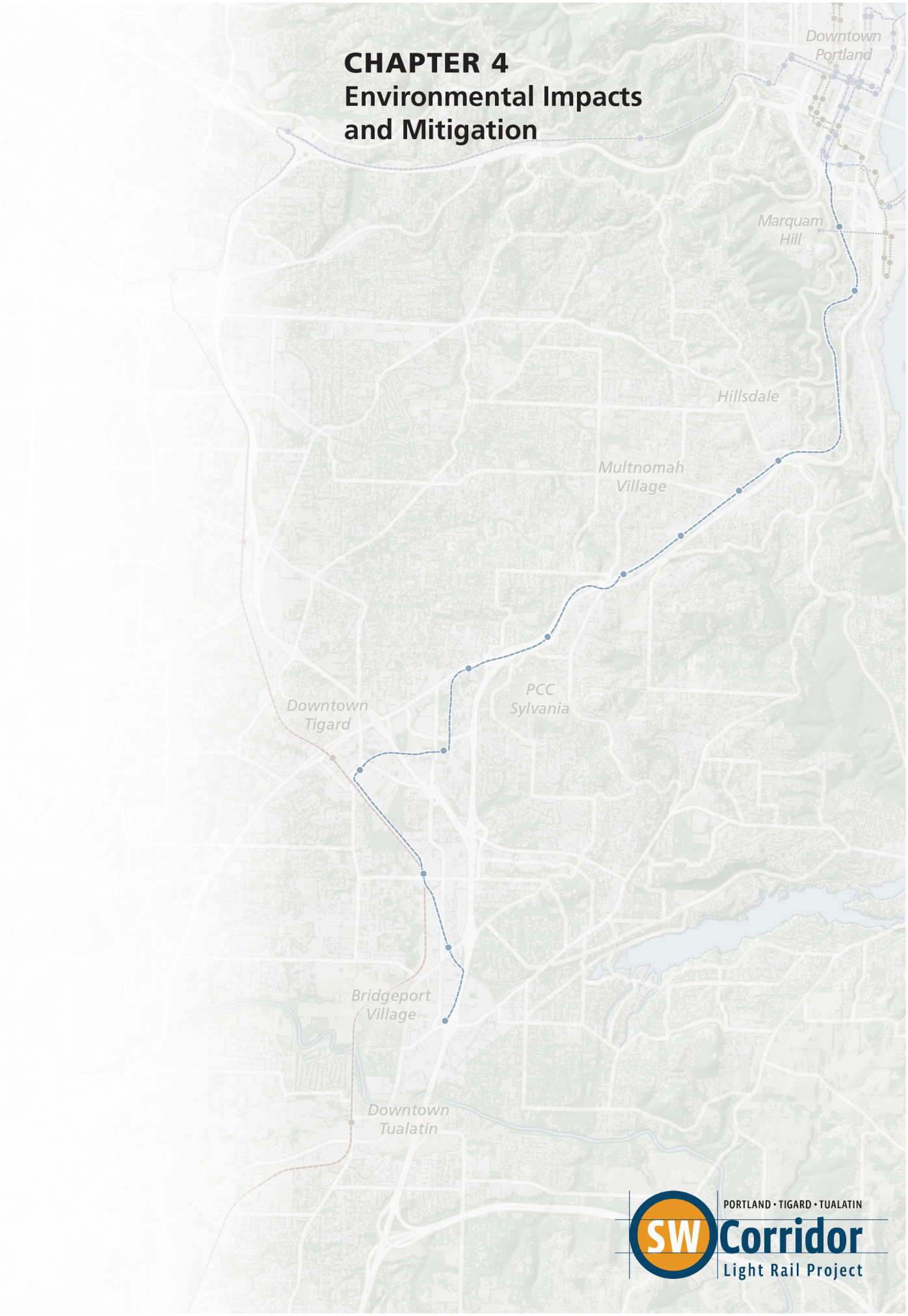
CHAPTER 4
Environmental Impacts and Mitigation



PORTLAND • TIGARD • TUALATIN
SW Corridor
Light Rail Project

CHAPTER 4

4. ENVIRONMENTAL IMPACTS AND MITIGATION

This chapter discusses the environmental impacts and mitigation for the resources listed at right. Each section describes the resource study area, potential direct beneficial and adverse long-term impacts and short-term (construction) impacts, as well as mitigation measures for adverse impacts for the Southwest Corridor Light Rail Project (Project).

This chapter updates information from the Draft Environmental Impact Statement (EIS) for the affected environment and focuses on the impacts of the Preferred Alternative and related transportation improvements compared to the No-Build Alternative. The Preferred Alternative for the light rail investment represents the full 11-mile light rail alignment that would terminate at the Bridgeport Station, paired with a connection to Marquam Hill, a shuttle to the Portland Community College Sylvania campus and a new operations and maintenance facility. The related transportation improvements consist of the Ross Island Bridgehead Reconfiguration and station access improvements. These are options for additional access and mobility improvements that could be phased to be built before, with or after the light rail investment, depending on funding availability, including other federal grants or local funding initiatives. This Final EIS also evaluates two terminus options, which are portions of the Preferred Alternative that could be constructed if there is insufficient funding for the full-length alignment. The Upper Boones Ferry Terminus Option would be a 10-mile light rail alignment that would terminate at the Upper Boones Ferry Station, including 12 new light rail stations and four new or modified park and rides. The Hall Terminus Option would be an 8-mile light rail alignment that would terminate at the Hall Station, including 10 new light rail stations and four new or modified park and rides.

The structure and definition of the alternatives considered in this analysis are described in more detail in Chapter 2, Alternatives Considered. The level of detail in which the impacts of the Project are described in this Chapter 4 varies by environmental resource and the degree to which a potential impact is likely to occur.

The Draft EIS described the potential impacts of the various light rail alternatives and the initial route proposal that were under consideration at the time of its publication.[1] Those impacts associated with the Draft EIS alternatives and initial route proposal are not described in detail in this Final EIS; however, each section of this chapter includes a comparison of the impacts of the Draft EIS alternatives to the impacts of the Project presented in this Final EIS. Areas that were evaluated in the Draft EIS but would not be a part of the Project are not discussed further in this Final EIS.

[1] On May 1, 2020, the City of Portland executed a readdressing project for a portion of the project area. Appendix O, Cross-Reference of Street and Address Changes, provides a table of the addresses used in the Draft EIS and Final EIS documents that the city has changed as part of the readdressing project.

The National Environmental Policy Act also requires that the EIS disclose the direct, indirect and cumulative impacts of a proposed action on the environment. Direct, indirect and cumulative impacts are defined as follows:

- **Direct (long-term or short-term) impacts** are caused by the action and occur at the same time and place. For example, there would be long-term impacts of stormwater runoff from increased roadway impervious surface or short-term air quality impacts from the operation of construction equipment.
- **Indirect impacts** are caused by the action and occur later in time or farther removed in distance but still are reasonably foreseeable, such as changes in land use patterns around station locations.
- **Cumulative impacts** result from the incremental impact of the proposed action when its impact is added to those of other past, present and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts are considered because the public and government agencies need to evaluate a proposed action and its alternatives from a broad perspective, including how the proposed action might interact with impacts that persist from past actions, with present-day activities, and with other projects that are planned but have not been built yet (reasonably foreseeable future actions). See Appendix B4.18, Indirect and Cumulative Effects Background Information, for the list of planned projects considered in this Final EIS.

4.1. Acquisitions, Displacements and Relocations

This section addresses the potential for the Project to acquire property, displace current land uses and relocate the parties or activities currently using the land. Appendix F, Properties Affected by Acquisitions and Permanent Easements, lists and maps the specific parcels that are currently anticipated to be permanently affected by acquisitions and easements as a result of the Project.

The related environmental effects of these potential property conversions are further analyzed in Chapter 3, Transportation Impacts and Mitigation; Section 4.2, Land Use; Section 4.3, Economics; Section 4.4, Communities; Section 4.6, Historic and Archaeological Resources; Section 4.7, Parks and Recreation Resources; Section 4.14, Hazardous Materials; Appendix C, Environmental Justice Compliance; and Appendix D, Final Section 4(f) Evaluation.

Since the Draft EIS, this section has been updated to reflect the definition of the Project in this Final EIS, including more detailed designs based on land survey information as well as information about permanent and temporary easements. Because the related transportation improvements may be undertaken by agencies other than the Tri-County Metropolitan Transportation District of Oregon (TriMet), information on the regulatory context has been updated to clarify who would be responsible for ensuring compliance with applicable regulations.

4.1.1. Affected Environment

Study Area

The study area for this analysis includes parcels that overlap with the project construction footprint, or where the Project could remove vehicular access to a parcel. The study area is heavily developed and contains transportation, residential, commercial, industrial, public, institutional and vacant property.

Regulatory Context

Property Acquisition and Relocation Policies

The Fifth Amendment of the U.S. Constitution requires that property owners are provided with "just compensation" when all or a portion of their property is acquired for public use. Just compensation must not be less than the fair market value of the property acquired, including damages or benefits to the remaining property in the case of partial parcel acquisitions. The federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Uniform Relocation Act), as amended, provides further direction on the process of acquiring property, as well as the process of compensating residents, businesses or organizations that must be relocated. While the Uniform Relocation Act specifically applies to federal agencies and agencies receiving federal funding for a project, it is also referenced by state regulations in Chapter 35 of the Oregon Revised Statutes (ORS), which regulates eminent domain and the public acquisition of property.

While the various elements of the Project would be undertaken by different entities, this analysis assumes that acquisitions and displacements would be subject to just compensation under state or federal law, as applicable. Property acquisitions for the Preferred Alternative would be undertaken by TriMet, and would also follow TriMet's acquisition and relocation policy, procedures and guidelines, which comply with the state and federal policies, and provide agency-specific guidance. Property acquisitions for the Ross Island Bridgehead Reconfiguration would be undertaken by the City of Portland or the Oregon Department of

Transportation (ODOT). The station access improvements are not anticipated to result in permanent property acquisition. If permanent use is found later to be needed, it would be the responsibility of local implementing agencies to ensure just compensation for any related acquisitions or relocations.

Coordination with Federal, State and Local Agencies

Federal policies also guide the process through which TriMet would request and potentially be granted permission to use Interstate 5 (I-5) right of way from ODOT and the Federal Highway Administration (FHWA).[1] TriMet, Metro and ODOT have coordinated to define the potential areas where transit could be accommodated while balancing current conditions in the corridor, applicable design standards for highways and light rail, and ODOT's ability to make future highway improvements.

ODOT and FHWA must review designs for any areas where I-5 ramps or interchanges could be affected. ODOT and FHWA could require more restricted road access and closure of intersections or driveways in order to maintain safe and effective interchange operations. If ODOT and FHWA require more restricted road access, a property that completely loses access as a result would need to be acquired. Similarly, the Federal Railroad Administration and ODOT have jurisdiction over modifications to at-grade freight rail crossings, which could affect adjacent property access.

The City of Portland and ODOT have signed an intergovernmental agreement to transfer ownership and maintenance responsibilities of a portion of SW Barbur Boulevard from ODOT to the City of Portland. This agreement is conditional on the Project's reconstructing the roadway as part of the Preferred Alternative.

4.1.2. No-Build Alternative

Transportation projects and anticipated regional growth under the No-Build Alternative could result in projects that require some partial or full property acquisitions. However, there are no known property acquisitions within the study area, and, for this analysis, it is assumed that no displacements or relocations would occur under the No-Build Alternative.

4.1.3. Long-Term Impacts

The Preferred Alternative would generally follow public streets, highways and railroad rights of way, but additional public and private property would be needed as well. The additional land would be converted to trackway, expanded roadways, sidewalks, bicycle lanes, stations, traction power substations, noise walls and other related facilities, such as an operations and maintenance (O&M) facility and stormwater facilities. Property easements would also be needed, typically to allow for maintenance of large retaining walls or elevated structures. The Ross Island Bridgehead Reconfiguration, one of the related transportation improvements, would have similar property needs. The station access improvements, also related transportation improvements, are expected to be constructed within existing right of way.

[1] Applicable policies include 23 Code of Federal Regulations (CFR) 810, "Mass Transit and Special Use Highway Projects," and 23 CFR 710, "Right-of-Way and Real Estate." TriMet will first submit an application to ODOT. ODOT may then seek authorization from FHWA. The request to FHWA would include evidence that the use of the right of way for light rail would not impair future highway improvements or the safety of highway users. FHWA would review the request and may authorize ODOT to make the I-5 right of way available for TriMet's use. ODOT would then enter into a written agreement with TriMet for use of the right of way.

Types of Permanent Property Impacts

There are three ways that property could be permanently converted to a transportation use or that property use could be permanently restricted through easements:

- **Full parcel acquisition** indicates that the Project would impact most or all of a parcel, and all current uses would be displaced. Full parcel acquisitions include parcels that might not be fully needed for the Project but would be affected to the extent that current uses would be substantially impaired (e.g., loss of parking or access).
- **Partial parcel acquisition** indicates that a portion of a parcel would be acquired, including sliver takes. A partial parcel acquisition generally would not displace existing uses on the parcel, but the parcel would be impacted by the Project. The Project could remove parking or access on certain parcels to a degree that existing uses would be displaced. In these cases, relocation assistance would be offered to the existing residential or commercial tenants while the owner would retain the remainder of the parcel, because buildings would remain intact and functional.
- **Permanent easement** indicates that existing uses would be restricted on a portion of a parcel through an easement purchased from the property owner. Typically, permanent easements are needed for the maintenance of relatively large retaining walls. Some properties with partial parcel acquisitions would also be affected by permanent easements.

Because design details and property uses may change as the Project develops, the number and/or type of acquisitions and displacements could vary between what is disclosed in this Final EIS and what would be required. Final determinations about the properties needed for the Project will be based on the Project's final design after the Federal Transit Administration (FTA) completes the National Environmental Policy Act (NEPA) process. Acquisitions of property would typically occur only after this Final EIS is published and the NEPA process is complete, except for the rare case of early acquisition to accommodate property owner hardships or to protect a given property from imminent development that may be incompatible with the Project. Section 4.1.6 includes a summary of the process for property acquisition, including notification of property owners.

If there is property no longer needed after construction of the Preferred Alternative, TriMet will manage surplus property in accordance with the FTA grant management circular 5010.E rules and all applicable state laws. Subject to meeting FTA requirements, surplus property would also be managed consistent with the Memorandum of Understanding signed between the City of Tigard, City of Portland, Metro, TriMet and Washington County, which stated a goal of identifying locations for 700 to 800 affordable housing units in Portland and 150 to 250 units in Tigard.

Affected Parcels, Residences and Businesses

Table 4.1-1 presents the estimated number of affected properties and the related acquisitions and displacements for the elements of the Project. Appendix F lists and maps the properties that would be affected by acquisitions and permanent easements as a result of the Project.

Table 4.1-1. Anticipated Long-Term Property Impacts and Displaced Uses

Project Element	Number of Properties Impacted			Displaced Uses	
	Full Parcel Acquisition	Partial Parcel Acquisition	Permanent Easement[1]	Residences	Businesses
Light Rail Investment: Individual Elements					
Segment A alignment and stations	36	68	22	35	13
Segment B alignment and stations	108	90	9	39	66
Segment C alignment and stations	49	48	1	21	33
Marquam Hill Connection	0	0	0	0	0
PCC-Sylvania Shuttle	0	0	0	0	0
Hunziker O&M Facility	3	0	0	0	2
Light Rail Investment: Totals					
Preferred Alternative	196	206	32	95	114
Upper Boones Ferry Terminus Option	193	201	31	95	113
Hall Terminus Option	185	183	31	95	105
Related Transportation Improvements					
Ross Island Bridgehead Reconfiguration	0	34	0	0	0
Station access improvements	0	0	0	0	0
Full Project					
Preferred Alternative + all related transportation improvements	196	240	32	95	114

Note: O&M = operations and maintenance; PCC = Portland Community College.

[1] This column includes properties impacted by a permanent easement but not also impacted by a partial parcel acquisition.

The Preferred Alternative would acquire all or a portion of 402 parcels, affecting a mix of residential, commercial and vacant properties. Of those affected parcels, 196 are expected to involve the full parcel, and 206 would involve part of the parcel, leaving its primary use in place. There would be 28 publicly owned parcels affected, including parks, vacant land, park and rides, and parcels occupied by state or local facilities such as a pump station or a public school or university. The Preferred Alternative would displace a total of 95 residential units, including 52 single-family homes; 25 units in nine duplexes, triplexes or fourplexes; and 18 units in two apartment complexes. Of the 95 total residential units displaced, 8 units are assumed to be retained for future residential use because the existing houses or apartments would remain intact. The current residents in these units would be offered relocation assistance due to loss of parking or other vehicle access. The Preferred Alternative would displace an estimated 114 businesses. See Section 4.3, Economics, for more information on impacts to businesses and employees.

The terminus options, which would construct a portion of the Preferred Alternative alignment, would result in fewer property impacts and displacements (see Table 4.1-1). The Upper Boones Ferry Terminus Option would acquire all or a portion of eight fewer parcels and displace one fewer business than the full-length Preferred Alternative. The Hall Terminus Option would acquire all or a portion of 34 fewer parcels and displace nine fewer businesses than the full-length Preferred Alternative.

The Ross Island Bridgehead Reconfiguration would result in 34 partial parcel acquisitions and no full acquisitions or relocations.

Individual station access improvement options are expected to remain within public rights of way and thereby avoid permanent property acquisitions or easements.

4.1.4. Short-Term Impacts

During construction of the Project, property will be needed in each segment for staging areas, construction access, and other construction easements to relocate or reconnect utilities, or to construct sidewalks, retaining walls or other infrastructure adjacent to parcels abutting the Project.

Construction staging needs would generally be accommodated on public right of way and private properties that are assumed to be full acquisitions due to impacts to buildings, access or parking. The Project could use ODOT right of way for construction staging where feasible and approved by FHWA and ODOT, and could use other available lands on a temporary basis, including parts of city street rights of way, or land that is available on the open market (i.e., a vacant private parcel). Maps in Appendix A, Detailed Maps and Descriptions of the Alternatives, identify properties that are expected to be needed for staging areas during construction.

The construction staging areas would primarily be adjacent to the project elements, but the contractor might also need off-site staging areas to stockpile excavated materials or to cast and store precast structural elements. These areas would be located close to work sites, when possible, to minimize the impact on local traffic.

Generally, construction access requirements would be fulfilled through temporary construction easements, which would allow for temporary use of a property during construction. After construction, the property would be restored to its previous condition for the owner, and the easement would be terminated. Temporary construction easements would be needed throughout the project area, and would affect around 165 parcels that are not anticipated to require any permanent area of acquisition or easement. The size of a temporary construction easement would depend on the type of activity expected on the property and the type of land uses in the area. For example, a vacant property would provide an opportunity for a larger easement, whereas easements adjacent to developed property likely would be smaller in order to reduce or avoid impacts.

4.1.5. Comparison to Impacts of the Draft EIS Light Rail Alternatives

The overall magnitude of property acquisitions and displacements identified for the Project in this Final EIS remains similar to that of the light rail alternatives in the Draft EIS. Table 4.1-2 provides a comparison of acquisitions and displacements for the full corridor between the Draft EIS and the Final EIS.

Table 4.1-2. Comparison of Acquisitions and Displacements Between the Draft and Final EIS

	Number of Properties Impacted		Displaced Uses	
	Full Acquisition	Partial Parcel Acquisition	Residences	Businesses
Draft EIS				
Full-corridor project range[1]	119–185	249–309	78–293	106–156
Final EIS				
Preferred Alternative	196	206	95	114
Full Project[2]	196	240	95	114

Note: O&M = operations and maintenance; PCC = Portland Community College.

[1] The Draft EIS full-corridor project range is defined as the range representing the lowest and highest possible sum of impacts from a composite of one alignment alternative within each segment, a Marquam Hill connection option, a PCC-Sylvania shuttle option and an O&M facility option.

[2] The full Project is defined as the Preferred Alternative plus the related transportation improvements.

The Preferred Alternative would result in 11 more full acquisitions than were previously estimated for the maximum for the light rail alternatives in the Draft EIS. Most of this change is due to an increase in the number of properties affected in Segment B, which ranged from 57 to 88 full parcel acquisitions for the Segment B alignment alternatives in the Draft EIS, compared to 104 full parcel acquisitions for the Preferred Alternative alignment and stations in Segment B in this Final EIS. A large portion of this increase in full acquisitions in Segment B resulted from design modifications to reduce impacts to Fulton Park, as well as traffic mitigation measures that are now assumed in the design of the Preferred Alternative.

4.1.6. Mitigation Measures

Table 4.1-3 summarizes the mitigation measures that would address long-term and short-term impacts of acquisitions, displacements and relocations.

Table 4.1-3. Mitigation Measures for Acquisitions, Displacements and Relocations

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
Long term	Acquisition of property and displacement or relocation of existing uses	When acquiring properties and relocating existing residents and businesses, TriMet would comply with the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Chapter 35 of the Oregon Revised Statutes, and TriMet's acquisition and relocation policy, procedures, and guidelines.	Project sponsors would comply with relevant laws and regulations when acquiring properties, including Chapter 35 of the Oregon Revised Statues and the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as applicable.
Short term	Use of property during construction	For portions of properties needed for temporary use during construction, TriMet would restore the affected area to its previous condition and/or provide alternative compensation, as specified in the conditions of the easement agreement negotiated for each property.	For portions of properties needed for temporary use during construction, project sponsors would restore the affected area to its previous condition and/or provide alternative compensation, as specified in the conditions of the easement agreement negotiated for each property.

Long-Term Mitigation

The permanent acquisition of properties and the resulting relocation of residents and businesses would be mitigated in compliance with applicable federal and/or state laws and regulations, which are summarized in Section 4.1.1. Compensation would vary by property depending on the level of impact, available relocation options and other factors.

The primary mitigation for full or partial parcel acquisitions would be payment of just compensation to the property owner. Just compensation must not be less than the fair market value of the property acquired, including damages or benefits to the remaining property in the case of partial parcel acquisitions. TriMet would coordinate with property owners when only parking areas are being displaced, to negotiate compensation and/or replacement plans.

Mitigation for displacements includes financial assistance to cover moving expenses for existing residents or businesses. Displaced residents may be eligible for housing replacement payments, as necessary, to ensure that the replacement dwelling meets federal standards for decent, safe and sanitary housing. TriMet would work with affected residents and businesses to help them plan ahead for relocation, assist in finding new homes or sites, and help solve problems that might occur. While the ultimate choice of a relocation site would be made by the affected resident or business, the agency would help investigate possible locations,

including nearby properties. TriMet would also use interpreters to help those with limited English proficiency understand their choices and options.

When the Draft EIS was released, TriMet and Metro mailed letters to the owners of properties potentially affected by a full or partial parcel acquisition by the Draft EIS light rail alternatives and design refinements. The letters identified whether the property in question would be affected by the draft Preferred Alternative (known as the initial route proposal in the Draft EIS) and provided information on how to access the Draft EIS and submit comments. At least 29 comment letters were received from potentially affected property owners, residents, businesses and employees. See Chapter 7, Draft EIS Comment Summary, and Appendix J, Draft EIS Comments and Responses, for more information on the comments received and the responses to those comments.

TriMet sent additional letters upon publication of this Final EIS to all owners of properties that would experience either an acquisition or a permanent easement as a result of the Preferred Alternative. Once designs are finalized, the project sponsor (or sponsors) of related transportation improvements will notify the owners of all properties that could experience an acquisition in accordance with all applicable federal, state and local regulations.

As the design progresses for the Preferred Alternative, TriMet will continue to seek opportunities to reduce the number of displaced homes and businesses.

Short-Term Mitigation

For temporary construction easements, in addition to just compensation for the temporary property rights acquired, TriMet or the project sponsor would pay for or perform any reasonable and necessary restoration for required elements, such as landscaping and paving.

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4.2. Land Use

This section addresses the potential long-term and short-term land use impacts of the Project. Since the Draft EIS, this section has been updated to reflect the definition of the Project in this Final EIS, including more detailed designs based on land survey information, conversations with stakeholders and public comments received on the Draft EIS. Existing conditions have been updated to align with changes in zoning and related comprehensive plans. More information has also been added about temporary easements.

The Metro Council adopted a Land Use Final Order (LUFO) for the Project on December 13, 2018, in accordance with Oregon Laws 2017, Chapter 714, establishing the improvements and their locations comprising the Project. The new light rail investment would still need to obtain federal, state and local permits related to the design and construction of the Project. See Chapter 6, Public Involvement, Agency Coordination and Required Permits, for more information regarding anticipated permits.

4.2.1. Affected Environment

The study area for land use includes the cities that the project elements intersect or border. A more detailed evaluation of the study area for the Preferred Alternative covers a 0.5-mile radius around stations and 0.25 mile along either side of the track centerline. For this Final EIS, existing land use data has been refined for accuracy within 0.5-mile station areas and for parcels that would be fully or partially acquired for the Project.

Overview of Existing Land Uses

Land use in the study area is diverse. It ranges from downtown Portland's high-density, mixed-use central business district and gradually becomes more suburban and industrial to the southwest into Tigard and Tualatin. Existing land uses are shown on Figures 4.2-1 through 4.2-3 and described below.

Segment A: Inner Portland

Segment A covers the southern end of downtown Portland and the South Waterfront District near the Portland State University campus and extends south to the Hillsdale neighborhood (see Figure 4.2-1).

In the northern portion of this segment, land use patterns transition from the larger-scale buildings and multiple uses found in downtown to the older city neighborhoods found along SW Barbur Boulevard and SW Naito Parkway. These areas have a mix of commercial, open space and residential uses, including multifamily housing and commercial and institutional uses, as well as parks, some dating back to the 1800s. South of SW Hamilton Street, the land uses along SW Barbur Boulevard transition to mostly wooded areas, much of which are parklands, with Interstate 5 (I-5) to the east and residential areas to the west.

Segment B: Outer Portland

Segment B covers the area generally along SW Barbur Boulevard and I-5 between the Hillsdale neighborhood and the Portland-Tigard city limits (see Figure 4.2-2).

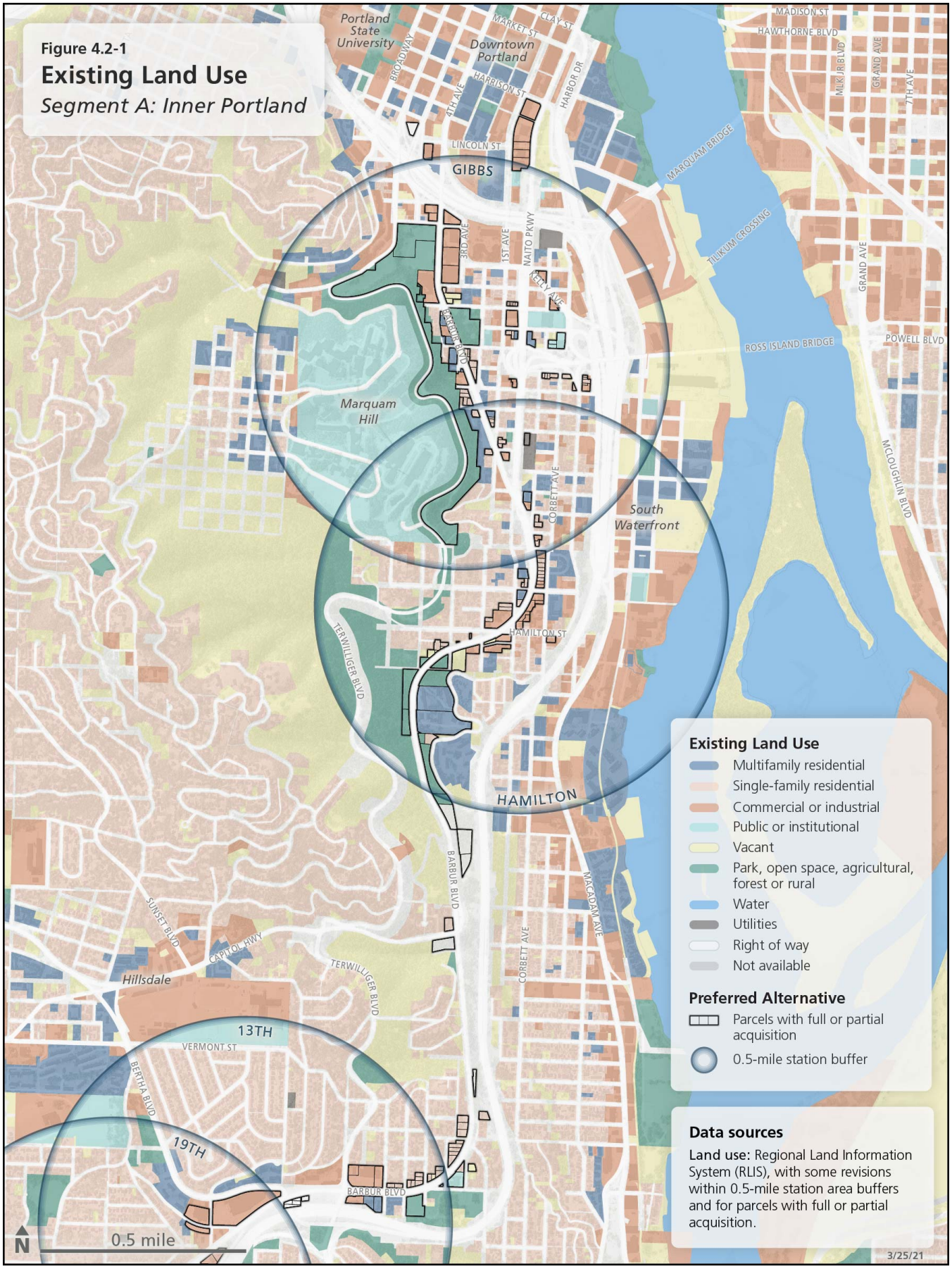


Figure 4.2-1
Existing Land Use
Segment A: Inner Portland
Portland State University
Downtown Portland
MARKET ST
CLAY ST
BROADWAY
HARRISON ST
4TH AVE
HARBOR DR
LINCOLN ST
GIBBS
MADISON ST
HAWTHORNE BLVD
MLK JR BLVD
GRAND AVE
7TH AVE
MARQUAM BRIDGE
TILIKUM CROSSING
3RD AVE
1ST AVE
NAITO PKWY
KELLY AVE
MARQUAM BLVD
ROSS ISLAND BRIDGE
POWELL BLVD
Marquam Hill
CORBETT AVE
South Waterfront
MCLOUGHLIN BLVD
HAMILTON ST
TERWILLIGER BLVD
HAMILTON
BARBUR BLVD
MACADAM AVE
SUNSET BLVD
CAPITOL HWY
Hillsdale
13TH
VERMONT ST
BERTHA BLVD
19TH
N
0.5 mile
Existing Land Use
Multifamily residential
Single-family residential
Commercial or industrial
Public or institutional
Vacant
Park, open space, agricultural, forest or rural
Water
Utilities
Right of way
Not available
Preferred Alternative
Parcels with full or partial acquisition
0.5-mile station buffer
Data sources
Land use: Regional Land Information System (RLIS), with some revisions within 0.5-mile station area buffers and for parcels with full or partial acquisition.
3/25/21

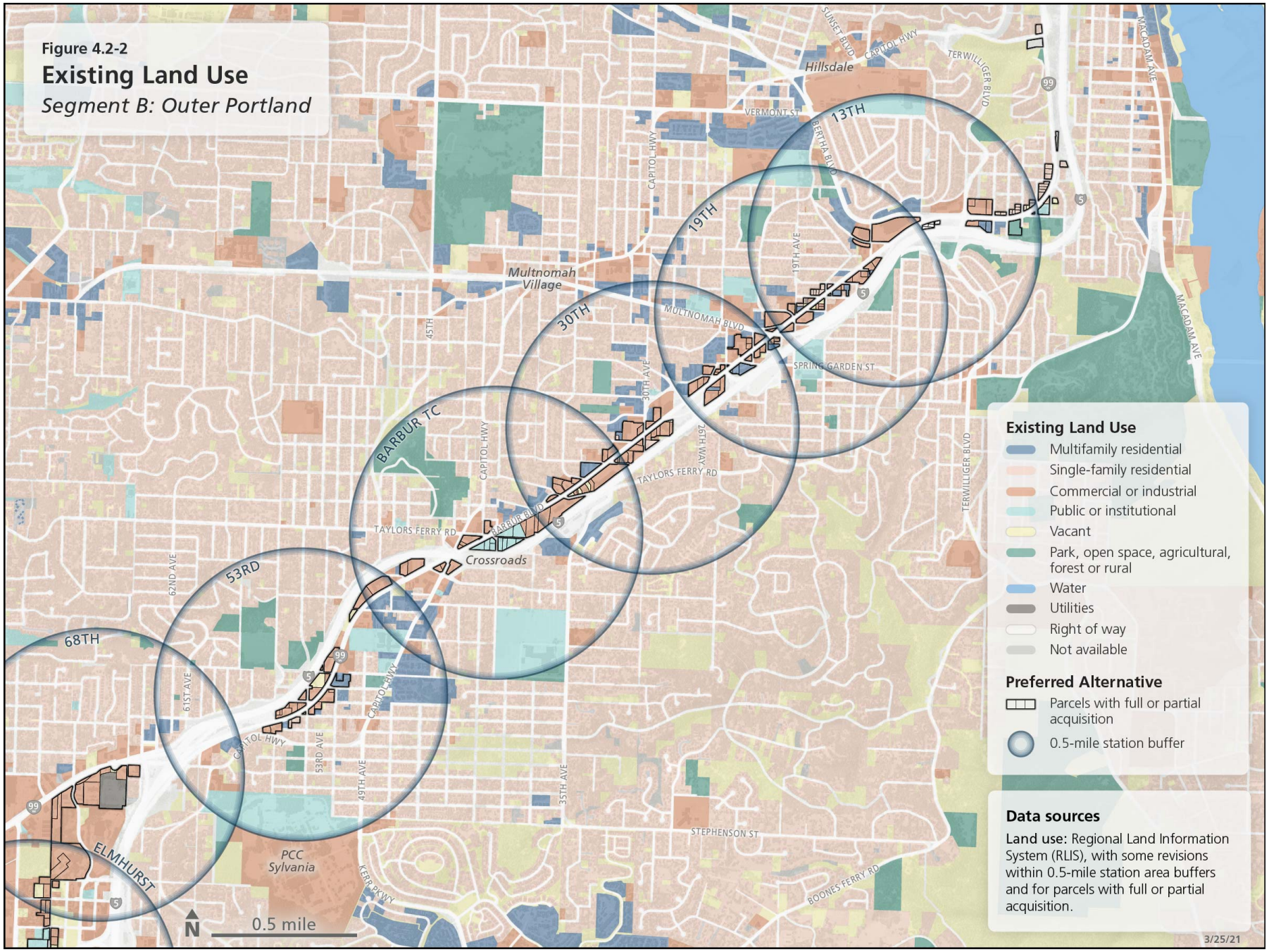


Figure 4.2-2
Existing Land Use
Segment B: Outer Portland
Existing Land Use
Multifamily residential
Single-family residential
Commercial or industrial
Public or institutional
Vacant
Park, open space, agricultural, forest or rural
Water
Utilities
Right of way
Not available
Preferred Alternative
Parcels with full or partial acquisition
0.5-mile station buffer
Data sources
Land use: Regional Land Information System (RLIS), with some revisions within 0.5-mile station area buffers and for parcels with full or partial acquisition.
3/25/21
13TH
19TH
30TH
BARBUR TC
53RD
68TH
ELMHURST
Hillsdale
Multnomah Village
Crossroads
PCC Sylvania
SUNSET BLVD
CAPITOL HWY
TERWILLIGER BLVD
MACADAM AVE
VERMONT ST
BERTHA BLVD
19TH AVE
MULTNOMAH BLVD
SPRING GARDEN ST
30TH AVE
26TH WAY
TAYLORS FERRY RD
BARBUR BLVD
45TH
62ND AVE
61ST AVE
53RD AVE
49TH AVE
35TH AVE
STEPHENSON ST
BOONES FERRY RD
KERR PKWY
N
0.5 mile

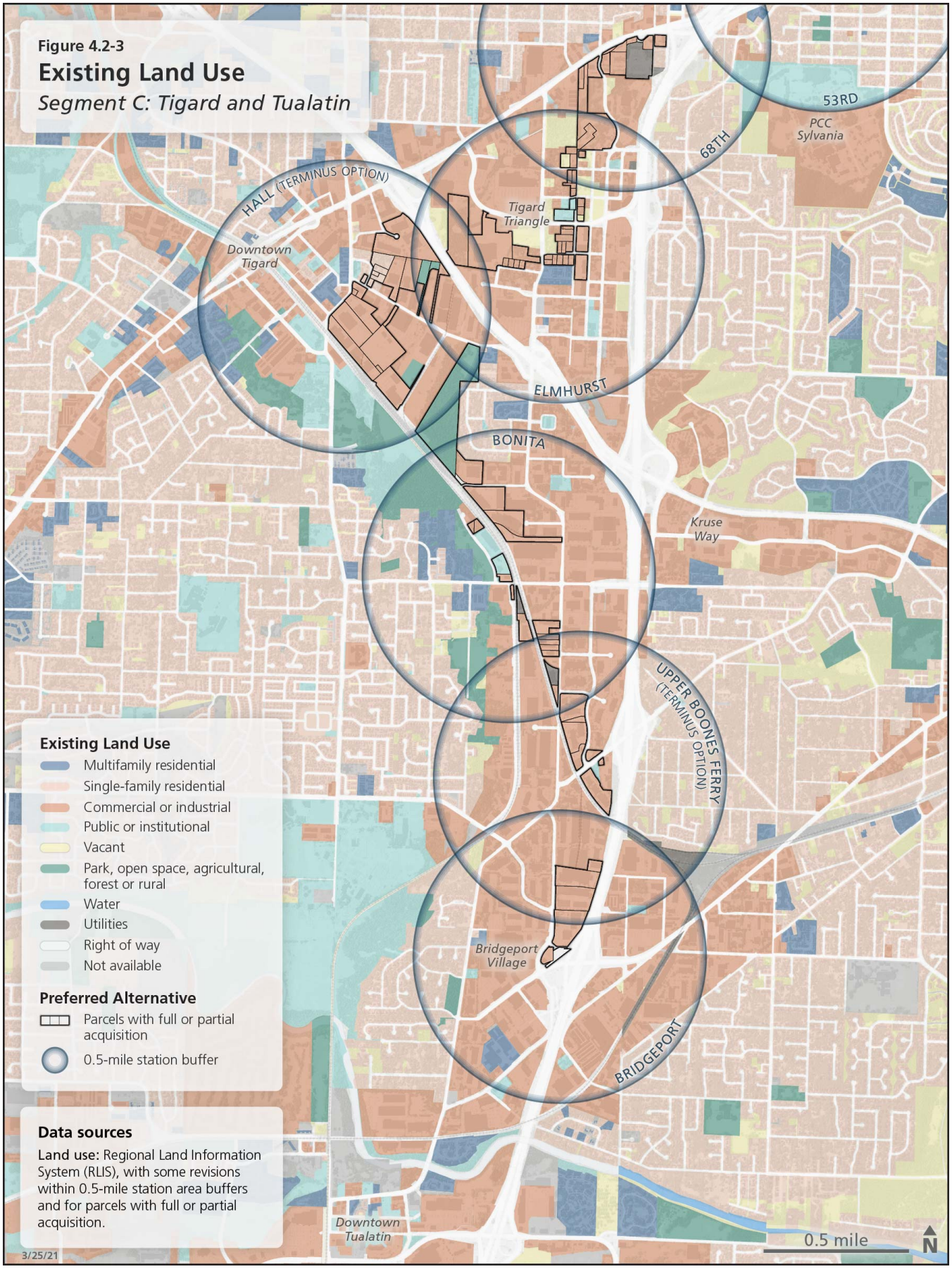


Figure 4.2-3
Existing Land Use
Segment C: Tigard and Tualatin
HALL (TERMINUS OPTION)
Downtown Tigard
Tigard Triangle
68TH
53RD
PCC Sylvania
ELMHURST
BONITA
Kruse Way
UPPER BOONES FERRY (TERMINUS OPTION)
Bridgeport Village
BRIDGEPORT
Downtown Tualatin
Existing Land Use
Multifamily residential
Single-family residential
Commercial or industrial
Public or institutional
Vacant
Park, open space, agricultural, forest or rural
Water
Utilities
Right of way
Not available
Preferred Alternative
Parcels with full or partial acquisition
0.5-mile station buffer
Data sources
Land use: Regional Land Information System (RLIS), with some revisions within 0.5-mile station area buffers and for parcels with full or partial acquisition.
3/25/21
0.5 mile
N

At the north end of Segment B, land uses along SW Barbur Boulevard transition from the wooded area in Segment A to a mix of residential and commercial uses. Continuing south, the area has rolling topography and a mix of commercial businesses offices and some multifamily residential properties. The most densely populated commercial centers are near major intersections, including I-5 access ramps.

Residential neighborhoods are adjacent to each side of SW Barbur Boulevard and I-5. Unlike the residential areas in Segment A, these neighborhoods often lack sidewalks even on high traffic streets, because much of it was developed before being annexed into the city of Portland. There are some nodes of commercial land uses along smaller arterial and collector streets connecting to SW Barbur Boulevard and I-5, including in Multnomah Village and Hillsdale. Many of these have a variety of land uses, including low-density commercial development surrounded by residential neighborhoods. The Portland Community College (PCC) Sylvania campus is located 0.5 mile south of SW Barbur Boulevard at the southern end of Segment B.

Segment C: Tigard and Tualatin

Segment C includes the Tigard Triangle, downtown Tigard and the northern end of Tualatin (see Figure 4.2-3).

Many commercial developments are located along the major roadways that pass through Segment C, which include I-5, Pacific Highway (designated as Oregon Route 99W) and Highway 217. Pacific Highway features auto-oriented commercial developments such as strip malls that are set to attract passing drivers. The commercial developments along parts of Highway 217 and I-5 include a mix of large-scale retail stores, several office buildings, the mixed-use retail developments of the Bridgeport Village shopping center and George Fox University's Portland Center. A mix of commercial, office and residential uses are located near the mixed-use central business district of downtown Tigard. Industrial uses are located to the east and south of downtown Tigard and along the freight rail tracks and SW 72nd Avenue. There are some areas of single-family homes adjacent to the commercial and industrial areas in Segment C, particularly north of Pacific Highway, west of the freight rail tracks and east of I-5.

Existing Land Uses by Station Area

Table 4.2-1 identifies the share of existing land use types within a 0.5-mile radius of each station for the Preferred Alternative.

Table 4.2-1. Existing Land Uses by Station Area

Station	Single-Family Residential	Multifamily Residential	Commercial or Industrial	Public or Institutional	Parks and Open Space	Utilities	Vacant	Right of Way	Water	Not Available
Gibbs	10%	5%	12%	21%	10%	1%	4%	38%	0%	0%
Hamilton	12%	11%	12%	6%	13%	0%	5%	31%	9%	0%
13th	47%	3%	5%	5%	5%	0%	1%	33%	0%	0%
19th	46%	5%	8%	5%	3%	0%	1%	32%	0%	0%
30th	51%	7%	9%	1%	2%	0%	2%	27%	0%	0%
Barbur TC	43%	5%	8%	8%	6%	0%	3%	27%	0%	0%
53rd	41%	7%	5%	10%	6%	0%	2%	29%	0%	0%
68th	41%	2%	22%	3%	1%	1%	5%	26%	0%	0%
Elmhurst	10%	1%	52%	2%	1%	0%	6%	27%	0%	1%
Hall	8%	6%	45%	7%	12%	1%	1%	21%	0%	0%
Bonita	16%	5%	46%	1%	11%	0%	2%	18%	0%	0%
Upper Boones Ferry	21%	0%	50%	0%	1%	2%	2%	22%	0%	0%
Bridgeport	12%	2%	61%	1%	1%	2%	1%	21%	0%	0%

Notes: TC = Transit Center. Totals may not sum to 100% due to rounding.

Zoning and Comprehensive Plan Designations

Appendix B4.2, Land Use Background Information, includes maps of the current generalized zoning and comprehensive plan designations in the study area.

In 2018, the City of Portland updated its Comprehensive Plan to change land uses, zoning and development guidelines citywide, which included changes to reflect the *Barbur Concept Plan*. As a result, the comprehensive plan designations and zoning in Segments A and B are intended to encourage dense development in accordance with the general city strategy of intensifying corridors with frequent transit service, whether local bus or high capacity transit. The City of Portland has previously adopted station- or corridor-specific plans and anticipates doing so in several locations along the Preferred Alternative alignment.

The City of Tigard has also adopted new land use and development regulations for the Tigard Triangle and downtown Tigard in the past five years in anticipation of the light rail investment. These changes encourage transit-oriented development as well as a greater mix of land use types, including buildings with multiple stories and more square footage. The southern portion of Segment C is mostly designated for industrial or commercial (office parks) and is largely developed. Only modest infill development of the same land use types, using existing regulations, is anticipated in the adopted plans and zoning.

Planning and Policy Framework

In Oregon, land use planning and development is guided by statewide land use goals and objectives that are implemented through local land use plans and codes. This section briefly reviews the major plans and policies that apply to the Southwest Corridor.

For further discussion of these and other plans and policies, see Appendix B4.2. The major plans, policies and goals relevant to the Southwest Corridor are shown in Table 4.2-2.

Table 4.2-2. Summary of Key Land Use Goals, Plans and Policies

Plan or Policy	Description
State of Oregon	
Oregon Statewide Land Use Planning Goals	Goal 12 – Transportation: guides transportation planning.
Metro	
2040 Growth Concept (1995, amended 2014)	Guides the region's growth into the central city, regional centers, town centers, main streets and corridors with focused civic activities, public services, and a variety of housing options and commerce well served by high capacity transit. See Appendix B4.2 for more information.
Regional Transportation Plan (2018)	Federally mandated guide for future investments in the region's transportation system.
Regional Transit Strategy (2018)	Provides a framework for implementing a regional transit system (part of the 2018 update to the *Regional Transportation Plan*).
High Capacity Transit System Expansion Policy (2011)	Metro's regional implementation guide for near-term and long-term regional high capacity transit priority corridors.
TriMet	
Southwest Service Enhancement Plan (2015)	TriMet's vision for transit in the southwest, including Tigard, Tualatin, Sherwood, Lake Oswego, West Linn, Durham, King City and Southwest Portland.
City of Portland	
Terwilliger Parkway Corridor Plan and *Terwilliger Parkway Design Guidelines* (1983)	These documents serve as supplements to and aid implementation of the Portland City Code Chapter 33.420. The guidelines provide the process for review of any proposed development within Terwilliger Parkway, including the definition of a major or minor project and the application approval process.
Marquam Hill Plan and *Marquam Hill Design Guidelines* (2003)	These documents include a vision, policies, objectives and action items that apply within the Marquam Hill Plan District.
Barbur Concept Plan (2013)	This plan presents the City of Portland's preferred concept for leveraging high capacity transit to advance a more walkable, vibrant SW Barbur Boulevard, with safer and more effective multimodal connections to neighborhood centers and major destinations, including OHSU and PCC-Sylvania.
Climate Action Plan (2015)	Provides strategies for addressing climate change, which include increasing transit ridership and options, and improving bicycle and pedestrian facilities.
Comprehensive Plan (2018)	Guides development around transit stations, providing land and tools to support job growth, guiding infill development, guiding neighborhood-compatible redevelopment, and supporting development along transit corridors to foster a healthy, equitable and resilient city.
City of Tigard	
Downtown Improvement Plan (2005)	This plan sets forth a vision to create "a vibrant and active urban village at the heart of the community that is pedestrian-oriented, accessible by many modes of transportation, recognizes and uses natural resources as an asset, and features a combination of uses that enable people to live, work, play, and shop in an environment that is uniquely Tigard."
Comprehensive Plan (2007)	An organizational and management tool that provides the broad policy basis for Tigard's land use planning program and represents the land use vision and values of the Tigard community.
Tigard High Capacity Transit Plan (2012)	This plan promotes multimodal transportation improvements, an intensification of land uses in designated centers and corridors, and a strategy for future light rail.
Tigard Triangle Strategic Plan (2015)	A blueprint for establishing a pedestrian-oriented, mixed-use district built around the Triangle's distinguishing natural features with the vision that, ultimately, the Triangle evolves into an active, multimodal district connected to the city and the region that attracts new residents and businesses.
City of Tualatin	
Comprehensive Plan (2019)	Provides guidance and outlines goals for addressing future traffic, bicycle, pedestrian and transit demand, as well as improving multimodal access to key destinations.
OHSU	
OHSU 20-Year Facilities Master Plan (2011)	Provides a clear guide for OHSU site decisions and capital planning for each of its four campuses over the next 20 years.

Note: OHSU = Oregon Health & Science University; PCC = Portland Community College.

4.2.2. No-Build Alternative

Land Use Conversion

The No-Build Alternative includes some projects listed in the *Regional Transportation Plan* (RTP). These projects would require land use conversions consistent with the plan. Additionally, as properties in the corridor redevelop, there could be changes to existing land uses within the constraints of zoning.

Compatibility with Statewide Planning Goals

The No-Build Alternative would not directly conflict with Statewide Planning Goals.

Compatibility with Regional and Local Plans

The No-Build Alternative would include multiple mobility improvements identified in the RTP. However, it would deliver fewer improvements than the Preferred Alternative. Transportation and mobility improvements are needed to support the region's long-range plans, adopted through Metro. These improvements are also needed to help implement the plans of Portland, Tigard and Tualatin. All regional and local plans anticipate managing future growth by focusing development in the corridor, supported by a strong multimodal transportation system. Without light rail, areas anticipating higher rates of growth, such as downtown Portland and the Tigard Triangle, would likely have a more difficult time maintaining good mobility. The lack of transit infrastructure investments could slow or discourage growth in these areas. Congestion and limited mobility choices would make the areas less attractive for businesses and residents. Slowed growth in these areas could also create more pressure for growth in less congested locations, typically on the fringes of the urban area, which is contrary to regional planning goals.

The No-Build Alternative does not change any plan designations, so it would not prevent the *2040 Growth Concept* from being achieved, but it could hinder its implementation. The regional multimodal transportation system would not include the light rail service in this corridor that is called for in the RTP. As a result, the Portland City Center, West Portland Town Center and Tigard Town Center would not be connected with high capacity transit as envisioned in the *2040 Growth Concept*.

4.2.3. Long-Term Impacts

This section identifies the anticipated long-term land use impacts of the Project, which include conversion of land uses to transportation use and compatibility with state, regional and local land use plans. This section begins with an overview of these impacts for the full Project, followed by individual discussions of the Preferred Alternative by segment and the related transportation improvements.

Project Overview

Land Use Conversion

The conversion calculations shown in Table 4.2-3, below, represent the total permanent area impacted by the Project, not including portions of parcels that would no longer be needed after construction. Table 4.2-3 shows the acreage of existing land use that would be converted to a transportation use for the elements of the Project. No land use conversions are anticipated for the PCC-Sylvania Shuttle or the station access improvements.

Table 4.2-3. Acres of Land Use Conversion

Project Element	Single- Family Residential	Multifamily Residential	Commercial or Industrial	Public or Institutional	Parks and Open Space	Utilities	Vacant	TOTAL
Light Rail Investment: Individual Elements								
Segment A alignment and stations	1.0	0.8	1.8	0.0	1.7	0.0	0.4	**5.7**
Segment B alignment and stations	1.1	0.8	11.5	4.6	0.0	0.0	1.8	**19.8**
Segment C alignment and stations	2.0	0.0	36.9	0.5	0.2	2.3	0.3	**42.2**
Marquam Hill Connection	0.0	0.0	0.0	0.0	0.6	0.0	0.0	**0.6**
PCC-Sylvania Shuttle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Hunziker O&M Facility[1]	0.0	0.0	9.3	0.0	0.0	0.0	0.0	**9.3**
Light Rail Investment: Totals								
Preferred Alternative	4.1	1.6	59.5	5.1	2.5	2.3	2.5	**77.6**
Upper Boones Ferry Terminus Option	4.1	1.6	57.6	5.1	2.5	2.3	2.4	**75.6**
Hall Terminus Option	4.1	1.6	53.6	4.5	2.5	2.3	0.3	**68.9**
Related Transportation Improvements								
Ross Island Bridgehead Reconfiguration	0.2	0.0	0.3	0.1	0.0	0.0	0.0	**0.6**
Station access improvements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Full Project								
Preferred Alternative + all related transportation improvements	4.3	1.6	59.8	5.2	2.5	2.3	2.5	**78.2**

Note: O&M = operations and maintenance; PCC = Portland Community College.

[1] Land use conversion at the Hunziker O&M Facility includes only the fully acquired parcels that result from the development of the facility. The remaining land use conversions at the facility are associated with and accounted for in the Segment C alignment and stations calculations.

Some of the properties to be acquired by the Project would leave some land available for redevelopment following light rail construction, which would reduce long-term impacts compared to full acquisition. Because much of the alignment follows existing rights of way, the acquisition impacts would be localized.

The Preferred Alternative would convert approximately 77.6 acres of existing land uses to a transportation use, but the level of conversion would not alter the overall patterns of land use. More detailed information about how the Project would impact land use is provided in the sections below.

Compatibility with State Planning Goals

The Project is consistent with the Statewide Planning Goal 12, which strengthens the connection between land use and transportation planning, and supports measures that encourage transit use and pedestrian and bicycle travel. Other key statewide planning goals are listed in Appendix B4.2.

Compatibility with Regional and Local Plans

The Project would be consistent with adopted regional plans and policies, including Washington County and Clackamas County plans, all of which encourage high quality transit serving growth centers, and transportation facility designs that encourage bicycle and pedestrian use. The Project would support planning goals by enabling greater growth in the Portland City Center, West Portland Town Center and Tigard Town Center by serving them directly with high capacity transit, allowing for development patterns of greater intensity that are not auto-dependent.

The Project would not alter total population or employment region-wide. While transit improvements can shape where new development and redevelopment occur within a region, which affects where population and employment growth would occur over time, adopted plans already anticipate this focused growth supported by transit. Metro's population growth projections already assume the Project and the cities' recently adopted land use regulations. The Project may quicken the pace of redevelopment and affect the details of individual developments, but growth in population and jobs is anticipated even with the No-Build Alternative through the year 2035. Additional discussion regarding the Project's potential impact on redevelopment and economic growth is provided in Section 4.18, Indirect and Cumulative Impacts.

The *Portland Comprehensive Plan* and *Climate Action Plan* have established a mode split goal of 25 percent of all trips on transit by 2035, and the 2035 RTP includes a goal of tripling transit mode share over 2005 levels. The Project supports these goals, because it is expected to result in more transit, bicycle and pedestrian uses.

The compatibility of the Project with plans at the local level is discussed by segment below.

Preferred Alternative: Segment A

Land Use Conversion

In Segment A, the Preferred Alternative would convert 6.3 acres of existing land uses to transportation use (see Table 4.2-3). This level of conversion would not alter the overall patterns of land use because the affected parcels are dispersed along the alignment.

Compatibility with Local Plans

In Segment A, the Preferred Alternative would be generally consistent with the overall intent of the *Barbur Concept Plan*, because it would increase accessibility for pedestrians, bicyclists and transit riders along SW Barbur Boulevard. The proposed station locations and the Marquam Hill Connection would be generally consistent with local plans by improving the pedestrian connection through Terwilliger Parkway. However, as Table 4.2-4 shows, the Marquam Hill Connection in Segment A would conflict with elements of the *Terwilliger Parkway Corridor Plan*, because the plan generally discourages development within wooded areas adjacent to SW Terwilliger Boulevard.

Table 4.2-4. Summary of Compatibility of the Preferred Alternative with Local Plans: Segment A

Local Plans	Compatibility of the Preferred Alternative: Segment A
Barbur Concept Plan	Generally consistent: · Transit improvements could support OHSU development and growth while helping protect the neighboring Lair Hill and South Portland Historic District. · The Marquam Hill Connection would address barriers to pedestrian and/or bicycle access between SW Barbur Boulevard, SW Naito Parkway, the neighborhood of Lair Hill, and the parks and the trails leading west to one of the main entrances of the OHSU Marquam Hill complex.
OHSU 20-Year Facilities Master Plan	Consistent: · The Marquam Hill Connection would address barriers to pedestrian access between SW Barbur Boulevard, SW Naito Parkway, the neighborhood of Lair Hill, and the parks and the trails leading west to one of the main entrances of the OHSU Marquam Hill complex.
Marquam Hill Plan	Generally consistent: · The Preferred Alternative would establish effective transit links throughout the OHSU campus. · It would increase pedestrian connections within the institutional area and between institutional, residential and open areas. · It would also enhance the range of access alternatives to Marquam Hill via development of a supplemental transportation option that links Marquam Hill with the regional transit system.
Terwilliger Parkway Corridor Plan and *Terwilliger Parkway Design Guidelines*	Generally consistent: · The Preferred Alternative would improve access to recreational uses along Terwilliger Parkway and reduce conflicts between increased travel demand, development and parkway character. · The Marquam Hill Connection would serve increasing travel demand between OHSU and SW Barbur Boulevard/South Portland without increasing vehicular trips through Terwilliger Parkway. · Improvements for the Marquam Hill Connection would replace wooded parkland and affect visual characteristics identified in goals and policies of the Terwilliger Parkway Corridor Plan, but these effects would be minimized with mitigation discussed in Section 4.7, Parks and Recreation Resources.

OHSU = Oregon Health & Science University.

Preferred Alternative: Segment B

Land Use Conversion

The Preferred Alternative in Segment B would convert 19.8 acres of land to transportation use from other uses (see Table 4.2-3). The existing land uses associated with these acquisitions are largely commercial or public use (including current use of the Barbur Transit Center for bus transfer and park and ride activities). This level of conversion would not alter the overall patterns of land use, because the affected parcels are dispersed along the alignment and commercial land would remain along the alignment.

Compatibility with Local Plans

The Preferred Alternative in Segment B would be consistent with the goals pertaining to transit-oriented development identified in the *Barbur Concept Plan* in that it includes stations in locations identified for medium density mixed-use development. It would also improve multimodal access along SW Barbur Boulevard and across I-5 for pedestrians, bicyclists and transit riders. The capacity of park and rides at nearby stations could increase automobile traffic in the area; however, allocation of these spaces would be informed by pending traffic analyses with the intent to avoid generating any new traffic impacts.

The PCC-Sylvania Shuttle and the sidewalk and bikeway improvements on SW 53rd Avenue would support PCC's campus master plan goals by improving overall mobility through better transit connections and pedestrian and bicycle access. Furthermore, the 53rd Station would support plan goals by converting land that is underdeveloped.

Preferred Alternative: Segment C

Land Use Conversion

The Preferred Alternative in Segment C would acquire properties in the Tigard Triangle and downtown Tigard, and then along the alignment adjacent to existing transportation facilities to Tualatin. In total, the Preferred Alternative would convert 51.5 acres of land to transportation use from other uses (see Table 4.2-3). The areas that would be converted to transportation use are primarily commercial and industrial land uses today, with some smaller areas of single-family residential in the Tigard Triangle and near downtown Tigard.

At a more localized level, the effect of the Preferred Alternative on land use patterns in the Tigard Triangle and downtown Tigard would affect several blocks of properties in a number of locations. The 68th Station and associated 350-space surface park and ride would convert several parcels along either side of SW 68th Parkway south of Pacific Highway, which include primarily commercial land uses today. The Preferred Alternative would include a new surface park and ride with about 100 spaces at the Hall Station, which would supplement the existing 103-space surface park and ride at the Tigard Transit Center. The 15-acre Hunziker O&M Facility would be located along the light rail alignment in the industrial area east of downtown Tigard; 9 acres of the facility would come from full acquisitions of parcels currently in industrial use. The Bonita and Upper Boones Ferry Stations would also convert adjacent parcels from commercial use to a transportation use. The alignment along the existing railroad tracks in this segment would largely avoid impacts to industrial lands.

Compatibility with Local Plans

In Segment C, the Preferred Alternative would have stations and other improvements including streets, paths and access elements that support the goals of the *Tigard Triangle Strategic Plan*, the City of Tigard's *Downtown Improvement Plan* and the *City of Tualatin Comprehensive Plan*, which are to increase multimodal access and provide an efficient and balanced transportation system.

The Preferred Alternative would include two stations in the Tigard Triangle (68th Station and Elmhurst Station) and one serving downtown Tigard (Hall Station). Together, the three station areas are expected to encourage more redevelopment and higher intensity land uses. The alignment between the Elmhurst Station and the Hall Station would support the City of Tigard's *Downtown Improvement Plan*, because it would connect the Tigard Triangle with downtown Tigard.

The Hunziker O&M Facility would be located along the light rail alignment in the industrial area east of downtown Tigard. The proposed facility would be compatible with all local plans and would not result in a change in land use in this area.

It is anticipated that changes to comprehensive plan policies and zoning maps would be desired to allow future land uses to complement the transportation improvements proposed by the Project.

Terminus Options

The terminus options, which would construct a portion of the Preferred Alternative alignment, would convert fewer acres of existing land uses to a transportation use (see Table 4.2-3) compared to the full-length Preferred Alternative.

Both terminus options would be less supportive of the *City of Tualatin Comprehensive Plan* than the Preferred Alternative, because they would not extend high capacity transit to the Bridgeport Station.

Related Transportation Improvements

Ross Island Bridgehead Reconfiguration

No major changes to the area land use patterns would be expected as a result of the Ross Island Bridgehead Reconfiguration, although it would open up around 3 acres of land for redevelopment that is currently occupied by roadways and ramps. The Ross Island Bridgehead Reconfiguration would support the goals of the National University of Natural Medicine's master plan by reconnecting neighborhood streets, and by increasing pedestrian and bicycle access currently separated by a busy roadway (SW Naito Parkway).

Station Access Improvements

The station access improvements stem from local transportation plans that support adopted land use plans and would not have a notable impact on existing land uses.

4.2.4. Short-Term Impacts

Construction of the Project would temporarily affect existing land uses due to construction activities (e.g., staging areas, earthmoving and truck traffic). Chapter 2, Alternatives Considered, describes the general construction approach for the Project. Temporary impacts include increases in noise levels, dust, traffic congestion, visual changes, and increased difficulty accessing residential, commercial and other uses. Although some land uses might experience inconveniences or hardships during construction, the level of temporary impacts would not rise to a level that would make a given land use unviable.

For more information on construction impacts, including impacts on the existing uses (i.e., businesses and residences) and measures to avoid, minimize and mitigate for those impacts, see Chapter 3, Transportation Impacts and Mitigation, and Sections 4.3, Economics; 4.4, Communities; 4.5, Visual Quality; 4.11, Noise and Vibration; and 4.12, Air Quality and Greenhouse Gases.

In areas that may not be permanently acquired, project construction activities would require temporary construction easements, including on public lands owned by Oregon Department of Transportation and local jurisdictions. Construction easements would be temporary, and the property would be returned to preconstruction conditions upon completion of the construction activities.

Finally, some larger parcels that could be acquired for construction of the Project could have remnant portions that may not be immediately redeveloped following the construction of the Project. The potential temporary presence of vacant lands along the alignment or near stations would be less consistent with applicable plans that envision a dense, vibrant mix of land uses along the corridor.

4.2.5. Comparison to Impacts of the Draft EIS Light Rail Alternatives

The Draft EIS light rail alternatives would convert between 64.4 and 91.5 acres of land to a transportation use, compared to 77.6 acres for the Preferred Alternative. For both the Draft EIS light rail alternatives and the Preferred Alternative, the impact from land use conversion would be minor in the context of both local and regional land supply. Land that would be converted to a transportation use as a result of the Project would be compatible with the local plans and policies shown in Table 4.2-2.

4.2.6. Mitigation Measures

No mitigation would be required for impacts to land use by the Project, as summarized in Table 4.2-5.

Table 4.2-5. Mitigation Measures for Land Use Impacts

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
Long term	Land use conversion	None required. TriMet would follow requirements outlined in Section 4.1, Acquisitions, Displacements and Relocations. TriMet could also partner with property owners and local agencies to plan for optimal use of property no longer needed after construction.	None required. Project sponsors would comply with applicable regulations and guidance related to land use acquisition.
Long term	Local plan compatibility	None required. Long-term land use impacts would be compatible with existing plans and policies.	None required. Long-term land use impacts would be compatible with existing plans and policies.
Short term	Use of property during construction	None required.	None required.

Long-Term Mitigation

No long-term land use impacts requiring mitigation have been identified for the Project. Overall, the Project would be consistent with state, regional and local land use plans, policies and goals. While some localized areas would experience changes to existing land uses, the compensation and relocation assistance described in Section 4.1, Acquisitions, Displacements and Relocations, would mitigate the effects on affected property owners and tenants. The impact from land use conversion would be minor in the context of both local and regional land supply. In some cases, existing property owners would retain ownership of portions of their property no longer needed after construction and could redevelop those areas consistent with applicable zoning. For portions of the properties not retained by the original owner, TriMet could partner with local jurisdictions to promote redevelopment that is compatible with local plans and policies.

Short-Term Mitigation

No mitigation would be required for short-term land use impacts. During construction, potential temporary impacts to existing land uses could be mitigated, as described in other sections of this Final EIS, including in Chapter 3 and in Chapter 4 sections on air quality, economics, noise and vibration, visual quality and ecosystems.

4.3 Economics

This section describes demographic and economic existing conditions and trends in the greater Portland metropolitan area as well as within the Southwest Corridor. This section provides context for a discussion of potential short-term and long-term economic impacts, whether beneficial or adverse, that may be directly caused by the Project. See Section 4.18, Indirect and Cumulative Impacts, for a discussion of likely indirect and cumulative impacts. Section 4.18 also includes information about how TriMet and Metro are working with other project partners to address regional economic and livability concerns.

This section evaluates impacts at several levels of the local and regional economy, and the municipal level in Multnomah and Washington Counties, focusing on the three cities intersecting the proposed Project: Portland, Tigard and Tualatin. For these jurisdictions, property tax revenues and employment could be impacted by acquisitions and relocations, as well as by other direct and indirect impacts. Appendix B4.3, Supplemental Economic Data, provides additional data to support the analysis presented below.

Since the publication of the Draft EIS, this section has been updated to reflect the definition of the Project in this Final EIS, and to respond to comments received on the Draft EIS.

4.3.1 Affected Environment

Economic conditions are described here at several levels, starting at the broader regional level, as defined for the seven-county Portland-Vancouver-Hillsboro Metropolitan Statistical Area (MSA) (referred to here as "the Portland MSA"), and at the corridor jurisdictional level for Multnomah and Washington Counties and the local municipalities of Portland, Tigard and Tualatin.

Demographic and Economic Trends

Population in the city of Portland grew by 1.4 percent annually between 2010 and 2018, approximately double the national growth rate. Over the same period, Tigard's population grew even faster, at nearly 1.6 percent annually, due largely to a surge in growth in 2017 and 2018. Tualatin's population grew by 0.7 percent per year, matching the nationwide annual rate. See Figure 4.3-1 for a chart of past population growth.

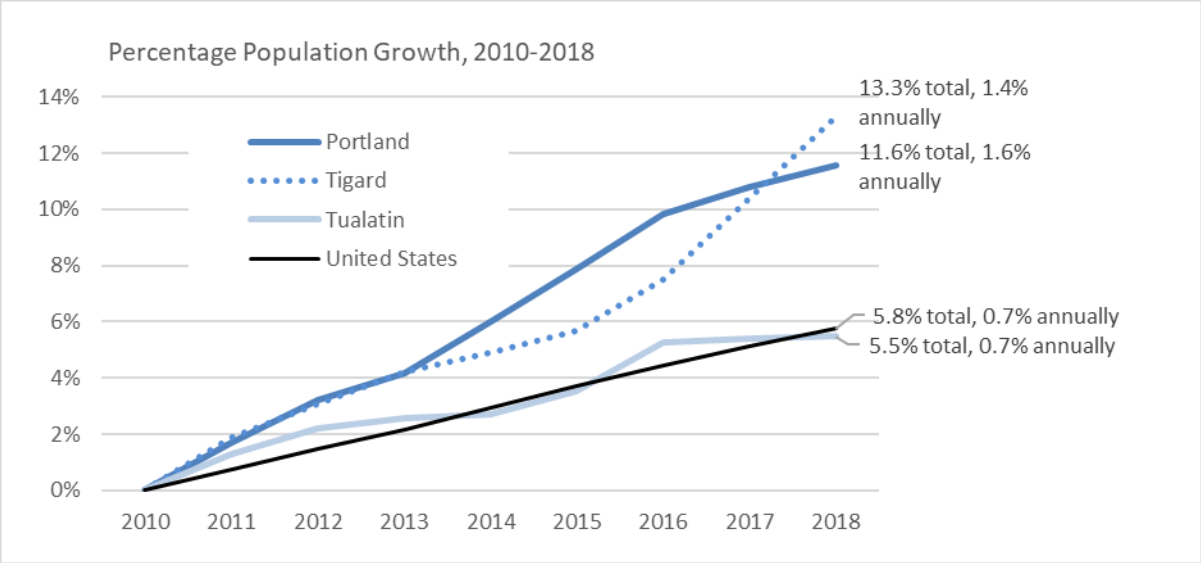
As of 2015, the overall Portland metropolitan area was approaching 1.1 million employees, 2.3 million residents and just over 850,000 households. The city of Portland accounts for approximately 32 percent of the population and 41 percent of the jobs within the Portland MSA. Within the city of Portland, there are 1.66 jobs per household, a substantially higher ratio than the Portland MSA's jobs/housing ratio of 1.26. Tigard and Tualatin are smaller municipalities, with populations of 46,000 and 28,000, respectively, as of 2015. While suburban in location, these cities both have considerable employment clusters and in fact have much higher jobs/housing ratios (2.40 and 2.68, respectively) than the city of Portland.

Housing Affordability

Housing affordability was a common topic raised in the Draft EIS public comments. In response, additional information on housing affordability is included here for economics, as well as in Section 4.1, Acquisitions, Displacements and Relocations; Section 4.4, Communities; and Section 4.18, Indirect and Cumulative Impacts. The Portland metropolitan area, like many other fast-growing urban areas in the United States, has experienced increases in rents and home prices, largely attributed to an imbalance of housing supply to

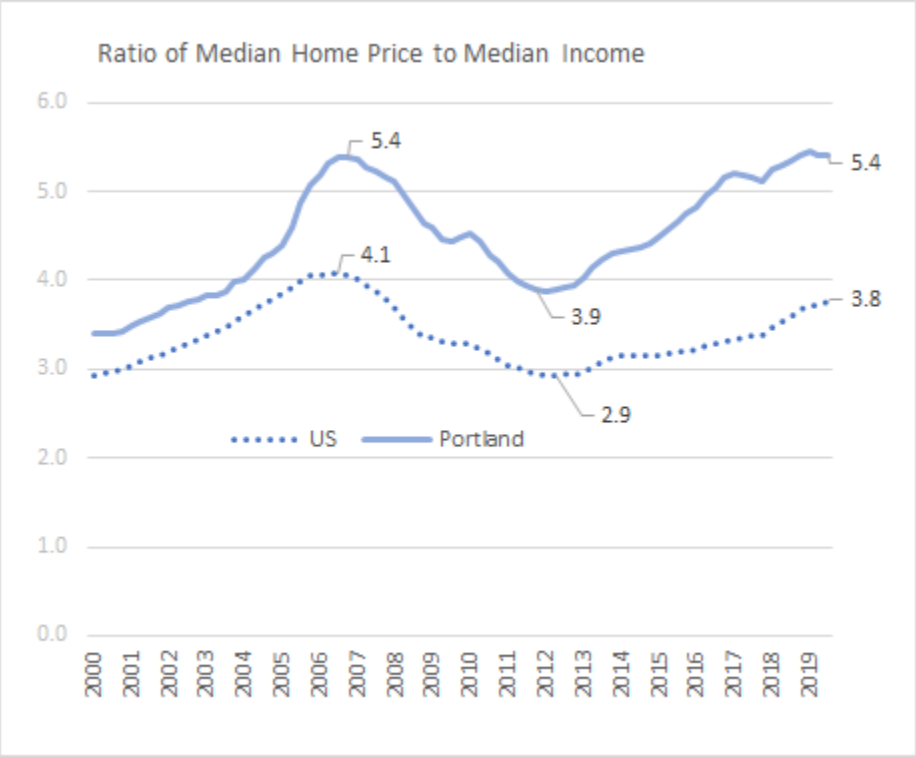
the demand posed by growth. One measure of affordability compares prevailing home prices to resident incomes. As shown in Figure 4.3-2, as of mid-2019, the ratio of median home prices to median incomes in the city of Portland was 5.4-to-1, versus a ratio of 3.8-to-1 nationwide. This ratio has risen substantially since Great Recession-era lows in 2012 of 3.9 in Portland and 2.9 in the nation.

Figure 4.3-1. Overall Population (by Year) Increase Since 2010



Sources: U.S. Census Bureau and Leland Consulting Group.

