new surface parking lots and a new parking structure. The roadway would be widened and reconfigured. The Union Pacific Railroad track would shift 15 feet to the west. Existing vegetation would be removed. The visual impacts from the project would occur primarily in the existing railroad corridor adjacent to industrial uses. Much of the project would be lower in elevation from State Street/Highway 43 and behind existing buildings maintaining the existing visual character of downtown Lake Oswego. Visual changes associated with the project could help unify the east and west sides of State Street and promote stronger visual and physical connections to the Willamette River. The moderate to high degree of change near the parking structure would be mitigated through design development with the City of Lake Oswego. Given the visual benefit the project could have on the area, the overall degree of change would be moderate.

Overall visual impacts with this design option would be moderate. Mitigation could include enhanced screening and terracing to soften visual impacts of retaining walls and designing the facilities to complement the aesthetics of downtown Lake Oswego.

Foothills Design Option. Viewers in proximity to the Foothills design option would be the same as the Union Pacific Railroad design option. The overall viewer sensitivity would be low to moderate.

Visual changes in the area would include new retaining walls varying in height, a pedestrian and bike connection from Southwest Fielding Road, streetcar crossing below the existing freight rail line,

a trestle over Tryon Creek, new stations, a new stairway connection from B Avenue, new surface parking lots and a new parking structure. Stampher Road would be reconfigured and extended. Foothills Road would be realigned and reconfigured. Intersection improvements would be made. Seven buildings would be removed, in addition to existing vegetation. The visual changes from the project would occur primarily in an industrial part of the city. Many of the buildings removed would be below view from State Street. The new road connection would provide continuity in the future as redevelopment occurs. Visual changes associated with the project would help unify the east and west sides of State Street and promote stronger visual and physical connections to the Willamette River. The moderate to high degree of change near the parking structure would be mitigated through design development with the City of Lake Oswego. Given the visual benefit the project would have on the area, the overall degree of change would be moderate to high.

Overall visual impacts with this design option would be moderate. Mitigation could include enhanced screening and terracing to soften visual impacts of retaining walls and designing the facilities to complement the aesthetics of downtown Lake Oswego.

3.4.3.2 Indirect Visual Effects

Indirect visual effects could include visual effects of development that may choose to locate close to the Streetcar Alternative for better access to transit at both ends of the corridor. Assuming that new development complies with local jurisdiction design review requirements, there would be no resulting indirect adverse visual effects. Indirect effects of the No-Build Alternative and Enhanced Bus Alternative could result in lower levels of visual change but could include visual changes associated with increased congestion, and roadway and public works projects. With the Streetcar Alternative and design options, indirect effects could include redevelopment activities around the proposed stations, north and south ends only, as well as through redevelopment of surplus land cleared during the construction of the project.

3.4.3.3 Cumulative Visual Effects

Cumulative visual effects could include the effects of the various alternatives and design options along with other reasonably foreseeable activities in the corridor that could affect the visual environment. Relative to cumulative effects, it is assumed that there will be slow to moderate new development and some redevelopment in the Portland central city, in the South Waterfront District, in the Johns Landing area and in the Lake Oswego town center. In the Lake Oswego town center area, the Foothills District is likely to progress with a new street plan and some new development.

No-Build Alternative. Selection of the No-Build Alternative would not result in any direct cumulative effects, and therefore it would not increase cumulative visual changes. Cumulative visual effects would include effects from further development of the area including increasing densities. However, with the No-Build Alternative, there also would be no project related improvements to the visual environment from features such as improved pedestrian facilities, and landscaping from project facilities.

Enhanced Bus Alternative and Streetcar Alternative. For both the Enhanced Bus and Streetcar alternatives, the cumulative effects could be similar. Redevelopment in downtown Portland, South Waterfront District and Lake Oswego would continue, regardless of if new transit improvements were made. However, the cumulative effect from the Streetcar Alternative could be greater because the station areas within the South Waterfront, Johns Landing, and Foothills could attract infill

development or redevelopment of existing uses to take advantage of the streetcar station than what would occur under the Enhanced Bus Alternative. With this development, there would be more potential for both negative and positive cumulative visual effects. Other projects, such as the South Portland Circulation Study Project, the Sellwood Bridge Project and the Foothills Redevelopment Plan would still be developed within the corridor and would alter the visual environment, with or without the transit project improvements.

3.4.4 Potential Mitigation Measures

This mitigation section identifies a range of potential mitigation measures that could be incorporated. Actual mitigation would be identified if a build alternative is selected as the Locally Preferred Alternative and during Preliminary Engineering and the Final Environmental Impact Statement phase. High-quality design and construction of the proposed transit facilities could help to ensure that the project improvements contribute to the visual environment of the corridor rather than detract from it.

The following techniques could be employed for any of the alternatives to improve the visual effects of the project improvements, depending on which option is selected as the locally preferred alternative and more specific impacts associated with that alternative.

- Planting vegetation, street trees and landscaping in and around the project where appropriate;
- Consideration of the design of alternatives in the vicinity of public parks, open spaces and historic sites;
- Shielding station and roadway lighting to reduce off site glare;
- Minimizing project width where appropriate; and
- Designing the facilities to complement or blend with the surrounding landscapes and communities.

3.5 Historic, Archaeological and Cultural Resources

This section presents an inventory of identified historic and cultural resources and a preliminary assessment of the proposed project's potential effects on those resources. More detailed information about the methodology, the historic resources evaluated, and the history of individual historic resources can be found in the *Lake Oswego to Portland Transit Project: Historic Resources Technical Report* (URS and TriMet/Metro, November 2010). Detailed information about the archaeological resources can be found in the *Lake Oswego to Portland Transit Project: Archaeology Technical Report* (URS and TriMet/Metro, November 2010).

3.5.1 Introduction, Applicable Regulations, Analysis Methods, Consultation

A. Applicable Regulations

This section addresses the requirements of Section 106 of the National Historic Preservation Act of 1966 as it relates to the project. Section 106 requires that federally funded or federally licensed projects include a consideration of project effects on districts, sites, structures objects or archaeological sites listed in or determined eligible for inclusion in the National Register of Historic Places (NRHP). Procedures for meeting Section 106 requirements are defined in *36 CFR Part 800 – Protection of Historic Properties*. Federal agencies must consult with the applicable State Historic Preservation Officer (SHPO) before undertaking projects that would adversely affect historic or cultural resources.

3.5.1.2 Analysis Methods

Area of potential effects (APE). The project team conducted an inventory of existing resources in the area of potential effect, which has been defined by FTA and Oregon SHPO as one-half block in each direction from the alternatives' alignments within the Portland and Lake Oswego downtown areas or areas with a similarly defined grid street pattern. In areas outside a defined grid street pattern, approximately one block or 150 feet in each direction from the study alternatives was used.

Historic resources. For above ground historic resources, all buildings and structures that will be at least 50 years old at the year of the anticipated transit improvement (2015) and located adjacent to the any of the proposed alternatives where construction would occur were evaluated and documented with a Reconnaissance Level Survey. This work included a pedestrian survey of the corridor and general research on the history and development of the area. Documentation included a brief description of the physical characteristics of the building or structure, photographs, and a description of alterations to the building or structure.

Archeological resources. Efforts toward identification of archaeological resources in the APE have been limited to the gathering of existing information. Records on file at the Oregon State Historic Preservation Office, Salem, were reviewed. Oregon SHPO maintains a statewide database of previously-recorded cultural resource sites and completed inventories, which are managed as restricted-access information. Historic General Land Office, Sanborn Fire Insurance and Metsker maps were consulted for information regarding potential historic use of the project area and thus the probability of encountering related resources. Ethnographic data and cultural resources reports were also reviewed to ascertain the past use of the project area and likelihood of encountering archaeological or other cultural resources.

3.5.1.3 Consultation

Project related consultation related to historic, archeological and cultural resources is being conducted as defined in the *Lake Oswego to Portland Transit Project: 6002 Coordination Plan* (August 2009) and as further described in Chapter 7 Public Involvement, Agency Coordination and Permits. Appendix A Agency Coordination and Correspondence includes copies of letters related to the consultation. Additional consultation between FTA, Oregon SHPO and interested tribes is expected to occur between issuance of this DEIS and the Final Environmental Impact Statement (FEIS).

The analysis and discussion of potential effects to historic, archaeological, and cultural resources in this DEIS is considered preliminary. FTA sent a letter in October 2009 to the Oregon SHPO requesting concurrence with the APE. FTA will consult with Oregon SHPO regarding concurrence on the list of properties that have been determined eligible for inclusion in the NRHP. FTA will also provide Oregon SHPO with the preliminary evaluation of the potential effects of all of the project alternatives. Following selection of the LPA and development of minimization or mitigation measures for the LPA, impacts to each historic resource will be re-evaluated and documented. If it is not possible to eliminate or significantly reduce adverse effects that would result from the LPA on historic and cultural resources, a Memorandum of Agreement (MOA) will be developed and executed between FTA, Oregon SHPO, TriMet, Metro and other affected parties to document the impacts of the LPA and the agreed upon mitigation.

3.5.2 Affected Environment

The following section describes the historic, archaeological, and cultural resources in and adjacent to the proposed project. The area of potential effect (APE) within which the historic, archaeological and cultural historical resources have been inventoried and evaluated for project effects has been defined above. For the archaeological resource investigation, the vertical APE may vary according to construction practice and depth of excavation, depending on the geomorphology of the landform where the project element occurs.

3.5.2.1 Historic Resources

There are 89 properties within the study area found to be at least 45 years old (50 years old in 2015). Table 3.5-1 lists all 89 properties and the preliminary evaluation of whether they are considered historic. Of those 89 properties, one (1) residence is individually listed on the NRHP (there are no historic districts in the study area); three (3) properties, including the rail line itself, had been determined eligible for listing on the NRHP by other recent projects; and twenty (20) properties were determined eligible for listing on the NRHP by this project. The remaining sixty-five (65) properties were determined to be not eligible for listing on the NRHP; most of those had been significantly altered and no longer retained sufficient historic integrity to be considered historic. As a result, there are twenty-four (24) historic resources in the study area. Those resources are shown on Figure 3.5-1.

The rail line itself was determined eligible for listing on the NRHP during the recent environmental analysis for the Sellwood Bridge Project. The determination of eligibility defined the Southern Pacific Railroad Red Electric Eastside Line (aka Jefferson Street Line) portion of the Red Electric lines as beginning at the intersection of Southwest Bancroft Street and Moody Avenue in southwest Portland and heading south 6 miles to 0.5 mile north of the intersection of North State Street/Highway 43. It is not clear why the southern terminus was defined in this way, as the Red

Electric Eastside Line's tracks continue west along the north side of Lakewood Bay and Oswego Lake, past Lake Grove.

The resource was considered eligible for its historic use as part of an interurban passenger rail network that connected Portland and larger communities with smaller Willamette Valley towns and strongly influenced growth and development of the outer suburbs south and west of Portland. The Elk Rock Tunnel and the Riverwood trestles (the long and short trestles in the vicinity of Riverwood Road) were described as important contributing elements. The determination of eligibility does not define the extent of the historic resource of the Red Electric any further, so for the purposes of this project, the eligibility has been assumed to include the rail-related features (tracks, ties, signs, signals, trestles and stations) associated with this segment of the Red Electric line. For the purposes of this DEIS, this historic resource is referred to as the "Red Electric Eastside Line."

The segment of rail line between Portland and Lake Oswego (site of the Streetcar Alternative) was completed in 1887 and provided both freight and passenger service. In 1914, Southern Pacific electrified the line and it became part of the Red Electric interurban rail network. The full line consisted of a loop from Portland to McMinnville, passing through Lake Oswego, Sherwood, Newberg, McMinnville, Carlton, Forest Grove and Hillsboro.[43] The Section 106 Determination of Eligibility stated that the railroad's period of significance is 1914 to 1929, the period during which the Red Electric interurban trains were operated on the line.

The Red Electric provided fast and convenient access to Lake Oswego (or Oswego, as the city was called at the time) and played an important role in the development of Lake Oswego and the Dunthorpe/Riverdale area. Between Portland and Lake Oswego, there were 13 stations along the route and the trains reached a maximum speed of 60 mph (remnants of the Riverwood Station near 11445 SW Riverwood Road still exist; traces of the other stations are no longer visible). Although some of these stations were little more than a set of stairs connecting the street to the rail line, they provided convenient access for daily commuters; by 1920, 64 cars ran daily between Portland and Lake Oswego. Importantly, nearly all[44] of the historic resources located along the rail corridor were built after the rail line was in place, and almost half were built during the period when the rail line was used for passenger service. As automobiles became increasingly popular and roads were built and paved, usage of the Red Electric declined. Southern Pacific ceased passenger service on the line in 1929 and removed the electric lines and poles around 1930. Segments of the western leg of the loop were dismantled; the eastern leg, the portion that would be used by the Streetcar Alternative, was retained for exclusively freight service. (Freight service had never entirely ceased on the line, but because the frequent passenger trains were given priority, freight often used alternate routes.) Freight trains used the line until 1983.

[43] Dill, Tom & Walter. Grande, The Red Electrics, 1994.
[44] Riverview Cemetery is the only historic resource that pre-dates the rail line. It was established in 1882, just five years before the rail line was built.

Table 3.5-1 National Register Status of Resources in the Area of Potential Effect

Resource Address	Resource Type	National Register Status[1]
3910-3930 SW Macadam Ave	Warehouse	not eligible
4000 SW Macadam Ave	Warehouse	eligible
4110 SW Macadam Ave	Warehouse	not eligible
4550-4600 SW Macadam Ave	Offices	not eligible
5200 SW Macadam Ave	Commercial	not eligible
5331 SW Macadam Ave	Offices	not eligible
6140 SW Macadam Ave	Commercial	not eligible
6328 SW Macadam Ave	Commercial	not eligible
6342 SW Macadam Ave	Commercial	not eligible
6626 SW Macadam Ave	Commercial	not eligible
6720 SW Macadam Ave	Commercial	not eligible
6840 SW Macadam Ave	Commercial	not eligible
6932 SW Macadam Ave	Commercial	not eligible
7330 SW Macadam Ave	Commercial	not eligible
7400 SW Macadam Ave	Commercial	not eligible
7520 SW Macadam Ave	Commercial	not eligible
7524 SW Macadam Ave	Commercial	not eligible
8240 SW Macadam Ave	Commercial	not eligible
8421 SW Macadam Ave	Riverview Cemetery	DOE
5511 SW Hood Ave	Commercial	not eligible
0753 SW Miles St	House	not eligible
0755 SW Miles St	House	not eligible
7505 SW Miles Pl	House	not eligible
7423 SW Miles Pl	House	not eligible
Willamette River Mile 16.5	Sellwood Bridge	DOE
10110 SW Riverside Dr	House	eligible
10150 SW Riverside Dr	House	not eligible
10224 SW Riverside Dr	House	not eligible
10234 SW Riverside Dr	House	eligible
10268 SW Riverside Dr	House	eligible
10400 SW Riverside Dr	House	not eligible
10609 SW Riverside Dr	House	eligible[45]
11124 SW Riverside Dr	House	eligible
11930 SW Riverside Dr	House	not eligible
12020 SW Riverside Dr	House	eligible
12410 SW Riverside Dr	House	not eligible
13150 SW Riverside Dr	House	eligible
13100 SW Riverside Dr	House	NRHP
13180 SW Riverside Dr	House	not eligible
13200 SW Riverside Dr	House	not eligible
10808 SW Riverwood Rd	House	not eligible
10925 SW Riverwood Rd	House	not eligible
11075 SW Riverwood Rd	House	not eligible
11100 SW Riverwood Rd	House	eligible
11175 SW Riverwood Rd	House	eligible
11235 SW Riverwood Rd	House	eligible

[45] The house at 10609 SW Riverside Drive is located on the west side of Riverside Drive (OR 43), but the property extends east across the road to the Willamette River. The boundary of the historic resource is limited to the portion of the tax lot on which the house is located (i.e. the area on the west side of Riverside Drive); the remnant portions of the tax lot that are located on the east side of Riverside Drive are not part of the historic resource.

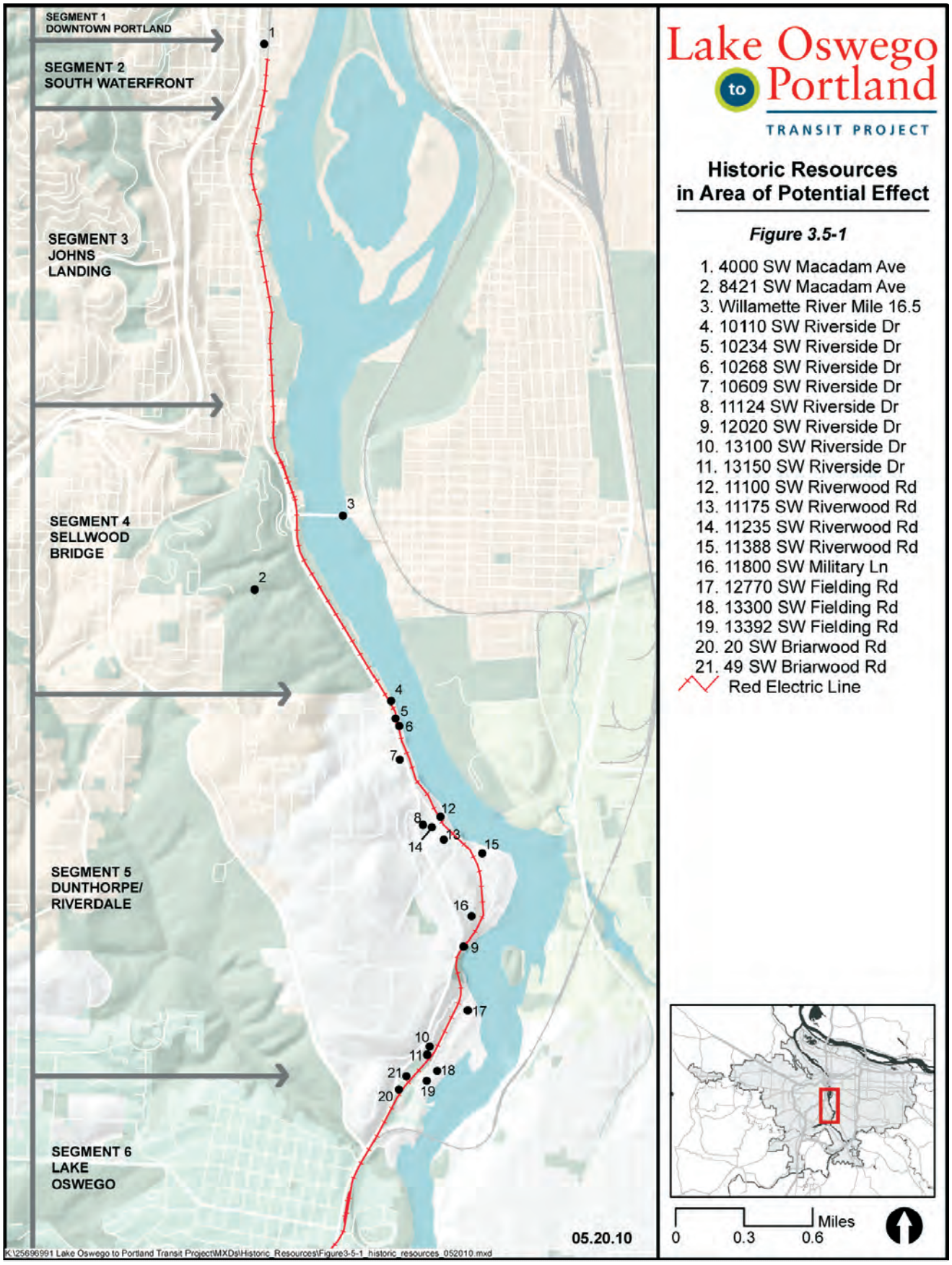
Table 3.5-1 National Register Status of Resources in the Area of Potential Effect

Resource Address	Resource Type	National Register Status[1]
11312 SW Riverwood Rd	House	not eligible
11322 SW Riverwood Rd	House	not eligible
11350 SW Riverwood Rd	House	not eligible
11385 SW Riverwood Rd	House	eligible
11388 SW Riverwood Rd	House	eligible
11445 SW Riverwood Rd	House	not eligible
11639 SW Riverwood Rd	House	not eligible
11701 SW Riverwood Rd	House	not eligible
11721 SW Riverwood Rd	House	not eligible
11745 SW Riverwood Rd	House	not eligible
11801 SW Riverwood Rd	House	not eligible
11821 SW Riverwood Rd	House	not eligible
11829 SW Riverwood Rd	House	not eligible
02473 SW Military Rd	House	eligible
02484 SW Military Rd	House	not eligible
11800 SW Military Ln	Office[46]	eligible
12950 SW Elk Rock Rd	House	not eligible
12870 SW Elk Rock Rd	House	not eligible
13060 SW Elk Rock Rd	House	not eligible
12770 SW Fielding Rd	House	eligible
13000 SW Fielding Rd	House	not eligible
13060 SW Fielding Rd	House	not eligible
13070 SW Fielding Rd	House	not eligible
13150 SW Fielding Rd	House	not eligible
13200 SW Fielding Rd	House	not eligible
13250 SW Fielding Rd	House	not eligible
13300 SW Fielding Rd	House	eligible
13348 SW Fielding Rd	House	not eligible
13382 SW Fielding Rd	House	not eligible
13392 SW Fielding Rd	House	eligible
13581 SW Fielding Rd	House	not eligible
13641 SW Fielding Rd	House	not eligible
13711 SW Fielding Rd	House	not eligible
20 SW Briarwood Rd	House	eligible
49 Briarwood Rd	House	eligible
50 Briarwood Rd	House	not eligible
51 Briarwood Rd	House	not eligible
311 N State St	Railroad Building	not eligible
141 N State St	Commercial	not eligible
117 N State St	Commercial	not eligible
47 N State St	Commercial	not eligible
27 S State St	Commercial	not eligible
Red Electric Eastside Line	Railroad	DOE

Source: Historic, Archaeological and Cultural Impacts Results Report, (TriMet and URS, February 2010)

[1] **NRHP** = Currently listed on the National Register of Historic Places;
DOE = Determination of Eligibility: Resource previously determined eligible for listing on the NRHP;
eligible = Resource that has been identified as potentially eligible for the NRHP (formal determinations have not yet been made by the SHPO);
not eligible = Resource that has been identified as not eligible for the NRHP and is therefore not considered historic for the purposes of this project (formal determinations have not yet been made by the SHPO).

[46] This structure was originally a house, but is now the Diocese Headquarters.


SEGMENT 1
DOWNTOWN PORTLAND
SEGMENT 2
SOUTH WATERFRONT
SEGMENT 3
JOHNS
LANDING
SEGMENT 4
SELLWOOD
BRIDGE
SEGMENT 5
DUNTHORPE/
RIVERDALE
SEGMENT 6
LAKE
OSWEGO
1
2
3
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K:\25696991 Lake Oswego to Portland Transit Project\MXDs\Historic_Resources\Figure3-5-1_historic_resources_052010.mxd
Lake Oswego to Portland
TRANSIT PROJECT
Historic Resources in Area of Potential Effect
Figure 3.5-1
1. 4000 SW Macadam Ave
2. 8421 SW Macadam Ave
3. Willamette River Mile 16.5
4. 10110 SW Riverside Dr
5. 10234 SW Riverside Dr
6. 10268 SW Riverside Dr
7. 10609 SW Riverside Dr
8. 11124 SW Riverside Dr
9. 12020 SW Riverside Dr
10. 13100 SW Riverside Dr
11. 13150 SW Riverside Dr
12. 11100 SW Riverwood Rd
13. 11175 SW Riverwood Rd
14. 11235 SW Riverwood Rd
15. 11388 SW Riverwood Rd
16. 11800 SW Military Ln
17. 12770 SW Fielding Rd
18. 13300 SW Fielding Rd
19. 13392 SW Fielding Rd
20. 20 SW Briarwood Rd
21. 49 SW Briarwood Rd
Red Electric Line
Miles
0
0.3
0.6

In 1988 a consortium of governments, the Willamette Shore Line Consortium, purchased the Portland to Lake Oswego section for the purpose of preserving the rail right of way for future public rail mass transit use. Currently, the city of Lake Oswego leases the line from the consortium and it contracts with the Oregon Electric Railway Historical Society to operate interim trolley operation that has operated on a seasonal excursion schedule. The right of way and rail facilities are maintained by the Willamette Shore Line Consortium. As outlined in the Maintenance Plan, the Willamette Shore Line Consortium performs routine maintenance and ongoing modifications to the rail corridor in order to provide for active rail operation. The line was out of service for much of 2009 and 2010 due to maintenance activities, which included repairs to tracks, ties and trestles. During the period of significance, passenger rail service was provided using "Red Electric" interurban trains over the line from Portland to Corvallis. Today, trolley service is provided using the Portland Traction "Broadway Car" Brill Master Unit #813 built in 1932. Due to weight limitations on the existing trestles, there are only certain types of trolley cars that can operate on the existing right of way without major improvements to the structures.

3.5.2.2 Archaeological Resources

For archaeological resources, this study reviewed existing records on file at the Oregon State Historic Preservation Office, as well as archival data and historic maps. Based on records available at the Oregon SHPO, there are no known archaeological sites within the APE, and no prior archaeological survey coverage has occurred within the APE. Six archaeological sites have been recorded within a one-mile radius of the project APE within a similar urban setting, including three prehistoric-period resources and three historic-period resources.

Much of the APE can be considered to have a general sensitivity for archaeological resources based on:

- Proximity to the Willamette River shoreline, which increases probability for pre-contact and historic period sites;
- Historic maps review, which indicates the presence of early historic settlement throughout much of the proposed corridor;
- Association with the historic rail corridor, which could have archaeological sites related to construction and operation of the original rail line;
- Known presence of pre-contact and historic archaeological sites in the broader vicinity that are found within similarly developed, urban settings;
- Literature review, which indicates potential for ethnohistoric use of the project area; and
- The presence of old town neighborhoods and urban centers of historic importance, such as Chinatown, the Pearl District, the Fulton and Dunthorpe/Riverdale neighborhoods, and Old Town Lake Oswego, for example, which indicates sensitivity for a variety of historic-period archaeological site types.

While there is the potential for archaeological resources, the extent of past impacts associated with modern urban development in the APE may have caused disturbances to, obscured, or obliterated evidence for such potential resources.

A field reconnaissance or pedestrian archaeological inventory has not been conducted for this project to date. Each of the alternatives has the general potential for as yet-undocumented archaeological sites. Because much of the proposed corridor falls within urban developed areas, a pedestrian inventory may be of limited value in terms of site reconnaissance in many areas. Appropriate and

practicable methods of archaeological site reconnaissance will be considered once Locally Preferred Alternative is selected and could include, but are not limited to, pedestrian survey, exploratory probing and/or monitoring of construction-related ground disturbing activities.

3.5.3 Environmental Consequences to Historic and Archaeological Resources

The assessment of effects contained in this DEIS is considered preliminary. It is based on evaluating a set of alternatives and design options that were initially defined before researching and evaluating in detail the location of potential historic, archaeological and cultural resources in the corridor. The assessment of effects has been done based on the initial design of the study alternatives. After the DEIS is published, the study partners are expected to select a Locally Preferred Alternative based on the DEIS results, including findings on historic and archaeological resources in the corridor. After the Locally Preferred Alternative is selected, the design of the alternative is expected to be refined based on knowledge of possible impacts to historic and archaeological resources, including first avoiding impacts to these resources and then minimizing effects if avoidance is not possible. Finally, the project team will work to define mitigation, if necessary, for effects that cannot be avoided or minimized.

The following section addresses the direct, indirect and cumulative effects of the study alternatives to historic, archaeological and cultural resources. Direct impacts would result from changes in right of way and access. Indirect effects include impacts to setting, including changes in noise and visual conditions. Short-term effects are those that would result from construction, and are addressed separately in Section 3.16 Construction Approach and Effects. Cumulative effects consider project impacts in the context of related past, present and future projects.

3.5.3.1 Direct Effects

Direct effects are those effects that would occur to historic, archaeological or cultural resources as a result of ground disturbing activities. For historic resources, direct effects would include direct changes to identified historic resources in the corridor resulting from construction of project related facilities. Table 3.5-2 summarizes the potential effects of the No-Build, Enhanced Bus and Streetcar Alternatives on the historic resources. Relative to archaeological resources, because no known sites have been previously recorded within the APE, direct effects would include the potential to affect as yet unidentified archaeological resources. Direct effects on traditional cultural properties or other sensitive or sacred resources that might be of concern cannot be determined until consultation with the tribes is concluded. This consultation is not expected to be completed until after the DEIS is issued.

Table 3.5-2 Summary of Effects of No-Build, Enhanced Bus and Streetcar on the Red Electric Line Historic Resource

Design Alternative	Red Electric Line Historic Resource Affected[1]	Red Electric Line Historic Resource Adversely Affected
No-Build	1	1
Enhanced Bus	1	1
Streetcar	1	0-1[2]

Source: Lake Oswego to Portland Transit Project Streetcar Plan Set, November 9, 2009.
[1] The Red Electric Rail Line runs the length of the corridor. Its impacts are detailed in each section of 3.5.3.1.
[2] Based on the project's current conceptual engineering (approximately 8 percent design), the Streetcar Alternative could result in an effect or an adverse effect on the Red Electric Eastside Rail Line, depending on further design work, analysis and coordination to be completed during Preliminary Engineering.

No Build Alternative. Except for the Red Electric Eastside Line, there would be no direct long-term impacts to historic properties resulting from the No-Build Alternative. The No-Build Alternative would likely result in adverse effects to the Red Electric Eastside Line, because the consortium purchased and maintains the Willamette Shore Line right of way to preserve it for future passenger rail service and could decide to relinquish ownership if its membership determines that passenger rail service in the corridor is not feasible or viable. Alternately, the consortium could decide to continue ownership and maintenance of the right of way indefinitely pending changes in conditions that would lead to conversion of the line to urban rail service in the future. However, the increasing decline of the condition of the existing track, ties and trestles and escalating maintenance costs would make it difficult for the consortium to continue ownership and maintenance of the line indefinitely. If passenger rail service is not reintroduced or maintained, the consortium would consider legal transfer or sale of the right of way. If the line were to be sold by the consortium, the interval excursion trolley service could be discontinued and ownership of at least portions of the Red Electric Eastside Line could revert to adjacent property owners. Further, contributing elements of the line (e.g., track, ties, ballast, trestles) could fall into disrepair and/or could be removed. If private individuals or other groups attained ownership of portions of the line, they would not be required to comply with Section 106 requirements for those portions of the line.

There would be no direct long-term impacts to archaeological sites with the No-Build Alternative. There is the potential for indirect effects to unidentified historic or archaeological resources due to development of other transportation projects that would still occur even if this transit project were not developed. These potential indirect effects cannot be quantified.

Enhanced Bus Alternative. The Enhanced Bus Alternative would result in the same risk of adversely affecting the Red Electric Eastside Line as would the No-Build Alternative, described above.

The construction of transit facilities (i.e., park-and-ride lot in downtown Lake Oswego and removal of approximately half of the existing bus stops between downtown Lake Oswego and downtown Portland) would not adversely affect any historic resources in the corridor.

For archaeological resources, the footprint for construction-related ground disturbance under the Enhanced Bus Alternative would be limited to the construction of a park-and-ride facility in Lake Oswego that would be constructed within an existing parking lot. Because construction of the park-and-ride lot would be confined to already-developed and disturbed property, the potential for the project to cause adverse impacts to historic resources or undiscovered, significant archaeological sites would be limited. However, additional evaluation would be necessary for those areas subject to ground disturbing construction if it were selected as the project's locally preferred alternative, because the Enhanced Bus Alternative could result in construction-related impacts to yet undiscovered pre-contact and historic-period archaeological resources within the APE. Long-term effects could include the impacts of disturbances to buried archaeological sites encountered during construction and the permanent loss of the archaeological deposits from destruction or removal. However, there would also be the potential for some compensatory benefits if resources are identified because they can be inventoried and recorded, and other preservation actions can be identified.

Streetcar Alternative. Effects of the Streetcar Alternative to historic resources are described below as precisely as possible, but the nature and extent of some impacts are not fully known at this point because of the current level of design. Once the Locally Preferred Alternative is selected, the project design is refined, and mitigation strategies are developed, impacts will be described and evaluated on a resource by resource basis and included in the project's FEIS. The preliminary finding is that there would be no historic properties adversely affected by the Streetcar Alternative, except for the potential for impacts to the Red Electric Rail Line. This information is summarized in Table 3.5-3 and described in further detail by segment below. Impacts to the Red Electric Eastside Rail Line are treated separately in the paragraph following the table.

Table 3.5-3 Effects of Streetcar Alternative and Design Options on Historic Resources

Segment	Design Option	Number of Historic Resources[1]	Number of Historic Resources Affected	Number of Historic Resources Adversely Affected*
1 – Downtown Portland	None	1	0	0
2 – South Waterfront[2]	None	0	0	0
3 – Johns Landing	Willamette Shore Line	0	0	0
	Macadam In-Street	0	0	0
	Macadam Additional Lane	0	0	0
4 – Sellwood Bridge[2]	None	1	0	0
5 – Dunthorpe/Riverdale	Willamette Shore Line	16	0	0
	Riverwood In-Street	19	0	0
6 – Lake Oswego	UPRR	1	0	0
	Foothills	1	0	0
All segments	**Red Electric Line[1]**	1	1	TBD[3]
Total (range)		22-24		0

Source: Lake Oswego to Portland Transit Project Streetcar Plan Set, November 9, 2009.
[1] The Red Electric Rail Line runs the length of the corridor through segments 2 through 6. [2] The Riverwood In-Street design option would use a non-historic portion of the tax parcel associated with 10609 SW Riverside Drive, but would not use any of the historic portion of that tax parcel.
[2] The South Waterfront and Sellwood Bridge Segmentscontain potential construction phasing options associated with the Streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.
[3] To Be Determined (TBD). Based on the project's current conceptual engineering (approximately 8 percent design), the Streetcar Alternative could result in an effect or an adverse effect on the Red Electric Eastside Rail Line.

Impacts to the Red Electric Eastside Rail Line

The Streetcar Alternative would use the Willamette Shore Line right of way, which is historically known as the Red Electric Eastside Rail Line. The Streetcar Alternative would result in the restoration of interurban electric rail service between downtown Portland and downtown Lake Oswego, a type of service that operated between 1914 and 1929. The existing railroad right of way and facilities generally between Southwest Lowell Road and downtown Lake Oswego would be restored, rehabilitated and replaced as needed to allow for the safe and efficient operations of interurban passenger electric rail service, meeting current design standards and permitting requirements. Based on the project's current conceptual engineering (approximately 8 percent design), the Streetcar Alternative could result in an effect or an adverse effect on the Red Electric Eastside Rail Line. Future design work during the Preliminary Engineering phase would further inform the determination of effect. In order to restore regular passenger service in the right of way, the whole line would be re-electrified. Safety improvements would be added to crossings, and stations would be reintroduced at various locations along the line. Streetcar improvements would likely include the replacement and reconstruction of the existing railroad ties and rails. Elk Rock

Tunnel, the one tunnel on the corridor, would be reinforced. The six rail trestles on the corridor will be analyzed for potential rehabilitation, restoration, or reconstruction. If the Streetcar Alternative is selected as the Locally Preferred Alternative, all future design work contributing the restoration of the interurban electric rail service would be completed in compliance will applicable elements of the Federal Section 106 regulations and guidelines, such as 36 CFR Part 800 (Protection of Historic Properties) and 36 CFR Part 68 (Secretary's Standards for the Treatment of Historic Properties).

TriMet, Metro and the City of Portland would conduct further design work during the project's Preliminary Engineering phase, prior to publication of the project's FEIS and final Section 106 and Section 4(f) report. That design work would be conducted in consultation with FTA and the Oregon SHPO with the intent to avoid any adverse effect on the Red Electric Eastside Rail Line, while providing for the safe and efficient operations of urban electric rail service, meeting current design standards and permitting requirements. If the design effort for the Streetcar Alternative were to result in an adverse effect on the Red Electric Eastside Rail Line, the project would need to demonstrate, consistent with Section 4(f) requirements), that there is no prudent or feasible alternative to that adverse effect and that all possible planning to minimize harm was done. That determination would be made, if warranted, prior to publication of the FEIS and final Section 106 and Section 4(f) report.

Effects to the Red Electric Eastside Rail Line would vary by design option. Option-specific effects are described in the following section. Some segments of the corridor include streetcar design options that would not use portions of the Red Electric Eastside Rail Line. In Segment 6, the current Willamette Shore Line right of way is not in the same location as the historic Red Electric Eastside Rail Line. For the most part, the project would extend the streetcar from its current locations at SW Lowell Street in South Waterfront with the necessary improvements to provide for safe and efficient passage between Lake Oswego and Portland. With the corridor there are design and phasing options that would not use the Red Electric Rail Line. A more detailed description of the streetcar design options follows.

Segment 1 – Downtown Portland (Northwest Portland to Southwest Lowell Street)
One historic resource, the Milwaukie Machinery Co. warehouse at 4000 SW Macadam Ave., is located in the APE of Segment 1. The preliminary finding is that there would be no historic properties adversely affected in this segment.[47]

Segment 2 – South Waterfront (Lowell Street to Hamilton Court)
Aside from the Red Electric Line, there are no historic properties in this segment; therefore the preliminary finding is that there would be no historic properties affected in this segment.

The streetcar could be built in the interim on the Red Electric line. In the future the streetcar would be integrated into the Moody and Bond avenues street network expansion as part of the South Portal project. The future street network would use the Red Electric right of way and private property to extend the street network to the south, as planned to accommodate the existing and planned growth in the South Waterfront.

[47] Potential impacts to the Red Electric Eastside Rail Line are described in the "Impacts to the Red Electric Eastside Line" section and are not included in the segment-by-segment analysis.

Segment 3 – Johns Landing (Hamilton Court to Miles Street)
Aside from the Red Electric Line, there are no historic properties in this segment; therefore the preliminary finding is that there would be no historic properties adversely affected by any of the three design options in this segment.

The design options would include use of the Red Electric Rail Line for future streetcar use or move the streetcar operations on to local private/public streets for a short distance. If the streetcar were to not use the Red Electric Rail Line in this section, there is a strong desire to construct a multi-use trail in this area

Segment 4 – Sellwood Bridge (Miles Street to south end of Powers Marine Park)
In addition to the Red Electric Rail Line, the Riverview Cemetery and the Sellwood Bridge are the only historic resources in this segment. The preliminary finding is that there would be no historic properties adversely affected by the project related improvement with any of the design options in this segment.

The existing Red Electric Rail Line would be displaced and moved as part of the Sellwood Bridge project. The Sellwood Bridge project has been designed to accommodate future potential streetcar tracks and concluded through the Sellwood Bridge Final Environmental Impact Statement that there would be no adverse effect on the Red Electric Rail Line.

Segment 5 – Dunthorpe/Riverdale (south end of Powers Marine Park to Briarwood Road)
Willamette Shore Line Design Option. In addition to the Red Electric Rail Line, there are sixteen (16) historic resources shown in Map 3.5-1 and listed in Table 3.5-1 in the APE for this design option, all of which are single-family houses except for 11800 SW Military Lane, a former residence that contains offices for the Episcopal Diocese of Oregon. The preliminary finding is that there would be no historic properties adversely affected by the re-introduction of the streetcar on the existing rail corridor.

Many of the historic resources are homes located close to the railroad; the rail corridor either bisects tax lots or is adjacent to properties on Riverside Drive and Riverwood Road. The rail corridor is located on a berm adjacent to Fielding Road, and is located beside properties on Briarwood Road. In Segment 5, all of the historic resources were built after the rail line, and two-thirds were built during the period when the Red Electric line was running frequent passenger service. Even after passenger service was discontinued, the rail line remained in continuous use for freight until 1983. The rail line is currently an active rail corridor. As a result, the reintroduction of an electric streetcar to the historic Red Electric Eastside Line would not, in itself, constitute an adverse effect.

One historic property located at 11100 SW Riverwood Road is bisected by the existing rail line. The house and attached garage were built in 1957 on the east side of the rail line (during a period when the rail line was in active use for freight). The driveway and a pedestrian walkway both cross the rail line. A second historic property located at 10268 SW Riverside Drive, built in 1941, is similarly situated; the driveway and pedestrian access both cross the tracks. A crossing gate or other safety mechanism is likely to be installed for these residences, although the design and nature of the crossings have not yet been developed. If the design is compatible with the site and does not substantially alter the historic integrity of the house or grounds, there would be no historic properties adversely affected by the installation of crossing equipment.

Three (3) historic properties lie above the Elk Rock Tunnel, which passes underneath on an easement. No effects are anticipated for the three properties above it.

The streetcar would use the Red Electric Rail Line for the entire length of this segment with the Willamette Shore Line design option.

Riverwood Design Option. In addition to the Red Electric Rail Line, there are nineteen (19) historic properties in the APE for this design option, all of which are single-family houses. The preliminary finding is that there would be no historic properties adversely affected by the re-introduction of the streetcar on the existing rail corridor.[48]

Potential impacts to historic properties are the same as for the Willamette Shore Line design option described above. In addition to those impacts, this design option would require the use of a non-historic portion of the tax parcel associated with the house at 10609 SW Riverside Drive. This house is located on the west side of Riverside Drive (OR 43), but the tax parcel extends east across the road to the Willamette River. The boundary of the historic resource is the portion of the tax parcel on which the house is located (i.e. the portion on the west side of SW Riverside Drive); the remnant pieces on the east side of SW Riverside Drive are not part of the historic resource. Because this design option would not use any of the historic resource itself, nor would it have any adverse effects on the historic resource, the preliminary evaluation is that there would be no historic properties adversely affected.

In the block where the new streetcar line would be added, the existing pavement is relatively narrow and there are wide unpaved shoulders on both sides. The rock walls that line many front yards along Riverwood Road are all located far enough from the roadway that they would not be displaced by this design option. Although the addition of a streetcar on Riverwood Road would be a change from the current conditions, it would not be significant enough to constitute an adverse effect.

The streetcar would be relocated to SW Riverwood Road for a portion of the alignment with the Riverwood Road design option. If the streetcar were to operate in SW Riverwood Road, the Red Electric Rail Line could be sold or abandoned.

Segment 6 – Lake Oswego (SW Briarwood Road to Lake Oswego Terminus)
In addition to the Red Electric Rail Line, there is one (1) historic resource in Segment 6. Potential impacts to this resource are similar to those described in Segment 5 for houses located adjacent to the rail line. This house was built during the period when the railroad was in use as the Red Electric line. The preliminary finding is that there would be no historic properties adversely affected by either of the design options in this segment.

Both of the design options in this segment would be located east of the existing tracks and terminate at Albertsons. The current location of the Willamette Shore Line right of way in this segment is not the historic location. The original alignment was modified as the district developed.

[48] The Riverwood design option would displace the house at 10808 SW Riverwood Road. This house, built in 1961, was evaluated but determined to be not eligible for the National Register of Historic Places because of its loss of historic integrity and lack of historic significance. Therefore it is not considered a historic resource.

Impacts to Archaeology Resources

Effects of the Streetcar Alternative to **archaeology resources** could result from construction-related impacts where yet to be discovered resources exist. The Streetcar Alternative would require construction of approximately six miles of new street car tracks, 10 new stations, and two new park-and-ride facilities. However, most of the proposed project would be confined to the already developed and disturbed existing right of way . The potential for the project to cause adverse impacts to undiscovered, significant, archaeological sites is probably limited but would need to be considered in more detail for those areas subject to ground disturbing construction upon selection of a preferred alternative. Effects of the Streetcar Alternative to archaeology resources could result from construction-related impacts to areas with the general potential for pre-contact and historic-period archaeological resources within the APE. The locations of archaeological resources may not be determined prior to selection of the preferred alternative. After selection of a locally preferred alternative, the project would conduct additional investigations, possibly including subsurface explorations in undeveloped areas and other methods in paved areas as appropriate, to help further define the potential presence of resources. Still, some resources could be undetected and may not be avoided prior to construction. Long-term effects could include the impacts of disturbances to buried archaeological sites encountered during construction and the permanent loss of the archaeological deposits from destruction or removal. However, there is also the potential for some compensatory benefits if resources are identified because they can be inventoried and recorded, and other preservation actions can be identified.

3.5.3.2 Indirect and Cumulative Effects

Indirect and cumulative effects to historic and/or traditional cultural properties or other sensitive or sacred resources that might be of concern cannot be fully determined at this time. FTA will notify the appropriate tribal governments in order to commence government-to-government consultation and request their review of this project from a cultural resources perspective.

Relative to indirect and cumulative effects, it is assumed that there will be slow to moderate new development and some redevelopment in the Portland Central City, in the South Waterfront area, in the Johns Landing/North Macadam area, and in the Lake Oswego Town Center. In the Lake Oswego Town Center area, the foothills area is likely to progress with a new street plan and some new development.

No-Build Alternative. Selection of the No-Build Alternative would not result in any direct impacts, and therefore it would not increase indirect or cumulative impacts to historic or archaeological sites. Indirect and cumulative effects would include the further development of the area, increasing densities and pressure for changes to historic resources.

However, with the No-Build Alternative, there also would be less potential for discovery of, identification and documentation of archeological resources. While archaeological sites are protected by state and federal law, currently unidentified sites could be inadvertently disturbed by other development actions and may not be subject to the level of protection as a federally-funded project such as the Portland to Lake Oswego Transit Project. Archaeological sites could also be adversely affected by the actions of others, which could range from modification, to loss of association, to demolition.

Enhanced Bus Alternative. Selection of the Enhanced Bus Alternative would result in continued redevelopment of the area, risking changes to historic structures. Other projects would still be

developed in areas that may contain pre-contact or historic-period archaeological sites, with or without the transit project. Cumulative impacts would derive from changes to historic resources that would decrease their historic integrity and the increased loss to the archaeological record of significant archaeological resources caused by new construction.

Streetcar Alternative. Selection of the Streetcar Alternative would also result in continued redevelopment of the area and the associated risks described under the Enhanced Bus Alternative. However, the Streetcar Alternative would enhance the economic development potential of the area more than the Enhanced Bus Alternative, so there may be slightly greater pressure for redevelopment or in-fill development. Increased development and redevelopment could result in an increased loss of archaeological resources. Because most of the historic resources are located in neighborhoods with relatively little potential for additional development, indirect and cumulative impacts to historic resources would not be substantially different from those associated with the Enhanced Bus Alternative.

3.5.4 Potential Mitigation

Mitigation could avoid adverse impacts to historic resources with the Streetcar Alternative. Following are potential mitigation measures. The potential mitigation measures are preliminary; Oregon SHPO may require additional or different measures as the project plans develop. Ongoing coordination, as described in Section 3.5.5 below, will be necessary to ensure that the project results in no historic properties adversely affected. Final mitigation will be determined during the FEIS and consultation under the Section 106 process.

- The Streetcar Alternative would replace the rails, railroad ties, and most trestles associated with the Red Electric Eastside Line. These resources could be documented and, in the case of the dated nails embedded in the railroad ties, retrieved and preserved. Documentation could include measured drawings, large-format photographs, and a detailed written narrative.
- Improvements to the Red Electric Rail Line could include elements to enhance and maintain the historic appearance, scale, materials or architectural elements of the rail line.

Unidentified archaeological resources could be affected by construction of the Enhanced Bus Alternative and Streetcar Alternative. Unlike historic buildings, archaeological resources are typically concealed beneath sidewalks, buildings, parking lots and streets. The probability of encountering archaeological resources is based upon presence of sensitive landforms or previous discoveries in the project vicinity; however, it is usually not possible to locate archaeological resources prior to construction, because they typically are hidden under sidewalks and streets. Because archaeological resources in urban settings are often identified only during project related construction, avoidance by selecting the alternative that would have the least impacts is not possible. The potential types of archaeological resources differ, but the treatment for potential mitigation would be similar.

Subsurface testing, shovel probing and exploratory excavations for buried archaeological sites during Preliminary Engineering, Final Design and in early construction could reduce potential impacts and minimize delays during general construction. Prior to such investigation, an inadvertent discovery plan would need to be prepared and approved by Oregon SHPO. This plan would establish procedures to deal with unanticipated discovery of cultural resources before and during construction. The plan would require immediate work stoppage and appropriate notification in the event of

discovery of previously unknown cultural materials. The plan would also specify protocols for the treatment of human remains that fulfill the requirements of the Native American Graves Protection and Repatriation Act in the event that human remains and/or funerary items are encountered during construction or operation of the project. Monitoring protocol would be addressed in consultation with the federal agencies, Oregon SHPO, Metro, TriMet and appropriate interested Tribes.

The Advisory Council on Historic Preservation (ACHP) has issued guidance for the recovery of information from archaeological sites (ACHP, 1999 and 2008). Mitigation measures could include, but are not limited to, avoidance or preservation in place, recovery of archaeological data, public interpretive display or other options. Data recovery as mitigation for adverse effects is acceptable only when specific conditions are met and a data recovery plan has been prepared. Mitigation of adverse effects to archaeological resources will need to be defined in consultation with Oregon SHPO and other designated consulting parties.

For resources identified during construction that cannot be avoided, mitigation would focus on documentation, data recovery and analysis, as determined through consultation with Oregon SHPO and interested Tribes. The final analysis of impacts would be documented in the Portland to Lake Oswego Transit Project FEIS. If there are significant effects from the selected alternative that could not be avoided, a Memorandum of Agreement (MOA) would be developed through consultation among the agencies, FTA, Oregon SHPO, interested Tribes (if applicable) and other affected parties. The MOA would document mitigation commitments. The MOA would be completed prior to publication of and be included within the FEIS

After selection of a preferred alternative, the project would conduct more focused additional archaeological investigations, possibly including subsurface explorations in undeveloped areas and other methods in paved areas as appropriate, to help further define the potential presence of resources. Still, some resources could be undetected and may not be avoided prior to construction.

3.5.5 Next Steps and Completion of the Section 106 Process

Ongoing coordination with Oregon SHPO and federally recognized tribes, as retained by tribal treaty rights, will be necessary to ensure that there no historic properties or archaeological resources would be adversely affected by the proposed project improvements.

During the DEIS phase of the project, Determinations of Eligibility have been submitted to Oregon SHPO along with preliminary Level of Effect assessments and identification of potential mitigation measures. In the DEIS phase, it is expected that Oregon SHPO consultation and concurrence with the Determinations of Eligibility will be completed.

The preliminary Level of Effect evaluations that have been documented in this DEIS and potential mitigation measures will serve as the initial recommendations for incorporating into future design refinements. The assessment is expected to be refined through the selection of the Locally Preferred Alternative and project related design refinements in the Preliminary Engineering/FEIS phase. Oregon SHPO may recommend additional or different mitigation measures. Further coordination with SHPO and the results of the consultation would be incorporated into the project design, and documented in the FEIS and the ROD. The project's goal would be to refine the design to the extent that there are no historic properties adversely affected. If necessary a Memorandum of Agreement between Oregon SHPO, FTA, TriMet and federally recognized tribes, if they so choose, would be

prepared to document mitigation strategies that are mutually agreed upon and design refinements that are necessary.

3.6 Parks and Recreational Resources

This section addresses park and recreation resources in the study corridor. It summarizes the applicable regulations, provides an inventory of park and recreation resources in the corridor (including categorizing them as Section 4(f) and/or Section 6(f) resources), provides an assessment of effects from the study alternatives and design options on the identified resources and identifies potential measures to minimize the adverse effects to park and recreation resources. Appendix E Preliminary Section 4(f) Assessment contains an inventory of Section 4(f) resources and a preliminary assessment of effects of the alternatives and design options on the identified resources in the corridor. The Section 4(f) analysis is preliminary and focuses on comparing the alternatives and design options. Depending on which alternative is selected, additional Section 4(f) analysis would be prepared in conjunction with the FEIS. Short-term effects of construction on parks and recreation resources are discussed in Section 3.16.

More detailed information about the analysis methods, the identified resources, the evaluation of the study alternatives effects on park and recreation resources and the preliminary Section 4(f) analysis can be found in the *Lake Oswego to Portland Transit Project Park and Recreation Technical Report and Preliminary Section 4(f) Analysis* (DEA/URS and TriMet/Metro, November 2010).

3.6.1 Applicable Regulations and Coordination

This section describes applicable regulations that affect parks and recreation areas, and it describes the project's coordination efforts to date with the owners of parks and recreation areas within the project corridor.

3.6.1.1 Applicable Regulations

Federal regulations known as "Section 4(f)" refer to a portion of the U.S. Department of Transportation (USDOT) Act of 1966 that address the use of "public park and recreation lands, wildlife and waterfowl refuges and historic sites" by transportation projects. In 1983, Section 4(f) of the DOT Act was amended and codified in Title 49 USC Section 303. In 2005, the DOT ACT was again amended by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFTEA-LU). The amended regulations are still referred to as "Section 4(f)" and state, in part, "It is the policy of the United States Government that special effort is made to preserve the natural beauty of the countryside and public park and recreation lands…and historic sites." This regulation requires that the US DOT avoid "use" of Section 4(f) properties unless there is no feasible and prudent alternative to using the land or unless the impact will be *de minimis*. A *de minimis* impact is defined as an impact that would not adversely affect the features, attributes or activities qualifying the property for protection under Section 4(f).

This section also addresses Section 6(f) requirements. State and local governments often obtain grants through the Federal Land and Water Conservation Fund (LWCF) Act of 1965 to acquire or make improvements to parks and recreation areas. Section 6(f) of the LWCF Act prohibits the conversion of property acquired or developed with these funds to a non-recreational purpose without the approval of the U.S. Department of Interior (DOI) National Park Service (NPS).

Section 3.5 Historic, Archeological and Cultural Resources address the project's evaluation of historic resources. Sections 106 of the National Historic Preservation Act of 1966 requirements are defined in 36 CFR Part 800 Protection of Historic Properties. Federal agencies must consult with the applicable State Historic Preservation Officer (SHPO) before undertaking projects that would

adversely affect historic or cultural resources. Historic sites can also qualify for protection under Section 4(f) and those potentially qualifying historic resources that could be affected or adversely affected by this project's alternatives are also addressed in Appendix E Preliminary Section 4(f) Assessment.

3.6.1.2 Coordination

Parks and recreation resources in the project area are managed by multiple public entities, including Portland Parks and Recreation, Lake Oswego's Department of Parks and Recreation, Metro and the State of Oregon. In addition, Multnomah County, Clackamas County, the cities of Portland and Lake Oswego maintain general park and recreational goals and policies within their comprehensive plans.

The statewide inventory of Section 6(f) resources is kept by the State of Oregon Parks and Recreation Department (OPRD). Information about the Land and Water Conservation Funds use on the parks in the corridor has been obtained from OPRD.

Section E-2 of Appendix E Preliminary Section 4(f) Evaluation and the *Park and Recreation Technical Report and Preliminary Section 4(f) Analysis* provide additional detail on agency coordination to date for Section 4(f)-related resources.

3.6.2 Affected Environment

The Lake Oswego to Portland Transit Project corridor is rich in public parklands, recreation areas and historic sites. There are no wildlife or waterfowl refuges within the corridor. Parks and recreation resources are identified below.

Table 3.6-1 lists the identified park and recreation resources in the study corridor, listing them from north to south. The table summarizes the location, ownership and types of use at each park. Figure 3.6-1 shows the location of these park and recreation resources in the corridor.

Fifteen of the identified resources are publicly owned. Of these, thirteen qualify as Section 4(f) resources. The other two along with the Peter Kerr Property and the six publicly-owned tax lots were analyzed for their potential status as Section 4(f) resources and were determined not to qualify as Section 4(f) resources. The reasoning for this conclusion follows.

The Peter Kerr property is a natural area located on a steep bluff west of Elk Rock Island. It is owned by the City of Portland and listed in their inventory of natural places. It is not considered a Section 4(f) resource because it is not publically accessible.

Table 3.6-1 Park and Recreation Resources and Natural Areas in the Project Vicinity and their Section 4(f) and 6(f) Status

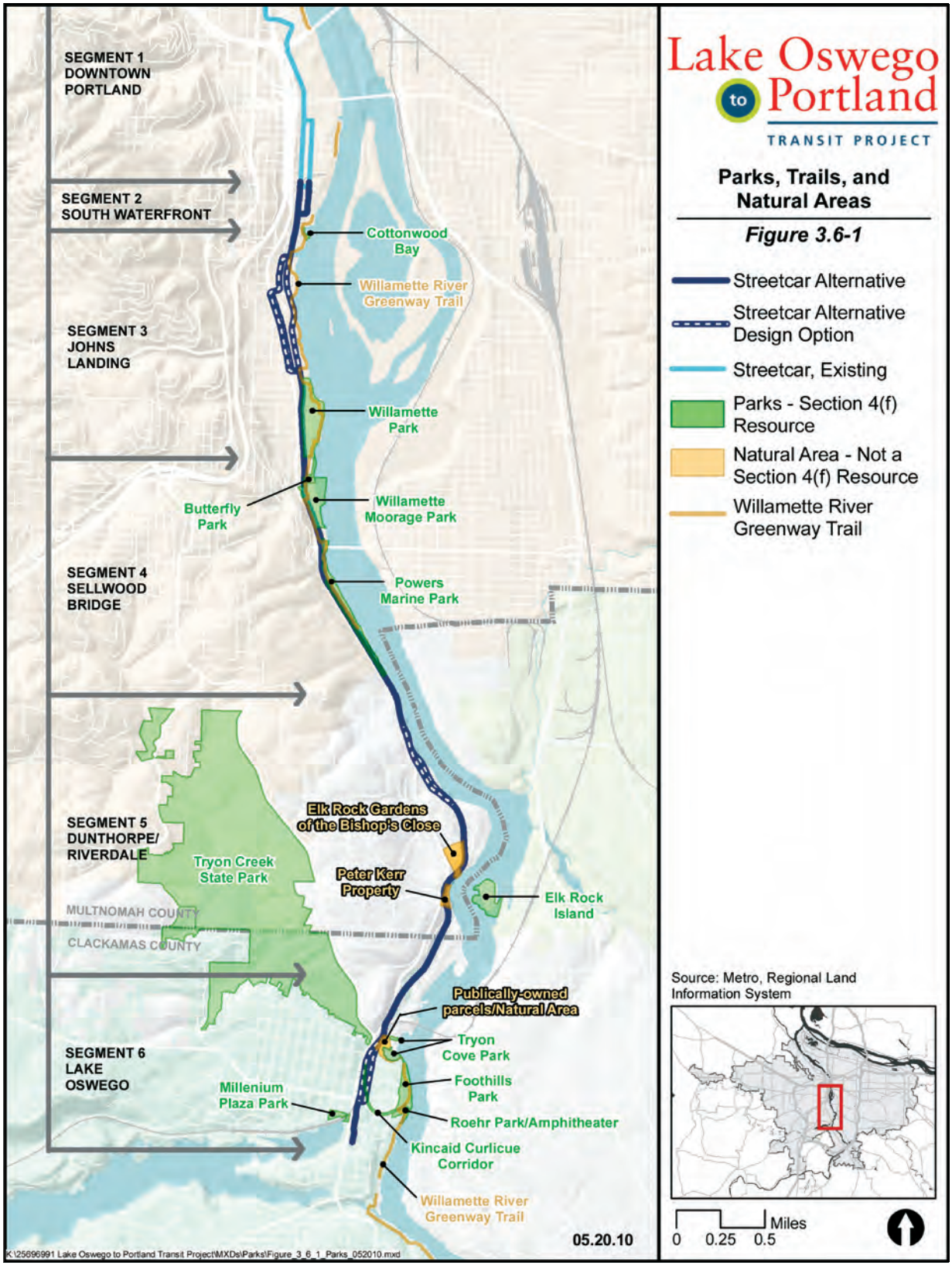
Name of Park or Recreation Area	Location	Adjacent to Project?	Owner(s)/ Custodian(s)	Size / Type of Recreational Uses	4(f) Resource?	6(f) Resource?
Willamette River Greenway Trail	Trail along portions of the west side of the Willamette River	Yes	City of Portland, City of Lake Oswego, private property	Trail along parts of the west bank of Willamette River	Yes	No
Lake Oswego to Portland Trail[1]	Planned alignment connecting Lake Oswego and Portland	Yes	To be determined	Planned trail	No[1]	No
Cottonwood Bay	Near SW Hamilton Court and Willamette River	No	City of Portland	0.67 acres / Natural area	Yes	No
Willamette Park	North of the Sellwood Bridge near SW Nevada Avenue	Yes	City of Portland	26.85 acres / Boat ramp, picnic area, soccer field, tennis courts, paved and unpaved paths	Yes	Yes[2]
Butterfly Park	7720 SW Macadam Ave	No	City of Portland	1.07 acres / Natural area, paths	Yes	No
Willamette Moorage Park	South of Willamette Park	Yes	City of Portland	10.3 acres / Natural area, path	Yes	No
Powers Marine Park	Sellwood Bridge area south	Yes	City of Portland	13 acres / Natural areas, picnic areas, unpaved trails	Yes	No
Elk Rock Gardens of the Bishop's Close	Adjacent to Elk Rock	No	Episcopal Diocese of Oregon	13 acres / Gardens open to public daily	No	No
Peter Kerr Property	Adjacent to Elk Rock	Yes	City of Portland	3.3 acres / City owned parcel, open space, no public access	No	No
Elk Rock Island	East side of Willamette River	No	City of Portland	13.24 acres / Natural area, hiking trails	Yes	No
Tryon Creek State Natural Area	At boundary between Portland and Lake Oswego, west of Highway 43	No	State of Oregon	645 acres / Nature center, hiking and horse trails, bicycle path	Yes	Yes
Tryon Cove Park Annex	Near Stampher Rd. on river	Yes	City of Lake Oswego	0.5 acres / Picnic tables, boat ramp constructed	Yes	No
Tryon Cove Park	At mouth of Tryon Creek	Yes	City of Lake Oswego	Natural area with access to Willamette River	Yes	No
Six tax lots adjacent to or near Tryon Cove Park [3]	Adjacent to or near Tryon Cove Park	Yes	City of Lake Oswego, Metro, City of Portland	4 acres / Open space, riparian habitat	No	No
Foothills Park	South of Tryon Cove Park, on Willamette River	No	City of Lake Oswego	9 acres / Trails, picnic area, grass amphitheater	Yes	No
Roehr Park	South of Foothills Park	No	City of Lake Oswego	7.5 acres / Amphitheater, paths, benches	Yes	No
Kincaid Curlicue Corridor	Trail linking existing trolley station and Foothills Park	Yes	City of Lake Oswego	3.6 acres / Walking and biking path	Yes	No
Millennium Plaza Park	200 First Street, Lake Oswego	No	City of Lake Oswego	Open space, fireplace, fountain	Yes	No

Source: LOPT Parks and Recreation Resources Results Report (Metro, January 2010). See Figure 3.6-1 for an illustration of these resources.

[1] This trail has been previously referred to as "Willamette Shoreline Trail." It is not a resource that would be protected by Section 4(f) because even though it is planned to be a public tr ail, no property is currently publicly owned for this purpose.

[2] Section 6(f) funds were used for development of the boat ramp in Willamette Park.

[3] Tax lot numbers are: 21E02CB02200, 21E02CB02300 (Lake Oswego), 21E02CB02400 (Metro) and 21E02CB02700, 21E02CB00900, and 21E02CB02800 (Portland). These are listed in summary tables as three resources, reflecting ownership.