Figure 4.3-2. Ratio of Median Home Price to Median Income, 2000–2019

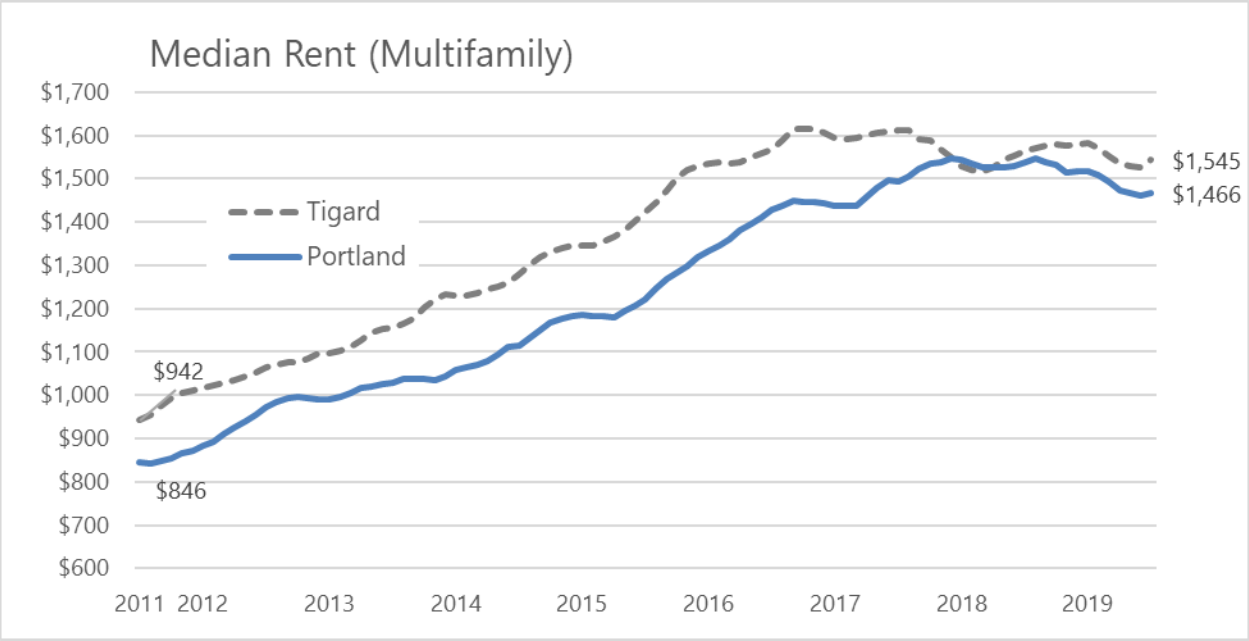


Sources: U.S. Census Bureau and Leland Consulting Group.

In Multnomah County, 46 percent of households are renters. The prevailing "fair market" monthly rent in 2019 for a one-bedroom apartment in the county was $1,234; however, households earning the renter median income of $40,263 can only afford to pay $1,007. Studies show 30 percent of renters (some 43,000 households) can reasonably afford just $659 a month towards housing. In Washington County, statistics are similar, but the median income is slightly higher and the percentage of renters is slightly lower, at 39 percent of households.[1]

From late 2011 to 2019, rents in the city of Portland rose 64 percent, while Tigard's went up by 73 percent (see Figure 4.3-3).

Figure 4.3-3. Median Rent in Portland and Tigard, 2011–2019



Source: Zillow

Property Tax Revenue

Property taxes are the largest single revenue source for each affected city in the project area, representing between 33 percent and 39 percent of all government revenues for the period from 2017 to 2018. See Appendix B4.3 for a table of property tax revenue for each jurisdiction in the study area.

4.3.2 No-Build Alternative

From the long-range regional perspective for the Portland MSA, the No-Build Alternative is assumed to experience continued economic growth from 2015 to 2035. These forecasts show population and economic growth occurring over the next several decades throughout the metropolitan area, with greater than 1.0 percent growth annually. While this growth would be slightly slower than past trends, it would continue to make the Portland MSA one of the fastest growing parts of the country. In the city of Portland, employment growth is expected to be somewhat constrained by land availability, with 1.0 percent annual projected employment growth in the city versus up to 1.5 percent annual growth in employment in other

[1] These statistics come from the National Low Income Housing Coalition's Out of Reach 2019 report, using data from the U.S. Department of Housing and Urban Development (for 2019 fair market rents) and the U.S. Census American Community Survey 2013–2017 estimates (for renter household statistics).

areas of the Portland MSA, including Tigard and Tualatin. Periodic economic disruptions, including the COVID-19-related economic disruptions beginning in 2020, may occur, but long-term growth is still expected. See Appendix B4.3 for a table showing the projected growth in population, households and employment across the metropolitan area as well as for the individual cities intersecting the Project.

Under the No-Build Alternative, the Project's direct property acquisitions and construction impacts within the cities of Portland, Tigard and Tualatin would not occur. As discussed in Section 4.2, Land Use, these cities' land use plans as well as Metro's *2040 Growth Concept* have been tailored to accommodate and manage this future growth by encouraging more concentrated land uses supported by transit in the Southwest Corridor. These land use plans are directly tied to regional and local economic visions, which see transit as a stimulus for economic development because it would connect vibrant local centers where new employment and housing opportunities would be concentrated. The No-Build Alternative would not make the major transit investment and related transportation improvements in the corridor, and these areas would lack a key stimulus to support their planned economic growth.

4.3.3 Long-Term Impacts

The primary source of long-term direct economic impacts of the Project is related to the conversion of developed or developable property to a transportation use, as described in Section 4.1, Acquisitions, Displacements and Relocations, and Section 4.2, Land Use. These changes to land uses would result in business and employee displacements and relocations, which could affect economic activity. The acquisition and removal of housing could also affect housing supply and affordability. The changes to both types of property would affect property tax revenue from the affected parcels. Other direct changes to municipal tax revenue would be minor; Oregon municipalities do not collect local sales tax, and business and employment taxes do not represent substantial sources of revenue.

Impacts of Business and Employment Displacements

Any permanent displacement of a business or other establishment due to the Project may result in long-term adverse economic impacts as businesses relocate or potentially cease operations. Table 4.3-1 estimates the number of businesses and employees that the Project would displace as a result of property acquisitions. In total, the Preferred Alternative would displace approximately 114 businesses with an estimated 1,418 employees. Compared to the Preferred Alternative, the Upper Boones Ferry Terminus Option would displace one fewer business and the Hall Terminus Option would displace nine fewer businesses. For both terminus options, if and when the remaining part of the line is built, the total impacts would be the same as the full-length Preferred Alternative. The related transportation improvements are not anticipated to result in any business displacements.

See Section 4.1, Acquisitions, Displacements and Relocations, for more information on how acquisitions and displacements have been estimated, as well as TriMet's compensation and relocation assistance commitments. If some of these businesses relocate in the same city or general area, business-related adverse impacts would be reduced. Employment (number of affected employees) is listed separately from displacements, because some businesses might choose not to relocate in the same area, which could affect their employees. TriMet's experience with past projects shows that most employers choose to relocate in the same cities. Therefore, the displacement numbers summarized in Table 4.3-1 would not equate to long-term net job losses for the affected cities.

Table 4.3-1. Estimated Business and Employment Displacements

Project Element	Number of Displaced Businesses or Institutions	Number of Affected Employees
Light Rail Investment: Individual Elements		
Segment A alignment and stations	13	150
Segment B alignment and stations	66	447
Segment C alignment and stations	33	791
Marquam Hill Connection	0	0
PCC-Sylvania Shuttle	0	0
Hunziker O&M Facility	2	30
Light Rail Investment: Totals		
Preferred Alternative	114	1,418
Upper Boones Ferry Terminus Option	113	1,413
Hall Terminus Option	105	1,281
Related Transportation Improvements		
Ross Island Bridgehead Reconfiguration	0	0
Station access improvements	0	0
Full Project		
Preferred Alternative + all related transportation improvements	114	1,418

Note: O&M = operations and maintenance; PCC = Portland Community College.

Most of the business and employment displacements in the city of Portland would occur within service industries such as dining/drinking establishments, retail and lodging. Some financial sector businesses (including insurance and real estate) would also be affected in Portland. None of the displacements would exceed 1 percent of citywide employment by major industry segment.

In Tigard, retail and food service businesses would account for many of the affected jobs, along with one plastics manufacturing establishment employing approximately 120 that could be more difficult to relocate within Tigard. Displacement of those 120 employees would represent just under 6 percent of Tigard's citywide manufacturing base. The Hunziker O&M Facility to be located in Tigard would employ approximately 150 people, which would offset the employment loss within Tigard. No businesses would be displaced in Tualatin.

Impacts of Property Acquisitions on Tax Revenue

The Project would acquire residential and commercial properties and convert them to public ownership, which would make them exempt from property taxes. Table 4.3-2 estimates the annual property tax impact of these property acquisitions on affected cities based on current tax bills for parcels that would be converted to untaxable use. These expected property tax impacts are based on anticipated full property acquisitions (see Section 4.1, Acquisitions, Displacements and Relocations).

Overall, the reduction in property tax revenue due to acquisitions from the Preferred Alternative or the terminus options would be negligible for the cities of Portland, Tigard and Tualatin, with less than 0.02 percent of total annual tax revenues affected. These cities collected $583 million, $18 million and $10 million in property taxes in the 2017–2018 fiscal year, respectively, and property taxes account for between 33 to 39 percent of their total revenues. Some of the land purchased for the construction of the

Preferred Alternative might not be permanently needed and could be released for development after construction, potentially returning affected land to taxable property status.

The related transportation improvements are assumed to have no impact on property tax revenue because they are not expected to result in any full property acquisitions.

Table 4.3-2. Property Tax Loss by City

Project Element	Estimated Property Tax Loss		
	City of Portland	City of Tigard	City of Tualatin
Light Rail Investment: Individual Elements			
Segment A alignment and stations	$253,300	$0	$0
Segment B alignment and stations	$647,200	$0	$0
Segment C alignment and stations	$0	$410,400	$22,700
Marquam Hill Connection	$0	$0	$0
PCC-Sylvania Shuttle	$0	$0	$0
Hunziker O&M Facility	$0	$29,000	$0
Light Rail Investment: Totals			
Preferred Alternative	$900,500	$439,400	$22,700
Upper Boones Ferry Terminus Option	$900,500	$435,900	$0
Hall Terminus Option	$900,500	$356,600	$0
Related Transportation Improvements			
Ross Island Bridgehead Reconfiguration	$0	$0	$0
Station access improvements	$0	$0	$0
Full Project			
Preferred Alternative + all related transportation improvements	$900,500	$439,400	$22,700

Source: Multnomah County and Washington County assessors; TriMet right of way estimates.
Note: O&M = operations and maintenance.

Impacts on Housing Affordability

The Preferred Alternative and the terminus options would remove 95 housing units, including a mix of single-family and multifamily units, as described in Section 4.1, Acquisitions, Displacements and Relocations. None of these units are government-supported public housing properties, but they may be "naturally-occurring" affordable housing (properties with relatively low rents). As discussed in Section 4.1, TriMet would provide fair market value compensation to the property owners and would also provide relocation assistance to qualified residents, which includes a commitment to find comparable replacement housing that would be affordable to them.

The removed units represent a small proportion of the overall regional housing supply and would not directly impact the housing economy. Even if all of these removed housing units were affordable units, they

would also represent a small proportion of the supply of affordable housing, accounting for less than 0.01 percent of the available supply of affordable housing units in Multnomah and Washington Counties.[2]

The related transportation improvements would not remove any housing units.

4.3.4 Short-Term Impacts

The construction of the Project would generate employment and economic activity broadly but also would have direct negative short-term effects to businesses in the vicinity of construction activity. These impacts are described below.

Positive Impacts from Construction Capital Expenditures

Construction increases employment and brings money into the economy from construction workers' wages and their purchases of local goods and services. Constructing the Project would increase employment and associated consumer spending in the project vicinity during construction. The extent of these temporary beneficial impacts would depend on the source of project funding and the composition of work crews used during project construction.

Of a total potential capital investment of up to $2.6 billion for the Preferred Alternative, approximately $2.0 billion would be spent on professional services and general construction and would be likely to expand the Portland MSA economy in the short term. Of this total, an estimated 60 percent, or just more than $1.2 billion, is expected to be paid for with state and federal funding sources that are outside of the Portland MSA economy, and thus constitute "new dollars" flowing into the area. See Chapter 5, Evaluation of Alternatives, for more details on the anticipated capital cost and finance plan for the Preferred Alternative.

The $2.0 billion in total construction cost (regardless of funding source) would be multiplied by recirculation in the local economy due to business-to-business local purchasing (indirect effects) and increased worker household spending (induced effects).[3] Based on this multiplier effect, the short-term influx of money from the Preferred Alternative would be likely to result in a one-time total impact of approximately:

- $3.1 to $3.27 billion in economic output (total value of goods and services) for the MSA
- $1.3 to $2.2 billion in Portland MSA earnings (wages and proprietor income)
- 26,700 to 32,000 (person-year) jobs

Construction of the terminus options would result in a smaller influx of money and fewer jobs compared to the Preferred Alternative due to the reduced capital cost. Positive economic impacts from construction have not been quantified for the related transportation improvements, but the improvements would result in positive short-term economic benefits.

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[2] Based on data from the National Low Income Housing Coalition's Out of Reach 2019 report, in Portland/Multnomah County in 2020, there were 300 low-income housing apartment communities (offered by either public or private owners) with 20,564 affordable rental units. In Washington County there were nearly 80 low-income housing apartment communities offering 4,349 affordable rental units.

[3] Estimates for indirect and induced multipliers are taken from the U.S. Bureau of Economic Analysis Regional Input-Output Modeling System (RIMS II), using the Portland MSA as the region of interest. The higher end of the ranges is calculated using the IMPLAN model estimate (IMPLAN Group LLC, IMPLAN 2020, Huntersville, NC. IMPLAN.com).

Negative Impacts from Construction

Construction can also negatively affect business establishments by reducing their visibility or making access more difficult as a result of increased congestion and detours. Short-term impacts would occur to nearby businesses as a result of noise, dust, construction traffic and restricted access. Potential customers might choose to avoid businesses due to real or perceived inconvenience caused by construction activities. Similar to all of TriMet's major construction projects, the Preferred Alternative or the terminus options feature an ongoing community and business outreach and involvement program that includes final design coordination, a construction planning outreach and communications plan, construction hotlines, construction information systems, public notices, signage, and marketing and communications assistance programs to help businesses both maintain operations and serve their customers.

The related transportation improvements could also have negative effects on nearby businesses during construction, but these effects are anticipated to be smaller in scale, less severe and shorter in duration compared to those of the Preferred Alternative. The related transportation improvements would feature final design coordination, construction planning and outreach to minimize the impacts, scaled to the size of the improvement and the potential for impacts to nearby businesses.

4.3.5 Comparison to Impacts of the Draft EIS Light Rail Alternatives

The economic impacts identified for the Project in this Final EIS remain similar to those identified in the Draft EIS. Refinement of the light rail alternatives in the Draft EIS into the Preferred Alternative changed the acquisitions and displacements, resulting in different estimates of property tax revenue and employment impacts. Table 4.3-3 compares the range of impacts presented in the Draft EIS to the results of the Final EIS analysis.

Table 4.3-3. Comparison of Economic Impacts Between the Draft EIS and the Final EIS

	Properties Impacted		Property Tax Loss		
	Displaced Businesses or Institutions	Affected Employees	City of Portland	City of Tigard	City of Tualatin
Draft EIS					
Full-corridor project range[1]	106–156	961–2,284	$144,098–$313,705	$72,390–$290,245	$19,188
Final EIS					
Preferred Alternative or full Project[2]	114	1,418	$900,500	$439,400	$22,700

Note: EIS = Environmental Impact Statement.

[1] The full-corridor project range is defined as the range representing the lowest and highest possible sum of impacts from a composite of one alignment alternative within each segment, a Marquam Hill Connection, a Portland Community College Sylvania campus shuttle option, and an operations and maintenance facility option, as presented in the Draft EIS.

[2] The full Project is defined as the Preferred Alternative plus the related transportation improvements. The related transportation improvements are not anticipated to cause additional business or institutional displacements, or reductions in property tax revenues resulting from acquisitions.

4.3.6 Mitigation Measures

Table 4.3-4 summarizes the mitigation measures that would address long-term and short-term economic impacts of the Project.

Table 4.3-4. Mitigation Measures for Economic Impacts

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
Long term	Business displacement	None required. As outlined in Section 4.1, TriMet would comply with the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970; Chapter 35 of the Oregon Revised Statutes; and TriMet's acquisition and relocation policy, procedures, and guidelines.	None required.
Long term	Tax loss due to property conversion	None required. The loss of tax revenue from converted properties represents a small portion of municipal revenues.	None required.
Long term	Affordable housing	None required. Displaced housing units would not adversely affect regional supply, and consistent with the Uniform Relocation Assistance and Real Property Acquisition Policies Act, TriMet would provide compensation to business owners and qualified residents.	None required.
Short term	Disruptions to business activities during construction	TriMet would provide notices and signage to maintain business accessibility and visibility during construction. As part of the Project, TriMet would coordinate with businesses affected during construction, including providing business hotlines to report construction concerns and updates; programs offering business planning assistance, marketing and retail consulting; business-oriented workshops; and promotions to generate patronage.	None required.

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4.4. Communities

This section describes how the Project would affect the surrounding communities. The analysis considers impacts to neighborhood cohesion, neighborhood quality of life and community facilities, which are defined as follows:

- **Neighborhood cohesion** is the sense of community within a neighborhood resulting from opportunities for interaction and features of the neighborhood that contribute to a shared identity.
- **Neighborhood quality of life** is the satisfaction residents derive from living in the neighborhood from factors such as aesthetics, noise, affordability and transit access.
- **Community facilities** include land uses that are important to the social characteristics or function of neighborhoods, such as parks, schools, religious institutions and community centers.

The analysis of impacts to communities is based on the impacts and mitigation identified in other sections within this Final EIS. Appendix B4.4, Communities Background Information, includes tables that identify long-term, short-term and indirect impacts that could result in an impact to neighborhood cohesion, neighborhood quality of life or community facilities.

In addition to neighborhoods and community facilities, this analysis considers impacts to transit-dependent populations. This analysis focuses on the following populations that are more likely to rely on transit than the overall population:

- minority (population not identifying as both "white alone" and "non-Hispanic")
- low income (population earning below 200 percent of the federal poverty level, or about $50,200 annually for a family of four in 2018)
- limited English proficiency (population speaking English less than "very well")
- older adults (population age 65 and over)
- youth (population age 21 and under)
- limited vehicle access (households with zero vehicles or one vehicle and two or more workers)
- people with disabilities

Information on impacts to minority and low-income populations in the context of environmental justice compliance is provided in Appendix C, Environmental Justice Compliance.[1]

Since publication of the Draft EIS, this section has been updated to reflect the definition of the Project for this Final EIS and any associated impacts identified in other disciplines within this Final EIS. In addition, this analysis recognizes concerns raised during the Draft EIS comment period regarding impacts to neighborhoods, community facilities and transit-dependent populations. For more information on public

[1] This EIS is addressing environmental justice in compliance with Presidential Executive Order 12898, Federal Actions to Address Environmental Justice to Minority Populations and Low-Income Populations (February 11, 1994); the U.S. Department of Transportation (USDOT) Order 5610.2, Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (April 15, 1997); and the USDOT Order 5610.2(a) (May 2, 2012) updating the USDOT policy to consider environmental justice principles in all programs, policies and activities.

comments and responses to comments, see Chapter 7, Draft EIS Comment Summary, and Appendix J, Draft EIS Comments and Responses.

4.4.1. Affected Environment

The community impacts analysis focuses on 19 study neighborhoods that are located fully or predominantly within a 0.5-mile buffer of the Preferred Alternative alignment (see Figure 4.4-1). This section provides an overview of the characteristics of the study neighborhoods and the broader Southwest Corridor related to neighborhood cohesion, neighborhood quality of life and community facilities. The study neighborhoods are also described individually in more detail in Appendix B4.4.

Downtown Portland, at the northern end of the corridor, contains the region's densest concentration of employment. The close-in Homestead and South Portland neighborhoods contain several large medical and educational institutions as well as clusters of single-family homes and multifamily residences as large as 30 stories tall. The South Portland neighborhood includes the South Portland Historic District (see Section 4.6, Historic and Archaeological Resources).

The outer portion of Southwest Portland contains primarily single-family neighborhoods, with commercial and multifamily land uses concentrated along major roadways such as SW Barbur Boulevard and SW Capitol Highway. The Hillsdale and Multnomah neighborhoods feature distinct town centers made up of relatively low-density commercial land uses such as shops and restaurants.

A swath of commercial land surrounds Highway 217 and Interstate 5 (I-5) in the cities of Beaverton, Tigard and Tualatin, including office, retail and manufacturing businesses. Single-family housing surrounds these commercial and industrial areas. Multifamily housing is located primarily along major roadways such as Pacific Highway (designated as Oregon Route 99W) and in each city's downtown.

Circulation and Barriers

The street network in much of the corridor is winding and discontinuous as a result of the hilly topography and suburban-style development patterns. Throughout the corridor, major roadways, rivers and rail lines obstruct connectivity and separate neighborhoods. High traffic volumes are funneled onto the streets that do cross these barriers, resulting in congestion for cars, trucks and buses, and less comfortable conditions for bicycling and walking.

Walking and bicycling are challenging in many parts of the corridor because of poor street connectivity; unimproved roads; steep terrain; high volumes and speeds of auto traffic; and limited sidewalks, bikeways and safe crossings. Transit service is relatively limited in the corridor. Bus travel times are somewhat slow, because many of the bus lines take circuitous routes along the non-gridded arterial and collector streets in the corridor. The Westside Express Service (WES) Commuter Rail and many bus lines operate either during peak periods only or with limited service frequencies during off-peak periods.

Transit-Dependent Populations

In general, the Southwest Corridor has a lower proportion of transit-dependent populations than the region overall, with the exception of older adults and households with limited vehicle access (see Table 4.4-1). Along the light rail alignment, the highest concentrations of transit-dependent populations are located in downtown Portland and in Tigard, Tualatin and Durham (see Appendix B4.4 for maps and a more detailed table by study neighborhood). In particular, these neighborhoods have a higher proportion

of minority residents, low-income households and households with limited vehicle access than the region overall.

Table 4.4-1. Percentage of Transit-Dependent Populations in the Corridor and Region

Transit-Dependent Population[1]	Southwest Corridor[2]	Region[3]
Minority	21%	28%
Low income	23%	28%
Limited English proficiency	4%	7%
Older adults	15%	14%
Youth	19%	20%
Limited vehicle access	14%	14%
People with disabilities	9%	10%

Source: American Community Survey (2014–2018).

[1] **Minority** = population *not* identifying as both "white alone" and "non-Hispanic"; **low income** = population earning below 200 percent of the federal poverty level, or about $50,200 per year for a family of four in 2018; **limited English proficiency** = population speaking English less than "very well"; **older adults** = population age 65 and over; **youth** = population age 21 or under; **limited vehicle access** = households with zero vehicles or one vehicle and two or more workers; **people with disabilities** = population with disabilities.

[2] See Chapter 1, Project Introduction, for a map of the overall Southwest Corridor boundary.

[3] Defined as the Metropolitan Planning Area boundary.

Community Facilities

The study neighborhoods contain many community facilities, including parks, public schools, places of worship, hospitals, farmers markets, and a range of government facilities such as fire stations and city halls. Figure 4.4-1 shows the location of existing community facilities within the study neighborhoods. See Appendix B4.4 for a list of the community facilities within each study neighborhood.

4.4.2. No-Build Alternative

The No-Build Alternative is assumed to not directly displace any residents, businesses or community facilities. Overall, cohesion within the study neighborhoods would remain relatively similar to today, with some localized changes over time as residents and businesses relocate for other reasons. While some improvements would be made to sidewalks, bikeways and crosswalks, there would be no major investments that could greatly enhance cohesion within the study neighborhoods that have incomplete walking and bicycling infrastructure today.

Quality of life in many of the study neighborhoods could worsen under the No-Build Alternative as a result of reduced mobility. Traffic congestion is anticipated to increase in future years under the No-Build Alternative. Neighborhoods located along major roadways would be most likely to experience increased cut-through traffic. Although TriMet is planning to add new bus routes and improve service frequencies on existing routes, bus travel times and reliability would worsen as a result of the increased congestion.

4.4.3. Long-Term Impacts

Neighborhood Cohesion, Neighborhood Quality of Life and Community Facilities

Table 4.4-2 describes the potential long-term impacts to neighborhood cohesion, neighborhood quality of life and community facilities by project element.

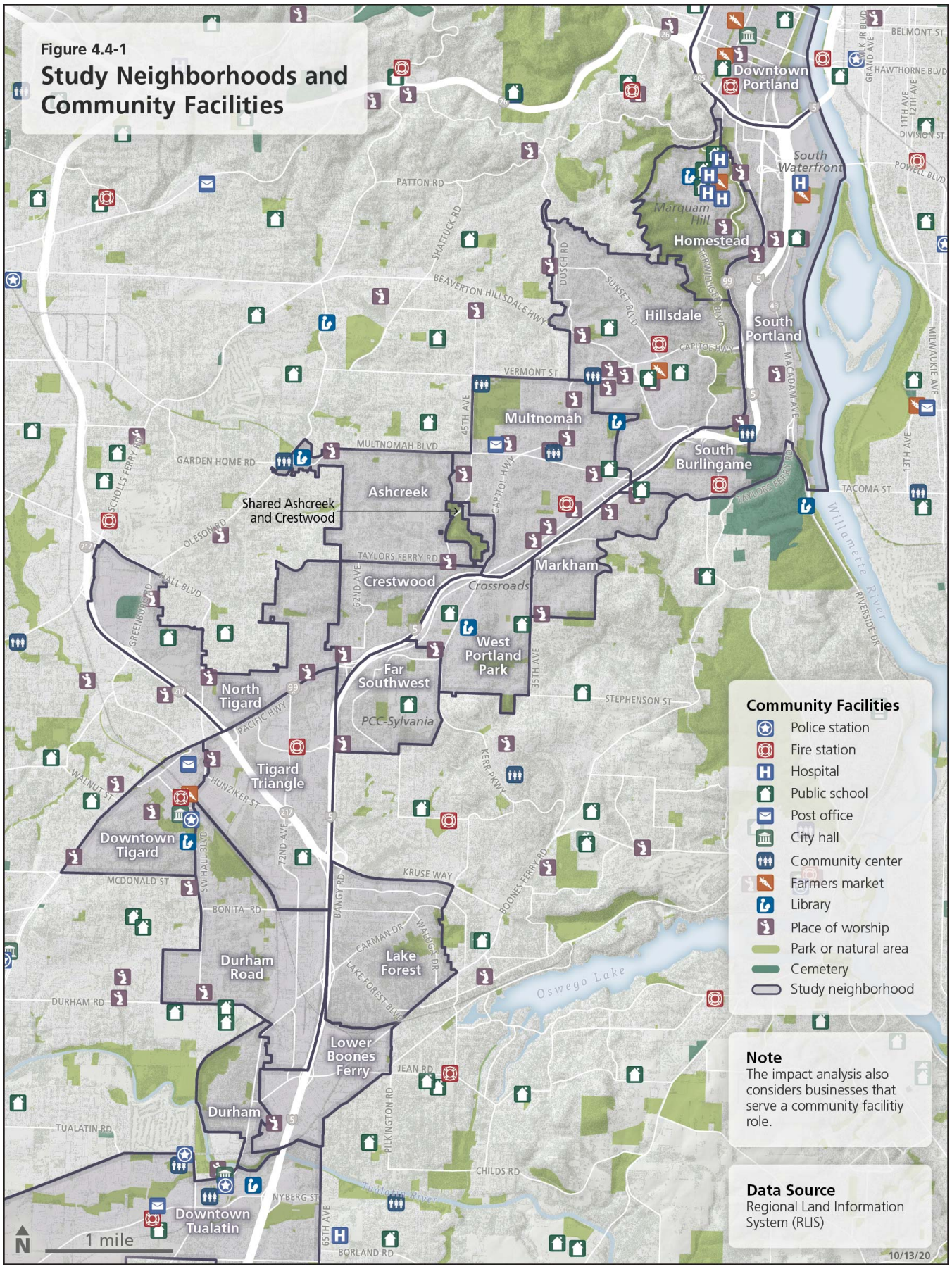
Figure 4.4-1
Study Neighborhoods and Community Facilities
Downtown Portland
South Waterfront
Marquam Hill
Homestead
Hillsdale
South Portland
Multnomah
South Burlingame
Ashcreek
Shared Ashcreek and Crestwood
Crestwood
Crossroads
Markham
West Portland Park
Far Southwest
PCC-Sylvania
North Tigard
Tigard Triangle
Downtown Tigard
Durham Road
Lake Forest
Lower Boones Ferry
Durham
Downtown Tualatin
Oswego Lake
Willamette River
Tualatin River
Community Facilities
Police station
Fire station
Hospital
Public school
Post office
City hall
Community center
Farmers market
Library
Place of worship
Park or natural area
Cemetery
Study neighborhood
Note
The impact analysis also considers businesses that serve a community facilitiy role.
Data Source
Regional Land Information System (RLIS)
N
1 mile
10/13/20

Table 4.4-2. Long-Term Community Impacts *(multipage table)*

Project Element	Neighborhood Cohesion	Neighborhood Quality of Life	Community Facilities
Light Rail Investment: Preferred Alternative			
Overall Preferred Alternative	· Overall cohesion in the adjacent neighborhoods would remain intact, though residential and business displacements could disrupt individual social ties. TriMet would offer relocation assistance, as described in Section 4.4.6, but the new residence and business locations would be dependent on the preferences of the affected residents and business owners as well as market availability at the time of relocation. · The alignment would typically run within or parallel to existing major roadways or railroads along the boundaries between neighborhoods.	· Overall, the Preferred Alternative would improve quality of life in the surrounding neighborhoods by providing faster and more reliable transit options. · Light rail operations would introduce a new source of noise and vibration along the alignment, primarily adjacent to other sources of noise, such as roadways and railroads.	*Impacts to specific community facilities are identified below for the individual elements of the Preferred Alternative.*
Segment A alignment and stations	· The light rail trackway would not create any new barriers within neighborhoods, because it would run along SW Barbur Boulevard, which generally follows the boundary between the South Portland and Homestead neighborhoods. New signalized intersections and pedestrian crossings would improve access across SW Barbur Boulevard at certain locations. · Walking access would be improved due to new or replaced sidewalks along SW Barbur Boulevard. Bicycling access would be improved on SW Barbur Boulevard south of SW Naito Parkway due to new raised protected bikeways, including on the new bridges that would replace the Newberry and Vermont trestle bridges. · The Preferred Alternative would add a signalized pedestrian crossing of SW Naito Parkway at SW Gibbs Street, which would help to reduce the effect of SW Naito Parkway as a barrier dividing the South Portland neighborhood. · The Preferred Alternative would displace 35 residential units and 13 businesses or institutions with an estimated 150 employees. The displacements would be relatively dispersed along the alignment, but with a small cluster of residential units and businesses displaced near SW Hamilton Street.	· The Project would improve transit access for the South Portland and Homestead neighborhoods, which would be served by the Gibbs and Hamilton Stations. Although local bus service would be reduced, light rail would provide faster and more reliable transit service with greater capacity. · The shared transitway would improve bus travel times and reliability between the Downtown Portland and the Hillsdale and Multnomah neighborhoods. · Some traffic would shift from SW Barbur Boulevard to SW Macadam Avenue, SW Terwilliger Boulevard and SW Corbett Boulevard. · The Preferred Alternative would remove 24 existing on-street parking spaces along SW Barbur Boulevard near Duniway Park and 6 spaces along SW Pennoyer Street. Eliminating these spaces could reduce neighborhood quality of life by increasing demand for remaining on-street parking.	· The Project would improve transit access to the medical and educational facilities in the Homestead and South Portland neighborhoods, including OHSU, VA Portland and NUNM. · The Preferred Alternative would acquire parcels that are used as parking for the Tabernacle Seventh-Day Adventist Church. · The Preferred Alternative would acquire portions of Duniway Park, Lair Hill Park and Terwilliger Parkway, but would not reduce the functionality of these parks.

Table 4.4-2. Long-Term Community Impacts *(multipage table)*

Project Element	Neighborhood Cohesion	Neighborhood Quality of Life	Community Facilities
	· The Preferred Alternative would affect the South Portland Historic District, including full acquisitions of 5 homes that contribute to the district's historic eligibility. These impacts could detract from the identity of this portion of the South Portland neighborhood as a historic district. · The Preferred Alternative would affect the Ahavath Achim Synagogue property, which is no longer owned or used by the congregation but is a historic property. The Preferred Alternative could remove the synagogue building, which serves as a landmark for the South Portland neighborhood due to its distinctive design. · The Preferred Alternative would affect Terwilliger Parkway, which is a historic property that contributes to the identity of the Homestead and South Portland neighborhoods. · The Preferred Alternative would remove and replace the Newbury and Vermont trestle bridges, which are both historic properties that contribute to the identity of SW Barbur Boulevard.		
Segment B alignment and stations	· No new barriers would be created within neighborhoods, because the light rail trackway would run within or parallel to existing major roadways along the boundaries between neighborhoods. Light rail might be perceived as reinforcing SW Barbur Boulevard as a barrier north of the Barbur Transit Center, although new and improved sidewalks, bikeways, protected crossings and signalized intersections would provide an offsetting benefit. · The Preferred Alternative would displace 39 residences and 66 businesses or institutions with an estimated 447 employees. The displacements would be relatively dispersed along the alignment, but there would be a band of single-family homes displaced along the north side of SW Barbur Boulevard near Fulton Park. · The Preferred Alternative would remove the Capitol Hill Motel, which is an historic property and one of three remaining auto court motels on SW Barbur	· The Preferred Alternative would improve transit access for the neighborhoods bordering SW Barbur Boulevard. Although local bus service on SW Barbur Boulevard would be reduced, light rail would provide faster, more reliable service with greater capacity. · The Preferred Alternative would change the character of SW 53rd Avenue to a more urban form with complete street paving and sidewalks. · The Preferred Alternative would remove 80 on-street parking spaces on SW Barbur Boulevard, but low usage of these spaces indicates there would be little resulting impact to quality of life.	· The Preferred Alternative would acquire a parcel that is used for vehicle donations, storage and occasional overflow parking by PDX Church. · The Preferred Alternative would displace one childcare facility in Segment B. · The Preferred Alternative would acquire a portion of Fulton Park and remove mature trees along SW Barbur Boulevard adjacent to the park, but would not reduce the functionality of the park. · The Preferred Alternative would pave and add sidewalks to SW 53rd Avenue adjacent to Sylvania Natural Area Park. No park property would be acquired, but the addition of sidewalks would create a more defined edge to the park.

Table 4.4-2. Long-Term Community Impacts *(multipage table)*

Project Element	Neighborhood Cohesion	Neighborhood Quality of Life	Community Facilities
	Boulevard. This impact could detract from the identity of SW Barbur Boulevard as a mid-20th century auto tourism route. · The Preferred Alternative would remove and replace the Oregon Electric Railway Overcrossing, which is a bridge over SW Multnomah Boulevard that is a historic property and contributes to the identity of SW Barbur Boulevard.		· The Preferred Alternative would improve transit access to PCC-Sylvania.
Segment C alignment and stations	· Within the Tigard Triangle neighborhood, the Preferred Alternative would change circulation by creating new street rights of way. · The Preferred Alternative would change the character of SW 70th Avenue, SW Elmhurst Street and SW Hermoso Way by reconstructing or adding portions of the roadways with light rail and sidewalks, and displacing existing single-family residences. · The Preferred Alternative would reduce the effect of SW Hall Boulevard as a barrier along the eastern edge of downtown Tigard by adding a signalized intersection at SW Commercial Street and realigning the intersection of SW Scoffins Street and SW Hunziker Street. · South of downtown Tigard, the trackway would generally run parallel to the existing barriers of the railroad tracks or I-5. · The Segment C alignment and stations would displace 21 residences and 33 businesses or institutions with an estimated 791 employees. (See the Hunziker O&M Facility row below for additional business displacements in Segment C.)	· Park and rides at the 68th and Bridgeport Stations would result in very small increases in traffic volume at the nearby I-5 interchanges. In downtown Tigard, the Hall Park and Ride would reduce potential usage of on-street parking to access light rail. · The Preferred Alternative would remove 30 existing on-street parking spaces along SW 70th Avenue near SW Dartmouth Street but would replace them with 18 new angled parking spaces underneath the light rail structure over SW Dartmouth Street. The net loss of 12 spaces could reduce neighborhood quality of life by increasing demand for remaining on-street parking.	· The Preferred Alternative would displace one childcare facility in Segment C.
Marquam Hill Connection	· The Marquam Hill Connection would improve pedestrian circulation between the South Portland and Homestead neighborhoods by providing faster and more accessible pedestrian access across the steep slopes of Terwilliger Parkway.	· The Marquam Hill Connection would have a high visual impact due to vegetation removal and the addition of the inclined elevator infrastructure within Terwilliger Parkway. These changes would be visible from along SW Barbur Boulevard in the South Portland neighborhood and along SW Terwilliger Boulevard in the Homestead neighborhood. · The Marquam Hill Connection would improve access to transit for the Homestead neighborhood.	· A portion of Terwilliger Parkway would be acquired near SW Gibbs Street and SW Campus Drive for the Marquam Hill Connection. · The Marquam Hill Connection would improve access to the medical and educational facilities on Marquam Hill, including OHSU and VA Portland. · The Marquam Hill Connection would improve access to Terwilliger Parkway, including the

Table 4.4-2. Long-Term Community Impacts *(multipage table)*

Project Element	Neighborhood Cohesion	Neighborhood Quality of Life	Community Facilities
			trail and bicycle path along SW Terwilliger Boulevard.
PCC-Sylvania Shuttle	· The van-sized shuttle buses would travel on a local residential street through the Far Southwest neighborhood.	· The addition of small van-sized shuttle buses to SW 53rd Avenue could reduce quality of life for adjacent residents, but this impact could be offset by the addition of sidewalks, street lighting and stormwater management (attributed to the Preferred Alternative alignment and stations in Segment B).	· The shuttle would operate adjacent to Sylvania Natural Area Park. · The shuttle would improve transit access to PCC-Sylvania.
Hunziker O&M Facility	· The Hunziker O&M Facility would displace 2 businesses or institutions with an estimated 30 employees (in addition to the business displacements caused by the Preferred Alternative alignment and stations in Segment C).	*No additional impacts specific to the Hunziker O&M Facility.*	*No additional impacts specific to the Hunziker O&M Facility.*
Light Rail Investment: Terminus Options			
Upper Boones Ferry Terminus Option	*Same impacts as the Preferred Alternative, except:* · One fewer business would be displaced.	*Same impacts as the Preferred Alternative.*	*Same impacts as the Preferred Alternative.*
Hall Terminus Option	*Same impacts as the Preferred Alternative, except:* · Nine fewer businesses would be displaced.	*Same impacts as the Preferred Alternative.*	*Same impacts as the Preferred Alternative, except:* · A childcare facility in Segment C would not be displaced.
Related Transportation Improvements			
Ross Island Bridgehead Reconfiguration	· The Ross Island Bridgehead Reconfiguration would reduce the existing barrier effect of SW Naito Parkway by adding signalized intersections that would reconnect the divided South Portland neighborhood. · Walking and bicycling access on and across SW Naito Parkway would be improved south of SW Lincoln Street.	· The Ross Island Bridgehead Reconfiguration would improve quality of life in the South Portland neighborhood overall. Regional through traffic would be rerouted off of SW Whitaker Street and SW Curry Street, which are local residential streets. Land currently used for ramps would become available for future development. · The Ross Island Bridgehead Reconfiguration would shift some traffic from SW Naito Parkway to SW First Avenue and SW Kelly Avenue, and from SW Barbur Boulevard to SW Corbett Avenue between SW Bancroft Street and SW Hamilton Street. · The Ross Island Bridgehead Reconfiguration would result in a net loss of 34 on-street parking spaces on SW Naito Parkway, SW Pennoyer Street and SW Corbett Avenue. The net loss of parking spaces could	· The Ross Island Bridgehead Reconfiguration would improve pedestrian and bicycle access to NUNM and two community gardens along SW Naito Parkway.

Table 4.4-2. Long-Term Community Impacts *(multipage table)*

Project Element	Neighborhood Cohesion	Neighborhood Quality of Life	Community Facilities
		reduce neighborhood quality of life by increasing demand for remaining on-street parking.	
Station access improvements	· All of the station access improvements would increase neighborhood cohesion by improving walking and bicycling facilities. · The four pedestrian bridges would create new connections across the barriers of I-5 (SA08, SA19 and SA20) and Highway 217 (SA30).	· All of the station access improvements would increase quality of life by improving access to transit. · Station access improvements may result in the loss of on-street parking to accommodate multimodal facilities such as bicycle lanes.	· Many of the station access improvements would improve access to nearby community facilities. · The Custer Walk/Bike Bridge (SA08) would cross over a portion of Burlingame Park, but would not reduce the functionality of the park.

Note: I-5 = Interstate 5; NUNM = National University of Natural Medicine; O&M = operations and maintenance; OHSU = Oregon Health & Science University; PCC = Portland Community College; VA Portland = Veterans Affairs (VA) Portland Health Care System.

Transit-Dependent Populations

Overall, the improved transit, walking and bicycling access provided by the Project would be particularly beneficial for transit-dependent populations. Light rail would provide faster and more reliable travel times than existing and future bus service (see Chapter 3, Transportation Impacts and Mitigation). Stations would have more amenities than most existing bus stops, including real-time arrival information, benches and platforms that allow for level boarding. It is currently assumed that to the degree practicable, TriMet would reallocate bus hours within the corridor from lines that would be removed or shortened with the addition of light rail. This reallocation would result in improved frequencies or improved span of service (e.g., adding midday, evening and weekend service) on bus lines that would connect to light rail.

Along SW Barbur Boulevard, it is currently assumed that light rail would replace the existing TriMet Line 12 bus service between the Barbur Transit Center and the Downtown Portland Transit Mall (see Appendix A, Detailed Maps and Descriptions of the Alternatives). Though the light rail stations would include more amenities, they would be spaced farther apart than the existing bus stops. The increased spacing could have the greatest impact on people with difficulty walking or those using mobility devices, which may include older adults and people with disabilities. However, the light rail investment would also provide offsetting benefits by filling in many existing sidewalk gaps on SW Barbur Boulevard, upgrading many existing sidewalks and curb ramps to meet current American with Disabilities Act (ADA) requirements, and adding additional protected pedestrian crossings. The station access improvements would fill additional sidewalk gaps on adjacent streets that would provide access to the light rail stations.

Some transit-dependent populations would be affected by residential displacements (see Section 4.1, Acquisitions, Displacements and Relocations). TriMet would help locate new residences for displaced households, which could include identifying housing with transit access. TriMet would use interpreters to help people with limited English proficiency navigate the relocation and compensation process.

4.4.4. Short-Term Impacts

Neighborhood Cohesion

Certain neighborhoods could temporarily experience reduced cohesion if the construction activities create a perceived barrier along the alignment. In Segments A and B, construction activities could reinforce the feeling of SW Barbur Boulevard or SW Naito Parkway acting as a barrier to east/west neighborhood connectivity within or between neighborhoods. In Segment C, the Tigard Triangle and Downtown Tigard neighborhoods could experience temporarily reduced cohesion during construction, because the light rail alignment would not follow existing boundaries between neighborhoods.

Adjacent businesses could experience a temporary reduction in customer activity due to a real or perceived inconvenience caused by construction activities (see Section 4.3, Economics). Among the businesses adjacent to the construction, commercial establishments such as restaurants and shops would be most likely to be affected.

Neighborhood Quality of Life

Neighborhood quality of life would be diminished in the area directly adjacent to the alignment during the construction period as a result of noise, dust, detours, loss of on-street parking, increased congestion and increased truck traffic (see Chapter 3, Transportation Impacts and Mitigation; Section 4.11, Noise and

Vibration; and Section 4.12, Air Quality and Greenhouse Gases). Detours and congestion during construction could result in slower and less reliable bus service, and could increase traffic volumes on other streets near the directly affected roadways.

Community Facilities

The function of community facilities located near the Project could be temporarily diminished during construction. Construction could impede access to community facility parking lots or buildings in the areas directly adjacent to active construction sites (see Chapter 3). Efforts would be made to maintain access to community facilities by establishing detours and alternative methods for entrance and egress to businesses and facilities that remain open during construction. During construction, visual impacts, light, glare, dust and noise could affect users of parks and other community facilities with outdoor functions located near the Project (see Section 4.5, Visual Quality, and Section 4.12, Air Quality and Greenhouse Gases).

Transit-Dependent Populations

Transit-dependent populations would experience the same short-term impacts from construction as the general population, including construction-related impacts such as dust, light/glare and other visual impacts, noise, and traffic congestion. During construction, ADA accessibility to sidewalks and street crossings would be maintained. There would be some short-term bus stop relocations during construction.

4.4.5. Comparison to Impacts of the Draft EIS Light Rail Alternatives

Neighborhood Cohesion

Overall, adverse effects on neighborhood cohesion would be reduced for the Preferred Alternative compared to the Draft EIS light rail alternatives. The Preferred Alternative would result in fewer residential, business and employee displacements (see Section 4.1, Acquisitions, Displacements and Relocations, and Section 4.3, Economics).

In particular, the Preferred Alternative would avoid displacing a cluster of 69 residential units in downtown Tigard that would be impacted by Alternatives C1, C2 and C5 from the Draft EIS (see additional discussion in the "Transit-Dependent Populations" section below). The Preferred Alternative would also avoid displacing a cluster of businesses along SW Beveland Street that would be impacted by Alternatives C1, C2 and C5 from the Draft EIS. During preparation of the Draft EIS and the Draft EIS comment period, several representatives of these businesses expressed concern about the displacements affecting cohesion among the business owners and employees (see Comment IDs B21, B22, B24 and B25 in Appendix J2.3, Full Responses to Draft EIS Comments – Business Comments).

Similar to the Draft EIS light rail alternatives, the Preferred Alternative would not result in the creation of any new neighborhood barriers. The Ross Island Bridgehead Reconfiguration, which is studied in this Final EIS as a related transportation improvement, would reduce the effect of SW Naito Parkway as a barrier within the South Portland neighborhood similar to Alternative A2-BH studied in the Draft EIS.

Neighborhood Quality of Life

Adverse impacts to neighborhood quality of life would also be somewhat reduced for the Preferred Alternative compared to the Draft EIS light rail alternatives. The Preferred Alternative has incorporated design changes to avoid several impacts to auto traffic that were identified in the Draft EIS, which would

reduce traffic congestion in some neighborhoods. The number and severity of noise and vibration impacts resulting from the Preferred Alternative would be similar to those identified in the Draft EIS. Visual impacts resulting from the Preferred Alternative would be slightly lowered, but generally similar to the Draft EIS light rail alternatives. The Preferred Alternative would reduce visual impacts most substantially in downtown Tigard, compared to the Draft EIS light rail alternatives.

Community Facilities

The extent of impacts to several parks has been reduced for the Preferred Alternative compared to the Draft EIS light rail alternatives, either by reducing the size of the anticipated partial parcel acquisition or avoiding the need for permanent acquisition altogether.

The Preferred Alternative would avoid several community facilities that would be displaced by various Draft EIS light rail alternatives, including the Tigard Post Office, a community lodge and multiple medical and counseling businesses.

The Preferred Alternative includes a design adjustment at the Bridgeport Station that was intended to avoid displacing the Village Inn restaurant, which has since closed permanently. Many of the Draft EIS comments related to the Village Inn describe the restaurant as a gathering place for families and community groups (see comments associated with petition P03 in Appendix J2.4, Full Responses to Draft EIS Comments – Petitions). The Village Inn parcel is currently anticipated to be used as a construction staging area for the Preferred Alternative.

The Preferred Alternative would displace two childcare facilities not identified as affected within the Draft EIS; of these, one is due to changes in the designs and the other is due to more detailed information available about affected businesses. Due to minor design changes, the Preferred Alternative would acquire one additional church parking parcel, which is used for vehicle donations, storage and occasional overflow parking by PDX Church.

The design of the Ross Island Bridgehead Reconfiguration has been adjusted to avoid displacing a National University of Natural Medicine health clinic, which would be displaced by Alternative A2-BH.

Transit-Dependent Populations

Generally, the Preferred Alternative would result in similar or reduced impacts to transit-dependent populations compared to the Draft EIS light rail alternatives. The light rail service and station amenities of the Preferred Alternative would be similar to those of the Draft EIS alignment alternatives using the Through Route (as opposed to the Branched Route), but with one fewer train per hour during the peak period in 2035 due to the Preferred Alternative's reduced park and ride capacities overall (see Chapter 2, Alternatives Considered, for a description of the Through Route and the Branched Route).

As noted above, the Preferred Alternative would result in fewer residential displacements than the Draft EIS light rail alternatives (see Section 4.1, Acquisitions, Displacements and Relocations). Several apartment buildings that would be impacted by various Draft EIS alignment alternatives are not anticipated to be displaced by the Preferred Alternative. In particular, the Preferred Alternative would avoid displacing a cluster of 69 residential units in downtown Tigard that would be impacted by Alternatives C1, C2 and C5 from the Draft EIS. These units are in an area with relatively high proportions of low-income households, people with limited English proficiency and households with limited vehicle access. The owner of one of

these apartment buildings shared during the Draft EIS comment period that the tenants in these buildings typically have low incomes and include older adults on fixed incomes (see Comment ID B02 in Appendix J2.3).

4.4.6. Mitigation Measures

No mitigation related to impacts to communities would be required during construction or operation of the Project beyond the mitigation strategies identified in other sections of this Final EIS. The following sections describe mitigation measures related to community impacts:

- **Chapter 3, Transportation Impacts and Mitigation,** describes measures to mitigate long- and short-term transportation and parking impacts.
- **Section 4.1, Acquisitions, Displacements and Relocations,** describes the applicable policies, procedures and guidelines for the long-term impacts of property acquisition and the relocation of residents and businesses. TriMet (or the specific project sponsor, for the related transportation improvements) would help investigate nearby properties for relocation in an effort to avoid disrupting social ties within neighborhoods. TriMet would coordinate with property owners when only parking areas are being displaced, to negotiate compensation and/or replacement plans.
- **Section 4.3, Economics,** describes measures to reduce short-term impacts to businesses during construction.
- **Section 4.5, Visual Quality,** describes measures to reduce long-term visual impacts, such as considering aesthetic treatments for the design of structures to improve compatibility with surrounding areas.
- **Section 4.6, Historic and Archaeological Resources,** describes mitigation measures that would address long-term impacts to historic properties, including the South Portland Historic District, the Ahavath Achim Synagogue, Terwilliger Parkway, the Newbury and Vermont trestle bridges, and the Capitol Hill Motel.
- **Section 4.7, Parks and Recreation Resources,** describes the mitigation measures that have been developed in coordination with park owners to reduce long-term impacts to parks.
- **Section 4.11, Noise and Vibration,** describes measures to reduce long-term and short-term noise and vibration.
- **Section 4.12, Air Quality and Greenhouse Gases,** describes measures to avoid the short-term impact of dust emissions during construction.
- **Section 4.16, Public Services,** describes measures to mitigate short-term and long-term impacts to public service providers.

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4.5. Visual Quality

This section describes the visual impacts of the Project and potential mitigation measures. Appendix B4.5, Supporting Material for Visual Quality Analysis, discusses the analysis methods and provides more detail on the affected environment. The appendix also has visual simulations of views that would change with the Project.

Since the publication of the Draft EIS, this section has been updated to reflect the definition of the Project in this Final EIS, and to respond to comments received on the Draft EIS. The list of scenic resources within the limits of the city of Portland has been updated to reflect the current inventory; viewpoints retired from the city's inventory have been removed from the analysis since the Draft EIS.

4.5.1. Affected Environment

Study Area

The study area for visual impacts consists of landscape units, which are general geographic areas in the project vicinity with similar visual conditions (see Figure 4.5-1). Overall, the Project would be located within the urbanized landscape of the Portland metropolitan area. The specific visual characteristics within each landscape unit are described below:

- **South Portland Landscape Unit** varies in character, from highly urbanized in the eastern segment to forested hillsides to the west. Prominent features include Marquam Hill, Oregon Health & Science University (OHSU), Veterans Affairs (VA) Portland Health Care System and the South Portland Historic District. Residential areas range in character from mid to low density. Interstate 5 (I-5), SW Naito Parkway, SW Barbur Boulevard and the Portland Aerial Tram transect the area.

- **Barbur Woods Landscape Unit** is a mid- to low-density residential part of Inner Southwest Portland, characterized by a variety of housing types secluded within verdant landscapes. It has large forested spaces, both inside the formal park boundaries of Terwilliger Parkway and George Himes Park, and outside the park in semi-managed open spaces.

- **Barbur Historic[1] Highway Landscape Unit** is a mixed suburban commercial corridor. Developments are primarily large- and medium-format retail and mid-rise office buildings that are set near the road and have minimal landscaping. Areas of both multifamily and single-family residential uses are adjacent to this segment of SW Barbur Boulevard.

- **Far Southwest Portland Landscape Unit** has a suburban/rural character. Commercial uses are small-scale and somewhat dispersed compared to the South Portland Landscape Unit, with few residential units close to the road. Unimproved right of way occurs in some areas, and open spaces include landscaped areas of commercial lots and several stretches of vegetation that are not managed adjacent to the roadway.

[1] Changes in this portion of SW Barbur Boulevard in South Portland in the mid-1930s set off a chain reaction of infrastructure projects and other public improvements that had a lasting impact on the fabric and character of the community.

- **Tigard Triangle Landscape Unit** varies in character, and includes contemporary commercial developments, single-family housing and undeveloped vegetated areas. Big box retail buildings with large parking lots are located on the west end of this landscape unit. Mid-rise office buildings with landscaping are located on the eastern and southern edges of the Tigard Triangle. Undeveloped land and small residential lots are in the center and north of this landscape unit.

- **Downtown Tigard Landscape Unit** encompasses the historic town center, as well as industrial land slightly to the south. Buildings in the downtown are two to three stories and set close to the street, with regularly occurring street trees. The industrial land consists of warehouse buildings and parking/storage yards. Existing freight railroad tracks run north/south through this unit.

- **I-5 Commercial Corridor Landscape Unit** follows I-5 south from Tigard to Bridgeport Village. It contains a mix of low-rise and mid-rise office parks, and low-rise industrial complexes. The landscape unit includes Bridgeport Village, a large outdoor shopping center.

Table 4.5-3 within Section 4.5.3 analyzes the change to the visual environment within each landscape unit.

Local Codes and Design Districts

While existing conditions define the visual characteristics of the affected environment, the Cities of Portland, Tigard and Tualatin have zoning and development codes that also help define desired future visual conditions as their urban areas develop. For example, the City of Tigard Community Development Code Chapter 18.420, Landscaping and Screening, includes standards for landscaping, screening and tree canopy.

The City of Portland Zoning Code 33.420, Design Overlay Zone, establishes design districts with adopted design guidelines. The design districts do not designate key viewpoints or other scenic resources. The design districts are included on Figures 4.5-1 and 4.5-2. The City of Portland design districts within the study area include:

- Central City Plan District
- South Auditorium Plan District
- Terwilliger Design District
- Marquam Hill Design District

The City of Tigard has plan districts for the Tigard Triangle, downtown Tigard and the Bridgeport area, but these plan districts do not have specific visual criteria. The City of Tualatin has a central design district for its downtown, which is not in the study area.

Designated Scenic Resources

The City of Portland has designated scenic resources through the following plans and codes:

- *Scenic Resources Protection Plan* (City of Portland Bureau of Planning, 1991)
- *Central City 2035 Volume 3A: Scenic Resources Protection Plan* (City of Portland Bureau of Planning and Sustainability, 2018)
- City of Portland Zoning Code 33.480, Scenic Resource Zone

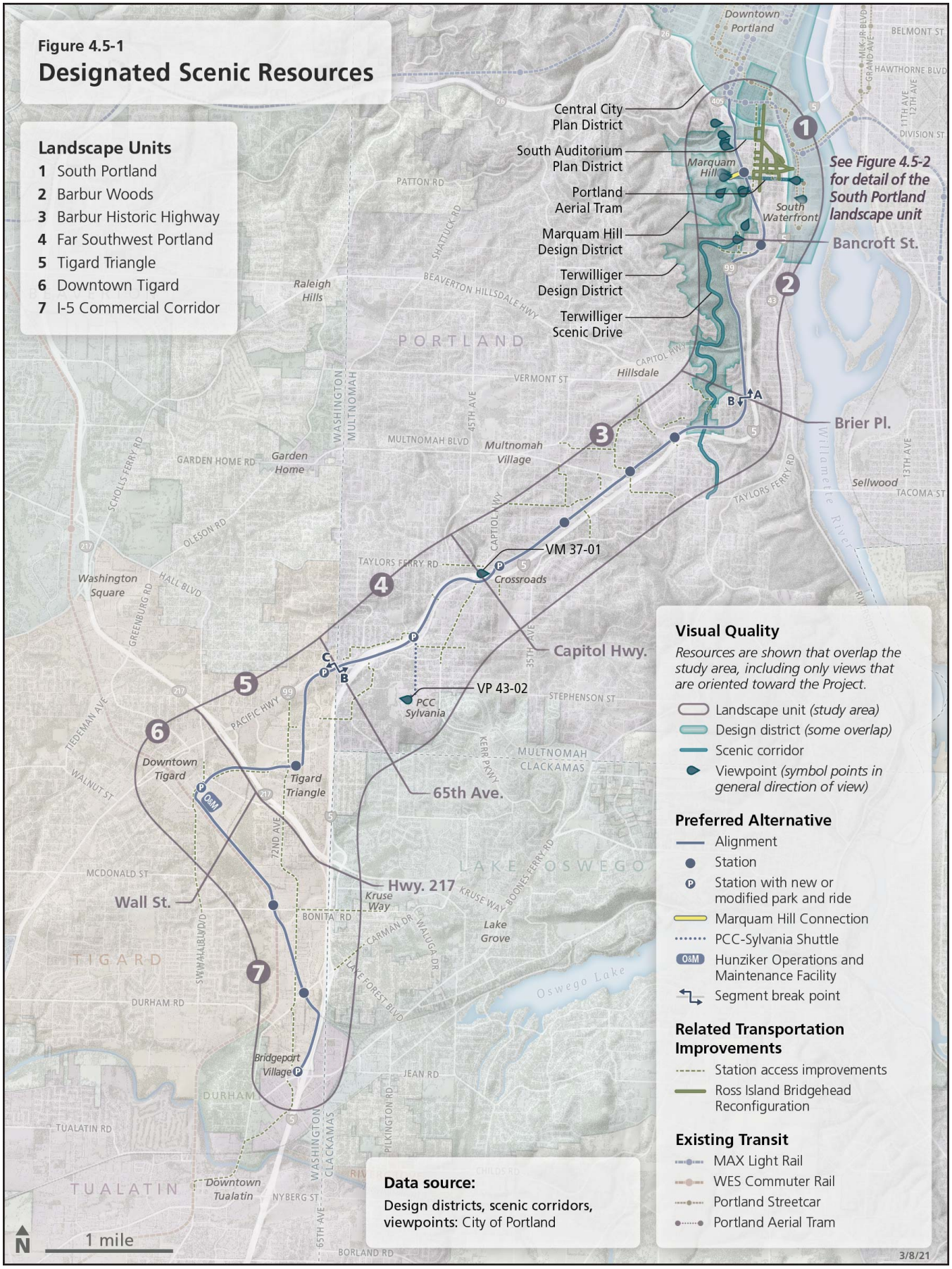
Figure 4.5-1
Designated Scenic Resources
Landscape Units
1 South Portland
2 Barbur Woods
3 Barbur Historic Highway
4 Far Southwest Portland
5 Tigard Triangle
6 Downtown Tigard
7 I-5 Commercial Corridor
Central City Plan District
South Auditorium Plan District
Portland Aerial Tram
Marquam Hill Design District
Terwilliger Design District
Terwilliger Scenic Drive
See Figure 4.5-2 for detail of the South Portland landscape unit
Bancroft St.
Brier Pl.
Capitol Hwy.
65th Ave.
Hwy. 217
Wall St.
VM 37-01
VP 43-02
Downtown Portland
Marquam Hill
South Waterfront
Raleigh Hills
Hillsdale
Multnomah Village
Garden Home
Washington Square
Crossroads
PCC Sylvania
Downtown Tigard
Tigard Triangle
Kruse Way
Lake Grove
Bridgeport Village
Downtown Tualatin
Sellwood
Oswego Lake
Visual Quality
Resources are shown that overlap the study area, including only views that are oriented toward the Project.
Landscape unit (study area)
Design district (some overlap)
Scenic corridor
Viewpoint (symbol points in general direction of view)
Preferred Alternative
Alignment
Station
Station with new or modified park and ride
Marquam Hill Connection
PCC-Sylvania Shuttle
O&M Hunziker Operations and Maintenance Facility
Segment break point
Related Transportation Improvements
Station access improvements
Ross Island Bridgehead Reconfiguration
Existing Transit
MAX Light Rail
WES Commuter Rail
Portland Streetcar
Portland Aerial Tram
Data source:
Design districts, scenic corridors, viewpoints: City of Portland
N
1 mile
3/8/21

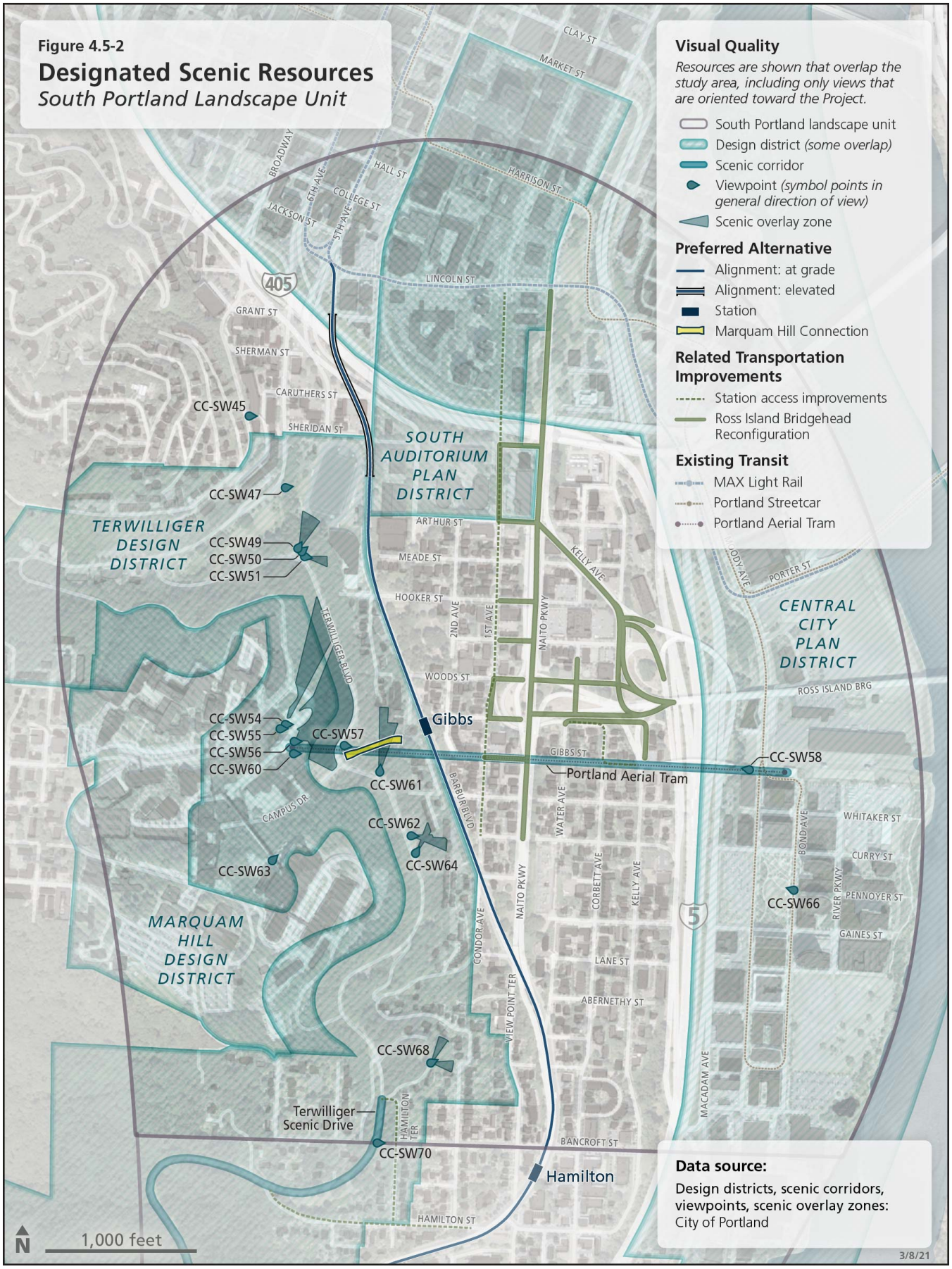
Figure 4.5-2
Designated Scenic Resources
South Portland Landscape Unit
Visual Quality
Resources are shown that overlap the study area, including only views that are oriented toward the Project.
South Portland landscape unit
Design district (some overlap)
Scenic corridor
Viewpoint (symbol points in general direction of view)
Scenic overlay zone
Preferred Alternative
Alignment: at grade
Alignment: elevated
Station
Marquam Hill Connection
Related Transportation Improvements
Station access improvements
Ross Island Bridgehead Reconfiguration
Existing Transit
MAX Light Rail
Portland Streetcar
Portland Aerial Tram
SOUTH AUDITORIUM PLAN DISTRICT
TERWILLIGER DESIGN DISTRICT
MARQUAM HILL DESIGN DISTRICT
CENTRAL CITY PLAN DISTRICT
CC-SW45
CC-SW47
CC-SW49
CC-SW50
CC-SW51
CC-SW54
CC-SW55
CC-SW56
CC-SW60
CC-SW57
CC-SW61
CC-SW62
CC-SW64
CC-SW63
CC-SW58
CC-SW66
CC-SW68
CC-SW70
Gibbs
Portland Aerial Tram
Terwilliger Scenic Drive
Hamilton
CLAY ST
MARKET ST
BROADWAY
6TH AVE
HALL ST
COLLEGE ST
JACKSON ST
5TH AVE
HARRISON ST
LINCOLN ST
GRANT ST
SHERMAN ST
CARUTHERS ST
SHERIDAN ST
ARTHUR ST
MEADE ST
HOOKER ST
WOODS ST
TERWILLIGER BLVD
2ND AVE
1ST AVE
NAITO PKWY
KELLY AVE
GIBBS ST
BARBUR BLVD
WATER AVE
CORBETT AVE
CAMPUS DR
CONDOR AVE
VIEW POINT TER
LANE ST
ABERNETHY ST
BANCROFT ST
HAMILTON TER
HAMILTON ST
MACADAM AVE
PORTER ST
ROSS ISLAND BRG
WHITAKER ST
CURRY ST
BOND AVE
RIVER PKWY
PENNOYER ST
GAINES ST
405
5
N
1,000 feet
Data source:
Design districts, scenic corridors, viewpoints, scenic overlay zones: City of Portland
3/8/21

There are 22 designated scenic resources within Segments A and B, including viewpoints and scenic corridors (see Figures 4.5-1 and 4.5-2). Many of these resources were initially identified in the 1989 *Scenic Views, Sites and Drives Inventory* (City of Portland Bureau of Planning) and protected through the 1991 *Scenic Resources Protection Plan*. For the central city area (including downtown Portland and portions of Marquam Hill and South Portland), the inventory was updated in 2018 through the *Central City 2035 Volume 3A: Scenic Resources Protection Plan*. This effort included adding, removing and updating scenic resources within the central city area. The designated scenic resources within the study area are described in more detail in Section 4.5.3. Table 4.5-4 within Section 4.5.3 provides the analysis of impacts to designated scenic resources.

The scenic resource overlay zones set limits on building heights within view corridors and establish standards for managing vegetation to preserve and enhance views. Within the study area, only the South Portland Landscape Unit contains scenic resource overlay zones. The scenic resource overlay zones within the study area are mapped in Figure 4.5-2. Table 4.5-4 within Section 4.5.3 identifies which viewpoints are protected by scenic resource overlay zones.

The Cities of Tigard and Tualatin do not have designated scenic resources within the study area.

4.5.2. No-Build Alternative

Under the No-Build Alternative, the visual character of the corridor would continue to evolve as redevelopment continues (see Section 4.2, Land Use). This evolution could include new structures in some areas and the redevelopment of existing structures in others, especially in suburban areas of Portland and Tigard. In some locations along the corridor, there are several road improvement projects, listed in Appendix A, Detailed Maps and Descriptions of the Alternatives, that are assumed to occur under the No-Build Alternative, but their visual impacts would be localized and not of the same scale and extent as the Project.

4.5.3. Long-Term Impacts

Changes to the Visual Environment

Visual impacts result from changes to landscape features in areas where viewers are sensitive to visual and aesthetic conditions. In addition to designated scenic resources, areas such as parks, places with scenic views or areas with residences often have higher levels of visual sensitivity. Industrial and commercial areas as well as corridors dominated by transportation facilities typically have lower levels of visual sensitivity.

To define the level of visual change, the analysis considered topography, vegetation, water, structures, visual pattern and blocked/altered views (described in Table 4.5-1).

Table 4.5-1. Levels of Visual Change

Physical Factor	Low	Moderate	High
Topography	At grade or below grade	Grade separation	Fully elevated structures
Vegetation	No removal of/full replacement of vegetation	Removal of some vegetation	Removal of all vegetation
Water	No change to water/small amount of new features	Slight change to water course or additional features	Removal/undergrounding of water body
Structures	No new structures, small changes to existing structures	Minor new structures, minor displacement of structures	Major new structures, multiple building removals
Visual Pattern	No change to street, full screening of neighborhood from alignments and project features	Changes to existing streets, partial screening of neighborhood from alignments and project features	New streets, no screening of neighborhood from alignments and project features
Blocked/Altered Views	Minor change to scenic views	Disruption of scenic views	Full blocking of scenic views

To identify the level of viewer sensitivity, the analysis considered physical and perceptual factors such as proximity, extent, duration, attention, focus and protection (described in Table 4.5-2).

Table 4.5-2. Levels of Viewer Sensitivity

Physical or Perceptual Factor	Low	Moderate	High
Proximity	Not in project area	In adjacent neighborhood	Directly adjacent to project
Extent	Seen by few people	Seen by some people	Seen by a very large number of people
Duration	Barely glimpsed for a short amount of time	Partly seen for a limited duration	Continually seen for a long time
Attention	Unengaged, inattentive viewers	Moderately engaged, attentive viewers	Fully engaged, very attentive viewers
Focus	No, or highly dispersed, focal objects, drawing no focus	Some focal objects, drawing moderate focus	Singular focal object, drawing intense focus
Protection	No protection or interest in preservation	Some social interest in protecting views, but no legal protection	Legal, or socially agreed-upon, protected views or vistas

Some visually prominent aspects of the Project would be common throughout the corridor:

- **Light rail trackway**. The light rail trackway would include steel track rails, paved concrete areas, ballast, ties, overhead wires, support poles and elevated structures. There would also be electrification stations and signal management structures, which are typically small buildings. The combination of these features would mainly affect foreground viewpoints and have a minimal impact on middle-ground and background views.
- **New/rebuilt roadway**. To accommodate light rail, much of the existing roadways affected by the alignment would be rebuilt. The roadway material would generally be visually similar to the existing road, with a variety of adjustments, including regrading, new lighting, modified intersections, and added or removed lanes.
- **New connecting infrastructure**. Throughout the corridor, various pedestrian and bicycle enhancements outside of the light rail alignment are proposed. These include, for example, sidewalks, bicycle lanes, crosswalks and traffic control signals. Two distinct connecting infrastructure elements are: (1) the Marquam Hill Connection, and (2) pedestrian, bicycle and shuttle connections to the

Portland Community College (PCC) Sylvania campus along SW 53rd Avenue. The Marquam Hill Connection would be an inclined elevator from SW Barbur Boulevard to SW Terwilliger Boulevard. See Appendix A for plan and profile views of the Marquam Hill Connection and Appendix B4.5 for renderings of the views of the connection from SW Barbur Boulevard and SW Terwilliger Boulevard. The SW 53rd Avenue connections to PCC-Sylvania would include an improved street with sidewalks and bicycle facilities, plus van-sized shuttle buses operating between the 53rd Station and the campus.

- **Streetscaping**. New streetscape elements would be added, including sidewalks, bicycle lanes (potentially with protection/buffer), landscape buffers, street trees, bioswales, benches, lighting and signage. These elements would affect foreground views more than middle-ground or background views.
- **Stations**. Stations would include platforms, shelters, seating, lighting and signage. These elements would affect foreground and middle-ground views from nearby. A few stations would be elevated above the existing grade. While most stations would include center platforms between the tracks in a roadway median, some would have platforms on both sides of the trackways or both sides of the street. Some stations in Segments B and C would include park and ride lots and modified transit centers, and a parking structure will be included at the Bridgeport Station.
- **Vegetation**. Some trees and vegetation along the alignment would require trimming or removal to accommodate the Project. This vegetation trimming or removal would mainly affect foreground and middle-ground views but could also reveal longer views.[2]
- **Removed buildings and other structures**. The Project would remove some existing structures (also see Section 4.1, Acquisitions, Displacements and Relocations, and Section 4.6, Historic and Archaeological Resources), which would affect localized foreground and middle-ground views.

In addition to the general visual impacts described above, Table 4.5-3 describes the impacts of the Project by landscape unit and project element, considering: (1) changes to the visual environment, (2) the level of visual change, (3) the level of viewer sensitivity and (4) overall visual impact rating for each landscape unit. Appendix B4.5 contains visual simulations of some of the key infrastructure elements at specific viewpoints.

As described in Table 4.5-3, the terminus options would avoid changes to the visual environment south of the Upper Boones Ferry Station or south of the Hall Station, within the I-5 Commercial Corridor Landscape Unit. For all other landscape units, the terminus options would have the same visual impacts as the Preferred Alternative.

[2] Section 4.9, Ecosystems, notes that TriMet would coordinate with consulting tribes to offer opportunities to harvest culturally significant native plants before construction.

Table 4.5-3. Summary of Visual Impacts of the Project by Landscape Unit *(multipage table)*

Landscape Unit	Project Element	Changes to Visual Environment	Level of Visual Change	Level of Viewer Sensitivity	Overall Impact
Preferred Alternative and Terminus Options: Segment A					
South Portland	Alignment and stations	The Preferred Alternative would add a new light rail structure over I-405, SW Broadway, SW Caruthers St. and SW Sheridan St. that would land in the median of SW Barbur Blvd. between SW Sheridan St. and SW Hooker St. South of SW Sheridan St., the addition of light rail within the median on SW Barbur Blvd. would widen the right of way, modify grades, add retaining walls, remove buildings and clear vegetation. Small changes to the east edge of Duniway Park are anticipated. Although some vegetation, including several trees, would be removed along Lair Hill Park, most existing trees within the park would remain. Other changes include the development of a new station at SW Barbur Blvd. and SW Gibbs St. as well as new or reconstructed stairs/ramps to connect several places along SW Barbur Blvd. to the Lair Hill neighborhood.	Moderate	Moderate	**Moderate**
	Marquam Hill Connection	The Marquam Hill Connection would include dual inclined elevators operating on an angled, elevated trackway with terminating loading/unloading station buildings at the top (near SW Terwilliger Blvd.) and bottom (near SW Barbur Blvd.). In addition to the elevator trackway structure with emergency stairs, the structure would feature supporting columns. Trees and other vegetation would be removed on a strip down the hillside of Terwilliger Parkway. This would affect immediate views of the hillside from SW Terwilliger Blvd. as well as up from SW Barbur Blvd. and South Portland. A replanting and revegetation plan that is part of the Project would help minimize the contrast between the infrastructure and the nearby natural areas of Terwilliger Parkway. The tree and vegetation clearing would also re-open middle and distant views to south and east Portland and the Cascades.	High	High	**High**
Barbur Woods	Alignment and stations	Adding light rail to the median of SW Barbur Blvd. would widen the right of way and remove vegetation in wooded sections adjacent to SW Terwilliger Blvd., including George Himes Park. Replacement bridges would be constructed. New retaining walls would be a prominent feature. A new station at SW Barbur Blvd. and SW Hamilton St. would also widen that intersection, remove buildings and add retaining walls.	Moderate	Moderate	**Moderate**
Preferred Alternative and Terminus Options: Segment B					
Barbur Historic Highway	Alignment and stations	A prominent new light rail structure would cross over I-5, SW Capitol Hwy. and SW Barbur Blvd. in the Crossroads area, with a potential maximum height of 60 feet above the ground in some areas. Several new stations would be added, with platforms in the median of SW Barbur Blvd. The Barbur Transit Center would be rebuilt. The street right of way would be widened, and several buildings would be demolished.	High	Moderate	**Moderate**
Far Southwest Portland	Alignment and stations	Light rail would be constructed between SW Barbur Blvd. and I-5, removing trees and widening the right of way. The improvements would include rebuilt intersections and street sections with lighting, sidewalks and bicycle lanes. A new station would be constructed at SW 53rd Ave., including a surface parking lot. A new bridge over I-5 would enter Tigard at SW 60th Ave. and would be visually similar to a nearby Pacific Hwy. (designated as Oregon Route 99W) overpass. The alignment would then tunnel beneath SW Barbur Blvd./Pacific Hwy. near SW 65th Ave. before re-emerging at a newly constructed station at SW 68th Ave., displacing existing buildings.	Moderate	Moderate	**Moderate**
	PCC-Sylvania Shuttle	The PCC-Sylvania Shuttle would use about three small van-sized shuttle buses and would operate in mixed traffic along SW 53rd Avenue between the PCC-Sylvania campus and the 53rd Station.	Low	High	**Low**

Table 4.5-3. Summary of Visual Impacts of the Project by Landscape Unit *(multipage table)*

Landscape Unit	Project Element	Changes to Visual Environment	Level of Visual Change	Level of Viewer Sensitivity	Overall Impact
Preferred Alternative and Terminus Options: Segment C					
Tigard Triangle	Alignment and stations	In the north end of the Tigard Triangle, adding light rail would rebuild existing roads and extend SW 70th Ave. This would create a prominent new continuous visual feature in an area that has frequent changes in visual character, but where some residences and undeveloped lands are now present. A new flyover section over SW Dartmouth St. would be visually prominent in a sloping area. A 2,300-foot-long bridge over Hwy. 217 would be a prominent visual feature, crossing areas with wetlands and vegetation as well as areas with major transportation infrastructure and large buildings.	High	Moderate to High	**Moderate/ High**
Downtown Tigard	Alignment and stations	Light rail would run in the existing WES Commuter Rail corridor on newly constructed track but with minimal contrast to the transportation-intensive corridor. The station and tracks would be along SW Hall Blvd. and adjacent to the residential area along SW Knoll Dr.	Low	Moderate	**Low**
	Hunziker O&M Facility	The O&M facility would remove an existing commercial/industrial complex of buildings, replacing them with a variety of new and sometimes larger structures. Overall, it would maintain an industrial visual character.	Low	Low	**Low**
I-5 Commercial Corridor	Alignment and stations: Preferred Alternative	Light rail would run in the existing WES Commuter Rail corridor and along I-5 on newly constructed trackway, but with minimal contrast to these transportation-intensive corridors. A new elevated crossing over SW Bonita Rd. would be prominent and visible to residential areas and users of Fanno Creek and Bonita Park.	Low	Moderate	**Low**
	Alignment and stations: Upper Boones Ferry Terminus Option	Same as described above for Preferred Alternative, except that light rail would not be constructed south of the Upper Boones Ferry Station.	Low	Moderate	**Low**
	Alignment and stations: Hall Terminus Option	No changes the visual environment within this landscape unit.	None	N/A	**None**
Related Transportation Improvements: Ross Island Bridgehead Reconfiguration					
South Portland	Roadway	Portions of SW Kelly Ave., SW Corbett Ave., and other streets and ramps would be reconstructed near the west end of the Ross Island Bridge. This would reduce the amount of urban land occupied by a transportation use. SW Naito Pkwy. would be reconfigured into a surface boulevard with at-grade intersections. Improvements would increase visual continuity along affected streets and reduce traffic congestion on adjacent neighborhood streets.	High but Beneficial	High	**High but Beneficial**

Table 4.5-3. Summary of Visual Impacts of the Project by Landscape Unit *(multipage table)*

Landscape Unit	Project Element	Changes to Visual Environment	Level of Visual Change	Level of Viewer Sensitivity	Overall Impact
Related Transportation Improvements: Station Access Improvements					
Segment A: South Portland, Barbur Woods	Sidewalk	Sidewalk improvements might remove strips of vegetation but frequently would add more visual continuity and could also incorporate other landscaping elements such as street trees or plantings.	Low	Low/ Moderate	**Low**
	Bicycle	New bikeways could cause minor changes to visual features and could remove strips of vegetation, but these improvements would maintain or improve the visual character of adjacent streets.	Low	Low/ Moderate	**Low**
Segment B: Barbur Historic Highway, Far Southwest Portland	Sidewalk	Similar changes to Segment A but with more sidewalks from connecting streets.	Low	Low/ Moderate	**Low**
	Bicycle	Similar changes to Segment A but with more sidewalks from connecting streets.	Low	Low/ Moderate	**Low**
	Pedestrian overpasses	Pedestrian overpasses are visually prominent due to their height. However, their location spanning over existing major roadways where there are other bridges and overpasses would be consistent with the existing visual environment.	Moderate	Low/ Moderate	**Moderate**
Segment C: Tigard Triangle, Downtown Tigard, I-5 Commercial Corridor	Sidewalk	Similar changes to Segments A and B.	Low	Low/ Moderate	**Low**
	Bicycle	Similar changes to Segments A and B.	Low	Low/ Moderate	**Low**
	Multi-use path on light rail structure	A multi-use path added to the Preferred Alternative's structure over Hwy. 217 would result in a wider bridge across areas with wetlands and vegetation as well as areas with major transportation infrastructure and large buildings. The added width would not substantially alter the level of visual change compared to a narrower structure without a multi-use path.	Low	Low/ Moderate	**Low**

Note: I-5 = Interstate 5; N/A = not applicable; O&M = operations and maintenance; PCC = Portland Community College; WES = Westside Express Service.

Impacts to Designated Scenic Resources

This section addresses impacts to areas that local jurisdictions have identified as having unique visual significance or design qualities. In Segments A and B, as shown in Figures 4.5-1 and 4.5-2, designated scenic viewpoints, drives and overlay zones near the alignment were analyzed. Table 4.5-4 describes the potential impacts found for all identified scenic resources. See the *Central City 2035 Volume 3A: Scenic Resources Protection Plan* for more detailed information on these scenic resources. There are no designated scenic resources in Segment C. This section focuses on the Preferred Alternative, because the related transportation improvements would have minimal impacts on any of the identified scenic resources. Because there are no designated scenic resources in Segment C, the impacts associated with the terminus options would be the same as those described below for the Preferred Alternative.

The SW Terwilliger Boulevard corridor includes Terwilliger Parkway and is part of a sensitive scenic resource, designated as a scenic drive. It is above the Preferred Alternative's light rail facilities, but adjacent to the Marquam Hill Connection, as discussed below. Multiple planning reports document the scenic character of the corridor and identify views from it to be preserved. The *Terwilliger Parkway Corridor Plan* (City of Portland Planning Bureau, 1983) identifies viewpoints and general policies intended to preserve the scenic character of the corridor, and *Central City 2035 Volume 3A: Scenic Resources Protection Plan* identifies numerous designated viewpoints along it. However, existing forest would largely screen the light rail alignment from view. With SW Terwilliger Boulevard on the hill above the light rail alignment, there would be no changes to views to the middle and far distance of south and east Portland (see Figure 4.5-3 below). Some open portions of the SW Terwilliger Boulevard corridor with existing views of SW Barbur Boulevard would have limited changes due to vegetation clearing and occasional screened views of the light rail facilities, but background and distant focal features would not be impacted.

The Marquam Hill Connection would be within Terwilliger Parkway, placing transportation infrastructure in an area that is valued for its natural wooded character, but located adjacent to the intensively developed OHSU complex. The connection would be minimally visible from designated viewpoints, as described in Table 4.5-3. Due to the tree and vegetation removal that would occur, the Marquam Hill Connection would open up a historically available view from a section of SW Terwilliger Boulevard at SW Campus Drive. Appendix B4.5 includes visual renderings of the Marquam Hill Connection.

Figure 4-5.3. View from SW Terwilliger Boulevard above Duniway Park

View from overlook at SW Terwilliger Boulevard over Duniway Park. The alignment would be visible seasonally in the middle ground, as indicated by the yellow arrow.

Table 4.5-4. Impacts to Designated Scenic Resources *(multipage table)*

Plan or Policy	Resource Name/ID	Location	Focal Features	Impact
South Portland Landscape Unit				
Central City 2035 Volume 3A: Scenic Resources Protection Plan (2018)	CC-SW45 (viewpoint)	SW Broadway Dr. north of Duniway Park	N/A. Development and vegetation blocks view.	Project would not be visible due to vegetation and development.
	CC-SW47 (viewpoint)	SW Terwilliger Blvd. at Duniway Park	Mt. Hood, eastern foothills, buttes	Beginning of light rail facilities would be visible, but light rail is already an established visual element of this corridor.
	CC-SW49 (viewpoint, protected by scenic overlay zone)	SW Terwilliger Blvd., north of SW Campus Dr., north view	Mt. St. Helens, downtown skyline	Starting section of light rail facilities would be minimally visible in middle ground; would not impact focal features.
	CC-SW50 (viewpoint)	SW Terwilliger Blvd., north of SW Campus Dr., panoramic view	Panorama of eastside neighborhood, Marquam Bridge and Mt. Hood	Starting section of light rail alignment would be minimally visible in middle ground; would not impact focal features.
	CC-SW51 (viewpoint, protected by scenic overlay zone)	SW Terwilliger Blvd. north of SW Campus Dr., east view	Mt. Hood, buttes, Willamette River	Starting section of light rail alignment would be minimally visible in middle ground; would not impact focal features.
	CC-SW54 (viewpoint)	OHSU Kohler Pavilion, lower level	Mt. Hood, Mt. St. Helens, Willamette River, Tilikum Crossing bridge	Project would not obstruct focal features of the viewpoint.
	CC-SW55 (viewpoint)	OHSU Kohler Pavilion, upper level	Mt. Hood, Mt. St. Helens, Willamette River	Project would not obstruct focal features of the viewpoint.
	CC-SW56 (viewpoint)	Portland Aerial Tram OHSU Terminal, north platform	Mt. Hood, Mt. St. Helens, buttes, Willamette River, Tilikum Crossing bridge	Project would not obstruct focal features of the viewpoint.
	CC-SW57 (viewpoint)	SW Terwilliger Blvd. at SW Campus Dr.	Mt. Hood, Willamette River, buttes, eastern foothills (limited visibility due to trees/vegetation)	Marquam Hill Connection would open some long-range views that are currently limited, but may also partially obstruct foreground views.
	CC-SW58 (viewpoint)	SW Gibbs St. pedestrian bridge	Views in four directions: Ross Island, Mt. Hood, South Waterfront, Willamette River, Mt. St. Helens, West Hills	Marquam Hill Connection would have limited change to views to West Hills in area below OHSU, with elevator infrastructure and vegetation removal partly visible.
	CC-SW60 (viewpoint)	Portland Aerial Tram OHSU Terminal, south platform	Mt. Hood, Mt. St. Helens, Mt. Adams, downtown skyline, Willamette River, Tilikum Crossing bridge	Project would not obstruct views of focal features.
	CC-SW61 (viewpoint, protected by scenic overlay zone)	SW Terwilliger Blvd., south of SW Campus Dr.	Downtown skyline, Mt. St. Helens, Willamette River, bridges, Lloyd District	Marquam Hill Connection would not obstruct focal features of the viewpoint, but it would be partially visible in low foreground views.

Table 4.5-4. Impacts to Designated Scenic Resources *(multipage table)*

Plan or Policy	Resource Name/ID	Location	Focal Features	Impact
	CC-SW62 (viewpoint, protected by scenic overlay zone)	SW Terwilliger Blvd. north of SW Condor Ln., north point	Panorama of downtown skyline, Marquam Bridge, Mt. Hood	The light rail alignment would be minimally visible but would not impact focal features.
	CC-SW63 (viewpoint)	VA Portland: skybridge	Mt. St. Helens, Willamette River, downtown skyline	Alignment would not be visible, and there would be no effects on the viewpoint's focal features. The upper landing for the Marquam Hill Connection would be partly visible but would be below the sightline of the viewpoint's focal features.
	CC-SW64 (viewpoint)	SW Terwilliger Blvd. north of SW Condor Ln., south point	Mt. St. Helens, eastern foothills, Willamette River, bridges	The light rail alignment would be minimally visible but would not impact focal features.
	CC-SW66 (viewpoint)	Caruthers Park	OHSU, West Hills	Project would not be visible.
	CC-SW68 (viewpoint)	Eagle Point	Mt. St. Helens, Mt. Hood	Project would not be visible.
	CC-SW70 (viewpoint)	SW Terwilliger Blvd. at SW Bancroft St.	Mt. Hood, Willamette River, Ross Island Bridge	Project would not be visible.
	Portland Aerial Tram (scenic corridor)	Between OHSU (upper terminal) and the South Waterfront (lower terminal)	Bridges, downtown skyline, Willamette River, buttes, Mt. St. Helens, Mt. Adams, Mt. Hood, eastern foothills	The alignment, station and Marquam Hill Connection would be visible in certain directions for a portion of the tram ride, but they would not obstruct views of focal features.
Barbur Woods Landscape Unit				
Terwilliger Parkway Corridor Plan (1983)	Terwilliger Scenic Drive (scenic corridor)	SW Terwilliger Blvd. (throughout Barbur Woods Landscape Unit)	Verdant boulevard with enclosed vegetative segments and viewpoints	Overhead wires, support poles and vegetative removal along SW Barbur Blvd. would be visible in open segments of corridor, but they would not significantly impact views along SW Terwilliger Blvd. itself.
Barbur Historic Highway Landscape Unit				
Scenic Resources Protection Plan (1991)	VM 37-01 (viewpoint)	Mt. Hood from SW Capitol Hwy. and SW Barbur Blvd. overpass over I-5	Mt. Hood	The proposed structure over I-5 is of a height and design that may impact the view.
Terwilliger Parkway Corridor Plan (1983)	Terwilliger Scenic Drive (scenic corridor)	SW Terwilliger Blvd. (throughout Barbur Historic Highway Landscape Unit)	Verdant boulevard with enclosed vegetative segments and viewpoints	Overhead wires, support poles and vegetative removal along SW Barbur Blvd. would be visible in open segments of corridor, but they would not significantly impact views along SW Terwilliger Blvd. itself.
Far Southwest Portland Landscape Unit				
Scenic Resources Protection Plan (1991)	VP 43-02 (viewpoint)	PCC-Sylvania	Panoramic views to the west	Project would not be visible.

Note: I-5 = Interstate 5; N/A = not applicable; OHSU = Oregon Health & Science University; PCC = Portland Community College; VA = Veterans Affairs.

4.5.4. Short-Term Impacts

Preferred Alternative

Construction of the Project would be staged and would occur over several years. For general construction sequencing, existing vegetation and obstructing structures would be removed first, likely creating areas that present a barren visual aesthetic. Staging and construction sites could add temporary visual clutter. Short-term impacts would affect a greater area than the finished Project, because more land would be required to stage construction equipment, divert traffic and construct the Project than would be needed for it when it is finished. New light rail bridges, such as those that would cross over Interstate 405 (I-405), I-5 and Highway 217, would have larger visual impacts during construction than during operation, because they would have equipment, scaffolding and partial finishes that would temporarily lack cohesion.

Terminus Options

The terminus options would avoid construction in the southern portion of the project area, thus reducing short-term impacts associated with construction south of the Upper Boones Ferry Station or south of the Hall Station and the Hunziker O&M Facility.

Related Transportation Improvements

The short-term impacts associated with the related transportation improvements would be similar to those described for the Preferred Alternative, consisting of visual clutter associated with staging and construction activities. The Ross Island Bridgehead Reconfiguration would require reconstruction of ramps, sidewalks and roadways in the South Portland neighborhood. The short-term impacts associated with the station access improvements are generally considered to be minor, except for those that require large-scale infrastructure and extended construction durations such as pedestrian bridges over existing roadways. Similar to the light rail bridges described above, pedestrian bridges would have equipment, scaffolding and partial finishes that would temporarily lack cohesion.

4.5.5. Comparison to Impacts of the Draft EIS Light Rail Alternatives

The overall visual impacts identified for the Project in this Final EIS are within the range of those of the light rail alternatives in the Draft EIS. Some aspects of the Project have been modified from the Draft EIS and would result in reduced visual impacts, while others have become more visually prominent, but generally in areas of lower visual sensitivity. These modifications include:

- The light rail bridge over I-405 has been extended south to cross over three surface streets in addition to the freeway, and then land in the center of SW Barbur Boulevard just south of SW Sheridan Street.
- The Marquam Hill Connection has been revised to feature an inclined elevator generally following the hillside slope of Terwilliger Parkway, which would be less visually prominent than the bridge and elevator options previously considered.
- Where possible, high-impact features such as light rail bridges have been modified from the Draft EIS alternatives in a way that will lessen their impact on highly sensitive viewers, especially residences. For example, the light rail bridge over I-5 in the Crossroads area was modified to be located farther away from neighboring residences, to preserve existing vegetation and to reduce the span length, which would result in a less visually prominent structure.

- Particularly in Tigard, the Preferred Alternative alignment has been modified from that of the Draft EIS light rail alternatives, resulting in the light rail alignment being located within land uses that have lower visual sensitivity, such as industrial areas or undeveloped rights of way.
- The Baylor Station and associated park and ride in the Draft EIS were relocated to the 68th Station, resulting in reduced visual impact in the Tigard Triangle Landscape Unit.
- A number of stations proposed to include multistory parking structures in the Draft EIS have been modified to surface lots, reducing the visual impact to neighboring properties.

4.5.6. Mitigation Measures

This section outlines the mitigation identified for unavoidable impacts to visual resources. The mitigation measures are in addition to the requirements that would be stipulated as part of the local agency permitting process, as described below.

Mitigation Measures for Unavoidable Impacts

Table 4.5-5 summarizes the mitigation measures that would address long-term and short-term impacts of visual changes. These are in addition to mitigation related to other environmental impacts, including impacts to parks, historic resources, land use and ecosystems, for which the potential mitigation measures include tree replacement or collaborative design processes to further develop aesthetic principles, as well as commitments to meet local agency permitting requirements that include visual and aesthetic requirements.

Table 4.5-5. Mitigation Measures for Impacts to Visual Resources

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
Long term	Changes to designated viewpoints, where project elements would be visible	None required. For locations where the Preferred Alternative could be visible from an identified scenic resource, such as the variety of regulated views, corridors and/or design districts, the Preferred Alternative would need to conform to applicable design review standards.	None required. Project sponsors would be required to develop projects to be consistent with applicable plans and policies with regard to urban design and landscaping.
Short term	Construction-related activities	TriMet would locate construction staging areas away from scenic viewpoints. Where construction staging areas are within view corridors (in the vicinity of the Gibbs Station and the Marquam Hill Connection), TriMet would implement shielding or other methods to minimize visual impact.	None required.

Best Management Practices to Avoid and Minimize Impacts

The following sections outline potential measures that TriMet (or the project sponsors for the related transportation improvements) could use to reduce visual impacts. These measures would be refined during applicable design review and local permitting processes.

Long-Term Best Management Practices

The following potential best management practices could help reduce moderate to high impacts of visual changes:

- develop potential alignments, associated facilities and station access improvements to be visually consistent with existing neighborhood pattern and scale; and where appropriate, follow local plans and policies to develop designs that are visually consistent with outlined future urban form
- design associated project structures, such as transit stops and park and ride facilities, to integrate with their visual environment, considering local scale and character
- use project-related facilities to integrate vacant or underused areas into the neighborhood, or to improve the visual character of neighborhood areas along the light rail alignment
- design project elements so that they consider their surroundings and have a relationship with them
- where project elements are added in highly visible or sensitive areas, use high quality design and materials that mitigate the overall impact and blend into the visual environment
- where possible, avoid demolition or alteration of structures that contribute to historic districts
- reduce or buffer the loss of existing visual resources through the addition of new street trees and other landscaping elements
- reduce obstructions or limitations to officially designated or socially recognized views
- consider aesthetic treatments for the design of new/replacement bridges, overhead structures or elevated sections of the ballasted track to improve compatability with surrounding areas (although, if more appropriate, design structures to contrast with their surroundings, so as to create a visual statement)
- where possible, make location-specific design adjustments to the street cross section (narrower lanes, elimination of a turn lane, narrower sidewalks, etc.) to avoid impacts to existing structures, slopes or vegetation
- use elements such as landscaping, streetscaping or fencing to provide an aesthetically pleasing visual buffer between the Project and adjacent high-sensitivity viewers
- adopt a strategy of coordinated street furnishing (such as signage, wayfinding, street furniture, lighting, and hardscaping) to create a harmonious visual environment
- use terraced vegetated landscaping to minimize the visual impact of large retaining walls where possible
- replace/restore removed vegetation and landscaping where possible
- where remnant parcels are created that are too small to be developed separately, use them for appropriate productive land use, such as public art, hardscaping, landscaping and/or community amenities, to make them visually appealing
- incorporate design treatments proposed in the Project's *Conceptual Design Report* (TriMet, 2020)
- where appropriate, use nonreflective materials and paint structures in dark or other visually subordinate colors

Short-Term Best Management Practices

The following potential best management practices could help reduce short-term impacts:

- locate construction staging areas away from scenic viewpoints, view corridors, or residential areas
- restore landscaping and streetscaping as the Project is being constructed rather than waiting for the final phases of construction
- shield light resources used in nighttime construction
- create viewing areas with project-related information for pedestrians
- design and place construction screens or barriers to limit the visibility of work areas that are adjacent to high-activity areas, particularly where pedestrians, parks, trails or residences are present
- use murals or comparable techniques in high-use areas to create barriers that have visual interest
- minimize storage of construction debris on-site

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4.6. Historic and Archaeological Resources

This section reviews historic, archaeological and cultural resources that could be impacted by the Project. It discusses long-term and short-term impacts, and also describes potential avoidance, minimization and mitigation measures.

Since the Draft EIS, this section has been updated to reflect the definition of the Project in this Final EIS. In addition, this Final EIS accounts for further surveys of affected areas, final determinations of eligibility and findings of effect for historic properties, and more detailed research and field surveys for archaeological resources.

4.6.1. Regulatory Context and Consultation

Section 106 of the National Historic Preservation Act requires federal agencies to consider the effects of their undertakings on **historic properties**, a term that broadly covers significant resources listed in or eligible for listing in the National Register of Historic Places (NRHP). These properties may be an archaeological site; a historic building, structure, district or object; or a traditional cultural property. In this Final EIS, the possible effects that the Project may have on a historic property are reviewed in accordance with the provisions of Section 106 of the National Historic Preservation Act. In this section, "effect" is equivalent to "impact."

Through the Section 106 process, federal agencies must consult with other agencies, tribes and other parties with an interest in the effects of a project on historic properties. The goal of consultation is to identify historic properties potentially affected by a project, assess the effects on these properties, and seek ways to avoid, minimize or mitigate adverse effects.

This Final EIS incorporates the Project's Section 106 compliance efforts. The results report, *Cultural Resource Survey for the Southwest Corridor Light Rail Project, Multnomah and Washington Counties, Oregon* (referred to in brief as the *Cultural Resource Survey*), which is included as Attachment C to this Final EIS, provides further details on the methods, research, coordination and documentation completed under Section 106.

FTA consulted with interested parties after initiating consultation with the Oregon State Historic Preservation Office (SHPO) to identify and assess the Project's impacts on historic buildings, structures, districts, objects and sites. These interested parties include the following agencies, tribes and organizations:

- Confederated Tribes and Bands of the Yakama Nation
- Confederated Tribes of the Grand Ronde Community of Oregon
- Confederated Tribes of Siletz Indians of Oregon
- Confederated Tribes of the Warm Springs Reservation of Oregon
- Cowlitz Indian Tribe
- Cities of Portland, Tigard and Tualatin
- Multnomah County
- Washington County
- Oregon Department of Transportation (ODOT)
- Restore Oregon

These parties were invited to participate in the environmental review and Section 106 processes. Appendix D, Final Section 4(f) Evaluation, and Appendix E, Agency Coordination and Correspondence, include more information on coordination associated with historic, archaeological and cultural resources.

4.6.2. Affected Environment

Area of Potential Effects

The area of potential effects (APE) is the study area for Section 106 analysis, legally defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties" (36 Code of Federal Regulations [CFR] Part 800.16).

FTA defined the APE for the Project (shown in Figures 4.6-1 through 4.6-3), first by including the area within 50 feet from the outer edge of the construction footprint for the Preferred Alternative and the Ross Island Bridgehead Reconfiguration, including easements, staging areas and property acquisitions.

In addition, the APE includes station access improvements that are proposed as a part of the Project. The APE covering these areas is narrower, because they are typically smaller in scope. They primarily include restriping for bicycle lanes or widening for bicycle lanes and new sidewalks, but some include retaining walls and pedestrian bridges. In general, these improvements are anticipated to stay within existing street rights of way, and avoid impacts to historic and archaeological resources.

The APE was extended beyond the 50-foot buffer where other environmental impacts would extend beyond that buffer. Specifically, the APE was adjusted for potential visual effects due to major structures such as bridges and elevated sections of the guideway. Noise and vibration impacts were also considered, but no such impacts extended beyond the APE. Any historic property that is within the APE or on a parcel that is intersected by the APE was evaluated for this Final EIS, including historic districts and parks.

The consulting parties listed in Section 4.6.1 were invited to review and comment on the APE for the Project, both for the Draft EIS and for the adjusted APE used in this Final EIS.

Survey of Historic Resources

This analysis focuses on significant historic-period resources, including buildings, structures or sites. The Project's historians identified these potential historic resources in the APE by:

- surveying every building, structure, district, site (e.g., park) and object that would be 50 years old by the year 2025[1]
- reviewing the NRHP, the SHPO Historic Sites Database, historic property inventories of local governments (Portland, Tigard, Tualatin, Multnomah County and Washington County), previous historic resource surveys and field investigations

[1] The year 2025 is used for this analysis because all of the Project's potential adverse effects on historic resources, such as property acquisition and construction, are expected to have commenced by then based on the current project timeline. Additional survey of resources will be conducted as needed if the timeline for construction is extended. See Appendix K, Memorandum of Agreement for Historic and Archaeological Resources, for more information.

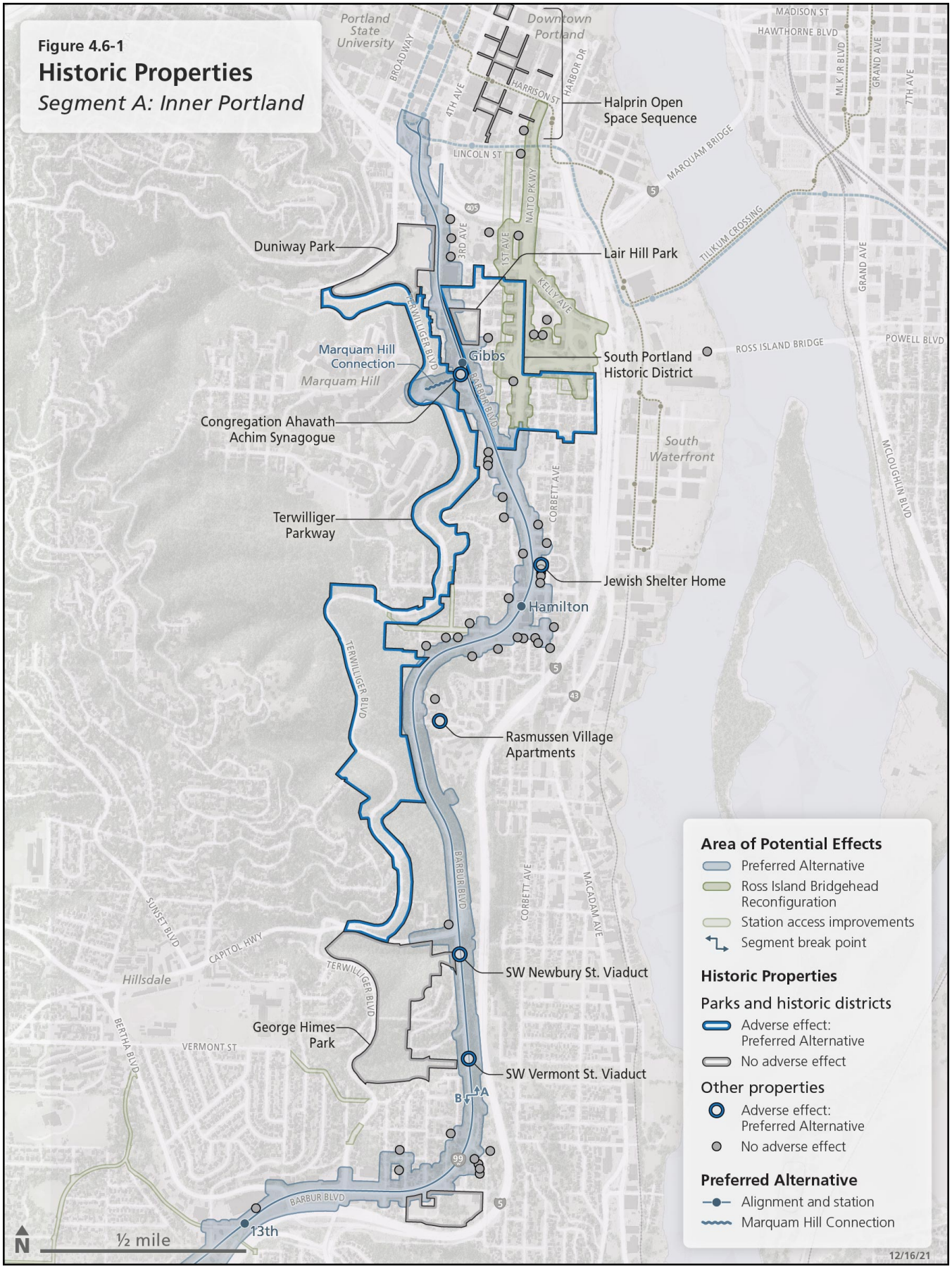
Figure 4.6-1
Historic Properties
Segment A: Inner Portland
Portland State University
Downtown Portland
Halprin Open Space Sequence
Duniway Park
Lair Hill Park
Marquam Hill Connection
Marquam Hill
Gibbs
South Portland Historic District
Congregation Ahavath Achim Synagogue
South Waterfront
Terwilliger Parkway
Jewish Shelter Home
Hamilton
Rasmussen Village Apartments
SW Newbury St. Viaduct
Hillsdale
George Himes Park
SW Vermont St. Viaduct
13th
½ mile
N
Area of Potential Effects
Preferred Alternative
Ross Island Bridgehead Reconfiguration
Station access improvements
Segment break point
Historic Properties
Parks and historic districts
Adverse effect: Preferred Alternative
No adverse effect
Other properties
Adverse effect: Preferred Alternative
No adverse effect
Preferred Alternative
Alignment and station
Marquam Hill Connection
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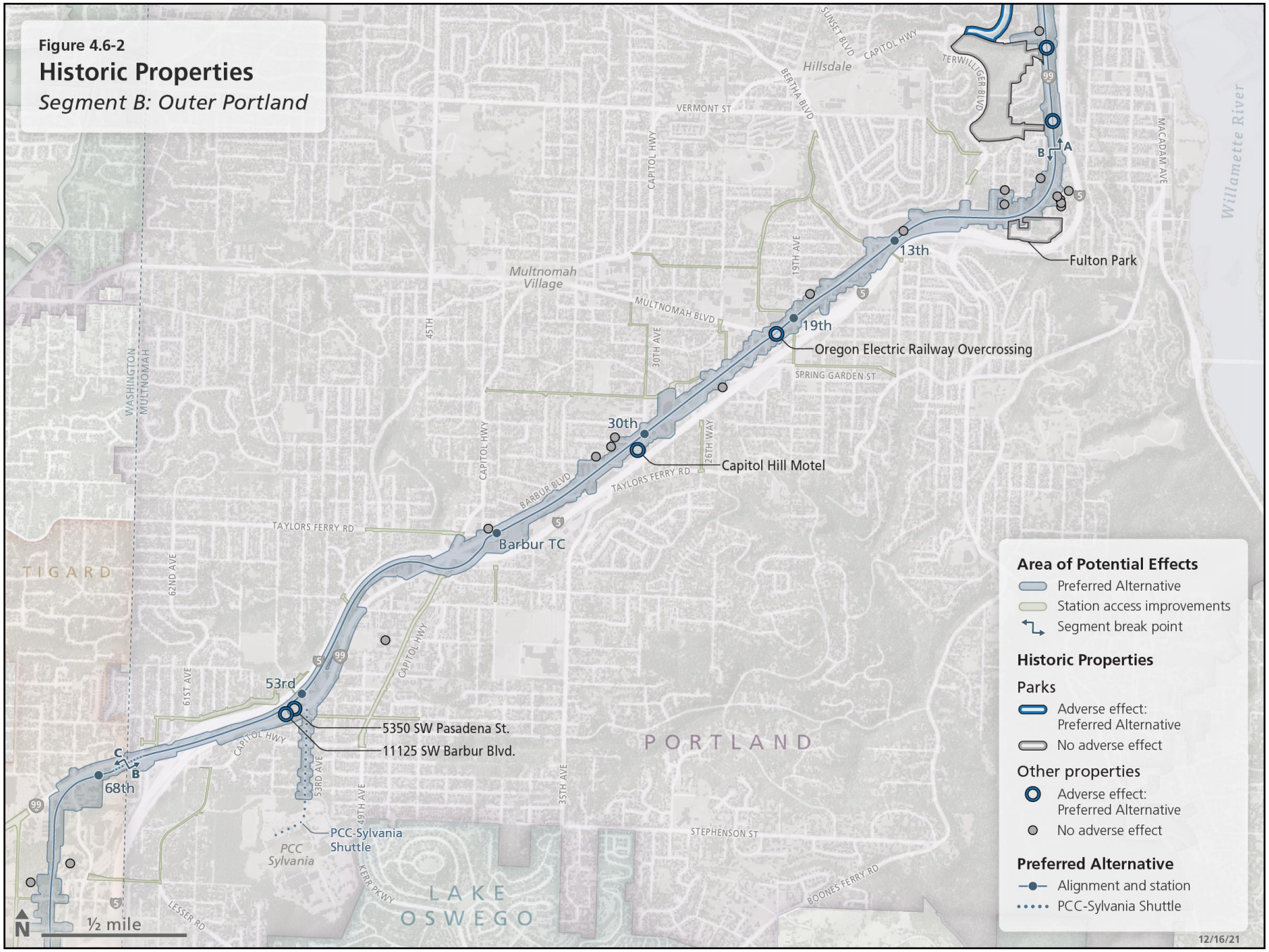


Figure 4.6-2
Historic Properties
Segment B: Outer Portland
Area of Potential Effects
Preferred Alternative
Station access improvements
Segment break point
Historic Properties
Parks
Adverse effect: Preferred Alternative
No adverse effect
Other properties
Adverse effect: Preferred Alternative
No adverse effect
Preferred Alternative
Alignment and station
PCC-Sylvania Shuttle
Fulton Park
13th
19th
Oregon Electric Railway Overcrossing
30th
Capitol Hill Motel
Barbur TC
53rd
5350 SW Pasadena St.
11125 SW Barbur Blvd.
68th
PCC-Sylvania Shuttle
Hillsdale
Multnomah Village
Willamette River
PORTLAND
TIGARD
LAKE OSWEGO
PCC Sylvania
VERMONT ST
CAPITOL HWY
SUNSET BLVD
BERTHA BLVD
TERWILLIGER BLVD
MACADAM AVE
MULTNOMAH BLVD
SPRING GARDEN ST
19TH AVE
30TH AVE
26TH WAY
45TH
BARBUR BLVD
TAYLORS FERRY RD
WASHINGTON
MULTNOMAH
62ND AVE
61ST AVE
53RD AVE
49TH AVE
35TH AVE
STEPHENSON ST
BOONES FERRY RD
KERR PKWY
LESSER RD
½ mile
N
12/16/21

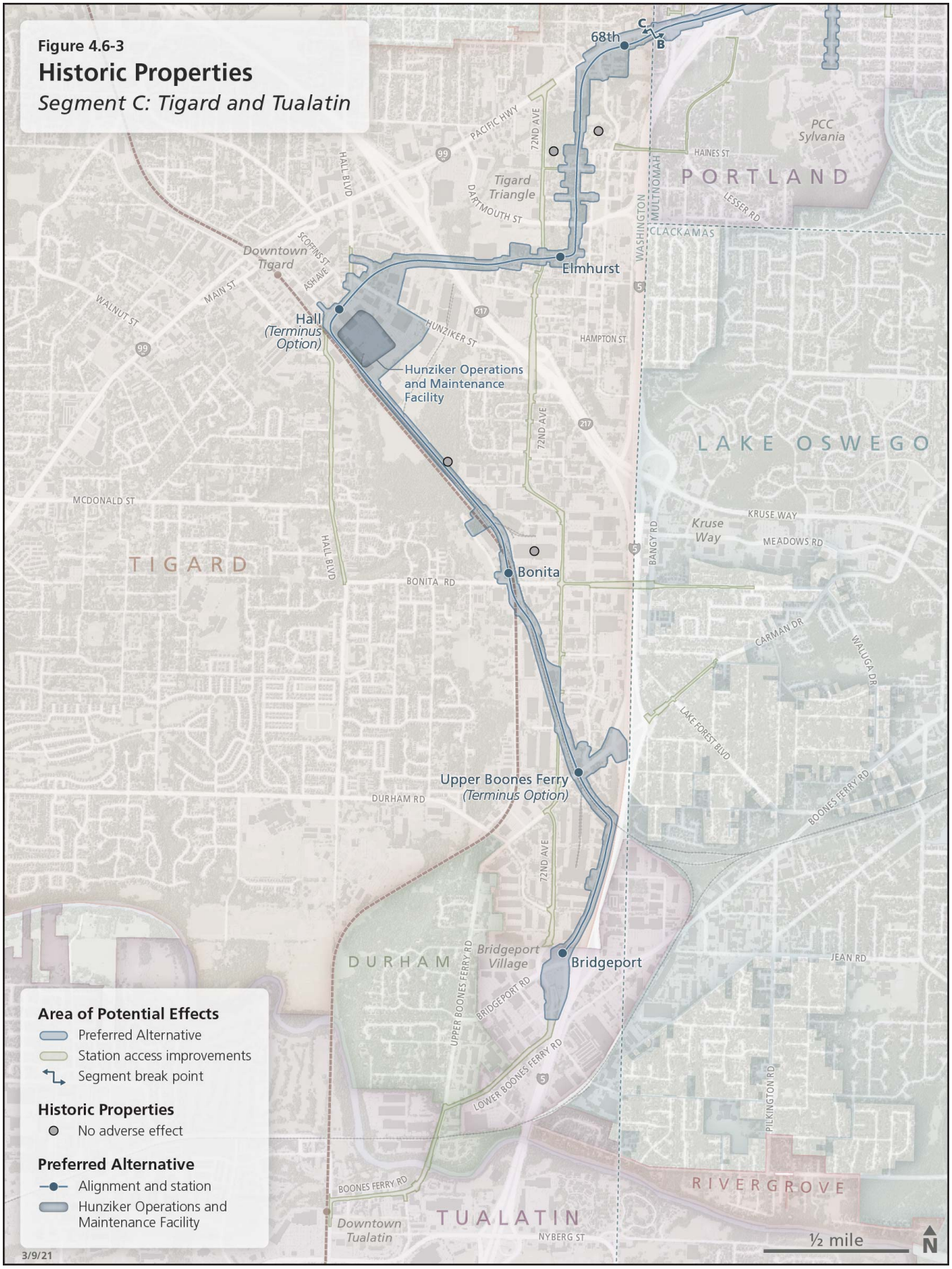


Figure 4.6-3
Historic Properties
Segment C: Tigard and Tualatin
68th
C
B
PACIFIC HWY
72ND AVE
HAINES ST
PCC Sylvania
PORTLAND
Tigard Triangle
DARTMOUTH ST
HALL BLVD
WASHINGTON
MULTNOMAH
LESSER RD
CLACKAMAS
Downtown Tigard
SCOFINS ST
ASH AVE
Elmhurst
MAIN ST
WALNUT ST
Hall (Terminus Option)
HUNZIKER ST
HAMPTON ST
Hunziker Operations and Maintenance Facility
LAKE OSWEGO
MCDONALD ST
KRUSE WAY
Kruse Way
MEADOWS RD
BANGY RD
TIGARD
Bonita
BONITA RD
CARMAN DR
WALUGA DR
LAKE FOREST BLVD
Upper Boones Ferry (Terminus Option)
DURHAM RD
BOONES FERRY RD
DURHAM
Bridgeport Village
Bridgeport
JEAN RD
UPPER BOONES FERRY RD
BRIDGEPORT RD
LOWER BOONES FERRY RD
PILKINGTON RD
RIVERGROVE
Downtown Tualatin
TUALATIN
NYBERG ST
½ mile
N
Area of Potential Effects
Preferred Alternative
Station access improvements
Segment break point
Historic Properties
No adverse effect
Preferred Alternative
Alignment and station
Hunziker Operations and Maintenance Facility
3/9/21

FTA, as the lead federal agency for the Project, in consultation with SHPO, has determined the resources eligible for listing in the NRHP. To inform the determination of which potential historic resources are significant historic properties, the historians conducted a targeted literature review of archival and online repositories, including books, maps and photographs, and conducted field visits.

In total, 619 historic resources were reviewed and documented within the APE (see Attachment C for a list, maps and photographs of all these resources). Of these, seven are listed in the NRHP and 72 have been determined to be eligible for individual listing in the NRHP. These 79 total resources are considered historic properties under Section 106 and for this Final EIS. The seven NRHP-listed properties in the APE are all located in Segment A, and include three historic districts, three houses and a community building.

Of the seven NRHP-listed properties, three are directly adjacent to the Preferred Alternative alignment: the South Portland Historic District, Terwilliger Parkway and the Jewish Shelter Home (4133 SW Corbett Avenue, Portland). The South Portland Historic District was listed in 1998 with a nomination identifying the buildings, structures, sites and objects that contribute to the district's historical significance. There are 79 resources that contribute to the eligibility of the district that also are within the APE. Three contributing resources of the district are also individually on or eligible for the NRHP. Terwilliger Parkway was listed in the NRHP as a historic district in March 2021. The Jewish Shelter Home, originally constructed as a private residence in 1902, was operated as a shelter home for Jewish children from 1919 to 1937. The house was listed in the NRHP in 1984.

FTA determined that the remaining 72 historic properties within the APE were eligible for listing in the NRHP based on research and documentation prepared for this Final EIS, including previous NRHP recommendations and consultation with the SHPO. These properties are mapped in Figures 4.6-1 through 4.6-3. For more detailed maps and descriptions of individual properties, see Attachment C.

Survey of Archaeological Resources

Archaeological resources can date from either before or after contact between Native Americans and non-native people. In the Pacific Northwest, development by non-native people began in the early 19th century. Buried remnants of these developments are called historic-period sites, and they provide information about the past, including native people living during this period. The history of residential, commercial, industrial and transportation development in the Portland area occurred during the 19th and early 20th centuries. Archaeological resources related to Native Americans prior to non-native settlers may also be present, especially in less developed areas. Much of the APE is paved and inaccessible to traditional archaeological survey methods. However, archaeological resources could be present beneath fill and pavement throughout the APE.

The archaeological survey within the APE accounts for both known **archaeological resources** as well as **high probability areas (HPAs)**, which are locations where project archaeologists have predicted a high likelihood of discovering a significant archaeological site.

There are 13 known archaeological resources within the APE. One is a pre-contact archaeological resource, and 12 are historic-period. The NRHP eligibility of four archaeological resources, including the single pre-contact resource, remains unevaluated due to lack of permission to access the properties. For the purposes of this analysis they are conservatively assumed to be historic properties, because they are potentially eligible for listing in the NRHP. The remaining nine historic-period archaeological resources have been determined not to be eligible for listing in the NRHP.

Project archaeologists have identified 20 HPAs in the APE that may also contain archaeological resources (see Attachment C for a list of the HPAs along with a description and typical photograph of each). The HPAs were located based on available maps and records of Euro-American and Native American land use within the APE, as well as analyses of intact landforms that are typically associated with the presence of archaeological resources. Historical records indicate that two pre-contact Native American camps or villages may have been within the APE: one in Portland and the other in Tigard. These two reported locations of Native American use are not documented as archaeological resources, but project archaeologists have accounted for them in defining the HPAs.

Other Cultural Resources

Other cultural resources may be eligible for inclusion in the NRHP due to their traditional religious and cultural importance, though no such resources have been identified within the APE for the Project beyond those identified as historic or archaeological resources. These types of cultural resources, sometimes referred to as *traditional cultural properties*, may be eligible for inclusion in the NRHP due to their association with cultural practices or beliefs of a living community that are both rooted in that community's history and important in maintaining the continuing cultural identity of the community.

4.6.3. No-Build Alternative

With the No-Build Alternative, the Project would not be built, and no changes to the urban environment, including to historic resources, would directly result due to a light rail project. The No-Build Alternative includes the assumption that other planned transportation projects would occur, as would population and employment growth. These other actions, which may include separate projects or developments, may occur over time, and they could result in impacts to historic, archaeological and cultural resources.

4.6.4. Long-Term Impacts – Historic Resources

Section 106 provides guidance on potential adverse effects to historic resources:

> An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative. (36 CFR 800.5)

The Project would acquire land and buildings, and by doing so would alter or remove some historic resources or alter their original setting. Changes that would alter or remove a resource's significant historic characteristics can result in an adverse effect. The analysis of adverse effects on historic resources considered changes due to noise, vibration, access, site context or visual conditions as a result of the Project. Indirect adverse impacts on historic resources, such as the effects of future development, are discussed in Section 4.18, Indirect and Cumulative Effects.

This Final EIS identifies FTA's findings of adverse effects on 11 eligible historic resources, one of which is the South Portland Historic District, where five buildings contributing to the district's significance would be removed. Other adverse effects in Segments A and B include the removal of several historic buildings and the replacement of three historic bridges on SW Barbur Boulevard. Table 4.6-1 summarizes the effects on

historic properties by segment, and Table 4.6-2 lists the resources and the nature of the impacts. These impacts are discussed in more detail in the following sections.

Table 4.6-1. Summary of Effects on Historic Resources[1]

Project Element	Section 106 Findings of Effect on Historic Resources	
	Adverse Effect	No Adverse Effect
Light Rail Investment: Preferred Alternative by Segment		
Segment A: Inner Portland	7	35
Segment B: Outer Portland	4	17
Segment C: Tigard and Tualatin	0	4
Light Rail Investment: Totals		
Preferred Alternative	11	56
Terminus options	11	56
Related Transportation Improvements		
Ross Island Bridgehead Reconfiguration	0	12
Station access improvements	0	0
Full Project		
Preferred Alternative + related transportation improvements	11	68

[1] These historic resources are buildings, structures or districts that are either listed in the National Register of Historic Places (NRHP) or have been determined by FTA to be eligible for listing in the NRHP.

Table 4.6-2 identifies the specific historic resource impacts by segment, focusing on resources with adverse effects, and identifying other resources with physical or setting effects that are not adverse. Resources that would have no effects or only minor proximity impacts, such as changes to the viewshed of the property without property impacts, are not listed in the table. Temporary effects due to construction and that are not adverse are discussed in Section 4.6.6 below, but the effects findings ultimately take into account both construction and permanent impacts.

Table 4.6-2. Summary of Historic Resource Effects by Segment (*multipage table*)

Property Name and Address	NRHP Status	Section 106 Finding of Effect	Nature of Impact
Preferred Alternative – Segment A			
Duniway Plaza, 2400 SW 4th Ave., Portland	Eligible	No Adverse Effect	Alteration of grounds
Marquam Plaza, 2525 SW 3rd Ave., Portland	Eligible	No Adverse Effect	Alteration of grounds
Congregation Ahavath Achim Synagogue 3225 SW Barbur Blvd., Portland	Eligible	Adverse Effect	Alteration of grounds and building, potential removal
Terwilliger Parkway (Historic District)	Listed in NRHP	Adverse Effect	Alteration of grounds, introduction of structures
3926 SW Water Ave., Portland	Eligible	No Adverse Effect	Alteration of grounds
3605 SW Condor Ave., Portland	Eligible	No Adverse Effect	Alteration of grounds
218–220 SW Hamilton St., Portland	Eligible	No Adverse Effect	Alteration of grounds
Jewish Shelter Home, 4133 SW Corbett Ave., Portland	Listed in NRHP	Adverse Effect	Alteration of grounds and building
4145 SW Corbett Ave., Portland	Eligible	No Adverse Effect	Alteration of grounds
4205 SW Corbett Ave., Portland	Eligible	No Adverse Effect	Alteration of grounds
4215–4217 SW Corbett Ave., Portland	Eligible	No Adverse Effect	Alteration of grounds
4231–4237 SW Corbett Ave., Portland	Eligible	No Adverse Effect	Alteration of grounds

Table 4.6-2. Summary of Historic Resource Effects by Segment (*multipage table*)

Property Name and Address	NRHP Status	Section 106 Finding of Effect	Nature of Impact
Tabernacle Seventh-Day Adventist Church, 26 SW Condor Way, Portland	Eligible	No Adverse Effect	Alteration of grounds
4820 SW Barbur Blvd., Portland	Eligible	No Adverse Effect	Alteration of grounds
Rasmussen Village, 4950 SW Barbur Blvd., Portland	Eligible	Adverse Effect	Alteration of grounds
5910 SW Ralston Drive, Portland	Eligible	No Adverse Effect	Alteration of grounds
SW Newbury St. Viaduct, Bridge #01983	Eligible	Adverse Effect	Removal
SW Vermont St. Viaduct, Bridge #01984	Eligible	Adverse Effect	Removal
Duniway Park, SW Sixth Ave. and SW Sheridan St., Portland	Eligible	No Adverse Effect	Alteration of grounds
George Himes Park, 6400 SW Terwilliger Blvd.	Eligible	No Adverse Effect	Alteration of grounds (temporary)
South Portland Historic District	Listed in NRHP	Adverse Effect	Removal of 5 residential buildings, alteration of 9 resources
Lair Hill Park, 3037 SW Second Ave., Portland	Eligible	No Adverse Effect	Alteration of grounds
4515 SW Corbett Ave., Portland	Eligible	No Adverse Effect	Alteration of grounds (temporary)
Marquam II, 2611 SW Third Ave., Portland	Eligible	No Adverse Effect	Alteration of grounds
Preferred Alternative – Segment B			
1801 SW Evans St., Portland	Eligible	No Adverse Effect	Alteration of grounds (temporary)
Original Pancake House, 8601 SW 24th Ave., Portland	Eligible	No Adverse Effect	Alteration of grounds (temporary)
Good Shepherd Lutheran Church and Little Lambs Preschool/Daycare, 3405 SW Alice St., Portland	Eligible	No Adverse Effect	Alteration of grounds (temporary)
Capitol Hill Motel, 9110 SW Barbur Blvd., Portland	Eligible	Adverse Effect	Removal
Master Wrench, 9803 SW Barbur Blvd., Portland	Eligible	No Adverse Effect	Alteration of grounds
5350 SW Pasadena St., Portland	Eligible	Adverse Effect	Removal
11125 SW Barbur Blvd., Portland	Eligible	Adverse Effect	Removal
Oregon Electric Railway Overcrossing, Bridge #02010	Eligible	Adverse Effect	Removal
Fulton Park, 68 SW Miles St., Portland	Eligible	No Adverse Effect	Alteration of grounds
Burlingame Fred Meyer Sign, 7529-7601 SW Barbur Blvd., Portland	Eligible	No Adverse Effect	Minor relocation on property
Preferred Alternative – Segment C			
Fought & Company, 14255 SW 72nd Ave., Tigard	Eligible	No Adverse Effect	Alteration of grounds (temporary)
Southern Pacific Railroad, Tigard Branch, Tigard	Eligible	No Adverse Effect	Alteration of grounds (temporary)
Oregon Education Association, 6900 SW Atlanta St., Tigard	Eligible	No Adverse Effect	Alteration of grounds

Note: NRHP = National Register of Historic Places.

Preferred Alternative Segment A: Inner Portland

There are seven historic resources that would be adversely affected by the Preferred Alternative in Segment A, including the South Portland Historic District that encompasses multiple historic buildings:

- In the South Portland Historic District, eight residential buildings within the district would be removed, including five houses that contribute to the significance of the district, resulting in an adverse effect to the district. Parts of nine other parcels with contributing resources would be altered, including Lair Hill Park, but no other buildings would be removed or altered within the district with the Preferred Alternative. On the western border of the district, the reconstruction of SW Barbur Boulevard to accommodate light rail and improve sidewalks and bicycle lanes would also remove street trees, build retaining walls, install new street lights, develop sidewalks and stairs connecting to the district, modify

overhead utilities and poles, develop the Gibbs Station, develop new catenary systems for light rail and revise street intersections with SW Barbur Boulevard.

- Congregation Ahavath Achim Synagogue on SW Barbur Boulevard would be impacted by the Preferred Alternative due to the widening of SW Barbur Boulevard, the development of the Gibbs Station, and the pedestrian plaza and landing for the nearby Marquam Hill Connection inclined elevator. These impacts would be an adverse effect due to the potential removal or modification of the building and the alteration of its setting.

- Terwilliger Parkway would be impacted by the Preferred Alternative due to the Marquam Hill Connection. This connection would feature an inclined elevator that would occupy a 27,200-square-foot area traversing Terwilliger Parkway, mostly in a sloping ravine. The inclined elevator's trackway and elevator cars would be visible from SW Terwilliger Boulevard. The one-story upper elevator house and plaza would be adjacent to the sidewalk/trail that follows the eastern edge of SW Terwilliger Boulevard. The upper elevator house and plaza would introduce a platform and building on the hillside and adjoining the sidewalk/trail, introduce lighting, and create a controlled crossing where a crosswalk exists today. See Appendix B4.5, Supporting Material for Visual Quality Analysis, for conceptual renderings of the Marquam Hill Connection.

- The Jewish Shelter Home on SW Corbett Avenue would be altered by the potential removal of a former isolation ward, which was moved and attached to the west side of the house in the 1950s.

- Rasmussen Village, an Art Deco apartment complex on SW Barbur Boulevard, would be altered by changes to its entrance and landscaping.

- The SW Newbury Street Viaduct (Bridge #01983) on SW Barbur Boulevard would be removed and replaced.

- The SW Vermont Street Viaduct (Bridge #01984) on SW Barbur Boulevard would be removed and replaced.

The Preferred Alternative would have permanent elements partly within the boundaries of 17 other historic resources, including two historic parks. These property impacts would be due to improvements such as sidewalks or retaining walls that would be on the edges of the parcels containing these resources but would have no adverse effects to their historic characteristics. At Duniway Park, a widened SW Barbur Boulevard would impact the northeastern edge of the park and modify features from the modern era. At Lair Hill Park, the Preferred Alternative would impact the western edge of the park, rebuilding a retaining wall and an access path, and removing trees along the park border.

Preferred Alternative Segment B: Outer Portland

Segment B has 21 historic resources within the APE. Four of those historic resources would be adversely affected by the Preferred Alternative:

- The Oregon Electric Railway Overcrossing (Bridge #02010) on SW Barbur Boulevard would be removed and replaced by a new bridge for the combined light rail and roadway alignment.

- The Capitol Hill Motel, a Minimal Traditional auto court motel on SW Barbur Boulevard, would be affected by the widening for light rail and the roadway, and the building would be removed.
- A Tudor Revival house at the 5300 block of SW Pasadena Street would be removed for the park and ride at the 53rd Station.
- A Modern Period commercial building at the 11100 block of SW Barbur Boulevard would be removed for the park and ride at the 53rd Station.

Three other historic resources in Segment B would have areas within their boundaries permanently altered by features of the Preferred Alternative, but the effect would not be adverse. This includes Fulton Park, where the Preferred Alternative improves intersections and sidewalks at the park, removes street trees, and requires a small sliver within the park for part of a sidewalk.

The Portland Community College (PCC)-Sylvania Shuttle would have no effect on historic properties.

Preferred Alternative Segment C: Tigard and Tualatin

None of the historic resources in the APE in Segment C would have adverse effects. The Oregon Education Association property would have improvements partly within its boundary, but there would be no adverse effect. The Hunziker Operations and Maintenance (O&M) Facility would have no effect on historic properties.

Terminus Options

The terminus options are two options to construct a portion of the Preferred Alternative alignment, terminating at either the Upper Boones Ferry Station or the Hall Station. The Preferred Alternative would have no long-term effects on historic resources along the portion of the alignment that would not be constructed for each terminus option. As a result, both terminus options would have the same long-term historic resource impacts as the Preferred Alternative.

Related Transportation Improvements

Ross Island Bridgehead Reconfiguration

The improvements associated with the Ross Island Bridgehead Reconfiguration would result in improvements in the vicinity of 12 resources, but there would be no adverse effects to individual historic properties. The reconfiguration would be partly within the South Portland Historic District but would not have adverse effects to any of the district's contributing properties. (The district would still have an adverse effect with the Preferred Alternative.)

Station Access Improvements

The station access improvements would remain within public rights of way and would thereby avoid permanent property acquisitions or easements. The improvements focus on sidewalks and bicycle facilities, which would not adversely affect the settings of nearby historic resources.

4.6.5. Long-Term Impacts – Archaeological Resources

Although adverse effects to archaeological resources could be caused by construction activities, the impacts are considered permanent. If a site eligible for the NRHP is encountered during construction, it would be

permanently altered and have the potential for the destruction of artifacts, loss of site integrity, or other features important for its significance. The APE was used to determine the potential for impacts to archaeological resources, but the primary focus is on the construction footprint, which is within the larger APE. The HPAs indicate locations that would likely need further detailed preconstruction surveys or archaeological monitoring during construction to discover whether or not an archaeological site exists and to reduce the potential for impacts. Raw land (undeveloped or unpaved land) can be surveyed for archaeological resources in advance, which minimizes risk during construction. Construction could impact unrecorded and unevaluated, potentially eligible archaeological sites where advance survey is not possible.

Table 4.6-3 summarizes the potential impacts of the Project on archaeological resources, including known resources as well as four HPAs that remain unevaluated for their historic significance due to lack of access. This table includes both the HPA acreage within the APE for each project element and the percentage of land in the HPAs that could be surveyed for archaeological resources before project construction. These potential impacts to archaeological resources are discussed in more detail in the following sections.

Table 4.6-3. Summary of Impacts on Archaeological Resources

Project Element	Known Archaeological Resources[1]	HPAs[2]	
		Acreage in APE	Surveyable Raw Land Percentage
Light Rail Investment: Individual Elements			
Segment A alignment and stations	0	76.0	27%
Segment B alignment and stations	0	50.7	2%
Segment C alignment and stations	1	76.3	42%
Marquam Hill Connection	1	6.5	100%
PCC-Sylvania Shuttle	0	0.0	0%
Hunziker O&M Facility	0	1.2	83%
Light Rail Investment: Totals			
Preferred Alternative	2	210.7	29%
Upper Boones Ferry Terminus Option	2	206.5	29%
Hall Terminus Option	2	182.7	29%
Related Transportation Improvements			
Ross Island Bridgehead Reconfiguration	2	34.0	2%
Station access improvements	0	0.0	0%
Full Project			
Preferred Alternative + all related transportation improvements	4	244.7	25%

Note: APE = area of potential effects; HPAs = high probability areas.

[1] Archaeological resources include resources listed in the National Register of Historic Places, as well as resources that are not yet evaluated but are potentially eligible to be listed.

[2] HPAs are locations where project archaeologists have predicted a high likelihood of discovering a significant archaeological site.

Preferred Alternative Segment A: Inner Portland

Five HPAs cover 76.0 acres of the APE in Segment A alignment and stations. The Preferred Alternative alignment and stations would not intersect unevaluated/potentially eligible archaeological sites. One ethnographic village location may be within Segment A, although it has yet to be confirmed on the ground. An HPA has been defined to encompass the village location. The Preferred Alternative would impact that HPA, which is paved and developed, preventing advance survey. Twenty-seven percent of the HPA acreage in Segment A could be archaeologically surveyed in advance of construction. As part of the Project, and as

discussed in Section 4.6.8, Potential Mitigation Measures, a construction monitoring plan would be developed defining how the remaining area would be monitored during construction. Construction monitoring would be conducted by staff trained to identify artifacts or other signs of an archaeological site; if a site is identified, construction would be halted to gather information on the resource, to determine whether it is a historic property, and to determine mitigation in consultation with agencies and tribes.

The portion of the Marquam Hill Connection within the HPA largely consists of 6.5 acres of undeveloped land. An archaeological pedestrian survey documented one unevaluated/potentially eligible historic-period archaeological site that could be affected by the Marquam Hill Connection, if the resource is determined eligible for listing in the NRHP and impacts by the Project cannot be avoided.

Preferred Alternative Segment B: Outer Portland

Seven HPAs cover 50.7 acres of the APE for the Preferred Alternative in Segment B. There are no recorded archaeological sites within the APE in Segment B, but the area has not been completely surveyed for archaeological resources. Just 2 percent of the HPA acreage in Segment B could be archaeologically surveyed in advance of construction. The remaining area would be monitored. The PCC-Sylvania Shuttle would have no effect on archaeological resources.

Preferred Alternative Segment C: Tigard and Tualatin

Ten HPAs cover 76.3 acres of the APE for the Segment C Preferred Alternative alignment and stations. Archaeological survey documented one unevaluated/potentially eligible pre-contact archaeological site that could be affected by construction of the Preferred Alternative. The resource could not be fully delineated within the APE due to property access restrictions. One ethnographic village location is suspected to be within Segment C, although it has yet to be confirmed on the ground. FTA will continue to consult with tribes regarding this village location. An HPA has been defined to encompass the suspected village location, and the Preferred Alternative intersects that HPA. This area has not been completely surveyed for archaeological resources due to lack of access. However, raw land would be archaeologically surveyed when property access become available, and about 42 percent of the HPA acreage for the Preferred Alternative alignment and stations would be surveyable in advance of construction. The remainder would be addressed as defined by the Project's construction monitoring plan.

The portion of the APE attributed to the Hunziker O&M Facility would intersect approximately 1.2 acres within two HPAs. There are no recorded archaeological sites within the APE at the Hunziker O&M Facility, but the area could not be completely surveyed for archaeological resources before the Final EIS was prepared, due to property access restrictions. Eighty-three percent of the HPA acreage related to the O&M facility could still be surveyed in advance of construction, and the remainder would be addressed as defined by the Project's construction monitoring plan.

Terminus Options

The terminus options would have the same impacts to known archaeological resources as the Preferred Alternative because there are no known archaeological resources along the portion of the Preferred Alternative south of the Hall Station and the Hunziker O&M Facility.

The terminus options would not include construction within certain HPAs at the southern end of the Preferred Alternative alignment. The Upper Boones Ferry Terminus Option would avoid two HPAs south of

the Upper Boones Ferry Station and the Hall Terminus Option would avoid four HPAs south of the Hall Station and the Hunziker O&M Facility.

Related Transportation Improvements

Ross Island Bridgehead Reconfiguration

The portion of the APE attributed to the Ross Island Bridgehead Reconfiguration would intersect 34 acres within two HPAs. There are two previously recorded unevaluated/potentially eligible historic-period archaeological sites that may be affected by the Ross Island Bridgehead Reconfiguration, but the area has not been completely surveyed for archaeological resources. Just 2 percent of the HPA acreage in the APE for the Ross Island Bridgehead Reconfiguration could be archaeologically surveyed in advance of construction. The remaining area would be monitored.

Station Access Improvements

The station access improvements would remain within public rights of way and would not require permanent property acquisitions or easements. The access improvements, which are primarily sidewalks and bicycle facilities but also include a pedestrian bridge, would typically not require extensive ground excavation that could disturb archaeological resources. If a station access improvement is later designed to require property acquisition or excavation below the fill beneath the existing pavement, further environmental review and clearance may be required.

4.6.6. Short-Term Impacts

Short-term impacts are those that would occur during the limited duration of project construction. As part of the Project, construction management plans would specifically address the measures to be taken to protect historic resources during construction, and final design measures would specify the activities to restore and replace temporarily impacted areas to conditions that would be equivalent or better than existing conditions. The Memorandum of Agreement (MOA) developed for the Project further addresses avoidance and mitigation commitments (see Appendix K, Memorandum of Agreement for Historic and Archaeological Resources).

Examples of construction impacts to historic resources during construction include:

- possible damage through vibrations or settlement caused by earthmoving and heavy equipment
- temporary alteration of access to a historic site
- potential temporary visual impacts during construction
- increased dust and noise near the construction area

Archaeological resources would not have short-term impacts, because any disturbance of a significant archaeological site would be a permanent impact.

Preferred Alternative and Terminus Options

In Segment A, construction activities would occur partly within the boundaries of and adjacent to 35 historic resources, including the South Portland Historic District and Fulton and George Himes Parks. With the Project's commitments to protect the resources and restore disturbed areas to the same as or

better than existing conditions, these construction activities would not alter the defining features or characteristics of the resources and would have no adverse effect.

In Segment B, the Preferred Alternative would involve construction partly within and adjacent to the boundaries of 17 historic resources. With the Project's protection and restoration commitments, these construction activities would have no adverse effect.

Three historic resources in Segment C would have construction activities partly within or adjacent to their boundaries. These activities would not have an adverse effect. One of these resources, Fought & Company, would not be impacted by the Hall Terminus Option during construction because it is located along the stretch of the Preferred Alternative that would not be constructed by that terminus option.

Related Transportation Improvements

Construction activities for the Ross Island Bridgehead Reconfiguration would occur partly within the boundaries of and adjacent to 12 historic resources, including the South Portland Historic District. The anticipated construction activities would not alter the defining features or characteristics of the resources and would have no adverse effect.

Although some station access improvements could require construction activities adjacent to historic resources, these activities would not alter the defining features or characteristics of the resources and would have no adverse effect.

4.6.7. Comparison to Impacts of the Draft EIS Light Rail Alternatives

Historic Resources

Overall, effects on historic resources as identified for the Preferred Alternative would be less than those reported for the Draft EIS light rail alternatives (see Table 4.6-4).

Table 4.6-4. Comparison of Effects on Historic Resources Between the Draft and Final EISs

Evaluation	Effects on Historic Properties[1]	
	Adverse Effect	No Adverse Effect
Draft EIS[2]		
Full Project range[3]	14–27	22–45
Final EIS		
Preferred Alternative	11	55
Full Project[4]	11	68

Note: EIS = Environmental Impact Statement; NRHP = National Register of Historic Places.

[1] For this Final EIS, historic properties include those historic properties that are listed in the NRHP and those that have been determined to be eligible for listing. In the Draft EIS, historic properties include NRHP-listed historic properties and other historic resources identified as potentially eligible.

[2] Draft EIS estimates were derived based on proposed acquisitions and easements. The range for adverse effects includes all full acquisitions and partial acquisitions with potential adverse effect.

[3] The full Project range for the Draft EIS was defined as the range representing the lowest and highest possible sum of impacts from a composite of one light rail alignment alternative within each segment, a Marquam Hill connection option, a PCC-Sylvania shuttle option, and an operations and maintenance facility option.

[4] The full Project is defined as the Preferred Alternative plus the related transportation improvements.

Development of the Preferred Alternative would result in 11 adverse effects on historic resources, which is below the range of 14 to 27 estimated for the light rail alternatives in the Draft EIS. Most of this change is due to efforts to revise the Preferred Alternative alignment to avoid historic properties, and to minimize the footprint of the Preferred Alternative at the locations of historic properties.

Archaeological Resources

Overall effects on archaeological resources as identified in this Final EIS remain similar to or less than the anticipated effects reported in the Draft EIS for the light rail alternatives, although the number of HPAs has been reduced by eight as a result of selecting the Preferred Alternative (i.e., those areas were part of alternatives studied in the Draft EIS and are avoided by the Preferred Alternative alignment). Construction of the Project may adversely affect four unevaluated archaeological resources—three fewer resources than estimated for the Draft EIS; two of these are associated with the Preferred Alternative, and two are associated with the Ross Island Bridgehead Reconfiguration. Most of the reduction in potential impact is due to several resources being determined not eligible for listing in the NRHP, based on further investigations following the publication of the Draft EIS.

4.6.8. Mitigation Measures

For unavoidable adverse effects on historic resources, FTA has developed a mitigation plan in consultation with SHPO and other consulting parties. The mitigation commitments are described in the Section 106 MOA developed for the Project, attached as Appendix K to this Final EIS. The mitigation is defined by individual resource. Examples of mitigation measures for historic resources include detailed documentation of the affected resource, conducting additional historic context studies, exploring opportunities to offer buildings for relocation where possible, salvaging materials, developing historic markers or displays, and restoring disturbed areas.

Mitigation measures for archaeological resources are also described in the MOA; examples of these measures include additional survey in HPAs that were not accessible during preparation of this Final EIS, a construction monitoring plan and an inadvertent discovery plan. These two documents are included in the Archaeological Site Protection and Monitoring Plan, which is provided in this Final EIS as Attachment G. The survey would include additional archaeological investigation during final design in areas identified in coordination with consulting parties. TriMet (or the project sponsors for related transportation improvements) would conduct preconstruction surveys to help avoid or minimize project impacts on as-yet unevaluated archaeological resources. In areas where preconstruction surveys can be completed once legal access has been allowed, archaeological resources would be identified and evaluated ahead of construction, thus allowing treatment or avoidance measures to be taken. In HPAs where there is less opportunity for preconstruction surveys, for example paved areas, TriMet would conduct monitoring early during construction to determine if archaeological resources are present, and if so, evaluate their significance and confirm appropriate measures before more intensive construction occurs. If archaeological resources were found during construction, TriMet would follow the protocol outlined in the inadvertent discovery plan to notify the necessary parties and determine appropriate next steps.

4.7. Parks and Recreation Resources

This section identifies parks and recreation resources in the study area, which include publicly owned parks, greenspaces, recreation areas, trails, natural areas and wildlife lands. The purpose of this section is to identify the facilities, features or functions within the parks that would be impacted by the Project. Further information on the Project's impact to natural resources, wildlife habitat and stormwater functions within the parks can be found in Section 4.9, Ecosystems, and Section 4.10, Water Resources.

Since the Draft EIS, this section has been updated to reflect the definition of the Project in this Final EIS, including more detailed designs based on land survey information, conversations with stakeholders including Portland Parks and Recreation (PP&R), and public comments received on the Draft EIS. More information has also been added about permanent and temporary easements.

The Draft EIS identified all parks and recreation resources that could be impacted by the full range of light rail alternatives considered in that document. Not all of the parks previously identified in the Draft EIS would be in the vicinity of the Preferred Alternative or the related transportation improvements presented in this Final EIS. Parks and recreation resources that are not within the study area for the Preferred Alternative and related transportation improvements are not discussed further in this Final EIS.

4.7.1. Affected Environment

Related Regulations

The Project must comply with federal regulations that restrict the conversion or use of certain parks and recreation resources for transportation purposes. Appendix D, Final Section 4(f) Evaluation, addresses park impacts pursuant to the requirements of U.S. Department of Transportation Act of 1966. Appendix N, Section 6(f) of the Land and Water Conservation Fund Act Documentation, reviews and documents the status and evaluation of properties funded by Section 6(f), including the Terwilliger Parkway, pursuant to the requirements of the Land and Water Conservation Fund Act of 1965.

Study Area Overview

The study area for parks and recreation resources consists of three overlapping study areas, each extending a certain distance from the construction footprint of the relevant project elements. The study areas for the Preferred Alternative and the Ross Island Bridgehead Reconfiguration extend 150 feet from the construction footprint, while the study area for the station access improvements extends 50 feet from the construction footprint.

Figures 4.7-1 through 4.7-3 show the parks and recreation resources in the study area for each segment. Tables 4.7-1 and 4.7-2 list the parks and recreation resources in the specific study areas for the Preferred Alternative and the related transportation improvements (the Ross Island Bridgehead Reconfiguration and the station access improvements), respectively.