SEGMENT 1
DOWNTOWN
PORTLAND
SEGMENT 2
SOUTH WATERFRONT
SEGMENT 3
JOHNS
LANDING
SEGMENT 4
SELLWOOD
BRIDGE
SEGMENT 5
DUNTHORPE/
RIVERDALE
SEGMENT 6
LAKE
OSWEGO
Cottonwood Bay
Willamette River Greenway Trail
Willamette Park
Butterfly Park
Willamette Moorage Park
Powers Marine Park
Elk Rock Gardens of the Bishop's Close
Tryon Creek State Park
Peter Kerr Property
Elk Rock Island
MULTNOMAH COUNTY
CLACKAMAS COUNTY
Publically-owned parcels/Natural Area
Tryon Cove Park
Foothills Park
Millenium Plaza Park
Roehr Park/Amphitheater
Kincaid Curlicue Corridor
Willamette River Greenway Trail
05.20.10
K:\25696991 Lake Oswego to Portland Transit Project\MXDs\Parks\Figure_3_6_1_Parks_052010.mxd
Lake Oswego to Portland
TRANSIT PROJECT
Parks, Trails, and Natural Areas
Figure 3.6-1
Streetcar Alternative
Streetcar Alternative Design Option
Streetcar, Existing
Parks - Section 4(f) Resource
Natural Area - Not a Section 4(f) Resource
Willamette River Greenway Trail
Source: Metro, Regional Land Information System
Miles
0 0.25 0.5

The project researched six publicly-owned parcels that are located adjacent to or near Tryon Cove Park to determine if they were qualified as park or recreational facilities under Section 4(f). The six tax lots, located in Lake Oswego, are owned by the City of Portland, the City of Lake Oswego or Metro. These parcels are not Section 4(f) resources for the following reasons.

- The adopted Foothills District Refinement Plan does not list these parcels as part of Tryon Cove Park. A parks map published in April 2010 as the City of Lake Oswego shows five of the seven parcels as part of Tryon Cove Park; however, this map is not part of an adopted plan. To date, no master plan has been adopted for these parcels.

- The City of Portland owns three tax lots adjacent to Tryon Creek. These parcels are managed by the City of Portland's Bureau of Environmental Services and are used for riparian restoration, provision of riparian habitat and restoration for natural resources. The City of Portland has a wastewater treatment facility on the south side of Tryon Creek, adjacent to the subject properties. An above ground sewage pipe and sewage easement runs across these properties. Based on the current intergovernmental agreement (2003) regarding these parcels, the City of Portland is responsible for the management, operations and maintenance. Two of these properties are shown on the April 2010 City of Lake Oswego Parks Map as part of Tryon Cove Park.

- Metro purchased one tax lot in this area using public bonds for open spaces. There are currently no trails, signage, public facilities or adopted plan for this parcel. Based on a 2003 intergovernmental agreement regarding this parcel, it is intended as open space, and the City of Lake Oswego may build a trail through the property, but formal use shall not begin until a resource management plan has been adopted. No resource management plan for the parcel has been adopted to date.

- The City of Lake Oswego owns two parcels adjacent to Southwest Stampher Road and north of the other public properties. There are no trails, public facilities or signage for these properties. The City of Lake Oswego has not made formal plans for these parcels. Based on the current intergovernmental agreement (2003) regarding these parcels, these parcels were identified as surplus properties, subject to future development or sale by the City of Lake Oswego.

In summary, there are 14 publicly owned parks and recreation resources in the corridor that could qualify for protection under Section 4(f). Two of these resources, Willamette Park and Tryon Creek State Natural Area, have had improvements made with Section 6(f) or Land and Water Conservation funds. Appendix E Preliminary Section 4(f) Evaluation includes additional information about Section 4(f) properties.

3.6.3 Environmental Consequences

This section describes the direct, indirect and cumulative effects to park and recreation resources from the study alternatives and design options. Direct impacts would result from changes in right-of-way and/or access. Indirect effects could include impacts to setting, including changes in noise and visual conditions. Cumulative effects consider impacts in the context of related past, present and future projects. Short-term effects are those that would result from project related construction, and are addressed separately in Section 3.16 Construction Effects.

3.6.3.1 Long Term Impacts

The potential effects of the study alternatives on park and recreation resources and historic sites have been evaluated. The evaluation has considered the qualities of the resources and assessed the extent of impairment that would likely occur to the protected resources. The number of resources that would be affected by each of the study alternatives is shown in Table 3.6-2 and described in more detail in the following sections.

Table 3.6-2 Number of Park and Recreation Resources and Natural Areas that Would Be Used, by Alternative

Measure	No-Build Alternative	Enhanced Bus Alternative	Streetcar Alternative
Section 4(f) Eligible Parks and Recreation Areas	0	0	1[1]
Natural Areas (not Section 4(f) Resources)	0	0	3[2]
Section 6(f) Resources[3]	0	0	0

Source: Lake Oswego to Portland Transit Project Streetcar Plan Set, November 9, 2009 and *Lake Oswego to Portland Transit Project: Park and Recreation Technical Report* and Preliminary Section 4(f) Analysis, DEA/URS and TriMet/Metro, August 2010. See Table 3.6-3 for additional detail.

[1] Preliminarily determined to be a *de minimis* impact to the Kincaid Curlicue Corridor – see Appendix E for additional detail.

[2] Includes six tax lots in Lake Oswego owned by Metro, the City of Portland and the City of Lake Oswego. These are counted as three resources to reflect ownership by three separate entities).

[3] See Table 3.6-1 for a list of qualifying Section 6(f) resources.

No-Build Alternative

The No-Build Alternative would not have direct impacts on park or recreational resources in the project area. This alternative would not include new significant transit improvements in the corridor; transportation improvements in the corridor would include those planned for in the 2035 financially constrained list of highway and transit projects in the Regional Transportation Plan (RTP). No impacts to the parks and recreation areas inventoried are anticipated with the No-Build Alternative.

Enhanced Bus Alternative

The Enhanced Bus Alternative would generally use established roadway and not require additional right of way, except for a new park-and-ride facility in downtown Lake Oswego and transportation improvements as defined in the 2035 financially constrained list of highway and transit project in the RTP. There would be no direct effects to park or recreational resources associated with the enhanced bus alternative.

Streetcar Alternative

The effects of the Streetcar Alternative on parks are described below. There would be one Section 4(f) park or recreation resource that would be used by the Streetcar Alternative, the Kincaid Curlicue Corridor. The use would vary based on design options. Table 3.6-3 summarizes the Streetcar Alternative use of Section 4(f) resources that would occur under the Streetcar Alternative, by segment and design option. Table 3.6-4 describes how other non-Section 4(f) natural area resources would be affected by the Streetcar Alternative. Following is a discussion of the Streetcar Alternative effects on Section 4(f) resources and non-Section natural area resources, by segments and design options.

Table 3.6-3 Public Parklands and Recreation Resources (Section 4(f) Resources) Used and/or Directly Impacted by the Streetcar Alternative, by Segment and Design Option

Segment/Design Option	Acres of Section 4(f) Resource Used	Summary Description of Direct Impacts by Resource
1 – Downtown Portland[1]	N/A	No direct impacts to Section 4(f) resources in this segment.
2 – South Waterfront	0.00	No direct impacts. Formally designated areas of the ***Willamette River Greenway Trail*** would be unaffected. There would be changes to temporary connections, including rerouting of the connector trail between SW Bancroft and Hamilton Streets (see temporary impacts).
3 – Johns Landing		
Willamette Shore Line	0.00	No direct impacts. Streetcar stations would be placed near the north and south ends of ***Willamette Park***.
Macadam In-Street	0.00	No direct impacts. A streetcar station would be placed near the south end of ***Willamette Park***.
Macadam Additional Lane	0.00	No direct impacts. A streetcar station would be placed near the south end of ***Willamette Park***.
4 – Sellwood Bridge[2]	0.00	No direct impacts. The project would add a pedestrian overpass over the Willamette Shore Line right-of-way to provide continued access to ***Powers Marine Park***.
5 – Dunthorpe/Riverdale		
Willamette Shore Line	N/A	No direct impacts to Section 4(f) resources in this segment.
Riverwood	N/A	No direct impacts to Section 4(f) resources in this segment.
6 – Lake Oswego		
UPRR	0.7[3]	The project would require the use of 0.7 acre of parkland from the ***Kincaid Curlicue Corridor***. The existing path in the corridor would be relocated to retain the trail function and improved with new connections.
Foothills	1.0[3]	This design option would result in use of 1.0 acre of parkland from the ***Kincaid Curlicue Corridor***. The existing path in the corridor would be relocated to retain the trail function and improved with new connections.

Source: *Lake Oswego to Portland Transit Project Streetcar Plan Set*, November 9, 2009 and *Lake Oswego to Portland Transit Project: Park and Recreation Technical Report and Preliminary Section 4(f) Analysis*, DEA/URS and TriMet/Metro, August 2010. See Figure 3.6-1 for an illustration of the location of these resources.

[1] The South Waterfront Segment contains potential construction phasing options associated with the Streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

[2] The Sellwood Bridge Segment contains potential construction phasing options associated with the Streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

[3] Preliminarily determined to be a *de minimis* impact – see Appendix E for additional detail.

Table 3.6-4 Other Natural Areas (Non-Section 4(f) Resources) Directly Impacted the Streetcar Alternative, by Segment and Design Option

Segment/Design Option	Acres of Natural Areas Impacted	Summary Description of Impacts by Natural Area Resource
1 – Downtown Portland[1]	0	None
2 – South Waterfront	0	None
3 – Johns Landing		
Willamette Shore Line	0	None
Macadam In-Street	0	None
Macadam Additional Lane	0	None
4 – Sellwood Bridge[2]	0	None
5 – Dunthorpe/Riverdale		
Willamette Shore Line	0	None
Riverwood	0	None
6 – Lake Oswego		
UPRR	0.33	• The UPRR design option would require the use of approximately 0.33 acre of undeveloped land adjacent to or near Tryon Cove Park (publicly-owned land but not protected by Section 4(f)); • A bicycle and pedestrian crossing of Tryon Creek would be added as part of the streetcar project.
Foothills	0.5	• The Foothills Realignment design option would require the use of approximately 0.5 acre of undeveloped land adjacent to or near Tryon Cove Park (publicly-owned land but not protected by Section 4(f)); • A bicycle and pedestrian crossing of Tryon Creek would be added as part of the streetcar project.

Source: *Lake Oswego to Portland Transit Project Streetcar Plan Set*, November 9, 2009 and *Lake Oswego to Portland Transit Project: Park and Recreation Technical Report and Preliminary Section 4(f) Analysis*, DEA/URS and TriMet/Metro, August 2010. See Figure E-2 for an illustration of the location of these resources.

[1] The South Waterfront Segment contains potential construction phasing options associated with the Streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

[2] The Sellwood Bridge Segment contains potential construction phasing options associated with the Streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

Segment 1 – Downtown Portland. No parks or recreational resources would be used directly impacted by the Streetcar Alternative or design options within the Downtown Portland Segment.

Segment 2 – South Waterfront. The Streetcar Alternative would extend the existing Streetcar within the couplet two blocks further south past the current couplet end at Southwest Bancroft Street. The temporary existing bicycle path used to access the Willamette River Greenway Trail would be changed. It could be incorporated into the street couplet extension, or it could be extended along the Willamette River. The existing temporary trail connection south of Bancroft Street is within the Willamette Shore Line right of way and would be replaced. The ultimate configuration of the Willamette River Greenway Trail alignment through this area is being planned by the City of Portland in conjunction with its South Portal planning efforts.

Segment 3 – Johns Landing. Within the Johns Landing Segment, both the Willamette Shore Line and the Macadam Avenue design options would change the existing temporary connection to the Willamette River Greenway Trail near the Boundary Street station. The trail connects Macadam Avenue with the Willamette River Greenway and crosses through private property. The streetcar alignment would cross the trail, either in the railroad right of way (Willamette Shore Line design option) or on the existing Landing Square Drive (Macadam Avenue design options). The Willamette Shore Line design option crossing would be altered from its current configuration to provide safety

features for trail users (Z-crossings are planned). The Macadam Avenue design option would also cross this trail at an existing private road crossing (Landing Drive).

Willamette Park is generally separated from the existing railroad right of way and Streetcar Alternative alignment by a row of mature trees and a roadway within the park that runs parallel to the rail alignment behind the row of trees. The streetcar project would be constructed fully within the public or Willamette Shore Line right of way. Some of the trees in Willamette Park have been designated by the City of Portland as "trees of merit" which recognizes the tree(s) as noteworthy trees in the city that have been nominated for Heritage Tree status but, for a variety of reasons, were not given the status. The designation of "trees of merit" does not afford special protection. Figure 3.4-6 shows a visual simulation of the streetcar alignment adjacent to Willamette Park. One of the mature trees may be within the existing right of way of the streetcar and its proximity to the proposed streetcar alignment may require it to be removed during construction of the project. The project would develop and consider potential mitigation measures that could avoid the removal of the tree, while maintaining safe streetcar operations, if the Streetcar Alternative is selected as the Locally Preferred Alternative. Those mitigation measures would be developed and evaluated in consultation with the City of Portland. The current plans suggest that no additional mature trees within or directly adjacent to Willamette Park would need to be removed to construct or operate the Streetcar Alternative.

As potential mitigation for park impacts for any of the design options, sidewalks could be added at the Nevada Street station to bring the sidewalk into compliance with the Americans for Disability Act. The City of Portland would likely retain responsibility for maintenance of the sidewalk entering the park and there would be no change to the key characteristics and function of the sidewalk.

The project would coordinate with the City of Portland regarding minimizing vegetation removal and mitigation for impacts to Willamette Park, if the Streetcar Alternative is selected as the Locally Preferred Alternative.

Segment 4 – Sellwood Bridge. right of wayright of wayThe Streetcar Alternative would travel adjacent to Powers Marine Park within the Willamette Shore Line right of way. The construction of a new pedestrian overpass to continue to provide access to the park is planned to be included with all of the Streetcar Alternative design options and would result in a long-term change in the park, but no property would be transferred to the project as part of this action. The location of the proposed pedestrian overpass is in the area of a likely historic easement crossing the tracks.

Segment 5 – Dunthorpe/Riverdale. There would be no park or recreation impacts from the Streetcar Alternative or design options in the Dunthorpe/Riverdale Segment

Segment 6 – Lake Oswego. Impacts to the Kincaid Curlicue Corridor would vary by design option. The Union Pacific Railroad Right of Way design option would be aligned along the western edge of the property, and would require use of approximately 0.7 acre of the parcel. The Foothills design option would cross the parcel, requiring approximately 1.0 acre. Both of the design options would place a park-and-ride facility over the existing trail. The primary feature of the park, a multi-use trail, would be relocated. Additionally, the project would include the placement of a stairway between State Street/Highway 43 and the Foothills area, enhancing connectivity in this area (see Figure E-7 in Appendix E). Initial coordination with the City of Lake Oswego suggests that the trail could be satisfactorily modified in response to the design of the project through this area. See

Appendix E, 4(f) for additional information about coordination and mitigation for the Kincaid Curlicue Corridor.

In addition, the project examined six publicly-owned parcels that are located adjacent to or near Tryon Cove Park. The project looked at those parcels to determine if they were qualified as park or recreational facilities under Section 4(f), as noted above in Section 3.6.2. Both the Union Pacific Railroad Right of Way and Foothills design options would extend the proposed streetcar alignment through five of the six publicly-owned tax lots. These publicly-owned tax lots are 21E02CB02200 and 21E02CB02300, owned by the City of Lake Oswego; 21E02CB02400, owned by Metro; and 21E02CB00900, 21E02CB02800, and 21E02CB02700, owned by the City of Portland. The Union Pacific Railroad design option would use approximately 0.33 acres of the publicly-owned land. The Foothills design option would use 0.5 acres. Either alignment will create a new bridge over Tryon Creek, which is a priority creek for habitat restoration and enhancement for multiple jurisdictions, including Metro, the City Lake Oswego and the City of Portland. The bridge will include a 14-foot bicycle and pedestrian path to provide connectivity across Tryon Creek. Project-related planning in coordination with the property owners in conjunction with Foothills District planning could ensure that future design work for the project is coordinated with the plans for future development of these properties, if the Streetcar Alternative is selected as the Locally Preferred Alternative.

3.6.3.2 Indirect Impacts

Indirect effects would typically include effects from project improvements that could cause changes to the parks, but would be less direct than those described above as direct impacts. Indirect impacts could include project related changes, such as from noise or visual conditions.

No-Build Alternative
There would be no indirect impacts to park or recreational resources from project improvements with the No-Build Alternative. The No-Build Alternative would not include new project related transit improvements in the corridor. There would be however be transportation improvements related to other projects included in the 2035 RTP financially constrained list that could result in indirect impacts to parklands in the corridor, such as changes to the visual environment or noise environment in corridor parks.

Enhanced Bus Alternatives
The Enhanced Bus Alternative would result in park access improvements similar to those defined below for the Streetcar Alternative. There would be slightly longer walking distances between the new transit stops and several corridor parks, since the bus stops would be located along Southwest Macadam Avenue. The Enhanced Bus Alternative would not have visual, noise, or other indirect effects to park or recreational resources in the project area. Indirect impacts as described for the No-Build Alternative from other transportation projects in the area would also apply for the Enhanced Bus Alternative.

Streetcar Alternatives
Minor indirect effects could occur at some park and recreational resources with the Streetcar Alternative and would vary depending on the design option. In general, indirect impacts could include changes in visual conditions, changes in transit and traffic patterns, changes in access and changes in noise levels. The Streetcar Alternative could result in visual changes adjacent to Willamette Park, Butterfly Park, Willamette Moorage Park, Powers Marine Park, Tryon Cove Park and the Kincaid Curlicue Connector. None of the visual changes would be considered significant

adverse visual impacts to the parks. A moderate noise impact is anticipated at Powers Marine Park. No severe noise impacts are anticipated at any of the park or recreational resources in the corridor. Based on current designs, transportation impacts and access changes would be minimal.

In general, the Streetcar Alternatives would improve access from transit to most of the publicly-accessible parks and recreational resources in the corridor. The exceptions are Elk Rock Island, which is accessed from the east side of the Willamette River, and Tryon Creek State Natural Area, which has entrances over 1.5 miles from the closest streetcar stop and can be more easily accessed by existing bus routes. The longest distance between a proposed station and a park would be 800 feet, which is the distance between Butterfly Park and the Sellwood Bridge station. It is possible that service frequency would decline for users of Powers Marine Park if bus service along Macadam Avenue is cut back as a result of the project.

In Willamette Park and Powers Marine Park, some users currently access the parks across the streetcar tracks at several locations, and some of these may be modified or relocated as a result of the project. In Willamette Park, there are four formal access points supported with easements (at Beaver, Nevada, Nebraska and Miles streets). These access points would be maintained with the streetcar project. There are at least three additional access points that are used by the public, which are generally located on private property. These crossing points will likely be consolidated or relocated by the project. The project team will work with the City of Portland regarding access to Willamette Park. Other than the crossings at roadways, which are marked with stop signs, the existing track crossings are not controlled with supplemental safety measures.

In Powers Marine Park, there are two park access points identified with easements across the existing tracks (at the north end of the park and near the proposed pedestrian bridge). There are two formal entrance points with associated parking areas and approximately five other parking areas located along the park on the shoulders of Macadam Avenue/Highway 43. These additional access points that are being used to enter the park may be modified due to safety restrictions with the operation of the streetcar. With the introduction of the streetcar project, people currently entering the park on foot from the south would need to walk along the roadway for approximately one-half mile to access the planned pedestrian bridge over the streetcar tracks. The project team would work with the City of Portland and the Oregon Department of Transportation (ODOT) regarding design and mitigation for access to Powers Marine Park during the project's preparation of its FEIS, if the Streetcar Alternative is selected as the Locally Preferred Alternative. The project would increase train traffic through Powers Marine Park, which could impede wildlife access patterns between the Willamette River and the hills to the west. However, Macadam Avenue provides a significant barrier to wildlife crossings between the river and the western hills.

Visual changes at Willamette Park, at Powers Marine Park and, to a lesser extent, at Tryon Cove Park and Kincaid Curlicue Corridor would occur due to construction of the streetcar alignment adjacent to these resources. In Willamette Park, visual changes related to construction of the streetcar at the west side of the park adjacent to the western boundary would be partially obscured by existing vegetation, and would not detract from existing views toward the Willamette River. (See Figure 3.4-6 for a visual simulation in Willamette Park.) Similarly, the streetcar would be located on the western edge of Powers Marine Park, allowing park users uninterrupted views of the Willamette River. Table 3.6-5 summarizes the anticipated indirect visual, noise and transportation impacts.

Table 3.6-5 Summary of Indirect Impacts to Park and Recreation Resources from the Streetcar Alternative

Segment/Design Option[1]	Access Modifications	Visual, Noise and Other Affects
1 – Downtown Portland	No impacts to resources in this segment	
2 – South Waterfront[2]		
No design options	• New streetcar route improves access to the ***Willamette River Greenway Trail*** at multiple points along its alignment • Access modifications to connector trail between Macadam and Willamette River Greenway Trail to enhance safety (no right-of-way changes) within Willamette Shore Line right of way (Willamette Shore Line Design Option) or SW Landing Drive (Macadam design options) • improved access to ***Cottonwood Bay***; Hamilton Station would be within 200 feet	• Delays associated with 7.5-minute peak-hour headways for connection trail near the Boundary Station • No impacts anticipated for Cottonwood Bay
3 – Johns Landing		
Willamette Shore Line	• Improved access for transit to ***Willamette Park*** (Nebraska and Nevada stations would be adjacent to park) • Change and potential consolidation of informal access across and along tracks	• Visual changes partially obscured by vegetation
Macadam In-Street and Macadam Additional Lane	• Improved access for transit to ***Willamette Park*** (Carolina and Nevada stations would be adjacent to park) • Change and potential consolidation of informal access across and along tracks	• Visual changes partially obscured by vegetation
4 – Sellwood Bridge[3]		
No design options	• Improved access with Sellwood Bridge station for ***Butterfly Park*** and ***Willamette Moorage Park*** • Sellwood Bridge station would be adjacent *to* ***Powers Marine Park*** • Change and consolidation of informal access across and along tracks at **Powers Marine Park**	• Visual changes for park users due to adjacent streetcar route • One moderate noise impact at **Powers Marine Park**
5 – Dunthorpe/Riverdale		
Willamette Shore Line and Riverwood	• Riverwood station would be approximately 500 feet from ***Elk Rock Gardens of the Bishops Close***; No changes to ***Peter Kerr Property*** or ***Elk Rock Island***	• None
6 – Lake Oswego		
UPRR and Foothills	• Improved access via B Avenue station for ***Tryon Cove Park, Tryon Cove Annex*** and ***six tax lots adjacent to or near Tryon Cove*** park, which would include a new multi-use bridge over Tryon Creek • Improved access to ***Foothills Park***, ***Roehr Park, Kincaid Curlicue Corridor***, and ***Millennium Plaza Park,*** which would include a new pedestrian crossing from State Street	• Visual changes for park users due to adjacent streetcar route for Tryon Cove Park, Tryon Cove Park Annex, six tax lots in the vicinity of Tryon Cove Park and the Kincaid Curlicue Corridor • No impacts on Foothills, Roehr or Millennium Plaza parks

Source: *Lake Oswego to Portland Transit Project Streetcar Plan Set*, November 9, 2009 and *Lake Oswego to Portland Transit Project: Park and Recreation Technical Report and Preliminary Section 4(f) Analysis*, DEA/URS and TriMet/Metro, August 2010. See Figure 3.6-1 for an illustration of the location of these resources.

[1] Except as noted in the Johns Landing Segment, the indirect impacts associated with the Streetcar Alternative would not vary by design option.

[2] The South Waterfront Segment contains potential construction phasing options associated with the Streetcar alignments. The Willamette Shore Line and Moody/Bond Couplet are considered phasing options rather than design options. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

[3] The Sellwood Bridge Segment contains potential construction phasing options associated with the Streetcar alignments. The Willamette Shore Line and New Interchange are considered phasing options rather than design options. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

3.6.3.4 Cumulative Effects

Cumulative effects include project-related impacts in the context of related past, present and future projects. Cumulative effects to park and recreational resources from the Enhanced Bus or Streetcar alternatives would generally be positive based on improved transit access. Considered in context of the benefits of the project to park users and considering past, present and reasonably foreseeable future projects in the project area, the cumulative effects on park and recreational resources in the project area would be positive.

3.6.4 Section 4(f) and Section 6(f) Resources

Section 4(f) resources include publicly owned parks, recreation areas, wildlife and waterfowl refuges, and historic sites. Section 6(f) resources are those public parks that received grants from the federal Land and Water Conservation Fund. Table 3.6-1 identifies Section 4(f) and Section 6(f) resources. The analysis of these resources helps determine if there would be any "use" or taking of Section 4(f) lands or if there would be impacts that would substantially impair the qualities, characteristic and attributes that make them Section 4(f) resources. The preliminary assessment is that the Enhanced Bus Alternative would have no impacts to parks in the project area, and impacts to parks in the project area by the Streetcar Alternative would either be temporary, minimal or positive. Further detail can be found in Appendix E, the preliminary Section 4(f) evaluation and in the documentation of the consultation under the Section 106 process.

A grant in the amount of $48,000 was made in 1980 to improve the boat ramps in Willamette Park by the Land and Water Conservation Funds, and grants were expended to acquire large portions of Tryon Creek State Natural Area and to develop the visitor center and trails there. No right of way would be required from either Willamette Park or Tryon Creek State Natural Area for any of the project's alternatives or design options. Thus, no further analysis regarding Section 6(f) requirements is required.

3.6.5 Potential Mitigation Measures

The design of Streetcar Alternative would be coordinated with park owners to minimize the effects of the project on park and recreational resources. The project will continue to coordinate with the City of Portland and the City of Lake Oswego to define appropriate measures for reducing impacts to identified resources. Many of the anticipated impacts to park and recreation resources could be reduced or eliminated through further project design efforts. The initial design for the project incorporates measures designed to minimize impacts and to provide opportunities for benefits (e.g., minimizing cutting of trees, planting vegetation in areas of impact and improving access opportunities for the public). Where the use of park property would be required, the project would work with the park owner to determine appropriate compensation or other agreements to allow use of the land for the project's improvements. After selection of the Locally Preferred Alternative and during future design efforts, the design team would explore other mitigation measures for the Locally Preferred Alternative. Potential mitigation measures could include new or replaced landscaping, park amenities or modified project design.

Mitigation is anticipated related to Section 4(f) requirements and would be developed in consultation with the park owners prior to the release of the FEIS if the Streetcar Alternative is selected as the Locally Preferred Alternative. No mitigation would be needed if the Enhanced Bus Alternative is selected as the Locally Preferred Alternative. See Appendix E Preliminary Section 4(f) Evaluation for more information.

3.7 Geology, Soils and Seismic Hazards

This section addresses geology, soils, hydrogeology and geologic hazards for Lake Oswego to Portland Transit Project. Detailed analyses of the geology, hydrogeology and geologic hazards within the project study area are presented in the *Lake Oswego to Portland Transit Project Geology, Soils and Seismic Hazards Technical Report* (URS and TriMet/Metro, November 2010). This section presents the following information:

- Methodology used for data collection and analyses and applicable regulations;
- Existing geology, hydrogeology and geo-hazards present within the affected environment;
- Summary of direct and indirect long-term effect and cumulative effects expected for each project alternative and option; and
- Potential mitigation measures.

3.7.1 Methodology and Applicable Regulations

The following documents were reviewed by project staff: local and regional soil surveys; water well and geotechnical boring logs; geologic maps; existing Oregon Department of Transportation (ODOT) subsurface information; and light distance and ranging based topography. In addition, a site reconnaissance was performed in the vicinity of the proposed transit alternatives to observe geologic and geotechnical features. The literature review included the final inspection report of the Elk Rock Tunnel, which is located approximately 1.5 miles north of the Lake Oswego terminus on the existing Willamette Shore Line right of way.

Laws or regulations pertaining specifically to geology that are applicable to the project area are addressed through industry practices established by ODOT's *Environmental Procedures Manual* (2002). [49]

3.7.2 Affected Environment

This section provides a description of the primary geologic and groundwater conditions and geologic hazards within the project's study area.

3.7.2.1 Geologic and Groundwater Conditions

The project is located in the northern Willamette Valley, positioned along the western side of the Portland Hills. Throughout the study area the near surface flood deposits, alluvium and artificial fill are generally underlain by completely weathered to fresh, basaltic volcanic rocks. The basaltic rocks are generally deeply weathered to depths of 30 feet or more, except where streams, rivers, glacial outburst flooding and human activity have removed the weathered rock. The 90-year old Elk Rock Tunnel is located within less-weathered basalt. The rock within the tunnel is unsupported and is coated with a very thin layer of unreinforced gunite.

The most prominent structural feature associate with the western edge of the Portland Basin is the Portland Hills Fault, which includes a series of northwest-trending subsurface faults that extend for a distance of about 25 miles along the eastern side of the Portland Hills. The main trace of the fault is inferred to cross the Willamette River from northwest to southeast between the west end of the Ross Island Bridge and the Oaks Bottom area. The mapped trace of the Oatfield Fault crosses the Lake

[49] Oregon Department of Transportation, 2002; *Environmental Procedures Manual, Volumes 1 and 2.*

Oswego to Portland transit corridor near Southwest Briarwood Road. The geology of the study area, as excerpted from Beeson et al. (1989),[50] is shown on Figure 3.7-1.

The United States Department of Agriculture Natural Resources Conservation Service (NRCS)[51] has mapped and described 10 soil map units within the project study area. A large percentage of the corridor is mapped by the NRCS as *Urban Land*, indicating considerable human modification of the near-surface soils. The soils identified on the NRCS maps consist predominantly of loams with varying sand, silt, clay and gravel contents. Predominant soils in the project area are within hydrologic class C or D and, therefore, have low rates of infiltration. All of the project's proposed capital improvements would generally be located within existing rail or roadway rights of way or developed parcels and within urbanized areas.

Groundwater levels within the study area are influenced by the Willamette River and groundwater flow from upland sources to the west of the proposed improvements. Groundwater data from existing wells in the project vicinity indicate depths to groundwater vary seasonally and spatially from within a few inches of the surface (near the Willamette River, especially north of the Sellwood Bridge) to tens of feet below the surface.

3.7.2.2 Geologic Hazards

Active or potentially-active crustal faults occur in the project vicinity. The mapped trace of the Portland Hills fault crosses the existing Portland Streetcar alignment in the vicinity of the Ross Island Bridge. The Oregon Department of Geology and Mineral Industries *Relative Earthquake Hazard Maps* (Mabey, et al, 1995[52], 1997[53]) for the Portland metropolitan area show the relative seismic hazards throughout the area based on a combination of liquefaction potential, earthquake-induced slope instability and amplification of ground motion during an earthquake. The rating system is divided into four categories or zones ranging from the greatest relative hazard (Zone A) to the least relative hazard (Zone D). The project study area is primarily located within Zone A to the north of the Sellwood Bridge and Zone B to the south of the bridge. The relative earthquake hazards of the study area as excerpted from Mabey, et al, (1995) are shown on Figure 3.7-2.

Volcanic ash fall from Mount Hood, Mount Saint Helens, or other volcanoes in the Cascade Range could occur within the project area.

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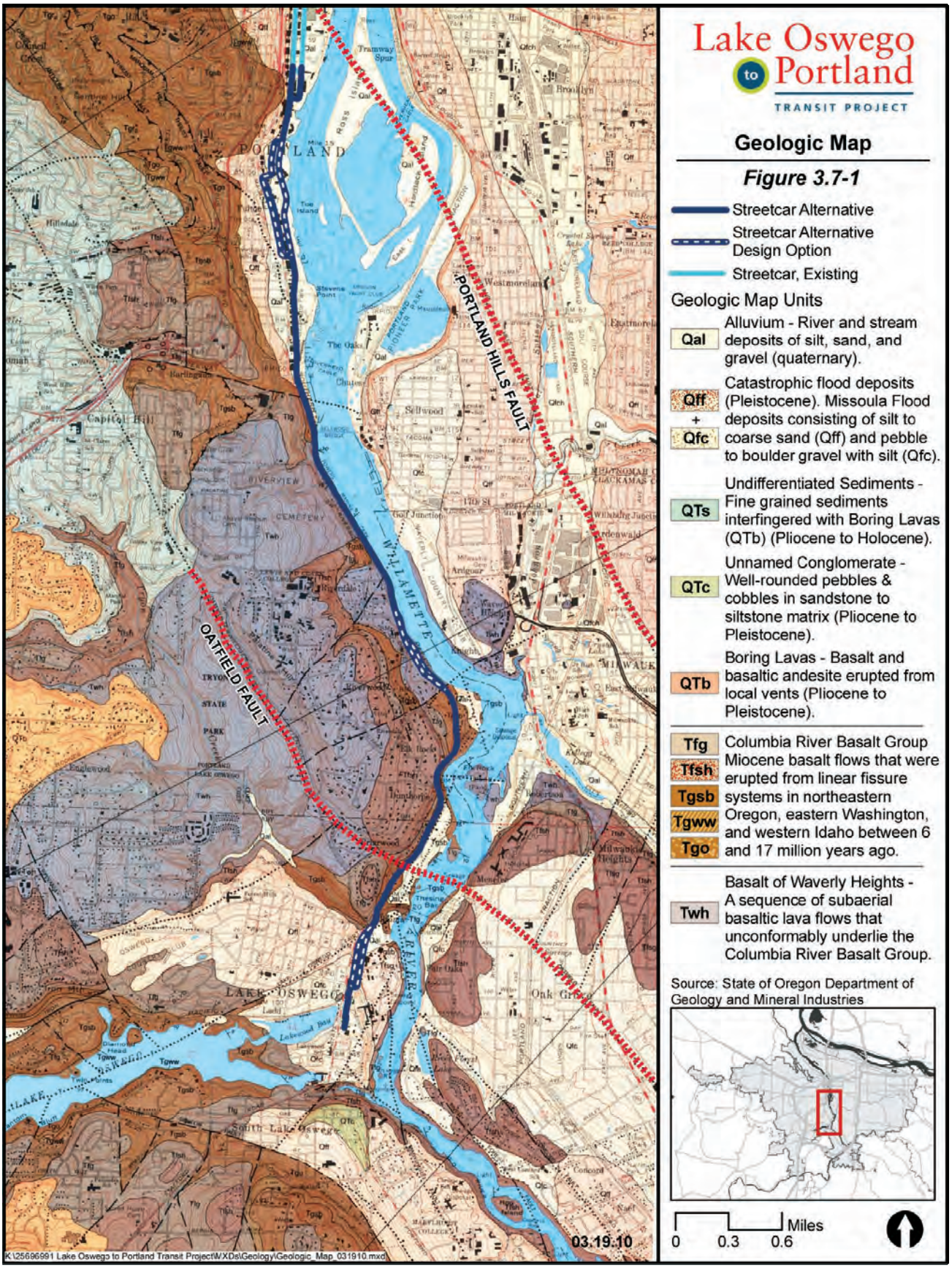
[50] Beeson, M. H., Tolan, T. L., Madin, I. P. 1989; *Geologic Map of the Lake Oswego Quadrangle, Clackamas, Multnomah and Washington Counties, Oregon.* Oregon Department of Geology and Mineral Industries, Geological Map Series 59.

[51] Natural Resources Conservation Service (NRCS), 2009. *Online Web Soil Survey, Custom Soil Resources Report. http://websoilsurvey.nrcs.usda.gov*. Accessed January 7, 2010.

[52] Mabey, M. A., Madin, I. P., Meier, D. B., 1995;*Relative Earthquake Hazard Map of the Lake Oswego Quadrangle, Clackamas, Multnomah, and Washington Counties, Oregon.* Oregon Department of Geology and Mineral Industries, Geological Map Series 91.

[53] Mabey, M. A., Black, G. L., Madin, I. P., Meier, D. B., Youd, T. L., Jones, C. F., Rice, J. B., 1997; *Relative Earthquake Hazard Map of the Portland Metro Region, Clackamas, Multnomah, and Washington Counties, Oregon.*


Lake Oswego to Portland
TRANSIT PROJECT
Geologic Map
Figure 3.7-1
Streetcar Alternative
Streetcar Alternative Design Option
Streetcar, Existing
Geologic Map Units
Qal
Alluvium - River and stream deposits of silt, sand, and gravel (quaternary).
Qff + Qfc
Catastrophic flood deposits (Pleistocene). Missoula Flood deposits consisting of silt to coarse sand (Qff) and pebble to boulder gravel with silt (Qfc).
QTs
Undifferentiated Sediments - Fine grained sediments interfingered with Boring Lavas (QTb) (Pliocene to Holocene).
QTc
Unnamed Conglomerate - Well-rounded pebbles & cobbles in sandstone to siltstone matrix (Pliocene to Pleistocene).
QTb
Boring Lavas - Basalt and basaltic andesite erupted from local vents (Pliocene to Pleistocene).
Tfg
Tfsh
Tgsb
Tgww
Tgo
Columbia River Basalt Group Miocene basalt flows that were erupted from linear fissure systems in northeastern Oregon, eastern Washington, and western Idaho between 6 and 17 million years ago.
Twh
Basalt of Waverly Heights - A sequence of subaerial basaltic lava flows that unconformably underlie the Columbia River Basalt Group.
Source: State of Oregon Department of Geology and Mineral Industries
PORTLAND HILLS FAULT
OATFIELD FAULT
WILLAMETTE
RIVER
LAKE OSWEGO
Miles
0
0.3
0.6
03.19.10
K:\25696991 Lake Oswego to Portland Transit Project\WXDs\Geology\Geologic_Map_031910.mxd

Landslide hazards were assessed as part of the public document review, aerial photograph investigation, field reconnaissance and Light Distance and Ranging image analysis. All of these studies indicate that the primary areas of concern with regards to slope instability are located adjacent to and south of the Sellwood Bridge. The elevated slope stability hazard near the bridge is due to an existing ancient landslide, referred to as the Sellwood Landslide (CH2MHILL, 2009).[54] Movement of the Sellwood Landslide has damaged the western abutment of the existing bridge and construction of the replacement Sellwood Bridge will require stabilization of the Sellwood Landslide.

South of the Sellwood Landslide, the project area traverses relatively steep terrain, which is also susceptible to slope instability. LiDAR imagery reveals a large, arcuate-shaped topographic low located west (upslope) of the alignment between Riverwood Road and Radcliffe Road. This feature may represent a large, dormant, ancient landslide or may be an erosional feature related to differential erosion of weaker rock. This feature has been identified as a landslide on DOGAMI's Statewide Landslide Information Database for Oregon (SLIDO).

Existing near-vertical rock slopes in the vicinity of the Elk Rock Tunnel portals appear to be stable, however there may be an elevated rock fall hazard where the cuts are not supported by retaining structures.

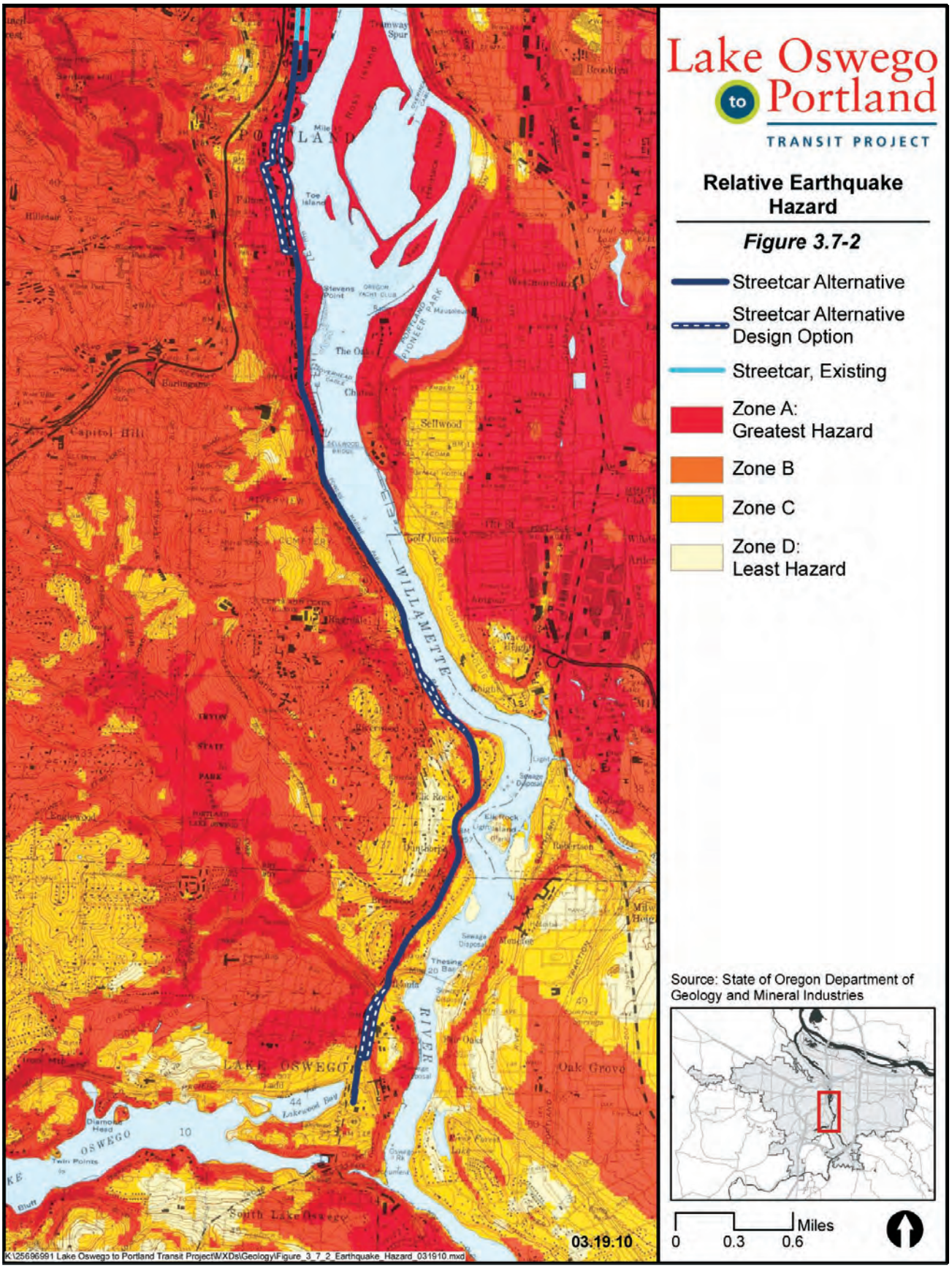
Steep slopes are defined as having an inclination greater than 20 degrees (37 percent). The proposed alignment of the Streetcar Alternative would traverse several steep slopes, some in excess of 30 degrees (60 percent). Hazards associated with steep slopes include higher susceptibility to landslides and rock fall and erosion.

3.7.3 Environmental Consequences

This section summarizes the long-term direct, indirect and cumulative affects on geology and soils that would occur due to the No-Build, Enhanced Bus and Streetcar alternatives, focusing on estimates of required cut and fill material and length of new retaining wall and on the potential of the alternatives to increase the risk of geologic and soils hazards. In geologic and soil science terms, the design options are not substantially different and are not individually assessed. Rather, the geologic and soil characteristics of the alternatives – No-Build, Enhanced Bus and Streetcar are analyzed in this document.

There would be no additional cumulative impacts due to the project alternatives beyond the described direct and indirect impacts, because the project's analysis is based on adopted state, regional and local land use plans and transportation project lists, which are the reasonably-foreseeable activities within the project vicinity that could also affect geology and soils. There are no prime or unique farmlands and soils within the project corridor as defined under the Farmlands Protection Policy Act.

[54] CH2MHILL, 2009; *2009 Geotechnical Data Report, Sellwood Bridge Project;* Prepared for Multnomah County, Oregon


Lake Oswego to Portland
TRANSIT PROJECT
Relative Earthquake Hazard
Figure 3.7-2
Streetcar Alternative
Streetcar Alternative Design Option
Streetcar, Existing
Zone A: Greatest Hazard
Zone B
Zone C
Zone D: Least Hazard
Source: State of Oregon Department of Geology and Mineral Industries
Miles
0
0.3
0.6
03.19.10
K:\25696991 Lake Oswego to Portland Transit Project\MXDs\Geology\Figure_3_7_2_Earthquake_Hazard_031910.mxd
WILLAMETTE RIVER
LAKE OSWEGO
Capitol Hill
Sellwood
Oak Grove
South Lake Oswego

No-Build Alternative
There would be no direct effects related to geology, hydrogeology and seismic hazards associated with the No-Build Alternative. Indirectly, without any planned construction activities within the existing Willamette Shore Line right of way, the No-Build Alternative would generally allow the continuing degradation of soils and stability within existing right of way. On-going regional development would use existing groundwater and rock resources.

Enhanced Bus Alternative
Long term direct and indirect effects of the Enhanced Bus Alternative would be similar to those resulting from the No-Build Alternative. Design of the 300-space structured park-and-ride lot at the Lake Oswego Village Shopping Center under the Enhanced Bus Alternative would comply with applicable earthquake design standards for the site. There would be no cut and fill of soil under the Enhanced Bus Alternative.

Streetcar Alternative
The proposed Streetcar Alternative would require the construction of cut slopes and placement of engineered fill to accommodate the track and associated structures. Table 3.7-1 shows total estimated cut and fill volumes and estimated volume of export (excess cut material) for the various Streetcar Alternative options. In summary, the Streetcar Alternative would result in the excavation of approximately 76,350 to 95,100 cubic yards of material (depending on the design options). Approximately 11,820 to 45,850 cubic yards of the excavated material would be used as fill within the project's alignment, while approximately 64,180 to 76,200 cubic yards of excavated material would be removed from the project site, which would require locating and filling an off-site disposal area and/or identifying and contracting with other projects that could use the excess excavated material.

The majority of the engineered cuts and fills under the Streetcar Alternative would be supported by retaining walls. The Streetcar Alternative would result in approximately 22,050 to 27,450 linear feet of new retaining wall, generally along the proposed streetcar alignment, depending on the design options. Through the use of appropriate design standards, the Streetcar Alternative would avoid increasing geologic hazards, which would include the following: areas of undocumented fill and/or shrink-swell soils may be encountered, which could require additional excavation and replacement with suitable fill material; and potential rehabilitation of the Elk Rock Tunnel and associated portal structures, which would provide improved stability of the rock within the tunnel and the rock slopes in the vicinity of the portals.

Engineered bridges and structures included in the Streetcar Alternative would be designed to withstand a major seismic event by using current applicable design standards based on site specific geologic and seismic criteria. The Streetcar Alternative would not increase the likelihood or severity of geologic or soils hazards in the project vicinity. However, through the addition of improvements along the existing Willamette Shore Line right of way, the Streetcar Alternative would lead to increased soil stability and reduce soil erosion due to the introduction of new improvements, such as new retaining walls, the replacement of unstable soils with stable soils and improved stormwater drainage.

Compared to the No-Build Alternative, the Streetcar Alternative could use additional rock resources for fill if the project's cut material is not acceptable fill for the project. In contrast, the excess

excavated material could be used for fill for other projects, which could reduce the demand for rock generally equivalent to the amount of excess cut from the project that could be used.

Table 3.7-1 Estimated Cubic Feet of Cut and Fill and Linear Feet of Retaining Wall for the Streetcar Alternative By Segment and Design Option

Segment/Design Option	Cubic Yards of Cut	Cubic Yards of Fill	Cubic Yards of Excess Cut[1]	Linear Feet of Retaining Wall
1 - Downtown Portland	0	0	0	0
2 - South Waterfront	4,000	8,000	(4,000)	1,200
3 - Johns Landing				
Willamette Shore Line	16,350	90	16,260	5,150
Macadam In-Street	6,400	30	6,370	3,250
Macadam Additional Lane	4,600	10	4,590	2,000
4 - Sellwood Bridge	24,000	110	23,890	6,450
5 - Dunthorpe/Riverdale				
Willamette Shore Line	24,400	250	24,150	8,100
Riverwood	27,750	3,950	23,800	8,850
6 - Lake Oswego				
UPRR	19,350	3,450	15,900	4,300
Foothills	23,000	33,700	(10,700)	5,800
Total (range)	**76,350 – 95,100**	**11,820 – 45,850**	**64,180 – 76,200**	**22,050 – 27,450**

[1] Excess cut material would be exported from the project site.
Source: *Lake Oswego to Portland Transit Project Streetcar Plan Set*, November 9, 2009.

Following is a summary of the approximate volume of cut and fill material and approximate length of new retaining wall would differ by Streetcar design option, by segment.

Segment 3 – Johns Landing. In Segment 3, Johns Landing, the Willamette Shore Line design option would result in the greatest volume of cut and excess cut material (16,350 and 16,260 cubic yards, respectively) and the greatest length of new retaining wall (5,150 linear feet). There would be 6,370 and 4,590 yards of excess cut material under the Macadam In-Street and Macadam Additional Lane design options, respectively. The Macadam In-Street and Macadam Additional Lane design options would also result in 3,250 and 2,000 feet of new retaining wall, respectively.

Segment 5 – Dunthorpe/Riverdale. In Segment 5, Dunthorpe/Riverdale, the Riverwood design option would result in the greater volume of cut material (27,750 cubic yards), but the lower volume of excess cut material (23,800 cubic yards), because it would require the greater volume of fill (3,950 cubic yards), which could be supplied from the cut material. In comparison, the Willamette Shore Line design option would result in 24,400 and 24,150 cubic yards of cut and excess cut material, respectively. The Riverwood design option would result in the greater length of new retaining wall (8,850 linear feet).

Segment 6 – Lake Oswego. In Segment 6, Lake Oswego, the Foothills design option would result in the greater volume of cut material (23,000 cubic yards), but the lower volume of excess cut material (a deficit of 10,700 cubic yards), because it would require the greater volume of fill (33,700 cubic yards), which could be supplied from the cut material in this and one or more segments. In comparison, the union Pacific Railroad design option would result in 19,350 and 15,900 cubic yards of cut and excess cut material, respectively. The Foothills design option would result in the greater length of new retaining wall (5,800 linear feet).

3.7.4 Potential Mitigation Measures

Long-term mitigation of effects related to geology, hydrogeology and seismic hazards would be based on the results of site specific geotechnical investigations, which would be performed in support of final design of the Locally Preferred Alternative, if the No-Build Alternative is not selected. Where hazards are identified, mitigation should be designed based on best practice geotechnical engineering in compliance with appropriate state and federal geotechnical and seismic design standards. Following is a summary of potential mitigation measures that the project could undertake to reduce risks related to geology, soils and seismic hazards.

3.7.4.1 Seismic Hazards

The primary seismic hazards that could affect the project include: liquefaction-related phenomena such as lateral spread and settlement; seismically-induced slope instability; strong ground motion; and surface fault rupture. Mitigation of these potential hazards could be achieved with one or more of the following techniques, depending upon the situation:

- Avoidance of the susceptible area(s);
- Densification of the subsurface soils through in-situ treatment including compaction or cement/chemical grout treatment;
- Removal of the liquefiable material and replacement with select backfill;
- Placement of retaining walls and/or rock-fall catchment zones or structures; and
- Improvement of rock slopes using mechanical reinforcement.

3.7.4.2 Landslides

Should landslides be identified through site-specific geotechnical investigations during subsequent phases of the project, stability analyses would be performed. Mitigation of landslide hazard could be accomplished using one or more of the following techniques:

- Mechanical retaining structures such as cantilevered walls, tied back walls, soil nail walls;
- Construction of shear keys and/or placement of earth buttresses at the landslide toe;
- Removal of driving forces in the upper portion of the landslide; and
- Installation of enhanced drainage facilities to redirect surface water and/or remove groundwater

3.7.4.3 Steep Slopes

Mitigation options for steep slope areas could include:

- Construction of retaining walls in areas of cuts (below ascending slopes) or fills (above descending slopes);
- Improvement of rock slopes using mechanical reinforcement such as rock bolts, steel mesh, shotcrete and drainage;
- If blasting is necessary to excavate rock slopes, controlled, pre-split blasting techniques should be employed to minimize damage to the finished rock cut face

3.7.4.4 Shrink/Swell and Hydric Soils

Hydric soils in areas of shallow groundwater may be encountered. Mitigation techniques for these soil types generally involve removal and replacement with engineered fill having properties that will

provide a stable foundation for the Lake Oswego to Portland transit facilities. Additional mitigation related to wetlands impacts may be necessary in areas where soft soils are encountered and treated (see Section 3.9 for additional information on wetlands and hydrology). If zones are encountered that involve very large volumes of unsuitable soils, it may not be economical to remove and replace all of the unsuitable base material. Other mitigation options include:

- Partial removal and replacement with a combination of geogrid or geofabric and specified rock to bridge soft and/or wet zones;
- soil treatment using amendments to improve the soil structure; and
- Permanent drainage facilities to lower the groundwater.

3.8 Ecosystems

This section describes the analysis and anticipated effects of the study alternatives to wetlands, vegetation, wildlife, fisheries and threatened, endangered and sensitive (TES) species in the corridor. This section addresses long-term direct, indirect and cumulative effects of the study alternatives. Short-term or construction effects are also discussed in Section 3.16 Construction Activities. Additional detail on the ecosystems regulations, technical analysis methods, agency consultation, expected effects of the study alternatives and potential mitigation measures can be found in the *Lake Oswego to Portland Transit Project Ecosystems Technical Report* (URS/DEA and TriMet/Metro, November 2010).

3.8.1 Applicable Regulations

The project will be subject to federal, state and local regulations concerning potential impacts to biological resources. The principle natural resource regulations, ordinances and permits that would apply to a project in this corridor are summarized in Table 3.8-1. In addition, a list of expected permits and approvals is included in Section 7.3 Project Permits and Approvals. While Table 3.8-1 lists the array of applicable regulatory compliance requirements, particular attention is generally focused on regulations governing wetland protection (Clean Water Act Section 404), as administered by the U.S. Army Corps of Engineers (USACE), impacts to navigable waterways under Section 10 of the Rivers and Harbors Act by the USACE, and regulations protecting federal TES species under the federal Endangered Species Act (ESA). Should the Enhanced Bus Alternative or the Streetcar Alternative be selected as the Locally Preferred Alternative, the Federal Transit Administration would consult with the U.S. Fish and Wildlife Service (USFWS) and/or the National Marine Fisheries Services (NMFS) in compliance with Section 7 of the ESA. Following selection of the Locally Preferred Alternative, pre-consultation with USFWS and NMFS will be initiated and the appropriate compliance documentation prepared. Current expectation is that a Biological Assessment would be required for the Streetcar Alternative, but may not be required for the Enhanced Bus Alternative.[55]

Additionally, Executive Order 11990 – Protection of Wetlands, requires federal agencies to take action to minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. Agencies must avoid undertaking or providing assistance for new construction located in wetlands unless the agency finds that there is no practicable alternative to such construction and that the proposed action includes all practicable measures to minimize harm to wetlands, which may result from such use. In making this finding, the head of the agency may take into account economic, environmental and other pertinent factors. Executive Order 11988 – Floodplain Management provides similar protection for floodplains.

3.8.2 Affected Environment

A transit project in this corridor has the potential to affect existing biological resources including wetlands, vegetation, wildlife, fisheries, and TES species. Assessment of the affected environment, focused primarily on resources within a study area extending 125 feet from the center line of the

[55] A Biological Assessment is a document prepared in compliance with the Endangered Species Act (ESA) to determine whether a proposed major construction activity under the authority of a Federal action agency is likely to adversely affect listed species, proposed species, or designated critical habitat.

Table 3.8-1 Summary of Natural Resource Regulations and Possible Permit Requirements

Regulation/ Permit	Responsible Agency	Resource Studies	Regulated Resources
Federal			
National Environmental Policy Act (NEPA)	Federal Transit Administration (FTA)	NEPA EIS addressing natural resource conditions, impacts, and mitigation	All
Clean Water Act (CWA) Section 404	U.S. Army Corps of Engineers (USACE)	Alternatives analysis; wetland delineation study; wetland functional assessment and impact analysis; and mitigation plan	Waters of the U.S., including wetlands
Rivers and Harbors Act (RHA) Section 10	USACE	Assessment of potential project impacts to navigable waters	Navigable waters
Endangered Species Act (ESA)	National Marine Fisheries Service (NMFS); U.S. Fish and Wildlife Service (USFWS)	Section 7 Consultation addressing project impacts to listed species, species proposed for listing, and candidate species, and their habitats. May require a Biological Assessment.	Vegetation, wildlife, fisheries, and habitats
Fish and Wildlife Coordination Act	USFWS; NMFS; Oregon Department of Fish, and Wildlife (ODFW)	Agency consultation; identify impacts to fish and wildlife resources; recommend mitigation if necessary	Vegetation, wildlife, fisheries, and habitat
Magnuson-Stevens Fishery Conservation Management Act	NMFS	Identify potential impacts to Essential Fish Habitat (EFH) (To be included in Biological Assessment)	Habitat for commercially significant fish: Chinook and coho salmon
Migratory Bird Treaty Act (MBTA)	USFWS	Identify impacts to migratory birds	Wildlife
State			
Oregon Removal-Fill Permit	OR Department of State Lands (DSL)	Alternatives analysis; wetland delineation study; wetland functional assessment and impact analysis; mitigation plan	Waters of the state, including wetlands
Oregon State ESA	ODFW; OR Department of Agriculture (ODA)	Identify project impact to state listed and candidate species	Vegetation, wildlife, fisheries
CWA Section 401 Water Quality Certification	OR Department of Environmental Quality (DEQ); U.S. Environmental Protection Agency (EPA)	Assess project compliance with state water quality standards; implement mitigation measures; stormwater management plan	Rivers, streams, other bodies of water
Oregon Fish Passage Statute	ODFW	Identify stream crossing and impacts to ability for fish to pass upstream and downstream	Native fish, streams, and culverts
Statewide Planning Goal 15 – Willamette River Greenway	City of Portland; City of Lake Oswego, Multnomah and Clackamas Counties	Project design alternatives relative to Greenway overlay and setback requirements	Willamette River shoreline within Greenway overlay
Local			
Portland Greenway Permit	City of Portland	Evaluation of impacts to native vegetation; mitigation, or preservation of native vegetation	Greenway setback, vegetation, wildlife, and fisheries
Environmental Zone Overlay	City of Portland	Identification of adverse impacts; mitigation plan	Streams, wetlands, and wildlife habitat
Environmental Zone Overlay Districts	City of Lake Oswego	Identification and evaluation of impacts to wetlands or waters, including associated buffers identified in a zoning overlay district	Vegetation, wildlife, waters, wetlands, and fisheries; may include buffers
Metro Urban Growth Management Functional Plan – Title 3	Metro (though administered by local governments)	Evaluation of impacts on water quality, flood management, and fish and wildlife	Wildlife and fisheries
Metro Urban Growth Management Functional Plan – Title 13	Metro (though administered by local governments)	Document Habitat Conservation Areas and local government compliance	Wildlife and fisheries
Setback Requirements	Clackamas County	Protection of river and stream corridors	Rivers and streams

Source: URS, January 2010

study alternatives and design options (creating a minimum 250-foot wide study corridor, though wider in areas of parallel design options). Where appropriate, potential effects to upstream and downstream aquatic resources were evaluated. The analysis is based on information collected during

field investigations and from local, state, and federal agencies to help characterize ecosystem resources.

3.8.2.1 Wetlands

Four small wetlands sites have been identified within the project study area. The wetlands have been identified as Wetland A, B, C and D, as shown in Figure 3.8-1 and summarized in Table 3.8-2. Wetlands found within the study area are supported where drainage is intercepted by the railroad berm, which acts as a hydrologic impoundment and results in seasonally saturated or inundated soil conditions. The source of drainage is either stormwater discharge from upslope impervious areas, natural drainage features or a combination of the two. The majority of water entering the rail corridor comes from culverts that outfall above the tracks. This drainage flows down gradient through ditches at the base of the railroad embankment until it reaches a culvert inlet, which allows conveyance to the east, towards the Willamette River. Wetland conditions develop where culverts are placed too high, too far away from the incoming drainage, or where the gradient is nearly flat.

Table 3.8-2 Summary Description of Wetlands within the Study Corridor

Site/ Wetland	Cowardin Class[1]	HGM Class[2]	Size AC/Sq Ft[3]	Comments
Wetland A	PSSC	RFT	0.07/3,049	Stormwater ditch with scrub/shrub habitat. Outflows via rock –lined ditch with no ordinary high water (OHW) line to a grated inlet. [4] Unknown offsite path.
Wetland B	PEMB	DEP	0.01/435	Isolated wetland with emergent habitat, stormwater collection point. Overflows via culvert to an infiltration area on the east side of the tracks.
Wetland C	PEMC	RFT	0.03/1,307	Ditch and stream-fed outfall collection with emergent habitat. Continues to the Willamette River in an unnamed waterway identified as ditch [2].
Wetland D	PEMC	DEP	0.01/435	Depressional area that collects groundwater discharge at toe of slope in emergent habitat. General low point that outflows via culvert to ponds to the east.
		SUM	**0.12/5,226**	

Source: Wetland Delineation conducted by URS, April and November 2009 in compliance with the USACE 1987 Wetlands Delineation Manual and the Western Mountains, Valleys, and Coast Regional Supplement (2010); GIS impact analysis conducted by David Evans and Associates, Jan. 2010.
[1] Cowardin Class based on Cowardin 1979: PSSC = Palustrine Scrub-shrub seasonally flooded; PEMB = Palustrine Emergent Saturated; PEMC = Palustrine Emergent Seasonally Flooded
[2] Hydrogeomorphic (HGM) Class based on Adamus 2001: RFT = Riverine Flow-Through; DEP = Depressional.
[3] The USACE and DSL have not verified the wetland delineation report prior to submittal of this document.
[4] The Ordinary High Water (OHW) line is the mark left on stream banks by regular high water flow at the 2-year return interval.

3.8.2.2 Waterways

The study area contains 23 observed waterways, including Stephens Creek, Tryon Creek, Terwilliger Creek and other unnamed waterways identified as Streams 1 through 13 and Ditches 1 through 6. The majority of these waters currently receive runoff from roadways and other surfaces, which is not treated to current design standards for quality or quantity. All of these linear drainage channels eventually discharge to the Willamette River. Floodplains associated with the stream crossings are minimal as the majority of waterways have been culverted and channelized prior to being routed under the existing rail infrastructure. No study alternatives would cross the Willamette River; therefore, impacts to the river would be limited to indirect / cumulative impacts. Figure 3.8-1 shows the rivers and streams in the analysis area. Table 3.8-3 provides summary data on the area waterways.