Parks and recreation resources in the study area are owned and managed by PP&R, City of Tigard Public Works Department, Portland Public Schools, The Wetlands Conservancy and Metro, which owns and manages public parks and open spaces on lands throughout the Portland metropolitan area.

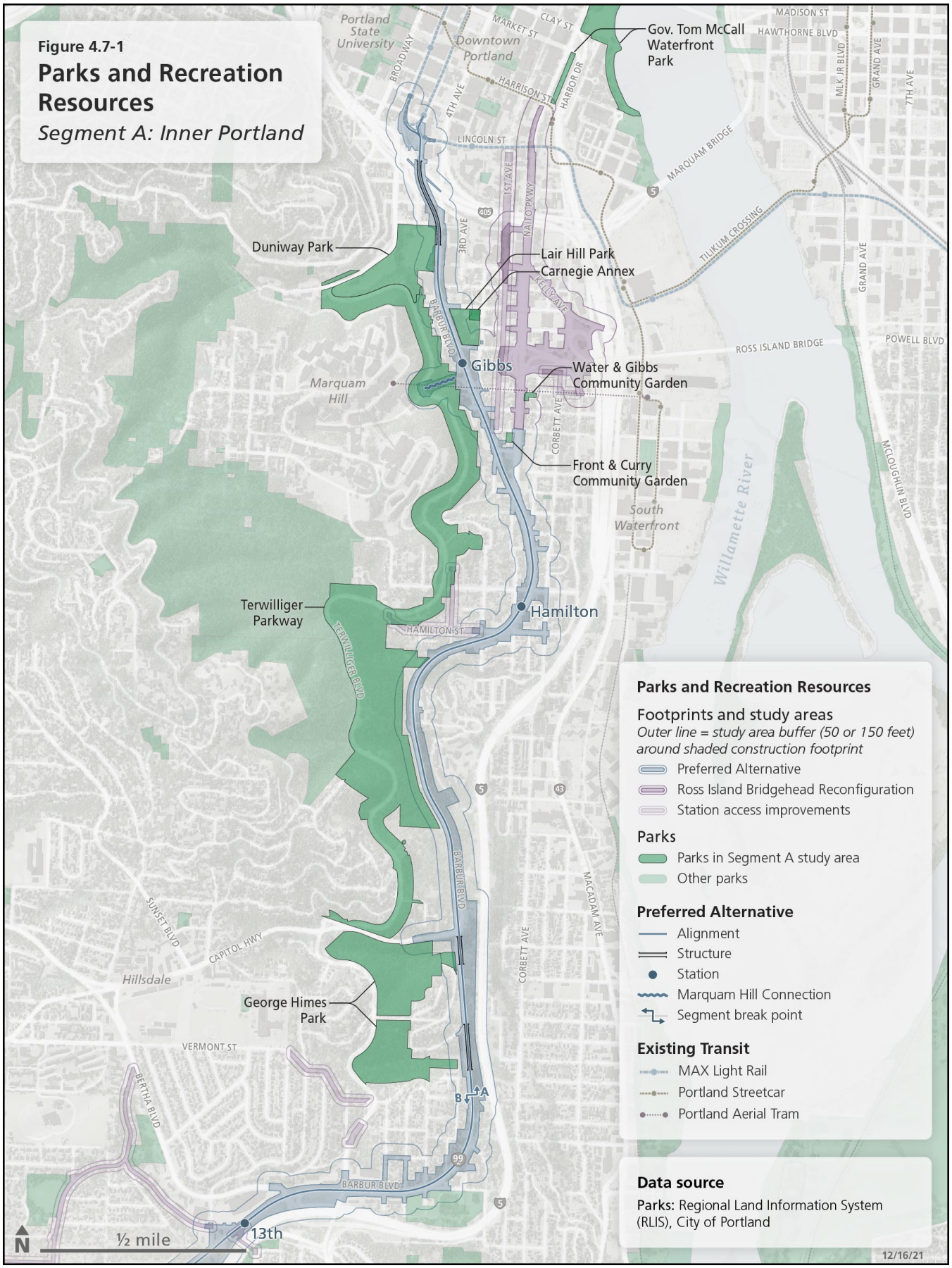
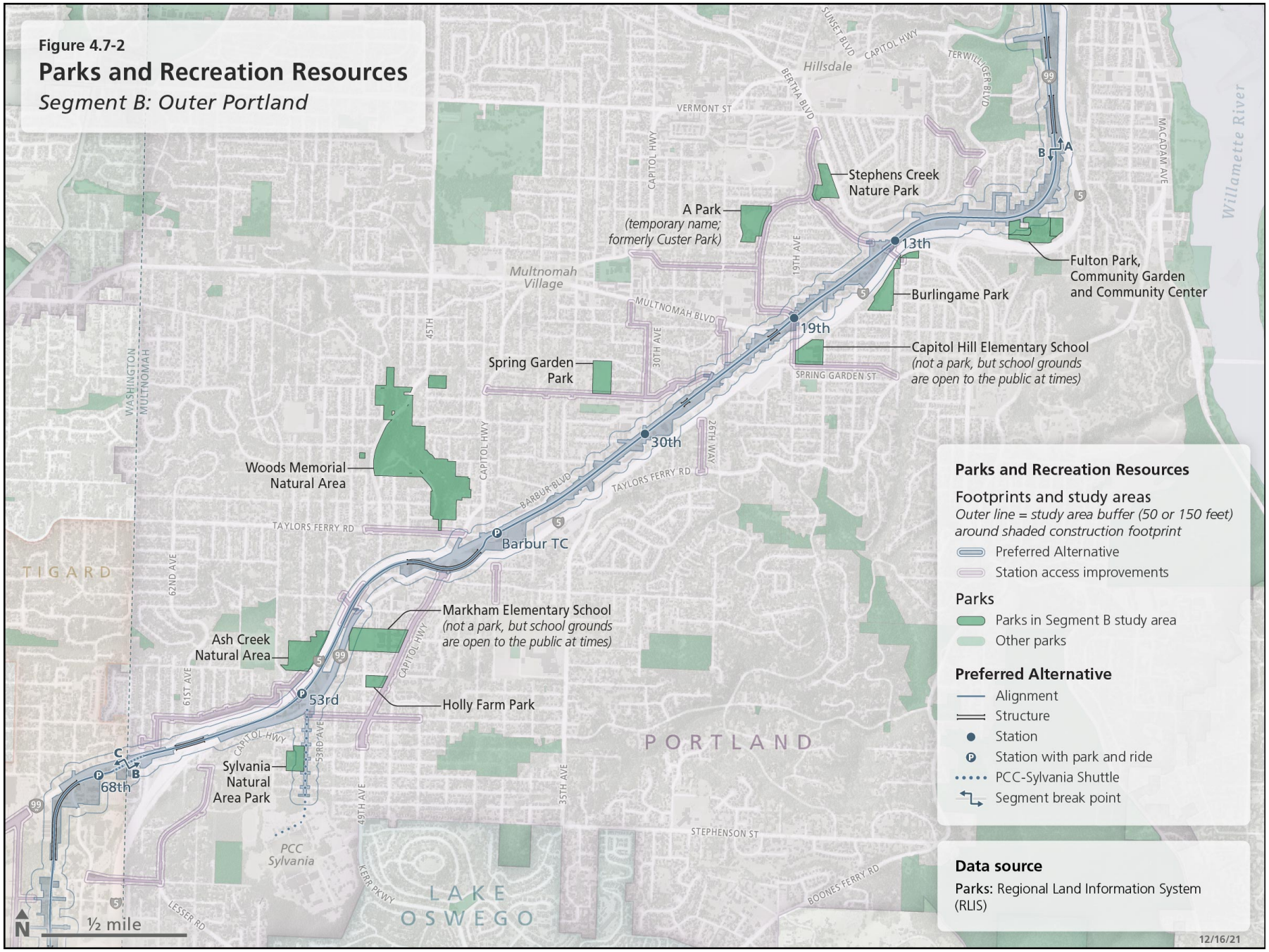


Figure 4.7-1
Parks and Recreation Resources
Segment A: Inner Portland
Portland State University
Downtown Portland
Gov. Tom McCall Waterfront Park
Duniway Park
Lair Hill Park
Carnegie Annex
Gibbs
Water & Gibbs Community Garden
Marquam Hill
Front & Curry Community Garden
South Waterfront
Willamette River
Terwilliger Parkway
Hamilton
George Himes Park
Hillsdale
13th
½ mile
N
MADISON ST
HAWTHORNE BLVD
MARKET ST
CLAY ST
BROADWAY
4TH AVE
HARRISON ST
HARBOR DR
LINCOLN ST
MARQUAM BRIDGE
1ST AVE
NAITO PKWY
3RD AVE
TILIKUM CROSSING
BARBUR BLVD
KELLY AVE
ROSS ISLAND BRIDGE
POWELL BLVD
GRAND AVE
MLK JR BLVD
7TH AVE
CORBETT AVE
MCLOUGHLIN BLVD
HAMILTON ST
TERWILLIGER BLVD
MACADAM AVE
SUNSET BLVD
CAPITOL HWY
VERMONT ST
BERTHA BLVD
Parks and Recreation Resources
Footprints and study areas
Outer line = study area buffer (50 or 150 feet) around shaded construction footprint
Preferred Alternative
Ross Island Bridgehead Reconfiguration
Station access improvements
Parks
Parks in Segment A study area
Other parks
Preferred Alternative
Alignment
Structure
Station
Marquam Hill Connection
Segment break point
Existing Transit
MAX Light Rail
Portland Streetcar
Portland Aerial Tram
Data source
Parks: Regional Land Information System (RLIS), City of Portland
12/16/21

Figure 4.7-2
Parks and Recreation Resources
Segment B: Outer Portland



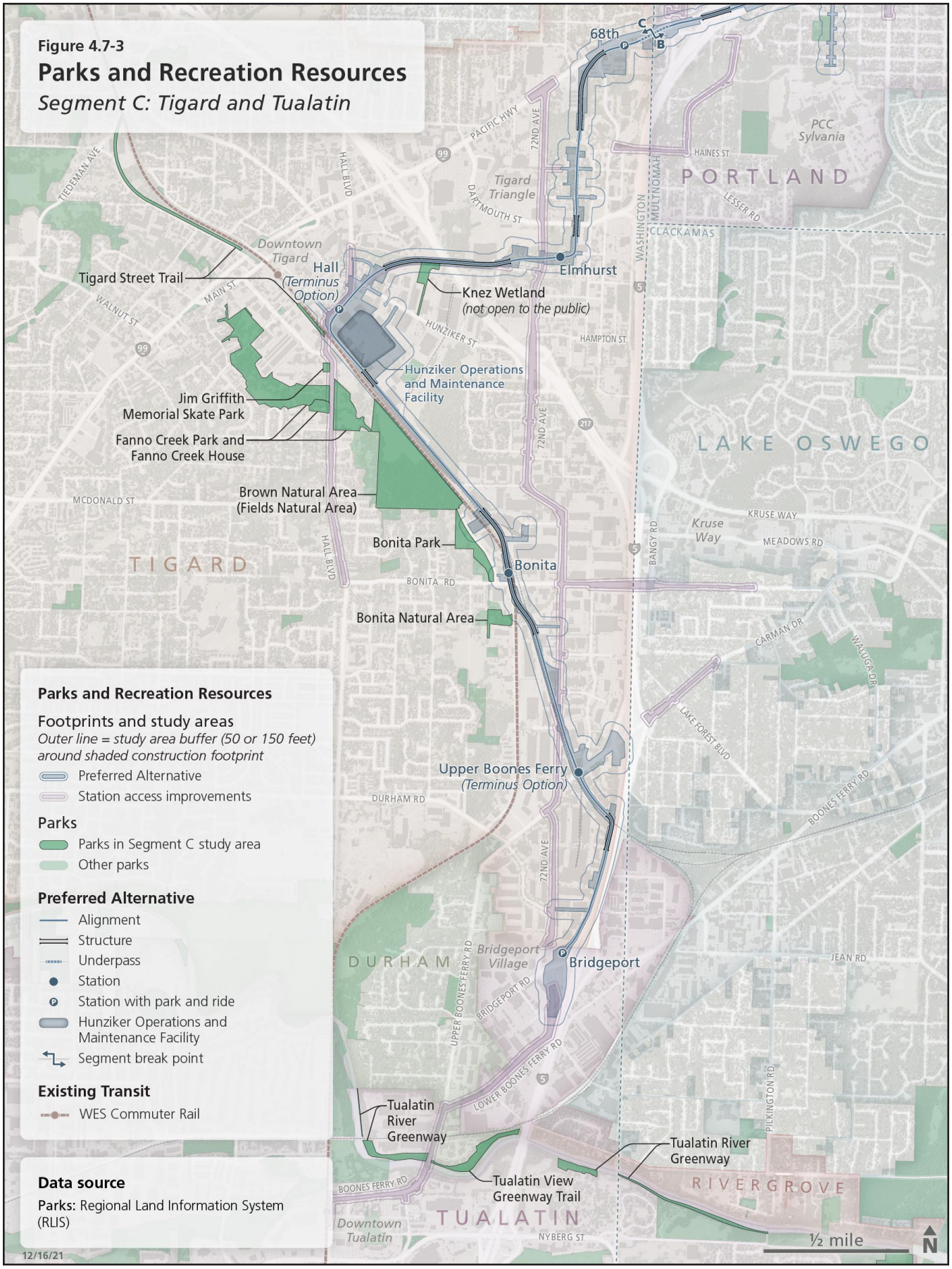


Figure 4.7-3
Parks and Recreation Resources
Segment C: Tigard and Tualatin
68th
C
B
PACIFIC HWY
72ND AVE
HAINES ST
PCC Sylvania
PORTLAND
Tigard Triangle
DARTMOUTH ST
WASHINGTON
MULTNOMAH
LESSER RD
CLACKAMAS
TIEDEMAN AVE
HALL BLVD
Downtown Tigard
Hall (Terminus Option)
Elmhurst
Tigard Street Trail
MAIN ST
WALNUT ST
Knez Wetland
(not open to the public)
HUNZIKER ST
HAMPTON ST
Hunziker Operations and Maintenance Facility
Jim Griffith Memorial Skate Park
Fanno Creek Park and Fanno Creek House
LAKE OSWEGO
MCDONALD ST
Brown Natural Area (Fields Natural Area)
Kruse Way
KRUSE WAY
MEADOWS RD
BANGY RD
Bonita Park
Bonita
TIGARD
BONITA RD
Bonita Natural Area
CARMAN DR
WALUGA DR
LAKE FOREST BLVD
Upper Boones Ferry (Terminus Option)
DURHAM RD
BOONES FERRY RD
Parks and Recreation Resources
Footprints and study areas
Outer line = study area buffer (50 or 150 feet) around shaded construction footprint
Preferred Alternative
Station access improvements
Parks
Parks in Segment C study area
Other parks
Preferred Alternative
Alignment
Structure
Underpass
Station
Station with park and ride
Hunziker Operations and Maintenance Facility
Segment break point
Existing Transit
WES Commuter Rail
DURHAM
Bridgeport Village
Bridgeport
JEAN RD
UPPER BOONES FERRY RD
BRIDGEPORT RD
LOWER BOONES FERRY RD
PILKINGTON RD
Tualatin River Greenway
Tualatin River Greenway
Tualatin View Greenway Trail
RIVERGROVE
Data source
Parks: Regional Land Information System (RLIS)
BOONES FERRY RD
Downtown Tualatin
TUALATIN
NYBERG ST
½ mile
N
12/16/21

Table 4.7-1. Parks and Recreation Resources by Segment: Preferred Alternative Study Area (*multipage table)*

Property	Total Acreage	Location	Owner/ Custodian	Existing Features	Public Access
Segment A: Inner Portland					
Duniway Park	14.0	SW Barbur Blvd. & SW Sheridan St.	PP&R	Lilac garden, horseshoe pit, paths, grass and landscaped areas, picnic tables, soccer field and track	Yes
Lair Hill Park[1]	3.3	SW Barbur Blvd. & SW Woods St.	PP&R	Mature trees, shrubs, grass and landscaped areas, playground, paths, picnic tables, public art, tennis backboard, tennis court and earthquake communication node	Yes
Carnegie Annex*	0.4	SW Hooker St. & SW Second Ave.	PP&R	Part of Lair Hill Park; building is used as office space for PP&R	Yes
Terwilliger Parkway	102.8	SW Terwilliger Blvd., between SW Sam Jackson Park Rd. & SW Capitol Hwy.	PP&R	Wooded/vegetated natural areas along the West Hills and SW Terwilliger Blvd., with paths, picnic tables, playground, viewpoints, and hiking and biking trails	Yes
Water and Gibbs Community Garden	0.3	SW Gibbs St. & SW Water Ave.	PBOT/PP&R	Community garden	Yes
Front and Curry Community Garden	0.2	SW Naito Pkwy. Frontage Rd. & SW Curry St.	PP&R	Community garden	Yes
George Himes Park	32.4	Between SW Capitol Hwy., SW Terwilliger Blvd. & SW Barbur Blvd.	PP&R	Natural area, paths, picnic tables and hiking trails (SW Trail #3)	Yes
Segment B: Outer Portland					
Fulton Park, Community Garden and Community Center	8.2	SW Barbur Blvd. & SW Miles St.	PP&R	Basketball court, paths, picnic tables, playground and soccer field, community center rental hall and community garden	Yes
Markham Elementary School	4.4	10531 SW Capitol Hwy.	Portland Public Schools	Play field and baseball diamonds	Yes[2]
Ash Creek Natural Area*	5.6	SW 53rd Ave. & SW Dickinson St.	PP&R	A natural area	Yes
Sylvania Natural Area Park	2.7	SW Capitol Hwy. & SW 53rd Ave.	PP&R	Natural area and paths	Yes
Segment C: Tigard and Tualatin					
Tigard Triangle Planned Recreation Resources[3]	N/A	Not sited	City of Tigard Public Works Department	N/A	N/A
Knez Wetland	1.9	Between SW Hunziker St. & Hwy. 217	The Wetlands Conservancy	Privately held natural area, with a trail periodically open to the public.	No[4]
Tigard Street Trail*	N/A	Parallel to SW Tigard St., between SW Tiedeman Ave. & SW Hall Blvd.	City of Tigard Public Works Department	A 730-foot paved trail	Yes
Brown Natural Area (Fields Natural Area)*	37.8	Between the end of SW Milton Ct. & the school bus yard on SW Hall Blvd.	Metro	Open field and wooded areas	Yes

Table 4.7-1. Parks and Recreation Resources by Segment: Preferred Alternative Study Area (*multipage table)*

Property	Total Acreage	Location	Owner/ Custodian	Existing Features	Public Access
Bonita Park*	3.5	SW Milton Ct. & SW Bonita Rd.	City of Tigard Public Works Department	Play structure, basketball court, picnic shelter, grassed play area, restrooms and drinking fountains	Yes
Bonita Natural Area*	5.0	SW 74th Ave. & SW Bonita Rd.	Metro	Natural area	No[4]

Source: Portland Parks and Recreation Parks Finder available at https://www.portlandoregon.gov/parks/finder/ (November 2019).

Note: N/A = not applicable; PBOT = Portland Bureau of Transportation; PP&R = Portland Parks and Recreation.

* Denotes parks that are situated within the 150-foot study area but would not be impacted by the proposed Project.

[1] The total acreage of Lair Hill Park includes the 0.4-acre Carnegie Annex.

[2] Markham Elementary School is open for public access on weeknights, weekends, holidays and summer breaks.

[3] Potential parks and recreation facilities are identified in the Tigard Triangle Strategic Plan (2015) and the Tigard Triangle Transportation Network Map (2017).

[4] Knez Wetland is not open to the public due to ongoing restoration activities of sensitive plant species.

[5] Bonita Natural Area is not currently developed for public access, but was purchased for a planned future segment of the Fanno Creek Trail.

Table 4.7-2 shows the park and recreation resources in the study area for the related transportation improvements. Most park and recreation resources listed in Table 4.7-2 would not be directly affected by the related transportation improvements and are not described in detail. The exception is Burlingame Park, which would be directly affected by the Custer Walk/Bike Bridge, as discussed in Section 4.7.3.

Table 4.7-2. Parks and Recreation Resources: Related Transportation Improvements

Related Transportation Improvement	Associated Park(s) in Study Area
Ross Island Bridgehead Reconfiguration	
Ross Island Bridgehead Reconfiguration	Governor Tom McCall Waterfront Park, Water and Gibbs Community Garden, Front and Curry Community Garden
Station Access Improvements	
Hamilton Sidewalks and Bikeway (SA03)	Terwilliger Parkway
Custer Sidewalks (SA07)	Stephens Creek Nature Park
Custer Walk/Bike Bridge (SA08)	Burlingame Park
Capitol Hill Sidewalks and Bikeway (SA09)	A Park (temporary name; formerly Custer Park), Stephens Creek Nature Park
Spring Garden and Dolph Sidewalks and Bikeway (SA12)	Capitol Hill Elementary School,[1] Spring Garden Park
Taylors Ferry Road Sidewalks and Bikeway (SA16)	Woods Memorial Natural Area
Capitol Sidewalks and Crossings (SA18)	Markham Elementary School,[1] Holly Farm Park
53rd Walk/Bike Bridge (SA20)	Ash Creek Natural Area
Hall Sidewalks (SA26)	Tigard Street Trail, Jim Griffith Memorial Skate Park, Fanno Creek Park, Fanno Creek House
Lower Boones Ferry and Boones Ferry Bikeway (SA29)	Tualatin River Greenway, Tualatin View Greenway Trail
Highway 217 Multi-Use Path (SA30)	Knez Wetland[2]

[1] Capitol Hill Elementary School and Markham Elementary School are open for public access on weeknights, weekends, holidays and summer breaks.

[2] Knez Wetland is privately owned and not currently open to the public due to ongoing restoration activities of sensitive plant species.

Park and recreation resources in the study area are described below by segment.

Affected Resources: Segment A

Duniway Park

Duniway Park is located on the west side of SW Barbur Boulevard, south of SW Sheridan Street. The City of Portland acquired this 14.0-acre park in 1918. It currently includes amenities such as a lilac garden with over 125 varieties of lilacs, a newly updated synthetic surface soccer field, two stone restroom buildings, a horseshoe pit, paved and unpaved paths, picnic tables and a newly resurfaced exercise track. The inner six lanes of the exercise track are used for revenue-generating or permitted use during special events, while the two outer lanes are generally always open to the public. The park has a small 11-space parking area accessed only by southbound traffic on SW Barbur Boulevard.

Lair Hill Park

Lair Hill Park is a 3.3-acre neighborhood park owned and maintained by the City of Portland that is bordered by SW Barbur Boulevard, SW Hooker Street, SW Second Avenue and SW Woods Street. The park features mature trees, lawns, structures and recreation amenities that include a tennis court, handball court, public art, picnic tables, playgrounds and paved paths. Lair Hill Park also hosts an earthquake communication node for trained individuals to use following seismic events.

Terwilliger Parkway

Terwilliger Parkway is a 102.8-acre linear parkway along SW Terwilliger Boulevard between SW Sam Jackson Park Road and SW Capitol Highway. The parkway was first envisioned in 1903 by landscape architect John C. Olmsted, who with his brother and father created more than 6,000 parks projects for cities and urban areas across the United States. The land for Terwilliger Parkway was acquired beginning in 1917. Today it is part of the regional 40-Mile Loop trail system and provides paved walking paths, picnic tables, viewpoints, hiking trails, bicycle paths and one playground.

Vegetation within Terwilliger Parkway consists of mature conifer forest and native Oregon white oak habitat. The parkway serves as a critical component of the Westside Wildlife Corridor. Section 4.9, Ecosystems, provides more detail on the natural resource services of Terwilliger Parkway.

The parkway consists of certain parcels purchased through federal grants. See Appendix N for further details showing that no properties purchased with Land and Water Conservation Funds would be affected.

Water and Gibbs Community Garden

Water and Gibbs Community Garden is a 0.3-acre community garden that was acquired by the City of Portland in 1976. The Portland Bureau of Transportation owns the property, but PP&R manages the park. It is located south of SW Gibbs Street, between SW Naito Parkway and SW Water Avenue.

Front and Curry Community Garden

Located on the west side of SW Naito Parkway Frontage Road, south of SW Curry Street, the Front and Curry Community Garden includes approximately 25 garden plot areas and a storage garage. The City of Portland acquired this 0.2-acre site in 1952.

George Himes Park

George Himes Park lies between SW Capitol Highway, SW Terwilliger Boulevard and SW Barbur Boulevard. The City of Portland acquired the park in 1903. It consists of 32.4 acres of steeply sloping forested natural area with paved and unpaved paths, picnic tables and hiking trails. One of the hiking trails (SW Trail #3) connects George Himes Park with the Willamette River and Willamette Park by passing under SW Barbur Boulevard at the site of the Newberry trestle bridge and under Interstate 5 (I-5) at SW Iowa Street. SW Trail #3 also serves as a corridor for wildlife to safely cross under the Newbury trestle bridge and I-5. In addition, PP&R uses a pullout owned by the Oregon Department of Transportation at the northwestern corner of the park to conduct routine park maintenance.

The section of SW Trail #3 in George Himes Park is part of the planned Red Electric Trail that would create a 16-mile bicycle and pedestrian route connecting the Tualatin and Willamette Rivers. The Red Electric Trail could divert from SW Trail #3 at SW Barbur Boulevard to connect to SW Slavin Road via the Newbury trestle bridge.

Affected Resources: Segment B

Fulton Park, Community Garden and Community Center

Fulton Park, Community Garden and Community Center (Fulton Park) is located on the south side of SW Barbur Boulevard at SW Miles Street and consists of 8.2 acres. It is owned and maintained by the City of Portland, and also includes the Fulton Park Community Center at the eastern end of the park. The park provides multiple recreation amenities, including a large community garden area (1.8 acres), the Metro Home Composting Demonstration Garden, a basketball court, unpaved walking paths, picnic tables, a playground and a soccer field. The community center offers one main hall that is rented out for community events and classes on a regular basis.

Burlingame Park

Burlingame Park is located on the west side of SW Barbur Boulevard and I-5 at SW 12th Avenue and SW Falcon Street. The 4.6-acre park consists of recreation amenities including an accessible play area, paved and unpaved paths, picnic tables, a playground, a soccer field and a softball field.

Markham Elementary School

Markham Elementary School is located at 10531 SW Capitol Highway. The western property boundary of the 4.4-acre school playground is located along SW Barbur Boulevard. The playground contains three baseball diamonds, open grass field areas, a paved basketball court and a play structure; these are open for public use during non-school hours.

Sylvania Natural Area Park

Sylvania Natural Area Park is located on the south side of SW Capitol Highway, west of SW 53rd Avenue. The City of Portland acquired this 2.7-acre forested park in 2002. It contains two paths that provide access to the park from all four of the adjoining streets. The Portland Community College (PCC) Sylvania campus routinely uses this park as an outdoor classroom.

Affected Resources: Segment C

Tigard Triangle Planned Recreation Resources

The Tigard Triangle has some designated walking paths, but no developed parks and recreation resources. The City of Tigard is planning new parks and recreation resources that would include natural areas with trails, two neighborhood parks, plazas and pathways, as outlined in the *Tigard Triangle Strategic Plan* (City of Tigard, 2015). Most of the new features are not yet sited, but the strategic plan identifies a proposed natural and recreation greenway generally along Red Rock Creek that would include a trail. The two new neighborhood park locations are unknown. The City of Tigard has also identified general locations for new off-road paths and trails within the Tigard Triangle as part of the Tigard Triangle Transportation Network Map (City of Tigard, 2017).

The other parks in the Segment C study area, shown in Figure 4.7-3, are not affected by the Project, and therefore are not discussed in detail here. The Knez Wetland, a privately-owned open space and conservation area that has previously restored wetlands in the area, is not a public park and is not currently open to the public. It is discussed in more detail in Section 4.9, Ecosystems.

4.7.2. No-Build Alternative

With the No-Build Alternative, no projects are known that would use any portion of the parks and recreation resources within the study area. Thus, these resources would be expected to continue to exist in their current configurations; the amenities available at each park and access to each park are not expected to change. The owners and managers of parks and recreation facilities would continue to plan for future maintenance and improvements throughout their park systems and would continue to develop plans for new parks where needed. No direct impacts would occur with the No-Build Alternative.

4.7.3. Long-Term Impacts

This section describes the potential long-term impacts for the parks and recreation resources in the study area with the Project. Parks in the study area that do not have anticipated long-term impacts are not included in this section. Appendix D and Appendix N address other federal regulations related to park impacts. Temporary, or short-term, impacts to these parks and other parks in the study area are discussed in Section 4.7.4.

As summarized in Table 4.7-3, four resources would experience long-term property impacts from the Preferred Alternative: Duniway Park, Lair Hill Park, Terwilliger Parkway and Fulton Park. A station access improvement project, the Custer Walk/Bike Bridge, would have an impact to a fifth resource, Burlingame Park. Water and Gibbs Community Garden, Front and Curry Community Garden, George Himes Park, Markham Elementary School and Sylvania Natural Area Park are not expected to incur long-term property impacts from the Project, but they are discussed in this section because of their proximity to the Project.

Table 4.7-3. Summary of Long-Term Property Impacts to Parks and Recreation Resources

Property	Project Element	Approximate Long-Term Property Impacts[1]
Light Rail Investment: Preferred Alternative and Terminus Options		
Duniway Park	Preferred Alternative alignment and stations: Segment A	0.05 acre partial parcel acquisition 0.02 acre permanent easement
Lair Hill Park	Preferred Alternative alignment and stations: Segment A	0.03 acre partial parcel acquisition 0.05 acre permanent easement
Terwilliger Parkway	Preferred Alternative alignment and stations: Segment A	0.04 acre partial parcel acquisition 0.02 acre permanent easement
	Marquam Hill Connection	0.44 acre permanent footprint/easement
Fulton Park, Community Garden and Community Center	Preferred Alternative alignment and stations: Segment B	<0.01 acre partial acquisition of Fulton Community Garden parcel
Related Transportation Improvements		
Burlingame Park	Station access improvement SA08: Custer Walk/Bike Bridge	Permanent easement over park property anticipated

[1] Partial parcel acquisition refers to areas that would be permanently used by the Project. Permanent easement typically refers to areas where surface features would be restored for park use, but there could be restrictions on future developments within the area because underground features for the Project could be present (i.e., buried structural support cables or underground utilities) or to maintain retaining walls or other structures.

Preferred Alternative: Segment A

The parks and recreation resources that would be affected by the Preferred Alternative within Segment A are described below and illustrated in Figure 4.7-1.

Duniway Park

The Preferred Alternative would acquire approximately 0.05 acre of park property in total, primarily located in the upper northeastern corner of the park. SW Barbur Boulevard would be expanded for center-running light rail and sidewalk and bicycle lane improvements, resulting in a small area of acquisition and permanent easement along the sidewalk to accommodate a retaining wall. The driveway and parking lot adjacent to the track would be modified. Small trees between the exercise track and the sidewalk in the northeastern corner of the park and along SW Barbur Boulevard would be removed and replaced, and the intersection of SW Barbur Boulevard and SW Sheridan Street would be modified. Other elements within the park and adjacent to the track, such as bleachers, would also be reconfigured. (See Appendix D for a map showing these impacts.)

None of the impacts would permanently change the recreation uses offered by the park, although widening of and improvements to SW Barbur Boulevard could reduce the buffering area around a portion of the exercise track. Light rail infrastructure would be visible to park users within the track and soccer field area, especially in the park's northeastern corner.

Lair Hill Park

The Preferred Alternative would widen SW Barbur Boulevard along the western boundary of Lair Hill Park, which would require a partial acquisition of approximately 0.03 acre of a narrow strip of land along the northwestern boundary of the park at SW Hooker Street. While expansion in this area would modify the park entrance by removing several mature evergreen and deciduous trees, access to the park would be retained.

Along SW Barbur Boulevard and adjacent to the park, a widened sidewalk and bicycle lane would be developed within the street right of way, requiring an 11-foot cut wall that would replace the current 3- to 5-foot retaining wall, slope and street trees that currently abut the park property. A permanent easement of approximately 0.05 acre would be needed in order to provide underground supports for the taller wall.

The loss of mature trees and vegetation would visually change conditions on the west side of the park by making it more open to SW Barbur Boulevard, although the park would be above the roadway, and the rebuilt retaining wall would also replace existing fencing that could provide a buffer. The sidewalk and retaining wall relocation would affect an estimated 26 mature trees. Within the park, 13 trees would be potentially affected, some with impacts to their roots, but several would be removed. The other 13 trees being removed are in the street right of way adjacent to the park, west of the park property line. The interior of the park on the west side would still contain mature trees, so the loss of perimeter trees would reduce but not remove the buffering function, and the interior trees would continue to provide shade and a semi-forested feeling in this part of the park. Redeveloping the western edge of the park would also change the setting of the metal art sculpture that is now about 10 feet from the fence by potentially removing some trees.

The proposed curb, sidewalk and access aprons would be outside of the current park property. No changes to park access or parking would occur as a result of the Preferred Alternative. Light rail infrastructure would be visible to park users, primarily in the western half of the park and in the northwestern corner of the park. Uses in these areas range from passive (viewing public art) to active (playing on the swing set or using the tennis or handball courts), and the Project would not adversely affect these activities.

Terwilliger Parkway

As described in Chapter 2, Alternatives Considered, the Marquam Hill Connection has undergone additional planning, design, outreach and analysis leading to the inclined elevator system that would link SW Barbur Boulevard near SW Gibbs Street to the intersection of SW Terwilliger Boulevard and SW Campus Drive, adjacent to Oregon Health & Science University. The design refinements were in response to public and agency comments about potential impacts of the Draft EIS options on the parkway's unique values. Figure 4.7-1 shows the general location of the Marquam Hill Connection relative to the park, and Chapter 2 provides a map, elevation profile and a detailed description of the connection. Additional information on effects on the park is also included in Section 4.6, Historic and Archaeological Resources, and Appendix D.

The Marquam Hill Connection would occupy approximately 0.44 acre of Terwilliger Parkway, mostly in a natural draw within the hillside, adjacent to an inside curve on SW Terwilliger Boulevard. The plaza, headhouse and elevator structure would be visible from immediately adjacent areas of SW Terwilliger Boulevard, near SW Campus Drive, including from the Terwilliger Trail path along the roadway. Designated view corridors within the parkway would be unobstructed. Section 4.5, Visual Quality, addresses other visual effects from neighborhoods near the parkway.

Table 4.7-4 summarizes other impacts related to Terwilliger Parkway and its features and activities.

Table 4.7-4. Summary of Impacts from the Marquam Hill Connection

Impact Type	Impact from the Marquam Hill Connection
Permanent footprint/easement	0.44 acre, or 0.4% of Terwilliger Parkway
SW Terwilliger Blvd. sidewalk	Sidewalk widened. Increase in activity levels of SW Terwilliger Blvd. sidewalk at SW Campus Dr.
Vegetation clearing	0.25 acre
White oak trees removed	None
Visual impacts to park users	Moderate to high for accessible park areas due to tree and vegetation removal and more prominent plaza landing, but moderate due to low-profile structures
Designated view impacts	Unobstructed
Impacts to views of park from areas adjacent to parkway (SW Barbur Blvd. and South Portland)	Highly visible cleared areas, moderately visible structures
Wildlife/natural habitat impacts	Low given the design and conservation measures allowing wildlife undercrossings, native species replanting and underplanting
Noise impacts to designated park activities	None
Other impacts to designated park activities, attributes and features	None, including to paved or nature trails

In addition to the impacts associated with the Marquam Hill Connection, the Preferred Alternative would acquire up to a 0.04 acre adjacent to SW Barbur Boulevard. This area is currently used by PP&R staff to access the park for maintenance, and is primarily compacted gravel with little vegetation. Maintenance access would continue to be provided with the Preferred Alternative.

Water and Gibbs Community Garden

The Preferred Alternative would construct a signalized pedestrian crossing of SW Naito Parkway near Water and Gibbs Community Garden. This crosswalk would not require any permanent use of the property, nor would it displace any garden plots. Views of the proposed light rail facility along SW Barbur Boulevard from the community garden would be screened by existing vegetation and surrounding buildings.

Front and Curry Community Garden

SW Naito Parkway would be improved adjacent to Front and Curry Community Garden, but the Preferred Alternative would not be within the park property and would not displace any garden plots. The Preferred Alternative would not change vehicle access to or from SW Naito Parkway to the community garden, and would improve pedestrian access.

George Himes Park

The Preferred Alternative would not require any permanent use of right of way from the park property, but it would replace the Newbury trestle bridge beside the eastern boundary of the park with a widened multimodal bridge for SW Barbur Boulevard. This bridge replacement would also require the removal of mature vegetation surrounding the bridge and part of SW Trail #3 and the planned Red Electric Trail below, altering visual conditions at this location as replacement trees and vegetation mature. Replacement of the Newbury trestle bridge would provide improved bicycle and pedestrian facilities for the portion of the Red Electric Trail that could use the bridge to connect to SW Slavin Road.

Views of the light rail infrastructure on SW Barbur Boulevard would be limited for users in George Himes Park due to topography. Users would see only glimpses of light rail features above the roadway when

approaching the bridge. The majority of the experience of using the trails within the park would be unchanged, and there would be no permanent changes to park access or trails.

Preferred Alternative: Segment B

There are three park resources that would be affected by the Preferred Alternative within Segment B. The locations of these parks are illustrated on Figure 4.7-2, and Table 4.7-3 shows the potential long-term property impacts to parks and recreation resources in Segment B.

Fulton Park, Community Garden and Community Center

As part of the Preferred Alternative, the widening of SW Barbur Boulevard along the northwestern portion of the park would convert an area of less than 0.01 acre (approximately 70 square feet) to a transportation use. The Preferred Alternative would remove mature trees along the sidewalk that partly buffer views of the roadway from the community garden. PP&R indicated that the removal of these trees would potentially allow more sunlight to reach the neighboring garden plots and therefore benefit the garden. The garden facilities would remain functional and otherwise unchanged. The light rail infrastructure and operations, including catenary poles and passing light rail trains in the center of SW Barbur Boulevard, would be visible to garden users toward the top of the hill near the roadway, but this view of the light rail infrastructure and operations is not anticipated to affect gardening activities. The nearby station, as well as rebuilt sidewalks that would be part of the Preferred Alternative, would improve access to the park and community center, which would benefit park users.

Markham Elementary School

The Preferred Alternative would widen SW Barbur Boulevard near the western edge of the Markham Elementary School property, but would not physically alter the property. Ballfield users could see elements of the light rail infrastructure, but ball games and other recreational activities on the grounds do not depend on a secluded environment.

Sylvania Natural Area Park

The Preferred Alternative would not require permanent use of Sylvania Natural Area Park property. SW 53rd Avenue would be improved adjacent to the park with lighting, sidewalks and other features. These physical changes would be accommodated within the existing street right of way and would not encroach upon the park. A strip of buffering vegetation within the street right of way may be removed as part of the improved roadway. These changes would be minor for most park users, because the interior of the park is densely forested, and the new sidewalks would improve access to the park overall.

SW Trail #7 uses the SW 53rd Avenue right of way adjacent to Sylvania Natural Area Park; after completion of the Preferred Alternative, this trail would use the new sidewalks on the improved roadway.

The PCC-Sylvania Shuttle would transport students and faculty between the PCC-Sylvania campus and the 53rd Station. The van-sized shuttle vehicles would run adjacent to Sylvania Natural Area Park along SW 53rd Avenue, which is in use today for general traffic. Park users would have limited to no views of the shuttles except when using the trail entrance at SW Buddington Street. Users of SW Trail #7 could see the shuttle vehicles while on the two-block stretch of the trail that uses the SW 53rd Avenue right of way.

Preferred Alternative: Segment C

The City of Tigard is planning to develop trails, two neighborhood parks, plazas and pathways in the Tigard Triangle; however, except for having general plans for the future Red Rock Creek greenway and trail area, the city has not yet sited these other planned facilities. As the Project develops, TriMet, Metro and the City of Tigard will continue to coordinate their planning to support the goals of the *Tigard Triangle Strategic Plan*.

The Preferred Alternative would acquire a variety of properties in the Tigard Triangle area, but no existing park properties or properties identified for future parks would be impacted. Areas acquired and permanently occupied by the Project would no longer be available to become future parks. Existing City of Tigard parks are illustrated on Figure 4.7-3.

Tigard Street Trail, Brown Natural Area (Fields Natural Area), Bonita Park and Bonita Natural Area are within the study area for the Preferred Alternative but would not be impacted directly. Knez Wetland would be directly impacted, but the Knez Wetland is not open for public recreational use (see Section 4.9, Ecosystems, and Section 4.10, Water Resources, for more information about impacts to Knez Wetland).

The Hunziker Operations and Maintenance (O&M) Facility would not result in any impacts to park and recreation facilities.

Terminus Options

The terminus options are two options to construct a portion of the Preferred Alternative alignment, terminating at either the Upper Boones Ferry Station or the Hall Station. Both terminus options would result in the same impacts as described for the Preferred Alternative, above, because the Preferred Alternative would not impact any parks or other recreation resources along the portion of the alignment that would not be constructed for each terminus option.

Related Transportation Improvements

Ross Island Bridgehead Reconfiguration

The Ross Island Bridgehead Reconfiguration would have no direct long-term impacts to parks and recreation resources. It would make additional improvements on SW Naito Parkway, in areas adjacent to the Water and Gibbs Community Garden, but no permanent impacts to the community garden would be involved.

Station Access Improvements

The station access improvements include improved or new sidewalks, bikeways and road crossings (see Appendix A, Detailed Maps and Descriptions of the Alternatives, for figures showing the station access improvements). Where these improvements would be adjacent to park and recreation sites, they would improve access to those sites both to and from the light rail stations. With the exception of the Custer Walk/Bike Bridge (SA08) described below, the station access improvements are expected to be constructed within existing right of way and are therefore not anticipated to result in permanent property acquisition. If permanent impacts are later found to be needed, it would be the responsibility of local implementing agencies to complete appropriate environmental review and compliance.

One of the station access improvements in Segment B, Custer Walk/Bike Bridge (SA08), could affect a portion of Burlingame Park. It would construct a 14-foot-wide pedestrian bridge over I-5 and the northern end of the park, to connect SW Multnomah Boulevard to SW 11th Avenue and provide access to the 13th Station. The bridge would cross the northern tip of Burlingame Park, which consists of a low-quality natural area. The bridge approach would match the existing elevation of SW Canby Street. No changes to the street profile or driveway grade at this location are proposed. Appendix D further discusses effects on the park.

For the other station access improvements, conceptual plans have attempted to avoid permanent property impacts to parks. The following station access improvement options would be adjacent to parks or recreation sites, and would have minimal to no physical impacts that would alter primary features or functions of those parks or recreation resources:

- Hamilton Sidewalks and Bikeway (SA03) would improve facilities in a section of Terwilliger Parkway.
- Capitol Hill Sidewalks and Bikeway (SA09) and Custer Sidewalks (SA07) would improve facilities adjacent to Stephens Creek Nature Park.
- Capitol Hill Sidewalks and Bikeway (SA09) would improve facilities adjacent to A Park (temporary name; formerly Custer Park).
- Spring Garden and Dolph Sidewalks and Bikeway (SA12) would improve facilities adjacent to Capitol Hill Elementary School and Spring Garden Park.
- Taylors Ferry Road Sidewalks and Bikeway (SA16) would improve facilities adjacent to Woods Memorial Natural Area.
- Capitol Sidewalks and Crossings (SA18) would improve facilities adjacent to Markham Elementary School and Holly Farm Park.
- Hall Sidewalks (SA26) would improve facilities adjacent to Fanno Creek Park on developed right of way and pass by Jim Griffith Memorial Skate Park.
- Lower Boones Ferry and Boones Ferry Bikeway (SA29) would improve facilities adjacent to the Tualatin River Greenway on existing developed right of way.

4.7.4. Short-Term Impacts

Construction of the Project would involve activities that could affect parks and recreation resources. This would include tree and vegetation removal near or within parks, utility work, detours and street closures, and construction traffic. Visual impacts, light, glare, dust, congestion, access changes and noise could also affect users in some of the parks. Most of these impacts would be in limited portions of the parks in areas closest to the light rail infrastructure. The noise impacts of construction would be temporary (see Section 4.11, Noise and Vibration). Mitigation measures such as signage, alternative traffic routing and traffic control can mitigate delays and perceptions of decreased access.

Table 4.7-5 summarizes the temporary construction areas needed for the Project. The table includes notes identifying locations where the Project would also make permanent changes, as discussed above in Section 4.7.2. Section 4.7.5 describes potential mitigation measures for short-term impacts.

Table 4.7-5. Summary of Short-Term Construction Impacts to Parks and Recreation Resources

Property	Project Element	Temporary Construction Area *(approximate)*
Light Rail Investment: Preferred Alternative and Terminus Options		
Duniway Park	Preferred Alternative alignment and stations: Segment A	0.58 acre*
Lair Hill Park	Preferred Alternative alignment and stations: Segment A	0.05 acre*
Terwilliger Parkway	Preferred Alternative alignment and stations: Segment A	0.02 acre
	Marquam Hill Connection	0.26 acre*
Front and Curry Community Garden	Preferred Alternative alignment and stations: Segment A	<0.01 acre
George Himes Park	Preferred Alternative alignment and stations: Segment A	0.13 acre
Fulton Park, Community Garden and Community Center	Preferred Alternative alignment and stations: Segment B	0.02 acre*
Sylvania Natural Area Park	Preferred Alternative alignment and stations: Segment B	0.03 acre
Related Transportation Improvements		
Water and Gibbs Community Garden	Ross Island Bridgehead Reconfiguration	0.02 acre
Front and Curry Community Garden	Ross Island Bridgehead Reconfiguration	<0.01 acre
Burlingame Park	Station access improvement SA08: Custer Walk/Bike Bridge	0.01 acre

* The construction area impact is in addition to permanent areas potentially needed (permanent areas are presented in Table 4.7-3).

The temporary construction impacts to each park associated with the Preferred Alternative are described in the sections below.

Preferred Alternative: Segment A

Duniway Park

An additional temporary construction area of approximately 0.58 acre near the upper northeastern corner of the track at Duniway Park would be needed to construct the proposed sidewalk, curbs and retaining walls as part of the Project, and to reconfigure the track parking area and driveway. Extended full closures of the entire track would be avoided during construction, but temporary closures of lanes of the track could occur, and access could be restricted. Additionally, the limited parking spaces at the park would be temporarily impacted and would be unavailable during part of the construction period.

Lair Hill Park

The Preferred Alternative requires an additional temporary construction area of approximately 0.05 acre along the northwestern (SW Hooker Street), western (SW Barbur Boulevard), and southern (SW Woods Street) edges of Lair Hill Park. These areas would likely experience vegetation removal and would be closed to the public during active construction. The construction area would be directly adjacent to the 1918 building at the southern end of the site, but access to the building would remain open. (The park and the building are also discussed in Section 4.6, Historic and Archeological Resources.)

Terwilliger Parkway

Construction activities to develop the Marquam Hill Connection would impact the forested, steeply sloping area of Terwilliger Parkway across from SW Campus Drive, and a larger construction and staging area would be needed, involving additional areas of vegetation removal and other clearing. Additional areas beyond the permanent footprint for the Marquam Hill Connection would be cleared for construction, and

heavy construction equipment, including cranes, would be used. Approximately 0.26 acre of this part of Terwilliger Parkway would be affected during construction.

In addition, in a section of the parkway to the south along SW Barbur Boulevard, approximately 0.02 acre of Terwilliger Parkway would be needed for construction activities, beyond the footprint permanently needed for the Marquam Hill Connection. This parcel does not contain any developed recreation resources or public access features. This area is mostly gravel today, but some vegetation removal may also be needed.

Front and Curry Community Garden

The Preferred Alternative would require a temporary construction easement of less than 0.01 acre (<100 square feet) in the northeastern corner of Front and Curry Community Garden to accommodate a wider sidewalk, potentially affecting trees that offer shading and a buffer from SW Naito Parkway.

George Himes Park

The Preferred Alternative would impact a strip of land on the eastern edge of the park, adjacent to the Newbury trestle bridge, which would be replaced. Construction staging areas would remove trees and vegetation below the bridge. Construction staging would temporarily require approximately 0.13 acre of the park property. In addition, the park's eastern entry point for SW Trail #3 would be temporarily closed below the Newbury trestle bridge, but the rest of SW Trail #3 would remain open within the park.

Preferred Alternative: Segment B

Fulton Park, Community Garden and Community Center

The widening of SW Barbur Boulevard and associated sidewalk improvements would result in temporary construction easements of approximately 0.02 acre along the northwestern and western edges of the park.

Sylvania Natural Area Park

The improvements to pedestrian and bicycle facilities on SW 53rd Avenue that would be part of the Preferred Alternative would remove a narrow strip of vegetation, potentially including mature trees, along the western edge of Sylvania Natural Area Park, requiring a temporary use of approximately 0.03 acre. This vegetation, though not within park property, buffers the edge of the park.

Preferred Alternative: Segment C

There are no park or recreation resources in Segment C that would incur temporary impacts due to the Preferred Alternative.

Terminus Options

The terminus options would result in the same impacts as described for the Preferred Alternative, above.

Related Transportation Improvements

Ross Island Bridgehead Reconfiguration

The Ross Island Bridgehead Reconfiguration would require temporary construction easements on portions of two community gardens:

- **Water and Gibbs Community Garden.** Improvements to sidewalks along SW Naito Parkway, which are part of the Ross Island Bridgehead Reconfiguration, would require a temporary construction easement of about 800 square feet (0.02 acre) on the west side of the community garden.
- **Front and Curry Community Garden.** Improvements to sidewalks along SW Naito Parkway, which are part of the Ross Island Bridgehead Reconfiguration, would require a temporary construction easement on the east side of the community garden. This easement would extend the sidewalk improvements beyond those that would be part of the Preferred Alternative.

Station Access Improvements

The construction of a walk/bike bridge to Burlingame Park and adjacent streets would likely involve temporary construction impacts, including a temporary closure of the northern end of Burlingame Park, but park users would still be able to access park features such as the picnic areas, play structures and the ball field. Construction of the bridge could result in the removal of some trees and vegetation within and adjacent to this corner of the park, adjacent to I-5.

As noted in Section 4.7.3, the other station access improvement options would be constructed within the existing right of way. However, if, based on further design, additional property is needed to construct the station access improvements, the Project would meet local permitting requirements for the temporary use of park property and comply with other applicable regulations.

4.7.5. Comparison to Impacts of the Draft EIS Light Rail Alternatives

Since the Draft EIS, impacts to parks and recreation resources have changed as follows for Segments A and B:

- **Duniway Park.** The size of the permanent impact to the park parcel has increased slightly due to adjustments in the design that would maintain the existing number of off-street parking spaces.
- **Lair Hill Park.** The size of the impact to the park has been reduced slightly by narrowing the sidewalk and auto lanes on SW Barbur Boulevard and removing the northbound left-turn and U-turn lane at SW Hooker Street.
- **Terwilliger Parkway.** The impacts to Terwilliger Parkway have been reduced through the refined design featuring an inclined elevator for the Marquam Hill Connection. Impacts to Terwilliger Parkway along SW Barbur Boulevard have been reduced by shifting the light rail alignment to the east.
- **Water and Gibbs Community Garden.** The Preferred Alternative would avoid direct impacts to Water and Gibbs Community Garden that were identified in the Draft EIS.
- **Front and Curry Community Garden.** The permanent impact to Front and Curry Community Garden identified in the Draft EIS would be avoided by the Preferred Alternative, but a small temporary construction area would still be needed.

- **George Himes Park.** A permanent encroachment into the eastern edge of George Himes Park has been avoided by shifting the Preferred Alternative light rail alignment to the east. The Preferred Alternative would still affect the park with a temporary construction easement.
- **Fulton Park, Community Garden and Community Center.** The size of the impact to Fulton Park has been reduced by shifting the light rail alignment and SW Barbur Boulevard to the north. A small partial acquisition of the community garden parcel would still occur.
- **Markham Elementary School.** The Project would avoid permanent or temporary encroachment within the western edge of the Markham Elementary School property, primarily by adjusting sidewalk and bicycle lane elements along SW Barbur Boulevard.
- **Sylvania Natural Area Park.** The impact to Sylvania Natural Area Park would be similar between the Draft EIS light rail alternatives and the Preferred Alternative, with a temporary construction easement and removal of vegetation adjacent to the park along SW 53rd Avenue.

Within Segment C, there would be no direct impacts to parks and recreation resources for any of the Draft EIS alignment alternatives or for the Preferred Alternative.

4.7.6. Mitigation Measures

Table 4.7-6 summarizes the mitigation measures that would be required to address long-term and short-term impacts related to parks. More detail regarding the mitigation commitments is available in Appendix D.

Table 4.7-6. Mitigation Measures for Impacts to Parks and Recreation Resources *(multipage table)*

Time Period	Type of Impact	Preferred Alternative and Terminus Options	Related Transportation Improvements
Long term	Duniway Park	Per written agreement between TriMet and the City of Portland/Portland Parks and Recreation, TriMet would reconfigure the driveway and parking area at the park's eastern edge near the circular track.	N/A
Long term	Lair Hill Park	TriMet would replace park trees and adjacent street trees in accordance with a written mitigation approach agreement between TriMet and the City of Portland/Portland Parks and Recreation.	N/A
Long term	Terwilliger Parkway[1]	TriMet would coordinate with the City of Portland to improve protected views currently blocked by trees and overgrowth; work with the City to design details to minimize impacts to wildlife; contribute funds for the development of a Natural Resource Management Plan; and incorporate measures related to the historic aspects of Terwilliger Parkway.	N/A
Long term	George Himes Park	Per written agreement between TriMet and the City of Portland/Portland Parks and Recreation, TriMet would restore the connecting trail to SW Trail #3 where it may be impacted by construction within ODOT right of way and would contribute to the development of a George Himes Natural Resources Management Plan, along with other park supporting measures.	N/A
Long term	Fulton Park	None required.	N/A
Long term	Burlingame Park	N/A	None required.

Table 4.7-6. Mitigation Measures for Impacts to Parks and Recreation Resources *(multipage table)*

Time Period	Type of Impact	Preferred Alternative and Terminus Options	Related Transportation Improvements
Short term	Construction activities and easements within City parks	None required. Construction activities would require permitting and approvals from the City of Portland; TriMet would comply with the requirements of the city's non-park use permit, and would replace removed trees in accordance with the City of Portland's Tree Code. Consistent with mitigation defined in Section 4.9, Ecosystems, TriMet would coordinate with consulting tribes to offer opportunities to harvest culturally significant native plants, such as the western red cedar, before construction. Additionally, to the extent practical, TriMet would incorporate culturally sensitive native plant species, as identified by the Section 106 consulting tribes, within landscaped areas.	None required. Construction activities would require permitting and approvals from the City of Portland; project sponsor would comply with the terms of those permits.

[1] Appendix K, Memorandum of Agreement for Historic and Archaeological Resources, identifies additional mitigation measures for Terwilliger Parkway related to it as a historic resource.

Long-Term Mitigation

All of the affected park properties are within Portland. During the preliminary design and as part of the development of the Final EIS, TriMet has worked with PP&R to develop a mitigation approach addressing long-term impacts to park properties. Where the use of park property is involved, TriMet will provide appropriate compensation, coordinate during final design to further minimize impacts, and comply with applicable permit conditions in accordance with the written agreement between TriMet and the City of Portland. Appendix D provides further details on mitigation commitments for the City of Portland parks, including the written agreement.

Short-Term Mitigation

Mitigation for short-term impacts to parks are also defined in the written agreement between TriMet and the City of Portland. For all affected parks, TriMet would comply with the requirements of the city's non-park use permit, and would replace removed trees in accordance with the City of Portland's Tree Code, which uses a multiplier for parks trees. TriMet would provide compensation for construction areas needed within parks, and coordinate with the city to restore the disturbed areas to the same or better condition than before construction. Areas disturbed by construction would be landscaped and revegetated. Details about the replacement of trees, vegetation or other landscaping and facility or hardscape features, would be further defined during final design and permitting for the Project.

Other mitigation measures would include providing signage and detour routes around construction areas, and temporarily modifying access points to maintain access to park resources where possible. The duration of construction in and around park facilities would be minimized to the extent practicable and would be less than the Project's full construction duration.

4.8. Geology, Soils and Hydrogeology

This section describes the existing geology, soils and hydrogeologic conditions that could affect or be affected by the Project.

Since the publication of the Draft EIS, this section has been updated to reflect the definition of the Project in this Final EIS. This section has also been revised in response to comments received on the Draft EIS.

4.8.1. Affected Environment

The geology, soils and hydrogeology study area is any contiguous set of conditions that are adjacent to the edge of construction of the Project. The scale differs depending on the resource being discussed. For example, the steep slopes considered are generally adjacent to project construction zones, but groundwater impact considerations can be region-wide. Maps showing landslide, steep slope and other hazardous soil conditions in the study area can be found in Appendix B4.8, Geology, Soils and Hydrogeology Maps. These maps show a 1/8-mile buffer area around the Preferred Alternative for reference.

Geology and Soils

The study area has an underlying mix of volcanic and sedimentary rocks and alluvium (sediments deposited by streams and rivers). Volcanic rock (primarily basalt) comprises the slopes south of downtown Portland along SW Barbur Boulevard and Mount Sylvania, an extinct volcanic vent that lies between Lake Oswego and Beaverton. Between these volcanic rocks are the terrestrial sedimentary rocks of the Hillsboro Formation.

From downtown Portland and the South Waterfront to Tigard and Tualatin, there are areas underlain by catastrophic Missoula Floods deposits (alluvium). Some areas near downtown Portland and along the major highways and roadways are underlain by artificial fill sitting on top of the older alluvial soils. More recently, smaller streams have created additional alluvial deposits.

Soils in the study area have developed from the subsurface geology described above. Many of the original soils within the study area have been removed or modified by cut, fill and grading associated with land development, and are classified as urban land. Where soils within the study area are undisturbed, they consist of loam to silt clay loam. There are no existing commercial soil, aggregate or rock resources within the study area.

Groundwater Resources

The study area straddles both the Portland and Tualatin Sub-basins. The Portland and Tualatin Sub-basins are largely separated by the Tualatin Mountains, also known as the West Hills. Shallow groundwater (5 to 15 feet below ground surface) exists in some areas close to the Willamette River in the vicinity of the South Waterfront (Portland Sub-basin) and in the area of downtown Tigard (Tualatin Sub-basin), where groundwater has been encountered at less than 5 feet below ground surface. Groundwater depths of more than 200 feet below ground surface exist near Marquam Hill and similar western hills of Portland. Some areas of perched shallow groundwater may exist in the vicinity of the southern reach slopes of the Tualatin Mountains.

There are no sole-source aquifers within the study area. Recharge of local aquifers generally occurs through infiltration. Federal and state programs relating to groundwater in Oregon are described in Section 4.10, Water Resources.

Seismic Hazards

The study area is in a seismically active region, due to the North American continental plate convergence with the Juan de Fuca oceanic crustal plate approximately 100 miles off the Pacific coast. The resulting fault zones generally trend northwest and are capable of producing subduction zone earthquakes with a magnitude 8 or greater. There are several crustal faults within or near the study area that are potentially active and could present a seismic hazard. These faults include the East Bank Fault, the Portland Hills Fault, the Oatfield Fault and the Lake Oswego Fault. These faults are considered potential sources for an earthquake that could cause severe ground shaking in the study area.

Relative earthquake hazard maps for the Portland metropolitan area (see Appendix B4.8) indicate that discrete portions of the study area are categorized as having high relative earthquake hazards. These areas include locations along the Willamette River (South Waterfront), portions of the slopes along SW Barbur Boulevard, areas of downtown Tigard, and areas south between Tigard and Bridgeport Village.

Volcanic Hazards

No portion of the study area falls within moderate to high volcanic hazard zones related to Mount Saint Helens and Mount Hood.

Landslides and Steep Slopes

Landslide and rockfall hazards occur due to slope geometry, local geology and soil condition, precipitation and groundwater flow, freeze/thaw cycles, seismic events, and human activity. Historical landslides mapped in the study area are found on the slopes along SW Barbur Boulevard (see Appendix B4.8). The original construction of SW Barbur Boulevard contributed to a number of these historical landslides. Marquam Hill and the other west hills of Portland along SW Terwilliger Boulevard and SW Barbur Boulevard comprise the majority of steep slopes (slopes of 25 percent or more) in the study area. Steep slopes are more prone to erosion and have higher landslide and rockfall risks; they also require special treatment to stabilize them if the Project's activities alter them.

Hazardous Soil Properties

Corrosive and/or hydric soils can be hazards to development and infrastructure projects. Soils with particular textures, pH and salt contents can be corrosive to both concrete and uncoated steel. The northern portion of the study area, west of SW Barbur Boulevard, contains soil types that can be corrosive (see Appendix B4.8).

Hydric soils are soils that have formed in water-saturated conditions and often are located in areas where groundwater is close to the surface. These soils lead to standing water and are generally limiting for construction purposes. In the study area, hydric soils are found primarily in downtown Tigard and the Tigard Triangle, with discrete zones of hydric soils from Tigard south to Bridgeport Village (see Appendix B4.8).

4.8.2. No-Build Alternative

Under the No-Build Alternative, transportation projects and anticipated regional growth could result in projects being built in areas with landslide risk, steep slopes and other hazardous soil conditions. Any of these projects would require compliance with applicable standards, engineering criteria and permitting requirements. Potential impacts could include erosion, groundwater contamination or modifications to unstable slopes, which would be minimized or mitigated through compliance with design and construction codes.

4.8.3. Long-Term Impacts

Long-term impacts are effects that might occur after construction of the Project is complete.

The proposed Project, including the Preferred Alternative, terminus options and related transportation improvements (Ross Island Bridgehead Reconfiguration and station access improvements), generally would traverse highly urbanized land. Long-term effects on soils or geologic and hydrogeologic conditions would be limited. The Project would:

- change localized topography and drainage patterns, which could affect existing landslide-prone areas and areas with unstable slopes
- cause minor settlement near surface features
- encounter corrosive soils that could compromise concrete and steel structures

In one location in Segment A, the Project would construct an inclined elevator for the Marquam Hill Connection, traversing a steep slope on a wooded hillside from SW Barbur Boulevard to SW Terwilliger Boulevard. The grade of the inclined elevator would be approximately 40 percent, which roughly matches the average grade of the hillside slope. The foundations and columns supporting the inclined elevator would be designed for the steep slope conditions, and long-term effects are not anticipated.

4.8.4. Short-Term Impacts

During construction of the Project, the following potential short-term effects could occur:

- wind or water erosion of soils within the construction area
- degradation of shallow groundwater quality from construction activities
- lowered groundwater levels due to dewatering (changing the direction of groundwater flow), along with potential localized ground settling
- increased landslide risk due to destabilization of steep slopes or reactivation of historical landslides

These short-term impacts would vary by corridor segment. Increases to landslide risks are more applicable to the Preferred Alternative in Segment A, including the Marquam Hill Connection, particularly in the vicinity of SW Barbur Boulevard between SW Hamilton Street and Fulton Park. Impacts to shallow groundwater are more likely with the Preferred Alternative in Segment C, including the Hunziker Operations and Maintenance Facility.

4.8.5. Comparison to Impacts of the Draft EIS Light Rail Alternatives

The overall impacts to geology, soils and hydrogeological conditions identified for the Project in this Final EIS remain similar to those of the light rail alternatives in the Draft EIS. The impacts and risks as described in the Draft EIS are similar to those for the Project in this Final EIS. That is, although refinements have been made to the Project between the Draft EIS and Final EIS, these changes did not result in substantive differences with respect to impacts on geology, soils and hydrogeology. This is because the Preferred Alternative is in the same corridor and would be required to adhere to the same design criteria and permitting requirements as were assumed for the Draft EIS light rail alternatives.

4.8.6. Mitigation Measures

Table 4.8-1 summarizes the mitigation measures that would be required to address long-term and short-term impacts related to geology, soils and hydrogeology.

Table 4.8-1. Mitigation Measures for Impacts to Geology, Soils and Hydrogeology

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
Long term	None identified	None required. The Preferred Alternative would be developed to minimize risk in accordance with engineering standards and applicable regulations.	None required. Project sponsors would be required to develop projects to be consistent with applicable standards.
Short term	Erosion, landslides and settlement during construction	None required. The Preferred Alternative would be developed to comply with applicable regulations and permitting requirements, including an Oregon DEQ 1200C permit that includes requirements for addressing erosion and stormwater during construction.	None required beyond those required by applicable regulations and permitting requirements.

Note: DEQ = Department of Environmental Quality.

Long-Term Mitigation

The potential long-term impacts identified in Section 4.8.3, as well as the seismic risks described in Section 4.8.1, would be mitigated through design in accordance with engineering standards and applicable regulations. TriMet or other project sponsors would meet applicable design and construction codes. No additional mitigation measures for long-term impacts are proposed.

Short-Term Mitigation

Project-specific mitigation measures for construction will be considered in subsequent geotechnical evaluations and design documents for the Project. In specific cases where geologic hazards are not avoidable in the study area, the impacts of these hazards would be mitigated through the use of appropriate engineering controls and practices. These hazards and possible mitigation measures are described below.

- **Erosion.** Potential erosion by wind and water would be mitigated by minimizing areas that are cleared of vegetation, providing temporary cover or mulch for exposed soil stockpiles, and using erosion control blankets or mulch on exposed slopes. The Project will secure an Oregon Department of Environmental Quality (DEQ) 1200C permit that includes requirements for addressing erosion and stormwater during construction.

- **Slope stability.** In areas of steep slopes and historical landslides or rock falls, affected slopes would be evaluated and designed for adequate stabilization using best management practices, including limited slope angle, retaining structures and reinforcement, and limitations on loads.
- **Settlement.** In areas where increased loads from new embankments and soil stockpiles might cause settlement, areas of soft soils would be identified and avoided. In areas where dewatering might be necessary, the settlement of associated soils would be mitigated by restricting dewatering to localized areas, using sheet piles to restrict flow and reinjecting groundwater. Surcharging (pre-construction consolidation) soils could also be considered as a measure to mitigate settlement.
- **Groundwater quality.** Best management practices for the protection of water quality in areas of shallow groundwater would include containing and controlling waste and hazardous materials on-site, and confining maintenance and refueling activities to areas where open excavations would not be impacted.

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4.9. Ecosystems

This section describes aquatic habitat and species, vegetation and wildlife species and habitat, wetlands and other biological resources that could be affected by the Project. Many of these resources are subject to federal, state and local regulations that will shape how impacts and potential mitigation measures are characterized. The *Ecosystems Results Report* (Attachment D) contains additional details on both the affected environment and the impacts discussed in this section.

Since the Draft EIS, this section has been updated to reflect the definition of the Project in this Final EIS and incorporate more detailed design information based on identification of the Preferred Alternative. In response to comments submitted on the Draft EIS, estimated impacts associated with tree removal and to protected vegetated corridors have been added to the analysis.

Endangered Species Act (ESA) consultation with the National Marine Fisheries Service (NMFS) has been completed for the Project. FTA prepared a biological assessment addressing fish species utilizing the lower Columbia River for migration and rearing. These include species that originate in the Upper Willamette River, Snake River, Upper Columbia River and Middle Columbia River Sub-basins because of the potential indirect effects of stormwater runoff from the Project. Appendix L, Biological Opinion, contains the Biological Opinion issued by NMFS on September 1, 2021, concluding the Project is not likely to jeopardize the continued existence of the identified species or destroy or adversely modify their designated critical habitat. Additional detail on the potential for stormwater impacts is included in Section 4.10, Water Resources. Appendix E, Agency Coordination and Correspondence, documents correspondence with NMFS.

The Project team reviewed species presence, critical habitat, and suitable habitat, and coordinated with the U.S. Fish and Wildlife Service (USFWS) on potential effects to species under its jurisdiction (see Appendix E). The Project was determined to have no effect on those species or habitat under USFWS jurisdiction due to lack of presence.

4.9.1. Affected Environment

The study area boundary for direct effects on ecosystems extends 50 feet from the edge of construction for the Preferred Alternative and related transportation improvements (referred to in text as the construction footprint and the 50-foot buffer). The construction footprint for the Preferred Alternative includes anticipated staging areas and construction access areas. This study area includes rivers, streams, wetlands, floodplains, vegetation and riparian corridors that intersect the study area boundary. While the entire construction buffer might not be impacted, it is presented in this Final EIS to disclose a worst-case scenario.

The study area for assessing presence and impacts for vegetation and wildlife (non-fish species) species is 0.25 mile from the edge of construction. For fish species and habitats, indirect, downstream impacts related to stormwater quality and hydrologic modifications are addressed by an expanded analysis area that extends downstream of the construction footprint to account for water quality impacts. These fish include species listed under the federal ESA and the Magnuson-Stevens Fishery Conservation and Management Act. For the ESA consultation reported in this Final EIS, the analysis area extends to the ocean because of the potential indirect effects on those species.

Much of the study area is along existing transportation corridors with adjacent urbanized land uses. These land uses include commercial and residential buildings, schools, roads, sidewalks, railroads and other infrastructure. The remainder of the study area consists of forested lands and undeveloped areas adjacent

to the northern portion of SW Barbur Boulevard and within road and railroad rights of way. Specific habitats and ecosystem resources that exist in the study area are described below.

Aquatic Habitat

The aquatic environment is analyzed at the subwatershed level (6th-field hydrologic unit code), which is the finest detail mapped in the study area (see Figures 4.9-1 to 4.9-3). The Project crosses the following four subwatersheds:

- Willamette River subwatershed
- Oswego Creek-Willamette River subwatershed
- Fanno Creek subwatershed
- Saum Creek-Tualatin River subwatershed

The Preferred Alternative, including the Marquam Hill Connection and the roadway improvements and shuttle along SW 53rd Avenue, would cross 17 mapped streams a total of 20 times (see Figures 4.9-1 to 4.9-3, as well as Table 4.10-1 in Section 4.10, Water Resources). Based on available data, 15 of these stream crossings currently flow under the Preferred Alternative alignment in pipes or culverts. Two named streams (Red Rock Creek and Ball Creek) flow on the surface and would be spanned by the Preferred Alternative alignment. Red Rock Creek is the largest stream in the study area that flows mainly on the surface, and it would be crossed three times by the Preferred Alternative. Streams that run through pipes or culverts have been previously impacted by development and are largely paved over within the study area. Minimal natural habitat associated with these streams is present within the study area. In addition, 9 of the 20 total mapped stream crossings of the Preferred Alternative, all located within Segment A, flow into the City of Portland's combined sewer infrastructure, where the water is treated at a wastewater treatment plant before discharging to the Columbia River. The Ross Island Bridgehead Reconfiguration would cross two mapped streams that both run through pipes at those locations. The station access improvements would cross mapped streams a total of 24 times. Attachment D includes additional details about stream crossings.

The surface water in the study area discharges to the Willamette River through tributary streams and conveyance system outfalls. In general, the streams in the study area have been highly affected by the surrounding urban environment, and all of the streams have reaches that are channelized or have been piped. The streams within the study area were identified through the use of existing mapping maintained by Metro in its Regional Land Information Service (RLIS) (Metro, 2020) and are identified by their given identification number based on the latitude and longitude of their discharge point (see Table 4.10-1). The mapping represents historical drainage patterns, and the existing drainages may be altered through piping so that the mapped streams are indistinguishable from storm sewers or roadway runoff. Because of the reliance on mapping for identifying streams, other drainages might have been missed that possess the same characteristics of mapped streams, such as ephemeral or intermittent flow. Coordination with the U.S. Army Corps of Engineers (USACE) and the Oregon Department of State Lands (DSL) will continue through the permitting process to confirm the jurisdictional status of these drainages.

In Segment A, surface water in most of the study area flows to the combined sewer system, where it is transported off-site for treatment. Currently, only 6 acres of the study area in Segment B, and none of the study area within Segment C, receive any water quality treatment.

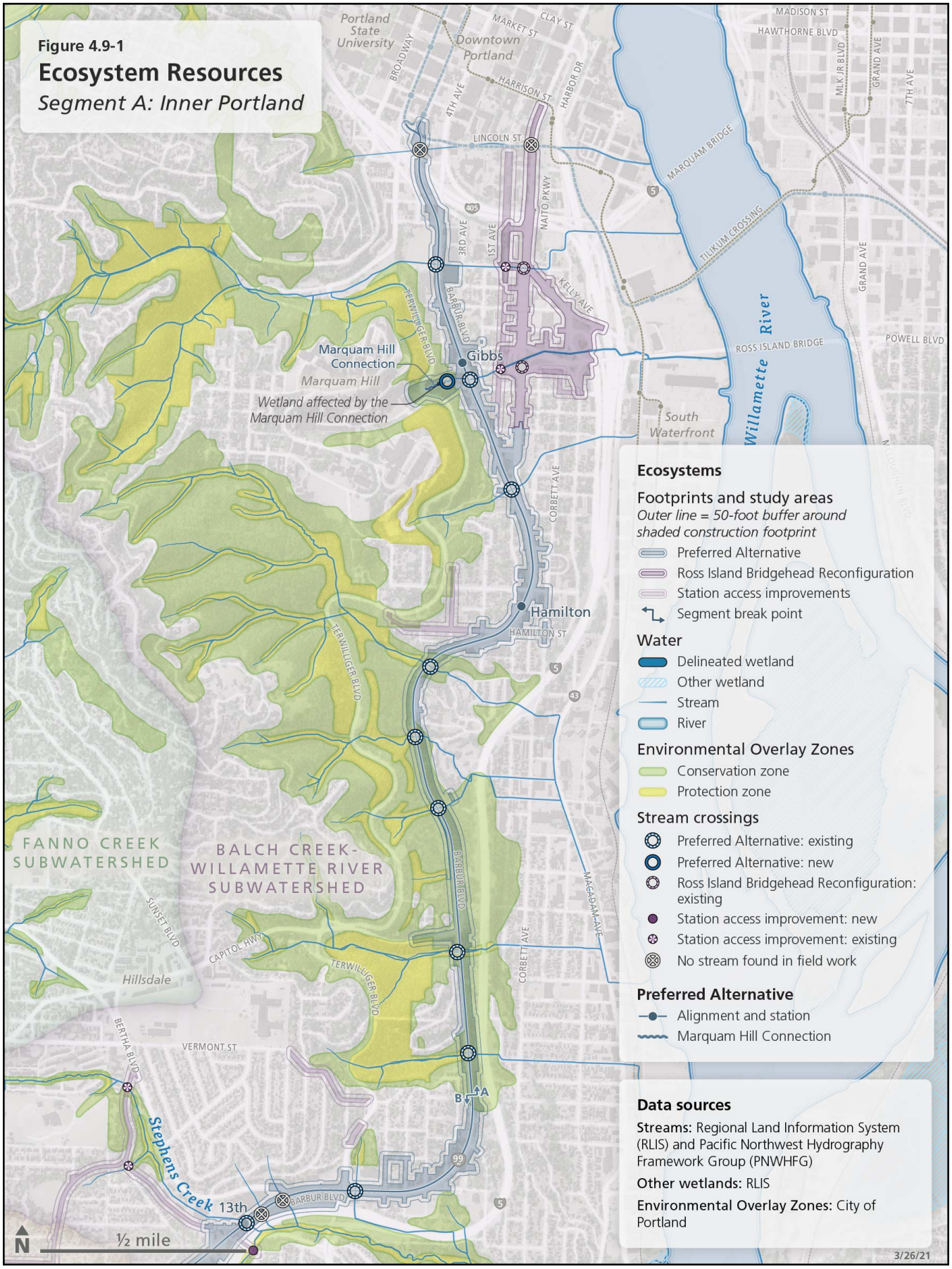
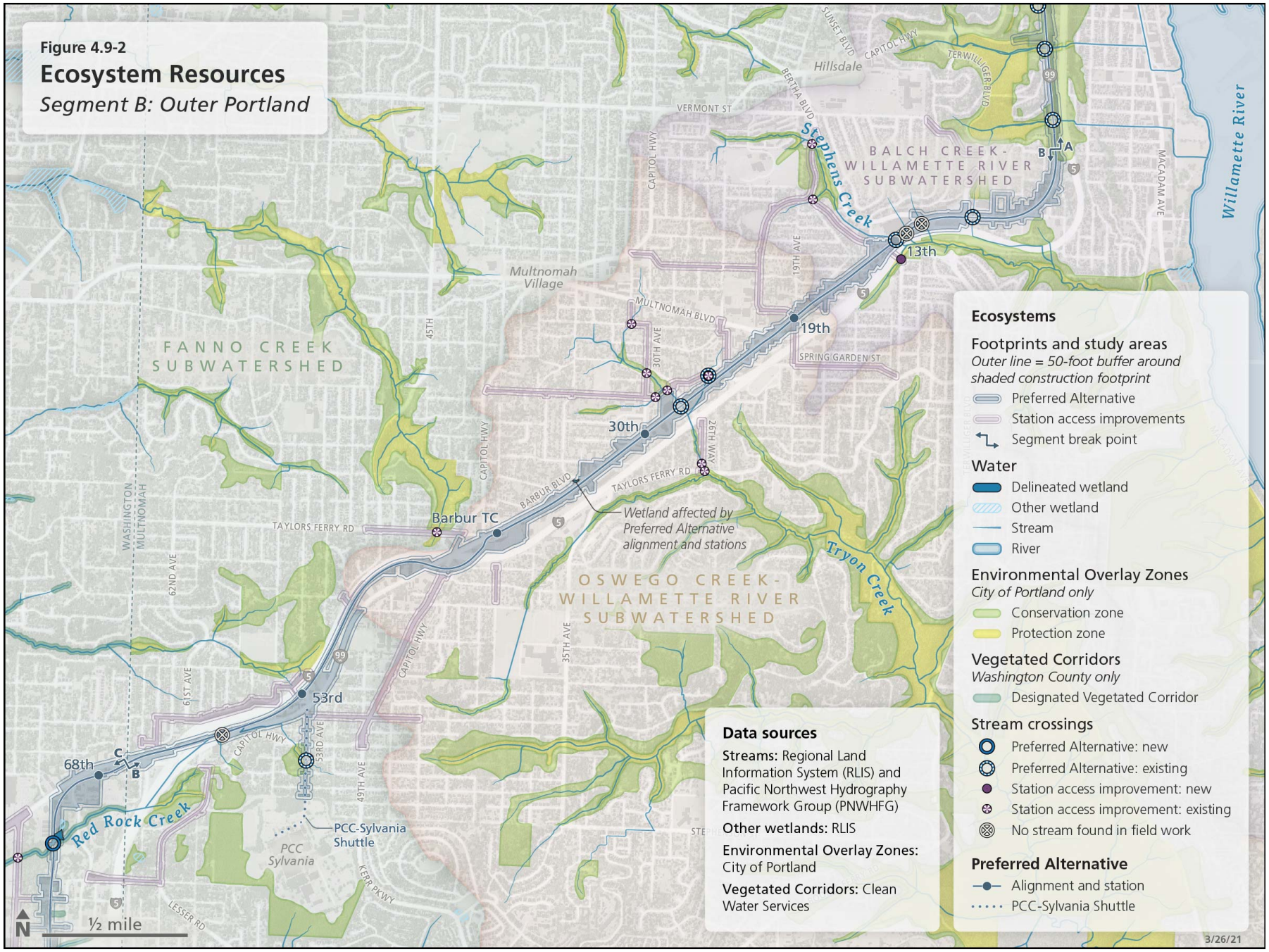


Figure 4.9-1
Ecosystem Resources
Segment A: Inner Portland
Portland State University
Downtown Portland
BROADWAY
MARKET ST
CLAY ST
HARRISON ST
HARBOR DR
4TH AVE
LINCOLN ST
MADISON ST
HAWTHORNE BLVD
MLK JR BLVD
GRAND AVE
7TH AVE
MARQUAM BRIDGE
TILIKUM CROSSING
ROSS ISLAND BRIDGE
POWELL BLVD
Willamette River
3RD AVE
1ST AVE
NAITO PKWY
KELLY AVE
BARBUR BLVD
TERWILLIGER BLVD
Marquam Hill Connection
Marquam Hill
Wetland affected by the Marquam Hill Connection
Gibbs
South Waterfront
CORBETT AVE
Hamilton
HAMILTON ST
MACADAM AVE
FANNO CREEK SUBWATERSHED
BALCH CREEK-WILLAMETTE RIVER SUBWATERSHED
SUNSET BLVD
CAPITOL HWY
Hillsdale
BERTHA BLVD
VERMONT ST
Stephens Creek
13th
B
A
Ecosystems
Footprints and study areas
Outer line = 50-foot buffer around shaded construction footprint
Preferred Alternative
Ross Island Bridgehead Reconfiguration
Station access improvements
Segment break point
Water
Delineated wetland
Other wetland
Stream
River
Environmental Overlay Zones
Conservation zone
Protection zone
Stream crossings
Preferred Alternative: existing
Preferred Alternative: new
Ross Island Bridgehead Reconfiguration: existing
Station access improvement: new
Station access improvement: existing
No stream found in field work
Preferred Alternative
Alignment and station
Marquam Hill Connection
Data sources
Streams: Regional Land Information System (RLIS) and Pacific Northwest Hydrography Framework Group (PNWHFG)
Other wetlands: RLIS
Environmental Overlay Zones: City of Portland
N
½ mile
3/26/21

Figure 4.9-2
Ecosystem Resources
Segment B: Outer Portland



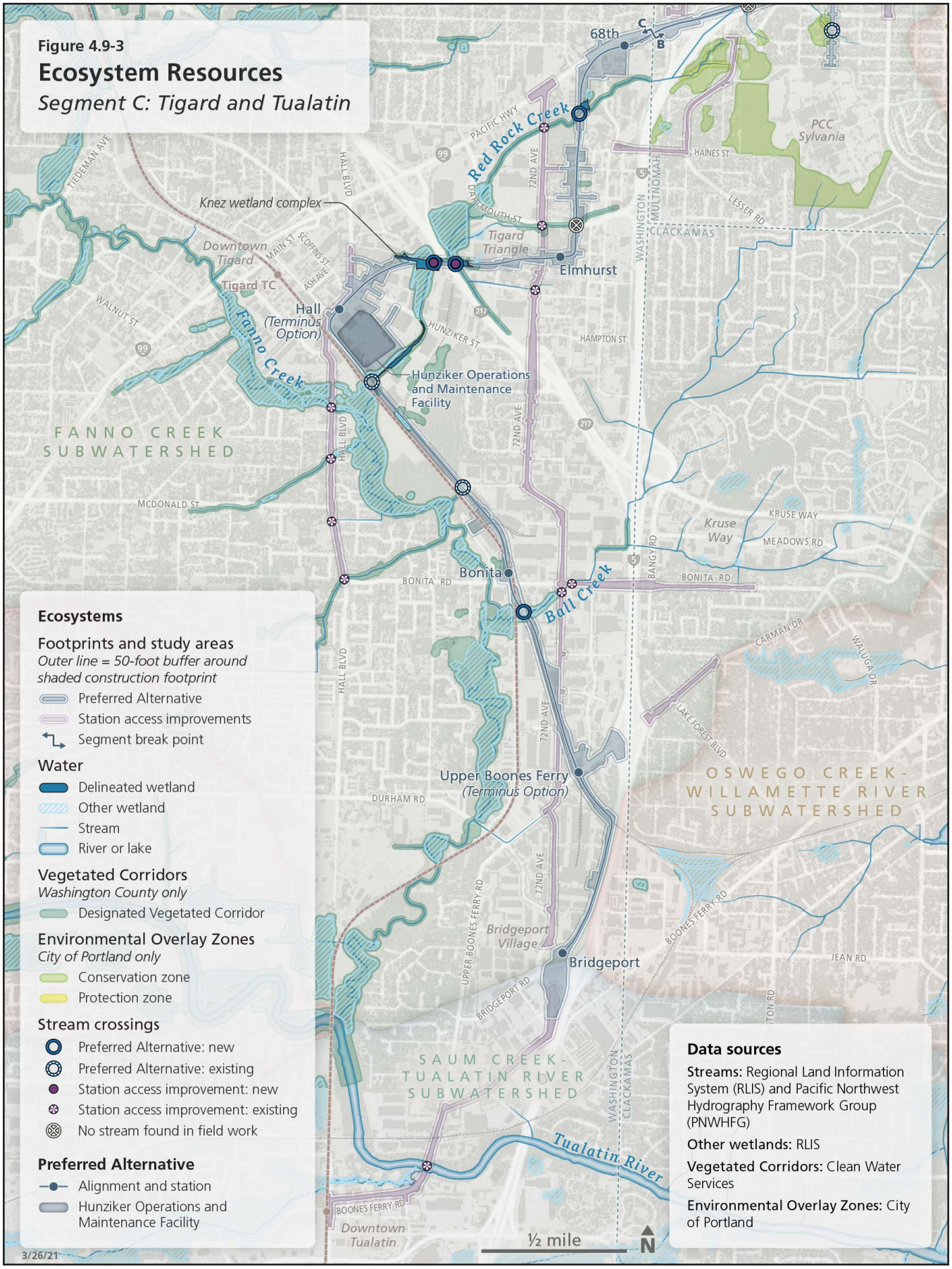


Figure 4.9-3
Ecosystem Resources
Segment C: Tigard and Tualatin
68th
C
B
Red Rock Creek
PACIFIC HWY
99
72ND AVE
DARTMOUTH ST
HAINES ST
PCC Sylvania
WASHINGTON
MULTNOMAH
CLACKAMAS
LESSER RD
TIEDEMAN AVE
HALL BLVD
Knez wetland complex
Tigard Triangle
Elmhurst
Downtown Tigard
MAIN ST
SCOFINS ST
ASH AVE
Tigard TC
WALNUT ST
Hall (Terminus Option)
Fanno Creek
HUNZIKER ST
HAMPTON ST
Hunziker Operations and Maintenance Facility
FANNO CREEK SUBWATERSHED
MCDONALD ST
Kruse Way
KRUSE WAY
MEADOWS RD
BANGY RD
Bonita
BONITA RD
Ball Creek
CARMAN DR
WALUGA DR
LAKE FOREST BLVD
Upper Boones Ferry (Terminus Option)
DURHAM RD
OSWEGO CREEK-WILLAMETTE RIVER SUBWATERSHED
UPPER BOONES FERRY RD
Bridgeport Village
Bridgeport
BOONES FERRY RD
JEAN RD
BRIDGEPORT RD
SAUM CREEK-TUALATIN RIVER SUBWATERSHED
Tualatin River
Downtown Tualatin
½ mile
N
3/26/21
Ecosystems
Footprints and study areas
Outer line = 50-foot buffer around shaded construction footprint
Preferred Alternative
Station access improvements
Segment break point
Water
Delineated wetland
Other wetland
Stream
River or lake
Vegetated Corridors
Washington County only
Designated Vegetated Corridor
Environmental Overlay Zones
City of Portland only
Conservation zone
Protection zone
Stream crossings
Preferred Alternative: new
Preferred Alternative: existing
Station access improvement: new
Station access improvement: existing
No stream found in field work
Preferred Alternative
Alignment and station
Hunziker Operations and Maintenance Facility
Data sources
Streams: Regional Land Information System (RLIS) and Pacific Northwest Hydrography Framework Group (PNWHFG)
Other wetlands: RLIS
Vegetated Corridors: Clean Water Services
Environmental Overlay Zones: City of Portland

Aquatic Species

Several databases were queried for potential species presence in the study area, including the Oregon Biodiversity Information Center (ORBIC) database; publicly available data from the USFWS Information, Planning, and Consultation (IPaC) System; USFWS county lists; and the Oregon Department of Fish and Wildlife (ODFW) Centralized Oregon Mapping Products and Analysis Support System (COMPASS). The database searches revealed the potential presence within the expanded analysis area, but not within the study area for direct effects, of eight fish species listed under the federal or state ESA or as federal species of concern or state sensitive:

- green sturgeon (*Acipenser medirostris*): federal listed threatened; critical habitat designated; state sensitive-critical
- Pacific lamprey (*Entosphenus tridentatus*): federal species of concern; state sensitive
- coastal cutthroat trout (*Oncorhynchus clarkii*): state sensitive
- chum salmon (*Oncorhynchus keta*): federal listed threatened; critical habitat designated; state sensitive-critical
- coho salmon (*Oncorhynchus kisutch*): federal listed threatened; critical habitat designated; state listed endangered
- steelhead (*Oncorhynchus mykiss*): federal listed threatened; critical habitat designated; state sensitive-critical or sensitive (depending on population)
- Chinook salmon (*Oncorhynchus tshawytscha*): federal listed threatened; critical habitat designated; state sensitive-critical, sensitive or threatened (depending on population)
- Pacific eulachon (*Thaleichthys pacificus*): federal listed threatened; critical habitat designated

Because of a combination of artificial and natural fish passage barriers, no anadromous fish are likely to occur in streams within the study area; however, these streams flow into water bodies where there are suitable anadromous and resident fish habitat and occurrence. Small numbers of resident fish may occur in portions of the study area in Red Rock Creek and Ball Creek, but are not likely to be present in the other streams within the study area.

Vegetation and Terrestrial Habitat

The study area, like many urban areas, is characterized by fragmented, noncontiguous habitats. Generally, the northern portion of the study area is highly developed, with little natural vegetation. In the southern portion of Segment A, more vegetation in the form of street trees and second-growth forest is present for approximately 1.5 miles. This area has been identified by Portland Parks and Recreation as a portion of the Westside Wildlife Corridor. This corridor is the forested spine of the West Hills and is identified as a local target area for linking Forest Park to Tryon Creek, buffering existing natural areas and providing neighborhood access to trails. The designation of this wildlife corridor does not convey any additional protections that are not already afforded by local land use regulations.

Within Segment B, the habitat transitions to suburban areas with moderate density housing and commercial development, and with pockets of vegetation in parks and adjacent natural areas. Within the northern portion of Segment C, the habitat is mixed between moderately dense commercial and industrial uses and natural areas associated with Red Rock Creek. In the southern portion of Segment C, the Preferred

Alternative light rail alignment would travel mainly along existing railroad and highway corridors, with little directly adjacent natural vegetation apart from at the crossing of Ball Creek. There are also natural areas associated with Fanno Creek located within 0.25 mile to 0.5 mile to the west of portions of the Preferred Alternative alignment.

In Segments A and B, the City of Portland has mapped environmental overlay zones (E-zones) that are intended to protect environmental resources and functional values that provide benefits to the public. E-zones are classified as either conservation or protection zones depending on the level of protection provided (mapped in Figures 4.9-1 to 4.9-3). The E-zones within the study area are mainly located within forested areas along SW Barbur Boulevard and within adjacent parks and natural areas, including those along the Marquam Hill Connection. The City of Portland is currently in the process of updating and revising E-zone maps; the existing mapping was used for analyzing impacts from the Project.

In Segment C, Clean Water Services designates vegetated riparian corridors and other components of sensitive lands that are regulated by the Cities of Tigard and Tualatin. These locally regulated areas come with protections similar to those afforded by E-zones in Portland. Table 4.9-1 details the acreage of E-zones and vegetated corridors in the construction footprint and the 50-foot buffer. Attachment D provides E-zone acreage by conservation and protection zones, as well as more information on potential impacts to mapped vegetation types, such as forested habitat areas, and regulated areas such as City of Tigard Sensitive Lands. There are no vegetated corridors or sensitive areas within the study area within the City of Tualatin.

Table 4.9-1. Environmental Zones and Vegetated Corridors within the Study Area

Project Element	Acres of E-Zones *(City of Portland)*			Acres of Vegetated Corridor *(City of Tigard)*		
	Construction Footprint	50-Foot Buffer	Study Area Total	Construction Footprint	50-Foot Buffer	Study Area Total
Light Rail Investment: Individual Elements						
Segment A alignment and stations	27.1	13.4	40.5	0.0	0.0	0.0
Segment B alignment and stations	1.0	1.3	2.3	0.0	0.0	0.0
Segment C alignment and stations	0.0	0.0	0.0	7.9	5.9	13.8
Marquam Hill Connection	1.7	1.4	3.1	0.0	0.0	0.0
Hunziker O&M Facility	0.0	0.0	0.0	2.4	1.0	3.4
Light Rail Investment: Total						
Preferred Alternative	29.8	16.1	45.9	10.3	6.9	17.2
Upper Boones Ferry Terminus Option	29.8	16.1	45.9	10.3	6.9	17.2
Hall Terminus Option	29.8	16.1	45.9	7.9	5.9	13.8
Related Transportation Improvements						
Ross Island Bridgehead Reconfiguration	0.0	0.0	0.0	0.0	0.0	0.0
Station access improvements[1]	1.7	6.2	7.9	2.0	5.5	7.5
Full Project[2]						
Preferred Alternative + all related transportation improvements	31.5	22.3	53.8	12.3	12.4	24.7

Note: O&M = operations and maintenance.

[1] Footprints of station access improvements are defined by the extent of the current right of way where improvements will be made.

[2] Impacts shown for the full Project may include small overlapping areas between the Preferred Alternative and station access improvements and buffers (i.e., totals may include a small amount of double-counting).

In all three segments, the Preferred Alternative alignment and related transportation improvements would traverse areas of forest that are governed by local tree codes. All three cities within the study area regulate tree removal based on size (measured in diameter at breast height, or DBH), location and condition, and prescribe specific mitigation options for tree removal. Most of the large areas of contiguous forest are located along SW Barbur Boulevard in Segments A and B. Tree removal would be required for construction of the Project. Table 4.9-2 shows the estimated number of trees within the study area for the Preferred Alternative, broken out by portions of each segment and tree size classes. Further detail on tree identification methods, removal impacts, mitigation requirements and potential mitigation measures is provided in Attachment D.

Table 4.9-2. Estimated Number of Trees within the Study Area by Size Class

Segment[1]	Tree Size Class	Number of Trees		
		Construction Footprint	50-Foot Buffer	Study Area Total
Segment A: Inner Portland				
North of SW Hamilton St.	Small (6”–12” DBH)	210	180	390
	Medium (12”–24” DBH)	360	140	500
	Large (>24” DBH)	100	50	150
South of SW Hamilton St.	Small (6”–12” DBH)	630	390	1,020
	Medium (12”–24” DBH)	480	310	790
	Large (>24” DBH)	120	70	190
Segment B: Outer Portland				
North of Barbur Transit Center	Small (6”–12” DBH)	400	160	560
	Medium (12”–24” DBH)	330	130	460
	Large (>24” DBH)	70	20	90
South of Barbur Transit Center	Small (6”–12” DBH)	180	120	300
	Medium (12”–24” DBH)	460	170	630
	Large (>24” DBH)	30	40	70
Segment C: Tigard and Tualatin				
Tigard	Small (6”–12” DBH)	580	170	750
	Medium (12”–24” DBH)	530	160	690
	Large (>24” DBH)	140	70	210
Tualatin	Small (6”–12” DBH)	20	10	30
	Medium (12”–24” DBH)	0	0	0
	Large (>24” DBH)	0	0	0
Totals				
Segment A	All (>6” DBH)	1,900	1,140	3,040
Segment B	All (>6” DBH)	1,470	640	2,110
Segment C	All (>6” DBH)	1,270	410	1,680
Full Project	All (>6” DBH)	4,640	2,190	6,830

Note: DBH = diameter at breast height.

[1] The tree counts include the Preferred Alternative alignment and stations for each segment, the Marquam Hill Connection in Segment A, and the Hunziker Operations and Maintenance Facility in Segment C. The PCC-Sylvania Shuttle would not result in tree removal. The Ross Island Bridgehead reconfiguration study area has few trees that would be subject to removal. The station access improvements are not included, because they are not defined with sufficient detail at this time to estimate tree removal.

Terrestrial Species

Database searches for threatened, endangered or sensitive terrestrial species revealed the presence of 8 plant species, 17 bird species, 5 mammal species, 2 reptile species, 1 amphibian species, 1 insect species and 1 mollusk species potentially occurring within or near the study area. Each of these species and its respective listing status under the federal or state ESA are discussed in further detail in Attachment D. As with the database queries described in the Aquatic Species section above, not all of the species identified in the databases are likely to occur within the ecosystems study area for the Project.

The presence of wildlife or plant species listed as threatened or endangered under the federal ESA is not likely within the study area. A few state-sensitive bird and mammal species could inhabit the forested areas along SW Barbur Boulevard in Segments A and B. In Segment C, state-sensitive bird, mammal and reptile species, including purple martin (*Progne subis*), Townsend's big-eared bat (*Corynorhinus townsendii*) and western pond turtle (*Actinemys marmorata*), likely inhabit the vegetated and wetland areas along Red Rock Creek.

Wetlands

Wetlands in the study area were identified through a wetland delineation on properties for which rights of entry were available. For properties without access rights, likely wetlands were identified using a combination of mapping and databases from a number of local and federal sources, as well as with reviews of aerial photography and field visits. Table 4.9-3 details the acreage of mapped wetlands within the study area. Figures 4.9-1 to 4.9-3 show the mapped wetlands that are located in each segment. Attachment E, *Wetland Delineation Report*, provides additional information on surveyed wetlands.

Segment A contains no previously mapped wetland resources within the study area, although a field-delineated wetland of approximately 0.2 acre lies within the construction footprint for the Marquam Hill Connection. Segment B contains less than 0.1 acre of mapped wetland resources near the 9400 block of SW Barbur Boulevard and other small and dispersed unmapped wetland areas. Segment C contains by far the greatest amount of wetland resources, which are primarily associated with Red Rock Creek, Ball Creek and Fanno Creek in Tigard. The portions of these wetlands near the Preferred Alternative alignment, stations and station access improvements are generally surrounded by development.

Historically, the area surrounding the lower portion Red Rock Creek was part of a larger wetland that was likely more than 25 acres in size and contained a mix of forested, shrub, emergent and open water wetland types. Historical aerial photos show that the area had been converted to agriculture by the 1950s, with roadway and railroad structures changing the hydrology of the area. The construction of Highway 217 severed the remaining wetland into two portions: a 6.7-acre wetland/pond complex on the southwest side of the highway that contains the Knez Wetland and a 15-acre wetland area on the northeast side of the highway. The two wetlands are still hydrologically connected by Red Rock Creek, which passes under the highway in a culvert. Both wetlands are mapped by the National Wetlands Inventory and Regional Land Information System as wetland.

The Knez Wetland, a 1.9-acre site, contains a remnant Willamette Valley wet prairie plant community that extends to a larger connected system of ponds and wetlands. According to the wetland site's management plan, Knez Building Materials, Inc. donated the property to the City of Tigard in 1992. The Wetlands Conservancy assisted with site management, and in 1994 the City of Tigard donated the property to The Wetlands Conservancy (The Wetlands Conservancy, 2004).

Table 4.9-3. Mapped Wetland Resources within the Study Area

Project Element	Mapped Wetland Resources (acres)		
	Construction Footprint	50-foot Buffer	Study Area Total
Light Rail Investment: Individual Elements			
Segment A alignment and stations	0.0	0.0	0.0
Segment B alignment and stations	<0.1	<0.2	<0.3
Segment C alignment and stations	4.0	1.1	5.1
Marquam Hill Connection	0.2	0.0	0.2
PCC-Sylvania Shuttle	0.0	0.0	0.0
Hunziker O&M Facility	0.4	0.6	1.0
Light Rail Investment: Total			
Preferred Alternative	4.7	1.8	6.5
Upper Boones Ferry Terminus Option	4.7	1.8	6.5
Hall Terminus Option	4.4	1.7	6.1
Related Transportation Improvements			
Ross Island Bridgehead Reconfiguration	0.0	0.0	0.0
Station access improvements[1]	0.2	1.6	1.8
Full Project[2]			
Preferred Alternative + all related transportation improvements	4.9	3.4	8.3

Note: O&M = operations and maintenance; PCC = Portland Community College.

[1] Station access improvement footprints are defined by the extent of the current right of way where improvements will be made. Fifty-foot buffers have been added to this footprint.

[2] Impacts of the full Project include overlaps between the Preferred Alternative and the station access improvements.

The Knez Wetland complex is situated along both sides of Red Rock Creek as it flows south from Highway 217, and the wetland complex narrows considerably through a narrow strip of riparian vegetation that ends at SW Hunziker Street. The wetland complex extends onto adjacent properties to the north, west and east of the main Knez Wetland parcel. The Wetlands Conservancy parcel contains additional wetland prairie, a hydrologically connected 1.3-acre stormwater detention pond and a short unnamed tributary of Red Rock Creek that enters the site from the northwest. The total area of the wetland/pond complex is approximately 6.7 acres, with about 4.4 acres of wetland prairie.

4.9.2. No-Build Alternative

Development projects and other transportation projects that would still occur under the No-Build Alternative would generally not adversely affect ecosystem resources, because they are proposed in areas that are largely urbanized. Further, other projects or land use actions that would take place under the No-Build Alternative would be subject to regulatory review and/or permitting. These regulatory and permitting actions would trigger measures to avoid, minimize or mitigate impacts to ecosystem resources, including streams, wetlands, and stream and wetland buffer areas. The stormwater runoff from the existing impervious surfaces would continue to cause pollutants such petroleum, copper, zinc, *E. coli* and suspended sediments to affect streams and aquatic organisms downstream of the Project. Effects on water quality are discussed further in Section 4.10, Water Resources.

4.9.3. Long-Term Impacts

As described in Section 4.9.1 above, the study area for direct impacts to ecosystems resources includes the construction footprint plus a 50-foot buffer. This total area represents a conservative estimate of the area that could experience long-term impacts due to project construction activities or permanent conversion to project use, as described below:

- The **construction footprint** includes areas with likely direct impacts, such as removal of trees and other vegetation. Some of these areas, such as the light rail trackway and sidewalks, would be permanently converted to project use. Other areas, such as temporary construction easements or areas under bridges, could be restored after construction. While not likely, clearing of trees might be necessary for the entire construction footprint. It may be possible to minimize impacts to sensitive areas within the construction footprint, such as by placing bridge piers in a manner that would not impact an entire wetland.

- The **50-foot buffer** covers adjacent areas that could also experience direct impacts, if designs change or additional construction access is required. It is unlikely that the entire 50-foot buffer would be impacted, but this buffer is included in the study area to cover a worst-case scenario of project impacts. This buffer is also included in this discussion to align with how impacts were calculated for the Draft EIS.

As noted in the Section 4.9.1 above, existing water quality treatment and runoff detention in the study area is limited. In Segment A, most of the project area flows to the combined sewer system, where it is transported off-site for treatment. Only 6 acres of the study area in Segment B, and none of the areas within Segment C, receive any water quality treatment. The Project would upgrade water quality treatment for new and modified impervious surfaces in compliance with regulatory requirements. These upgrades likely would result in a decrease in the amount of pollutants reaching surface waters under most storm conditions. The effects on listed fish species are detailed in Appendix L, the Biological Opinion issued by NMFS for the Project.

Preferred Alternative: Segment A

- **Aquatic habitat and species.** Direct impacts to fish and fish habitat are not anticipated within this segment, because there are no streams that contain fish within the study area. In addition, all but one of the mapped streams in this segment flow through pipes and into the City of Portland combined sewer system. The remaining mapped stream flows through more than 0.5 mile of sewer pipe before discharging to the Willamette River. The pipes that carry these drainages are likely to be replaced by the Project or its partners, and further discussion with the USACE and DSL will be required. Other aquatic species, such as amphibians and invertebrates, might be affected by removal of riparian vegetation and hydrological changes in those streams that still maintain surface connections to other streams.

- **Vegetation and wildlife habitat and species.** Within Segment A, both the Preferred Alternative alignment and stations and the Marquam Hill Connection would impact mapped E-zones, including both conservation and protection areas. For the alignment and stations, E-zone areas within the study area total approximately 40.50 acres, of which 27.1 acres are within the construction footprint. E-zone protection areas within the study area for the alignment and stations total 2.6 acres, of which 1.4 acres

are within the construction footprint. E-zone areas for the Marquam Hill Connection total 3.0 acres. Of this area, 1.7 acres of E-zone are within the construction footprint.

Most of these E-zone impacts would be in the forested area along SW Barbur Boulevard. Trees and vegetation within the construction footprint could be completely removed. This removal could also impact small portions of the Westside Wildlife Corridor. While the Marquam Hill Connection would result in the presence of infrastructure within the gully, the inclined elevator is anticipated to be elevated. This would allow for some movement of wildlife through the area. Overall, up to approximately 1,900 trees are within the construction footprint and could be removed in Segment A. However, it is unlikely that all trees within the construction footprint would be removed. Therefore, this number could potentially decrease. Further, many of the removed trees would be replaced in accordance with City of Portland tree removal codes, and street trees would be planted as part of the Project. Potential impacts would be further refined during tree surveys, which would be required as part of the Project's permitting process.

- **Wetlands.** No impacts to mapped wetlands would occur in Segment A for the Preferred Alternative alignment and stations. Approximately 0.2 acre of potentially jurisdictional wetland lies within the construction footprint for the Marquam Hill Connection and would likely be impacted by fill. Additionally, unmapped, small riverine wetlands are likely found along small unnamed tributaries that lead from forested slopes west of SW Barbur Boulevard, and if they are present, they could slightly increase total wetland impacts. Impacts to smaller, undiscovered wetlands are possible but would be limited. Overall, the level of potential impacts to wetlands in Segment A from the Preferred Alternative and the Marquam Hill Connection, would be minor.

- **Threatened, endangered and sensitive species.** No threatened or endangered species are likely to be present within this segment. Impacts to downstream fish and habitat from stormwater runoff would be unlikely, because this segment drains to the City of Portland's combined sewer. Only during extreme precipitation events would runoff drain to the Willamette River, similar to existing conditions. Sensitive bird and mammal species might inhabit the forested areas along SW Barbur Boulevard. Removal of trees would have a negative impact on these species due to the loss of habitat; however, potential impacts to forested habitat in Segment A would be limited to a maximum of 29.3 total acres within the construction footprint and up to 20.3 acres within the 50-foot buffer (see Attachment D). The forested area along SW Barbur Boulevard adjoins approximately 400 acres of additional contiguous forested habitat, approximately 350 acres of which are designated as parks and protected from future development. The impact would therefore be minimal in the context of the remaining forested habitat in the surrounding area.

Preferred Alternative: Segment B

- **Aquatic habitat and species.** Direct impacts to fish and habitat are not anticipated within this segment, because there are no streams within the study area that contain fish, and the Preferred Alternative would not cross any surface-flowing streams. Other aquatic species, such as amphibians and invertebrates, might be affected by removal of riparian vegetation and hydrologic changes in those streams that still contain surface connections to other streams. The pipes that carry these drainages would likely be replaced by the Project or its partners, and further discussion with the USACE and DSL would be required.

- **Vegetation and wildlife habitat and species.** Within Segment B, the Preferred Alternative alignment and stations would result in impacts to mapped E-zones. The PCC-Sylvania Shuttle would not result in E-zone impacts. E-zone areas within the Preferred Alternative study area total 2.3 acres, of which 1.0 acre is within the construction footprint. Most of these impacted areas would be associated with the small patches of forested areas along SW Barbur Boulevard. Trees and vegetation within the construction footprint might be completely removed. This removal could also impact small portions of the Westside Wildlife Corridor. Under the most impactful (worst-case) scenario, up to approximately 1,470 trees could be removed within Segment B, although it is unlikely that all trees would be removed. Potential impacts would be further refined during tree surveys, which would be required as part of the project permitting process. Moreover, mitigation in the form of replacement trees would occur as part of the Project, resulting in a more cohesive canopy of trees along the light rail alignment in this segment.

- **Wetlands.** Up to 0.3 acre of potential permanent impact to an identified wetland is possible along SW Barbur Boulevard as a result of the Preferred Alternative alignment and stations. It is possible that other small impacts to unmapped wetland areas could occur in Segment B, but there are limited amounts of wetlands in this mostly developed segment. A few unmapped, riverine wetlands can likely be found along small unnamed tributaries that lead from areas west of the Preferred Alternative, and if they are present, they could slightly increase the impacts to wetlands in Segment B, but such impacts would be minor (likely less than an additional 0.1 acre).

- **Threatened, endangered and sensitive species.** No threatened or endangered species are likely to be present within this segment, and no potential impacts are identified. Impacts to fish and habitat from stormwater runoff are possible for species using downstream waters. However, construction of the Preferred Alternative would include increased stormwater treatment, which would provide a benefit in the long term by managing stormwater from approximately 50 acres of existing impervious surfaces that currently is not being treated. Sensitive bird and mammal species may inhabit the relatively small patches of forested areas in proximity to SW Barbur Boulevard. Removal of trees would have a negative impact on these species by removing habitat; however, potential impacts to forested habitat in Segment B would be limited to 17.0 total acres within the Preferred Alternative construction footprint and 7.6 total acres within the 50-foot buffer (see Attachment D). As discussed for Segment A above, these areas are adjacent to approximately 400 acres of contiguous forested habitat, the majority of which is protected as parks. The impact would thus be minimal in the context of the remaining habitat in the surrounding area.

Preferred Alternative: Segment C

- **Aquatic habitat and species.** The Preferred Alternative is not expected to result in direct impacts to anadromous fish and their habitat within this segment; however, small numbers of resident fish may be present. Impacts to other aquatic species, including turtles, amphibians and invertebrates, would be possible within Red Rock Creek and Ball Creek, because potential habitat is present adjacent to those streams.

- **Vegetation and wildlife habitat and species.** The Cities of Tigard and Tualatin have mapped vegetated corridors, which are designated and regulated by the local jurisdictions and Clean Water Services. Vegetated corridors require mitigation and restoration through Clean Water Services' Design and Construction Standards. Vegetated corridors are among those resources associated with Tigard's

sensitive lands designation (City of Tigard Development Code Chapter 18.510). Vegetated corridors in the study area within Segment C total approximately 17.2 acres, of which 10.3 acres are within the construction footprint. Most of these impacts would occur in the areas near Red Rock Creek and Ball Creek. Trees and vegetation within the construction footprint of the Preferred Alternative would be removed. Overall, up to approximately 1,270 trees could be removed within Segment C. However, this number could potentially decrease if the entire construction area is not used. Potential impacts would be further refined during tree surveys which would be required as part of the project permitting process. Vegetation at the Hunziker Operations and Maintenance (O&M) Facility is mapped as grass/developed area, with no forested vegetation present. The Hunziker O&M Facility would be located in an area with existing development, and no direct impacts are anticipated. No vegetated corridors are mapped within the study area within Tualatin.

- **Wetlands.** Table 4.9-3 above shows the area of wetlands present in the study area. The impacts are based on wetland delineation information collected in support of the Project, where available. In areas that could not be accessed for delineations, the City of Tigard's local wetland inventory mapping results are used, because they indicate the highest level of potential impacts. These wetlands are assumed to be among those resources associated with the City of Tigard's sensitive lands designation (City of Tigard Development Code Chapter 18.510). The analysis assumes the entire study area could be affected. However, the direct potential construction impact and the potential impact in the 50-foot buffer that makes up the study area are shown separately in the table. Because bridges and viaducts would largely span stream and wetland crossings, the total area of potential permanent and temporary impacts would be far less than the totals shown in Table 4.9-3 and would only include the footprint of permanent bridge piers, abutments and trackway along the existing railroad alignment. Additionally, it would be possible to avoid some of the direct temporary impacts within the construction footprint by using pile-supported work platforms during construction. Therefore, while the construction footprint includes approximately 4.0 acres of wetlands in Segment C, the Preferred Alternative would be likely to permanently impact a total of approximately 0.8 acre of wetlands within Segment C. Approximately 0.05 acre of this total would consist of impacts to the Knez Wetland in the vicinity of the Highway 217 overcrossing. The remainder of the impact would consist of fill of several delineated low-quality wetlands along the existing railroad alignment. The *Ecosystems Results Report* (Attachment D) includes additional calculations of wetland areas that provide more details about these results, as well as the results obtained using wetlands mapped through processes other than the City of Tigard's local wetland inventory mapping.

- **Threatened, endangered and sensitive species.** No threatened, endangered or sensitive fish or wildlife species are likely to be present within this segment. One federally listed plant, the Nelson's checkermallow (*Sidalcea nelsoniana*), was noted as being planted within the Knez Wetland as part of a previous restoration effort. Surveys of the area were conducted for the Project, but no individuals were found, and the habitat is not currently suitable for the presence of Nelson's checkermallow because of the density of invasive reed canarygrass. The Preferred Alternative would not affect Nelson's checkermallow.

  Impacts to fish from stormwater runoff are possible for species using downstream waters. However, construction of the Preferred Alternative would include increased stormwater treatment, which would provide a benefit in the long term by managing stormwater from over 36 acres of existing impervious surfaces that currently is not being treated.

Sensitive bird, mammal and reptile species, including purple martin, Townsend's big-eared bat and western pond turtle, likely inhabit the vegetated and wetland areas along Red Rock Creek. Removal of trees and modification of wetland and pond areas would have a negative impact on these species due to habitat loss. However, impacts to wetlands and vegetated areas would be localized and limited in extent. For forested habitat in particular, potential impacts would be limited to a maximum of 4.5 total acres in Segment C (2.1 acres within the project construction footprint and 2.4 acres within the 50-foot buffer), because Segment C largely traverses urbanized, developed areas. Several large areas of contiguous forested and wetland habitat exist within 1 mile or less of the Segment C alignment, including 48-acre Dirksen Nature Park, 30-acre Fanno Creek Park and 79-acre Cook Park. The anticipated impacts would therefore be minimal in the context of the remaining habitat in the surrounding area and would not be expected to affect these sensitive species on a population level.

Terminus Options

The terminus options would have lesser localized effects because they would not construct the southernmost 1 to 3 miles of the Preferred Alternative alignment. The terminus options would not remove trees or impact wetlands along the portion of the Preferred Alternative that would not be constructed. Up to 0.75 acre of delineated wetland along the existing railroad alignment would not be impacted by the Hall Terminus Option. Approximately 30 trees within Tualatin and approximately 200 trees within Tigard would likely not be removed by the Upper Boones Ferry Terminus Option. An additional 200 trees within Tigard would likely not be removed with the Hall Terminus Option. The terminus options would add slightly less additional impervious surface than the Preferred Alternative, and therefore would contribute to less of an incremental increase in runoff during large rain events; however, they would also not provide as much benefit in terms of upgraded stormwater management compared to the No-Build Alternative.

Related Transportation Improvements

The potential long-term impacts of the Ross Island Bridgehead Reconfiguration and the station access improvements are considered by type of potential impact below.

Ross Island Bridgehead Reconfiguration

The Ross Island Bridgehead Reconfiguration would be in a previously developed area with few ecosystem resources present. It would likely require no to a few tree removals, and stormwater would flow to combined sewer and not require pretreatment and may not require detention. As a result, the overall impacts are anticipated to be negligible.

- **Aquatic habitat and species.** Direct impacts to fish and fish habitat are not anticipated for the Ross Island Bridgehead Reconfiguration, because there are no streams that contain fish within the vicinity. The two mapped streams flowing through this area are piped into culverts upstream of the Ross Island Bridgehead. Other aquatic species would thus not be affected, because this project component would not result in impacts to hydrology or the quality of riparian habitat. In addition, all stormwater generated in this area flows to the City of Portland combined sewer system; the Ross Island Bridgehead Reconfiguration is therefore not anticipated to result in indirect impacts to fish from stormwater runoff.

- **Vegetation and wildlife habitat and species.** Impacts to vegetation and wildlife habitat and species from the Ross Island Bridgehead Reconfiguration are expected to be negligible because of the heavily developed nature of this area and the fragmentation of existing vegetated habitat. No E-zones are present within the study area for this project element.

- **Wetlands.** No mapped wetland areas are present within the construction footprint or the buffer for the Ross Island Bridgehead Reconfiguration. As a result, no wetland impacts are expected from construction of this project element.

- **Threatened, endangered and sensitive species.** No threatened or endangered species are likely to be present within the area of the Ross Island Bridgehead Reconfiguration. Indirect impacts to downstream fish and habitat from stormwater runoff would also be unlikely, because stormwater from this area flows to the City of Portland's combined sewer system.

Station Access Improvements

Detailed designs have not yet been developed for the station access improvements, so potential ecosystem impacts are described in terms of the maximum extent of each ecosystem resource present within the construction footprint and buffers. As noted in Section 4.9.1, the construction footprints for the station access improvements are defined by the extent of the current right of way where improvements would be made. Similar to the Preferred Alternative, 50-foot buffers have been added to this footprint to identify nearby ecosystems resources. The station access improvements would be developed largely within and immediately adjacent to previously developed and/or disturbed areas. As a result, they would likely have minimal additional impacts beyond those described for the Preferred Alternative, and they are not expected to impact large areas of contiguous high quality ecosystem resources. However, they would require construction activities, similar to the rest of the Project, and would result in impacts.

- **Aquatic habitat and species.** Station access improvements would have potential impacts similar in character to those described above for the Preferred Alternative alignment and stations. No direct impacts to fish and habitat are anticipated, although other aquatic species, such as amphibians and invertebrates, might be affected by removal of riparian vegetation and hydrologic changes in those streams that still contain surface connections to other streams.

- **Vegetation and wildlife habitat and species.** Within Segments A and B, the maximum extent of impacts to mapped E-zones from the station access improvements would include up to 5.27 acres of impacts to E-zone conservation areas and approximately 0.94 acre of impacts to E-zone protection areas. This assessment assumes that trees and vegetation within the construction footprint of the station access improvements will be completely removed.

  In Segment C, station access improvements could potentially impact a maximum of up to 1.98 acres of vegetated corridors within the construction footprint. Due to the similarities in construction activities, the nature of impacts to vegetation and wildlife habitat and species from the station access improvements would be similar in character to those described for the Preferred Alternative alignment and stations. The station access improvements would be constructed to meet the requirements of the local jurisdictions, and while some vegetation would be removed, these impacts would be mitigated to meet local standards.

- **Wetlands.** Approximately 0.2 acre of mapped wetlands is located within the construction footprints for the station access improvements and approximately 1.6 acres are located within the buffers. Potential wetland impacts would be primarily concentrated within Segment C. As with the potential wetland impacts described for the Preferred Alternative above, the total area of potential direct permanent and temporary impacts is expected to be less than the total acreage of mapped wetlands within the construction footprint. Overall, the level of potential impacts to wetlands from the station access improvements is expected to be minimal.

- **Threatened, endangered and sensitive species.** Sensitive bird and mammal species might inhabit the forested areas along SW Barbur Boulevard. Removal of trees to construct the station access improvements could have a negative impact on these species. However, similar to the potential impacts to forested habitat described for the Preferred Alternative in Segments A and B above, the impacts would be minimal in the context of the remaining forested habitat in the surrounding area. Additionally, most of the wildlife species residing in these areas are mobile, and it is anticipated that they would be able to move away from the area of construction disturbance to other available forested habitat nearby.

  In Segment C, potential impacts to sensitive species and their habitat would be similar to those described above for the Preferred Alternative in Segment C. These potential impacts would be localized and limited in extent, occurring in locations such as the vegetated and wetland areas along Red Rock Creek, and as a whole would be expected to add minimally to the impacts from the Preferred Alternative alignment and stations. Impacts to downstream fish and habitat from stormwater runoff would be unlikely, because increased stormwater treatment resulting from construction of the station access improvements would minimize potential impacts and could provide a benefit to water quality and runoff quantities in the long term.

4.9.4. Short-Term Impacts

Construction of the Project could result in impacts such as soil disturbance and compaction, soil erosion, and removal of trees and other vegetation in or adjacent to wetlands and streams. Soil compaction could cause changes in hydrology in adjacent streams, and if severe enough, these changes could be permanent. Soil erosion and vegetation removal could cause soils to enter wetlands and streams, possibly raising turbidity levels and degrading water quality. Any temporary removal of trees and shrub vegetation for construction would also likely result in decreased shading of study area wetlands and potential habitat loss.

Preferred Alternative

Temporary impacts to jurisdictional wetlands would occur in the wetlands associated with Red Rock Creek at the Knez Wetland and the wetlands adjacent to Ball Creek. Temporary, pile-supported work platforms would be used in the construction of the guideway bridges. Up to 550 piles would be used within the Knez Wetland. Work platforms would be approximately 30 feet wide with extensions up to 70 feet wide at bridge bent locations. The temporary work platforms would be in place for up to 24 months. Construction of the light rail structures over Red Rock Creek near the Hunziker O&M Facility and over Ball Creek would involve similar techniques and would use approximately 100 piles each. Temporary wetland impacts would include approximately 750 square feet of direct impacts due to disturbance of soils and vegetation at the work platform pile locations as well as approximately 1.0 acre of indirect impacts due to shading of existing

vegetation by the work platforms. The locations of the temporary impacts would be restored to pre-project conditions after construction.

In addition, noise, light and other disturbance from construction could negatively affect breeding, foraging and dispersal of both common and protected terrestrial wildlife that may avoid loud machinery, and migratory birds that may no longer rest or feed near the construction areas. Lights used for night work could disturb nocturnal animals such as owls or bats, or disrupt night-migrating birds. Most of the wildlife species residing in project area are mobile, and it is anticipated they would be able to move away from the area of construction disturbance to other available forested habitat nearby. Construction impacts involving the removal of vegetation during the breeding season could potentially destroy nests or eggs and kill birds protected under the federal Migratory Bird Treaty Act. However, timing of activities would be implemented to minimize or avoid these impacts.

No appreciable temporary construction effects are anticipated outside of the construction area, primarily because impact minimization measures, pollution control measures, sediment and erosion control, and stormwater management would be implemented. No direct impacts to fish or other aquatic species from in-water or overwater work are anticipated, because the Preferred Alternative would completely span the surface-flowing streams that it would cross (one crossing of Ball Creek and three crossings of Red Rock Creek). Replacement of any culverts flowing to surface streams would likely need to occur during the applicable in-water work window unless a waiver from ODFW is received.

Terminus Options

The terminus options would have fewer short-term effects than the Preferred Alternative, as there would be no work on the portion of the Preferred Alternative alignment that would not be constructed with each terminus option. The Upper Boones Ferry Terminus Option would not have short-term impacts south of the Upper Boones Ferry Station, and the Hall Terminus Option would not have short-term impacts south of the Hall Station and Hunziker O&M Facility.

Related Transportation Improvements

The related transportation improvements would have short-term impacts similar to those described above for the Preferred Alternative. Construction of these improvements could result in impacts such as soil disturbance and compaction, soil erosion, and removal of trees and other vegetation removal in or adjacent to wetlands and streams. Soil compaction could cause changes in hydrology in adjacent streams, and if severe enough, these changes could be permanent. Soil erosion and vegetation removal could cause soils to enter wetlands and streams, possibly raising turbidity levels and degrading water quality. Any temporary removal of trees and shrub vegetation for construction would also likely result in decreased shading of project study area wetlands and potential habitat loss.

4.9.5. Comparison to Impacts of the Draft EIS Light Rail Alternatives

Table 4.9-4 compares the ecosystems impacts of the Draft EIS light rail alternatives to those of the Preferred Alternative. The differences in impacts are explained below.

Table 4.9-4. Comparison of Ecosystems Impacts Between the Draft EIS and Final EIS

	City of Portland E-Zone Conservation Areas (acres)		City of Portland E-Zone Protection Areas (acres)		City of Tigard Vegetated Corridors (acres)		Permanent Wetland Impacts (acres)
	Construction Footprint	50-foot Buffer	Construction Footprint	50-foot Buffer	Construction Footprint	50-foot Buffer	Estimated Impact
Draft EIS							
Full-corridor project range[1]	19.9–20.5	14.3–14.7	1.0–1.5	1.4–1.7	3.3–6.0	4.0–7.8	1.3-1.6
Final EIS							
Preferred Alternative	28.5	14.8	1.4	1.3	10.3	6.9	1.3[2]

Note: EIS: Environmental Impact Statement.

[1] The full-corridor project range is defined as the range representing the lowest and highest possible sum of impacts from a composite of one alignment alternative within each segment, a Marquam Hill connection option, a PCC-Sylvania shuttle option and an O&M facility option.

[2] Wetland impacts include those impacts that are likely to occur and are based on the potential for minimizing impacts through use of bridges, bents and reduced abutments.

The Draft EIS used a draft footprint plus a 50-foot buffer to account for likely changes in the designs and construction activities such as staging and access as designs progressed. This Final EIS uses refined designs that include proposed staging and access areas within the construction footprint. A 50-foot buffer is still included in this Final EIS to account for any potential changes in the design or in case of field-modified changes as a result of site-specific issues. Therefore, the comparison of impacts between the Draft EIS and the Final EIS does not necessarily use the same levels of information, but it does represent likely maximum impacts overall. Impacts from the Preferred Alternative on ecosystem resources would be generally within the range of potential impacts anticipated for the Draft EIS light rail alternatives.

The Preferred Alternative's impacts to E-zone conservation areas appear to be higher for the construction footprint, which is largely because the Preferred Alternative would include a wall maintenance road and defined construction staging and access areas in the wooded areas along SW Barbur Boulevard in Segment A. As noted in the paragraph above, the 50-foot buffer was used to capture these types of impacts for the Draft EIS alternatives. The 28.5 acres of E-zone conservation area impacts in the construction footprint of the Preferred Alternative compare favorably to the combined 34 to 35 acres of impact for the Draft EIS construction footprint plus 50-foot buffer. A similar situation occurs with the vegetated corridors designated by Clean Water Services in Tigard, where the Preferred Alternative construction footprint includes a wider area for the construction of the light rail structure over Highway 217 and the Knez Wetland area. In total, the Draft EIS light rail alternatives would impact approximately 7 to 17 acres of vegetated corridor in the construction footprint and buffer combined, compared to a Preferred Alternative impact of 10.3 acres for the construction footprint.

The study area for the Preferred Alternative construction footprint and buffer would contain more mapped wetlands than the range of wetland acreages shown in the Draft EIS. However, avoidance measures incorporated into the design of the Preferred Alternative have allowed the permanent impacts to wetlands of approximately 1.3 acres to remain within the Draft EIS impact estimated range of 1.3 to 1.6 acres. For example, most of the wetlands within the construction footprint in Segment C are in the Knez Wetland and would be spanned by light rail structures; thus they would not be affected directly and permanently except by bridge supports. The remaining impacts would occur along the existing railroad alignment. Additionally, potential wetland impacts from construction of the Hunziker O&M Facility under the Preferred Alternative would be less than anticipated in the Draft EIS due to changes in the design of the facility to remain outside of the floodplain.

Impacts from the Preferred Alternative on all other ecosystem resources would be within the range of potential impacts anticipated under the Draft EIS light rail alternatives that had enough information available at the time the Draft EIS was prepared. The station access improvements were one element that could not be assessed in detail in the Draft EIS, but they are considered in more detail in this Final EIS.

4.9.6. Mitigation Measures

The project would comply with regulatory requirements associated with wetland impacts, stream crossings, and local tree and zoning ordinances. Table 4.9-5 summarizes the additional mitigation measures that would address long-term and short-term impacts to ecosystem resources.

Table 4.9-5. Mitigation Measures for Impacts to Ecosystem Resources *(multipage table)*

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
Long and short Term	Impacts to threatened or endangered species	TriMet would adhere to mitigation requirements stipulated in the Biological Opinion issued by the National Marine Fisheries Service, attached as Appendix L of this Final EIS.	None required beyond those required by applicable regulations and permitting requirements.
Long term	Unavoidable impacts to wetlands and waters from fill, vegetation removal or disruption of hydrology	TriMet would mitigate unavoidable impacts to wetlands and waters consistent with state and federal regulations.	Project sponsors would mitigate unavoidable impacts to wetlands and waters consistent with state and federal regulations.
Long term	Removal of vegetation, including trees, within the construction footprint or the buffer area	TriMet would coordinate with the Section 106 consulting tribes to offer opportunities to harvest culturally significant native plants before construction. To comply with the Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act, TriMet would consult with state and federal resource agencies on measures to avoid impacts on migratory birds due to vegetation removal. These measures may include pre-construction surveys for migratory birds and/or restrictions on vegetation clearing during the breeding season for migratory birds. TriMet would mitigate tree removal through coordination with the applicable city government or local agency under the applicable ordinance, based on location of the impact. To the extent practical, TriMet would incorporate culturally sensitive native plant species, as identified by the Section 106 consulting tribes, within landscaped areas.	Project sponsors would mitigate tree removal through coordination with the applicable city government or local agency under the applicable ordinance, based on the location of the impact.
Long term	Unavoidable impacts to E-zones and sensitive lands	TriMet would design the Marquam Hill Connection to provide wildlife passage below and minimize light spillover to vegetated areas below. TriMet would likely address unavoidable impacts to areas with E-zones within the City of Portland and sensitive lands overlays within the City of Tigard through on-site or off-site mitigation. An environmental review process would likely be required for E-zone impacts. A sensitive lands approval, in addition to a comprehensive plan amendment and environmental, social, economic	Project sponsors would likely address unavoidable impacts to areas with E-zones within the City of Portland and sensitive lands overlays within the City of Tigard through on-site or off-site mitigation. An environmental review process would likely be required for E-zone impacts. A sensitive lands approval, in addition to a comprehensive plan amendment and environmental, social, economic and energy

Table 4.9-5. Mitigation Measures for Impacts to Ecosystem Resources *(multipage table)*

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
		and energy consequences analysis, could be required.	consequences analysis, could be required.
Long term	Impacts to wildlife associated with the Marquam Hill Connection	TriMet would work with the City of Portland/Portland Parks and Recreation to develop design details for the Marquam Hill Connection to minimize impacts to wildlife, including bird-friendly cabs and elevator headhouse, with an elevator guideway span clearance designed to accommodate wildlife passage, which while minimizing impacts to views.	N/A
Short term	Impacts to wetlands and waters from erosion, spills and vegetation damage or disruption of hydrology	During construction activities that are taking place in proximity to wetlands and waters, TriMet would use best management practices to avoid erosion, spills, vegetation damage or disruption of hydrology. Standard specifications and special provisions would direct contractors to avoid and minimize impacts.	During construction activities that are taking place in proximity to wetlands and waters, project sponsors would use best management practices to avoid erosion, spills, vegetation damage or disruption of hydrology. Standard specifications and special provisions would direct contractors to avoid and minimize impacts.
Short term	Impacts to wetlands from temporary work platform piles and decking	TriMet would restore disturbed sites to pre-project conditions.	None required. No impacts from related transportation improvements are anticipated.

Note: DSL = Oregon Department of State Lands.

Mitigation

Long-term impacts to fish and aquatic habitat would be likely limited to water quality and water quantity elements, including removal of vegetation near streams. Therefore, the Preferred Alternative would implement stormwater management strategies to decrease negative impacts from increased impervious surfaces and provide a benefit by treating much of the of existing impervious areas for quality and quantity. More details on these techniques are discussed in the ESA consultation documents in Appendix L.

In addition to the mitigations for tree removal defined through the local permitting processes identified below, TriMet would coordinate with Section 106 consulting tribes to offer opportunities to harvest culturally significant native plants, such as the western red cedar, before construction. (See Chapter 6, Public Involvement, Agency Coordination and Required Permits, for a list of Section 106 consulting tribes.)

TriMet would work with the City of Portland/Portland Parks and Recreation to develop design details for the Marquam Hill Connection to minimize impacts to wildlife, including bird friendly cabs and elevator headhouse, with an elevator guideway span clearance designed to accommodate wildlife passage, while minimizing impacts to views.

Regulatory Requirements and Best Management Practices to Avoid and Minimize Impacts

Regulatory Requirements and Best Management Practices for Long-Term Impacts

Impacts to trees would be avoided to the greatest extent practicable outside of the footprint of construction activities. Trees within the construction footprint may need to be completely removed. Each of the three cities that the Preferred Alternative would traverse has different preservation and planting requirements

that prescribe the measures to be taken in order to mitigate for tree removal, based on tree size, condition, location and other factors. Mitigation for impacts to trees and vegetated corridors would be addressed through coordination with the applicable city government or local agency under the applicable ordinance, based on the location of the impact. Tree removal could be mitigated through on-site replacement of trees that are removed (where possible), replacement via planting of trees in an off-site location, or payment to the applicable urban forestry fund. Tree plans that outline proposed mitigation would be required as part of the development permitting process. Tree plans would be based on detailed tree surveys that would be conducted in support of development permit applications. The tree removal mitigation process is described further in Attachment D.

Impacts to E-zones within Portland and to sensitive lands and vegetated corridors would be avoided to the extent practicable. City of Portland land use code stipulates that development must meet the E-zone requirements under Chapter 33.430. When the development standards cannot be met, an environmental review process is required. Given the likely impacts to both conservation and preservation areas within E-zones, an environmental review would likely be required for local permitting. Potential mitigation would consist of on-site planting, off-site planting and site restoration, and potentially funding for city-led planting in the affected watersheds.

Impacts to sensitive lands within Tigard would require compliance with Chapter 18.510, Sensitive Lands, of the Community Development Code of the City of Tigard. If development standards cannot be met, a sensitive lands review and approval process would be required. Effects from the Preferred Alternative might also require a comprehensive plan amendment and an environmental, social, economic and energy consequences analysis.

Compensatory mitigation for unavoidable impacts to wetlands would be addressed either by purchase of credits through an approved mitigation bank, payment to an approved in-lieu fee program, or preparation and implementation of a compensatory wetland mitigation plan as part of the Clean Water Act Section 404 permitting process. Attachment D describes the Clean Water Act Section 404 process in further detail. If the permittee is responsible for compensatory mitigation that is required for wetland impacts, then the mitigation would typically require on-site enhancement, off-site enhancement, or restoration of existing degraded wetland areas, or creation of new wetlands nearby to compensate for functions lost or degraded by those impacts. Impacts to the existing Knez Wetland could be mitigated through enhancement or restoration of the existing wetland complex, or purchase of adjacent parcels for the benefit of protecting the existing wetland complex.

Regulatory Requirements and Best Management Practices for Short-Term Impacts

During construction, best management practices would be used to avoid impacts to wetlands, waters and other jurisdictional resources from erosion, spills, damage to vegetation or disruption of hydrology. Areas of temporary work platforms would be restored through removal of work platforms and support piles, and through revegetation to meet necessary permit conditions. Standard specifications and special provisions would direct contractors to avoid and minimize impacts. In addition, standard terms and conditions of approvals from local, state and federal regulatory agencies have been incorporated into the preliminary designs that are analyzed in this Final EIS. The project team would work collaboratively with local, state and federal permitting agencies to determine appropriate site-specific impact avoidance and minimization measures during the permitting phase of the Project.

4.10. Water Resources

This section covers the Project's potential long-term and short-term impacts, and mitigation measures for water resources, which consist of:

- surface waters, including streams, rivers and lakes
- floodplains, based on Federal Emergency Management Agency (FEMA) mappings of the areas affected by the base flood (100-year flood) event
- floodways, which are the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height[1]
- drainage systems, including drainage sub-basins defined for stormwater management, and the related major facilities for managing stormwater, such as outfall locations
- groundwater, including critical aquifer recharge areas and sole-source aquifers

Impacts to wetlands, aquatic habitat and other biological resources, including the potential effects on aquatic habitat and species from stormwater runoff, are discussed in Section 4.9, Ecosystems.

Since the Draft EIS, this section has been updated to reflect the definition of the Project in this Final EIS. The analysis of the Preferred Alternative incorporates additional information on stormwater treatment and detention, beyond what was available for the Draft EIS light rail alternatives. Stormwater treatment is described in more detail in Appendix L, Biological Opinion.

4.10.1. Affected Environment

The study area for water resources consists of the drainage basins where the Project would be located and covers the water resources within those basins, as well as in downstream receiving waters. Figure 4.10-1 shows the applicable water basins and mapped water resources.

Streams, Floodplains and Floodways

Streams in the study area discharge to the Columbia River and the Willamette River. The water that discharges to the Columbia River flows through pipes and is treated at the Columbia Boulevard Wastewater Treatment Plant. The water that discharges to the Willamette River flows through tributary streams and conveyance system outfalls. In general, the streams in the study area have been highly affected by the surrounding urban environment, and all of the streams have reaches that are channelized or have been piped. The streams within the study area were identified through the use of existing mapping maintained by Metro in its Regional Land Information Service (RLIS) and are identified by their given identification number based on the latitude and longitude of their discharge point (see Table 4.10-1). The mapping can represent historical drainage patterns, and the existing drainages may be altered through piping, making some mapped streams indistinguishable from storm sewers or roadway runoff. Because of the use of mapping for identifying streams, other drainages may possess the same characteristics as mapped streams, including ephemeral or intermittent flow streams.

[1] Where FEMA floodway boundaries have not been mapped separately from the floodplain, federal regulations direct communities to assume the floodway spans the entire width of the floodplain.

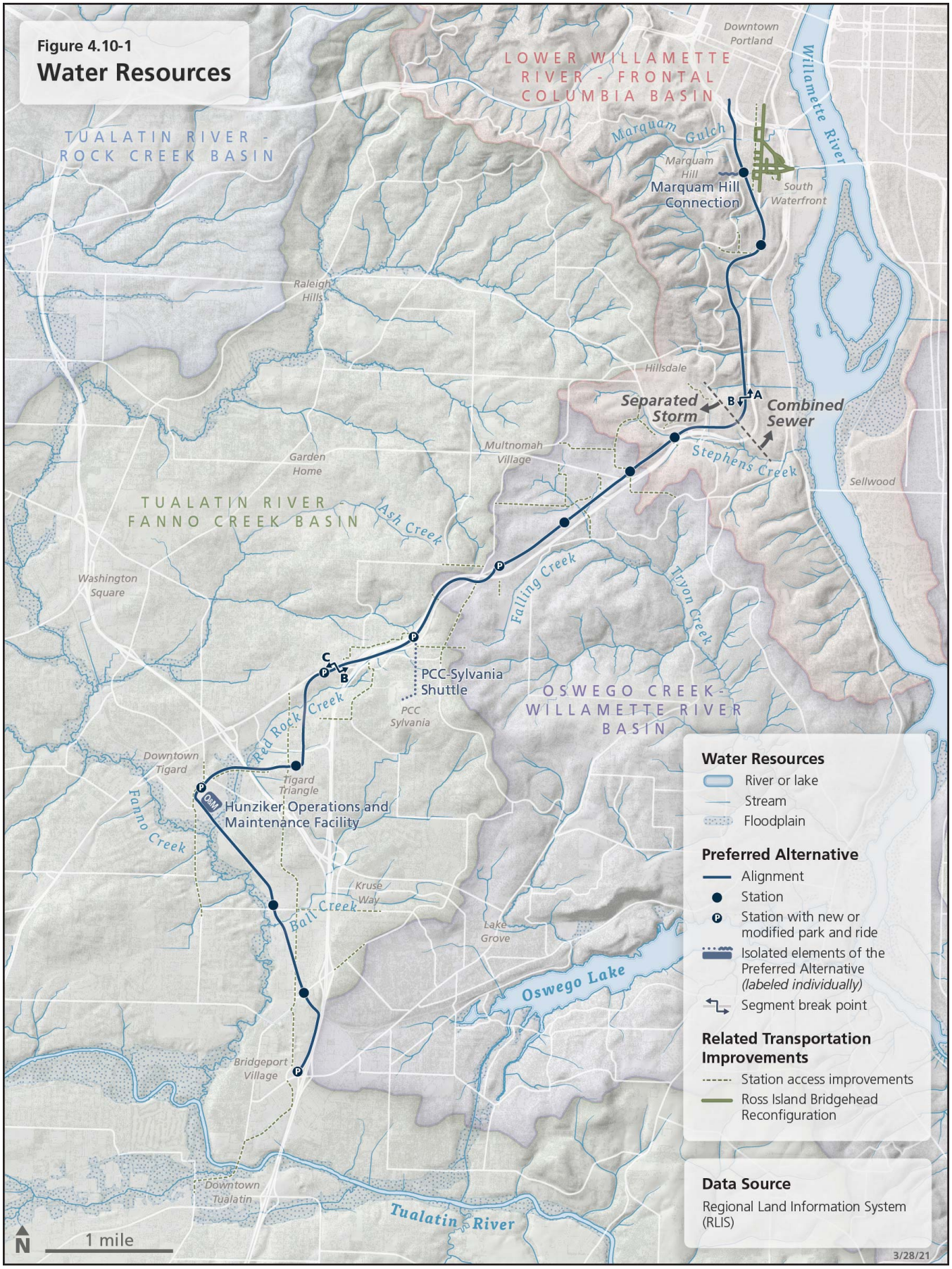


Figure 4.10-1
Water Resources
LOWER WILLAMETTE RIVER - FRONTAL COLUMBIA BASIN
TUALATIN RIVER - ROCK CREEK BASIN
TUALATIN RIVER FANNO CREEK BASIN
OSWEGO CREEK - WILLAMETTE RIVER BASIN
Downtown Portland
Willamette River
Marquam Gulch
Marquam Hill
Marquam Hill Connection
South Waterfront
Raleigh Hills
Hillsdale
Separated Storm
Combined Sewer
Stephens Creek
Sellwood
Multnomah Village
Garden Home
Ash Creek
Washington Square
Falling Creek
Tryon Creek
PCC-Sylvania Shuttle
PCC Sylvania
Red Rock Creek
Downtown Tigard
Tigard Triangle
Hunziker Operations and Maintenance Facility
Fanno Creek
Kruse Way
Bull Creek
Lake Grove
Oswego Lake
Bridgeport Village
Downtown Tualatin
Tualatin River
N
1 mile
Water Resources
River or lake
Stream
Floodplain
Preferred Alternative
Alignment
Station
Station with new or modified park and ride
Isolated elements of the Preferred Alternative (labeled individually)
Segment break point
Related Transportation Improvements
Station access improvements
Ross Island Bridgehead Reconfiguration
Data Source
Regional Land Information System (RLIS)
3/28/21

Table 4.10-1 lists the mapped streams and associated FEMA-mapped floodplains that would be crossed by the Preferred Alternative, and also indicates, for each stream, the location of the stream, whether it is an open channel, and whether it is on the 303(d) list (see the discussion in this section below).

Table 4.10-1. Preferred Alternative Stream Crossings

Stream Crossing Location	Oregon Stream ID Number	Open Channel	Mapped Floodplain	On 303(d) List	Segment
Lower Willamette River Watershed – Frontal Columbia Basin					
Duniway Park at SW Arthur St.	1226675455059				A
Marquam Gulch: SW Grover St.[1]	1226653455017				A
SW Lane St.	1226714455006				A
4800 block of SW Barbur Blvd.	1226780454885				A
4900 block of SW Barbur Blvd.	1226696454865				A
5400 block of SW Barbur Blvd.	1226783454858/1226817454846 (branched)				A
SW Iowa St.	1226690454806				A
SW Vermont St.	1226662454766				A
SW Terwilliger Blvd.	1226790454686				B
SW Custer St.	1226667454690 (Stephens Creek)			●	B
Lower Willamette River Watershed – Lake Oswego Basin					
SW Spring Garden St.	1227048454606				B
SW 26th Way	1226557454227 (Tryon Creek)			●	B
Tualatin River Watershed – Fanno Creek Basin					
SW 53rd Ave. at Sylvania Park	1227422454406 (tributary to Red Rock Creek)				B
South of Pacific Hwy. (designated as Oregon Route 99W)	1227626454239 (Red Rock Creek)	●			C
Hwy. 217 (east)	1227575454314 (tributary to Red Rock Creek)	●			C
Hwy. 217 (west)	1227626454239 (Red Rock Creek)	●	●		C
North of SW Wall St.[2]	1227626454239 (Red Rock Creek)	●	●		C
SW Tech Center Dr.	1227580454188				C
South of SW Bonita Rd.	1227534454137 (Ball Creek)	●			C

Sources: Oregon Stream ID Numbers taken from Metro Regional Land Information System (RLIS)) (Metro, 2020); mapped floodplains that extend beyond banks of streams taken from FEMA (Flood Insurance Rate Map Panels); DEQ 303(d) list (DEQ, 2016; EPA, 2018).

[1] The Preferred Alternative would cross this stream twice: at the Marquam Hill Connection (a new crossing of the stream) and along the light rail alignment at the Gibbs Station (an existing crossing under SW Barbur Boulevard).

[2] The Preferred Alternative would cross Red Rock Creek at this location on a new structure directly upstream of an existing culvert under the freight rail tracks.

Red Rock Creek (Stream 1227626454239) has a FEMA-mapped floodplain extending beyond its banks, which is classified by FEMA as Zone A, meaning that no base flood elevation or floodway boundary has yet been calculated for the floodplain. Consistent with regulatory guidance, the floodway is assumed to span the entire width of the floodplain boundary until and unless FEMA approves a revised mapping (see Figure 4.10-2 in Section 4.10.3). Appendix B4.10, Water Resources Regulatory Information, provides information on floodplain regulatory requirements.

Water quality of the surface water resources is evaluated through the Oregon Department of Environmental Quality (DEQ) Water Quality Assessment (referred to as the Clean Water Act Section 303(d)

list) (DEQ, 2016; EPA, 2018), which is based on water quality analysis of discrete reaches throughout the water bodies. The 303(d) list designates waters that have beneficial uses—such as drinking, recreation, aquatic habitat and industrial use—but that have reaches that are impaired by pollution. Table 4.10-2 lists the water bodies that have impaired reaches in the study area and the related pollution parameters.

Table 4.10-2. 303(d) Impaired Water Bodies in the Study Area

Stream Name	Oregon Stream ID Number	303(d) List Parameters by Category
Willamette River	1227618456580	**Category 5:** Aldrin, Biological Criteria, Chlordane, Chlorophyll A, Copper, Cyanide, DDE 4,4, DDT 4,4, Dieldrin, Hexachlorobenzene, Iron, Lead, Mercury, Polychlorinated Biphenyls (PCBs), Polynuclear Aromatic Hydrocarbons (PAHs) **Category 4A:** Dioxins, *E. coli,* Temperature **Category 4B:** Pentachlorophenol
Stephens Creek	1226667454690	**Category 5:** Biological Criteria
Tryon Creek	1226557454227	**Category 5:** Biological Criteria, Dissolved Oxygen **Category 4A:** Temperature
Tualatin River	1226500453377	**Category 5:** Ammonia, Biological Criteria, Copper Iron, Lead, Mercury, Zinc **Category 4A:** Aquatic Weeds or Algae, Chlorophyll A, Dissolved Oxygen, *E. coli,* Phosphorus, Temperature
Fanno Creek	1227639453931	**Category 5:** Copper, Dieldrin, Dissolved Oxygen, Iron, Lead, Tetrachloroethylene, Thallium, Zinc **Category 4A:** Biological Criteria, Dissolved Oxygen, *E. coli,* Phosphorus, Temperature

Source: DEQ, 2016; EPA, 2018.

Note: *E. coli* = *Escherichia coli;* N/A = not applicable.

Limits called Total Maximum Daily Loads (TMDLs) are established for impaired waters to set the maximum amount of a pollutant allowed to enter a water body, and TMDL plans often extend to the tributary streams that discharge to the impaired waters or throughout the entire basin. Impaired waters are those designated as Category 5 (TMDL needed), Category 4A (TMDL approved), Category 4B (TMDL-equivalent plan in place) and Category 4C (cannot be addressed through a TMDL). There are no Category 4C impaired waters in the study area. TMDL plans are in place for the Willamette Basin for bacteria, mercury and temperature (DEQ, 2006; DEQ, 2011), and for the Tualatin Sub-basin for temperature, bacteria, dissolved oxygen, pH and chlorophyll *a* (total phosphorus) (DEQ, 2001; DEQ, 2012).

Drainage System

Much of the study area has been developed, and stormwater runoff is collected by piped or ditched municipal systems. In all of Segment A and a small portion of Segment B, stormwater runoff is collected by the City of Portland's updated combined sewer system. This system collects stormwater and municipal sewage and conveys the mixture to the Columbia Boulevard Wastewater Treatment Plant before discharge to the Columbia River. While the system has been upgraded in the last two decades, very heavy rains can still cause untreated stormwater/sewage mixture to overflow to surface waters before treatment.