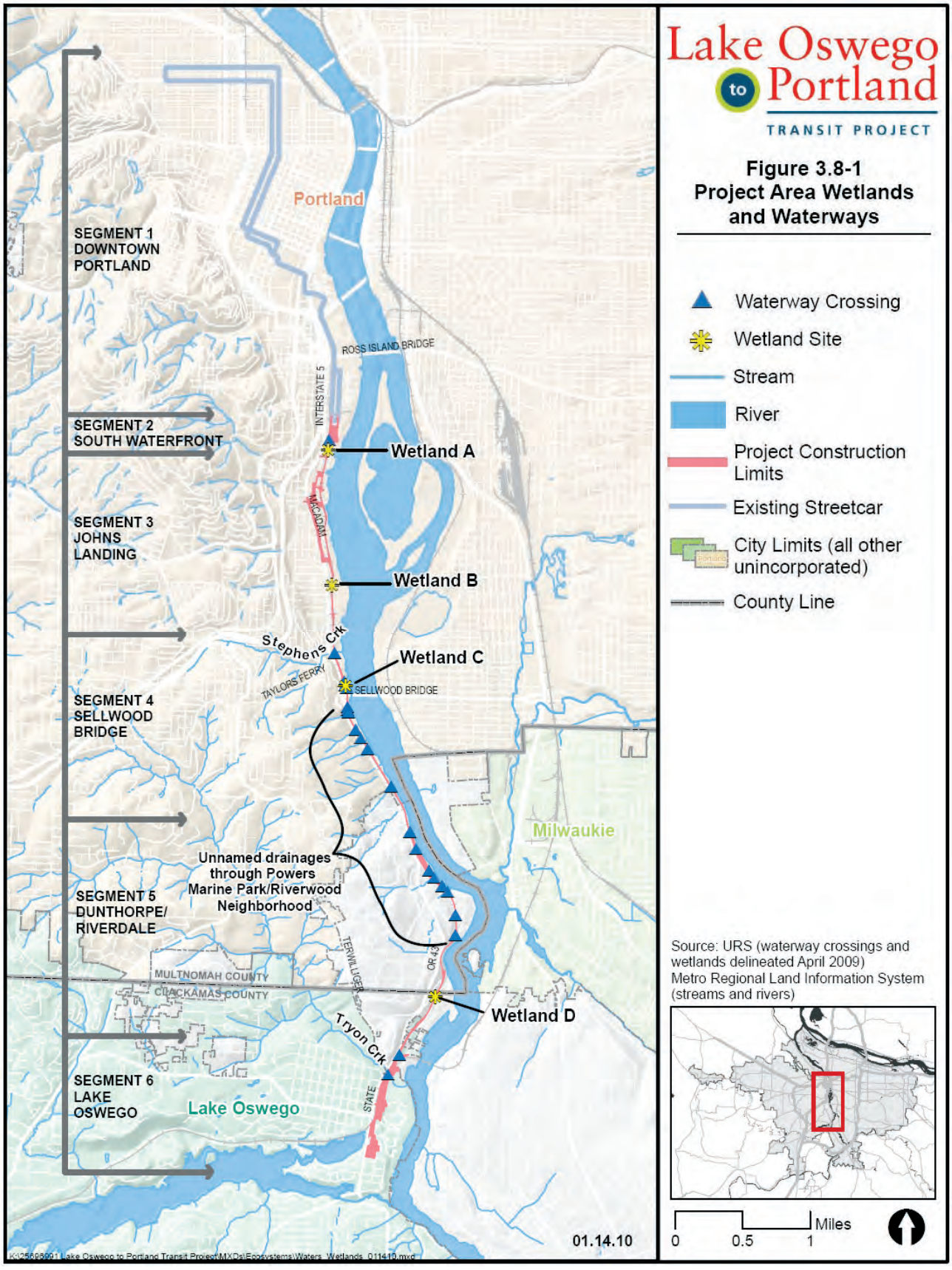

Lake Oswego to Portland
TRANSIT PROJECT
Figure 3.8-1
Project Area Wetlands and Waterways
Waterway Crossing
Wetland Site
Stream
River
Project Construction Limits
Existing Streetcar
City Limits (all other unincorporated)
County Line
Portland
SEGMENT 1 DOWNTOWN PORTLAND
SEGMENT 2 SOUTH WATERFRONT
SEGMENT 3 JOHNS LANDING
SEGMENT 4 SELLWOOD BRIDGE
SEGMENT 5 DUNTHORPE/ RIVERDALE
SEGMENT 6 LAKE OSWEGO
ROSS ISLAND BRIDGE
INTERSTATE 5
MACADAM
Wetland A
Wetland B
Stephens Crk
TAYLORS FERRY
Wetland C
SELLWOOD BRIDGE
Milwaukie
Unnamed drainages through Powers Marine Park/Riverwood Neighborhood
TERWILLIGER
OR 43
MULTNOMAH COUNTY
CLACKAMAS COUNTY
Wetland D
Tryon Crk
STATE
Lake Oswego
01.14.10
Source: URS (waterway crossings and wetlands delineated April 2009)
Metro Regional Land Information System (streams and rivers)
Miles
0
0.5
1

Table 3.8-3 Summary of Project Area Streams

Waterbody Name	Corridor Segment	Supports TES Aquatic Species[1]	Channel Width (OHWL) in Feet[2]	Waterbody Flow Regime	Water Quality Limited Waterbodies for Following Parameters[3,4]	TMDL(s) Approved for Following Parameters[3,5]
Willamette River	None	Yes	1,200 (approximate/ varies)	P[6]	aldrin, biological criteria, DDT, DDE, dieldrin, E. coli, fecal coliform, iron, manganese, mercury, PCBs, PAHs, pentachlorophenol	Dioxin; temperature; bacteria
Ditch 1	2	No	0.5	E[6]	N/A	N/A
Stephens Creek	4	Yes	4	P	bacteria, mercury, temperature	temperature; bacteria
Ditch 2	4	No	1	E	N/A	N/A
Stream 1	4	No	0.5	I[6]	N/A	N/A
Stream 2	4	No	2	I	N/A	N/A
Ditch 3	4	No	0.5	E	N/A	N/A
Ditch 4	4	No	2	E	N/A	N/A
Stream 3	4	No	3	I	N/A	N/A
Stream 4	4	No	3	I	N/A	N/A
Ditch 5	4	No	1	E	N/A	N/A
Stream 5	4	No	1	I	N/A	N/A
Stream 6	4	No	5	I	N/A	N/A
Stream 7	4	No	2	I	N/A	N/A
Stream 8	5	No	3	I	N/A	N/A
Stream 9	5	No	3	I	N/A	N/A
Irrigation	5	No	2	I	N/A	N/A
Stream 10	5	No	4	I	N/A	N/A
Seep A	5	No	2	E	N/A	N/A
Stream 11	5	No	2	I	N/A	N/A
Stream 12	5	No	2	I	N/A	N/A
Stream 13	5	No	3	I	N/A	N/A
Ditch 6	6	No	0.5	E	N/A	N/A
Tryon Creek	6	Yes	10	P	temperature, bacteria, nutrients	temperature; bacteria

[1] Sources: PNW Ecosystem Research Consortium (2002); StreamNet (2007a); City of Portland (2007).[2] Source: URS field observations
[3] Source: DEQ 2007.
[4] The 303(d) list is a list of waterbodies (or segments of waterbodies) that do not meet their designated water quality standards as defined by Section 303(d) of the Federal Clean Water Act. These "impaired" waterbodies are reported to EPA every two years on the 303(d) list, which is maintained by DEQ.
[5] A Total Maximum Daily Load (TMDL) is a quantitative analysis of a waterbody that includes two components: (a) a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and (b) an allocation of that total amount amongst the pollutant's sources (both point and nonpoint).
[6] Flow Regime is defined as: P = Perennial, E = Ephemeral, I = Intermittent

3.8.2.3 Vegetation

The study area contains large sections of medium- and high-density commercial and residential development mixed with natural areas. Areas of commercial development include commercial buildings, roads, sidewalks and other infrastructure with limited landscaped vegetation and patches of invasive vegetation species. Residential developments include some high-density neighborhoods with limited landscaped vegetation and low-density residential areas characterized by mature landscaped vegetation and open lawns. Natural areas include the banks of the Willamette River, areas that traverse the riparian areas of Stephens Creek and Tryon Creek corridors, park land associated with Cottonwood Bay, Willamette Park, Butterfly Park, Powers Marine Park, and a few undeveloped lots. The entire project area is broadly classified as developed or composed of westside coniferous/deciduous forest. Vegetated areas consist of woodland/herbaceous plant communities composed of landscaped vegetation or a mix of landscaped and natural vegetation.

Of note are individual Oregon white oak (*Quercus garryana*) trees located in Willamette Park in proximity to the rail alignment. Oregon white oaks are rare in the region and there is concern over potential impacts to these trees. Current design shows the Streetcar Alternative potentially impacting several white oaks by encroaching within the drip line. At this level of design, specific avoidance and minimization measures have not been evaluated, but which will be developed and employed to the extent practicable.

3.8.2.4 Wildlife

Wildlife species that occur within the study area include small mammals, reptiles, amphibians and birds. Many of these species are commonly found in urban habitats and use available habitats for foraging, nesting, cover and movement (habitat connectivity) purposes. They are generally adapted to life in urbanized areas, often occurring in edge habitats that exist along the boundaries of different habitat types. Bird species are the largest group of animals that occur in urban areas, including the study corridor. Raptor species, such as peregrine falcons and bald eagles, use some of the study area for nesting, foraging and migration activities.

Mammals in urban areas are usually found near larger undisturbed habitats. Mammals expected to occur in the project vicinity include: Virginia opossum, Eastern cottontail, raccoon, coyote, fox squirrel, vole, bat species, house mice and Norway rat. Black-tailed deer utilize habitat adjacent to the Willamette River and its tributaries as well as forested habitat areas. Urban areas are usually characterized by fragmented noncontiguous habitats and generally limit movements of ambulatory species. The study area is primarily located along existing streets and railways which may create a barrier to wildlife movement.

3.8.2.5 Fisheries

Fisheries resources in the study area include perennial, intermittent and ephemeral streams with the potential to provide habitat for fish. Waterbodies in the study area originate in the hills west of the corridor (the southern extent of Portland's West Hills) and discharge into the Lower Willamette River Subbasin. Tryon Creek, Stephens Creek and Terwilliger Creek comprise the named drainages crossed by the Willamette Shore Line right of way. Smaller unnamed drainages are found within the Johns Landing, Sellwood Bridge and Dunthorpe/Riverdale segments of the corridor, with the majority in the Powers Marine Park area (See Figure 3.8-2 and Table 3.8-4).

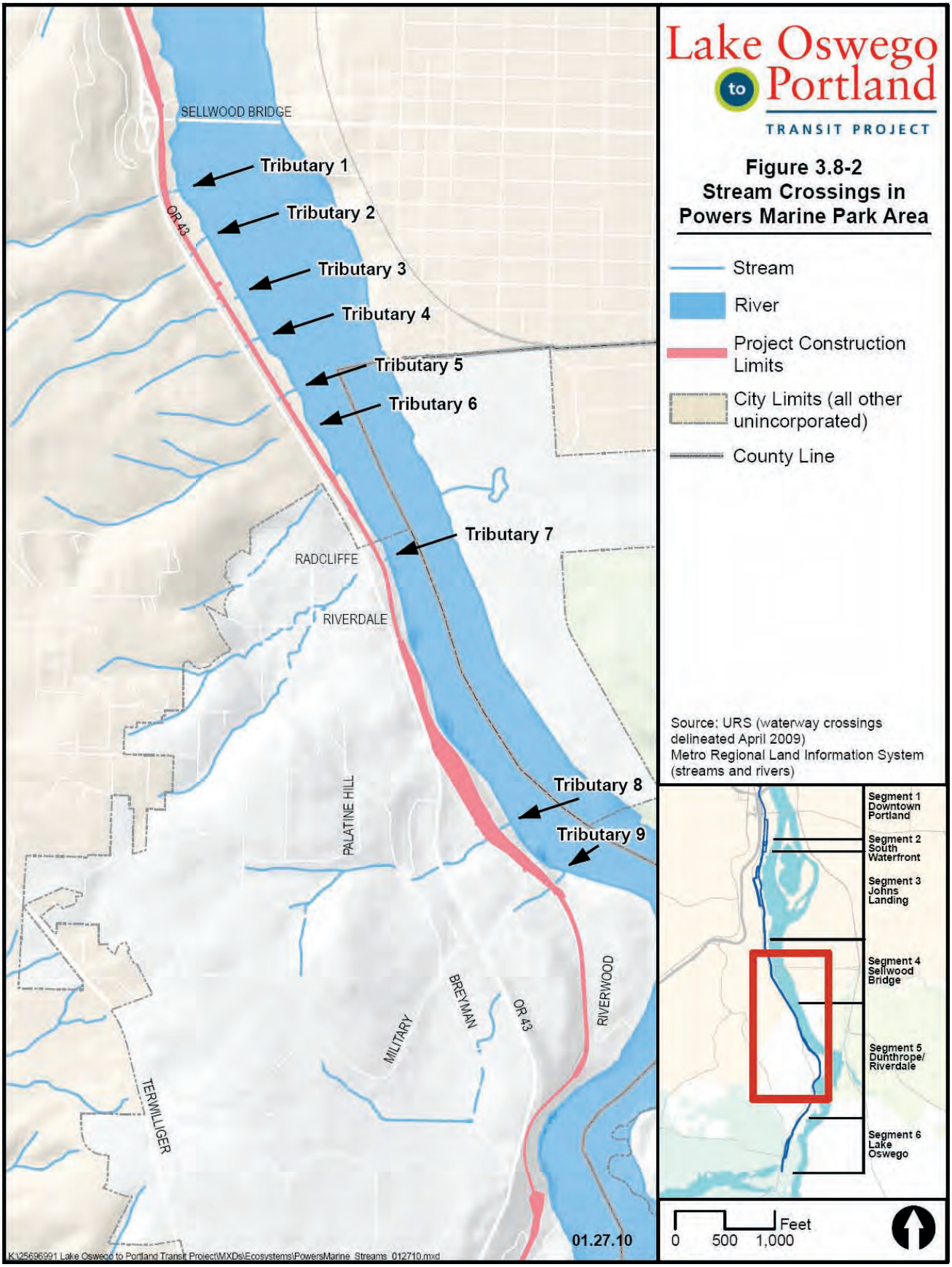

Lake Oswego to Portland
TRANSIT PROJECT
Figure 3.8-2
Stream Crossings in
Powers Marine Park Area
Stream
River
Project Construction Limits
City Limits (all other unincorporated)
County Line
Source: URS (waterway crossings delineated April 2009)
Metro Regional Land Information System (streams and rivers)
SELLWOOD BRIDGE
Tributary 1
Tributary 2
Tributary 3
Tributary 4
Tributary 5
Tributary 6
Tributary 7
Tributary 8
Tributary 9
OR 43
RADCLIFFE
RIVERDALE
PALATINE HILL
MILITARY
BREYMAN
OR 43
RIVERWOOD
TERWILLIGER
Segment 1 Downtown Portland
Segment 2 South Waterfront
Segment 3 Johns Landing
Segment 4 Sellwood Bridge
Segment 5 Dunthrope/ Riverdale
Segment 6 Lake Oswego
Feet
0 500 1,000
01.27.10
K:\25696991 Lake Oswego to Portland Transit Project\MXDs\Ecosystems\PowersMarine_Streams_012710.mxd

Table 3.8-4 Stream Crossings within the Project Corridor

Stream Name (or Identifier)	Segment	Station[1] (Approx.)	Culvert ID Number	Description/Notes
Terwilliger Creek	3 - Johns Landing	Varies	N/A	Creek is piped under much of Johns Landing and does not daylight within the project corridor. Creek alignment has been altered such that it flows south, under Macadam Avenue, until it turns east at SW Carolina Street and continues in its pipe out to the Willamette River.
Unnamed Tributary to Terwilliger Creek #1	3 - Johns Landing	Varies	N/A	Creek is piped under much of Johns Landing and does not daylight within the project corridor. Creek is intercepted by the piped section of Terwilliger Creek and conveyed in the same pipe to the Willamette River.
Unnamed Tributary to Terwilliger Creek #2	3 - Johns Landing	Varies	N/A	Creek is piped under much of Johns Landing and does not daylight within the project corridor. Creek is intercepted by the piped section of Terwilliger Creek and conveyed in the same pipe to the Willamette River.
Unnamed Tributary to Willamette River #1	3 - Johns Landing	Unknown	N/A	Creek is piped under much of Johns Landing and does not daylight within the project corridor.
Stephens Creek	4 - Sellwood	1093+43	46	Twin 48-inch pipe culverts convey Stephens Creek under the rail grade, which is downstream from the Highway 43 culverts, which are identified fish passage barriers.
Unnamed Tributary to Willamette River #2	4 - Sellwood	2009+46	40	Single 24-inch CMP culvert conveys tributary into Powers Marine Park. Culvert under Highway 43 constitutes a complete passage barrier.
Unnamed Tributary to Willamette River #3	4 - Sellwood	2016+78	39	Single 24-inch CMP culvert conveys tributary into Powers Marine Park. Culvert under Highway 43 constitutes a complete passage barrier.
Unnamed Tributary to Willamette River #4	4 - Sellwood	2025+86	36	Single 48-inch wood box culvert conveys tributary into Powers Marine Park. Culvert under Highway 43 constitutes a complete passage barrier.
Unnamed Tributary to Willamette River #5	4 - Sellwood	2026+04	34	Single 18-inch CMP culvert conveys tributary into Powers Marine Park. Culvert under Highway 43 constitutes a complete passage barrier.
Unnamed Tributary to Willamette River #6	4 - Sellwood	2033+39	31	Single 12-inch CMP culvert conveys tributary into Powers Marine Park. Culvert under Highway 43 constitutes a complete passage barrier.
Unnamed Tributary to Willamette River #7	4 - Sellwood	2037+35	29	Single 24-inch CMP culvert conveys tributary into Powers Marine Park. Culvert under Highway 43 constitutes a complete passage barrier.
Unnamed Tributary to Willamette River #8	4 - Sellwood	2042+90	27	Culvert conveys tributary into Powers Marine Park. Culvert under Highway 43 constitutes a complete passage barrier.
Unnamed Tributary to Willamette River #9	5 - Dunthorpe/ Riverdale	2053+64	25	Culvert conveys tributary down steep hillslope to Willamette River. Gradient of downstream reach prevents upstream passage of fish.
Unnamed Tributary to Willamette River #10	5 - Dunthorpe/ Riverdale	Approx.206 3+60	N/A	Trestle Crossing over tributary.
Unnamed Tributary to Willamette River #11	5 - Dunthorpe/ Riverdale	Approx. 2067-2074	N/A	Trestle Crossing over tributary.
Tryon Creek	6 - Lake Oswego	3017+00	1	An eight foot concrete box culvert conveys Tryon Creek under combined rail crossing and Highway 43 crossing. Total culvert length is 400 feet. Culvert is believed to be fish passage barrier for certain species under certain flow conditions.

Source: Information based on URS field survey of project corridor, Fall 2009. DEA Impact Analysis of URS GIS data, Fall 2009.
[1]*Lake Oswego to Portland Streetcar Plan Set*, URS, 2009.

Stream habitat quality varies within the study area, with all streams demonstrating some degree of impairment from urban development. Current impacts include invasive species, encroachment, deforestation, stream channelization/piping, channel incision, floodplain filling, storm water runoff,

and alterations disconnecting stream flows from historic channels and flood prone areas. Intensity of existing impacts is typically dependent on adjacent land uses and existing barriers to fish passage and upstream habitat access. Aquatic resources are described in the following paragraphs.

The **Lower Willamette River Subbasin** is the basin into which all streams within the study area discharge. While the study alternatives would not cross the Willamette River, there are portions of the study area that fall within the Willamette River's 100-year floodplain. The Lower Willamette Subbasin supports numerous native and non-native species, including Lower Columbia River chinook salmon and Upper Willamette River chinook salmon (*Oncorhynchus tshawytscha*), Lower Columbia River coho salmon (*O. kisutch*), resident and coastal (Columbia River) cutthroat trout (*O. clarki*), Lower Columbia River steelhead and Upper Willamette steelhead (*O. mykiss*), green sturgeon (*Acipenser medirostris*), Pacific lamprey (*Lampetra tridentatus*) and Western brook lamprey (*L. richardsoni*).[56] Although bull trout (*Salvelinus confluentus*) typically are found in cold, clear streams at relatively high elevations, they may use portions of the Columbia River, and perhaps the Willamette River, seasonally. Consequently, although their presence in the study area is unlikely and is not documented, they could occur in the area during winter and spring months.

Tryon Creek is the largest tributary watershed within the study area (4,200 acres). Approximately 640 acres surrounding the main stem of Tryon Creek is protected in the Tryon Creek State Natural Area Park. Fish and amphibian passage is limited by a 400-foot culverted section located under the existing rail alignment and Highway 43. Tryon Creek maintains habitat for resident and coastal (Columbia River) cutthroat trout and Lower Columbia River steelhead trout in its lower, middle and upper watershed, while providing habitat for Pacific lamprey, Western brook lamprey, Lower Columbia River chinook salmon and Lower Columbia River coho salmon in stream reaches below the Highway 43 culvert.[57,58]

In 2008 the Oregon Department of Transportation completed the initial phase of a stream enhancement project upstream and downstream of the Highway 43 culvert and modified the culvert to improve fish passage. The City of Portland's Bureau of Environmental Services is conducting the second phase of the project that will enhance riparian conditions from the confluence with the Willamette River upstream to the work completed in the initial phase.[59]

Three **unnamed tributaries in the Dunthorpe/ Riverdale segment** are a mix of perennial and intermittent tributaries to the Willamette River. These creeks originate on the steep slopes of Palatine Hill, passing under Highway 43 in culverts and frequently flowing into manmade, ornamental water features before cascading down to the Willamette River. The gradient of these streams in their lower watersheds likely precludes habitat access by fish resources, though no studies have been conducted to confirm this assumption.

The **unnamed tributaries in the Powers Marine Park area** are a mix of perennial and intermittent tributaries to the Willamette River. The Bureau of Environmental Services is currently evaluating

[56] Tinus, E. S., J. A. Koloszar, and D. L. Ward. 2003. Abundance and distribution of fish in City of Portland streams, Volume 1 & 2. Final report to the City of Portland, Portland, Oregon.
[57] Henderson Land Services. 2007. Tryon Creek @ Hwy 43 Culvert Alternates Analysis. June 2007.
[58] Graham, J. C., and D. L. Ward. 2002. Distribution of fish in Portland tributary streams. Final Report by the Oregon Department of Fish and Wildlife to the City of Portland Endangered Species Act Program, Portland, Oregon.
[59] Tryon Creek Confluence Habitat Enhancement Project. City of Portland on-line webpage. Accessed on 7/15/2010 at: http://www.portlandonline.com/bes/index.cfm?a=225319&c=46964

these drainages for suitable fish habitat and fish use. These creeks originate on the steep slopes of Palatine Hill, passing under Highway 43 through culverts that create complete barriers to upstream fish. Culvert crossings under the existing rail alignment may present upstream passage barriers for fish, as well.[60]

Stephens Creek watershed comprises approximately 760 acres with land use dominated by residential development and the Riverview Cemetery. Upstream fish passage is blocked by the culvert under Highway 43, but Pacific and Western brook lamprey, Lower Columbia River chinook and Lower Columbia coho salmon, resident and coastal cutthroat trout, and steelhead are all present downstream of the barrier culvert (Graham and Ward 2002).[61] The City of Portland has completed a stream restoration project to enhance fish habitat at the confluence of Stephens Creek with the Willamette River.[62]

Terwilliger Creek and three unnamed tributaries are a mix of perennial and intermittent streams that drain the hills west of Johns Landing. The Terwilliger Creek watershed is approximately 345 acres in area, the lower portion of which has been piped under the developed portion of Johns Landing, including the project corridor. The unnamed tributaries are similarly piped under Johns Landing and the project corridor. No fish or amphibian passage is expected in any of these drainages.

The Oregon Department of Fish and Wildlife (ODFW) has conducted fish presence, distribution and density studies within Tryon and Stephens creeks. Sampling results indicate that both native and non-native species can be found in these streams, including TES species.[63] Studies on these two creeks indicate that the culverts that convey these streams through the project corridor constitute a partial passage barrier for Tryon Creek[64] and a complete passage barrier in the case of Stephens Creek.[65] The Tryon Creek culvert is ranked as the City's highest fish passage priority by the Bureau of Environmental Services.[66] Additional features of streams crossed by the existing rail alignment are detailed in Table 3.8-4.

3.8.2.6 Threatened, Endangered and Sensitive Species

Threatened and endangered species include those species listed as threatened or endangered, proposed for listing or candidates for listing under the federal ESA[67,68] and the Oregon ESA.[69] Sensitive species are categorized as Species of Concern (SOC) by federal agencies and by ODFW

[60] Bushman, M. 2010. Personal Communication with Mary Bushman, Bureau of Environmental Services. January 2010.
[61] Graham, J. C., and D. L. Ward. 2002. Distribution of fish in Portland tributary streams. Final Report by the Oregon Department of Fish and Wildlife to the City of Portland Endangered Species Act Program, Portland, Oregon.
[62] Communication from Nancy Gronowski, Park Planner with Portland Parks and Recreation. May 5, 2010.
[63] Gronowski. 2010.
[64] Henderson Land Services 2007
[65] Tinus et al. 2003
[66] Communication from Kaitlin Lovell, Biologist with Bureau of Environmental Services, May 5, 2010.
[67] US Fish and Wildlife Service (USFWS) 2009a. Federally Listed, Proposed, Candidate species and species of concern under the Jurisdiction of the Fish and Wildlife Service which may occur in Clackamas County, Oregon. Accessed on December 11, 2009 at www.fws.gov/oregonfwo/Species/Lists/Documents/County/CLACKAMAS %20COUNTY.pdf
[68] USFWS 2009b. Federally Listed, Proposed, Candidate species and species of concern under the Jurisdiction of the Fish and Wildlife Service which may occur in Multnomah County, Oregon. Accessed on December 11, 2009 at www.fws.gov/oregonfwo/Species/Lists/Documents/County/MULTNOMAH %20COUNTY.pdf
[69] Oregon Department of Fish and Wildlife (ODFW) 2009. Threatened and Endangered Species List. Accessed on December 11, 2009 at: http://www.dfw.state.or.us/wildlife/diversity/species/threatened_endangered_species.asp

through the Oregon Sensitive Species lists.[70] In addition, other entities may denote the special status of species including the City of Portland and the Oregon Natural Heritage Information Center (ORNHIC).[71] Threatened, endangered and sensitive species (collectively TES species) are addressed in this evaluation if there is a presumption or evidence of their presence. TES species are identified in Table 3.8-5, with state and federal threatened and endangered species presented first, followed by sensitive species.

Of the species identified in Table 3.8-5, only a subset are evaluated in this assessment. Exclusion of species from assessment is due to the absence of the species from the project vicinity, lack of suitable habitat conditions within the project area, or the presumed extinction of a species locally or regionally. Species excluded from evaluation are discussed fully in the *Lake Oswego to Portland Transit Project Ecosystems Technical Report* and indicated in Table 3.8-5 as not occurring in the project study area. Table 3.8-6 summarizes the status of TES species that occur in the study.

ORNHIC, NMFS, and USFWS identify ten native TES fish species comprising thirteen Evolutionarily Significant Units (ESU)[72] /Distinct Population Segments (DPS)[73] that could potentially occur in study area streams. Of these, four species, comprising six ESU/DPS occur in the study area and are listed as threatened under the Federal ESA. Three species are identified as SOC and occur in the study area. As listed in Table 3.8-5, waterbodies within the study area that support some or all of these species include the Willamette River, Tryon Creek, and Stephens Creek.[74,75] It is possible that the unnamed tributaries that drain to the Powers Marine Park area provide limited off-channel habitat for species in the Willamette River during periods of high water; however, such habitat is limited to stream reaches downstream of passage barriers under the existing rail line and Highway 43.

[70] ODFW 2009. 2008 Sensitive Species List. Accesses on December 11, 2009 at: http://www.dfw.state.or.us/wildlife/diversity/species/sensitive_species.asp

[71] Oregon Natural Heritage Information Center (ORNHIC). December 9, 2009. Data system search for threatened and endangered plant and animal records for the Lake Oswego to Portland Transit Project.

[72] An ESU is a distinct local population within a species that has very different behavioral and phenological traits and thus harbors enough genetic uniqueness to warrant its own management and conservation agenda. NMFS uses the ESU as the smallest management unit warranting listing under the Endangered Species Act for anadromous salmonids, excluding steelhead, which employs the DPS terminology.

[73] A DPS is the smallest management unit warranting listing under the Endangered Species Act. Species, as defined in the ESA for listing purposes, is a taxonomic species or subspecies of plant or animal, or in the case of vertebrate species, a distinct population segment (DPS).

[74] Streamnet. On-line query of fish distribution in project area streams. Accessed on 01/15/10 at: http://www.streamnet.org/

[75] Graham and Ward 2002.

Table 3.8-5 Species with Federal and/or State Status Potentially Occurring in the Project Vicinity

Common Name	Scientific Name	Federal Status	State Status	Tryon Creek	Stephens Creek	Willamette River	Occurs in Project Study Area	Critical Habitat in Study Area
Threatened and Endangered								
Mammals								
Columbian white-tailed deer	*Odocoileus virginianus leucurus*	LE	SV	-	-	-	No	NA
Steller sea lion (Eastern Stock)	*(Eumetopias jubatus)*	LT	-	-	-	-	No	No
Avians								
Bald eagle	*Haliaeetus leucocephalus*	DL	LT	-	-	X	Yes	NA
Northern spotted owl	*Strix occidentalis caurina*	LT	-	-	-	-	No	No
Streaked horned lark	*Eremophila alpestris strigata*	C	SC	-	-	-	No	NA
Fish								
Lower Columbia River Coho Salmon ESU[1]	*Oncorhynchus kisutch*	LT	LE	X	X	X	Yes	No
Lower Columbia River Steelhead DPS	*O. mykiss*	LT	SC	X	X	X	Yes	Yes
Upper Willamette River Steelhead DPS	*O. mykiss*	LT	SV			X	Yes	Yes
Lower Columbia River Chinook Salmon ESU[1]	*O. tshawytscha*	LT	SC	X	X	X	Yes	Yes
Upper Willamette River Chinook Salmon ESU[1]	*O. tshawytscha*	LT	-	-	-	X	Yes	Yes
Bull trout	*Salvelinus confluentus*	LT	SC	-	-	X	No	No
Green sturgeon (southern DPS)	*Acipenser medirostris*	LT	-	-	-	X	Yes	No
Oregon chub	*Oregonichthys crameri*	LE	SC	-	-	-	No	No
Pacific eulachon/smelt (southern DPS)	*Thleichthys pacificus)*	LT	-	-	-	-	No	No
Plants								
Bradshaw's desert parsley	*Lomatium bradshawii*	LE	-	-	-	-	No	No
Nelson's checker-mallow	*Sidalcea nelsoniana*	LT	-	-	-	-	No	No
Water howellia	*Howellia aquatilis*	LT	-	-	-	-	No	No
White rock larkspur	*Delphenium leucophaeum*	SOC	LE	-	-	X	No	No
White-topped aster	*Sericocarpus rigidus*	SOC	LT	-	-	-	No	NA
Willamette daisy	*Erigeron decumbens var. decumbens*	LE	-	-	-	-	No	No
Northern wormwood	*Artemisia campestris var. wormskioldii*	C	-	-	-	-	No	NA
Oregon sullivantia	*Sullivantia oregano*	SOC	C	-	-	-	No	NA
Tall bugbane	*Cimicifuga elata var. elata*	-	C	-	-	-	No	NA
Sensitive Species								
Mammals								
California wolverine	*Gulo gulo luteus*	SOC	-	-	-	-	No	NA
Camas pocket gopher	*Thomomys bulbivorus*	SOC	-	-	-	-	No	NA
Fringed myotis bat	*Myotis thysanodes*	SOC	SV	-	-	-	No	NA
Long-eared myotis bat	*M. evotis*	SOC		-	-	-	No	NA
Long-legged myotis bat	*M. volans*	SOC	SV	-	-	-	No	NA
Pallid bat	*Antrozous pallidus pacificus*	SOC	SV	-	-	-	No	NA

Table 3.8-5 Species with Federal and/or State Status Potentially Occurring in the Project Vicinity

Common Name	Scientific Name	Federal Status	State Status	Tryon Creek	Stephens Creek	Willamette River	Occurs in Project Study Area	Critical Habitat in Study Area
Red tree vole	*Arborimus longicaudus*	SOC	SV	-	-	-	No	NA
Silver-haired bat	*Lasionycteris noctivagans*	SOC	SV	-	-	-	No	NA
Townsend's western big-eared bat	*Corynorhinus townsendii townsendii*	SOC	SC	-	-	-	No	NA
Yuma myotis bat	*M. yumanensis*	SOC	-	-	-	-	No	NA
Avians								
Acorn woodpecker	*Melanerpes formicivorus*	SOC	-	-	-	-	No	NA
Band-tailed pigeon	*Patagioenas fasciata*	SOC	-	-	-	X	Yes	NA
Harlequin duck	*Histrionicus histrionicus*	SOC	-	-	-	-	No	NA
Lewis' woodpecker	*Melanerpes lewis*	SOC	SC	-	-	-	No	NA
Mountain quail	*Oreortyx pictus*	SOC	SV	-	-	-	No	NA
Northern goshawk	*Accipiter gentilis*	SOC	SV	-	-	-	No	NA
Olive-sided flycatcher	*Contopus cooperi*	SOC	SV	-	X	-	Yes	NA
Oregon vesper sparrow	*Pooecetes gramineus affinis*	SOC	SC	-	-	-	No	NA
Peregrine falcon	*Falco peregrinus anatum*	DL	SV	-	-	X	Yes	NA
Purple martin	*Progne subis*	SOC	SC	-	-	-	No	NA
Tricolored blackbird	*Agelaius tricolor*	SOC	-	-	-	-	No	NA
Western burrowing owl	*Athene cunicularia hypugaea*	SOC	SC	-	-	-	No	NA
Yellow-breasted chat	*Icteria virens gramineus affinis*	SOC	SC	-	-	-	No	NA
Amphibians & Reptiles								
Cascades frog	*Rana cascadae*	SOC	SV	-	-	-	No	NA
Coastal tailed frog	*Ascaphus truei*	SOC	SV	-	-	-	No	NA
Larch Mountain salamander	*Plethodon larselli*	SOC	SV	-	-	-	No	NA
Northern red-legged frog	*R. aurora aurora*	SOC	SV	-	-	-	No	NA
Northern Pacific pond turtle	*Actinemys marmorata marmorata*	SOC	SC	-	-	-	No	NA
Oregon slender salamander	*Batrachoceps writorum*	SOC	SV	-	-	-	No	NA
Oregon spotted frog	*R. pretiosa*	SOC	SC				No	NA
Western painted turtle	*Chrysemys picta bellii*	SOC	SC	-	-	-	Yes	NA
Fish								
Resident and coastal cutthroat trout (Columbia River ESU)	*O. clarki*	SOC	SV	X	X	X	Yes	NA
Green sturgeon (northern DPS)	*A. medirostris*	SOC	-	-	-	X	Yes	NA
Pacific lamprey	*Lampetra tridentatus*	SOC	SV	X	X	X	Yes	NA
Western brook lamprey	*L. richardsoni*	SOC	SV	X	X	X	Yes	NA
Plants								
Barrett's penstemon	*Penstemon barrettiae*	SOC	-	-	-	-	No	NA
Cliff paintbrush	*Castilleja rupicola*	SOC	-	-	-	-	No	NA
Cold-water corydalis	*Corydalis aquae-gelidae*	SOC	-	-	-	-	No	NA
Henderson's checker-mallow	*S. hendersonii*	SOC	-	-	-	-	No	NA

Table 3.8-5 Species with Federal and/or State Status Potentially Occurring in the Project Vicinity

Common Name	Scientific Name	Federal Status	State Status	Tryon Creek	Stephens Creek	Willamette River	Occurs in Project Study Area	Critical Habitat in Study Area
Howell's bentgrass	*Agrostis howellii*	SOC	-	-	-	-	No	NA
Howell's daisy	*E. howellii*	SOC	-	-	-	-	No	NA
Oregon fleabane	*E. oreganus*	SOC	-	-	-	-	No	NA
Pale blue-eyed grass	*Sisyrinchium sarmentosum*	SOC	-	-	-	-	No	NA
Peacock larkspur	*D. pavonaceum*	SOC	-	-	-	-	No	NA
Snake River goldenweed	*Pyrrocoma radiata*	SOC	-	-	-	-	No	NA
Thin leaved peavine	*Lathyrus holochlorus*	SOC	-	-	-	-	No	NA
Willamette Valley larkspur	*D. oreganum*	SOC	-	-	-	-	No	NA

Table Key: DPS = Distinct Population Segment, ESU = Evolutionarily Significant Unit, SOC = Species of Concern, LT = Listed Threatened, LE = Listed Endangered, C = Candidate, SC = Sensitive Critical, SV = Sensitive Vulnerable, DL = De-listed.
Sources: USFWS (2009a); USFWS (2009b); PNW Ecosystem Research Consortium (2002); StreamNet (2010); City of Portland (2007); ODFW (2002); NMFS (2007). Streamnet (2010).
[1] Essential Fish Habitat, as designated under the Magnuson-Stevens Fishery Conservation Management Act, exists for these species in the project area.

The USFWS identified three federal TES plants species that may occur within Multnomah County[76] and five federal TES plant species that may occur within Clackamas County.[77] The ORNHIC database identified five state and federal TES botanical species within the two-mile search area. The majority of recorded occurrences are outside of the 250-foot wide study corridor. Of those species potentially occurring within the 250-foot study corridor, several are historic records and represent species that are not likely still within the project area. Field investigations did not observe any TES plant species within the study area. Additional literature search and contact with state resource agencies identified botanical TES and terrestrial species that may occur in the study corridor, but were ruled-out upon further investigation. Species ruled-out are discussed fully in the *Lake Oswego to Portland Transit Project Ecosystems Technical Report* and indicated in Table 3.8-5 as not occurring in the project study area.

[76] U.S. Fish and Wildlife Service (USFWS). 2009. Federally Listed, Proposed, Candidate Species and Species of Concern Under the Jurisdiction of the Fish and Wildlife Service which may occur in Multnomah County, Oregon. Northwest Habitat Field Office. Portland, Oregon. Last updated May 16, 2009.
[77] USFWS. 2009. Federally Listed, Proposed, Candidate Species and Species of Concern Under the Jurisdiction of the Fish and Wildlife Service which may occur in Clackamas County, Oregon. Northwest Habitat Field Office. Portland, Oregon. Last updated May 16, 2009.

The USFWS, ORNHIC and ODFW identify five TES wildlife species that may occur within the project vicinity. Of these, four are avian species and one is a turtle. For purposes of this assessment, the Western painted turtle is assumed to be impacted by those project activities that affect either aquatic or terrestrial, riparian habitats. Analysis of aquatic and terrestrial habitats presumes the potential to impact the painted turtle, unless specifically excluded. Of the avian species identified, both peregrine falcon and bald eagle have nested in the project vicinity, though documented nests occur outside the quarter-mile threshold for noise disturbance resulting in take.[78,79,80] Consequently, project activities may affect forage and perch habitat, but are unlikely to directly result in impacts to nesting habitats. It is possible that both band-tailed pigeons and olive-sided flycatchers utilize habitat in the project study area for nesting, foraging and cover/movement.

The list of TES species considered as likely to occur in the study area or potentially impacted by project construction and/or operation, include those identified in Table 3.8-6, below.

Table 3.8-6 TES Species Likely Occurring in the Project Vicinity

Common Name	Federal Status	State Status
Lower Columbia River Coho Salmon ESU	LT	LE
Lower Columbia River Steelhead DPS	LT	SC
Upper Willamette River Steelhead DPS	LT	SV
Lower Columbia River Chinook Salmon ESU	LT	SC
Upper Willamette River Chinook Salmon ESU	LT	-
Green Sturgeon (southern DPS)	LT	-
Bald eagle	DL	LT
Band-tailed pigeon	SOC	-
Olive-sided flycatcher	SOC	SV
Peregrine falcon	DL	SV
Western painted turtle	SOC	SC
Columbia River cutthroat trout ESU	SOC	SV
Green Sturgeon (northern DPS)	SOC	-
Pacific lamprey	SOC	SV
Western brook lamprey	SOC	SV

Table Key: DPS = Distinct Population Segment, ESU = Evolutionarily Significant Unit, SOC = Species of Concern, LT = Listed Threatened, LE = Listed Endangered, SC = Sensitive Critical, SV = Sensitive Vulnerable, DL = De-listed.
Sources: USFWS (2009a); USFWS (2009b); PNW Ecosystem Research Consortium (2002); StreamNet (2010); City of Portland (2007); ODFW (2002); NMFS (2007). Streamnet (2010).

[78] ORNHIC. December 9, 2009. Data system search for threatened and endangered plant and animal records for the Lake Oswego to Portland Transit Project.
[79] Oregon Department of Transportation (ODOT). 2008. Endangered Species Act Guidance Manual. ODOT Geo-Environmental Section. Salem OR. June 2008.
[80] Isaacs and Anthony. 2009. Bald eagle nest locations and history of use in Oregon and the Washington portion of the Columbia River Recovery Zone, 1971 through 2008. Oregon Cooperative Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University. Corvallis, Oregon.

3.8.3 Environmental Impacts to Ecosystems

This section provides the analyses of potential environmental consequences to ecosystem resources from the study alternatives as described in Chapter 2. The effects could include long-term (during operations), short-term (during construction) and cumulative effects to ecosystem resources. Construction effects are discussed separately in Section 3.16 of this DEIS. Further analysis of specific effects, such as precise volumes of removal/fill activities, precise areas of vegetation removal, and hydraulic effects on streams, will be further evaluated during the preliminary engineering phase and during the natural resource permitting processes.

3.8.3.1 No Build Alternative

Long-Term Direct Effects
The No-Build Alternative would not include new transit construction and, therefore, would have no direct impacts to wetlands, vegetation, wildlife, fisheries or TES species or habitats.

Long-Term Indirect Effects
Potential indirect effects associated with the No-Build Alternative could include increased pollutant loading associated with increasing traffic and congestion on roadways throughout the project area. Increased congestion accelerates brake pad wear and, because brake pads contain metals such as copper and zinc, increased wear results in increased deposition of metals on roadways and parking lots. These pollutants subsequently are transported to project-area streams and wetlands by stormwater runoff. The same rationale applies to other motor vehicle pollutants such as oil and grease, whose deposition on impervious areas and concentrations in stormwater runoff also increase with increasing traffic and congestion. While traffic and congestion would increase over time with all project alternatives, the No-Build Alternative would be associated with worse congestion than the Enhanced Bus or Streetcar alternatives.

Furthermore, most of the area's transportation facilities and adjacent developments were built prior to current stormwater management practices. Therefore, pollutant loading in stormwater runoff from impervious surfaces would continue to flow untreated or undertreated to project area streams and wetlands until redevelopment occurs (See Section 3.9.3.4 for further discussion of potential effects to water quality/water quantity).

It is possible for the No-Build Alterative to result in long-term degradation of aquatic resources as a result of incremental habitat impacts associated with the existing conditions. Should the No-Build Alternative become the Locally Preferred Alternative, no measures retarding long-term indirect impacts associated with increasing peak hour vehicle trips would be implemented. Consequently, fish habitat would be incrementally impaired as a result of continuing stormwater pollutant loading. Untreated and undertreated stormwater runoff would have long-term negative impacts on fishes and fish habitats. Furthermore, culverts passing under the rail alignment may constitute a barrier to upstream fish passage, particularly in the Sellwood Bridge Segment. The No-Build Alternative would not provide this opportunity to replace these culverts with structures designed to allow for fish passage.

The No-Build Alterative could result in impacts to aquatic TES species' habitats as a result of incremental habitat impacts associated with the existing conditions. Should the No-Build Alternative become the Locally Preferred Alternative, no measures regarding long-term indirect impacts associated with increasing peak hour vehicle trips would be implemented. Consequently, TES aquatic

habitat would be incrementally impaired as a result of continuing stormwater pollutant loading. Untreated and undertreated stormwater runoff would have long-term negative impacts on TES fishes and turtles, including critical habitats (where designated). Furthermore, culverts passing under the rail alignment may constitute a barrier to upstream fish and turtle passage, particularly in the Sellwood Bridge Segment. The No-Build Alternative would not provide the opportunity to replace these culverts with structures designed to allow for fish or small animal passage. The No-Build Alternative would have no effect on avian TES species or their habitat.

While no Section 7 ESA consultation would occur under the No-Build Alternative, it is anticipated that it could affect, and is likely to adversely affect, TES fish and turtle species within the study area and connected aquatic habitats. It would not destroy or adversely modify designated critical habitat; however, it is likely to adversely affect essential fish habitat (EFH), primarily because the existing conditions incrementally degrade, over time, the aquatic habitats used by Magnuson-Stevens Fisheries Conservation Act (MSA)-regulated species.

Cumulative Effects

It is projected that there will be slow to moderate new development and some redevelopment in the Portland central city, South Waterfront area, Johns Landing/North Macadam area and in the Lake Oswego town center. The Foothills District located within the Lake Oswego town center is also expected to redevelop in the future. Future plans include mixed-use development with associated urban infrastructure such as new roadway network. Additionally, bicycle and pedestrian facilities associated with the proposed construction of the Portland to Lake Oswego Trail Project, may provide non-motorized vehicular facilities within the study area. Planned projects include street improvements and a new bridge over Tryon Creek. However, use of such a trail system for peak hour travel is expected to have only minimal effects on overall traffic patterns and congestion. It is unlikely that these actions would result in large amounts of vegetation removal.

In addition, the metropolitan area will likely continue to develop pursuant to existing land use and zoning regulations, including requirements to protect and mitigate for sensitive environmental resources. Cumulative effects of the No-Build Alternative may occur as a result of any or all of the past, present and reasonably foreseeable future infrastructure and development projects. Over time, these factors have reduced the extent and diversity of the region's ecosystems. The No-Build Alternative could exacerbate the decline of ecosystem health by failing to slow the increase in personal automobile usage in the region and encouraging growth in a manner that is inconsistent with regional density goals. As previously discussed, increased motor traffic on Highway 43 may lead to a degradation of wetlands and streams within the project due to increased pollutant loading. The No-Build Alternative would not create these opportunities to treat additional runoff prior to discharge to area waterbodies.

3.8.3.2 Enhanced Bus Alternative

Long-Term Direct Effects

The Enhanced Bus Alternative would not result in long-term direct effects to wetlands, vegetation, or wildlife, fisheries or TES species or habitats. It would change the existing bus service by eliminating some stops and increasing frequency without major modification to existing roadway infrastructure. An additional two-way road between the proposed 300-space park-and-ride lot and Foothills Road would accommodate some commuter traffic. The park-and-ride facility would be located within the existing Lake Oswego Village shopping center parking area, where no significant ecosystem resources exist.

Long-Term Indirect Effects

Long-term indirect effects of the Enhanced Bus Alternative could increase transit ridership and could reduce the projected increase in peak hour vehicle use by commuters as the population and development increases. The Enhanced Bus Alternative would utilize existing infrastructure (roadway, bus stops) to improve transit. With the exception of a new park and ride facility, no additional impervious surface would be added. However, the buses would operate within a congested corridor, thus contributing to increased adverse effects of traffic and congestion on roadways in the study area. Increased congestion could result in increased deposition of pollutants such as metals, oil and grease on roadways and these pollutants would subsequently be transported to area streams and wetlands by stormwater runoff. Compared with the No-Build Alternative, this alternative may result in a long-term benefit to water quality by reducing the number of peak hour vehicle trips and reducing overall traffic and congestion within the project corridor. With a reduction in vehicles and congestion on Highway 43, fewer pollutants would be added to roadway runoff, compared with the No-Build Alternative (See Section 3.9.3.4 for further discussion of potential effects to water quality/water quantity). Similar to the No-Build Alternative, the Enhanced Bus Alternative would not provide the opportunity to replace culverts passing under the rail alignment in the Sellwood Bridge Segment with structures designed to allow for fish and turtle passage compared to the Streetcar Alternative. The Enhanced Bus Alternative would have no effect on avian TES species or their habitat.

Section 7 ESA consultation may not be required under the Enhanced Bus Alternative; however, based on preliminary information, it is anticipated that the Enhanced Bus Alternative may affect, and is likely to adversely affect, aquatic TES species within the project corridor and connected aquatic habitats as a result of incremental degradation of water quality from stormwater pollutants. It would not destroy or adversely modify designated critical habitat; however, it is likely to adversely EFH, primarily because the existing conditions incrementally degrade, over time, the aquatic habitats used by MSA-regulated species.

Cumulative Effects

As discussed above for the No-Build Alternative it is expected that there will be slow to moderate new development and some redevelopment in the Portland central city, South Waterfront area, Johns Landing/North Macadam area and in the Lake Oswego town center, including redevelopment of the Foothills District. Cumulative impacts from the Enhanced Bus Alternative may produce positive effects by reducing overall daily, peak hour vehicle trips, thereby reducing additional stormwater pollutants to local wetlands or waterways. This consequence is regarded as a positive effect of the Enhanced Bus Alternative. Additionally, bicycle and pedestrian facilities associated with the proposed construction of the Portland to Lake Oswego Trail project, may provide non-motorized vehicular transportation alternatives within the project corridor. However, use of such a trail system for peak hour transit is expected to have minimal effects on overall traffic patterns and congestion.

Potential cumulative impacts to vegetation include additive impacts from proposed projects that have been, or will be, constructed in the area. These impacts include the temporary and permanent removal of vegetation, as a result of other projects within the corridor. Indirect cumulative impacts also include modification of soils, hydrology, or other existing growing conditions, and an increase in noxious weeds due to disturbance. Past projects altered the area from a natural habitat to its current condition. Planned projects include street improvements and development of a pedestrian and bike trail connecting Lake Oswego and Portland including a new bridge over Tryon Creek. It is unlikely that these actions would result in large amounts of vegetation removal. In addition, the metropolitan

area will likely continue to develop pursuant to land and zoning regulations, including requirements to protect and mitigate for sensitive environmental resources.

3.8.3.3 Streetcar Alternative

3.8.3.3.1 Wetlands

Direct impacts to wetlands and jurisdictional waters would be avoided and minimized to the extent practicable in accordance with relevant state and federal regulations and Executive Order 11990. Estimated direct long- and short-term impacts to wetlands and waterways are in Table 3.8-7. Construction effects are discussed separately in Section 3.16. Wetland locations are shown in Figure 3.8-1. Long-term impacts to wetlands would be minor, totaling 0.11acres (approximately 4,792 square feet). Impacted wetlands would result in minimal loss of water quality functions and loss of low-quality habitat for amphibians and insects.

The indirect impacts of the Streetcar Alternative to wetlands would be negligible due to the existing impervious development upslope of the proposed streetcar. By improving ridership, the Streetcar Alternative would reduce the number of additional peak hour vehicle trips by commuters as population and development increases. Additional impervious surfaces would have a minor affect on groundwater storage and associated base flow support to creeks that cross the alignment.

Cumulative impacts to wetlands from implementation of the Streetcar Alternative may result in a positive effect on waters compared to the No-Build Alternative. The streetcar would likely result in fewer peak hour vehicle trips than the No-Build Alternative. Increased use of mass transit would result in a reduction in loading of stormwater pollutants to local waterways and wetlands from adjacent roadways due to less traffic and congestion (See Section 3.9.3.4 for further discussion of potential effects to water quality/water quantity). Areas of new construction or redevelopment would require construction of stormwater treatment systems to meet current standards for water quality prior to discharge. Local wetland inventories map few wetlands within the vicinity of the Streetcar Alternative that would be impacted by reasonably foreseeable future development.

Table 3.8-7 Wetland and Waterway Impacts by Segment and Design Option[1]

Segment	Design Option	Wetland Affected	Acres of Temporary Wetlands Impacts	Acres of Permanent Wetlands Loss
Potential Wetland Impacts				
1 - Downtown Portland	None	NA	0.00	0.00
2 - South Waterfront[2]	None	Wetland "A"	0.07	0.07
3 - Johns Landing	Willamette Shore Line	Wetland "B"	0.01	0.01
	Macadam In-Street	Wetland "B"	0.01	0.01
	Macadam Add'l Lane	Wetland "B"	0.01	0.00
4 - Sellwood Bridge[3]	None	Wetland "C"	0.03	0.02
5 - Dunthorpe/Riverdale	Willamette Shore Line	Wetland "D"	0.01	0.01
	Riverwood In-Street	Wetland "D"	0.01	0.01
6 - Lake Oswego	UPRR	none	0.00	0.00
	Foothills	none	0.00	0.00
		Maximum Possible Impacts	0.12	0.11
Potential Waterway Impacts				
Segment	**Design Option**	**Acres of Temporary Jurisdictional Open Waters Impacts**	**Acres of Permanent Jurisdictional Open Waters Impacts**	**Acres of Temporary Jurisdictional Culverted Waters Impacts**
1 - Downtown Portland	None	NA	NA	NA
2 - South Waterfront[2]	None	0.01	0.01	0.00
3 - Johns Landing	Willamette Shore Line	0.00	0.00	0.00
	Macadam In-Street	0.00	0.00	0.00
	Macadam Add'l Lane	0.00	0.00	0.00
4 - Sellwood Bridge[3]	None	0.03	NA	0.01
5 - Dunthorpe/Riverdale	Willamette Shore Line	0.05	NA	0.01
	Riverwood In-Street	0.05	NA	0.01
6 - Lake Oswego	UPRR	0.10	NA	0.01
	Foothills	0.10	NA	0.00
	Maximum Possible Impacts	0.19	0.01	0.03

Source: DEA Impact Analysis of URS GIS data, Fall 2009.

[1] All acreages based on field delineation conducted by URS.No jurisdictional determination has been made on the wetlands and waterways delineated by URS; some of the impacts may be to non-jurisdictional waters. All impacts calculated using GIS. Temporary impact footprint = construction limits. Permanent impact footprint = conservative estimate of all new development.

[2] The South Waterfront Segment contains potential construction phasing options associated with the Streetcar alignments. The Willamette Shore Line and Moody/Bond Couplet are considered phasing options rather than design options. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

[3] The Sellwood Bridge Segment contains potential construction phasing options associated with the Streetcar alignments. The Willamette Shore Line and New Interchange are considered phasing options rather than design options. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

3.8.3.3.2 Vegetation

Long-term *direct impacts* to vegetation would primarily result from track realignment and adding a second rail track. It is assumed that impacts to vegetation in high/medium density development would be limited to incidental removal of ornamental trees. In low-density residential and park settings, tree removal may be more extensive, including contiguous vegetation patches with high habitat values, depending on the vegetation density within right of way. The majority of the impacts would occur

between the Sellwood Bridge and Tryon Creek, where the alignment passes through the mature native and landscaped vegetation of Powers Marine Park and the residential community of Dunthorpe/Riverdale. Where the alignment traverses residential and commercial areas, impacts to vegetation would occur in isolated instances and would not result in the loss of substantial amounts of vegetation. Total vegetation impacts exclude areas of open water (i.e., Willamette River tributaries).

Expansion of the rail ballast in proximity to Willamette Park could result in loss of vegetation, including mature Oregon white oak trees located in Willamette Park. Current estimates of impacts are based on the extent of right of way, which appears to impact the root zone of several white oaks in the park. Pending revised design engineering, species specific impacts will be quantified and avoidance and minimization measures will be developed to limit impacts to these sensitive species and habitats to the degree practicable.

Long-term *indirect impacts* to project area vegetation could result from changes in hydrological/ drainage patterns and in the inability to restore the impacted area to natural conditions. Soil compaction could cause changes in hydrology and the ability of the soil to support new vegetation growth. Vegetation removal would cause loss of habitat, thermoregulation and filtration functions.

Potential *cumulative impacts* to vegetation include additive impacts from proposed projects that have been, or will be, constructed in or near the study area. Direct cumulative impacts include the removal of vegetation as a result of other projects within the study area. Indirect cumulative impacts include temporary vegetation removal, modification of soils, hydrology, or other existing growing conditions, and an increase in noxious weeds due to disturbance.

Past projects have altered the area from a natural habitat to its current condition. Planned projects include street improvements, development of a proposed pedestrian and bike trail connecting Lake Oswego and Portland, including a new bridge over Tryon Creek and the construction of the proposed Fulton Pump Station at Willamette Park. These actions, in conjunction with the proposed streetcar, if selected as the Locally Preferred Alternative, could result in loss of vegetation, including mature Oregon white oak located in Willamette Park. Pending revised design engineering, species specific impacts will be quantified and avoidance and minimization measures will be developed to limit impacts to sensitive species and habitats to the degree practicable. In addition, the metropolitan area will likely continue to develop pursuant to land and zoning regulations, including requirements to protect and mitigate for sensitive environmental resources.

3.8.3.3.3 Wildlife

Long-term *direct impacts* of the Streetcar Alternative would result from realigning and widening the rail line and would include permanent loss of a small amount of habitat, including mature westside coniferous/deciduous forest located in Powers Marine Park and in the residential area of Dunthorpe. This may include areas important to wildlife for breeding, shelter or foraging and may cause some direct mortality to birds, small mammals, invertebrates or other terrestrial organisms. Long-term impacts to wildlife could also occur as a result of proposed retaining walls and fencing along the right of way in Segments 4 and 5. The height of the retaining walls varies from less than one foot to 15 feet in height, not including the fence to be located atop the wall. Figure 3.8-3, depicts a generalized example of changes to the existing conditions as a result of the Streetcar Alternative. The presence of retaining walls could result in animals falling into the rail alignment, resulting in injury or mortality, or becoming trapped within the alignment, possibly resulting in mortality from streetcar activity.

Long-term *indirect impacts* to project area wildlife from the Streetcar Alternative could include disturbance to existing nesting/denning and movement from upland areas near Powers Marine Park, Dunthorpe and Tryon Creek to the Willamette River. The height of the retaining walls and fencing could preclude species movement from adjacent habitats, resulting in an increase in habitat fragmentation and loss of connectivity. This is particularly relevant for species that transit between upland and riparian habitats.

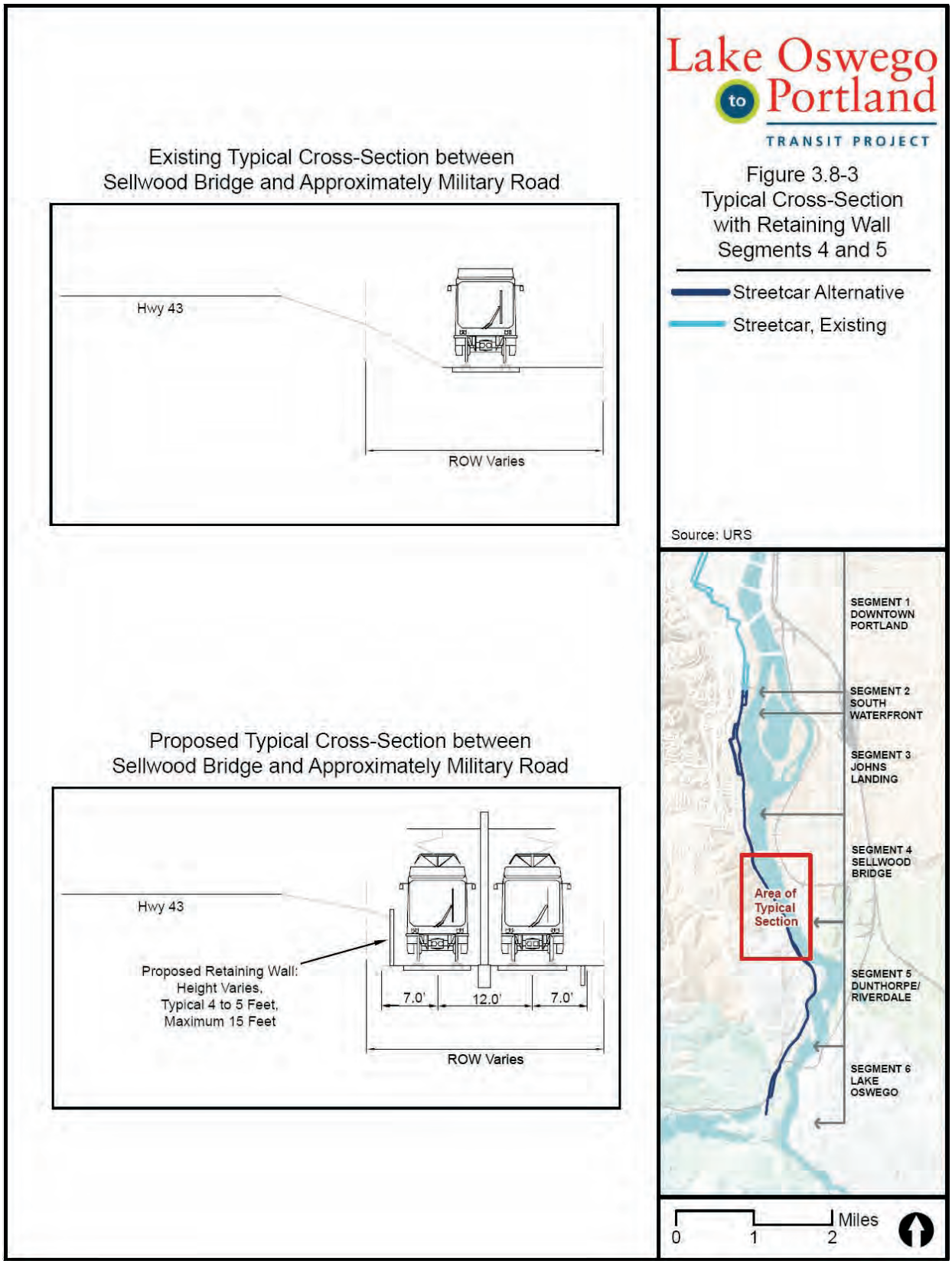
Direct *cumulative impacts* of the Streetcar Alternative could include increased transportation-related disturbance, increased habitat fragmentation, increased incidence of wildlife mortality and permanent vegetation removal to accommodate facilities or other structures. Indirect cumulative impacts include temporary vegetation removal due to construction and modification of soils, hydrology, or other existing growing conditions from other projects. Past projects have developed the area from natural habitats to its current condition. Expected future development would include projects in the financially constrained Regional Transportation Plan and low to moderate levels of residential and commercial development and redevelopment in compliance with adopted plans.

3.8.3.3.4 Fisheries

The Streetcar Alternative may potentially adversely impact fish and fish habitats. Impacts to fish resources include temporary construction impacts within active stream channels to replace culverts; a new crossing structure within the 100-year floodplain of Tryon Creek; and permanent removal of riparian vegetation within the 100-year floodplain of the Willamette River, Tryon Creek, Stephens Creek and several unnamed tributaries to the Willamette River. Specific discussion of direct, indirect and cumulative impacts to fisheries is below.

The Streetcar Alternative has the potential to *directly affect* fisheries resources through stream channel alteration, in-stream work associated with culvert replacement/modification, permanent loss of riparian vegetation to accommodate new structures, changes in rail width and minor decreases in available aquatic habitats. Such impacts are primarily within Segments 3 through 6 - Johns Landing, Sellwood Bridge, Dunthorpe/Riverdale and Lake Oswego. Table 3.8-8 summarizes anticipated impacts of the Streetcar Alternative based on segments and design option.