In the remainder of the study area, stormwater runoff is collected by municipal storm drainage systems that are separated from sewage systems. Approximately 6 acres of drainage area within this remaining portion of the study area is treated for water quality, and none of it is treated for water quantity (e.g., treated to protect stormwater treatment facilities and streams from excess flow during storms). As a result of development, historical drainage patterns have been drastically altered.

Groundwater

Groundwater resources are described in Section 4.8, Geology, Soils and Hydrogeology.

Most federal and state programs relating to groundwater in Oregon are implemented by four state agencies: Oregon DEQ, the Oregon Department of Human Services Drinking Water Program, the Oregon Water Resources Division (OWRD) and the Oregon Department of Agriculture. Oregon DEQ, the primary agency responsible for groundwater quality protection, has not found elevated pollution concentrations in aquifers in the study area. The U.S. Environmental Protection Agency protects aquifers that it identifies as the main supply, or "sole-source," of drinking water for a local population; it has not designated any sole-source aquifers in the study area.

OWRD and Washington County cooperatively regulate water supply management (groundwater quantity) within the Tualatin, Lake Oswego and Lower Willamette basins. Other state and local agencies are responsible for regulating groundwater quantity. Segment C has two groundwater management areas:

- The Sherwood, Dammasch-Wilsonville Ground Water Limited Area has been designated with special restrictions in place to help stabilize groundwater levels.
- The Cooper Mountain-Bull Mountain Critical Ground Water Area has been protected against pumping of groundwater that has historically exceeded the long-term natural replenishment of the underground water reservoir.

4.10.2. No-Build Alternative

Under the No-Build Alternative, other regional development and transportation projects would occur, which could increase impervious surface area and result in related water quality and quantity impacts. Without light rail service in the Southwest Corridor, traffic and congestion could potentially increase over time and result in increased pollutant loading. Increases in traffic and congestion would lead to increases in metals, oil and grease on roadways and parking lots. These pollutants subsequently would be transported to area streams by stormwater runoff. Many of the roadways in the corridor, including most of SW Barbur Boulevard, were developed before the passage of the Clean Water Act and related stormwater management requirements; therefore, runoff from these roadways is not controlled to current standards. As a result, under the No-Build Alternative, discharges of pollutants and unnatural flows would continue to enter study area water bodies.

4.10.3. Long-Term Impacts

The following elements were considered in evaluating the Project's long-term impacts to water resources:

- **Changes in impervious surface.** When vegetation is permanently replaced by impervious surface or track sections with ballast, it can affect water quality as well as stormwater runoff amounts and infiltration levels in a basin. Increases in the amount of impervious surface reduce groundwater recharge; increase runoff volumes, flow rates and flooding frequencies; and contribute to stream erosion and aquatic habitat degradation. When a roadway is widened, the increased impervious surface area can capture more contaminants from the road uses. These contaminants can pollute water bodies by stormwater runoff or infiltration into the groundwater. Throughout all three segments, conversion of land would trigger stormwater management requirements. The changes to the land surface cover

were determined using EnviroAtlas Meter-Scale Urban Land Cover Data (EPA, 2012) as a baseline and refined based on high resolution aerials and engineering judgment. The changes were further classified as either non-pollution-generating impervious surface, including areas within a building footprint, sidewalks, rooftops and the light rail trackway, or as pollution-generating impervious surface, including parking lots, roads and driveways. Pollution-generating impervious surface can be an indicator of potential impacts to water quality, and can inform and refine sizing needs of any treatment facility. Estimated changes to impervious surface in the study area are summarized in Table 4.10-4.

- **O&M facilities.** Activities at O&M facilities, where light rail vehicles are stored and maintained, use hazardous materials such as petroleum products and metals in areas that can come into contact with rainfall or stormwater runoff. This potential transport of hazardous materials by stormwater runoff can impact stormwater quality.

- **New stream crossings.** Adding new guideways and columns in and over streams and riparian areas, as part of project construction, can degrade the stream's condition and function. More detailed discussion of impacts to streams and riparian vegetation is presented in Section 4.9, Ecosystems.

- **Replacement of existing stream crossings.** When an existing stream crossing—either a culvert or bridge over an open stream, or an underground segment of a piped stream—is replaced, there is an opportunity to improve the crossing by making it larger, resulting in a benefit to the stream's condition and function compared to the existing condition.

- **Floodplain and floodway crossings.** Adding new guideways or columns within a floodplain and/or floodway could displace the storage volume of the floodplain and affect flows within the floodway. Additional regulatory requirements would apply and mitigation such as compensatory storage would be needed, as discussed in more detail in Appendix B4.10.

Throughout the study area, the rebuilding of roadway, as well as conversion of other land by the Project, would be subject to the latest requirements for stormwater best management practices (BMPs). Applicable flow control and water quality BMPs, including stormwater management facilities, have been included in the design of the Preferred Alternative and would be included in the design of the related transportation improvements, as the design progresses, to minimize impacts to water resources. BMPs applicable to the Project are discussed as part of the mitigation measures in Section 4.10.6.

As noted in Table 4.10-1, the Preferred Alternative alignment would cross 17 mapped streams a total of 20 times (see Figures 4.9-1 to 4.9-3 in Section 4.9, Ecosystems). Based on available data, 15 of these stream crossings currently flow under the Preferred Alternative alignment in pipes or culverts. Two named streams (Red Rock Creek and Ball Creek) flow on the surface and would be spanned by the Preferred Alternative. Red Rock Creek is the largest stream in the study area that flows mainly on the surface, and it would be crossed three times by the Preferred Alternative. In addition, 9 of the 22 total mapped streams, all located within Segment A, flow into the City of Portland's combined sewer infrastructure at the Columbia Boulevard Wastewater Treatment Plant, where the water is treated before being discharged to the Columbia River. Some of the existing stream crossings would be replaced or upgraded. Many streams that would be crossed by the Preferred Alternative already flow through pipes or culverts, have been previously impacted by development, and are not expected to be directly impacted by the Preferred Alternative. The Preferred Alternative's design would avoid placing columns or other infrastructure directly in streams.

Table 4.10-3 summarizes the Project's impacts to water resources, including streams and floodplains. Table 4.10-4 provides additional detail on the change in impervious surface area as a result of the Project.

Table 4.10-3. Summary of Impacts to Water Resources by Project Element

Project Element	Project Footprint (acres)	New Impervious Area[1] (acres)	Number of Mapped Stream Crossings[2]		Floodplain Impact
			New	Existing	
Light Rail Investment: Individual Elements					
Segment A alignment and stations	102	13	0	8	No
Segment B alignment and stations	184	17	0	5	No
Segment C alignment and stations	164	22	4	2	Yes
Marquam Hill Connection	5	1	1	0	No
PCC-Sylvania Shuttle	Not applicable[3]				
Hunziker O&M Facility	39	0	0	0	Yes
Light Rail Investment: Totals					
Preferred Alternative	494	53	5	15	Yes (see above)
Upper Boones Ferry Terminus Option	462	49	5	15	Yes (see above)
Hall Terminus Option	412	39	4	13	Yes (see above)
Related Transportation Improvements					
Ross Island Bridgehead Reconfiguration	50	4	0	2	No
Station access improvements[4]	131	2	3	21	Potential
Full Project					
Preferred Alternative + all related transportation improvements	675	59	6[5]	36[5]	Yes (see above)

Note: O&M = operations and maintenance; PCC = Portland Community College.

1 New impervious area is the approximate amount of vegetation that would be converted to impervious surface.

2 *New* stream crossings are those that would result from construction of the Project where there previously was no impact. *Existing* stream crossings assume some in-kind replacement of a crossing structure, and some that would not be disturbed by construction of the Project.

3 The PCC-Sylvania Shuttle would operate within areas already assumed to be improved by the Segment B alignment and stations; therefore, it would not independently change impervious surfaces.

4 Station access improvements would either be within existing, built right of way or constructed on new elevated structures. Limited floodplain impacts may occur depending on the final design of these projects. Improvements include bicycle lane and sidewalk improvements, assuming nonmotorized use, which are not anticipated to create impacts requiring mitigation beyond the commitment to meet permitting standards of the local jurisdiction and are not included in in the *full Project* total.

5 Three overlapping crossings between the Preferred Alternative and station access improvements result in totals that are not directly additive for stream crossings. One existing crossing at SW Spring Street (Segment B) and two new crossings at the east and west sides of Highway 217 (Segment C) are not included in the final totals due to overlapping areas.

Table 4.10-4. Change in Impervious Surface in the Study Area: By Project Element

Project Element	Non-Pollution-Generating Impervious Surface[1] (acres)			Pollution-Generating Impervious Surface[2] (acres)		
	Existing	Proposed	Change	Existing	Proposed	Change
Light Rail Investment: Individual Elements						
Segment A alignment and stations	13	23	10	47	50	3
Segment B alignment and stations	21	40	19	106	104	-2
Segment C alignment and stations	13	40	27	80	75	-5
Marquam Hill Connection	0	1	1	1	1	0
PCC-Sylvania Shuttle	Not applicable[3]					
Hunziker O&M Facility	9	10	1	23	22	-1
Light Rail Investment: Totals						
Preferred Alternative	56	114	58	257	252	-5
Upper Boones Ferry Terminus Option	54	107	53	239	235	-4
Hall Terminus Option	48	98	49	222	219	-3
Related Transportation Improvements						
Ross Island Bridgehead Reconfiguration	8	12	4	27	27	0
Station access improvements	Not evaluated[4]					
Full Project						
Preferred Alternative + all related transportation improvements	64	126	62	284	279	-5

Source: EPA EnviroAtlas (Portland, OR) Meter-Scale Urban Land Cover (MULC) Data (EPA, 2012), with refinement by Parametrix staff based on current high-resolution aerials.

Notes: O&M = operations and maintenance; PCC = Portland Community College. Analysis was performed using conservative estimation, based on the construction footprint plus a 50-foot buffer. Manual adjustments were made for tree canopy overhang onto impervious surface in non-forested areas.

[1] Non-pollution-generating impervious surfaces include areas within a building footprint, sidewalks, rooftops and trackway.

[2] Pollution-generating impervious surfaces include areas used by cars and trucks, such as parking lots, roads and driveways.

[3] The PCC-Sylvania Shuttle would operate within areas already assumed to be improved by the Segment B alignment and stations; therefore, it would not independently change impervious surface area.

[4] The station access improvements would either be within existing, built right of way or constructed on new elevated structures. Improvements include bicycle lane and sidewalk improvements, assuming nonmotorized use, which are not anticipated to create impacts requiring mitigation beyond the commitment to meet permitting standards of the local jurisdiction.

Preferred Alternative: Segment A

Alignment and Stations

The Preferred Alternative in Segment A would expand the SW Barbur Boulevard roadway to accommodate light rail, sidewalks and bicycle facilities. The widening would occur in areas currently occupied by bicycle lanes and sidewalks, as well as mixed-use commercial (mostly impervious surface with some vegetation) and residential uses (a mix of impervious surface and vegetation). The Preferred Alternative alignment and stations in Segment A would result in approximately 13 acres of new impervious surface, with a 3-acre increase in pollution-generating surface (see Tables 4.10-3 and 4.10-4, above).

Conversion of land in Segment A could potentially increase stormwater runoff to the City of Portland combined sewer system. During very heavy rainstorms, higher stormwater volumes interacting with other components of the combined sewer system could exacerbate the possibility of discharge of an untreated stormwater-sewage mix, known as a combined sewer overflow. However, the Preferred Alternative design has incorporated and sized stormwater management facilities in cooperation with local jurisdictions to

avoid overwhelming the system. By incorporating stormwater management facilities to control increases in surface runoff, increases in the volume and frequency of combined sewer overflow events are not anticipated as a result of the Preferred Alternative.

Marquam Hill Connection

The Marquam Hill Connection would result in approximately 1 acre of new non-pollution-generating impervious surface. The paved areas would be limited to the landings at SW Barbur Boulevard and SW Terwilliger Boulevard and the structure of the inclined elevator. The structure would cross the piped Marquam Gulch (Stream 1226653455017).

Preferred Alternative: Segment B

Alignment and Stations

Conversion of land throughout Segment B would generally fall into two categories:

- **Widening of SW Barbur Boulevard.** The Preferred Alternative would reconstruct SW Barbur Boulevard and add light rail, bike lanes, sidewalks and stormwater management facilities. Some of the widening would be accomplished by removing impervious two-way center turn lanes and on-street parking. The remainder of the widening would be accomplished by converting shoulder areas and portions of adjacent parcels; some of these areas are already impervious, but others are vegetated and would be replaced by new impervious surface.
- **Use of Oregon Department of Transportation right of way adjacent to Interstate 5 (I-5).** The Preferred Alternative would cross over I-5 twice and run along the south side of the interstate between SW Capitol Highway and SW 60th Avenue. Some of this area is currently vegetated and would be replaced with the light rail trackway, which would be a mix of elevated and at-grade or retained facilities. The bridges would have new impervious surface and some ballast track.

The Preferred Alternative would replace existing roadway along SW Barbur Boulevard and convert a portion of vegetated right of way to trackway, some of which would be ballast and some of which would be impervious surface. The southern portion of Segment B would convert a section of the I-5 right of way to trackway, which would result in vegetation removal and replacement with trackway. The estimated level of change to the amount of impervious surface with the Preferred Alternative and the related transportation improvements is presented in Tables 4.10-3 and 4.10-4. However, regardless of the change in the amount impervious surface, only 6 acres of the study area in Segment B currently receive any water quality treatment. The Project would upgrade water quality treatment for new and modified impervious surfaces in compliance with local requirements. The upgrades would likely decrease the amount of pollutants that would reach surface waters under most storm conditions, including in areas where the Preferred Alternative would increase the amount of impervious surface.

Increases in impervious surface in Segment B would affect one small sub-drainage where stormwater runoff would go to the City of Portland combined sewer system. The rest of Segment B runoff would be managed before flowing into the surrounding Stephens, Tryon, Woods and Ash Creeks. The Project would incorporate stormwater management BMPs to control increases in runoff and pollutant loading associated with the land cover conversions. The BMP controls would address water quality by treating flows to the standards of the City of Portland and the recommendations of the National Marine Fisheries Service. With the inclusion of flow controls and treatments to manage increases in surface runoff, water quality and

water quantity impacts would be reduced compared to the No-Build Alternative, which would continue to lack stormwater management features.

PCC-Sylvania Shuttle

The PCC-Sylvania Shuttle would operate within areas already assumed to be improved by the Preferred Alternative alignment and stations; therefore, it would not have additional changes in impervious surface area.

Preferred Alternative: Segment C

Alignment and Stations

The Preferred Alternative in this segment would in some locations add trackway by converting existing commercial parcels and vegetated areas to impervious surface, and would in other locations upgrade parts of existing paved highway and municipal roads with new, improved impervious surface. In the southern portion of Segment C, land conversions along the light rail alignment adjacent to the existing railroad would involve removing mostly vegetated railroad right of way and converting impervious commercial areas to impervious track facilities. In Segment C, the Preferred Alternative alignment and stations would result in approximately 22 acres of new impervious surface, with a 5-acre decrease in pollution-generating impervious surface (see Tables 4.10-3 and 4.10-4). Stormwater management facilities have been incorporated into the design of the Preferred Alternative to minimize these long-term impacts to water resources in Segment C. At station locations, there would be larger changes in the area of impervious surface than from the alignment, and these increases in impervious surface would therefore require larger stormwater management facilities that would include flow control and water quality treatment. In Segment C, the Preferred Alternative would upgrade water quality treatment for new and modified impervious surfaces in compliance with local requirements, which includes areas that currently have no water quality treatment or outdated treatment. These upgrades are expected to decrease the amount of pollutants that would reach surface waters under most storm conditions, resulting in a long-term benefit to water quality and resources overall compared to the No-Build Alternative.

In Segment C, the alignment would include five open-channel stream crossings, two of which have associated FEMA-mapped floodplains. Impacts associated with each open-channel stream crossing are described in the following bullets:

- **Red Rock Creek (Stream 1227626454239) south of Pacific Highway.** At this northernmost crossing of Red Rock Creek, the Preferred Alternative would cross the creek on an elevated structure. No direct impacts from in-water work are anticipated as part of this crossing, because the light rail structure would completely span Red Rock Creek. No floodplain impacts are anticipated here because this crossing location is not associated with a mapped floodplain.
- **Tributary to Red Rock Creek (Stream 1227575454314).** The Preferred Alternative would cross this small tributary to Red Rock Creek that runs along the northeast side of Highway 217. The light rail alignment would be on an elevated structure at this location, and the columns would be placed outside of the streambed. A portion of the Red Rock Creek floodplain would be adjacent to the alignment (to the north) at this location, but the Preferred Alternative would not place columns within the floodplain at this location.

- **Red Rock Creek (Stream 1227626454239) southwest of Highway 217.** Along the southwest side of Highway 217, the Preferred Alternative would cross Red Rock Creek and its associated FEMA-mapped floodplain and assumed floodway (see Figure 4.10-2). The alignment would run on an elevated structure through this area and would span the streambed, but would include approximately six columns in the mapped floodplain and assumed floodway. Without mitigation, this encroachment could adversely impact the storage capacity and function of the floodplain and would not meet federal and local regulations. Mitigation is proposed for this impact (see Section 4.10.6).

- **Red Rock Creek (Stream 1227626454239) along railroad near SW Wall Street.** The southernmost crossing of Red Rock Creek would be located along the existing freight rail right of way, in between the Hunziker O&M Facility and SW Wall Street (see Figure 4.10-2). The light rail alignment would span over Red Rock Creek at the location where it enters an existing culvert under the freight rail tracks, which are on an embankment. There is a FEMA-mapped floodplain at this location, but more detailed survey and mapping are needed to determine the actual floodplain boundary relative to the light rail trackway and structure. For this Final EIS analysis, it is assumed that the floodplain extends outside of the FEMA-mapped boundary near the existing culvert, up to the edge of the freight rail embankment, and that the floodway spans the full area of the assumed floodplain. As a result, the Preferred Alternative is designed to include an elevated structure in this area, but would include approximately three columns within the assumed floodplain and floodway (just outside of the FEMA-mapped boundary). Without mitigation, this encroachment could adversely impact the storage capacity and function of the floodplain and would not meet federal and local regulations. Mitigation is proposed for this potential impact (see Section 4.10.6).

- **Ball Creek (Stream 1227534454137).** The Preferred Alternative would cross Ball Creek just south of SW Bonita Road. Ball Creek does not have a mapped floodplain beyond its banks, and the Preferred Alternative alignment fill and support structures would completely span the stream. Therefore, no floodplain or floodway impacts are anticipated at this location.

Executive Order 11988 requires federal agencies to avoid conducting, allowing or supporting actions on a floodplain unless no other practicable alternatives are available. The order further directs agencies to design or modify the action to minimize potential harm to or within the floodplain. There are no practicable alternatives that would allow the Project to meet its Purpose and Need and also avoid floodplain impacts. As described in Section 4.10.5, the design of the Preferred Alternative has been modified to reduce potential harm to the floodplain compared to the Draft EIS light rail alternatives. The Final EIS also identifies mitigation commitments in Section 4.10.6 to further minimize impacts to floodplain functions and values. Appendix B4.10 has further details on compliance with Executive Order 11988 and related floodplain regulations.

Hunziker Operations and Maintenance Facility

The Hunziker O&M Facility (see Figure 4.10-2) would be adjacent to the stream buffer and floodplain of Red Rock Creek, approximately 0.2 mile upstream from the confluence of Red Rock Creek with Fanno Creek. The facility would replace existing industrial businesses that have buildings and paved areas within the Red Rock Creek buffer and floodplain.

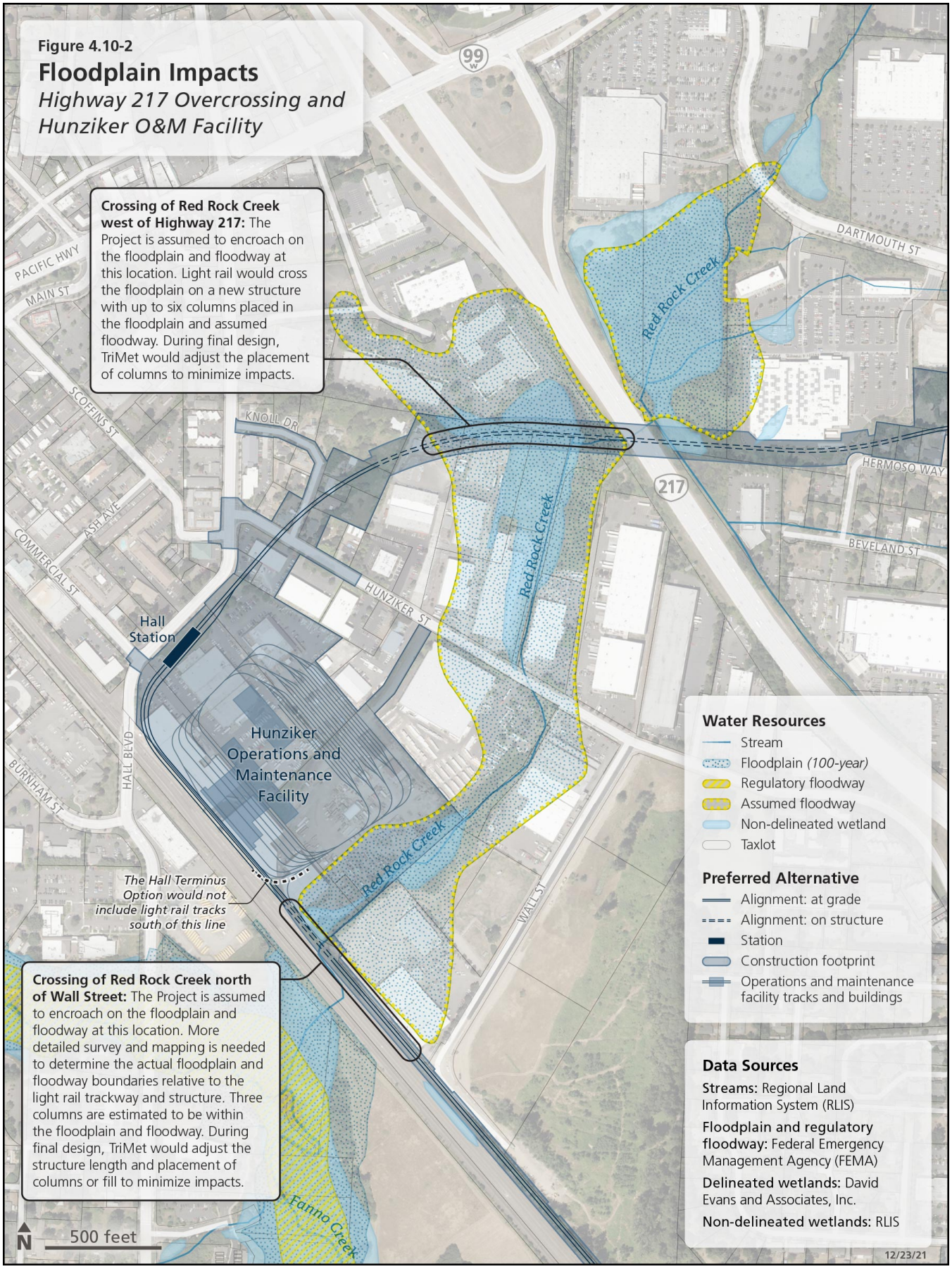


Figure 4.10-2
Floodplain Impacts
Highway 217 Overcrossing and Hunziker O&M Facility
Crossing of Red Rock Creek west of Highway 217: The Project is assumed to encroach on the floodplain and floodway at this location. Light rail would cross the floodplain on a new structure with up to six columns placed in the floodplain and assumed floodway. During final design, TriMet would adjust the placement of columns to minimize impacts.
Crossing of Red Rock Creek north of Wall Street: The Project is assumed to encroach on the floodplain and floodway at this location. More detailed survey and mapping is needed to determine the actual floodplain and floodway boundaries relative to the light rail trackway and structure. Three columns are estimated to be within the floodplain and floodway. During final design, TriMet would adjust the structure length and placement of columns or fill to minimize impacts.
The Hall Terminus Option would not include light rail tracks south of this line
Hall Station
Hunziker Operations and Maintenance Facility
Red Rock Creek
Fanno Creek
99 W
217
PACIFIC HWY
MAIN ST
SCOFFINS ST
KNOLL DR
ASH AVE
COMMERCIAL ST
HUNZIKER ST
HALL BLVD
BURNHAM ST
WALL ST
DARTMOUTH ST
HERMOSO WAY
BEVELAND ST
Water Resources
Stream
Floodplain (100-year)
Regulatory floodway
Assumed floodway
Non-delineated wetland
Taxlot
Preferred Alternative
Alignment: at grade
Alignment: on structure
Station
Construction footprint
Operations and maintenance facility tracks and buildings
Data Sources
Streams: Regional Land Information System (RLIS)
Floodplain and regulatory floodway: Federal Emergency Management Agency (FEMA)
Delineated wetlands: David Evans and Associates, Inc.
Non-delineated wetlands: RLIS
N
500 feet
12/23/21

Activities at the Hunziker O&M Facility would include the use of hazardous materials, such as petroleum products and metals, in areas that could come into contact with rainfall or stormwater runoff and could impact water quality. Stormwater management has been incorporated into the design of the facility to provide water quality treatment, flow control and spill containment where required. Uncontrolled spills during operation of the facility could impact water quality. Operation of the facility also would be conducted to protect water quality by preventing, containing and cleaning up spills in accordance with applicable requirements.

Terminus Options

In Segments A and B, the terminus options would include the same impacts to stream crossings, wetlands and mapped floodplains as the Preferred Alternative. Both terminus options involve the addition of less impervious surface than the Preferred Alternative in Segment C, and would therefore lead to a slightly smaller associated increase in runoff volume (see Tables 4.10-3 and 4.10-4). The Upper Boones Ferry Terminus Option would have the same stream crossings and impacts to the Red Rock Creek floodplain and assumed floodway as the Preferred Alternative. The Hall Terminus Option would not include a crossing over Ball Creek or the southernmost crossing of Red Rock Creek (north of SW Wall Street). Both terminus options would include the crossing of Red Rock Creek and the floodplain and assumed floodway west of Highway 217. The mitigation for this impact would be the same with the terminus options as with the Preferred Alternative.

Related Transportation Improvements

Station Access Improvements

The station access improvements would convert or expand existing impervious area and some vegetation to new impervious area, such as sidewalks or bicycle lanes, resulting in approximately 2 acres of new impervious surface (see Table 4.10-3). These areas would facilitate mainly nonmotorized access, which would not be pollutant-generating. These areas would not be expected to create impacts to stream crossings or mapped floodplains that would require mitigation beyond the commitment to meet permitting standards of the local jurisdiction. The design of the station access improvements would include stormwater management facilities that would meet the applicable jurisdictional standards; therefore, the station access improvements are not expected to adversely impact water resources.

Ross Island Bridgehead Reconfiguration

The Ross Island Bridgehead Reconfiguration would expand existing impervious area and convert some vegetation to new impervious area, including roadways, sidewalks and bicycle lanes. It would result in approximately 4 acres of new impervious surface with no net change to pollution-generating surface (see Tables 4.10-3 and 4.10-4). The addition and replacement of the impervious surface would trigger stormwater management requirements, which would require incorporating stormwater management BMPs to control changes in runoff in areas where the runoff may not be currently managed.

4.10.4. Short-Term Impacts

Construction activities for the Project that could affect surface water resources include:

- **Earthwork, footings, trench work, stockpiling and delivery of materials.** Clearing and grubbing (removing trees and vegetation that are within the new cut/fill limits) and regrading, including fill

and/or excavation, could expose and destabilize soil by removing roots that anchor it in place. If exposed soil becomes dry, wind and water could erode it and carry it off-site to stormwater channels or streams, where it could increase turbidity in the water. Construction vehicle tires could track soil onto roadways, from which the soil could be carried into ditches or streams during storms.

- **Concrete work.** Concrete work is associated with the construction of track structures, stations, retaining walls, curbs, sidewalks and traffic barriers. If stormwater runoff were to come in contact with process water or slurry from concrete work or from curing of concrete, the surface water pH could increase to levels harmful for fish and wildlife.
- **Construction machinery and material storage.** Water quality in surface water bodies and groundwater could be impacted by leaks or spills from construction machinery or stored materials.
- **Construction activity in or near a water body or sensitive area.** Over-water work and construction in and near stream buffers could pose a direct risk to water quality through pollutant spills, sediment transport or wind deposition of stockpiled materials.
- **Dewatering.** Unrestricted construction subsurface dewatering could impact the water supply to underground aquifers. In addition, uncontrolled surface discharge of dewatering water could increase flows and erode surface soils.

4.10.5. Comparison to Impacts of the Draft EIS Light Rail Alternatives

Impacts from the Preferred Alternative on water resources would be within the range of potential impacts anticipated for the Draft EIS light rail alternatives, with some localized differences:

- In the Tigard Triangle, design refinements incorporated into the Preferred Alternative have shifted the location of the northern crossing of Red Rock Creek (Stream 1227626454239). While the Segment C Draft EIS alignment alternatives would cross Red Rock Creek adjacent to I-5, the Preferred Alternative would cross the creek in a larger vegetated area between SW 68th Parkway and SW 72nd Avenue, which would result in removal of more vegetation than the Draft EIS light rail alternatives.
- At the Highway 217 crossing, design refinements incorporated into the Preferred Alternative have resulted in a slight shift of the alignment, but with little change to the overall impacts on water resources at this crossing location. Both the Segment C Draft EIS light rail alternatives and the Preferred Alternative are expected to cross the streambed, associated FEMA-mapped floodplain and assumed floodway of Red Rock Creek (Stream 1227626454239) with elevated structures at the Knez Wetland. See Section 4.10.6 for proposed mitigation.
- The Segment C Draft EIS alignment alternatives would cross Red Rock Creek (Stream 1227626454239) just south of the Hunziker O&M Facility near SW Wall Street without a structure, by extending the existing culvert under the freight rail tracks, which are on an embankment outside the FEMA-mapped floodplain. However, more detailed survey and mapping are needed to determine the actual floodplain boundary at this location. For this Final EIS analysis, it is assumed that the floodplain extends outside of the FEMA-mapped boundary at this location, up to the edge of the freight rail embankment. As a result, the design of the Preferred Alternative was adjusted to span the streambed of Red Rock Creek and cross the associated floodplain and floodway with an elevated structure. Three columns are estimated

to be within the floodplain and floodway. The structure length and placement of columns or fill would be adjusted during final design to minimize impacts. See Section 4.10.6 for proposed mitigation.

- Potential floodplain impacts from the Hunziker O&M Facility under the Preferred Alternative would be less than anticipated in the Draft EIS due to adjustments made to the layout of the facility to avoid floodplain impacts.

In all segments, the Preferred Alternative also incorporates stormwater management BMPs into the designs that were not yet included for the Draft EIS light rail alternatives. See Section 4.10.6 for more information about these and other BMPs.

4.10.6. Mitigation Measures

This section outlines the mitigation, anticipated permit requirements and best management practices related to water resources.

Long-Term and Short-Term Mitigation Measures

Table 4.10-5 summarizes the planned mitigation measures for unavoidable impacts to water resources.

Table 4.10-5. Mitigation Measures for Unavoidable Impacts to Water Resources

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
Long term	Red Rock Creek floodplain or floodway encroachment	During final design and permitting, TriMet would seek FEMA approval of a Conditional Letter of Map Revision, in accordance with 44 CFR 65.12: 1. TriMet would complete a detailed survey and hydraulic modeling to confirm the base flood elevation and delineate the regulated floodway boundary in coordination with the City of Tigard and FEMA. 2. TriMet would refine designs to minimize unavoidable encroachments in the floodplain and minimize or avoid encroachments within the floodway defined in step 1. 3. TriMet would provide compensatory flood storage where encroachments within the floodplain are unavoidable. 4. If any encroachments to the floodway are identified in step 2, or if adequate compensatory storage areas cannot be identified for floodplain encroachments under step 3, then TriMet would perform a net-rise analysis to map the floodplain and floodway boundaries that would result from the Project. 5. If the Project would impact new areas by the increased base flood elevation or channel impacts, TriMet would coordinate with the local jurisdictions and FEMA to provide flood-impact prevention or mitigation in accordance with 44 CFR 65.12, such as relocating a stream, elevating buildings or installing flood berms. 6. TriMet, in coordination with the City of Tigard, would submit a Conditional Letter of Map Revision to FEMA for conditional approval. 7. After construction, TriMet, in coordination with the City of Tigard, would submit a Letter of Map Revision to FEMA. Through the steps outlined above, TriMet would also meet the City of Tigard's requirements for a detailed engineering study to confirm that the Project would not increase the base (100-year) flood elevation.	None required.
Short term	None expected	None required.	None required.

Note: FEMA = Federal Emergency Management Agency

Regulatory Requirements and Best Management Practices to Avoid and Minimize Impacts

The Project would be designed to comply with all federal, state and local regulations, which would prevent or minimize potential impacts to water resources. The Project would also incorporate other project commitments to protect ecosystems and federally protected species.

Regulatory Requirements and Best Management Practices for Long-Term Impacts

Through planning, design and the application of required BMPs, the Project would provide water quality treatment and flow control to prevent long-term impacts to water resources, including mitigating flow changes to combined and separated sewer systems (see Appendix E, Agency Coordination and Correspondence). Depending on the relevant jurisdiction, long-term BMPs to manage stormwater generally would be designed based on the guidance outlined in the *City of Portland Stormwater Management Manual*, the *Clean Water Services Design and Construction Standards for Sanitary Sewer and Surface Water Management* (applicable in unincorporated areas and the cities of Tigard and Tualatin), the Oregon Department of Transportation *Hydraulics Design Manual*, and the most recent version of the Standard Local Operating Procedures for Endangered Species (or "SLOPES"). Water quality treatment BMPs could include settling ponds, filter strips, sand filter or bioinfiltration facilities, and water quality basins. Flow control BMPs could include detention or retention ponds or vaults. Required stormwater management facilities would likely be larger in areas where more vegetation is converted to new impervious surfaces.

The Project would comply with federal, state and local protections for floodplains and floodways through the measures listed in Table 4.10-5. For development within floodplains or floodways, TriMet would coordinate with the City of Tigard to complete detailed engineering studies to confirm that no increase in base (100-year) flood elevation would occur, and to meet City of Tigard restrictions regarding the types of development allowed in the floodway. Additional information on floodplain regulatory requirements is in Appendix B4.10.

Regulatory Requirements and Best Management Practices for Short-Term Impacts

Construction-related impacts on water resources would be prevented or minimized by complying with the federal, state and local regulations, and by implementing construction-related BMPs, such as:

- developing construction plans to minimize impacts on sensitive areas such as streams and their buffers
- phasing the work to minimize the amount of disturbed area at any one time
- stabilizing construction entrances, haul roads and other surfaces that could produce erosion or sediment tracking
- providing tire wash, silt fence, stockpile covers and other protection measures to avoid sediment transport
- containing and controlling concrete, fuel and hazardous materials on-site
- installing temporary ditches, erosion control covering and temporary piped conveyances to protect slopes from concentrated runoff
- implementing stream protection measures, including diverting stream flow around the construction area

4.11. Noise and Vibration

This section describes the results of the noise and vibration analysis, which considers the potential for impacts to approximately 1,200 noise- and vibration-sensitive properties along the light rail corridor. This analysis has been updated since the Draft EIS to reflect the definition and design of the Project for this Final EIS, including current displacement assumptions and characteristics of the light rail trackway, such as track crossover locations. Indirect and cumulative impacts are addressed in Section 4.18, Indirect and Cumulative Impacts. The *Noise and Vibration Technical Results Report* (Attachment F) provides additional detail on the analysis and the methods used.

4.11.1. Regulatory Context

This section discusses the fundamentals of the noise and vibration analysis and regulatory information governing noise and vibration for federally funded projects. Additional information on noise and vibration, including the measurement and analysis of noise and vibration, is provided in Attachment F.

Noise is defined as unwanted sound; it is measured in terms of sound pressure level and is usually expressed in decibels (dB), a conversion of the air pressure to a unit of measurement that represents the way humans hear sounds. The human ear is less sensitive to higher and lower frequencies than it is to midrange frequencies. To provide a measurement meaningful to humans, a weighting system was developed that reduces the sound level of higher and lower frequency sounds, similar to what the human ear does. This filtering system is used in virtually all noise ordinances. Measurements taken with this "A-weighted" filter are referred to as A-weighted decibel (dBA) readings.

Two primary noise measurement descriptors are used to assess noise impacts from traffic and transit projects: the equivalent sound level (Leq) and the day-night sound level (Ldn). The Leq is the level of a constant sound for a specified time period that has the same sound energy as an actual fluctuating noise over the same time period. The peak-hour Leq is used for all traffic noise analyses and for light rail noise analyses at locations with daytime use, such as schools and libraries. The Ldn is the Leq over a 24-hour period, with 10 dBA added to nighttime (between 10 p.m. and 7 a.m.) sound levels as a penalty to account for the greater sensitivity and lower background sound levels during this time. The Ldn is the primary noise level descriptor for light rail noise at residential land uses.

Criteria for Long-Term Transit Noise Impacts

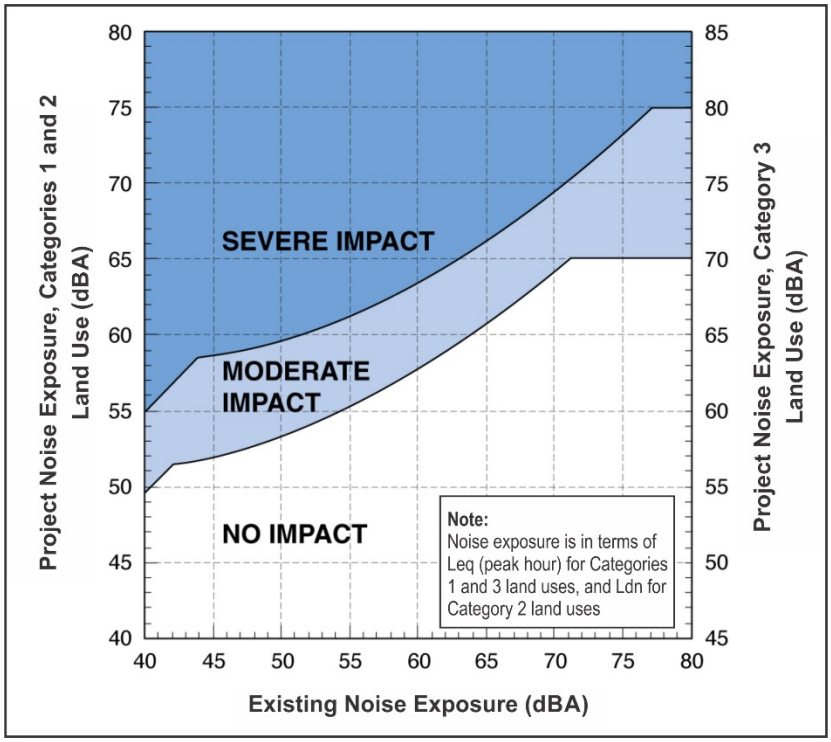
Because the Project is expected to receive funding from FTA, the FTA methods are the governing methods for the noise and vibration analysis. The FTA methods to evaluate transit noise and vibration and the FTA criteria are defined by the *FTA Transit Noise and Vibration Impact Assessment* (FTA, 2018). Other criteria that are applicable to specific parts of this analysis, including those from the Federal Highway Administration (FHWA) and local noise control ordinances, are discussed in Attachment F.

The FTA noise impact criteria group noise-sensitive land uses into the following three categories: Category 1 for areas where quiet is an essential element in their intended purposes; Category 2 for residences, hospitals and hotels where nighttime sensitivity is assumed to be of utmost importance; and Category 3 for schools, libraries, theaters and churches. Category 2 uses the Ldn to identify impacts, while Categories 1 and 3 use the peak-hour Leq.

There are also two levels of noise impact included in the FTA criteria: "severe impacts," for which consideration of mitigation is required and which are considered "significant" according to the usage of this term in the National Environmental Policy Act, and "moderate impacts," which require the consideration of factors, including existing and planned land use and the cost of mitigation, in order to determine the need for mitigation.

The existing noise level is used to determine the FTA criteria for moderate or severe impacts. As the existing noise exposure increases, an increasingly smaller increase in project noise is permitted before an impact occurs. For example, in an area with an existing background noise level of 50 dBA, an impact would occur if project noise meets or exceeds 54 dBA (e.g., project is 4 dB louder than the existing background noise level); however, if the existing background noise level was 60 dBA, an impact would occur if project noise meets or exceeds 58 dBA, which is 2 dB below the existing background level. For an existing background of 70 dBA, a project impact occurs at 64 dBA, or, in this case, the project noise must be more than 5 dB below the background noise level for no impact to occur. The FTA impact criteria are shown in Figure 4.11-1, and Attachment F provides additional information.

Figure 4.11-1. FTA Noise Impact Criteria



Criteria for Long-Term Traffic Noise Impacts

Under FTA regulations, projects that substantially modify roadways, vertically or horizontally, or that have new through lanes, must use FHWA methods to analyze potential traffic noise impacts. Under FHWA criteria, a traffic noise impact occurs if predicted traffic noise levels approach the criteria levels for specific FHWA land use activity category or substantially exceed existing noise levels (e.g., a 10-dBA increase). These levels are defined as noise abatement criteria (NAC) and are based on hourly Leq noise levels during the peak traffic noise hour. The land use activity categories of greatest concern along the Project's light rail alignment are Type B for residences and Type C, which includes playgrounds, active sports areas, parks, schools, churches, libraries and hospitals. The noise abatement criterion used to determine impacts on

Type B and C land uses is 65 dBA Leq. Some commercial uses, including hotels and motels, have a criterion of 70 dBA. Most other commercial uses, such as general offices and retail businesses, are not considered noise-sensitive. Unlike the FTA criteria, the FHWA criteria do not distinguish between moderate or severe impact levels for traffic noise; they only indicate impact or no impact.

As stated, traffic noise is considered only for areas where the Project would substantially modify the roadway or increase roadway capacity (e.g., increase the number of through lanes). For such "horizontal" alignment changes, the distance from the roadway to the receiver location must be reduced by half to meet the criteria for traffic noise analysis. A vertical alignment change is one that provides a new line of sight to the roadway, which typically occurs where existing structures between a noise-sensitive property and a roadway are displaced, thereby removing the acoustical shielding and increasing exposure to traffic noise. This analysis therefore includes all locations where traffic noise impacts from project-related modifications and displacements are anticipated. Attachment F provides additional information on the traffic noise analysis methods.

Criteria for Long-Term Transit Vibration Impacts

Vibration generated from train operations of the Project would be transmitted from the tracks through the soil to nearby properties. Vibration above certain levels can disrupt sensitive operations and cause annoyance to humans within buildings. Bus and light rail systems rarely produce vibration with sufficient magnitude to cause any structural damage. The response of humans, buildings and equipment to vibration is most accurately described using vibration velocity level in decibels (VdB). The abbreviation VdB is used in place of dB to avoid confusing vibration decibels with sound decibels.

Under FTA criteria, for transit systems with frequent operations, defined as 70 light rail train pass-bys or more per day (such as the Project), the general vibration impacts criterion for residences, hospitals and hotels is 72 VdB. For institutional land uses, including schools, libraries and churches, the criterion is 75 VdB. Any site anticipated to have vibration impacts from the Project would undergo a detailed vibration analysis during final design to consider mitigation measures. The analysis may include testing to quantify the propagation characteristics of the strata (i.e., the material or materials) between the light rail tracks and the receiver expected to have vibration impacts. Attachment F provides additional information on the vibration impact analysis.

Local Construction Noise Regulations

Local noise ordinances and regulations govern noise for project construction. Regulations and ordinances that are applicable to construction of the Project include those of the Cities of Portland, Tigard and Tualatin. Each of these jurisdictions has periods when most construction activities are exempt from the regulations. General exemptions for construction during daytime hours by jurisdiction are:

- 7 a.m. to 6 p.m. in Portland
- 7 a.m. to 8 p.m. in Tigard
- 7 a.m. to 6 p.m. in Tualatin

Any proposed construction outside of the hours listed above would require a noise variance from the local jurisdiction. Noise variances typically limit noise levels and construction times depending on the land use in the area and the type of construction.

4.11.2. Affected Environment

The section describes the study area, land use and existing noise environment for the Project. This information is important, because the noise impact thresholds are related to land use types and the existing noise environment. Attachment F provides more details on the standards and measurements used in the noise and vibration analysis.

Study Area

The study area for noise was determined using the FTA-recommended analysis distance of up to 350 feet from the edge of construction for a typical light rail system as well as information on noise levels from existing TriMet light rail vehicles, track type, speed, land use, topographical conditions and structural shielding (see Exhibit 4.11-1 for a summary of track types). The noise analysis used the distance of 350 feet from the edge of construction and then expanded that distance to include structures that were far enough from the trackway that they would not have any noise impacts, thus ensuring that all of the potential noise impacts were identified.

The study area for vibration used FTA's recommended analysis distance of 100 feet from the edge of construction for most vibration-sensitive properties, and extended the analysis distance to 200 feet for buildings considered to be highly sensitive. Figures 4.11-2 through 4.11-4 show the overall area considered for the noise and vibration analysis.

Exhibit 4.11-1

Track Types Defined

Continuously Welded Rail: TriMet uses continuously welded rail on all service tracks to prevent the noise and vibration common to butted rail installations.

Ballast and Tie Track: Ballasted track is the standard for light rail transit routes that are constructed on an exclusive right of way, consisting of ballast and concrete ties supporting the tracks.

Direct-fixation Track: Direct-fixation track is a track structure in which the rail is mounted directly on an underlying concrete slab. This type of track is also used for most elevated structures, and can be slightly louder than at-grade, ballast and tie track types.

Embedded Track: Embedded track is generally the standard for light rail track where rubber-tired vehicles must operate.

Crossovers: Track crossovers are mechanical devices that enable light rail cars to be guided from one track to another; they have a gap in the rails that can increase noise and vibration levels.

Source: Michael Minor and Associates and the Transportation Research Board, 2012.

Existing Land Use

Land use in the study area consists of single-family and multifamily residential, parks, schools and churches, as well as commercial uses. In addition to the many multifamily residential properties immediately adjacent to the alignment, some of the more notable noise- and vibration-sensitive uses in Segment A are Lair Hill Park, Cedarwood Waldorf School and Tabernacle Seventh-day Adventist Church. Also in Segment A, the National University of Natural Medicine is located just south of SW Naito Parkway. In Segment B, noise- and vibration-sensitive uses are more limited but include single-family and multifamily residential uses, the PDX Church, Fulton Park and Markham Elementary School. Segment C is mainly commercial and industrial but has some residential uses at the northern end and in the downtown Tigard area. Attachment F and Section 4.2, Land Use, provide additional details on land use in the study area. A review of the entire study area, for the full length of the Project's light rail alignment, did not

identify any locations within the study area that meet the FTA Category 1 requirements where quiet is an essential element in their intended purposes.

Existing Noise Levels

To determine existing noise levels, noise measurements were taken at a total of 33 monitoring sites: 11 sites in Segment A, 16 sites in Segment B and 6 sites in Segment C. Twenty-five of the 33 sites were monitored continuously for approximately 48 hours, while the remaining 8 sites were monitored twice during normal daytime hours for 30 minutes each. Selection of the noise-monitoring sites was based on the ability of the site to: represent multiple noise-sensitive receivers in a specific area, provide information on traffic noise and provide a detailed understanding of the noise levels throughout the study area. By applying information from standard acoustical propagation characteristics, area maps and local shielding, the measured noise levels were used to calculate and predict the existing Ldn noise levels for Category 2 land uses and the peak-hour noise level in Leq for Category 3 land uses. Attachment F presents the noise-monitoring sites for the Preferred Alternative.

The dominant noise source in Segments A and B is traffic along Interstate 5 (I-5) and SW Barbur Boulevard. Other major contributors to the existing noise environment in Segment A include transportation noise sources along Interstate 405 (I-405), U.S. Highway 26 (U.S. 26) and associated Ross Island Bridge access roads (SW Barbur Boulevard, SW Naito Parkway, SW Terwilliger Boulevard and SW Capitol Highway). The measured Ldn in Segment A ranged from 59 dBA to 71 dBA, and in Segment B the Ldn ranged from 61 dBA to 82 dBA. In Segment C, the dominant noise sources include I-5 and Highway 217. Other noise sources are the Westside Express Service (WES) Commuter Rail and occasional freight rail traffic; traffic on SW Hall Boulevard, Pacific Highway (designated as Oregon Route 99W) and other major arterial roadways; and substantial industrial and commercial activities. Noise levels in Segment C ranged from 59 dBA to 74 dBA Ldn.

The measured noise levels in Segment A were typical for a busy urban area, with the highest levels near I-405, I-5 and SW Barbur Boulevard. Noise levels in Segment B were consistently loud because of the proximity of some sites to I-5, and some locations have noise levels higher than FTA or FHWA would allow for a new project. The measured noise levels in Segment C were similarly high in some locations, but other areas were more protected from existing transportation noise sources and had lower noise levels.

Existing Vibration Levels

Existing vibration levels in the study area are primarily the result of heavy truck traffic on public roadways. However, vibration from rail traffic is notable in Segment C, where freight trains and the WES Commuter Rail operate. No other major sources of vibration were identified in the study area.

4.11.3. No-Build Alternative

Long-Term Impacts – Noise

With the No-Build Alternative, noise levels in the study area would continue to be dominated by other transportation-related noise sources, including cars, trucks and, in Tigard, WES Commuter Rail and freight rail. With the No-Build Alternative, no light rail project would be built, none of the project-related roadways modifications would occur, and no existing acoustical shielding (structures) would be removed. Therefore, no light rail-related noise or project-related traffic noise impacts would be created. With the No-Build

Alternative, changes in noise levels from unforeseen projects or developments could occur. Planned transportation projects under the No-Build Alternative would assess impacts and develop mitigation as required by applicable regulations.

Long-Term Impacts – Vibration

With the No-Build Alternative, vibration levels in the study area would continue to be dominated by other transportation-related vibration sources, primarily heavy trucks and, in Tigard, the WES Commuter Rail and freight rail. Other vibration sources could include miscellaneous industrial activities and local construction projects. With the No-Build Alternative, there would be no light rail project and therefore no light rail-related vibration.

Short-Term Impacts

Aside from other planned projects that are already assumed to be developed, there would be no short-term noise and vibration impacts due to construction with the No-Build Alternative.

4.11.4. Long-Term Impacts – Noise

This section summarizes and identifies locations where noise levels are predicted to exceed the FTA impact criteria with the Project. There are multiple noise sources associated with a light rail project, including noise from light rail operation (wheel/rail rolling noise), warning bells (used at stations), special trackwork (crossovers and storage tracks), and ancillary facilities such as maintenance and storage areas. Noise impacts associated with the removal of shielding are also discussed. This type of impact would occur in some locations along the corridor where realignment of the roadway would cause an increase in noise due to the removal of buildings between existing roadways and noise-sensitive properties.

No noise impacts are anticipated as a result of the Marquam Hill Connection, the shuttle at the Portland Community College (PCC) Sylvania campus (PCC-Sylvania Shuttle) or the Hunziker Operations and Maintenance (O&M) Facility. These non-rail project elements of the Preferred Alternative are addressed later in this section. Attachment F provides more information on the technical assessment of noise impacts, including supporting tables and detailed maps.

Preferred Alternative – Light Rail Noise

The number and severity of light rail noise impacts under the Preferred Alternative are provided in Table 4.11-1 and illustrated in Figures 4.11-2 through 4.11-4 for Segments A, B and C. Noise from all light rail operations at each receiver is compared to the FTA criteria, based on the existing noise levels in that area and the FTA land use type, to determine whether an impact would occur and whether the impact would be moderate or severe under FTA criteria. Each unit represents an individual single-family residence, apartment or condominium unit—in the case of residences—or a single building—in the case of schools, churches or hospitals. These impacts reflect the Preferred Alternative *before* mitigation is included. Many of the impacts would be at multi-unit apartments and condominiums, and therefore the analysis estimates the number of units that would have impacts, based on site visits, window counts and unit numbers. The figure also shows the locations of tight radius curves where wheel squeal could occur and major project elements.

The segment that would have the highest number of noise impacts from light rail operations is Segment A. The higher number of impacts in Segment in A would be a result of the large number of single-family and

multifamily residences near the alignment in this segment. In addition, of the three segments, only Segment A would have noise impacts in the FTA severe category.

Table 4.11-1. Potential Light Rail Noise Impacts of the Preferred Alternative

Segment	Noise Impacts[1] (residential units)	
	Moderate Impacts	Severe Impacts
Segment A: Inner Portland	64	12
Segment B: Outer Portland	59	0
Segment C: Tigard and Tualatin	46	0

Source: Michael Minor & Associates, Inc. modeling using methods from FTA (2018).

[1] These impacts reflect the Preferred Alternative *before* mitigation is included.

Segment A: Inner Portland

The potential noise impacts in Segment A reflect the large number of single-family and multifamily residences in this densely populated part of the study area. However, there are several specific areas of the segment where the study area includes primarily commercial use that would not incur noise impacts. At the northern end of Segment A, near SW Jackson Street and SW Fifth Avenue, where the Preferred Alternative would connect to the existing light rail tracks in south downtown Portland, no noise impacts were identified. The lack of anticipated noise impacts here is primarily because most land use in this area is commercial, which has no impact under FTA criteria. There are classrooms for Portland State University in this area; however, they are in established commercial buildings with commercial grade windows, air conditioning and no external uses. In addition, noise levels at the leased Portland State University building on SW Fifth Avenue would not meet the impact criteria due to the relatively slow speeds at which the light rail train would operate in this area.

Severe Noise Impacts: The analysis predicts severe noise impacts at a multifamily building on the west side of SW Barbur Boulevard, just south of SW Hooker Street, because of the proximity of the building to the Preferred Alternative's tracks and the nearby double crossover (see Exhibit 4.11-1 above for a definition of crossover). No other severe noise impacts are predicted in Segment A.

Moderate Noise Impacts: Moderate noise impacts are predicted at multiple residences in Segment A. These include moderate noise impacts at two single-family residences and two units at a four-unit multifamily building on SW Sheridan Street and SW Fifth Avenue. The houses are well shielded from I-405 traffic noise, because they are located behind existing commercial structures and I-405 is located in a deep cut. The Preferred Alternative would include elevated structure over I-405 and a double crossover (see Exhibit 4.11-1 above for a definition of crossover) located on the structure at this location. The added light rail noise from the elevated structure and double crossover would result in these moderate noise impacts.

Between SW Meade Street and SW Woods Street, where the light rail alignment would be at grade in the middle of SW Barbur Boulevard, several additional moderate impacts were identified. A moderate impact was identified at a single-family residence on SW Meade Street due in part to the removal of the first-row home on SW Barbur Boulevard. There are two components to this type of impact: First, the first-row structures currently shield the second-row structures from traffic noise, thereby reducing the existing noise environment at the second-row residence, which makes for a more stringent impact criterion (see Figure 4.11-1). Second, as a result, when a first-row structure is removed, the second row-structure is exposed to increased traffic noise and noise from light rail operations. Moderate noise impacts were also

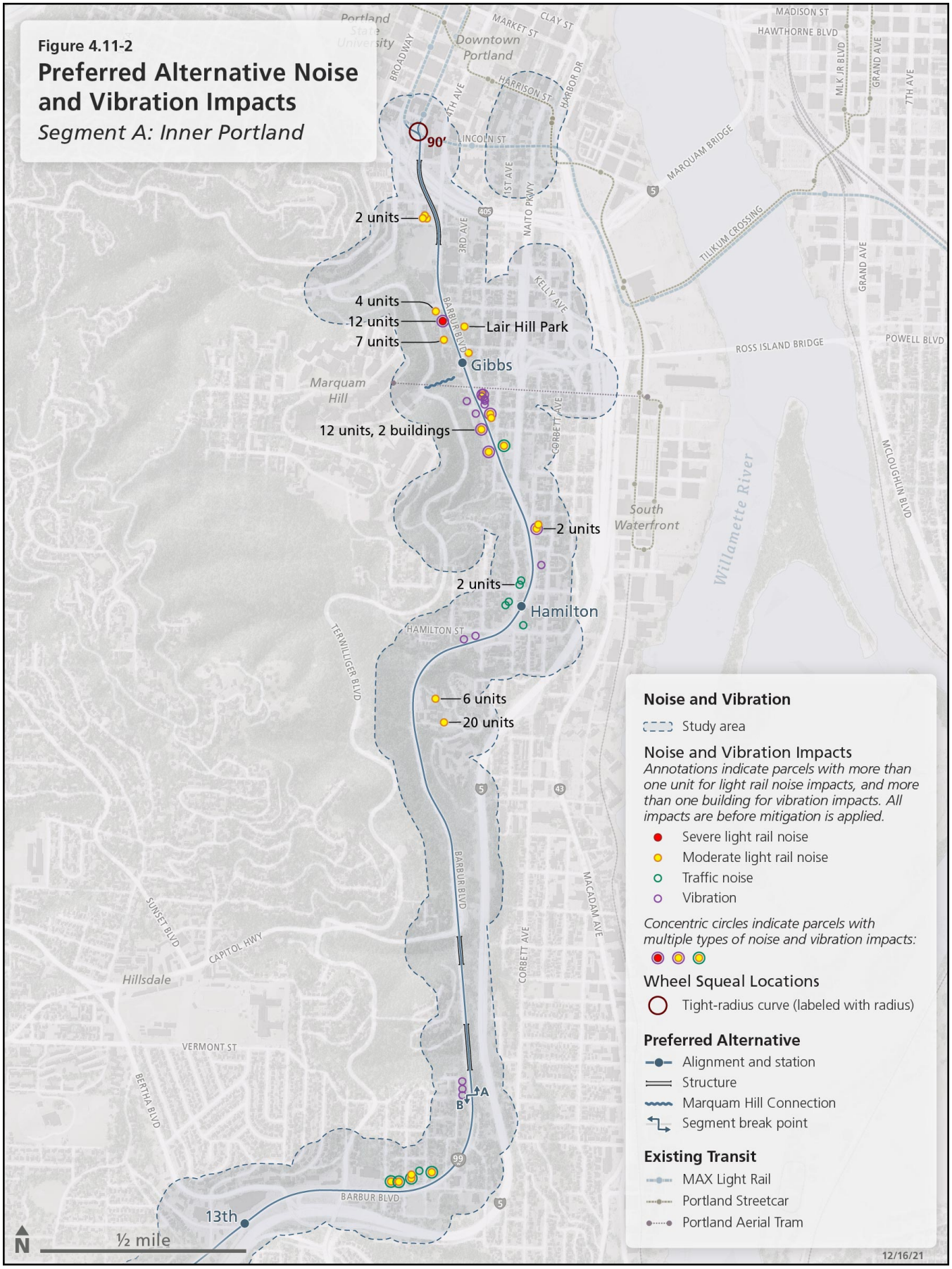
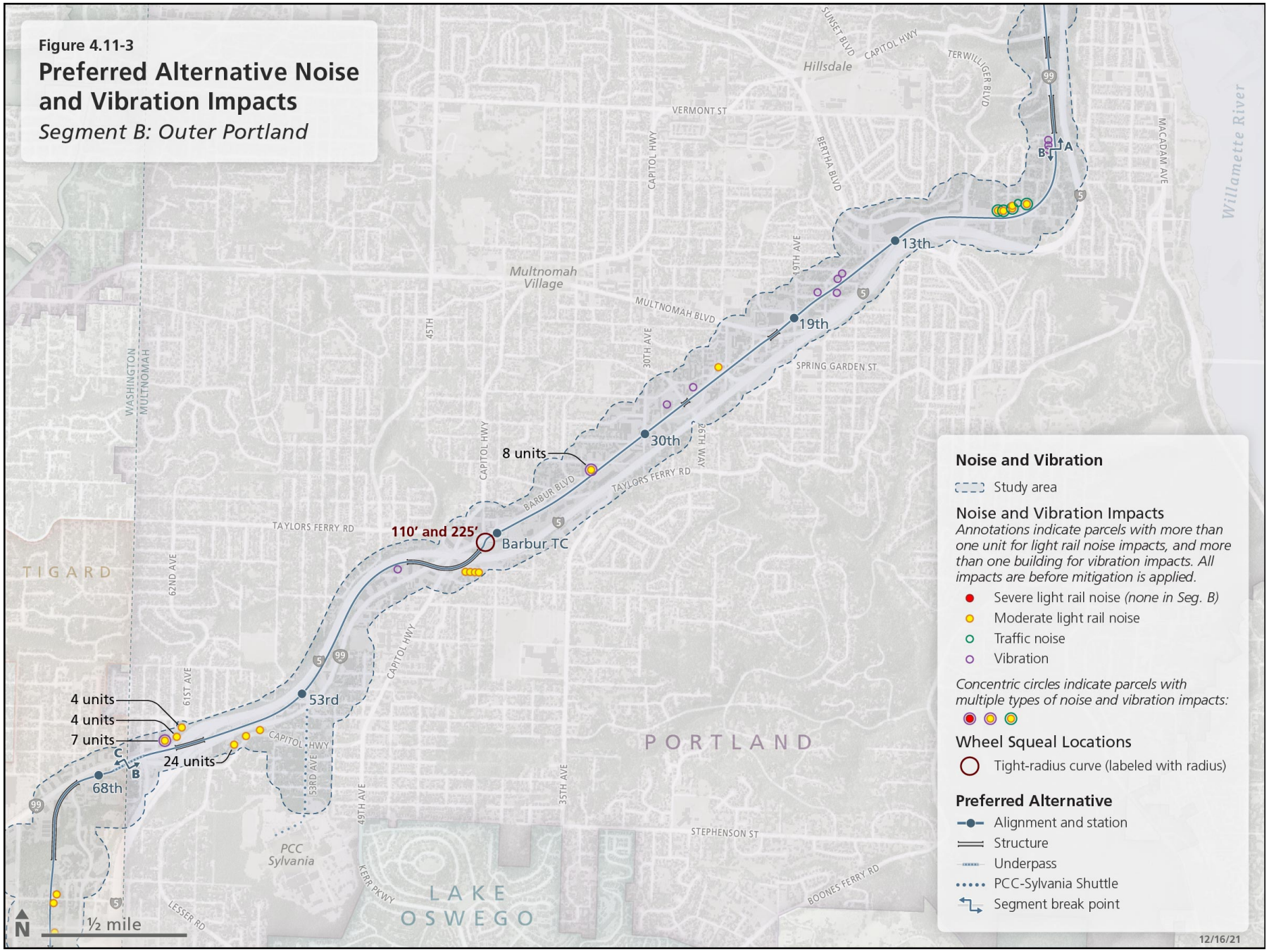


Figure 4.11-2
Preferred Alternative Noise and Vibration Impacts
Segment A: Inner Portland
Portland State University
Downtown Portland
BROADWAY
MARKET ST
CLAY ST
HARRISON ST
HARBOR DR
4TH AVE
INCOLN ST
1ST AVE
NAITO PKWY
3RD AVE
90'
2 units
4 units
12 units
7 units
Lair Hill Park
Gibbs
BARBUR BLVD
KELLY AVE
Marquam Hill
12 units, 2 buildings
CORBETT AVE
2 units
2 units
Hamilton
HAMILTON ST
TERWILLIGER BLVD
6 units
20 units
South Waterfront
Willamette River
MARQUAM BRIDGE
TILIKUM CROSSING
ROSS ISLAND BRIDGE
POWELL BLVD
MADISON ST
HAWTHORNE BLVD
MLK JR BLVD
GRAND AVE
7TH AVE
MCLOUGHLIN BLVD
MACADAM AVE
SUNSET BLVD
CAPITOL HWY
Hillsdale
VERMONT ST
BERTHA BLVD
A
B
13th
½ mile
N
Noise and Vibration
Study area
Noise and Vibration Impacts
Annotations indicate parcels with more than one unit for light rail noise impacts, and more than one building for vibration impacts. All impacts are before mitigation is applied.
Severe light rail noise
Moderate light rail noise
Traffic noise
Vibration
Concentric circles indicate parcels with multiple types of noise and vibration impacts:
Wheel Squeal Locations
Tight-radius curve (labeled with radius)
Preferred Alternative
Alignment and station
Structure
Marquam Hill Connection
Segment break point
Existing Transit
MAX Light Rail
Portland Streetcar
Portland Aerial Tram
12/16/21

Figure 4.11-3
Preferred Alternative Noise and Vibration Impacts
Segment B: Outer Portland



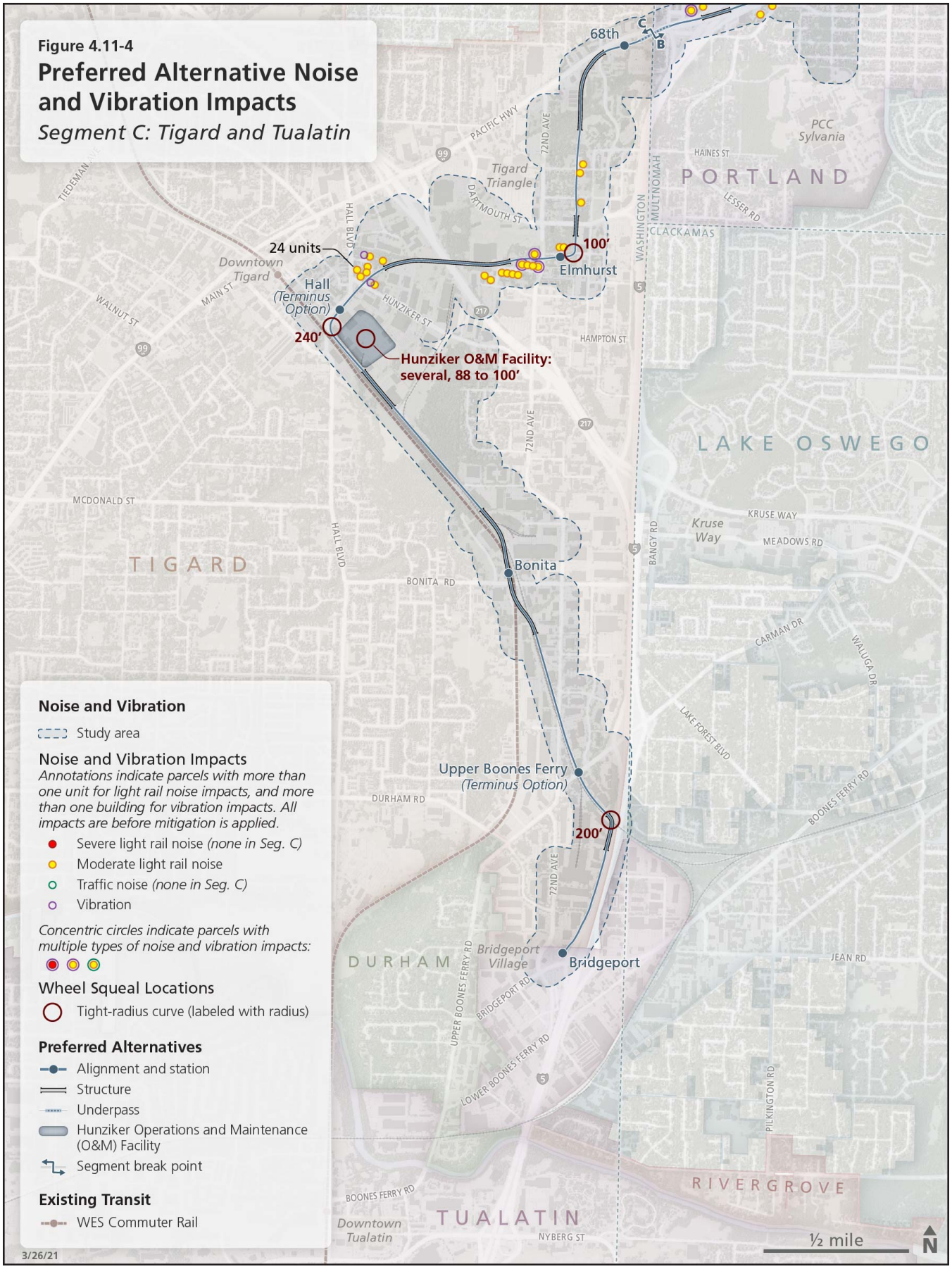


Figure 4.11-4
Preferred Alternative Noise and Vibration Impacts
Segment C: Tigard and Tualatin
68th
C
B
PACIFIC HWY
72ND AVE
Tigard Triangle
DARTMOUTH ST
HALL BLVD
24 units
Downtown Tigard
Hall (Terminus Option)
MAIN ST
WALNUT ST
TIEDEMAN AVE
240'
HUNZIKER ST
Hunziker O&M Facility: several, 88 to 100'
100'
Elmhurst
HAMPTON ST
WASHINGTON
MULTNOMAH
CLACKAMAS
HAINES ST
PCC Sylvania
PORTLAND
LESSER RD
LAKE OSWEGO
MCDONALD ST
TIGARD
Bonita
BONITA RD
BANGY RD
Kruse Way
KRUSE WAY
MEADOWS RD
CARMAN DR
WALUGA DR
LAKE FOREST BLVD
Upper Boones Ferry (Terminus Option)
DURHAM RD
200'
BOONES FERRY RD
DURHAM
Bridgeport Village
Bridgeport
JEAN RD
UPPER BOONES FERRY RD
BRIDGEPORT RD
LOWER BOONES FERRY RD
PILKINGTON RD
RIVERGROVE
TUALATIN
Downtown Tualatin
NYBERG ST
½ mile
N
Noise and Vibration
Study area
Noise and Vibration Impacts
Annotations indicate parcels with more than one unit for light rail noise impacts, and more than one building for vibration impacts. All impacts are before mitigation is applied.
Severe light rail noise (none in Seg. C)
Moderate light rail noise
Traffic noise (none in Seg. C)
Vibration
Concentric circles indicate parcels with multiple types of noise and vibration impacts:
Wheel Squeal Locations
Tight-radius curve (labeled with radius)
Preferred Alternatives
Alignment and station
Structure
Underpass
Hunziker Operations and Maintenance (O&M) Facility
Segment break point
Existing Transit
WES Commuter Rail
3/26/21

identified at several multifamily residences along SW Fourth Avenue, west of SW Barbur Boulevard and north of SW Hooker Street, generally because of wheel/rail rolling noise from light rail operations. An impact was also identified in the northwestern corner of Lair Hill Park because of added noise from the double crossover that would be nearby.

Moderate noise impacts were also predicted from light rail operations on the east side of SW Barbur Boulevard north of SW Woods Street and south of SW Pennoyer Street at several single-family residences and multifamily units adjacent to SW Barbur Boulevard. In the same area, but on the west side of SW Barbur Boulevard, impacts were identified at units nearest the alignment at the Lair Hill Heights Condominiums (3505 SW Barbur Boulevard) and at a residence on SW Condor Avenue, just west of SW Barbur Boulevard. North of the intersection of SW Naito Parkway and SW Barbur Boulevard, moderate light rail noise impacts were identified at the nearest three residences along SW Water Avenue just south of SW Abernethy Street.

South of SW Hamilton Street, moderate noise impacts are predicted at the front row units of the Town and Country Apartments and the Rasmussen Village Apartments (two large apartment complexes on the east side of SW Barbur Boulevard, south of SW Hamilton Street). The noise analysis did not identify any noise impacts on the west side of SW Barbur Boulevard just north of where Segment B begins, along SW Second Avenue, due to the reduced speed the light rail train would have along the nearby curve.

Figure 4.11-2 shows the properties in Segment A that would have noise impacts.

Segment B: Outer Portland

The study area in Segment B contains a mixture of single-family and multifamily residences, along with schools, churches, parks and commercial uses. Because much of the land use adjacent to the light rail alignment is commercial, and many of the noise-sensitive uses are set back from the light rail alignment, fewer light rail noise impacts were identified in Segment B than in Segment A.

Severe Noise Impacts: There would be no severe noise impacts in Segment B.

Moderate Noise Impacts: At the northern end of Segment B, there would be noise impacts to single-family residences along the west (north) side of SW Barbur Boulevard on SW Second Avenue, SW Third Avenue, SW Fourth Avenue and SW Fifth Avenue.

Noise impacts were also identified along SW Barbur Boulevard at a single-family residence on SW Spring Garden Street and at up to eight units at a multifamily residential complex between SW Alice Street and SW 35th Avenue. No other noise impacts were identified in Segment B north of the Barbur Transit Center.

South of the Barbur Transit Center, noise impacts were identified east of the light rail alignment, where the light rail would cross over I-5 on an elevated structure from the Barbur Transit Center, at four single-family residences. These predicted noise impacts would be along SW Wilbur Street, near the on-ramp to I-5. The impacts would result, in part, from the added noise associated with light rail operations on an elevated structure. At the southern end of Segment B, there would be noise impacts to multiple units at the Westview Terrace Apartments and several small single-family residences along SW 62nd Avenue and the southbound off-ramp from I-5 to Pacific Highway. Impacts in this area would result from the elevated guideway over I-5 and the relatively higher speed at which the light rail train would operate in this area.

Figure 4.11-3 shows the properties in Segment B that would have noise impacts.

Segment C: Tigard and Tualatin

Segment C includes single-family and multifamily residences, undeveloped lands, and commercial and industrial uses. The northern end of Segment C has virtually all of the noise-sensitive uses in this segment. Once the light rail alignment transitions to the existing railroad corridor, south of downtown Tigard, land use is mainly commercial and industrial; the only FTA noise-sensitive uses in this area are two hotels located near I-5.

Severe Noise Impacts: There would be no severe noise impacts in Segment C.

Moderate Noise Impacts: The analysis identified moderate noise impacts to single-family residences along several streets in the Tigard Triangle, including SW Baylor Street, SW Clinton Street, SW Hermoso Way, SW 72nd Avenue and SW Beveland Street. All impacts are predicted to occur at single-family residences located directly adjacent to the light rail alignment as it transitions through this area to the elevated structure over Highway 217.