Stream Channel Modification, In-Stream Work and Reduction of Available Aquatic Habitats. The Streetcar Alternative would involve expanding the existing rail alignment to accommodate an additional parallel rail track through much of the corridor. In most areas, the widening could be accommodated within the existing right of way. In areas where the tracks would be installed in existing streets or other impervious surfaces, primarily Segment 2 (Johns Landing), no direct impacts to existing stream channels are anticipated, as stream channels in this segment are piped underground and would not be disturbed for construction or operations of the Streetcar Alternative. However, in areas where the existing rail alignment would be constructed on rock ballast, the addition of an additional parallel track would require expansion of the rock ballast by approximately 14 feet (on average) through the southern portion of Segment 3 (Johns Landing), all of Segments 4 and 5 (Sellwood Bridge and Dunthorpe/Riverdale) and the majority of Segment 6 (Lake Oswego). In these areas, existing culverts and ditches within the right of way would be replaced to accommodate the expanded ballast width. Expansion of the rock ballast within Segments 3 and 4 may encroach within the 100-year floodplain of the Willamette River and Stephens Creek. Development located within the



Source: Field Surveys and Plan and Profile drawings, URS Biologists and Engineers, January 2010

Table 3.8-8 Summary of Potential Temporary and Permanent Direct Effects to Fisheries-Related Resources by Segment and Design Option

Segment	Design Option	Permanent Stream Channel Alteration	Loss of Aquatic Habitats	Temporary In-Stream Construction Impacts	Permanent Loss of Riparian Habitat
1 - Downtown Portland	None	No	No	No	No
2 - South Waterfront[1]	None	No	No	No	No
3 - Johns Landing	Willamette Shore Line	No	No	No	No
	Macadam In-Street	No	No	No	No
	Macadam Additional Lane	No	No	No	No
4 - Sellwood Bridge[1]	None	Yes	Yes	Yes	Yes
5 - Dunthorpe/Riverdale	Willamette Shore Line	Yes	Yes	Yes	Yes
	Riverwood	Yes	Yes	Yes	Yes
6 - Lake Oswego	UPRR	Yes	Yes	Yes	Yes
	Foothills	Yes	Yes	Yes	Yes

Source: DEA Impact Analysis of URS GIS data, Fall 2009.

[1] The South Waterfront and Sellwood Bridge Segments contain potential construction phasing options associated with the Streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

100-year floodplain can change erosion and deposition patterns, changes in conveyance capacity and reduce the amount of available refuge habitat for species during high water events.

Field investigations identified 56 culvert crossings under the existing rail alignment. These culverts include conveyances for Tryon Creek, Stephens Creek, unnamed tributaries that discharge to the Powers Marine Park (Segments 4 and 5; see Figure 3.8-2), and numerous ephemeral drainage culverts and stormwater conveyance culverts. Sheet CS-040 in the Streetcar Plan Set[81] details all drainage features discovered in the field. Of these culverts, 41 would be replaced or modified as a result of rail construction, including the culverts conveying all eight unnamed tributaries in the Powers Marine Park. Replacement of the Powers Marin Park culverts would require in-stream construction and may require fish exclusion/fish salvage to minimize impacts to aquatic biota during construction. In general, culverts would be replaced in their existing locations, but will be sized appropriately for anticipated conveyance requirements and for fish passage, where appropriate. In most cases, replaced and modified culverts would be longer than the extent culverts, to accommodate the wider ballast footprint.

In the Powers Marine Park area (Segment 4), the culvert replacements of identified tributaries could result in the loss of aquatic habitat due to the longer length of the replacement structures. Analysis of conceptual level design estimates permanent stream habitat losses downstream of culverts to be between zero and 20 linear feet, depending on specific culvert conditions, and total approximately 110 linear feet of stream within the entire segment. As discussed previously, this stream habitat is largely used as off-channel refugia from the Willamette River, during periods of high water. The loss of the upper extent of these streams may not impair or prevent such habitat use, but the loss constitutes a decrease in the total off-channel habitat potentially available to aquatic species.

[81] URS. 2009. *Lake Oswego to Portland Transit Project Streetcar Plan Set*. November 9, 2009. Portland, Oregon.

The proposed design would not alter passage barriers that are associated with Highway 43, but may facilitate passage up to and under the rail alignment. While this will not allow access to any additional habitat, it could allow for future access to upstream habitat should the Highway 43 culverts be modified to allow passage for fish, amphibians and small mammals at a future opportunity. As proposed, culverts would be continuously piped from under Highway 43 under the new rail right of way and discharge to the Willamette River. This proposed alteration would eliminate existing daylighted sections of the streams between Highway 43 and the rail alignment. While this does not effectively eliminate existing fish habitat, it would change the existing conditions. Figure 3.8-4 depicts the anticipated change from existing conditions.

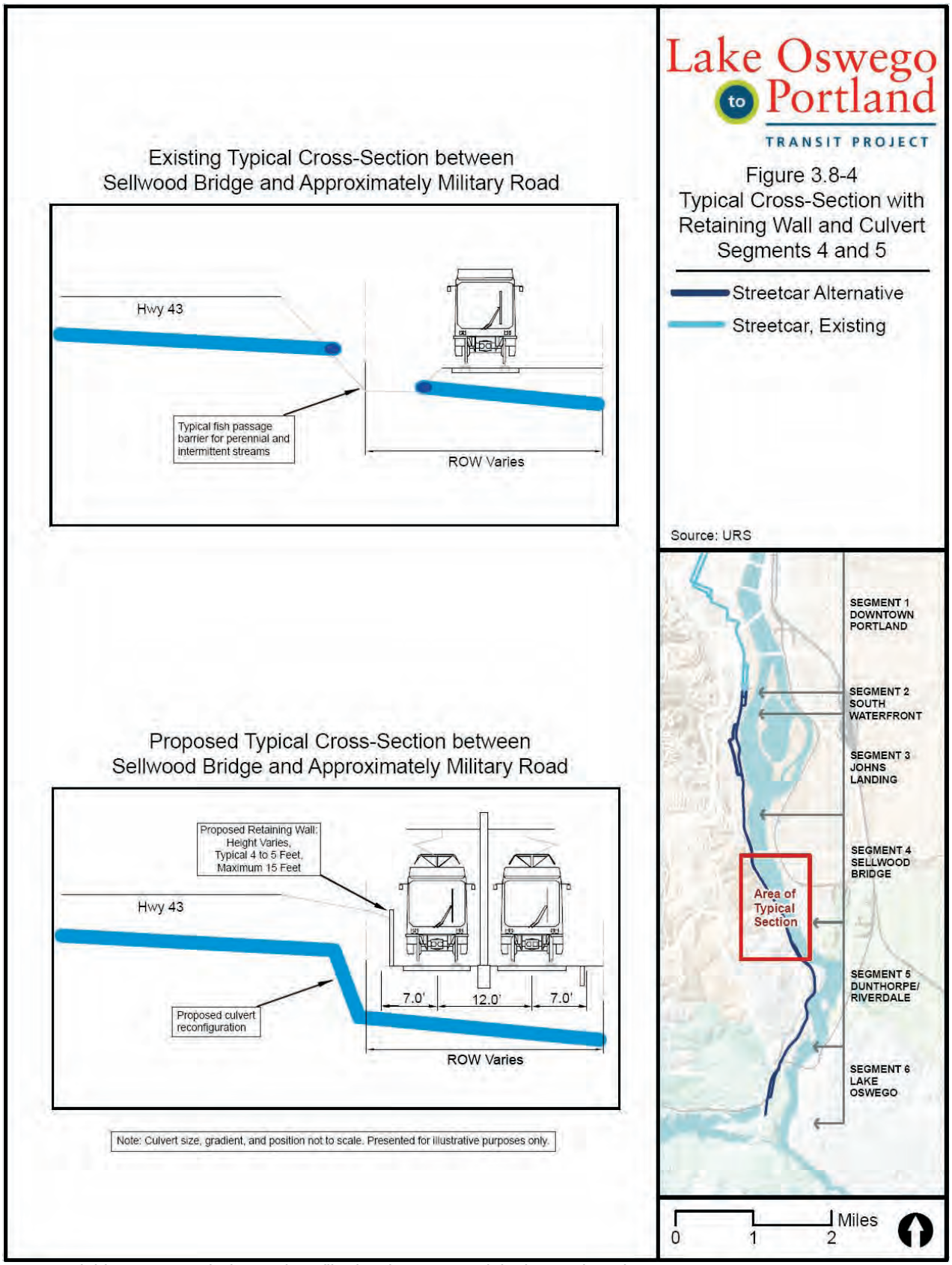
Unlike the No-Build and Enhanced Bus alternatives, the Streetcar Alternative would involve permanent alteration of existing stream habitat and loss of seasonally available fish habitats. Additionally, temporary construction would require in-stream work and may necessitate fish salvage/fish exclusion. Where the No-Build and Enhanced Bus alternatives would result in no changes to existing fish passage barriers, the Streetcar Alternative would allow for the removal of fish passage barriers associated with the rail alignment, allowing for potential future habitat access.

Permanent Riparian Vegetation Loss. Unlike the No-Build and Enhanced Bus alternatives, the Streetcar Alternative would involve permanent loss of riparian vegetation. For the Streetcar Alternative, the expanded ballast needed to support two sets of tracks throughout much of the corridor, the proposed new bridge crossing over Tryon Creek, and new piers for replaced trestle structures would result in the permanent loss of riparian vegetation. The current level of design leaves uncertainty as to the potential permanent loss of riparian vegetation. The anticipated permanent losses (for operations) are expected to be less than the temporary losses (for construction) but cannot be effectively calculated currently. Table 3.8-9 details anticipated temporary losses to riparian habitat resulting from the Streetcar Alternative. The Willamette Shore Line right of way may be relocated and a bridge over Stephens Creek may be required due to the Sellwood Bridge Project. This may impact riparian vegetation, but is outside the scope of this project.

Table 3.8-9 Potential Temporary Riparian Vegetation Loss by Segment and Design Option

Segment	Design Option	Acres of Temporary Riparian Vegetation Impacted
1 - Downtown Portland	None	0
2 - South Waterfront[1]	None	0.02
3 - Johns Landing	Willamette Shore Line	4.06
	Macadam In-Street	3.29
	Macadam Additional Lane	3.29
4 - Sellwood Bridge[1]	None	5.74
5 - Dunthorpe/Riverdale	Willamette Shore Line	0.9
	Riverwood	0.9
6 - Lake Oswego	UPRR	2.16
	Foothills	1.86

Source: All impacts calculated by DEA (2010) using GIS. Permanent impact footprint = proposed right of way within the 100-year floodplain.
[1] The South Waterfront and Sellwood Bridge Segments contain potential construction phasing options associated with the Streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.



Source: Field Surveys and Plan and Profile drawings, URS Biologists and Engineers, January 2010

Indirect impacts associated with the Streetcar Alternative that could affect fisheries resources include the creation or modification to stormwater generating surfaces, potential water quality impairment from construction-related erosion and temporary riparian vegetation loss associated with construction activities. Such impacts apply to nearly all segments. Table 3.8-10 summarizes anticipated impacts by segment and design option.

Table 3.8-10 Summary of Potential Temporary and Permanent Direct Effects to Fisheries-Related Resources by Segment and Design Option

Segment	Design Option	New Impervious Surface Area Created	Redevelopment of Existing Impervious Surface Areas	Construction-related Water Quality Impairment	Temporary Loss of Riparian Habitat
1 - Downtown Portland	None	No	Yes	Yes	No
2 - South Waterfront[1]	None	No	Yes	Yes	No
3 - Johns Landing	Willamette Shore Line	Yes	Yes	Yes	No
	Macadam In-Street	Yes	Yes	Yes	No
	Macadam Additional Lane	Yes	Yes	Yes	No
4 - Sellwood Bridge[1]	None	Yes	Yes	Yes	Yes
5 - Dunthorpe/Riverdale	Willamette Shore Line	Yes	Yes	Yes	Yes
	Riverwood	Yes	Yes	Yes	Yes
6 - Lake Oswego	UPRR	Yes	Yes	Yes	Yes
	Foothills	Yes	Yes	Yes	Yes

Source: URS Analysis of Metro GIS data, Fall 2009.

[1] The South Waterfront and Sellwood Bridge Segments contain potential construction phasing options associated with the streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

Stormwater Management and Impervious Surface Area. The Streetcar Alternative would require the creation of new impervious surface area and redevelopment of existing impervious surface areas within the corridor. For areas of new and redeveloped impervious surface area, stormwater capture and treatment is proposed in compliance with state and local regulations. Redeveloped impervious surface area may result in improvements to receiving waters, as existing impervious surface area that is untreated or undertreated would be brought into compliance with current regulations. Section 3.9, Hydrology and Water Quality discusses new and redeveloped impervious surface area, treatment standards and evaluation by drainages. Table 3.8-11 summarizes the anticipated area of new and redeveloped impervious surface area by segment and design option.

With the Streetcar Alternative, stormwater generated from new and redeveloped impervious surface areas would be treated in compliance with current stormwater guidance. Consequently, the Streetcar Alternative may result in a long-term benefit to water quality, when compared to the No-Build and Enhanced Bus Alternatives, by increasing treatment of redeveloped impervious surface area, reducing the number of peak hour vehicle trips and reducing overall traffic and congestion within the corridor.

Table 3.8-11 New and Redeveloped Impervious Surface Area by Segment and Design Option

Segment	Design Option	Acres of New Impervious Surface Area	Acres of Redeveloped Impervious Surface Area
1 - Downtown Portland	None	--	--
2 - South Waterfront[1]	None	3.54	1.54
3 - Johns Landing	Willamette Shore Line	0.69	0.29
	Macadam In-Street	6.15	0.58
	Macadam Additional Lane	7.20	1.51
4 - Sellwood Bridge[1]	None	0. 00	0.05
5 - Dunthorpe/Riverdale	Willamette Shore Line	0.37	0.22
	Riverwood	2.46	1.58
6 - Lake Oswego	UPRR	2.75	1.75
	Foothills	5.02	2.88
	Maximum Possible Impacts	**18.22**	**7.56**

Source: URS analysis of Metro GIS data, Fall 2009.
[1] The South Waterfront and Sellwood Bridge Segments contain potential construction phasing options associated with the Streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

Cumulative Effects of the Streetcar Alternative. Slow to moderate new development and redevelopment in the Portland central city, South Waterfront, Johns Landing/North Macadam and in the Lake Oswego Town Center is projected to occur throughout the planning horizon of this analysis. Consequently, traffic and congestion are expected to increase within the project corridor as a result of population growth, particularly in regards to peak hour vehicle trips. The Streetcar Alternative would produce positive affects by reducing overall daily peak hour vehicle trips, thereby reducing additional pollutants to local aquatic habitats. Mitigation measures required for impacts to waters / wetlands would further address water quality through upgraded and redesigned crossings, allowing for capture of sediment and pollutants through treatment wetlands adjacent to the tracks or in other appropriate areas (See Section 3.9.3.4 for further discussion of potential effects to water quality/water quantity). Runoff from these reconstructed waterways and wetland areas is anticipated to be cleaner than the existing flow into the Willamette River. This consequence is regarded as a positive effect of this alternative.

3.8.3.3.5 TES Species and Habitats

TES species likely to occur within the project study area that may be impacted by the alternatives considered include fish and turtle species and their aquatic and riparian habitats as well as avian species and their (primarily) forested habitats. For this reason, much of the information presented in this section relative to TES aquatic species is effectively identical to the effects discussed in the Fisheries discussion (Section 3.8.3.3.4). To reduce redundancy, the entire discussion relative to impacts to fishes and aquatic habitats are not repeated here, but summarized. Impacts to avian TES species are addressed in the following section.

Although designs for the Streetcar Alternative are currently conceptual and Section 7 ESA consultation is expected to occur in 2011, it is anticipated that the Streetcar Alternative may affect, and is likely to adversely affect, TES fish species and their habitats. Impacts to aquatic resources include: temporary construction within active stream channels; a new crossing structure within the 100-year floodplain of Tryon Creek; and removal of riparian vegetation within the 100-year

floodplain of the Willamette River, Tryon Creek, Stephens Creek and several unnamed tributaries to the Willamette River. This alternative is not likely to destroy or adversely modify designated critical habitat; however, the extent of existing aquatic habitats will be reduced, primarily through culvert extensions and changes in existing surface drainage patterns. This alternative is likely to adversely affect EFH. Project design, construction and conservation measures will be part of the Section 7 ESA consultation with NMFS and USFWS as project planning continues. Discussion of direct, indirect and cumulative impacts on aquatic habitats is presented in Section 3.8.3.3.4, above, and summarized for all TES species below.

Direct impacts associated with the Streetcar Alternative include the potential to directly affect TES aquatic species and their habitats include stream channel alteration, in-stream work associated with culvert replacement/modification, and permanent loss of riparian vegetation to accommodate new structures/rail width. Such impacts are largely contained in Segments 3 through 6 - Johns Landing, Sellwood Bridge, Dunthorpe/Riverdale and Lake Oswego. Table 3.8-12 summarizes anticipated impacts by segment and design option.

Table 3.8-12 Summary of Potential Temporary and Permanent Direct Effects to TES Fish Species and Aquatic Habitats by Segment and Design Option

Segment	Design Option	Permanent Stream Channel Alteration	Loss of Aquatic Habitats	Temporary In-Stream Construction Impacts	Permanent Loss of Riparian Habitat
1 - Downtown Portland	None	No	No	No	No
2 - South Waterfront[1]	None	No	No	No	No
3 - Johns Landing	Willamette Shore Line	No	No	No	No
	Macadam In-Street	No	No	No	No
	Macadam Additional Lane	No	No	No	No
4 - Sellwood Bridge[1]	None	Yes	Yes	Yes	Yes
5 - Dunthorpe/Riverdale	Willamette Shore Line	Yes	Yes	Yes	Yes
	Riverwood	Yes	Yes	Yes	Yes
6 - Lake Oswego	UPRR	Yes	Yes	Yes	Yes
	Foothills	Yes	Yes	Yes	Yes

Source: Impact Analysis of URS GIS data, Fall 2009.

[1] The South Waterfront and Sellwood Bridge Segments contain potential construction phasing options associated with the streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

With respect to avian TES species, removal of coniferous forested habitat could impact band-tailed pigeon and olive-sided flycatcher habitat, particularly because both species favor edge habitats which are present along the existing rail alignment. Coordination with USFWS will be required to avoid or minimize take of these and other migratory birds during construction. Neither the bald eagle nor the peregrine falcon is documented as nesting within the area proposed for tree removal. However, both species may use the project area for foraging, perching and cover/shelter. Long-term, the impact on avian TES species and their habitat is highly speculative, as project construction could create suitable habitat conditions in portions of the alignment just as easily as rendering existing suitable habitat less suitable. Such impacts may occur in the coniferous and mixed coniferous forested areas found in the Sellwood Bridge, Dunthorpe/Riverdale and Lake Oswego segments.

Unlike the No-Build and Enhanced Bus alternatives, the Streetcar Alternative involves permanent alteration of existing TES aquatic habitats and permanent removal of riparian vegetation. Additionally, temporary construction would require in-stream work and may necessitate fish salvage/fish exclusion. Where the No-Build and Enhanced Bus alternatives would result in no changes to existing fish passage barriers, the Streetcar Alternative would allow for the removal of fish passage barriers associated with the rail alignment, allowing for potential future habitat access.

With the Streetcar Alternative, stormwater generated from new and redeveloped impervious surface areas would be treated in compliance with current stormwater guidance. Consequently, when compared to the No-Build and Enhanced Bus alternatives, the Streetcar Alternative may result in a long-term benefit to water quality by increasing treatment of redeveloped impervious surface area, reducing the number of peak hour vehicle trips and reducing overall traffic and congestion within the corridor. The Streetcar Alternative involves ground disturbing construction, increasing the potential for temporary water quality impairment from turbidity and sedimentation. Unlike the No-Build and Enhanced Bus alternatives, the Streetcar Alternative involves the temporary loss of riparian vegetation.

Indirect impacts associated with the Streetcar Alternative that could affect TES aquatic resources include the creation or modification to stormwater generating surfaces, potential water quality impairment from construction-related erosion, and temporary riparian vegetation loss associated with construction activities. Such impacts apply to nearly all segments. Table 3.8-10 summarizes anticipated aquatic resources impacts by segment and design option.

Indirect impacts on avian TES habitats from the Streetcar Alternative may include modification of adjacent habitats rendering them less suitable/unsuitable for TES species' forage resources, predation avoidance, or disturbing other necessary life cycle activities. Such impacts may occur in the coniferous and mixed coniferous forested areas found in the Sellwood Bridge, Dunthorpe/Riverdale and Lake Oswego segments.

Cumulative effects include slow to moderate new development and redevelopment in the Portland Central City, South Waterfront, Johns Landing/North Macadam and in the Lake Oswego Town Center is projected to occur throughout the planning horizon of this analysis. Consequently, traffic and congestion are expected to increase within the project corridor as a result of population growth, particularly with regard to peak hour vehicle trips. The Streetcar Alternative will produce positive affects by reducing overall daily peak hour vehicle trips, thereby reducing additional pollutants to local TES habitats. Mitigation measures required for impacts to waters and wetlands would further address water quality through upgraded and redesigned crossings, allowing for capture of sediment and pollutants through treatment wetlands adjacent to the tracks or in other appropriate areas (See Section 3.9.3.4 for further discussion of potential effects to water quality/water quantity). Runoff from these reconstructed waterways and wetland areas is anticipated to be cleaner than the existing flow into the Willamette River. This consequence is regarded as a positive effect of this alternative. Improvement in this regard does not constitute a cessation of incremental degradation of aquatic ecosystems used by TES aquatic species.

Cumulative effects on avian TES species are limited to the direct impacts of habitat loss and fragmentation resulting from increased urbanization in the project corridor. Indirect impacts are identical to those associated with habitat loss and fragmentation; i.e. modification of adjacent habitats rendering them less suitable/unsuitable for TES species' forage resources, predation avoidance, or

disturbing other necessary life cycle activities. Such impacts are anticipated to be limited due to the level of development already extent in the project corridor and would be restricted to the coniferous and mixed coniferous forested areas found in the Sellwood Bridge, Dunthorpe/Riverdale and Lake Oswego segments.

3.8.4 Potential Mitigation Measures

Mitigation for the project would include attempts to first avoid, then minimize and finally to compensate for all unavoidable impacts. Impact avoidance and minimization would largely be addressed through further project design. Some Streetcar Alternative design options have been modified to reduce impacts to resources. These avoidance and minimization efforts would be continued (with ongoing agency input) through preliminary engineering, final design and construction.

The Enhanced Bus and Streetcar alternatives would mitigate their potential impacts through full compliance with all applicable regulations, as summarized in Table 3.8.1. It should be noted that further refinement of mitigation designs, including determination of the size and location of mitigation features, would occur after the alternative, alignment and/or design options are selected as the Locally Preferred Alternative. Discussions with federal, state and local agencies to determine appropriate mitigation measures will be initiated and will continue during the preliminary engineering stage, including those that may arise from the Section 7 ESA consultation and drafting of the FEIS, and through other permitting processes during final design. Consequently, mitigation measures presented in this section are preliminary and are described in conceptual terms.

The project has identified areas where there is a potential for greater environmental impacts such as stream crossings. In an effort to design a project that first avoids and then minimizes and, where appropriate, mitigates unavoidable impacts, the project team will evaluate different options that meet all local, state and federal requirements. Avoidance and minimization efforts will be developed in on-going coordination with local, state and federal agencies and incorporate the requirements for local, state and federal regulations and permit conditions. Examples include bridges versus culverts, constructability and sequencing.

Where impacts cannot be avoided, mitigation will be developed in coordination with local, state and federal agencies. The project will mitigate detrimental effects to vegetation, waterways and fisheries, including impacts to both habitat quality and quantity, through compliance with federal, state and local regulations and permitting requirements, including conservation recommendations and terms and conditions stipulated in a Biological Opinion and requirements placed as conditions for the sale of land or easements to the project by jurisdictional property owners.

3.8.4.1 Wetlands and Waterways

Due of the limited scale of anticipated wetlands and waterways impacts, wetland and waterway functions would not be difficult to replace in-kind. However, depending on design options selected, in-kind mitigation may require the use of areas beyond the existing right of way. Opportunities for onsite waterway mitigation exist within the Powers Marine Park area (expanding existing waters or enhancement of degraded waters). Other onsite opportunities for mitigating wetland or waterway impacts exist around Stephens and Tryon Creeks. Portions of these creeks could be enhanced by reestablishing a native riparian corridor, creating wetland floodplain, providing in-stream habitat features or improving fish and wildlife access. Similar riparian enhancement of Stephen’s Creek at its

confluence with the Willamette River was completed by the City of Portland recently. Enhancement of these on-site waters could occur in concert with fisheries mitigation.

If onsite mitigation is not feasible, off-site mitigation for wetland impacts would likely be required. The corridor is not located within a mitigation bank service area. Therefore, offsite mitigation opportunities are limited to applicant-provided, offsite wetland mitigation or monetary contribution to the Oregon Department of State Land's (DSL's) In-Lieu Fee Program. Project sponsored offsite mitigation could include wetland restoration, creation or enhancement within the Lower Willamette River Subbasin. However, due to the high cost and limited availability of urban land where offsite mitigation could take place, contribution to the DSL's In-Lieu Fee Program account could be the preferred off-site mitigation option. This option is acceptable to the DSL and may be acceptable to the USACE due to the small area of impact.

3.8.4.2 Vegetation

Vegetation impacted by the project would be replaced with native vegetation where appropriate and will be coordinated with regulatory agencies. Potential vegetation mitigation opportunities exist in areas adjacent to and nearby the streetcar alignment. Such opportunities occur in similar locations as described for wetland mitigation above. Coordination with the City of Portland and City of Lake Oswego and other stakeholders in the areas adjacent to the Willamette River and Tryon Creek would also occur to ensure planned restoration and enhancement activities at these sites are supported for the Streetcar Alternative. Additionally, vegetation mitigation could include removal of invasive non-native species and replacement with desirable native species. The City of Portland also requires preservation or replacement of trees over six inches in diameter with similar sized trees.

3.8.4.3 Wildlife and Avian TES Species

The following mitigation measures could be implemented to avoid or reduce potentially adverse impacts to wildlife within the corridor:

- Avoid removal of native vegetation;
- Where native vegetation removal is unavoidable, remove potential bird nest trees outside of nesting season and leave cut trees and large shrubs onsite to provide cover for small mammals, ground-nesting birds and herpetofauna;
- Retain snags and downed woody material;
- Provide for nesting and roosting habitats where practicable for native birds and bats;
- Provide culverts and concrete box structures for small mammal and amphibian passage in order to reduce habitat fragmentation and facilitate movement of small mammals under retaining walls/fences;
- Manage vegetation at culverts targeted for smaller mammal species to encourage the effectiveness of the crossing; and
- Provide terrestrial connectivity between the river and upland habitat communities by incorporating design elements that promote passage by terrestrial and aquatic species.

3.8.4.4 Fisheries Resources and TES Species

Impacts to aquatic TES species, fish species, and aquatic and riparian habitats are likely to occur, but avoidance or minimization of impacts to riparian areas, waterways and native, treed habitats could reduce negative effects. Additional mitigation measures would likely be developed in coordination

with regulatory agencies and project sponsors during Section 7 EPA consultation. Through the consultation process, the project team could mitigate impacts by:

- Developing alignment refinements and designs that avoid and minimize impacts to TES species;
- Identifying elements of the project that could enhance habitat and fish production to compensate for unavoidable impacts, such as:
    - Restoring shallow-water habitat in the lower Willamette River,
    - Upgrading culverts and other passage constraints on smaller streams so that they are fish passable,
    - Removing invasive vegetation and replacement with native species,
    - Planting of large, native trees in riparian areas for shading and large woody debris recruitment,
    - Replacing or restoring off-channel riparian and floodplain habitat,
    - Integrating of pervious pavement where practical,
    - Designing infrastructure elements within floodplains to reduce stranding of fish during flood events, and
    - Implementing enhanced treatment for stormwater;
- Reviewing listed species recovery plans to determine if conservation measures could be implemented to support management recommendations and recovery efforts;
- Coordinating planned restoration and enhancement efforts and locations with the plans and proposals of other parties active in the watershed;
- Removing existing abandoned piles in water;
- Developing construction practices that minimize unavoidable impacts, such as in-water work timing, isolation of in-water work areas when practical and erosion and sediment control; and
- Implementing fish exclusion and fish salvage actions, as required to preclude TES species from active in-stream work areas.

3.9 Hydrology and Water Quality

This section describes the analysis and anticipated effects of the Lake Oswego to Portland Transit Project's alternatives on hydrology, water quality and floodplains. Water bodies within the vicinity of the project include the Willamette River, Tryon Creek and Stephens Creek. Tryon Creek and Stephens Creek are both tributaries of the Willamette River. Terwilliger Creek also passes through the project study area, but the lower portion has been piped under the developed portion of Johns Landing. Because of this, Terwilliger Creek has not been evaluated for project-related effects.

This section summarizes the *Lake Oswego to Portland Transit Project Hydrology and Water Quality Technical Report* (URS/DEA and TriMet/Metro, November 2010). Additional information on the hydrology and water quality technical analysis methods, agency consultation, expected effects of the study alternatives and potential mitigation measures can be found in the technical report.

3.9.1 Introduction, Approach and Methodology and Applicable Regulations

Project-related changes to water quality, hydrology and floodplains are primarily a function of changes to impervious surface area, stormwater runoff characteristics and fill in floodplains or water bodies resulting from study alternatives and design options.

3.9.1.1 Approach and Methodology

The technical analysis methods for the water quality evaluation are based primarily on FHWA procedures, as identified in *Pollutant Loadings and Impacts from Highway Storm Water Runoff* (FHWA-RD-88-006, April 1990).

The study has evaluated possible effects in the Lower Willamette Subbasin including areas that either discharge to the Lower Willamette River directly or via small, unnamed tributaries. Areas within the Stephens Creek and Tyron Creek subbasins are also evaluated and effects are documented. Effects related to water quality, hydrology and floodplains have been estimated based on evaluation of the alternatives as defined in Chapter 2 of this DEIS, regulatory guidance and best professional judgment. Direct, indirect and cumulative effects have been assessed and documented in the following section. Short-term or temporary effects related to construction have been evaluated and are documented in Section 3.16 Construction Effects. For purposes of this analysis, the project area was assumed to extend 125 feet out from the proposed project alignment centerline (creating a 250-foot wide study corridor). For the Streetcar Alternative, the analysis documents the expected effects as a range in projected water quality effects (high and low) as associated with the various design options. Any combination of the design options would result in water quality effects between the two extremes. The No-Build and Enhanced Bus alternatives do not have design options.

Water quality is a function of the deposition of pollutants on surface areas that allow for the conveyance and discharge of such pollutants (i.e., impervious surfaces). Consequently increases in impervious surfaces could result in changes to water quality. The analysis of water quality effects estimated the projected increase in annual loading and pollutant concentrations from the additional impervious area that would be added by the project alternatives. The analysis provides information related to predicted in-stream pollutant concentrations and increases in pollutant concentrations resulting from runoff from the project alternatives.

Impervious surfaces can prevent the direct infiltration of stormwater runoff, resulting in changes in **hydrology**. The addition of impervious surface area could result in increased runoff volume and peak flows discharging to public stormwater conveyance systems and waterways.

Effects to **floodplains** could include encroachment on 100-year floodplains of affected watersheds. For this analysis, the 100-year floodplain was defined as the boundaries established by Metro in response to the 1996 flood event in the Portland metropolitan area. Project improvements within floodplain areas can result in a loss of flood storage area, which can exacerbate flooding during high-flow events. The effect to the 100-year floodplain has been estimated by examining the area of expected project improvements within the floodplain for each alternative and design option.

3.9.1.2 Applicable Regulations

Water resources in the project area are protected by federal, state and local regulations addressing stormwater quality and quantity and restrictions on modifying floodplains. In general, regulations governing stormwater quality and quantity have been developed and implemented primarily at the local and state level, while floodplain regulations (e.g., Executive Order 11988 – Floodplain Management) are developed at the federal level and implemented at the local level. The State of Oregon does not have specific stormwater quantity control or floodplain development guidelines; however, under authority of the U.S. Environmental Protection Agency (EPA), it implements federal water quality regulations. The City of Portland, City of Lake Oswego, Multnomah County and Clackamas County regulate water quantity and quality through standards for new development and redevelopment.

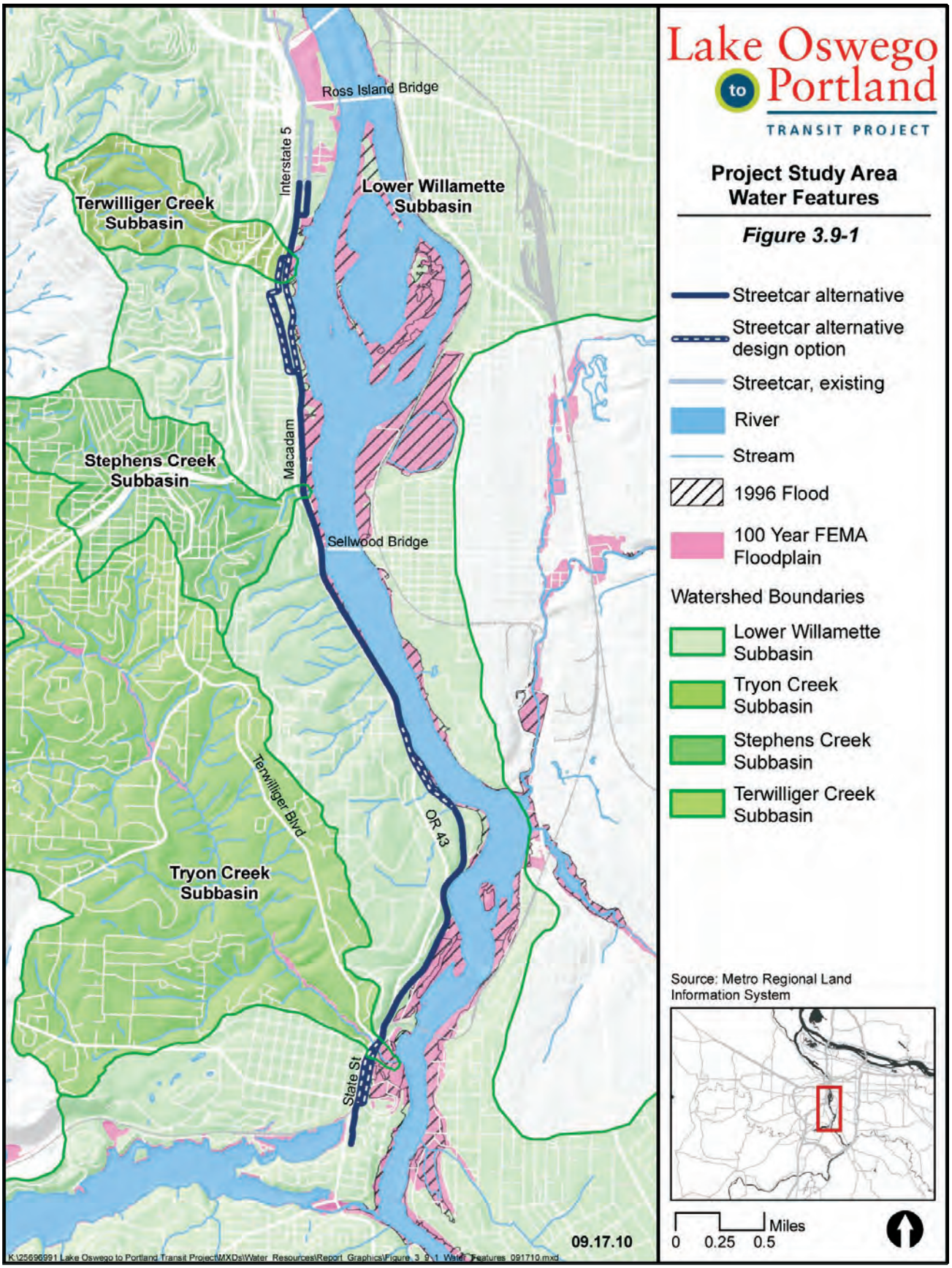
Generally, the regulations and standards intend to accomplish the following:

- Maintain predevelopment flow rates and timing (known as the hydrograph);
- Prevent flooding conditions from worsening;
- Protect new facilities constructed in the floodplain from damage; and
- Protect water quality.

3.9.2 Affected Environment

The study corridor is located in the Lower Willamette River Subbasin (refer to Figure 3.9-1). Existing land use in the vicinity of the project area is primarily urban. Current land use includes single-family residential with pockets of other urban land use types (e.g., multifamily residential, mixed-use commercial and industrial). Additionally, the study corridor crosses through several parks and open spaces.

Much of the study area in and adjacent to the project improvements is developed with significant impervious surface coverage, such as streets, roofs and parking areas. Impervious surfaces affect the hydrology of a basin and the water quality within its receiving streams because they provide a medium for collecting pollutants and a conveyance mechanism for efficiently transporting these pollutants to local streams. Consequently, a primary indicator of a potential project's effect on hydrology and water quality is the amount of impervious surface area that could be added or converted to a higher intensity use.


Lake Oswego to Portland
TRANSIT PROJECT
Project Study Area Water Features
Figure 3.9-1
Ross Island Bridge
Interstate 5
Lower Willamette Subbasin
Terwilliger Creek Subbasin
Macadam
Stephens Creek Subbasin
Sellwood Bridge
Terwilliger Blvd
OR 43
Tryon Creek Subbasin
State St
Streetcar alternative
Streetcar alternative design option
Streetcar, existing
River
Stream
1996 Flood
100 Year FEMA Floodplain
Watershed Boundaries
Lower Willamette Subbasin
Tryon Creek Subbasin
Stephens Creek Subbasin
Terwilliger Creek Subbasin
Source: Metro Regional Land Information System
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K:\25696991 Lake Oswego to Portland Transit Project\MXDs\Water Resources\Report Graphics\Figure 3 9-1 Water Features 091710.mxd

3.9.2.1 Hydrology

The study corridor is within the Lower Willamette River Subbasin and includes Tryon Creek and Stephens Creek, which are tributaries to the Willamette River, as well as several additional unnamed tributaries to the Willamette River and within the Lower Willamette River Subbasin. These features are shown on Figure 3.9-1. Three basins are discussed in this analysis: the Lower Willamette Subbasin, the Tryon Creek Subbasin and the Stephens Creek Subbasin. As mentioned above, Terwilliger Creek passes through the project study area, but has not been evaluated for project-related effects because it has been piped under the developed portion of Johns Landing.

Topography within the project area slopes from west to east, and runoff from Highway 43 and other upstream areas is directed downslope towards the existing railroad tracks via storm drains or overland flow, where it is frequently collected in trackside ditches and culverts. Fifty-four existing culverts that convey runoff underneath the existing tracks were identified during field reconnaissance. The majority of these culverts are buried, blocked or damaged such that they do not provide adequate conveyance. These culverts either discharge to the top of slope on the east side of the tracks prior to discharging to the Willamette River via overland flow or discharge to the Willamette River directly. Predominant soils in the project area are within hydrologic class C or D and do not have favorable infiltration potential.[82]

Willamette River. The Lower Willamette River Subbasin covers approximately 261,120 acres and is highly urbanized with residential, commercial, industrial and recreational land use.[83] Portions of the lower Willamette River have been channelized, with much of its banks either constrained by riprap or the Portland seawall. Most of the river's original off-channel and floodplain habitat has been eliminated or is highly degraded, and its channel largely lacks topographic and habitat diversity. The river is regulated by 11 multipurpose flood control/recreation/hydropower reservoirs, all located upstream of the project area and operated by the U.S. Army Corps of Engineers (USACE). These facilities have substantially altered the hydraulics of the River compared to its original state.[84] Table 3.9-1 summarizes average flow and flood flows in cubic feet per second (cfs) in the Willamette River in the vicinity of the project area.

Table 3.9-1 Estimated Average Flows for Project Area Streams

Water body	Average Flow (cubic feet per second)
Willamette River[1]	32,000
Tryon Creek[2]	8.5
Stephens Creek[3]	1.5

Notes: cfs = cubic feet per second.
[1] USGS, 2002, as reported by Metro.
[2] 2008; USGS, 2007.
[3] BES, 2010. This flow represents the average of a range of average flows provided on the BES website for Stephens Creek

[82] Natural Resources Conservation Service (NRCS), 2009. Online Web Soil Survey, Soil Water Features Report. http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm. Accessed November 30, 2009.
[83] Department of Environmental Quality (DEQ), 2006. Willamette Basin TMDL: Chapter 5 Lower Willamette Basin TMDL. September 2006.
[84] South Corridor Portland-Milwaukie Light Rail Project, Water Quality and Hydrology Results Report, Metro: May 2008.

Tryon Creek. The Tryon Creek Subbasin covers an area of approximately 4,200 acres. The Tryon Creek main stem is about seven miles long and flows southeast from its headwaters near Multnomah Village (just north of Interstate 5 and Highway 99W) to its confluence with the Willamette River in the City of Lake Oswego at the Highway 43 crossing. Development in the Tryon Creek Subbasin is concentrated in the upper portion of the watershed and therefore affects the hydrology of the entire main stem of Tryon Creek. The project corridor crosses Tryon Creek near its confluence with the Willamette River, and the creek passes underneath the existing rail tracks via an 8-foot by 8-foot concrete box culvert. The hydrology of the Tryon Creek watershed has been modified by the effects of development and urbanization. The most significant modifications include the loss of native vegetation, including mature forest cover; the increase in impervious surfaces, including travel corridors; and the construction of closed-conveyance drainage systems, including piped storm sewer systems and culverts.

Stephens Creek. The Stephens Creek Subbasin covers an area of approximately 760 acres and runs in a northwest to southeast direction through Southwest Portland. Several areas of the creek have been culverted as it flows through urban areas of Southwest Portland. Land use in the subbasin is dominated by residential, parks and vacant areas, and some commercial land uses. The project corridor crosses Stephens Creek, very near its confluence with the Willamette River, where the creek passes underneath the existing rail tracks via two parallel concrete culverts. The riparian area through this segment of the stream is wooded, with some rocks. Woody debris has been placed in the area as part of a City of Portland habitat restoration project in completed in 2008. The project was intended to improve in-stream, stream bank and floodplain wetland habitat.

3.9.2.2 Floodplains

Portions of the project area are within the regulatory 100-year floodplain for the Willamette River (as shown on Figure 3.9-1). A major flood event occurred in the Portland metropolitan area in February 1996. Flooding during the February 1996 event within downtown Portland was, in many areas, more extensive than the 100-year floodplain area shown on the Flood Insurance Rate Map (FIRM) as shown on Figure 3.9-1. The South Waterfront area floodplain is defined by the extents of the FEMA 100-year floodplain and the February 1996 flood inundation area combined.[85] The South Waterfront area, which includes portions of the project study area, is exempt from Metro Title 3 regulations, which include requirements for balanced cut and fill.

Although the February 1996 flood event caused severe landslide, streambank and streambed damage to Tryon Creek and its tributaries, it did not cause any significant flooding or property damage in the watershed. The effects of flooding will likely remain the same in the future. Changing hydrologic conditions may continue to cause damage to the stream system in the watershed but may not result in any significant flooding of properties.[86]

3.9.2.3 Water Quality

A Total Maximum Daily Load (TMDL) was approved by the Environmental Protection Agency (EPA) in 2006 for the entire Willamette Basin for temperature, bacteria and mercury. This TMDL includes Tryon Creek, specifically, and Stephens Creek as a tributary to the Willamette River. The

[85] South Corridor Portland-Milwaukie Light Rail Project, Water Quality and Hydrology Results Report, Metro: May 2008.
[86] Bureau of Environmental Services (BES). 2005. Fanno and Tryon Creeks Watershed Management Plan.

Willamette River and Tryon Creek are listed on the Department of Environmental Quality's (DEQ's) 2004/2006 list of impaired waterbodies (Section 303(d) of the Federal Clean Water Act) (DEQ, 2009c) Table 3.9-2 presents the 303(d) parameters within the project area.

Table 3.9-2 303(d) 2004/2006 Listed Reaches[1] within Project Area

Water Body	Listed Reaches (RM)[2]	Parameter	Season
Tryon Creek	0 to 5	Temperature	Summer
Willamette River	0 to 186.4	E. Coli	Fall/Winter/Spring
Willamette River	0 to 24.8	Aldrin	Year-round
Willamette River	0 to 24.8	Biological Criteria	Undefined
Willamette River	0 to 24.8	DDT	Year-round
Willamette River	0 to 24.8	Dieldrin	Year-round
Willamette River	0 to 24.8	Fecal Coliform	Fall/Winter/Spring
Willamette River	0 to 24.8	Iron	Year-round
Willamette River	0 to 24.8	Manganese	Year-round
Willamette River	0 to 24.8	Mercury	Year-round
Willamette River	0 to 24.8	PCB	Year-round
Willamette River	0 to 24.8	Pentachlorophenol	Undefined
Willamette River	0 to 24.8	PAH	Year-round
Willamette River	0 to 50.6	Temperature	Year-round

Source: DEQ, 2009c.
[1] Listed reaches are those reaches or portions of reaches listed in the 303(d) 2004/2006 Integrated Report Database, which reports on streams or lakes identified as impaired for one or more pollutants and do not meet one or more water quality standards.
[2] RM = River Mile.

Willamette River. General water quality issues in the portion of the Willamette River located in the project area include aquatic ecosystem degradation, soil erosion from construction, and elevated concentrations of nutrients, synthetic compounds and trace elements (e.g., heavy metals). The Willamette River TMDL was approved by EPA in 2006 for mercury, bacteria and temperature within the Willamette River maintstem (Lower Willamette Subbasin). Additionally, the Willamette River is on DEQ's 303(d) list of water quality limited waterbodies for the following parameters: dieldrin, DDT, DDE, PAHs, aldrin, PCBs, manganese, iron and pentachlorophenol.[87]

Tryon Creek. Water quality issues in the Tryon Creek watershed include elevated temperatures, elevated instream bacteria concentrations and elevated levels of nutrients (phosphorous and nitrogen), especially during storm events.[88] Elevated temperatures are likely the result of low streamflows during the summer months, warmer air temperature resulting from urban heat island effects, reduced riparian vegetation (and consequent lack of stream shading), and stormwater runoff from impervious surfaces exposed to sunlight. The Willamette River TMDL approved by EPA in 2006 also established TMDLs for Tryon Creek for temperature and bacteria.

Stephens Creek. Portions of Stephens Creek run through urbanized areas, and it is subject to stormwater pollutants typical of urbanized areas such as sediments, pesticides, oil and grease, and metals. Stephens Creek is not specifically listed as water quality limited by DEQ; however, as a tributary to the Willamette River it is incorporated into the Lower Willamette Subbasin TMDL for bacteria, mercury and temperature.

[87] DEQ 2009c. 2004/2006 Integrated Report Database. Accessed on November 4, 2009 at http://www.deq.state.or.us/wq/assessment/rpt0406.htm.
[88] Bureau of Environmental Services (BES). 2005. Fanno and Tryon Creeks Watershed Management Plan.

3.9.3 Environmental Consequences

Project-related effects to water resources, specifically hydrology, floodplains and water quality, are discussed below. Long-term effects include direct, indirect and cumulative effects, which are likely to affect the area for the operational life of the project and are discussed below. Short-term effects are those associated with construction and are discussed in Section 3.16 Construction Effects.

The increase in impervious surface is the main indicator used to classify water quality and hydrology effects. Floodplain effects and impacts are primarily determined by estimating the amount of project work and fill that may occur within the floodplain. An increase in impervious surface can have an adverse effect on hydrology and water quality because it collects pollutants and prevents stormwater from entering the ground, therefore increasing runoff volumes and providing a means of conveyance for accumulated pollutants to waterbodies within the project area. Table 3.9-3 provides a summary of the increase in new impervious surface, by alternative and subbasin, which was used to analyze potential effects as discussed in the following sections. Due to the various design options associated with the Streetcar Alternative, the increase in impervious surface is presented as a range.

Table 3.9-3 Percent Increase in Impervious Surface Area, by Basin and Alternative

Basin	Existing Impervious Area in the Basin (No-Build Alternative)	Enhanced Bus Alternative	Streetcar Alternative	
			Minimum	Maximum
Willamette River	27,517[1]	0.002%	0.012%	0.031%
Tryon Creek	1,121[2]	0%	0.010%	0.017%
Stephens Creek	207[2]	0%	0.020%	0.020%

[1] Source: Metro, 2008
[2] Source: Metro, 2009; Clackamas County, 2008

3.9.3.1 Direct Effects to Hydrology

Direct Effects to Hydrology typical of linear development projects include the following:

- Alterations to the stormwater hydrograph (increased volume, altered timing);
- Changes in drainage flow paths, routing and discharge locations;
- Reductions in infiltration capacity; and
- Modifications to channel conveyance capacity.

Most of these effects are directly related to the increase in impervious surface associated with construction of stations, park and ride lots, maintenance facilities and segments of non-ballasted track. These direct hydrologic effects are also related to the encroachment of development on the stream channels as well as changes in drainage patterns. Potential hydrologic effects based on these three indicators were determined for the No-Build, Enhanced Bus and Streetcar alternatives. The new impervious surface area created by the various alternatives is summarized in Table 3.9-3.

No-Build Alternative. The No-Build Alternative represents existing conditions in the project area. The No-Build Alternative would not include new streetcar or bus facilities in the area and associated new impervious surface and, therefore, would not induce project-related effects. There would also be no effect to drainage patterns or channel conveyance capacity. However, in association with hydrologic effects, existing culverts along the existing tracks would not be improved and likely continue to degrade, becoming further blocked.

Enhanced Bus Alternative. The Enhanced Bus Alternative would result in approximately 3.6 acres of new and redeveloped impervious surface. The majority (approximately 80 percent) is redeveloped impervious surface, consisting of a park-and-ride facility and associated access road. Stormwater runoff generated from the new and redeveloped impervious surfaces would likely be intercepted by the existing storm drainage system that currently serves that area and drains to the Willamette River. As part of the design and construction process, the downstream capacity of the existing storm drainage system would be assessed and redesigned as necessary to maintain flow. Therefore, changes to site drainage patterns are expected to be minimal. No new waterbody crossings would be constructed as part of the Enhanced Bus Alternative. All new impervious surface added as a result of the Enhanced Bus Alternative would occur within the Lower Willamette Subbasin.

The amount of new impervious surface that would be added as a result of the Enhanced Bus Alternative (0.8 acres) is negligible compared to the overall size of the basin. This construction would occur within the City of Lake Oswego and per the city's design standards, sufficient storm water detention shall be provided to maintain runoff rates at their natural undeveloped levels (City of Lake Oswego, 2002).

Direct effects associated with hydrology are expected to be negligible due to the small increase in impervious surface associated with the alternative, in adherence to City of Lake Oswego design standards, and the lack of modifications to site drainage patterns and stream encroachments.

Streetcar Alternative. Depending on the design option selected, the Streetcar Alternative would result in between 11.2and 25.8acres of new and redeveloped impervious surface. These impervious areas consist of stations, park-and-ride lots, maintenance facilities and segments of track embedded in concrete pavement. Note that tie and ballast track is considered pervious surface and therefore is not factored into the impervious area estimates. As previously noted, the only Streetcar Alternative design options summarized in this DEIS are those that would result in the minimum and the maximum increases in impervious surface. The range of the percent increase in impervious surface area for each river basin that would be created by the Streetcar Alternative is shown in Table 3.9-3. Table 3.8-11 in Section 3.8 Ecosystems shows the increase in acres of new and redeveloped impervious surface area for each design option.

Rearranging of existing culverts or re-grading to alter existing drainage patterns is not anticipated with the construction of the Streetcar Alternative. However, it is assumed that culverts in disrepair would be replaced or maintained to improve conveyance capacity and provide for fish passage if necessary, and conveyance ditches along the existing tracks would be improved for better conveyance to culverts. (See Section 3.8 for more detail on fish passage issues) This could increase the amount of runoff directed to the culverts; however, the majority of the runoff currently received is from upland areas and thus a noticeable increase in flow associated with construction of the project would not be expected. In several locations along the western boundary of the track alignment, retaining walls are proposed. In these areas, a new drainage ditch on the upslope area of the retaining wall would be constructed, which would intercept runoff from Highway 43 that currently flows into the existing drainage ditches and would convey it to the existing (or replaced) culverts running underneath the track. This is also not anticipated to noticeably increase flows or velocities to the culverts, and hydrologic effects are expected to be minimal. The crossings at Stephens Creek and Tryon Creek are not anticipated to involve construction below the ordinary high water mark (OHWM) (OBEC, 2009); therefore, no hydraulic effects to those creeks are anticipated.

Hydrologic effects associated with the Streetcar Alternative resulting from an increase in impervious surface and projected changes in drainage patterns are expected to be minor, because the Streetcar Alternative would adhere to all applicable stormwater quantity regulations, including providing sufficient storm water detention to maintain runoff rates at their natural undeveloped levels, and the amount of new impervious surface added is very low compared to the overall size of the basins in which it is located.

3.9.3.2 Direct Effects to Floodplains

No Build Alternative. No direct effects related to floodplains would be associated with the No-Build Alternative.

Enhanced Bus Alternative. The Enhanced Bus Alternative would encroach upon approximately 1.3 acres of the FEMA-designated floodplains of the Willamette River. Effects to 100-year floodplains would be analyzed in accordance with local regulations and Executive Order 11988 – Floodplain Management. As required by these regulations, all lost storage would be mitigated by creating additional volume elsewhere in the floodplain.

Streetcar Alternative. Depending on the design option, the Streetcar Alternative would encroach on between 6.4 and 10.1 acres of the FEMA-designated floodplains of the Willamette River, as summarized in Table 3.9-4. Based on these numbers, the Willamette Shore Line design option would have the largest effect on floodplains in each segment where it is a design option. Additional effects to floodplains could potentially occur due to new stream crossings at Tryon Creek and Stephens Creek.

Effects to 100-year floodplains would be analyzed in accordance with local regulations and Executive Order 11988, Floodplain Management. As required by these regulations and not otherwise exempted by Metro regulations, lost storage would be mitigated by creating additional storage elsewhere in the floodplain. Furthermore, where appropriate, culverts would be placed under the proposed track to allow water to flow under the elevated track and to provide access to adjacent floodplain storage areas and preserve their functionality. These two mitigation measures would combine to substantially minimize, and perhaps eliminate, any potential rise in flood elevation.

Table 3.9-4 Floodplain Effects in Acres

Alternative / Segment	Design Option	Area (acres)
Enhanced Bus	None	1.3
Streetcar		
1 - Downtown Portland	None	0.0
2 - South Waterfront[1]	None	0.1
3 - Johns Landing	Willamette Shore Line	2.5
	Macadam In-Street	1.6
	Macadam Additional Lane	1.6
4 - Sellwood Bridge[2]	None	4.4
5 - Dunthorpe/Riverdale	Willamette Shore Line	2.7
	Riverwood	0.0
6 - Lake Oswego	UPRR	0.4
	Foothills	0.4

Source: Metro RLIS GIS Database (Accessed in 2009). Originally published in 1996/2004.
[1] The South Waterfront Segment contains potential construction phasing options associated with the streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.
[2] The Sellwood Bridge Segment contains potential construction phasing options associated with the streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

3.9.3.3 Direct Effects to Water Quality

Water quality effects associated with linear projects typically are a result of:

- Reduced infiltration potential and increase in volume of runoff (and pollutants) conveyed to waterbodies through the increase in impervious surface;
- Increased in-stream water temperatures as a result of riparian vegetation removal;
- Export of pollutants from motor vehicles using park-and-ride lots and other associated infrastructure; and
- Export of small amounts of oil and grease, sediment and metals from streetcar under the Streetcar Alternative.

The water quality impacts for the study alternatives are based on the increase in impervious area, as shown in Table 3.9-3.

No-Build. The No-Build Alternative would not result in increases in impervious surface area associated with the Lake Oswego to Portland Transit Project. Despite this, background development and other projects would still occur, causing an increase in impervious surface area and its related effects associated with water quality. Potential adverse effects associated with the No-Build Alternative could include:

- Stormwater runoff from currently untreated impervious surfaces would continue to flow untreated to project area streams and generally would not be improved unless there is redevelopment that adheres to current standards.
- Over time, an increase in traffic and congestion is likely, which will result in a likely increase in pollutant loading, including increases in sediment, heavy metals, and oil and grease concentrations from roadways and parking lots. These pollutants subsequently are transported to project area waterbodies by stormwater runoff. It is assumed that the Streetcar

and Enhanced Bus alternatives would reduce vehicle congestion in their service areas; while the No-Build Alternative would either result in no change or potentially an eventual increase in traffic congestion. Therefore, pollutant transport is expected to be higher with No-Build Alternative.

Enhanced Bus Alternative. The new and replaced impervious surface associated with the Enhanced Bus Alternative represents a small overall increase in total impervious surface area in the Lower Willamette Subbasin, and results in no impervious area increase in the Stephens Creek and Tryon Creek basins (see Table 3.9-3). Approximately 80 percent of the Enhanced Bus Alternative's total impervious area is replaced impervious surface area. Most of these areas were initially developed prior to current stormwater controls and therefore have little, if any, stormwater treatment. Because current regulations require that stormwater from redeveloped areas be treated, water quality conditions could improve as a result of the Enhanced Bus Alternative by managing runoff from replaced impervious surfaces and adhering to current regulations.

Streetcar Alternative. The new and replaced impervious surfaces related to the Streetcar Alternative represent a small overall increase in total impervious surface area specific to each basin (see Table 3.9-3). Therefore, similar to the Enhanced Bus Alternative, water quality conditions could improve as a result of the Streetcar Alternative by managing runoff from replaced impervious surfaces and adhering to current regulations.

Additionally, although operation of streetcar facilities has the capacity to release small amounts of pollutants (primarily sediment, oil and grease, and metals), pollutant generation typically is very low and, as stated above, the Lake Oswego to Portland Transit Project would adhere to all applicable stormwater regulations. Consequently, adverse water quality effects associated with impervious surfaces are not anticipated for the Streetcar Alternative.

3.9.3.4 Indirect and Cumulative Effects

Indirect effects are not anticipated from this project. If the project enables future development or redevelopment to occur, water quantity and quality mitigation would likely be required in addition to the proposed water quality mitigation for this project. Development upstream and within the drainage basins intersected by this project will also be subject to the regulatory requirements for mitigation of stormwater quality and quantity controls.

Past and future development within the watershed cumulatively affects the health of the watershed by removing natural cover, creating impervious surfaces, channelizing streams, altering flow regimes and discharging contaminants into water bodies. With or without the implementation of the Enhanced Bus or Streetcar alternatives, continued development and redevelopment activities are expected along the project corridor and throughout the Portland metropolitan area. Although the build alternatives will contribute to additional pollutant loadings and concentrations, by adhering to current water quality and quantity regulations, it is not expected that the proposed build alternatives would worsen conditions in the project corridor's receiving water bodies.

The region's land use plans envision that most of the future growth in population and employment will be focused on established regional and urban centers connected by high quality multimodal transportation systems. The No-Build Alternative would not include one of the major transportation investments assumed in regional growth management plans. One possible indirect effect of the No-Build Alternative would be increased pressure to develop in areas with lower congestion, which tend

to be on the outskirts of the region. These areas would experience an increase in impervious surfaces as they are further developed.

In contrast the Streetcar Alternative, and Enhanced Bus Alternative to a lesser extent due to its impermanent nature, would help facilitate future development that reduces dependence on vehicular travel and is consistent with regional growth plans and density goals. Much of this development would occur in previously disturbed, existing impervious areas. Additionally, by focusing development in underutilized urban areas, development pressure in outlying rural areas could be lessened, which could potentially limit sprawl and help to protect forests and farmland in headwater reaches.

3.9.4 Potential Mitigation Measures

The project would be required to meet local, state and federal design guidelines, which require stormwater treatment and volume (flow control) via permanent structural best management practices (BMPs) and may include Low Impact Development (LID) alternatives. Improvements to water quality would occur when pollutants are removed from stormwater runoff; filtered through the use of separators, screens, filter media or soils; and/or taken up by plants. Hydrologic and water quality benefits would occur when stormwater is infiltrated onsite (retained) or discharged to the receiving waterbody at flow rates and durations consistent with pre-developed conditions.

Additional tools available to minimize water quality effects are nonstructural BMPs, which are source control activities related to maintenance, pollution prevention or other housekeeping activities that help prevent stormwater from coming in contact with pollutants. They could include activities such as street sweeping, properly maintaining vehicles and routine litter removal.

Potential mitigation measures for construction-related activities for control of accidental spills and leaks (to prevent water quality problems) could include diapering dump trucks, routine inspection and cleaning of heavy equipment and mandatory presence of spill control kits. Mitigation measures to protect riparian vegetation could include protecting large trees and other components of vegetative buffers, limiting construction footprints and replanting after construction is complete.

Water quality and hydrologic mitigation measures implemented as part of the Enhanced Bus and Streetcar alternatives would include minimizing impervious surface area (especially new impervious surfaces) and implementation of structural and nonstructural BMPs (especially onsite infiltration facilities), which could include the use of LID alternatives.

The Streetcar and Enhanced Bus alternatives could mitigate channel/floodplain effects through full compliance with applicable regulations and implementation of other project design features to help maximize benefits to water resources. Local jurisdictions require balanced cut and fill for fill placed in the 100-year floodplain unless technical analysis shows that the development would not result in an increase in the base flood elevation or exempt, as is the case in the South Waterfront area. Removal of existing structures in the floodplain also may be used to partially or fully account for mitigation of floodplain effects. In addition to including the same volume of fill, floodplain mitigation should occur at the same land surface elevation as the effect. Wherever possible it would be beneficial for floodplain cuts to be incorporated with projects that improve water quality, such as revegetating riparian areas that are currently in a degraded state.

3.10 Noise and Vibration

This section summarizes the assessment of the potential noise and vibration effects that would result from the project's alternatives and design options. This section addresses the affected environment, the potential environmental consequences, and possible mitigation related to the noise and vibration analysis. For more detail, see the *Lake Oswego to Portland Transit Project Noise Technical Report* (ENVIRON/URS and TriMet/Metro, November 2010).

3.10.1 Terminology and Standards

This section provides a summary of the terms and FTA impact criteria used for the project's noise and vibration analysis. See the *Noise and Vibration Technical Report* for additional detail and for a description of FTA, FHWA and ODOT noise criteria as well as a summary of local ordinances related to noise and vibration.

3.10.1.1 Noise

Within this analysis, the terms *noise* and *sound* are used interchangeably. The decibel (dB) scale used to describe sound is a logarithmic rating system capable of assessing large differences in audible sound intensities. This scale accounts for the human perception of a doubling of loudness as an increase of 10 dB. For example, a 70-dB sound level would sound about twice as loud as a 60-dB sound level. People generally cannot detect sound level differences (increases or decreases) of 1 dB in a given noise source. Differences of 2 dB or 3 dB can be detected by humans under ideal laboratory situations, although they are often difficult to discern in an active, outdoor noise environment. However, a 5-dB change in a given noise source or environment would likely be perceived by most people under normal listening conditions.

When assessing potential effects of noise on people, it is necessary to consider the range of frequencies that the human ear perceives the best. Sound-measuring instruments are designed to weight sounds based on the way people hear. The frequency weighting most often used to evaluate environmental noise is known as A-weighting (dBA) and this scale is used exclusively in this evaluation for noise. Sound levels associated with a range of common noise sources are listed in Figure 3.10-1.

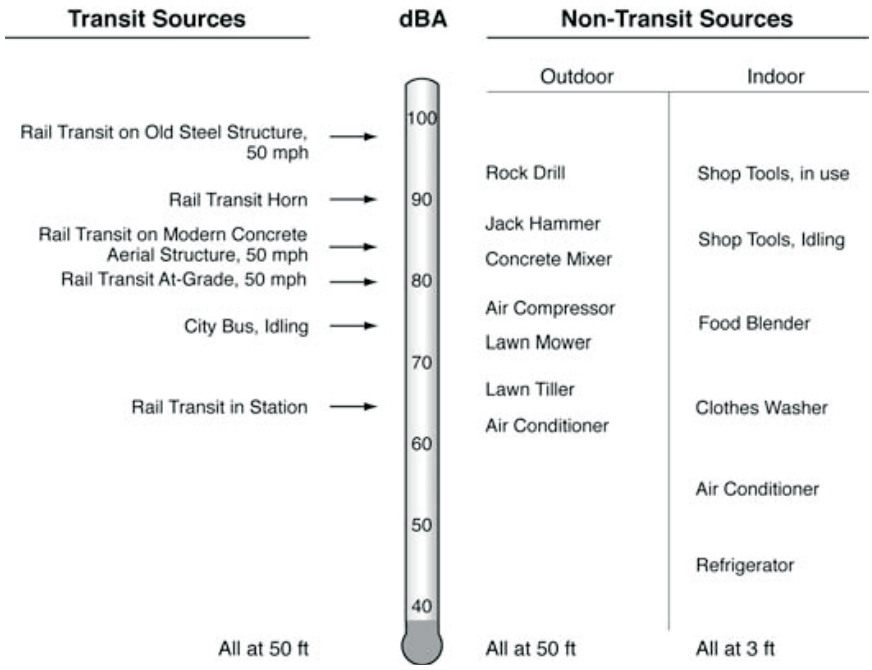
Factors affecting the sound transmission from a given source, which in turn affects the potential for noise impacts, include distance from the source, frequency of the sound, absorbency and roughness of the intervening ground surface, the presence or absence of obstructions and their absorbency or reflectivity, and the duration of the sound. The degree of impact on humans also depends on existing sound levels at the receiving location and who is listening, and the perception of impact also may depend on any preconceived attitudes regarding the noise source.

Two metrics used to quantify sound are used throughout the project's noise analysis. Each is described below.

- **The equivalent sound level (L_{eq}).** L_{eq} considers sound levels over time and accounts for the number, levels and durations of noise events during a specific time interval. In general, the L_{eq} noise metric is highly correlated to community response to noise, and this metric is used within the noise impact criteria developed by the FTA. FTA's criteria that apply at locations primarily involving daytime use (e.g., parks, schools, libraries, churches) are based on the hourly L_{eq} in an average weekday when the most transit vehicles would be operating.

- **Day-night sound level (L_{dn})**. L_{dn} is derived from the hourly L_{eqs} across an entire day and is similar to 24-hour L_{eq}, except that the calculation of this metric includes adding 10 dBA to sound levels between 10:00 p.m. and 7:00 a.m. In this way, the L_{dn} reflects the greater noise sensitivity of most people during the nighttime hours when typical background noise is lower and most people are sleeping. FTA uses L_{dn} to assess potential noise impacts to residential and other properties used for sleeping, such as residences, hospitals and hotels.

Figure 3.10-1 Sound Levels Produced by Common Noise Sources



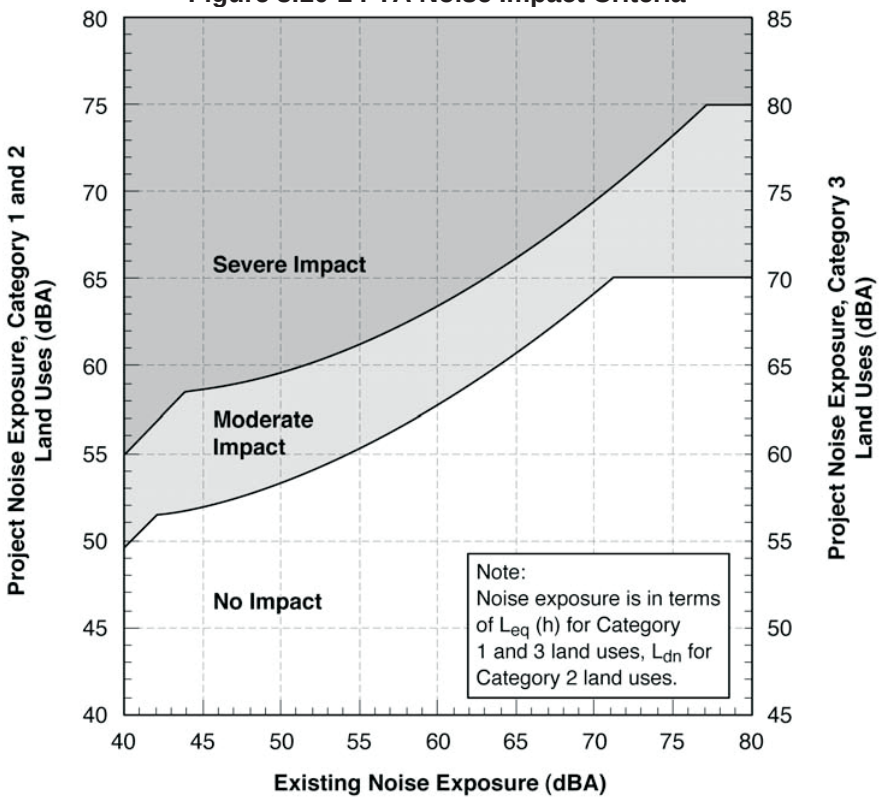
Source: FTA 2006.
Note: The rail transit sound level indicated on this figure likely represents Commuter Rail Transit, not LRT or Streetcar. Because Commuter Rail is a diesel powered vehicle, the sound profile would typically be much higher than LRT or Streetcar, which are electrically powered.

FTA noise impact criteria are based on comparing expected project-related noise to existing sound levels (see Figure 3.10-2). Under these criteria, receiving locations with low existing sound levels can be exposed to greater increases in overall noise due to the addition of project noise before an impact would occur; conversely, locations with higher existing sound levels can be exposed to smaller increases in overall noise before an impact would occur. The FTA noise impact analysis is based on a three-step process: 1) screening using standard distances, 2) a general noise assessment using a simple noise model produced by FTA and 3) a detailed noise analysis. Most of the streetcar components of this project were considered in a detailed analysis using noise modeling.

The majority of the Lake Oswego to Portland Transit Project alternatives and design options would be subject only to FTA noise impact criteria. Only the Macadam Additional Lane design option of the Streetcar Alternative would result in a change to the geometry of Highway 43, an ODOT roadway facility, which would make it subject to FHWA/ODOT noise impact criteria. However, this design option would not add a through lane of traffic, construct a new roadway on a new alignment,

result in an acoustically significant shift in the roadway alignment, or bring about a new traffic noise impact. Therefore, in accordance with the provisions of 23 CFR 772(h), an ODOT traffic noise study is not required by this project (*ODOT Noise Manual*, March 2009, pg 2).

Figure 3.10-2 FTA Noise Impact Criteria



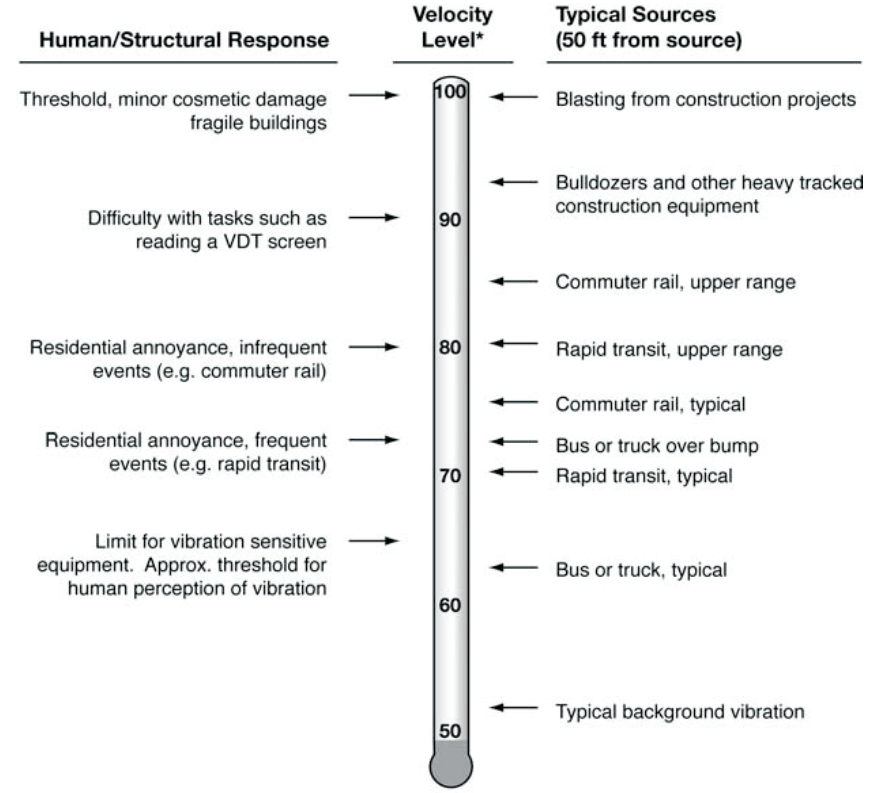
Source: FTA; 2006.
Note: Land Use Category 1 corresponds to tracts of land where quiet is an essential element in the intended purpose (e.g., an outdoor amphitheater). Land Use Category 2 denotes residences and buildings where people normally sleep. Land Use Category 3 represents institutional land uses (e.g., schools, churches) with primarily daytime and evening use where it is important to avoid interference with speech. See Section 3.10-1(A) for a description of the noise measurements.

3.10.1.2 Vibration

For this analysis, *ground-borne vibration* is assessed as the motion of building surfaces such as rattling of windows, items on shelves or pictures hanging on walls, or as a low-frequency rumbling noise, which is referred to as *ground-borne noise*. Some common levels of ground-borne vibration are shown in Figure 3.10-3. FTA's guidance calls for vibration to be reported as vibration decibel levels (VdB).

FTA characterizes impacts from ground-borne vibration and ground-borne noise based on three categories of land uses: 1) buildings where vibration would interfere with sensitive interior operations, 2) residences and buildings where people normally sleep and 3) buildings that are primarily used during the daytime. FTA's approach for screening potential vibration impacts for vehicles like streetcars is based on distances of 200, 100 and 50 feet for the three categories of land uses, respectively. FTA has established thresholds of impact for three categories of noise event frequency for both ground-borne vibration and ground-borne noise: frequent, occasional and infrequent events (see the *Noise and Vibration Technical Report* for the specific threshold criteria per land use and type of event).

Figure 3.10-3 Typical Levels of Ground-Borne Vibration



Source: FTA 2006.
Note: The "rapid transit typical" would be the most likely to correlate to LRT and Streetcars that would be lower because they are lighter vehicles.

3.10.2 Affected Environment

Existing noise levels at representative locations throughout the project area were documented using a series of long-term (about 24-hours) and short-term (about one hour) sound level measurements. Existing vibration conditions in the project study area were determined through a survey of existing homes and other buildings and a determination of their distance from the proposed transit improvements and construction areas under the alternatives and Streetcar Alternative design options. The sound level measurements and vibration receiver survey were conducted during three separate site visits to the project study area. Based on the FTA vibration screening criteria described in Section 3.10.1, the survey found that there are 103 buildings within the project area, which were then evaluated for potential ground-borne vibration impacts. Ground-borne noise was not specifically assessed because such noise is typically more of a concern for trains in long tunnels or in underground transit systems such as subways where little to no airborne noise reaches the receivers. Ground-borne noise is associated with and related to levels of ground-borne vibration and, according to FTA guidance, can be estimated by reducing projected levels of ground-borne vibration by amounts that vary depending on the frequency spectrum of the source. Based on this relationship, ground-borne noise related to operation of the streetcar was reviewed and dismissed as a potential source of impacts due to the project. The *Noise and Vibration Technical Report* documents in detail the results of the existing noise and vibration surveys and further discusses the review of ground-borne noise.

3.10.3 Environmental Consequences

This section summarizes the noise and vibration impacts that would result from the project's alternatives (see Tables 3.10-1 and 3.10-2). The noise assessment included sounds from the streetcar line, the associated park-and-ride lot, and streetcar bells at gated crossings and stations.

In summary, the No-Build and Enhanced Bus alternatives would not result in any moderate or severe noise impacts or ground-borne vibration impacts based on FTA's impact criteria.

Without potential mitigation measures in place, operation of the Streetcar Alternative would result in severe noise impacts to one residential property in the Dunthorpe/Riverdale Segment with either the Willamette Shore Line or Riverwood design options. Without potential mitigation measures, the Streetcar Alternative would also result in moderate noise impacts to 13 to 24 residences in the Johns Landing, Sellwood Bridge and Dunthorpe/Riverdale segments. Figure 3.10-4 depicts the noise receptor locations considered in the analysis and the range of potential noise impacts. See the *Noise and Vibration Technical Report* for a list and illustration of specific locations and how the moderate impacts would vary by design option.

The survey of the potentially affected area revealed 103 buildings within the screening distances defined by FTA as being subject to operational vibration impacts based on the varying uses of these buildings. The screening distances are 200 feet for particularly sensitive uses (e.g., research facilities with vibration-sensitive equipment), 100 feet for residences, and 50 feet for institutional uses such as banks and offices. After considering the specific anticipated streetcar travel speeds, the uses of the buildings within screening distance of the tracks, and the actual distances of the buildings from the tracks, it was determined that 23 to 28 buildings remained as potentially impacted. See Figure 3.10-5 for a depiction of the vibration receiver locations considered and areas subject to potential operational vibration impacts. With the use of ballast mats for the rail line near these potentially affected locations, all of these possible operational vibration impacts could be mitigated to the level of no impact under FTA criteria. Refer to Section 3.10.4 for additional information regarding where such mitigation measures would be implemented.

Table 3.10-1 Severe Operational Noise Impacts and Operational Vibration Impacts without and with Potential Mitigation by Alternative

Type of Impact	No-Build	Enhanced Bus	Streetcar
Severe Noise Impact			
Without Potential Mitigation	0	0	1[1]
With Potential Mitigation	0	0	0
Ground-Borne Vibration Impact			
Without Potential Mitigation	0	0	23-28[2]
With Potential Mitigation	0	0	0

Source: ENVIRON International Corporation 2010

Note: All data are based on operations during an average weekday, 2031. Determination of a severe noise impact is based on existing noise conditions and on FTA impact criteria and methods described in sections 3.10-1 and 3.10-2 of this DEIS.

1 The severe noise impact would be at an outdoor use area associated with a residence and would occur within the Dunthorpe/Riverdale Segment. The projected impact would occur under both the Willamette Shore Line and Riverwood design options (see Figure 3.10-6). Without the potential mitigation measures, the Streetcar Alternative would also result in moderate noise impacts to 13 to 24 residences in the Johns Landing, Sellwood Bridge, and Dunthorpe/Riverdale segments (see the *Noise and Vibration Technical Report* for a list and illustration of specific locations and how the moderate impacts would vary by design option). No assessment was made of how many of the projected moderate impacts could be lowered to *no impact* based on potential mitigation measures and on the FTA impact criteria.

2 The range reflects the potential number of buildings (i.e., not total residences) impacted by vibrations with the varying alternatives.

Table 3.10-2 Noise and Vibration Impacts without and with Potential Mitigation Measures By Segment Design Options (2035)

Segment/Design Option	Moderate Noise Impacts[1]		Severe Noise Impacts[1]		Vibration Impacts	
	Without Mitigation	With Potential Mitigation	Without Mitigation	With Potential Mitigation	Without Mitigation	With Potential Mitigation
1 – Downtown Portland[2]	-	-	-	-	-	-
2 – South Waterfront[3]	0	0	0	0	0	0
3 – Johns Landing						
Willamette Shore Line	8	8	0	0	3	0
Macadam In-Street	0	0	0	0	5	0
Macadam Additional Lane	0	0	0	0	5	0
4 – Sellwood Bridge[3]	2	2	0	0	4	0
5 – Dunthorpe/Riverdale						
Willamette Shore Line	14	15	1	0	19	0
Riverwood	11	12	1	0	16	0
6 – Lake Oswego						
UPRR	0	0	0	0	0	0
Foothills	0	0	0	0	0	0

Source: ENVIRON International Corporation.
Note: All data are based on operations during an average weekday, 2031. Determination of a severe noise impact is based on existing noise conditions and on FTA's impact criteria and methods described in sections 3.10-1 and 3.10-2 of this DEIS.

1 Impacts are those that are categorized as *moderate* or *severe* using FTA noise criteria. Mitigation measures are potential and have not been incorporated into the project design. Impacts are those generated by operation of rail transit vehicles. The increase in the number of moderate impacts with mitigation is due to the severe noise impact being reduced to a moderate impact. No assessment was made of how many moderate impacts could be lowered to no impact based on potential mitigation measures and on the FTA impact criteria.

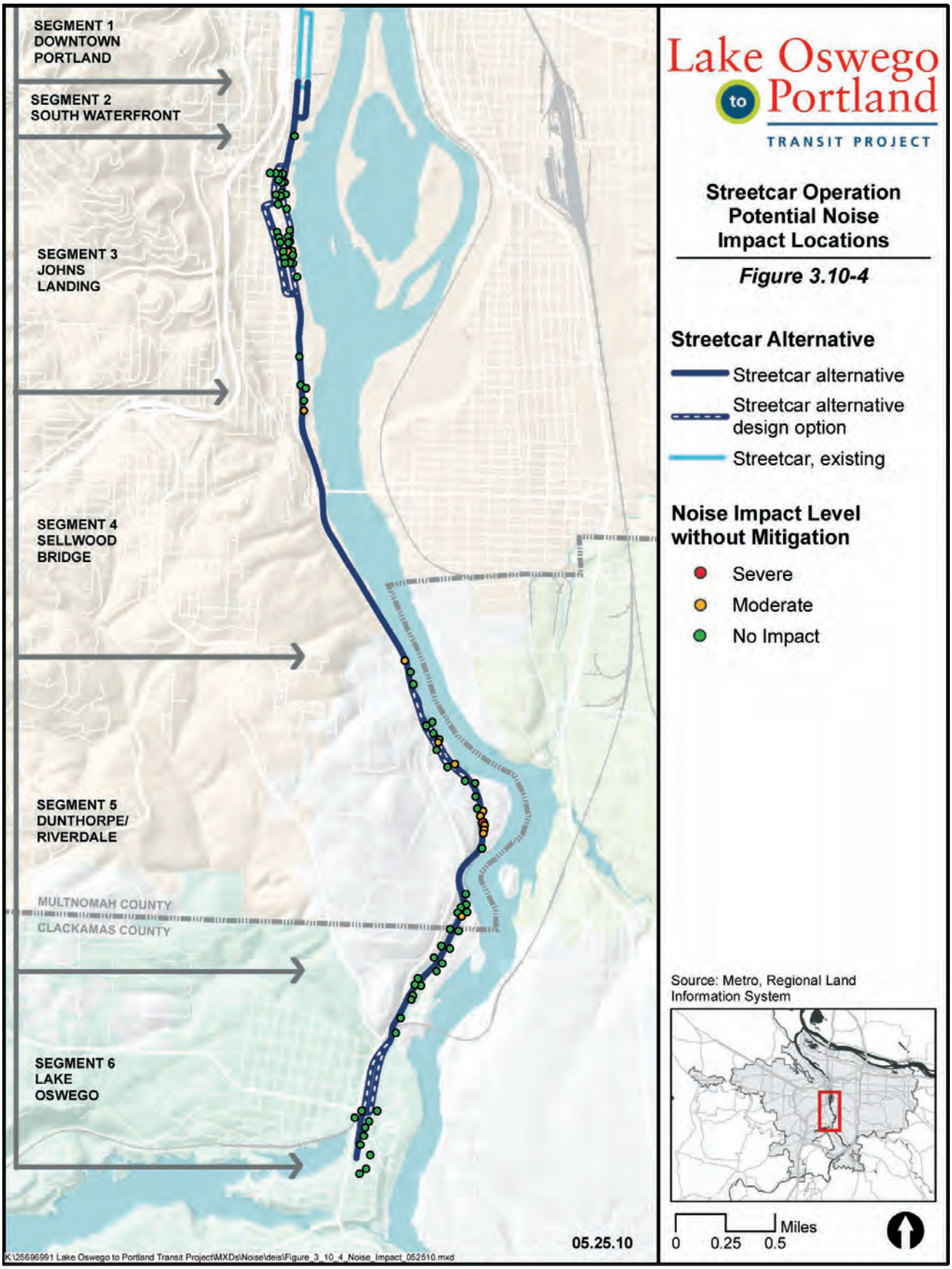
2 Noise and vibration impacts were not assessed in the Downtown segment 1 because no new facilities would be constructed in this area.

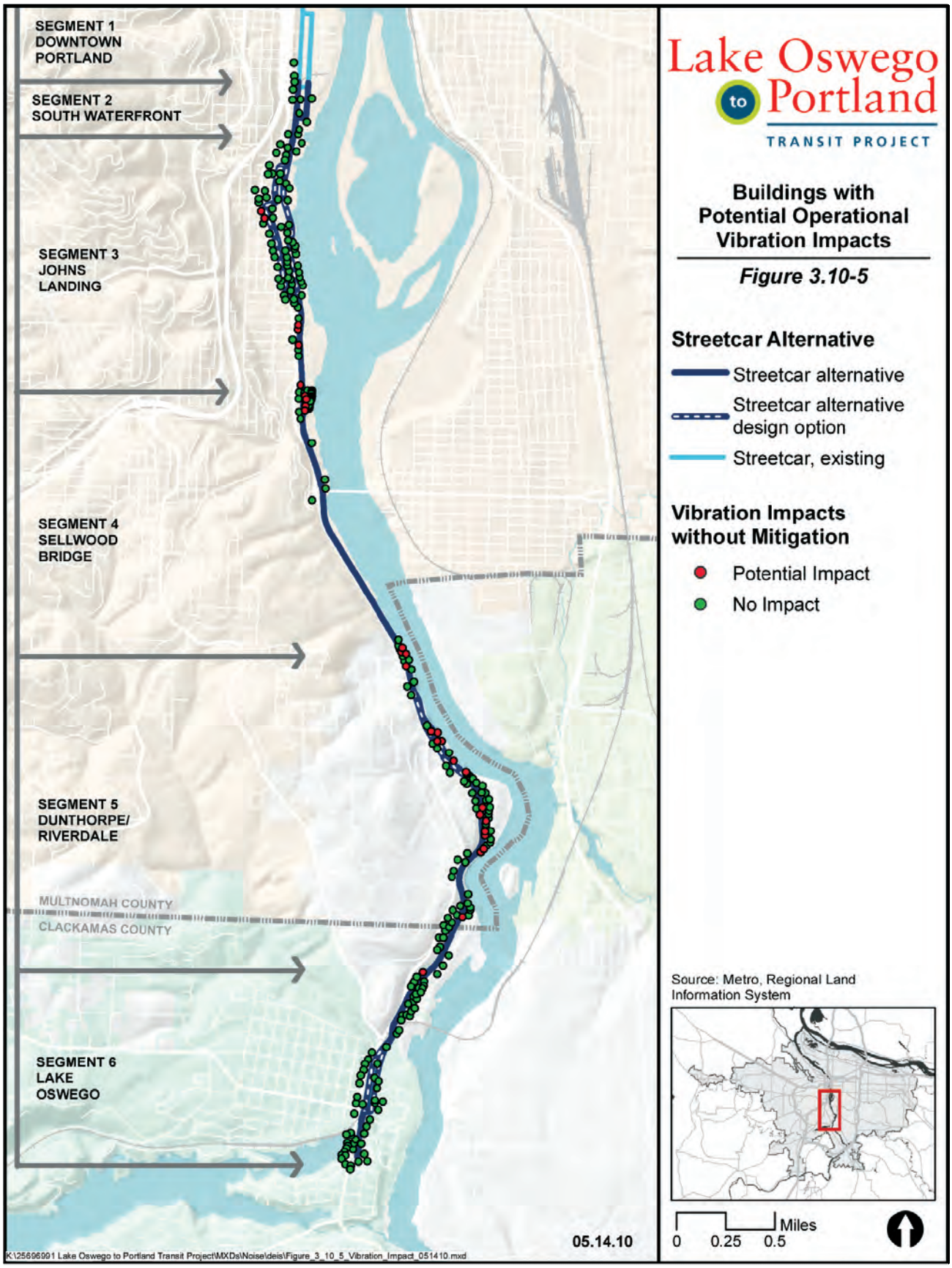
3 The South Waterfront and Sellwood Bridge Segments contain potential construction phasing options associated with the Streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

3.10.4 Potential Mitigation

As required by the FTA, noise and vibration impacts associated with the project will be considered for possible mitigation. FTA guidance says, "If it is not practical to avoid severe impacts by changing the location of the project, mitigation measures must be considered… Projected noise levels in the moderate impact range will also require consideration and adoption of mitigation measures when it is considered reasonable" (FTA, 2006, page 3-11). Thus, the potential noise impacts associated with the proposed project were considered in a preliminary analysis of potential mitigation measures. This section describes the potential noise and vibration mitigation measures that could be implemented to resolve project related impacts, including discussion of an initial review conducted for one location.

A preliminary review indicated the severe noise impact to one residence in the Dunthorpe/Riverdale Segment that would result from the Streetcar Alternative could be mitigated with a noise wall located between the residence and the streetcar tracks, generally within what would be the streetcar right of way. The noise wall approximately 3 feet tall and 200 feet long east of the tracks could reduce the *severe* noise impact to a *moderate* impact. The noise wall is illustrated in Figure 3.10-6.


SEGMENT 1
DOWNTOWN
PORTLAND
SEGMENT 2
SOUTH WATERFRONT
SEGMENT 3
JOHNS
LANDING
SEGMENT 4
SELLWOOD
BRIDGE
SEGMENT 5
DUNTHORPE/
RIVERDALE
MULTNOMAH COUNTY
CLACKAMAS COUNTY
SEGMENT 6
LAKE
OSWEGO
05.25.10
K:\25696991 Lake Oswego to Portland Transit Project\MXDs\Noise\deis\Figure_3_10_4_Noise_Impact_052510.mxd
Lake Oswego to Portland
TRANSIT PROJECT
Streetcar Operation
Potential Noise
Impact Locations
Figure 3.10-4
Streetcar Alternative
Streetcar alternative
Streetcar alternative design option
Streetcar, existing
Noise Impact Level without Mitigation
Severe
Moderate
No Impact
Source: Metro, Regional Land Information System
Miles
0
0.25
0.5


SEGMENT 1
DOWNTOWN
PORTLAND
SEGMENT 2
SOUTH WATERFRONT
SEGMENT 3
JOHNS
LANDING
SEGMENT 4
SELLWOOD
BRIDGE
SEGMENT 5
DUNTHORPE/
RIVERDALE
MULTNOMAH COUNTY
CLACKAMAS COUNTY
SEGMENT 6
LAKE
OSWEGO
05.14.10
K:\25696901 Lake Oswego to Portland Transit Project\MXDs\Noise\deis\Figure_3_10_5_Vibration_Impact_051410.mxd
Lake Oswego to Portland
TRANSIT PROJECT
Buildings with Potential Operational Vibration Impacts
Figure 3.10-5
Streetcar Alternative
Streetcar alternative
Streetcar alternative design option
Streetcar, existing
Vibration Impacts without Mitigation
Potential Impact
No Impact
Source: Metro, Regional Land Information System
Miles
0
0.25
0.5

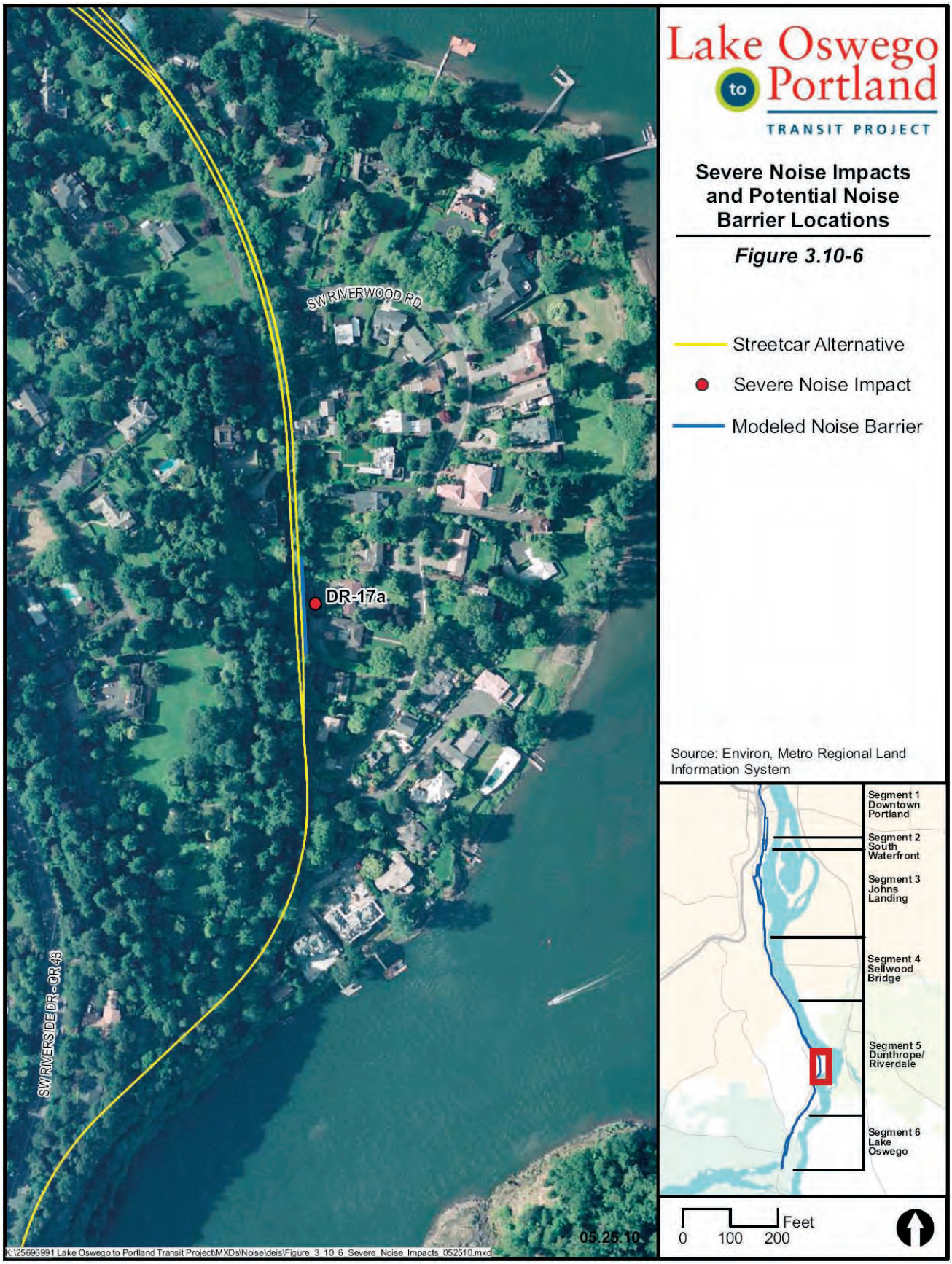
The preliminary review of mitigation measures suggests that at least some of the *moderate* noise impacts that would occur in three of the six project segments also could potentially be mitigated using noise walls between buildings and the streetcar tracks. The effectiveness of the potential mitigation measures on *moderate* impacts has not yet been fully examined, and noise walls may not be feasible and/or cost-effective in all locations (e.g., where gaps in the walls would be required to retain vehicular and/or pedestrian access and in any locations where there is insufficient room to accommodate such barriers). These issues would be more completely considered after the selection of the Locally Preferred Alternative.

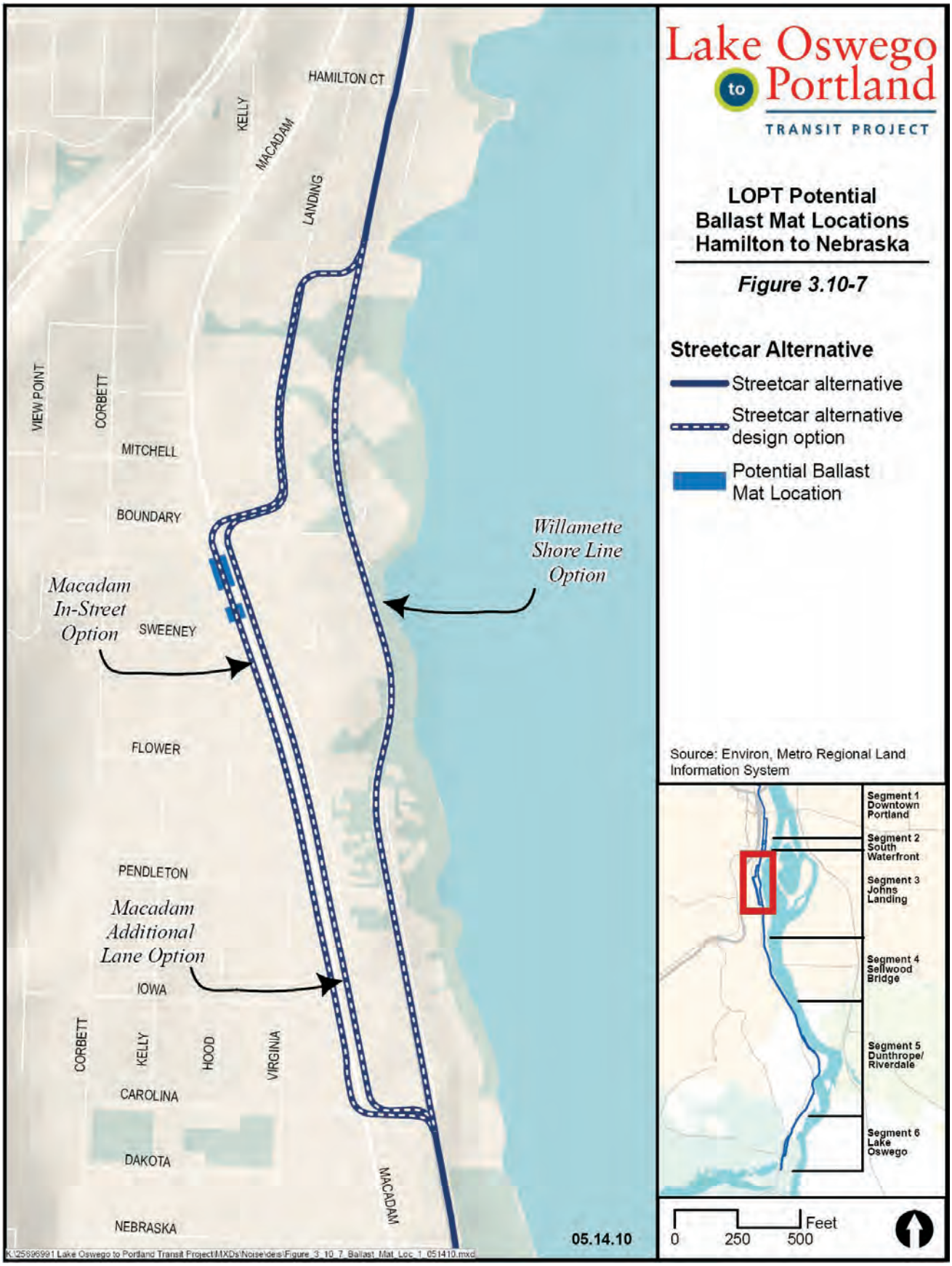
In the event the Streetcar Alternative is selected as the Locally Preferred Alternative, the size, design and location of noise walls and/or other mitigation measures that would be constructed with the project would be determined during the project's Preliminary Engineering phase and before publication of the project's Final EIS. Those decisions would be based on several factors, such as FTA criteria for mitigation measures, costs compared to effectiveness and any secondary impacts associated with the potential mitigation measures (e.g., visual or access impacts that could result from noise walls). The following factors are typically considered in evaluating mitigation measures:

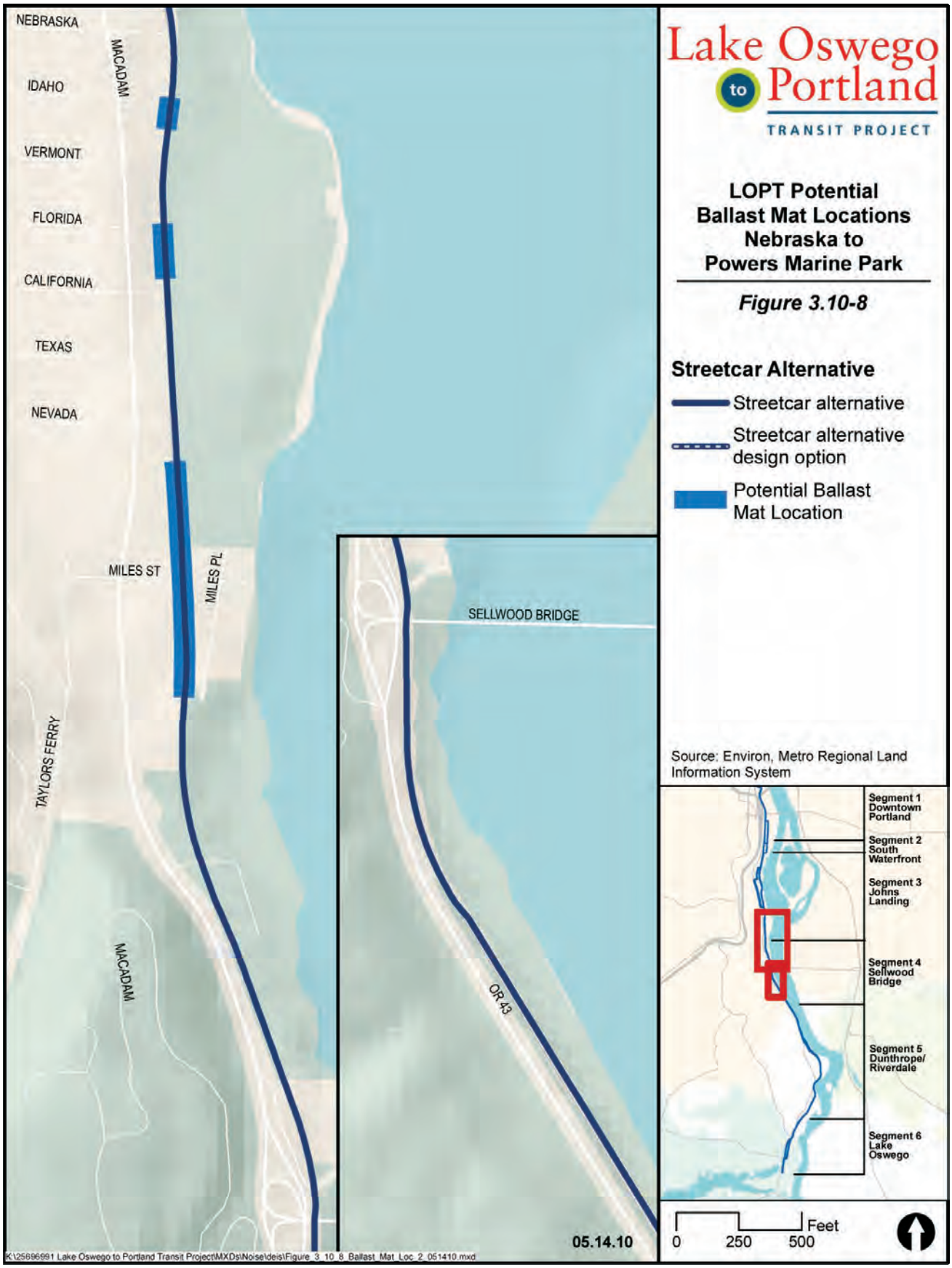
- The number of noise-sensitive sites affected at a particular noise level;
- The increase over existing noise levels and the "location" of the estimated noise level in relation to the moderate and severe ranges depicted in Figure 3.10-2;
- The noise sensitivity of the property;
- The effectiveness of the potential mitigation measures in terms of the magnitude of the noise reduction that can be achieved and the number of receptors that would benefit; and
- Cost versus potential noise-reduction benefit will be a critical factor during deliberations regarding whether and where to implement mitigation for this project.

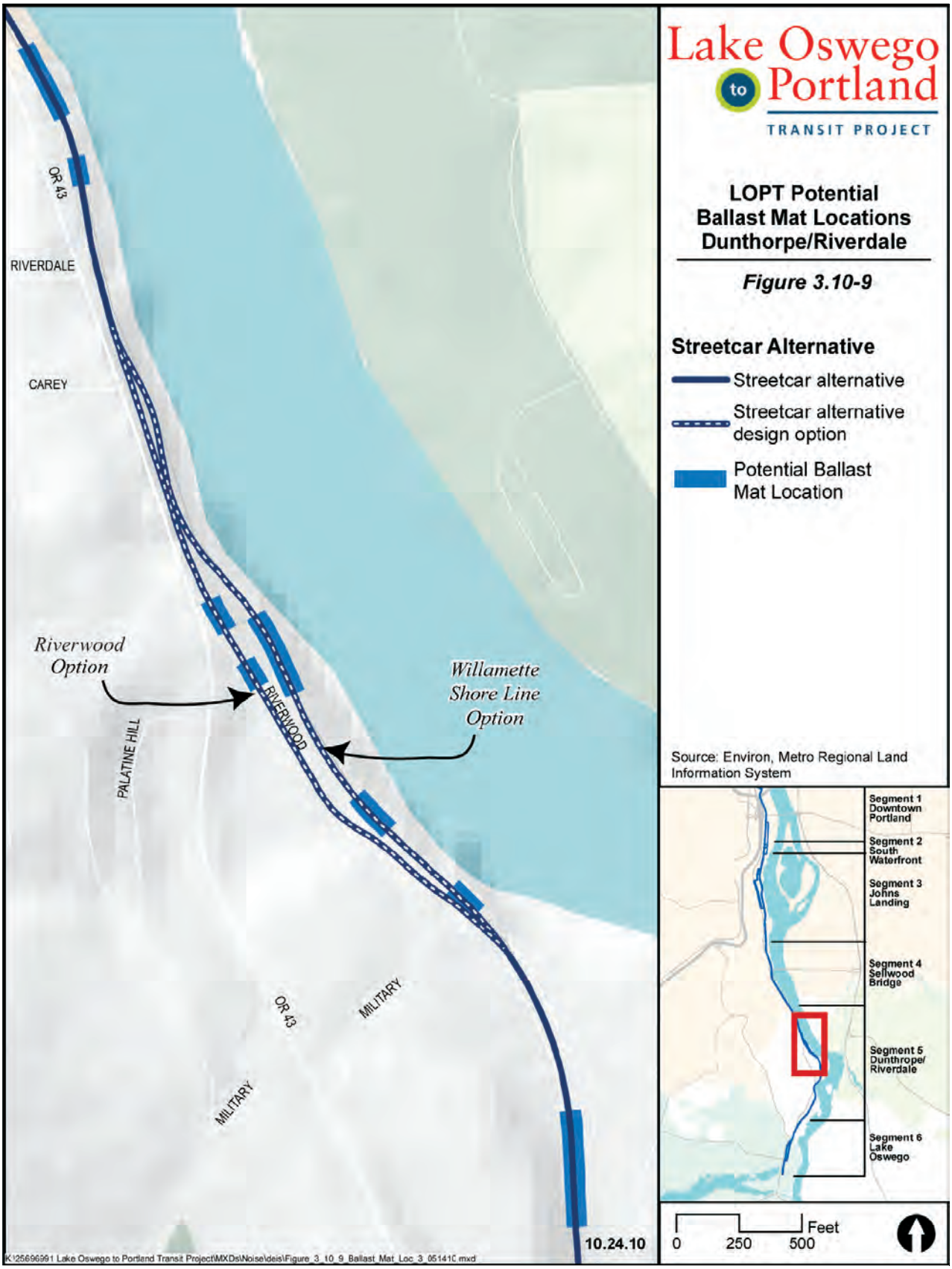
Thus, project-related operational severe and moderate noise impacts will be considered in additional detail after selection of a preferred alternative. Mitigation determined to be both feasible and reasonable will be considered for implementation on a case-by-case basis. Decisions would be reached and commitments to any selected mitigation measures would be made prior to publication of the Final EIS, and these decisions and any related commitments to implement mitigation measures would be included in this document.

The only mitigation measure necessary to avoid operational vibration impacts associated with operation of the Streetcar Alternative would be in the form of ballast mats under the rail line. With the use of ballast mats or similarly effective vibration-reducing technology in locations where the rail would be very near one or more potentially affected buildings, all the potential operational vibration impacts could be avoided. Figures 3.10-7 through 3.10-10 depict the locations where ballast mats would be needed to avoid vibration impacts from operation of the streetcar alternative and design options. Refer to the *Noise and Vibration Technical Report* for additional information in this regard.


Lake Oswego to Portland
TRANSIT PROJECT
Severe Noise Impacts and Potential Noise Barrier Locations
Figure 3.10-6
Streetcar Alternative
Severe Noise Impact
Modeled Noise Barrier
Source: Environ, Metro Regional Land Information System
SW RIVERWOOD RD
DR-17a
SW RIVERSIDE DR - OR 43
Segment 1 Downtown Portland
Segment 2 South Waterfront
Segment 3 Johns Landing
Segment 4 Sellwood Bridge
Segment 5 Dunthrope/ Riverdale
Segment 6 Lake Oswego
0 100 200 Feet
05.25.10
K:\25696991 Lake Oswego to Portland Transit Project\MXDs\Noise\deis\Figure_3_10_6_Severe_Noise_Impacts_052510.mxd


Lake Oswego to Portland
TRANSIT PROJECT
LOPT Potential Ballast Mat Locations Hamilton to Nebraska
Figure 3.10-7
Streetcar Alternative
Streetcar alternative
Streetcar alternative design option
Potential Ballast Mat Location
Source: Environ, Metro Regional Land Information System
HAMILTON CT
KELLY
MACADAM
LANDING
VIEW POINT
CORBETT
MITCHELL
BOUNDARY
SWEENEY
FLOWER
PENDLETON
IOWA
CAROLINA
DAKOTA
NEBRASKA
HOOD
VIRGINIA
MACADAM
Willamette Shore Line Option
Macadam In-Street Option
Macadam Additional Lane Option
05.14.10
Segment 1 Downtown Portland
Segment 2 South Waterfront
Segment 3 Johns Landing
Segment 4 Sellwood Bridge
Segment 5 Dunthrope/ Riverdale
Segment 6 Lake Oswego
0
250
500
Feet


NEBRASKA
IDAHO
VERMONT
FLORIDA
CALIFORNIA
TEXAS
NEVADA
MACADAM
MILES ST
MILES PL
TAYLORS FERRY
MACADAM
SELLWOOD BRIDGE
OR 43
05.14.10
K:\25696991 Lake Oswego to Portland Transit Project\MXDs\Noise\deis\Figure_3_10_8_Ballast_Mat_Loc_2_051410.mxd
Lake Oswego to Portland
TRANSIT PROJECT
LOPT Potential Ballast Mat Locations Nebraska to Powers Marine Park
Figure 3.10-8
Streetcar Alternative
Streetcar alternative
Streetcar alternative design option
Potential Ballast Mat Location
Source: Environ, Metro Regional Land Information System
Segment 1 Downtown Portland
Segment 2 South Waterfront
Segment 3 Johns Landing
Segment 4 Sellwood Bridge
Segment 5 Dunthrope/ Riverdale
Segment 6 Lake Oswego
0
250
500
Feet


Lake Oswego to Portland
TRANSIT PROJECT
LOPT Potential Ballast Mat Locations Dunthorpe/Riverdale
Figure 3.10-9
Streetcar Alternative
Streetcar alternative
Streetcar alternative design option
Potential Ballast Mat Location
Source: Environ, Metro Regional Land Information System
OR 43
RIVERDALE
CAREY
Riverwood Option
Willamette Shore Line Option
RIVERWOOD
PALATINE HILL
OR 43
MILITARY
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Segment 1 Downtown Portland
Segment 2 South Waterfront
Segment 3 Johns Landing
Segment 4 Sellwood Bridge
Segment 5 Dunthrope/ Riverdale
Segment 6 Lake Oswego
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Lake Oswego to Portland
TRANSIT PROJECT
LOPT Potential Ballast Mat Locations Dunthorpe to Lake Oswego
Figure 3.10-10
Streetcar Alternative
Streetcar alternative
Streetcar alternative design option
Potential Ballast Mat Location
Source: Environ, Metro Regional Land Information System
Segment 1 Downtown Portland
Segment 2 South Waterfront
Segment 3 Johns Landing
Segment 4 Sellwood Bridge
Segment 5 Dunthrope/ Riverdale
Segment 6 Lake Oswego
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05.14.10
BREYMAN
RIVERWOOD
GREENWOOD
EDGECLIFF
OR 43
ELK ROCK
FIELDING
MIDVALE
BRIARWOOD

3.11 Air Quality

This section discusses the air quality analysis and conformity determination for the Lake Oswego to Portland Transit Project alternatives. It includes a summary of the applicable regulations, methods used, affected environment and anticipated environmental consequences. Potential mitigation measures and a discussion on climate change are also included. For additional detail, see the *Lake Oswego to Portland Transit Project Air Quality Technical Report* (URS, TriMet/Metro, November 2010). There are two potential sources of air pollution associated with the project: 1) changes to vehicular traffic as a result of transit operation and 2) project construction. This section focuses on transit changes that affect vehicular-caused air pollution; see Section 3.16 for a discussion of construction activities and their affect on air quality.

3.11.1 Introduction, Applicable Regulations, Analysis Methods and Coordination

Proposed surface transportation projects seeking federal funding must meet the Clean Air Act standards and its related rules on a regional level and on a localized (project) level. To meet conformity at a regional level, a project must be included in the approved Metro financially constrained Regional Transportation Plan (RTP) and demonstrated to meet air quality standards. This air quality conformity is a condition to securing federal funds for surface transportation projects. The RTP and the Metropolitan Transportation Improvement Program (MTIP) include a set of regional projects, all of which are analyzed for regional air quality conformity to ensure that the entire package of projects help the region meet federal and state air quality guidelines.

There are two potential sources of air pollution associated with the project: construction and vehicular traffic (operation). Construction impacts are associated with the build alternatives only. They are temporary and expected to be minimal. Most construction emissions (and impacts) are usually generated during earth moving activities. Air pollution associated with operational activities (vehicular traffic) will most likely be reduced due to implementation of the build alternatives, but modifications in traffic patterns can potentially create localized areas of elevated pollution, or "hot-spots," which are assessed below.

3.11.1.1 Applicable Regulations

Air quality in the project area is regulated by the U.S. Environmental Protection Agency (EPA) and the Oregon Department of Environmental Quality (ODEQ). Under the Clean Air Act, EPA has established the National Ambient Air Quality Standards (NAAQS), which specify maximum concentrations for carbon monoxide (CO), particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), ozone (O_3), sulfur oxides (SO_x), lead (Pb), and nitrogen dioxide (NO_2). Federal and state standards for the five pollutants relevant to vehicular emissions (CO, PM_{10}, $PM_{2.5}$, O_3 and NO_2) are listed below in Table 3.11-1.

Nonattainment areas are geographical regions where air pollutant concentrations exceed the NAAQS for a pollutant. Air quality maintenance areas are regions that have historically been in nonattainment for air quality standards but have achieved compliance through improved planning and control measures. The project area lies within the Portland Air Quality Maintenance Area (AQMA) which extends from Portland, south to Wilsonville, east to Gresham and west past Hillsboro. Air quality emissions in the Portland metro region are currently being managed under the provisions of the State Implementation Plan, which has adopted the Portland Area Carbon Monoxide Maintenance Plan (ODEQ, Air Quality Division, December 10, 2004) and the Portland-Vancouver Air Quality Maintenance Area (Oregon Portion) and Salem-Keizer Area Ozone Maintenance Plan

(ODEQ, Adopted by the Environmental Quality Commission February 22, 2007). Any regionally significant transportation project in the Portland AQMA must conform to the maintenance plans. Generally, conformity is demonstrated by showing that the project would not cause or contribute to any new violation of any NAAQS, would not increase the frequency or severity of any existing violation of any NAAQS, or would not delay timely attainment of the NAAQS. For the Portland metro region, conformity must be demonstrated for carbon monoxide only, being in attainment or not having to demonstrate conformity for any other air pollutant for surface transportation projects.

Table 3.11-1 Ambient Air Quality Standards (AAQS)

Pollutant	Averaging Time	Federal Standard (NAAQS)	State Standard
Carbon Monoxide (CO)	1-hour	35 ppm	35 ppm
	8-hour	9 ppm	9 ppm
Ozone (O_3)	8-hour	0.075 ppm	0.08 ppm
Particulate Matter < 2.5 µm ($PM_{2.5}$)	24-hour	35 µg/m3	--
	Annual	15 µg/m3	--
Particulate Matter < 10 µm (PM_{10})	24-hour	150 µg/m3	150 µg/m3
	Annual	N/A	50 µg/m3
Nitrogen Dioxide (NO_2)	1-hour	0.100ppm	--
	Annual	0.053 ppm	0.053 ppm

Source: EPA Office of Air Quality Planning (http://www.epa.gov/air/criteria.html) and Oregon Administrative Rule (OAR) 340-202-0050 through -0130. [Note: EPA is in the process of revising the ozone standard to between 0.06 and 0.07 ppm. Further, EPA is revising the 1-hour nitrogen dioxide standard at 0.100 ppm, effective April 12, 2010. Oregon is in the process of updating rules to incorporate new lead and $PM_{2.5}$ standards.]
Notes:
µm = microns (for particulate diameter)
$\mu g/m^3$ = micrograms of pollutant per cubic meter of air
ppm = parts per million

3.11.1.2 Analysis Methods for Conformity

Regional Analysis

As part of the adoption of the 2035 RTP, a list of surface transportation projects planned and expected to be built in the future was included in the regional level air quality analysis. To assess the expected CO emissions, this analysis used the resulting road and transit networks planned for the year 2035, the forecast jobs and housing for several intervening years, and the EPA and DEQ approved MOBILE6.2 air quality model. These emissions were compared against the EPA and DEQ approved "motor vehicle emission budgets," or maximum emissions allowed from surface transportation sources. The Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), after consulting with EPA, approved this regionwide air quality conformity on February 29, 2008 (Air Quality Conformity Determination, 2035 RTP and 2008-2011 MTIP, February 2008, Metro). The RTP analysis included the Lake Oswego to Portland Transit Project (Metro Project Number 10912).

For the purposes of this DEIS, a comparison of emissions for the alternatives was made using mileage data from Metro along with emission factor data, also provided by Metro and described further below. This methodology follows that performed for the Air Quality Conformity Determination (AQCD). The emission comparison is shown in Table 3.11-2.

Table 3.11-2 Estimated Regional Average Weekday Pollutant Emissions for Motor Vehicles (lbs/day)

Alternative	Daily Vehicle Miles Traveled (VMT)[1]	Carbon Monoxide (CO) (lbs/day)[2]
Existing Conditions (Year 2005)[3]	41,611,800	1,476,394
Project Alternatives (Year 2035)		
No-Build	63,090,900	1,423,436
Enhanced Bus	63,049,900	1,422,511
Streetcar with In-Street/Additional Lane Design Options	63,025,500	1,421,961
Streetcar with Willamette Shore Line Design Option	63,022,900	1,421,902

Notes:
[1] Source: Metro, 2010.
[2] Based on MOBILE6.2 data from Metro (2010): emission factors for winter conditions with average speed of 35 mph (Year 2007 - 16.108 gram/mile; Year 2035 - 10.243 gram/mile).
[3] Existing regional VMT data only available for 2005.

Hot Spot (Localized) Analysis

To determine whether a proposed project meets localized, "hot spot" level conformity, traffic levels at local intersections must be examined. A hot-spot analysis includes air quality modeling to determine whether a project conforms to the NAAQS.

The analysis used traffic data for the No-Build, Enhanced Bus and Streetcar alternatives for existing year, 2009 (No-Build Alternative only), and future year 2035.[89] A complete description of this data is provided in the *Lake Oswego to Portland Transit Project Transportation Analysis Technical Report* (DEA, URS, TriMet and Metro, November 2010). The intersections along the project route were evaluated by level of service (LOS) and volumes to assess the need for hot spot analyses. The project itself appears to have minimal effect on intersection traffic, causing slightly decreased volumes (vehicles per hour) and volume to capacity ratios compared to the No-Build Alternative for most intersections. However, 18 of the intersections showed LOS worse than C for at least one scenario and analysis year; 12 of the intersection showed LOS F. Therefore, a hot spot analysis was performed to demonstrate local conformity.

Predictions of existing and future localized CO concentrations in the project vicinity were made using the MOBILE 6.2 emission factors and the CAL3QHC line-source dispersion model following ODOT methodology (*ODOT Air Quality Manual*, September 26, 2008; *MOBILE 6.2.03*, EPA, September 24, 2003; *CAL3QHC: Line Source Dispersion Model – Version 2.0*, EPA, August 9, 1995).[90] Emission factors and idle emission rates are based on average vehicle speeds, regional vehicle registration mixes and annual mileage accumulation rates, the effects of vehicle inspection and maintenance programs, and regional ambient conditions. Emission factors were calculated for the existing year (2009) and future year (2035).[91] To be conservative, CO emission factors are based on winter temperatures.

[89] David Evans and Associates, Inc. ,Lake Oswego to Portland Transit Project Traffic Data (Synchro Model Runs and Operations Figures; based on data from Metro), e-mails from Scott Harmon (DEA) to Christy Schmitt (URS), February 3, 2010).
[90] The MOBILE 6.2 factors were provided by Metro personnel (*MOBILE 6.2 Emission Factors*, Email from Bill Stein (Metro) to Christy Schmitt (URS), February 11, 2010.
[91] Note: Metro had data for 2007, not 2009. Because vehicle emission factors *decrease* with time (due to vehicle emissions reduction programs), the 2007 emission factors were used as a conservative surrogate for 2009 analyses.

A local CO hot spot analysis is used to identify when traffic patterns, idle times, queue lengths and vehicle CO emission rates might lead to elevated CO levels near congested intersections, possibly exceeding the NAAQS. Signalized intersections for the CO analysis were selected using traffic data from the project's traffic analysis, following ODOT and EPA guidance.[92] The guidance recommends ranking intersections based on LOS and vehicles per hour to select the intersections where CO impacts are most likely to occur. Signalized intersections expected to operate at LOS D, E or F must be included in the ranking analysis. Following this methodology, the following three intersections were selected as the worst case modeling scenario based upon both the No-Build Alternative and build alternatives' traffic conditions:

- A Avenue and Highway 43
- Foothills Road and Highway 43
- North Shore Road and Highway 43

It is expected that the CO impacts at these intersections will be higher than those at all other intersections; therefore, a demonstration of compliance for the modeled intersections will show compliance for all other intersections. Since the geometry and traffic patterns for each of these intersections are slightly different, all three were analyzed for hot spots. The full analysis methodology is presented in the *Air Quality Technical Report*.

3.11.1.3 Coordination

Metro is the local Metropolitan Planning Organization responsible for coordinating the regional transportation planning processes, including performing regional conformity assessments. Metro has provided the regional CO emission factors for use in the local conformity assessment. Traffic data was provided in the *Transportation Analysis Technical Report.*

3.11.2 Affected Environment

As discussed above, the project area lies within the Portland AQMA. Portland is currently in compliance for all regulated air pollutants (CO, PM_{10}, $PM_{2.5}$, O_3, NO_2, SO_2, and Pb). [Note: although Portland is in compliance for all regulated air pollutants, it has not yet been redesignated as attainment status for CO.] As shown in Table 3.11-3 below, the calculated worst-case CO concentrations for existing conditions (2009) do not exceed the one-hour or eight-hour average NAAQS for CO at any of the three modeled intersection locations (eight-hour concentrations are between 5.4 and 6.2 parts per million (ppm), well below the standard of 9 ppm).

3.11.3 Environmental Consequences

3.11.3.1 Regional Analysis

As noted above, when Metro modeled regional air quality, it included the Lake Oswego to Portland Transit Project. Regional pollutant emissions, including the effects of the project, were demonstrated to be within regionally-allowable amounts.

[92] *Air Quality Manual*, ODOT, September 26, 2008, and *Guideline for Modeling Carbon Monoxide from Roadway Intersections.* EPA-454/R—92-005, Office of Air Quality Planning and Standards, Technical Support Division. November, 1992.

For comparative purposes, estimates of *regional* motor vehicle CO emissions are shown in Table 3.11-2 for each of the project alternatives. Because the air quality differences between the design and phasing options are beyond the ability of current analysis methods sensitivity, only the alternatives – No-Build, Enhanced Bus and Streetcar are analyzed and compared. The table shows a slight decrease in regional vehicular traffic for each of the two build alternatives over the No-Build Alternative. The decreases range from 0.06 to 0.11 percent (for the Enhanced Bus Alternative and the Streetcar Alternative Willamette Shore Line design option, respectively). For regional examination, CO emissions are directly related to vehicle miles traveled (VMT), so CO emissions also show a slight decrease due to either of the build alternatives over the No-Build Alternative, with the Streetcar Alternative Willamette Shore Line design option having the greatest reduction (1,534 lbs/day reduction over the No-Build Alternative). Emissions of other pollutants are also expected to follow this same trend for Year 2035 (comparison of Alternatives), as emissions are directly related to VMT.

3.11.3.2 Local Hot Spot Analysis

The results of the air quality hot spot analysis are summarized in Table 3.11-3. As shown, the maximum predicted eight-hour CO concentrations for the No-Build Alternative and two build alternatives were found to be within the air quality standard of 9 ppm. Because the project would not cause or contribute to any violation of the NAAQS for CO, it would not cause any adverse localized CO Impacts.

With the No-Build Alternative, operations would not change from the existing transit scenario, however, overall traffic volumes (regardless of the project) are expected to increase in future years. As mentioned above, the project itself appears to have minimal effect on intersection traffic, causing slightly decreased volumes and volume to capacity ratios as compared to the No-Build Alternative for most intersections. Compared to the No-Build Alternative, operations for the Streetcar Alternative and Enhanced Bus Alternative are not expected to have significantly different local air quality effects through the design and future analysis years. Because the hot spot analysis only looks at the worst-case intersections, some segments of the project are not specifically included in the analysis. For example, the Johns Landing area, which does show some design option variations for the Streetcar Alternative, does not include any of the analyzed intersections (based on LOS and volume, as shown in Section 3.11.1.2). However, by the ranking methodology, the Johns Landing intersections are assumed to have better air quality than the three analyzed intersections and are therefore assumed to be in compliance with air quality standards for each of the alternatives and design options.

By intersections, A Avenue and Highway 43 is predicted to have the highest eight-hour CO impact (6.2 ppm for each alternative and year). Northshore Road and Highway 43 has a predicted impact of 5.4 ppm for year 2009 and 5.5 ppm for each alternative in year 2035. Foothills Road and Highway 43 has predicted impacts of 5.6 ppm for 2009 existing and 2035 No-Build Alternative scenarios, and 5.5 ppm for each build alternative in 2035. As noted above, the differences in predicted impacts between the alternatives are minimal. The alternatives do not cause any major changes to these worst-case intersections (besides the slight decreases in volumes and volume to capacity ratios); there are no physical lane modifications at any of these intersections. In addition, the similarities between predicted impacts for the alternatives follows along with the regional analysis which showed overall daily VMT to be very similar, especially between the build alternatives.