On the west side of Highway 217, near downtown Tigard, there would be an estimated 31 properties with light rail noise impacts in the area near SW Hall Boulevard, SW Knoll Drive and SW Hunziker Street. Most impacts (up to an estimated 24 units) would be to the rear portion of The Knoll at Tigard, a three- to four-story apartment building along SW Hall Road between SW Knoll Drive and SW Hunziker Street. The remaining impacts would be at single-family residences on SW Knoll Drive and SW Hunziker Street just south of the Preferred Alternative's elevated structure over Highway 217.

Preferred Alternative: Non-Rail Project Components

There are three major non-rail project components that are part of the Preferred Alternative. Noise related to the operations of these components is discussed below.

Marquam Hill Connection

The Marquam Hill Connection would link SW Barbur Boulevard near SW Gibbs Street to the intersection of SW Terwilliger Parkway and SW Campus Drive on Marquam Hill. Noise sources would include electric motors and power substations required to power the system. The design and equipment selected for the facility would comply with the City of Portland Noise Control Ordinance. Therefore, no noise impacts are predicted to result from operation of the Marquam Hill Connection.

PCC-Sylvania Shuttle

The PCC-Sylvania Shuttle would involve the operation of small shuttle buses on existing roadways. Because the PCC-Sylvania Shuttle operations would not increase the capacity of any roadways or widen any roadways, no traffic noise analysis is required under FTA or FHWA regulations. Therefore, no noise impacts were identified from the proposed PCC-Sylvania Shuttle operations.

Hunziker Operations and Maintenance Facility Noise Impacts

No light rail noise impacts are anticipated due to the Hunziker O&M Facility, based on both FTA and City of Tigard criteria. The facility site would be located in an established industrial area and would be set back behind the location of the Hall Station. The nearest noise-sensitive receivers are located north of the site, off SW Hall Boulevard and approximately 400 feet from the northern edge of the site and more than 600 feet from the proposed location of the maintenance building.

Preferred Alternative – Light Rail Wheel Squeal

Light rail wheel squeal is caused by the oscillation of the wheel against the rail on curved sections of rail. Based on measurements at curves with radii of less than 300 feet along existing TriMet lines, tight-radius curves can produce maximum wheel squeal noise levels of 80 dBA to 90 dBA at 50 feet. The actual noise produced from wheel squeal depends on the curve radius, speed of the train and rail condition. For example, at slower speeds the level of squeal is typically lower than at higher speeds. In addition, during periods of wet weather when the rails are damp or during active rain, squeal can be eliminated entirely, because the water on the rails can act as a friction modifier, allowing the light rail wheels to slip on the rail without producing the squeal.

Because of the varying level and difficulty predicting the noise level produced during wheel squeal, it is not included in the normal wayside light rail noise modeling. Instead, this analysis identified all curves along the proposed alignment with radii of 300 feet or less, where wheel squeal typically occurs. These curves will be reviewed and considered for lubrication if squeal is identified during initial system testing. If lubrication is necessary, general maintenance of the rail would include servicing the curves to prevent squeal impacts in noise-sensitive areas. Track lubrication can occur manually or by using automated machines called wayside lubrication systems. Wheel lubrication systems can also be installed on the light rail vehicles to prevent the squeal.

Tight-radius curves were identified at the north end of Segment A, near SW Jackson Street and SW Fifth Avenue. In Segment B, tight-radius curves were identified at the Barbur Transit Center, and in Segment C, tight-radius curves were identified at SW Elm Street and SW 70th Avenue, SW Ash Avenue at SW Commercial Street, and at the transition from the railroad corridor to I-5.

The Hunziker O&M Facility would also have multiple tight-radius curves. The nearest noise-sensitive property to the Hunziker O&M Facility is located approximately 500 feet to the north of the closest curve, at the multifamily units north of SW Hall Road (the Manchester Square Apartments). Squeal from the curves at the O&M facility will also be mitigated with some form of lubricant as needed to prevent the squeal.

Table 4.11-2 lists all of the tight-radius curves along the Preferred Alternative. Figures 4.11-2, 4.11-3 and 4.11-4 show the locations of the tight-radius curves.

Table 4.11-2. Tight-Radius Curves with the Potential for Wheel Squeal

Preferred Alternative	Curve Radii (feet)
Segment A: Inner Portland	
SW Fifth Ave. at SW Lincoln St.	90
Segment B: Outer Portland	
Barbur Transit Center	110, 225
Segment C: Tigard and Tualatin	
SW Elm St. at SW 70th Ave.	100
SW Ash Ave. at SW Commercial St.	240
At transition from railroad corridor to I-5	200
Hunziker O&M Facility (SW Hall Blvd. at SW Commercial St.)	88–100 (several)

Source: Review of Preferred Alternative project design files and drawings.

Note: I-5 = Interstate 5; O&M = operations and maintenance.

Preferred Alternative – Traffic Noise

Traffic noise analysis is only required for new roadways, roadways with increased capacity and substantially realigned roadways. There are several areas where the Preferred Alternative would modify or realign roadways, but the analysis found that most of these changes would not meet the FHWA criteria requiring a traffic noise impact analysis (see Section 4.11.1) or that no noise-sensitive properties are located in the immediate area that would be affected. Therefore, most roadway modifications included in the Preferred Alternative would not create any new traffic noise impacts or increase the severity of any existing traffic noise impacts. However, there are several areas where the Preferred Alternative would remove structures that shield existing traffic noise. Removal of structures could result in new traffic noise impacts or increase the severity of existing impacts and therefore require consideration for noise mitigation.

Traffic noise impacts, identified in Table 4.11-3, are those locations where traffic noise levels would meet one of three conditions: (1) would increase to above the FHWA criteria (65 dBA Leq for residences); (2) would increase by 10 dB or more (substantial increase); or (3) at sites that already had traffic noise levels above the FHWA criteria, would be expected to experience an increase in traffic noise directly related to the Project (increased severity). The traffic noise impact results are based on the analysis of 92 individual receiver locations representing 145 residences and other noise-sensitive properties along the light rail alignment. Noise impacts are presented by segment; no traffic noise impacts are associated with the Marquam Hill Connection, the PCC-Sylvania Shuttle or the Hunziker O&M Facility.

Table 4.11-3. Potential Traffic Noise Impacts of the Preferred Alternative

Segment	Traffic Noise Impacts[1]
Segment A: Inner Portland	7 residences
Segment B: Outer Portland	5 residences
Segment C: Tigard and Tualatin	None

Source: Michael Minor & Associates, Inc. modeling using methods from FTA (2018).

[1] These impacts reflect the Preferred Alternative *before* mitigation is included. Traffic noise regulations do not identify a moderate level or severe level of impacts.

Segment A: Inner Portland

In Segment A, areas with increased exposure to traffic noise would include one single-family residence at SW Pennoyer Street; five residences (three single-family residences and one duplex) on the west side of SW Barbur Boulevard between SW Bancroft Street and SW Hamilton Street; and one residence east of SW Barbur Boulevard, north of SW Hamilton Street. The first traffic noise impact, which occurs near SW Pennoyer Street, would be a direct result of the removal of shielding to accommodate the widening of SW Barbur Boulevard. The group of three single-family residences and one duplex would have traffic noise impacts related to the removal of shielding. One residence on SW Hamilton Street behind the existing Swan Mart would have a traffic noise impact related to the displacement of the Swan Mart building.

Segment B: Outer Portland

In Segment B, widening of SW Barbur Boulevard would also require the removal of several existing structures directly adjacent to the roadway along SW Barbur Boulevard between SW Second Avenue and SW Fifth Avenue. Removal of these structures would also remove the acoustical shielding they provide, and

therefore would result in increased noise from traffic along SW Barbur Boulevard at the newly exposed residences. Five homes in his area were identified to have traffic noise impacts.

As part of the Preferred Alternative, improvements are planned along SW 53rd Avenue to provide a connection and access from the 53rd Park and Ride to and from the PCC-Sylvania campus. Because of planned improvements on SW 53rd Avenue, a review of traffic noise levels at residential areas and the Sylvania Natural Area Park along SW 53rd Avenue was also performed. As part of the Preferred Alternative, SW 53rd Avenue would be brought up to current street standards with sidewalks, bicycle facilities and curbs. The planned improvements do not meet the FHWA requirements for a traffic noise study; therefore, no traffic noise study was performed for this area, and no traffic noise impacts are predicted.

Several other areas in Segment B where the Preferred Alternative would realign roadways were also reviewed for potential traffic noise impacts, and none were identified.

Segment C: Tigard and Tualatin

In Segment C, there would be roadway widening and realignment along SW 70th Avenue; however, traffic volumes and speeds would be low, and no traffic noise impacts are predicted. The only other roadway reconfiguration in Segment C would be the realignment of SW Hunziker Street to meet SW Scoffins Street at SW Hall Boulevard. No traffic noise impacts are predicted at this location, because SW Hunziker Street would be shifted away from the remaining residences.

Complete information on modeled traffic noise levels for the Preferred Alternative can be found in Attachment F.

Terminus Options

No noise impacts are anticipated south of the Hall Station. Therefore, the impacts for both terminus options would be the same as those presented for the full-length Preferred Alternative.

Related Transportation Improvements

The Ross Island Bridgehead Reconfiguration would result in changes to traffic noise due to realigning roadways, particularly where it would affect ramps. An initial screening showed few noise-sensitive receivers in the vicinity of where roadways would be realigned, and the reduction of traffic on neighborhoods streets is likely to reduce noise levels. The Ross Island Bridgehead Reconfiguration would not remove any buildings that provide shielding from traffic noise. Further analysis of traffic noise impacts and the potential need for mitigation associated with the Ross Island Bridgehead Reconfiguration would be performed separately if that project is constructed. The level and type of analysis performed would be based on the funding source and owner of that project, which have not been finalized at this time.

The station access improvements would not result in long-term noise impacts.

4.11.5. Long-Term Impacts – Vibration

This section summarizes the locations where vibration levels are predicted to exceed the FTA vibration impact criteria for the Project. The number of potential vibration impacts is based on a count of buildings, not individual units. The vibration impacts would be the result of many factors, including the proximity of the building to the tracks, speed of the train, location of crossovers and track type (i.e., ballast and tie track

produces less vibration then embedded track). Attachment F provides more details on vibration and vibration impacts.

Because the related transportation improvements (Ross Island Bridgehead Reconfiguration and station access improvements) would not cause any vibration impacts, they do not require long-term vibration analysis. They are therefore omitted from the discussion in this vibration impacts section.

Preferred Alternative

Table 4.11-4 summarizes the projected number of buildings with light rail operational vibration impacts for the Preferred Alternative. All vibration impacts predicted were at residences (single-family and multifamily structures); there would be no vibration impacts to any commercial buildings due to the less stringent criteria for that type of land use. The largest number of vibration impacts would occur in Segment A because of the proximity of the light rail alignment to residences in that segment. The following sections provide a summary of the potential vibration impacts for each segment.

Table 4.11-4. Summary of Potential Vibration Impacts: Preferred Alternative

Preferred Alternative	Number of Residential Buildings with Vibration Impacts
Segment A: Inner Portland	20
Segment B: Outer Portland	9
Segment C: Tigard and Tualatin	5

Source: Michael Minor & Associates, Inc. modeling using methods from FTA (2018).

Segment A: Inner Portland

The analysis identified potential vibration impacts in Segment A at residences within approximately 36 feet to 100 feet of the light rail alignment. A vibration impact was identified at the multifamily building on the east side of SW Barbur Boulevard just south of SW Hooker Street. This site has one of the highest vibration levels calculated and would include added vibration from a nearby crossover. Most other vibration impacts would be located between SW Whitaker Street and SW Pennoyer Street at residences adjacent to SW Barbur Boulevard, including several at the multifamily buildings at 3328 SW Barbur Boulevard. Vibration impacts were also identified near SW Bancroft Street, along SW Hamilton Street and along SW Ralston Drive. In the southern part of the segment, vibration impacts are predicted on SW Second Avenue.

Segment B: Outer Portland

In Segment B, vibration impacts are predicted to occur along the west side of SW Barbur Boulevard near, and on, SW 17th Drive and SW Evans Street, including a multifamily residence and two single-family residences. The Budget Lodge Hotel on the west side of SW Barbur Boulevard north of SW 26th Way is also predicted to have a vibration impact. Because of the proximity to a double crossover, a vibration impact is predicted at Sumner College at 8909 SW Barbur Boulevard. Vibration impacts are also predicted at a multifamily structure along I-5 at SW Huber Street and at a group of multifamily residences near the off-ramp from I-5 southbound to Pacific Highway along SW Palatine Street.

Segment C: Tigard and Tualatin

In Segment C the five vibration impacts would be at single-family residences near SW 72nd Avenue and SW Hermoso Way, and on SW Knoll Drive. Vibration was also evaluated for the new Compass Oncology

building, and levels would be at or below 72 VdB, which is below the FTA criteria for this type of use. During final design, the building will be reviewed to determine what vibration-sensitive equipment is in use and whether light rail operations will affect operations at this building.

The Hunziker O&M Facility would not have vibration impacts because of the slow speeds of the trains at the facility and the lack of nearby vibration-sensitive land uses.

Terminus Options

No vibration impacts are anticipated south of the Hall Station. Therefore, the impacts for both terminus options would be the same as those presented for the full-length Preferred Alternative.

4.11.6. Short-Term Impacts – Noise and Vibration

Preferred Alternative – Noise

Construction of the Preferred Alternative would result in construction-related noise all along the light rail alignment. Noise related to construction varies greatly depending on the type of construction activity, the duration of the activity, the distance between the receiver and the source, and the topographical conditions between the source and the receiver. In general, noise levels produced for the construction of the Preferred Alternative would be similar to noise produced for most major transportation projects. As noted in Section 4.11.1, local noise ordinances and regulations govern noise for project construction.

Typical construction noise levels were predicted using the FHWA *Roadway Construction Noise Model* (FHWA, 2006). These predictions use reference noise levels from typical construction equipment and account for typical equipment operation, including typical noise levels when the equipment is loaded and typical operational times. The actual noise levels expected during construction would generally be lower than those presented, because it is unlikely that all of the equipment would be running at once at a given site. Table 4.11-5 summarizes the major construction phases for a typical light rail project and the worst-case noise levels for each of these phases as measured at 50 feet from the construction site.

Table 4.11-5. Summary of Construction Phases and Associated Noise Levels

Scenario	Equipment	Lm (dBA)[1]	Leq (dBA)[2]
Demolition, site preparation and utility relocation	Air compressors, backhoe, concrete pumps, crane, excavator, forklifts, haul trucks, loader, pumps, power plants, service trucks, tractor trailers, utility trucks, vibratory equipment	94	87
Structure construction, track installation and paving	Air compressors, backhoe, cement mixers, concrete pumps, crane, forklifts, haul trucks, loader, pavers, pumps, power plants, service trucks, tractor trailers, utility trucks, vibratory equipment, welders	94	88
Miscellaneous activities	Air compressors, backhoe, crane, forklifts, haul trucks, loader, pumps, service trucks, tractor trailers, utility trucks, welders	91	83

Source: Michael Minor & Associates, Inc. modeling of construction noise using the FHWA *Roadway Construction Noise Model* (FHWA, 2006).

Note: dBA = A-weighted decibels.

[1] Lm is approximately equal to the Lmax, or the loudest one-second period.

[2] The Leq, or equivalent sound level, is for a typical worst-case hour of active construction.

Maximum noise levels during construction could reach 94 dBA at the nearest residences (i.e., within 50 feet of construction). The loudest noise sources during construction would include cement mixers, concrete pumps, cranes, pavers, haul trucks and tractor-trailers. Following heavy construction, general construction would still be required, such as installation of guideway railing, signage, and communication and power

systems, as well as other miscellaneous activities. These less intensive activities are not expected to produce noise levels above 91 dBA at 50 feet except during rare occasions.

Pile driving is a special type of construction that can produce notably higher noise levels and more complaints than typical construction activities described above. Pile driving is expected only in those areas with elevated light rail structures. This activity would produce higher noise levels than those described above. Workers would install piles using a standard pile-driver, which can produce impact noise levels up to 105 dBA Lmax at 50 feet. Sheet piles can also be used to shore up areas with weak soils and can also produce higher noise levels than normal construction, with levels ranging from 95 to 105 dBA Lmax, depending on the type of sheet piles and soil conditions.

Preferred Alternative – Vibration

Construction-related vibration levels depend greatly on the construction equipment and methods in use. Major sources of construction vibration include impact pile drivers, large track-mounted jackhammers used for demolition (hoe-rams) and vibratory rollers used for compacting soils. Construction has the potential to affect vibration-sensitive equipment, produce rumbling, and in rare circumstances, cause damage to buildings.

Terminus Options

Due to their shorter length, the terminus options would result in fewer short-term impacts associated with construction.

Related Transportation Improvements – Noise and Vibration

The related transportation improvements would create construction period noise and vibration impacts from similar sources as those described for the Preferred Alternative. In all cases, they would involve smaller affected areas and the durations would be shorter, because the scope of the improvements are more limited, typically involving sidewalk or bikeway improvements and few structures. The Ross Island Bridgehead Reconfiguration would be the most likely of the related transportation improvements to generate noise and vibration impacts similar to the Preferred Alternative, because it would remove and reconstruct more structures.

4.11.7. Comparison to Impacts of the Draft EIS Light Rail Alternatives

Overall, the number and severity of transit noise and vibration impacts with the Preferred Alternative are similar to those identified for the light rail alternatives in the Draft EIS. The main difference in the number of transit noise impacts identified in the Draft EIS and those identified in the Final EIS comes from a better understanding of the number of units located in many of the multifamily buildings. For the Draft EIS, the worst-case number of units was used for all noise analysis at multifamily buildings. For this Final EIS analysis, on-site visits were performed to count the number of units and provide a more accurate count of the actual number of units that would have impacts from noise. As a result, this Final EIS noise analysis identifies fewer potential light rail noise impacts than the Draft EIS.

The Final EIS vibration analysis was also updated based on on-site visits and a more detailed understanding of the types of buildings along the corridor. As a result, the analysis in this Final EIS identifies a lower number of predicted vibration impacts than the Draft EIS. Additional vibration testing will be performed near some of the identified vibration impacts to further detail the vibration mitigation

measures needed to remedy any vibration impacts. TriMet is also considering testing its newer fleet of light rail vehicles, because the newer fleet of vehicles has not yet been tested for force density levels. The testing information will allow for more detailed vibration mitigation design.

4.11.8. Mitigation Measures

For locations where TriMet has identified potential noise and vibration impacts, mitigation measures would be considered and reviewed using the FTA criteria for noise and vibration mitigation. Table 4.11-6 summarizes the mitigation measures that would address noise and vibration impacts. Final determination of any noise or vibration mitigation would be based on further analysis completed closer to project construction, which would take into account the area land use, background noise and vibration levels, and the amount by which the predicted level exceeds the criteria. This section first summarizes long-term noise and vibration mitigation measures in general, and then presents the specific long-term and short-term mitigation measures proposed for the Project. For additional information on the approach to determining mitigation, refer to Attachment F.

Table 4.11-6. Mitigation Measures for Noise and Vibration Impacts *(multipage table)*

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
Long term	Light rail noise impacts	TriMet would conduct further noise analysis to verify light rail noise impacts based on final design. TriMet would mitigate all severe light rail noise impacts and would consider mitigation to address moderate light rail noise impacts. Mitigation strategies that could be used include special trackwork at crossovers, sound walls where they can be feasibly and reasonably constructed, and sound insulation for remaining impacts.	None required. The related transportation improvements would not cause light rail noise.
Long term	Light rail wheel squeal	None required. Tight-radius curves would be considered for lubrication if squeal is identified during initial system testing per TriMet policy. If lubrication is necessary, general maintenance of the rail would include servicing the curves to prevent squeal impacts in noise-sensitive areas.	None required. The related transportation improvements would not cause light rail wheel squeal.
Long term	Traffic noise impacts	TriMet would conduct further noise analysis to verify traffic noise impacts and detailed mitigation based on final design. TriMet would mitigate for impacts where increased traffic noise would exceed applicable criteria by installing sound walls where they can be feasibly and reasonably constructed; other techniques such as sound insulation would be considered if sound walls would not be effective in reducing impacts.	Project sponsors for the Ross Island Bridgehead Reconfiguration would conduct further traffic noise analysis to verify traffic noise impacts and detailed mitigation based on final design. The analysis methods would be consistent with applicable standards based in part on the source of funding. The station access improvements would not cause traffic noise impacts and would not require mitigation.
Long term	Vibration impacts	TriMet would mitigate for vibration impacts exceeding FTA's thresholds. Mitigation strategies would likely include several different methods of absorbing vibration near the tracks, so the vibration is not transmitted into the adjacent soil. These methods include the use of high compliance direct fixation fasteners, ballast mats, tire-derived aggregate and floating slabs.	None required. The related transportation improvements would not cause vibration impacts.

Table 4.11-6. Mitigation Measures for Noise and Vibration Impacts *(multipage table)*

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
Short term	Noise impacts during construction	None required. Project construction noise would generally meet the local noise regulations, and TriMet would seek noise variances from local regulators for required nighttime construction activities.	None required. Project construction noise would generally meet the local noise regulations, and project sponsors would seek noise variances from local regulators for required nighttime construction activities.
Short term	Vibration impacts during construction	During final design, TriMet would perform a review of vibration sensitive and historic buildings. If necessary, TriMet would conduct vibration monitoring during construction.	None required. Project construction noise would meet the local noise regulations.

Note: FTA = Federal Transit Administration.

Long-Term Mitigation – Summary

Long-term noise and vibration mitigation for the Project is summarized in this section and presented in Table 4.11-6. It is described in more detail in the following sections, which are separated into light rail noise, wheel squeal noise, traffic noise, and vibration. This discussion focuses on mitigation strategies to address the impacts of the Preferred Alternative and terminus options. No long-term noise or vibration impacts have been identified in this document for the related transportation improvements.[1]

TriMet typically provides mitigation for both moderate and severe light rail noise impacts, beginning with source treatment as agency best management practices and followed by treatments in the noise path. Source treatment includes purchasing low-noise light rail vehicles and maintaining the vehicles and rails. Maintenance that helps to reduce noise and vibration includes wheel truing, rail grinding and other general system maintenance. Mitigation treatments in the noise path include sound walls and berms, which block the noise from reaching the receiver. If source and path treatments are not sufficient to mitigate the impact, TriMet would evaluate and implement sound insulation at affected properties where the existing building does not already achieve sufficient exterior-to-interior reduction of noise levels.

Source noise treatments include starting with a low-noise light rail vehicle, and TriMet is committed to maintaining a quiet and effective transit system, including its light rail vehicles. This commitment includes using state-of-the-art vehicles equipped with wheel skirts, periodic rail grinding or replacement, wheel truing or replacement, vehicle maintenance and operator training, all of which help to reduce noise levels along transit corridors. For noise impacts that would still exist after these source noise treatments, other potential noise mitigation measures that are consistent with the FTA requirements would be considered.

The primary noise mitigation measure would be sound walls, which are a treatment in the noise path. Sound walls would be proposed where they can be feasibly and reasonably constructed. Sound walls would be located along the side of the guideway structure for elevated structures, and, where appropriate, on the ground for at-grade or cut profiles. Sound walls are a preferred option, because they are effective at reducing noise before it arrives at the receiver.

[1] Analysis of traffic noise impacts associated with the Ross Island Bridgehead Reconfiguration would be performed based on final design. The analysis methods would be consistent with applicable standards based in part on the source of funding.

The sound walls would be designed to provide noise mitigation for impacts from light rail and to reduce noise from traffic in those areas where shielding was removed for roadway realignment or widening. The heights of the walls would be based on the location of the noise source (light rail and/or traffic), the elevation of the receiver and the topographical conditions between them.

Where potential vibration impacts are identified, vibration mitigation measures will be considered. Mitigation for vibration impacts typically includes several different methods of absorbing vibration near the tracks, so the vibration is not transmitted into the adjacent soil. These methods include the use of high compliance direct fixation fasteners, ballast mats, tire-derived aggregate and floating slabs. Vibration mitigation measures focus primarily on reducing the source of vibration, whereas path and building treatment are considered as secondary measures.

Finally, for areas with noise or vibration impacts, or both, at crossovers (e.g., switches or side tracks), another potential mitigation measure could include special trackwork, including movable point or spring rail frogs, which eliminate the gap between tracks at crossovers that causes noise and vibration at these locations, or flange bearing frogs, which transfer the vehicle load from the wheel tread to the wheel flange and raise the light rail car up and over the gap, thus reducing noise and vibration levels. Special trackwork can be used to reduce both noise levels and vibration levels in one area, as are experienced for some noise and vibration impacts under the Preferred Alternative and terminus options.

Long-Term Mitigation – Light Rail Noise

TriMet would mitigate all severe light rail noise impacts and would consider mitigation to address moderate light rail noise impacts. The proposed mitigation strategies based on the noise analysis in this Final EIS are described in the following sections by geographic segment. TriMet would conduct further noise analysis closer to project construction to verify impacts and mitigation strategies based on final design. The one location with severe light rail noise impacts is proposed to be mitigated using special trackwork. Moderate light rail noise impacts are proposed to be mitigated with sound walls where feasible, paired with consideration of building insulation for remaining impacts.

Segment A: Inner Portland

To provide mitigation for light rail noise impacts near the structure over I-405, a 500-foot-long, 4-foot-tall sound wall is proposed along the west side of the structure. An additional 136-foot-long, 6-foot-tall sound wall is proposed on the east side of SW Barbur Boulevard between SW Meade Street and SW Hooker Street to mitigate the light rail noise impact and removal of shielding. A 140-foot-long, 6-foot-tall sound wall is proposed on the east side of SW Barbur Boulevard between SW Woods Street and SW Gibbs Street to mitigate for a light rail noise impact. Two more light rail sound walls are proposed—one along SW First Avenue between SW Whitaker Street and SW Curry Street (110-foot-long, 6-foot-tall wall), and one north of SW Pennoyer Street (75-foot-long, 6-foot-tall wall).

In addition to the sound walls, special trackwork including a low-impact frog would be needed for the crossover between SW Hooker Street and SW Hood Street. The frog is the integral part of the crossover that allows the train to switch track, and using a low-impact frog would reduce both noise and vibration levels. The crossover at this location would cause the severe noise impact at an apartment complex and the noise impacts at Lair Hill Park, and using a low-impact frog at this crossover would reduce the noise impact at the apartment complex from severe to moderate.

Mitigation for the remaining light rail noise impacts south of SW Hamilton Street would include consideration of sound insulation. Buildings considered for sound insulation are typically limited to structures with severe impacts and older buildings with single-pane windows. The building mitigation objective is to maintain an interior noise level of 45 dBA Ldn, as specified by the U.S. Department of Housing and Urban Development. The interior noise level of 45 dBA Ldn is applicable to living and sleeping areas only, and requires some form of fresh air ventilation. Sound insulation may be considered for several multifamily units on the west side of SW Barbur Boulevard, between SW Woods Street and SW Gibbs Street. Sound insulation would also be considered at the multifloor apartment building east of SW Barbur Boulevard between SW Gibbs and SW Whitaker Streets, and at two units on the east side of SW Barbur Boulevard, on SW Water Avenue north of SW Thomas Street, where a sound wall could not be constructed. If it is determined that the residences in question already have sufficient building insulation and required ventilation, these impacts would be considered to be mitigated.

Mitigation at the Town and Country Apartments may not be needed, because there is only a limited exterior use facing toward SW Barbur Boulevard and the light rail alignment, and the impact would just meet the moderate criteria. Further consideration of potential noise mitigation will be provided during final design, including a review of the Town and Country Apartments shared outdoor use and pool, which are located east of the building and are well shielded from traffic and light rail noise. Mitigation for the noise impact at the Rasmussen Village Apartments could consist of a sound wall for lower floors; sound insulation may also be considered for upper floors, depending on the limitations of sound wall construction due to sight distance and traffic safety.

Segment B: Outer Portland

Near the northern end of Segment B, along the north side of SW Barbur Boulevard along SW Third Avenue to SW Fifth Avenue, there is a group of residences that would have noise impacts from both light rail and traffic. The traffic noise impacts would be due to removal of shielding, and the light rail impacts would be due to the lower existing noise levels at the second row of homes that would become front-row homes with the removal of shielding. A pair of sound walls designed for traffic noise mitigation would also mitigate all light rail noise impacts in this area. More information on these walls is provided in the traffic noise mitigation section below.

Other light rail noise mitigation in Segment B will include sound insulation at a multifamily building just east of SW Barbur Boulevard, between SW 24th Avenue and SW Spring Garden Street. In addition, four sound walls are proposed for this segment. A sound wall is also recommended along the west side of SW Barbur Boulevard between SW Alice Street and SW 35th Avenue to mitigate light rail noise at a multifamily complex. Mitigation for several single-family homes with light rail noise impacts from the elevated light rail structure over I-5, just south of the Barbur Transit Center, would be mitigated with a 4-foot-tall, 550-foot-long wall. Two additional sound walls are recommended near the southern end of Segment B—one 1,050-foot-long, 6-foot-tall wall for noise impacts at two single-family residences and a multifamily complex just east of the crossing over I-5, and one 800-foot-long, 4- to 6-foot-tall sound wall on the elevated structure for the multifamily complex along SW Palatine Street and SW 62nd Avenue.

Segment C: Tigard and Tualatin

Noise mitigation in Segment C would include a combination of sound walls and sound insulation. Residences along SW Baylor, SW Clinton and SW Elmhurst Streets would be considered for sound insulation because access requirements would make a sound wall noise infeasible for this area. Two sound

walls are recommended for residences with impacts located just east of SW 72nd Avenue. The two walls would provide mitigation for light rail impacts along both sides of the alignment. The wall on the north side of the light rail alignment would be approximately 300 feet long and 6 feet tall, while a second 6-foot-tall wall would be constructed on the south side of the light rail alignment for approximately 1,200 feet, from SW 72nd Avenue to the elevated structure over Highway 217. Two additional sound walls are also recommended on the west side of Highway 217, from the light rail structure to SW Hunziker Street. The southern wall would be 250 feet long and 6 feet tall, while the northern wall would be 750 feet long and 6 to 8 feet tall. In addition, sound insulation may be considered for upper-floor units at The Knoll at Tigard multifamily complex (12291 SW Knoll Drive). Special trackwork may be required for the crossover near SW Hunziker Street.

Long-Term Mitigation – Wheel Squeal Noise

Research into methods of reducing wheel squeal noise, including using non-oil-based lubricants (such as water) and friction modifiers, has found that such methods effectively reduce or eliminate wheel squeal. The lubricants can be applied by personnel working trackside or by an automated applicator. TriMet's primary method of mitigating wheel squeal is using a trackside lubrication system. These systems periodically apply a lubricant or friction modifier near the location of the squeal, which allows the light rail wheels to slip on the rail without producing noise. In some cases, TriMet uses personnel to manually lubricate tracks in specific areas where wheel squeal occurs infrequently. The noise model did not account for wheel squeal; however, TriMet's policy of providing lubrication to mitigate noise from wheel squeal would ensure that all squeal impacts would be minimized and mitigated.

Long-Term Mitigation – Traffic Noise

As previously discussed, traffic noise impacts were identified in Segments A and B. Traffic noise mitigation applicable to these impacts is discussed below.

Segment A: Inner Portland

Traffic sound walls proposed in Segment A include one of the walls, discussed previously, that would mitigate traffic and light rail noise; two additional sound walls that would act as a system to reduce traffic noise; and a short wall to replace lost shielding from a building displacement. One of the residences with a light rail noise impact on SW Pennoyer Street would also have a traffic noise impact due to the removal of the front-row structure currently providing acoustical shielding. The 6-foot-tall, 75-foot-long wall would not only be sufficient to mitigate light rail noise, but would also mitigate the increased traffic noise. A sound wall also would be needed to replace shielding lost by the displacement of the Swan Market at SW Hamilton Street. This 100-foot-long, 8-foot-tall wall would provide traffic noise mitigation for the multifamily units located directly east of the existing Swan Market.

On the opposite side of the street from the Swan Market, the widening of SW Barbur Boulevard to accommodate the light rail and updated roadway and intersections would result in the displacement of several structures between SW Lowell Street to the north and SW View Point Terrace at SW Barbur Boulevard to the south. To mitigate the traffic noise impacts caused by the removal of the structures, sound walls are proposed in combination with the retaining walls needed along the west side of SW Barbur Boulevard. Two sound walls are proposed—one for each side of the new pedestrian access stairway also proposed with the Preferred Alternative in this location. The two sound walls would extend 300 feet north and 275 feet south of the opening for the stairway, and the overall height of the retaining walls and sound

walls would be 14 to 20 feet above the grade of SW Barbur Boulevard. These two walls would mitigate all traffic noise impacts occurring along SW View Point Terrace.

Segment B: Outer Portland

The only traffic sound wall proposed in Segment B is located at the northern end of the segment and would provide noise mitigation for both traffic and light rail noise. The sound wall would be constructed in conjunction with the retaining walls and pedestrian access areas. The two-segment wall would start east of SW Third Avenue and extend for 210 feet, with combined heights above the roadway of 14 feet to 16 feet. The second wall, located between SW Third Avenue and SW Fifth Avenue, would have a length of 500 feet and would range, with the retaining wall, from 14 feet to 26 feet above the roadway.

Segment C: Tigard and Tualatin

There are no traffic noise impacts identified in Segment C, and no traffic noise mitigation is recommended.

Long-Term Mitigation – Vibration

Vibration impacts that exceed the FTA criteria would be mitigated if the mitigation measures are determined to be reasonable and feasible. The current set of vibration mitigation measures, which is based on the most current information on TriMet's fleet of light rail vehicles, includes ballast mats, isolated ballast mats for embedded trackway, vibration-reducing fasteners, booted rail (embedded track only) and special trackwork. With the use of these vibration mitigation measures, the majority, if not all, of the project vibration impacts could be mitigated.

Mitigation selected for an area is based on the track type, the amount the vibration level exceeds the criteria and the frequency at which the vibration impact occurs. For most high-frequency impacts, mitigation measures such as booted rail for embedded track or resilient fasteners for at-grade track are normally sufficient. However, the primary vibration frequency from the impacts along the Preferred Alternative are in the lower frequency bandwidth of 8 Hertz (Hz) to 20 Hz, limiting the mitigation options. Low-frequency mitigation typically includes some form of a floating slab, where concrete track slab is isolated, or floated, using a ballast mat. Because much of the trackway in the northern section of SW Barbur Boulevard is embedded, mitigation options are in many areas limited to floating slabs and formed embedded track with ballast mats, which is essentially a type of floating slab that has a lower overall installation cost.

The types of special trackwork considered are those for which data are readily available. Depending on the level of vibration impacts and whether noise impacts also exist, movable point frogs are typically used. Other types of frogs, including spring rail frogs and flange bearing frogs, may also be considered during final design. A new type of frog that is in use on several systems—the conformal fixed frog—may also be considered during final design. Other mitigation measures, including tire-derived aggregate (or shredded rubber ballast) for ballast and tie track and conformal movable point frogs, may be considered, where applicable, during final design.

Segment A: Inner Portland

Vibration impacts at the multifamily building on SW Barbur Boulevard just south of SW Hooker Street would occur as a result of the proximity of the building to the embedded tracks and the nearby crossover. Mitigation for vibration would include special trackwork and additional measures, such as an embedded

track ballast mat or floating slab tuned to 14 Hz. All other vibration impacts along this section of SW Barbur Boulevard, continuing to just south of SW Hamilton Street, would also require mitigation: (1) for the embedded track segments, an embedded track ballast mat or floating slab, and (2) for the ballast and tie segments, floating slabs or tire-derived aggregate. The rest of the vibration impacts in Segment A would occur at single-family residences along SW Second Avenue, where predicted vibration levels would just meet the FTA criteria. If vibration mitigation is required at these residences, ballast mats are likely to be the selected method.

Segment B: Outer Portland

Vibration mitigation in Segment B would be similar to that described for Segment A. In general, depending on the track type, ballast mats, embedded track ballast mat or floating slab would be used for mitigation. A ballast mat would be sufficient for mitigation of impacts near SW 17th Avenue and SW Evans Street. All other locations, except two, would be just over the FTA criteria and could be mitigated with ballast mats or embedded track ballast mats. There are two locations—Sumner College on SW Barbur Boulevard and an apartment complex on SW Huber Street—where the predicted vibration levels would exceed the criteria by more than 10 VdB. At the college, the higher level would be due to a double crossover, which would include the use of special trackwork (low-impact frogs). At the apartment complex, where the high vibration level would be due to proximity to the trackway and increased train speed, the current design calls for a floating slab tuned to 10 Hz.

Segment C: Tigard and Tualatin

In Segment C, ballast mats and embedded ballast mat tracks would be used to mitigate the vibration impacts. West of SW 72nd Avenue, ballast mats would be used for the at-grade segments, with resilient fasteners along any elevated segment or areas with direct-fixation track types. Vibration mitigation at the at-grade crossing at SW Knoll Drive and SW Hunziker Street would include ballast mats or floating slab and potentially, special trackwork for the crossover near SW Hunziker Street.

Short-Term Mitigation – Noise

Project construction noise would meet the local noise regulations, which would depend on the location of the construction activity. Any potential nighttime construction noise would be restricted to the levels authorized by applicable regulations or variances issued to the Project. Local noise regulators will determine the type, timing and amount of nighttime construction activity allowed, both with and without mitigation, through their review to minimize impact on the surrounding sensitive noise receivers. The project team will be required to notify potentially impacted neighbors before any nighttime work. Noise-control for nighttime or daytime work could include the following best management practices, as necessary, to meet required noise limits:

- installing construction site sound walls by noise-sensitive receivers
- using smart backup alarms during nighttime work to automatically adjust the alarm level or tone based on the background noise level
- using low-noise emission equipment
- implementing noise-deadening measures for truck loading and operations
- conducting monitoring and maintenance of equipment to meet noise limits

- using lined or covered storage bins, conveyors and chutes with sound-deadening material
- using acoustic enclosures, shields or shrouds for equipment and facilities
- installing high-grade engine exhaust silencers and engine-casing sound insulation
- prohibiting nighttime aboveground jackhammering and impact pile-driving
- minimizing the use of generators or using whisper-quiet generators to power equipment
- limiting the use of public address systems
- using movable noise barriers at the source of the construction noise
- implementing pile-driving mitigation measures that focus on limiting the time of day during which the activity can occur

Short-Term Mitigation – Vibration

During final design, TriMet would perform a review of vibration sensitive and historic buildings. If necessary, vibration monitoring during construction would be conducted. However, most construction activities would not likely produce vibration levels that would be of sufficient magnitude to cause any building damage.

Measures to minimize short-term annoyance from construction vibration include use of alternative methods with less vibration, such as drilled shafts in place of driven piles or the use of static roller compactors rather than vibratory roller compactors. Activities with potential for short-term annoyance could also be restricted to shorter periods and daytime hours, when vibration is less noticeable.

4.12. Air Quality and Greenhouse Gases

This section reviews potential effects on air quality and greenhouse gases (GHGs) from the Project. Air pollutants can affect human and environmental (flora and fauna) health. Transportation systems, including light rail projects, can have beneficial and adverse effects to air quality and GHG emissions during construction, operation and maintenance activities. Appendix B4.12, Air Quality and Greenhouse Gases Background Information, provides supporting information about air quality standards and the impact assessment methodology.

This analysis has been updated since the Draft EIS to reflect the definition of the Project for this Final EIS, including updated transit and traffic estimates for the future year (2035).

The Project's regional impact assessment for air quality and GHGs consists of emissions estimates associated with three scenarios: (1) existing conditions; (2) the No-Build Alternative, which looks at future conditions without the Project; and (3) the Preferred Alternative, which looks at future conditions with the Southwest Corridor Light Rail Project. These emissions were estimated using vehicle activity data generated by the regional transportation model and local emissions rates produced by the current version of the U.S. Environmental Protection Agency (USEPA) emissions model (MOVES, 2014). For carbon monoxide (CO) and GHGs, the estimates represent average weekday conditions in July, the time of year with the greatest impact of these pollutants due to weather conditions and seasonal traffic patterns. Estimates include emissions associated with passenger and freight vehicles, and correspond to the entirety of the four counties present in the regional transportation model network: Clackamas, Multnomah and Washington Counties in Oregon, and Clark County in Washington. Given that the analysis region contains vehicles subject to multiple inspection and maintenance regimes, separate sets of emissions rates were produced for the following fleets: (1) Oregon-inspected vehicles, (2) Washington-inspected vehicles and (3) non-inspected vehicles. GHG emissions are reported in terms of carbon dioxide (CO_2) equivalent, which includes the three primary GHGs (CO_2, methane [CH_4] and nitrous oxide [N_2O]). The idea is to express the impact of each different GHG in terms of the amount of CO_2 that would create the same amount of potential global warming. In this way, GHGs can be expressed as a single number.

This document assesses GHG emissions in a manner consistent with the Council on Environmental Quality (CEQ) guidance from August 2, 2016. The CEQ is currently evaluating the 2016 guidance to make appropriate updates and recommendations. An examination of GHG emissions as related to the Southwest Corridor is warranted because of the potential long-term impacts of climate change, which can include: extreme storm events and flooding, rising sea levels and storm surge, coastal erosion and landslides, and higher temperatures and wildfire risks.

4.12.1. Affected Environment

The federal government has established National Ambient Air Quality Standards (NAAQS) for six pollutants known as "criteria pollutants." These include CO, lead, ozone, nitrogen dioxide, sulfur dioxide and particulate matter (PM, evaluated as PM2.5 and PM10 based on particle size). Oregon also has State Ambient Air Quality Standards (SAAQS), which are at least as stringent as the NAAQS. The USEPA has delegated the implementation of the air quality program to the Oregon Department of Environmental Quality (DEQ).

Monitoring by ODEQ in the Portland metropolitan area shows no exceedances of the NAAQS or SAAQS for CO, PM2.5 or PM10 in the period from 2008 to 2017. Furthermore, pollution levels are trending sharply downward for CO and slightly downward for PM10, and have remained relatively level for PM2.5. Ozone levels also tended downward from 2008 to 2014. There was an increase in ozone in 2015 and 2016, and a larger increase in 2017, all of which were at least partially due to smoke from forest fires.

Nonattainment areas are geographical regions where air pollutant concentrations exceed the NAAQS for any criteria pollutant (a pollutant regulated by the USEPA, such as CO). Air quality maintenance areas are regions, such as the Portland metropolitan area, that have historically been in nonattainment for an air quality standard but have achieved compliance through improved planning and control measures. Air quality maintenance areas are required to comply with prescribed maintenance plans that are approved by the USEPA, including demonstrating that projects proposed for federal funding would conform to those plans (transportation conformity).

After the completion of two consecutive 10-year maintenance plans, the Portland area maintenance period ended in October 2017, and transportation conformity no longer applies for the NAAQS for CO. However, the terms of the maintenance plan remain in effect. For example, the region must comply with transportation control measures and all measures and requirements contained in the plan until the state submits a revision to the plan and it is approved by the USEPA. The potential changes to CO from the No-Build Alternative and the Preferred Alternative are evaluated below. For all other criteria pollutants besides CO, the Portland region is in compliance; therefore, PM and ozone are not evaluated further in this document.

4.12.2. No-Build Alternative

Chapter 3, Transportation Impacts and Mitigation, summarizes the expected growth in the region and corridor over the next 20 years. Despite expected growth in population and vehicle miles traveled (VMT), GHG and CO emissions are expected to decrease in the future. The expected reductions in emissions are primarily a result of improvements in technology and more stringent vehicle inspection and maintenance programs. Table 4.12-1 in the next section summarizes the difference in daily emissions between existing conditions and future conditions with the No-Build Alternative. Aside from effects resulting from other planned projects, there would be no short-term air quality impacts with the No-Build Alternative.

4.12.3. Long-Term Impacts

Preferred Alternative

Table 4.12-1 summarizes the difference in daily emissions between existing and future conditions. As noted in the discussion of the No-Build Alternative, despite the growth in population and households that would result in more people driving, vehicle emissions are projected to be much lower in 2035 than today for both the Preferred Alternative and the No-Build Alternative. As discussed in Chapter 3, the Project would result in more use of transit and less vehicle travel than the No-Build Alternative. Thus, applying the regional air quality model, the analysis finds a regional benefit with the Preferred Alternative, compared to the No-Build Alternative, in terms of future (2035) regional daily emissions.

This analysis also referenced the *Greenhouse Gas Emissions from Transit Projects: Programmatic Assessment* (FTA, 2017) and the *Greenhouse Gas Emissions Estimator Tool* (FTA, 2016) developed to estimate GHG emissions of the Preferred Alternative for construction and ongoing operations and

maintenance. Consistent with the regional transportation model, the programmatic assessment and estimator tool indicate a reduction in GHG emissions with construction, maintenance and operation of the Preferred Alternative.

Table 4.12-1. Regional Daily Emissions

Scenario	GHGs (pounds)[1]	CO (pounds)
Existing conditions (2015)	44,196,163	384,789
No-Build Alternative (2035)	35,890,666	134,586
Preferred Alternative (2035)	35,848,281	134,482

[1] Greenhouse gas (GHG) emissions are reported in terms of carbon dioxide (CO_2) equivalent, which includes the three primary GHGs: CO_2, methane (CH_4) and nitrous oxide (N_2O).

Terminus Options

Based on the transit benefits associated with the terminus options, there would be an air quality benefit with either of the terminus options compared to the No-Build Alternative, but the benefit would be smaller than that provided by the Preferred Alternative.

Related Transportation Improvements

The calculations presented above are regional and are based on the transit benefits offered by the Preferred Alternative. The Project with the related transportation improvements is expected to offer similar benefits as the Preferred Alternative.

4.12.4. Short-Term Impacts

Construction of the Project would involve activities that could temporarily affect air quality, such as operation of heavy construction equipment, on-road construction activities and potential activities at staging areas. Traffic congestion would occur on some roadways during construction, and potentially along detour or construction haul routes (see Chapter 3 for more information). The primary impacts to air quality would be the generation of dust from demolition, site clearing, excavation and grading activities; and direct exhaust emissions from construction equipment. The estimated GHG emissions associated with construction of the Preferred Alternative, including maintenance of construction equipment, are presented in Table 4.12-2. The terminus options would have similar or lower daily construction GHG emissions compared to the Preferred Alternative. GHG emissions from construction of the related transportation improvements have not been calculated.

Table 4.12-2. Estimated Average Daily Construction GHG Emissions – Preferred Alternative

	Daily Construction GHG Emissions[1]
Construction	1,366,950
Maintenance of construction equipment	630
Total	**1,367,580**

Note: GHG = greenhouse gas.

[1] GHG emissions are reported in terms of carbon dioxide (CO_2) equivalent, which includes the three primary GHGs: CO_2, methane (CH_4) and nitrous oxide (N_2O).

4.12.5. Comparison to Impacts in the Draft EIS

The Draft EIS analyzed the impacts related to air quality and GHGs of what it referred to as a "representative Light Rail Alternative." The analysis for this Final EIS resulted in an incrementally smaller estimate of daily GHG and CO emissions for the Preferred Alternative than the Draft EIS analysis of the representative Light Rail Alternative. Both the Draft EIS and Final EIS daily emissions estimates would be approximately 0.1 percent lower than those of the No-Build Alternative. Table 4.12-3 compares the estimates for the No-Build Alternative, Draft EIS representative Light Rail Alternative and the Final EIS Preferred Alternative.

Table 4.12-3. Regional Daily Emissions

Scenario	GHGs (pounds)[1]	CO (pounds)
Existing conditions (2015)	44,196,163	384,789
No-Build Alternative (2035)[2]	35,890,666	134,586
Draft EIS representative Light Rail Alternative (2035)	35,849,052	134,485
Final EIS Preferred Alternative (2035)	35,848,281	134,482

[1] Greenhouse gas (GHG) emissions are reported in terms of carbon dioxide (CO_2) equivalent, which includes the three primary GHGs: CO_2, methane (CH_4) and nitrous oxide (N_2O).

[2] The Draft EIS had slightly higher estimates of GHG and CO emissions for the No-Build Alternative (35,891,438 pounds/day and 134,589 pounds/day, respectively) than the Final EIS, as a result of the adjustment in the regional model estimate for the No-Build Alternative.

4.12.6. Mitigation Measures

Table 4.12-4 summarizes the mitigation measures that would be required to address long-term and short-term impacts to air quality and GHGs.

Table 4.12-4. Mitigation Measures for Impacts to Air Quality and GHGs

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
Long term	CO and GHG emissions	None required. The Preferred Alternative and terminus options would reduce CO and GHG emissions compared to the No-Build Alternative.	None required.
Short term	Dust, diesel emissions during construction	None required beyond those required by applicable regulations and permitting requirements.	None required beyond those required by applicable regulations and permitting requirements.

Note: CO = carbon monoxide; DEQ = Department of Environmental Quality; GHG = greenhouse gas.

The region is in attainment for criteria pollutants and the Project would lower GHGs, so no long-term mitigation is proposed.

During construction, contractors must comply with state regulations (Oregon Administrative Rule 340-208-0210) requiring that reasonable precautions be taken to avoid dust emissions. Best management practices include applying water or suppressants during dry weather and taking other measures, such as truck and equipment washing, to prevent the transport of dirt and dust from construction areas onto nearby roads.

The City of Portland. as part of a consortium of local and regional agencies to accelerate air quality improvements beyond state regulations, has additional policies to reduce diesel emissions, outlined in its Clean Air Construction program. The program focuses on the reduction of idling times and USEPA's schedule for the retirement of older diesel-powered equipment. TriMet is considering joining this

consortium to implement similar policies that would be applied to construction contracts such as those needed to implement the Project.

Strategies to minimize the occurrence and effects of construction-related traffic congestion will be developed throughout the design of the Project. These strategies will include further analyzing traffic impacts and developing detailed construction traffic mitigation plans.

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4.13. Energy

This section summarizes transportation energy consumption and evaluates the potential impacts to energy demand on utilities in the Portland metropolitan area for the Project. The analysis considers energy consumption during construction (short term), and during maintenance and operation (long term). The energy consumed, or used, during operation of the Project includes that from transportation sources, including buses, passenger vehicles and trucks.

Since the Draft EIS, this analysis has been updated to reflect the definition of the Project in this Final EIS, updated vehicle miles traveled (VMT) by mode for the No-Build Alternative and the Preferred Alternative, and updated costs used to generate the estimate of short-term energy use.

4.13.1. Affected Environment

The study area for this analysis includes the entirety of Clackamas, Multnomah and Washington Counties in Oregon, and Clark County in Washington. The affected environment consists of energy use by passenger vehicles, heavy-duty trucks and transit, which includes buses, streetcar, light rail and commuter rail. Table 4.13-1, which is provided in Section 4.13.2 below, summarizes daily energy consumption for each vehicle type based on daily VMT and energy consumption per mile (fuel use) for each vehicle type. In 2015, total daily transportation energy consumption in the Portland metropolitan area was estimated at 234,000 million British thermal units (Btu) per day (Btu/day).

Operation of the light rail system is powered by electricity. Renewable energy sources, such as hydroelectric power and wind, contribute to more than half of the net electricity generated in Oregon. The State of Oregon's Renewable Portfolio Standard requires, by 2040, that 50 percent of the electricity Oregonians use comes from renewables.

4.13.2. No-Build Alternative

Under the No-Build Alternative, the daily VMT for the Portland metropolitan area is expected to increase from approximately 44.4 million VMT in 2015 to approximately 55.0 million VMT in 2035 (see Table 4.13-1). The increase in daily VMT would result in an expected transportation energy consumption of approximately 305,000 million Btu/day. The increase in the number of passenger vehicles is expected to create greater levels of congestion and slower speeds on the transportation system, which could place additional demands on energy in the region.

Additionally, the No-Build Alternative assumes that projects on the financially constrained list in the *Regional Transportation Plan* would be constructed. These projects would have short-term energy requirements during construction that are roughly proportional to the cost of each project.

Table 4.13-1. Existing (2015) and No-Build Alternative (2035) Daily Vehicle Miles Traveled and Energy Consumption

Vehicle Type	Energy Consumption Factor (Btu/vehicle mile)[1]	Existing Conditions		No-Build Alternative		Difference	
		Daily VMT	Million Btu/Day	Daily VMT	Million Btu/Day	Daily VMT	Million Btu/Day
Passenger vehicle	4,451	42,285,400	188,200	51,475,100	229,100	+9,189,700	+40,900
Heavy-duty truck	21,132	1,995,600	42,200	3,389,900	71,600	+1,394,300	+29,400
Transit bus[2]	36,468	84,300	3,100	98,800	3,600	+14,500	+500
Light rail (transit)[3]	30,578	16,400	500	21,000	600	+4,600	+100
Total		**44,381,700**	**234,000**	**54,984,800**	**304,900**	**+10,603,100**	**+70,900**

Sources: Metro and TriMet, 2017 (Existing) and Metro and TriMet, 2020 (No-Build).

Notes: Btu = British thermal units; VMT = vehicle miles traveled.

VMT data correspond to the entirety of Clackamas, Multnomah, Washington and Clark (Washington state) Counties.

[1] Transportation Energy Data Book: Edition 38.1, 2020. Table 2.13 and Table 2.16.

[2] Transit bus VMT includes service miles only.

[3] Light rail (transit) includes streetcar and commuter rail.

4.13.3. Long-Term Impacts

Preferred Alternative

The long-term direct energy impacts of the Preferred Alternative are based on projected year 2035 daily VMT, consistent with the transit modeling performed by Metro as part of the transportation analysis for this Final EIS. The anticipated energy required to operate the Preferred Alternative was estimated by projecting future daily VMT with the proposed light rail line and the associated transit network changes compared to the No-Build Alternative.

The daily VMT, energy consumption rate and total energy consumption for the No-Build Alternative and the Preferred Alternative are presented in Table 4.13-2. Compared to the No-Build Alternative, the Preferred Alternative would result in a reduction of passenger vehicle VMT as people shift their demand to the light rail system.

Expanding the light rail system would place increased demand on the local electricity utilities, but there is no shortage of power in the Portland region that would indicate the utilities could not handle the increased demand. Overall daily energy use during project operation is expected to result in approximately 0.11 percent less energy use than the No-Build Alternative in 2035.

Table 4.13-2. 2035 Daily Vehicle Miles Traveled and Energy Consumption: Preferred Alternative Compared to No-Build Alternative

Vehicle Type	Energy Consumption Factor (Btu/vehicle mile)[1]	No-Build Alternative		Preferred Alternative		Difference	
		Daily VMT	Million Btu/Day	Daily VMT	Million Btu/Day	Daily VMT	Million Btu/Day
Passenger vehicle	4,451	51,475,100	229,100	51,388,300	228,700	−86,800	−400
Heavy-duty trucks	21,132	3,389,900	71,600	3,389,200	71,600	−700	0
Transit bus[2]	36,468	98,200	3,600	98,800	3,600	+600	0
Light rail (transit)[3]	30,578	19,200	590	21,000	640	+1,800	+50
Total		**54,982,400**	**304,890**	**54,897,300**	**304,540**	**−85,100**	**−350**

Sources: Metro and TriMet, 2020.

Notes: Btu = British thermal units; VMT = vehicle miles traveled.

VMT data correspond to the entirety of Clackamas, Multnomah, Washington and Clark (Washington state) Counties.

[1] Transportation Energy Data Book: Edition 38.1, 2020. Table 2.13 and Table 2.16.

[2] Transit bus VMT includes service miles only.

[3] Light rail (transit) includes streetcar and commuter rail.

Terminus Options

Compared to the No-Build Alternative, the terminus options would result in a reduction of passenger vehicle VMT as people shift their demand to the light rail system, but marginally less reduction than under the Preferred Alternative.

Related Transportation Improvements

The long-term energy impacts associated with the related transportation improvements are expected to be positive, because the options would be supportive of nonmotorized travel and would support its use and growth. The Ross Island Bridgehead Reconfiguration would improve pedestrian and bicycle connectivity, and would likely shift travelers to those modes. Similarly, the station access improvements would support bicycling and walking, and would improve local connections to transit, thus supporting further reductions in passenger vehicle VMT.

4.13.4. Short-Term Impacts

Preferred Alternative

The estimated energy required for construction of the Preferred Alternative is based on preliminary engineering and anticipated construction costs. Estimates of energy consumption associated with different types of construction activities were used to calculate the estimated energy needed to run equipment and the energy used in producing the materials needed for construction. The estimated energy consumption of the Preferred Alternative during construction is 5,268,400 million Btu, which would be spread out over multiple years. The one-time energy use required to construct the Preferred Alternative would be offset by the Project's long-term, beneficial operational impacts on energy use.

Terminus Options

The one-time energy use required for construction of either of the terminus options would be approximately 5 percent lower than that of the Preferred Alternative.

Related Transportation Improvements

The related transportation improvements would also consume energy during construction, but because there are currently no cost estimates for these projects, estimates of energy use are not quantified at this time. Based on the types of projects, the amount of energy consumed would be due to operation of construction equipment and fabrication of materials and supplies (e.g., concrete and steel for bicycle paths and structures). The short-term energy use during construction of these projects would be offset over time by reductions in energy consumption resulting from anticipated reductions in VMT.

4.13.5. Comparison to the Impacts in the Draft EIS

Similar to the results found in the Draft EIS, the long-term impact of the operation of the Preferred Alternative is an expected reduction in daily energy consumption compared to the No-Build Alternative. Comparisons of the reductions in daily VMT and reduction in energy consumption for the Draft EIS light rail alternatives[1] and the Preferred Alternative are presented in Table 4.13-3.

Table 4.13-3. Comparison of Long-Term Energy Consumption of the Preferred Alternative to the Draft EIS Light Rail Alternatives

Measure of Long-Term Energy Consumption vs. No-Build Alternative	Draft EIS Light Rail Alternatives	Preferred Alternative
Total reduction in VMT	60,500	85,100
Total reduction in daily energy consumption	260 million Btu	350 million Btu
Percent reduction in daily energy consumption	0.08%	0.11%

Note: Btu = British thermal units; VMT = vehicle miles traveled.

The short-term increase in energy consumption during construction was estimated at 5,886,900 million Btu in the Draft EIS, which is approximately 10 percent higher than the Final EIS estimate of 5,268,400 million Btu. The Final EIS estimate is based on the estimated construction cost for the Preferred Alternative, which is lower and has been refined from the Draft EIS. The Final EIS estimate also used updated factors for calculating energy use from construction activities.

4.13.6. Mitigation Measures

Operation of the Project would not affect the regional power supply and would reduce overall energy consumption for the total transportation system compared to the No-Build Alternative. Short-term energy use for project construction would be offset by the overall reduction in the long term. Therefore, no mitigation measures are necessary.

[1] In the Draft EIS, the anticipated energy required to operate the Project was estimated using the daily VMT estimates for what is referred to as the "Light Rail Alternative," which looked at future conditions with the maximum build-out (full-length light rail alignment that assumed the largest capacity under consideration for each proposed park and ride) of the Project compared to the No-Build Alternative.

4.14. Hazardous Materials

This section summarizes potential impacts caused by existing hazardous materials sites that could be encountered by the Project. Some of these sites may require further measures to address existing contamination or to avoid risks to human health and the environment. The section also considers the potential for the Project to expose people or the environment to hazardous materials, and discusses potential long-term and short-term impacts, as well as potential mitigation measures.

Since the Draft EIS, this analysis has been updated to reflect the definition of the Project in this Final EIS, including updates to property acquisitions and other refinements in design that have occurred since the Draft EIS. The analysis also considers updated assessments of properties potentially affected by the Project, including reviews of regulatory database records, historical background research and other investigations, in accordance with FTA's standard operating procedures for potentially contaminated properties.

Appendix B4.14, Hazardous Materials Background Information, provides information related to properties with anticipated acquisitions, including results from site investigations and recommendations related to environmental concerns and anticipated clean up requirements.

4.14.1. Affected Environment

The hazardous materials analysis study area includes the construction limits of the Project and extends to the limits of potentially acquired parcels, plus a 400-foot buffer, in accordance American Society for Testing and Materials (ASTM) E1527-13 Standard Practice for Environmental Site Assessments. The study area is largely developed and contains 819 potential hazardous materials sites. Many of these sites are listed on state and federal regulatory databases, and include properties potentially acquired by the Project as well as other sites near the construction footprint.

For all properties that may be acquired by the Preferred Alternative, the Final EIS completed initial Environmental Site Assessments (ESAs) examining in more detail areas where contaminants may have been released. Appendix B4.14 describes the methods and findings from the initial ESAs, which are also known as Phase I ESAs. In addition to regulatory databases, other sources of information for the property investigations included fire insurance maps dating back to 1909, assessments of current and past land uses potentially involving hazardous materials, and field observations. This approach helped identify properties with activities involving the use or storage of hazardous materials or petroleum products, including gasoline/service stations, wrecking yards, machine shops, dry cleaners, foundries and former landfills.

Maps and tables in Appendix B4.14 show the hazardous material sites identified in the study area (Figures B4.14-1 through B4.14-3).

Hazardous material sites have the potential to impact humans or the environment. This section focuses on properties near the Project where there is the potential for adverse impacts through exposure of existing hazardous materials or contaminants or their potential release to the environment. It highlights priority sites, which are sites of highest concern for contamination as identified through the ESA process. These are typically sites with potential or confirmed groundwater contamination that has not yet been completely defined. It also applies to project sites adjacent to properties that have potential or confirmed groundwater contamination and that would be likely to impact a project site.

The high priority sites with potential contamination in the study area are described below. Most of them involve petroleum products, but a foundry was also identified. Leaking underground storage tanks (LUSTs) are the most common type of contamination in urban areas, and are a concern because of their potential to contaminate groundwater and migrate to other properties. The identification numbers in parentheses correspond to the project-specific parcel IDs used in Appendix B4.14.

Gas Stations

The priority hazardous material sites in the study area include the following former or currently operating gas stations:

- **4412 SW Barbur Boulevard (SW_20824 and SW_20825).** Two former gas stations occupied these parcels from the 1930s to the 1970s, as identified in both historical sources and regulatory databases. In addition, a gas station was located on the adjacent parcel to the north in the 1970s and 1980s. Multiple underground storage tanks (USTs) are recorded as having been installed on the subject property but only limited information (a 1971 tank removal permit with no number or content of USTs) was available regarding removal and/or decommissioning of the USTs. It is unknown whether the tanks are still in place or whether there has been a release to soil or groundwater at this site.

- **7914 SW Barbur Boulevard (SW_2758).** This former gas station was identified in historical sources as a gasoline station at least from the 1930s to the 1950s. No records of UST decommissioning and/or removal (or other regulatory involvement) were found during the site assessment process. It is unknown whether the tanks are still in place or whether there has been a release to soil or groundwater at this site.

- **8604 and 8630 SW Barbur Boulevard, 8700 SW Barbur Court (SW_11916, SW_15898 and SW_16139 respectively).** This former gas station (8604 SW Barbur Boulevard) had commercial LUSTs that required cleanup. Tanks and contaminated soil were removed, and an air sparge/soil vapor extraction system was installed to remove gasoline and diesel from the soil and groundwater. The site was given an No Further Action determination by the Oregon Department of Environmental Quality (DEQ) in 2012, which means that DEQ will not require additional remedial action because the site provided no unacceptable risks to human health or the environment at the time of the determination. However, the site has a recorded grant of Easement and acceptance of Equitable Servitudes (E&ES), which is an agreement between DEQ and the property owner to grant DEQ certain rights to use the land and to control the use of the land. The agreement states that future construction and excavation workers could be at risk from remaining groundwater contamination. It requires the property owner to submit construction, contaminated media management, and worker health and safety plans before redeveloping the site, and to pay any necessary costs for DEQ to review redevelopment documents related to the site and impacted adjacent properties. Due to the potential for impacts to 8630 SW Barbur Boulevard and 8700 SW 26th Avenue from the adjacent site, E&ESs have been recorded for these properties, requiring any contaminated media exposed on the property to be managed per the property's contaminant media management plan.

- **15670 SW Boones Ferry Road (SW_217).** This currently operating gas station is listed in the Oregon LUST database with seven decommissioned USTs. During the decommissioning, gasoline-contaminated soil was discovered and removed from the site, and the site was given a No Further Action determination in 1995. A former gas station located adjacent to the east is also listed in the LUST

database and received a No Further Action determination in 2004, satisfying applicable requirements, which include the DEQ standards in place at that time. Based on a risk-based evaluation, residual soil and groundwater contamination (located immediately adjacent to and upgradient of the site) was allowed to remain on-site.

Former Foundry

One priority hazardous material site in the study area is a former foundry at 8200 SW Hunziker Street (SW_19093). This site had multiple releases associated with foundry operations that have been cleaned up as required by DEQ, but site restrictions remain in place because of remaining lead contamination in the soil, benzene in the groundwater and potential impacts to nearby surface water. The No Further Action determination granted by DEQ assumes that the site use will remain industrial in nature.

4.14.2. No-Build Alternative

Under the No-Build Alternative, any potential hazardous materials impacts would be related to the implementation of other transportation projects and ongoing redevelopment. These activities could result in release of hazardous materials during construction, as well as remediation in accordance with state and federal regulations. In addition, vehicle miles traveled (VMT) would continue to increase in the corridor, which would result in higher risk for collisions and an associated increased release of hazardous materials.

4.14.3. Long-Term Impacts

Long-term impacts could occur where hazardous materials remain present on properties after the Project is constructed, with potential impacts to humans or the environment. Based on the analysis conducted for this Final EIS, these potential impacts would be minimal given the measures already incorporated within the Project, which include following FTA standard procedures and other state and federal environmental regulations for hazardous materials. Specific measures to address site contamination risks identified in this Final EIS would be implemented prior to project construction (see Section 4.14.4). TriMet would engage with DEQ through an intergovernmental agreement for technical and regulatory assistance for remediation activities and would abide by covenants or restrictions that may be attached to a given property as a result of DEQ agreements. Some longer-term remediation, monitoring and reporting on previously contaminated sites could extend beyond construction of the Project, but based on the analysis of properties potentially involved, such activities are expected to be minimal. Potential cleanup or remediation of contaminated sites is discussed further below and in Appendix B4.14.

Section 4.13, Energy, discusses the predicted future decrease in VMT for passenger vehicles, heavy-duty trucks and transit buses for the Preferred Alternative. Assuming these vehicles continue to operate using petroleum products, the Preferred Alternative would have the potential for hazardous materials releases due to collisions. Given the lower VMT with the Preferred Alternative, fewer collisions and resulting releases would be expected compared to the No-Build Alternative. In most cases the quantities of hazardous materials released would be low.

Preferred Alternative: Segment A

Within Segment A, the Preferred Alternative would require acquisition of two parcels associated with a high priority site with potential contamination (see Table 4.14-1). These two parcels are associated with two former gas stations where the removal/decommissioning of USTs cannot be confirmed and where

contaminated soil and groundwater may be present. Depending on subsurface conditions found at this site, it may require remediation activities associated with protecting excavation and/or construction workers from petroleum-contaminated soil and groundwater.

Table 4.14-1. High-Priority Hazardous Material Sites Impacted by the Preferred Alternative: Segment A

Parcel ID	Site Type	Address	Acquisition Type
SW_20824 and SW_20825	Former gas stations	4412 SW Barbur Blvd.	Full

Preferred Alternative: Segment B

In Segment B, the Preferred Alternative would require acquisition of four parcels (two are partial acquisitions) associated with two high priority sites with potential contamination (see Table 4.14-2). Both sites involve former gas stations. Contamination has been documented at one of the sites and, at the other site, the status of the USTs associated with the gas station is unknown. Depending on subsurface conditions found at these sites, they may require remediation activities associated with protecting excavation and/or construction workers from petroleum-contaminated soil and groundwater. These sites are further described in Section 4.14.1 above.

Table 4.14-2. High-Priority Hazardous Material Sites Impacted by the Preferred Alternative: Segment B

Parcel ID	Site Type	Address	Acquisition Type
SW_2758	Former gas station	7914 SW Barbur Blvd.	Full
SW_11916	Former gas station	8604 SW Barbur Blvd.	Full
SW_15898	Former gas station	8630 SW Barbur Blvd.	Partial
SW_16139	Former gas station	8700 SW Barbur Ct.	Partial

Preferred Alternative: Segment C

In Segment C, the Preferred Alternative would require acquisition of two parcels associated with two high priority sites with potential contamination (see Table 4.14-3). One site is associated with a gas station and the other was a former foundry. Depending on conditions found at these sites, they may require remediation of residual contamination in soil, groundwater, and sediment on and adjacent to the sites. South of downtown Tigard, the Preferred Alternative would follow an existing railroad corridor, which can also be a source of past contamination.

Table 4.14-3. High-Priority Hazardous Material Sites Impacted by the Preferred Alternative: Segment C

Parcel ID	Site Type	Address	Acquisition Type
Alignment and Stations			
SW_217	Gas station	15670 SW Upper Boones Ferry Rd.	Full
Hunziker O&M Facility			
SW_19093	Former foundry	8200 SW Hunziker St.	Full

O&M = operations and maintenance.

Alignment and Stations

The site that would be affected by the Preferred Alternative alignment and stations in Segment C is an operating gas station with a history of soil contamination and an adjacent former gas station that may have contributed to soil and groundwater contamination on the property boundary. Measures to address subsurface conditions found at this site, including protecting excavation and/or construction workers from

petroleum-contaminated soil and groundwater, will be implemented prior to construction. This site is further described in Section 4.14.1 above.

Hunziker Operations and Maintenance Facility

Acquisitions associated with the Hunziker O&M Facility would involve one high priority site with potential contamination (see Table 4.14-3). The facility would involve acquisition of a site formerly containing a foundry that has existing contamination. Cleanup and remediation at the site could be complicated enough to extend beyond completion of the Preferred Alternative construction, although the No Further Action determination issued by DEQ assumed a continued industrial use and could likely remain in place even if some excavation-related remediation is required. This site is further described in Section 4.14.1 above.

In addition, ongoing operations at the O&M facility could result in long-term impacts from the use, storage and/or generation of hazardous materials such as fuels, cleaning solvents, paints and lubricants. Although state and federal rules regulate the use, storage and transport of these hazardous materials, there is still the potential over the long term for release of these materials. The new facility will benefit from state-of-the-art engineering controls that are intentionally designed to lower the risk of spills. Operations plans associated with the O&M facility would minimize the potential for spills or accidental releases in accordance with state and federal regulations.

Terminus Options

The gas station located on SW Boones Ferry Road, which is a high priority site with potential contamination needed for the Preferred Alternative, would not be acquired for either terminus option, and no project activity would disturb or remediate the site. Other potential impacts would be the same as defined above for the Preferred Alternative.

Related Transportation Improvements

No properties associated with high priority sites with potential contamination would be acquired for the Ross Island Bridgehead Reconfiguration.

Station access improvements would not include any acquisitions. If acquisitions are found to be required at a later date, potential impacts from hazardous substance releases would be evaluated at that time.

4.14.4. Short-Term Impacts

The remediation or cleanup of any hazardous material sites affected by the Project would be required prior to construction. As described in more detail in Appendix B4.14, the Project would follow FTA's standard operating procedures to complete individual property evaluations and assessments prior to acquisition, including confirming the extent of contamination and defining the specific measures and applicable regulatory agency approvals needed to address the contamination. During final design and as part of the property acquisition process for the Project, the Project would develop detailed hazardous materials management plans and would then obtain necessary regulatory approvals to address areas where cleanup and remediation are needed. The majority of these actions would occur prior to other major construction activities for the Project.

The majority of properties identified through the Environmental Site Assessments conducted as part of the Final EIS involve LUSTs, including heating oil tanks at residences. For these properties, further

investigations would confirm the extent of contamination, and the typical measure would involve excavating and disposing of contaminated soils in accordance with regulatory requirements, which protects against exposure to workers, the public and the environment. This type of one-time cleanup is usually of short duration and does not require ongoing remediation activities. Affected sites would be closed to public access during construction. With these standard procedures in place, additional mitigation would not be necessary.

The high priority properties identified through the Environmental Site Assessments were mostly gas stations, vehicle service facilities, and other commercial or industrial operations with commercial LUSTs or other sources for hazardous materials releases. In accordance with FTA's standard operating procedures and applicable regulations for hazardous materials sites, the Project's actions to address this type of contamination would be defined in more detail at the individual property level, in consultation with regulatory agencies. However, such sites would typically be addressed with soil excavation and disposal, and the use of technologies such as in-situ chemical injection, bioremediation, or air-sparge/soil vapor extraction. A period of groundwater monitoring during and after remediation may also be required if groundwater is impacted.

Properties with former land uses that resulted in residual soil contamination, subsurface debris, or both, such as former industrial properties and landfills, may have a mix of cleanup activities along with engineering or institutional controls to prevent human and environmental exposure to contaminants. Excavation or construction on these properties would need to take these controls (such as engineered caps or legal restrictions on land use) into consideration, but such controls would further reduce the potential for construction impacts due to hazardous materials.

Environmental Site Assessments of properties or structures on properties acquired for the Project would also identify other hazardous materials, including asbestos or lead-based paint or a wide variety of other materials commonly used in the past as part of construction of roadways, infrastructure, utilities, residential and commercial properties, or as part of an individual property's ongoing use. Several bridges and structures, including the Vermont and Newbury trestle bridges, have materials such as creosote-treated timbers, lead or lead-based paint. The removal and disposal of these materials would be done in accordance with FTA standard procedures and following regulatory requirements, minimizing potential impacts.

Other short-term impacts from construction activities could occur as a result of accidental spills and leaks that could affect soils and infiltrate to groundwater, run off with stormwater or enter directly into surface waters. Construction activities such as demolition could expose workers, the public and the environment to hazardous materials, including lead or asbestos. However, to minimize this impact risk, TriMet requires that the handling of such materials during construction or demolition be done according to regulatory protocols, which would minimize these risks. During construction, and particularly during excavation, contamination associated with hazardous materials or petroleum hydrocarbons could become exposed.