Table 3.11-3 Air Quality Hot Spot Analysis[1] – Predicted 8-Hour CO Concentrations (ppm)[2]

Existing Conditions	2009
Avenue A and Highway 43	6.2
North Shore and Highway 43	5.4
Foothills and Highway 43	5.6
Alternative	**2035**
No-Build Alternative	
Avenue A and Highway 43	6.2
North Shore and Highway 43	5.5
Foothills and Highway 43	5.6
Enhanced Bus Alternative	
Avenue A and Highway 43	6.2
North Shore and Highway 43	5.5
Foothills and Highway 43	5.5
Streetcar Alternative (in Segment 3 Johns Landing)	
In-Street/Additional Lane Design Options	
Avenue A and Highway 43	6.2
North Shore and Highway 43	5.5
Foothills and Highway 43	5.5
Willamette Shore Line Design Option	
Avenue A and Highway 43	6.2
North Shore and Highway 43	5.5
Foothills and Highway 43	5.5

Source: URS, March 2010.
Notes:
1 For the following intersections: Avenue A and Highway 43; North Shore and Highway 43; Foothills and Highway 43.
2 8-Hour concentration = 1-Hour concentration times persistence factor of 0.76; 1-Hour concentration equals 1-Hour modeled impact plus background concentration of 2 ppm.

3.11.3.3 Mobile Source Air Toxics

In addition to the regional effects on criteria pollutants, Mobile Source Air Toxics (MSATs) are also expected to be minimally impacted by project. Regionally, MSAT emissions are proportional to vehicle miles traveled (VMT); however, MSAT emission rates are expected to be greatly reduced by technological improvements over the next several years. As shown above in Table 3.11-2, the differences in regional VMT between the alternatives is minimal, with each of the build alternatives having lower predicted VMT than the No-Build Alternative. The Streetcar Alternative In-Street/Additional Lane design option has the lowest expected VMT, and therefore, would be expected to have the lowest MSAT emissions.

3.11.3.4 Climate Change

Climate change is a global problem caused by emissions of greenhouse gases (GHG) from every conceivable source in every nation of the world. Transit projects, in general, can both add (e.g., operations of buses) and reduce GHG (e.g., the overall reduction of vehicle trips). A study by the American Public Transportation Association, *Public Transportation's Contribution to Greenhouse Gas Reduction* by Todd Davis and Monica Hale of Science Applications International Corporation, September 2007, suggests that investments in transit generally lead to long-term reduction in the

growth of GHG emissions. Further, because transit projects vary, it is difficult to provide an overall statement of transit projects' effects on GHG. However, very generally speaking, the (adverse) impact of any one transit project on GHG emissions, even in a cumulative effects evaluation, is miniscule within the global context of the problem. Thus, the increased use of transit locally in the Portland metro region, and across the United States, may have a measurable (positive) impact on the environment from the overall reduction in GHG emissions but, as a general proposition, the overall increase or decrease in global GHG emissions resulting from an individual transit project is so small that it is not necessarily possible to predict the impact of that project on the global climate. Because of this, climate change historically has not been considered useful in choosing a preference from among the alternatives considered during the National Environmental Policy Act (NEPA) review of a single proposed transit project.

Recent guidance from the Council on Environmental Quality (*Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions*, CEQ Memorandum, February 18, 2010) states:

> 25,000 metric tons may provide a useful, presumptive, threshold for discussion and disclosure of GHG emissions because it has been used an proposed in rule-makings under the Clean Air Act (e.g., EPA's Mandatory Reporting of Greenhouse Gases Final Rule, 74 FR 56260, October 30, 2009). This threshold is used in Clean Air Act rulemakings because it provides comprehensive coverage of emissions with a reasonable number of reporters, thereby creating an important data set useful in quantitative analyses of GHG policies, programs and regulations (see 74 FR 56272). This rationale is pertinent to the presentation of NEPA analysis as well.

For the purpose of this DEIS, GHG emissions were calculated to compare the differences for each of the alternatives (2035 only). Table 3.11-4 shows effects of the various build alternatives as compared to the No-Build Alternative on emissions of carbon dioxide (CO_2), evaluated as a surrogate for all GHGs as it is a major component (approximately 95 percent) of transportation-related GHGs. The build alternatives are considered to have a slightly beneficial impact on CO_2 emissions, up to an approximate 42-ton per day reduction due to the Willamette Shore Line design option. Over a one year period, this equates to a reduction of approximately 15,375 tons, which is below the CEQ proposed level of 25,000 metric tons (27,560 tons) of CO_2 'equivalents' (includes prorated amounts of other GHG's based on their potency) to require further evaluation for NEPA analysis.

Apart from the overall reduction in GHG due to the build alternatives, public transportation also produces significantly lower GHG emissions per passenger mile than private vehicles. On a national average, CO_2 emissions per passenger mile are approximately 62 percent lower with light rail as they are for average single occupancy vehicles (SOV), and 23 percent lower for large bus systems as compared to SOVs (*Public Transportation's Role in Responding to Climate Change*, FTA, Updated January 2010).

Table 3.11-4 Estimated Average Daily Difference in Carbon Dioxide (CO_2) Emissions Between Project Alternatives (tons/day)

Project Alternative (2035)	Difference between No-Build and Build Alternative Daily Vehicle Miles Traveled (VMT)[1]	Difference between No-Build and Build Alternative Carbon Dioxide (CO_2) (tons/day)[2]
No-Build	--	--
Enhanced Bus	-41,000	-25.40
Streetcar with In-Street/Additional Lane Design Options	-65,400	-40.51
Streetcar with Willamette Shore Line Design Options	-68,000	-42.12

Notes:

[1] VMT from Metro, 2010 (see data provided in Table 3.11-2).

[2] Based on MOBILE6.2 data from Metro (2010): emission factor for winter conditions with average speed of 35 mph (562.489 gram/mile). [Example calculation for Enhanced Bus Scenario: -41,000 (miles/day) * 562.489 (grams/mile)/908000 (grams/ton) = -25.40 (tons/day)]

3.11.3.5 Cumulative and Indirect Impacts

The project alternatives are not expected to have significant effect upon energy supply or consumption at the regional level. Therefore cumulative effect of this project with other projects and ongoing demand for energy are expected to be limited.

The forecast traffic volumes used to analyze the air quality impacts of the project alternatives include traffic from other sources and are based on the future expected land use and employment information for the project area (which include expected traffic from development in the region and project area). Background concentrations representing the cumulative emissions of other sources in the area are added into the predicted local concentrations for CO at intersections. Because of these inclusive analysis methodologies, the impacts are representative of cumulative and indirect sources, and no further analyses are conducted.

3.11.4 Conformity Determination

In summary, the Lake Oswego to Portland Transit Project is included in the 2035 RTP, which will be implemented through the 2008-11 MTIP. Metro has performed an AQCD for the 2035 RTP and 2008-2011 MTIP. As shown in the project's air quality analysis, none of the project alternatives would cause or contribute to any violation of the NAAQS for CO. Therefore, the project would not cause any significant adverse air quality impacts.

3.11.5 Potential Mitigation Measures

The Lake Oswego to Portland Transit Project would meet air quality conformity criteria, as discussed above; therefore, no operational air quality mitigation is required. Construction impacts and mitigation are addressed in Section 3.16 Construction Activities and Consequences.

3.12 Energy

This section describes the analysis and anticipated effects of the project alternatives on energy consumption from operation and construction. This section addresses long-term direct, indirect and cumulative effects of the study alternatives. Short-term or construction energy use is also discussed below and in Section 3.16 Construction Activities. Additional detail on the energy analysis, including applicable regulations, consultations, comprehensive technical analysis methods, expected effects of the study alternatives and potential mitigation measures can be found in the *Lake Oswego to Portland Transit Project Energy Technical Report* (URS and TriMet/Metro, August 2010).

3.12.1 Introduction and Analysis Methods

Introduction

The purpose of performing an energy analysis is to compare, in general, the amount of energy that each alternative would require to construct and operate. Energy use, supply sources, rates of energy use and demand forecasts in the greater Portland/Vancouver metropolitan area are characterized for petroleum, electricity and natural gas.

The energy consumption of the study alternatives is evaluated using regional roadway data and corridor data from Metro for the base year (2005) and the planning horizon year (2035) for each alternative. The alternatives for the project are the No-Build Alternative, the Enhanced Bus Alternative and the Streetcar Alternative. For the Streetcar Alternative, there are various design options in various segments as described in Chapter 2. Only one segment has design options with significant enough differences to evaluate the differences in energy consumption. The Johns Landing Segment includes three streetcar design options: the Willamette Shore Line, Macadam In-Street and the Macadam Additional Lane. The analysis considers the differences in operation energy consumption between the Willamette Shore Line design option and the two Macadam Avenue design options. The differences between the Macadam In-Street and the Macadam Additional Lane design options are minimal; therefore, no separate analysis was performed.

Analysis Methods

The procedures and analysis is conducted in accordance with guidance provided by the Federal Transit Administration (FTA) and uses FTA approved transportation energy analysis methods created by Caltrans.

Energy analysis addresses two components: long-term use (operational energy consumption) and short-term use (construction energy consumption). Long-term energy impacts refer to the fuel consumed by the operations of project alternatives, such as cars, buses and streetcar vehicles. Short-term energy impacts refer to the energy associated with the construction of the Enhanced Bus Alternative or the Streetcar Alternative. Both long-term and short-term energy consumption is measured in British thermal units (Btu). One Btu is the quantity of energy necessary to raise one pound of water one degree of Fahrenheit at one atmosphere of pressure.

3.12.2 Affected Energy Environment

Existing Energy Consumption Overview. Energy generated from gasoline and diesel fuels generally account for over 95 percent of the total energy demand for the surface transportation sector.

Existing Transportation Energy Consumption in the Portland Metropolitan Area. Existing energy consumption includes energy used for motor vehicles, the TriMet light rail system, the Portland Streetcar system, TriMet buses, transit vehicle maintenance and the operation of maintenance facilities, and park-and-ride lots. Table 3.12-1 summarizes the daily energy consumption for these activities. Year 2005 total daily transportation energy consumption in the Portland metropolitan area was estimated at 354 billion Btu per day, which was equivalent to 2,827,800 gallons of gasoline per day.

Table 3.12-1 Transportation Operations Energy Consumption in Portland Metropolitan Area, Base Year (2005)

Vehicle and Facility Operations	Daily VMT[1]	Daily Fuel Consumption[2] (Gallons)	Daily Energy Consumption (Billions of Btu*)
Motor Vehicle Operations Totals	41,611,800	2,528,800	322
Motor Vehicle Maintenance[3]		278,300	29
Total Motor Vehicle Energy Usage		2,807,100	351
Transit Bus Vehicles	85,900	13,600	1.891
Non-Fuel Source Transit System[4]	13,100		0.367
LRT Maintenance Facility Operation[5]			0.029
Bus Vehicle Maintenance[5]		7,100	0.147
Bus Maintenance Facility Operation[5]			0.147
Park and Ride Operation[5]			0.008
Total Transit Energy Usage		20,700	2.600
Combined Energy Usage		2,827,800	354

Source: South Corridor Portland to Milwaukie Light Rail Project SDEIS - Energy Results Report (Metro and DEA, 2008).
Note: * Btu = British Thermal Unit, Btu/gallon of gasoline = 125,000 (gross), Btu/gallon of diesel = 138,700 (gross)
[1] Vehicle Miles Traveled, Metro 2002
[2] Methodology derived from Caltrans 1997
[3] Methodology derived from Caltrans 1983
[4] Includes MAX, Portland Streetcar, and Tram; energy calculated as (8.2 kWH/car mile) x (13,127 car miles) x (3,412 Btu/kWH)
[5] TriMet 2007

3.12.3 Environmental Consequences

This section evaluates and assesses the effects of the project alternatives on the transportation-related energy consumption in the study corridor. The energy analysis focuses on the following components:

- Energy consumed during operation (direct, long-term impacts) and construction (direct, short-term) of the project alternatives;
- Indirect impacts and cumulative energy impacts; and
- Projected long-term and short-term energy savings for the transportation system with the operation and construction of the project alternative.

Variations associated with the Streetcar Alternative design and phasing options would result in only minor differences in energy use (less than 1 percent) on a systemwide level.

3.12.3.1 Direct Impacts

3.12.3.1.1 Long-Term Energy Impacts

Long-term, direct energy impacts refer to the fuel and electricity consumed by motor vehicles and transit for operations and maintenance of the project alternatives.

Summary of Daily Corridor Energy Impacts

Year 2035 total daily transportation energy consumption in the corridor for the No-Build Alternative is estimated at 1.817 billion Btu per day, which is equivalent to 14,533 gallons of gasoline per day. The Enhanced Bus Alternative is estimated at 1.825 billion Btu per day, which is equivalent to 14,593 gallons of gasoline per day. The Streetcar Alternative Willamette Shore Line design option is estimated at 1.772 billion Btu per day, which is equivalent to 14,176 gallons of gasoline per day. The Streetcar Alternative Macadam In-Street or the Macadam Additional Lane design option is estimated at 1.775 billion Btu per day, which is equivalent to 14,200 gallons of gasoline per day.

The daily corridor transportation operations fuel consumption for motor vehicle use and transit energy use in 2035 is summarized in Table 3.12-2.

Table 3.12-2 Summary of Daily Corridor Transportation Operations Energy Consumption, Future Year 2035, Lake Oswego to Portland Transit Project Alternatives

			Streetcar Alternative[3] (Billions of Btu)	
Vehicle and Facility Operations[1]	No-Build Alternative (Billions of Btu[2])	Enhanced Bus Alternative (Billions of Btu)	with Willamette Shore Line Design Option	with Macadam In-Street/ Macadam Additional Lane Design Options
Motor Vehicle Operations Totals	1.36200	1.35700	1.34300	1.34600
Motor Vehicle Maintenance	0.16100	0.16100	0.15900	0.15900
Total Motor Vehicle Energy Usage	1.52300	1.51800	1.50200	1.50500
Transit Bus Vehicles	0.07100	0.08400	0.05100	0.05100
Non-Fuel Source Transit System	0.00000	0.00000	0.00012	0.00012
Total Transit Energy Usage	0.07100	0.08400	0.05112	0.05112
Bus Vehicle Maintenance	0.00600	0.00700	0.00400	0.00400
Bus Maintenance Facility Operation	0.05500	0.05500	0.05500	0.05500
LRT Maintenance Facility Operation	0.00100	0.00100	0.00100	0.00100
Total Transit Maintenance Energy Usage	0.06200	0.06300	0.06000	0.06000
Heavy Duty Vehicle Maintenance	0.08800	0.08750	0.08670	0.08690
Light Duty Vehicle Maintenance	0.07290	0.07270	0.07200	0.07220
Total Vehicle Maintenance Energy Use	0.16090	0.16020	0.15870	0.15910
Combined Energy Usage (Billions of Btu per day)	1.817	1.825	1.772	1.775
Combined Energy Usage (Gallons of Gasoline per day)	14,533	14,593	14,176	14,200

Sources: URS Corporation 2010, Metro 2010, TriMet 2010, Caltrans 1983

[1] There are no energy contributions from operations of commuter rail vehicles, commuter rail maintenance and park-and-ride operations.

[2] Btu = British Thermal Unit, Btu/gallon of gasoline = 125,000 (gross), Btu/gallon of diesel = 138,700 (gross)

[3] The Streetcar Alternative is for the full length project form South Portland to Lake Oswego. Most design options would not have significant energy consumption differences, but the ones in the Johns Landing Segment would, and are shown in this table.

Comparison of Alternatives

The energy analysis and comparison of alternatives are conducted for the differences among the project alternatives, as compared to the No-Build Alternative. The operations energy consumption for the Enhanced Bus Alternative would increase 0.008 billion Btu per day, as compared to the No-Build Alternative. This is equivalent to a daily increase in expenditure of 60 gallons of gasoline and would require approximately 0.42 percent more operations energy than the No-Build Alternative.

With the Streetcar Alternative, the operations energy consumption for the Willamette Shore Line design option would decrease 0.045 billion Btu per day, as compared to the No-Build Alternative. This is equivalent to a daily decrease in expenditure of 360 gallons of gasoline and would require approximately 2.46 percent less operations energy than the No-Build Alternative.

The operations energy consumption for the Macadam In-Street or the Macadam Additional Lane design options would decrease 0.042 billion Btu per day, as compared to the No-Build Alternative. This is equivalent to a daily decrease in expenditure of 335 gallons of gasoline and would require approximately 2.29 percent less operations energy than the No-Build Alternative.

Besides the Willamette Shore Line design option and the Macadam In-Street or the Macadam Additional Lane design options, there are no length differences between the Streetcar Alternative design options, therefore, no operational energy consumption difference. The energy differences between the design options are negligible; therefore, no separate comparison analysis of energy consumption between the design options was conducted.

Table 3.12-3 compares the daily and annual corridor energy operations consumption for the corridor by alternatives and design options, with respect to the No-Build Alternative for future year 2035.

Power Consumption for the Streetcar Alternative

Portland General Electric (PGE) would supply the energy that powers the streetcar. PGE's power supply mix consists of hydro (approximately 36 percent), coal (approximately 39 percent), natural gas (approximately 23 percent) and others such as nuclear, biomass and waste (approximately 2 percent).

Streetcars typically operate as a single car, requiring a peak current of 800 amps during acceleration. Streetcars operate at relatively low speeds, typically the speed of traffic on central city roadways. The low power requirements of streetcars allow the system to be fed at the supply utility's secondary voltage (between 120 volts and 480 volts).

Traction Power Substations (TPS) supply direct current (dc) electric power for operation of the streetcar ystem. The traction power system, with transformer substations placed at approximately half-mile intervals, is able to maintain operational voltage levels while eliminating the need for adding underground conduits for a parallel feed cable. Streetcar substations do not require a dedicated utility feed at the primary distribution voltage and sometimes can be fed from existing transformers as additional load.

The existing Portland streetcar system uses 750 volts of direct current (Vdc) traction power system. In the past, the Portland streetcar has used substations supplied by the electrical utility at 400 volts of alternating current (Vac). Streetcars have regenerating capability to minimize the power demand. This voltage is commonly available and it is assumed this voltage will be used to supply the substations for the Streetcar Alternatives extension (*Traction Electrification System Report,* February 2010).

Table 3.12-3 Total and Comparison of Operations Energy Consumption for the Lake Oswego to Portland Corridor, Future Year 2035

	Daily			Annual[2]		
Project Alternatives and Design Options (DOs)	**Vehicle Miles Traveled (Daily VMT)**	**Energy Consumption[1] (Billions of Btu/day)**	**Fuel Consumption (gal/day)**	**Vehicle Miles Traveled (Annual VMT)**	**Energy Consumption[1] (Billions of Btu/year)**	**Fuel Consumption (gal/year)**
No-Build Alternative	220,100	1.817	14,500	79,151,600	595	4,747,700
Enhanced Bus Alternative	219,600	1.825	14,600	78,756,600	595	4,734,200
Streetcar Alternative[3]						
Willamette Shore Line design option	215,900	1.772	14,200	77,979,600	585	4,681,400
Macadam In-Street design option	216,400	1.775	14,200	78,144,100	590	4,689,800
Macadam Additional Lane design option	216,400	1.775	14,200	78,144,100	590	4,689,800
Percent Change in Energy Consumption as Compared to the No-Build Alternative[4]						
Enhanced Bus Alternative	-0.23%	0.42%	0.42%	-0.50%	-0.28%	-0.28%
Streetcar Alternative[3]						
Willamette Shore Line design option	-1.88%	-2.46%	-2.46%	-1.48%	-1.40%	-1.40%
Macadam In-Street design option	-1.67%	-2.29%	-2.29%	-1.27%	-1.22%	-1.22%
Macadam Additional Lane design option	-1.67%	-2.29%	-2.29%	-1.27%	-1.22%	-1.22%
Net Difference In 2035 Energy Consumption as Compared to the No-Build Alternative[5]						
Enhanced Bus Alternative	-500	0.008	60	-395,000	-2	-13,500
Streetcar Alternative[3]						
Willamette Shore Line design option	-4,200	-0.045	-360	-1,172,000	-8	-66,400
Macadam In-Street design option	-3,700	-0.042	-335	-1,007,600	-7	-58,000
Macadam Additional Lane design option	-3,700	-0.042	-335	-1,007,600	-7	-59,000

Sources: URS Corporation 2010, Metro 2010, DEA, Inc. 2010
Lake Oswego to Portland Transit Project Transportation Technical Report (DEA Inc. and Metro/TriMet, March 2010)
Btu = British Thermal Unit
VMT = Vehicle Miles Traveled
These figures do not include maintenance and maintenance facility energy use
[1] Energy Consumption, Auto: Btu/gallon of gasoline = 125,000, Trucks: Btu/gallon of diesel = 139,000
[2] Annual energy consumptions are estimates only and do not accurately account for variations in seasonal energy use
[3] Streetcar Alternative calculations reflect the whole alignment with the design options in the Johns Landing segment.
[3] Percentages computed from unrounded numbers.
[4] Differences computed from unrounded numbers and rounded.

3.12.3.2 Indirect Impacts and Cumulative Energy Impacts

Cumulative effects related to energy use are integrated into the long-term effects analysis since energy estimates are based on travel demand forecasts and their associated operational efficiency. Compared to the No-Build Alternative, operation of the Enhanced Bus Alternative and the Streetcar Alternatives would cumulatively add to the availability of energy by reducing overall VMT and associated energy consumption in the Portland metropolitan area. Construction and operation of any project alternative are not expected to affect local or regional fuel availability or require the development of new energy sources.

No notable indirect energy impacts are expected to result from the project alternatives. None of the project alternatives is expected to have a significant cumulative effect on energy supply or consumption at a regional level. Construction and operations of any of the project build alternatives are not expected to affect local or regional fuel availability or require development of new energy sources.

3.12.4 Potential Energy Mitigation Measures and Projected Energy Savings

One of the goals of the Lake Oswego to Portland Transit Project is to reduce demand for energy. Operation of the Streetcar Alternative would reduce operating energy consumption for the total transit system, as compared to the No-Build Alternative and the Enhanced Bus Alternative; therefore, no energy mitigation measures are necessary for the Streetcar Alternative. The operating energy consumption for the Enhanced Bus Alternative is minimally higher than the No-Build Alternative and would not require mitigation.

Although no energy mitigation is required, innovative approaches such as new technologies, energy conservation methods, employment of sustainable design and techniques during construction, and maintenance programs could reduce the amount of energy the project would require during construction. Efforts to incorporate energy savings objectives may result in a reduction of overall construction energy use. The following examples of energy-efficient construction practices could help to minimize energy use:

- Minimizing the number of hauling trips by using full trucks to and from the site;
- Using recycled materials when possible, so that energy is not used to create new products;
- Using regional products whenever possible to reduce the distance materials travel;
- Using bio-diesel or other non-petroleum fuels;
- Limiting vehicle idling;
- Locating staging areas near work sites;
- Reusing construction signage, barriers, lighting, and other common materials to reduce energy in the production of materials; and
- Ensuring that all diesel-powered medium and heavy duty vehicles and off-road construction equipment have advanced emissions exhaust controls to reduce diesel particulate matter and nitrogen oxides.

In addition to reducing energy use during construction, consideration should be given to reducing the energy required to operate and maintain the project longer term, such as lighting, water collection and treatment, roadway materials, landscape maintenance and structural maintenance.

3.13 Hazardous Materials

This section identifies potential hazardous material sites in the area of potential effect (APE) for the Lake Oswego to Portland Transit Project. A hazardous materials site is a location or facility that has reportedly contained a hazardous substance or has released a hazardous substance into the environment. Results are based on review of the regulatory databases. For more information, see the *Lake Oswego to Portland Transit Project Hazardous Materials Technical Report* (TriMet/Metro, November 2010). Short-term hazardous materials impacts are summarized in Section 3.16 Construction Activities and Consequences.

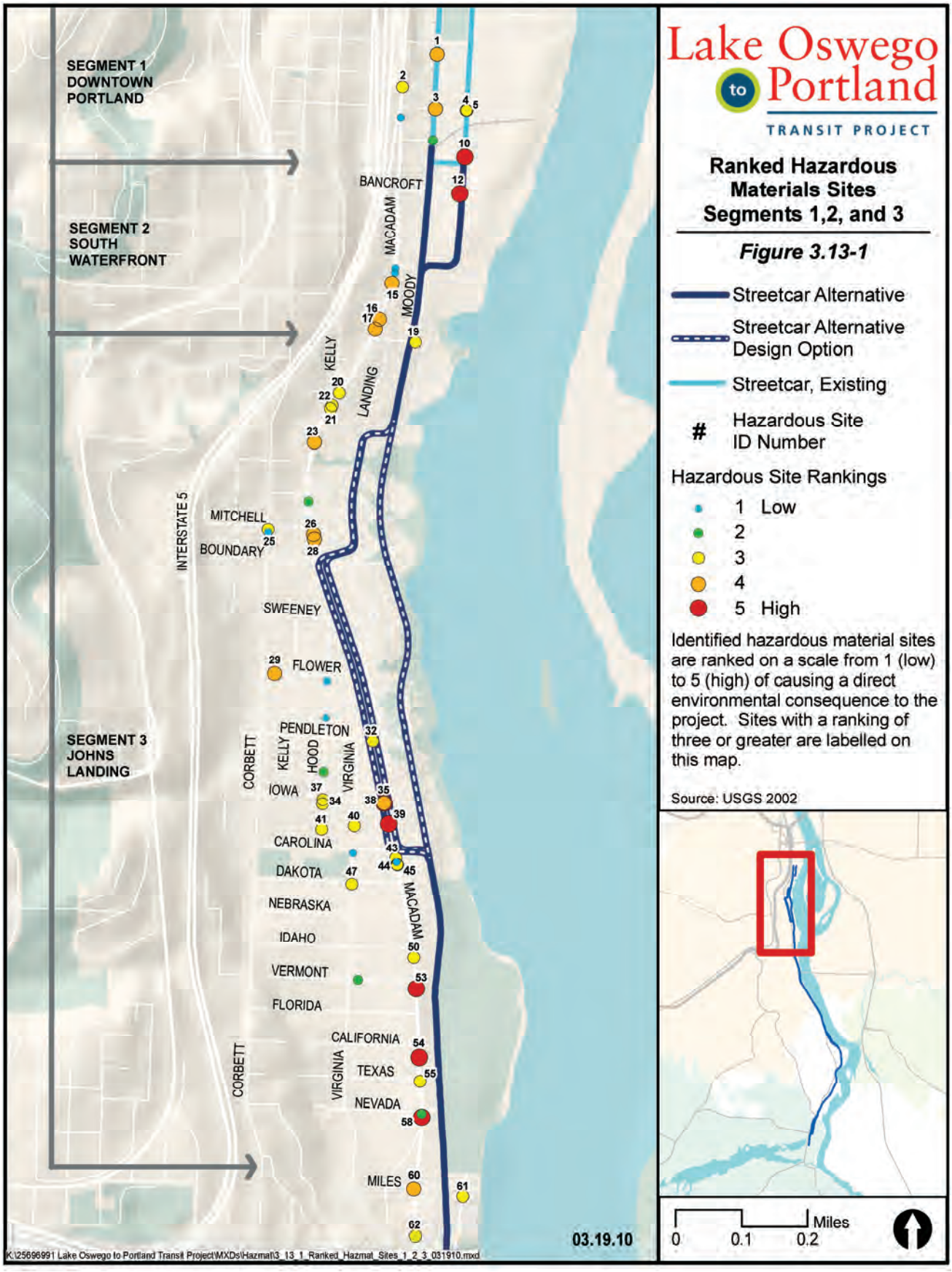
3.13.1 Affected Environment

The hazardous material APE is defined as a 500-foot buffer zone located laterally on each side of the project with the northern terminus at Southwest Bancroft Street and Moody Avenue, and the southern terminus at North State Street and Northshore Road. The affected environment within the APE was assessed by reviewing readily-available government database records from federal and state sources. Information for the database review is based, in part, on the Environmental Data Report that compiled database records through November 2, 2009. Based on this review, 119 sites were identified as potential hazardous material sites within the project's APE.

The project team assessed each of the potential sites and ranked them based on their potential impact to the project. Sites were ranked one to five, with five having the greatest potential to impact the project. Sites that were ranked three, four or five were given a unique site identification number by the project team, generally in ascending order from north to south. Sites ranked four or five were used for the assessment of environmental consequences for comparing the alternatives and options (see Section 3.12.2). Sites identified with a one to two include sites that were too far from the alignment and/or contained hazardous issues that could not affect the corridor. These sites included sites that were confirmed clean or were reported as not affecting the soil or groundwater. Sites identified as three to five are sites that have the greatest potential to affect the corridor site. Sites with the number three to four affected the soil and groundwater, have open files with the State of Oregon DEQ, or not enough information was available to determine their affect on the corridor alignment, but are not directly on the alignment. Sites listed as a "five" are impacted sites that have the greatest potential to directly affect the corridor due to minimal or no environmental actions currently being performed. Sites ranked "four" and "five" have a direct affect on the corridor and are in need of further investigation. Figures 3.13-1 to 3.13-3 illustrate the approximate location of the identified sites.

3.13.2 Environmental Consequences

This section summarizes the long-term direct and indirect impacts and cumulative impacts to hazardous materials sites that would result from the project alternatives and design options. Table 3.13-3 summarizes by alternative the number of known hazardous material sites that are located within 500 feet of proposed ground disturbing construction activities that would occur under the No-Build, Enhanced Bus, and Streetcar alternatives. Data for the Streetcar Alternative is reported as a range, reflecting differences due various Streetcar Alternative design options under study. Table 3.13-2 summarizes the differences in hazardous materials sites that would be within 500 feet of the proposed streetcar alignment under the design options, by segment.


SEGMENT 1
DOWNTOWN
PORTLAND
SEGMENT 2
SOUTH
WATERFRONT
SEGMENT 3
JOHNS
LANDING
BANCROFT
MACADAM
MOODY
KELLY
LANDING
INTERSTATE 5
MITCHELL
BOUNDARY
SWEENEY
FLOWER
PENDLETON
CORBETT
KELLY
HOOD
VIRGINIA
IOWA
CAROLINA
DAKOTA
NEBRASKA
IDAHO
VERMONT
FLORIDA
CALIFORNIA
TEXAS
NEVADA
MILES
MACADAM
CORBETT
VIRGINIA
03.19.10
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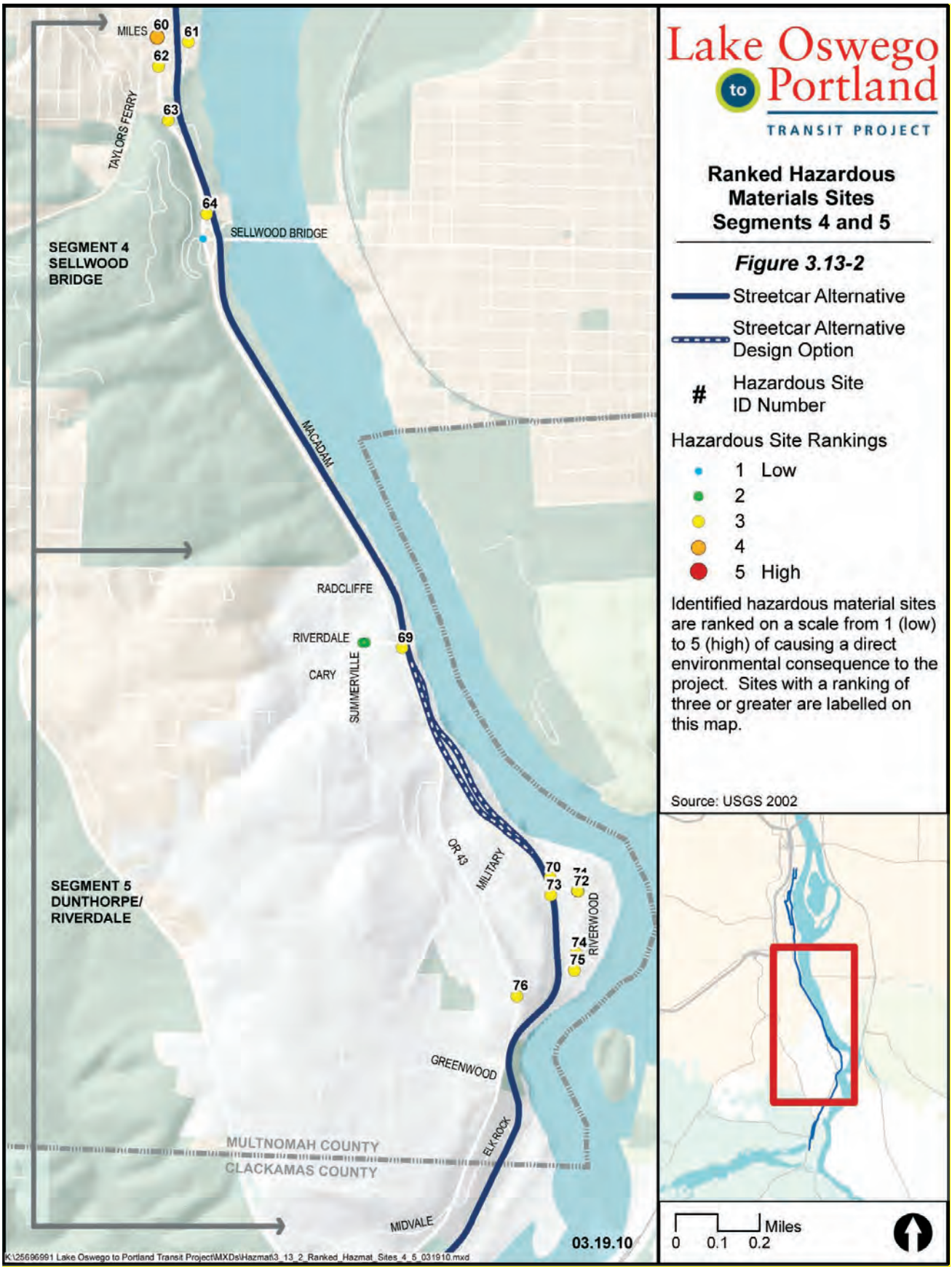
Lake Oswego to Portland
TRANSIT PROJECT
Ranked Hazardous Materials Sites Segments 1,2, and 3
Figure 3.13-1
Streetcar Alternative
Streetcar Alternative Design Option
Streetcar, Existing
Hazardous Site ID Number
Hazardous Site Rankings
1 Low
2
3
4
5 High
Identified hazardous material sites are ranked on a scale from 1 (low) to 5 (high) of causing a direct environmental consequence to the project. Sites with a ranking of three or greater are labelled on this map.
Source: USGS 2002
0 0.1 0.2 Miles


Lake Oswego to Portland
TRANSIT PROJECT
Ranked Hazardous Materials Sites Segments 4 and 5
Figure 3.13-2
Streetcar Alternative
Streetcar Alternative Design Option
Hazardous Site ID Number
Hazardous Site Rankings
1 Low
2
3
4
5 High
Identified hazardous material sites are ranked on a scale from 1 (low) to 5 (high) of causing a direct environmental consequence to the project. Sites with a ranking of three or greater are labelled on this map.
Source: USGS 2002
MILES
60
61
62
63
64
TAYLORS FERRY
SELLWOOD BRIDGE
SEGMENT 4 SELLWOOD BRIDGE
MACADAM
RADCLIFFE
RIVERDALE
69
CARY
SUMMERVILLE
SEGMENT 5 DUNTHORPE/ RIVERDALE
OR 43
MILITARY
70
73
72
RIVERWOOD
74
75
76
GREENWOOD
ELK ROCK
MULTNOMAH COUNTY
CLACKAMAS COUNTY
MIDVALE
03.19.10
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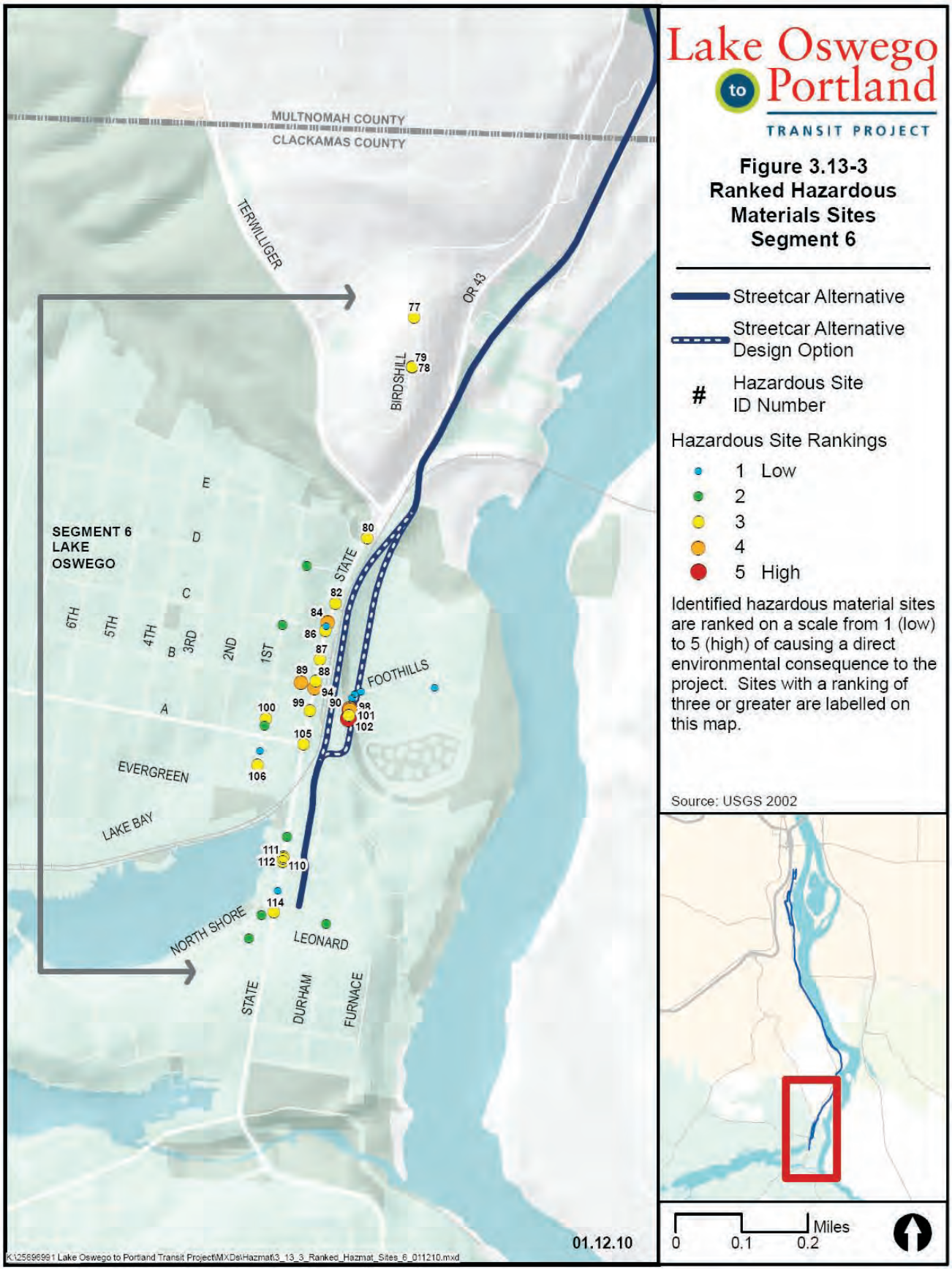
Miles
0 0.1 0.2


Lake Oswego to Portland
TRANSIT PROJECT
Figure 3.13-3
Ranked Hazardous Materials Sites
Segment 6
Streetcar Alternative
Streetcar Alternative Design Option
Hazardous Site ID Number
Hazardous Site Rankings
1 Low
2
3
4
5 High
Identified hazardous material sites are ranked on a scale from 1 (low) to 5 (high) of causing a direct environmental consequence to the project. Sites with a ranking of three or greater are labelled on this map.
Source: USGS 2002
MULTNOMAH COUNTY
CLACKAMAS COUNTY
TERWILLIGER
OR-43
BIRDSHILL
SEGMENT 6
LAKE
OSWEGO
STATE
FOOTHILLS
EVERGREEN
LAKE BAY
NORTH SHORE
LEONARD
STATE
DURHAM
FURNACE
6TH
5TH
4TH
3RD
2ND
1ST
A
B
C
D
E
77
79
78
80
82
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89
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94
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101
102
99
100
105
106
111
112
110
114
Miles
0
0.1
0.2
01.12.10
K:\25696981 Lake Oswego to Portland Transit Project\MXDs\Hazmat\3_13_3_Ranked_Hazmat_Sites_6_011210.mxd

The following table summarizes the total number of sites potentially impact by proposed alternative:

Table 3.13-1 Hazardous Materials Sites within 500-Feet of Ground-Disturbing Construction, by Alternative

Measure	No-Build Alternative	Enhanced Bus Alternative	Streetcar Alternative
Hazardous Materials Sites[1]	0	10	31

[1] Number of known hazardous materials sites within 500-feet of ground-disturbing construction.
Source: URS – January 2010.

3.13.2.1 No-Build Alternative

Under the No-Build Alternative, ground disturbances associated with the project would not occur. The lack of these disturbances would create both potentially adverse as well as beneficial long-term effects associated with the No-Build Alternative. Adverse long-term effects include hazardous materials sites that would not be investigated or subsequently remediated. Such sites would likely continue to pose long-term environmental risk. In addition, adverse effects may be associated with the No-Build Alternative due to increased traffic demands in the corridor. These effects would include but would not be limited to bridge, roadway and transit upkeep, incidental spills or releases from vehicles or transit, and stormwater management and treatment. Beneficial long-term effects of the No-Build Alternative would include limiting the potential for exacerbating contamination in soil or groundwater because identified and unidentified hazardous material sites would not be aggravated. As a result, the long-term hazardous materials impacts would generally tend to be greater from the No-Build Alternative compared to the Enhanced Bus and Streetcar alternatives.

3.13.2.2 Enhanced Bus Alternative

Except for the effects associated with the proposed 300-space structured park-and-ride lot at the Lake Oswego Village shopping center, the effect of the Enhanced Bus Alternative would be similar to those under the No-Build Alternative. Long-term impacts to hazardous material sites from the Enhanced Bus Alternative at the park-and-ride lot site may include adverse effects on remedial actions proceeding at hazardous material sites. Remedial actions could include active cleanup, long-term monitoring and maintenance, enforcement, institutional controls (i.e., deed restrictions, restrictive covenants) and/or engineering controls (i.e., soil cap, groundwater pump and treat). Long-term operation of these remedial actions could conflict with transit operations under the Enhanced Bus Alternative. Risk of these conflicts would be minor.

Ten known hazardous material sites rated four or five are within the APE of the proposed Lake Oswego park-and-ride facility (see Figure 3.13-1). Long-term impacts associated with remedial actions at these sites would be minor. Long-term impacts to hazardous materials sites under the Enhanced Bus Alternative would also include direct and indirect exposure or mobilization of contaminated materials as a result of roadway and transit operation and maintenance. In general, operation and maintenance associated with the Enhanced Bus Alternative would not cause an appreciable increase in incidental spills or releases of hazardous materials from vehicles or transit.

3.13.2.3 Streetcar Alternative

There are 31 known hazardous materials sites that are rated four or five that would be located within 500 feet of ground-disturbing construction locations under the Streetcar Alternative (see figures 3.13-1 to 3.13-3), including the ten sites that were identified for the Enhanced Bus Alternative. As illustrated in Table 3.13-2, there are no differences between the streetcar design options in the

number of known hazardous material sites that would be within 500 feet of ground-disturbing construction.

Long-term impacts associated with remedial actions at the 31 known sites would be minor. Long-term impacts to hazardous materials sites under the Streetcar Alternative would also include direct and indirect exposure or mobilization of contaminated materials as a result of roadway and transit operation and maintenance. In general, operation and maintenance associated with the Streetcar Alternative would not cause an appreciable change in incidental spills or releases of hazardous materials from vehicles or transit.

The Streetcar Alternative would not add to the number of hazardous materials sites along the corridor, so there would be no increase in the cumulative hazardous materials sites as a result of the project. Existing sites as well as currently unidentified sites, if any, would otherwise be subject to further measures for clean up activities or contain contaminated sites.

Table 3.13-2 Hazardous Materials Sites within 500-Feet of Ground-Disturbing Construction Under the Streetcar Alternative, by Segment and Design Option[1]

Segment	Design Option	Hazardous Materials Sites[1]
1 – Downtown Portland	None	4
2 – South Waterfront[2]	None	5
3 – Johns Landing	Willamette Shore Line	11
	Macadam In-Street	11
	Macadam Additional Lane	11
4 – Sellwood Bridge[3]	None	1
5 – Dunthorpe/Riverdale	Willamette Shore Line	0
	Riverwood In-Street	0
6 – Lake Oswego	UPRR	10
	Foothills	10

Source: URS – January 2010.
Note: UPRR = Union Pacific Railroad.
[1] Number of known hazardous materials sites within 500-feet of ground-disturbing construction.
[2] The South Waterfront Segment contains potential construction phasing options associated with the Streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.
[3] The Sellwood Bridge Segment contains potential construction phasing options associated with the Streetcar alignments. See Section 3.17 Phasing for more information regarding phasing options and differences between those options.

3.13.5 Mitigation

Project improvements would be constructed to current state and federal standards and, as a result, would tend to reduce long-term effects of contaminant migration from shallow soil to groundwater and/or surface water, relative to existing conditions. Potential releases of hazardous substances and petroleum products on roadways and located adjacent to or within the roadway or project right of way would be mitigated by the applicable federal, state or local response agency. Responses by the Oregon State Fire Marshal would be under *Hazardous Waste Operations and Emergency Response: Responding to Hazardous Substance Releases* (i.e., directive A-206, issued April 15, 1994 and revised September 14, 2000).Mitigation for short-term hazardous materials impacts are summarized in Section 3.16 – Construction Activities and Consequences.

3.14 Safety and Security

This section describes the safety and security conditions in the project area and evaluates potential effects of the Lake Oswego to Portland Transit Project. This DEIS has a related section on Neighborhoods, Displacements and Relocations (Section 3.3), which contains discussion about public services, such as fire, police, emergency medical services and hospitals. This section focuses on public safety considerations for the communities to be served by the transit project and discusses safety and security factors for the transit facilities.

Safety and security issues related to construction are addressed in Section 3.16 Construction Activities and Consequences. For more details on safety and security issues and effects of the study alternatives and design options, refer to the *Lake Oswego to Portland Transit Project Safety and Security Technical Report* (Alta/URS and TriMet/Metro, November 2010).

3.14.1 Affected Environment

Figures 3.3-2, 3.3-3 and 3.3-4 in section 3.3 Neighborhoods, Displacements and Relocations, show the location of fire, emergency services, law enforcement and other public service providers found in the study area.

3.14.1.1 Law Enforcement, Fire and Emergency Medical Services

Oregon State Police (OSP) Patrol Services Division provides a uniformed presence and law enforcement services throughout the state, with a primary responsibility for crash reduction, crime reduction, and other transportation safety issues; as well as to respond to emergency calls-for-service on Oregon's state and interstate highways. The study area is located in the Willamette Patrol Area headquartered in Milwaukie. One trooper is assigned to the patrol area which includes Highway 99E and Interstate 205 in western and southern Clackamas County. Within the study area OSP has primary responsibility for a short segment (one-half mile) of Highway 43 in the area between Lake Oswego and the Multnomah County line. City agencies assume primary enforcement responsibilities for Highway 43 within their jurisdictions, with backup and other cooperation from OSP.

The City of Portland Police Bureau (PPB) is the largest city law enforcement agency in Oregon. The Bureau has approximately 1,000 full-time officers, up to 100 reserves, 50 cadets, and 300 civilian positions. The PPB provides law enforcement services in three precincts: Central, North, and East. A portion of the Lake Oswego to Portland Transit Project will be located within the Central Precinct which covers 32.4 square miles with an estimated residential population of 99,174 as of 2000.

City of Portland Fire and Rescue (PF&R) is Oregon’s largest fire and emergency provider. PF&R has 30 stations, two of which serve areas adjacent to the proposed light rail alignment: Station 4 (Portland State University) serves downtown Portland and the South Portland (formerly Corbett-Terwilliger-Lair Hill) and Homestead neighborhoods; and Station 10 (Burlingame) on Southwest Taylors Ferry Road serves the South Burlingame, Collins View, Arnold Creek and Johns Landing neighborhoods. While each station is responsible for specific parts of the city, stations support one another to provide 24-hour emergency operational readiness.

Multnomah County Sheriff’s Office (MCSO) provides patrol, incarceration, civil process, and search and rescue services for over 17,000 residents in 291 square miles within Multnomah County. The MCSO employs 28 patrol officers and up to 75 law enforcement personnel. In addition to

enforcing state statutes and county ordinances, patrol deputies provide direct assistance to city residents as well as routine and emergency backup for city police officers and specialized units. One patrol car is normally assigned to the 65 square mile Westside Patrol District which includes the Riverdale and Dunthorpe neighborhoods, an area in the middle of the project area bounded to the north by Portland's southern city boundary, to the south by the northern boundary of Clackamas County, and to the east by the Willamette River. Patrol deputies may be dispatched out of the sheriff's office at Northeast 122nd Avenue and Glisan Street.

Clackamas County Sheriff's Office provides patrol, incarceration, civil process, and search and rescue services for approximately 1,893 square miles within Clackamas County with approximately 90 patrol officers. In addition to enforcing state statutes and county ordinances, patrol deputies provide direct assistance to county residents as well as routine and emergency backup for city police officers and specialized units. The Wilsonville patrol district covers the Birdshill neighborhood, a small triangular area in the southern end of the project area bounded to the north by the Clackamas County boundary, to the southwest by Lake Oswego's northern city boundary and to the east by the Willamette River. Patrol deputies may be dispatched out of the Wilsonville, South Station in Oregon City and Oak Lodge substation. The Lake Oswego Police Department provides police services for a small portion of this area.[93]

City of Lake Oswego Police Department (LOPD) provides law enforcement within the jurisdiction of Lake Oswego, back-up to the Clackamas County Sheriff's Office, response to major crimes in Clackamas County, and direct support to the City of Portland. In addition to areas within the city, the Lake Oswego Police Department responds to calls in the Birdshill[94] neighborhood north of the city. Lake Oswego's Police Station is in City Hall at 380 A Avenue, on the corner of 4th Street and A Avenue, approximately one-third mile west of the project corridor. The LOPD has 43 officers including 29 patrol officers and serves an area of 11.5 square miles with a population of approximately 36,700 (2009). As part of their commitment to addressing local criminal issues quickly and fully, the City of Lake Oswego also has a municipal court which handles local jury trials on Monday mornings and all other cases on Wednesdays.

Lake Oswego Fire Department provides fire, rescue and emergency medical response to approximately 37,000 citizens within the City of Lake Oswego and three adjoining contract districts, including Riverdale/Dunthorpe Fire District within the project corridor. The department has 51 fire fighters serving 15 square miles. Fire Station 214, Lake Oswego's main fire station is at 300 B Avenue in Lake Oswego, about one-third mile west of the project corridor. Fire Station 212 serving the southern tip of the corridor is at 1880 South Shore Boulevard.

Riverdale Dunthorpe Patrol, Inc. is a private security patrol company serving individual families and homeowners in Dunthorpe and surrounding neighborhoods. It has no responsibility to a homeowners association or neighborhood organization. Response to enforcement or emergency situations is exactly like a citizen reporting an incident.

[93] Some parcels in the Birdshill neighborhood are within the Lake Oswego city limits. The unincorporated areas are in Clackamas County.
[94] See note above.

3.14.1.2 Safety and Security Statistics by Neighborhood

City of Portland, Multnomah County, Clackamas County and City of Lake Oswego crime statistics for the project area are shown in Table 3.14-1.

Table 3.14-1 Number of Crimes in Portland, Multnomah County, Clackamas County and Lake Oswego January 2009 through December 2009

	Part I Crimes	Part II-A Crimes	Part II-B Crimes	Total
Portland				
South Portland (formerly Corbett-Terwilliger- Lair Hill)	228	125	81	434
Multnomah County				
Dunthorpe-Riverdale	12	7	5	24
Clackamas County				
Birdshill	2	14	0	16
Lake Oswego				
Birdshill	1	0	12	13
Foothills	30	44	162	236

Source: Portland Police Bureau, 2010. Multnomah County Sherriff's Office, 2010. Lake Oswego Police Department, 2010. Clackamas County Sherriff's Office, 2010.

The area patrolled by the Portland Police Bureau falls entirely within the South Portland neighborhood in the Central Precinct. The population of the neighborhood was 6,877 (2000 Census). Part I Crimes[95] account for 53 percent of the reported crimes in the neighborhood.

The area patrolled by the Multnomah County falls entirely within the Dunthorpe/Riverdale Neighborhood in the Westside Patrol District. The population of the neighborhood was 1,025 (2000 Census). Part I Crimes account for 50 percent of the reported crimes in the neighborhood.

The area patrolled by Clackamas County includes the unincorporated portion of the Birdshill Neighborhood (population 215). Part I Crimes account for 13 percent of the reported crimes in the neighborhood.

The area patrolled by the Lake Oswego Police department includes a portion of the Birdshill (population 215), and Foothills (population 413) neighborhoods. Part I Crimes account for 12 percent of the reported crimes in the neighborhoods.

3.14.1.3 Transit Safety and Security Statistics

TriMet's service district covers 575 square miles in the urban portions of the tri-county area. TriMet's 52-mile light rail system and 81 bus routes provide about 322,900 rides each weekday. Streetcars operated by Portland Streetcar Inc., run on an 8.0-mile continuous loop (4.0-mile in each direction) from Northwest 23rd Avenue, through the Pearl District, downtown past Portland State

[95] Each agency labels crimes differently, this analysis classifies Part I Crimes as: aggravated assault, arson, burglary, homicide, larceny, rape, robbery, theft from vehicle and vehicle theft. Part II Crimes include: drugs, embezzlement, forgery, fraud, prostitution, sex crime, simple assault, stolen property vandalism and weapon. Part III Crimes include Curfew, DUI, trespass, disorderly conduct, gambling, kidnapping, liquor laws, offense against family, runaway, and other less serious crimes such as traffic or fish and game violations.

University, to the South Waterfront District at Southwest Lowell Street and Bond Avenue, and back. The streetcar system provides approximately 10,000 rides each day. On average about three incidents are reported per day for the entire transit system. Generally, these are non-weapon and non-violent incidents.

3.14.1.4 Transit Safety and Security

The Department of Homeland Security provides guidance on safety and security that apply to TriMet and Portland Streetcar Inc., and both agencies collaborate with state and local agencies to coordinate fire and life safety policies. TriMet and Portland Streetcar Inc. take the following steps to implement safety and security measures for major new capital facilities:

- Prepare a Safety and Security Management Plan. This plan would define the safety and security activities and methods for identifying, evaluating and resolving potential safety issues and security vulnerabilities, and would establish responsibility and accountability for safety and security during each project phase – Preliminary Engineering through startup. A Safety and Security Certification Program, also a required element, would verify that identified safety-critical items have been designed and constructed into the system. These plans are reviewed by the FTA Project Management Oversight Committee and FTA staff.

- Meet regularly with a Fire, Life and Safety Committee comprised of police, fire and safety personnel along with transit operations staff to ensure safe project operations.

- Review procedures, staffing levels, and safety and security measures with the Fire, Life and Safety Committee during on-going operations. This allows transit agencies and their partners to identify and respond to localized security concerns that may occur over time.

TriMet and Portland Streetcar Inc. consider safety and security management as an integral part of their mission to develop and operate an effective transit system. Safety and security are key factors in the planning and design of transit stations and other facilities. The agencies use a combination of design, public education, and operations measures to lower the potential for crime and to minimize potential conflicts among trains, buses, people, and other vehicles.

While safety and security are terms that are often used interchangeably, they have distinct meaning and each needs to be addressed with a unique approach. Safety can be described as freedom from unintentional danger, whereas security represents freedom from intentional danger.

From a transit system perspective, safety focuses on elements of the system such as vehicle operations, station area function, pedestrian movements, crossings and emergency response. Safety measures aim to reduce potential conflicts related to interactions among transit, autos, bicyclists and people. Transit agencies prepare an annual systemwide safety plan that reinforces safety as a core value and defines safety requirements, lines of authority, accountability and documentation.

Transit system security starts with facility design and is achieved by establishing appropriate policies and procedures and optimizing the use of human resources, technology and equipment, and by establishing strong partnerships among the community, transit operators and law enforcement. Transit agencies prepare an annual security plan that establishes systemwide security goals aimed at enhancing facility design, increasing employee and public awareness, reducing unlawful behavior and facilitating emergency preparedness.

Security improvements are affected by system design and maintenance, technology, community outreach, and enforcement. While enforcement is critical, a design that deters misconduct and promotes safety is of utmost importance. In planning the proposed enhanced bus and streetcar alternatives, the project team proposes facility designs to be responsive to the neighborhood context and to maximize community benefits.

To allow crime prevention principles to be fully incorporated into a project, safety and security considerations are evaluated when making choices about station siting, layout, platform design, and park-and-ride facilities, beginning with the project's earliest planning stages. TriMet and Portland Streetcar Inc. consider best practices related to security when designing transit facilities and especially stations.[96] The best practices are derived from Crime Prevention Through Environmental Design[97] (CPTED) concepts, which provide guidelines to deter unlawful activity in a number of areas, described as follows:

- **Design and Maintenance.** Station security starts with good design and upkeep. Generally, well-kept and well-lit neighborhoods, office and industrial parks, good building stock, and few vacant spaces correlate with fewer security issues. Good maintenance and timely response to repairs also demonstrates capable guardianship of transit property, deterring adverse behavior.

- **Natural Surveillance**. The activity levels on surrounding streets or neighborhoods, the presence of passersby, transit personnel, and other riders waiting at a station or parking area all contribute to the number of "eyes on the street," helping to reduce the potential for security concerns. Strategies include good platform visibility, street-level windows, adequate lighting, and pedestrian friendly designs.

- **Territorial Reinforcement.** A sense of ownership among users translates into a deterrent to intruders. Features that define property lines and distinguish public from private spaces through the use of plantings, landscaping design, pavement materials, and fencing are common tools to create ownership. Features that suggest community ownership or pride in place such as neighborhood specific art or interpretive elements, message centers or furnishings, can also create this feeling.

- **Natural Access Control**. Guiding people to safe access routes and denying access to potential targets creates a sense of risk in potential offenders. This is achieved by clearly delineating public routes through landscaping and design, and preventing access to private property through physical barriers.

- **Target Hardening**. Managing entry and access means including features that make it more difficult to vandalize improvements, things like graffiti-resistant surfaces. It could also include emergency call-boxes and/or closed circuit television (CCTV).

According to these CPTED principles, station areas should be easily accessible to law enforcement personnel and should maximize opportunities for natural surveillance. The design of the station and its surroundings should promote personal safety and security by providing good sight-lines and

[96] TriMet Report to the Legislature, Light Rail Safety & Security, February 7, 2008.
[97] International CPTED Association.

avoiding conditions such as tall landscaping or other features that could obscure the presence of individuals on transit property. Well-lit, bright environments with high degrees of visibility from nearby streets or public areas also help deter vandalism and increase the perception of security. Though the lights from stations should be shielded from adjacent neighborhoods, the safety of pedestrians walking to those neighborhoods must be considered in design. Bright designated station areas and walkways with appropriate landscaping, free of entrapment areas, deter unlawful behavior. Stations should be kept clean, and signs of vandalism should be removed immediately to send the message that the community is in control.

Based on TriMet and Portland Streetcar Inc. experience with their existing systems and on national information, crime levels along rail transit project corridors are typically closely related to the existing conditions that prevail in the surrounding community.[98] A study of' the Los Angeles Green Line light rail revealed that inner city stations showed a decrease in crime that generally followed a decrease throughout Los Angeles County and crime in the higher income western suburbs did not increase after the Green Line was built.[99] In 2006, the Denver Regional Transportation District (RTD), which administers the FASTRACKS light rail system, conducted a review of one Denver light rail station and revealed that crime rates at the station directly correlated to issues occurring in the surrounding neighborhood.[100]

3.14.2 Impact Assessment

TriMet and Portland Streetcar Inc. develop and operate transit projects to provide a transportation benefit to the community, to support long-range land use plans and economic development goals, and to minimize other environmental impacts.

Public safety and security planning are major considerations in the development of transit projects such as the Lake Oswego to Portland Transit Project. Public involvement efforts for transit projects have also highlighted a number of questions and issues from the community about how transit projects are implemented, including:

Safety
- The need for lighting at transit stations and park-and-ride lots
- Interaction at vehicular, pedestrian and bike crossings of the transit alignment
- Interaction between children and transit vehicles and the transit right of way

Security
- Passenger security on transit vehicles
- Incidence of misconduct along the transit corridor
- Nuisance behavior aboard transit vehicles
- Streetcar station placement and access, especially in less active areas or near schools

[98] Numerous reports have been written and studies conducted across the U.S. and Europe regarding general crime patterns and criminal behavior. A study of transit security by the U.S. Department of Transportation noted that transit stations with high crime rates are generally located in neighborhoods with high crime rates (USDOT: Transit Security: A Description of Problems and Countermeasures Mauri, Ronald et al October 1984, reprint May 1985).
[99] Liggett, R, Loukaitou-Sideris, A, and Isek, H, Journeys to Crime: Assessing the Effects of a Light Rail Line on Crime in the Neighborhoods, 2002.
[100] Denver Regional Transportation District, Technical Memorandum: Neighborhood vs. Station Crime Myths and Facts November 16, 2006.

- The public's perception of security near parks, trails, and the Willamette River within vicinity of proposed stations
- Car and bike prowls, theft or graffiti near transit station locations
- Neighborhood visibility from the transit line

3.14.2.1 Long-Term Impacts

No-Build Alternative
With future growth in households and employment at the north and south ends of the corridor, demand for emergency services and law enforcement services would increase over time. As the population grows, there would be a corresponding demand for public safety and security services. Increased traffic would be a byproduct of growth and would be likely to increase congestion on roadways, which has the potential to slow emergency response times, as discussed in more detail in Chapter 4, Transportation, and Section 3.3, Neighborhoods, Displacements and Relocations of this DEIS. Because no new streetcar stations or bus facilities would be built along the corridor with the No-Build Alternative, local opportunities to improve safety conditions through transit-related improvements to streets, intersections, sidewalks, and lighting would not occur. Improved security through overall higher activity levels would also not occur.

Enhanced Bus Alternative
Household and employment growth is forecast to be the same under all of the alternatives. As with the No-Build Alternative, regionally and locally there will be increased demand for public safety and security services to meet the demands of growth. Increased traffic would also occur at levels similar to the No-Build Alternative, which would be likely to increase congestion on roadways and slow emergency response times, as discussed in more detail in Chapter 4 Transportation and Section 3.3 Neighborhoods, Displacements and Relocations.

Safety. Considering operational safety, the Enhanced Bus Alternative transit stops would all be street-oriented stations and transit centers. The lighting and amenities at the Lake Oswego park-and-ride lot located near Albertsons east of State Street in downtown Lake Oswego, taken with the higher activity levels that would accompany Enhanced Bus operation, would be an improvement over existing transit stops. Remaining bus stops would not be altered.

Buses accessing the park-and-ride location could increase the potential for transit/pedestrian and transit/auto conflicts.

Security. Considering system security, the facilities proposed in the Enhanced Bus Alternative are at locations with existing TriMet bus stops where TriMet's Transit Police Division already provides security, as they do throughout the transit system. Maintaining security and providing for emergency responses at all of the transit stops would be handled through TriMet's Transit Police Division and established fire, life and safety programs, which feature cooperative and ongoing planning between TriMet and local jurisdictions. This allows TriMet and its local partners to identify and address security concerns and response needs at all phases of systems development and operation.

The Lake Oswego park-and-ride lot would be in an area with a relatively low incidence of crime. State Street/Highway 43 is an active roadway. The station and park-and-ride lot would also benefit from the 6:00 a.m. to midnight activity at the grocery store because retail patrons may observe a more irregular schedule than park and ride patrons, providing passive surveillance of the area at times when the parking area may otherwise be unoccupied. The principles of passive surveillance

suggest illegal activities are less likely to be carried out when they might be observed by others. As with other facilities in the transit system, the stations and park-and-ride would be designed to maximize visibility, provide for safe and convenient access for patrons, and reduce potential property loss or damage to parked vehicles. Other potential measures could include access controls, emergency call boxes, the use of CCTV, and security patrols.

Streetcar Alternative

As with the No-Build Alternative, there will be increased regional and local demand for public safety and security services to meet the demands of growth. Increased traffic would also occur at levels similar to the No-Build Alternative, which is likely to increase congestion on roadways and slow emergency response times, as discussed in more detail in Chapter 4 Transportation and Section 3.3 Neighborhoods, Displacements and Relocations.

Safety. Streetcar safety is related to function and operation. The stations and crossings for the streetcar would incorporate a combination of design, education and operating measures to minimize potential safety concerns to anyone who may access the streetcar or cross the corridor. Outreach and education programs would be targeted directly to community members and nearby schools to help them better understand streetcar operation and safety issues.

Station access would be oriented to streets and sidewalks and all crossings would be clearly designated. The station and the streetcar alignment would feature physical barriers to discourage people from walking directly across the tracks from the station or onto private properties.

The streetcar alternative and design options include segments running in the street as well as within separated right of way. These variables and the transitions between them present safety challenges that are addressed through audible warnings, signing, striping, signalization, enforcement and education. Signals would be the primary method for accommodating transitions between in-street and separated segments, offering a protected signal phase for the streetcar to enter and leave the roadway. Within the roadway, the streetcar vehicles would operate similar to buses.

Thirty-five public and private roadway, railroad and pedestrian track crossings have been identified in the proposed alignment. Proposed crossing treatments include closure or relocation, grade separation, stop signs, gates, traffic signals and pedestrian Z-crossings. Treatment selection criteria include sightlines, traffic volumes and speeds, transit vehicle speed, proximity and suitability of alternative routes, and convenience for pedestrians and transit patrons.

Security. Streetcar security is focused at stations. Except for the stations at SW Nebraska Street and SW Nevada Street, all the proposed stations in Johns Landing for all design options would be street-oriented in areas that currently have mixed-use environments, with residential and commercial uses nearby and high levels of activity.

The proposed stations adjacent to Willamette Park at Southwest Nebraska Street and Nevada Street are within sight of Macadam Avenue and would be located next to a large, heavily programmed regional park and nearby office buildings that provide natural surveillance. Collaboration with City of Portland Parks and Recreation on streetcar station design elements, including lighting and amenities at the stations, with the higher activity levels that accompany streetcar operation, would create an improvement over existing conditions.

The proposed Sellwood Bridge station would be located on currently active transit Lines 35 and 36 adjacent to Highway 43 at the west end of the Sellwood Bridge. The lighting and amenities at the station, with the higher activity levels that accompany streetcar operation, would be an improvement over existing conditions. With the expected replacement of the Sellwood Bridge, possibly open in 2016, bus transfers will occur at this station, further increasing station activity.

The proposed Riverwood and Briarwood stations are surrounded by single-family neighborhoods that are not anticipated to change character or redevelop as a result of transit improvements. These station sites are close to neighborhood roadways, which provide opportunities for natural surveillance from surrounding uses. The Riverwood station would be more visible to travelers on Riverwood Road, compared to the Briarwood station which is above Briarwood Road. The Riverwood and Briarwood stations are located in a neighborhood with very low incidence of crime. Design and operating measures are available for either station to provide patrons with well-lit and visible station areas and accessways. Note that lighting will be limited to the station area and access routes from the nearest roadway and surrounding homes will be shielded from glare.

The B Avenue station and park-and-ride lot would be located in an area that currently includes industrial uses, although commercial areas are located nearby and the area is anticipated to redevelop with a mix of land uses. While State Street/Highway 43 and Foothills Road are active roadways, activity levels in the area surrounding the B Avenue station and park-and-ride lot are currently relatively low outside of daytime hours. Design and operating measures are available to provide well-lit and visible station areas and accessways. With redevelopment, activity levels are expected to increase, providing more "eyes on the station."

The Lake Oswego terminus station and park-and-ride lot would be located adjacent to a commercial shopping center with a high level of activity. As with other facilities in the transit system, the station and park-and-ride facility would be designed to maximize visibility, provide for safe and convenient access for patrons, and reduce potential property loss or damage to parked vehicles. Other potential measures could include access controls, emergency call boxes, the use of CCTV, and security patrols.

Streetcar Design Options (Safety). Streetcar operations and safety issues would be addressed, somewhat differently based on design option.

- *Johns Landing Design Option, Willamette Shore Line*. The Wi1lamette Shore Line Design Option would operate on the existing Willamette Shore Line right of way through Johns Landing. This alignment would operate in an exclusive transit alignment through commercial and residential areas. The residential areas include condominiums that have lawn and other landscaping surrounding the existing rail right of way. The streetcar would operate at a relatively low speed through these residential areas that would allow the driver sufficient time to react to any right of way encroachments. Pedestrian crossing treatments would include signage and Z-crossings.

- *Johns Landing Design Options, Macadam Avenue*. Both the Macadam In-Street and the Macadam Additional Lane design options would veer southwest off of the Willamette Shore Line and operate in mixed traffic on SW Landing Drive, SW Boundary Street, SW Macadam Avenue and SW Carolina Street. For in-street operations, special traffic signals, improved pedestrian crossings and signage would be used to facilitate safe movements among auto,

bicycles, pedestrians and transit. Stations at SW Boundary Street and SW Carolina Street would increase pedestrian activity on adjacent sidewalks, on neighborhood streets and on SW Macadam Avenue.

- *Dunthorpe/Riverwood Design Option, Willamette Shore Line.* The Willamette Shore Line design option would operate on the existing Willamette Shore Line right of way through this segment. Approximately five private crossings would be included with this design option, most typically a driveway or access road crossing where the right of way is between SW Riverwood Road and garages and homes on the east side of the Willamette Shore Line. Appropriate private crossing treatments would be developed in conjunction with individual property owners.

- *Dunthorpe/Riverwood Design Option, Riverwood.* The Riverwood design option would operate in mixed traffic on SW Riverwood Road. The streetcar would not exceed the existing speed limit of 25 mph. This design option would close the access for Riverwood Road to Highway 43 which would reduce the amount of traffic on Riverwood Road in this vicinity. The Riverwood Road streetscape would include sidewalks and bike lanes, increasing potential for "eyes on the street".

- *Lake Oswego Design Options.* Both the Foothills and UPRR design options would operate in a similar manner through this segment and have similar safety and security treatments.

In summary, the Streetcar Alternative is not anticipated to create unique concerns.

3.14.2.2 Indirect and Cumulative Impacts

Secondary impacts are reasonably foreseeable effects that occur as a result of an action or not doing an action, but which are removed from the direct impacts of a project in place or time. Cumulative impacts are the sum of effects from past, current and other expected improvements or public actions. Safety and security issues related to construction are addressed in Section 3.16 Construction Activities and Consequences.

Streetcar projects typically encourage nearby development. Current streetcar alignments have contributed to public and private redevelopment investments occurring, for instance, in the developments in South Waterfront, including projects underway (see Section 3.1 Land Use). According to existing plans and policies, development or redevelopment in this corridor would be focused in Johns Landing and Lake Oswego and is not anticipated in the Dunthorpe/Riverdale or Birdshill areas.

In station areas that do experience redevelopment, the uses would typically be denser and involve higher levels of activity, greater design attention to personal security and renewed levels of maintenance. All of these elements contribute to more "eyes on the street," improvements in defensible space and a better sense of personal security, according to above CPTED principles for safety and security.

3.14.3 Safety and Security Mitigation Measures

There are different approaches to provide transit safety and security mitigation. The current Portland Streetcar Inc. model uses the Portland Police Bureau in downtown Portland. TriMet uses a dedicated transit police force and support personnel. A hybrid approach that fits the context of each segment of this corridor is likely to mix elements from Portland Streetcar Inc. and TriMet approaches to address safety and security needs throughout the transit system and in the Lake Oswego to Portland corridor. The approaches will respond to public issues and questions regarding safety and security related to specific conditions affecting the Lake Oswego to Portland Transit Project.

The public involvement programs for similar projects in the region have generated constructive feedback on:

- Use of CPTED principles throughout the design process;
- Incorporating design principles to enhance safety and security at station areas;
- Including a multidisciplinary review of safety and security design and operations practices prior to final design and construction;
- Evaluating station locations, overall alignment issues and operations as they relate to safety and security;
- Location of ticket machines away from platforms, so anyone on the platform will already have purchased a ticket;
- Clear delineation of platform area and communication that riders must have a fare in the platform areas, if station access is not restricted;
- Way-finding at platforms to help pedestrians find bus connections and other destinations;
- Work with freight railroads to adopt industry standards for safe operations in shared corridors;
- Safety and security outreach and education upon construction and operation of the system; and
- Consideration of emergency call boxes and CCTV cameras at stations.

3.14.3.1 Safety Measures

TriMet and Portland Streetcar Inc. are committed to making continued improvements to help maintain a safe transit system. Potential measures to address safety issues along the Lake Oswego to Portland Transit Project are shaped by comments and suggestions from the project team, local jurisdictions and the public and could include the following:

- To address streetcar safety for school children, new users, especially children, would be educated on how to be safe around the transit system, particularly before opening a new streetcar extension. By collaborating with teachers and parents, extensive safety outreach programs would reach schools located close to the new transit service.

- To address safe roadway crossings, the public would be alerted to the fact that streetcars pass through crossings with a brief signal cycle. The system would operate with computer controls and operator procedures that minimize the potential for conflicts.

- To address safe pedestrian crossings, the pedestrian and bicycle network along the proposed transit alignment would be evaluated and Z-crossings or other crossing treatments added where needed. After station platforms have been sited, the pedestrian network may be re-evaluated and the pedestrian crossings refined. Z-crossings control movements of pedestrians by turning pedestrians toward the direction of approaching trains before they cross each track. Z-crossings

may be used at locations where pedestrians are likely to cross the tracks, such as at isolated, midblock or pedestrian-only crossings. Other crossing treatments are being considered and may be evaluated to address other crossing needs in the corridor.

- For streetcar operations within Macadam Avenue/Highway 43, safety and security measures would include traffic signals, signage, station design, pedestrian crossings and other features that contribute to a safe and pedestrian-oriented streetscape.

3.14.3.2 Security Measures

Security measures would be addressed by applying established policies, procedures and responsibilities appropriate to the Lake Oswego to Portland corridor. The following describes the TriMet and Portland Streetcar Inc. approach to system security.

TriMet's Transit Police Division (**TPD**) is a special unit within the Portland Police Bureau with cooperating agreements with the police agencies in the region including Multnomah and Clackamas County Sheriff's Offices. To provide more focused deployment and presence, four precincts have been established with offices in Hillsboro, Gresham, Clackamas Town Center, and downtown Portland. The TPD currently (2010) consists of 58 sworn officers. Transit security efforts are supplemented by contract security personnel, 30 fare inspectors and 46 field supervisors as well as operators, customer service staff and maintenance workers. TriMet's Director of Safety and Security and the TPD commander meet regularly with various community members, law enforcement agencies and security partners to evaluate issues and collaborate on solutions. TriMet also has an established transit rider security program that combines enforcement with public safety resources from community organizations.

Portland Streetcar Inc. Safety and Security Plans are reviewed at least annually. The transit system organizational structure includes safety committees to evaluate the effectiveness of the system safety and security programs and activities. Throughout the design process, the project team conducts safety and hazard analysis of the alignment, including identification of traffic conflicts and development of mitigation strategies, analysis of pedestrian and bicycle safety, and design of a safe interface between streetcars and other transit. Portland Streetcar certifies that new extensions are operationally ready before entering service. Managers of transit operations and safety coordinate with local governments, Department of Homeland Security, and other agencies to ensure emergency responders are familiar with transit equipment and property and that personnel are trained to perform satisfactorily in emergency situations. Portland Streetcar Inc. relies on the City of Portland Police Bureau to respond to safety and security issues and questions.

Based on transit system experience, specific security measures include the following:

- To address vandalism and graffiti, quick clean-up response times will be maintained. Murals, etched glass and other techniques may be used at station platforms to deter vandalism.

- To address passenger safety on streetcars at night, riders would be encouraged to implement personal safety strategies such as choosing to sit near the driver in the front of the train.

- TriMet employs more than 2,600 staff members and Portland Streetcar Inc. employs 40 staff who receive system safety and security training. Most of the employees work in the community, serving as "eyes and ears" and visible deterrents to crime.

If the Enhanced Bus Alternative or No-Build Alternative is chosen as the Locally Preferred Alternative, TriMet would continue with its existing safety and security policies and practices while working with the local jurisdictions and communities. If the Streetcar Alternative is selected as the preferred alternative, TriMet and Portland Streetcar Inc. would continue to develop and refine specific safety and security measures in consultation with the local communities and jurisdictions through preliminary engineering, the Final EIS and Final Design.

3.15 Utilities

This section identifies the utilities in the project area and evaluates the project alternatives' potential effects on them. This section first briefly describes the existing utilities within the Lake Oswego to Portland Transit Corridor, followed by an assessment of the potential effects on utilities that the project's alternatives and options would have on utilities, concluding with a summary of potential mitigation measures.

3.15.1 Affected Environment

The Lake Oswego to Portland Corridor currently has both underground and aerial utilities. Underground utilities include water, sanitary sewer facilities, storm sewer facilities and natural gas lines. Electrical service facilities are sometimes located underground. Underground utilities in the LOPT Corridor include City of Portland water, storm and sanitary sewers, City of Lake Oswego water, storm and sanitary sewers. Natural gas is provided by Northwest Natural.

Aerial utilities typically include communication facilities that are attached to electric distribution poles or on their own special-purpose structures, such as high-tension power lines or wireless communication towers. Electric service providers within the Lake Oswego to Portland Transit Corridor include Portland General Electric and PacificCorp. Communications providers in the corridor area include Qwest, Sprint, T-Mobile, Verizon and Comcast.

3.15.2 Environmental Consequences

This section summarizes how the project alternatives and options would affect utilities in the corridor. The conceptual engineering efforts for the LOPT Project included initial reviews of major utilities to identify locations where the Enhanced Bus Alternative, Streetcar Alternative and Streetcar design options could be in conflict with major utilities. Because the project's analysis of potential utility impacts is based on the state, region and local jurisdiction's adopted land use plans and lists of transportation projects, there would be no cumulative long-term impacts other than those summarized in this section, except for upgrades to utilities that typically occur when project construction is in the area of existing utilities.

3.15.2.1 No-Build Alternative

The No-Build Alternative would have no direct or indirect effect on utilities within the corridor. Although other transportation and development projects are programmed or planned within the corridor, utility conflicts would be addressed through the individual projects' design and construction measures and long-term effects would not be anticipated.

3.15.2.2 Enhanced Bus Alternative

The primary capital improvement that would occur under the Enhanced Bus Alternative would be the construction of the proposed 300-space structured park-and-ride lot at the Oswego Village Shopping Center. The park-and-ride lot would not adversely affect existing aerial or underground utilities, because the design of the lot would accommodate existing utilities. Utilities located on the park-and-ride site, where the structure would be located, would likely be relocated. Other transportation and development projects that are programmed or planned within the corridor would address utility conflicts through design. Construction measures and other long-term effects resulting from the Enhanced Bus Alternative are not anticipated.

3.15.2.3 Streetcar Alternative

In general, the Streetcar Alternative would be designed to allow utilities to cross under or over the proposed streetcar alignment and it would generally allow ongoing utility maintenance or improvements to occur without affecting transit operations. The required relocation of specific utilities would be identified during Preliminary Engineering and final design phases of the project, after a preferred alternative has been identified and in close coordination with the utility companies and agencies. This design process for utilities would be used because a higher level of detailed engineering information is required to verify site-specific conditions, such as depth of excavation for construction, or how the drainage system would be constructed. Therefore, the utility facilities and infrastructure impacts identified for this DEIS generally represent typical conditions, as well as any major conflicts that have been identified in available conceptual engineering documents.

The general types of impacts to utilities due to the Streetcar Alternative would be categorized as longitudinal or crossing. A potential longitudinal impact would occur where the utility is located in close proximity and parallel to the proposed transit alignment and the utility would need to be relocated to either side, out from under or over the proposed streetcar alignment. A potential crossing impact would occur where the proposed streetcar alignment would intersect the existing utility facility and the utility may need to be either lowered further underground or elevated to a greater height. In general, the longitudinal impacts would require relocation of a greater number of linear feet of utilities than required by crossing impacts. There is a relative increased potential for longitudinal impacts on major roadways such as Highway 43 and along the Willamette Shore Line right of way, because these are typically major utility corridors. In general, underground utilities that are located under the proposed transit trackway would be relocated to either side of the trackway to facilitate future utility maintenance without disruption to the transit service. New drainage or stormwater features for the project could also affect the need to relocate existing utilities.

Typically, private utilities located within public rights-of-way or in the Willamette Shore Line right of way would pay for their own relocation costs as part of their agreements that allow them to use of the right of way, although some franchise agreements could provide for exceptions. In contrast, private utilities are typically allowed on private property through easements. Private utilities on private property often have the right to be reimbursed for the costs of relocations or changes. Public utility relocation costs are normally paid for by the project, but, in general, upgrades to the facilities would not be. The Streetcar Alternative would be designed to minimize the corrosive effect that potential stray electrical current could have on underground utilities.

The electric energy demands for the streetcar operations could require upgrades to electrical transmission systems along the corridor, which could include increasing the capacity of transmission lines, replacing poles or towers and improving electrical substations. Necessary improvements would be determined through consultation with the electrical utility providers during the Preliminary Engineering and Final Design phases of the project. Improvements to the electrical transmission system as a result of the project would likely involve upgrading existing transmission facilities, rather than creating new facilities. Section 3.12 Energy, provides additional information on the expected energy effects of the project alternatives.

Indirect impacts resulting from the relocation of utilities could include the need to reconstruct or widen existing public right of way, which could result in effects on adjacent properties, and in limited cases could require acquisition of additional property, or temporary or permanent easements

for the utilities. The extent of indirect impacts due to utility relocations will be determined in greater detail during the Preliminary Engineering and Final Design phases of the project.

Following is a summary by segment of the differences in effects on utilities that would result from the different Streetcar design options under study.

A. South Waterfront Segment

In the South Waterfront Segment it is anticipated that all the existing utilities in the affected area will be adjusted to the revised grades of the Moody/Bond Couplet extension. In addition, new utilities could be designed in the public right of way to address existing sewer and water needs for the area. Design for this area will be coordinated with the City of Portland Moody/Bond Extension project.

B. Johns Landing Segment

All Design Options. A 60-foot water main is located at Southwest Nevada Street. Utilities scheduled for installation by 2012 include two additional water lines up to 36 inches in diameter each. In addition, in the vicinity of the Nevada Station, existing Oregon Public Broadcasting (OPB) fiber optic lines may be affected. The water main would be protected by extension of the existing casing pipe and additional corrosion measures determined as part of the design process. Project improvements would be designed to avoid the OPB fiber optic lines.

Macadam In-Street and Additional-Lane Design Options. Existing sewer lines would be directly in conflict with the proposed track location for both the Macadam In-Street and the Macadam Additional Lane design options. These sewer lines run on the outside lanes of Macadam Avenue where the tracks would be located. Approximately 2,500 feet of sewer line would be relocated, generally between Southwest Boundary and Carolina streets.

Willamette Shore Line Design Option. The streetcar alignment under the Willamette Shore Line Design Option would be located within the existing railroad right of way, except at stations. This would minimize the need to relocate existing utilities. A field verification and review of the existing utility maps show no significant utilities exist within the right of way, except for the 60-foot water main located at Nevada Street referenced above.

C. Sellwood Bridge Segment

A field verification and review of the existing utility maps show no significant utilities exist within the Willamette Shore Line right of way in this segment, except for a 30-foot water main located at Southwest Sellwood Ferry Road, which would be sleeved to protect it from the corrosive effect of stray current. There are few overhead lines that cross the tracks that may be affected by the proposed alignment, including a high-capacity power transmission line located just north of the Macadam Bay driveway. Because that power line is generally 30-feet high, it would not need to be relocated horizontally or vertically.

Because utilities will be addressed by Multnomah County and others when the design of the proposed new interchange and Sellwood Bridge is finalized, there would likely be no conflicts between utilities and the proposed Streetcar alignment. Project staff would coordinate with the Sellwood Bridge designers to ensure that utility relocations would not result in additional impacts to utilities.

D. Dunthorpe/Riverdale Segment

Riverwood Design Option. There are approximately 2,500 feet of underground utilities along Southwest Riverwood Road, between Highway 43 and the at-grade crossing of the Willamette Shore Line right of way that would need to be relocated as a result of the Riverwood Design Option. These utilities include sewer lines and water mains that service approximately 15 houses. Private utilities along Riverwood Road may also need to be relocated under this design option.

Willamette Shore Line Design Option. This design option would locate the Streetcar alignment within the existing Willamette Shore Line right of way, thereby minimizing the number of utilities that would need to be relocated. A field verification and review of the existing utility maps show no significant utilities exist within the right of way, except for a parallel pressurized sewer line, which is incased in concrete for the full length of the Elk Rock Tunnel (approximately 1,500 feet). It is unlikely that the sewer line would need to be relocated under this design option, but it would be protected from stray current.

E. Lake Oswego Segment

UPRR Design Option. There are three sanitary sewer lines that cross the UPRR right of way that serve the Tryon Creek Sewage Facility. The three pipes cross beneath the existing freight tracks south of Tryon Creek and they would remain there under the UPRR Design Option. Private utilities include an overhead power transmission lines that may need to be relocated. There are existing sewer lines and a water main within the Foothills Road right of way that would need to be relocated under this design option. The realignment of Foothills Road would also lead to the relocation of an existing transmission line that crosses Foothills Road and connects to an adjacent power substation.

Foothills Road Design Option. This design option would locate the proposed Streetcar alignment within a proposed redesigned Foothills Road. Most of the utilities within the existing right of way of Foothills Road likely need to be relocated under this design option. This design option would not, however, require the relocation of the three sewer lines that connect to the Tryon Creek Sewage Facility. The existing Foothills Road portion of the roadway will have similar affect as described for the UPRR design option.

3.15.3 Mitigation

This section provides a summary of potential mitigation of effects on utilities if the Streetcar Alternative is selected as the Locally Preferred Alternative.

During the future design phases of the project development process, including Preliminary Engineering, Final Design and construction, the project team would contact all utility providers and would work with them to coordinate and develop plans to either protect or relocate utility facilities. The project sponsors would work with the affected utility owners to minimize effects to existing utilities and to minimize the amount of utility relocation for the project. The relocation of utilities can involve impacts of their own, including the need to reconstruct or widen existing public right of way, which could result in effects on adjacent properties, and in limited cases could require acquisition of additional property, or temporary or permanent easements for the utilities. During the Preliminary Engineering phase the design team would work with the utility owners to more carefully locate and map all potentially affected utilities in the area where the project would have direct impacts. During the Final Design phase, the design team would develop plans in consultation with the utility owners to specifically define where and when utilities would need to be relocated and/or

upgraded, and how they would be relocated and/or upgraded. During construction utility work typically precedes the project related civil construction work.

Proper coordination and the use of standard construction procedures and techniques would ensure minimal disturbance to system users and avoid damage or impacts to existing facilities that would not require relocation or upgrades. Typically, new facilities such as poles or ducts are installed and then service is switched over to the new facilities, thereby minimizing any disruption of service to the utility users.

3.16 Construction Activities and Consequences

This section addresses construction of the Lake Oswego to Portland Transit Project and the expected temporary effects of construction with respect to the natural environment and social topic areas that have been discussed previously in the earlier sections of Chapter 3 of this DEIS. Additional information on the short-term effects of construction can be found in the more detailed technical reports listed in Appendix B Supporting Documents.

Construction related impacts can be direct or indirect, are short-term in duration and generally end with the completion of project related construction. Construction impacts can also be more disruptive than the longer-term impacts of project operations.

The No-Build Alternative would not cause construction related impacts related to the Project. Other projects that are listed in the RTP financially constrained network that would be included in the No-Build Alternative would individually have construction impacts, but it is not possible to measure or document them at this time because most of the projects have not yet been designed or evaluated for specific impacts.

3.16.1 Approach to Construction of Project Improvements

This section describes the construction activities that would result from the Enhanced Bus and Streetcar alternatives.

3.16.1.1 Enhanced Bus Alternative

With the Enhanced Bus Alternative project related construction would consist mainly of a new 300-space park-and-ride structure and related bus facilities in downtown Lake Oswego. Construction of the park-and-ride structure would include demolition of the existing facilities on the site (consisting of existing impervious surface associated with parking areas for the Lake Oswego Village shopping center), excavation for utility and foundation work, construction of the parking structure and surrounding road and bus streets, and finishing work such as landscaping and signage for the structure and related bus facilities. Rerouting of buses would require changes to bus stops in the corridor including downtown Portland areas.

3.16.1.2 Streetcar Alternative

In general, construction of the Streetcar Alternative would be similar to previous streetcar projects in the region. Construction of the streetcar would mostly occur within the existing Willamette Shore Line right of way, within existing streets, or in areas where future streets are planned and include two park-and-ride facilities in downtown Lake Oswego: one 300-space structure and one smaller surface lot. The final construction approach for the Streetcar Alternative would be defined in detail, including methods, staging and sequencing, would be determined in coordination with the project's yet-to-be determined construction contractor.

Before construction activities would commence, some public and private utility companies, under direction of the project and local jurisdiction engineers would need to relocate some utility infrastructure that is in conflict with the proposed streetcar facilities. This could include limited relocation of utility duct banks, reconstruction of utility vaults to provide an access outside of the streetcar operating envelope, or the relocation or adjustment of power service lines.

Construction of the Lake Oswego to Portland Transit Project Streetcar Alternative is projected to take approximately 24 to 30 months. Major construction activities would be done within 24 months and finishing and testing would take the remaining time. The project construction is expected to be between 2014 and 2016. All construction would be performed in full coordination with TriMet and Portland Streetcar Inc., and would comply with all applicable safety requirements.

It is expected that construction of the tracks and the supporting structures would commence in stages. The contractor could segment the alignment into four or five "reaches" allowing the different construction teams to work in sequence. The work could be done from inside of the Willamette Shore Line right of way using existing access to move equipment in and out of the right of way. The plans have identified potential staging areas, which are typically in parking or vacant lots adjacent to commercial sites. It is anticipated that a temporary rail yard operation would be established at one end of the project. The rail yard would be used for flash butt welding operations to produce lengths of ribbon rails used in continuously welded rail.

The initial stage of the construction would involve preparation of the right of way, including clearing and grubbing of the work zone. This would remove any trees or other vegetation identified for removal, establish barriers and protection zones and secure staging areas. The contractor could use the existing the Willamette Shore Line tracks for access and haul by using hi-rail vehicles or track maintenance vehicles, or they could remove the existing tracks and trackbed and expose the subgrade for prep work.

The next phase of construction would be advanced utility work for the in-street segments, installation of any subgrade conduits, culvert upgrades and replacement work. A number of culverts have been identified for replacement and would require upgrades. In some cases there may be a need to install manholes and additional piping (such as in the area of Powers Marine Park) as a few exiting culverts would require upgrades.

Following the subsurface and drainage work, the contractor would begin grading and construction of the retaining walls. The type of retaining walls has not been defined so construction methods are not established. Likely scenarios would include gravity walls for low walls (5 feet and under) and concrete masonry units which are precast and stacked or cast in place walls for higher walls. It is expected that the majority of work on the walls would be from within the right of way with some areas requiring a work zone outside the right of way. At the same time work on the trestles, as recommended in the structural report, would begin. Structures and tunnel work would be advancing in preparation for the track installation.

Once the grades are established and the subgrade is compacted, the installation of foundations for the overhead catenary poles, station foundations and other structure foundations would begin. Ballast mats or vibration attenuators would be placed and the subballast, ballast, ties and rails sections would be placed. Insulated joints and field welds would be next. Once the initial track is set, a tamper would run the length of the alignment and finished the final grades for the track. The stations would be constructed and the traction electrification system installed along with signals, gates and other communication systems.

The last phase of the construction would be the testing of the system along with final grading, landscaping and right of way improvements as necessary to finish the work.

3.16.2 Impacts Related to Construction

As noted above, there would be no construction related impacts associated with the No-Build Alternative. Following is a description of the short-term effects that would result from construction activities for the Enhanced Bus and Streetcar alternatives.

3.16.2.1 Enhanced Bus Alternative Construction Impacts

In the vicinity of the park-and-ride lot in downtown Lake Oswego, temporary traffic impacts would occur on local streets and occasional daytime lane closure north bound on Highway 43 could occur during construction. Pedestrian and auto access to area businesses would be disrupted, but access would be maintained at all times. Local businesses and nearby residents could experience short-term noise and vibration, air quality and visual effects. Also, the project would be required to prepare a hazardous materials work plan, including a containment plan for any contaminants encountered during construction.

The Enhanced Bus Alternative park-and-ride structure and an associated access road would be within the Lower Willamette Subbasin, and could result in approximately 7 acres of ground disturbance due to construction. Potential construction-related effects to hydrology would be minor. However, a 1200-C construction permit would be required which would require an erosion and sediment control plan and best management practices, which could include temporary detention and flow controls. With the implementation of these requirements, construction effects to hydrology would be minimized and considered negligible.

The Enhanced Bus Alternative would encroach upon approximately 1.3 acres of the FEMA-designated 100-year floodplain for the Willamette River. Construction within the floodplain could result in a temporary decrease in floodplain storage. No construction at stream crossings is proposed with this alternative. In addition, there would be 1.14 acres of riparian vegetation temporarily impacted with the Enhanced Bus Alternative along with relatively limited ground disturbing construction in Segment 6 (Lake Oswego) associated with the park-and-ride facility.

Construction effects to water quality associated with the Enhanced Bus Alternative include increased rates and volumes of sediment-laden runoff during construction activities, risk of accidental spills and leaks from construction vehicles and equipment, and removal of riparian vegetation. A construction storm water plan would be required that would implement erosion and sediment best management practices.

The Enhanced Bus Alternative would require approximately 20.3 billion Btu or 1.63 million of gallons of gasoline for construction of the project.

3.16.2.2 Streetcar Alternative Construction Impacts

Following is a summary, by discipline area, of the construction activity consequences for the Streetcar Alternative with various design options.

Transportation

Transit. During daytime hours, project construction could result in some transit service delays with the Macadam In-Street and Macadam Additional Lane design options in the Johns Landing area. Temporary closure or relocation of bus transit stops would occur along Macadam Avenue/Highway

43 in construction zones. The seasonal Willamette Shore Line trolley would permanently close with the commencement of construction.

Traffic. Construction traffic effects during weekday daytime hours would occur in the corridor in various locations where construction activities would interface with Highway 43, local roadways and private access, such as:

- In the South Waterfront Segment where both design options would interface with, or cross local streets.

- In the Johns Landing Segment with the In-Street and Additional Lane design options where the alignment would be constructed within Highway 43 right of way. There would be no construction traffic effects on Highway 43 with the Willamette Shore Line design option in this segment.

- In the Sellwood Bridge Segment with both design options where the alignment would be constructed crossing existing public and private streets and access points.

- In the Dunthorpe/Riverdale Segment with both design options where the alignment would be constructed crossing existing public and private streets and access points, and where the Riverwood In-Street design option would affect local access and circulation.

- In the Lake Oswego Segment where both design options would interface with local streets in the area where the alignment would connect to the new park-and-ride structure and the new streetcar station.

Public and private parking in the vicinity of project construction would be disrupted during construction primarily in the South Waterfront, Johns Landing and Lake Oswego segments.

Freight Rail. With both the design options in the Lake Oswego Segment, construction of the Streetcar Alternative alignment would have effects on the existing freight rail line, either the streetcar would cross under the existing rail line with the Foothills design option, or running adjacent to it with the Union Pacific Railroad Right of way design option. Either option would require negotiations with the railroad and agreements about how construction would interface with the railroad.

Land Use and Economics

Construction of the project is unlikely to result in changes to land use in the corridor during the construction period. Streetcar Alternative related construction would result in between 1,430 and 1,530 short-term jobs, depending on the design options chosen. Construction can be disruptive or supportive of businesses in the vicinity of the construction activity. Where construction activity occurs in streets near businesses, access for customers can be disrupted. Construction activity can also be good for businesses, such as when construction workers patronize local businesses and when construction related activities utilize local contractors or utilize local suppliers.

Streetcar construction could result in reduced access to properties adjacent to the construction zone for short periods, often less than one month, but access would not be eliminated during this time. The project would employ typical construction management practices to avoid or minimize adverse

economic consequence to adjacent resident and businesses such as avoiding full access closures, providing temporary alternative access, signage indicating that businesses are open and timely communications with business owners.

Neighborhoods, Displacements and Relocations Construction activities from the Streetcar Alternative and design options would likely affect the adjacent residents and neighborhoods by temporarily increasing noise and dust, establishing construction zones and signage, altering or reducing access and establishing detours, and temporarily disrupting utilities as they are reinforced or relocated. The project would undertake standard types of construction practices to avoid or minimize these effects on neighborhoods and adjacent uses, as described for each of the discipline areas in this section. Relocations would be offered to displaced activities through TriMet's Acquisition and Relocation program, which is consistent with USDOT guidelines.

Visual Quality and Aesthetics
Construction of the Streetcar Alternative would cause temporary visual impacts relating to the presence of construction equipment, the storage of materials, the disruption of the existing railroad corridor and streetscape where applicable to the various design options. The location of the construction zones would tend to move as the construction begins and ends in the corridor. Due to the temporary nature and the fact that construction is a common visual element in the region and corridor, construction visual impacts would be classified as low to moderate.

Construction in the project corridor would occur in stages over a period of approximately two years, although any one location would likely experience construction activities that would be shorter. Construction is conducted in stages but begins with utilities relocation, clearing and grading, and reconstruction. These actions could remove existing visual features and create visual clutter. Construction equipment, trailers, workers' parking, construction materials, debris, lighting, and signage also change visual conditions in a corridor under construction. The areas affected can be larger than the permanent facility to allow construction equipment and materials to be brought to alignment.

The Streetcar Alternative would have higher level of construction visual effects than the Enhanced Bus Alternative. The differences are more closely related to where construction would be occurring, and the extent of the construction activities.

Historic, Archaeological and Cultural Resources
Construction of the Streetcar Alternative could affect known historic, archaeological or cultural resources. Minor temporary changes in the vicinity of known resources could include: nearby clearing and grading; dust, exhaust and other airborne matter; and reduced vehicular and pedestrian access. The Streetcar Alternative would be constructed in the historic Red Electric Railroad right of way, and construction could affect contributing features of the historic corridor such as trestles, railroad ties and other features.

Currently unknown archaeological or cultural resources encountered during construction would be protected from any adverse effects by taking some or all of the following actions, in compliance with federal and state regulations: notification to and consultations with regulatory agencies and/or tribes, temporary work stoppage at the site, additional surveying and/or documentation, removal and preservation, and other actions as appropriate. See the discussion of this in Section 3.5.4.

Parklands and Recreation Areas
Short-term effects of construction of the Streetcar Alternative could include temporary disruption adjacent to or within some parks in the corridor. Short-term impacts could result from noise and dust generated during construction, from temporary disruptions in access, or due to construction easements onto park property.

In the South Waterfront Segment, the temporary bicycle path used to connect to the Willamette River Greenway Trail would be temporarily disrupted during construction. The construction of the streetcar project would also temporarily disrupt the connector trail between Southwest Macadam Avenue and the Willamette River Greenway near the proposed Boundary Street station. Trail use would be interrupted during construction with temporary closures. Interim routes would be provided.

The project could result in short-term construction impacts adjacent to and possibly within Willamette Park. Construction activities could extend into the park area near the Nebraska Street station at a small area east of the tracks and west of Beaver Avenue. The other potential area within the park that could be affected by construction is near the Nevada Street station, south of the tennis courts.

There would be a small area of construction impact within the Willamette Moorage Park north of the Sellwood Bridge Station. Also, project construction could impact property within Powers Marine Park from construction of a pedestrian overpass of the rail alignment, and from improvement of culverts that pass under the existing tracks. Of the eight anticipated culvert replacements, two are expected to have temporary impacts in the park, based on right of way location.

In the Lake Oswego Segment, there would be a new bridge constructed over Tryon Creek. The properties to the north of the creek are owned by public entities and planned for future park land. Construction staging areas have not been determined in the area around Tryon Cove Park, but it is possible that the publicly-owned land adjacent to the bridge may be used for staging. Further planning between the project and the owners of the parcels in question could avoid a Section 4(f) impact in this area.

The Foothills design option alignment would result in temporary construction impacts to the Kincaid Curlicue Corridor path. Both design options would result in construction impacts to path in this area. An alternate pathway would be made available during construction, probably along the existing road.

Geology, Soils and Seismic Hazards
The Streetcar Alternative would require the construction of several cut slopes and placement of engineered fill to accommodate the track and associated ancillary structures. Locally, cut excavations may be temporarily unsupported during construction, and fill slopes may be exposed to erosion prior to establishment of permanent vegetative cover. Most of the proposed cut slopes on the project will be permanently supported by retaining structures (walls). Construction of park and ride facilities may temporarily expose native and human-placed soil and/or rock to potential erosion, especially if constructed during wet weather conditions.

Ecosystems

Construction of the Streetcar Alternative would cause some effects to wetlands, vegetation, wildlife and/or fisheries. Effects would be short-term, localized and of limited consequence, which could include: increased dust and emissions, increased noise, inadvertent small-scale soil contamination and vegetation removal. Expected effects would include:

- Temporary disturbance to vegetation would occur as a result of direct removal of vegetation and potential soil compaction. Work access, the expanded ballast needed to support two rail tracks throughout much of the corridor, the proposed new bridge crossing over Tryon Creek, and new piers for replaced trestle structures would result in the temporary loss of riparian vegetation. Coordination with the proposed Sellwood Bridge Project may necessitate a new bridge crossing structure over Stephens Creek. Table 3.16-1 details anticipated temporary losses to riparian habitat resulting from construction of the Streetcar Alternative.

Table 3.16-1 Temporary Riparian Vegetation Loss from the Streetcar Alternative by Segment and Design Option

Segment	Design Option	Acres of Temporary Riparian Vegetation Impacted
1 - Downtown Portland	None	0
2 - South Waterfront	None	0.02
3 - Johns Landing	Willamette Shore Line	4.06
	Macadam In-Street	3.29
	Macadam Additional Lane	3.29
4 - Sellwood Bridge[1]	None	5.74
5 - Dunthorpe/Riverdale	Willamette Shore Line	0.9
	Riverwood	0.9
6 - Lake Oswego	UPRR	2.16
	Foothills	1.86
Total Range for Design Options (low to high)		11.81 – 12.88

Note: All impacts calculated by DEA (2010) using GIS. Temporary impact footprint = construction limits within the 100-year floodplain.

- Temporary construction impacts to wetlands, including grader and dozer work and material storage, may result in soil compaction, vegetation removal and minor sedimentation from upgradient erosion areas. Soil compaction could cause changes in hydrology and the ability of the soil to support new vegetation growth. Vegetation removal in these areas would cause loss of habitat, thermoregulation and filtration functions.

- Temporary impacts to wildlife may include visual and auditory disturbance and temporary removal of vegetation during construction, including noise from operating machinery. Potential construction noise impacts could cause birds, including species of breeding birds, to abandon nest sites prematurely.

- Temporary ground disturbing construction-derived erosion would be likely, increasing the potential for water quality impairment from turbidity and sedimentation. Construction involving ground disturbance has potential for fugitive sediment transport as a result of erosion. Erosion can result in sediment-laden runoff entering streams, resulting in water column turbidity and sedimentation of substrates, particularly spawning gravels. Table 3.16-2

identifies the acreage of anticipated temporary ground disturbing construction activities by segment and design option.

Table 3.16-2 Construction-Related Temporary Impacts from Ground Disturbing Activities for the Streetcar Alternative by Segment and Design Option

Segment	Design Option	Acres of Temporary Ground Disturbance
1 - Downtown Portland	None	--
2 - South Waterfront	None	8.79
3 -Johns Landing	Willamette Shore Line	9.68
	Macadam In-Street	17.34
	Macadam Additional Lane	18.71
4 -Sellwood Bridge[1]	None	8.81
5. Dunthorpe/Riverdale	Willamette Shore Line	11.82
	Riverwood	11.82
6. Lake Oswego	UPRR	22.43
	Foothills	23.27
Total Range for Design Options (low to high)		**61.53 to 71.4**

Note: All impacts calculated by DEA (2010) using GIS. Temporary impact footprint = construction limits

Construction could indirectly affect threatened and endangered species and habitats including creation/modification to stormwater generating surfaces, potential water quality impairment from construction-related erosion, and temporary riparian vegetation loss associated with construction activities. Such impacts would apply to nearly all segments. Table 3.16-3 summarizes anticipated impacts by segment and design option. There would be no in-water work with the Streetcar Alternative.

Table 3.16-3 Summary of Temporary Indirect Effects to Fisheries Resources of the Streetcar Alternative by Segment and Design Option

Segment	Design Option	New Impervious Surface Area Created	Redevelopment of Existing Impervious Surface Areas	Construction-related Water Quality Impairment	Temporary Loss of Riparian Habitat
1 - Downtown Portland	None	No	Yes	Yes	No
2 - South Waterfront	None	Yes	Yes	Yes	No
3 - Johns Landing	Willamette Shore Line	Yes	Yes	Yes	No
	Macadam In-Street	Yes	Yes	Yes	No
	Macadam Additional Lane	Yes	Yes	Yes	No
4 - Sellwood Bridge	None	Yes	Yes	Yes	Yes
5 - Dunthorpe/Riverdale	Willamette Shore Line	Yes	Yes	Yes	Yes
	Riverwood	Yes	Yes	Yes	Yes
6 - Lake Oswego	UPRR	Yes	Yes	Yes	Yes
	Foothills	Yes	Yes	Yes	Yes

Source: URS
Note: All impacts calculated by DEA (2010) using GIS

Hydrology and Water Quality

Although a new stream crossing at Tryon Creek and a potential new crossing at Stephens Creek would be constructed, preliminary design information suggests the structures will be above the ordinary high water mark (OHWM), thus not requiring in-water construction permits. In the event that in-water construction cannot be avoided, all in-water work would be conducted during agency-coordinated and approved in-water work windows. Details regarding construction equipment, methods, timing and sequencing would be developed in conjunction with the appropriate regulatory agencies at a later date, if this alternative was selected as the Locally Preferred Alternative.

Typical construction effects for the Streetcar Alternative related to hydrology would include the replacement, removal, addition or extension of existing stormwater drainage features (culverts, crossings, and conveyance ditches) or facilities which could temporarily affect flow patterns and result in minor, short-term effects to the instream flow conditions in the immediate proximity of construction. Temporary stormwater conveyance structures may need to be installed during construction, which would result in modification to existing drainage patterns. Additionally, compaction of soils and removal of vegetation associated with construction activities could result in reduced infiltration capacity and temporarily increase flows.

Construction associated with the Streetcar Alternative would result in between approximately 56 to 71 acres of overall construction disturbance, depending on the design options chosen. Potential construction related effects would include the replacement, removal, addition or extension of existing stormwater drainage features (culverts, crossings, and conveyance ditches) or facilities which could temporarily affect flow patterns and result in minor, short term effects to the instream flow conditions in the immediate proximity of construction.

The Streetcar Alternative would encroach upon the FEMA designated 100-year floodplain for the Willamette River. The encroachment could potentially result in temporary decreases in floodplain storage. Additionally, effects to floodplains from construction of the Streetcar Alternative could occur at stream crossings, particularly Tryon Creek and Stephens Creek.

Noise and Vibration

During construction there would be temporary increases in sound levels near the active areas of construction and near any materials staging areas due to the use of heavy equipment. In some areas construction activities would occur within close proximity to buildings, some immediately adjacent to the Willamette Shore Line right of way, including residences and numerous commercial structures along Highway 43. Construction noise and vibration received at both commercial and residential uses adjacent to the alignment could be perceived as intrusive. However, construction in any one area is expected to be of limited duration and any such intrusive noise or vibration would be temporary in duration. The project would be required to comply with the City of Portland Noise Ordinance which defines the hours for construction related noise. In general, the project's construction activities would occur during weekday daytime hours (i.e. 7:00 a.m. to 7:00 p.m.) and construction activities outside of daytime hours would require obtaining a noise variance from the City of Portland.

Construction of the streetcar line would involve some noise sources similar to those used during recent repairs of some of the Willamette Shore Line corridor trestles. Thus, resulting noise levels would be similar, but in most locations periods of construction would be of shorter duration than occurred during repair of the area trestles.

Air Quality

Construction activities from the Streetcar Alternative, primarily earth moving, would temporarily create dust and would result in emissions from construction equipment. Construction effects to air quality could include generation of PM_{10} and small amounts of CO and other criteria pollutants from construction machinery exhaust. The sources of particulates would be "fugitive dust" from demolition (removal of existing trackway and rail ties) and earth moving excavation and diesel exhaust. Fugitive dust includes fine particles raised by construction activities and is common in dry windy weather. Its dispersion depends on dryness of the soil, the soil texture and the general weather conditions such as presence or absence of participation and wind velocity. It is most common in dry windy weather. Larger particles would settle near the source, while fine particles could be dispersed over greater distances.

Energy

Construction energy effects involve a one-time, non-recoverable energy cost associated with construction of roadways, structures, etc. The analysis was conducted using the Input-Output Approach for Urban Conventional Highway Construction developed by CalTrans (1983). This method assigns an energy-to-dollar ratio to various roadway construction activities, which converts construction dollars into energy consumption.

The No-Build Alternative would require minimal consumption of energy associated with construction. The construction energy would be in a form of indirect energy consumption due to maintenance cost per mile.

The Enhanced Bus Alternative would require approximately 139 billion Btu or 1.12 million gallons of gasoline for construction of the project. The Streetcar Alternative would require approximately 1,400 billion Btu or 11.2 million gallons of gasoline for construction of the project. In addition, the maintenance facility storage yard, which includes building and equipment, would require approximately 17.4 billion Btu or 140,000 gallons of gasoline for construction. Table 3.16-4 provides the results of the construction energy expenditures with respect to construction using gasoline fuel. Section 3.16 Construction Impacts also addresses short-term construction energy effects

Table 3.16-4 Summary of Construction Energy Consumption, (Billions of Btu[1])

Alternative	Energy Consumption (Billions of Btu[1])	Fuel Consumption (Million Gallons of Gasoline)
No-Build Alternative	Negligible	Negligible
Enhanced Bus Alternative	139	1.12
Streetcar Alternative	1,400	11.2
Maintenance Facility	17.4	0.14

Sources: URS Corporation 2010, Metro 2010, TriMet 2010
[1] Btu = British Thermal Unit. One gallon of gasoline = 125,000 Btu.

Hazardous Materials

The Streetcar Alternative would not result in exposure to known hazardous materials sites, and the use of Phase I (and potentially Phase II) environmental site assessments for all property acquisitions should identify any unknown sites within the portions of parcels to be acquired for the project. Soil would be monitored during construction and any contaminated soil encountered would be managed appropriately. If contaminated soil is uncovered, remedial actions could include the excavation and proper disposal of affected soils by properly trained and equipped technicians before construction

begins or proceeds. Adverse impacts to construction workers from contamination would be avoided or minimized through the development and implementation of a hazardous materials work plan that would be designed for the project and that would include actions to be implemented if construction activities encounter contaminated soil. Construction impacts related to hazardous materials for the Streetcar Alternative are not considered significant.

Public Safety and Security

Safety and security issues during construction typically include access to the construction site areas, safety of construction workers (particularly when working near moving vehicles). Short-term construction safety and security issues would be addressed by TriMet's Safety Engineer and Risk Manager, using construction, contractor and safety management plans prepared for the project. Fences and barriers will be used as necessary to secure construction areas from public access and signage will redirect vehicles, bicycles and pedestrians as needed.

Utilities

The construction of streetcar tracks and associated facilities would result in physical conflicts with existing and planned utilities, including street lighting, electrical, sewer, water and gas services along with communication cables. These conflicts would likely be greatest where the streetcar alignment and other facilities would be within existing street right of way. Streetcar electrification could lead to stray electrical current that could accelerate corrosion of metal pipes and, as a result, some water or gas pipes under the trackway may need to be relocated. During Preliminary Engineering, TriMet would coordinate with utility providers and would identify specific conflicts and define strategies for managing cost and construction scheduling. The relocation of utilities would be carefully managed and scheduled during Final Design to avoid construction delays and additional project costs. Also, TriMet would coordinate with local utilities to assure adequacy of services necessary to operation the project related facilities, including enough power along the corridor for streetcar operations.

Environmental Justice, Elderly, and Disabled Populations

Construction activities from the Streetcar Alternative would result in temporary detours and nuisances to businesses and residences located near construction areas, which could include protected populations, but these would not be disproportionately high adverse impacts. These impacts include: noise and dust from construction equipment and machinery, temporary loss of on-street (and possibly some off-street) parking, traffic delays and temporary changes in routings to businesses or residences. These impacts would not differ from those experienced by other populations in the project area.

3.16.3 Mitigation of Construction Impacts

Mitigation measures for project related construction impacts would begin following selection of the Locally Preferred Alternative. The FEIS will describe the project commitments for mitigation, depending on the selection of the locally preferred alternative. The potential mitigation measures described below are measures that could be implemented by the project to reduce the construction related impacts, generally identified above. Mitigation of construction impacts will be further defined in the Preliminary Engineering and Final Design phases of the project development process.

Transportation (transit, traffic, bikes, pedestrians and freight)

Following is a list of potential transportation construction mitigation measures. This list represents a range of measures that could be implemented:

- During construction affected transit stops could be temporarily relocated to the nearest possible location on the same route.

- During construction, temporary sidewalks and/or pathways could be provided to replace any sidewalks or paths that are affected by construction.

- To minimize the amount of construction related traffic to and from the construction sites, efforts should be made to recycle or reuse as much of the excavated earth from the project sites as possible.

- Construction truck trips could be monitored on a regular basis to minimize effects on traffic operations on nearby roadways, such as Highway 43.

- Implement a comprehensive public outreach program to inform local resident and businesses of construction related issues that could result in potential delays and impacts to the local street network due to construction.

- To help minimize on-street parking impacts, temporary parking could be identified to mitigate the temporary loss of parking due to construction.

- Preparation and implementation of a traffic management plan for the construction period.

Land Use and Economics
Because there would not be adverse land use impacts, no land use mitigation measures would be necessary during construction. Mitigation of economic impacts would include working with local businesses during construction to minimize the impact of nearby construction activities to local businesses. If access to a business would be temporarily affected, an alternative, safe and temporary access would be provided.

Communities and Neighborhoods
Mitigation for temporary impacts to neighborhoods during construction could include the public information and coordination efforts that would focus on affected businesses and residents and on implementing measures to help minimize the effects of construction and to address ongoing concerns. Mitigation for specific issues such as noise and air quality is specifically addressed in other section below.

Visual Quality and Aesthetics
There would not be significant visual impacts during construction of the Streetcar Alternative; therefore, no visual mitigation is required during construction.

Historic, Archaeological and Cultural Resources
Because the railroad right of way is considered historic and construction would alter features that are considered contributing to the historic resource, documentation of the historic features of the corridor that would be altered would be implemented prior to initiation of construction as defined in a (future) Memorandum of Agreement between the Oregon SHPO, FTA and the project proponents. Also, and inadvertent discovery plan would be developed to address the possibility of discovery of undocumented historic or cultural resources during construction.

Parklands and Recreation Areas
Depending on the type of resource and the type of project-related impacts, short-term mitigation measures can include a wide range of options, including those defined within individual topic areas such as noise, visual and transportation. Where direct or proximity impacts are expected, the project will coordinate with park owners to maintain access to park resources where possible and, when restrictions to access or the use of park or recreational resources are unavoidable, the project would work to minimize the duration.

Geology, Soils and Seismic Hazards
Mitigation of construction effects related to geology, hydrogeology and seismic hazards should be based on the results of site specific geotechnical investigations, which will be performed in support of final design of the Locally Preferred Alternative and associated options.

The primary approach to mitigation of construction issues is avoidance of geologic hazards, where possible. Because the majority of the project alignment is already determined, especially for the Lake Oswego terminus option of the Streetcar Alternative, this approach has limitations. Erosion of exposed cut and fill slopes can be mitigated using erosion control best management practices during construction and until permanent erosion control measures are established. Areas of shallow groundwater, unsuitable fill material and shrink-swell soils should be identified, to the extent possible, through the geotechnical investigations and mitigation strategies established prior to construction.

Areas of potential slope instability, such as suspected ancient landslides or steep slopes should be identified and delineated during site specific geotechnical investigations and slope stability analyses should be conducted as part of the design. The design should consider temporary factors of safety for slopes during construction, as well as permanent slope stability.
Close attention should be paid to proposed bridge abutment areas during the site specific geotechnical investigations to provide the necessary detail to design stable temporary construction access.

Ecosystems
Temporary impacts to vegetation would be minimized by limiting construction staging and access corridors to the minimum size practicable and siting such areas in already disturbed areas where possible. All temporarily disturbed areas would be re-vegetated with native plant species and restored to pre-project conditions or better. Silt fencing and other erosion control methods would be utilized to minimize the potential short-term impacts to adjacent vegetation.

Hydrology and Water Quality
The project would comply with all applicable water quality regulations in all areas of construction, including the implementation of erosion control best management practices that prevent offsite sediment transport. Some of the erosion control best management practices required by state and local jurisdictions include the following:

- Using straw, plastic, or other coverings for exposed ground;
- Protecting large trees and other components of vegetative buffers;
- Restricting vegetation clearing activities and site grading to dry weather periods;
- Installing natural or synthetic geomembranes to prevent soil from eroding; and

- Using barrier berms (such as hay bales or check dams), silt fencing, and/or temporary sediment detention basins to help control sediment transport.

A 1200-C construction permit would be required which would require an erosion and sediment control plan and construction best management practices, which could include temporary detention and flow controls. With the implementation of these requirements, construction effects to hydrology would be minimized and considered negligible.

Noise

Noise from construction of any elements of the Streetcar Alternative or the various options would be unlikely to result in significant noise impacts. Such noise may nonetheless be intrusive at nearby locations and especially at homes. However, there are means through which such intrusive noise can be minimized.

Practices that can reduce the extent to which people are affected by construction noise and could include elements such as using properly sized and maintained mufflers, engine intake silencers, engine enclosures and turning off idle equipment. Construction contracts could specify that equipment mufflers be in good working order and that engine enclosures be used on equipment when the engine is the dominant source of noise.

Stationary equipment could be placed as far away from sensitive receiving locations as possible. Where this is infeasible, or where noise levels are nonetheless still loud at nearby receivers, temporary, portable noise barriers could be placed around the equipment with the opening directed away from the sensitive receiving property. These measures are especially effective for engines used in pumps, compressors, welding machines and similar equipment that operate continuously and contribute to high, steady background noise levels. Such measures can typically provide about a 10-dBA reduction in equivalent sound levels from shielded equipment.

Construction staging areas expected to be in use for more than a few weeks should be located, and to the extent practicable laid out, to situate the most frequent or loud activities as far as possible from sensitive receivers, particularly residences. Likewise, in areas where construction would occur within about 200 feet of existing uses (such as residences and noise-sensitive businesses), effective noise control measures (possibly outlined in a construction noise management plan) should be employed to minimize the potential for noise impacts. In addition to placing noise-producing equipment as far as possible from homes and businesses, such control could include using quiet equipment and temporary noise barriers to shield sensitive uses and orienting the work areas to minimize noise transmission to sensitive off-site locations. Although the overall construction sound levels will vary with the type of equipment used, common sense placement to maximize distance attenuation should be applied. Additionally, effort could be made to plan the construction schedule to the extent feasible with nearby sensitive receivers to avoid the loudest activities during the most sensitive time periods.

Vibration

The potential for impacts from ground borne vibration related to construction equipment and activities could be most effectively controlled by avoiding use of problematic equipment within defined critical distances for such equipment. Where avoidance is impractical or impossible, using equipment that generates less ground borne vibration instead of more standard equipment also would reduce the potential for impacts. If neither option is applicable, potentially affected buildings should

be examined for preconstruction conditions and possibly monitored during nearby construction activities to reduce the potential for ground borne vibration impacts.

Air Quality
The project has potential for temporary and localized air quality affects from construction activities. The temporary effects would result from activities such as demolition, grading, paving and the use of heavy equipment. The construction contractors would be required to comply with relevant federal, state and local air quality regulations. With the implementation of best management practices for the duration of the project construction, effects on air quality are not anticipated to be significant.

During construction, measures would be implemented to minimize construction effects in the project vicinity. Measures to minimize construction effects to air quality during construction would include best management practices, including the following:

- Use of water spray as necessary to prevent dust emissions;
- Prompt cleanup of any spills of transported material on public roads by frequent use of a street sweeper machine or other appropriate methods; and
- Require contractors to maintain all construction machinery engines in good mechanical condition to minimize exhaust emissions.

Hazardous Materials
Lands containing hazardous materials could incur risk for the project. To reduce risks, the data compiled in this DEIS should be reviewed and evaluated to identify possible locations where hazardous materials are known to exist or may be present. Sites that are currently owned by project sponsors or would be acquired for the project that may contain hazardous materials should be evaluated in more depth during Preliminary Engineering. This could include file reviews, reviewing permits, conducting geophysical surveys and/or conducting subsurface assessments. Coordination with appropriate regulatory agencies would occur, so that appropriate steps can be taken to decrease the project's risk.

Prepare a health and safety plan for construction, incorporating a work plan for handling any identified hazardous materials on the site, and specifically addressing any identified hazardous materials sites.

Public Safety and Security
Short-term construction impacts related to the Streetcar Alternative would be addressed by TriMet and Portland Streetcar Inc. Safety engineers and risk managers using construction, contractor and safety management plans written specifically for this project. Fences and barriers will secure construction areas from public access and signage will redirect vehicles, bicycles and pedestrians as needed. Persons with disabilities will be provided for as well.

3.16.4 Cumulative Construction Impacts

The construction impacts of the Streetcar Alternative described above could combine with impacts from the construction of other planned projects, if their construction periods overlap. Construction of the Sellwood Bridge Project is expected to begin in late 2012. When the Streetcar Alternative would be constructed, if selected as the Locally Preferred Alternative, has not been determined. For this reason, how the construction impacts of both projects would combine is too uncertain to be described. Other projects that could be constructed at the same time as the Streetcar Alternative are

the South Portal project in Segment 2 and the extension of Foothills Road in Segment 6. When these projects would be constructed is uncertain. Were construction of the Streetcar Alternative to overlap with construction of any of these other projects, project sponsors would coordinate with each other to minimize the combined impacts.

3.17 Phasing Effects

This section summarizes how the environmental effects of the Streetcar Alternative would vary based on construction phasing options currently under consideration – neither the No-Build Alternative nor the Enhanced Bus Alternative include construction phasing options. The project's construction phasing options for the Streetcar Alternative are described in Section 2.2.3.3, summarized in Table 3.17-1 and illustrated in Figures 3.17-1 and 3.17-2. In summary, there are two types of phasing options: 1) those related to the project's finance plan (i.e., Full Project Construction and the Sellwood Bridge MOS Construction); and 2) those related to coordination between this project and other capital projects in three of the project segments (i.e., South Waterfront, Sellwood Bridge and Lake Oswego segments). The Streetcar Alternative evaluated under this DEIS is as Full-Project Construction. Should the Streetcar Alternative with phasing be selected as the Locally Preferred Alternative, during preliminary engineering (PE) additional analysis of environmental impacts resulting from the interim project alignment (as opposed to Full-Project Construction) will be conducted and additional opportunity for public review and comment may be required.

3.17.1 Finance Plan Related Phasing Options

There are currently two phasing options for how the Streetcar Alternative might be initially implemented: 1) Full Project Construction; and 2) the Sellwood Bridge MOS Construction as shown in Figure 3.17-1. These two phasing options would constitute the project's capital improvements and transit operating plan for the initial opening of the Streetcar Alternative. Currently, the Metro and TriMet estimate that the project would initially open during 2017. Note that the Full Project Construction phasing option also represents the proposed Streetcar Alternative for the project's forecast year (i.e., 2035), as documented throughout this DEIS. The two finance plan related construction phasing options under consideration would lead to full implementation of the Streetcar Alternative by the project's forecast year and, therefore, the long-term impacts associated with the Streetcar Alternative would not be affected by these two construction phasing options. The project's current conceptual finance plan is summarized in Chapter 5 of this DEIS and it is based on the Full Project Construction phasing option.

Full Project Construction Phasing Option. Under the Full Project Construction phasing option, the Streetcar Alternative would be constructed and begin initial operations as a full project to Lake Oswego with capital improvements between Southwest Bancroft Street and downtown Lake Oswego. All project elements described in Chapter 2 of this DEIS for the Streetcar Alternative would be completed prior to the project's initial opening for revenue service. Under the Streetcar Alternative and this phasing option, no additional capital improvements would occur between the project's initial opening of revenue service and 2035. The project's initial operating plan (i.e., frequency of transit lines) would generally be scaled to meet ridership demand during the project's opening year through to 2035. The project's initial purchase of streetcars could be sized to meet anticipated streetcar ridership during the project's opening year of service or up to projected ridership for 2035, depending on the project's final finance plan.