The Project would implement best management practices in order to reduce the risk of spills, leaks or other releases during construction activities. These best management practices could include:

- fueling, conducting maintenance and cleaning in areas that are contained by measures such as berms or other containment
- minimizing the production or generation of hazardous materials

- labeling and storing hazardous waste according to federal regulations
- locating hazardous waste storage away from storm drains or surface water
- recycling materials such as used motor oil and water-based paint as appropriate
- handling potential spills of hazardous materials in conformance with applicable Safety Data Sheets

4.14.5. Comparison to Impacts of the Draft EIS Light Rail Alternatives

Some of the priority sites identified in the Final EIS analysis differ from those identified in the Draft EIS, but the number and types of potential impacts are similar. The Draft EIS concluded that a full-corridor project would acquire, for the alignment, five to eight priority hazardous materials sites with a higher risk for remaining hazardous materials, and for an O&M facility, would involve two additional priority hazardous materials sites. The Final EIS analysis found that the Preferred Alternative alignment and stations would affect seven priority hazardous materials sites.

4.14.6. Mitigation Measures

No mitigation would be required for the Project beyond the implementation of the due diligence investigation, clean up and remediation measures identified as part of the Project, and as part of FTA's standard operating procedures. Applicable federal, state and local regulations would guide handling of hazardous materials encountered by the Project.

Appendix B4.14 identifies environmental conditions of concern for each property subject to acquisition for the Project, and identifies the properties involving site specific treatments and regulatory approvals to address contamination. Table 4.14-4 summarizes the types of mitigation measures anticipated for the Project, including investigation, clean up and remediation measures.

Table 4.14-4. Mitigation Measures for Hazardous Materials *(multipage table)*

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
Long term and short term	Existing hazardous materials	TriMet would conduct pre-acquisition site investigation for parcels that would be acquired for the Preferred Alternative or terminus options. The level of investigation for each parcel is listed in Appendix B4-14, and may include one or more of the following: · **Simple Phase II investigation:** sites with potential or residual soil contamination that has not been completely defined or confirmed · **Complex Phase II investigation:** sites with potential or confirmed groundwater contamination that has not been completely defined and sites located adjacent to properties that have potential or confirmed groundwater contamination likely to impact subject site · **Structures and Building Surveys (hazardous building materials abatement):** sites with structures of an age where building materials that are now considered hazardous to human health, such as lead paint, asbestos, or polychlorinated biphenyls (PCBs), or creosote timbers, could have	None required beyond those required by applicable regulations and permitting requirements.

Table 4.14-4. Mitigation Measures for Hazardous Materials *(multipage table)*

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
		been used during construction; this abatement could be paired with any of the previous three possible subsurface investigation scenarios. For sites with defined contamination based on investigations, TriMet would conduct clean up and remediation activities as required by environmental regulators, including: · hazardous structures or building materials containment, removal and disposal · soil excavation and disposal · remediation technologies such as in-situ chemical injection, bioremediation, or air-sparge/soil vapor extraction · contaminated groundwater removal and treatment/disposal · groundwater monitoring	

4.15. Utilities

This section describes the potential long-term and short-term effects on private and public utilities where the Project could encounter a major utility. Major utilities are those that provide an essential service including drinking water, sewer and/or stormwater facilities, electrical facilities, or natural gas pipelines, and provide intrastate or interstate service or service to a large area within a project segment.

Since the Draft EIS, this section has been updated to reflect the definition of the Project in this Final EIS, and to respond to comments received on the Draft EIS.

4.15.1. Affected Environment

The study area for utilities is 20 feet from the edge of construction, and consists of the area to be occupied or altered by the Project. Utilities that run parallel to or intersect with the study area are identified. All along the Preferred Alternative, there are overhead and underground utilities that are owned by public or private entities. These utilities include aboveground and below-ground facilities such as pipelines, cables and wires that provide water, power and communications services, and sanitary sewer and stormwater throughout the study area. Major utilities within the study area are summarized in Table 4.15-1 and are defined as the primary facilities needed to serve the area, such as large pipes that convey water or sanitary sewer, electrical transmission lines and primary communications facilities. Additional utilities (e.g., Northwest Metal Fab & Pipe) are also present in the study area. Within the study area, primary arterial roads, such as SW Barbur Boulevard, are major utility corridors. Finally, additional utilities may be identified during final design; plans for relocation will be developed through coordination between the utility and the project sponsor.

Table 4.15-1. Overhead and Underground Utilities in the Study Area

Owner	Overhead Utilities	Underground Utilities
Public Entities		
City of Portland	Communications (Bureau of Technology Services)	Water (Water Bureau), stormwater and sanitary sewer facilities (Bureau of Environmental Services)
City of Tigard	N/A	Water, sanitary sewer and stormwater
City of Tualatin	N/A	Water, sanitary sewer and stormwater
Oregon Department of Transportation	N/A	Storm facilities, electrical facilities and communications
Tualatin Valley Water District	N/A	Water
Raleigh Water District	N/A	Water
Clean Water Services (Washington County)	N/A	Stormwater and sanitary sewer
Private Entities		
Comcast	Communications	Communications
Frontier Communications	Communications	Communications
Northwest Natural Gas	N/A	Natural gas
Portland General Electric	Power	Power
CenturyLink	Communications	Communications

Note: N/A = not applicable.

4.15.2. No-Build Alternative

The No-Build Alternative assumes continued growth in the region, with or without the Project. While no major projects are anticipated in the study area, ongoing development and other construction projects

would likely result in short-term impacts to utilities in the study area. Additionally, some expansions and upgrades over time are likely as a result of growing demand in the region.

4.15.3. Long-Term Impacts

The Project is not anticipated to result in long-term impacts to utilities, because site-specific conflicts would have already been addressed by design and construction measures, including relocating utilities as appropriate. The relocation of some public utilities (e.g., stormwater pipes) could be considered a net improvement to the utility, because the older infrastructure would be replaced with newer pipes. For underground utilities along the Preferred Alternative, there is the potential for stray electrical current to accelerate corrosion, but the Preferred Alternative would be designed to include protective measures to avoid transferring current to the utilities. In addition, local utility providers may opt to pay TriMet to relocate utility facilities at a cost savings by using the TriMet's contractors, which will be already mobilized and equipped to perform the work. Similarly, project sponsors of the related transportation improvements could perform utility relocations at a potential cost savings for the affected utility providers.

The electric energy demands for the Preferred Alternative could require upgrades to electrical transmission systems along the Preferred Alternative, which could involve 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, but they would usually involve upgrading existing transmission facilities rather than creating new facilities. More information on the impacts of changes in energy use is included in Section 4.13, Energy.

4.15.4. Short-Term Impacts

The Project includes construction that would conflict with existing utilities. This section highlights anticipated conflicts with utilities where the relocation of utilities or interruption of service is likely to affect larger service areas or create longer, more complex utility construction and relocation activities.

Construction impacts to overhead utilities could occur where existing roadways would be widened to accommodate sidewalks, bicycle facilities and light rail trackway, and would impact existing poles or towers. These impacts could involve relocation of the overhead lines and their poles or towers outside of the roadway, but in some cases the lines, poles or towers may need to be moved to adjacent streets. There would also be an impact to overhead utilities in locations where the Project would change the grade of the ground or require a structure that reduces clearances for utilities. The overhead utilities may also need to be relocated to provide required clearances from the overhead power line system used for light rail.

Underground utility conflicts could also be created where the Project would need to alter the existing grade, which could expose, reduce or increase the depth of cover for an underground utility, and require the utility to be moved to a deeper or shallower location. In some locations, this altering of the grade can have a ripple effect of impacts to other utilities, especially when several utilities cross each other underground. Many stormwater and sanitary sewer lines are gravity conveyance systems and are sensitive to changes in elevation, which can add to relocation challenges.

Utility relocations can be large projects in themselves and could be conducted as an early phase of the construction of the Preferred Alternative. Underground utilities that are directly underneath light rail tracks or structures are normally moved so that they can be maintained or upgraded in the future without interrupting light rail service. The drainage or stormwater features of the Preferred Alternative could also

conflict with a utility and require its relocation. TriMet would employ standard design procedures and would closely coordinate with utilities to plan for and conduct a relocation. During final design and before construction, TriMet would conduct utility location surveys to identify and develop avoidance or relocation plans to address utility conflicts. TriMet would also employ standard construction procedures to minimize the potential for damage to utilities and unscheduled disruption to utility service during construction. Short-term disruptions, typically less than a few hours to a day, may occur when service is switched from an existing utility facility to a relocated one. A short-term shutoff could also occur if a property's connection to a utility needs to be modified.

Most of the utility relocations for the Preferred Alternative would be fairly routine, meaning they would be localized, have disruptions of service to few users or have little potential for relocation out of the existing right of way. However, there are several locations where more complex utility relocations would be required, as discussed below by segment.

Preferred Alternative: Segment A

In Segment A the Preferred Alternative would have a high number of conflicts with utilities, because the alignment would be within primary arterials that have many utilities along or crossing them, both overhead and underground. The utility relocation efforts in this segment have been accounted for in estimating the overall construction duration (see Chapter 2, Alternatives Considered, for more information on construction activity).

The Preferred Alternative would conflict with a Northwest Natural Gas district transmission main along SW Barbur Boulevard in Segment A. This transmission main serves much of the west side of Portland, and relocating it would be more technically complicated than relocating a typical local distribution line. This relocation could also involve temporary disruptions in service to a larger area than a more localized line relocation would.

Impacts to the Portland General Electric (PGE) aerial transmission line that parallels SW Barbur Boulevard in Segment A would likely require relocation. The new poles would likely be placed in the "furnishing zone," within the roadway section planned for the Project. If sufficient right of way beside a widened SW Barbur Boulevard is not available, the relocation of the transmission line and poles might need to shift into adjacent areas.

The Marquam Hill Connection would impact sewer, water and storm mains serving the Oregon Health & Science University (OHSU) complex on Marquam Hill. The connection would also impact the main potable water source for the OHSU complex and the Barbur Gibbs Pump Station, requiring the use of the existing backup supply system during construction.

Preferred Alternative: Segment B

There are several cell phone facilities along SW Barbur Boulevard that would require relocation. These facilities typically take more time to relocate than standard utilities, because they are often developed using an easement granted by another property owner. They are also located to physically provide coverage for a specific area, so a relocation site would need to provide customers with the same coverage.

A major water main is located along SW Barbur Boulevard in Segment B. The water transmission line provides water for the City of Portland, Tualatin Valley Water District, the City of Tualatin and the Raleigh

Water District. The utility owners have stated that the size of the pipe cannot be reduced, and further coordination between TriMet and the utility owners will be required during final design. Construction shutdown on this water line can occur only during winter months, because the backup system cannot meet peak summer demands.

As in Segment A, in Segment B the Preferred Alternative would impact PGE's transmission line running along the southbound side of SW Barbur Boulevard. One of the more complex conflict points is where the alignment, as well as the transmission line, crosses Interstate 5 (I-5). The structure would conflict with the transmission line, potentially requiring a relocation of the power lines over I-5.

The planned shuttle to the Portland Community College (PCC) Sylvania campus (the PCC-Sylvania Shuttle) would not impact major utilities.

Preferred Alternative: Segment C

In Segment C, the Preferred Alternative would likely require relocation or modification of approximately 1 mile of PGE's transmission line that runs parallel to the railroad tracks. Although there are other major utilities in the area, conflicts related to them would be fairly routine to resolve, largely because the Preferred Alternative alignment in Segment C would not follow primary arterials where major utilities are located, and most of the conflicts would be crossings, thus reducing the need for complex relocations.

The Hunziker Operations and Maintenance (O&M) Facility would not impact major utilities. However, because the O&M facility would be a large site development, it would require utility connections.

Terminus Options

The impacts associated with the terminus options would be similar to those above; however, because construction would terminate at either the Hall Station or the Upper Boones Ferry Station, there would be fewer impacts and costs associated with utility conflicts and relocation.

Related Transportation Improvements

Ross Island Bridgehead Reconfiguration

Impacts from the Ross Island Bridgehead Reconfiguration would be similar to the impacts described for the Preferred Alternative in Segment A. A high number of conflicts with utilities is anticipated along SW Naito Parkway, because it is a major arterial roadway heavily used by utilities.

Station Access Improvements

The station access improvements generally would not require significant utility relocations, because those types of improvements do not require full road reconstruction. Within the city of Portland if an existing vault or aboveground utility structure, such as a pole, were located within the Pedestrian Through Zone (i.e., pedestrian area[1]) of the new sidewalk, relocation would be required.

[1] In accordance with Portland Bureau of Transportation Development Administrative Rule Adopted ARB-TRN-10.19, vault lids and aboveground utility structures must be located within the Furnishing Zone of the sidewalk. The Through Pedestrian Zone per Portland Title 17.46.010 Definitions, "means the area intended for pedestrian travel as defined by the Portland Pedestrian Design Guide." The Furnishing Zone is the area between the curb and the Through Pedestrian Zone. The Portland Pedestrian Design Guide shows the applicable width criteria for the zones.

4.15.5. Comparison to Impacts of the Draft EIS Light Rail Alternatives

The overall utility impacts identified for the Project in this Final EIS remain similar to those of the light rail alternatives in the Draft EIS. Refinement of the light rail alternatives in the Draft EIS to the Preferred Alternative did not add or remove major new utility conflicts, or increase or decrease the number of general conflicts with utilities.

4.15.6. Mitigation Measures

Table 4.15-2 summarizes the mitigation measures that would address long-term and short-term impacts to utilities.

Table 4.15-2. Mitigation Measures for Impacts to Utilities

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
Long term	None identified	N/A	N/A
Short term	Utility impacts and relocation	None required. All affected utility companies would be contacted during the preliminary engineering phase to help locate and map potentially affected utilities, and to develop plans to coordinate either protection of the facilities within the construction area or relocation of impacted facilities.	None required. All affected utility companies would be contacted during the preliminary engineering phase to help locate and map potentially affected utilities, and to develop plans to coordinate either protection of the facilities within the construction area or relocation of impacted facilities.

Note: N/A = not applicable.

Long-Term Mitigation

The Project is not anticipated to pose significant long-term impacts to utilities, and no mitigation is required.

Short-Term Mitigation

No mitigation for short-term impacts is required. TriMet (or the project sponsor for the related transportation improvements) would contact affected utility companies during the preliminary engineering and final design phases to help locate and map potentially affected utilities, and to develop plans to coordinate either protection of the facilities within the construction area or relocation of impacted facilities. TriMet would coordinate with the utilities to inform them regarding design and construction of the Project. Utilities, in turn, would use that information to provide advance communication to their customers as necessary. The use of standard construction management techniques would minimize disturbance to system users and would also avoid damaging existing facilities that would remain in place. Temporary utility impacts such as service disruptions could occur during construction activities. However, in general those impacts would be short in duration, and advance communication about outages could minimize the inconvenience to customers. Service interruptions would often be controlled by permits required by local jurisdictions.

Typically, new facilities such as poles, conduits or pipe would be installed, and then service would be switched over, thereby minimizing any disruption of service. With these measures in place, no significant impacts to the operation of utilities are expected, and no additional mitigation measures would be required. The project sponsor for the related transportation improvements would conduct similar coordination with utility companies.

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4.16. Public Services

This section describes the impacts of the Project on major public services. The impact analysis considers emergency service provision, which includes law enforcement, fire protection, rescue and emergency medical services, and hospitals. It also considers schools and school transportation, postal service and solid waste services. The analysis focuses on whether the Project would affect the service providers' ability to fulfill their missions to the community. It evaluates the potential long-term and short-term impacts to the service providers' facilities, services and response routes, as well as the level of demand. Impacts to existing transit service are discussed in Chapter 3, Transportation Impacts and Mitigation.

Since the Draft EIS, this section has been updated to reflect the definition of the Project in this Final EIS, and has been revised in response to comments received on the Draft EIS.

4.16.1. Affected Environment

There are many public services within the study area, which extends 0.5 mile from the Preferred Alternative and 0.25 mile from the related transportation improvements. Key public service facilities are shown in Figure 4.16-1, including police stations, fire stations, hospitals, schools and one post office.

Within the study area, three jurisdictions provide law enforcement: the Cities of Portland, Tualatin and Tigard. Fire protection, rescue and emergency medical services are provided by the City of Portland and Tualatin Valley Fire and Rescue. The City of Portland Police Bureau Central Precinct serves the portion of the study area within Portland. The Cities of Tigard and Tualatin each have police departments that provide law enforcement for their respective jurisdictions. The City of Tualatin also has an Intergovernmental Agreement to assist the City of Tigard when needed.

In addition to fire protection services, the fire departments within the jurisdictions listed above also provide specialty technical rescue teams and emergency medical services. Portland Fire and Rescue has four stations that serve the study area within Portland. The Tualatin Valley Fire and Rescue Command & Business Operations Center and Station 51 serve the portions of the study area within Washington County. Emergency medical transportation is a joint effort on the part of the cities, Washington County and private ambulance companies, which include American Medical Response in Multnomah County and Metro West in Washington County. The northern portion of the study area is home to several hospitals and medical centers.

There are multiple public schools that serve the study area, some of which are located within the study area. The northern part of the study area is within the boundaries of the Portland Public School District and is served by five elementary schools, three middle schools and two high schools. The southern part of the study area is within Tigard-Tualatin School District boundaries and is served by one elementary school, one middle school and two high schools.

Within the study area, there is one U.S. Post Office facility, located in Tigard. Throughout the study area, local jurisdictions contract solid waste and recycling services to a number of private entities, although the services remain public. Solid waste and recycling collection services in the study area are provided by Arrow Sanitary, Heiberg Garbage Service, Waste Management Service, Pride Disposal and Republic Services. The routes extend well beyond the study area, and there are no solid waste and recycling collection and disposal facilities within the study area.

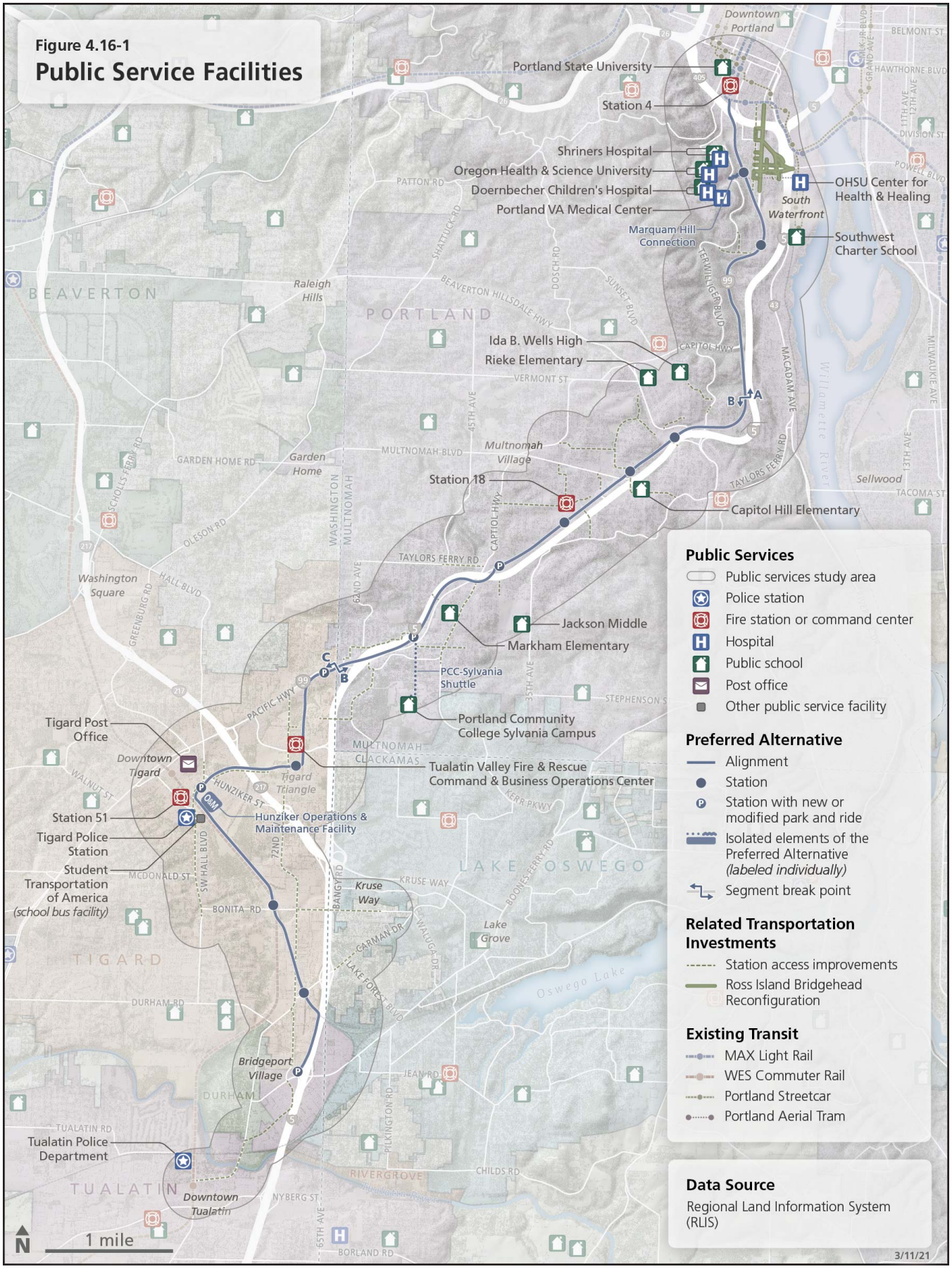
Figure 4.16-1
Public Service Facilities
Portland State University
Station 4
Shriners Hospital
Oregon Health & Science University
Doernbecher Children's Hospital
Portland VA Medical Center
Marquam Hill Connection
OHSU Center for Health & Healing
Southwest Charter School
Ida B. Wells High
Rieke Elementary
Station 18
Capitol Hill Elementary
Jackson Middle
Markham Elementary
PCC-Sylvania Shuttle
Portland Community College Sylvania Campus
Tualatin Valley Fire & Rescue Command & Business Operations Center
Tigard Post Office
Station 51
Tigard Police Station
Student Transportation of America (school bus facility)
Hunziker Operations & Maintenance Facility
Tualatin Police Department
Downtown Portland
South Waterfront
Multnomah Village
Garden Home
Raleigh Hills
Washington Square
Downtown Tigard
Tigard Triangle
Kruse Way
Lake Grove
Bridgeport Village
Downtown Tualatin
Sellwood
BEAVERTON
PORTLAND
LAKE OSWEGO
TIGARD
TUALATIN
Public Services
Public services study area
Police station
Fire station or command center
Hospital
Public school
Post office
Other public service facility
Preferred Alternative
Alignment
Station
Station with new or modified park and ride
Isolated elements of the Preferred Alternative (labeled individually)
Segment break point
Related Transportation Investments
Station access improvements
Ross Island Bridgehead Reconfiguration
Existing Transit
MAX Light Rail
WES Commuter Rail
Portland Streetcar
Portland Aerial Tram
Data Source
Regional Land Information System (RLIS)
N
1 mile
3/11/21

4.16.2. No-Build Alternative

As the population in the region and the communities in the study area grow, there will be increased demand for public services. Additional services and facilities will be needed to maintain adequate service levels. Individual public service providers regularly plan for this growth as part of their normal operations. Construction for projects that would occur under the No-Build Alternative may result in short-term impacts to public services in the study area due to detours and interruptions of service.

4.16.3. Long-Term Impacts

There would be few differences in long-term impacts to public services among the segments. Therefore, the discussion of impacts below applies to all segments unless otherwise noted.

Preferred Alternative

Emergency Service Providers

No police or fire and rescue facilities within Portland city limits would need to be relocated in Segments A and B. Both segments would alter the configuration of and conditions on roadways in the study area, as discussed in Chapter 3. These alterations would include modifications to fire and emergency medical services response routes. Along SW Barbur Boulevard, light rail would operate in the median (center-running) for a large portion of the Preferred Alternative, with Segment A having the largest section of operation in the median. This operation of light rail in the median would result in changes in access, circulation and response times for law enforcement, fire response and other emergency service providers.

The changes to roadways would include new and modified intersections and traffic signals, the addition of crossing gates in some locations, and new or modified structures in other locations. Portland Fire and Rescue relies on a pre-emption Opticom system, maintained by the City of Portland Bureau of Transportation, which allows the normal operation of traffic lights to be pre-empted to give green lights to emergency vehicles. Tualatin Valley Fire and Rescue also relies on a pre-emption system. Development of this system in the corridor is considered critical by Portland Fire and Rescue for safety and response times. In portions of the alignment where light rail would operate in the median, crossings of the median would be restricted for general traffic and could also be restricted for emergency vehicles. In addition, these modifications to emergency response routes, configurations and facility types will typically require additional training and new procedures for police, fire and emergency response personnel.

In Segment C, the Preferred Alternative would involve acquiring a portion of property for the Tualatin Valley Fire and Rescue's Command & Business Operations Center (see Figure 4.16-1). The area to be acquired is currently vacant and unused; the center and station would not require relocation and would remain fully operational. Neither the Tigard Police Department nor the Tualatin Police Department has facilities that would be directly impacted by the Preferred Alternative.

As within Portland, there would be gated intersections, new traffic signals, new median barriers and other obstacles associated with light rail along critical emergency response routes in Tigard and Tualatin, which could delay emergency vehicles. In particular, Tualatin Valley Fire and Rescue uses SW Hall Boulevard and SW Hunziker Street to access the Tigard Triangle from Station 51 on SW Burnham Street. The Preferred Alternative would add an at-grade light rail crossing on this route, which could delay vehicles accessing the Tigard Triangle. Shriners Hospitals for Children, Oregon Health & Science University, Doernbecher

Children's Hospital and the Veterans Affairs Portland Health Care System are within the study area on Marquam Hill, but their facilities would not be impacted. However, the Preferred Alternative alignment in Segment A would affect emergency service response routes to the hospitals and could also alter response times along the roadways traversed by the Preferred Alternative, including SW Naito Parkway and SW Barbur Boulevard. The Marquam Hill Connection is expected to improve access to the hospitals for staff, patients and visitors.

Schools and School Transportation

Some bus routes for schools, such as Capitol Hill Elementary School or Markham Elementary School, and in Tigard along SW Hall Boulevard north of the Student Transportation of America school bus facility, could be minimally affected by movement restrictions. These restrictions include gated crossings or other modifications required for the safe operation of light rail. Vehicle and walking routes would be maintained or improved.

Postal Service and Solid Waste

Although the light rail alignment would be located near a U.S. Post Office in Segment C, the Preferred Alternative would not impact postal service or solid waste facilities. Some postal routes might need to be modified because of roadway alterations required for the Preferred Alternative. Some routes to recycling and solid waste routes might also need to be modified because of turn restrictions or other roadway alterations required for the Preferred Alternative.

Terminus Options

The terminus options would construct a portion of the Preferred Alternative alignment, terminating at either the Upper Boones Ferry Station or the Hall Station. The terminus options are not anticipated to have long-term impacts that are different than those described above for the Preferred Alternative.

Related Transportation Improvements

The Ross Island Bridgehead Reconfiguration would improve accessibility and safety by reconnecting the street network and adding sidewalks and bikeways along SW Naito Parkway. These improvements could enhance access to the medical and educational facilities on Marquam Hill and in the South Waterfront area.

Station access improvements would improve accessibility and safety by adding dedicated sidewalks, bikeways, pedestrian crossings and improved intersections. These improvements would align with the goals of the Safe Routes to School program, which promotes walking and bicycling to school, and advocates for safer streets. Several of the improvements would be located near existing schools.

4.16.4. Short-Term Impacts

Preferred Alternative

The sections below describe potential short-term impacts to public services generally, and highlight differences by segment as appropriate.

Emergency Service Providers

During construction in Segments A and B, street or lane closures on major roadways, such as on SW Barbur Boulevard and SW Naito Parkway, would impact law enforcement, fire protection, and rescue and

emergency medical service operations and emergency response routes, including routes to the hospitals on Marquam Hill. The Marquam Hill Connection would construct facilities to cross SW Terwilliger Boulevard, which would create short-term delays or lane closures for a section of this primary route to the medical centers, although emergency access would be maintained. If required for project construction, complete lane closures of SW Barbur Boulevard would require alternative fire response plans, and limited access could require multi-unit responses.

Construction in Segment C within Tigard and Tualatin would also increase response times for the Tigard Police Department, Tualatin Police Department, and Tualatin Valley Fire and Rescue.

Schools and School Transportation

Bus routes in all school districts are often adjusted annually to meet changing student needs and population patterns. Coordination with the school districts before construction begins could minimize the impacts of street or lane closures from construction of the Project. Current maps available through the Safe Routes to School program indicate that walking or bicycling routes could be affected by construction.

Postal Service and Solid Waste

Short-term impacts to these services would be similar in all of the segments. Although minor adjustments may be needed on some postal routes, construction activities would allow mail delivery and collection services to continue. Solid waste collection would also continue. The Project would involve land clearing, the demolition of buildings and the removal of debris, which would increase demand for hauling and disposal services. However, on a regional scale, the increase in demand would not be significant.

Terminus Options

The terminus options would avoid potential short-term impacts south of the Upper Boones Ferry Station or south of the Hall Station.

Related Transportation Improvements

The construction of the Ross Island Bridgehead Reconfiguration could result in delays to emergency service providers during the construction period and could have potential impacts on school bus routes and postal and solid waste services.

The construction of the station access improvements could have short-term impacts on public services, including detours affecting emergency services, postal routes, and possibly school or public bus routes. These impacts are expected to be minor.

4.16.5. Comparison to Impacts of the Draft EIS Light Rail Alternatives

The overall impacts to public services identified for the Project in this Final EIS remain similar to those of the light rail alternatives in the Draft EIS. The biggest difference is the elimination of the potential impact to a U.S. Post Office in downtown Tigard, which was associated with two of the six Draft EIS alignment alternatives in Segment C.

4.16.6. Mitigation Measures

Table 4.16-1 summarizes the mitigation measures that would address long-term and short-term impacts to public services as a result of the Project.

Table 4.16-1. Mitigation Measures for Impacts to Public Services

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
Long term	Route changes	None required. As standard practice and as part of the permitting process, TriMet would coordinate with service providers before opening day of the Project to plan for operational service.	None required. As standard practice and as part of the permitting process, project sponsors would coordinate with service providers during design and before construction is complete to avoid and mitigate potential impacts.
Short term	Street closures and detours	TriMet would develop a construction management plan in coordination with providers of public services in the corridor.	Project sponsors would coordinate with service providers regarding construction plans, including timing and duration.

Long-Term Mitigation

The long-term impacts that the Preferred Alternative would have on the routes and operations of public services would be mitigated by planning and coordination with the service providers before the light rail line begins operation. This planning and coordination would include facility design considerations to support the needs of public services staff, particularly police, fire and emergency services, so that they can safely and effectively respond to emergencies involving light rail. TriMet already has an existing fire, life and safety coordination program with the City of Portland, which would be expanded to include providers in Tigard and Tualatin as well. Planning and coordination for the related transportation improvements would be the responsibility of the project sponsors and would likely be similar to that outlined above.

Short-Term Mitigation

To mitigate for the short-term street and lane closures that would occur throughout the study area during construction of the Preferred Alternative, TriMet would work closely with and communicate construction issues to the police departments, fire and emergency service providers, hospitals and ambulance services, schools, the U.S. Postal Service and solid waste collection services. TriMet's standard procedures for light rail construction require notice of closures well in advance and feature ongoing coordination with police, fire and emergency responders during construction planning as well as during construction.

TriMet would develop a construction management plan with the providers of public services. It would further define construction-period communications and coordination measures and techniques that would minimize impacts. TriMet would also develop a construction traffic management plan that would include traffic control measures such as bypasses, detours, signage and flaggers. The construction traffic management plan would be used to minimize and avoid delays for emergency responders and minimize impacts to all public services. These plans would be developed in coordination with the cities, school districts and other service providers.

Construction activities might require coordination for the pickup of solid waste or delivery of mail at individual addresses directly along the alignment.

Mitigation related to the related transportation improvements would be the responsibility of the project sponsors and would likely be similar to that outlined above.

4.17. Safety and Security

This section focuses on safety and security as they relate to crime and safety to the traveling public. It identifies potential direct impacts that may occur during the construction or operation of the Project. Section 4.16, Public Services, evaluates impacts involving fire, police and emergency medical service providers, including hospitals. Chapter 3, Transportation Impacts and Mitigation, considers safety in terms of vehicular, pedestrian, bicycle, freight and rail conflicts. Section 4.18, Indirect and Cumulative Impacts, addresses potential indirect and cumulative impacts to public safety.

Since the Draft EIS, this section has been updated to reflect the definition of the Project in this Final EIS, including more detailed designs and modified station areas and configurations. There are no substantive changes in the impacts compared to the analysis presented in the Draft EIS.

4.17.1. Affected Environment

The Southwest Corridor is within an urban area where violent crime incidents or other serious crimes are relatively rare. Most police calls in the study area, which comprises lands within 0.5 mile of the stations, involve property crimes and misdemeanor offenses as well as public nuisances or other infractions (identified as "crimes against society"). Table 4.17-1 provides crime statistics for proposed station areas.

TriMet's existing transit system has standard safety and security features that would be employed for the Preferred Alternative. Security cameras are placed on all vehicles and at all facilities, including trains, buses, transit centers and station platforms. Transit police, fare inspection teams and security patrols serve TriMet's system. TriMet also employs Crime Prevention through Environmental Design (CPTED), which is a multidisciplinary approach to designing public facilities to help deter criminal activity. One of the primary principles of CPTED is to maximize the visibility of a public facility and avoid creating blind or hidden areas. Open areas that are highly visible to other transit users as well as to transit staff, police and people in surrounding areas are more likely to deter criminals, because there is a greater likelihood that an offender will be detected and apprehended. This strategy combines active surveillance and enforcement by TriMet with what is often called "eyes on the street," or "natural surveillance," by which people perceive they are in a place where they can be seen by others.

For the current transit system, TriMet has a dedicated transit police division of assigned staff from local police agencies that operates out of four transit police precincts. The division works cooperatively with local law enforcement agencies, as well as fire and other emergency responders, to respond to incidents. TriMet also works with the federal Transportation Security Administration for specialized services and support. TriMet maintains security systems that include cameras, monitoring devices and communication systems that cover all rail transit centers, light rail stations, transit vehicles and elevators. In addition, contracted security personnel, TriMet operators, supervisors, customer service staff and maintenance workers serve as visible deterrents to crime, and are trained to identify and respond to security concerns. There are three 9-1-1 systems serving the project area: City of Portland Bureau of Emergency Communications (BOEC), Washington County Consolidated Communications Agency (WCCCA) and Clackamas Communications (C-COM). All incidents on the TriMet system are coordinated through these three regional 9-1-1 systems, allowing the closest available unit to serve as the first responder.

On TriMet's system, approximately 1.3 crimes are reported through BOEC (Multnomah County only) per every 100,000 rides. Historically, the City of Portland accounts for approximately 75 percent to 80 percent

of crimes reported system-wide. Most crimes reported to the transit police are minor incidents and property crimes such as vandalism. TriMet employs a crime analyst to regularly review incident data, so that the transit police can adjust their safety and security strategies, including patrols, throughout the system.

Table 4.17-1 shows 2016 annual crime levels within 0.5 mile of each station proposed for the Project. In Segment A, much of which is densely populated, property crimes are the most common offense. Segment B generally has lower rates of crime in all categories, but its station areas are also less densely populated than those in Segment A. Based on reported crime, Segment C has several areas that have higher levels of crime involving property as well as crimes against society, including the areas around the Elmhurst, Hall and Bridgeport Stations.

Table 4.17-1. Annual Crime Statistics, by Station Area (2016 annual data)

Station Area by Segment[1]	Crimes Against Persons[2]	Crimes Against Property[3]	Crimes Against Society[4]
Segment A: Inner Portland			
Gibbs	38	360	21
Hamilton	17	217	2
Segment B: Outer Portland			
13th	12	154	4
19th	13	156	4
30th	11	126	2
Barbur TC	10	130	5
53rd	9	103	2
Segment C: Tigard and Tualatin			
68th	28	159	41
Elmhurst	15	208	14
Hall	45	244	94
Bonita	14	121	13
Upper Boones Ferry	5	64	9
Bridgeport	16	285	17

Sources: City of Portland; City of Tigard; City of Tualatin.

Note: TC = Transit Center.

1 Incidents of crime were collected for the area encompassing 0.5 mile around each station location.

2 Crimes against persons include assault offenses, homicide, human trafficking, kidnapping/abduction, sex offenses, sex offenses non-forcible, child neglect, stalking, use of force and bias crime.

3 Crimes against property include arson, bribery, burglary, counterfeiting/forgery, embezzlement, extortion/blackmail, fraud offenses, larceny offenses, stolen property offenses, motor vehicle break-ins or theft, robbery, and vandalism.

4 Crimes against society include pornography/obscene material, prostitution offenses, weapon law violations, drug/narcotic offenses and animal cruelty.

4.17.2. No-Build Alternative

With the projected future growth in households, employment and transportation activity in the corridor, the number of reported crimes is likely to increase under the No-Build Alternative. TriMet's existing safety and security programs would continue on the routes and transit facilities serving the corridor. Based on past trends, the study area would continue to have relatively low incidences of crime.

4.17.3. Long-Term Impacts

The Preferred Alternative would feature the same safety and security techniques and systems that are applied throughout the regional transit system, which includes the Metropolitan Area Express (MAX) light rail system. TriMet's transit police and contracted security staff patrols and supporting resources, technology, and safety and security systems would be expanded to address the additional facilities developed as part of the Preferred Alternative. The agency would continue to apply its established transit rider security program that combines TriMet surveillance and enforcement with public safety resources from other jurisdictions and agencies in the corridor. TriMet would continue to coordinate with agencies that are part of TriMet's system-wide fire, life and safety program; all of the agencies in the Southwest Corridor already participate in the program. Based on local data within the TriMet system, as well as on findings at the national level, the introduction of light rail would not cause more crime on a per capita basis. However, park and rides can increase property crimes, because large numbers of parked vehicles can be potential targets for criminals. See Appendix B4.17, Safety and Security Background Information, for more detail on law enforcement agencies and transit-related crime.

Another safety factor is the response times for emergency personnel, a topic that is discussed in Section 4.16, Public Services. Chapter 3 reports locations where localized congestion would increase on roadways with the Project compared to the conditions without the Project, which in turn could slow emergency response times.

The following sections discuss, by segment, where the proposed stations and facilities involve unique conditions that could affect safety and security.

Preferred Alternative: Segment A

Alignment and Stations

The Segment A stations would not be in areas with high incidences of crime, particularly crimes against persons. The stations would be oriented toward the street along busy arterials, and would be in areas with high activity levels, good visibility and no unique safety concerns.

Marquam Hill Connection

The Marquam Hill Connection would have an east entrance near the station at SW Gibbs Street but off of SW Barbur Boulevard and a west entrance on the east side of SW Terwilliger Boulevard, near SW Campus Drive. The east entrance would be near the Gibbs Station, which would be an active public space during operating hours. When this east entrance is not directly serving arriving or departing riders, its relative isolation and low visibility, given its location away from SW Barbur Boulevard, could make it difficult to provide a secure environment for patrons, particularly outside of daylight hours and in off-peak periods. The west entrance to the inclined elevator at SW Terwilliger Boulevard would be integrated into the existing pathway, adjacent to the roadway. The existing pathway and the roadway are actively used during daylight hours but quieter in the evenings. Generally, patron use of the Marquam Hill Connection will improve localized safety conditions on SW Barbur Boulevard and on the Terwilliger Parkway, by increasing the number of people present during transit service hours. The hours of operation for the Marquam Hill Connection have not yet been determined.

Each of the two elevators would be equipped with surveillance cameras, which would help with security for passengers while in the elevator and would provide views of the interior of the elevators after hours. However, the isolated and confined environment of the elevators would limit a patron's ability to avoid a potential safety threat if one were present.

Preferred Alternative: Segment B

Alignment and Stations

None of the stations in Segment B would be in areas that currently experience high levels of crime.

The stations near SW 13th Avenue, SW 19th Avenue and SW 30th Avenue would be street-oriented along a busy arterial, offering good visibility from the street and from retail businesses and other developments. There would be no unique safety or security concerns.

At the Barbur Transit Center, the combined station, transit center, and park and ride would be adjacent to a busy arterial and near other businesses, and would offer generally good visibility and fairly high activity levels, which would tend to deter criminal activity. The existing surface park and ride would be reconstructed with underground stormwater tanks and would have a slightly reduced capacity of around 300 parking spaces. The Preferred Alternative would not impact the existing pedestrian bridge that crosses Interstate 5 (I-5). Standard security features, such as security cameras, surveillance and patrols, along with the presence of transit staff and patrons from connecting bus and paratransit activity at the transit center, would be deterrents for criminals.

The station at SW 53rd Avenue and its adjacent surface parking lot would be along a part of SW Barbur Boulevard where there are few adjacent businesses or other developments, thus reducing their visibility from nearby land uses. The park and ride would have a capacity of approximately 310 parking spaces and would be oriented along SW Barbur Boulevard. The station would be situated behind the parking lot, along I-5, and thus moderately isolated from street traffic. The potential for increased crime would be reduced by use of CPTED measures, such as enhanced lighting and security cameras, and by providing long sight distance with open areas and low barriers.

PCC-Sylvania Shuttle

The shuttle for the Portland Community College (PCC) Sylvania campus, referred to as the PCC-Sylvania Shuttle, would include van-sized shuttle vehicles operating along an improved SW 53rd Avenue between the 53rd Station and a stop on the campus. The PCC-Sylvania Shuttle would operate like a typical TriMet bus, with no unique safety concerns, or it could be a driverless system, which would require specialized security measures that will be addressed when more is known about the feasibility of this option. TriMet and PCC would coordinate on security procedures for the shuttle terminus, which would be in a less active part of the campus.

Preferred Alternative: Segment C

Alignment and Stations

Segment C has several areas with comparatively higher levels of reported crime than other station areas along the alignment, but overall crime levels are low and crimes against persons remain very low. The primary areas with elevated levels of reported crime (which still average less than one per day and involve property crimes and crimes against society) are in the Tigard Triangle and near the existing transit center

near downtown Tigard. Bridgeport Village also has a comparatively higher level of property crimes than many of the other potential station areas, which is not uncommon for major retail centers that have high numbers of parked vehicles.

The Preferred Alternative would include two stations in the Tigard Triangle and one serving downtown Tigard. The northern Tigard Triangle station (68th Station) would be at grade on the south side of Pacific Highway (designated as Oregon Route 99W) just east of SW 68th Parkway. It would include a new surface park and ride lot with up to 350 spaces. The park and ride, which would be adjacent to a busy arterial and near other businesses, offers generally good visibility and fairly high activity levels, which would tend to deter criminal activity. A Portland General Electric substation is adjacent to the proposed park and ride, but it is fenced and therefore should present no unique safety hazards.

The southern Tigard Triangle station (Elmhurst Station) would be on SW Elmhurst Street between SW 72nd Avenue and SW 70th Avenue. The Hall Station would be located on the southeast side of SW Hall Boulevard between SW Commercial Street and SW Hunziker Street. These station locations are in areas of the highest incidences of property crimes along the Preferred Alternative alignment. Both of these stations would be at grade, and nearby streets and existing buildings would have views of the stations. No park and ride is planned at the Elmhurst Station, which would reduce the opportunity for expanded property-related crime in that area. The Hall Station would include a 100-space park and ride surface lot. The park and ride at the Hall Station would be located adjacent to existing businesses and the Hunziker Operations and Maintenance (O&M) Facility, which would bring increased surveillance and activity to the space and which therefore could deter or even reduce property crimes in the area. Both the Elmhurst and Hall station areas would benefit from TriMet's use of surveillance cameras, enhanced lighting and security patrols, which would reduce the safety concerns associated with those locations.

South of downtown Tigard, stations would be included at SW Bonita Road, SW Upper Boones Ferry Road and Bridgeport Village. The Bonita Station would be an elevated station located on the north side of SW Bonita Road between SW Milton Court and the Westside Express Service (WES) Commuter Rail tracks. The Upper Boones Ferry Station would be at grade, with near-side platforms on either side of SW Upper Boones Ferry Road.

The Bonita Station and the Upper Boones Ferry Station would be in areas with low levels of reported crimes and low levels of pedestrian activity and adjacent development. The Bonita Station would be less visible in its location on an elevated platform north of SW Bonita Road and adjacent to the railroad, so station patrons could feel somewhat isolated. Neither station would include park and ride facilities, so there would not be an additional attractant for property crime. TriMet's use of surveillance cameras, lighting and security patrols would reduce the safety concern associated with that isolation. The Upper Boones Ferry Station would be at grade, and nearby streets and existing buildings would have views of the station, so no unique safety concerns are anticipated at that station.

The Bridgeport Station would be located on the north side of SW Lower Boones Ferry Road between SW 72nd Avenue and I-5. The station would be at grade with good visibility from nearby streets, and the added activity of the station would be beneficial to localized safety concerns. It would include a structured park and ride to be built on the site of the existing surface park and ride south of SW Lower Boones Ferry Road. The park and ride would have about 960 spaces on five levels, plus bus bays on the ground level. A new pedestrian bridge, featuring closed-circuit television, lighting and signage, would be constructed across SW Lower Boones Ferry Road to allow people to safely connect between the station and the bus

bays and park and ride. Both the parking garage and the pedestrian bridge would have good visibility from multiple locations, though the park and ride could interrupt some sight lines. No unique concerns are anticipated at this station.

Hunziker Operations and Maintenance Facility

The Hunziker O&M Facility would have restricted access, and the general public would not be allowed on the site without supervision. This facility would have similar safety and security procedures as TriMet's existing O&M facilities and would have no unusual safety and security considerations.

Terminus Options

The terminus options are two options to construct a portion of the Preferred Alternative alignment, terminating at either the Upper Boones Ferry Station or the Hall Station. The terminus options would have the same impacts described above for the Preferred Alternative except that they would not impact safety and security at stations that would not be constructed as part of each option. The Upper Boones Ferry Terminus Option would not construct the Bridgeport Station and the Hall Terminus Option would not construct the Bonita, Upper Boones Ferry and Bridgeport Stations.

Related Transportation Improvements

Ross Island Bridgehead Reconfiguration

The Ross Island Bridgehead Reconfiguration would redirect traffic from downtown Portland to Interstate 405 (I-405), including changing ramp accesses to the bridge, adding bicycle lanes and opening up nearly 3 acres of land for redevelopment. There would be no unique safety or security concerns for the bridge and road reconfigurations. As noted in Chapter 3, the Ross Island Bridgehead Reconfiguration would improve safety for nonmotorized users by creating signalized crossings, wider sidewalks and bicycle facilities where there are currently few of these facilities; this would have the benefit of attracting more pedestrian and bicycle activity to the area, and increasing the active use of the space. Future development of the newly reopened land would need to consider safety and security, depending upon what is constructed there.

Station Access Improvements

Most of the station access improvements would involve completing missing portions of sidewalks and bicycle facilities adjacent to existing local roadways, where visibility would be high; they involve no unusual safety concerns. In many cases, the station access improvements would improve safety conditions for bicyclists and pedestrians by increasing activity levels in station areas and by improving visibility. Users would have more "eyes on the street" and therefore would have a greater perception of safety. The exceptions are the potential new bicycle and pedestrian bridges over I-5 at SW Custer Street, SW Luradel Street and SW 53rd Avenue, and the new bicycle and pedestrian bridge over Highway 217 in Tigard, which would place users in more isolated locations.

4.17.4. Short-Term Impacts

During construction of the Project, unsecured construction areas could pose a threat to the traveling public if the plans, policies and procedures that are in place to protect the public are not followed.

In addition, the high crime areas could pose a challenge for construction crews because of potential theft of equipment and supplies. Security services would be provided by construction contractors. Construction impacts to emergency responders are discussed in Section 4.16, Public Services.

4.17.5. Comparison to Impacts of the Draft EIS Light Rail Alternatives

There are no substantive changes in the impacts for the Project presented in this Final EIS compared to the analysis of impacts of the light rail alternatives presented in the Draft EIS.

4.17.6. Mitigation Measures

Table 4.17-2 summarizes the mitigation measures that would address long-term and short-term impacts to safety and security.

Table 4.17-2. Mitigation Measures for Impacts to Safety and Security

Time Period	Impact Type	Preferred Alternative and Terminus Options	Related Transportation Improvements
Long term	Station security and safety	None required. Design and operations would consider best management practices including CPTED approaches and engagement with existing local agencies and emergency service providers to address site-specific needs.	None required.
Long term	Operational safety	None required. TriMet would prepare a Safety and Security Management Plan, in coordination with the Fire, Life and Safety Committee.	None required. Operational safety of the related transportation improvements would follow applicable safety procedures required by the project sponsors.
Short term	Construction safety	None required. Construction safety would follow TriMet's applicable safety procedures.	None required. Construction of the related transportation improvements would follow applicable safety procedures required by the project sponsors.

Note: CPTED = Crime Prevention through Environmental Design.

For all light rail facilities, final design and operations planning would consider best practices for CPTED, including modified siting or layout concepts; the use of lighting, communications, and electronic and security/police surveillance; and controlled entry. For unique facilities such as the Marquam Hill Connection and the PCC-Sylvania Shuttle, and for park and rides, a combination of customized site-specific measures could be necessary, and would be developed in consultation with local agencies, emergency service providers, Oregon Health & Science University and PCC. For example, design of stations and park and rides will consider, in addition to platforms and walkways, providing adequate closed-circuit television cameras, signage and lighting to help reduce person and property crimes.

TriMet is committed to maintaining a safe and effective transit system. As the Project continues into final design, TriMet would continue to develop and refine specific safety and security measures in consultation with the jurisdictions in the corridor by doing the following:

- Park and ride and station area design would include site-specific measures to maximize security and discourage criminal activity.

- The Marquam Hill Connection would include design features that provide enhanced visibility and lighting along with safety features to monitor potential criminal activity.
- Bicycle and pedestrian facilities would include design features that enhance visibility and discourage criminal activity.
- During final design, TriMet would form a Project Safety and Security Committee comprising internal operations staff, staff from local jurisdictions, project design staff and maintenance staff. The committee would review CPTED approaches being applied to the Preferred Alternative.
- TriMet would prepare a Safety and Security Management Plan addressing potential safety hazards and security vulnerabilities.
- TriMet would form a Fire, Life and Safety Committee for the Preferred Alternative composed of police, fire and safety personnel, and other emergency services providers in the corridor, to advise on design development and operations planning. This committee would review and advise on procedures, staff levels, and safety and security concerns.

Unrelated to the Project, TriMet is gathering feedback from riders, front-line employees and community members on the best approaches to providing security on the transit system that is free from bias. Agency-wide changes resulting from this process could affect future Southwest Corridor safety and security approaches.

4.18. Indirect and Cumulative Impacts

This discussion of the indirect and cumulative impacts of the Project has been updated since the Draft EIS to reflect the definition of the Project in this Final EIS and the mitigation measures the Project includes. It has also been updated to respond to comments received on the Draft EIS.

4.18.1. Approach to the Analysis of Indirect Impacts

Indirect impacts are consequences that are related to the Project but may occur at a different time, may be more physically removed, or may result from subsequent actions occurring in response to the Project. For the Southwest Corridor Light Rail Project, which is in a developed urban area, the most reasonably foreseeable indirect consequences would involve increased levels of activity around the new stations, including more developments. These activities and developments would be expected to cause other changes in environmental conditions over time.

The findings in this Final EIS about direct long-term impacts for transportation (Chapter 3, Transportation Impacts and Mitigation), land use (Section 4.2) and economics (Section 4.3) provide much of the basis for the indirect effects analysis covered here. These long-term impact analyses inherently consider other actions, because they combine existing conditions information with projections about what is expected to happen in the urban area in the future. The adopted plans for the urban area incorporate future increases in populations and employment in the Portland metropolitan area and in this corridor through 2035, with local and regional plans identifying where growth should be focused and the types of land use to be developed. Because light rail would be one element of the larger multimodal system serving the Southwest Corridor, the growth in population and jobs is expected to occur whether the Project is built or not, but light rail investments can affect the timing, intensity and location of growth-related changes.

The indirect impacts analyses that are based on transportation and the regional model forecasts include air quality, energy, and noise and vibration. The remaining topics in this Chapter 4, Environmental Impacts and Mitigation, have the same 0.5-mile radius study areas as land use, primarily surrounding stations, given that the most likely indirect impacts would be related to potential future developments and transportation activity in station areas. Although the other environmental topics discussed in Chapter 4 have larger study areas for direct impacts, none would have impacts requiring mitigation beyond 0.5 mile from the Project, and most impacts would be within 200 feet of the Project.

Section 4.2, Land Use, provides more detail on the areas around stations that could be affected, including existing conditions in station areas. This includes Figures 4.2-1 through 4.2-3 that map by segment the existing land use types within each 0.5-mile radius station study area. These maps generally correspond to the corridor maps included in Appendix B4.2, Land Use Background Information, that show comprehensive plan designations indicating future plans and zoning. These maps show the areas, primarily designated as mixed-use or commercial areas, where local agencies have adopted plans that would also influence development near stations.

Compared to mixed-use districts, areas with single-family residential properties and areas that are primarily industrial or are park or natural areas would be less likely to see transit-oriented developments. As the maps show, the areas along Segments A and B that would allow mixed-use, transit-oriented developments are adjacent to the primary arterial corridor of SW Barbur Boulevard. Residential neighborhoods beyond SW Barbur Boulevard would still accrue mobility benefits, but they would be less

likely to attract larger redevelopments that would become a source of notable indirect effects. In addition, large areas in Segments A and B are occupied by natural areas, parks or other transportation facilities, including Interstate 5 (I-5), where those land uses are unlikely to change due to development, and therefore or less likely to create a source of indirect impacts. Still, there are stations in Segment B, generally along SW Barbur Boulevard, where land use plans encourage town centers and a mix of land uses, including at the Barbur Transit Center. For three stations in Segment C, along Pacific Highway (designated as Oregon Route 99W), in the Tigard Triangle and in downtown Tigard, the primary surrounding land uses are mixed use and commercial, and adopted plans indicate high levels of anticipated population and employment growth. Following the light rail alignment south, the industrial areas south of downtown Tigard and along I-5 would be less likely to see development actions influenced by stations, until the Bridgeport Station, which is surrounded by more commercial and mixed-use areas.

Section 4.2, Land Use, covers in more detail how jurisdictions along the corridor have adopted plans and zoning encouraging a wider mix of allowed uses, including more multistory buildings, higher levels of square footage and an increased variety of housing types. Based on these types of transit-supportive zoning, the Project, in conjunction with other real estate market factors, may affect the rate of future development in station areas. However, the timing of specific developments would vary according to factors such as the characteristics of a location, the interests of property owners, parcel size, detailed zoning requirements, and the ability of developers to assemble properties suitable for development. Based on the experience of other light rail projects locally as well as nationally, some of the station areas might be more likely than others to experience change, but the variety of market drivers at play might cause certain locations along the corridor to change even before the Project is developed, while other locations might not change for decades.

4.18.2. Approach to the Analysis of Cumulative Impacts

Other actions in the corridor have already affected environmental conditions, including the urbanization of the Portland metropolitan area and major infrastructure developments such as I-5, Interstate 205 (I-205) and the railroads. Other similar actions may occur in the future, both with or without the Project. The effects of all of these actions together are considered in the analysis of cumulative impacts. Appendix B4.18, Indirect and Cumulative Impacts Background Information, lists the future transportation projects that are planned for development in the corridor. Section 4.2, Land Use, and Appendix B4.2 identify the land use plans that could affect transportation and environmental conditions.

4.18.3. Summary of Indirect and Cumulative Impacts

Table 4.18-1 summarizes potential indirect and cumulative impacts related to transportation and each environmental resource analyzed in Chapter 4 of this Final EIS. The mitigation described in the table below would be part of terms and conditions with future permitting or approvals required for construction, as described in previous sections of Chapter 4. No new mitigation is identified in this section.

Table 4.18-1. Summary of Indirect and Cumulative Impacts *(multipage table)*

Resource	Indirect Impacts	Cumulative Impacts
Section 4.1, Acquisitions, Displacements and Relocations	There is the potential for additional indirect displacements if transit-oriented developments obtain additional land surrounding stations. These would typically be private developments, unless TriMet or other agencies are involved as partners. Relocation assistance	There are no sizable public projects currently planned in the project vicinity that would acquire properties and displace their current uses. Acquisitions and displacements from other public projects would be mitigated by their sponsors as required by applicable

Table 4.18-1. Summary of Indirect and Cumulative Impacts *(multipage table)*

Resource	Indirect Impacts	Cumulative Impacts
	for displaced tenants may not always be provided; it would depend on whether any public agencies are directly involved. Displacements related to a station area development may be mitigated by ordinance (as in the city of Portland) or as a condition of approval for a development. During final design and construction, TriMet and Metro would continue to coordinate with local and regional partners to develop station area redevelopment plans that include measures to minimize indirect impacts, including advancing programs to increase affordable housing supply in the corridor. As discussed in Communities, below, there are several ongoing cooperative multiagency programs focused on these goals. See Appendix B4.18 for more information.	law. Ongoing development would be the other source of cumulative impacts. In many of the areas along the corridor, planned growth in population and jobs would spur increased development, and parties could be displaced. The mitigation described for indirect effects would avoid the potential for increased cumulative effects due to acquisitions or displacements.
Section 4.2, Land Use	As described in the approach to indirect impacts analysis in Section 4.18.1 above, development or redevelopment in station areas would be made more attractive by the presence of stations, when combined with transit-supportive mixed-use, commercial or multifamily zoning designations. Segment B has several stations, particularly the Tigard Transit Center, where such land uses are present, but they are primarily along SW Barbur Boulevard and connecting arterials. In Segment C, Tigard would have three stations that would increase transit access and support development and redevelopment in larger districts where land use plans and regulations would allow a mix of more concentrated land uses. Additionally, in the Tigard Triangle and downtown Tigard, the Project would complete parts of a roadway network called for in the City of Tigard's plans, including SW 70th Avenue, which could also contribute to redevelopment in the adjacent areas. South to Tualatin, the remaining stations would have relatively low levels of land use change because of the limited amount of underdeveloped lands nearby, and because I-5, railroads and topography limit development potential. Redevelopment to higher levels than existing is already included in the local land use planning and zoning that are considered in the long-term impact analysis in Chapter 4. While the Project may change the pace of redevelopment, it would not result in additional indirect land use impacts. The Project's transportation improvements would be one of a complex array of factors influencing redevelopment activity in the corridor, but the Project may accelerate the timing of development in areas near stations. Any developments within the study area would be subject to local jurisdictional approvals and would need to conform to applicable land use and zoning requirements, providing consistency with local and regional planning goals. The mitigation proposed for acquisitions and displacements, as well as the existing land use development and permitting conditions administered by local jurisdictions, would avoid the need for additional mitigation for indirect land use effects.	Due to long-term population and employment growth, and as called for in local agency plans and enabled by zoning that allows developments with taller buildings and more square footage than exist today, existing land uses would change in and beyond the project corridor. Other planned transportation infrastructure projects and associated improvements would also support additional development and land use change in and beyond the project corridor. However, any changes to existing land uses would be subject to local permitting approvals. The coordination described for indirect acquisitions and displacement impacts would also minimize potential cumulative land use effects. Chapter 3 identifies measures for mitigating indirect and cumulative land use changes due to increases in traffic congestion or indirect changes in accessibility. For other types of indirect or cumulative impacts, TriMet could partner with ODOT, Metro, local jurisdictions and other agencies to coordinate the development of other projects, and to develop programs and incentives to minimize undesired effects of land use changes, including changes due to escalating land values and pressure to redevelop existing land uses (particularly existing affordable housing stock).

Table 4.18-1. Summary of Indirect and Cumulative Impacts *(multipage table)*

Resource	Indirect Impacts	Cumulative Impacts
Section 4.3, Economics	Potential redevelopments in station areas and along the corridor, as described in this table under Land Use, would have net beneficial indirect economic impacts, because they would attract new businesses and employment, and would increase tax revenues and property values. However, existing businesses and their associated jobs may need to relocate if underlying properties redevelop. This need to relocate could result in additional business closures or job loss for some parties, although overall economic activity levels would increase with the additional investment and subsequent more intensive urban development. Property owners, businesses and residents could be affected by increasing property values and taxes (and thus rental costs). However, studies of past light rail projects indicate that the magnitude of increase in property values is typically relatively small—generally less than 5%. During the Draft EIS comment period, public comments raised concerns about increases in property values contributing to the displacement of existing residents or businesses as a result of either increased costs or redevelopment. However, many other factors aside from transit access affect property values and costs, including zoning and allowable land uses; access to schools, parks and other amenities; the presence of pedestrian and bicycle facilities; general transportation conditions; and national, regional and local market conditions. Based on historical trends, property values in the study area as well as in the greater Portland metropolitan area are expected to continue to rise over the long term either with or without the Project. As discussed in Communities, below, the project partners would continue to participate in local and regional programs to address affordability, including outreach, information and legislative measures (such as Metro's recent measure to provide funding for affordable housing). See Appendix B4.18 for more information. For potential short-term construction impacts of other station area developments that might occur at the same time as the Project, TriMet would coordinate the light rail construction activities and mitigation programs with the other developments to minimize disruption to businesses.	The long-term economic impact analysis is inherently cumulative, because the economic impacts assessment already takes into account multiple local, regional and national factors in considering future economic conditions with or without the Project. Cumulative short-term construction impacts would be limited, because there are no other projects of a similar scale or duration planned in the project vicinity. Overall increases in local and regional population and employment, taken with land use plans and zoning designed to manage growth, could increase economic activity and property values near and beyond the corridor. These increases in economic activity and property values would be considered a net benefit and could be experienced along all project segments; however, they are expected to be greater in Segments B and C, where there is a greater supply of underdeveloped lands. Other agencies may construct transportation projects in the corridor; although, as discussed above, none is expected to be of a similar scale or duration as the Project. If multiple projects are constructed at the same time as the Project, there could be reduced short-term business activity levels if customers are discouraged by real or perceived inconveniences during construction. The same mitigation approach described for indirect effects also would avoid potential cumulative effects.

Table 4.18-1. Summary of Indirect and Cumulative Impacts *(multipage table)*

Resource	Indirect Impacts	Cumulative Impacts
Section 4.4, Communities	Indirect impacts to communities could occur as a result of increased development near stations as described above under Acquisitions, Displacements and Relocations; Land Use; and Economics. Some additional residents and businesses could be displaced by redevelopment or by affordability issues driven by property taxes, rents or other costs. These changes to existing communities could disrupt social ties and impact neighborhood cohesion in areas where communities are near stations in Segments A and B, and in parts of the Tigard Triangle and downtown Tigard in Segment C. However, communities would generally indirectly benefit from the Project through increased vitality from improved access to transit, improved bicycle and walking facilities, and related multimodal connections. The increased supply and range of housing types that could be developed could also offset impacts, particularly as transit-oriented developments allow more efficient use of developable land. Indirect impacts to community character or cohesion could also be caused by redevelopment resulting in the removal of historic resources that contribute to neighborhood identity in the South Portland Historic District and along Terwilliger Parkway. However, the City of Portland has policies and permitting processes to protect historic resources, which would minimize this risk. In addition, Section 4.6 identifies measures that the Project would undertake to increase public understanding and recognition of historic resources in these communities. Public comments on the Draft EIS raised concerns about the risk of gentrification. The potential for market-driven indirect change to communities is discussed above under Land Use and Economics, which identify several strategies, including multi-agency partnership programs. These strategies would continue the efforts of the project partners and other state and local governments, which have ongoing initiatives to reduce impacts to communities due to economic and development displacements and to mitigate the impacts. In October 2018, TriMet, the City of Tigard, the City of Portland and Metro signed a Memorandum of Understanding that details goals and roles to increase the supply of affordable housing in the Southwest Corridor, including identifying locations for 700 to 800 affordable housing units in Portland and 150 to 250 units in Tigard. TriMet would consider this memorandum when disposing of property no longer needed by the Project. The Southwest Corridor Equitable Development Strategy (SWEDS) identifies other multi-agency programs focusing on actions to minimize the social impacts of development. See Appendix B4.18 for more information. No additional mitigation for indirect impacts would be needed beyond the existing programs above, and the indirect impact mitigation proposed for transportation, acquisitions and displacements, and economics.	A potential effect could be community change due to turnover of residents and businesses as surrounding communities redevelop consistent with local plans and future population and employment growth, particularly along SW Barbur Boulevard, in the Tigard Triangle and in downtown Tigard. With the Project and other local community development and transportation initiatives, improved neighborhood cohesion and vitality could result from improved walking, bicycling and transit access. Similarly, increased opportunities for employment, entertainment and services could become available in areas with multi-use developments. This would help offset cumulative impacts to communities. Other construction or infrastructure development projects could affect communities that would already be affected by the multiyear construction of the Project. No additional mitigation for cumulative impacts would be needed beyond measures already proposed for long-term and construction (short-term) impacts in transportation, acquisitions and displacements, land use and economics.

Table 4.18-1. Summary of Indirect and Cumulative Impacts *(multipage table)*

Resource	Indirect Impacts	Cumulative Impacts
Section 4.5, Visual Quality	Greater levels of development around station areas could intensify visual change by increasing the extent of urban development. This would occur primarily in the locations described above under Land Use, but the visual impacts would be low, because the majority of stations are in commercial or industrial areas where viewers are less visually sensitive. No additional mitigation would be needed.	Increased development due to urban growth, along with other transportation projects, could increase the Project's impacts and intensify the existing trend of visual change. These visual changes would be highest in areas where the land use plans anticipate the greatest level of growth, specifically in the Tigard Triangle and South Portland Landscape Units. However, the other transportation projects are smaller in scale than the Project, and applicable local agency land use plans also include planning guidelines for development in order to minimize negative impacts. No additional mitigation would be needed.
Section 4.6, Historic and Archaeological Resources	Greater levels of development around station areas could introduce new visual elements as well as redevelopment pressures, which could result in a loss of historic or archaeological resources or impacts to their character-defining features. In Segment A, these changes could affect the South Portland Historic District as well as individual properties.	Increased development and other transportation projects could affect additional historic properties and archaeological resources. These effects would be similar in nature to those described for indirect effects.
Section 4.7, Parks and Recreation Resources	Station area developments as well as improved multimodal connections along the corridor could increase the use of park and recreation facilities. However, as noted in other sections, these increases would be generally consistent with the plans of local jurisdictions and their strategies for managing growth. No mitigation would be needed.	The development of other projects in the corridor, particularly transportation projects, could result in increases in traffic, noise and potentially encroachments on parks and recreation resources. Individual projects would be responsible for mitigating their adverse impacts and would need to meet local permitting requirements, minimizing the potential for cumulative impacts. Other construction activities, if they overlap in location and time with the Project, could reduce accessibility to parks and recreation properties. The construction coordination measures already identified would help reduce cumulative impacts.
Section 4.8, Geology, Soils and Hydrogeology	No indirect effects were identified for geology, soils and hydrogeology. Station area developments would be built to meet applicable codes and standards, and would be restricted in areas with higher levels of geologic risk (such as steep slopes). No mitigation would be needed.	Similar to indirect effects, with other projects and developments being built to meet applicable codes and standards, the potential for unmitigated cumulative effects would be avoided. No mitigation would be needed.
Section 4.9, Ecosystems	The majority of the corridor is already developed, and station area transit-oriented developments would have limited indirect effects on ecosystems, because they would largely occur in already developed lands. There would be indirect beneficial effects to ecosystems from improved stormwater treatment for water quality and water quantity associated with the Project. Minor indirect adverse effects to biological species would occur during very heavy precipitation events when stormwater management facilities exceed capacity, but effects would still be less than existing conditions. No additional mitigation would be needed.	No cumulative ecosystem impacts were identified. Developments, as well as other transportation projects, would generally not adversely affect ecosystem resources, because they are proposed in areas that are largely urbanized. Further, other projects or land use actions would be subject to regulatory review and/or permitting, which would trigger measures to avoid, minimize or mitigate impacts on ecosystem resources, including streams and wetlands. Such processes would also result in compensatory mitigation for any unavoidable impacts to streams or stream buffers, wetlands or wetland buffers. No additional mitigation would be needed.

Table 4.18-1. Summary of Indirect and Cumulative Impacts *(multipage table)*

Resource	Indirect Impacts	Cumulative Impacts
Section 4.10, Water Resources	The Project could be expected to shift a portion of future growth in travel from vehicular traffic to light rail, which could reduce the levels of vehicle-related stormwater pollutants compared to the future conditions without the Project. The Project could also attract future development to station areas designated for higher densities. Many of these high-density-zoned areas were developed long ago and are less likely to have stormwater management facilities that meet current standards. Attracting redevelopment to these areas could trigger requirements for new water quality treatment on these currently untreated surfaces, resulting in a benefit to water resources. No additional mitigation would be needed.	Cumulatively, urban development in the Pacific Northwest has led to discharges of municipal sewage, stormwater runoff and industrial wastes into local area surface waters. Logging, land clearing and urbanization, including the development of highways and the roadway system, have altered watersheds; overwhelmed infrastructure; rechanneled streams and rivers; reduced groundwater recharge; and resulted in sedimentation and pollution in streams, lakes and marine water bodies. Pesticides and fertilizers used on landscaped areas and contaminated runoff from impervious surfaces have been making their way into surface water via stormwater runoff for decades. These types of past and ongoing actions have degraded water quality in many of the water bodies in the study area. Runoff from much of the developed land today still discharges through aging infrastructure to streams and other natural water bodies with no flow control or water quality treatment. Current regulations require stormwater management of site runoff, and new development, including redevelopment, must manage runoff from converted surfaces and must size drainage systems up to current standards for water quality treatment, flow control, groundwater recharge and conveyance. Therefore, by complying with current stormwater management regulations, the Project is not expected to contribute to adverse impacts to water resources. In addition, while the watersheds and water bodies in the region will not return to their natural conditions, small improvements in water quality are expected to occur over time, with or without the Project. Other development or transportation projects would comply with current stormwater management regulations and would improve water quality. No additional developments or other transportation projects are anticipated within floodplains or floodways. No additional mitigation would be needed.
Section 4.11, Noise and Vibration	No long-term indirect noise and vibration impacts are expected because of the largely mixed-use nature of future station area developments that would be allowed by existing zoning. In addition, larger buildings in station areas and along the project corridor could provide additional shielding from existing traffic noise sources such as I-5 or SW Barbur Boulevard. Further, additional noise due to increased transportation activity is already addressed in the long-term impacts analysis. The construction of station area redevelopments could create additional construction-period noise or vibration, but impacts would be limited by the controlling codes, ordinances and permits of local jurisdictions. No additional mitigation is needed beyond the measures already identified for long-term and short-term (construction-period) effects.	The Project is unlikely to contribute to cumulative long-term adverse impacts from noise and vibration effects, because mitigation measures are integral to project design and because no other major projects involving noise-generation are reasonably foreseeable. The noise and vibration analysis already considers past projects, because it uses ambient conditions, which include highways, railways and other sources of noise, for the analysis. There is the potential for localized construction-related noise and vibration cumulative effects if other land development projects were to occur in a way that overlaps with the Project, but each of these other projects would be subject to the noise control requirements of the local jurisdiction. Other developments built and operated in accordance with local land use plans or other transportation projects could have noise-generating activities. Any

Table 4.18-1. Summary of Indirect and Cumulative Impacts *(multipage table)*

Resource	Indirect Impacts	Cumulative Impacts
		new transportation projects would be expected to consider mitigation for their own noise or vibration impacts. The Project, which would mitigate its severe noise impacts, would not contribute to increased cumulative impacts. No additional mitigation would be needed beyond the measures already identified for long-term and short-term (construction-period) effects.
Section 4.12, Air Quality and Greenhouse Gases	The long-term air quality impacts analysis is based on the transportation analysis and already takes into account effects from station area developments and related growth in transportation activity levels. No additional mitigation would be needed.	The air quality analysis is cumulative in nature and shows that cumulative air pollutant and greenhouse gas emissions from regional transportation sources will decrease in the future with the Project, compared to the No-Build Alternative. No additional mitigation would be needed.
Section 4.13, Energy	Energy demand for future transportation conditions already considers transportation related to future developments in station areas. Increases in energy demand for the developments around stations themselves would be insignificant relative to the energy demand for the metropolitan area overall. No mitigation would be needed.	Cumulative energy demand would increase but is not anticipated to outpace the capacity of energy providers, who plan long-term operations and capital improvements to meet future demand. No mitigation would be needed.
Section 4.14, Hazardous Materials	Development and redevelopment around light rail stations has the potential to result in the demolition of structures that contain hazardous materials or the disturbance of subsurface contaminants in the soil and groundwater. These activities would be subject to regulatory requirements for the treatment of contaminated sites, and no adverse indirect impacts are expected. Some properties with contamination would be acquired by the Project for construction and may later be made available for development, but current contamination would be addressed. No additional mitigation would be needed.	Cumulative growth and projects, including transportation and development projects, would be subject to regulatory requirements for the treatment of contaminated sites. No adverse effects are expected, and associated cleanup and treatment of hazardous materials would be considered a cumulative benefit. No additional mitigation would be needed.
Section 4.15, Utilities, and Section 4.16, Public Services	Higher demand for utilities or public services is already expected under local land use plans, although it might occur earlier or more rapidly if light rail is present. Redevelopment in station areas and surrounding communities would require providers to manage their facilities and services to meet increased demand, but this would not be considered an adverse effect. No additional mitigation would be needed.	The impacts of other transportation projects to utilities or public services would be avoided, because each of the other projects would be expected to mitigate its individual impacts. Continued development due to urban growth could require utility upgrades and increased levels of public services, which utilities and service providers routinely plan for and implement to meet future demand. No additional mitigation would be needed.
Section 4.17, Safety and Security	Indirect safety and security impacts would be limited, because current design practices and standards for developments incorporate safety principles, and additional public activity in more developed areas tends to improve public safety and security. Conditions would be similar to those described under long-term impacts. No additional mitigation would be needed.	Similar to what is described for indirect impacts, cumulative effects with other transportation projects and local and regional growth and development are anticipated to improve public safety and security, and would be similar to those described under long-term impacts. No additional mitigation would be needed.

Note: EIS = Environmental Impact Statement; I-5 = Interstate 5; ODOT = Oregon Department of Transportation.