Sellwood Bridge MOS Construction Phasing Option. The Sellwood Bridge MOS Construction phasing option could be used as a component of the project's finance plan to address issues, such as, but not limited to, projected cash flow or reducing finance costs. Under the Sellwood Bridge MOS Construction phasing option, the proposed Streetcar Alternative alignment and associated improvements proposed for the area generally between Southwest Bancroft Street and the Sellwood

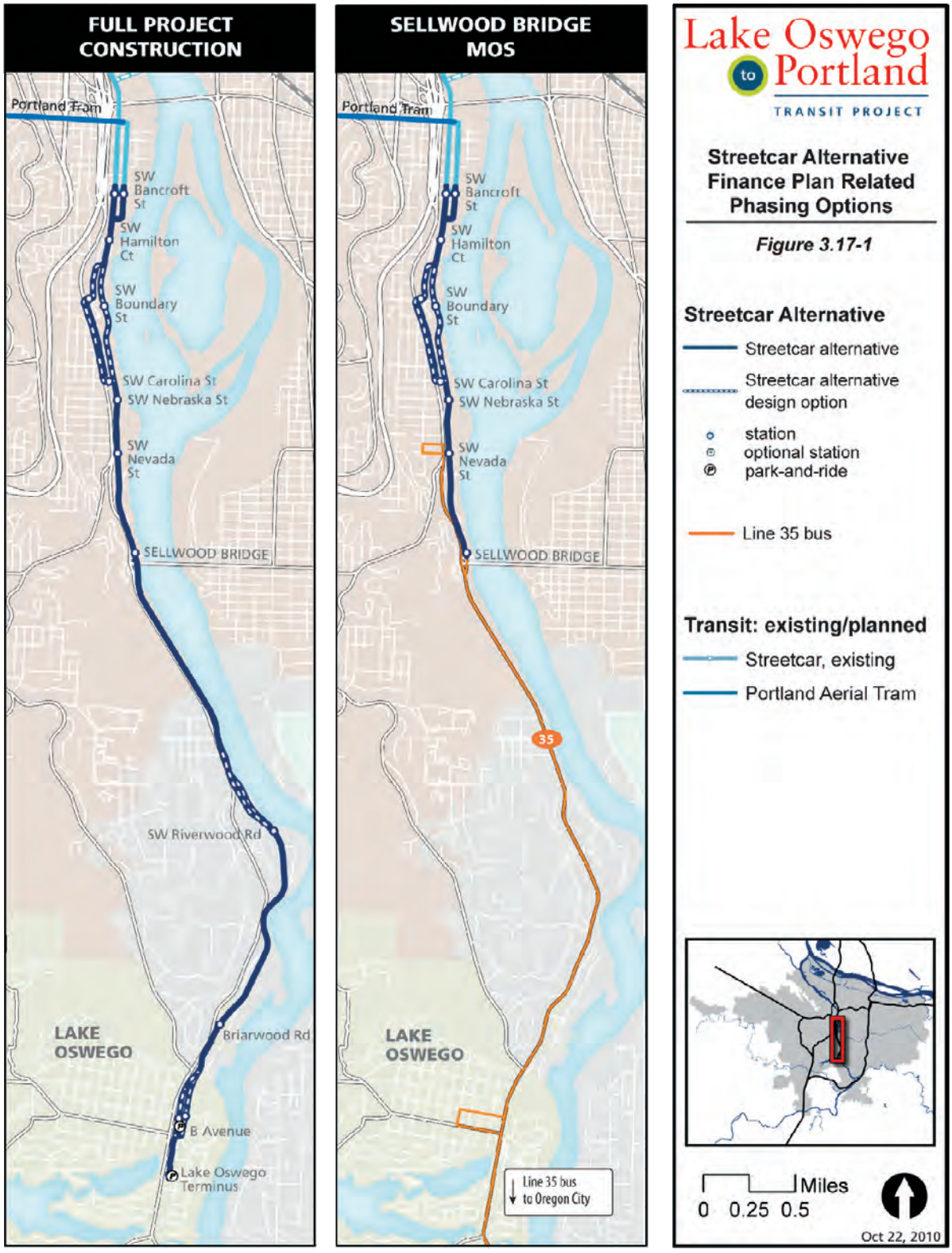

FULL PROJECT CONSTRUCTION
SELLWOOD BRIDGE MOS
Portland Tram
SW Bancroft St
SW Hamilton Ct
SW Boundary St
SW Carolina St
SW Nebraska St
SW Nevada St
SELLWOOD BRIDGE
SW Riverwood Rd
LAKE OSWEGO
Briarwood Rd
B Avenue
Lake Oswego Terminus
35
Line 35 bus to Oregon City
Lake Oswego to Portland
TRANSIT PROJECT
Streetcar Alternative Finance Plan Related Phasing Options
Figure 3.17-1
Streetcar Alternative
Streetcar alternative
Streetcar alternative design option
station
optional station
park-and-ride
Line 35 bus
Transit: existing/planned
Streetcar, existing
Portland Aerial Tram
Miles
0 0.25 0.5
Oct 22, 2010

Table 3.17-1 Summary of Finance Plan Related Phasing Option and External Project Coordination Related Phasing Options

Type / Segment	Phasing Option	Notes
Finance Plan Related Phasing Options		
	✓Full Project Construction	• Base alignment for funding plan
	Sellwood Bridge MOS Construction	• Would address potential cash flow issues • Would result in a phased opening of the project
External Project Coordination Related Phasing Options		
1 – Downtown Portland	None	
2 – South Waterfront	✓South Portal Alignment	• Base alignment • Streetcar would be constructed concurrently with or subsequent to the roadway improvements associated with the South Portal project.
	South Portal Alignment – Streetcar Only	• Streetcar would be constructed in the same location as under the base alignment • Roadway improvements associated with the South Portal project would occur after the streetcar alignment is constructed
	Willamette Shore Line	• Streetcar would initially be constructed in the existing Willamette Shore Line alignment • Roadway improvements as a part of the South Portal project would occur after the streetcar alignment is constructed • The South Portal project would move the streetcar track to the South Portal alignment when the roadway improvements are made
3 – Johns Landing	None	
4 – Sellwood Bridge	✓New Interchange	• Base alignment • Streetcar would be constructed concurrently with or subsequent to the roadway improvements of the Sellwood Bridge project's replacement interchange • Impacts from the New Interchange alignment (compared to the Willamette Shore Line alignment) are addressed in the Sellwood Bridge FEIS
	Willamette Shore Line	• Streetcar project would occur prior to the construction of the new Sellwood Bridge interchange • Streetcar project would use the existing Willamette Shore Line right of way and there would be no streetcar improvements outside of the right of way • Sellwood Bridge project would move the streetcar tracks to the New Interchange alignment when the new interchange is constructed
5 – Riverdale/Dunthorpe	None	
6 – Lake Oswego	✓Foothills Design Option	• Base alignment • Streetcar would be constructed concurrently with or subsequent to the roadway improvements associated with the Foothills development project
	Foothills Design Option – Streetcar Only	• Roadway improvements as a part of the Foothills development project would occur after the streetcar alignment is constructed • Streetcar would be located in the same location as it would be under the base alignment

✓ = base alignment

Bridge would be implemented as a first construction phase. The remaining Streetcar Alternative alignment and related improvements south of the Sellwood Bridge would be made at a later time, but prior to 2035. Under the Sellwood Bridge MOS Construction phasing option there would be 2.2 miles of new streetcar track (4.3 miles of new one-way streetcar track miles) and six new streetcar stations, and there would be 10 Line 35 bus stops on Highway 43 between Lake Oswego and the Nevada Street Station As currently defined for this interim phasing option, Line 35 would operate on Highway 43 between Oregon City and the Nevada Street station, where through passengers would transfer to and from the proposed streetcar line. Other operating plans for the Sellwood Bridge MOS may also be considered if this phasing option becomes a component of the project's final finance plan.

Table 3.17-2 summarizes the facility improvements and transit operating characteristics that would occur under the Streetcar Alternative's finance plan related construction phasing options. Table 3.17-3 summarizes the differences in interim environmental effect on the two finance plan related design options. Ranges in the tables account for design and other phasing options under consideration. Under the Sellwood Bridge MOS, these characteristics and effects would be in place between the date of initial revenue service and the date when the remainder of the Streetcar Alternative would be constructed and opened for revenue service, before 2035. Under the Full Project Construction phasing option, there would be no change in the long-term effects of the project between the initial date of revenue service and 2035, except for those related to the frequency of streetcar service, which would generally be scaled to meet anticipate ridership between the initial revenue service and 2035. The long-term (2035) facilities, transit operating characteristics and environmental effects of the Streetcar Alternative (Full-Project Construction) would be unchanged by either finance plan related phasing option (see chapters 2, 3 and 4 of this DEIS). Should the Streetcar Alternative, with the Sellwood Bridge MOS construction phasing option, be selected as the Locally Preferred Alternative, during PE additional analysis would identify and document the duration of time for the phased construction. Depending on the length of time between phases, additional environmental analysis on the short- and long-term effects associated with shorter alignment and additional opportunity for public review and comment on the analysis may be required. Additional detail on the effects of the two finance plan related phasing options can be found in the discipline-related supporting technical memoranda listed in Appendix B of this DEIS.

Table 3.17-2 Summary Capital and Operating Characteristics of the Streetcar Alternative's Finance Plan Related Construction Phasing Options[1]

Attribute	Full Project Construction	Sellwood Bridge MOS Construction
New Streetcar Track Miles	6	2.2
New Streetcar Stations	10	6
Line 35 Bus Stops North of Lake Oswego	0	10
Corridor Park-and-Ride Lots / Spaces	5 / 476	3 / 76

Source: Metro, TriMet; January 2010.

[1] This table summarizes the transit facility improvements and transit operating characteristics under the Streetcar Alternative's finance plan related construction phasing options as a result of the project's initial construction phase. The long-term (2035) transit facilities and transit operating characteristics of the Streetcar Alternative (see Chapters 2of this DEIS) would be unchanged by either finance plan related phasing option.

[2] Operating costs for the opening year of the alternatives have not been calculated, because opening year travel demand forecasts have not been prepared (see footnote 3 in Table 3.17-2). Operating costs for opening year will be prepared for the Streetcar Alternative, if it is selected as the LPA. Those opening year forecasts and operating costs, which would be documented in the project's FEIS, would be based on the finance plan related phasing option included in the project's final finance plan.

In general, the initial interim effects of the Sellwood Bridge MOS Construction phasing option would be less than those of the Full Project Construction phasing option. For those not related to

travel demand, the effects would generally be reduced in the Dunthorpe/Riverdale and Lake Oswego segments compared to the full project construction, as those segments would be delayed until the full project would be complete. For the effects that would be related to travel demand, the general direction of the effect (e.g., increased, decreased) has been estimated based on an assessment

Table 3.17- 3 Summary Environmental Effects of the Streetcar Alternative's Finance Plan Related Construction Phasing Options[1]

Attribute	Full Project Construction	Sellwood Bridge MOS Construction
Households/Jobs within New Fixed-Guideway Station Areas	12,080 / 24,920	8,329/19,180
P.M. In-Vehicle Transit Travel Time PSU to Lake Oswego	33 or 30	Increased[2]
Annual Systemwide Transit Ridership	Greater than MOS[3]	Less than Full Project[3]
Regional Vehicle Hours of Delay	Greater than MOS[3]	Less than Full Project[3]
New Congested Intersections(compared to No-Build)	2 or 4	0 or 2
Parking Spaces Removed	0 to 175	0 to 175
Construction Jobs Created	1,430 to 1,530	570 to 580
Available Floor Area in New Station Areas (x 1,000 square feet)	42,760 or 42,830	42,760 or 42,830
Potential Displacements	0 to 7	0 to 1
Severe Noise Impacts (without / with potential mitigation)	1 / 0	0/0
Vibration Impacts (without / with potential mitigation)	23 to 28 / 0	23 to 28 / 0
Tons of CO_2 Released by Vehicles	TBD	TBD
Visual	Same as for 2035[4]	Less than Full Project[4]
Historic Resources Adversely Affected	TBD	TBD
Acres of Parkland Used	0.7 or 1.0	0.0
Acres of Wetland Filled	0.09 to 0.11	0.09 to 0.11[5]
Acres of Fill in Floodplain	6.4 to 11.0	3.6 to 8.2
Acres of Net New Impervious Surfaces	3.6 to 8.8	0.4 to 3.1

Source: Metro, TriMet; January 2010. Note: TBD = to be determined.

1 The long-term (2035) environmental effects of the Streetcar Alternative (see chapters 2, 3 and 4 of this DEIS) would be unchanged by either finance plan related phasing option.

2 P.M. peak-period in-vehicle transit travel time from PSU to Lake Oswego would increase under the Sellwood Bridge MOS, compared to the Full Construction Project, due to a slower bus travel time (compared to the streetcar) from the Nevada Street Station to the Lake Oswego Transit Center and due to the transfer from the streetcar to the bus at the Nevada Street Station. Actual travel times would be dependent upon the level of congestion on Highway 43 between the Nevada Street Station and downtown Lake Oswego, which would be used by Line 35, and the level of congestion would be dependent upon the time period that the MOS would be in place.

3 Opening year travel demand forecasts for the project's alternatives have not been prepared. Based on FTA's guidance, opening year forecasts for the LPA would be prepared for the project's finance plan, during Preliminary Engineering. The estimated relative scale of transit ridership and regional vehicle miles of delay is based on an assessment of the travel demand forecasts for the No-Build and Streetcar alternatives for 2035. Systemwide transit ridership compared to the No-Build Alternative would be reduced under the Sellwood Bridge MOS, compared to the Full Construction Project because of decreased fixed-guideway household and employment coverage and generally longer transit travel times in the corridor.

4 Under the Full Project Construction phasing option, visual effects would be the same as described for the Streetcar Alternative in Section 3.4 of this DEIS; under the Sellwood Bridge MOS Construction phasing option, the visual effects of the Streetcar Alternative described in Section 3.4 of this DEIS for the Streetcar Alternative in the Dunthorpe/Riverdale and Lake Oswego segments would be temporarily avoided.

5 There would be a reduction of approximately 0.0025 acres of wetland filled (in the Dunthorpe/Riverdale Segment) under the Sellwood Bridge MOS Construction, which is not reflected in the total due to rounding.

of the 2035 travel demand forecasts for the No-Build and Streetcar alternatives (see Table 3.17-2). Opening year travel demand forecasts for the Streetcar Alternative have not been prepared for this DEIS, but they would be prepared for the project's final finance plan and Final EIS, which would be prepared during Preliminary Engineering, if the Streetcar Alternative is selected as the Locally Preferred Alternative. Because there would be no additional park-and-ride lot spaces in the corridor under the Sellwood Bridge MOS Construction phasing option, there could be more potential transit patrons parking vehicles in the Sellwood Bridge and Johns Landing segments generally near streetcar stations than under the Full Project Construction phasing option, which may warrant the consideration and implementation of one or more interim parking management programs to avoid or minimize and mitigate potential effects. The project's Final EIS would address this issue in more

detail, including consideration of mitigation measures, if appropriate, if the Streetcar Alternative is selected as the Locally Preferred Alternative and if the Sellwood Bridge MOS Construction phasing option is included in the project's final finance plan.

3.17.2 External Project Coordination Related Phasing Options

This section addresses phasing options related to the coordination of the Streetcar Alternative (see Figure 3.17-2), if it is selected as the Locally Preferred Alternative, and other external projects. These phasing options represent interim steps in the construction process that would be taken to implement the Streetcar Alternative, in response to external projects as further explained below.

Following is a summary of how the direct impacts of the Streetcar Alternative would be temporarily affected by external project coordination related phasing options in the South Waterfront, Sellwood Bridge and Lake Oswego segments. The project's technical memoranda for the various environmental disciplines listed in Appendix B of this DEIS provide more detail on the changes to the direct environmental effects of the Streetcar Alternative due to the phasing options in the South Waterfront and Sellwood Bridge Segments. Chapters 3, 4, 5 and 6 of this DEIS summarize the changes to the changes to the direct environmental effects of the Streetcar Alternative due to the design options in the Lake Oswego segments.

3.17.2.1 South Waterfront Segment

This section addresses construction phasing options for the South Waterfront Segment, which would be affected by the status of the City of Portland's planned and programmed South Portal roadway improvements (see Section 2.2.1.1). These phasing options represent potential scenarios of how the project would be constructed dependent on how external conditions transpire with South Portal roadway improvement project. As such, the phasing options for the South Waterfront Segment do not constitute choices that would be made by the project, as much as response to external circumstances.

If the South Portal roadway improvements were made before, or concurrently with, construction of the Streetcar Alternative, the streetcar would operate on the Southwest Moody and Bond avenues couplet. If the South Portal roadway improvements are not in place or would not be constructed concurrently with the Streetcar Alternative, there would be two interim phasing options, as shown in Figure 3.17-2 for proceeding with construction of the streetcar alignment in the South Waterfront Segment: 1) the streetcar alignment and its required infrastructure improvements would be constructed, consistent with the alignment under the Full Project Construction phasing option (Moody/Bond couplet), but other non-project roadway improvements would be constructed at a later date by others; or 2) a different streetcar alignment using the Willamette Shore Line right of way would be initially constructed, until the South Portal improvements are constructed. If the Willamette Shore Line right of way were to be used, then when the South Portal roadway improvements were made, the streetcar alignment would be reconstructed consistent with the alignment described in Section 2.2.2 (i.e., within the right of way of the new Southwest Bond and Moody avenues, between Bancroft and Bond streets). The transit operating characteristics of the Streetcar Alternative would not be affected by the South Portal phasing options. Either phasing scenario or option could be implemented as Streetcar Alternative's initial construction phase described in Section 3.17.1.

During the interim period under the first phasing option, the Streetcar Alternative would be located in the Willamette Shore Line right of way and there would be a temporary change in some of the direct environmental effects of the Streetcar Alternative, until the South Portal roadway improvements were completed. The streetcar alignment would be changed at a later date to be consistent with the design of the Full Project Construction phasing option, concurrent with construction of the South Portal roadway project.

As shown in Table 3.17-4, phasing options in the South Waterfront Segment would not change the basic characteristics of the Streetcar Alternative (Moody/Bond Couplet); for example, the number of new streetcar stations and one-way track miles would remain unchanged, compared to the Full Project Construction option. Further, the direct effects of the Streetcar Alternative would remain unchanged under phasing options (compared to the Full Project Construction phasing option), except that there would be a 0.3-acre increase in fill within the 100-year floodplain.

Table 3.17-4 Summary Characteristics of the South Portal Construction Phasing Options for the Streetcar Alternative

	Moody/Bond Couplet[1]	Willamette Shore Line	Interim Moody/Bond Couplet[2]
New Streetcar Alignment Length (miles)	5.9 to 6.0	5.9 to 6.0	5.9 to 6.0
New One-Way Track Miles	10.5 to 11.3	10.5 to 11.3	10.5 to 11.3
New Streetcar Stations	10	10	10
Line 35 Bus Stops North of Lake Oswego	0	0	0
Corridor Park-and-Ride Lots / Spaces	5 / 476	5 / 476	5 / 476
P.M. In-Vehicle Transit Travel Time PSU to Lake Oswego	33 or 30	33 or 30	33 or 30
Transit Ridership (compared to No-Build)	6,700 or 7,000	6,700 or 7,000	6,700 or 7,000
New Congested Intersections(compared to No-Build)	2 or 4	2 or 4	2 or 4
Net Parking Spaces Removed	0 to 175	0 to 175	0 to 175
Potential Displacements	0 to 7	0 to 7	1 to 8
Severe Noise Impacts (without / with potential mitigation)	5/0	5/0	5/0
Vibration Impacts (without / with potential mitigation)	39 to 46 / 0	39 to 46 / 0	39 to 46 / 0
Visual[3]	low to moderate	low to moderate	low to moderate
Historic Resources Adversely Affected	TBD[4]	TBD[4]	TBD[4]
Acres of Parkland Used	0.7 to 1.0	0.7 to 1.0	0.7 to 1.0
Acres of Wetland Filled	0.10 to 0.12	0..10 to 0.12	0.10 to 0.12
Acres of Fill in Floodplain	6.4 to 10.1	6.7 to 10.4	6.4 to 10.1
Acres of New Impervious Surfaces	7.35 to 18.27	4.92 to 15.84	7.35 to 18.27

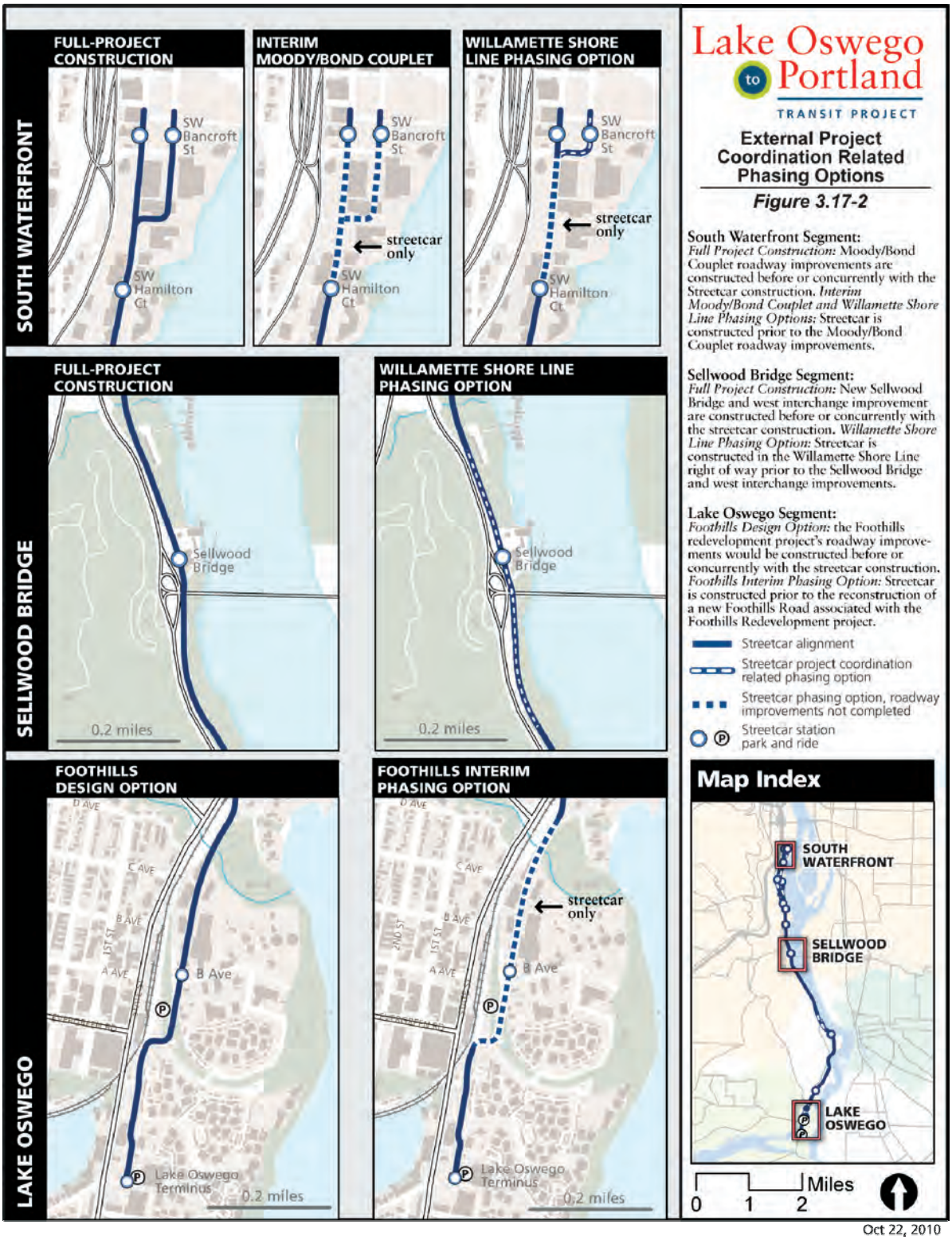
Source: Metro, TriMet; January 2010.

1 Based on the Moody/Bond Couplet alignment in the South Waterfront Segment as described for the Streetcar Alternative throughout this DEIS.

2 The streetcar alignment and stations would be in the same location in the South Waterfront Segment under the Interim Moody/Bond Couplet as under the Moody/Bond Couplet phasing option, except that the roadway improvements that would be associated with the South Portal roadway project would not be in place and would be constructed by others at a later date.

3 The initial interim effects of the Streetcar Alternative's in the South Waterfront Segment would vary by phasing options. Under the Moody/Bond Couplet phasing option, the alternative's visual effects would be those described for the South Waterfront Segment in Section 3.4 of this DEIS. Under the Willamette Shore Line interim phasing option, the visual effects that would occur on SW Moody and Bond streets due to the introduction of Streetcar facilities would occur within the vicinity of the Willamette Shore Line Right-of-Way. The Streetcar facilities and resulting visual effects under the Interim Moody/Bond Couplet phasing option would be the same as under the Moody/Bound Couplet phasing option, but initially there would be no roadway improvements.

4 To Be Determined (TBD). Based on the project's current conceptual engineering (approximately 8 percent design), the Streetcar Alternative could result in an effect or an adverse effect on the Red Electric Rail Line.


SOUTH WATERFRONT
FULL-PROJECT CONSTRUCTION
INTERIM MOODY/BOND COUPLET
WILLAMETTE SHORE LINE PHASING OPTION
SW Bancroft St
SW Hamilton Ct
streetcar only
SELLWOOD BRIDGE
FULL-PROJECT CONSTRUCTION
WILLAMETTE SHORE LINE PHASING OPTION
Sellwood Bridge
0.2 miles
LAKE OSWEGO
FOOTHILLS DESIGN OPTION
FOOTHILLS INTERIM PHASING OPTION
D AVE
C AVE
B AVE
A AVE
1ST ST
2ND ST
B Ave
Lake Oswego Terminus
0.2 miles
Lake Oswego to Portland
TRANSIT PROJECT
External Project Coordination Related Phasing Options
Figure 3.17-2
South Waterfront Segment:
Full Project Construction: Moody/Bond Couplet roadway improvements are constructed before or concurrently with the Streetcar construction. Interim Moody/Bond Couplet and Willamette Shore Line Phasing Options: Streetcar is constructed prior to the Moody/Bond Couplet roadway improvements.
Sellwood Bridge Segment:
Full Project Construction: New Sellwood Bridge and west interchange improvement are constructed before or concurrently with the streetcar construction. Willamette Shore Line Phasing Option: Streetcar is constructed in the Willamette Shore Line right of way prior to the Sellwood Bridge and west interchange improvements.
Lake Oswego Segment:
Foothills Design Option: the Foothills redevelopment project's roadway improvements would be constructed before or concurrently with the streetcar construction.
Foothills Interim Phasing Option: Streetcar is constructed prior to the reconstruction of a new Foothills Road associated with the Foothills Redevelopment project.
Streetcar alignment
Streetcar project coordination related phasing option
Streetcar phasing option, roadway improvements not completed
Streetcar station park and ride
Map Index
SOUTH WATERFRONT
SELLWOOD BRIDGE
LAKE OSWEGO
Miles
0 1 2
Oct 22, 2010

3.17.2.1 Sellwood Bridge Segment

The Sellwood Bridge Segment includes two potential phasing options for the Streetcar Alternative (see Figure 3.17-2). The phasing options reflect two scenarios for construction of the project in relationship to the construction of a proposed new interchange for the Sellwood Bridge replacement project. Because the two phasing options in this segment are dependent upon how construction of the Sellwood Bridge replacement project progresses, they do not constitute a choice of alignments for the Lake Oswego to Portland Transit Project; instead, they represent two construction phasing scenarios, dependent upon how external conditions transpire. In effect, the Sellwood Bridge replacement project would displace the Willamette Shore Line right of way and the effects of that displacement are addressed within the Sellwood Bridge replacement project's environmental documentation (see the Sellwood Bridge Final Environmental Impact Statement (FEIS), at www.sellwoodbridge.org). Following is a summary of the two phasing options for the Streetcar Alternative in the Sellwood Bridge Segment.

New Interchange Phasing Option. If the new interchange is constructed prior to or concurrently with the Streetcar Alternative, the initial and long-term streetcar alignment (considered the Full Construction Project) would be based on the Sellwood Bridge new west interchange as described in Chapters 2, 3, 4, 5 and 6 of this DEIS. The streetcar alignment under New Interchange phasing option could not be constructed prior to the Sellwood Bridge replacement project's reconstruction of the interchange, because of existing roadway facilities within that alignment that need to be maintained until the interchange is replaced.

Willamette Shore Line Phasing Option. If the proposed Sellwood Bridge's western interchange is constructed after the Streetcar Alternative, then the initial streetcar alignment to be constructed would be on the Willamette Shore Line. Under the Willamette Shore Line phasing option for the Sellwood Bridge Segment, when the proposed interchange is constructed, the Sellwood Bridge replacement project would relocate the streetcar alignment to the New Interchange alignment. Therefore, the long-term streetcar alignment would be the New Interchange phasing option, and the Willamette Shore Line phasing option would only be implemented as an interim alignment. Streetcar service under the Willamette Shore Line phasing option could be disrupted for an undetermined period of time while the streetcar alignment is moved from the Willamette Shore Line right of way to the new streetcar right of way, depending on the Sellwood Bridge replacement project's construction plan and final design of the new west interchange.

Neither of the phasing options would change the long-term effects of the Streetcar Alternative in the Sellwood Bridge Segment; those long-term effects of the Streetcar Alternative are represented by the New Interchange alignment. The two phasing options would only change the initial interim environmental effects of the Streetcar Alternative in the Sellwood Bridge Segment: 1) if the New Interchange phasing option unfolds, then the interim and long-term environmental effects of the Streetcar Alternative would be the same in this segment; and 2) if the Willamette Shore Line phasing option unfolds, then the effects associated with Willamette Shore Line phasing option would occur between the initial opening of the streetcar project and the time the Sellwood Bridge replacement project constructs the new roadway interchange and moves the Streetcar alignment from the Willamette Shore Line right of way to the New Interchange alignment.

As shown in Table 3.17-5, phasing in the Sellwood Bridge Segment would not change the basic characteristics of the Streetcar Alternative – for example, the number of new streetcar stations and one-way track miles would remain unchanged, compared to the Full Project Construction option.

Further, the direct effects of the Streetcar Alternative would remain unchanged under the phasing to accommodate the Sellwood Bridge reconstruction (compared to the Full Project Construction phasing option), except 0.01 acres increase in wetland fill, 0.1 decrease in fill in the floodplain and 0.05 increase in new impervious surfaces.

Table 3.17-5 Summary Characteristics of the Sellwood Bridge Construction Phasing Options for the Streetcar Alternative

Attribute	New Interchange[1]	Willamette Shore Line
New Streetcar Alignment Length (miles)	5.9 to 6.0	5.9 to 6.0
New One-Way Track Miles	10.5 to 11.3	10.5 to 11.3
New Streetcar Stations	10	10
Line 35 Bus Stops North of Lake Oswego	0	0
Corridor Park-and-Ride Lots / Spaces	5 / 476	5 / 476
P.M. In-Vehicle Transit Travel Time PSU to Lake Oswego	33 or 30	33 or 30
Transit Ridership (compared to No-Build)	6,700 or 7,000	6,700 or 7,000
New Congested Intersections(compared to No-Build)	2 or 4	2 or 4
Net Parking Spaces Removed	0 to 175	0 to 175
Potential Displacements	0 to 7	0 to 7
Severe Noise Impacts (without / with potential mitigation)	5/0	5/0
Vibration Impacts (without / with potential mitigation)	39 to 46 / 0	39 to 46 / 0
Visual[2]	Low to Moderate	Low to Moderate
Historic Resources Adversely Affected	TBD[3]	TBD[3]
Acres of Parkland Used[4]	0.7 to 1.0	0.7 to 1.0
Acres of Wetland Filled[5]	0.10 to 0.11	0.11 to 0.12
Acres of Fill in Floodplain[6]	6.5 to 10.1	6.4 to 10
Acres of New Impervious Surfaces[7]	4.92 to 18.22	4.97 to 18.27

Source: Metro, TriMet; January 2010.

1 Based on the New Interchange alignment in the Sellwood Bridge Segment as described for the Streetcar Alternative throughout this DEIS.

2 The initial interim effects of the Streetcar Alternative's in the Sellwood Bridge Segment would not vary by phasing options. Under the New Interchange and Willamette Shore Line phasing options, the alternative's visual effects would be those described for the Sellwood Bridge Segment in Section 3.4 of this DEIS. Under the Willamette Shore Line interim phasing option, the visual effects that would occur within the vicinity of the Willamette Shore Line right of way without roadway improvements associated with the Sellwood Bridge project.

3 To Be Determined (TBD). Based on the project's current conceptual engineering (approximately 8 percent design), the Streetcar Alternative could result in an effect or an adverse effect on the Red Electric Rail Line.

4 In order for the Sellwood Bridge replacement project's interchange to be constructed, the streetcar alignment could not use the current Willamette Shore Line right of way. Because the Sellwood Bridge project would, in effect, displace the streetcar alignment from the Willamette Shore Line right of way, the impacts associated with a change in the streetcar alignment are addressed within the Sellwood Bridge replacement project's EIS. The design of the streetcar alignment is being coordinated with the Sellwood Bridge replacement project. The Sellwood Bridge Project also discloses impacts to Powers Marine Park and the Willamette Moorage Park. The LOPT project would not add to those impacts. See Sellwood Bridge DEIS, at http://www.sellwoodbridge.org.

5 There is a difference in wetland impacts associate with the two Sellwood Bridge phasing options. The New Interchange phasing option would include 0.02 acre of wetland impacts, while the Willamette Shore Line would include 0.03 acres of wetland impacts

6 There is a difference in acres of fill in the floodplain with the two Sellwood Bridge phasing options. The new interchange phasing option would include 4.4 acres of fill in the floodplain and the Willamette Shore Line would include 4.3 acres of fill in the floodplain.

7 There is a difference in acres of new impervious surfaces with the two Sellwood Bridge phasing options. The new interchange phasing option would 0.00 acres of new impervious surfaces and the Willamette Shore Line would include 0.05 acres of new impervious surface.

3.17.2.3 Lake Oswego Segment

The Lake Oswego Segment has two design options Streetcar Alternative that represent choices for the project, as well as two potential phasing options for one of those design options.

The two Streetcar Alternative design options in the Lake Oswego Segment are: 1) the Foothills design option; and 2) the Union Pacific Railroad Right of Way design option. The effects of the

Foothills and Union Pacific Railroad design options are summarized in Chapters 2, 3, 4 and 5 of this DEIS; see Figure 2.2-5 for an illustration of the streetcar alignment under both design options.

There are no construction phasing options for the Streetcar Alternative in the Lake Oswego Segment under the Union Pacific Railroad design option. The Foothills design option includes two potential construction scenarios that are dependent upon the Foothills redevelopment project. How the Foothills design option would be constructed would be dependent upon the construction schedule for Foothills redevelopment project, which is currently not certain. The Foothills redevelopment project includes proposed property development/redevelopment and infrastructure improvements, which includes proposed new and redesigned roadways. Some of the planned roadway improvements would be designed and constructed in coordination with the Lake Oswego to Portland Transit Project, if the Streetcar Alternative is selected as the Locally Preferred Alternative.

With the Foothills design/phasing option, the Foothills redevelopment project's roadway improvements would be constructed before or concurrently with the Foothills design option. If so, then the interim effects of the Streetcar Alternative (i.e., from the project's opening year) and long-term environmental effects of the Streetcar Alternative would be identical. Alternately, if the Foothills redevelopment project's roadway improvements are not constructed prior to or concurrently with construction of the streetcar alignment, then the Lake Oswego to Portland Transit Project would construct the streetcar alignment and required infrastructure improvements using the same alignment as under the Foothills design option (see Figure 2.2-5), but the roadway improvements would be added at a later date by others. In the interim, when the Streetcar Alternative would be initially constructed and open for service, there would be no environmental effects of the Foothills redevelopment project's proposed roadway improvements. The environmental effects of the subsequent roadway improvements would occur only when the roadway improvements are made by others. There would be no change in the long-term effects of the Streetcar Alternative and the Foothills design option whether the roadway improvements are made before, concurrently with or after construction of the streetcar improvements. The long-term environmental effects of the Foothills design option are summarized in chapters 2, 3, 4 and 5 of this DEIS.

3.18 Environmental Justice, Elderly and Disabled Populations

This section summarizes the potential effects of the proposed alternatives and options on minority, low-income, elderly and/or disabled populations. These populations are protected through regulations to ensure that issues of concern to these populations are considered in the project development process and that disproportionately high impacts to minority and low-income populations do not occur. Outreach efforts specifically target these groups to facilitate involvement of protected populations. Additional information on the assessment of impacts to environmental justice, elderly and disabled populations is included in the *Lake Oswego to Portland Transit Project Community Impact Assessment Technical Report* (URS and TriMet/Metro, November 2010).

3.18.1 Affected Environment

3.18.1.1 Minority and Low-Income Populations

Executive Order 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations forms the basis for environmental justice policies in the United States. It requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies and activities on minority[101] and low-income[102] populations. USDOT Order 5610.2 (*Order to Address Environmental Justice in Minority Populations and Low-Income Populations*) implements the Executive Order for federally-funded transportation projects.

The Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) work with their state and local transportation partners to ensure that the principles of environmental justice are integrated into their transportation projects. These principles are to:

- Ensure the full and fair participation by all potential affected communities in the transportation decision-making process;
- Avoid, mitigate, or minimize disproportionally high and adverse human health and environmental impacts, including social and economic impacts, on minority and low-income populations; and
- Prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority and low-income populations.

The analysis units for this project's environmental justice evaluation are the neighborhoods that are located fully or predominantly within the project corridor and the unincorporated areas of Clackamas and Multnomah counties that are located between Portland and Lake Oswego in the project area (which encompasses the suburban communities known as Dunthorpe or Riverdale). These neighborhoods and unincorporated areas are illustrated in Figure 3.3-1 in Section 3.3 Neighborhoods, Displacements and Relocations.

The data in Table 3.18-1 show that minority and low-income populations exist within neighborhoods in the project area. This table identifies which U.S. Census Bureau tracts (according to Census 2000)

[101] A person is considered minority if he or she is Hispanic, Latino, black or African American, American Indian, Alaska Native, Asian, Native Hawaiian/Pacific Islander, or of mixed-race.
[102] Low income is defined as populations that are at or below the federal poverty level.

had a higher percentage of minority and/or low-income populations than the tri-county region[103] for that demographic characteristic.

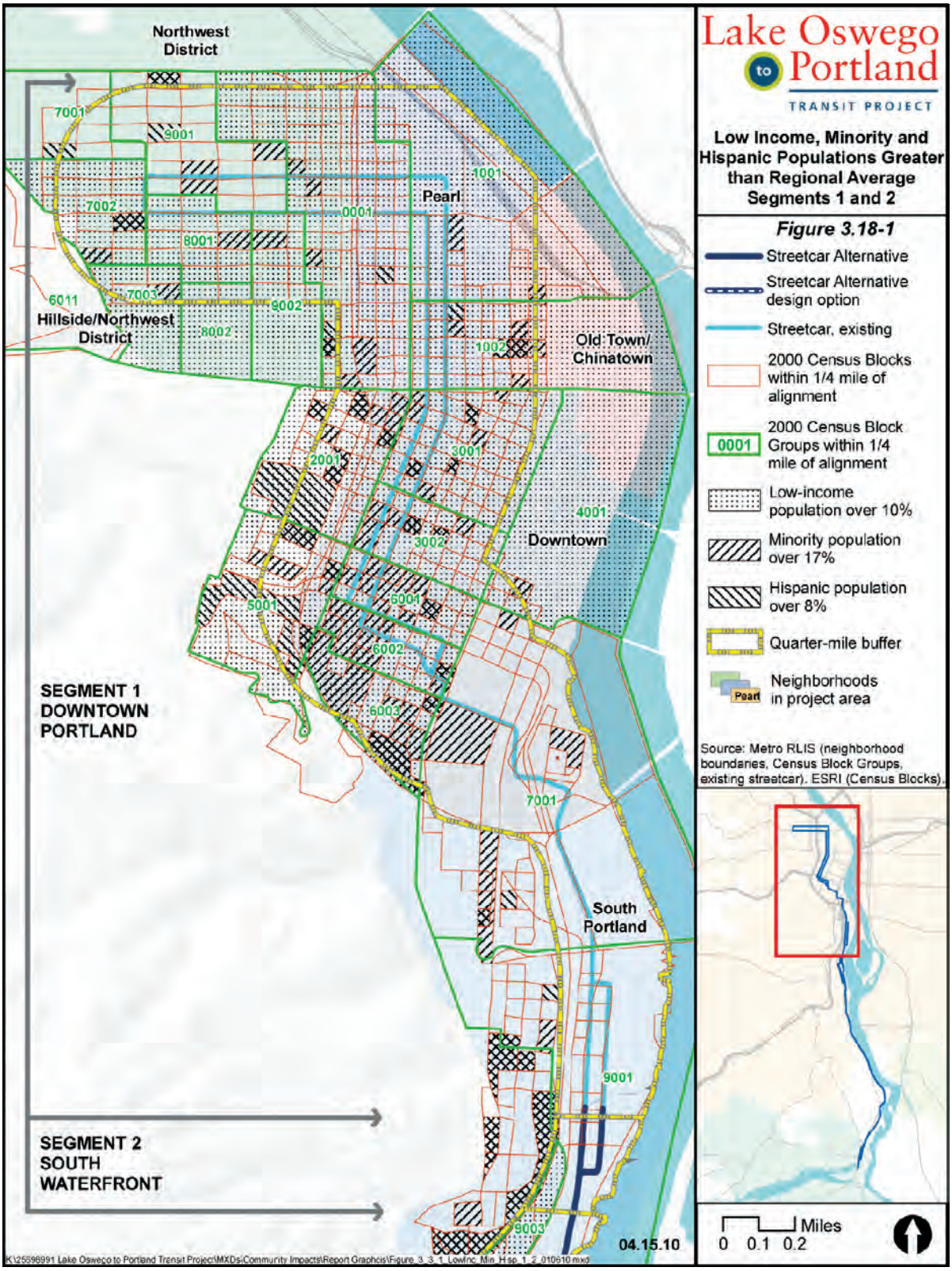
Table 3.18-1 Demographic Characteristics in the Project Area (2000)[1]

Jurisdiction Neighborhood[2]	Persons	Households	Residents over 65	Renter Occupied	Disabled	Below Poverty	Minority[3]
City of Portland							
Northwest District	10,309	4,388	**13%**	37%	12%	10%	10%
Pearl District	1,702	858	**33%**	**56%**	9%	9%	9%
Old-Town/Chinatown	603	284	**12%**	**41%**	9%	**12%**	14%
Downtown	7,653	4,987	**11%**	**80%**	12%	**16%**	13%
South Portland	6,877	4,390	10%	**88%**	13%	**31%**	**22%**
South Burlingame	1,829	1,065	**12%**	**62%**	12%	**17%**	14%
Collins View	726	407	9%	**49%**	10%	**11%**	11%
Unincorporated Multnomah County							
Dunthorpe/Riverdale	1,025	592	**11%**	11%	11%	8%	10%
Unincorporated Clackamas County							
Birdshill[4]	213	97	**11%**	13%	14%	2%	11%
City of Lake Oswego							
Birdshill	21	9	**11%**	13%	14%	2%	11%
First Addition	2,879	1,004	10%	21%	9%	6%	11%
Foothills	413	171	**11%**	11%	10%	4%	9%
Old Town	186	76	**11%**	10%	10%	4%	9%
Evergreen	795	357	7%	24%	8%	**11%**	11%
Lakewood	424	174	**11%**	10%	10%	4%	9%
Tri-County Region[5]	*1,444,219*	*569,461*	*10%*	*39%*	*17%*	*10%*	*17%*

Source: U.S. Census Bureau. *Census 2000*, Summary File 1 and Summary File 3.
[1] **Bold** percentages indicate that that Census tract had a percentage greater than the Tri-County Region for that demographic characteristic.
[2] See the *Community Impacts Technical Report* for a description of the method used to define the neighborhood boundaries relative to Census block group boundaries for this analysis.
[3] See Table 3.3-2 for additional detail by minority group. The total of minority groups shown in Table 3.3-2 does not equal the minority data in this table because individuals may be members of two or more minority groups.
[4] The Birdshill neighborhood encompasses portions of the City of Lake Oswego and portions of unincorporated Clackamas County.
[5] The Tri-County Region includes all of Multnomah, Clackamas, and Washington counties.

According to Census 2000, a higher than average percentage of low-income persons resides in the Old Town/Chinatown, downtown Portland, South Portland, South Burlingame, Collins View and Evergreen neighborhoods. The highest percent of low-income persons reside in the South Portland neighborhood. Higher percentages of minorities reside in the South Portland neighborhood. Figures 3.18-1, 3.18-2 and 3.18-3 depict locations of higher percentages of environmental justice populations in the Lake Oswego to Portland Transit Project area for the census blocks and block groups within one-quarter mile of the project alignment.

[103] The tri-county region includes Multnomah, Clackamas and Washington counties.


Northwest District
Pearl
Old Town/ Chinatown
Hillside/Northwest District
Downtown
South Portland
SEGMENT 1 DOWNTOWN PORTLAND
SEGMENT 2 SOUTH WATERFRONT
7001
9001
1001
7002
0001
8001
7003
9002
6011
8002
1002
2001
3001
4001
3002
5001
6001
6002
6003
9003
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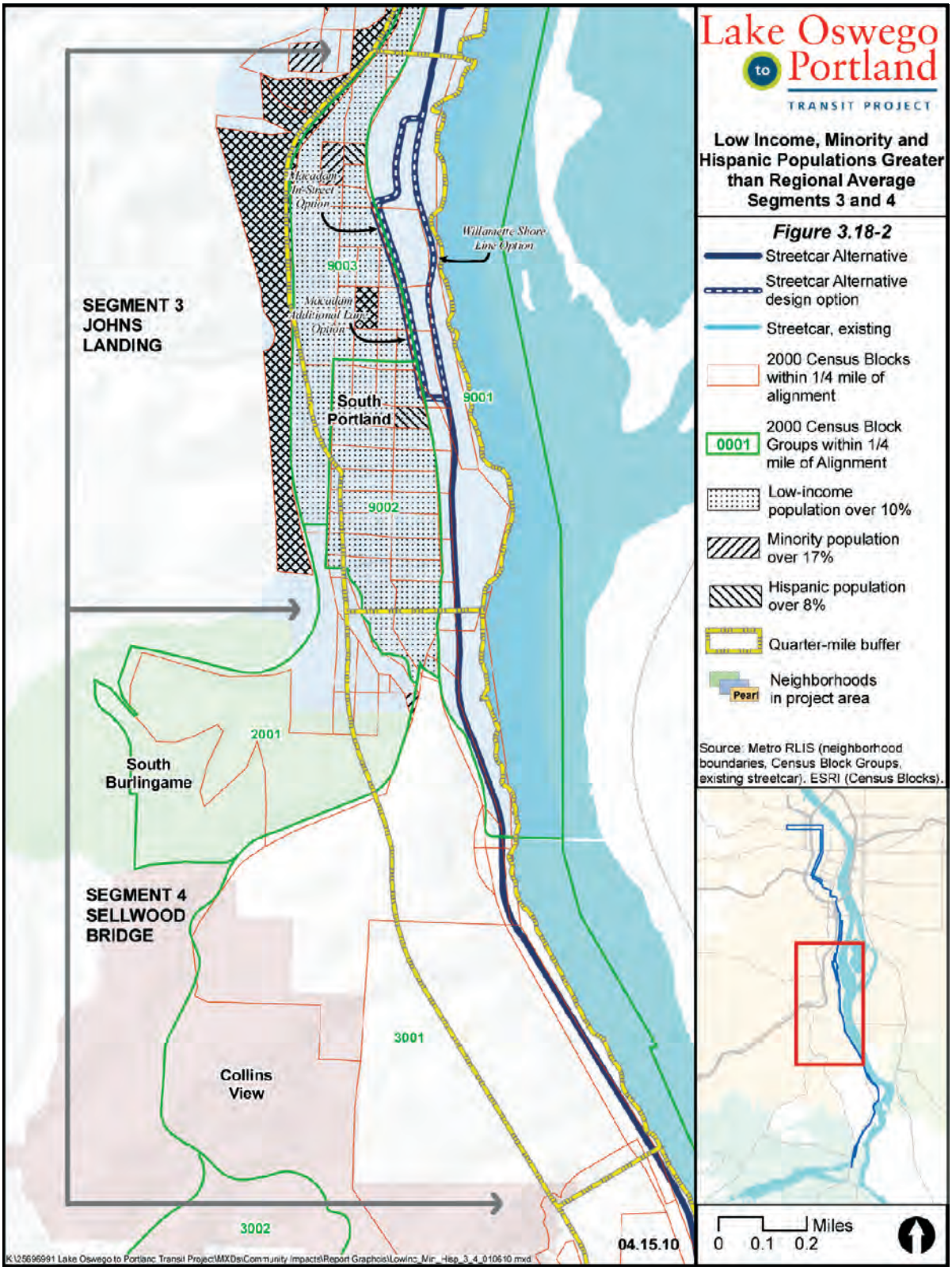
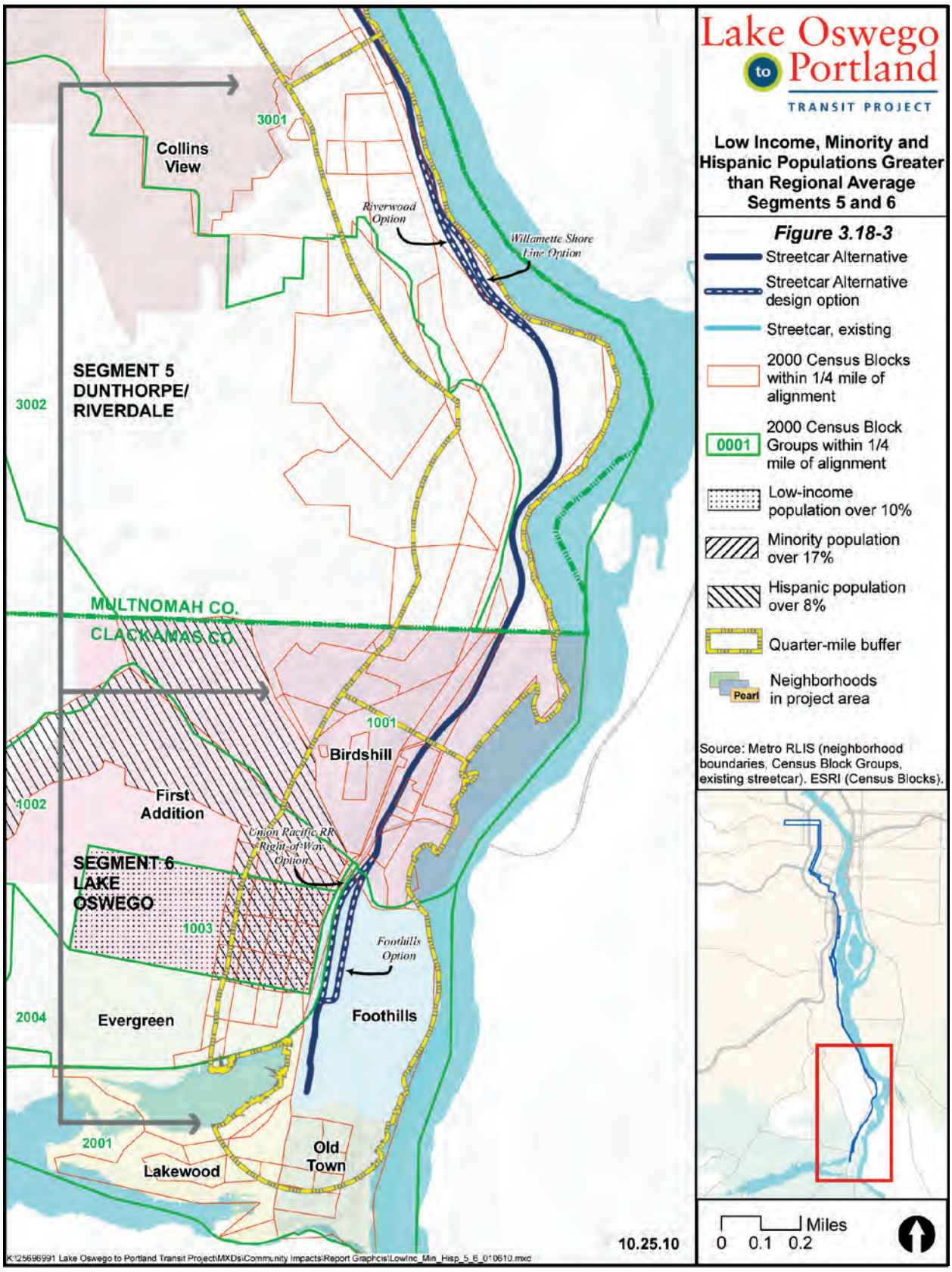
Lake Oswego to Portland
TRANSIT PROJECT
Low Income, Minority and Hispanic Populations Greater than Regional Average Segments 1 and 2
Figure 3.18-1
Streetcar Alternative
Streetcar Alternative design option
Streetcar, existing
2000 Census Blocks within 1/4 mile of alignment
0001 2000 Census Block Groups within 1/4 mile of alignment
Low-income population over 10%
Minority population over 17%
Hispanic population over 8%
Quarter-mile buffer
Pearl Neighborhoods in project area
Source: Metro RLIS (neighborhood boundaries, Census Block Groups, existing streetcar). ESRI (Census Blocks).
Miles
0 0.1 0.2


Lake Oswego to Portland
TRANSIT PROJECT
Low Income, Minority and Hispanic Populations Greater than Regional Average Segments 3 and 4
Figure 3.18-2
Streetcar Alternative
Streetcar Alternative design option
Streetcar, existing
2000 Census Blocks within 1/4 mile of alignment
0001 2000 Census Block Groups within 1/4 mile of Alignment
Low-income population over 10%
Minority population over 17%
Hispanic population over 8%
Quarter-mile buffer
Pearl Neighborhoods in project area
Source: Metro RLIS (neighborhood boundaries, Census Block Groups, existing streetcar), ESRI (Census Blocks).
SEGMENT 3 JOHNS LANDING
SEGMENT 4 SELLWOOD BRIDGE
South Portland
South Burlingame
Collins View
Macadam Int-Street Option
Macadam Additional Lane Option
Willamette Shore Line Option
9003
9001
9002
2001
3001
3002
Miles
0 0.1 0.2
04.15.10


Lake Oswego to Portland
TRANSIT PROJECT
Low Income, Minority and Hispanic Populations Greater than Regional Average Segments 5 and 6
Figure 3.18-3
Streetcar Alternative
Streetcar Alternative design option
Streetcar, existing
2000 Census Blocks within 1/4 mile of alignment
0001
2000 Census Block Groups within 1/4 mile of alignment
Low-income population over 10%
Minority population over 17%
Hispanic population over 8%
Quarter-mile buffer
Pearl
Neighborhoods in project area
Source: Metro RLIS (neighborhood boundaries, Census Block Groups, existing streetcar). ESRI (Census Blocks).
Miles
0 0.1 0.2
Collins View
3001
Riverwood Option
Willamette Shore Line Option
SEGMENT 5 DUNTHORPE/ RIVERDALE
3002
MULTNOMAH CO.
CLACKAMAS CO.
1001
Birdshill
1002
First Addition
Union Pacific RR Right-of-Way Option
SEGMENT 6 LAKE OSWEGO
1003
Foothills Option
2004
Evergreen
Foothills
2001
Lakewood
Old Town
10.25.10
K:\25696991 Lake Oswego to Portland Transit Project\MXDs\Community Impacts\Report Graphics\LowInc_Min_Hisp_5_6_010610.mxd

3.18.3.1 Elderly and/or Disabled Populations

Although federal regulations do not provide for separate consideration of elderly and disabled populations, these populations are protected by Title VI of the Civil Rights Act of 1964 and related nondiscrimination statutes. The Americans with Disabilities Act (ADA) requires that transportation facilities accommodate the disabled, including those with mobility or vision impairments. A larger elderly and/or disabled population can indicate a population with special transportation needs. Many may not be able to walk as well or as far as younger people, and many no longer drive; therefore, they can often be more dependent on transit. A larger elderly population can also signify a lower-income community because many retirees are on fixed, lower incomes.

A higher than average percentage of persons over 65 reside in the majority of neighborhoods within this corridor, including Northwest District, Pearl District, Old Town/Chinatown, downtown Portland, South Burlingame, Dunthorpe/Riverdale, Birdshill, Foothills, Old Town and Lakewood. None of the neighborhoods in the project area contain a higher than average percentage of disabled persons.

3.18.2 Public Outreach to Low Income and Minority Populations

The project team has conducted targeted public outreach activities to protected populations in the project area in order to help identify and address their issues of concern. Outreach specific to these populations included:

- Direct mailing to residents in the corridor area that would specifically reach low-income persons;
- Holding all public meetings and events in ADA-accessible buildings and areas;
- Including a representative of persons over 65 on the project's Community Advisory Committee (there are nine persons representing this age group on the committee).

Outreach efforts will continue to ensure that development of this project is sensitive to the needs of minority, low-income, elderly and disabled populations. Continued outreach activities may include the following:

- Project team attendance at regularly scheduled neighborhood association meetings, particularly in the Old Town/Chinatown, downtown Portland, South Portland, South Burlingame, Collins View, and Evergreen neighborhoods;
- Door-to-door canvassing;
- Tabling at grocery stores and community events;
- Radio interviews on Spanish-speaking and English-speaking radio stations;
- Provision of information in newsletters targeted to people over the age of 65, such as the Lake Oswego Adult Community Center and Elders in Action newsletters; and
- Meetings at the Lake Oswego Adult Community Center to share information about how to participate in the DEIS process.

3.18.3 Environmental Consequences

Section 3.3.2 addresses the environmental consequences that the project's alternatives and design options would have on communities and neighborhoods. These effects are addressed below as they apply to environmental justice, elderly and disabled populations.

3.18.3.1 Direct Impacts to Environmental Justice Populations

No-Build Alternative. There would be no changes to existing conditions; there are therefore no direct disproportionate impacts to minority and low-income populations from the No-Build Alternative.

Enhanced Bus Alternative. The following summarizes the impacts to environmental justice populations anticipated with the Enhanced Bus Alternative.

- *Neighborhood Cohesion.* The Enhanced Bus Alternative is not expected to result in a major change to neighborhood cohesion, except for a moderate visual change in Segment 6 due to the construction of the new park-and-ride lot. This visual change would affect one small area and would not disproportionately impact minority and/or low-income populations.

- *Neighborhood Quality of Life.* The Enhanced Bus Alternative would not negatively affect the quality of life in neighborhoods in the project corridor. Therefore, the Enhanced Bus Alternative would not result in a disproportionate burden to minority or low-income populations.

- *Neighborhood Mobility.* The Enhanced Bus Alternative would improve transit travel times to most of the project area. This impact would provide a benefit to minority and low-income populations as well as other demographics throughout the area. However, the Enhanced Bus Alternative would reduce access to transit in Segments 3, 5 and 6. Because the stops would still be located within one-quarter mile of each other, access to transit would still be considered good. In addition, while this impact would affect low-income and minority residents, the impact would be no greater than for other populations. Thus, this alternative would not result in a disproportionate impact to environmental justice populations.

- *Property Acquisitions and Displacements.* The Enhanced Bus Alternative would result in eight property acquisitions of commercial and multifamily residential properties in Segment 6. However, these properties are located in an area where there is not a significant concentration of minority or low-income populations. Therefore, the Enhanced Bus Alternative would not result in a disproportionate impact to environmental justice populations.

Streetcar Alternative. The following summarizes the impacts to environmental justice populations anticipated with the Streetcar Alternative.

- *Neighborhood Cohesion.* The Streetcar Alternative could have an effect on neighborhood cohesion in Segments 3, 5 and 6. Consistent with adopted land use plans in the study area, existing land uses in Segment 3 would be expected to change. These changes could impact all demographics but not necessarily cause a disproportionate adverse impact to minority or low-income residents. The change to neighborhood cohesion in Segment 6 resulting from visual changes in the corridor. Changes to neighborhood cohesion in Segments 5 and 6 could occur from moderate to high visual changes associated with the Streetcar Alternative (e.g., the addition of streetcar tracks, electrical lines, and park-and-ride lots). The visual changes are not likely to disproportionately result in adverse effects to minority and low-income populations in the

Evergreen neighborhood (Segment 6), because although that population exists within the neighborhood, it is not immediately adjacent to the proposed improvements.[104]

- *Neighborhood Quality of Life.* The Streetcar Alternative would result in effects to neighborhood quality of life based on anticipated moderate noise impacts in Segments 3, 4 and 5. The noise impacts in Segment 3 have the potential to affect low-income persons in the South Portland neighborhood (Segment 3) because of the high percentage of low-income population in that area. However, it is anticipated that this would not constitute a disproportionate impact because the precise locations of low-income and minority populations are unknown within the census block group. Therefore, the presence of protected populations on the census block level does not necessarily indicate a concentration of highly impacted protected populations. Low-income persons in the South Burlingame and Collins View neighborhood (Segments 4 and 5), while they are within the neighborhood boundaries, do not reside immediately adjacent to the project.

- *Neighborhood Mobility.* The Streetcar Alternative would provide a benefit to minority and low-income populations throughout the area by decreasing transit travel times and by providing an overall improvement in traffic operations. The installation of a traffic signal and resulting traffic congestion at Southwest Macadam Avenue and Carolina Street in either of the Segment 3 Macadam Avenue design options could impact the adjacent low-income population. The small decrease in access to transit from the Streetcar Alternative in Segments 3 and 4 is not substantial enough to be considered a disproportionate impact to environmental justice populations.

- *Property Acquisitions and Displacements.* For the Streetcar Alternative, Segments 3, 5 and 6 have potential acquisitions and/or displacements.

  In Segment 3, the Streetcar Alternative would result in the acquisition of right of way from seven to 25 properties, depending on the design option selected. However, all except one of these properties are along the east side of Southwest Macadam Avenue. The high percentage low-income population in South Portland is only along the west side of Macadam Avenue, so the vast majority of these acquisitions would not likely impact that population and would not, therefore, represent a disproportionate burden to low-income and minority residents.

  In Segment 5, the Streetcar Alternative Riverwood In-Street option, would result in right of way acquisition from eight properties. One of these acquisitions would result in displacement of a residential building. Because this is a singular displacement, it would not constitute a disproportionate impact to potential minority and/or low-income residents in the Dunthorpe/Riverdale area. The remaining seven acquisitions are small and would not impact the use of those properties.

  In Segment 6, **t**he Streetcar Alternative would result in 21 to 27 property acquisitions, depending on the design option chosen. Five of the 27 acquisitions in the Foothills option are considered displacements. These displacements are to industrial properties that are not specifically identified as under minority or low-income ownership and are considered unlikely to result in disproportionate adverse impacts to environmental justice populations.

[104] For more details on the specific population groups adjacent to the project, see the *Lake Owego to Portland Community Impacts Technical Report.*

3.18.3.2 Direct Impacts to Elderly and/or Disabled Populations

No-Build Alternative. There would be no changes to existing conditions and therefore no direct impacts to elderly and/or disabled populations with the No-Build Alternative.

Enhanced Bus Alternative. The impacts associated with the Enhanced Bus Alternative are anticipated to be very similar to those associated with minority and/or low-income populations. The additional potential impacts are identified below. Regulations do not require evaluation of disproportionate adverse impacts related to the elderly and/or disabled.

- *Neighborhood Mobility.* The Enhanced Bus Alternative would improve transit travel times to most of the project area, thus providing a benefit to elderly and/or disabled populations as well as other demographics throughout the area. However, the Enhanced Bus Alternative would reduce access to transit in Segments 3, 5 and 6. Although transit travel times would still be considered good, the reduced number of stops would require additional distance for the elderly and/or disabled to travel. This would increase the time and difficulty required to reach bus stops for these populations, who may have restricted mobility.

- *Property Acquisitions and Displacements.* The property acquisitions associated with this alternative are to properties that are not specifically used by persons over 65 more than persons of other ages; these are not businesses that target persons over 65.

Streetcar Alternative. The impacts to persons over 65 and/or the disabled that would be associated with the Streetcar Alternative are similar to those identified above for minority and/or low-income populations.

3.18.3.3 Indirect Impacts to Environmental Justice Populations, the Elderly and/or Disabled

No-Build Alternative. No potential indirect impacts to minority, low-income, the elderly, and/or disabled are anticipated with the No-Build Alternative that would differ from impacts to other populations.

Enhanced Bus and Streetcar Alternatives. Properties in Segment 3, portions of Segment 5, and Segment 6 could experience development pressure which could be attributable to the project, and which could ultimately result in the displacement of protected populations. It is not known at this time whether any of these potential displacements would be disproportionate when compared to other populations. It is also not known whether the impacts would be considered negative since this will vary from property to property and individual to individual.